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Analysis of forest fires spatial clustering using local fractal measure

Mikhail Kanevski, Mikael Rochat, and Vadim Timonin
Center for Research on Terrestrial Environment, University of Lausanne, Switzerland (Mikhail.Kanevski@unil.ch)

The research deals with an application of local fractal measure – local sandbox counting or mass counting, for the characterization of patterns of spatial clustering. The main application concerns the simulated (random patterns within validity domain in forest regions) and real data (forest fires in Ticino, Switzerland) case studies. The global patterns of spatial clustering of forest fires were extensively studied using different topological (nearest-neighbours, Voronoi polygons), statistical (Ripley's k-function, Morisita diagram) and fractal/multifractal measures (box-counting, sandbox counting, lacunarity) (Kanevski, 2008). Generalizations of these measures to functional ones can reveal the structure of the phenomena, e.g. burned areas. All these measures are valuable and complementary tools to study spatial clustering. Moreover, application of the validity domain (complex domain where phenomena is studied) concept helps in understanding and interpretation of the results.

In the present paper a sandbox counting method was applied locally, i.e. each point of ignition was considered as a centre of events counting with an increasing search radius. Then, the local relationships between the radius and the number of ignition points within the given radius were examined. Finally, the results are mapped using an interpolation algorithm for the visualization and analytical purposes. Both 2d (X,Y) and 3d (X,Y,Z) cases were studied and compared.

Local "fractal" study gives an interesting spatially distributed picture of clustering. The real data case study was compared with a reference homogeneous pattern – complete spatial randomness. The difference between two patterns clearly indicates the regions with important spatial clustering. An extension to the local functional measure was applied taking into account the surface of burned area, i.e. by analysing only data with the fires above some threshold of burned area. Such analysis is similar to marked point processes and helps to understand the spatial structure of the phenomenon itself. The cross analysis, when forest fires are compared with random pattern was performed as well. Finally, in order to better characterize all patterns an anisotropic variography was performed to study their spatial correlations.

In comparison with the global measures, the produced results gave very detailed local information on the distribution of ignition points and the spatial structure of the phenomenon.

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References
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