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Radiative Aspects of Antarctic Ozone Hole in 1985

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In order to investigate the radiative heating effects of aerosols during September-October,1985, at Antarctica, we have solved the radiative transfer equation using one dimensional model, which includes the absorption of solar energy by water vapor, carbon dioxide, ozone and aerosols, the thermal emission and absorption by the above species and in addition, Rayleigh and Mie scattering, and the surface scattering effects. In this calculation, we have used data of ozone density, water vapor density and aerosol extinction at 0.385, 0.453, 0.525 and 1.02 μm in the stratosphere obtained by SAGE II satellite and meteorological data from NOAA. The SAGE II data have been supplied by Dr.McCormick, NASA LRC.

Our results show that the Antarctic stratosphere is nearly in radiative equilibrium during that period, if the effects of aerosols are excluded (Figure 1). It is also shown that the heating effects of aerosols are too small to cause effective upward motions, in spite that some ambiguous parameters such as aerosol composition, the size distribution and so on are chosen so that they magnify the effects (Figure 2). As to the parameter dependences of our results will be also discussed.

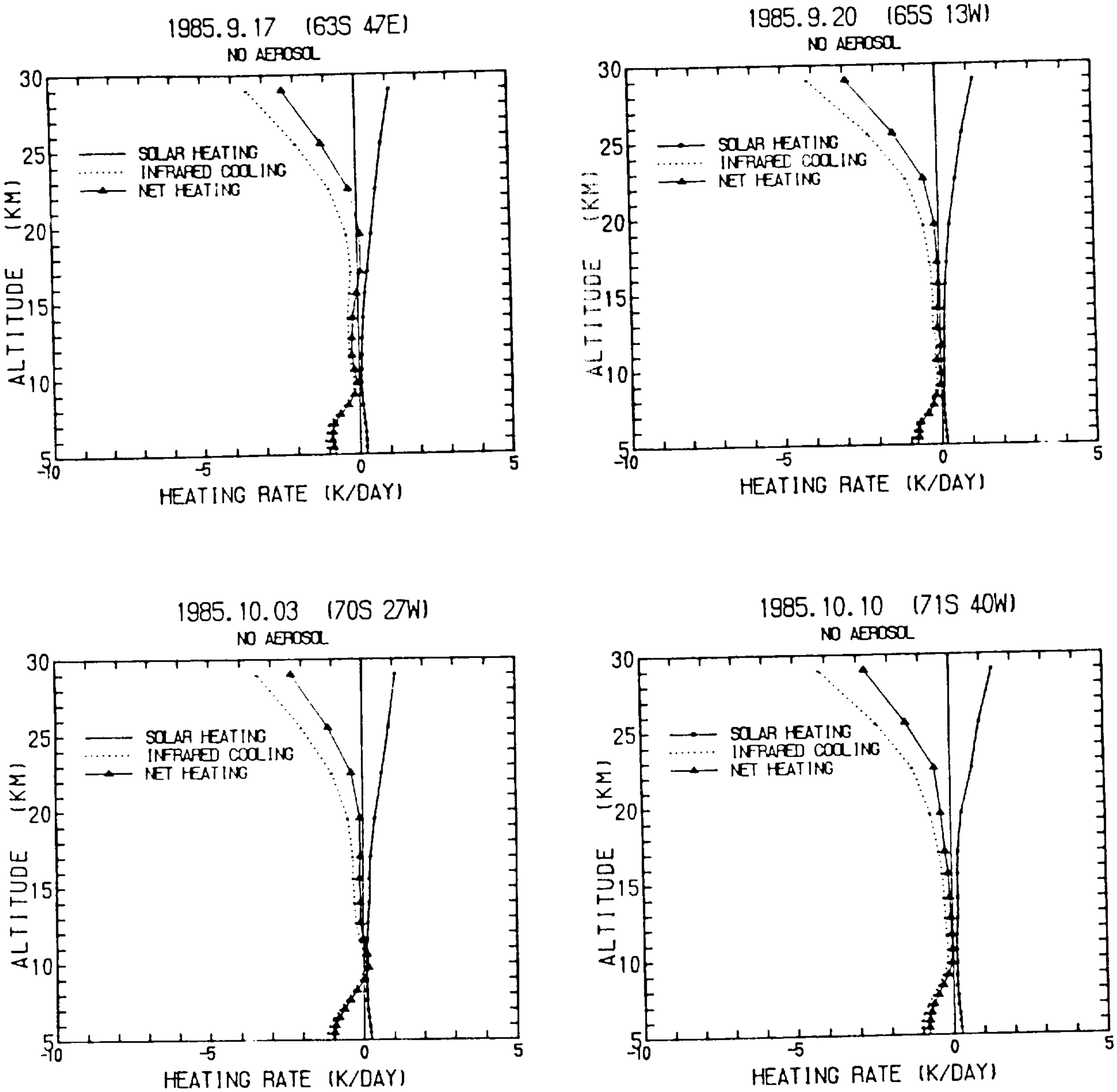

Figure 1

Day average heating rate without aerosols. Solid line, dotted line and triangle show solar heating thermal cooling and net heating, respectively.

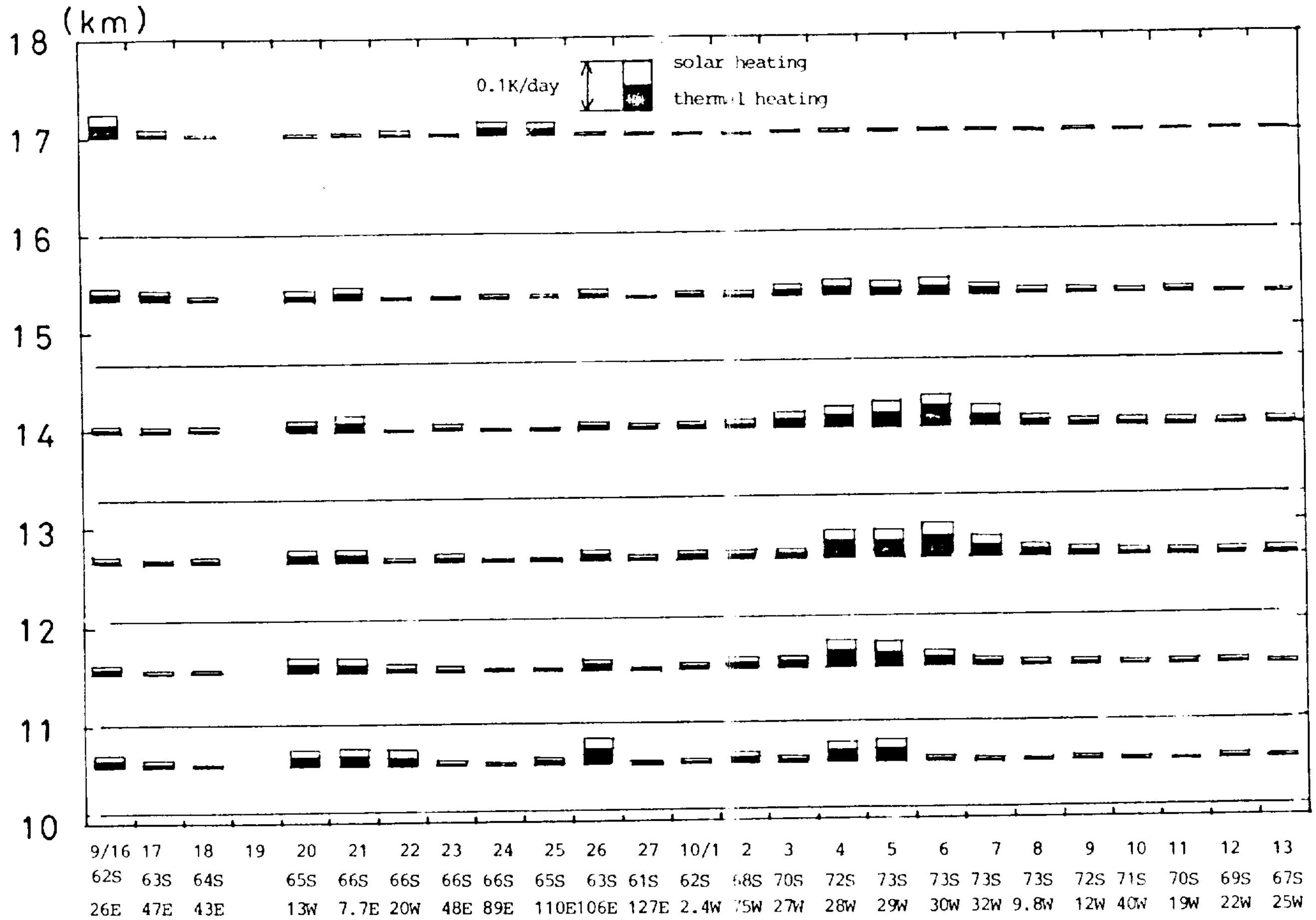

Figure 2

Additional heating rate due to aerosols, i.e., (heating rate including radiative effects of aerosols) minus (heating rate without them). The heating rate due to the absorption of solar energy is shown by white, and the thermal heating is shown by black. Aerosols can heat the atmosphere even in thermal spectrum region, because of the low ambient temperature in this height range. Dates, latitudes and longitudes of the data used in this calculation are indicated in abscissa. The size of heating, 0.1 K/day, is also shown.