

HAMP - The Microwave Package on the High Altitude and LOng range research aircraft  
(HALO) M. Mech, E. Orlandi, F. Ament, L. Hirsch, and S. Crewell

Clouds and precipitation play an important role in the atmospheric water cycle and radiation budget. Unfortunately, the understanding of the processes involved in cloud and precipitation formation and their description in global and regional models are still poor. To improve our understanding of these processes and to reduce model uncertainties, new observation and retrieval techniques are needed. The upcoming Global Precipitation Mission (GPM) provides a combination of a 36 GHz cloud radar and a suite of passive microwave instruments. For this and other upcoming missions, airborne platforms are a useful tool to develop and test the algorithms exploiting the synergy of active and passive microwave instruments, and to validate satellite measurements and retrievals.

In this respect, a microwave package for the High Altitude LOng (HALO) range research aircraft HAMP (HAMP, HALO Microwave Package), consisting of a 36 GHz Doppler cloud radar and a 26-channel radiometer, has been developed. HAMP radiometers have frequencies along absorption lines (22, 60, 118 and 183 GHz) and in window regions, overlapping with those of AMSU A and B. HAMP will participate in 2013/2014 in the dedicated remote sensing HALO mission NARVAL (Next-generation Aircraft Remote-sensing for VALidation studies). The NARVAL mission is split in two objectives. The first part investigates post-frontal precipitation over the North Atlantic, that is often missed or too weak in satellite retrievals, but shown in ship observations. The second part focuses on shallow cumulus clouds in the Carribean area. During NARVAL, the HALO payload will include a water vapor lidar and drop sondes in addition to HAMP. The NARVAL campaign will thus be an excellent opportunity to test the newly developed remote sensing instruments and retrieval algorithm, which exploits the synergy between passive and active microwave observations.

This presentation introduces the microwave package operated on HALO. We will show the results obtained during a demo mission (NARVAL-D) in May 2013. During this mission, HALO with the NARVAL payload on board will fly over several super sites with ground-based remote sensing instruments in Central Europe for test and validation purposes. The potential of the selected passive microwave frequencies for the retrieval of temperature and humidity profiles, especially upper tropospheric water vapor, is investigated. Furthermore, the capability of HAMP for hydrometeor observations and the retrieval of integrated contents and profiles is investigated by developing retrieval algorithms based on a data set of simulated brightness temperatures, radar reflectivities, and concurrent hydrometeor contents and profiles. Radar reflectivities and radiometer brightness temperatures are calculated with the radiative transfer model PAMTRA (Passive and Active Microwave TRAnsfer). The atmospheric state and hydrometeor content profiles, used as input for PAMTRA, are supplied by high-resolution (2.5 km) simulations from the limited area model COSMO-DE including two-moment cloud microphysics. Numerous COSMO-DE simulations of precipitating frontal systems crossing the North Atlantic are used to create a database of clear-sky, cloudy, and precipitating profiles and corresponding brightness temperatures and reflectivities. The different sensitivities of the various passive microwave frequencies to varying hydrometeor contents and surface properties can be clearly seen. Additionally, the results of retrieval approaches, based on the simulation database, for hydrometeor contents over ocean and land combining the active and passive information are presented.