Perturbation quantities derived from super-pressure balloons drifting on constant density surfaces are necessarily defined with respect to averages on constant density surfaces and this materially alters the way that wave quantities are related to each other. A special feature of our methodology is the use of gravity wave relations in density coordinates, which are more direct and easier to apply than relations derived from equations for constant level surfaces. We calculate gravity wave momentum fluxes over the Antarctic continent using data from balloons drifting in the southern hemisphere polar vortex during the VORCORE campaign. In situ data were collected at much higher resolution than is possible from satellite borne sensors and with much better coverage than is possible from ground-based instruments. We present a wavelet analysis for October and November 2005 for intrinsic periods from 1 hour to the inertial period. We also calculate fluxes for three frequency bands covering this range. The largest fluxes are found over the Antarctic Peninsula and are more localized in October. In October the peak fluxes are ~25 mPa at an altitude near 18 km. A spectrum saturated at this altitude would give an acceleration of ~ 4 m/s/day; greater in proportion to inverse density for saturation at greater altitudes. The analysis shows that the 1-4 hour band pass accounts for most of the flux over the Antarctic Peninsula, consistent with a mountain wave source. The methodology also permits the calculation of the sensible heat fluxes and we give results for this as well.