Characterization of polar stratospheric clouds at Ny-Alesund, Norway

Hideaki Nakajima[1]; Isao Murata[2]; Kosuke Saeki[3]; Hidemi Goto[2]; Kouichi Shiraishi[4]; Takashi Yamanouchi[5]

[1] NIES; [2] Environmental Studies, Tohoku Univ.; [3] Environmental, Tohoku Univ.; [4] Faculty of Science, Fukuoka Univ; [5] NIPR

Chlorine amount in the atmosphere has peaked at around 2000 thanks to the international regulations by the Montreal Protocol after the recovery of Antarctic ozone hole in 1980s. However, it has not yet firmly proved that the Antarctic ozone hole had begun to recover in a statistical manner. Therefore, we need to monitor the stratospheric ozone layer at least for few more decades.

On the other hand, there has been substantial ozone loss in the Arctic in 1995, 1996, 2000, and 2005. In other years, especially in 1999, 2001, and 2002, there were almost no ozone loss in the Arctic. Such a large annual variation in ozone loss amount in the Arctic is caused by higher stratospheric winter mean temperature by about 10 degrees compared with that in the Antarctic, due to higher planetary wave activity, which is caused by geographical distribution of continents. Mean winter stratospheric temperature in the Arctic is just around the threshold of polar stratospheric cloud (PSC) formation temperature. Since PSC plays key role in polar ozone depletion, Arctic ozone loss amount highly depends on winter stratospheric temperature in the Arctic in that year.

Characteristics of PSCs, such as types, radius, mixture, and composition still remains unclear due to the difficulty of direct measurement, because normal research aircraft cannot reach the appearance altitude of PSCs (15-25 km). To date, it is suggested by remote-sensing and laboratory experiments that there are several types of PSCs, such as NAT (Type-Ia), STS (Type-Ib), and Ice (Type-II). However, there is no data on chlorine activation power, nor ozone destruction power, by each type of PSC. Therefore, we decided to start measurements to characterize PSCs and ozone loss in Ny-Alesund, Svalbard, Norway (79N, 12E).

In Ny-Alesund, NIPR has been operating Micro-Pulse Lidar (MPL) since 2003. Although the main target of this MPL is tropospheric aerosols and clouds, it can measure PSCs when there is no tropospheric cloud. We picked up PSCs from MPL data for winters from 2004. It was found that PSC appeared when temperatures above Ny-Alesund get lower than PSC threshold temperature.

We started another PSC measurements by a low resolution Fourier-transform infrared spectrometer (FTIR) in Ny-Alesund from 2008/2009 winter. The purpose of this FTIR measurement is to determine characteristics of PSCs such as types, radius, mixture, and composition from infrared emission and scattering by PSCs. We will present some initial results by analysis of measurements in December 2008-January 2009 in Ny-Alesund.