

Interactive comment on “Exploring spatial-temporal dynamics of fire regime features at mainland Spain” by Adrián Jiménez-Ruano et al.

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REVIEWER 3: The manuscript analyses the dynamics of fire regime components, more accurately fire regime elements, as two crucial fire regime metrics are not addressed - fire frequency (see specific comment below) and fire severity – for peninsular Spain. Results generally concur with the findings of previous studies, namely Moreno et al. (2014) for Spain and Turco et al. (2016) for southern Europe. Hence the novelty resides mostly in examining the trends in variables other than number of fires and area burned. On the methods side I commend the authors on the depth and diversity of the statistical analysis, which I believe has not been seen before in similar studies. I see improvement opportunities on the Discussion section, which is comparatively weaker. What are the motives behind the trends found? Given the existence

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of previous analysis of this type one would expect a deeper perception/development of the discussion on the driving causes, be it fire weather, land management, or fire management. There are reasons to believe that the major influence is/has been the extraordinary investment (perhaps the highest in the world) that Spain has devoted to fire suppression, see Seijo & Gray (2012). For comparison the authors can check Fernandes et al. (2014), which examined trends in northern Portugal where a shift towards decreasing area burned did not happen in 1980s-1990s, presumably because of unsuccessful/insufficient firefighting efforts. Another aspect in need of improvement is a joint explanation of the trends, i.e. an attempt to relate trends detected for the different metrics can be made. E.g. in NW Spain, large fires have increased, there are more winter fires, and summer burned area did decrease. It is likely that the fire exclusion policy in place is resulting in less area burned. Because of the repression of fire use to manage land, people will be inclined to use fire in winter (when fire preparedness is low) rather than on summer, but this traditional use of fire will not have an impact on the extent of flammable landscapes, because fires are usually small. Hence a more flammable landscape is developing, explaining the increase in the number of large fires, particularly in years with more extreme fire weather days and/or higher number of extreme fire weather days, a consequence of climate change. This is the type of inference/analysis that would really benefit the ms.

AUTHORS: Firstly, we would like to thank the reviewer for his/her useful comments and suggestions about the manuscript. Regarding to not include fire severity and fuels, we understand that both factors are remarkable important in fire research. Unfortunately, these aspects are not possible to be addressed due to several of factors. First of all, there is no information about fire severity. At best, severity can be derived from remote sensing imagery, but that's not feasible given both the spatial and temporal scales of analysis. On the other hand, finding direct causes for each trend detected is beyond the scope of our work. We have tried to mention certain factors that might be behind the detected changes and trends. Regarding the novelty of our work, indeed this topic is not new in the context of Spain we believe that our work goes a step further in

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providing insights and analyze dynamics in fire regime features. Specifically we have (i) extended the analysis to other fire regime features in our change-point analysis; (ii) we also apply traditional trend analysis to these other features; (iii) assessing not only the sign of trends, but its magnitude, which has not yet been addressed; (iv) at different scales; (v) this work would also allow progress in the fire regimes zoning; (vi) finally, our most novel contribution is exploring the relationships and association among trends in fire features using Principal Components in an effort to provide a more synthetic interpretation as well. We also provide a summary map of the main trends detected which allows outlining homogeneous zones of temporal dynamics at province level. To our knowledge such kind of analysis and cartographic outputs has not yet been done.

REVIEWER 3: I also advise the authors on doing some discussion regarding the limitations of the trend analysis methods. Because fires are self-limiting the landscape preserves a memory of fire, especially where fires are larger or fire frequency is higher. Thus, what the analysis reveals as decreasing trends may in fact be a consequence of relatively long fire cycles in relation with landscape-level fuel build-up, and this may really impact the results. References: Seijo, F., Gray, R., 2012. Pre-industrial anthropogenic fire regimes in transition: the case of Spain and its implications for fire governance in Mediterranean type biomes. *Hum. Ecol. Rev.* 19, 59e69. Fernandes, P.M., Loureiro, C., Guiomar, N., Pezzatti, G.B., Manso, F., Lopes, L. 2014. The dynamics and drivers of fuel and fire in the Portuguese public forest. *J. Environ. Manage.* 146, 373-382.

AUTHORS: We really appreciate this observation regarding to the limitations of the trends analysis, since we only have commented benchmark concerning with the spatial units employed or the necessary exploration of deeper insights causes. Thus, we have finally included this comment in the discussion section.

Specific comments REVIEWER 3: P1, L24. Replace “conversely”: it has the opposite meaning of what you are trying to convey.

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AUTHORS: We have replaced the “conversely” to “similarly”.

REVIEWER 3: P2, L36. Vegetation type and structure, as variation in fire behaviour is high within a given vegetation type.

AUTHORS: We really appreciate this observation and we have included in the corresponding sentence.

REVIEWER 3: P2, L41. “improve”, not “improving”.

AUTHORS: We have changed “improving” to “improve”.

REVIEWER 3: P2, L41. Rephrase. “How wildfire works” is quite subjective in its meaning.

AUTHORS: We appreciate this useful observation and we have to tried to make this part of the sentence more objective.

REVIEWER 3: P2, L50. remains.

AUTHORS: We have corrected this word.

REVIEWER 3: P2, L68. This sentence lacks a 2nd part: “Since most studies focus mainly on analysing ‘generic’ fire (number of fires and burned area).”

AUTHORS: We have changed the beginning of this sentence to complete the idea.

REVIEWER 3: P2, L88-95, L96-98. Too much detail here on the methods used. Delete or reduce substantially.

AUTHORS: We have reduced the length of this paragraph to only introduce general aspects of the methodology used.

REVIEWER 3: P3, L103. Environmental can be understood as incorporating some of the climatic and topographic features. Replace by land cover, or vegetation, or fuel.

AUTHORS: We have changed this concept to “vegetation communities”.

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REVIEWER 3: P3, L109. I don't think ash (*Fraxinus*) is a relevant land cover type. This region also has a quite important component of forest plantations such as *Pinus radiata* and eucalypts.

AUTHORS: We really appreciate this particular nuance of this region and we have finally considered including the forest plantations component.

REVIEWER 3: P4, L114-115. Add other important oak (*Q. suber*) and pine (*P. nigra*, *pinaster*, *sylvestris*) species.

AUTHORS: We have included these species in this section.

REVIEWER 3: P4, L144. By definition "fire frequency" is the number of times a given area has burned in the past, divided by the number of years considered, thus an annual probability. You must rename this variable for what it really is, i.e. Number of fires, here and elsewhere in the text and figures.

AUTHORS: We appreciate the observation made by the reviewer concerning to "fire frequency". Fire frequency is replaced by number of fires as defined in the Glossary of Wildland Fire Terminology of the National Wildfire Coordinating Group in 2008. Although we used the term frequency in accordance with the classic FAO 1986 terminology (FAO (1986) Wildland Fire Management Terminology. FAO Forestry Paper 70, Food and Agriculture Organization of the United Nations, Rome/ <http://www.fao.org/docrep/016/ap456t/ap456t00.pdf>), widely accepted in Spain.

REVIEWER 3: P4, L144-145. Regardless of size.

AUTHORS: We have corrected these mistakes.

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