Sub-pixel Cloud Fraction Retrieval Based on the CO2M Multi-Angular Polarimetric Satellite Measurements

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The Earth's atmosphere contains suspended particles and molecules with a wide range of characteristics. Their interaction with radiation (in both solar and thermal spectral regions) affects the transfer of energy as well as its spatial distribution in the atmosphere, affecting the weather at any moment and climate in the long term. Multi-Angular Polarimetric (MAP) observations have a great potential for quantifying the properties (e.g., size, concentration, etc.) of aerosol particles at a high accuracy. For this reason, a MAP is included on the Copernicus Carbon Dioxide Monitoring satellite mission (CO2M; intended launch date: 2026) to provide a correction of the light path to meet the mission's stringent requirements for CO2 column retrievals. However, for both trace gas and aerosol retrievals it is also essential to filter out any cloud-contaminated measurements, because clouds strongly interact with radiation and cover between 60-70% of the Earth's surface at any given time. The focus of this study is on a neural network algorithm designed at SRON for quantifying cloud coverage at the sub-pixel level based on the MAP instrument on CO2M. This algorithm is an adaptation of an approach that was initially developed at SRON for the MAP instrument onboard the Polarisation and Anisotropy of Reflectances for Atmospheric Science coupled with Observations from a Lidar (PARASOL) platform (i.e., POLarization and Directionality of Earth Reflectances; POLDER) [1]. It is trained based on synthetic measurements and quantifies the sub-pixel cloud fraction. Here we will provide information on the algorithm's performance at different cloud coverage levels and as a function of cloud properties. Further, suitability of the approach for the CO2M mission will be discussed.

References

[1] Yuan, Z., G., Fu, B., van Diedenhoven, H. X., Lin, J. W., Erisman, O. P., Hasekamp, 2023: Cloud Detection from Multi-Angular Polarimetric Satellite Measurements using a Neural Network Ensemble Approach, Atmos. Meas. Tech. Discuss. doi: https://doi.org/10.5194/amt-2023-145 .

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