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# Aerosol property retrievals with the use of an airborne compact multi-angle polarimeter (C-MAP)

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Atmospheric aerosol particles originating either from natural (i.e. dust, volcanic ash, smoke, sea salt) or anthropogenic (i.e. pollution, agricultural activities) sources, affect the Earth's climate through absorption and scattering of the incoming solar radiation and cloud property modifications. Aerosols can further significantly deteriorate air quality and result in adverse human health problems.

Aerosols multifarious effects depend on their intrinsic optical properties and their load, as well as the radiative characteristics of the underlying surface. The quantification of the aerosol net effect on the Earth's radiative budget is subject to large uncertainties owing to the rapid temporal and spatial changes of the aerosol field and the aerosol properties. Multi-angular polarimetric remote sensing can provide detailed information on aerosol microphysical and optical properties in order to better constrain the aerosol radiative forcing and chemical composition.

The Compact Multi-Angle Polarimeter (C-MAP) is an airborne sensor that will provide highly accurate measurements of intensity and polarization at 7 measurement wavelengths (410, 443, 490, 555, 670, 753 and 865nm) and 5 different viewing angles (0, ±15 and ±40°). C-MAP is currently being developed by Thales Alenia Space-UK in collaboration with the University of Leicester. The project aims to incorporate the MAP technology into a compact airborne MAP that will fly on board a UK demonstrator flight in late 2022. The instrument design is based on the upcoming MAP sensor on-board the CO2M mission (Sierk et al., 2021; Spilling et al., 2021), also developed by TAS-UK.

Herein we illustrate the performance of C-MAP in terms of aerosol and surface property retrievals using the Generalized Retrieval of Atmosphere and Surface Properties (GRASP) algorithm (Dubovik et al., 2011; 2021). Our analysis is carried out using simulated radiances generated by GRASP for various synthetic scenes characterized by pre-assumed atmospheric conditions in terms of aerosol content (shape, size, composition and load), solar zenith angle and surface albedo. The series of

sensitivity tests developed, aims to verify the C-MAP capability to derive a set of aerosol optical and microphysical properties along with surface characteristics. Here, microphysical properties include the aerosol size distribution, complex refractive index and fraction of spheres for coarse mode, while optical properties consist of the aerosol optical depth (AOD) and single scattering albedo (SSA). Surface reflectance is described through retrievals of Bidirectional reflectance distribution function (BRDF) and Bidirectional Polarization Distribution Function (BPDF) parameters.