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ANTARCTIC MEASUREMENTS OF OZONE, WATER VAPOR, AND AEROSOL EXTINCTION BY SAGE II IN THE SPRING OF 1987

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Realization that springtime ozone abundances have declined rapidly in the past decade (Farman et al., 1985; Stolarski et al., 1986) led to several intensive measurement campaigns (NOZE, 1986; NOZE II, 1987; and AAOE, 1987) with the goals of characterizing chemical and dynamical conditions in the Antarctic region to better understand the depletion phenomenon. Concurrent with these campaigns, and also in 1985, the Stratospheric Aerosol and Gas Experiment II (SAGE II) obtained simultaneous measurements of ozone, water vapor, and multiple wavelength aerosol extinction at high southern latitudes in September and October.

SAGE II uses the solar occultation technique to measure the extinction of aerosols and trace gases during spacecraft sunrise/sunset. Fifteen sunset and sunrise measurements evenly distributed over longitude along a latitude circle are obtained daily. The highest latitudes reached in September and October are approximately 66°S and 72°-73°S, respectively. Although the vortex typically remains centered on the pole during this time period, it is not entirely zonal, thus providing measurement opportunities over a wide range of meteorological conditions each day. The extent to which SAGE II penetrates the vortex each day can be estimated by comparing the 50-mb temperatures at the SAGE II measurement locations to 50-mb map temperature minimums. By October 4 in all three years, SAGE II encountered 50-mb temperatures within 1 to 2 degrees of the daily map minimum. Figure 1 displays the daily minimum total ozone profiles (which generally correspond to the daily minimum 50-mb temperature) observed by SAGE II for 10 days in October 1985, 1986, and 1987. The top frame presents the ozone profiles as concentration versus altitude, the primary SAGE II data product. In the middle frame are the same profiles expressed as ozone partial pressure versus pressure with the help of the NMC temperature data shown in the bottom frame. The loss region extends from about 13 to 22 km for 1985/1987, while for 1986 the upper boundary of the loss region is about 1 km lower. Thus, the 1986 profiles display peak ozone values some 5 to 20 nbars higher than the 1985/1987 peaks of 70 to 80 nbars at 35 mbars altitude. Minimum ozone values within the depletion region are 10 nbars on October 8, 1985/1986, and fall below 5 nbar on October 7 and 9, 1987. Despite a gradual shift northward of the extreme measurement latitudes, the 1987 ozone depletion is considerably greater than either 1985 or 1986. The October 9, 1987, profile is notable in that minimum values on 5 nbar extend over a 4-km layer. The minimum concentration for this profile, which is also the monthly minimum, dropped to less than 1.0E + 11 (molecules/cm^3) at 16 km which is considerably lower than the 1985/1986 monthly minimum attained on October 8 of 4.0E + 11 (molecules/cm^3). The daily total ozone (100-mb base) minimums in 1987 dropped 17 percent relative to 1985, the previous worst year.

In this talk we will present recent measurements of ozone, water vapor, and aerosol extinction from the spring of 1987, compare them to 1985 and 1986, and relate the observed changes to variations in meteorological conditions in the vortex for these three years. March ozone data at similar latitudes for these three years will be used to investigate coupling between the severity of the springtime depletion and early fall values. We will also investigate correlations between the measured species of water vapor, ozone, and aerosols throughout the vortex region.

REFERENCES

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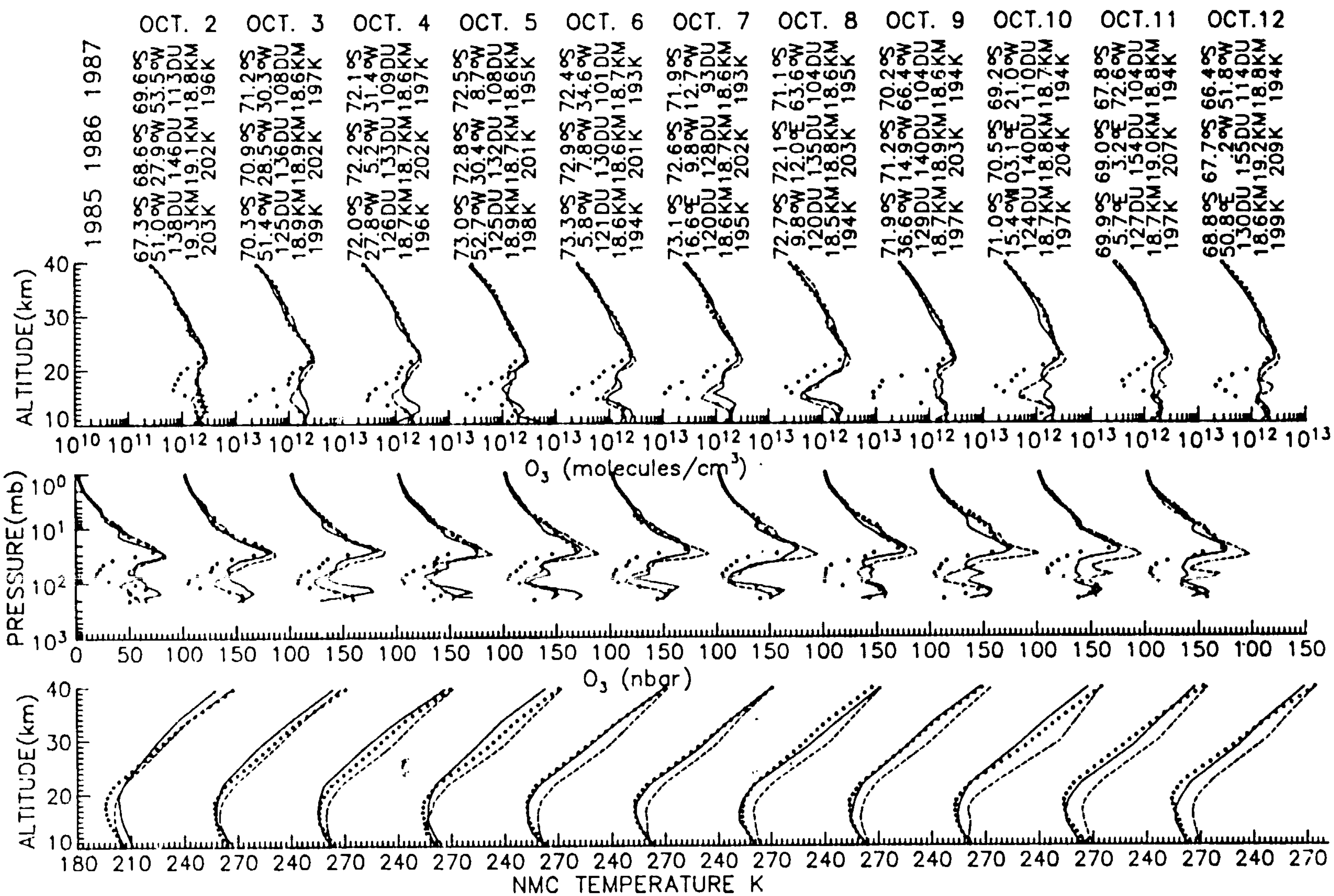

Figure 1. Daily minimum total ozone profiles measured by SAGE II for October 2 to 12, 1987 (dots), 1986 (dashed), and 1985 (solid). Top frame presents the ozone profiles as concentration versus altitude, the primary SAGE II data product. In the middle frame, the ozone profiles have been converted to partial pressure versus pressure using the NMC supplied temperature profiles shown in the bottom frame. Above each day's profiles are shown the measurement latitude and longitude, total ozone calculated with a 100-mb column base and the 50-mb geopotential height and temperature.