First year of observations from TGO/NOMAD UVIS: retrievals of ozone on Mars

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(**Twitter**: **@apic79**)

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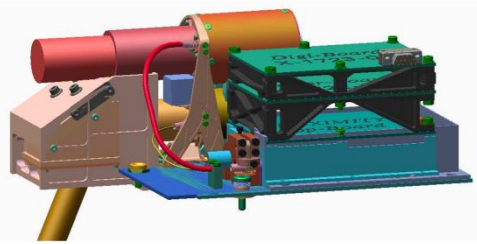
UVIS solar occultations



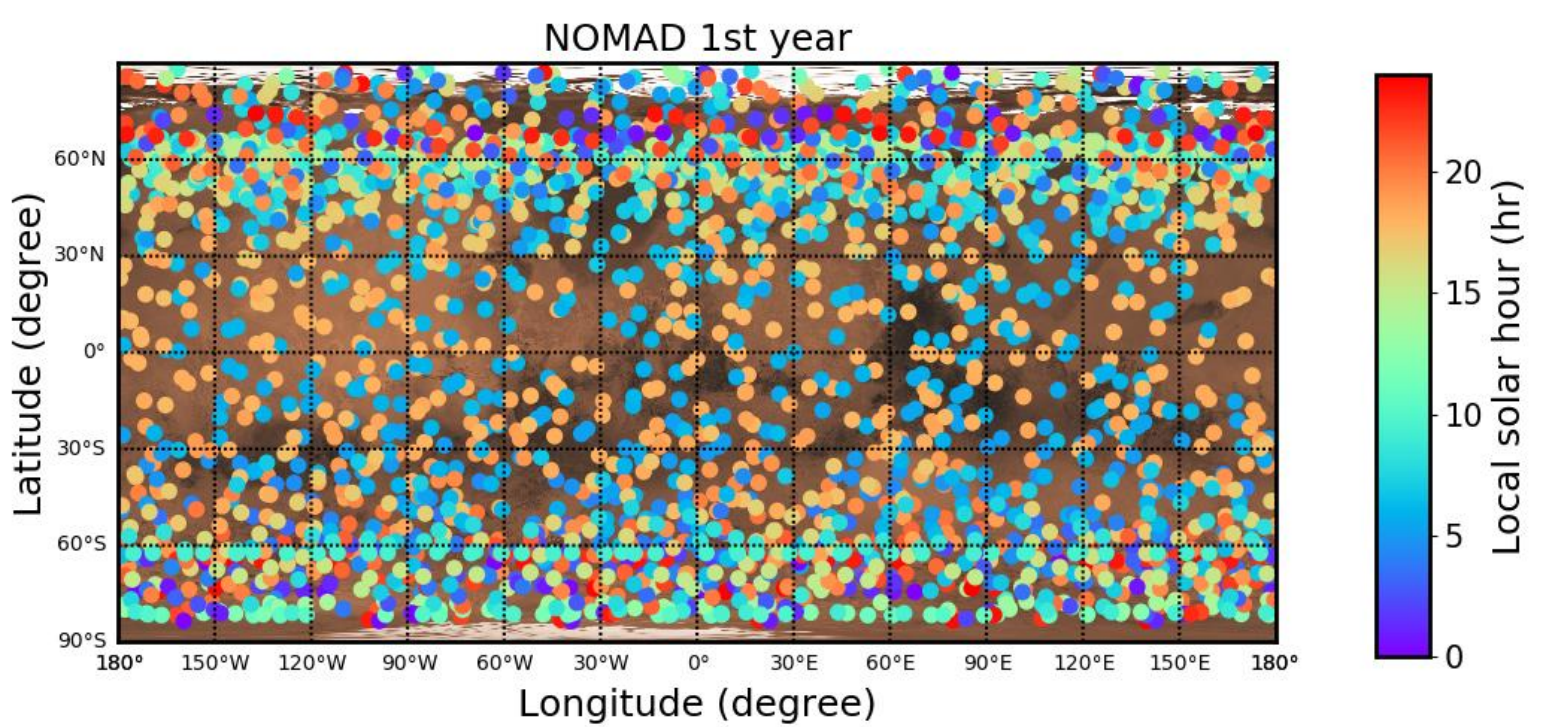
UVIS channel

- *Nadir and **Solar occultation***
- ***Climatology of Ozone**, UV level*
- *Dust, clouds*

UVIS channel

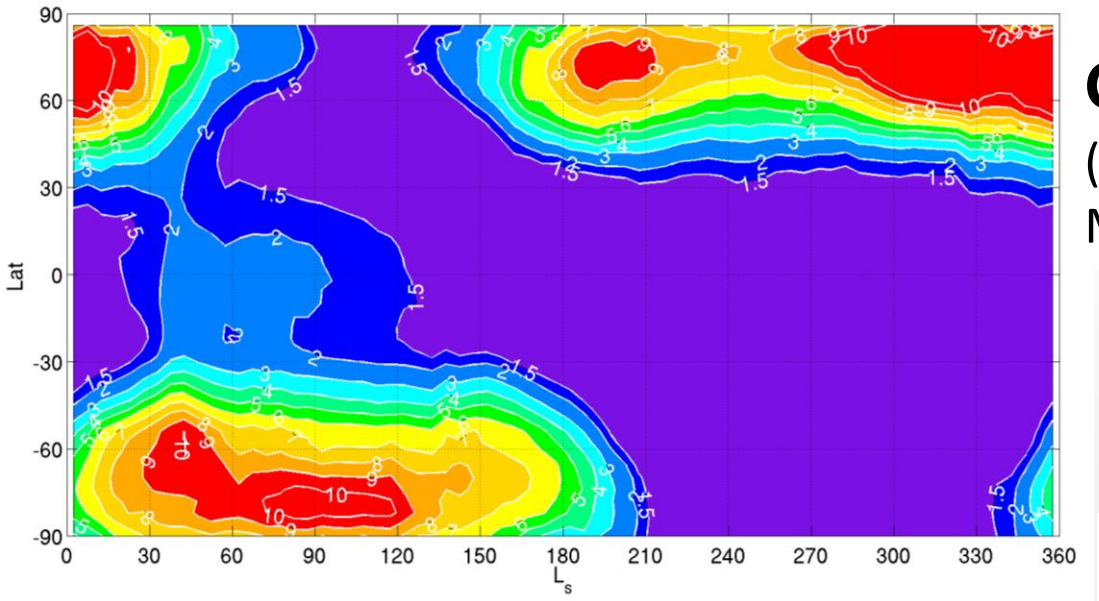
- Wvl range: **200–650 nm**
- Spectral resolution: **1–2 nm**
- Vertical sampling : **<300 m**

- From April 2018 to August 2019:
  - **2738 solar occultations!**



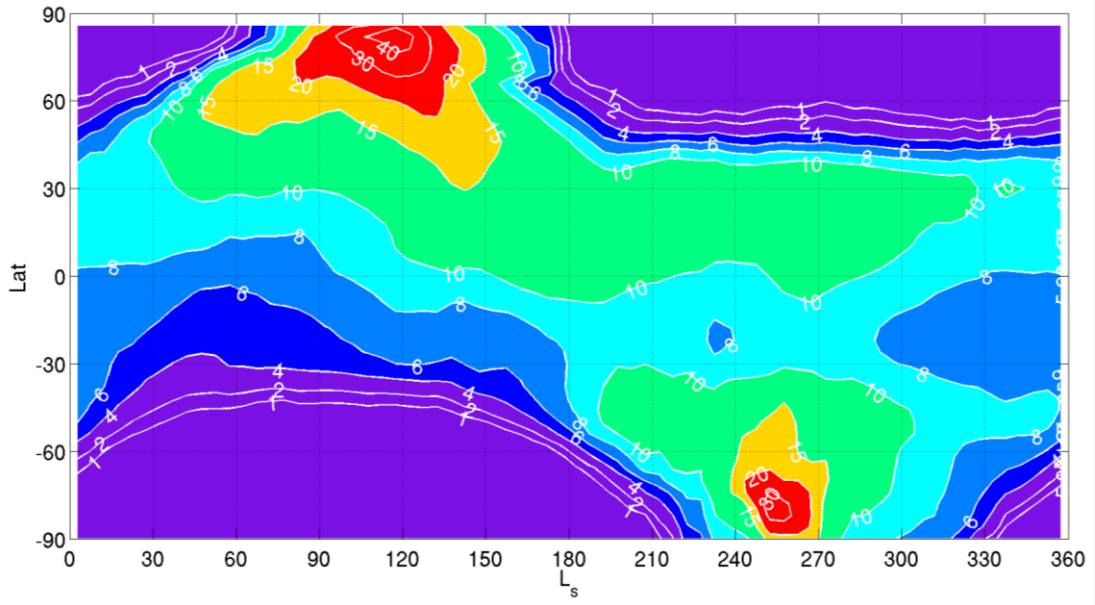
Ozone climatology

Ozone



GEM-Mars GCM
(General Circulation Model)

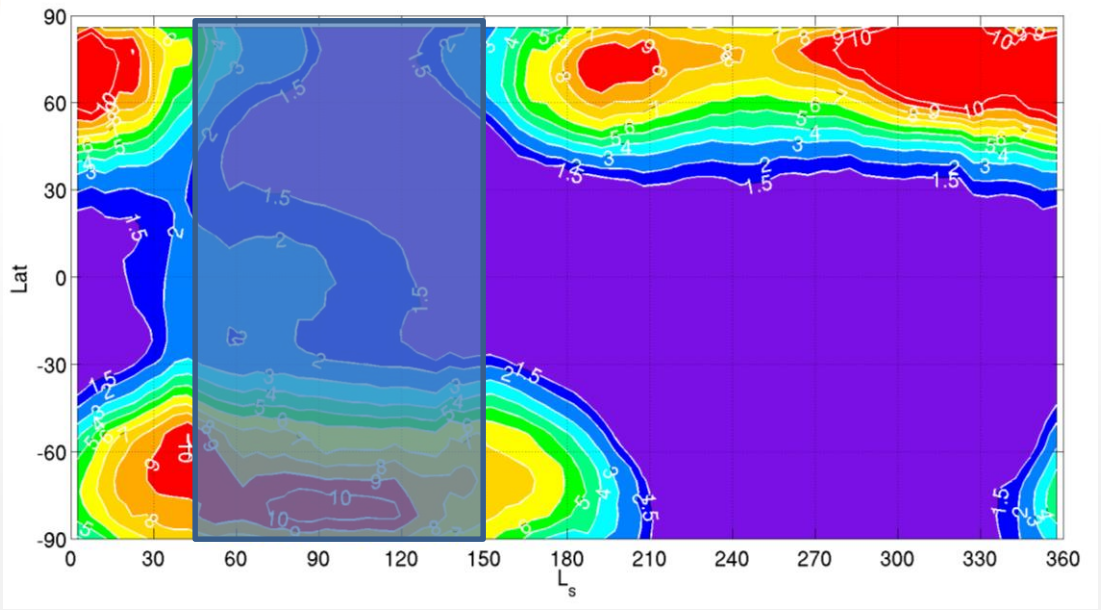
Water vapor



Ozone is **anti-correlated** with water vapor

Daerden et al., 2019

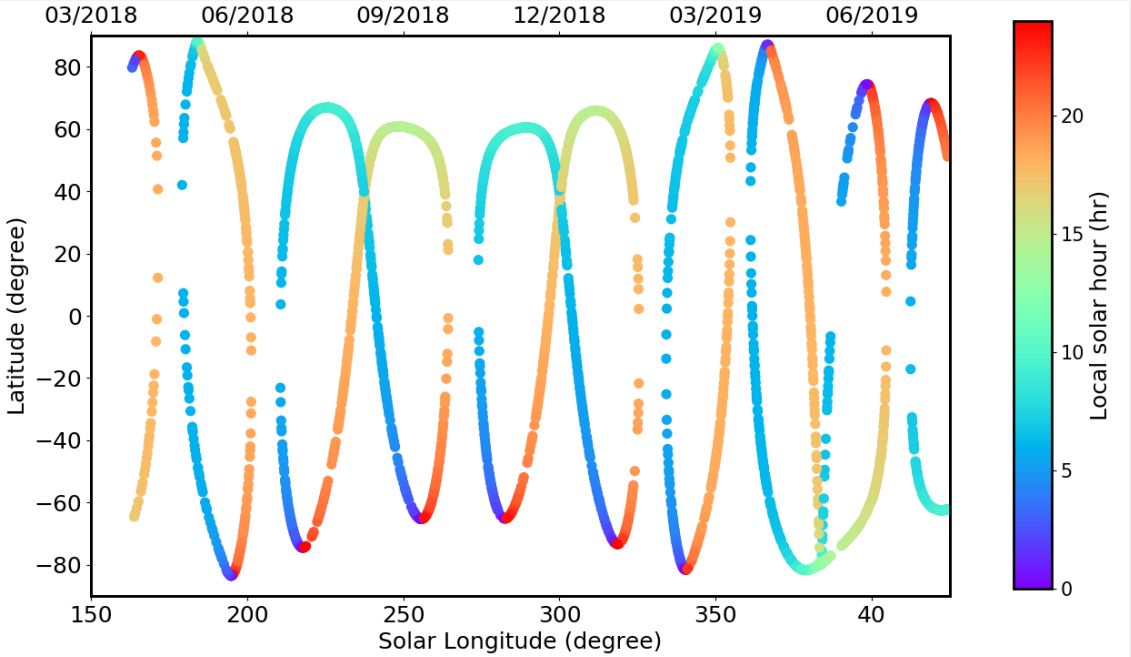
Ozone: 1 year of NOMAD observations



May (*Ls* ~ 180-185)

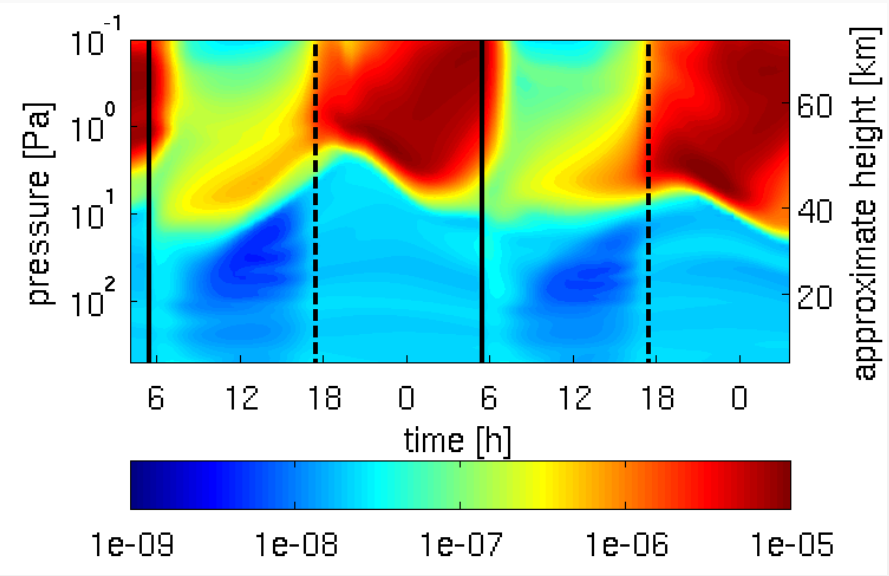
July (*Ls* ~ 205)

September (*Ls* ~ 250°)



Martian atmosphere @the terminator

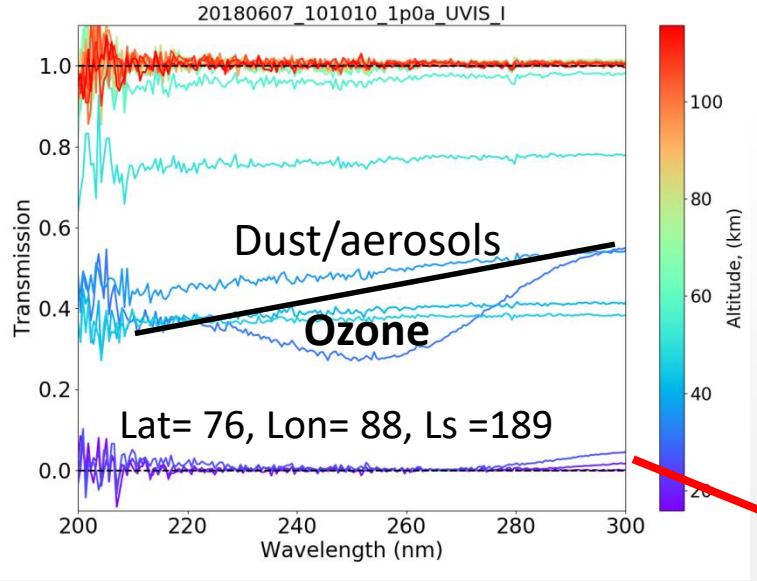
Diurnal cycle of **ozone** (3D GCM)

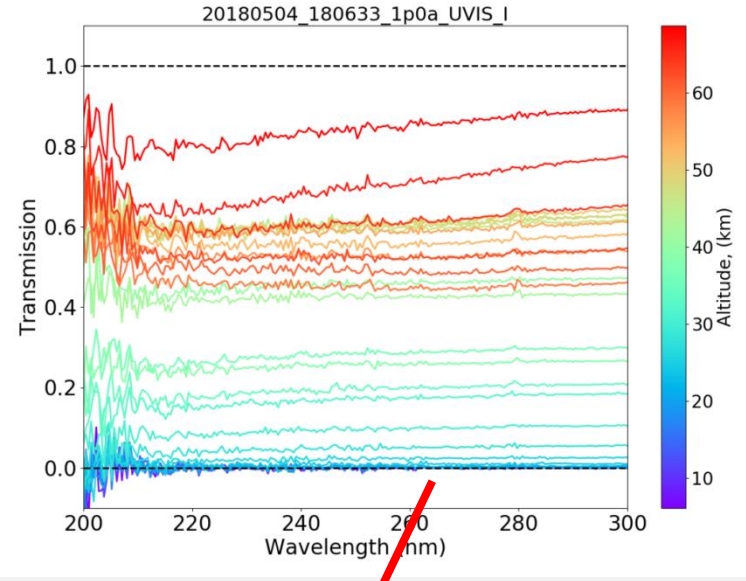


Atmosphere simulated by the **3D GEM-Mars GCM (**Neary, L. et al., 2017).

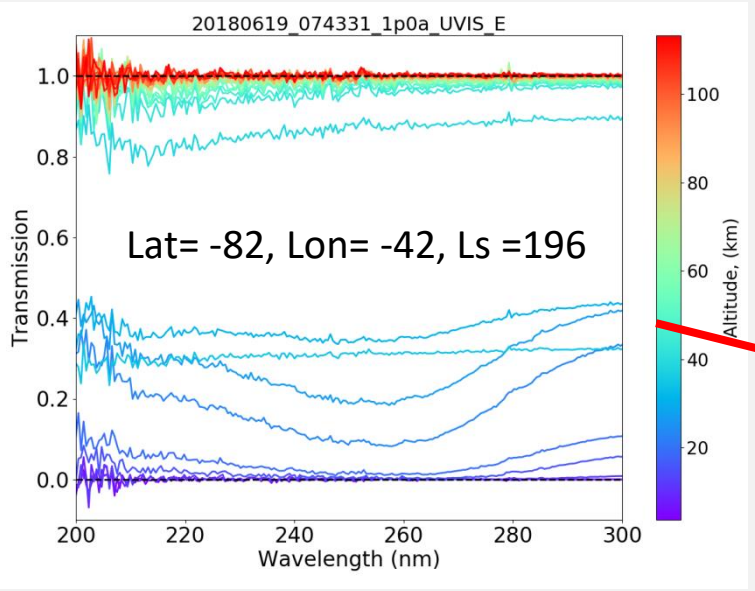
- complex photochemistry driven by the solar illumination
- **rapid timescales of photochemistry at sunrise and sunset**
- Ozone (O_3) is more abundant during the nighttime, especially above 40-50 km.
- As the Sun rises, the destruction of O_3, although stronger in the high atmosphere, is observed at all altitudes.

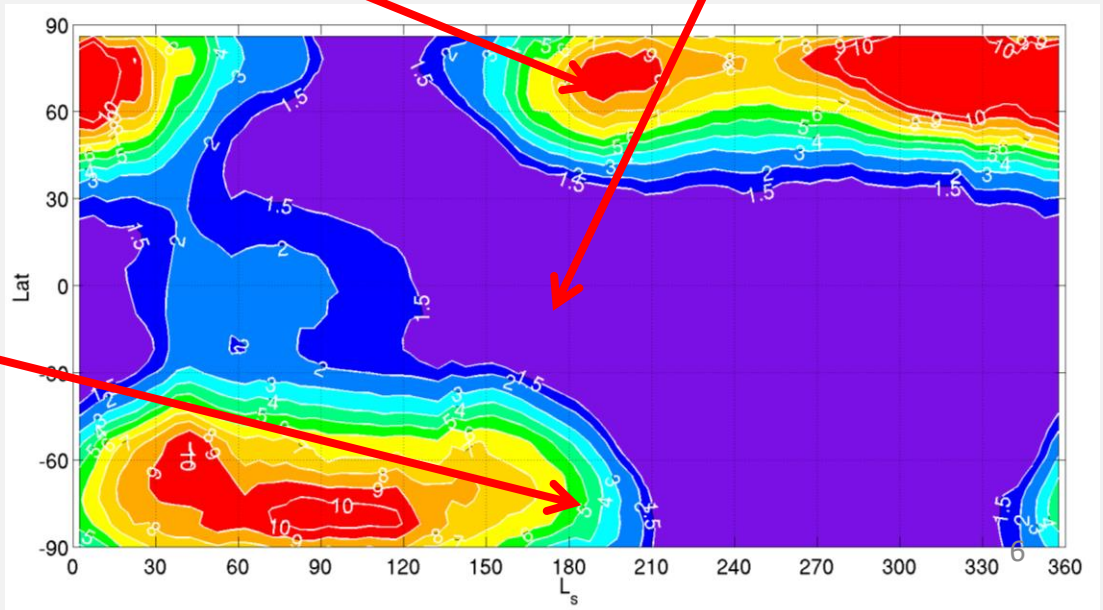
Before the dust storm



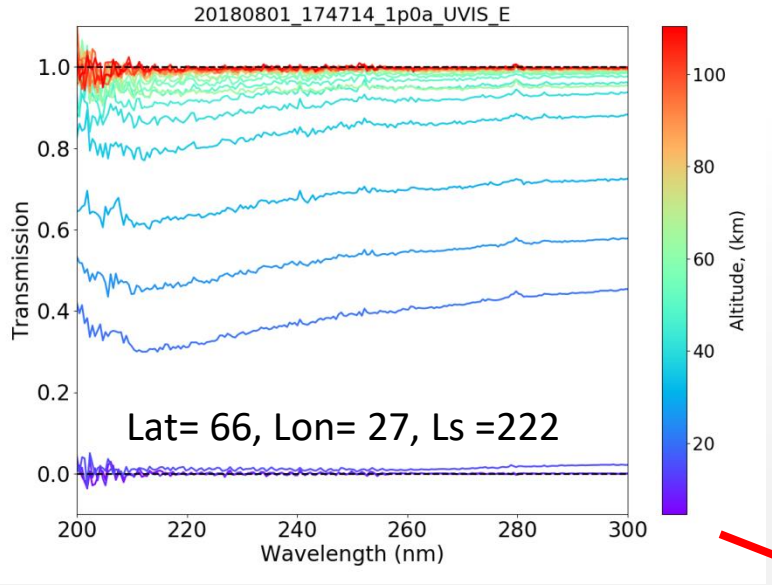


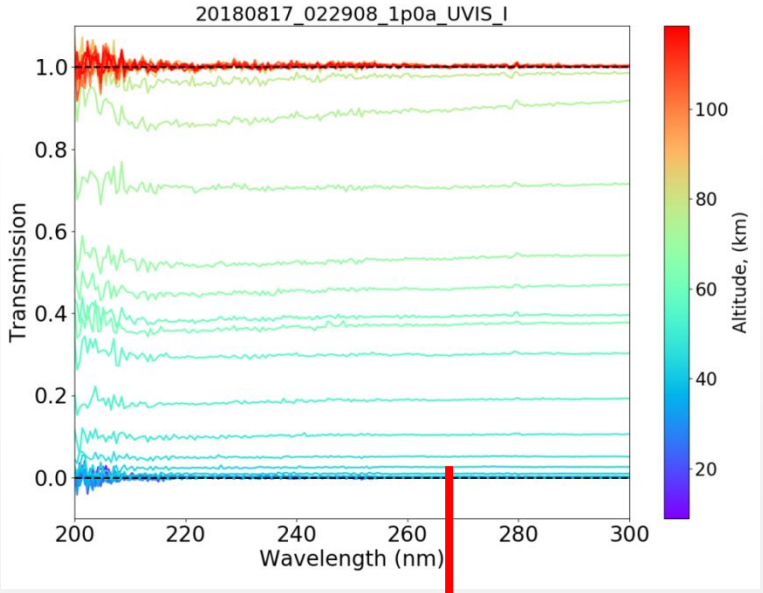
Lat= -23, Lon= 17, Ls =170



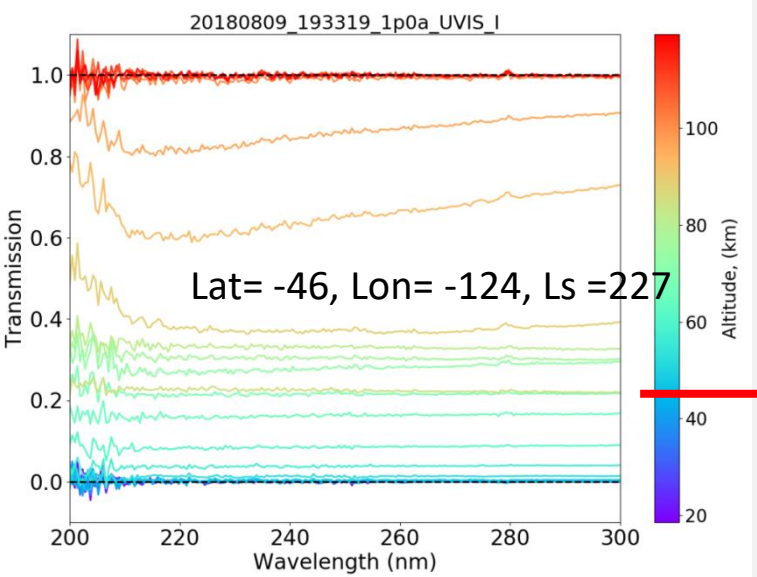


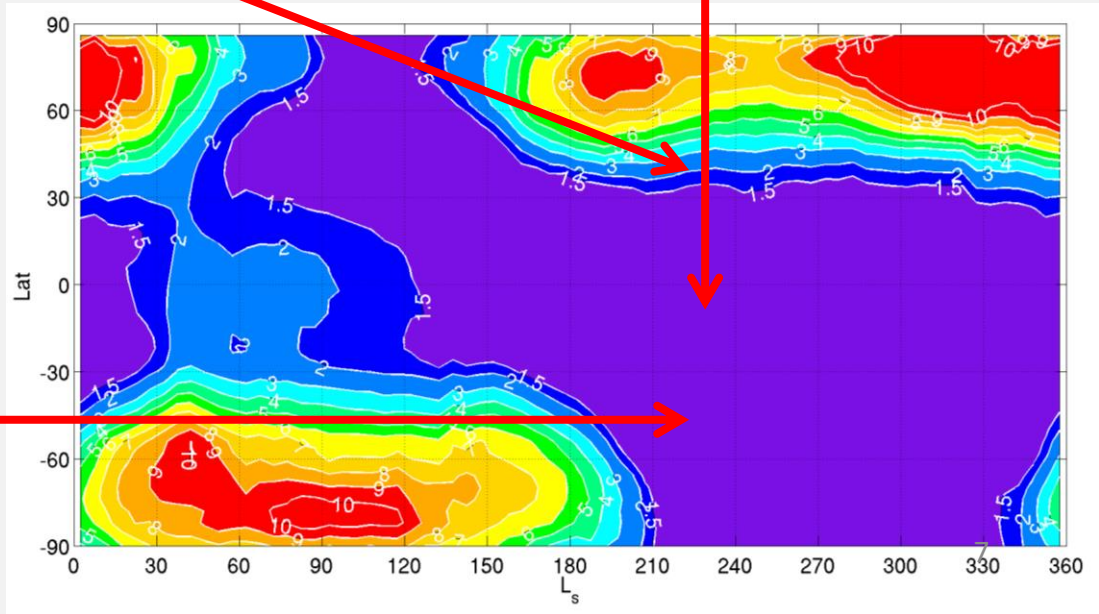
During the dust storm



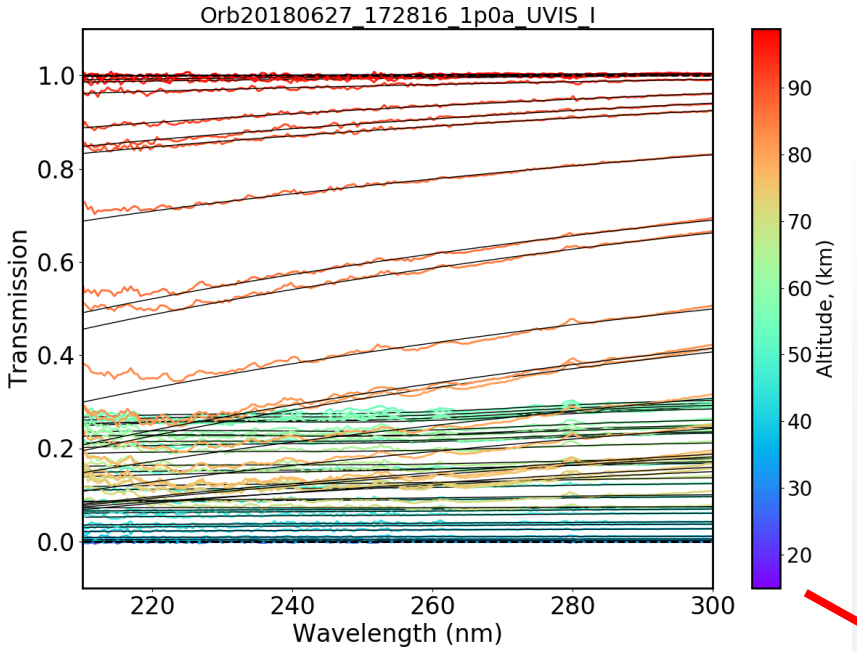


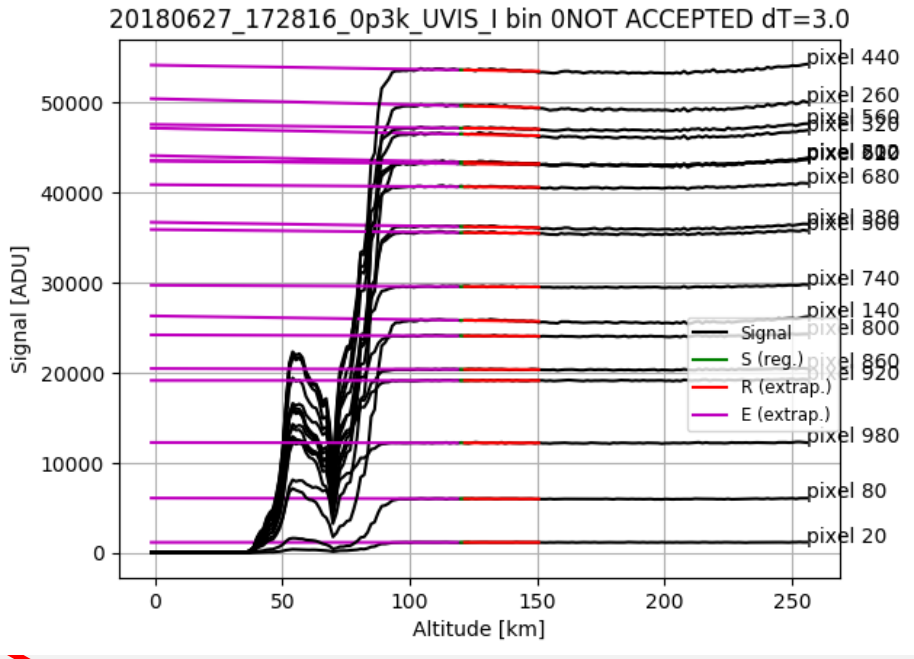
Lat= -15, Lon= -172, Ls =232



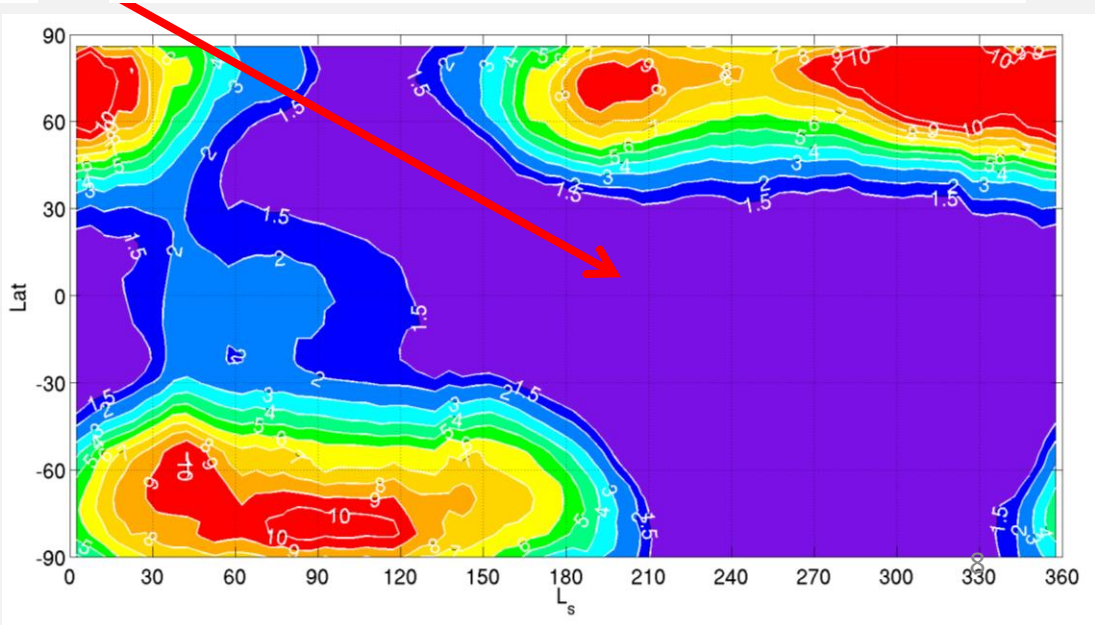


During the dust storm



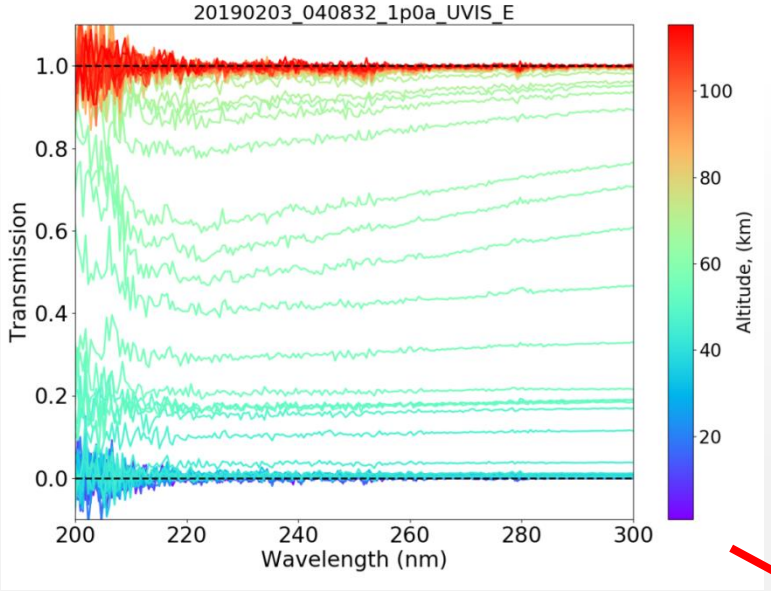


Lat= 5.5, Lon= -173, Ls =201

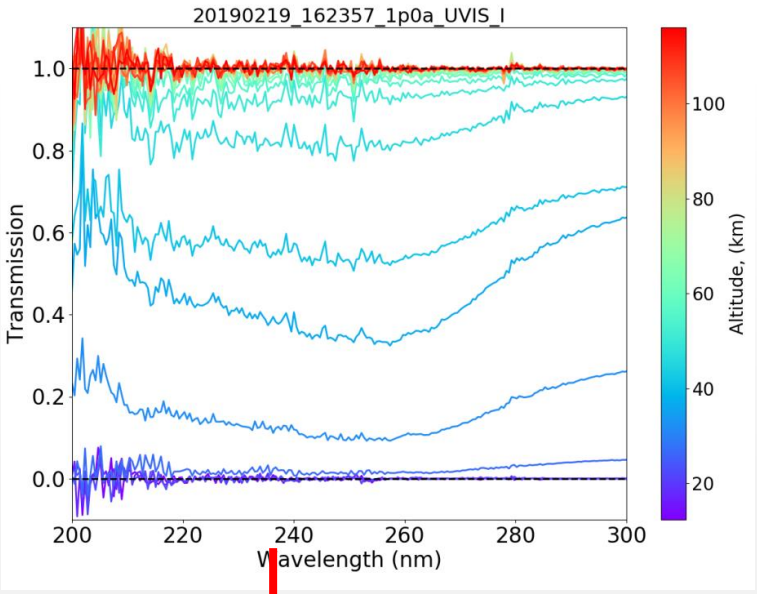


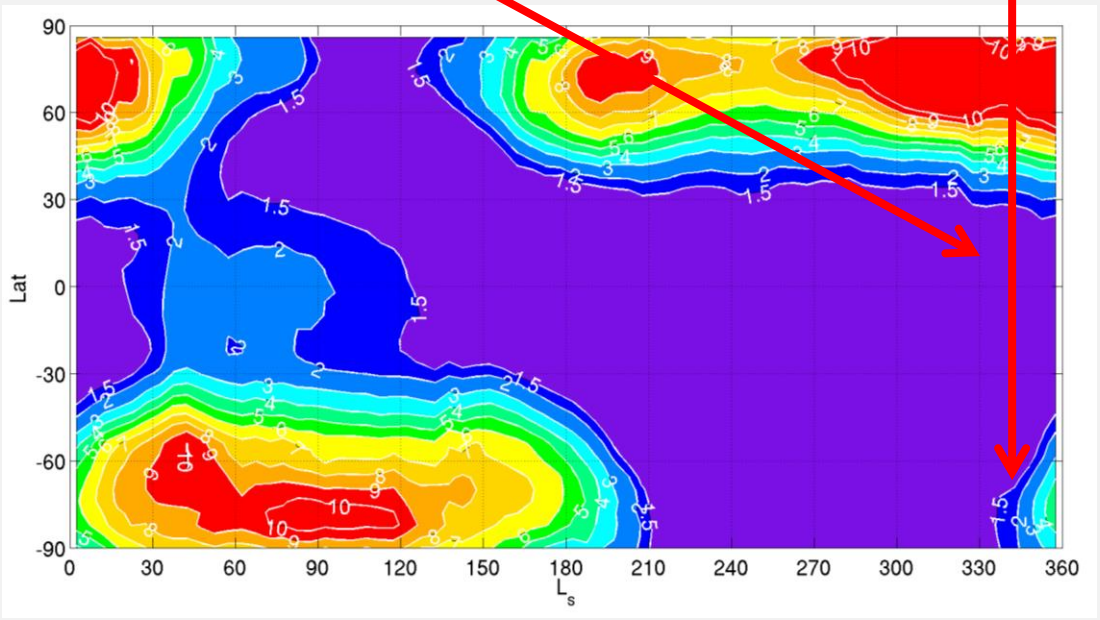
After the dust storm

Lat= 17, Lon= -161, Ls =334



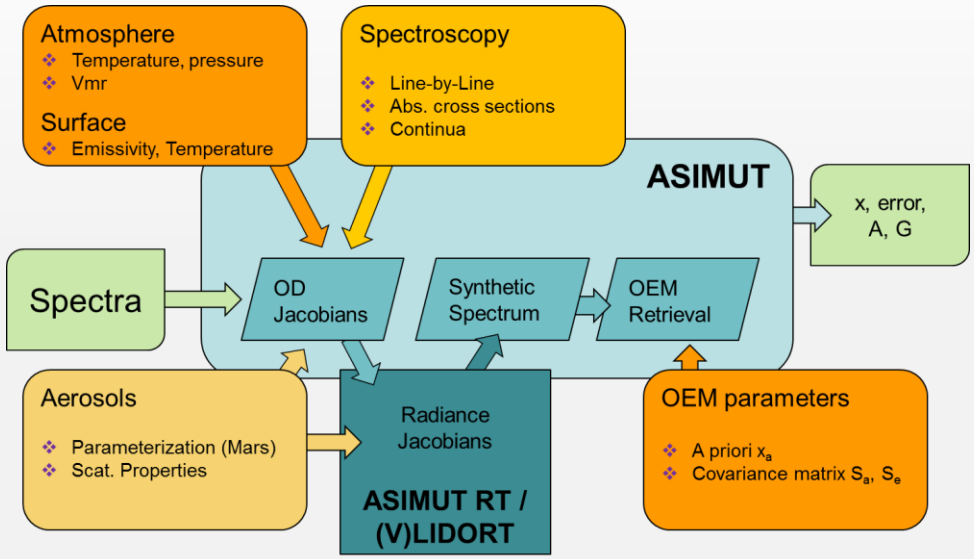
Lat= -74, Lon= 16, Ls =343

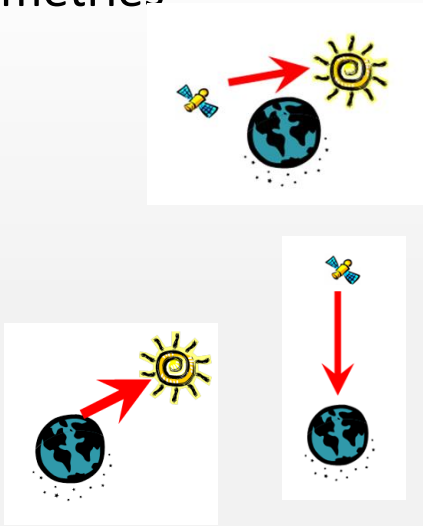




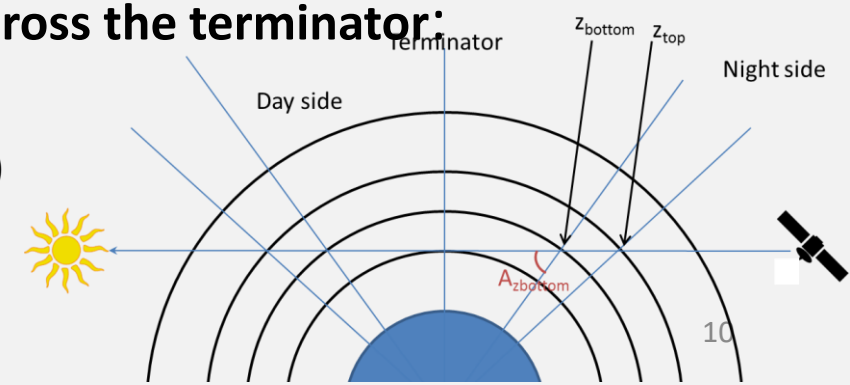
A Radiative transfer code: ASIMUT

- 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)

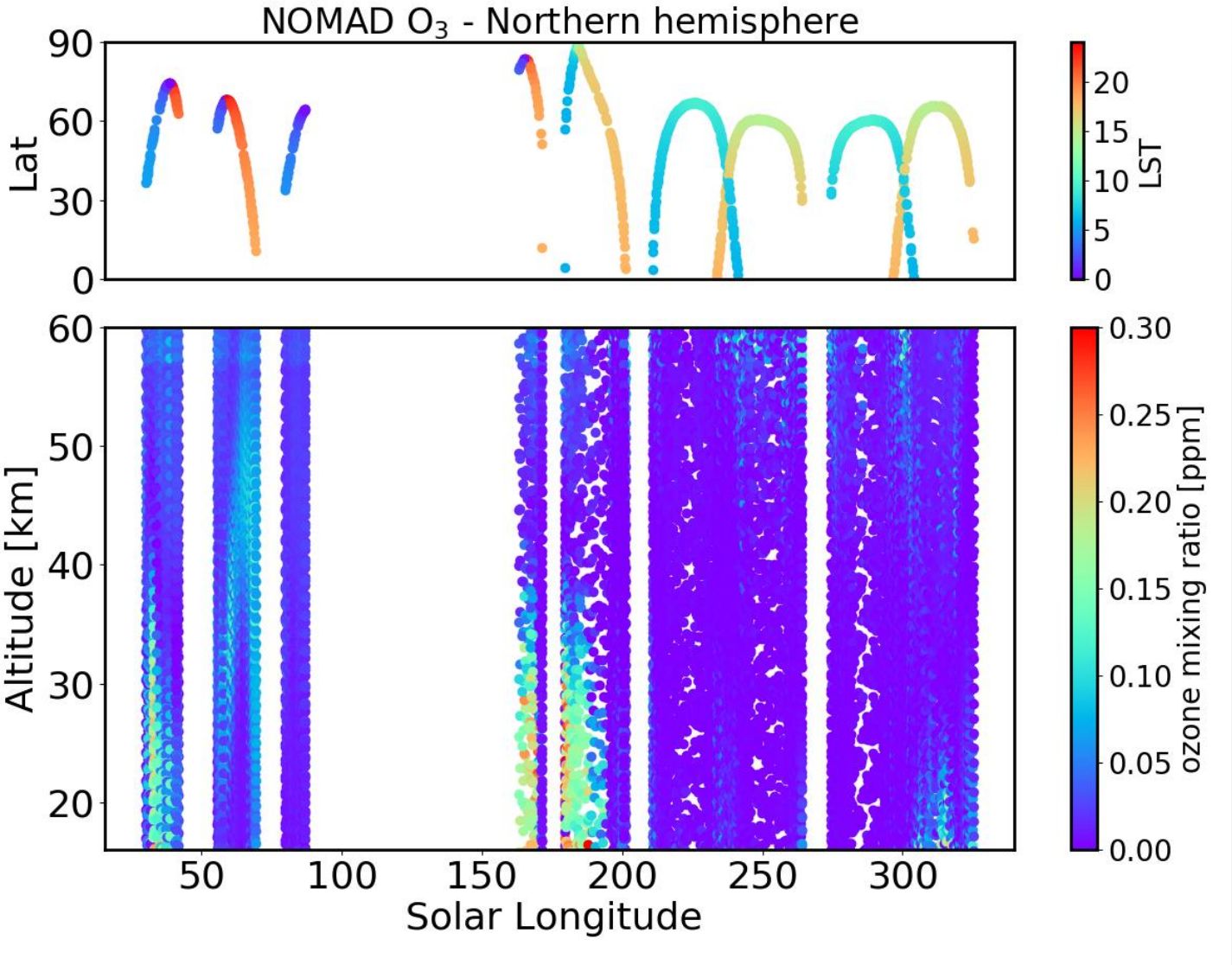


Vandaele et al. 2008
Piccialli et al., 2019

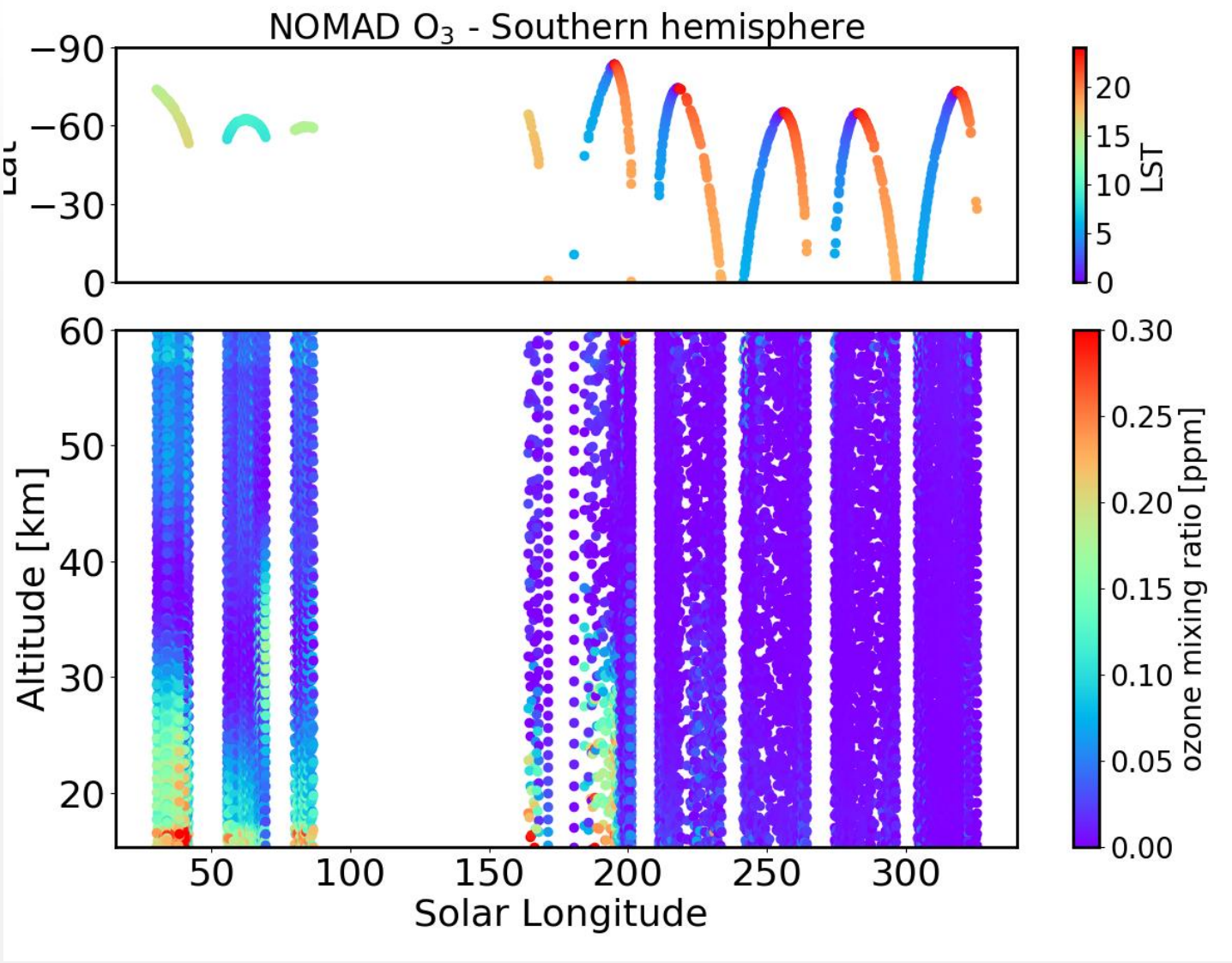
ASIMUT: inputs

- **Preliminary Retrievals:**
  - Input atmosphere: GEM-GCM profiles at specific location
  - No gradients: spherical symmetry
  - Straylight correction partly implemented

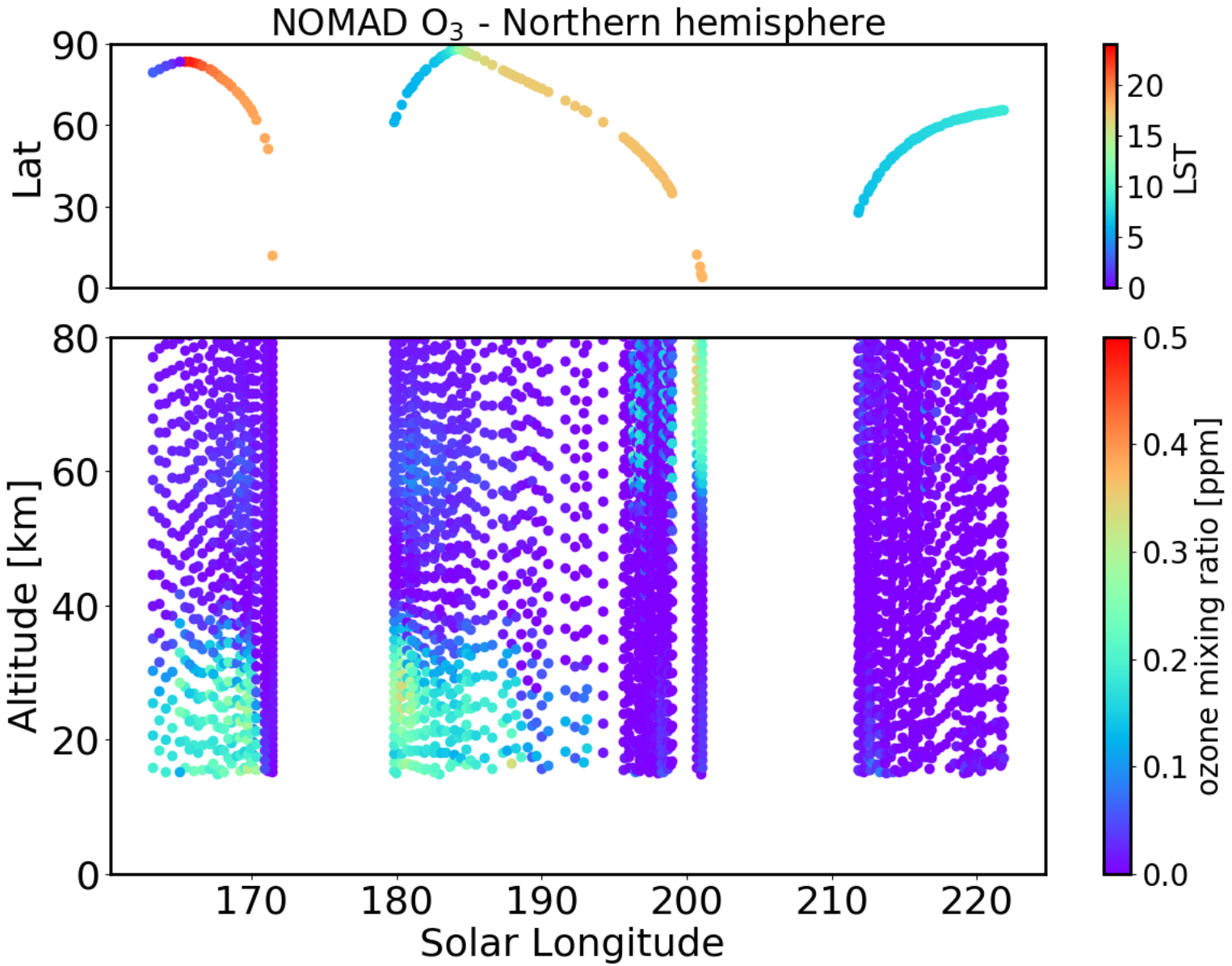
O_3 maps (4/2018 – 9/2019)



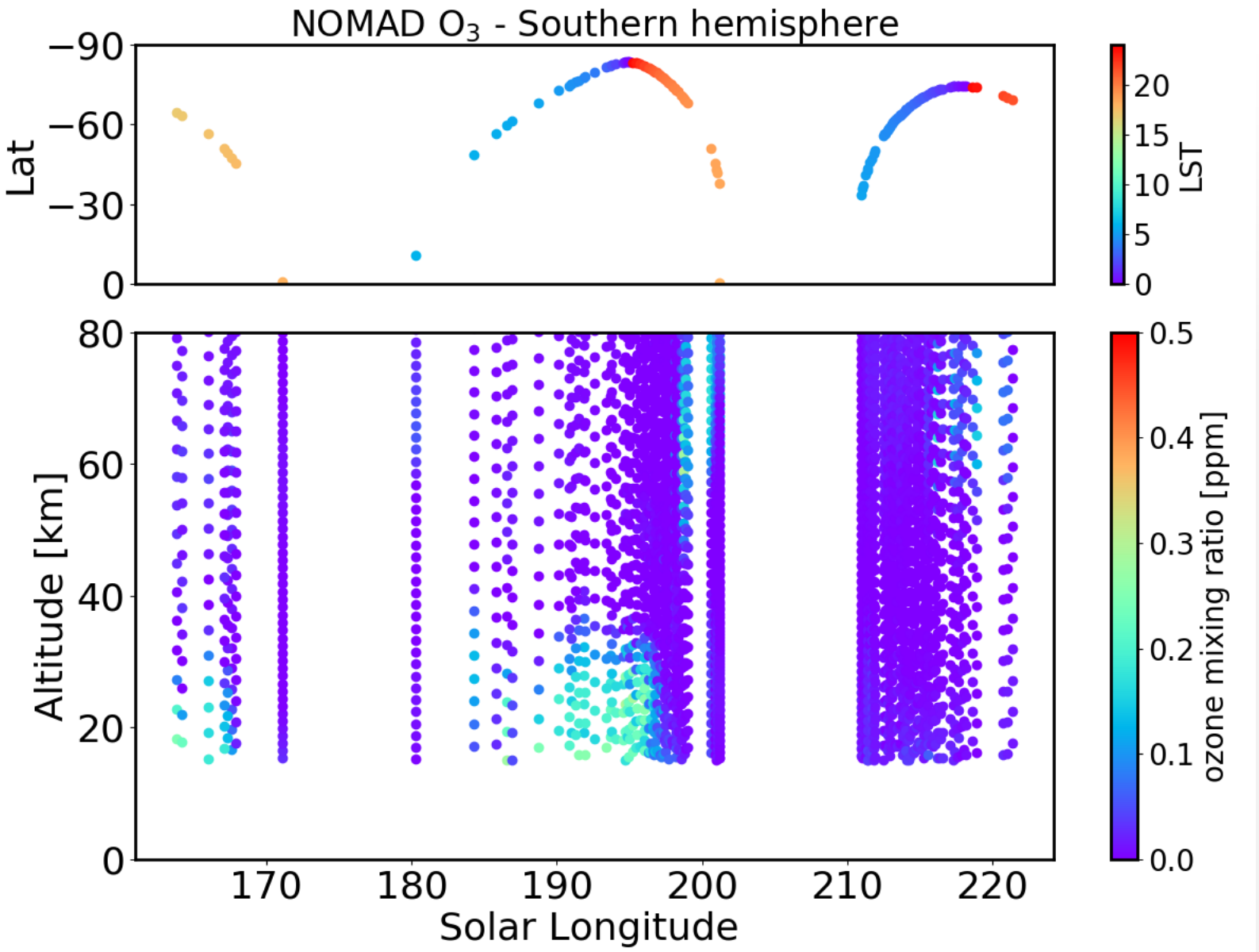
O_3 maps (4/2018 – 9/2019)



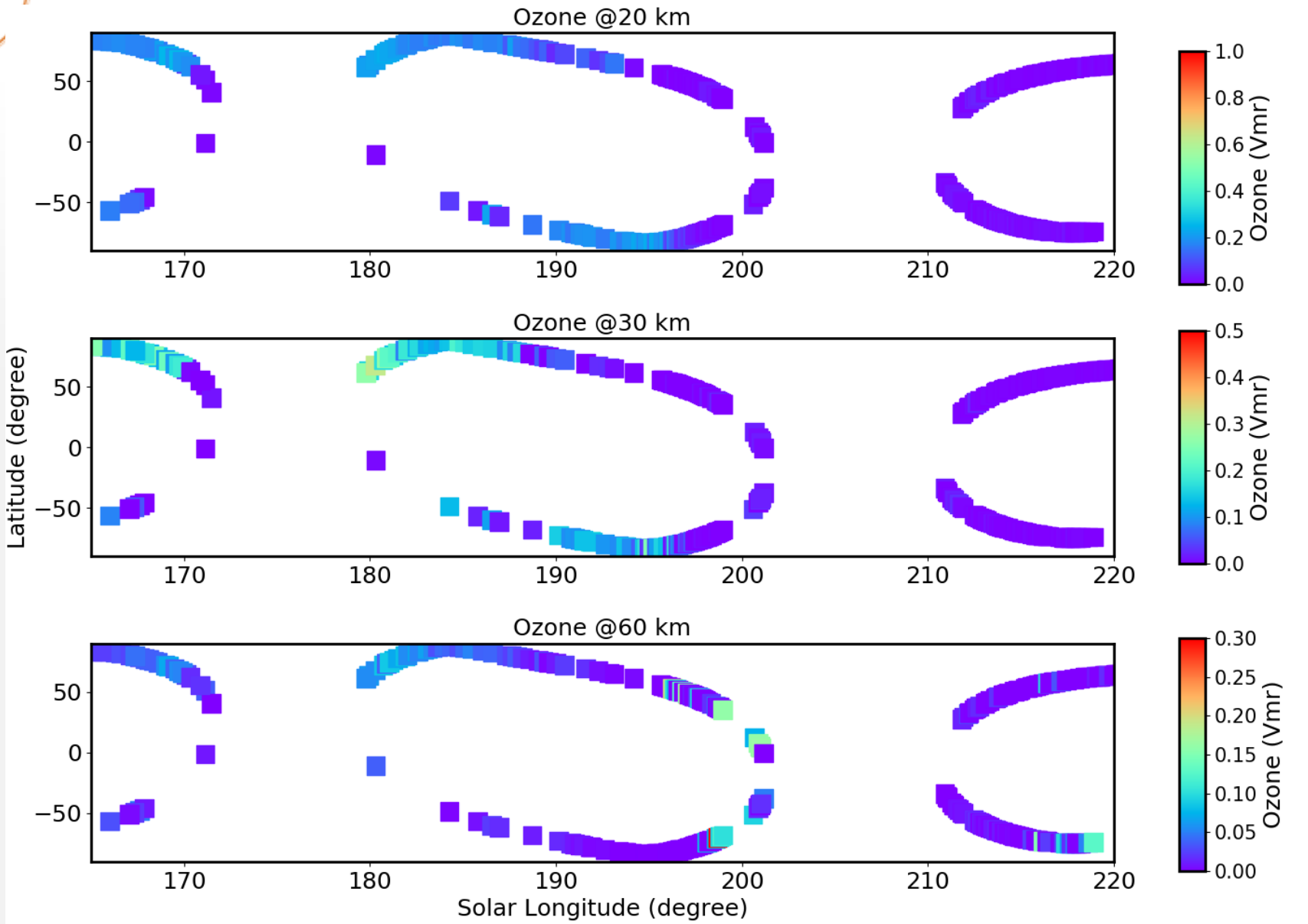
O_3 maps (4 – 7/2018)



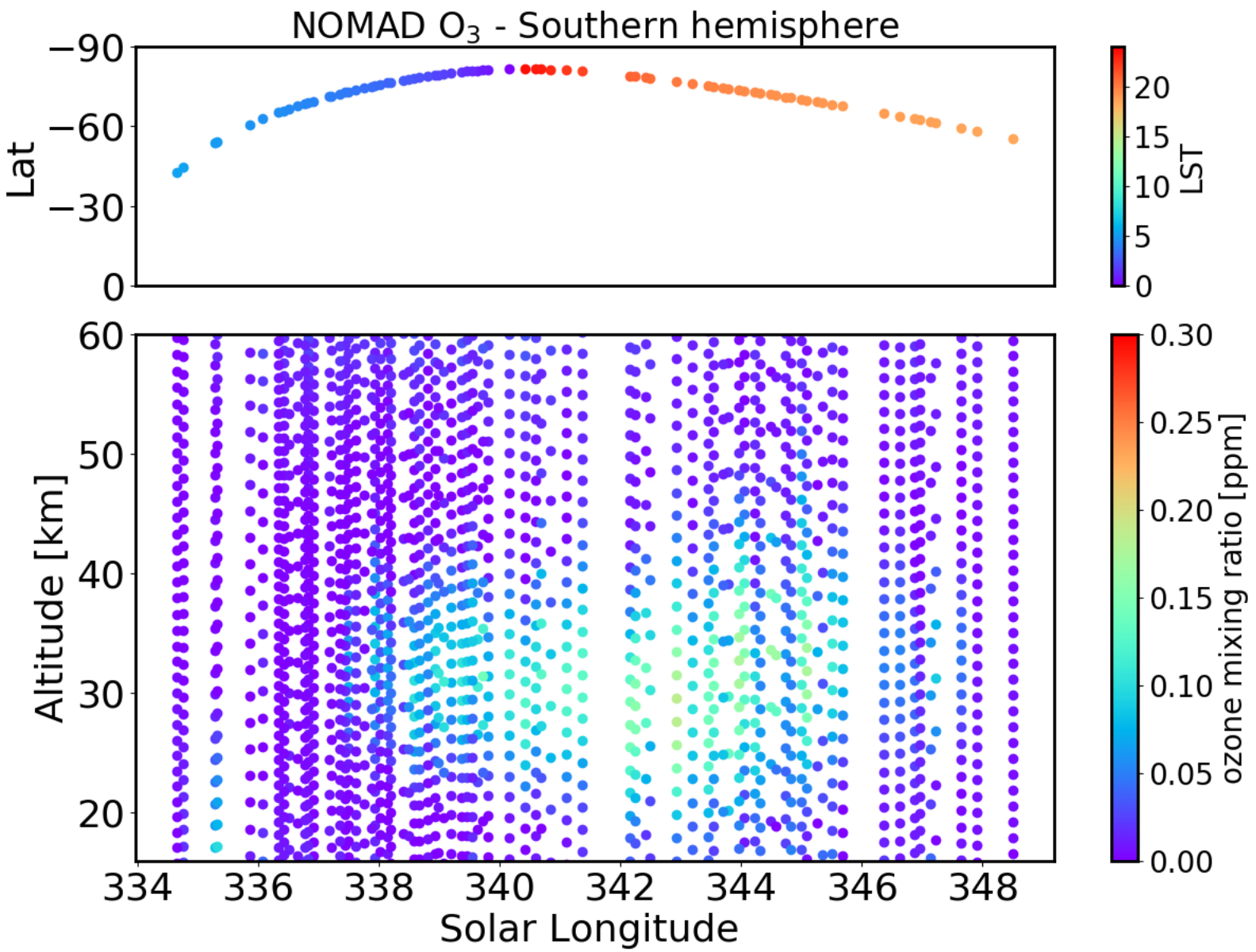
O_3 maps (4 – 7/2018)



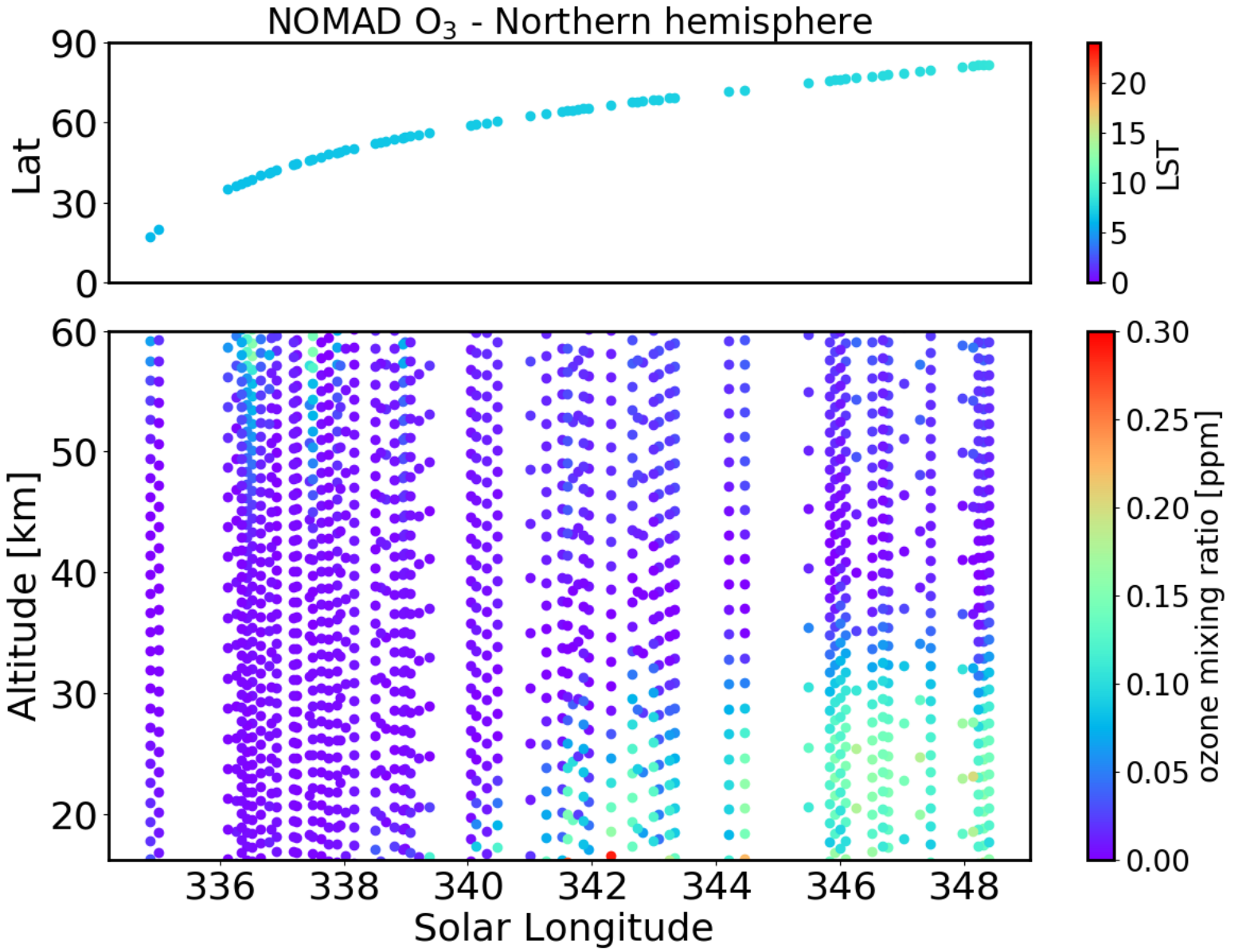
O_3 maps 4 – 7/2018



O_3 maps (2/2019)



O_3 maps (2/2019)



Summary

Retrieval of **ozone** from **UVIS** solar occultations:

- **2738 occultations** between April 2018-August 2019
- The Radiative Transfer Model used at BIRA-IASB, **ASIMUT**, is implemented for UVIS/NOMAD data.
- Ozone abundance is higher at high latitudes
- We observe **two ozone layers**: one below 30 km and a second layer at between 30-40 km. An upper layer at 60 km need to be confirmed.
- **Future work:**
  - Take in account **gradients** along the line of sights
  - Retrieval of aerosols
  - **Climatology of ozone and dust (and comparison to H_2O)**