## Benchmark Campaign of the COST Action GNSS4SWEC: Main Goals and Achievements

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This talk will give an overview of achievements of the Benchmark campaign, one of the central activities in the framework of the COST Action ES 1206 GNSS4SWEC. The main goal of the campaign is supporting the development and validation of advanced Global Navigation Satellite System (GNSS) tropospheric products, in particular high-resolution and ultra-fast/real-time zenith total delays (ZTD) and asymmetry products in terms of tropospheric horizontal gradients and slant delays.

For the Benchmark campaign a complex data set of GNSS observations and various meteorological data were collected for a two-month period in 2013 (May-June) which included severe weather events in central Europe. An initial processing of data sets from GNSS and numerical weather models (NWM) provided independently estimated tropospheric reference products – ZTDs, tropospheric horizontal gradients and others. The comparison of horizontal tropospheric gradients from GNSS and NWM data demonstrated a very good agreement among independent solutions with negligible biases and an accuracy of about 0.5 mm. Visual comparisons of maps of zenith wet delays and tropospheric horizontal gradients showed very promising results for future exploitations of advanced GNSS tropospheric products in meteorological applications such as severe weather event monitoring and weather nowcasting.

The benchmark data set is also used for an extensive validation of line-of-sight tropospheric Slant Total Delays (STD) from GNSS, NWM ray-tracing and Water Vapour Radiometer (WVR) solutions. Six institutions delivered their STDs based on GNSS observations processed using different software and strategies. STDs from NWM ray-tracing came from three institutions using three different NWM models. Results show generally a very good mutual agreement among all solutions from all techniques. Among all an influence of adding not cleaned as well as cleaned GNSS post-fit residuals, i.e. residuals with eliminated and not eliminated non-tropospheric systematic effects such as multipath, to estimated STDs will be presented.