Properties of Polar Stratospheric Clouds over the European Arctic from ground-based lidar

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Polar Stratospheric Clouds (PSCs) are a special type of cloud that forms below 195K in the Polar winter mid stratosphere. While in the Antarctic PSCs occur each winter and provide the surface for ozone destruction, the occurrence of PSC in the Arctic region is more variable.

Unlike tropospheric clouds, which are liquid water or ice, these PSCs can be ice, solid nitric acid trihydrate (NAT) c rystals, supercooled liquid ternary (sulfuric acid/nitric acid/water) solution (STS) droplets, or combinations of these.

Most recent analyses of satellite PSC observations have assumed that NAT particles are nearly spherical. However, some infrared observations of large NAT particles can only be reconciled by assuming the particles have needle or disc-like shapes. Measurements of NAT particle shape would lead to more realistic calculations of NAT optical properties and improve the future characterization of PSC composition.

In this work data from the multiwavelengths Raman lidar KARL in the European Arctic in Ny-Ålesund, Spitsbergen for the winter 2021/22 is presented. We estimate the lidar ratio of the PSCs by the constrain of clear sky conditions (same backscatter ratio) above and below the PSC. Generally, higher lidar ratios at 532nm and lower values at 532nm were found. Hence, the extinction coefficients of the PSCs could be estimated. Further, a low aerosol polarization was retrieved, indicating almost spherical liquid particles. A derivation of the lidar ratio at 1064nm was, however, not possible by this method, as due to the low extinction the backscatter coefficient below the PSC hardly depends on the assumed lidar ratio within the PSC layer.

Therefore, we may apply the spherical particle model and we retrieved the microphysical properties by regularized inversion. The inversion procedure is explained in detail in. We found preliminary results. The mean real part of refractive index is 1.51-1.53 and the mean imaginary part is about 0.027i which is in a quite good agreement with findings in. The effective radius is 0.26-0.31µm, the total surface area and volume concentration is 42.65-44.17 (μm^2 / cm^3) and 3.64-4.52 (μm^3 /cm^3), respectively.