



Evaluation of EarthCARE aerosol layer height retrievals with ground-based measurements and collocated satellite data

Kalliopi Artemis Voudouri¹, Nikolaos Papagiannopoulos², Pilar Gumà-Claramunt², Andreas Karipis¹, Dimitra Karkani¹, Athena A. Floutsi³, Georg H. Müller³, Holger Baars³, Nikolaos Siomos⁴, Konstantinos Michailidis⁵, Dimitris Balis⁵, Eleni Marinou¹, Vassilis Amiridis¹

¹National Observatory of Athens (NOA), Athens, Greece, ²Consiglio Nazionale delle Ricerche – Istituto di Metodologie per l'Analisi Ambientale (CNR-IMAA), Italy, ³Leibniz Institute for Tropospheric Research (TROPOS), Leipzig, Germany, ⁴Chair of Experimental Meteorology, Faculty of Physics, Ludwig-Maximilians-Universität München, ⁵Laboratory of Atmospheric Physics, Physics Department, Aristotle University of Thessaloniki, Greece



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Objectives - Methodology - Dataset

In this study we evaluate EarthCARE aerosol layer heights from the **ATLID Aerosol Layer Descriptor product** (ECA_EX*_ATL_ALD_2A; Wandinger et al., 2023) using the LTOOL module (version 2.0.4; <https://pypi.org/project/ltool/>; Siomos et al., 2018; Voudouri et al., 2022) applied to ACTRIS/EARLINET ground-based lidar measurements. Furthermore, collocated observations from passive sensors (e.g., PACE/SPEXone) are utilized to assess A-ALD products and the A-EBD weighted extinction/backscatter profiles on selected atmospheric scenes.

The **Wavelet Covariance Transform (WCT)** method is applied for layer boundary detection, enabling the extraction of aerosol layer geometrical features, including:

- Planetary Boundary Layer (PBL) height
- Aerosol layers in the free troposphere

We compare LTOOL and A-ALD (**Baseline BA, BB, proto-BD**) products, as both determine aerosol layer boundaries using the same WCT methodology: A-ALD provides upper and lower geometrical layer boundaries and LTOOL automatically identifies layer geometrical properties when applied to optical products.

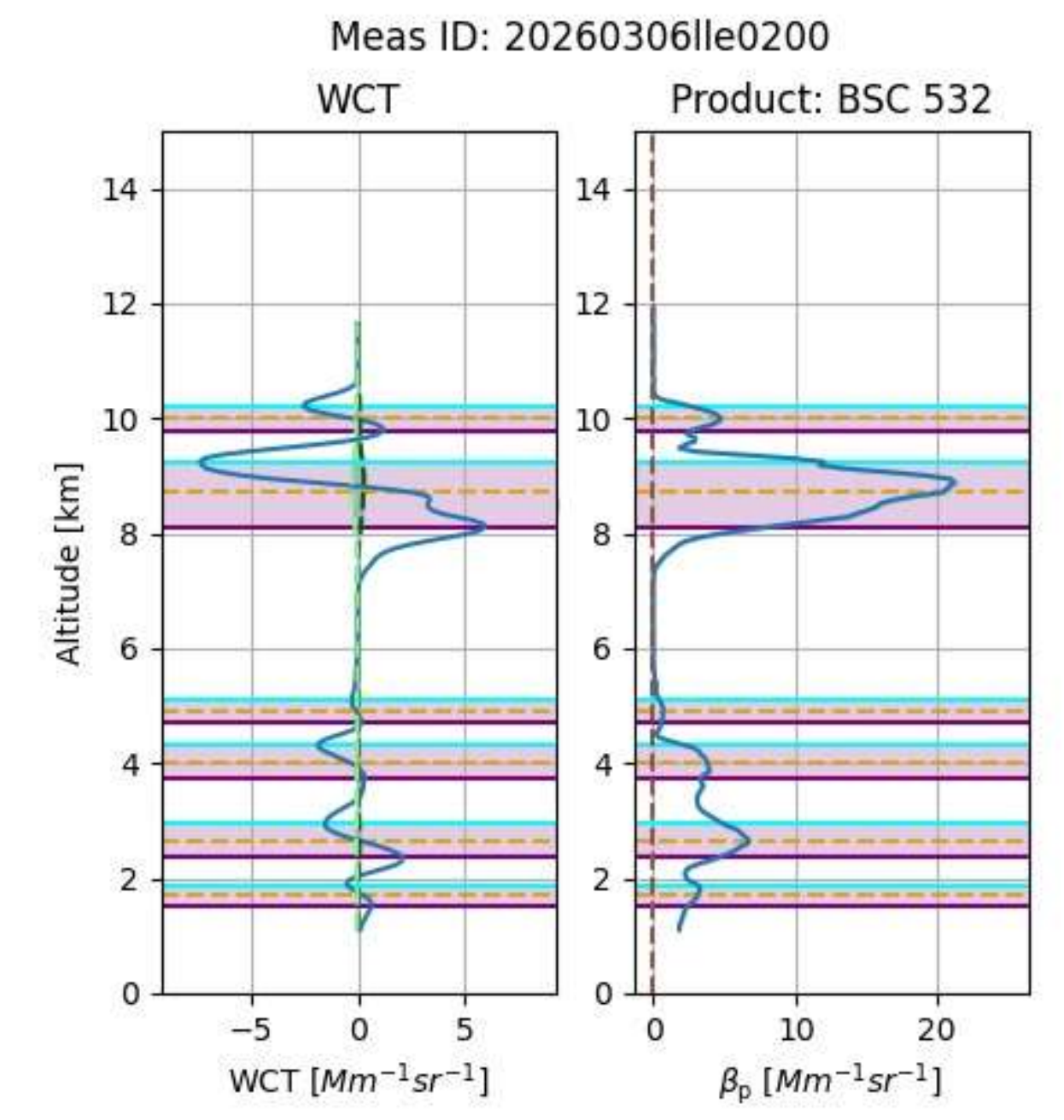


Figure: LTOOL application on EARLINET optical products.

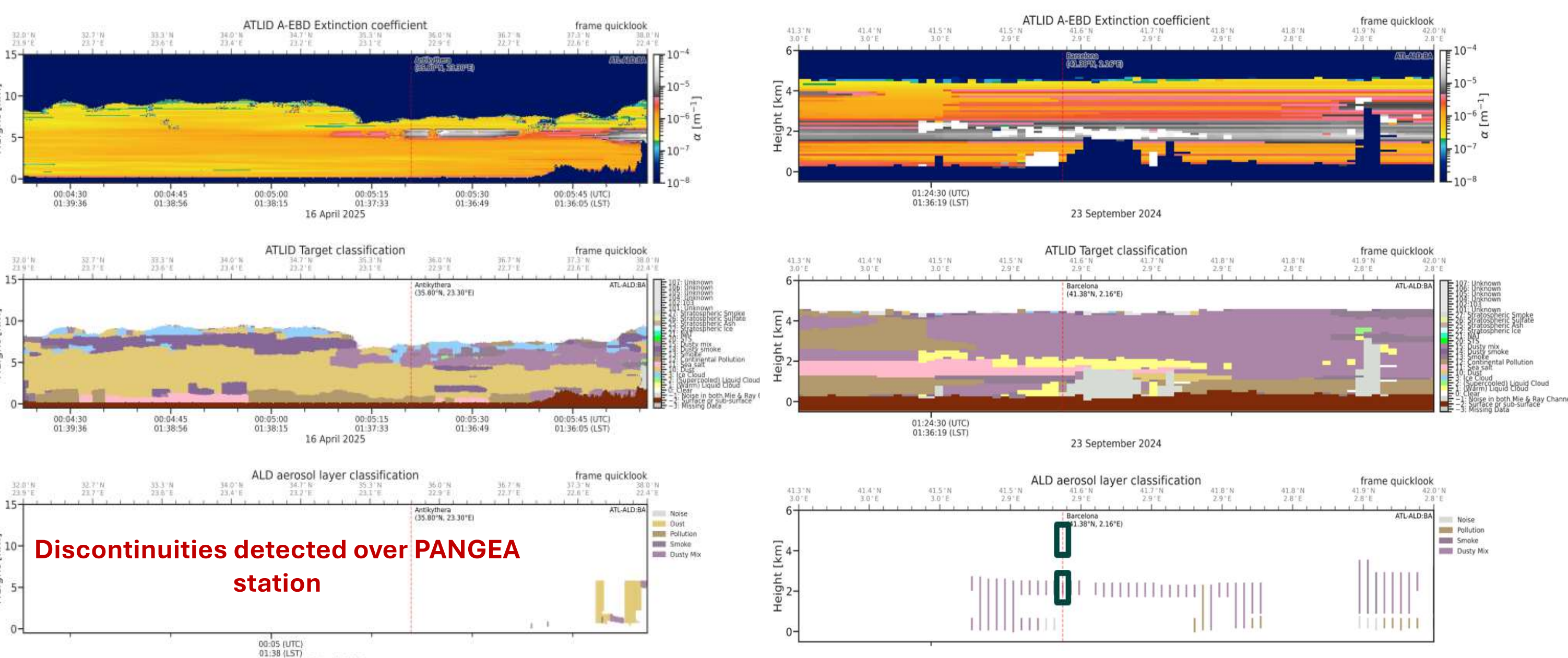
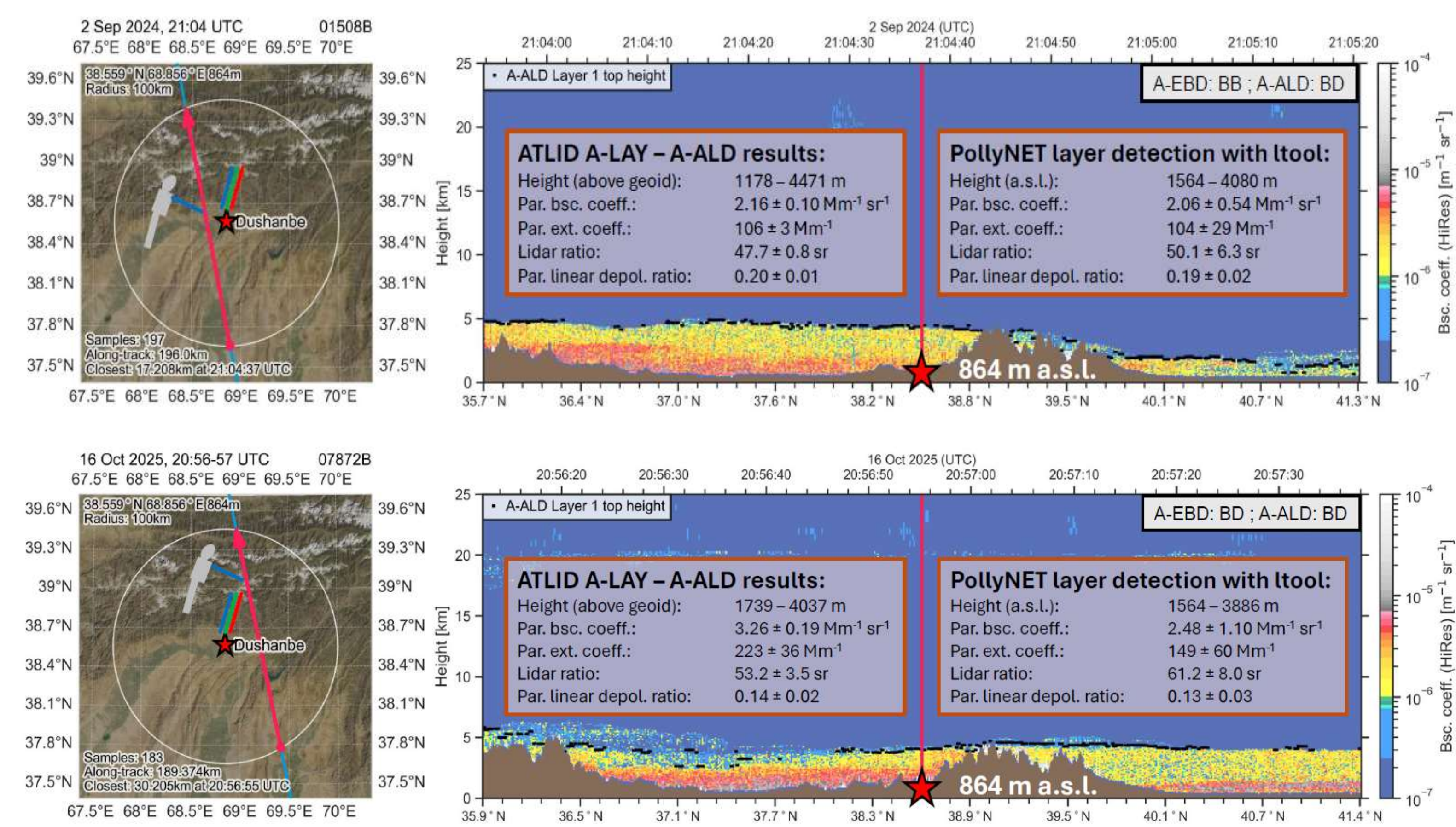
A-ALD performance and comparison with LTOOL module

- EarthCARE aerosol layer heights (ECA_EX*_ATL_ALD_2A; **Baseline BA, BB**)
- Collocated ACTRIS/EARLINET ground-based lidar measurements
- EARLINET Layer height is derived using the **LTOOL module** (Siomos et al., 2018; Voudouri et al., 2022).

Findings for baseline B*:

- Several undetected layers (9 cases over PANGEA)
- When layers are detected, heights are accurately assigned

Comparison for proto-BD Baseline with LTOOL module - Dushanbe Case Studies



L2 A-EBD aerosol layers height vs PACE/SPEXone ALH

Case study – Dusty Smoke / Dusty mix

26-7-2025: smoke ~2.5-3km, overpass diff time ~2h

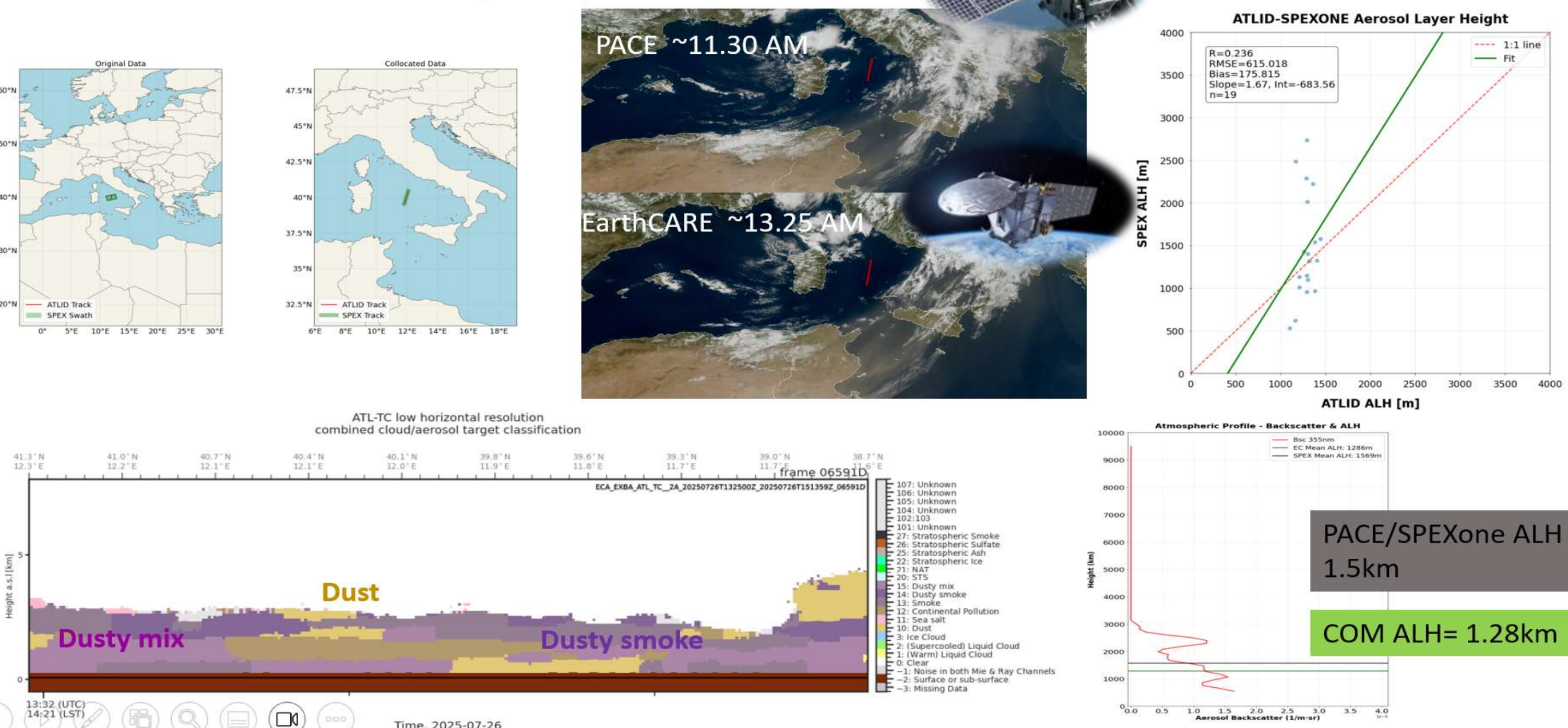


Figure: EarthCARE/ATLID and PACE/SPEXone overpasses (upper left and center) and the EarthCARE/ATLID target classification (bottom left), on 24 July 2025. The lidar-weighted aerosol height is shown as a thick green line and the PACE/SPEXone mean ALH is given as a thick black line. All collocated points along the EarthCARE track are presented in the scatterplot (upper right panel).

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Aerosol types from A-ALD and A-TC

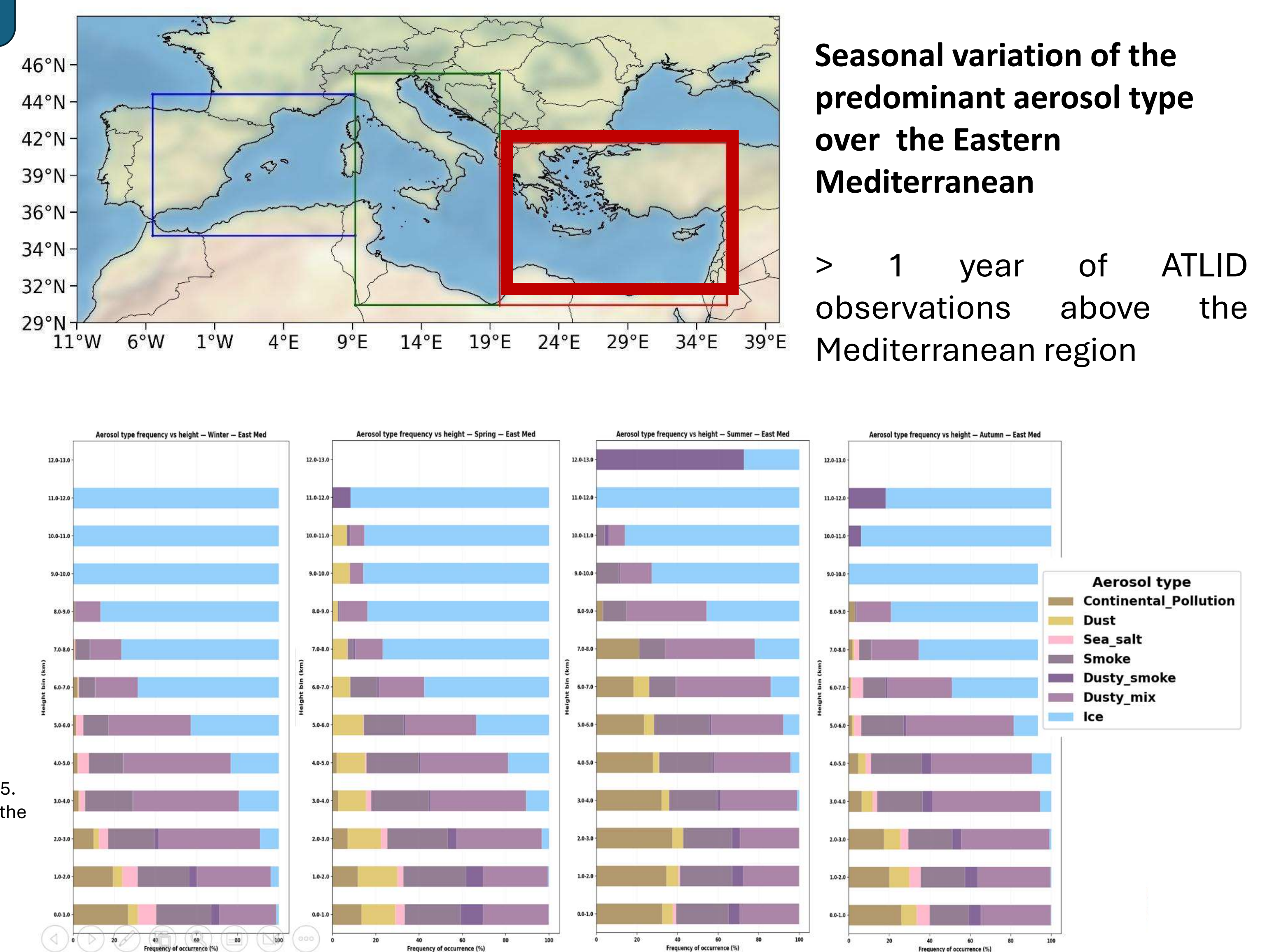


Figure: Seasonal variation of the predominant aerosol type over the Eastern Mediterranean. Layers are derived from A-ALD B* Baseline and aerosol types within these layers are derived from A-TC product (B* Baseline).

More cases will be investigated for the validation of L2 A-ALD product and all cases will be reprocessed with new Baselines.