Retrieval development and test for HAMP, the HALO microwave package.

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New cloud observation techniques are needed to improve our understanding of the impact of clouds on the Earth's water cycle and radiation budget, which still represents one of the largest uncertainties in global and regional climate modelling. An airborne platform for such observation techniques will be provided by the new German research aircraft HALO (High Altitude LOng Range).

In early 2013 the dedicated remote sensing mission NARVAL (North Atlantic Rainfall VALidation) will be performed to investigate the precipitation process in shallow clouds. The measurements in the North Atlantic will investigate the discrepancies in surface precipitation that are found between different satellite algorithms. In addition the measurements will be used to evaluate microphysical schemes in numerical weather prediction models. HALO will be equipped with the microwave package HAMP (HALO Microwave Package; 26 channels microwave radiometer and 35.5 GHz Doppler radar), wind and water vapor lidar as well as auxiliary measurements in much higher detail than feasible on space-borne platforms.

The suite of microwave radiometers includes frequency channels in K-, V-, W-, F- and G-bands combining frequencies along absorption lines and window channels and overlap with those of the Advanced Microwave Sounder (AMSU) A and B. Water vapor distribution throughout the troposphere comes from the water vapor lines at 22.235 GHz and 183.31 GHz. The channels along the 60 GHz oxygen complex measurements together with whose along the 118 GHz oxygen line provide temperature information and hint at the vertical distribution of liquid water that show a strong emission increase with frequency. By including higher microwave channels sensitive to scattering in the ice phase various precipitation retrieval algorithms can be compared with measurements from HAMP.

Linear regression inversion algorithms have been developed for the microwave radiometers. Integrated water vapor and hydrometeor (cloud liquid, frozen hydrometeors and rain), together with temperature and humidity profiles, are retrieved in precipitating, clear sky and cloudy conditions over North Atlantic. Synthetic observations used to develop and test the algorithm have been obtained applying a forward radiative transfer model to the atmospheric state and hydrometeor profiles supplied by COSMO (Consortium for Small-scale Modeling) limited area model simulations at 2.8 km resolution. In this presentation the accuracy for retried quantities using different frequency combinations is investigated.

Together with linear regression, also the optimal estimation approach is used to assess the additional information content on temperature and humidity profiles gained using HAMP channels selection. A case study using a database of mid-latitude clear sky radiosonde ascent is used to calculate the averaging kernels for different frequency combinations and evaluate the accuracy of the retrieved profiles.