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Comparison of Tilt and SG-Gravity Residuals at Conrad Observatory (Austria)

Gábor Papp (1), Hannu Ruotsalainen (2), Judit Benedek (1), Bruno Meurers (3), and Roman Leonhardt (4)

(1) Geodetic and Geophysical Institute, Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences, Sopron, Hungary, (2) Finnish Geospatial Research Institute, FGI, National Land Survey of Finland, (3) University of Vienna, Department of Meteorology and Geophysics, Wien, Austria, (4) Zentralanstalt für Meteorologie and Geodynamik (ZAMG), Conrad Observatory

Since spring 2016 two tilt meters have been operating continuously at the Conrad Observatory (Austria): a 5.5m long interferometric water level tilt meter (iWT) built by the Finnish Geodetic Institute (FGI) and a Lippmann-type 2D tilt sensor (LTS). While iWT monitors E-W tilts, LTS provides both N-S and E-W tilt time series. The instruments are installed 100 m apart of the Superconducting Gravimeter GWR C025 monitoring the vertical component of the gravity vector. The co-located and co-oriented set up makes a wide range of investigations possible. Tilts indicate not only geometrical deformations of the solid earth but are also coupled to the change of gravity potential defining the local horizontal position.
We compare the gravity time series from both the tilt meters and the SG. The residuals of all sensors clearly reflect the gravity/deformation effects due to short- and long-term environmental processes. The SG residuals decrease immediately and sharply in case of heavy rain events. As all sensors are underground installations, this behavior is expected when precipitation water accumulates on topography. Later, surface water intrudes into the ground and accumulates below the sensors, associated with a slow long-term increase of the SG residuals. Karstic phenomena may play an important role as well. The time series reveal an obviously very complex transport process. Remarkable long-term signatures show a clear correlation between the tilt and SG sensor data. E-W tilt signals are obviously much weaker than those of the N-S component are. In particular, this holds true for snowmelt processes. Short-term effects are much less pronounced in the tilt residuals, While the SG clearly reflects the water accumulation on top of the topography (residual drop), tilts do not. Modelling results suggest to exclude a purely gravitational source of the observed tilts.