Marble Point. The average wind speed is 0.9 meters per second less at Pegasus site than at Ferrell site. The big difference between Farrell and Pegasus sites is in the maximum wind speed for each month. The average maximum wind speed for the period February through October, 1989 is 7.3 meters per second higher at Pegasus site than at Ferrell site. Savage and Stearns (1985) described the jet-effect wind occurring in the area do to the constrictions on the airflow provided by White and Black islands. Slotten and Stearns (1987) demonstrate the relative pressure increase that occurs in Windless Bight that forces the air past White and Black islands causing the high wind speed at Pegasus site.

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Numerical simulation of the katabatic wind circulation over the antarctic continent

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Radiational cooling of the antarctic ice slopes is responsible for the formation and maintenance of the gravity-driven slope (katabatic) wind regime. The katabatic wind regime in the lowest levels of the antarctic atmosphere appears to play a key role in establishing large-scale circulations in the middle to upper troposphere. From mass continuity considerations, the export of cold surface air northward across the antarctic coastline must be compensated for by southward movement of warmer air in the middle and upper troposphere and predominant sinking over the continent. This meridional circulation and attendant convergence in the upper troposphere over Antarctica generates cyclonic vorticity. The circumpolar vortex thus appears to be constrained by the katabatic wind regime; the persistence and location of the vortex may be dependent on the intensity of the drainage winds.

Numerical experiments have been made to address the development of the katabatic wind circulation over the antarctic continent and to assess the relationship between the katabatic wind regime and the circumpolar vortex. A three-dimensional version of the numerical model described in Parish and Waight (1987) was used in this study of antarctic surface winds. To isolate the katabatic wind influence, the model was initiated about a state of rest with no synoptic-scale wind systems present. A parameterized form of radiation was used to drive the model; the model equations were integrated for a 48-hour period. A more detailed account of the simulations can be seen in Parish and Bromwich (in press).

Figure 1, blocks A and B, show the resulting streamlines and wind speeds of the katabatic flows, respectively, in the lowest layer of the model after the 48-hour integration period. The outstanding feature of the streamline map is the highly irregular drainage pattern in the lowest level of the antarctic atmosphere. The main drainage occurs in a radially outward pattern originating atop the various interior ice lobes. Significant irregularity in the streamline patterns can be seen over the interior and near-coastal regions of the continent. In certain locations, such as upslope from the Adélie Land coast (67°S 140°E) and Terra Nova Bay (75°S 165°E), a marked confluence of the drainage patterns can be seen. As noted by Parish and Bromwich (1987) and Bromwich et al. (1990), such confluence zones act as anomalously large sources of negatively buoyant air which enhance katabatic winds downwind of such features. The model simulation illustrates a number of such confluence zones.

The pattern of katabatic wind speed over the entire continent after the 48-hour time integration is shown in figure 1, block B. It should be noted that the simulated wind speeds have been produced under idealized conditions of wintertime radiative cooling in a cloud-free atmosphere over a 2-day period without the disruptive influences of extratropical cyclones. Thus, the wind speeds should be viewed as mature katabatic wind episodes rather than as representative time-averaged winds. The weakest katabatic winds follow the backbone of the east antarctic continent. The highest elevations are associated with the most gentle terrain slopes and hence weakest drainage flows. The wind speeds increase away from the ice ridges in a monotonic manner in response to increasingly steeper terrain slopes. Effects of drainage confluence begin to modify the relationship between wind speed and terrain slope near the coast. Note that the simulated katabatic wind speeds along coastal perimeter of Antarctica show a wide range, from the rather tranquil winds over much of the west antarctic coastline adjacent to the Ross Sea to localized regions of strong katabatic flows near Adélie Land and the Amery Ice Shelf (70°S 70°E). Clearly depicted are the well-documented intense katabatic wind regimes of Cape Denison near 67°S 143°E (Parish 1981) and Terra Nova Bay (Bromwich and Kurtz 1982; Bromwich 1989; Parish and Bromwich 1989). The analysis also suggests that other broad-scale areas may be prone to intense, persistent katabatic winds.

To illustrate the development of the circumpolar vortex, the 500-and 250-hectopascal geopotential height field was com-

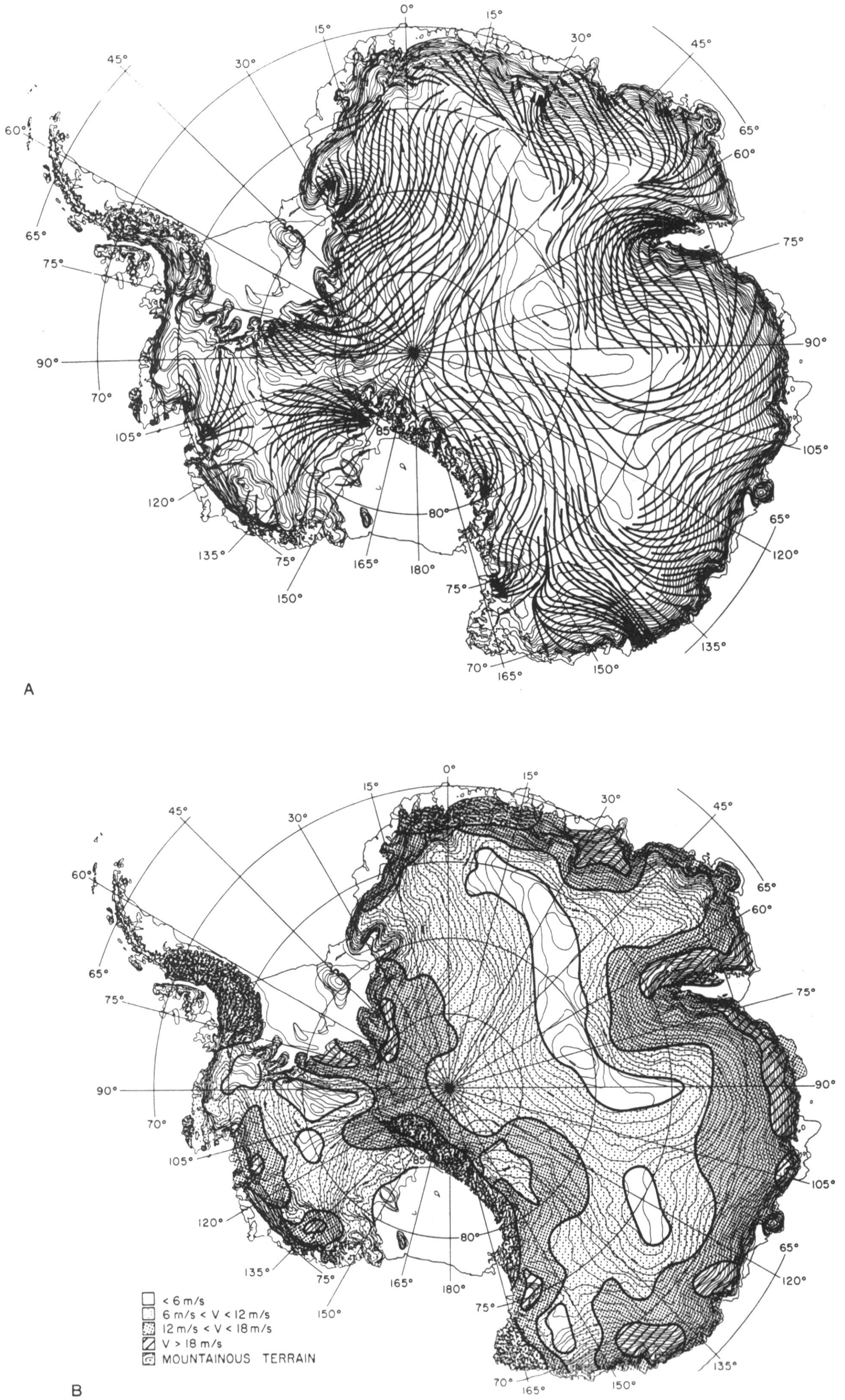

Figure 1. Results of 48-hour model simulation. A. Streamlines of the katabatic windfield. B. Katabatic wind speed in meters per second (m/s).

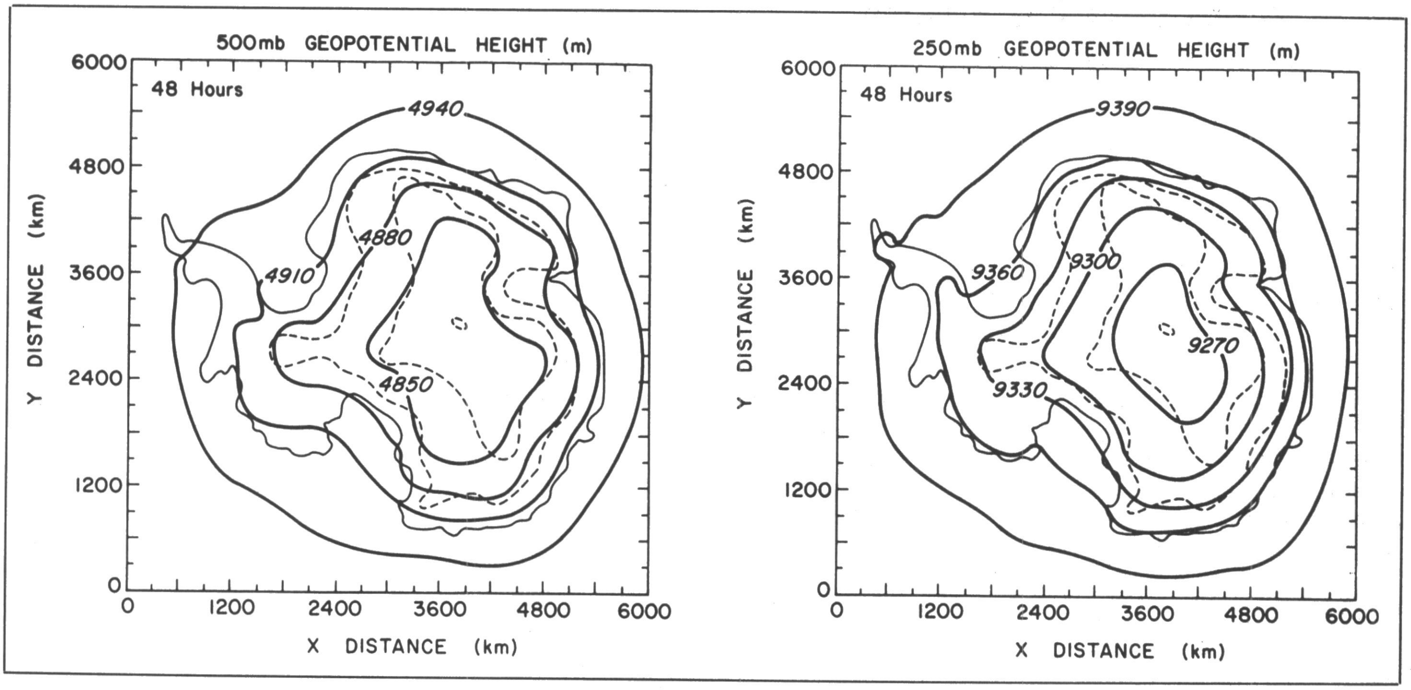

Figure 2. Model results of 500- and 250-hectopascal geopotential height fields in meters (m) after 48-hour integration period. Thin solid line is the antarctic coastline; dashed lines represent 2,000-, 3,000-, and 4,000-meter contours. (mb denotes millibar. km denotes kilometer.)

puted regularly during the course of the model integration. The geopotential height patterns at the 500- and 250-hectopascal levels after the model integration period of 48-hour are shown in figure 2. The circumpolar vortex develops rapidly in response to the cooling of the ice slopes and development of the katabatic wind regime. Height contours are centered over the high east antarctic plateau, emphasizing the topographic origins of the forcing of the upper level circulations. The center of the vortex is positioned over the highest ice topography of East Antarctica at both 500- and 250-hectopascal levels and the tightest gradient of the geopotential heights occurs over the coastal sections. Maximum geostrophic winds at 500-hectopascal are in excess of 10 meters per second above sections of the continental rim; the strongest 250-hectopascal geostrophic winds are approximately 15 meters per second. Note that the 500- and 250-hectopascal height topography is a mirror image of the underlying antarctic terrain with the lowest geopotential heights situated over the highest portions of the continent.

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