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The Meteorological Risk of Fire over continental Portugal from HadRM3 simulations and the Canadian Forest Fire Weather Index System *(CFFWIS)*

R. M. Durão (1), J. A. Corte-Real (1, 2), J. M. C. Pereira (3), I. C. Menezes (1)

(1) ICAT-FCUL, Campo Grande- Edifício ICAT,1749-016 Lisboa- PORTUGAL, (2) Centro de Geofísica de Évora, Rua Romão Ramalho 59, 7000-554 Évora- Portugal, (3) Department of Forestry, Instituto Superior de Agronomia, Lisboa, Portugal.
rddurao@fc.ul.pt, jmcr@uevora.pt, jmcpereira@isa.utl.pt, iamenezes@fc.ul.pt

Portugal is a country where forest fires constitute a severe hazard every year during the warm season. Therefore we investigated the impacts of changes in climate and climate extremes on the meteorological risk of fire, using ***HadRM3*** simulations for present and future climate conditions and the indices computed from the ***CFFWIS.***

The ***CFFWIS*** indices are: the Fine Fuel Moisture Code (***FFMC***), the Drought Code (***DC***), the Duff Moisture Code (***DMC***), the Initial Spread Index (***ISI***), the Buildup Index (***BUI***), the Fire Weather Index (***FWI***), the Daily Severity Rating (***DSR***) and the Seasonal Severity Rating (***SSR***). The DSR is a nonlinear transformation of the FWI that is better correlated with fire intensity, and the SSR is the integral of DSR over a specified period of time.

These indices were computed on a daily basis at each grid point of ***HadRM3*** over continental Portugal (in a total of 38 grid cells) from simulated daily values of temperature, relative humidity, wind speed and precipitation.

The main research focussed on the analysis of ***DSR*** and ***SSR***.

DSR allows the study of the temporal variability of the risk of fire, while ***SSR*** is very important to compare the risk of fire, in different seasons, over the same region.

The period of the year chosen is not only the conventional summer period, when forest fires exhibit a greater incidence over continental Portugal, but a wider period containing the former, going from April 1^{st} to November 30^{th}, in order to accommodate the

expected changes in length of the fire season in a warmer world.

The ***CFFWIS*** model was applied in the following periods: ***1961-1990***, ***SRESA2a*** and ***B2a, 2071-2100.***

The occurrence of forest fires is closely related with ***FFMC,*** an index representing the amount of moisture contained in the upper soil layer.

In the same way, the index DC related to moisture in the biomass contained in the deeper soil layers was also considered.

All the spatial distributions of ***FFMC, DC, DSR*** and ***SSR*** were obtained, as well as a statistical analysis of extremes related to the same indices.

Maps of ***FFMC, DC, DSR*** and ***SSR*** fields for both the SRES scenarios A2 and B2, using a surface mapping software, and linear kriging as the interpolation method, were produced.

As forest fires are more likely to occur when temperatures are high and relative humidity and/or rainfall values are low, situations of joint occurrence of extremes of these variables were considered for the entire domain, including the spells of maximum number of consecutive days.

It is concluded that the meteorological risk of fire increases in future warmer world over continental Portugal, especially in interior areas of the country, where more vulnerable regions are identified.

This increase is observed not only in mean values, but clearly also in minimum and maximum values of the considered indices.

The empirical joint probabilities of high temperatures and low relative humidity/precipitation are very small, indicating the simultaneous occurrences of extreme conditions are rare over continental Portugal in both present and future climates; spells of joint occurrences of extremes favourable to forest fires are even more rare.

The substantial increase in the meteorological risk of fire over continental Portugal in future climatic conditions seems to be a direct consequence of the increase in the number of days with hot and dry conditions.