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The $5' \times 5'$ global geoid 2014 (GG2014) based on shallow layer method and its evaluation

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We provide an updated $5' \times 5'$ global geoid 2014 (GG2014), which is a further improvement of the $5' \times 5'$ global geoid 2013 (GG2013, presented at EGU 2013, Shen and Han 2013). GG2014 is determined based on the shallow layer method (Shen, 2006), and its basic idea, determination procedures and relevant techniques are summarized as follows. (1) Choosing the shallow layer bottom surface (SLBS) that is an inner surface below the EGM2008 geoid (as reference surface) by 15 m, the layer bounded by SLBS and the Earth's surface is referred to as the shallow layer (SL). (2) The 3D shallow layer model (SLM) is established based on SLBS, the digital topographic model DTM2006.0 combining with the DNSC2008 mean sea surface (as upper surface) and the refined $5' \times 5'$ crust density model, CRUST2.0-5re, which is an improved $5' \times 5'$ density model of the CRUST2.0 with taking into account the corrections of the areas covering by ice sheets (based upon ICE-5G model) and the land-ocean crossing regions. (3) Subtracting the potential field V1 generated by the SLM and expressed by a truncated spherical harmonic expansion (SHE) from a $5' \times 5'$ external gravitational potential field model SHE V which is defined outside the Earth, a new gravitational potential field SHE V0 defined outside the Earth is obtained, which is generated by the masses enclosed by SLBS, and the mentioned external gravitational potential field SHE V is the presently most accurate 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. EIGEN6s). The field V1 is first calculated by Newtonian integral based on a $2.5' \times 2.5'$ density distribution of the SLM and then expanded to a SHE. (4) Based on the field SHE V0 defined outside the Earth, taking a natural downward continuation of the SHE V0, we determine a new field SHE V0* defined in the region outside SLBS. (5) Taking the sum of the potential field V1 generated by the SLM and the new field V0*, we obtain the Earth's gravitational potential field V*(P) defined in the whole region outside SLBS. (6) Solving the geoid equation W* (P) =V*(P)+Q(P)=W0 via iterative technique, where Q(P) is the centrifugal potentia, W0 is the geopotential constant on the geoid and it is granted the value 62636856.0 $m^2/s^2 given by Bursa et al. (2007), we obtain an updated 5' \times 5'$ global geoid (GG2014). Comparisons show that the GG2014 fits the globally distributed GPS/leveling points obviously better than the EGM2008 geoid.
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