

Estimation of slip scenarios of megathrust earthquakes: Application to Central Andes, Peru

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The recent 2011 Tohoku-oki earthquake occurred in a region where giant megathrust earthquakes were not expected. This earthquake proved the difficulty to assess seismic hazard mainly based on information from historical earthquakes. In this study we propose a methodology to estimate the slip distribution of megathrust earthquakes likely to occur in the future, based on a model of interseismic coupling (ISC) distribution in subduction margins obtained from GPS measurements (Chlieh et al. 2011), as well as information of historical earthquakes, and apply the method to the Central Andes subduction region in Peru. Our results indicate that an earthquake of moment magnitude of 8.9 is very likely to occur at this region, as a result of the rapid convergence between the Nazca and South American plates and considering a large slip deficit of 15m since the 1746 earthquake, which is the largest and more damaging earthquake and tsunami in Central Andes according to historical information. The slip model obtained from geodetic data represents the large scale features of asperities within the megathrust, which is appropriate for simulation of long period waves and tsunami modelling. In order to create slip models appropriate for broadband strong ground motion simulations it becomes necessary to introduce small scale complexities to the source slip that allow the calculation of high frequency ground motions. To achieve this purpose we propose a 'broadband' source model in which large scale features of the model are constructed from our geodetic scenario slip, and the small scale heterogeneities are obtained from a spatially correlated random slip model. This spatial heterogeneity of slip is obtained from the spectral amplitudes at high wave-numbers of a Von Karman Pseudo Spectral Density function (PSD) that fits the PSD of our geodetic slip.

Our results indicate that the PSD of a slip model of the (Mw8.8) 2010 Maule earthquake, Chile, (Pulido et al. 2010), is very similar to the PSD of our geodetic scenario slip for Central Andes, suggesting that our methodology might be appropriate to typify megathrust earthquakes at this region.

References

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