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Topography and structural heterogeneities in surface ground deformation: a simulation test for Somma-Vesuvius volcano

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Through a 3D finite element code we simulate, the deformation of Somma-Vesuvius volcano caused by some overpressure sources. Under the assumption of linear elastic isotropic material behavior, the volcano deformation sources are located at various depths and their geometry (shape and lateral extension) is mainly constrained by the results of recent seismic tomography studies. These simulations have the objective to inquire about the influence of topography and structural heterogeneity on ground deformation. Structural heterogeneities have been modeled in terms of dynamical elastic parameters (Young's modulus) accounting for previous seismic tomography and gravity studies. Topography of Somma-Vesuvius is taken into account, using a digital terrain model. The main outcomes of this study is a strong deviation from axially symmetric pattern of the displacement field, which is quietly unaccounted by simplistic Mogi modeling in homogeneous medium with simplified topography. These results demonstrate that real topography and structural heterogeneities are key factors controlling the pattern of ground deformations, i.e. one of the most relevant problem in volcano monitoring. Moreover, an improved knowledge of deformation patterns can significantly help in the location of monitoring sensors as well as in the design of an efficient geodetic network.