Geophysical Research Abstracts
Vol. 16, EGU2014-6095, 2014
EGU General Assembly 2014

Maximum magnitude in the Lower Rhine Graben

Kris Vanneste (1), Miguel Merino (2), Seth Stein (2), Bart Vleminckx (1), Eddie Brooks (2), and Thierry Camelbeeck (1)

(1) Royal Observatory of Belgium, Brussels, Belgium (kris.vanneste@oma.be), (2) Department of Earth & Planetary Sciences; Northwestern University, Evanston, USA (seth@earth.northwestern.edu)

Estimating Mmax, the assumed magnitude of the largest future earthquakes expected on a fault or in an area, involves large uncertainties. No theoretical basis exists to infer Mmax because even where we know the long-term rate of motion across a plate boundary fault, or the deformation rate across an intraplate zone, neither predict how strain will be released. As a result, quite different estimates can be made based on the assumptions used. All one can say with certainty is that Mmax is at least as large as the largest earthquake in the available record. However, because catalogs are often short relative to the average recurrence time of large earthquakes, larger earthquakes than anticipated often occur. Estimating Mmax is especially challenging within plates, where deformation rates are poorly constrained, large earthquakes are rarer and variable in space and time, and often occur on previously unrecognized faults.

We explore this issue for the Lower Rhine Graben seismic zone where the largest known earthquake, the 1756 Düren earthquake, has magnitude 5.7 and should occur on average about every 400 years. However, paleoseismic studies suggest that earthquakes with magnitudes up to 6.7 occurred during the Late Pleistocene and Holocene. What to assume for Mmax is crucial for critical facilities like nuclear power plants that should be designed to withstand the maximum shaking in 10,000 years. Using the observed earthquake frequency-magnitude data, we generate synthetic earthquake histories, and sample them over shorter intervals corresponding to the real catalog's completeness. The maximum magnitudes appearing most often in the simulations tend to be those of earthquakes with mean recurrence time equal to the catalog length. Because catalogs are often short relative to the average recurrence time of large earthquakes, we expect larger earthquakes than observed to date to occur. In a next step, we will compute hazard maps for different return periods based on the synthetic catalogs, in order to determine the influence of underestimating Mmax.