



# The ASKOS experiment for Aeolus Cal/Val: Focusing on aerosol products

**Vassilis Amiridis**

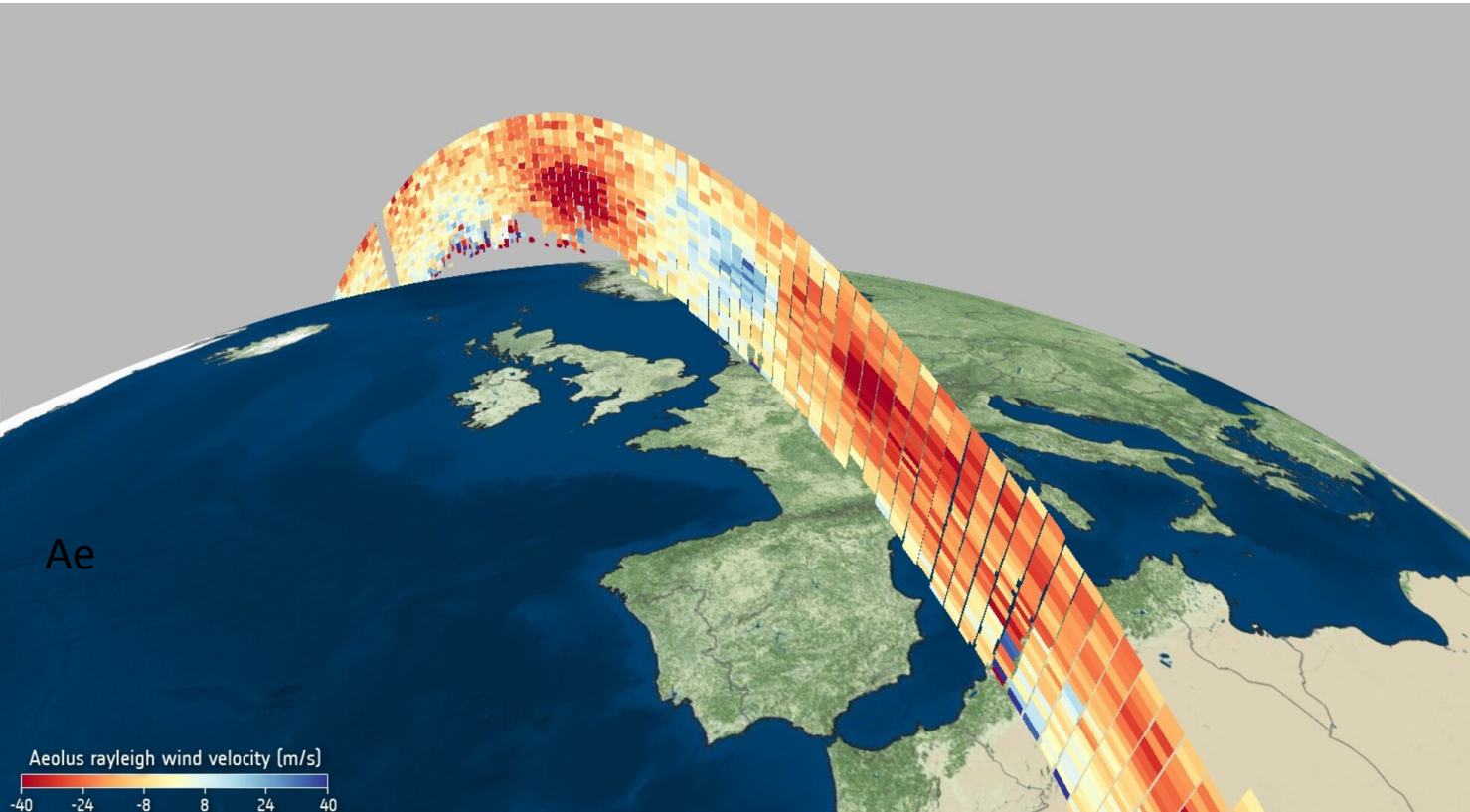
With contributions from the JATAC community:

Marinou E, Baars H, Paschou P, Močnik G, Siomos N, Engelmann R, Skupin A, Pirloaga R, Lenarčič M, Zenk C, Silva E, Rodrigues E, Silva P, Maqueo Anaya S, Gebauer H, Moussa Idrissa S, Tetteh Quaye D, Fiogbe Attannon D, Bühl J, Radenz M, Antonescu B, Ene D, Pfitzenmaier L, O'Conor E, Seifert P, Mavropoulou I, Georgiou T, Spirou C, Drakaki E, Kampouri A, Tsikoudi I, Gkikas A, Proestakis E, Jones L, Nemuc A, Haarig M, Floutsi A, Ansmann A, Bervida M, Drinovec L, Jagodič U, Žibert B, Kandler K, Sudharaj A, Marengo F, Kezoudi M, Keleshis C, Sciare J, Heese B, Althausen D, Do Rosario N, Almeida C, Benedetti A, Wandinger U, Nicolae D, Mona L., Kollias P, Koopman R, Von Bismarck J, Fehr T

# The Aeolus mission - Winds

Aeolus is a flagship European mission that provided wind profiling from space for the first time using the lidar technique

Aeolus has a high impact on NWP, through the assimilation of wind fields, especially in the free troposphere

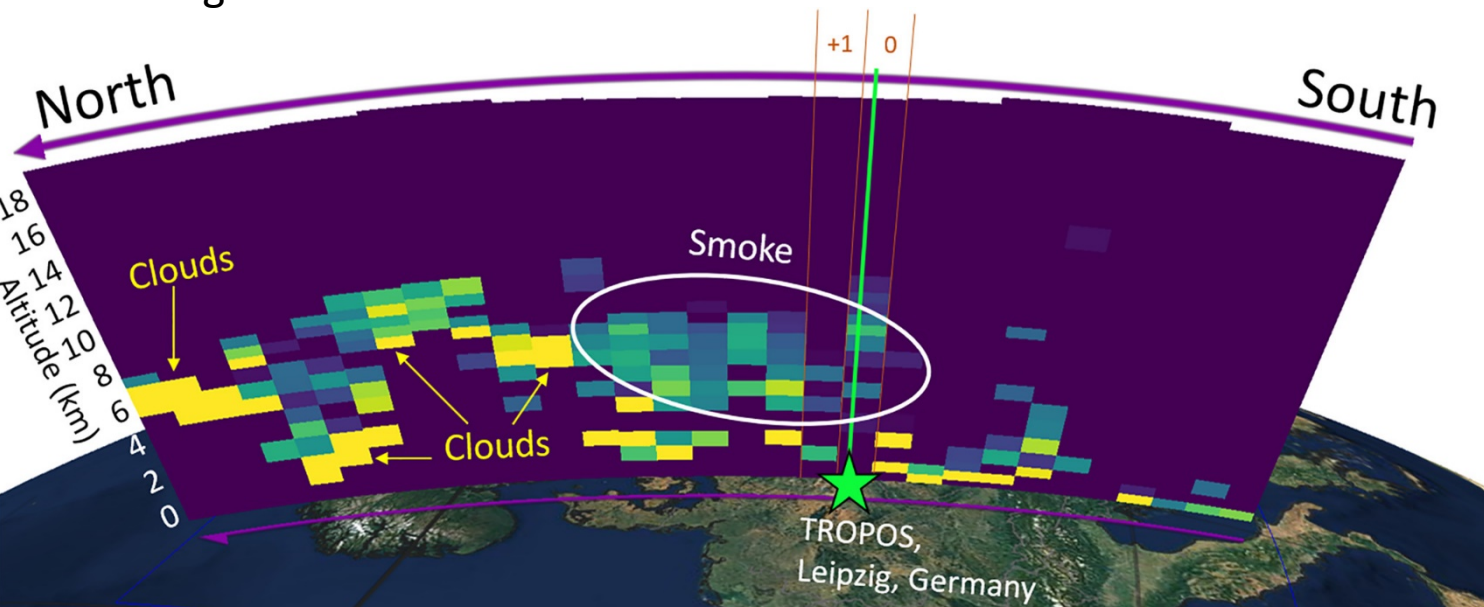


# The Aeolus mission – Aerosol/Clouds

Aeolus delivers additionally an aerosol and cloud product (L2A).

Besides the enhancement of applications for atmospheric composition studies, the simultaneous observation of wind and aerosol fields by Aeolus allows for synergistic retrievals of new products from space (i.e. aerosol deposition and emission fields).

Before its use for applications the aerosol product went through a thorough validation effort







## WHERE:

Mindelo, Sao Vicente island of Cabo Verde

## WHEN:

June 2021: initial setup and first ASKOS experiment

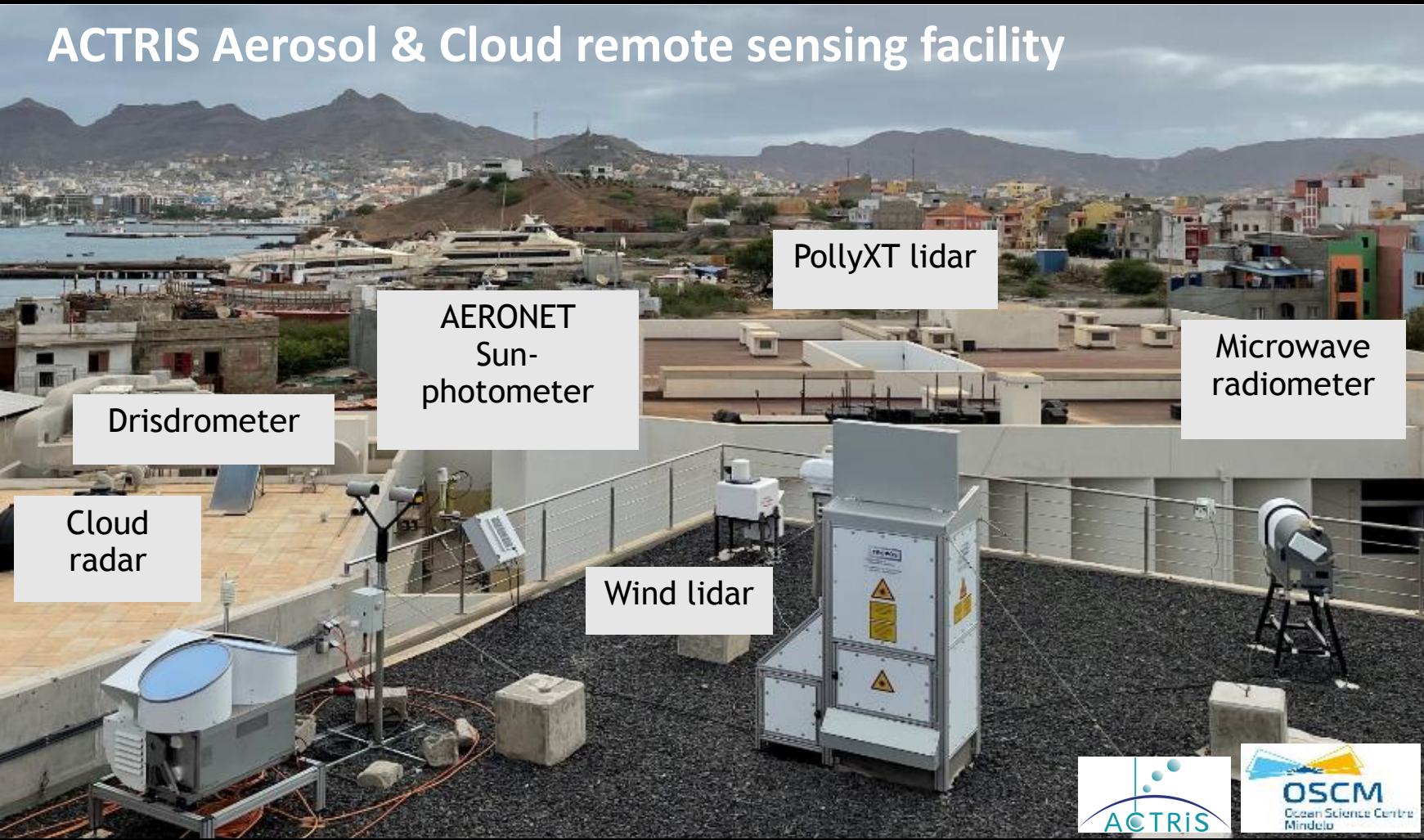
September 2021: Along with other experiments in the framework of JATAC

June 2022: Collocated with the ERC D-TECT experiment

September 2022: Along with NASA CPEX experimental campaign



## ACTRIS Aerosol & Cloud remote sensing facility



### NOA:

- eVe reference lidar
- SolPol polarimeter
- Radiosondes

### TROPOS:

- AERONET station
- PollyXT lidar
- Wind lidar (Halo)
- Microwave radiometer (RPG)

### ESA/INOE:

- 94Ghz Cloud radar (RPG)



**Visualizations:** PollyXT: [Polly.tropos.de](http://Polly.tropos.de)  
All other instruments: [askos.space.noa.gr](http://askos.space.noa.gr)

## eVe lidar

## for Aeolus Cal/Val



### The mission

Aeolus is the first satellite mission to acquire profiles of Earth's wind on a global scale. These observations are being used to improve weather forecasts and climate models. The Aeolus satellite carries just one large instrument – a Doppler wind lidar that will measure the winds sweeping around our planet.

### The launch

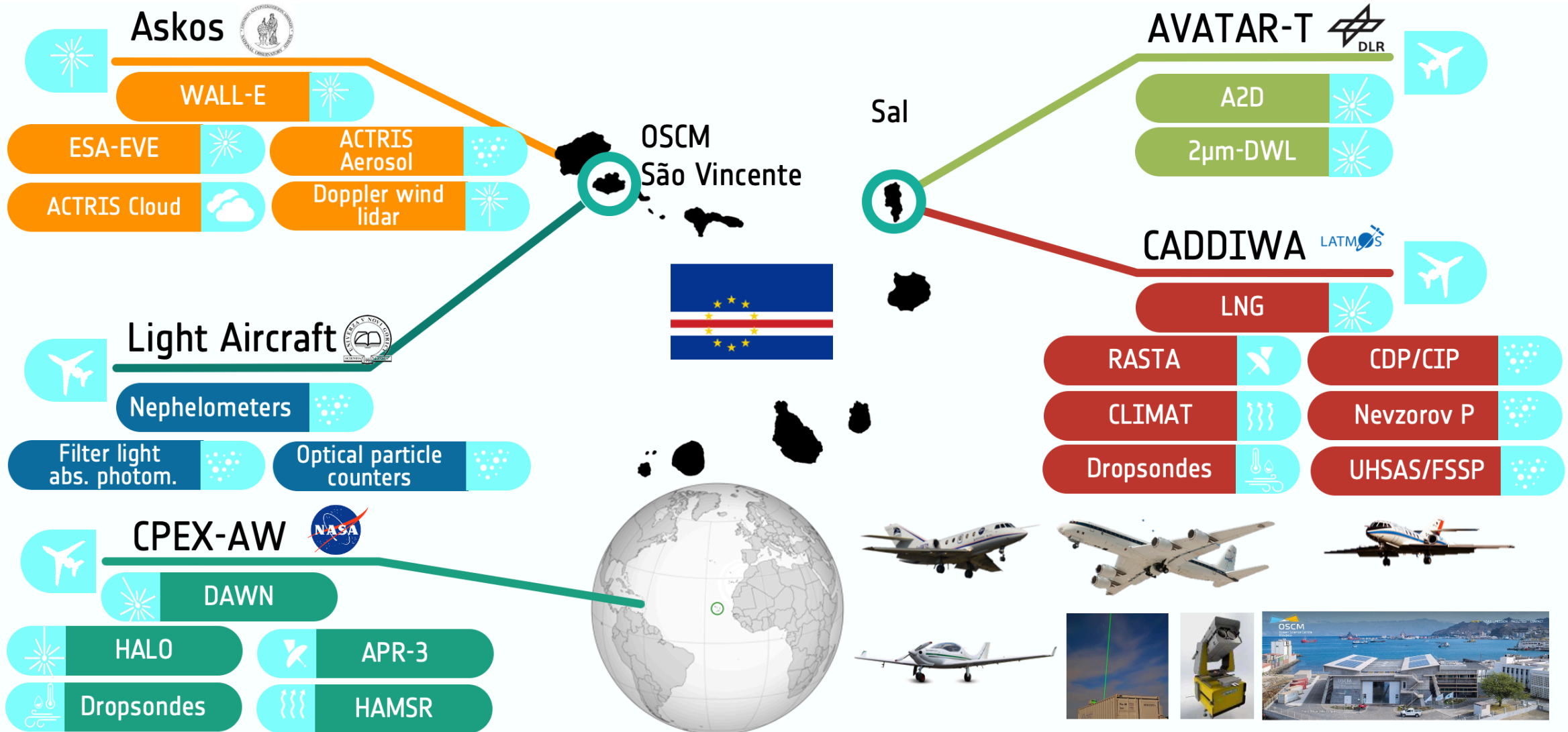
**Date:** 22 August 2018

**Site:** Kourou, French Guiana

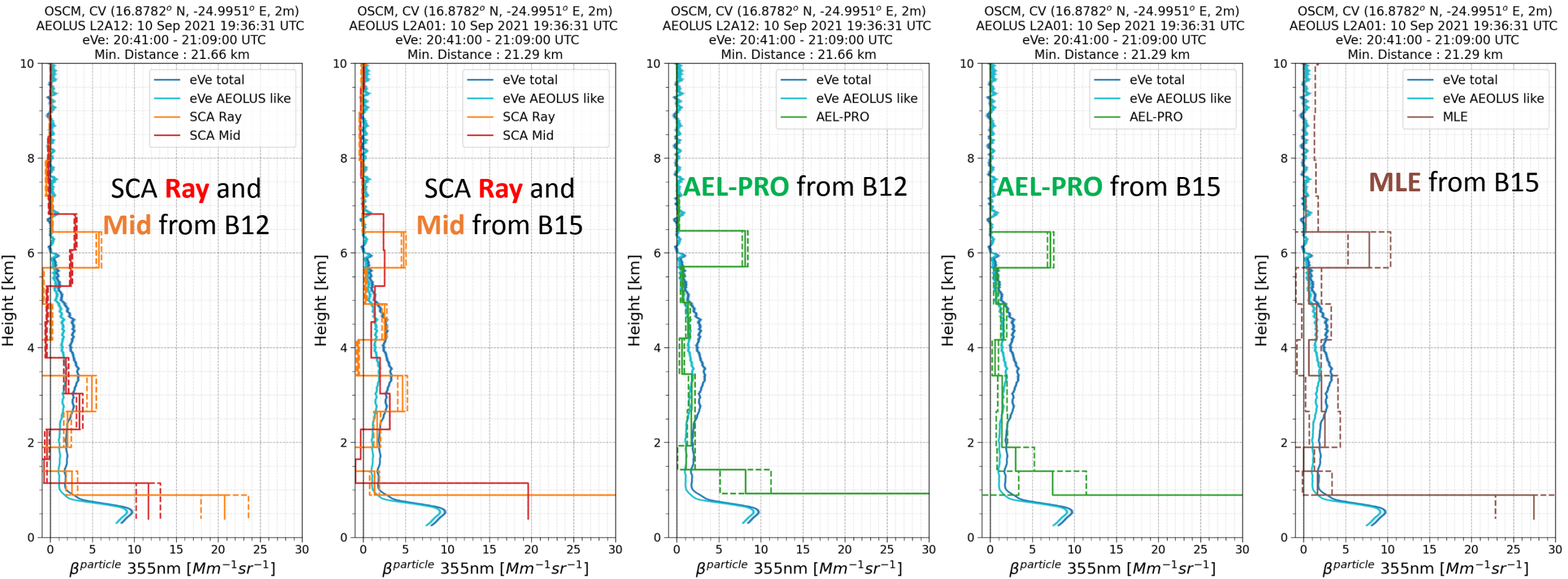
**Rocket:** Vega



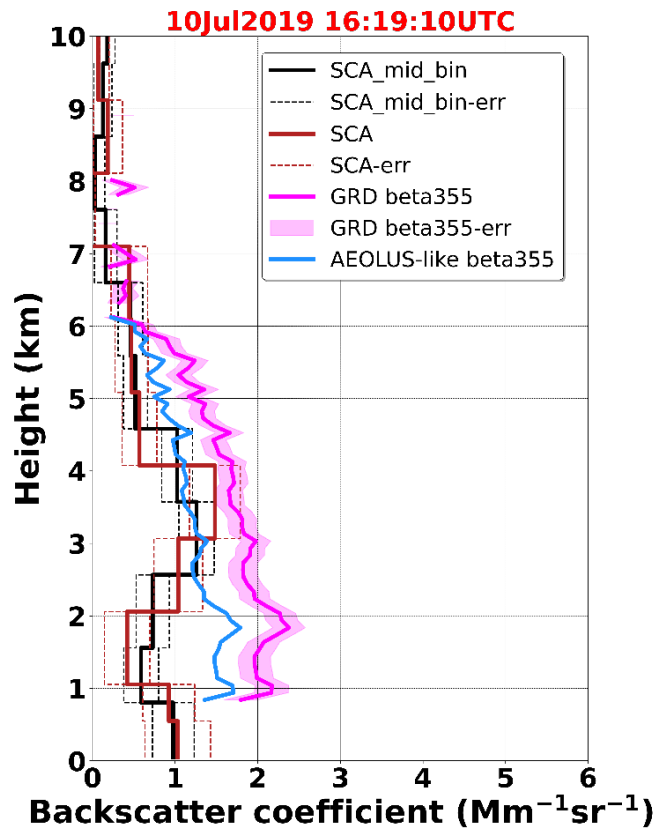
# JATAC campaign cluster for Aeolus Cal/Val



## $\beta^{part}$ comparison from 10 September 2021

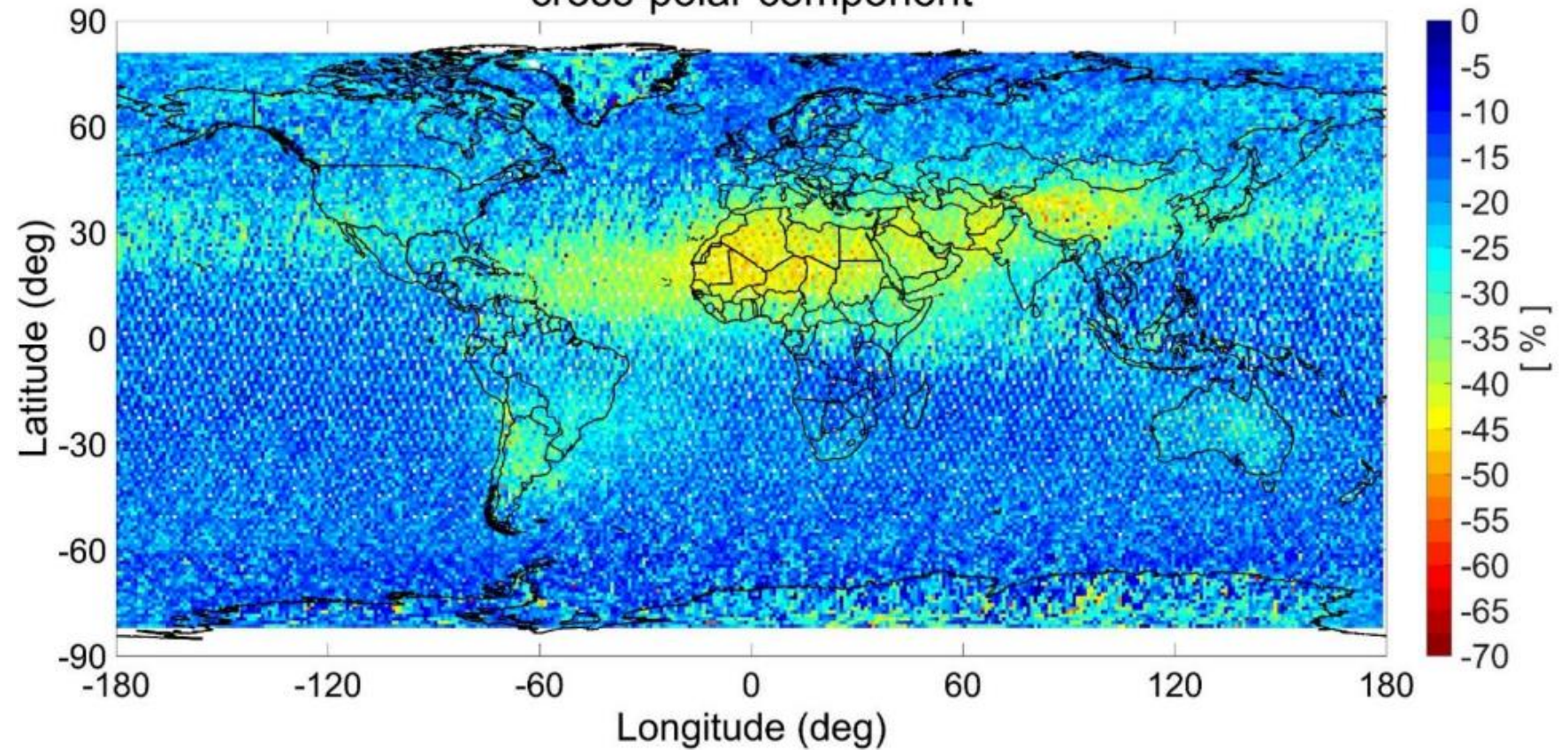




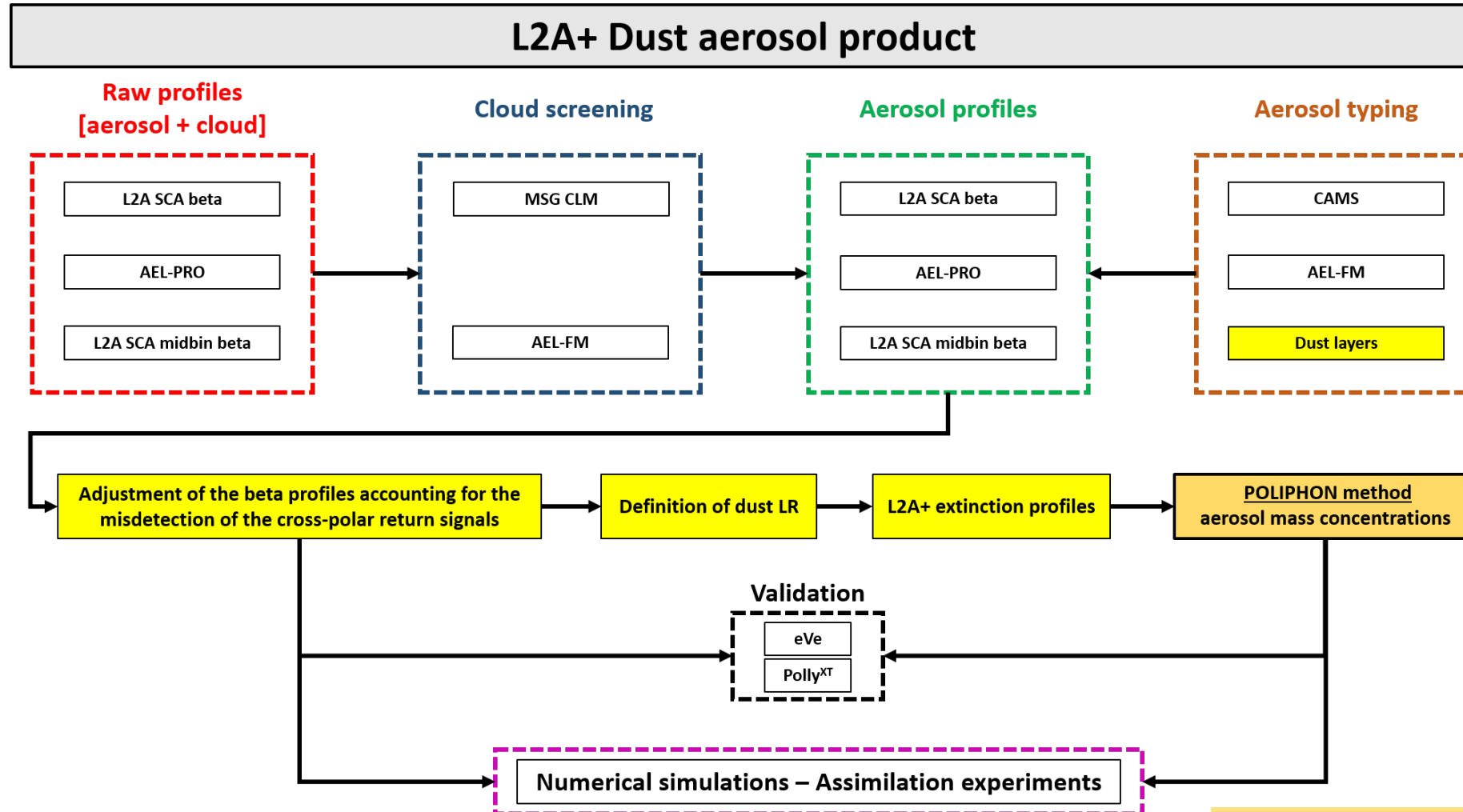


PANACEA, A. Gkikas, 2022

Aeolus underestimation due to the undetected cross-polar component



# L2A+: correction of the L2A product for dust

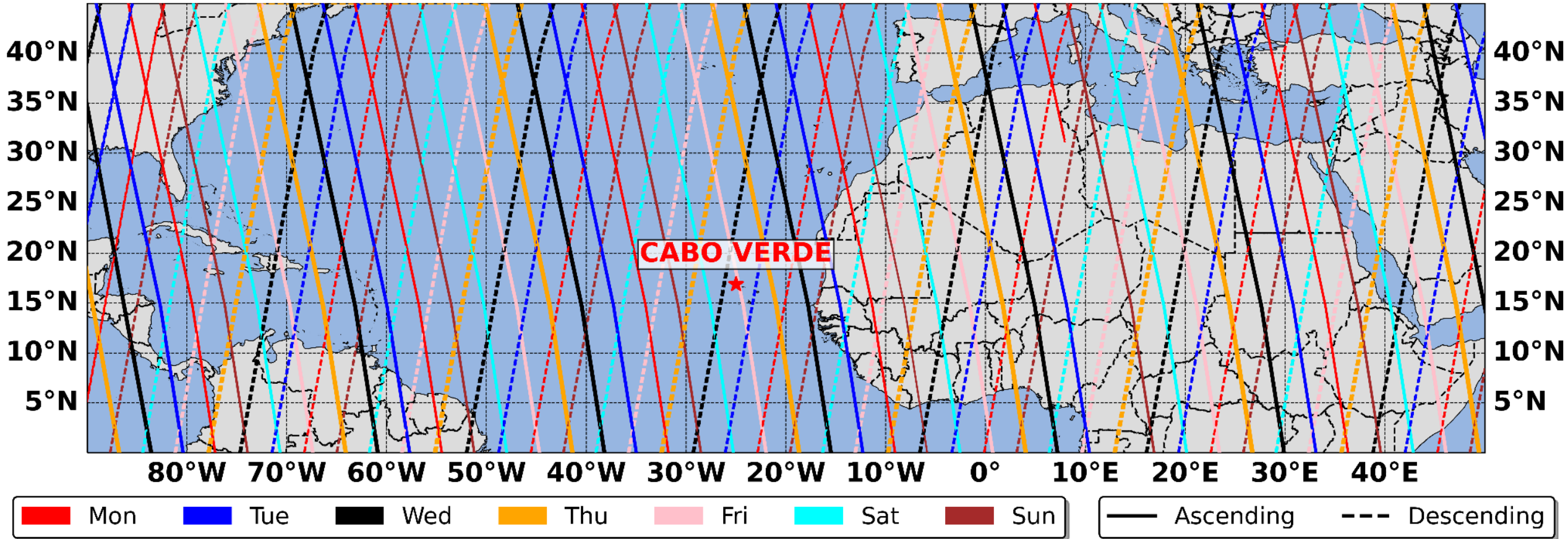




# L2A+: correction of the L2A product for dust

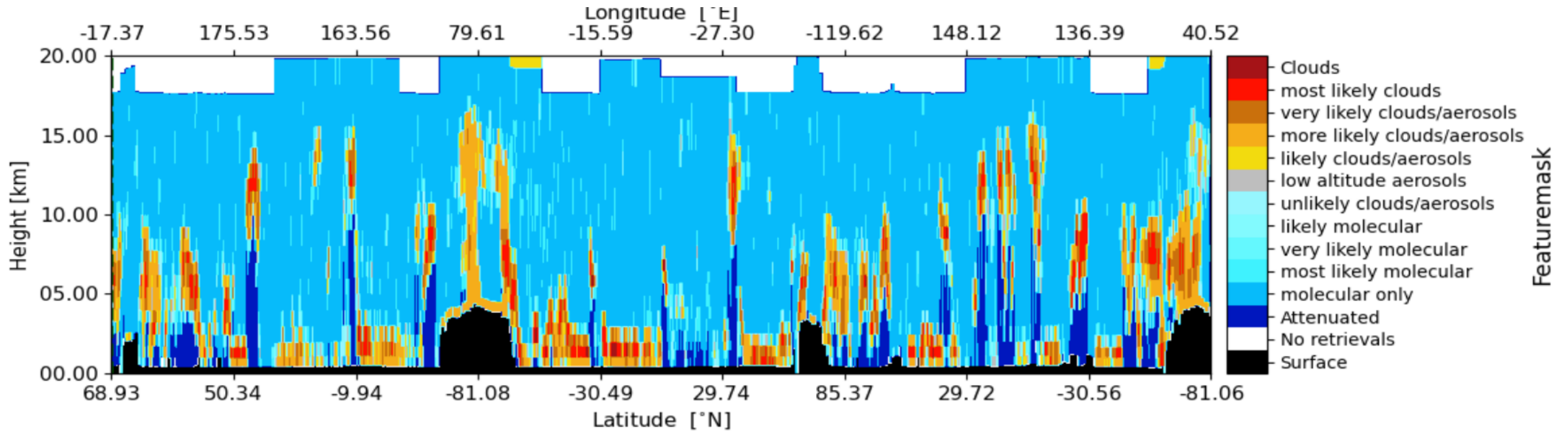
**Aeolus overpasses [01 Sep 2021-30 Sep 2021] | Num of orbits: 386**

80°W 70°W 60°W 50°W 40°W 30°W 20°W 10°W 0° 10°E 20°E 30°E 40°E



# L2A+: correction of the L2A product for dust

AEL-FM product (courtesy Dave Donovan, KNMI)

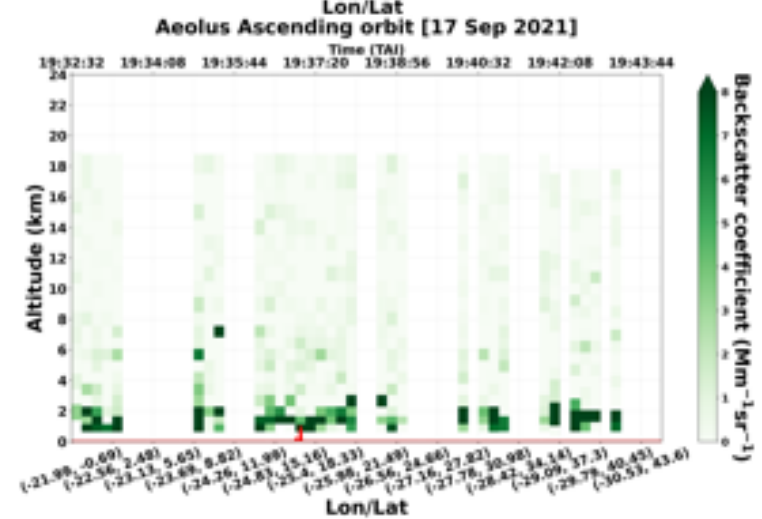
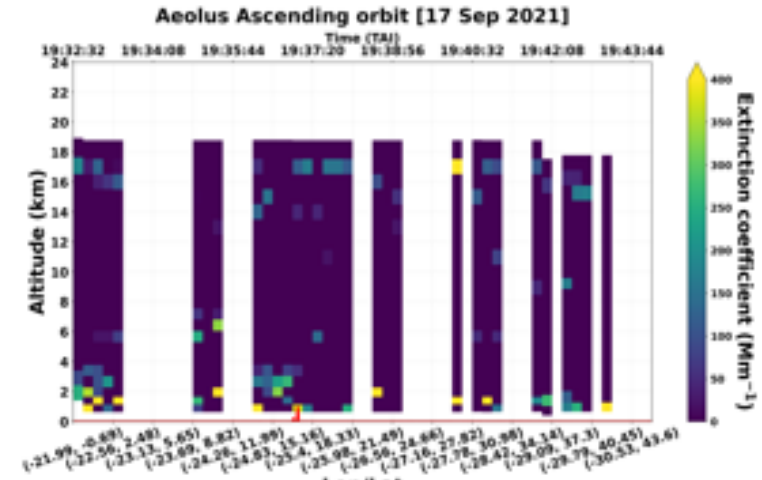
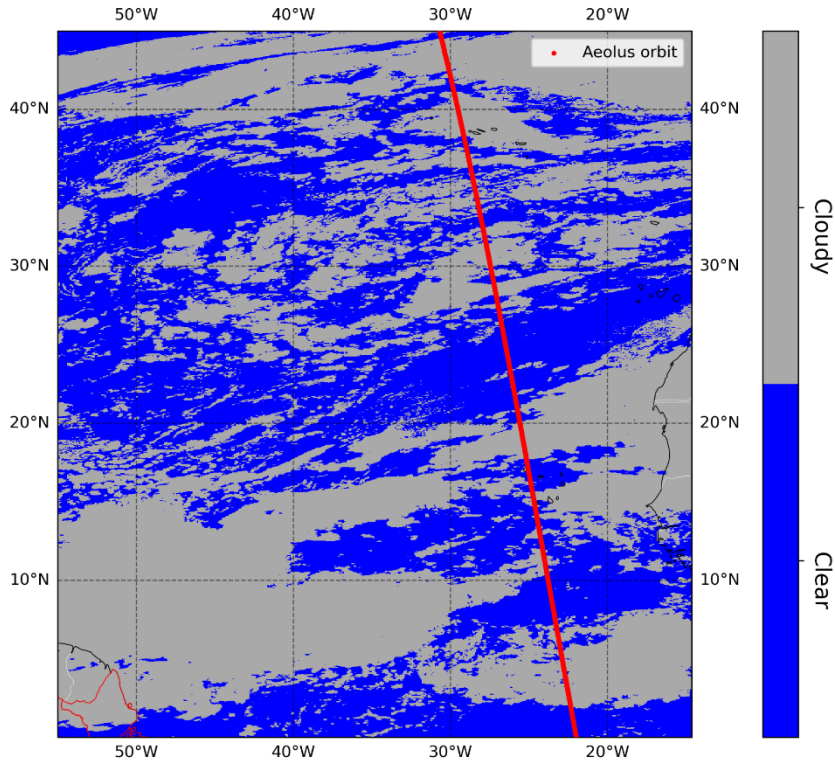




## Cloud-filtering based on MSG SEVIRI CLAAS3 cloud dataset

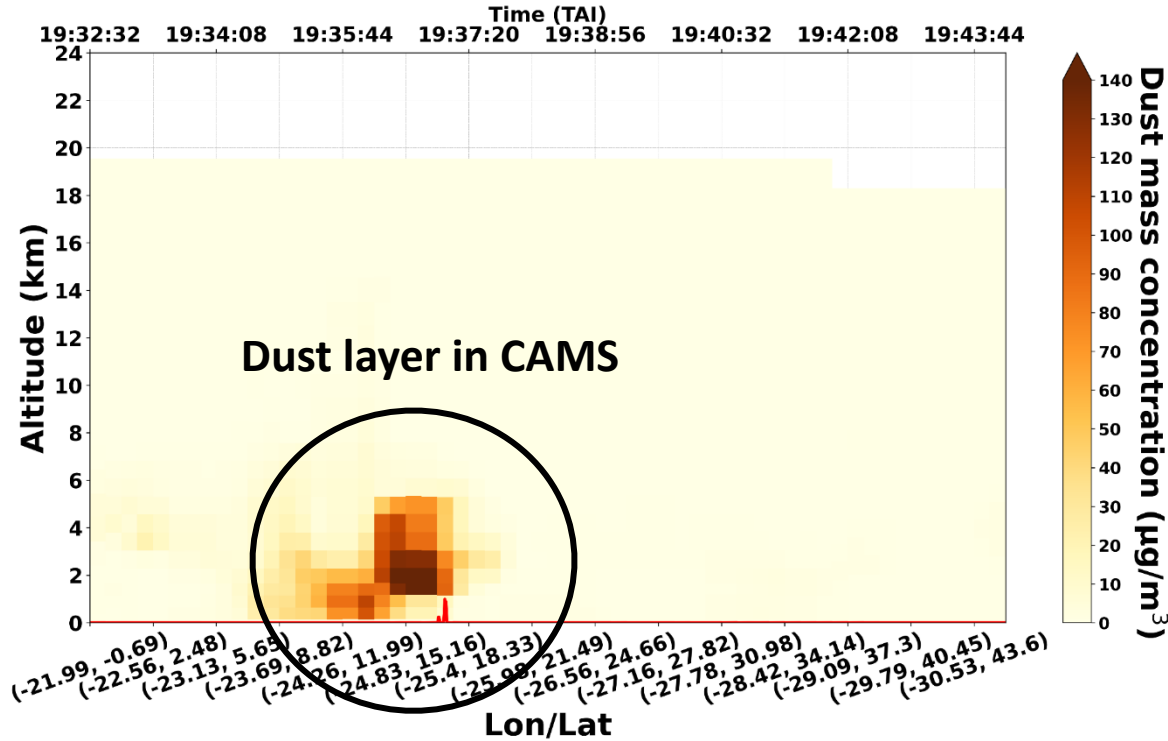
Aeolus Ascending orbit

Start: 17 Sep 2021 19:32:32UTC  
Stop: 17 Sep 2021 19:44:07UTC

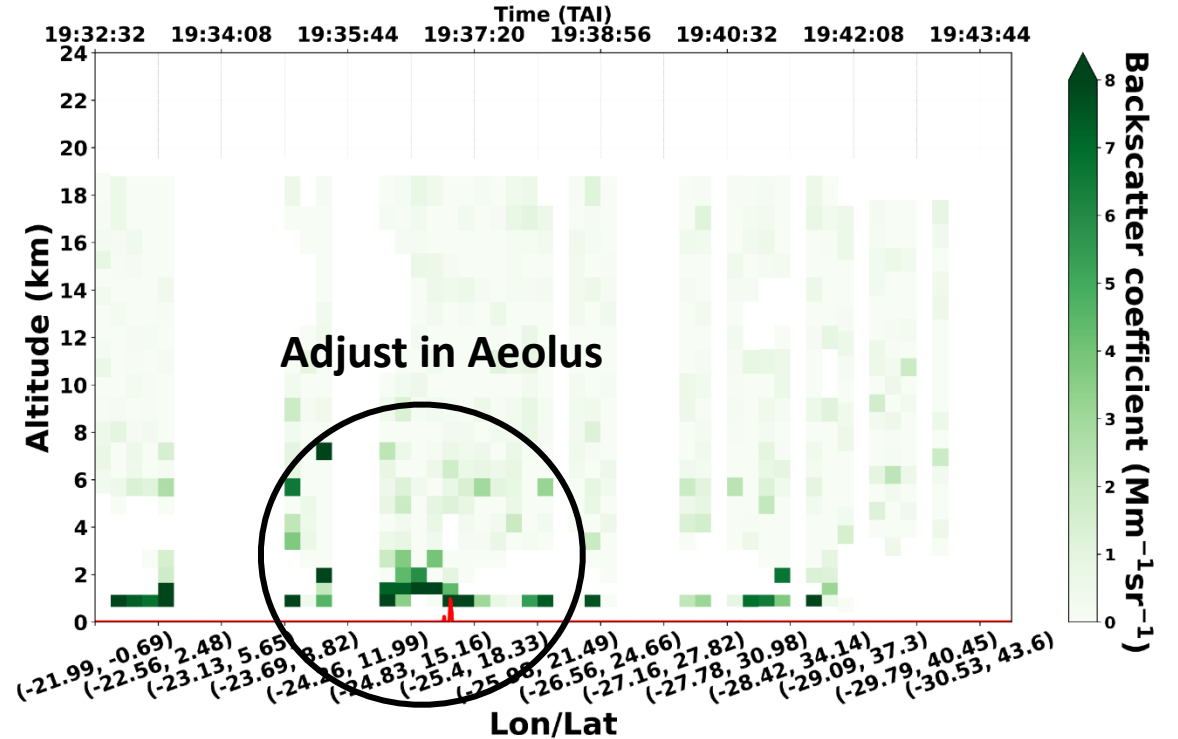


# L2A+: correction of the L2A product for dust

**Aeolus Ascending orbit [17 Sep 2021]**

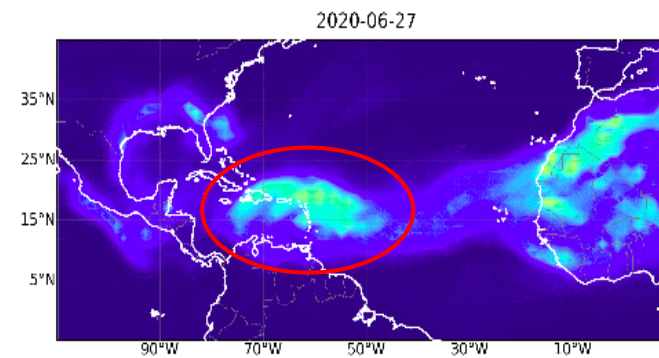
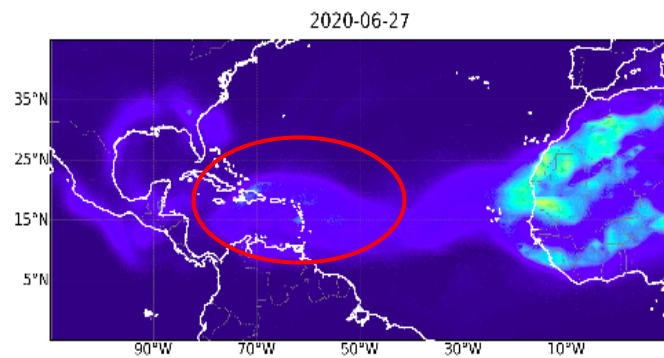
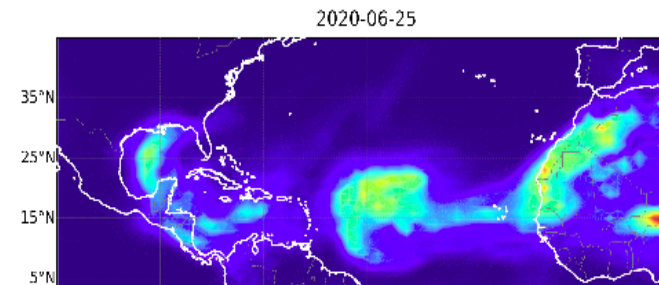
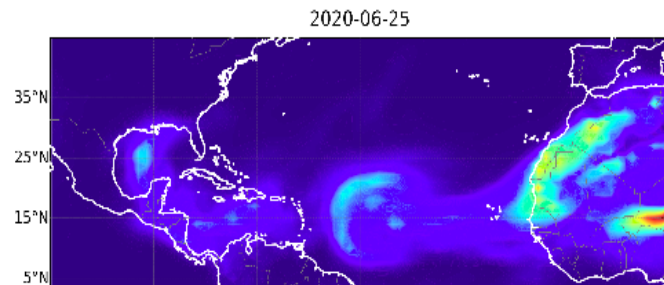
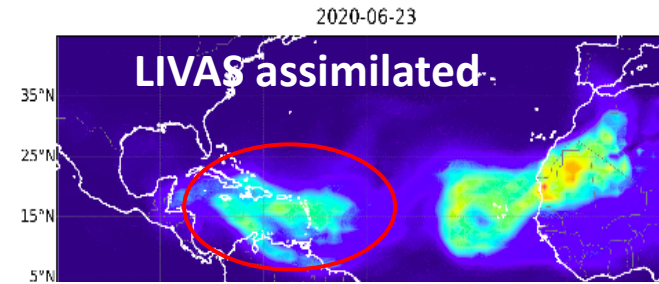
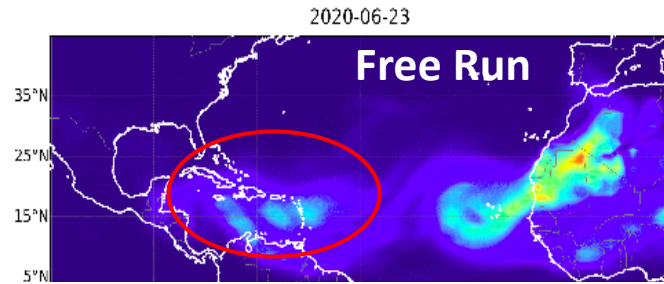


**Aeolus Ascending orbit [17 Sep 2021]**

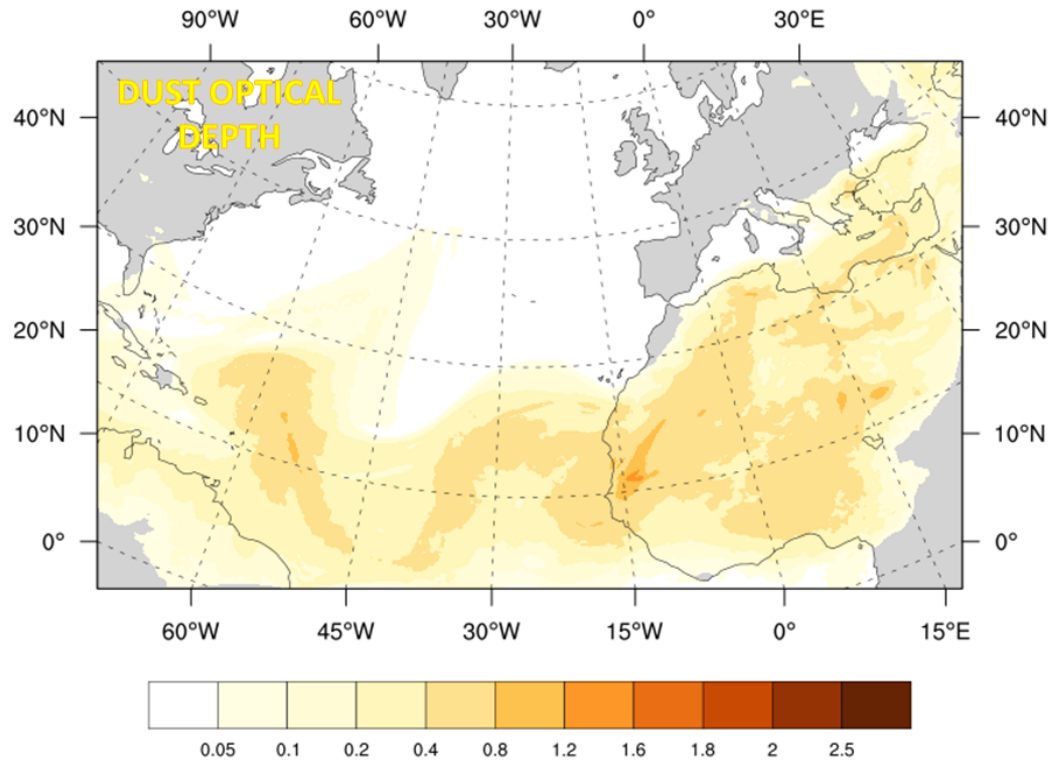




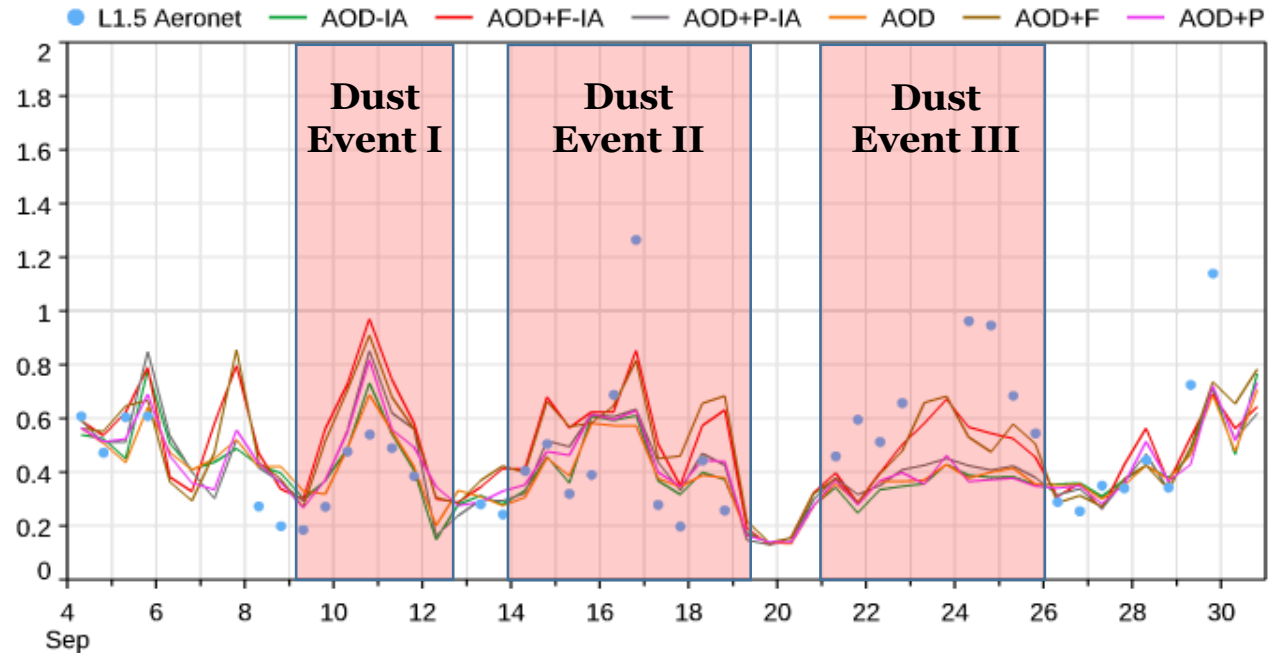
# Applications for Desert Dust Research: Assimilation



Godzilla, in collaboration with BSC



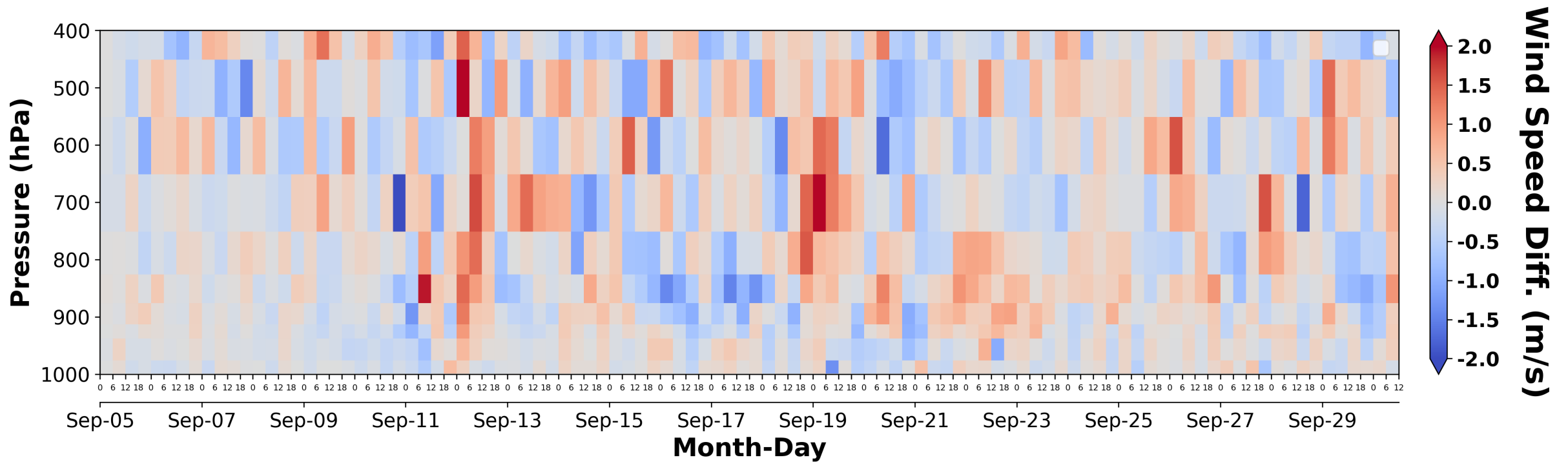
Comparison of hprh, hs5w, hrox, hr8k, hrw1 & hrp1 and L1.5 Aeronet AOT at 500nm over Mindelo\_OSCM (16.88°N, 25.00°W). Model: 00 & 12UT, 4-30 Sep 2021, T+3 to T+12. 12hr means.



**ADD-CROSS EUMETSAT study, A. Gkikas**

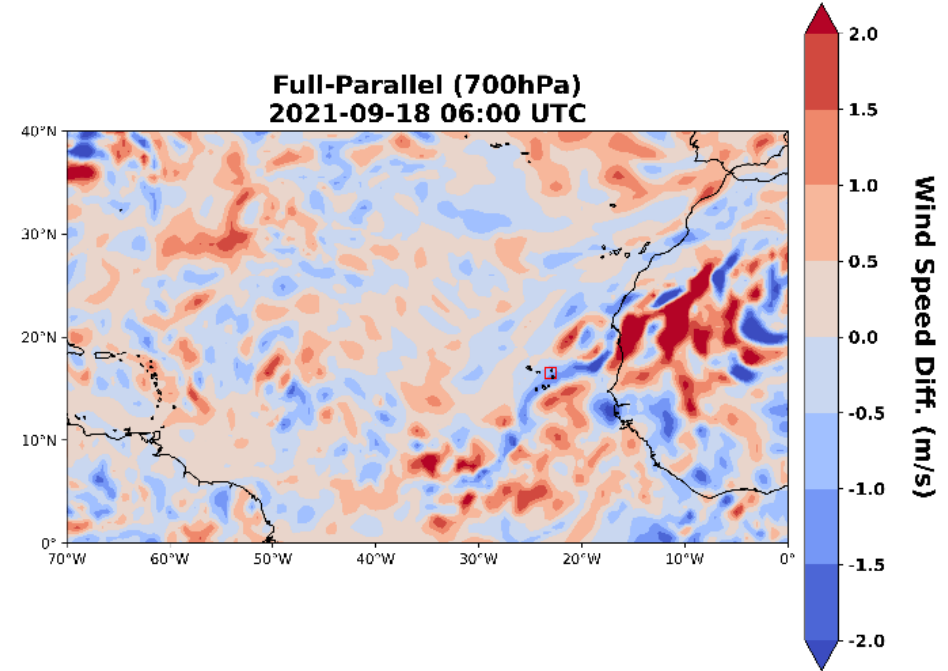
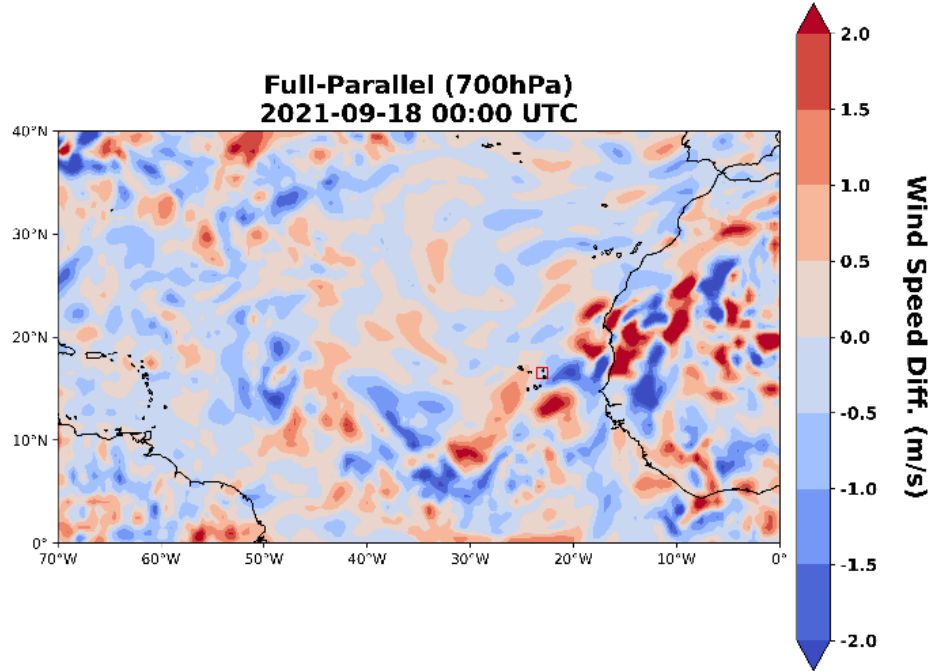
**L2A improved the columnar optical depth, for dust events II and III, when the Aeolus full (cross+co-polar) backscatter is assimilated**

## L2A assimilation affects Wind fields





## L2A assimilation affects Wind fields

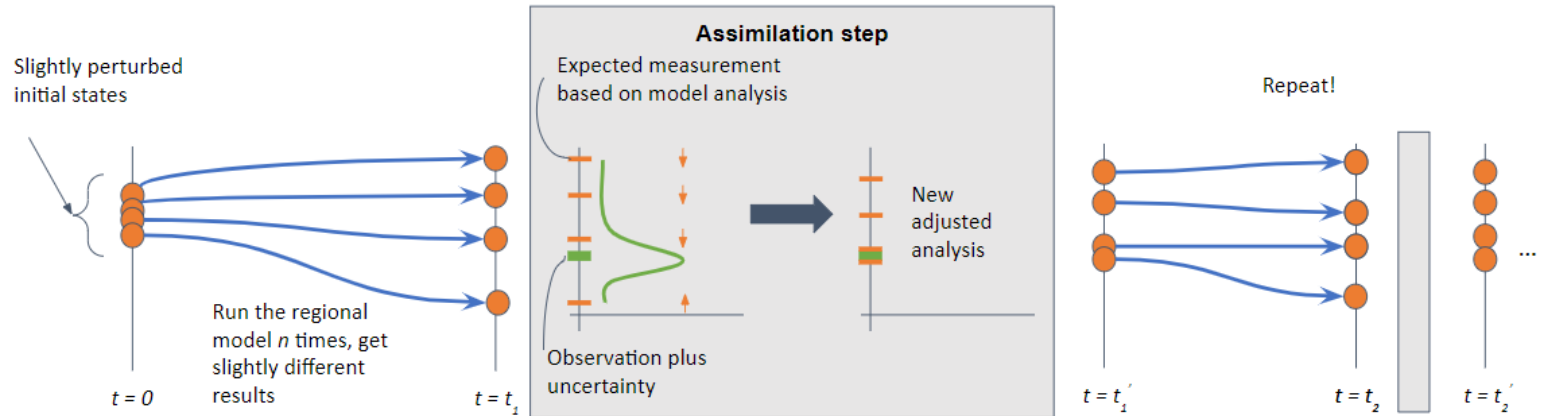


Use both L2B and L2A data assimilation within the same regional coupled model to reveal the synergistic impact on NWP

## NCAR | DART

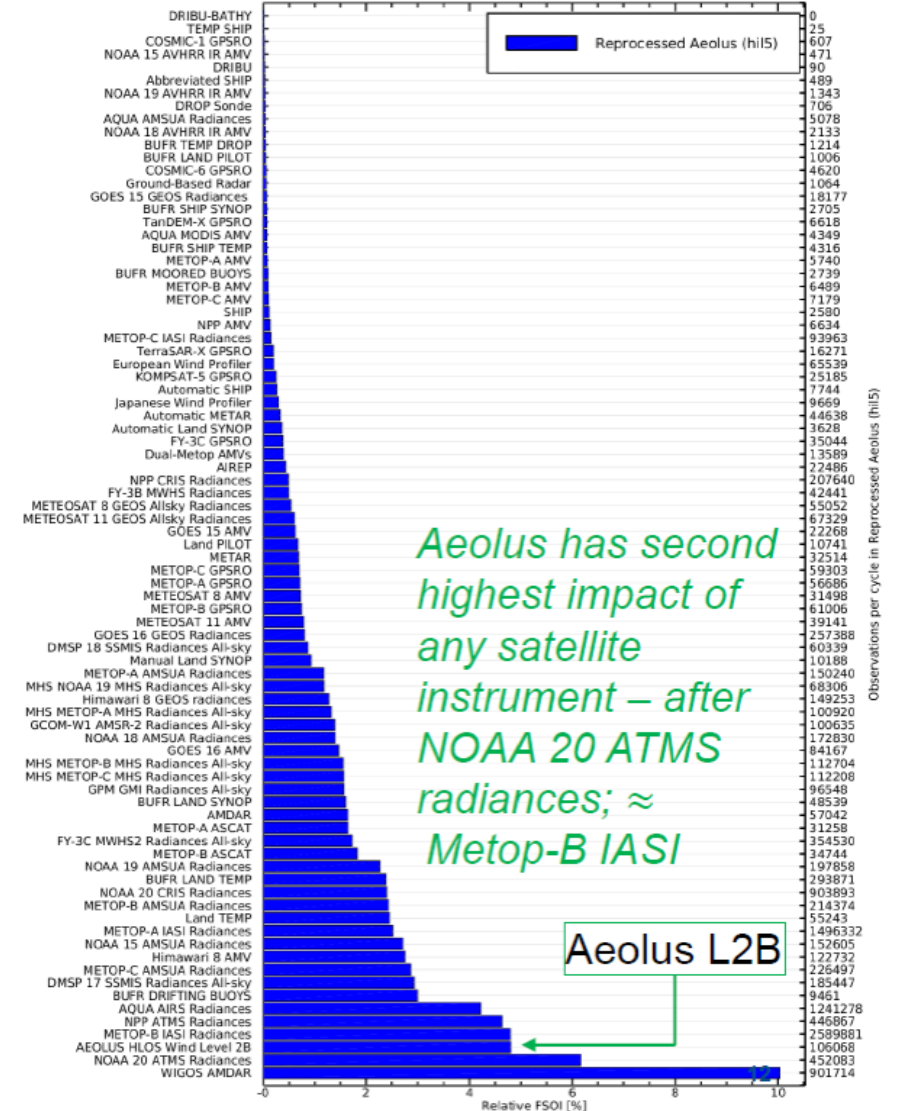
- Model State
- Model Run

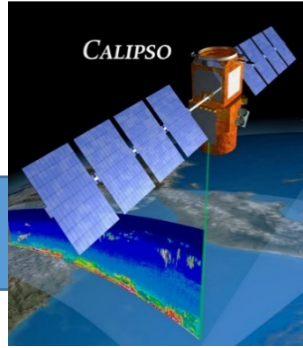
- The Data Assimilation Research Testbed (DART) toolkit will be used to assimilate the L2A and L2A+ products into WRF-L.
- DART is maintained by the Data Assimilation Research Section at NCAR.
- Various ensemble assimilation algorithms are already implemented, including Ensemble Adjustment Kalman Filter (EAKF).



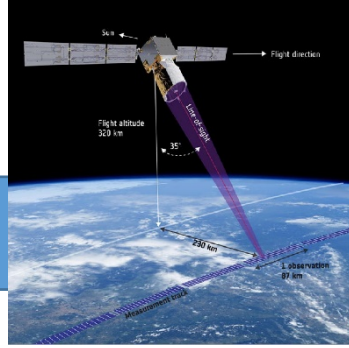
L2A+ ESA study, T. Georgiou

## FSOI split by instrument type





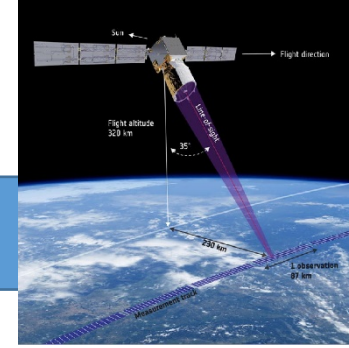
CALIPSO



Aeolus



EarthCARE



Aeolus FO



AOS

### LIVAS ESA study

### The LIVAS concept:

Bridge multi-wavelength dust products from different missions.

Feasible due to the weak wavelength dependence for dust (355-532nm) for dust, and trustworthy aerosol typing through depolarization (ESA-LIVAS study)

**CALIP observations at 532 nm** →  
 Quality Filtering →  
 → Conversion Factors →  
 → **CALIP at 355 nm**



### The LIVAS project

#### Lidar Climatology of Vertical Aerosol Structure for Space-Based Lidar Simulation Studies

General Statistics	
Mean	0.0071
Min	0.001
Max	0.016
Number of observations	171
Number of profiles generated	1714

Aerosol Statistics	
Sample averaged after filtering:	
Total	14254
Aerosol	750
Clear Air	13504

Category	Product	Wavelength	Partial Products
Aerosol	Backscatter	355nm	Backscatter
Cloud	Backscatter	355nm	Backscatter
Stratospheric	Depolarization	355nm	Depolarization

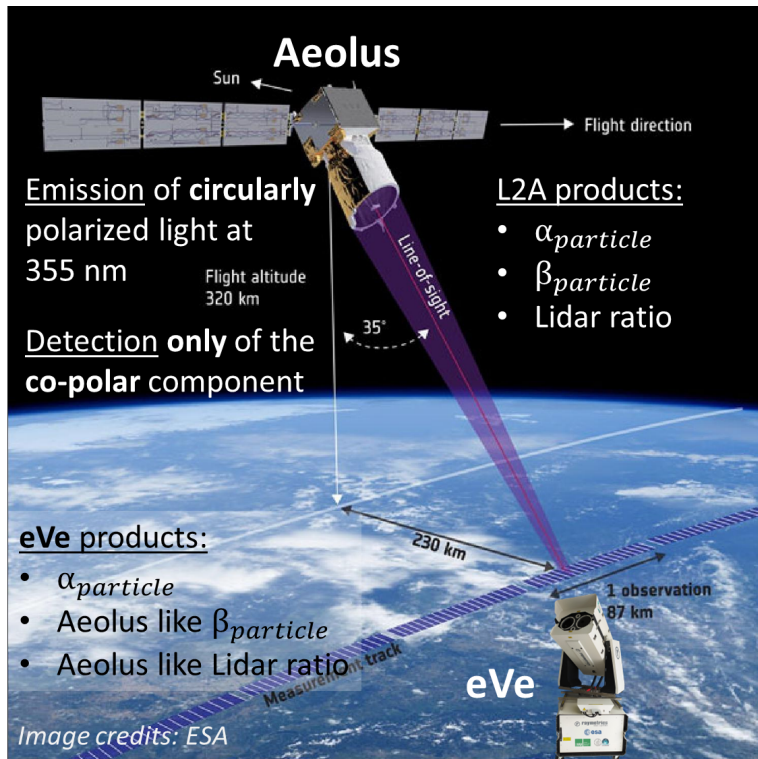
Source: <http://lidar.space.noa.gr:8080/livas/climatology.html>



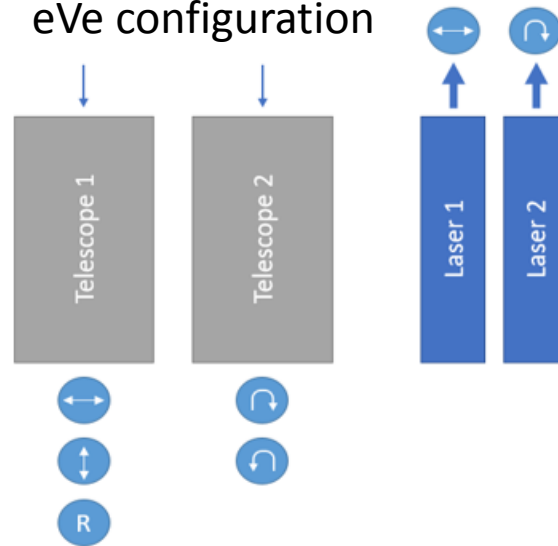
# Future plans for EarthCARE



- Pointing on Aeolus track and at  $37.6^\circ$  off-zenith
- Use of **circular** depolarization measurements
- Harmonize eVe profiles with Aeolus L2A



eVe configuration



- Future plans:
- Upgrade of eVe lidar to a multi-wavelength system ( $2\beta + 2\alpha + 2\delta$ )
- ESA lidar systems (eVe and EMORAL) characterization as ACTRIS reference (ATMO-ACCESS)
- enhancing EarthCARE Cal/Val



- Pointing on EarthCARE track and at  $3^\circ$  off-zenith
- ATLID: Use of **linear** depolarization measurements at 355 nm

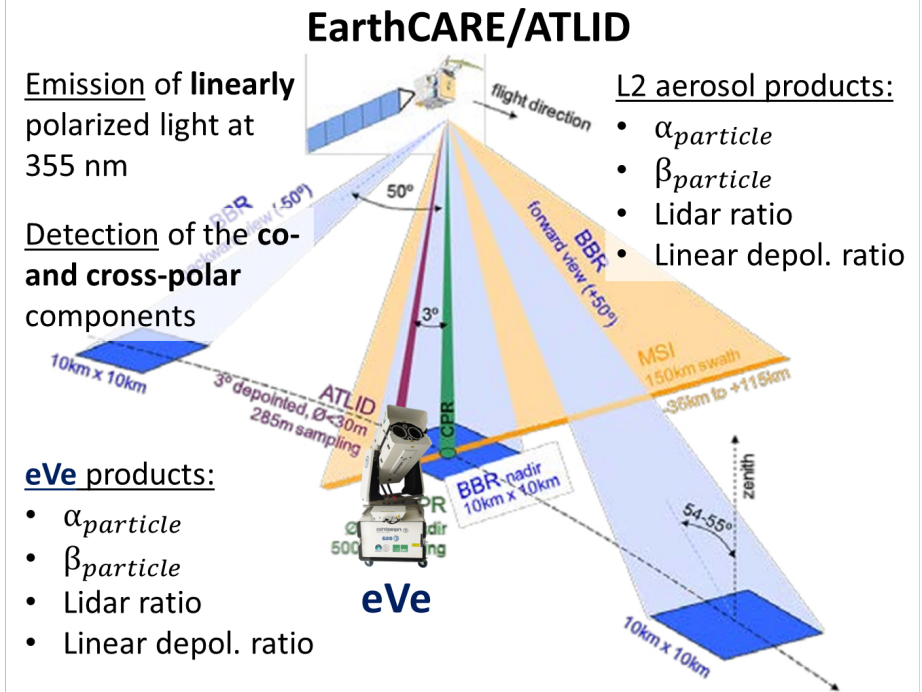
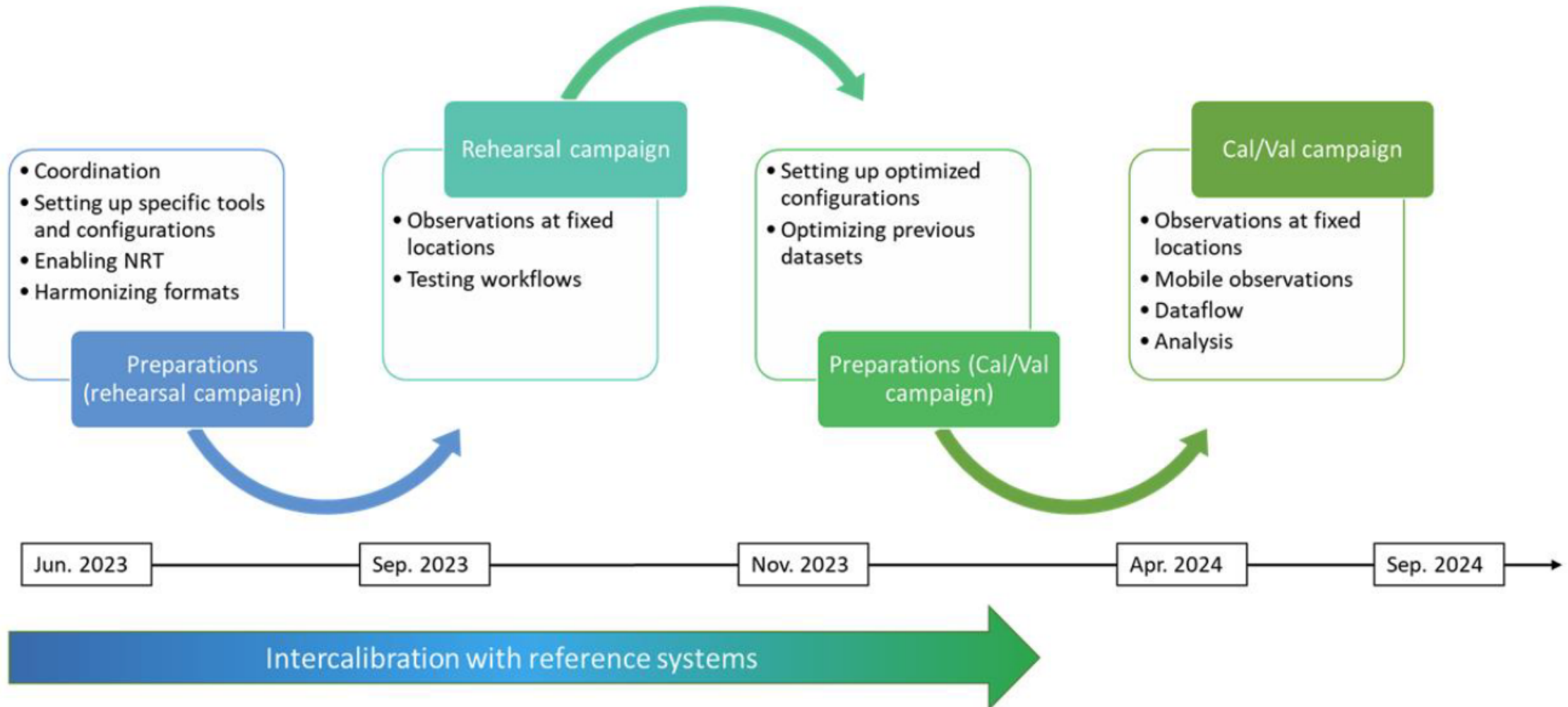


Image credits: Hélière et al., Proc. SPIE 10564, 2017

# Future plans for EarthCARE

ATMO-ACCESS European project will invest to setup ACTRIS for EarthCARE Cal/Val







# NASA, ESA and JAXA coordination in ACPV for common best practices for Cal/Val



Cal/val community contributors  
(networks, Research Infrastructures)



**Implementation Group**

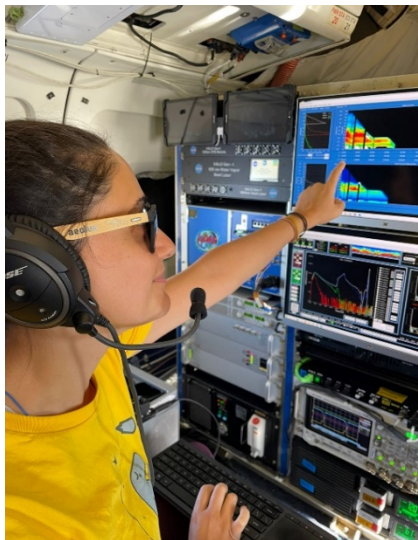


Foster community convergence on best common Cal/Val practices for ACPV

Document the consensus and the best practices for ACPV for CEOS

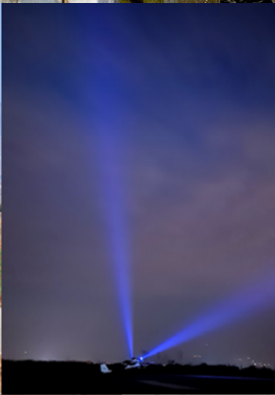
Promote the implementation of ACPV best practices in the wider communities

# Similar to ASKOS experiments are planned for the Mediterranean to further advance our knowledge on ARI/ACI

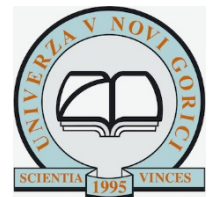




# Similar to ASKOS experiments are planned for the Mediterranean to further advance our knowledge on ARI/ACI



Airborne platforms will participate to support ground operations



Thank you for your attention!