G5.2 Atmospheric and Environmental Monitoring with Space-Geodetic Techniques and Contributions to Extreme Weather Studies

Multi-GNSS Meteorology at GFZ Potsdam: Severe flood events in Germany in July 2021

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The year 2021 abounded in many severe weather events. The Ahr Valley flood in July, where almost 200 people have lost their lives, was the deadliest natural disaster in Germany since 1962. This shows that heavy precipitation is still one of the most dangerous weather phenomena in Europe. Improving its prediction will lead to better warning systems e.g., against flash floods, debris falls or landslides. One way of improving the forecasts is the assimilation of external data. Several weather services operationally assimilate the data from Global Navigation Satellite Systems (GNSS), mostly the GPS-only zenith total delay (ZTD) or integrated water vapor (IWV) into their Numerical Weather Models (NWMs).

The current research project of the German Research Foundation DFG (Advanced MUlti-GNSS Array for Monitoring Severe Weather Events, AMUSE), performed in a cooperation of TUB, GFZ and the German Weather Service (DWD), focuses on the assimilation of the advanced multi-GNSS products, especially slant total delays (STDs), into NWMs. In this study, we present the derivation of the multi-GNSS (at the moment GPS/GLONASS/Galileo) tropospheric products at GFZ, i.e. the ZTDs, STDs and tropospheric gradients, for the severe floods in July 2021 in Germany. The obtained parameters are compared with the global NWMs: ERA5 reanalysis of ECMWF and two forecast models: ICON run by the DWD and GFS run by the US Weather Service. The results show that all considered GNSS solutions have a similar level of agreement with the NWMs. However, for the flood regions in the western Germany, the biases from the multi-GNSS solutions are smaller compared to the GPS-only solutions. The NWM parameters are compared also with each other. There are differences between the particular models, however, the differences are smaller than between the NWM and GNSS.