The RemoTAP algorithm for characterization of aerosol microphysical and optical properties

Guangliang Fu[a,*], Sha Lu[a], Zihao Yuan[a], Neranga Hannadige[a], Erik van den Boogaard[a], Otto Hasekamp[a,*]

[a] *SRON Netherlands Institute for Space Research, Niels Bohrweg 4 2333 CA Leiden, the Netherlands*

[*] *Presenting author (g.fu@sron.nl)*

In the 2020s, a number of satellites with Multi-Angle Polarimetric (MAP) instruments have been and will be launched, such as the NASA PACE mission (launched 8 February 2024) with onboard the SPEXone and HARP-2 polarimeters, METOP-SG from ESA/EUMETSAT (launch planned Q4 2025) with the 3MI polarimeter, the ESA CO2M-mission (2026), and in the late 2020s the NASA ATMOS mission. MAP measurements provide the largest information content on aerosol properties from a passive remote sensing point of view, and allow accurate retrieval of aerosol optical properties (optical thickness, single scattering albedo, phase function) and microphysical properties (size distribution, refractive index, shape), needed for climate and air quality research.

The Remote Sensing of Trace gas and Aerosol Products (RemoTAP) algorithm [1,2,3,4], developed at SRON Netherlands Institute for Space Research, is a full inversion algorithm (including first guess retrieval and full physics retrieval) that considers a continuous space of aerosol microphysical properties (size distribution, refractive index), instead of using standard aerosol models, and properly accounts for land or ocean reflection by retrieving land or ocean parameters simultaneously with aerosol properties. The RemoTAP algorithm has different options for state vector definitions, e.g., parametric 2 mode (fit fine and coarse mode size distribution), multi-mode (fix size distribution for all modes to make the inversion problem more linear), and 3-mode (extension of parametric 2 mode by separating coarse mode to a dust mode and a soluble mode). These options give more flexibility for application to choose the best suited state vector definition. The algorithm also has different options to account for surface, e.g., two options Ross-Li and RPV to account for land surface angular dependence, two options over ocean to account for foam/whitecap contributions. In the recent years, the RemoTAP algorithm has been significantly speeded-up by looking into and targeting at the time-consuming source codes step by step, without hurting accuracies. This helps in terms of operational usage, e.g., for PACE/SPEXone.

This presentation will give an overview of the RemoTAP algorithm for aerosol retrievals and introduces new developments. Over the past 15 years, RemoTAP has gained successes on aerosol retrievals of satellite measurements from PARASOL/POLDER and PACE/SPEXone, of airborne measurements from RSP, AirMSPI, SPEX Airborne. In this presentation, we will first show how the latest RemoTAP version performs for POLDER and SPEXone, including a validation against AERONET. Next, we will introduce RemoTAP Neural Network (RemoTAP-NN) which has been developed to enhance speed and accuracy. It includes an ensemble of

RemoTAP retrieval- and forward model NNs with high accuracies. We will show examples of the use of RemoTAP-NN as stand-alone tools and in combination with the standard RemoTAP.

References

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