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Comment on nhess-2022-47

Anonymous Referee #1

Referee comment on "Characterizing the Rate of Spread of Wildfires in Emerging Fire Environments of Northwestern Europe" by Adrián Cardil et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2022-47-RC1>, 2022

Tapia et al. presented a new approach to cluster VIIRS hotspots and derive the rate of spread (ROS) for each fire in this manuscript. They applied this approach to landscape fires in northwestern Europe, and examined the relationship between ROS and land cover type, season, as well as geographical locations (countries). The ROS is closely related to other fire behavior and the impact of fires on ecosystems. So the documentation of ROS across northwestern Europe in this manuscript provided a good reference for future studies. However, there are some issues in the current manuscript that prevent me from recommending it to be accepted by NHESS.

1. Need more complete description of the VIIRS data and the approach

For VIIRS fire data, the authors need to provide some background information on the satellite, the remote sensor, the data product (including the name, resolution, uncertainty, etc.), as well as the data filtering approaches. For example, what exact fire product did you use, the monthly data or the near real time (NRT) data? Is the resolution 375 m for all the pixels?

Some of the information on the fire clustering algorithm is also missing or not clear. How was the temporal grouping performed? How were the timing and the land cover of a fire determined? How did you verify whether a fire is real fire? See the 'Minor comments' below for detailed questions.

The approach to calculate ROS, which is the centerpiece of this study, also lacks important information. Sometimes the descriptions are contradictory or confusing (e.g. Which ROS statistics did you use? You mentioned maximum ROS, median ROS, and average ROS in the manuscript). The interpolation algorithm of vertices is also unclear to me.

2. Concerns about methodology

The VIIRS active fire data represent the center location of each pixel. The pixel size is $\sim 375\text{m}$ at nadir and varies with scan angle (can be much bigger at the edge). The current fire shape algorithm used these center locations directly, without considering the detection uncertainty of the data. Can this influence the calculated ROS? In the spatial grouping of fire pixels, 5km rasters were used. This leads to possible merging of fire pixels with distances at a maximum of $\sim 14\text{km}$. Is this too conservative? How does the variation in this value affect the clustering and ROS? For the Alpha value, why did you use 1km? Should you estimate the uncertainty related to this value?

3. Statistical robustness

The other issue I'm concerned about is whether some of the analyses (and results) are statistically robust. The total number of fires you used for analysis in this manuscript is only 254. While this number may be sufficient for whole-regional statistical analysis, you

further divided the fires into different seasons, land cover types, and countries. I doubt the sample number is enough for all the categories.

4. More analysis on ROS

It's good to see the ROS variations across different land covers and seasons. But I expect the authors to do more analysis to support the usefulness of the dataset. Some examples include, but not limited to, the relationships between burned area increment and ROS; the influences of weather variables on ROS; the statistical relationship between ROS and fire size.

Minor comments;

Line 23: "suggesting that may present the extent of the fire season"

What does the 'that' refer to? May change to something like 'this period' or 'these months'.

Line 38: "Moritz et al. ((Moritz et al., 2012))"

Some citations (such as this example) are not formatted correctly.

Lines 39-40: "in the last quarter of the 21st century (2070–2099)"

2070–2099 has 30 years and is more than a quarter of a century.

Lines 117-118: "its higher spatial and temporal resolution compared to other satellites such as MODIS"

Some satellites have higher spatial or temporal resolution than VIIRS. Need additional defining words for 'other satellites'

Lines 134: "VIIRS detections are points scattered in time and space"

This is not quite true. A location record in the VIIRS fire data file does not represent the exact burning location, which could be anywhere within a pixel of the VIIRS footprint (which also varies with scanning angle).

Line 143-145: "The clustering in time was conducted by ordering the space clusters by time and creating divisions or break points if there was a time difference greater than 48 hours in between consecutive points."

The clustering method at the temporal axis is not clear for me. How did you determine which space clusters should be tested temporally? What do 'consecutive points' mean? Individual fire center locations, or the 5km pixels?

Line 174-176: "To increase the accuracy of the spread vectors, the number of vertices at each polygon and time step was increased by linear interpolation between neighboring points."

The algorithm of RoS is a center piece of this study, and needs to be clearly described. For example in this sentence, please be more specific about the condition (e.g., when the distance between two consecutive vertices exceeds X m...) when the linear interpolation should be performed; and more detailed description about the interpolation (e.g., number of vertices every X m...).

Line 183-184: "Copernicus Land Monitoring Service's Corine Land Cover Map 2018 ((2019a)) to distinguish landscape fires from other heat sources such as active volcanoes, artifacts of heated plumes"

Can the Copernicus Land Cover Map be used to distinguish volcanic eruptions from fires?

Line 192: "As each timestep also featured data on land cover"

What land cover product did you use for this purpose? Still Copernicus Land Monitoring Service's Corine Land Cover Map 2018? Please also describe how you determined the land cover type for each fire when the fire is big enough to cover different land cover pixels.

Line 198: "ANOVA and Tukey statistical analysis"

This statistical method may not be familiar to many readers. Please add a reference.

Line 204-205: "of which 254 were verified to be "real" landscape fires"

Please specify the details about the way you verified the real fires.

Line 209: "timing of the fire, the burnt area, the land cover, and the maximum ROS"

For a fire covering multiple raster pixels and time steps, how did you determine the 'timing of the fire' and 'the land cover' for the whole fire?

Line 219-221 : "On the other hand, fires less than 0.01 km² were rarely detected with our satellite-based analysis, comprising approximately 0.002% of the total burned area and 1% the total number of fires. Fires between 0.01–0.1 km² were also seldom observed with 0.3% of the burnt area set by 10.2% of total fires."

In the method section (Line 136), you mentioned you "filtering out clusters with less than 20 VIIRS hotspots". This filtering will reduce the number of small fires (in <0.01km² and 0.01-0.1km² bins) for certain. So the fraction of the number of fires in different size groups can be artificial.

Line 229: "It was during this period that the median ROS was the greatest"

In the Method section (Line 192), you said you used 'maximum ROS', here you said you used 'median ROS'. Did you calculate the maximum ROS for a single fire (at a single time step, or for all time steps?), and then calculate the median ROS from all fires? The description needs to be clear in the Methods section.

Line 278-280: "The lack of fires smaller than 1 km² can likely be explained by the fact that the VIIRS satellite was unable to capture fires of this magnitude due to limitations of the temporal and spatial resolution."

Again, is this because you filtered fires with less than 20 VIIRS hotspots?

Line 330: "our study did not yield any significant effect of land cover on ROS"

This conclusion is not consistent with that shown in Figure 5, where we can see the obvious differences in the RoS for different land cover types.

Line 369: "lie within the methodology implemented, which produced average spread rates."
"

Now you say 'average spread rates'. So it's not the 'maximum ROS' you mentioned in line 192?

Figure 1. The caption says "b) VIIRS hotspots retrieved from the area of interest". But I didn't see hotspots in this panel. I only see land cover types shown on the map.

Figure 4. Considering there are only 254 fires in total, the number of samples in each country-month bin is expected to be small (It's also good to show this number in the

Figure). The statistical robustness needs to be addressed.

Figure 5. What are the 'n' values referred to? I don't think they are numbers of fires, since the total is way above 254 (the total fire number).