HAMP - The Microwave Package on the „High Altitude and LOng range“ research aircraft HALO

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1. Introduction

New cloud and precipitation observation techniques are needed to improve our understanding of the earth‘s radiation budget and water cycle - both presenting major challenges in global and regional climate modeling.

HAMP (High Altitude and LOng range-Microwave Package) will provide an advanced set of microwave remote cloud and precipitation sensing instrumentation to be operated on board of the new German research aircraft HALO. It consists of:

- 3 passive radiometers with 37 channels between 22 and 183 GHz
- a 36.5 GHz polarimetric cloud radar

Here we will give an overview of the microwave package HAMP on HALO and demonstrate its potential for observing clouds, precipitation, and the atmospheric water cycle.

2. Instrumentation

Band	K	V	W	F	G
Frequencies [GHz]	22.24	50.30	90.0	118.75±8.5	183.31±12.5
	23.04	51.76		118.75±4.2	183.31±7.5
	23.84	52.8		118.75±2.3	183.31±4.5
	25.44	53.75		118.75±1.4	183.31±3.5
	26.24	54.94			183.31±2.5
	27.84	56.66			183.31±1.5
	31.40	58.0			183.31±0.6
FWHM	4.0°	2.5°	2.5°	2.5°	2.5°

Tab. 1: *HAMP passive microwave frequencies and their half power beam widths.*

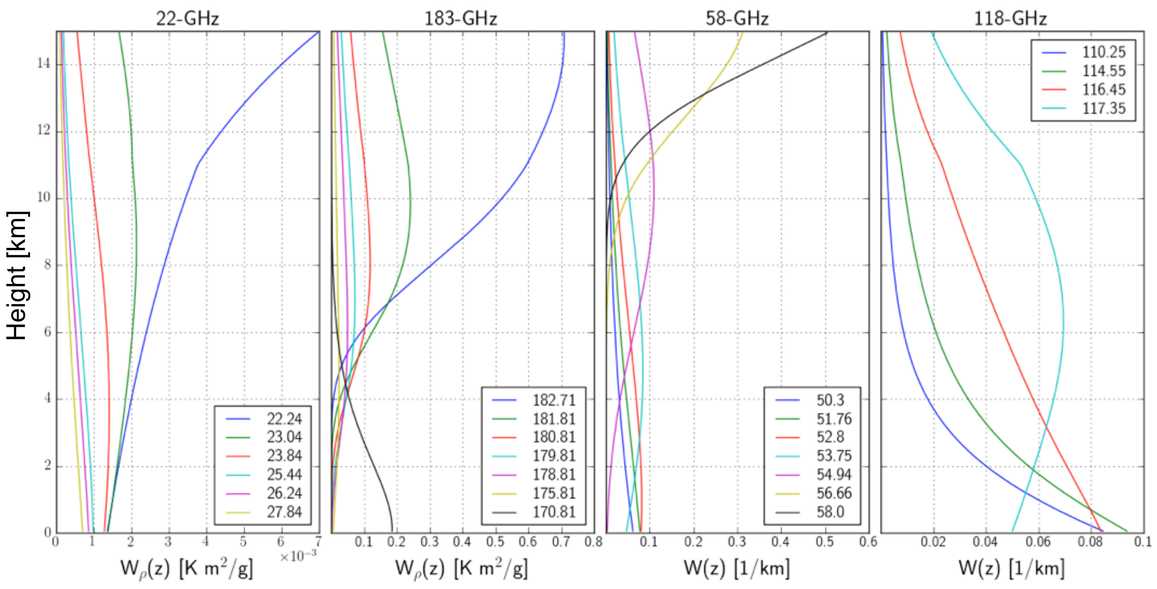

Abb. 1: *Temperature and humidity weighting functions for a maximum ceiling height of 15 km.*

Cloud radar MIRA-36:

- Ka-Band Doppler radar at 35.563 GHz
- -44 dBZ sensitivity at 5 km
- 30 m vertical resolution
- 50 m resolution across flight direction
- 250 and 50 m resolution along flight direction
- Profiles: reflectivity, Doppler velocity, LDR

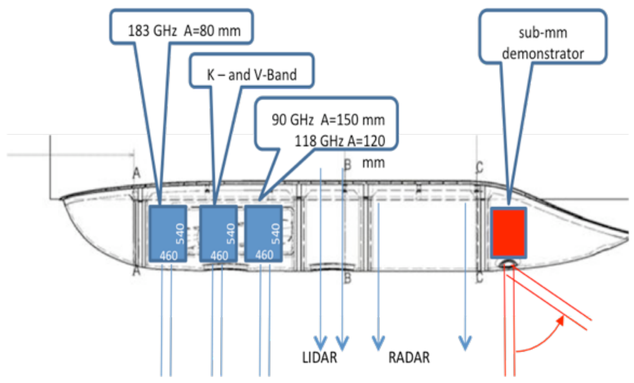

Abb. 2: *Instrumentation within the belly pod of HALO*

3. Simulations

Simulations based on cloud resolving model output (*Chaboureau et al. 2007*) and passive *(MWMOD, Mech et al. 2007)* and active (QuickBeam, *Haynes et al. 2007*) microwave forward operators show the potential of HAMP observations:

- Emission of liquid water (clouds and rain) over ocean
- Scattering signal of frozen hydrometeors at higher frequencies
- Channels within the absorption bands provide information of temperature and humidity profiles
- High dynamic range of cloud radar shows light rain, water and ice clouds

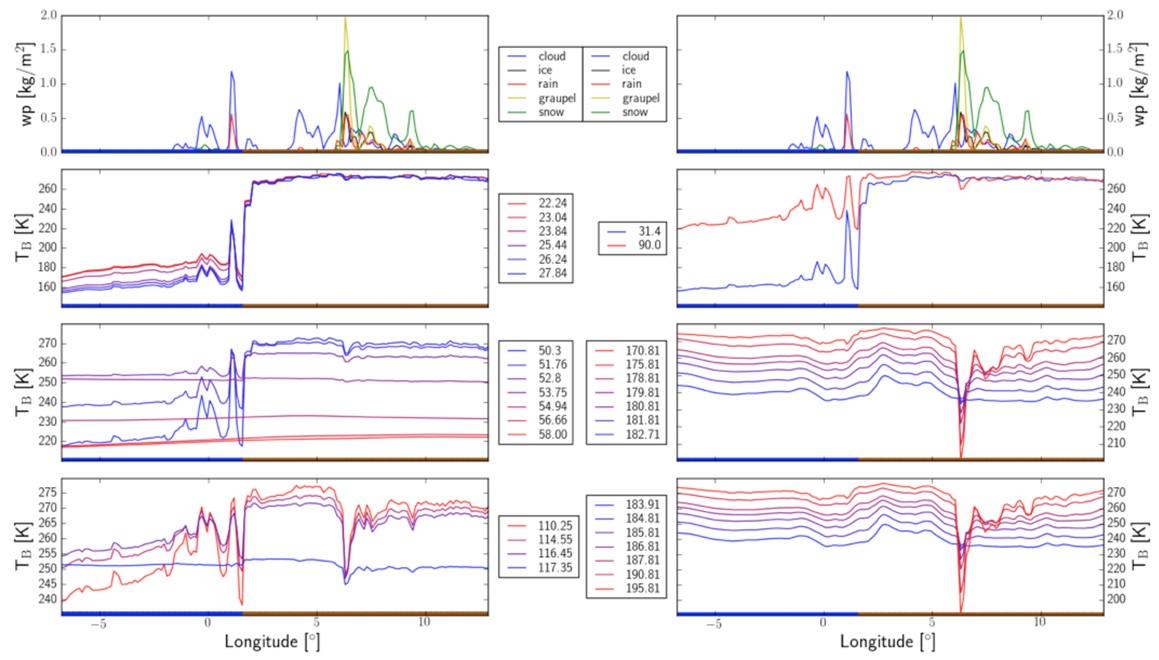

Fig. 3: *Modeled hydrometeor contents (top row) and simulated passive microwave observations for the 37 HAMP channels. Land and ocean surfaces are indicated by brown (land) and blue (ocean) lines respectively.*

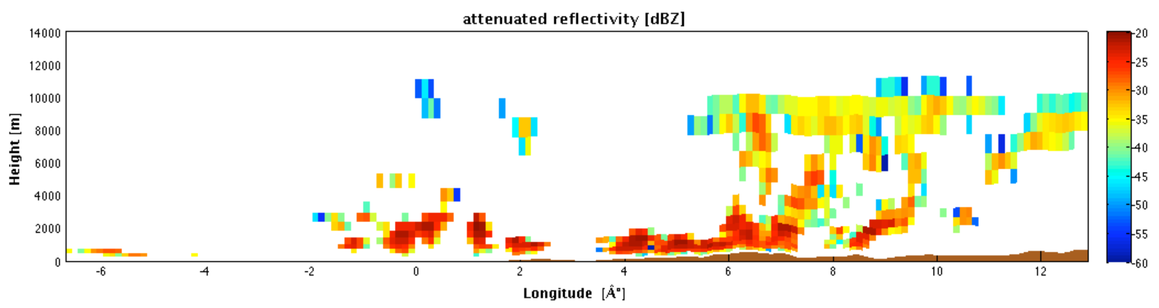

Fig. 4: *Simulated MIRA-36 radar reflectivities along the cross section in Fig. 3*

4. Conclusion and Outlook

The combination of active and passive microwave radiometry techniques provides a unique potential for the observation of hydrometeors and the environmental conditions, like temperature (60 and 118 GHz) and humidity profiles (22 and 183 GHz).

Missions operating HAMP on HALO (in combination with lidar, drop sondes, etc.) open new opportunities for process studies and satellite validation campaigns.

Within the next months various retrieval algorithms (statistical, semi-statistical, and physical) will be developed and implemented to fully exploit the potential of HAMP observations.

NARVAL/ACPC (North Atlantik and Carribean area) and ACRIDICON (convective clouds) are under the upcoming mission that will operate HAMP on HALO.

References:

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Haynes, J. M., R. T. Marchand, Z. Luo, A. Bodas-Salcedo, and G. L. Stephens, 2007: A multipurpose radar simulation package: QuickBeam, Bull. Amer. Meteor. Soc., 88, pp. 1723–1727.

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