

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

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Abstract:

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) operated by the ERATOSTHENES Centre of Excellence, using a suite of advanced ground-based instruments including PollyXT lidar, Doppler lidar, and cloud radar systems.

These observations captured the vertical and temporal evolution of the smoke plume, including its initial detection at 3 km altitude and subsequent descent to near-surface levels, where it remained concentrated between 500 and 1500 meters. The observed optical thickness exceeded 1.0, classifying the episode as extremely intense for the region. Simultaneously, Doppler lidar recorded wind field variations associated with fire-induced convection, while radar observations confirmed the plume's density and the presence of large absorbing aerosol particles. 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.

In conclusion, the 2025 Limassol wildfire demonstrated the value of EarthCARE's capabilities in active remote sensing of smoke plumes and underscored the strategic role of observatories like CARO-LIM in enhancing the scientific return and societal relevance of satellite missions.

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Keywords:

Wildfire, Smoke Plume, CARO, EarthCARE, Lidar, Remote Sensing, Cyprus, Aerosols, Biomass Burning