Water vapor profiles along the flight track from Europe to Australia by microwave radiometry and its comparison with FISH, FLASH, Lidar and satellites

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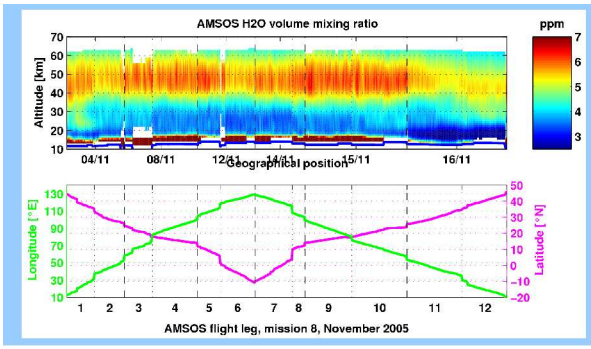
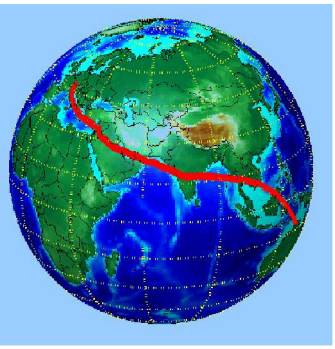
Introduction Water vapor plays a key role in the earth atmosphere. In the upper troposphere it acts as the most important greenhouse gas. In addition it is involved in processes related to ozone depletion. Further it can be used as a tracer for studies of atmospheric motion because of its long chemical lifetime.
We have flown the microwave remote sensing instument AMSOS for water vapor measurements in the middle atmosphere onboard the Swiss Air Force Learjet during the SCOUT-O3 Darwin campaign obtaining H_2O profiles along the flight track.

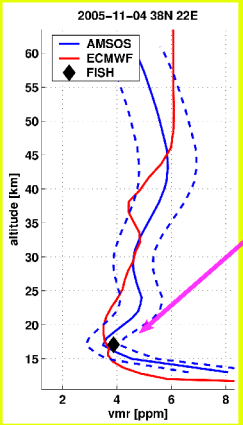


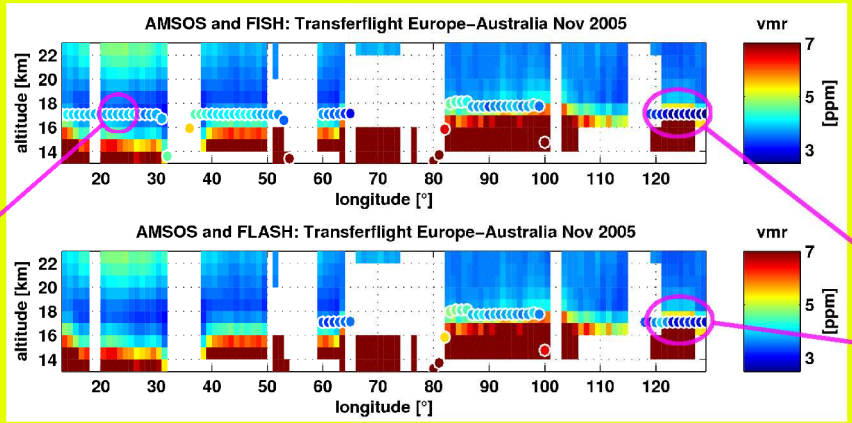
AMSOS dataset:

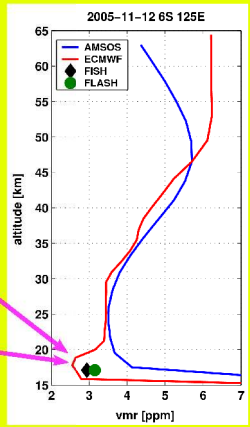
- 838 profiles UTLS/Stratosphere from 15-60km. 2-D cut through the atmosphere along the flight track
- Horizontal resolution: 100km
- Altitude resolution: ~10km
- Profiles Mesosphere 40-80km (☞ see poster 3.4 Thomas Flury, University of Bern)

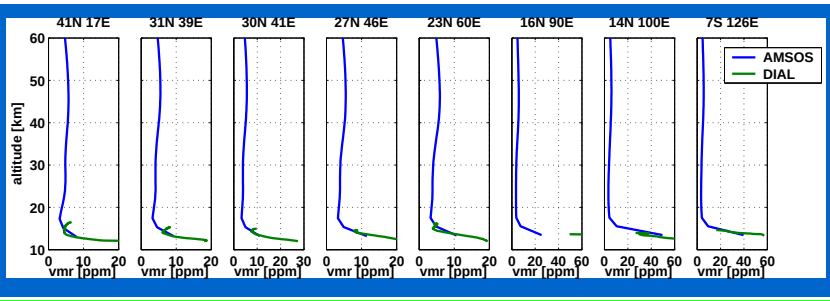


Comparison to FISH and FLASH onboard Geophysica M55 AMSOS water vapor profiles show similar values compared to FISH and FLASH in the lower stratosphere in the mid-latitudes. In the tropics we have differences up to 50% for the case of a thin very dry layer, which is shown in the ECMWF profile. Geophysica with FISH and FLASH has been flown inside this dry air. Due to the limited altitude resolution of the microwave instrument, AMSOS can not detect this fine structure.

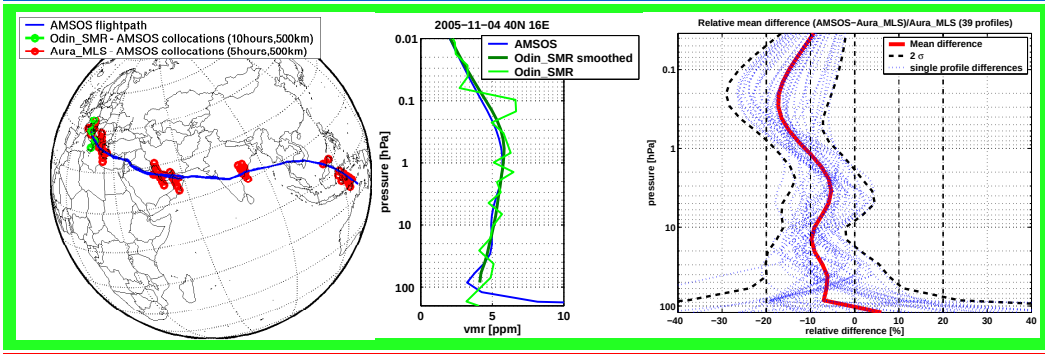








Combination of water vapor profiles with the Differential Absorbtion Lidar (DIAL) onboard DLR-Falcon A possibility to get a water vapor profile from the troposphere up to the mesosphere ist the combination of LIDAR and Microwave measurements. As we can see the DIAL profile stops around 17 km where the AMSOS profile continues. In the short overlap region the microwave profile measures the mean value of water vapor of the LIDAR profile with higher resolution.



Comparison to satellite experiments Two collocations with the satellite Odin/SMR and 39 with Aura/MLS could be found for comparison. The higher resolved profiles of the limb sounding instruments have to be smoothed first by the avreaging kernels of the microwave instrument.
AMSOS and Odin/SMR show a very good agreement in the stratosphere. With respect to Aura/MLS AMSOS has a dry bias of 8% with less than 5% error throughout the stratosphere.

Conclusion The microwave radiometer provides a 2-D cut through the atmosphere along the flight track. Comparisons to other instruments and observation techniques show good agreement, but the limitted altitude resolution does not allow to detect any fine structure of the vertical water vapor distribution. Combining the LIDAR and microwave technique, one can achieve profiles from the troposphere to the mesosphere.

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