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Aerosol Optical Thickness Retrieval in Presence of Clouds

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The discrimination between cloudy and cloud free satellite observations is a common preliminary step for aerosols and cloud retrieval algorithms. However, it is estimated that about 20% of all available observations are discarded by both types of algorithms as they do not fall neither in the clear sky nor the cloudy condition [1]. Several studies showed the dependency of aerosol retrieval algorithms on the actual cloud mask [2]. To address these issues, the Combined Inversion of Surface and AeRosols (CISAR) algorithm developed by Rayference for the joint retrieval of surface and aerosol single scattering properties has been further improved to extend the retrieval to clouds [3]. The state vector consists in the surface reflectance model parameters, the aerosol optical thickness (coarse and fine – absorbing and non-absorbing - mode) and the cloud optical thickness (small and large water particles and ice particles). In the presence of thin clouds, both aerosol and cloud optical thickness can be retrieved within the same pixel. Satellite observations are accumulated in time during an given period, during which the surface reflectance properties are considered invariant, while aerosol and cloud single scattering properties are retrieved at each satellite acquisition. In the event of a mostly cloudy accumulation period, i.e., when the averaged cloud optical thickness retrieved by CISAR is larger than 5, no surface retrieval takes place, and the solution is set equal to the prior information.

The sensor's cloud mask can be either used to build the prior information on aerosol and cloud single scattering properties or simply discarded after a so-called training period, during which only cloud-free observations are processed; this is necessary to build a reliable surface prior information. The prior information definition on the cloud single scattering properties capitalizes on the specific sensor characteristics: temporal and spatial resolution, spectral response function, etc. [3]. Results obtained applying the CISAR retrieval to S3A/SLSTR, MSG1-MSG4/SEVIRI and PROBA-V observations in the framework of the ESA aerosol-CCI+, DUST2MSG and SPAR@MEP projects will be presented. The setup of the algorithm and the prior information are sensor-specific: the implication of different sensor characteristic on the retrieval performances will be discussed.

Keywords: retrieval algorithm, aerosol, clouds, inverse modelling

References

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