Crustal seismic velocity changes associated with the 1 January 2024 Mw 7.5 Noto earthquake

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Earthquakes can induce significant alterations of the mechanical properties of crustal material via various geophysical mechanisms such as co-seismic stress changes, fluid migration, and creation of damaged zones in shallow layers. Relative seismic wave velocity changes (dv/v) have been identified as a reliable proxy to discern these processes, and its temporal evolution can provide insights into fault healing and reloading processes. Therefore, utilizing ambient noise seismic interferometry, we conduct a comprehensive analysis to monitor seismic velocity changes in the Noto Peninsula region following the Mw 7.5 earthquake that struck the peninsula on January 1st, 2024 at 7:10 a.m. UTC. Leveraging Hi-net data, our investigation focuses on the frequency band spanning 0.3-1.1 Hz, where a stable seismic noise source originates from the Sea of Japan. We analyze daily autocorrelations and cross-correlations among proximal stations across all components to construct the complete Green's tensor for every station pair. By aggregating 3.5 months of pre-earthquake correlations as the baseline reference and 1.5 months post-earthquake data, we discern seismic travel-time shifts (dt) using the wavelet cross-spectrum analysis. For each station pair and for each component of the Green’s tensor, we infer the associated relative seismic velocity changes (dv/v) assuming a spatially homogeneous relative seismic velocity change within the medium between each station pair. Finally, we calculate station-specific relative seismic velocity changes by averaging the measurements obtained from all the pairs involving each station. Our results show a significant decrease in relative velocity of Rayleigh waves, averaging around 0.5% across the peninsula, comparable to the velocity drop caused by the 2008 M7.2 Iwate-Miyagi Nairiku earthquake. The largest velocity drop, reaching 0.65%, occurred at station WMZH in the western part of the peninsula, which is the closest station to the main coseismic slip area reported by other research groups. At the presentation, we discuss the origin of the large velocity drops caused by the Noto earthquake by thoroughly comparing them with Peak Ground Velocity (PGV), Peak Ground Acceleration (PGA), coseismic static stress and strain changes. To this end, our ongoing research involves analysis of GNSS data at GEONET and Softbank stations to derive coseismic static stress and strain changes.

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