A comparison of different mass elements for use in gravity gradiometry

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Classical topographic-isostatic reduction methods as well as modern gravity field modelling concepts such as Residual Terrain Modelling (RTM) and Remove-Restore Techniques (RRT) require the calculation of the gravitational effects of volumetric mass elements which are usually represented by prisms.

In terrestrial and airborne gravity field determination the formulae for the gravitational potential and its first order derivatives have to be evaluated, while second order derivatives are related to the analysis of upcoming satellite gravity gradiometry missions of GOCE type.

In this presentation the modelling of prisms is opposed to the modelling of point masses, mass lines, mass layers and tesseroids. Using tesseroids can be distinguished in two different methods: Since the triple integrals are related to elliptic integrals which are not analytically solvable in an elementary way, the respective volume integrals are solved by Taylor series expansions of 3rd order on the one hand and on the other hand by performing the vertical integration analytically, resulting in a 2D spherical integral.

Test computations show the high numerical efficiency of the tesseroid model with vertical analytical integration in comparison with the modelling using other mass elements.