Improved Dust Climatology on Mars with New and Revised MGS/TES Aerosols Retrievals

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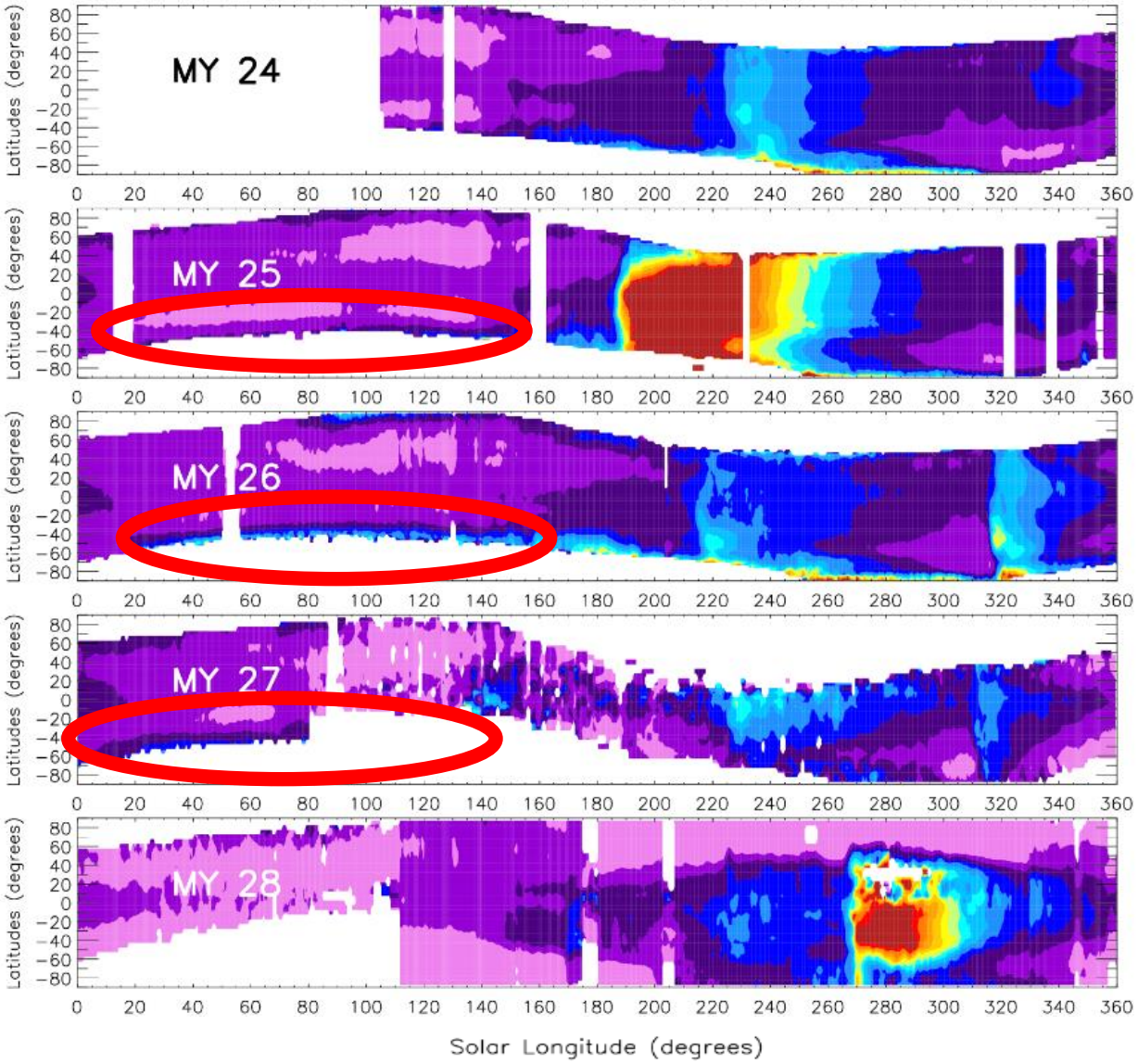
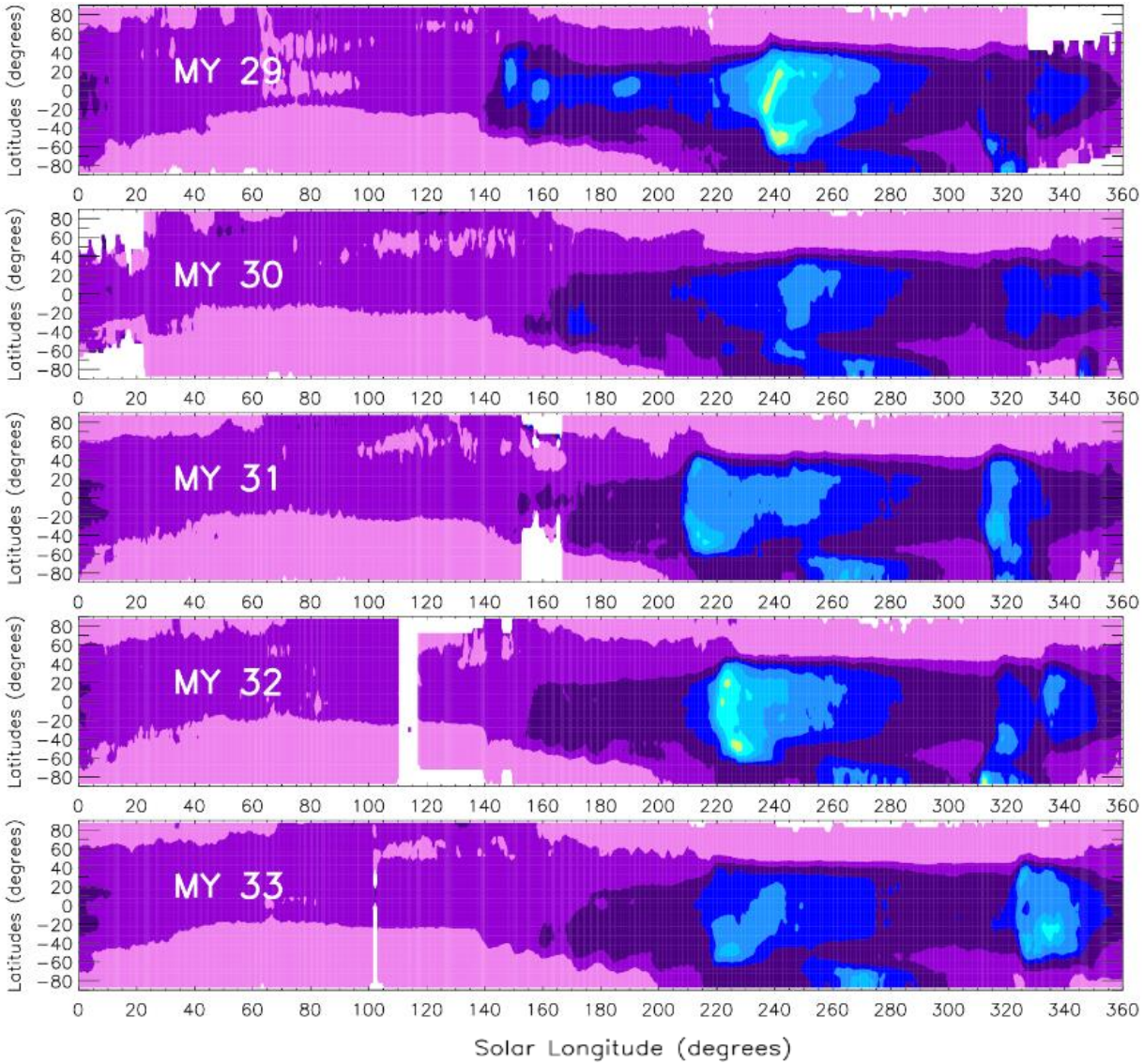
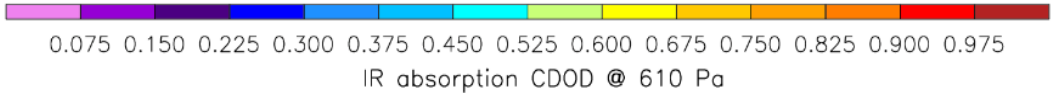
From TES/THEMIS/MCS column dust optical depth (CDOD) retrievals/estimates





Montabone et al., Icarus 251, 2015

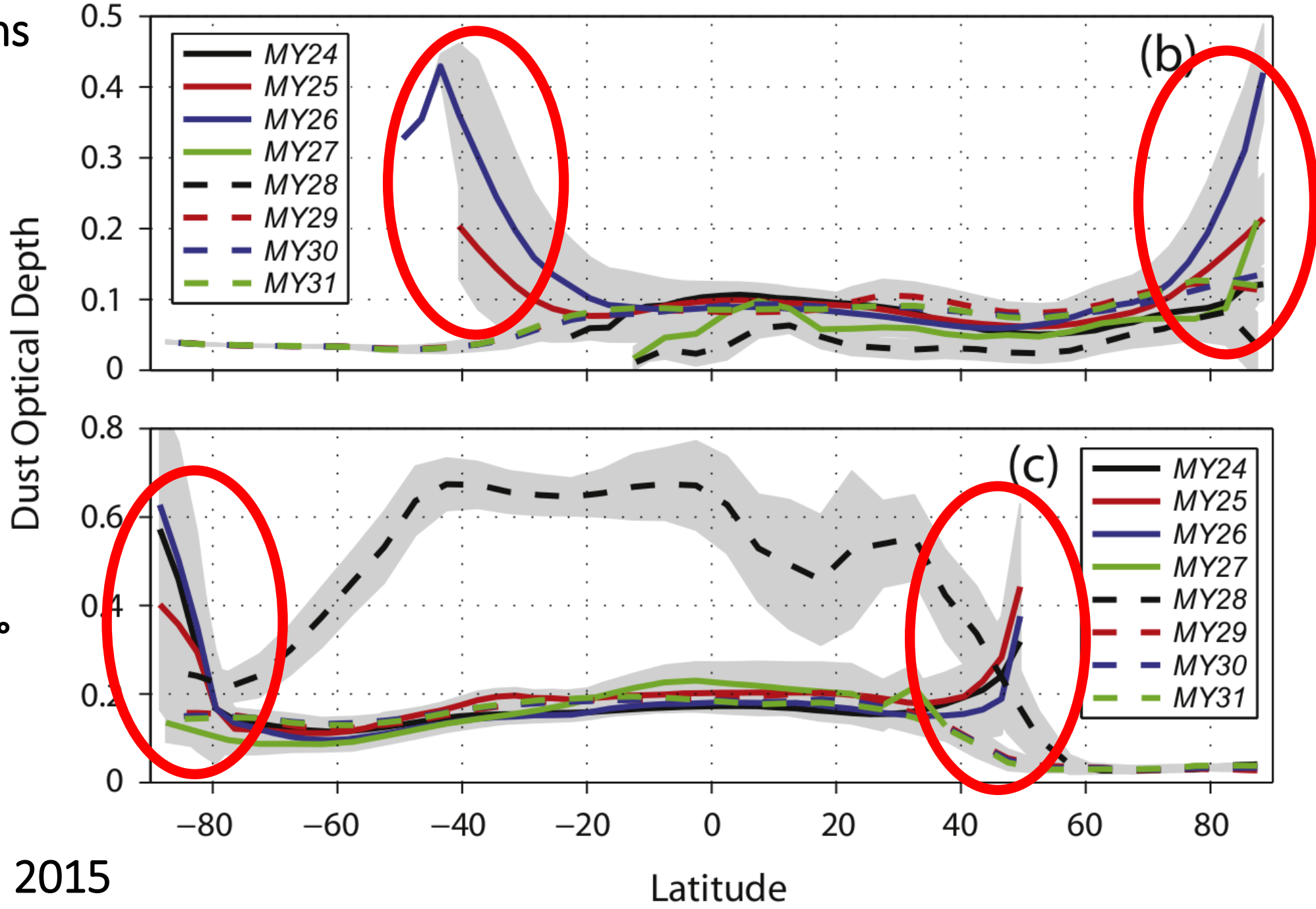


Dataset publicly available on the Mars Climate Database webpage

Zonal/time means

$95° < L_S < 105°$

$295° < L_S < 305°$



Montabone et al., 2015

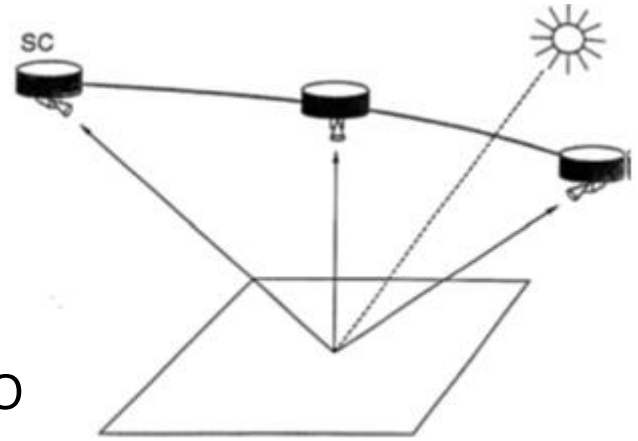
Improving data: A necessary task

➢ Improving/updating retrievals of TES IR CDODs

- Discarding observations with retrieved surface temperature too far off first-guess one (highest dust optical depths in old retrievals)
- New criterion for accepting retrievals: $|dI/d\tau| > 10^{-7}$ ($dI/d\tau \propto \Delta T_{surf-atm}$)
- Better accounting of noise in TES calibration (Pankine & McConnochie)

➢ Performing new (visible) CDOD retrievals using TES Emission Phase Function (EPF) observations

- Using Hapke function for non-icy surface reflectance; Lambert albedo for icy surfaces
- Allowing for reflectance variations within EPFs (due to planet rotation and single-axis mirror pointing)



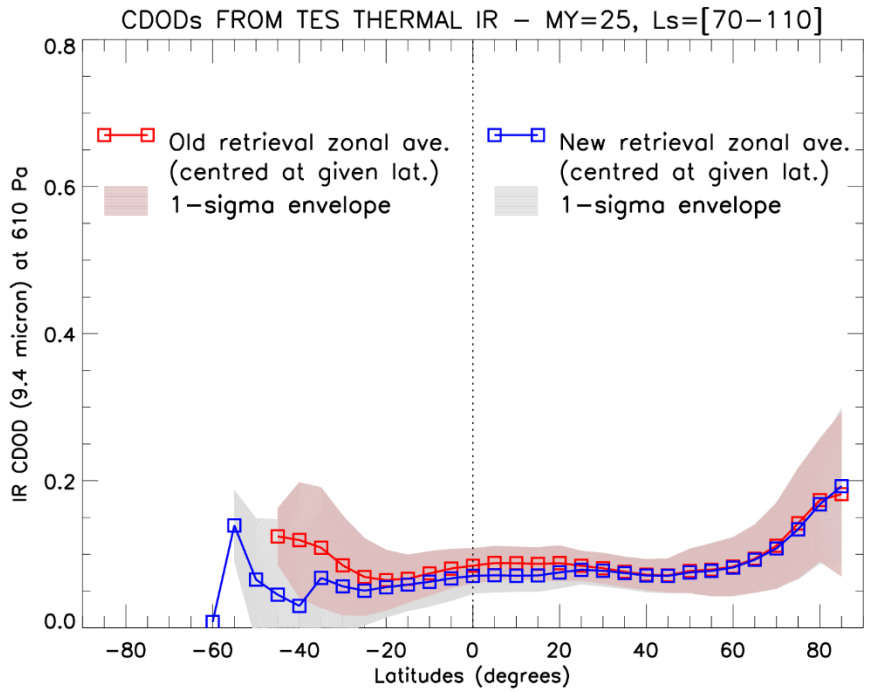
From Clancy et al., 2003

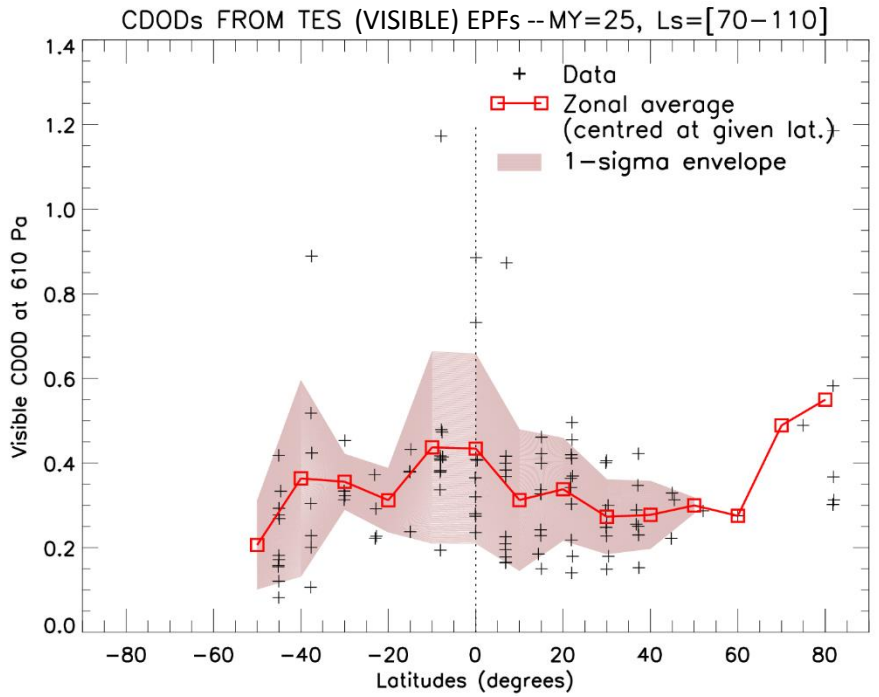
Some preliminary results

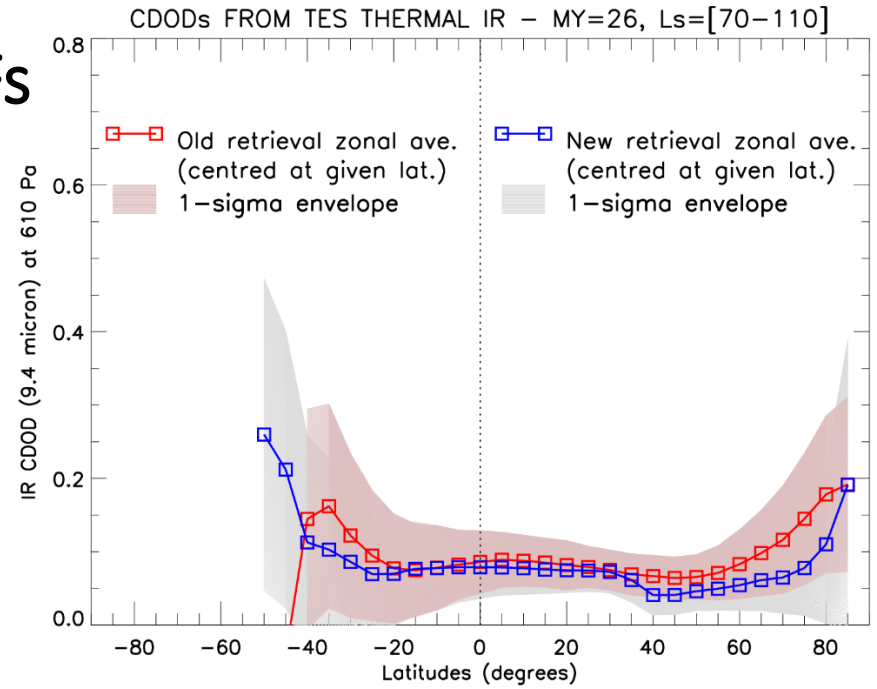
$70° < L_S < 110°$

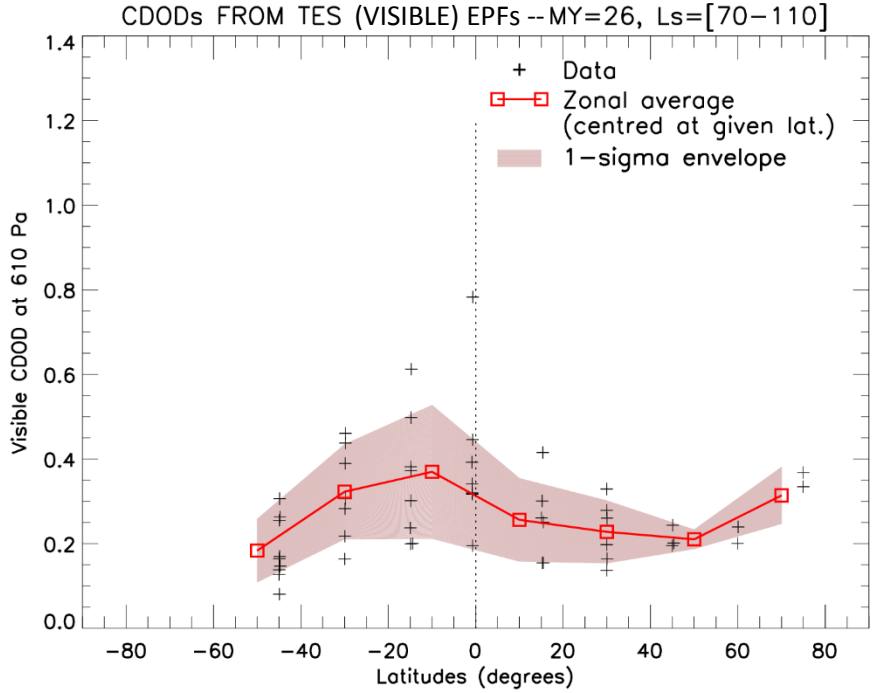
Left: Thermal IR
Right: Visible from EPFs

CDODs normalized to 610 Pa







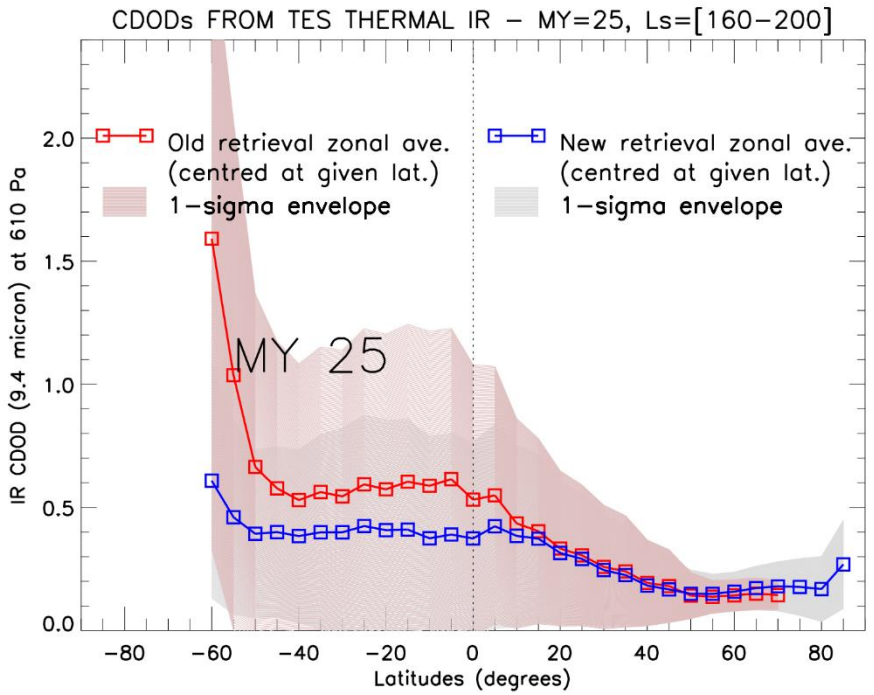


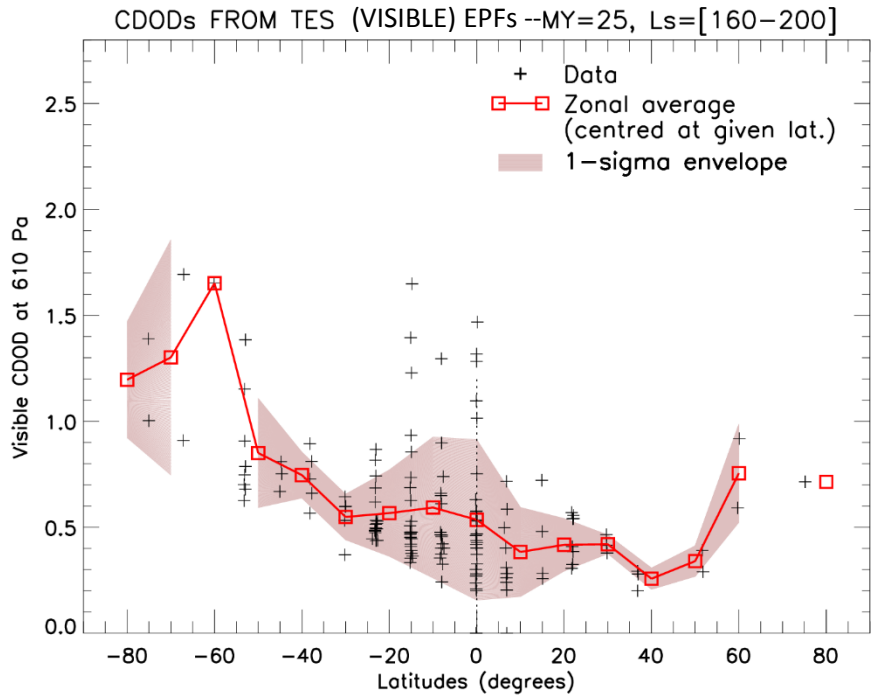
Some preliminary results

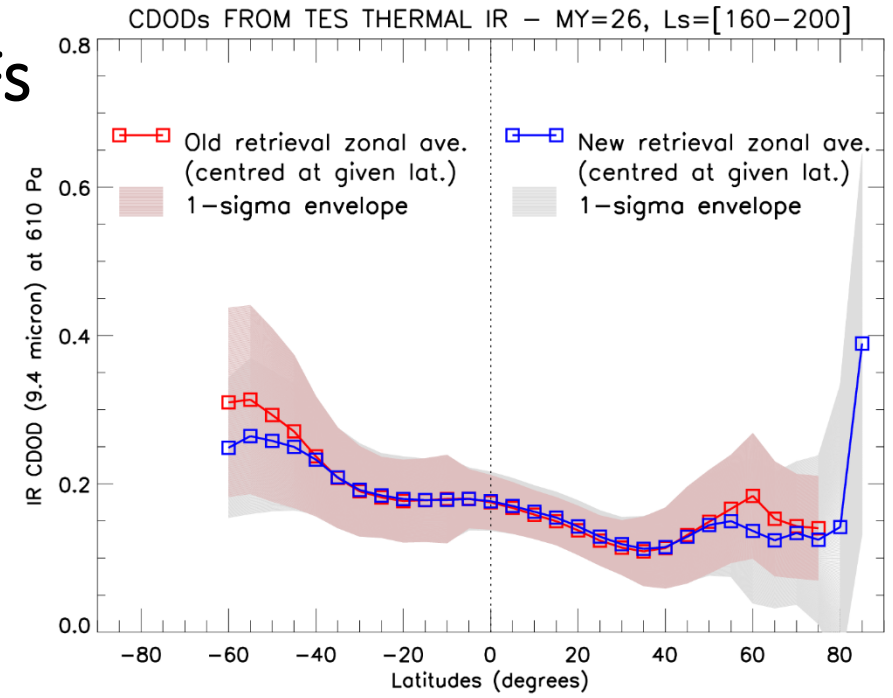
$160° < L_S < 200°$

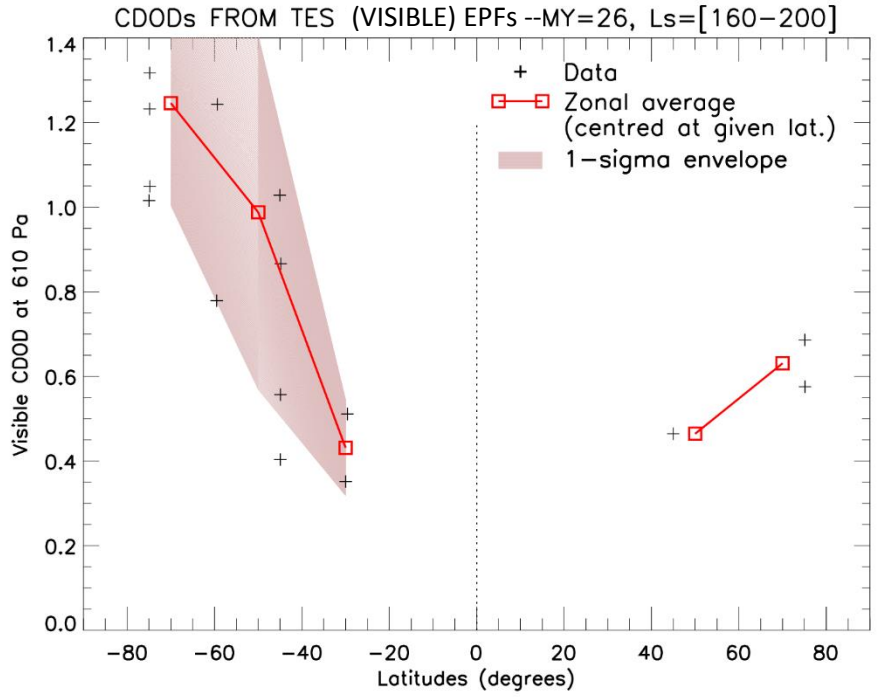
Left: Thermal IR
Right: Visible from EPFs

CDODs normalized to 610 Pa







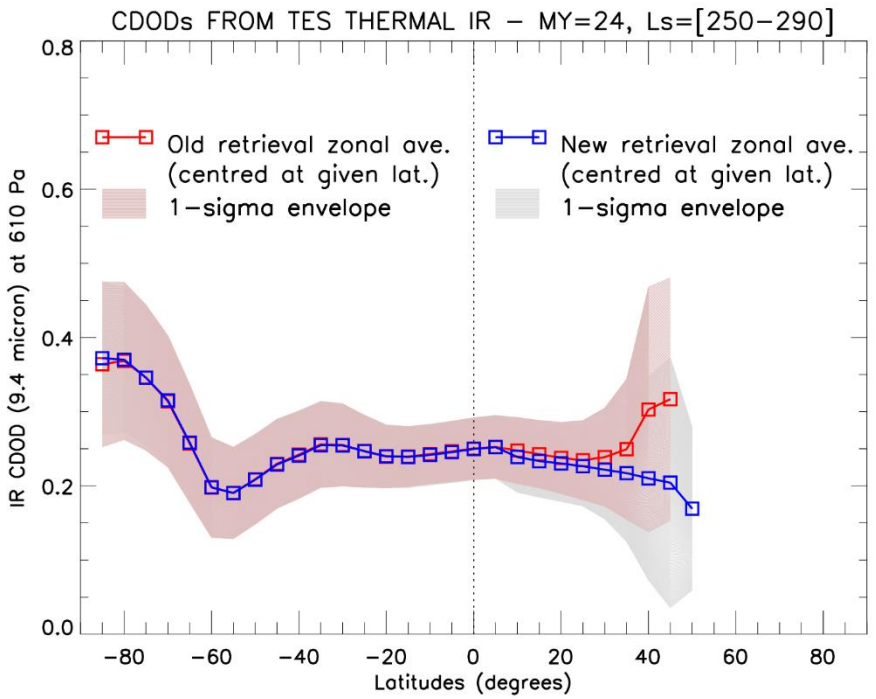


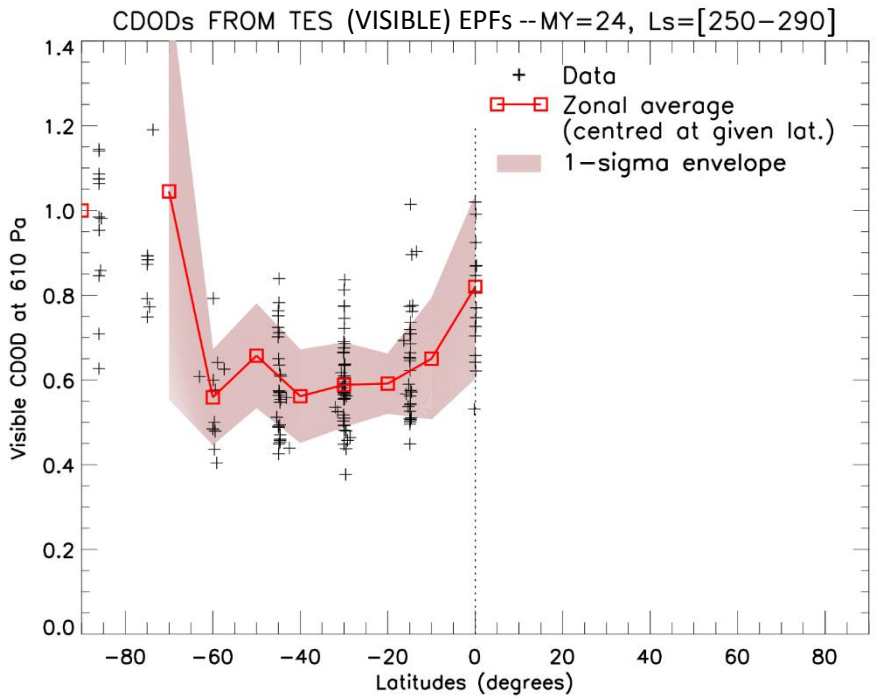
Some preliminary results

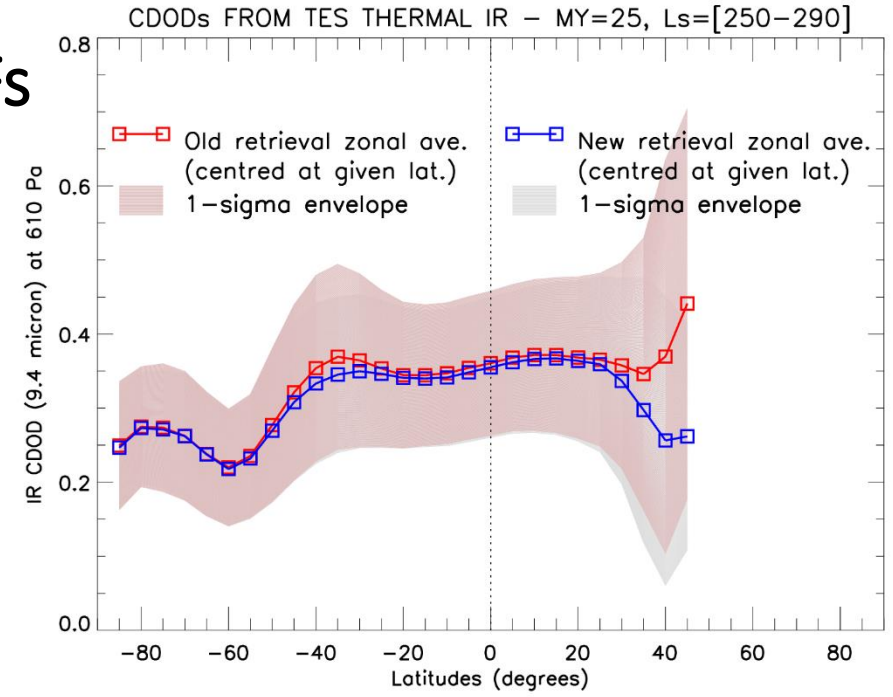
$250° < L_S < 290°$

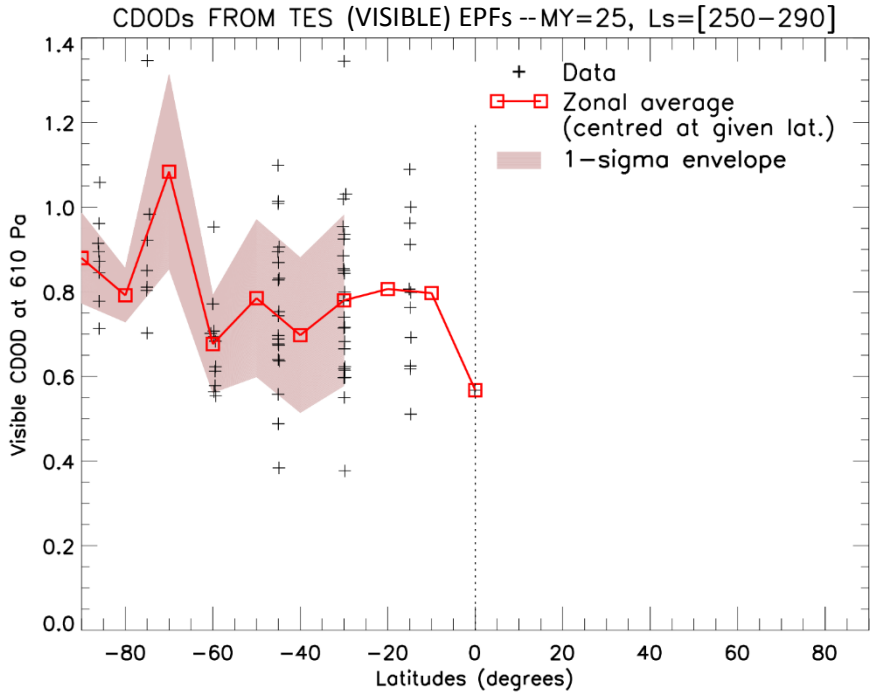
Left: Thermal IR
Right: Visible from EPFs

CDODs normalized to 610 Pa

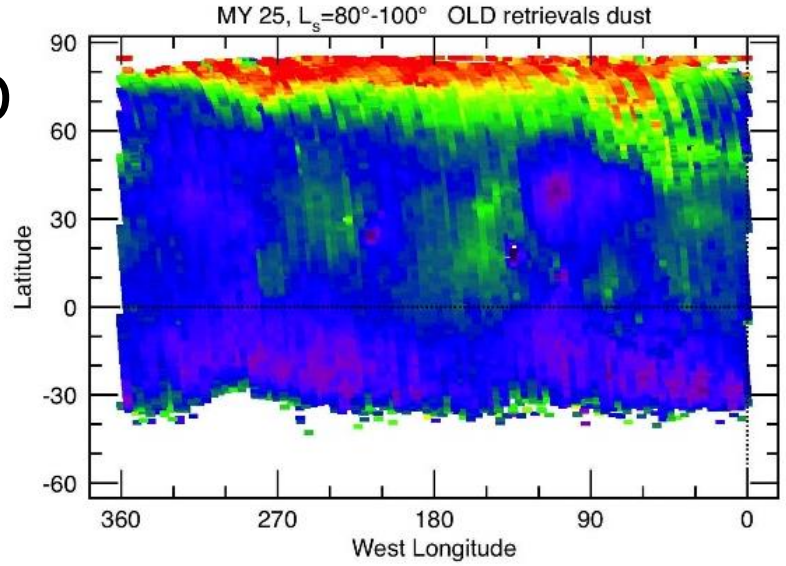
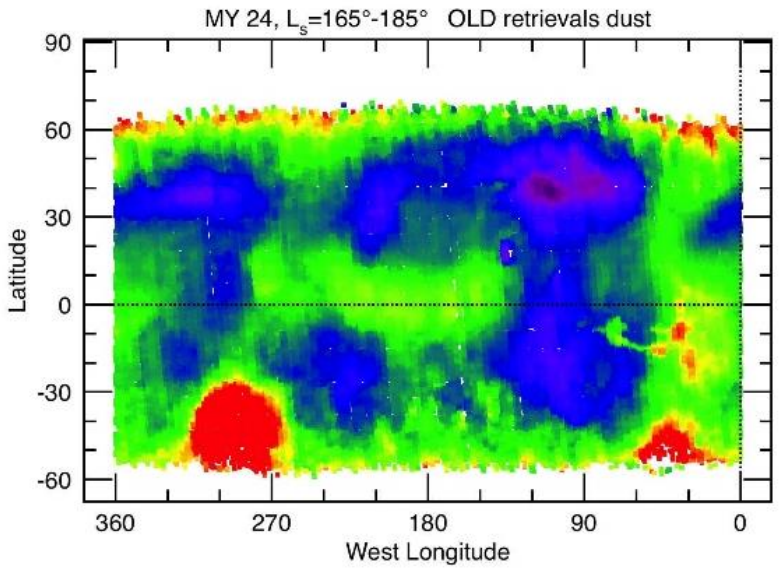
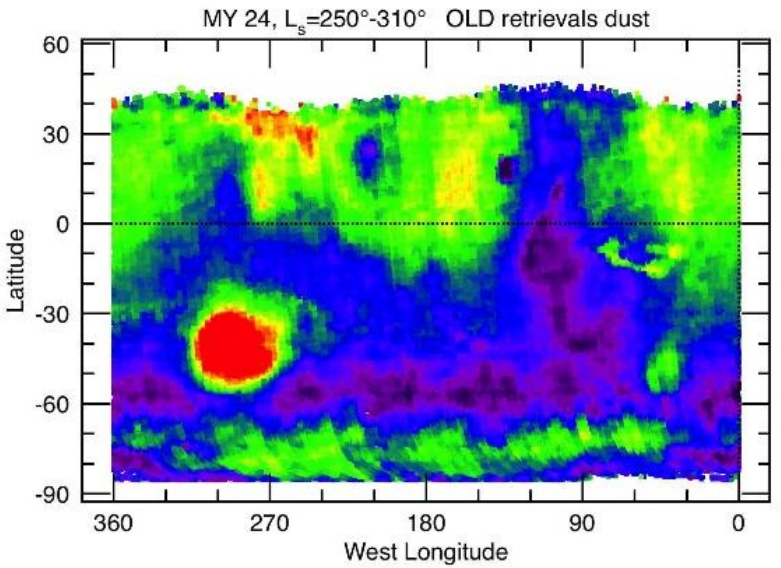
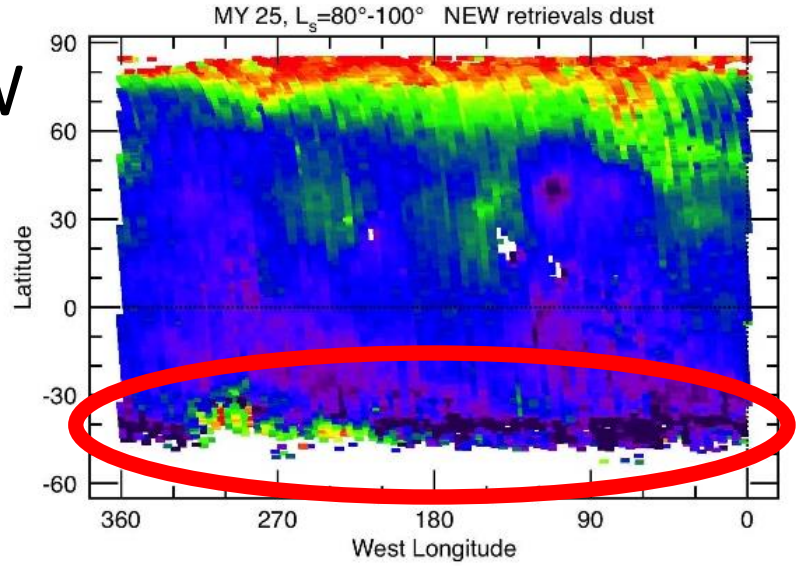
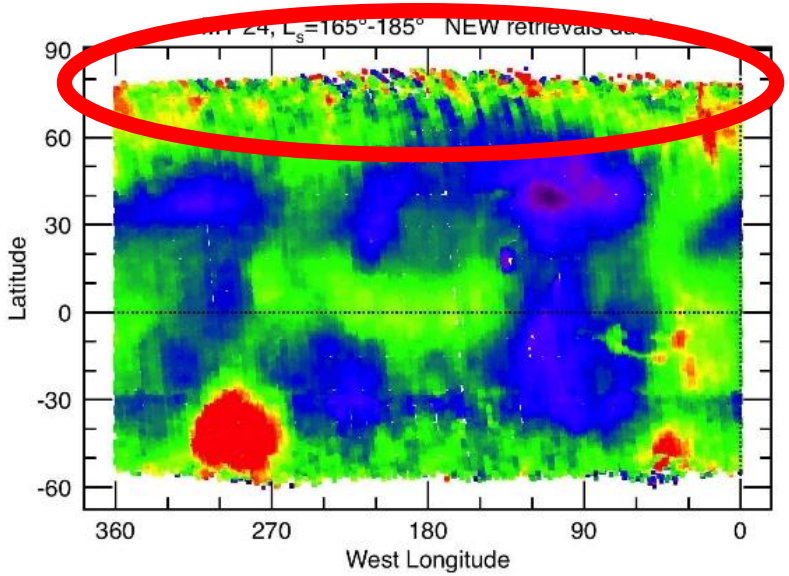
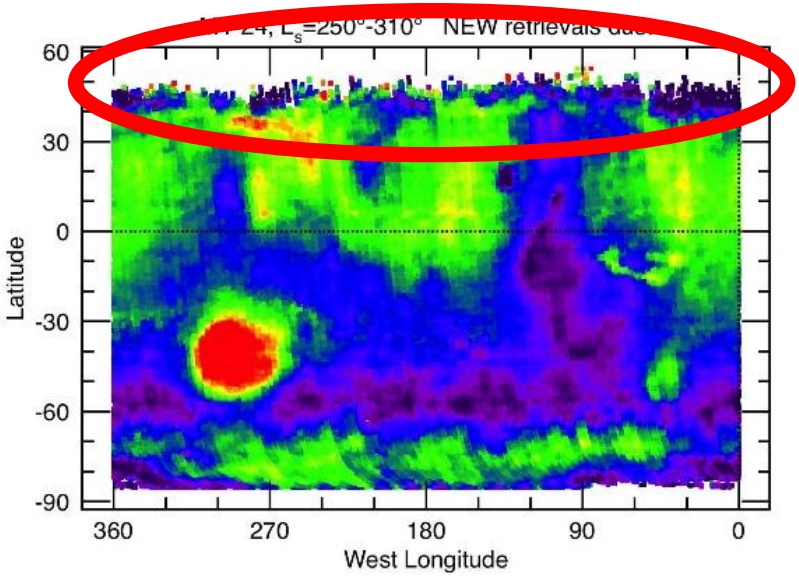




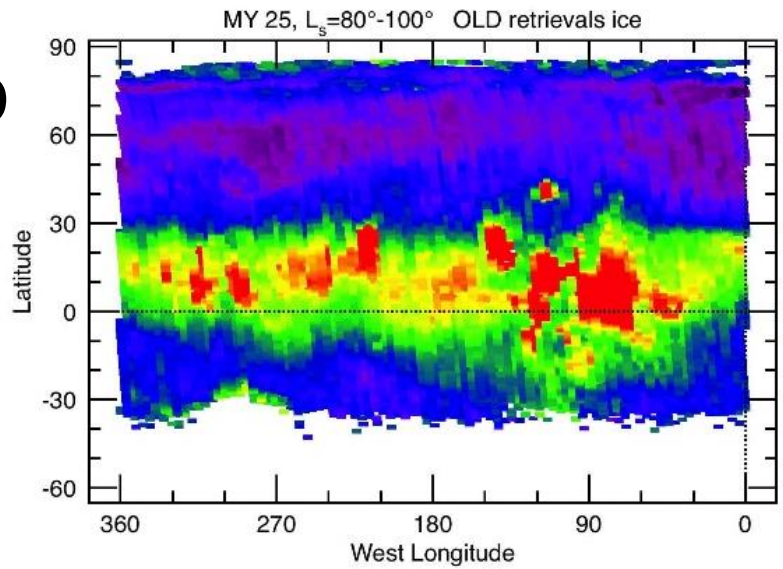
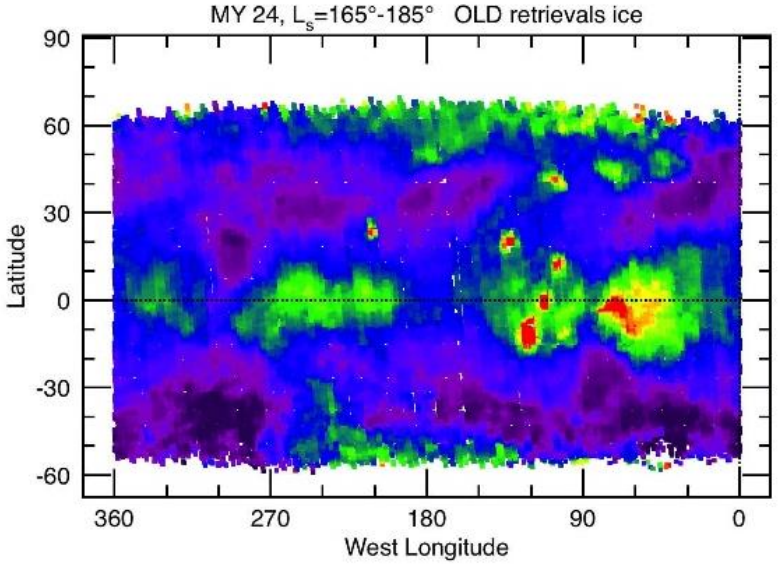
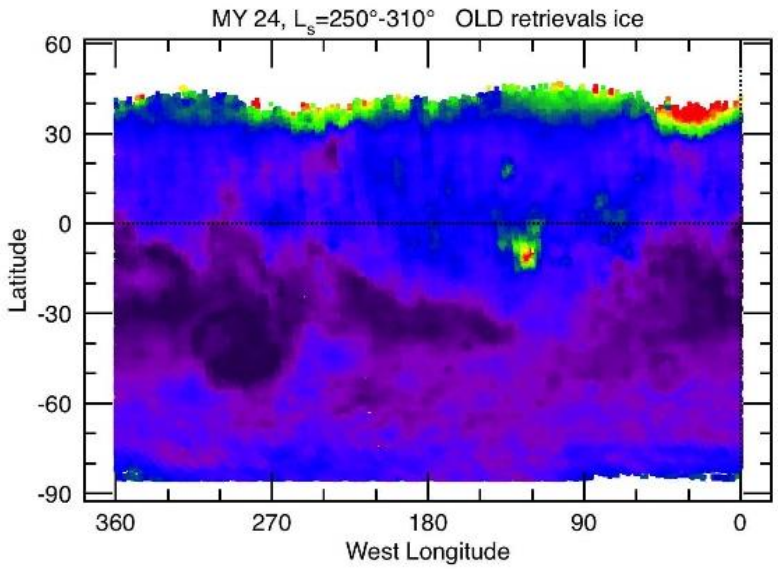
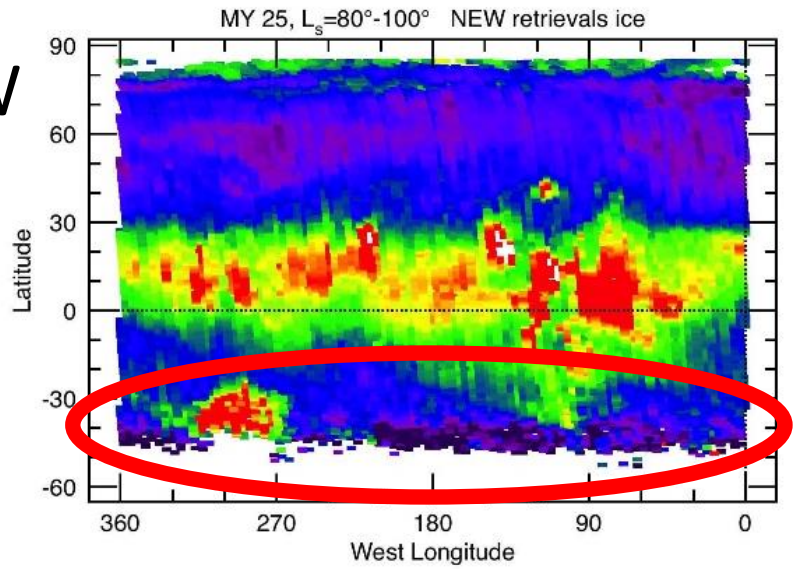
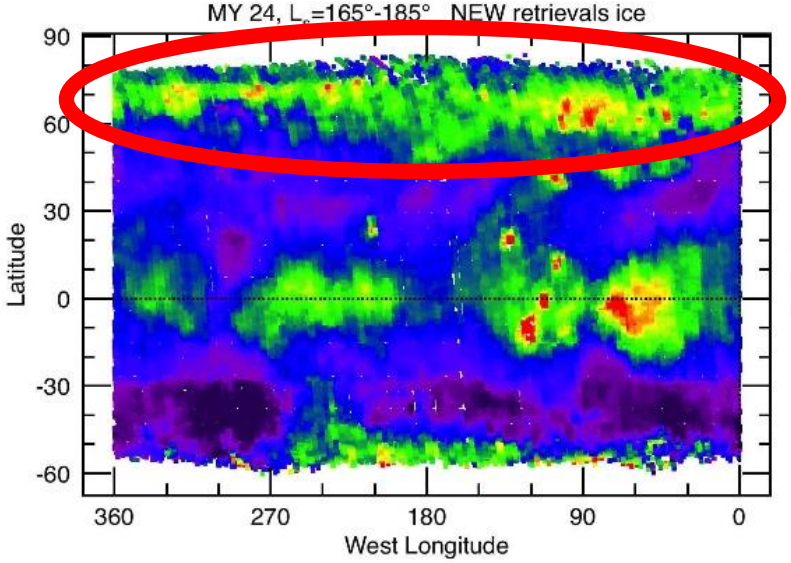
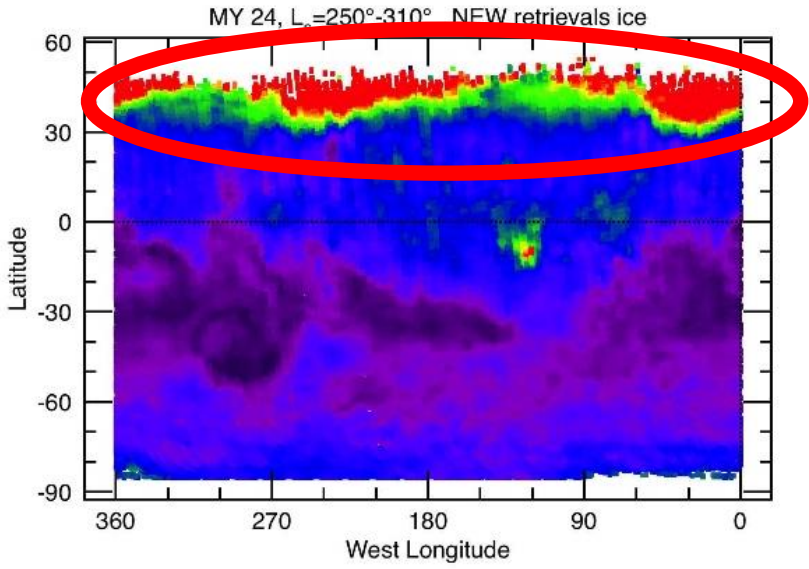




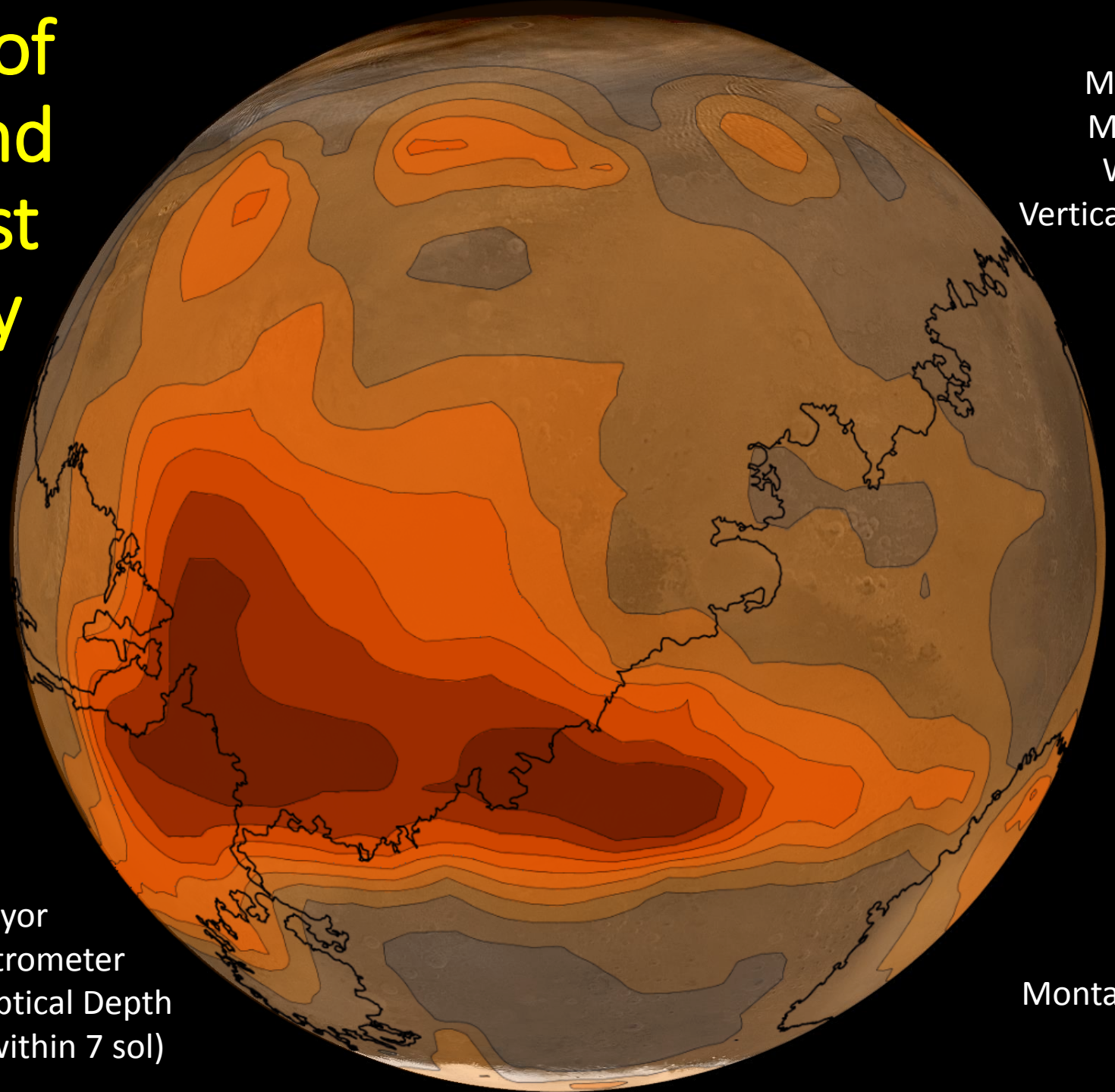
Time-averaged map of (non-normalized) CDOD

	$80° < L_S < 100°$	$165° < L_S < 185°$	$250° < L_S < 310°$
OLD			
NEW			

“By-product”: water ice optical depth retrievals

	$80° < L_S < 100°$	$165° < L_S < 185°$	$250° < L_S < 310°$
OLD			
NEW			

Validation of retrievals and gridded dust climatology



Mars Global Surveyor
Mars Orbiter Camera
Wide-angle images
Vertical Perspective Projection

Example:
MY 24
L_S ~ 220°
Sol-of-Year 438

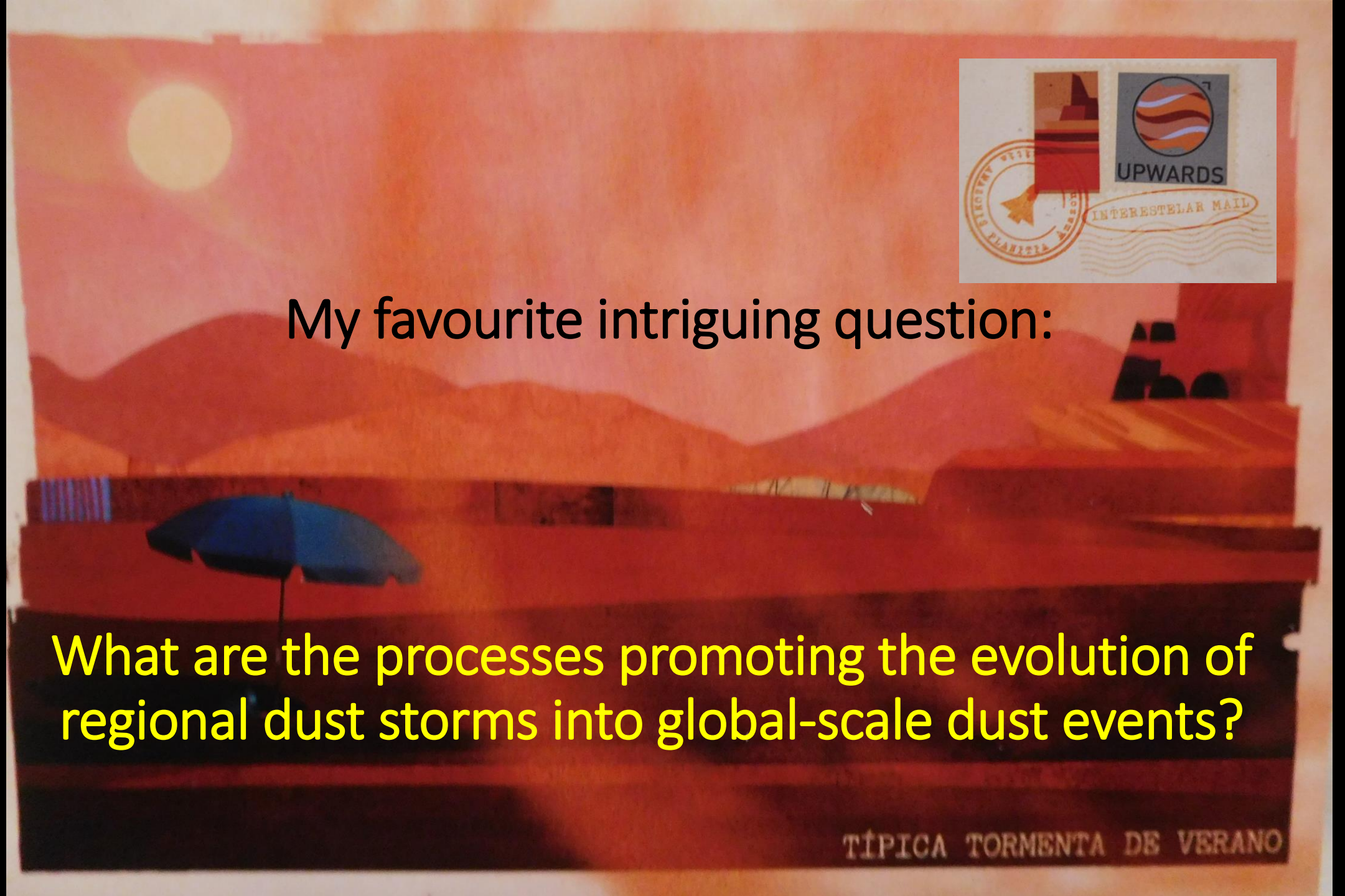
Mars Global Surveyor
Thermal Emission Spectrometer
Gridded IR Column Dust Optical Depth
(dust scenario from data within 7 sol)

Data from:
Montabone et al., Icarus, 2015

Wrapping-up

- We focus on improving retrievals of TES IR CDODs and carry out new retrievals from TES (visible) EPFs
- Preliminary results generally show lower CDODs at high latitudes and at the polar cap edges → better agreement between TES- and MCS-observed years. CDODs appear also lower during the MY 25 global-scale dust event.
- Retrievals at low and mid-latitudes stay the same outside winters
- Better coverage also for the water ice optical depth
- Next steps: final production of retrievals, and systematic validation with MOC images. Release to NASA PDS at the end of the project.

Acknowledgment: Funding from NASA PDART program (grant N. NNX15AN06G)



My favourite intriguing question:

What are the processes promoting the evolution of regional dust storms into global-scale dust events?

BACKUP SLIDES

Figure 1 in Bandfield and Smith 2003

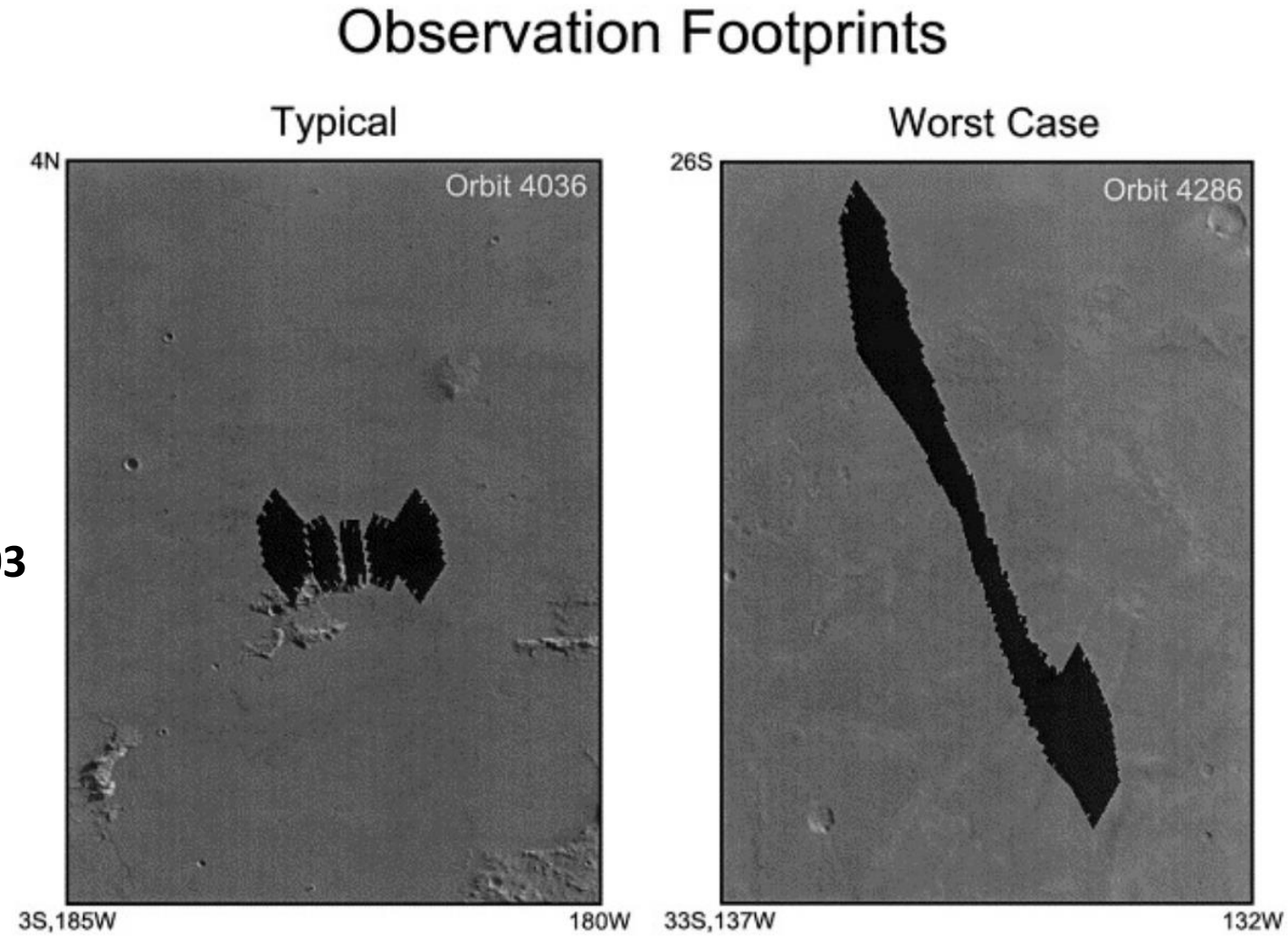
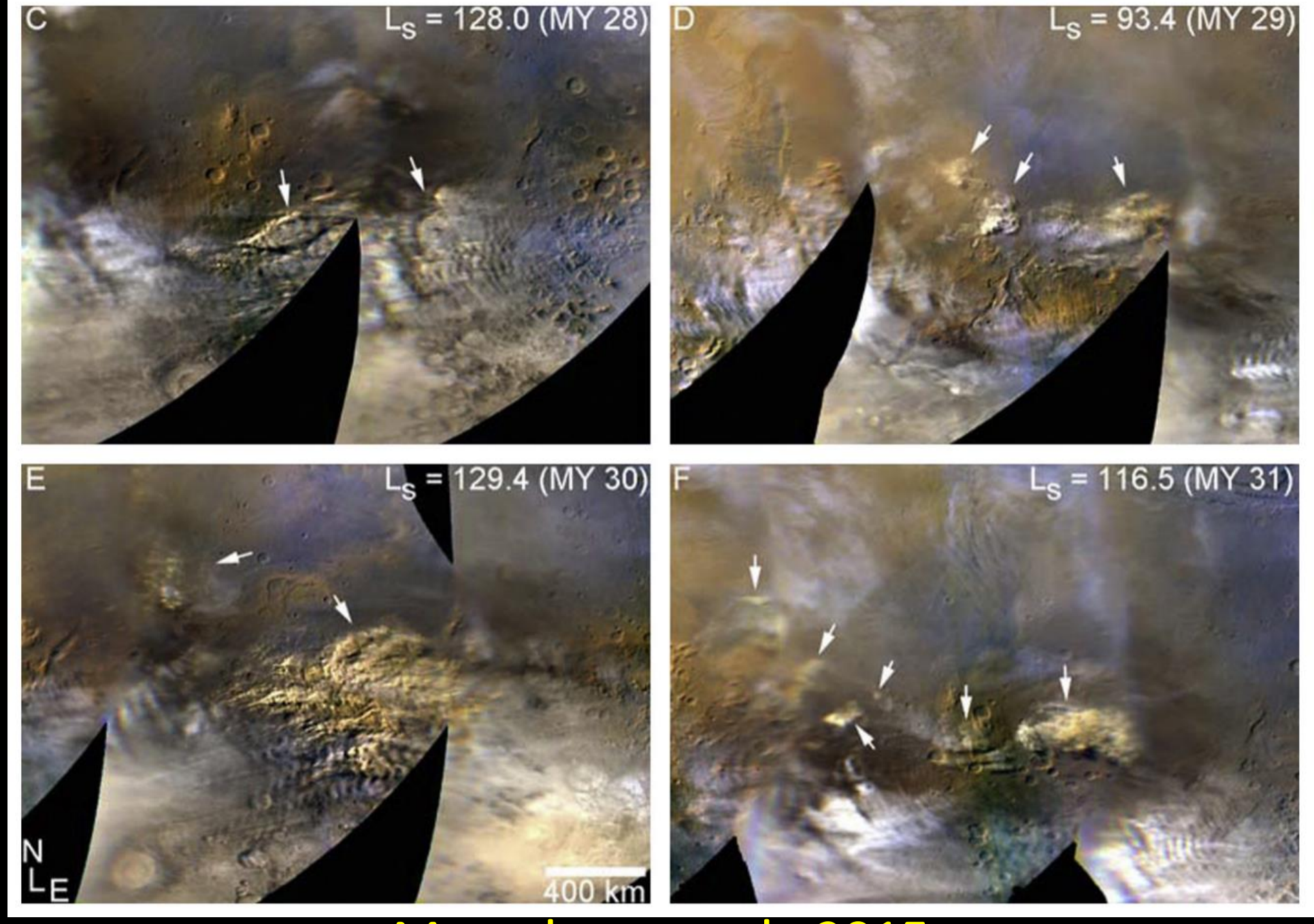


Fig. 1. Spatial coverage of TES EPF observations for a typical-case (left) and a worst-case dense EPF observation (right). Longitudinal spread is a function of latitude and is negligible at the poles and at maximum at the equator because of the rotation of the planet relative to the spacecraft orbit.



Montabone et al., 2015