Retrieval of temperature, humidity, and hydrometeor contents from observations with the microwave package HAMP on HALO

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1. Introduction

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 for cloud and precipitation observations. It consists of:

- 3 passive radiometers with 37 channels between 22 and 183 GHz

- a 35.563 GHz polarimetric cloud radar

Here we will give an overview of the microwave package HAMP on HALO and demonstrate its potential for observing and retrieving clouds, precipitation, and the atmospheric water cycle.
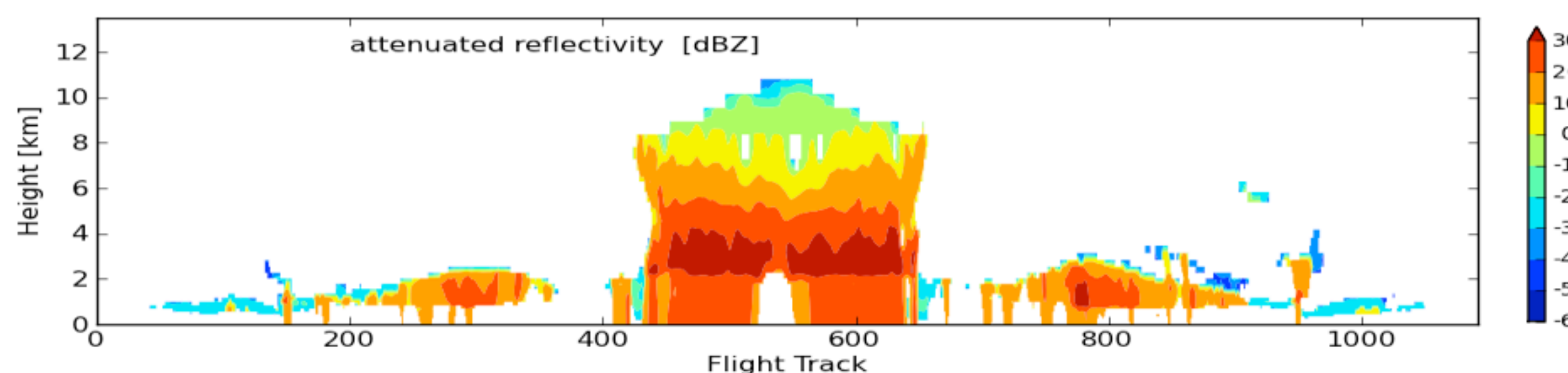
3. Simulations
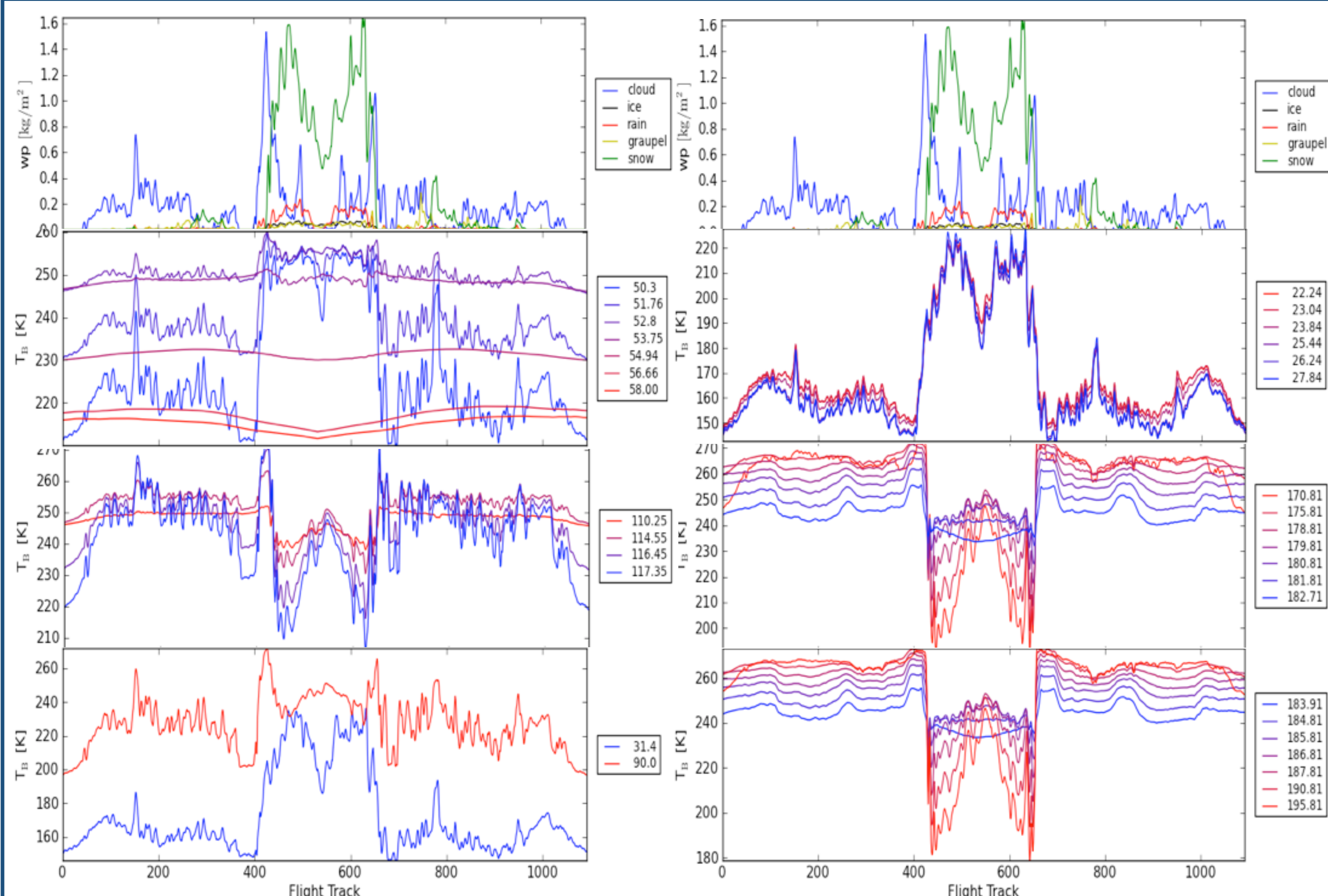
Modeled hydrometeor contents (top row) and simulated passive microwave observations for the 37 HAMP channels along an imaginary flight track over ocean.

Simulations based on cloud resolving model output and passive and active microwave forward operators show the potential of HAMP observations:

- Emission signal of liquid water (clouds and rain)

- 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
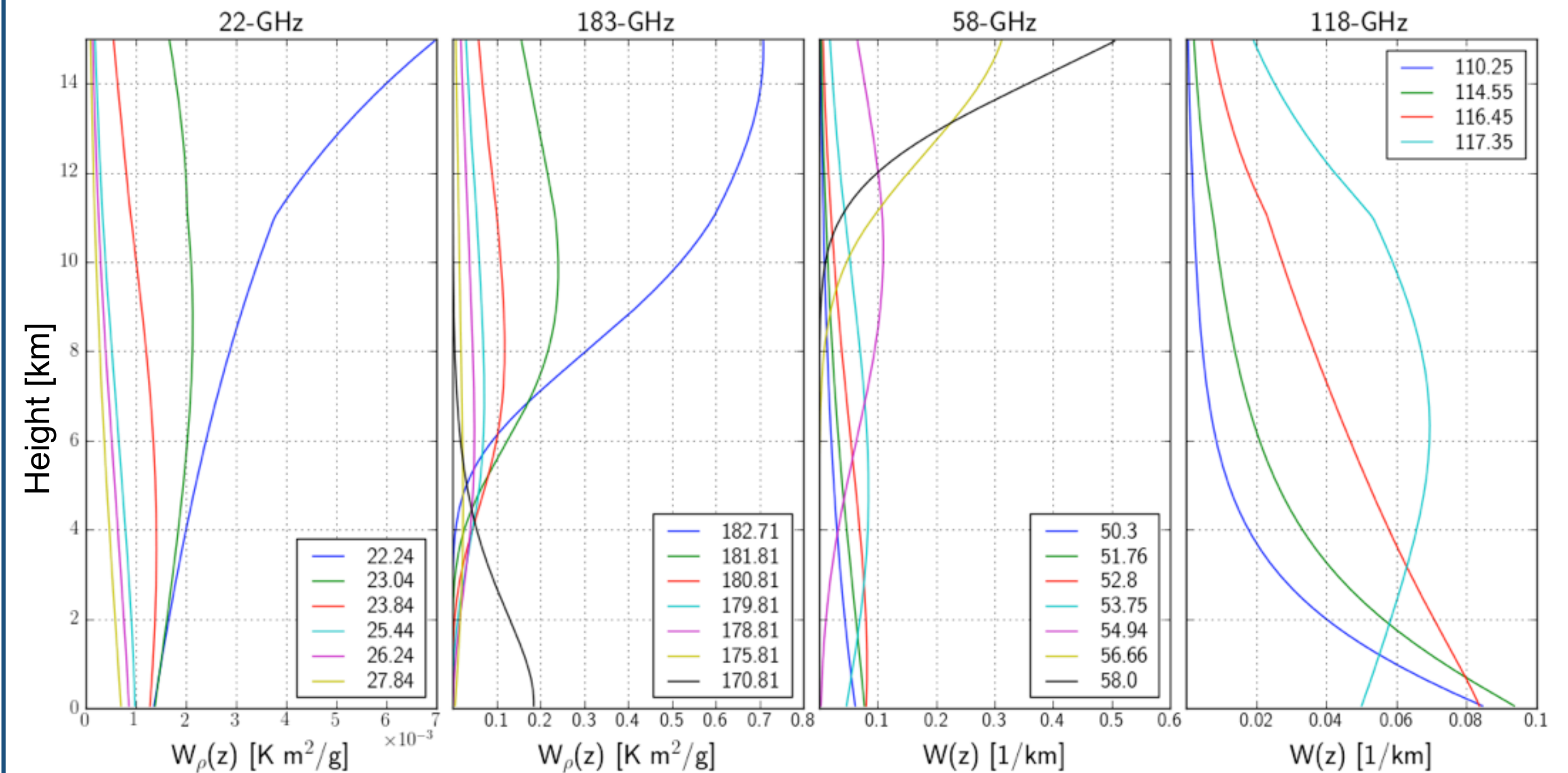

Simulated MIRA-36 radar reflectivities along the imaginary flight track.

2. Instrumentation

Temperature and humidity weighting functions for the passive microwave radiometers and 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

Instrumentation within the belly pod of HALO

4. Retrieval

Retrieved temperature and humidity profiles along a simulated flight.

Retrieved integrated rain and snow water path with all passive microwave frequencies used.

4. Conclusion

- HAMP provides a unique plattform for the observation of hydrometeors and the environmental conditions like temperature and humidity

- First retrievals based on a simulated database show good results for temperature and humidity profiles

- Simple retrieval approaches of integrated hydrometeor contents with constraints give promising results
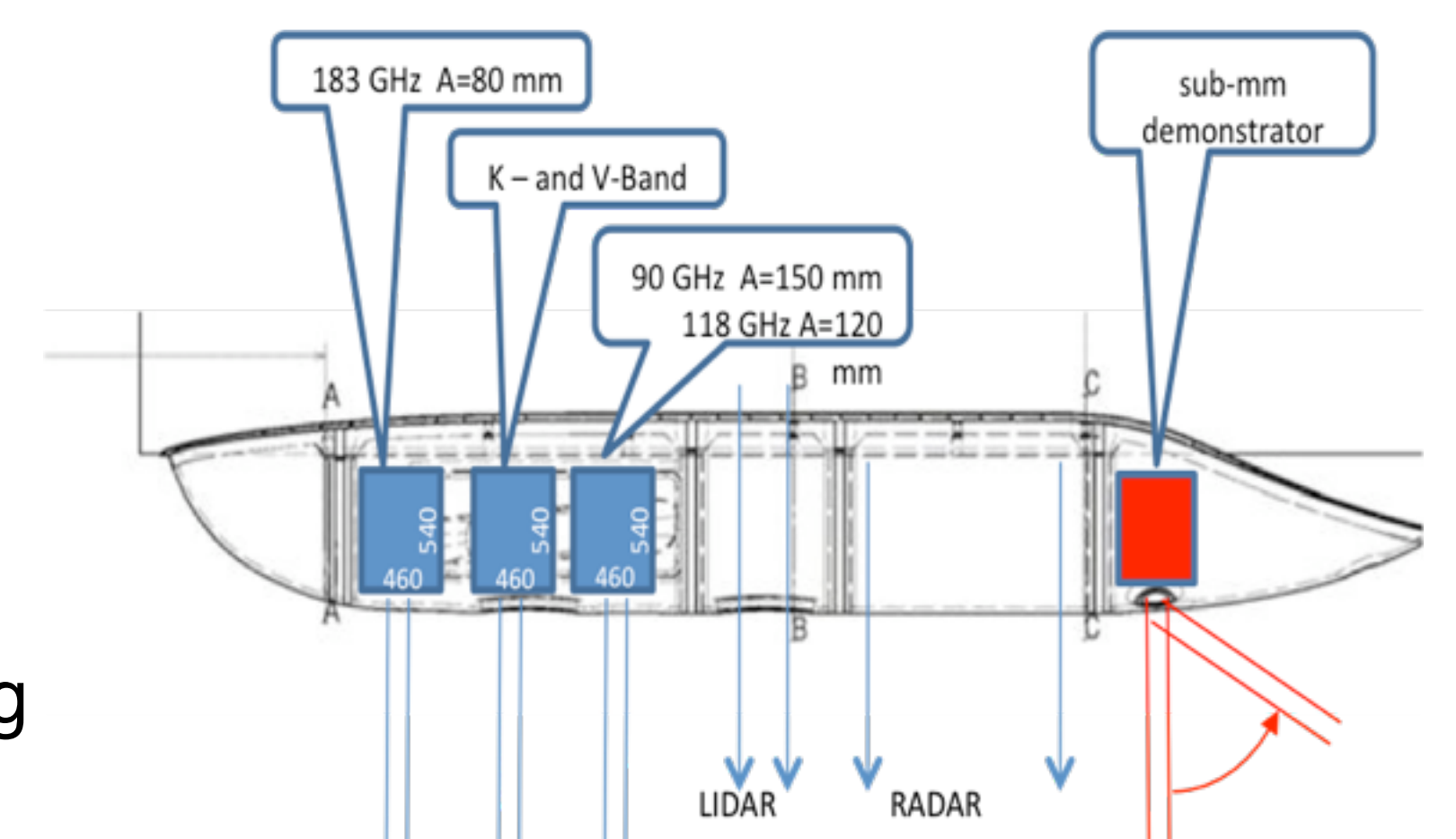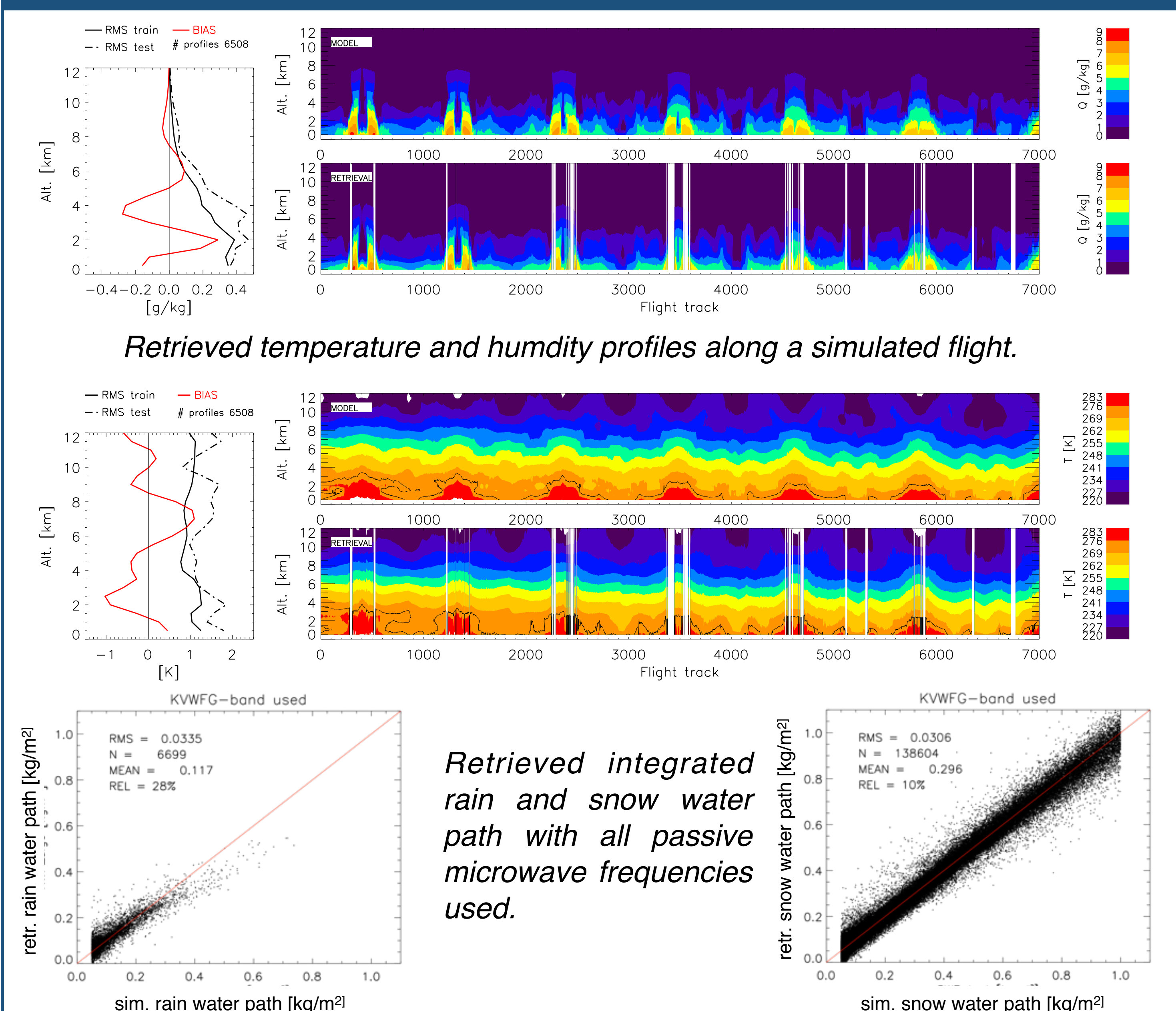
5. Outlook

- Combination of passive and active observation within the retrieval and application of optimal estimation techniques

- Simulations based on 2-moment microphysics and more „realistic" radiative transfer assumption (single scattering properties)

- First campaign over Northern Atlantic (NARVAL) with HAMP on board is scheduled for Jan./Feb. 2013