BUREAU OF METEOROLOGY
DEPARTMENT OF THE ENVIRONMENT AND HERITAGE

Meteorological Study No. 43

Statistically based weather forecast guidance

Harvey Stern

June 1999

PREFACE

It has sometimes been suggested that Australia does not fully take advantage of the original ideas and the inventions of its citizens. It is further suggested that for these innovations to gain recognition here, it is necessary for them to be firstly accepted overseas. As a consequence, Australia often misses out on the full benefits from them that might otherwise flow to the country.

This fate has not befallen the analogue statistics approach to weather forecast guidance. When I first proposed it during the mid-1970s, its development gained initial impetus largely due to the support of Mr Keith Hannay, the then Victorian Regional Director of the Australian Bureau of Meteorology. That impetus has been maintained for more than two decades by a combination of valuable input at all stages of development by Victorian staff involved in weather forecasting operations, and the continued support of a number of Bureau managers.

A pilot model was developed. The concept then achieved reality in the early 1980s in the Victorian Regional Forecasting Centre where Robert Dahni and John de la Lande successfully worked on its inaugural operational implementation. Further development of the operational model took place over ensuing years. The latter half of the 1990s will see the model "go national".

Australia is unique in the world in being the only nation that has a comprehensive weather forecast guidance system based upon statistical analysis of weather associated with analogues.

ABSTRACT

A large portion of the forecaster's subjective prognosis involves recalling situations similar to the present one and arriving at a prediction by mentally weighting the outcome of these situations. This process was automated in the Victorian Regional Office (VRO) of the Australian Bureau of Meteorology (BoM) as the analogue statistics model (ASM). The ASM became the main source of forecast guidance in the VRO's Regional Forecasting Centre (RFC) and it is now to be extended nationwide.

The nature of the prediction process is complex and is influenced by factors that go beyond the knowledge and training of the forecasting practitioner and the tools that are available. The form of verification employed, that is, whether it evaluates forecasts from an "accuracy" or "economic value" perspective, and psychological influences, such as the impact of a recent forecast failure, are but two of these factors.

An analysis of trends in the accuracy of daily weather forecasts at Melbourne shows that improvements in weather forecast accuracy appear to reflect improved capability in predicting the broadscale flow. This can be largely attributed to a combination of an enhancement in the description of the atmosphere's initial state, provided by remote sensing and other technological developments, and to advances in broadscale Numerical Weather Prediction (NWP) models. The analysis yields less encouraging results with regard to the prediction of weather elements where forecasting the mesoscale and understanding of the physics of moisture processes are involved.

The development of NWP techniques took place well before they could be implemented as a part of weather forecasting operations. However, by the 1950s, with technological advances allowing such implementation, a paradigm for the future development of meteorology was set in train, with NWP at its core and statistical methods somewhat neglected. The historical literature suggests that this focus upon NWP was based upon the weather forecasting problem being seen as sensitive to deterministic solution. NWP was seen as "scientific" in contrast to the statistical approach. Ramage (1993) proposed that this view resulted in the science of weather forecasting being left with two sub-disciplines, one theoretical in nature, the other practical in nature and led to the two sub-disciplines not communicating well with each other. Analogies may be drawn with other fields where this type of situation has occurred. These fields are as diverse as linguistics and the pricing of financial market instruments.

Those same technological advances that allowed the realisation of NWP, have advanced to the point where implementation of sophisticated statistical approaches analysing vast quantities of data in a highly interactive man-

ner are now possible. The potential for a high level of interaction allows the statistical approach to bring about the communication, to which Ramage (1993) refers, by feeding back increased understanding about the physical processes and the causes of forecast error. The power of the statistical approach is illustrated with examples from the author's systems for forecast guidance such as the ASM, both in its Classical Statistical Method (CSM) mode and Perfect Prog (PP) mode; the parameter enveloping approach, which is seen as a proxy for the ASM; and, in order to cater for gaps in the observations record, an application to the creation of artificial climatologies.