



The $5' \times 5'$ global geoid 2013 (GG2013) and its evaluation

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We determine a new global geoid (GG) with spatial resolution $5' \times 5'$. The GG model is determined based on the shallow-layer method (Shen, 2006), which is different from the conventional ones. The determination procedure is stated as follows. (1) defining the Bjerhammar surface, which is a proper closed inner surface below a reference geoid (by e.g. 150m), the region bounded by the Bjerhammar surface and the Earth's surface is referred to as the shallow layer, in which the density distribution is provided by the global crust model CRUST2.0, and the Earth's surface was determined by the digital topographic model DTM2006.0 combining with the DNSC2008 mean sea surface. (2) subtracting the potential field generated by the shallow layer from a $5' \times 5'$ external gravitational potential field model V which is defined outside the Earth, a new gravitational potential field V_0 defined outside the Earth is obtained, which is generated by the masses enclosed by the Bjerhammar surface, and here the $5' \times 5'$ external gravitational potential field model V is the external gravitational potential field model EGM2008 with its lower degree/order (120/120) parts replaced by a satellite-only global gravity field model (e.g. GOCO02S or EIGEN6s). (3) extending this new field V_0 naturally downward to the Bjerhammar surface, we obtain a new field V_0^* defined in the region outside the Bjerhammar surface. (4) adding the potential field generated by the shallow layer to the newly extended field V_0^* , we obtain the Earth's gravitational potential field $V^*(P)$ as well as the geopotential field $W(P)=V^*(P)+Q(P)$, both of which are now defined in the whole region outside the Bjerhammar surface, where $Q(P)$ is the centrifugal potential. (5) solving the geoid equation $W(P) = V^*(P)+Q(P)=W_0$ via iterative technique, where W_0 is the geopotential constant on the geoid, we obtain a GG with spatial resolution $5' \times 5'$, which is referred to as the GG2013 for convenience. Both the GG2013 and the EGM2008 geoid are validated by globally available GPS/leveling benchmarks (GPSBMs). Results show that the GG2013 fits the GPSBMs better than the EGM2008 geoid. For instance, comparisons with GPSBMs in the Xinjiang region of China show that the GG2013 is better than EGM2008 geoid and EGM2008/EIGEN6s combined geoid by 4cm and 2cm, respectively. This work was supported partly by the NSFC (grant No. 41174011), National 973 Project China (grant No. 2013CB733305), NSFC (grant No. 41210006, 41128003, 41021061, 40974015).