

Monitoring the Changing Earth - From Observations to Modelling

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Repeated and continuous geodetic observations nowadays have the potential to monitor the earth system and its various partial systems on different temporal and spatial scales. Deformations of the earth's surface can be detected by classical terrestrial and modern space geodetic observations on global up to local scales. Mostly, these deformations are accompanied by mass shifts in the vicinity of the earth's surface and/or its interior, inducing also changes in the gravitational field; thus, monitoring the time-variable gravity field of the earth provides another source of information related to the underlying geodynamic and hydrological processes. Furthermore, since geodetic space observations generally are based on electromagnetic signals propagating through the atmosphere, they also contain information about meteorological parameters, in particular the spatio-temporal water vapor distribution.

Since many processes interact and influence several subsystems of the Earth system simultaneously, modeling of geodetic observables is an extremely complex task, requiring competences from and collaboration between various fields of geosciences. Nevertheless, recent results in the joint analysis of geodetic and geophysical observations are very encouraging. In the lecture, recent results from an analysis of geodetic observations in the tri-national Upper Rhine Graben area, one of the most seismically active regions in Europe north of the Alps, will be presented, based on a combination of repeated levellings, permanent GNSS observations and InSAR data. Challenges in merging the results of the three geodetic techniques are related to the definition of a unified geodetic datum, the different spatio-temporal locations of the observation sites, the small size of the displacements in the region, the discrimination between natural and anthropogenic sources of deformations, as well as the different precision standards used in the national services in Germany, France and Switzerland. Furthermore, the significance of long-term recordings is pointed out, in particular referring to the long time interval of levellings of more than 100 years. Finally, a joint modelling of geodetic and geophysical observations in the region of the Marmara Sea is presented. In the outlook, various problems and challenges on the route from observation to complex modelling of the Earth System will be pointed out.