Geodetic heights, such as ellipsoidal, geoid/quasigeoid, and orthometric/normal heights, are essentially needed in numerous engineering applications as well as in research concerning, in particular, the shape of the Earth. Over the past 150 years, these heights obtained at reference geodetic stations, such as reference tide gauges, have been utilized for the definition of national levelling networks. In 2015, the International Association of Geodesy (IAG) has pointed out the need for the definition and realization of an International Height Reference System (IHRS). The parameters, observations, and data that are intended to be used for the definition and the realization of IHRS shall be related to the mean tidal system/mean crust. Currently, the realization of the IHRS; i.e. the establishment of the International Height Reference Frame (IHRF): a global network with regional and national densifications, whose geopotential numbers referred to the global IHRS are known, is one of the main challenges in geodetic science.

The main purpose of project is to investigate and assess temporal variations of geodetic heights at the IHRF sites using Gravity Recovery and Climate Experiment (GRACE) and GRACE Follow–On (GRACE–FO) satellite missions data as well as GNSS (Global Navigation Satellite System), VLBI (Very Long Baseline Interferometry), SLR (Satellite Laser Ranging), DORIS (Doppler Orbitography and Radiopositioning Integrated by Satellite), tide gauges and hydrology data.

The geodetic heights are, so far, considered as static heights in the majority of land areas over the world. The only exception are areas of an evident land subsidence/uplift. For such areas, the secular change of geodetic heights was considered. Temporal variations of geodetic heights are, however, affected by both secular and seasonal changes. For example, temporal mass variations within the Earth system generate both temporal mass loading and potential changes that results in temporal variations of geodetic heights. Thus, such temporal variations of geodetic heights should be investigated and assessed.

Within the course of this project, a new research team including young promoted scientists, will be established. This team is expected to enrich the Polish scientific activities on the advances of geodetic science, and sustainably contribute to the IHRF in the future. The anticipated results from this project will considerably help to:

- assess the reduction of geodetic heights at IHRF sites into the mean tidal system/mean crust that required for the definition and the realization of the IHRS;
- determine and investigate global changes in the up component of the Earth’s surface induced by temporal mass variations within the Earth’s system as well as regional crustal deformations due to mass loading needed for dealing with natural hazards;
- detect seasonal and secular changes of the sea level;
- update national levelling networks by considering their temporal variations;
- unify national levelling networks of contiguous territories considering temporal variations of orthometric/normal heights at their IHRF reference sites;
- improve the accuracy and the reliability of orthometric/normal height values utilized by land surveyors and geodetic engineers.

Overall, results from this project are expected to be essential for the development of the geodetic field and its related Earth science disciplines.