This page is purposely left blank.

A web-based Melbourne Airport fog and low cloud forecasting technique

Harvey Stern and Kevin Parkyn
Victorian Regional Office, Bureau of Meteorology, Australia

Abstract: In 1998, a synoptic classification of fog situations at Melbourne Airport was carried out. This classification was followed with the development of an aid to the assessment of fog risk at the Airport. In 1999, an aid to the assessment of low cloud risk at Melbourne Airport was developed. During 2000, the fog and low cloud forecasting aids were combined into a user-friendly WEB-based technique, developed utilising *JavaScript*. The WEB-based nature of the technique, renders it accessible to a wide range of people who may wish to explore its mode of operation

1. INTRODUCTION

In 1998, a synoptic classification of fog situations at Melbourne Airport was carried out [Stern and Parkyn, 1998]. This classification was followed with the development of an aid to the assessment of fog risk at the Airport.

The paper describing the aid was presented to the 1999 Annual Meeting of the American Meteorological Society [Stern and Parkyn, 1999]. Development of the aid follows a similar synoptic approach to that which was employed by Harry Goodhead in the development of his aid to the forecasting of fog onset time at Melbourne Airport [Goodhead, 1978].

In 1999, an aid to the assessment of low cloud risk at Melbourne Airport was developed. The paper describing this aid was presented to the 2000 Annual Conference of the Australian Meteorology and Oceanography Society [Stern and Parkyn, 2000].

Development of the low cloud aid also followed a synoptic approach - similar to that which was employed by Ross Keith in the development of his aid to the forecasting of low cloud at Melbourne Airport [Keith, 1978].

2. SYNOPTIC CLASSIFICATION SYSTEM

The basis for the synoptic classes, or types, is the direction, strength and curvature of the surface flow.

The strength of the flow is divided into four categories, light (*L*) , weak (*W*), moderate (*M*) and strong (*S*). Where the strength is *L*, the direction is said to be variable (V); otherwise the direction of the surface flow is divided into octants (NNE, ENE, ESE, SSE, SSW, WSW, WNW, NNW). The cyclonicity of the flow is divided into two categories, anticyclonic (*A*) and cyclonic (*C*).

3. SYNOPTIC CLIMATOLOGY OF FOG AT MELBOURNE AIRPORT

Fog occurs quite frequently at Melbourne Airport with some synoptic types (Figures 1 and 2). For example, there is fog associated with 18% of the occurrences of the synoptic type "weak ENE cyclonic".

By contrast, there has never been a fog in association with some other synoptic types, for example, the synoptic type "strong NNW anticyclonic".

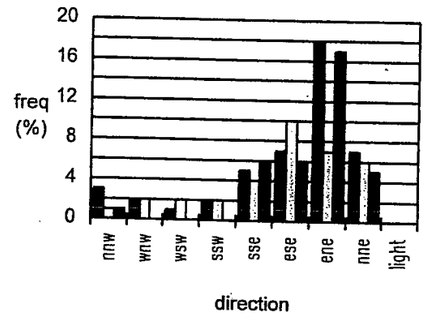

Figure 1 Frequency (%) of fogs associated with each direction for weak (left column), moderate (middle column), and strong (right column) cyclonic synoptic flow, and for light and variable cyclonic synoptic flow [Stern and Parkyn, 1999].

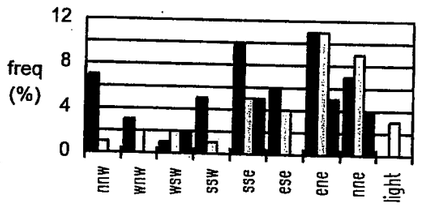

Figure 2 As for Figure 1, but for anticyclonic synoptic flow [Stern and Parkyn, 1999].

4. SYNOPTIC CLIMATOLOGY OF LOW CLOUD AT MELBOURNE AIRPORT

As with fog, low cloud occurs quite frequently at 9am at Melbourne Airport with some synoptic types, and only rarely with others (Figures 3 and 4). For example, there is low cloud associated with 21.0% of the occurrences of the synoptic type "strong ESE cyclonic".

By contrast, on only 0.9% of the occurrences of the synoptic type "strong WNW anticyclonic", has there been low cloud.

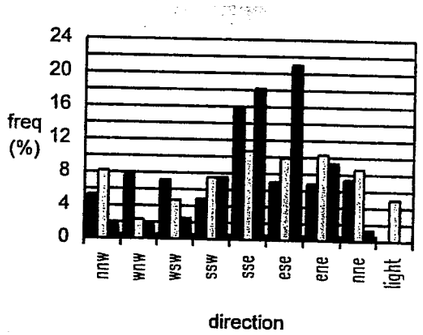

Figure 3 Frequency (%) of 9am low cloud associated with each direction for weak (left column), moderate (middle column), and strong (right column) cyclonic synoptic flow, and for light and variable cyclonic synoptic flow [Stern and Parkyn, 2000].

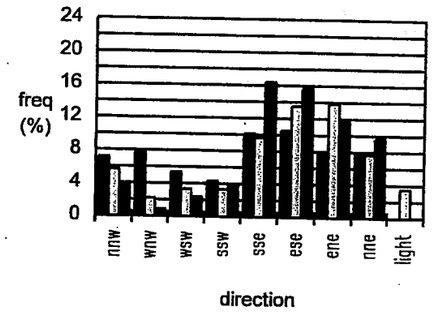

Figure 4 As for Figure 3 but for anticyclonic synoptic flow [Stern and Parkyn, 2000].

5. THE FORECASTING TECHNIQUE

The new technique uses logistic regression to predict the probability of fog and and the probability of low cloud at Melbourne Airport, and was developed with several decades of observational data.

In a logit regression model the predicted values for the dependent variable will never be less than or equal to 0, nor greater than or equal to 1, regardless of the values of the independent variables. This is accomplished by applying the following regression equation:

$$y=(\exp(a+\Sigma b_i x_i))/(1+(\exp(a+\Sigma b_i x_i))) \quad (1)$$

where 'y' is the dependent variable,
the x_i are the independent variables,
and a and the b_i are constants.

In operation, where 'y' is a yes/no variable, the equation yields the probability of occurrence of a particular phenomenon.

The same predictors were utilised for determining both the probability of fog and the probability of low cloud, namely - the previous afternoon's dewpoint (x_1), the previous afternoon's temperature (x_2), and a "length of night" parameter, (x_3), defined as |month-6|.

6. THE WEB-BASED TECHNIQUE

During 2000, the fog and low cloud forecasting aids were combined into a user-friendly WEB-based technique, developed utilising *JavaScript*. The WEB-based nature of the technique, renders it accessible to a wide range of people who may wish to explore its mode of operation. It may be accessed at:

http://www.geocities.com/weather_climate/fog.html.

In applying the technique, the user inserts a variety of MSL pressure data from tomorrow's 9am prognosis, the current month, and today's 3pm dewpoint and temperature at Melbourne Airport. The aid returns:

- The probability of fog during the forthcoming night, based upon whether or not the following day was designated as a fog event.
- The probability of low cloud the next morning, based upon whether or not low cloud was observed either at 6am or 9am.
- Various synoptic information.

Figure 5 illustrates the application of the technique.

7. REFERENCES

Goodhead, H. M., 1978:
An objective method for predicting fog and mist at Melbourne Airport. *Airmet Conference Papers, Canberra Meteorological Society; Royal Meteorological Society (Australian Branch); Canberra, 1978,* 27-38.

Keith, R , 1978:
Formation of low cloud at Melbourne Airport in a lee trough. *Airmet Conference Papers, Canberra Meteorological Society; Royal Meteorological Society (Australian Branch); Canberra, 1978,* 39-44.

Stern, H. and Parkyn, K., 1998:
Synoptic climatology of fog at Melbourne Airport. *Abstracts, ANZ Climate Forum, Perth, 1998,* 51.

Stern, H. and Parkyn, K., 1999:
Predicting the likelihood of fog at Melbourne Airport. *8th Conference on aviation, range and aerospace meteorology, Amer. Meteor. Soc., Dallas, Texas, 10-15 Jan., 1999,* 174-178.

Stern, H. and Parkyn, K., 2000:
Low cloud at Melbourne Airport: A synoptic climatology leading to a forecasting technique. *Australian Meteorology and Oceanography Society Annual Conference, Melbourne, 2000,* 109.