



L2A+

Ref: ESA AO/1-11041/22/I-NS

Progress Report 05 – PR05

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

## L2A+

Progress Report 05 – PR05  
[07/2023-08/2023]

(Version 1.0)

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### Executive Summary - Progress Report 05 (PR05)

This is the Progress Report 05 (PR05) documentation file of the European Space Agency (ESA) project entitled L2A+ [Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP]. PR05 reports on the activities performed during the period from between July 2023 and August 2023 (KO+9 - KO+10 months).

### Work Package Status

|        |  |
|--------|--|
| WP1000 | Management, reporting and promotion.   |
|        | Status: Ongoing.<br>Schedule: KO – KO+24 months.<br>Started on: November 2022.<br>Objectives: 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, consolidating the scientific requirements for L2A+ study.   |
| Status | Ongoing.<br><br>Activities conducted between KO+9 and KO+10 months included the general management of the L2A+ project as well as the communication among all partners and with the Agency. Meetings were organised to ensure a smooth execution of all scientific and technical tasks. Moreover, activities related to WP1000 included coordination towards the first version (V1) of DIO3 entitled “Description of Algorithm Developments - ALGO”, as well as coordination towards addressing the comments raised by the ESA-L2A+ officers.  |
| WP2000 | ASKOS ground-based datasets in support of L2A+.  |
|        | Status: Ongoing.<br>Schedule: KO – KO+16 months.<br>Started on: November 2022.<br>Objectives: To provide ASKOS ground-based datasets for L2A+ product validation and model evaluation studies.   |
| Status | Ongoing<br><br>Activities conducted between KO+9 and KO+10 included review and QA of the datasets acquired during ASKOS as part of the Joint Tropical Atlantic campaign (JATAC) and ASKOS Campaign. The collected datasets are undergoing analysis, exploitation, and pre-processing towards completion of L2A+ dataset, towards derived aerosol optical properties, including (1) PollyXT-derived aerosol optical properties and target classification, (2) CloudNet target classification, and (3) two-step POLIPHON results for June and September 2022 in addition to September 2021, to be included in DIO2-V2. |
| WP3000 | Development of the L2A+ aerosol product.<br>Schedule: KO+4 – KO+21 months.<br>Started on: February 2023.   |
| Status | Ongoing.<br><br>Overarching technical Objective of L2A+ WP3000 consists the development of a refined Aeolus aerosol optical product (L2A+) over the North Atlantic Ocean, based on AEL-FM/AEL-PRO algorithms, CAMS reanalysis outputs with focus on non-spherical atmospheric particles (i.e., dust). Towards realisation of the L2A+ product,   |

the work-in-progress conducted between KO+09 months and KO+10 months, included, among others, the following:

- 1) Expansion of the cloud-filtering methodology based on the AEL-FM feature mask product to include the cloud-filtered Aeolus SCA products at the middle-bin vertical scale (23 vertical bins).
- 2) Implementation of a second cloud-filtering methodology based on the use of the MSG SEVIRI CLAAS3 cloud-mask dataset. Based on the methodology, Aeolus BRC profiles comprised of cloud-contaminated measurements exceeding a given threshold are removed.
- 3) Implementation of a rigorous cloud-filtering of the raw Aeolus L2A retrievals, based on the synergistic use of AEL-FM and MSG SEVIRI datasets, providing the cloud-free Aeolus profiles.

The cloud filtering results for an indicative Aeolus overpass on the 17<sup>th</sup> of September 2021 are presented below (Fig.1):

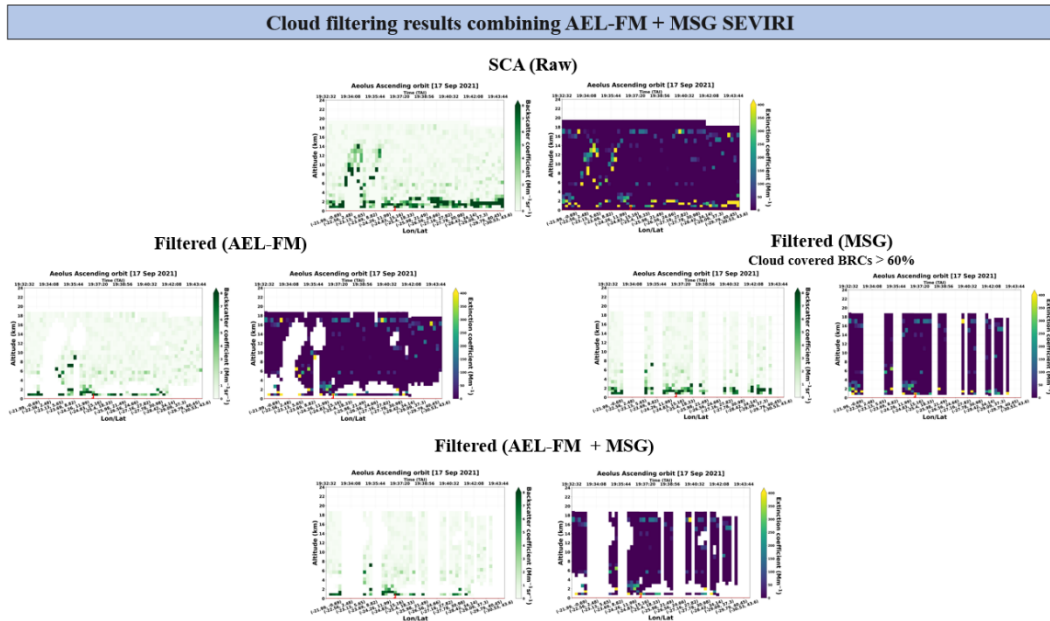


Figure 1: a) Raw Aeolus SCA backscatter and extinction profiles along the Aeolus overpass on 17 Sep. 2021 and cloud-filtered SCA backscatter and extinction profiles based on b) AEL-FM feature mask product, c) MSG SEVIRI CLAAS3 cloud-mask dataset and d) combination of AEL-FM and MSG SEVIRI cloud datasets.

In addition, between To+9 and To+10 months of L2A+, for the identification of the dust layers along the Aeolus measurement track, CAMS reanalysis outputs were also used. Vertical profiles of the dust mass concentration and dust to total aerosol mass concentration ratio were derived (Fig. 2).

Both procedures aim to be used in order to identify dust layers to derive the L2A+ pure-dust extinction coefficient profiles.



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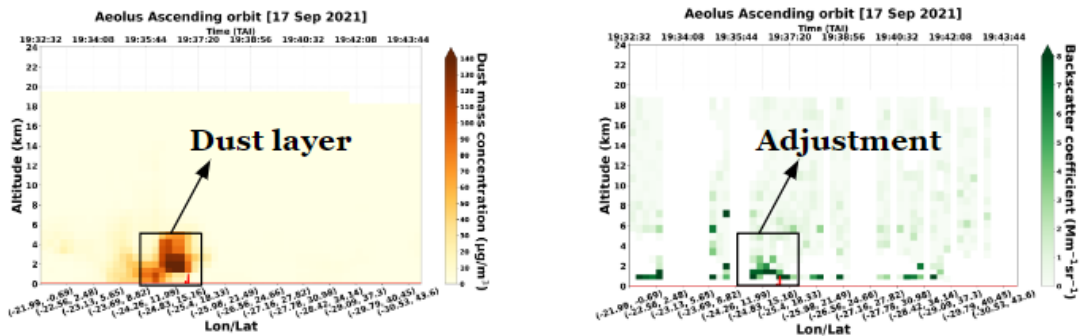


Figure 2: (a) CAMS reanalysis profiles of dust mass concentration along the Aeolus overpass on 17<sup>th</sup> Sep. 2021 and (b) cloud-filtered backscatter profiles adjusted using a lidar ratio for the dust-affected BRC bins.

|        |   |
|--------|---|
| WP4000 | Assimilation of L2A/L2A+ and application of WRF-L experiments.  |
|        | <p>Status: Not started.<br/>         Schedule: KO+6 – KO+24 months.<br/>         Objectives: Assimilation of L2A and L2A+ dust products on WRF-L and pertinent simulations.</p>   |
| Status | <p>Ongoing</p> <p>The goal of WP4000 is to study the improvements of L2A+ through their impact on NWP and dust-transport experiments. To this end, between L2+ T0+9 and T0+10 months WP4000 focused on Aeolus support to the Data Assimilation Research Testbed (DART), which will in turn be used with the WRF-CHEM model for the studies of WP5000.</p> <p>During the months KO+09 and KO+10, the following actions took place:</p> <ol style="list-style-type: none"> <li>1) The necessary “glue” code to allow using DART w/ WRF was implemented. While WRF is officially supported by DART, it is up to the user to provide the appropriate scripts to run experiments on his available HPC facility. The developed set of scripts is meant to be portable as to present the WRF/DART community with a reliable starting point for such activities. The code is to be released on GitHub in the following months.</li> <li>2) Aeolus wind support has been added to DART and the code is currently undergoing testing. Adding a new observation type to DART required the development of the forward observation operator and the appropriate data format converters. Both of these programs behave as expected and some preliminary results are available. When the results are validated, the new developments will be contributed to the DART community to be available publicly.</li> <li>3) WP4000 is preparing assimilation experiments to study the impact of Aeolus winds on regional dust transport modelling.</li> </ol> <p>The following figure contains preliminary results of an assimilation experiment that corrects the model state with Aeolus observations and checks the impact after 6h of simulation. Two distinct ensembles of forecasts (each with 16 members) are performed over the general North Atlantic region. The first, CONTROL, continues for 12h without any assimilation. In the second ensemble, AEOLUS, wind observations from one Aeolus overpass are assimilated at T=+6h, before cycling and continuing forecasts for another 6h. The figure shows the differences in U Wind component when comparing the two ensemble means, at surface level. These results</p> |

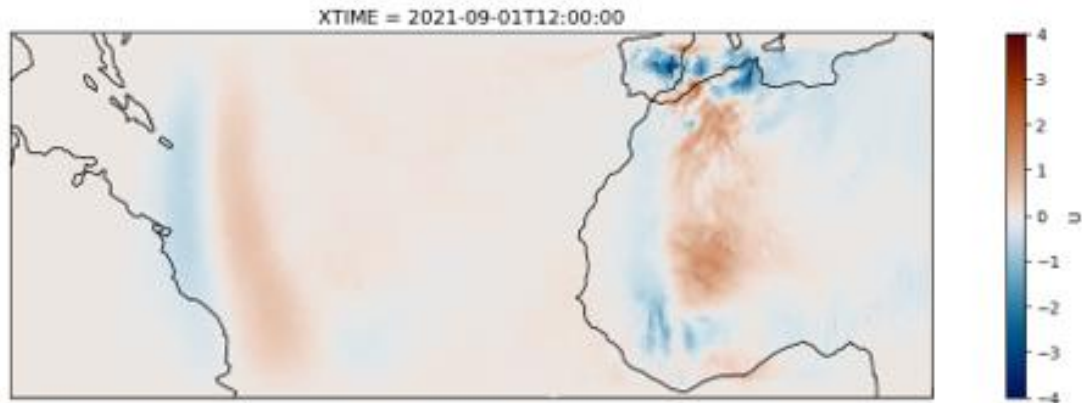


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are not validated with independent observations but serve as an indicator that the assimilation system is behaving in an expected manner.



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| WP5000 | Impact Studies.<br>Status: Not started.<br>Schedule: KO+12 – KO+24 months.<br>Objectives: Scientific Analysis and Impact Assessment.   |
| Status | Not started.   |
| WP6000 | Recommendations.<br>Status: Not started.<br>Schedule: KO+12 – KO+24 months.<br>Objectives: Summary of the main scientific outcomes of the project and recommendations for expanding the performed research activities. |
| Status | Not started.   |



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### Status of Deliverable Items

| Code     | Deliverable Item  | Type          | Delivery Date | Status     |
|----------|---|---------------|---------------|------------|
| MoM      | Minutes of Meeting – Kick-Off Meeting                   | Documentation | KO            | Completed. |
| PR01     | Progress Report 1                                       | Documentation | KO+2 Months   | Completed. |
| Do1 – V1 | Requirement Baseline Document (RB)                      | Documentation | KO+3 Months   | Completed. |
| Do7 – V1 | L2A+ project website (WEB)                              | Webpage       | KO+3 Months   | Completed. |
| MoM-PM01 | Minutes of Meeting – Progress Meeting 1                 | Documentation | KO+3 Months   | Completed. |
| PR02     | Progress Report 2                                       | Documentation | KO+4 Months   | Completed. |
| Do1 – V2 | Requirement Baseline Document (RB)                      | Documentation | KO+6 Months   | Completed. |
| Do2      | Data Pool (DP)  | Dataset       | KO+6 Months   | Completed. |
| PR3      | Progress Report 3                                       | Documentation | KO+6 Months   | Completed. |
| MoM-PM02 | Minutes of Meeting – Progress Meeting 2                 | Documentation | KO+6 Months   | Completed. |
| PR04     | Progress Report 4                                       | Documentation | KO+8 Months   | Submitted. |
| MoM-PM03 | Minutes of Meeting – Progress Meeting 3                 | Documentation | KO+9 Months   | Pending.   |
| Do3      | Description of the Algorithm Developments (ALGO)        | Documentation | KO+9 Months   | Pending.   |
| PR05     | Progress Report 5                                       | Documentation | KO+10 Months  | Pending.   |
| Do5      | Output data product (OP)                                | Dataset       | KO+12 Months  | Pending.   |
| Do8      | Multi-media material (MM)                               | Documentation | KO+12 Months  | Pending.   |
| PR06     | Progress Report 6                                       | Documentation | KO+12 Months  | Pending.   |
| MoM-MTR  | Minutes of Meeting – Mid Term Review Meeting            | Documentation | KO+12 Months  | Pending.   |
| PR07     | Progress Report 7                                       | Documentation | KO+14 Months  | Pending.   |
| Do2      | Data Pool (DP)  | Dataset       | KO+15 Months  | Pending.   |
| Do3      | Description of the Algorithm Developments (ALGO)        | Documentation | KO+15 Months  | Pending.   |
| Do4      | Analysis of the Validation Activities carried out (VAL) | Documentation | KO+15 Months  | Pending.   |
| MoM-PM04 | Minutes of Meeting – Progress Meeting 4                 | Documentation | KO+15 Months  | Pending.   |
| PR08     | Progress Report 8                                       | Documentation | KO+16 Months  | Pending.   |
| Do5      | Output data product (OP)                                | Documentation | KO+18 Months  | Pending.   |
| Do7 – V2 | L2A+ project website (WEB)                              | Webpage       | KO+18 Months  | Pending.   |
| PR9      | Progress Report 9                                       | Documentation | KO+18 Months  | Pending.   |
| MoM-PM05 | Minutes of Meeting – Progress Meeting 5                 | Documentation | KO+18 Months  | Pending.   |
| PR10     | Progress Report 10                                      | Documentation | KO+20 Months  | Pending.   |
| Do2      | Data Pool (DP)  | Dataset       | KO+21 Months  | Pending.   |
| Do3      | Description of the Algorithm Developments (ALGO)        | Documentation | KO+21 Months  | Pending.   |
| Do4      | Analysis of the Validation Activities carried out (VAL) | Documentation | KO+21 Months  | Pending.   |
| Do6      | Scientific Analysis, Impact Assessment and              | Documentation | KO+21 Months  | Pending.   |



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|            |   |               |              |          |
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|            | Scientific Roadmap (SIR)  |               |              |          |
| MoM - PM06 | Minutes of Meeting – Progress Meeting 6                             | Documentation | KO+21 Months | Pending. |
| PR11       | Progress Report 11  | Documentation | KO+22 Months | Pending. |
| Do4        | Analysis of the Validation Activities carried out (VAL)             | Documentation | KO+24 Months | Pending. |
| Do5        | Output data product (OP)  | Documentation | KO+24 Months | Pending. |
| Do6        | Scientific Analysis, Impact Assessment and Scientific Roadmap (SIR) | Documentation | KO+24 Months | Pending. |
| Do8        | Multi-media material (MM)   | Documentation | KO+24 Months | Pending. |
| Do9        | Final Report and Executive Summary Report (FR)                      | Documentation | KO+24 Months | Pending. |
| MoM -FR    | Minutes of Meeting – Final Review Meeting                           | Documentation | KO+24 Months | Pending. |

L2A+ Gantt Chart

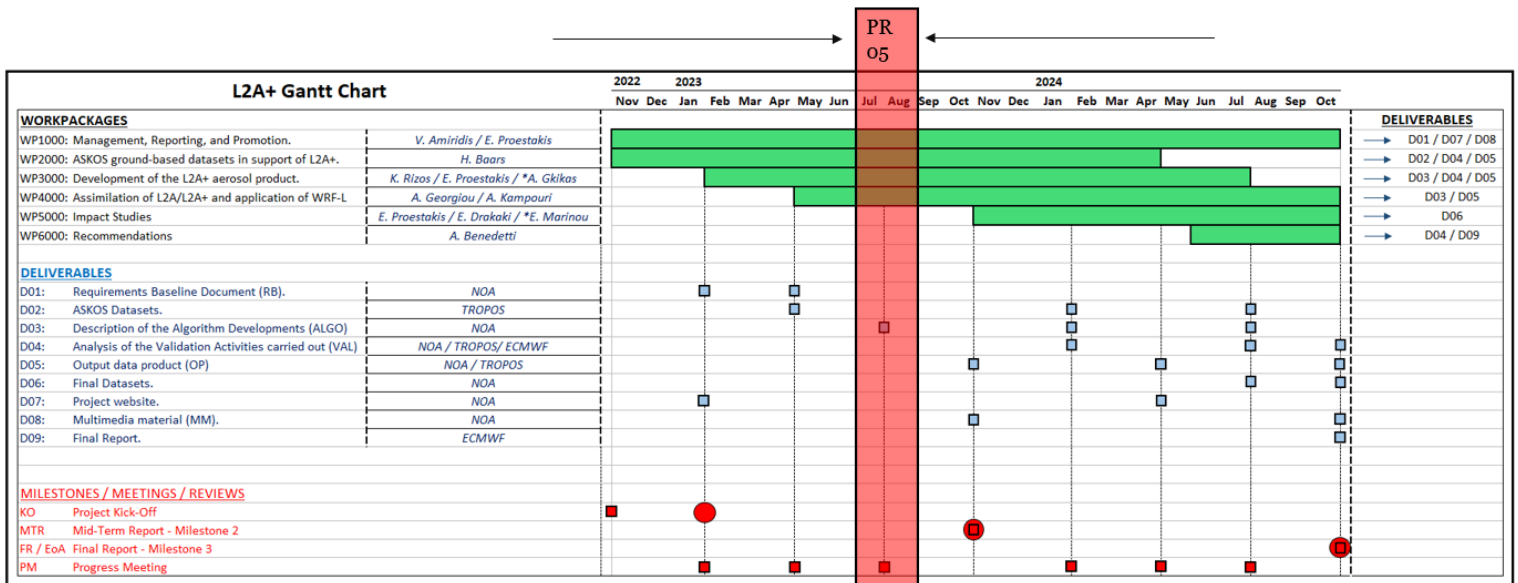


Figure: L2A+ Gantt Chart and current PR05 temporal period.