A Fractal Approach to the Clustering of Earthquakes: Applications to the Seismicity of the New Hebrides

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The concept of fractals provides a means of testing whether earthquake clustering in time or space is a random or scale invariant process. If the probability of finding an event in a time interval r is given by $Pr \sim r^{1-D}$ then the distribution is a fractal implying scale invariant clustering (curdling). Spatial clustering can be studied using squares with a dimension ℓ; fractal behavior implies $Pr \sim \ell^{2-D}$. We have analyzed a catalogue of earthquakes from the New Hebrides for the occurrences of clusters in time and space to determine if the observed clustering is a fractal phenomena, a statistical effect that does not contradict the hypothesis that earthquakes are generated by a Poisson process, or neither. This catalog contains 15,000 earthquakes recorded over eight years in a 2° by 2° area with a magnitude range of 2.7-7. Significant deviations from random distributions are found. Our technique permits the isolation of that part of the data that appears non-Poisson. Clusters that are statistically significant can then be used to study the physical properties of the earthquake process, and possibly for earthquake prediction.

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