# Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP

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*Progress Meeting 01*
*[PM01]*

*Virtual*
*07/02/2023*
*11:00-12:30 CET*

## - *Agenda.*

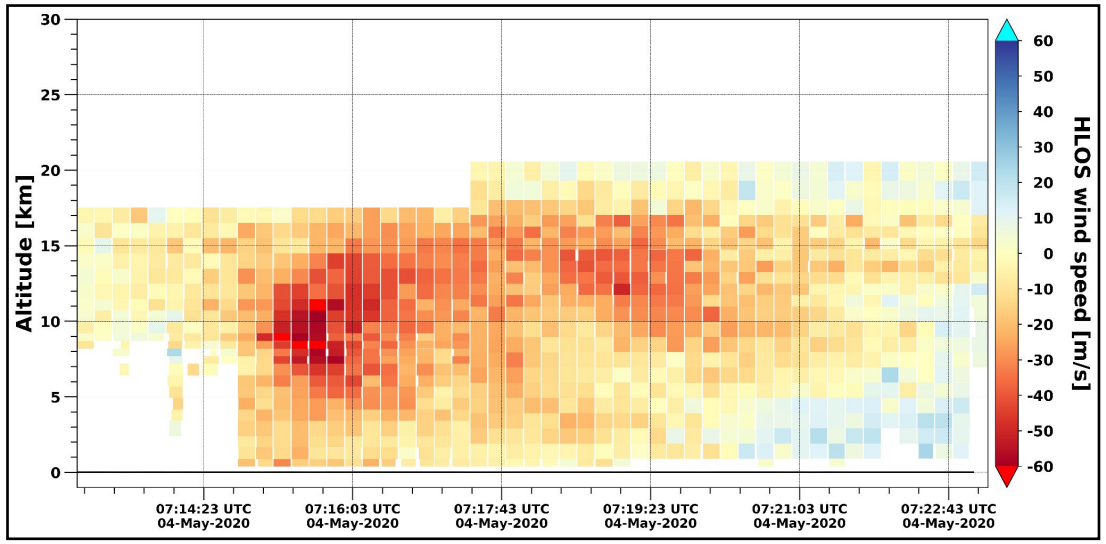
| | | |
|---|---|---|
| Title:<br>Presenter: | Introduction – Welcome.<br>Christian Retscher (ESA), Vassilis Amiridis (NOA). | 11:00 – 11:10 |
| Title:<br>Presenter: | WP1000 – Management, reporting and promotion.<br>Emmanouil Proestakis. | 11:10 – 11:25 |
| Title:<br>Presenter: | WP2000 – ASKOS ground-based datasets in support of L2A+.<br>Holger Baars. | 11:25 – 11:40 |
| Title:<br>Presenter: | WP3000 – Development of the L2A+ aerosol product.<br>Konstantinos Rizos – PREPARATORY STEPS. | 11:40 – 11:45 |
| Title:<br><br>Presenter: | WP4000 – Assimilation of L2A/L2A+ and application of WRF-L experiments – PREPARATORY STEPS.<br>Athanasios Georgiou. | 11:45 – 11:50 |
| Title: | Summary, discussion and Concluding Remarks. | 11:50-end of PM01 |

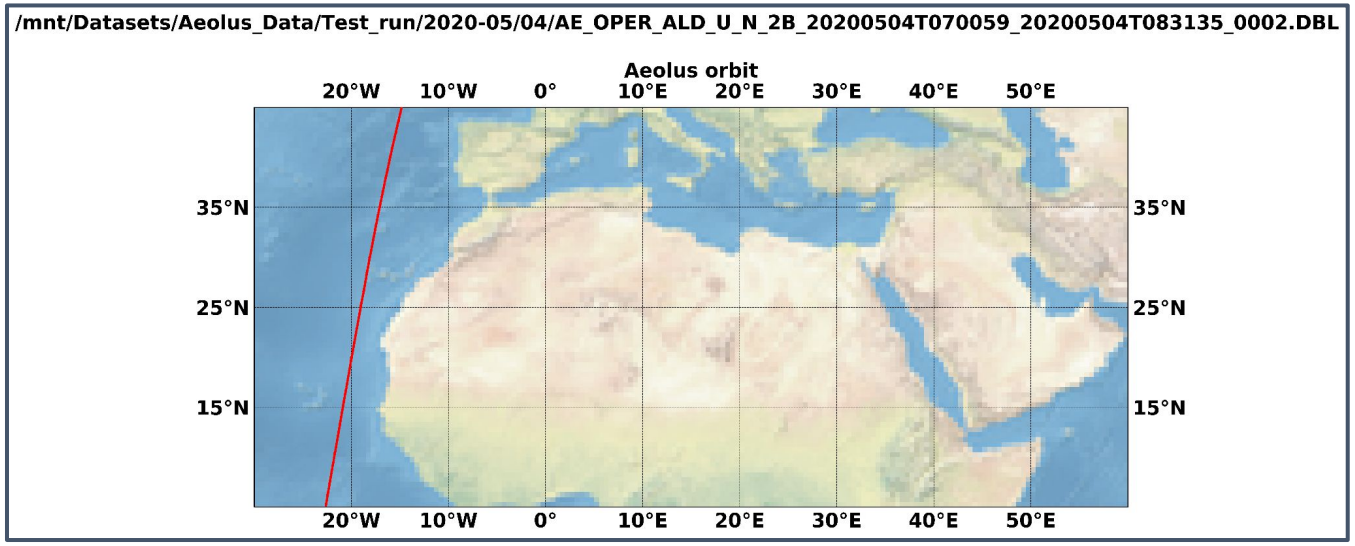
# L2A+

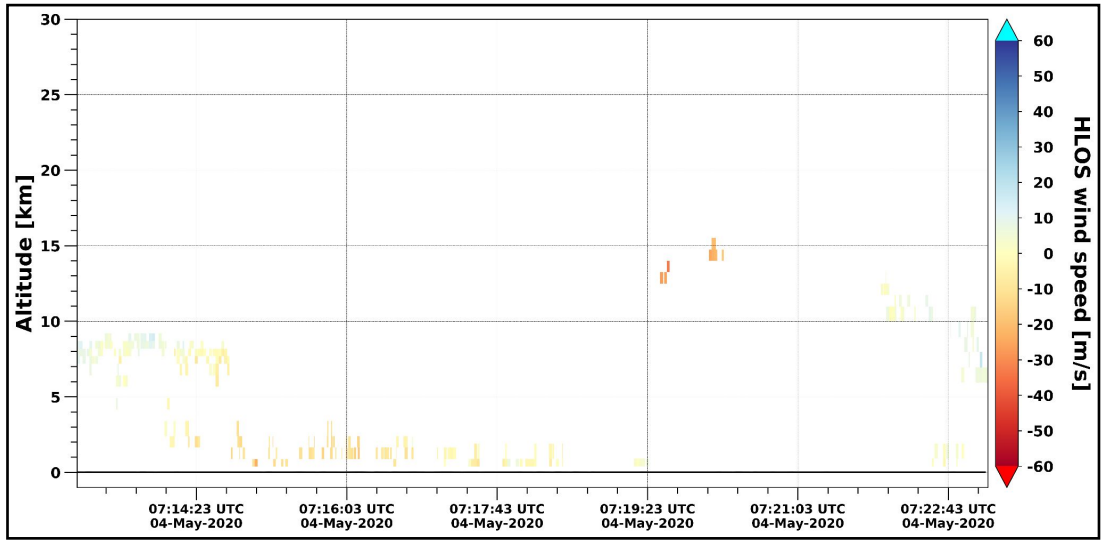
# Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

## - *Background.*

Aeolus, ESA's DWL – ALADIN – space mission provides:
- profiles of the HLOS wind component in the troposphere and the lower stratosphere.
- profiles of optical properties of aerosols and clouds (i.e., extinction/backscatter coefficients, lidar ratio).



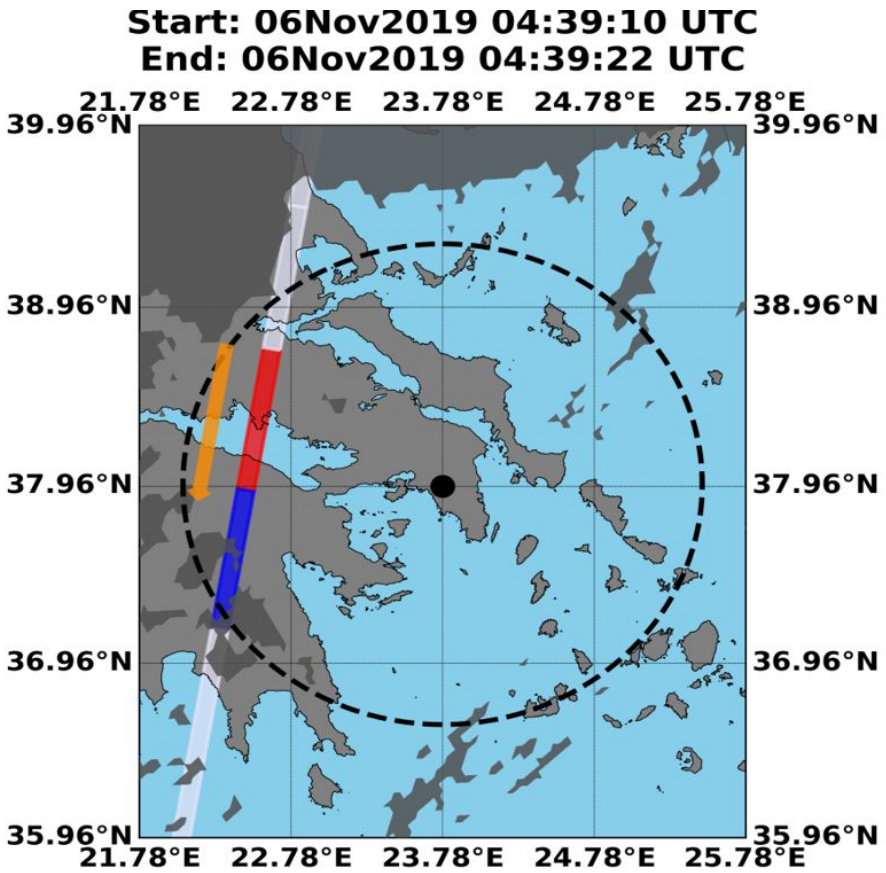



# L2A+

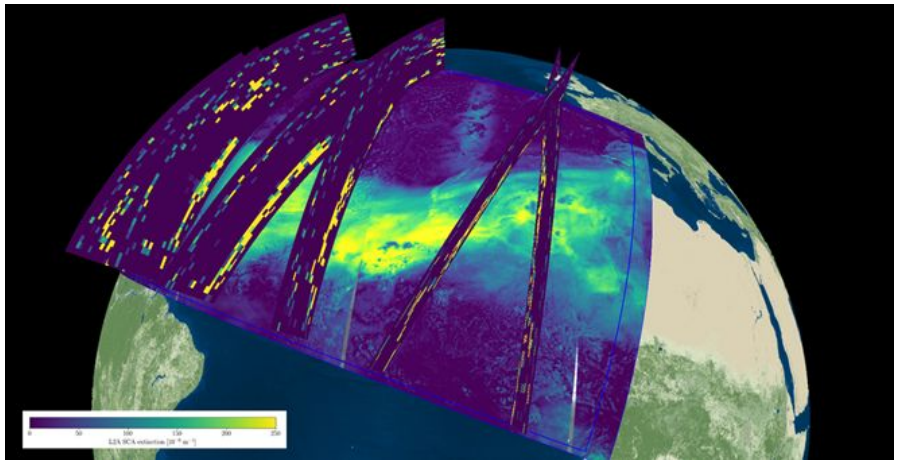
# Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

## - Challenge (1): Cloud Contamination.

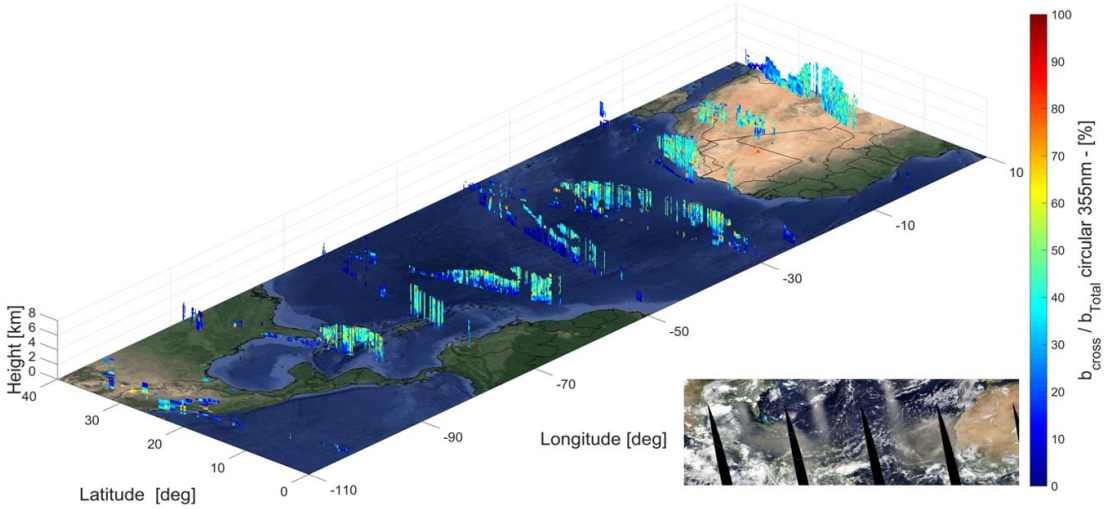



(Gkikas et al., 2022, ACPD)

## - Challenge (2): Undetected cross polar backscattered component.



Retrieved from: esa.int




*Estimates of Aeolus L2A underestimation due to the missing cross-channel using the Aeolus-like profiles retrieved based on CALIPSO for the transAtlantic Godzilla dust event on the 23rd of June, 2020.*

# L2A+

## Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

### *- Project Objectives.*

Objective 1. **Develop a refined Aeolus aerosol optical product** (L2A+) over the **Atlantic,** based on AEL-FM/AEL-PRO algorithms, geostationary AOD products, CAMS, and new AOD retrievals from the Aeolus itself. The product will be thoroughly **compared with L2A** and **validated** against quality-assured measurements from the ASKOS/JATAC experiment in Cape Verde.

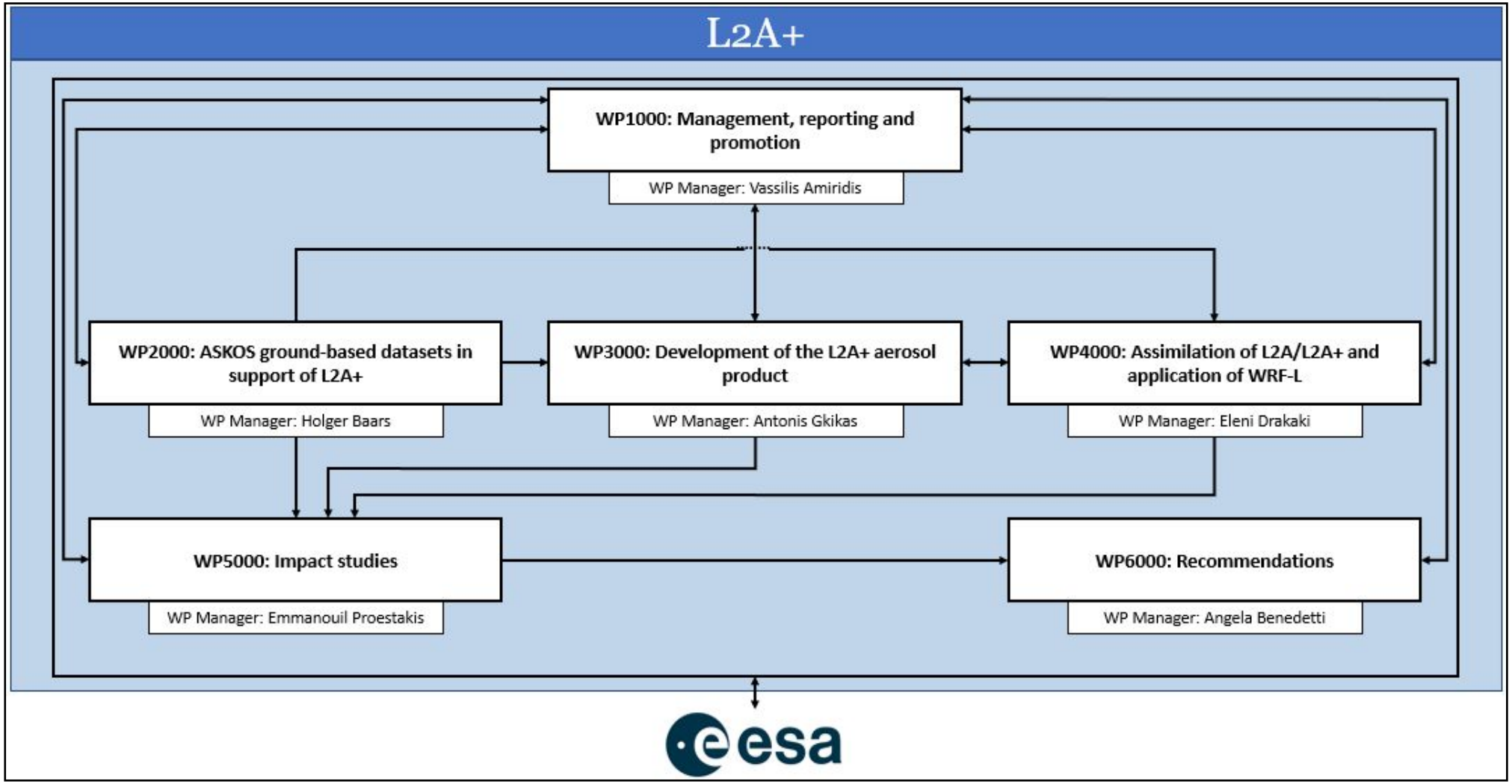
Objective 2. Examine the impact of L2A and L2A+ **on aerosol assimilation** and dust transport models.

Objective 3. Assess the **impact of Aeolus on NWP**, utilising L2A+ aerosol assimilation in an online coupled regional model driven by Aeolus wind-assimilated meteorological fields.

Objective 4. Highlight the benefit of the Aeolus joint aerosol and wind assimilation for **simulating dust deposition fields**, and compare with CAMS reanalysis to assess the impact of L2A+ for ocean biogeochemistry studies (working in parallel with the ESA-DOMOS study).

Objective 5. Compare the **monthly averaged L2A+** product with the **CALIPSO L3 product**, to assess the **climatological value of L2A+** for aerosol databases such as the **ESA-LIVAS long-term climate dataset**.

## - *Work Breakdown Structure.*



# L2A+

## Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

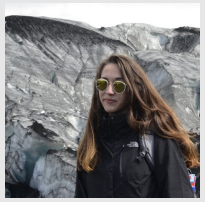
### - *The L2A+ Team.*

**WP1000**

*V. Amiridis*

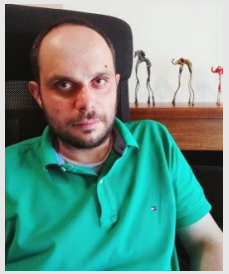
**WP2000**

*H. Baars*



*A. Floutsi*

**WP3000**



*A. Gkikas*

*K. Rizos*

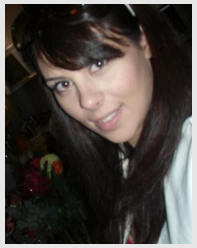
**WP6000**

*A. Benedetti*

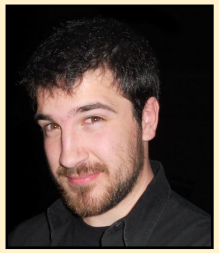
**WP4000**

*A. Georgiou*

*A. Kampouri*



*E. Drakaki*

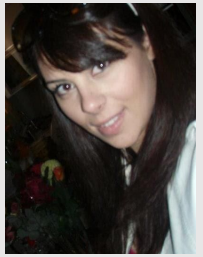


*A. Tsikerdekis*

**WP5000**

*E. Proestakis*

*A. Kampouri*

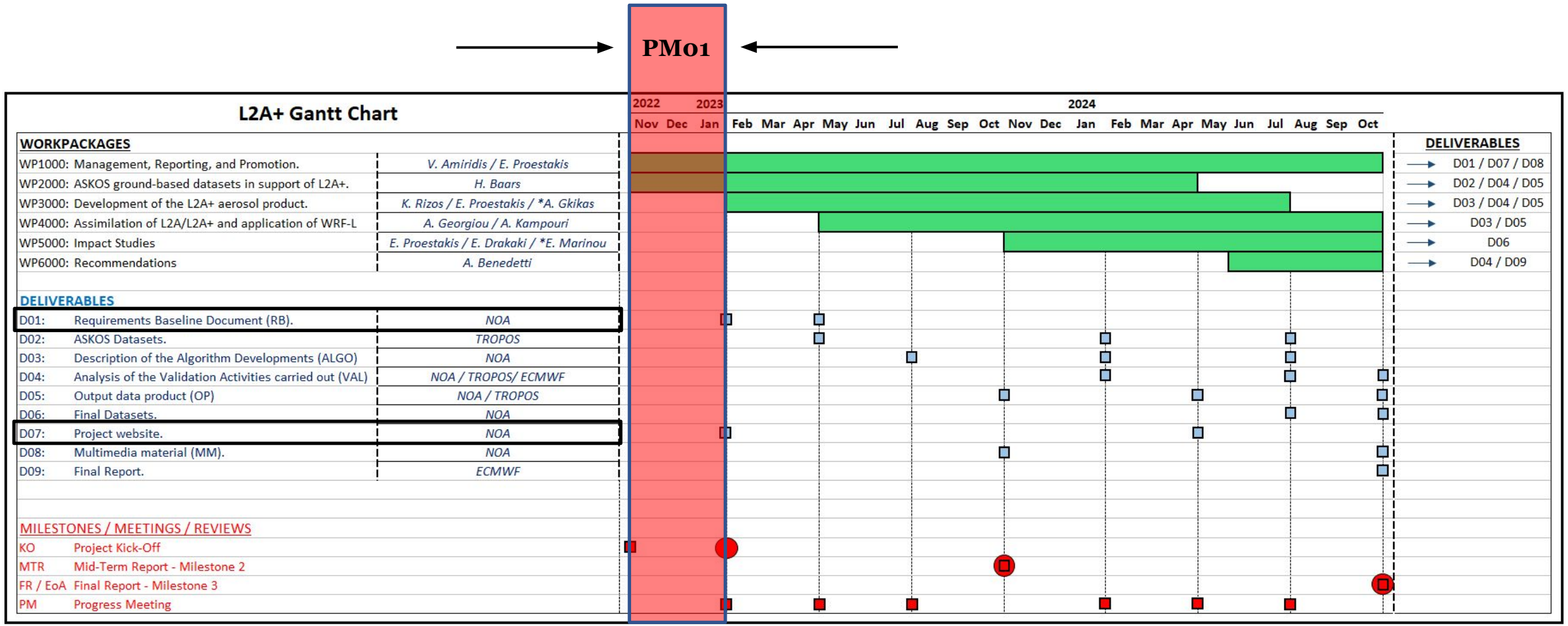


*E. Drakaki*

# L2A+

# Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

## - *L2A+ Gantt Chart.*



# L2A+

Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

## WP1000: *Management, reporting and promotion.*

| | |
|---|---|
| Objective: | Monitoring of the L2A+ project, ensuring the timely and efficient accomplishment of the planned activities and administrative tasks and promotion of the project to the scientific community. Furthermore, WP1000 aims at consolidating the scientific requirements for L2A+ study. |
| Inputs: | All documents produced during the project. |
| Tasks: | Overall management and coordination of the project, in accordance with the terms of the signed contract. |
| Output: | • Building in and updating the project website.<br>• Presenting the L2A+ results at scientific conferences and other international forums.<br>• Publishing the work undertaken in peer-reviewed journals and conference proceedings.<br>• DI01: Requirements Baseline Document (RB)<br>• DI07: Project website including the compliance to the ESA Open Science catalogue server.<br>• DI08: Multimedia material (MM) (Publications in peer-reviewed journals and conference proceedings, representation of the research at scientific conferences and other international forums through scientific presentations and exhibitions). |

# L2A+

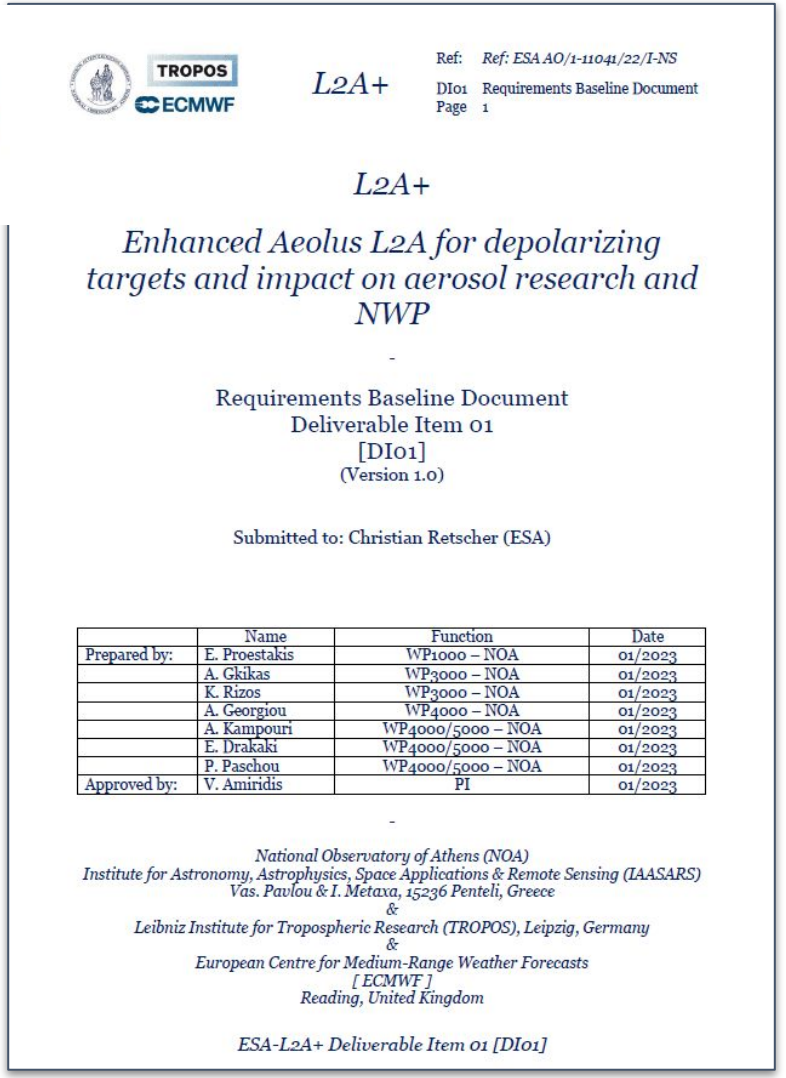
## Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

## WP1000: *Management, reporting and promotion.*

Requirements Baseline Document - RBD - DI01

- Initial version - submission: T0+3 months.
- Final version - submission: T0+6 months.

SUBMITTED FOR REVIEW



TROPOS ECMWF L2A+ Ref: Ref: ESA AO/1-11041/22/I-NS
DI01 Requirements Baseline Document
Page 1

L2A+

*Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP*

-

Requirements Baseline Document
Deliverable Item 01
[DI01]
(Version 1.0)

Submitted to: Christian Retscher (ESA)

| | Name | Function | Date |
|---|---|---|---|
| Prepared by: | E. Proestakis | WP1000 – NOA | 01/2023 |
| | A. Gkikas | WP3000 – NOA | 01/2023 |
| | K. Rizos | WP3000 – NOA | 01/2023 |
| | A. Georgiou | WP4000 – NOA | 01/2023 |
| | A. Kampouri | WP4000/5000 – NOA | 01/2023 |
| | E. Drakaki | WP4000/5000 – NOA | 01/2023 |
| | P. Paschou | WP4000/5000 – NOA | 01/2023 |
| Approved by: | V. Amiridis | PI | 01/2023 |

-

*National Observatory of Athens (NOA)*
*Institute for Astronomy, Astrophysics, Space Applications & Remote Sensing (IAASARS)*
*Vas. Pavlou & I. Metaxa, 15236 Penteli, Greece*
*&*
*Leibniz Institute for Tropospheric Research (TROPOS), Leipzig, Germany*
*&*
*European Centre for Medium-Range Weather Forecasts*
*[ ECMWF ]*
*Reading, United Kingdom*

*ESA-L2A+ Deliverable Item 01 [DI01]*

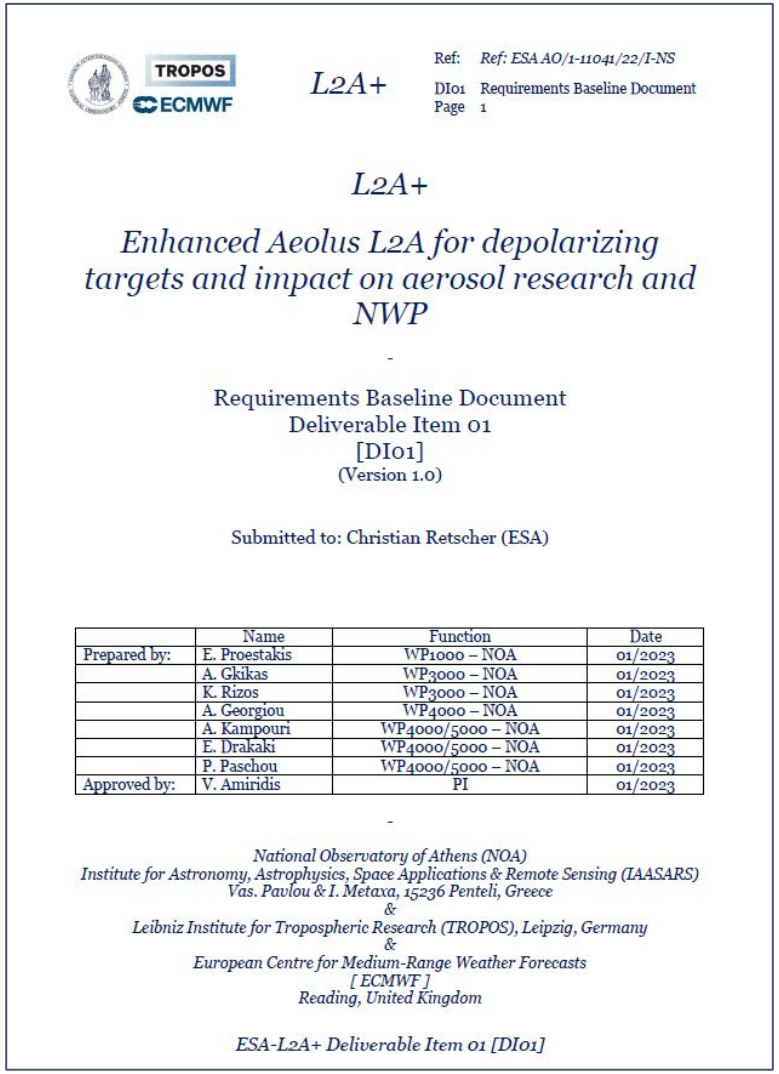
# L2A+

## Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

## WP1000: *Management, reporting and promotion.*

DI01 provides:

1) a review of (a) Aeolus L2A products (Flament et al., 2021; Ehlers et al., 2022), (b) AEL-FM and AEL-PRO, (c) CAMS, and (d) the assimilation technique to be applied over L2A+ RoI.
2) a survey of (a) satellite-based and (b) ground-based accessible datasets to be used for the framework of the developments and validation of L2A+ (WP3000/4000) and the evaluation of the model simulations, including the comparisons for the impact assessment of aerosol assimilation in NWP (WP5000). More specifically, includes the consolidation of the ESA-ASKOS/JATAC dataset for L2A+ needs (i.e. ground-based lidar measurements, water-vapour and wind profiles, radiosondes, airborne dropsondes and radiation measurements) to be used for evaluation of the NWP runs and impact studies (WP4000/5000).
3) an overview of concluded and ongoing initiatives and projects related to the technical and scientific overarching objectives of L2A+ (i.e., ESA-ASKOS / eVe / NEWTON / DOMOS).
4) a consolidated risk analysis pointing out which risk areas could affect the final success of the project and proposed solutions.



TROPOS ECMWF *L2A+*

Ref: *Ref: ESA AO/1-11041/22/I-NS*
DI01 Requirements Baseline Document
Page 1

*L2A+*

*Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP*

Requirements Baseline Document
Deliverable Item 01
[DI01]
(Version 1.0)

Submitted to: Christian Retscher (ESA)

| | Name | Function | Date |
|---|---|---|---|
| Prepared by: | E. Proestakis | WP1000 – NOA | 01/2023 |
| | A. Gkikas | WP3000 – NOA | 01/2023 |
| | K. Rizos | WP3000 – NOA | 01/2023 |
| | A. Georgiou | WP4000 – NOA | 01/2023 |
| | A. Kampouri | WP4000/5000 – NOA | 01/2023 |
| | E. Drakaki | WP4000/5000 – NOA | 01/2023 |
| | P. Paschou | WP4000/5000 – NOA | 01/2023 |
| Approved by: | V. Amiridis | PI | 01/2023 |

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*&*
*European Centre for Medium-Range Weather Forecasts*
*[ ECMWF ]*
*Reading, United Kingdom*

# L2A+

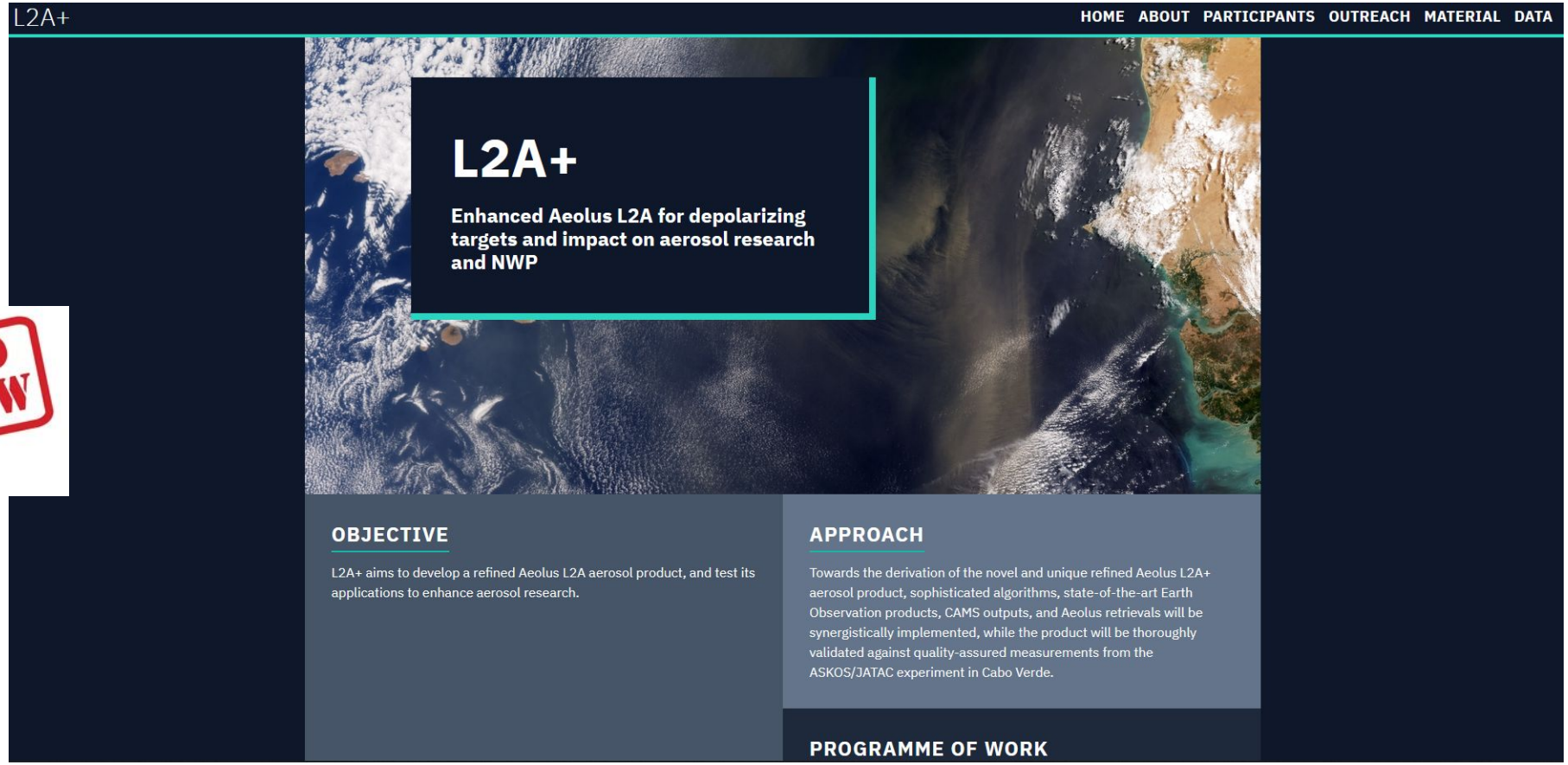
# Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

## WP1000: *Management, reporting and promotion.*

L2A+ project website - DI07 - https://l2a.space.noa.gr/

- Initial version - submission: T0+3 months.
- Final version - submission: T0+18 months.

SUBMITTED FOR REVIEW




# Enhancing Aeolus L2A for depolarizing targets and impact on aerosol research and NWP

**A. Georgiou**[1,2], E. Proestakis[1], A. Gkikas[1,3], K. Rizos[1,4], E. Drakaki[1,5], A. Kampouri[1,6], A. Tsikerdekis[7,8], H. Baars[9], A. Floutsi[9], A. Benedetti[10], V. Amiridis[1]

(1) Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing, National Observatory of Athens, Athens, Greece; (2) School of Physics, Faculty of Sciences, Aristotle University of Thessaloniki; (3) Research Centre for Atmospheric Physics and Climatology, Academy of Athens, Athens, Greece; (4) Laboratory of Atmospheric Physics, Aristotle University of Thessaloniki, 54124 5 Thessaloniki, Greece; (5) Harokopio University, Department of Geography, Athens, Greece; (6) Department of Meteorology and Climatology, School of Geology, Aristotle University of Thessaloniki, Thessaloniki, Greece; (7) Earth Group, SRON Netherlands Institute for Space Research, 2333 CA Leiden, the Netherlands; (8) Department of Earth Science, Vrije Universiteit Amsterdam, 1081 HV Amsterdam, the Netherlands; (9) Leibniz Institute for Tropospheric Research (TROPOS), Leipzig, Germany; (10) European Centre for Medium Range Weather Forecasts (ECMWF), Reading, UK.

Presenting author e-mail: eldrakaki@noa.gr.

WP1000: *Management, reporting and promotion.*


New submissions to Aeolus 2023 conference in Rhodes:

1) Drakaki et al.: “Implications of dust in radiation using AEOLUS wind assimilating data on WRF-Chem”.
2) Georgiou et al.: “Impact of L2A assimilation on aerosol research and NWP”.
3) Kampouri et al.: “The impact of Aeolus on volcanic ash quantitative dispersion modeling by applying inversion techniques on volcanic emissions.”

# L2A+

## Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

aeolus ECMWF TROPOS

## WP2000: *ASKOS ground-based datasets in support of L2A+.*

| | |
|---|---|
| Objective: | Provide ASKOS ground-based datasets for L2A+ product validation and model evaluation studies |
| Inputs: | Data acquired during ASKOS as part of the Joint Tropical Atlantic campaign (JATAC). All data has already been collected, but the analysis and exploitation has not yet been intensified or completed. |
| Tasks: | • Creation of a unique feature mask (Combined Cloudnet + EARLINET lidar target categorisation)<br>• Application of the well-established Poliphon method to estimate the vertical resolved dust fraction<br>• Application of an EarthCARE-like (HETEAC-Flex) typing scheme on the data from ground-based lidar in Mindelo to retrieve the volume concentration of mineral dust<br>• Extraction of Aeolus-like profiles taken by the Aeolus reference instrument eVe<br>•Use of the vertical wind information obtained with Doppler lidar and radar to estimate dust flux |
| Output: | •D2: Data set of feature mask over Mindelo for September 2021 including aerosol optical properties; Documentation on time series of profiles of wind speed over Mindelo and radiosonde profiles obtained at Sal.<br>• D4: Analysis of Aeolus-like optical properties for Aeolus overpasses for validating/evaluating the new retrievals<br>• D5: Final data set on the height-resolved dust-only profiles above Mindelo, Cabo Verde |

# L2A+

# Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

## WP2000: *ASKOS ground-based datasets in support of L2A+.*

Instrumentation: Patchwork ACTRIS Aerosol & Cloud remote sensing facility


Ground-based instrumentation in September 2021

TROPOS:

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

ESA/INOE:

- 94Ghz Cloud radar (RPG)
- Distrometer
-

NOA:

- EVE reference lidar
- can mimic Aeolus observations

Quicklooks:

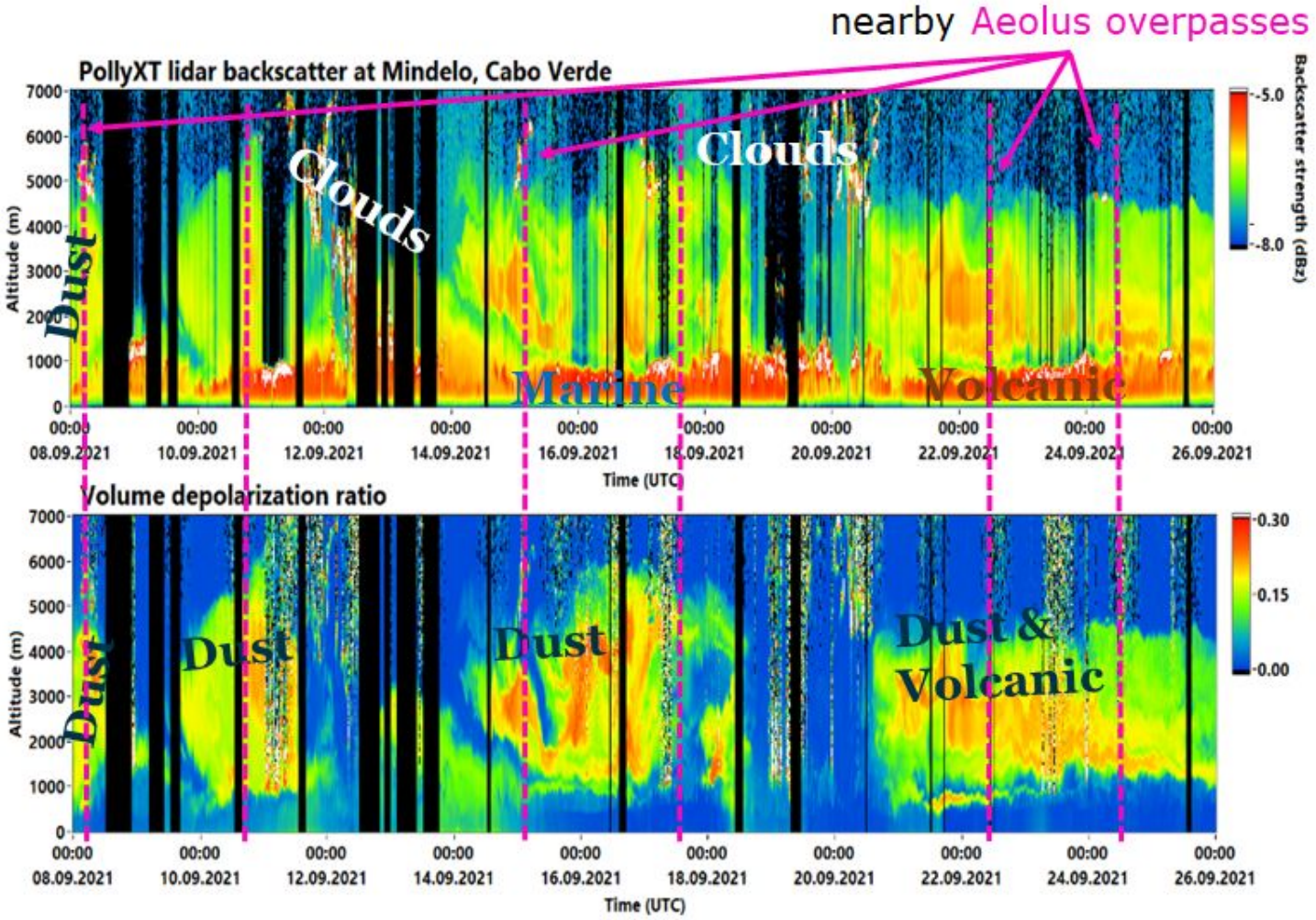
- polly.tropos.de (PollyXT quicklooks and products)
- All other products: askos.space.noa.gr

# L2A+

# Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

## WP2000: *ASKOS ground-based datasets in support of L2A+.*

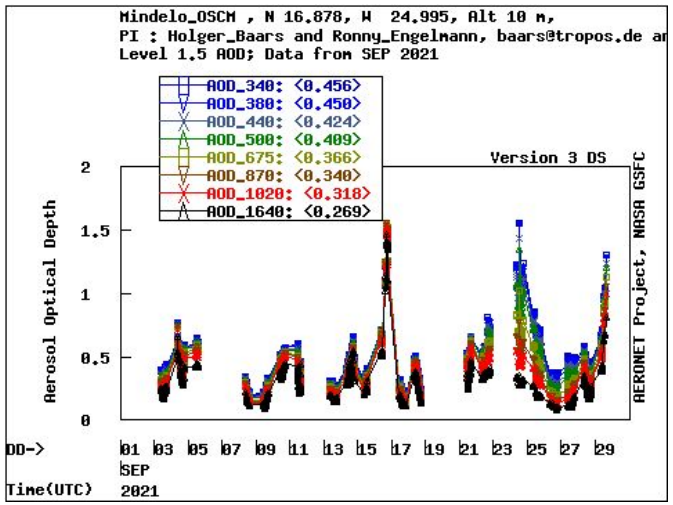
September 2021 observations




**3 periods with different characteristic conditions:**

1. Very homogenous dust layering, high AOD
2. Complex horizontal and vertical dust structure (combined with pollution)
3. Influence of volcanic eruption from La Palma

AERONET AOD

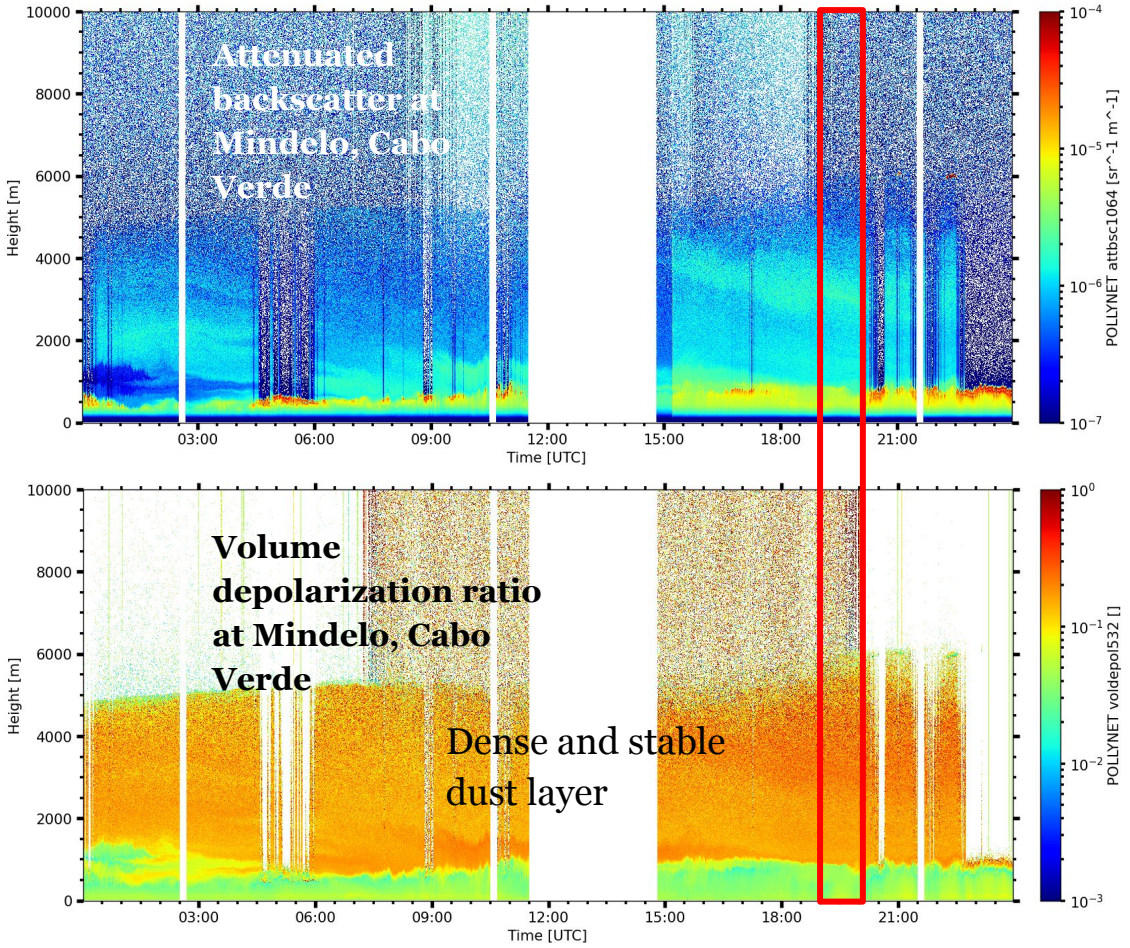


# L2A+

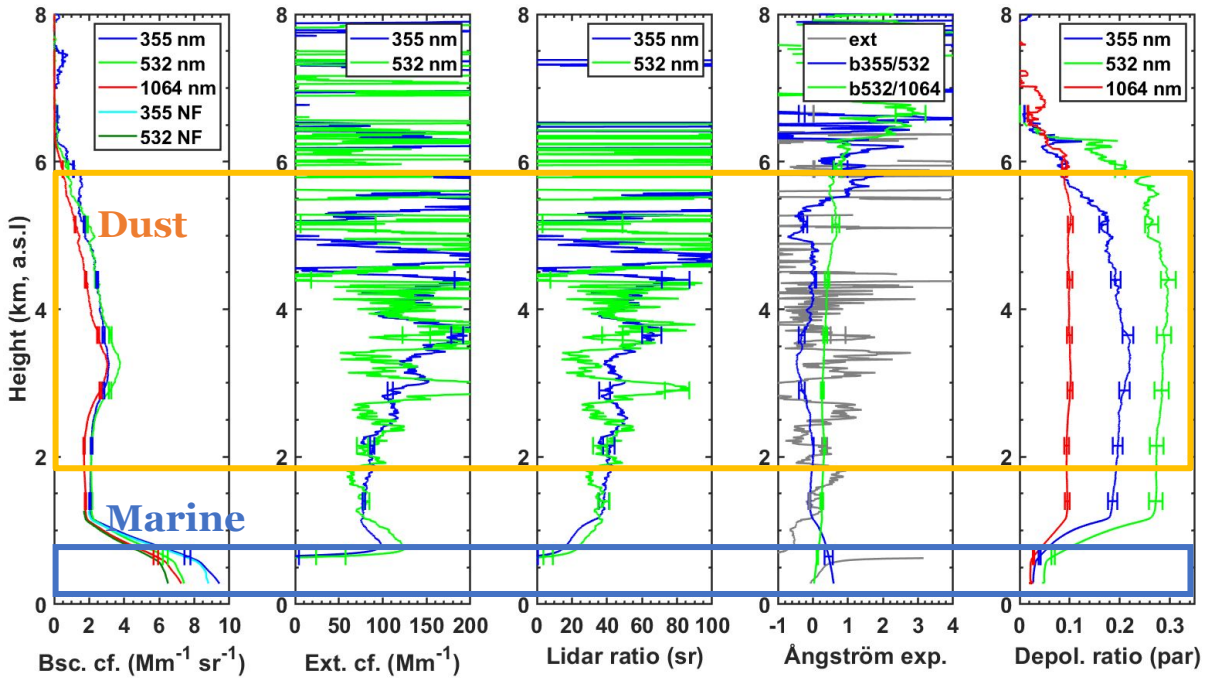
# Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

## WP2000: *ASKOS ground-based datasets in support of L2A+.*

Friday 10 September 2021




2-6 km
Lidar ratio ~45 sr
Depolarization ratio ~30%, up to 6 km!
→ Saharan dust particles



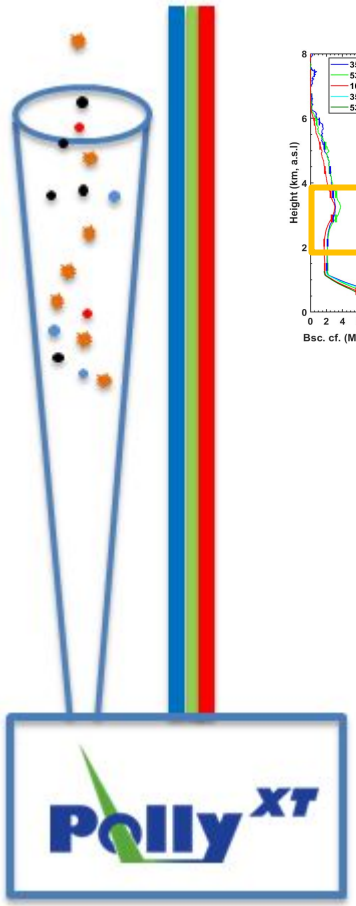

PBL
Medium aerosol load (Extinction < 200 Mm-1)
Lidar ratio ~25 sr, 5% particle depolarization ratio
→ Marine aerosol

# L2A+

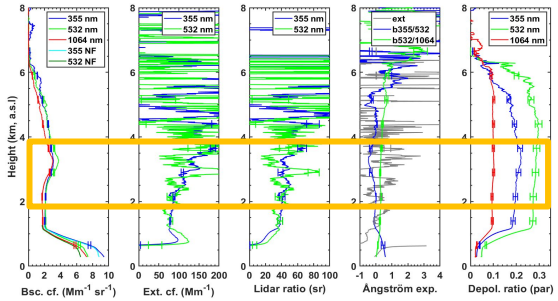
# Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

## WP2000: *ASKOS ground-based datasets in support of L2A+.*

### HETEAC-Flex: an EarthCARE-like typing algorithm




Input

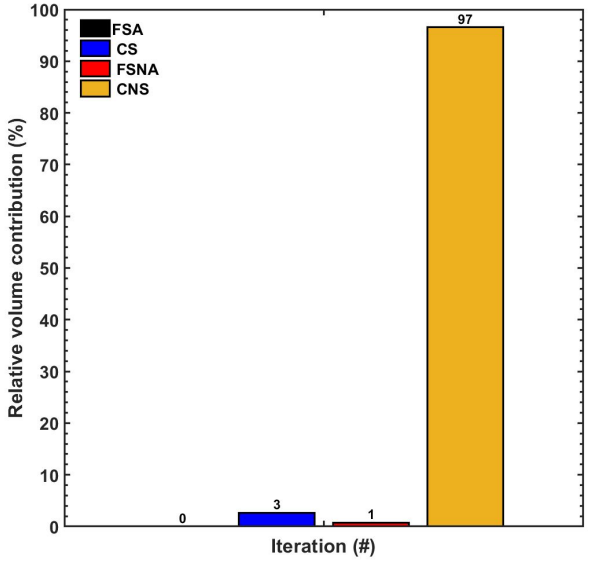



OEM

Output

- *Fine Spherical Absorbing*
- *Coarse Spherical*
- *Fine Spherical Non- Absorbing*
- *Coarse Non-Spherical*

Floutsi et al., to be submitted




$R_{eff}$ = 1.7 ± 0.2 µm

Relative volume

**0±14% FSNA**
**3±16% CS**
**1±16% FSNA**
**96±22% CNS**

Volume concentration

**0±1.9 µm³/cm³ FSNA**
**3.5±4.1 µm³/cm³ CS**
**1±2.2 µm³/cm³ FSNA**
**126±19 µm³/cm³ CNS**

Number concentration

**0±390 #/cm³ FSNA**
**0.3±0.4 #/cm³ CS**
**194.6±439 #/cm³ FSNA**
**12.2±1.8 #/cm³ CNS**

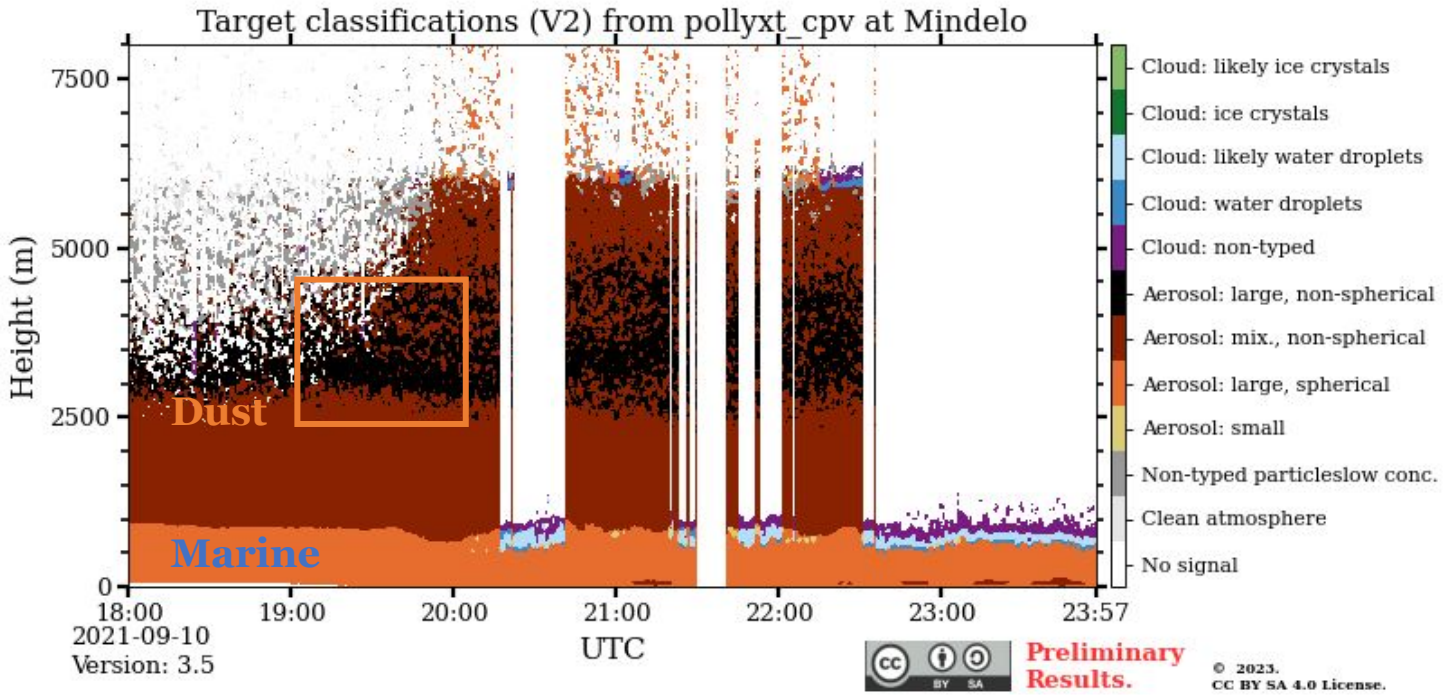
# L2A+

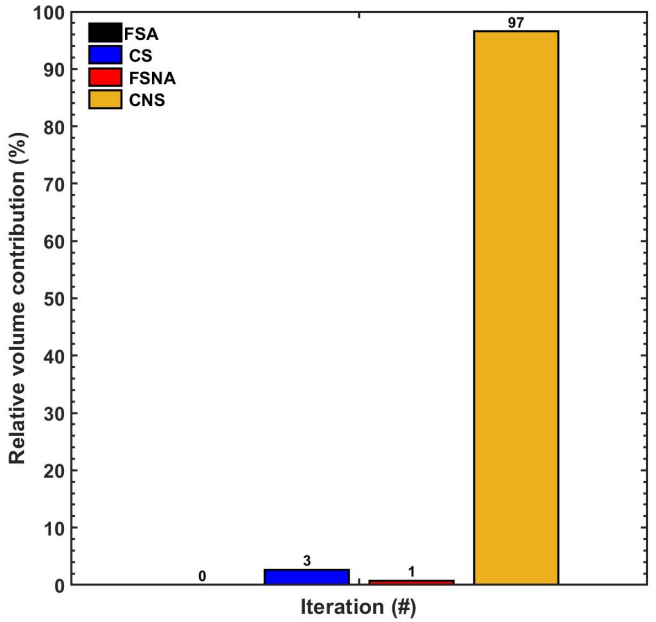
## Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

**WP2000:** *ASKOS ground-based datasets in support of L2A+.*

EARLINET lidar target categorization

HETEAC-Flex

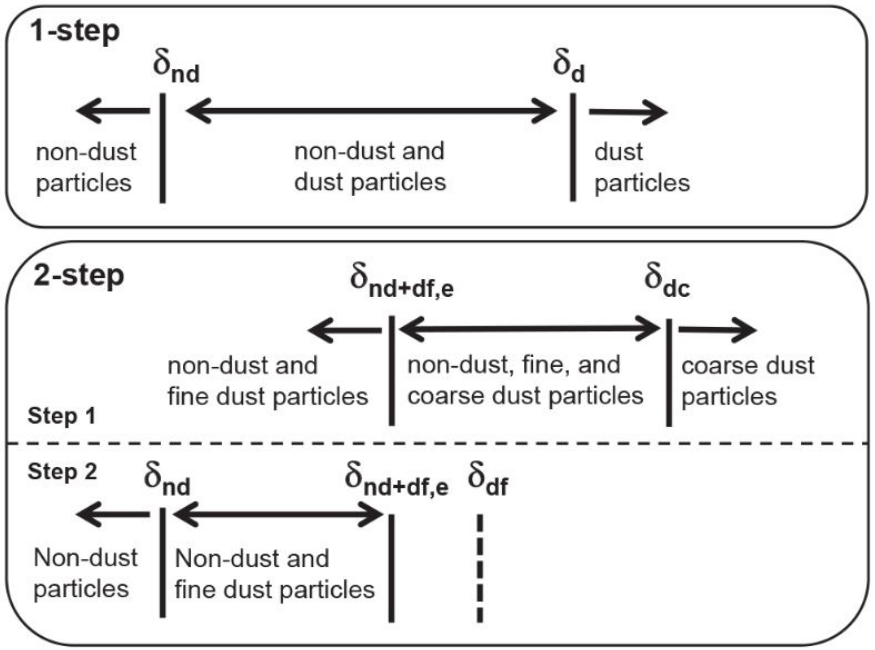



Important step for the developments of feature mask (Combined Cloudnet + EARLINET lidar target categorization)

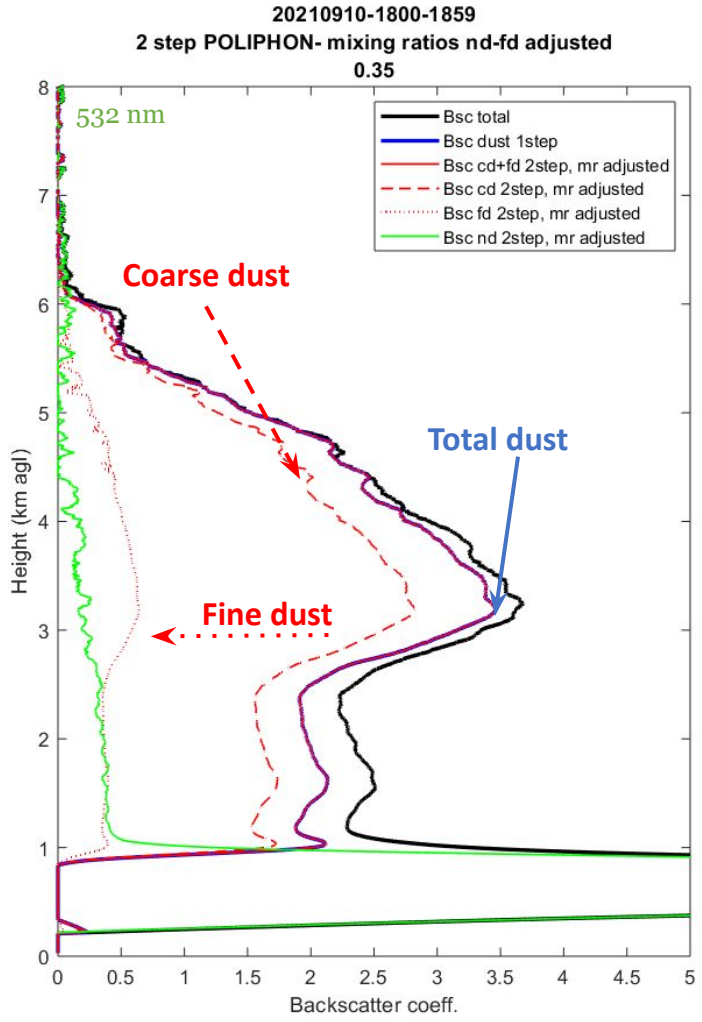
WP2000: *ASKOS ground-based datasets in support of L2A+.*

POLIPHON: dust-only backscatter coefficient




Mamouri and Ansmann, Atmos. Meas. Tech., 2014

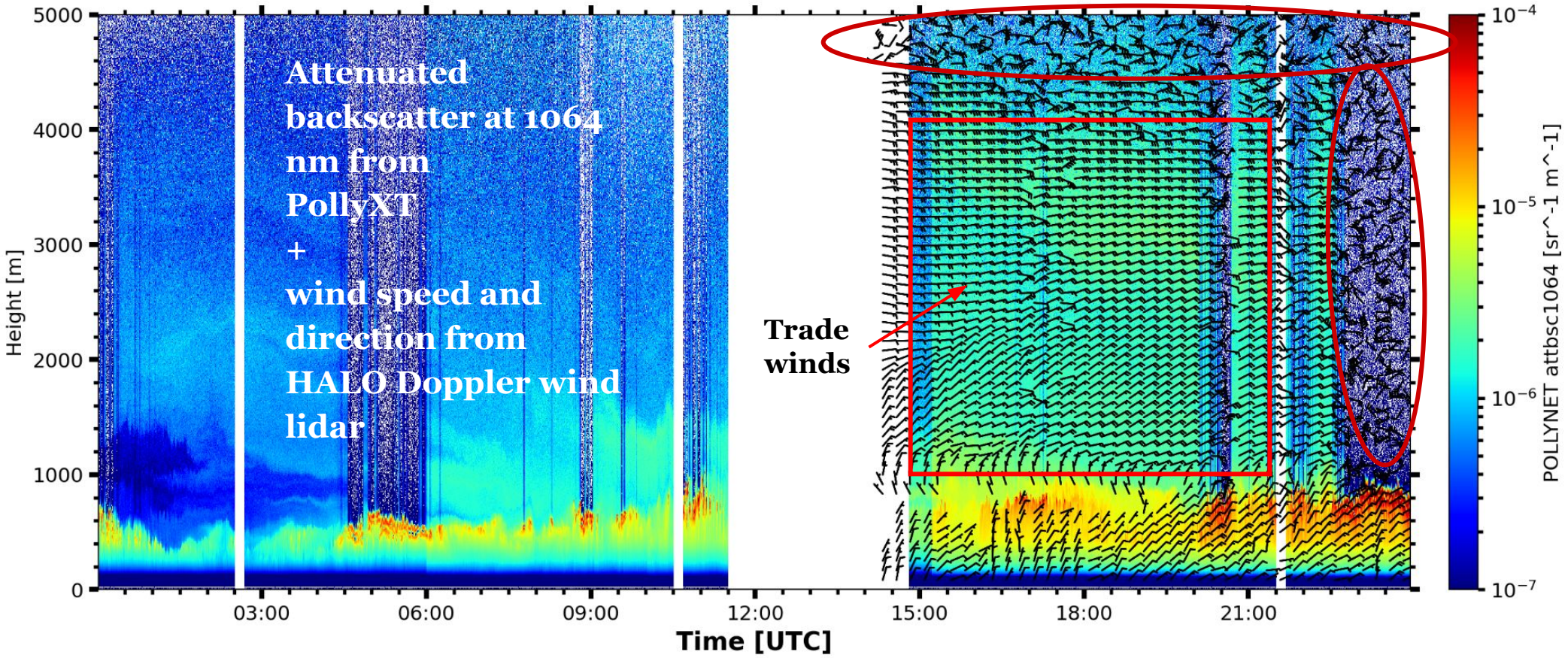
- Coarse dust dominates between 1 and 6 km
- Small contributions from non-dust particles between 1 and 4 km
  → HETEAC-Flex: coarse spherical & fine non-absorbing particles



WP2000: *ASKOS ground-based datasets in support of L2A+.*

## Dust fluxes

work in progress...



## WP2000: *ASKOS ground-based datasets in support of L2A+.*

Summary & Status of WP2000

Case studies: → show consistency between the different methodologies
→ complementary to each other (e.g., HETEAC-Flex can identify the non-dust aerosol components, whereas POLIPHON cannot)

Status: ongoing

- Creation of a unique feature mask (Combined Cloudnet + EARLINET lidar target categorization)
- Additional quality-assurance (QA) procedures are applied to the PollyNET retrievals
- Implementation of EARLINET's automatic aerosol layering tool
- HETEAC-Flex and POLIPHON are to be applied for the whole September 2021

# L2A+

Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

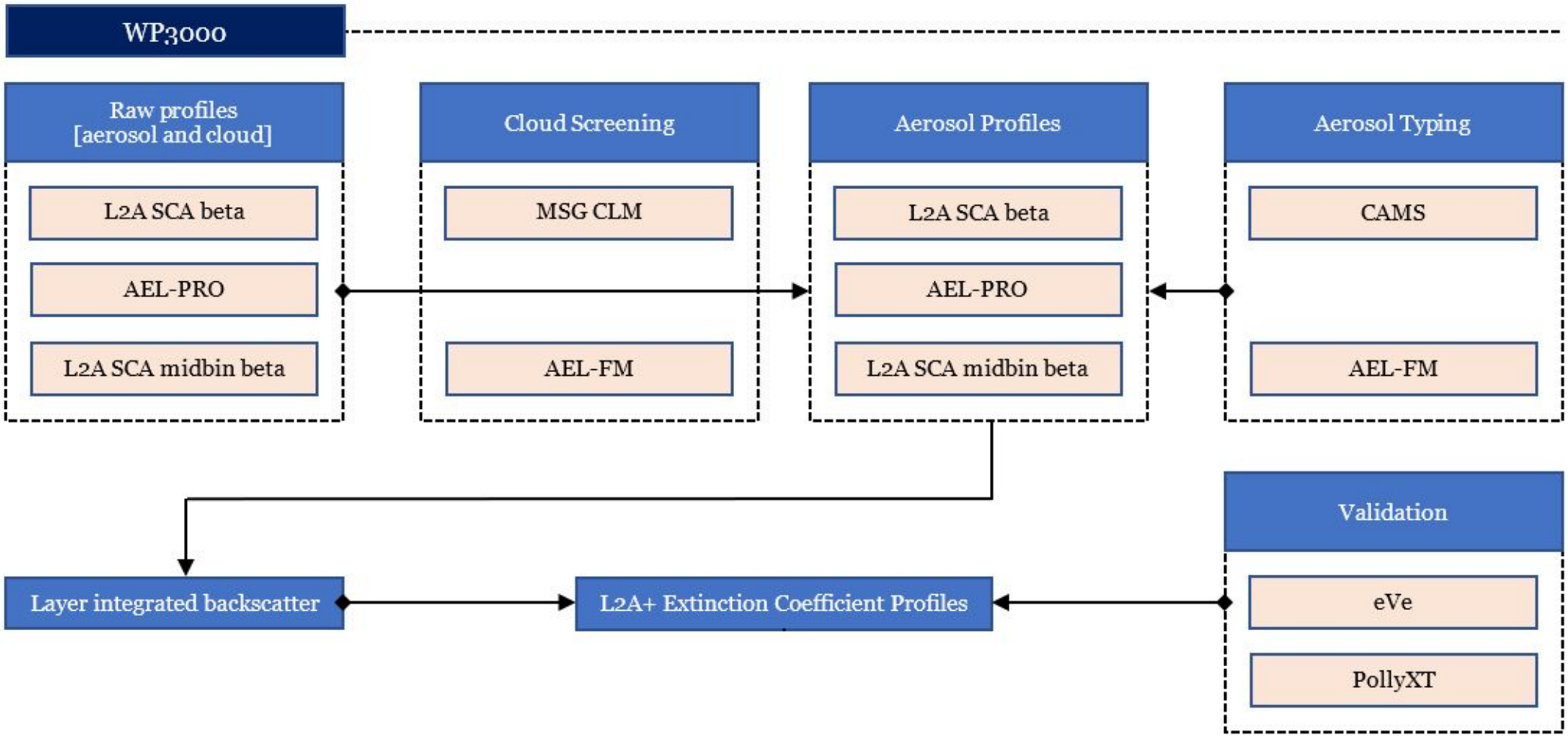
## WP3000: *Development of the L2A+ aerosol product.*

| | |
|---|---|
| Objective: | **Derivation of the L2A+ extinction and aerosol mass concentration product** |
| Inputs: | Aeolus L2A profiles, AEL-FM/PRO, SEVIRI CLAAS-3 cloud dataset, CAMS |
| Tasks: | 1. **Implementation of a rigorous screening of cloud contaminated Aeolus profiles** via the synergy of AEL-FM retrievals and MSG geostationary cloud imagery<br>2. **Exploitation of CAMS vertically resolved aerosol typing** for identifying the vertical extension of dust layers within the RoI<br>3. **Reconstruction of Aeolus cloud-free dust extinction profiles** by adjusting the absent cross-polar backscatter and defining suitable dust lidar ratio(s)<br>4. **Assessment analysis of Aeolus L2A+ aerosol profiles** |
| Output: | • D3: Description of the Algorithm Developments (ALGO)<br>• D4: Analysis of the Validation Activities carried out (VAL)<br>• D5: Output data product (OP) |

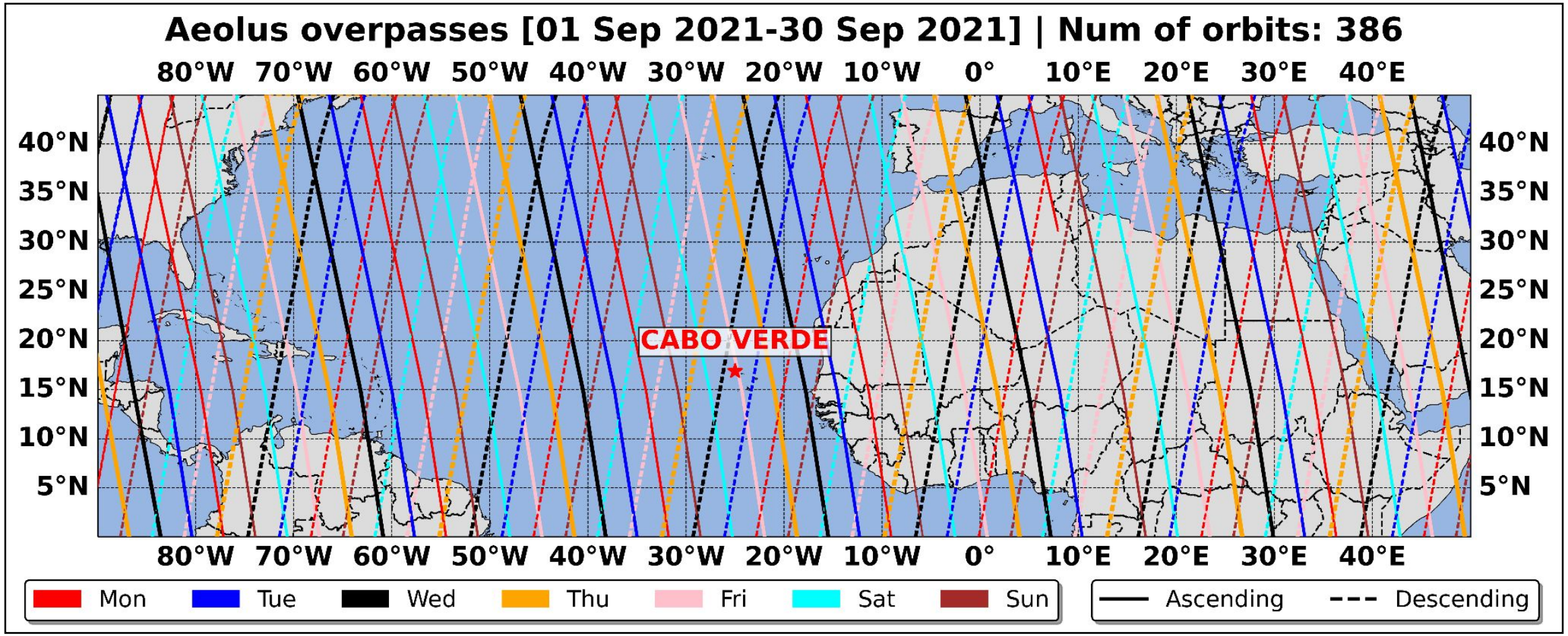
# L2A+

Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

## WP3000: *Development of the L2A+ aerosol product.*



## Aeolus overpasses within the RoI over the study period (September 2021)



# L2A+

## Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

aeolus ECMWF TROPOS

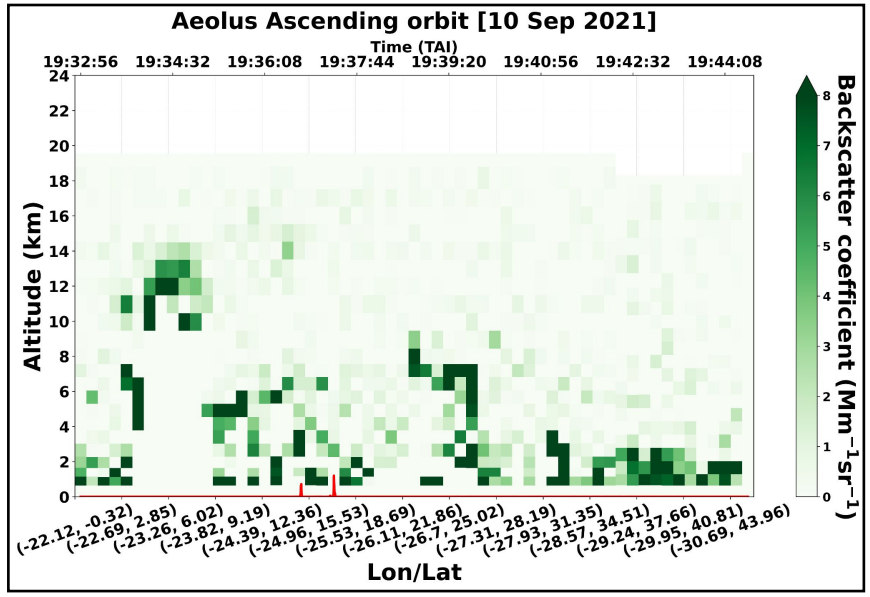
**WP3000:** *Development of the L2A+ aerosol product.*

Raw profiles [aerosol and cloud]

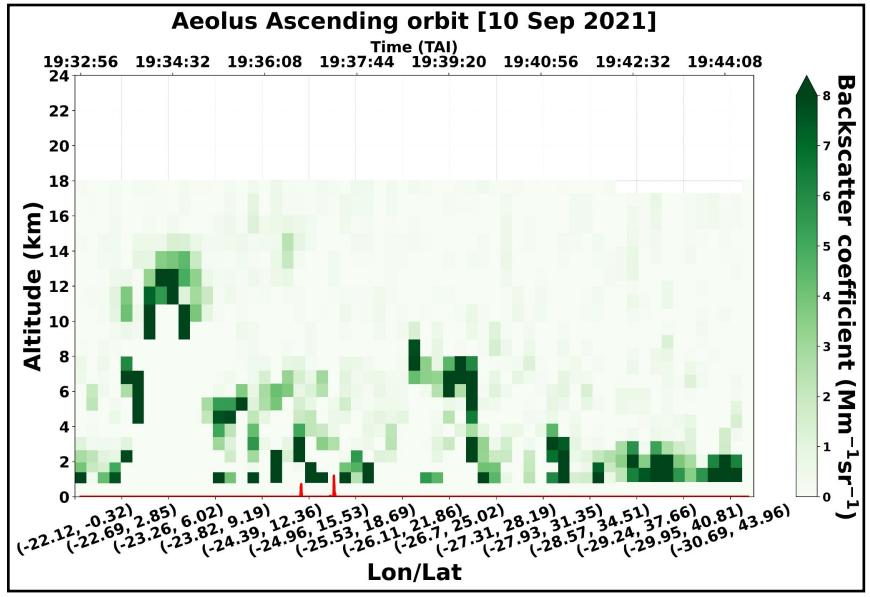
- L2A SCA beta
- AEL-PRO
- L2A SCA midbin beta

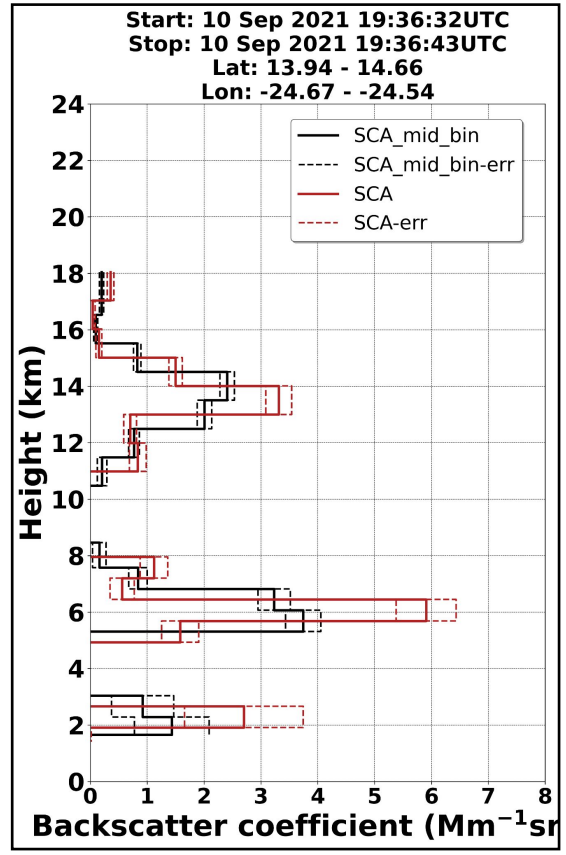
## Aeolus raw SCA-ray and SCA-midbin profiles

### SCA-ray [24 bins]




### SCA-midbin [23 bins]



# L2A+

## Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

aeolus ECMWF TROPOS

## WP3000: *Development of the L2A+ aerosol product.*

Cloud Screening

- MSG CLM
- AEL-FM

### Removal of cloud-contaminated profiles via the synergy with AEL-FM

- AEL-FM product for September 2021 period will be provided for the needs of the L2A+ study -Contribution by Dave Donovan (KNMI).
- Some data files have already been provided to test the cloud-filtering methodology.
- A request has been sent for the provision of the Aeolus retrievals processed with the latest L2A processor version (i.e., Baseline 15)
- AEL-PRO, AEL-FM are included and are available at the measurement scale (~3km)

@Antonis Gkikas

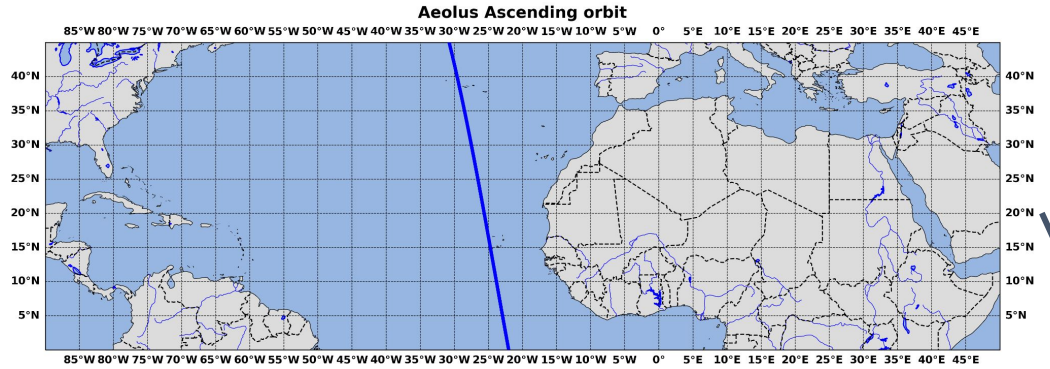
At the National Observatory of Athens (NOA) we are running an ESA project (entitled L2A+) in collaboration with TROPOS, ECMWF and KNMI. The main objective of the project is to assess the potential impact on NWP via the assimilation of Aeolus L2A profiles in a regional model. Would be feasible to process the Aeolus retrievals with Baseline 15 for the orbits residing within the region of interest (see figure) during September 2021? I can provide the orbit IDs or other useful information which can facilitate the providers.

# L2A+

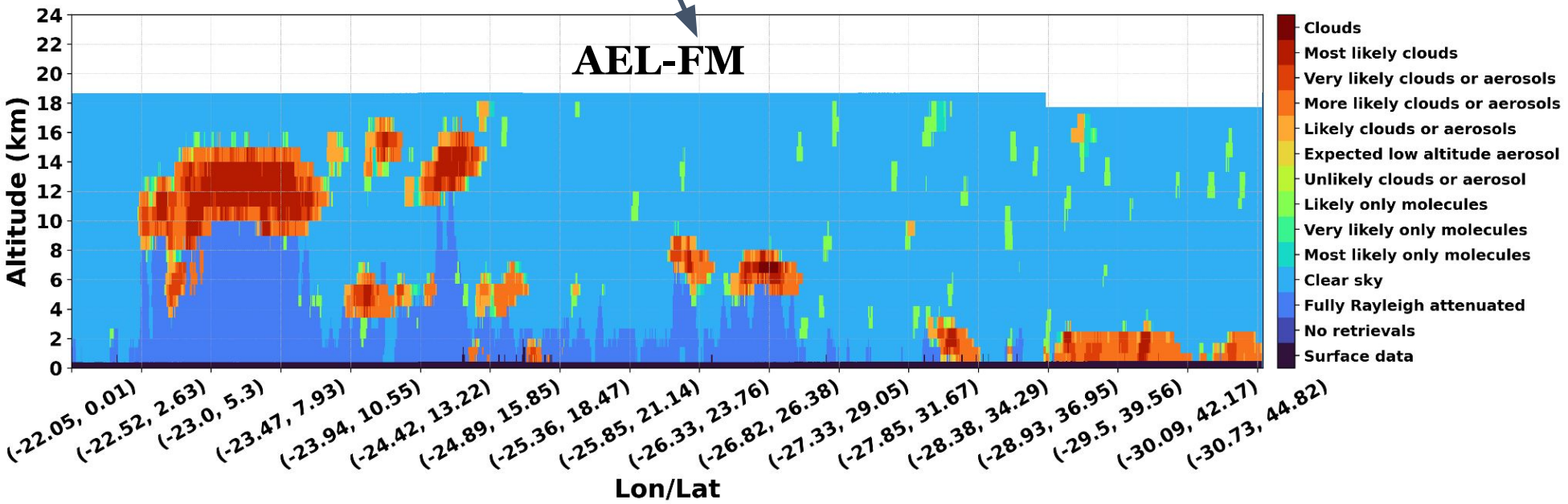
# Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

## WP3000: *Development of the L2A+ aerosol product.*

### Removal of cloud-contaminated profiles via the synergy with AEL-FM




**Orbit no. 7679 (10 Sep 2021)**



# L2A+

# Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

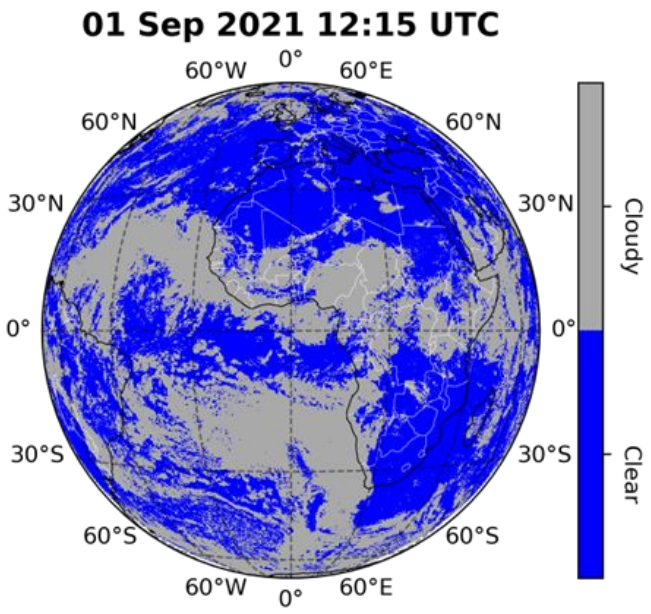
## WP3000: *Development of the L2A+ aerosol product.*

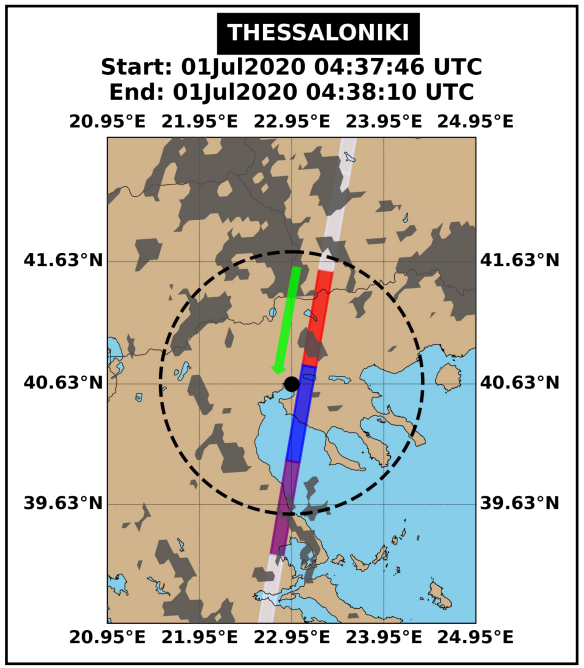
Cloud Screening

- MSG CLM
- AEL-FM

### Removal of cloud-contaminated profiles via the synergy with MSG cloud imagery

- The SEVIRI CLAAS-3 cloud dataset (September 2021) for masking Aeolus L2A profiles affected by clouds (Gkikas et al., 2022).
- The whole dataset has already been provided for the period of interest - Contribution by Dr. Nikos Benas (KNMI) and Dr. Stengel Martin (DLR).
- For an optimum cloud-screening, AEL-FM + SEVIRI CLAAS 3 products will be jointly utilized.




Gkikas et al. (2022) [AMTD]

# L2A+

## Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

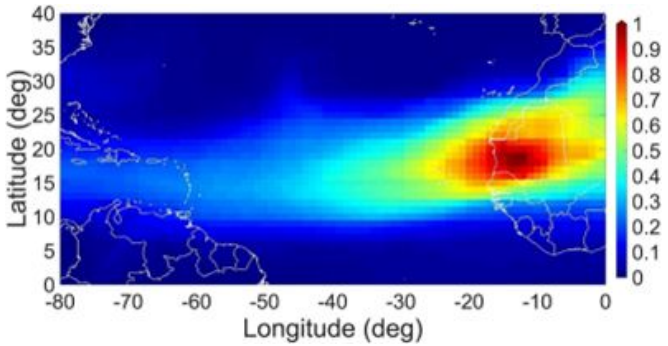
aeolus ECMWF TROPOS

## WP3000: *Development of the L2A+ aerosol product.*

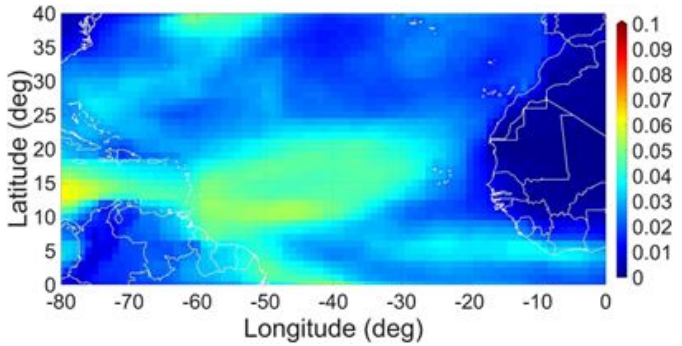
- Aerosol Typing
  - CAMS
  - AEL-FM

### Aerosol typing on Aeolus profiles relying on CAMS outputs

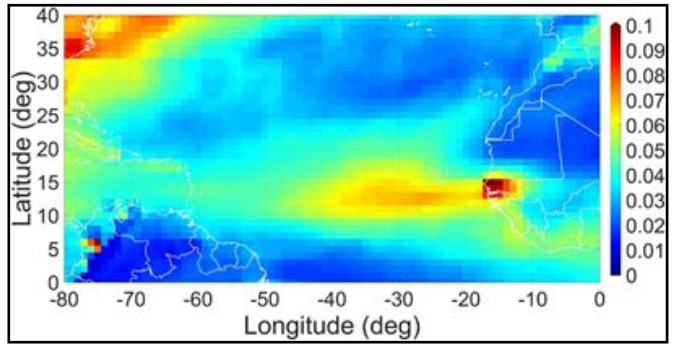
**Dust**



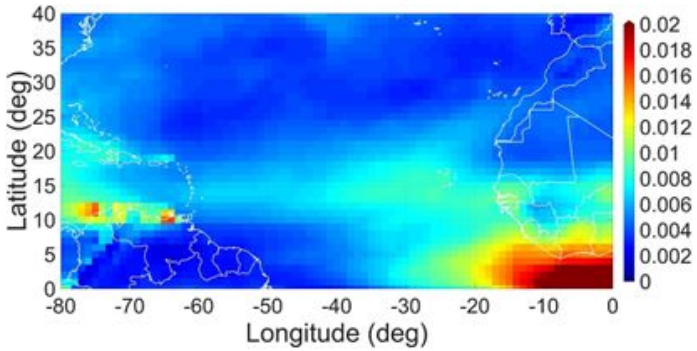

**Sea Salt**



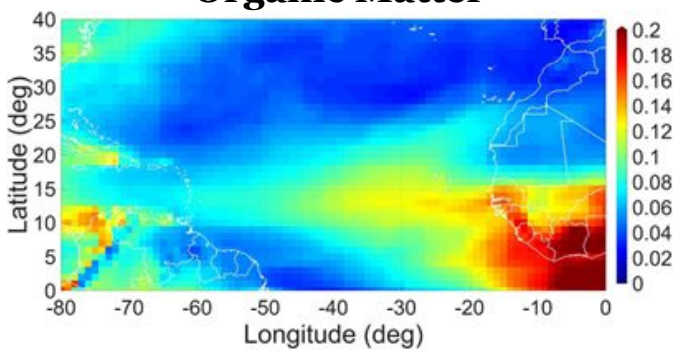

**Sulphate Aerosol**




**Black Carbon**




**Organic Matter**



# L2A+

## Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

**WP3000:** *Development of the L2A+ aerosol product.*

Validation

- eVe
- PollyXT

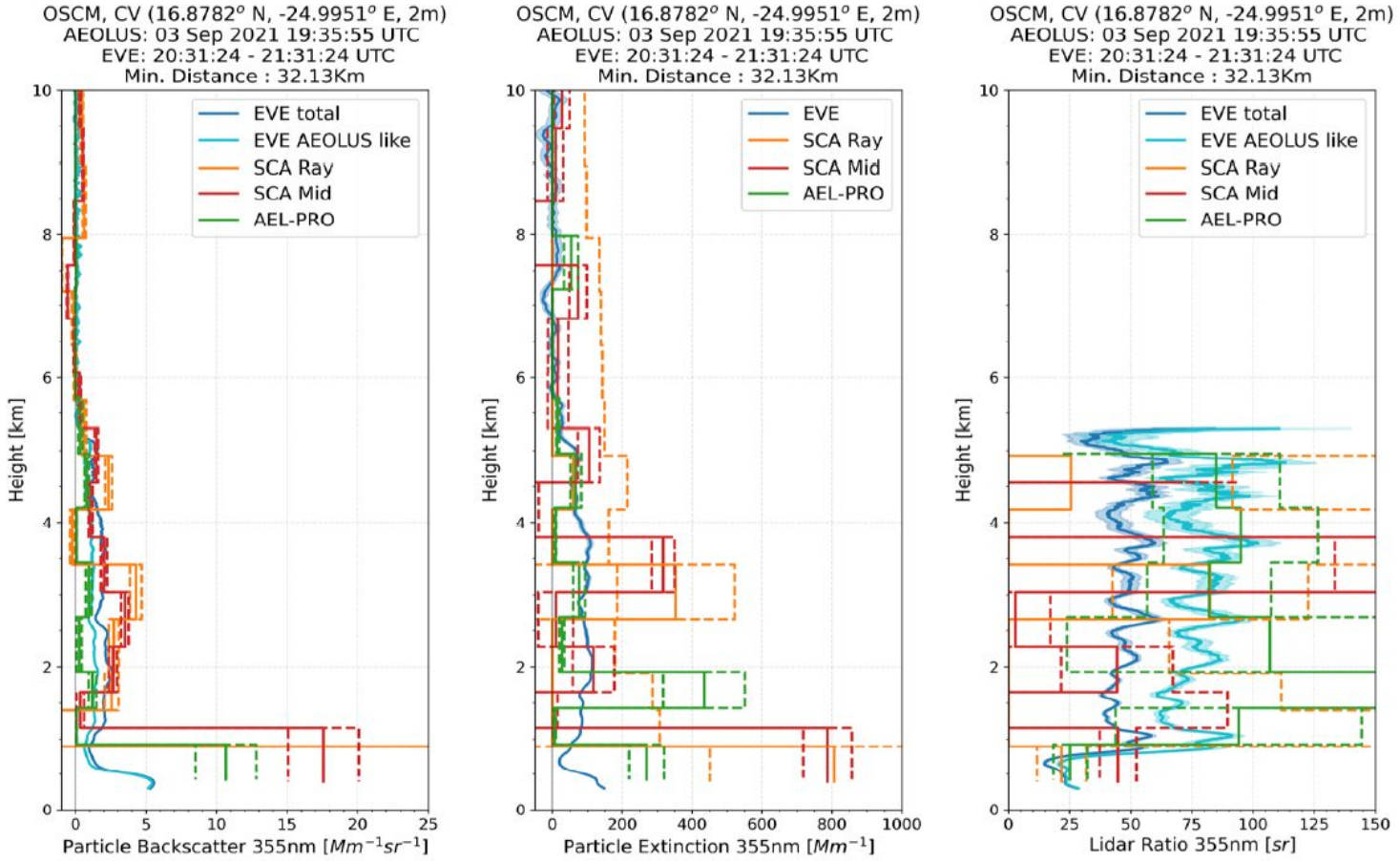
↓

L2A+ Extinction Coefficient Profiles

↓

**Assimilation Methodology WP4000**

## Evaluation of Aeolus L2A+ aerosol (dust) profiles versus eVe and Polly$^{XT}$




**Courtesy Peristera Paschou [NOA]**

## WP4000: *Assimilation of L2A/L2A+ and application of WRF-L experiments.*

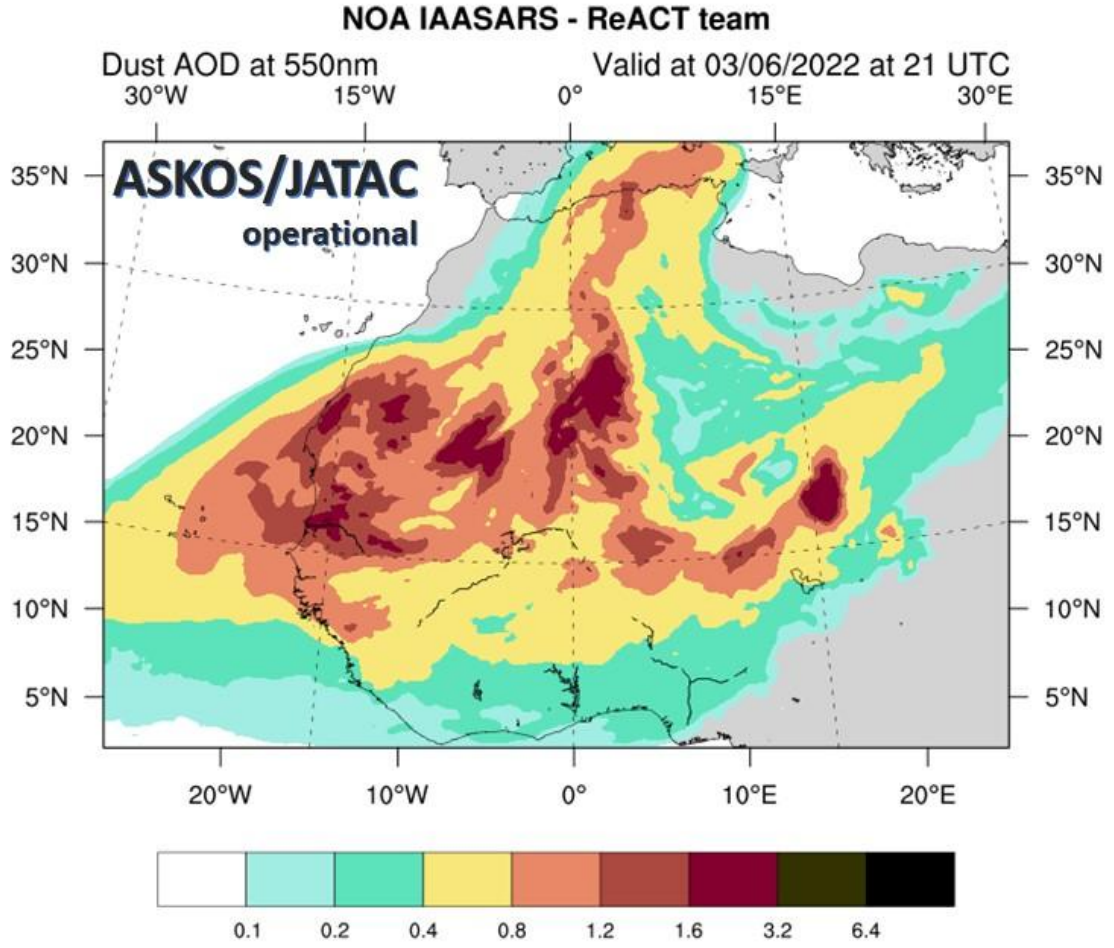
| | |
|---|---|
| Objective: | Assimilation of L2A/L2A+ and application of WRF-L experiments. |
| Inputs: | 1) Aeolus L2A and L2A+ dust profiles from WP3000<br>2) ECMWF IFS wind fields with /without Aeolus assimilation (available from ECMWF) |
| Tasks: | 1) Development of data assimilation routines (DART)<br>2) Evaluation of assimilation methodology<br>3) Performance of short term dust and NWP forecasts with WRF model. |
| Output: | DI03: Description of the Algorithm Developments (ALGO) for assimilating Aeolus L2A and L2A+.<br>DI05: WRF simulation outputs for all experiments. |

## Numerical Modeling

- popular open-source tool (NCAR ,NCEP, NOAA, US. Air Force, Naval Research Laboratory, Univ. of Oklahoma, FAA)

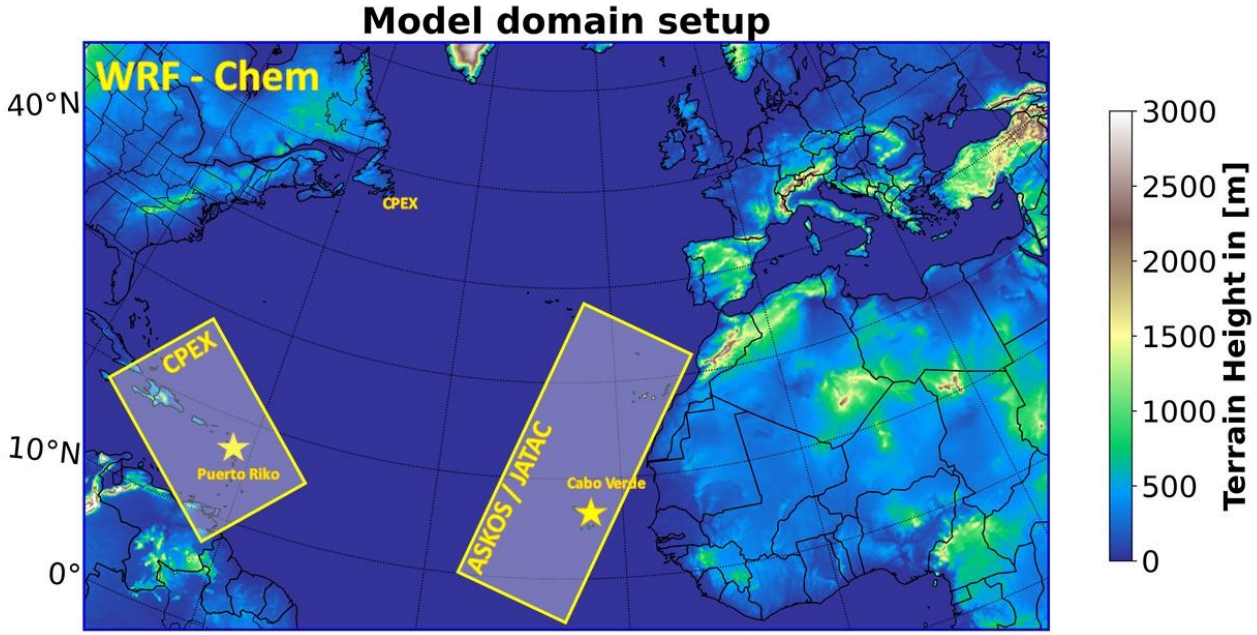
- simulates meteorological conditions, emission, formation, transport, deposition, nucleation and radiation effects of dust, so has a unique advantage in simulating dust process

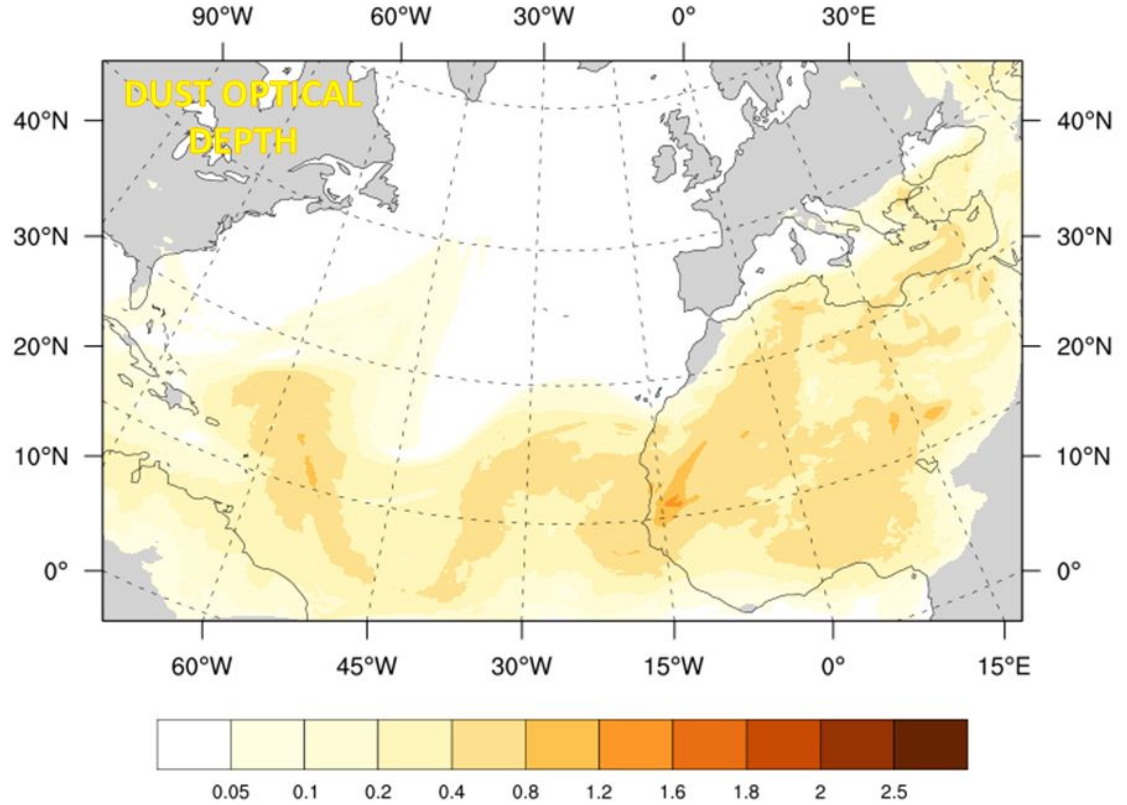
- scales from tens of meters to thousands of kilometers



## WP4000: *Assimilation of L2A/L2A+ and application of WRF-L experiments.*

A bigger domain for the project that contains all the available observational datasets



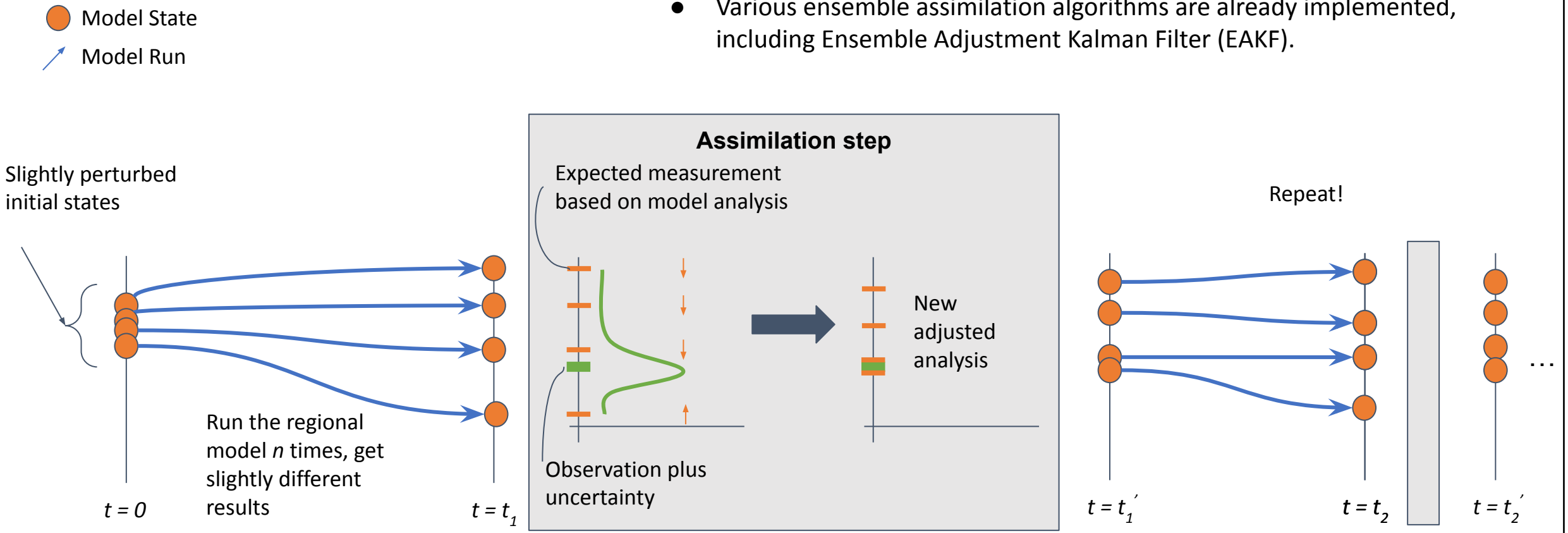
# L2A+

# Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

## WP4000: *Assimilation of L2A/L2A+ and application of WRF-L experiments.*

NCAR | DART

- 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+

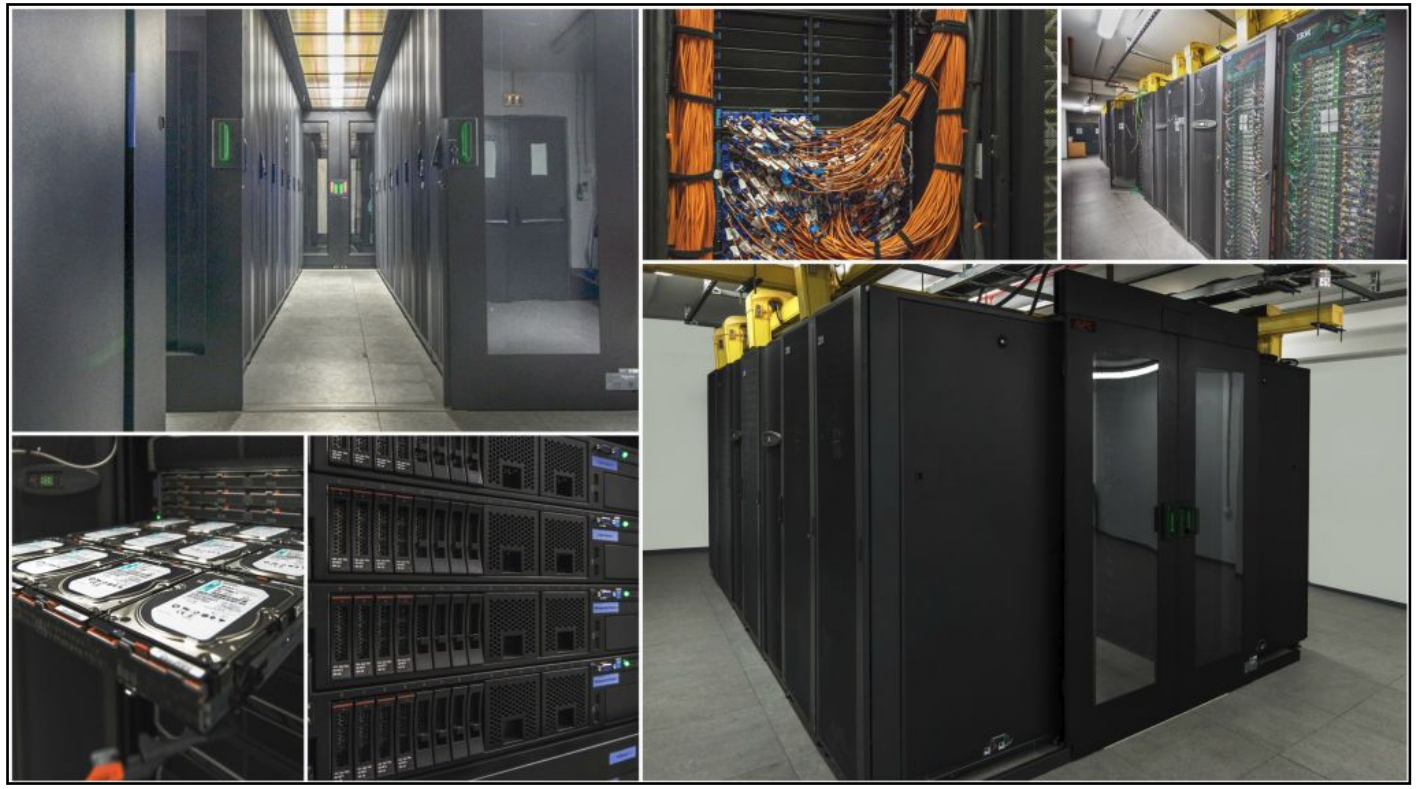
# Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

## WP4000: *Assimilation of L2A/L2A+ and application of WRF-L experiments.*

For WP4000, we worked on securing computational resources that will be required for the assimilation experiments.

1. Preparatory access to National HPC Facility ARIS to **test WRF performance and scalability**
2. Submit **project proposal to request 2m core hours** for assimilation experiments.

This work was supported by computational time granted from the National Infrastructures for Research and Technology S.A. (GRNET S.A.) in the National HPC facility - ARIS - under project ID pa221205.



Photos of ARIS system, credit: GRNET (https://hpc.grnet.gr/supercomputer/)

## WP4000: *Assimilation of L2A/L2A+ and application of WRF-L experiments.*

**Testing methodology:**

- Execute 6h simulations on ARIS HPC w/ different configurations (node count, spatial resolution)
- Extrapolate for total experiment simulation time
- Compute required resources

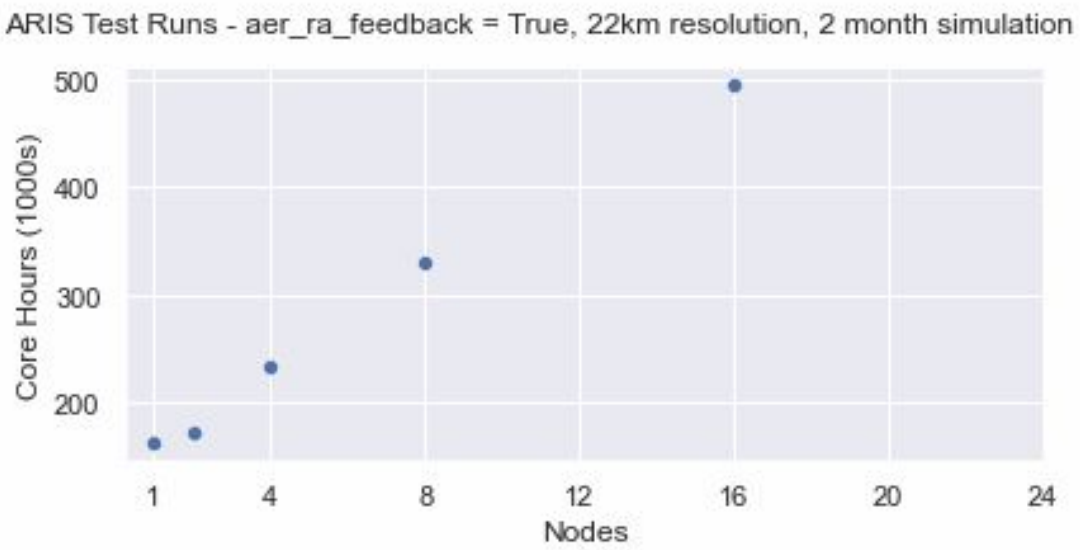
**Results:**

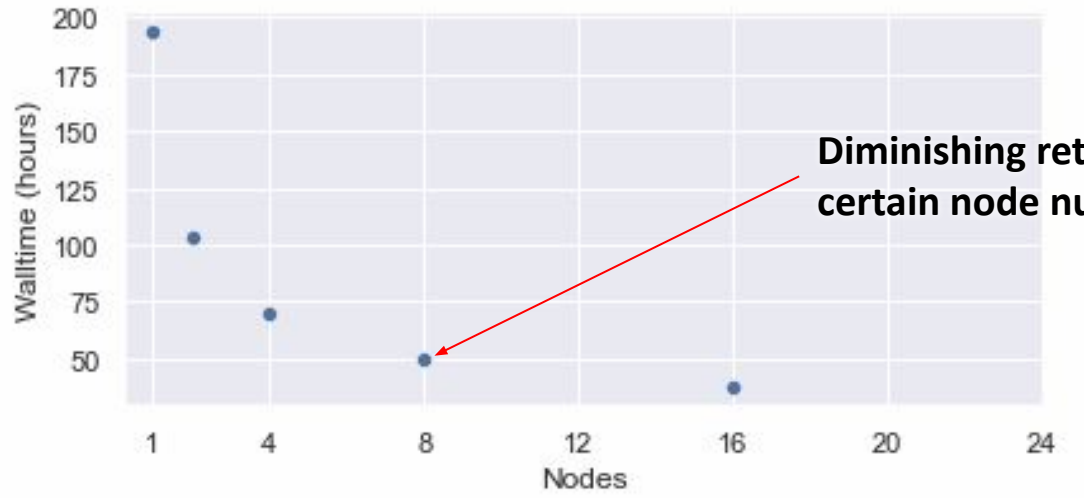
| Experiment | Description | Simulation days | Core hours |
|---|---|---|---|
| CTRL | Control run without any AEOLUS assimilation | 76 | 10k |
| EXP-0 | Use initial & boundary conditions w/ AEOLUS wind field assimilation (IFS) | 76 | 10k |
| EXP-L2A | Use AEOLUS wind fields and L2A dust product assimilation | 2432 | 400k |
| EXP-L2A+ | Use AEOLUS wind fields and L2A+ dust product assimilation | 2432 | 400k |
| **Total** | *(**without** any overhead for assimilation algorithm)* | 5016 | 820k |

# L2A+

## Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP.

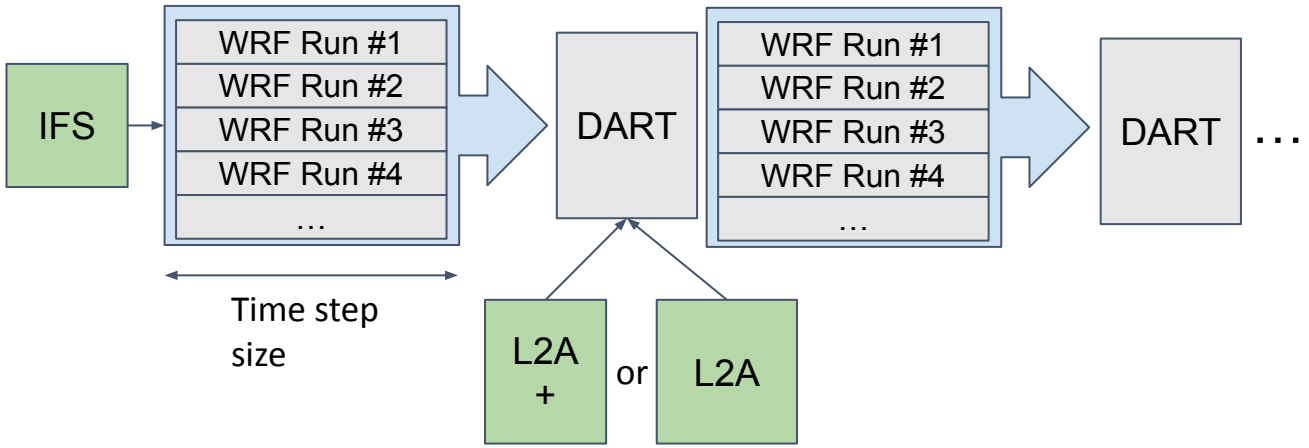
**WP4000:** *Assimilation of L2A/L2A+ and application of WRF-L experiments.*




**Diminishing returns after certain node number!**

HPC access still very convenient: ensemble members can be executed in parallel!




Would take 7 months of continuous runtime to do all experiments this sequentially.