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GNSS in real-time: Demonstration experiment at Berlin Airport International

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Real-time (RT) applications are in focus of recent GNSS research. International activities related to the RT data collection and distribution, as well as provision of specific RT data products (e.g., satellite orbits and clocks, station coordinates) are coordinated within the Real-Time Project of the International GNSS Service (IGS). Currently IGS provides real-time data from more than 100 globally distributed GNSS ground stations. This number, in parallel with the extension of various additional international real-time networks, is continuously increasing.

In parallel to the rapid development of GNSS RT activities also innovative geophysical applications were pioneered by GNSS research groups and institutions, including GFZ. One prominent example is the use of GNSS components in early warning systems. GNSS measurements can be used there for the rapid detection and characterization of deformation fields, related to earthquakes, which induce Tsunamis. Such deformation data cannot be provided by seismometer measurements, but are important for the prediction of the tsunami wave propagation caused by earthquakes.

The GNSS real-time group at GFZ is involved in several research projects related to geophysical RT GNSS applications, and also operates one of the RT analysis centers of the IGS. We introduce results of a real-time GNSS demonstration project, which was performed in 2012 at the new Berlin International Airport BER at Schönefeld, south-east of Berlin city center. The main goal of the project was the demonstration of the functionality of a complex RT–PPP server-client solution for dynamic applications which was developed within a joint research project of GFZ and the company Alberding GmbH. Compared to the standard PPP (clock & orbit) this solution uses additional information (ionosphere, uncalibrated phase delays UPD) to increase the positioning accuracy and to reduce the convergence time.

The major challenges of the experiment were the stable operation of the entire server-client system, the implementation of a mainly for scientific purposes developed software to a potentially commercial positioning solution, the real-time GNSS data management, and the generation and usage of the correction data. We evaluate the server-client system functionality and PPP results of the experiment in view of the project goals and indicate problems to be focused in future work.

In addition, the GNSS data from a temporary ground station at the air-field was used to derive vertically integrated water vapor (IWV) data to demonstrate the potential of real-time water vapor data to improve the weather forecast at the airport. The IWV data are compared with measurements from nearby stations of the permanent German GNSS network for atmosphere sounding and with a water vapor radiometer, operated at GFZ.