Understanding Earthquake Clustering: A Nearest-Neighbor Approach

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Clarifying whether earthquake clusters follow universal patterns or exhibit different forms related to physical properties of the lithosphere is among the main problems of statistical seismology. This talk reviews and discusses results obtained by nearest-neighbor analysis of earthquakes in space-time-magnitude domain. This approach connects every event in the catalog to its nearest neighbor, referred to as parent, thus creating a time-oriented spanning tree of events. Observational results show bimodality of nearest-neighbor earthquake distances, which allows partitioning catalogs into sub-trees corresponding to individual earthquake clusters. Application of this approach to a variety of problems validates its general utility and reveals the existence of several different robust types of earthquake clusters. We will discuss recent results on global earthquake clustering in relation to heat flow and plate boundary type, distinguishing between tectonic and human-induced seismicity, and catalog declustering. The presentation will also illustrate ramifications of the nearest-neighbor technique into multi-parent network-based cluster representation.