

Shear strain energy changes and aftershocks of the 2024 Noto Peninsula earthquake

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I investigated shear strain energy changes caused by the 2024 Noto Peninsula earthquake (M_j 7.6) and their influences on the aftershock distribution. The changes of shear strain energy could be connected with those of stress invariant J₂ or equivalent stresses, and its increase is considered to correspond to an increase of the averaged amplitudes of shear stresses for randomly-distributed faults (Saito et al., 2018). In the analysis, I used the hypocenters of shallow earthquakes with focal depths of 30 km or shallower and with magnitudes of 1.0 or larger listed in the NIED Hi-net catalog for the period from January 2010 to February 2024. At the location of each earthquake, I calculated the tensor of stress change caused by the M_j 7.6 earthquake (Okada, 1992) using the uniform slip fault model of GSI (2024), and evaluated the shear strain energy change for the background stress orientations estimated by applying a stress tensor inversion (Michael, 1987) to the Hi-net focal mechanism solutions from 2003 to 2023 (Saito et al., 2018). The 2024 M_j 7.6 earthquake had many aftershocks extending over ~150 km from southwest to northeast. I found 62% of the aftershocks occurred at the locations with positive shear strain energy changes. I also examined the events in the period from 2010 to 2019, which was set as a reference period so as not to include the nearby swarm activity from 2020 to 2023 as well as the 2024 M_j 7.6 sequence. 58% of the events in this period lie in the areas where the shear strain energy increased by the mainshock. This seems to suggest that a significant correlation cannot be seen with the shear strain energy changes for all the aftershocks. Dividing the aftershock region into small subareas, however, I found a high correlation with the positive shear strain energy changes. In the areas of southwest and northeast ends of the aftershock zone, which locate outside the mainshock slip area, more than 80 to 90% of the aftershocks occurred in the region where the shear strain energy increased. This may imply that the aftershock distribution in such areas can be strongly linked with an increase of shear strain energy induced by the M_j 7.6 mainshock.

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