Investigation of the twilight zone between aerosols and clouds using active and passive remote sensing

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One of the main key uncertainties in the assessment of the Earth's radiatve balance and in the modeling climate is the aerosol indirect effect (AIE). A relevant part of the study of AIE is related to the effect of the twilight zone. The twilight zone is described as a distinct zone characterized by intermediate conditions associated with evaporating cloud fragments and enhanced aerosol [1, 2]. The twilight zone has been observed both close to the edge of visible cloud layers or also in apparently clear skies [3].

In order to better characterize the twilight zone a synergy of active and passive remote sensing instrumentation has been used to find evidence of the presence of liquid water in visible clear skies. We analyzed microwave radiometer data from the CNR-IMAA site in Potenza, Italy [4] along with co-located LIDAR retrievals and sky camera imagery.

Several scenarios near clouds or in broken cloud fields has been found which exhibit an increase in the brightness temperatures (Tb) measured at the 30 GHz by the microwave radiometer which is the most sensitive radiometer channel to liquid water. Co-located simultaneous LIDAR observations and images from the sky camera allow to classify these scenarios as "clear sky".

This behaviour is consistent with previous twilight zone scenarios described in literature by Madonna *et al*. [3] and Koren *et. al*. [5]. At the present stage, an asseement of the effect on the twilight zone on the Tb measurements is under development using radiative transfer modelling and Large-eddy simulation models.

[1] Koren *et al*. (2007) *Geophys. Res. Lett*. **34**, L08805. [2] Charlson *et al*. (2007) *Tellus B* **59**, 715-727. [3] Madonna *et al*. (2009) *Geophys. Res. Lett*. **36**, L18802. [4] Madonna *et al*. (2011) *Atmos. Meas. Tech*. **4**, 1191-1208. [5] Koren *et al*. (2009) *Geophys. Res. Lett*. **36**, L14805.