

Temporal and spatial distribution of stratospheric trace
gases over Antarctica in August and September, 1987

by
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There have been a large number of suggestions made concerning the origin of the Antarctic "ozone hole" since its discovery by Farman *et al.* (1985); these have included suggestions that it is related to changes in polar meteorology, changes in stratospheric chemistry, or changes in the solar input, or combinations of these effects. Supporting or refuting these theories requires a wide variety of data for comparison with the predictions. In August and September, 1987, a field observation expedition was made over Antarctica from a base in Punta Arenas, Chile. Two aircraft, an ER-2 with *in-situ* instruments flew at altitudes up to 18 km measuring ozone, water, ClO, BrO, NO_x, particles, and meteorological parameters in the ozone layer. A DC-8 flew at altitudes of 10-12 km, below the ozone layer, using remote sensing instruments for measuring composition and aerosol content of the ozone layer, as well as *in-situ* instruments for measuring composition at aircraft altitudes.

The observation of a number of chemical species and their correlation with each other and with meteorological parameters gives a useful set of data for comparison with various theories. Infrared spectroscopy is a particularly valuable observational technique for this purpose as it can measure with good sensitivity and time resolution and can measure a large number of chemical species simultaneously. Two high resolution infrared spectrometers were among the instrument complement on the DC-8. Our experiment, described in greater detail in the accompanying paper, enabled us to determine the total column above the flight aircraft of ozone, water, methane, nitrous oxide, nitric oxide, nitrogen dioxide, nitric acid, hydrochloric acid, hydrofluoric acid, chlorine nitrate, and several other species. Many of these were measured nearly in real time. Plots of the geographical variation of these species on various flights enables us to see how the concentration of these constituents varies inside and outside the vortex, as well as to see the temporal development of their concentration during the late winter and early spring. It is especially interesting to look for changes after mid-September, when the stratosphere began to warm above the temperatures for condensation of water and nitric acid at stratospheric concentrations.

Figure 1 shows samples of our data for three chemical species for two days late in the mission. We shall show similar results for other observed species throughout the whole mission, along with midlatitude results for comparison. The correlation of these measurements with the meteorological situation will be considered.

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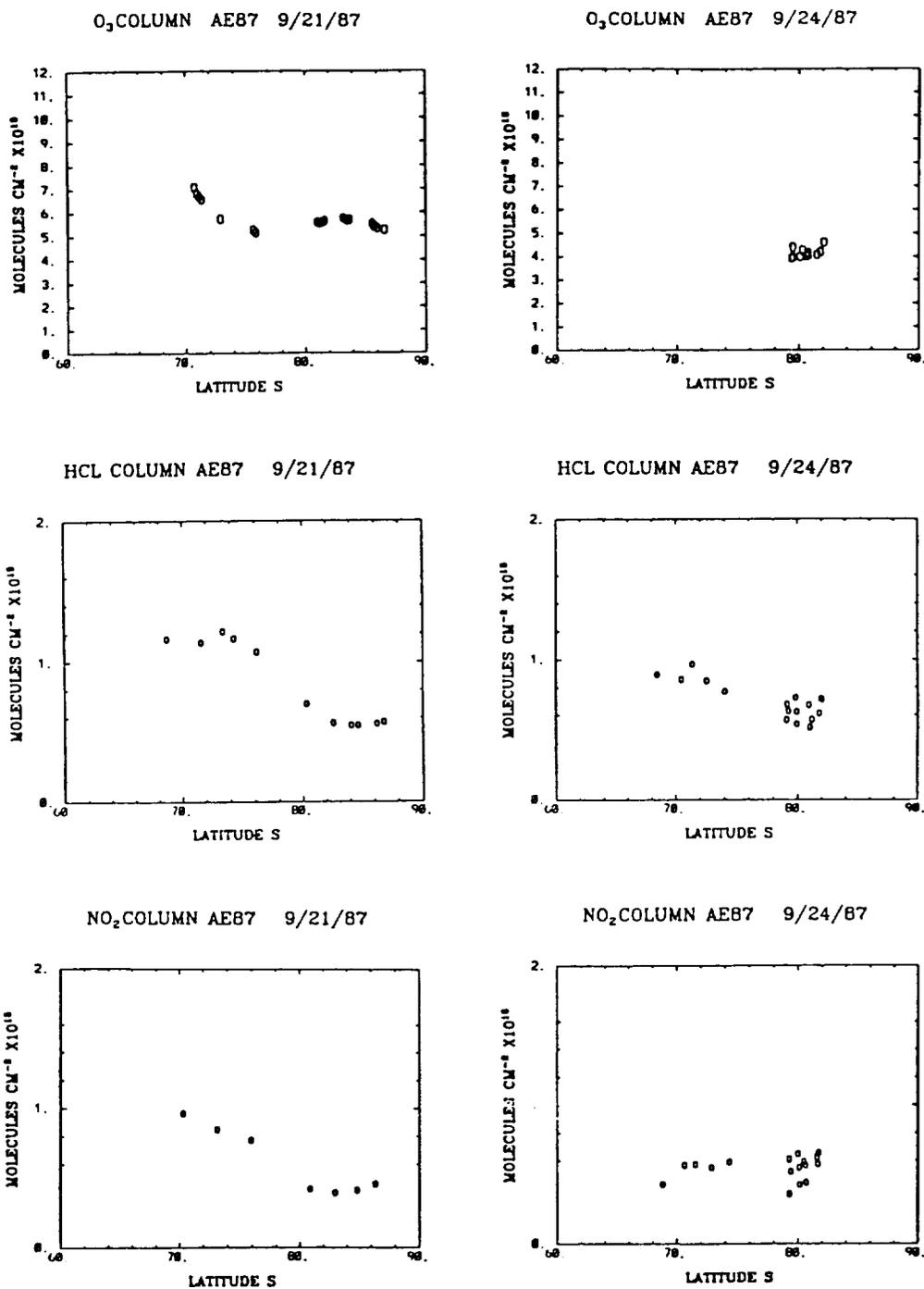


Figure 1. Latitudinal variation of ozone, hydrochloric acid, and nitrogen oxide above the DC-8 flight altitude on 21 September and 24 September, 1987.

Reference

Farman, J.C., B.G. Gardiner, and J.D. Shanklin, 1985: Large losses of total ozone in Antarctica reveal seasonal ClO_x/NO_x interaction. *Nature*, 315, 207.