

Characterization of polar stratospheric clouds at Ny-Alesund, Norway and its relationship to ozone depletion in 2010

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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 ~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).

We started PSC measurements with 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. In the winter of 2008/2009, the stratospheric temperature remained warm and we could not observe much PSC events. However, in the winter of 2009/2010, stratospheric temperature sometimes got colder than PSC saturation temperature, and we observed several PSC events. On January 8, 2010, we made optical particle counter measurement and succeeded to observe PSC layers above 20 km altitudes. Moreover, chemical ozone depletion was quantified by ozonesonde Match campaign over the Arctic in 2010 winter. We will present some initial results by analysis of relationship between PSC types and ozone depletion amounts in 2010 winter in the Arctic.

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