High-resolution local or regional gravity field determination / RTM errors sources and its effect in regional gravity field determination

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Background
Gravity field is a fundamental element which reflects the mass distribution and mass redistribution in the Earth system. Gravity field, respectively the geoid, plays an important role in climate research, as a record of and reference for the observation of mass transport. With advanced geodetic observation systems, obtaining 1 cm geoid has been the goal for regional or local gravity field studies.

Over past decades, studies on regional gravity field modelling from the combination of different input data sets has been implemented based on RCR (remove-compute-restore) technique. In the concept of RCR, gravity field is split into three parts, the long-wavelength part represented by GGMs (global gravity field models), the high-frequency part finer than resolution of GGM, and residual part after removing low- and high-frequency from geodetic observations.

Limited by the sparse gravity observations and resolution of gravity satellite, the high-frequency signals of gravity field is normally computed from high-resolution public topographic models based on the forward modelling. Most often, the residual terrain modelling (RTM) (Forsberg, 1984) is used for this purpose. High accuracy topographic models and high resolution density models are required in this case. In practice, DSM (digital surface model) rather than DTM (digital terrain model), and constant density assumption rather than actual density model, are often used as the representations of topography and mass density in the RTM. This will introduce errors in high-frequency gravity field determination, and in turn in local / regional gravity field determination. The aim of this thesis is to study the RTM errors and its effect in local / regional gravity field determination.
Methods and aims
During the dissertation, the error sources of high-frequency gravity field modelling will be discussed, which including the errors introduced by the constant density assumption, tree canopy, and rock-equivalent approximation (Hirt and Rexer, 2015).

Actual density model (Tenzer et al., 2011), bare-ground terrain models (Yamazaki et al., 2017), and precise forward modelling over water bodies, will be considered. The performances of different forward modelling methods (2D, 3D of smoothing topography, 3D of smoothing gravity field) will be discussed and evaluated.

Errors evaluation of high-frequency gravity field, and errors propagation to the geoid determination will be of great interest. Validation strategies based on the ground observations ensures the evaluation quality and allows for the accuracy estimates of regional / local gravity field determination.

References

