DESCRIPTION-FOR-THE-GENERAL-PUBLIC [ENGLISH]

The project focuses on the determination of temporal mass variations within the Earth system on a regional/local scale using space geodetic data. The estimation of those temporal mass variations with the best accuracy as well as high temporal and spatial resolutions is one of the main tasks in the Earth science-related disciplines, e.g. in geodesy, geodynamics and geophysics.

The knowledge of temporal mass variations within the Earth system is essentially needed for understanding, monitoring and predicting many issues related to the Earth system, e.g. (1) crustal deformation due to mass loading – needed for dealing with natural hazard, (2) water mass variations – needed for dealing with climate change, flood, drought, groundwater depletion, (3) temporal gravity variations – needed to correct gravity control as well as to model regional geoid/quasigeoid with sub-centimetre accuracy.

The GRACE mission launched in 2002 brought a unique opportunity for the determination of temporal mass variations within the Earth system. The mission initially planned for five years, is expected to be in operation until 2018. It is, without any doubt, a state-of-the-art space geodetic technique for monitoring temporal mass variations within the Earth system. The GRACE mission has clearly revolutionized research in many disciplines of Earth sciences. The tremendous success achieved from the mission emphasized the need of launching a GRACE-type mission for a sustainable long-term monitoring of temporal mass variations within the Earth system. The GRACE Follow-on (GRACE-FO) mission is in the implementation phase with a target launch date at the turn of 2017 and 2018. Besides GRACE-type satellite missions, the Global Navigation Satellite System (GNSS) has proven itself as one of the most powerful space geodesy tools for the determination of temporal mass variations in the Earth system and related geodynamic processes. It is successfully used to study the elastic ground loading deformation in response to the Earth hydrological mass variations.

The coarse spatial resolution of GRACE/GRACE-FO products is one of the main weaknesses of these missions. Moreover, GRACE level-2 products (e.g. GRACE-based GGMs) as well as GRACE-based mascon products being the results of a complex processing of GRACE mission data, are released to scientific users with a delay of a few months. On the other hand, temporal mass variations can be obtained using GNSS data in real or near real time, but they represent the local effect for a very limited area within the radius of a few kilometers from the GNSS station. Furthermore, coordinate variations obtained from GNSS data are affected by many errors, e.g. the draconitic error that systematically affects the seasonal periods in GNSS series. However, investigation concerning the use of GNSS CORS networks to study temporal mass variations within the Earth system is essentially needed. GRACE data and GNSS data seem complementary to each other to study temporal mass variations within the Earth system, in particular, in terms of resolution as well as mutual verification and validation.

The overarching objective of the proposed project is better understanding the mechanisms of temporal mass variations within the Earth system on a regional/local scale and modelling them using GRACE mission data and GNSS data. The proposed project is dedicated to provide an innovative estimation of temporal mass variations by combining temporal mass variations obtained from GRACE mission data and from GNSS data. Case study for the area of Poland shall be performed, but similar research can be conducted in any part of the world where GNSS CORS networks of homogeneously distributed stations are in operation. Numerical results obtained for the study area might be of great importance for better understanding regional geodynamics but also for applications in different branches of economy and environmental management.

The expected advantage of this project could considerably help to (1) enhance and update the gravity control and its dynamic change, (2) upgrade the vertical height system by considering the seasonal variation of the crust, (3) develop a sub-centimetre accuracy geoid model – needed for scientific purposes as well as for high precision applications, (4) open a new application of the national GNSS CORS network that has already been established; the national GNSS CORS stations can be considered as in-situ instrumentation that enables the collection of information related to mass variations within the Earth system, (5) provide significant benefits to the water resource management.