



The interaction of temperature and light on vegetative and reproductive growth of Vitis vinifera cv. Shiraz

Speedtalk+Poster presentation

Session: Poster session



Subhashini Abeysinghe¹

¹National Wine and Grape Industry Center, Charles Sturt University, Wagga Wagga, Australia.

In the growing season, both temperature and light intensity have a major impact on plant growth and development (Greer and Weedon 2012). However, the probability of the incidence of high temperature and/or heat events is likely to increase and become significant phenomena in the Australian viticulture in future (Gladstones 1992; Sadras and Soar 2009; Webb et al. 2009; Greer, Weston and Weedon 2010) due to climate change. During heat events, high temperature is likely to be compounded by the addition of high light intensity or radiant energy/heat (Webb et al. 2009) which are already a characteristic feature in Australian vineyards at present and it is expected to continue into the future. Despite its importance, there are few studies on the minimisation of the effects of photon flux densities and temperature of radiant load on grapevine physiology.

This study is being conducted to quantify the impact of the interaction of light intensities and temperatures, including high temperature and high light, on Vitis vinifera cv. Shiraz over three consecutive years in the field. Also examined will be the use of shading to ameliorate the effects of this interaction. The phenological characters of vegetative and reproductive cycle of Shiraz will be monitored closely under varying degrees of shading. Control environment chamber trials will also be carried out to assess the effect of high light and low temperature condition, and vice versa, on grapevine physiology and the carbon budget. The use of control environment chambers will enable the application of precisely controlled heat events.



Best practices case studies to climate change adaptation and water management

Speedtalk+Poster presentation

Session: Speedtalk session 5

Time: 5.15-5.20



¹Aida Afrooz, ¹Tracie Harvison, ¹Michael Neuman.

¹UNSW, Sydney, NSW, Australia.

Many cities are learning from each other in prioritizing approaches to adaptation. Before prioritising adaptation, it is important to identify adaptation options following by an assessment to determine the best options, which suit the city's specific context. A review of adaptation mechanisms, in the scale of buildings and neighbourhoods, are identified and grouped to reveal common approaches emerging in response to drought and water management. To adapt to climate change in water management, there is a need to have sufficient strategies for both supply and demand approaches, based on the type of land cover. Indeed, there are several supply-demand balance programs in different cities such as the Building and Sustainability Index (BASIX) and Water Efficiency Labelling and Standards (WELS). These should be modified to incorporate climate change adaptation, including the identification of drought-prone areas. This would be the primary challenge for adaptation in water management. In essence, an immediate step for adapting to climate change for water resources is to change the approach of supply-side management to demand-side management. How tools such as BASIX and WELS can incorporate consideration of adaptation measures for new buildings and when renovation is undertaken as part of the refurbishment cycle remains a poorly articulated but potentially significant question for further investigation. This research was supported by a grant from the NSW Office of Environment and Heritage, and was delivered in Harvison, T., Afrooz, A., Neuman, M. 2012 Climate Change Adaptation: Buildings and Neighbourhoods. Report to the NSW Office of Environment and Heritage, Sydney, Australia.



Is our local government ready to adapt climate change?

Oral presentation

Session: Speedtalk session 13

Time: 5.10-5.15



Reazul Ahsan¹

¹University of South Australia, Adelaide, South Australia, Australia.

The impact on human settlements has been startling, demonstrated by climate events such as flash floods and cyclones in Queensland, Hurricane Katrina in Florida and Cyclone SDR and AILA in Bangladesh. But the results of such climate change induced events are not confined to the immediate or primary effects. Hundreds of millions of people, mostly from those exposed coastal zones, face forced displacement and will need to migrate in search of alternative livelihoods which is considered an indirect impact of climate change. Such climate induced push factors lead to a chaotic overwhelming urbanisation with attendant congestion and pollution choking urban growth as the tertiary level of impact of climate change. This tertiary level of climate impact is not only a challenge for developed nations but it is a challenge for low-elevated coastal countries as well. The question is how the local government and planning system could address such flux of migration and urbanisation resulting from the primary impacts of climate change. The state of Queensland, Australia and the city of Khulna, Bangladesh are both low-elevated areas and threatened by extreme climate events and forced displacement, even though they are two different regions and have different local government systems. Using those two regions as examples, this study seeks to develop a local level planning approach, to cope with the escalating scale of the problems, and examine the interconnections between climate change, displacement and urban policy.

Key words: climate change, displacement, urbanization, urban planning, planning framework.



Framing resilience: practitioners' view of its meaning and usefulness in disaster risk management practice

Oral presentation

Session: Speedtalk session 6

Time: 5.15-5.20



Paulina Aldunce^{1,2}, Mark Howden^{3,1}, Ruth Beilin¹, John Handmer⁴

¹The University of Melbourne, Melbourne, Australia, ²Universidad de Chile, Santiago, Chile, ³Commonwealth Scientific and Industrial Research Organisation, Australia, Canberra, Australia, ⁴RMIT University, Melbourne, Australia.

This research thesis investigates the construction of the disaster resilience discourse to a disaster management initiative in Australia; the Natural Disaster Resilience Program (NDRP), in Queensland. Resilience is not a new concept for Disaster Risk Management (DRM) practitioners and researchers, but only in the last decade has it been strongly introduced into the policy arena. However, there is no single, agreed definition of disaster resilience with the idea being highly contested. Using Hajer's 'social-interactive discourse theory' to analyse the framing among practitioners, three distinct ways of understanding resilience's contribution to DRM emerge, characterised by seven discourse categories. Through an analysis of program and government documentation, stakeholders' interviews and the observation of different activities, the discourse was analysed and implications for policy and practice within DRM were revealed.



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Stakeholder participation key for building resilience: positive and dangerous implications of divergent frames

Oral presentation

Session: Speedtalk session 12

Time: 4.50-4.55



Paulina Aldunce^{1,2}, Ruth Beilin², Mark Howden³, John Handmer⁴

¹University of Chile, Santiago, Chile, ²University of Melbourne, Melbourne, Australia, ³Commonwealth Scientific and Industrial Research Organisation, Canberra, Australia, ⁴RMIT University, Melbourne, Australia.

Resilience is not a new concept for Disaster Risk Management practitioners and researchers, but only in the last decade has resilience been strongly emphasised in the policy arena. However, there is no single, agreed definition of disaster resilience and the concept is highly contested. This paper presents results of a discourse analysis research into an institutional arrangement that explicitly incorporates resilience within its framework: the Natural Disaster Resilience Program (NDRP) at the state and local level in Queensland, Australia. Results show that stakeholder participation is a relevant feature of the discourse, with practitioners giving diverging meanings to it. Key elements emerging from the analysis that underpin participation are self-reliance, social capital and co-management. The positive and negative, perhaps dangerous connotations and implications of how these ideas are framed are discussed.



Linkages between environment and food security in northern Ghana drylands

Oral presentation

Session: Poster session



Oppong Christopher Ampadu-Kwakwah^{2,1}, Kwarteng Acheampong¹, Frederick Tabi Asamoah¹.

¹University of Education, Winniba Kumasi Campos, Kumasi, Ghana, ²Uuniversity of Developmet Studies, Temale, Ghana.

Keywords: food security, policy, international development programs, Ghanaian national policies. This paper shall analyze the different rules and actors involved in linking environmental protection concerns with food security issues in Ghana and the existing perceptions about it. Mainstreaming food security issues into programs for biodiversity and land conservation poverty is a vital part of the CCD and the CBD. Programs focusing on poverty reduction and food security are also involved in environmental activities; examples include the World Food Programme, the UN Millennium Project and the Poverty Reductions Strategies. Instruments of these programs show a broad and partly contradictory variety, varying from bottom-up to top-down approaches. Indigenous people and other locals may be involved, while at the same time experts and foreign NGO's may be involved. As a consequence, within the various international agreements, there exist synergies as well as trade-offs between environment and food security issues concerning their goals and also their processes of implementation. These are reflected accordingly by the implementing institutions from a national level down to the local level in Ghana. To analyse these, with the means of contingency and trade-off models, this paper intends to elaborate on the vertical and horizontal integration of the respective main international agreements and programs into Ghanaian national policies regarding environment and food security. Actors to be considered will be the major relevant stakeholders from responsible governmental and international organizations as well as farmers' organizations on the community level.



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Cumulative impacts from local, regional and global-scale stressors on Great Barrier Reef marine ecosystems

Oral

Session: Parallel session 31

Time: 2.30-2.45



Ken Anthony¹, Jeffrey Dambacher ², Terry Walshe³, Roger Beeden⁴

Australian Institute of Marine Studies, Townsville, Australia¹, CSIRO, Hobart, Australia², University of Melbourne, Melbourne, Australia³, GBRMPA, Townsville, Australia⁴

The Great Barrier Reef (GBR) has in the recent decades shown signs of vulnerability from a suite of stressors ranging from severe cyclones, coral bleaching events, crown-of-thorns starfish (COTS) and declining water quality. Successful management of the GBR into the future will require a deeper understanding of our opportunities to influence environmental and societal drivers and pressures at local, regional, and global scales. In this talk we present a framework for understanding cumulative stressors on marine ecosystems, and for informing environmental decisions under complex scenarios. The framework builds on qualitative and probabilistic models developed with diverse groups of ecologists and stakeholders. We present examples of how cumulative stress scenarios of run-off from agricultural and coastal development activities, combined with business-as-usual climate change, represent risks to coral reefs, seagrass ecosystems, and dugong and turtle populations. Environmental consequences of these scenarios are highly dependent on how the local and regional-scale stressors are managed spatially, e.g. the spatial planning of catchment land-use management and ports/urban developments along the Queensland coast. Climate change represents the greatest long-term risk to the GBR as it has the largest (global) Zone of Influence. Reduced water quality related to agricultural land-use runoff has an intermediate Zone of Influence largely encompassing the 20-30km inshore band of the GBR. The proposed causal link between nutrient pulses during floods and the outbreak likelihood of COTS imply that the Zone of Consequence for nutrients runoff on the GBR could be as large as that for climate change. While port developments represent high localised risk from dredging operations, the Zone of Influence is potentially small depending on location. However, risks associated with increased ship traffic through the GBR has high spatial and temporal uncertainty. Lastly, we present examples of spatial configurations for agriculture and port developments, and their potential mitigation options, that can inform multi-objective spatial planning decisions on the GBR.



Finding the adaptation path

Oral presentation

Session: Parallel session 22

Time: 11.45-12.00



Ian Armstrong¹, Geoff Withycombe¹.

¹Sydney Coastal Councils Group, Sydney, Australia

Sydney Coastal Councils Groups (the SCCG) has actively researched and promoted climate change adaptation for over 8 years, delivering more than nine major projects, including winning the Eureka Prize for Innovative Solutions to Climate Change. The SCCG carried out three projects under the recent Australian Government's Coastal Adaptation Program, which included 11 separate case studies. The projects deal with: assessing and managing existing small seawalls; the management of interconnected water infrastructure; and prioritising coastal adaptation and development options for Local Government.

The outcomes include a range of resources and tools to assist practitioners, primarily Local Government, to explore and implement adaptation programs. The case studies broadly cover the three 'levels' of policies, programs, and projects, and deal with issues of scale and complexity, risks and vulnerability, and the need for holistic management based on the contributions of stakeholders.

We will explore the need to define the problem space, ways to find an adaptive pathway (if not a "solution") and what it means to be "flexible", how we monitor and evaluate our progress, and the tools that have been developed under the CAP projects to assist Local Government staff to develop adaptation programs. This paper reviews the learnings from the three most recent adaptation projects, while evaluating what the SCCG and its member Councils have done over the eight years, to discuss gaps and future priorities.



Exploring the nexus between climate adaptation and mitigation in primary industries

Oral presentation

Session: Speedtalk session 11

Time: 4.40-4.45



Zaida Contreras¹, **Peta Ashworth**¹, Mark Howden².

¹CSIRO, Pullenvale, QLD, Australia, ²CSIRO, Black Mountain, ACT, Australia.

The opportunity to integrate greenhouse gas (GHG) mitigation and climate adaptation practices that lead to more effective outcomes remains relatively unexplored. This integration would be valuable as it could develop more resilient and sustainable industries, while using resources more efficiently.

Our research conducted interviews with a range of experts and practitioners across key areas of the primary industries sector. The interviews were designed to isolate a range of institutional, technical and social aspects that help to explain the costs and benefits of various combined actions. A meta-analysis of the cases identified through the interviews was conducted to assess the relative importance of these key aspects for adopting combined adaptation and mitigation strategies in farming decision-making. This is important in moving beyond the rhetoric and framing of the issue into understanding and facilitating adoption of effective practices.

Our preliminary results indicate that in the agricultural sector there are substantial interactions between adaptation and mitigation. For example, responding to lower protein levels in grain can result in increased nitrous oxide emissions. Systematic assessments of such trade-offs will support more sustainable management.

The findings of this empirical research provides a sound basis for a range of stakeholders, including practitioners, policy makers and researchers, to identify opportunities for combining mitigation and adaptation opportunities more effectively. This work will also inform policy makers about relevant mechanisms to enable these opportunities and will assess whether linking economic incentives provided through mitigation policies along with adaptation outcomes is sufficient.



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To what extent do case studies add robustness and improve consistency of climate risk assessments?

Oral presentation

Session: Parallel session 16

Time: 4.00-4.15



Stacey Atkinson¹, Nicola Glendining¹, Guillaume Prudent-Richard¹.

¹AECOM, Sydney, Australia

This paper investigates the robustness of the climate change risk assessment process, and in seeking to add consistency, investigates the use of case studies of relevant recent climate events to inform assessments for the transport sector.

A level of subjectivity is inherent in all forms of risk assessment, including the assessment of risks associated with climate change. Current risk assessment standards (e.g. AS/NZS ISO 31000:2009, AS/NZ 4360:2004) do not explicitly define the number or scale of consequence and likelihood criteria. Although risk assessment criteria are typically well defined in practice on an individual or industry sector basis, there is a high level of subjectivity in defining the scale of consequence and likelihood for assigning climate risk ratings.

To further reduce subjectivity and inconsistencies in rating climate risks, a review of recent climate events was undertaken to identify the magnitude of potential impacts, and a sector's ability to respond to such events. The study focused on the transport sector, given the availability of case studies and the impacts experienced by the sector from recent climate events. The lessons learned from each case study were used to inform likelihood and consequence scales, and identify suitable climate change risk avoidance and mitigation measures.

The use of case studies increases the robustness of the climate risk assessment framework, contributing to a more comprehensive and consistent assessment of risk, which in turn aids in prioritising these risks. Once refined, this process could be implemented across a range of industry sectors.



Is a grassroots movement influential enough towards development of climate supportive adaptation and mitigation policy in Australia?

Either presentation

Session: Speedtalk session 13

Time: 4.40-4.45



Mehdi Azam¹

¹Macquarie University, Sydney, Australia

Given the continuing failure of governments and multilateral treaties to deliver effective climate outcomes reflected in the UNFCCC climate talks and domestic policy and practice, this research investigates an emerging, but potentially powerful new 'actor' in climate governance regimes in Australia. These new actors take the form of climate change new social movements facilitated by different action groups campaigning for a sustainable climate solution around the world. This research examines the circumstances under which these new movements can shape climate supportive policy and practice to climate change adaptation and mitigation approaches through direct action mechanisms, lobbying and partnerships, networking and media engagement. Specifically the research will conduct interviews with grassroots social movement organizations and campaigners to measure the effectiveness of the climate action movement. The final outcome of this research is expected to be the development of principles to guide new social movements to better influence climate law regimes and to deliver improved climate outcomes adaptation choices and mitigation of GHG emission.



Future of climate change adaptation in the coastal region of Bangladesh: current strategies and governance challenges

Either presentation

Session: Speedtalk session 8

Time: 5.00-5.05



Tapan Sarker¹, **Mehdi Azam**².

¹Griffith University, Brisbane, Australia, ²Macquarie University, Sydney, Australia.

The study investigates the current climate change adaptation strategies and governance challenges in the coastal region of Bangladesh. Based on a field study in the two southern coastal districts (namely Khulna and Satkhira located near the Sunderbans reserve forests and the Bay of Bengal), the study identifies the causes and consequences of climate change induced vulnerability in the coastal region of Bangladesh. These include: human displacement, intrusion of saline water, loss of crop and livestock, resulting in livelihood and food insecurity. In particular, a large number of people are being displaced locally and regionally to sustain their livelihoods. Several community based adaptation strategies have been implemented. These include: integrated farming, rain water harvesting, floating gardening, tree plantations in embankments and marginal lands, house fortification and introduction of saline tolerant rice. However, there seems to be a lack of coordination in the adoption of these initiatives among the broader community level due to inadequte finanacial capacities and lack of poor institutional support from Government and non-government organisations. This study suggests possible ways to help implement effective climate change adaptation strategies for the affected communities in the coastal areas of Bangladesh.



Corporate climate change legal risk and opportunity management - the road to corporate resilience

Oral presentation

Session: Parallel session 23

Time: 11.30-11.45



Mark Baker-Jones¹

¹DLA Piper, Brisbane, Queensland, Australia

There are two very important messages that corporations need to accept. The first is that corporations that deal with or interact with the natural environment need to ensure that legal risk is an integral part of their environmental risk management process. The second message is that the environmental legal risk management process is part of the organisation's overall strategy. The environmental legal risk we will consider in this paper is the legal risk that arises from changes in the natural environment. We refer to this latter form of environmental legal risk as 'climate legal risk'.

In this paper we examine climate legal risk and consider ways in which corporations can manage it, by:

- Identifying physical climate risks, with a view to determining the range of legal decisions that
 may be required to be made as a consequence of physical risk to which the corporation is
 exposed.
- Analysing how the relevant law regulates the issue at stake (ie, a hypothetical application of the law). This will involve identifying what, why, where, when and how climate events could impact the achievement of the corporation's objectives by assessing what impact the applicable law and other relevant material may have on the environmental rights and duties of the corporation.
- Evaluating whether the legal outcome serves the corporation's interests by distinguishing between acceptable legal risks and those legal risks that should be considered for treatment.
- Treating climate legal risk by developing corporate resilience.



Impact of the 2011 flood event on a Brisbane industrial area

Oral presentation

Session: Speedtalk session 6

Time: 5.05-5.10



Claudia Baldwin¹

¹University of the Sunshine Coast, Maroochydore, Queensland, Australia

The severe weather events that caused flooding in Brisbane in early 2011 had widespread effects on residential, commercial and industrial areas. This study focuses on the environmental, social and economic impacts on the primarily industrial area of Rocklea, based on interviews with flood-affected businesses, photo documentation, and other information. The Queensland government response to future risk management and potential for flood-proofing in this area is examined. The findings have broad implications for understanding of perception of risk, risk communication, and impacts beyond individual enterprises.



Incorporating climate change adaptation into South Australian emergency risk management programs

Oral presentation

Session: Speedtalk session 12

Time: 4.55-5.00



Jacqueline Balston¹, Narelle Rawnsley².

¹Jacqueline Balston & Associates, South Australia, Australia, ²Leading Emergency Services, South Australia, Australia.

Global warming has resulted in a number of changes to extreme climate events in South Australia including an increase in very hot days and nights, the number of extreme fire danger days, sea level rise and an increase in the height of storm surge events. As greenhouse gas emissions continue to increase over the coming decades these trends are likely to continue with resulting changes to the return interval and/or intensity of severe climatic events that affect emergency management.

Emergency management in South Australia is underpinned by the "PPRR" model (Prevention, Preparedness, Response and Recovery) and the Zone Emergency Risk Management System (ZERMS) that incorporates processes defined in the National Emergency Risk Assessment Guidelines (NERAG). However, as yet neither the currently observed, nor the future impact of climate change on severe climatic events has been included in any detail in the ZERMS risk management and planning processes.

As part of the South Australian Climate Change Adaptation Framework, regional climate change adaptation planning based on integrated climate change vulnerability assessments (IVAs) has begun for all regions across South Australia. In collaboration with emergency risk management (ERM) practitioners and key stakeholders, this project reviewed the current ZERM and planning processes to assess how the outputs from the IVAs can provide ERM practitioners with the necessary information to ensure that actions to address climate change adaptation are incorporated into emergency management plans. Outputs included a final project report, "How to Guide" and supporting material with details about the likely expected climate changes for the region.



Development of a guide for Councils to identify climate change adaptation actions

Oral presentation

Session: Parallel session 18

Time: 3.15-3.30



Jacqueline Balston¹, Adam Gray².

¹Jacqueline Balston & Associates, South Australia, Australia, ²Local Government Association of South Australia, South Australia, Australia.

As part of the Local Government Association (LGA) South Australia (SA) Climate Change Strategy, a climate change risk assessment was undertaken for all Councils across SA to identify key areas that are likely to be affected by climate change. Although risk assessments take into account preventative measures and corrective actions from outside the system, they generally do not explicitly consider intrinsic capacity from within a system to adapt to the impacts. More recently, a tool used to determine which regions, ecosystems, economic sectors or social groups are most at risk from climate change is an integrated vulnerability assessment (IVA) - a process that takes into account climate change sensitivity, exposure and its adaptive capacity. In addition to identifying what will be most vulnerable, an IVA can also identify adaptation actions that will reduce climate change sensitivity or exposure, enhance adaptive capacity or take advantage of new opportunities.

In collaboration with key stakeholders, the LGA SA developed a user friendly step-by-step guide that provides a methodology for developing a climate change adaptation plan, including the process of undertaking an IVA. The methodology considers not only the climate change impacts to council business but also the sensitivity and adaptive capacity of the social, economic and environmental components of the region within which the council operates. This standardised approach will provide local government and other key agencies state wide with an integrated view of the likely challenges posed by climate change and what actions will best improve resilience of the region.



Conserving freshwater biodiversity. Joining downscaled climate projections, hydrology, ecosystem values, and management frameworks: successes and obstacles.

Oral presentation

Session: Speedtalk session 3

Time: 5.05-5.10



Leon Barmuta¹, Peter Davies¹, Martin Read², Bryce Graham², Anne Watson¹, Danielle Warfe³.

¹University of Tasmania, Hobart, Tasmania, Australia, ²Department of Primary Industries, Parks, Water and Environment, Hobart, Tasmania, Australia, ³The University of Western Australia, Albany, WA, Australia.

We used Tasmania to demonstrate how outputs from downscaled climate models could be integrated with spatially resolved hydrological models and freshwater biodiversity data. In consultation with a variety of stakeholders, we quantified how different climate change scenarios could affect the risks to biodiversity assets, the scope and types of adaptation actions, and assessed the strengths and weaknesses of the policy and planning instruments in responding to climate change. We concluded that downscaled climate predictions linked with modelling of catchment and hydrological processes now refines projections for climate-driven risks to aquatic environments. Spatial and temporal hazards and risks can now be compared at a variety of scales via Bayesian Belief Networks, as well as comparisons between biodiversity assets. Uncertainties can be identified and built into adaptation processes. Notwithstanding this progress, we identified the following obstacles to implementation both in Tasmania and interstate.

Biodiversity data sets need to be improved and updated, and better, spatially explicit information on the contributions of groundwater to surface waters is needed. The bewildering array of adaptation tools available to stakeholders needs to be organised using procedures such as scenario modelling which incorporate explicit tools for comparing costs, benefits, feasibility and social acceptability so that priorities can be set transparently. Formal mechanisms for the uptake of knowledge about identified risks into policy and legislative instruments remain undeveloped. The greatest challenge is to integrate multiple adaptation strategies (sometimes at different scales) to achieve specific adaptation objectives-especially where a mix of water management and non-water management is required.



Low income households and adaptation to extreme heat

Oral presentation

Session: Parallel session 27

Time: 11.15-11.30



Guy Barnett¹, Matt Beaty¹, Jacqui Meyers¹, Dong Chen², Stephen McFallan³.

¹CSIRO Ecosystem Sciences, Canberra, ACT, Australia, ²CSIRO Ecosystem Sciences, Melbourne, Victoria, Australia, ³CSIRO Ecosystem Sciences, Brisbane, Queensland, Australia.

There are a range of intervention strategies proposed for dealing with extreme heat in cities. Some include public health interventions such as heat wave warning systems. Others relate to urban heat island mitigation strategies and include ecological solutions such as tree planting, or engineering solutions such as cool roofs and pavements or improvements to building performance. Yet there has been little evaluation of these strategies, and their application is often uncoordinated and piecemeal.

This presentation outlines findings of a recently completed research project undertaken by the CSIRO Climate Adaptation Flagship in partnership with two agencies responsible for the provision of social housing in Australia. With a focus on the climate change impact of extreme heat, various modelling and simulation techniques were employed to quantify the complex interrelationships between people, housing, and place, and how this manifests to influence vulnerability and the efficacy of adaptation.

We found heat-related health risk factors were most prevalent in low income households, who also tended to live in the hottest parts of the landscape. Quality rather than type of housing had the most influence on indoor thermal performance. In some locations, building retrofits can largely mitigate future impacts, whereas in others, a suite of adaptation actions across multiple scales will be required.

Four broad pathways for the adaptation of low income households to extreme heat were identified. These are discussed with regard to opportunities for housing portfolio managers and urban planning and management authorities to better coordinate and target their adaptation response to extreme heat.



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A resilience decision framework for the Great Barrier Reef World Heritage Area

Oral presentation

Session: Parallel session 24

Time: 12.00-12.15



Roger Beeden^{1,2}, Ken Anthony¹, Jeffrey Dambacher⁴, Rachel Pears¹, R Black⁵.

¹GBRMPA, Townsville, Australia, ²James Cook University, Townsville, Australia, ³Australian Institute of Marine Science, Townsville, Australia, ⁴Commonwealth Scientific and Industrial Research Organisation, Australia, Australia, ⁵Department of Sustainability, Environment, Water, Population and Communities, Australia, Australia.

The Great Barrier Reef is the world's largest coral reef ecosystem. It has been protected as a Marine National Park since 1975, and was listed as a World Heritage Area in 1981. The Great Barrier Reef Marine Park Authority has a long history of implementing management actions that support ecosystem resilience. However, the current and increasing impacts caused by climate change, coastal development and altered water quality are affecting the World Heritage values of the Reef.

This presentation reports on the development of a qualitative resilience decision framework for the Great Barrier Reef. The framework was designed to analyse the influence of activities and cumulative stressors on the key values for which the Reef was inscribed as a World Heritage Area.

The principles of structured decision-making have been employed in the framework to generate a prototype decision-support system. The integrated modelling and decision-support framework has been applied to two "demonstration" ecosystems; coral reefs and seagrass meadows, and three geographic demonstration cases: Cape York, Wet Tropics and Capricorn Bunker. Preliminary analyses of the spatial distribution of exposure likelihoods against management objectives under a range of development scenarios are presented to illustrate the utility of the framework.

A key strength of the framework is that it provides managers with a decision-support tool that integrates resilience science, management options and value judgments into qualitative models. The models capture critical ecosystem dependencies without disappearing into the proverbial "rabbit hole" of complex science for each ecosystem component.



Australia's country towns under climate change to 2050: analysis, case studies and action

Oral presentation

Session: Parallel session 1

Time: 3.30-3.45



Andrew Beer¹, Selina Tually¹, Mike Taylor², Rolf Gerritsen³, John Martin⁴.

¹Adelaide University, South Australia, Australia, ²University of South Australia, South Australia, Australia, ³Charles Darwin University, Northern Territory, Australia, ⁴La Trobe University, Victoria, Australia.

Australia's country towns sit on the frontline of climate change across the nation. They are potentially affected by many of the forecast impacts of climate change, including increasing temperatures, greater risk of fires, changing rainfall patterns and more frequent natural disasters, including droughts and floods. This presentation will present the outcomes of an NCCARF funded study that first developed an index of vulnerability and then examined the likely impacts of climate change on Australia's country towns through the use of Delphi analysis, an analysis of policy frameworks and via the in-depth examination of a number of case studies. The research found that some rural and remote settlements across Australia are especially vulnerable to the impacts of climate change, with many Indigenous settlements at risk. Settlements with larger and more diverse economies were likely to have greater resilience in the face of climate change, as were places closer to the capital cities. The presentation also notes that while there are worthy models for climate change adaptation available to country towns and their local governments, the avenues for communicating these pathways for innovation are poorly developed.



Framework for adapting Australian households to heat waves

Oral presentation

Session: Parallel session 13

Time: 1.30-1.45



Wasim Saman¹, John Boland¹, Barbara Pocock¹, Richard deDear², Veronica Soebarto³, Stephen Pullen¹, **Martin Belusko**¹, Helen Bennett^{1,3}, Barbara Ridley¹, Wendy Miller⁴, Jasmine Palmer¹, Jian Zuo¹, Tony Ma¹, Nicholas Chileshe¹, Natalie Skinner¹, Janine Chapman¹, Natalija Vujinovic¹, Moira Walsh¹, Max Deuble², Christhina Candido².

¹University of South Australia, Adelaide, South Australia, Australia, ²University of Sydney, Sydney, New South Wales, Australia, ³University of Adelaide, Adelaide, South Australia, Australia, ⁴Queensland University of Technology, Brisbane, Queensland, Australia.

Climate change is leading to an increased frequency and severity of heat waves. The problem is compounded by the escalating energy costs and associated increasing peak electrical demand due to air conditioning. A multidisciplinary study has been conducted to evaluate and ameliorate the potential impacts of heat waves on households in Australia. Future climatic data has been developed for all capital cities in Australia. This data has been used to evaluate the heating and cooling electricity costs from houses. It was identified that across mainland Australia, electricity usage for cooling is likely to be greater than heating for all capital cities. Electricity running costs for southern Australia increases marginally, while Sydney and Brisbane experience a dramatic increase in costs by 2030. Peak power demand from housing marginally increases in southern mainland cities, while dramatic increases in Sydney and Brisbane are predicted, further increasing electricity running costs. A number of design options were investigated for new and existing homes which can significantly impact on cooling demand, ranging from inclusion of cool retreats within new house designs to the use of high reflective paints for roofing. Measurements were made which showed that households are capable of remaining comfortable during hot periods with higher than typical room temperatures, which supports the use of demand side management. Further surveys identified that households are willing to adjust behaviour during hot periods to reduce air conditioning usage. However, increased education is needed to support household adaptation.



Climate Change Impact on Comfort Provision in Australian Housing

Oral

Session: Parallel session 9

Time: 1.17-1.29



Wasim Saman¹, Martin Belusko¹, Stephen Pullen¹, Helen Bennetts¹

University of South Australia, Adelaide, Australia1

Climate change is leading to an increased frequency and severity of heat waves. Spells of several consecutive days of unusually high temperatures have led to increased mortality rates for the more vulnerable in the community. The problem is compounded by the escalating energy costs and increasing peak electrical demand as people become more reliant on air conditioning. Domestic air conditioning is the primary determinant of peak power demand which has been amajor driver of higher electricity costs

The paper presents the findings of multidisciplinary research which develops a framework to evaluate the potential impacts of heat waves. It estimates the anticipated increased need for cooling and reduced need for heating and their impact on household energy consumption and peak power demand in major Australian cities. It also evaluates the likely impact of higher and more frequent temperatures on size and cost of air conditioning on typical house designs in Australia and associated increased demand on electricity infrastructure.

Through incorporating a number of retrofitting measures which could be implemented during renovation, the results show a potential for substantial improvement in comfort and reduction for air conditioning use in most climatic regions. Through modifying the dwelling design to incorporate the addition of a cool retreat, the analysis shows dramatic improvement in thermal comfort and reduction of air conditioning requirements if the households were to use the cool retreat during heat waves.



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A SWISH way to assess the health impacts of climate change

Either presentation

Session: Parallel session 27

Time: 11.45-12.00



Charmian Bennett¹, Ivan Hanigan¹, Keith Dear¹, Ian Szarka¹.

¹Australian National University, Canberra, ACT, Australia.

This presentation evaluates an innovative new research tool called Kepler (https://kepler-project.org/) to assess the health impacts of future climate change and adaptation scenarios. Kepler allows users to link together analytical steps and data sources (called "Actors") to create a "Workflow" using a drag-and-drop interface (instead of complex programming scripts). The SWISH project ("Scientific Workflow and Integration Software for Health") has extended the Kepler tool with custom Actors specifically designed to assess and project the health impacts of extreme weather events under climate change, and was funded by the Australian National Data Service (http://ands.org.au/).

Researchers can use Workflows to combine different Actors to construct sophisticated analytical processes that acquire, manipulate and analyse data from disparate sources and locations, and readily add or modify variables in subsequent analyses. The Kepler tool and SWISH Actors are freely available and open-source, allowing Workflows to be stored, shared, reused and extended, thus enhancing reproducible and collaborative research opportunities applicable to many areas of climate change, especially the analysis of impacts and adaptation scenarios. In adaptation research, many groups are tackling similar questions using complex data and methods. Well documented, reproducible workflows are essential for meaningful comparison and the integration of results.

This case study uses SWISH to identify extreme heat events in New South Wales over the baseline period 1980-2012, using a range of heat stress measures correlated with historical health outcome datasets. Future impacts related to climate change are then assessed to facilitate the development of relevant and useful planning and adaptation activities.



Integrating climate change adaptation and coastal management in Australia: moving from government to adaptive governance

Oral presentation

Session: Parallel session 10

Time: 1.00-1.15



Alicia Bergonia¹, Mark Diesendorf¹, John Merson¹.

¹Institute of Environmental Studies, Sydney, Australia

The vulnerability of the Australian coasts to climate change impacts is both an environmental and a developmental problem. Population growth and movement, along with tourism and urbanisation, constitute complex and interconnected problems. Interactions of these factors constantly undermine coastal ecosystems and expose a growing number of people to increasing risks of extreme weather events and sea-level rise. The sensitivity of economic and socio-cultural values of coastal settlement, infrastructure, industries and ecological resources to increasing risk suggest that, while adapting to climate change could be costly, doing nothing is likely to be more costly over the longer-term.

To reduce coastal vulnerability, adaptation needs to address the complex socio-economic pressures and current environmental stressors arising from increasing climate change risks. Collectively addressing these aspects could optimize the benefits generated from the use of coastal resources and its ecosystems, reduce negative effects of socio-economic activities, and harmonise social and political conflicts. Adaptation in this context means integration of two 'wicked' yet closely related policy domains: coastal management and climate change adaptation. Integration underpins a coherent pathway for coastal governance that provides a systematic framework for generating information and facilitating the science-policy interface and a well-informed adaptive decision-making process. It creates a robust, multi-level and multi-sectoral management structure, which proactively responds to coastal impacts of climate change while enhancing coastal resilience. This paper assesses how experiences gained from Australia's integrated coastal zone management and climate adaptation policies could inform the development and implementation of coastal governance in Australia.



Community-based climate change adaptation in action: EWB Australia and Nepal Water for Health

Speedtalk+Poster presentation

Session: Speedtalk session 1

Time: 5.10-5.15



Amanda Binks^{1,2}, Catherine Sherwood^{1,2}.

¹Engineers Without Borders Australia, Melbourne, Australia, ²Nepal Water for Health, Kathmandu, Nepal.

Engineers Without Borders Australia (EWB) is a not-for-profit organisation with 10 years' experience creating systemic change through humanitarian engineering. One of the ways they do this is by working in partnership with community organisations to address a lack of access to basic human needs such as clean water, sanitation and hygiene, energy, basic infrastructure, waste systems, information communications technology and engineering education.

EWB has partnered with Nepal Water for Health (NEWAH), a national Nepali water, sanitation and hygiene NGO, for over three years. Since 2011, EWB's volunteer engineers have supported NEWAH's Climate Change Adaptation (CCA) Program, which aims to build community resilience to the impacts of climate change from the bottom-up. In Nepal, marginal rural communities are being impacted by changing climate including an increased number of extreme events, poor crop yields, increased prevalence of disease and impacts on water supply and quality.

Based in one of NEWAH's regional offices in the west of Nepal, the EWB volunteer focus is on working with field staff to develop a pilot community-based CCA planning approach and assisting to identify ways in which learnings can be used to focus NEWAH's CCA support to communities. The program aims to generate awareness, trigger identification of vulnerabilities to climate change impacts and support communities in the preparation and implementation of community action plans with a focus on water supply, sanitation and hygiene.

The presentation, in addition to discussing the partnership, will describe the participatory methods used in the pilots and the learnings generated.



Maximising colonial waterbirds breeding events, using identified ecological thresholds and environmental flow management

Oral presentation

Session: Parallel session 33

Time: 1.45-2.00



Gilad Bino¹, Celine Steinfeld¹, Richard Kingsford¹.

¹Australian Wetlands, Rivers and Landscapes Centre, School of Biological, Earth & Environmental Sciences, University of New South Wales, Sydney, Australia.

Increasing demand for freshwater has severely degraded the world's freshwater ecosystems. This will be exacerbated by climate change. A key adaptation is to increase the quantity, quality, and frequency of the natural flow regimes. Formalising ecological models depicting key ecological components and the underlying processes of cause-and-effect is a crucial component of conservation-management. We modelled fluctuations in breeding abundances of ten colonial waterbird species over the past quartercentury (1986-2010) in the Macquarie Marshes, a wetland of international importance. We constructed a spatially-explicit Bayesian-belief network for an intuitive decision-making framework for conservationmanagement of breeding waterbirds. Breeding events thresholds emerged in all ten species, but these varied among species. Three species displayed a sharp threshold response between 100-250GL, with a breeding probability of 0.5 when flows were >180GL and a 0.9 breeding probability with flows >350GL. Remainder species had a breeding probability >0.5 when flows were >400GL. We explored alternative water timing-releases management strategies and identified maximal strategies for successful long-term management of colonial waterbirds. Depending on selected strategy, breeding likelihood for all ten colonial waterbirds ranged from 0.36±0.09SD to 0.53±0.14SD. We identified a strategy enabling managers to increase the likelihood of breeding for colonial waterbirds by 47.5%±18.7SD. Adaptation and management of complex ecosystems to current threats (e.g. river regulation) and climate change depends on good understanding of the responses of organisms. Considerable opportunity exists for implementing similar frameworks for other ecosystem attributes, following understanding of their responses to the flow regime, achieving a more complete model of the entire ecosystem.



State-transition analysis of flood dependent vegetation communities

Oral presentation

Session: Speedtalk session 3

Time: 4.50-4.55



Gilad Bino¹, Scott Sisson², Richard Kingsford¹.

¹Australian Wetlands, Rivers and Landscapes Centre, School of Biological, Earth & Environmental Sciences, University of New South Wales, Sydney, Australia, ²School of Mathematics & Statistics, University of New South Wales, Sydney, Australia.

Wetlands are characterised by a unique ecology displaying patterns of succession, dominantly driven by extreme variability in hydrological patterns, driven by climate, across the landscape and impacted by river regulation. While exposure to wet conditions can drive a succession process towards an aquatic condition, exposure to drying conditions can transform a community to a terrestrial one. Transitions between stable states are commonly triggered by multiple disturbances occurring rapidly or prolonged. We employed a quantitative approach to model the State and Transition probabilities of vegetation communities found within the Macquarie Marshes nature reserve. Using a Bayesian logistic regression approach, we modelled the probability of a transition between states vegetation communities at each cell (100mx100m). We used two vegetation surveys taken 16 years apart (1991, 2008). Significant extent transitions occurred among extent of vegetation communities in the Macquarie Marshes nature reserve, with an overall transition towards more dry states. We found that probability for inundation between the two vegetation surveys (1991 and 2008) and distance to nearest stream as the most superior model. We extended our approach to provide spatially-explicit predictions of transition probabilities for the vegetation communities based on two contrasting hydrologic regimes (regulated and unregulated). Ecological models linking successional ecological theory and ecosystem management are developing as tools for describing and predicting community change with climate change. Knowledge of impacts can inform mitigation possibilities for adaptation including environmental flow management.



Impact of the 2010-11 floods and the factors that inhibit and enable household adaptation strategies

Oral presentation

Session: Parallel session 6

Time: 4.00-4.15



Deanne Bird¹, David King², Katharine Haynes¹, Pamela Box¹, Tetsuya Okada¹.

¹Risk Frontiers, Macquarie University, Melbourne, Australia, ²Centre for Disaster Studies, James Cook University, Townsville, Australia.

The main objective of this research was to identify the factors that inhibit and enable adaptation strategies within flood affected communities. To achieve this, a mixed methods survey was carried out in three case study locations: Brisbane and Emerald, Queensland, and Donald, Victoria. In order to understand the broader story from a local perspective, we also investigated people's experience of the flood in terms of response and recovery. The main factors that were identified as either enabling or inhibiting response, recovery and adaptation were: direct experience; outcome expectancy; methods of communication and availability of information; governance and physical protection; uncertainty surrounding insurance; financial restraint and relief assistance; housing design and construction; personal health and wellbeing; options for relocation; and, positive and negative aspects of volunteerism as well as community initiatives. A dominant finding from the study is that a greater number of constraints inhibit adaptation than factors that enable adaptive change and behaviour. However, balanced against the criticisms and fault identification the study showed resilient communities getting on with their lives and largely driving recovery themselves.



Grassroots practices, urban food and climate adaption

Speedtalk+Poster presentation

Session: Speedtalk session 11

Time: 5.05-5.10



Meghan Bond¹

¹Griffith University (past student), QLD, Australia

In the search for practices to respond to climate change and sustainability concerns, Seyfang (2009) states that grassroots actor's practices are a neglected site of innovation. This paper presents the emerging urban food-focused practices from the grassroots layer of climate action. The specific grassroots practice of a permablitz will illustrate the potential climate change adaption and mitigation benefits. A permablitz involves the creation of an edible garden premised on permaculture principles by volunteers over the duration of one to two days. While the practice may seem simple enough, a permablitz, and the philosophy that underpins it, could contribute to urban food security and provide additional climate change adaptation benefits. The concept of the permablitz has its origin in the grassroots layer of climate action in the Australian state of Victoria. The urban food-focused practices are but some of an array of innovative grassroots practices uncovered as part of a PhD project exploring the Australian grassroots layer of climate action. Argued in this paper is that these practices offer additional avenues for climate action and warrant further research attention.



Community engagement in DRR and CCA: the need to transform our discourse

Poster only presentation

Session: Poster session



Karyn Bosomworth¹, Darryn McEvoy¹, Michael Howes², Deanna Grant-Smith², Kim Reis², Pete Tangney², Michael Heazle², Paul Burton².

¹RMIT University, Melbourne, VIC, Australia, ²Griffith University, Gold Coast, QLD, Australia.

Like much of the world, Australian societies are growing in a time of changing socio-ecological interactions and increasing urbanisation. Combined with climate change, these shifting dynamics will expose more Australian communities to an increasing frequency and intensity of natural hazards, placing further pressures upon our social-economic-ecological systems. A comparative study of three recent Australian natural hazard inquiries - the 2009 Victorian bushfires, and the 2011 Queensland floods and Perth Hills bushfires - provided insights into the challenges of integrating climate change adaptation (CCA) and disaster risk reduction (DRR) to enhance 'social resilience' (Howes et al. 2012, 2013). That study found that effective community engagement remains a crucial public policy practice in DRR and as a foundation for longer-term CCA. Drawing from that study, this paper reiterates and builds on the argument that a shift toward more participatory approaches in community engagement is required in Australia's emergency management sector to bolster integration between DRR and CCA. It argues that community engagement efforts based on an understanding of the complexities of community resilience as a point of convergence between CCA and DRR, may facilitate constructive approaches to supporting natural hazard resilience as a foundation for longer-term adaptive and transformative capacities. Finally, the paper will argue that to begin such an approach, we - researchers and policymakers - might transform our own discourse from ideas of 'natural disasters' to living with natural hazards, and cease reliance on the misleading idea that passive provision of information will support the adaptive actions we advocate.



Water quality changes in the Great Barrier Reef given more intense storms and floods associated with climate change

Oral

Session: Parallel session 31

Time: 1.45-2.00



Jon Brodie¹

Catchment to Reef Research Group, TropWATER, James Cook University, Townsville, Australia1

Over the last eight years the number of Category 4 and 5 cyclones and the number of record river discharges in the Great Barrier Reef (GBR) region has been higher than any time in the instrumental record (largely the last 100 years). The intense cyclones, particularly Hamish and Yasi, have caused immense physical damage to coral reefs and seagrass meadows. The record discharges from rivers such as the Burnett, Fitzroy and Burdekin, with their associated loads of suspended sediment, nutrients and pesticides, have caused large-scale loss of seagrass meadows and, particularly over the last two years, high mortality of dugongs and turtles. Coral cover on reefs south of Cooktown is already at the lowest levels seen since monitoring began and seagrass condition is now at its worst. These acute events come on top of chronic water-quality stressors for the GBR, including the nutrient-linked Crown of Thorns Starfish coral predator, that have reduced the resilience of coral reefs. While management of terrestrial discharges of pollutants from agricultural sources has begun under Reef Plan activities, especially the Reef Rescue initiative, the success of management will be compromised if frequent, acute events continue. Given lack of management response to increasing coastal development (ports, urban and industrial development) successful management of the GBR will be difficult under the predicted scenarios of more intense storm events associated with more heat energy in the oceans and atmosphere.



Climate change adaptation and the Royal Australian Navy

Oral presentation

Session: Parallel session 29

Time: 2.00-2.15



Steve Cole¹, Ian Brown¹.

¹Royal Australian Navy, Canberra ACT, Australia.

The Royal Australian Navy (RAN) recognises that good seamanship practices include sound environmental stewardship, particularly in a maritime nation dependent on rich marine resources and trade by sea. Stewardship includes understanding the impacts of climate change and associated risks to capability and infrastructure, and finding ways to reduce reliance on fossil fuels.

New vessels including the Canberra Class Landing Helicopter Dock (LHD) ships will significantly increase Australian naval operational capabilities. These will enhance responses to regional security, humanitarian crises and natural disasters within the Asia Pacific region. The high value and coastal siting of RAN infrastructure increases vulnerability to sea level rise and weather events. A project to assess vulnerabilities and to find ways to increase resilience is underway.

Options to reduce reliance on fossil fuels are being explored through two flagship projects. At HMAS Stirling, construction will commence shortly on Australia's first semi-commercial scale wave energy plant. When commissioned, the plant is expected to meet 15% of the total energy needs of the base. Separately, the RAN is preparing to take advantage of alternative fuels. In 2012 the RAN completed an alternative fuel trial with a Seahawk Helicopter, and certification for use in Australian warships is to follow in 2014. The RAN is aiming to ensure readiness to receive alternative fuels as they become available and cost effective. The RAN has assessed that its current and future capability is well placed to manage operational risks posed by climate change, although the cost to adapt infrastructure will likely be significant.



How will the health system adapt to climate change? Strengths, gaps and barriers in the Australian system

Oral presentation

Session: Parallel session 21

Time: 3.15-3.30



Anthony Burton¹, Hilary Bambrick¹, Sharon Friel², Tony Capon³.

¹University of Western Sydney, NSW, Australia, ²Australian National University, ACT, Australia, ³University of Canberra, ACT, Australia.

Climate change is likely to increase morbidity and mortality from existing health disorders and to amplify health inequities. Whilst the primary adaptive responses to reduce these health impacts must necessarily be taken in other sectors (e.g. urban planning, infrastructure), health systems should also plan, resource and prepare for climate-related health impacts. To ensure that the system is proactive and responsive, the barriers, strengths and opportunities within the health system must be identified and services planned within this context. This presentation provides a snapshot of the perceived barriers, strengths and opportunities as they relate to climate change within the existing Australian health system.

Results from semi-structured interviews (n=16) with current senior health service planners indicate the Australian health system is robust and there are areas of strength in the system. Interviewees identified that the health system was staffed by well trained professionals, it makes good use of emerging technology and has good systems of communication.

However, through the interview process we identified potentially significant gaps including the system being inflexible, unable to cope with rapid change and one that is already under enormous pressure. In addition, perceived barriers to adaptation planning are substantial, in particular the lack of political commitment, professional leadership, widespread scepticism and a culture of medical conservatism. While the Australian Health system is robust with many strong points there are significant gaps and substantial barriers that will reduce the ability of the health system to be proactive in the management of the future health impacts of climate change.



Stepping out of the way - driving effective reform by empowering local leaders

Oral presentation

Session: Speedtalk session 8

Time: 5.05-5.10



Lauren Burton¹

¹Government of South Australia, South Australia, Australia

Prospering in a Changing Climate: South Australia's Adaptation Framework provides a unique foundation for South Australians to prepare for climate change. Adaptation to climate change is required across all sectors of our society and economy. An integrated approach is designed to increase cost effectiveness and reduce risks of maladaptation.

South Australia's key challenge is facilitating a diverse range of partners to deliver integrated regional adaptation plans. Partners include state and local governments, regional natural resources management boards, Regional Development Australia boards, other local authorities and relevant peak bodies. Experience has shown that each partner organisation has a unique interest and differing level of motivation. Further, State Governments have tended to retain some control over the actions of regional authorities.

Traditional solutions would involve mandating participation through legislation, or taking a centralised approach to adaptation planning. But South Australia has developed a set of governance mechanisms focusing on creating genuine buy-in of the regional partners.

The approach includes setting out roles and responsibilities through voluntary agreements and forming steering committees to drive implementation. Through early engagement, regions are supported to deliver a planning process which meets their own needs. The funding model is designed to ensure a relatively small investment by State Government drives significant investment in shared projects at the regional scale.

By implementing governance mechanisms for shared solutions, South Australia has been able to leverage significant support from regional partners. Implementation has been well supported across the state with regional results already informing the State's approach to adaptation.



Effects of climate change on river macroinvertebrates

Oral presentation

Session: Speedtalk session 3

Time: 5.10-5.15



Alex Bush¹

¹Macquarie University, Sydney, Australia

This study assesses the vulnerability of Australian dragonflies to climate change and proposes an appropriate conservation network for eastern Australian rivers. Species distribution models provide a means of establishing spatially specific predictions at the landscape scale that can then be used by systematic conservation planning to improve efficient representation of species.

A range of modelling methods was used to predict the distribution of 270 (84%) species of Australian dragonflies nationwide for both current and future climate scenarios in 2085. Using a simplified phylogeny based on taxonomic relationships a weighted score of phylogenetic endemism was then calculated for dragonflies across Australia. Reserve design was evaluated at the reach-scale, including connectivity for both reserve design, and climate change affected species.

15% of species appear highly vulnerable to the effects of climate change, and although many species could potentially expand their range, almost 40% show a decline. There are clear geographic biases in the predicted effects, and evolutionary losses are biased among families. The conservation network focuses on localised refugia, and regions that retain their existing assemblages, or are needed by range-shifting species.



Getting smarter: a technological approach to sharing adaptation knowledge

Speedtalk+Poster presentation

Session: Speedtalk session 7

Time: 4.40-4.45



Samantha Capon¹, Wade Hadwen¹.

¹Griffith University, Nathan, Queensland, Australia

The knowledge generated by adaptation research projects is often both sizable and complex due to the interdisciplinary and multi-faceted approaches typically employed. Sharing this knowledge in an efficient and effective manner can therefore present a considerable challenge to researchers, knowledge brokers and information users. The Coastal Ecosystems Responses to Climate Change Synthesis (CERCCS) Project was no exception, generating a 342 page scientific report, numerous fact sheets and reams of underlying data. While these outputs have their appropriate audiences, the project team sought a means of making findings from CERCCS more widely available and applicable to those adaptation practitioners urgently requiring information of relevance to their specific situation. Enter the smartphone app. With GPS capabilities, database searching and the capacity to store large quantities of information in the palm of your hand, smartphones offer a relatively novel means of broadly delivering targeted information to endusers. In this short talk and poster session we will launch the CERCCS App, demonstrate its functionality and discuss its potential application. We will also comment on the process of its development including its future with respect to uptake, evaluation and management.



Reactions to different precision formats in climate change communication

Speedtalk+Poster presentation

Session: Speedtalk session 7

Time: 5.05-5.10



Hui Yih Chai¹, Ben Newell¹.

¹University of New South Wales, Sydney, NSW, Australia

Communicating uncertainty about the potential impacts of climate change to the general public is challenging. The current study aimed to develop further understanding of uncertainty communication, specifically, whether favourable or positive framing of uncertain information could encourage people to engage in more pro-environmental behaviours. Participants compared eight pairs of statements about possible climate change consequences in which the severity of the forecasted outcomes were framed in two precision formats: (1) point format (e.g. reduced rainfall by 20%) or (2) range format (e.g. reduced rainfall by 10-30%). Favourability of the outcomes was also manipulated. The forecasts claimed that the consequences were either less (favourable condition) or more (unfavourable condition) extreme than previously predicted. Not surprisingly, people preferred favourable over unfavourable predictions, although they rated the former less credible. When analysing the reasons behind participants' preferences for different precision formats, we identified different classes of responses. For example, participants who preferred the range format (e.g. 10-30%) indicated that the lower boundary of the estimate (i.e. 10%) seemed to suggest possibilities for better outcomes and hence, more likely to promote mitigative action. In contrast, those who preferred point format (i.e. 20%) felt that because the lower bound of the range estimate (i.e. 10%) was less than the single estimate (i.e. 20%), the statement was less conducive for promoting climate-positive behaviours. These findings provide insight into the interpretation of informationally equivalent estimates and as such offer preliminary guidance on effective precision formats for communicating uncertainty about the impacts of climate change.



Seasonal forecasting in the Pacific: combining traditional knowledge with statistical and dynamical methods to aid adaptation

Oral presentation

Session: Parallel session 32

Time: 2.15-2.30



Lynda Chambers¹, Mike Waiwai², Philip Malsale², Silas Robson Tigona², Savin Chand⁵, Karen Bennett⁵, Christopher Bartlett³, Salesa Kaniaha⁴.

¹Centre for Australian Weather and Climate Research, Melbourne, Australia, ²Vanuatu Meteorological and Geohazards Department, Port Vila, Vanuatu, ³SPC-GIZ Coping with Climate Change in the Pacific Islands Region, Port Vila, Vanuatu, ⁴Secretariat of the Pacific Regional Environment Programme, Apia, Samoa, ⁵Australian Bureau of Meteorology, Melbourne, Australia.

Many indigenous people in the Pacific forecast seasonal climate conditions through observation and monitoring of meteorological, astronomical and biological indicators (e.g. behavior of plants and animals). Built over many generations, these knowledge systems are adapted to local conditions to cope with a highly variable and vulnerable environment. Traditional climate knowledge systems continue to influence all aspects of modern Pacific livelihoods from agricultural productivity to disaster response and recovery. In recent years, alternative forecasting methods have been promoted by national meteorological services based on statistical and dynamical modelling of the climate system. However, in some locations, uptake of these 'new' methods is low with locals continuing to use traditional forecasts for many reasons including inadequate access to the new forecasts, insufficient trust in new forecasting methods or historical usefulness of traditional forecasts. Enabling adaptation to changing seasonal climatic conditions in the Pacific requires improved understanding of how traditional forecasting methods compare to those based on climate models. Building on global experiences with traditional seasonal forecasting, e.g. Kenya, we develop a methodology for the Pacific region for:

- 1. Documenting and cataloguing traditional indicators used for seasonal climate forecasting;
- 2. Assessing the accuracy of traditional forecasts and those based on statistical and dynamical modelling of the climate system;
- 3. Optimally combining traditional and modeling-based forecasts.

The integrated approach to forecasting has the potential to improve the accuracy and utility of local forecasts as well as ensuring the communication of climate information is in a locally relevant context to increase adaptive capacity.



Adapting to climate change: a risk assessment and decision framework for managing groundwater dependent ecosystems with declining water levels

Oral presentation

Session: Parallel session 26

Time: 11.30-11.45



Jane Chambers¹, Bea Sommer², Peter Speldewinde³, Simon Neville⁴, Stephen Beatty¹, Gaia Nugent¹, Stacey Chilcott¹, Stefan Eberhard⁵, Nicola Mitchell³, Frances D'Souza⁶, Olga Barron⁷, Don McFarlane⁷, Michael Braimbridge⁶, Belinda Robson¹, Paul Close¹, David Morgan¹, Adrian Pinder⁸, Ray Froend², Pierre Horwitz², Peter Davies³.

¹Murdoch University, Murdoch, WA, Australia, ²Edith Cowan University, Joondalup, WA, Australia, ³The University of Western Australia, Western Australia, Australia, ⁴Ecotones and Associates, William Bay, WA, Australia, ⁵Subterranean Ecology, Stirling, WA, Australia, ⁶Department of Water, Perth, WA, Australia, ⁷CSIRO Land and Water Division, Floreat, WA, Australia, ⁸Department of Environment and Conservation, Wanneroo, WA, Australia.

One of the key gaps in climate change adaptation research is translating science into useful management tools that can be applied to on-the-ground decision-making and action. This paper outlines an innovative risk assessment and decision-making framework for managing groundwater dependent wetlands and caves with declining water levels due to climate change, groundwater extraction and land use. The tool was created in south-western Australia, a global biodiversity hotspot and one of the earliest regions impacted by climate change. Underlying the framework is a conceptual model that shows the interactions between hydrology, water quality, resource requirements of biota and biotic responses. The interactions between each of these components are quantified using a Bayesian Belief Network, which uses probabilities to provide a risk-based approach. The framework is based on a standard risk assessment framework, which consists of five steps: identify the hazard (Step 1), determine exposure and vulnerability of the ecosystem (Step 2), assess effects (Step 3), characterise risk (Step 4) and manage the risk (Step 5). Applications for decision support are presented at each step of the framework to guide monitoring and management. The benefit of this approach is it can be used to identify ecosystem consequences of declining water levels (a top down approach) or the critical thresholds at which a change in water levels will result in some predicted environmental or biological response (a bottom up approach). This framework is designed to help environmental managers adapt to climate change at the local, landscape and catchment scales across Australia.



High resolution fire weather projections for the Sydney Climate Impact Profile

Either presentation

Session: Speedtalk session 12

Time: 5.00-5.05



Hamish Clarke^{1,2}

¹Office of Environment and Heritage, NSW, Australia, ²Climate Change Research Centre and ARC Centre of Excellence for Climate Systems Science, University of NSW, NSW, Australia.

The NSW Office of Environment and Heritage is working to provide a regionally specific information resource outlining the best known information on climate change and the potential impacts for the Sydney Metropolitan Area. To enable this, researchers from the University of NSW have developed high resolution climate projections for the Sydney Metropolitan Area using dynamical downscaling to 2km grids.

This downscaled climate data has been used to calculate the McArthur Forest Fire Danger Index, used by weather forecasters and fire management agencies to declare fire warnings and total fire bans and to predict fire behaviour. Mean daily FFDI and days with FFDI above 50 are used to summarise and evaluate the model fire weather. Twentieth century model hindcast results are also compared with observational data from two weather stations within the study area.

There is projected to be an overall increase in fire danger conditions in Sydney, driven largely by strong increases during Spring in mean conditions in Sydney's West and in extreme conditions in the east. Changes in relative humidity appear closely linked to projected increases in mean fire weather conditions; the cause of changes in extreme values is uncertain. The modelled climate performs reasonably well in comparison with FFDI observations at Sydney Airport, but strongly underestimates FFDI at Richmond.



Climate change projections to support natural resource management planning

Oral

Session: Parallel session 12

Time: 1.00-1.15



Penny Whetton¹, Aurel Moise², Jonas Bhend¹, Ian Watterson¹, Michael Grose¹, Kevin Hennessy¹, Tony Rafter¹, Louise Wilson¹, Marie Ekstrom³, Paul Holper¹, **John Clarke** ¹

¹CSIRO Marine and Atmospheric Research, Aspendale, Australia, ²BoM, Melbourne, Australia, ³CSIRO Land and Water, Canberra, Australia.

Regional climate change projections are required to serve the needs of adaptation planning in a broad range of human and natural systems. These descriptions of future climate need to convey all those aspects of climate change which may be important in driving system impacts, present uncertainties appropriately, but also be easy for users to understand and employ. With the support of DCCEE, CSIRO and BoM are undertaking a major new project aimed at providing updated climate change projections for Australia specifically aimed at supporting the needs of natural resource management (e.g. ecosystems, agriculture and water resources). The projections are to be based on analysis of CMIP5 climate model results, as well as a range of downscaled data. Development of these projections entails extensive consultation with natural resource management planners and associated impacts and adaptation researchers to ensure that the projections meet their needs and expectations. The projections will also underpin a major update to national projections released in 2007. Extensive analysis of the CMIP5 ensemble has been completed and interim projections for eight regions have been developed for a range of variables, such as temperature, precipitation, humidity, and radiation, including some aspects of extremes, such as hot days and extreme rainfall. We will present the updated projections based on CMIP5 models and compare these to the previously published projections based on CMIP3.



Heatwaves in Australia 1788-2010: who, really, is most at risk?

Oral presentation

Session: Parallel session 13

Time: 1.15-1.30



Lucinda Coates¹

¹Risk Frontiers, Macquarie University, Sydney, NSW, Australia

Effective planning for natural hazards includes knowing who is most at risk. Heatwaves, due to their complex and pervasive nature, have not traditionally attracted the study due their importance in terms of human mortality. Research utilising PerilAUS - Risk Frontiers' database of historic natural hazard impacts has quantified heat-associated deaths in Australia from European settlement to the present day. Demographic trends and circumstances surrounding such deaths were analysed in order to understand which groups of the population have been most vulnerable and how these trends have changed over time. To date, figures indicate that, from 1844-2010, heatwaves have been responsible for at least 5 332 fatalities. Data from 1900 onwards indicate they have killed more Australians than the combined total of deaths from all other natural hazards and that approximately 31% of these deaths have occurred in just nine events. Trends examined to date suggest that the overall decadal death rate has fluctuated over time but has steadily declined from a high of 1.69 deaths per 100 000 population in the 1910s to its current rate of 0.26. The male to female death-rate ratio has fluctuated over time from 4.81 in the 1880s to the current 1.10 and approaches, but does not reach, equality. Case studies were undertaken of five of the worst heatwave events in Australian history - 1896, 1908, 1939, 1959 and 2009 - to further explore any trends. Policy implications in view of changing climate and societal conditions are discussed with respect to the trends analysis.



Community conceptions of vulnerability – from discourse to policy

Speedtalk+Poster presentation

Session: Speedtalk session 1

Time: 5.05-5.10



Lisette Collins¹, David Schlosberg¹.

¹University of Sydney, Sydney NSW, Australia

This paper asks a straightforward question: how do community adaptation plans reflect the public's concerns about vulnerability? We compare a discourse analysis of conceptions of vulnerability in local and regional media, stakeholder websites and literature, and government literature with the language of actual adaptation plans in a number of communities across Australia. Additional questions include how such local discourses differ depending on place, and how different stakeholders may inequitably influence the development of adaptation plans.



Displaced twice: what has changed for refugee men after the 2011 Queensland floods?

Oral presentation

Session: Parallel session 1

Time: 4.15-4.30



Ignacio Correa-Velez^{1,2}, Augustine Conteh^{1,2}.

¹Queensland University of Technology, Brisbane, QLD, Australia, ²Institute of Health and Biomedical Innovation, Brisbane, QLD, Australia.

What can we learn from resettled refugees who have been affected by an environmental disaster? This presentation discusses the impact of the 2011 Queensland floods on a cohort of refugee men living in Brisbane and the Toowoomba-Gatton region of Southeast Queensland. Between 2008 and 2010, the SettleMEN study yielded pre-disaster measures of health and settlement among a cohort of refugee men. The current 2012-2013 follow-up study offers a rare opportunity to investigate the impact of an environmental disaster on a group of resettled refugee men.

Using a mixed-method approach and a peer interviewer model, the study has assessed participants' degree of exposure to the floods, the impact of the floods on their health and settlement, their perceptions of safety and security, and their vulnerability and adaptive capacity to extreme weather events. Fifty percent of participants, mainly those living in the Toowoomba-Gatton region, were temporarily evacuated or moved out of home due to the floods, 35% experienced illness or injury, 70% reported moderate/major impact of the floods in terms of their emotional wellbeing, and 60% felt less safe and secure after the floods. Forty five percent received assistance from neighbours or volunteers outside their ethnic/cultural community during/after the floods.

The presentation will discuss how the floods impacted on participants' interaction with their neighbours, how resettled refugee communities perceive the impact of their past refugee experience on their capacity to cope with environmental disasters, and what key factors can best support refugee's adaptation to extreme weather events in a resettlement context.



Adaptation research communication to influence real world decisions

Oral presentation

Session: Parallel session 25

Time: 12.15-12.30



Liese Coulter¹

¹NCCARF, Gold Coast, Australia

While a primary goal of research on adapting to climate change is ensuring that new findings can influence real world decisions, most traditional impact measures in scientific publishing target long term references by other researchers rather than immediate awareness and use in the policy or business community. There is evidence that some communication strategies can increase the speed and scope of access to climate adaptation research by key stakeholders and decision makers outside of the research community. Using a case study approach we profile the short term communication and distribution pattern of three final reports from the NCCARF research program highlighting metrics of online access and mentions in the media, blogs and sector specific publications. The selected research projects relate to public perceptions of climate change, vulnerability to heatwaves and readiness for flooding in the mining industry.



Eastern Seaboard Climate Hazard Tool - MATCHES

Oral presentation

Session: Parallel session 14

Time: 1.00-1.15



Aaron Coutts-Smith¹, Felicity Gamble¹, Clinton Rakich², Martin Schweitzer².

¹Bureau of Meteorology, Darlinghurst, NSW, Australia, ²Bureau of Meteorology, Melbourne, Australia.

With a significant proportion of the New South Wales and southern Queensland population and infrastructure concentrated in the corridor between the coast and the tablelands, knowledge of the highly variable weather systems that cause significant impacts in this region is vital. The Bureau of Meteorology (BoM), in partnership with the NSW Office of Environment and Heritage under the Eastern Seaboard Climate Change Initiative, has developed the Eastern Seaboard Climate Hazard Tool aka Maps and Tables of Climate Hazards of the Eastern Seaboard (MATCHES). The tool identifies significant rainfall/wind/wave/water-level events on the Eastern Seaboard according to user specified thresholds while simultaneously displaying east coast low (ECL) tracks. This allows easy analysis of the relationship between the movement and location of an ECL and where its impacts are subsequently felt.

MATCHES draws on the BoM's rainfall and wind datasets and Manly Hydraulics Laboratory's wave height and water-level datasets, which are displayed graphically for each event, and available for download. An objective analysis is used to identify ECL tracks using the National Centers for Environmental Prediction (NCEP) Mean Sea Level Pressure (MSLP) reanalysis dataset. Each ECL track point is linked to the corresponding Australian daily gridded rainfall map to enable users to visualize the spatial extent of rainfall impacts with each system.

MATCHES will be accessible via a 'registered-users page' hosted on the BoM website and will provide users across a range of sectors with the ability to assess their own climatic risk associated with ECL. The authors would like to acknowledge the funding providing by the NSW Environmental Trust.



Future fit? A comparative assessment of farm resilience in eastern New Zealand dairying

Oral presentation

Session: Parallel session 4

Time: 4.15-4.30



Nick Cradock-Henry¹, Claire Mortimer¹.

¹Landcare Research, Lincoln, New Zealand, ²Earthwise Consulting, Hastings, New Zealand.

Resilient systems have been characterised as those that have a higher capacity to absorb shocks and stresses; have the ability to self-organize into flexible and responsive networks for learning, distribution and change, and; have a high capacity for learning and adaptability through feedback mechanisms within the system. While these concepts have been well developed in the literature as theoretical and conceptual frameworks, there are few examples of operationalizing and empirically applying these concepts, particularly for agroecosystems which are among the most complex of social-ecological systems. Using a 'bottom-up' and participatory-based approach, we reviewed and empirically applied a set of behavioural indicators across three different types of dairy farm systems in the Bay of Plenty, New Zealand: organic, low-input or grass-based; and high-input, or intensive systems in which supplemental feed is the major input. Results show significant differences in the resilience of the different farm types. The 'lock in trap' of highly intensive systems, while profitable in the short term, may be less resilient to climatic shocks as these will likely occur in conjunction with changing market and financial risks. Low-input systems are less dependent, in particular, on fossil fuels and were associated with higher levels of farmer satisfaction and well-being. The research demonstrates that in-depth, robust qualitative assessments of resilience can provide a complement to quantitative metrics. The characterisation of resilient dairying also has the potential to contribute to broader sustainability frameworks for agriculture. The findings have implications for the future of the world's largest exporter of dairy products.



Understanding the responses of taro and cassava to climate change - implications for Pacific food security

Speedtalk+Poster presentation

Session: Speedtalk session 11

Time: 5.00-5.05



Steven Crimp¹, Roslyn Gleadow², Shaun Lisson¹, John Hargreaves¹, Poasa Nauluvula³, Bruce Webber¹.

¹CSIRO CAF, Canberra, Perth, Brisbane, Australia, ²Monash University, Melbourne, Australia, ³Fiji Department of Primary Industries, Suva, Fiji.

Communities in the Pacific Island countries reliant on agriculture-based livelihood systems have been identified as particularly at risk from climate change, due to likely increases in crop failure, new patterns of pests and diseases, lack of appropriate seed and plant material, loss of livestock and potential loss of arable land. In the Pacific region, recent shortfalls in agricultural production resulting from changing export markets, commodity prices, climatic variation, and population growth and urbanisation, have contributed further to regional food insecurity concerns.

A number of activities are already underway in the Pacific region to identify ways to ameliorate existing climate risk and enhance current agricultural production. Whilst these activities are important to ensure long-term agricultural sustainability, there remains a significant degree of uncertainty as to how effective these strategies may be in the face of a changing and increasingly variable future climate.

We present our current understanding of the impact of climate change on key Pacific production systems - specifically those based on the staple root crops, taro and cassava. This includes:

- Our understanding of the responses of cassava and taro crops to existing environmental drivers (climate, soil and nutrient interactions);
- The responses of cassava and taro crops to enhanced CO2 conditions; and
- Efforts to model productivity responses (within the APSIM framework) and results for locations in the Pacific.



Modelling sub-daily rainfalls for flood estimation

Oral presentation

Session: Speedtalk session 5

Time: 5.00-5.05



Phuong Cu Thi¹, James Ball¹.

¹University of Technology, Sydney, Australia

Design flood estimation under current climatic conditions remains a problem for many catchment managers. This problem will be more complex in the future when unknown future climatic conditions exist. Nonetheless, estimation of current and future flood risks is required for assessment of a range of climate change adaptation proposals.

When catchment modelling is used for prediction of flood flow quantiles, the uncertainty of the prediction to related to the robustness of the calibrated catchment modelling system. As shown by Umakhanthan and Ball (2004), the rainfall model used to predict the rainfall over the catchment significantly influences predictions obtained from the modelling system. Presented in this paper will be a discussion of the data analysis undertaken to provide adequate information for robust flow predictions.

The analysis presented will use a catchment in Vietnam (the Ba River system) as a case study. The focus of the analysis will be the disaggregration of daily rainfall information into sub-daily rainfall data to enable development of a suitable rainfall model for simulation of flood flows in the Ba River catchment. The disaggregation technique discussed is the non-parametric method developed by Sharma and his colleagues referred to as "Method of Fragments". Use of this technique for both current and future climatic conditions will enable assessment of climate change impacts on predicted flood flow quantiles.



Assessment of climate change impacts and local adaptation measures in the livelihoods of indigenous community in the hills of Sankhuwasabha District

Poster only presentation

Session: Poster session

Time:



Subash Dahal¹, Muna Sharma^{1,2}.

¹Institute of Agriculture and Animal Sciences, Chitwan, ²Nepal, Department of Agriculture, Lalitpur, Nepal.

Climatic complexity, agriculture based economy, marginality and topographical adversity of hilly regions of Nepal makes it the most vulnerable area to the impacts of climate change. A survey was carried out in 50 households of Makalu and Pathivara VDCs of Sankhuwasabha district in 2010 to assess the impacts of climate change on the livelihoods of people living in these areas. This study examined the consistency of local peoples' perceptions about climate change with climate observation data recorded by meteorological stations. It documented the local adaptation measures using a semi structured questionnaire. Respondents experienced erratic rainfall pattern, decreased length of winter, increased frequency and length of droughts associated with decrease in water sources in recent years. The analysis of climatic data showed similar results. Landraces had disappeared and new invasive weeds had appeared. Farmers were forced to adopt new cultivars and changes in planting time to adapt with changing conditions. Incidence of human, plant and animal diseases and natural hazards in recent years are major threats to livelihood. The linear trend line of productivity of rice indicates decreasing productivity. Analysis of climate data of Sankhuwasabha district showed 0.034°C increase in maximum temperature and 0.048°C decrease in minimum temperature per year in past 22 years. The correlations between temperature and productivity of rice, wheat and maize were significant. The study showed that people started adaptation measures autonomously. Adoption of new crop varieties, construction of stone walls and local irrigation canals and cultivation of some cash crops were the major adaptation measures observed.



Local government planning for the future: adaptable buildings for flooding and sea level rise impacts

Oral presentation

Session: Parallel session 16

Time: 3.45-4.00



Sarah Campbell¹, Greg Giles², **Tom Davies**¹.

¹Edge Environment, Sydney, NSW, Australia, ²Lake Macquarie City Council, Lack Macquarie, NSW, Australia.

The highly urbanised foreshore surrounding Lake Macquarie is at risk from the increased frequency and severity of flooding events and permanent inundation from sea level rise. Developments in at-risk areas such as Lake Macquarie's foreshore need to be designed to be adaptable to allow continued occupation for the lifetime of the development. Guidelines for adaptable buildings allow local governments to assess development in high risk areas against design principles for adaptability, and provide performance criteria to ensure developments are capable of being adapted. This kind of planning for the future means desirable coastal land need not be sterilised due to predicted risk and prevents legacy issues of unliveable coastal development.

Lake Macquarie Council commissioned Edge Environment to produce "Development Guidelines for Adaptable Residential buildings in Response to Sea Level Rise". An adaptable building can be easily reconfigured to respond to changing hazards, if and when required. It allows the building to function safely over a range of scenarios, and the investment in additional risk mitigation can be timed to coincide with the increase in hazard, which may occur faster or slower than predicted. It may also allow construction in areas of high risk, where other buildings would fail or become dysfunctional. The Guidelines will be integrated into a Development Control Plan to give developers direction on acceptable solutions for building in areas impacted by predicted sea level rise. This project sets a precedent for local government action on adapting the built environment to potential risk to sea level rise.



Insurance industry tools and knowledge development for a more resilient built environment

Oral presentation

Session: Speedtalk session 10

Time: 5.00-5.05



Jacqui Bonnitcha¹, **Tom Davies**¹.

¹Edge Environment, Sydney, NSW, Australia

The Insurance Council of Australia (ICA), supported by Edge Environment, is delivering a suite of projects to provide decision makers with the tools and knowledge for a better adapted, and more resilient, built environment. These projects and tools are coordinated through the Australian Resilience Taskforce (ART), an ICA initiative to promote collaboration and coordination amongst the diverse stakeholders involved in adaptation and resilience.

A key initiative under the ART is the Building Resilience Rating Tool (BRRT) which will inform homeowners, local authorities, building professionals and insurers of the resilience of homes to a broad range of hazards. Development of the BRRT began in 2010 and the first public version of the tool will be released in May 2013. This version of the BRRT will be targeted at the general public and will address inundation and storm hazards. Future versions will target additional hazards and tailor information to different audiences.

The BRRT takes in to account the location of the house, details of the plot, the archetype of the house, dependencies between building components and the building materials used. The rating is provided on a simple 1 to 5 scale, accompanied by detailed information regarding which components of the house face the greatest risk and how to improve these.

The BRRT is supported by the Building Resilience Knowledge Database that provides information on the resilience of building products to extreme weather hazards. These initiatives form the backbone of the ICA's ongoing efforts to deliver more resilient built environments for Australian communities.



Building the climate resilience (and resistance) of arid zone aquatic ecosystems and freshwater biodiversity

Oral presentation

Session: Parallel session 33

Time: 2.30-2.45



Jenny Davis¹, Paul Sunnucks¹, Ross Thompson¹, Jayne Brim Box², Adrian Pinder³, Satish Choy₄, Dale McNeil⁵.

¹Monash University, Clayton, Victoria, Australia, ²NT Dept of Land Resource Management, Alice Springs, NT, Australia, ³DEC WA, Perth, WA, Australia, ⁴QLD Department of Environment & Heritage Protection, Brisbane, QLD, Australia, ⁵SA Dept of Environment, Water & Natural Resources, Adelaide, SA, Australia.

The major goal of climate adaptation for Australian arid zone aquatic ecosystems and freshwater biodiversity is to reduce the risk of the loss of aquatic habitats, deteriorating water quality and the extinction of aquatic and water-dependent species. This includes increasing the resilience and, in some cases, the resistance, of the biota of arid zone springs, riverine waterholes, rockholes, lakes and other wetlands to changing water availability, especially increasing water stress. This stress will occur in conjunction with elevated temperatures, an increasing frequency of extreme events (floods and droughts) and major pre-existing environmental impacts, including land degradation and invasive species. We have developed a portfolio of adaptation approaches to maintaining aquatic habitats, the water resources that support them, and the species dependent upon them, to be applied within a framework of strategic adaptive management. This approach best addresses the uncertainty that exists as to how climatic changes will play out with respect to water availability and ecological processes across the arid zone. The importance of different types of refugial habitats (evolutionary refugia and ecological refuges) as key sites for climate adaptation planning to conserve arid zone freshwater biodiversity is highlighted. The need to reduce pre-existing stressors, and to identify new and novel waterbodies created by arid zone industries (e.g. mining, pastoralism) that could provide valuable offsets for aquatic systems lost through climatic drying, are also recognised as major adaptation strategies.



An adaptive thermal comfort study in Sydney homes with air conditioning

Oral presentation

Session: Parallel session 20

Time: 3.45-4.00



Richard de Dear¹, Christhina Candido¹, Max Deuble¹, Thomas Parkinson¹.

¹The University of Sydney, Sydney, Australia

Dramatic growth in air-conditioning use in residential buildings has been the subject of intense debate due to its contribution to greenhouse gas emissions and the electricity grid infrastructure investment it demands. But what is often forgotten is that the end-product delivered by air-conditioning is thermal comfort, and yet, to date, very little research in the Australian residential context has been conducted. This paper presents results from the first ever right-here-right-now study into thermal comfort and air conditioning (A/C) usage in Sydney. A total of 30 households were recruited based on two criteria; householders had to own a smartphone (to receive the comfort questionnaire) and their house had at least one A/C unit installed. Data collected included: (i) times, rooms and durations of air conditioning usage, ii) outdoor climatic observations, (iii) indoor environmental factors including room temperature, room humidity, clothing insulation, metabolic rate, and (iv) householders' perceptions of thermal comfort in that room at that point in time, and, v) related adaptive comfort behaviours. Results from the summer of 2012/13 campaign were compared against the 80% acceptability limits from the ASHRAE 55-2010 adaptive comfort standard. Results indicate that the majority of comfortable temperatures calculated for each participant fell within the adaptive model's predictions. Indoor temperatures between 18 and 28°C represent an acceptable range for this sample. Moreover, most participants were able to attain thermal comfort for most of the summer by relying solely on passive cooling strategies such as operable windows, which was the most preferred adaptive opportunity for summer conditions.



Identifying existing sustainable weather and seasonal adaptation strategies in Australia's tropical north

Oral presentation

Session: Parallel session 20

Time: 4.00-4.15



Eliza de Vet¹

¹University of Wollongong, Wollongong, Australia

In a climate of change, recognising individual and societies' sustainable adaptive capacities to environmental variations is increasingly important. While research has begun exploring existing strategies, adaptation focus has been placed on temperature and broad temporal trends (e.g. seasons) within temperate climates. This paper contributes to this field by examining how Darwin residents, in Australia's tropical north, experience and adapt to daily weather variations in addition to seasonal changes. Using daily diaries and photographs completed seasonally - 'the build-up', 'the wet' and 'the dry' - this paper explores how individuals at home and in the workplace dealt with the extended periods of heat, high humidity, rain, dry weather and even cyclonic conditions. Results indicate that despite the tropical climate, the use of domestic energy demanding technologies, such as air conditioners and tumble dryers, were limited and alternatives utilised. In fact, these technologies were often avoided based on their energy consumption and for fear of reducing individuals' tolerance for the climate. Workplace results indicated that air conditioning held more appreciation and acceptance than in the home. However, it was not uncommon for participants to feel uncomfortable, employing counteracting adaptation strategies for warmth. This raises concern over proliferating workplace air conditioning that is not only cause for discomfort, but potentially acts to decrease climatic tolerance. These research findings recognise that many individuals living in Darwin do sustainably adapt their daily activities to the tropical climate with little assistance from energy demanding technologies. These adaptations should be supported and promoted locally, and possibly extended elsewhere.



Sensitivity of estuaries to climate related changes in catchment hydrology

Oral presentation

Session: Speedtalk session 2

Time: 5.15-5.20



Jocelyn Dela-Cruz¹, Mark Littleboy¹, Peter Scanes¹.

¹Office of Environment and Heritage, Sydney South, Australia

Proactive management that avoids, reduces or takes advantage of the effects of climate change, is the main adaptation strategy for increasing the resilience of estuary ecosystems. The capacity to undertake proactive management is partly dependent on knowledge of the inherent sensitivity of estuaries to climate stressors. For example, estuaries that intermittently open and close are particularly sensitive to changes in coastal conditions and catchment runoff, and are therefore expected to be significantly impacted by climate related changes in sea level and rainfall.

Climate projection data, generated from the NSW and ACT Regional Climate Modelling (NARCIiM) project, has been used to develop a water balance model to predict surface flows from catchments in the Sydney region. The model predictions indicate that surface flows will increase the most in catchments that fringe the estuaries within the Sydney Metropolitan Area. Surface flows are also predicted to be greatest in autumn, in line with predicted changes in rainfall patterns. In this study, we examine how the predicted changes in surface flow are likely to change the export of sediments and nutrients from Sydney's catchments and consequently impact on the ecological state of the estuaries. We highlight how knowledge about the inherent sensitivities of estuaries are useful for guiding decisions on best practice actions that enhance resilience, especially in the context of on-going pressures from coastal development.



Community-based flood adaptation strategies under climate change in Nepal

Oral presentation

Session: Parallel session 18

Time: 3.45-4.00



Rohini Devkota¹, Geoff Cockfield¹, Tek Maraseni¹.

¹Australian Centre for Sustainable Catchments, University of Southern Queensland, Toowoomba, Australia.

Many areas of south and east Asia are both flood prone and flood vulnerable. Recent research findings suggest that climate change has accelerated the intensity and frequency of flood hazards in countries such as Nepal. This paper reports on a study of indigenous knowledge of flood forecasting and flood adaptation strategies at the community level in two districts in Nepal. From focus group discussions, surveys and field observations, it was found that there are some very effective local flood forecasting practices such as identifying the position of clouds; monitoring the extent of rainfall in upper catchments; analyzing the mobility of ants; analyzing the magnitude of thunderstorms and wind blows; analyzing the magnitude of hotness; and hearing strange sounds from river/torrents. Synthesis and analysis of these indicators helps communities prepare for potential flood events, through: (1) preparation of search and rescue related materials; (2) creation of small drainage structures in each plot of land and storage of the valuable material; and (3) being psychologically prepared for floods. This paper argues that this indigenous flood forecasting and adaptation strategies could be particularly useful in flood prone and vulnerable areas, where people have trouble accessing and implementing relevant knowledge.



Pathways for adaptive and integrated disaster resilience

 $Speedtalk+Poster\ presentation$

Session: Speedtalk session 13

Time: 4.50-4.55



Riyanti Djalante¹

¹Local Government of Kendari City, Kendari, Indonesia.

Disasters are increasingly uncertain and complex due to rapid environmental and socio-economic changes occurring at multiple scales. Understanding the causes and impacts of disasters requires comprehensive, systematic and multi-disciplinary analysis. This paper introduces recent multidisciplinary work on resilience, disaster risk reduction (DRR), climate change adaptation (CCA) and adaptive governance (AG), and then proposes a new and innovative framework for adaptive and integrated disaster resilience (AIDR). AIDR is defined as the ability of nations and communities to build resilience in an integrated manner, and strengthen mechanisms to build system adaptiveness. AIDR provides the ability to face complexities and uncertainties by designing institutional processes that function across sectors and scales, to engage multiple stakeholders, and promote social learning.

We identify seven pathways to achieve AIDR. These pathways are a conceptual tool to support scholars, policy makers and practitioners to better integrate existing DRR strategies with CCA and more general development concerns. They describe institutional strategies that are aimed at dealing with complexities and uncertainties by integrating DRR, CCA and development; strengthening polycentric governance; fostering collaborations; improving knowledge and information; enabling institutional learning; self-organisation and networking; and provision of disaster risk finance and insurance.

We also examine the implications of these pathways for Indonesia, one of the most vulnerable countries to natural hazards and climate change impacts. Our findings suggest that there is an urgent need to commit more resources to and strengthen multi-stakeholder collaboration at the local level. We also argue for placing the community at the centre of AIDR strategies.



Adaptor of last resort?: an economic perspective on the Government's role in adaptation

Oral presentation

Session: Parallel session 30

Time: 1.30-1.45



Leo Dobes¹, Frank Jotzo¹.

¹Australian National University, Canberra, Australia.

Individuals and societies have always adapted to change, whether catastrophic or slow onset. Over the last two centuries governments have significantly extended their role as ultimate social managers of risk. It is as yet unclear whether, how, or to what extent governments will add adaptation to climate change to their portfolio of responsibilities.

Economics suggests that governments should limit intervention to cases of genuine market failure, such as the provision of information on likely impacts of climate change including at the local level, or to support people affected by uninsurable events. But any role as 'insurer of last resort' needs to be circumscribed by rigorous social cost-benefit analysis to ensure that government intervention is beneficial, in the context of the need to adapt to climatic changes. However, 'government failure' can also stymie efficient adaptation. We compare the concepts of 'government as insurer of last resort' with 'government as insurer of first resort' as forms of intervention in markets. In contrast to current thinking in academic and government circles, we conclude that the government should not act as an 'adaptor of first or last resort'. Rather, government can best contribute to efficient adaptation by reducing the economic costs and institutional barriers to adaptation faced by individuals. Comprehensive micro-economic reform, and the promotion of institutional flexibility are potential 'no regrets' strategies because they can promote economic growth and social wellbeing, as well as adaptation. In a companion paper we present quantitative analysis.



A climate change focused socio-geomorphological typology of Australian estuaries to underpin effective management

Oral

Session: Parallel session 10

Time: 2.00-2.15



¹M Doblin, ¹M Bishop, ²D Rissik

¹University of Technology Sydney, Sydney, Australia, ²National Climate Change Adaptation Research Facility, Gold Coast, Australia

Estuaries are the hubs of human settlement and are in the "front-line" when it comes to climate change, due to both landward and seaward shifts in environmental conditions. To assist decision makers with climate change adaptation strategies, a diverse group of researchers with expertise in ecology, geomorphology, oceanography, social science, and economics set out to develop a typology which considered both geomorphological and social settings of estuaries around Australia. By considering key climate change drivers and estuarine geomorphology, an index of exposure was generated. Assessment of the number of settlements and their population sizes along estuaries formed the basis of a social sensitivity index, with the product of exposure and sensitivity yielding the potential for harm. This novel approach is the first typology to combine both environmental and social data, and reveals some interesting insights at regional scales where adaptation options might include prevention of new settlements in some areas, and a shift from "holding the line" to "retreat".



Fiddling while Rome burns: current approaches to landscape design for biodiversity are not climate ready

Oral presentation

Session: Parallel session 12

Time: 1.30-1.45



Veronica Doerr¹, Kristen Williams¹, Michael Drielsma², Erik Doerr¹.

¹CSIRO Climate Adaptation Flagship, Canberra, ACT, Australia, ²New South Wales Office of Environment and Heritage, Armidale, NSW, Australia.

Landscape design, especially the spatial placement of efforts to restore native vegetation, is a primary approach to climate adaptation for biodiversity. However, approaches to landscape design have not been evaluated in future landscapes, where changes in the amount of restoration, land uses and the distributions of species could influence effectiveness. We investigated which current approaches to landscape design are most likely to improve the persistence of native species (and decrease persistence of key invasive species) across many possible futures. We modelled a range of future landscapes, incorporating land-use changes including amount of restoration, and shifts in vegetation communities. We then overlayed current approaches to landscape design (the detailed placement of the restoration) and evaluated the resulting change in the capacity of landscapes to support viable populations of four functional groups of native species and two key invasive species. On average, our future landscapes declined in their ability to support native species and curtail invasive species. The particular approach to landscape design had very little influence on this outcome. Instead, factors beyond the control of natural resource managers had the strongest influence, including future climate. However, land-use changes such as agricultural intensification also had a significant effect on the degree of decline in landscapes, and these can sometimes be influenced by natural resource managers. Thus, we suggest that current approaches to landscape design and management may not be sufficient to serve as climate adaptation strategies for biodiversity, but more integrated spatial planning of all types of land uses shows promise.



Exploring adaptation policy options: contributions of graduate student courses to local adaptation efforts

Oral presentation

Session: Parallel session 18

Time: 3.30-3.45



Dana Dolan¹, Todd La Porte¹.

¹George Mason University, School of Public Policy, Arlington VA, USA.

Our changing climate requires adaptation, both today and into the future. The dual challenges of developing immediately actionable science and preparing a future generation of climate policy practitioners has inspired an innovative, interdisciplinary graduate course at GMU, in the Washington DC metropolitan area. This session will provide an overview of the pedagogical design of a graduate course developed over 4 semesters of teaching and research, a tour of its policy-relevant outcomes, including reactions from students, faculty and staff, outside scholars and policy makers, and interested members of the public.

The primary innovation of this course is its capstone event, a student poster exhibit and panel discussion. Research on climate impacts, vulnerabilities, and policy theories set the stage for student field work centered on sectorally distinct regional climate adaptation hotspots, including interviews with individuals active in the relevant policy network. Students' posters synthesized this data to communicate highly complex scientific and policy data during the course's capstone event, which included a panel discussion with outside experts and community leaders suggested by the students' research, and featuring a poster exhibit where students explained their research, answered questions, and gained feedback from attendees. A brief film for communicating the results of students' work more broadly is also planned.

This year's event aims to spur public discussion and build support for broader impacts in the region; prompt higher quality projects compared to work in prior semesters; and attract new students to this dynamic research area.



Low carbon living communities

Oral presentation

Session: Parallel session 9

Time: 1.41-1.53



Phil Donaldson¹

¹Renewal South Australia, Adelaide, Australia.

The SA Government 30 year plan for greater Adelaide sets out the approach that development need to take in order to deliver a low carbon living urban form including higher density mixed-use development around transport nodes , creating walkable liveable neighbourhoods and moving development towards a 70 % infill development and 30 % Greenfield development target over the next 30 years.

Three very different projects showcase SA government innovation and leadership in providing a new dialogue and built form with the development industry and the community in low carbon living and environments adapted to the impacts of climate change.

Lochiel Park

Lochiel Park homes already have achieved 54 per cent lower greenhouse gas emissions than average South Australian households and use 64 per cent less energy and 60 per cent lower water than that consumed by SA average households based on a 2004 baseline. Further Lochiel Park has confirmed a zero carbon status of its infrastructure and in 2013 will have a Zero Carbon House built which aims to be carbon neutral over a life cycle of 50 years.

Bowden

Bowden will exemplify a new low carbon living built form demonstrating a high quality built form to be developed in accordance with the Bowden Urban Design Guidelines (including a minimum 5 Star Green Star 'As Designed' accreditation). Ground Breaking Street and park designs, including more than 2 ha of additional public open space, to be delivered by the Authority and its innovative approaches such as targeting alternative water and energy supply systems will further enhance this place as ability to adapt to climate change impacts.

Tonsley

The Tonsley Park Redevelopment Project (Tonsley Park) will deliver an exemplar interconnected and intelligent mixed use precinct that integrates industry, education, training, research, residential living options and community amenities. Tonsley Park will contribute to a number of South Australia's Strategic Plan targets, including economic growth, business investment, strategic infrastructure, industry collaboration, research and development, and jobs. It proposed that over 6,000 FTEs in high value jobs on site will be created with approximately 10,000 students p/a using the site with 1,500 to 2,000 residents living on site. Tonsley will also be the site for the new Sustainable Industries Education Centre (SIEC) which will specialise in training more than 8,000 people a year in new green technologies associated with the building and construction industry, including civil construction and engineering, plumbing and carpentry. The centre will also offer new training in renewable energy and water operations.



climateadaptation knowledge + partnerships

An overview of Western Australian climate change adaptation initiatives and some insights from experience

Oral presentation

Session: Parallel session 35

Time: 2.00-2.15



James Duggie¹

¹Department of Environment and Conservation, Western Australia, Australia.

There have been a range of climate change adaptation efforts occurring in Western Australia including by state government agencies, local governments, and businesses. This paper will provide an overview of the climate change adaptation activities in Western Australia. This will include discussion of the State government's climate change strategy, *Adapting to our Changing Climate*, released in October 2012, and state agency adaptation initiatives, as well as initiatives of local government regional groups, and their role in pooling capacity to address climate change adaptation. The paper will also discuss implementation of adaptation initiatives based on the Western Australian experience to date.



Managing change: biodiversity conservation in a climate change world

Oral presentation

Session: Parallel session 26

Time: 11.00-11.15



Michael Dunlop¹, H Parris^{1,2}.

¹CSIRO, Canberra, Australia, ²Interface NRM, Victoria, Australia.

The impact of climate change on biodiversity is expected to be far-reaching, impose significant change and loss on biodiversity, and substantially increase the complexity of managing the species, ecosystems and landscapes that are valued by the community. In particular, climate change profoundly challenges what may be possible to achieve through conservation management - i.e. the management objectives - and that responding to climate change is more complicated, and requires a broader response, than implementing new or improved management actions. Core to this challenge is the concern that existing conservation objectives are inadequate to the task of describing and directing appropriate biodiversity management responses under significant levels of climate induced change.

This project supports climate adaptation through the development of a major new approach to biodiversity conservation objective setting that incorporates three processes we contend will be central to biodiversity conservation under climate change: managing for large scale change and loss, managing for a broad range of biodiversity values and managing for uncertainty.

Defining conservation objectives that incorporate these processes as being "climate ready", we evaluate existing biodiversity conservation documents to determine their 'climate readiness '. Along with field work and theoretical research, the analysis underscores the need for developing new concepts, metaphors and language around conservation planning for climate change and processes for incorporating them into existing planning structures. Acknowledging that this will remain a substantial challenge into the future, this project seeks to begin this process through the development of a suite of tools to assist managers in becoming 'climate ready'.



Perceptions of usefulness: supply and demand of future climate change information for adaptation decision-making. A case study of climate scientists

Oral presentation

Session: Parallel session 11

Time: 2.00-2.15



Miriam Dunn¹, Mark Howden², Janette Lindesay¹.

¹Australian National University, Canberra, ACT, Australia, ²Commonwealth Scientific and Industrial Research Organisation, Canberra, ACT, Australia.

Much future climate information exists to support decision-making as regards adaptation, but what are the characteristics that make future climate information useful to support on-ground decision-making? Is the level of detail of the information currently being produced useful to users?

This paper presents qualitative analysis of in-depth, semi-structured interviews with climate scientists who use future climate model output and who also work with groups of on-ground decision-makers. The purpose of the research was to compare and contrast perceptions of the usefulness of future climate information for adaptation between the traditionally climate-centric approach of many climate modellers and the decision-centric approach taken by on-ground decision-makers in the primary industries, with previous work having produced a case study within the viticulture sector in south-eastern Australia. The ideas of co-production of information and a decision-centric approach to information provision are not new - however, this research seeks to explore the characteristics which make the process and the information provided therein useful during adaptation.

Results suggest that two typologies exist within the climate scientist interviewee group: those who see a responsibility to co-produce information; and those who operate primarily outside the sphere of co-production of information. The types of information considered useful for on-ground decision-making by the climate scientists and the decision-makers in viticulture do not consistently align. The information considered most useful for adaptation decision-making by interviewees in the viticulture case study is either available and/or possible to produce, but many of the climate scientist interviewees expressed specific concerns at providing such information.



Quantifying user needs for future climate information in the wine-grape sector

Oral presentation

Session: Parallel session 15

Time: 3.30-3.45



Miriam Dunn¹, Mark Howden², Janette Lindesay¹.

¹Australian National University, Canberra, ACT, Australia, ²Commonwealth Scientific and Industrial Research Organisation, Canberra, ACT, Australia.

Which characteristics make future climate change information useful for on-ground decision-making as regards adaptation in viticulture? While many aspects of climate change, decision-making and viticulture have been researched, no known study has, to date, considered the characteristics which make future climatic information useful for long-term decision-making as regards adaptation in the wine-grape sector. This paper presents the results of the second stage of a two-stage study conducted with viticulturists, wine-makers and industry representatives. The user-needs framework focuses on questions about the specific kinds of current and future climatic information, including spatial and temporal scales, that these groups find useful in their adaptation decision-making. The secondary aim was to determine whether a relationship exists between the complexity of information and the utility of that information.

The first stage of the study consisted of in-depth, semi-structured interviews with the aforementioned groups in the Canberra District of south-eastern Australia. This second stage of research consisted of a survey, designed from the results obtained in the initial interviews, which sought to clarify and quantify those initial results, and to extend the research to all wine-grape growing regions within Australia.

Results indicate that a future, regionally-specific, climatic comparison of likely changes in a user's region and other regions compared to the current climates in existing wine-grape growing regions would be most useful when making long-term decisions, such as whether to change the varieties of grapes grown. For these types of decisions, increased complexity of the information was not considered to provide increased levels of usefulness.



Indigenous intercultural governance of adaptation

Oral presentation

Session: Speedtalk session 1

Time: 4.45-4.50



Tran Tran¹, **Anna Dwyer** ², Jessica Weir³.

¹Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS), Canberra, Australia, ²University of Notre Dame, Broome, Australia, ³University of Canberra, Canberra, Australia.

The roles of Indigenous people in climate change adaptation are little understood. Current research highlights the contribution of Indigenous knowledge to climate change monitoring and observation, the role of community organisations in developing adaptive capacity, environmental justice and regimes for the participation of Indigenous people in abatement and climate change economies. The way in which Indigenous decision-making is exercised and expressed in managing Country however, is rarely situated in the context of adaptation governance. This presentation reflects on the challenges created by intercultural governance on successful participation in adaptation decision making within two remote Aboriginal communities. It focuses specifically on the role of recognised native title holders who have legally determined rights and interests to their traditional territories. This presentation is based on results from an 18-month project, carried out by the Australian Institute of Aboriginal and Torres Strait Islander Studies, on social-institutional barriers to the role of native title holders in climate change adaptation decision making, with two case study partners: the Karajarri Traditional Lands Association based in Bidyadanga, and Abm Elgoring Ambung located in Kowanyama.



Predicting water quality and ecological responses to a changing climate

Oral presentation

Session: Parallel session 33

Time: 2.15-2.30



Fiona Dyer¹, Paloma Lucena-Moya¹, Sondoss El Sawah^{2,3}, Evan Harrison¹, Jarrod Kath¹, Alica Tschierschke¹, Rachael Griffiths^{2,1}, Renee Brawata¹, Barry Croke^{2,3}, Trefor Reynoldson¹, Anthony Jakeman^{2,3}.

¹Institute for Applied Ecology, University of Canberra, Canberra, ACT, Australia, ²Integrated Catchment Assessment and Management Centre, Australian National University, Canberra, ACT, Australia, ³National Centre for Groundwater Research and Training, Australian National University, Canberra, ACT, Australia, ⁴Department of Mathematics, Australian National University, Canberra, ACT, Australia.

Managing freshwater species and ecosystems in the future requires prediction of the magnitude of the changes in flow and water quality likely to occur as a result of the combined effects of climate change and other stressors such as population growth, and management policies. Such predictions are often impeded by a lack of integrated quantitative tools for predicting the relationship between future climate, human activities, water quality and ecology. We used Bayesian Networks (BN) to model the complex interactions between climate impacts, non-climate pressures (such as population growth), adaptation (management) decisions, stream-flows, water quality attributes, and macroinvertebrate and fish fauna in the Upper Murrumbidgee River Catchment. The structure of the BN was developed using both a 'top down' and 'bottom up' approach. Expert advice was used to define links between climate variables, stream flow, water quality attributes, land management and ecological responses (top down). The resulting model was then simplified by identifying key predictors of the ecological responses (bottom up) using multivariate and univariate statistical techniques. The models showed a strong regional response to climate and management scenarios with the direct impacts of river management activities outweighing predicted climate change effects. This means that adaptation policies need to consider the management of river regulation and effluent discharge as central strategies for protecting freshwater ecosystems into the future.



Risk priorities and perceptions in two Australian coastal communities: uncovering diversity to inform risk management

Oral presentation

Session: Parallel session 1

Time: 3.45-4.00

Carmen Elrick-Barr¹

¹University of the Sunshine Coast, Maroochydore, QLD, Australia.

This paper presents the results of the first phase of an Australian Research Council Discovery research project exploring household vulnerability in the Australian coastal zone. The impacts of climate change represent a significant challenge for Australian coastal communities. Sea-level rise, storms, heat stress, and associated impacts to the natural environment and infrastructure will necessitate adaptation across many Australian coastal communities. These adaptations will range from national policy responses to local adaptive actions that aim to reduce exposure and sensitivity or enhance adaptive capacity. In Australia, responsibility for adaptation is increasingly delegated to local scales, including local government, households, and individuals. Research suggests local scale adaptive action will be diverse, depending on perceptions of risks and cultural and social values, which underpin adaptation goals. Based on a survey of 400 households in two Australian coastal communities, diversity in risk perception of environmental hazards is explored. Households within small geographic areas have varied views on their exposure and sensitivity to environmental hazards and past experience does not directly align to risk perceptions. Variation in risk perception within communities has implications for climate risk management, where managers aim to balance the opportunities and risks of different management decisions with the needs and visions of the community. The results indicate that uncovering diverse and divergent views is a critical step in developing policies that empower rather than polarize coastal communities.



Tackling transferability: lessons from applying climate change assessment frameworks in the Upper Murrumbidgee and Golburn-Broken catchments

Oral presentation

Session: Speedtalk session 8

Time: 4.50-4.55



Sondoss ElSawah^{1,3}, Fiona Dyer², Paloma Lucena-Moya², Barry Croke^{1,3}, Evan Harrison², Jarrod Kath², Tony Jakeman¹.

¹Integrated Catchment Assessment and Management Centre, Australian National University,, Canberra, ACT, Australia, ²Institute for Applied Ecology, University of Canberra, Canberra, ACT, Australia, ³National Centre for Groundwater Research and Training, Adeliade, Australia, ⁴Department of Mathematics, Australian National University, Canberra, ACT, Australia

Climate change assessment frameworks should not only aim to provide useful information in relation to target study locations, but explicitly consider how outputs can be translated and adapted to advance adaptation in other areas i.e., transferability. Here, we present our experience transferring a model-based assessment framework to predict impacts of climate change on ecological systems from the Upper Murrumbidgee Catchment (UMC) to the Goulburn-Broken Catchment (GBC). We reflect on how we tackled the concept of transferability as an integral part of the project design, including technical (i.e. transfer of outputs) and cognitive (i.e. transfer of outcomes) transferability. Our results showed that the conceptual thinking behind the modelling framework constructed for the UMC was generally transferable to the GBC. However, in terms of technical transferability some changes need to be made to the modelling framework to make it applicable to the GBC. The main differences between model approaches is that in the UMRC, focus on ecological outcomes allowed a bottom up model structuring method to be applied, producing computationally efficient models. For the GBC a top down method was required to meet the specific requirements of the managers and stakeholders in this catchment. Although the developed framework could not be fully transferred from one catchment to the other, it has provided a useful way for managers to think through their assessment requirements, conceptually structure their system of interest, and identify what data and knowledge are needed to customise the assessment framework to their situation.



Preparing for invasion: a decision support tool to manage future weeds

Oral presentation

Session: Parallel session 19

Time: 3.15-3.30



Daisy Englert Duursma¹, Rachael Gallagher¹, Michelle Leishman¹, Lesley Hughes¹.

¹Macquarie University, North Ryde, NSW, Australia.

Since European settlement \sim 29,000 species of plants have been introduced to Australia, with 2,700 of these recorded as naturalised and \sim 400 as invasive. Considerable resources are spent managing and understanding invasive plants but little effort has been made to identify naturalised plants that may become environmental or agricultural weeds under future climates. The aims of our work are to assess current and future invasion potential of naturalised plant species, assess the likely risk of invasion for a range of areas at different spatial scales, and develop an online interactive decision support tool for land managers and policy makers.

We compiled a trait database and modelled habitat suitability for ~300 naturalised plants that occur within Australia. Information included in the trait database was compiled from numerous floras and online databases of species observations. We used the species distribution model (SDM) MaxEnt to model climate and soil suitability under current conditions, and projected the SDMs onto future climate scenarios for decades centred on 2035 and 2065 using two scenarios of future emissions and seven Global Climate Models. We combined this information to assess species invasion potential and to prioritise species for detailed future risk assessments at the national and state scale as well as for Local Government Areas, IBRA regions, natural resource management regions and conservation reserves. Our results are available on an open access website which can be interrogated by land managers to provide species- and site-specific information on potential invasion risk of these species.



Toward future projections of East Coast Lows

Oral presentation

Session: Parallel session 14

Time: 1.15-1.30



Jason Evans¹

¹Climate Change Research Centre, University of New South Wales, Sydney, Australia.

The East coast of Australia from north-east Victoria to south-eastern Queensland is subject to heavy rain, strong winds and large waves resulting from low pressure systems adjacent to the Tasman Sea that develop from a variety of synoptic and mesoscale systems. These systems, referred to as "East Coast Lows" (ECLs), cause a significant amount of damage along the east coast each year. They are also a major source of water recharge for the reservoirs serving coastal communities, and thus are both vital to, and dangerous for, human activities in the area. These systems can develop rapidly and have relatively small spatial extents, making it difficult for global models to simulate them. In this study a regional climate model is used to simulate the climate of the east coast (including ECLs) at relatively high spatial resolution (10km) with the aim of better simulating ECLs over the recent past. Potential changes in ECL frequency and intensity can then be investigated through future climate simulations.



Double jeopardy: will climate change and disease affect the distribution of Philoria loveridgei?

Oral presentation

Session: Speedtalk session 3

Time: 5.00-5.05



Mariel Familiar Lopez¹, David Newell², Greg Lollback¹, Jean-Marc Hero¹.

¹Environmental Futures Centre, School of Environment, Griffith University, Gold Coast Campus, Gold Coast, Queensland, Australia, ²School of Environment, Science and Engineering, Southern Cross University, Lismore Campus, Lismore, New South Wales, Australia.

Climate change and diseases have been strongly linked to enigmatic global amphibian declines, particularly for high elevation species. Increases in temperature and fluctuations in precipitation due to climate change may alter distribution and abundance of species, with the general expected trend that species will shift towards the poles and to higher elevations. For narrowly distributed mountain top endemics, global warming can have devastating effects, as it may force these species beyond the limit of their distribution into extinction. Despite the comparatively high risk they face, few studies have explored the effects of climate change on the distribution and abundance of amphibians in montane habitats. Niche modelling algorithms (e.g. Maxent) are powerful tools for modelling species distribution and have great potential in species conservation. However, few studies have used field surveys based on occupancy models to evaluate the predicted species occurrence. Herein I modelled the present and future distribution of Philoria loveridgei using Maxent. Results show distribution maps representing habitat suitability that were tested with field surveys and occupancy modelling. The "naïve" occupancy estimate was 76.2%, describing a high occupancy within the predicted distribution. The restricted distribution of this species was confirmed and the likely impacts of climate change evaluated, suggesting the species distribution will decrease. Extinction risk is exacerbated for high elevation Philoria species as they are confined to cooler climates. Moreover, these mountain top endemics, may become increasingly vulnerable to the lethal pathogen Batrachochytrium dendrobatidis, hence, frogs that inhabit this area could experience a double jeopardy.



Unintended consequences of management decisions on the environmental footprint of seafood and implications for climate change adaptation

Poster only presentation

Session: Poster session

Time:



Anna Farmery^{1,2}, Caleb Gardner^{1,2}, Bridget Green^{1,2}, Sarah Jennings¹.

¹University of Tasmania, Hobart, Tasmania, Australia, ²Institute of Marine and Antarctic Studies, Hobart, Tasmania, Australia.

Adaptation to climate change must occur across food supply chains. For seafood, the management focus for climate change has been on biological impacts in marine ecosystems and resilience. Reducing the environmental footprint of seafood, particularly the carbon footprint, across the supply chain is a new concept for seafood sustainability. The influence of management decisions on carbon emissions is rarely considered in regards to seafood sustainability and adaptation options.

We used life cycle assessment (LCA) to measure the environmental footprint of the Southern rocklobster (SRL). The LCA results were analysed under a series of management scenarios to determine impacts of marine resource management decisions on the environmental footprint of the SRL.

We found significant changes in the overall footprint of the SRL under different management scenarios. Reducing the harvest rate to maximise economic benefit (target MEY) decreased the carbon footprint. Surprisingly, management decisions based on increasing marine protected areas increased the carbon footprint by 8% in one case. The unintended consequences of management changes suggest that in a future of carbon accounting and increased regulation of CO_2 emissions, marine resource decision making should not be made in isolation of downstream impacts.

Management decisions in fisheries can be a tool to reduce seafood environmental impacts, including carbon emissions, as fuel use at capture is typically the dominant input across the life cycle. Fisheries managed under low harvest rates are better placed to incorporate these indicators than fisheries that are not well managed or managed for objectives such as maximum food or employment.



Energy tree crops as transformative adaptation to climate change in dryland agriculture of southern Australia

Oral presentation

Session: Speedtalk session 11

Time: 4.45-4.50



^{1,2}Amir Abadi, ^{1,3}**Bob Farquharson**, ^{1,4}John Finlayson, ^{1,3}Thiagarajah Ramilan, ⁵De Li Liu, ⁵Muhaddin Anwar, ⁶Steve Clark, ⁷Susan Robertson, ⁸Daniel Mendham, ⁹Quenten Thomas.

¹CRC for Future Farm Industries, Perth, WA, Australia, ²WA Department of Environment and Conservation, Perth, WA, Australia, ³University of Melbourne, Melbourne, VIC, Australia, ⁴University of Western Australia, Perth, WA, Australia, ⁵NSW Department of Primary Industries, Wagga Wagga, NSW, Australia, ⁶VIC Department of Primary Industries, Hamilton, VIC, Australia, ⁷Charles Sturt University, Wagga Wagga, NSW, Australia, ⁸CSIRO Ecosystem Sciences, Tasmania, Australia, ⁹Quisitive Pty Ltd, Perth, WA, Australia

EverFarm®, a project funded by NCCARF, is evaluating profitable integration of woody crops into dryland farming for transformational adaptation to climate change. Economic analysis is finding the place of trees in the optimal enterprise mix for the limited and changing resources including rainfall, land, labour and finance.

Mallee eucalypts regrow after periodic machine harvests of their above ground biomass. Occupying only about 6% of a field they are planted in narrow two-row belts leaving wide alleys for minimal interruption to conventional cropping and livestock. Regional processing of the biomass provides feedstocks for bioenergy, biofuels and industrial materials.

A bio-economic analysis software, IMAGINE, was used to assess the profitability and cashflow consequences of land use sequences (LUS) incorporating mallees. This LUS analysis accounted for the positive as well as the negative spatial and temporal interactions between the grain crops, pastures and energy tree crops. The optimal LUSs were identified through a combination of interviews with farmers and consultants as well as study of industry reports and modelling.

Estimated net returns from conventional agriculture were compared with a system integrating mallee biomass production and perennial pastures. Cash flow analysis indicates that the mallee component may take the sting out of the bad years reducing income variability. For this to occur, the price of mallee biomass must compensate the grower for the production cost which includes the opportunity cost of land under trees, losses that occur in some seasons due to tree-crop competition, and a premium for adoption of a new crop.



EverFarm®: perenniality as an adaptation for dryland farming systems in southern Australia

Oral presentation

Session: Parallel session 12

Time: 2.00-2.15



Robert Farquharson^{1,2}, Amir Abadi^{3,2}, John Finlayson^{4,2}, Thiagarajah Ramilan^{1,2}, De Li Liu⁵, Muhaddin Anwar⁵, Steve Clark⁶, Susan Robertson⁷, Daniel Mendham⁸, Quenten Thomas⁹.

¹The University of Melbourne, Melbourne, Victoria, Australia, ²Future Farm Industries CRC, Perth, Western Australia, Australia, Australia, ³WA Department of Environment and Conservation, Perth, Western Australia, Australia, ⁴University of Western Australia, Perth, Western Australia, Australia, ⁵NSW Department of Primary Industries, Wagga Wagga, NSW, Australia, ⁶Victorian Department of Primary Industries, Hamilton, Victoria, Australia, ⁷Charles Sturt University, Wagga Wagga, NSW, Australia, ⁸CSIRO Ecosystem Services, Tasmania, Australia, ⁹Quisitive Pty Ltd, Perth, Western Australia, Australia.

Perennial plants are an adaptation option for dryland farming systems in southern Australia. Given the commercial orientation of most agriculturalists, the likely profit change for perennials under a changed climate scenario is important information for land managers and policy makers.

Due to their deeper rooting systems, perennials are potentially valuable under drier and warmer climates. Substantial information from experimental work conducted by the Future Farm Industries CRC was available as a basis for analysis. A predicted future climate downscaled to four locations contained daily minimum and maximum temperatures, and rainfall. Plant growth simulation models (APSIM and GrassGro) were used to predict important biophysical information (annual crop yield distributions and seasonal pasture production patterns) for these temperature, rainfall and CO_2 projections. The plant parameters were input to economic models for the historical and predicted future climate series.

Perennials were considered in a farming systems context, where the farm profit objective is constrained by availability of resources and limits to crop-pasture rotations. The MIDAS whole-farm model was used to test farming systems at three locations in south-western and south-eastern Australia with and without perennials under historic and predicted climates.

The economic results indicate that climate change is likely to impact the farming systems and farm profits detrimentally in the order of tens of dollars per ha. The introduction of new and/or improved perennial plants is likely to be economically appealing to farm managers under a warmer and drier climate. Changes in price relativities did not change the main thrust of results.



Multi Criteria Analysis of adaptive options in the south west costal region of Bangladesh

Oral presentation

Session: Poster session

Time:



KM Faruque¹

¹Area Development Organization, Khulna, Bangladesh.

The study was conducted in two climate vulnerable districts in the south west coastal region of Bangladesh, aiming to identify the appropriate adaptation options using qualitative research. For decision-making, multi criteria analysis (MCA) of adaptation options was done based on the social, economic and environmental indicators. The study revealed that salinity intrusion and seasonal water logging have persistence in the locality which has adverse impact on livelihoods. In water logging areas, the adaptive options are hydroponics, ring based vegetable culture, fish trap building, and duck rearing while reed cultivation, mat weaving, kewra (Sonneratia apetala) cultivation, crab fattening, sheep rearing are in the saline prone area. Following MCA, it is disclosed that the weighted value of adaptive options changed after 3 months, 1 year and 3 years. After three years, the weighted value of hydroponic, ring based vegetable cultivation, duck rearing and fish trap building were 37.5, 82.5, 77.5 and 62.5 respectively while mat weaving, reed cultivation, kewra cultivation, crab fattening, sheep rearing showed the weighted value 80, 50, 25, 42.5 and 75 respectively. Finally, the study revealed that mat weaving and duck rearing are the most feasible for climate change adaptation in the coastal region of Bangladesh.



Revisiting resilience and climate change adaptation in the Great Barrier Reef

Oral presentation

Session: Parallel session 10

Time: 1.30-1.45



Pedro Fidelman¹, Erin Bohensky², Anne Leitch³, Nadine Marshall², Steve Sutton⁴, Renae Tobin⁴, Margaret Gooch⁵.

¹Sustainability Research Centre, University of the Sunshine Coast, Sippy Downs, Australia, ²CSIRO Ecosystem Sciences, Townsville, Australia, ³CSIRO Ecosystem Sciences, Brisbane, Australia, ⁴Centre for Sustainable Tropical Fisheries and Aquaculture and the School of Earth and Environmental Sciences, James Cook University, Townsville, Australia, ⁵Great Barrier Reef Marine Park Authority, Townsville, Australia.

Climate change has been identified as a key long-term threat to the Great Barrier Reef (GBR). Projected effects of climate change on the GBR (e.g., increases in air temperature, summer rainfall and the frequency of severe tropical cyclones, sea level rise and ocean acidification) are predicted to interact with local and regional non-climate stressors (e.g., catchment runoff and coastal development); ultimately, undermining the ability of the GBR to provide ecosystem goods and services that support regional communities and industries. In the GBR, adaptation to climate change is therefore a key issue requiring urgent action. At the same time, responses to climate change have the potential to impact on the resilience of social-ecological systems. In this paper we draw on a framework proposed by Adger and colleagues - based on governance, problem framing, and sensitivity to feedbacks - to examine how adaptation efforts can impact on the ability of the GBR social-ecological system to absorb further disturbances, adapt to current and future changes, and learn and create new pathways of change. Drawing on case studies from different sectors (e.g., fisheries and conservation), we revisit the concepts of resilience and climate change adaptation by examining how the ways we think about resilience have evolved over time in the context of the GBR. We demonstrate how responses to change can have profound implications for long-term social-ecological resilience. Our analysis of the GBR social-ecological system provides lessons that may prove valuable to the resilience and adaptation theory, policy and practice.



Defining acceptable risk in a changing coastal zone

Either presentation

Session: Parallel session 7

Time: 4.15-4.20



Tom FitzGerald¹

¹University of New South Wales, Sydney, NSW, Australia.

In times where normal conditions are a changing notion, coastal communities must adjust. With rising sea levels, extreme events such as coastal inundation and storms are likely to pose an increasing risk. We now understand the climate to be increasingly dynamic as it gains more energy. Climate extremes are likely to be experienced in new ways and in new places than before – potentially becoming more damaging, perhaps even catastrophic.

For decision-makers today this means that basing decisions on the experiences of yesteryear is unlikely to lead to good coastal management outcomes tomorrow. So how are good coastal management decisions made? Are there some key values or principles common to such decisions? Risk based approaches to decision-making are designed to deal with uncertainty, and are presently being advocated by government agencies and professional institutions here in Australia. But the real decision-makers in a democracy are the community, and it is they that decide what risk to take. Is a 1 in100 year storm or flood level still a relevant benchmark? Is it more important to preserve the public beach or private property? What is an acceptable risk at the coast, and to whom?

This paper will assess technical coastal management guidelines in Australia and interrogate them for how they assess, define and communicate risk. The extent of collaboration or consultation mandated with stakeholders will be identified and representative case studies chosen to illustrate successes and failures.



Adaptation to energy-efficient practices: effects of the greening of community organisations on Australian citizens before and after the carbon pricing scheme

Oral presentation

Session: Speedtalk session 8

Time: 4.40-4.45

Gabriele Fitzgerald^{1,2}

¹University of South Australia, Adelaide, Australia, ²Zero Waste Research Centre for Sustainable Design and Behaviour, Adelaide, Australia.

Governments are concerned with encouraging more energy-efficient sustainable practices in the home because citizens are responsible for a significant proportion of energy use. This paper presents case studies that focus on the role of community organisations in shaping pro-environmental adaptive practices in individuals. In 2010, a leading green NGO tapped into existing networks of community hubs by launching a Green Hub community engagement program. It targeted sports clubs and church- or council-led community centres with the obvious aim of reducing their CO₂ production. However, another important goal of this program was the intent of influencing individual members of those organisations to adopt also energy saving practices across other spheres, affecting homes, work-places and other community spaces. A systemic and collaborative practice-oriented Green Hubs program was implemented to achieve these outcomes. Findings presented include an analysis of the adoption of energy-efficient practices before and after the introduction of carbon pricing by individual members of 'Green Hubs' (participating community organisations). Data was collected via focus groups, individual phone interviews and surveys using semistructured questions. Findings suggest a significant uptake of energy-efficient practices by members across their home and work environments. Therefore, community hubs should attract more attention as engagement platforms with citizens from a wide cross-section of the community. Green Hubs are potentially change agents that could offer practice-based solutions to citizens in support of their adaptation process to use energy efficiently.



Health care capacity for disaster response under a changing climate in the Pacific

Either presentation

Session: Parallel session 15

Time: 3.15-3.30



Stephanie Fletcher^{1,2}, Michele Rumsey^{1,2}, Anna Gero^{1,3}, Jodi Thiessen^{1,2}, Natasha Kuruppu^{1,3}, James Buchan^{1,2}, John Daly^{1,2}, Juliet Willetts^{1,3}.

¹University of Technology Sydney, Ultimo, NSW, Australia, ²World Health Organisation Collaborating Centre for Nursing, Midwifery and Health Development, Ultimo, NSW, Australia, ³Institute for Sustainable Futures, Ultimo, NSW, Australia.

The health sector in Pacific Island Countries (PICs) is actively involved in disaster coordination at the national level, providing frontline response to the health care needs of their respective populations. This research investigated disaster response in the Pacific and the capacity of responding organisations in both Australia and Pacific Island Countries, to adapt under a changing climate. Key stakeholder interviews were used to assess how key immediate humanitarian needs following a disaster were met, and drew upon the adaptive capacity concept to assess the resilience of individual organisations and the broader system of disaster response in four case study countries (Fiji, Cook Islands, Vanuatu and Samoa).

'Capacity' -including health care capacity was one of the objective determinants identified as most significant in influencing the adaptive capacity of the organisations responding to disasters. While health care workers were ready to respond to disasters, their response was often constrained by limited human resources for health (HRH). Significant gaps include technical and material capacity, including the lack of technical capacity for psychosocial support for HRH and the community; and the need for a coordinated regional approach to address the health care training needs. However, elements of adaptiveness were demonstrated by multi-skilling nurses to address the shortfall in HRH.

Recommendations included the establishment of a national disaster response trust fund for each country's health sector's response, supported by donors. A coordinated approach is needed for the technical training and up-skilling of HRH, with a view to build institutional and individual capacity in PICs.



Costs and coasts: economic, equitable and affordable adaptations to protect coastal settlements against storm surge

Oral presentation

Session: Parallel session 30

Time: 1.45-2.00



Cameron Fletcher¹, Alicia Rambaldi², Felix Lipkin⁴, Ryan McAllister³.

¹CSIRO Ecosystem Sciences, Atherton, Queensland, Australia, ²School of Economics, The University of Queensland, St Lucia, Queensland, Australia, ³CSIRO Ecosystem Sciences, Dutton Park, Queensland, Australia, ⁴CSIRO Ecosystem Sciences, Highett, Victoria, Australia.

The distribution of risk of coastal inundation, and the potential benefits of adapting to protect against inundation, varies greatly within and between coastal communities. This diversity is a result of both physical factors, such as the risk of storm surge, sea level rise projections, and the topography of the landscape, and socio-economic factors, such as the level of development and the capacity within the community to adapt. Despite this strong local variation, various communities share common characteristics that constrain or enable different adaptation options in different situations. Understanding these drivers may provide new insights into which adaptation options are suitable for each of our at-risk coastal communities.

We performed a property-level analysis of six suburb-sized case studies distributed along the coast of Queensland, Australia. We assessed the potential economic costs of inundation events to residential property now and in the future under sea level rise projections, and the potential avoided costs following adaptation to protect against inundation. We went beyond this to estimate the distribution of risk in each community, and compared the potential costs of adaptation with the capacity of the community to pay for their implementation. We use these insights to propose a typology of coastal communities based on their exposure to total inundation risk, the distribution of risk within the community, and their capacity to adapt.



Trade-offs in adaptation planning

Oral presentation

Session: Parallel session 34

Time: 2.30-2.45



Anita Foerster¹, Jan McDonald¹, Andrew Macintosh².

¹University of Tasmania, Hobart, Tasmania, Australia, ²Australian National University, Canberra, ACT, Australia.

Climate change adaptation decision-making involves difficult trade-offs between public and private values and conflicting policy objectives. The work of Eakin et al (2009) is helpful in understanding how different approaches to adaptation (eg, risk-based, vulnerability, or resilience approaches) influence the nature of trade-offs. However, there has been little published research explicitly exploring how trade-offs are approached in adaptation decision-making in practice.

This paper explores how existing land use planning frameworks and adaptation planning processes in Australia have framed some of the central trade-offs in the context of coastal climate hazards and bushfire. In a coastal context, the regulation of coastal protection works raises trade-offs between private property and public interest values (eg. public beach access and coastal ecosystems). Existing legal and policy frameworks are highly contested and unsettled. They tend to prioritise the protection of private property and lead to ad hoc decision-making; rather than supporting strategic consideration of the cumulative, longer term effects of coastal protection measures on public interest values. In a bushfire context, planning regulations tend to prioritise bushfire safety measures (often involving native vegetation removal) over biodiversity and amenity considerations, particularly in jurisdictions which have recently experienced tragic bushfires.

The authors use these two specific contexts to explore options to improve consideration and protection of public interest values in adaptation decision-making. The discussion focuses particularly on decision-making parameters in planning instruments; the spread of roles and responsibilities for decision-making; and the design and conduct of adaptation planning processes.



Anticipating and adapting emergency management to changes in the Victorian landscape

Oral presentation

Session: Speedtalk session 6

Time: 5.10-5.15



Holly Foster¹

¹Fire Services Commissioner, Victoria, Australia.

This presentation will outline the findings of the Fire Services Commissioner's 2021 Research Program (2021). 2021 comprises a comprehensive environmental scan of anticipated changes and trends across Victoria.

The purpose of this research is to draw out the implications of these changes for emergency management and emergency service organisations in the year 2021. This research will analyse adaptation pathways for emergency management organisations to improve integrated strategic, service delivery planning across Victoria.

The presentation will outline the impacts of climate change alongside other anticipated changes in the environment, economy and society. It will focus on changes occurring across three critical community sectors; rural, peri-urban and urban communities. The notion of how climate change transcends and, in some cases, amplifies existing stressors in the macro environment will be explored. The presentation will examine projected changes in demographics (including population composition, growth and transfer), land use (farming types, population density) and impacts on the natural environmental (more frequent and severe hazards, environmental degradation).

The presentation will also identify some of the adaptation needs and potential adaptation pathways for the emergency management sector. New methods of community engagement, fire management planning and supporting policy are some of the areas of adaptation critical to the reform of the emergency management sector preparing for the year 2021.



Secondary, compound and multiple hazards: wow a changing climate necessitates an all-hazard, all-agency approach

Oral presentation

Session: Parallel session 6

Time: 3.15-3.30

Holly Foster¹

¹Fire Services Commissioner, Victoria, Australia.

Scientific evidence shows that climate change is contributing to more frequent climate events, often with greater duration and severity. In many cases, these events are triggering multiple or varying impacts where they strike. Changes in human settlement and environmental landscape can contribute to broader consequences of a single climate hazard.

This presentation discusses the phenomena of 'multiple' hazards. It addresses definitions of secondary events (hazards occurring during the course of a particular natural hazard), compound hazards (hazards making other hazards more intense or serious) and multiple events (separate hazards occurring simultaneously). The research builds on a limited pool of primary research on this topic, advancing a lexicon for these phenomena, for not only Victoria but other parts of Australia.

The presentation draws on examples of these phenomena, outlining some of the key challenges for emergency services before, during and after events. The presentation discusses primary research undertaken by the Fire Services Commissioner, that explores pathways to build a more robust emergency service sector by actively pursing an integrated unified approach to emergency management.

The research will explore the requirements to effectively adapt by preparing and planning to respond to an anticipated increase in such events. Adaptation is critical to establish a more resilient community and emergency services in the face of all-hazards and multiple hazards.



Climate change and fisheries in Ghana: trends and adaptive strategies by small-scale fishers

Either presentation

Session: Speedtalk session 11

Time: 4.55-5.00



George Freduah¹

¹University of the Sunshine Coast, Queensland, Australia.

This study examines climate change and associated adaptive strategies by fishers in Ghana, West Africa. The research uses the Vulnerability framework of the Intergovernmental Panel on Climate Change (IPCC) and the Sustainable Livelihood Approach (SLA) to understand how the government, institutions and fishing communities perceive risk, vulnerability and opportunities from climate change by assessing their past and current adaptive strategies as well as coping mechanisms. West Africa and Central Africa constitute the majority of countries whose economies are most vulnerable to climate impacts on fisheries. In Ghana, for example, small-scale fishers are confronted with the full force of these impacts through less stable livelihoods, change in availability and quality of fish for food and rising risks to their health, safety at work and home. Amid these challenges, no/little scientific research has been committed to understanding the adaptation and mitigation processes of small-scale fishers to climate change. In this context, this study intends to fill this knowledge gap and provide policy makers, non governmental organizations (NGOs) and other developmental organizations with specific knowledge on small-scale fisheries in Ghana with regard to climate change induced adaptive mechanisms. It will ultimately inform decision makers on proper adaptive measures for vulnerable fishing communities. This study will be the first to specifically look at how climate change shows up in the small-scale fishing communities in Ghana and how fishers are adapting to these changes. Lessons from this study may prove relevant to small-scale natural resource management efforts in developing countries.



Out of the frying pan into the fire - doing climate change adaptation with an authoritarian and neo-patrimonial government

Oral presentation

Session: Parallel session 32

Time: 2.30-2.45

Tim Frewer¹

¹The University of Sydney, Sydney, Australia.

This study looks at climate change adaptation in Cambodia. It focuses on the issue of governance and the role of knowledge in adaptation. The international development community has singled out Cambodia as being particularly vulnerable to the vagrancies of human induced climate change, where rural farmers' dependency on non-mechanised agricultural systems, a primitive irrigation network and a non responsive local government have all been singled out as contributing factors. As such millions of dollars of bi-lateral and multi-lateral aid (as well as private investment) have poured into Cambodia as part of the fight against climate change. Yet where flagship projects have already been rolled out by donors, government departments and NGOs, few have asked serious questions about the viability of working with an authoritarian government and donor-driven NGOs which don't always work in the interest of local communities. Whereas much of the literature has focused on the ecological and livelihoods imperative of doing climate change adaption, little if any has tackled the difficult questions surrounding accountability, representation and aid effectiveness. This study aims to fill in these gaps through an in depth qualitative study of climate change adaptation activities in Cambodia. The main conclusion is that practioners need to take into account previous experiences of the international development community in neo-patrimonial settings and give particular attention to the questions of knowledge production and in whose interests its being used.



climateadaptation knowledge + partnerships

The vulnerability of electricity infrastructure due to climate change

Oral presentation

Session: Parallel session 16

Time: 3.00-3.15



Craig Froome^{1,2}, Liam Wagner^{1,2}.

¹Global Change Institute, The University of Queensland, Brisbane, Australia, ²Energy Economics and Management Group, School of Economics, The University of Queensland, Brisbane, Australia.

Electricity is a key element in the climate change debate, with the 2011 National Greenhouse Gas Inventory showing that the sector accounted for 34% of all emissions, double its nearest rival. Whilst there has been much discussion about moving from fossil fuel to more sustainable renewable technologies, one area that has been largely ignored is what effect climate change will have on the sector, particularly the National Electricity Market (NEM), and what adaptation strategies will be needed for both power generation and supply infrastructure.

The main motivation for this paper stems from the development of existing institutional arrangements under the premise of stable climate conditions. Environmental issues, such as drought and increased climate variability have been largely overlooked and recent events have demonstrated that this premise is no longer appropriate. The Government's policy response has been varied and somewhat uncoordinated, which has the potential to compromise the reliability of the NEM.

Whilst the accurate prediction of climate change is fraught with uncertainty, there is scientific consensus that climate change is highly probable and the cost of not proactively adapting to climate change is high. This paper considers those factors that are required within the electricity sector to adapt to climate change and in particular the effect of institutional fragmentation and lack of a diversified portfolio of generation has on supply risk.



Learning to adapt to climate change in the community welfare sector: preliminary findings from an empirical study in Victoria

Oral presentation

Session: Parallel session 18

Time: 4.00-4.15



¹Victorian Centre for Climate Change Adaptation (VCCCAR), Melbourne, Australia, ²RMIT University, Melbourne, Australia, ³Monash University, Melbourne, Australia.

In Australia, much of public sector climate change adaptation efforts have focussed on developing adaptation strategies and plans in governmental organisations and their agencies, in particular at the local government level. Despite this seemingly favourable policy context, most government-funded agencies and service providers working directly on community welfare issues have not been able to engage as systematically in climate change adaptation. If, to what extent, and how government-funded community service organisations and primary health care agencies are adapting to climate change, and what enables or hinders their adaptation, are not well understood.

This paper presents preliminary findings from a research project currently underway in the state of Victoria, Australia, which explores, among other inquiries, the needs, organisational capacities and institutional contexts for adaptation among community service organisations and primary care partnerships. In the initial context setting and needs analysis phase of the project, conducted in late 2012, a soft systems methodology approach was used to examine the social and institutional learning processes for adaptation. A mix of qualitative research methods was used to produce rich 'stories' about how climate variability and change affect government-funded organisations and the services they provide, and to better understand which factors influence their ability to respond to climatic events and prepare themselves for a future in a rapidly changing climatic, socio-economic and institutional context. The paper raises critical issues about specific challenges that 'frontline' community welfare organisations face in the context of climate change adaptation.



climateadaptation knowledge + partnerships

Prioritization of management actions for conservation of sea turtles in north Queensland under climate change

Oral

Session: Parallel session 31

Time: 2.15-2.30



¹Mariana Fuentes, ²H Marsh, ³F Pouzols, ¹B Pressey, ⁴P Visconti

¹Australian Research Council Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, Australia, ²School of Earth and Environmental Sciences, James Cook University, Townsville, Australia, ³Department of Biosciences, University of Helsinki, Finland, Finland, ⁴Computational Science Laboratory, Microsoft Research, Cambridge, UK

The Great Barrier Reef has globally significant populations of sea turtles that have spiritual and social importance to Australia's indigenous peoples and value to the tourism industry. The resilience to climate change of these populations is already severely compromised by dramatic reductions in population sizes due to impacts such as bycatch, direct take, boat strike, and pollution. Depletion of populations increases their vulnerability to additional threats and lowers their ability to adapt to and recover from climate change. Therefore, managers face the challenge of addressing the direct effects of climate change, as well as ongoing threats that sea turtles face throughout their geographic ranges. For logistical, financial and political reasons, natural resource agencies cannot address all of these drivers or "threats" simultaneously; priorities must be established. Consequently, there is an urgent need for a systematic decision-theory framework that accounts for the benefits and costs of actions while incorporating the complex effects of climate change, all with incomplete knowledge. Here we describe a novel systematic decision framework for the management of flatback turtles in the Gulf of Carpentaria and Torres Strait that incorporates multiple threats as well as the variable benefits of management actions for different life stages. The framework uses a budget constraint and maximizes the likelihood of management actions being successfully applied and accepted by local communities. This structured approach can be applied to guide prioritization of management actions to mitigate the effects of climate change on turtles and others species.



Coping strategies of rural populations: how best to approach climate risk management in the Sahel zone?

Speedtalk+Poster presentation

Session: Speedtalk session 8

Time: 4.55-5.00



Yanon Galiné¹, Ndiaye Aminata¹.

¹Université Cheikh Anta Diop, Dakar, Senegal.

The worsening climatic conditions, noted in recent years, has increased the risk of crop failure in the department of Bambey where the rainfall knows a decadent evolution (period 1947-2012). This poor outcome in rainfall is reflected, in particular, by huge deficits in water (deficit significant at 95% for a Kendall tau -0.32 on the series from 1947 to 2010) and the accentuation of adverse effects of climate risks including drought, high winds, high temperatures and high occurrence of dry spells within the season. Henceforth, we are witnessing a change in the peasant agricultural calendar, imposing different lifestyles and cultural practices just as distinct. Thus, when agricultural yields decrease, when community resources are degraded, when the imbalance is installed between the demographic and available resources, rural develop adaptation measures. These measures revolve mainly with regard to the study area around the rural-urban migration (65.74% of the movements to the coast) or simply resignation. This paper is an overview of the adaptation strategies of rural populations to the effects of major climate risks identified and provides a tool for climate risk management through crop insurance index based weather and satellite.

Keywords: adaptation - Climate Risk - rural - agriculture



climateadaptation knowledge + partnerships

Towards "green" streets - using the typical suburban street to mitigate climate change; a case study from Western Sydney

Oral presentation

Session: Parallel session 2

Time: 4.00-4.15

Libby Gallagher¹

¹Faculty of Architecture, Design and Planning, University of Sydney, Sydney, Australia.

Streets are the single largest public domain resource of our cities, comprising between approximately 25 - 30% of the total area. Over the last decade a drive for higher density has resulted in the evolution of a new suburban form in Australia, where single dwellings with large footprints dominate and private open space is limited. Within this built form context, streets become highly significant environmental resources. This study explores the capacity of residential streets to mitigate GHG emissions and improve climate change adaption in existing suburbs. A case study in the north-western growth corridor in Sydney is used to test opportunities to reduce GHG emissions by modifying the structure, layout and components of existing streets. The research project uses a combination of new and existing modeling techniques including terrestrial laser scanning and housing simulation software, specific to the Sydney context to model core streetscape components including street trees, materials and lighting.

Outcomes indicate that traditional streetscape design solutions could be altered to reduce GHG emissions and household energy costs. Alternative streetscape design scenarios are illustrated and projected GHG emissions profiles compared. Simulations indicate that by simply changing street tree layout and species can result in GHG reductions of up to 7 times that of typical streetscapes. Conflicting ownership and user demands are also briefly outlined. This study lays the basis for design professionals and government authorities to test and calculate optimum street configurations and allows governments to make informed decisions, set targets and measure outcomes for these essential public assets.



Disaster response and adaptive capacity in the Pacific

Speedtalk+Poster presentation

Session: Speedtalk session 6

Time: 4.55-5.00



Anna Gero¹, Stephanie Fletcher¹, Michele Rumsey¹, Jodi Thiessen¹, Natasha Kuruppu¹, James Buchan¹, John Daly¹, Juliet Willetts¹.

¹University of Technology, Sydney, Sydney, NSW, Australia.

Climate change is likely to affect the pattern of some disasters in the Pacific, and therefore the organisations and systems involved in disaster response. This research focused on how the immediate humanitarian needs following disasters are met by various stakeholders, both in the affected country and those offering support from outside. The concept of adaptive capacity was used to assess both the resilience of individual organisations and the robustness of the broader system of disaster response. Objective and subjective determinants of adaptive capacity were used to assess the 'disaster response system', comprised of actors and agents from government and non-government sectors, and the governance structures, policies, plans and formal and informal networks that support them. Four case study countries (Fiji, Cook Islands, Vanuatu and Samoa) were chosen for deeper investigation of the range of issues present in the Pacific.

Results revealed that in small Pacific island bureaucracies, responsibility and capacity often rests with individuals rather than organisations. Leadership, trust, informal networks and relationships were found to have a strong influence on the adaptive capacity of organisations and the broader disaster response system. Recommendations to enhance adaptive capacity of responding organisations and the system as a whole included strengthening the links between key responding organisations in the Pacific (e.g. Ministry of Health and National Disaster Management Offices); improving policies and mechanisms to request overseas assistance; and provision of support to maintain formal and informal networks for ongoing relationships, efficient information flows and trust between Pacific disaster response stakeholders.



Climate change adaptation-mitigation GHG tradeoffs in livestock industry

Oral presentation

Session: Parallel session 19

Time: 3.30-3.45



Afshin Ghahramani¹, Andrew Moore¹.

¹CSIRO, ACT, Australia.

A significant negative effect of climate change on grassland and livestock productivity has been predicted 1 , suggesting requirement for effective adaptation strategies. However, trade-offs between production, resource management, and adaptation and mitigation are complex interactions that mitigation consequences of effective adaptations should be taken into account to include them in mitigation policies. We used the AusFarm model 2 , 3 to simulate the effects of climate change (SRES A2 scenario) in 2030 and in ewe Merino enterprises. Effectiveness of increased soil fertility adaptation 4 (by phosphorous) simulated to predict system productivity, N_2O & ruminant CH_4 emission.

At Lake Grace (WA, rainfall = 352 mm), average long-term net primary productivity of pasture (ANPP) and dry sheep equivalent (DSE) changed by -10.6% and -76% in comparison with historical period. Increased soil fertility adaptation could recover 7.3% and 24% of decrease in ANPP and DSE. At Wellington (NSW, rainfall = 610 mm), ANPP and DSE changed by -15% and -11%, and adaptation predicted to recover +8.6% and +2.3% of decrease in ANPP and DSE.

In 2030, while adaptation could increase productivity, N_2O and CH_4 emission (kgha-1) changed by -7% and +1% (owing to increased stocking rate) at Lake Grace and -25% and +1% at Wellington in comparison to no adaptation.



Barriers to sea level rise adaptation: asset anchoring

Oral presentation

Session: Parallel session 35

Time: 1.45-2.00



Mark Gibbs¹.

¹AECOM, Brisbane, Qld, Australia.

It is commonly accepted that there are three main approaches for adapting at-risk legacy coastal assets to sea level rise: retreat, protect or manage. There have been many calls for coastal retreat in particular. However it can be argued that apart from a small number of isolated examples of individual facilities or structures being relocated shoreward, there has been a lack of uptake of large-scale coastal retreat strategies. It has been previously recognised that one of the major implementation barriers to community-wide coastal retreat has been the existence of allocated, strong private property rights in the coastal zone and lack of alignment between the risk management behaviour of the key actors that include right-holders, councils and the insurance sector.

In the study presented here, another factor, labelled asset-anchoring, discusses how large community civil infrastructure such as roads, rails, hospitals, utilities etc. act to anchor coastal communities in place and present a barrier to the implementation of large-scale coastal retreat strategies. The implementation barrier arises as a result of both the cost and long-lived nature of large community infrastructure, but also the common lack of integrated planning process as a result of the institutional and governance arrangements of community infrastructure.



Zones of friction and traction: conceptualising the adaptability of Australian households

Oral presentation

Session: Parallel session 1

Time: 3.00-3.15



Chris Gibson¹, Lesley Head¹, Gordon Waitt¹, Nick Gill¹, Carol Farbotko¹.

¹University of Wollongong, Wollongong, NSW, Australia.

Households are increasingly addressed as a focus of environmental policy, with varying degrees of success in achieving more sustainable outcomes at the domestic level. Part of the problem is black boxing, in which the inherent complexity of households tends to be taken for granted. This paper draws on cultural environmental research to put forward a more sophisticated conceptualisation - the connected household approach. The connected household framework uses the themes of governance, materiality and practice to illustrate and explain the ways everyday life, and the internal politics of households, are connected to wider systems of provision, demographic change and socioeconomic networks. The twin concepts of zones of friction and zones of traction represent different pathways of connection between the spheres. Friction and traction can help decision-makers think through the possibilities and constraints of working at the household scale. Selected examples are used to illustrate, drawing on longitudinal ethnographic and large survey work with households conducted for a new book, *Household Sustainability: Challenges and Dilemmas in Everyday Life* (Edward Elgar, 2013).



Developing and evaluating an engagement framework: a case study with recreational spearfishers

Oral presentation

Session: Parallel session 17

Time: 3.15-3.30



Daniel Gledhill¹, Alistair Hobday¹, David Welch^{2,4}, Stephen Sutton³.

¹CSIRO Marine & Atmospheric Research, Hobart, Tasmania, Australia, ²C20 Fisheries, Coffs Harbour, NSW, Australia, ³James Cook University, Townsville, QLD, Australia, ⁴Australian Underwater Federation, Coffs Harbour, NSW, Australia.

The impacts of climate change and the development of adaptation options can seem remote from many in the non-scientific community - and thus may represent a barrier to widespread engagement and action. Some community groups, however, collect high quality data, and these may be useful for detecting climate impacts and planning adaptation. One leading example is high quality information collected as part of recreational spearfishing competitions which represents one of few long-term datasets available for Australian recreational coastal fisheries. These data, collected during competitions dating to the 1960s, could therefore provide further detail of species range extensions in response to warming waters in eastern Australia, as well as assist an active group of ocean users consider their options as fish change distribution and availability under a changed climate.

However, accessing these data for scientific study is complicated following what many spearfishers consider an unfavourable history of science and management interactions. Following an extensive consultation process with spearfishing representative bodies, each party could foresee benefit from utilising the data, and importantly, the concerns and interests of each party could be acceptably protected or mitigated. After reaching in-principal agreement to utilise data, we embarked on a project within the National Climate Change Adaptation Research Plan (NARP) framework in 2011. We've used this often challenging project to develop a process model for engagement, potentially suitable for other community groups. Spearfishers have also previously undertaken autonomous adaptation measures within competitions, and we consider the suitability of autonomous versus directed adaptation for this community group.



climateadaptation knowledge + partnerships

Changing behaviour in a changing climate: can psychology help save the Great Barrier Reef?

Oral presentation

Session: Speedtalk session 4

Time: 4.45-4.50



Jeremy Goldberg^{1,2}, Alastair Birtles¹, Peter Case¹, Nadine Marshall¹.

¹James Cook University, Townsville, QLD, Australia, ²CSIRO, Townsville, QLD, Australia.

Although approximately 97% of climate researchers agree that climate change is caused by humans, recent polls suggest that only about 50% of the Australian public agrees. In America, the proportions are similar. Why is this? How can 97% of scientists fail to convince approximately half of the general public that climate change is real and requires urgent action to prevent catastrophic long-term damage? One issue is that a significant gap exists between having some knowledge of climate change and taking action to address it. In addition, effectively communicating about climate change is challenging, as is changing the individual behaviours associated with its cause and its ongoing and anticipated effects. However, practical and theoretical approaches from trans-disciplinary fields such as psychology and marketing can improve the effectiveness of climate change communication, enhance public awareness and promote positive adaptation and mitigation actions. In this review, we describe the key psychological components involved in the individual decision-making process, as well as the factors that lead to a willingness to act and the initiation of pro-environmental behaviours. We also present a case study detailing how psychographic variables may enhance the management effectiveness and socio-ecological resilience of the Great Barrier Reef, Australia.



East Coast storm climatology over the past millennium

Oral presentation

Session: Parallel session 14

Time: 1.30-1.45



Ian Goodwin¹, Stuart Browning¹.

¹Marine Climate Risk Group, Climate Futures and Department of Environment and Geography, Macquarie University, Sydney, Australia.

A group of high-impact weather events known as East Coast Cyclones (ECC) occur along the Eastern Australian Seaboard and generate damaging winds, flooding, hail, and heavy seas and swells affecting infrastructure and communities. In June 2007, an East Coast Low (ECL) caused significant damage to the coast near Newcastle and led to nine deaths, insurance claims of \$1.6 billion and the grounding of the Pasha Bulker bulk container ship. Our current understanding is that the magnitude and sequencing of ECCs is related to the decadal-multi-decadal climate variability, particularly in the Pacific basin, known as the Interdecadal Pacific Oscillation (IPO). The summer of 2011 produced a return to extreme storm events in Queensland that have not been experienced since the benchmark year of 1974, and were prevalent from the 1940s onwards (during the previous La Nina-like phase of the IPO).

Little was known about decadal climate pattern variability in the Australian region prior to 1900, and the long-term relationship between ECL magnitude and frequency and decadal variability was a major research gap. To address this, we present a quasi-decadal scale reconstruction of Southern Hemisphere sea-level pressure fields for the past 500 years using proxy climate data. In parallel our research also produced a synoptic typology of the different types of ECLs that affect southern Queensland/northern NSW, central NSW and southern NSW coasts, and their relationship to the large scale Southern Hemisphere climate. We present a reconstruction of the frequency of ECL types at quasi-decadal scale over eth past 500 years. Our research demonstrates that risk profiles based on the past 100 years have under-estimated ECL magnitude and clustering.



Coastal response to extreme East Coast storms over the past 500 years

Oral presentation

Session: Parallel session 14

Time: 1.45-2.00



Ian Goodwin¹, Stuart Browning¹, John Tibby², Cameron Barr², David Hanslow³, Peter Scanes³.

¹Marine Climate Risk Group, Climate Futures and Department of Environment and Geography, Macquarie University, Sydney, Australia, ²University of Adelaide, Adelaide, Australia, ³NSW Office of Environment and Heritage, NSW, Australia.

Sea-level rise and severe maritime weather present the largest combined threats to the natural coastal system and the intensely populated areas of the east coast of Australia in the immediate to medium-term. The risk of extreme or 'ultimate' storm impacts from Tropical Cyclones and East Coast Cyclones (ECC) also known as East Coast Lows (ECL) is presently significantly under-determined from the observations over the past century. East Coast Cyclones are complex weather systems that form off the east coast of Australia and/or travel parallel to the coast of Australia from south-east Queensland to Victoria. The joint hazard of ECLs is from storm beach erosion, marine inundation, coastal lowland flooding, and persistently high relative sea-level anomalies. The historical records over the past century show that the magnitude and frequency of East Coast Lows (ECL) is linked to decadal-scale variability in the climate system. Storm signatures of extreme wave erosion, storm surge inundation limits, and catchment flooding extent are preserved in the geological archive; the coastal, estuarine and floodplain sediment stratigraphy; the microfossil record in estuarine sediments, and in the coastal and floodplain geomorphology.

The multi-centennial coastal behaviour has been interpreted for the past 500 years and was analysed together with our decadal scale reconstruction of sea-level pressure fields and number of ECL storm days. Between AD 1650 and 1750 (the 'storm century') the entire coastline experienced a high frequency/magnitude of ECL storms that produced coastal impacts not seen in the past century. We are using this data to: (i) define the ultimate storm impacts; (ii) to determine the coastal system response and recovery to extreme storm sequences; (iii) to identify the threshold or tipping points for abrupt physical/ecological changes; and, (iv) to develop conceptual regional models for northern NSW - south-east Queensland, central NSW, and southern NSW - north-eastern Victorian coastal types.



Australian case studies of investment in adaptation: shifting from decision support to co-evolving multi-scale social systems

Oral presentation

Session: Parallel session 28

Time: 12.00-12.15



¹CSIRO Ecosystem Sciences, Canberra, ACT, Australia, ²Griffith Centre For Coastal Management, Griffith University, Gold Coast, Queensland, Australia.

Much of the adaptation literature over the last decade has framed adaptation as a relatively static function of impact (itself the product of exposure and sensitivity) and the capacity to adapt. However, there are emerging concerns about the usefulness of this framing for guiding decision making. There is a growing realisation that difficult adaptation problems involve fundamental and complex changes in society and therefore long-term transitional processes. Adaptation therefore needs to be viewed from numerous theoretical perspectives and involves an associated range of strategies. However, practical frameworks are still required to guide and evaluate public investment in adaptation in the face of this complexity. We argue that a focus on how the rules, knowledge and values underpinning adaptation decisions are co-evolving can help in structuring both tactical and strategic investments in adaptation. We show how such an integrated focus links to several key theoretical perspectives on adaptation pathways, including resilience, innovation, institutional economics, evolutionary economics, social psychology and the multi-level perspective on transitions. We illustrate the use of this 'rules-knowledge-values perspective' to evaluate a range of localgovernment-scale case studies of coastal adaptation in Australia. Finally, we use this analysis to suggest some directions for adaptation research. In this regard, we suggest the most pressing and neglected arena of adaptation research involves meeting the need for a better understanding of how formal and informal rules and norms at different levels can be evaluated and adapted over time. This is critical to inform the processes of adaptation policy design and policy implementation.



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The social impacts of adaptation to sea-level rise in Lakes Entrance, Victoria

Oral presentation

Session: Parallel session 1

Time: 4.00-4.15



Sonia Graham¹, Jon Barnett¹, Ruth Fincher¹, Anna Hurlimann¹, Colette Mortreux¹.

¹University of Melbourne, Melbourne, Victoria, Australia.

Many existing analyses of the impacts of sea-level rise on coastal communities focus on conventionally measured metrics such as the area of land that may be subsumed, the numbers of properties at risk, and the capital values of assets at risk. The implication of focusing on such metrics is that sea-level rise only becomes important to society when it affects material aspects of well-being; thereby overlooking non-material dimensions that contribute to meaningful lives. This paper explains how the concept of lived values-valuations that individuals make about what is important in their lives and the places they live-was used to understand the social impacts of adaptation to sea-level rise in Lakes Entrance, Victoria. Residents' lived values were captured through a phone survey (n=199). Cluster analysis revealed that there exists at least eight types of permanent residents in Lakes Entrance; each with unique interests and lifestyles. Understanding the differences in lived values among these groups provides insights into the distribution of social impacts of adaptation to sea-level rise. It also reveals the need to develop a set of adaptation policies that can address the diverse needs of this and other communities at risk of sea-level rise.



A strategic state-wide adaptation strategy that identified and delivered a decision support tool for Local Governments to assess climate change impacts on infrastructure

Oral presentation

Session: Parallel session 22

Time: 12.00-12.15

Adam Gray¹, Jacqueline Balston².

¹Local Government Association of South Australia, Adelaide, South Australia, Australia, ²University of South Australia, Adelaide, South Australia, Australia.

LGASA led parallel projects providing Council climate change risk assessments and financial and asset management reforms identified that Local Government assets and infrastructure were at significant risk from climate change, however there were no tools to assist with understanding and quantifying the physical and financial implications.

In 2011 the LGASA successfully applied for funds from the NCCARF settlements and infrastructure round of research grants. The project aimed to deliver a decision support tool for Local Governments to assess climate change impacts on infrastructure. The result is an analytical tool that will be incorporated into a nationally recognised and utilised asset management framework.

To undertake this project the LGASA required input and support from a national multi-disciplinary team including various disciplines within university/research institutions, State Government departments, CSIRO and BoM, Councils from WA, VIC, SA and Tasmania and the Institute of Public Works and Engineering Aust (IPWEA). The expertise engaged by the project covered climate science, engineering, financial/business modelling and Local Government asset and financial management. Funding and in-kind support was secured from a number of stakeholders.

To facilitate the uptake of this tool by the Local Government sector the LGASA and IPWEA have developed a training package, hosting sessions across southern Australia.

While the analytical elements and research outcomes of this project are of significant interest, the success of this project is primarily due to the strategic approach from the lead agency, collaboration across many professional fields and the provision for end user engagement via an established and recognised industry body.



Response of soil organic carbon and other soil properties to predicted climate change over the Sydney - Central NSW Region

Oral presentation

Session: Speedtalk session 5

Time: 5.05-5.10



Jonathan Gray¹, Xihua Yang¹, Thomas Bishop², Greg Chapman¹, Andrew Rawson¹.

¹Office of Environment & Heritage, Sydney, NSW, Australia, ²University of Sydney, Sydney, NSW, Australia.

This project examined the potential change in the key soil properties of organic carbon (OC), pH_{ca} and base (nutrient) levels that may occur due to the predicted climate change over the Sydney - Central NSW Region up to 2050. These properties all have a significant bearing on the agricultural potential of the soil and carbon levels are also important for climate change modelling.

Multiple linear regression models combining all key soil forming factors were developed for these properties for three depth intervals down to 1 m for the eastern Australian region. Coefficients of determination (R²) values generally ranged from 0.45 to 0.60. By running these models using current climate data, then again with the future (2050) climate predictions for the Region, digital spatial surfaces depicting the expected soil property changes were derived.

The modelling results present varied patterns of change for each soil property, depending on the subregion and their differing predicted future rainfall and temperature regimes. For example, in the 0-10cm depth interval, the Coastal Sydney sub-region the predicted relative changes are 12.3% increase in OC, 5.6% decrease in pH $_{ca}$ and 10.4% decrease in base (nutrient) levels reflecting significantly wetter conditions, This compares with the Hunter sub-region where predicted relative changes are 9.5% decrease in OC, 1.8% increase in pH $_{ca}$ and 6.2% increase in base levels, reflecting slightly drier and warmer predicted conditions. The results may assist natural resource managers to better plan for potential changes in the soil behaviour across their districts.



Cumulative impacts of human activities on the Great Barrier Reef coast

Oral

Session: Parallel session 31

Time: 2.45-3.00



¹Alana Grech, ¹Bob Pressey

¹Australian Research Council Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, Australia

The impacts of human activities on biodiversity features, even those arising from individual stressors, are often poorly assessed. The situation is compounded for the assessment of cumulative impacts, where one or more activities generate multiple, interacting stressors. A voluntary cumulative impact assessment conducted by several proponents at the Port of Abbot Point was the first of its kind in the Great Barrier Reef (GBR) region of Queensland, but failed to consider: (1) the cumulative effects of the proposed developments in combination with other past, present and future activities in the region, such as fishing and agriculture; and, (2) the relative magnitude of stressors; or (3) the synergistic interactions between multiple stressors. In this presentation, we locate the Port of Abbot Point exercise conceptually relative to what should be achieved in a cumulative impact assessment. We also illustrate the restricted and inadequate scope of Environmental Impact Assessments that are currently required for developments along the GBR coast. The voluntary, though inadequate, nature of the cumulative impact assessment by the Port of Abbot Point and the lack of requirement for comprehensive cumulative assessments with clear guidelines indicate regulatory failure at various levels of Government. Cumulative impact assessments that integrate past, present, and future actions across the entire GBR are the only mechanism available to understand the actual effect of each new development on the GBR's biodiversity and socio-economic values



Indigenous voices in climate change adaptation: building the capacity of the Yorta Yorta community to respond to climate change

Oral presentation

Session: Parallel session 8

Time: 1.15-1.30



Dave Griggs¹, Lee Joachim², Amanda Lynch³, Xuan Zhu¹, Carollina Adler⁴, Zac Bischoff-Mattson³, Jackie Walker², Pan Wang¹, Tahl Kestin¹.

¹Monash University, Melbourne, Victoria, Australia, ²Yorta Yorta Nation Aboriginal Corporation, Shepparton, Victoria, Australia, ³Brown University, Providence, Rhode Island, USA, ⁴ETH Zurich, Zurich, Switzerland.

A unique partnership between the Yorta Yorta community and an interdisciplinary group of scientists is working to build knowledge, tools and connections that will empower the Yorta Yorta community to respond to climate change. The Yorta Yorta regard the Murray River, with its rich network of lagoons, creeks, and wetlands, as the life source and the spirit of the Yorta Yorta Nation. Their country, however, is part of the Murray-Darling Basin (MDB) - with an agricultural industry worth more than AUS\$9 billion per year - and has suffered considerably from overexploitation and poor management. Climate change is likely to intensify this decline further.

Guided by the needs identified by the Yorta Yorta community, this project is developing the community's capacity to advocate their needs and actively participate in the complex policy and decision-making environment of the MDB. This work encompasses several components, namely: collection, archiving and transgenerational transfer of traditional knowledge; the construction of a GIS management database that integrates Yorta Yorta knowledge with more conventional forms of knowledge and science; development of provisions for Indigenous knowledge protection; analysis of regional stakeholder perspectives and values regarding MDB management; and developing connections and joint approaches with Indigenous communities around Australia and overseas. This presentation reports on progress made to date, as well as insights and lessons learnt so far on this multi-stakeholder and interdisciplinary experience.



The urban heat island and temperature-dependence of office building electricity consumption in the Adelaide CBD

Oral presentation

Session: Parallel session 9

Time: 1.05-1.17



Huade Guan^{1,2}, John Bennett¹, Roger Clay³, Shanyou Zhu¹, Veronica Soebarto⁴, Vinodkumar¹, Caecilia Ewenz¹, Simon Benger¹, Andrew McGrath¹, Kathryn Bellette⁵.

¹School of the Environment, Flinders University, Adelaide, Australia, ²National Centre for Ground Water Research and Training, Flinders University, Adelaide, Australia, ³School of Chemistry and Physics, University of Adelaide, Adelaide, Australia, ⁴School of Architecture Landscape Architecture & Urban Design, University of Adelaide, Adelaide, Australia, ⁵Waterand Environment Research Hub, Flinders University, Adelaide, Australia.

Climate change and an increasing urban population with associated demands for space, water, energy and other resources, have increased pressures on urban environments. Urban weather strongly influences human health and comfort, water consumption, and electricity usage. The urban microclimate is controlled by regional climate systems, and influenced by global warming. It is also affected by the urban heat island phenomenon. A three-year study has been performed to characterise and interpret Adelaide urban heat island, and its association with office building electricity consumption in the central business district (CBD).

The results indicate that the Adelaide CBD is 1.5° C(0.5° C) warmer in the night (day) time than the surrounding parklands. The locations of peak warm spots in the CBD vary between day and night. The mean night-time urban heat island intensity can be well interpreted by an improved sky view factor concept incorporating sky temperature effects.

Electricity consumption of office buildings in the Adelaide CBD is sensitive to urban air temperature when the daytime mean temperature is above 17° C. Climate change and the urban heat island have strong implications for energy consumption and associated CO_2 emission. A warming of 1° C daytime temperature may increase cooling electricity consumption by 1.5 million kWh, and associated 1000 tonnes e- CO_2 , per year for the sum of office buildings in the Adelaide CBD. Heat waves strongly influence electricity demand. For an event similar to the early 2009 heat wave, the daytime office building electricity demand may increase on average by 50% from the daytime base electricity consumption.



Yorke and Mid North Regional Alliance planning for coordinated climate change action

Oral presentation

Session: Speedtalk session 8

Time: 4.45-4.50



Natasha Hall^{4,3}, Anita Crisp¹, Kelly-Anne Saffin².

¹Central Local Government Region, South Australia, Australia, ²Regional Development Australia Yorke & Mid North, South Australia, Australia, ³Northern & Yorke Natural Resources Management Board, South Australia, Australia, ⁴Yorke & Mid North Regional Alliance, South Australia, Australia.

It is expected that by 2030 (compared with 1990 levels) the Yorke and Mid North Region of South Australia could be faced with a decrease in average May - October rainfall of 10.4% and 10-20m recession of sandy shores as a result of erosion (Balston, 2011). These climatic based changes, and others, present the region with challenges and opportunities for the future.

The Regional Alliance Climate Change Steering Committee has been at the forefront of climate change adaptation for the region since 2008, and in 2011, partnered with the South Australian State Government through a Climate Change Sector Agreement.

An Action Plan has been prepared, aimed at ensuring ongoing coordinated action and united, community-driven leadership on the issue of climate change. It follows on from the "Central Local Government Region Integrated Climate Change Vulnerability Assessment - 2030", and gathers and prioritises ideas from across the region to address what the community determined to be most vulnerable to future climatic stressors. The process of combined planning with all sectors (environmental, social and economic) at a local scale has proved beneficial for equipping local leaders with the ability to integrate climate information, impacts and responses into decision making. The resulting plan represents the region's aspirations for the following 2 years through actions that provide for early on-ground action and longer-term transformational change. The Regional Alliance, Sector Agreement, planning process and early actions serve as practical case studies for other organisations preparing to lead climate change adaptation within and behalf of regional areas.



Poverty, inequality and climate change: adapting critical social infrastructure to the impacts

Oral presentation

Session: Parallel session 2

Time: 4.15-4.30



Karl Mallon^{2,1}, **Emily Hamilton**¹.

¹ACOSS, NSW, Australia, ²Climate Risk Pty. Ltd., NSW, Australia.

People experiencing poverty and inequality are at greatest risk from climate change impacts: they have the least ability to cope, move and adapt. Community service organisations (CSOs) play a critical role in assisting them to meet basic needs and respond to non-climate related adversity. The critical role CSOs play in helping communities recover from natural disasters suggests they are also an important part of the social infrastructure that people will turn to for assistance to respond to climate change.

Using results from the first national survey about CSOs and climate change, the Extreme Weather, Climate Change and the Community Sector – Risks and Adaptations project demonstrates CSOs are highly vulnerable and poorly prepared for its impacts. Their responses to risk lack sophistication and the failure of critical infrastructure services such as power, water and telecommunications have the potential to decimate their service delivery capacity. As a result, people experiencing poverty will be at even greater risk of harm as climate change accelerates. As services fail, greater strain will be placed on interconnected elements of the social system such as emergency services, hospitals, social security and the criminal justice system.

If well-adapted, CSOs have specialist skills and resources to make a positive contribution to individual and community resilience to climate change. As the findings from this project show, addressing the adaptation needs of this critical sector must be prioritised: if social service delivery fails in response to climate change, there is a real risk that poverty and inequality in Australia will increase.



Simulation on wind environment at pedestrian level in a street canyon at Docklands

Speedtalk+Poster presentation

Session: Speedtalk session 2

Time: 5.10-5.15



Jun Han¹, Dong Chen¹, Xiaoming Wang¹.

¹CSIRO Climate Adaptation Flagship and CSIRO Ecosystem Sciences, Victoria, Australia.

Wind environment at the pedestrian level in urban street canyons influences the air quality of street canyons, as well as the comfort and safety of pedestrians. Acceptable wind environment in a street canyon would help dilute traffic related pollution and induce safe wind velocity at pedestrian levels around buildings. The main purpose of this study is to explore the wind conditions in a street canyon at Docklands to ensure pedestrian safety when new buildings are constructed among existing building blocks. In order to achieve this purpose, the wind speed was examined through CFD modelling using wind statistics data of Docklands, Melbourne. Wind characteristics of the street canyon under various wind directions including annually dominated wind directions were simulated. Suggestions on building layout planning in urban area were then recommended.



Open software for restricted data: a climate/suicide health impact assessment example

Speedtalk+Poster presentation

Session: Speedtalk session 10

Time: 5.05-5.10



Ivan Hanigan^{1,2}, Steven McEachern³, David Fisher⁴.

¹National Centre for Epidemiology and Population Health, Australian National University, Canberra, ACT, Australia, ²Commonwealth Scientific and Industrial Research Organisation, Climate Adaptation Flagship, Aspendale, VIC, Australia, ³Australian Data Archive, Australian National University, Canberra, ACT, Australia, ⁴Information Technology Services, Australian National University, Canberra, ACT, Australia.

We present an environment for analysing restricted data using open software. The system is described using an analysis of the historical association of suicides with drought in Australia; and extrapolate this under climate change and adaptation scenarios. These tools were assembled to allow users to access restricted data in a manner that protects confidentiality of sensitive data, whilst also allowing use of open software for reproducibility.

Recently restrictions on access to confidential health records have increased, especially for sensitive data on suicide used in our case study. Previous solutions to this challenge make access so restricted that usability is compromised. We aimed to build a collection of tools for the conduct of many types of health and social science research. The starting point for users is the data catalogue, which provides for finding data available from the store of unrestricted and restricted data for approved use. Once data are discovered, the researcher has capacity to manipulate the datasets on the secure server. The PostgreSQL database integrates and Geoserver visualises, while statistical tools are available in the R-studio server browser.

Such analytical tools will enhance the ability of adaptive management practitioners to assess the potential influence of adaptations. The use of the system shows the ease with which multiple data sources (some restricted) can be analysed in a secure way using open software. This will build capacity to answer complex research questions and compare multiple climate change scenarios or adaptation assumptions; achieving simultaneous vision of potential future outcomes from different standpoints.



Rising heat: actual heat exposures where we live, work and play

Oral presentation

Session: Parallel session 20

Time: 3.00-3.15



Liz Hanna¹, James Hall¹, Tord Kjellstrom¹, Bruno Lemke¹, Clem Davis¹, Keith Dear¹, Tony McMichael¹, Laura Martich¹.

¹Australian National University, Canberra, ACT, Australia.

Australia is widely recognized for her heat extremes and the associated significant human health risks. Each decade since 1970 has been warmer than the previous, and the rate of record breaking heat extremes is also trending upwards. The summer of 2013 is shaping to be Australia's hottest to date, reaching an all-time highest national average of $40.3\,^{\circ}$ C, and longest run of consecutive hot national average days. This relentless warming trend forced the Bureau of Meteorology (BoM) to add new colours to accommodate the additional heat extremes above $50\,^{\circ}$ C in their colour interactive graphics.

Climate science uniformly agrees we are facing a hotter future. Australia's BoM produces world class, standardised observations that are revered for their accuracy. Recordings are measured inside Stephenson Screens, often at airports, whereas humans are exposed to radiant heat from direct sunlight, and urban environments that serve as heat traps. Recent rising heat trends now prompt us to explore actual heat exposures, and detail the significance for human physiology and adaptation limits. Our group is researching what this means for human physiology in its social context; where we live, work and play.

Step one was to devise transportable heat measuring equipment, and validate that against the BoM equipment output. Step two was to record on-site thermal environments. This paper presents an analysis of the thermal environments that humans are naturally exposed to as part of their daily routines during the summer months.

This work informs our program of study identifying adaptive options for coping with the heat.



From climate change research to policy and practice

Oral presentation

Session: Parallel session 20

Time: 4.15-4.30



Alana Hansen¹, Val Smyth², Monika Nitschke², Leigh Wilson³, Peng Bi¹.

¹The University of Adelaide, Adelaide, South Australia, Australia, ²South Australian Department of Health, Adelaide, South Australia, Australia, ³The University of Sydney, Sydney, NSW, Australia.

Based on evidence from overseas that people in ethnic minority groups are vulnerable to extreme heat, we conducted a qualitative study to determine if migrants and refugees in Australia will be more at risk in a warmer climate. Interviews and focus groups were conducted amongst stakeholders involved with, and part of, a range of culturally and linguistically diverse (CALD) communities in Adelaide, Melbourne and Sydney. The study identified that socio-cultural barriers may exist, potentially placing some migrants and refugees at higher risk of heat-health impacts, and that at present there are unmet information needs in CALD communities. A full-day stakeholder workshop was organised to communicate findings to end users. The program was carefully designed to include presentations, interactive sessions, and scenario based discussion groups. Fifty seven people attended the Workshop including representatives from nongovernment organisations and service providers, key policymakers and government officials. The State Minister for Multicultural Affairs opened the proceedings. As an outcome from the Workshop, several recommendations were made. These included a recommendation that a leadership group be formed to increase the accessibility of heat awareness messages to people whose first language is not English. As a consequence, the 'Extreme Heat and CALD Communities Working Group' was formed with representatives from government departments, NGOs, emergency services and academia. This group now meets on a regular basis. This case study is a rare example of qualitative research being translated into action and has the potential for policy implications for climate change adaptation and risk communication in Australia.



climateadaptation knowledge + partnerships

'Sufficient science and deficient publics'?: South Australian publics' understanding of climate change risk and adaptation - implications for communication and engagement initiatives

Oral presentation

Session: Speedtalk session 7

Time: 4.50-4.55

Scott Hanson-Easey¹, Peng Bi¹.

¹The University of Adelaide, Adelaide, South Australia, Australia.

It is now generally accepted as imperative in academic and policy domains that climate change risk, adaptation, and mitigation information needs to be promulgated in forms that galvanise public action and augment community resilience. In Australia, climate change communication is recurrently informed by the so-called 'deficit model' (Wynne, 1982). The deficit model of communication is undergirded by the assumption that adaptation behaviour and policy acceptance can be propagated by effective provision of robust and targeted scientific information. This article affords an alternative characterisation of climate change communication, and advances the idea that without furthering knowledge of the sense-making resources available to various publics, efforts to build adaptation capacity will be seriously constrained. To elaborate this argument, we draw from a corpus of focus group and survey data to examine how various interpretive resources are employed to make sense of climate change in terms of individuals' representations, values, material contexts, and experiences of local weather. There are important implications for future research and policy development arising from this study. We suggest that climate change communication needs to move beyond mere provision of information to a homogenised 'public' and, instead, finesse its messages in accord with various publics' interpretive, contextual and socioeconomic circumstances. Furthermore, we contend that it is crucial that decision makers recognise and build upon local forms of knowledge to meaningfully engage various publics on climate change adaptation.



climateadaptation knowledge + partnerships

Households' perception of climate change (CC) and human health risks: a community perspective

Oral presentation

Session: Parallel session 20

Time: 3.15-3.30



Md. Aminul Haque^{1,2}.

¹Department of Population Sciences, University of Dhaka, Dhaka, Bangladesh, ²Institute of Public Health, Heidelberg University, Germany, Germany.

As a climate vulnerable country, little is known about the perception of CC from the community, which is important for developing adaptation strategies.

A total of 450 households were selected randomly through multistage sampling completed a semi-structure questionnaire. This was supplemented with 12 focus group discussions (FGDs) and 15 key informant interviews (KIIs).

Over 95% of the respondents reported that the heat had increased and 80.2% reported that rainfall had decreased, compared to their previous experiences. Approximately 65% reported that winters were warmer than in previous years but they still experienced very erratic and severe cold during the winter for about 5-7days. FGDs and KIIs also reported that overall winters were warmer. 82%, 72.5% and 54.7% survey respondents perceived that the frequency of water, heat and cold related diseases/health problems, respectively, had increased compared to five to ten years ago. FGDs and KIIs respondents were also reported the same.

Respondents had clear perceptions about changes in heat, cold and rainfall that had occurred over the last 5-10 years. The effects of climate vulnerability (CV) were mostly negative in terms of means of living, human health, agriculture and overall livelihoods. Most local perceptions on CV are consistent with the evidence regarding the vulnerability of Bangladesh to CC. Such findings can be used to formulate appropriate sector programs and interventions. The systematic collection of such information will allow scientists, researchers and policy makers to design and implement appropriate adaptation strategies for CC in countries that are especially vulnerable.



Global lessons for adapting our coastal communities to protect against storm surge inundation

Oral presentation

Session: Parallel session 21

Time: 3.45-4.00



Ben Harman¹, Sonja Heyenga¹, Cameron Fletcher¹, Bruce Taylor¹.

¹CSIRO, Brisbane, QLD, Australia.

Coastal inundation as a result of global sea level rise and storm surge events is expected to impact on many coastal regions and settlements. The impacts are likely to be exacerbated by ongoing urbanization in coastal environments. Adaptation is widely accepted as an important strategy for managing inundation risk. Adaptation progress in Australia has been slow and often undermined by changes in government and government policy. By looking at how decisions are made elsewhere, and what decisions are being made, we may be able to improve the effectiveness of adaptation to coastal inundation in Australia. This paper reviews both the international and national literatures to better understand the different contexts in which adaptation decisions are being made to manage inundation risk under the three widely recognized strategies of defend, accommodate, and retreat. Comparisons between national and international adaptation practices revealed a number of key findings which are grouped under the following headings: roles and responsibilities, scale and effectiveness, and suitability and acceptability.



A coastal hazard adaptation study for Townsville: pilot study

Oral presentation

Session: Parallel session 22

Time: 11.15-11.30



Bruce Harper¹, Mitchell Smith¹, Dorean Erhart², Sel Sultmann³.

¹GHD Pty Ltd, Brisbane, QLD, Australia, ²Local Government Association of Queensland, Brisbane, QLD, Australia, ³Department of Environment and Heritage Protection, Brisbane, QLD, Australia.

The study considers the potential ongoing cumulative impacts of coastal hazards on the Townsville regional community in Far North Queensland for both present extremes of climate and also projected changes in future climates up until the year 2100. This included the effects of ocean inundation from storm tide events (both tropical cyclone and non-cyclonic events) together with long-term sea level rise and consideration of likely coastal recession due to erosion over time. The study represents the first step in identifying potential practical coastal adaptation strategies to respond to existing and future threats from coastal hazards in the region; these being categorized nominally as either Defend, Retreat or Accommodate. The results are expected to be used for informing decision making in the preparation of the new Council planning scheme, infrastructure plan and asset management plan.

The results identified regions likely to be affected by high coastal hazards, assessed the vulnerability and risk to key Council and community assets, developed potential coastal adaptation options to mitigate the impact of these hazards and assessed the viability of adaptation options through stakeholder engagement and detailed economic assessments (costs and optimal timing). The study provided an assessment of over 150 separate potential adaptation options for 11 coastal districts.

The study was a pilot project funded by the Commonwealth Department of Climate Change and Energy Efficiency's Coastal Adaptation Pathways Program undertaken in collaboration with the Local Government Association of Queensland (LGAQ), the Queensland Government and Townsville City Council (TCC).



Piloting participatory media: a tool of empowerment for climatic-vulnerable communities

Poster only presentation

Session: Poster session

Time:



Usha Harris¹, Ulamila Kurai Wragg^{1,2}.

¹Macquarie University, NSW, Australia, ²Pacific Gender Climate Coalition, Rarotonga, Cook Islands.

Through a discussion of a participatory media training project this presentation explores how participatory media methodology can enable participants to better understand climate change impacts and risks through the process of message creation. The training was conducted with community facilitators who work with vulnerable communities in the frontline of climate change in the Pacific Islands. The facilitators were trained in the use of videos to produce stories exploring how climate change impacts on a community's everyday life and culture. Five group projects were completed on topics in which they had an interest or wanted to gain further knowledge. Climate Change Impacts in Namata Village Fiji, a six-minute video produced as part of the training will be screened as part of the presentation. Shot in the village of Namata, which is nestled amongst the mangroves along the winding Bau river in Fiji's Central Division, this short film captures the strong link between the villagers of Namata and the strategic location of the village, and how the rising tides are affecting the village way of life. You Tube link: http://www.youtube.com/watch?v=-mezyqw81EY



Known unknowns, unknown unknowns, and the design and timing of adaptation responses and interventions

Oral presentation

Session: Parallel session 7

Time: 3.45-4.00



Michael Harris¹

¹Australian Bureau of Agricultural and Resource Economics and Sciences, DAFF, Canberra ACT, Australia.

The impacts of climate change will manifest themselves in a number of ways, notably involving changes in risks and uncertainties. These will change the frequency and timing of particular events, with consequences for the extent of their impacts, such as more frequent storms and floods, and possibly longer droughts. To the extent scientific research is able to reliably inform us of how these changes are expected to occur, we have examples of "known unknowns"; risks where we have some ability to understand the shifting probabilities of occurrences. We may also face deep uncertainties around events where forecasting is highly unreliable; here we are in the realm of unknown unknowns, or events so unpredictable that our most reliable expectation is to be taken by surprise. Both the preferred design and timing of our responses to these situations will vary. With predictable events, it is likely to be preferable to bring forward our interventions - to be *anticipatory*. With unknown unknowns, the preferred approach is likely to be based on building resilience and adaptive capacity, delaying specific and costly interventions to allow time for learning - combining *resilience* with the *real options* approach. Both of these are consistent with a broad view of being *precautionary*.



Information systems and knowledge management: tools for adaptation

 $Speedtalk+Poster\ presentation$

Session: Poster session

Time:



Helen Hasan¹, Stephen Smith².

¹University of Wollongong, NSW, Australia, ²Macquarie University, NSW, Australia.

When allocating responsibility for human-induced climate change, we invariably turn to the rise in carbon emissions associated with activities of the Industrial Age. Since then the Information and Knowledge Ages have brought globalization and new activities whose impact on the environment is not clear. Certainly there are negative impacts from the manufacture and use of information and communications technologies (ICT), with estimates of 2-5% contribution to global carbon emissions.

The well-known efforts to mitigate these effects are called "Green IT". Less prominent are the roles of information and knowledge supporting mitigation and adaptation, however the emerging literature deals almost exclusively with the use of ICT for mitigation programs, such as Energy Informatics. There is little research on the production and use of information, as well as the generation and application of knowledge, in adaptation initiatives.

Climate change adaptation projects are heavily dependent on the information available to them and on the knowledge required to apply that information appropriately. While the data sets are huge, with unprecedented demands on data storage and processing power, the main challenge is the complexity of the information systems that integrate incompatible data structures and present information that is understandable and relevant for adaptation decision-making. These are issues that have concerned the field of knowledge management (KM) since the 1990s.

We present research that applies KM tools to guide information systems support for complex adaptation programs involving partnerships between government, business and community where information and decision-making is shared among the partners often via social media.



Will primary producers transform their industry in response to climate change?

Oral presentation

Session: Parallel session 30

Time: 2.00-2.15



Greg Hertzler¹, Todd Sanderson¹, Tim Capon², **Peter Hayman**³, Ross Kingwell⁴, Anthea McClintock⁵, Jason Crean⁵, Alan Randall¹.

¹The University of Sydney, NSW, Australia, ²CSIRO, ACT, Australia, ³SARDI, SA, Australia, ⁴DAFWA, WA, Australia, ⁵NSW T&I, NSW, Australia.

The ROADs (Real Options for Adaptive Decisions) framework is applied to assess whether farmers in wheat dominant agriculture will transform their industry. Transects across space were used as an analogue for climate change, with transects in New South Wales, South Australia and Western Australia selected for their sensitivity to climate change.

As climate becomes hotter and drier in South Australia and Goyder's line moves south, high quality cropping areas like Clare will become more like marginal cropping areas of Orroroo, and Orroroo will become more like ultra-marginal Hawker. The landscape will change as wheat becomes less dominant, merinos are adopted on more farms and some farms leave agriculture.

In WA, even though the impacts of climate change are expected to be severe and make the state much hotter and drier, wheat will continue to dominate agriculture in all agro-ecological zones, including high, medium and low rainfall zones. Sheep do not compete with wheat in any zone. Farmers will continue to choose wheat and will not transform agriculture in Western Australia in response to climate change.

In NSW, as climate changes, Cootamundra will switch to become more like Temora and manage the risks with a mixed cropping system. Temora may become more like Narrandera with the adoption of sheep. Narrandera is likely to adopt sheep only enterprises or abandon farming altogether.

Although stating the obvious, we reiterate that farmers' decisions are crucial in assessing the impacts of climate change.



Modelling the future, remembering the future, visiting the future and playing with the future; four complementary ways to communicate climate and adaptation options

Oral presentation

Session: Parallel session 25

Time: 11.00-11.15

Peter Hayman¹.

¹SARDI, Adelaide, Australia

Thinking about future climates is difficult and remains a significant challenge for adaptation planning. The most common approach is to access projections from global climate models. Adaptation decision makers in Australia have been well served by access to output from GCMs and the communication of the uncertainty by climate science. However, there is (and always will be) a mismatch between the level of information (spatial and temporal resolution and range of outcomes) that climate science can offer and adaptation practice wants.

This mismatch can lead to a search for a science offering more and more precision (which may be empty resolution), the choice of a single "best estimate", generic advice to plan for the worst and hope for the best or, an acceptance of a range of future climates, not all of which are equally likely.

The mismatch can also lead to a richer conversation about future climates that does not exclude projections but adds sensitivity analysis (how would the system cope with a 5%, 10%, 20% drying) and looks to temporal analogues (what worked in the recent drought or hot spell) and spatial analogues (how do people manage in a warmer drier environment than we are dealing with).

Each approach has strengths and weaknesses but these approaches can complement each other, especially when quantification is included. Examples will draw from agricultural and NRM decision making in South Australia.



Youth-centred participatory video as a tool for climate change adaptation and disaster risk reduction

Oral presentation

Session: Parallel session 25

Time: 12.00-12.15



Katharine Haynes¹, Thomas Tanner².

¹Risk Frontiers, Macquarie University, Sydney, NSW, Australia, ²Institute of Development Studies, Brighton, UK.

This presentation investigates the use of youth-centred participatory video as a tool for engaging and empowering young people in disaster risk reduction and climate change adaptation issues. Young people regularly face the greatest hurdle to get their voices heard, while research and practice in the disaster and climate change community commonly represents young people as passive victims requiring protection. Consequently, their capacities to inform the decision-making process, communicate risks to their communities and take direct action to reduce risks have been neglected.

The paper presents empirical data from participatory video methods with groups of young people in three communities in Eastern Samar, the Philippines. Producing these videos enabled groups to research, document and raise awareness of disaster risk, and to use screening events to mobilise and advocate for risk reduction measures for their communities.

The results suggest that participatory video process provided an effective tool to empower young people to raise important issues with decision makers and advocate change on behalf of their communities.



Indigenous experiences of Cyclone Tracy

Speedtalk+Poster presentation

Session: Speedtalk session 12

Time: 4.40-4.45



Katharine Haynes¹, Deanne Bird¹, Dean Carson^{2,3}, Steven Larkin².

¹Risk Frontiers, Macquarie University, Sydney, NSW, Australia, ²Charles Darwin University, Darwin, Australia, ³Flinders University, Adelaide, Australia.

Cyclone Tracy devastated Darwin early on Christmas morning in 1974, leaving only 6% of the city's housing habitable. The systematic failure of Darwin's building stock led to a humanitarian disaster that provided the impetus for an overhaul of building regulations and construction practices throughout Australia. Much has been written of the subsequent evacuation of Darwin and the societal impacts on the non-Indigenous population. Very little, however, has been documented concerning Indigenous experiences and learning from Cyclone Tracy. This project addresses this imbalance by examining how Indigenous communities in Darwin were impacted by, coped with and have since adapted to cyclone risks. The mixed methods approach involved interviews with Indigenous survivors and government workers at the time, examination of oral histories held at the NT archives office and analysis of demographic data. The project aimed to (1) examine how Cyclone Tracy and the destruction of Darwin impacted on Indigenous people (including social, cultural and personal impacts) and the Indigenous population as a whole and (2) develop a longitudinal understanding of Indigenous adaptive capacities in the face of change. The project provides opportunities for Indigenous people to contribute their knowledge and experiences to current risk management and future adaptation.



China's policy, legal and institutional framework on climate change adaptation: big progress?

Poster only presentation

Session: Poster session

Time:



Xiangbai He¹.

¹University of Western Sydney, Sydney, Australia

Both externally international factors and internalized needs contribute to the development of adaptation framework in China. At the international level, the active participation in international negotiations and the need to access adaptation funds has influenced China's domestic policy focus and institutional setting. At the domestic level, the economic and social loss due to climate change vulnerability stimulates China to establish a new adaptation framework through policies, legislation and institutional arrangements. An analysis of this framework reveals that: (1) China starts to transit from climate change policy-oriented response which is temporary and flexible to legislation-oriented response which is long lasting and institutionalized; (2) Local governments, especially those at provincial level, start to take some responsibilities in adapting to climate change; (3) Adaptation has been required to treat equally with mitigation and has been put on governments' agenda; (4) Private actors and the public start to involve in climate change adaptation issues. The progress made in adaptation shows that China has learned a lot from the adaptation theories and lessons developed primarily in western countries. However, a closer inspection of this framework reveals that its way of managing climate change adaptation has been entrenched in and shaped by China's mentality, path and approach of dealing with economic development and environmental protection.



Assisting local governments to decide on adaptation actions using the CATLoG Tool (Climate Adaptation decision support Tool for Local Governments)

Oral presentation

Session: Parallel session 18

Time: 3.00-3.15



Ann Henderson-Sellers¹, Stefan Trueck¹, Supriya Mathew¹, Ros Taplin², Tim Keighley¹, WoonChoo Chin¹, Jenny Scott³, Louise Pilkington⁴.

¹Macquarie University, Sydney, NSW, Australia, ²University of New South Wales, Sydney, NSW, Australia, ³Ku-ring-gai Council, Sydney, NSW, Australia, ⁴Gosford Council, Sydney, NSW, Australia.

Climate change is clearly evident in the form of increasing atmospheric temperatures. Warming atmospheres are likely to result in the occurrence of more frequent and intense extreme weather events across locations. Local governments will thus have to prepare their communities to face the damages due to extreme events. Despite the need to adapt, decisions on appropriate adaptation responses are slow because extreme event analyses and predictions are complicated by: limited data characteristic of low frequency events, and many future climatic and non-climatic uncertainties. Currently available climate projections especially for extreme events at local scales are associated with a wide range of uncertainties. Apart from that, analysis and damage assessment of the extremes over a period of time also involves many uncertainties related to economic factors (e.g. discount rate, growth rate) and the unknown future. The CATLoG (Climate Adaptation decision-support Tool for Local Governments) has been developed by researchers from Macquarie University and University of New South Wales (funded by NCCARF). The tool aims to equip end users with a better understanding of the range of uncertainties surrounding the evaluation of catastrophic and climate impacted events. It further aims to provide stakeholders with an opportunity to better prepare for extreme events in a less predictable, complex world. The tool uses a combination of quantitative (Cost-Benefit Analysis and Bayesian inference) and qualitative (Multi-Criteria Analysis) methods to develop a decision-making support framework. The tool also allows users to conduct sensitivity tests to examine the effects of uncertain climatic and economic variables.



Adaptive management planning for turtles on Raine Island changed the way we think

Oral presentation

Session: Parallel session 24

Time: 11.30-11.45



John Hicks¹

¹GBRMPA, Townsville, Australia

Five years ago the managers of Raine Island, the largest green turtle rookery in the world, found themselves at a crossroad. Nesting of green turtles has been monitored on the island for the last 40 years. Over the last 15 years a concerning downward trend in recruitment has been detected. Additional concerns about climate change spurred action. Managers decided that a change from business as usual was required and an adaptive management plan for Raine Island was developed. The process of getting to an agreed plan was challenging, but valuable. It exposed people to new techniques and considerations. People began to think differently about management approaches and how these might need to change and respond as climate change continues to unfold.

The plan includes a greatly increased focus on both monitoring and on-ground actions to minimise adult turtle deaths and boost nesting and hatching success. Successful on-ground actions to date include: the installation of 200m of barrier fencing along the top of rock ledges to prevent mature nesting females turtles (the most valuable age class) tipping over; the blocking of crevices under rock cliffs and the filling of beach rock cavities that trap nesting turtles; and the installation of remote monitoring devices to accurately measure sea level, tidal movements and water table fluctuations. While it is early days, the results of the trials on Raine Island are providing encouraging signs that local management actions can help reduce the vulnerability of species and habitats to climate change.



Climate adaptation practices: achieving spatial climate and environmental justice in Australian communities

Speedtalk+Poster presentation

Session: Speedtalk session 1

Time: 4.55-5.00



Jean Hillier¹, Diana MacCallum³, Wendy Steele², Jason Byrne², Donna Houston⁴.

¹RMIT, Melbourne, Australia, ²Griffith University, Brisbane, Australia, ³Curtin University, Perth, Australia, ⁴Macquarie University, Sydney, Australia.

Australian local government authorities' Climate Adaptation Strategies or Plans have become locked into a particular model of risk assessment, policy formulation, and technical response in how they respond to global environmental change – in particular climate change. This model actually constrains the ability of actors at the local level to respond in context-sensitive ways, because it straightjackets their thinking about alternative ways of doing things. The model also tends to exclude social and ecological concerns and impacts, potentially leading to inequitable outcomes. There is a growing number of researchers calling for more research on community-based adaptation, identified as a particularly neglected research area (Adger et al, 2007; Moser, 2010; Pahl-Wostl et al, 2012). This paper takes a 'practice approach' to understanding the potentials for actors at the local level to effect appropriate locally adaptive responses to change. We are especially interested in the nexus between environmental and social concerns. Building on the emerging work around climate justice we ask questions about how practices associated with climate adaptation policy responses shape lived outcomes in Australian communities. These questions include: which and whose concerns, knowledge, skills, tacit understandings, dominate action? Who benefits, and who and what get left behind? How do and might actors 'go round the back' of local institutions in search of social or environmental justice and how might such practices be incorporated in climate adaptation processes?



Capacity building adaptation tools: the Climate Adaptation Knowledge Exchange and the Adaptation Marketplace

Oral presentation

Session: Parallel session 11

Time: 2.15-2.30



Lara Hansen¹, **Jessica Hitt**¹, Alessandra Score¹.

¹EcoAdapt, Bainbridge Island, WA, USA.

While many researchers, conservation practitioners, and resource managers understand the reality of climate change, they are often still challenged by what to do about it. As a result, the conservation community needs assistance in developing its thinking on dealing with climate change, finding the information or data it needs to make informed decisions, and finding people to interact with on this topic as individuals develop their own approaches. Money is often used as an excuse for not taking on the issue of climate change in planning and management, or becomes a showstopper in the middle of the process. We will introduce two essential online tools to help build capacity, understanding, and promote funding for adaptation; the Climate Adaptation Knowledge Exchange (CAKE; cakex.org), which can help support practitioners' efforts and the Adaptation Marketplace (adaptationmarketplace.org), which links projects to available funders. In this session, participants will explore adaptation and resilience strategies for incorporation in their own work through presentation of case studies, exploration of CAKE, and discussion of personal experiences. The Coral Triangle Adaptation Marketplace will also be discussed, providing participants with a framework of connecting investors with project implementers according to matchmaking criteria in an interactive and supported forum, thus increasing the numbers of adaptation initiative. These two essential online tools if used will help build capacity, understanding, and promote adaptation.



Prioritization tools for evaluating adaptation options for seabirds and marine mammals

Oral presentation

Session: Parallel session 26

Time: 12.15-12.30



Alistair Hobday¹, Lynda Chambers², John Arnould³, Toby Patterson¹.

¹CSIRO Climate Adaptation Flagship, Hobart, Australia, ²Centre for Australian Weather and Climate Research, Melbourne, Australia, ³Deakin University, Melbourne, Australia.

Iconic and protected Australian seabirds and marine mammals are impacted by climate change. This Marine NARP project developed taxa-specific adaptation options in response to climate impact scenarios based on the IPCC vulnerability framework. Under this framework, climate change vulnerability can be reduced by adaptation options that (i) reduce exposure of individuals to physical changes, (ii) reduce sensitivity of individuals to physical changes, or (iii) increase adaptive capacity of individual/species to cope with the climate change. We evaluated a range of options in each vulnerability category with three new screening tools. These tools were designed to evaluate (i) technical aspects (cost-benefit-risk, CBR), (ii) institutional barriers, and (iii) potential social acceptability. The CBR tool identified which adaptation options were high cost and low benefit and so might be discarded, and which were high benefit and low cost and might be rapidly implemented (depending on risk). The second evaluation tool was based on the conceptual framework on barriers to effective climate adaptation developed by Moser and Ekstrom (2010) to identify where barriers may exist, and thus leads to strategies for overcoming them. Finally, adaptation options may not be acceptable to society at large, or may be resisted by vocal opponents or groups. The third tool to assess social license identified potentially contested options - useful to managers charged with implementation. Scores from each tool allowed relative "ranking" for the suite of adaptation options. This approach will be useful for a wide range of adaptation strategies both for biodiversity and other sectors.



From fish to dish – future opportunities for Australian fisheries and aquaculture

Oral presentation

Session: Parallel session 17

Time: 4.00-4.15



Alistair Hobday¹, Rodrigo Bustante², Linda Thomas¹, Ana Norman-Lopez², Anna Farmery³, Aysha Fleming¹, Bridget Green³, Eva Plaganyi², Gretta Pecl³, Ingrid van Putten¹, Lilly Lim-Camacho², Olivier Thebaud³, Sarah Jennings³, Sean Pascoe², Stewart Frusher³, Eriko Hoshino³, Peggy Schrobback².

¹CSIRO Climate Adaptation Flagship, Hobart, Australia, ²CSIRO Climate Adaptation Flagship, Brisbane, Australia, ³University of Tasmania, Hobart, Australia.

Climatic changes in the marine environment are occurring around Australia. These changes impact the distribution and availability of fish and together with a growing population and increased demand for seafood, it is clear that adaptation across fishery supply chains is needed. In this marine NARP project we take this broader perspective to ensure that opportunities across the chain are recognized. We modelled supply chains for seven fisheries and aquaculture business and explored opportunities and weaknesses. This multi-disciplinary team developed holistic solutions and participatory approaches with stakeholders, guided by findings from different analytical tools, including life cycle assessment, market demand and integration, and network analysis. While Australian supply chains vary widely, from direct sales to the consumer or via multiple processing and transport steps to both national and international markets, commonalities do exist, as well as industry-specific issues and opportunities. In interviews, both climate and non-climate issues were highlighted and participants identified that more collaboration is needed to produce better marketing strategies, raise awareness of sustainable practices and combat product substitution. A particular focus highlighted for policy development was the need to simplify complex or outdated regulations that may contradict current industry priorities, such as improving efficiency. We found that climate change impacts are well understood at the harvest stage, yet are not a strong driver for change higher up the chain, despite evidence for potential impacts and disruption to supply chains. Holistic adaptation planning along the supply chain, underpinned by targeted information and policy for the nonharvest elements, is needed.



Governance dimensions of key Great Barrier Reef issues under climate change - A Whitsunday case study

Oral

Session: Parallel session 31

Time: 1.30-1.45



¹Marc Hockings, ²Julie Davidson, ²Marcus Haward, ²Michael Lockwood, ²Lorne Kriwoken

¹The University of Queensland, Brisbane, Australia, ²University of Tasmania, Tasmania, Australia

The 2009 Outlook Report for the Great Barrier Reef Marine Park identified climate change as the most serious long-term threat to the health of the Great Barrier Reef (GBR). Despite the values and threats to the reef related to climate change being well understood, and good planning processes established by the Great Barrier Reef Marine Park Authority (GBRMPA), the likely outcomes for the reef were nevertheless poor. GBRMPA's response was to maximise resilience of the system by reducing other stressors such as increased sediments and nutrients to provide the best chance of improving outcomes. Most of these other stressors arise from management of the adjacent coastal zone where the capacity of GBRMPA to reduce these stressors depends on governance arrangements where responsibility lies primarily at State and local levels. The Outlook Report identified the lack of effective governance for mitigating and adapting to climate change as a deficiency, particularly a lack of consistency in coastal planning to manage land-based impacts on the GBR. While shared governance arrangements in the marine area between the Commonwealth and State governments have withstood many tests over nearly four decades, and many of the elements required for an adaptive governance arrangement to address climate changes impacts are in place, extension of this shared governance approach to management of key coastal impacts is likely to be difficult. We present the outcomes of a scenario approach that developed narratives of possible biodiversity outcomes for the Whitsundays if current governance and management arrangements are not reformed. These show that reform of management arrangements for the terrestrial/marine and coastal interface is essential to building GBR system resilience.



climateadaptation knowledge + partnerships

Staying afloat with CRATER: a decision making tool for mine management under extreme climatic events

Speedtalk+Poster presentation

Session: Speedtalk session 10

Time:4.45-4.50



Jane Hodgkinson¹, Micaela Grigorescu^{1,2}, Habib Alehossein¹.

¹CSIRO, Brisbane, Australia, ²Queensland Government, DNRM, Brisbane, Australia.

We have developed a framework that uses pre-existing data to decrease climate related vulnerabilities to avoid or minimise risk to infrastructure, people, downtime, environment and revenue. The CRATER ('Climate Related Adaptation from Terrain Evaluation Results') method was tested at a coal mine and provides quantitative information that can assist decision makers when designating investment for adaptation options for climate related vulnerability reduction. The 3 step approach performs (i) multicriteria evaluation on pre-existing data within a geographic information system (GIS) to rank the natural conditions at the mine, such as drainage, slope, soil and vegetation; (ii) 'fault tree analysis' to assess how climate impact can occur and how it can be reduced; and (iii) resource assessment of the mine's capacity to adapt using the '5-capitals analysis' method. The GIS step provides the mine with a spatial analysis tool to inform fault tree analysis that can identify adaptation options to reduce vulnerability. The adaptation options can be compared with one another using the adaptive capacity assessment to select the most achievable and most appropriate option based on the mine's capacity to adapt. Additionally, CRATER can be used for 'what-if' scenarios to identify the suitability of locations for placing future roads, buildings or other critical infrastructure. The methodology is transferrable to any mine, series of mines or location along the mining value chain that has sufficient data, providing a practical decision making tool to identify 'no-regrets' actions that could enhance production between extreme events as well as reduce downtime after an event.



Living architecture techniques to reduce building energy consumption and create a better urban micro climate

Oral presentation

Session: Parallel session 9

Time: 1.29-1.41



Graeme Hopkins¹

¹Fifth Creek Studio, Adelaide, Australia

This presentation demonstrates how living architecture: green roofs and walls, can be used strategically to make considerable energy and GHG emissions savings.

Two experimental projects financed by the SA Government's Building Innovation Fund and private developer Aspen Development were constructed under real life conditions and monitored for 12 months to provide data to be compared with control data of existing buildings. These two projects were: a series of green roof plots of varying substrate depth located on the 22^{nd} level roof of a city building, and a prototype hybrid living wall constructed over 3 floors in height. This living wall was designed for multi-storey application.

At the completion of the monitoring period the living wall was relocated onto the adjacent completed Tower 8 office building to demonstrate how this living wall construction can be retro-fitted or assembled onto a new building with fully mature plants in situ.

The collected data was used in the respective NABERS modelling for the two buildings, and results demonstrate how this green technology reduces energy consumption of the building. Also, the data provides valuable information on how to innovatively manage heat loadings during the day to conserve heating and cooling energy.

An important development was the formulation of an insulation design tool for various green roof profiles suitable for Adelaide's hot, dry climate. A further by-product of this research shows how living architecture techniques reduce CO_2 levels and ambient air temperatures to the surrounding urban canyon, thus modifying the urban micro climate of the public realm to produce a more liveable city environment.



'Climate-smart' development: does the vulnerability measurement for coastal people matter?

Oral presentation

Session: Poster session

Time:



Moazzem Hossain¹, Eliyathamby Selvanathan¹.

¹Griffith University, Nathan, QLD, Australia

In its last global report (Fourth Assessment, 2007), the Intergovernmental Panel on Climate Change (IPCC), predicts that the global average temperature will rise between 1.1 to 6.4° Celsius by 2100. A recent study by the World Bank (2012) emphasises that it is essential to outline a range of risks focusing on developing countries and especially the poor, associated with a 4° Celsius warming within this century as against 6° Celsius predicted by the IPCC (2007). In view of the above, it is now widely recognised that the coastal regions of the world would suffer heavily both in economic and social terms from frequent climatic hazards due to the direct impact of global warming and rising sea level.

The major aims of this study, therefore, are: to investigate the types of adaptation strategy needed to overcome the economic and social devastation from frequent and extreme climatic hazards locally; and, to measure the socio-economic vulnerability of a frontline region (in this case the Bay of Bengal delta covering eastern India and Bangladesh) for policy purposes.

The paper focuses on the following specific aims:

- 1. to investigate what levels of awareness, resilience and resistance exist among the victims who are considered vulnerable in the study region; and,
- 2. to explore how to make the vulnerability measures proposed in the present study robust out of a primary survey out of data from two villages located in both sides of the Sundarbons. Measurement of vulnerability is essential for making the adaptation policies at local and national level.



Auatralia has three and a half levels of government!

Oral presentation

Session: Parallel session 28

Time: 11.00-11.15



Greg Hunt¹.

¹South East Councils Climate Change Alliance, Victoria, Australia

Climate change response is often much more in evidence at the local government level than at state and/or national levels. Local governments are highly responsive to their communities, they have feedback loops between action and response that are almost immediate. But councils often work better within their municipal boundaries than more broadly, even when the issue they are working on is felt regionally. Enter the half level of government!

Local governments working together in groupings based around identity, geography or community can attain the critical mass to conduct research, implement projects and provide services that would not otherwise be possible.

Victoria's nine greenhouse alliances are successful examples of adjacent councils working in collaboration on climate change response. These alliances are more than just occasional meetings of interested councils though - they are formal entities of a varying number of councils with strong governance, mature strategies for dealing with diversity and a range of ways of working to respond to the breadth and depth of the climate change challenge.

Regional groupings of councils can present all the benefits of local action yet not suffer the distance that often characterises state government action. They show that it is possible to build action on local knowledge without falling prey to parochialism.

In this paper, models of governance and operations for regional alliances will be presented and discussed. The benefits of working regionally will be analysed through case studies of successful programs and projects.



Living with floods: key lessons from Australian flood reviews, the Netherlands, China and the USA

Oral presentation

Session: Parallel session 32

Time: 2.45-3.00



Karen Hussey¹

¹Australian National University, Canberra, Australia

2010-2011 saw some of the biggest flood events in Australia's history, with approximately 80% of Queensland declared a disaster zone and extensive flooding in other eastern states, notably Victoria. The large scale of events, the number of lives lost and the scale of the damage incurred prompted numerous inquiries and review processes by different governments and organizations. As climate change is expected to increase the severity and likelihood of flooding events in the future, a project was developed and funded by the National Climate Change Adaptation Research Facility (NCCARF) to analyse these reviews and determine if they offered any lessons for climate change adaptation. The project focused on four recent reviews from Queensland and Victoria.

The project compared Australia's review processes and findings with similar processes from the Netherlands, China and the USA to determine points of similarity that reinforced Australian findings and to explore differences.

This presentation will highlight some of the major findings of the reviews. It will draw some conclusions as to where Australia is innovating when it comes to future flood management and where reforms are needed, particularly with respect to land use planning, structural versus non-structural measures, the role of disaster relief funds, flood insurance, and relocation.



Climate risk and adaptation assessment in city, case study Palembang City, Indonesia

Oral presentation

Session: Parallel session 15

Time: 3.45-4.00



Reini Silvia Ilmiaty¹, Budhi Setiawan^{1,2}, Norma Puspita³.

¹Sriwijaya University, Palembang, South Sumatera, Indonesia, ²Secretariat for Climate Change Resilience - Bappenas, Jakarta, Indonesia, ³Secretariat for Regional Climate Change Resilience - Bappeda Sumsel, Palembang, South Sumatera, Indonesia.

A 3-step approach has been taken to develop a tool to reduce the impact of climate change through important adaptation considerations in the management of flood risks in Climate Risk and Adaptation Assessment (CRAA). The approach is based on anthropogenic disaster risk management with the steps as follows: (1) the result climate model i.e. variability of rainfall as input in flood hazard modeling both in (a) baseline condition that deal with everyday rainfall-runoff events and (b) projection conditions that deal with extreme event in the future, (2) deal with 'flood risk model' as result of impact both hazard and vulnerability to develop strategies to reduce the risk of climate change, and (3) use countermeasures to manage residual risk by mainstreaming into spatial planing both in urban and rural area through focus group discussions between experts, policy makers and other stakeholders. Traditionally, drainage systems have been designed as separate entities to the general urban surface and have concentrated on design events (1a, above), neglecting opportunities provided by the effective management of smaller storms for e.g. aesthetic and amenity purposes in urban areas. CRAA, by managing these events collectively in combination with the others, drainage systems can be more effective in reducing of flood risk in lowland area. In this paper it is shown how CRAA can be used in adaptation strategies in Palembang City as a lowland city in South Sumatera Province.



The productivity trajectories and components of broadacre farms adapting to a warming, drying climate

Oral presentation

Session: Parallel session 30

Time: 2.30-2.45



Nazrul Islam^{1,2}, Ross Kingwell^{3,4}, Vilaphonh Xayavong¹, Lucy Anderton¹, David Feldman¹.

¹Department of Agriculture and Food, WA, South Perth, WA, Australia, ²Curtin University, Bentley, WA, Australia, ³University of Western Australia, Crawley, WA, Australia, ⁴Australian Export Grains Innovation Centre, South Perth, WA, Australia.

We examine the productivity trends and productivity components of 223 broadacre farms over the period 2002 to 2011. A multiplicatively complete Färe-Primont index number is used in applying Data Envelopment Analysis (DEA) to the farm data for productivity assessment. The results reveal pronounced variability in the annual productivity of these farms. According to the geometric mean of their total factor productivity and the variance of this productivity the farms were classified into four groups and then the relationship between the volatility of productivity growth and farm business characteristics was investigated to identify the drivers of productivity growth. Key findings are that, farms experienced a warming, a drying trend in the climate, the total factor productivity of most farms improved. The principal cause of this improvement was greater technical efficiency rather than technical change. Farms that experienced the highest growth in their total factor productivity often were from lower rainfall regions. They typically increased their farm size, became more crop dominant, generated more profit, were less exposed to debt and generated more crop yield and more livestock income per millimetre (mm) of growing season rainfall.



(In)Consideration of climate change and human health in local government planting and weed management policy

Oral presentation

Session: Parallel session 28

Time: 11.30-11.45



Paul Beggs¹, **Alison Jaggard**¹.

¹Macquarie University, Sydney, New South Wales, Australia

The impacts of climate change on aeroallergens such as pollen and resulting adverse impacts on allergic diseases such as asthma are now widely and internationally acknowledged. As part of a 2012-2013 New South Wales (NSW) Environmental Trust funded project which is examining adaptation for aeroallergens and allergic diseases at the local and state government levels in NSW's urban areas, the completed research presented here aimed to assess the extent to which climate change and human health are considered in local government planting and weed management policy. All 59 local governments in the Hunter, Sydney, and Illawarra regions were studied. A total of 64 documents were analysed, including 16 Council Street Tree Master Plans and 48 Council Development Control Plans. The analysis shows that these important planning documents rarely consider climate change or human health, let alone both together. Only about 25% of the Street Tree Master Plans mentioned "climate change" in any way, just over 10% mentioned "impacts" of climate change, and none mentioned adaptation. Even fewer of the Development Control Plans mentioned climate change and climate change impacts, although 1 of the 68 mentioned adaptation. The implications of these results are considerable. They suggest that despite visible climate change action by local government in some respects, there remain very concerning policy voids regarding both climate change and human health.



Assessing climate change vulnerability and resilience in a commercial property portfolio

Oral presentation

Session: Parallel session 30

Time: 2.15-2.30



Greg Johnson¹

¹Stockland, Sydney, NSW, Australia

Climate science tells us that the future will be warmer, sea levels will rise and extremes of weather will be less predictable. What does this mean for the built environment? Shopping centres are places of trade, entertainment and are social hubs for the community. They can also be places of refuge from heat and cold, facilities used for evacuation and their resilience to climate change is important to business continuity for retailers. Many buildings do not cope well with the forces of nature now. How will they cope if it is predicted that there will be more days over 35 degrees and more rain events over 150 mm?

Stockland has been working with consultants Manidis Roberts to develop a methodology that can help assess the vulnerability and resilience of its buildings and has been conducting assessments of its commercial property and retirement living portfolio over the last 18 months. Focusing on shopping centres and armed with an understanding of the climate predictions for regions where it has a presence, Stockland can determine how it may be impacted by changing climate conditions and implement short and long term actions to improve the resilience of its portfolio.

In this presentation, Greg Johnson, Environmental Sustainability Manager, Stockland will provide an overview of the methodology used to determine vulnerability and resilience and give examples of what was found across Stockland's shopping centre portfolio.



Adaptation and risk culture in private vs listed companies

Speedtalk+Poster presentation

Session: Speedtalk session 9

Time: 4.45-4.50



Gareth Johnston¹, Jules Livingstone¹.

¹Complexitas, Sydney, Australia

Building on findings from the NCCARF funded "Climate in the Boardroom" project, Johnston and Livingstone contrast the treatment of adaptation by large private and large listed companies. Based on field based research, literature reviews and reviews of company disclosures, the authors suggest that current governance approaches continue to impede action on climate adaptation. Private companies appear to be more effective and the authors present a number of findings and areas for further research.



climateadaptation knowledge + partnerships

"Climate in the Boardroom": Reporting on the NCCARF Funded Synthesis Research Project

Speedtalk+Poster presentation

Session: Speedtalk session 7

Time: 5.00-5.05



Gareth Johnston^{1,5}, Donovan Burton², Peter Best³, Mark Baker-Jones⁴.

¹Future Ready, Sydney, Australia, ²Climate Planning, Brisbane, Australia, ³Cindual, Brisbane, Australia, ⁴DLAPiper, Brisbane, Australia, ⁵Complexitas, Sydney, Australia.

Following the year long project a number of barriers and opportunities have been identified related to corporate adaptation action. Despite significant awareness of mitigation, little or no adaptation action is being taken by Australian companies surveyed in contrast to trans-nationals and multi-nationals. Some of these findings should inform adaptation science, enable better decision making at a company level and suggest areas for further investigation by policy makers, regulators, corporate leaders and adaptation researchers.



Trusted Information Sharing Networks for Adaptation

Speedtalk+Poster presentation

Session: Poster session

Time:



Gareth Johnston¹, Jeremy Mansfield².

¹Complexitas, Sydney, Australia, ²Green Cross, Brisbane, Australia.

Networks play a strong role in connecting communities of practice, sharing knowledge + providing fertile ground for policymakers, scientists and practitioners. Evidence from research together with anecdotal reports suggest that industry peak body groups are not fully engaged or may even be opposing adaptation policy.

The authors suggest that new networks need to and will emerge to connect industry to the broader adaptation community and enable their critical role in delivering adaptation action.



Valuing adaptation under rapid change: anticipatory adjustments, maladaptation and transformation - project wrap

Oral presentation

Session: Parallel session 23

Time: 11.45-12.00



Roger Jones¹, Celeste Young¹, John Handmer², Adriana Keating², Peter Sheehan¹.

¹Victoria University, Melbourne, Victoria, Australia, ²RMIT University, Melbourne, Victoria, Australia.

The value of planned adaptation is how much the adaptation deficit - values at risk from climate impacts can be feasibly reduced over a given time period, less the cost of intervention. Values at risk include monetary, social and environmental values. Scientific descriptions of gradual climate change had led to a gradualist adaptation narrative, where the economic benefits of adaptation are assumed to accrue incrementally over time, discounted against an initial outlay. This is a risky assumption. Both climate and economy are subject to rapid changes that will escalate the costs of changing extreme events, so actions based on gradualism are liable to fail.

The project articulates the following conclusions: the costs of climate change will be dominated by non-linear changes in extremes; this will require greater attention from policymakers as markets are largely unprepared for such changes; greater investments in the next few decades than currently being planned are justified; disaster economics - addressing disaster risk reduction, resilience and planned transformation - are useful for managing rapid change; the risks of rapid changes in extremes are best mapped at the institutional scale to identify gaps and allocate roles for risk governance; innovation frameworks are suited to managing planned transformation by crafting an orderly transition; and adaptive management that combines narratives - scientific, economic, collaborative and practice-based - with monitoring and evaluation is best placed to manage rapid change.



The scientific and economic origins of the gradualist adaptation narrative and how to move beyond it

Oral presentation

Session: Speedtalk session 5

Time: 4.40-4.45



Roger Jones¹

¹Victoria University, Melbourne, Victoria, Australia

This presentation describes how scientific narratives of climate change influence gradualist adaptation narratives, their origin, and how they process information and influence communication, thus delaying action. The scientific enlightenment of 17th and 18th century Europe imposed the values of balance and order onto the physical measurement of observable phenomena, including heat balance and national economic accounts. Climatic averages were calculated from stochastic variability, and climate-environment relationships assumed to move gradually towards equilibrium. As our physical understanding of climate and its impacts has improved, these embedded values have retained significant explanatory power. They represent the first law of thermodynamics, governing heat balance; if Earth's radiative forcing is increased, the atmosphere gradually moves towards equilibrium, initially mixing heat into the ocean, then re-emitting it into the atmosphere. The signal to noise model of climate change, climate model skill and forecasting all reflect these values. The second law of thermodynamics, describing the disordered process of how that heat is distributed throughout the climate system, dominates how climate extremes change. Steps, shifts and hiatus periods driving climate extremes dominate the economic impacts of climate change. Peoples' observations - 'no warming since 1998', also clash with the gradualist narrative. Scientific and economic narratives need to properly reflect theory and observation. Model skill needs to be measured according to the ability to reproduce non-linear behaviour. Scenarios representing shocks, anticipatory and resilient responses need to be widely applied. Decision-making processes need to incorporate non-linear behaviour, promoting robustness and resilience, rather than being constrained by outdated cultural ideals.



Baseline survey on risk reduction and adaptive measures in the context of climate change impact on health sector in Bangladesh

Oral presentation

Session: Parallel session 27

Time: 11.30-11.45



Md. Iqbal Kabir^{1,2}, Abul Hasnat Milton¹, Md Bayzidur Rahman³, Wayne Smith¹.

¹Universitry of Newcastle, Newcastle, NSW, Australia, ²Climate Change and Health Promotion Unit, Ministry of Health and Family Welafre, Dhaka, Bangladesh, ³University of New South Wales, Sydney, Australia.

The survey was jointly conducted by the Climate Change and Health Promotion Unit of the Ministry of Health and Family Welfare, Bangladesh and The University of Newcastle, Australia. The Specific Objective of the study was to collect community based data on peoples' perception, magnitude of climate sensitive diseases and health systems response to climate variability and change.

The cross sectional study was carried out in purposively selected seven cyclone, flood and salinity prone most vulnerable coastal districts of Bangladesh with total population 19,228,598. Randomly selected 4 upazilas (sub-district) from each district, i.e. 28 Upazilla and 4 unions per upazila, a total of 112 unions & 2 villages from each union i.e. 224 Villages, 30 households from each selected village, thus a total of 6720 households were surveyed in rural areas.

The study revealed that Bangladesh is not yet ready to face the health risk of the impact of climate change; particularly in the coastal vulnerable population. 46% people didn't hear about climate change (P<0.001), 45% people became homeless with a mean duration of 38 days due to extreme weather events. 40% of the population was homeless for two times and 20% for more than two times. 97.8% people think their health care expenditure increased after the extreme events. Age, educational qualification, monthly income and occupation were significantly associated with the knowledge of climate change (P<0.001). The baseline morbidity and mortality of diarrhea (31.4%), dengue (0.51%), pneumonia(23.8%) malaria (4.4%), drowning (1.7%), snake bite (3.1%) and childhood malnutrition were significant.



A decade of climate change and marine fisheries: assessing the catchment volume in Peninsular Malaysia

Poster only presentation

Session: Poster session

Time:



Abu Hena Mustafa Kamal¹, Johan Ismail¹.

¹Universiti Putra Malaysia Campus Bintulu Sarawak, Bintulu, Malaysia.

Global climate change variations over the past 30 years have produced numerous impacts in the abundance and production performance of marine fish and fisheries worldwide. The consequences in terms of flooding of low-lying estuarine habitats due to over rainfall, fluctuation of temperature, dilution of water parameters, devastation of feeding and breeding habitats, salinity fluctuations and acidification of waters, high siltation in coastal area, changes in the sea water table and breeding triggers have raised serious concerns for the well-being of marine fisheries and their production. This study shows that the overall total catchment of marine fisheries decreased 38% in 2009 compared to 1998 while considering the fishing gears and vessels number used in Peninsular Malaysia. Registered vessels number increased up to 92% in 2009 compared to 1998 which eventually increased the total catchment volume of marine fisheries. In 2009, the catching efforts and performance was very low as per vessels compared to 1998. Analysis of climate change variables shows that temperature decreased as rainfall increased within the year from 1998 to 2009. However, it is still too early to conclude whether climate change variables could have unpleasant impacts on fish production in the tropical seas like Malaysia. In spite of this it is predicted that the prolonged existence of monsoons and increases of rainfall in this area results in stresses and sometimes interference on the habitat, reproductive cycle and their related ecosystems in this coastal marine environment in tropics.



An inconvenient curve – moving beyond the mean in adaptation economics

Oral presentation

Session: Parallel session 23

Time: 12.00-12.15



Adriana Keating¹, John Handmer¹, Roger Jones², Celeste Young².

¹RMIT University, Melbourne, VIC, Australia, ²Victoria University, Melbourne, VIC, Australia.

Ideas of adaptation to climate change generally assume that both the impacts of climate change and adaptation to these impacts will happen smoothly and gradually. Gradualism is analytically convenient, but change is manifest through sudden events. Most economic and policy analyses are not suited to accommodating abrupt, non-linear and non-marginal change. We compare the outcomes of standard linear modelling with step-change modelling, with three examples – heatwave deaths in Melbourne, the costs of climate change impacts to the Victorian agricultural and timber industries. Focusing on sudden change has significant impacts on total cost estimates and the distribution of those costs over time. We draw on the field of disaster economics to help with the analysis of sudden change, and with factoring in the issues of maladaptation and transformation.

Using the results of our modelling, coupled with theory and examples from the disasters field, we explore how the narrative of gradualism may engender maladaptation through the application of traditional economic tools. This research calls into question the assumptions and modelling underlying dominant adaptation economics and its resulting policy implications, in Australia. We identify a need for deliberately transformative adaptation policy and draw lessons from the disasters field for transformation economics.



Climate change vulnerability assessment of selected council buildings

Oral presentation

Session: Speedtalk session 2

Time: 4.50-4.55



Gerard Healey¹, **Svenja Keele**¹, Ian Barnes².

¹Arup, Melbourne, Australia, ²City of Whitehorse, Melbourne, Australia.

There is increasingly widespread recognition amongst governments, the private sector and academia that current built environments will have to evolve in response to the unavoidable impacts of human-induced climate change. This requires new approaches to understand the impacts on the built to identify and prioritise upgrades, and develop new design standards for future development. Both nationally and internationally, a number of different approaches have been trialled but no protocol is yet widely established.

The City of Whitehorse and Arup developed an approach and piloted on 15 buildings for assessing vulnerability of buildings to climate change, and then prepared recommendations for adaptation, both specific to the pilot buildings and generally for the capital works and asset management program. Project involved a literature review to validate the vulnerability methodology, identify the impact pathways of 6 climatic events and trends on buildings and collate potential adaptation measures. The components of a building were divided by engineering discipline and criteria developed to evaluate exposure and sensitivity of each component to the 6 climatic trends and events to define potential for disruption, damage or failure of a building component. Adaptive capacity was defined in terms of the capacity of building use to accommodate the disruption, in particular when considering emergency relief buildings.

Vulnerability was determined for each building component and adaptation measures proposed. The pilot determined that most vulnerabilities can be addressed as part of normal asset management and capital works program, and in response a set of design guidelines were prepared for future climate.



Applying Bayesian inference to analyse extreme events with limited historical observations

Oral presentation

Session: Speedtalk session 2

Time: 4.50-4.55



Supriya Mathew¹, Stefan Trueck¹, Ann Henderson-Sellers¹, Ros Taplin², **Tim Keighly**¹

¹Macquarie University, Australia, ²University of New South Wales, Australia

Analysis of extreme events is challenging, but important, as occurrences of such events are usually associated with high damage. In general, frequency of extremes are modelled using Poisson distributions while damage is modelled using heavy-tailed distributions or distributions that allow for extreme outcomes such as the Gumbel, Frechet, Weibull and Pareto distributions. These distributions are widely used to fit damage data and help to better represent the tails of the distribution. There are certain specific contexts (e.g. local studies, extremely rare events) where data available may not be sufficient to fit a distribution or derive parameter values for the frequency or damage distributions. This paper discusses such circumstances and examines the potentials of using Bayesian estimation a method that combines expert judgements with existing historical data to analyse extreme events to obtain values of the distribution parameter.



Collective behavioral change: the fourth pillar of climate change mitigation

Either presentation

Session: Speedtalk session 12

Time: 5.15-5.20



Rajab Khalilpour¹, Faezeh Karimi¹.

¹The University of Sydney, Sydney, NSW, Australia

The paradox of our time is that we require more energy for development, yet the greenhouse gases (GHGs) generated from the energy sources have the potential to ruin our society. The sustainable energy policy for solving this problem has three pillars: (1) efficiency improvement, (2) development of relatively clean energy sources (renewable, biofuel and nuclear), and (3) capturing and storing CO_2 emissions. This paper firstly investigates each of these options and discusses their pros and cons in the endeavor to analyze the reason for unsuccessful climate change mitigation negotiations, and secondly it investigates the possibility of achieving the goal of capping global temperature below 2 °C by 2030. It is concluded that these approaches are techno-economically limited and are not expected to lead us to the Copenhagen goal of capping temperature rise at 2°C by 2030. The main medium-term solution is the fourth pillar i.e. "energy conservation through collective behavioral change". Therefore, human synergy is the next energy.



Bridging the gap between end user needs and climate science capability: do we need a 'knowledge broker' and if so what should it look like?

Oral presentation

Session: Speedtalk session 7

Time: 4.45-4.50



Anthony Kiem¹, Danielle Verdon-Kidd¹, Emma Austin¹.

¹Centre for Water, Climate and Land-use Management (CWCALM), University of Newcastle, Newcastle, NSW, Australia.

There is a recognised gap between what climate science can currently provide and what end users of that information require in order to make robust adaption decisions about their climate related risks. A recent project conducted for the Australian Government's National Climate Change Adaptation Research Facility (NCCARF) identified a number of factors that contribute to this gap. These included uncertainty in climate information, misunderstanding or misuse of key terminology, poor communication and/or packaging of the climate science information and the lack of appropriate decision support tools that adequately account for uncertainty. Importantly, it emerged that simply providing more climate change information is unlikely to address the great challenge of climate change adaptation (i.e. to understand and overcome the barriers to successful adaptation in the face of uncertainty about the future). While it is unrealistic to expect that the gap between end user needs and science capability will ever totally close, there are opportunities to bridge the gap (or at least improve awareness of the gap). To help narrow the gap it is recommended that education, communication and packaging of climate information be improved via a formalised 'knowledge broker' program. Here the desirable attributes of such a program are explored (e.g. what the knowledge broker would look like, who would best fill the role and how would this be accomplished) and recommendations are provided as to how success of the 'knowledge broker' could be defined and measured.



Hypothetical case study to explore decision making under uncertainty for the water resource management sector

Oral presentation

Session: Parallel session 18

Time: 4.15-4.30



Anthony Kiem¹, Danielle Verdon-Kidd¹, Emma Austin¹.

¹Centre for Water, Climate and Land-use Management (CWCALM), University of Newcastle, Newcastle, NSW, Australia.

Climate change adaptation (particularly in the water resource sector) generally follows a linear pathway, in which scenarios of future climate are first defined, impacts assessed and adaptation options developed. However, uncertainty tends to compound at each step in this pathway and this uncertainty is not well communicated, hindering the decision making process. This paper focuses on what information decision makers from the Australian water resources management sector actually need (or think they need) to make an informed decision on adaptation options under a variable and changing climate. The strengths and weaknesses of the existing 'predict-then-plan' or 'scenario-first' decision making process are also explored. This was achieved through a hypothetical case study where participants were given a theoretical future climate scenario and were asked to make decisions based on available information. The decisions were then assessed at various points in the future as new information came to light. The outcomes of the study confirmed that uncertainty is most often dealt with in decision making by considering a range of adaptation or management options, with particular emphasis on the worst case scenario, however, improved understanding into the impact of climate change on climate variability (or vice versa), the interplay between climate impacts and social-political-environmental-economical, and translation of uncertainty into risk were all identified as necessary for ensuring robust decisions and successful climate change adaptation. Further, it was identified that improved communication and packaging of climate science (in particular uncertainty), and the associated outputs, is crucial for developing effective decision making processes.



The influence of East Coast Lows on the water security of coastal New South Wales

Oral presentation

Session: Parallel session 14

Time: 2.00-2.15



Garry Willgoose¹, **Anthony Kiem**¹, Danielle Verdon-Kidd¹, George Kuczera¹.

¹University of Newcastle, Newcastle, Australia.

East Coast Lows (ECL) are intense low-pressure systems which occur off eastern Australia. ECLs can generate gale force winds and heavy rainfall, often resulting in major flooding. ECLs and their associated rainfall are also thought to be important for generating significant inflows into major water storages along the east coast. However, we have a poor understanding of, and unresolved questions about, ECL frequency and intensity. This talk summarises a recently awarded ESCCI and ARC Linkage project which aims to understand ECL's role in runoff generation (particularly during drought) and how climate change is projected to influence ECLs and the knock-on impacts for water security along the densely populated eastern seaboard.



No adaptation without legislation: natural hazard constraints to land use planning

Either presentation

Session: Parallel session 34

Time: 1.45-2.00



David King¹, Yetta Gurtner¹.

¹James Cook University, Townsville, Australia

IPCC scenarios of greater numbers and intensities of floods as a consequence of climate change, will enforce change in land use planning practice. The flood events and cyclone of 2011 triggered questions about planning practices and initiated a process of adaptive change. Recommendations of the Queensland Floods Commission of Inquiry (2012) that relate to land use planning responses to increased flooding proposed sensible improvements to mitigate the impact of natural hazards, but research amongst planners highlighted responses that may be difficult to implement or that may be contested. There was strong support from planners in four key areas of Inquiry recommendations: whole of catchment flood mapping; climate change adaptation as a component of hazard mitigation; creation of zones of limited or constrained development; and planning for flash flooding, targeting the need for supporting legislation. There was no consensus among planners on the desirability of some recommendations; especially on land swaps, retreat, levees, and defined flood levels. Adaptive responses of land swaps and coastal reconstruction illustrate contradictions and complexity in adapting land use planning to increased hazard impacts.



Small towns don't get climate change: attitudes to climate change and hazard resilience

 $Speedtalk+Poster\ presentation$

Session: Speedtalk session 12

Time: 4.45-4.50



David King¹, Helen Boon¹.

¹James Cook University, Townsville, Australia

Four small towns in Victoria and Queensland that had experienced natural disasters in recent years were the focus of analysis of community resilience and adaptation. Attitudes to climate change were questioned as part of much large surveys (n = 1008). Most people do not trust what scientists or the government say about climate change, but most are concerned about it. People mistrust what the media say about climate change, and are split over whether it is caused by human activity. Importantly, most respondents believed that climate change is a serious problem right now. At the same time, most did not feel that they knew a lot about climate change and did not know who to trust in relation to climate change information. The study showed no significant gender difference, apart from males believing they knew more about climate change than females. The age group of 26-40 year olds were most concerned about climate change and believed they had the greatest knowledge about it. Better educated people also believed they had greater knowledge, and so did newer arrivals into each community. Analysis of resilience and adaptive capacity for individuals identified 4 aggregate variables of climate change concern, prior disaster experiences, financial capacity, and perceived climate change knowledge and trust of climate change communication. As communication was a critical support for resilience in other aspects of disaster preparedness this is a key area for improvement for all agencies and organisations.



Strategic adaptive management in the Macquarie Marshes - incorporating climate adaptation

Oral presentation

Session: Parallel session 33

Time: 2.45-3.00



Richard Kingsford¹, Gilad Bino¹.

¹Australian Wetlands, Rivers and Landscapes Centre, University of NSW, Sydney, Australia.

Freshwater ecosystems are connected over large spatial scales, have varied drivers including climate change, strong and often conflicting societal interests and interacting management processes. Many of the world's protected areas (>100,000, ~12% of land) include freshwater ecosystems, some specifically declared for freshwater protection (e.g. Ramsar). Such complex social-ecological systems have considerable challenges, particularly in adapting to climate change. Strategic Adaptive Management (SAM) provides a management framework for climate adaptation. It is built around an agreed vision and/or mission among stakeholders, with a hierarchy of objectives which incorporates climate adaptation, and indicators to be measured, allowing learning and adaptation. It is supported by a good understanding of drivers to assist in identifying cause and effect processes. Also scientific investment can occur once objectives are identified, providing data for improved updateable models that generate predictions. Early implementation of SAM has begun within the Murray-Darling Basin, focusing on the Macquarie Marshes. There are many challenges, including varied governance, different institutions but the process potentially allows tracking of natural resource management and a focus on achieving goals and specific objectives which allow for climate adaptation. There is no panacea for achieving aquatic conservation, but SAM offers hope with its interlinked processes for achieving aquatic conservation, but SAM offers hope with its interlinked processes for navigating complexity and learning. SAM in freshwater conservation is progressing because of the imperative for sustainability, history of interaction between scientists and managers and the need for transdisciplinary governance of rivers.



Broadacre farm performance in a warming, drying climate

Oral presentation

Session: Parallel session 12

Time: 1.45-2.00



Ross Kingwell^{1,2}, Lucy Anderton³, Nazrul Islam³, Vilaphonh Xayavong³, David Feldman³.

¹Australian Export Grains Innovation Centre, Perth, WA, Australia, ²University of Western Australia, Nedlands, WA, Australia, ³WA Department of Agriculture & Food, South Perth, WA, Australia.

We examine farm performance in south-western Australia, a region experiencing a warming, drying trend. The region is a main source of cereal and live sheep exports. Data on the financial and physical characteristics of 242 broadacre farm businesses were analysed for the years 2002 to 2011. The majority of the sample farms were mixed enterprise farms, often increasingly crop dominant. We employed a categorisation of farms that led to 65% of the farms being financially classed as growing or strong, 23% as secure and only 13% as less secure. Hence, despite the adversity of climate change, the vast majority of farm businesses prospered over the decade. Greater profitability was associated with increased crop area but with an increase in profit volatility. Financially growing farms were larger, generated a higher rate of return to capital and equity, carried less debt per hectare, were slightly more crop dominant, had higher personal and machinery replacement expenses yet similar debt repayments, had much lower debt to income ratios, had slightly higher equities in percentage terms, generated similar livestock income per hectare but much higher crop income per hectare. We drew on complementary socio-managerial data and found that growing farms adopted more cropping management innovations over the last decade and continued to use them. They adopted and made greater use of farm business tools and electronic technologies. They had a greater quality of commitment to maintaining their cropping gear, were more involved in their local community and expressed more care regarding their work-life balance.



climateadaptation knowledge+partnerships

Assessing present and future coastal erosion and inundation impacts for the Sydney region

Oral presentation

Session: Parallel session 3

Time: 3.30-3.45



Michael Kinsela¹, David Hanslow¹, Geoff Withycombe².

¹Office of Environment and Heritage, Sydney, Australia, ²Sydney Coastal Councils Group, Sydney, Australia.

Historical records of coastal hazards including beach erosion and oceanic inundation indicate the potential for significant damage to properties and infrastructure in the Sydney region. Such impacts may become more severe over the coming century due to the potential for shoreline recession and enhanced inundation associated with raised mean sea levels.

This paper assesses the impacts of beach erosion, shoreline recession and oceanic inundation hazards in the Sydney region for present and potential future conditions. Potentially at-risk properties and infrastructure were assessed using a spatial model, which identifies public and private assets defined by the Geo-coded Urban and Rural Address System (GURAS) and NSW infrastructure datasets that are impacted by modelled hazard extents for immediate and future scenarios. Coastal Hazard Studies carried out for Sydney councils and regional-scale inundation modelling undertaken by CSIRO for the Sydney Coastal Councils Group were the primary datasets used to define the hazard areas for each scenario. The impacts of both 1-year and 100-year average recurrence interval (ARI) storms were considered along with potential future sea level rise of 0.4 m and 0.9 m.

The findings suggest that in excess of 8,000 Sydney addresses may be presently exposed to beach erosion and oceanic inundation hazards associated with 100-year ARI storms. If sea level were to increase by 0.4 m or 0.9 m, this figure may exceed 13,000 and 20,000 addresses respectively. Potential impacts of beach erosion and shoreline recession were most severe for the Northern Beaches region. The impacts of oceanic inundation were more widespread throughout the Sydney region, although predicted exposure was highest for the southern suburbs, inner-Sydney and eastern suburbs. Impacts to transport infrastructure and public recreation spaces were also identified throughout the Sydney region.



State Government agencies supporting community based adaptation planning in South Australia

Oral presentation

Session: Parallel session 35

Time: 2.30-2.45



Andrew Klos¹

¹Government of South Australia, Adelaide, South Australia, Australia

The Climate Change Adaptation Framework for South Australia articulates the roles and responsibilities of governments and private parties and outlines a decentralised process for building climate change resilience in South Australia. Community consultation undertaken during the development of the Framework identified State Government action as a critical success factor in implementing the Framework. The Government Action Plan addresses this requirement by committing the Government to undertake a leadership and coordination role in implementing the Framework; developing climate change responses that are founded on the best scientific knowledge; and supporting the climate resilience of natural, economic and social systems. The Plan provides a critical link between regional adaptation planning and the development of government policies. It identifies processes which ensure that the Government's climate change action is integrated across government, cognisant of cross-sectoral interactions and informed by the findings of regional assessments.

The implementation of the Plan was initiated by its approval and launch in September 2012 providing the necessary permission to promote the adaptation agenda across government agencies. To date, the multifaceted agency engagement has significant agency support and is delivering government policy realignment driven by agency champions.

The interaction with and coordination of government agencies has been informed by a government engagement strategy which assesses the operational context and identifies key strategies and messages for the various stakeholders and management layers. This paper describes the key learnings from working with government agencies and provides an outline of a government process for delivering climate change adaptation reform.



Robust optimal design of urban water resource systems in the face of uncertain climate change

Oral presentation

Session: Parallel session 5

Time: 4.00-4.15



Mohammad Mortazavi¹, **George Kuczera**¹, Anthony Keim¹, Ben Henley¹.

¹University of Newcastle, Newcastle, NSW, Australia.

Future climate change presents a significant challenge in the planning and management of urban water supply systems. A large number of studies have been conducted in the past decade on hydrologic impacts of climate change. These studies revealed a difficult-to-quantify uncertainty in respect to available water resources in future. This study considers the issue of identifying Pareto-optimal solutions for urban water supply that are robust in the face of uncertain climate change. The approach is based on the simulation of two plausible bounding future climate scenarios to allow expected performance to be traded off against the variability in performance. A case study demonstrates the feasibility of this approach for a complex urban water supply system based on the Lower Hunter system. The primary objective is to minimize the present worth of costs associated with infrastructure decisions, operation and drought contingency. By introducing a second objective which minimizes the difference in present worth costs across future climate scenarios, the trade-off between efficiency and robustness is identified.



Optimal habitat protection and restoration for climate change adaptation of Australia's threatened species

Oral presentation

Session: Parallel session 26

Time: 11.15-11.30



Heini Kujala¹, Ramona Maggini², Richard A. Fuller^{2,4}, Martin F. J. Taylor³, Hugh P. Possingham², Federico Montesino Pouzols⁵, Atte Moilanen⁵, Brendan A. Wintle¹.

¹ARC Centre of Excellence for Environmental Decisions (CEED), School of Botany, University of Melbourne, Victoria, Australia, ²ARC Centre of Excellence for Environmental Decisions (CEED), School of Biological Sciences, University of Queensland, Queensland, Australia, ³WWF-Australia, Queensland, Australia, ⁴CSIRO Climate Adaptation Flagship and CSIRO Ecosystem Sciences, Queensland, Australia, ⁵Center of Excellence in Metapopulation Research, Department of Biosciences, University of Helsinki, Helsinki, Finland.

Australia's biodiversity is threatened by climate change, yet we know very little about what and where on ground conservation action should be employed to best minimise extinctions. In this project, we move beyond the common practice of predicting the impacts of climate change, to a more utilitarian approach of delineating the best options for climate adaptation for over 500 of Australia's threatened species. We derive the first national projections of distributional responses of threatened species to climate change under several climate change scenarios of differing severity. We then optimize the allocation of resources for protection and restoration of the habitat for each species, taking into account variation in the set of available actions, their respective costs in different habitats, and their expected long-term benefits. Finally, we combine information from the predicted distributions and the resource optimization to create a spatial prioritization of areas for actions that maximize the long-term availability and quality of habitats for threatened species. This step explicitly accounts for both spatial and temporal connectivity requirements of the species. We found that habitat protection is the most important action for Australia's threatened species to adapt to climate change, although restoration plays a critical role for some species and locations. Geographically, the protection and restoration effort should be focused on areas in the woodlands and rangelands of eastern Australia, Northern Territory, northwest Western Australia, and southern South Australia and Victoria. Our results are vital for guiding national-scale conservation policy, in particular wildlife corridors and multi-purpose carbon farming.



Adaptation planning with various levels of government in Victoria: knowledge, tools and principles

Oral presentation

Session: Speedtalk session 10

Time: 4.55-5.00



Carl Larsen¹, Shelley McGuinness¹, Shayne Annett¹.

¹RM Consulting Group, Melbourne, Victoria, Australia.

Planning for adaptation to climate change will be important in enabling government and organisations to respond to likely impacts, including increased extreme events (IPCC 2007; IPCC 2012).

In several recent projects, we have assisted local and state government agencies in Victoria to prepare climate change adaptation plans. The knowledge requirements of stakeholders, and tools used, are critical to adaptation planning. We have identified a number of common principles that can be applied to future adaption planning. We aim to use our experience to highlight factors that we believe are integral to successful adaptation planning.

Information and knowledge needs of stakeholders involved in adaptation planning vary, and is dependent on operating context. The tools required to undertake adaptation planning govern the process and outcome. We found drawing on people's learned experience from recent extreme events was a useful technique when coupled with climate change scenarios. A number of principles for adaptation planning have been identified across the development, planning, implementation and review spectrum. These include ensuring relevance through appropriate framing, undertaking a whole-of-business approach, using trusted knowledge brokers, determining relativity of risks, using adaptive management to address uncertainty, and embedding in existing frameworks and plans.

Climate change presents an additional element of uncertainty in undertaking strategic planning. In recognising the information and knowledge needs of various stakeholders and effective tools, it is important that government agencies and organisations consider their operating context and learn from the past, while taking a holistic, iterative and flexible approach to adaptation planning.



TMImap: an online database for historical impact of climate change on soil moisture and built environment

Oral presentation

Session: Parallel session 5

Time: 3.15-3.30



Simone Leao¹, Kok-Leong Ong¹, Linda Osman-Schlegel¹.

¹Deakin University, Geelong, Victoria, Australia

Expansive soils are susceptible to significant ground movement from differential soil moisture during dry and wet conditions. Climate change, with altered regimes of rainfall, temperature and evaporation across the globe, affects this process. In urbanized areas, inappropriate footing/slabs construction for local climate conditions result in structural damage of dwellings. Billions of dollars are spent worldwide in repairing such damages.

This study maps 100 year soil moisture patterns in order to better understand the progressive effects of climate change on soil. This understanding, and associated database, can assist to devise strategies for climate change mitigation (new housing development appropriate to changing soil moisture conditions) and for adaptation (identification of areas with historical changing soil moisture conditions, and inclusion of this parameter in plans for urban retrofitting).

Results for Victoria, the pilot study of this national wide project, indicate that there has been significant change in soil moisture conditions in 30% of the state area along 100 years, particularly in the last 20 years period. This is of concern considering that half of the state surface is composed by expansive soils, high rate of urban growth, and the fact that the regulation for footing and slabs (AS2870-1996) contains an out-of-date map of soil moisture from 1960-1990s.

An online spatial database and tool to disseminate this information for important stakeholders is presented and potential applications of the proposed information system for policy, planning and management of the built environment are discussed.



Optimal educational building retrofit strategy for thermal comfort and energy reduction.

Speedtalk+Poster presentation

Session: Speedtalk session 12

Time: 5.10-5.15



Laia Ledo¹

¹University of Wollongong, Wollongong, Australia

The potential impacts of climate change on energy usage and thermal comfort on buildings and their occupants are significant. Buildings in higher education institutions may be particularly susceptible to the impacts of climate change given the limited resources that universities and colleges have to upgrade their existing buildings. This paper presents the results of the Energy Signature (ES) method applied to the question of how best to estimate the potential impact of climate change on the cooling energy demand of existing university buildings. The methodology of the project involves firstly the application of the ES method to determine the actual thermal characteristics of particular buildings via inverse modelling of hourly metered HVAC consumption data correlated against outside mean daily temperature over the period of a year. Secondly, the predicted hourly temperatures for 2050 and 2100 have been estimated using various Intergovernmental Panel for Climate Change (IPCC) scenarios at the location in question. Thus, the future cooling energy consumption is predicted. The results of this analysis and the comparison of both current and forecasted energy consumption are presented and discussed for a number of actual university buildings. In addition, a discussion is presented of how the practical effects of various energy conservation measures that have already been implemented have been quantified through use of the ES model and how this has assisted Facilities Managers and others to better understand the effects of retrofitting for climate change and energy efficiency.



Migration decision-making process in response to climate change - a case study in Shangnan county of China

Oral presentation

Session: Parallel session 15

Time: 4.00-4.15



Yinru Lei¹, Max Finlayson^{2,1}, Rik Thwaites^{2,1}, Guoqing Shi^{2,1}.

¹The Institute of Land, Water and Society, Aulbury, NSW, Australia, ²National Research Center for Resettlement, Nanjing, Jiangsu, China.

Emerging empirical research indicates that environmental changes, including climate changes, currently play a role in human migration. Although previous debates on climate change and migration have tended to focus on migration as a problem or threat, mention has been made of how human migration has been used as a proactive adaptation strategy to climate change. This research seeks to explore how climate change factors interact with other migration determinants that influence the decision-making process people use to determine if they will migrate or not. A case study is being conducted in Shangnan County in Shaanxi Province of China given its frequent climate change related disasters and an ongoing government-initiated resettlement project.

Initial results show that people in the case study area underwent five stages in their migration decision process, as outlined in Haberkorn's model, namely: appraising the challenge, surveying alternatives, weighing of alternatives, deliberating about commitment, and adhering despite negative feedback. Climate change related factors acted as "stress", "stimulation" or "trigger" in the decision-making process, based on different influences and risk perceptions. Objective place-related factors, such as institutional, policy and cultural factors can either constrain or facilitate migration in accordance with people's perceptions about these factors.



The language of climate change adaptation: building a framework for adaptation planning in Indigenous communities of Northern Australia.

Oral presentation

Session: Parallel session 8

Time: 2.15-2.30



Sonia Leonard¹, Marcia Langton¹.

¹University of Melbourne, Melbourne, Victoria, Australia.

In the Kimberley region of Northwestern Australia, Indigenous people account for 90% of the permanent population and are likely to be disproportionately affected by climate change, due to direct environmental impacts and pre-existing social and economic disadvantages. However, there has been limited research to develop adaptation planning frameworks that incorporate the complexities of Indigenous worldviews and traditional knowledge systems. This project investigated how Indigenous people perceived climate change risks and understood options for adaptation in Bidyadanga, Warmun and Keep River communities. The results demonstrated the importance of working with local knowledge systems to allow Indigenous people to understand climate change in terms of their own socio-ecological relationships. The language of climate change or "adaptation talk" was identified as a considerable barrier to Indigenous adaptation. In a region with over 18 different languages spoken this posed a number of challenges. Direct translation of abstract climate terminology and concepts used in planning activities were poorly understood and subsequently, significantly changed Indigenous peoples' perceptions of risk and how they viewed that risk in terms of their own worldview. Alternative participatory planning frameworks were identified to help Indigenous communities build capacity and increase understanding of "adaptation talk" allowing effective pathways to adaptation and sustainable futures. The project not only built partnerships and community consensus, but also, and more importantly, allowed indigenous people to critically evaluate scientific predictions on their own terms and test adaptive capacity at a community level.



Vulnerability and adaptive capacity of Mediterranean viticultural systems facing climate change (1956-2060): a comparative case study from France (Roussillon) and Australia (McLaren Vale)

Poster only presentation Session: Poster session

Anne-Laure Lereboullet¹, Gérard Beltrando¹, Douglas K. Bardsley².

¹University Paris-Diderot-Sorbonne Paris Cité, Paris, France, ²University of Adelaide, SA, Australia.

Viticulture is highly sensitive to variations in climate and regional wine industries could thus have to adapt in the long term to climate change. Mediterranean climatic areas are situated at the edge of grapevine optimal growth range and could suffer from negative impacts of changes in climate over the coming decades. In addition, climatic changes occur simultaneously with socio-economic changes, at various time and spatial scales. Our study offers to analyze the vulnerability and adaptive capacity of two regional wine industries in such climate, with a systemic approach: Roussillon in France, and McLaren Vale in Australia. First, we defined the past, current and future exposure to changes in climate by using daily observed data in temperature and rainfall (1956-2010) and simulations from two regional climate models (2001-2060), with three emission scenarios: ARPEGE-RETIC for Roussillon, and CSIRO Mk3.5 for McLaren Vale. Secondly, sixty in-depth interviews with producers and key actors of the regional wine industries enabled to frame the impacts of climate change in both regions, coupled to socio-economic changes, and to define successful adaptation pathways to a range of changes.

Results show that both regions have faced especially hot and dry growing seasons during the last decade, and are likely to face a 1.5-2°C air temperature increase by 2060. Observed impacts on producers, as well as their estimated capacity to deal with future change depend on factors such as: economic situation and financial capital, state involvement and legislation, as well as social capital and cooperation.



climateadaptation knowledge + partnerships

The Australian public's understanding of climate adaptation: familiarity, conceptualisations, and reported adaptation actions

Oral presentation

Session: Parallel session 4

Time: 3.00-3.15

Zoe Leviston^{1,2}, Iain Walker¹, Sarah Malkin¹.

¹CSIRO, Perth, Australia, ²Curtin University, Perth, Australia.

To date, the bulk of research investigating how people respond behaviourally to climate change has emphasised mitigation behaviours. Comparatively little research has focussed on adaptation behaviours, particularly at the individual level, and how people define adapting to a changing climate to begin with. To examine how people conceptualise climate adaptation, and to identify the range of behavioural adaptation responses the community are engaging in, we surveyed 5081 people across urban, regional, and rural Australia in July and August of 2012. The results revealed that, while less the one-fifth of respondents were familiar with the term "climate adaptation", almost a third reported taking at least some action to adapt to the anticipated impacts of climate change. Respondents' definitions of climate adaptation varied widely in both content and complexity. Familiarity with climate adaptation was largely unrelated to opinions on the existence and causes of climate change, although these opinions were linked to adaptation activities. Adaptation responses varied greatly, but the most popular areas of activity were in the power, water, and transport sectors. A considerable proportion (around one-third) were unsure whether their reported behaviours constituted climate adaptation, and there was evidence that adaptation and mitigation activities are conflated in the community. In many instances it was unclear whether behaviours constituted an attempt to reduce one's carbon footprint or a genuine adaptation response to changing social, economic, and environmental cues. Finally, while many of the activities reported were beneficial to the natural environment, activities that potentially exacerbate mitigation efforts were often mentioned.



climateadaptation knowledge + partnerships

Sydney Climate Impact Profile: impacts of a changing climate on hydrology and water balance

Oral presentation

Session: Parallel session 5

Time: 3.00-3.15



Mark Littleboy¹

¹NSW Office of Environment and Heritage, NSW, Australia.

The NSW Office of Environment and Heritage is developing a series of regional impact assessments on the potential impacts of a changing climate for the Sydney Metropolitan Area. Researchers from the University of NSW have used dynamic downscaling to produce high resolution climate projections for the Sydney Area at a resolution of 2km. These projections are being used for a range of impact assessments that will be compiled into the Sydney Climate Impact Profile.

This paper will present the results from an impact assessment to determine the impacts of a changing climate on surface flows and recharge to groundwater. Two alternative modelling approaches will be compared to determine the spatial patterns of hydrological impacts from a changing climate. While both modelling approaches have a strong scientific basis, they produce different spatial patterns of hydrological change. The importance of matching the type of hydrological model used for an impact assessment with the type of downscaling method used to develop climate projections is illustrated. One of the two modelling approaches is preferable because it is conceptually better suited to the changing temporal dynamics of rainfall that result from a dynamic downscaling methodology.



Wheat stubble, soil carbon and atmospheric CO₂: To incorporate or not to incorporate, that is the question

Oral presentation

Session: Speedtalk session 11

Time: 4.50-4.55



De Li Liu^{1,2}, Muhuddin Rajin Anwar^{1,2}, Mark K. Conyers^{1,2}.

¹NSW Department of Primary Industries, WaggaWagga Agricultural Institute, WaggaWagga, NSW 2650, Australia, ²EH Graham Centre for Agricultural Innovation (An alliance between Industry & Investment NSW and Charles Sturt University), Wagga Wagga, NSW 2650, Australia.

Carbon (C) sequestration in agricultural soils has the potential to remove a considerable amount of C from the atmosphere. Carbon contents in agricultural products are virtually all from photosynthetic C assimilation. Harvested crop-grains or un-harvestable by-products such as stubble are eventually broken down, becoming CO2 emissions into the atmosphere. However, these sources of C are recycled from the atmosphere; hence they should not be considered as net anthropogenic CO2 emissions. The CO2 balance should be accounted for based on whether agriculture changes soil carbon, i.e. outcomes of farming practices increasing or decreasing soil carbon. This presentation will use a modelling approach to estimate how stubble incorporation can affect soil C balance between soil C sequestration and CO2 emission into the atmosphere. Currently soil organic carbon (SOC) in 0-30 cm soil depth across the NSW wheat belt is in a range from 25 to 50 t ha-1. To maintain this current level of SOC in higher rainfall areas (eastern area) will require 40 to 75% stubble incorporation, whereas in lower rainfall areas, the requirement varies from 20 to 45% stubble incorporation. With 100% stubble removal (burning), the existing SOC will be broken down, emitting 11.2 Mt CO2 into the atmosphere, while incorporating 100% stubble will result in 7-9 Mt CO2 removal from the atmosphere over the entire NSW wheat cropping area. The simulation indicates that incorporating wheat stubble into soils can be an effective adaptation option for the reduction of projected Australian agriculture CO₂ emission and for mitigating climate change.



Incentivising corporate action on climate change - time for tax breaks, direct support and shared approaches?

Speedtalk+Poster presentation

Session: Speedtalk session 9

Time: 5.00-5.05



Gareth Johnston¹, **Jules Livingstone**¹.

¹Complexitas, Sydney, NSW, Australia.

Little dialogue has occurred on incentivising corporate adaptation. Governments expect the private sector to do the "heavy lifiting" yet few incentives are in place to encourage risk taking. This paper suggests that multi-party trans-boundary approaches to incentivisation including tax incentives, direct financial support and other shared risk models may offer better outcomes than laissez faire. The authors offer a new framework for adaptation investment as a driver of growth that could deliver lower carbon adapted investment .



A mining company's journey to adaptation: the FMG Extreme Weather Event Risk Assessment project

Speedtalk+Poster presentation

Session: Speedtalk session 9

Time: 4.50-4.55



Barton Loechel¹

¹CSIRO, Pullenvale, QLD, Australia.

Mining enterprises face a range of risks arising from climate change. Flooding, cyclones, heat waves, bushfires, drought and sea level rise all pose a risk to mining operations and their supply chains, threatening productivity, health and safety, revenue and reputation. This presentation describes one company's experience conducting a climate change adaptation risk assessment and the lessons they learnt during the process. In an effort to identify climate vulnerabilities in their organization, the Fortescue Metals Group (FMG) undertook an 'Extreme Weather Events Risk Assessment' project in 2011, utilizing the services of a number of consultants. The assessment examined both the vulnerability and adaptive capacity of the company's recent iron ore mining infrastructure expansion in the Pilbara region of Western Australia. Recent CSIRO investigations show that performing a formal climate adaptation assessment such as this is atypical in the Australian mining industry. The fact that FMG were willing to report publicly on their project provided a rare opportunity to investigate the mining company's adaptation efforts through interviews with project personnel. This presentation will explore the various drivers, challenges, enablers, benefits and lessons learnt from the project which can helpfully inform further Australian resource sector adaptation to climate change.



Climate change pressures on native vegetation in the Sydney Basin

Oral presentation

Session: Speedtalk session 3

Time: 4.45-4.50



Vicki Logan¹

¹Office of Environment and Heritage, NSW Department of Premier and Cabinet, Sydney, Australia.

The Intergovernmental Panel on Climate Changes Fourth Assessment Report concludes that contemporary global warming is unequivocal. In the history of the Earth such changes are associated with significant changes in biodiversity including range shifts and extinctions. Prompted by intense public debate, communities are looking for accurate information and robust predictions of biodiversity impacts, with efforts hampered by inherent, significant and inescapable uncertainty. Nonetheless new approaches utilizing existing data and innovative methods can produce predictions which give a sense of the nature and extent of the impacts of climate change on biodiversity. Work in OEH Science Division has explored the existing relationship between biodiversity and climate across NSW, resulting in the development of a continuous community compositional turnover surface related to available climate and soil variables. This model is used to explore the potential impact of changes in climate under different climate change models and scenarios on vegetation community composition across NSW. In this study the model is used to predict the vegetation turnover in the Sydney Basin for the A2 climate change scenario using the CSIRO MK 3.5 global climate change model and the downscaled (2km grid) projections for 2050.



The risk typology of sea level rise: understanding the problem of houses falling into the sea

Oral presentation

Session: Parallel session 3

Time: 3.00-3.15



Mark Gibbs¹, **Donna Lorenz**², Olivier Thebaud³.

¹AECOM, Brisbane, Qld, Australia, ²AECOM, Sydney, NSW, Australia, ³CSIRO, Wealth From the Oceans Flagship, Australia.

A number of assets on the Australian coastline are vulnerable to inundation from the sea. Whilst this is not a new problem, the spectre of anthropogenic-induced sea level rise and increased storminess has raised the concerns of owners of coastal assets. Some owners of assets-at-risk have sought recourse in the judiciary in which arguments on the wording of planning provisions often dominate proceedings rather than what may or may not be the best outcome for society. By contrast, it is argued here that the problem needs to be cast into one describing the allocation and distribution of risk and hence the challenge becomes one of finding incentives so that these risks are allocated in an optimal and equitable manner.

We analyse the reasons why many of the solutions proposed by the scientific climate adaptation community have not been implemented. The investigation is cast in the form of an analysis of risk sharing, the incentives which result from the existing and proposed sharing arrangements, and the ensuing distributional issues.

The analysis revealed a number of ways risk can be allocated to the major actors but none whereby risk can be relatively easily distributed, explaining why the issue remains problematic. We recommend the issue be recast from a physical sciences problem to a social and economic problem informed by science and engineering, contending more progress might be made if the problem is cast in terms of risk allocation and distribution rather than simplistic terms of retreat of defence.



Effectively communicating climate science to executive and political decision makers and achieving better informed decisions

Oral presentation

Session: Speedtalk session 7

Time: 4.55-5.00

Scott Losee¹

¹Katestone Environmental Pty Ltd, Brisbane, Queensland, Australia.

As a threat, climate change is global, multi-dimensional and socially embedded. It has been tempting for concerned persons to respond with appeals at similarly broad levels: awareness raising, public education, better science. However, the decisions being sought are actually made by a small number of decision makers with discrete spheres of influence and specific motivators. Broad appeals are often misaligned. Compounding the misalignment is scientists' default mode of communication. Scientists support claims with evidence, dwell on uncertainty and make cautious, reflective contributions to knowledge. Scientists may also think that decision makers are obliged to consider the science prior to making decisions where it is clearly important. Yet daily interactions with decision makers are filled with misunderstandings, displeasure at unwanted results, confusion over statistics, failure to grasp modelling, neglect of qualifiers and assumptions and even selective reading. With the heightened prominence of climate science, its daily appearance in the media and with entire government departments and ministers devoted to it - how can scientists cut through to better inform decision makers? This paper examines the interaction of individual scientific practitioners with decision makers. It considers how scientific content and its visual and oral presentation can improve decision makers' understanding. It also discusses how the information will be received and what messages and means of communicating will increase impact, particularly for nonscientific decision makers. The presentation will offer practical advice on giving decision makers the best chance of making informed decisions.





Using climatic variability and regional influences to improve risk assessment - a mine and quarry application

Oral presentation

Session: Parallel session 30

Time: 2.45-3.00



Scott Losee¹, Andrew Wiebe¹, Adam Thomas¹.

¹Katestone Environmental Pty Ltd, Brisbane, Queensland, Australia.

Risk assessment has been a useful initial approach for government authorities, proponents of developments and business managers to incorporate climate risk into planning and decision making. Among its advantages are that it was already a well-understood technique and that it encouraged stakeholders to talk to each other. However, its practice has arguably plateaued and its limitations are impeding its ability to become a more integrated and influential management tool. Many organisations complete and subsequently shelve risk assessments with little follow-through. One key limitation is the generalised nature of climate data used to assess the likelihood factor in the risk equation. This downplays variability and can make climate changes seem slight and distant. This paper describes a method that combines analysis of localised historical observations (using 60-110 years of data) with interpretation in terms of variability and decadal scale climate drivers such as the El Nino Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO). Probabilities are generated for key climate risks and interpreted according to ENSO phases and the possible implications of predictions from ensemble global climate models. The authors have applied the method as part of the environmental assessment of an open cut coal mine and a coastal quarry development. Projects of this nature will be completed within 40 years, making the focus on near-term climate variability of greater practical value. The paper presents advantages of the method together with challenges including communicating climatological considerations such as ENSO and PDO and overlap with established management practices in water resources.



Current and future heatwave vulnerability in Australian capital cities

Oral presentation

Session: Parallel session 13

Time: 1.00-1.15



Margaret Loughnan¹

¹Monash University, Clayton/Victoria, Australia.

In the last 3 decades the Earth's surface has warmed by approximately 0.6°C and climate models predict further rises between 1.1°C and 6.4°C over the 21st century. Associated increases in heatwave intensity and frequency have already resulted in increased mortality and morbidity, and placed considerable stress on emergency services. This has necessitated the development of heatwave adaptation and response plans. To advise heatwave planning, this project has developed threshold temperatures above which the demand for emergency services increases. A composite index of heatwave vulnerability was created and mapped for each capital city to illustrate the spatial distribution of heatwave risk. Projected changes in two known risk factors, urban density and an ageing population, were also mapped to provide some guidance for heatwave preparedness and response in the future.

Heatwave frequency and intensity is predicted to increase by mid-century, increasing the likelihood of adverse health effects from heat related conditions. There remains considerable uncertainty associated with predictions of climate extremes for regions such as capital cities. Detailed regional projections are required to assess local impacts on a scale that is more useful to policymakers. We used CSIRO Marine and Atmospheric Research projections downscaled (60 km resolution or better) from their CCAM simulations using the A2 and B1 emissions scenarios to estimate the proportional increase in days that exceed heat thresholds in each capital city. Predicted changes in the number of days exceeding the predefined thresholds indicated that extreme heat days would increase in frequency in all capital cities.



Climate change adaptation opportunities for peri-urban Indigenous communities

Oral presentation

Session: Parallel session 8

Time: 2.00-2.15



Darryl Low Choy¹, David Jones², Philip Clarke¹, Silvia Serrao-Neumann¹, Robert Hales¹, Olivia Hoschade¹.

¹Griffith University, Brisbane, QLD, Australia, ²Deakin University, Geelong, VICT, Australia.

Climate change is expected to have social, economic and environmental impacts on urban and peri-urban Indigenous communities inhabiting coastal areas. These include a loss in community and environmental assets, including cultural heritage sites, with significant impact on the quality of life of populations inhabiting these areas. This paper will report on selected key findings of a year long NCCARF-funded study titled: Understanding Urban and Peri-urban Indigenous People's vulnerability and adaptive capacity to Climate Change.

The paper addresses the question: what climate change adaptation opportunities exist for coastal urban and peri-urban Indigenous communities?

From working with five urban and peri-urban Indigenous communities in South East Queensland, Greater Melbourne and Adelaide Plains, the study has recognised a number of adaptation opportunities that these communities could positively respond to at the individual, family, business and institutional levels in response to future climate change. Some communities have well developed land and sea management plans whilst others have only embarked on this important planning process. Individually, the Traditional Owner case study groups investigated in the research are at varying stages of management development and each has different plans and strategies to address their visions and aspirations. This diversity of plans formed the basis for the initial assessment of the capacity of Indigenous individuals, households, businesses, and institutions to adapt to climate change.

This work commences to fill a gap in the Australia and International literature on the relationship between peri-urban and urban Indigenous people and contemporary climate change.



Institutional challenges for implementing an ecosystembased approach for climate change adaptation in the Murray-Darling Basin

Oral presentation

Session: Parallel session 28

Time: 11.45-12.00

Anna Lukasiewicz¹, Max C. Finlayson¹, Jamie Pittock².

¹Charles Sturt University, Albury, NSW, Australia, ²Australian National University, Canberra, ACT, Australia.

An ecosystem-based approach (EBA) to climate change adaptation maintains and restores natural ecosystems, protects vital ecosystem services and reduces land and water degradation. The central tenet of the EBA is that healthy, resilient ecosystems will be better able to withstand shocks caused by climate change. The approach links climate change, biodiversity and sustainable resource management and acknowledges the role of non-climate stressors on ecosystems.

Using a case study approach we sought to more systematically test ways of planning for climate change adaptation using catchment scale case studies for increasing the resilience of freshwater ecosystems in the Murray-Darling Basin to climate change. In the case studies we identified the risks, costs and benefits of a range of adaptation options. We found that existing management actions, if extended and linked, would comprise a comprehensive ecosystem-based approach to adaptation with significant co-benefits to biological conservation. The Goulburn-Broken, Lachlan and NSW Murray catchments were used as case studies in partnership with their Catchment Management Authorities.

We focussed on the underlying institutional challenges and constraints we encountered. These included the limited ability of government actors to act on private land, inter-jurisdictional complexity caused by multiple actors with overlapping areas of responsibility, limited resourcing of catchment bodies, constraints caused by existing rules and regulations and limited opportunity to practice adaptive management. While these challenges are profound, recognition of the EBA concept could lead to improved coordination of activities and avoidance of maladaptation, and lay the foundation for climate change adaptation across the Basin.



Transitioning from vulnerability to resilience: integrated adaptation approaches to transforming Melbourne's landscape

Oral presentation

Session: Parallel session 2

Time: 3.45-4.00

Yvonne Lynch¹

¹City of Melbourne, Melbourne, VIC, Australia.

Melbourne's environment is facing three primary challenges: population growth and intensification, urban heating and climate change. The cumulative impact of these is creating less healthy urban environments; the flow-on effects include the social cost of heat-related illness and morbidity, damage to vital infrastructure, and diminishing quality of city life and liveability.

How do we respond to these challenges whilst increasing the resilience of our public realm and creating a legacy for future generations? A holistic adaptation approach that acknowledges the critical nature and multi-functionality of green infrastructure interventions is clearly required.

It's time for green infrastructure to transcend its niche function in public policy as an aesthetic amenity. This presentation will outline how the City of Melbourne is embracing a multidisciplinary approach to responding to these challenges and how green infrastructure solutions are being implemented. It will detail a response that seeks to transform Melbourne's urban landscape with ambitious city targets for green infrastructure development to mitigate flood and urban heat island impacts. It will focus on a range of green infrastructure solutions including green roofs, living walls, urban forest development, integrated water management, stormwater harvesting, open space connectivity, permeability expansion and urban landscape cooling strategies.

This presentation will also illustrate how the use of key technical data, spatial mapping, GIS analysis, microclimatic modelling, lidar based modelling and innovative research has informed a suite of initiatives to realise a robust and resilient city.



A typology of spatial planning instruments for climate change adaptation

Oral presentation

Session: Parallel session 34

Time: 2.00-2.15



Andrew Macintosh¹, Anita Foerster^{2,1}, Jan McDonald^{2,1}.

¹Australian National University, ACT, Australia, ²University of Tasmania, TAS, Australia.

Settlements in coastal and bushfire-prone areas across Australia face challenges in adapting to the impacts of climate change. There is a range of policy instruments that can be used to influence the spatial distribution and nature of land use and development, and thereby reduce the exposure and vulnerability of settlements to climate hazards. These include instruments that seek to control and influence new development (the traditional domain of land use planning) and those that specifically target existing development. This paper presents a typology of spatial planning instruments, classified according to the role they play within an adaptation planning framework: for example, communicating information on climate hazards; regulating land use and development; or incentivising private hazard mitigation activities. Drawing on an analysis of existing planning frameworks, and interviews with local and state planning and emergency management practitioners in selected coastal and bushfire-prone areas in Australia, the authors identify potential benefits and challenges associated with different instruments and make recommendations on the way they can be employed to support effective and efficient adaptation. The authors highlight that there is currently a relatively narrow reliance on traditional regulatory land use planning instruments within Australian jurisdictions. They argue for broader use of the full range of available spatial planning instruments, particularly more flexible regulatory measures for both new and existing development, and more targeted use of information instruments and incentive programs to promote private adaptation in the context of existing development.



Terra Nova - discovering, sharing and reusing climate change adaptation research data & information

Oral presentation

Session: Parallel session 11

Time: 1.30-1.45



Brendan Mackey¹, Malcolm Wolski¹, Sam Mackay¹, Andrew Bowness¹.

¹Griffith University, Queensland, Australia.

One of the main barriers to adaptation identified by the Productivity Commission's consultation process was poor access to quality adaptation information. Terra Nova is a national e-infrastructure project funded by Australia National Data Services (ANDS) which aims to make climate change adaptation research data and information more discoverable, shareable, and re-usable. Notwithstanding the many technical challenges facing the project, and the technological innovations being deployed, the major challenge to the project's success are sociological and behavioural. Data and information can only be discoverable, shareable and re-usable if there is widespread uptake among researchers and practitioners of appropriate meta-data standards and protocols. So doing requires recognition by both individuals and organisations of their responsibilities to a public good (namely, climate change adaptation), the long term accumulated value to researchers and the community in making adaptation data and information re-usable, and the development and implementation of in-house, professional, and sectorial data sharing norms. Examples are provided from Terra Nova that demonstrate the added value of so doing, drawing upon results from the South East Queensland Climate Adaptation Research Initiative.



An assessment of the vulnerability of the coastal regions of Bangladesh to the changing climate

Poster

Session: Poster session



¹Sania Mahtab

¹McGill University, Montreal, Canada

Extreme climate events are an important concern for a resource constraint country like Bangladesh due to its impacts on society in the form of loss of economic goods, life and property. Reliable estimates of future extreme climate events relating to extreme precipitation and extremes of temperature are a valuable guide for policy makers in determining infrastructure requirements for the 21st century. Using a standard set of annual and seasonal climate extreme indices derived from daily temperature and precipitation data, rate of change of extreme indices and 30- year average values of the indices are analyzed for the baseline period (1961-1990). Extreme indices from PRECIS (Providing REgional Climates for Impacts Studies) output data were validated against those calculated from the observed data of Bangladesh Meteorological Department (BMD), to predict the values of extreme indices in the coming decades. The results show that PRECIS is able to simulate daily temperature related extreme indices with lower percentage bias as compared to the precipitation extreme indices. The temperature extremes are found to occur more at the coastal regions like Cox's Bazar and Teknaf than at the inland stations for both the BMD and PRECIS data. PRECIS predicted that towards the end of coming decades like 2021, 2031 and 2051 Sylhet and Srimangal will remain as the wettest regions of the country with a stark change to come in 2071 and 2091 when Teknaf, Cox's Bazar or Patuakhali will be receiving extreme precipitations.



Statistical modeling of daily temperature extremes for climate change impact studies at the urban catchment scales around south western Quebec

Speedtalk

Session: Speedtalk session 5

Time: 4.55-5.00

¹Sania Mahtab

¹McGill University, Montreal, Canada

Global climate change is no longer an illusion, it is a reality and it will pose a myriad of challenges for water resource managers in Canada and the world over likewise. To quantify the change at an urban catchment scale we need to model the parameter that is vital to almost all hydrological processes i.e. temperature. Although many studies suggest that critical temperature sequences are necessary for accuracy and conformity of the predictions, many urban hydrologists measure snowmelt runoff, evapotranspiration, heating/cooling demands etc. using temperature at the daily scale largely because very few meteorological stations around the world record temperatures at sub-daily scales since it is cost intensive. Hence a mathematical tool is crucial to establish the scale transferability of temperature characteristics from daily to sub-daily scales, so that regions where funding is a major constraint could still climate proof themselves as much as possible by knowing the critical cutoff values of significant hydrological processes when and as they occur.





Automating adaptation – Using big data and big computation to find the biggest risks and the best pathways

Oral

Session: Parallel session 2

Time: 3.00-3.15



¹Karl Mallon

¹Climate Risk Pty Ltd, Sydney, NSW, Australia

Imagine trying to test, one-by-one, 250,000 utility assets and buildings, spread from Perth to Queensland, for multiple climate change hazards and scenarios, every year for the next century with full probabilistic analysis. This cannot be done by hand but requires a completely new approach based on big data-sets and large-scale high-speed computation.

This paper first covers the axioms of required computational solutions to such problems and then provides examples of computational tools already created based on work with insurers, local governments, utilities thoughout Australia.

The paper will also outline internationally patented computational methods that have been developed in Australia capable of addressing large portfolio risk and adaptation analysis.



Climate change and adaptation: Building resilience in the urban water sector - a case study of Indian city

Poster

Session: Poster session



¹Shailendra Mandal, ¹Manoj Kumar, ¹Vivekanand Singh

¹National Institute of Technology Patna, Patna, Bihar, India

This paper looks at associated discourses and actions related to climate adaptation strategies about the water sector in urban areas. Unique to developing country cities is the predominance of informal actors in the water sector. The formal or government sector, which often exclusively manages water access and distribution in developed country cities, is only one among many players in the water sector. In these cities, thousands of people directly access the water source itself from self-supply through private boreholes. In this environment, with already existing pressures on water availability and use, the impacts of climate change on water will be strongly felt by all these water managers. Climate change is already having impacts on temperature and the hydrologic cycle, which complicates planning for water supply and demand and increases water insecurity. For those, particularly the urban poor, who barely meet their water-related needs, climate change is likely to increase high levels of water insecurity. The purpose of this research is to understand the complex dynamics of the water sector, to investigate the needs of urban water managers and ultimately to suggest strategies and tools that can help these managers to meet ever growing needs in the face of climate change and increasing water insecurity. This paper would also discuss about the approach and methodology used in the study, the resilience planning process, climate forecast in and around the city, specific vulnerabilities within the water supply system in city, the resilience interventions to address these vulnerabilities and tools to support overall resilience.



Network governance and climate change adaptation: collaborative responses to the Queensland floods

Oral

Session: Parallel session 6

Time: 3.30-3.45



¹Susan Kinnear, ¹Kym Pattison, ¹**Julie Mann**, ²Elizabeth Malone, ³Victoria Ross, ⁴Garry Robins, ¹David Swain

¹CQ University, Bruce Highway, North Rockhampton, Queensland, Australia, ²U.S. Pacific Northwest National Laboratory, Maryland, USA, ³Griffith University, Brisbane, Australia, ⁴University of Melbourne, Melbourne, Australia

This research involved case studies of organisations that participated in the response to the major flood disaster in Queensland in 2010/11. Social network analyses and qualitative investigations were conducted on data collected from 63 organisations across the communities of Rockhampton, Emerald and Brisbane. The network analyses examined collaboration and communication patterns; changes in the network structure from routine management to flood operations; similarities and differences between the geographic regions, and whether collaboration was correlated with trust. In both the Brisbane and Central Queensland (CQ) networks, slightly higher levels of collaboration amongst organisations were recorded during flood periods compared with routine operations; and organisations tended to provide, as well as receive, information and/or resources from their collaborators.

Overall, both networks appeared to feature high trust, with only a low level of difficult ties (problematic relationships) being reported. Cultural values analysis was also performed to identify the key values of different organisations. In Brisbane, a high value was placed on shared information systems and resources; shared communication and language; as well as on collaboration and flexibility. In CQ, there was a greater emphasis on local solutions, community wellbeing and longitudinal issues (such as post-disaster supply chains for recovery). The current structure of Local Disaster Management Groups appeared to be heavily influential on broader network participation. This study demonstrated that a network governance approach can provide new ways of understanding the core elements of adaptive capacity, in areas such as enablers and barriers to adaptation, and translating capacity into adaptation.



The need to replace scientific uncertainties with social acceptance of changing risks

Oral

Session: Parallel session 7

Time: 3.15-3.30



¹Martin Manning

¹NZ Climate Change Research Institute, Wellington, New Zealand

When atmospheric CO_2 was found increasing much faster than expected it was immediately considered a global experiment because science is focused on observations that reduce uncertainties. But limits to scientific understanding mean that uncertainties are increasing because our environment is becoming unprecedented, as seen by the unexpected Antarctic Ozone Hole and a widening range of future sea level rise estimates¹. Moreover, some experiments should be avoided.

Development of better approaches to uncertainty in complex systems analysis has allowed fuzzy limits in knowledge to still provide a clear basis for expert judgement and decision making² But this leaves the challenge of communication across society in ways that acknowledge uncertainties, while ensuring these avoid becoming barriers to response³ Even the precautionary principle requires development before becoming effective⁴. Consequently dealing with uncertainty now requires broader social engagement aimed at developing recognition of: changing risks; the need for consensus on response options; and a greater underlying resilience to change⁵

¹ Bamber, J. L. & Aspinall, W. P. An expert judgement assessment of future sea level rise Nature Climate Change, online January (2013). ² Dubois, D. & Guyonnet, D. Risk-informed decision-making Intl J General Systems, 40, 145-167 (2011). ³ Berkhout, F. Adaptation to climate change by organizations. Wiley: Climate Change, 3, 91-106 (2012). ⁴ Sunstein, C.R., Laws of Fear: Beyond the Precautionary Principle, 234 pp., Cambridge University Press, Cambridge, U.K., 2005. ⁵ Norris, F. H., et al. Community Resilience as a Metaphor, Theory, Set of Capacities, American J Community Psychology, 41, 127-150 (2008).



Social vulnerability of marine resource users to extreme weather events

Oral

Session: Parallel session 17

Time: 4.15-4.30



¹Nadine Marshall, ²Renae Tobin, ³Paul Marshall, ³Margaret Gooch, ⁴Alistair Hobday

¹CSIRO, Townsville, QLD, Australia, ²Centre for Sustainable Tropical Fisheries and Aquaculture, Townsville, QLD, Australia, ³Great Barrier Reef Marine Park Authority, Townsville, QLD, Australia, ⁴CSIRO, Hobart, TAS, Australia

Knowledge of vulnerability provides the foundation for developing actions that minimise impacts and supports system views that are particularly desirable. We modified a well-established model to assess and describe the vulnerability of the two major industries dependent on the Great Barrier Reef (GBR) to extreme weather events. The modification entailed distinguishing between the properties that determine exposure, sensitivity and adaptive capacity for both the ecological and the social components of a natural resource system. We surveyed 145 commercial fishers and 62 tourism operators following a severe tropical cyclone and a major flooding event that extensively affected the region in 2011. Exposure of these industries included direct risk to life and infrastructure and indirect risk from loss of important ecosystem services. Our study found that many commercial fishers and marine-based tourism operators were sensitive to changes in the GBR's condition and limited in their adaptive capacity. However, those with smaller businesses, higher levels of occupational identity, place attachment, formal networks, and strategic approaches also had higher levels of adaptive capacity. These results suggest that resource users with higher sensitivity to change are not necessarily the most vulnerable; sensitivity may be offset by adaptive capacity. That is, while exposure and sensitivity determine the potential impact of a climate-induced change, adaptive capacity may be a major influence on the impacts that eventuate. We empirically show that adaptive capacity is an obvious focus for climate adaptation planning.



Why understanding people helps improve adaptive capacity over time: A long term social and economic monitoring program in the Great Barrier Reef region

Oral

Session: Parallel session 24

Time: 11.45-12.00



¹Renae Tobin, ²Erin Bohensky, ²Matthew Curnock, ^{1,3}Jeremy Goldberg, ⁴Margaret Gooch, **Nadine** ²**Marshall**, ²Petina Pert

¹Centre for Sustainable Tropical Fisheries and Aquaculture and the School of Earth and Environmental Sciences, James Cook University, Townsville, Australia, ²Ecosystem Sciences, Commonwealth Scientific and Industrial Research Organisation, Townsville, Australia, ³School of Business, James Cook University, Townsville, Australia, ⁴Climate Change & Science, Great Barrier Reef Marine Park Authority, Townsville, Australia

Climate change affects the entire socio-ecological system. When there is a change in the ecosystem it flows through to the human system, and vice versa. For those charged with managing systems under increasing climate stress, it is therefore important to not just understand how ecosystems are affected by changes to their environment, but also how people are directly and indirectly affected, and how they react. To design 'people-relevant' adaptive management approaches, natural resource managers need to understand people's values, attitudes, the way they view and understand the environment, how they use or interact with the environment, and their inherent capacity to adapt to change.

Researchers from the CSIRO and James Cook University are working to develop a Social and Economic Long Term Monitoring Program (SELTMP) for the Great Barrier Reef (GBR) region, collating existing and collecting new information annually about people and industries connected to the GBR. Combining top-down (science-driven) and bottom-up (multiple stakeholder involvement) approaches, SELTMP aims to better understand the key social, cultural and economic factors across the region that impact on the well-being of the GBR ecosystem and the people connected to it. Understanding and monitoring the strength of connections to the GBR, level of resource dependency and the adaptive capacity of people within this system are critical elements of the Program. These elements will help inform the design of approaches that managers, communities and industries can use to build adaptive capacity and encourage positive interactions within the GBR socio-ecological system.



Working at the pointy end: Local Government and climate change

Oral

Session: Parallel session 29

Time: 2.15-2.30



¹Narelle Martin

¹Two Hemispheres Environmental Consulting Pty Ltd, Murmungee, Australia

Local Government has no choice but to deal with climate shocks. Local Government has been for years dealing with climate change impacts and trends. They may not recognise it, and are often busy reacting to events rather than being in position to be proactive.

In 2012 the Regional Climate Change Adaptation Strategy for North East Victoria: Water and Beyond was launched. This was an initiative of the North East Greenhouse Alliance (NEGHA). NEGHA is a consortium of six municipalities and partners in North East Victoria. The Strategy was developed over two years. It commenced after the region had experienced significant bushfires, and while the region was experiencing a serious drought. During the last year of the project the region experienced three floods in six months. This paper describes the development of the Adaptation Strategy, its findings, and discusses some of the challenges and opportunities identified. There was extensive collaboration in the development of the Adaptation Strategy, with significant funding provided by the Australian Government. The development of the Adaptation Strategy has provided an opportunity for the participants to consider in a proactive way risks and opportunities. An emphasis of the Adaptation Strategy and the contributing reports and research has been to try and add value to the partners. As a result there are now a suite of tools, reports, case studies and resources available to assist NEGHA and its partners, and through them the wider community and businesses.



Improving communication about Climate Change Adaptation between mining professionals

Oral

Session: Parallel session 32

Time: 1.45-2.00



¹Leah Mason

¹University of Technology, Sydney, New South Wales, Australia

The mining industry has a diverse base of professional and non-professional personnel, with different interests and responsibilities for a range of mine site operations over the mine's life-cycle. Some of these professionals will never meet but their performance in their respective roles has the potential to make a big difference to the adaptation capacity of the mine. A partnership between NCCARF, the Australasian Institute of Mining and Metallurgy (AusIMM), and the Institute for Sustainable Futures (UTS) produced a guide for these professionals, using case studies of mining operations that have experienced and/or successfully adapted to flooding and storms, drought, high temperatures, bushfire. Following an overview of the guide, the paper describes the project's approach to navigating divided attitudes towards climate change adaptation within the industry, and using language that opens up lines of conversation between professionals of different ages and experience. Reviews of existing guidance for this industry, and consultation with mining professionals revealed a number of key concepts for achieving good outcomes for climate change adaptation in the mining and mineral processing industry. Terms that resonate with mining and mineral professionals were found to come from conventional risk assessment and risk management, such as preparedness and value-protection. Another concept that has proven to be engaging with this audience are landscape-scale assessments of infrastructure risk ('reading the landscape'). Further research, to identify language that can increase the transmission of important experiences, across sites and over time, will be important to further progress in this area.



Future change in ancient worlds: The importance of land and sea as cultural identity in Indigenous Australia

Oral

Session: Parallel session 8

Time: 1.45-2.00



^{1,2}**Eddie Mason**, ³Deanne Bird, ³Katharine Haynes, ⁴Jeanie Govan, Natalie Carey

¹Senior Traditional Land Owner, Saltwater Burrarra People, Arnhem Land, NT, Australia, ²Protect Arnhem Land, Maningrida, NT, Australia, ³Risk Frontiers, Macquarie University, Melbourne, VIC, Australia, ⁴The Northern Institute, Charles Darwin University, Darwin, NT, Australia

This project investigated barriers to and opportunities for embracing adaptation strategies within Indigenous communities in northern Australia in regards to slow onset environmental changes and extreme weather events. We utilised ethnographic participatory research to garner a multifaceted understanding of why Indigenous people may be vulnerable or resilient to weather events and climate change. Broader socioeconomic and political changes were also investigated as potential catalysts for influencing vulnerability. "If I lose my land or my salt water, I lose who I am. That songline, out in my ocean, you cut him out, I lose my identity and I am nothing". Presenters will discuss the fundamental relationship Indigenous people have with their ever changing environment and the issues that are inhibiting or enabling adaptation. The voices of research participants from Maningrida and Ngukurr, Northern Territory; Broome, Western Australia; and Wujal Wujal, Queensland provide further insight into the underlying vulnerabilities and adaptive capacities within Indigenous communities across northern Australia.



Climate change anxiety in rural Tasmania

Speedtalk

Session: Speedtalk session 4

Time: 4.55-5.00



¹Christine Materia

¹University of Tasmania, Hobart, Tasmania, Australia

Climate change has been identified as the biggest global health threat of the 21st century. Tasmania is experiencing significant changes in seasonal patterns of rainfall and temperature; and increasing intensities and frequencies of climate driven events. Academic literature supports the notion that humans derive physical and psychological benefit from spending time in nature. Research on the mental health impacts of climate change has tended to be disaster focused; examining the direct psychological impacts of extreme events.

This paper reports preliminary finding from a doctoral study in Tasmania examining relationships between connectedness to nature, anxiety and psychological well-being in a changing climate. The study aims to develop a theoretical model for health practitioners, policy-makers and local government to better understand and respond to community level anxiety about climate change.

178 people self-nominated and completed Spielberger's State-Trait Anxiety Inventory (Form Y) to measure climate change state and trait anxiety. Data was analysed using SPSS. Preliminary findings indicate people aged 50 and over experience levels of anxiety in excess of levels reported for the normative sample. OECD reports suggest unprecedented aging in the global population, including for Australia. Climate and health literature identifies older people as a particularly climate-vulnerable group. International attitudinal evidence suggests older people are less concerned about climate change. In light of this, the present study offers interesting insights into how older people experience climate change. The presentation offers important implications for understanding the health and well-being of older people linked to their anxieties and experience of climate change



Natural disasters, insurance and climate change

Oral

Session: Parallel session 6

Time: 4.15-4.30



¹John McAneney, ¹Ryan Crompton, ²Rade Musulin, ²Delphine McAneney, ²George Walker

¹Risk Frontiers, Sydney, Australia, ²Aon Benfield, Sydney, Australia

The rising cost of natural disasters can be firmly sheeted home to the fact that there are now more of us living in vulnerable places with more to lose. The current contribution of global climate change to this toll is trivial and in the case of US hurricanes likely to remain so for the order of a century or more. This has been unequivocally demonstrated across jurisdictions and for different perils. It is also unlikely that we have seen the worst that the current climate has to offer. So society faces (at least) two problems: on the one hand, we have the warming of the planet and long-term and largely unknown consequences that this may bring about but which are likely weighted towards negative outcomes. Secondly we have a natural disaster problem, which is current and in many cases a direct consequence of poor land use planning by individuals and government. The two problems are currently unrelated except in the minds of politicians and many media commentators. If we genuinely wish to reduce disaster losses or even arrest their increase, land-use planning has to become more risk-informed. Insurance can play an indirect role in encouraging change by pricing risk correctly and sending clear signals to homeowners and governments to stimulate risk-reducing behaviours. The success of the regulated use of the building code in tropical cyclone-prone regions in Australia and the performance of modern seismic building codes in Christchurch shows what can be achieved when there is a demonstrated need and political will.



Climate Change, World Heritage and Adaptive Management: incorporating climate change into the Strategic Assessment of the Great Barrier Reef

Oral

Session: Parallel session 24

Time: 11.15-11.30



Laurence McCook, ¹Roger Beeden, ¹Julia Chandler, ¹Jen Dryden, ¹Josh Gibson, ¹Margaret Gooch, ¹Hayley Gorsuch, ¹Jess Hoey, ¹Fergus Molloy, ¹Rachel Pears, ¹Chloe Schauble, ¹Hilary Skeat, ¹Karen Vohland

¹GBRMPA, Townsville, Australia

Climate change was identified as the most serious threat to the Great Barrier Reef in the 2009 Great Barrier Reef Outlook Report, which stated that the Reef was "at a cross-roads". Since then there has been emerging evidence of long-term declines in coral and seagrass habitats, major expansion of coastal development, ports and shipping activities, much of it associated with coal exports, and global carbon levels have continued to increase largely unchecked.

The Great Barrier Reef Marine Park Authority (GBRMPA) and Queensland Government are undertaking a Strategic Assessment of the Great Barrier Reef World Heritage Area. Together with the 5 yearly Outlook Report cycle, this provides a critical opportunity for review and analysis of the status and trend of the biodiversity, heritage and community values of the Reef, and the cumulative impacts on those values, with a view to ensuring they are maintained in a future profoundly affected by climate change. Despite some impressive successes in management, the clear picture is of an ecosystem in decline, especially in the southern, inshore regions. Importantly, Reef stakeholders from a wide range of backgrounds and sectors strongly, indeed passionately, support the urgent need for a major increase in management action across the full range of pressures on the Reef, explicitly including the need for global action and leadership on reducing climate change. The GBRMPA's Climate Change Adaptation Strategy and Action Plan provides the basis for incorporating climate into reef management, but the context for that work is itself changing with these adaptive management processes.



Leading change on climate change - A decade of work

Oral

Session: Parallel session 22

Time: 11.00-11.15



¹Gabrielle McCorkell

¹Mornington Peninsula Shire, Victoria, Australia

The Mornington Peninsula Shire has been preparing for the potential impacts of climate change for a decade. Its commitment has been driven by the Sustainable Peninsula Initiative, developed in conjunction with the Mornington Peninsula community in 2001. The Initiative provides a framework that ensures it incorporates sustainability principles into its operations.

"Leading Change on Climate Change" is one of five key goals in the Shire's Community Plan. To achieve this goal, over a dozen strategies have been identified and articulated within its Strategic Plan; that flow into Business' Unit Plans.

The Shire has also integrated climate change risks into its Corporate Risk Register and the overall management of the Shire's approach to Climate Change is overseen by a cross functional internal Advisory Committee.

Recent outcomes include:

- a 60% reduction in potable water use to ensure better preparation for more severe droughts;
- a budget of \$30 million to develop and implement an Integrated Drainage Strategy focused on managing increased rain intensity and sea level rise;
- requirements for planning applications; coastal developments and Coastal Management Plans to identify and respond to sea level rise risks;
- an increase of \$1.5 million in annual fire prevention works;
- implementation of a Heatwave Strategy and action plans for vulnerable residents;
- ESD requirements incorporated into new Council buildings, refurbishments and purchases;
- innovative community engagement programs engaging over 15,000 residents; and
- ongoing amendment of the Planning Scheme to identify areas subject to climate change risks as data becomes available.



Legal frameworks for biodiversity conservation in a changing climate: can we do better?

Oral

Session: Parallel session 21

Time: 3.30-3.45



¹Phillipa McCormack, ¹Jan McDonald

¹University of Tasmania, Hobart, Tasmania, Australia

Australia is one of the most biodiverse countries in the world but, with high rates of extinction and ecological degradation, it has a poor record for biodiversity conservation. Many species and ecological communities are currently listed as endangered, threatened or vulnerable. Climate change will increase the pressure of existing stressors and pose an additional threat to these species and communities (Steffen et al, 2009). Climate change will also affect the resilience of populations currently considered healthy (Dunlop et al, 2012).

Although the climate change implications for Australia's biodiversity are well recognised, effective adaptation responses are only now emerging. Very little work has examined the role of conservation and natural resources law and policy in promoting or hindering adaptation. This paper seeks to fill this gap. It argues that current frameworks may require new mechanisms but, most importantly, we may need to rethink the fundamental goals of conservation law and policy.

The paper considers a range of adaptation strategies for conservation (including increasing the number, size, diversity, and connectivity of protected areas, engaging in assisted migration and captive breeding programs, and reducing existing stressors and threats) and how well current legal frameworks facilitate or impede their implementation. These options face technical, financial, political, ethical and legal barriers, but failure will have consequences across many sectors (Dunlop et al, 2012).

As conservation priorities shift towards transformation and adaptive management, so too must the supporting legal framework. At the very least, legal and institutional arrangements should not create unnecessary additional barriers for adaptation.



Climate change scepticism and voting behaviour: what causes what?

Oral

Session: Parallel session 4

Time: 3.45-4.00



¹Rod McCrea, ²Zoe Leviston, ²Iain Walker

¹CSIRO Ecosystems Sciences, Brisbane, Australia, ²CSIRO Ecosystems Sciences, Perth, Australia

Policies for action on climate change need support from the electorate. Such support necessitates that scepticism about anthropogenic climate change be low. Rational models of behaviour suggest that scepticism about climate change impacts on voting behaviour and election outcomes. However, other psychological theories suggest the reverse: that voting behaviour causes climate change scepticism. There is a growing body of research investigating the often strong associations between climate change scepticism and political preferences, but this research has been limited to correlational analyses. This paper uses longitudinal panel data from an Australian survey of attitudes to climate change and crosslagged modelling to make stronger causal inferences about the direction of impacts between scepticism and voting, while controlling for potential confounds. We found that voting influenced subsequent climate change scepticism, at both the individual and electorate levels, to a greater extent than scepticism influenced voting. This study covered a post-election context, the 2010 Australian federal election. Similar research is now needed in pre-election contexts. Nonetheless, these findings show that voting behaviour influences levels of climate change scepticism consistent with their party preference. An implication is that governments gain an advantage when implementing their climate change policies shortly after winning elections. Another is that partisan politics on climate change increase fluctuations in climate change scepticism. Alternatively, bipartisan politics decreases such fluctuations.



Adaptation planning and action for nine sectors in Tasmania

Oral

Session: Parallel session 34

Time: 1.30-1.45



¹Jan McDonald, ²John Harkin, ¹Andrew Harwood, ³Alistair Hobday, ¹Anna Lyth, ¹Holge Meinke

¹University of Tasmania, Hobart, Australia, ²Tasmanian Office of Climate Change, Hobart, Australia, ³CSIRO Climate Adaptation Flagship, Hobart, Australia

Research efforts around Australia have focused on improving adaptation in a range of sectors. While this research effort is relatively new, largely occurring since the establishment of the CSIRO Climate Adaptation Flagship and NCCARF in 2008, there is anecdotal evidence of changing sectoral practices in response to perceived or actual climate impacts. In this NCCARF-funded project, we reviewed adaptation research and action in Tasmania- a state facing unique challenges under climate change. It is likely to become a climate refuge for Australia as the southernmost refuge for a range of terrestrial and marine species, and a potential residential destination for mainland émigrés and industries displaced by climate change related impacts. It also has a unique socio-economic profile with a limited mix of industry, a low-density dispersed population, and some distinct regional differences. Thus, many impacts will be particularly felt by socially, physically and economically vulnerable communities with limited capacity or resources to adapt. Literature reviews, stakeholder interviews, and workshops revealed that Tasmania is a leader in adaptation research in some sectors, including marine and primary industries, due in part to strong research networks. In other sectors, such as health, there has been little directed research to date. Closely connected sciencemanagement-end user communities have progressed towards adaptation action, while more poorly connected sectors are still at the planning stage. By examining cross-sectoral linkages at state, national and international levels we also explored how Tasmania can provide and receive information to help with future adaptation planning, and reduce the risk of maladaptation.



Supporting local climate change adaptation: a participatory assessment tool for secondary cities in Vietnam and Bangladesh

Oral

Session: Parallel session 11

Time: 1.45-2.00



¹RMIT University, Melbourne, Australia

Vietnam and Bangladesh are countries already vulnerable to weather-related extreme events. Climate change, and changes to climate variability, will increase the risks for both countries in the future. This presentation will reflect on the lessons learned from participatory action research that was carried out jointly in the Vietnamese city of Hue and the Bangladeshi city of Satkhira to assess climate-related risks, identify adaptation options, and to strengthen local adaptive capacity. The focus on secondary cities was intentional from the outset as they face unique challenges - a combination of rapid growth and development, climate impacts, and in many cases less institutional capacity to respond than primary cities. Whilst numerous assessment toolkits already exist, these have typically been developed for rural or natural resource contexts. The objective of the recently completed research project was therefore to develop a flexible suite of assessment methodologies targeted specifically to the urban environment; as well as being suitable for use by local practitioners at the city and neighbourhood scales. The presentation will not only highlight some of the main findings from each of the case studies but will also critique the assessment to distil some key recommendations for future climate assessment activity in secondary cities across the Asia Pacific region.



Future Farm Landscapes - a new approach for engaging farmers in planning for climate change

Oral

Session: Parallel session 19

Time: 3.45-4.00



¹Ian McFarland, ^{1,2}Mark Stanley

¹Rural Solutions SA, South Australia, Australia, ²Regional Connections, South Australia, Australia

Farmers are faced with seasonal variability twelve months of the year, year in year out. It comes as no surprise that many farmers are somewhat sceptical about climate change and the so called carbon economy. Through the Future Farm Landscapes project a group of ten farm businesses on Eyre Peninsula, South Australia, have been looking at how they can use the experts and current best knowledge to plan the future for their farming businesses.

'Next generation' farm plans and action plans have been developed by each farm business. The plans incorporate assessments of production/risk, the value of biodiversity, a farm carbon audit and management strategies for the short to long term. The farmers have had the opportunity to hear the latest information and actively discuss climate change, soil carbon and biology, biodiversity values and carbon farming.

This paper will provide detail on the process used, outcomes from the planning process, farmer feedback and further recommendations for farmer engagement in climate change.



Hot weather and the health of working people - what protects them now?

Speedtalk

Session: Speedtalk session 12

Time: 5.20-5.25



¹Judith McInnes

¹Monash University, Melbourne, Victoria, Australia

Workers who undertake physical labour, who work outdoors or in hot humid environments, who wear protective clothing, or who cannot regulate their pace of work may be vulnerable to harmful effects of hot weather including heat-related illness and an increased risk of injury.

The impact of hot weather on worker health is likely to increase in the future. Climate model projections indicate that hot days and heatwaves are very likely to become more frequent and severe. Policies to reduce the risk of harm to workers from hot weather are therefore essential.

Through a systematic review of grey and peer-reviewed literature this study will investigate policies, regulations, standards and guidelines that are currently in place to minimise harm to workers from exposure to heat in Australia and internationally. I will also review the evidence base for existing policies and identify current gaps in policies and regulations.

Sources of information will include publications of relevant organisations, electronic databases, and electronic repositories of grey literature. Information will be sought about Australia, the USA, Canada, the UK, New Zealand, the Middle East and Singapore. Preliminary findings will be reported.

Knowledge of current policies to minimise harm to workers from hot weather, and of the evidence base for these, will highlight existing gaps, identify future research priorities, and inform policies to reduce occupational exposures, improve resilience and increase adaptive capacity.



Climate change and health in the South Pacific: Assessing vulnerability and planning health adaptations in Pacific Small Island developing states

Oral

Session: Parallel session 15

Time: 3.00-3.15

¹Lachlan McIver

¹World Health Organization, South Pacific Office, Suva, Fiji

Pacific island countries (PICs) are among the most vulnerable in the world to the impacts of climate change, including the likely detrimental effects on human health. Between 2010 and 2012, the World Health Organization (WHO) South Pacific office supported eleven PICs to conduct climate change and health vulnerability assessments and compile national adaptation plans of action to minimise the health impacts of climate change on island communities in the South Pacific.

This work was conducted via a mixed-methods approach, which combined quantitative analysis of the available climate and health data with a rigorous, qualitative "Health Impact Asssessment" methodology. The resulting National Climate Change and Health Action Plans provide an evidence basis for health systems strengthening strategies aimed at avoiding the most serious impacts of climate change on health in PICs.

This presentation summarises the methodology, key findings and implications of this vulnerability assessment and adaptation planning work, undertaken by WHO in collaboration with Ministries of Health and a range of other partners from across sectors, and lays out an adaptation roadmap for the health sector and agencies supporting health and wellbeing in the South Pacific.



The impacts of climate change on infrastructure and ecosystems

Speedtalk

Session: Speedtalk session 2

Time: 5.05-5.10



¹Lisa McKinnon, ^{1,2}Greg Fisk, ¹Rebecca Miller

¹Arup Pty Ltd, Brisbane, Australia, ²BMT WBM, Brisbane, Australia

In November 2012, the Abbot Point Cumulative Impact Assessment (CIA) was released detailing the cumulative environmental impacts associated with port expansion activities at the Port of Abbot Point in north Queensland. Commissioned by mining proponents and the port authority, the study represented a landmark approach to environmental assessment that was done both voluntarily and proactively by the proponents.

Supporting the CIA, were 16 technical studies exploring various environmental impacts. Two of the reports focussed specifically on climate change impacts and adaptation measures:

- 1. Potential impacts of climate change on the natural environment
- 2. Carbon footprint and climate change adaptation assessment for physical infrastructure

The first paper featured a vulnerability assessment and explored the impacts of climate change on the sensitive natural environment within the project areas, which included the Kaili Valley Wetland (A wetland of national significance), and the Great Barrier Reef World Heritage Area. The second paper analysed carbon emissions associated with the port's construction and future operation, and went on to explore the risk to physical infrastructure from the potential impacts of climate change making recommendations on building resilience into the future.

In presenting the methodology used to undertake these two technical studies on climate change, the authors will explore challenges associated with the development of key and critical infrastructure in coastal areas, the uncertainty and challenges of incorporating climate change into planning and decision making and provide insights and strategies for building climate resilient and adaptive approaches.



Taking the next steps towards building a city resilient to climate change

Oral

Session: Parallel session 22

Time: 11.30-11.45



¹Beth McLachlan

¹City of Melbourne, Melbourne, Victoria, Australia

This presentation will provide an overview of the key activities the City of Melbourne (CoM) is undertaking to build resilient in the city. CoM released its climate change adaptation strategy in 2009 and since then has undertaken a range of projects to understand and manage the associated risks facing the city.

Understanding the impact - CoM has undertaken research to further understand the impacts of climate change on our city, both from a social and an economic perspective. In 2010-11 CoM undertook social research to understand how our residents, businesses and visitors perceived the risks associated with climate change. In 2011 and 2012 two separate pieces of research were undertaken by CoM to understand the economic impact of two of the most significant climate change risks facing Melbourne, increased heat and floods. This presentation will discuss the findings of this research.

Working together - One of the key challenges facing any large community attempting to adapt to a changing climate is developing an effective approach to working together. CoM recognised the need for a network for those actively working on managing climate adaptation risks facing the Melbourne. In 2012 CoM established the Inner Melbourne Climate Adaptation Network (IMCAN) to facilitate this discussion. This presentation will discuss CoM's approach to understanding stakeholder's needs and building an effective network.

This presentation will also cover other program and activities CoM is undertaking to build a climate change resilient Melbourne.



Why should we take notice of you? Climate change science in complex community decision making

Oral

Session: Parallel session 32

Time: 2.00-2.15



^{1,2}**Josie McLean**, ²Sam Wells, ³Brett Bryan, ²Greg Lyle, ²Wayne Meyer, ⁴Chris Raymond, ⁵Mark Siebentritt, ³David Summers

¹The Partnership, SA, Australia, ²University of Adelaide, SA, Australia, ³CSIRO, SA, Australia, ⁴Enviroconnect, SA, Australia, ⁵Mark Siebentritt & Associates, SA, Australia

The history and literature of community engagement is extensive and impressive. On the ground, there has been much good work done. But in relation to climate change mitigation and adaptation, it appears that community decision-making processes still struggle to embrace sound science...and the scientists who proclaim it. The complex socio-ecological systems within which decisions are made about landscape futures preclude certainty, and science, so long perceived as the champion of certainty, must develop the capacity to contribute to a cycle of 'action learning', rather than to supply 'right answers'.

This paper focuses on one approach to the facilitation of community decision making informed by climate science and scientists. It draws on our experience with complexity thinking and the dynamics of organisational change, seen through the lens of complexity. In particular, our research has explored the value of an envisioning process that facilitates adaptive change 'on the ground'.

We describe the contribution that envisioning can make to regional NRM planning and explore the conceptual flaws in planning processes based on 'Newtonian' or linear, mechanistic assumptions.

Envisioning nourishes a more systemic, organic approach to planning and decision making, which honours the nature of complex living systems, and brings science and scientists to the table without alienating or patronizing the local community.

Finally, we touch on the institutional changes that could support and enable local communities as they shape sustainable landscape futures in collaboration with the best that science can contribute.



Adapted future landscapes - from aspiration to implementation

Oral

Session: Parallel session 12

Time: 1.15-1.30



¹Wayne Meyer, ²Brett Bryan, ²David Summers, ¹Greg Lyle, ¹Sam Wells, ¹Josie McLean, ¹Travis Moon, ³Mark Siebentritt

¹University of Adelaide, Adelaide, Australia, ²CSIRO Ecosystems Sciences, Adelaide, Australia, ³Mark Siebentritt & Associates, Adelaide, Australia

Helping regions in Australia adapt through planning and implementing changes in land use for food and conservation in the face of changing climate, markets and social requirements is important. Studies have shown that it is theoretically possible to adapt well but this will require policy incentives and guidance for planning and actions. This project worked with Eyre Peninsula and the Murray Darling Basin NRM Regions in South Australia to test a new approach to engagement and planning and to help regions and communities plan better to become 'climate change ready'.

The research team worked with community representatives and NRM Board staff to review previous planning processes. The same groups then underwent an envisioning process to develop a shared vision of the region expressed through narratives of how they wanted to experience the planning process and the regional landscape. This brought disparate groups together and drew out explicit shared values, which when embedded in the planning process address how people really want to live within their region. This process informed the development of the user friendly and spatially explicit Landscape Futures Analysis Tool (LFAT). LFAT enables users to consider, quantify and interrogate different climate and market conditions and how these may impact upon the regional economy, land use and biodiversity. This process is now being used in these regions to facilitate engagement and inform their next round of regional planning and assist prioritisation of actions.



Natural disasters in the Australian press: implications for climate change policy

Oral

Session: Parallel session 25

Time: 11.30-11.45



¹Diana MacCallum, ¹Garry Middle, ¹Rebecca Scherini

¹Curtin University, Perth, Australia

One of the acknowledged likely impacts of climate change will be an increase in both the frequency and intensity of natural disasters such as flood and fire. As such, natural disasters have the potential to serve as catalysts for the development of climate change adaptation policy. This paper is concerned with this potential, and takes as its starting point the extraordinary series of natural disasters that occurred in the summer of 2010-2011. The paper looks at the shape of public discourse surrounding two of these events - the Queensland floods and the Perth bushfires - through the medium of the press. Using a corpus of articles from the mainstream State and national newspapers (The Courier Mail, the Sunday Mail, the West Australian, the Sunday Times, and the Australian), we identify the key themes that dominate the press coverage, finding that climate change tends to be left almost entirely out of these accounts - both in the reporting of the events themselves and in commentary about their implications. The paper concludes with some discussion of this finding with respect, firstly, to some possible reasons for it and, secondly, to its implications for climate change adaptation policy in Australia.



Food safety practices and knowledge during heat waves: A survey of Salmonella and Campylobacter cases

Speedtalk

Session: Speedtalk session 4

Time: 5.05-5.10



¹**Adriana Milazzo**, ^{2,1}Ying Zhang, ³Ann Koehler, ^{4,1}Janet Hiller, ¹Peng Bi

¹The University of Adelaide, Adelaide, South Australia, Australia, ²The University of Sydney, Sydney, New South Wales, Australia, ³SA Health, Adelaide, South Australia, Australia, ⁴Australian Catholic University, Melbourne, Victoria, Australia

In Australia, heat waves are increasing in frequency, intensity and duration. Warmer ambient temperatures can compromise food safety with a potential direct effect on human health, being an increase in foodborne diseases. The aim of this project is to explore if people's knowledge, eating behaviours, food preferences, and food processing practices during hotter days, may contribute to increased cases of Salmonella and Campylobacter infection.

The project is in partnership with Communicable Disease Control Branch (CDCB) SA Health and is important because information from the survey will help to develop appropriate messages to the public about ways to prevent themselves or their family from becoming ill with infectious gastroenteritis during heat wayes.

A cross-sectional survey to elicit information from Salmonella and Campylobacter cases about food safety practices of their households during hot weather, including an exploration of attitudes and knowledge is currently being conducted. Confirmed cases resident of South Australia and notified to CDCB with an onset of illness from 1 January to 31 March 2013 are invited to participate in the survey. The survey tool is a structured questionnaire in electronic or hard-copy format. Comparison analyses will be performed using t test and $\chi 2$ test. Relevant ethical approvals have been obtained.

Results are preliminary and a full analysis will be available June 2013. The findings from this study will provide information for early warning systems to the public about the risk of Salmonella and Campylobacter infection during heat waves as well as policy recommendations at different government and non-government levels.



The Activation of policy and institutional responses to heat waves: a socio-cultural analysis

Oral

Session: Parallel session 27

Time: 11.00-11.15



¹Annie Bolitho, ²Fiona Miller

¹University of Melbourne, VIC, Australia, ²Macquarie University, NSW, Australia

It is vital to understand the socio-cultural terrain of complex decision making in response to heat extremes. Increasingly commonplace in cities, such events introduce multi-stress vulnerability, affecting health and well-being, finances, mobility, social relations and access to basic services. Planning to reduce heat vulnerability has become part of government business and community level planning. But how well are the social and equity dimensions of extreme heat addressed? Our research, based on interviews and desktop research in Melbourne Australia (2011), found tensions between addressing heat as an emergency versus heat as ongoing chronic stress. These tensions between approaches stand in the way of effective activation of an institutional response. In a complex decision making environment, consideration must be given to the development of relations between policy managers, non-government organisations and vulnerable people to be effective in extreme heat scenarios. Further, sharing disciplinary assumptions and approaches to protecting vulnerable people needs to be part of preparation for management of extreme heat. This will enable different actors to understand tensions between framing and responding to heat as an emergency versus heat as chronic stress, and to enact responses that take into account the often chronic structural factors that shape vulnerability.



Reconceptualising hospital facility resilience to extreme weather events using a panarchy model

Speedtalk

Session: Speedtalk session 6

Time: 4.50-4.55



¹Anumitra Mirti-Chand

¹University of New South Wales, Sydney, NSW, Australia

Hospitals have a pivotal role in disaster management and as a critical infrastructure provide healthcare needs in managing large scale injuries and illness associated with disasters. However, the fragility of the hospital built infrastructure to the increasing frequency and intensity of natural disasters in particular extreme weather events have been widely acknowledged. There is increasing evidence of hospital services being disrupted during such events. Given the vulnerability of hospitals to extreme weather and the significance of their service delivery to social and economic wellbeing, there is an urgent need for research into factors that contribute towards hospital resilience in these situations. Using a panarchy model to integrate theories of resilience, adaptation and learning, a new conceptual framework is presented to inform the development of more effective hospital resilience strategies.



Climate change and population vulnernability in Tuvalu

Poster

Session: Poster session



¹Racheal Missingham

¹Griffith University, Brisbane, Queensland, Australia

A number of extreme events are part of natural climatic variability. However there is a growing concern for affected population in Tuvalu, especially when the population have high likelihood of being vulnerable to significant impacts of climate change. The significant consequences of climate variation have forced people to migrate to safe place as the Pacific Islands Region are ill-equipped to address this issue in an effective manner (Morton et al., 2008). There is evidence of interdependencies between policy issues, climate changes and migration however it requires collaboration between the governments within Pacific Region. At the same time, existing programmes and policy frameworks have significant gaps that make it difficult to address the problem adequately. The purpose of this research is to explore the relationship between climate change and population vulnerability in Tuvalu to establish a policy analysis to develop effective policy responses to population vulnerability and how to adapt and mitigate the impacts of climate change.



Lessons learnt in translating climate data for use by impact scientists and policy makers

Speedtalk

Session: Parallel session 7

Time: 4.20-4.25



¹Erin Roger, ¹Polly Mitchell, ¹Mark Littleboy, ¹Graham Turner

¹Office of Environment and Heritage, Sydney, NSW, Australia

The NSW Office of Environment and Heritage is working to provide a regionally specific information resource outlining the best known information on climate change and the potential impacts for the Sydney Metropolitan Area. To enable this, researchers from the University of NSW have developed high resolution climate projections for the Sydney Metropolitan Area using dynamical downscaling to 2km grids. Impact researchers are translating this data into a series of biophysical impact assessments. Findings from this work are being compiled into the Sydney Climate Impact Profile. The project has encouraged the application of new data and built greater knowledge of the biophysical impacts of a changing climate for Sydney. Importantly, the project has also served as a test case for the delivery of raw data access and impact assessments for the broader NSW and ACT Regional Climate Modelling (NARCIIM) project. This presentation will discuss the lessons learnt in making large climatic datasets accessible and usable for impact scientists and policymakers. We discuss the observed "disconnects" that can occur between climate modellers and impact scientists. We highlight important issues with data formatting, data transformation, data quality assurance and differences in communication and terminology that can significantly affect the translation of projections data into usable climate impact information. Finally, we emphasise the importance of continued dialogue and knowledge sharing in order to ensure climate science is effectively interpreted into other research areas and into the policy-making process.



climateadaptation knowledge + partnerships

Understanding coral range expansions to enhance management strategies

Oral

Session: Parallel session 17

Time: 3.30-3.45



¹Toni Mizerek, ¹Joshua Madin, ^{1,2}Andrew Baird

¹Macquarie University, NSW, Australia, ²James Cook University, QLD, Australia

Increased sea surface temperatures as a result of global climate change are contributing to the potential for alterations in marine species' range distributions. Hundreds of coral species thrive in the northern waters of Australia and recent observations have documented several of these species' ranges expanding poleward. I seek to understand and predict which coral species are more likely to move southwards along the Australian coast as waters warm and which native species will be most likely displaced. Using a comprehensive database of coral species traits and geographic ranges, I will present evidence that species that are generalists (in terms of the depths and water quality they tend to occupy), attached to hard substrates, and are able to grow "off reef" (e.g., on rock) are most likely to migrate southward along the New South Wales coastline. Based on present-day correlations of species ranges with environment (namely temperature), I will then present future predictions of range extensions based on climate change scenarios and species traits. Understanding the relationships between species' distributions, traits, and the environment, and thus predicting how those relationships may change, can directly inform monitoring efforts, the evaluation process, and ultimately inform the adjustment of management strategies through proactive rather than reactive efforts.



Rockhampton 2050: defining current and future climate hazard for planning consideration

Oral

Session: Parallel session 34

Time: 2.15-2.30



¹Duncan Moore, ¹Martyn Hazelwood, ¹Bob Cechet, ¹Craig Arthur, ¹Ian French, ¹Richard Dunsmore, ¹Augusto Sanabria, ¹Tina Yang, ¹Martine Woolf

¹Geoscience Australia, Canberra, ACT, Australia

Potential impacts of climate change present significant challenges for land use planning, emergency management and risk mitigation across Australia. Even in current climate conditions, the Rockhampton Regional Council area is subject to the impacts of natural hazards, such as bushfires, floods, and tropical cyclones (extreme winds and storm surge). All of these hazards may worsen with climate change. To consider future climate hazard within council practices, the Rockhampton Regional Council received funding from the National Climate Change Adaptation Research Grants Program Project for a project under the Settlements and Infrastructure theme. This funding was provided to evaluate the ability of urban planning principles and practices to accommodate climate change and the uncertainty of climate change impacts. Within this project, the Rockhampton Regional Council engaged Geoscience Australia to undertake the modelling of natural hazards under current and future climate conditions. Geoscience Australia's work, within the broader project, has utilised natural hazard modelling techniques to develop a series of spatial datasets describing hazards under current climate conditions and a future climate scenario. The following natural hazards were considered: tropical cyclone wind, bushfire, storm tide, coastal erosion and sea-level rise. This presentation provides an overview of the methodology and how the results of this work were presented to the Rockhampton Regional Council for planning consideration.



Alternative futures for climate change adaptation of coastal settlements and communities

Oral

Session: Parallel session 29

Time: 1.30-1.45



¹Phil Morley, ¹Jamie Trammell, ¹Judith McNeill, ¹Ian Reeve, ¹David

¹Institute for Rural Futures, University of New England, NSW, Australia

Though shaped by past elements, history demonstrates that future landscapes will be very different from those of the present. This is particularly so in coastal areas of rapid urban growth. The effects of climate change in the future will therefore be impacting on

these quite different landscapes, not on those we see today. To gauge the severity of these impacts we must understand the future settlement patterns likely to emerge. This project examines the past and present drivers of landscape change in the Northern Rivers region of north-eastern New South Wales, and then models several scenarios for the future, based on land use planning decisions that might be taken. For example, the two extremes are a scenario of 'deregulated' growth, and one which takes a high degree of precaution, a 'high climate adapted' scenario. The effects of these 'alternative futures' can be visualised, and the area of land, and number of people affected by climate change impacts, quantified.



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Using the Köppen climate classification scheme to examine potential climate change in South East Australia

Speedtalk

Session: Speedtalk session 7

Time: 5.10-5.15



Tim Morrissey, ²Harvey Stern, ²Robert Dahni, ^{3,4}Leanne Webb, ^{3,4}Penny Whetton, ⁴Craig Heady, ^{3,4}John Clarke

¹Office of the Commissioner for Environmental Sustainability, Melbourne, Victoria, Australia, ²Bureau of Meteorology, Melbourne, Victoria, Australia, ³Climate Adaptation Flagship, Aspendale, Victoria, Australia, ⁴CSIRO, Marine & Atmospheric Research, Aspendale, Victoria, Australia

The modified Köppen climate classification scheme, developed for Australia by BoM, is a useful tool for visualising climate change projections and communicating potential impacts by making direct comparisons to present day conditions.

We used the Köppen scheme to generate a map of current climate zones (based on 1975-2004) for SE Australia. Victoria is dominated by Temperate climate in the south and drier Grassland in the north. Desert and Subtropical climate zones are present in New South Wales. We compared baseline climate zones to outcomes from 23 CMIP3 models for the years 2030 and 2050 under the SRES scenarios A1FI, A1B and B1.

Overall, in 2050 there was a decrease in the median area of Temperate (from 55% to 37%) and Grassland (from 40% to 35%) zones. These decreases were matched by increasing southward movement of Desert and Subtropical climate zones. We analysed future climate outcomes for selected locations in Victoria. In Mildura, all models showed a warmer climate by 2050 with a transition from Grassland to Desert classification in 57% of models under A1FI and 22% under B1 scenarios. Avalon, currently in the Temperate zone, shows an emergent Grassland climate in many of the models and, under A1FI, this is the dominant (74%) outcome. Outcomes for central Melbourne show a warmer climate in 2050 and transition to a drier Grassland climate is a possibility under A1FI. We discuss the implications for adaptation in areas that have the greatest potential change, such as Northwest Victoria.



Perceived coastal distress in tsunami affected Andaman Islands of India and psychological/behavioural resilience to climate change

Speedtalk

Session: Speedtalk session 4

Time: 4.50-4.55

¹Ruchi Mudaliar, ^{1,2}Parul Rishi

¹Sant Hirdaram Girls College, Bhopal, Madhya Pradesh, India, ²National Institute of Technical Teachers' Training and Research, Bhopal, Madhya Pradesh, India

Islands are examined due to their increased vulnerability to climate change related hazards like flooding, sea-level rise, storms, cyclones etc. Out of the several projected impacts of climate change in India, coastal zones are apprehended to suffer most devastating effects. India has been identified as one amongst 27 countries which are most vulnerable to the impacts of global warming related accelerated sea level rise (UNEP, 1989). Under article 6 of New Delhi Work Programme (2007), a special effort to foster psychological/behavioral change has been stressed through public awareness. In view of this, a psychological assessment of Indian islanders' perceptions, stressors and resilience to climate change was conducted in Tsunami affected Andaman islands of India (N=100 adult respondents) using Islanders' Perception to Climate Change Inventory (IPCCI) classified into subsections like Climate Change Perceptions, Islanders' Distress, Coping/Adaptation and Psychological Resilience. Results were discussed in line with human-climate interface/ psychological variables in order to suggest tradeoffs between individual, community and institutional responses to natural disasters so that resilience and subjective well being can be further promoted in islanders to overcome the anticipated distress from Tsunami like environmental events.



climateadaptation knowledge + partnerships

Climate resilient seaports

Oral

Session: Parallel session 16

Time: 3.30-3.45



¹Jane Mullett, ¹Darryn McEvoy

¹RMIT University, Melbourne, Victoria, Australia

As highlighted by the National Adaptation Research Plan for Settlements and Infrastructure, seaports are vital to Australia's current and future prosperity and there is recognition that climate change impacts will pose challenges to the operation of seaports and their associated infrastructure over coming decades. However, whilst there has been considerable emphasis placed on the importance of ports and the need for anticipatory planning to ensure a sustainable ports system in the future, the integration of climate change impacts into decision-making processes remains at an embryonic stage, and in many cases the required technical detail remains lacking. This presentation will highlight some of the challenges involved when assessing the risks that Australian ports need to contend with; not only contributing to the knowledge-base generally but also describing the development of an integrated assessment methodology that can be replicated for other cases and other infrastructure types. Particular attention will be paid to the interpretation of climate projections, reconciling climate data with research needs (assessing the vulnerability of infrastructural and functional assets), and contextualising the data with information on non-climate drivers. The presentation will conclude by highlighting some of the major implications of ensuring the resilience of Australian seaports.



Climate Smart Seaports: online decision support tool for climate resilient seaports

Speedtalk

Session: Speedtalk session 10

Time: 4.50-4.55



¹Jane Mullett, ¹Darryn McEvoy, ¹Heinrich Schmidt, ¹Sophie Millin, ¹Alexei Trundle, ¹Ravi Sreenivasamurthy, ¹Guilluame Prevost

¹RMIT University, Melbourne, Victoria, Australia

Building on NCCARF-funded research into the resilience of seaports to a changing climate, this project is creating an online decision support tool which can be readily used by port authorities and others in Australia and potentially internationally. This activity will involve three discrete components: (1) the sourcing and refinement of multiple large scale data sets needed for context specific climate change adaptation decision-making; (2) the integration of both primary and transformed data; and, (3) the development of innovative software that provides an interactive interface (developed in consultation with port authorities) for considering future climate change impacts, the implications for organisational risk management strategies, and the identification of possible adaptation options. This ANDS-funded Applications project adds value by building on scientific knowledge, translating science into usable information for the policy community, and through direct application by practitioners.



Rapid assessment model for reconstruction following extreme weather events in Victorian parks

Speedtalk

Session: Speedtalk session 6

Time: 4.40-4.45



¹Joseph Mumford

¹Parks Victoria, Melbourne, Victoria, Australia

Climate change presents new challenges for managing Victoria's parks. In the last decade the parks system has experienced a number of major bushfire and flood events that are consistent with scientific projections for extreme weather events that are more frequent, more intense and more widespread. The high cost to respond and recover from these events has given impetus to improve planning for risks and reconstruction that builds resilience for future events. Two key adaptation responses have followed Parks Victoria using its established risk based management approach to understand the potential impacts of climate change. 1) The recovery planning Visitor Experience Rapid Assessment Process (VERAP). This provides a strategic basis for making rapid decisions about the treatment of visitor sites which have been impacted by extreme weather events. Site treatments include: reinstatement, redesign or reduction. VERAP incorporates the key components of the visitor experience offer: setting, activity and infrastructure, into emergency recovery of visitor sites. Major parks such as Wilsons Promontory and the Grampians that have experienced several extreme weather events over 2010 and 2011 are used as examples. 2) The Future Coasts spatial datasets for sea level rise and storm tides for 4 scenarios (2009, 2040, 2070 & 2100) have been used to assess parks with vulnerability due to low lying marine and coastal environments along the Victorian coast. Parks in Port Phillip, Westernport and Corner Inlet will be used as examples for risks associated with sea level rise and storm tide impacts on environmental and infrastructure assets.



climateadaptation knowledge + partnerships

Walking on Country with Spirits: Enhancing adaptive capacity through Aboriginal research tourism

Speedtalk

Session: Speedtalk session 1

Time: 4.40-4.45



¹Helen Murphy, ^{1,2}Marilyn Wallace

¹James Cook University, Cairns, Australia, ²Bana Yarralji Rangers, Rossville, Australia

This paper describes an Aboriginal research tourism enterprise with a specific focus on how climate change information is gained and shared between Aboriginal people and the scientific community within a tourism context. This paper describes the Aboriginal research tourism enterprise of Bana Yarralji located in the Wet Tropics World Heritage area. Aboriginal research tourism is a relatively new phenomenon whereby scientists, students and volunteers pay to experience cross cultural collaboration in research on Aboriginal land.

Aboriginal people throughout northern Australia experience high levels of vulnerability to climate change. The competition for research and grant monies in climate change research is fierce, yet the impact is enduring and profound for Aboriginal people in the Wet Tropics. This paper describes how Bana Yarralji have acknowledged climate change as an impact on their culture and livelihoods and how they have in turn incorporated their own monitoring activities into their product range of research tourism opportunities. This research is important as it describes how an Aboriginal group identified a gap in the tourism market and are using this opportunity to create jobs, foster knowledge exchange and mitigate the effects of climate change. The results from this research demonstrate that knowledge of climate change adaptation and mitigation can be achieved through tourism enterprise and offers outstanding opportunities to both the scientific community and students alike for cross cultural collaboration in climate research activities.



Understanding the adaptive capacity of Small-to-Medium Enterprises (SMEs) to climate change and variability

Speedtalk

Session: Speedtalk session 6

Time: 4.45-4.50



¹Janina Murta, ¹Natasha Kuruppu, ¹Pierre Mukheibir

¹Institute for Sustainable Futures, Sydney, Australia

Small to medium enterprises (SMEs) play an important role within socio-economic systems. Comprising 96 per cent of all private businesses in Australia, SMEs are the largest employers and significant contributors to GDP. The extent to which this sector adapts to climate change risks will thus shape the extent to which society in general, deals with these same stresses. This study examines the underlying factors and processes shaping the adaptive capacity of SMEs in Australia to climate change.

In exploring the processes that mediate adaptive capacity of SMEs, the study adopts theories from Political Ecology and draws on literature on vulnerability and hazards.

A central conclusion is that contextual processes operating externally to the SMEs at various spatial scales, and at different tiers of governance, are critical to enhancing the adaptive capacity of SMEs. These processes have been largely overlooked in formal programmes that aim to build business resilience to climate extremes; these tended to be reactive and focus on business recovery during and after disaster events rather than altering the vulnerability context through anticipatory prevention and preparedness or adaptation planning. The research indicates that many of the measures required to enhance the adaptive capacity of SMEs in ensuring business continuity under climate change can be integrated into existing processes and networks. There are opportunities on several fronts to build on existing programmes and strengthen existing networks to support vulnerability reduction.



Would somebody please listen – Applying insights from behavioural economics and social psychology to coastal adaptation

Speedtalk

Session: Speedtalk session 2

Time: 5.20-5.25

¹Konar Mutafoglu

¹Global Change Institute, University of Queensland, St. Lucia, Queensland, Australia

To understand and manage climate impacts, individuals, communities, businesses, and governments need to process climate information, assess risks, and evaluate different adaptation options under uncertainty. Such a complex process places a number of burdens that may result in barriers to effective adaptation. This work provides an overview of findings from behavioural economics, social psychology and related fields that are relevant to adaptive behaviour. The case of coastal adaptation serves as an example to discuss some techniques to overcome these constraints and barriers.

Decision-makers can underlie cognitive constraints that lead to inconsistent, biased or seemingly irrational decisions. Facing the uncertainty of climate projections, it may be tempting to call for more data, and more detailed regional or sectoral assessments. With more choice options, individuals as well as organizations may be reluctant to take decisions. In such situations, mental shortcuts and rules of thumb replace a structured decision-making progress. Relevant to climate adaptation are also cognitive limits to process probabilities or non-linear developments.

For managing climate impacts, the capability of taking time-consistent decisions becomes crucial. When confronted with choices at different points in time, decision-makers may opt for inconsistent choices. A further important area relates to how information is processed, based on prior knowledge or beliefs as regards climate risks, which has to be taken into consideration when presenting new findings to decision-makers. In an organizational context, further behavioural effects such as group dynamics are relevant as well. These and the above factors warrant for special care when communicating climate information.



Planning for sustainable urban water systems in adapting to a changing climate - a case study in Can Tho City, Vietnam

Oral

Session: Parallel session 2

Time: 3.30-3.45



¹Minh Nguyen, ¹Stephen Cook, ¹Magnus Moglia, ¹Luis Neumann, ²Hieu Trung Nguyen

¹Climate Adaptation Flagship, CSIRO, Melbourne, Australia, ²College of Environment and Natural Resources, Can Tho University, Can Tho, Viet Nam

The Climate Adaptation through Sustainable Urban Development was a research initiative supported by the AusAID-CSIRO Alliance, which focussed on how to bring sustainable urban development principles into practice, as an effective means of adapting to climate change. The project in Can Tho City, Vietnam, investigated the use of Integrated Urban Water Management principles to improve the planning of urban water services, through which to enhance the resilience of the city to climate change. The project demonstrated an approach to build adaptive capacity for local communities in Mekong Delta region.

The project ran over two years from October 2010 to September 2012, with three focus areas: (1) understand the current context for water service provision in the city, and implications of climate change; (2) develop a set of strategic adaptation options with the city; and (3) demonstrate 'no-regret' adaptation options through pilot case studies. The research was underpinned by the development of strong partnerships with local stakeholders, and the active involvement of local research partners.

The project has produced a range of outputs targeted to providing practical knowledge and useful tools that support planning for adaptive and sustainable water supply and sanitation systems. The project developed the new research for development capacity through working alongside local research partners. Also, the project has introduced a systems way of thinking, which encouraged local stakeholders to depart from traditional 'silo' management to an integrated thinking and collaborative approach. The project team received the City Award in recognition of the contribution to the city's development.



Service life of housing structures in a changing climate

Speedtalk

Session: Speedtalk session 2

Time: 4.45-4.50



¹Minh Nguyen, ¹Xiaoming Wang, ¹Guy Barnett

¹CSIRO Climate Adaptation Flagship, Melbourne, Australia

The service life of a structure is defined as the lifetime that a structure is considered to maintain an acceptable level of performance. Billions of dollars are spent annually maintaining the service life and thus performance of existing infrastructure against material degradation, which is strongly governed by local climate and the surrounding environment. However, climate change science has projected a different climate in the future to the one that we experience today. These changes in local climate are likely to affect the rate of degradation in materials and therefore the expected service life of structures.

This presentation outlines a quantitative approach for assessing the impacts of future climates on the durability performance of construction materials commonly used in housing, including structural steel and timber. These assessments were made using available durability models developed for structural engineering purposes, with the results used to estimate the changes in service life of housing structures in a changing climate. Climate change projections were developed using the emission scenario A1FI and nine different Global Circulation Models. To demonstrate the approach, the outcomes are presented for four Australian cities covering diverse climates: Melbourne, Sydney, Brisbane and Townsville.

The implications of this research and the opportunities for progressively incorporating climate change adaptation into the mainstream risk management and business planning of organisations responsible for the construction of new housing and for those managing large housing portfolios are discussed. The study formed part of a recent NCCARF project on adaptation pathways for low income housing.



Adaptation Research Synthesis - Lessons for State Government policy anddecision makers

Oral

Session: Parallel session 21

Time: 4.15-4.30



¹**Michael Nolan**, ¹Jennifer Cane, ¹Laura Cacho, ¹Nicholas Dircks, ²Greg Picker, ³Guillaume Prudent-Richard, ¹Peter Steele, ¹Sandra Valeri

¹AECOM, Melbourne, VIC, Australia, ²AECOM, Brisbane, QLD, Australia, ³AECOM, Canberra, ACT, Australia

Adaptation research is useful when it helps people make informed decisions that reduce risk and increase resilience to the impacts of climate change. This presentation will explore the NCCARF Adaptation Synthesis Project, which provides a synthesis of research outputs for each Australian state and territory. This synthesis informs state and territory policy makers of the strategic implications and lessons that can be learned from adaptation research. It seeks to present findings in a way that will enhance adaptation understanding of decision-makers in state government.

The research examined for this synthesis explores a broad range of themes and sectors, such as natural resource management, primary production, emergency management, health, and community resilience. However, the synthesis looks across themes and captures cross-sectoral findings. Lessons explored in the presentation may include:

- Recommendations of ways to increase resilience and adaptive capacity pre- and post- extreme events through better messaging and communication;
- An understanding of community expectations of government regarding adaptation;
- The challenges and recommendations regarding the timing and scale of adaptation;
- How experience with previous climate-related disasters can help and hinder adaptation action;
 and
- The constraints of current models and economic approaches for financing adaptation.

The NCCARF Adaptation Synthesis Project also highlights some of the key findings of the research regarding how researchers and decisions-makers can better engage and focus their research on practical outcomes. The presentation will explore the challenges of coordinating outcome-based, policy-relevant research activities and how these issues may be overcome to improve research outcomes for both researcher and end user.



Have we got farmers' attitudes to climate change wrong? Experiences from Victoria and WA

Oral

Session: Parallel session 4

Time: 4.00-4.15



²Graeme Anderson, ¹Chris Evans, ¹John Noonan, ²Danielle Parke, ¹Chris Sounness

¹Curtin University, Western Australia, Australia, ²Department of Primary Industries, Victoria, Australia

Research in WA in 2008 showed only a third of farming community participants accepted climate change was occurring. Scepticism and uncertainty with poor understanding of the associated issues, in an environment where there was a high frequency, range and volume of messages about climate change in various forms, was common. A 2011 Victorian survey identified low belief in climate change; however, it showed farmers were responding to the impacts of climate change. These studies provide insights into farmer attitudes and behaviours about variability of climatic conditions and climate change. Profiling in the WA study identified three climate change attitude typologies - 'Acceptors', 'Uncertains' and 'Sceptics'. The typologies were defined by statistical linked patterns associated with climate change, science and scientific information and experience of living in an area or farming. Such attitudes indicate the need to implement different approaches to diffusing climate information. Curtin University's RuralGROWTH program in WA and DPIV's climate extension program, independently

Curtin University's RuralGROWTH program in WA and DPIV's climate extension program, independently used approaches where climate change and impacts were framed within local and industry contexts: acknowledging farmers' knowledge, experience, observations and language. The approaches reduced divergence between farmer and science knowledge forms, enabling pathways for scientific knowledge to be linked and incorporated into farmers own knowledge forms without conflict.

There are many barriers blocking farmer "acceptance" of climate change as yearned for by many scientists and policymakers. The Victorian and WA experiences provided new approaches capable of creating better spaces in which to realistically consider climate and the adaptation pathways open to farming businesses.



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Coastal urban climate futures in South East Australia: from Wollongong to Lakes Entrance

Oral

Session: Parallel session 3

Time: 3.15-3.30



¹Barbara Norman

¹University of Canberra, ACT, Australia

The southeast coastal region of Australia provides a unique opportunity to examine small town communities in the context of climate change. This is when coastal pressures are apparent but still of a scale where strategic intervention could make a long-term difference to coastal urban futures. The key research question explored is what a climate adapted Australian settlement would look like from the perspective of coastal small town communities to 2030. This presentation will outline the key issues, challenges, scenarios and findings. The research focused on seven local government areas – Wollongong, Shoalhaven, Shellharbour, Kiama, Eurobodalla, Bega and East Gippsland, involving two states and relevant regional organizations. An interdisciplinary approach was taken involving coasts and climate change, urban and regional planning, health and wellbeing. A distinctive element of the methodology was a focus on local and regional perspectives. Focus groups involving key government decision makers raised significant issues including governance. A key outcome is an understanding of two contrasting scenarios – business as usual and a more collaborative approach to coastal urban futures. Policy implications for coastal urban futures for the southeast coast are then discussed. In conclusion some principles are suggested as a framework for consideration for climate adapted small coastal towns 2030



The contributions of microfinance organisations to reducing vulnerability to climate change

Oral

Session: Parallel session 23

Time: 12.15-12.30



¹**AKM Nuruzzaman**, ¹Jon Barnett

¹The University of Melbourne, Melbourne, Australia

Research and policy both recognise that many people in Bangladesh are highly vulnerable to climate change, for they are both extremely exposed to climate related hazards and adaptive capacity is very low. Bangladesh is also well known for the extent and effectiveness of its microfinance industry: some 60% of the country's population are actively engaged with at least one microfinance organisation. Microfinance organisations provide capital and skills and help build social networks. It is to be expected, then, they would help reduce vulnerability to climate change, although until now this has never been empirically examined. The objective of this presentation is to explain the contributions microfinance organizations make to reducing vulnerability to climate change in Bangladesh. It discusses findings from research investigating the outcomes of the work of one national-level and one local-level microfinance organisation, both working in a disaster-prone coastal area in south-western Bangladesh. Quantitative and qualitative data was collected through interviews, focus group discussions and participatory observations over 10 months between 2011-12. Preliminary results indicated that while microfinance can help reduce vulnerability, it is effective only at the margins by helping people with immediate needs post-disaster, while the deep social causes of vulnerability - such as poverty and gender discrimination are not always sufficiently addressed. Nor has microfinance helped reduce peoples' exposure to climate risks. So, while the current model of microfinance might help many households to reduce vulnerability in the short-term, it is not always effective in helping people to get beyond the vulnerability trap.



Property, Power, and Process. The role of property value in climate adaptation.

Oral

Session: Parallel session 21

Time: 4.00-4.15



¹Tayanah O'Donnell

¹University of Western Sydney, Sydney, Australia

Since 2007, climate change discourse has shifted significantly in its focus on adaptation contra mitigation strategies. At the same time, various response strategies designed to aid and encourage local, placebased adaptation have been scrutinised and analysed for both effectiveness in attempting to mitigate against the impacts of climate change and in terms of aiding broader adaptation plans. Increasingly, and for a number of reasons, law as an institution became a tool that both drove and supported such adaptation strategies, particularly in the context of sea level rise and coastal planning, within Australia.

A comparative case study has been completed in two coastal councils located in New South Wales, Australia. Port Stephens and Lake Macquarie Local Government Areas were chosen due to having a significant amount of residential property 'at risk' resulting from expected increased flood and coastal hazard events due to expected climate change induced sea level rise, and also because of their contrasting policy positions on climate change. A predominately qualitative methodology was utilised to explore climate change adaptation in the context of the rule of law, the public and private property divide, and place-based governance.



Yield, carbon density and climate change impact on Bagras (Eucalyptus deglupta Blume) in smallholder tree-based agroforestry systems in Northern Mindanao, Philippines

Poster

Session: Poster session



¹Richmund Palma, ²Wilfredo Carandang

¹Misamis Oriental State College of Agriculture and Technology, Claveria, Misamis Oriental, The Philippines, ²University of the Philippines Los Banos, Los Banos, Laguna, The Philippines

Agroforestry systems using Eucalyptus deglupta Blume for timber and biomass production are essential options for smallholder agroforestry farms in northern Mindanao, Philippines for the reason that they amalgamate timber and food production. In this study, the multiple linear regression analysis was used to develop an appropriate prediction model for estimating yield and carbon sequestration stand attributes (i.e. age, site index, spacing, basal area, provenance), rainfall, temperature in woodlot or block planting. Results showed strong association among variables. It was found that about 88.70 % proportion of variance of yield can be predicted from the set of independent variables. Comparison of yield and aboveground biomass accumulated by bagras from alley, boundary and woodlot was in order woodlot > boundary > alley. Based on the models, future climate scenario had shown an inverse relationship between yield and seasonal mean rainfall. Predicted yield will increase by 0.1515 m³ (64 bd ft) per tree with decreasing seasonal mean rainfall (100mm).



Adapting communication conventions: communicating climate change adaptation to Aboriginal peoples

Oral

Session: Parallel session 25

Time: 11.45-12.00



¹Rob Palmer

¹University of Adelaide, South Australia, Australia

Global research shows that communicating climate change is a difficult and challenging exercise. Layer climate change adaptation upon that communication challenge and the messaging process becomes increasingly difficult. Add one more layer, that of communicating climate change adaptation to Aboriginal peoples, and the challenge seems insurmountable. Research conducted by universities and commercial entities such as the UK marketing firm Futerra highlight that communicating big picture, gloomy messages about climate change puts people off, causing the communication process to fail. We present a study that shows the opposite and indicates communicating climate adaptation benefits from presenting the big picture, but in local contexts. In this conference paper, we use a case study approach to describe a methodology for how to effectively communicate climate change adaptation to Indigenous peoples. Our case study, working with the Arabana people of South Australia demonstrates that the conventional thought on how to effectively communicate climate change is not necessarily applicable to communicating climate change adaptation to Indigenous peoples. Using a combination of visual, aural and online tools, the methodology we developed and trialled has demonstrated an effective way of communicating climate change adaptation to Indigenous peoples. Given the significant decline in support around the world for taking urgent action on and adapting to climate change, our study could make a significant contribution for reframing the way governments, ENGOs and others communicate climate change adaptation to society.



Changing science needs for different management paradigms on a protection - restoration spectrum

Oral

Session: Parallel session 24

Time: 12.15-12.30



¹Rachel Pears, ¹Roger Beeden, ²Rebecca Albright, ³Eva Abal, ²Ken Anthony

¹GBRMPA, Townsville, Australia, ²AIMS, Townsville, Australia, ³Great Barrier Reef Foundation, Townsville, Australia

In the face of increasing pressures on the Great Barrier Reef ecosystem, marine park managers and scientists are recognising the need for good, collaborative research focused on management solutions. Demand for exploring unconventional options is likely to increase, along with calls to consider more interventionist strategies than currently used. Guidance is needed on which solutions could form safe, cost-effective management strategies, including what would be required to thoroughly assess proposals. Ocean acidification is an example of an emerging threat to coral reef ecosystems that poses serious management challenges. The imperative is to avoid serious change to the acidity of the ocean. Management objectives under the Great Barrier Reef Climate Change Adaptation Strategy and Action Plan recognise that managers and scientists have a role in informing the public policy debate about climate change and ocean acidification implications for reefs. With considerable uncertainty about the global response to climate change, we also need to consider what can be done in tandem to reduce or delay the impacts of ocean acidification.

As environmental values and conditions deteriorate from good to poor, the management paradigm also shifts along the spectrum from protection of values to arresting declines and then to restoration or enhancement. For ocean acidification, the attention may move from protecting values and supporting natural adaptation and resilience to assisted adaptation and restoration of values or enhancement of ecosystem services. Scientists and managers are exploring potential solutions and associated knowledge gaps, and considering where these might be applicable on this spectrum.



Indigenous Leadership for Climate Change

Oral

Session: Parallel session 8

Time: 1.00-1.15



¹Rafe Pfitzner

¹The University of Adelaide, Adelaide, Australia

I am an Indigenous researcher and environmentalist; identifying with the Kokatha People. I have an Environmental Management degree from Flinders University and am currently a Masters Candidate at Adelaide University where my research topic is "Indigenous Leadership for Climate Change". Being an Indigenous person, looking after and respecting the environment holds special importance to me. It is this 'sacred duty' (as I consider it to be) that has lead me to focus my research on Indigenous Environmental Management. Specifically, my research is focussing on on the intertwining themes of Indigenous Leadership and Climate Change.

The rationale for the research comes simply from the fact that climate change is one of the most important environmental challenges currently facing societies (both Indigenous and non-Indigenous). And that I have a deep love and respect for and connection to Indigenous people and culture and its wellbeing. My research is examining what "leadership" for climate change means to Indigenous communities. This examination is being undertaken, in part, through at least two (intended) case studies: 1) The Kokatha People and 2) The existing group of NCCARF Indigenous Communities researchers (utilising a "delphi method" technique on researchers across all of the IC research projects). A third potential case study is the Ngarrindjeri Nation.

The second case study will explore an important aspect to the Indigenous leadership dynamic: the fact that non-Indigenous decision makers (who reside within western power structures such as state and federal governments) make decisions that directly impact Indigenous communities.

The research outcomes will have both local (to the case study communities) and widespread (in terms of government policy and decision making) relevance and will, hopefully, help to inform future work and leadership efforts by both Indigenous and non-Indigenous people managing climate change that impacts on Indigenous communities.



One regional collaborative governance structure is unlocking doors and leading the way to transformational change

Oral

Session: Parallel session 29

Time: 2.30-2.45



¹Evelyn Poole, ^{2,1}Cecilia Woolford, ¹Heather Horrocks

¹DEWNR, SA, Eyre Peninsula, Australia, ²EPICCA, SA, Eyre Peninsula, Australia

The Eyre Peninsula, an ecotone bounded by desert and ocean, is home to unique ecosystems and an economy dependent on natural resources. Higher temperatures, less rainfall and rising sea levels in a climate-changed future will bring both challenges and opportunities.— Formed in 2009, the Eyre Peninsula Integrated Climate Change Agreement (EPICCA) is now moving beyond consolidation of collaborative arrangements to joint delivery of adaptive actions within the region.

Through EPICCA, the region's peak bodies have a governance mechanism capable of facilitating progress towards integrated, co-ordinated, community- and industry-endorsed change within the region: a crucial element in achieving transformational change within a resilient and sustainable environment. In a region susceptible to the southerly progression of climate zones, EPICCA identified that despite extensive research on climate change being undertaken, it sat in silos not easily accessible to stakeholders. For this reason EPICCA conducted an audit to establish a usable, manageable, comprehensive knowledge and research database suitable for analysis and able to be synthesised so as to identify gaps.

This paper will explore the role of EPICCA as the catalyst in leading the region's key stakeholders through a research-based process towards the development of an adaptation framework. The paper will illustrate how EPICCA provides overarching collaborative guidance for key practitioners to inform government while advocating for support to achieve key stakeholder goals: NRM in the preparation of a climate-change-ready landscape scale plan; RDA looking forward in terms of renewable energy opportunities; and local government in assessing the risk to their extensive infrastructure.



Marine population genetics: identifying marine regions of high diversity and low connectivity through meta-analysis

Poster

Session: Poster session



¹**Lisa Pope**, ¹Cynthia Riginos, ^{1,2}Jenny Ovenden

¹The University of Queensland, Brisbane, Qld, Australia, ²Molecular Fisheries Laboratory, Brisbane, Qld, Australia

Knowledge of connectivity and genetic diversity are key components for effective reserve design and the protection of endangered species. Using genetic methods to determine population boundaries is extensively used in commercial fisheries, to set sustainable limits on harvest for current and future resource management. We have undertaken a literature review to examine the marine animal species that have been studied at a population level, around Australia. Using this information we identify 'information gaps', species groups and regions that have been understudied. Using this database, we will perform a meta-analysis of genetic diversity and genetic divergence measures from multiple species to identify common 'barriers' around Australia, and regions of high and low genetic diversity. We aim to integrate this information into management plans, with a view to aiding future adaptive management to climate change of both commercial and endangered Australian marine species.



Spatial management for climate-related patchy disturbances in the Great Barrier Reef

Oral

Session: Parallel session 31

Time: 2.00-2.15



¹Bob Pressey

¹Australian Research Council Centre of Excellence for Coral Reef Studies, James Cook University, Townsville, Australia

The 2004 rezoning of the Great Barrier Reef (GBR) Marine Park put Australia on the world map as a leader in marine conservation. However, the 2004 zoning plan was based mainly on static depictions of marine biodiversity. Consequently, uncertainty surrounds its ability to promote the persistence of the GBR's biodiversity in the face of current dynamic disturbances or their future regimes under climate change. This uncertainty is underlined by the recent 50% loss of coral cover across the GBR since 1985, attributed to cyclone waves, crown of thorns starfish, and coral bleaching. Planning for the GBR's future must involve a better understanding of scenarios of these and other key disturbances, how disturbances interact with connectivity between reefs, and clear objectives linked to the GBR's resilience. This presentation describes an approach to designing spatial management in the face of dynamic disturbances. A first requirement is to understand spatio-temporal regimes of disturbances. This begins with time-series analysis as a foundation for ensemble modeling to project multiple scenarios under climate change and uncertainty. A second crucial requirement is to formulate quantitative objectives in relation to dynamic disturbances, and there are several ways of doing this. With models and objectives in place, systems of no-take and other marine protected areas (MPAs) can be reviewed for achievement of objectives into the future, noting when and how often objectives are not met. This analysis then informs revised design of MPAs to maximize achievement of objectives and the persistence of marine species and ecosystems.



How shared values and beliefs shape climate change responses: cultural biases, policy preferences, and behaviour

Speedtalk

Session: Speedtalk session 13

Time: 5.20-5.25



¹Jennifer Price, ¹Zoe Leviston, ¹Iain Walker

¹CSIRO, Floreat, WA, Australia

Cultural theory is an effective framework for understanding the conflicting perspectives about society and the environment that drive climate change responses. Cultural biases represent patterns of shared values and beliefs that have been linked to policy preferences, risk perceptions and behaviour. Despite compelling evidence of their role in shaping climate change responses key issues remain unresolved, and largely unquestioned. The underlying dimensional structure of cultural environmental biases is yet to be empirically tested, preventing identification of the role they play. The current research details quantitative measures of cultural environmental biases, identifying: a) their role in climate change adaptation behaviours and policy preferences; b) their underlying structure; and c) their stability over time. Three online surveys were conducted in Australia in 2010 (N=5036), 2011 (N=5030), and 2012 (N=5081), with 668 respondents completing all three surveys. Cultural environmental biases were related to adaptation behaviours such as taking out insurance and moving house due to climate impacts. They were also linked to carbon-relevant behaviours and support for carbon pricing policy. Cultural environmental biases shifted over time, however, with just 41% of the sample remaining constant. The degree of consistency an individual demonstrates is related to their belief in anthropogenic climate change, and can be predicted by right-wing authoritarianism, social dominance orientation, and socio-political locus of control. This suggests that while cultural environmental biases shape climate change responses, they are dynamic and open to influence. Policies and communication that appeals to these different perspectives and traits may shape adaption behaviours.



From the Tiwi Islands to Arnhem Land: Climate Change Risk Assessments and Adaptation Planning in the Tropical North

Oral

Session: Parallel session 8

Time: 1.30-1.45



¹Guillaume Prudent-Richard, ¹Marcus Sainsbury

¹AECOM Australia, Canberra, Australia

The presentation will focus on the challenges and specifics of working on climate change adaptation within Aboriginal communities. This project, funded through the Local Adaptation Pathways Program, helped to deliver climate change risk assessments and adaptation plans for six Shire Councils (Belyuen, Coomalie, East Arnhem, Tiwi Islands, Wagait and West Arnhem) of the Northern Territory. These Shire Councils are populated predominately by Aboriginal people (up to 95%).

Within the communities, there was a strong demand for information on climate change but also significant confusion (e.g. between greenhouse gases and air pollution, storm surge, sea level rise and tsunami). Communicating climate change proved challenging given the varying perceptions of the local communities in terms of climate, seasonal (e.g. up to 14 seasons in the local calendar) and timescale. There were a number of challenges including the high cost of travel in each community, the highest priority given to more pressing issues, the lack of relevant data.

The study found that while Aboriginal communities present significant vulnerabilities to climate change for some risks they is also a high degree of resilience within the community (for instance a strong recovery capacity after extreme events). The adaptation plans were developed in a workshop format and strongly considered the limited capacity of the Shire Council to develop and implement adaptation actions on account of their lack of resources (financial, human and technical) and also because of their lack of control over land use planning and land development in general.



Incorporating climate change impacts and adaptation in environmental impact assessment: Opportunities and challenges

Speedtalk

Session: Speedtalk session 13

Time: 4.45-4.50



¹Guillaume Prudent-Richard, ¹Marcus Sainsbury

¹AECOM Australia, Canberra, Australia

National governments and development agencies have invested considerable effort to develop methodologies and tools for climate change adaptation. However, these tools have largely been developed by the climate change community and their application within actual project settings remains quite limited. An alternate and complementary approach would be to examine the feasibility of incorporating consideration of climate change impacts and adaptation within existing modalities for project design, approval, and implementation. Environmental Impact Assessments (EIA) are particularly relevant in this context.

The study undertaken by the Organisation for Economic Co-operation and Development (OECD) and AECOM shows that there is ample scope for employing EIA procedures as a vehicle for enhancing the resilience of projects to the impacts of climate change. A number of entry points have been identified to incorporate climate change impact and adaptation considerations, from the strategic phase that precedes the initiation of the EIA, to the scoping, detailed assessment and implementation stages. Several national and sub-national authorities as well as multilateral development banks have already made some progress in terms of examining the possibility of incorporating climate change impacts and adaptation measures within the context of EIA modalities. To a large extent, however, the goal of incorporating climate change impacts and adaptation within EIAs remains more aspirational than operational. While a number of governments have signalled their intent to move in this direction, this assessment could find examples in only three countries of projects that considered climate change as part of EIAs.



Engaging the private sector in adaptation

Speedtalk

Session: Speedtalk session 9

Time: 4.40-4.45



¹Guillaume Prudent-Richard

¹AECOM Australia, Canberra, Australia

Adaptation to climate change is recognised as an equally important and complementary response to mitigation. There has been considerable expansion of policy and economic analyses to assess adaptation efforts and progress. The core emphasis, however, has been on activities that are primarily financed and implemented by public entities. Less attention has been paid to the role of the private sector in fostering adaptation. However, success in adaptation depends heavily upon the decisions made within the private sector.

This paper considers the principal risks that businesses are likely to face due to climate change, the actions they have taken to address these risks, and how they are managing current climate variability and adapting to future climate conditions. This paper addresses the questions of (i) What motivates private actors to undertake adaptation actions? (ii) What factors determine processes of adaptation? (iii) What is the role of government in enabling and encouraging the private sector to take action on adaptation to climate change? Businesses' attitudes towards adaptation and the actions taken to address risks arising from climate change are analysed using a three-tier framework that considers companies' actions in terms of their: (1) risk awareness; (2) risk assessment; and (3) risk management. This paper considers case studies based on information collected from a number of companies and is supplemented with publicly available information, supporting literature, and an analysis of companies' responses to the Carbon Disclosure Project. The key findings were published in an OECD report in 2011.



Links between climate variability, vegetation cover and dust storm frequency in Australia

Poster

Session: Poster session



¹Christa Pudmenzky, ¹Harry Butler

¹Australian Centre for Sustainable Catchments, University of Southern Queensland, Toowoomba, Queensland, Australia

Australia has one of the most variable climates in the world and 70% of the continent is within the arid and semi-arid zone, receiving less than 400mm of rainfall and is the largest dust source in the Southern Hemisphere. The climate is influenced by the El Niño-Southern Oscillation phenomenon and is the prime driver of extreme weather events. 50% of annual rainfall variability in northern and eastern Australia is linked to the ENSO cycle. Drought is probably the most economically costly climate event by reducing agricultural output and having social impacts on rural communities. Sustained drought conditions reduce vegetation cover in arid and semi-arid regions, exposing soils to increased dust storm activity in the future. Agricultural land is under increasing pressure to produce more food and fibre to support an increasing population.

This research investigates the relationship between climatic conditions and vegetation cover in erodible areas of the Lake Eyre Basin, Channel Country and north-western NSW (i.e. is it possible to use climate information to predict remote sensed vegetation cover). To test the possibility, data from the 2000 to 2012 time period was used due to the range of climatic changes. The development of a Climate Aridity "Vegetation" Index (CAVI) together with medium to long term weather forecasts could provide a valuable tool to improve current land management practices. With the projected increase in global population from 8.9 to 9.3 billion people by 2050 reduction in soil erosion and the improvement of land condition for food production is imperative.



How will the health of remote Australian communities be affected by climate change?

Speedtalk

Session: Speedtalk session 4

Time: 5.00-5.05



¹Jane Addison, ^{2,3}**Digby Race**

¹Jane Addison Consultancy, Alice Springs, Northern Territory, Australia, ²CSIRO Sustainable Ecosystems, Alice Springs, Northern Territory, Australia, ³Ninti One Limited & the Cooperative Research Centre for Remote Economic Participation, Alice Springs, Northern Territory, Australia

Many areas of remote Australia have communities with poor health outcomes. With climate change, health is predicted to be further affected. To help guide adaptation discussions with communities in Cape York, Central Australia and the Kimberley, we i) explored exposure to climate change, ii) cross-referenced vulnerability indicators from the literature with demographic data, iii) identified vulnerable community segments, and iv) suggested how this vulnerability may manifest with climate change. Exposure levels do not seem to be significantly higher than other areas of Australia. Major population centres (i.e. >5,000 people) in remote Australia, such as Broome, Kununurra and Alice Springs, have low levels of sensitivity at the township level due to the high socioeconomic status of a large proportion of the population. However towns, communities and outstations outside these major centres have relatively high levels of vulnerability. This is due to low socioeconomic status, poor health and large numbers of children. Given high levels of uncertainty, adaptation measures to climate change should follow key risk-related adaptation principles. In general, addressing socioeconomic disadvantage by, for example, improving primary health care for cardiorespiratory disease, is likely to be the adaptation measure to climate change that best meets all such principles. Other 'soft' measures, such as climate related health education or creating back-up plans for ongoing health care facilities that may be affected by extreme weather events (e.g. renal units), may also be appropriate. In this presentation, the authors will present key impacts from climate change for communities in remote Australia.



Effective adaptation to climate change for coastal property development in Victoria

Speedtalk

Session: Speedtalk session 10

Time: 5.10-5.15



¹Alianne Rance

¹The University of Melbourne, Melbourne, Australia

With the muting of the climate change debate, there has been a judicious shift toward attenuation of associated climatic impacts through adaptation. The observation of the wider impacts of changed weather patterns as well as increased risks from physical exposure to sea level rise, erosion, and storm surge, with implications for coastal infrastructure, has motivated much action on the part of local government in coastal Australia. However, property developers driven through regulation or lack thereof have not been so energetic in this sphere. The relationship between local government and property developers, especially in the minefield that is coastal Greenfield development, has been tenuous at best. In the light of climate change impacts and associated movement in policy arenas, tension is set to rise.

New legislation or even broad governance to clarify approaches for adaptation planning is pending and end users may be legally required or encouraged to utilize a particular approach in conducting their adaptation planning process. Yet, the interaction and engagement between property developers and local government in the development of coastal urban communities must first be explored.

This PhD research investigates the principles for monitoring and evaluation in the context of climate change adaptation and encompasses these within a framework applicable to property developers and local government in coastal Victoria.



Considerations of climate risk in new coastal developments

Speedtalk

Session: Speedtalk session 2

Time: 4.55-5.00



¹Alianne Rance

¹The University of Melbourne, Melbourne, Victoria, Australia

Climate legal risk and adaptation law is an evolving field and spans a range of issues including corporate law, regulatory risks, and insurance risks to name a few. Climate change risk varies from other corporate risks due to its far reaching impacts across all aspects of company operations, but eventually it will become of the traditionally considered risks that corporations must attenuate when it comes to strategic planning. But what of the property industry and new developments with long time frames? How can property developers consider their climate risk and act to attenuate it? Questions surrounding who bears the primary liability for climate risk in the context of coastal greenfield property development, what are the roles and responsibilities surrounding climate change adaptation for property developers and what would motivate them to act are now due consideration.

This presentation considers these pressing issues in the context of coastal greenfield development in Victoria.



Climate change indicators for interdisciplinary reporting

Oral

Session: Parallel session 15

Time: 4.15-4.30



¹Scott Rawlings

¹Office of the Commissioner for Environmental Sustainability, Victoria, Australia

The Commissioner for Environmental Sustainability is responsible for producing a State of the Environment Report for Victoria every five years. Critically, the Commissioner is concerned with producing reporting products that are more focussed on the wider public as an audience, address the gaps in science communication, and more nuanced in how they articulate the social and cultural impacts of climate change.

To this end, our approach explains how changes in the natural environment due to climate change impact on the well-being of Victorians. We have used the "Five Capitals" model to derive indicators that accurately reflect both the environmental changes driven by climate and the social and human implications of that change. The direct effects of climate change are primarily environmental, thus the ecosystem services concept is suitable for linking environmental challenges to social impacts and priorities. The community values and priorities of the ecosystem services of urban, agricultural and coastal communities vary considerably - reflecting the dominant social and business sectors in these regions. Ultimately, sustainability reporting and the development of a functional set of indicators enhances the policy cycle. The transfer of data and information into knowledge and decision making is crucial. To make effective decisions faster - and for those decisions to be supported by clear policy implementation accountability - we need innovative ways of collecting and cataloguing the information and knowledge we use. This is particularly critical for environmental research where the barriers between research and policy (and between research disciplines) are considerably vexed.



Developing resilient green roofs for Adelaide

Speedtalk

Session: Speedtalk session 2

Time: 5.00-5.05



¹Mostafa Razzaghmanesh

¹University of South Australia, Adelaide, Australia

Adelaide is the capital city of the driest state in Australia and it currently faces three major challenges, namely urbanisation growth, water scarcity and climate change. The consequences of these threats put more stress on the urban water cycle and increase metropolitan temperatures through urban heat island effects.

Introducing green infrastructure through water sensitive urban design is one of the solutions to reduce the harmful impacts of urbanisation while providing additional amenity and water quality benefits for communities and the environment. This paper describes the results of a current research project that is investigating the water quantity and quality effects and thermal benefits of two different types of green roofs, namely intensive and extensive.

Two study sites are used. The first is a full scale green roof, at ANZ House in the Adelaide CBD. The other one consists of a series of small scale green roofs located at the University of South Australia's Mawson Lakes campus. The results of the water quality studies show it is still possible to reuse this runoff for nondrinking purposes such as toilet flushing and urban landscape irrigation. Laboratory and field investigations of rainfall and runoff confirm that green roofs can retain significant amounts of stormwater and can also mitigate the peak flow and attenuate the time of concentration. The thermal benefits of green roofs have also been investigated through two scenarios of cold and warm days. The outcomes indicate that the thermal variation of the media is less than surrounding areas and on cold days the media's temperature is warmer than outside and on warm days it is colder. Integrating green roofs into the built environments of Adelaide could work as a climate change adaption tool that could yield significant benefits.



Opposing trends affecting Climate Change adaptation in agriculture in New South Wales

Oral

Session: Parallel session 19

Time: 4.00-4.15



¹Greg Reid

¹NSW Dept of Primary Industries, NSW, Australia

Primary producers are attempting to adapt to climate change but there are demographic, economic and structural forces working in opposing directions. Water use efficiency measures are highly desirable however rising electricity prices are making some of these high pressure systems uneconomic. Sustainable land management is a high priority on family farms however rising debt and the aging demographic of Australian farmers is driving increasing corporatisation in agriculture. Diversification is an important strategy in a variable climate however high capital costs favour specialisation. Rising insurance costs are leaving producers more vulnerable to climatic impacts. Carbon credits were expected to help stabilise farm incomes but also favour a reduction in available farmland. Negative production impacts of these trends would be expected to be countered by rising prices however in a global economy the result can instead be a transfer of food from countries with lower production costs. If climate change adaptation is to have a net positive effect on food security then integrated policies and incentives will be needed that compensate for counter trends in the agricultural sector.



Re-conceptualising community resilience in Australian disaster risk management

Oral

Session: Parallel session 6

Time: 3.00-3.15



¹**Kimberley Reis**, ¹Deanna Grant-Smith, ¹Paul Burton, ¹Michael Howes, ³Michael Heazle, ¹Peter Tangney, ²Karyn Bosomworth

¹Griffith School of Environment and the Urban Research Program, Griffith University, Queensland, Australia, ²Climate Change Adaptation Program, Global Cities Research Institute, RMIT University, Victoria, Australia, ³Griffith Asia Institute and School of Government and International Relations, Griffith University, Queensland, Australia

This presentation summarises the outcomes of a recent NCCARF project investigating the integration of climate change adaptation and disaster risk management to enhance community resilience in Australia. This was done via a comparative analysis of reports from official inquiries into three Australian disasters. They included: the 2009 Victorian bushfires; the 2011 Perth Hills bushfires; and the 2011 Brisbane floods. Interviews and workshops were conducted with key stakeholders representing social welfare, environmental, emergency management, and planning interests. This paper confirms and builds on recent international and national findings regarding approaches to enhance community resilience. It finds that while the idea of community resilience is becoming increasingly popular within the disaster risk reduction community, current framings of both 'community' and 'resilience' have been oversimplified. This has particular implications for how responsibilities for disaster resilience may be shared, and the role of community engagement. We argue that a re-conceptualisation of 'community' and 'resilience' is needed to ensure that the benefits promised can be realised.



Personal encounters with climate change: Their status, significance, and adaptation implications

Poster

Session: Poster session



¹**Joseph Reser**, ¹Graham Bradley

¹Griffith University, Gold Coast, Qld, Australia

Recent national survey findings in Australia relating to public risk perceptions, understandings, and responses to climate change and natural disasters have revealed the surprisingly powerful significance and seeming influence of perceived direct experiences with environmental changes or events over the past ten years which respondents thought might be due to climate change. Equally surprising was the finding that 45% of respondents across two sequenced surveys in 2010 and 2011(N=7443) reported having such encounters. Comparisons between those with and without such experiences revealed dramatic differences across virtually all core variables being researched, including belief/acceptance, perceived risk, concern, distress, psychological adaptation, objective knowledge, and behavioural engagement. As the research also examined the nature and extent of reported prior experience with natural disasters, it was possible to compare the relative influence of these two differing types of direct experiences across respondents. Perceived direct experience with climate change evidenced far stronger relationships with mediating psychological variables than personal experience with natural disasters. The phenomenon, threat, and multi-modal nature of climate change exposure and experience has required a reflective re-consideration of the nature of direct and indirect exposure and experience, and the mediating roles of sense-making processes, interpretive lenses, and assumptive worlds in our respective climate change encounters. The presentation reports and discusses these research findings, convergent literatures, possible explanations, and implications relating to public understandings, psychological adaptation, and inter-relationships between direct and virtual exposure and experience to environmental events and changes associated with climate change.



Are the general public mental models consistent? A numerical assessment

Oral

Session: Parallel session 4

Time: 3.15-3.30



²Claire Richert () presenting, ¹Fabio Boschetti, ¹Iain Walker, ¹Jennifer Price

¹CSIRO, WA, Australia, ²AgroParisTech, Paris, France

We have developed a computational model of the mental representations people use to understand climate change, mitigation, and adaptation options. The model can be parameterised according to different beliefs and values commonly held among the public, and allows us to check the consistency of the expectations such beliefs and values generate.

We asked 250 Australians to 'run their mental model' for us; we asked members of the public to 1) parameterise our model according to their actual beliefs and values and 2) assess what the consequences of such beliefs and values may be. This allows us to compare the respondents' expectations to the model results

With the exception of the economic cost of mitigation and adaptation initiatives (which are generally largely overestimated), their choice of parameters is fairly well aligned with current scientific opinion. Also, at a group level, the combination of the results of each participant's mental model is reasonably consistent with the computational model, at least in terms of general trend. However, when such projections are analysed at an individual level, consistency drops significantly, showing that most participants draw conclusions which may be inconsistent with their own assumptions. Finally, we studied the relation between the participants' mental models and their worldviews, political preferences, attitudes towards the environment and other cognitive traits. We found that the main predictors of their choices were their stated environmental commitment and their 'concern for future consequences'. This clearly highlights how climate change is understood both as an environmental and a social dilemma issue.



Framing and re-framing drought within agriculture

Oral

Session: Parallel session 19

Time: 4.15-4.30



²Lauren Rickards, ¹Peter Hayman

¹SARDI, Adelaide, Australia, ²University of Melbourne, Melbourne, Australia

Understanding the adaptation challenge in agriculture requires that we understand the changing phenomenon of drought. To do so requires not only physical science, but social science, for how drought is framed by farmers, scientists and policy makers within agriculture has changed over time. This paper draws on historical and social science research to map out the way drought has been framed during three overlapping eras of agriculture from the 1900s to present: productivity, sustainability and climate change. It argues that within the first two eras drought has been interpreted as, first, a disruption and business risk and, second, an environmental risk in dryland farming and irrigation. It then highlights the various roles attributed to drought within the current climate change era: an analogue for future conditions and a source of adaptive capacity; an obstacle to adaptation; a window of opportunity for transformational change; and a signal event. Examining the different ways in which drought is framed within agriculture is crucial for understanding the mixed policy signals and heated discussions about drought within the sector. As such, it is crucial for identifying competing needs and for progressing effective adaptation to drought and other climatic risks. Furthermore, interrogating how drought is framed within agriculture casts light on some of the reasons many farmers resist the anthropogenic climate change message by highlighting assumptions about the role of science in the sector.



Cloud Nasara* Pacific Climate Animation Project: communicating climate science in the Pacific region

Speedtalk

Session: Speedtalk session 7

Time: 5.15-5.20



⁹Ula Majewski, ¹Rebecca McNaught, ²**Jill Rischbieth**, ⁷Salesa Kaniaha, ³Phillip Malsale, ⁴Brad Murphy, ⁵Christopher Bartlett, ⁶Shannon Owen, ⁸Joseph Siri

¹Red Cross Climate Centre, The Hague, The Netherlands, ²Commonwealth Scientific and Industrial Research Organisation - CSIRO, Melbourne, Australia, ³Vanuatu Meteorology and Geo-hazards Department, Port Vila, Vanuatu, ⁴Australian Bureau of Meteorology, Melbourne, Australia, ⁵SPC-GIZ Climate Change Program, Port Vila, Vanuatu, ⁶EyeSpy Films, Melbourne, Australia, ⁷SPREP, Apia, Samoa, ⁸JKS GRAFIKS, Port Vila, Vanuatu, ⁹AVID - Red Cross, Melbourne, Australia

The Cloud Nasara Pacific Climate Animation Project aims to increase awareness of the science and impacts of climate variability in the Pacific, and to provoke discussion around how communities can take 'low regrets' actions to prepare for future El Niño and La Niña events and adapt to climate change. Two short comical animation films are being developed as communication tools. One film will give an overview of climate processes and impacts in the Pacific region as a whole. The other film will be specifically focused on Vanuatu's climate as a pilot country. They will be accompanied by a comprehensive 'tool kit' which will include resources to help facilitators link the information presented in the animation to decision making and action.

The Cloud Nasara project is being developed through an ongoing consultative process, which includes research, focus groups, forums and direct communication with key stakeholders in Vanuatu and across the Pacific region. Cloud Nasara will be launched in July 2013.

The films and accompanying resources will be useful for organisations, governments, schools, regional bodies and community groups throughout the Pacific Island countries and territories. They may assist those working in fields that address climate risk such as climate change adaptation, disaster risk management, health, food security, community planning, and environmental protection.

*In Vanuatu, a 'nasara' is a meeting place



Development of a generic framework to determine the economic impact on NSW locations from natural disaster events

Oral

Session: Parallel session 14

Time: 2.15-2.30

¹Kevin Roche

¹Risk Frontiers, Macquarie University, Sydney, Australia

Development of a generic framework to determine the economic impact on NSW locations from natural disaster events

Measuring the impacts of natural hazards is a fundamental step and a necessary condition to enable efficient decisions, including those around resource allocation, to assist in progressing national capability in recovery and making communities more resilient. Insurance only covers part of the losses in an adverse event. Traditionally, estimates of economic losses focus on the financial cost of, and insurance payouts for, what has been or would be destroyed in a given event scenario. In this paper a framework is developed that can be used to estimate both the direct and indirect costs using a computable general equilibrium (CGE) model.

The CGE model enables the interdependencies and linkages across the various sectors and regions of the Australian economy affected by a natural disaster event to be identified. By evaluating the distributive effects of these relationships we can determine the winners and losers at different levels (sectorial, business, household and geographic) throughout both the affected region and general economy. From this, effective actions can be taken to speed up the recovery process. In addition they provide an indication of the recovery elements, such as supply choke points, which may restrict the rebuilding and restoration effort. At present there is no generally available model or set of tools that can model the economic recovery costs of a natural disaster event in Australia. This framework addresses this gap and will provide extensive evidence for prioritising interventions, risk mitigation measures (especially where lifelines are concerned) and risk management.



Public or private responsibility for adaptation? Legal and regulatory considerations

Oral

Session: Parallel session 28

Time: 11.15-11.30



^{1,2}Lisa Caripis, ^{1,2}Lee Godden, ^{3,2}**Francine Rochford**, ^{1,2}Jacqueline Peel, ^{3,2}Rachel Carter, ^{1,2}Jude Wallace, ^{4,2}John Handmer

¹University of Melbourne, Melbourne, Australia, ²Victorian Centre for Climate Change Adaptation, Victoria, Australia, ³Latrobe University, Victoria, Australia, ⁴RMIT University, Melbourne, Australia

Where does government's responsibility for climate change adaptation end and the private sector's begin? In the aftermath of another summer of bushfire and floods, this is a question on the lips of policy-makers, insurers, industry and business, and the general public. Answers are contentious, with significant cost, liability and policy implications. Governments through COAG have sought to answer this question through the adoption of a statement of understanding of the 'Roles and responsibilities for climate change adaptation in Australia'.

But asking this question assumes there is a clear divide between the public and private sector; that government departments and agencies operate in a realm distinct from that of business and community. Shifts to privatise government functions, embed market and corporate thinking in government operations and to strike 'partnerships' between government and industry mean that a public-private spectrum rather than clear divide is a more appropriate lens through which to develop answers to the question of responsibility.

We categorise the ways in which law regulates responsibility proactively and reactively, for example through legislatively enshrined statutory functions and duties, the building code and planning law, and liability in contract and negligence law. When applying this typology to the multi-sectoral and -scalar governance of flood risk in floodplains in rural Victoria, we find key areas of overlap and gaps. We show that development of policy responses to allocate roles and responsibilities for adaptation to climate change needs to take into account the existing legal framework to identify constraints, leverage points and enabling capacity.



The challenges of climate change adaptation for judges: developing new methodologies for judicial reasoning in climate change litigation

Oral

Session: Parallel session 7

Time: 4.00-4.15



¹Nicole Rogers, ²Brendan Mackey

¹Southern Cross University, Lismore NSW, Australia, ²Griffith University, Gold Coast Queensland, Australia

In the last decade we have seen the rise of innovative climate change litigation. This often involves the creative deployment of existing legal concepts; in the absence of comprehensive climate change legislation, lawyers have been forced to explore the potential for climate change mitigation and adaptation in existing regulatory regimes. Yet the outcomes are rarely successful. Many judges appear reluctant to adapt existing law to the exigencies of a climate changed future.

By way of contrast, the majority of scientists have accepted that such a future is inevitable and drastic measures are needed. In reaching this conclusion they have embraced new methodologies, involving simulation modelling, transdisciplinary perspectives and speculative futuristic scenarios. This departure from Popperian science serves as an example to those judges who are operating within conservative models of statutory interpretation and precedent in reaching their decisions. Judges must depart from such well-entrenched disciplinary traditions if they wish to engage with speculative future visions in decision-making in climate change litigation.

There is an urgent need for judicial education in the science of climate change mitigation and adaptation, in the associated ecological and societal consequences, and in scientific methodologies. In this paper we identify disciplinary constraints on judicial thinking in existing climate change litigation, analyse the judicial use and understanding of scientific findings and scientific methodologies in such case law, and suggest new methodologies for judicial decision-making. A transdisciplinary approach is the first step in identifying and challenging the constraints which prevent effective adaptation outcomes in climate change litigation.



Living with Nature - Ceremony is Adaptation

Speedtalk

Session: Speedtalk session 1

Time: 4.50-4.55



¹Phillip Roos

¹Deakin University, Victoria, Australia

Aboriginal people of the South-west coast in Victoria live close to the land, and they have a distinctive way of identifying our connection with the world. Instead of viewing actions of nature and man as instant and individual disconnected processes, they tend to see the whole picture. This wholeness with nature is embedded within tradition, culture, settlement patterns, daily activities and ceremony. For centuries the Wathaurong and Gadubanud people have been confronted with changing ecological and climatic events, and living close to nature required an in depth knowledge of sea level rise, tidal changes, landscape changes, behaviour of animals, and the availability of food sources. Reviewing the concept of wholeness with nature, backed by extensive literature reviews, this paper seeks a better understanding of the past indigenous environmental management practices of the coastal region, and considers its possible application for future coastal planning under climate change effects and sea level rise.



Indigenous population movement in south east Australia during a 20th century drought event

Oral

Session: Parallel session 29

Time: 2.45-3.00



¹James Rose

¹University of Melbourne, Melbourne, Australia

Between 1918-1920 severe nation-wide drought resulted in the closure of numerous govenment reserves designated as living areas for Aboriginal people in central-western NSW (Beckett 1994, 2005; Donaldson 1980; Kabaila 1996). The semi-arid Cobar Peneplain region in particular was severely affected, and much of the Indigenous population evacuated, either by choice or under government relocation programs, to peripheral areas with more relaible water sources (ibid.). To handle this sudden population concentration, large-scale government-run settlements were established at several outlying locations, notably at the towns of Menindee, Brewarrina and Coonamble, on the Darling, Barwon and Macquarie Rivers respectively. Although this major population concentration was partly reversed during the subsequent two decades, its effects were permanent, and few of the remote locations previously occupied by Aboriginal people were ever systematically resettled. While there are numerous first-hand accounts of this event, recorded by anthropologists, linguists and historians (see above), there appear to be no formal large-scale studies of population-wide adaptation to this climate event. Utilizing large-scale genealogical and geospatial population data collected from public sources, this paper will present 3-dimensional computer visualizations of the Aboriginal population's response to this event, beginning in the two decades preceeding it, and over the six decades following. This modelling shows a population initially distributed over a relatively high number of smaller remote settlements, suddenly concentrating into a small number of larger settlements, and then partly redistributing to mid-range towns, and later to major urban centres.



Climate change and its impacts on planning and adaptation strategies (case study from Punjab and Sindh: Provinces in Pakistan)

Poster

Session: Poster session



¹Awais Sadiq

¹LaTrobe University, Victoria, Australia

Climate change is one of the biggest issues which the world is facing at the moment. "Climate change refers to a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (United Nations Framework Convention on Climate Change 1992, p. 3). The human beings are solely responsible for making our climate and atmosphere so vulnerable. The seasons are shifting, temperatures and sea levels are rising and our planet still has to supply us and all the living creatures with food, water, and fresh air and safe place to live.

Climate change now is such a reality for Pakistan from which Pakistan cannot escape. The geographical location of Pakistan is such that any change in climate will bring severe impacts on the country. Although the contribution of Pakistan to global climate change is low but still it is one of the most vulnerable countries to climate change. Climate change is no longer a choice for the country, it is now a major issue and which the country has to deal itself. The country does not have enough resources to combat the issue so the main objective of my research is to develop some adaptation strategies for climate change in a country like Pakistan where there is so much uncertainty.



Patterns of climate change and coping strategies of small farmers in mountainous area of Kaghan Valley, Northwest Pakistan

Speedtalk

Session: Speedtalk session 6

Time: 5.00-5.05

¹**Umair Safdar**, ¹Babar Shahbaz, ¹Dr. Tanvir Ali, ¹Shoukat Al

¹University of Agriculture, Faisalabad, Punjab, Pakistan

The mountainous areas of northwest Pakistan are typified by patches of agriculture field and terrace farming, while continuation of livelihood depends on agriculture and livestock in this region. These mountainous areas are very vulnerable to climate change and climatic extremes. Kaghan Valley was selected purposively because it is a fragile area and changing of weather patterns and climate change negatively affects the source of livelihood of the people. The study was designed to analyze the patterns of climate change and how small farmers cope with climate change and climatic extremes. The results designate that there has been significant change in climate pattern in the study area for the last fifty years and this change has its adverse impacts on the agriculture and livelihoods of small farmers. Food storage, crop rotation and migration were reported as the most experienced coping strategy of the small farmers to build their resilience against climate change. It is therefore suggested that alternate agricultural practices should be introduced to build the resilience of the people and forest must be conserve to avoid deforestation. In this regard agricultural extension and forest department have to play their role to build the capacity of the small farmers to cope with the changing trends of climate. Key words: Climate change, Coping strategies, Mountainous area, Kaghan Valley



Application of SWAT model for climate change impact analysis on Yass River flow: a sub-catchment of Murrumbidgee River

Speedtalk

Session: Speedtalk session 5

Time: 5.10-5.15



¹Partha Pratim Saha, ²Ketema Zeleke, ^{3,4}Mohsin Hafeez

¹School of Environmental Sciences, Charles Sturt University, Wagga Wagga, NSW, Australia, ²School of Agricultural and Wine Sciences, Charles Sturt University, Wagga Wagga, NSW, Australia, ³School of Environmental Sciences, Charles Sturt University, Albury, NSW, Australia, ⁴GHD, Pty Ltd, Brisbane, QLD, Australia

Australia is the driest inhabited continent with variable climate and the country is vastly exposed to the impacts of climate change. Water resources management is expected to be more challenging as most of the future climate projections are indicating reduced water availability. Comprehensive research is required to identify the probable impact of climate change on the water yield of major catchments because each individual catchment has unique characteristics. This research uses the physically based distributed watershed model "Soil and Water Assessment Tool" (SWAT) to analyse the impact of climate change on Yass River watershed in the Murrumbidgee catchment, Southern New South Wales. A hydrological model was developed in SWAT using 90m SRTM DEM, Dynamic Land Use of Australia, and Digital Atlas of Australian Soil. The model was successfully calibrated and validated for 1993 to 2011 flow with a combination of manual and auto calibration techniques. Sequential uncertainty fitting (SUFI-2) and parameter solution (ParaSol) algorithm were used for auto-calibration. Nash Sutcliffe Efficiencies (NSE) of 0.83 and 0.78 for calibration and validation respectively indicate very good agreement between measured and simulated flow. Average of four GCMs downscaled data for three main IPCC scenarios: B1, A1B and A2 were used to simulate the stream flow of the river for three future periods: 2030, 2050 and 2090. All the simulations indicate reduced flow ranging from 22% to 78% where 2090 flow of A2 scenario being the worst. The seasonal variation also shows decreasing trend except A1b, B1 autumn and A2 winter flow of 2030.



Climate Change Adaptation with People Participation: A Case study of village Panchayat in India

Poster

Session: Poster session



¹Gita Sahibi

¹Forest, Shimla, India

Water scarcity, unemployment, lack of higher education, degradation, timber, fuel wood, increased fodder demands, low farm income & poverty, compelled the people of villages under study in the Indian Himalayas to reach a common platform and chalk out means for adaptation to meet with these challenges posed by climate changes. Villagers constructed check dams, water harvesting structures, water tanks, spurs, raised 32 hectares of plantations, water ponds, mangers (feeding stalls for livestock), and vermi compost units. This study is based on the data collected from a sample of 50 beneficiary households from Panchayat. Control samples of 25 households drawn from one village adjoining to selected Panchayat, having similar agro-climatic conditions. Analysis reveals that after community participation, the area under irrigation increased by 38 percent. Number of graduates, middle standard & primary level increased. The green cover increased by 25 percent, incidences of forest offences have declined by 58 percent, 42 percent reduction in extraction of fodder from the forests, livestock grazing have declined by 90 percent, 80 percent increase in forest crop protection due to community participation. Dependence for fuel wood, and fodder from forest, decreased by 45 and 20 percent respectively. Increase in use of LPG gas, milk production and employment in regular service by 30, 67, and 30 percent respectively. The production of cash crops, vegetables flowers, organic farming use increased by overall 45 percent respectively.

Poverty alleviation, improvement in living standards, decrease in dependence on forest resources, increase in green cover, milk, crop production due to people participation in climate change adaptation.



The Oasis model, as a sustainable response to global changes, combating desertification and climate change adaptation in Morocco.

Poster

Session: Poster session



¹Adil Said

¹International Institute of Tourism, Tangier, Morocco

Oases represents an extraordinary source of knowledge for all drylands, or those threatened by desertification. In Morocco, Oases cover about 7 Millions ha.

A specific program for adaptation to climate change has been initiated. It aims at reinforcing the resilience of oasis ecosystems and their ways of life and methods of production, as well as at safeguarding their historical and cultural heritage.

Oases are a model for efficient resource management for the whole planet. They can become a new model for development and economy through the actions undertaken to safeguard and value them.

The vast desert lands, including the oases, offer enormous renewable energy opportunities, such as solar energy to name only one.

High-quality, eco-friendly tourism which respects the environment offers opportunities yet not fully explored.

Oases are a model of sustainability and adaptation despite their know-how and capacity to adapt to a hostile environment, the populations of these zones need the support of new technologies and strong partnerships in order to safeguard and sustain their heritage.

These ambitious programs are based on a participative and partnership-based approach, founded on agreements with the regions, provinces, and communes. They give the local actors a central role to play in development.

The oasis is an extraordinary model for the whole planet. The work that has been started within the strategy of mitigation and adaptation to climate change in resilient oases in Morocco requires building solid partnerships and mobilizing important funds in order to safeguard this model of sustainability.



A world with less water - Adapting to a changing climate in the Riverina

Oral

Session: Parallel session 5

Time: 3.45-4.00



¹Marcus Sainsbury, ¹Guillaume Prudent-Richard, ¹Nicola Glenndining

¹AECOM Australia, Canberra, Australia

In 2010-2012 AECOM was engaged by the Riverina Eastern Regional Organisation of Councils (REROC) to undertake a multiple stage climate change and water security adaptation program. This program supported ten local councils and two water utilities in terms of climate change risk assessment and adaptation. The project included the identification of past and future climate trends. Both changes in mean variables and extreme events such as intense rainfall were considered. During the first two stages of the project these inputs were used to identify changes in water availability and the implications for REROC local governments and regional industries. The third stage of the project focused on the potential risks to assets owned and operated by the REROC Councils (in terms of potable, wastewater and stormwater services) as well as impacts on land use planning and strategic development.

Current asset management practices were documented and benchmarked against best practices. Detailed risk assessments were undertaken for each asset class for a range of climate change risks using an online risk assessment tool. The project also considered implications of climate change and reduced water availability to land use planning and strategic development by reviewing the adequacy of current practices and tools and considering changes in the regional competitiveness. Finally, initiatives were proposed to Councils to address the identified risks and one initiative was selected for further work in the form of a pre-feasibility study.



"Switch off", part-time environmentalism or effective engagement? The limited impact of the deficit model on people's responses to climate change

Poster

Session: Poster session



¹Rodolfo Sapiains, ¹Robert J (Bob) Beeton, ²Iain Walker

¹The University of Queensland, Brisbane, Queensland, Australia, ²CSIRO, Perth, WA, Australia

Climate change communication is complicated. Neither massive information access nor consensus in the scientific community has been enough to achieve sufficient public support for non-controversial climate change actions. Two decades after the 1992 Rio summit, scientific publications have grown exponentially but the public remains divided about the causes, magnitude and solutions needed to address the problem. This paper reports a qualitative study conducted in Australia to explore people's responses to climate change communication. Overall, scientific consensus does not impact on those whose belief system is incompatible with the message. Through the cultural cognition process people filter the information to accommodate it to their own values and beliefs. Our conclusions suggest that trying to convince or educate such peoples about climate change or environmental issues in general using the deficit model strategy will fail. Different narratives should be built to promote actions on climate change, emphasising the positive consequences of the actions and their coherence with cultural beliefs and values of different groups.



Expecting adaptation: the who, when, where and what of managing the Great Barrier Reef in a climate stressed world

Oral

Session: Parallel session 24

Time: 11.00-11.15



¹Chloe Schauble

¹GBRMPA, Townsville, Australia

The challenge of looking after the Great Barrier Reef is set to get harder as our climate changes. What do we expect of the agencies, industries and communities that manage and use this global treasure? The Great Barrier Reef Marine Park Authority has set out on an incredibly important, yet unavoidably challenging, adaptation journey. After five years of striving to put theory into practice what has been done, who have we worked with, what's been achieved, and where we are going next? Find out in this introductory presentation for the Adaptation in action for the Great Barrier Reef special session.



The human face of climate change: Adaptation in a vulnerable coastal community context

Oral

Session: Parallel session 3

Time: 4.15-4.30



¹Paul Schneider

¹Massey University, Palmerston North, New Zealand

Climatic changes are being recorded and experienced and coastal communities are already adversely affected with impacts projected to intensify. Adaptation is embryonic at best and needs to take place in the face of already diverse and contested interests presenting coastal communities with a dilemma: Wellintentioned approaches dressed in the rhetoric of adaptation are compounding existing problems by fostering unsustainable and maladaptative development. While 'business as usual' dominates, the need for new governance modalities has never been more urgent. This research focuses on New Zealand's Coromandel Peninsula in a case study that underscores the need to understand the 'messy' local factors that present barriers to and opportunities for climate change adaptation. Drawing upon insights from and integrating political ecology and environmental planning, this research is based on an ethnographic approach that provides new insights about adaptation barriers and opportunities. Particular attention is focused on the relationship between adaptation rhetoric (as legislative and guidance imperatives, and case law), and multiple local realities (in vulnerable, multilayered community setting). The narratives garnered from the research revealed a disjunction between rhetoric and reality and suggests practical ways forward. These suggested ways forward do not involve technical solutions. Instead, the findings show that adaptation needs to be located in innovative governance approaches founded on processes of constructive deliberation. Consequently, current consultative processes and social order which have proven to be incapable of addressing this vexatious situation need to be transformed.



Climate Change Adaptation in Cities: a Synthesis-Analysis for Sydney

Oral

Session: Parallel session 16

Time: 4.15-4.30



^{1,2}Sandra S. Schuster, ²Erica C. Tinio, ²Michael Neuman

¹Independent Consultant, Sydney, NSW, Australia, ²City Futures Research Centre at University of New South Wales, Sydney, NSW, Australia

Sydney is expected to experience warmer temperatures, more variable rainfall, increased evaporation, rising sea levels and an increased risk of flooding and bushfires. This presentation demonstrates Sydney's vulnerability to these changes and expected impacts on key sectors of society and diverse Sydney metro ecosystems. Sydney's planning concept of 'multi-centralisation' promotes many large regional centres, which serve catchment areas across the metropolitan area.

Themes addressed in the presentation are:

- Urban form, land use and sustainability.
- Temperature and the UHI effect.
- · Bushfire.
- · Riverine flooding including flash flooding.
- Coastal flooding.
- Social impacts and adaptive capacity.

Our review canvassed, synthesised, and analysed national and international examples of local Climate Change Adaptation (CCA) in the built environment. Key examples of adaptation strategies include:

- Evaluation of future options and scenarios for urban form and structure using comparative life cycle methods.
- Green spaces; creation of light coloured reflective surfaces; more compact city design.
- Distance enhancement between bushland and developments; use of hazard reduction measures, community education and engagement.
- Distribution and decentralisation of green infrastructure to reduce stormwater run-off, adoption of early warning systems.
- Mitigation of sea level rise risk through protection and accommodation and use of comparative life cycle cost-benefit analysis to assess the most appropriate and effective strategies.
- Providing ameliorative infrastructures and facilities to vulnerable communities.



Climate Change Adaptation in Sydney: a Synthesis

Poster

Session: Poster session



^{1,2}**Sandra S. Schuster**, ²Erica C. Tinio, ²Michael Neuman

¹Independent Consultant, Sydney, NSW, Australia, ²City Futures Research Centre at University of New South Wales, Sydney, NSW, Australia

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- Providing ameliorative infrastructures and facilities to vulnerable communities.



Strengthening community resilience to extreme weather events using trans-dimensional, multi-hazard Self Assessment

Oral

Session: Parallel session 29

Time: 1.45-2.00

¹Jenny Scott, ¹Jennie Cramp, ¹Michelle Rose

¹Ku-ring-gai Council, New South Wales, Australia

Ku-ring-gai Council completed its climate change adaptation strategy in 2010. The key adaptations emerging from the merit analysis demonstrated sustainability and risk reduction to more than one hazard type.

The Climate Wise Communities (CWC) program developed in 2012 sought to deliver these high priority adaptations. Three pilot workshops were conducted which focused on bush fire. These workshops tested a new method from RMIT to enable community members to identify bush fire hazards, self assess their vulnerability and examine the adequacy of their bush fire plans. This method guides self assessment across the personal, property and neighbourhood dimensions. It promotes the reality of shared responsibility as central to reducing vulnerability and explores the local context through people's experience of past bushfire events. This method highlights the resilience benefits from participating in an interdependent network. It also allows the most vulnerable residents to be included in the neighbourhood response framework without being labelled as 'vulnerable'. Participation was enhanced by targeting existing community networks such as schools and Bushcare groups and through the neighbourhood's 'social facilitator' because such people often bind neighbourhoods together. The participatory nature of the workshops provided excellent opportunities for residents to develop and strengthen local connections; share past experiences; explore locally relevant questions and clarify areas of concern. This interactive format proved valuable in developing a shared responsibility compared with more traditional methods of presentation. The challenge for Ku-ring-gai Council now is to expand the RMIT method into a multi-hazard approach including bushfire, storms, floods and extreme heat.



Recovering from natural hazards under a changing climate: lessons from cyclone Yasi

Oral

Session: Parallel session 6

Time: 3.45-4.00



¹Silvia Serrao-Neumann, ¹Florence Crick, ¹Jenny Wadsworth, ¹Darryl Low Choy

¹Griffith University, QLD, Australia

Climate change is expected to increase the frequency and intensity of extreme weather events affecting Australia. This is likely to add extra pressure to emergency management services, which are already stretched, especially if multiple extreme events occur over a short period of time. An example of this situation occurred in early 2011 when Queensland was affected by major flood events followed by category four tropical cyclone Yasi. Additionally, recovering from disasters caused by natural hazards is a long and complex process that requires further understanding in particular in terms of how it can contribute to adapting to climate change. This paper aims to contribute to this understanding by focusing on the recovery process of the Cardwell community which was severely affected by tropical cyclone Yasi on February 2nd 2011.

Drawing on empirical data collected through two series of interviews and seven workshops conducted between 2011 and 2013, the paper reports on the experiences of community members related to the response and recovery from Yasi. In particular, the paper highlights the areas that need further improvement in the disaster response and recovery phases. Lessons learnt from cyclone Yasi are then discussed to inform future climate change adaptation initiatives related to the emergency management sector.



The emergence of local climate change policy: international diffusion or local development?

Speedtalk

Session: Speedtalk session 13

Time: 5.15-5.20



¹Rukuh Setiadi, ¹Paul Burton

¹Urban Research Program, Griffith University, QLD, Australia

This presentation draws on research that is concerned with improving our understanding of how climate change policy responses are developed in localities such as cities, municipalities and provinces and why different policies develop in different places.

It is widely accepted that while climate change is a global phenomenon, adaptive responses are best developed locally to suit local conditions. However, it is also believed that localities can learn from each other in developing their responses and that processes of policy learning and transfer can help in this. The presentation provides a critical review of the general literature on policy development, policy learning and policy transfer and applies this to a selection of international experience of local climate change policy development. The review compares four major strands of literature: innovation and diffusion models; advocacy coalition frameworks; institutional analysis and development; and multiple streams approaches. In the application of these strands of analysis to local cases of climate policy development particular attention is paid to the interaction of local factors with external factors such as the promotion of good practice by international NGOs and transnational networks of climate policy advocates. The presentation concludes that while there is some evidence of structured processes of policy diffusion and learning among localities concerned with the development of climate change policy, local factors are more important in these processes.



Integrating landslide risk assessment into city spatial planning in improvement of climate change resilience, case study Tarakan City, East Kalimantan Province, Indonesia

Speedtalk

Session: Speedtalk session 5

Time: 4.50-4.55

^{1,2}Budhi Setiawan, ²Zamsyar Giendhra Fad

¹University of Sriwijaya, Palembang, Indonesia, ²Secretariat of Climate Change Resilience, Jakarta, Indonesia

In current situations related to climate change, decision-markers and stakeholders either participate in or drive the assessment, shifting from research-driven approaches to assessment integrated toward policy marking (UNDP, 2005). Since 2008, the Government of Indonesia has explored the use of a risk assessment approach climate change adaptation planning. Several case studies have been done including the preparation of a national document, namely Indonesia Climate Change Sectoral Roadmap, Climate Change Risk and Adaptation Assessment in the Province of South Sumatera, the Province of Nsa Tenggara Barat, Greater Malang and the City of Tarakan (Soeroso et. all, 2012).

Tarakan is a city in a small island in Indonesia that is tipped to be prone to the impact of climate change. The interdecadal variation of rainfall indicate a potential climate (data at 1960s) when the decadal mean of monthly rainfall during April-August decreased by about 100 mm compared to its longterm average (Hadi, et all, 2012).

Historically, Tarakan has experienced many landslides in its riverways and other ground- water bodies. Several landslides have caused loss of properties and even lives. Generally, landslides, erosion and sedimentation are very closely related to the condition of surface water flow and water behavior underground, where a high quantity of groundwater could cause landslides; also, a heavy flow of surface water on relatively open lands is causing erosion and sedimentation. Thus, landslides, erosion, and sedimentation problems in Tarakan are important considerations as strategic issues in city planning in improvement of climate change resilience.



There is more to it than public transport

Poster

Session: Poster session



¹Rosemary Sharples

¹University of Technology, Sydney, Sydney, NSW, Australia

Like all other facets of life, everyday travel will need to adapt to the new realities of a changing climate, by, for example, reducing the number and length of journeys undertaken by vehicles whose energy source involves the burning of fossil fuels at any stage in order to reduce the amount of greenhouse gases emitted. This is particularly relevant to journeys by car.

When trying to find solutions to a dilemma, it can be instructive to study the way similar problems have been handled in the past. There have been occasions where it has not been possible to continue to travel as before because transport infrastructure has been damaged. People have been required to rethink their travel behaviour to accommodate the change.

Motorists' responses to these, and less extreme, situations show that there is a wide range of possible reactions beyond simply changing route. The responses vary over time and are not confined to a single action. Several examples of complex strategies will be presented. The evidence is that less extensive changes are made first, with more major ones only being used if these more minor ones are not adequate. This provides some indications of how people are likely to behave if substantial changes are required in their travel.

Climate change has its own characteristics, which make it unique. However, knowledge of motorists' responses to damaged transport infrastructure can give planners some insight into how they might most productively guide and facilitate necessary changes.



Climate adaptation in the Abrolhos Islands fishing community: a cascade of environment, management, economic and social changes

Speedtalk

Session: Speedtalk session 3

Time: 5.15-5.20



^{1,3}Jenny Shaw, ²Nick Caputi, ¹Laura Stocker

¹Curtin University Sustainable Policy Institute, Fremantle, WA, Australia, ²WA Fisheries and Marine Research Laboratories, Hillarys, WA, Australia, ³Western Australian Marine Science Institution, Perth, WA, Australia

Global, national and regional changes to the marine environment are following predicted patterns. More recently, fine-scale changes consistent with climate predictions are being documented in Australian marine systems. Adaptation strategies have been developed, and in some cases implemented, in relation to fisheries management. However, little research has been conducted on the socio-economic consequences to communities of this cascade of climate, environmental, and management changes. This paper explores the social changes in a rock lobster fishing community at the Abrolhos Islands, Western Australia. From 2006 to 2012 there was a very low settlement of post-larval lobsters, including the lowest rate in 40 years in 2008/09. The reduction in lobster larvae appears to be climate driven. Significant effort and catch reductions were imposed across the entire fishery. The linkages between climatic, environmental and subsequent management, economic and social changes have been investigated. Key findings are that the management changes resulted in almost half of the boats leaving the fishery over a 3-4 year period. Fishers generally had to make the decision to sell or lease their licences (unit entitlement) or buy units from other fishers. The fishers who remained have altered their patterns of fishing so that they fish to price, coming to the Islands only when the price is high, often supplementing their income with alternative livelihoods. Wives and children no longer stay on the Islands, with many wives having to work on the mainland instead. Clubs, sporting fixtures and schools have closed down as a result, leading to community collapse.



Adapting Between the Flags: enhancing the capacity of surf life saving australia to cope with climate change

Oral

Session: Parallel session 3

Time: 4.00-4.15



¹**Shauna Sherker**, ¹Norman Farmer, ²Russell Richards, ²Oz Sahin, ²Marcello Sano, ²Rodger Tomlinson, ²Daniel Ware

¹Surf Life Saving Australia, Sydney, Australia, ²Griffith Centre for Coastal Management, Gold Coast, Australia

Surf Life Saving Australia (SLSA) has assets and facilities exposed to climatic drivers, including 311 surf life saving clubs (SLSCs) and more than 160,000 trained volunteers delivering coastline services. We employed a range of methods to identify climate change adaptation options and to explore adaptive capacity, combining stakeholder engagement, systems thinking, system dynamics and Bayesian network modelling within selected SLSCs.

Stakeholder workshops, involving national SLSA representatives, surf lifesavers, lifeguards, local council and community representatives focused on asset management, lifesaving operations and the role of local clubs in increasing community resilience.

A first round of workshops was the base to identify relevant adaptive responses from stakeholders. These included the defence of current assets, their relocation and retreat, and the improvement of lifesaving operation through training and equipment upgrades. At a national level, improving partnerships with external organisations, building capacity to provide guidance for clubs and mainstreaming climate adaptation in current procedures were identified as priorities for climate change resilience. A second round of workshops was centred on a Bayesian belief network modelling exercise to identify the determinants of implementing these adaptation options, such as type of funding, knowledge in developing options, and will for change. Adaptive capacity determinants fell into three broad categories: (i) funding, (ii) technical knowledge and (iii) social and institutional networks.

Other outputs anticipated from this important study include: user friendly case study outcomes and factsheets on coastal hazards and adaptation options relevant to SLSA.

Acknowledgements: The project was funded by NCCARF and SLSA



Integration of species distribution models and metapopulation models to investigate the potential impacts of climate change on the endangered rainforest shrub Triunia robusta (Proteaceae), endemic to the south-east Queensland, Australia



Poster

Session: Poster session

¹Yoko Shimizu, ¹.²Arnon Accad, ¹Richard Warrick, ¹Scott Burnett, ¹Mike Powell, ¹Alison Shapcott

¹Genecology Research Centre, The University of the Sunshine Coast, Queensland, Australia, ²Queensland Herbarium, Department of Science, Information Technology, Innovation and the Arts, Queensland, Australia

Climate change is already affecting plant distributions, and the species predicted to be the most vulnerable are the ones that have small, isolated populations and low genetic diversity. Many studies have modelled the potential impact of climate change on plant distributions, however, the majority are based on geographical and a-biotic factors and often ignore the potential effects on species population demographics and ecological dynamics. This research focuses on investigating the potential long-term viability and extinction risk of the endangered rainforest shrub Triunia robusta under projected climate change scenarios through an integration of species distribution models and metapopulation models. Triunia robusta is endemic to the Southeast Queensland, Australia, and its habitat is restricted to small subtropical rainforest fragments. Here we present preliminary results of potential impact of climate change on T. robusta distribution using a maximum entrophy approach. MaxEnt version 3.3.3k was used to predict the current distribution of T. robusta using high resolution climate surface data obtained from SIMCLIM® and environmental data from Queensland state government as to be used as the baseline model. Future climate projection surfaces were developed for each decade between 1990 and 2070 with A1F1, A1B and A2 SRES scenarios, and the Maxent baseline model was then projected onto these future climate surfaces to investigate the potential changes in distribution. The predicted future distribution of T. robusta under climate change scenarios will later be used to develop a spatial framework for metapopulation models and population viability analysis (PVA).



Working out what to put where in the landscape in a climate ready future

Oral

Session: Parallel session 19

Time: 3.00-3.15



²Mark Siebentritt, ¹Wayne Meyer

¹University of Adelaide, SA, Australia, ²Mark Siebentritt & Associates, SA, Australia

Landscape science has progressed to the point where modelled data presented in various visual formats can provide detailed maps of how combinations of future climate, commodity prices and carbon price impact on land management options such as agriculture, carbon plantings, biodiversity conservation and weed management. This information is valuable for informing the development of NRM and regional development plans and is of general interest to farmers and land managers. But as we strive to produce maps with finer resolution, longer term forecasts and increasingly complex scenarios, we risk presenting information that either distresses landholders if their property ends up on the wrong side of a "red line" or leads them to challenge the validity of underlying models; both outcomes acting as a barrier to use what we regard as best available science. This paper identifies implementation learnings relevant to application of the results of landscape science, drawing on the experience of the Adapted Future Landscapes project in the Eyre Peninsula and South Australian Murray-Darling Basin NRM regions, which involved both researchers and end users in its design and delivery.



Psychological theories of environmentally responsible behaviour

Speedtalk

Session: Speedtalk session 4

Time: 4.40-4.45



¹Donna Simpkins

¹Monash University, Melbourne, Australia

The field of psychology is intimately associated with behaviour change and therefore is ideally suited to helping address behaviour change within the individual or community to generate environmentally significant benefits. A body of research within environmental psychology has explored the area of environmentally responsible behaviour (ERB), which refers to any individual or set of behaviours which consciously seeks to minimise the negative impact of their behaviour on the environment, such as by recycling, buying organic products, and reducing waste and energy use. Much of this research has sought to explain why people engage in environmentally responsible behaviours and what the barriers are to engaging in these behaviours. A key feature of this body of research has been the recognition of a 'value-action gap', whereby people's environmental behaviour does not match their stated values or attitudes regarding the environment. Numerous theoretical frameworks and models have been developed to explain and predict individual's environmentally responsible behaviour. However, currently no conclusive answers have been found.

This presentation will give an overview of a number of influential psychological frameworks and models which have arisen from research and continue to inform thinking on ERB. The presentation will conclude with a review of the author's current PhD work in progress which will apply the Transtheoretical Model to the area of ERB, specifically energy use.



A comparative study of sustainable development initiatives in two public health enterprises

Poster

Session: Poster session



1,2 Judith Singleton

¹Griffith University, Brisbane, QLD, Australia, ²University of Queensland, Brisbane, QLD, Australia

Public health enterprises have a significant carbon footprint. As responsible corporate citizens, and particularly since their core business is to treat public health as well as provide preventative health information, they should be endeavouring to not only reduce their carbon footprint, but move towards becoming truly sustainable enterprises - sustainable in the sense of recognising the inter-relationships between economic, social and ecological systems.

This research was an exploratory study of the sustainable development initiatives in Queensland Health (QH) and the NHS England (NHS). Due to time constraints, it was a 'snapshot' and involved two phases - the first phase consisted of a thematic content analysis of publicly available documents on the websites of the sustainable development units of QH and the NHS and the second phase consisted of interviews with the staff of these two units.

Consistent themes were found between the two phases for both QH and the NHS, with the NHS documents and interviews demonstrating a broader, strategic, systems approach and the QH documents and interviews showing a much narrower, facilities and utilities focus. Evidence of good examples of practice was seen with both enterprises, but the actual extent of the uptake of sustainability enterprise-wise was unclear from this study.

This research argues for a systems approach to transition these enterprises to sustainable enterprises. The strategic, systems-focused approach of the NHS England would benefit Australian public health enterprises as they strive to build capacity for climate change adaptation.



Enhancing adaptive capacity in South East Queensland

Oral

Session: Parallel session 35

Time: 2.45-3.00



¹**Tim Smith**, ^{1,2}Anne Roiko, ¹RW (Bill) Carter, ¹Dana Thomsen, ¹Julie Matthews, ¹Noni Keys, ¹Marcus Bussey, ³Russell Richards, ³Marcello Sano

¹Sustainability Research Centre, University of the Sunshine Coast, Queensland, Australia, ²School of Public Health and Smart Water Research Centre, Griffith University, Queensland, Australia, ³Griffith Centre for Coastal Management and Griffith Climate Change Response Program, Griffith University, Queensland, Australia

This paper presents the findings of the Adaptive Capacity theme of the South East Queensland Climate Adaptation Research Initiative (SEQCARI), Australia's largest single investment in a regional adaptation research initiative that ran over 3-years. While many adaptation plans have been (and are being) developed, often little consideration is given to the various factors (adaptive capacity) needed for their successful implementation. This paper presents an assessment of adaptive capacity across a range of sectors in South East Queensland. A multi-method approach was adopted for the research, including an historical assessment of adaptive capacity, analysis of socio-economic trends affecting the region, participatory systems workshops, and Bayesian Belief Network (BBN) analysis. A number of recommendations will be presented to build adaptive capacity in the region based on the findings. We conclude that the major issue impacting adaptive capacity is not the availability of physical resources but the dominant social, political and institutional culture of the region.



Assembly processes at biogeographic transition zones in tropical-to-temperate eastern Australia

Oral

Session: Parallel session 17

Time: 3.45-4.00



¹Brigitte Sommer, ²Maria Beger, ³Peter L. Harrison, ⁴Russ C. Babcock, ¹John M. Pandolfi

¹Australian Research Council Centre of Excellence for Coral Reef Studies, The University of Queensland, Brisbane, Australia, ²Australian Research Council Centre of Excellence for Environmental Decisions, The University of Queensland, Brisbane, Australia, ³Marine Ecology Research Centre, Southern Cross University, Lismore, Australia, ⁴CSIRO Marine and Atmospheric Research, Brisbane, Australia

Understanding how and why ecological communities vary along spatial and environmental gradients is critically important to predicting how they may respond to climate change, and for their management and conservation. Biogeographic transition zones, in particular, are projected to undergo multidimensional changes, both through altered environmental conditions and shifts in the distribution of organisms. The ambient energy hypothesis postulates that patterns in species distribution and abundance are linked to available energy. Here we test this hypothesis for benthic communities in the tropical-to-temperate transition zone in eastern Australia (24°48'S to 32°48'S), where tropical, subtropical and temperate taxa overlap and corals occur at the margins of their ranges. We quantify variation in species abundance distribution along the latitudinal and environmental gradients and demonstrate systematic spatial variation in community structure. High-latitude reefs are typified by widely distributed, generalist, stresstolerant coral species. Although over 80% of coral species recorded in the study region are tropical, their contribution to overall abundance in the region is limited, as they are generally narrowly distributed and rare, except at northerly locations. This highlights interspecific differences and species interactions with the environment as key drivers of community organisation in biogeographic transition zones. Close coupling between patterns in community structure and gradients of available energy supports the ambient energy hypothesis and suggests that benthic communities in the tropical-to-temperate transition zone will be sensitive to climate change. Our findings enable predictions of how communities may respond to projected change and inform spatial management, marine reserve planning and policy-making under climate change.



Cross-border governance to support climate change adaptation in Australia – prospects and pitfalls

Speedtalk

Session: Speedtalk session 13

Time: 5.00-5.05



¹Wendy Steele

¹Griffith University, Brisbane, Queensland, Australia

The impacts of climate change do not adhere to conventional governance boundaries. Floods, for example do not stop at the state border, nor are storm surges contained within local government jurisdictions. Whilst this may appear self-evident, this 'inconvenient institutional truth' poses considerable challenges to existing and deeply embedded governance frameworks. Despite growing recognition that implementing effective adaptation initiatives will require transcending artificially imposed bureaucratic and/or administrative boundaries, the cross-boundary governance implications of climate change adaptation have been largely ignored within the Australian context (partly as a result of the historical context and nature of Australian federalism). What can we learn from existing cross-border governance initiatives in order to strengthen and improve cross-border climate change adaptation in Australia?



Climate adaptation engineering and risk-based design and management of built infrastructure

Oral

Session: Parallel session 16

Time: 3.15-3.30



¹Mark Stewart, ^{1,2}Xiaoming Wang

¹The University of Newcastle, Newcastle, Australia, ²CSIRO Climate Adaptation Flagship, Highett, Australia

The impact of climate change on infrastructure performance is a temporal and spatial process, but most existing models of infrastructure hazard and performance are based on a stationary climate. Moreover, relatively little attention has been paid to quantifying the costs and benefits of adaptation strategies (retrofitting, strengthening, enhanced designs) for built infrastructure and assessing at what point in time climate adaptation becomes economically viable - we define this as 'climate adaptation engineering'. The presentation will describe how risk-based approaches are well suited to optimising climate adaptation strategies related to the design and maintenance of new and existing infrastructure. Risk-based decision support is described to assess the risks and economic viability of climate adaptation measures. An important aspect is assessing at what point in time climate adaptation becomes economically viable, and decision preferences for future costs and benefits (many of them intergenerational). Stochastic methods are used to model infrastructure performance, effectiveness of adaptation strategies, exposure, and costs. The concepts will be illustrated with current research of risk-based assessment of climate adaptation strategies including designing new houses in Queensland subject to tropical cyclones and other extreme wind events. For example, it was found that increasing design wind loads for new houses in Brisbane and South East Queensland will lead to a net benefit of up to \$10.5 billion by 2100. This anticipatory adaptation measure will help pave the way for more efficient and resilient infrastructure, and help 'future proof' existing infrastructure to a changing climate.



Climate adaptation engineering for extreme events - a Climate Adaptation Flagship cluster

Poster

Session: Poster session



¹Mark Stewart

¹The University of Newcastle, NSW, Australia

The CSIRO Climate Adaptation Flagship has recently provided over \$3 million to establish the Climate Adaptation Engineering for Extreme Events Cluster. The cluster brings together researchers from across Australia with a wide range of expertise, and includes the University of Newcastle, James Cook University, University of New South Wales, Swinburne University of Technology, University of Western Australia, and the CSIRO Climate Adaptation Flagship.

The cluster aims to assess the risks, benefits, and costs of climate adaptation strategies, and recommend those that are practical and cost-effective - we define this as 'climate adaptation engineering'. The cluster partners will identify and develop climate adaptation strategies using innovative design and construction processes - these will rely on the latest developments in engineering technology to ensure durable, environmentally friendly and less vulnerable infrastructure. The effect of extreme wind, heat and floods on the cost-effective of adaptation strategies for houses, commercial and industrial buildings, bridges, power poles and railway infrastructure will be assessed. A key innovation of the cluster is to bring risk and uncertainty into the decision-making process. Research partners will consider uncertainties of climate change projections and infrastructure vulnerability into model development using latest probabilistic and reliability analysis techniques. Added to this will be a decision-support framework that balances economic, social and environmental aspects of climate adaptation to ensure adaptation solutions that are robust and acceptable to all stakeholders. The poster will describe the aims and scope of the cluster, explain the research plans, and provide details of industry involvement.



Adaptive Syngeries: An institutional analysis of urban resiliency and governance

Oral

Session: Parallel session 2

Time: 3.15-3.30



¹**Ryan Stock**, ¹Pamela Barclay, ¹Cara Bastoni, ¹David Eisenhauer, ¹Masooma Hassan, ¹Melody Lopez, ¹Leila Mekias, ¹Sundeep Ramachandran

¹University of Michigan, Ann Arbor, MI, USA

Can the cities and people of the Laurentian Great Lakes adapt to climate change while improving economic, social, and ecological resiliency? Answering this question requires understanding how social, economic, political and ecological processes interact over various spatial and temporal scales to shape climate adaptation. Climate models project warmer temperatures and shifting precipitation patterns with an increased likelihood of extreme events by the end of the 21st century. To better understand how the Great Lakes region can adapt to climatic impacts, we evaluated the adaptive capacity of four cities in Ohio (Avon Lake, Dayton, Elyria, and Toledo) by conducting an Integrated Assessment that measured various capitals and capacities presumed to increase a system's ability to respond favorably to climate impacts. Further, using the Institutional Analysis and Development Framework, we investigate how each government manages that adaptive capacity to achieve positive adaptive outcomes.

We conducted a total of sixty interviews with policy- and decision-makers. Using qualitative coding software data was analyzed to identify leverage points, synergistic projects and partnerships. A key finding is that each city is experiencing significant storm water impacts, extreme heat events, and influx of invasive species. Approaches to managing these impacts include broad stakeholder engagement, private-public partnerships, and forming regional networks. However, scarce resources, incomplete knowledge, and unclear vision constrain the potential of these innovative initiatives to increase resiliency. Using an institutional analysis framework to identify system leverage points and opportunities, our research offers lessons and methods to better understand how governance of climate change adaptation progresses.



Coastal adaptation to climate change: factors affecting governance, knowledge, the consituency and implementation

Oral

Session: Parallel session 10

Time: 1.15-1.30

¹Laura Stocker

¹Curtin University, Perth, Australia

This paper reports on some research findings of the Governance Theme of the Coastal Collaboration Cluster. The present research has sought to enhance the governance of coastal adaptation. Governance for coastal adaptation requires going beyond the science deficit model. A new analytical framework is presented to identify key interactions and issues affecting coastal adaptation. Four domains are considered important. 1. Knowledge includes science, lay, managerial and Indigenous knowledges. 2. Governance includes decision-makers, policy-makers and a wide range of stakeholders. 3. The constituency includes the community and private sector and their political power. 4. Implementation includes management strategies and monitoring regimes. The key emergent issue in the analytical frame is captured by the notion of 'legitimacy'. Legitimacy includes: legitimacy of knowledge about coastal adaptation to climate change; legitimacy to make significant governance decisions around coastal adaptation; legitimacy of the means by which those decisions are implemented; and legitimacy of the policy process as conferred by the policytakers, the constituents. Legitimacy is conferred as a result of a 'quadalog' or mutual conversation among the above four domains. Conferral results when certain criteria are met. Governance has to meet criteria of efficacy and accountability. Knowledge has to meet criteria of adequacy and cogency. Implementation has to establish appropriate standards and professional practice. Constituency confers legitimacy when it accepts that knowledge and actions meet criteria of credibility and salience. The paper identifies the issues that influence whether these criteria are met or not.



Supporting decision-making in the sugar cane industry with integrated seasonal climate forecasting

Poster

Session: Poster session



¹Roger Stone, ^{2,1}Yvette Everingham, ¹Christa Pudmenzky, ¹Torben Marcussen

¹Australian Centre for Sustainable Catchments, University of Southern Queensland, Toowoomba, Queensland, Australia, ²James Cook University, Townsville, Queensland, Australia

Climate forecasting has the potential to have immense value for the Australian sugar industry, especially in regard to the provision of timely warning of excessive rainfall occurring during the critical harvest periods of autumn/early winter and spring/early summer. While statistical climate forecasting approaches have been demonstrated to provide modest skill and value for sugar industry management decisions, key issues in regards to provision of longer lead times and also for those decisions related to harvesting in autumn/early winter remain a problem. Development and application of fully coupled ocean-atmosphere model seasonal (and intra-seasonal) climate forecast systems offer major opportunity for improved management decisions and industry cost savings, especially for those periods for which statistical forecast systems have not proven useful and in the provision of more useful seasonal climate forecasting outputs under future climate change. Integration of recently developed dynamical seasonal climate forecast systems with cane and sugar growth simulation models would also provide considerable value to the sugar industry in terms of the provision of more accurate forecasting of potential yield and commercial cane sugar (CCS) for this industry.



eReefs: Responding to a changing climate in the Great Barrier Reef

Oral

Session: Parallel session 17

Time: 3.00-3.15



¹Greg Stuart, ²Theresa Fyffe, ³Andreas Schiller, ⁴Richard Brinkman, ⁵Paul Lawrence

¹Bureau of Meteorology, Brisbane, QLD, Australia, ²Great Barrier Reef Foundation, Brisbane, QLD, Australia, ³CSIRO, Hobart, TAS, Australia, ⁴Australian Institute of Marine Science, Townsville, QLD, Australia, ⁵Queensland Department of Science, Information Technology, Innovation and the Arts, Brisbane, QLD, Australia

eReefs is a response by Australian and Queensland Government agencies plus private investors to mitigate the risks associated with the multiple use of the Great Barrier Reef. The project uses the latest measurement technologies to monitor and deliver observations together with a suite of integrated and data assimilating models across paddock, catchment, estuary, reef lagoon and ocean scales. By 2015, the project partners of eReefs (BoM, CSIRO, AIMS, the Queensland Government and the Great Barrier Reef Foundation) will deliver a framework to explore and predict the impact of factors such as temperature, chlorophyll, nutrients, turbidity and pH, and provide an interactive visual picture of the reef and its component parts. Further enhancements through citizen science initiatives within eReefs will allow the broader community to engage on the health of the reef - contributing monitoring information and learning about the reef. This paper outlines the progress made in delivering the foundations of eReefs. These are: a) a dashboard to access and analyse remotely sensed water quality data across the reef; b) numerical models to simulate hydrodynamics, sediment transport and nutrient concentrations; and c) an information system that allows increased discovery, access and re-use of the eReefs data sets.

This unprecedented level of access to information will allow coastal land and marine managers, industry, and the community to make informed decisions about the changes to the environment and their impact on it. Systems such as eReefs provide an integral component of the adaptive management framework required to live within a changing climate.



A Comparative Study on the Decision Making Process of the Coastal Climate Adaptation of Bangladesh

Oral

Session: Parallel session 28

Time: 12.15-12.30



¹Nahid Sultana

¹The University of NSW, Sydney, Australia

The maintenance of people's livelihoods in the coastal zone of Bangladesh largely depends on the climate adaptation strategies adopted by the key stakeholders and the local government. Although national plans encourages stakeholder engagement during the development phase, their efforts tend to be topdown in nature, which creates critical gaps between national and local level governance. Consequently, the outputs of Integrated Coastal Zone Management Plan (ICZMP, 2005), National Adaptation Action Plan (NAPA, 2005) and Bangladesh Climate Change Strategy and Action Plan (BCCSAP, 2009) are ineffective in the phases of implementation, monitoring and evaluation to achieve the sustainable livelihood strategy for the coastal zone. The aim of this paper is to understand how stakeholders and practitioners at different scales (national, district, local) make decisions for diverse coastal districts. It reports on a comparative study of a coastal island and a coastal estuarine region in Bangladesh, and assessed people's adaptive capacity to climate change. Its findings demonstrate that the selection of priority components by government agencies and local stakeholders in relation to 'sustainability decision making' can help to overcome the institutional gaps and risks related to climate change. Considering the barriers to the effective implementation of national plans e.g. ICZM, NAPA and BCCSAP, these case studies provide an evaluation of the successes and failings of the process, and its relevance for similar regions in other developing countries of the world.



Rationalist policy-making for climate change adaptation: a cautionary tale from disaster risk management in Australia

Oral

Session: Parallel session 7

Time: 3.30-3.45



¹Peter Tangney, ¹Michael Heazle, ¹Paul Burton, ¹Michael Howes, ¹Deanna Grant-Smith, ¹Kim Reis, ²Karyn Bosomworth

¹Griffith University, Brisbane, Queensland, Australia, ²RMIT University, Melbourne, Victoria, Australia

The linear, 'rationalist' policy model is the principal means by which governments justify and evaluate policy decisions, despite its practical difficulties and the widespread criticism it has received when accounting for the complexity, uncertainty and divergence of opinions and values associated with contemporary policy problems. Our research, part of a NCCARF-funded project to integrate climate change adaptation and disaster risk management (DRM), demonstrates how rationalist 'predict-then-act' approaches promote unrealistic public expectations of DRM and a reactive approach to natural hazards overall. Examining institutional responses to three recent natural disasters across Australia, our research also reveals how rationalist policy making masks normative decisions behind technical 'evidence'; overrelies on technical expertise, engineering and the reduction of exposure to natural events; while neglecting the types of <i>social capital</i> required when engineering provisions inevitably fail, or fail to provide the level of protection expected of them. We propose an alternative approach, in line with the pressing need for climate change adaptation and the practical difficulties of reducing uncertainties. By re-casting the existing Prevent, Prepare, Respond, Recover model of DRM in terms of a normative, incremental policy cycle, we argue that DRM can become more adaptive to future climates so that communities will be progressively better prepared for each new climate extreme. This approach focuses on managing uncertainties rather than reducing them and building resilience not simply through the reduction of hazard exposure, but through the reduction of community vulnerability, explicit consideration of normative policy priorities and increased community engagement in climate risk debates.



Scaling-up, scaling-down, and scaling-out: Local planning strategies for sea-level rise in NSW, Australia

Oral

Session: Parallel session 35

Time: 2.15-2.30



¹Bruce Taylor, ¹Ben Harman, ²Matthew Inman

¹CSIRO, Brisbane, Australia, ²CSIRO, Sydney, Australia

Globally, sea-level rise is expected to impact on many coastal regions and settlements. While mitigation of global greenhouse gas emissions remains an important task, adaptation is now seen as a critical component of the policy equation. Local government are key players in adaptation planning and managing risk through their mandated role in land use planning and development control. Yet, managing the predicted impacts of climate change is proving to be a complex and difficult task for planners and policy makers. This paper reports on a case of local governments deliberating on possible planning responses to address future sealevel rise impacts in New South Wales, Australia. Using structured discussions involving expert knowledge of planners and other technical experts engaged in a collaborative network in the Sydney region, this paper explores the feasibility of implementing planning measures at the local and regional scale to respond to inundation risk. The research presents practical examples of how local governments use specific scale-oriented strategies to engage private and public actors at different levels to help manage the legal, financial and technical risks associated with coastal adaptation.



climateadaptation knowledge + partnerships

Modelling Sub-daily Rainfalls for Flood Estimation

Poster

Session: Poster session



¹Phoung Thi Cu

¹University of Technology, Sydney, Australia

Design flood estimation under current climatic conditions remains a problem for many catchment managers. This problem will be more complex in the future when unknown future climatic conditions exist. Nonetheless, estimation of current and future flood risks is required for assessment of a range of climate change adaptation proposals.

When catchment modelling is used for prediction of flood flow quantiles, the uncertainty of the prediction to related to the robustness of the calibrated catchment modelling system. As shown by Umakhanthan and Ball (2004), the rainfall model used to predict the rainfall over the catchment significantly influences predictions obtained from the modelling system. Presented in this paper will be a discussion of the data analysis undertaken to provide adequate information for robust flow predictions.

The analysis presented will use a catchment in Vietnam (the Ba River system) as a case study. The focus of the analysis will be the disaggregration of daily rainfall information into sub-daily rainfall data to enable development of a suitable rainfall model for simulation of flood flows in the Ba River catchment. The disaggregation technique discussed is the non-parametric method developed by Sharma and his colleagues referred to as "Method of Fragments". Use of this technique for both current and future climatic conditions will enable assessment of climate change impacts on predicted flood flow quantiles.



Buffering our aquatic habitats from climate change: using riparian vegetation to reduce impacts on stream biodiversity and ecosystem function.

Speedtalk

Session: Speedtalk session 3

Time: 4.55-5.00



^{1,2}**Ross Thompson**, ²John Beardall, ²Jason Beringer, ²Michael Grace, ²Darren Giling, ²Jim Thomson, ^{2,3}Paula Sardina

¹University of Canberra, Canberra, ACT, Australia, ²Monash University, Melbourne, VIC, Australia, ³Consejo Nacional de Investigaciones Científicas y Técnicas, Caba, Argentina

Understanding the effects of changing climates on the processes which support aquatic biodiversity is of critical importance for managing aquatic ecosystems. Using manipulative experiments, we assessed the community-level responses of aquatic ecosystems to a realistic future temperature regime which included extreme events. There was evidence of major changes in community composition, with an unpredictable suite of species favoured. Body size of component species declined, and there was evidence that the top-down (grazing) influence of stream invertebrates was reduced, allowing increased algal biomass. Emerging aquatic insects were smaller, and timing of emergence was altered, with potential impacts for terrestrial consumers which rely on this resource. In some species, there were temporal mismatches between emergence of the sexes, with potential impacts on species' persistence. Field studies were used to determine the potential for riparian plantings to reduce stream temperatures of sufficient magnitude to mitigate against these effects. There was evidence that riparian replanting was sufficient to cool stream reaches to a degree consistent with preventing the predicted increases under climate change scenarios. There is potential therefore to use revegetation activities to mitigate against the impacts of warming climates in aquatic processes and biodiversity.



Climate change on film: pass the popcorn, choc top and catastrophe

Oral

Session: Parallel session 25

Time: 11.15-11.30



¹Dana Thomsen

¹Sustainability Research Centre, University of the Sunshine Coast, Queensland, Australia

Communication of climate change adaptation messages presents persistent challenges in terms of mainstream engagement. This paper presents an analysis of the potential integration of climate change storylines within popular films. Danger, inspiring protagonists, seemingly insurmountable hurdles, and opportunities for character growth and development are the holy grail of popular films. Climate change has all of these. But, perhaps most importantly, climate change offers a connection that transcends geographical, temporal and cultural boundaries. The analysis presented in this paper is focused on mechanisms with the potential to portray climate change as a transformative and inspiring contemporary narrative for mainstream film audiences. These are used to develop character archetypes and compelling narrative structures from official climate change reports authored by the Intergovernmental Panel on Climate Change and associated media in Australia. Analysis based on Joseph Campbell's influential theory of universsal mythology and recent conceptual adaptations by Christopher Vogler and others for screen writers.



Communicating social change towards sustainability: The narrative power of values, social identity and the human act

Poster

Session: Poster session



¹Christopher Thornton

¹University of South Australia, Adelaide, South Australia, Australia

Recent findings from Common Cause Research in the UK strongly argue that mainstream marketing tactics appealing to the extrinsic human values of power, wealth, image and status can fundamentally undermine behaviour-change for sustainability. To support this concern, the research agenda below identifies three interdependent factors thought to be crucial for improving behaviour-change communication. Drawing from G. H. Mead's theories on social identity, Ricoeur's narrative hermeneutics and studies on human values by Common Cause Research, this study contends that communication for sustainability should elicit intrinsic values, self-efficacy and social collaboration in the public sphere, instead of fear and on-going social competition. To demonstrate this, case studies will be made of sustainability initiatives including the Transition Network and CAT, to explore alternative community relations that demonstrate lasting adaptations for environmental change. Analysis of the emergent narratives and social phenomena from these contexts will describe how self-authored communities build their narrative identity towards social resilience. As Ricoeur states, human freedom, is recovered by reclaiming the potential of being as act. This concept is central to the argument that motivating sustainability is determined not by appeals to reason or purchase choice but by the social and narrative practices that shape who we believe we are. Therefore, 'selling' sustainability, as outlined by the UNEP for example, may be strategically misguided and unlikely to drive the depth of change needed for sustainability long-term. Instead, this study aims to participate in a redirective practice of design which seeks to communicate a shift towards a participatory social ecology.



Climate adaptation and sustainable livelihoods: An analysis of selected subsistence communities of West Timor, Indonesia

Speedtalk

Session: Speedtalk session 1

Time: 5.15-5.20

1,2,3Yenny Tjoe

¹Griffith University, Brisbane, QLD, Australia, ²Centre of Excellence for Sustainable Development for Indonesia, Brisbane, QLD, Australia, ³University of Indonesia, Jakarta, DKI Jakarta, Indonesia

The traditional subsistence production is an important part of rural Indonesia. For many rural households, yields from subsistence production are the main source of food to maintain their health and livelihoods. Like commercial agricultural producers, the subsistence communities are highly exposed to the current extreme drought conditions.

A number of studies have examined the impact of climate change-related harm on commercial farming and coastal regions, but little research is done in the context of subsistence communities. Through a combination of quantitative and qualitative methods, this research investigates the factors that contribute to livelihood vulnerability of the subsistence communities to extreme droughts, one in an upland region and the other in a coastal area. It then identifies ways to create capacity building and learning environments for adaption of the subsistence communities.

A quantitative method consists of primary data collected through a household survey. Data gathered will be used to produce a vulnerability index for each community. The relationship amongst responses will be explored using Probit analysis. The qualitative method involves a participatory action research. The information gathered from the survey (about the knowledge of subsistence communities, types of tools and skills) will be used to stimulate community participation in the operation of research, including identification of specific issues and experimenting with solutions.

By providing the formative insights into the knowledge of subsistence communities and their associated activities, this research contributes to the existing knowledge of rural livelihoods and to the validation of data for future planning and suitable rural development.



Ethno-religious diversity and climate change adaptation in Australia

Poster

Session: Poster session



¹Stephanie Toole, ¹Natascha Klocker, ¹Lesley Head

¹University of Wollongong, Wollongong, New South Wales, Australia

In recent years, climate change research and policy initiatives have foregrounded the importance of adaptation at the local scale, including in households. Research into the 'everyday' adaptive roles and capacities of Australian households is a rapidly growing area of research interest. However, the vast majority of existing research into household understandings of climate change adaptation has been overwhelmingly 'white'. This research explores Australian households' understandings of, and attitudes towards, climate change adaptation through the unique lens of ethno-religious diversity. Addressing this knowledge gap is particularly important as Australia is a country of high ethnic diversity and immigration, and understandings of (and engagements with) the environment and environmentalism have been shown to differ on the basis of ethnicity and religious faith. To address this aim, 679 survey responses were collected from New South Wales households across a range of ethnic groups (Chinese, Arabic speaking, Vietnamese, Filipino, Indian and Anglo-Australian) and religious affiliations (e.g. Hindu, Sikh, Muslim, Christian and Atheist). The findings indicate that understandings of climate change and perceptions of the need for adaptation were not constant across ethnic and religious groups. Perceptions of household responsibility for climate change adaptation also diverged markedly according to respondents' ethnicity and religious beliefs. Given the growing importance and urgency of climate change adaptation, as well as an increasing awareness that the household is a crucial site of analysis, this research makes a case for further diversifying ethnicity and religion in climate change debates.



Farmers' awareness and response to climate variability and change in North-West Cambodia

Speedtalk

Session: Speedtalk session 1

Time: 5.00-5.05



¹Van Touch, ¹Robert John Martin

¹University of New England, Armidale, Australia

Climate predictions for Cambodia are for increases in temperatures and rainfall with the likelihood of wetter monsoon seasons and less rainfall in the dry seasons. A baseline survey of 832 households was conducted in North-Western Cambodia in 2012 to determine upland cropping farmers' awareness and response to climate variability and climate change (Martin et al. 2013).

Production of upland crops, mainly maize and cassava makes up 80% of farm income in the region where there is an area of 50,020 ha under crop production. Farmers usually grow two upland crops per year. Early Wet Season (EWS) crops are planted in February-March and in the Main Wet Season(MWS) crops are planted in July-August. The predicted trend for shorter wet seasons and longer dry seasons could potentially make the EWS more prone to drought and for adverse impacts of high rainfall events in the MWS.

Most farmers observed that the climate was getting hotter (56%) and wetter (70%) which is consistent with climate predictions but not with the Battambang rainfall records which show a declining trend for rainfall since 1982. Most farmers also said that increasing temperature(58%) and rainfall (70%) had affected their farming activities and they were not aware of measures to cope with increasing temperature or rainfall. Follow up research is required to better understand the farming systems in North-West Cambodia and how farmers can adapt to perceived and predicted climate change.



Green Infrastructure and the Urban Heat Island: Is it adaptation, and does it matter if it isn't?

Oral

Session: Parallel session 13

Time: 2.00-2.15



¹**Alexei Trundle**, ¹Karyn Bosomworth, ¹Darryn McEvoy

¹RMIT University, Melbourne, Australia

This presentation will reflect on a recently completed cross-disciplinary project examining Melbourne's Urban Heat Island and the potential reduction of this phenomenon through enhanced use of Green Infrastructure.

Green Infrastructure offers a number of potential ecosystem services and benefits, ranging from stormwater retention to increased energy efficiency. Similarly, Green Infrastructure represents only one of a large range of approaches for reducing urban heat, with alternatives including high-albedo 'cool roofs', street planning for enhanced airflow, and active transport infrastructure.

Although Green Infrastructure is regularly incorporated into adaptation strategies and planning, the link between cooling the urban form's microclimatic conditions - already significantly hotter than their rural surrounds - and increased temperatures due to an enhanced greenhouse effect is rarely critically discussed or explained. Furthermore, the scale, form and spatial distribution of these cooling benefits, as well as the relationship (or lack thereof) between these benefits and the costs associated with Green Infrastructure implementation, often lacks systematic examination at an actor-based level.

The research approach integrated thermal imaging, policy analysis and green infrastructure expertise, with the aim of developing a decision framework for Green Infrastructure implementation in Urban Heat Island hotspots. This presentation will highlight the key findings from this study, with a focus on state and municipal level governance strategies for the mainstreaming of green infrastructure. These practical implementation measures will form the basis of reflections on a wider theoretical question underpinning the research; specifically, is the reduction of urban heat through Green Infrastructure truly climate change adaptation?



Not just talking to the "Greenies": effects of selfconcordance on individual adaptation

Oral

Session: Parallel session 4

Time: 3.30-3.45



¹Kerrie Unsworth, ¹Jon Heath, ¹Ilona McNeill

¹University of Western Australia, Perth, Western Australia, Australia

When trying to help an entire population adapt to climate change, we will be communicating not only with people who want to help the environment but also those who do not think about it very much. We propose that, if done cleverly, this will not matter. Instead, we hypothesise that the degree to which adaptation is connected to an individual's important goals is what will affect adaptation, not just whether they care about the environment or believe in climate change. For example, if a person believes that using the airconditioner less helps them to save money for a holiday then they are more likely to turn the airconditioner off than if the behaviour was connected only to an environmental goal which the person did not care about. Therefore, we hypothesise that self-concordance (the number of positive connections between the person's adaptive behaviours and their other values, identities and goals) will be strongly and positively related to adaptive coping and behaviour. Across three survey studies we found support for this hypothesis. The effect of self-concordance was related to adaptive coping and behaviour, above and beyond the effects of environmental values and anti-environmental beliefs. This means that people with more hedonistic or individualistic goals might also be influenced to engage in adaptive behaviours, if they can be convinced that adaptation helps them to achieve those goals. Practically, this means that we need to identify common goals, such as being healthy or saving money, and demonstrate how adaptation leads to these goals.



What about me? Reporting the results of the effect of emotion on individual climate change adaptation in a workplace setting

Poster

Session: Poster session



¹Sally Russell, ²Kelly Fielding, ¹Alice Evans, ³Kerrie Unsworth

¹Griffith University, Nathan, QLD, Australia, ²The University of Queensland, St Lucia, QLD, Australia, ³The University of Western Australia, Crawley, WA, Australia

Researchers to date have generally neglected to explore the affective dimensions of mitigation and adaptation behaviours for individuals. This is somewhat surprising in view of evidence that emotions are reactions to significant events and provide an impetus for action. In this paper we present the results of three studies where we aimed to examine how emotions in response to climate change affect individual adaptive behaviours in the workplace. Using the Cognitive-Motivational-Relational (CMR) theory of emotion (Lazarus, 1991a) we proposed that different emotions may be elicited in response to climate change and that these emotions would have differing effects on adaptive behaviours. Using two experimental studies and one correlational survey study, we examined how different appraisals, or evaluations, of climate change result in different emotions and behaviours. In our studies we examined two key emotional attributions: goal congruence (the extent to which an outcome is likely to lead to harm or benefit), and the ascription of blame (an attribution of the cause of an event). Preliminary results show that goal congruence is particularly important in determining emotional responses to climate change. Furthermore, results also show that when participants felt enthusiasm, worry and hope in relation to climate change reported more intentions to engage in adaptive and mitigation behaviours. Overall, the results suggest that both positive and negative emotions are important in driving behavioural responses to climate change. We further outline the results of these studies and highlight the important implications for businesses and policy makers.



Sea Level Rise and Contaminated Sites - More Challenges and Hard Decisions Lie Ahead

Oral

Session: Parallel session 3

Time: 3.45-4.00



¹Paul van der Beeke

¹Golder Associates Pty Ltd, Perth, Western Australia, Australia

A contaminated sites practitioner will provide perspectives on emerging issues for future contaminated sites management. Investigating and cleaning up these sites is scientifically challenging at the best of times. Sea level rise adds further complexity which will need to be addressed sooner than many realize, long before actual inundation occurs.

There are many potentially contaminating industries and land uses located on coastal and estuarine shores that will be submerged in the decades ahead. The submerged land will become part of the marine environment requiring more onerous cleanup standards, at greater cost.

Why should property owners and occupiers pay for the added cost to meet the more stringent criteria? Should they be compensated? Does the hierarchy of responsibility enshrined in current legislation still apply? What if the liabilities default to the banks or to Government if the responsible parties cannot pay? Who will pay when property values collapse in vulnerable areas as it becomes indisputable that inundation is going to happen? This realization may occur within 20 years.

Should adaptation include mandatory relocation with the demolition of all the buildings and infrastructure so that contamination investigation and remediation can occur in time? Are we thinking about the policy and legal framework that would allow this to occur? What if we do nothing? These are difficult questions with unpalatable answers.

Major challenges and hard decisions lie ahead for the community, policy makers, owners, occupiers, banks, legal profession and Governments. This presentation will outline the issues and suggest some approaches and actions.



Identifying Climate Change refugia for freshwater biodiversity across Australia

Oral

Session: Parallel session 26

Time: 12.00-12.15



¹Jeremy VanDerWal, ²Cassandra James, ³Doug Ward, ³Samantha Capon, ¹Lauren Hodgeson

¹Centre for Tropical Biodiversity and Climate Change, School of Marine and Tropical Biology, James Cook University, Townsville, QLD 4811, Australia, ²Centre for Tropical Water and Aquatic Ecosystem Research, James Cook University, Townsville, QLD 4811, Australia, ³Australia Rivers Institute, Griffith University, Nathan Campus, Nathan, QLD 4111, Australia

Freshwater ecosystems have very high biodiversity relative to their areal extent. They are particularly vulnerable to climate change because of their limited extent, their limited connectivity and, in much of Australia, their susceptibility to drying resulting from the high variability of temperature and rainfall. Identifying, protecting and managing freshwater refugia that will help protect Australian biodiversity from the impacts of climate change must be a key component of all future conservation planning and policy. Here we investigate the relative stability of biophysical attributes and species assemblages of freshwater ecosystems regimes across the Australian continent. We not only assess the relative stability or general refugial value of regions across all of Australia, but also highlight the outcomes for areas currently recognised as ecologically important (e.g., RAMSARs). Climate change is highly spatially and seasonally variable. Future stable and unstable areas have been identified; we highlight the relatively stable areas that will be areas of least concern. However, many regions and freshwater biophysical features will experience climates well outside their current range of variability and thus there will be significant changes in assemblages. Within unstable areas refugia will be a high priority, for example areas where temperatures are ameliorated through shading from vegetation or topographic shading.



Climate change and Australian birds - adaptation for the next half century

Oral

Session: Parallel session 33

Time: 2.00-2.15



¹Stephen Garnett, ¹Don Franklin, ²Glenn Ehmke, ³Jeremy VanDerWal

¹Charles Darwin University, NT, Australia, ²BirdLife Australia, VIC, Australia, ³James Cook University, QLD, Australia

In the first continental analysis of the effects of climate change on a faunal group, we classified 396 Australian bird taxa as being very highly exposed, sensitive or both. Of these 42 Australian terrestrial and inland water bird taxa are likely to have <10% of their current climate space remaining by 2085, 12 marine taxa have breeding sites that are predicted to be 10% less productive than today, and 61 terrestrial taxa are likely to be exposed to more frequent or intense fires. For most taxa actions that are already important will continue to be essential to effective conservation - of these the most prominent are fire management, weed and feral animal control for terrestrial taxa and, for marine taxa, controls on fishing. In the meantime, in order to identify climatic refugia within the landscape, there is a need for fine scale modelling of regions identified as having numerous highly exposed bird taxa. Regions that have particularly large numbers of taxa that are both sensitive and exposed are Cape York Peninsula, the Wet Tropics and the large continental islands. Secondly the intensity of monitoring should be increased to ensure change is detected in time for action, with the ongoing Atlas of Australian Birds being the most cost-effective means of monitoring most taxa. Although hugely uncertain, the cost of managing Australia's birds over the next 50 years to ensure they persist in the face of climate change is estimated at \$20 million per year - \$48,000 per year for each taxon.



Using climate and biodiversity indicators to identify macroscale refugia for terrestrial biodiversity across Australia

Speedtalk

Session: Speedtalk session 3

Time: 4.40-4.45



¹April Reside, ¹Stephen Williams, ¹Jeremy VanDerWal

¹James Cook University, Townsville, QLD, Australia

Refugia will be required to safeguard biodiversity against the worst impacts of climate change. The challenges for science are to develop robust predictions on the location and characteristics of crucial refugia, and how best to protect their refugial properties. We investigated the utility of incorporating both environmental and biotic data to predict macro-scale refugia for terrestrial biodiversity across Australia. For the environmental predictors we used paleo climate, recent (past 60 years) climate, and projections of future climate involving likely scenarios and 18 general circulation models. For biodiversity predictors we modelled the distributions of over 1700 vertebrate species for current and projected future. For all predictors, we focussed on metrics indicating stability, as climate stability is known to be correlated with high diversity and endemism. We determined the areas with the lowest proportional change and lowest long-term variance in climate variables, as well as the lowest turnover in species composition for each taxonomic group. We found that areas identified as having the greatest climatic stability were highly dependent on the metric and time frame used; however, the southern coast of Australia appears to have the least absolute change. The general trend for biodiversity predictions is that climate space will shift east and south; and the areas with the lowest species turnover occur in these areas, even when accounting for the original species richness. The next challenge is to incorporate the refugia into comprehensive climate change adaptation strategies to help protect Australia's biodiversity from the worst impacts of climate change.



Bridging the gap between end user needs and science capability: decision making under uncertainty

Oral

Session: Parallel session 7

Time: 3.00-3.15



¹Danielle Verdon-Kidd, ¹Anthony Kiem, ¹Emma Austin

¹University of Newcastle, NSW, Australia

There is a recognised gap between what climate science can currently provide and what end users of that information require in order to make robust adaptation decisions about their climate related risks. This issue is emphasised within the water resource management and agricultural sectors due to high uncertainty surrounding precipitation projections and has been identified as a major barrier preventing successful climate change adaptation outcomes. This paper details the outcomes of an extensive survey and workshop aimed at clearly identifying and quantifying this gap. A number of recommendations have arisen from this study in order to help bridge the gap. It is recommended that communication and packaging of climate information be improved via a formalised 'knowledge broker' program. It is also suggested that a 'terms of reference' for key climate change related words be developed and agreed upon by both climate science providers and end users to reduce the misuse of terminology and confusion that subsequently arises. Further, it is recommended that additional research be conducted into natural variability and baseline risk to provide a realistic background on which climate change projections and associated uncertainty are assessed. Finally new tools and methods to integrate between projections and decision making (e.g. decision support tools) that deal explicitly with uncertainty need to be developed and implemented within the adaptation community. While it is unrealistic to ever expect that we can close the gap, it is clear that there are opportunities to start bridging the gap.



A health and social services perspective on climate change and disability

Oral

Session: Parallel session 27

Time: 12.00-12.15



¹Rae Walker, ^{1,2}Wendy Mason

¹La Trobe University, Melbourne, Australia, ²SEHCP Inc, Melbourne, Australia

Institutions serving the Australian community need to adapt their core functions and evolve to address the impacts of climate change relevant to their mandate. The SEHCP Inc has begun this process with its 30 member community based health and social service agencies. In this paper we discuss the impacts of climate change on people with a disability, arguably the most vulnerable population in the community, and the implications for organisations striving to meet their community's needs.

The most common definition of disability used in Australian official statistics is 'any limitation, restriction or impairment which restricts everyday activities and has lasted or is likely to last for at least six months' (ABS 2010). Most of the information about climate change and disability is in reports on aspects of disadvantage, exacerbated by climate change, experienced by people with disabilities. The one issue on which there is a small body of research is on the experience people with disabilities have of emergencies and extreme weather events.

In this paper we report on a literature review and agency consultations that explore a health and social services approach to two major impacts of climate change on people with a disability. The first is engagement with the inequities people with a disability experience as market-based climate change policy initiatives take effect. The second is engagement with emergency planning to establish an inclusive response strategy that reduces the disproportionate harms (unmet needs, long term decline in function, potential for high mortality), in this population group.



A health and social services perspective on climate change related violence

Speedtalk

Session: Speedtalk session 4

Time: 5.10-5.15



¹Rae Walker, ^{1,2}Wendy Mason

¹La Trobe University, Melbourne, Australia, ²SEHCP Inc, Melbourne, Australia

Institutions serving the Australian community need to adapt their core functions and evolve to address the impacts of climate change relevant to their mandate. The SEHCP has begun this process with its 30 member community based health and social service agencies. In health violence is more complex than the climate change literature suggest. In this paper we discuss the impacts of climate change on the issue of violence and the implications for health and social service organisations striving to meet their community's needs. Violence is defined by the WHO as: 'The intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community, that results in or has a high likelihood of resulting in injury, death, psychological harm, mal-development or deprivation.' Self directed violence includes self harm and suicide. Interpersonal violence includes family violence (against children, partners and elders) and community violence (against acquaintances or strangers). Collective violence may be social, political or economic. The magnitude of harm, in descending order, is violence against self, interpersonal violence and, finally, collective violence.

In this paper we report on a literature review that frames the intersection of violence and climate change using the WHO violence and health framework linked to the current impacts of climate change. We consider: the impacts of extreme weather events on mental health, self harm, and interpersonal violence; and the pathways to collective violence and some evidence that suggests interventions to reduce the risk of collective violence occurring.



Walking on Country with Spirits: Enhancing adaptive capacity through Aboriginal research tourism

Speedtalk

Session: Speedtalk session 1

Time: 4.40-4.45



¹Helen Murphy, ^{1,2}Marilyn Wallace

¹James Cook University, Cairns, Australia, ²Bana Yarralji Rangers, Rossville, Australia

This paper describes an Aboriginal research tourism enterprise with a specific focus on how climate change information is gained and shared between Aboriginal people and the scientific community within a tourism context. This paper describes the Aboriginal research tourism enterprise of Bana Yarralji located in the Wet Tropics World Heritage area. Aboriginal research tourism is a relatively new phenomenon whereby scientists, students and volunteers pay to experience cross cultural collaboration in research on Aboriginal land.

Aboriginal people throughout northern Australia experience high levels of vulnerability to climate change. The competition for research and grant monies in climate change research is fierce, yet the impact is enduring and profound for Aboriginal people in the Wet Tropics. This paper describes how Bana Yarralji have acknowledged climate change as an impact on their culture and livelihoods and how they have in turn incorporated their own monitoring activities into their product range of research tourism opportunities. This research is important as it describes how an Aboriginal group identified a gap in the tourism market and are using this opportunity to create jobs, foster knowledge exchange and mitigate the effects of climate change. The results from this research demonstrate that knowledge of climate change adaptation and mitigation can be achieved through tourism enterprise and offers outstanding opportunities to both the scientific community and students alike for cross cultural collaboration in climate research activities.



Plans for an Australian Climate Extremes Service (ACES)

Speedtalk

Session: Speedtalk session 12

Time: 5.05-5.10



¹David Walland, ¹Doerte Jakob, ¹David Jones

¹Bureau of Meteorology, Melbourne, Victoria, Australia

The earliest impacts of climate change will be felt through extreme events which often act as a shock to systems that had previously appeared resilient. The most tangible and immediate way to adapt to a changing climate is to either protect against, or take advantage of, extremes.

The Bureau of Meteorology recognises the increasing need for tools and technologies to enable decision-makers to manage risks presented by extremes and considers sector-relevant indices could be valuable. The severe impacts of bushfires, heatwaves and flooding over the last three summers were felt throughout the health, energy, water, agriculture and disaster risk management sectors, and evidence the need for ACES. The Bureau is looking for partners and collaborators to progress it.

The Bureau is developing concepts to put extreme weather-related impacts into historical context, including the frequency and strength of past extremes. We are also looking at ways to forecast these key indices in the days ahead as well as potentially offering guidance over seasonal time scales. This intelligence will enable decision-makers to more effectively prepare for more extremes under a changing climate.

ACES will include robust assessments of sector-focused climate risks, early warnings on risks of extreme events, and aims to improve understanding and identification of key weather-related vulnerabilities. The proposed service will lead to better informed climate adaptation activities through improved understanding and identification of important points of vulnerability as well as increased recognition of the interaction between climate variability, climate extremes and climate change.



Perceptions of climate change adaptation among catchment management authorities: findings from an empirical study in Victoria

Oral

Session: Parallel session 12

Time: 2.15-2.30



^{2,3}**Philip Wallis**, ^{1,3}Hartmut Fuenfgeld, ^{1,3}Sophie Millin, ^{1,3}Alianne Rance, ¹Kate Lonsdale

¹RMIT University, Melbourne, Victoria, Australia, ²Monash University, Melbourne, Victoria, Australia, ³Victorian Centre for Climate Change Adaptation (VCCCAR), Melbourne, Victoria, Australia

The catchment-based Natural Resources Management (NRM) sector in Victoria is adapting 'with' a changing climate. Regional NRM is a sector that easily recognises the variability of Australian climatic conditions, having experienced the consequences of medium-term drought and extreme events, such as bushfires and floods. As such, the institutional arrangements in place to fulfill the role of Catchment Management Authorities (CMAs) as 'the caretakers of river health', while complex, are relatively flexible and community-focused as a result of earlier experiments in community-led governance. The unfolding effects of climate change in the long-term, however, may pose a different set of challenges to established management processes in the NRM sector and require NRM organisations to engage in different types of planning and decision-making in the context of uncertainty.

This paper discusses current perceptions of climate change impacts and adaptation and the institutional and organisational context for adaptation from the perspective of Catchment Management Authorities (CMAs) in Victoria. The paper presents preliminary findings from current qualitative social research, which investigated existing processes and systems that enable or hinder adaptation among Victorian CMAs. Institutional and policy context data is contrasted with additional primary data collected on CMA's perceived adaptation needs and their adaptive capacity. The paper concludes with a discussion of the policy implications the findings may have for better supporting adaptation among NRM bodies in Victoria and other states and territories.



Community preferences for roles and responsibilities for adaptation to sea level rise

Oral

Session: Parallel session 10

Time: 1.45-2.00



¹Elissa Waters, ¹Jon Barnett

¹The University of Melbourne, Victoria, Australia

It is widely recognised that there are legal, institutional and cultural barriers to climate change adaptation. A persistent and cross cutting-barrier is the lack of certainty, across both public and private domains, about who should be responsible for adaptation. Using the context of adaptation to sea level rise in Australia, this project aimed to investigate this barrier by studying community preferences for the distribution of responsibility for adaptation in two case study locations: Eurobodalla Shire in New South Wales and Mornington Peninsula Shire in Victoria.

The project undertook 80 hour-long interviews with a range of coastal users: business owners; homeowners; community organisation leaders; and coastal managers. The interviews elicited views on: current regimes of coastal management, the likelihood of sea level rise, and coastal adaptation policy options. Respondents were also asked about preferences for who should be responsible for a range of adaptation tasks, namely: providing information and creating knowledge; managing public assets; managing private assets; leading local planning; and paying for adaptation.

The findings reveal a widespread expectation for a significant role for government in all aspects of adaptation to sea level rise. They also show that coastal users have a well-considered set of preferences regarding the different roles and responsibilities of each level of government, and of the private sector. There is also some degree of consensus in these preferences. This presentation will outline the findings of this research and their implications for governance in adaptation to sea level rise and other adaptation contexts.



A typology of barriers to adaptation

Oral

Session: Parallel session 21

Time: 3.00-3.15



¹Elissa Waters, ¹Jon Barnett, ¹Aedan Puleston

¹The University of Melbourne, Victoria, Australia

Advances in adaptation science and policy increasingly show that there is a range of factors that impede climate change adaptation. Knowledge about barriers is, however, constrained by a limited body of evidence, both in Australia and internationally. In this study we develop a typology of barriers to climate change adaptation based on a unique body of evidence. Systematic analysis of over eight hundred pages of submissions to the Australian Productivity Commission's inquiry to barriers to adaptation, including from governments, the private sector, and civil society, reveals that there are five key kinds of barriers to adaptation. These concern governance, policy, uncertainty, resources, and psychosocial factors. The results of our study show that respondents prioritized these barriers differently according to the sector in which they operate. Overall however, some barriers are more important than others, with governance and policy being the major impediments to adaptation. This presentation will outline the typology and give examples from the submissions of barriers in the Australian context. The presentation will also explain the implications of our analysis for efforts to enable adaptation, including a discussion on sequencing steps to address barriers and the role of government in that process.



The Adaptation Plan of King Canute: Engaging communities on sea level rise

Speedtalk

Session: Speedtalk session 13

Time: 4.55-5.00



¹Stuart Waters

¹Twyfords, Wollongong, Australia

This oral presentation tells the story of a Collaborative Governance approach to decision making on sea level rise adaptation planning. Collaborative Governance is a five-step process for working with stakeholders on controversial projects to co-create enduring solutions. This presentation describes the co-creation of a long-term, multi-tiered sea level rise adaptation plan. It describes the Collaborative Governance (CG) model and the way in which it enabled diverse stakeholders to co-define their shared dilemma, co-design the collaborative decision-making process, co-create the plan and be ready to co-deliver it.

The presentation describes how the sponsoring agency (local council) went about building its internal commitment to work collaboratively with the at-risk community of stakeholders. It includes a discussion of how CG managed to bring together people representing the full spectrum of climate beliefs and non-beliefs to build a genuine commitment to work together on this vexed question.

Collaborative governance is designed for application in complex environments. This presentation describes the rationale one model of complexity provides for a collaborative approach to sea level rise adaptation planning. It also challenges the role of the climate "expert", presenting the case that our technical expertise is perhaps the biggest barrier to good adaptation planning.



Will climate change impacts be any worse than river regulation?

Poster

Session: Poster session



¹**Anne Watson**, ^{1,2}Leon A. Barmuta

¹University of Tasmania, Hobart, Tasmania, Australia, ²Tasmanian Aquaculture and Fisheries Institute, Hobart, Tasmania, Australia

The shallow Tooms Lake dam was constructed in 1840 and supplies water for irrigation to much of the Tasmanian midlands, via Tooms River. Although this river has been regulated for over 170 years, the invertebrate community remains depauperate and dominated by fly larvae, worms and snails, in contrast to the diverse fauna of the adjacent unregulated Macquarie River. In addition, the 2006-08 drought impacted more severely on the macroinvertebrate community of Tooms River, showing that the biota have less resilience to drought and potentially to climate change, than the biota of the highly variable-flow Macquarie River.

There is a tendency to consider that the benefits of dams outweigh the detriments, but little monitoring has been done to actually measure the impacts of small irrigation supply dams. Despite this, further irrigation projects are proposed for the central midlands, with more dams and intercatchment transfers of water to expand agricultural productivity and build resilience to drought and climate change.

-The NCCARF 'Joining the Dots' project combined outputs from dynamically downscaled climate models with hydrological modelling and systematic biodiversity data as inputs to Bayesian Belief Networks (BBNs). The BBNs identified major impacts to Tasmanian freshwater biota from projected climate change. These impacts are predicted to be most severe in low rainfall regions which already heave high demand for irrigation supply, such as central midlands. Is this the future for freshwater biodiversity in southern Australia? A prolifertion of dams to exacerbate the

impacts of climate change?



Coming ready or not: Managing climate risks to Australia's infrastructure

Oral

Session: Parallel session 23

Time: 11.15-11.30



¹Olivia Kember, ^{2,1}Stella Whittaker, ¹Corey Watts

¹The Climate Institute, Sydney, Australia, ²Manidis Roberts, Sydney, Australia

The Climate Institute, with research support from Manidis Roberts, reviewed the state of climate adaptation across several Australian infrastructure sectors. Research consisted of a desktop review of academic, business and government documents supplemented by engagement with companies, industry associations, regulators and government departments. Key findings were as follows: Australia still lacks a nationally coordinated approach to managing climate risks to major infrastructure, with much of the burden of policy implementation left to local councils. Information on Australia's preparedness for likely climate impacts is fragmentary and dispersed. The business response is uneven. Some organisations are moving to better understand and manage their exposure to climate risks. However, most infrastructure owners and operators are focused on maintaining their assets to standards based on historic, not future, climate. Laggards face no or little penalty, while early movers are hampered by fragmented information, and inappropriate and inconsistent regulation. Infrastructure is highly interdependent, but action on adaptation is isolated at the organisational level. The implications of climate impacts on interdependent systems and communities remain underexplored. Concern about climate change has fallen among those sectors most exposed. There is also emerging resistance to adaptive decisions at the community level. The implication of these trends is 'maladaptation' or counterproductive actions resulting in unnecessary costs, risks, and impacts to business, government and the community. The report makes recommendations for business and government.



Adaptation support strategies for Australia: addressing the gap

Oral

Session: Parallel session 11

Time: 1.00-1.15



¹Bob Webb, ¹Jie-lian Beh

¹ANU, Canberra, ACT, Australia

The presentation describes the outcomes of an NCCARF-funded project that identified end-user needs to support adaptation practice and decision-making, and reviewed international and Australian products and services currently available. This includes products, mostly web-based, that aim to assist in knowledge development and sharing, adaptation processes, and access to relevant data. It identifies a significant gap in meeting end-users' expressed needs across public, private and community sectors, and recommends product and enabling strategies to better deliver adaptation support within Australia. Current product development and support is highly fragmented, leading to confusion amongst end-users, insufficient critical mass and continuity of resourcing for sustained product support and improvement, unnecessary duplication of effort, and fragmentation of learning. Categories of end-user need identified included entry-level planning, more complex decision making, and assurance and review over the management of adaptation issues. For public, private and community sector organisations grappling with adaptation there is an urgent need for products that will provide better guidance and more confidence. The stakeholder consultations confirmed that some needs are likely to be common or 'core' across sectors and regions and others highly differentiated. The proposed strategies therefore address how common needs can be met, in some cases nationally, whilst distributed demand-driven approaches can best meet the differentiated needs.

The timing for a more coordinated strategic approach is right. There is potential to build on a number of current and proposed product initiatives which, if positioned and enhanced within a more intentional overall strategy, could collectively make a significant difference.



Principles for good adaptation governance: a more robust adaptation practice

Oral

Session: Parallel session 35

Time: 1.30-1.45



¹Bob Webb

¹ANU, Canberra, ACT, Australia

The presentation identifies ten principles for good adaptation governance and practice, and an overarching framework indicating how they can be addressed in the framing and management of adaptation initiatives. It is based on a combination of adaptation experience, drawing especially on local and regional projects in Australia; testing of the principles with a range of stakeholders; and a review of the relevant literature. Climate adaptation is characterised by the diversity of organisational strategies, planning issues and decisions impacted. New and complex challenges arise from the need to address increasing current and future climate risks and uncertainties, and the underlying drivers of vulnerability and resilience. Potential responses range from incremental to transformational. New interdependencies arise from the pervasiveness of climate impacts across natural and human systems, sectors and scales; the need to consider different time horizons; and the nature and levels of uncertainty involved. This complicates decision-framing and objective-setting, which also often need to be embedded within broader (non-climate) issues and objectives.

Whilst analogies to each of these issues can be found in non-climate decision-making and policy areas, the combination of them in climate adaptation presents a unique challenge. It is little wonder that many organisations struggle to know where to start; and others get started but stall in moving from assessment to decisions.

Incorporating the set of principles more overtly into adaptation processes will facilitate a more holistic and strategic approach to adaptation initiatives, and the ongoing integration of learning from additional research and experience as it becomes available.



Prioritising children and young people's social and emotional wellbeing during and after climate-related extreme events

Oral

Session: Parallel session 1

Time: 3.15-3.30



¹Nadine Elizabeth White, ¹Anne Graham, ²Kylie Valentine, ³Melinda Phillips

¹Centre for Children and Young People, Southern Cross University, Lismore, NSW, Australia, ²Social Policy Research Centre, University of New South Wales, Sydney, NSW, Australia, ³Good Grief Ltd, North Sydney, NSW, Australia

Along with the aged and disadvantaged, children are especially vulnerable to the negative effects of climate change. Building resilience to climate change impacts is an urgent priority, particularly for children. Research has shown that a clear sense of how climate change is problematic for children and young people is not well understood and that Australian children risk falling between the research-policy-action cracks regarding climate change. Evidence-based programmes that reduce children's vulnerability and help them understand the impacts of climate change, including how they and their communities can best respond, are needed.

Good Grief is an Australian owned, not-for-profit organisation that is committed to building resilience and fostering wellbeing in Australian communities. It provides programs for children, young people and adults challenged by loss and change, including the Seasons for Growth and Stormbirds programs. Stormbirds supports young people to understand and manage the changes they experience as a result of a natural disaster and enables them to develop coping, problem solving and decision-making skills. The partnership between *Good Grief*, the *Centre for Children and Young People* and the *Social Policy Research Centre* has identified an urgent research agenda that prioritises the social and emotional wellbeing of children and young people during and after climate-related extreme events. It is argued that programs that build resilience and adaptive capacity and reduce the contextual vulnerabilities of children and young people create pathways towards resilient climate adapted futures for Australian regional communities.



Price Regulation and climate risk – a case study of the energy distribution sector

Oral

Session: Parallel session 23

Time: 11.00-11.15



¹Stella Whittaker, ¹Adam Davis

¹Manidis Roberts, Sydney, Australia

Manidis Roberts, KPMG and The Climate Institute collaborated to undertake an exercise to credibly identify, quantify and cost climate impacts on city infrastructure (Melbourne) as a result of extreme heat event. We modelled the impacts on infrastructure and their interdependencies under a specified climate event. This provided a case study of the flow-on impacts of the damage to infrastructure from future climate events.

We explored the interdependencies that play out between businesses and infrastructure owners and operators under future climatic conditions, such as an extreme heat, sea level rise or extreme rainfall events. The exercise identified nodes of interconnectivity and interdependency and where there are critical infrastructure vulnerabilities to future climatic events. It also analysed flow-on effects throughout the economy of any resulting disruption to services and performance of assets as a consequence of these events. There have been very few exercises of this nature carried out to date, and this now forms an important body of research for the TCI Resilience Flagship Project and more widely.

An analysis found businesses and organisations are largely unprepared for a heatwave event of magnitude. 2030 predictions doubling both frequency and severity of impacts would severely overstretch budgets, infrastructure capacity, coping ranges and system interactions and would be unmanageable. The potential impact on individual businesses in terms of effect on total revenue was calculated. The exercise also shows that the responsibility for planning and actions to reduce vulnerabilities lies with multiple parties and not just those initially impacted. Systems resilience rather than sector resilience is required.



Climate impacts— analysing infrastructure interconnectivity and flow-on effects for Australian cities

Speedtalk

Session: Speedtalk session 2

Time: 4.40-4.45



¹Stella Whittaker, ¹Olivia Kembler, ¹Adam Davis, ¹Nicki Hutley

¹Manidis Roberts, Sydney, Australia

Manidis Roberts, KPMG and The Climate Institute collaborated to undertake an exercise to credibly identify, quantify and cost climate impacts on city infrastructure (Melbourne) as a result of an extreme heat event. We modelled the impacts on infrastructure and their interdependencies. This provided a case study of the flow-on impacts of the damage to infrastructure from future climate events. We explored the interdependencies that play out between businesses and infrastructure owners and operators. The exercise identified nodes of interconnectivity and interdependency and where there are critical infrastructure vulnerabilities to future climatic events. It also analysed flow-on effects throughout the economy of any resulting disruption to services and performance of assets as a consequence of these events. There have been very few exercises of this nature carried out to date, and this now forms an important body of research for the TCI Resilience Flagship Project and more widely. An analysis found businesses and organisations are largely unprepared for a heatwave event of magnitude. 2030 predictions doubling both frequency and severity of impacts would severely overstretch budgets, infrastructure capacity, coping ranges and system interactions and would be unmanageable. A typical potential impact on individual businesses is predicted to be a 0.2 - 1.1% reduction of total revenue. The exercise also shows that the responsibility for planning and actions to reduce vulnerabilities lies with multiple parties and not just those initially impacted. Systems resilience rather than sector resilience is required.



Improved climate-readiness of intensive livestock management through use of a Heat Load Index as an indicator of heat stress

Oral

Session: Parallel session 13

Time: 2.15-2.30



¹Christine Killip, ¹**Andrew Wiebe**, ^{2,1}Des Reinhart

¹Katestone, Milton, QLD, Australia, ²Meat & Livestock Australia, Sydney, NSW, Australia

With temperature records being exceeded across Australia during last summer, the 'heatwave' has been a focus of public discussion. But what does this really mean for managing heat stress? Katestone has been working for many years with MLA to develop a forecasting system to assist with the management of heat stress in cattle. This system uses an algorithm developed specifically for Australian feedlot cattle, to calculate a heat load index (HLI) from meteorological parameters.

Media reports commonly focus on the forecast daily maximum temperature as the indicator of an upcoming heatwave. However, the important roles of high humidity, light winds and intense solar radiation in the generation of heat stress are not credited. Hence, the focus on maximum daily temperature is likely to confuse people and leads to poorly targeted actions for the management of heat stress. This is also relevant in the consideration and analysis of outputs from models of the future climate.

This paper reviews the reported heatwave conditions across Australia for last summer and compares daily maximum temperatures to the HLI and indicators for human heat stress. The approach is delivering increased climate resilience within the intensive livestock industry. It may also have wider implications for anticipating and managing heat stress in human populations providing a practical tool for adaptation to episodes of extreme heat.



Expert elicitation as a tool for identifying climate impacts, monitoring targets, and adaptation options

Oral

Session: Parallel session 26

Time: 11.45-12.00



¹Chris Wilcox, ¹Alistair Hobday, ²Lynda Chambers

¹CSIRO Marine and Atmospheric Research Division and Climate Adaptation Flagship, Hobart, Australia, ²Bureau of Meteorology, Melbourne, Australia

The first step in adaptation is understanding the species and ecological characteristics likely to be affected by a changing climate. This basic understanding is required for detecting impacts, and for identifying and evaluating potential adaption options. However, analyses suggest that up to 20 years of data is required to detect changes in vital rates and other characteristics of marine species in response to climate change. There are exceedingly few species for which records of this longevity exist, and this ignores the possibility that the measurements may not even cover those characteristics that respond to climate. As an alternative to analyzing field data, we used expert elicitation to identify ecological traits of seabirds and marine mammals that were expected to respond to climate change. We surveyed 29 experts, who provided 41 survey responses covering 19 species. We investigated 5 general classes of ecological traits: foraging and diet, body mass, breeding phenology, breeding success, and population size. The goal of our study was to formalize the knowledge held by these experts in order to predict which traits would be most responsive to climate effects.

We found that foraging and diet related traits were expected to change the most with climate change, but that predictions for traits in this category were also the most variable across experts. Body mass was nearly as widely expected to change, but with much lower variance between experts. Indirect evidence suggests that while there may be some bias in responses, expert predictions are relatively reliable and can be used to design climate change monitoring and adaptation plans.



Exploring current analogues of future climate to evaluate the likely response of sensitive montane birds of the Australian Wet Tropics to a warming world

Oral

Session: Parallel session 34

Time: 2.45-3.00



¹James Cook University, Townsville, Qld, Australia

Among birds, tropical montane species are likely to be among the most vulnerable to climate change, yet little is known about how climate drives their distributions, nor how to predict or monitor their responses to temperature increases. Models of species' environmental niche have been used to predict changes in distribution with climate change among rainforest birds of the Australian Wet Tropics, but direct tests of the relationship between variables such as temperature, and species' actual distributions are few. Spacefor-time substitutions, where warmer conditions are used as analogues of future conditions, offer an opportunity to test for species' responses to climate variables. We collected density data for rainforest birds across the elevational gradient in higher (warmer) and lower (cooler) latitude subregions within the Australian Wet Tropics (AWT). We first identified 28 species as potentially sensitive based on their unimodal elevational abundance response. Of these, environmental optima were located higher upslope in the lower latitude populations for 19 species, ten significantly so, with a median difference (~83m) concordant with that expected due to a latitudinal temperature difference of ~ 0.4 degrees (75m). These findings strongly suggest that temperature is a critical factor governing elevational distributions of these species, and that they are likely to shift upslope to track their preferred environmental conditions as climate warms. Our approach is sensitive enough to detect distribution shifts in response to small changes in temperature. We foresee important applications in the urgent task of detecting and monitoring the impacts of climate change on montane biodiversity.





Heat Ready? Caring for aged care residents in three Australian states

Oral

Session: Parallel session 13

Time: 1.45-2.00



¹Leigh Wilson

¹University of Sydney, Sydney NSW, Australia

Aged care facilities are home to an increasing number of frail aged people, a group who are more likely to experience adverse health effects in very hot weather. This study investigated the ways aged care facility staff care for older people on hot days in three Australian states and explored staff knowledge and thoughts on ways they could adapt practices to cope with increasing heat.

Two hundred and eighty seven aged care facilities in NSW, Queensland and South Australia were recruited into the study. Five hundred and sixty two staff were interviewed by telephone and asked about their knowledge of caring for older people on very hot days.

Staff used a range of strategies to keep elderly residents cool on hot days. These varied significantly by state, as did the level of staff knowledge and training on caring for the elderly in hot weather. Staff made positive comments about how they could improve practice, including temperature monitoring, hot day transfer packs and additional care support.

Staff knowledge of ways to care for older people was variable between states, however all staff mentioned strategies they used to assist residents when it was hot. The development of a consistent educational training module for aged care nursing staff would assist in the consistency of staff knowledge and practice during hot weather.



Reconceptualising "adaptation pathways" for informing responses to complex adaptation problems

Speedtalk

Session: Speedtalk session 10

Time: 5.15-5.20



¹Russell Wise, ¹Russell Gorddard

¹CSIRO Ecosystem Sciences, Canberra, Australia

Responses to change depend on knowledge of the nature of change, how change might affect things valued by society, and the rules that determine available choices. The prevailing interactions between knowledge, values and rules (kvr) have evolved under a relatively stationary climate and are (arguably) reasonably suited to supporting responses to incremental changes within the range of historical variability. Under climate change, however, unevenly distributed, non-marginal, and fundamentally uncertain impacts will mean values will be contested, preferences unstable or unknown, and governance unsuited to cross-scale responses. "Adaptation pathways" was introduced as a metaphor to help visualise and support decision making in contexts with uncertainty in knowledge but clearly-defined goals and limited distribution of power. These pathways approaches emphasised the adaptive nature of the decision process itself; allowing for sets of possible actions to be explored and sequenced in the face of deep uncertainty and inter-temporal complexity. This has limited usefulness in contexts where knowledge is uncertain, power is distributed, and goals are ambivalent. Here we present innovative contributions to the adaptation pathways conceptualisation to support responses to complex adaptation problems. We provide a perspective which emphasises the need to frame adaptation as both a decision problem AND as a process of societal change. The perspective stresses that if research and decision processes are to lead to better adaptation decisions, then adaptation strategies need to focus on influencing the co-evolution of the systems of kvr which surround critical decision processes. While acknowledging this is not easy, the 'adaptation pathways' and 'kvr' perspectives provide the concepts and frameworks around which stakeholders can engage and deliberate whilst also providing insights and guidance into the timing, intent and outcomes of possible interventions for steering the systems of kvr, and ultimately promoting more coordinated and strategic adaptation planning and implementation.



The association between temperature and work-related injuries in South Australia, 2001-2010

Poster

Session: Poster session



¹Jianjun Xiang, ¹Peng Bi, ¹Dino Pisaniello, ¹Alana Hansen

¹Discipline of Public Health, The University of Adelaide, Adelaide, Australia

Objective: To investigate the association between temperature and work-related injuries, to identify the groups of workers at high risk of heat-related injuries, and to explore the possible lagged effects of extreme heat on work-related injuries.

Method: Workers' compensation claims data were obtained from SafeWork SA for the period of 2001-2010 and weather data were collected from the Australian Bureau of Meteorology. The impacts of temperature on daily workers' injury rates were estimated by using generalized estimating equation models. A piecewise linear spline function was utilized to quantify the effect of temperature on work-related injury rates below and above thresholds.

Result: Overall, there was an association between temperature and work-related injuries in South Australia. One degree increase in temperature below 38°C was associated with 0.2% increase of daily injury rate. However, the injury risk declined significantly above this temperature. Specifically, the following groups of workers were at high risk of heat-related injuries: male workers; and young workers aged <=24. Occupations at risk were labourers; production and transport workers; and tradespersons. Industries showing an association between temperature and injuries were agriculture, construction, and overall outdoor industries. A lagged effect of extreme heat exposure on work-related injury risk has not been found.

Conclusion: The risk of work-related injuries is significantly associated with heat exposure, especially for vulnerable groups in the workplace. Relevant adaptation and prevention measures are required at both policy and practice levels to reduce heat-related injury risk particularly in regions with predicted increasing heat exposure due to climate change.



Predicting rainfall erosivity and hillslope erosion for climate impact assessment in the Sydney Region

Oral

Session: Parallel session 5

Time: 3.30-3.45



Xihua Yang

¹NSW Office of Environment & Heritage, Parramatta, Australia

There is considerable seasonal variability in rainfall amount and intensity in NSW, particularly across the Sydney Region. These changes have significant effect on rainfall erosivity and soil erosion, but the magnitude of the impact is not well quantified because of the lack of high resolution rainfall data. Recently, the 2km rainfall data from regional climate models (NARClim-Sydney simulations) has become available for the Sydney Region at sub-daily time steps for the period 1990-2009 (present) and 2040-2059 (future). These recent climate projections allow detailed impact assessment and modelling of rainfall erosivity and hillslope erosion between the two contrasting periods. In this study, we developed a daily rainfall erosivity model specifically for the Sydney Region to estimate rainfall erosivity values from present and future daily rainfall data. We further produce time series hillslope erosion maps using revised universal soil loss equations (RUSLE) for the same periods. Both products are at monthly and annual intervals with a finer spatial resolution of 100m which can be used for climate impact assessment and soil erosion identification and rehabilitation. We implement these processes in a geographic information system (GIS) so that they are automated, fast, and repeatable. Our prediction on rainfall erosivity shows relatively good correlation with point-based Pluviograph calculation (R² = 0.66). The results indicate that hillslope erosion for bare soils will increase about 53% in the Sydney Region within the next 40 years, and changes are greater in the coastal and south-west regions in summer with the highest in February.



Building adaptation capacity through narratives

Oral

Session: Parallel session 32

Time: 1.30-1.45



¹Celeste Young, ¹Roger Jones

¹Victoria University, Victoria, Australia, ²VCCCAR, Victoria, Australia

Communication has been identified as a key component of adaptation. Due to the size and complexity of adaptation tasks, a range of tools is required. These tools need to enable the participation of multiple stakeholders and build collaborative understandings that incorporate diverse areas of knowledge. Narratives are a key tool for enabling this. This presentation looks at the different types of collaborative narratives needed to enable aspects of adaptation. Through the lens of the practitioner this presentation shows the role of collaborative narratives and how they can inform understanding and decision making in the adaptation area. Using case studies it will also describe briefly some of the different processes for developing different types of collaborative narrative and illustrate how they can be applied and the different ways they can be communicated.

Cases studies include: Collaborative institutional and community adaptation narratives. Collaborative impact and solution adaptation narratives developed from a scenarios workshop at the Beyond the Mean workshop as a part of an NCCARF project Valuing Adaptation Under Rapid Change.



Adaptation and innovation - reframing adaptation implementation

Speedtalk

Session: Speedtalk session 10

Time: 4.40-4.45



1,2Celeste Young

¹Victoria University, Victoria, Australia, ²VCCCAR, Victoria, Australia

Adaptation at the implementation level has to date been primarily seen through risk frameworks. These frameworks serve the first part of the adaptation process which is to identify the problem and possible actions, and prioritise them. However, they do not address fully the next stage which is developing and implementing adaptation solutions. As described in the recent NCCARF report, Valuing Adaptation Under Rapid Change, adaptation practice is an emerging area of need. Adaptation practice requires that (often complex) knowledge from many sources be applied practically - innovation frameworks are very appropriate for this task. An innovation framework built around a core area of knowledge transfer and communication will provide the basis for iterative processes that allow for uncertain outcomes, multistakeholder involvement and foster social learning. Innovation frameworks that are already established and used in areas of industry and community development and can be more easily adopted by practitioners who are developing and implementing adaptation actions.

Using models from innovation research and a new communication framework for adaptation, this presentation will examine the major characteristics of innovation frameworks and how they can be modified and used to implement adaptation policy and practice.



Impact of climate variability on Plasmodium vivax and Plasmodium falciparum malaria in the high risk area of Yunnan Province, China

Oral

Session: Parallel session 27

Time: 12.15-12.30



^{1,2}Yan Bi, ¹Weiwei Yu, ³Wenbiao Hu, ⁴Hualiang Lin, ³Yuming Guo, ¹Zhiwei Xu, ¹Shilu Tong

¹School of Public Health and Social Work, Institution of Health and Biomedical Innovation, Queensland University of Technology, Brisbane, Queensland, Australia, ²Yunnan Center for Disease Control and Prevention, Kunming, Yunnan, China, ³School of Population Health, University of Queensland, Brisbane, Queensland, Australia, ⁴Guangdong Provincial Institute of Public Health, Guangdong Provincial Center for Disease Control and Prevention, Guangzhou, Guangdong, China

Malaria remains a public health problem in the remote and poor area of Yunnan Province, China. This study aimed to identify the high risk area of malaria transmission in Yunnan Province, and to estimate the effects of climatic variability on the transmission of malaria in the identified area.

We identified spatial clusters of malaria cases using spatial cluster analysis at a county level in Yunnan Province, during 2005-2010, and estimated the weekly effects of climatic factors on P.vivax and P.falciparum using a distributed lag nonlinear model up to 10-week lags.

The results show that the primary cluster area was identified in western Yunnan along China-Myanmar border. The highest relative risk (RR) in malaria cases with a 1 °C increase in minimum temperature was 1.03 (95% CI, 1.01, 1.05) for P.vivax at a 7 week lag and 1.07 (95% CI, 1.04, 1.11) for P.falciparum at a 6-week lag; the highest RR with a 10-mm increment in rainfall was 1.03 (95% CI, 1.01, 1.05) for P.vivax at a 2-week lag and 1.04 (95% CI, 1.01, 1.06) for P.falciparum at a lag of 2 weeks; and the highest RR with a 10% rise in relative humidity was 1.24 (95% CI: 1.10, 1.41) for P.vivax at a 5-week lag.

China-Myanmar border is a high risk area for malaria transmission. Climatic factors appeared to be major determinants for malaria transmission in this area. The estimated lag effects for the association between climate and malaria are consistent with the life cycle of malaria parasite.



Development of a framework for Local Government adaptation strategies

Speedtalk

Session: Speedtalk session 13

Time: 5.05-5.10



¹**Anis Zaman**, ¹Philip Jennings

¹Murdoch University, Perth, Western Australia, Australia

Adaptation to the impacts of climate change is a fundamental challenge for Local Government Authorities (LGAs) in Australia. The severity and frequency of climate change events are increasing the vulnerability of local governments' operations and services. It is, therefore, important that the LGAs improve their adaptive capacity to increase their climate resilience. However, the current lack of capacity of LGAs inhibits them from taking appropriate measures to adapt to climate change. Development of this framework was undertaken to increase the adaptive capacity of the local governments to the impacts of climate change and help in the decision-making process by incorporating climate change adaptation into mainstream LGA operations and services. The framework identifies a range of concerns that need to be addressed to produce an effective adaptive management strategy for climate change by LGAs. While there are barriers that are related to the governance system of LGAs, such as commitment, competing priorities and lack of knowledge; there are external barriers as well, for example, access to networking and limitation of statutory authority. This paper presents the key features of the framework including Governance, Communication, Planning, Networking and Funding, and explains how this framework can assist LGAs to incorporate climate change adaptation into mainstream operations and services. Key steps to develop an effective implementation plan for climate change adaptation measures, including a mechanism to regularly monitor and evaluate the implementation are also discussed. Finally, this paper briefly discusses the findings from trialling the framework in several LGAs.



Older Chinese's perceptions, behaviors and attitudes towards heatwave and health: A comparison between urban and rural areas

Oral

Session: Parallel session 20

Time: 3.30-3.45



¹Ying Zhang, ²Jinna Wang, ²Wei Ma, ⁴Monika Nitschke, ³Alana Hansen, ³Peng Bi, ²Baofa Jiang

¹University of Sydney, Sydney, NSW, Australia, ²Shandong University, Jinan, Shandong, China, ³University of Adelaide, Adelaide, SA, Australia, ⁴South Australian Department of Health, Adelaide, SA, Australia

More extreme heat events have been projected due to climate change and evidence suggests that older people are at a particular risk to extreme heat. However, research to understand their perceptions, attitudes and behaviors during heatwave is insufficient. Face-to-face interviews of randomly selected residents aged 60 years or over in Jinan city and rural areas in Shandong Province were conducted in late summer 2012. In total, 1208 questionnaires were collected with 600 from the rural areas. Compared to the urban area, in the rural areas, there were significantly higher proportions of the elderly who worried about how they would feel during heatwave (39% vs. 19%) and how to cope with it (5% vs. 2%), who received no phone calls (52% vs. 30%) and no visits (59% vs. 48%) during heatwave. A lower recall of heatwave warning messages (38% vs. 58%) and less willingness to make changes according to the messages (37% vs. 47%) were reported from the rural elderly. In addition, the adaptive behaviors during heatwave varied significantly between the two areas. Logistic models showed that having more social activities could significantly reduce morbidity during heatwave in both urban OR=0.51(0.29-0.88) and rural areas 0.41(0.25-0.67). In conclusion, the elderly living in the rural areas have more worries and fewer resources to cope with the health impact of heatwave in China. The differences in choosing adaptive behaviors, as well as its socio-economic determinants, should be considered in developing adaptive strategies and targeted intervention programs for the Chinese elderly. (Partially funded by China973Program: 2012CB955500-955502)

