Neural network-based cloud property retrievals from satellite multi-angle polarimetry

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Satellite multi-angle polarimetry is a useful technique for observing cloud microphysical properties on a global scale [1]. Many algorithms for the retrieval of cloud properties from satellite are based on lookup-tables (LUTs). In these algorithms, the retrieval is performed by choosing, within a predefined database of combinations of clouds or aerosol properties, the combination that best fits the measurements. LUT retrievals are quicker than full-physics, iterative retrievals, but their accuracy is limited – among other factors – by the number of entries stored in the LUT. Another retrieval method capable of producing very quick retrievals without a big sacrifice in accuracy is the neural network method. Neural network methods are routinely applied to several types of satellite measurements, but their application to multi-angle polarimetric data is still in its early stage, mainly because of the difficulty of accounting for the angular variability of the measurements in the training process.

We have recently developed a neural network scheme for the retrieval of cloud properties from POLDER-3 data [2]. The neural network retrieval is trained using synthetic measurements performed for realistic combinations of cloud properties and measurement angles, and is able to process an entire orbit in about 20 sec. Comparisons of the retrieved cloud properties with Moderate Resolution Imaging Spectroradiometer (MODIS) products over one year show encouraging retrieval performance for cloud optical thickness and effective radius. In this presentation we will discuss the setup of the neural network and the validation results, as well as the possibility of extending the method to future satellite multi-angle polarimeters such as 3MI [3].

References

[1] Bréon, F.-M., and P. Goloub, 1998: Cloud droplet effective radius from spaceborne polarization measurements. *Geophys. Res. Lett.* **25**, 1879–1882.

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[3] Fougnie, B., T. Marbach, A. Lacan, *et al*., 2018: The multi-viewing multi-channel multi-polarisation imager – overview of the 3MI polarimetric mission for aerosol and cloud characterization. *J. Quant. Spectrosc. Radiat. Transfer* **219**, 23–32.

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