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GEAR1 forecast: Distribution of largest earthquakes and number test

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We have obtained new results in the statistical analysis of global earthquake catalogs with special attention to the largest earthquakes, and we examined the statistical behavior of earthquake rate variations. These results can serve as an input for updating our recent earthquake forecast, known as the "Global Earthquake Activity Rate 1" model (GEAR1, Bird et al., BSSA, 2015), which is based on past earthquakes and geodetic strain rates. The GEAR1 forecast is expressed as the rate density of all earthquakes above magnitude 5.8 within 70 km of the sea level everywhere on earth at 0.1 by 0.1 degree resolution, and it is currently being tested by the Collaboratory for Study of Earthquake Predictability (CSEP). The seismic component of the present model is based on a smoothed version of the Global Centroid Moment Tensor (GCMT) catalog from 1977 through 2013. The tectonic component is based on the Global Strain Rate Map (GSRM2.1) of Kreemer et al. (GGG, 2014), a "General Earthquake Model" (GEM) product. The seismic and tectonic components were prepared and optimized separately, then combined in various linear, log-linear, and other combinations, and were optimized using pseudo-prospective testing. We found that a log-linear mixture of 60% seismicity with 40% tectonics provided the best forecast of events from 2005 to 2012 based on earlier events. The model also fits well the earthquake locations from 1918 to 1976 reported in the longer duration ISC-GEM global catalog of instrumental and pre-instrumental magnitude determinations (Storchak et al., PEPI, 2015). We revised our estimates of the upper magnitude limits, described as corner magnitudes, based on the massive earthquakes since 2004 and the seismic moment conservation principle. The new corner magnitude estimates are somewhat larger but consistent with their previous estimates. For major subduction zones we find the best estimates of the corner magnitude to be in the range 8.9 to 9.6 and consistent with a uniform average of 9.35. Statistical estimates tend to grow with time as larger earthquakes occur. However, by using the moment conservation principle that equates the seismic moment rate with the tectonic moment rate inferred from geodesy and geology, we obtain a consistent estimate of the corner moment largely independent of seismic history. These evaluations confirm the above-mentioned corner magnitude value. The new estimates of corner magnitudes are important both for the forecast part based on seismicity as well as the part based on geodetic strain rates and they can be used in other seismicity forecasts. We analyze the distribution of earthquake numbers by magnitude in successive time intervals. Earthquakes larger than magnitude 6.5 obey the Poisson distribution; for smaller events the negative-binomial distribution (NBD) provides a much better fit. We analyze the distribution of the earthquake numbers to test the forecast of earthquake numbers based on the NBD. The earthquakes with magnitude larger than 6.5 can be tested applying the commonly used Poisson distribution. The NBD is applied to test smaller events.