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Memory and scaling in Climate and Earthquakes: Clustering of Extreme

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In many natural systems such as climate, rivers flow and earthquakes, long term persistence exists. We study the statistics of the return intervals between extreme events above a certain threshold in long term persistent records. We find [1] that the long-term memory leads (i) to a stretched exponential distribution of the return intervals and (ii) to a pronounced clustering of extreme events. Using a scaling approach we demonstrate that these features can be seen in long climate records. We also study [2] the statistics of the recurrence times between earthquakes above a certain magnitude M in six (one global and five regional) earthquake catalogs. We find pronounced clustering in the recurrence time records such that small and large recurrence times tend to cluster in time. For example, the distribution of the recurrence times strongly depends on the previous recurrence interval, such that short and long recurrence times tend to cluster in time. We also demonstrate the existence of large clusters of short return intervals as well as large clusters of long return intervals. As a consequence, the risk of encountering the next event within a certain time span after the last event depends significantly on the past, an effect that has to be taken into account in any effective earthquake prognosis.

References:

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