Discrimination of molecular, aerosol and cloud scattering and polarization by combination of lidar, radar and radiometer observations

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The combined data from active and passive remote sensing instruments, namely the ESA Mobile Raman Polarization and Water Vapor Lidar (EMORAL), the LATMOS Bistatic Doppler Cloud Radar System for Atmospheric Studies (BASTA), and the INOE Microwave Radiometer (HATPRO-G2) have been used to explore synergies for spatio-temporal discrimination of polarization and molecular, aerosol and cloud scattering.

The threshold-based methodology is developed to perform an aerosol-cloud typing using the three instruments at the same time. This new scheme for target classification, developed collaboratively by the UW and the OUC, allows to determine molecules, aerosol (spherical, non-spherical, fine, coarse), cloud phase (liquid, ice, supercooled droplets) and precipitation (drizzle, rain).

For molecular, aerosol, and cloud discrimination, the thresholds are set on the backward scattering ratio, the linear particle depolarization ratio and the backscatter color ratio, all calculated from lidar signals. For cloud phase and precipitation categorization, the thresholds are set on the reflectivity and the Doppler velocity derived from cloud radar signals. For boundary layer particles, precipitation, and supercooled droplets separation, the thresholds are set on the profiles of temperature and relative humidity obtained by the microwave radiometer.

We will demonstrate that this algorithm is able to perform separation under complicated meteorological situation for consecutive 24-hour observations on several days of June 2019 during the ESA-funded POLIMOS Field Campaign conducted at the PULS PolWET peatland station in Rzecin, Poland. We will discuss limitations and advantages of proposed scheme and show examples of long-term derivation of such high-level data products.

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