The New Gravimetric Geoid Model of Qatar: QG2020

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SUMMARY

With the advent of GNSS, geoid undulations models are the new norm to obtain precise orthometric heights. Global geoid models, such as EGM2008 and EIGEN-6C4, are already able to provide few decimetres level accuracy but are still not able to properly model the short wavelengths of the Earth's potential. Consequently, when higher accuracy is necessary, the global models need to be refined for the area of interest.

The state of Qatar was using officially a geoid model (Qatar95) based on the OSU91A global model. Qatar95 was clearly outdated because the OSU91A global model has low accuracy and low spatial resolution and few terrestrial gravity data for this area were included for its computation. In addition, Qatar95 was constrained with levelling observations which, although improving the consistency with the official vertical datum, was causing significant deformations in some areas. More recent global geoid models such as EGM2008 still show differences of around ±30cm with GNSS/levelling data. For EIGEN-6C4, GOCE-OGMOC and XGM2019e these differences are smaller but still around ±10cm.

To compute the new official geoid (QG2020) for the State of Qatar, purely based on gravity, a field campaign has been performed in February 2020 during which 399 new gravity and GNSS measurements were made, covering the whole country with an average spacing of 5km. Using the Remove-Compute-Restore technique (using EIGEN-6C4 to model the long wavelengths of the Earth's gravity field) and Least-Squares Collocation, these gravity values were converted into the new geoid. The new geoid has been linked to the national vertical datum of Qatar, at the main fundamental benchmark.

We describe here QG2020 focusing on the methodology and its validation with three different sets

of GNSS/levelling data. The new geoid QG2020 is made available in various digital formats that can be used in most GNSS equipment and software packages. The formal (relative) error (predicted standard deviation) of the computed geoid is better than 1 cm in most of the country, never exceeding 2 cm at the country boundary.