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3D modeling of the displacement field generated by a pressure source inside a caldera: the case of Campi Flegrei

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The activation or reactivation of a volcanic area is often accompanied by surface deformation and the related field is one of the experimental data that is measured to retrieve information about the source. The structural setting of the area is recognized to have an influence on the deformation pattern. In particular, calderas, characterized by large explosive eruptions followed by important collapses and subsequent refilling, can have a deformation field that reflect in a somewhat peculiar way this particular setting.
We developed a 3D heterogeneous, elastic finite element model of Campi Flegrei caldera, based on seismic tomography results, that take into account all the main structural features of the area, and is aimed at clarify how structural elements influence the displacement field generated by a pressurized reservoir. In particular, we analyzed, in this context, how the deformation field is affected by the position, the shape and possibly an uneven pressurization of the source, an uneven source, together with the possible presence of a regional tectonic stress field.
Our results show that the parameters determining the position of the source in the caldera and the shape of the source have great influence in determining, in particular, the pattern of horizontal surface displacements, without sensible differences in the related vertical displacement field, so that it is possible to obtain a fairly good agreement between model results and the horizontal displacements measured during the 1982-84 bradyseismic crisis at Campi Flegrei.