

Dear Reviewer,

Thank you for your positive review, and for the helpful corrections – which we have implemented throughout the paper.

Best wishes,  
Theodore Keeping

### **General Comment:**

*This is a well-written and timely contribution that will have significant impact on the wildfire research and management community. The multi-region approach is interesting and commendable, and the combination of attribution methodology with vegetation and land-use analysis provides a genuinely comprehensive picture of the 2025 European fire season. The writing is generally clear and technically rigorous, though at times sentences become complex enough to obscure the intended meaning for a first-time reader. The figure captions, while necessarily detailed for a paper of this scope, tend toward verbosity and contain some internal redundancy that could be reduced. A few methodological clarifications are needed — most notably regarding the use of the term "anomaly" in figures where ratios rather than differences appear to be plotted. Once these are addressed, the paper will be in excellent shape for publication.*

### **Minor Corrections (Typographic and Grammatical)**

**Line 25 — "drier summer summers": remove duplicate word ("drier summers").**

Revision made.

**Line 41 — "2025 also recorded...": rewrite as "The year 2025 also recorded...".**

Revision made.

**Line 62 — "which drive": should be "which drives".**

Revision made.

**Line 83 — "climate change has and could": rewrite as "climate change has already and could continue to".**

Revision made.

**Line 89–93 — *The sentences on gross primary production and CO<sub>2</sub> fertilization are somewhat convoluted for a first-time reader; consider simplifying the sentence structure.***

Changed to:

“Europe has seen an increasing trend in gross primary productivity – GPP, the carbon taken up by vegetation through photosynthesis – over recent decades, also known as greening (Eisfelder et al, 2025; Kempf et al., 2023). GPP is a key driver of wildfire activity (Pausas and Ribeiro, 2013; Haas et al., 2024). This is because faster vegetation growth means greater fuel availability, causing higher heat release and increased burnt area due to more abundant and connected vegetation (Haas et al., 2022). The primary driver of increased GPP over Europe is increased photosynthetic activity through the CO<sub>2</sub> fertilization effect (Cai and Prentice, 2020).”

**Line 104 — *"obverse": replace with "opposite".***

Revision made.

**Line 105 — *"increasingly intense European fire per European Environment Agency reporting": rewrite as "increasingly intense European fires, as reported by the European Environment Agency".***

Revision made.

**Line 116 — *"Considering the continuing...": consider replacing with "Considering the ever-growing..."*.**

We respectfully prefer ‘continuing’, as an ‘ever-growing emergence’ is a bit conceptually confusing.

**Lines 170–171 — *"is the region with highest burned area across the Iberian Peninsula [...] as was also the case in 2025": rewrite as "is historically the region with the highest burned area in the Iberian Peninsula [...], and this was also the case in 2025".***

Revision made.

**Line 178 — *"marked topography": the use of "marked" is ambiguous; consider replacing with "pronounced" or "rugged" to make the reference to elevation unambiguous.***

Changed to:

“fueled by frequent fronts interacting with rugged topography – leading to considerably wetter conditions”

**Line 191 — "mountain, bog and heath landscapes – all characterised by low, highly connected vegetation": rewrite as "mountains, bogs, and heath landscapes – which are all environments characterised by short and highly connected vegetation".**

Revision made.

**Line 193 — "on the other hand are": should be "are instead".**

Revision made.

**Lines 195–196 — "though larger and landscape scale fires do occur": rewrite as "though larger fires do occur, even reaching landscape-scale".**

Revision made.

**Lines 200–201 — "especially when multiple events at the same time can cause pressure": rewrite as "especially when multiple events occur at the same time, causing pressure".**

Revision made.

**Line 204 — "by frequent, but small": replace with "by frequent and small".**

Changed to:

"by frequent, small summer fires"

**Line 205 — "2003 saw a record-breaking year for fire occurrence in the region": rewrite as "The year 2003 was record-breaking in terms of wildfire occurrence in the region".**

Revision made.

**Line 206 — "which have limited small to moderately sized fires but not the likelihood of large fires": rewrite as "which have limited the extent of smaller fires, but have not prevented the spread of larger ones".**

Revision made.

**Line 219 — "Weather conditions conducive to catastrophic wildfires nonetheless occur in the region, particularly in the summer": rewrite as "weather conditions leading to extreme wildfires occur in this region nonetheless, particularly during summer months".**

Revision made, but 'conducive' kept over 'leading' due to prevent a deterministic interpretation.

**Line 224 — "illustrative": replace with "an example".**

Revision made.

**Lines 224–225 — "The highest concentrations of fire frequency and burned area are coastal": rewrite as "The majority of fires and burned area are concentrated on the coast".**

Changed to:

"Further north, Albania is an example of the highly fire-prone eastern Adriatic summer fire regime. The majority of fires and burned area are concentrated near the coasts"

**Lines 226–228 — "Satellite-based analyses using Sentinel imagery, which shows that wildfire impacts...": rewrite as "Satellite-based analyses using Sentinel imagery show that wildfires in the period 2020–2025 have predominantly affected open and semi-natural vegetation types, including sclerophyllous shrublands, broadleaved forests, and degraded formations (such as garrigue and transitional woodland–shrub)".**

Revision made.

**Line 229 — "indicate that these latter classes account for a substantial share of total fire impact": replace "share" with "fraction".**

Revision made.

**Line 230 — Is the line break here intentional? It interrupts the paragraph flow.**

Line break removed.

**Lines 559–560 — "to do past climate change": appears to be a typo for "due to past climate change".**

Revision made.

**Line 560 — "temperature driven": hyphenate as "temperature-driven" or rephrase as "driven by temperature".**

Changed to: "temperature-driven"

**Lines 562–563 — "three times as likely with a 70% increase": insert comma — "three times as likely, with a 70% increase".**

Revision made.

**Line 585 — "drying (curing)": the term "curing" is used without explanation here but was already used at line 566. Consider defining it at first occurrence (line 566) and using it freely thereafter.**

Definition inserted at 566: “(the slow drying processes that make bulky dead vegetation highly flammable)”

At 585: “drying (curing)” replaced with “curing”

**Line 603 — “80% – whilst...”: consider starting a new sentence: “80%. However, while...”.**

Revision made.

**Line 683 — “with VPDx7x not a rare event in today's climate”: this phrasing is ambiguous — please clarify what return period or frequency is implied.**

Revised to: “with the return period for VPDx7x not rare in today’s climate”

**Line 697 — “..., and in the Eastern Adriatic, the semi-arid...”: remove the comma after “Adriatic”.**

Revision made.

**Line 712 — “when considering only reanalysis data”: replace with “according to ERA5-Land reanalysis data”.**

Revision made.

Line 733 — “signalled”: the intended meaning is unclear; consider rephrasing (e.g., “being deployed” or “announced”).

Change made: “announced”

## **Presentation and Formatting**

**Figure 2 — The image resolution appears low in the PDF version; please verify this is not an export artifact. The superposition of many FRP dots makes the figure difficult to read — consider reducing the dot size to improve legibility.**

The FRP dots have been slightly shrunk (but not too much to keep them visible in Britain and France). The fact that dots are hard to distinguish in Iberia is illustrative of how much fire activity there was in the region. The figure was reinserted it at a higher DPI.

**Figure 3 caption — The phrase “for each grid cell” is repeated multiple times across the caption items. Consider consolidating this into a single introductory statement.**

New caption proposed:

“Figure 3: (a), the average FRP over the period March to October, 2025, according to the MODIS active fire product, and (b), the rank of 2025 MODIS FRP from Mar-Oct compared to other years since 2003. All statistics for subfigures c-h are calculated at the grid-cell level using ERA5-Land data: (c), The maximum annual 7-day rolling average of maximum daily vapour pressure deficit (vpdmax7x), and (d), the anomaly of vpdmax7x in 2025 relative to the climatology from 1990-2019. (e) the maximum annual 7-day rolling average of maximum daily windspeed (sfcWindmax7x), and (f), the anomaly of sfcWindmax7x in 2025 relative to the climatology from 1990-2019. (g) the maximum annual 7-day rolling average of the hot-dry-windy index – the product of maximum daily vapour pressure deficit and maximum daily windspeed (hdwi7x), and (h), the anomaly of hdwi7x in 2025 relative to the climatology from 1990-2019. Using ERA5-Land: (i), the standardised precipitation evapotranspiration index (SPEI) for spring (March-May) in 2025, calculated relative to 1990-2019. (j), the SPEI for summer (June-August) in 2025, calculated relative to 1990-2019.”

**Table 4 caption — The caption text is not formatted in bold, unlike the other table captions. Please apply consistent formatting.**

Formatting corrected.

## **Substantial Comments**

**Line 208 — “which fragment the landscape”: this claim is left unexplained and a bit unclear. Either provide a brief justification (e.g., roads create discontinuities in vegetation cover) or remove the clause.**

Inserted: “by creating discontinuities in vegetation cover”

**Section 2.6 (Research Justification, lines 255–270) — This section reads as an extension of the introduction rather than a component of Section 2. Consider relocating it to the end of the Introduction, where it would serve more naturally as a motivation and scope statement.**

The final paragraph of the introduction presents a vade mecum of the chapter, prefaced with a sentence that somewhat overlaps with this content. We have removed that sentence and replaced it with the text that was in section 2.6. The final introduction paragraph is now two paragraphs, and reads:

“As detailed in section 2, there is detailed knowledge of the regional drivers of extreme wildfire events across European fire regimes – with many changes in these drivers observed across environments. However, partially due to the relatively short observed, satellite-based wildfire record, the causes of historic changes in the fire regime are poorly understood, especially in comparison to the highly detailed understanding of drivers in the most recent decades. To fill this gap, we provide a systematic attribution study of the weather-related drivers of fire, aiming to give a detailed overview of how the likelihood of the different contributing weather conditions to extreme wildfire has changed over time. This quantification of the

changing probability of realised extreme fire weather and its resulting wildfires can be a key input to expert and operational planning for future wildfire extremes across Europe. By assessing five extreme fire seasons across Europe, this research samples a high diversity of meteorological drivers of elevated fire danger (e.g. spring drought in Britain; heat and hydroclimatic whiplash in Iberia; and compound hot, dry and windy conditions in the Eastern Adriatic) across a broad range of fire-prone environments, whilst also accounting for trends in vegetation and land use. In addition to being specifically useful to understanding (1) why the 2025 fire year was so extreme in Europe and (2) how the hazard profile is changing in the five case study regions, this work is also illustrative of the spread of possible extreme fire events and their drivers across Europe and how those are likely to change in the future.

In section 2, we introduce the five study regions considered in the analysis, including an overview of the fire regime and key drivers of change in wildfire activity for each. In section 3, an overview of the variables, datasets, and attribution methodology used is given. Section 4.1 covers fire weather experienced across Europe in 2025, with trends in vegetation cover and land-use also presented. Sections 4.2-4.6 give a probabilistic attribution of the changing likelihood and intensity of the drought and fire weather conditions seen in 2025 due to climate change from pre-industrial to present, and from present to +2.6°C, using a synthesis of reanalysis and climate model data per Philip et al. (2020). Time series in overall spring and summer vegetation cover, as well as the managed land fraction, were also aggregated for each case study region. Interpretation of these changes and their implications is given in section 5.”

***Line 316 — "Climate models were first evaluated on their ability to replicate each variable's seasonal and spatial patterns across each study region": please add at least a brief description of how this first-stage evaluation was conducted (e.g., which metrics or thresholds were used).***

The sentence following this one describes the metrics used to evaluate, this stage of evaluation was a preliminary visual sense check, testing that the climate model acceptably reproduces the climatology we expect from observations.

The sentence has been replaced with:

“Climate models were first checked visually against reanalysis according to their spatial climatology and seasonal cycle, with models not capturing patterns in each study region excluded.”

***Line 373 — "SPEI": this is the first occurrence of the index in the Results section; write out the full name "Standardised Precipitation Evapotranspiration Index (SPEI)".***

Revision made.

**Lines 385–386 — The discussion of VPD and its anomaly conflates two distinct quantities. Consider separating the description of absolute maximum VPD values from their anomaly relative to the 1990–2019 climatology, to avoid confusion.**

As the fact that absolute VPD is high in southern Europe is expected, we have rephrased to only focus on the anomaly:

“The anomaly in the highest 7-day average period of maximum daily VPD relative to 1990-2019 shows high values across Europe (Fig. 3c, 3d), with the exception of some Baltic regions and Belarus.”

**Line 432 — "the lower right panel": this appears to be an error, likely a reference to a previous figure layout. Please correct the panel reference.**

This has been corrected to 5b, and the the reference to the naturalisation fraction above to 5a.

### ***Important Issue***

***Anomaly definition throughout the paper (e.g., Figure 3d) — The colour bars and axis labels in multiple figures suggest that "anomaly" is expressed as a ratio (present value / climatological mean) rather than as an absolute difference (present value – climatological mean). Anomaly conventionally refers to a difference, and using a ratio without explicit labelling is likely to mislead readers. Please either (a) change the label to "relative anomaly" or "normalised anomaly" and add a clear definition in the caption, or (b) recalculate and present the anomalies as absolute differences. This issue affects multiple figures and should be resolved consistently throughout the paper.***

This has been addressed in figure 3, corrected to “relative anomaly”. All other anomalies in the paper are not ratios, so have been kept as is.