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Global stratospheric water vapor distributions from MIPAS/Envisat for the period 2002 to 2008

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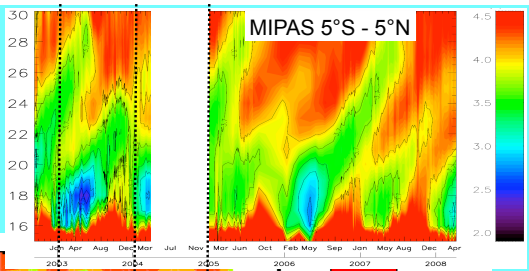
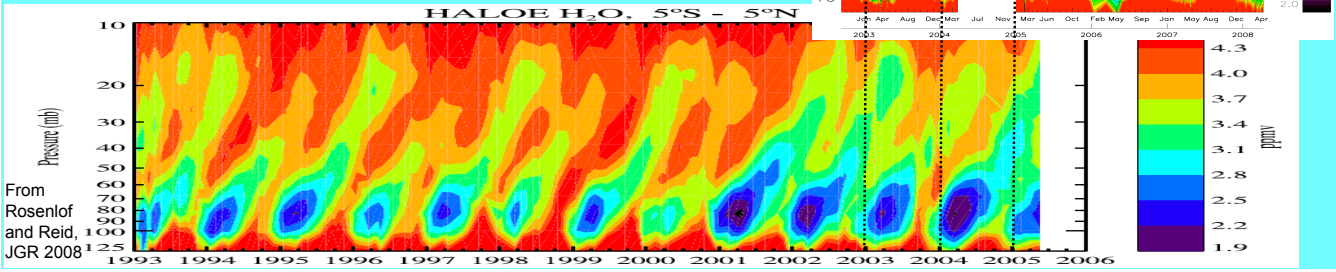
Motivation / Background

Vertical profiles of water vapor (WV) from the upper troposphere to the stratopause were derived from MIPAS observations in the full spectral resolution mode (2002 to 2004) and the reduced spectral resolution mode (2005 to present). They are used to study the evolution of stratospheric WV. A steady increase in the 1980ies and 1990ies has been observed in Boulder hygrometer time series (Oltmans et al., GRL 2000), and partly also in HALOE time series during the 1990ies; in 2001, however, a sudden drop in stratospheric WV occurred (Randel et al., JGR 2006).

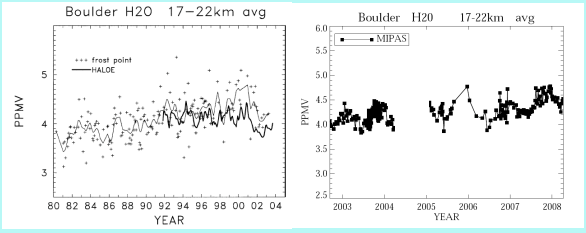




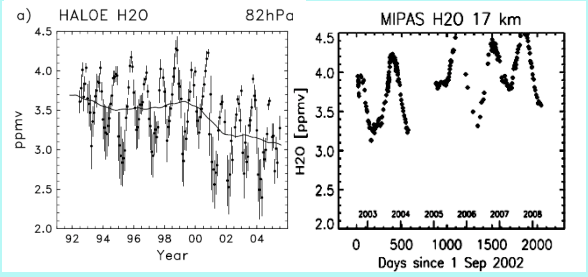
From Rosenlof and Reid, JGR 2008

Time series

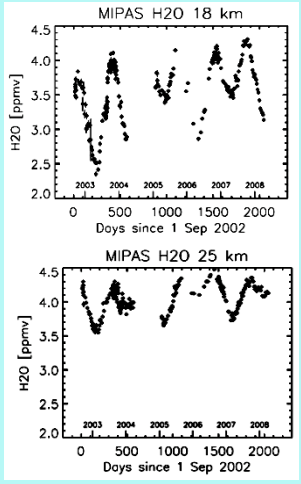
Comparison to Boulder time series:
Left: Boulder frost point hygrometer time series and HALOE data (35-45°N, 80-130°W) (Randel et al., JAS 2004)
Right: MIPAS time series 2002 to 2008 around Boulder (35-45°N, 80-130°W)



Comparison to near-global time series from HALOE (60°S-60°N):
Left: HALOE time series at 82 hPa from Randel et al., JGR 2006.
Right: 60°S-60°N MIPAS time series at 17 km for 2002 to 2008;
vmrs during 2002-2005 are higher than HALOE, probably due to averaging at altitude, not pressure.
Continuous increase from 2002 to 2008 overlaid by season variation.



Tropical (10°S-10°N) time series at 18 and 25 km

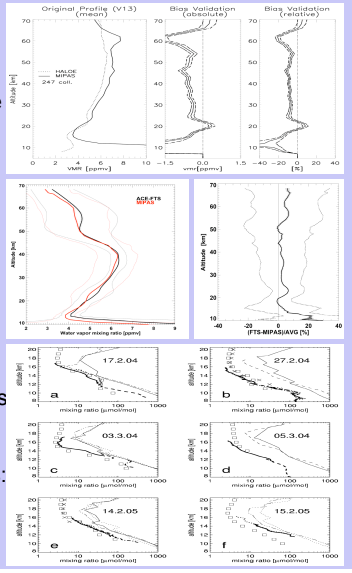


Validation

Comparison of MIPAS full resolution WV measurements (2002 to 2004) to HALOE sunrise observations for NH mid to high latitudes (Milz et al., paper in preparation).

Comparison of MIPAS full resolution WV measurements (Feb to Mar 2004) to ACE-FTS occultation sunset observations between 30°N to 80°N (Carleer et al., ACPD 2008).

Comparison of MIPAS FR (2004) and RR (2005) WV measurements to the air-borne LIDAR instrument DIAL during the TROCCINOX campaigns in the tropics; symbols: MIPAS; lines: DIAL; thin lines: ice saturation vmrs (Kiemle et al., ACPD 2008; accepted for ACP).



Conclusions

- ❑ MIPAS is a suitable instrument to continue the HALOE water vapor time series.
- ❑ The MIPAS tropical stratospheric WV time series agrees well with HALOE observations, both in vmr amount and shape of the WV tape recorder. NH Mid/high-lat MIPAS stratospheric WV is 10% higher than HALOE, but agrees well with ACE-FTS.
- ❑ The tropical WV tape recorder shows a pronounced QBO effect.
- ❑ The episode of low stratospheric WV starting with a dip in 2001 (Randel et al., JGR 2006) seems to be over; a continuous increase is observed in the MIPAS WV time series since 2002.

Within the proposed project SHARP (Stratospheric Change and its Role for Climate Prediction), the HALOE and MIPAS WV time series will be homogenized, and the HALOE time series will be continued by MIPAS observations (mission extension until 2010/2014). The decadal time series of combined HALOE and MIPAS observations will be used to validate several GCMs. Processes leading to seasonal, inter-annual and decadal variation of stratospheric WV will be analyzed by sensitivity studies. The validated GCMs will predict stratospheric WV; a potential decadal WV trend will be identified.