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Retrieval of ice nucleating particle concentrations from spaceborne lidar measurements

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Aerosol particles affect the climate directly through interaction with radiation. They also can cause a radiative forcing due to aerosol-cloud interactions (ACI), by acting as cloud condensation nuclei (CCN) in the formation of warm clouds or as ice nucleating particles (INP) during the phase change in mixed-phase clouds. Spaceborne remote sensing is a promising approach for quantifying ACI at a global scale and a useful technique for assessing and improving the performance of climate models. A more than 14-year data set of height-resolved measurements of aerosol optical properties from the Cloud Aerosol Lidar with Orthogonal Polarization (CALIOP) onboard the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) satellite (Winker at al., 2009) is utilized for estimating the vertical distributions of cloud-relevant particle concentrations. More specifically in this satellite-based study, conversion factors are applied to extinction coefficient observations to obtain vertical profiles of dry particle number and surface area concentration (Mamouri and Ansmann, 2015; 2016; Marinou et al., 2019). The last two are then used as input in measurement-based INP parameterizations in order to retrieve the INP active fractions for different aerosol types. Second part of this methodology is to combine images of geostationary sensors which provide continuously the history of cloud development with polar-orbiting observations on aerosol and cloud parameters that will allow the quantification of ACI. The spaceborne-based findings are crucial for identifying the effects of changes in aerosol concentration on the glaciation of warm and cold clouds.