



CARO NF: A Key Component in Holistic Atmospheric Observation and Complex event Analysis

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October 1st, 2025



Vision and role of the Atmospheric Sector

- **Establish a state-of-the-art ground-based remote sensing station (GBS)**

To monitor the Eastern-Mediterranean climate and to provide tailored products based on ground based and spaceborne observations of the environment to potential stakeholders. **The station designed as a mobile station with the advantage to participate to dedicated and targeted observation and campaigns in the EMMENA region.**

- **Link the ERATOSTHENES CoE to the National and International Research Infrastructures**

To provide long-term observations in key regions of climate change and specifically of aerosol-cloud-precipitation-dynamics interactions.

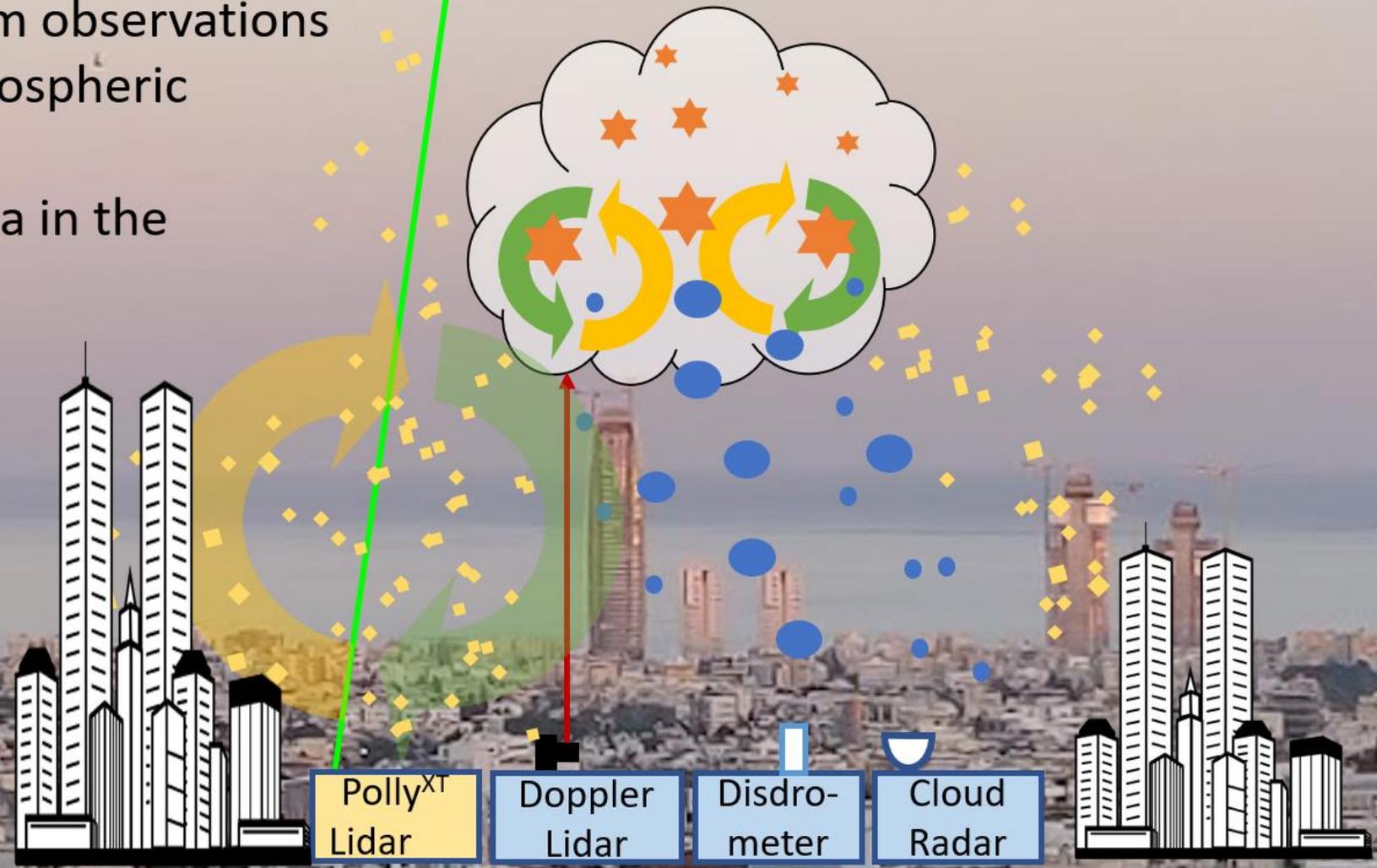
ERATOSTHENES will exploit the wealth of GBS data toward products which are of distinct use for stakeholders and the public and will bring newly developed products into application.

- **Link the ECoE to Cal/Val activities of satellite mission**

Future satellite missions rely on evaluation datasets in order to accurately determine the **quality of the spaceborne data and derived Products.**

The main scientific idea is to create a unique dataset of longterm observations of aerosol clouds and atmospheric dynamics profiling in a fast grown coastal area in the Eastern Mediterranean.

Mediterranean



Λ Ε Μ Ε Σ Ο Σ

Courtesy: TROPOS team

Cyprus Atmospheric Remote-Sensing Observatory (CARO) National Facility

CARO ECoE National Facility | Limassol, CY | 34.677°N, 33.038°E , 10m a.s.l



CARO – Instrumentation and Measurements

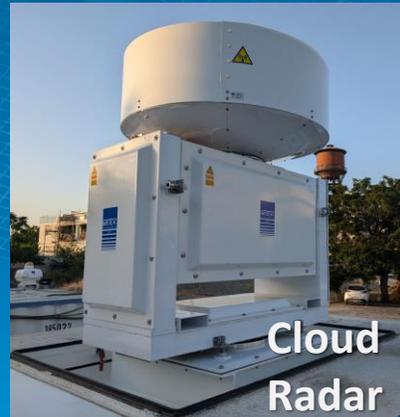
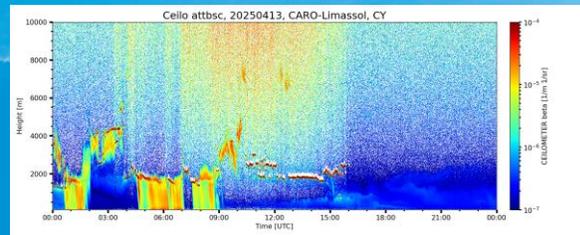
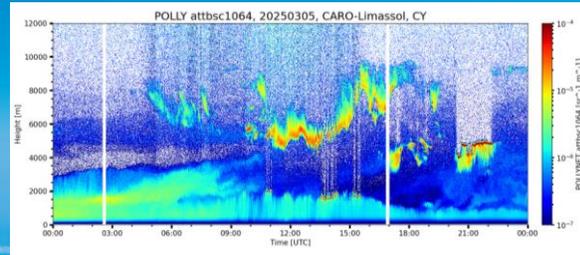


**PollyXT
Lidar**



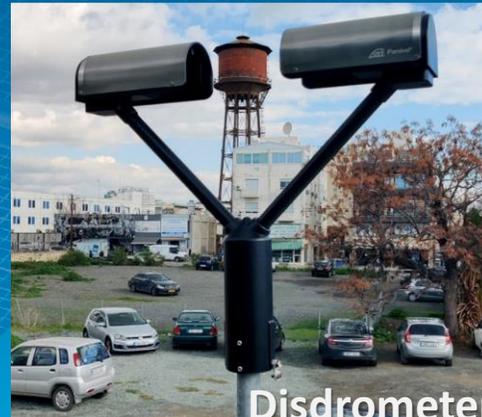
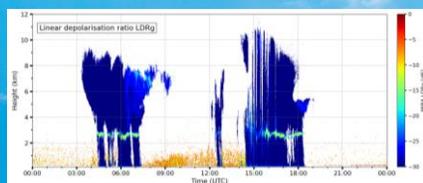
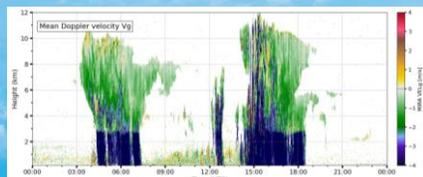
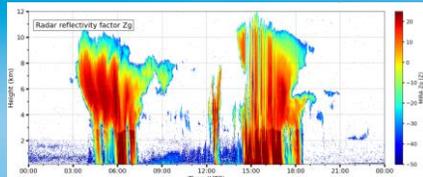
Ceilometer

Aerosols



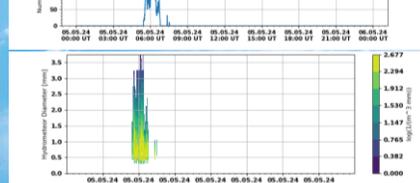
**Cloud
Radar**

Clouds



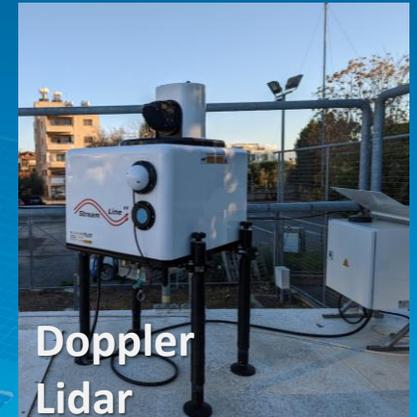
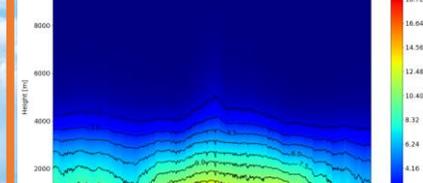
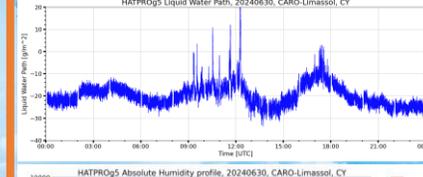
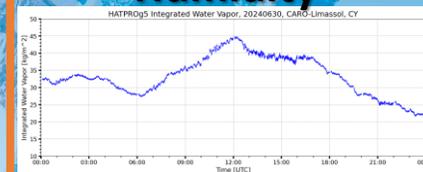
Disdrometer

Precipitation



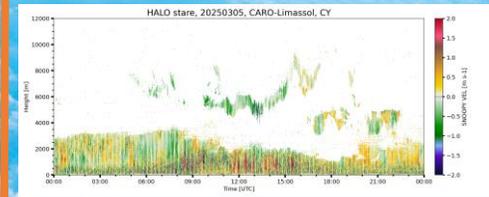
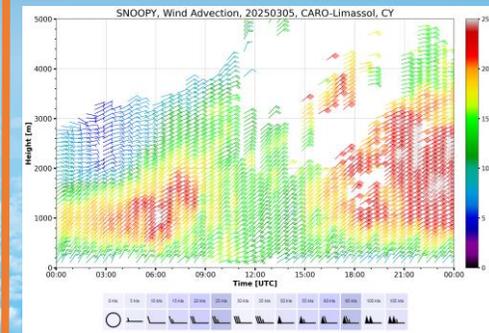
**Microwave
Radiometer**

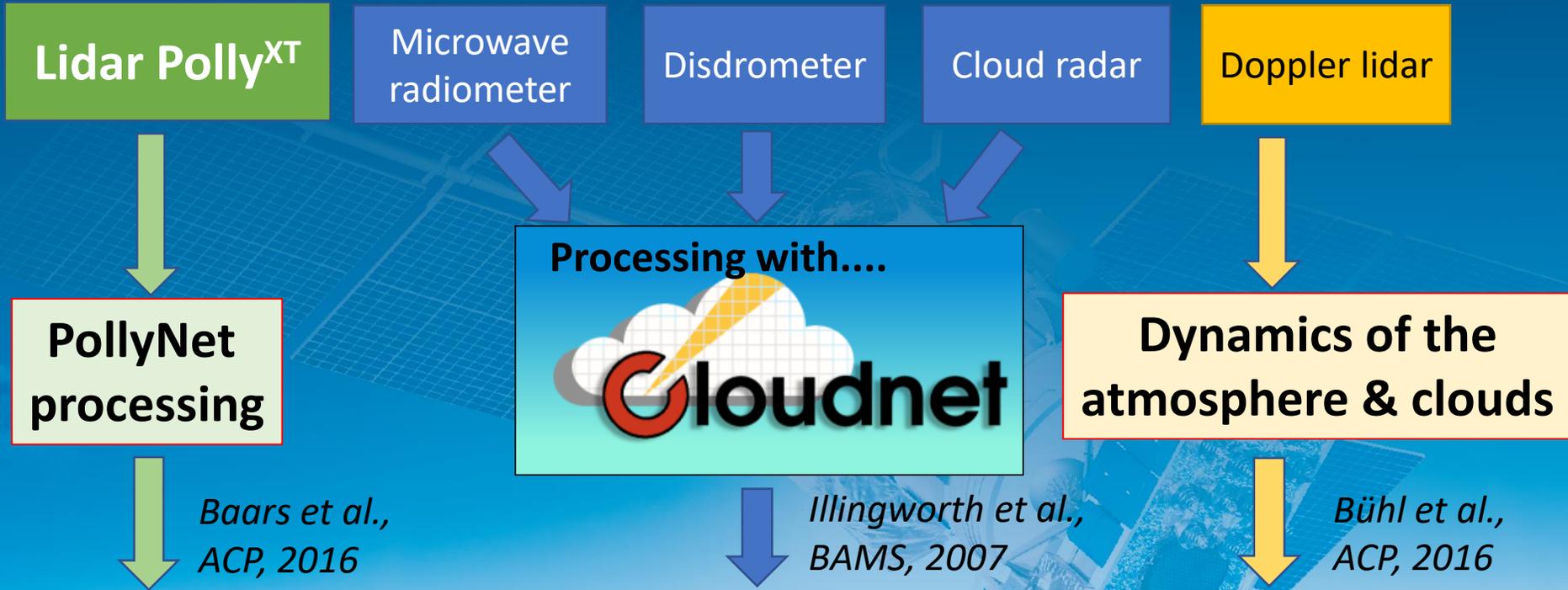
Temperature & Humidity



**Doppler
Lidar**

Dynamics



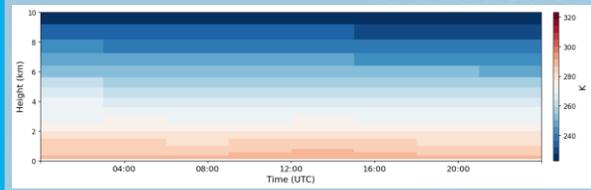


- Aerosol optical properties
- Aerosol and cloud typing
- Aerosol microphysics
- Cloud condensation nuclei & Ice nucleating particle concentration

- Cloud boundaries
- Hydrometeor typing
- Cloud microphysics (ice and liquid water content, drizzle properties)
- Cloud fraction

- Turbulence parameters of aerosol air masses and clouds
- Profiles of wind vector

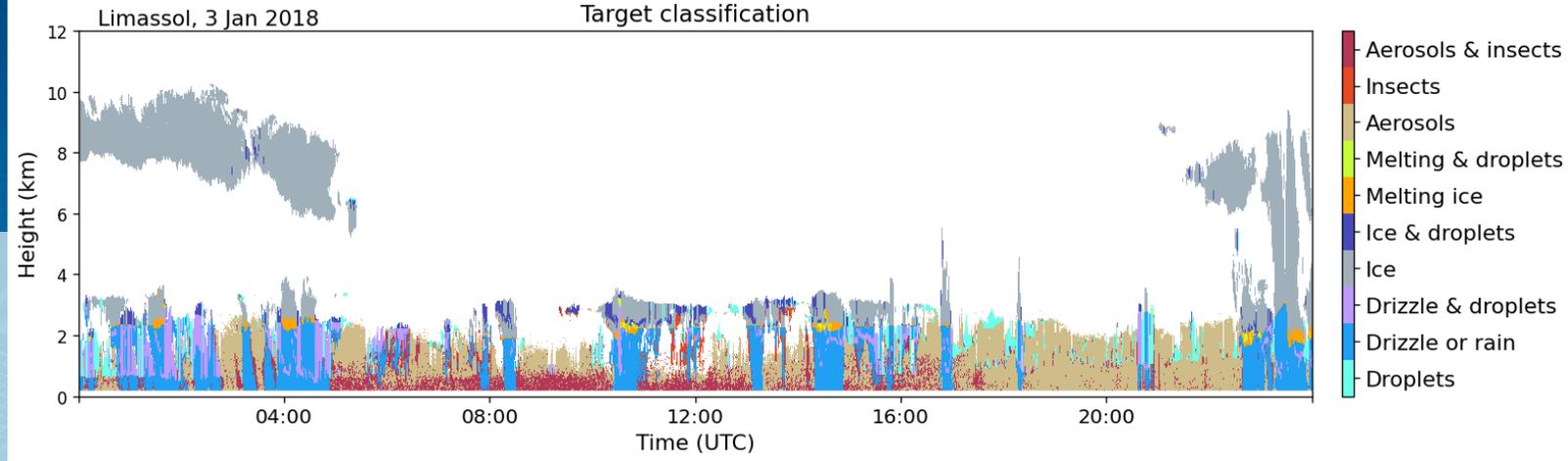
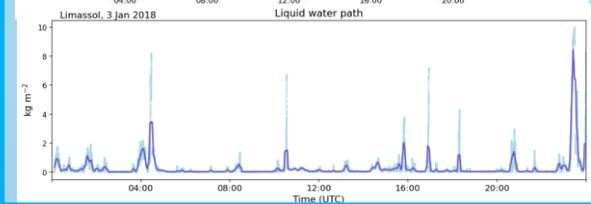
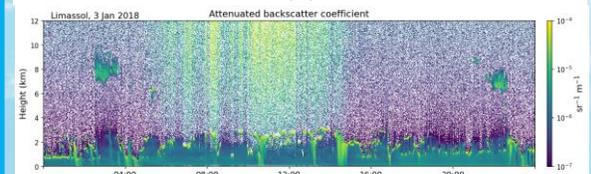
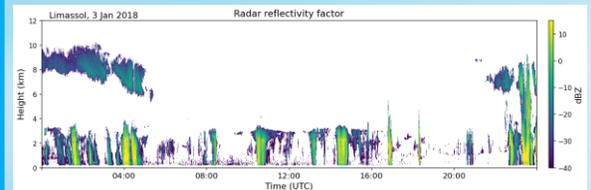
...for investigating aerosol-cloud-dynamics interaction



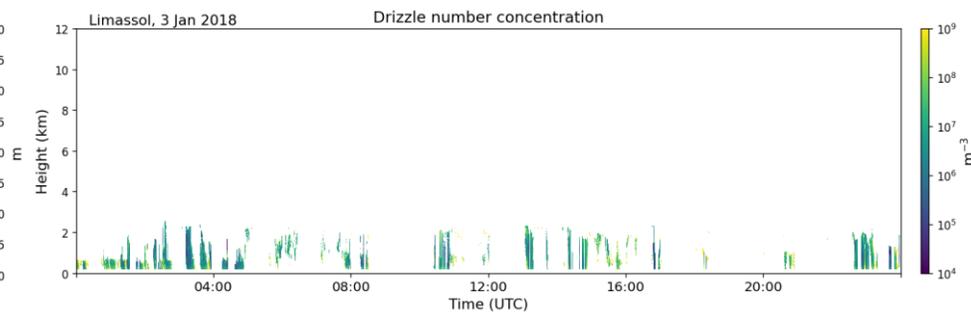
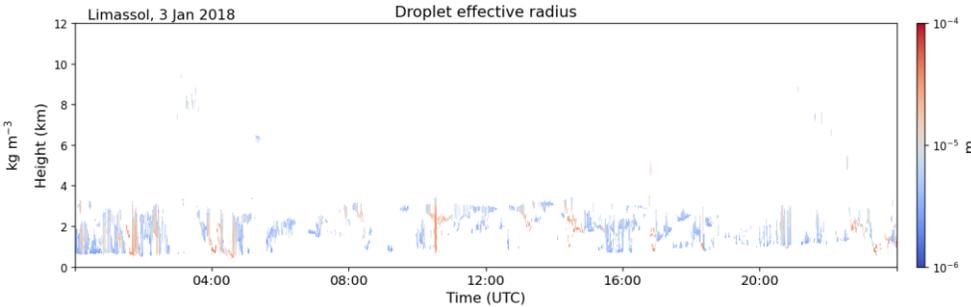
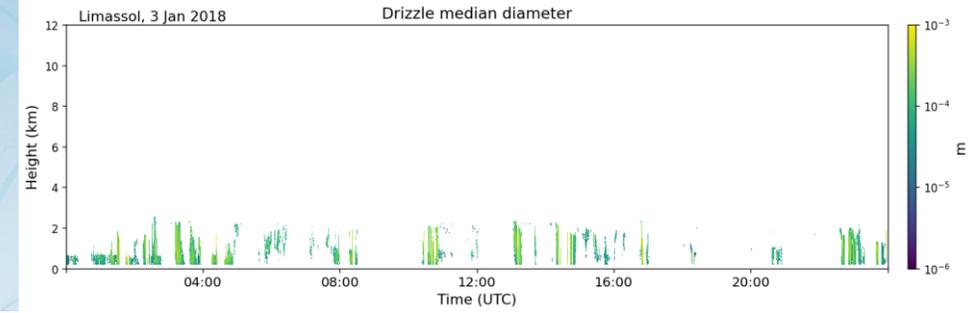
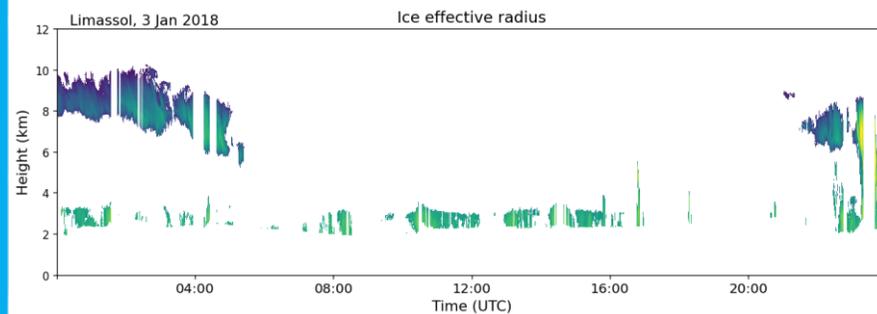
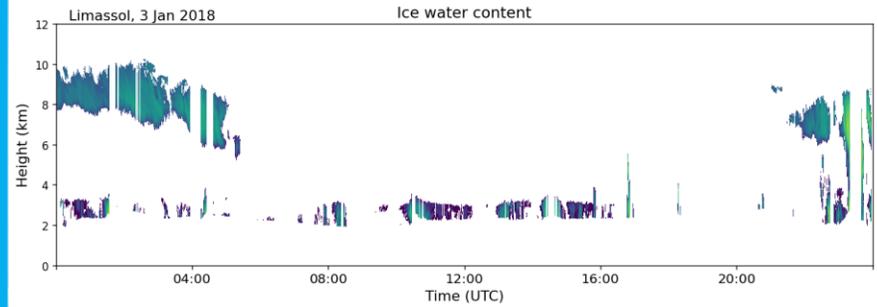
Model

+

Instruments



Cloudnet products





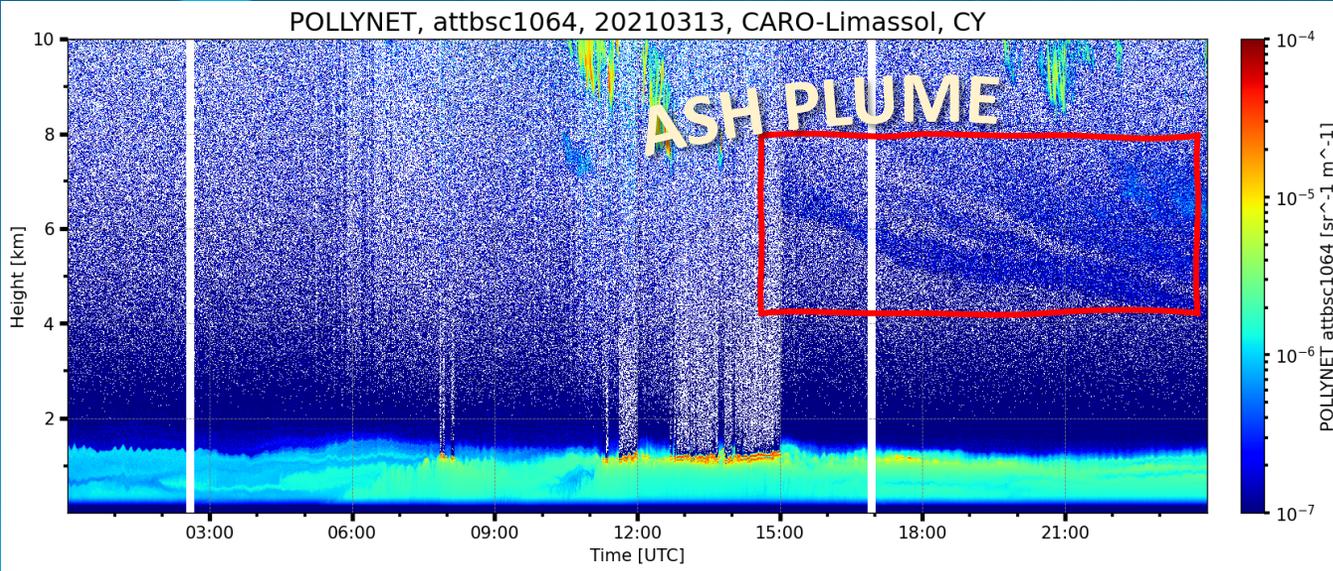
Extreme Events Recorded by CARO-NF

EXTREME WEATHER EVENT
ETNA ERUPTION
13.03.2021

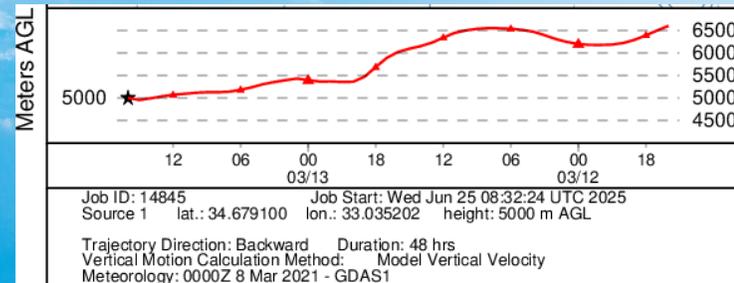
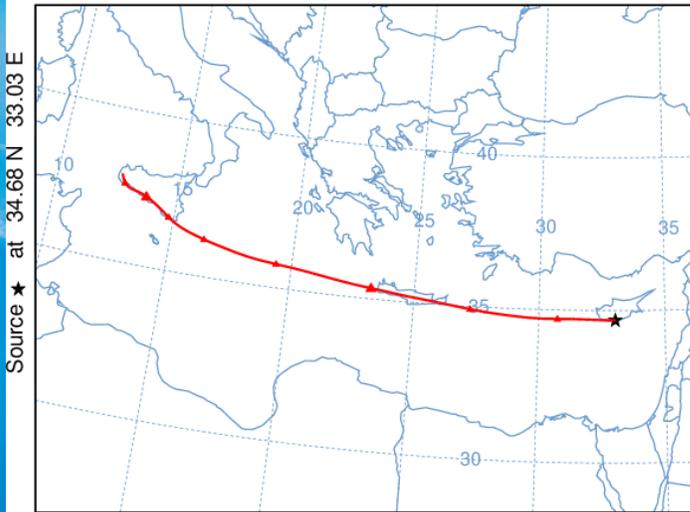


ASH PLUME FROM ETNA VOLCANO

13.03.2021

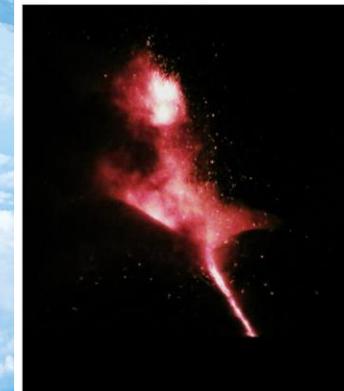


NOAA HYSPLIT MODEL
Backward trajectory ending at 1600 UTC 13 Mar 21
GDAS Meteorological Data



March "on fire"

March 2021 was a month "on fire", literally. In that period, Etna erupted four or five times in a row, with very short pauses between one event and another. Between March 10th and March 31st, marvelous fire fountains, eruptive columns, lava flows were recorded, with the volcano completely in turmoil and offering almost no pauses. People had definitely "got used" to the show, and also to the annoyances associated with it. Almost no one noticed anything different in the eruption that characterized that end of the month. Yet **this particular paroxysm is defined as "anomalous" or "mysterious"**.



The paroxysm of March 31-April 1

This paroxysmal event began on March 31st around 11 am and ended the following day late at night, almost at dawn on April 2nd.

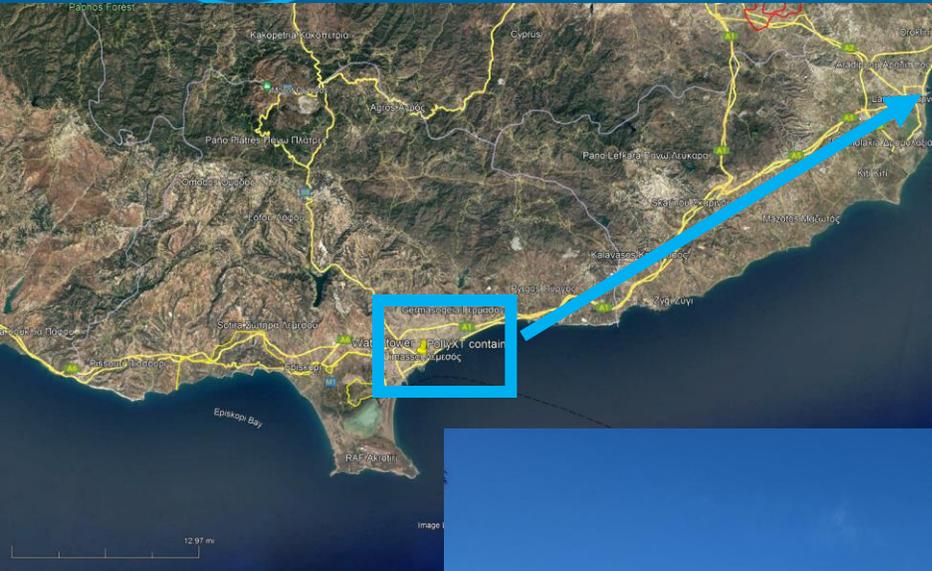
What makes it anomalous and mysterious, compared to the many paroxysms that preceded it (and that will follow it), was the long duration, the set of phenomena that occurred and the **copious quantity of lava emitted**. Long duration because, as a rule, each paroxysm lasted a few hours and then ended. This instead **went on for 48 hours without any break**. In this period of time it produced a series of phenomena (**cracks in the ground**, effusive vents, lava fountains) which usually manifested themselves separately. Finally, there was a huge amount of lava emitted from an "ephemeral vent" which normally should emit little or nothing.

was a huge amount of lava emitted from an "ephemeral vent" which normally should emit little or nothing.

EXTREME WEATHER EVENT
T O R N A D O
1 4 . 0 2 . 2 0 2 4



34°40'37.53"N
33°2'15.37"E
< 2km from the coastline

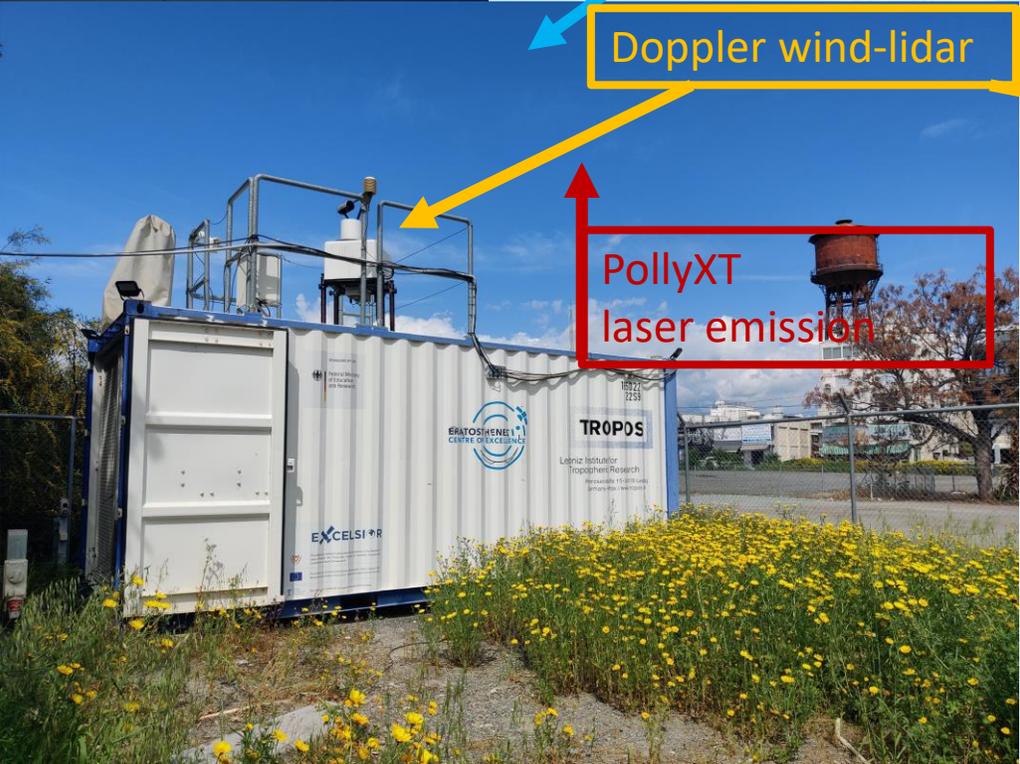


Doppler wind-lidar

PollyXT
laser emission

Disdrometer

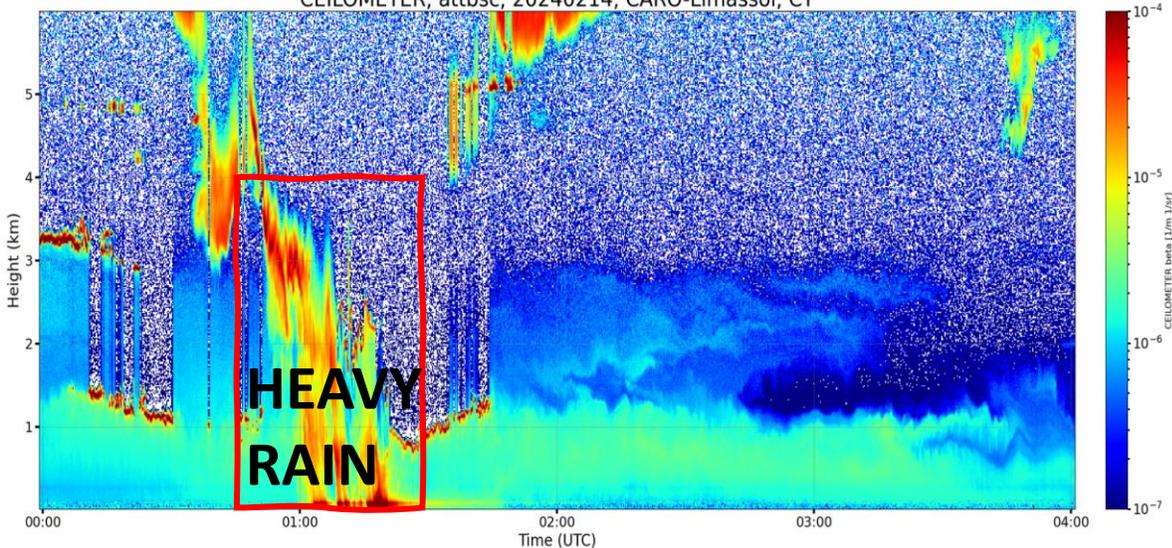
Ceilmeter



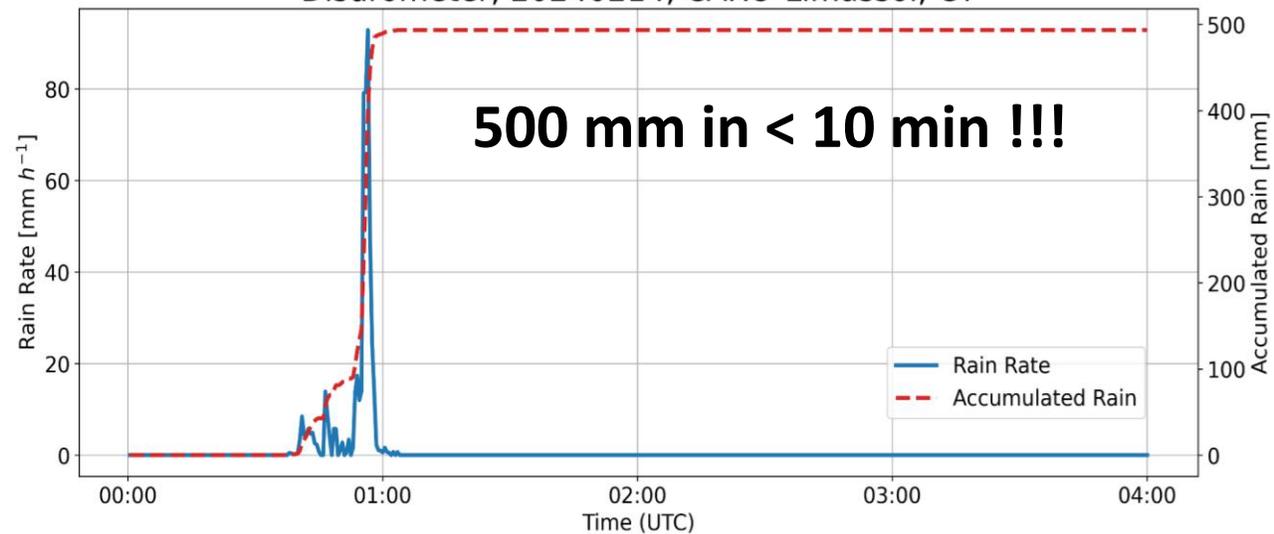
TORNADO

14.02.2024

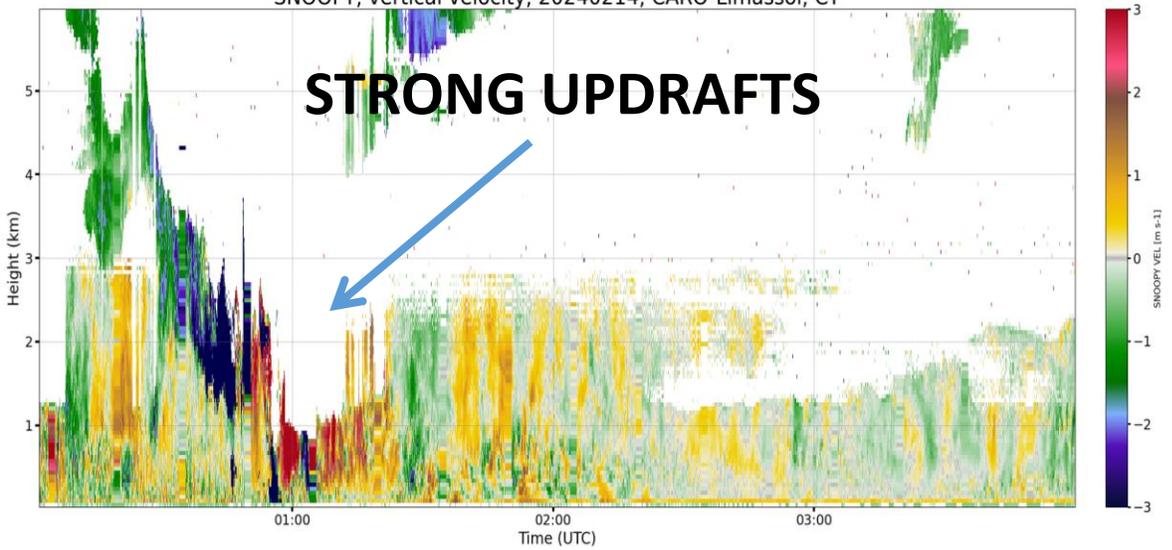
CEILOMETER, attbsc, 20240214, CARO-Limassol, CY



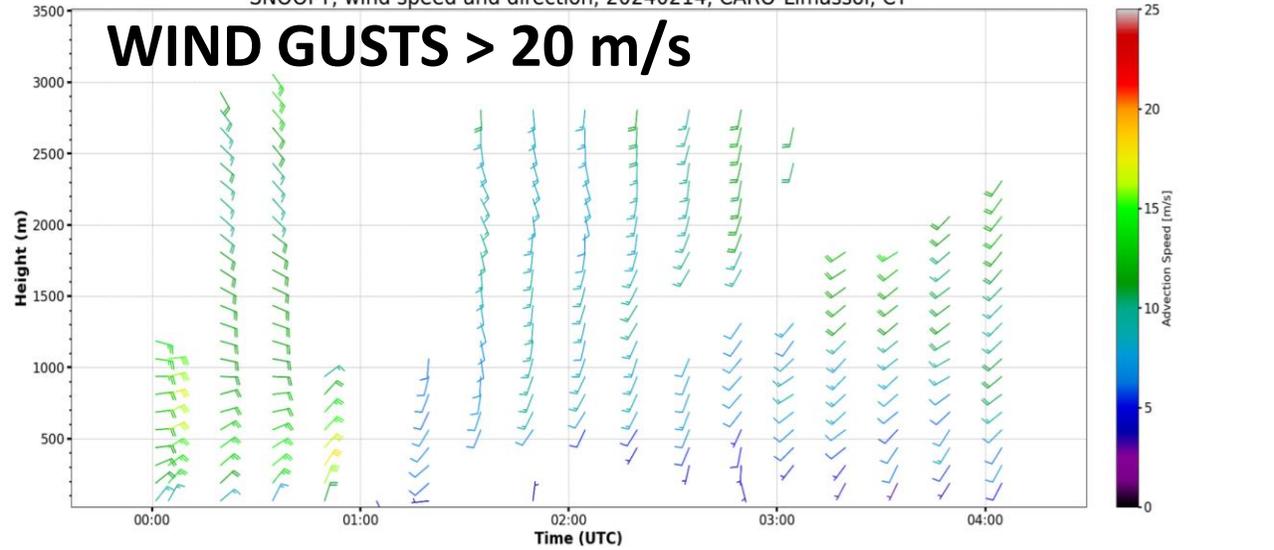
Disdrometer, 20240214, CARO-Limassol, CY

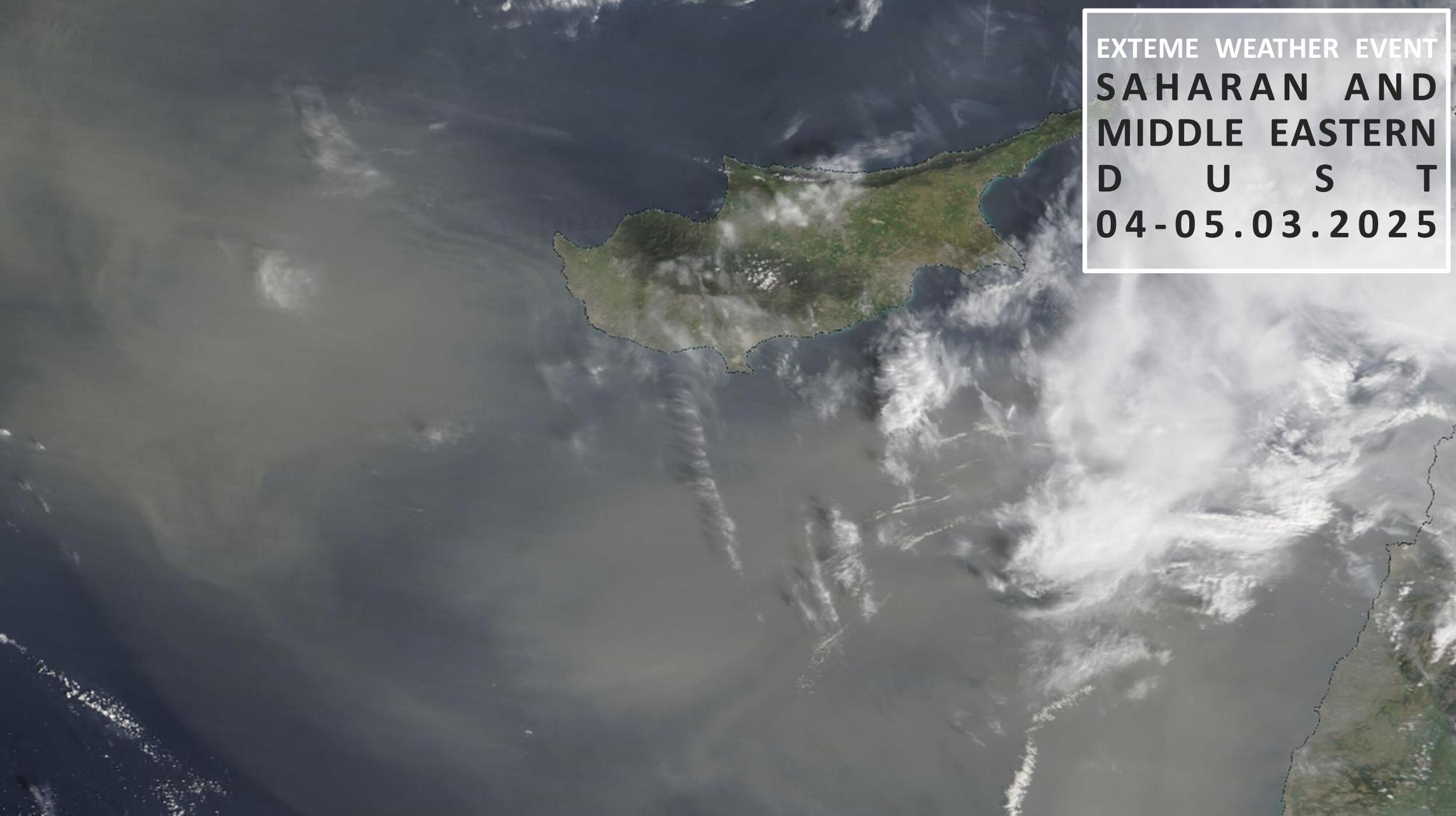


SNOOPY, vertical velocity, 20240214, CARO-Limassol, CY



SNOOPY, wind speed and direction, 20240214, CARO-Limassol, CY



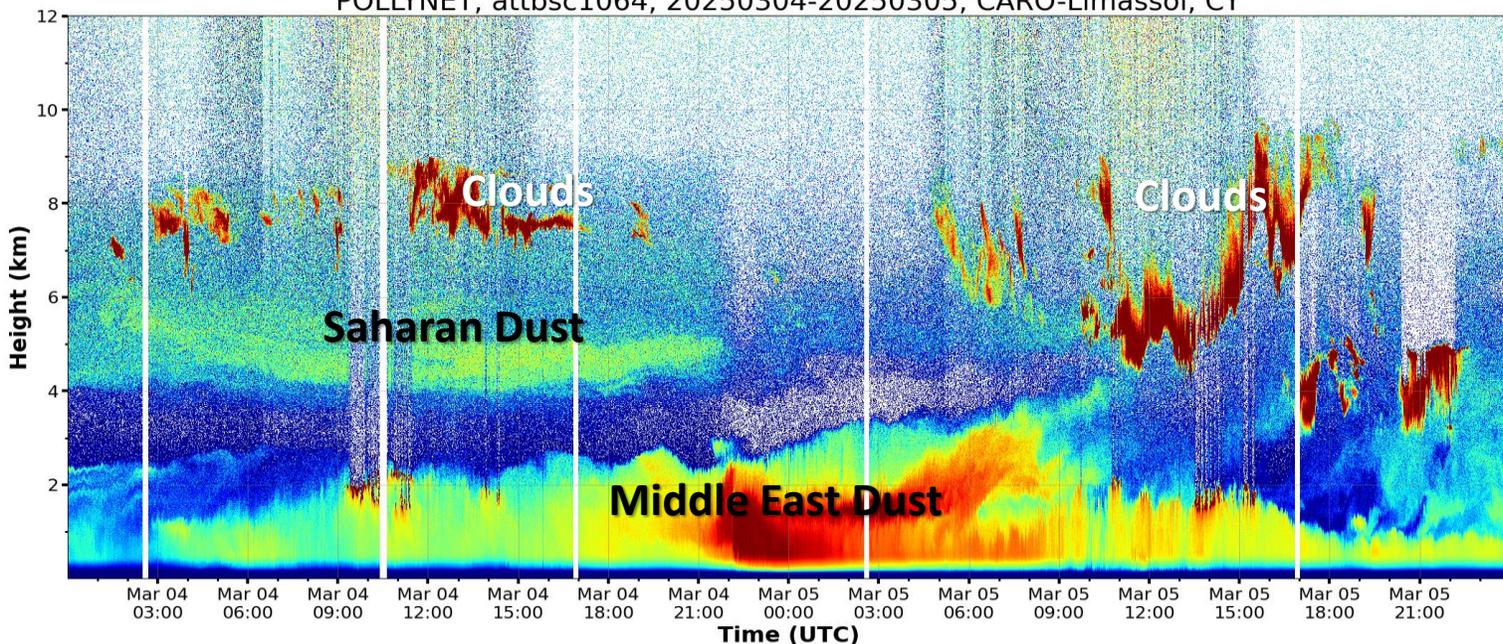
A satellite image showing a massive dust storm originating from the Saharan region and moving over the Middle East towards the United States. The dust is visible as a thick, greyish-white plume extending across the Atlantic Ocean. The landmasses of Africa, the Middle East, and North America are visible, with the dust storm's path clearly marked. The text in the top right corner provides context for the event.

**EXTEME WEATHER EVENT
SAHARAN AND
MIDDLE EASTERN
D U S T
04-05.03.2025**

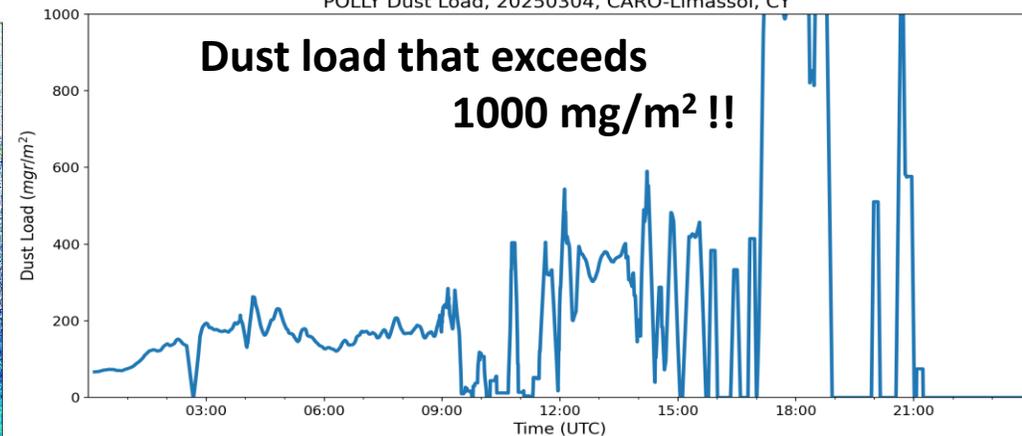
SAHARAN AND MIDDLE EASTERN DUST

04-05.03.2025

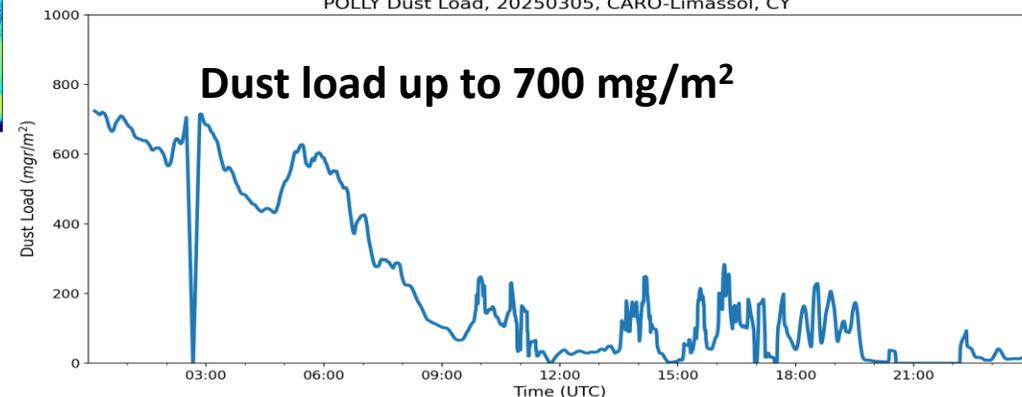
POLLYNET, attbsc1064, 20250304-20250305, CARO-Limassol, CY



POLLY Dust Load, 20250304, CARO-Limassol, CY

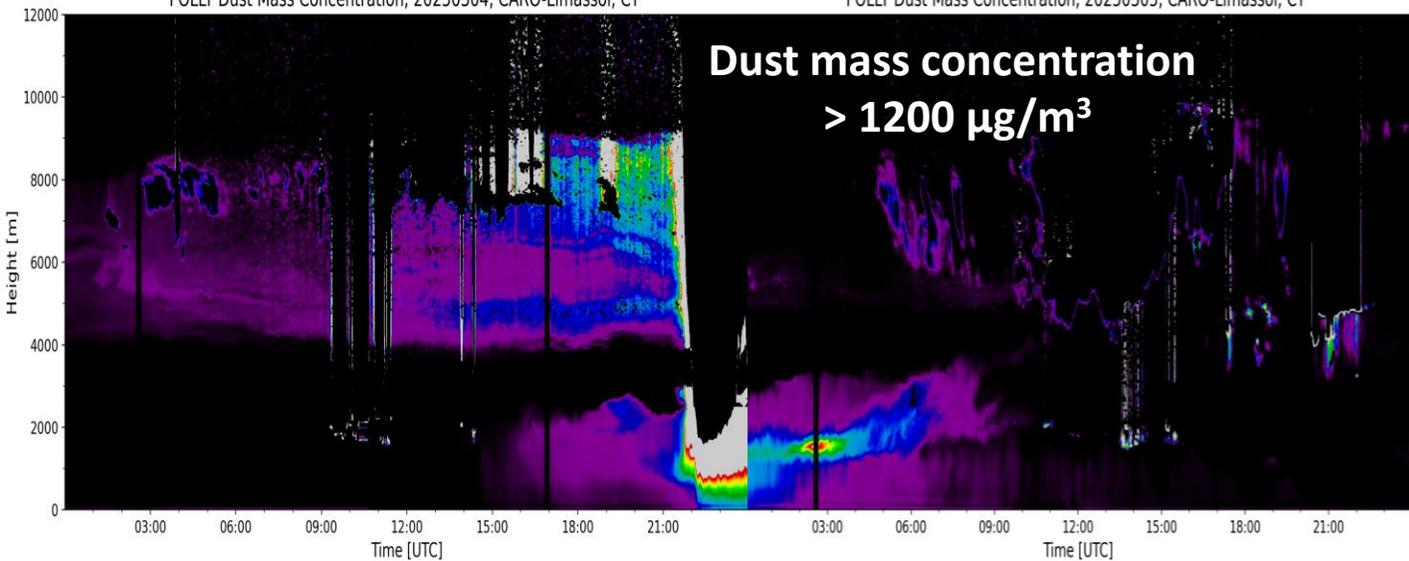


POLLY Dust Load, 20250305, CARO-Limassol, CY



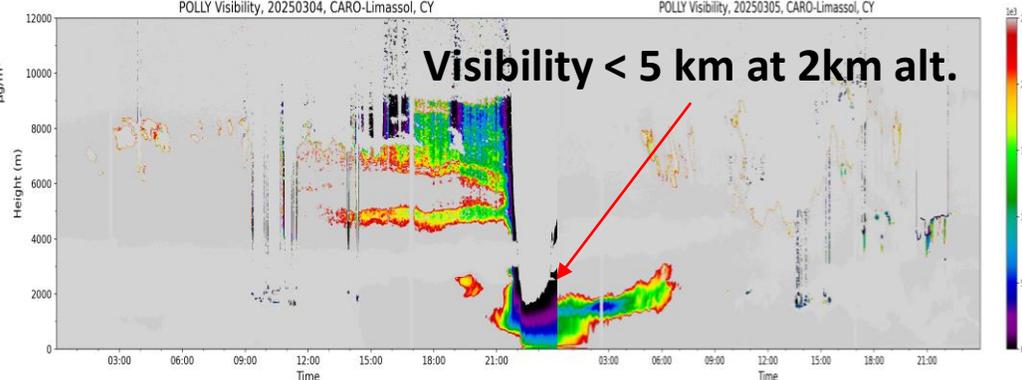
POLLY Dust Mass Concentration, 20250304, CARO-Limassol, CY

POLLY Dust Mass Concentration, 20250305, CARO-Limassol, CY



POLLY Visibility, 20250304, CARO-Limassol, CY

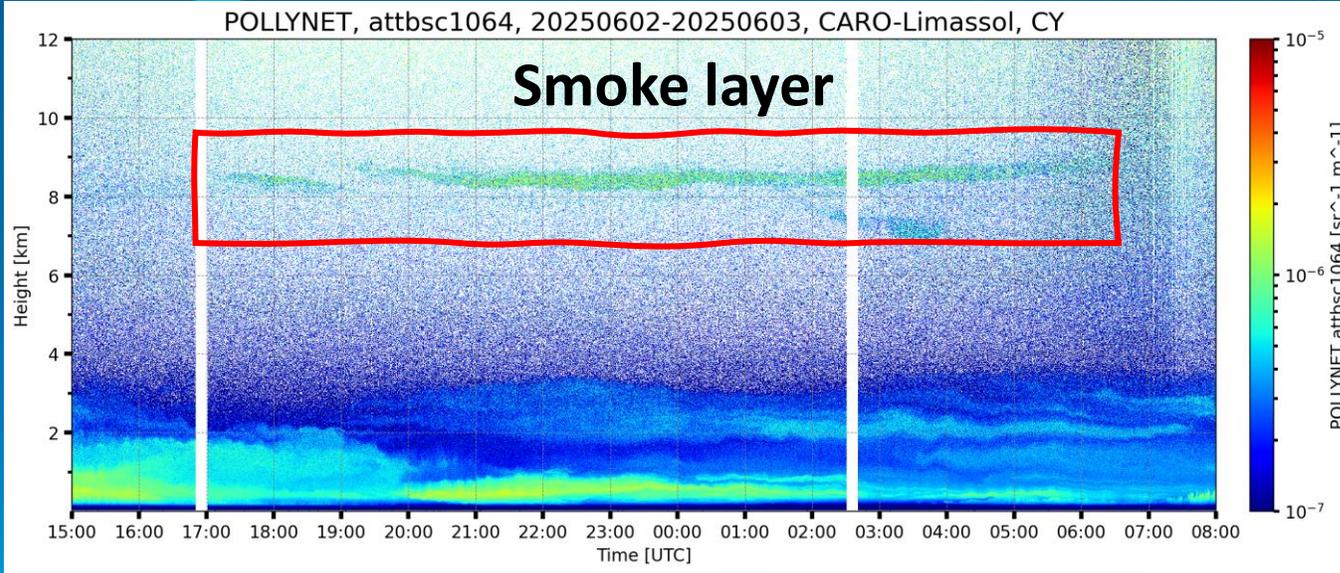
POLLY Visibility, 20250305, CARO-Limassol, CY



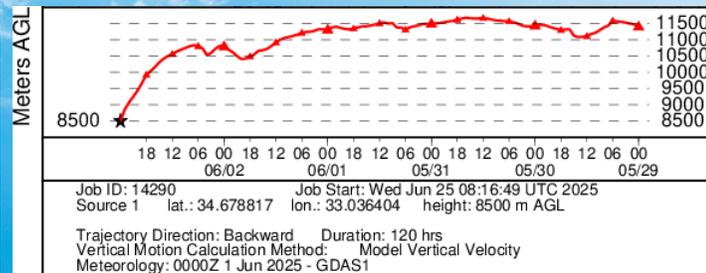
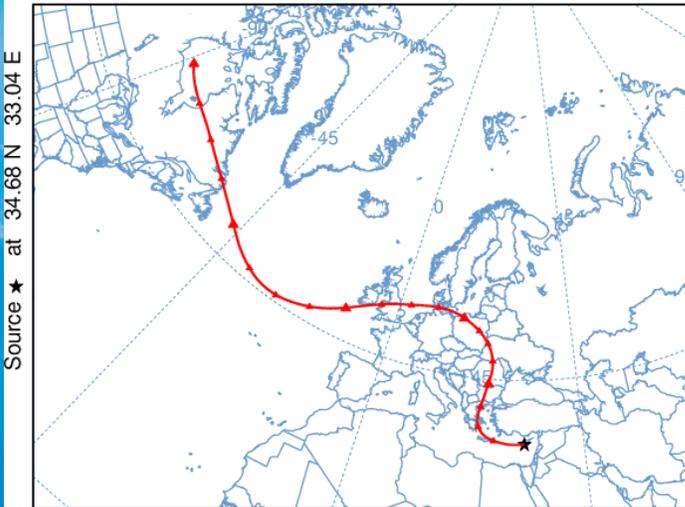


SMOKE PLUME FROM CANADIAN WILDFIRES

03.06.2025



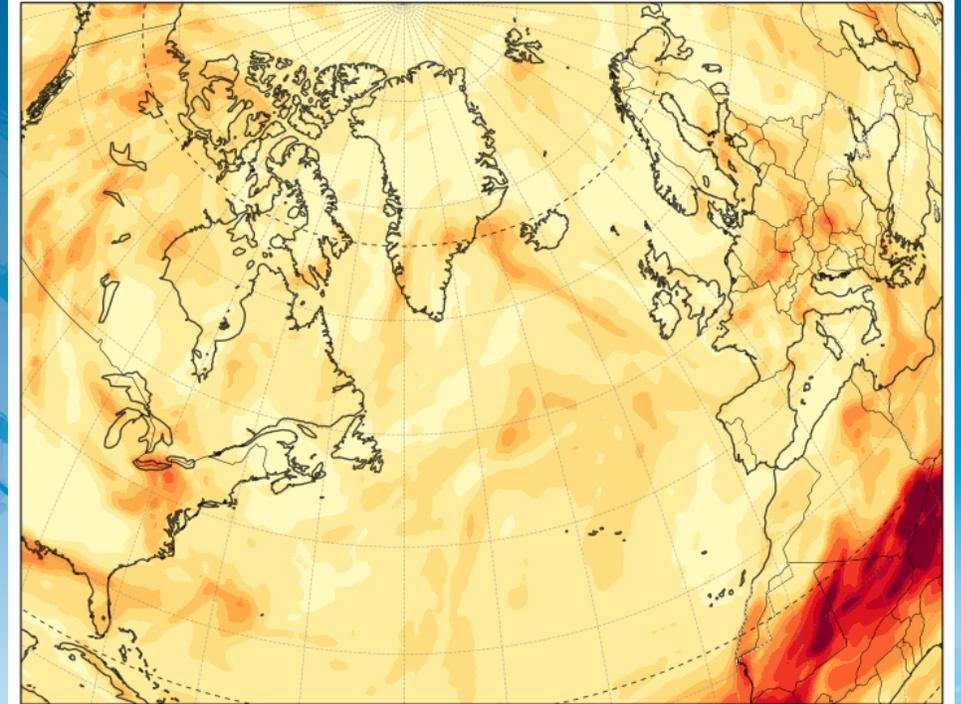
NOAA HYSPLIT MODEL
Backward trajectory ending at 0000 UTC 03 Jun 25
GDAS Meteorological Data



CAMS Analysis Total Aerosol Optical Depth at 550nm

2025-05-22 T00

Data: CAMS global atmospheric composition forecast • Credit: CAMS/ECMWF



PROGRAMME OF THE EUROPEAN UNION



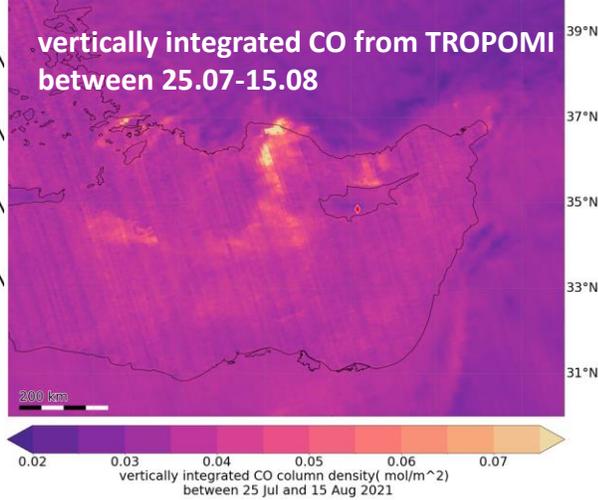
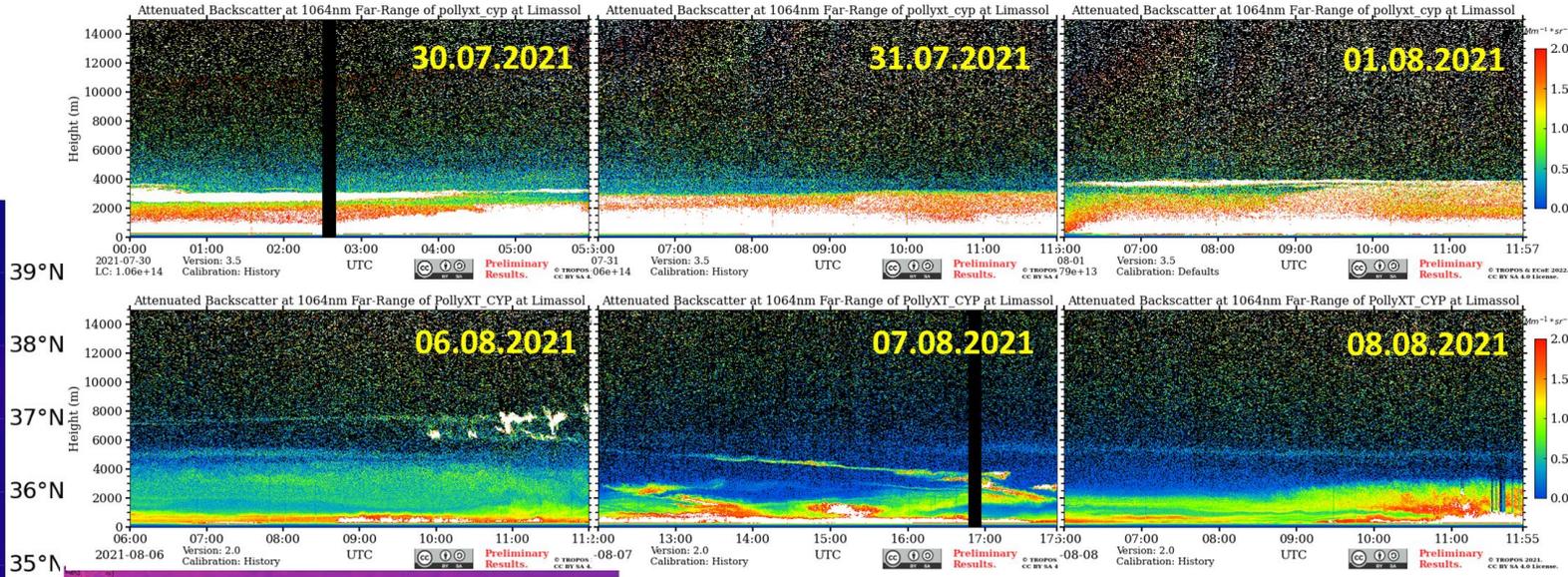
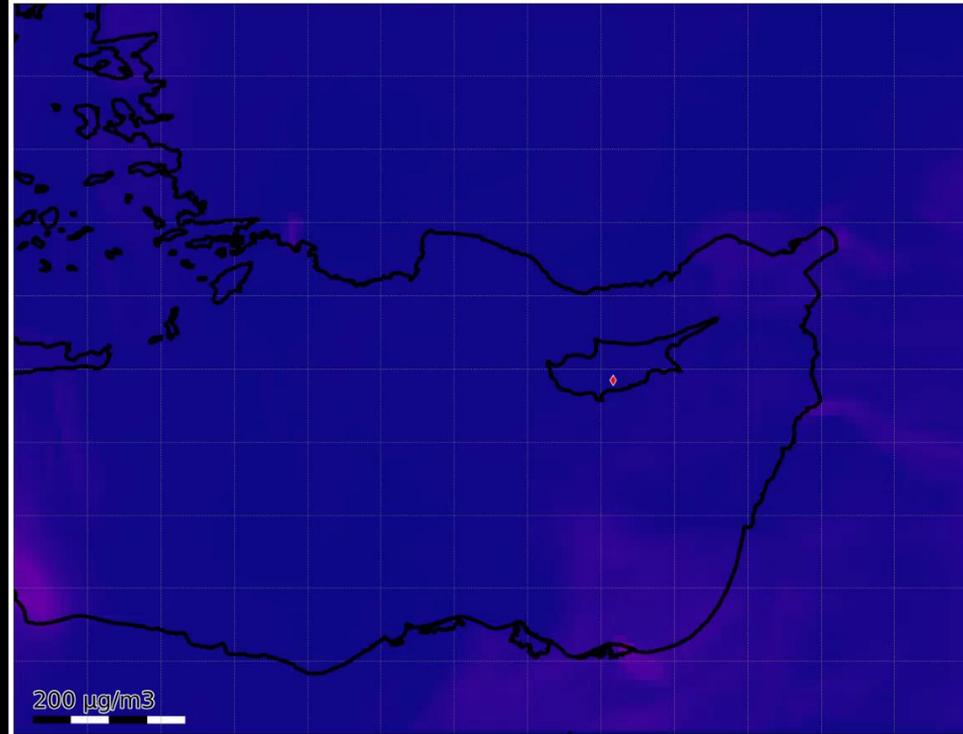


Monitoring of Wildfires in the Eastern Mediterranean using ground based, satellite and modelling data

Smoke layers observed by PollyXT-CYP lidar system above Limassol, Cyprus between 27 July to 10 August 2021

"CAMS air quality interim reanalysis"
mass concentration of wildfire aerosol within PM10

26°E 27°E 28°E 29°E 30°E 31°E 32°E 33°E 34°E 35°E 36°E 37°E



"Sentinel 5P payload;
level 2 offline product"



0.00 0.55 1.10 1.65 2.20 2.75 3.30 3.85 4.40 4.95
pmwildfire_I50 (µg/m3) for 10 Aug 21 at 13:00

0.02 0.03 0.04 0.05 0.06 0.07
vertically integrated CO column density (mol/m²)
between 25 Jul and 15 Aug 2021

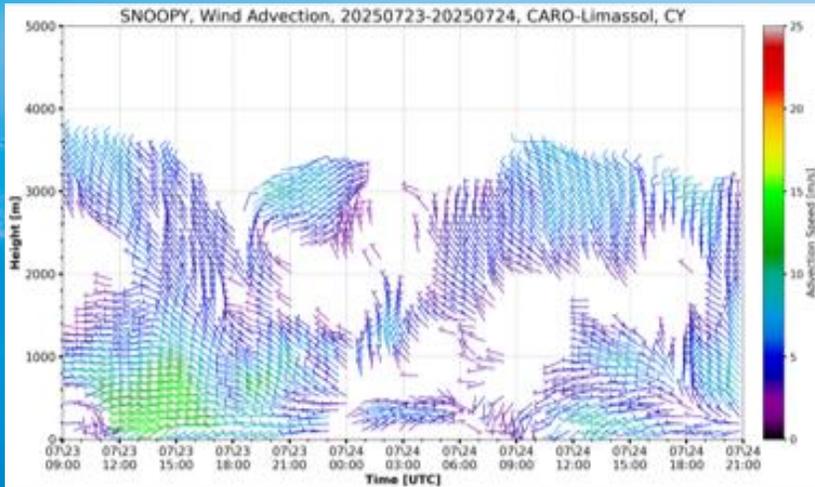
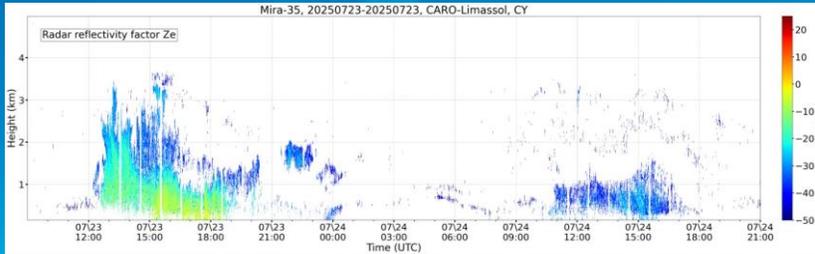
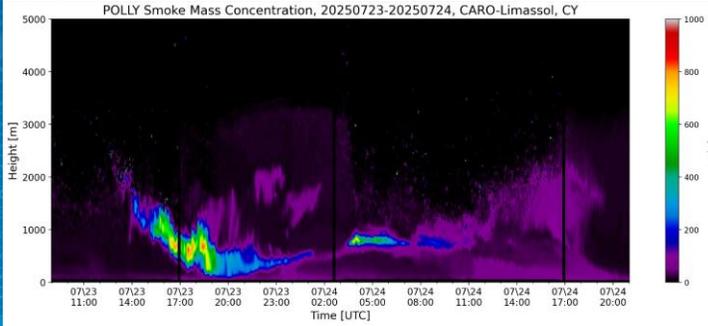
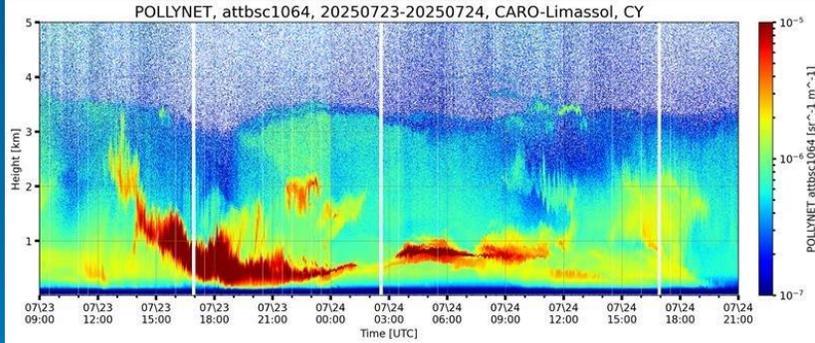
Limassol, CY, 23 July 2025, 17:00 UTC



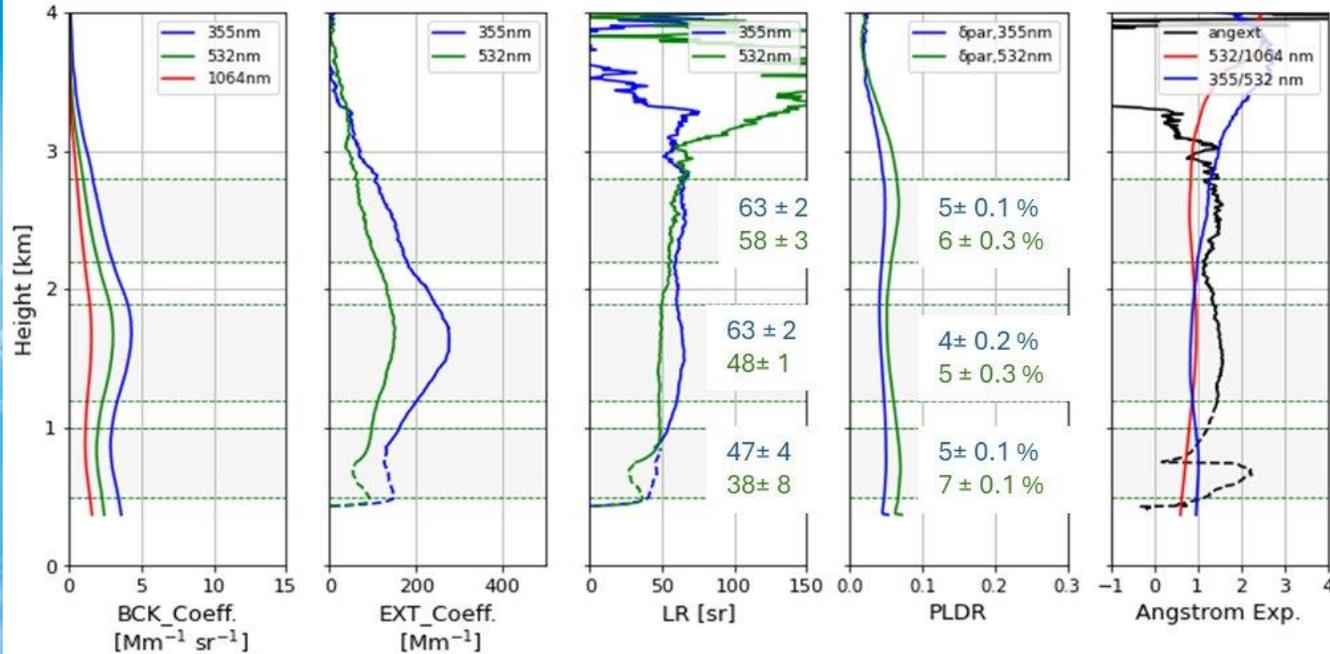
All sky camera,
23.07.2025, 17:00 UTC



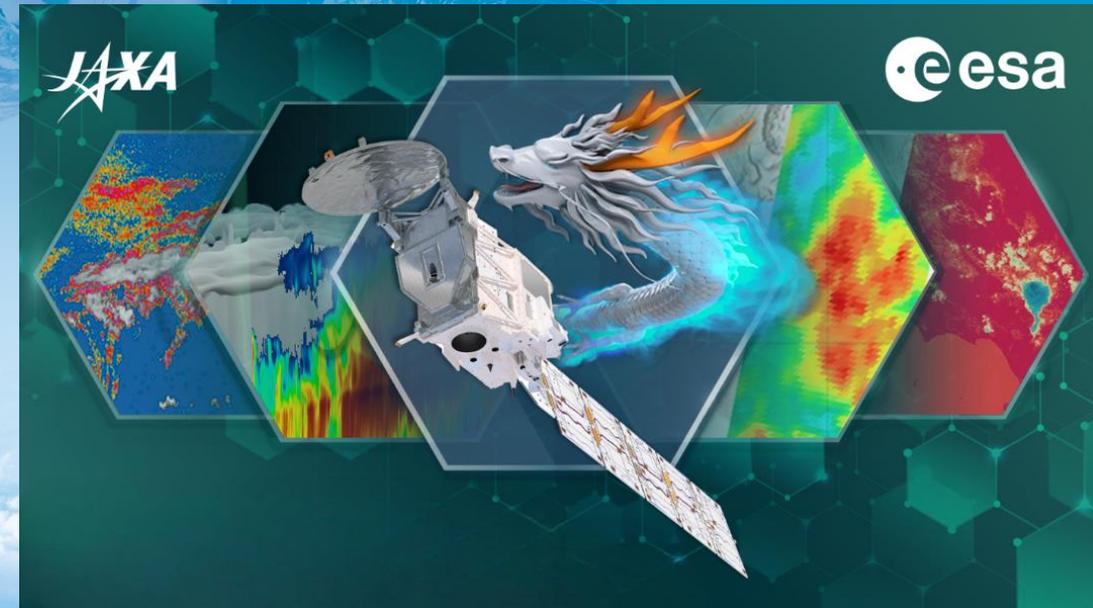
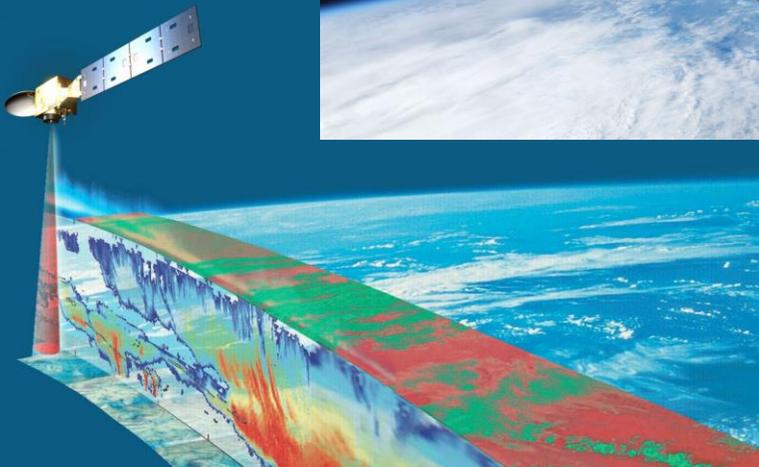
MODIS NASA, 24
July 2025

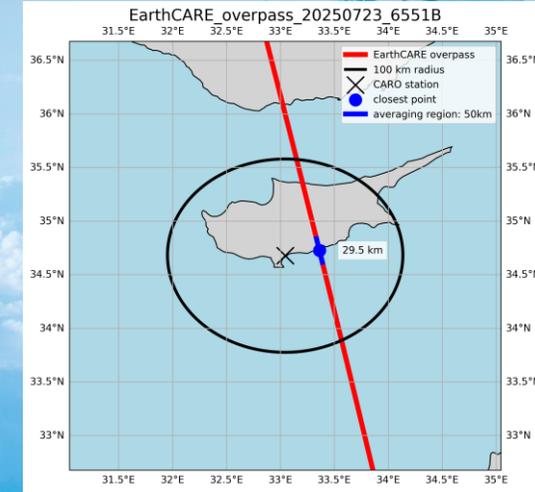
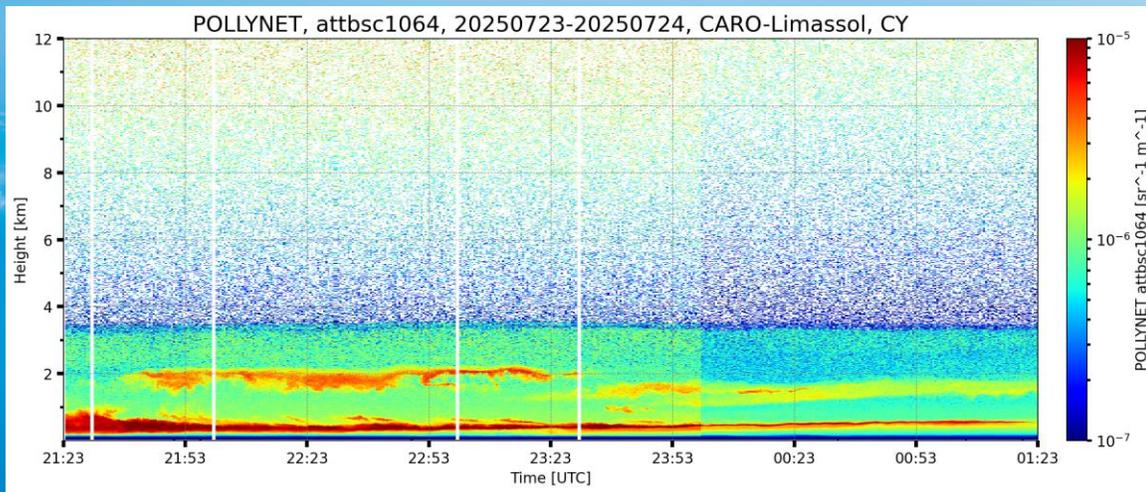
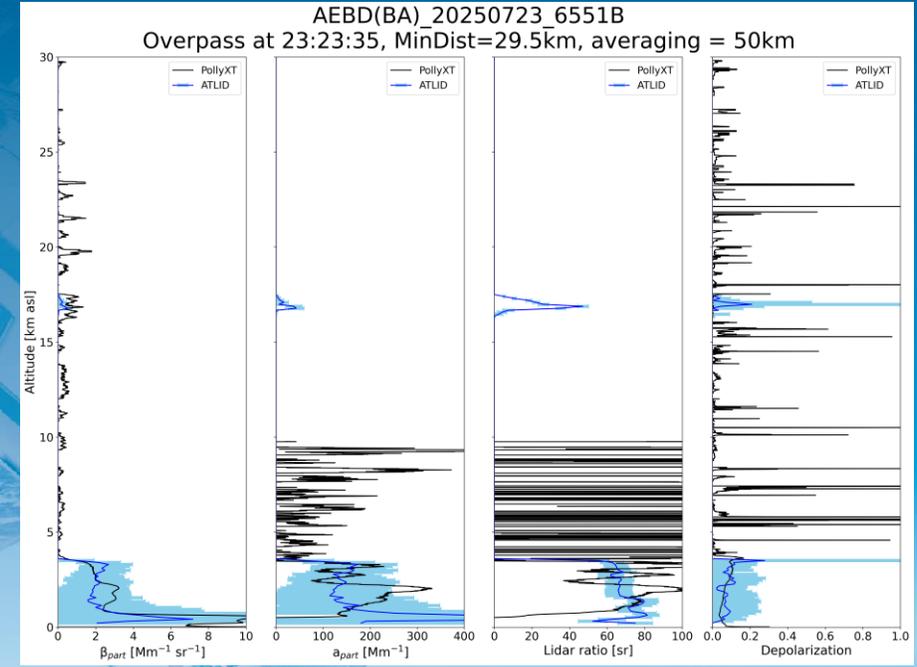
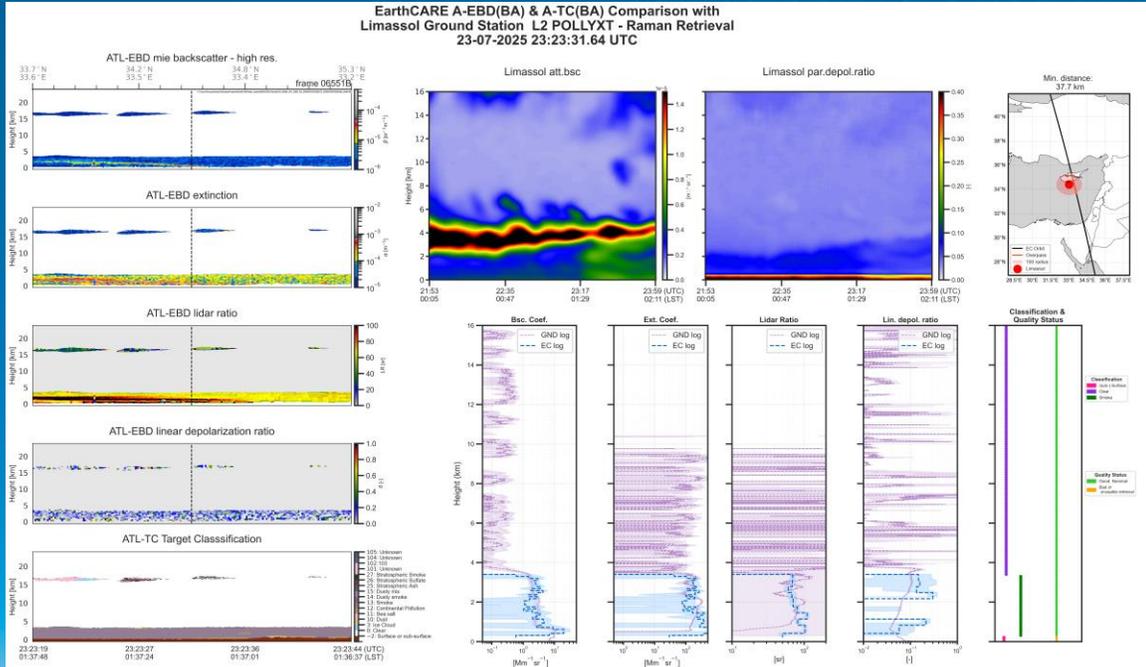


Date: 2025_07_24, Hour: 1730_1930

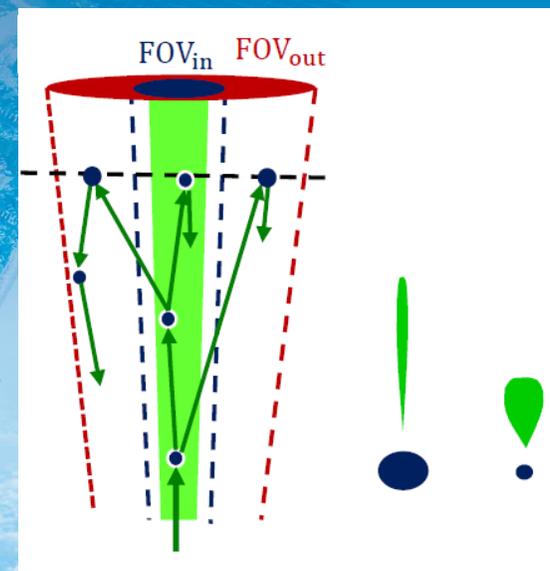
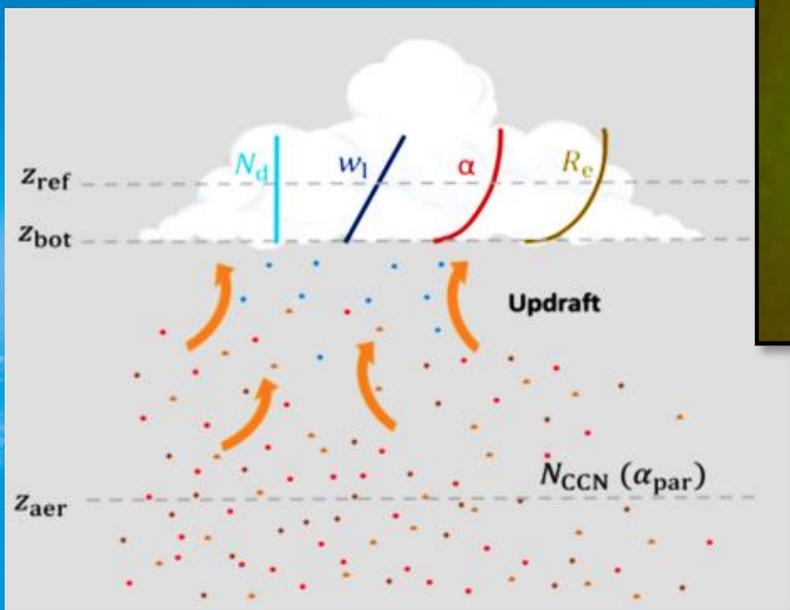


Calibration and Validation activities of the EarthCARE satellite with CARO-NF measurements





Study of Aerosol-Cloud Interactions

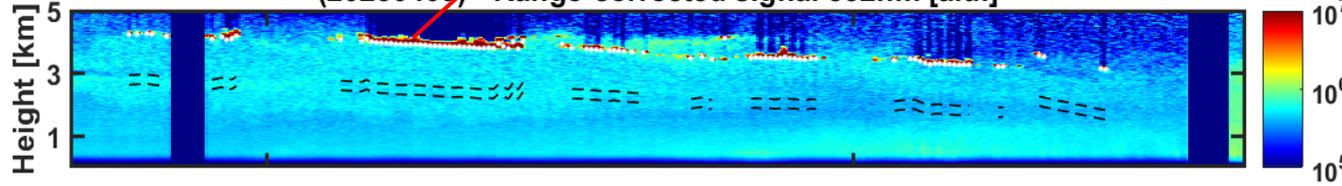


Cloud Formation over a layer of Dust

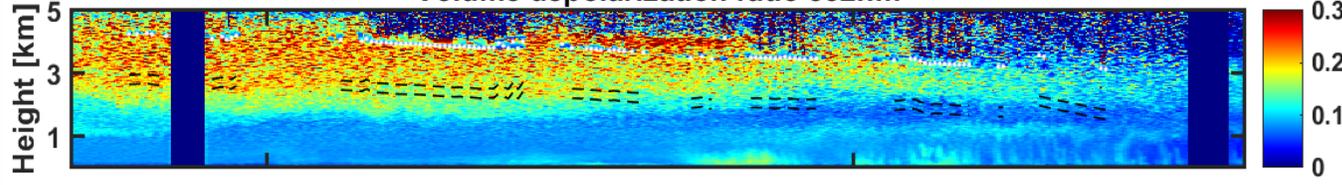
09.04.2025

CBH ~ 3-4 km
T ~ -5 °C

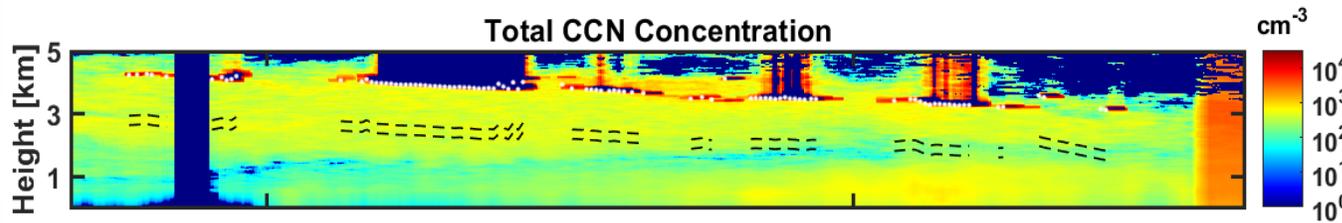
(20250409) - Range-corrected signal 532nm [a.u.]



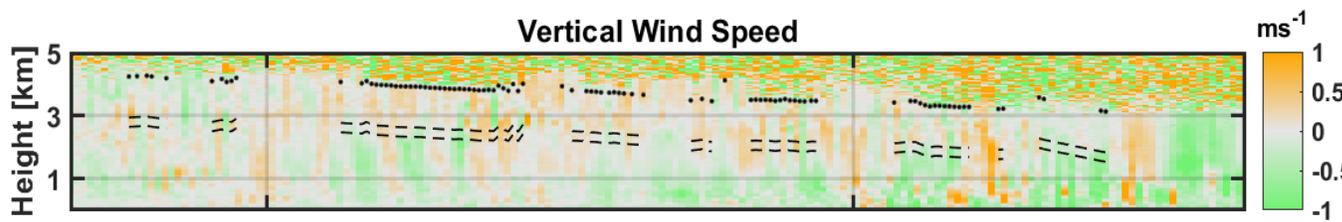
Volume depolarization ratio 532nm



Total CCN Concentration



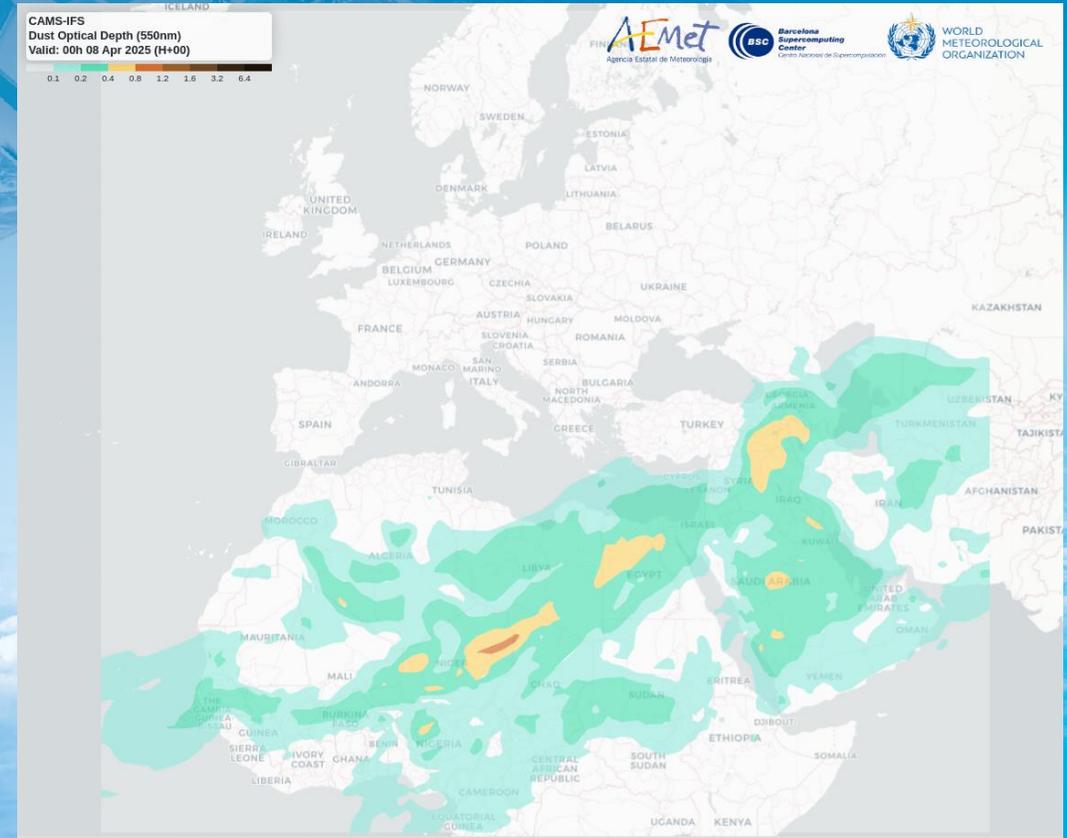
Vertical Wind Speed



03:00

06:00

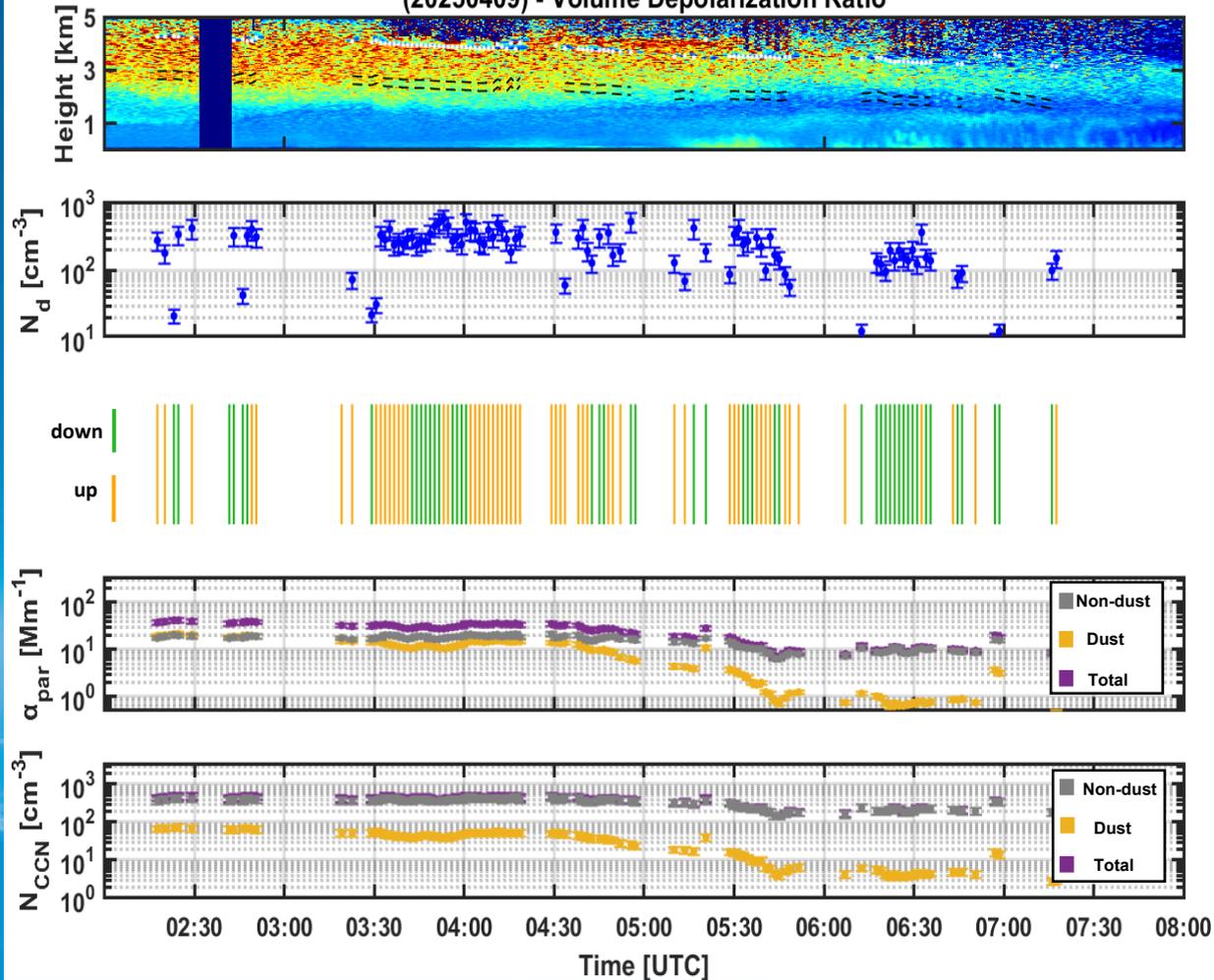
Time [UTC]



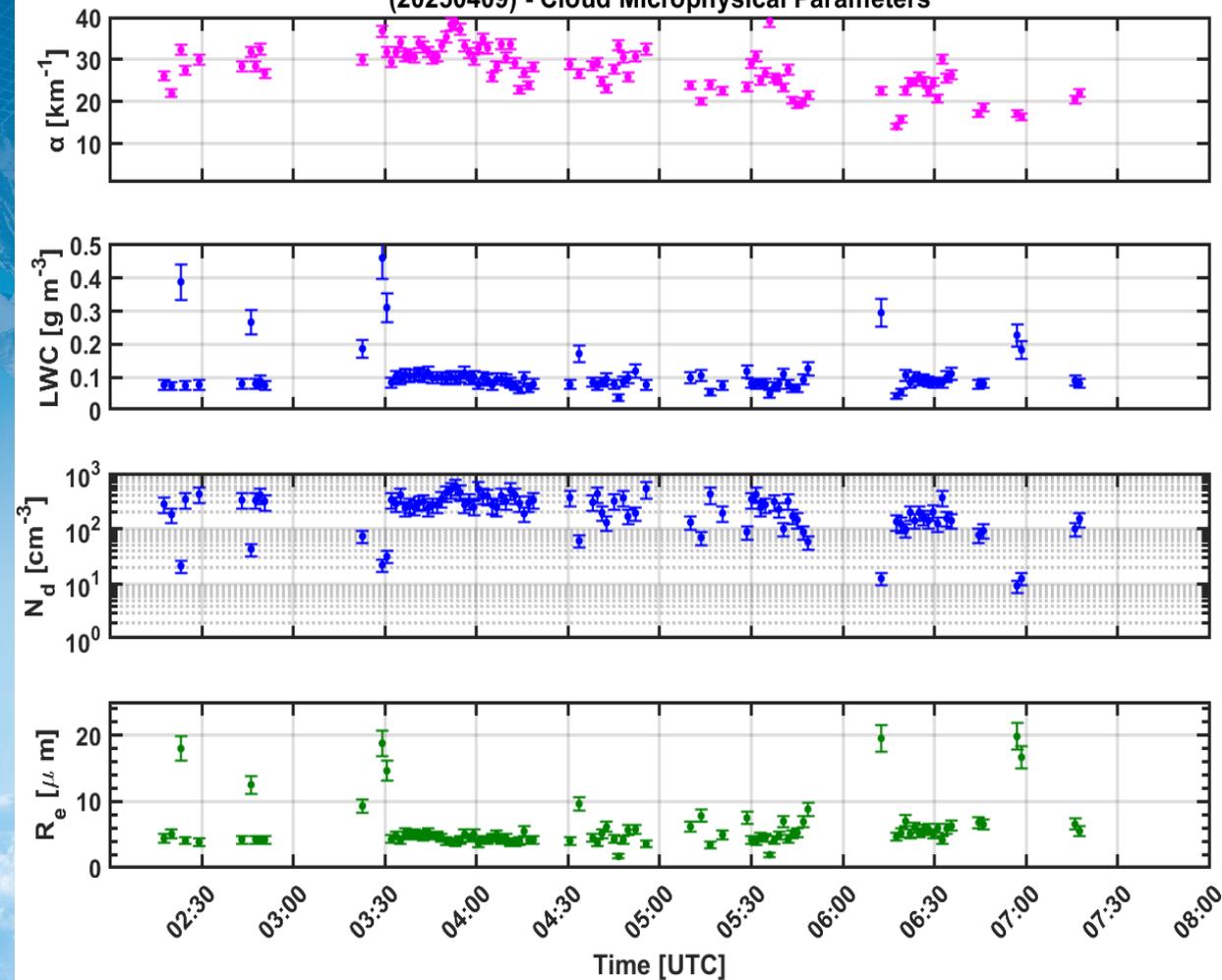
Cloud Formation over a layer of Dust

09.04.2025

(20250409) - Volume Depolarization Ratio



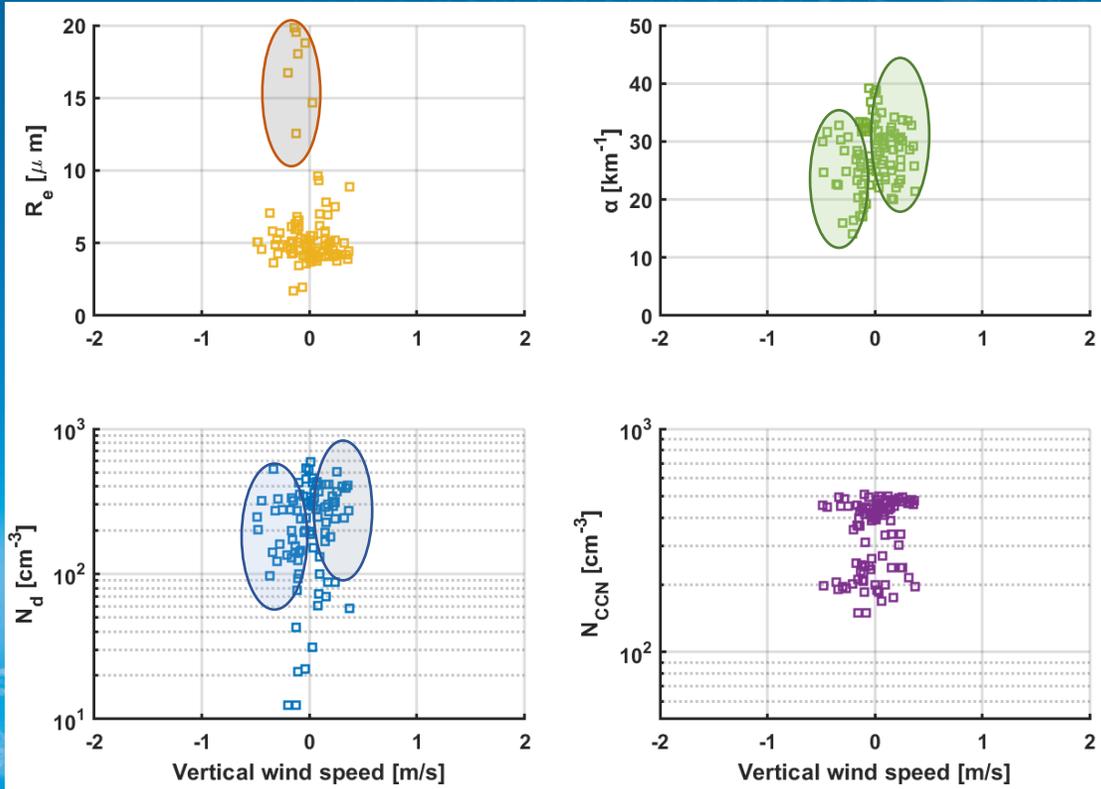
(20250409) - Cloud Microphysical Parameters



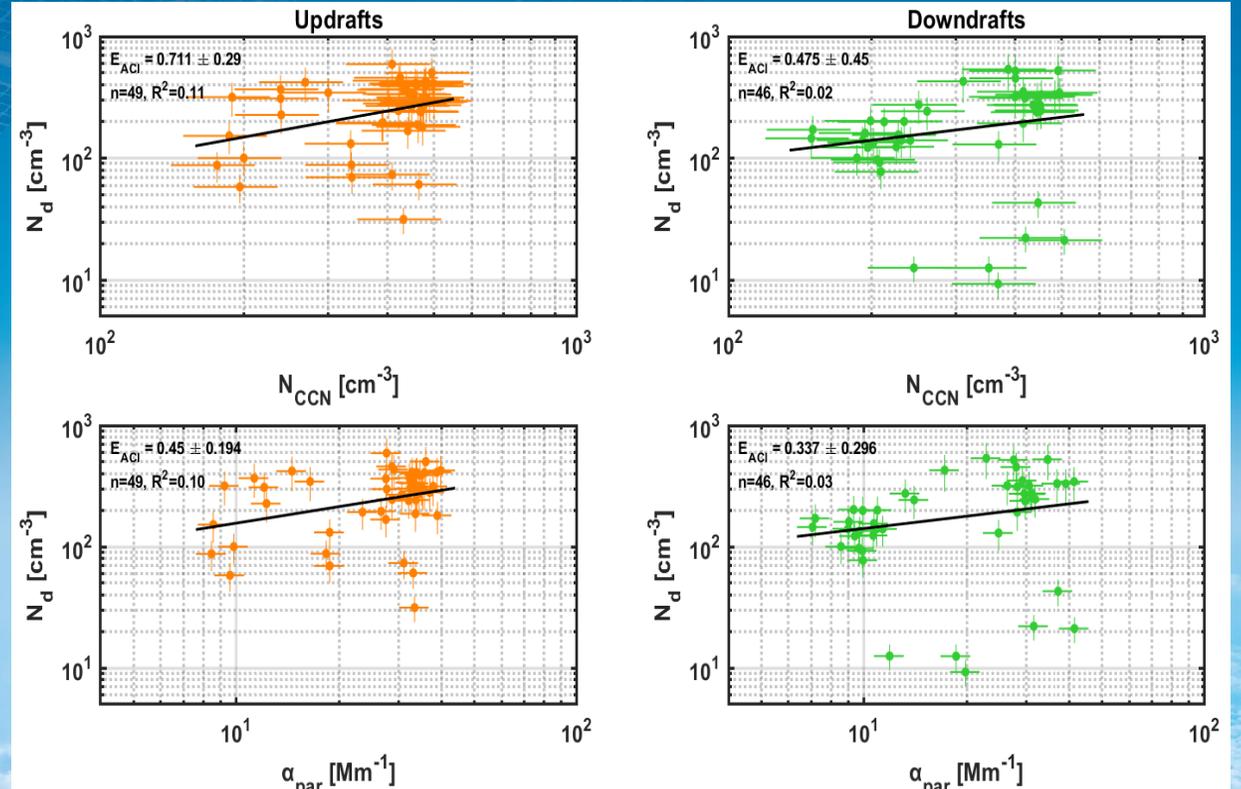
DFOV Polarization Lidar Technique

Cloud Formation over a layer of Dust

09.04.2025



Correlation of cloud microphysical parameters with the vertical wind



Aerosol-Cloud Interaction Efficiency parameter

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THANK YOU

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