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The role of meteorological factors on interannual variability of fire activity in Iberia: an assessment performed over four subregions

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The Iberian Peninsula is recurrently affected by devastating wildfires that result from an interplay of human activities, landscape features, and atmospheric conditions. The fact that the Mediterranean basin, and the Iberian Peninsula in particular, is a hotspot of climate change, strongly suggests that particular attention should be devoted to the role played by atmospheric conditions on wildfire activity.

Here we present a statistical model that is able to simulate the probability of occurrence of a fire event that releases a given amount of Fire Radiative Power, provided a specified level of meteorological fire danger as rated by the Fire Weather Index.

The model combines a lognormal distribution central body with a lower and an upper tail, both consisting of Generalized Pareto (GP) distributions, and daily FWI is used as a covariate of the parameters of the lognormal and the two GP distributions.

The Iberian Peninsula is subdivided into four spatially homogeneous pyro-regions, namely the northwest(NW), southwest (SW), north (N) and east (E) regions. Fire data cover the period 2001-2020 and consist of Fire Radiative Power (FRP) as acquired by the MODIS instrument on-board Aqua and Terra Satellites. Fire Weather (FWI) data covering the same period were obtained from the Copernicus Emergency Management Service.

For each region, the statistical model is fitted to the sample of FRP of all recorded events. First a base model (with fixed parameters) is fitted to the decimal logarithm of FRP, and the quality of fit is assessed using an Anderson-Darling test. Then the model is improved using FWI as a covariate, and performances of models without and with covariate are compared by computing the Bayes Factor as well as by applying the Vuong's closeness test.

For each region, a set of 100 synthetic time series of total annual FRP is set up using the statistical models without and with FWI as a covariate. This is achieved by randomly generating probabilities for each observed event, generating the FRP associated to that probability and then adding up the generated FRP all events for each year. The interannual variability of synthetic time series obtained is then compared with the corresponding interannual variability of the recorded events.

Results obtained for region SW show an increase from 91 to 96% of interannual explained

variance of FRP when going from the model without to the model with FWI. Increases from 95 to 96%, 84 to 90% and from 78 to 86% were obtained for regions NW, N and E. It is worth stressing that these are conservative estimates of change since the dependence of number of ignitions on FWI was not taken into account.

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