Geophysical Research Abstracts, Vol. 9, 01306, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-01306

Comparison of measures of spatial clustering. The case of forest fires.

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Analysis and quantification of clustering of spatial phenomena is a very important topic in many real life applications: natural hazard, epidemiology, ecology/biodiversity, etc. There exist many measures of different nature in order to characterize spatial clustering: first order measures based on density modeling, topological measures, second order statistical measures (e.g. Morisita index, Ripley's K-function), dimensional/fractal resolutions.

Cluster detection of forest fires sequences, by its impact on the allocation of damage prevention resources, is a crucial question in risk management. Knowledge about clustering of events and their dependency on secondary factors (population, vegetative stress, etc.) can improve the regional awareness and play an important role both in risk assessment and emergency management.

The main objective of the present research deals with coherent and consistent application of different measures of clustering, in particular spatial events density estimations, Morisita and K-function indexes, fractal and lacunarity measures, to compare their outputs and information contents. These measures are used to characterize spatio-temporal patterns of simulated, with known properties of clustering, and real data on forest fire events in Toscana (center of Italy). The real dataset includes 3700 ignition points for fires for the period 1997-2003, and has been divided into yearly sequences, in order to detect changes in the temporal behavior of the events.

The simulated datasets were generated within the regions of modelling interest called validity domains. Three validity domains have been used for this study and for every

index: a rectangular one covering region, the administrative geographic boundaries of Toscana (therefore excluding allocation of events over the sea) and the areas occupied by forest (excluding the allocation of events to areas unable to ignite a forest fire). Application of simulated homogeneous patterns within the validity domain helped to estimate reference measures and partly to avoid problems with edge effects. Deviations from reference patterns quantify real degree of clustering.