

# Incorporating focal mechanisms into the ETAS model

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The epidemic-type aftershock sequence (ETAS) model describes how each earthquake produces subsequent events. The original ETAS model considers only the locations, times, and magnitudes of each event. This time, we explore the possibility of combining the focal mechanisms into the model formulation. We hypothesize that, in the excitation part, the focal mechanism component is independent of all the other components and check whether the new form of the ETAS model fits better the earthquake aftershock data. In the conditional intensity (time-varying seismicity rate) of the extended ETAS model, the distribution of the focal mechanism of the direct offspring only depends on its Kagan angle (rotation angle) from the focal mechanisms of the parent event

To find a suitable form of the Kagan angle distribution, we use the stochastic reconstruction procedure proposed by Zhuang et al (2004) to rebuild it from the F-net data. We select focal mechanism of events with magnitudes 4.0+ . The triggering probabilities that each event is triggered by a previous earthquake are estimated by the original ETAS model. When calculating the Kagan angles, the focal mechanisms are transformed into quaternions. Figure 1 shows the reconstructed pdf of the kagan angles between parent events and direct offspring under the assumption of DC4 symmetry.

We also test whether the rotation poles are uniform distributed and whether the probability density of Kagan angles depends on the orientations of the mother events, by classifying them into reverse, strike and normal types.

Figure 1. (a) Density of Kagan Angles. The black, red, and green curves represent the complete random distribution for DC1, DC2, and DC4 symmetry assumptions, respectively. The light blue curve represents the probability density between any arbitrary pairs of events in the F-net catalog, and dark blue curve represents the probability of Kagan angle between any pair of direct offspring and ancestor. (b) The ratio between the dark blue curve and the green curve in (a).

## References:

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