Supplementary material for "An Exploratory Framework for Cyclone Identification and Tracking"

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Abstract

This document presents additional material supporting the paper "An Exploratory Framework for Cyclone Identification and Tracking" including heatmaps of cyclone centre density from the IMILAST study [1], tracks computed by various algorithms for two cyclones from IMILAST, and tracks computed by a track surgery algorithm proposed by Hanley and Caballero [2] for multicentre cyclones. All images are included here to facilitate a quick comparison with the results from this paper.

1 Cyclone Center Density

This section shows the heatmaps of cyclone centre density computed using our framework and by the different tracking algorithms from the IMILAST study. Figure 1 shows the heatmap using a color map similar to the one used by IMILAST. While we think that the use of multiple hues make it difficult to compare densities between different regions in the resulting visualization, we include it here to support a direct comparison of our results with those from IMILAST. The heatmap that appears in the paper uses a better color map. Figures 2 and 3 are heatmaps of cyclone centre density for cyclones detected by the algorithms covered in the IMILAST study.

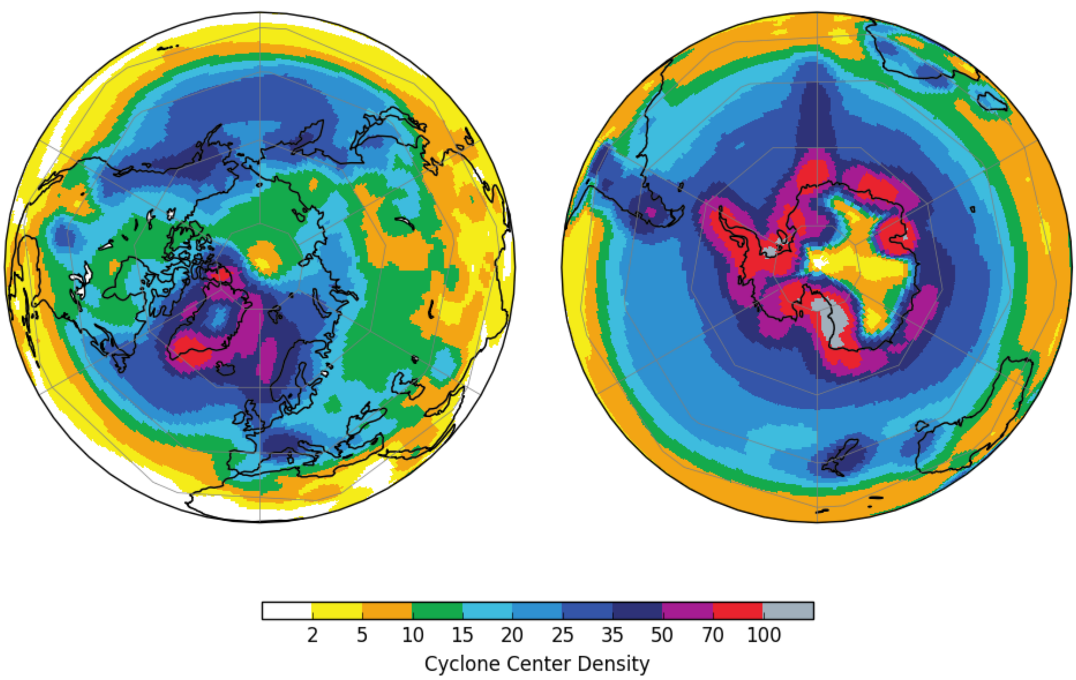


Fig. 1. Heatmap of cyclone centre density in the winter season for northern (left) and southern hemispheres (right) during 1979-2012. The cyclone centres are identified using relative vorticity. The color map used here is similar to the one used by IMILAST.

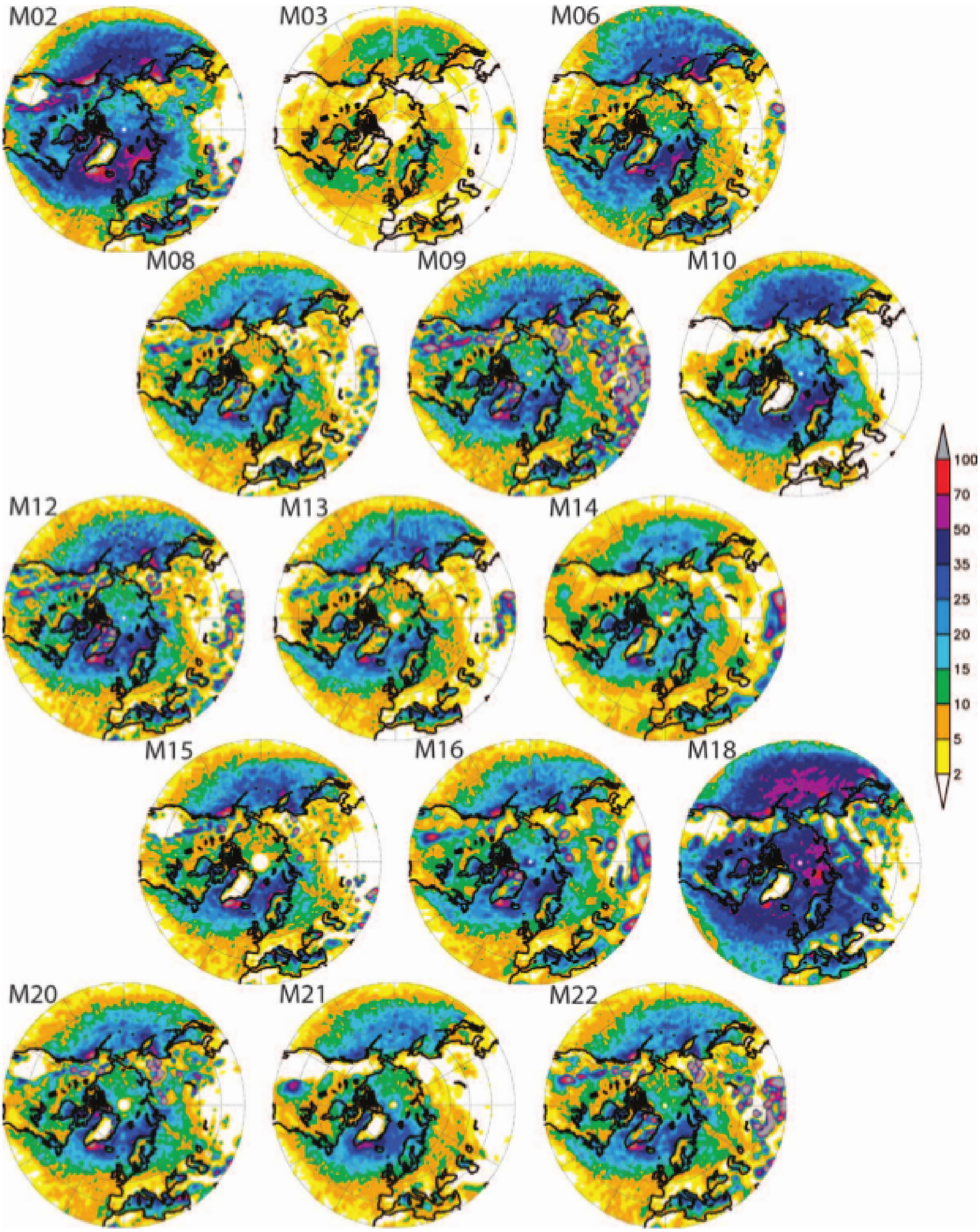


Fig. 2. Total cyclone center density in the northern hemisphere for cyclones lasting 24 h or more in the winter season for various detection and tracking methods [1].

2 IMILAST STORM 1: 22-29 MAY 1994

One of the case studies from IMILAST is a cyclone near the Australian Bight. Figure 4 shows the tracks obtained by the algorithms covered in the IMILAST study and the evolution of pressure during the cyclone.

3 IMILAST STORM 2: 22-27 JAN 2009

A second case study from IMILAST is a cyclone in the northern hemisphere. Figure 5 shows the tracks obtained by the algorithms covered in the IMILAST study and the evolution of pressure during the cyclone.

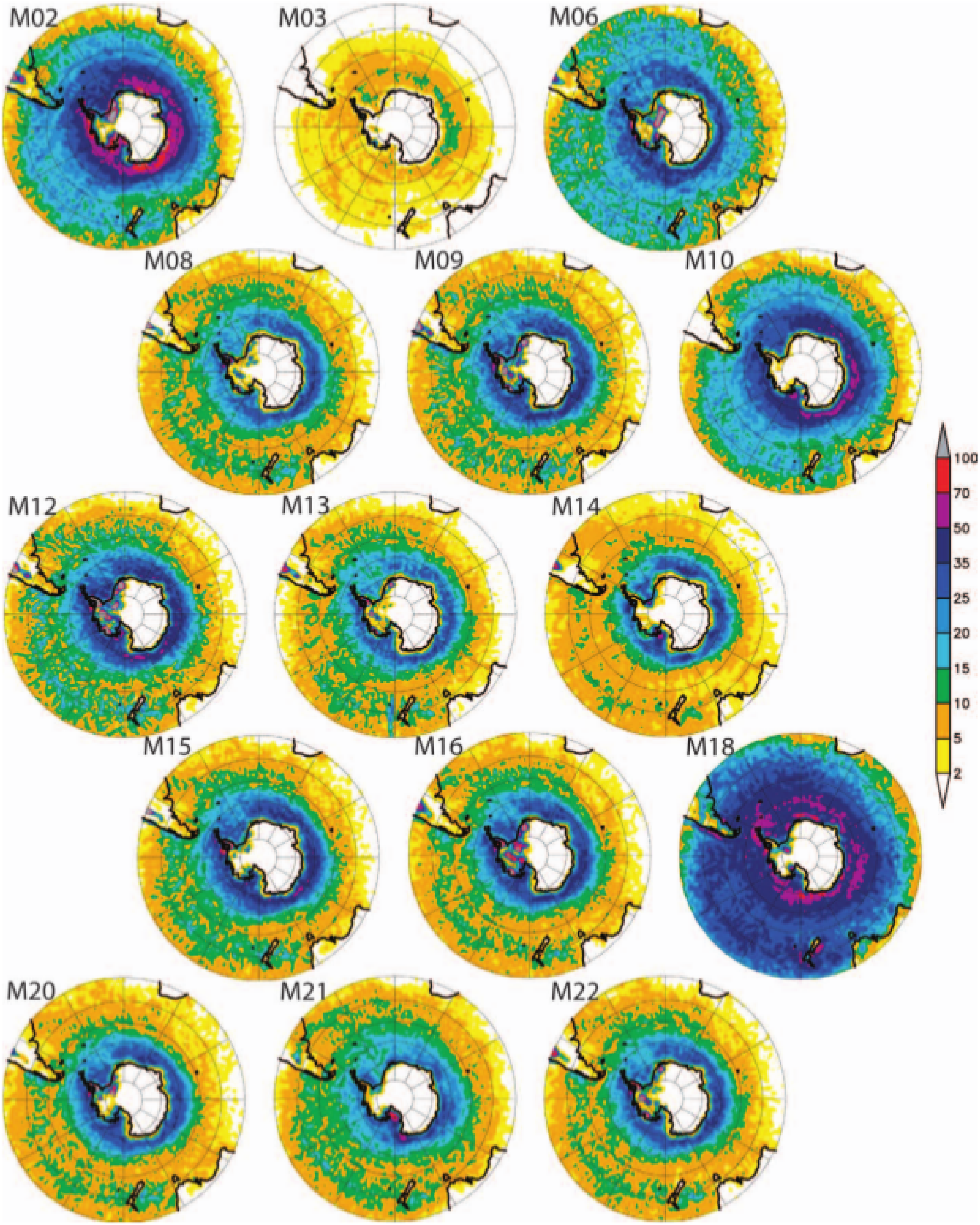
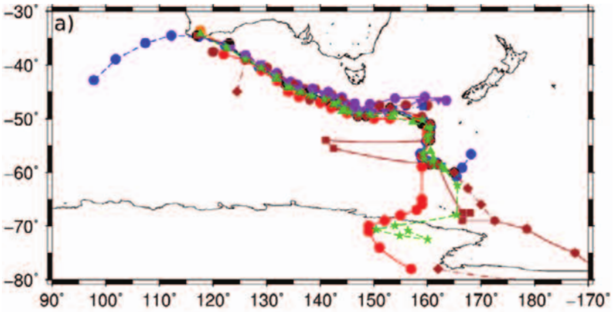


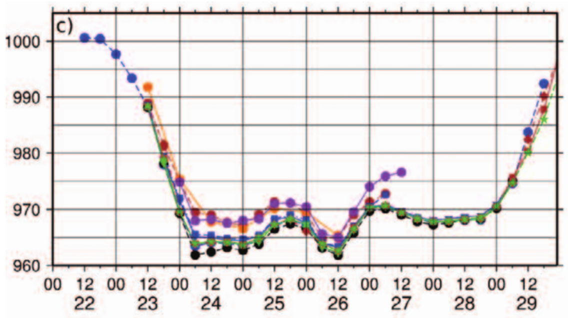
Fig. 3. Total cyclone center density in the souther hemisphere for cyclones lasting 24 h or more in the winter season for various detection and tracking methods [1]

4 NORTH ATLANTIC MULTICENTRED CYCLONE

Figure 6 shows tracks of a multicentred cyclone from the study of Hanley and Caballero [2]. A naïve algorithm that traces the evolution of each depression individually will report two tracks. The track surgery algorithm by Hanley and Caballero traces multiple cyclone centres and performs a comprehensive case analysis to compute a single track for this multicentre cyclone. The figures are included here to facilitate a direct comparison with our results.

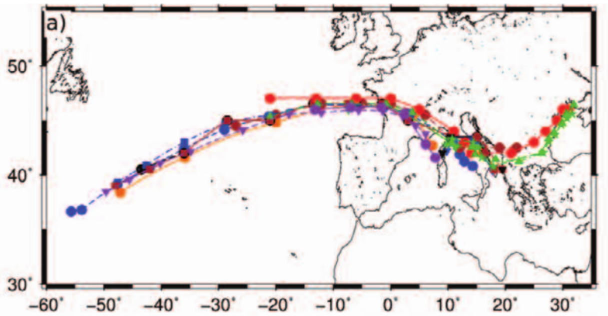


(a)

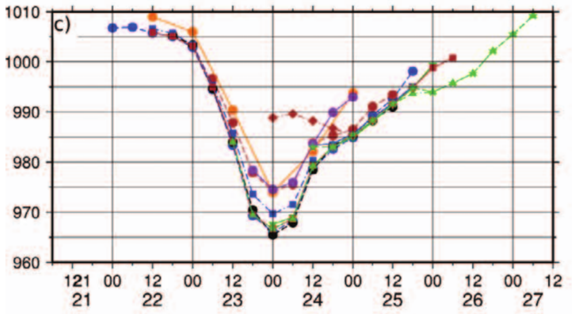


(b)

Fig. 4. Tracks obtained near Australian Bight due to a southern hemisphere storm (22-29 May, 1994). Most of the tracks either capture eastward or southward movement of the cyclone. (a) Tracks obtained from different algorithms compared against each other by IMILAST. (b) Core pressure evolution over the tracks.

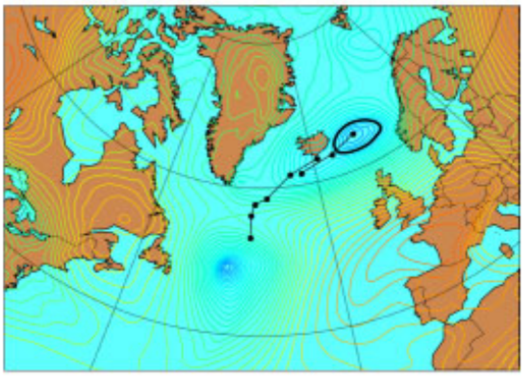


(a)

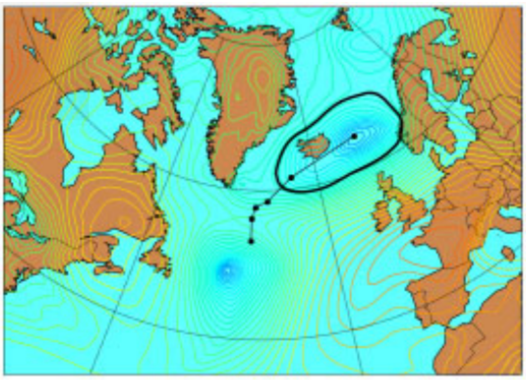


(b)

Fig. 5. Tracks obtained by different algorithms for the storm Klaus in the northern hemisphere (22-27 January, 2009). (a) Comparison of various tracking algorithm by IMILAST for storm Klaus. (b) Core pressure evolution comparison by IMILAST.



(a)



(b)

Fig. 6. Comparison of north Atlantic cyclone track obtained in Jan 2008. (a) Two tracks obtained using single centre cyclone approach, which considers multicentre cyclones as two separate cyclones. (b) Track obtained by using specialized multicentre cyclone technique of track surgery [2].

References

[1] U. Neu, M. G. Akperov, N. Bellenbaum, R. Benestad, R. Blender, R. Caballero, A. Cocozza, H. F. Dacre, Y. Feng, K. Fraedrich *et al.*, "Imilast: a community effort to intercompare extratropical cyclone detection and tracking algorithms," *Bulletin of the American Meteorological Society*, vol. 94, no. 4, pp. 529–547, 2013.

[2] J. Hanley and R. Caballero, "Objective identification and tracking of multicentre cyclones in the era-interim reanalysis dataset," *Quarterly Journal of the Royal Meteorological Society*, vol. 138, no. 664, pp. 612–625, 2012.