Geophysical Research Abstracts
Vol. 21, EGU2019-8605-1, 2019
EGU General Assembly 2019

The Zugspitze Geodynamic Observatory Germany – Installations and First Data Analysis

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The Zugspitze Geodynamic Observatory Germany (ZUGOG) has been setup on the summit of mountain Zugspitze at an altitude of almost 3000 m during 2018 with the main scientific objective to obtain a better understanding of seasonal and long-term mass redistributions in the European Alps. This knowledge is known to be very important, e.g. with regard to water storage and its high sensitivity to climate change, but not very advanced due to sparse data availability. ZUGOG is connected to the Environmental Research Station Schneefernerhaus as the home base of a large research consortium operating a dense sensor network for almost 20 years as well as providing technical support and infrastructure. It is accessible all around the year with cable cars.

In September 2018, the Observatory Superconducting Gravimeter (SG) 052 has been installed at ZUGOG after removal from Sutherland, South Africa, as one of two SGs operating in parallel and refurbishment at the manufacturer GWR. This former laboratory of the Max Planck Society on the summit of Zugspitze has no mass variations above the sensor, no snow accumulation on the roof and a largely increased gravimetric footprint due to the high altitude. Moreover, this location fits very well into the central European network of SGs. In addition, a GNSS station has been setup as well as meteorological and hydrological sensors in the local vicinity. The completed installations are described, and the first months of data are analysed with regard to noise characteristics, drift and signal separation.

This location offers a large variety of connections to other scientific groups and disciplines, which are discussed. These include episodic absolute and monthly relative gravimetric observations with the continuous SG observations filling an important gap in the concept of hybrid gravimetry. From a hydrological perspective, the conditions of the Research Catchment Zugspitze are very suitable being regarded as a natural lysimeter. In addition to the point measurements of individual storage compartments of the hydrological sensor network, the SG provides the total water storage variations from a bird's eye perspective on the summit in the sense of hydrogravimetry. These will also be applied for the validation of GRACE Follow-On. For the monitoring of mountain permafrost in Zugspitze, geoelectric and seismic observations but also permanent temperature observations are used. The SG on the summit directly above the permafrost supports the analysis of seasonal and long-term evolution of permafrost and allows for joint interpretation with complementary geophysical observations.