



## **Monitoring water cycle elements using GNSS geodetic receivers at the field research station Marquardt, Germany**

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Water storage variations in the atmosphere and in soils are among the most dynamic within the Earth's water cycle. The continuous measurement of water storage in these media with a high spatial and temporal resolution is a challenging task, not yet completely solved by various observation techniques. With the development of the Global Navigation Satellite Systems (GNSS) a new approach for atmospheric water vapor estimation in the atmosphere and in parallel of soil moisture in the vicinity of GNSS ground stations was established in the recent years with several key advantages compared to traditional techniques.

Regional and global GNSS networks are nowadays operationally used to provide the Integrated Water Vapor (IWV) information with high temporal resolution above the individual stations. Corresponding data products are used to improve the day-by-day weather prediction of leading forecast centers. Selected stations from these networks can be used to additionally derive the soil moisture in the vicinity of the receivers. Such parallel measurement of IWV and soil moisture using a single measuring device provides a unique possibility to analyze water fluxes between the atmosphere and the land surface.

We installed an advanced experimental GNSS setup for hydrology at the field research station of the Leibniz Institute for Agricultural Engineering and Bioeconomy in Marquardt, around 30km West of Berlin, Germany. The setup includes several GNSS receivers, various Time Domain Reflectometry (TDR) sensors at different depths for soil moisture measurement and an meteorological station. The setup was mainly installed to develop and improve GNSS based techniques for soil moisture determination and to analyze GNSS IWV and SM in parallel on a long-term perspective. We introduce initial results from more than two years of measurements. The comparison in station Marquardt shows good agreement (correlation 0.79) between the GNSS derived soil moisture and the TDR measurements.

A detailed study for several periods with different GNSS settings, vegetation and soil conditions in the vicinity of the station is presented with emphasis on the behavior of GNSS derived soil moisture, compared to TDR. Case studies of intense rainfall events and lasting dry periods show the interaction between the IWV and soil moisture.