

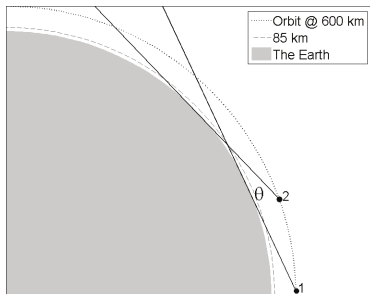
First tomographic inversions based on ARTS

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Tomographic Inversions

- ARTS 2.0 handles 2D- and 3D-atmospheres.
- Use information along the propagation path.
- ARTS can generate Jacobians (analytical and numerical).
- Atmlab support functions.

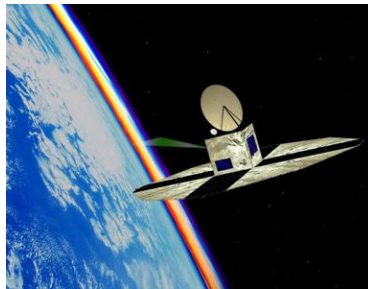


PMC formation

- PMC forms in the summer mesopause at high latitudes (76-85 km)
- Two important parameters for PMC formation is the background water vapour and temperature
- Sublimation and deposition of water
- Simultaneous coverage with high horizontal and vertical resolution

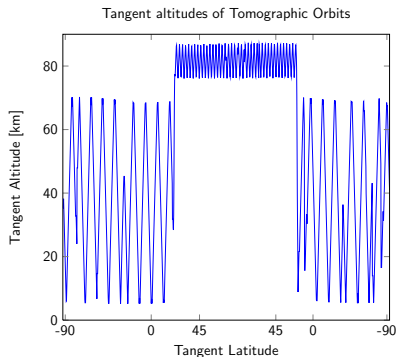


- Launched 2001
- OSIRIS, limb scattering
 - Measures PMC Clouds and Temperature
- SMR, Submillimeter radiometer
 - Measures Temperature and Water vapour using the strong 557 GHz H₂O line

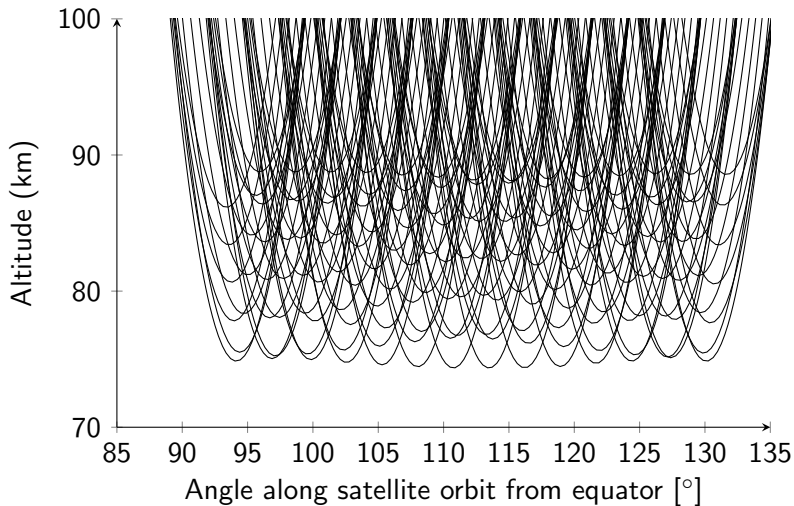


Tomographic Scans

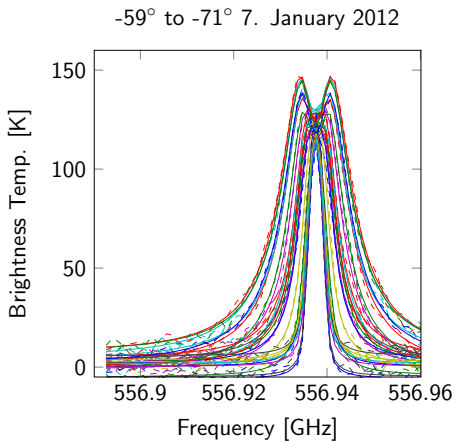
- Performed 3 consecutive days in June, July, Aug in 2010 and 2011
- Tangent altitudes 75-90 km (compared to 7-110 km for standard)



Tomographic Scans

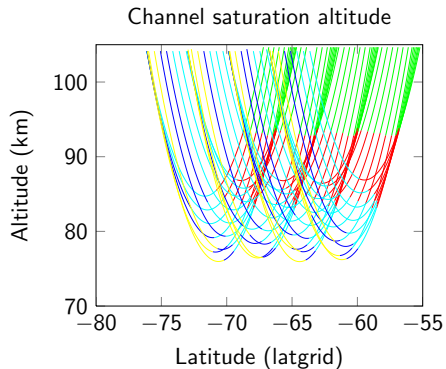
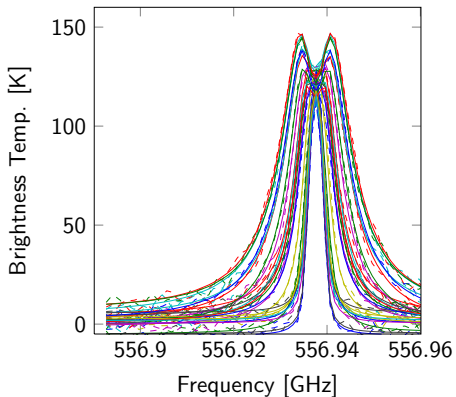


Tomographic Scans



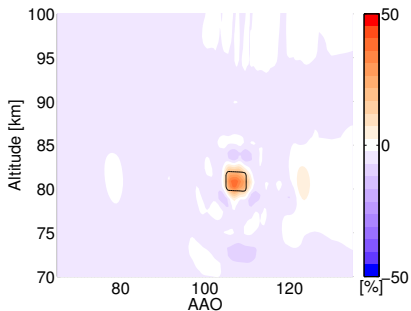
Tomographic Scans

-59° to -71° 7. January 2012



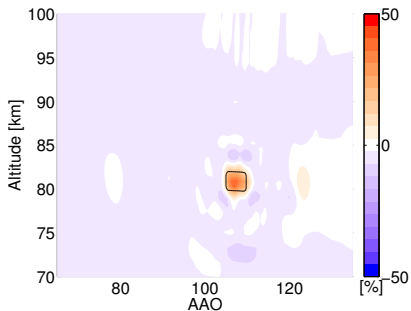
- Accompanying package Atmlab provides interface to do retrievals (OEM)
- 2D-Atmosphere Along orbit, Latgrid = Angle along orbit
- Resolution of forward model grid ($100\text{m} \times 0.25^\circ$ ($\sim 25\text{km}$))
- Resolution of retrieval grid ($1\text{km} \times 0.5^\circ$ ($\sim 50\text{km}$))
- Apriori atmosphere from MSIS90 (T,p,z) and MLS (H_2O).
- Apriori covariance must be specified in two dimensions (Latitude = $4/20^\circ$, Altitude = $2/6$ km)
- Levenberg-Marquard non-linear retrievals

Perturbation of 50% more H₂O

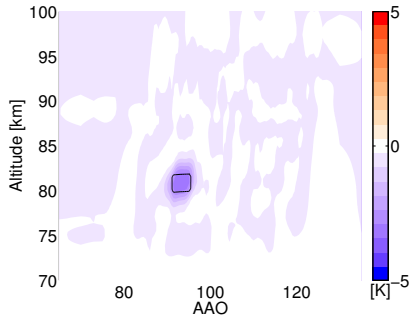


Simulation

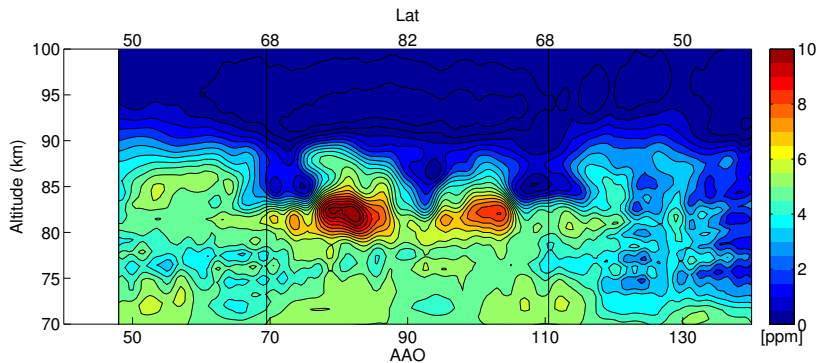
Perturbation of 50% more H₂O



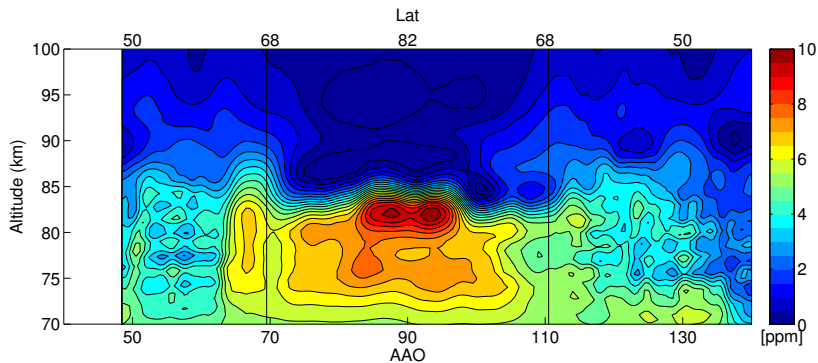
Perturbation of -5 K



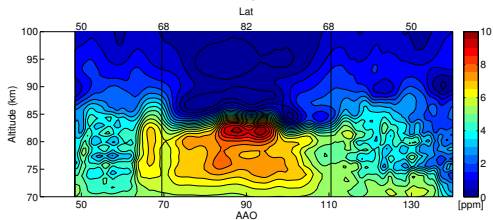
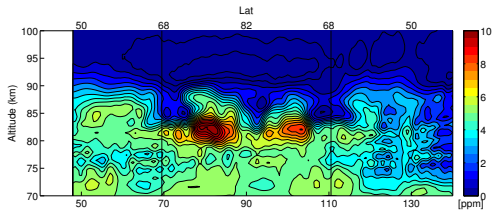
Water vapour July 15 2010



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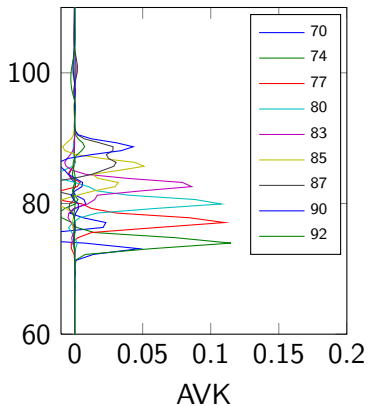


Water vapour July 15 2010

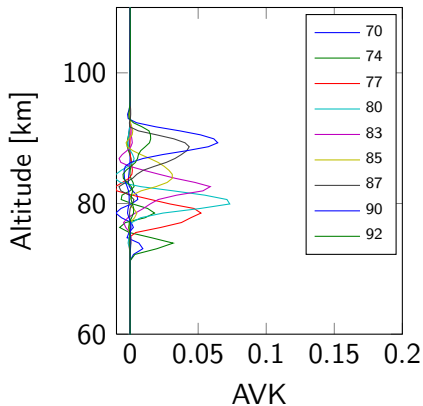


Vertical Resolution

Vertical AVKs H₂O

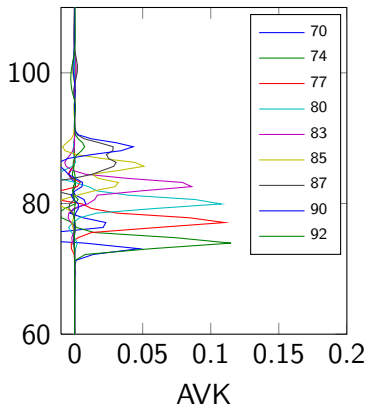


Vertical AVKs T

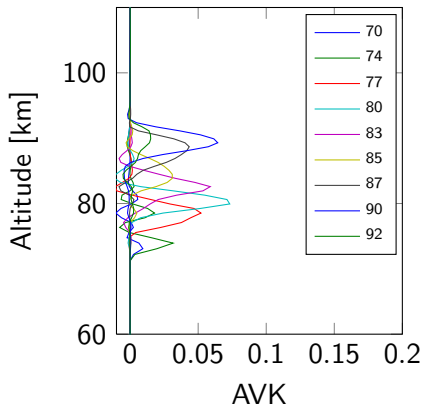


Vertical Resolution

Vertical AVKs H₂O



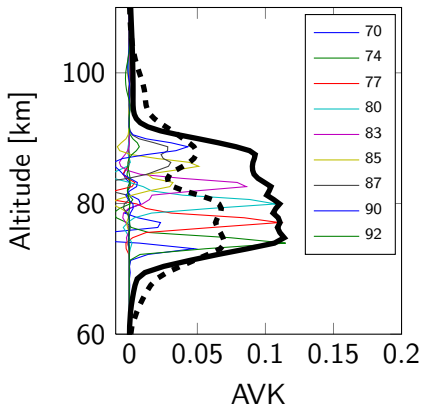
Vertical AVKs T



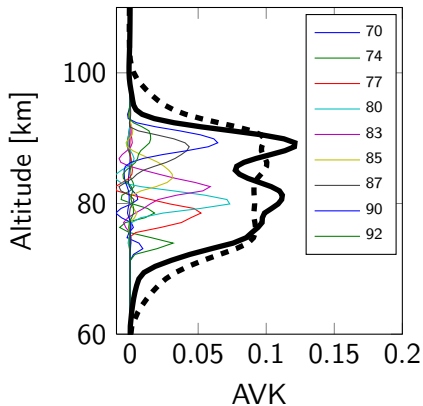
Vertical resolution: 1-2 km for H₂O , 2-4 km for Temperature

Measurement Response

Vertical AVKs H₂O

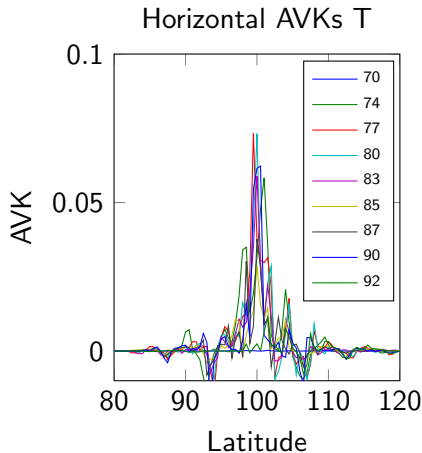
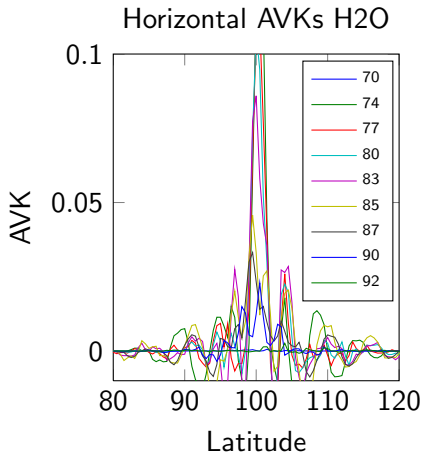


Vertical AVKs T

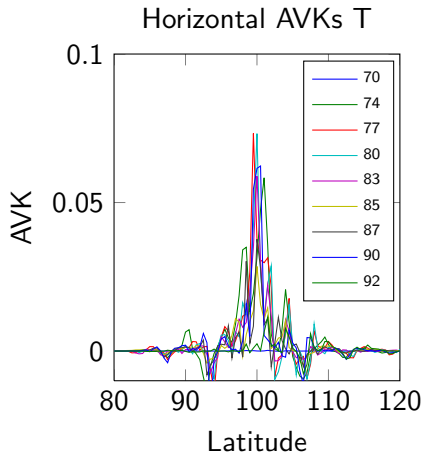
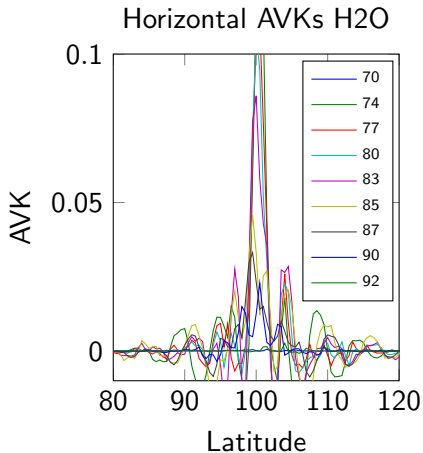


Vertical resolution: 2-3 km for H₂O , 4 km for Temperature

Horizontal Resolution



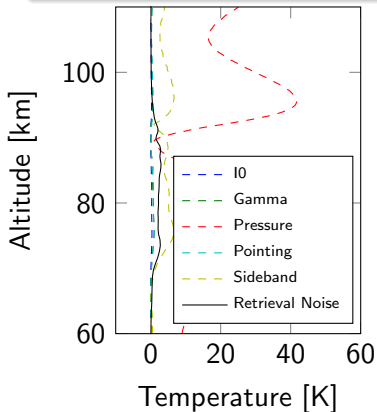
Horizontal Resolution



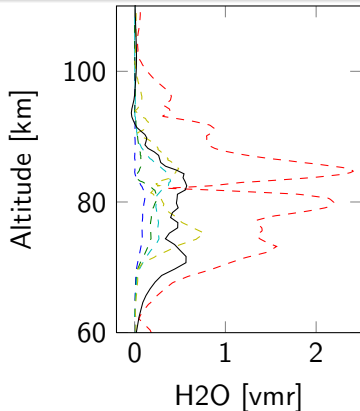
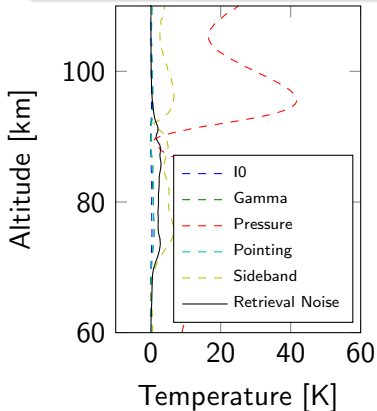
Horizontal resolution: 2 degrees for H₂O,
4 degrees for Temperature

Linearized errors around the mean retrieved state.

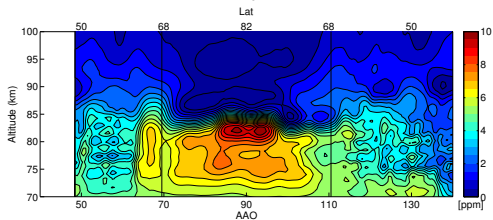
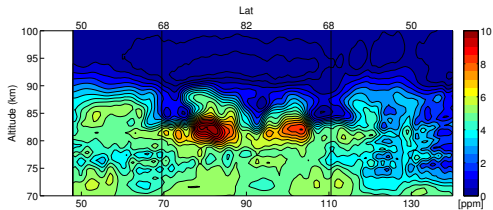
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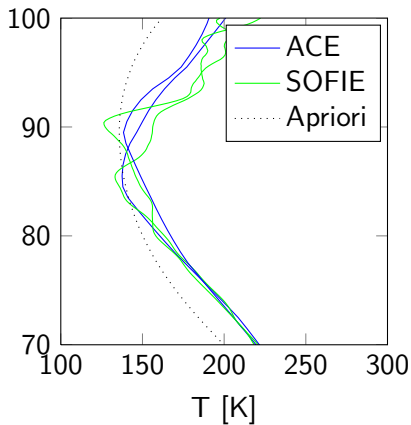
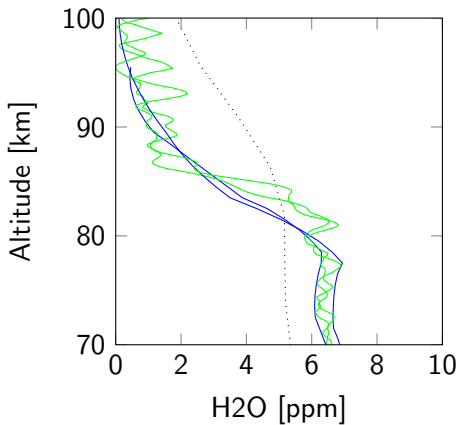
Linearized errors around the mean retrieved state.



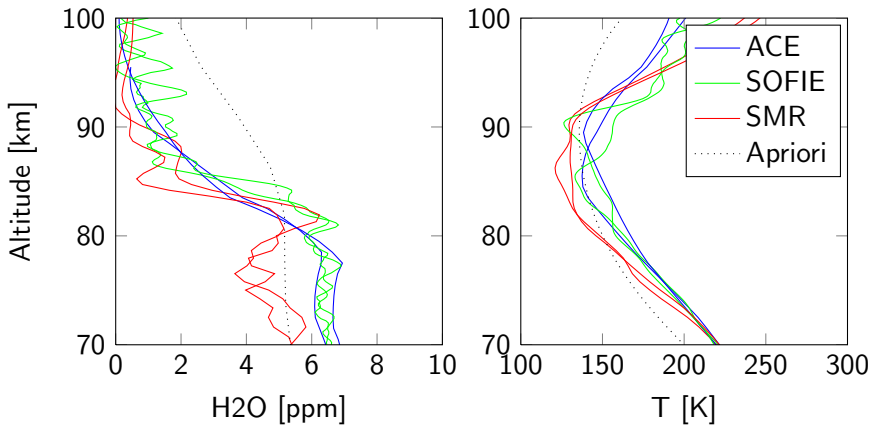
Comparison to ACE-FTS / SOFIE



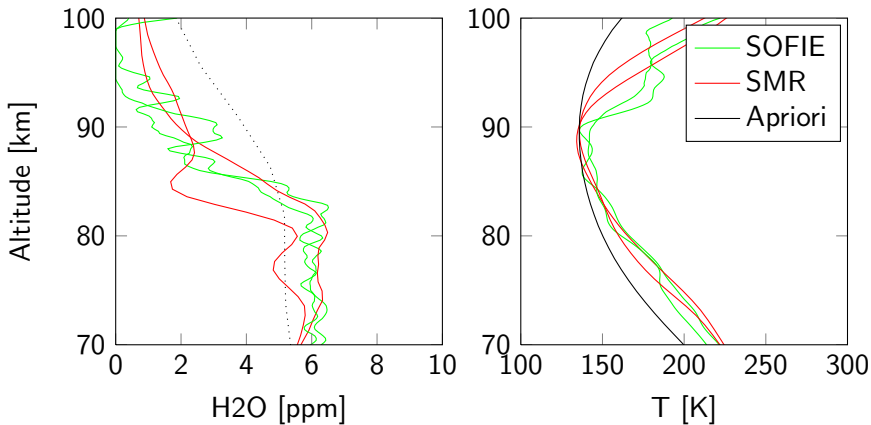
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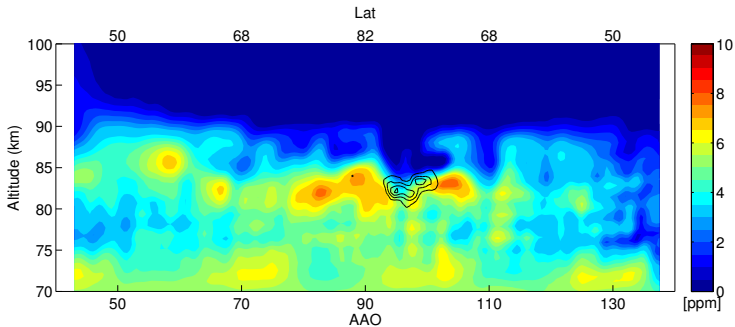
Comparison to ACE-FTS / SOFIE



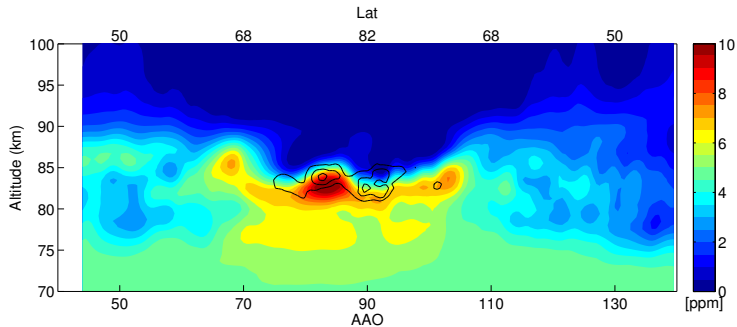
Comparison to ACE-FTS / SOFIE



Results orbit 17 June 2010



Results 17. July 2011



Summary

- Used ARTS-2/Atmlab for tomographic retrievals
- Linearized error analysis
- Compared to other instruments

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Combining instruments can reveal interesting structures.

Atmlab functions for tomographic retrievals

Non-linear error analysis, negative VMR

Interpretation of measurement response and AVKs

```
C1 = covmat1d_from_cfun( Q.T.GRIDS{1}, 1, 'lin', 0.2,  
0,@log10);  
C2 = covmat1d_from_cfun( Q.T.GRIDS{2}, 1, 'lin', 4, 0);  
Sa_02 = covmat_partstat_corr(0.4,C1,C2);
```

```
Q.T.HSE = 'off'; %Set wether to anjust for HSE or not in  
jacobians;
```

```
Q.LAT_TRUE vs Q.LAT_GRID
```