Title: Lidar Measurements of Polar Stratospheric Clouds during the 1989 Airborne Arctic Stratospheric Expedition

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The Airborne Arctic Stratospheric Expedition (AASE) was conducted during January-February 1989 from the Sola Air Station, Norway (59°N, 5°E). As part of this expedition, the NASA Langley Research Center's multiwavelength airborne lidar system (Browell, 1989) was flown on the NASA Ames Research Center's DC-8 aircraft to measure ozone (O_3) and aerosol profiles in the region of the polar vortex.

The lidar system simultaneously transmitted laser beams at 1064, 603, 311, and 301.5 nm to measure atmospheric scattering, polarization and O_3 profiles. Long range flights were made between Stavanger, Norway, and the North Pole, and between 40°W and 20°E meridians. Eleven flights were made, each flight lasting an average of 10 hours and covering about 8000 km. Atmospheric scattering ratios, aerosol polarizations, and aerosol scattering ratio wavelength dependences were derived from the lidar measurements to altitudes above 27 km. Details of the measurements at 1064 nm (IR) and 603 nm (VIS) have been given by Browell et al. (1990), and their aerosol optical properties have been discussed by Toon et al. (1990).

Polar stratospheric clouds were observed in the polar vortex on 10 of 11 flights between January 6 and February 2, 1989. The altitude range of the PSC observations was from 14 to 27 km, and the altitude of the most frequent PSC occurrence was near 20 km. On the missions conducted in the first half of January, two types of large-scale PSCs (depth >2 km and horizontal extent >200 km) with distinctly different optical characteristics were observed for aerosols thought to be composed of nitric acid trihydrate (NAT). These PSCs were present at temperatures between 190-198 K, where it is expected that aerosols containing NAT will form at ambient vapor pressures for nitric acid and water vapor in the wintertime polar stratosphere. Within the general category of NAT PSCs (Type 1), two sub-types of NAT PSCs were found. Type 1a PSCs had low atmospheric scattering ratios (≈1.35 VIS) and high depolarizations (>30 %), and Type 1b PSCs had high scattering ratios (3-8 VIS) and low depolarizations (<4%). Water ice PSCs (Type 2) were observed in isolated

regions on January 24 and February 2 and over a wide area on January 31. Type 2 PSCs were observed in regions of very low temperatures <190 K. The optical characteristics of the PSCs, observed during the AASE, are given in Table 1 where α is the aerosol scattering ratio wavelength dependence parameter and β is the aerosol depolarization wavelength dependence parameter (Browell et al., 1990).

In this paper the details of the aerosol scattering properties of lidar observations in the IR, VIS, and UV regions will be presented along with correlations with the National Meteorological Center's temperature profiles.

Table 1. Optical Characteristics of PSCs Observed During AASE

TYPE	SCAT. RATIO		α	AERO. DEPOL. (%)		β
	VIS	IR		VIS	IR	
1a	1.2-1.5	2-5	0.4	30-50	30-50	≈0
1b	3-8	5-20	2-3	0.5-2.5	<4	--
2	>10	>20	<0.8	>10	>10	≈0

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