Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

AAS003-06 Room: 301B Time: May 27 12:00-12:15

A study of modulation of Polar stratospheric clouds by atmospheric disturbances using CALIPSO lidar data

Masashi Kohma[1*], Kaoru Sato[2]

[1]Earth and Planetary Science, U. Tokyo, [2]U. Tokyo

Polar stratospheric clouds (PSCs) are clouds which appear in the cold lower stratosphere in the polar regions. So far, a lot of observations and laboratory experiments have been performed on the PSC in terms of its composition and roles in the depletion of stratospheric ozone. Moreover, previous studies pointed out that the formation of PSC is largely affected by variability of temperature in the lower stratosphere caused by atmospheric waves, such as Rossby waves, synoptic-scale waves, and gravity waves. However, there are few comprehensive and quantitative analyses focusing on the relationship between PSC and various scales of disturbances in the lower stratosphere.

As a first step, we focused on PSC in the southern hemisphere in June through September in 2007 and 2008 using lidar data observed by CALIPSO (Cloud-Aerosol-Lidar and Infrared Pathfinder Satellite Observations). CALIPSO lidar data has such a high resolution (1km along the orbit track and 60m in the vertical at altitudes from 8 to 20km) that includes fine structures of PSCs caused by small-scale temperature fluctuations associated with gravity waves can be detected. We calculated frequency of PSC at each location and time from CALIPSO VFM data (Vertical Feature Mask, simply showing the presence of PSC at the observation point), and used it as proxy of the PSC amount. The behavior of atmospheric disturbances including planetary-scale, synoptic-scale and small-scale waves such as gravity wave was analyzed using ECMWF reanalysis and COSMIC radio occultation data.

Longitude-time sections of the PSC frequency and temperature anomaly from zonal mean show that negative temperature anomalies approximately correspond to high PSC frequency regions. Synoptic-scale disturbances propagating eastward and disturbances with longer time-scales were observed in both the figures. The synoptic-scale disturbances are the anticyclones having a geopotential height maximum near the tropopause. Teitelbaum et al. (2001) proposed a mechanism that anticyclonic potential vorticity anomaly near the tropopause caused sufficiently low temperature anomaly in the lower stratosphere to form PSC. Our result agrees with this mechanism.

We also have analyzed the effect of gravity waves on the PSC formation. Near the Antarctic Peninsula, where the potential energy of gravity wave tends to be higher than other regions, PSC appear more frequently than PSC expected by the synoptic-scale or larger-scale temperature field.