EMS Annual Meeting Abstracts
Vol. 14, EMS2017-28, 2017

Monitoring of water cycle elements using GNSS geodetic receivers in North-East Germany at sub-daily resolution

Tzvetan Simeonov (1,2,3), Sibylle Vey (1), Fadwa Alshawaf (1), Galina Dick (1), Guergana Guerova (3), Andreas Güntner (1), Christian Hohmann (1), Efren Lopez (2), Eric Pottiaux (4), Benjamin Trost (5), Jens Wickert (1,2)

(1) German Research Centre for Geosciences (GFZ), Potsdam, Germany (tzvetan.simeonov@gfz-potsdam.de), (2) Technische Universität Berlin, Germany, (3) Sofia University, Bulgaria, (4) Royal Observatory of Belgium, Belgium, (5) Leibniz Institute for Agricultural Engineering and Bioeceonomy, Potsdam-Bornim, Germany

The atmosphere and the soils are the first and third most dynamic water storage components on the Earth. Continuous measurement of water quantities in these media with a high spatial and temporal resolution is a challenging task, solved by a spectrum of measurement techniques. With the development of the Global Navigation Satellite Systems (GNSS) new techniques for water estimations in the atmosphere and in soils have been established with several key advantages.

Integrated Water Vapour (IWV) in the atmosphere has operationally been monitored using the GNSS for more than two decades. Specific GNSS ground-based stations also provide the possibility for estimating Volumetric Water Content (VWC) in soils, thus widening the range of water cycle products that can continuously be estimated with one sensor.

The GNSS soil moisture estimations are currently limited in temporal resolution to daily time series, due to the scarcity of used reflected signals from GNSS satellites in the vicinity of the GNSS geodetic stations. This limitation can partly be overcome by using a sliding windows technique with 24-hours averaged values at a hourly interval. In this study a validation of this technique is performed using collocated Time Domain Reflectometry (TDR) sensors in near-surface soil layers, providing data with hourly resolution. Thus, the main limitation of GNSS retrieved soil moisture compared to in-situ soil sensors will be markedly reduced without loosing the advantage of large area coverage advantage.

Two GNSS stations in North-East Germany are the core of this experiment. These stations are operational since 2014 with co-located TDR sensors and calibration of soil moisture performed using the gravimetric technique on direct soil samples. For both stations the correlation between the GNSS and TDR VWC daily time series is above 0.75 for the period between 2014 and the beginning of 2017. Differences between the GNSS and TDR methods can be attributed to the different area coverage and the different vertical integration depths in the soil.

The soil moisture data with higher temporal resolution from GNSS reflected signals will enable a better analysis of severe precipitation events and for soil-atmosphere interactions. Further comparison between the behaviour of VWC in soils and IWV in the atmosphere will reveal the coupling between these water cycle components.