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Distributions of extreme bursts above thresholds in a fractional Lévy toy model of natural complexity.

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In 2 far-sighted contributions in the 1960s Mandelbrot showed the ubiquity of both non-Gaussian fluctuations and long-ranged temporal memory (the “Noah” and “Joseph” effects, respectively) in the natural and man-made worlds. Much subsequent work in complexity science has contributed to the physical underpinning of these effects, particularly in cases where complex interactions in a system cause a driven or random perturbation to be nonlinearly amplified in amplitude and/or spread out over a wide range of frequencies. In addition the modelling of catastrophes has begun to incorporate the insights which these approaches have offered into the likelihood of extreme and long-lived fluctuations.

I will briefly survey how the application of the above ideas in the earth system has been a key focus and motivation of research into natural complexity at BAS [e.g. Watkins & Freeman, Science, 2008; Edwards et al, Nature, 2007]. I will then discuss in detail a standard toy model (linear fractional stable motion, LFSM) which combines the Noah and Joseph effects in a controllable way and explain how it differs from the widely used continuous time random walk. I will describe how LFSM is being used to explore the interplay of the above two effects in the distribution of bursts above thresholds. I will describe ongoing work to improve the accuracy of maximum likelihood-based estimation of burst size and waiting time distributions for LFSM first reported in [Watkins et al, PRE, 2009]; and will also touch on similar work for multifractal models [Watkins et al, PRL comment, 2009].