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Towards the fusion of GNSS and InSAR observations for the purpose of water vapor retrieval

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Incompletely or incorrectly modeled atmospheric effects limit the quality of observations of space-based geodetic sensors, such as GNSS (Global Navigation Satellite Systems) and InSAR (Interferometric Synthetic Aperture Radar). In contrast, state variables of the Earth's atmosphere – especially water vapor – contain valuable information for climate research and weather forecast, which can be derived based on the sophisticated exploitation of these observations. Therefore, the long-term goal of our research is aiming at the fusion of geodetic and additional meteorological data (e.g., Weather Research and Forecasting Model, WRF) combining the benefits of each input data set (e.g., GNSS: continuous high-rate data; InSAR: high spatial resolution).

Up to now, the Institute of Photogrammetry and Remote Sensing (IPF) and the Geodetic Institute (GIK) of the Karlsruhe Institute of Technology (KIT) have carried out various research in the context of water vapor retrieval in close cooperation especially focusing on the comparison of the geodetic sensors GNSS and InSAR and taking into account meteorological information (e.g., WRF, surface meteorology) resp. data from other Earth observing systems (e.g., Medium Resolution Imaging Spectrometer). The area under investigation is the Upper Rhine Graben (URG), which is covered by the dense GNSS network GURN (GNSS Upper Rhine graben Network) since 2002. In addition, a large stack of ENVISAT SAR data is available in the period from 2003 to 2009.

This presentation aims at the straight-forward comparison of signal-direction-related path delays derived from GNSS and InSAR. Therefore, InSAR's neutrospheric phase, separated from other components contained in InSAR measurements, is compared to GNSS results, which consist of prediction model, mapping function, estimated zenith and gradient parameters as well as estimated observation residuals. Within the GNSS (InSAR) data processing the precise point positioning (persistent scatterer) approach is applied.

In particular, the effect of the Vienna mapping function on the GNSS results is evaluated based on a comparative study carried out with respect to other mapping functions. In addition, the significance of the estimated neutrospheric parameters and the GNSS residuals is discussed regarding their contribution to the signal-direction-related path delays. Using the most suitable GNSS-related path delays, comparisons with respect to the signal direction of the InSAR satellite are carried out resolving the differential characteristic of InSAR-based neutrospheric delays. A complementary comparison with neutrospheric delays deduced from numerical weather model data of WRF is planned.