Remote sensing of water storage variation in Dinaric karst

Ines Vidmar\textsuperscript{1} and Mihael Brenčič\textsuperscript{1,2}

\textsuperscript{1}Faculty of Natural Sciences and Engineering, Department of Geology, Aškerčeva cesta 12, 1000 Ljubljana (ines.vidmar@ntf.uni-lj.si)
\textsuperscript{2}Geological Survey of Slovenia, Dimičeva ulica 14, 1000 Ljubljana

Having shown potential for long-term monitoring of terrestrial water variation, satellite data from GRACE (Gravity Recovery and Climate Experiment) and its successor GRACE-FO (Follow-on) operating from 2002 could provide a cost-effective approach to water resource management in regions with scarce ground monitoring networks or in regions where representative in-situ monitoring is difficult to ensure, such as karstic areas. One such example is Dinaric karst, a large karstic aquifer system extending from Italy through Slovenia, Croatia, Bosnia-Herzegovina, Montenegro, Serbia to Albania. There, groundwater storage variation on a regional scale is difficult to infer from existing locally scattered data.

For that purpose, GRACE Level-3 gridded mass concentration terrestrial water storage (TWS) anomaly data was used. Gridded scale factors provided at 0.5° resolution based on land-hydrology models were considered as well. Spatial variability was analysed for the area of Dinaric karst and adjacent areas in Austria and Hungary owing to the resolution of the data. For preliminary validation, GRACE derived liquid water equivalent (LWE) thickness data was compared to data from available ground measurement points.

Based on the 2004-2009 average, the temporal data variability analysed for the period of March 2002 until September 2019 (containing 163 monthly data aggregates) showed variability of 17 cm to 83 cm with the average range amounting to 47 cm in the native GRACE resolution. According to the unscaled data, the variability is 29 cm to 54 cm with a mean of 43 cm. In both cases, higher amplitudes were observed at the southern parts of Dinaric karst. Weak negative temporal trend of water storage anomalies is present in all analysed land grid cells showing the difference of less than 10 cm during the entire measurement period, while the average monthly change in total water storage is around 4 cm.