



Evaluation of the Geopotential value for the Local Vertical Datum of China using GRACE/GOCE GGMs and GPS/Leveling Data

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Abstract: National height reference systems have conventionally been linked to the coastal local mean sea level, observed at one tide gauge, such as the China national height datum 1985. Due to the effect of the local sea surface topography, the reference level surface of local datum is inconsistent with the global datum or other local datum. In order to unify or connect the local datum to the global height datum, it is necessary to obtain the zero-height geopotential value of local datum or the height offset with respect to the global datum. The GRACE and GOCE satellite mission are promising for purposes of unification of local vertical datums because they have brought a significant improvement in modeling of low-frequency or rather medium-frequency part of the Earth's static gravity field in the past ten years. The focus of this work is directed to the evaluation of most available Global Geopotential Models (GGMs) from GOCE and GRACE, both satellite only as well as combined ones. From the evaluation with the 649 GPS/Levelling benchmarks (BMs) in China, the GOCE/GRACE GGMs provide the accuracy at 42-52cm level, up to their max degree and order. The latest release 5 DIR, TIM GGMs improve the accuracies by 6-10cm compared to the release 1 models. The DIR_R1 is based on the fewer GOCE data performs equally well with the DIR_R4 and DIR_R5 model, this is attributed to the fact that during its development which used a priori information from EIGEN-51C. The zero-height geopotential value W0LVD for the China Local Vertical Datum (LVD) is $62636855.1606\text{m}^2\text{s}^{-2}$ from the originally GOCE/GRACE GGMs. Taking into account the GPS/Levelling data contains the full spectral information, and the GOCE-only or GRACE-GOCE combined model are limited to the long wavelengths. To improve the accuracy of the GGMs, it is indispensable to account for the remaining signal above this maximum degree, known as the omission error of the GGM. The effect of GRACE/GOCE omission error is investigated by extending the models with the high-resolution gravity field model EGM2008. In China, the effect of the GRACE/GOCE GGMs omission error is at the decimeter level. The combined GGMs (up to 2160 degree and order) could provide an accuracy at 20cm level, which is better than that from EGM2008. Meanwhile, if an appropriate degree and order is chosen for the GOCE-only or GRACE-GOCE combined GGMs to connect with the EGM2008, the extended GGMs provide an accuracy at 16cm level. From the extended GGMs, the geopotential value W0LVD determined for the China local vertical datum is $62636853.4351\text{m}^2\text{s}^{-2}$ [U+FF0C] indicates a bias of about $2.5649\text{m}^2\text{s}^{-2}$ compared to the conventional value of $62,636,856.0\text{m}^2\text{s}^{-2}$. This is support by National key research and development program [U+FF08] No:2016YFB0501702 [U+FF09].

Keywords: Global Geopotential Models; GRACE; GOCE; GPS/Levelling; zero-height geopotential