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An approach for comprehensive retrieval of aerosol properties from enhanced satellite observations.

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The proposed development is an attempt to enhance aerosol retrieval by emphasizing statistical optimization in inversion of advanced satellite observations. The concept improves retrieval accuracy relying on pronounced data redundancy (excess of the measurements number over number of unknowns). The concept has been successfully adopted and refined in the operational AERONET algorithm retrieving the detailed aerosol properties from ground-based sun-photometer observations, however the required redundancy of observations is not common in satellites observations. Nonetheless, the observations by POLDER imager on board of the PARASOL micro-satellite registering spectral polarized reflected atmospheric radiation in up to 16 viewing directions over each observed pixel provide sufficient basis for applying the proposed methodology. Moreover, the observations by POLDER can be further enhanced by the synchronized observations of other satellite sensors of A-Train constellation, such as MODIS and CALIPSO. The retrieval scheme is designed as statistically optimized multi-variable fitting of complete observation set including both measurements of total and polarized radiances at all available spectral channels. Based on this strategy, the algorithm is driven by large number of unknowns and aimed on retrieval of extended set of parameters affecting measured radiation. This approach is expected to allow robust retrieval of both the optical properties of aerosol and underlying surface from satellite observations over ocean and land. Even over land, the algorithm provides more detailed (compare to current operational PARASOL algorithm) information about aerosol properties including some information about aerosol sizes, shape, absorption and composition (refractive index).

In addition, the algorithm is developed as simultaneous inversion of a large group of pixels within one or several images. Such, multi-pixel retrieval regime takes advantage from known limitations on spatial and temporal variability in both aerosol and surfaces properties. Specifically the pixel-to-pixel or day-to-day variations of the retrieved parameters are enforced to be smooth by additional appropriately set a priori constraints. This concept is expected to provide retrieval of higher consistency for aerosol retrievals from satellites, because the retrieval over each single pixel will be benefiting from co-incident aerosol information from neighboring pixels, as well, from the information about surface reflectance (over land) obtained in preceding and consequent observation over the same pixels. It is should be noted that the approach considerably relies on the accumulated experience. Many aspects of the retrieval, as well as, actual computer tools were inherited from precedent efforts on developing AERONET operational retrieval and currently operating PARASOL algorithm.