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Towards a standard procedure for validation of satellite-derived cloud liquid water path: a study with SEVIRI data

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Differences between satellite-derived and ground-based values of cloud liquid water path (LWPsat and LWPgr) in validation studies are partly caused by issues associated with the validation itself, in particular scale differences and the parallax. We have performed calculations aiming at establishing standards for validation procedures so that contributions to the differences by the validation issues are minimized. To study this topic LWP values computed from ground-based microwave radiometer (MWR) summer measurements made at two Cloudnet sites and from the space-borne SEVIRI instrument were collected. The large amount of all-sky sample pairs (2̃500 after selection) formed an essential condition for the present study.

Best settings of validation parameters and methodology were determined by optimum statistical agreement between LWPsat and LWPgr. The optimum method consists of i) computation of LWPsat by averaging LWP over the pixels surrounding the ground station using a Gaussian weight function with a length scale that defines the 'validation area', ii) computation of LWPgr by averaging the MWR measurements with a Gaussian weight function, using a time scale that is considerably longer than the time needed for the clouds to move across the validation area (by a factor of 3-15) and iii) correcting for parallax. It is argued that the best length scale for averaging the satellite data is equal to the image resolution.

The improvement due to the parallax correction was significant at the 99.5% level, but its effect was not significant for a sub-set of the data representing relatively homogeneous cloud fields. Also, adjusting the time scale for averaging the ground data to the instantaneous wind field instead of taking a constant does not have a significant effect.

Our suggestions might also be applicable for the validation of other cloud-related properties that vary at the same scales as cloud LWP, in particular cloud optical thickness and atmospheric transmission.