P1-24 The Comparison of PSC Layers observed over Svalbard and Dome Station, Antarctic

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Scientific interest in the physical and chemical perturbation in the stratosphere over polar regions, especially the appearance of polar stratospheric clouds (PSCs), has increased dramatically since Farman et al(1985) reported the drastic depletion of stratospheric ozone over the antarctic. PSCs are considered to play important roles on ozone depletion converting the chlorine atoms from inactive to active forms through the heterogeneous reaction on the particle surfaces.

We installed a lidar system at Ny-Aalesund (79 ° N,12 ° E), Svalbard in September 1993 and have performed the observation in every winter since January 1994. In 1994/95, 1995/96, 1996/97 winter campaigns, we detected many PSCs events in the stratosphere under low temperature condition. While in the antarctic the lidar observation was performed from April, 1997 to January, 1998 at Dome Fuji (78 ° S,40 ° E), and detected many PSCs events in the winter season. The arctic polar vortex does not grow fully as the antarctic one does because of the geographical effect. The temperature in the arctic stratosphere is not always low enough to form PSC particles. Therefore the formation mechanism and behavior of PSCs observed in the arctic stratosphere are different from those observed in the antarctic stratosphere.

Comparing the results of observation at Ny-Aalesund with that at Dome Fuji, antarctic, we will examine the difference in the behavior of PSCs in detail and discuss the particle formation mechanism.

Observations at Ny-Aalesund were made using both the fundamental (1064nm) and second harmonic (532nm) wavelengths of a Nd:YAG laser. The output energy of the lasers are about 200mJ/pulse for 1064nm and 50mJ/pulse for 532nm, respectively, with the pulse repetition rate of 10 Hz. Backscattered light was collected by a 35 cm Schmidt Cassegrainian telescope and split into four channels of the light detecting system, each including a photomultiplier, an interference filter and some other optics. Two channels detected signals in planes parallel and perpendicular to the primary polarization plane of the transmitted laser light (532nm). The other three channels measured the fundamental signal and the Raman scattering signals from N2 and H2O molecules, respectively. The lidar system at Dome Fuji, antarctic, is almost similar to that used at Ny-Aalesund with some difference in the receiving system.

PSCs observed above both lidar stations varied in time and height remarkably. In order to discuss the relation between scattering ratio(R) and depolarization ratio(D) of PSCs observed above both stations, we estimated the correlation coefficients between R and D in the height range where the PSCs appeared, that is, values of R exceed those of background aerosols. Figure 1a shows the variation of correlation coefficient versus the temperature difference dT (dT=Temp. – the frost point of NAT estimated at 5 ppmv H2O and 10 ppbv HNO3) at the peak

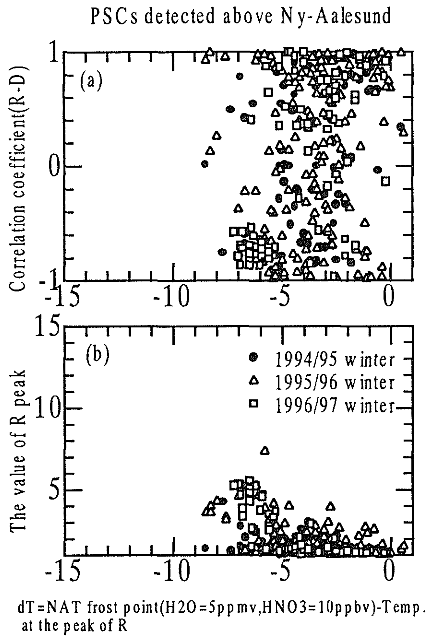

Fig.1

height of R. Also Figure 1b shows the development of R at peak with temperature difference dT in the same height.

In the case of PSCs observed above Ny-Aalesund in figure 1, there is a clear tendency that the increase in R is accompanied by the decrease of dT, especially below dT = –5 K. Most PSCs detected at dT =–7 K to –5 K show negative correlation between R and D, which means that the detected PSCs were composed of liquid or very small particle. On the other hand, PSCs detected at Dome Fuji in figure 2 show a different tendency. PSCs detected at dT lower than –5 K show positive correlation although they have the same negative correlation as in the arctic at the higher temperature.

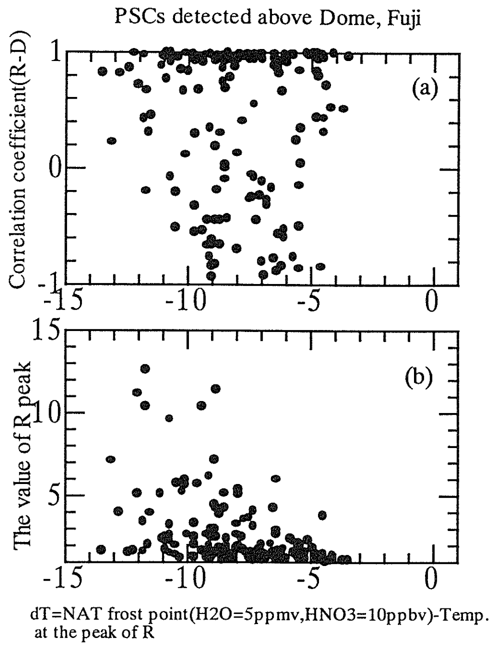

Fig.2

Figure 3 shows the temporal development of correlation coefficient between R and D of PSCs detected above Dome Fuji during PSCs event from the end of May, 1997 to the end of October, 1997. The correlation coefficient is reestimated by dividing the height range of PSCs into three height ranges 7–13km, 13–18km, 18–28km. In mid June the invasion of blocking high into the polar vortex was observed and not only the troposphere but also the stratosphere above Dome Fuji was disturbed seriously. The temperature of the stratosphere above Dome Fuji became lower than the ice frost point(H_2O=5ppmv), when the extreme enhancement of R (over 150) was detected, which was presumably the echoes from ice cloud. The date of invasion of blocking high corresponds to the 21th day in figure 3, when most PSCs show clear positive correlation between R and D. After that, values of correlation coefficient in two height ranges 7-13km and 13-18km are dispersed to both negative and positive sides, whereas most PSCs detected at the height range of 18-28km show positive correlation, that is, the detected layers in this range are mainly composed of solid particle. Bowman(1993) studied the mixing properties of the antarctic polar vortex using detailed trajectory calculations and concluded that at and above the 450 K potential temperature surface (about 18 km) there was little exchange of air across the vortex, whereas at lower potential temperature surfaces (425 and 400 K , below 17 km) substantial mixing occurred. It is possible that most stratospheric aerosols detected above Dome Fuji were frozen in the stratosphere disturbed by the the blocking high. After that, PSCs above the height of 18 km showed clear positive correlation between R and D for a long time because of the prohibition of horizontal mixing by polar vortex.

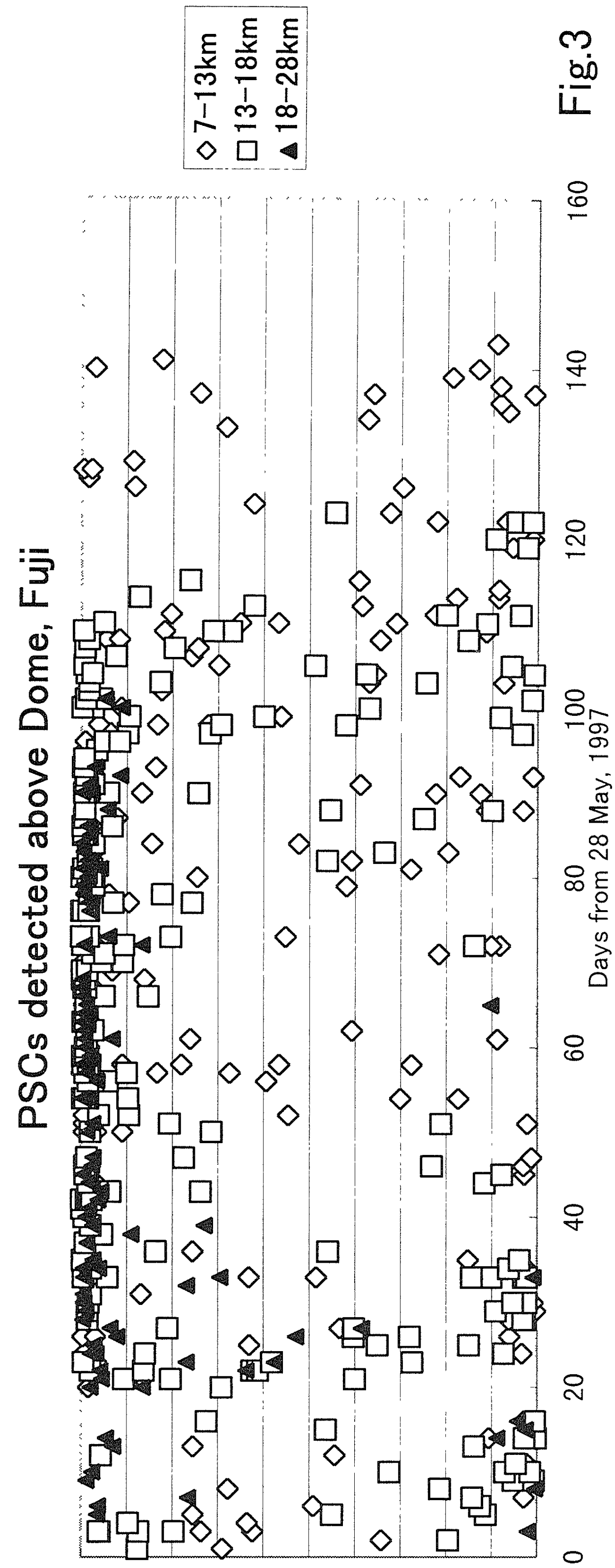

Fig.3