Validation of MIPAS H_2O vapour by comparison with independent satellite measurements

ACVT-MASI

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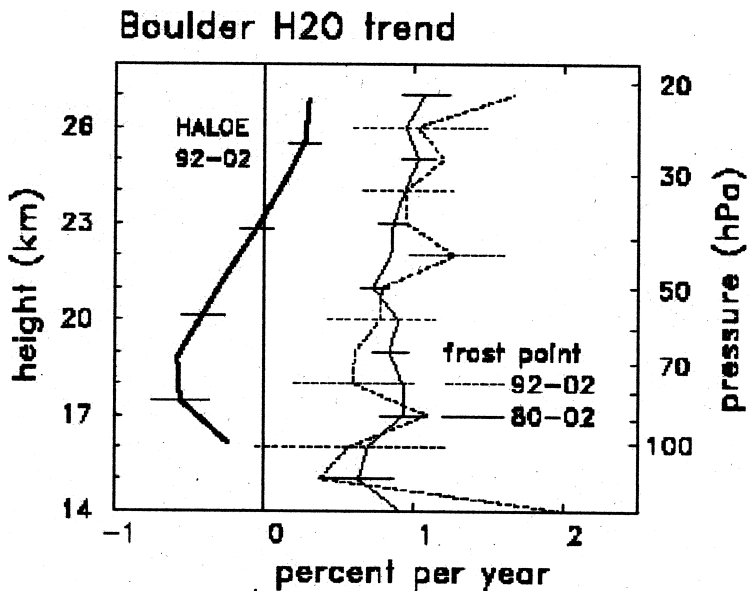
ACVE-2 Workshop, 3-7 May 2002

- importance of stratospheric water vapour in current/future climate
  - ➔ planetary radiation balance (green house gas)
  - ➔ UT/LS chemistry
  - ➔ atmospheric circulation/dynamical tracer
- Uncertainties in longterm trend (~1%/y)



Randel et al. 2004

satellite water vapour profiles

satellite instrument	viewing mode	operation
SAGE II/ERBS	occultation	1984-present
HALOE/UARS	occultation	1991-present
MLS/UARS(?)	mw/limb	1991-present
POAM III/Spot-4	occultation	1998-present
SAGE III/Meteor-3	occultation	2001-present
SMR/ODIN	mw/limb	2001-present
SABER/Timed	IR/limb	2002-present
MLS/Aura	mw/limb	launch 2004
TES/Aura	IR/limb/nadir	launch 2004
HRDLS/Aura	IR/limb	launch 2004

➔ SCIAMACHY and GOMOS also measure water vapour profiles!

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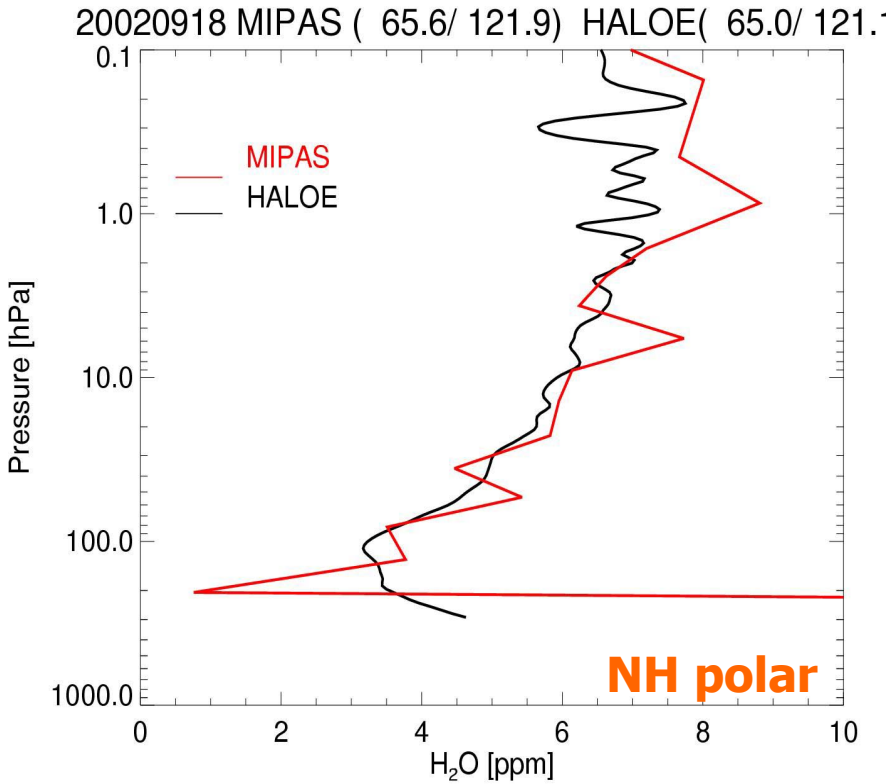
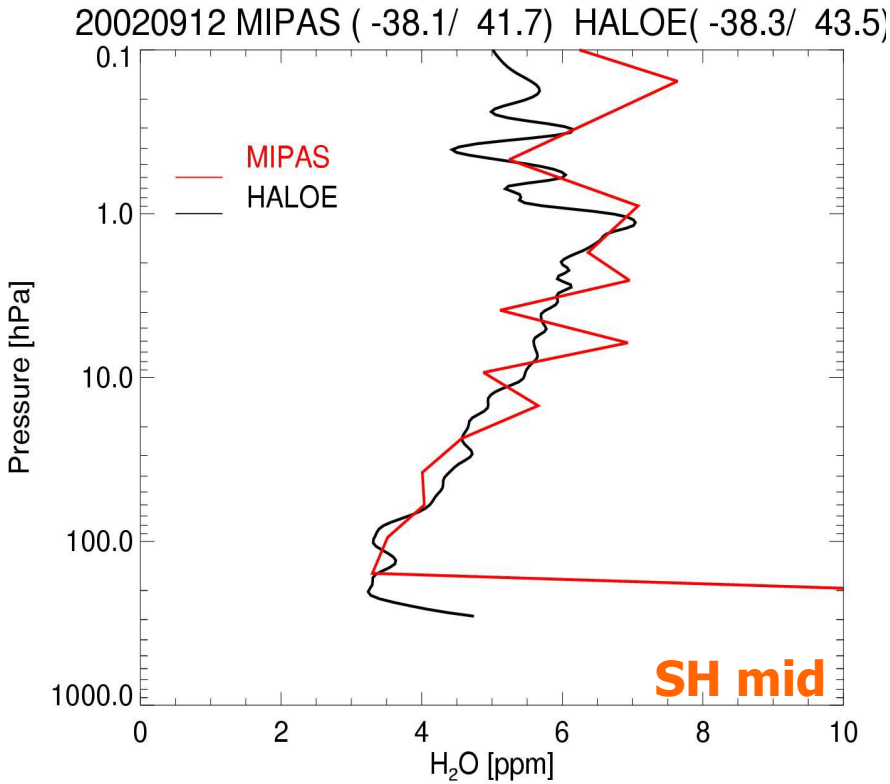
➔ this talk: validation with **SAGE II, HALOE**, and **POAM III**

Validation with HALOE H20





MIPAS data set OL V4.61:

- 101 collocations (22 July-27 Dec 2002)
- majority in NH mid latitudes (50) and NH polar (31)
- Few SH (12) and tropical (8) profiles

Collocation criteria:

- 250 km and same day

Accuracy of HALOE V19

- 25% 15-30 km
- 30% 30-50 km

Bracher et al.

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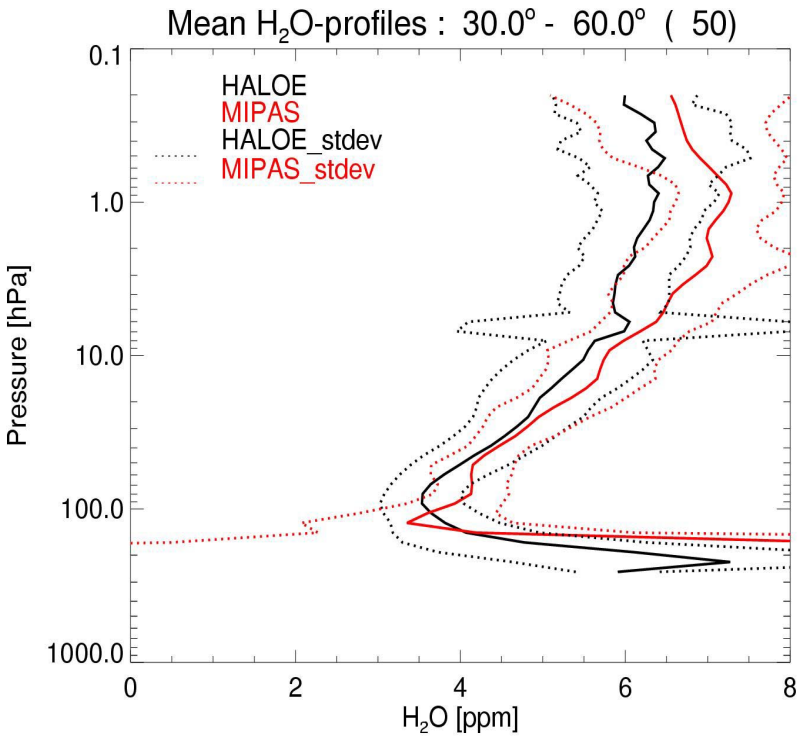
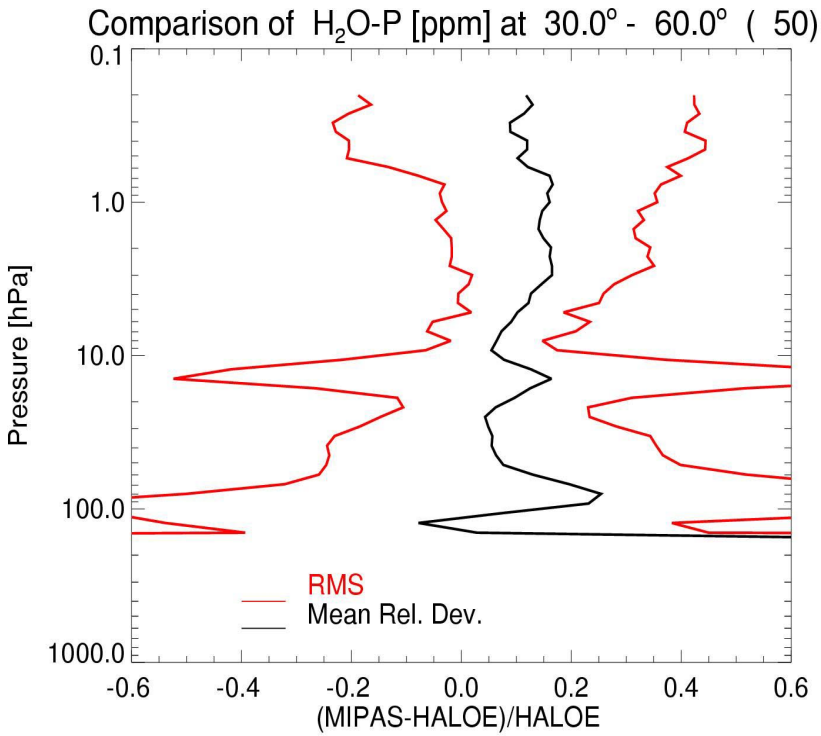
Validation with HALOE H2O: Statistics

NH mid latitudes: 30°N - 60°N





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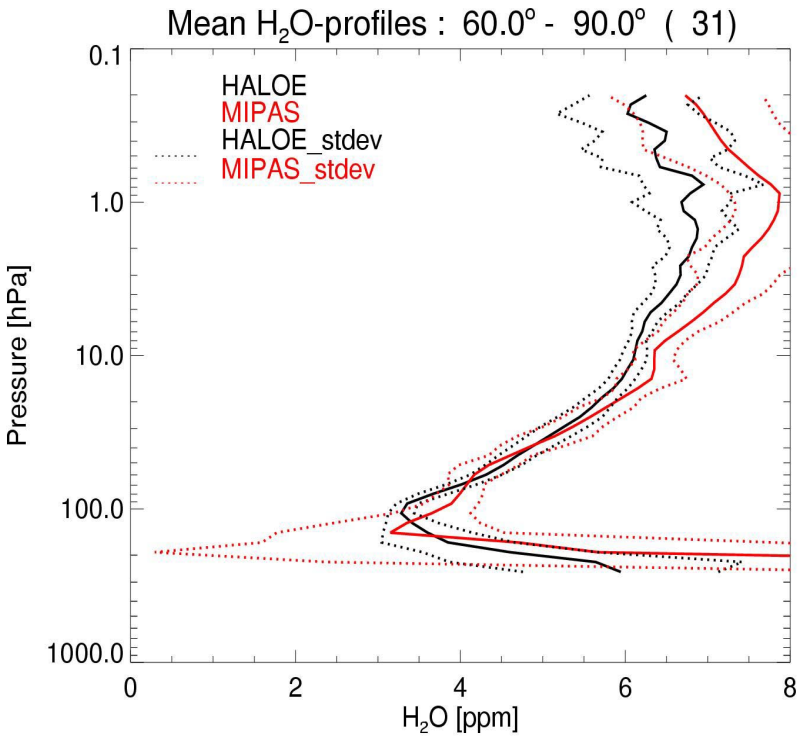
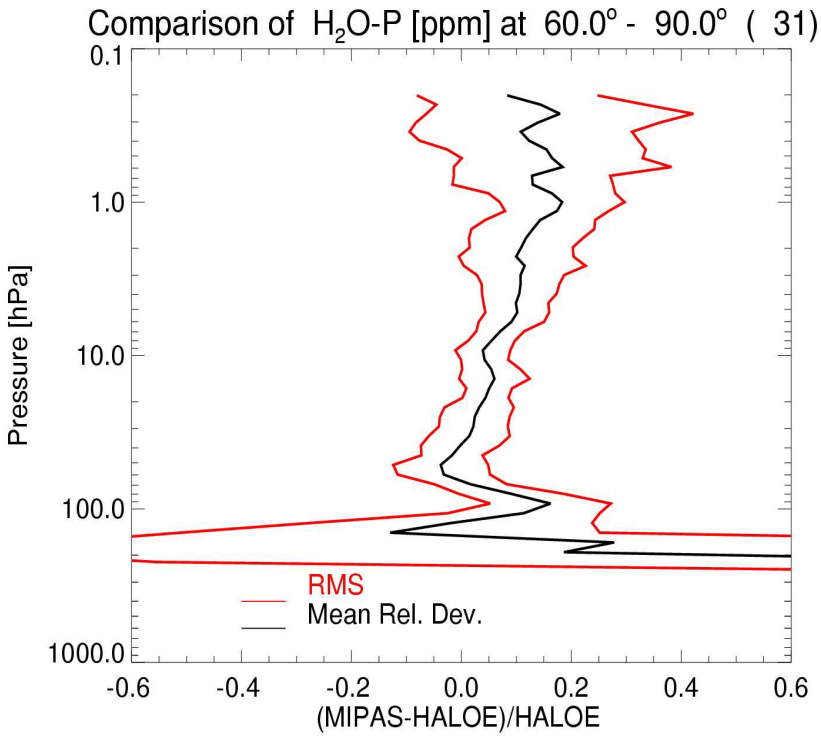
50 collocations

- Small positive bias (<10%) between 100 hPa and 10 hPa (20-30 km)
- +10% to +20% bias above 10 hPa
- Large scatter in differences (up to ±30%), like MIPAS v4.53

Validation with HALOE H2O: Statistics

NH polar latitudes: 60°N - 90°N



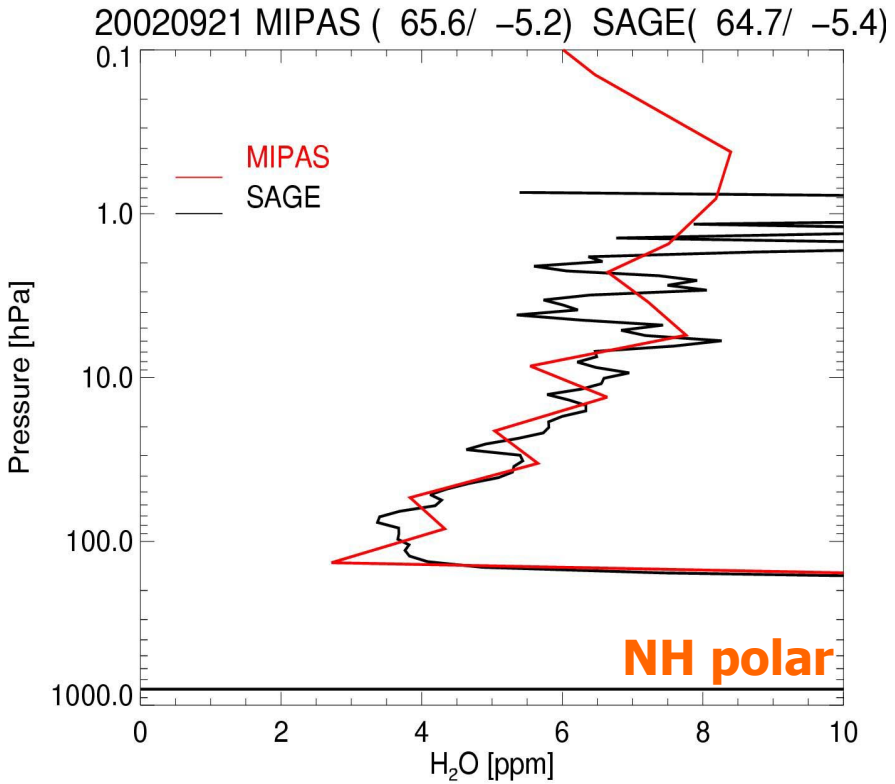


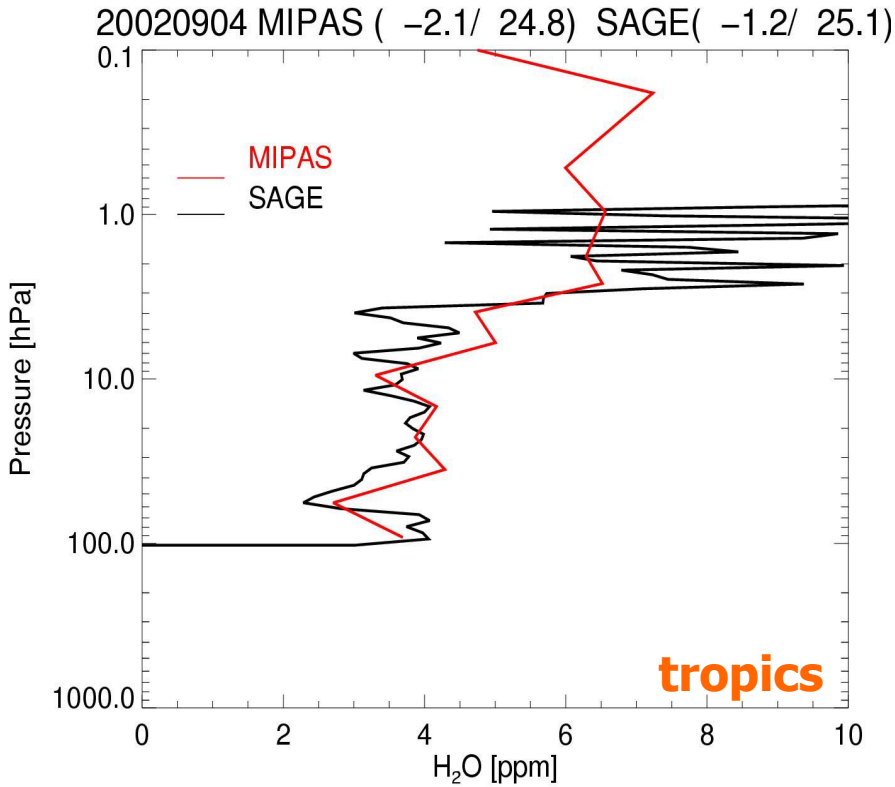
Bracher et al.

31 collocations

- similar results as in mid-latitude: small bias in lower stratosphere and positive bias of 10 to 15% above 10 hPa
- Other latitude bands (tropics and SH) provide a similar picture

Validation with SAGE II H2O





SAGE II Version 6.2

- new version
- improved altitude registration (v6.1)
- adjusted aerosol model/spectral shift correction (v6.2)
- Error (v5.96):
  - ➔random 10%-15%
  - ➔sytematic 20%-30%

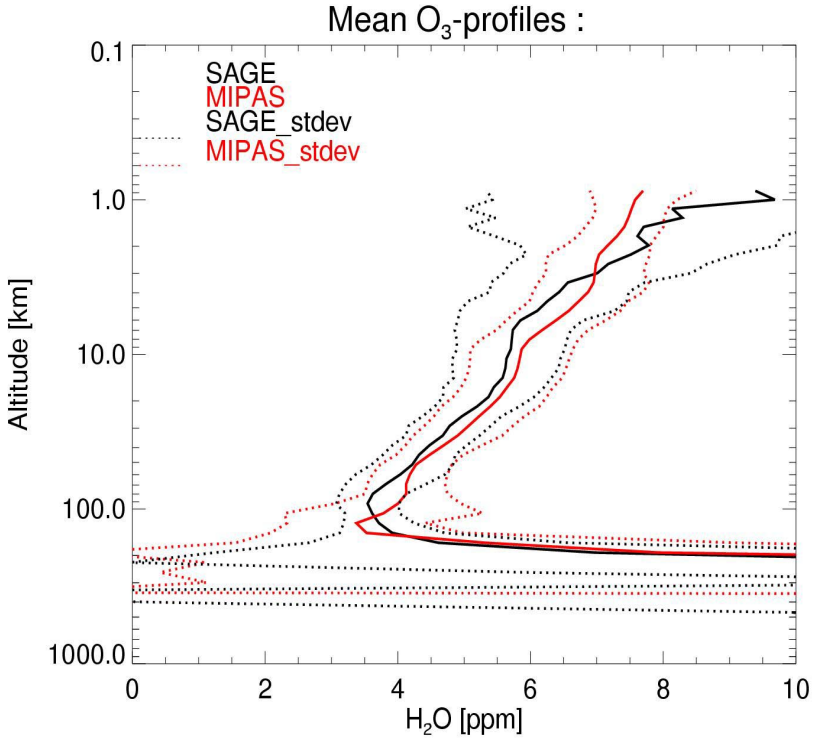
137 collocations (250 km/same day)

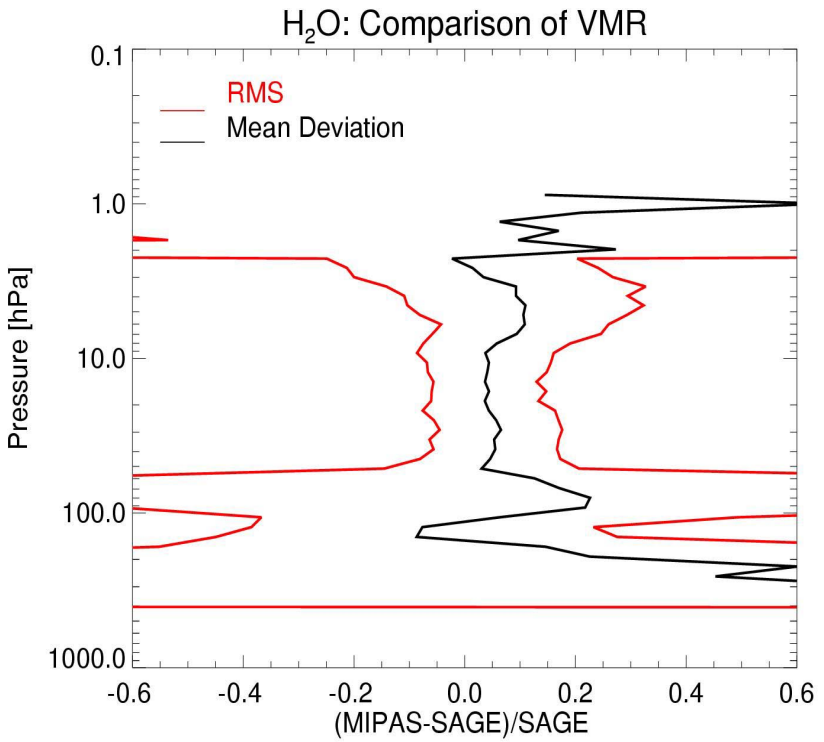
- period: 18 July-15 Dec 2002
- majority in NH polar (66), NH mid latitudes (28), and SH polar (24)
- few in tropics (13) and SH mid lat (6)

Bracher et al.

Validation with SAGE II H2O: statistics

mean of all collocations





137 profiles

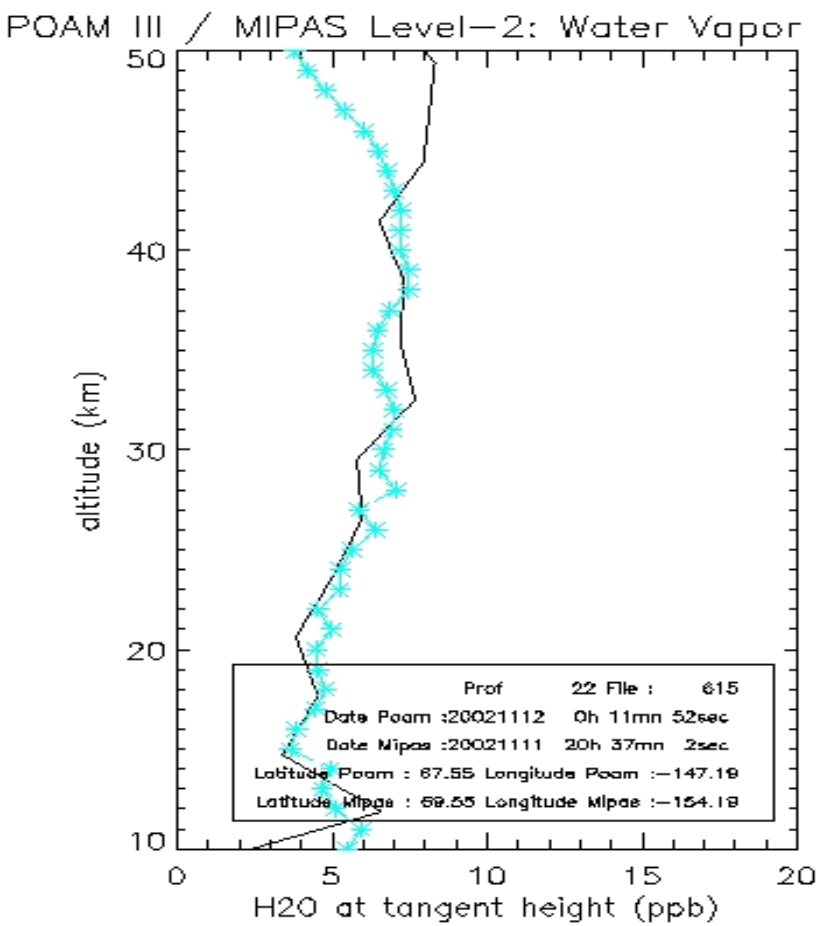
Bracher et al.

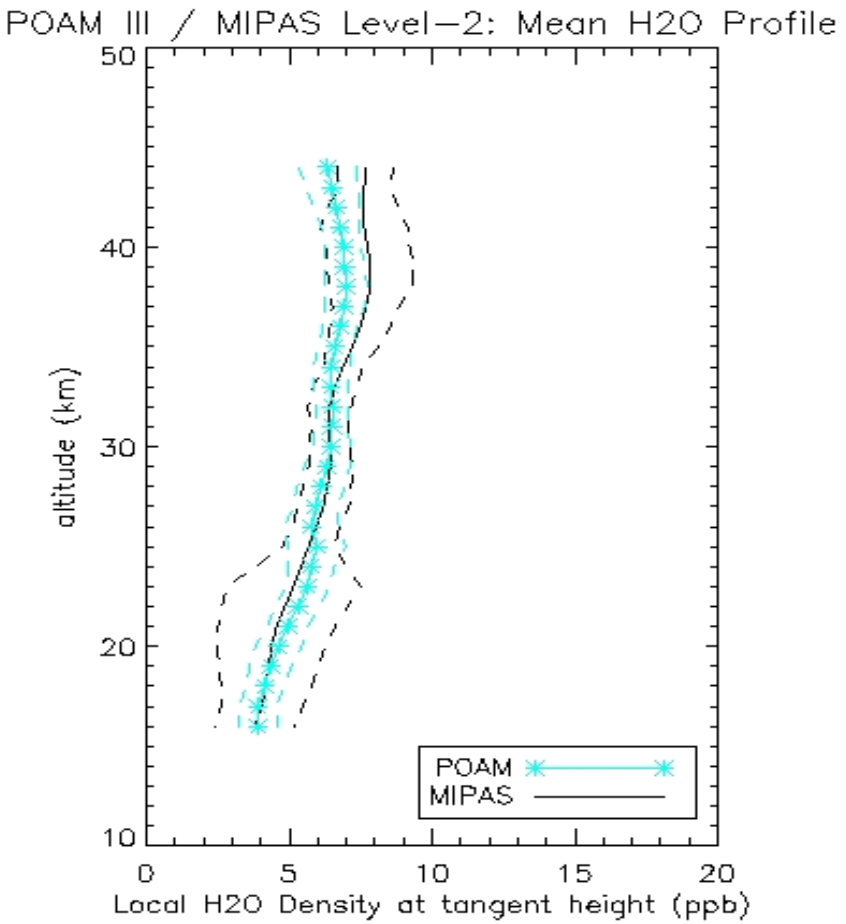
- between 50 hPa and 3 hPa agreement between +5% and +10%
- above 3 hPa SAGE profiles quite noisy
- below 50 hPa large RMS

- Latitude band 60°N-70°N
- Collocations from August 2002 to December 2002
- 616 profiles (5 unreadable)
- Coincidence criteria
  - ➔ 600 km, 24 h

	POAM III PRECISION	
	Northern Hemisphere	Southern Hemisphere
H2O	5% (15-45 km)	8% (15-45 km)

Validation with POAM III





Single collocation pair

mean profiles and dispersion

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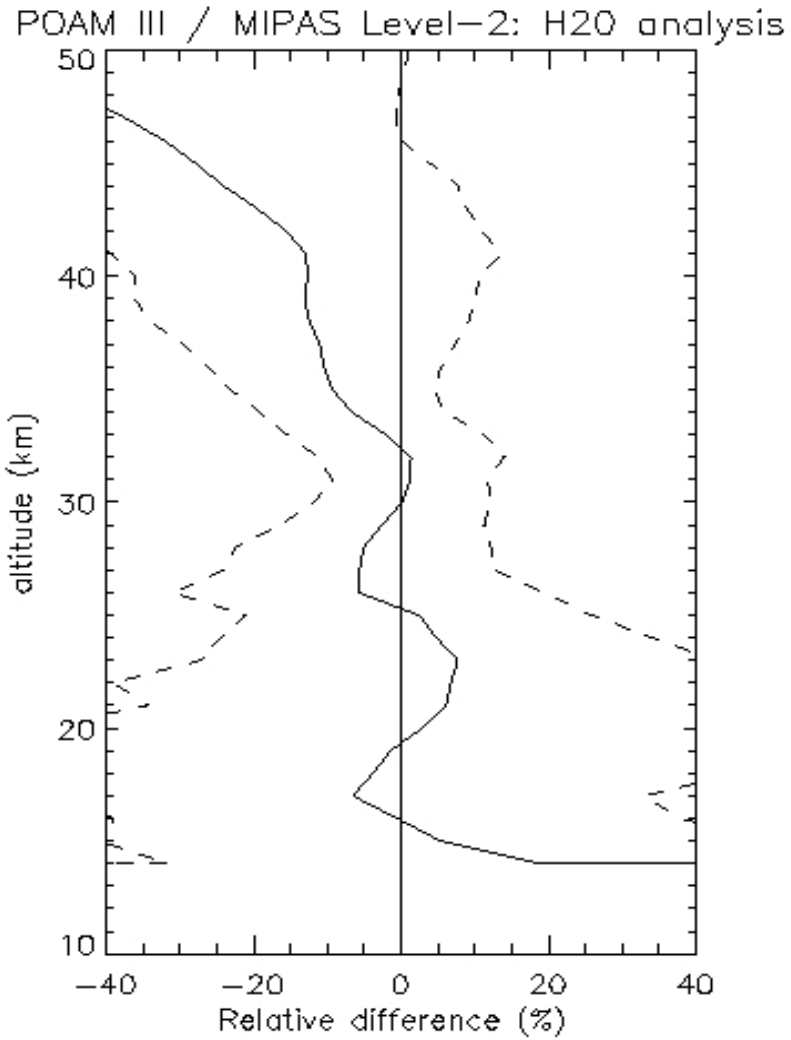
Validation with POAM III: statistics



Precision MIPAS:

- 20 km 30%
- 25-35 km 8%
- 40 km 30%

Bias:

- No bias between 15 and 35 km
- positive bias above 35 km

➔ Note: 5% accuracy for POAM III

relative difference: POAM-MIPAS

Bazureau and Goutail

Conclusion

- Between **100 hPa and 10 hPa** (15-30 km) **good agreement** between MIPAS and the three satellite instruments to within the combined error with a precison of 10% (POAM III) to 30% (HALOE)

- Above **30 km (10 hPa) positive bias up to 20%,** however, below 2 hPa strong oscillations in SAGE II profiles
  - ➔ Related to water vapour line saturation near 1650 cm^{-1}?

- In **lowermost stratosphere RMS scatter in differences increases** dramatically (above 100 hPa HALOE and POAM, above 50 hPa SAGE II)
  - ➔ Improvement by extending the bottom of retrieval grid down to 9 km?