Answer to Anonymous Referee #2
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Comment 1

This paper presents an exploratory analysis of 984 fires recorded in a study area from Galicia, Spain over 2007–2011. The focus is on characterizing patterns in space-time, using a spatial-temporal version of Ripley's K function. They find evidence of short-term space-time clustering of ignitions. Their main conclusion is that fire risk that leads to conditions which are conducive to sustained ignition and spread of wildfires in this area occur in local neighbourhoods over short periods of time. This is a well-known property of wildfire ignitions, regardless of the region.

ANSWER: Thanks for these comments. Agreed, wildfires generally tend to cluster and follow relatively local patterns that may change rapidly over time. The issue is: how rapidly, and how locally? Not enough is known about the risk time span and the distance dimension of human risk in different regions, but we propose a method of analysis that could be useful for risk regionalization. And previous work did not consider spatiotemporal interactions. Our goal in this study was to explore temporal and spatial dimensions and interactions which would allow to better model fire occurrence taking into account existing spatiotemporal structures.

Comment 2

I have strong concerns with the relatively small size of this study area. The study area is small, only 30 km x 30 km. They discuss results up to spatial distances of 12 km. It is my opinion that this study area may not be big enough to make conclusions at these distances (e.g., not that many non-overlapping discs/cylinders with 12 km diameters can be placed in this study region. And, this is the methodology that Ripley's K is based on. Hence, there is great uncertainty about results and strong concern about boundary effects when examining results at large spatial lags).

ANSWER: The study area is representative of the conditions in this Spanish ecoregion and provides a reasonable number of points for obtaining robust estimators of summary statistics to study the spatiotemporal dynamics of fire ignition. The high-risk Galician landscape is highly fragmented in small patches (Figure 1, Costafreda-Aumedes et al. 2013), so 900 sq km allow encompassing the land use patch diversity of the region appropriately. Moreover, we have considered the maximum lag distance between points as 12 km. This lag distance it is not so large, in our opinion, bearing in mind that the maximum possible distance between two points in this planar region is of around 42 km (the diagonal of this squared region). In any case, the Ripley's K function is defined from 0 to 12 km, so covering all possible scales of interaction between points from very small distances to very large ones, to detect all ranges of dependencies.

Comment 3

The same issue occurs temporally. There are only 5 years of data. I question whether this is enough data to be confident about making conclusions about cyclic structures and the estimate temporal curve in Figure 2(c) is not strong exploratory work to support this conclusion.

ANSWER: We have considered the largest temporal dataset available in this Spanish region (Galicia), from the public dataset of the Ministry of Environment, Rural and Marine Affairs of Spain (MAGRAMA). Fire ignitions recorded before 2007 were recorded in a lattice structure which allows more than one fire ignition to be placed in the same spatial location. As such, data recorded before 2007 cannot be analysed as a point pattern. Moreover, the year 2011 is the latest update of this public dataset. Also cited in the paper, there was a policy change in fire management in 2007. In any case, the referee is right about complaining about making strong conclusions of this tentative cycle structure. In fact, to avoid defining a strict mathematical assumption on the shape of this intensity (i.e. a strong conclusion about this temporal configuration), we considered a spline regression to characterize the temporal structure of this data, while providing a robust temporal intensity estimator for this dataset. We shall re-write the manuscript to clarify this point and focus ourselves on the mathematical implication of this temporal point intensity. It will be interesting to explore a longer time frame when available in the future, since 4-5 years is the usual time frame for fire prevention planning in Spain and elsewhere, as it is assumed to be sufficient to describe risk patterns.

Comment 4

Besides, look at how variable the annual counts of ignitions are (Section 2.2 states there were "110 ignitions in 2007, 138 in 2008, 216 in 2009, 247 in 2010 and 273 in 2011"). If anything, these annually aggregated counts suggest counts of fires that there has been an increase, but obviously – because of how variable large-scale weather patterns can be from year to year – a much longer series of data is required before strong conclusions could be made about the significance of any possible trend over time.

ANSWER: As explained in Comment 2, this is the reason why we have considered a spline regression instead of a more sophisticate model to characterize the temporal structure. As such we do not need strong conclusions about the temporal structure of this dataset, but a reliable representation of the temporal intensity of points to incorporate it in the methodology explained in this paper. Realistically, there may be a weather –based trend in the data, but it could also be due to better performance in the recording of fire starts over time.

Comment 5

They state that they modified the bandwidth parameter "to avoid zero-intensity values". But, look at Figure 1's north-east quadrant: there is a large region there where there were no fires at all! There's no empirical reason to assume that this region should have a non-zero intensity here!

ANSWER: Apologies, this point is not properly written in the manuscript. We want to say that we modified the bandwidth parameter to avoid very sharp intensity surfaces, promoting the presence of very high-intensity values close to very low intensity ones (zero values). A kind of space surface where zero values and large values are close together (lack of spatial dependencies). We should modify this sentence in the original manuscript to clarify this point, and consider the point made by the referee.

Comment 6

The null hypothesis is the underlying point process is homogeneous. The same comment applies to K_st(u,v) = 2 pi uˆ2 v. This is the formula for the volume of a cylinder centered in a region of space and extending over time and the expected number of points from a homogenous Poisson process (not "inhomogeneous" as the authors incorrectly state) is related to this volume.

ANSWER: For any inhomogeneous spatio-temporal Poisson process, K_st(u, v)=2pi u^2v, and hence KST(u, v)-2pi u^2v can be used as a measure of the spatio-temporal aggregation or regularity, using an inhomogeneous Poisson process as a benchmark (see the original paper of Gabriel and Diggle (2009), Møller and Ghorbani (2012) and Gabriel et al., (2013)). This a basic property of Inhomogeneous Poisson processes:

"*Poisson distribution of point counts*. The number of points of N in any bounded set B has a Poisson distribution with mean Integral over B of lambda(x) d(x)"   Illian et al. (2008) page 118.

Here lambda(x) is the intensity function. In fact, the count of point in a given window of observation follow a Poisson distribution regardless if the process is homogeneous or inhomogeneous.

Comment 7

199 replicates is relatively small for the Monte Carlo based methodology that is employed. Using 500 or 1000 replicates would be more common and would lead to more precise estimates of the percentiles of interest

ANSWER: The use of 199 Monte Carlo simulations is a quite standard procedure for point process statistics. In this case, 199 replications results in an exact significance level of 0.05. We do not think that the use of a large number of simulations would change the results obtained already. Note that the use of 199 Monte Carlo replications is also a quite standard practice in point process statistics applied to ecology (see, for instance, Law *et. al.*, 2009).

Comment 8

To conclude, I would prefer that the authors present a more thorough exploratory analysis of the data, without making strong conclusions (due to the limitations of their data set). What are the temporal trends in presence/absence of fires? What are the temporal trends in the counts of fires? What are the spatial patterns overall, and for each year? Why does that one region in the north-east appear to never have any fires? Are there "hot-spots" of activity each year? Or, does the short-term clustering appear to occur more randomly in space/time? And, does the ignition process appear to be separable in space time?

ANSWER: The referee is right, we shall follow suggestions to present a more thorough exploratory manuscript avoiding strong conclusions about our results. We shall also answer some of the questions suggested by the referee to obtain a more sound work: Acknowledged limitations in the temporal series of data available suggest caution on interpreting trends. We did have 110 ignitions in 2007, 138 in 2008, 216 in 2009, 247 in 2010 and 273 in 2011, but data just released in our study area adds to 176 fires in 2012. We can include figures displaying the spatial pattern for each year, or over the year (somewhat fewer fires in winter). Visual analyses of the yearly data suggest relatively stable spatial patterns and hotspots in the same areas that move short distances over time. The region in the NE, like other spatial gaps in the window, does have fuels that could sustain fires, but human risk coupled with weather patterns creates certain structures apparently non-separable.

References

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