Measurements of NO and total reactive odd-nitrogen, NOy, in the Antarctic Stratosphere

by

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Measurements of NO and total reactive nitrogen, NOy, were made as part of the Airborne Antarctic Ozone Experiment conducted in Punta Arenas, Chile during August and September 1987. The total reactive nitrogen reservoir includes the species NO, NO2, NO3, N2O5, HNO3, and CLONO2. The instrument was located on board the NASA ER-2 aircraft which conducted twelve flights over the Antarctic continent reaching altitudes of 18 km at 72 S latitude. The NOy technique utilized the conversion of component NOy species to NO on a gold catalyst and the subsequent detection of NO by the chemiluminescence reaction of NO with ozone. Since the inlet sample line is heated and the catalyst operates at 300 C, NOy incorporated in aerosols evaporates and is converted to NO. NO was measured on two separate flights by removing the catalyst from the sample inlet line.

The NOy values between 15 - 20 km pressure altitude and between 53 and 64 S latitude were in the range 8 - 12 parts per billion by volume(ppbv). The corresponding NO values were between 0.1 and 0.2 ppbv. These values are in reasonable accord with the results of 2-D models that are zonally symmetric and incorporate only homogeneous chemistry.

At latitudes near 64 S, large latitude gradients of NO and NOy were often found. When the aerosol NOy component was low, NOy values dropped to the range of 0.5 - 4 ppbv within several degrees of latitude. NO values declined similarly to levels below the detection limit of ~0.03 ppbv. In addition, the altitude gradient of NOy was small at the highest latitudes between 15 and 20 km. The latitude region > 64 S is the center of the polar vortex and the region of perturbed chemistry as defined by the observed ClO levels.

The discussion of the results will address low NOy levels as evidence of the systematic removal of NOy from the stratosphere, the partitioning of residual NOy in the vortex between HNO3 and ClONO2, and calculations of the steady state between NO, O3, and ClO used to determine the abundance of NO2 and ClONO2 inside and outside the vortex.