
AN EXPERIMENTAL VIEW ON EARTHQUAKE MAGNITUDE CORRELATIONS

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The clustering of earthquakes in time and space is widely accepted, however the existence of correlations in earthquake magnitudes is more questionable [1]. In standard models of seismic activity, it is usually assumed that magnitudes are independent and therefore in principle unpredictable. Our work seeks to test this assumption by analysing magnitude correlation between earthquakes and their aftershocks. In other words, does an increase in the seismic activity mean an increase in the magnitude?

Fracturing is the most prevalent deformation mechanism in rocks deformed in the laboratory under simulated upper crustal conditions. Fracturing produces acoustic emissions (AE) at the laboratory scale and earthquakes on a crustal scale. The AE technique provides a means to analyse microcracking activity inside the rock volume and since experiments can be performed under confining pressure to simulate depth of burial, AE can be used as a proxy for natural processes such as earthquakes.

Experimental rock deformation provides us with several ways to investigate time-dependent brittle deformation. Two main types of experiments can be distinguished: (1) constant strain rate experiments in which stress varies as a result of deformation, and (2) creep experiments in which deformation and deformation rate vary over time as a result of an imposed constant stress [2]. We conducted constant strain rate and creep experiments on air-dried Darley Dale sandstone samples in a variety of confining pressures in water saturated samples with 20 MPa initial pore fluid pressure.

Firstly the magnitude of each AE event was calculated and then we search the relationship between the conditional intensity estimates of the Epidemic Type Aftershock Sequence (ETAS) model in which magnitude correlations are absent by construction and the AE events magnitudes. The ETAS model characterizes a sequence of earthquakes and aftershocks over space and time via a conditional intensity. The conditional intensity function is a convenient and intuitive way of specifying how the present depends on the past in an evolutionary point process. A positive relation would suggest the existence of magnitude correlations. Applying the ETAS model to experimental data will allow us to validate our results from earthquake catalog data and provide for the first time a holistic view on the correlation of earthquake magnitudes.

References

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