ESA-JAXA Pre-Launch EarthCARE Science and Validation Workshop

13 – 17 November 2023 | ESA-ESRIN, Frascati (Rome), Italy

EVID39: CORAL - Cyprus Observations for EarthCARE vALidation

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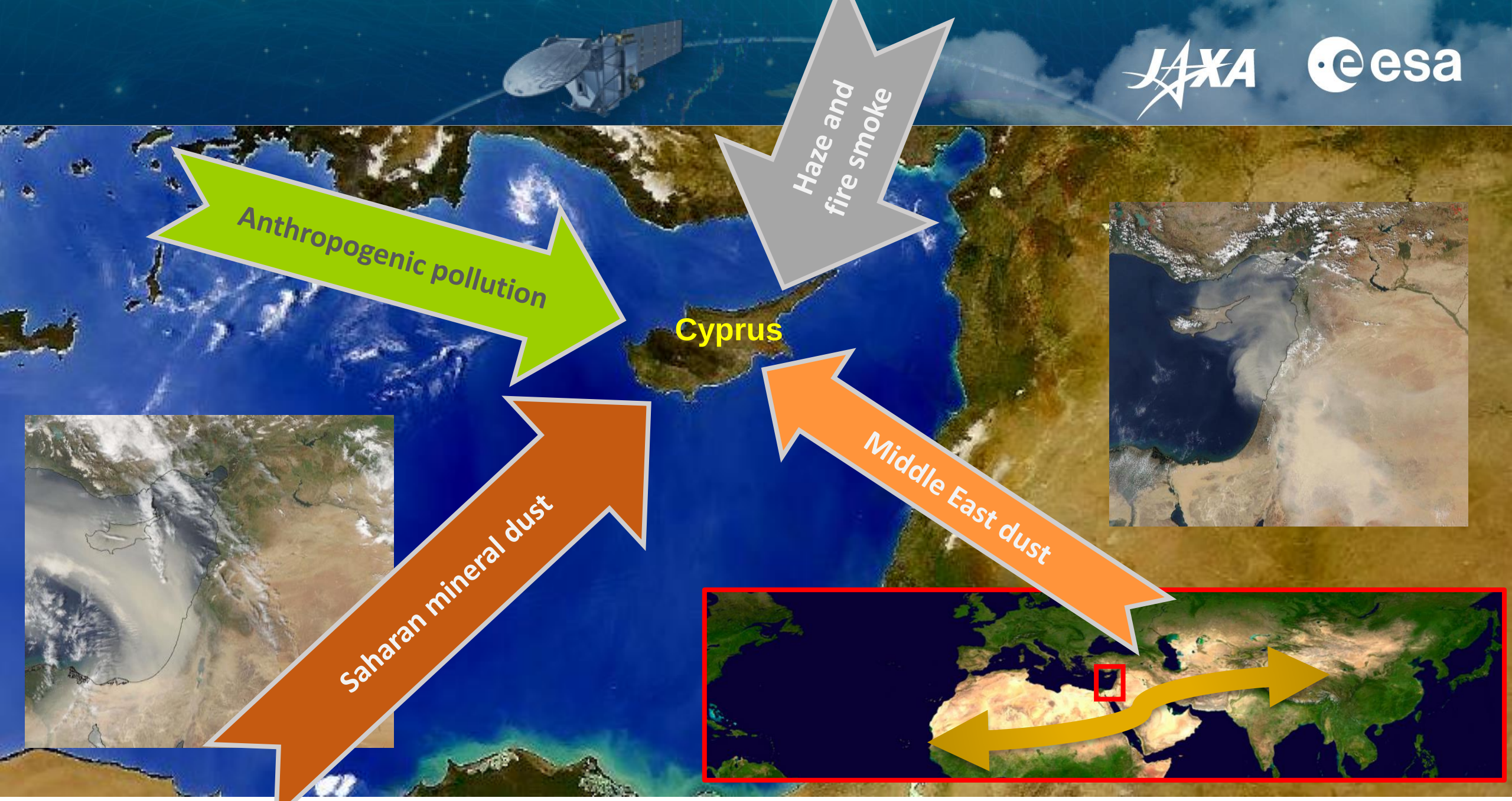
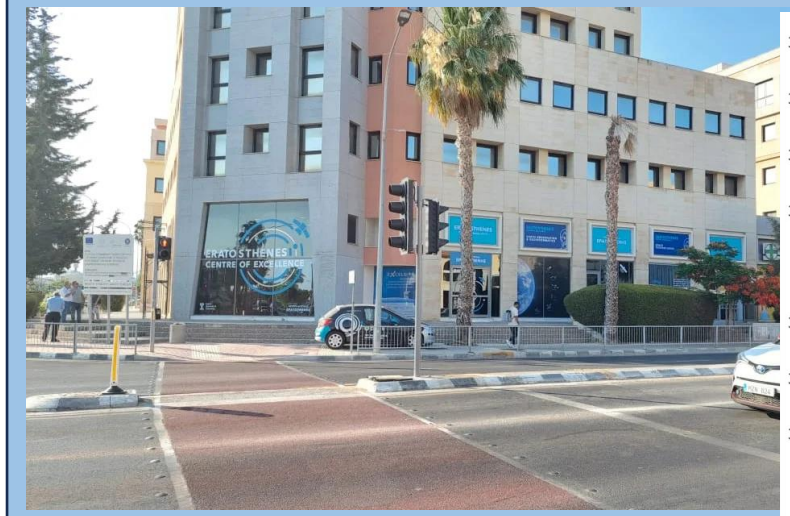
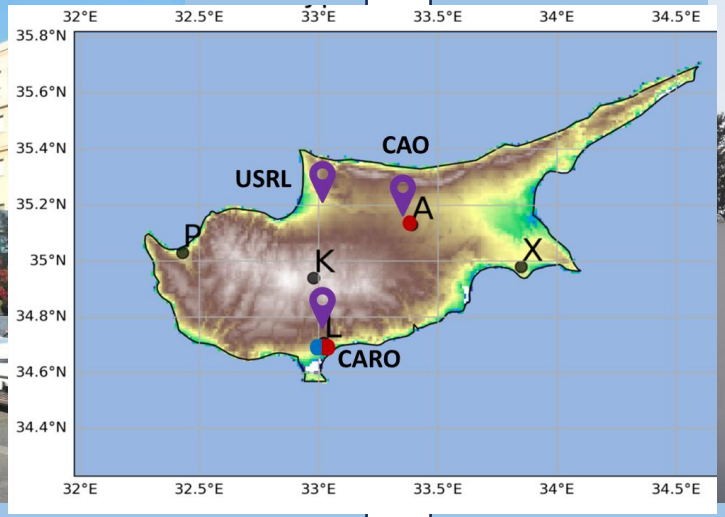

Haze and fire smoke
Anthropogenic pollution
Cyprus
Middle East dust
Saharan mineral dust

CORAL consortium

ERATOSTHENES Center of Excellence:

- Limassol, coastal area
- Cyprus Atmospheric Remote Sensing Observatory (**CARO**) – planned ACTRIS aerosol and cloud RS observational Platforms
- Solar Radiation observations



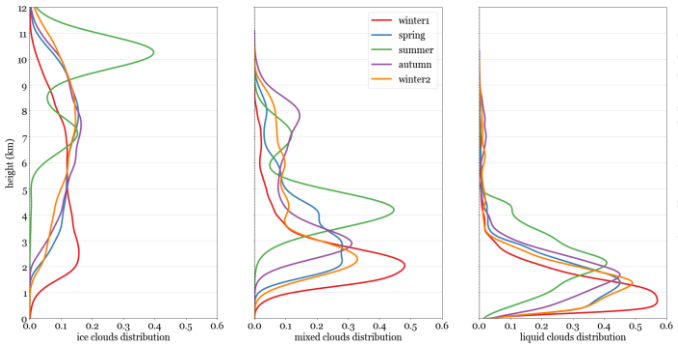


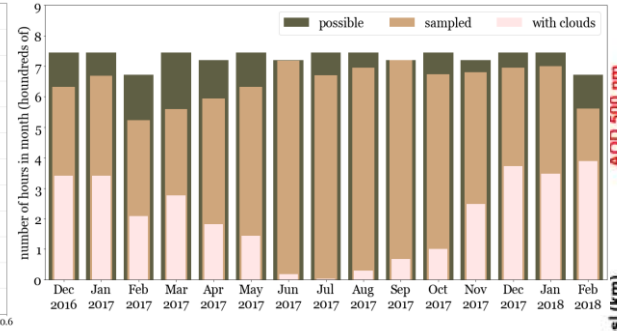
CARE-C of the Cyprus Institute

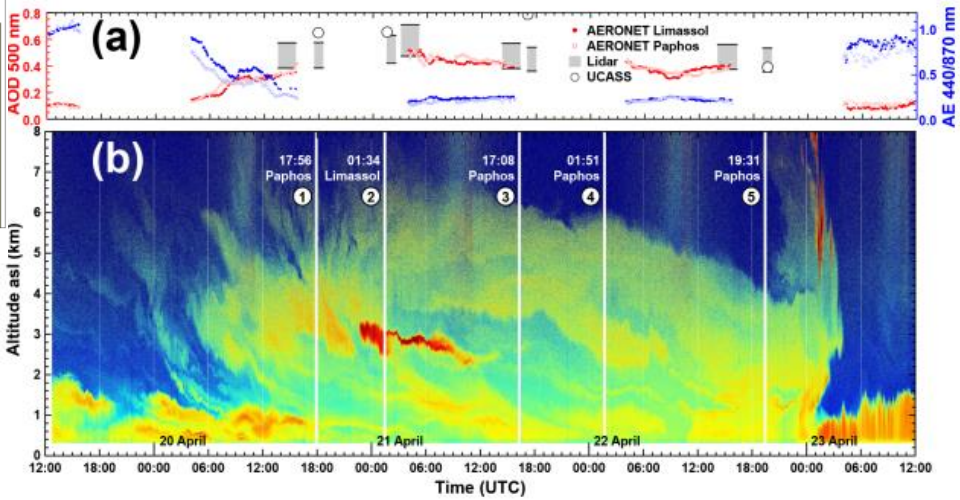
- Nicosia, urban and inland areas
- Cyprus Atmospheric Observatory (**CAO**) – ACTRIS aerosol in situ observational platform
- Unmanned Systems Research Laboratory (**USRL**) – ACTRIS exploratory platform

Scope of CORAL project and main objectives

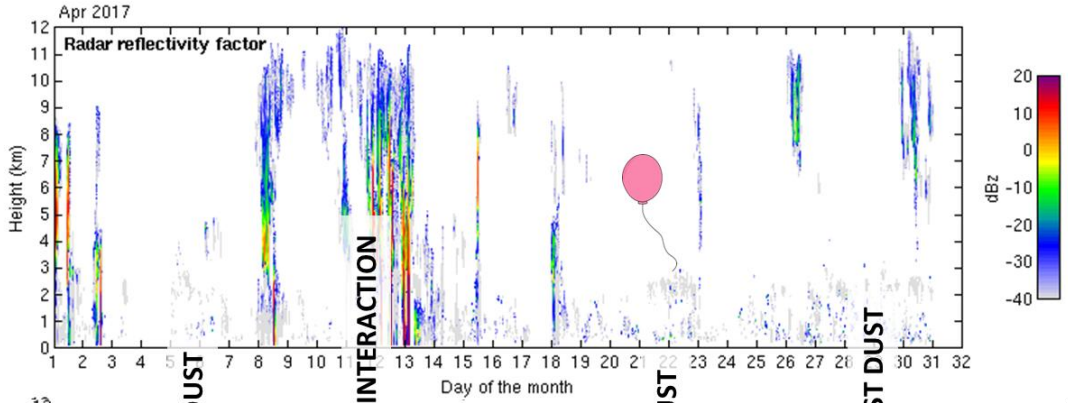
- **to perform thorough cal/val investigations on EarthCARE cloud and aerosol products over Cyprus, a region well-known for its complex atmospheric environment**
- **To enhance solar radiation observations**
- **validation will be performed in coastal and inland and urban stations with**
  - Cyprus Atmospheric Remote Sensing Observatory (CARO) ground-based Raman/polarization lidar and radar instruments in Limassol, providing unbiased profiles of particle extinction, optical depth, backscatter, extinction-to-backscatter ratio and linear and circular depolarization ratios for clouds and aerosol;
  - Cyprus Atmospheric Observatory (CAO) ceilometers and sunphotometers at three stations (Nicosia, Agia Marina Xyliatou, and Troodos) and polarization lidar in Nicosia.
  - Drones of the Unmanned Systems Research Laboratory (USRL), providing high-altitude in-situ aerosol observations with optical particle counters, impactors and backscattersonde



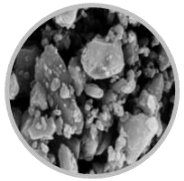


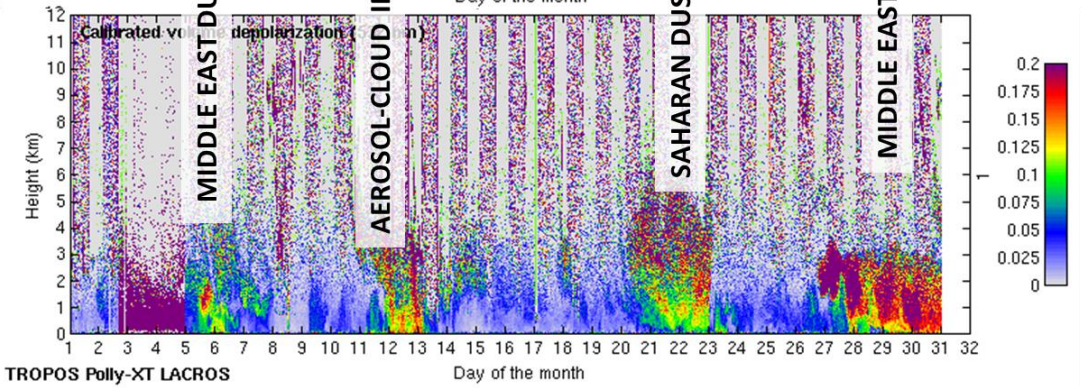


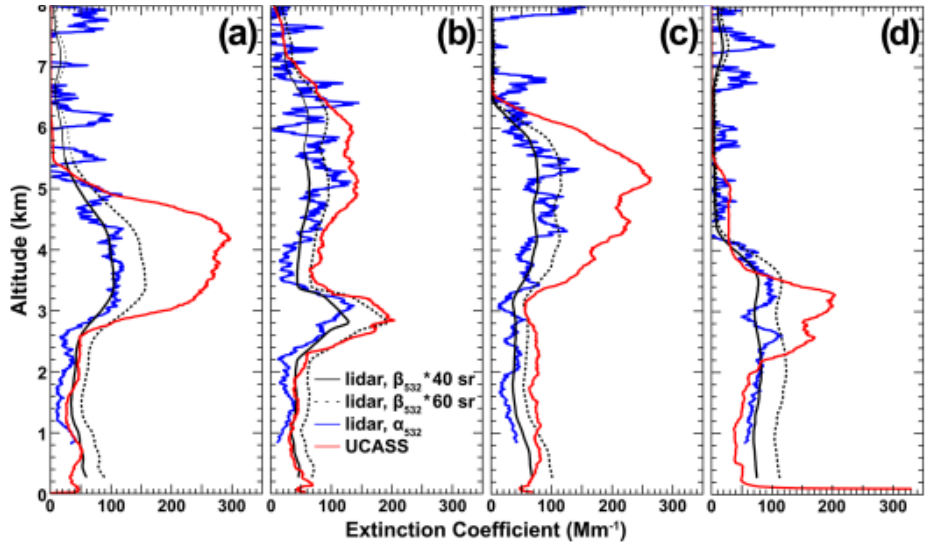
clouds



aerosols

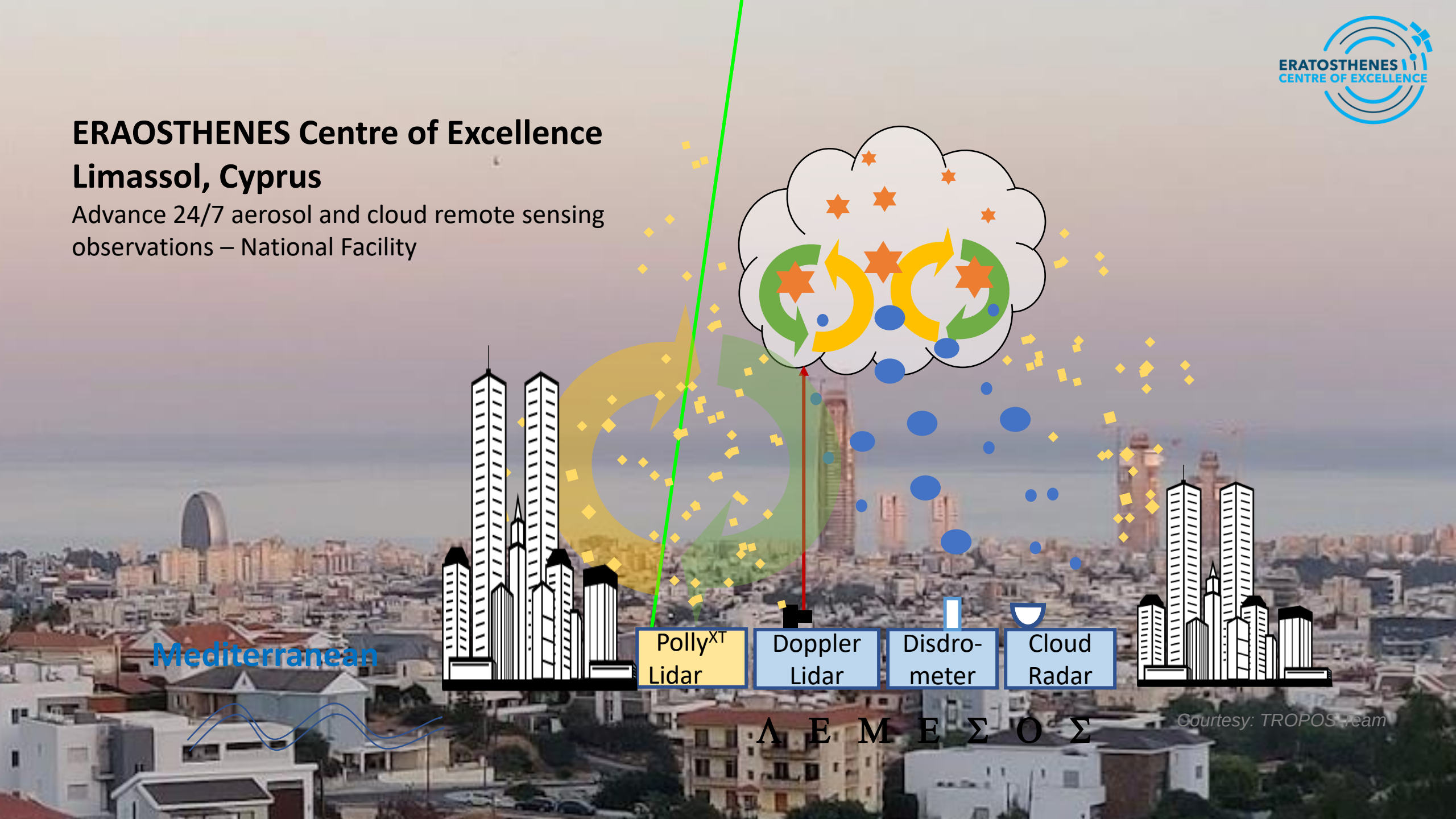






ERAOSTHENES Centre of Excellence
Limassol, Cyprus

Advance 24/7 aerosol and cloud remote sensing observations – National Facility



ERATOSTHENES - Cyprus Atmospheric RS Observatory

Funding:
These activities are supported EXCELSIOR

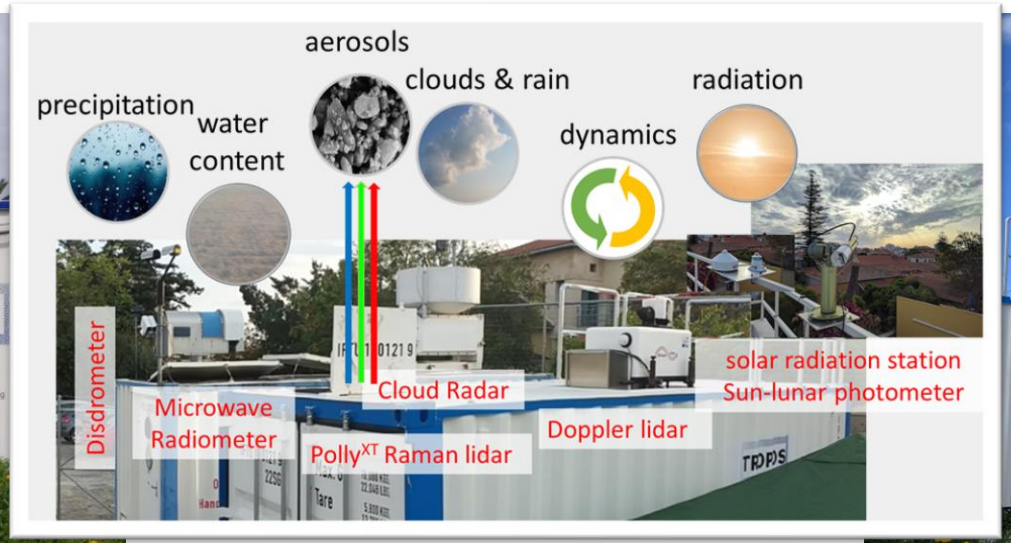
Limassol, Cyprus (34.7°N, 33°E)

- less than 2 km from the coastline; conditions representative of typical Mediterranean and Middle East region

- **AEROSOL REMOTE SENSING OBSERVATIONAL PLATFORM**
  - AERONET Sunphotometer – operates since 2010
  - PollyXT - operates since 2020
  - StreamLine Doppler Lidar - Operates since 2023

- **CLOUD REMOTE SENSING OBSERVATIONAL PLATFORM**
  - microwave radiometer – ready to be installed;
  - ceilometer, disdrometer – ready to be installed;
  - 35 GHz MiRA cloud radar – to be installed January 2024;
  - Full operation of the Cloud Platform expected Spring 2024.

Operates since October 2020



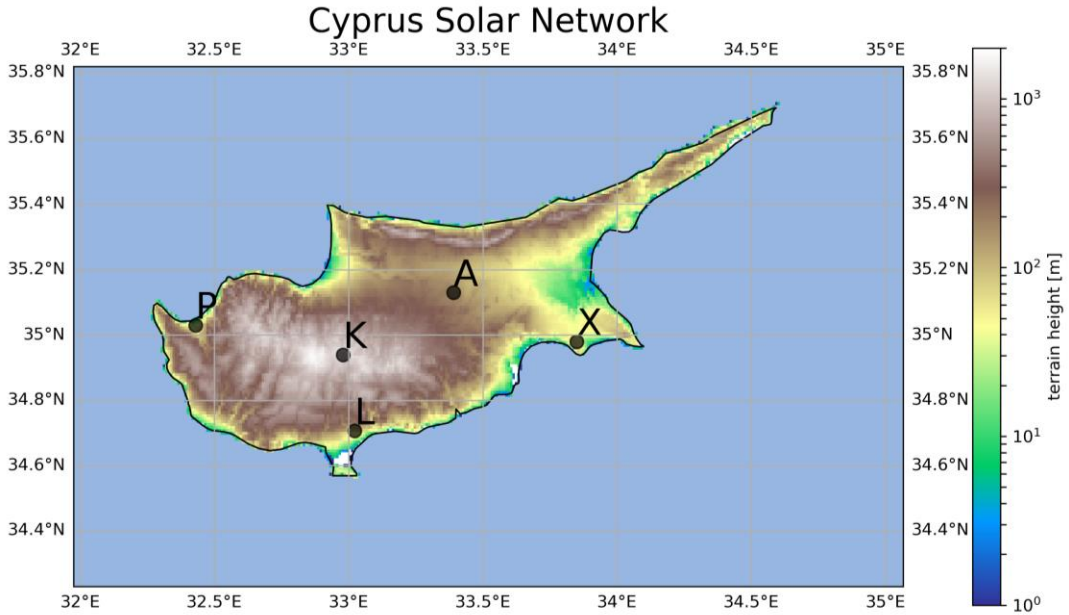
Cyprus Atmospheric Remote Sensing Observatory
CRS NF Planned for early 2024

Planned for 2024

ERATOSTHENES Cyprus Solar Network

Network composed of 5 stations:

- central station in Limassol (L);
- Polis Chrysochous (P);
- Kyperounta (K);
- Athalassa (A) – location with radisounding;
- Xylofagou (X).



Instrument type	Model	Measured quantity	Location
Pyranometer (x6)	MS-80 EKO EKO Instruments Co., Ltd.	Downwelling total shortwave irradiance (W/m2)	Limassol (x2, one for global and one for diffuse), other stations (x1)
Pyrheliometer	MS-57 EKO Instruments Co., Ltd.	Direct shortwave irradiance (W/m2)	Limassol
Pyrgeometer	MS-21 EKO Instruments Co., Ltd.	Downwelling longwave irradiance (W/m2)	Limassol
UV Radiometer (x5)	SUV-E UVE Radiometer Kipp & Zonen B.V	Erythemal UV irradiance (W/m2)	All stations (x1)
Spectrophotometer UV/VIS .	DMc150 Double Monochromator Bentham Instruments Ltd	Global spectral (290–500 nm) irradiance (W/nm·m2)	Limassol
Sky Camera	ASI-16 All Sky Imager	Cloud cover, Cloud base height	Limassol

CARE-C: Cyprus Atmospheric Observatory (CAO)

- devoted to long-term monitoring
- 3 stations in Cyprus (Agia Marina Xyliatou, Nicosia, Troodos)
- Polarisation lidar (Elastic backscatter lidar with near-infrared (808 nm) and green (532 nm, Depolarization channel at 532 nm)
- Ceilometers
- Sun-photometers
- Radiative flux station

AERONET sunphotometers
(Nicosia, AMX, Troodos)

Radiative flux station (AMX)

Vaisala CL51
(Nicosia, AMX)

CIMEL CE376 Polarisation lidar

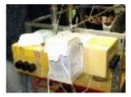
Pilot project implementation plan
ESA EarthCARE Cal/Val support

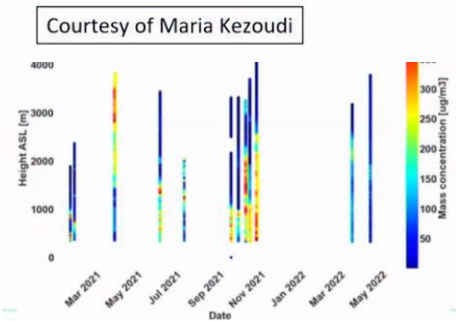
Funding:
These activities are supported until 2024 by the ATMO-ACCESS pilot.
Additional support to continue beyond that is being sought.

CARE-C: USRL

UAV flights up to 4-6 km for height-resolved observations with the following instruments:

- POPS and UCASS **optical particle counters** (0.1–40 µm)
- GPAC: Impactors for **sample collection** (particles up to 100 µm)
- COBALD backscatter sondes (**particle orientation**)

SENSOR	UCASS 	GPAC 	COBALD 	POPS 
USE	Aerosol size distribution 0.4–20 // 3–40 µm	Impactors (>1µm)	Backscatter ratio (2 orientations)	Aerosol size distribution 0.14–3.3 µm
UAV	 Skywalker 2015			 I-Soar



THE CYPRUS INSTITUTE
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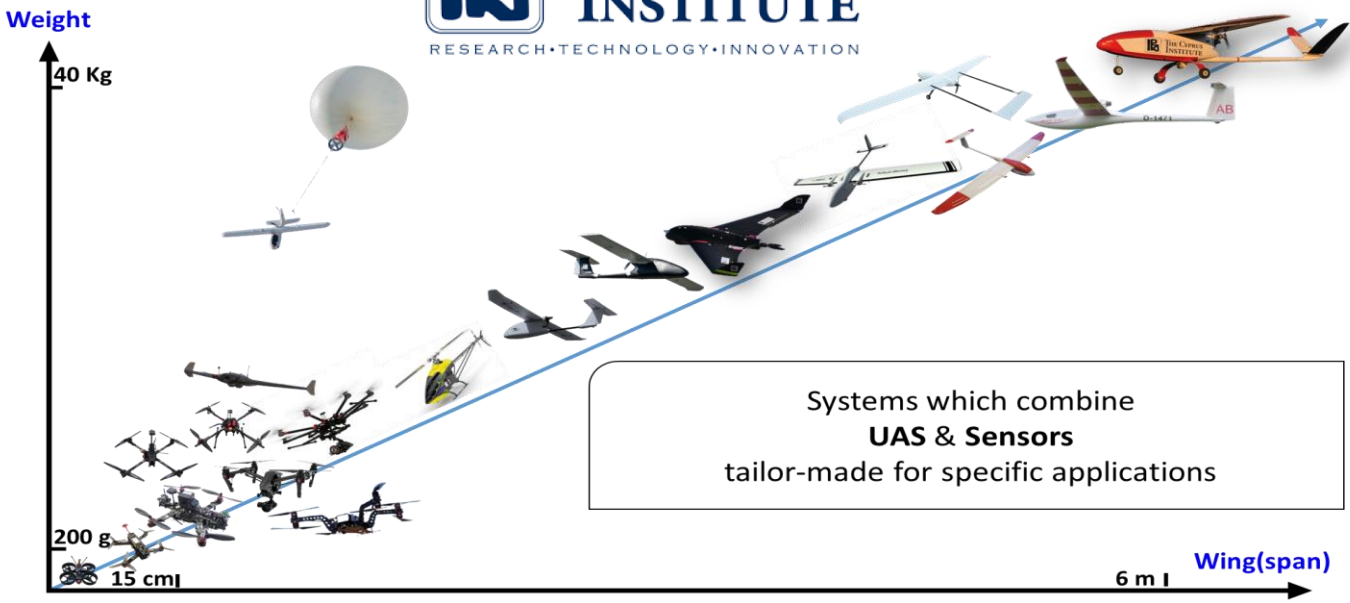
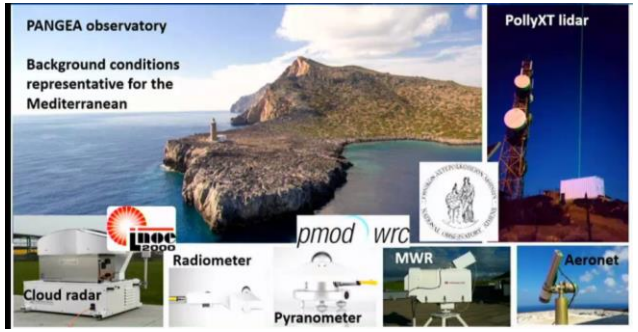


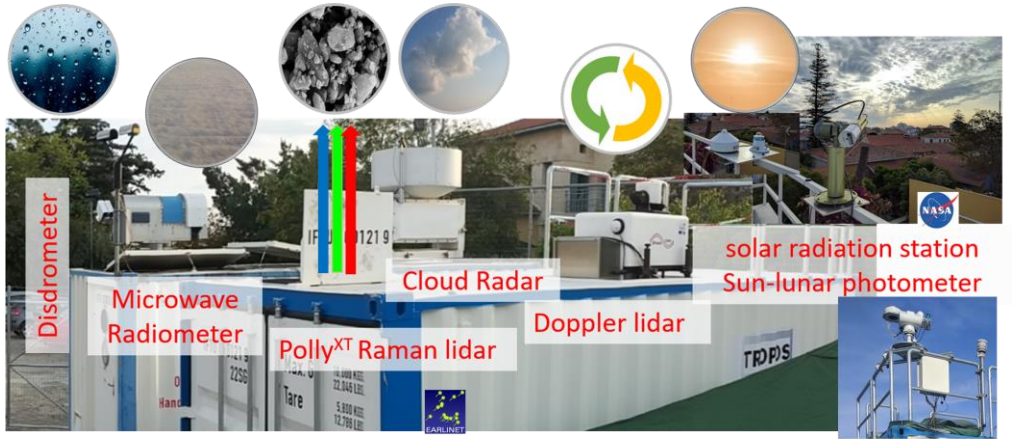
Validation activities will involve:

- a continuous observing activity in Limassol in collaboration with similar activities performed in Greece and Europe through other EarthCARE cal/val activities;

ACROSS

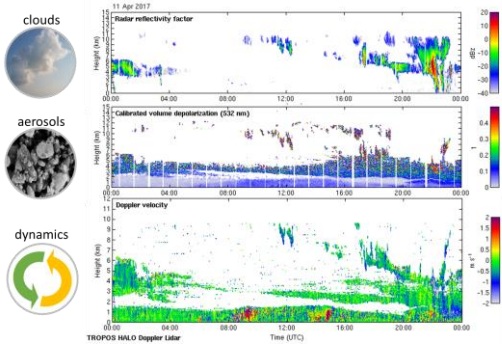


CORAL



Courtesy: TROPOS Team

- dedicated campaigns on the island, co-designed and co-implemented by the CARE-C/CyI using ground-based and airborne observations and ERATOSTHENES CoE providing ground-based remote sensing aerosol and cloud observations based on the instrument's availability



- **collocated measurements** will be performed during ground and airborne campaigns, planned to be carried in Cyprus as an initiative of the ERATOSTHENES Centre of Excellence (ERATOSTHENES CoE) and the Climate and Atmosphere Research Center (CARE-C) of The Cyprus Institute (for the airborne activities of USRL);
- **experiments** will be designed such as to achieve the following core objectives:
  - perform a thorough validation of the EarthCARE stand-alone aerosol and clouds products;
  - to utilize the validated aerosol and clouds products in Radiative Transfer Model (RTM) simulations for depicting radiation and further intercompare with high-quality solar irradiance measurements at the surface (ground-based actinometry) and at TOA (spaceborne radiometers, including BBR);
- **Validation** of the L2 products of the EarthCARE mission;
  - Using ground based lidar and radar to validate the ATLID and CPR L2 products: C-FMR, C-CD, C-TC, C-CLD, ACTC, ACM-CAP, ACM-COM.
  - L1 products are beyond the scope of the CORAL, but a validation study for ATLID attenuated backscatter is also feasible by both PollyXT and CiMEL lidar systems:
- **Funding:** CARO operation is supported by EXCELSIOR EU project, CAO and USRL activities supported by ATMO-ACCESS project up to 2024.

ATMO ACCESS
Access to Atmospheric Research Facilities

Pilot project implementation plan
ESA EarthCARE Cal/Val support

Authors: Holger Baars[1], Eleni Marinou[2], Rob Koopman[3], Stephanie Rusli[3], Lucia Mona[4], Constantino Munoz Porcar[5], Alejandro Rodriguez[5], Ewan O'Connor[6], Martial Haeffelin[7], Michael Sicard[8], Patric Seifert[1], Vassilis Amiridis[2], Ann Mari Fjæraa[9], Doina Nicolae[10]

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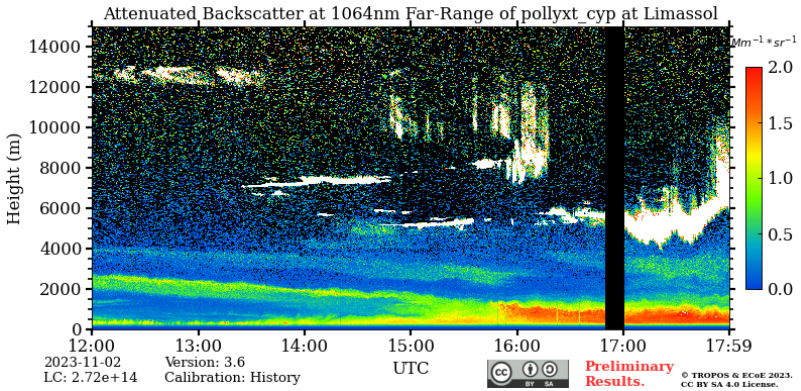
10) National Institute of R&D for Optoelectronics (INOE), Romania

Date: 2023-05-15

- Gain experience on the quality assured measurements and data transfer to EVDC
- First synchronized observations using remote sensing and UAV flights on 25 Oct and 3 Nov 2023 simulated overpasses over Cyprus.
- Atmospheric conditions: Saharan Dust and Cloud formation



Work packages		2023							2024								
		June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep
		M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16
WP 1	Preparation of network rehearsal campaign																
WP 2	Network rehearsal campaign																
Event:	EarthCARE workshop Frascati																
WP 3	Preparation of Cal/Val campaign																
Event:	EarthCARE rehearsal																
Event:	EarthCARE launch																
WP 4	Cal/Val campaign																
WP 5	Intercalibration with reference systems																

SETUP

- **Aerosol and Clouds** ACTRIS remote sensing facilities in Cyprus
- **Radiation** remote sensing measurements for closure studies
- **UAV** in situ flights collocated with RS measurements

EXPECTED OUTCOMES

- **Aerosol and Clouds products validation**
- **ACI and Radiation closure studies**