



## **Spatio-temporal evolution of forest fires in Portugal**

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A key issue in fire management is the ability to explore and try to predict where and when fires are more likely to occur. This information can be useful to understand the triggering factors of ignitions and for planning strategies to reduce forest fires, to manage the sources of ignition and to identify areas and frame period at risk. Therefore, producing maps displaying forest fires location and their occurrence in time can be of great help for accurately forecasting these hazardous events. In a fire prone country as Portugal, where thousands of events occurs each year, it is involved to drive information about fires over densities and recurrences just by looking at the original arrangement of the mapped ignition points or burnt areas. In this respect, statistical methods originally developed for spatio-temporal stochastic point processes can be employed to find a structure within these large datasets.

In the present study, the authors propose an approach to analyze and visualize the evolution in space and in time of forest fires occurred in Portugal during a long frame period (1990 – 2013). Data came from the Portuguese mapped burnt areas official geodatabase (by the Institute for the Conservation of Nature and Forests), which is the result of interpreted satellite measurements. The following statistical analyses were performed: the geographically-weighted summary statistics, to analyze the local variability of the average burned area; the space-time Kernel density, to elaborate smoothed density surfaces representing over densities of fires classed by size and on North vs South region. Finally, we employed the volume rendering technique to visualize the spatio-temporal evolution of these events into a unique map: this representation allows visually inspecting areas and time-step more affected from a high aggregation of forest fires. It results that during the whole investigated period over densities are mainly located in the northern regions, while in the southern areas spread hot-spot are spatially randomly distributed and temporally more concentrated in the frame 2000 – 2004.

To conclude, this study let us to identify a multitude of clustering space-time features of forest fires in Portugal, which can be useful for a better planning of educational activities and prevention campaigns as well as for a better allocation of monitoring systems and firefighting.

### References:

Tonini M., Pereira M. G., Parente J. (2016) - Evolution of forest fires in Portugal: from spatio-temporal point events to smoothed density maps. *Natural Hazard*, doi:10.1007/s11069-016-2637-x

Lu B., Harris P., Charlton M., Brunsdon C. (2014) - The GWmodel R package: further topics for exploring spatial heterogeneity using geographically weighted models. *Geo-spatial Information Science*, Vol. 17: 85-101

Rowlingson B., Diggle P., Bivand M.R. (2012) - Splanx: spatial point pattern analysis code in S-Plus. *Computers and Geosciences*, Vol. 19: 627-655

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