Shallow low-frequency tremor in the Japan Trench subduction zone

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In the regions off Tokachi and Sanriku, we have identified shallow low-frequency tremor using the records from the Seafloor observation network for earthquakes and tsunamis along the Japan Trench, S-net (Tanaka et al., 2019). It occurs between the 10- and 25-km depth contours of the plate interface, and its characteristics including duration (half a day to a few weeks) and recurrence time (one month to one year) vary with location along the trench. In the present study, we extend our analysis to a wider offshore area from Hokkaido to Boso Peninsula. The data we used are the continuous three-component velocity seismograms recorded at 125 S-net stations (S1-S5) for the period from 2017 to 2019. We constructed root mean square (RMS) envelopes of the seismograms band-pass filtered between 2 and 10 Hz, and searched tremor sources every one minute using overlapping two-minute time windows by the method of Tanaka et al. (2019) based on an envelope correlation analysis (Obara, 2002) and an event clustering scheme (Frohlich and Davis, 1990). In addition to the regions off Tokachi and Sanriku, clusters of tremor were located in the regions off Fukushima and Ibaraki. These clusters also lie within a narrow zone between the 10- and 25-km depth contours of the plate interface. As is the case with the tremor off Tokachi and Sanriku, the tremor off Fukushima occurs at similar locations to the very low frequency (VLF) earthquakes detected using seismic data from onshore networks (Matsuzawa et al., 2015). About 20 episodes of tremor were observed in this region, and some were coincident with the VLF earthquakes. In the region off Ibaraki, tremor episodes were detected less frequently (six in the three years), with each lasting for half a day to a day, although these were located in a smaller area than previously reported by Nishikawa et al. (2019). On the other hand, no tremor was found in the large slip area of the 2011 Mw 9.0 Tohoku earthquake as was shown by Nishikawa et al. (2019). The locations of tremor and the variations of its properties show strong lateral heterogeneities of the slip behavior at the shallow plate interface in the Japan Trench subduction zone.

Keywords: shallow low-frequency tremor, Japan Trench, S-net

