Earthquake modeling incorporating non-seismic data

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Although early studies suggested a certain amount of precursory information in both earthquake catalogs and non-catalog observations, the earthquake forecast is still far from satisfactory at present. In most case, the precursory phenomena were studied individually. An earthquake model that combines self-exciting and mutually exciting elements was developed by Ogata and Akaike from the Hawkes process. The core idea of this combined model is that the status of the event at present is controlled by the event itself (self-exciting) and all the external factors (mutually exciting) in the past. In essence, the conditional intensity function is a time-varying point process, which is composed of the background rate term, the self-exciting term (the information from past seismic events), and the external excitation term (the information from past non-seismic observations). This model shows us a way to integrate the catalog-based forecast and non-catalog-based forecast. Meanwhile, measurements of electromagnetic fields and GPS ground deformations have documented accumulative signals associated with large earthquakes during the past few decades. To date, a large number of statistical investigations have shown the correlation between these signals and large earthquakes. As an attempt, we are trying to develop new earthquake models which incorporate information from both earthquake catalog and non-seismic observations.

Keywords: Earthquake modeling, the self-exciting and mutually exciting model, GPS ground deformation, geo-electromagnetic variations