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Modelling Fluid Migration and Seismicity in an Active Volcano: A Case Study of Campi Flegrei Caldera, Southern Italy

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Several observables from geological, geophysical and geochemical studies (e.g., seismic velocities, seismic amplitudes/attenuation, isotopic ratios, and gas composition from fumaroles) have indicated that activities at active volcanoes change over different time scales. We have modelled the cause of this spatiotemporal evolution of deformation and seismicity at Campi Flegrei caldera (southern Italy) as two high coda wave attenuation anomalies (at ~ 1 km and ~2-3 km, respectively) separated by ca 0.5-km-thick low seismic attenuation layer “caprock”, which acts as a major blocking interface for the uprising hot magmatic fluids. We have used these observations along with rock physics data as constraints to conduct fluid flow simulation studies to gain more insights into how this active volcano works. We adopt a coupled modelling approach using mechanical (deformation) and fluid low simulators (TOUGH2-FLAC^{3D}) to simulate seismic slips in the caldera’s computational domain both in isothermal and non-isothermal modes. The method allows us to investigate the roles of both hydromechanical and thermal effects of fluid injections in triggering seismicity at the caldera. The magnitudes of seismicity generated are comparable to the field observations and records of the major seismicity for the caldera in the 1980s.