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Space-weighted seismic attenuation mapping of the aseismic source of Campi Flegrei 1983-84 unrest

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Coda wave attenuation imaging is able to detect fluid/melt accumulation and ancient magmatic bodies in volcanoes. Here, we use recently-developed space-weighting sensitivity functions to invert for the spatial distributions of multi-frequency coda-wave attenuation (Q_c^{-1}), measured during the largest monitored unrest at Campi Flegrei caldera (1983-84). The kernels are built based on radiative transfer theory, in a diffusive approximation, and are suited for application in highly heterogeneous materials across scales. We integrate our results with relocalised seismicity using the NonLinLoc search-grid algorithm and results of deformation and gravity inversions using 1D starting models.

High-attenuation anomalies are spatially correlated with the regions of highest structural complexities and cross faulting. They characterise deep fluid circulation in and around the aseismic roots of the 1534 AD Mount Nuovo eruption and fluid accumulation in the areas of highest hydrothermal hazard. Just offshore Pozzuoli and at the highest frequency (wavelengths of ~150 m), the main cause of ground deformation and seismicity during the unrest is an aseismic low-attenuation circular anomaly, similar in shape and nature to those produced by ancient magmatic reservoirs and active sills at other volcanoes.