N89-14565

TEMPORAL TRENDS AND TRANSPORT WITHIN AND AROUND THE ANTARCTIC POLAR VORTEX DURING THE FORMATION OF THE 1987 ANTARCTIC OZONE HOLE

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During the 1987 Airborne Antarctic Ozone Experiment an ER-2 high altitude aircraft made twelve flights out of Punta Arenas, Chile (53°S, 71°W) into the Antarctic polar vortex. The aircraft was fitted with fast response instruments for in-situ measurements of many trace species including O_3, ClO, BrO, NO_Y, NO, H_2O and N_2O. Grab samples of long-lived tracers were also taken and a scanning microwave radiometer measured temperatures above and below the aircraft. Temperature, pressure, and wind measurements were also made on the flight tracks. Most of these flights were flown to 72°S, at a constant potential temperature, followed by a dip to a lower altitude and again assuming a sometimes different potential temperature for the return leg. The potential temperature chosen was 425K (17 to 18 km) on 12 of the flight legs, and 5 of the flight legs were flown at 450K (18 to 19 km). The remaining 7 legs of the 12 flights were not flown on constant potential temperature surfaces.

Tracer data have been analyzed for temporal trends. Data from the ascents out of Punta Arenas, the constant potential temperature flight legs, and the dips within the vortex are used to compare tracer values inside and outside the vortex, both with respect to constant potential temperature and constant N_2O. The time trend during the one-month period of August 23 through September 22, 1987, shows that ozone decreased by 50% or more at altitudes from 15 to 19 km. This trend is evident whether analyzed with respect to constant potential temperature or constant N_2O. The trend analysis for ozone outside the vortex shows no downward trend during this period. The analysis for N_2O at a constant potential temperature indicates no significant trend either inside or outside the vortex; however, a decrease in N_2O with an increase in latitude is evident. Small scale and large scale correlations between different trace species have also been examined. These correlations and the changes in O_3 and N_2O relative to the polar jet will be discussed as they relate to isentropic and diabatic transport of air within and around the Antarctic polar vortex.