CHANGES ON DEFORMATION AND GRAVITY BY GROUND TOPOGRAPHY: 3D INDIRECT BOUNDARY ANALYSIS

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The deformation due to the expansion/contraction of a magma chamber has frequently been modeled as a source of dilatation in an elastic half-space. We investigate the effects of the topography on the surface deformation and gravity changes caused by a magmatic intrusion in the Earth’s crust. Using the elastic-gravitational model that considers the interaction of the intrusion mass with the ambient gravity field, we show that neglecting the topographic effects may, in some cases, introduce an error greater than neglecting the self-gravitation of the medium. A comparison of results predicted by traditional half-space models using varying depth methodology to estimate topographic effects with a three dimensional model is shown for interpreting deformation and gravity changes on volcanoes. For the analysis, we develop a 3D Indirect Boundary Elements Method (IBEM). It is based on an integral representation of the displacement field caused by a ground irregularity like topography in terms of single-layer boundary sources that is derived from Somigliana’s identity. Our study provides limits to the use of classical half-space models.