

# Abstract for GR-TR Conference on Statistical Mechanics and Dynamical Systems

Talk Invited

Invited Talk

---

## From rock fracture to plate tectonics, evidence of non-extensive statistical mechanics in Earth physics: A review

Filippos Vallianatos\*

Laboratory of Geophysics and Seismology,  
Technological Educational Institute of Crete, Greece  
and

Institute for Risk and Disaster Reduction, UCL, UK

\* Electronic Address: [fvallian@chania.teicrete.gr](mailto:fvallian@chania.teicrete.gr)

The non-extensive statistical mechanics pioneered by the Tsallis group offers a consistent theoretical framework, based on a generalization of entropy, to analyze the behavior of systems with fractal or multi-fractal distribution of their elements. Such systems where long-range interactions or intermittency are important, lead to power law behavior. The question of whether earth systems are described by non-extensive statistical physics, even at the phenomenological level (i.e., without specifying any underlying model), represents a challenge. This is the problem we review here. Our aim is not to present a precise model, but rather to emphasize in simple arguments of physical plausibility. Examples supporting the non-additive behavior of earth system, from rocks fracture (e.g., acoustic emissions) to geodynamic (e.g., plate tectonics, global seismicity) scale are presented.

**Acknowledgments.** This work was partly supported by the THALES Program of the Ministry of Education of Greece and the European Union in the framework of the project entitled "Integrated understanding of Seismicity, using innovative Methodologies of Fracture mechanics along with Earthquake and non extensive statistical physics Application to the geodynamic system of the Hellenic Arc. SEISMO FEAR HELLARC".

- 
- [1] Tsallis, C., Introduction to Nonextensive Statistical Mechanics: Approaching a Complex World, Springer, Berlin, 1-378, 2009.
  - [2] Tsallis, C., Nonadditive entropy  $S_q$  and nonextensive statistical mechanics. Applications in Geophysics and elsewhere. *Acta Geophysica*, 60/3, 2012.
  - [3] Vallianatos, F. and Telesca, L., (editors), Statistical Mechanics in Earth Physics and Natural Hazards, *Acta Geophysica* , 60/3, 2012.