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Space and time correlations in the activity of fracture front dynamics: a comparison to the statistics of slip and microseismicity of natural faults.

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We analyze the scaling laws in space and time of two types of displacement fields, generated by treatment of images: at small scale, sequences of experimental pictures of crack front propagating in a transparent and disordered material in the laboratory, and at large scale, sequences of INSAR pictures of small faults during creep in the Asal rift.

The analysis of the deformation of the crack front in one case, and of the slip along the faults in the other case, shows a statistical self-affine character with similar Hurst exponent in both situations.
Applying the same technique to the two data sets, we generate from the sequence of images, maps of thresholded velocity, analog to a catalog of reconstructed fast events.
Analyzing these events as slowly seismic ones, we look at the distribution of event sizes, and at the time and space correlations between events.
We show that some striking similarities exist in the two cases, notably a Gutenberg-Richter type of law, and that these scaling laws are directly comparable to the ones of large scale seismic catalogs.

The existence of these scaling laws for the time and space heterogeneity of the activity seems thus to hold for different speed ranges of fault slip, both for the seismic activity, and the one usually seen as aseismic creep.
They can also be found at small scale in slow fracture experiments. Notably, the physical origin of the time variability and of these scaling law, in the later case, cannot be attributed to a variable fluid source, since it is absent of the setup. In this case, these fluctuations and their scaling arise solely from collective effects in a balance between elasticity and local disorder in pinning thresholds.