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Quantification of forest fires clustering in space and time: global vs local approaches

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Forest fires are one of the main concerns when speaking about environmental risk. Every year, important amounts of forest burn in drought periods because of climatic or anthropogenic factors. Forest fires give rise to big economical and environmental damages, therefore corresponding risks have to be quantitatively assessed and mitigated.

One of the main issues is therefore the allocation of resources, in order to concentrate efforts where they are the most urgent and where the most population at risk is exposed. Such an objective can be achieved through the study of spatial clustering of fire processes: forest fires do not occur randomly in space and several measures can be applied in order to detect preferential areas at risk and link them to human behavior or environmental phenomena.

Two general approaches can be applied: global and local. In global approach, the presence of clustering is detected as departure from homogeneous distribution of events, without considering the exact location of the fires. Statistical as well as fractal measures can be used in such situations. They allow to detect the presence and the significance of spatial (or spatiotemporal) clustering of the phenomena under study. In local approach, the location of individual clusters is considered: by working with moving widows, specific clusters can be detected and assessed by comparing the local density of events to a certain distribution considered as random.

In this paper, global and local methods for cluster detection are tested and evaluated through several studies carried out on a Tuscany forest fires dataset. Accent is put on space-time modeling by analysis of time-moving windows fractal indices and spatial scan statistics.