Estimation of extratropical cyclone characteristics from station data

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Our group is experimenting with algorithms designed to diagnose the nature of 'nearby' extratropical cyclones solely from station data. The diagnosis of cyclone characteristics from quality analyses (such as reanalyses) is an important tool for the climatologist. Having said that it is known that the various reanalysis sets have artificial trends of various types, and the length of reliable record is relatively short, particularly in the Southern Hemisphere. Hence diagnosing cyclone climate variability and trends with these must be undertaken with caution. A useful complement to such approaches is to attempt to diagnose 'nearby' cyclones from station data.

A number of measures of 'storminess' have been developed using station data (e.g., Wang et al. (2006). We report on a novel approach, which we exemplify for the station records at Melbourne. From the NCEP2 reanalysis for the period 1979-2008 we determine with The University of Melbourne cyclone identification algorithm (Simmonds et al. 2003, Lim and Simmonds 2007) the times when a cyclone centre was in the proximity of Melbourne. We show a test case where 'near' means cyclone centres lie within 142.5-147.5^{o}E, 50-37.5^{o}S. 190 extratropical cyclone events were so-identified. For each of these events we extracted the four (3-hourly) Melbourne pressure observations for the 12-hour periods prior to and after the time of cyclone identification. The structures of these 24-hour pressure traces (represented as anomalies from their individual means) can be used to diagnose nearby cyclonic behaviour. Here we show the simple case of compositing all the traces into one 'characteristic' sequence, which is shown in Fig. 1. In this simplest case, one can say that if a given pressure anomaly sequence is a 'close' fit to the characteristic sequence then there is a cyclone in the vicinity. A fit is said to be close if the RMS difference is less than a prescribed amount.

Fig. 2(a) shows the distribution of the pressure anomalies averaged over all the cases when cyclones were in the target area defined above. Fig. 2(b) shows a similar composite but, this for the times identified as close matches to the 'characteristic sequence'. The presence of a significant pressure minimum very similar to that in part (a) indicates that the method does in fact identify times when extratropical cyclone activity is present. Further details can be found in Kent (2008). We have described here a very simple version of our scheme. Work is continuing on making use of synoptic-typing options and on transportability to very different environments.

Kent, D., 2008: Estimation of Extratropical Cyclone Characteristics from Station Data. Honours thesis, School of Earth Sciences, The University of Melbourne, 38 pp.

Lim, E.-P., and I. Simmonds, 2007: Southern Hemisphere winter extratropical cyclone characteristics and vertical organization observed with the ERA-40 reanalysis data in 1979-2001. *J. Climate*, **20**, 2675-2690.

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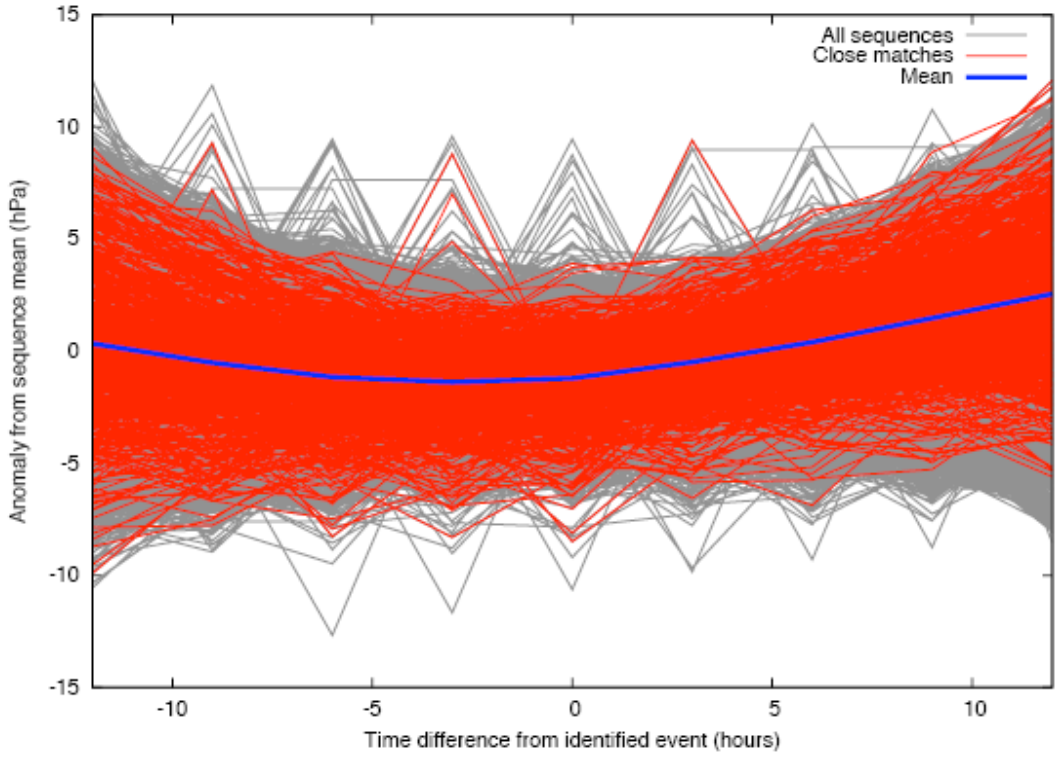

Fig. 1: Extracted pressure sequences for Melbourne, with . Blue line is mean sequence presented in blue). (The grey lines have large RMS difference from the mean.)

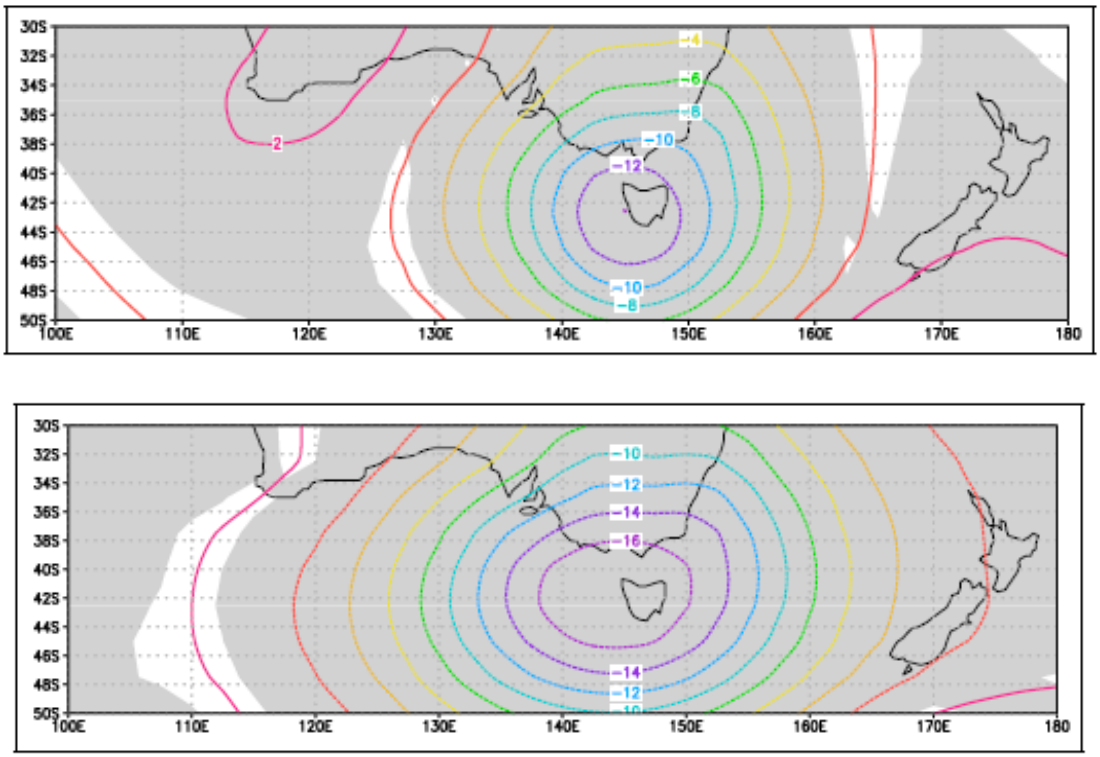

Fig. 2: Composite pressure anomaly for (a, top) all cyclone centres identified in the reanalysis in the target area and (b, bottom) all times identified by the sequence matching process.