

Combined retrieval of XCO₂, XCH₄ and aerosol properties from SWIR spectrometric and multiangle polarimetric measurements with 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).

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