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

L2A+

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Progress Report 07 – PR07
[11/2023-12/2023]

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(Version 1.0)

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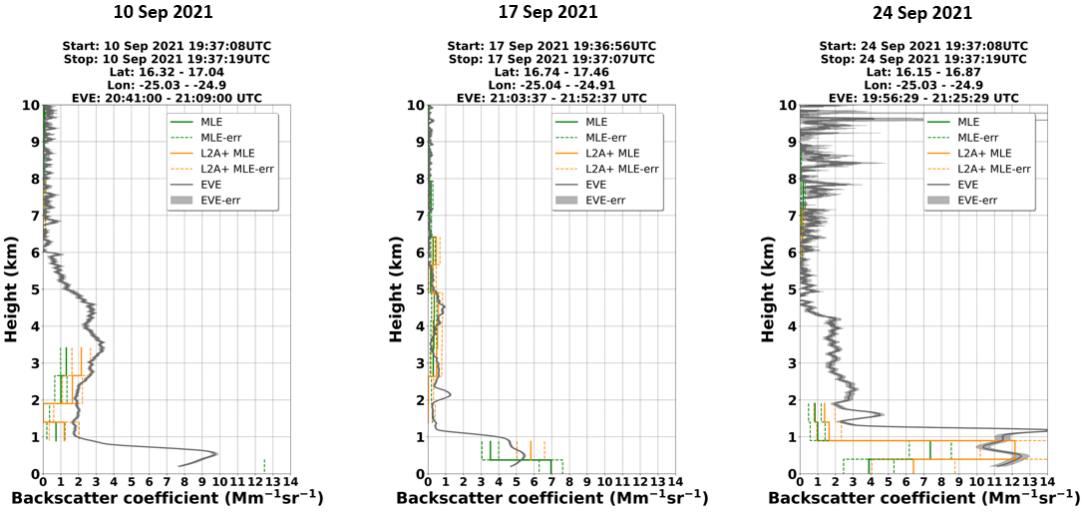
Executive Summary - Progress Report 07 (PR07)

This is the Progress Report 07 (PR07) documentation file of the European Space Agency (ESA) project entitled *L2A+* [Enhanced Aeolus L2A for depolarizing targets and impact on aerosol research and NWP]. PR07 reports on the activities performed during the period from between November 2023 and December 2023 (KO+13 - KO+14 months).

Work Package Status

WP1000	Management, reporting and promotion.
	Status: Ongoing. Schedule: KO – KO+24 months. Started on: November 2022. 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. Activities related to WP1000 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.
WP2000	ASKOS ground-based datasets in support of L2A+.
	Status: Ongoing. Schedule: KO – KO+16 months. Started on: November 2022. Objectives: To provide ASKOS ground-based datasets for L2A+ product validation and model evaluation studies.
Status	Ongoing. Activities conducted during KO+11 and KO+12 months included updating the documentation supporting the ground-based datasets (DI02).
WP3000	Development of the L2A+ aerosol product. Schedule: KO+4 – KO+21 months. Started on: February 2023.
Status	Ongoing. The overarching technical Objective of L2A+ WP3000 consists of 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 a focus on non-spherical atmospheric particles (i.e., dust). Towards realization of the L2A+ product, the work-in-progress conducted between KO+13 months and KO+14 months, includes, among others, the following: • Retrieval of the raw Aeolus L2A products produced under a new processor version (Baseline 16) for all the satellite overpasses that fall within the L2A+ region of interest during September 2021. Three retrieval algorithms were used for the production of the raw Aeolus L2A products which include the Standard Correct Algorithm (SCA), the SCA algorithm at middle-bin scale and the Maximum Likelihood Estimation (MLE) algorithm. • Development of the new Aeolus product (L2A+) for all the Aeolus overpasses that fall within the RoI during September 2021. The new product includes the Aeolus total backscatter coefficient at 355nm after adjusting the missing cross-polar backscatter component, the reconstructed L2A+ extinction profiles at 355 and 532nm, and the final dust mass concentration product.

	• Validation of the new L2A+ product against ground-based measurements from eVe and PollyXT lidars operated for the ESA-ASKOS/JATAC experiment in Cabo Verde. The validation was carried out for three indicative Aeolus overpasses from Mindelo station, Cabo Verde on 10th, 17th and 24th of September 2021.  *Figure: Comparison of QA L2A and L2A+ backscatter coefficient at 355 nm retrieved from the MLE algorithm against the corresponding backscatter profiles at 355 nm acquired by eVe lidar for three indicative cases on 10th, 17th, and 24th of September 2021.*
WP4000	Assimilation of L2A/L2A+ and application of WRF-L experiments.
	Status: Not started. Schedule: KO+6 – KO+24 months. Objectives: Assimilation of L2A and L2A+ dust products on WRF-L and pertinent simulations.
Status	Ongoing. The goal of WP4000 is to study the improvements of L2A+ through their impact on NWP and dust-transport experiments. The team is continuing work on adding Aeolus observations to the Data Assimilation Research Testbed and, after wind support has been completed, has moved onto aerosol assimilation. Specifically: • Alongside WRF, WRF-CHEM support has been added to the assimilation system, allowing assimilation experiments with dust (and possibly chemistry) enabled. This is an essential precursor to aerosol assimilation but also yields information about the impact of wind assimilation on dust emission and transport. The team is currently investigating this further. • In order to initialize the WRF-CHEM model with CAMS-EAC4 fields, an appropriate preprocessor application has been developed. Following the methodology of WRF's Preprocessor System (WPS), the new application can interpolate global aerosol (and chemistry) model fields to the regional model domain. • A mapping to translate from the three dust size bins of CAMS-EAC4 to AFWA-GOCART's (the dust scheme used in WRF-CHEM) five has been developed. • Work is ongoing to develop the observation operator (or forward model) for dust extinction coefficient. Firstly, the extinction efficiency for each size bin is calculated using Mie scattering codes, specifically for the wavelength of

	ATLID (355nm). Then this look-up table is used in DART to determine the extinction coefficient, given the model state, that is finally compared with the observations.
WP5000	Impact Studies.
	Status: Not started. Schedule: KO+12 – KO+24 months. Objectives: Scientific Analysis and Impact Assessment.
Status	Ongoing. Overarching objective of the ESA-L2A+ WP5000 includes the assessment of the L2A+ assimilation impact on NWP as well as the assessment of the contribution of Aeolus L2A and L2A+ optical properties profile products to the ESA-LIVAS atmospheric aerosol database. Due to the fact that the WP is at its early stages the work is still quite preliminary. Work in progress for WP5000 includes the development of an improved aerosol product focusing on dust via the synergy of Aeolus L2A/L2A+ and CALIPSO retrievals. More specifically, for the derivation of the synergistic dust product, the quasi-synchronized observations with ALADIN and CALIOP were selected. Starting from the ALADIN observations, the nearest CALIPSO footprints that satisfied different spatiotemporal collocation criteria were found. The next step will include the identification of the dust layers exploiting the collocated particle depolarization ratio profiles from CALIPSO at 532 nm. For the specific dust layers, the Aeolus co-polar backscatter coefficient will be corrected after adjusting the misdetected cross-polar backscatter component and the new Aeolus lidar ratio values will be derived. By applying the new lidar ratio from Aeolus as a correction for the CALIOP extinction retrievals an improved dust product will be derived.
WP6000	Recommendations.
	Status: Not started. Schedule: KO+12 – KO+24 months. Objectives: Summary of the main scientific outcomes of the project and recommendations for expanding the performed research activities.
Status	Not started.

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.
D01 – V1	Requirement Baseline Document (RB)	Documentation	KO+3 Months	Completed.
D07 – 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.
D01 – V2	Requirement Baseline Document (RB)	Documentation	KO+6 Months	Completed.
D02	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	Completed.
MoM-PM03	Minutes of Meeting – Progress Meeting 3	Documentation	KO+9 Months	Completed.

D03	Description of the Algorithm Developments (ALGO)	Documentation	KO+9 Months	Completed.
PR05	Progress Report 5	Documentation	KO+10 Months	Completed.
D05	Output data product (OP)	Dataset	KO+12 Months	Completed.
PR06	Progress Report 6	Documentation	KO+12 Months	Completed.
MoM-MTR	Minutes of Meeting – Mid Term Review Meeting	Documentation	KO+12 Months	Completed
PR07	Progress Report 7	Documentation	KO+14 Months	Submitted
D02	Data Pool (DP)	Dataset	KO+15 Months	Submitted
D03	Description of the Algorithm Developments (ALGO)	Documentation	KO+15 Months	Submitted
D04	Analysis of the Validation Activities carried out (VAL)	Documentation	KO+15 Months	Submitted
MoM - PM04	Minutes of Meeting – Progress Meeting 4	Documentation	KO+15 Months	Pending.
PR08	Progress Report 8	Documentation	KO+16 Months	Pending.
D05	Output data product (OP)	Documentation	KO+18 Months	Pending.
D07 – 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.
D02	Data Pool (DP)	Dataset	KO+21 Months	Pending.
D03	Description of the Algorithm Developments (ALGO)	Documentation	KO+21 Months	Pending.
D04	Analysis of the Validation Activities carried out (VAL)	Documentation	KO+21 Months	Pending.
D06	Scientific Analysis, Impact Assessment and Scientific Roadmap (SIR)	Documentation	KO+21 Months	Pending.
MoM - PM06	Minutes of Meeting – Progress Meeting 6	Documentation	KO+21 Months	Pending.
PR11	Progress Report 11	Documentation	KO+22 Months	Pending.
D04	Analysis of the Validation Activities carried out (VAL)	Documentation	KO+24 Months	Pending.
D05	Output data product (OP)	Documentation	KO+24 Months	Pending.
D06	Scientific Analysis, Impact Assessment and Scientific Roadmap (SIR)	Documentation	KO+24 Months	Pending.
D08	Multi-media material (MM)	Documentation	KO+24 Months	Pending.
D09	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

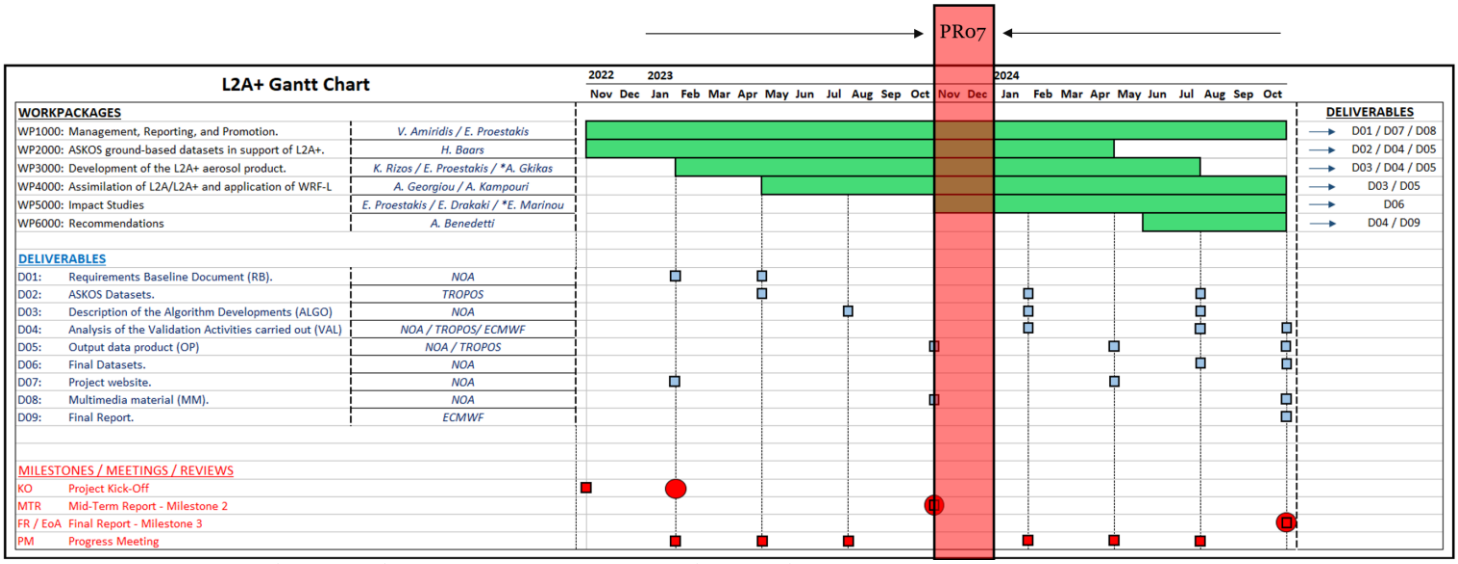


Figure: L2+ Gantt Chart and current PR07 temporal period.