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Spaceborne passive remote sensing of cloud properties: bottom altitude, profile of droplet radius, optical thickness of ice and aerosol-contaminated clouds

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The main goal of this work is the development of algorithms suited for the retrieval of cloud parameters from spaceborne passive spectral measurements. They will be applied to measurements of the forthcoming ESA missions such as Sentinel 3 and Sentinel 5(-precursor), respectively equipped with the TROPOMI and OLCI payloads. To this end, two different approaches have been adopted for the retrieval of macro and micro-physical cloud properties. The first method exploits the well-known sensitivity of the oxygen A-band (centred at 761 nm) to cloud vertical displacement. The algorithm, based on analytical approximations of radiative transfer, retrieves the top height and the geometrical thickness of a cloud, enabling the calculation of the bottom altitude. The quality of the retrievals is globally assessed with comparison of co-located cloud products inferred from ground-based measurements of the ARM network and from the CALIOP instrument onboard the CALIPSO satellite. The second method uses selected spectral channels in the near and short-wave infrared to infer the vertical profile of effective radius of cloud droplets, optical thickness of ice and aerosol-contaminated clouds. The technique is based on the sensitivity of variations of top-of-atmosphere radiance to changes in the respective cloud parameters, and is implemented with weighting functions. These algorithms have been tested on MODIS Terra radiances and their results have been compared to the standard MOD06 collection.