HETEAC-Flex Model: Comparative Evaluation of 6 Forward model configurations for Dust Cases using Ground-based Lidar Observations in Limassol

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The Cyprus Atmospheric Remote Sensing Observatory National Facility (CARO NF) of Eratosthenes Centre of Excellence plays a key role in atmospheric research and the characterization of atmospheric conditions in the Eastern Mediterranean.
Equipped with cutting-edge remote sensing instruments including a PollyXT Polarization Raman Lidar, a Cloud Radar and a Solar Infrastructure, CARO provides critical observations for studying aerosol properties, cloud dynamics, and radiative processes.
Its advanced capabilities make it an essential ground-based station for satellite validation studies, particularly in the context of the EarthCARE mission (ESA/JAXA).

To ensure compatibility between ground-based observations and satellite measurements, the HETEAC-Flex model, introduced by A. A. Floutsi et al., 2024 have been applied for the aerosol layer classification. This model was created to validate the aerosol classification of ATLID (ATmospheric LIDar) measurements, onboard EarthCARE, by providing a robust comparison framework. Based on an Optimal Estimation Method (OEM) HETEAC-Flex provides six forward retrieval modes, each incoporationg different sets of optical properties including Particle linear depolarization ratio at 355, 532 nm, Lidar ratio at 355, 532 nm, Extinction-related Ångström exponent at 355/532 nm and the Backscatter-related color ratio for 532/1064 nm.

The typing scheme enables the identification of four aerosol components of aerosol mixtures, absorbing and less-absorbing fine-mode particles and spherical and non-spherical coarse-mode particles (FSA, FSNA CS, CNS, respectively).
CARO's **PollyXT lidar in Limassol** can retrieve all the optical properties needed for the utilization of all the 6 retrieval modes. In this study, we apply the HETEAC-Flex model to several dust cases recorded in Limassol between the period 2021-2024, aiming to determine which retrieval mode is the most optimum for the characterizing dust aerosol layers.

Acknowledgements: The study is supported by the 'EXCELSIOR': ERATOSTHENES: EXcellence Research Centre for Earth Surveillance and Space-Based Monitoring of the Environment H2020 Widespread Teaming project (www.excelsior2020.eu). The 'EXCELSIOR' project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 857510, from the Government of the Republic of Cyprus through the Directorate General for the European Programmes, Coordination and Development and the Cyprus University of Technology. The authors acknowledge the ATARRI project funded by the European Union's Horizon Europe Twinning Call (HORIZON-WIDERA-2023-ACCESS-02) under the grant agreement No 101160258.

Keywords: HETEAC-Flex, Dust Cases, Aerosol Characterization, Lidar, Limassol