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Mayon volcano, Philippines: relative importance of elasticity, self-gravitation and topography in the interpretation of gravity changes

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Most deformation models of volcanoes assumes the Earth as a linear, elastic, isotropic and homogeneous half-space. Discrepancies in data interpretation demand refinement models that produce more realistic results. Volcanism, as agent of mountain building, can be associated with prominent relief. Dimensional analysis and scaling give some insight about elastic-gravitational modelling before diving into a numerical technique for including self-gravitation interaction of dilatational and gravitational sources with topography. Our results show that for magma chambers at relatively shallow depths topography has a significant effect on the magnitude of mass interaction with gravity field. Therefore, displacement and gravity changes interpretation could gain accuracy by using a model that includes topography although elastic-gravitational coupling is neglected. Numerical comparison of three dimensional modelling and classical half-space models using varying depth methodology to estimate topographic effects shows that a varying-elevation model can be used to interpret changes in gravity. Then, varying-depth methodology provide a simple way to increase the accuracy of inversions based on gravity changes. We apply this methodology to Mayon volcano, Philippines. A quasi-analytic model fits gravity changes observed during 1992-1996 and emphasizes the importance of considering topographic relief.