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Inter-technique comparison of integrated water vapour measurements for climate change analysis

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Water vapour plays a dominant role in the climate change debate. However, observing water vapour for a climatological time period in a consistent and homogeneous manner is a challenging task. To this end, water vapour estimations derived from ground-based Global Navigation Satellite System (GNSS) observation networks such as the International GNSS Service (IGS) network are very promising, with continuous observations spanning over the last 15 years. On the other hand, the AErosol RObotic NETwork (AERONET) also provides long-term and continuous ground-based observations of the total water vapour content performed with standardized and well-calibrated sun photometers.

The aim of the present study is to assess the applicability of either dataset for water vapour time series analysis. Therefore, we compare the integrated water vapour (IWV) measurements retrieved (at zenith) from these two techniques, focusing on a selection of about 30 sites worldwide. We show that both techniques agree at the level of 0.300 mm +/- 1.367 mm of IWV. In a case study, we further investigate at the station Uccle (Brussels, Belgium) the influence of the clouds on the IWV inter-technique comparison and we compare the IWV values obtained from these instruments directly in the direction of the sun ("solar slant IWV").

Additionally, for our selection of 30 sites, we compare the GNSS and sun photometer IWV values with simultaneous and co-located radiosonde and satellite-based IWV measurements (IASI, GOME/SCIAMACHY/GOME2 and AIRS). In particular, we investigate the geographical dependency of the properties of the IWV scatter plots between all these different instruments.