Southern Ocean atmospheric fronts identified in ERA-Interim

Ian Simmonds, Kevin Keay, and John A. T. Bye

School of Earth Sciences, The University of Melbourne, Victoria, 3010, Australia
simmonds@unimelb.edu.au

Our group has for many years developed algorithms for the automatic detection and tracking of cyclones in global analyses (e.g., Simmonds and Keay 2002, Lim and Simmonds 2007) This work has now been extended to the tracking of atmospheric fronts. Such features are central components of weather (and hence climate) over much of the world.

Simply described, our mobile frontal identification determines all points at which between successive 6-hourly analyses (i) the 10m wind changes from the northwest quadrant to the southwest quadrant and (ii) the arithmetic value of the change in the meridional wind exceeds $2ms^{-1}$. As described in detail by Simmonds et al. (2012) we compile all such points into 'frontal objects', and locate fronts at the eastern edge of these objects. We determine a range of statistics from each front so-identified, including the centroid of its frontal points, the length of the front, and its 'intensity' (defined as the meridional wind change integrated along the length of the front).

We apply our scheme to the identification of surface (10m) fronts over the southern extratropics to the ERA–Interim reanalysis (Dee et al. 2011) for all winters (JJA) over the 20-year period 1989-2008.The top panel of Figure 1 shows the frequency distribution of all frontal points, with high values cantered near 50ºS in the Indian Ocean . The distribution of frontal length (the length of each front being plotted at the centroid of its frontal points) also shows its maximum values in the Indian Ocean (close to 2,000 km), and secondary maximum in the Atlantic Ocean (middle panel). The bottom panel in Figure 1 presents the winter mean of the intensity (again plotted at the centroid of each individual front); this also shows its extreme values to the south and upstream of Australia. The mean intensity of fronts in the Pacific Ocean is relatively low.

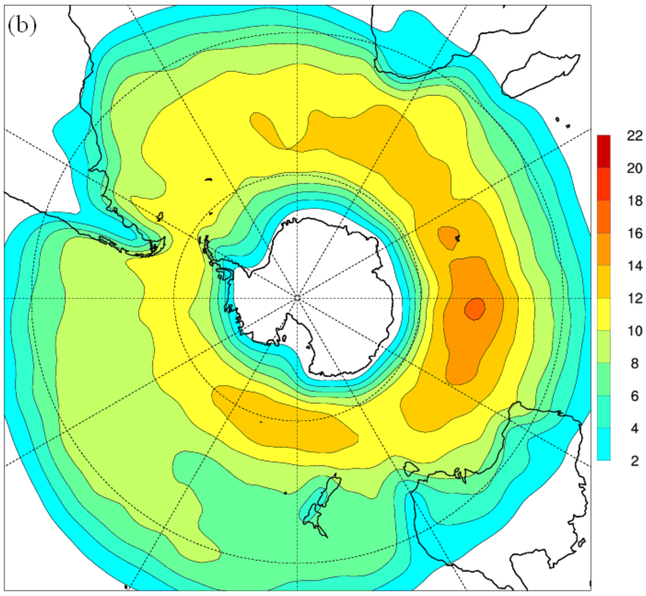
Dee, D. P., et al., 2011: The ERA-Interim reanalysis: Configuration and performance of the data assimilation system. *Quart. J. Roy. Meteor. Soc.*, **137,** 553-597.

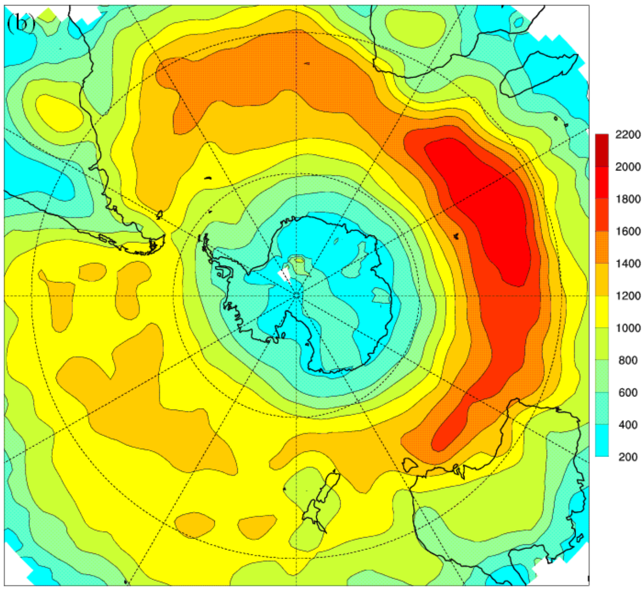
Lim, E.-P., and I. Simmonds, 2007: Southern Hemisphere winter extratropical cyclone characteristics and vertical organization observed with the ERA-40 reanalysis data in 1979-2001. *J. Climate*, **20,** 2675-2690.

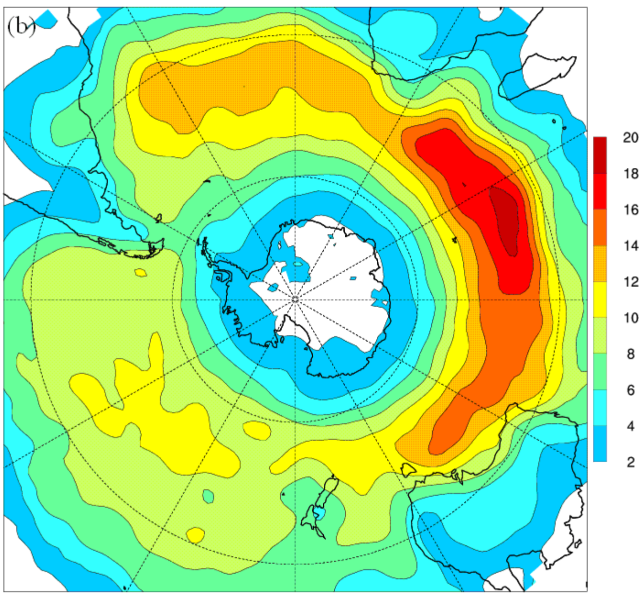
Simmonds, I., and K. Keay, 2002: Surface fluxes of momentum and mechanical energy over the North Pacific and North Atlantic Oceans. *Meteor. Atmos. Phys.*, **80,** 1-18.

Simmonds, I., K. Keay and J. A. T. Bye, 2012: Identification and climatology of Southern Hemisphere mobile fronts in a modern reanalysis. *J. Climate,* **25,** 1945-1962.

Figure 1 (next page): JJA climatology of the characteristics surface fronts. (top) frequency, (middle) length, and (bottom) intensity. The units are counts per 10^3 (degrees of latitude)^2, km, and ms^{-1} (1000 km), respectively.


(b)
22
20
18
16
14
12
10
8
6
4
2


(b)
2200
2000
1800
1600
1400
1200
1000
800
600
400
200


(b)
20
18
16
14
12
10
8
6
4
2