Triggering and Decay Characteristics of Dynamically Activated Seismicity in Southwest Japan

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Dynamic triggering of seismicity at remote locations by the passage of surface waves from large earthquakes is well-documented (Hill and Prejean, 2015). Somewhat surprisingly, remote activation of earthquakes in Japan is scarce (Harrington and Brodsky, 2006). There are, however, two notable cases of widespread remote triggering, after the occurrence of the 2011 M9.0 Tohoku-oki earthquake (e.g., Miyazawa, 2011; Yukutake et al., 2011) and the 2016 M7.3 Kumamoto earthquake (e.g., Enescu et al., 2016; Miyazawa, 2016; Uchide et al., 2016). Previous research (Miyazawa, 2011) revealed a dynamically triggered earthquake front propagating along SW Japan, in correlation with the arrival of surface waves from the Tohoku-oki earthquake. However, some characteristics of the dynamically initiated seismic activation have not been investigated in detail.

1. Triggering characteristics: Love versus Rayleigh waves passage activation

In this study (Opris et al., 2018), we analyze first the dynamic triggering process following the Tohoku-oki earthquake, using the National Institute for Earth Science and Disaster Resilience (NIED) waveform data. Our results suggest that at several triggering sites in SW Japan, including volcanic areas in Kyushu, the arrival of larger amplitude Love waves correlate better with the occurrence of the first locally triggered events, compared to the Rayleigh wave arrivals. We also observe that triggering takes place during relatively high-period surface waves.

To have a better understanding of the triggering characteristics, we search for other cases of dynamic triggering in SW Japan by remote large earthquakes and show that the distinctive phase arrivals of both Love and Rayleigh waves from the 2008 M7.9 Wenchuan earthquake triggered local events in Kyushu. These observations suggest that sharing motion on well-lubricated local faults may have started failure in these areas.

2. Decay characteristics: the cases of the 2011 M9.0 Tohoku-oki and 2016 M7.3 Kumamoto mainshocks

Based on the analysis of an extended earthquake catalog - composed of JMA events and small earthquakes detected by us in the first ~30 min. after the Tohoku-oki mainshock -, we find that the stacked seismicity for the dynamically triggered regions in SW Japan after the Tohoku-oki earthquake has a significant, albeit weak increase after the megathrust event, followed by a relatively slow decay towards the background level for the next 7-10 days. The relatively slow decay may reflect the temporal pattern of stacked swarm-like seismicity, which has been mainly activated at volcanic/geothermal areas in Kyushu.

The decay of seismicity within a single activated earthquake cluster may have, however, different characteristics. The analysis of the aftershocks initiated dynamically (e.g., Miyazawa, 2016) at the Yufuin-Beppu geothermal area (Kyushu), by the 2016 M7.3 Kumamoto earthquake, shows a very fast decay that may reflect quick stress recovery near higher-temperature volcanic or geothermal regions.

References:

Opris, A., Enescu, B., Yagi, Y., and J. Zhuang, Triggering and decay characteristics of dynamically activated

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seismicity in Southwest Japan, Geophys. J. Int., 212, 2, 1010-1021, doi: 10.1093/gji/ggx456, 2018.

Enescu, B., Shimojo, K., Opris, A., and Y. Yagi, Remote triggering of seismicity at Japanese volcanoes following the 2016 M7.3 Kumamoto earthquake, Earth, Planets and Space, 68:165, doi: 10.1186/s40623-016-0539-5, 2016.

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