

November 2006

Water, he said

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Experimental setup



Previous high resolution measurements

Experimental conditions:

Spectral range: 4200 – 6600 cm^{-1}

Absorption path: 30 cm to 1800 m

Pressure: 1.3 to 22.7 hPa H_2O + up to 340 hPa of dry air

Temperature: 293 K

Resolution: 0.015*, 0.010, 0.007 cm^{-1} (MOPD = 60*, 50, 74 cm)

*: Bruker definition

Parameters: positions, intensities, self- and air-broadenings,
air-shifts

Molecules: H_2^{16}O , H_2^{17}O , H_2^{18}O , HDO from natural abundance water

Fourier Transform measurements of water vapor line parameters
in the 4200-6600 cm^{-1} region

Alain Jenouvrier, Ludovic Daumont, Laurence Régalia-Jarlot,
Vladimir G. Tyuterev, Michel Carleer, Sophie Fally, Ann Carine Vandaele,
Semen Mikhailenko
JQSRT, in press

Current high resolution measurements

Experimental conditions (H₂O):

Spectral range: 5500 – 10000 cm⁻¹

Absorption path: 200 to 1000 m

Pressure: 8.6 and 18.0 hPa H₂O + up to 336 hPa of dry air

Temperature: ~ 293 K

Resolution: 0.015cm⁻¹ (Bruker definition, MOPD = 60 cm)

Experimental conditions (D₂O + HDO):

Spectral range: 5500 – 10000 cm⁻¹

Absorption path: 600 m

Pressure: 2.7 to 13.3 hPa of either “pure” D₂O or a 50%-50% mixture of H₂O + D₂O + up to 300 hPa of dry air

Temperature: ~ 293 K

Resolution: 0.015cm⁻¹ (Bruker definition, MOPD = 60 cm)

Just been recorded, must now be measured and analyzed

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Current low resolution measurements

Experimental conditions:

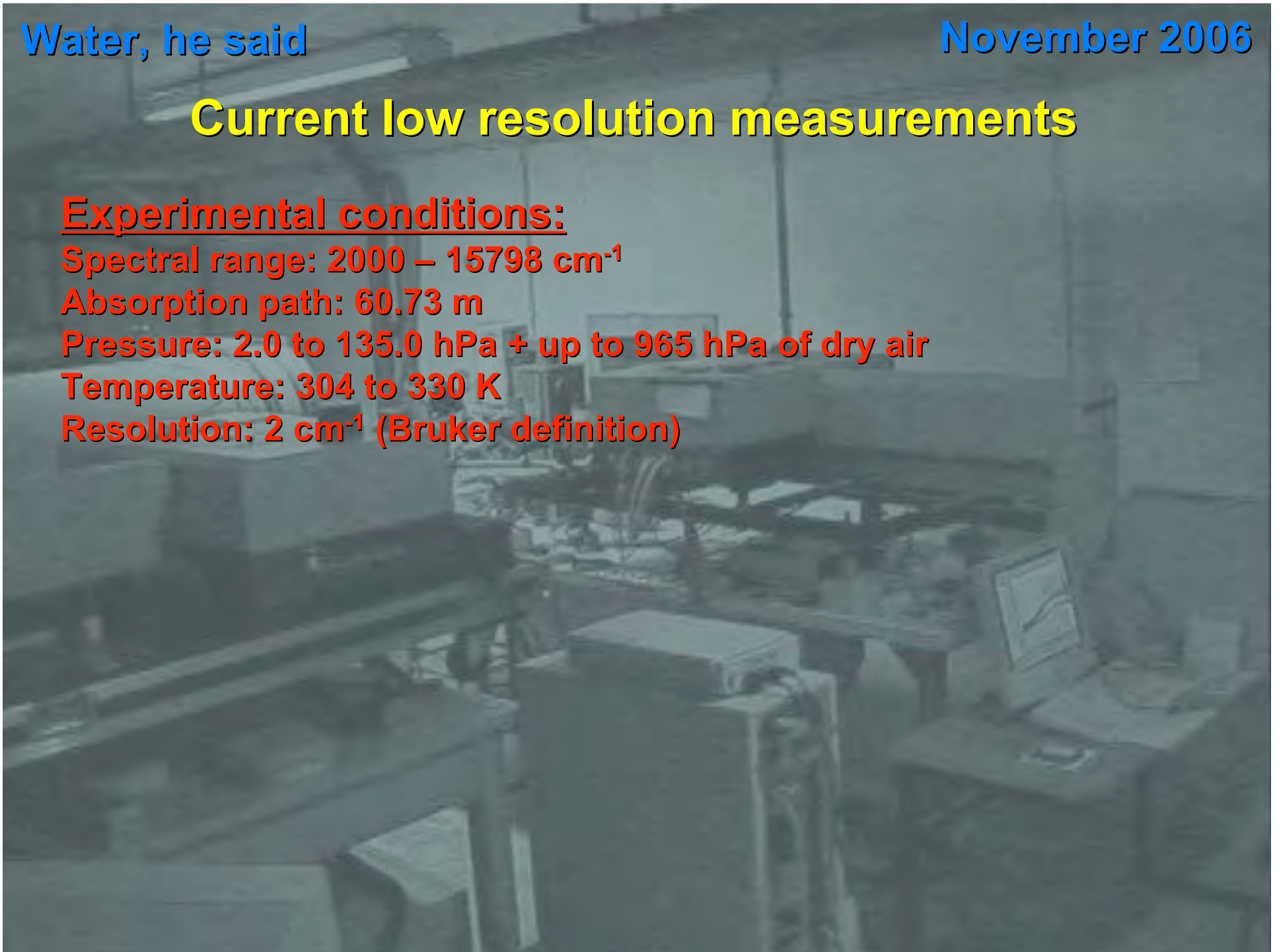
Spectral range: 2000 – 15798 cm^{-1}

Absorption path: 60.73 m

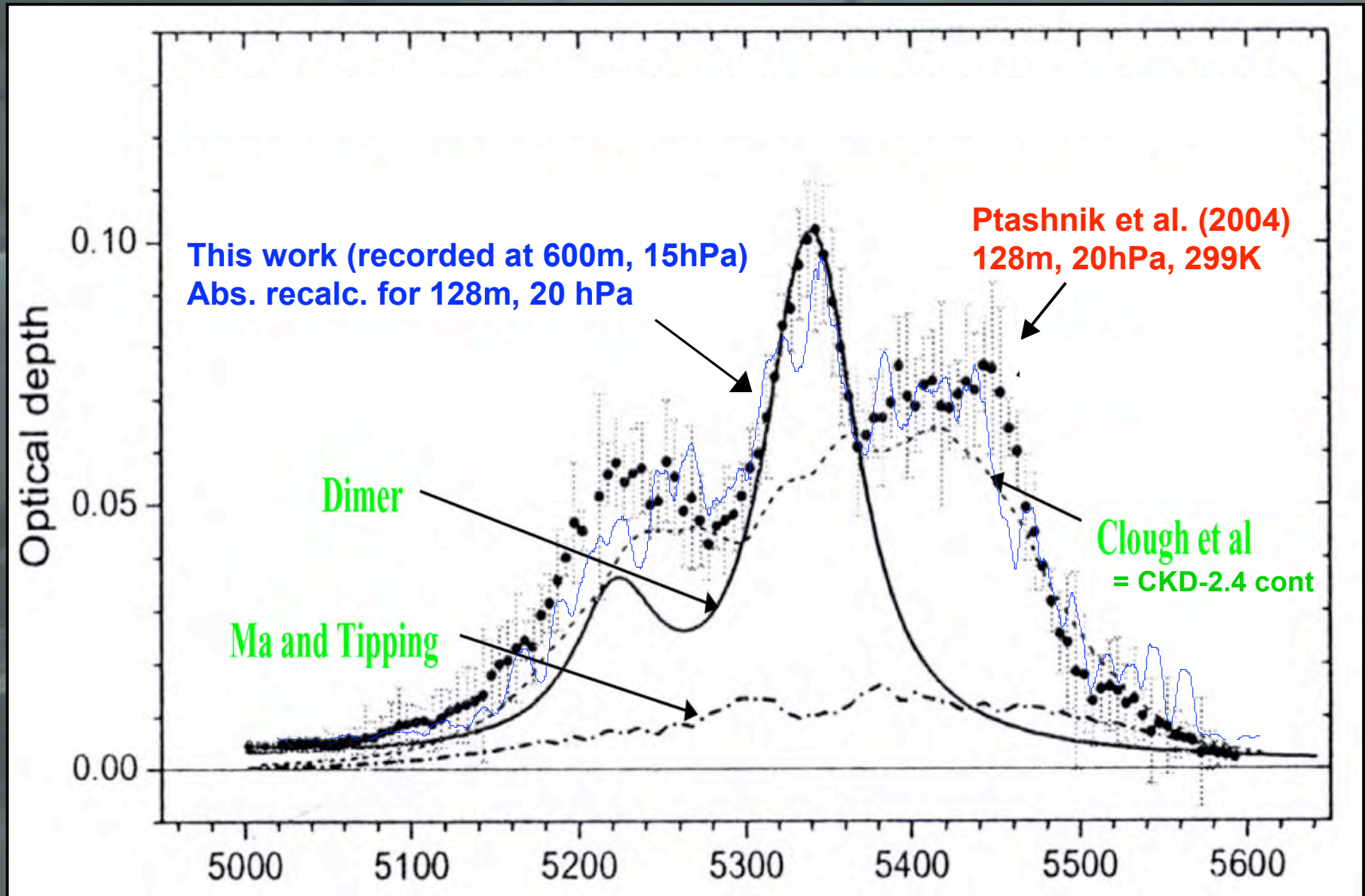
Pressure: 2.0 to 135.0 hPa + up to 965 hPa of dry air

Temperature: 304 to 330 K

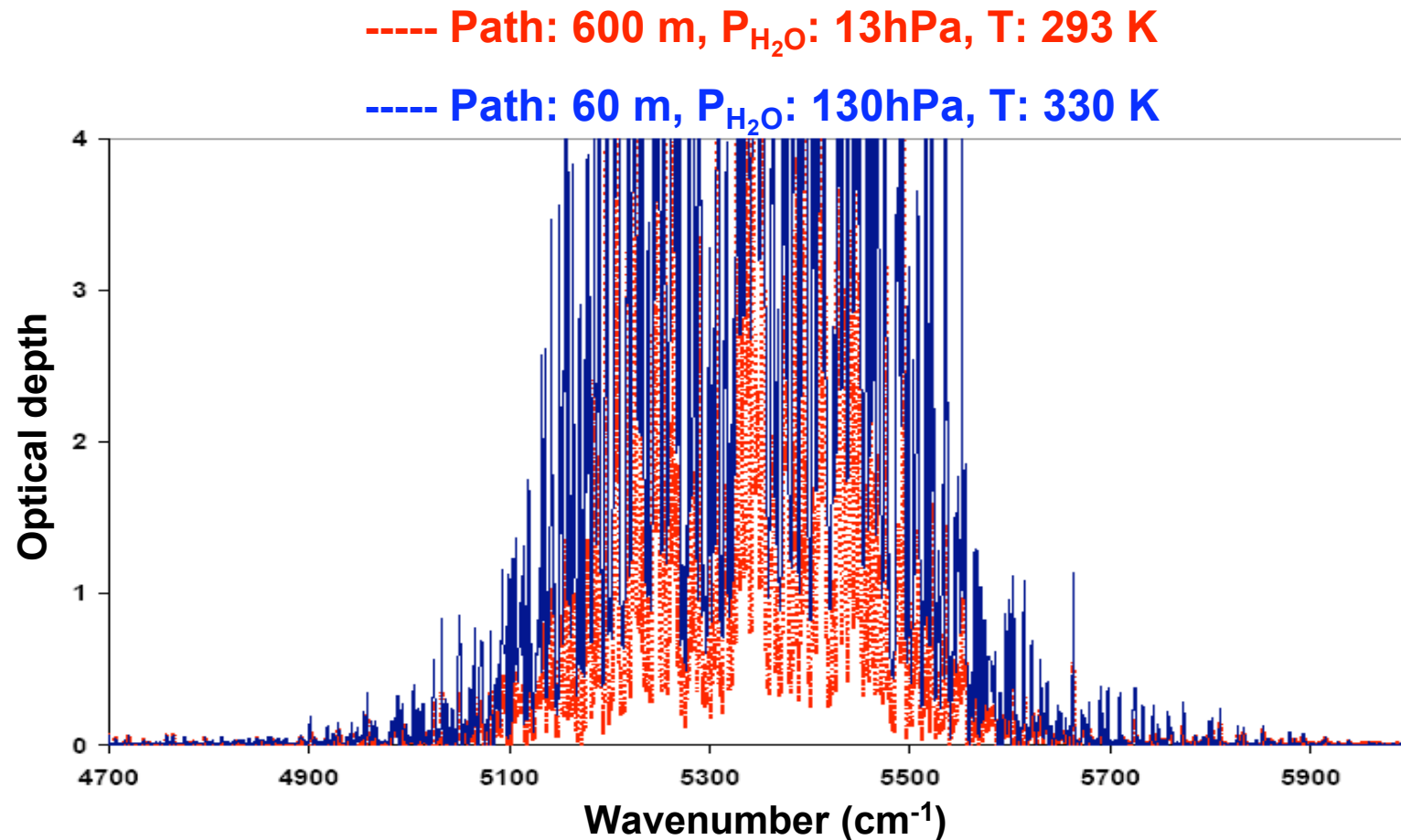
Resolution: 2 cm^{-1} (Bruker definition)



Previous continuum measurements



Comparing low and high pressure spectra with the same $P \cdot L$ value



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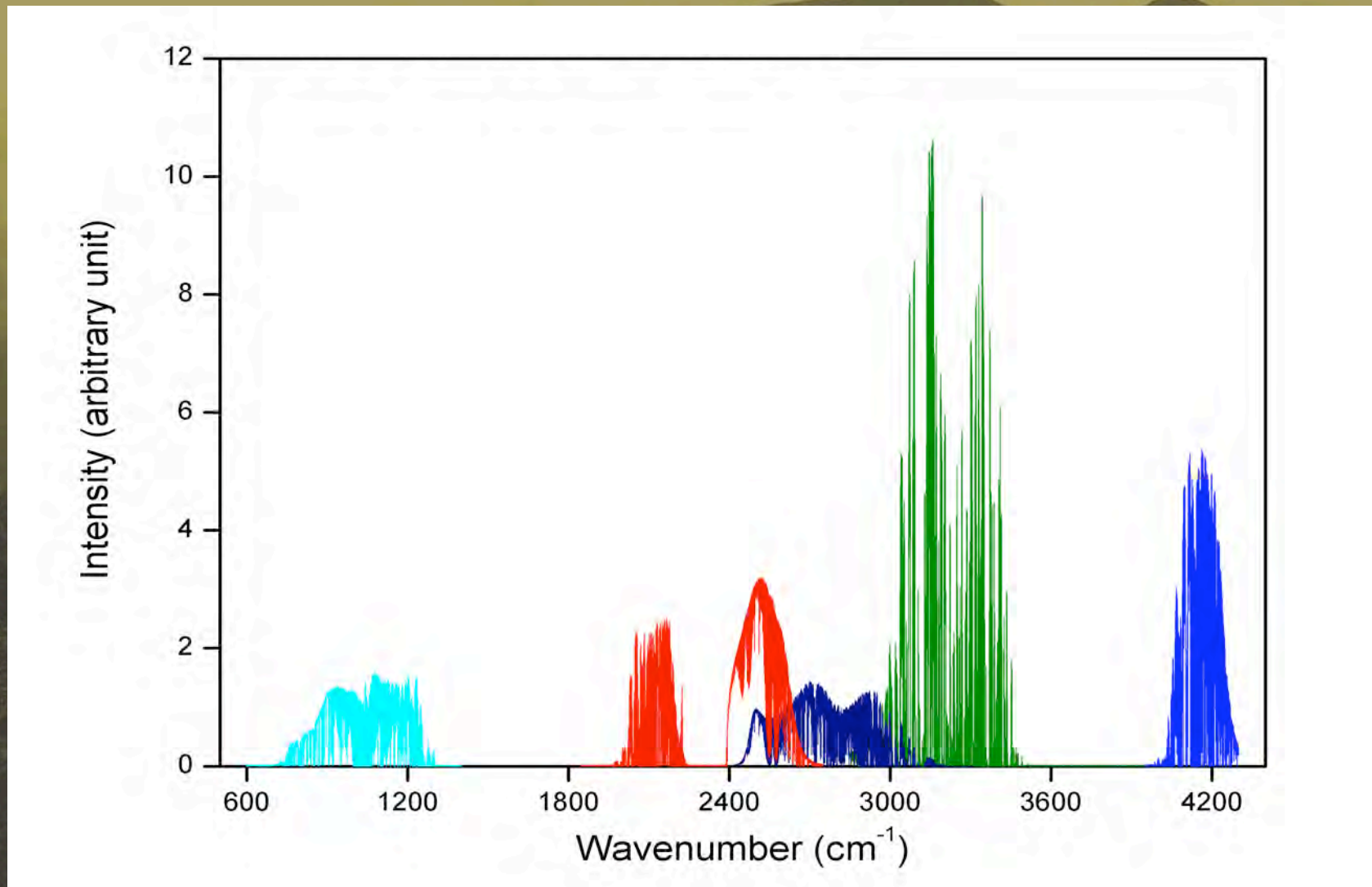
Ground based measurements at Réunion Island



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Ground based measurements at Reunion Island



NDACC spectral regions

Ground based measurements at Réunion Island

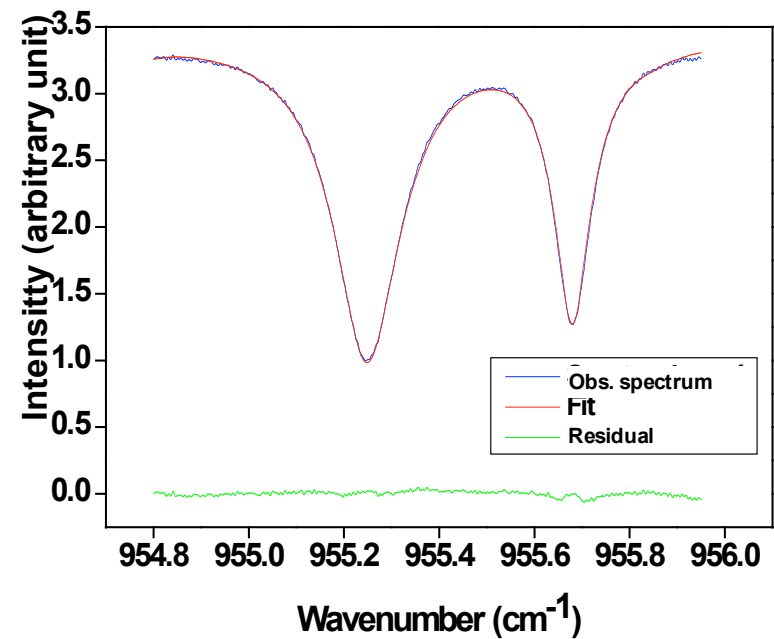
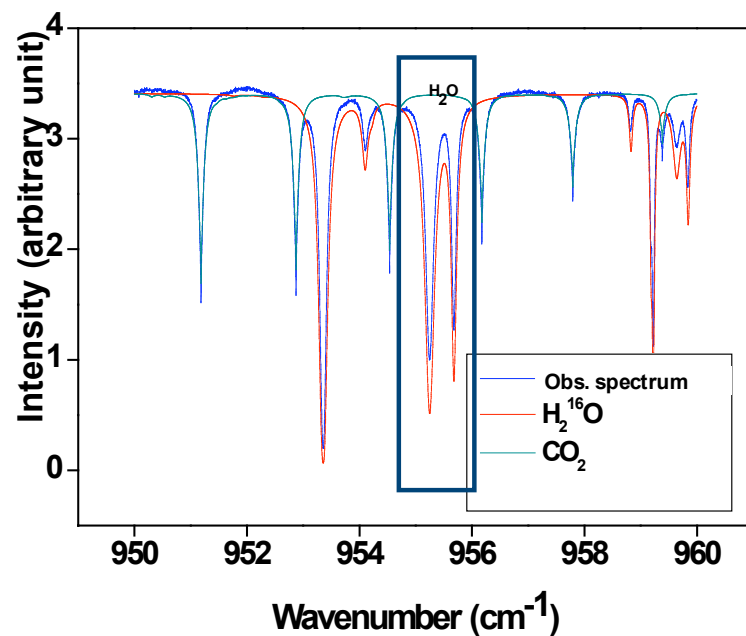
Isotopologue	Microwindow (cm ⁻¹)	Interference
H ₂ ¹⁶ O	841.3 - 842.5	H ₂ ¹⁸ O
→ H ₂ ¹⁶ O	954.8 - 955.95	-----
H ₂ ¹⁷ O	1168.6 - 1171.8	O ₃ , CH ₄
H ₂ ¹⁶ O, H ₂ ¹⁷ O, H ₂ ¹⁸ O	3171.04 - 3172.52	O ₃
→ H ₂ ¹⁷ O	1171.8 - 1172.3	O ₃ , N ₂ O
→ H ₂ ¹⁸ O	4090.65 - 4090.96	H ₂ ¹⁶ O
H ₂ ¹⁸ O, H ₂ ¹⁶ O	3164.77 - 3165.93	CH ₄
HDO	2658.65 - 2659.97	CH ₄
HDO	2712.45 - 2713.49	CH ₄
→ HDO	2687.96 - 2690.67	CH ₄
HDO	2705.64 - 2706.52	O ₃ , CH ₄
→ HDO	2709.15 - 2709.78	O ₃ , CH ₄

Microwindows selected for optimal estimation method inversion by Atmosphit

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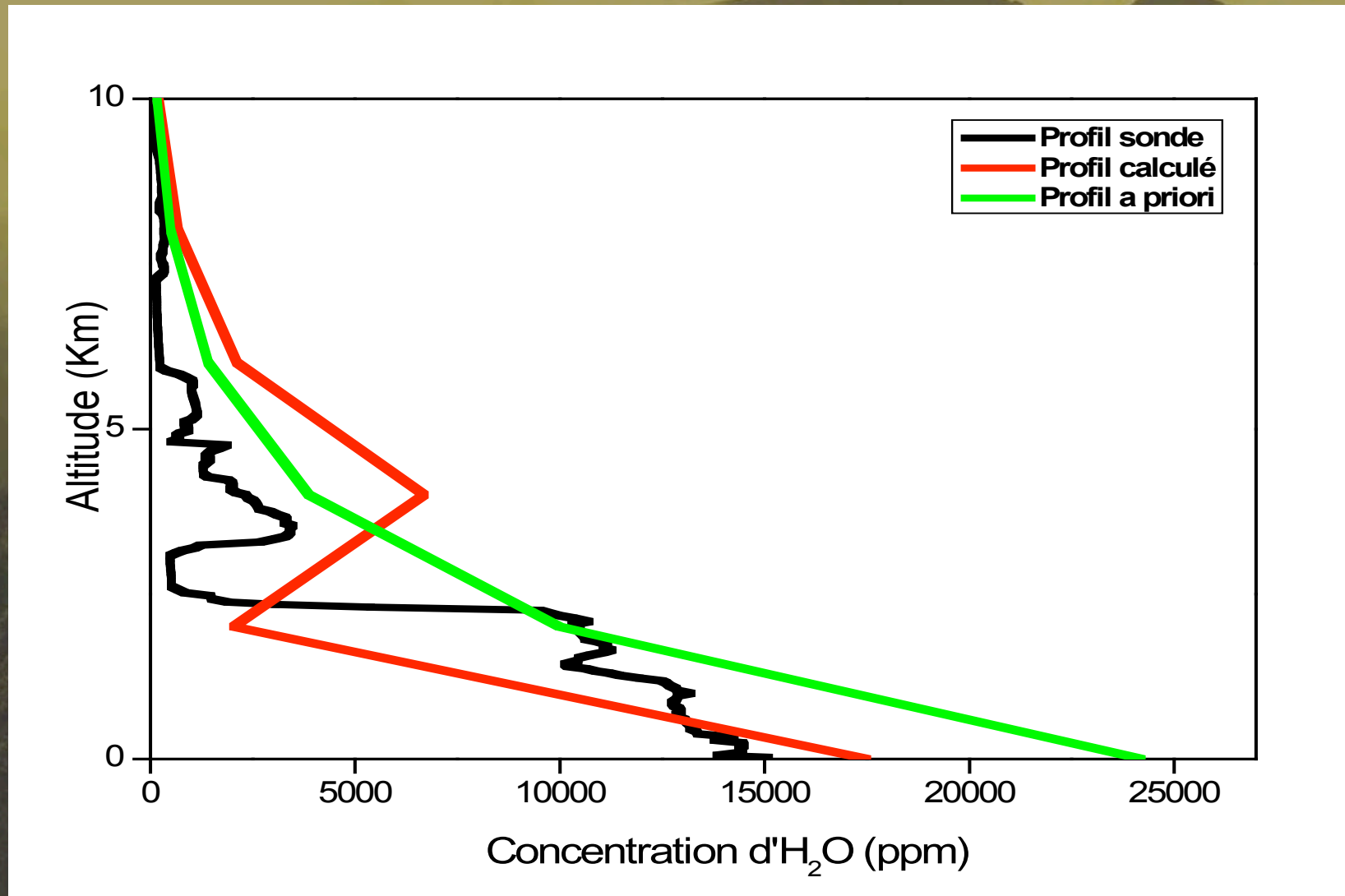
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Ground based measurements at Réunion Island



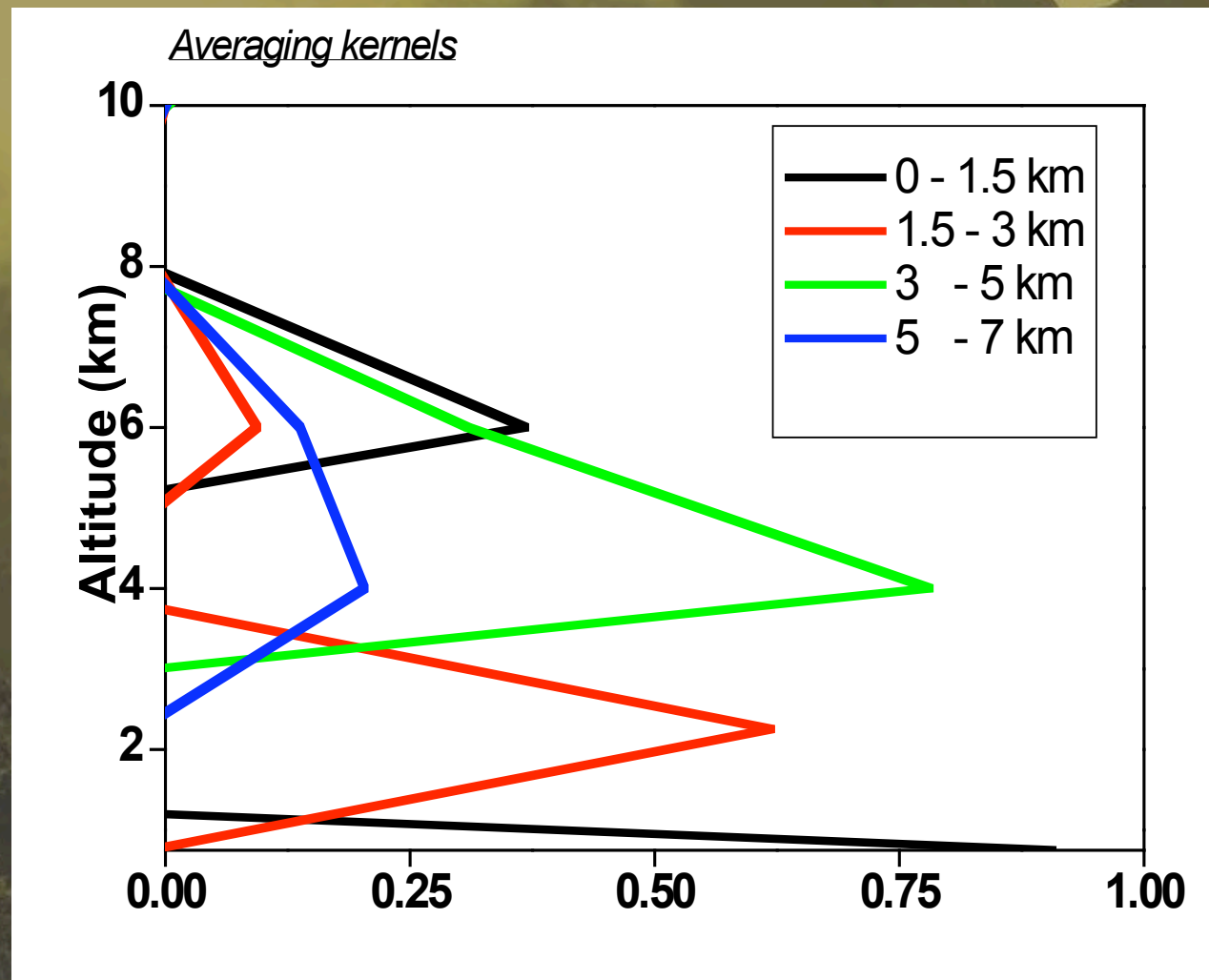
H_2^{16}O

Ground based measurements at Réunion Island



H₂¹⁶O

Ground based measurements at Réunion Island

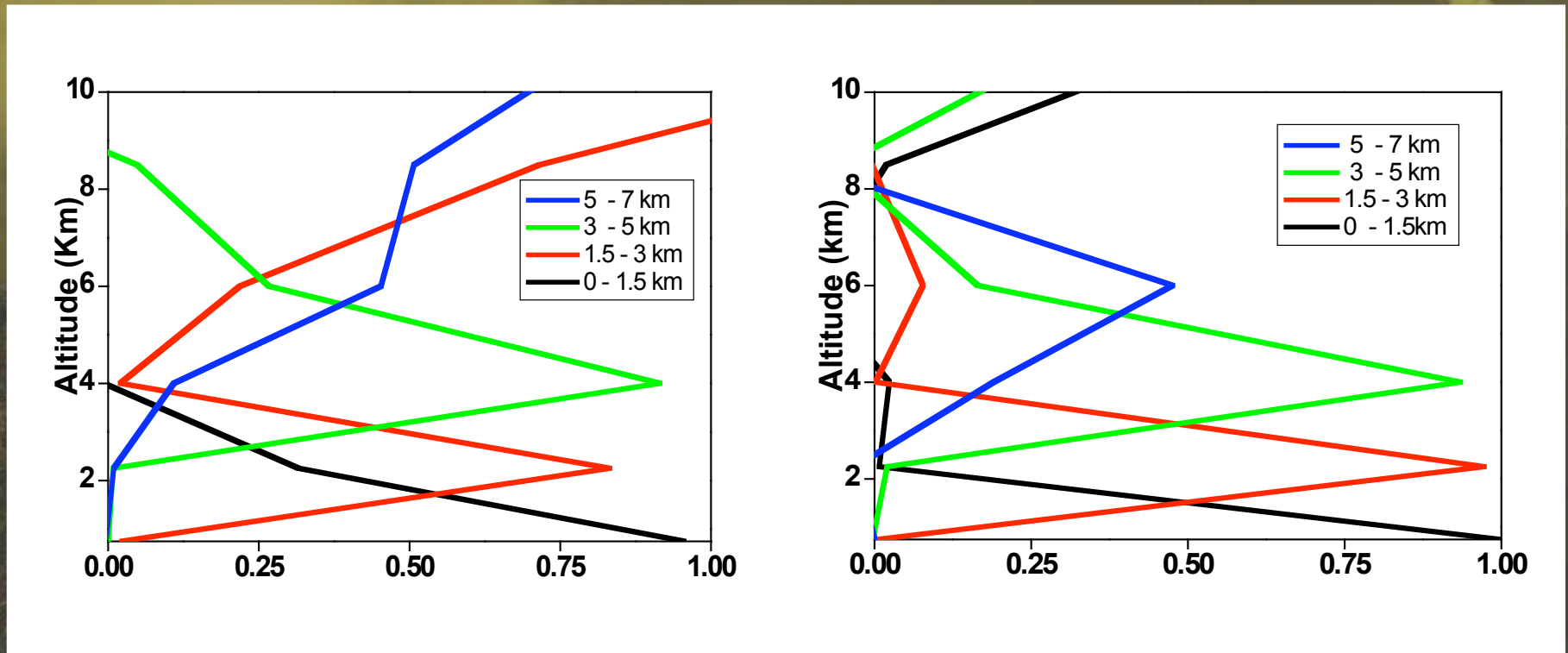


$H_2^{16}O$

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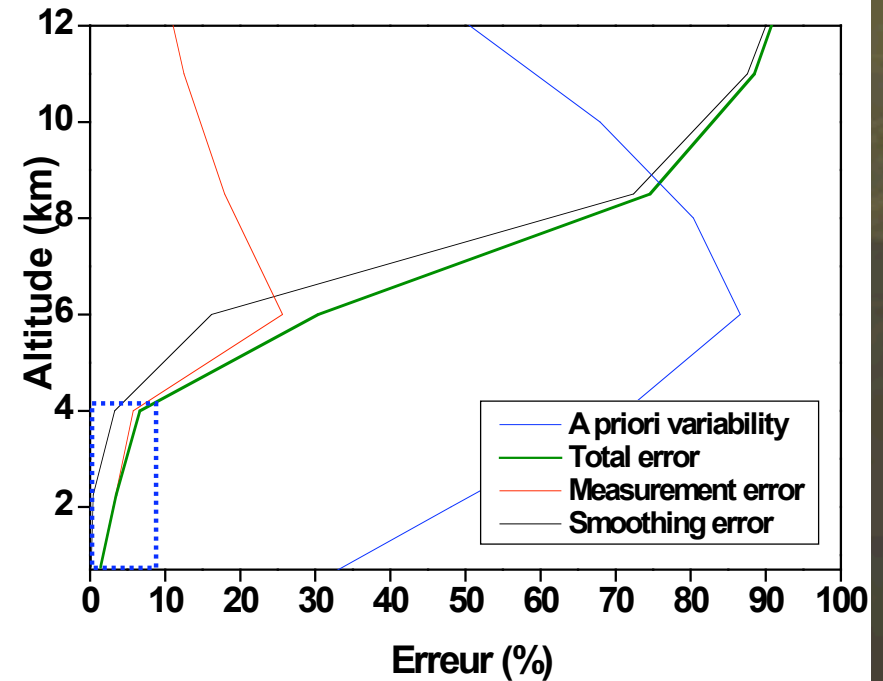
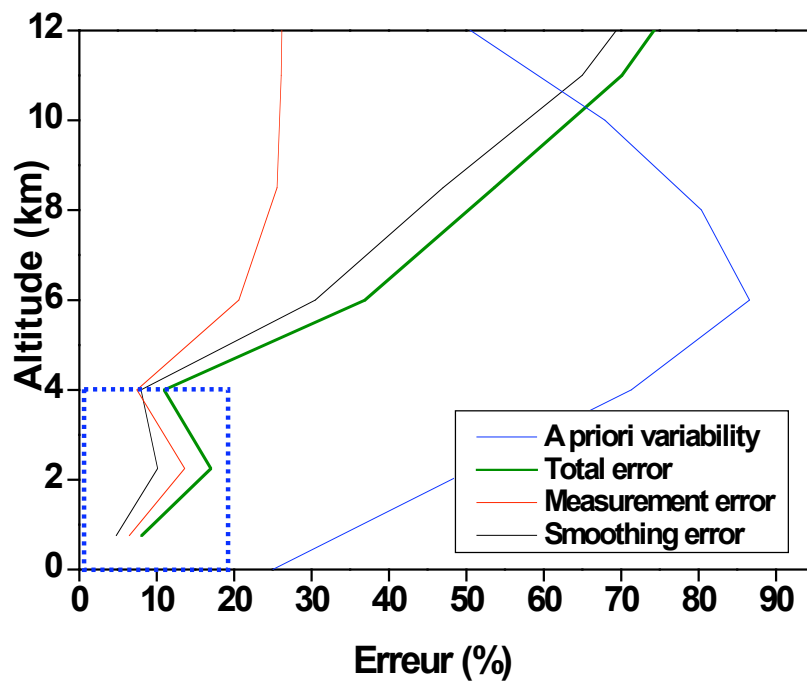


HDO

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HDO

Ground based measurements at Réunion Island

- We could retrieve vertical profiles for H_2^{16}O , H_2^{18}O and HDO. The inversion procedure for H_2^{17}O however diverges wildly, we still don't understand why.
- Even though the vertical resolution is quite low, the inversion definitively shows the second maximum at around 4 km.
- Using 2 properly chosen lines improves both the vertical resolution, the sensitivity and the maximum altitude. Unfortunately, using 3 or 4 lines decreases all that. Reason? Probably because of inconsistencies in the line parameters which were measured in the lab by different scientists.
- Can only retrieve profiles up to 5 or 9 km. But the spectra were recorded at sea level. What about spectra recorded at 2 or 3 km asl? Like spectra recorded at the Maïdo or the Jungfrauoch?
- We still have quite some work to do to find the proper microwindows to enhance the results. This is what we are doing now, both for sea level and high altitude recorded spectra.

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