

Tracking the 2025 Limassol Wildfire Smoke Plume: Combined Observations from CARO and the EarthCARE Mission



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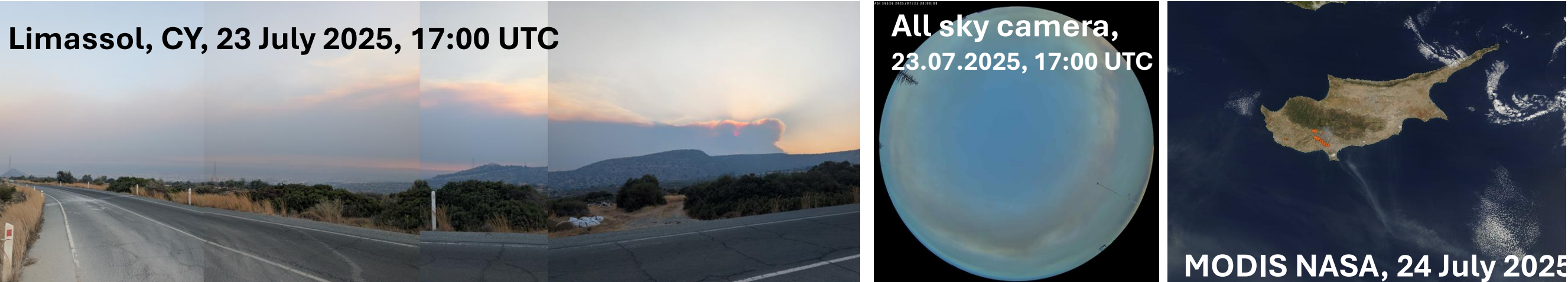


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A fresh smoke case

CARO National Facility – Limassol, CY

On July 23–24, 2025, a large wildfire originating near Mallia in the Limassol district of Cyprus generated an extensive smoke plume that affected air quality across the island and extended over the south-eastern Mediterranean.



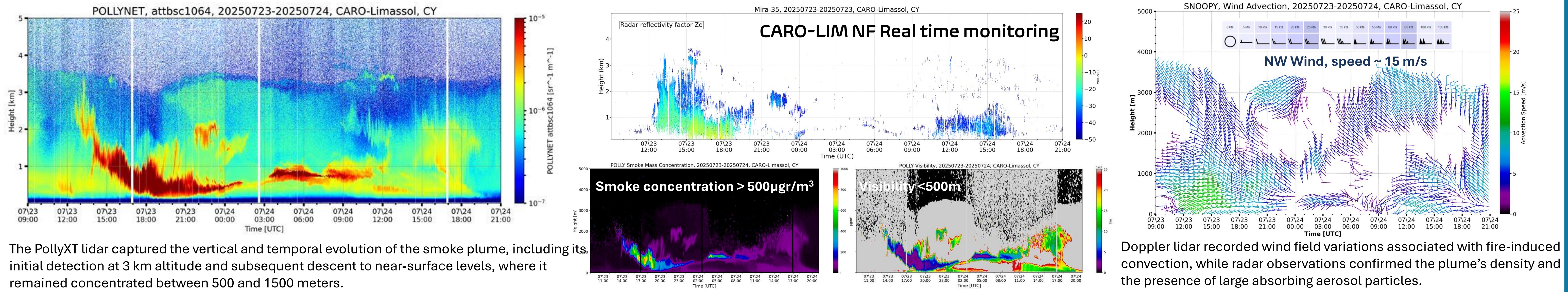
The event was monitored in near real-time by the Cyprus Atmospheric Remote Sensing Observatory (CARO) National Facility (NF), in Limassol (LIM) [34.67° N, 33.04°E] operated by the ERATOSTHENES Centre of Excellence, using a suite of advanced ground-based instruments including PollyXT lidar, Doppler lidar, and cloud radar systems.

The July 2025 Limassol wildfire demonstrated in addition the value of EarthCARE's capabilities in active remote sensing of smoke plumes and underscored the strategic role of observatories like CARO-LIM in deepens scientific understanding of aerosol-radiation-cloud interactions, and in enhancing the scientific return and societal relevance of satellite missions.

The observatories are equipped with aerosol and cloud remote sensing instruments running continuously.

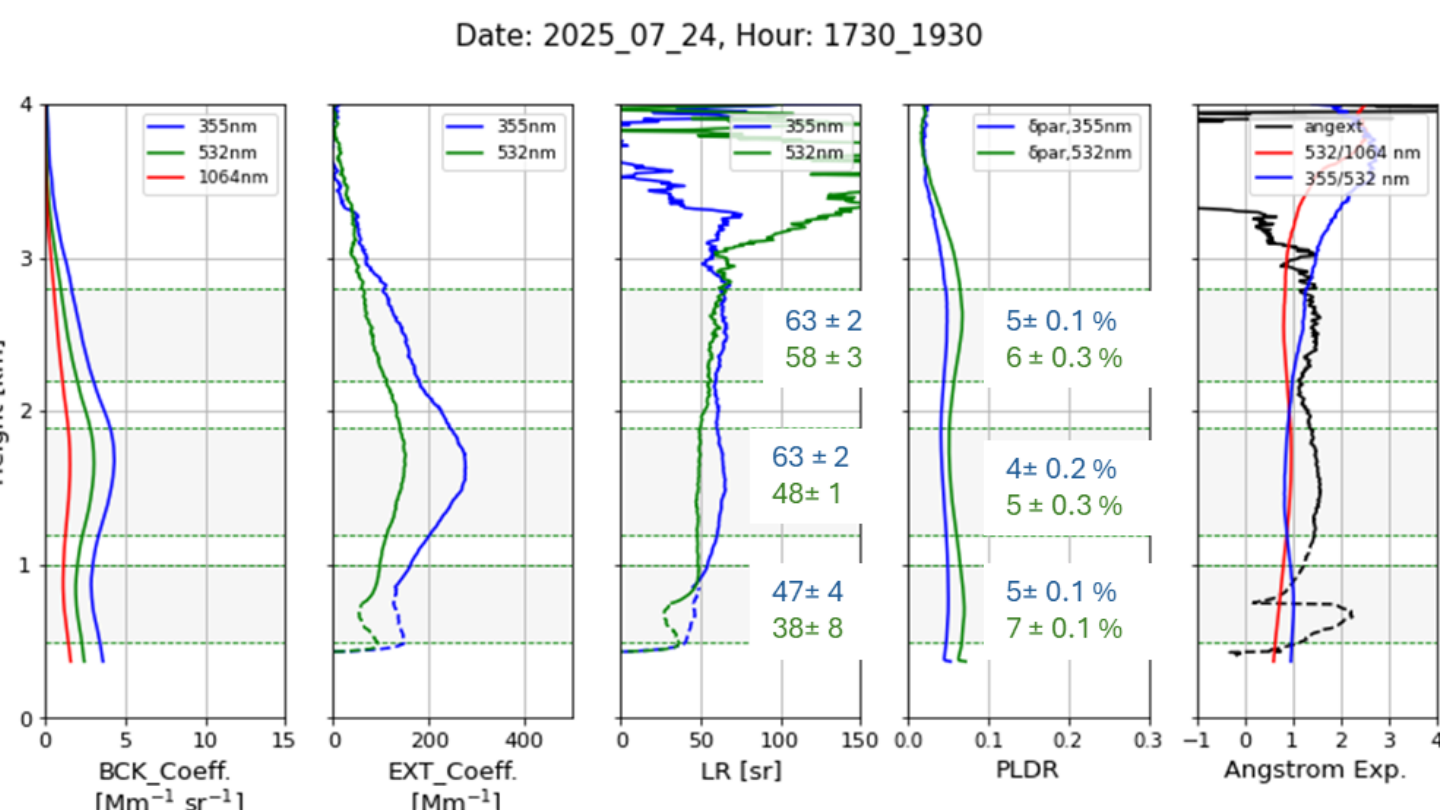
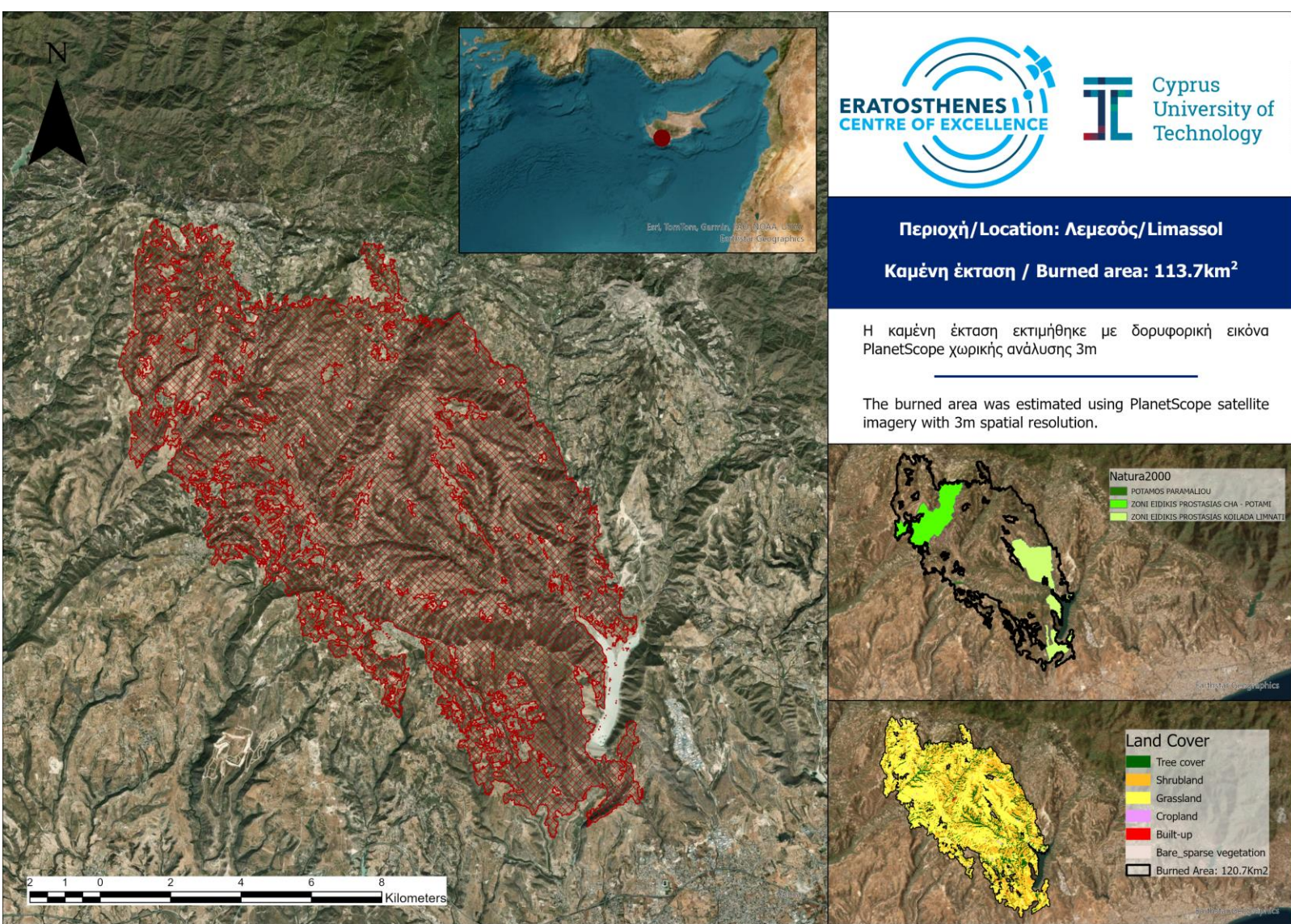
Table 1: Instruments deployed at LIM observatories for the EC VAL.

Limassol - CARO
PollyXT
AERONET photometer
Wind lidar
Cloud Doppler Radar 35GHz
CHM15k ceilometer
Disdrometer
MWR HATPRO RPG
All sky camera
Pyranometer
Spectrophotometer

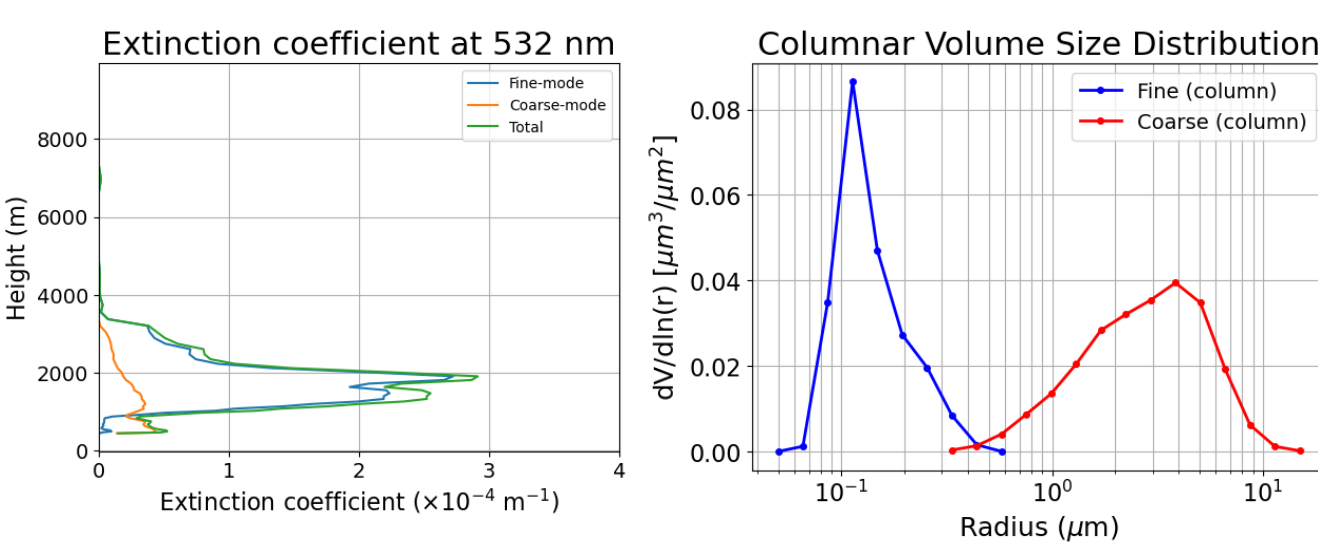


PlanetScope constellation : Burned area estimation (3m resolution)

The wildfire is estimated to have burned a total of 113.7 km². Taking into account that the total area of Cyprus is 9,251 km², the burned area corresponds to approximately 1.3% of the island's surface, a particularly significant percentage considering that it resulted from a single wildfire. In addition, about 21% of the burned area falls within the Natura 2000 network, affecting important protected sites such as the Paramaliou River, the Cha Potami Special Protection Area, and the Limmati Valley Special Protection Area.

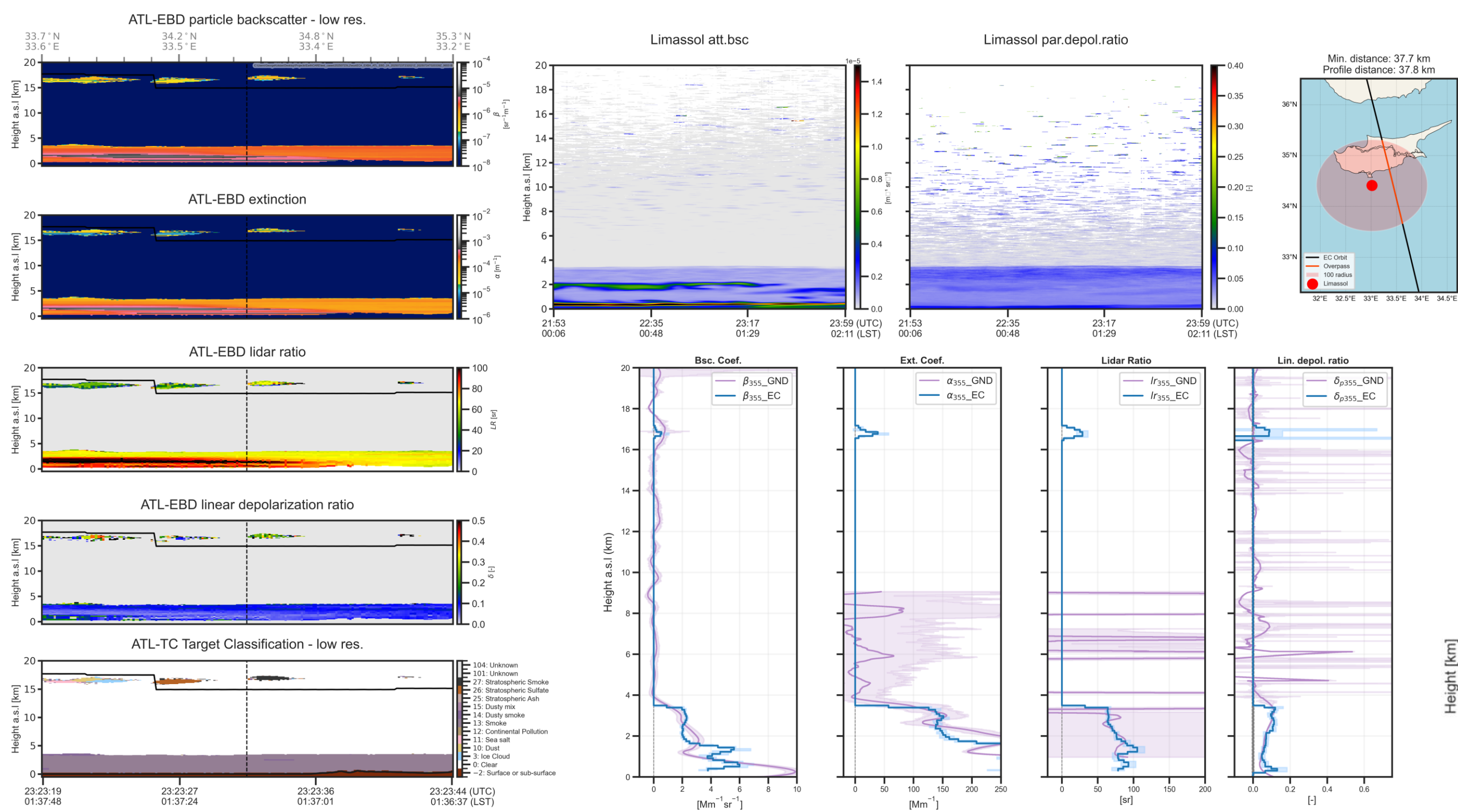


Optical and Microphysical properties POLLYxt and GRASP retrievals

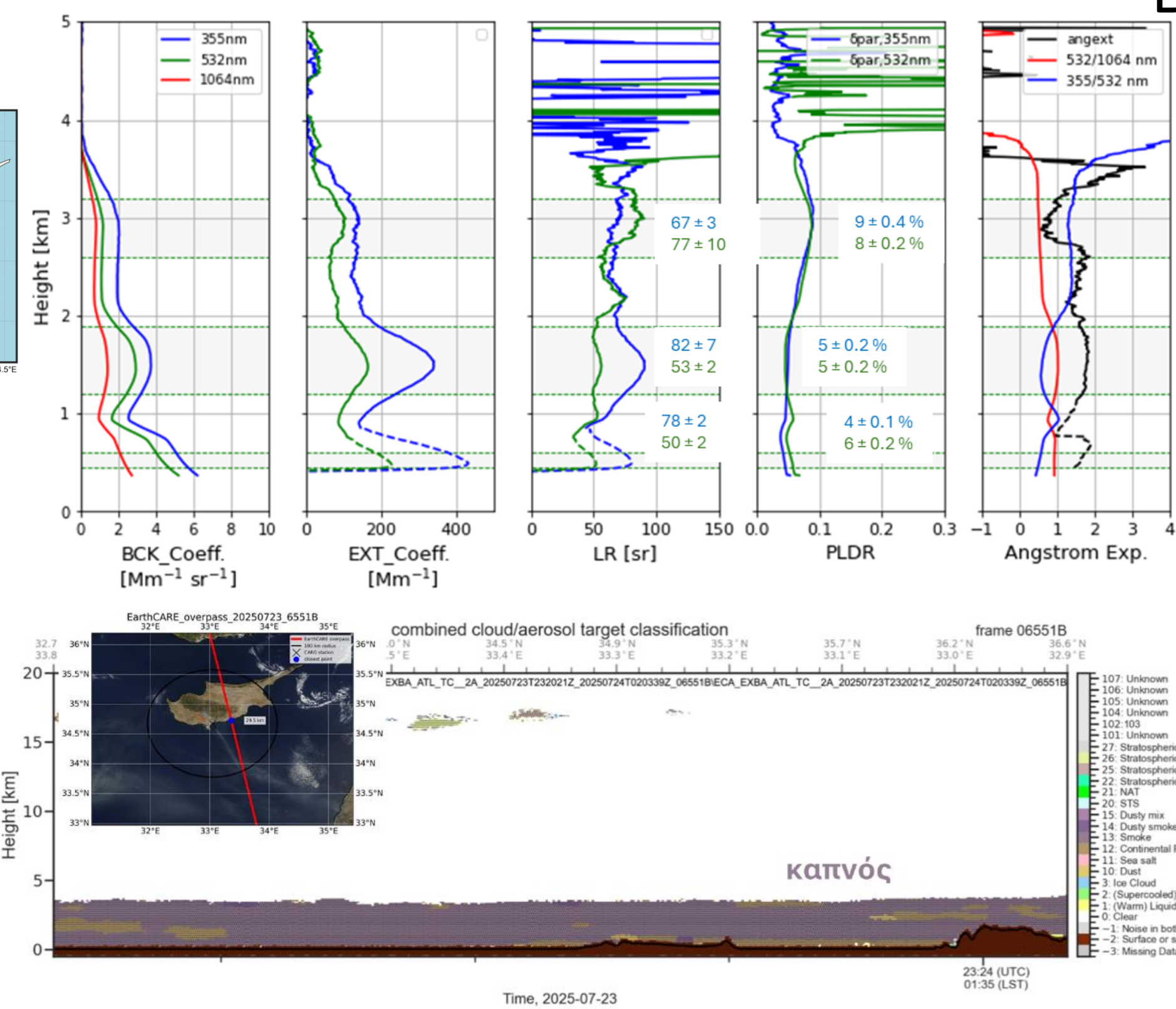


Fresh smoke		Optical properties - PollyXT				Microphysical properties - GRASP						
Date	Time (UTC)	δ_{355} [%]	δ_{532} [%]	S_{355} (sr)	S_{532} (sr)	SSA_F	SSA_C	SSA	$Reff_F$ (μm)	$Reff_C$ (μm)	η_{F440nm}	η_{C440nm}
24.07.2025	15-16	4 ± 0.2	6 ± 0.5	62 ± 3	53 ± 5	0.84	0.97	0.85	0.149	3.262	1.47±0.03	1.54±0.001

EarthCARE A-EBD(BA) & A-TC(BA) Comparison at 23-07-2025 23:23:32 UTC with Limassol Ground Station L2 Raman Retrieval at 23-07-2025 23:04:23:59 UTC



Date: 2025_07_23, Hour: 2330_0130



EARTHCARE overpass at 23.7.2025, 23:23 UTC

Satellite data from the ESA-JAXA EarthCARE mission provided valuable complementary observations during its overpass on July 23 at 23:23 UTC, capturing the horizontal spread of the plume over Cyprus and its south-eastward transport across marine areas. This case study highlights the critical importance of combining next-generation satellite missions with state-of-the-art ground-based observatories. While EarthCARE offers global coverage and vertical detail from space, ground stations like CARO-LIM NF provide continuous, localized data essential for calibration, validation, and real-time assessment. The integration of these datasets deepens scientific understanding of aerosol-radiation-cloud interactions.



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