Measurement of water vapour at 1.38 micron in the Mars atmosphere with the SPICAM AOTF near-IR spectrometer.

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Characteristics of the SPICAM IR channel

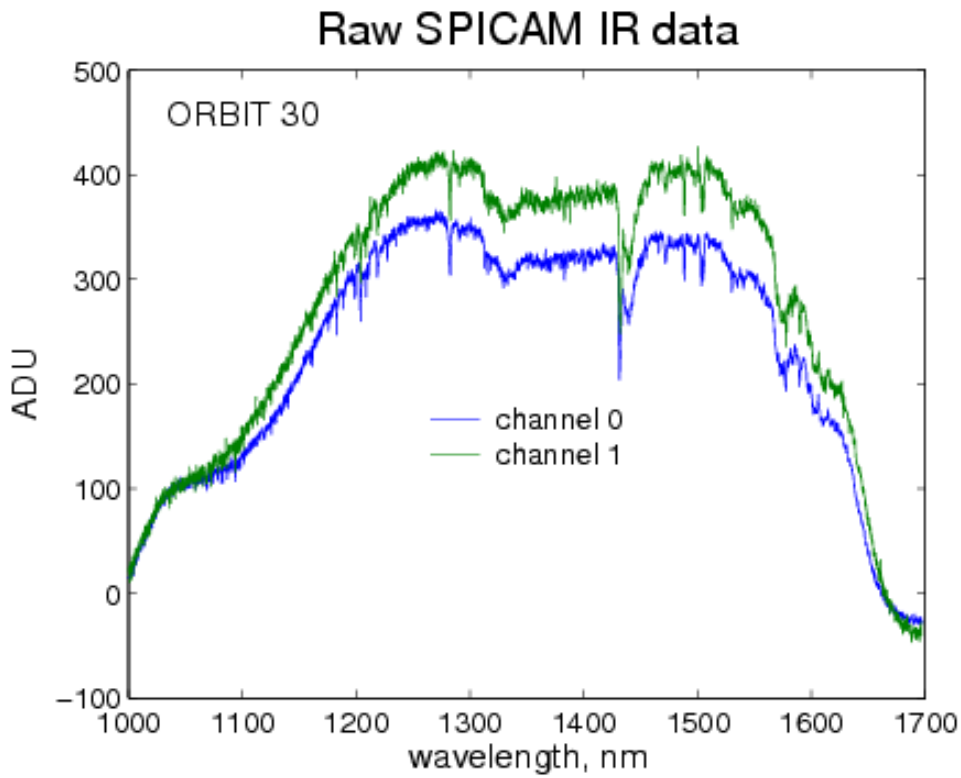
- Spectral range 1-1.7 μm

- Spectral resolution:
- Δλ~0.5 nm for λ=1 μm (3.5 cm^{-1})
- Δλ~1.2 nm for λ=1.7 μm
- About 0.8 nm in H_2O 1.37 micron band

- FOV for nadir and limb ~ 1˚

- About 270 SPICAM nadir orbits for L_s from 330 to 140° are suitable for water vapour retrieval

- **179** orbits are done



Retrieval of water vapour in Martian atmosphere (SPICAM)

- Signal-to-noise ratio in averaging is better than 30
- But for small signal it can be ~10

- Uniform mixing in the atmosphere of both H_2O (up to the saturation level) is assumed

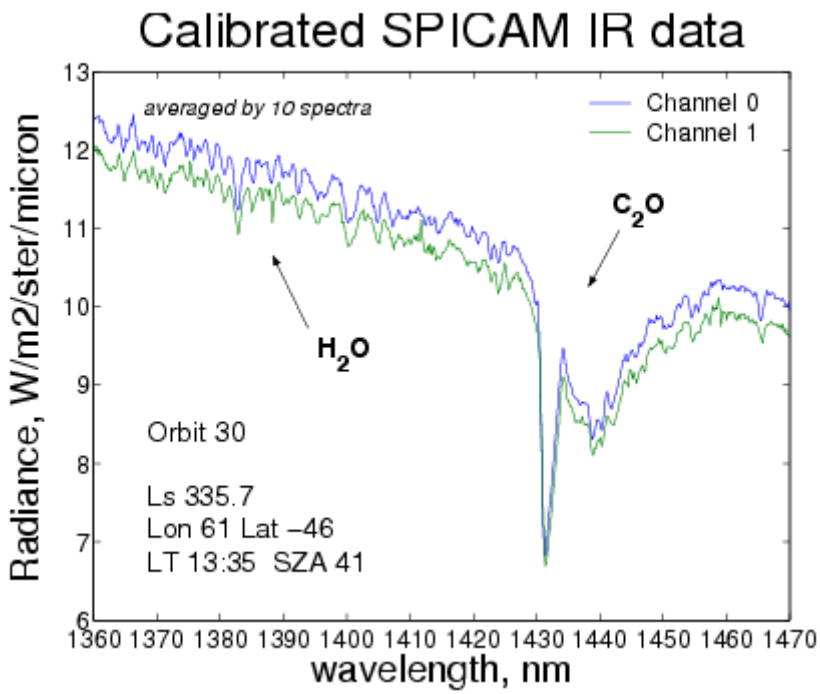
- An important issue is an accurate solar spectrum (**Kurucz, 1995 for SPICAM**), which lines are mixed with the signatures of the Martian atmospheric gases.

- Spectroscopic database:
- HITRAN
- Liny-by-line calculations

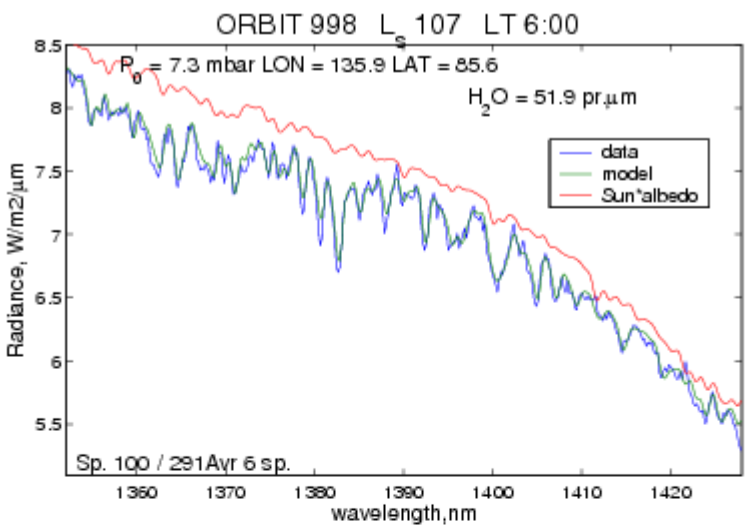
- Atmospheric parameter was taken from:
- 1) **European Martian Climate Database LMD GCM (F.Forget et al., 1999)**
- 2) GFDL GCM (Richardson, Wilson, Rodin, 2002)
- 3) Mola topography

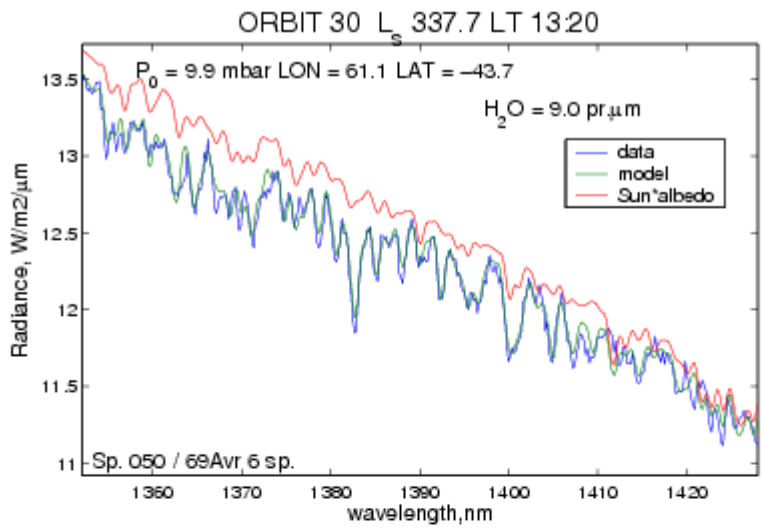
- **We didn't take into account aerosols for near IR retrievals.**

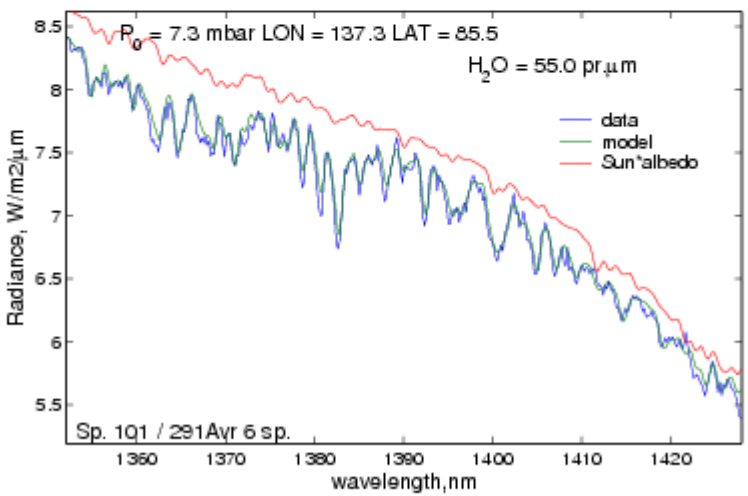
- To minimaze a noise SPICAM spectra were averaged by **6 spectra** for a fitting

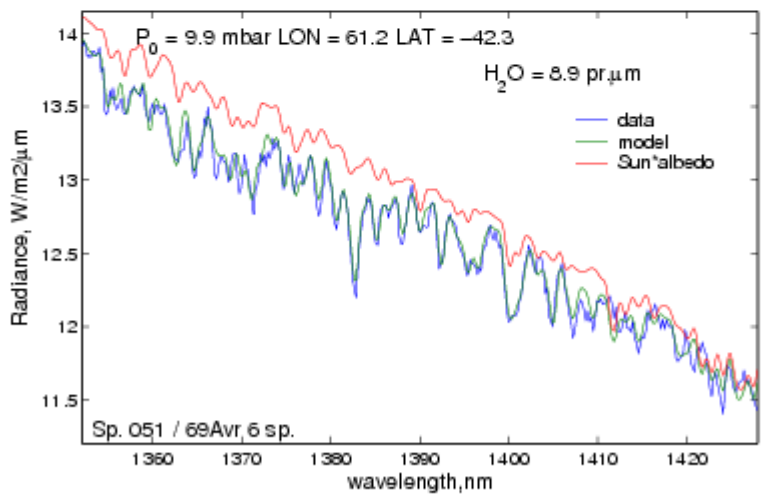


Examples of fitting of 1.37 μm H_2O band



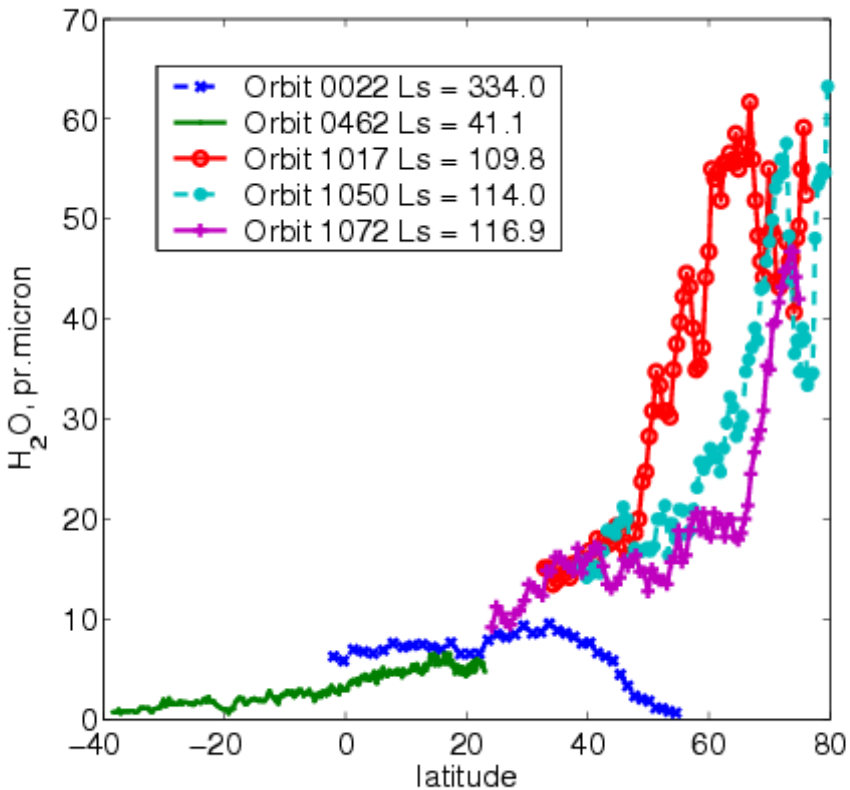




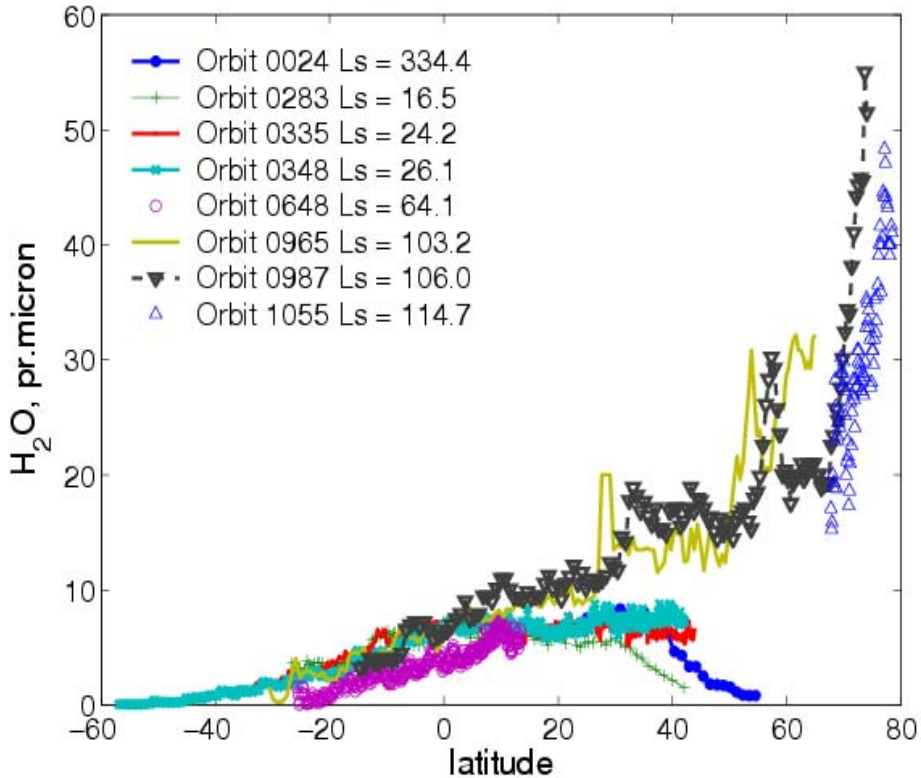


Water vapour content for same longitude but for different seasons

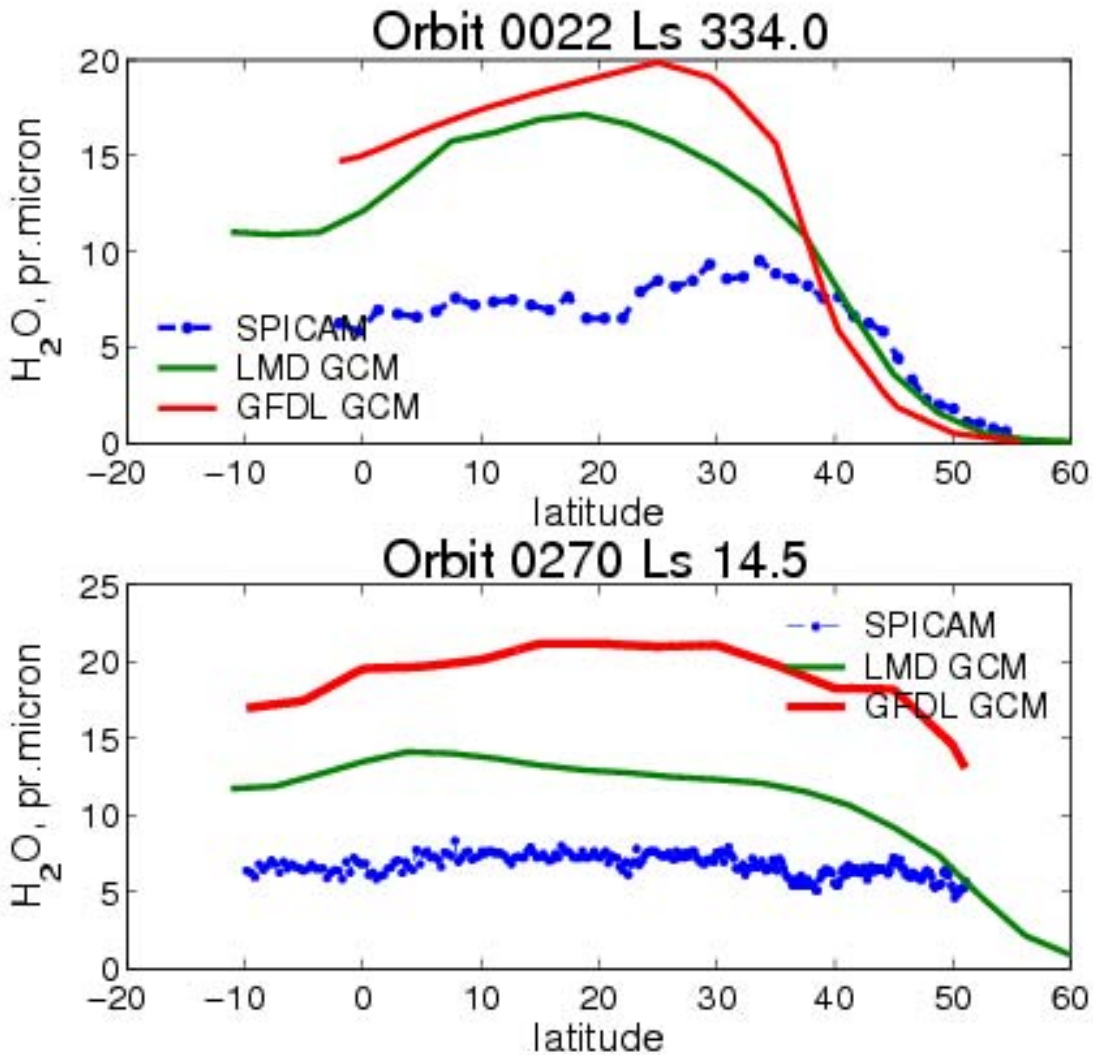
Lon 100 -103°



Lon 174 -176°

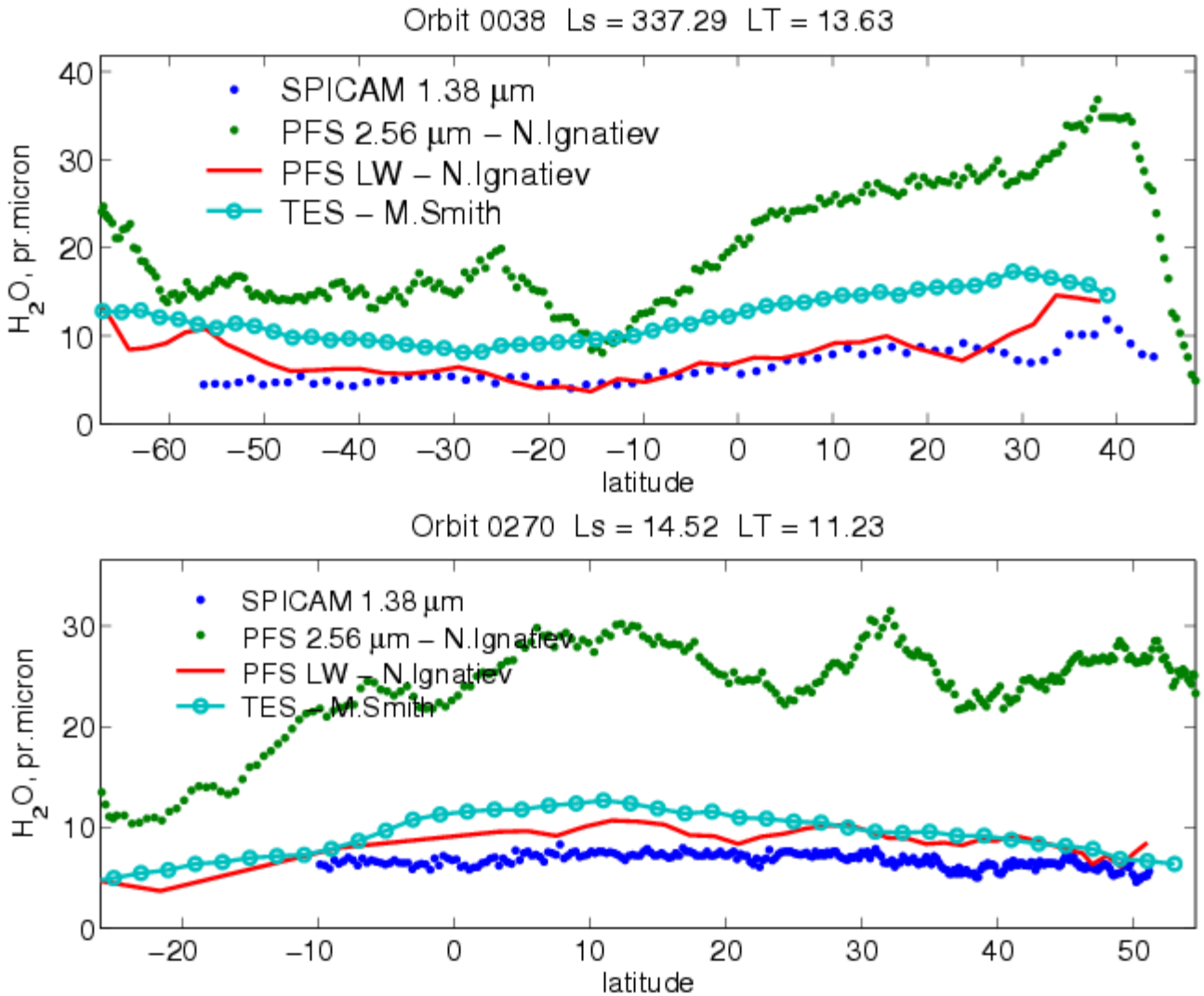


Comparison with General Circulation Models
LMD and GFDL



Comparison with TES and PFS data

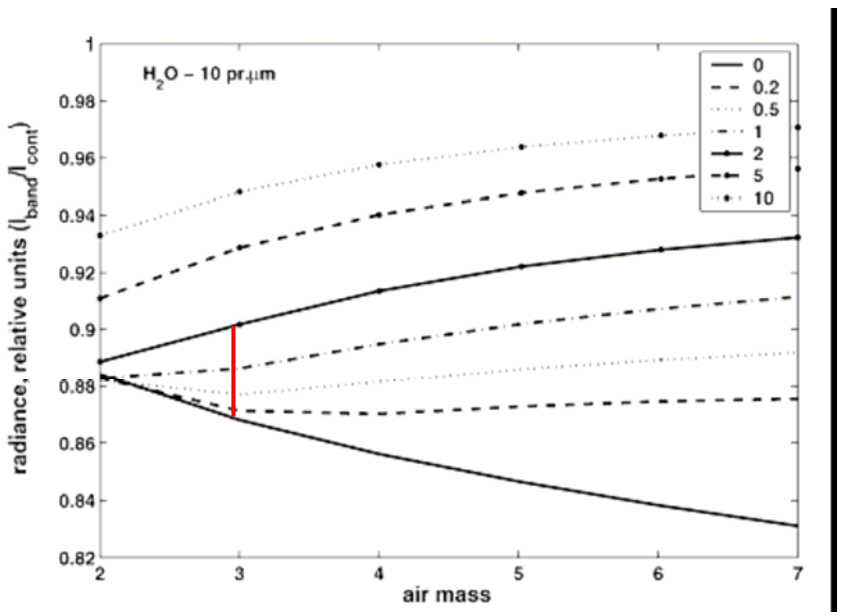
- TES has about 30-50% more water



Possible sources of errors

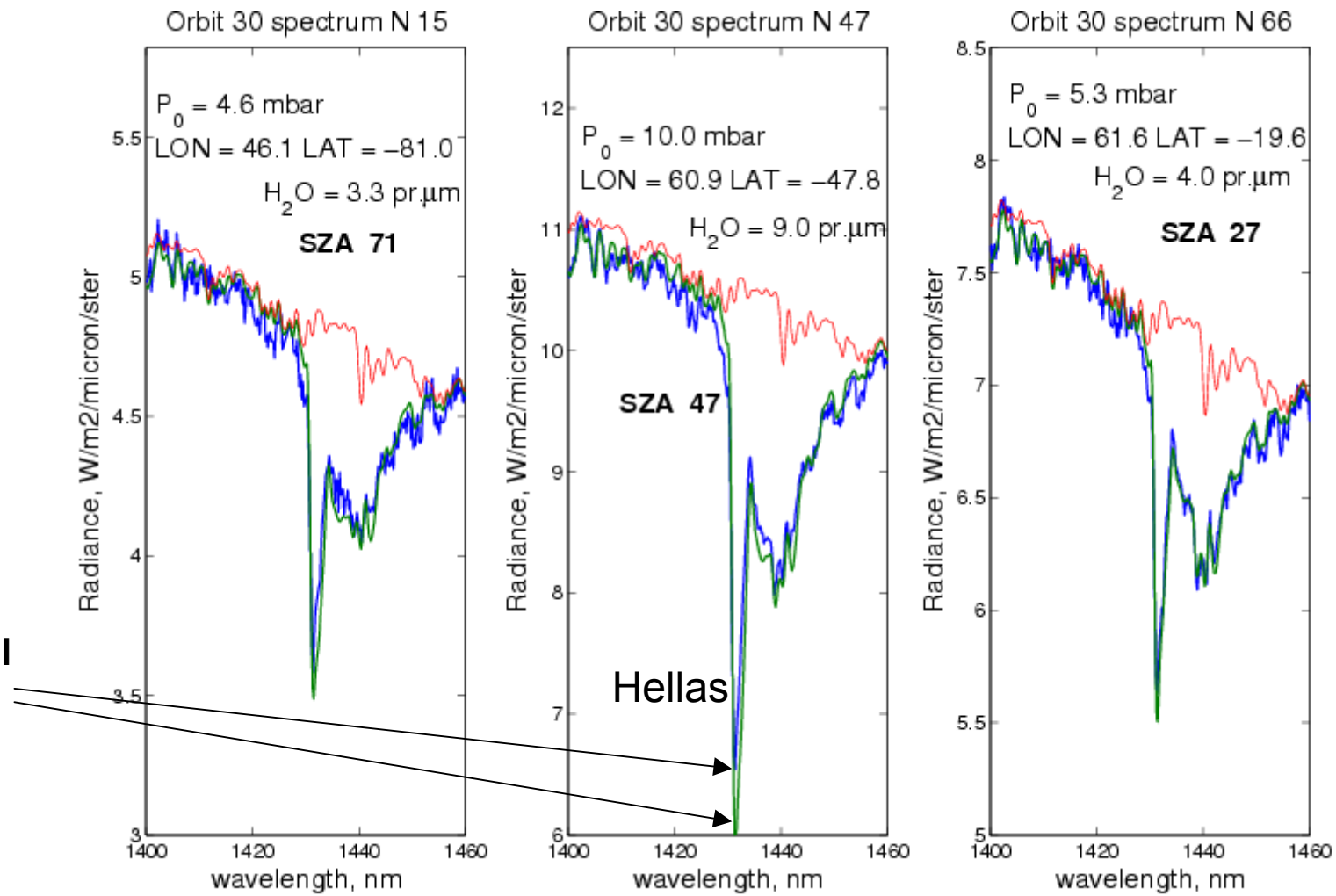
- Why an amount of SPICAM water vapour is so small? It is an lower limit for all other observations

Possible explanation is dust impact on near IR spectra,
but in case of nadir observations (air mass < 3)
the effect doesn't exceed 20-30%

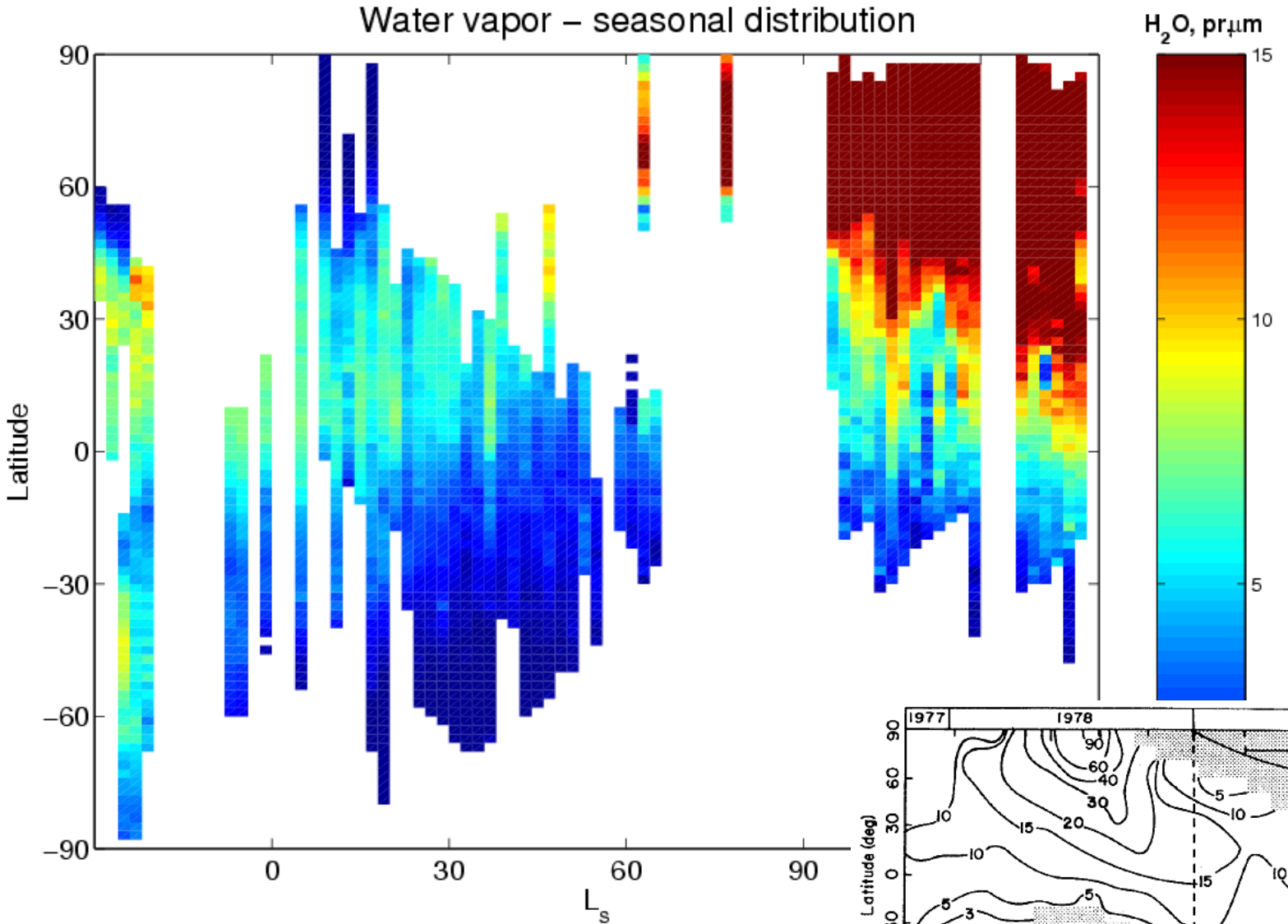


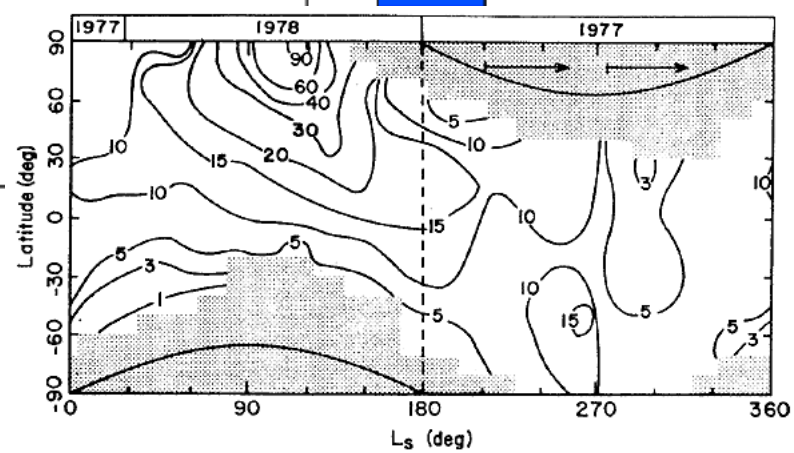
CO_2 band by SPICAM

Disagreement between CO_2 Data and model

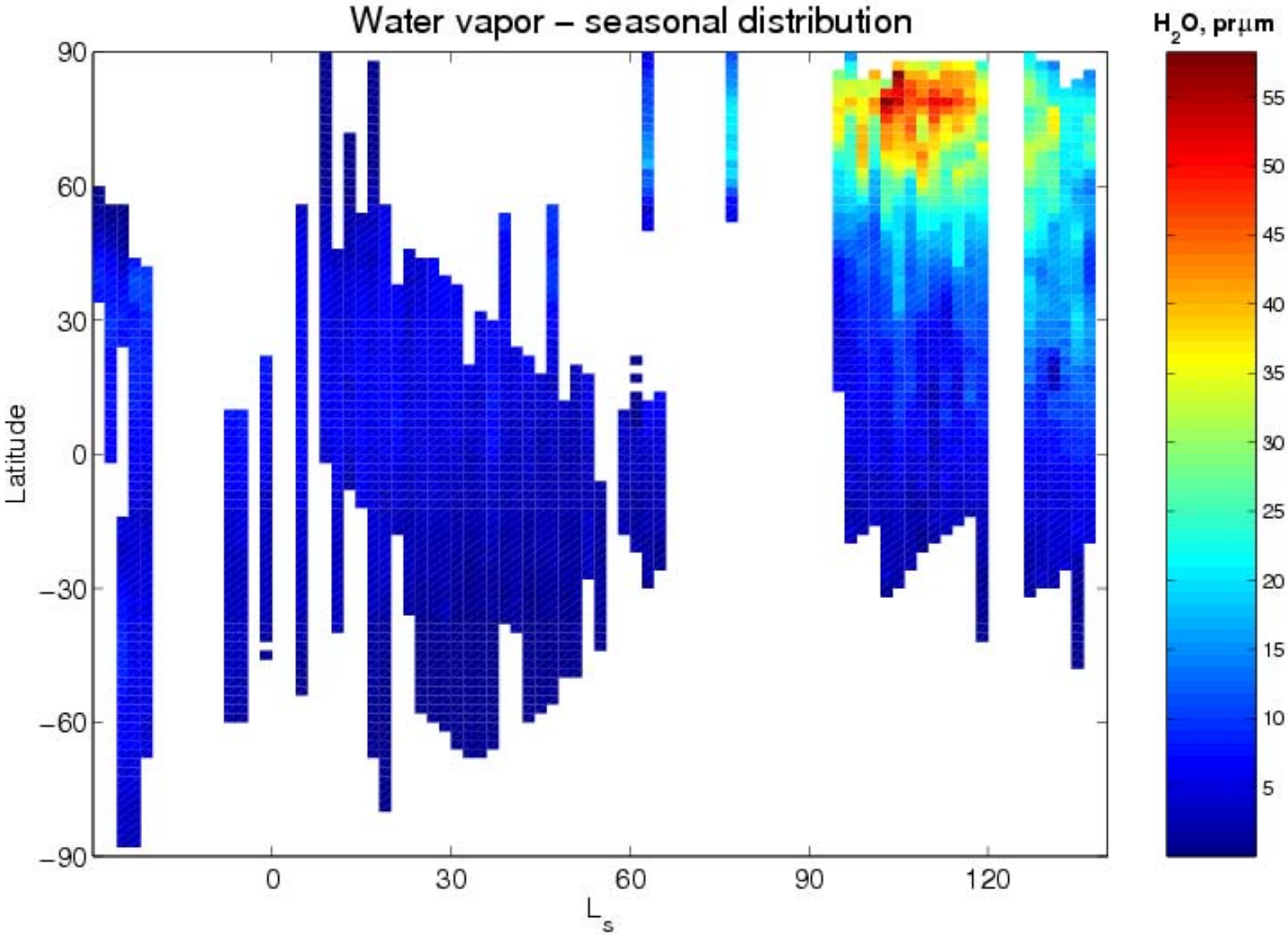


Seasonal distribution of water vapour

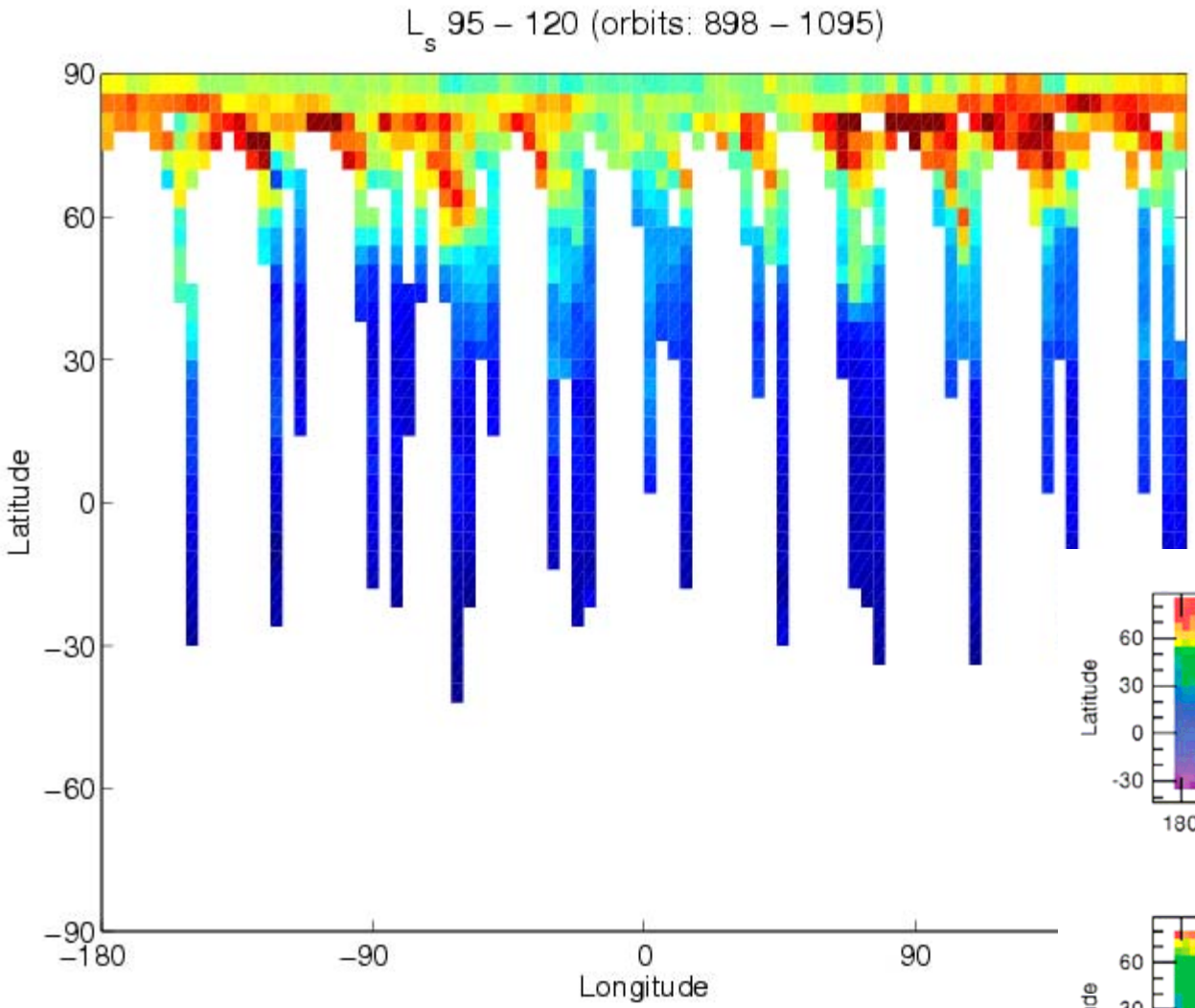


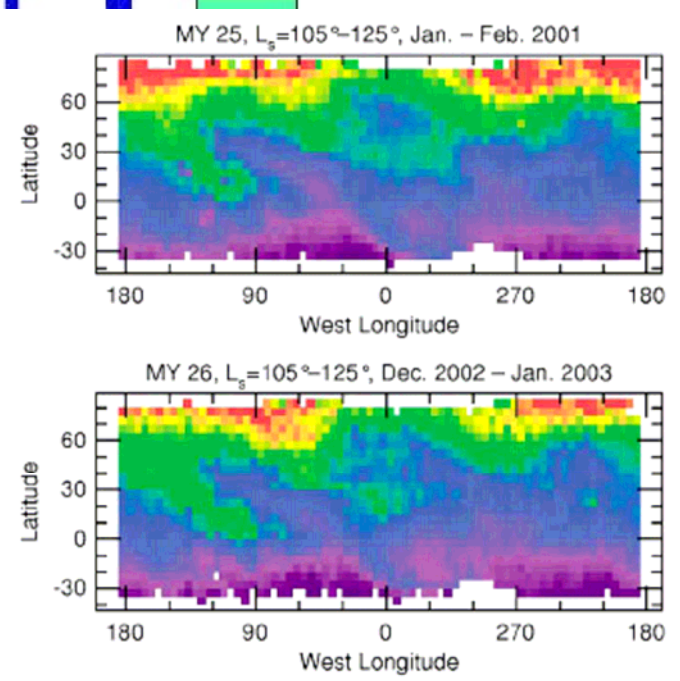


Viking 1,2 **MAWD H_2O 1.38 µm band**


Water vapor – seasonal distribution
H2O, prμm
55
50
45
40
35
30
25
20
15
10
5
90
60
30
0
−30
−60
−90
Latitude
0
30
60
90
120
Ls

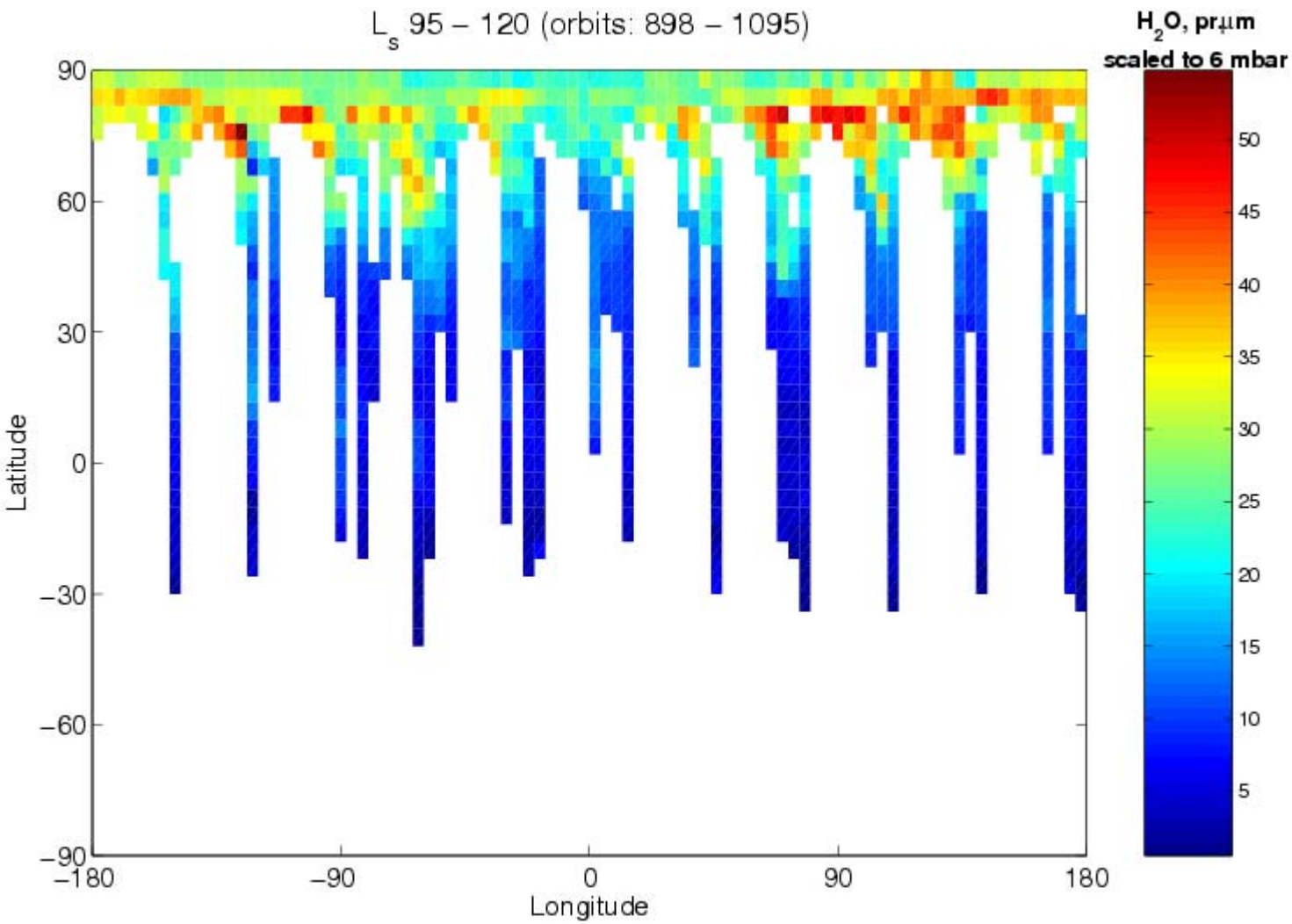
Spatial distribution of water vapour for summer in North hemisphere



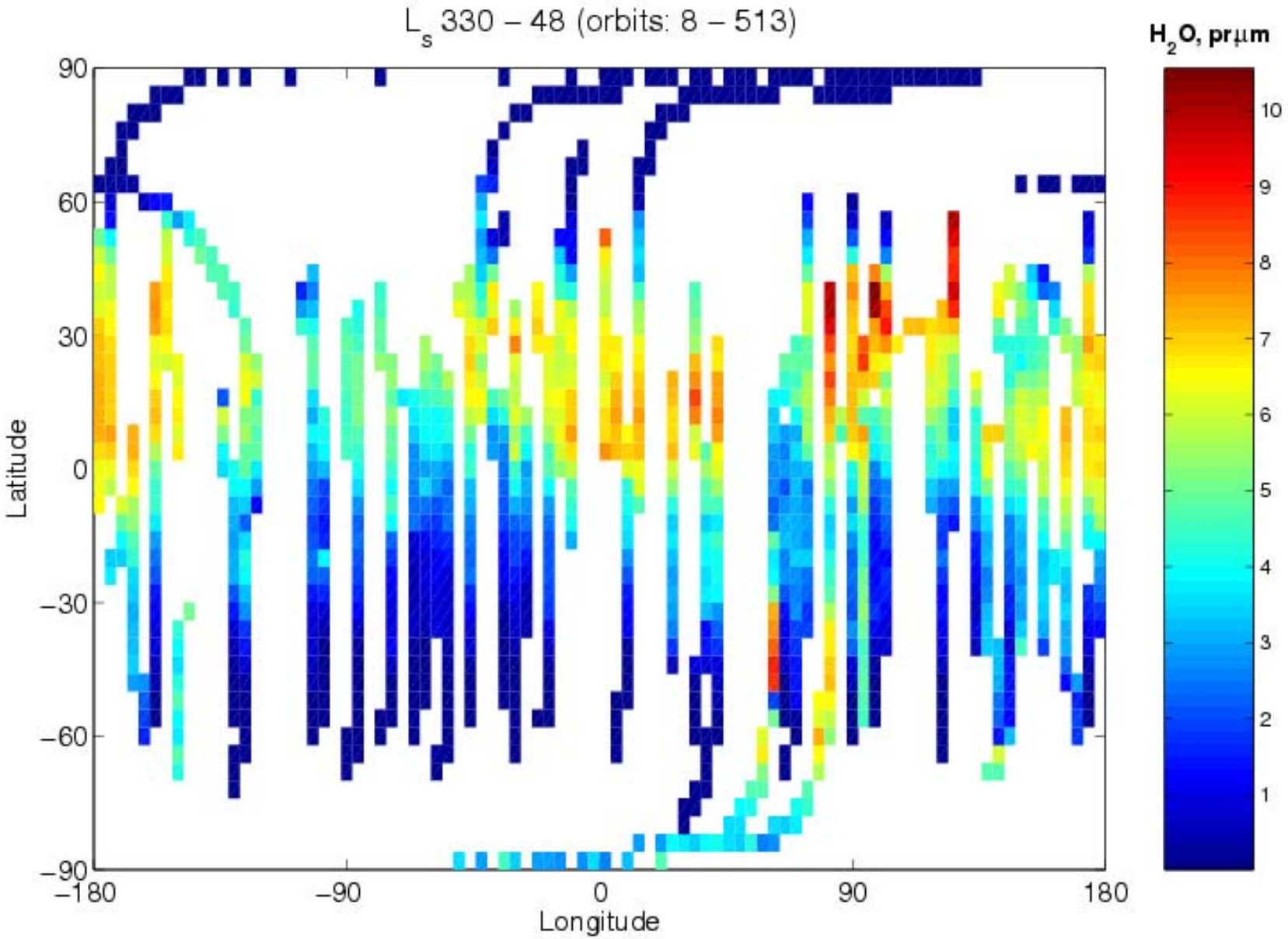


L_s 95-120:
59 orbits from 72 orbits are presented

Spatial distribution of water vapour for summer in North hemisphere

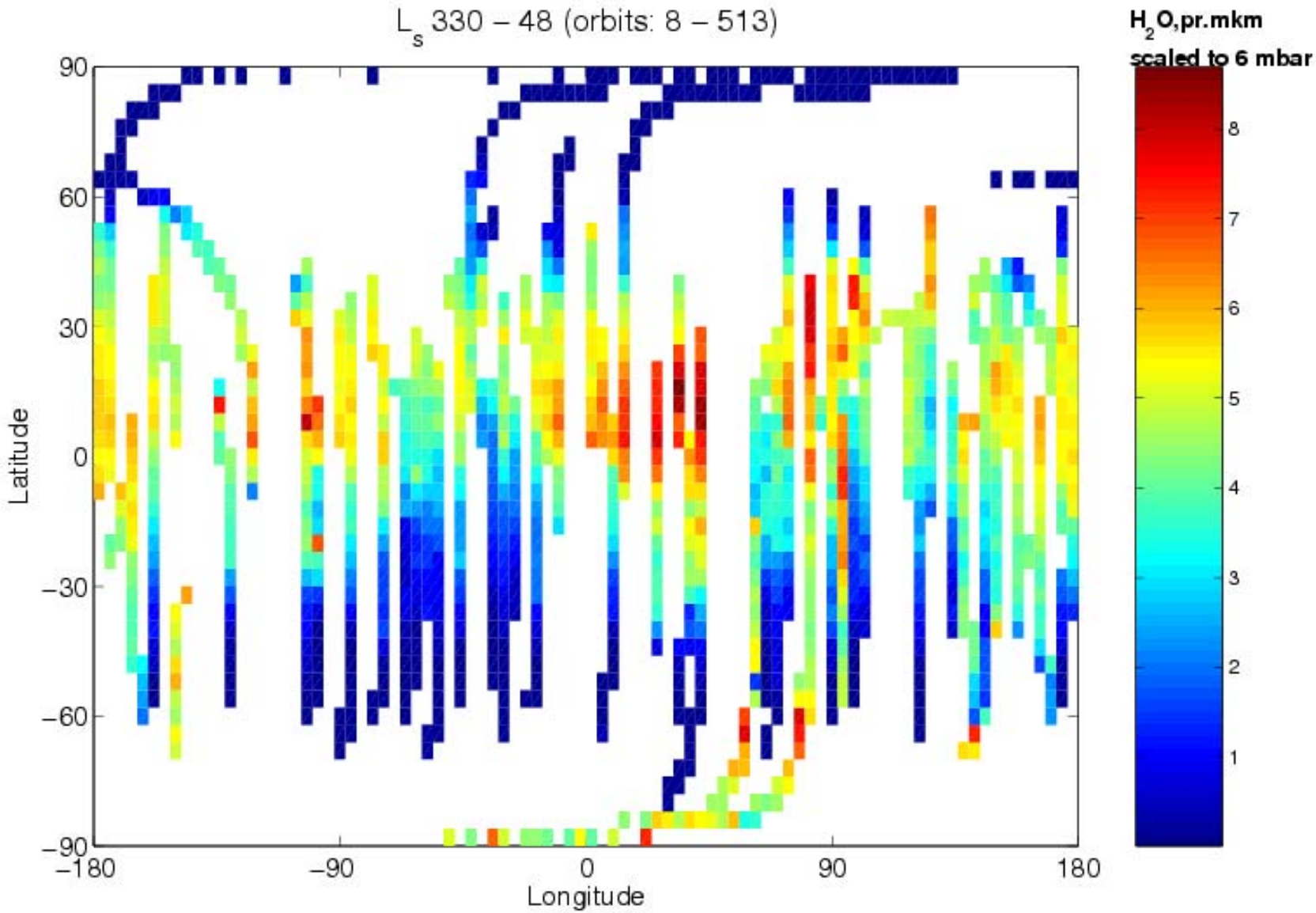


Spatial distribution of water vapour for first orbits



73 orbits from 110 nadir orbits are presented

Spatial distribution of water vapour for first orbits



Conclusions

- 1) H_2O retrieval was produced for 179 from ~ 270 nadir orbits
- 2) Seasonal and spatial distributions are in agreement with MAWD, LW PFS and TES data except TES is in 30-50% higher than SPICAM
- 3) Consistence with PFS LW and 1.38 micron band
- and disagreement with PFS SW 2.56 micron band
- 4) Does SPICAM really underestimate the water vapor in Martian atmosphere?

Dust impact: for nadir observation with airmass < 3 the effect doesn't exceed 20-30% for $\tau < 1$