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Numerical evaluation of terrain induced gravitational potentials and their derivatives by combination of analytical formulae and discrete integration

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Currently available high-resolution digital elevation models (DEM) permit evaluation of terrain-related gravitational quantities, such as terrain corrections or gravity reduction, with unprecedented accuracy. In addition, given the increasing availability of new high-resolution global terrain models specifically over continental regions, such as the SRTM models offering a 30x30 m resolution for selected parts of the Earth, the investigation and assessment of the short-wavelength part of the gravity field spectrum becomes an issue of high demand. The latter is modeled nowadays by lower resolution global terrain models which contain in many cases erroneous information for large areas around the globe. The terrain related gravitational signal can be combined with the long-wavelength part of the gravity field spectrum provided with an increasing accuracy by the dedicated satellite gravity field missions CHAMP and GRACE or other available Earth gravity models, such as EGM96, for precise gravity field modeling. This presentation concentrates on numerical evaluation of terrain related gravitational quantities, such as the gravitational potential and its first-order derivatives, by merging two different modeling and computational strategies: the planar and spherical approximation of the terrain. The former is sufficient over limited regions offering a very detailed representation and computational accuracy of the topographical potential for a critical area surrounding the computational point. The latter is then indispensable for larger distances from the computation point. The test area chosen for numerical investigations is bounded by eastern longitude of 8 and 12arcdeg and northern latitude of 46and 50 arcdeg, respectively. The resolution of the available compiled DEM for this

alpine region of Central Europe is 30x30 arcsec. Apart from establishing a threshold between the inner planar region and the outer spherical shell, the numerical investigations aim at quantifying the role of terrain in the frame of external assessment studies of new satellite-only Earth gravity models.