COMPARISON OF WATER VAPOR MEASUREMENTS BETWEEN THE SATELLITE LIMB SOUNDER MIPAS/ENVISAT AND THE AIRBORNE MICROWAVE RADIOMETER AMSOS

Stefan C. Müller[1], Mathias Milz[2], Niklaus Kämpfer[1]

[1]Institute of Applied Physics, University of Bern, Switzerland

[2]Institut für Meteorologie und Klimaforschung, FZ Karlsruhe, Germany

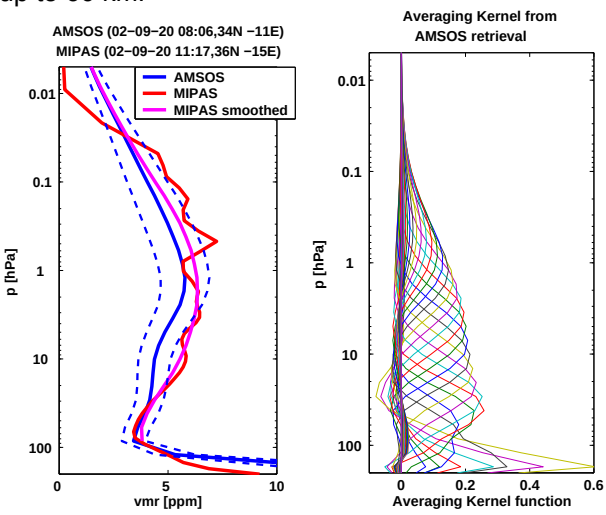
Contact: stefan.mueller@mw.iap.unibe.ch

Introduction

Water vapor is interesting for atmospheric studies because it is the most important natural greenhouse gas and it is involved in ozone depletion processes in the stratosphere. Due to the large dynamical range over altitude it is difficult to measure and data products need to be validated between each other.

Measurement technique and water vapor data product

The Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) onboard the satellite Envisat covers the water vapor distribution in an altitude range from 6-68 km over the whole globe using limb sounding technique. The Airborne Microwave Stratospheric Observing System (AMSOS), an uplooking microwave radiometer, has been flying once a year for one week during the last ten years onboard a Learjet over the northern hemisphere determining the distribution of water vapor from flight altitude at around 12-14 km up to 60 km.

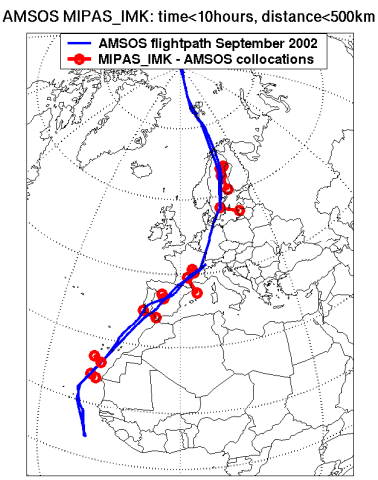


AMSOS and MIPAS vmr profiles (left) and AMSOS averaging kernel functions (right)

When comparing MIPAS data with high altitude resolution with microwave data with lower resolution the former have to be folded with the averaging kernels of the microwave instrument according

$$\mathrm{MIPAS}_{\mathrm{smoothed}} = \mathrm{AMSOS}_{\mathrm{apriori}} + A * (\mathrm{MIPAS} - \mathrm{AMSOS}_{\mathrm{apriori}}).$$

This leads to a smoothing out of fine structures as observed by MIPAS. Below the hygropause the difference ($\mathrm{MIPAS} - \mathrm{AMSOS}_{\mathrm{apriori}}$) can be very large due to the strong water vapor gradient affecting other altitudes by multiplication with A. For this reason the averaging kernel functions have been cut at the hygropause level and only the middle atmospheric part has been folded. For the tropospheric part normal differences have been built.



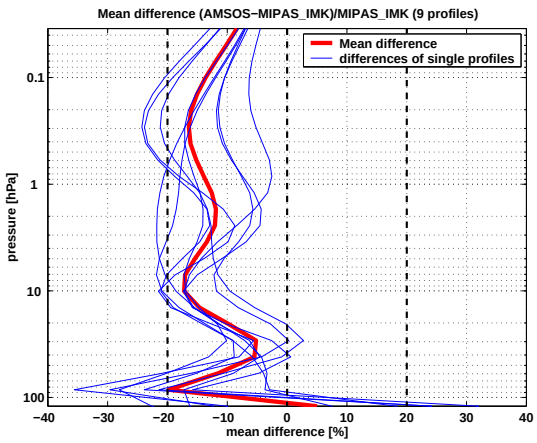
AMSOS flight path September 2002 and collocation sites

AMSOS - MIPAS profile comparison

For September 2002 we have a set of 9 collocations between MIPAS_IMK and AMSOS profiles within a time / distance window of 10 hours and 500 km from subtropics to subarctic regions. The mean difference is of the order of 10-15% over the whole overlap. The level of the hygropause is well reproduced by both instruments.

Conclusions

The comparison showed a dry bias of AMSOS with regard to MIPAS of the order of 15% that might be due to errors in the spectral parameters. However besides this offset agreement between both instruments is less than ± 10% over the whole altitude range.



Relative difference between MIPAS and AMSOS profiles

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