17.4 TRENDS AND VOLATILITY IN THE ACCURACY OF TEMPERATURE FORECASTS

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1. INTRODUCTION

The purpose of the current paper is twofold:
(1) To investigate the relationship between the accuracy of Melbourne day-1 maximum temperature forecasts and

- the time of year (month); and,
- the type of *initial* synoptic situation (the synoptic situation at the time that the forecast is being prepared).

(2) To expand the study to incorporate a preliminary analysis of trends in the accuracy of forecasts out to 7 days.

2. BACKGROUND

The Australian Bureau of Meteorology's Melbourne office possesses data about the accuracy of its temperature forecasts stretching back over 40 years.

Customers receiving weather forecasts have, recently, become increasingly interested in the quality of the service provided. This reflects an overall trend in business towards implementing risk management strategies. These strategies include managing weather related risk (Stern and Dawkins, 2003).

There has been a great deal of work carried out on trends in the accuracy of Melbourne's temperature forecasts, largely on account of the sharp improvement that can be documented since the 1970s (Stern, 1996).

The aforementioned work came to some preliminary conclusions about how that accuracy varies with the type of synoptic situation.

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A more recent paper (Stern and Dawkins, 2003) utilised forecast accuracy data to price the cost of a financial product that could be used to guarantee the reliability of temperature forecasts.

3. DISCUSSION

It was found that the accuracy of the forecasts varies substantially, depending both upon the time of year and the type of weather pattern.

Regarding the time of the year, the highest day-1 Root Mean Square (RMS) errors, of about 3.5 deg C, are registered during the summer months, namely, December, January and February (Fig 1). This is attributed to these months being associated with the highest inter-diurnal variability. By contrast, RMS errors during the winter months are below 2 deg C for day-1 forecasts.

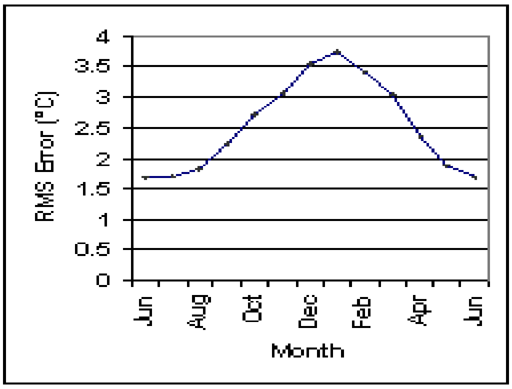

Fig 1 Seasonal variation in RMS errors (°C) for Melbourne day-1 maximum temperature forecasts 1961-2000.

The type of weather pattern determines the size of forecast errors (Fig 2). Larger errors are associated with anticyclonic northerly flow on the forecast day, often during summer with an approaching front. The timing of the approaching front has a large influence on the maximum temperature forecast. Smaller errors are associated with post-frontal southerly cyclonic situations, and particularly during the winter months. The smaller inter-diurnal temperature range makes forecasting easier.

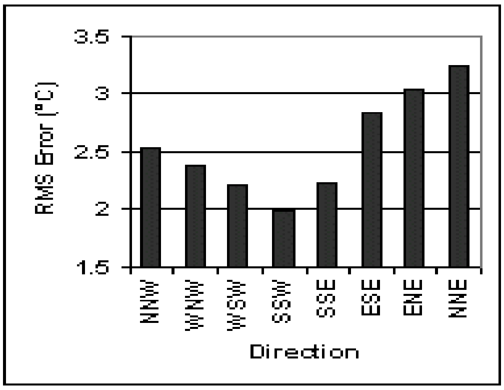

Fig 2 RMS Errors (°C) for Melbourne day-1 maximum temperature forecasts (1961-2000) - issued in association with moderate cyclonic flow from each of eight directions

Over the years, many synoptic patterns have been associated with substantial decreases in the size of errors, whilst only a few have not.

For example, forecasts composed with a "strong, cyclonic, ENE" synoptic flow (Fig 3a) have had the largest decrease in RMS error over the period. This is attributed to the increased capability of the Numerical Weather Prediction (NWP) guidance at forecasting the evolution of the "blocking" pattern, and the location of the associated easterly dip - critical to temperature forecasts.

By contrast, forecasts composed with a "strong, anticyclonic, WNW" synoptic flow (Fig 3b) have actually decreased in accuracy. This is attributed to the NWP guidance having considerable difficulty in determining whether or not a cloud band is likely to form - critical for temperature forecasting in this situation.

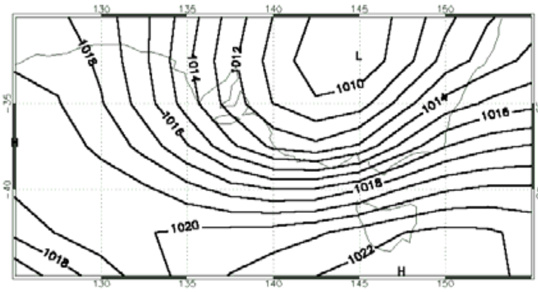

Fig 3a Mean sea level pressure analysis of the "strong, cyclonic, ENE" synoptic situation - Melbourne is located 37°S 145°E (Dahni, 2003).

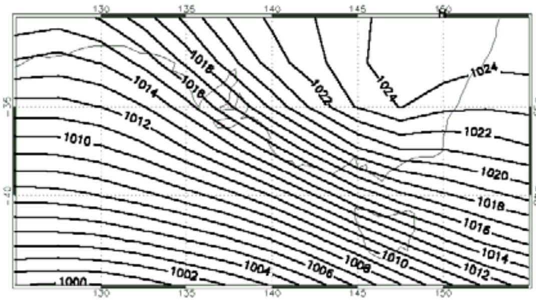

Fig 3b Mean sea level pressure analysis of the "strong, anticyclonic, WNW" synoptic situation (Dahni, 2003).

Overall, the trend towards forecast improvement, already established since the 1970s, has accelerated during the past year (Fig 4). Specifically, the 1980s was a decade of rapidly decreasing errors, a feature attributed to advances in both NWP and remote-sensing technologies.

Interestingly, there appears to have been little further improvement during the 1990s, but a sharp improvement in day-1 forecasts is registered in 2001. This is attributed, at least in part, to an influx of additional meteorologists and the implementation of new techniques.

Forecasts out to day-2, day-3, and day-4 have steadily improved (Fig 5). Indeed, the day-4 maximum temperature forecasts are now showing an RMS error of 0.5 deg C less than the day-1 forecasts were registering during the 1960s and 1970s. Forecasts out to days 5, 6, and 7 are also improving, but to a lesser extent.

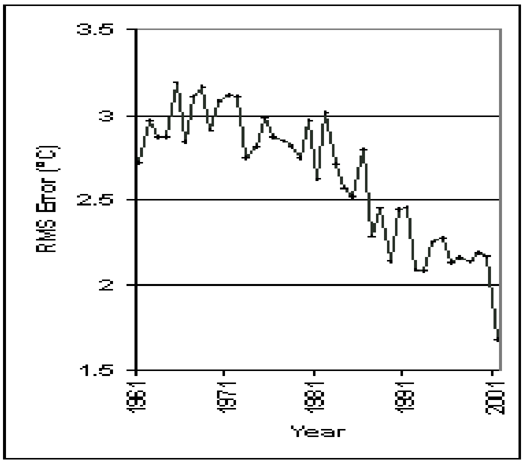

Fig 4 Annual RMS Errors (°C) for Melbourne day-1 maximum temperature forecasts (1961-2001) - note the sharp decrease at the end of the verification period.

These improvements are mainly due to corresponding improvements in the NWP models at these longer time frames. The NWP models are, now, far more accurate and reliable than they were in the past. Remote sensing techniques have also improved the quality and resolution of the observational data that is input into the models.

4. CONCLUSIONS

Day-1 maximum temperature forecasts for Melbourne have improved greatly over the last 40 years, especially in the last two decades. Improvements in days 2-7 have also been significant. These improvements can be largely attributed to the improvements in NWP output and improved observation networks. Forecasts for approaching frontal situations have improved, whilst situations where cloud cover and rainfall are critical have not. This is reflective of the performance of the models.

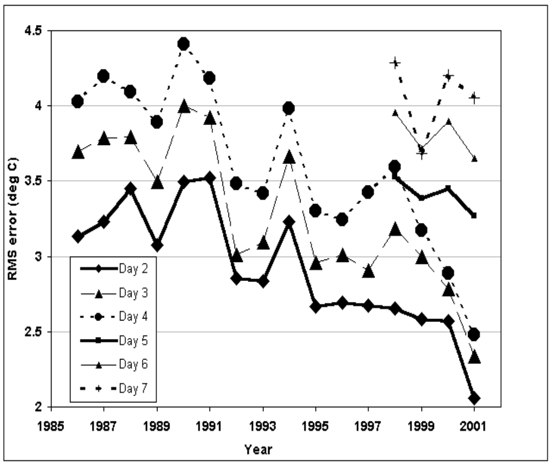

Fig 5 Annual RMS Error (Melbourne maximum temperature forecasts) for days forecast days 2 - 7.

5. ACKNOWLEDGEMENT

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6. REFERENCES

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