

Hybrid kernel estimates of space–time earthquake occurrence rates using the epidemic-type aftershock sequence model

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Abstract The following steps are suggested for smoothing the occurrence patterns in a clustered space–time process, in particular the data from an earthquake catalogue. First, the original data is fitted by a temporal version of the ETAS model, and the occurrence times are transformed by using the cumulative form of the fitted ETAS model. Then the transformed data (transformed times and original locations) is smoothed by a space–time kernel with bandwidth obtained by optimizing a naive likelihood cross-validation. Finally, the estimated intensity for the original data is obtained by back-transforming the estimated intensity for the transformed data. This technique is used to estimate the intensity for earthquake occurrence data for associated with complex sequences of events off the East Coast of Tohoku district, northern Japan. The intensity so obtained is compared to the conditional intensity estimated from a full space–time ETAS model for the same data.

Keywords Bandwidths · Shape parameters · Cross-validation · ETAS models · Intensity function · Kernel estimates · Space–time point processes · Space–time ETAS model · Transformation of time