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The use of the Electrical Resistivity Tomography to image deep volcanic structures: a methodological study applied to Mt. Vesuvius (Italy).

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Geophysics is considered a powerful tool both for modeling the structure and controlling the dynamics of active volcanoes. In particular, the application of the electrical and electromagnetic (EM) methods is a topic of great interest, given the strong dependence of the electrical resistivity on the shallow and deep physical characteristics of a volcanic apparatus.
Among the EM methods, the magnetotellurics (MT), reaching investigation depth ranging from a few hundred meters to tens of km, is the optimal tool to characterize the volcanic environments leading often to remarkable imaging of the buried structures. However, its dependence from a natural source make its application often difficult due to the presence of high noise levels. Moreover, MT curves are subjected to the so-called static shift effect, an anomalous displacement of the curves that cannot be modeled without some external constrain. Electrical Resistivity Tomography (ERT), on other hands, using an artificial source, ends in a more controlled imaging that is, however, often limited to the very shallow parts of the structures. The realization of a deeper ERT imaging is complicated by both physical and logistic reasons. The resolved depths depend from the intensity of the source, an electrical current injected into the ground, whereas the displacement of the measurements array often implies hard problems due to the nature of the volcanic environments.
The actual progresses of the technologies offer some way to bypass the main limitation of the ERT technique. The use of new kind of measurement stations permits the realization of a sort of wireless electrodic arrays. The easiness of use of the actual power generators represents a further notable element. In conclusion, the ERT imaging could now represents an optimal tool also in the imaging of structures buried at intermediate depths (up to a few km). In such a way, also its interaction with the MT methods could results notably enhanced, due to the increasing of the information overlapping.
We present a study concerning this capability, applying the deep ERT imaging to the Mt. Vesuvius (Italy), that is among the most surveyed active volcanoes in the world for the great concern due to the high level of urbanization existing all around its slopes. 12 wireless ERT stations has been distributed along a nearly straight NW-SE transect, about 7 km long and passing about 2 km south of the Vesuvius crater. Despite several recent works present various MT imaging of the same area, a strong degree of uncertainty still persist due to contrasting results. Deep ERT imaging could furnish useful elements to resolve such ambiguity. An accurate analysis of the coherence degree of the artificial ERT source signals has been performed up to a several km distance. Performance of different statistical estimator has been evaluated and a deep imaging has been tested in order to resolve structures up to a few km depths.