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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Wildland fire potential outlooks for Portugal using meteorological indices of fire danger" *by* Sílvia A. Nunes et al.

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The authors thank Referee #2 for his very constructive comments.

All changes made in the manuscript are marked in yellow.

Question: One could expect that the discussion would bring much information about the added value of the work comparing to other methods (does that really bring much information than seasonal forecasts?), its potential use for direct operational applications, the potential improvements (other indices, why is the year 1998 not correctly classified?)...

Answer: The Discussion section was entirely rewritten. The case of 1998 is now addressed in detail, the added value of the proposed model when compared with sea-

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sonal forecasts is discussed and improvements of the model are considered.

Question: I was also surprised by the choice of your indices for the pre fire season (Dpfs). I don't see the rationale for using the cumulated DSR as an index for "vegetation stress". First the DSR includes many other information that is not related to vegetation dryness (such as wind speed). Second, as the DSR already depends on its previous values, I don't understand why you should use its cumulative value. The way I see it, a daily index that is recognized to be a proxy of vegetation dryness (e.g. the Drought code of the FWI among others) would be more appropriated here. Also, and If your objective was to obtain the best performance I was also wondering why you did not compare several indices.

Answer: The Drought code (DC) is sensitive to the slow-varying conditions of soil moisture in deep compact duff layers. DC is mainly controlled by precipitation and this slow-acting moisture code is especially useful as a warning when the lower layers of duff may be drier than the upper ones (van Wagner, 1987). However, the slow rate of change of DC makes it too insensitive to meteorological changes that may change soil moisture at the intermediate and surface layers. FWI, in turn, presents the advantage of reflecting the conditions of soil moisture at deep, intermediate and surface layers; FWI was nevertheless designed to be used at the daily level and is too sensitive to day to day changes in meteorological conditions. A compromise may be achieved by adding up the daily contributions of FWI. However, the high peaks of FWI introduce distortions in the cumulated values, but this problem is mitigated when using DSR that is obtained from FWI by means of a transformation that weights FWI sharply as it raises. In fact, there is a long tradition in Portugal to use cumulated values of DSR (since January 1st of each year) as an indicator of proneness of vegetation to burn. Moreover, as stated in the manuscript, cumulated DSR was successfully used as a meteorological predictor in previous studies. A first assessment of the potential of DC and of cumulated DSR to discriminate between severe and weak years is provided in Fig.1 and 2 that presents the temporal evolution of the medians of DC (upper panel) and cumulated DSR (lower panel) for all 39 year of 1980-2018 (black curve) and for the subsets of severe (red curve) and weak (green curve) years. Both DC and cumulated DSR present different distributions for severe and weak years but differences between these two groups are more pronounced in the case of cumulated DSR (this is especially visible when taking into account the interquartile ranges, as indicated by the shaded areas in light red and light green).

Question: Finally, I think that much emphasis is placed on the “diagnostic model of BA”, i.e. using meteorological information during the pre-fire and the fire seasons while this model does not bring much added value to the field.

Answer: The “diagnostic model of BA” (i.e. the model with pre-fire and fire season covariates, respectively psi(d) and chi) requires meteorological information along the fire season and its usefulness is therefore limited as a prediction tool of severity of the fire season. However, when pre-fire conditions are known (i.e. psi(d) at a given day), the diagnostic model may still be used to anticipate the severity of the fire season. This may be achieved by specifying a threshold of probability that a certain amount of BA will be exceeded, then inverting the model to compute the required value of chi (given the known value of psi(d)) and finally estimating the probability that this value will be exceeded in the fire season (e.g. based on the statistical distribution of chi of past years). This empirical line of reasoning was adopted in a previous feasibility study (Nunes et al., 2014). Here, the “diagnostic model of BA” is used as a benchmark to assess the decrease in performance of the statistical model of BA when reducing to the meteorological covariate respecting to the fire season. As shown in Fig.4, the relative importance of covariate psi(d) increases along the fire season and therefore the loss in performance decreases when reducing from covariates psi(d) and chi to covariate psi(d). Nunes, S. A., DaCamara, C. C., Turkman, K. F., Ermida, S. L. and Calado, T. J.: Anticipating the severity of the fire season in Northern Portugal using statistical models based on meteorological indices of fire danger, in: Advances in Forest Fire Research 2018 (Ed Domingos Xavier Viegas), edited by: Imprensa da Universidade de

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Coimbra, ISBN 978-989-26-0884-6, 1634-1645, http://dx.doi.org/10.14195/978-989-26-0884-6_180, 2014.

Question: P2, L25-28: That part is interesting and should be developed. You should also provide some citations that shows the links between spring drought and the likelihood of summer heatwaves. Not sure the references are appropriate

Answer: The reviewer is correct when pointing out that the link between hot and dry spring with summer heatwaves was not clearly supported by appropriate references. The text was amended in order to make these connections more clear as follows: The rationale is that soil moisture deficit and drought have an impact on the increased frequency and can amplify the magnitude of hot summer extreme events in the Mediterranean (Vautard et al., 2007; Hirschi et al., 2011). Thus, persistent warm and dry conditions along the pre-fire season induce thermal and water stress on vegetation making the landscape more prone to the occurrence of very severe fire episodes and, at the same time, increase the likelihood of heat wave spells that steer the onset and propagation of large fires (Gudmundsson et al., 2014; Turco et al., 2017).

Question: P3, L15: could you provide more details on how does the DSR differs from FWI.

Answer: DSR results from a direct transformation of the Fire Weather Index (FWI), the last of the six components of CFFWIS, according to the relation DSR=0.0272 (FWI)ˆ1.77. This transformation weights FWI sharply as it raises so that DSR becomes more suitable than FWI to be cumulated or averaged. These two sentences are now included in the manuscript.

Question: P4 : L8-14: That would be clearer if that part was moved before indices descriptions

Answer: The sentence was moved as suggested.

Question: P4 : L16, is psi(d) computed according to the mean and standard deviation of day d or over the entire population (including all days)

Answer: psi(d) is obtained by normalizing D_pfs(d), i.e. by subtracting the mean and dividing the standard deviation of that day. The original text was slightly enlarged for clarification.

Question: P7, L7, why starting from May 26 only. That would be interesting to start earlier to see also when does that information becomes relevant

Answer: Indeed, the starting date of May 26th was set a posteriori so that results presented provide relevant information for users. This is now clarified in the manuscript.

Please also note the supplement to this comment:
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2019-60/nhess-2019-60-AC2-supplement.pdf

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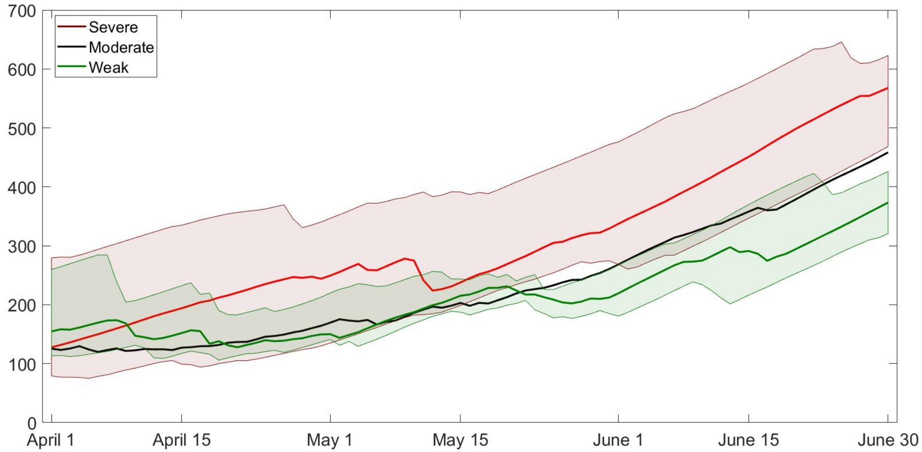

Fig. 1. Daily values of DC for the pre fire season for severe, moderate and weak years (red, black and green lines). The areas between percentiles 25 and 75 for the severe and weak years are also indicated.

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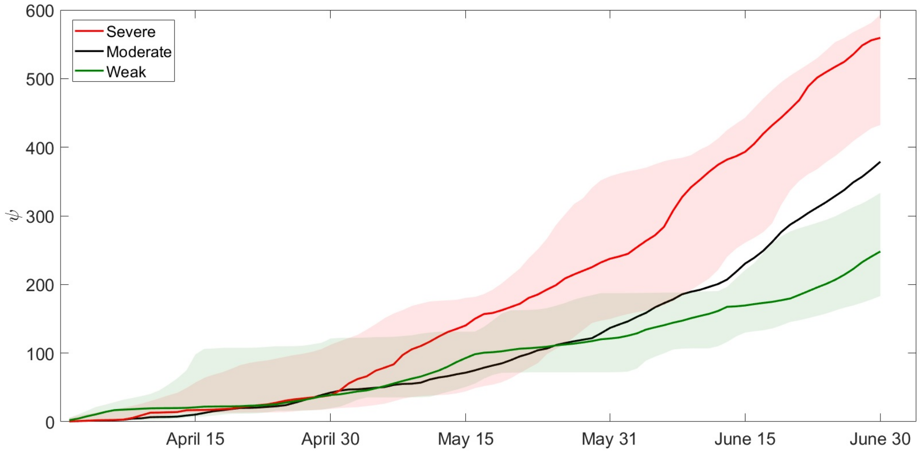

Fig. 2. Daily values of DSR for the pre fire season for severe, moderate and weak years (red, black and green lines). The areas between percentiles 25 and 75 for the severe and weak years are also indicated.

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