

Validation of the Middle Atmospheric Water Vapour Radiometer MIAWARA

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MIAWARA: Middle Atmospheric Water Vapour Radiometer



Instrumentation

Measured H ₂ O line	22.235 GHz rotational transition
Radio-frequency (RF) range	21.735 – 22.735 GHz
Operational mode	Single sideband (SSB) 50 dB sideband suppression uncooled operation
RF amplification	2 HEMT amplifiers Noise figure: 1.49 / 2.2 dB, Gain: 35 dB each
T_{rec}	135 Kelvin
Antenna	Corrugated horn (HPBW 6°)
Broadband spectral analysis	Acousto-optical spectrometer (channels: 1725, f: 1.6–2.6 GHz, Δf_{FWHM} : 1.2 MHz)
Narrowband spectral analysis	Chirp transform spectrometer (channels: 4200, f: 390–430 MHz (f: 1480–1520 MHz) Δf_{FWHM} : 14 kHz)
H ₂ O profile retrieval	Altitude range: 22 - 80 kilometres

'Validation-Partners'

- Validation issue: H₂O 20-70 km
- Satellites: HALOE, POAM III, SAGE 2
- Other microwave instruments
- Stratospheric balloonsoundings

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- **Stratospheric balloonsoundings** → **LAUTLOS Campaign**

Validation during the LAUTLOS / WAVVAP Campaign

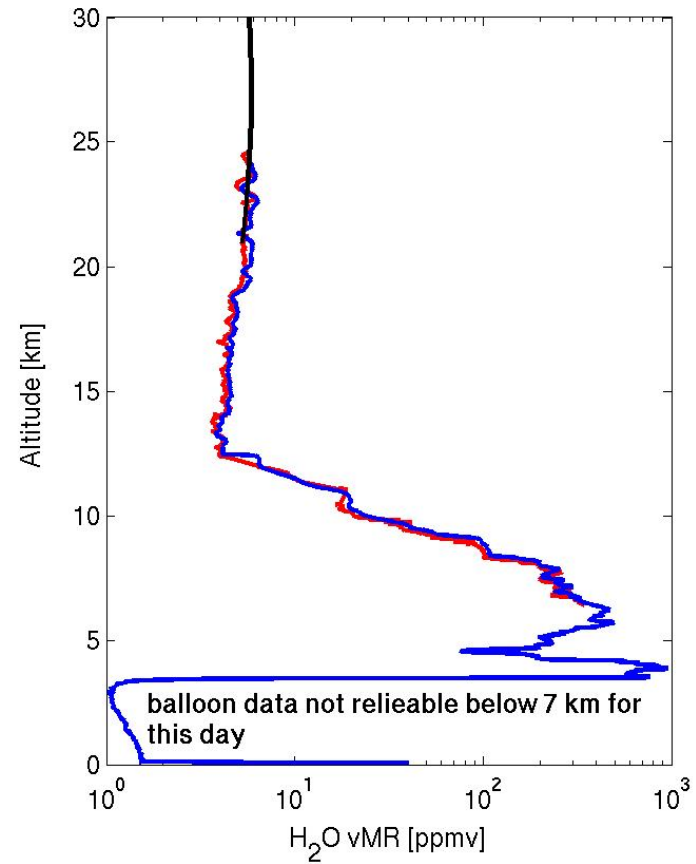
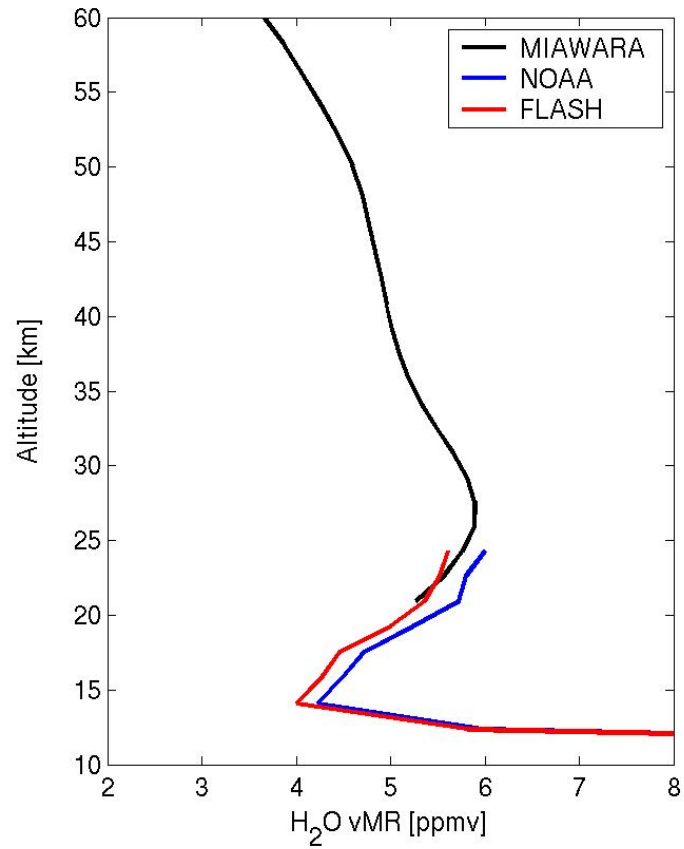


Lapbiat upper tropospheric lower stratospheric water vapour validation project

Validation during LAUTLOS

- Instruments: FLASH-B & NOAA/CMDL (Vaisala 80A/H/FN, 90 & 92 / MeteoLabor SnowWhite)
- Overlapping range of 0-6 km between microwave and balloons from 20 - 26 km
- Microwave profiles considered with less than 30% a priori contribution
- Reduction of balloon grid to microwave retrieval grid using Curtis-Godson
- Wet contamination of balloon data during ascent: only descent data useful
- Microwave profile: 24 hour integration

Comparison Example LAUTLOS: Feb-18-2004



Results LAUTLOS

- 10 launches with corresponding microwave data
- Mean relative difference good: NOAA: -2.84% FLASH: -3.37%

$$\Delta VMR[\%] = \frac{MIAWARA - xxx}{MIAWARA}$$

- Mean relative difference good without 'worst day' (Feb-25): NOAA: -0.67% FLASH: -1.43%. This day needs further investigation (distance MW - balloon descent, ...)

Satellite Validation

- Only very few 'real' coincidences
- Match criteria:
 - △ latitude $\pm 5^\circ$
 - △ longitude $\pm 20^\circ$

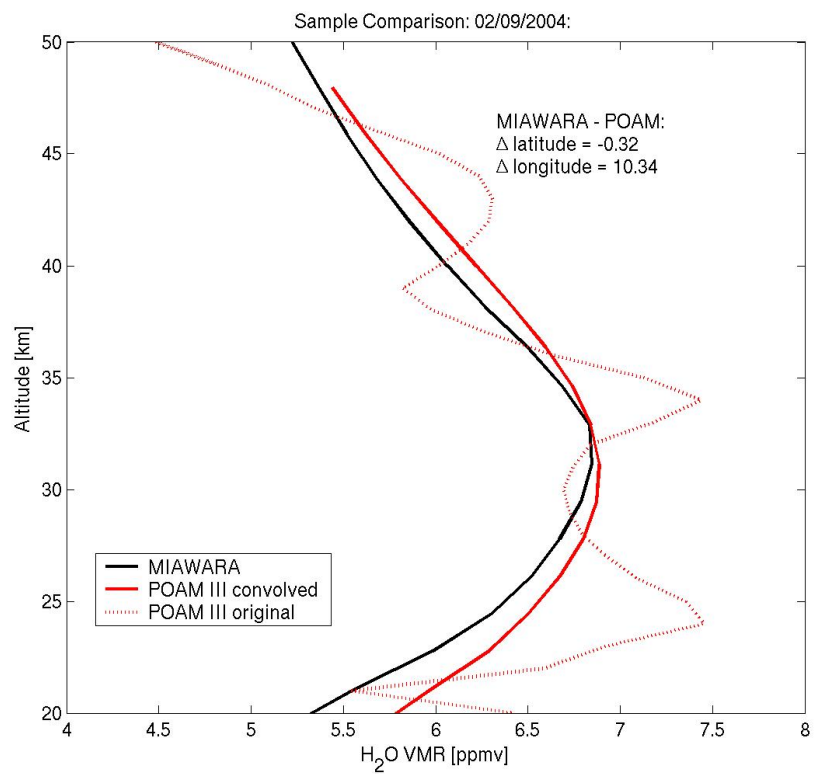
Northern Finland measurements: Polar Vortex?

HALOE: zonal monthly mean

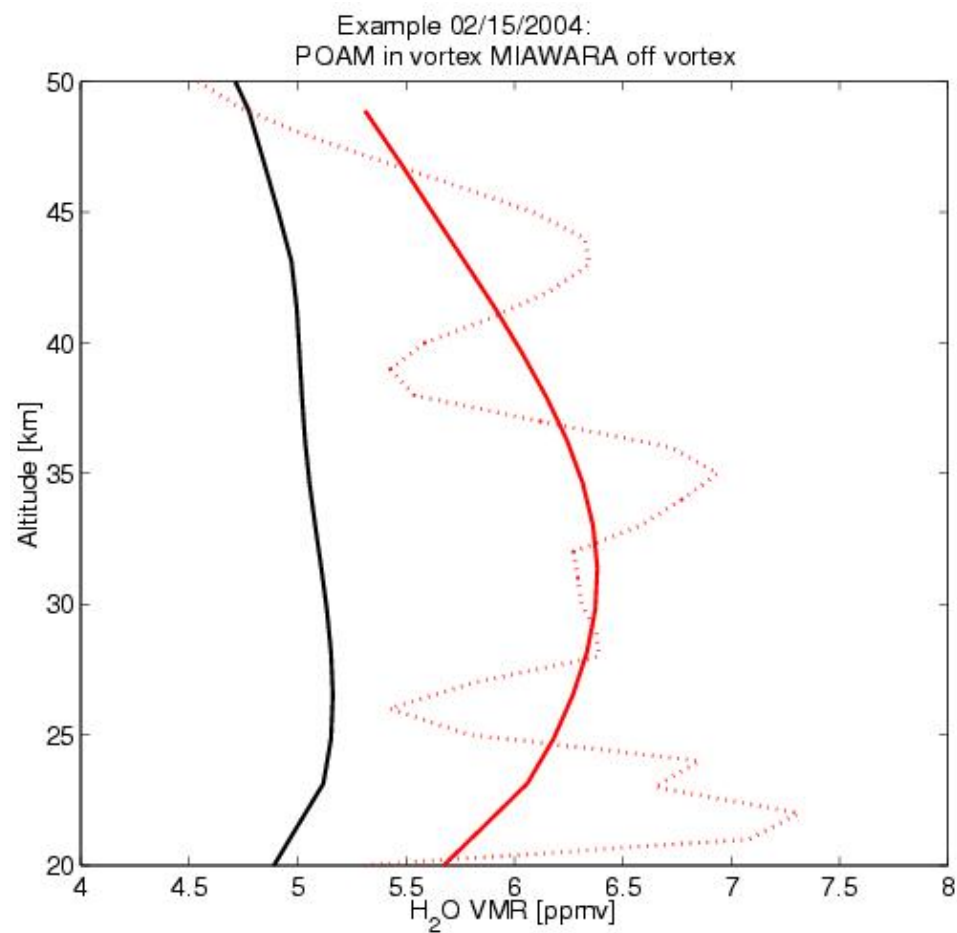
- Apriori contribution / averaging Kernel:

$$\hat{\mathbf{x}} = \mathbf{x}_{ap} + \mathbf{AK} (\mathbf{x} - \mathbf{x}_{ap})$$

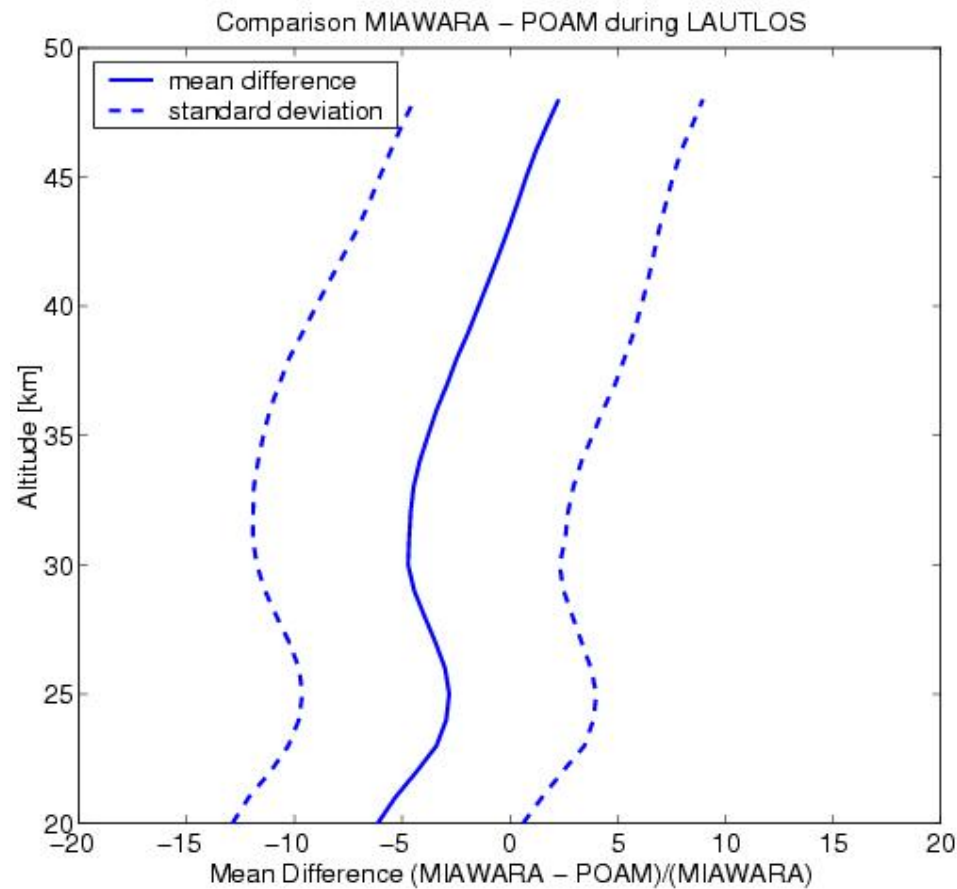
Example POAM III: equal vortex situation



Example POAM III: different Vortex situation



Results POAM III for all matching data during LAUTLOS



Conclusion

- Mean relative differences between MIAWARA and NOAA resp. FLASH are smaller than 3.5% - neglecting worst day mean differences are almost 0%.
- Mean relative difference between MIAWARA and POAM is -5%@20km and +2%@47km.
- MIAWARA seems to slightly underestimate the water vapour content but not significantly (1σ).

Points to discuss

- Satellites: match criteria?
(Δ latitude, Δ longitude, vortex, ...)
- Are zonal/monthly mean values suitable for validation?
- Convolution of profiles with averaging kernels? Consider AVK for both instruments?
- Reference instrument?

