Retrieval of temperature, humidity, and integrated hydrometeor contents from observations with the microwave package HAMP on the High Altitude and LOng range aircraft HALO

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 modeling. An airborne platform for such observation techniques will be provided by the new German research aircraft HALO (High Altitude LOng Range). HALO will open a new dimension for climate and atmospheric research. HALO will enable to survey the atmosphere on continental scales but with much finer resolution and with more powerful instrumentation than feasible on space-borne platforms.

An advanced set of microwave remote cloud sensing instruments (HAMP - HALO Microwave Package) is to be operated on board of HALO. It consists of a cloud radar and a suite of passive radiometers in different frequency bands. The radar MIRA-36 operates at 36.5 GHz. The frequencies for the passive microwave radiometers were selected in allusion to the AMSU-A and -B sounder. The 150 GHz channel of AMSU-B were replaced by frequencies in the 118 GHz oxygen band. In combination with the 60 GHz oxygen complex channels, these frequencies can be used for precipitation retrieval after Bauer and Mugnai (2003). Furthermore, by including channels in the water vapor lines at 22.235 GHz and 183.31 GHz, information about the water vapor distribution throughout the troposphere can be retrieved. By including higher microwave channels sensitive to scattering in the ice phase various precipitation retrieval algorithms can be compared with measurements from HAMP.

This presentation introduces the microwave package on HALO. 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 and concurrent hydrometeor contents and profiles. These are achieved by cloud resolving model simulations and forward radiative transfer calculations. 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 for hydrometeor contents over ocean and land combining the active and passive information are presented.

Bauer, P., and A. Mugnai (2003), Precipitation profile retrievals using temperature-sounding microwave observations, J. Geophys. Res., p. 4730.