EarthCARE Aerosol products intercomparison with CARO Polly Lidar in Limassol, Cyprus

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The Cyprus Atmospheric Remote Sensing Observatory (CARO) of ERATOSTHENES CoE actively participates in the calibration/validation (CAL/VAL) activities of the EarthCARE mission as part of the CORAL project (EVID39). The station's contribution is very important due to two different reasons. First, Cyprus unique geographical location and excellent weather conditions offers a unique opportunity to study the vertical distribution of several types of the atmospheric constituents. Marine aerosols, dust particles from the Sahara Desert and Middle Eastern deserts, smoke particles from biomass burning in neighboring areas and from US-Canadian wildfires, as well as anthropogenic particles from urban and industrial regions in Central and Eastern Europe, are characteristic examples of aerosols observed in the atmosphere above Cyprus. Especially, Limassol as a coastline region play a crucial role in satellite Cal/Val activities due to its unique environmental characteristics and diverse surface properties. The area provide a natural transition between land and ocean, enabling simultaneous validation of both terrestrial and marine satellite observations. Second, the CARO is a multi-instrument National Facility infrastructure specializing in investigating aerosols and cloud interactions. The major instruments operated at the CARO station include an improved Dual Field of view multiwavelength polarization Raman lidar (Dual-FOV PollyXT), a 35-GHz cloud radar (MIRA-35), a microwave radiometer (HATPRO), a wind lidar (Streamline-XR), a ceilometer (OTT/LUFFT CHM15k), and an optical precipitation disdrometer (OTT Parsivel). The Aerosol and Cloud Remote Sensing Platforms together with the solar radiation station of ERATOSTHENES CoE CARO National Facility is measuring continues from the beginning of the EarthCare mission.
In this study the ATLID L1 and L2 products have been compared with ground-based PollyXT recordings operating in 24/7 mode in Limassol, Cyprus. For L1 products, the signal ratio (Mie cross-polar signal divided by the Mie co-polar signal) has been compared for both AC and AD baselines for atmospheric scene containing dust aerosols (12 October 2024) and Cirrus clouds (10 December 2024). The first comparison revealed that the ATLID signal ratio retrieved from the AC baseline shows lower values compared to the PollyXT particle depolarization ratio for both dust and Cirrus cases. For L2 products, we will compare directly the lidar ratio and the particle linear depolarization ratio at 355nm obtained from EarthCARE HSRL lidar L2 products and the ground-based Raman polarization lidar in Limassol, Cyprus. The PollyXT lidar detected an intense Saharan dust layer up to 4 km height on October 12, 2024. The mean values of the lidar ratio and particle depolarization ratio at 355 nm were in good agreement with literature findings for desert particles in the Cyprus region. The mean lidar ratio was 56.74 ± 3.51 sr, and the mean particle depolarization ratio was 0.27 ± 0.01. A cirrus cloud was observed at heights of 8-12 km during the overpass on December 10, 2024. Based on the 10-minutes analysis of ground-based measurements, the mean lidar ratio of the cirrus layer at 355 nm was 20.46 ± 9.92 sr and the mean particle depolarization ratio was 0.42 ± 0.08.

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