RETRIEVALS OF OZONE AT THE TERMINATOR OF MARS FROM SPICAM/MEX SOLAR OCCULTATIONS

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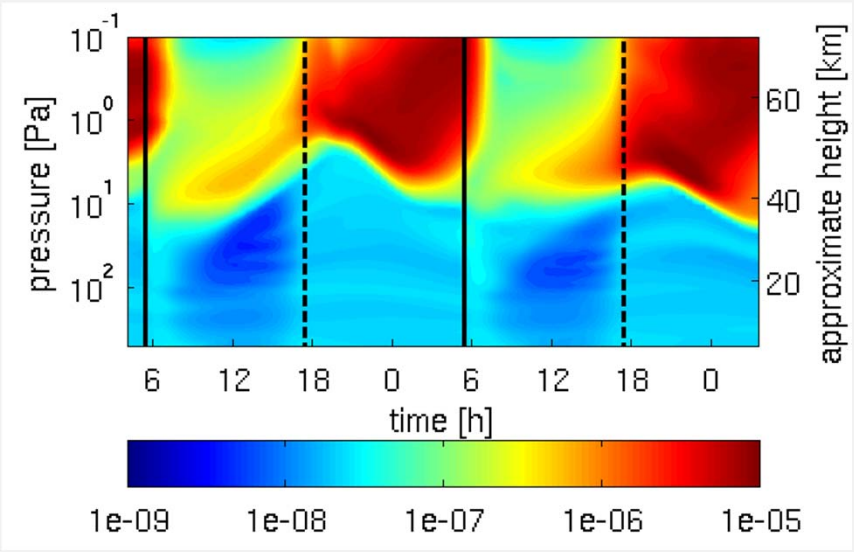
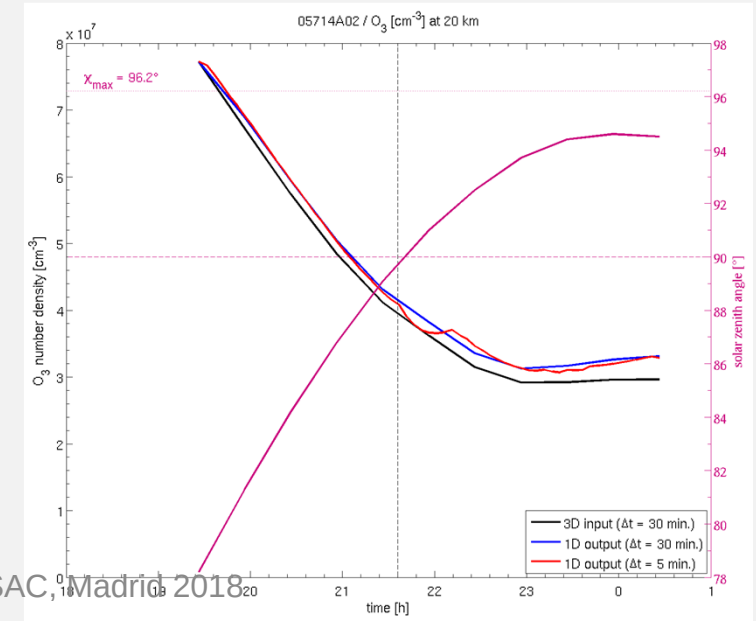
Martian atmosphere @the terminator

Diurnal cycle of ozone (3D GCM)

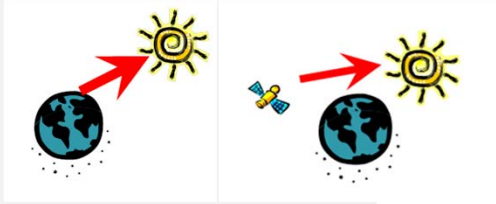


Ozone at sunrise terminator (1D model)

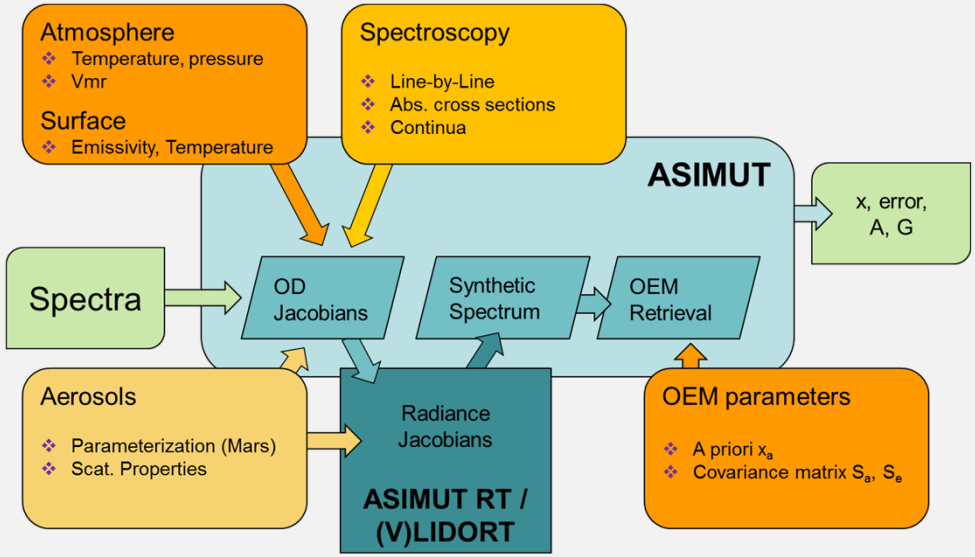


- Atmosphere simulated by the **GEM-Mars GCM (**Neary, L. et al., 2017).
  - complex photochemistry driven by the solar illumination
  - **rapid timescales of photochemistry at sunrise and sunset**
  - Ozone (O3) is more abundant during the nighttime, especially above 40-50 km.
  - As the Sun rises, the destruction of O_3, although stronger in the high atmosphere, is observed at all altitudes.
- **Comparison of the model results of a 3D-GCM & a 1D model** using a short time step
  - At 20 km, the agreement between the three model ozone fields is fairly good.
  - A disagreement can be found at other altitudes, which is due to the **inability of the 1D model to describe the horizontal transport of ozone**.
  - Recent improvements of the **3D GCM** (e.g. implementation of the Kinetic PreProcessor (KPP) and of a correct calculation of the slant path) make it more appropriate for interpreting the observations of ozone around the terminator.

ASIMUT



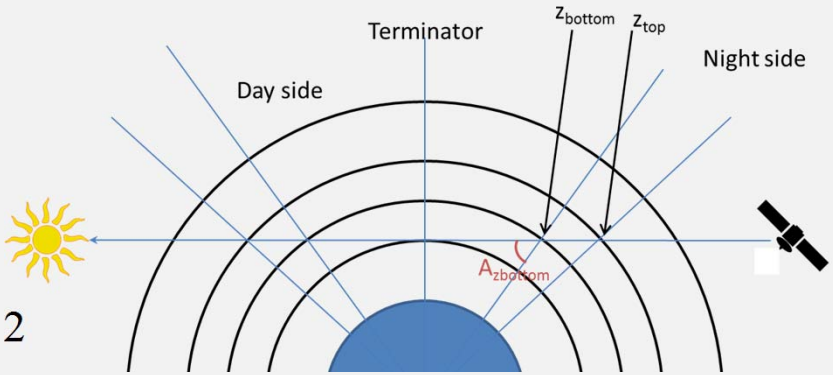
- Possibility to retrieve columns and/or profiles of atmospheric constituents simultaneously from different spectra , different geometries



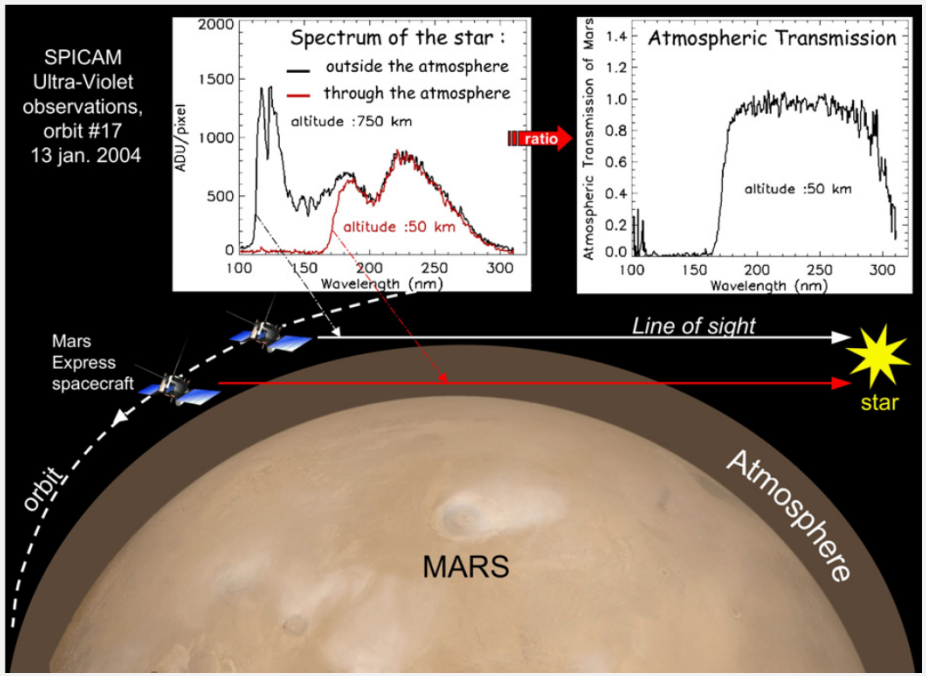
- New improvement: consider the gradients across the terminator:
  - Temperature and total density gradients
  - Density gradient for specific species (here: O_3)

$LST_z = LST_{Terminator}$ + Correction(A(z), D/N side)
Interpolation of T and N at LST_z

$$OD_{Layer\ i}^{species\ k} = \left[OD_i^k(T_i^{Day}) \times N_{k,i}^{Day} + OD_i^k(T_i^{Night}) \times N_{k,i}^{Night} \right] / 2$$



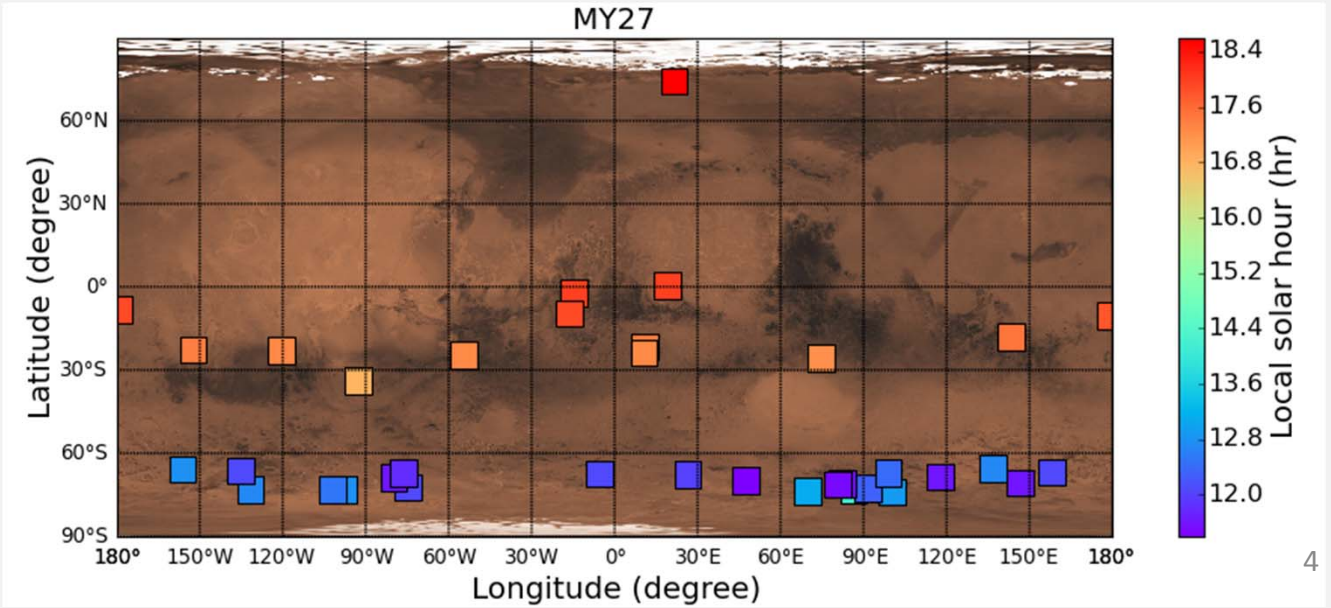
SPICAM solar occultations



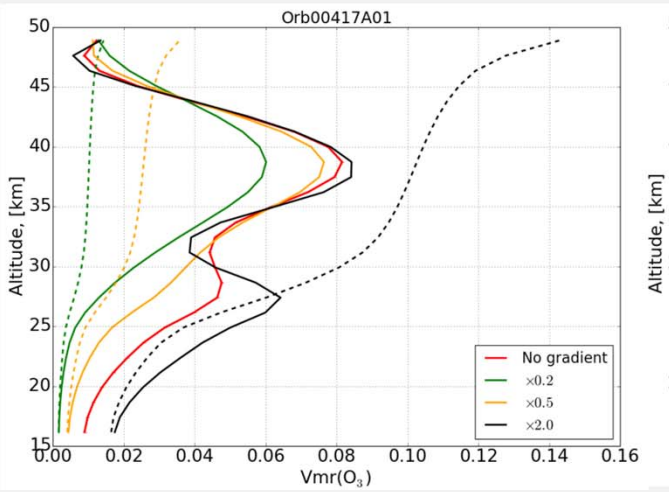
New transmittances calculation

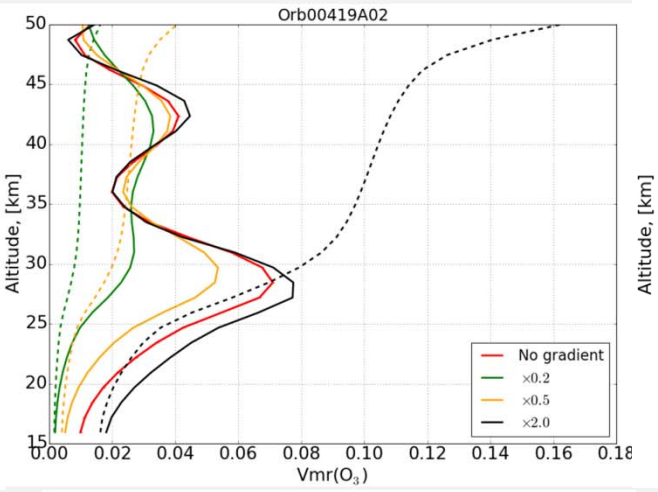
- Improved way of defining the '**Solar Reference**' spectrum
- To avoid transmittances >1
- Same method as in Trompet et al., 2016

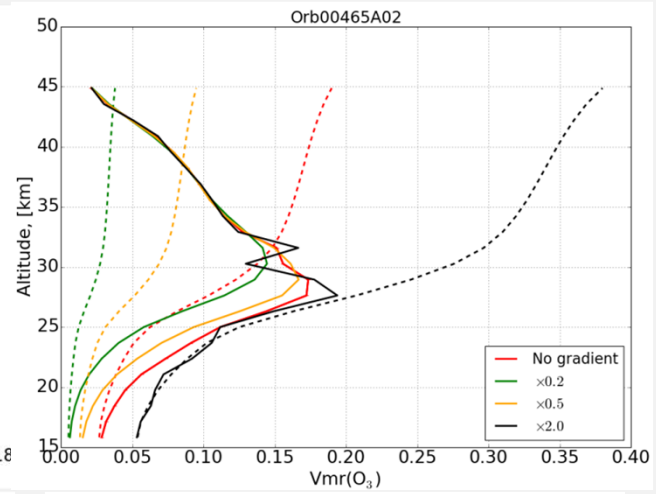
- **36** Solar occultations for MY 27

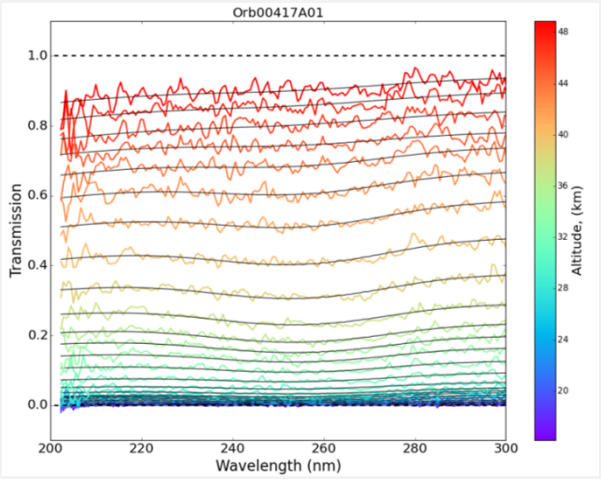


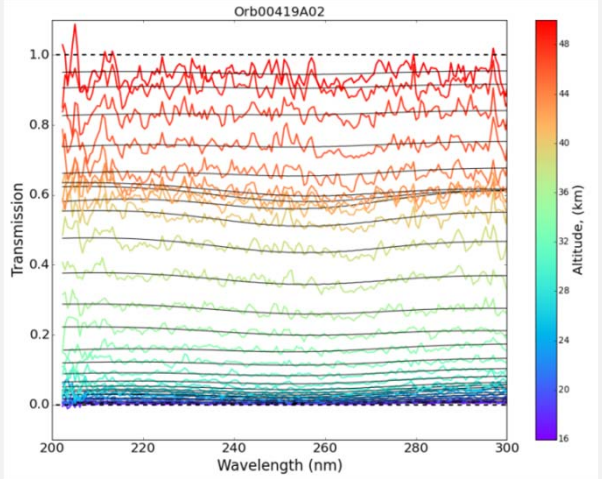
O_3 retrieval (without gradients)

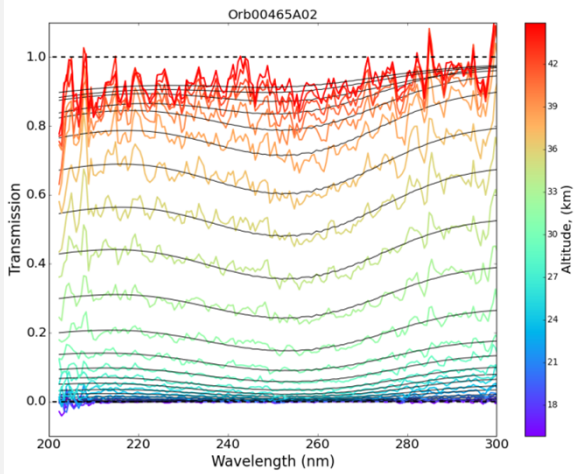




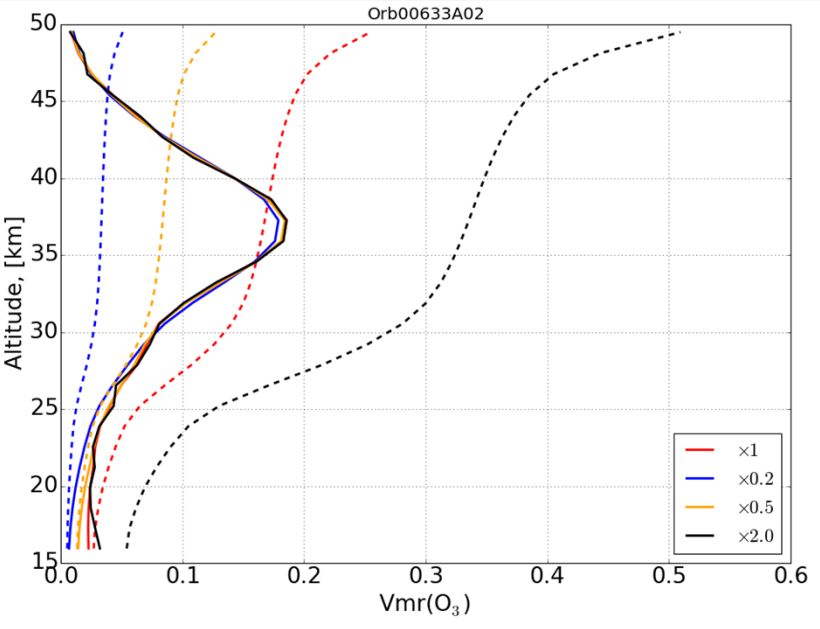


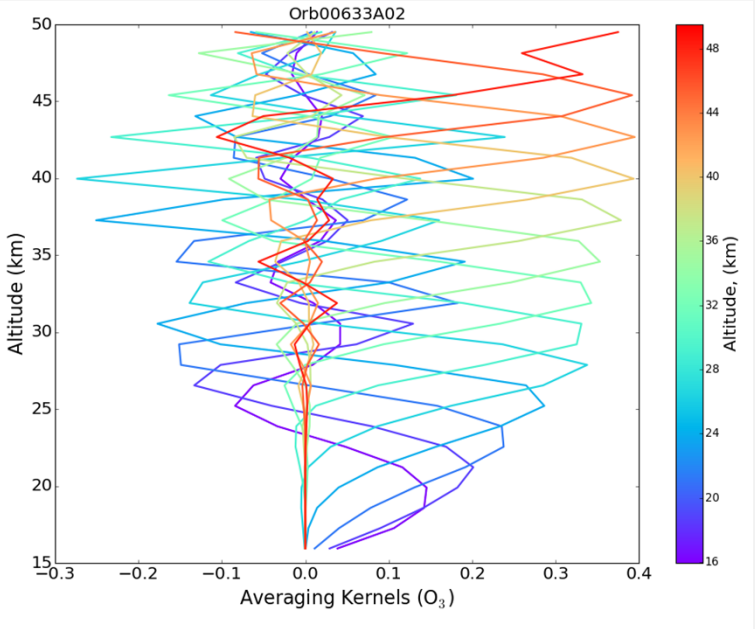


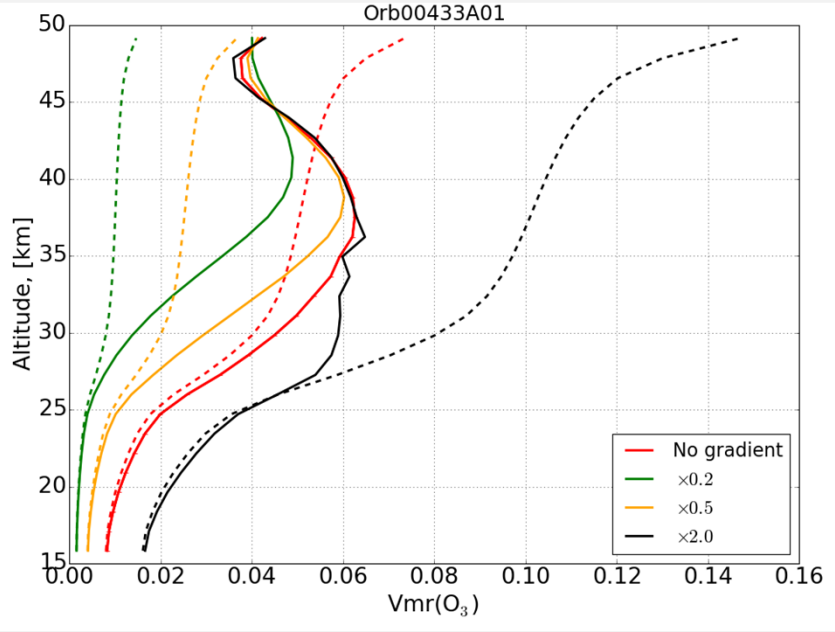


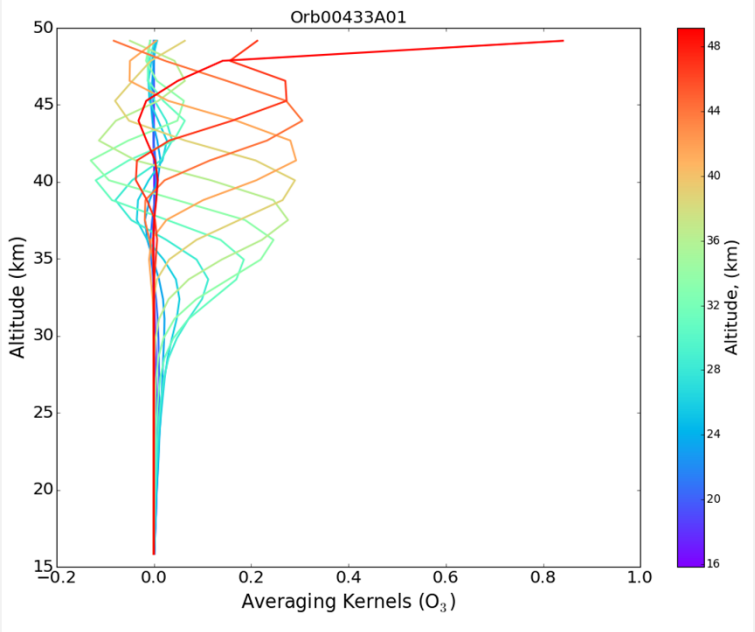


O_3 retrieval (without gradients)

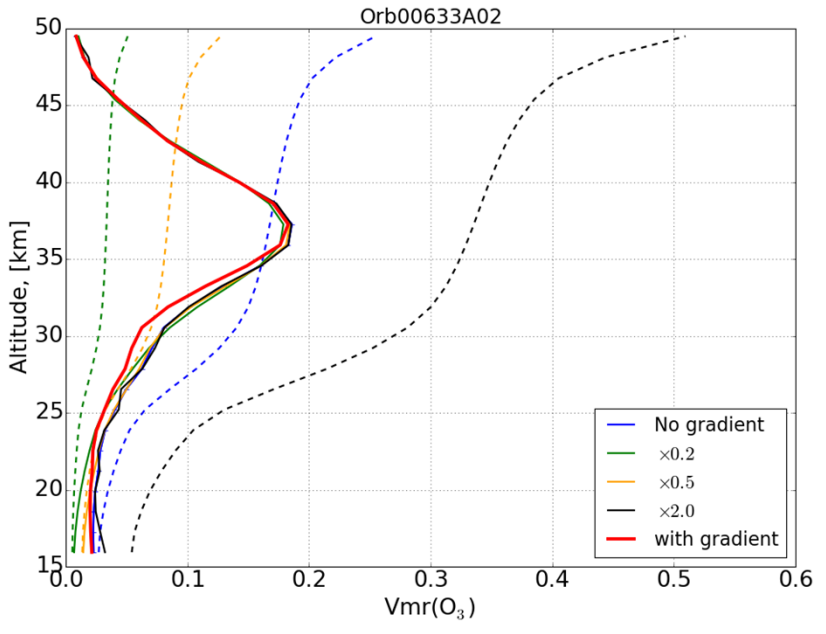


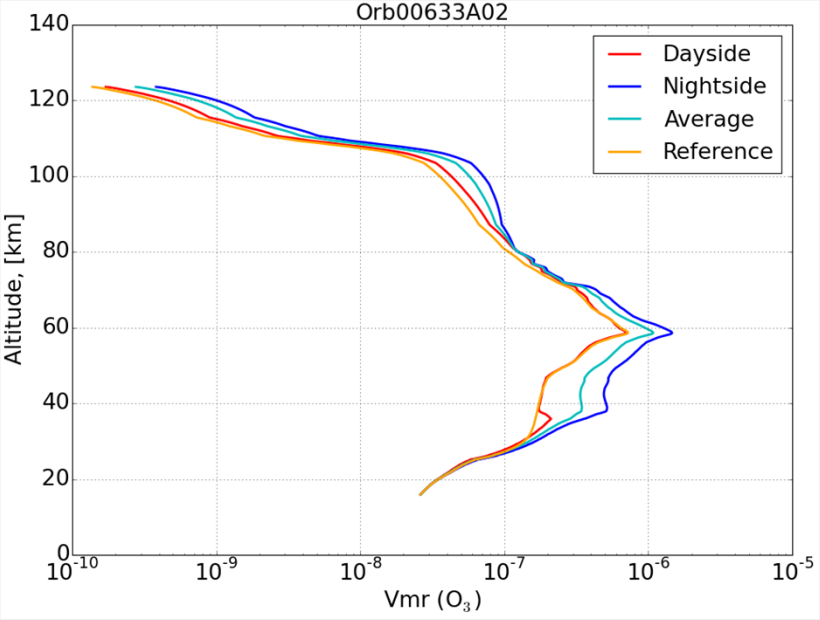


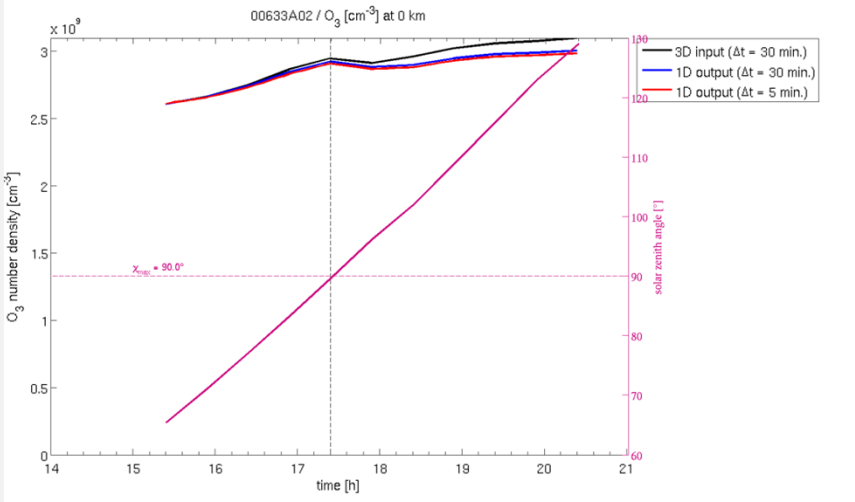


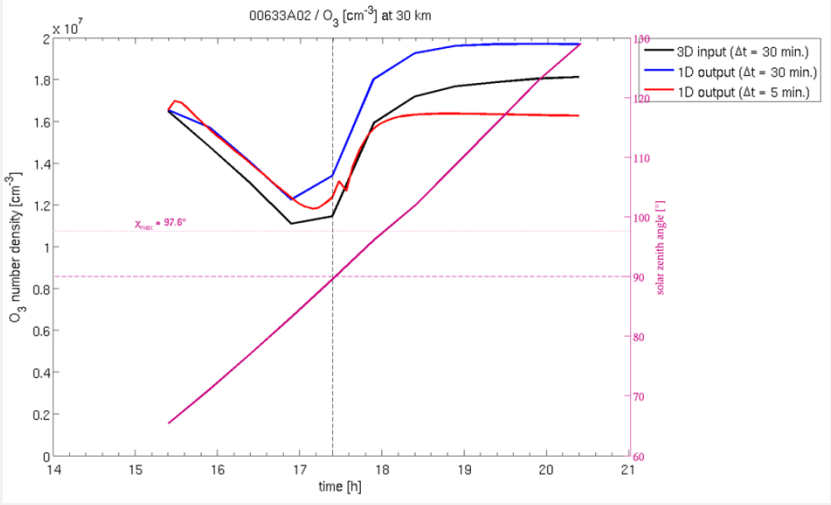


O_3 retrieval (with gradients T & O_3)

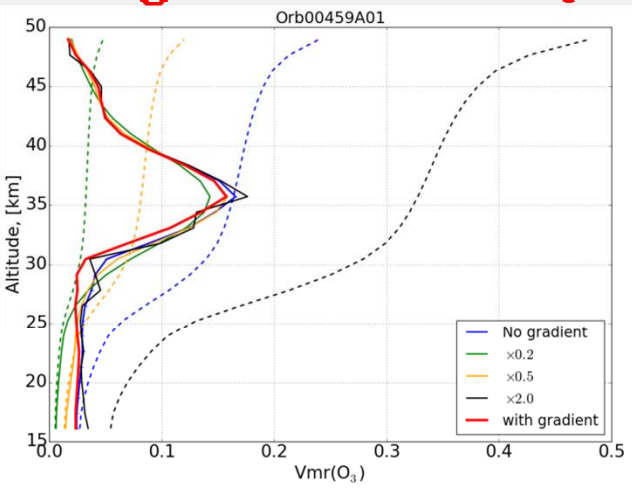


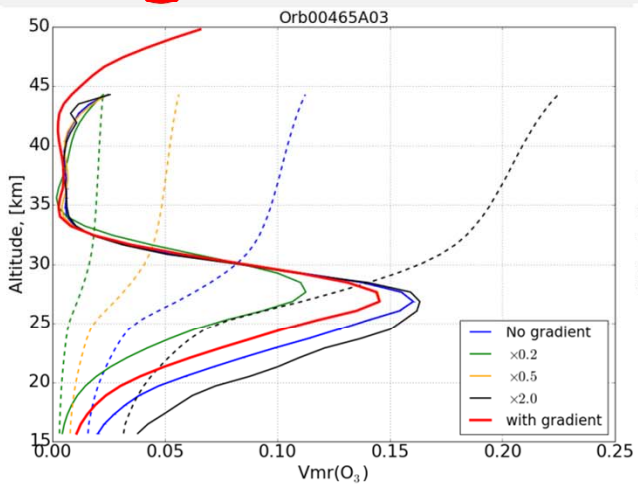


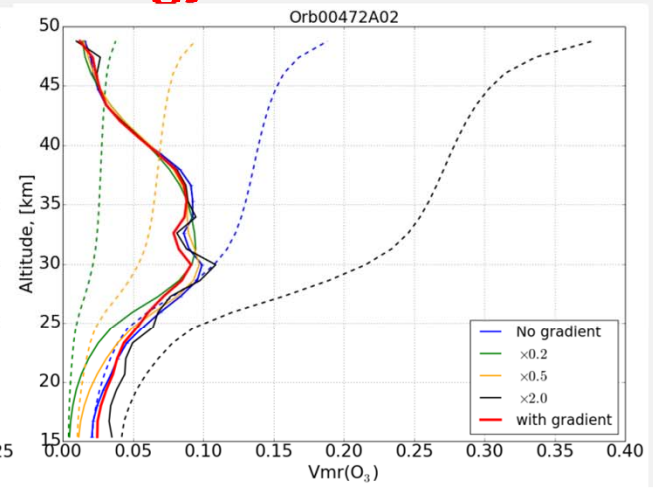


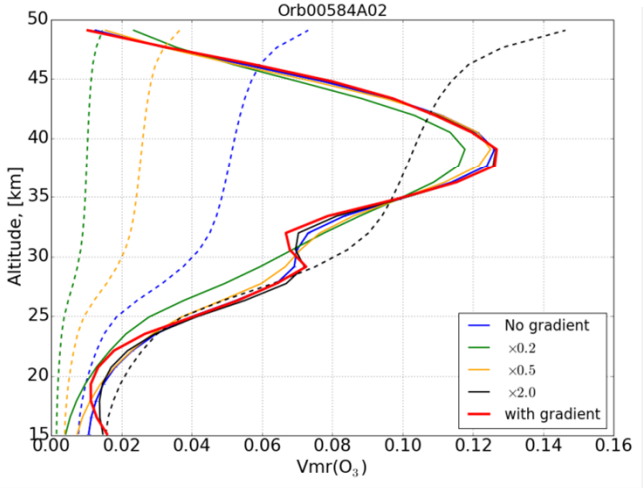


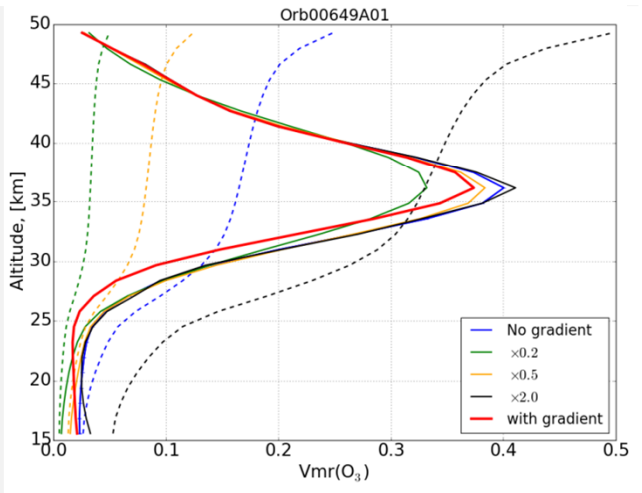
O_3 retrieval (with gradients T & O_3)

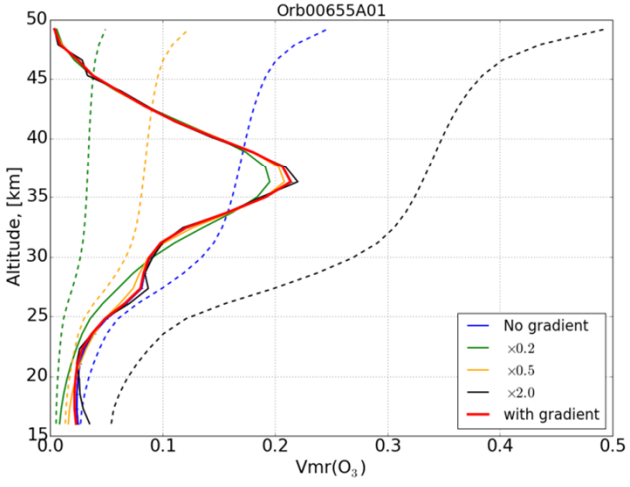












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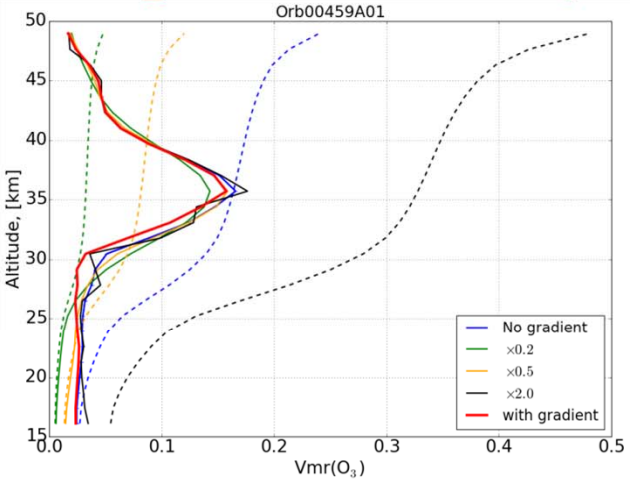
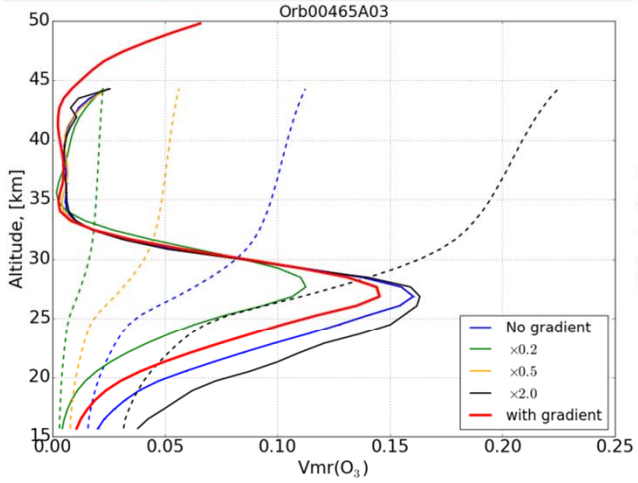
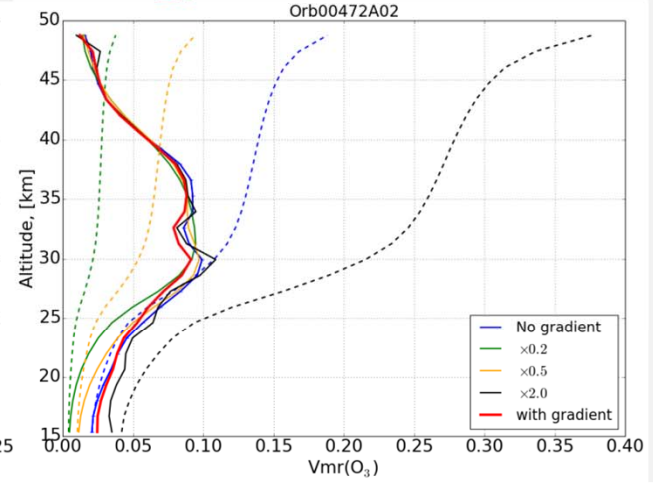
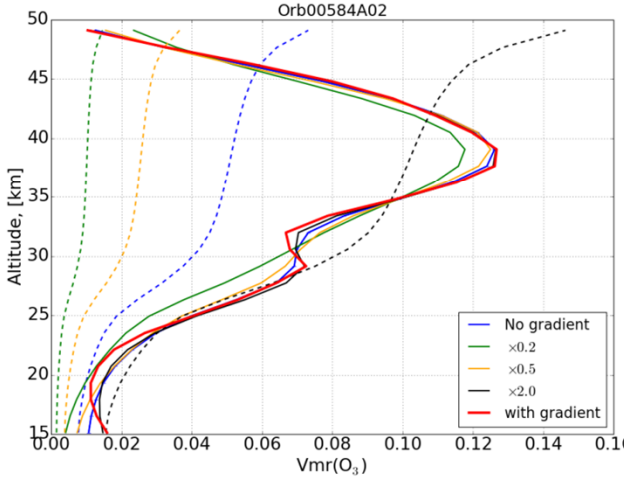
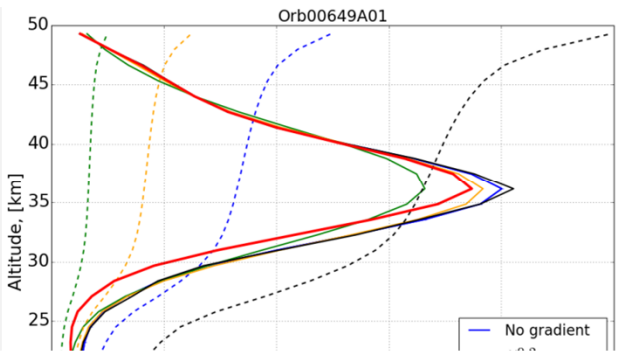
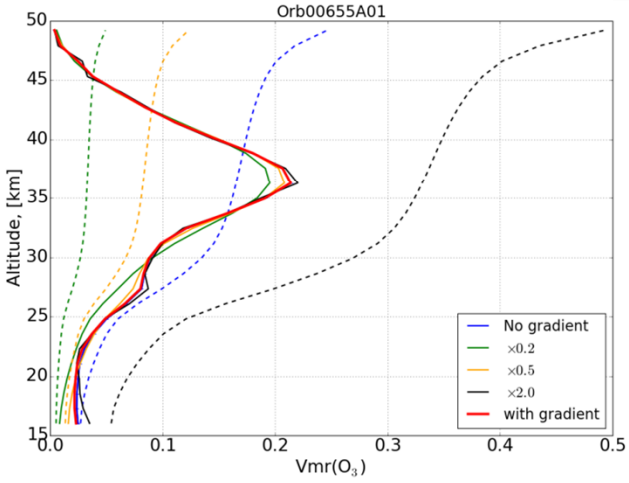


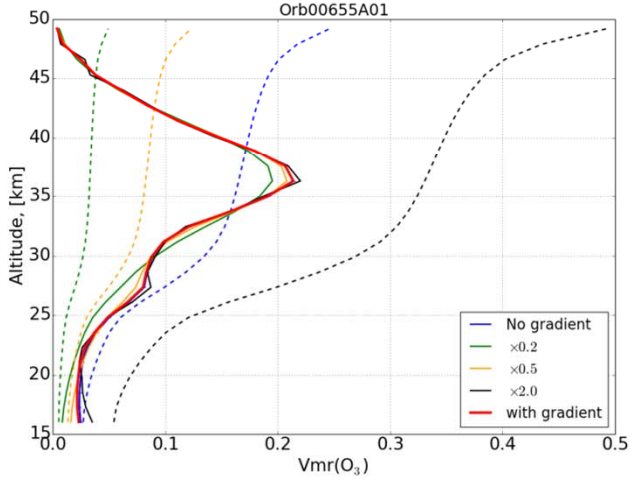












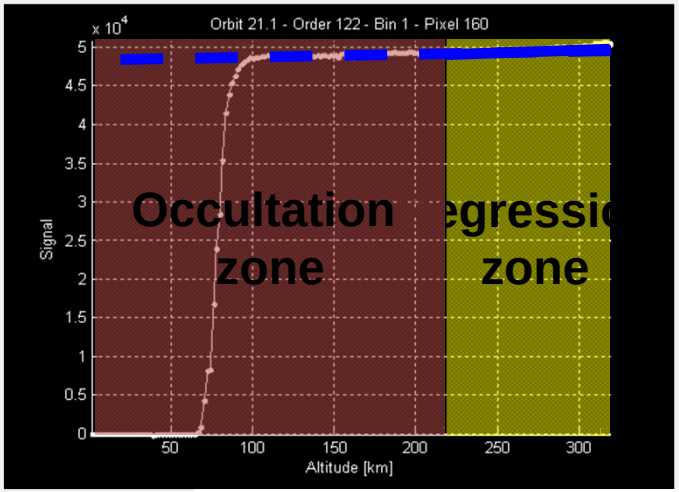
Conclusions & Future Work

- We implemented the Radiative Transfer Model used at BIRA-IASB, **ASIMUT**, to better take into account the temperature, pressure and O_3 gradients across the terminator predicted by GCM.
- **Transmittances** were calculated using a **new method previously** used for SOIR/Vex (Trompet et al. 2016).
- As first step, we retrieved **O_3 profiles without** taking in account **gradients** (results in agreement with previous studies).
  - Tested sensitivity to a priori profiles (converge between **20-45 km altitude**).
- **Retrievals of O_3 taking in account gradients:**
  - O_3 gradient has an impact on the retrieval
  - O_3 (with gradients) are systematically lower than profiles without considering gradients.
- **Future work:**
  - Sensitivity studies to investigate fully the impact of the gradients on the retrieval.
  - Analyze the whole SPICAM database
  - We will compare the slant profiles from SPICAM LATMOS with the results from the work by BIRA-IASB.

Task 6.2 : "New retrieval of SPICAM solar occultation observations" (IASB, CNRS)

New transmittances calculation

- Improved way of defining the '**Solar Reference**' spectrum



Criteria

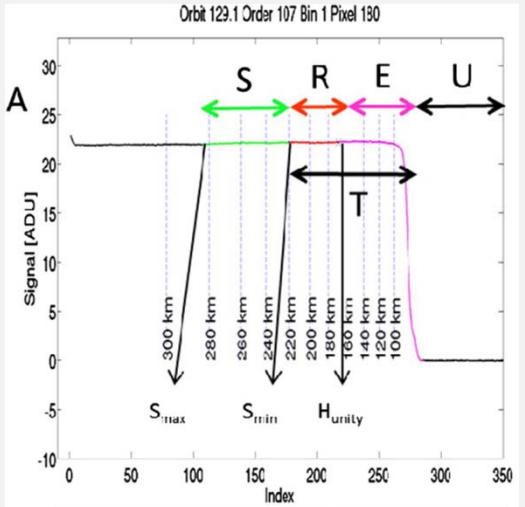
$$|1 - \mathrm{Tr}(i)| < f * \delta\mathrm{Tr}(i) \qquad i \in R,$$

$$\delta\mathrm{Tr}(i) < \frac{1}{\mathrm{SNR}_{\min}} \qquad i \in R,$$

$$\delta\mathrm{Tr}(i) < f * \mathrm{std}(\mathrm{Tr}(R)) \qquad i \in R,$$

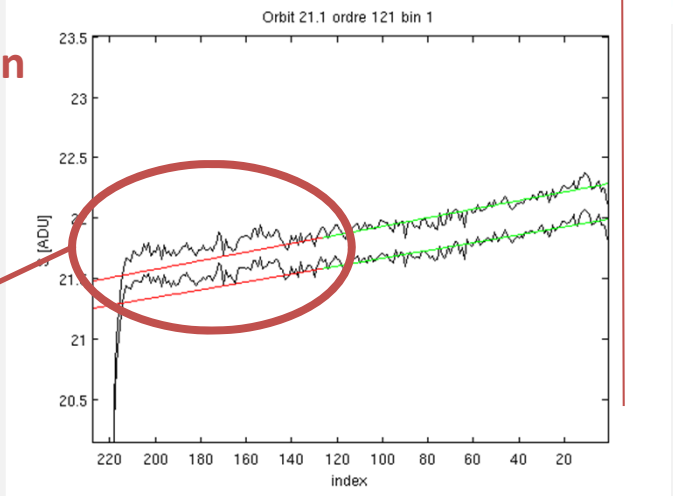
$$\mathrm{Tr}(i) - 1 < f * \delta\mathrm{Tr}(i) \qquad i \in E,$$

$$|1 - \mathrm{Tr}(H_{\mathrm{unity}})| < f * \delta\mathrm{Tr}(H_{\mathrm{unity}}),$$



Trompet et al., 2016

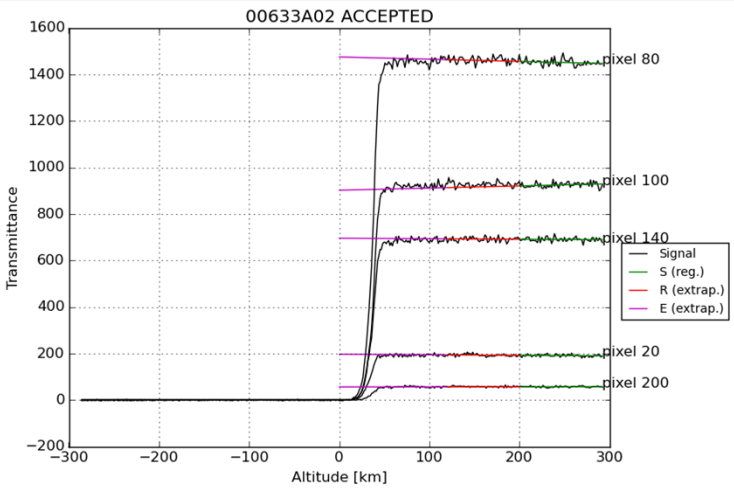
OLD situation

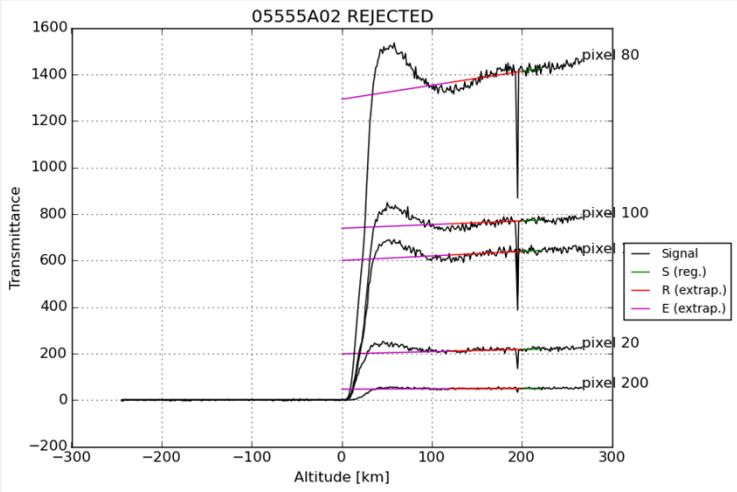


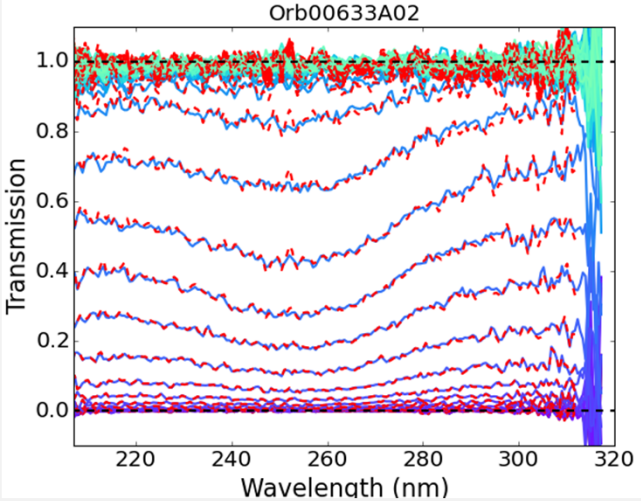
Transmittance values are > 1

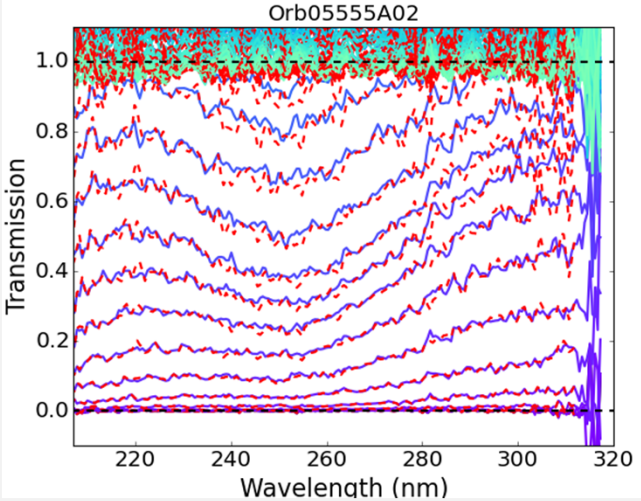
Task 6.2 : “New retrieval of SPICAM solar occultation observations” (IASB, CNRS)

New transmittances calculation



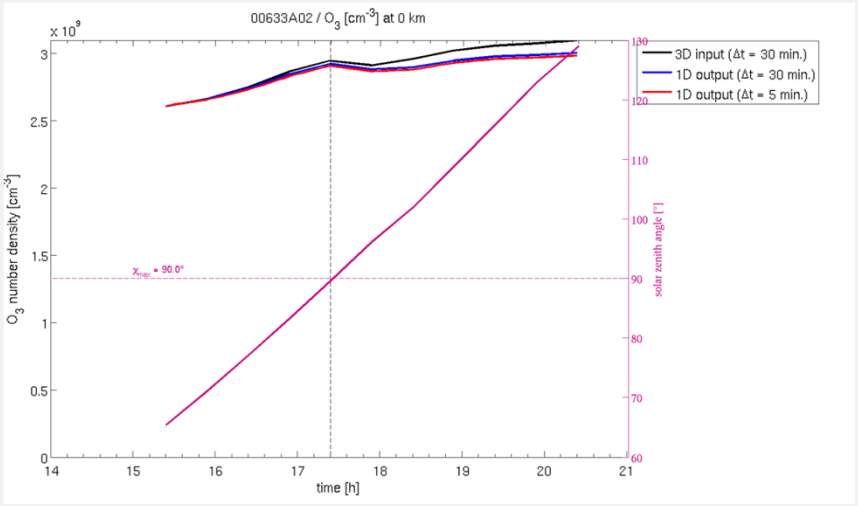


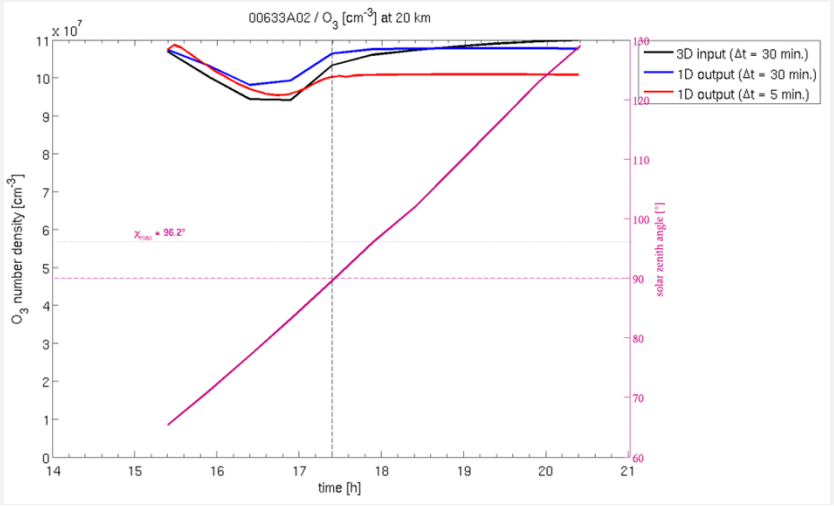


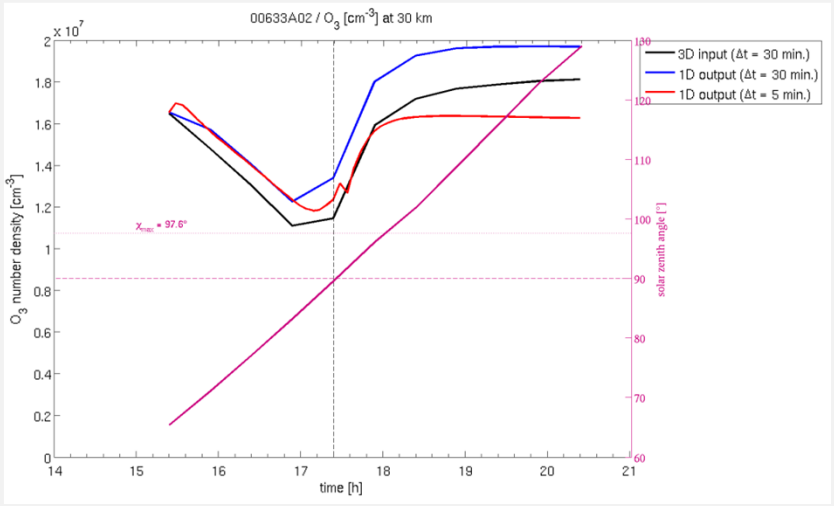


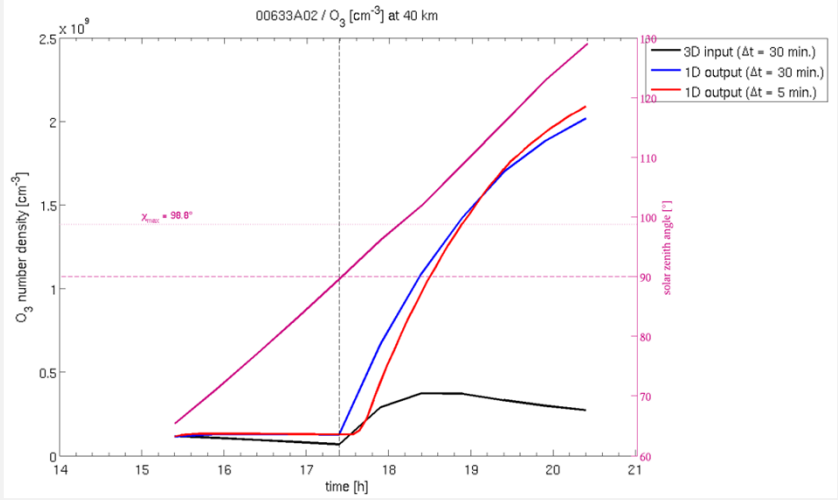
Task 6.2 : “New retrieval of SPICAM solar occultation observations” (IASB, CNRS)

O_3 retrieval (with gradients Temperature & O_3)









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