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Comparison of PSC classification schemes from lidar measurements

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During late winter and early spring polar stratospheric clouds (PSCs) provide the surface for heterogeneous reactions which transform stable chlorine and bromine species into their highly reactive ozone-destroying states. Therefore, PSCs are important for severe depletion of ozone during polar winter at high latitudes. The formation of PSCs depends strongly on temperature. PSCs are classified into three types (PSC Ia: nitric acid di- or trihydrate crystals, NAD or NAT; PSC Ib: supercooled liquid ternary solutions, STS; PSC II: ice) according to particle composition and physical phase.

This classification into different types is based on lidar measurements at high latitudes which have been conducted regularly since several decades. Lidar measurements can provide continuous observations with high temporal and vertical resolution. If such an instrument is sensitive to the state of polarization of the backscattered light, it is possible to characterize the type of a PSC depending on the intensity of the backscattered light and the amount of depolarization of the returned signals. However, even though various lidar systems measure similar optical properties, different characterization schemes were derived and applied for PSC classifications. For a better understanding of the occurrence and distribution of the different PSC types and of previous reports in the literature it is of importance to use a homogenized PSC classification scheme.

In this study, we utilize measurements from the lidar at Esrange and aboard the CALIPSO satellite. Both systems are capable of measuring the backscatter ratio and to derive the linear particle depolarization ratio at 532 nm. Knowledge of these properties allows for discerning the three different types of PSC. We use the measurements to compare the different classification schemes that are published in the literature and currently applied to characterize PSC observations. To our knowledge, such a comparison of the findings of different PSC classification schemes from lidar measurements has not been performed yet.