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Geostatistical Analysis of Spatio-Temporal Forest Fire Data

Carmen D. Vega Orozco (1), Mikhail Kanevski (1), Marj Tonini (1), and Marc Conedera (2)

(1) Institute of Geomatics and Analysis of Risk - IGAR, University of Lausanne, CH-1015 Lausanne, Switzerland (carmen.vegaorozco@unil.ch), (2) WSL Swiss Federal Research Institute, Insubric Ecosystems Research Group, via Belsoggiorno 22, CH-6500 Bellinzona, Switzerland

Forest fire is one of the major phenomena causing degradation of environment, landscape, natural ecosystems, human health and economy. One of the main topic in forest fire data studies deals with the detection, analysis and modelling of spatio-temporal patterns of clustering. Spatial patterns of forest fire locations, their sizes and their sequence in time are of great interest for fire prediction and for forest fire management planning and distribution in optimal way necessary resources. Currently, fires can be analyzed and monitored by using different statistical tools, for example, Ripley's k-function, fractals, Allan factor, scan statistics, etc. Some of them are adapted to temporal or spatial data and are either local or global.

In the present study the main attention is paid to the application of geostatistical tools – variography and methods for the analysis of monitoring networks (MN) clustering techniques (topological, statistical and fractal measures), in order to detect and to characterize spatio-temporal forest fire patterns. The main studies performed include: a) analysis of forest fires temporal sequences; b) spatial clustering of forest fires; c) geostatistical spatial analysis of burnt areas. Variography was carried out both for temporal and spatial data.

Real case study is based on the forest-fire event data from Canton of Ticino (Switzerland) for a period of 1969 to 2008. The results from temporal analysis show the presence of clustering and seasonal periodicities. Comprehensive analysis of the variograms shows an anisotropy in the direction 30° East-North where smooth changes are detected, while on the direction 30° North-West a greater variability was identified.

The research was completed with an application of different MN analysis techniques including, analysis of distributions of distances between events, Morisita Index (MI), fractal dimensions (sandbox counting and box counting methods) and functional fractal dimensions, adapted and applied to characterize spatio-temporal events. The results are compared with the reference patterns (no spatial clustering) simulated within the natural validity domains (forests).

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