

Markov-modulated Hawkes process with stepwise decay

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Abstract This paper proposes a new model—the Markov-modulated Hawkes process with stepwise decay (MMHPSD)—to investigate the variation in seismicity rate during a series of earthquake sequences including multiple main shocks. The MMHPSD is a self-exciting process which switches among different states, in each of which the process has distinguishable background seismicity and decay rates. Parameter estimation is developed via the expectation maximization algorithm. The model is applied to data from the Landers–Hector Mine earthquake sequence, demonstrating that it is useful for modelling changes in the temporal patterns of seismicity. The states in the model can capture the behavior of main shocks, large aftershocks, secondary aftershocks, and a period of quiescence with different background rates and decay rates.

Keywords Markov-modulated Hawkes process with stepwise decay · EM algorithm · ETAS model · Simulation · Landers