Correcting biases in the estimates of earthquake clustering parameters caused by short-term missing of aftershocks

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Short-term missing of aftershock in the early stage after the mainshock always biases the estimates of earthquake clustering models such as the ETAS model and the Omori-Utsu formula. For example, the parameters c and p in the Omori-Utsu formula change with the cutoff magnitude threshold. To correct the biases caused by such short-term aftershock missing, we apply a method developed by Zhuang et al (2016) to replenishing missing data. The basic idea of this method is that, if a temporal point process with time independent marks is completely observed, the whole process can transformed into a homogeneous Poisson process on the unit square by a biscale empirical transformation. Using this method, we can simulate the missing events and re-estimate model parameter with the replenished dataset. For example, applying this method to the aftershock sequence following the 2008 Wenchuan Ms7.9 earthquake in southwestern China, the results show that the Omori parameters c and p do not change with magnitude threshold anymore and that the missing of small events in the early stage of the aftershock sequence causes the inconsistent estimate of the earthquake clustering models.
Figure: Results from applying the replenishment algorithm to the earthquake data from Southwest China. (a) Marks (magnitudes) versus occurrence times of the earthquakes.
(b) Empirical distribution of marks (magnitudes) versus empirical distribution of occurrence times of the recorded events. (c) Rescalled marks (magnitudes) versus rescaled occurrence times of the combination of the observed events, with the rescaling based the empirical distributions of events in the time-magnitude range with complete observation. (d) Rescalled marks (magnitudes) versus rescaled occurrence times of the observed events and replenished events. (e) Marks (magnitudes) versus occurrence times of the observed events and the replenished events. (f) Cumulative numbers of events against occurrence times. Blue polygon is corresponding to the time-magnitude range in which the missing events fall. Blue dots are the replenished events.
Reference:
Zhuang, J., T. Wang and K. Kiyosugi, (2016) Detection and replenishment of missing data in marked point processes, *in preparation*.

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