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D. Grassi[2], M. Tschimmel[3], Th. Encrenaz[4], T. Fouchet[4], M. Giuranna[2].

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(2) Istituto di Fisica dello Spazio Interplanetario (INAF-IFSI), Rome, Italy,
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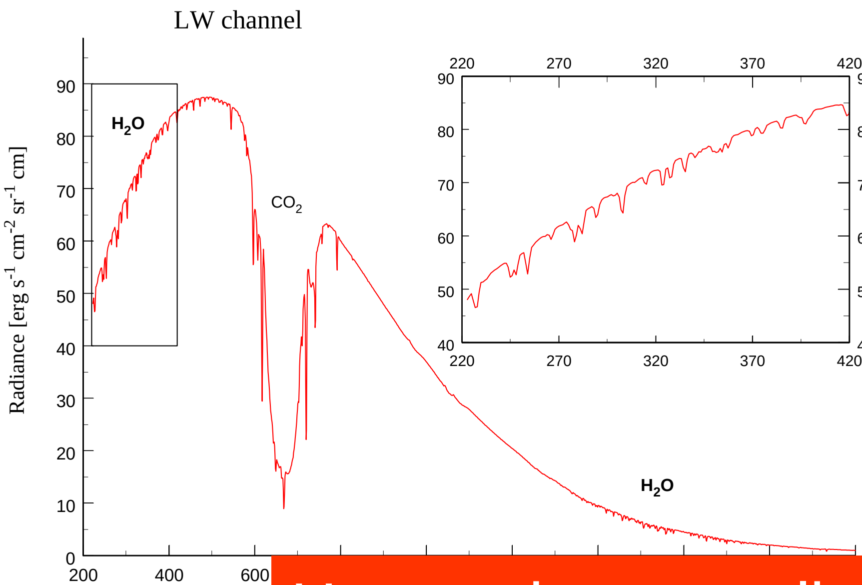
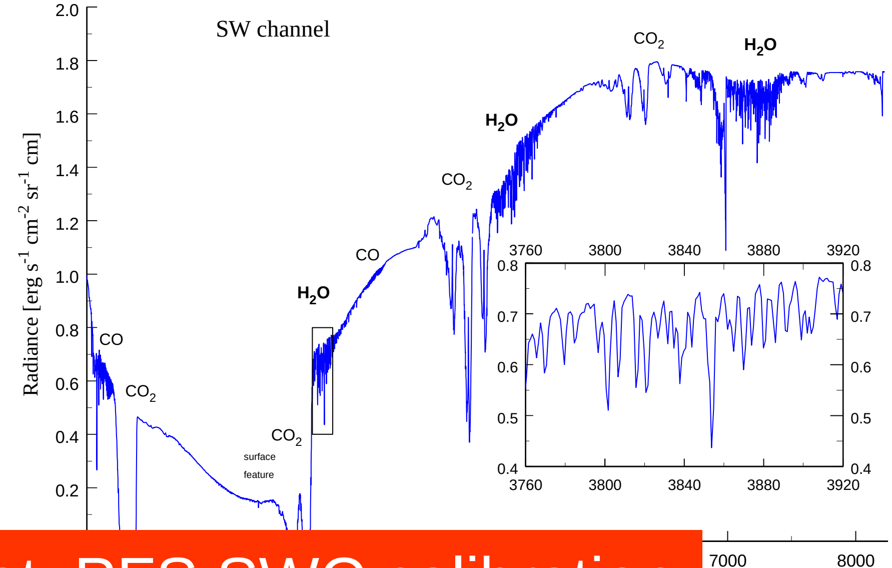
Water vapour in the Martian atmosphere from PFS/Mars express data.

1st Mars Express Science Conference, 21 - 25 February 2005
European Space Research and Technology Centre (ESTEC)
Noordwijk, The Netherlands

Original H_2O retrieval technique



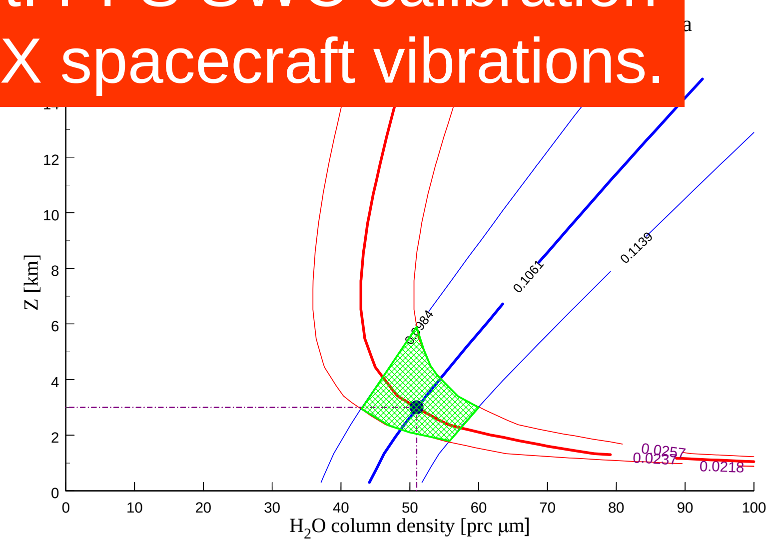


Has not been applied yet: PFS SWC calibration problems caused by MEX spacecraft vibrations.

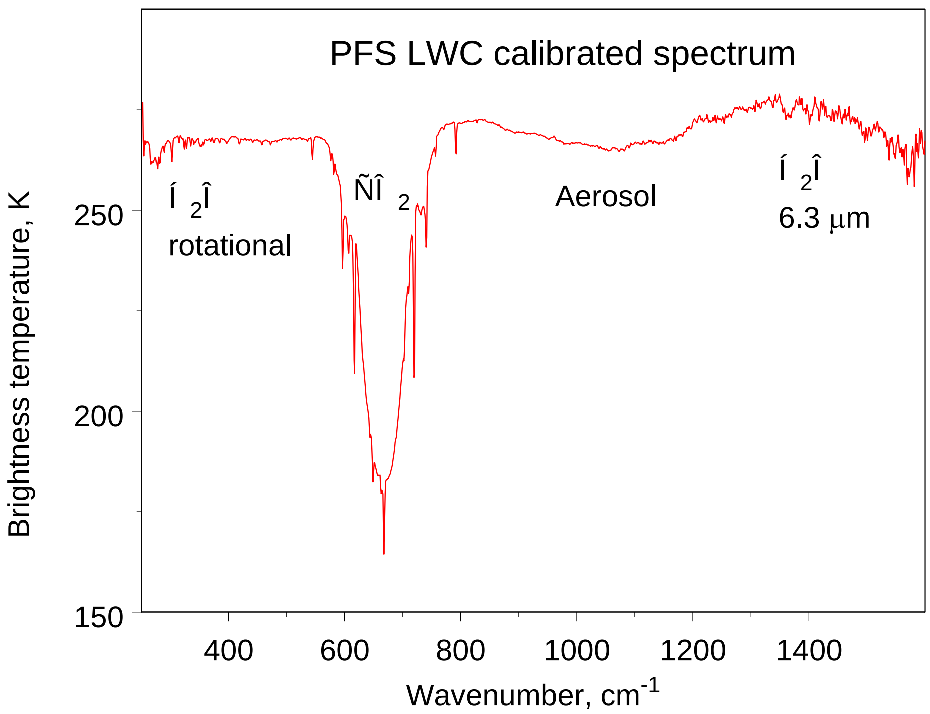
$$N = \int_0^\infty n(z)\,dz$$ Column density

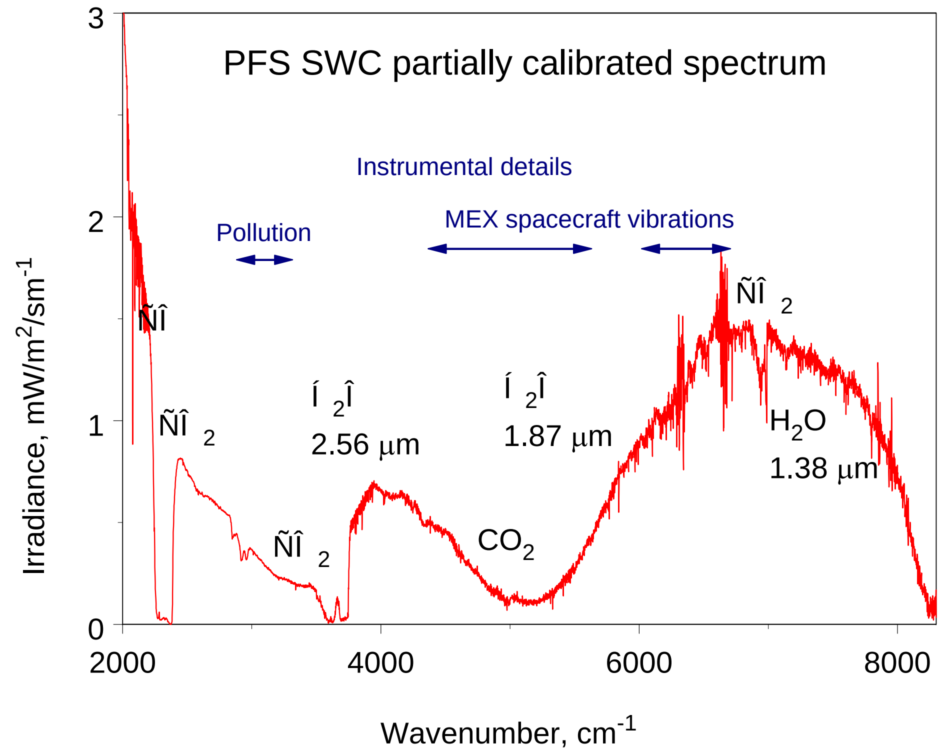
$$Z = \frac{1}{N}\int_0^\infty z\,n(z)\,dz$$ Effective altitude or scale height

$$\begin{cases} W_{SW} = W_{SW}(N,Z) \\ W_{LW} = W_{LW}(N,Z) \end{cases} \Rightarrow \quad N, Z\,?$$



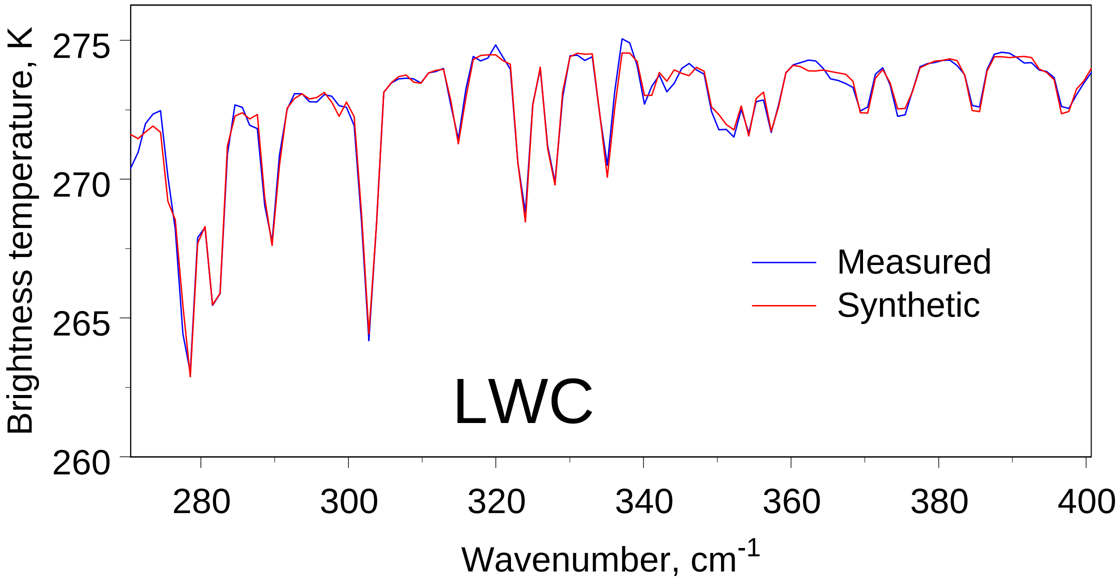
Atmospheric water vapour bands in the PFS spectrum





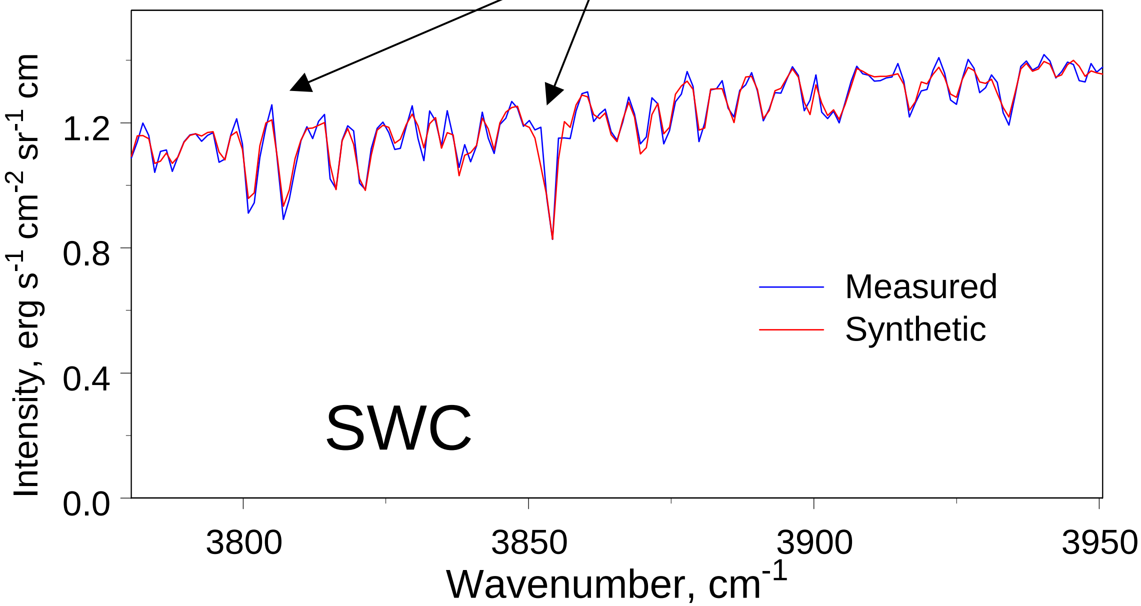
Channel	Band	Status	Note
LWC	**20 - 50 μm**	**OK**	T-profile sensitive. Calibrated orbits: up to 683 (Feb 2005).
	6.3 μm	Noise, unusable	
SWC	**2.56 μm**	**OK ??**	More dust sensitive. Dayside only.
	1.87 μm	Noise, distorted	
	1.38 μm	Noise	

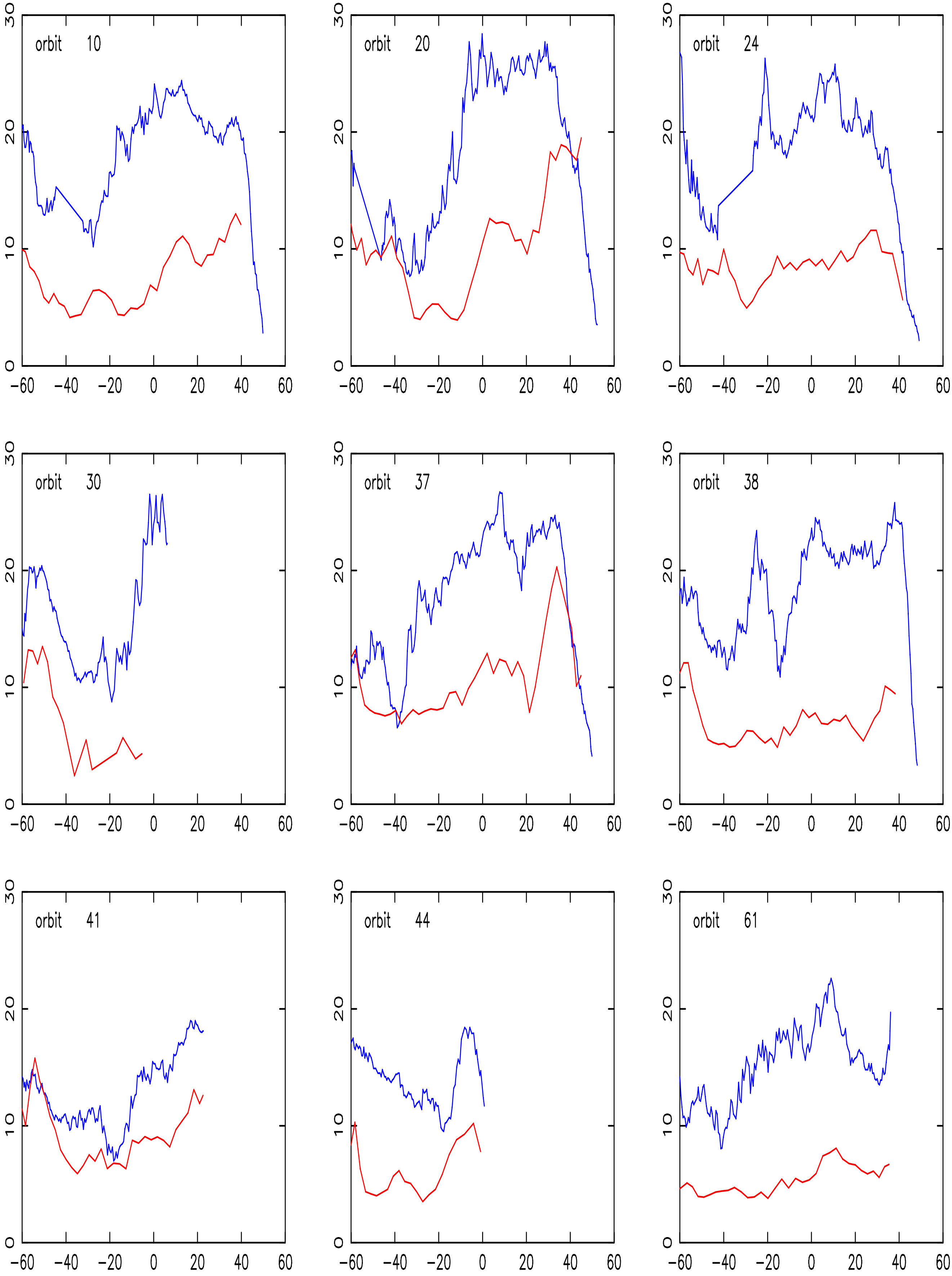
Examples of spectrum fitting



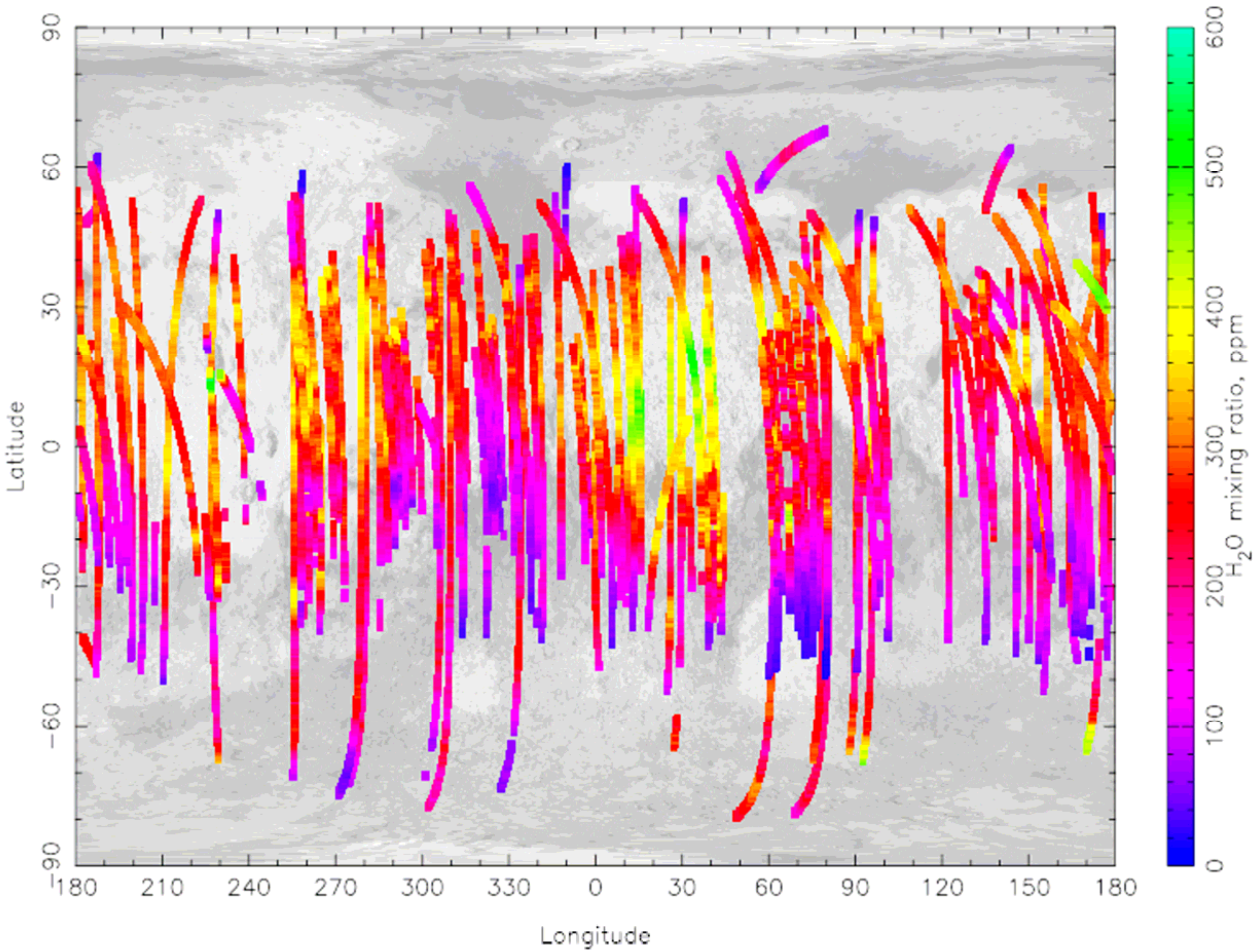
Averaging by 19 individual spectra

Small systematic misfits

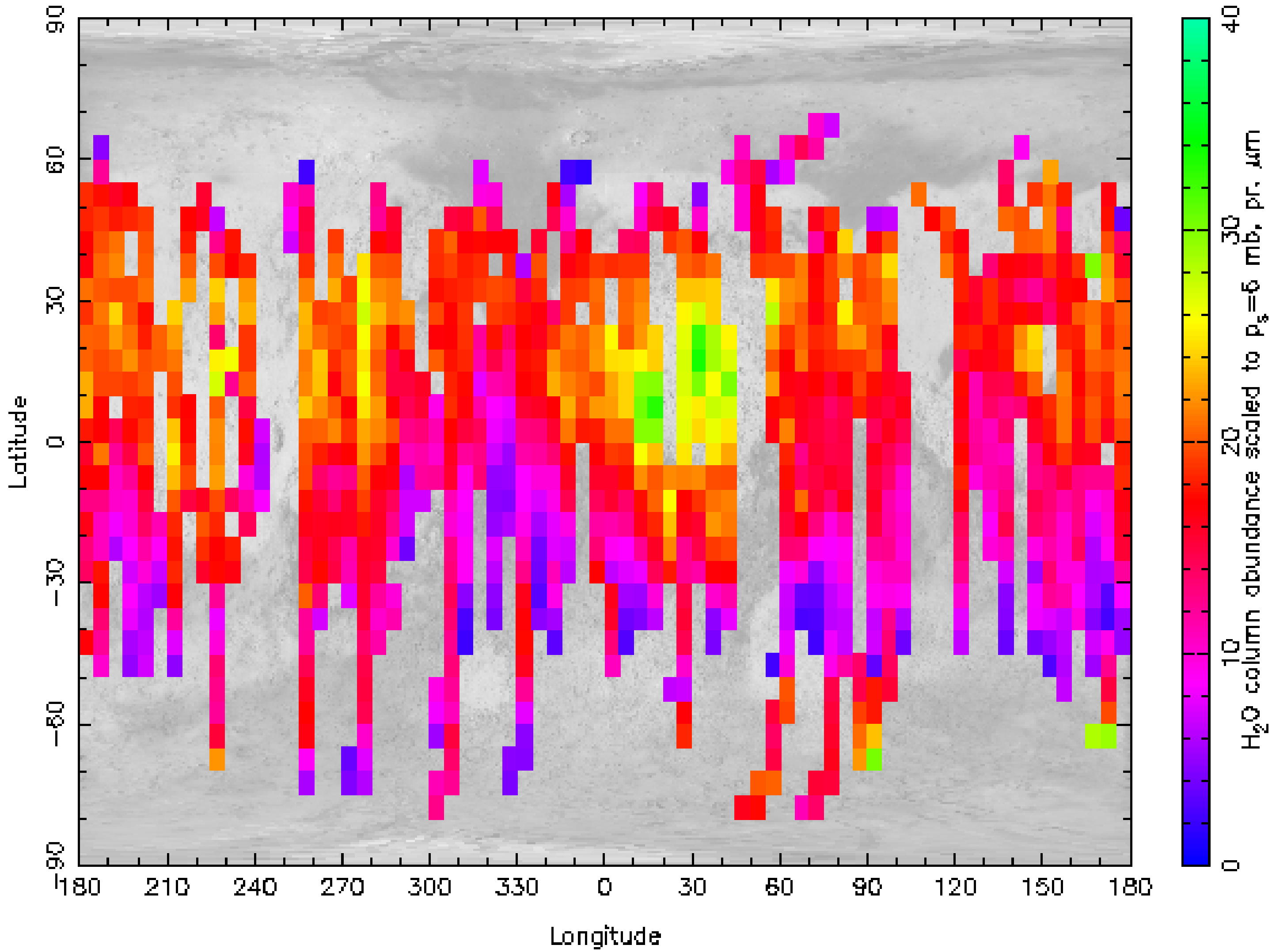



orbit 10
orbit 20
orbit 24
orbit 30
orbit 37
orbit 38
orbit 41
orbit 44
orbit 61
0
10
20
30
-60
-40
-20
0
20
40
60

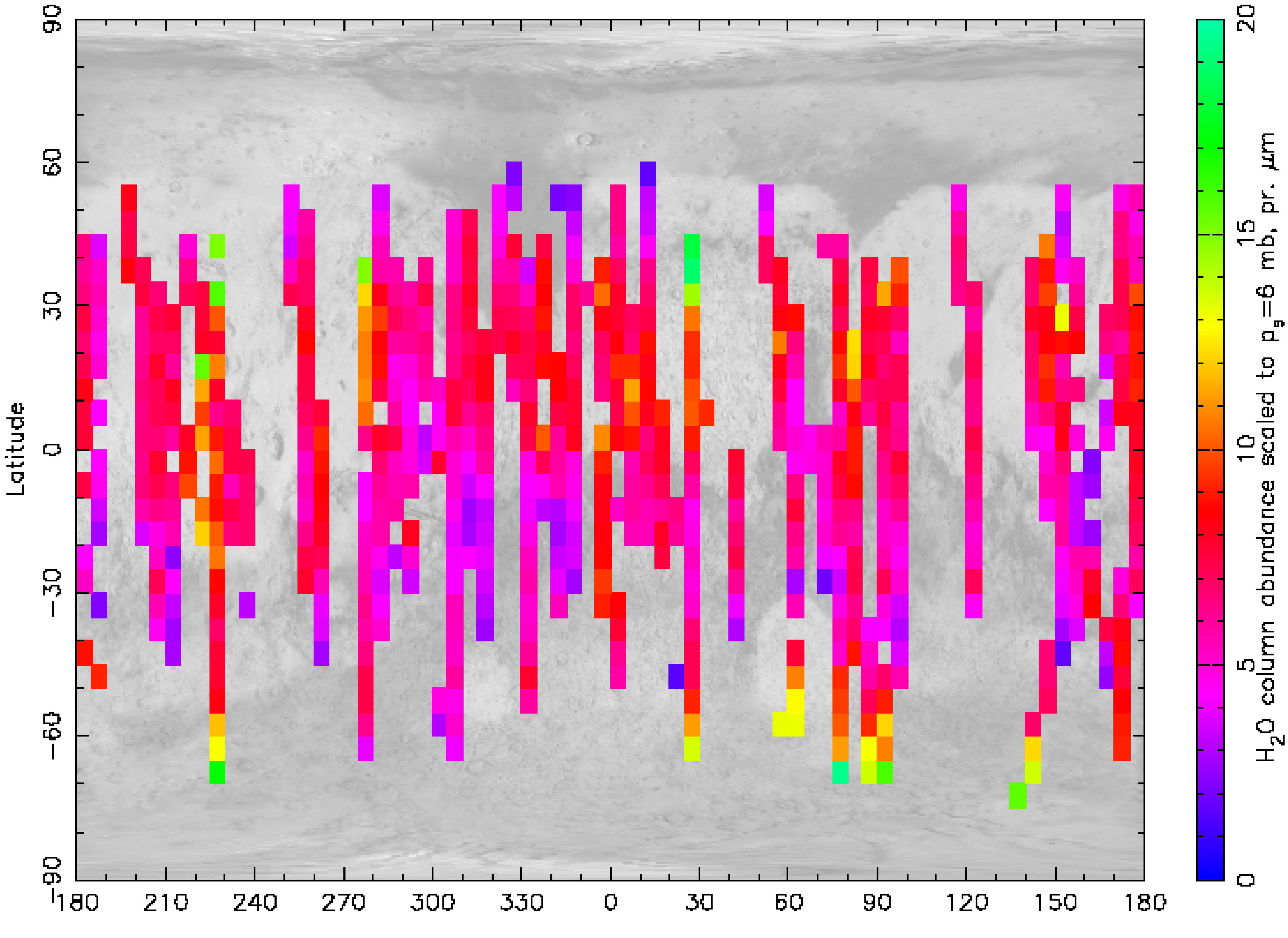
SWC picture, orbits 10-538, L_s=330-50°, ppm



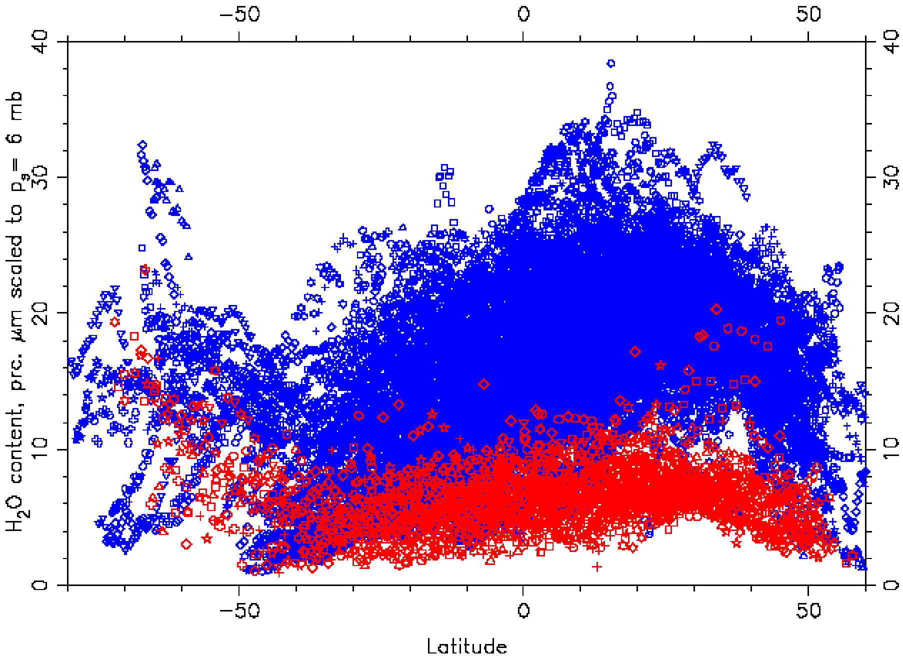
Seasonally averaged SWC picture, orbits 10-538, L_s=330-50°, prc. µm scaled to p_s = 6 mb

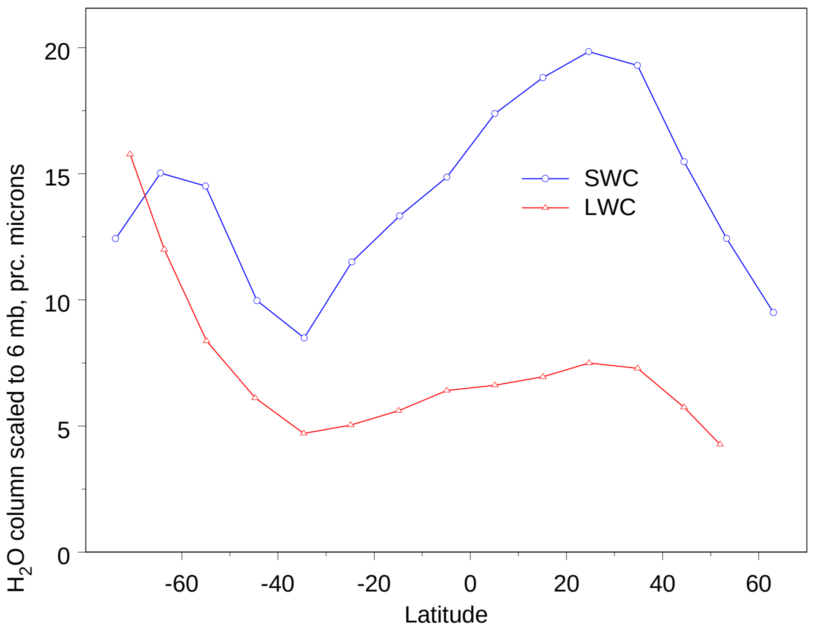


Seasonally averaged LWC picture, calibrated orbits of 10-612, L_s=330-60°, scaled prc. μm



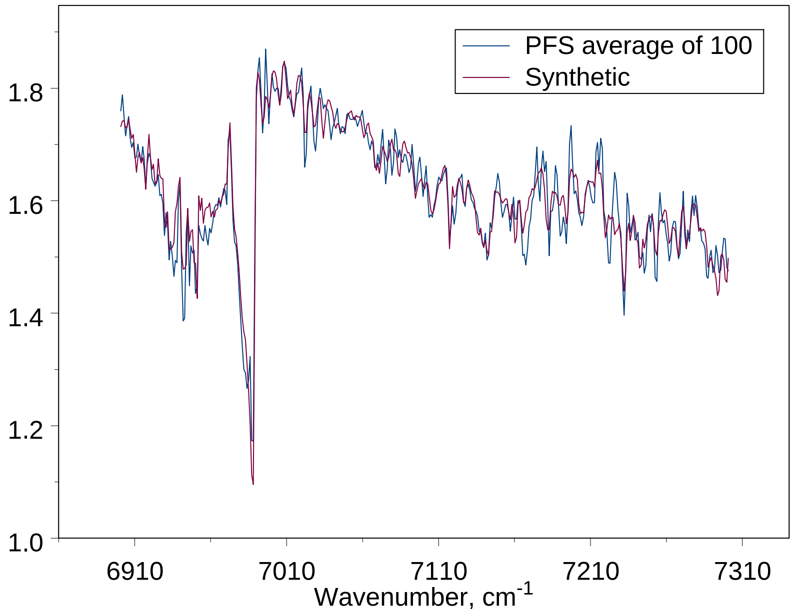
Disagreement of the LWC & SWC
Physics or instrument calibration?





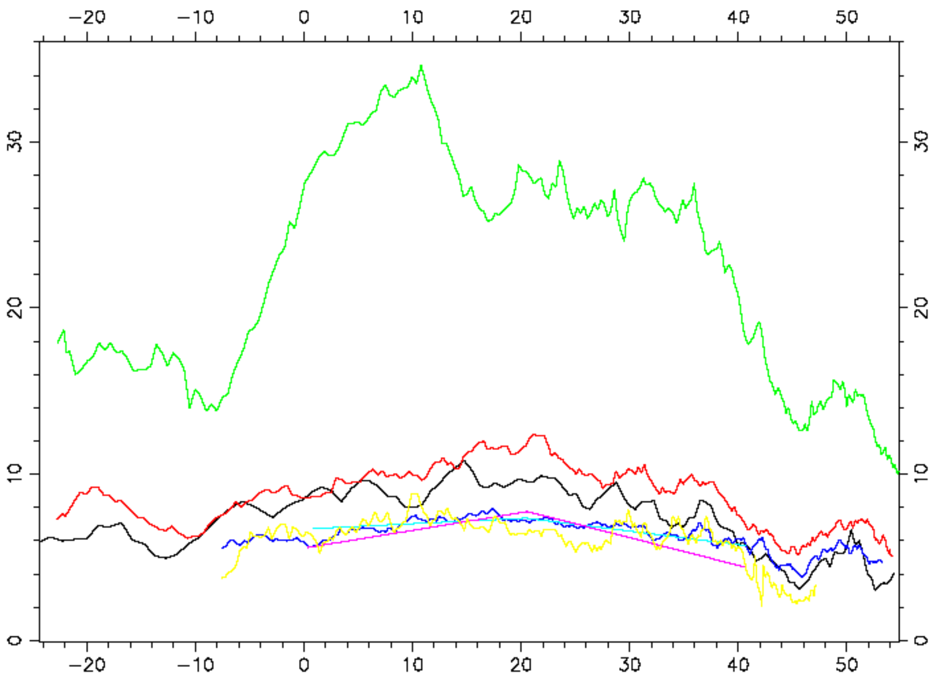
- ➢ Calibration (spectrum distortion caused by MEX spacecraft vibrations)?
- ➢ Wrong spectroscopic data, in particular line broadening?
- ➢ True difference?

Comparison PFS LW, SW 2.56 & 1.38 µm H_2O band & 1.38 µm in SPICAM AOTF spectra



Poor S/N, but useful for diagnostics when averaged

Example: orbit 278



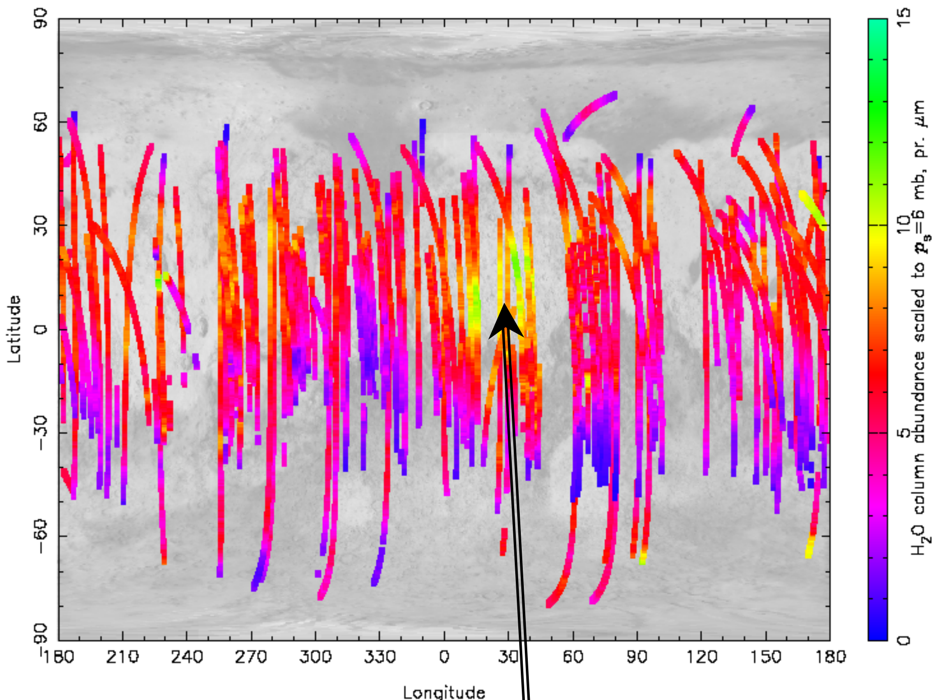
- PFS SW 2.56
- PFS LW Ignatiev
- PFS LW Fouchet
- SPICAM 1.38, PFS algorithm
- SPICAM 1.38, Fedorova
- PFS SW 1.38

- See also the today presentations by E. Lellouch, D. Titov, and A. Fedorova

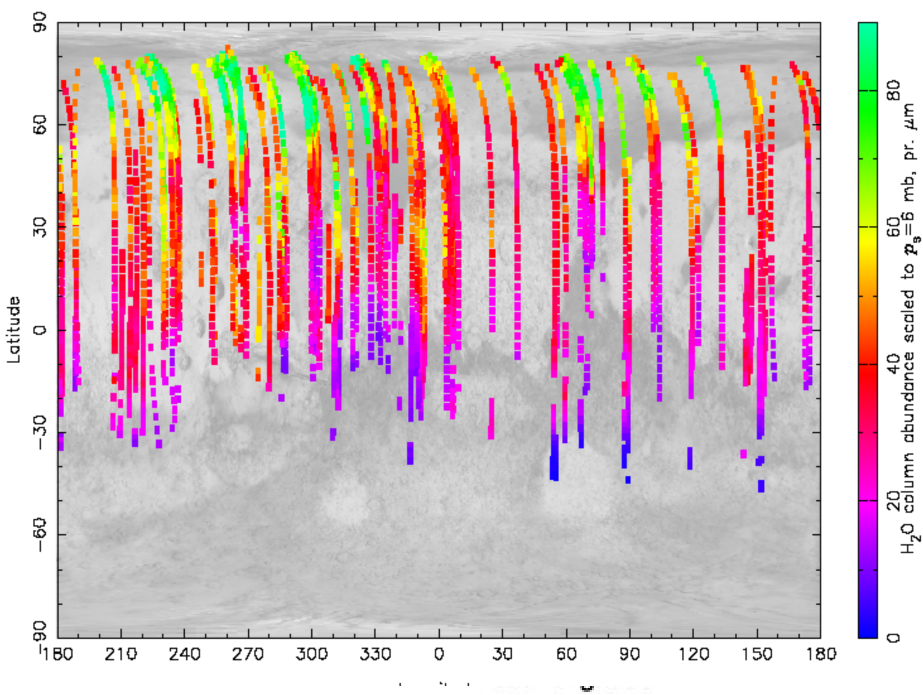
- Such a big difference between 2.56 & 1.38 μm bands can hardly be explained by physical reasons (e.g. by dust optical properties).
- Incorrect spectroscopic data can be partially responsible for the difference.
- LWC is more reliable now, while SW channel requires careful re-calibration for quantitative analysis.
- A very rough correction: a factor of 3.

SWC 2.56 µm H_2O column scaled by 1/3

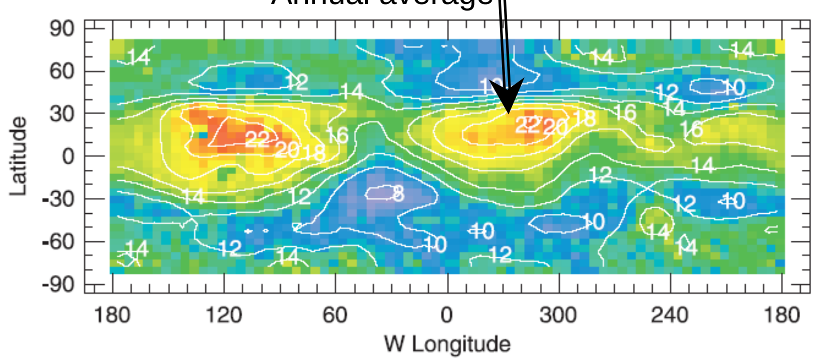
orbits 10-538, *Ls*=330-50°



orbits 987-1331, *Ls*=106-152°

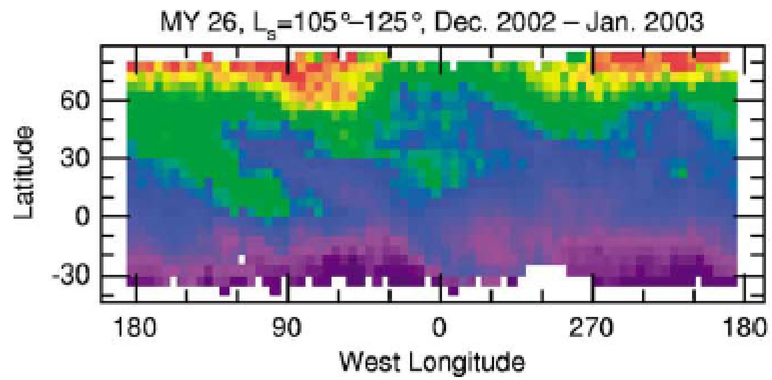


Annual average

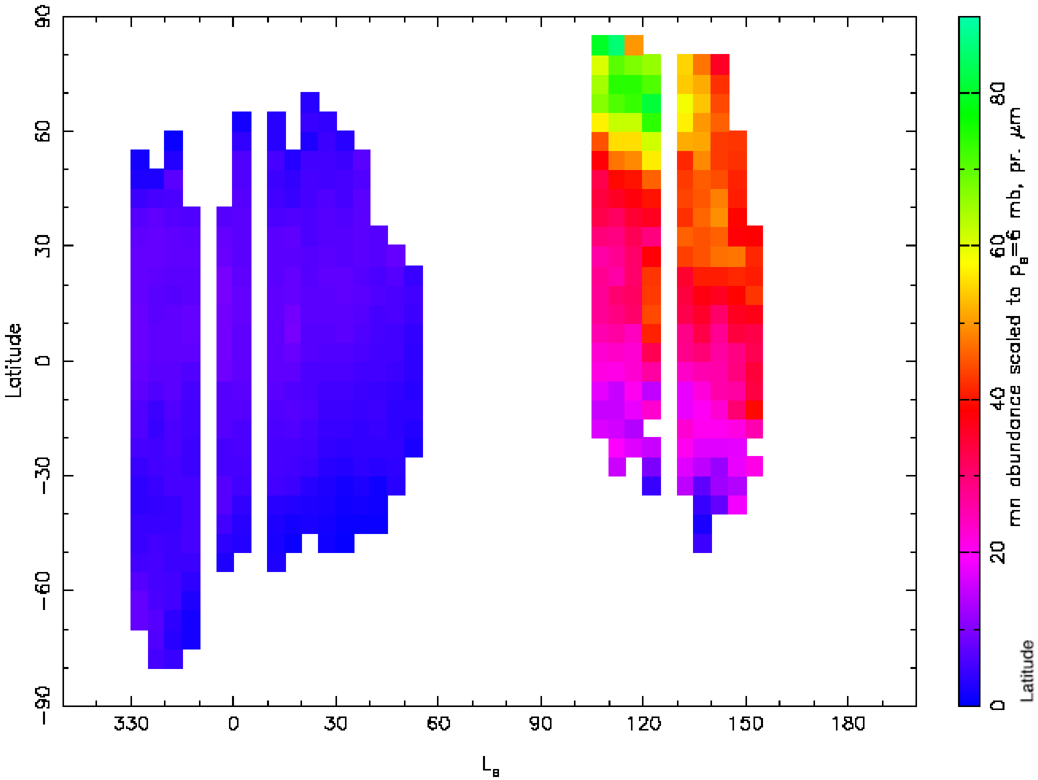


MGS TES,

M. Smith

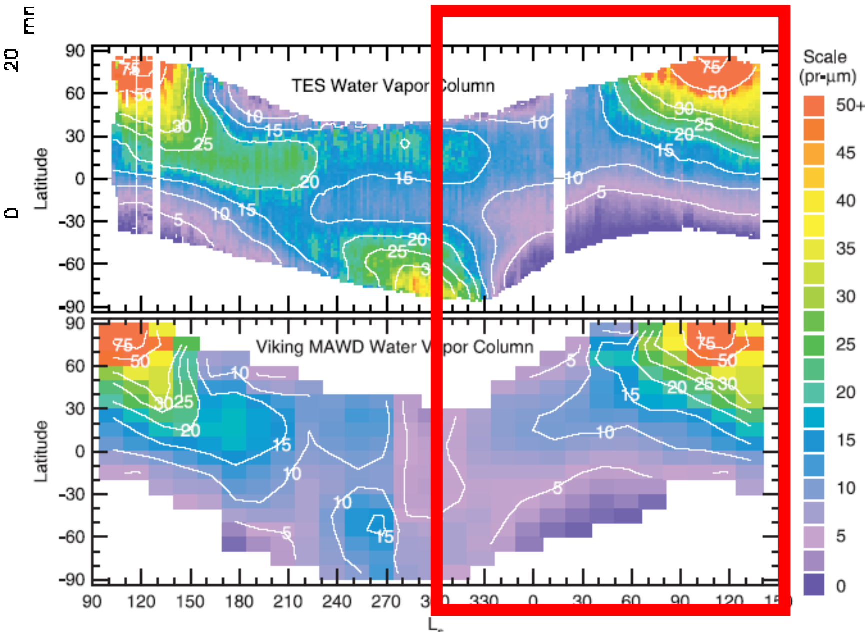


Water vapour column abundance (SWC scaled by 1/3) as a function of season and latitude



TES & MAWD data

M. Smith, JGR, 2002



Summary

- Global picture of water vapour as seen by PFS is close to MAWD & TES.
- PFS LW gives ~ 30% less water that TES (see also talks by E. Lellouch and by A. Fedorova).
- Detailed quantitative analysis requires careful PFS SWC data re-calibration and/or correction of spectroscopic data.
- Complete picture is to be obtained from joint study of PFS, SPICAM AOTF, and OMEGA.