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Satellite retrievals of the ice crystal number concentration: a challenging step towards better quantifying aerosol-cloud interactions

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Interactions between aerosols and clouds, as well as their radiative consequences, have been a long-standing problem to understand cloud physics as well as anthropogenic impacts on climate. Satellite-based investigations of the direct and indirect impact of aerosols on liquid clouds have led, during the last decade, to significant progress in the understanding and quantification of such processes.

This study presents retrievals of ice crystal number concentrations (Nice) obtained from combined liDAR-raDAR (DARDAR) measurements. Global distributions of Nice are presented and the influence of retrieval assumptions, such as on the particle size distribution, are discussed through comparisons to in-situ observations. Suggestion are made regarding future improvement of such retrieval products. Furthermore, this study shows how such new dataset can provide a new understanding in aerosol-cloud interactions (aci). We use the Nice dataset co-jointly with collocated aerosol information from the Copernicus Atmospheric Monitoring Service (CAMS) reanalyses to investigate the global impact of aerosols on Nice. A multitude of cloud regimes, subdivided into seasonal and regional bins, are considered to disentangle meteorological effects from the aci signature. First results of joint-histograms between Ni and the aerosol mass show an overall positive sensitivity of Ni to the aerosols load. We find that this sensitivity is particularly strong towards to cloud-top and flattens towards cloud-base, consistently with expectations for homogeneous nucleation processes.

Keywords: satellite retrievals, reanalysis, clouds, aerosol-cloud interactions