Combination of multiangular-polarimetric and SWIR spectrometric measurements for the simultaneous CO2, CH4 and aerosol retrieval in GRASP algorithm.

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One of the primary challenges in achieving the necessary precision in satellite retrievals of XCO2 and XCH4 is accurately characterizing atmospheric aerosols. Multiangular-Polarimetric measurements (MAP) represent the most advanced approach for understanding aerosol properties from space-borne platforms. Conversely, the optimal sensitivity to CO2 and CH4 concentrations, while minimizing scattering effects, is typically found within the SWIR-1 and SWIR-2 spectral bands. As a result, upcoming Copernicus missions such as Sentinel-7 CO2M or MetOp-SG Sentinel-5 with 3MI onboard are equipped with both MAP and SWIR spectrometric measurements.

The Generalized Retrieval of Atmosphere and Surface Properties (GRASP) is a recently developed versatile algorithm designed for various remote sensing observations (Dubovik et al., 2021). GRASP relies on comprehensive and rigorous modeling of atmospheric radiation, applicable to simulating a wide range of observations. Its numerical inversion is executed through highly statistically optimized fitting, following the Multi-Term Least Square minimization concept. Originally applied to MAP-like measurements in various applications (POLDER, 3MI, CO2M/MAP), the GRASP approach has now been extended to combine MAP and SWIR spectrometric measurements, offering a synergistic combined product of aerosol properties alongside additional information on columnar XCO2 and XCH4 (Li et al., 2019; Chen et al., 2020).

The GRASP algorithm is set to be employed with two different combinations of MAP and SWIR spectrometer instruments: CO2M/MAP+CO2M/CO2I (Lu et al., 2022) and 3MI+S5/UVNS. The inherent generality and high flexibility of the GRASP code will demonstrate the advantages of incorporating MAP measurements for improved XCO2 and XCH4 accuracy compared to standalone spectrometers. Additionally, it will highlight the benefits of combining additional spectrometric bands around the O2 A-Band to enhance aerosol layer height characterization (Herreras-Giralda et al., 2022).

References

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