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Uncertainties in time-dependent probability of characteristic earthquake occurrence for the major fault zones in the Central Apennines, Italy

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We calculate the probability of occurrence of earthquakes Mw>5.5 for individual fault sources in the Central Apennines for the 30-year period (2008-2038). We show the effect of time-dependent and time-independent occurrence (BPT and Poisson) models together with uncertain slip rates and uncertain maximum magnitudes and, hence, uncertain recurrence times. In order to reduce the large prior geological slip-rate uncertainty distribution for most faults, we obtain a posterior slip rate uncertainty distribution using a likelihood function obtained from regional historical seismicity. We assess the uncertainty of maximum magnitude by assuming that the uncertainty in fault width and length are described by a normal distribution with standard deviation equal to $\pm 20\%$ of the mean values. We then estimate the uncertainties of the 30-year probability of occurrence of a characteristic event using a Monte Carlo procedure. Uncertainty on each parameter is represented by the 16th and the 84th percentiles of simulated values. These percentiles bound the range that has a 68% of probability of including the real value of the parameter. We do these both for the Poisson case and for the BPT case by varying the aperiodicity parameter (alpha value) using the values 0.3, 0.5, and 0.7.

The Bayesian posterior slip-rate uncertainties typically differ by a factor of about 2 from the 16th to the 84th percentile. Occurrence probabilities for the next 30 years at the 84th percentile typically range from 1 to 2 percent for faults where the Poission model dominates, and from 2 to 21 percent where one of the BPT models dominates. The uncertainty in occurrence probability under the time-dependent hypothesis is very large, when measured by the ratio of 84th to 16th percentile, frequently being as much as 2 orders of magnitude. On the other hand, when measured by standard deviation, these standard deviations range from 2 to 6 percent for those faults whose elapsed time since previous event is large, but always 2 percent or less for faults with relatively recent previous occurrence, because the probability of occurrence is always small.