RESPONSE TO REVIEWER 1:

Dear Reviewer,

Thank you very much for the comments you have provided for our manuscript. Please find a response to each of your comments and the proposed revision below.

Best wishes,
The Authors

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.

> Thank you for these comments. As a number of your comments build on these themes, we reply to those specific comments and outline the proposed changes below. We believe we have addressed this comment throughout.

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_2 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 CO2 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.

RESPONSE TO REVIEWER 2:

Dear Reviewer,

Thank you very much for these substantive comments. Please find a response and the proposed revision below.

Best wishes,
The Authors

The manuscript addresses an important and timely topic and provides a broad regional analysis of the 2025 European wildfire season. The combination of

fire-weather attribution, vegetation trends, and land-use change is valuable. However, some sections would benefit from clearer wording, reduced repetition, and smoother explanation of the research gap and methodological logic. In several places, the text is scientifically meaningful but syntactically heavy, which may reduce readability for a broad NHESS audience. I consider the manuscript suitable for publication after revision.

Thank you for these comments, we've addressed these issues throughout – both in response to your comments below, and in response to the comments of the other reviewer above.

Line 25 – The phrase "drier summer summers" appears to contain a repetition/typo. Please revise.

Revision made.

Introduction / early framing

Some sentences in the introduction are very long and contain several ideas at once. Consider splitting them to improve readability, especially where fire weather attribution, vegetation trends, and land-use analysis are introduced together.

Line 36 – Remove extra space after "was ".

This and all repeated spaces were removed.

Line 42 – Maybe better not to start the sentence with 2025; for example, "The European wildfire season also recorded..."

Changed to: "The year 2025, "

Line 44 – This sentence provides useful impact context, but smoke is not a central component of the study. Consider shortening it or linking it more clearly to the motivation for studying extreme wildfire seasons.

This opening paragraph details the impacts of the wildfires, with a fuller explanation for the justification of the study coming towards the end of the introduction. We have tightened this sentence, having a shorter sentence explaining that smoke is a key impact of wildfires, followed by a sentence summarising the top line on emissions and air quality:

"Wildfire smoke broadens the otherwise localised impacts of wildfire events, resulting in major health and mortality impacts globally (Naeher et al., 2006; Johnston et al., 2012; Chen et al., 2021). The year 2025 had the highest European wildfire emissions since 2003 when the full global MODIS record began, leading to worsened air quality in Portugal and Spain (Parrington and McNorton, 2025)."

Line 51–54 – This sentence is conceptually important but difficult to follow. Consider simplifying the structure after "allows" and clarifying that the study assesses how changing wildfire drivers contribute to the severity of extreme wildfire seasons.

We have split up and clarified this:

"This paper offers a detailed description of the driving conditions of 2025's extreme wildfire events, coupled with attribution of fire weather conditions and trend analysis of land-use and vegetation. This allows the contribution of multiple rapidly changing wildfire drivers to extreme wildfire seasons to be assessed in detail, providing insight into the present and future state of the European wildfire hazard."

Lines 117, 188, 218, 222, and 238–246 – Several regional background statements would benefit from stronger citation support.

Line 117: This sentence was removed following feedback from reviewer 1.

Line 188: The statements about burned area and fire weather are substantiated above, the statement on suppression capacity is substantiated by Sánchez-Hernández et al. (2025), which has been added to the end of the sentence.

Line 218, changed to: "Western Greece and the Ionian islands north of the Peloponnese peninsula are less fire-prone than southern and eastern Greece (Kalabokidis et al., 2024), due to generally less extreme fire weather."

Line 222, changed to: "Wildfires are primarily human-caused, and typically occur in mosaic shrubland and pine forest ecosystems (Kalabokidis et al., 2024)."

Line 238–246, changed to: "The wildfire regime of northwestern Türkiye is a transitional dual system, with the historically humid, low-frequency regime of the Euro-Siberian Black Sea forests increasingly replaced by the frequent, high-intensity fire dynamics of the Mediterranean coast (Şahan et al., 2022; Şahan et al., 2023). The high-intensity fires peak in summer, with a late-spring also seeing a pulse of smaller, predominantly human-ignited agricultural fire use in Thrace and southern Marmara (Yakupoğlu et al., 2022). Although usually small, these agricultural fires frequently escape into forest edges – especially given a dry spell, as observed in the Bursa–Bilecik–Eskişehir fires of early summer 2025. Critical wildfire danger is understood to increase sharply under elevated temperatures, low humidity and delayed autumn precipitation. This condition is now increasingly common during summer heatwaves, as Mediterranean climate characteristics expand northward and formerly humid forests lose their buffering capacity (Ekberzade, 2026)."

Line 190 – The phrase "low, highly connected vegetation" may be vague for some readers. Consider revising to "short, continuous vegetation" or "connected surface fuels" to clarify that "low" refers to vegetation height, not low fuel amount.

Revised to "short and highly connected vegetation"

Line 255 – Please remove the repetition of "detailed" and make the research-gap explanation smoother. The contrast between the relatively strong understanding of recent regional wildfire drivers and the limited understanding of longer-term fire-regime changes due to the short satellite-based record is important, but it could be expressed more clearly.

Per a comment from the other reviewer, we have moved this paragraph to the introduction, we have clarified the explanation and extended it:

"As laid out 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 – as detected fire trends are often not statistically significant over short observation periods (). Using our knowledge of the drivers of wildfire extremes, we are able to address 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."

Methods section

The methodological framework is strong, but some readers may benefit from a clearer explanation of why specific variables were selected, especially HDWI, VPD, seasonal effective precipitation, LAI, and managed land fraction. A short linking paragraph could help connect these variables to the conceptual wildfire-driver framework.

To facilitate this link, we have merged sections 3.5 and 3.6, into the following combined section, with the first paragraph inserted:

"3.5 Additional Analysis of Leaf Area Index and Managed Land Fraction

This study is primarily concerned with the attribution of the meteorological drivers of fire to climate change. Whilst this could be achieved via a composite fire weather index, this would not help with disentangling (1) how different meteorological drivers combine to create different fire extremes, or (2) how these meteorological drivers are separately changing. The five meteorological indices analysed here capture both instantaneous fire weather conditions (dry heat – VPD, high winds, and a simple composite of the two – HDWI) and the key, additional roles of ecological drought (fire season effective precipitation) and growing season moisture availability (prior season effective precipitation). Whilst weather extremes drive fire extremes, without consideration of the vegetation and land management, attributed trends cannot be linked to realised fire activity. To assess these we analysed trends in LAI, as a metric of fuel availability, and the fraction managed land, as a measure of land reclamation or abandonment.

To calculate the managed land fraction, we analysed changes in cultivated versus natural lands in Europe using the HILDA+ land-cover dataset (Winkler et.al., 2021) for the years 1990 and 2019 for Europe, (-12° to 45°E, 34° to 72°N). We consider all croplands and the pastures as human managed lands, while as all forest land cover types, grass/shrubland, and sparsely vegetated are considered as natural, not cultivated lands. Then, we estimate the fraction of the area that was converted from natural to managed land, as well as the fraction of the land that was converted from managed to natural land, between years 1990 and 2019. We further extract trend in the fraction of managed land relative to natural and managed land over time since 1960, for each of five case study regions. This does not capture trends in the wildland and rural urban interfaces, which contribute strongly to both ignitions (Badia et al., 2011) and impacts (Radeloff et al., 2018) of wildfires, with the focus being on the effect of overall vegetation management intensity in a landscape.

LAI is a dimensionless measure that primarily represents the amount of living and photosynthetically active vegetation, used here as a metric for vegetation/fuel availability in a landscape. Instantaneous vegetation greenness tends to reduce wildfire occurrence and spread due to increased vegetation moisture content, whereas accumulated antecedent vegetation can increase wildfire activity due to vegetation build-up and the availability of dead biomass (Kuhn-Régnier et al., 2022). As such, mean spring (MAM) LAI can be used as a proxy for the amount of vegetation which may become available to burn during the subsequent summer season. Mean summer (JJA) LAI could act both as a potential barrier to wildfires (through live vegetation) but also as potential fuel if this vegetation were to dry out quickly. We analysed the trends in leaf area index (LAI) from two LAI products: the MODIS 500m LAI product (Myneni et al., 2021) and the corrected Seoul National University (SNU) LAI product at a 0.1° resolution (Jeong et al., 2024). The SNU LAI data was available from 1982 to 2021 and the MODIS LAI data was available from 2001-2024, providing a time-series covering the last 42 years (1982-2024) with a 20-year overlap (2001-2021). We conducted a spatial aggregation to 0.5° resolution and computed the significant pixel-wise trends in annual spring (MAM: March, April, May) and summer (JJA: June, July, August) LAI using a Mann-Kendall test and significance threshold of 0.05. The magnitude of significant trends were estimated using a Theil-Sen estimator to fit a linear slope. Spatially averaged trends were also computed for each of the study regions by taking the mean spring (MAM) and summer (JJA) LAI over the study regions and fitting a linear trend following the same trend methodology.”

Discussion

The discussion is rich and well connected to the results, but some claims could be made more cautious where the evidence is indirect, especially when interpreting LAI and land-use change as proxies for fuel load, fuel continuity, or abandonment effects.

We agree that conclusions on the basis of trends in LAI and land-use should not be too bold. This was addressed in the final paragraph of the discussion, which we have expanded on to clarify this:

“Second, LAI provides a good representation of the area covered by photosynthetically active vegetation, but does not directly represent total fuel load, including dead fuels, or fine-scale vegetation continuity. Whilst a comprehensive fuel model, able to distinguish live and dead fuels, would be very useful, seasonal and total LAI in combination with moisture stress (SPEI) is sufficient to describe the basic trends in fuel moisture and abundance covered here. The trends in LAI presented in this paper give context to trends in the direct vegetation drivers of wildfire such as fuel load and continuity, but should be interpreted as indirect evidence of such shifts. Site-based studies are required for ground-truthed fuel trends. Third, the land management fraction used to describe land management here is of variable utility in different regions. It is a first-order measure of shifts in total landscape management scheme in a region, but does not account for differences in how different management schemes may result in different vulnerability to fires. For example, in the UK the great majority of forests are managed in some way, but nonetheless vulnerable to fires (e.g. Swinley Forest in 2011 or Galloway Forest Park in 2025), whilst agriculturally managed land is much less so. Whilst trends in land management should thus perhaps be ignored over Britain, in other more fire-prone regions it provides a useful heuristic for changes in land use and vegetation management.”

Conclusion

The conclusion effectively summarizes the main regional contrasts, but it is quite dense. Consider shortening some sentences and emphasizing the main contribution more clearly: climate change has increased key fire-weather hazards, while vegetation and land-use changes modulate regional wildfire potential.

To improve readability, we split the concluding paragraph and broke sentences up where possible. This emphasised the main conclusion in what is now the second paragraph, detailing where there is emergence from variability in models and observations. In the conclusion we focus on the effect of climate change on key fire-weather hazards, with the modulation of vegetation and land-use treated as additional context but not as highly weighted analysis. This is also in alignment with the comment on the Discussion section.

“This study offers a comprehensive overview and attribution of the key weather drivers of five extreme wildfire events over Europe in 2025. These events spanned a broad range of weather drivers and extremity of event. In northwestern Iberia, persistent heat followed by moderate winds, in combination with a moist spring and dry summer, contributed to the largest Spanish burned area on record. On the eastern Adriatic and Ionian coast, simultaneous elevated winds and VPD occurred in combination with similar wet spring, dry summer conditions. In both cases, all meteorological drivers were more common than 10-year events. In western and northern Britain, an extremely rare 140-year spring drought and 25-year spring VPD event contributed to the highest UK burned area on record. In Occitania, summer and spring moisture were not extraordinary, but a 70-year VPD event contributed to France's largest record wildfire in 80 years. In northern and western Türkiye, a moderately dry spring was followed by a 30-year dry summer event which, in combination with rare VPD and HDWI conditions, drove extremely damaging wildfires throughout the region. The case study regions also spanned distinct fire regimes,. These included the European region most prone to large fires in northwestern Iberia; an historically small fire dominated region in Occitania; and western and northern Britain where wildfires predominantly occur in the spring. The studied fire regimes are also changing rapidly, with large wildfires increasing in Iberia and southwestern France, the emergence of a summer fire season in Britain, and the transition of historically humid northern Turkish forest to a drier, more fire prone environment.

Across all of these diverse drivers and different fire regimes, a straightforward increase in the likelihood and intensity was found across many key weather drivers of wildfire. Strong trends towards drier summers were found across the southern European regions. Summer effective precipitation emerged from natural variability in northwestern Iberia, Occitania and northern and western Türkiye (Fig. 11b). Extreme weekly VPD was also found to have increased in frequency across all study region fire seasons. VPD extremes were emergent in the reanalysis data across all regions, and the synthesised trend was especially strong over Türkiye. Despite minor to nonexistent trends in high winds, these shifts in VPD resulted in emergence from natural variability in the hot, dry, windy compound index (HDWI) across the synthesis of reanalysis and climate models in northwestern Iberia, the eastern Adriatic/Ionian, and northern and western Türkiye, and in the reanalysis only for western and northern Britain, and Occitania (Fig. 11a)."