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Multi-instrument synergetic retrieval for aerosol/surface characterization and validation with GRASP algorithm

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Big variety of different satellites on Earth orbit are dedicated to aerosol studies. However, due to limited information content, the main aerosol products of the most of satellite missions is AOD while the accuracy of aerosol size and type retrieval from space-borne remote sensing still requires essential improvement.

The problem of accurate extended aerosol characterization from satellite measurements is strongly affected by reliable separation of atmosphere and surface signals. There are several main requirements which can be applied on measurements to address this problem:

(i) Availability of multi-angular measurements in a wide range of scattering angle range where the differences between angular dependence of aerosol and surface signals can be observed and the angular sampling is enough for aerosol characterization.
(ii) Availability of measurements in a wide spectral range to take advantage of different spectral dependence of aerosol and surface signals and to observe spectral features of aerosol.
(iii) Availability of frequent temporal measurements to account for differences in the temporal variability of aerosol and surface conditions.
(iv) Availability of polarimetric measurements to gain advantages of different polarization dependence of aerosol and surface signals and strong dependence of such measurements on microphysical properties of aerosol.

Strictly speaking, since the end of the POLDER/PARASOL polarimetric mission in 2013, no single currently operating satellite satisfies above presented requirements. Though the currently operating satellites alone do not fit all formulated above requirements, the combination of measurements from different ones can satisfy them. The treatment of these multi-instrument data is beyond the capacity for most of the existent traditional algorithms since it requires simultaneous multi-pixel retrieval. For these purposes the new generation of the retrieval algorithm like GRASP can be used.

In this presentation we describe the possibilities of aerosol and surface extended characterization with GRASP algorithm in the post PARASOL period. In the framework of different ESA projects GRASP algorithm was adjusted to synergetic retrieval from different combination of space-borne as well as space-borne and ground-based instruments. It will be shown that the combination of satellites with fine (less then 100 m resolution) and coarse (a few kilometers and more and global coverage) spatial resolution opens new possibilities for aerosol sources identifications at fine spatial resolution and aerosol emission/pollution monitoring. We also present the concept of synergetic retrieval from the combination of the ground-based (AERONET) measurements with diverse space-borne instruments like PARASOL, S5P/TROPOMI, S2 and S3/OLCI. Finally, the synergetic retrieval from multi-instrument space-borne measurements will be discussed on the example of synergy of polar orbiting instruments S5P/TROPOMI, S3A/ and S3B/OLCI.

Keywords: synergetic retrieval, aerosol, surface, remote sensing