A SUPPRESSION OF POLAR STRATOSPHERIC WARMING DUE TO PLANETARY WAVE SATURATION (ABSTRACT)

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Based on the fact that the total ozone content is highly correlated to the atmospheric temperature, a model simulation was carried out to produce a cold core pattern over the Antarctic lower stratosphere, which is sustained during ozone hole events. The Matsuno model, originally used to simulate the stratospheric sudden warming, is adopted here, together with incorporation of Newtonian cooling. A key factor to suppress the stratospheric warming and, instead, to form a cold core pattern is Lindzen-Schoeberl-type saturation condition of stationary planetary waves, which is a simplified form of barotropic instability.

Results of the simulation demonstrate that reasonable constraints of the wave saturation (*e.g.*, 700 m in the maximum) for the wavenumber 1 planetary waves lead to a typical cold core pattern if realistic forcing in the southern hemisphere (*e.g.*, 200 m) is set at the tropopause level. Rapid rotation of the pattern, which is quite analogous to the observed rotation of total ozone pattern by Nimbus 7 TOMS, is also well simulated. A significant acceleration of westerly wind and poleward shift of its axis, which could be induced by EP flux divergences associated with the planetary wave saturation, seem to be responsible for formation of indirect meridional circulation, upward in the polar region and downward in mid-latitudes, and the resulting formation of cold core pattern over Antarctica. This mechanism also seems to be responsible for rapid rotation of the pattern.

The suppression of polar stratospheric warming tends to result in a recent dramatic ozone decrease over Antarctica only if some heterogeneous chemical reaction processes are superposed. We need to include nonlinear wave interactions of planetary waves for the next step.

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DESCENDING MOTION OF PARTICLES AND ITS EFFECT ON OZONE HOLE (ABSTRACT)

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The descending motion of the aerosol layer was observed by a lidar at Syowa Station. The particle size would be about a few micrometers or larger, if the descending motion was due to a gravitational sedimentation (Y. IWASAKA: Tellus, **38B**, 364, 1986). As shown in Fig. 1, the condition of super-saturation was not always satisfied for pure water vapor or nitric acid vapor even in mid-winter if the density profiles in mid-latitudes are assumed. Therefore the particle which settles to the region of $P<P_D$, where P and P_D are partial pressure of water vapor (or nitric acid vapor) and saturation pressure of them, respectively, evaporates the gases condensed in the particles.

IWASAKA and KONDOH (Geophys. Res. Lett., **18**, 87, 1987) showed that ozone depletion rate was largest near 15 km and the second peak was near 10 km and lower. The heights of these

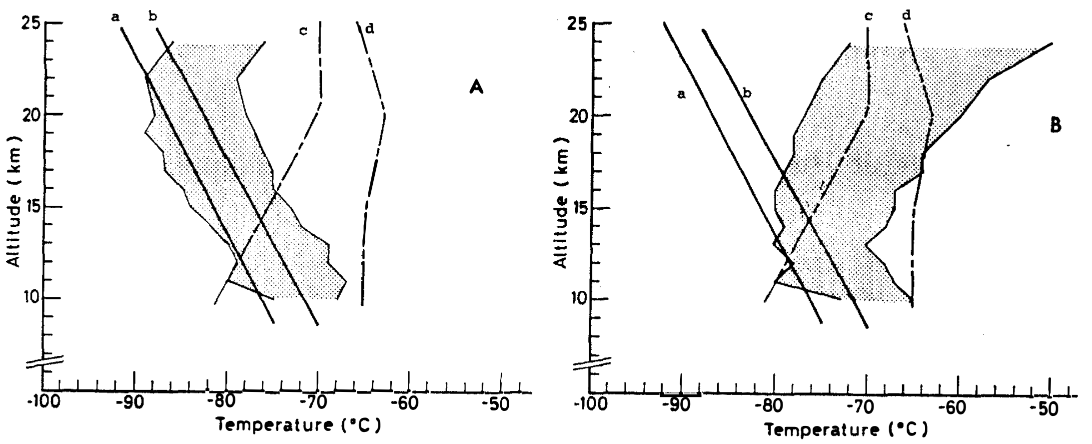

Fig. 1. The shaded area indicates the observed temperature range at Syowa Station (69°S, 40°E) in July 1983 (A) and in September (B). Lines a and b are frost-point temperature of pure water. Lines c and d are frost point of HNO_3-H_2O (50% weight) crystal.

active ozone-loss regions do not correspond to the region where particle production rate is large. The height of the ozone-loss region is lower than that of active particle formation area. The descending motion of particles to the region where evaporation rate is high seems to occur the formation of Cl_2 and ClOH.

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LOW-FREQUENCY VARIATIONS WITH ZONAL WAVENUMBER 0 IN THE SOUTHERN HEMISPHERE TROPOSPHERE (ABSTRACT)

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An observational study is made of the low-frequency variations in the southern hemisphere troposphere, using global geopotential height and wind field data for 6 years, from 1980 to 1985, provided by the European Centre for Medium Range Weather Forecasts (ECMWF).

Prominent variations with a rhythm of about one to two months are observed in the height field during the southern hemisphere winter and spring. The variations on a hemispheric scale show a barotropic seesaw pattern with an almost circular node around 60°S in the whole troposphere. This is closely related to the mean zonal wind field in the upper troposphere; there is only one latitudinal maximum of the westerlies at subtropical latitudes when the height field at high latitudes is relatively high (we call it D+ event), but there is another maximum at high latitudes when it is relatively low (we call it D− event).

Although these variations are basically zonal ones, stationary planetary weve of wavenumber 3 is dominant in D+ events but stationary wave 1 is dominant in D− events. Moreover, time variations of high-pass (<7 day) height field data, which indicate synoptic-scale wave activity, show that large variation around 50°S is confined in the eastern hemisphere for D− events but it surrounds the whole latitude circle for D− events. The active region in the western hemisphere corresponds to another westerly maximum at high latitudes for D− events.

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