Geophysical Research Abstracts
Vol. 15, EGU2013-5461, 2013
EGU General Assembly 2013

Spatio-temporal patterns of forest fires: a comprehensive application of the K-function

Marj Tonini (1), Carmen Vega Orozco (1), Mikhaïl Kanevski (1), and Marco Conedera (2)

(1) Center for Research on Terrestrial Environment - Lausanne University, Lausanne, Switzerland (marj.tonini@unil.ch), (2) WSL Swiss Federal Research Institute, Insubric Ecosystems Research Group, Via Belsoggiorno 22, CH-6500 Bellinzona, Switzerland

The spatial distribution of uncontrolled hazardous events, such as forest fires, is largely investigated from the scientific community with the purpose of finding out the more vulnerable areas. Mapping the location of spatio-temporal sequences for a given environmental dataset is of great impact; however, the majority of the studies miss the analysis of the aggregation over time. Nonetheless discovering unusual temporal pattern for a given time sequence is fundamental to understand the phenomena and underlying processes.
The present study aims investigating both the spatial and the temporal cluster behaviour of forest fires occurrences registered in Canton Ticino (Switzerland) over a period of about 40 years and testing if space and time interact in generate clusters. To do this, the purely spatial, the time and the space-time extensions of the Ripley's K-function were applied.
The Ripley's K-function is a statistic exploratory method which enables detecting whether or not a point process (e.g. the location of the ignition points) is randomly distributed. The purely spatial K-function K(r) is defined as the expected number of further events within an area of radius r around an arbitrary point of the pattern, divided by the intensity of the phenomenon. Under completely spatial randomness, the value of the K(r) is equal to the area around the point (=πr2), while observations above this theoretical value imply a clustering behaviour at the corresponding distance r.
For the purely time analysis, the Ripley's K-function K(t) can be taught as a reformulation of the spatial version to detect unexpected aggregation of events over the temporal scale. For its computation, the value of the intensity used in K(r) is replaced by the total duration of the time sequence divided by the total number of observed events, and the distance r is replaced by the time interval t. Under time-regularity, K(t) equals 2t, whereas, observed measures above this theoretical value indicate a temporal cluster behaviour at the corresponding temporal scale t.
For the analysis of the space-time clustering, we applied the spatio-temporal (bivariate) K-function K(r,t), which evaluates if events are closer in both space and time. Intuitively, if there is no space–time interaction K(r,t) = K(r) * K(t). Accordingly, if K(r,t) minus K(r) * K(t) is positive, this indicates an interaction between space and time in producing clusters, which arise from a well detectable spatial and temporal scales.
This study allowed detecting: 1) the purely spatial and the purely temporal scales at which the registered forest fires events are clustered, given by the results of the K(r) and the K(t) computations; and 2) the time period where spatial clusters take place at a given distance scale, exhibited by the results of the K(r,t) computation.

Key words: spatio-temporal sequences, cluster, Ripley's K-function, forest fires.

Acknowledgements
This work was partly supported by the SNFS Project No. 200021-140658, "Analysis and Modelling of Space-Time Patterns in Complex Regions".

References
- Bivand R., Rowlingson B., and Diggle P. (2012) – splancs package in R project
- Diggle P., Chetwynd A., Haggkvist R. and Morris S. (1995) Second-order analysis of space-time clustering. Statistical Methods in Medical Research, vol. 4(2): 124-136.
- R Development Core Team (2012). R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria. URL: http://www.R-project.org/.
- Vega Orozco C., Tonini M., Conedera M., Kanveski M. (2012) Cluster recognition in spatial-temporal sequences: the case of forest fires, GeoInformatica, vol. 16(4): 653-673.