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Joint Retrieval Of Surface Reflectance And Aerosol Properties: Application To MSG/SEVIRI in the framework of the aerosol_cci project

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A new versatile algorithm for the joint retrieval of surface reflectance and aerosol properties has been developed and tested at Rayference. This algorithm, named Combined Inversion of Surface and Aerosols (CISAR), includes a fast physically-based Radiative Transfer Model (RTM) accounting for the surface reflectance anisotropy and its coupling with aerosol scattering. This RTM explicitly solves the radiative transfer equation during the inversion process, without relying on pre-calculated integrals stored in LUT, allowing for a continuous variation of the state variables in the solution space.

The inversion is based on a Optimal Estimation (OE) approach, which seeks for the best balance between the information coming from the observation and the a priori information. The a priori information is any additional knowledge on the observed system and it can concern the magnitude of the state variable or constraints on temporal and spectral variability. Both observations and priori information are provided with the corresponding uncertainty.

For each processed spectral band, CISAR delivers the surface Bidirectional Reflectance Factor (BRF) and aerosol optical thickness, discriminating the effects of small and large particles. It also provides the associated uncertainty covariance matrix for every processed pixels.

In the framework of the ESA aerosol_cci project, CISAR is applied on TOA BRF acquired by SEVIRI onboard Meteosat Second Generation (MSG) in the VIS0.6, VIS0.8 and NIR1.6 spectral bands. SEVIRI observations are accumulated during several days to document the surface anisotropy and minimize the impact of clouds. While surface radiative properties are supposed constant during this accumulation period, aerosol properties are derived on an hourly basis. The information content of each MSG/SEVIRI band will be provided based on the analysis of the posterior uncertainty covariance matrix. The analysis will demonstrate in particular the capability of CISAR to decouple the fraction of TOA BRF signal coming from the surface from the one originating from the aerosols.

The results of the algorithm are compared with independent data sets of AOD and surface reflectance. Comparison with ground observations from the AERONET network shows a good agreement between these data. The surface reflectance evaluation is performed comparing white-sky albedo retrieved by CISAR with the MODIS surface product. This evaluation shows a very good consistency. The retrieved aerosol optical depth is consistent also in term of spatial distribution, being comparable in terms of geographical location and intensity.