

Correspondence

The Editor

Australian Meteorological Magazine

I refer to the paper 'The origin and characteristics of cold air outbreaks over Melbourne' (AMM 44 (1995) 41-59).

I think it is regrettable that the authors (Perrin and Simmonds) have chosen such an arbitrary and limiting definition of a 'cold outbreak' in the face of a long history of consistent usage which covers a range of meteorological elements involved in a significant event that affects all of southern Australia from time to time.

Indeed the *Glossary of Meteorology* has the following definitions:

'cold-air outbreak — Same as polar outbreak'; and 'polar outbreak — The movement of a cold air mass from its source region; almost invariably applied to a vigorous equatorward thrust of cold polar air, a rapid equatorward movement of the polar front',

so that the traditional use of the term in Australia gives it equivalence with international usage.

In particular the inclusion of the so called 'warm front' and 'blocking anticyclone' types by Perrin and Simmonds leads to confusion over the phenomenon describing as they do, different meteorological situations and accompanying weather vastly different from the 'classical' cold outbreak.

It may well be that little has been written about 'cold outbreaks' but there must be a vast (untapped) pool of anecdotal information available from meteorologists familiar with the traditional event over the past 30 years or more.

For example, perhaps, the situation of 24-31 December, 1968, briefly described in the (Bureau of Meteorology) *Meteorological Note No. 39*, May 1970, may describe a 'Perrin and Simmonds' situation but was not thought of as a 'cold outbreak' at the time.

I worked in Melbourne in the late 1960s with Keith Hannay who proposed the criterion of '850 hPa temperature zero or less' and it was established in those years that the outbreaks could be due to either cold air advected or dynamically cooled *in situ*. I believe Jack Langford proposed that they were in fact visitations of the polar front. These ideas continue to be useful in analysing and forecasting 'cold outbreaks' today.

One can easily propose a more appropriate title for the phenomenon covered by the Perrin and Simmonds index and I modestly suggest they use

something like 'index of bleak days' to describe their index which would sit nicely with the colloquial description of Melbourne as 'bleak city'.

M.H. Lamond

Lamond Weather Services

Editor

Australian Meteorological Magazine

Dear Sir,

We are pleased with the interest Mr Lamond has shown in our paper 'The origin and characteristics of cold air outbreaks over Melbourne'.

The definition of a cold air outbreak used in the paper represented our desire to study the anatomy of uncommonly cold events. Whilst various papers, such as Hannay (1959), Elliot (1989) and Wayland and Raman (1989), use a single fixed temperature at a particular level of the atmosphere or a checklist of meteorological elements to define a cold air outbreak, these definitions were felt to lack consideration of the long-term average conditions of the study region and/or restrict the possibility of events to a small part of the year. Defining an outbreak day as one with an 850 hPa temperature of 0°C or less, for example, does not consider the uniqueness of a cold air outbreak over Melbourne in terms of average conditions and makes no distinction on the mechanisms generating the cold air. In fact, virtually all definitions which have appeared in the literature make no reference to circulation. A definition requiring the presence of some meteorological condition such as snow to low levels would omit the opportunity to examine summer or warmer month events where this criteria would have a small chance of fulfilment (it was initially disappointing to recognise that the definition used in the paper was somewhat restrictive in terms of selecting warmer month events). Various literature definitions, such as Joung and Hitchman (1982), were found to be regionally specific as were those used by Elliott (1989) for Tasmania. The definition of cold outbreak as quoted from the *Glossary of Meteorology* does not allow for this

regionality and hence cannot be assumed to apply to all regions of the earth. We are the first to apply a comprehensive and reliable trajectory analysis to the problem of quantifying and dissecting these events. This novel work reveals the air to be of Antarctic origin in only two of 13 cases and hence 'polar' may not be suitable in a definition of cold air outbreaks over southern Australia.

The fact that all events selected in the paper are considered as 'cold air outbreaks' is not unrealistic. Indeed considering only accompanying weather the 'warm front' type events were not dissimilar to the 'classic' type. Both types were associated with particularly cold and windy conditions, good snowfalls and cumuliform and stratiform clouds. Precipitation characteristics and relative humidity values throughout the days were also quite similar.

An 'outbreak' is defined in the *Shorter Oxford English Dictionary* as 'an eruption; an outburst' and hence whether or not the events examined could be classed as 'outbreaks' (since the days were 'cold' and therefore this part of the definition cannot be questioned) depends upon the temperature characteristics in the days before, during and after the day in question. The characteristics of the maximum temperature with day relationships have been shown for five of the days in Figs 5, 6, 9, 10 and 14. It is apparent from these, and also from those not shown, that the temperature did indeed drop fairly significantly on the outbreak day in each case before returning to more normal values. The drop was greatest for the classic type (4.2°C) whilst being reasonable for the warm front events (3.5°C). The results for the 'blocked anticyclone' type, although lowest at 1.8°C, were obscured by the fact that two events occurred in succession. The temperature rise after the event was greatest for the warm front events (4.1°C) whilst, perhaps surprisingly, the classic event rise (3.1°C) was lower than that for the blocked anticyclone (3.2°C). Therefore, considering the classic type observed in the study was not questioned in its applicability, the remaining types must also be able to be considered as cold air outbreaks. The cold air mass responsible for each outbreak was seen to spend little time over Melbourne, except for the events in July 1973 where the air mass affected Melbourne for two days, and could be considered to have surged across the region fulfilling the definition of 'an eruption' and hence an outbreak. The fact that differing synoptic conditions were responsible for moving these cold air pools over Melbourne does not affect the fact that the days were significantly cold and the cold snaps brief.

The suggestion of a title of 'index of bleak days' for the paper is interesting although not overly applicable to the rare events examined. Despite the fact that the days examined could be considered bleak (we suggest those interested in skiing might differ with this view), 'bleak days' would encompass many more days than these and hence is not suitable. As we have pointed out we are interested in the general nature of cold air outbreaks with specific reference to location. Hence, for example, an event over Brisbane may be cold in a climatological sense but certainly not 'bleak'. It is unfortunate that the 'vast (untapped) pool of anecdotal information available' on cold air outbreaks has not been published in the refereed literature, and hence is not readily accessible, since we feel these events are of tremendous importance and interest to many throughout the community.

We believe that the study of these events is of importance and it is appropriate that the quantitative methods and aids of modern meteorology should be brought to it. History teaches that an active science is one whose ideas are changing, and it is certainly true we think of the dynamics of the southern hemisphere in somewhat different ways to, say, a few decades ago. Work is continuing on cold air outbreaks within the group with an examination of air-sea interaction characteristics as well as an extension of the study to other regions of Australia. The topic is certainly of significance in the Australia region and we welcome input into its examination.

Yours sincerely,

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