Advancing Atmospheric Research in the Eastern Mediterranean: Insights from the Cyprus Atmospheric Remote Sensing Observatory

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The Cyprus Atmospheric Remote Sensing Observatory (CARO), a National Facility (NF) for remote sensing of aerosols and clouds, is under evaluation to become an ACTRIS National Research Infrastructure facility for Cyprus. It comprises the Aerosol Remote Sensing (ARS) and Cloud Remote Sensing (CRS) observational platforms. Located in Limassol, a coastal city in Cyprus (34.677°N, 33.0375°E, 2.8 m above sea level), CARO is poised to serve as the reference observatory for the Eastern Mediterranean, North Africa, and Middle East (EMMENA) region.

Cyprus's climate and air quality are strongly influenced by a diverse mix of aerosols, including urban haze from industrial and urban activities in Southeast Europe, the Middle East, and North Africa; biomass-burning smoke from northern regions (e.g., Black Sea countries); mineral dust from arid zones in Turkey and Middle Eastern deserts (often mixed with anthropogenic pollution); and Saharan dust from North Africa (Mamouri and Ansmann, 2017). Additionally, Mamouri *et al.* (2023) documented the long-range transport of wildfire smoke from intense fires in the United States and Canada toward Cyprus's atmosphere. As an island, Cyprus is also significantly affected by marine aerosols.

Situated at a strategic location, CARO provides critical data for understanding atmospheric aerosols, cloud dynamics, and radiative forcing, contributing to regional and global climate studies. Recently, CARO acquired a comprehensive suite of active and passive remote sensing instruments (see Table 1). Beyond aerosol-cloud interaction studies, CARO supports the EarthCARE satellite validation through the CORAL project (Cyprus Observations for EarthCARE Validation), delivering ground-truth observations of the atmosphere's vertical structure. The CARO infrastructure, enhanced through the ATARRI project (Atmospheric and Solar Research and Innovation in the Eastern Mediterranean), enables a synergistic measurement-modelling approach to address major environmental and atmospheric research challenges.

Active and Passive (grey background) sensors in the CARO observatory	Starting date of operation
A) A multi-wavelength dual field of view Raman polarization Lidar	October 2020
B)A scanning polarimetric cloud Doppler radar (Mira-35)	July 2024
C)A Streamline-XR Doppler lidar (Halo Lidar Snoopy)	February 2023
D)A 1064-nm ceilometer (CHM 15kx)	January 2024
E) A 14-channel microwave radiometer (HATPRO G5)	July 2024
F) An optical 1-d precipitation disdrometer (PARSIVEL)	January 2024
G) A CUT-TEPAK AERONET Sun-photometer	April 2010
H) A Radiation station (Sun-traker STR22G, Pyrgeometer)	March 2021

Table 1. List of instrumentation operating continuously at CARO observatory

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Mamouri, R.-E. and Ansmann, A. (2017) Atmos. Meas. Tech., 10, 3403–3427, https://doi.org/10.5194/amt-10-3403-2017.

Mamouri, R.-E., et al (2023) Atmos. Chem. Phys., 23, 14097–14114, https://doi.org/10.5194/acp-23-14097-2023.