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ANALYSIS OF MIDLATITUDE STORMS WITH WINDS AND PRESSURES FROM QUIKSCAT

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1. INTRODUCTION

Over the last 10 years, the European Space Agency (ESA) ERS1 and ERS2 and the NASA NSCAT scatterometers have improved our ability to identify, locate and understand midlatitude storms and fronts (Brown and Levy, 1986; Brown and Zeng, 1994; Zierden et al., 2000; Levy and Brown, 1991). With a 1700-km-wide swath and a 25-km grid-spacing, the SeaWinds-on-QuikSCAT (QS) scatterometer offers an unprecedented look at the surface wind field over the ocean. Complex structures are revealed, such as double lows, double cold fronts, wind field asymmetries around lows and frontal waves.

Midlatitude cyclones are investigated here using QS surface wind measurements and a planetary boundary layer (PBL) model, along with ancillary data and satellite imagery. Examples are given over the Southern Ocean.

2. MODELS AND TOOLS

The PBL model and tools developed by Patoux and Brown (2001) are used to compute surface pressure fields from QS surface wind measurements. The model includes a gradient wind correction that improves the estimation of the pressure field in regions of strongly curved flow (Patoux and Brown, 2002). The resulting pressure fields are used to correct the QS winds for errors due to rain contamination and to the geometry of the antenna.

By plotting 7 successive swaths of pressure, a quasi-synoptic picture of the global marine surface pressure can be obtained. Fig. 1 is such a hemispheric map for the Southern Hemisphere. Note that the swaths are separated by 101 minutes. For comparison, the corresponding European Centre for Medium-Range Weather Forecasts (ECMWF) surface pressure field is shown in Figure 2. One will note that the cyclones are deeper (lower central pressure and stronger pressure gradients) and the fronts more pronounced (sharper curvature changes) in the QS-derived pressure fields. This is due to the gradient wind correction taking into account the centrifugal acceleration where the curvature of the flow is strong. This is illustrated in figure 3 with two examples over the Southern Ocean. Panel (a) shows a QS swath cutting through an anticyclone. The colors and thick contours correspond to the pressure field retrieved from QS winds. For reference, the dashed contours in the background represent the closest-in-time National Center for Environmental Prediction (NCEP) surface pressure analysis. Panel (b) shows the same after the gradient wind correction has been applied. One will note that the high is “flatter”, with low winds at the center, as predicted by theory (Holton, 1992). Panel (c) shows the same data for a QS swath cutting through a midlatitude cyclone. In panel (d), the gradient wind correction has been applied. One will notice the tighter isobars (and stronger geostrophic winds) on the Western flank of the low and the different shape of the system overall. This asymmetry is not captured without the correction.

3. EXAMPLES

Surface pressure, divergence of the corrected QS winds and satellite infrared images obtained from the Global Hydrology Resource Center (GHRC) are used to identify storms and study their development. Two examples are shown in figure 4.

Panel (a) shows a strip of convergence (in red) corresponding to a cold front wrapping around a

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low. The cyclone and front are visible in the pressure field shown in panel (b). Panel (c) is the corresponding infrared satellite image. This almost ideal “comma”-shaped cyclone is characterized by the absence of a warm or occluded front. More is shown about the development of this frontal wave in a joint-poster and extended abstract presented in this session (Patoux and Brown).

Panels (d) through (f) show a mature storm with an occlusion. The so-called “T-bone” structure is observed here in great detail, with in particular a decrease in convergence at the junction between the two fronts. The cold front is over 3000 km long and will survive the parent system for several days.

4. CONCLUSION

High-resolution surface winds have been produced steadily since July 1999 from QS measurements. The surface structure and development of storms can now be studied with an extensive three-year data set covering most of the world oceans. More examples and analyses are available at pbl.atmos.washington.edu.

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REFERENCES

Brown, R. and G. Levy, 1986: Ocean surface pressure fields from satellite sensed winds. *Mon. Wea. Rev.*, **114**, 2197–2206.

Brown, R. and L. Zeng, 1994: Estimating central pressures of oceanic mid-latitude cyclones. *J. Appl. Meteor.*, **33**, 1088–1095.

Holton, J., 1992: *An Introduction to Dynamic Meteorology*. Academic Press.

Levy, G. and R. Brown, 1991: Southern hemisphere synoptic weather from a satellite scatterometer. *Mon. Wea. Rev.*, **119**, 2803–2813.

Patoux, J. and R. Brown, 2001: A scheme for improving scatterometer surface wind fields. *J. Geophys. Res.*, **106,D20**, 23,985–23,994.

Patoux, J. and R. Brown, 2002: A gradient wind correction for surface pressure fields retrieved from scatterometer winds. *J. Applied Meteor.*, **41**, 133–143.

Zierden, D., M. Bourassa and J. O’Brien, 2000: Cyclone surface pressure fields and frontogenesis from NASA scatterometer (NSCAT) winds. *J. Geophys. Res.*, **105**, 23,967–23,981.

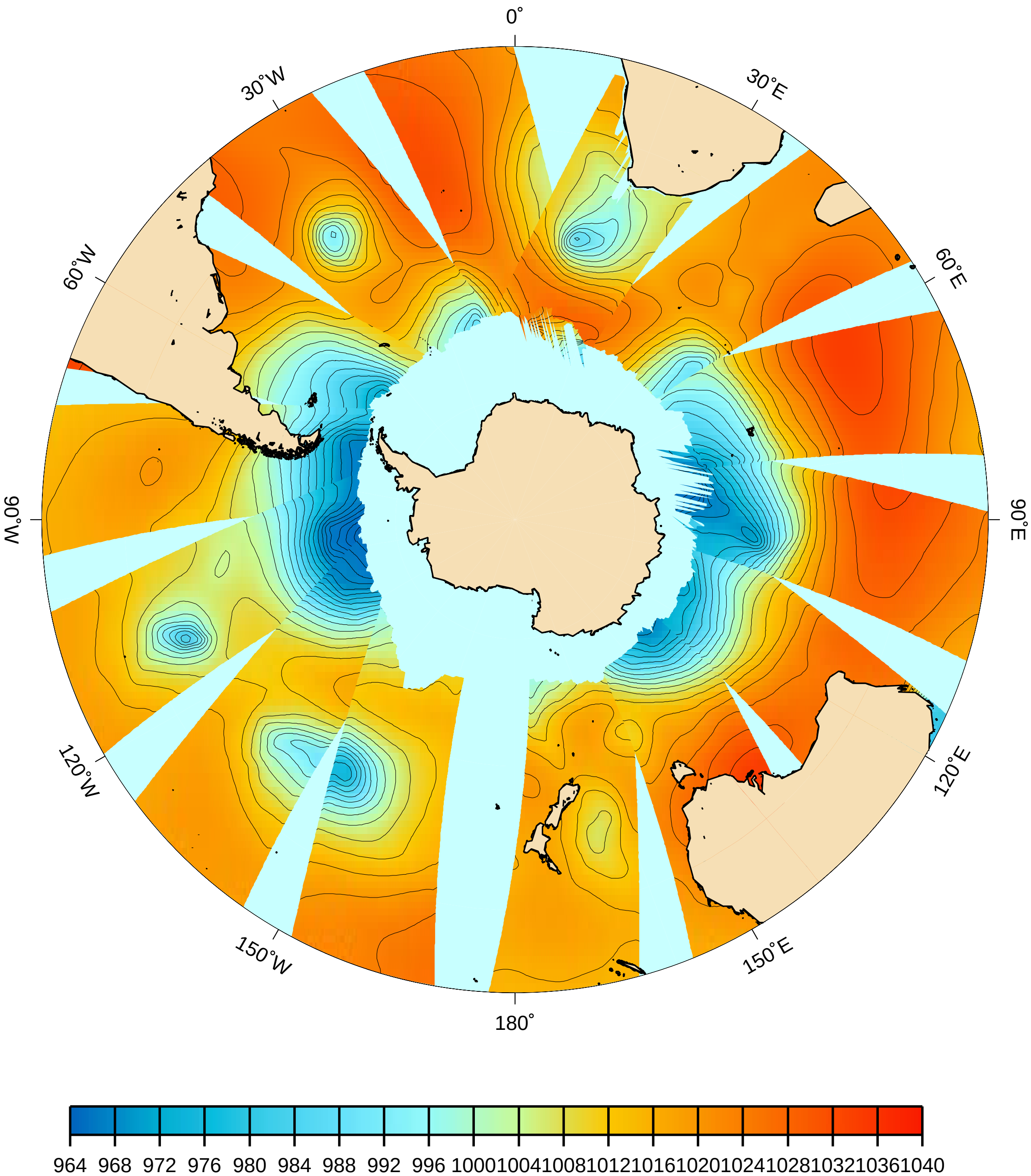

Figure 1: Quasi-synoptic hemispheric view of the Southern Ocean obtained by running a pressure retrieval model on seven consecutive QuikSCAT swaths

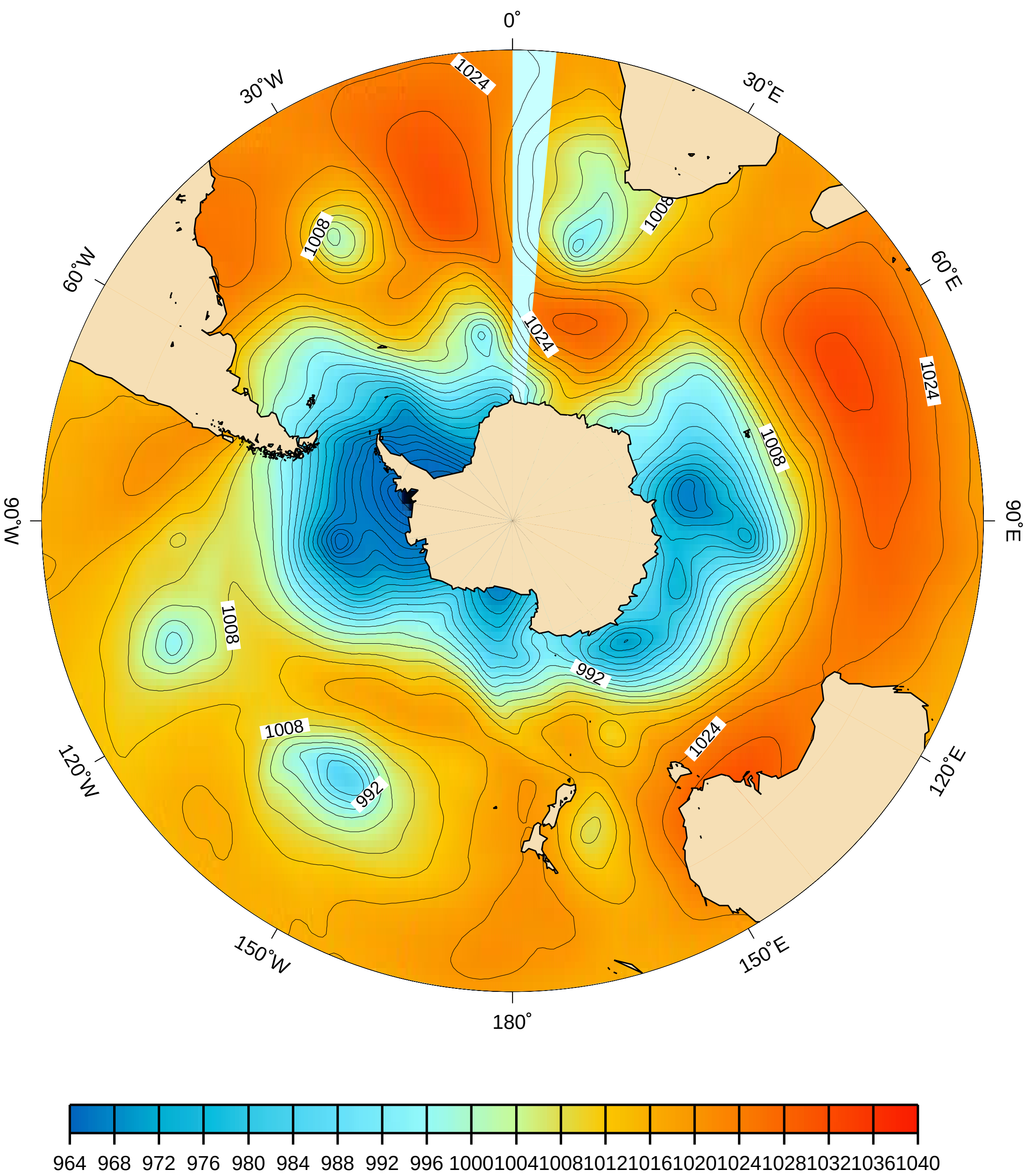

Figure 2: ECMWF surface pressure field corresponding to figure 1

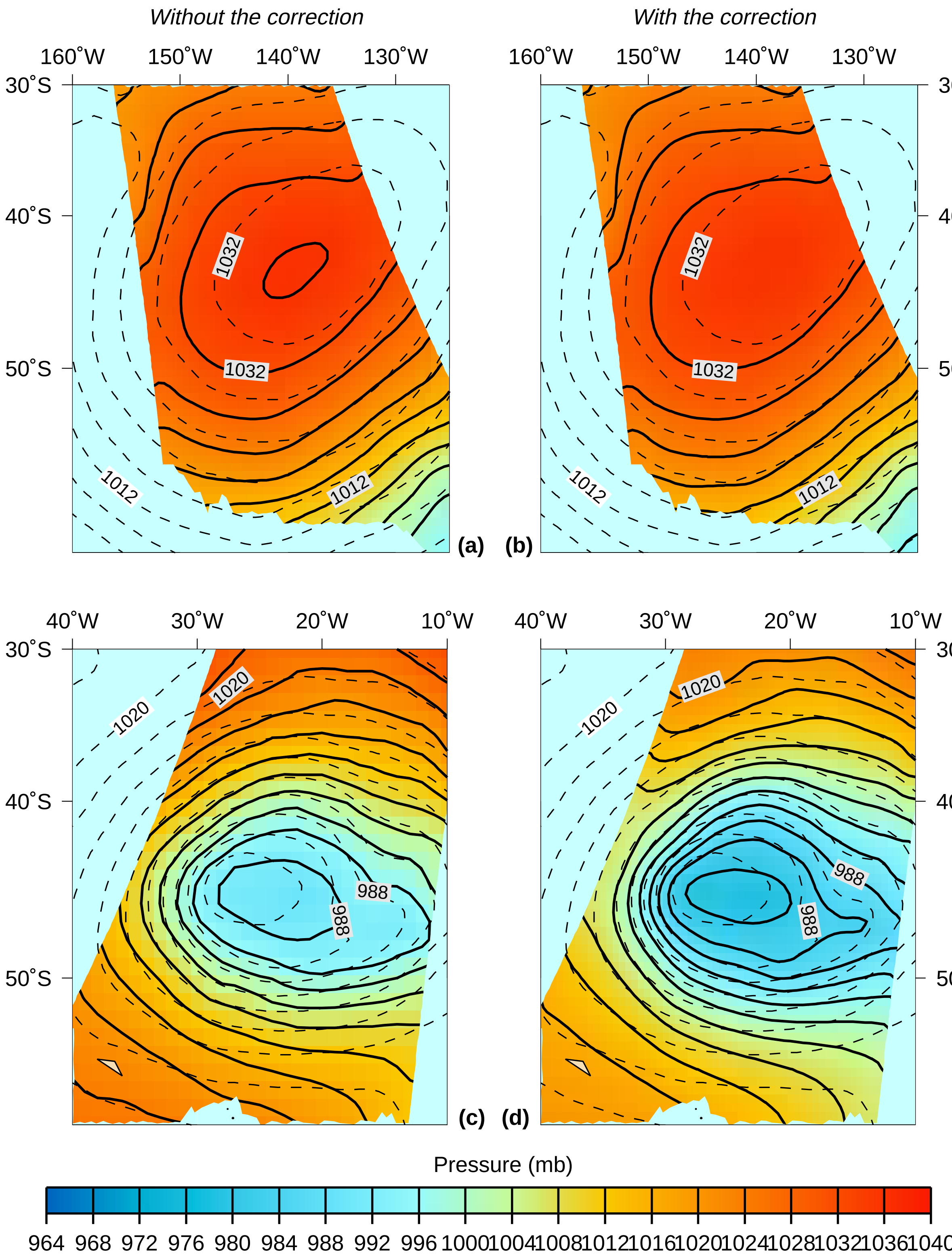

Figure 3: Gradient wind correction on surface pressure fields over the Southern Ocean (a-b) anticyclone (c-d) cyclone

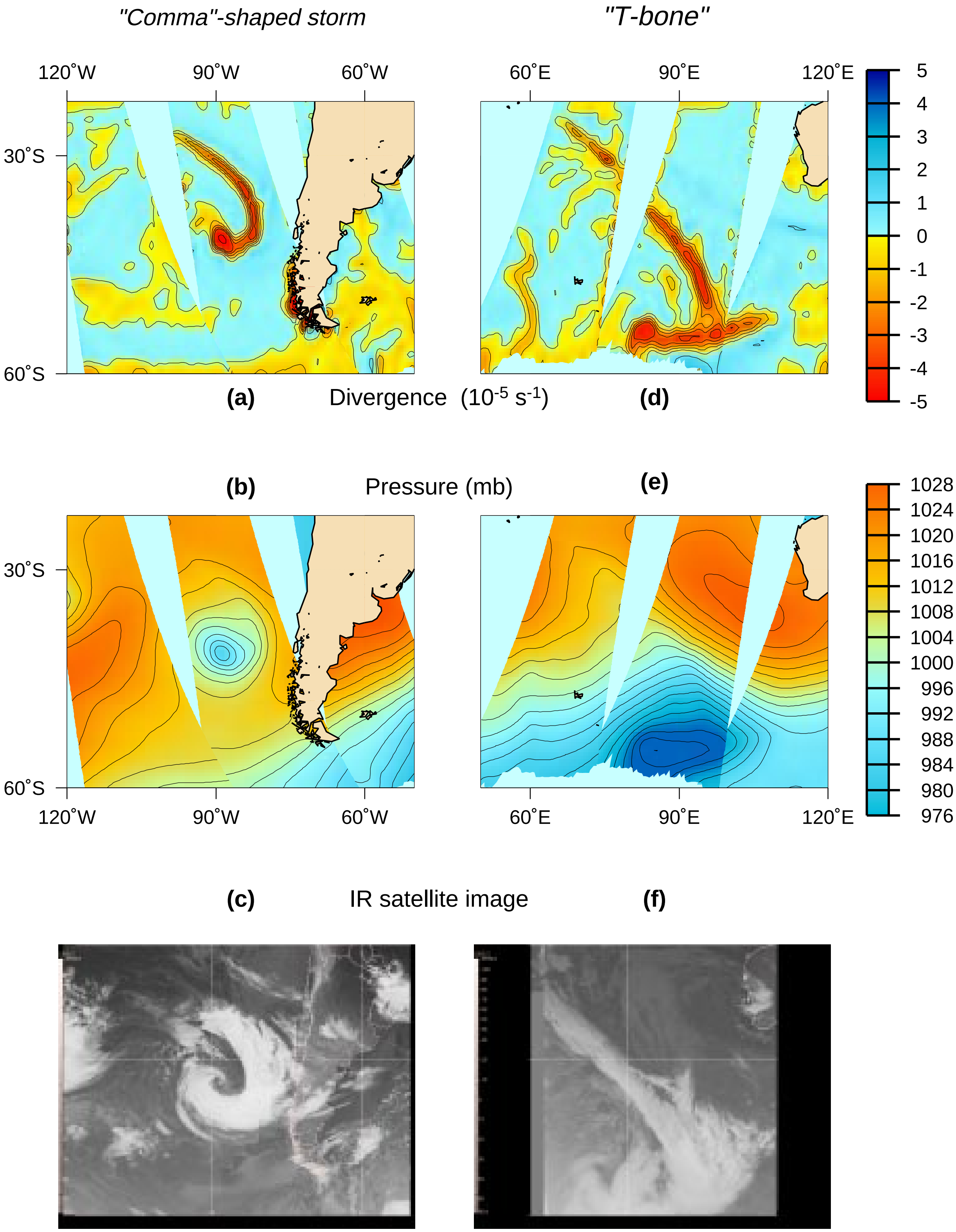

Figure 4: Two examples of storms over the Southern Ocean