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Record-breaking Earthquakes, Forward and Backward

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A record-breaking earthquake has a magnitude larger than any previous earthquake. In order to constrain the problem, the region, starting time, and minimum magnitude must be specified. A remarkably simple theory is applicable if the earthquakes occur randomly. The mean number of record-breaking earthquakes is simply related to the natural logarithm of the number of earthquakes that have occurred independent of the statistical distribution of magnitudes. Specifying this distribution allows the mean magnitudes of the record-breaking earthquakes to also be determined. We compare the predictions of the random theory with several observed record-breaking sequences. We first consider the global CMT catalog for the years 1977 to 2007. We determine the numbers and magnitudes of record-breaking earthquakes during specified time intervals and find excellent agreement with the random theory. The analysis of record-breaking earthquakes can be applied forward and backward. For random earthquakes the statistical results will be the same. However, when aftershocks play a significant role the backward record-breaking earthquake will occur much more often than froward record-breaking earthquakes. We demonstrate this difference using earthquakes from Southern California.