Spatial var. in b and p val. for the aftershocks of the 2000 Tottori eq. and its relation to the source process of the mainshock

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We study in this paper the spatial variation of the b-value of the frequency-magnitude distribution and the p-value of the modified Omori law, describing the decay rate of aftershock activity. We analyze more than 5000 aftershocks, identified in the first four months after the 2000 Tottoriken-Seibu earthquake. We used both JMA and DPRI, Kyoto University, catalogs. The study reveals significant space variation of the parameters, while the time variation is not significant. The higher values of b seem to correlate with areas of large slip on the fault during the main shock.

Aftershock sequences offer a rich source of information about the Earth's crust, because a very big number of events can occur over a short period of time in a small area. Aftershocks also pose a significant seismic hazard. Two basic relations describe the aftershock activity, the Gutenberg-Richter law, which describes the power low size distribution of earthquakes, and the modified Omori law, which describes the decay of the aftershock activity. Here we present detailed analyses of the spatial variability of the b-value of the frequency-magnitude distribution and the decay rate of aftershocks as described by the p-value of the modified Omori law, for more than 5000 aftershocks, identified in the first four months after Tottoriken-Seibu earthquake. We have used the JMA and the DPRI, Kyoto University, catalogs of hypocenters of earthquakes. For the estimation of both b and p values, it is important to use a data set which is complete for all magnitude bands. The magnitude of completeness (MC) is found to vary in time, having a maximum of about 3 at the very beginning of the sequence but decreasing steeply afterwards, reaching a value of about 2 in 4-5 hours after the main shock. To assure completeness, we have excluded the first few hours from further analysis and took a value of 2 for the threshold magnitude. There is no significant time change of the parameters. By using dense spatial grids, we mapped out the distribution of b and p values of the aftershock sequence. Significant spatial variability is found, with b values of independent subvolumes ranging from 0.7 to 1.35. Both catalogs show similar variation of b and p in space. The higher values of b seem to correlate with areas of large slip on the seismic fault during the main shock, as determined from strong motion records. The results argue that it is an oversimplification to assign one single p and b value to an aftershock sequence. Thus, the observed variability may reflect the rupture process of the main shock (for example slip distribution) and/or the crust heterogeneity in the aftershock region. The space variability of the parameters was found for other aftershock sequences as well. However, it is not clear yet which is the main factor responsible for this spatial change. In order to understand better the relation between the spatial distribution of b and p values, and the physics of the earthquake process and crustal structure, we are planning to analyze also other relevant sets of data. The aftershock hazard assessment after the main shock can be improved by taking into account the spatial distribution of the parameters, since the aftershock hazard depends strongly on both the b and p values. Thus, in function of the "local" b and p values one can estimate the probability of a large aftershock in a certain area of the aftershock region, in a certain period of time after the mainshock.