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Wildfire cluster detection using space-time scan statistics

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The aim of the present study is to identify spatio-temporal clusters of fires sequences using space-time scan statistics. These statistical methods are specifically designed to detect clusters and assess their significance. Basically, scan statistics work by comparing a set of events occurring inside a scanning window (or a space-time cylinder for spatio-temporal data) with those that lie outside. Windows of increasing size scan the zone across space and time: the likelihood ratio is calculated for each window (comparing the ratio "observed cases over expected" inside and outside): the window with the maximum value is assumed to be the most probable cluster, and so on. Under the null hypothesis of spatial and temporal randomness, these events are distributed according to a known discrete-state random process (Poisson or Bernoulli), which parameters can be estimated. Given this assumption, it is possible to test whether or not the null hypothesis holds in a specific area. In order to deal with fires data, the space-time permutation scan statistic has been applied since it does not require the explicit specification of the population-at risk in each cylinder.

The case study is represented by Florida daily fire detection using the Moderate Resolution Imaging Spectroradiometer (MODIS) active fire product during the period 2003-2006. As result, statistically significant clusters have been identified. Performing the analyses over the entire frame period, three out of the five most likely clusters have been identified in the forest areas, on the North of the country; the other two clusters cover a large zone in the South, corresponding to agricultural land and the prairies in the Everglades. Furthermore, the analyses have been performed separately for the four years to analyze if the wildfires recur each year during the same period. It emerges that clusters of forest fires are more frequent in hot seasons (spring and summer), while in the South areas they are widely present along the whole year.

The analysis of fires distribution to evaluate if they are statistically more frequent in some area or/and in some period of the year, can be useful to support fire management and to focus on prevention measures.