Reviewer 3

This manuscript aims to demonstrate the role of Persistent Positive Anomalies in 500 hPa Geopotential Heights (PPAs) for fire weather danger and wildfires in England, a temperate and evolving fire-prone region using wildfire occurrence records between 2010 and 2020. The authors base their study on a short database of fires in England. I have several criticisms related to methodology (the threshold for burned area and number of fires) and interpretation of results (concept of wildfire, fuel load and moisture and ignitions) listed below that should be addressed before considering the paper for publication in Natural Hazards and Earth System Sciences journal.

*Thank you kindly for your feedback on this manuscript. We have already thoroughly addressed your criticism of the methodology in the comments to Reviewer 2, and we hope this resolves your concerns too as we do not believe there are any methodological flaws in the manuscript. There were places where the manuscript lacked clarity, and we are grateful for the opportunity to more thoroughly justify our methodology in the revised manuscript. We have responded to your comments below in blue with a *, with substantial proposed changes to the manuscript text being indicated in red with “”. We have pasted the overall comment to Reviewer 2 here for your convenience:

Given your concern regarding the methodology and terminology of wildfires, we would like to address this first here before moving to the specific comments. We do not believe there are flaws in the methodology or interpretation of results, and we hope that this explanation will resolve any concerns – A lack of clarity in the manuscript may have contributed to this misunderstanding and we thank you for the opportunity to address this in the revised manuscript.

Respectfully, we disagree that small fires and fires in built-up areas and gardens should be excluded from this manuscript, though we thank you for bringing to our attention that this should be better justified and communicated throughout our manuscript. In England, due to a high population density and landscape fragmentation, there are no truly ‘wild’ or ‘natural’ areas as one might expect to find elsewhere like North America (Gazzard et al., 2016). Fires will always be smaller because of this, but this is also exactly why small fires and fires surrounding urban areas are important (arguably potentially more so than larger fires in remote locations) because they can easily put people and property in danger. A notable large-scale destruction of homes from vegetation fire in the UK was ‘just’ 20 ha in size (Wennington Fire – 2022). At the same time, a single 20 ha fire in a crop field resulted in £40,000 damage to one farm. National Farmers Union Mutual (a UK insurance company) reported costs of £110 million from farm and vehicle fires in the UK in 2023, despite the average crop fire burning 1.5 ha (unpublished data).

The term ‘wildfire’ appears to be causing some confusion as there is no globally agreed definition and it spans across many different scales of fire occurrences. This is a very interesting discussion that would make a nice opinion piece, but this is well outside the scope of our own research. Instead, we have now opted to remove the use of the term wildfire in this manuscript, and instead we refer to ‘vegetation fire occurrence’. We hope this provides complete clarity in the focus of this manuscript and avoids the potential for confusion introduced by preconceived perceptions of the term wildfire that the reader may have (e.g., Tedim and Leone, 2020). We have also clearly defined vegetation fire occurrences in the context of our manuscript using the UK Fire and Rescue Services Wildfire Operational Guidance definition: “A wildfire is any uncontrolled vegetation fire that requires a decision or action regarding suppression” (Scottish

Government, 2013). We have moved this definition earlier in the manuscript and have elaborated on our discussion of the importance of small vegetation fires and the UK situation in the introduction section to clarify what it is we are interested in and why it is relevant very early on.

Similarly, we have not discriminated on the landcover on which the vegetation fire burned because fires within urban vegetated areas pose a significant threat to people and property. Sadly, the recent fires in California are testament to the importance of this now more than ever. Again, we have placed greater emphasis on why these fires are important in the introduction.

Rather than removing all small fires and specific landcovers, we instead explored these relationships within the manuscript, demonstrating how relationships with PPAs change when using different thresholds of vegetation fire size (using all fires, > 1 ha, > 10 ha, > 50 ha, > 100 ha, > 500 ha) annually and by month. We also look at the number of fires in each of these categories to be very clear about the sample size when considering different thresholds. Section 3.5 (previously section 3.4) also breaks down the relationships according to key landcover types, which excludes fires in urban areas and focuses on heathland/moorland, grassland, broadleaf forest, standing crops, and conifer forest – again providing all details on the number of fires in each category.

Within this review, Reviewer 2 suggested fires smaller than 10 ha, 30 ha or even 50 ha should be excluded, while Reviewer 3 suggested thresholds of 100 ha or 500 ha, which illustrates that applying a size threshold would be an arbitrary decision that there is not a consensus on. We believe that our analysis, which presents the results across key landcovers, months, and for different threshold sizes provides a much more thorough examination of the relationship between PPAs and vegetation fires than narrowing the scope to a single arbitrary size or landcover category. This in turn allows the reader to understand the nuances between fire size and number of fires in the data set when drawing conclusions.

Thank you for entertaining this somewhat lengthy comment, but we hope that this clarifies the decisions made in the manuscript and resolves any concerns the reviewers previously had. We appreciate the chance to improve our manuscript to more clearly articulate these points to the readership of NHESS. We have added a section on UK vegetation fires in the introduction to outline the vegetation fire context, define vegetation fires and introduce the significance of small fires:

“1 Introduction

1.1 Vegetation fire risk in emerging fire prone regions

Vegetation fire risk is increasing in temperate regions like the UK, which have historically experienced few large fires, due to mild, humid climates that mean fuels are generally less flammable (Belcher et al., 2021). However, changes in land management practices combined with a warming climate are increasing the quantity of live biomass available to burn (Glaves et al., 2020). Research in these so-called “emerging fire-prone” regions has been limited because wildfires tend to be dominated by smaller fires, many of which are not detected in satellite records nor included in historical records (Fernandez-Anez et al., 2021). Consequently, decision support systems based on fire weather–fire relationships have primarily been developed in fire-prone regions that have a long history of experiencing large and extreme wildfires (e.g., Canada, Southern Europe, Australia, USA) and then adapted for use in emerging fire-prone regions (e.g., de Jong *et al.* 2016; Masinda *et al.* 2022; Steinfeld *et al.* 2022). Despite and because of these challenges, there is an urgent need to understand and quantify wildfire risk to inform long-term wildfire preparedness in these regions (Pandey et al., 2023).

1.2 Vegetation fires in the UK

Vegetation fires are a semi-natural hazard in the UK as ignitions are almost entirely anthropogenic (Gazzard *et al.* 2016). Human use of fire on the landscape has been a traditional practice for centuries in the UK, particularly as a tool for land management and habitat creation, and fire can bring positive ecological benefits (Belcher et al., 2021); however, there is evidence that the risk of severe vegetation fires is increasing (Arnell et al., 2021; Belcher et al., 2021; Perry et al., 2022). In the UK, Fire and Rescue Services Wildfire Operational Guidance defines a vegetation fire incident as 'any uncontrolled vegetation fire that requires a decision or action regarding suppression' (Scottish Government, 2013). Currently, this does not impose a minimum size threshold on the definition of a vegetation fire, and indeed wildfires do not need to be large to be impactful (Belcher et al., 2021; Kirkland et al., 2023; Stoof et al., 2024). The UK has a high population density of 280 people per square km, compared to traditionally fire prone countries like Australia (3 people per square km), Canada (4 people per square km) and USA (36 people per square km) (World Bank, 2022). This means that natural landscapes are highly fragmented and lack the fuel continuity to generate massive burned areas, and fires tend to be detected quickly. Moreover, a high population density means that a high proportion of fires occur in the interface between people, infrastructure and environment. Vegetation fires in these areas can threaten lives and property, despite their often small size (Graham et al., 2020; John and Rein, 2024; London Fire Brigade, 2023). Critically, vegetation fire preparedness still lags behind other countries and response capabilities can be overwhelmed in extreme conditions (John and Rein, 2024; Climate Change Position Statement, 2025; Pandey et al., 2023).

1.5 Rationale

Fewer studies have explored the large-scale atmospheric drivers of fire weather and vegetation fire occurrence in countries historically not prone to fires, such as the UK. Although fire risk is increasing in these regions, established tools for predicting fire weather and fire occurrence are often lacking. In the UK, extended periods of atmospheric blocking likely play a key role in sufficiently drying out vegetation and elevating fire risk. To address this gap, it is crucial to better understand the role of PPAs in vegetation fires, particularly in temperate regions like the UK, where fires are often smaller than those detectable by satellite but still impactful. A comprehensive fire occurrence database allows us to examine the seasonality and land cover-dependent relationships between PPAs and vegetation fires, extending beyond the larger fires typically observed in summer on specific land covers. We investigate the importance of PPAs for fire weather and vegetation fire occurrence by addressing the following research questions: (1) what is the association between PPAs and surface fire weather across the UK between March–October 2001–2021? Then, using the comprehensive vegetation fire occurrence database for England, (2) What is the association between PPAs and vegetation fire occurrence across key land cover types in England from March–October 2010–2020?"

Major suggestions/comments:

Introduction:

The subsections in the Introduction Section resemble a pile of tiles and make the reading very segmented, descriptive and didactic. I suggest rewriting the introduction in a logical order, avoiding repetitions. A possible solution to avoid a very large section would be the addition of a new section named for instance "Rationale"

*Thank you for this suggestion, we have substantially reworked the introduction on the feedback of all the reviewers and have followed a more logical subheading order and removed any repetition:

“1. Introduction

1.1 Vegetation fire risk in emerging fire prone regions

Vegetation fire risk is increasing in temperate regions like the UK, which have historically experienced few large fires, due to mild, humid climates that mean fuels are generally less flammable (Belcher et al., 2021). However, changes in land management practices combined with a warming climate are increasing the quantity of live biomass available to burn (Glaves et al., 2020). Research in these so-called “emerging fire-prone” regions has been limited because wildfires tend to be dominated by smaller fires, many of which are not detected in satellite records nor included in historical records (Fernandez-Anez et al., 2021). Consequently, decision support systems based on fire weather–fire relationships have primarily been developed in fire-prone regions that have a long history of experiencing large and extreme wildfires (e.g., Canada, Southern Europe, Australia, USA) and then adapted for use in emerging fire-prone regions (e.g., de Jong *et al.* 2016; Masinda *et al.* 2022; Steinfeld *et al.* 2022). Despite and because of these challenges, there is an urgent need to understand and quantify wildfire risk to inform long-term wildfire preparedness in these regions (Pandey et al., 2023).

1.2 Vegetation fires in the UK

Vegetation fires are a semi-natural hazard in the UK as ignitions are almost entirely anthropogenic (Gazzard *et al.* 2016). Human use of fire on the landscape has been a traditional practice for centuries in the UK, particularly as a tool for land management and habitat creation, and fire can bring positive ecological benefits (Belcher et al., 2021); however, there is evidence that the risk of severe vegetation fires is increasing (Arnell et al., 2021; Belcher et al., 2021; Perry et al., 2022). In the UK, Fire and Rescue Services Wildfire Operational Guidance defines a vegetation fire incident as ‘any uncontrolled vegetation fire that requires a decision or action regarding suppression’ (Scottish Government, 2013). Currently, this does not impose a minimum size threshold on the definition of a vegetation fire, and indeed wildfires do not need to be large to be impactful (Belcher et al., 2021; Kirkland et al., 2023; Stoof et al., 2024). The UK has a high population density of 280 people per square km, compared to traditionally fire prone countries like Australia (3 people per square km), Canada (4 people per square km) and USA (36 people per square km) (World Bank, 2022). This means that natural landscapes are highly fragmented and lack the fuel continuity to generate massive burned areas, and fires tend to be detected quickly. Moreover, a high population density means that a high proportion of fires occur in the interface between people, infrastructure and environment. Vegetation fires in these areas can threaten lives and property, despite their often small size (Graham et al., 2020; John and Rein, 2024; London Fire Brigade, 2023). Critically, vegetation fire preparedness still lags behind other countries and response capabilities can be overwhelmed in extreme conditions (John and Rein, 2024; Climate Change Position Statement, 2025; Pandey et al., 2023).

1.3 Synoptic controls on surface fire weather and vegetation fire

In the midlatitudes, surface weather is driven by synoptic-scale weather patterns (i.e., large scale upper-air atmospheric circulation patterns (Franzke et al., 2020)). While surface weather is highly spatiotemporally variable and difficult to forecast beyond the short-term, synoptic-scale upper-air (500 hPa) atmospheric patterns can be more reliably predicted in the medium range (+10 days) (Hohenegger and Schär, 2007). As such, considering synoptic-scale indicators of vegetation fire occurrence in addition to surface fire weather may provide additional insights for improving near-to-medium range forecasting of fire danger to aid fire preparedness and management decision-making (Humphrey et al., 2024; Jain et al., 2024; Papavasileiou and Giannaros, 2023).

Within Europe, previous research examining large-scale weather patterns associated with vegetation fire occurrence have tended to focus on countries in the Mediterranean (e.g., Duane and Brotons 2018; Pineda *et al.* 2022; Rodrigues *et al.* 2022), likely due to the history of significant vegetation fires and comprehensive fire occurrence databases; though there are some exceptions that examine Europe-wide (Giannaros and Papavasileiou, 2023; Little et al., 2024) and Northern European (Drobyshev et al., 2021; Wastl et al., 2013) relationships. While atmospheric blocking has been associated with vegetation fire occurrence across Southern Europe, other studies have also highlighted the importance of strong wind events and atmospheric instability as drivers of extreme vegetation fire activity (Artés et al., 2022; Resco de Dios et al., 2022; Ruffault et al., 2017).

1.4 Persistent positive anomalies in geopotential heights (PPAs)

Atmospheric blocking occurs when a high pressure system remains nearly stationary such that it effectively "blocks" the usual mid-latitude zonal airflow, leading to dry, clear-sky conditions and high surface temperatures that may be amplified by land–atmosphere feedbacks (Rex, 1950). Such conditions promote fuel aridity and consequently vegetation fire occurrence (Sharma et al., 2022). Moreover, persistent atmospheric blocking events can lead to synchronous elevated fire danger across large areas, which can overwhelm fire response capabilities (Abatzoglou et al., 2021; Jain et al., 2024).

Positive geopotential height anomalies at the 500 hPa level are widely used to identify high-pressure blocking events (Tibaldi and Molteni, 1990). One such method, Persistent Positive Anomalies in 500 hPa geopotential heights (PPAs), are an event-based paradigm for tracking extremes in high pressure blocking patterns (that exceed a threshold amplitude, size, and duration) through space and time (Dole and Gordon 1983). Compared with other methods of identifying atmospheric blocking patterns, such as measuring the reversal of meridional flow (Pinheiro et al., 2019; Tibaldi and Molteni, 1990) and dynamic potential vorticity (Pelly and Hoskins, 2003; Small et al., 2014), PPAs are less constrained by the specific blocking mechanism, which can be important for capturing events during the main fire season when strong polar dynamics are not common (Dole and Gordon, 1983; Miller et al., 2020). PPAs can be used to capture the potential persistent, weaker pressure gradient events that characterise hot, dry surface conditions for fires in summer (Sousa et al., 2018; Woollings et al., 2018).

PPAs have recently been associated with extreme fire weather (hot, dry weather as defined by the Canadian Fire Weather Index) and vegetation fires in the Northern Hemisphere mid-latitudes for both Western North America (Jain et al., 2024; Sharma et al., 2022) and Europe (Little et al., 2024). We recently established the importance of PPAs for vegetation fires at a pan-European scale finding that fires were more than twice as likely to occur during PPA events across Europe and were associated with 53% of burned area for Western Europe (Little et al., 2024). However, the EFFIS burned area product used in that study only includes vegetation fires of around 30 ha and greater detected by satellite imagery, which resulted in very few records in regions with predominantly small vegetation fires. Notably, for the period March–October 2010–2020, EFFIS reported 348 vegetation fires for the UK (San-Miguel-Ayanz et al., 2012). In comparison, for the same period, the Fire and Rescue Service incident database reported 291,963 vegetation fires occurring in England alone (Forestry Commission, 2023).

1.5 Rationale

Fewer studies have explored the large-scale atmospheric drivers of fire weather and vegetation fire occurrence in countries historically not prone to fires, such as the UK. Although fire risk is increasing in these regions, established tools for predicting fire weather and fire occurrence are often lacking. In the UK, extended periods of atmospheric blocking likely play a key role in sufficiently drying out vegetation and elevating fire risk. To address this gap, it is crucial to better understand the role of PPAs in vegetation fires, particularly in temperate regions like the UK, where fires are often smaller than those detectable by satellite but still impactful. A comprehensive fire occurrence database allows us to examine the seasonality and land cover-dependent relationships between PPAs and vegetation fires, extending beyond the larger fires typically observed in summer on specific land covers. We investigate the importance of PPAs for fire weather and vegetation fire occurrence by addressing the following research questions: (1) what is the association between PPAs and surface fire weather across the UK between March–October 2001–2021? Then, using the comprehensive vegetation fire occurrence database for England, (2) What is the association between PPAs and vegetation fire occurrence across key land cover types in England from March–October 2010–2020?"

Another important topic related to the scope of this paper is the definition of wildfire and the use of this term in case of small fires not detectable by satellite. Rewrite the manuscript having this in mind. (please see the comments below).

*We trust this question has been thoroughly resolved in the overall comment to Reviewer 2. To improve the clarity and focus of the manuscript and avoid entering into debate around terminology, we have opted to remove the term 'wildfire' from the manuscript and instead refer to 'vegetation fire occurrence'. This highlights both that we refer to outdoor fires where vegetation is burning and that it is the occurrence of a fire (rather than the subsequent behaviour of the fire) that we are interested in. We have added a section to the introduction to explain the importance of small vegetation fires and to define vegetation fires in the UK context.

Still important is the confusion between vegetation cover and fuel load and moisture, as well as the concept and quantification of ignitions.

*We are not sure what part of the text this comment refers to, but we have taken care to ensure all terminology is correct and clearly explains the linkages between concepts. For example, in lines 38–39 and line 392 we have now specified that we are referring to live fuels (rather than just fuels).

Line 37- The closed link between heat and dry extremes and low fuel content is known. Please clarify how heatwaves and droughts are causing increased fuel availability

*We were referring to how existing fuel that previously has been too wet to burn (see previous sentence) is drying out and becoming available fuel for vegetation fires (rather than an increase in net biomass over the long term). We can see how the phrase fuel availability may be misleading so have changed the wording to be less ambiguous:

"Vegetation fire risk is increasing in temperate regions like the UK, which have historically experienced few large fires, due to mild, humid climates that mean fuels are generally less flammable (Belcher et al., 2021). However, changes in land management practices combined with a warming climate are increasing the quantity of live biomass available to burn (Glaves et al., 2020)."

Lines 100-101 – Accordingly, with the fire triangle on Moritz et al., (2005) the wildfires are driven by weather, fuel and topography and this rationale is based on the temporal and spatial extension of fires and weather or synoptic patterns must be linked to a fire with temporal and spatial extension that surpass a single ignition (e.g., domestic or garden fires).

*Apologies, we do not understand how this comment relates to this section of the text, are these the correct line numbers? We do not look to only consider single ignitions, rather the cumulative burned area and elevated number of ignitions under PPA conditions. A large number of small ignitions would meet this extension. The purpose of this section of the text is to introduce the novelty of this comprehensive dataset and the significance of small fires in this region, which is a core reason for conducting this research. We do wonder if maybe the reviewer thought we were looking at the role of PPAs through the life time of a fire, i.e., the impact on fire behaviour? If this is the case, we have clarified this in the text by replacing the term 'wildfire' with 'vegetation fire occurrence'.

Such a large number of fires could be classified as wildfires? How many burned area are associated with this large number of fires? What were the causes of such fires?

*As discussed above, changing the definition of a wildfire used in the UK or trying to form an international consensus on the definition of a wildfire is well outside the aim and scope of this paper and would be better suited to an opinion piece style publication (which would be interesting!). Instead, we have opted to remove the term 'wildfire' from this manuscript to avoid entering into this discussion and replaced it with 'vegetation fire occurrences', which is more specific and less associated with perceived definitions the reader may have (e.g., Tedim and Leone, 2020). We have also added text to the introduction to explain early on the definition of a vegetation fire and the context around small fires in the UK, backed by other references. The causes of vegetation fires in the UK are not well known and there are many gaps and errors in the cause attributed to incidents in this dataset so it would not be suitable to analyse cause here. Nearly all ignitions in the UK are anthropogenic in origin in one form or another, which we have also elaborated on in the introduction. Please see the overall comment to Reviewer 2 for changes we have made to the revised manuscript to address your concerns.

Lines 102-103 – The fires not detectable by satellite data are forest, rural or crop fires? Are they classified as wildfires? Which kind of impacts?

*We trust this comment has been well addressed elsewhere in the response and through the added paragraph on small fires in the introduction. Please see the overall comment to reviewer 2 for changes we have made to the revised manuscript to address your concerns.

Lines 119-123 – Move to the introduction section

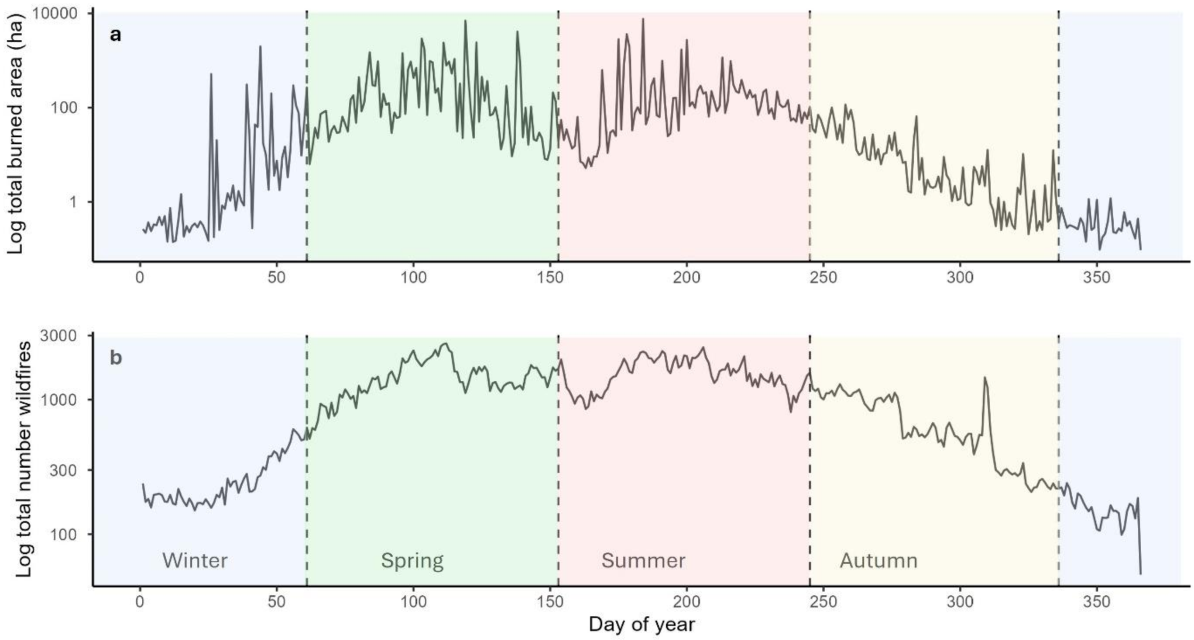
*We have moved this to the introduction section as suggested.

Figure 1 - Present in the figure the labels (a), (b), (c), and (d).

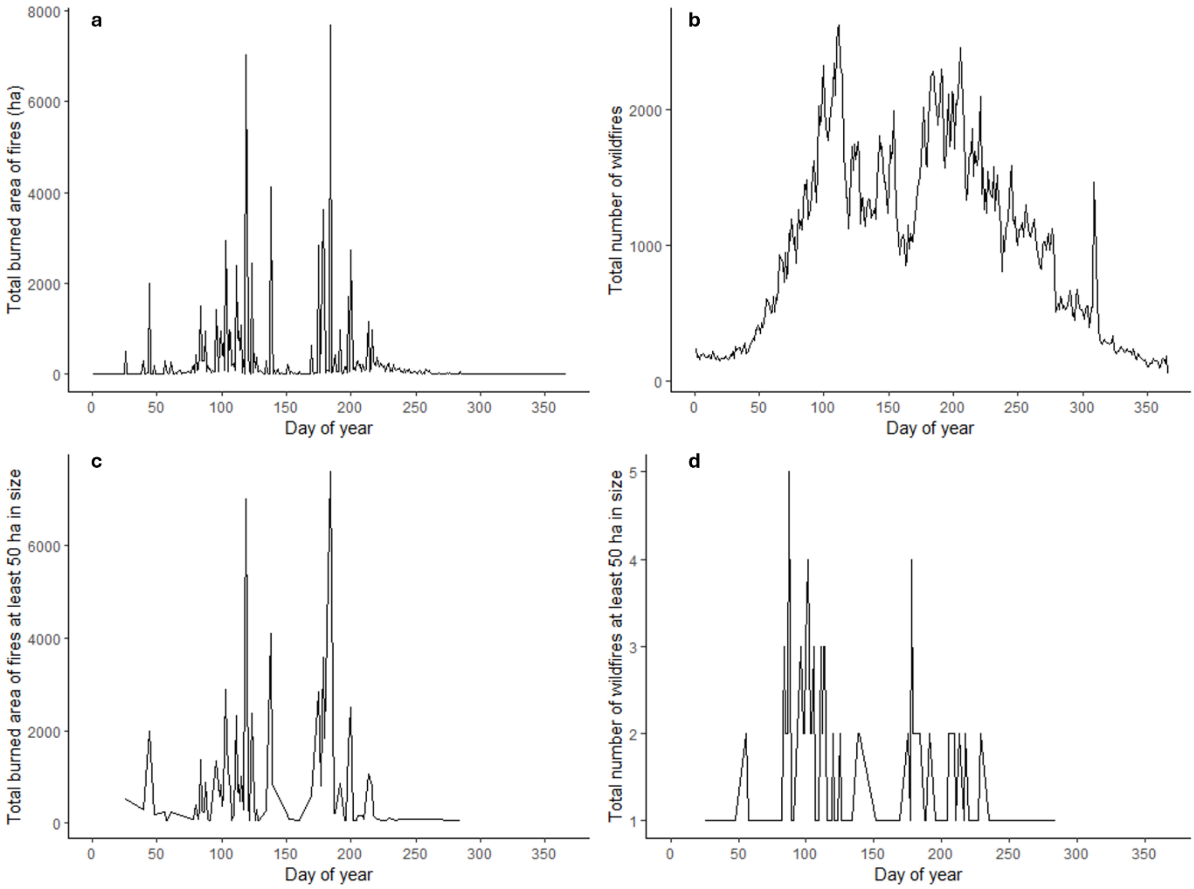
*Done.

Figure 1 shows an enormous number of fires burned less than 1 ha (almost 3000 in Spring and Summer), which does not have representation in terms of burned area (figures on left panel). Consider replacing the figure with a new figure using the threshold of 50ha or 100ha.

*We have updated this figure following other reviewer suggestions and have log transformed the y axes for readability rather than applying a threshold. This has now become Figure 4 in the results section. We have also added Figure S5 to the Supplementary Material, which shows the initial figure without log transformation as well as using the threshold of 50 ha in a 4 panel plot.



“Figure 4: Total log transformed daily (a) burned area and (b) number of vegetation fires recorded in England between 2010–2020. Day of year on the x-axis is partitioned to show the calendar months (dashed lines) winter (DJF), spring (MAM), summer (JJA) and autumn (SON).”



"Figure S5: Total daily (a) burned area, (b) number of wildfires, (c) burned area from vegetation fires at least 50 ha in size and (d) number of fires at least 50 ha in size recorded in England on each day of the year between 2010–2020."

Data:

Lines 164-174 – Move to introduction section.

*We agree with the reviewer and have moved this to the introduction to elaborate on PPAs.

Lines 204-210: How were the individual fire events aggregated to each 1 x1 grid cell?

*We apologise; this was an analysis that was not included in the final manuscript so this text should have been removed. The percentage of burned area and fires associated with PPAs was analysed by fire record rather than by grid cell (the opposite to how it was communicated originally). The text now reads:

"We labelled each incident as a PPA–fire event if a PPA was present in the grid cell the incident occurred in either on the same day or up to five days preceding the incident, otherwise it was labelled a noPPA–fire event. This five day lag is to account for the role of PPA conditions in pre-drying fuels that subsequently ignite (supported by Fig. S1 and previous research (Sharma et al., 2022)). (Little et al., 2024) assessed the sensitivity of PPA–fire associations across Europe to a range of different time lags, finding no major differences in the results. It should be noted that incident burned area is assigned to the incident start date as there is no daily breakdown of burned area within individual events. We acknowledge this limitation; however, as 99.9% of all vegetation fires and 72.7% of burned area are from incidents that occur within a single day or up to five days length, we believe this metric still largely captures whether incidents are associated with PPA events (particularly as PPA–fire events are defined by a five-day lag period). We also repeated the above steps but first applying a minimum fire size threshold of greater than 1 ha; 10 ha; 50 ha; 100 ha; and 500 ha and filtering by fires on specific key UK landcovers (heathland/moorland; grassland (grassland, pasture, grazing); conifer forest; broadleaf forest; and standing crops) to examine PPA–fire relationships across different vegetation fire sizes and landcover types."

The small fires may have a panoply of drivers. An ignition may have different causes, but fire propagation is related to fuel, weather and topography. To evaluate the role of weather we should have a fire higher than a single ignition and therefore consider only the fires higher than 50ha or 100ha.

*We agree that there are many drivers of small fires, which is why we look at the total amount of burned area and number of fire occurrences associated with PPA events. The records refer to the individual incident, so do not specify whether the incident was the result of a single ignition or multiple ignitions that joined up. By looking at cumulative burned area and number of fire occurrences, we give the capacity to identify days where there were an elevated number of vegetation fires occurring, even if they only burned a small area (which may be related to many other factors such as fuel continuity, suppression actions amongst other reasons). The 50 ha / 100 ha threshold is arbitrary and not appropriate for the study location as discussed above, but we have presented the results using different size thresholds (for both burned area and number of fires) in the main text for the interested reader. We wonder if the reviewer is thinking we are looking at PPAs across the lifetime of wildfires and how they impact wildfire behaviour instead of fire occurrences? If so, we apologise for the lack of clarity here. By replacing the term 'wildfire' with 'vegetation fire occurrence' and being more specific when talking about occurrences we hope we have addressed this issue.

In the case of using statistical analysis be careful with the sample size and significance level.

*We are sorry, but we are not sure what aspect of the text you are referring to. Our assumption is Figure 4, with the linear regression analysis? We can confirm that the sample sizes are all sufficient to conduct this analysis (sufficient PPA versus non PPA days by grid cell and month across the 2001-2021 period) and we report the statistical significance ($p < 0.05$) by grid cell.

Figure 3 – For the sake of clarity, present in figures the name of the variables

*The names of the variables are on the right hand axes of the figures, but we have also labelled them a-i with the names in the caption also for clarity. This is now Figure 2 in the revised version.

Results

Consider showing how the predictable skill of PPA for fire occurrence is better than climatology or persistence.

*We are sorry, but we are not 100% sure we understand what the reviewer is suggesting here. Are you referring to climatology / persistence in terms of fire occurrence (i.e., can PPAs predict fire occurrence beyond seasonal fire activity) or the climatology/persistence of PPAs / geopotential height anomalies?

Discussion:

Lines 382-392: the role played by PPA on fuel and ignitions is quite qualitative. The authors present in the manuscript an analysis using land cover types. Fuel conditions, such as loads and moisture could not be extrapolated from land cover types.

*Yes, the discussion of the different landcover types burning is qualitative for the reasons you say, that it is not possible to extrapolate fuel loads and moisture in a quantitative manner. We use current understanding of fires in these different landcovers (i.e., how heathland/moorland fires behave and compare to grassland and crop fires) based on published literature and the database that shows when these fires occur to inform our discussion of the role of PPAs on fuel and ignitions. We have been careful to word these as our 'hypotheses' of the relationships, rather than stating these as our results.

Clarify the threshold of fuel moisture to allow ignitions. How is ignition frequency estimated? I suggest including a quantitative analysis of fuel load and moisture analysis or removing such sentences.

*As this is the discussion section, we are simply putting our results in context with previous literature here, but we have taken care in the revised manuscript to be clear about what are our findings and what are hypotheses and we have also been clear with the terminology used.

Lines 401-407: If the authors do not consider FWI adequate for spring fire weather danger, why FWI is used in this analysis? Which kind of tools should be used instead? Please consider clarifying the ideas in the paragraph.

*We include the FWI analysis because it is so widely used and in lieu of a replacement that is so well established, like has been used in many other studies in regions outside of Canada (e.g., Fogarty et al., 1998; Dimitrakopoulos et al., 2011; Wastl et al., 2013, including UK-based studies (e.g., Arnell et al., 2021; de Jong et al., 2016; Perry et al., 2022) and global studies (e.g., Bedia et al., 2015; Abatzoglou et al., 2019))). Furthermore, other subcomponents of the CFWIS, e.g., the FFMC, perform better in spring than the FWI subcomponent, which seems to perform better in summer. This finding is supported by other research in the UK (Davies and Legg, 2016; Nikonovas et al., 2024) and other temperate regions (Lambrechts et al., 2024), and we have added a section 3.4 in the results that shows the distribution of CFWIS indices during vegetation fires in England between spring and summer (below).

We also realised the wording of the paragraph in lines 401-407 is quite strong but ambiguous, e.g., it may not have been clear that we were referring to the FWI subcomponent rather than the entire CFWIS of the same name. We also state that phenological indicators offer an improvement in spring and point the reader to references that support this. We have clarified these aspects in the text:

"To date, the dual spring and summer fire seasons have been a major challenge for predicting fire weather in the UK as the fuels burning and their drivers differ seasonally (Belcher et al., 2021). Surface fire weather indices like the FWI subcomponent of the CFWIS perform reasonably well in summer but fail to capture the spring fire season (Davies and Legg, 2016; de Jong et al., 2016; Nikonovas et al., 2024), while phenological indicators (for example, vegetation greenness indices like the Enhanced Vegetation Index 2 (EVI2) (Nikonovas et al., 2024)) improve spring fire season predictions but do not capture the heatwave events during summer that can lead to extreme drying of live fuels (Ivison et al., 2024; Nikonovas et al., 2024). It is important to consider all available tools to accurately predict different periods of fire danger, including surface variables like weather, landcover, and phenology, but also synoptic indicators."

"3.4 Surface fire weather and vegetation fire occurrence across England

Surface fire weather, as indicated by the CFWIS indices, tends to be anomalously high when vegetation fires occur in England (Fig. 5). This is true for both spring and summer fires less than and greater than 50 ha, though fire weather anomalies are highest for larger fires in summer. In spring, the FFMC is the most elevated when vegetation fires occur, while the other indices are distributed around the average or slightly above average in the case of the FWI. In summer, the DC and BUI are anomalously high when vegetation fires occur and the FWI is positively skewed for large fires but not fires < 50 ha.

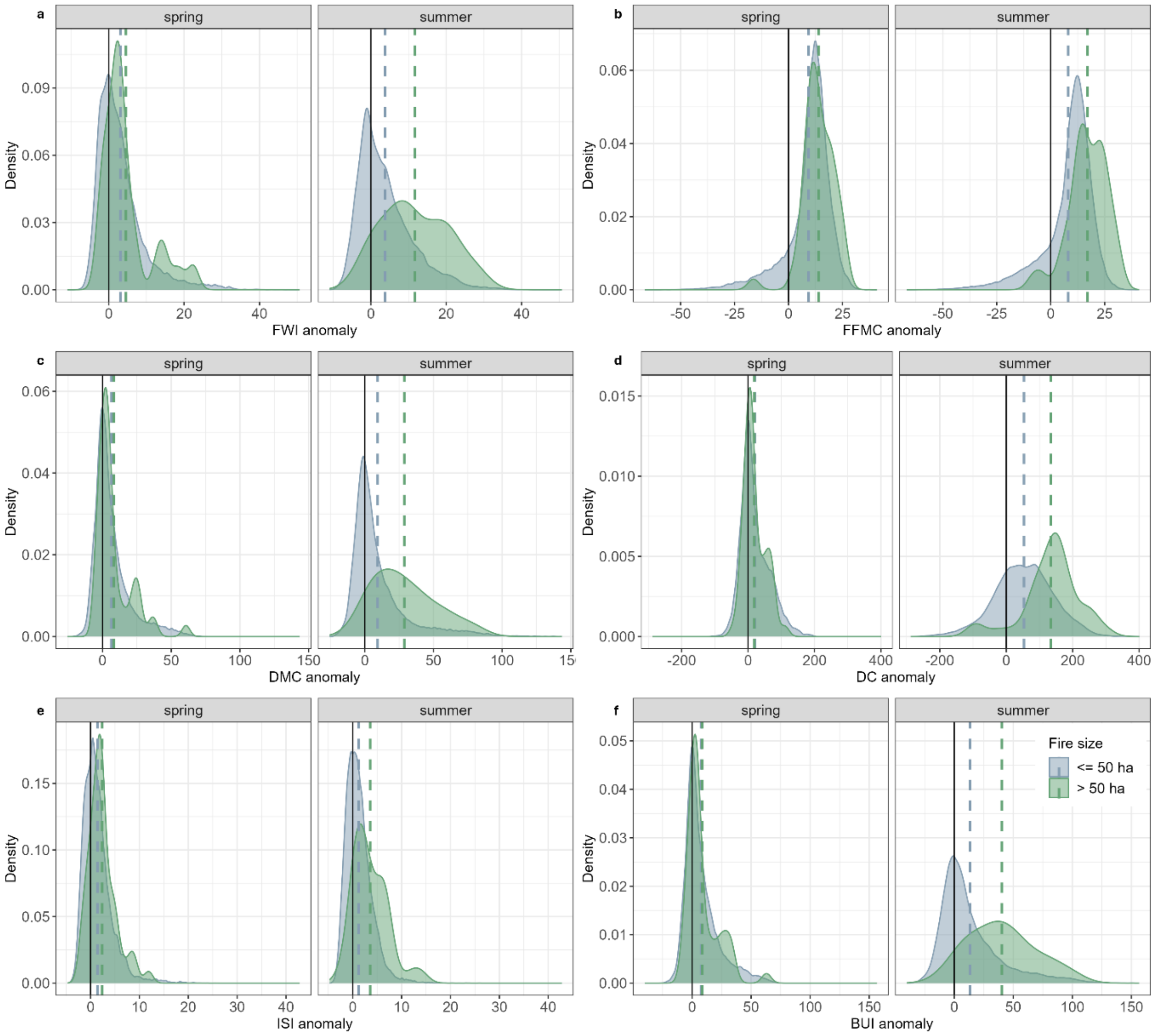


Figure 5: Density plots showing the distribution of the Canadian Fire Weather Index System indices anomalies: (a) FWI, (b) FFMC, (c) DMC, (d) DC, (e) ISI and (f) BUI for spring (left subpanel) and summer (right subpanel). Distributions are presented for wildfires less than or equal to 50 ha (blue fill shows the distribution, dashed blue vertical line shows the mean value) and wildfires greater than 50 ha (green fill shows the distribution, dashed green vertical line shows the mean value). The black vertical line at zero separates positive anomalies (indices are higher than average during wildfires) from negative anomalies (indices are below average during wildfires). Note the independent axes labels for readability.”

Lines 428-438: Not clear how the PPA methodology could improve the fire rating in England or how this information will be integrated into it.

*We do not suggest that the PPA methodology be integrated into MOFSI, as there are many other issues with the MOFSI tool, which is fundamentally used for a different purpose. Rather, we believe that synoptic indicators, like PPAs, could be used as an additional tool to provide a longer-range forecast of elevated wildfire danger periods, something that is not currently available in the UK. Once we have a better understanding of fuel moisture thresholds for vegetation fires in the UK across key landcovers, PPA forecasts could be combined with (for example) observations of soil moisture as antecedent soil moisture conditions contribute to heatwaves (Horowitz et al., 2022) or combined with other circulation patterns that PPAs are known to have nonlinear interactions with (Bartusek et al., 2022) to provide a better understanding of elevated fire weather periods driven by multiple controls. We have added some text to improve the clarity of this section:

"The UK does not have a fire danger rating system although the Met Office Fire Severity Index (MOFSI), an adaptation of the Canadian FWI, is used to trigger land closures in England and Wales during the most extreme conditions (England and Wales Fire Severity Index, 2023). The evolution of PPA events through 500 hPa geopotential height forecasts could be tracked to identify periods of sustained elevated fire weather that may challenge or overwhelm available resources for fire management (Jain et al., 2024). Synoptic indicators of elevated wildfire danger periods would therefore provide significant benefits for near-to-medium range wildfire preparedness and awareness in emerging fire-prone regions like the UK where tailored assessments of fire danger do not yet exist."

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