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Time-repeated (pseudo-4D) seismic tomography: The example of the 2009 L'Aquila earthquake

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Normal faulting earthquakes in Italy often show the occurrence of multiple large shocks and seismicity jumps on adjacent fault segments, probably driven by fluid pressure diffusion along the fault system. Sharp changes of Vp/Vs and seismic anisotropy are revealed by foreshocks of the 2009 L'Aquila earthquake and ascribed to a precursory fluid pressure variation in the volume hosting the main rupture. In this study, we subdivided the 3-months long sequence of aftershocks recorded by a dense temporary seismic network into three epochs that have a similar amount of data and sampling of the crustal volume around the fault. For each of the three epochs, tomographic models are computed independently obtaining similarly well resolved Vp and Vp/Vs images. We find that time-repeated seismic tomography (4D) resolves changes of Vp and Vp/Vs during the aftershocks sequence, revealing post-faulting fluid flow from the normal fault to the surrounding volume. Two transient Vp/Vs anomalies are observed, suggesting an upward migration of fluid pressure in the fault hanging-wall and on an adjacent fault located a few kilometers to the north. These transient anomalies suggest that localized build-up of fluid pressure drove the seismicity migration on adjacent segments, large aftershocks and post-seismic slip on a compliant portion of the fault.