Geophysical Research Abstracts
Vol. 20, EGU2018-15676, 2018
EGU General Assembly 2018

Development of a 3D cloud microphysics retrieval combining active remote sensing instruments with the hyperspectral imaging spectrometer specMACS

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The Fifth Assessment Report of the IPCC made it clear once more that clouds contribute to the largest uncertainties in climate predictions. The reason is their direct influence on radiation budgets throughout the troposphere. In the same way clouds influence atmospheric structure and weather development by diabatic cooling and heating. An accurate retrieval of cloud macro- and microphysical properties for the implementation into climate and weather models can reduce uncertainties.

The retrieval of 3D cloud micro- and macrophysical properties can be achieved by combining active and passive remote sensing instruments. At the NAWDEX and NARVAL II campaigns, a lidar, a radar and the passive hyperspectral imaging spectrometer specMACS were aboard the research aircraft HALO, allowing a synergistic retrieval of cloud physical properties is possible.

Firstly, the hyperspectral imaging spectrometer specMACS allows the determination of horizontal 2D information such as cloud size, cloud distribution, cloud top height, optical thickness, effective radius and thermodynamic phase. Secondly, a third dimension and additional microphysical properties are added by using active remote sensing information from the nadir track (lidar, radar). Barker et al. (2011) suggested an approach that distributes information from the nadir track to a wider imager swath. Following this approach for the specMACS spectral imager, a nadir pixel is identified for each pixel in the wider imager swath where visible and infrared specMACS spectra match. Thus, vertical information from active sensors are distributed into the horizontal, and 3D cloud property distribution are created.

3D cloud reconstructions will be presented for the first cases. The final aim is to quantify the effect of diabatic heating and cooling of these 3D clouds.