Ice cloud, dust and ozone nadir retrieval using SPICAM/UV and influence of dust properties on the retrieved quantities

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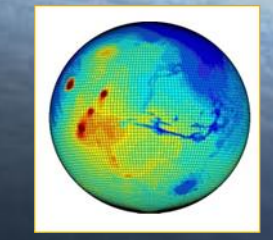

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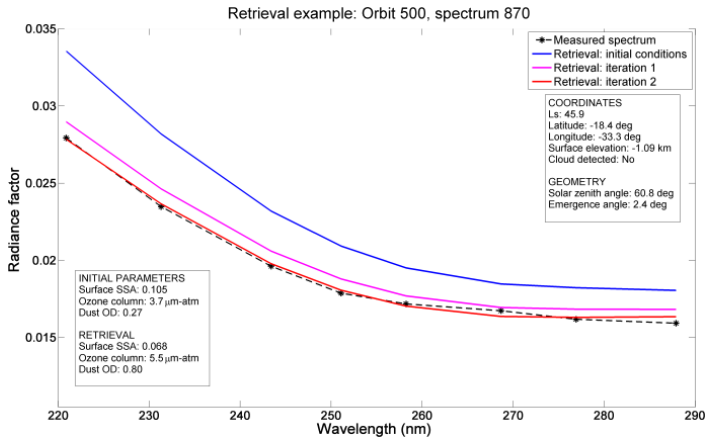
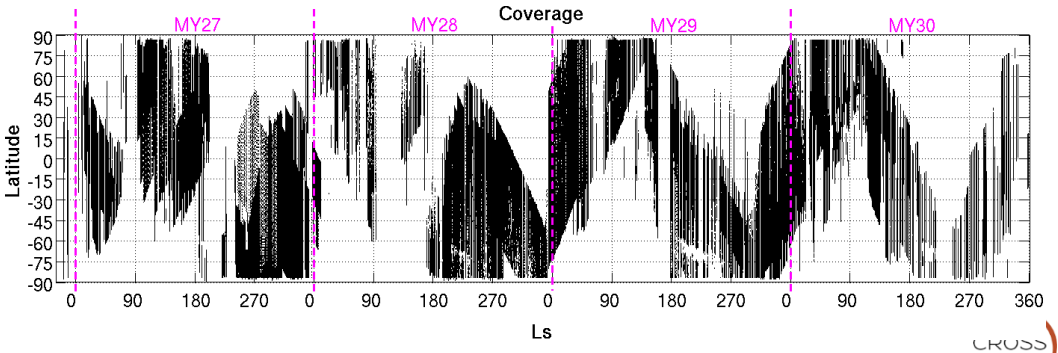
Introduction

- Using SPICAM/UV on board MEX
- Wavelength range: UV 220-290 nm
- Nadir viewing



- Retrieval algorithm [Willame et al., 2017]
- 3 parameters : dust OD, O_3 column & cloud OD or surface albedo
- Cloud detection method

- Performed on 4 MYs (27-30)



⇒ Climatologies

Cloud detection

Principle

Clouds are **bright** in the UV!

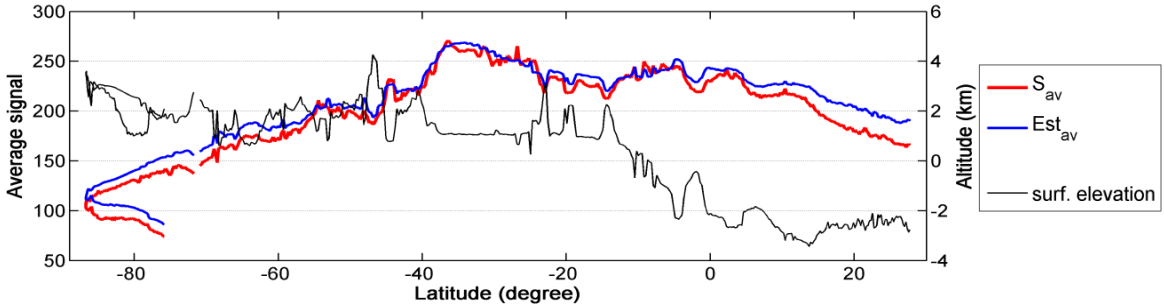
⇒ increase of measured signal (S_{av})

& increase of long/short λ signal ratio (R_{rb})

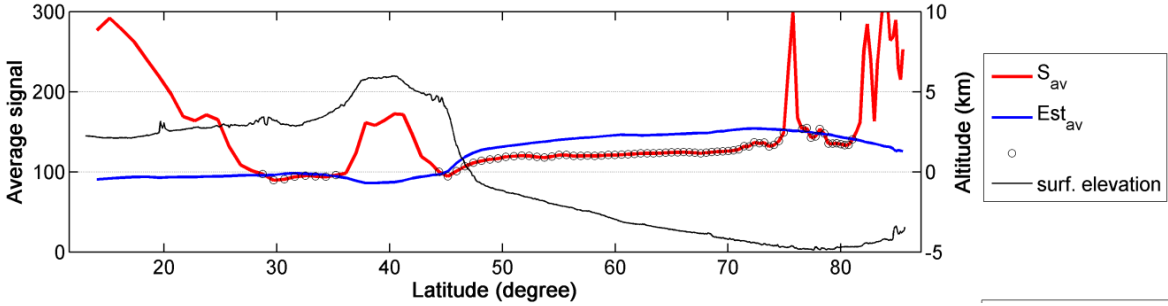
Simulate the estimated signal (Est_{av}) from a priori (MCD)

⇒ approximation of the cloud and ice free conditions

Example **without cloud**: Orbit 2201 (Ls = 299°)



Cloud detection example: orbit 891 (Ls = 94°)



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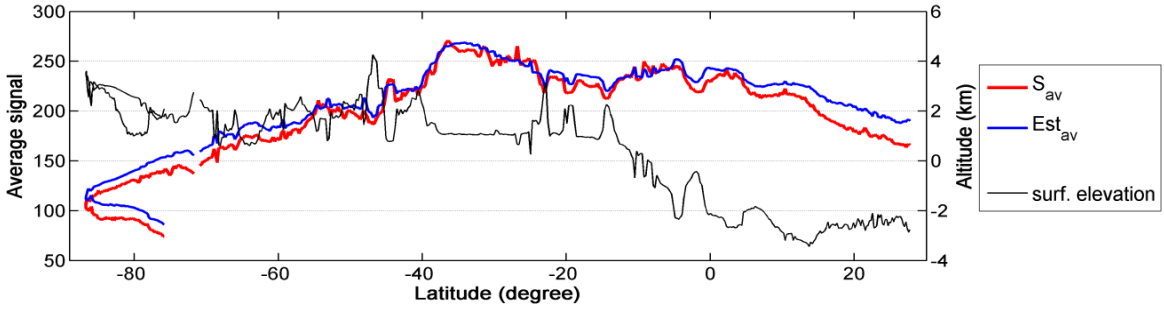

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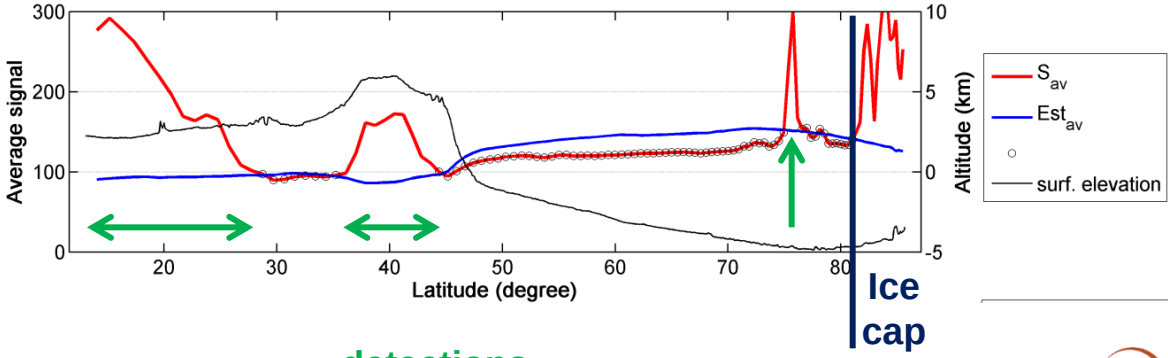
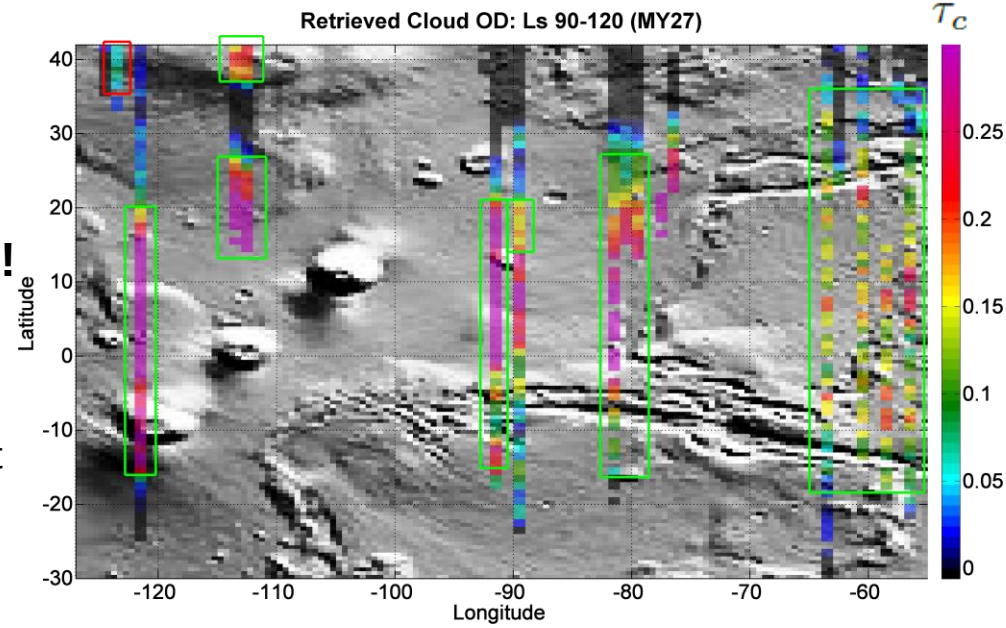


Comparison with OMEGA

Comparison with OMEGA detections (using cloud index, cf. Langevin et al. 2007)

(Comparison over the cloud presence & spatial extension, not the optical depth! obtained after retrieval)

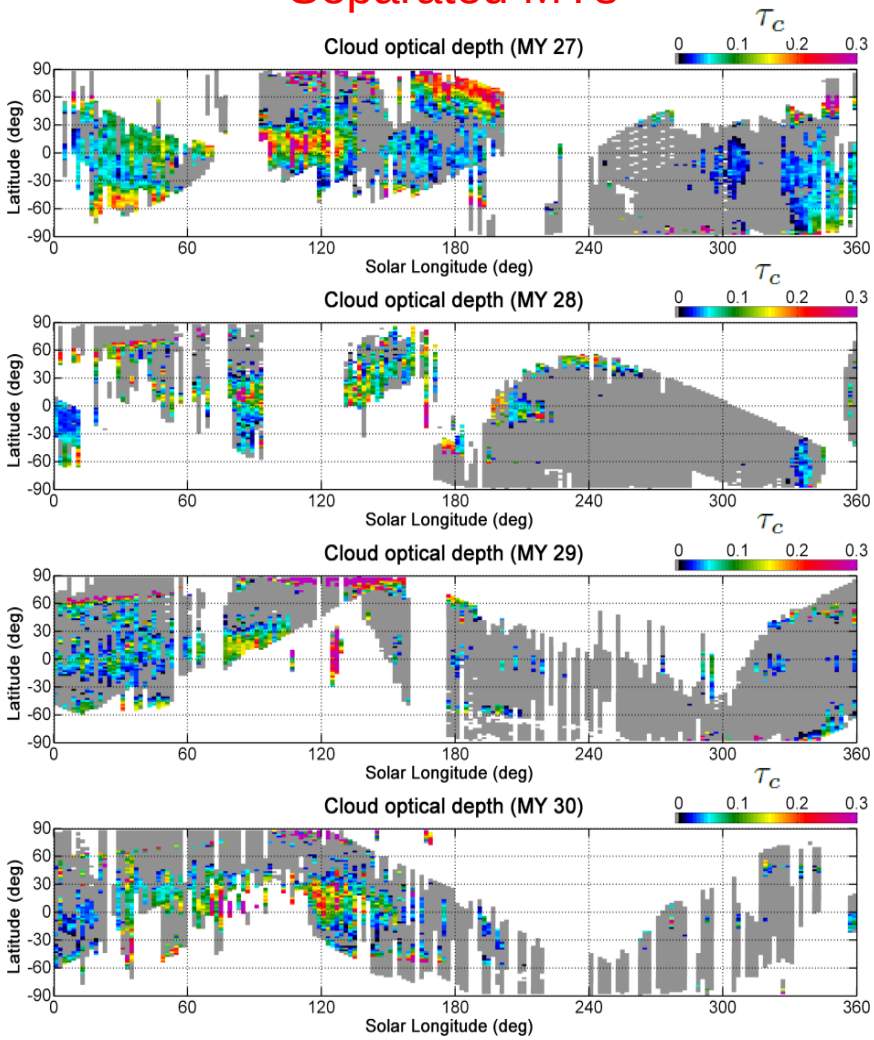
- **Low to mid latitudes**
  (comp. with Madeleine et al. 2012)
  - When τ_c > 0.10: **very good match!**
  - For 0.07 > τ_c > 0.10: partial match
    seems to correspond to OMEGA detection limit



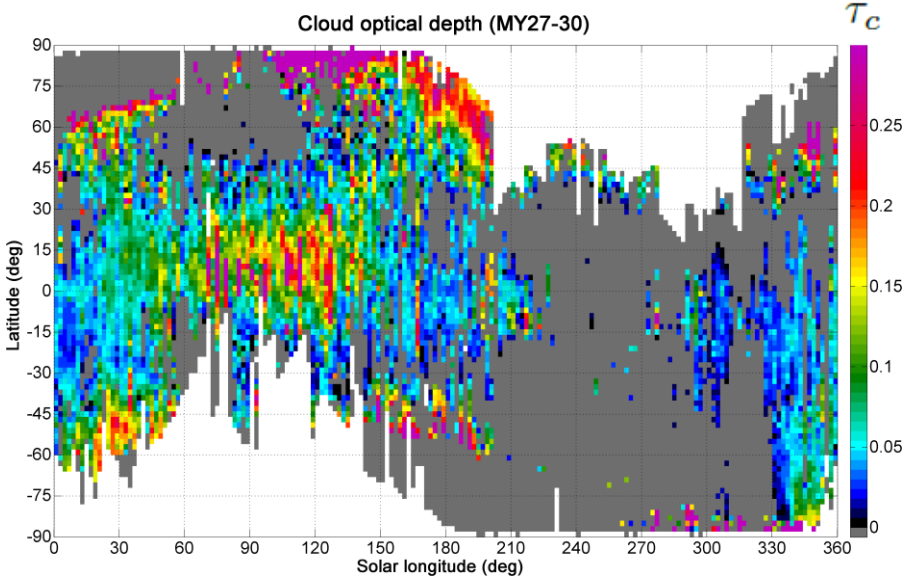
- **Mid to high latitudes** (only few orbit cases tested)
  - Vicinity of the polar cap: ambiguous detections (cloud or ice surface?)
  - τ_c > 0.15: generally matches
  - 0.10 < τ_c < 0.15: detections match but spatial extension not always perfect
  - τ_c < 0.10: partial match of detections and spatial extension

Cloud climatology: seasonal overview

Separated MYs



All MYs combined



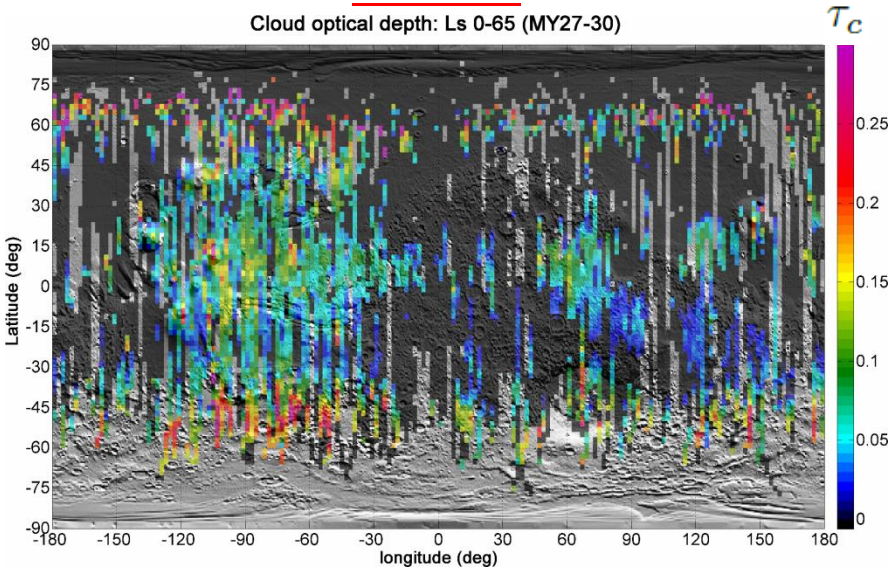
Overview of the main cloud features:

- Aphelion cloud belt
- Polar hoods

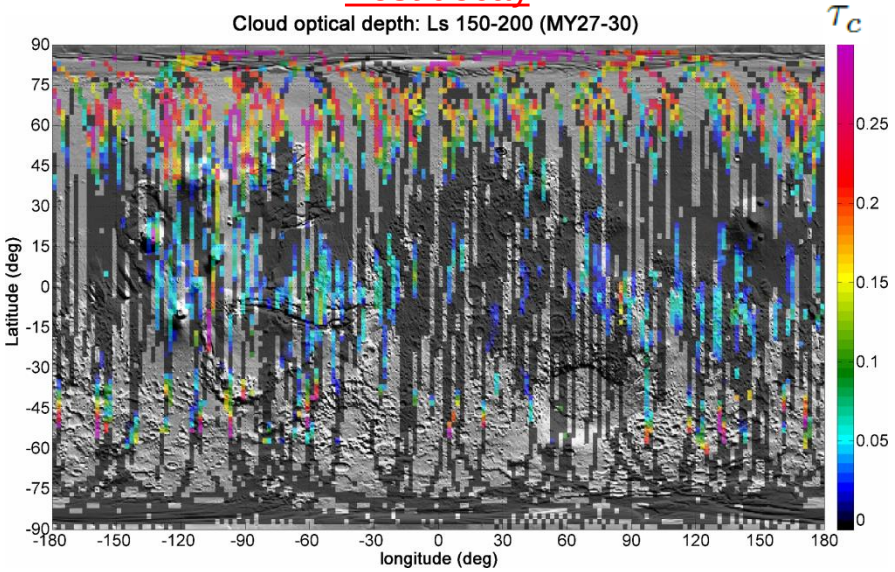
!! Contamination by ice surface at NP during summer
(no H_2O ice in a priori, MCD v5.0)

Ice clouds: spatial distribution

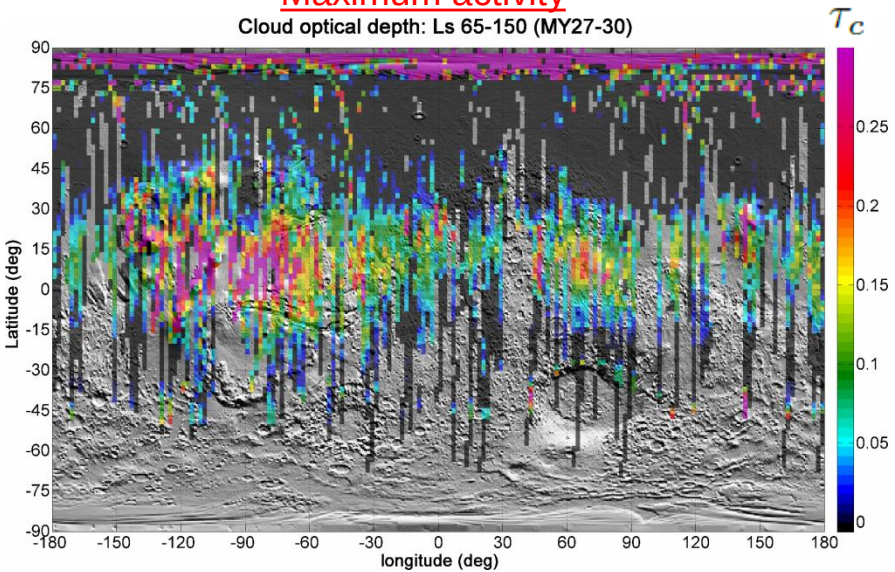
Formation



Post decay



Maximum activity



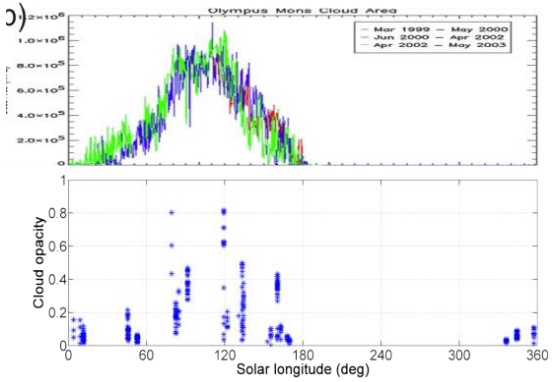
- Start in Tharsis and Syrtis Major where higher OD are observed
- Encircling planet at max. activity
- Almost disappeared after Ls=150°

Orographic clouds

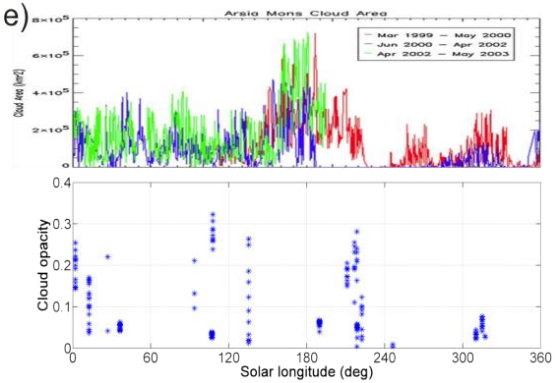
Volcanoes particularly favourable places for clouds

Comparison with MGS/MOC
(from Benson *et al.*, 2006)

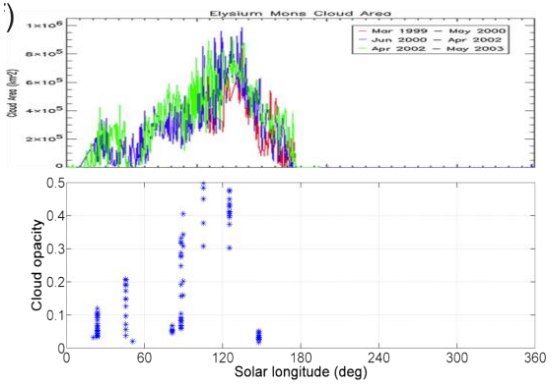
- Cloud presence is in agreement
  ⇒ Conforting annual repeatability
- Correlation (sometimes) observed between MOC cloud area & SPICAM cloud OD.



OLYMPUS



ARSIA



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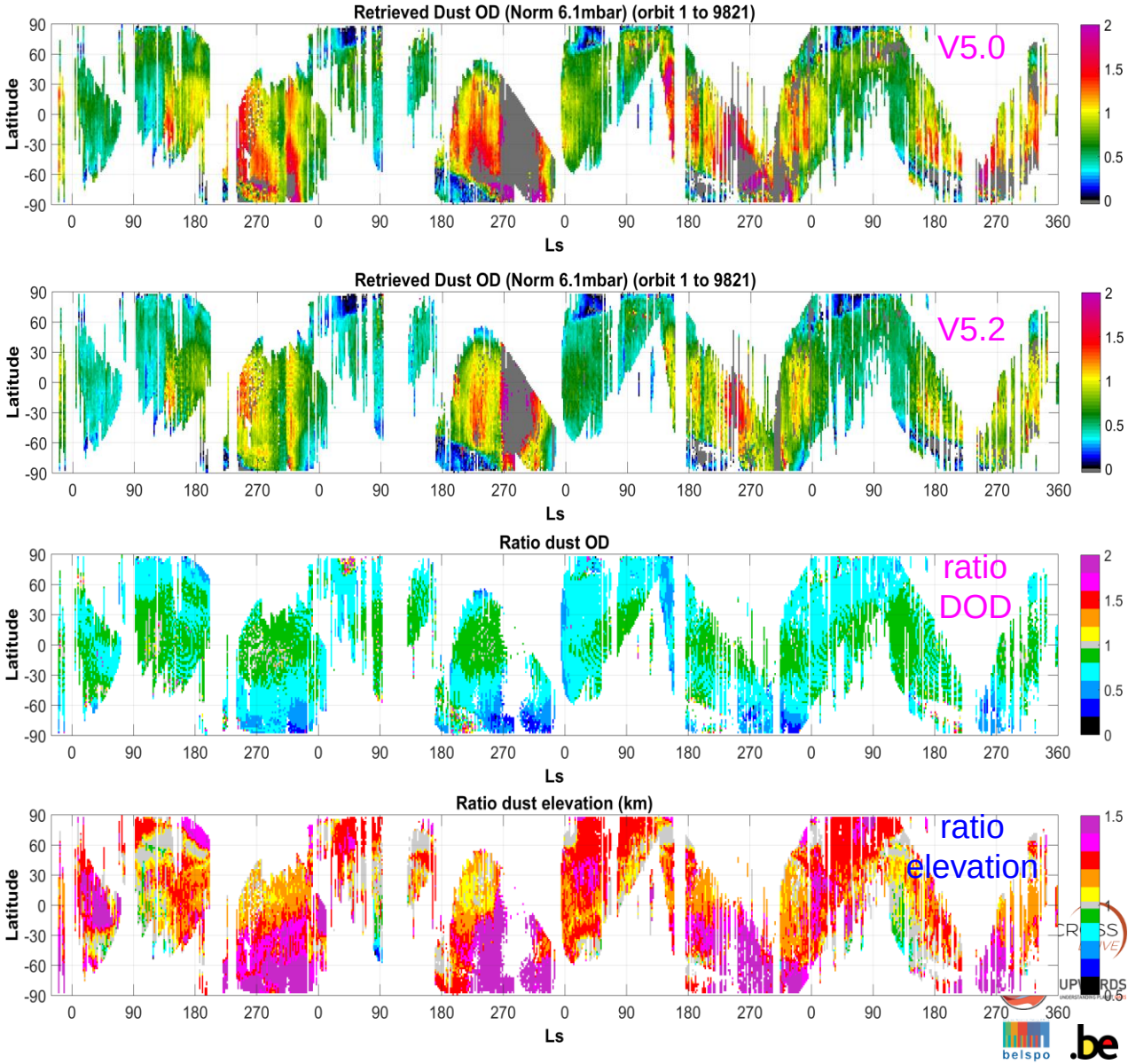
Dust: Altitude profile influence

- Convergence issue in high dust OD (DOD)
- Retrieved DOD higher than other results (Pancam, CRISM)
- Altitude profile of MCD v5.0 too low? (especially in high dust loading)
- Comparison altitude profile from v5.2 (with adapted dust scenario from [Montabone et al., 2015])

⇒ Higher elevation of dust profile

⇒ Improved convergence (inversion)

⇒ Better agreement with other results



Dust: Scattering properties' influence

- Tested use of another scattering property set

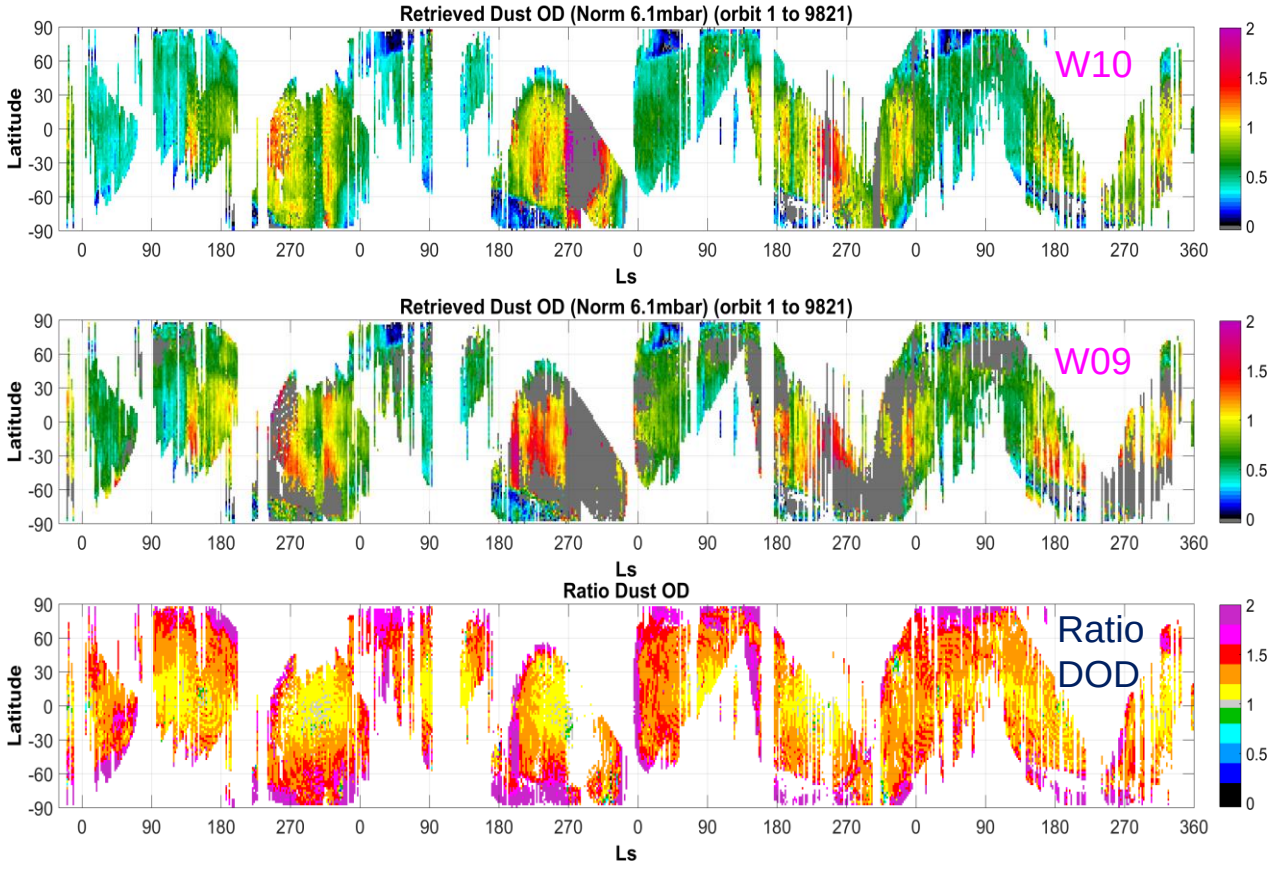
⇒ different SSA, PF, particle size

- Nominal set:
  W10: 1.5 µm particle size
- Other tested set:
  W09: variable particle size

⇒ Degrade convergence (inversion)

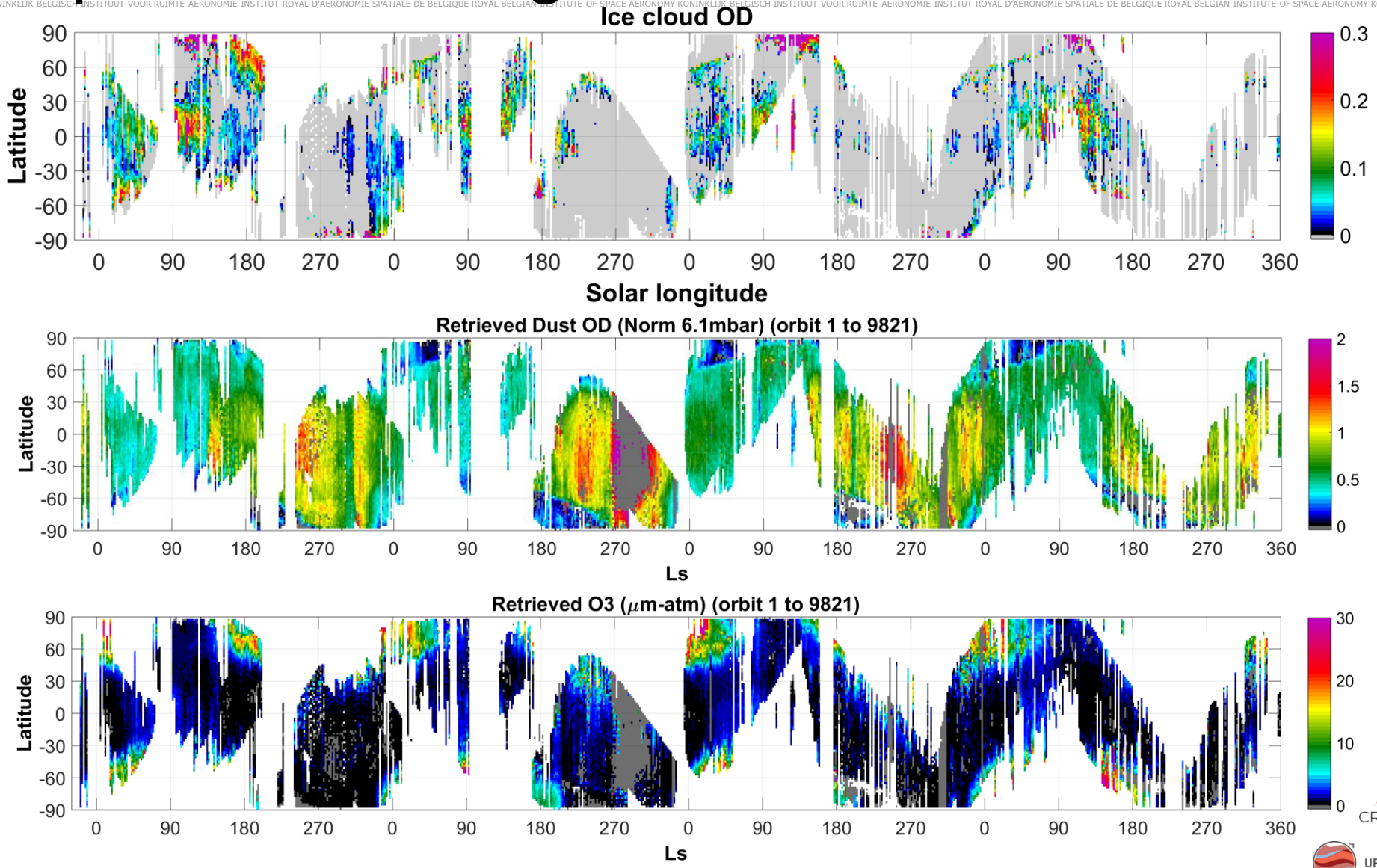
⇒ Degrade agreement with other results

⇒ Comfort our nominal choice for dust scat. prop. set W10



W09: from CRISM [Wolff et al. 2009]
W10: from MARCI [Wolff et al. 2010]

Updated climatologies



Will be applied to NOMAD/UVIS…

Summary and future prospects

- Retrieval algorithm for ice cloud OD, dust OD and ozone column [Willame et al., 2017]
- Cloud detection method (no distinction between H_2O clouds, CO_2 clouds and surface ice)
- Good agreement with OMEGA detection (comparison to be pursued)

  $\Rightarrow$ validate the method

- Derived climatologies over 4 MYs of SPICAM data
- Generally agrees qualitatively with other instrument results
- Use of altitude profiles from MCD v5.2 (with [Montabone et al., 2015] dust scenario) as a priori improves the retrieval

  $\Rightarrow$ better convergence and quantitative agreement with other works

  $\Rightarrow$ dataset reprocessed and updated climatologies

- Incoming paper on our detection & climatology of clouds

- This study will be continued with NOMAD/UVIS