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Ground-based remote sensing of optically thin ice clouds

P. Hausmann, T. Zinner, C. Emde, and B. Mayer
Meteorologisches Institut, Ludwig-Maximilians-Universität, München, Germany

The representation of clouds and their feedbacks on climate remain the largest source of uncertainty in climate models [1]. Especially thin ice clouds play a significant and badly known role in the radiation budget. Beside remote sensing with passive instruments, existing methods in ice cloud research include active remote sensing with lidar and radar [2]. Passive methods mostly rely on the use of a few spectral channels, as it is the case for most satellite retrievals. High spectral resolution measurements covering large parts of the solar or terrestrial spectrum are still rarely used. To improve our knowledge about ice clouds we use a newly established ground-based imaging spectrometer for remote sensing of microphysical properties of ice clouds. Downward spectral radiance measurements are obtained at research station Schneefernerhaus (2650 m) situated on Zugspitze, Germany. This elevated location allows to minimize influences of boundary layer aerosols and water vapor. The spectrometer provides spectral radiances in the visible (0.4 - 1.0 μm), near infrared (1.0 – 2.5 μm) and thermal infrared (8.0 – 14.0 μm) with a resolution of 2.8 nm in the visible and 10 nm in the near infrared. Radiative transfer through thin ice clouds is simulated using the libradtran model package [3] for varying viewing and solar zenith angles and ice cloud microphysical properties. On this basis we provide a lookup table of spectral radiances that is used for the retrieval of cloud phase, particle size (effective radius), optical thickness and ice crystal habit. This work focuses on thin ice clouds with optical thickness up to 10. For verification purposes the retrieved cirrus properties are compared to simultaneous measurements with the Munich depolarization lidar POLIS.

References:

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