

Description for “Topographic Gravity Field Models” at ICGEM

What are topographic gravity field models?

- Synonyms: topographic potential models, topography related models, synthetic gravity models, forward models
- Definition: Topographic potential models represent the gravitational potential generated by the attraction of the Earth's topographic masses.
- Gravity in these models is computed based on (1) a model of the topographic masses, i.e., a digital elevation model describing the shape of Earth's topography and (2) assumptions of the mass-densities inside the topography.
- Since gravity in the models is not based on actual gravity measurements, the gravity is only predicted by the models. The accuracy of the prediction mainly is affected by
 - o the resolution of the model,
 - o accuracy/errors of the involved digital elevation model(s),
 - o validity of density assumptions,
 - o the mass arrangement (spherical vs. ellipsoidal), and
 - o the forward computation technique.
- Topographic masses typically mean all solid matter of Earth's topography (rock, sand, basalts, etc.) but also includes ocean water, lake water and ice sheets.
- Forward models may or may not account for isostasy/ isostatic masses. Models not accounting for isostasy often are referred to as *uncompensated* topographic potential models.

Applications

- Typical applications are:
 - o Terrain or topographic gravity reductions
 - o Smoothing of gravity measurements
 - o Omission error modeling
 - o Bouguer gravity modeling
 - o High-resolution gravity modelling
 - o Independent evaluation of (satellite-based) gravity field models

Hints for usage of topography-related models and important remarks

- Models are given in terms of spherical harmonic coefficients (akin to ordinary gravity models) and can be evaluated with appropriate synthesis software at any point of Earth's surface and above. The model constants (GM and a) are found in the header of the coefficients file.
- The coefficients of topographic potential models must not be reduced by the coefficients of a normal gravity field. To allow the evaluation by synthesis software that by default subtracts a normal field, additional versions are available for most models, where the zonal harmonic coefficients implied by the GRS80 normal field are added.

- Since the models are not based on measurements, the models may not be used directly for any kind of geophysical interpretation. However, the models are useful to unveil geophysical signal/phenomena together with auxiliary/measurement-based gravity data, e.g., in the difference between measured gravity and forward modelled gravity.
- Topographic potential models that do not account for isostatic masses typically overestimate the gravitational attraction at large scales, i.e., at scales $> \sim 100$ km.

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