Synergetic retrieval from multi-instrument measurements for advanced aerosol and surface characterization

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For number of climate studies the extended aerosol and surface characteristics in global scale are required. The global information can be obtained from space-borne measurements only. At present time there are a number of different satellites on Earth orbit dedicated to aerosol studies. Nevertheless, due to limited information content, the main aerosol products of the most of satellite missions is AOD while the accuracy of the extended properties requires essential improvements. This is relevant, in particular, to the retrieval of such properties as aerosol Size Distribution (SD), Single Scattering Albedo (SSA), full surface Bidirectional Reflectance Distribution Function (BRDF) etc. These extended characteristics are required, for example, for generation of high-quality aerosol and surface essential climate variables (ECVs) product, air-quality monitoring, aerosol emission and transport studies etc. In addition to the global scale, the extended aerosol properties with high temporal resolution are necessary for such important but challenging studies as aerosol-cloud interactions, gas-to-particle transformation, and aerosol dynamic in general.

At present time no single instrument satisfies all requirements for global and high-temporal extended aerosol characterization. One of the promising solutions of this problem originates from the idea of the synergetic aerosol and surface characterization from multi-mission instruments. Since a long time the realization of this idea has always been related to number of instrumental and algorithmic problems.

In the frame of ESA GROSAT and SYREMIS projects, the synergetic approach was implemented in GRASP algorithm and have been tested on different synergetic instrument constellations: (i) synergy of satellite and ground-based measurements; (ii) synergy of polar-orbiting (LEO) satellites (in particular, synergy of Sentinel-5p/TROPOMI, Sentinel-3A, -3B/OLCI instruments) and (iii) synergy of LEO and geostationary (GEO) satellites (in particular, synergy of Sentinel-5p/TROPOMI, Sentinel-3A, -3B/OLCI and HIMAWARI/AHI sensors).

We present the physical basis of the GRASP multi-instrument synergetic approach and demonstrate its new possibilities for extended aerosol and surface characterization in global scale and at high temporal resolution. The application of the developed synergetic concept to the new generation of space-borne polarimeters (for example, 3MI, SPEX, HARP etc) will be discussed.

Preferred mode of presentation: Invited