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Precursory seismic anomalies and transient crustal deformation prior to the 2008 Iwate-Miyagi Nairiku earthquake

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The epidemic-type aftershock sequence (ETAS) model has been widely used for detecting seismicity anomaly, such as quiescence or activation during aftershock sequences of large earthquakes and background levels of seismicity. The causes of such anomalies are sought to be associated with spatiotemporal changes in stress, even tiny perturbation of local stress. Here we analyze the seismic activities during a decade prior to the 2008 Iwate-Miyagi inland earthquake of M7.2 to fit the ETAS model to the seismicity from various regions around the source over the northern Honshu, Japan.

From the viewpoint of the ETAS models, we find northern Honshu is divided into three distinctive areas, increased seismicity, decreased seismicity, and normal relative to the ETAS prediction. As other previously published papers, here we hypothesize that Coulomb stress changes due to the year-order precursory slip of the Iwate-Miyagi earthquake resulted in the seismicity changes in and around the 2008 source region. The confirmed significant seismic anomalies in respective regions are consistent with the increments of the Coulomb failure stress of the corresponding regions that are calculated by the assumed slow-slip on the southern part of the faults of the mainshock.

The local crustal deformations observed from a dense GPS network support that slow slip on the fault had been taken place during about five years prior to the occurrence of the focal earthquake, and suggest that the slip terminated or migrated to down-dip extension of the fault during one and odd years prior to the rupture.

Keywords: ETAS model, AIC, precursory seismicity, change-point, crustal deformation