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Stress field of normal-faulting seismic sequences in Ibaraki and Fukushima Prefectures triggered by the Mw9.0 Tohoku-oki

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The 2011 M9.0 Tohoku-Oki Earthquake triggered widespread seismicity throughout the Japanese island arc including Hokkaido and Kyushu regions. In particular, a significant increase in the shallow seismicity was observed in the minutes following the main-shock along the Pacific coast of NE Japan, notably the northern part of Ibaraki Prefecture and the southern part of Fukushima Prefecture. The most striking feature of the induced seismicity is that the focal mechanisms reveal normal faulting with a T-axis orientated in a roughly E-W direction. Several large magnitude events including the maximum 7.0 earthquake have occurred during the sequence. It is very important to understand the stress field of driving such intensive seismic swarm activities.

We have, therefore, conducted a series of temporary seismic observations through a dense deployment of about 60 portable stations after outbreak of the intensive seismic swarm. We manually picked polarity of first motion of P-wave observed at each seismic station. Then, we have determined focal mechanism of earthquakes applying the method developed by Hardebeck and Shearer [2002] to the first motion data.

Most of the determined focal mechanisms at depths shallower than 10 km show normal faulting with a vertical P-axis. It interesting that the orientation of T-axis shows spatial variation. The T-axis at the northern part of the Ibaraki is roughly oriented ENE-WSW. The T-axis at the southeast part of the Fukushima is roughly oriented NEN-SWS. In contrast, focal mechanisms at depths greater than 15 km are complex. They consist of normal-, reverse- and strike-slip faulting.