



## **Dragon-Kings or Dragon-Fools? Outliers or Extremes?**

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Geophysics with extremes of all magnitudes seems full of monsters like Victor Hugo's Court of Miracles. These extremes have been statistically considered for a while as outliers with respect to rather mild distributions of more normal events. However, a characteristic magnitude separating the abnormal events from the normal ones would be at odd with the generic scaling behaviour of nonlinear systems, contrary to "fat tailed" distributions.

More precisely, it can be shown [1] how the apparent monsters could be mere manifestations of a singular measure mishandled as a regular measure. Monstrous fluctuations are the rule, not outliers and they are more frequent than usually thought up to the point that (theoretical) statistical moments can easily be infinite. The empirical estimates of the latter are erratic and diverge with sample size. The corresponding physics is that intense small scale events cannot be smoothed out by upscaling.

However, based on a few examples, it has also been argued [2] that one should consider "genuine" outliers of fat tailed distributions so monstrous that they can be called "dragon-kings". We critically analyse these arguments, e.g. finite sample size and statistical estimates of the largest events, multifractal phase transition vs. more classical phase transition. We emphasize the fact that dragon-kings are not needed in order that the largest events become predictable. This is rather reminiscent of the Feast of Fools picturesquely described by Victor Hugo.

[1] D. Schertzer, I. Tchiguirinskaia, S. Lovjeoy et P. Hubert (2010): No monsters, no miracles: in nonlinear sciences hydrology is not an outlier! *Hydrological Sciences Journal*, 55: 6.

[2] D. Sornette (2010): Dragon-Kings, Black Swans and the Prediction of Crises. *International Journal of Terraspace Science and Engineering* (in press).