

Variations of lower clouds and water vapor amount in deep Venus atmosphere based on night windows observations by the SPICAV-IR/Venus-Express

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SPICAV IR night nadir observations

SPICAV –

Spectroscopy for Investigation of Characteristics of the Atmosphere of Venus

Performing period – 2006-2014 years.

Spectral range 1.05 – 1.7 μm

Covered transparency

windows 1.10 μm

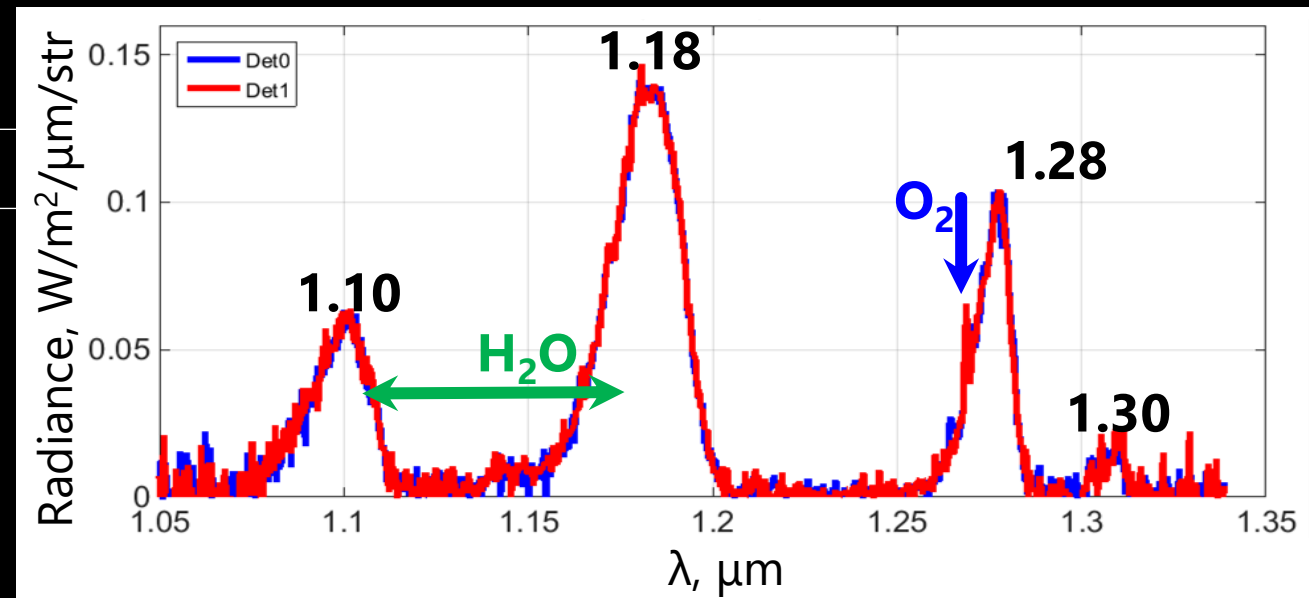
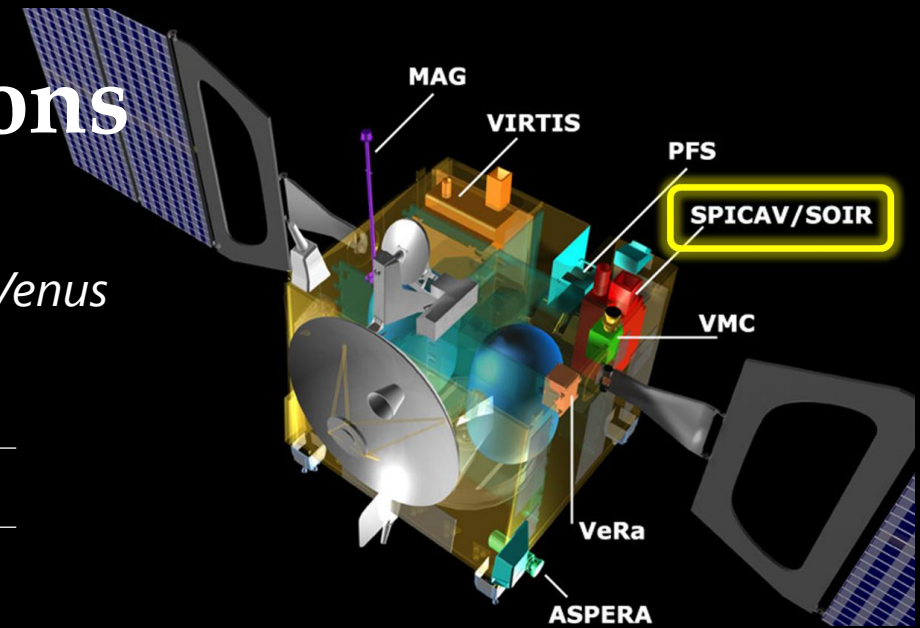
1.18 μm

1.28 μm

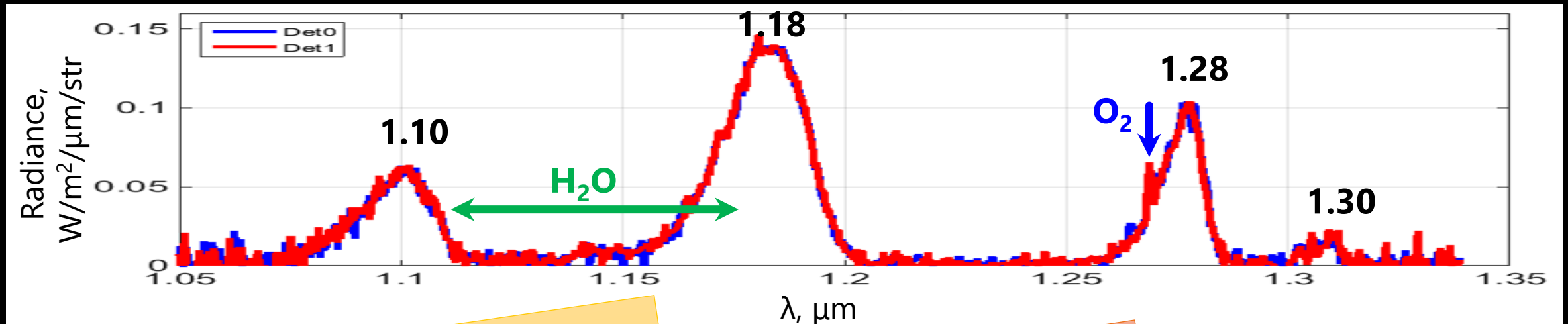
1.30 μm

Spectral resolution

5.2 cm^{-1}



Night windows: SPICAV IR spectrum



1.10-μm and 1.18-μm windows

- 0-15 km – sensitive to the surface
- H₂O
- scattering and absorption by aerosol

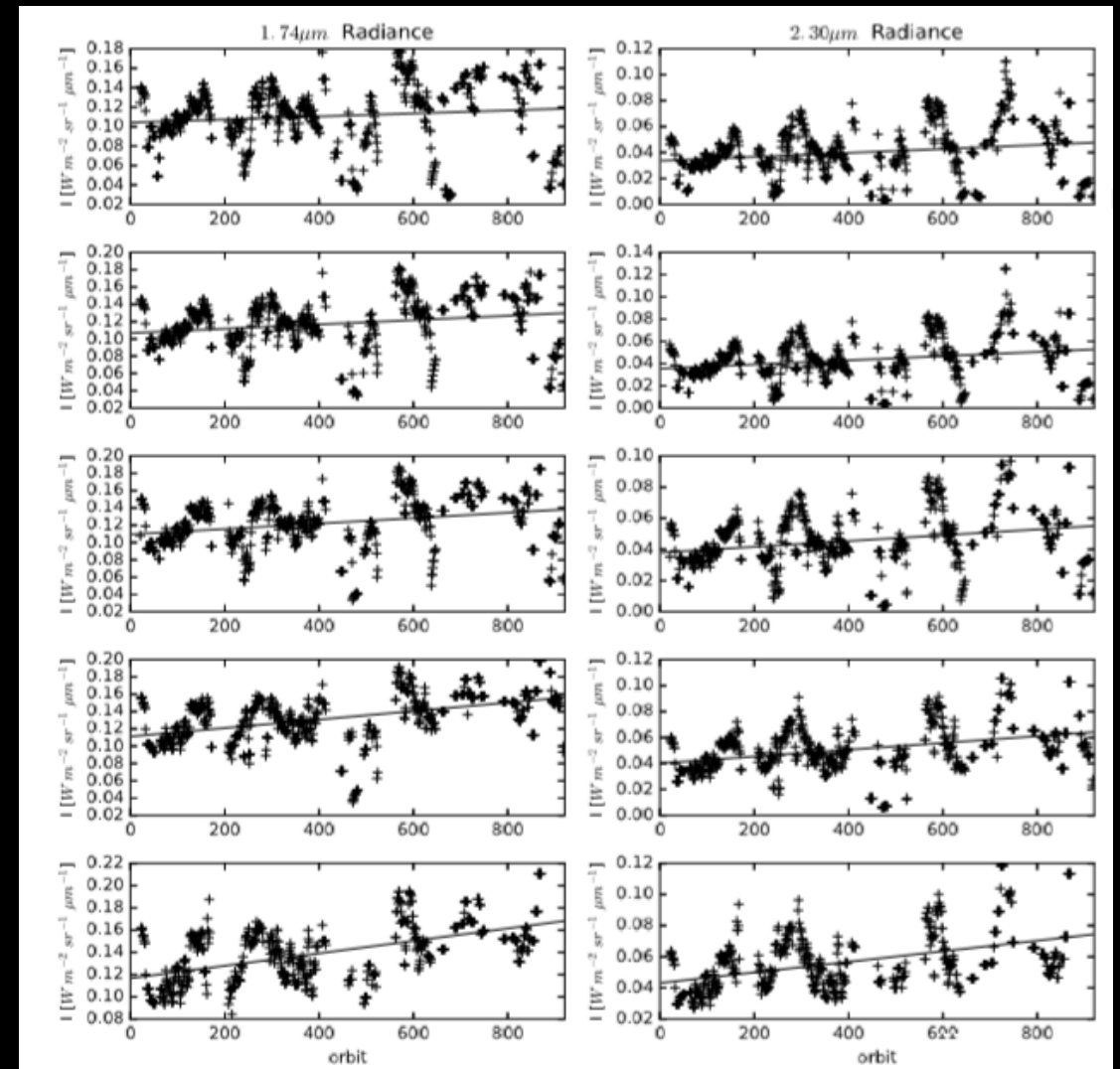
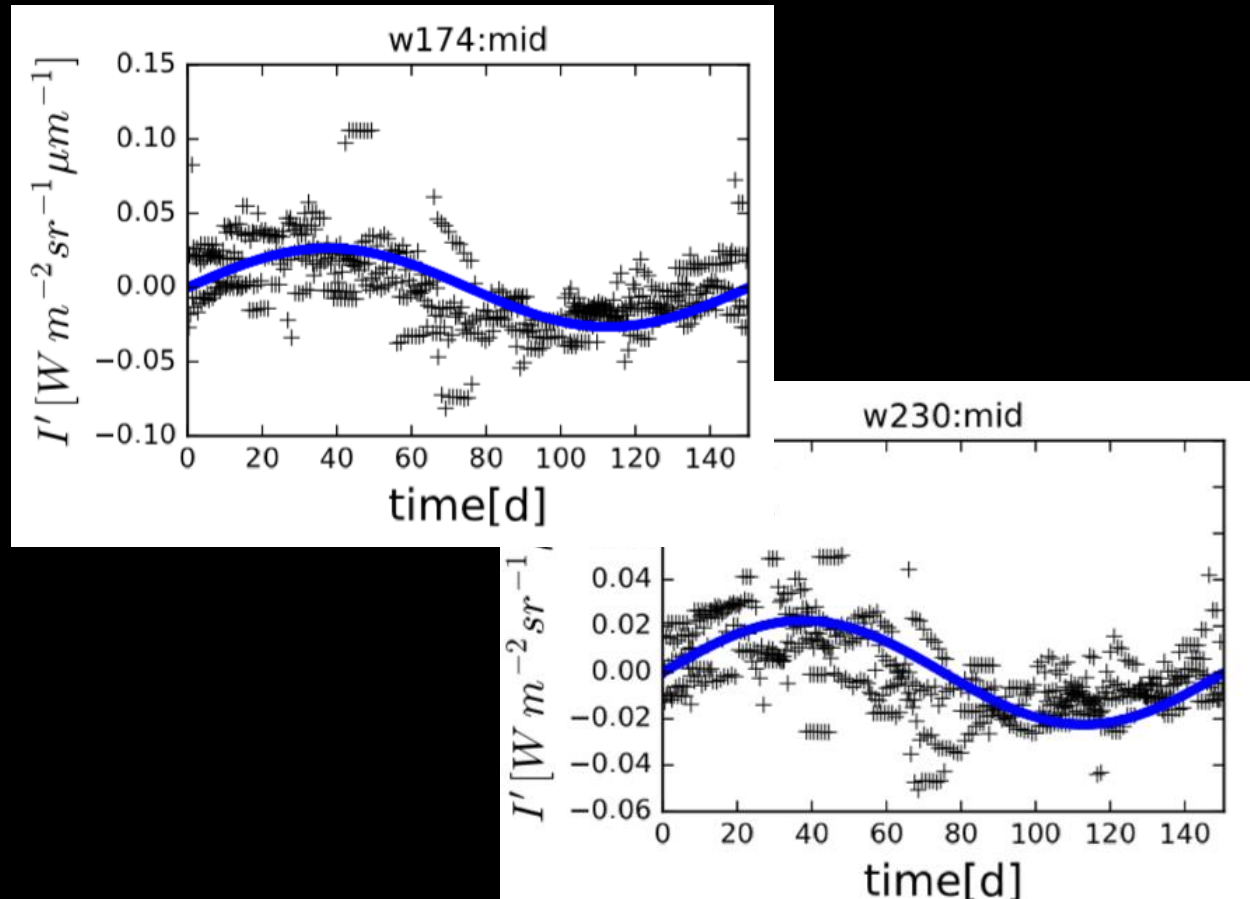
1.28-μm window

- 15-30 km
- scattering and absorption by aerosol
- O₂ airglow at 95 km

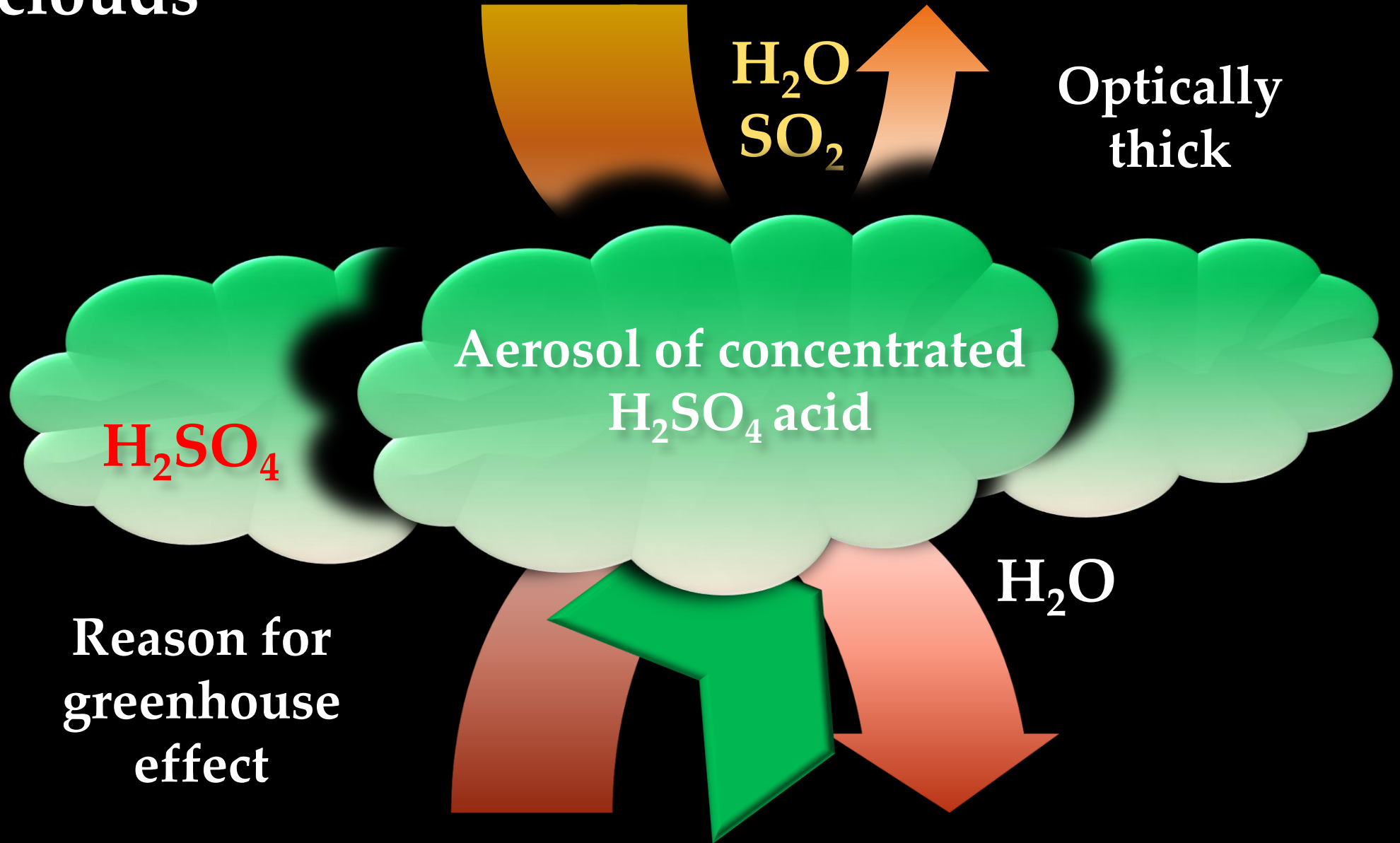
- ## 1.31-μm window
- scattering and absorption by aerosol

Night windows at 1.74 and 2.3 μm : VIRTIS/VEX

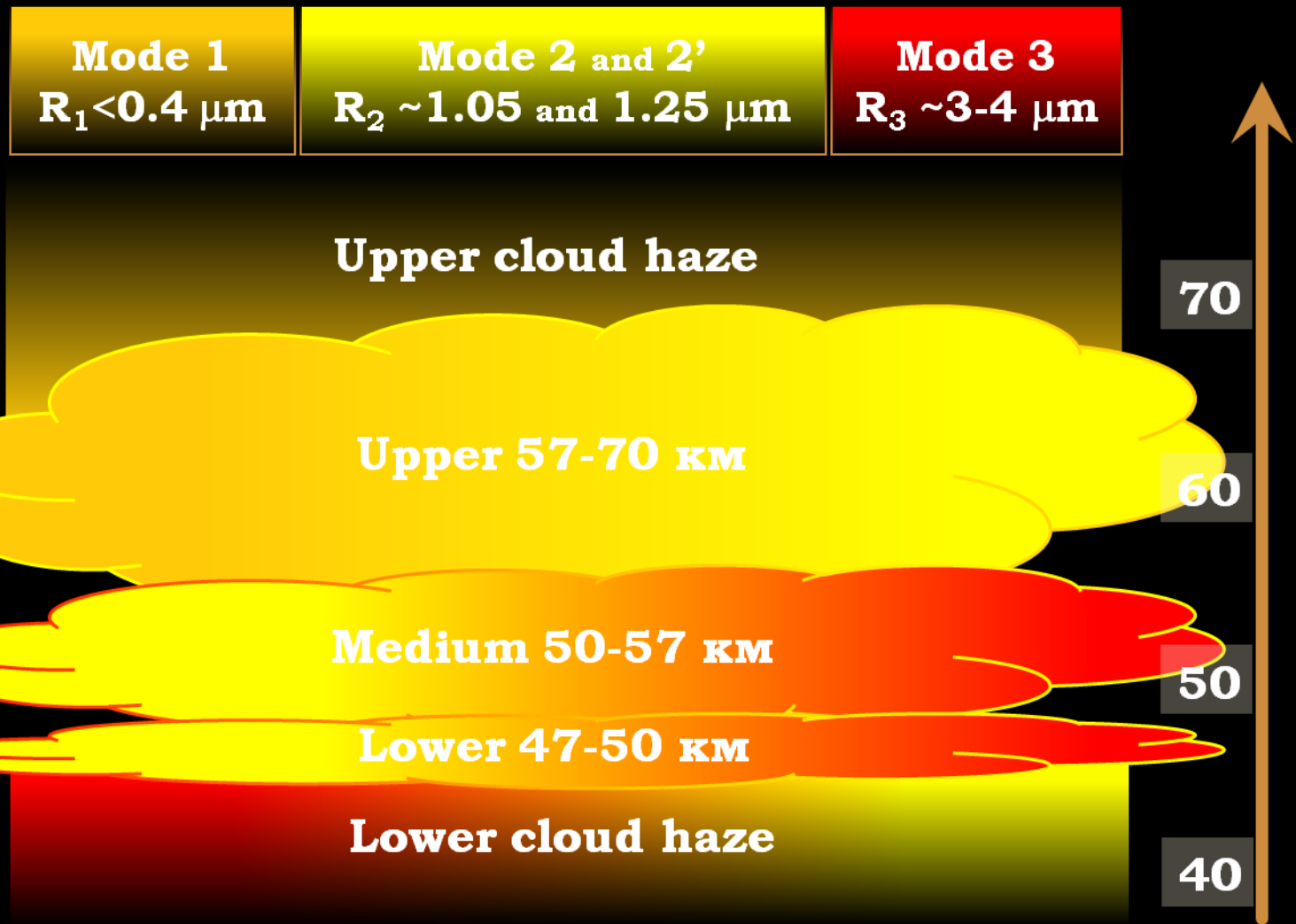
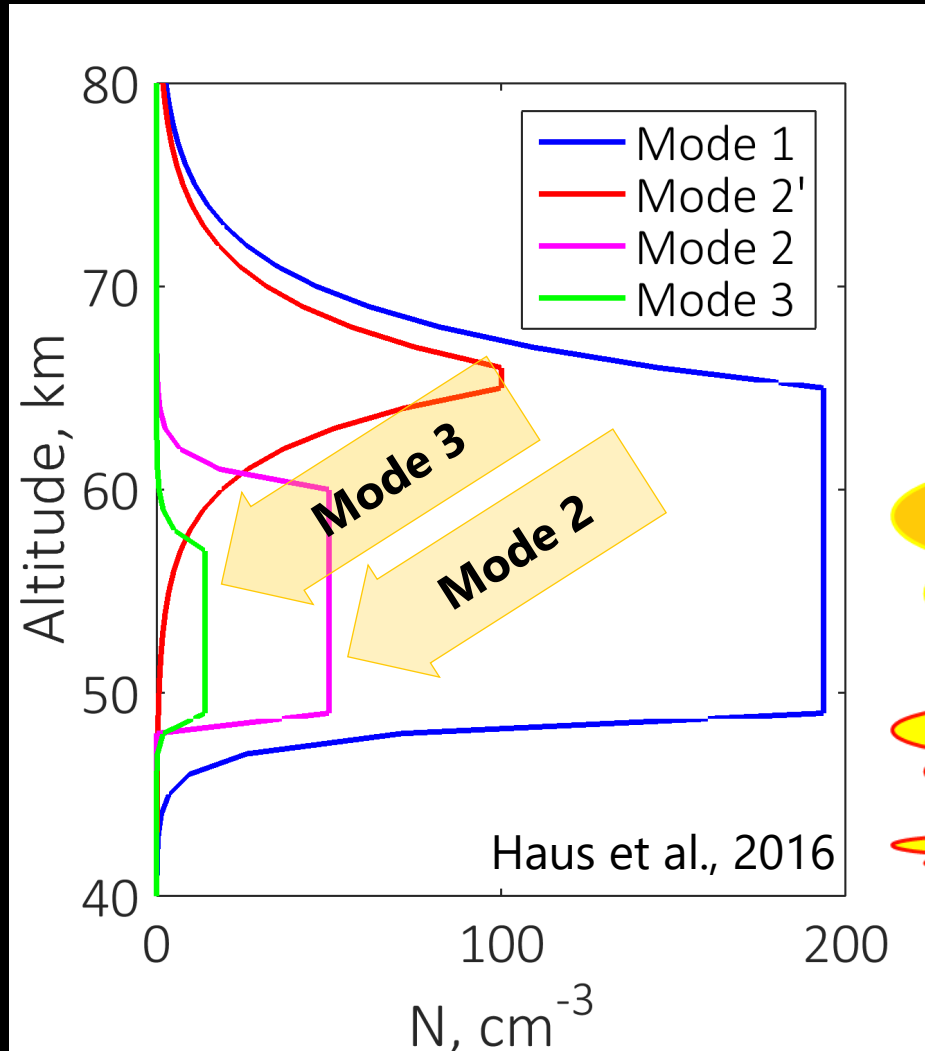
McGouldrick & Tsang, 2017



Venus clouds

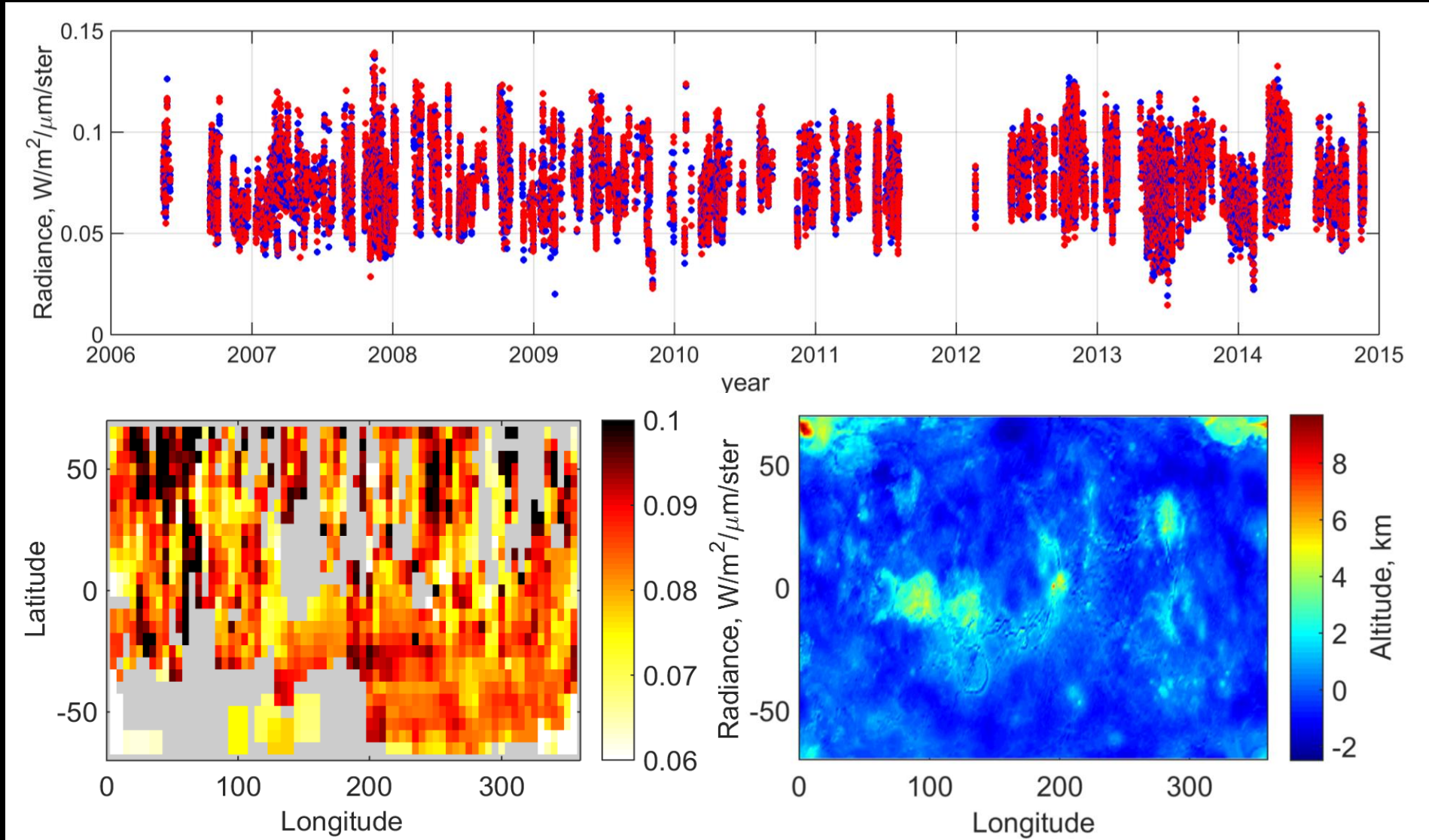
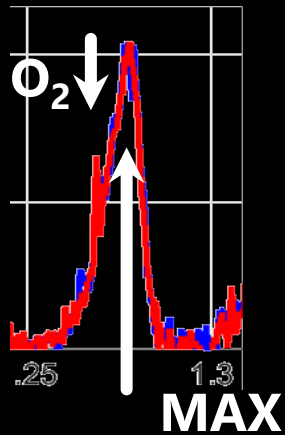


Clouds model



SPICAV IR night nadir observations

Fluctuations of **mean value of intensity** calculated in maximum of transparency window (1.277-1.280 μm)



Radiative transfer model with multiple scattering

Method

- **SHDOMPP** – method of spherical harmonical ordinates in plane parallel atmospheres [*Evans, 2007*]
- **Look-up table with the nearest minimum adjustment**

Model fixed parameters

- **Temperature and pressure** – **VIRA** [*Seiff, 1983*]
- **CO₂ lines** – «**High-T**» database [*Pollack, 1993*]
- **Clouds aerosol** – **75% H₂SO₄ solution**
- **CO₂ continuum factor** [*Fedorova et al., 2015*]
 - 1.28- μm – **$0.75 \cdot 10^{-9} \text{ cm}^{-1} \text{ amagat}^{-2}$** from $(0.30-0.78) \cdot 10^{-9} \text{ cm}^{-1} \text{ amagat}^{-2}$
 - 1.18- μm – **$0.38 \cdot 10^{-9} \text{ cm}^{-1} \text{ amagat}^{-2}$** from $(0.29-0.66) \cdot 10^{-9} \text{ cm}^{-1} \text{ amagat}^{-2}$

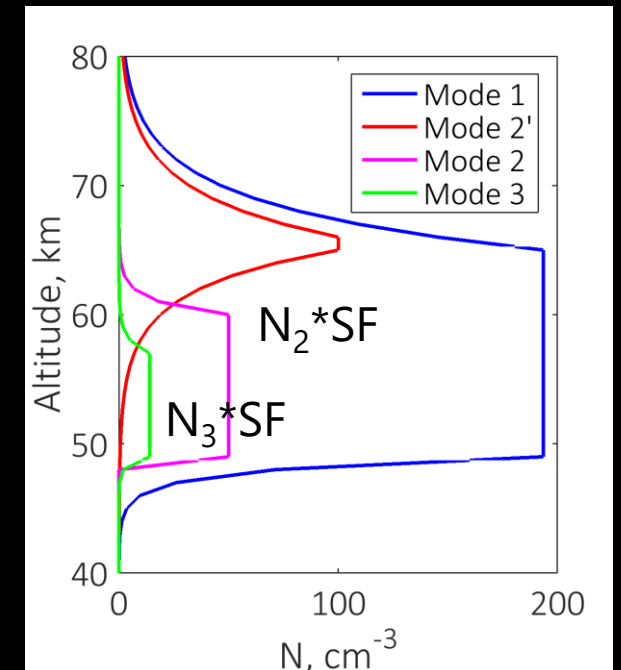
Radiative transfer model with multiple scattering

Method

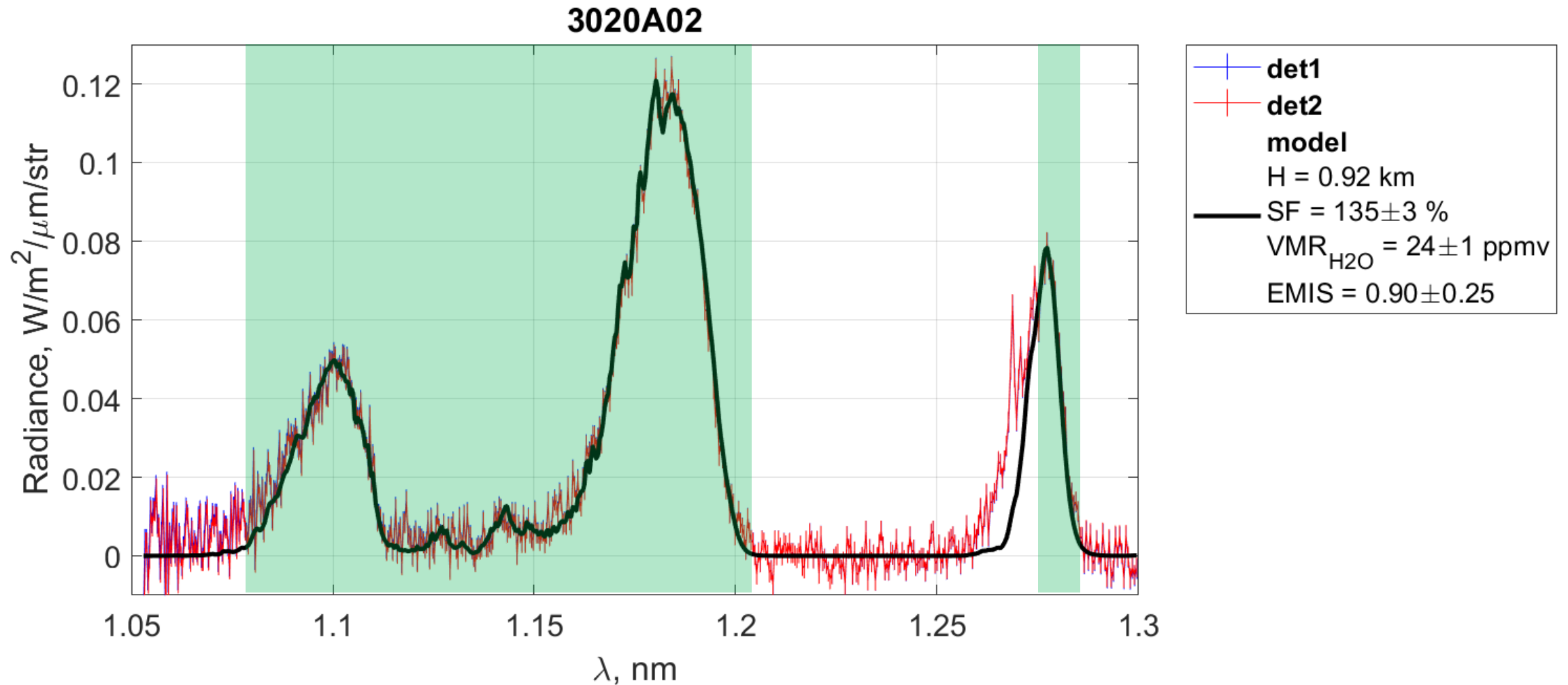
- **SHDOMPP** – method of spherical harmonical ordinates in plane parallel atmospheres [Evans, 2007]
- **Look-up table with the nearest minimum adjustment**
SF – 5%, H₂O – 2 ppmv, EMIS – 0.05

Model fitting parameters

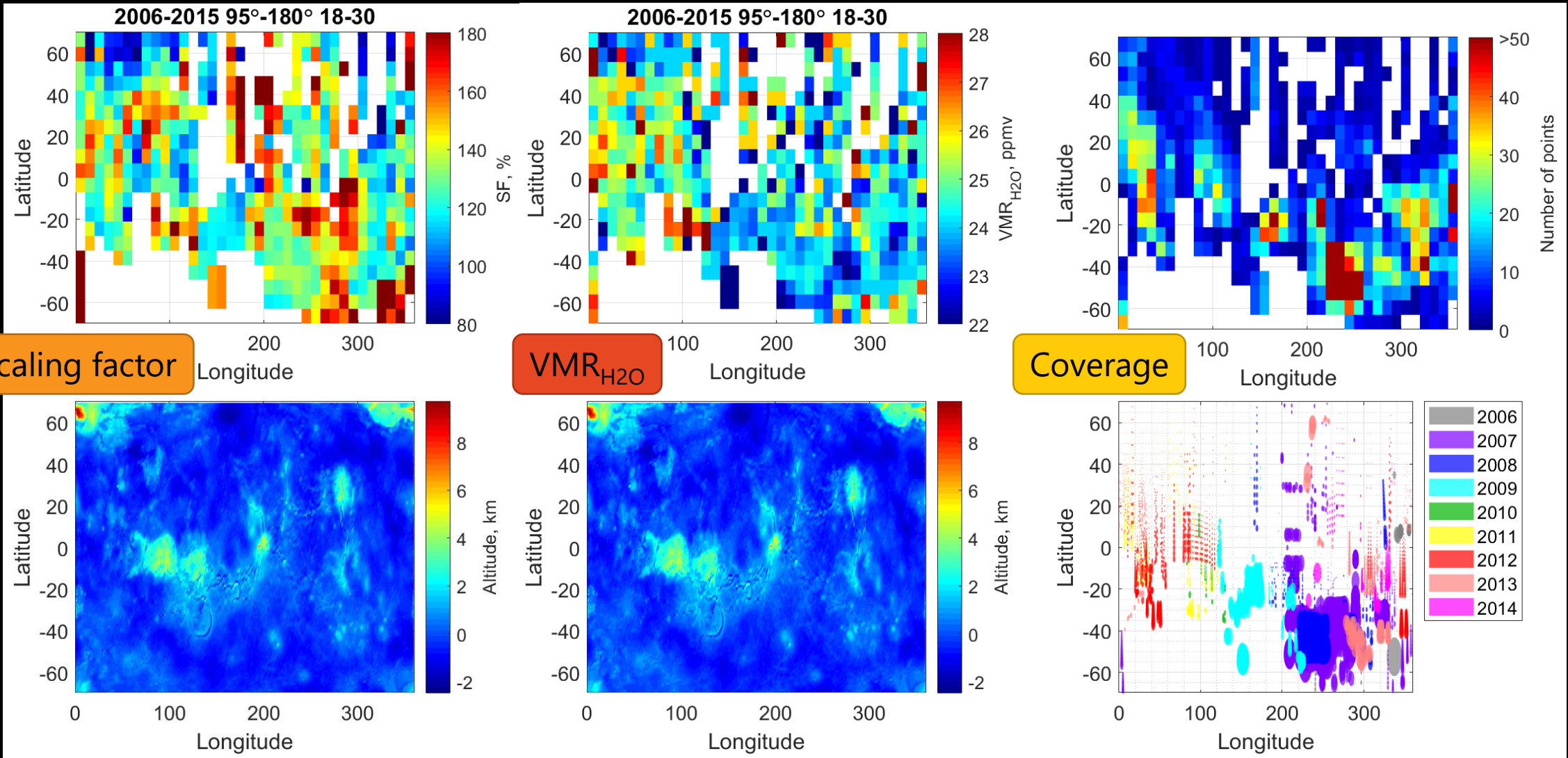
- **Common scaling factor** applied to concentration profiles of mode 2 and 3
- **H₂O mixing ratio**
H₂O lines – the BT2 linelist [Barber et al., 2006]
- **Common surface emissivity**



Radiative transfer model with multiple scattering



Preliminary results



Conclusions

- SPICAV IR observations show in the 1.28 μm transparency window that emission intensity is changing in range from 0.05 to 0.1 $\text{W}/\text{m}^2/\mu\text{m}/\text{sr}$
- Geographical distribution of window intensity does not exhibit any trends.
- Preliminary retrievals of water vapor VMR below clouds seems uniform and constant at 24.5 ± 2 ppmv
- Preliminary retrievals of cloud opacity show some spatial variability yet to understand.