Dilation of a sheared granular model experiment of earthquake to serve as a possible precursor

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Earthquake forecast has long been an objective for geoscience, resisting scientific efforts for more than a century. This difficulty stems in part from the very large spectrum of time and energy scales, a feature required of physics-earthquake analogies [1]. There are indications that any progress in prediction will come not from any single observable, but more likely in the form of a probabilistic combination (either analytical or based on recent machine-learning progress [2]) of many signals and measurements. The search for precursory signals had lead to a wide variety of candidates, such as slow-slip events [3] or low-frenquency changes. New precursors can be searched either in real-world data, or through model experiment –we focus on the later approach.
We present a granular shear experiment in a cylindrical couette geometry [1] which creates artificial quakes in the form of acoustic burst or mechanical energy release. This system has been shown to exhibit quantitative agreement to several key statistical features of earthquakes (Gutenberg-Richter law, Omori law, inter-event time distribution [4]). Additionally, the dilation of the granular medium is monitored during an experimental. This dilation increases on average prior to large events [5]. Furthermore, we show the link between average dilation increase and upcoming events hold for several magnitudes.

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