稠密地震観測網に基づく関東地方における地震の発震機構解（2008年-2015年）

Focal Mechanism Solutions of Earthquakes in the Kanto Region during 2008-2015 Obtained from Highly Dense Seismic Array

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A highly dense seismic array observation network in and around Tokyo, called MeSO-net (Kasahara *et al.*, 2009; Sakai and Hirata, 2009), has been constructed and maintained. We determined 2,786 focal mechanism solutions of earthquakes in the Kanto region from April 1st, 2008 to February 9th, 2015 by using first-motion polarities observed by the MeSO-net, and compiled them as the MeSO-net First-Motion Focal Mechanism catalog (MeSO-FM^2) (Fig.). This catalog includes reliable and accurate focal mechanism solutions for small-magnitude (M≥1.9) earthquakes which are not determined by other networks. The quality of focal mechanism solutions is generally better for earthquakes which occurred near the center of network and worse for earthquakes near the edge or outside the network. MeSO-FM^2 will be useful in investigating temporal changes following the occurrence of the 2011 Tohoku-Oki earthquake in detail, as well as spatial and temporal heterogeneity of stress fields in this region. Following the 2011 Tohoku-Oki earthquake, in the shallow depths, strike-slip and normal fault types with the T-axes striking roughly NE-SW or E-W directions have been increased. On the other hand, thrust-faulting earthquakes, which can be correlated with subductions of two oceanic plates beneath the Tokyo Metropolitan area, were typically activated in the intermediate depths.

We compared the focal mechanism solutions obtained in this study and those from JMA, for 862 pairs of earthquakes considered to be identical based on hypocenter information (i.e., origin time, longitude, latitude, depth, and magnitude). MeSO-net focal mechanism solutions basically showed good agreement with those provided by JMA, while some show significant discrepancies. In order to quantify the similarity between the focal mechanism solutions determined in this study and those from JMA, we used the Kagan angles, a three-dimensional rotation angle by which one double-couple earthquake source can be rotated into another arbitrary double-couple earthquake source (Kagan, 1991). The average and median Kagan angles between MeSO-FM^2 and JMA were 21.2°and 17.3°, respectively.

We first determined the hypocenters by using HYPOMH (Hirata and Matsu’ura, 1987) with the seismic velocity structure which is routinely used by the Earthquake Research Institute, the University of Tokyo. Then, we determined the focal mechanism solutions by using the first-motion polarities and a modified algorithm of HASH v.1.2 (Hardebeck and Shearer, 2002), a method of determining focal mechanisms taking into consideration possible errors in hypocenters, seismic velocity structures, and reported polarities. We omitted earthquakes with the ≤8 reported polarities from the analyses because the reliability and stability are considered to be low. We conducted grid searches for strike, dip, and rake angles at 2° intervals. The quality of focal mechanism solutions were classified as A, B, C, or D considering various criteria (see Hardebeck and Shearer, 2002 for the definition of qualities), and excluded the D quality events from the catalog.

The catalog can be also utilized to investigate plausible fault models generating strong ground motions and tsunamis in the Tokyo Metropolitan area. Precise determinations of both hypocenters and focal mechanism solutions of earthquakes from dense array are also important to evaluate the

thickness of seismogenic zones and possible source regions of semi-historical earthquakes using recently-developed template matching technique (Ishibe *et al*., 2015).

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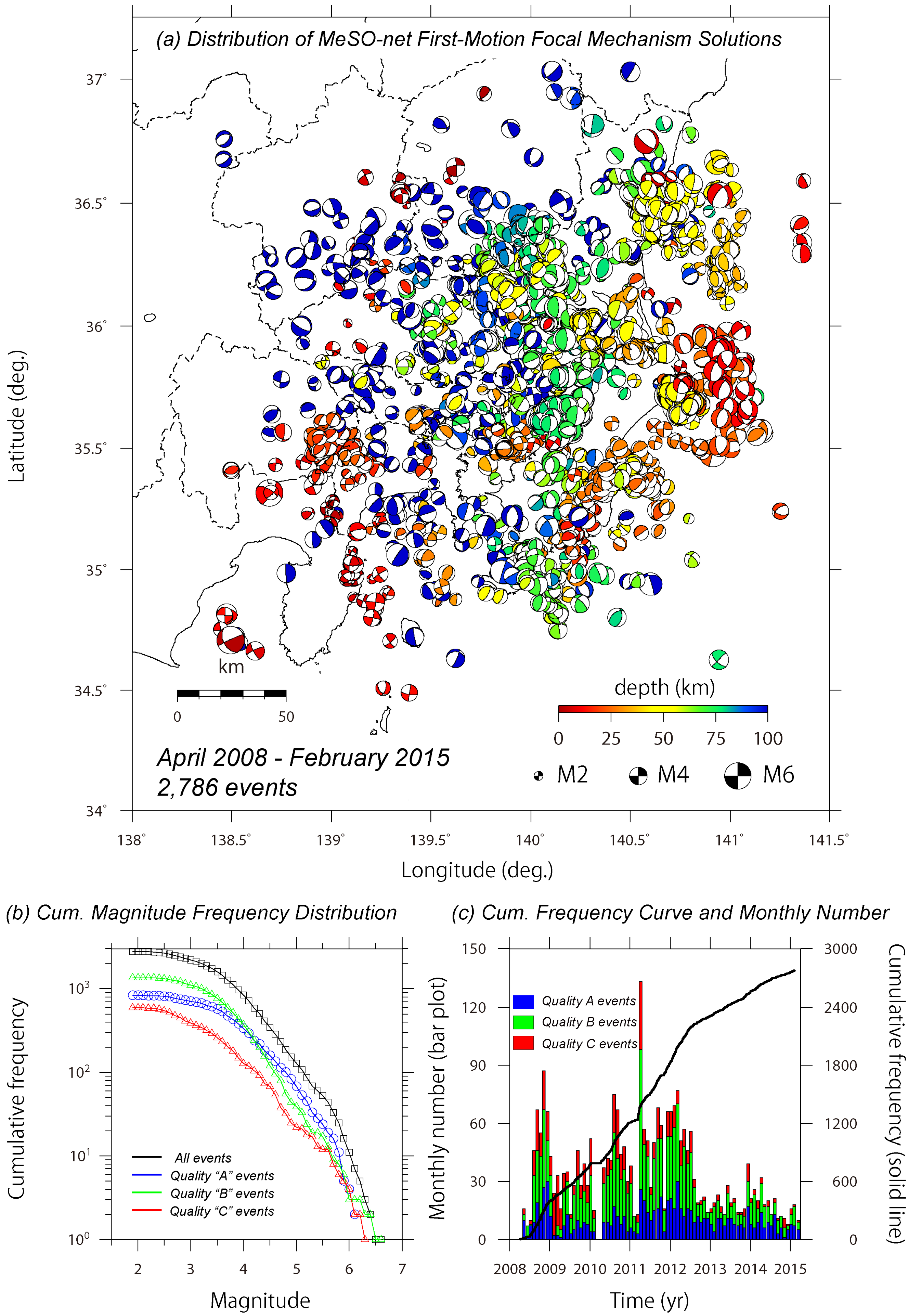
(a) Distribution of MeSO-net First-Motion Focal Mechanism Solutions
Latitude (deg.)
37°
36.5°
36°
35.5°
35°
34.5°
34°
138°
138.5°
139°
139.5°
140°
140.5°
141°
141.5°
Longitude (deg.)
km
0
50
depth (km)
0
25
50
75
100
M2
M4
M6
April 2008 - February 2015
2,786 events
(b) Cum. Magnitude Frequency Distribution
Cumulative frequency
Magnitude
All events
Quality "A" events
Quality "B" events
Quality "C" events
(c) Cum. Frequency Curve and Monthly Number
Monthly number (bar plot)
Cumulative frequency (solid line)
Time (yr)
Quality A events
Quality B events
Quality C events