Initial report on the magnitude of complete reporting for Japan, using the Gutenberg-Richter frequency-magnitude law

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Modern seismic networks used to create the bulletin maintained by the Japan Meteorological Agency (JMA) detect and locate more than 100,000 events per year. This is a vast improvement over the past and an invaluable resource for statistical seismology and the development of earthquake forecasting models. Many seismicity studies analyze, for example, transients in the seismicity rate or the earthquake size distribution, because such transient can be related to changes in physical properties in the Earth crust (e.g., changes in static/dynamic stress, complexity, fluid migration or precursory signals). However, such transients critically depend on the completeness, homogeneity, and consistency of earthquake catalogs, which can dramatically change as a function of space and time. It is vital for advancing forecast models that we establish clear benchmarks for quality control; monitor completeness and consistency continuously; and create online databases or web services available for all researchers. Creating such resources would be one of the high priorities for the basis of robust forecasting tools for Japan. An example of the work that needs to be done is to determine the magnitude of complete reporting, above which all events in the sample have been recorded. The first approach to Japan is based on the method of 'Probability-based Magnitude of Completeness' (PMC: Schorlemmer & Woessner, 2008). This method derives the completeness from the observed recording capabilities of each station within a seismic network. The PMC technique has been applied to the Japanese networks for the period since 2000 and the creation of its database is underway (Schorlemmer et al., 2008). Next step is (1) to ensure the reliability of the completeness levels by taking an alternative approach to deriving the completeness and (2) to characterize the data quality for longer periods rather than the period since 2000. Here we present an initial report to tackle these two tasks. Our approach for (1) is based on detecting the point of deviation from a power-law or Gutenberg-Richter (GR) distribution of earthquake magnitudes. For (2), we derive completeness from the GR-based application to the data in the JMA catalog since 1923. Our results together with the PMC approach allow us to move towards constructing a space-time history of the completeness as a baseline for forecast model development and testing for Japan.