



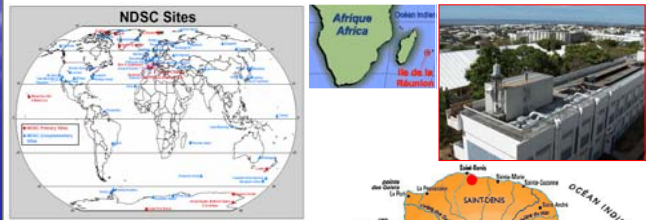
Water vapour retrievals from ground-based FTIR observations at Ile de la Réunion: Focus on isotopologues

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1. THE CAMPAIGNS

- Ground-based solar absorption Fourier transform infrared (FTIR) spectroscopic observations
- Sub-tropical complementary NDACC station (21°S, 55°E)
- 2 campaigns = preparation for long-term monitoring of the atmospheric composition by FTIR remote sensing
- 1) Oct. 2002: **St-Denis (Alt 50 m)** & **Maido summit (Alt 2203 m)**
- 2) Aug-Oct. 2004: **St-Denis (Alt 50 m)**

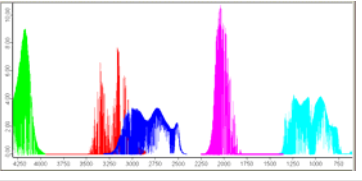


BARCOS Bruker Automation & Remote Control System [1]:

Composed of a solar tracker, a meteorological station, a data logger, a software (developed in LabView) for housekeeping, suntracker commanding and interaction with the FTS, a scripting language → scripts automatically executed daily at a predefined time or zenith angle.

Example of spectra:

- Many target species: HF, HCl, CO, HNO₃, N₂O, CH₄, O₃, C₂H₆, HCN
- See Poster AS.0-XY0024 by C. Senten
- 600-4300 cm⁻¹ with NDACC optical bandpass filters
- MOPD=80 → 250 cm



REFERENCES

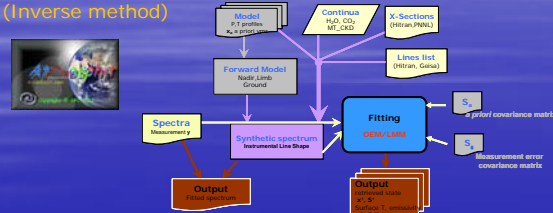
- Neefs et al., poster, OSA, Quebec, Ca, 2003
- Coheur et al., JGR110(D24303), 2005
- Barret et al., JGR119(4), 2005
- Hurtmans et al., Poster, ASSIS Atmospheric Science from Space using Fourier Transform Spectrometry, Quebec, Ca, 2005
- <http://home.scarlet.be/dhurmtna/> & dhurmtna.ulb.ac.be
- Rodgers, Inverse methods for atmospheric sounding: Theory & Practice, World Sci, Hackensack, 2000
- Thompson et al., JGR108(D2), 8238 & 8241, 2003 (<http://cro.cpc.nasa.gov/shadow/>)
- Meier et al., Spectroscopic atlas of atmospheric microwindows in the middle infrared, IRF technical report, 2004
- Schneider et al., ADP(5), 9493-9545, 2005
- Kuang GRL30(1372), 25-1-4, 2003
- Notholt et al., JGR119(11), 112-125, 2005 <http://www.lup.physik.uni-bremen.de/ftir/afip>

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2. THE RETRIEVAL METHOD

- Atmosfit software developed at ULB [2, 3, 4, 5] is used
- Based on a line-by-line radiative transfer model
- Use of the Optimal Estimation Method OEM [6] (inverse method)

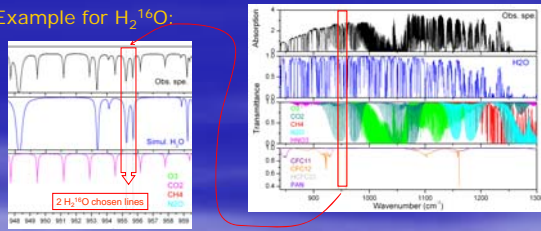


A-priori : 1 year average of ECMWF values for [+23°, -23°] latitudinal range + balloon soundings for P & T [7]

3. THE TARGET MOLECULES: H₂¹⁶O H₂¹⁷O H₂¹⁸O HDO

Micro-windows choice: based on spectroscopic Atlas [8], on literature [9, 10, 11], on simulations with the "linefinder" software [12], on spectrum characteristics: no saturation, stable baseline, high S/N, few interfering gases.

Example for H₂¹⁶O:



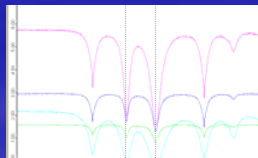
4. EXPLORATORY & CHALLENGING RESEARCH

Many retrieval tests done: With & without a-priori covariance matrix Sa, user ILS based on a HBr cell measurement instead of theoretical ILS based on MOPD and FOV; different windows & pwindows couplings; different distributions of retrieved layers (thickness & number of the layers).

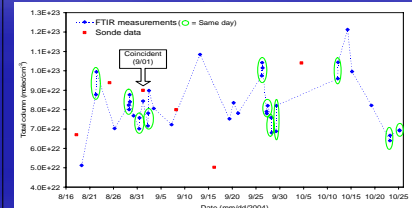
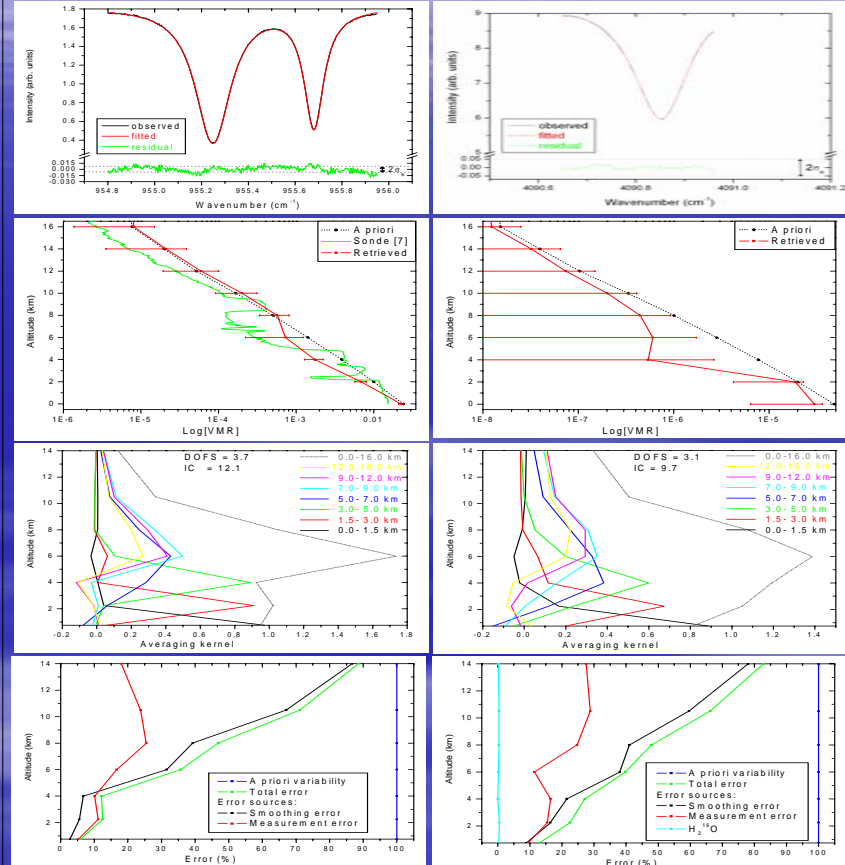
Difficult task of choosing the best lines due to:

Temporal (seasonal, daily, hourly) & spatial (vertical) variability of H₂O concentrations, and therefore of line intensities; very large spectral region to investigate: 4 isotopic species.

Example for H₂¹⁶O: from weak (Maido summit & low SZA) to saturated (St-Denis & high SZA)



5. SOME RESULTS



6. CONCLUSIONS & OUTLOOK

- First analysis of H₂O isotopologues from FTIR spectra at Réunion Island.
- Successful retrievals of vertical profiles for H₂¹⁶O, H₂¹⁸O, HDO between 0 & 8 km with 3 to 4 levels of information.
- Full dataset analysis, including isotopic ratios & temporal trends to be pursued.
- Characterizations to be refined.