EGU24-10252, updated on 11 Oct 2024
https://doi.org/10.5194/egusphere-egu24-10252
EGU General Assembly 2024

Cloud thermodynamic phase from spectral and multi-angle polarimetric imaging with specMACS

Anna Weber, Veronika Pörtge, Tobias Zinner, and Bernhard Mayer
Meteorologisches Institut, Ludiwg-Maximilians-Universität München

We present a method to retrieve cloud thermodynamic phase from multi-angle polarimetric and spectral imaging. Spectral absorption differences between water and ice in the near infrared are commonly used to discriminate between liquid, mixed, and ice clouds. For example, the spectral slope between 1500 and 1700 nm increases with decreasing liquid cloud fraction. These methods are very sensitive to small amounts of ice in liquid clouds. On the other hand, the polarization signal of clouds shows different features depending on the cloud thermodynamic phase. The cloudbow is formed by single scattering on liquid cloud droplets. Observation of the cloudbow indicates the presence of liquid water while its absence indicates pure ice clouds. In addition the slope of the Q component of the Stokes vector for scattering angles in the range of 60 to 100 degree depends on the partitioning between liquid and ice phase. The polarimetric method is much more sensitive to small amounts of liquid water compared to the spectral method and represents cloud thermodynamic phase at cloud top. In addition, polarization is dominated by single scattering and thus does not suffer from 3D radiative effects.

Both methods are applied to data of the airborne hyperspectral and polarized imaging system specMACS measured during the HALO-(AC)^3 campaign. specMACS provides wide-field and high spatial resolution data with a horizontal resolution down to a few 10m. By a combination of the spectral and multi-angle polarimetric observations we will retrieve cloud thermodynamic phase partitioning of single layer mixed-phase clouds and investigate spatial and temporal scales of phase transitions in low-level arctic mixed-phase clouds.