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# Infrared-Microwave synergy to improve low values Liquid Water Path retrievals in fog conditions.

**Donatello Gallucci**[1], Pauline Martinet[2], and Domenico Cimini[1,3]
[1]National Research Council - Institute of Methodologies for Environmental Analysis, Earth system science and environmental technologies, Italy (donatello.gallucci@cnr.it)
[2]Météo-France, 42 avenue Gaspard Coriolis, 31057 Toulouse, France
[3]Center of Excellence Telesensing of Environment and Model Prediction of Severe events (CETEMPS), University of L'Aquila, 67100 L'Aquila, Italy

Accurate measurement of physically relevant parameters through cloudy atmospheres is crucial for climate studies and radiative transfer modelling. In particular, small perturbations in the Liquid Water Path (LWP) retrieval within liquid water clouds greatly affect longwave and shortwave radiative fluxes when LWP is lower than 100 g/m$^2$. Since a large fraction of liquid water clouds in all climate regimes feature such a condition, improving the retrieval of low LWP amounts from ground-based observations is highly desirable. In fact, uncertainties for LWP retrievals from Microwave radiometer (MWR) are generally acceptable for the high LWP values, but are relatively large for lower values typically observed in fog conditions. Further work is therefore required to achieve the accuracy needed when the LWP is small. In this work, we show the benefit of a combined infrared (IR) and microwave (MW) approach, to improve ground-based liquid water path retrievals during fog. We consider a 14 MWR profiler operating in the 22-58 GHz frequency range and a IR radiometer operating at 10.5um. The research is conducted over a simulated dataset of atmospheric profiles from a numerical weather prediction model (AROME) and radiative transfer calculations from MonoRTM and RTTOV-gb radiative transfer models. The IR signal is shown to be very sensitive for LWP values lower than 100 g/m$^2$, spanning a temperature range as high as 80 K. To that end, statistical (linear and quadratic) regressions are first trained with synthetic observations. We analyse the differences in LWP retrieval with and without the IR contribution, in order to evaluate its impact. As a future step, these coefficients will be applied to real measurements from the Météo-France SOFOG3D experiment (Burnet et al., 2020; Martinet et al., 2020) for evaluation. This work is conducted in the framework of COST Action PROBE (CA18235, Profiling the atmospheric Boundary layer at European scale, http://probe-cost.eu/) (Cimini et al., 2020).

Burnet et al., https://doi.org/10.5194/egusphere-egu2020-17836, 2020.

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