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# Assessing the stability of the rate of background seismicity

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Seismic rate, defined simply as the number of events per unit time, is an important parameter in many types of earthquake hazard assessment. In one of the most recent applications, based on a rate-state friction model, background seismicity rate is a crucial element in the calculation of earthquake probability change due to a sudden stress step. This method, however, implicitly relies on the assumption that a stable background rate can be measured for any target space-time window. Results of many studies depend on convergence of the measure over time scales on the order of a few days and on spatial scales on the order of a few square kilometres.

How valid is this assumption? We test this by investigating the temporal properties of the southern California catalog over a range of temporal and spatial scales. From inspection of the frequency size distribution the catalog is complete for M$>$3.0 and contains $>$15000 events from 1932 to present. Here we examine the convergence of the event rate with increasing space-time windows. We find that the catalogues exhibit very slow convergence and the event rate can only be defined for the entire region by examining more than 20 years of data. This picture becomes worse for sub-regions of the catalogue. These results call into question the use of event rate defined for small space-time windows since it would appear unlikely that the rate measured in this way exposes any fundamental property of the system.