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Assessment of the recent GOCE/GRACE earth geopotential models over a network of collocated GPS/Levelling benchmarks in Greece

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With the successful launch of GOCE in March 17, 2009 and the continuous release of its data, new versions of GOCE earth geopotential models, based on ESA's mission, have become available through IAG's ICGEM service. This, combined with the continuous release of new GRACE-based satellite-only and combined Global Geopotential Models (GGMs) allows their use, among other purposes, for the common adjustment of the so-called GPS/Levelling and GGM-derived geoid heights. The increasing performance of the GOCE/GRACE GGMs and the improved accuracy they offer to higher bands of the geoid spectrum facilitate their performance in the combination with GPS/Levelling observations on trigonometric and levelling benchmarks (BMs). A new database was compiled recently and based on GPS measurements which were performed during a five-year period on levelling BMs. This resulted in most part of northern Greece to be covered with accurate observations within an area extending 7 degrees in longitude and 3 degrees in latitude, where common adjustments of the available geometric, orthometric and geoid heights are carried out using various parametric surfaces to model and interpret the detected differences. In this work, the performance of a local LSC-based gravimetric geoid model is investigated along with that of EGM2008 and the complete range of GOCE/GRACE/CHAMP GGMs. The adjusted differences between the three types of heights are used to assess the accuracy of the various geoid models employed (both global geopotential and local gravimetric models), while an extensive outlook is paid to the varying behaviour of the orthometric heights. Absolute as well as relative differences are determined in order to investigate the accuracy achieved by the GGMs, the improvement brought by GOCE data in modelling the long- and medium-wavelengths of the gravity field spectrum and, finally, the accuracy that can be reached when GPS/Levelling is utilized for the determination of orthometric heights. The latter is of main importance for the Greek territory, since the available benchmarks are delaminated in so-called "map-leaflets" and a common adjustment of the entire vertical network has not been carried out so far. It is concluded that even between neighbouring "map-leaflets" large biases in the adjusted GPS/Levelling and gravimetric geoid heights exist, which primarily indicate distortions in the Greek vertical datum.