

Development of a megathrust earthquake return period model

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The assessment of megathrust return periods can be considered the most difficult part of seismic hazard assessments, since often both their maximum magnitude as well as their respective return period is ambiguous and has much uncertainty associated with them. Megathrust earthquake events such as the 2004 offshore Sumatra, 2011 in Japan or even 1960 in Chile show that the actual capability of a subduction zone to produce mega earthquakes is often underestimated or simply unknown. In conjunction with the development of a subduction zone parameter database, an assessment method to determine megathrust return periods has been undertaken. This assessment follows the principle of robustness, reducing the amount of external parameters and a priori knowledge for the quantification of megathrust return periods.

A new method is proposed, which utilises Gutenberg-Richter estimates in conjunction with tectonic convergence rates and seismic coupling in order to calculate both the return period of strong seismic events and their respective possible maximum magnitudes. It introduces a stochastic procedure comparing the Gutenberg-Richter derived probability of a certain magnitude with the accumulated slip-dependent trigger mechanism. This leads to a truncation of strong magnitudes similar to a general truncated Gutenberg-Richter relationship and a comparison is thus made. The advantage of this new method is that it does not necessarily need a priori information about characteristic or maximum magnitudes, instead deriving it completely from slip accumulation and magnitude frequency of low and moderate-seismic events.

This method has been applied to the majority of global subduction zones and compared to the historic and paleo-seismic observations within each of these zones.