Aerosol Climatology on Mars as Observed by NOMAD UVIS/SO on ExoMars TGO

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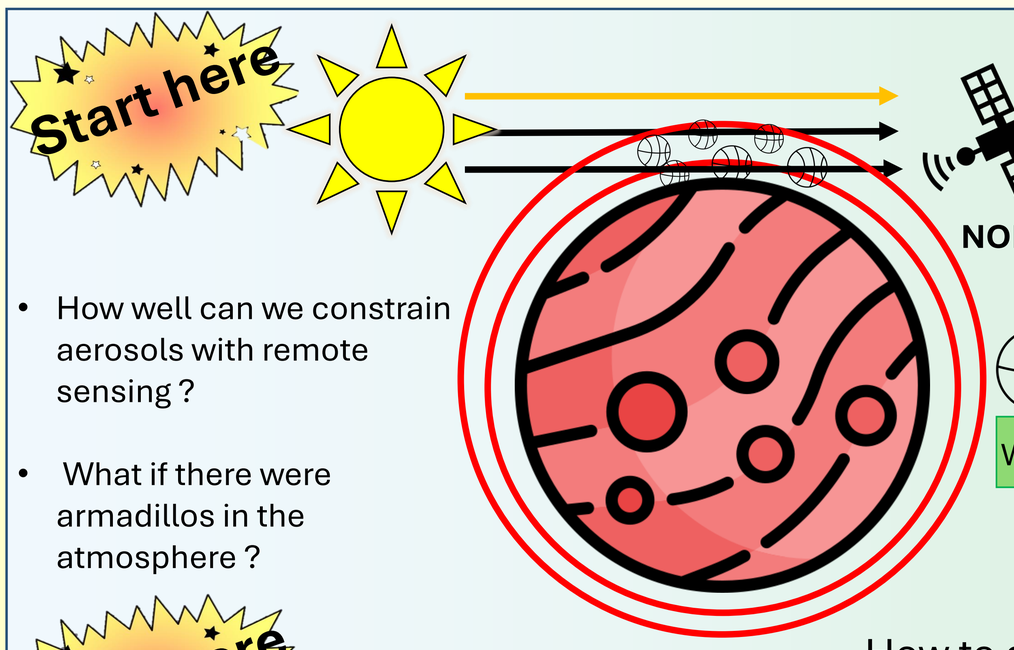
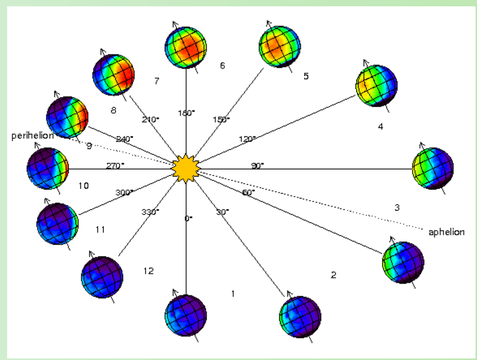


- How well can we constrain aerosols with remote sensing ?
- What if there were armadillos in the atmosphere ?

To compute aerosols property, we are doing the following methodology

Seasonal cycle on Mars



Aerosols in the Martian atmosphere

Dust :

- **Heats the atmosphere**
- Impacts with other retrievals
- Dust storms are present, and more active during perihelion

Ice :

- Could be H_2O or CO_2
- Reflects sunlight and cool the atmosphere
- Forms on dust condensation nuclei
- More present during aphelion

How to differentiate armadillos from aerosols ?

Refractive indices

- Dust and ice are indistinguishable in the UV

Cross sections

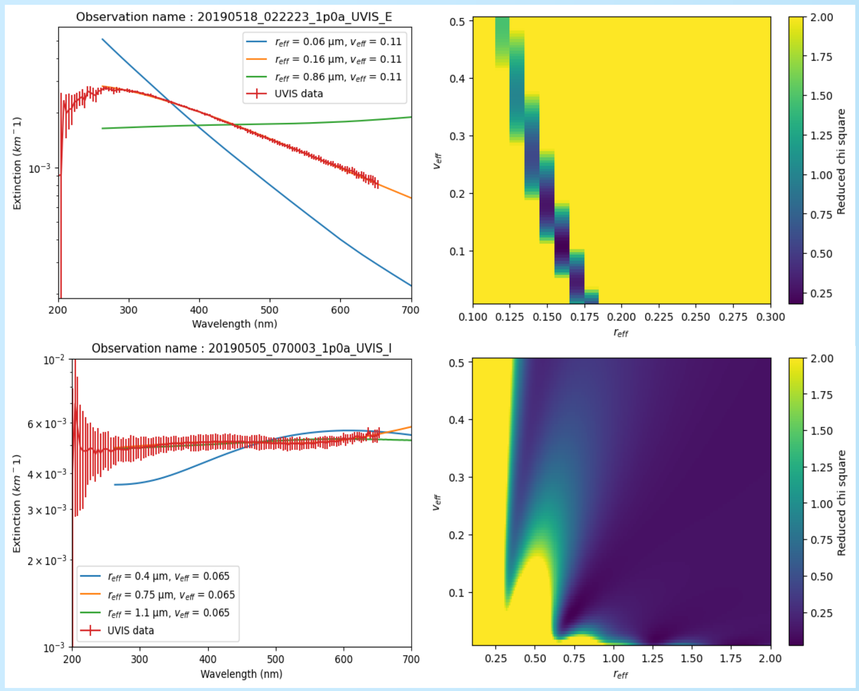
- Mie code (spherical shape)
- Monomodal log normal distribution
- r_{eff} : [0.1 , 0.8] µm
- v_{eff} : 0.1

Fit to find the best size

- $\beta = n * C_{ext}(reff,veff)$, with β the extinction, n the number density and C_{ext} the cross section
- Fit with least square algorithm
- Best reduced chi square obtained gives us the optimal r_{eff}

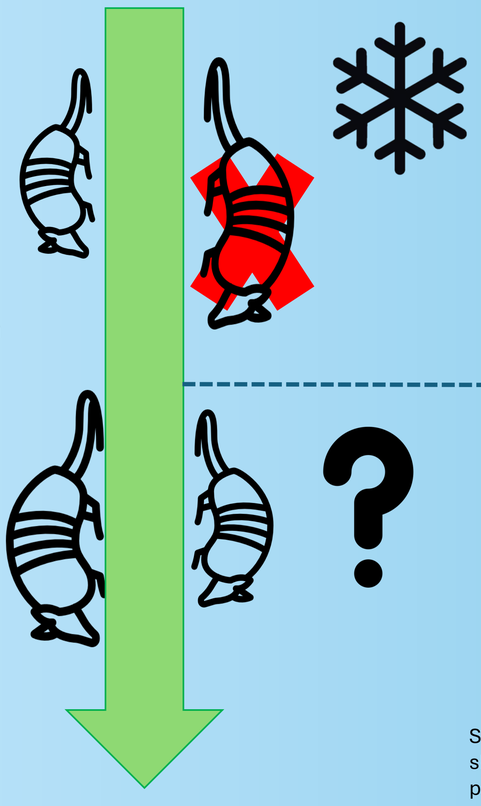
UV (UVIS) : 200-650 nm

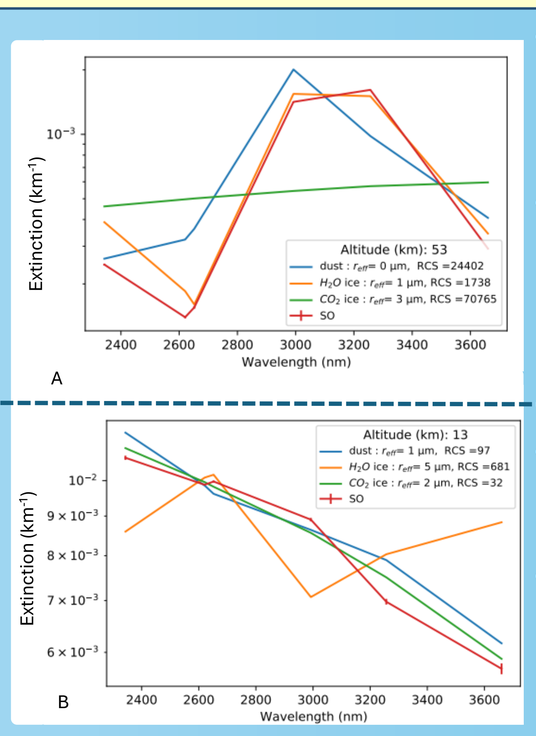
IR (SO) channels : 2.3 – 4.3 µm



Size sensitivity study on the UVIS data. The right panel shows the reduce chi squared of different r_{eff} and v_{eff}. The sensitivity limit of the dataset is given as 0.1-0.8 µm.

- The reduced chi square is constrained for small r_{eff}
- v_{eff} doesn't change the retrieved r_{eff} by more than 0.05 µm
- Large particles gives a flat spectra which make it difficult to fit accurately

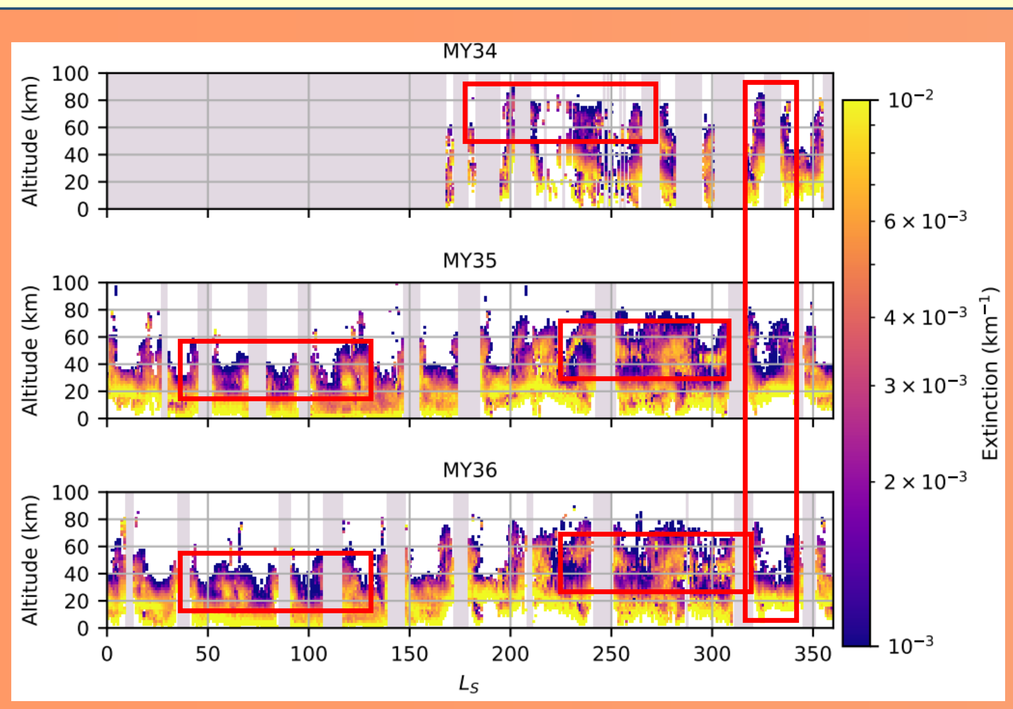




SO extinction profiles with different aerosols fit. Panel A shows water ice absorption and panel B a non water ice profile.

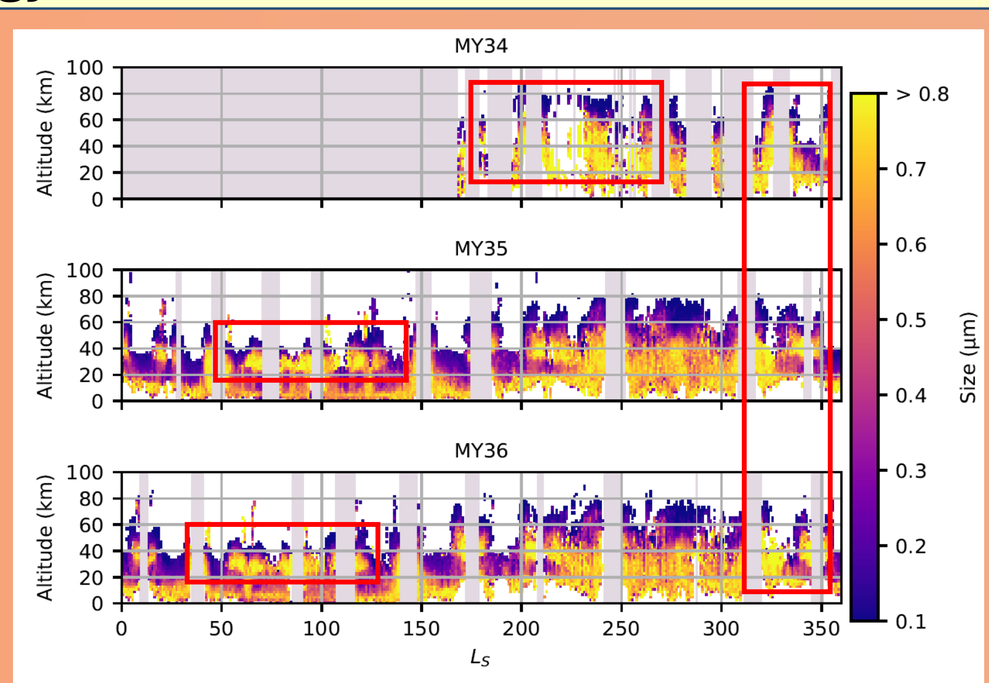
- **5 orders of diffraction** are used to retrieved the background
- Aerosols composition can be differentiated, **armadillos and H_2O ice are spectrally different**
- Dust and armadillos don't have signatures
- CO_2 ice signature is within 1 diffraction order of the instrument

Aerosol climatology



- Vertical extinction profiles for latitude bins by row [30° 70°], [-30° 30°], [-70° -30°], respectively from top to bottom

- Similar vertical structure are reproduced from one Martian year to another
- Detached layers are present around 50 km in the northern regions and up to 70 km in the equator
- Dust storm can be observed at L_S 330° in all MY
- The global dust storm is present in MY 34 around L_S 200°



- Vertical size profiles for latitude bins by row [30° 70°], [-30° 30°], [-70° -30°], respectively from top to bottom

Conclusion

- We produced an **aerosol climatology** covering **three different Martian years**
- We derived particle sizes between **0.1 and 0.8 µm** and information on the presence of larger particles
- **No composition can be derived spectrally in the UV** but the use of the IR channel can help to constrain it
- In future work, we will retrieve the aerosols property **with both UVIS and SO** to add more constraints on our retrieval and gains new insight.