157633

N89-14566

Small Scale Structure and Mixing at the Edge of the Antarctic Vortex

D.M. Murphy, A.F. Tuck, K.K. Kelly, M. Loewenstein, J.R. Podolske, S.E. Strahan, and K.R. Chan

Small scale correlations and patterns in the chemical tracers measured from the NASA ER-2 aircraft in the 1987 AAOE campaign can be used to investigate the structure of the edge of the polar vortex and the chemically perturbed region within it. Examples of several types of transport processes can be found in the data.

Since ClO and O_3 have similar vertical gradients and opposite horizontal gradients near the chemically perturbed region, the correlation between ClO and O_3 can be used to study the extent of horizontal transport at the edge of the chemically perturbed region. Horizontal transport dominates the correlation for a latitude band up to 4 degrees on each side of the boundary. This implies a transition zone containing a substantial fraction of the mass of the total polar vortex. Similar horizontal transport can be seen in other tracers as well. It has not been possible to distinguish reversible transport from irreversible mixing.

One manifestation of the horizontal transport is that the edge of the chemically perturbed region is often layered rather than a vertical "curtain." This can be seen from the frequent reversed vertical gradients of nitrous oxide, caused by air with high nitrous oxide overlapping layers with lower mixing ratios.

Water and nitrous oxide are positively correlated within the chemically perturbed region. This is the opposite sign to the correlation in the unperturbed stratosphere. The extent of the positive correlation is too great to be attributed solely to horizontal mixing. Instead, it is hypothesized that dehydration and descent are closely connected on a small scale, possibly due to radiative cooling of the clouds that also cause ice to fall to lower altitudes.