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Validation of integrated water vapour from IGS ground-based GPS observations with sun photometer measurements

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Reliable and precise water vapour data are important for both, numerical weather prediction and climatological studies. Considering the high spatial and temporal variability of water vapour, conventional observing systems (e.g., radiosondes or meteorological satellites) are rather inadequate for proper monitoring, and additional data from new observation techniques are highly desirable. Ground-based zenith path delay (ZPD) observations from the Global Positioning System (GPS) provide a valuable source of vertically integrated water vapour (IWV) information. The International GNSS Service (IGS) provides ZPD data of currently about 300 globally distributed GPS stations. Meteorological information (ground pressure and temperature at the station) are needed to derive IWV from ZPD. Only a limited number of IGS stations is equipped with meteorological ground sensors up to now. We applied 6-hourly global analyses from the European Centre for Medium-Range Weather Forecasts (ECMWF) to convert the IGS 5-minute ZPD data set (starting from October 2000) to IWV. In this study we validate the GPS IWV results with collocated sun photometer observations from the AErosol RObotic NETwork (AERONET). Sun photometry exploits water vapour absorption, provided that no clouds or only thin cirrus are between the radiometer and the sun. In the considered time-frame (2001-2007) AERONET provides about 340 stations, about 60 of them show less than 50 km horizontal and 100 m vertical distance to IGS stations. According to validation results we discuss the applicability (including temporal interpolation) of ECMWF analyses data for ZPD to IWV conversion. To prove whether GPS and photometer data provide significant additional

water vapour information we also intercompare with IWV from ECMWF analyses.