Empirical Models of Vertical Crustal Motion in the Great Lakes Region

Elena Rangelova and Dimitrios Piretzidis (Canada)

Key words: GNSS/GPS; Positioning; Reference frames; geoid, vertical datum

SUMMARY

The new geoid-based vertical datum in Canada CGVD2013 provides the physical height component of a 3-dimensional spatial reference frame and enables a direct transformation of the physical heights to ITRF. Compatible models of the geoid temporal variations and vertical crustal motion are needed for applying corrections in the height data to ensure a temporal homogeneity in areas with ongoing significant geodynamic processes such as the Great lakes region. These models can come from combining the traditional, local geodetic observations such as GNSS with the global GRACE data. Particular challenges in such data integration include minimizing the leakage of the geophysical signals over the area of interest that contaminates the GRACE-observed geoid changes and vertical crustal motion due to the geodynamics in the region, as well as deriving point estimates of the crustal motion from spatially integrated GRACE data.

In this study, we combine GRACE-observed rates of gravity change converted to vertical crustal motion and GNSS velocity data in the Great Lakes area. The combined vertical motion model is realized via a least-squares adjustment procedure including variance-component estimation and robust outlier detection. The latter is necessary to ensure reliable estimates of the relative errors in the least-squares adjustment via re-scaling of variance-covariance matrices and to ensure that the vertical crustal motion model is not distorted by erroneous observations.