Project Abstract

Agnew and Jones (JGR) proposed a method for calculating the conditional probability of a main shock, given a potential foreshock. Their model uses as input the rate of background earthquakes, the rate of foreshocks before main shocks, and the long-term probability of a main shock in the absence of a foreshock event. They applied their model using the concept of characteristic earthquakes on predefined fault segments. Thus, the region of possible main shock nucleation defined by their model relies on specifying a fault segment-specific background seismicity rate and gives an equal potential for main shock nucleation for a foreshock located anywhere along the fault segment. This approach yields inconsistent results when a potential foreshock occurs in a region of closely spaced or overlapping faults, since different faults have different background rates and different long-term probabilities.

Our model abandons this main shock-centric view in favor of a foreshock-centric approach. The region of interest is redefined as the region within 10 km of the potential foreshock. The probability of a mainshock is the integrated probability of earthquakes over a threshold magnitude nucleating anywhere within the region. Background rate is also calculated only in the area surrounding the potential foreshock, and results in a single total probability of the earthquake being a foreshock to any possible mainshock within 10 km.

A preliminary test of this model was performed using hypothetical earthquakes near the Parkfield segment of the San Andreas fault. The annual probability of a Parkfield main shock in the absence of foreshock is taken from Michael and Jones (BSSA). The resulting conditional three-day probability of a main shock, given a magnitude 5.0 potential foreshock, ranged from 0.0002 to 0.08 when the potential foreshock is near the southern end of the segment, and from 0.13 to 0.16 when the potential foreshock is near the northern end. These results are lower than the corresponding probabilities obtained with the Agnew and Jones (JGR) calculation, which ranged from 0.02 to 0.19 (Michael and Jones, BSSA).