On the relation between the seismic activity data and Hurst exponent in support of energy investments in Albania.

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Earthquakes constitute a threat to human activity and must be considered when designing engineering facilities.

We empirically examine the dependence between earthquake’s magnitudes and their intrinsic value through Hurst’s rescaled range analysis.

Estimating the Hurst exponent for a data set provides a measure of whether the data is a random process or has underlying trends.
Can the past be used to predict the future?

The basic assumption of Probabilistic Seismic Hazard Analysis is the same as that of financial markets, and other disciplines that deal with self-similar processes, or even that of a Japanese quote: “Through Inquiring of the Old We Learn the New”.
We have a total of 4219 data (total number of earthquake’s magnitudes).

<table>
<thead>
<tr>
<th>Region</th>
<th>N</th>
<th>M ≥ 4.5</th>
<th>$M_{\text{min}(N)}$</th>
<th>$M_{\text{avg}(N)}$</th>
<th>$M_{\text{max}(N)}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albania</td>
<td>4219</td>
<td>735</td>
<td>1.00</td>
<td>3.02</td>
<td>7.20</td>
</tr>
</tbody>
</table>
Results

Rescaled range analysis, 50BC to Apr. 2019, N=4219

Average magnitude = 3.02
Maximum magnitude = 7.20
Minimum magnitude = 1.00

Magnitudes series in Albania, 4219 data, 50BC – 2019
Source: Institute Geosciences and Energy, Water and Environment (IGEWE)
Results

Rescaled range analysis, 50BC to Apr. 2019, N=4219

Average magnitude = 3.02
Maximum magnitude = 7.20
Minimum magnitude = 1.00

Source: Institute Geosciences and Energy, Water and Environment (IGEWE)
Results

Rescaled range analysis, 50BC to Apr. 2019, N=4219

Hurst exponent (H) = 0.68
Fractal Dimension (D) = 1.32

R/S - earthquake’s magnitude data in Albania
Results

Rescaled range analysis, 50BC to Apr. 2019
$M \geq 4.5$, $N=735$

Average magnitude = 5.12
Maximum magnitude = 7.20
Minimum magnitude = 4.50

Magnitudes series in Albania, 735 data; $M \geq 4.5$
Source: Institute Geosciences and Energy, Water and Environment (IGEWE)
Results

Rescaled range analysis, 50BC to Apr. 2019
\( M \geq 4.5, N=735 \)

Average magnitude = 5.12
Maximum magnitude = 7.20
Minimum magnitude = 4.50

Frequency of magnitudes in Albania, 735 data; \( M \geq 4.5 \)
Source: Institute Geosciences and Energy, Water and Environment (IGEWE)
Results

Rescaled range analysis, 50BC to Apr. 2019
M >= 4.5, N=735

Hurst exponent (H) = 0.76
Fractal Dimension (D) = 1.24
We conclude by indicating a long-term correlation in earthquakes magnitudes in Albania.

Examination of seismic data series through Hurst’s rescaled range analysis shows that seismicity is a memory process, not random. \((H > 0.5)\)

Regarding the fractal dimension \((D)\) we estimated that the seismicity in Albania has a dimension between the roughness of a snowflake (Van Koch Snowflake) and that of Sierpinski triangle. \((D = 1.32 ; D_{M>4.5} = 1.24)\)
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