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Modulation of the thermo-rheological properties of the crust beneath Ischia Island (Southern Italy) on the ground deformation pattern

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We present a model able to simulate the physical process responsible for the long-term ground deformation of Ischia Island Volcano (Southern Italy) by considering the role of the thermo-rheological properties of the crust. To this aim, we develop and implement in a Finite Element (FE) environment an innovative approach that integrates and homogenizes a large amount of data derived from several and different observation techniques (i.e, geological, geophysical and remote sensing). In detail, the main steps of the proposed approach are: (i) the generation of a 3D geological model of the crust beneath the Island by merging the available geological and geophysical information; (ii) the optimization of a 3D thermal model by exploiting the thermal measurements available in literature; (iii) the definition of the 3D B/D (Brittle/Ductile) transition by using the temperature distribution of the crust and the physical information of the rocks; (iv) the optimization of the ground deformation velocity model (that takes into account the rheological stratification) by considering the spatial and temporal information detected via satellite multi-orbit C-Band SAR (Synthetic Aperture Radar) measurements acquired during the 1992-2010 time period. The achieved results allow investigating the physical process responsible for the observed ground deformation pattern. In particular, they reveal how the rheology modulates the spatial and temporal evolution of long-term subsidence phenomenon, highlighting a coupling effect of the viscosities of the rocks and the gravitational loading of the volcano edifice. Moreover, the achieved results provide a very detailed and realistic image of the subsurface crust of the Ischia Island Volcano in order to study the ongoing deformation phenomena.