Regional evolution of network detection completeness in Japan

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An important characteristic of any seismic network is its detection completeness, which should be considered a function of space and time. Many researchers rely on robust estimates of detection completeness, especially when investigating statistical parameters of earthquake occurrence like earthquake rates. Contrary to traditional approaches, we do not estimate completeness using methods in which the completeness magnitude is defined as the deviation of the frequency-magnitude distribution from the linear Gutenberg-Richter relation. Here, we present a method based on empirical data only: phase data, station information, and the network-specific attenuation relation. For each station of the network we estimate a time-dependent distribution function describing the detection capability depending on magnitude and distance to the earthquake. For each point in time, maps of detection probabilities for certain magnitudes or overall completeness levels are compiled based on these distributions. Therefore, this method allows for inspection of station performances and their evolution as well as investigations on local detection probabilities even in regions without seismic activity.
We present a full history of network detection completeness for Japan and discuss details of this evolution, e.g. the effects of the Tohoku-oki earthquake sequence. For practical purposes we deliver completeness estimates for catalog data of selected regions and document the conservative completeness estimates researchers can use when investigating the JMA catalog in different regions over different periods. All presented results are published on the CompletenessWeb (www.completenessweb.org) from which the user can download completeness data from all investigated regions, software codes for reproducing the results, and publication-ready and customizable figures.

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