INTENSE DUST TRANSPORT EVENT OVER ATHENS, GREECE DURING THE BIOSPHERE CAMPAIGN SUMMER 2023: AEROSOL PROFILING IN RELATION TO THE NEAR-GROUND UVB LEVELS

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Abstract

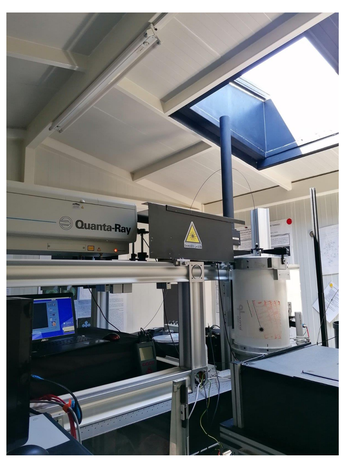
We present an intense dust transport event occurred over Athens, Greece during the BIOSPHERE campaign in summer 2023. Three multi-wavelength lidar systems have been used to provide the vertical profiles of the aerosol optical properties, and relevant mass concentration, together with temperature profiles, for the case of 13 July 2023. The dust load presence was responsible for the reduction of the UVB radiation at ground of the order of 5-10%.

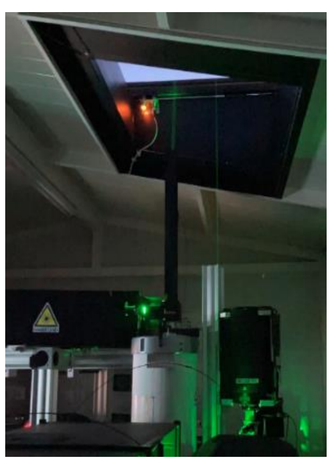
I. The BIOSPHERE Project (2022-2025)

The **EURAMET European Partnership on Metrology (EPM) project BIOSPHERE** (https://euramet-biosphere.eu) (2022-2025) aims to develop the necessary tools, methodologies and measurement infrastructure needed to evaluate the mutual impact of cosmic rays and biologically active UV radiation on the Earth's biosphere, and to support EU policy makers with scientific assessments and information that have the potential to substantially improve policies on climate, health, and anthropogenic activities. Since the generation and decay of SCR depends on air density, knowledge of atmospheric profile parameters such as temperature, density, and aerosols is needed to establish an accurate relationship between SCR and PCR fluxes. To this end, the first BIOSPHERE's measurement campaign was carried out in Athens, Greece, during summer (July-August) 2023, at the premises of the National Scientific Research Center Demokritos (NCSR-DEM) and the National Technical University of Athens (NTUA).

II. Experimental Instrumentation

NTUA Multi-wavelength Raman-Elastic lidar EOLE Depolarisation lidar DEPOLE





354.93(P+S)-386.6-407.5-532(P+S)-607.4-1064.2 nm

NTUA Mobile Two-wavelength Elastic-Depolarization lidar AIAS

532(P+S)-1064.2 nm

Raymetrics Elastic-Raman-Temperature lidar

354.78-387-407-355.4-356.3 nm

NTUA Sun/Lunar Photometer (CIMEL

340-380-440-500-675-870-937-1020-1640 nm

NKUA UV-B Photometer

290-315 nm

Case Study: Dust Event 13 July 2023

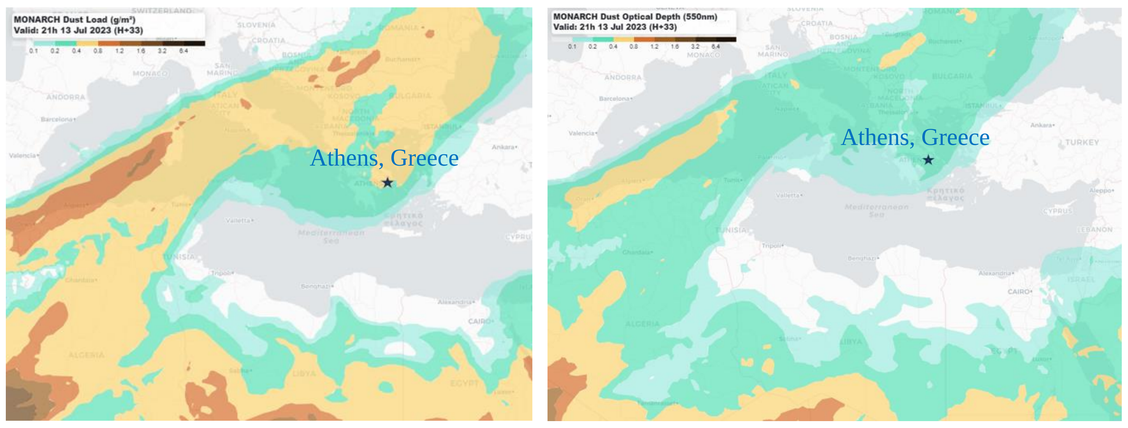


Figure 1. Aerosol dust load (g/m^3) and aerosol optical depth (AOD) at 550 nm as provided by the Multiscale Online Nonhydrostatic AtmospheRe CHemistry model (MONARCH) weather forecast model for 13 July 2023 (21:00 UTC).

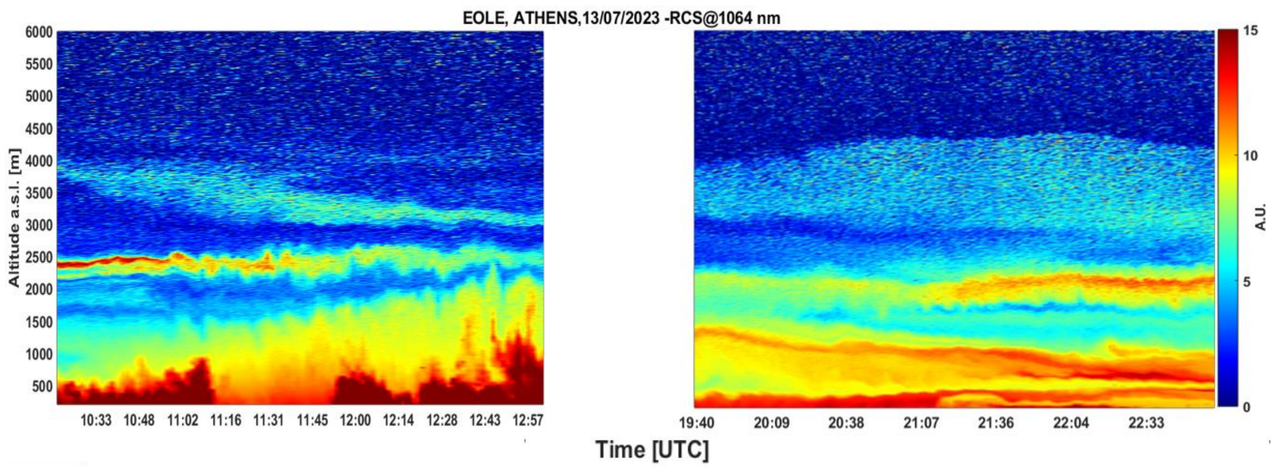


Figure 2. Spatio-temporal evolution of the range-corrected lidar signal obtained by EOLE at 1064 nm (in arbitrary units-AU) over Athens on 13 July 2023 (10:00-23:00 UTC).

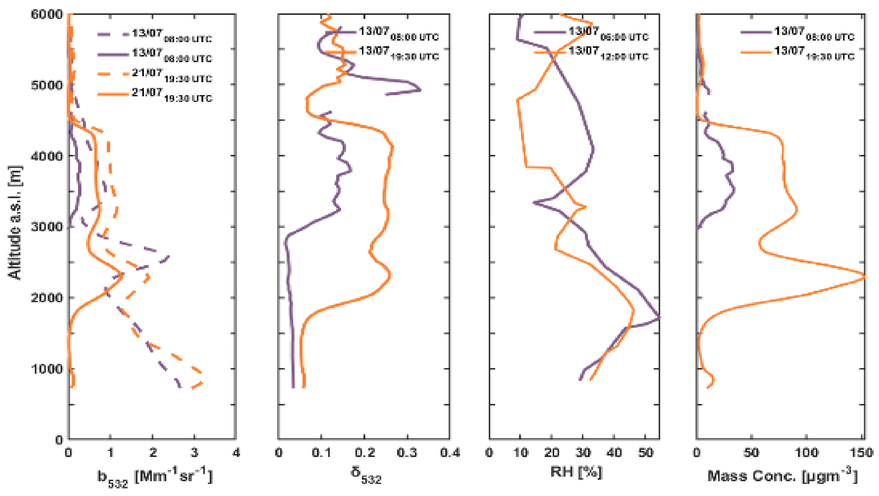


Figure 3 (left to right). Vertical profiles of the aerosol backscatter coefficient b_{aer} ($Mn^{-1}sr^{-1}$) discriminating between the dust and the non-dust components, linear particle depolarization ratio at 532 nm (δ_{532}), relative humidity RH (%) and aerosol mass concentration, obtained by the NTUA lidars on 13 July 2023 (08:00 and 19:30 UTC).

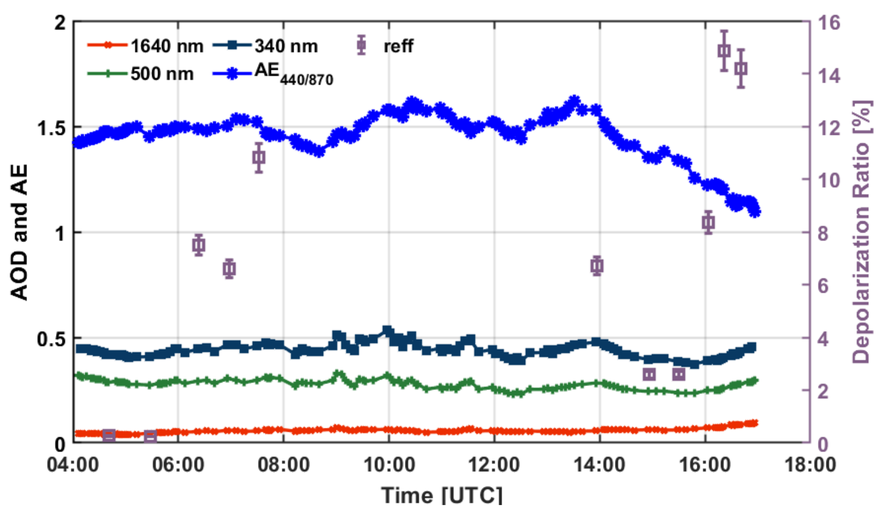


Figure 4. Daytime evolution of the aerosol optical depth (AOD) at 340, 500 and 1640 nm, Ångström exponent (440nm/870nm) and columnar depolarization ratio (%) obtained over Athens by the NTUA sun-sky AERONET photometer on 13 July 2023 (04:00-18:00 UTC).

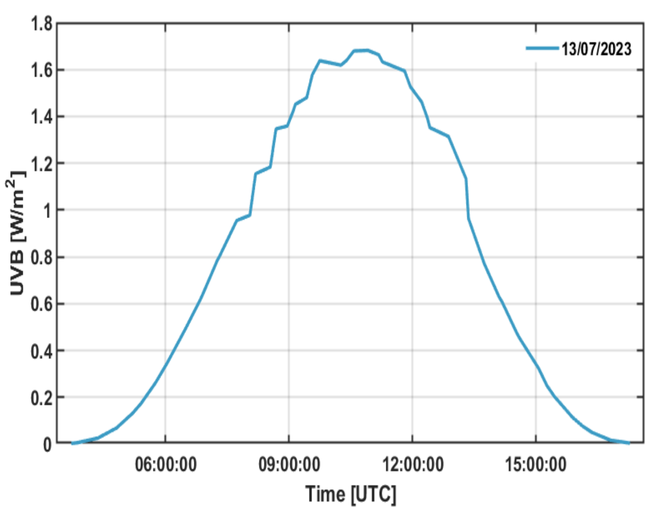


Figure 5. Daytime evolution of the total UVB radiation (W/m^2) reaching ground, as measured by the Brewer spectrophotometer of BRFAA on 13 July 2023 over Athens.

Conclusions

- High linear particle depolarization ratios δ_{532} : 15-32% (between 2-5 km height asl.) indicate the presence of dust aerosols
- High aerosol mass concentrations aloft (1.5-4.5 km height): 50-150 μg/^{3}
- Aerosol Optical Depth over Athens (AOD) ~0.5 (340 nm)
- Columnar Ångström Exponent ($AE_{440/870}$) ~ 1.4-1.6
- Columnar depolarization ratio ~ 6-15%
- AODs (500 nm) of the order of 0.5, contribute to a 5-10% reduction of the UVB radiation levels reaching ground

Acknowledgements

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