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Application of a new Structural Joint Inversion Approach to Teleseismic and Gravity Data from Mt.Vesuvius, Italy

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A 3-D joint inversion of seismic and gravimetric data is performed to re-investigate the subsurface structure of Mt. Vesuvius (Italy) utilizing an improved joint inversion method. The aim is to derive models of the 3D distribution of velocity and density perturbations that are consistent with both data sets and with local velocity models. Mt. Vesuvius is a strato volcano located within a graben (Campania Plain) formed in Plio-Pleistocene. Campania Plain is bordered by mostly Mesozoic carbonaceous rocks. Mt. Vesuvius is the southernmost and the youngest of a group of Pleistocene volcanoes, three of which (Ischia, Campi Flegrei and Mt. Vesuvius) have erupted in historical times. The most recent eruption of Mt. Vesuvius occurred in 1944 and since then the volcanic activity has been characterized by moderate low magnitude seismicity and low temperature fumaroles at the summit crater. We modified the coupling mechanism between velocity and density models in the JI-3D optimized joint inversion method (Jordan and Achauer, 1999). This method was designed to provide stable and high resolution results and involves iterative optimized parameterization, 3D ray tracing, and the incorporation of a priori information. The coupling of the velocity and density models, vital to the joint inversion, is based on a cross-gradient approach (e.g. Gallardo and Meju, 2004), which has been proven to work very well in a variety of cases involving seismic, magnetic, CSEM, MT and gravity data sets. We implemented the cross-gradient coupling for our 3-D irregular adaptive grid parameterization. In contrast to conventional joint inversion methods this approach encourages structural similarities in the models and does not rely on predefined relationships between velocity and density parameters. As a consequence, the resulting velocity-density relations are not contaminated by a priori assumptions and can be utilized to derive rock physical parameters. We apply this method to data from the TomoVes project (Gasparini et al. 1998), combining seismics and Bouguer gravity and local high resolution velocity models as a priori information. The starting models for the joint inversion are derived by separate inversions of the individual data sets. We show 3D distributions of velocity perturbations and density variations from the joint inversion of teleseismic relative traveltimes and Bouguer anomaly data with the aim of extracting further information about the physical status of the volcano- tectonic system.