Wildfire statistics in Corsica: a multifractal approach

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Introduction

The spatio-temporal occurrences of fires over a given territory is a complex scale-dependant process. It manifests though complex geometries with roughness and singularities in the spatial repartition of fires. Theoretical aspects of modern fractal analysis lead to consider these forms as singular measures over a given support [1]. The figure 1 presents such a distribution in Corsica for the period 1981-2007.

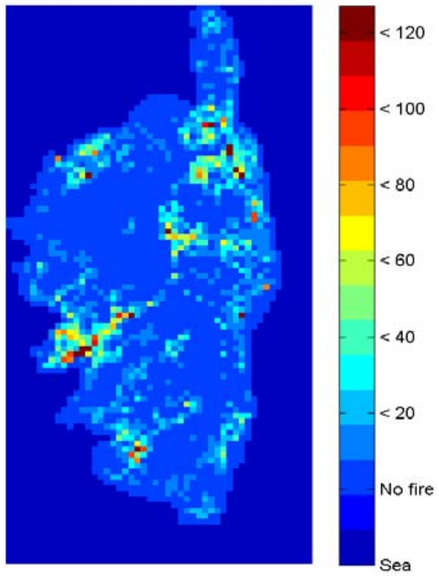

Figure 1: fire number N over each DFCI cell (2km²) in Corsica

Objectives

The fire safety science attempts to provide empirical laws of fire behavior over a range of large scales. This study is in this framework. Some of the **questions** arising from such a random distribution is :

•does it exist any law setting the spatial repartition of fire over a given territory?

•do these laws set the fire hazard for this territory?

The study purposes to check if a dependence of the fire number N to the local length scale ε could not be put in evidence according to:

$$N(\varepsilon) \sim \varepsilon^{\alpha} \qquad (1)$$

The multifractal approach

A method for accounting fires in a scale ε is given by the multifractal formalism. If measure N (or equivalently probability) is invariant over a domain partitioned in P parts, N and ε must respect:

$$\sum_P N^q \varepsilon^{-\tau} \sim 1 \qquad (2)$$

Evaluating the generalized partition function $Z(q,\varepsilon)$ yields to quantify the multifractality of the distribution through the $\tau(q)$ spectrum (fig.2).

$$Z(q,\varepsilon) = \sum_P N^q \sim \varepsilon^{\tau} \qquad (3)$$

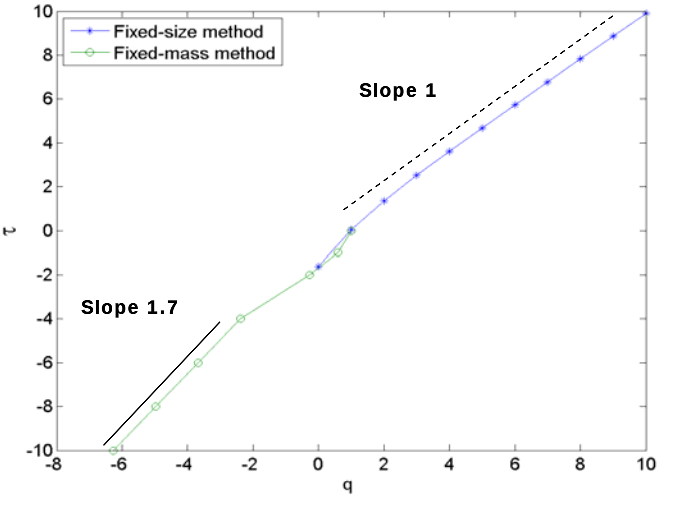

Figure 2: τ(q) spectrum

Such a spectrum illustrates that the distribution presented on fig.1 obeys to 2 different scaling laws (1).

Indeed, from (1) and (3), it can be derived that: **$N \sim F(\varepsilon\ ;\ \varepsilon^{1.7})$**

In some case:

-N increases as <u>« fractal » surfaces</u> **$N_1(\varepsilon) \sim \varepsilon^{1.7}$**

-N increases with <u>lengths</u> **$N_2(\varepsilon) \sim \varepsilon$**

From such laws, one may assume that:

-fire occurrence maps the natural repartition of vegetal cover with **N_1**

-fire occurrence maps the network of largest roads with **N_2**

Each law stands for the quantification of a well-identified hazard: N1 is related to the natural fire occurence process whereas N2 is rather due to the anthropic activity.

Conclusion

The present study illustrates that the use of multifractal formalism for investigating wildfire fire database allows the explicit formulation of a hazard probability including its geographical dependence.

Work-in-progress concerns the processing of the complete Prométhée database reporting fires in 15 different regions in Southern France since 1973 [2]

Because <u>precipitation events</u> lead to similar singular distributions [3], we plan to apply this methodology, looking for <u>empirical laws</u> which incorporate the regional and seasonal influence of rainfalls on wildfire distributions.

References

[1] J.F. Muzy, E. Bacry and A. Arneodo, The multifractal formalism revisited with wavelets, Int. Journal of Bifurcations and Chaos, Vol. 4, P. 245, 1994

[2] The Prométhée database:http://www.promethee.com

[3] D. SCHERTZEL and S. LOVEJOY Physical Modeling and Analysis of Rain and Clouds by Anisotropic Scaling Multiplicative Processes, Journal of Geophysical Research, Vol. 92, No. D8, PP 9693-9714, 1987

Information

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