Shallow tremor activity around the source areas of the Nankai and Tonankai earthquakes by using LTBMS and DONET

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Several studies reported the activities of the non-volcanic tremors, Slow Slip Events (SSE) and the Very Low Frequency earthquakes (VLF) had occurred along the Nankai trough, southwest Japan (e.g., Obara, 2002; Obara and Hirose, 2006; Sugioka et al., 2012). SSEs were accompanied by tremors and VLFs, and those migrated with various pattern in response to SSEs (e.g., Obara 2011; Yamashita et al., 2015). Although tremors were well detected at the plate interface deeper than the source areas of mega-thrust and large earthquakes along the Nankai trough, tremors were little detected at the shallower part except for off southern Kyushu at where Yamashita et al. (2015) reported by the means of ocean bottom observation. It is considered as a reason why the shallow tremors along the Nankai trough were rare to be detected that S/N ratios of those signals are low because of the long distance between those sources and the onshore seismic network.

Japan Agency for Marine-Earth Science and Technology (JAMSTEC) installed the cabled observation system called Dense Oceanfloor Network System for Earthquakes and Tsunamis (DONET) in the source areas of the Nankai and Tonankai earthquakes, southwest Japan, to monitor earthquakes and tsunamis (Kaneda et al, 2015; Kawaguchi et al., 2015). In addition, JAMSTEC installed the borehole observation system called Long-Term Borehole Monitoring System (LTBMS) for seismic, geodetic, and hydrological observation in the seafloor targeting on the seismogenic faults along the Nankai trough as a part of the NanTroSEIZE by IODP program (e.g., Kopf et al., 2011), which is connected to DONET system. LTBMS and DONET stations can cover from coast to trough axis and are connected to land stations with fiber optic cables. The digitized data of them are continuously transferred in real-time to our laboratory at JAMSTEC. Therefore, we can continuously monitor the tremor activity occurred at shallow part of the source areas of the Nankai and Tonankai earthquakes. In this study we purpose to investigate the characteristics of the shallow non-volcanic tremor activity around the source areas of the mega-thrust earthquakes.

We detected non-volcanic tremors that occurred between Jan. 2011 and Dec. 2016, around the source areas of the mega-thrust earthquakes by applying the envelope correlation method (Ide, 2010, 2012) to the records of the broadband seismometers deployed to LTBMS and DONET stations. Shallow tremors have stably occurred around the aftershock area of the 2004 off Kii peninsula earthquake that occurred near the trough axis. Episodic shallow tremors were activated after the large earthquakes such as the off Mie earthquake (Mw = 6.0) on 1 April 2016. In addition, some episodic shallow tremor activities were observed without the large earthquakes. Several tremor activities were synchronized with deviations of the pore pressure deployed to LTBMS.