

egusphere-2025-4859 – Author’s response to Anonymous Referee 1

Evripidis Avouris¹, Christopher Marrs¹, Kristina Beetz^{1,*}, Lucie Kudláčková², Markéta Poděbradská², Miroslav Trnka², Matthias Forkel¹

5 ¹TUD Dresden University of Technology, Faculty of Environmental Sciences, Environmental Remote Sensing Group, Dresden, Germany

²Global Change Research Institute of the Czech Academy of Sciences, Brno, Czech Republic

* Now at ICEYE, Finland apartment example, University example, city, postal code, country

Correspondence to: Matthias Forkel, TUD Dresden University of Technology, Faculty of Environmental Sciences, Technische Universität Dresden, Helmholtzstr. 10, 01062 Dresden, Germany, E-mail: matthias.forkel@tu-dresden.de

10 *Referee comments are written in blue italics; author’s responses are written in normal font; and proposed changes are highlighted in green font.*

This is an interesting manuscript that describes the application and dissemination of a wildfire risk and exposure assessment in the border region between Germany and the Czech Republic. This region, like many others in Northern and Central Europe, has not been typically considered as a hub of wildfire activity (unlike Southern Europe). Consequently, both the public and

15 *government agencies lack the awareness and preparedness to address the possibility of fire becoming a more common natural hazard in the near future due to climate change. A large wildfire in 2022 which had devastating effects on both human property and local forest ecosystems has motivated the authors to study fire risk and exposure in the region. To that end, they utilized a common modelling approach based on a widely-used fire spread model, FlamMap, to create maps of burn probability and flame length across the entire region assuming three weather scenarios and three fire durations. They then intersected fire*

20 *hazard maps with data on property and infrastructure to estimate potential wildfire for all settlements in the region. Finally, they created a web-based interactive map that allows stakeholders to learn about fire risk in the region; and presented this tool to a group of stakeholders, soliciting their inputs on the map.*

We thank the reviewer for the detailed review and helpful suggestions. We have revised the manuscript accordingly and provide point-by-point responses below.

25

Major comments

The main strength of this manuscript is its holistic approach to addressing a growing wildfire problem in a new region. In contrast to most studies, this study did not end with the completion of the fire risk map, but continued to dissemination and accepting feedback from relevant stakeholders. This provides valuable lessons to researchers in other regions where fire

30 *problems may arise in the future, as they seek to educate stakeholders on an emerging threat. This strength of the manuscript compensates for the fact that its scientific novelty is rather low. The methodology follows a standard approach for mapping wildfire hazard and exposure that's been around for more than a decade, so it's only novelty is the generation of a fire risk*

map for a region that didn't have one before. The development of the web-based map is important for dissemination but it's mostly a technical contribution. And the focus group approach to study the relevancy of the results is not novel in the context of fire risk analysis, though the insights gleaned from it may be used to improve publicly available fire risk maps in the future. I have no qualms with the risk mapping approach, as it was based on mostly standard procedures, though these had to be adapted to the particularities of the specific study region (i.e., generation of new fuel models and selection of suitable weather data). I think that the authors' approach is reasonable given data limitations, and consequently the predictions of the models under different scenarios make sense.

40 We thank the reviewer for taking the time for the in-depth review. We appreciate the recognition of the study's holistic approach, particularly the combination of wildfire risk mapping, dissemination through an interactive map, and stakeholder feedback. We also acknowledge that the methodological components are based largely on established approaches. Our intention was therefore not to introduce a novel methodological framework, but to adapt these methods to a region where such assessment was previously unavailable and to extend the work toward communication and stakeholder-oriented application.

45 We have revised the manuscript to clarify this contribution more explicitly.

In contrast, the choice of methodology for the purpose of validation was confusing to me. If the actual perimeter of the 2022 fire is known, why was the ground truth based on remote sensing data? Is it because the daily progression of the fire is unknown?

50 Unfortunately, no official data has been produced in relation to a day-to-day mapping of the 2022 wildfire, neither by the German nor the Czech authorities. To counter this lack of ground truth data, it was decided to employ active fire detections from MODIS and VIIRS from FIRMS as the best possible approximation for the progression of the fire. However, please note that we have revised the validation approach in order to provide a more detailed quantification of model accuracy in representing the burned area and spread of the 2022 fire as seen from the answer to the comments below.

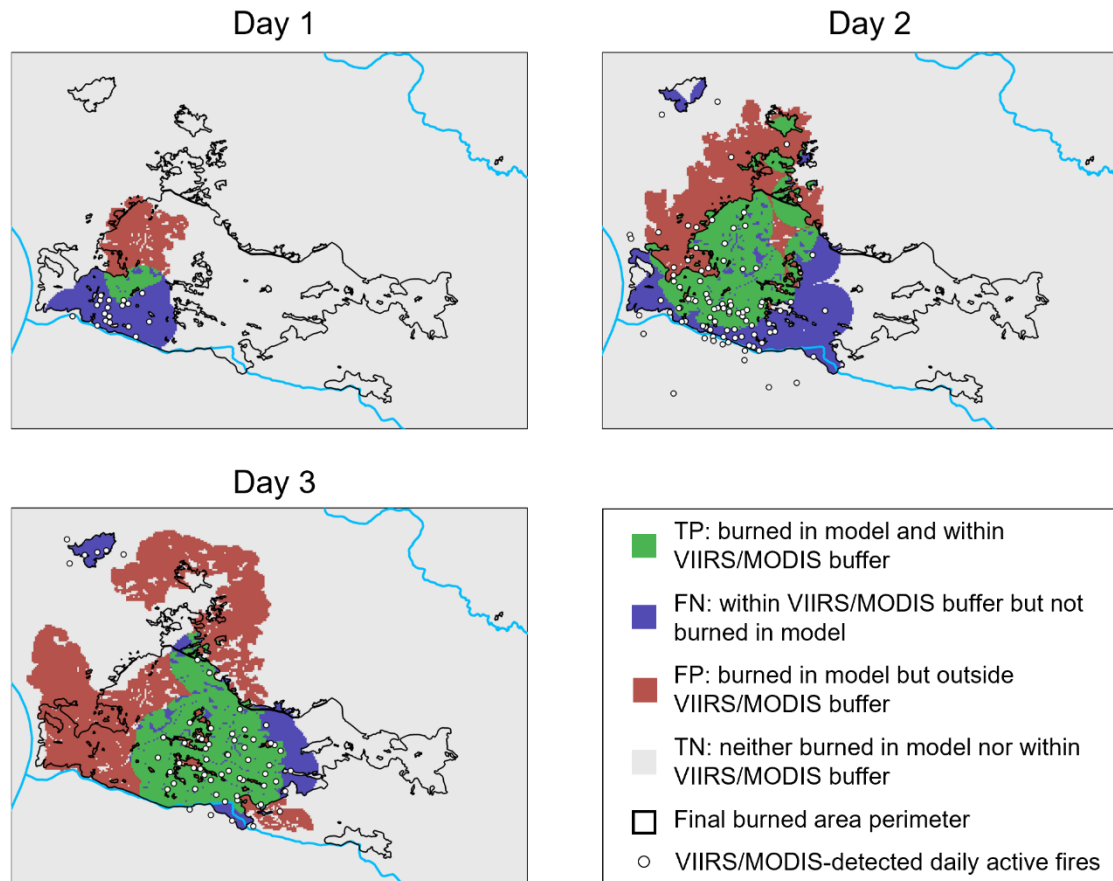
55

To what extent can we trust remote sensing data as "ground truth" for validation purposes, given that RS fire products suffer from significant commission and omission errors?

We acknowledge that MODIS and VIIRS active fire products contain omission and commission errors and should not be considered strict ground truth. We have revised the manuscript to clarify that these products were used as independent remotely sensed datasets rather than absolute ground truth. We therefore recommend adding to the Limitations “We acknowledge that this evaluation approach can only approximate the assessment of actual fire spread because active fire products contain omission and commission errors, which are caused by the limited temporal overpass of the satellites, the under-detection of low intensity and small fires, and the coarse spatial resolution, respectively. Therefore, the evaluation should be interpreted as an informed consistency check rather than strict accuracy validation.”

65 For the validation of simulated fire spread, we now combine the timing of active fire detections from VIIRS/MODIS with the map of total burned area of the fire event. The burned area map is based on the map of the Copernicus emergency management

service, which has been checked and revised by in situ mapping of the National Park administrations. We already used this map in our earlier publication (Beetz et al., 2024). We extracted the day of fire detection from the VIIRS and MODIS active fire observations and created a 500m buffer around each daily detected ignition, representing a compromise between the spatial resolutions of the two sensors. These buffered detections were then overlaid with the mapped burned-area perimeter to approximate when burning was first detected within different parts of the final burned area, and were compared with the modelled fire extents (Figure AC1 1).



75 **Figure AC1 1: Comparison of modelled daily fire spread with the area derived from combining 500 m buffers around VIIRS- and MODIS-detected daily active fires. TR: true positive, FN: false negative, FP: false positive, TN: true negative.**

This new validation method therefore assesses spatial consistency between modelled fire spread and the day of first fire detection, restricted with the actual burned area. We describe this new approach by altering lines 420-431 to:

80 “The modelled daily fire perimeters were evaluated with the dates of first active fire detection by the VIIRS and MODIS sensors within the boundary of the final burned area perimeter. NASA’s Fire Information for Resource Management System (FIRMS), distributes Near Real-Time (NRT) active fire / thermal anomalies data from the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard the Aqua and Terra satellites (NASA MODIS Science Data Support Team, 2021), and the Visible Infrared Imaging Radiometer Suite (VIIRS) aboard S-NPP and NOAA 20 (formally known as JPSS-1) (NASA VIIRS Land Science Team, 2020). This data comes in 375 m (VIIRS) and 1 km (MODIS at nadir) spatial resolutions. The 85 final burned area perimeter is based on the map of the Copernicus emergency management service, which has been checked and revised by in situ mapping of the National Park administrations. It has been used before in Beetz et al. (2024). For the evaluation, the available satellite-detected active fires for the first three days of the 2022 wildfire (24.07.2022 – 26.07.2022), were merged and then classified into three daily layers. Each active fire point was then assigned a 500m buffer as a compromise between the spatial resolutions of the VIIRS and MODIS sensors. The resulting buffered daily active-fire 90 detections were overlaid with the final burned-area perimeter to approximate which areas of the final burned area were burning on each day. These daily detection-based areas were then compared with the fire perimeters derived from the three aforementioned FlamMap modelling runs, which were likewise produced for the first three days of the wildfire. Their comparison can be seen in Figure 8 [here, Figure AC1 1]”

95 *Also, I get why the validation was done on a day-by-day basis (to account for the static wind conditions in FlamMap), but constricting the prediction of fire spread to a single day (starting the actual fire perimeter at the day's start) can inflate the model's accuracy.*

We agree that the use of three consecutive daily simulations reduces cumulative error and does not represent a continuous three-day fire reconstruction. However, FlamMap operates under static weather assumptions. The day-by-day implementation 100 was therefore chosen to approximate short-term spread under quasi-static daily wind conditions, rather than to fully reconstruct the historical wildfire event. We have clarified this limitation in the revised manuscript. To address this, we recommend changing the strong wording of lines 404-405 to: “To assess the plausibility of the wildfire modelling approach used in this study, we evaluated whether FlamMap could reproduce spatially consistent short-term fire spread patterns during the first three days of the 2022 wildfire, under daily mean fire-weather conditions.”

105 *If FlamMap cannot handle dynamic weather, perhaps we shouldn't expect it to reliably reconstruct actual fires but use it only for its intended purpose: revealing areas at risk due to existing fuel composition and configuration and prevailing fire weather conditions (typically assuming extreme weather, because these conditions results in the worst fire outcomes).*

We agree that FlamMap is primarily designed to reveal areas at risk due to existing fuel composition and configuration and 110 prevailing fire weather conditions, or to simulate potential fire behaviour under specified fuel and weather conditions rather than to reproduce historical wildfire events. Indeed, in this study the objective of the evaluation was not to replicate the wildfire

precisely, which has already been undertaken by some of our co-authors (Kudláčková et al., 2024), but to assess whether the modelling framework produces spatially plausible fire spread patterns under observed daily fire weather conditions.

115 *Another issue in the validation method is the choice of accuracy metric. The % of fire detections within the modelled fire perimeter would always be 100% if FlamMap predicts that the entire landscape burns. But this will obviously reflect a massive commission error, which cannot be accounted by the metric used here. Instead, both omission and commission errors should be reported, ideally based on actual fire perimeters (see my previous comment) rather than on remotely sensed data.*

We fully agree with the reviewer. Based on the daily maps of first fire detection as described above, we now perform a complete
120 accuracy assessment of the modelled daily fire spread maps - by keeping the limitations of the active fire detection data in mind. Therefore, we now quantify for the first three days of fire spread the area of correct and false positives and negatives, after a random sampling of 50000 points within the study area (Table AC1 1).

125 **Table AC1 1: Confusion-matrix counts and derived validation metrics comparing simulated fire spread with satellite-based active-fire detections for the first three days of the 2022 wildfire, based on a random sample of 50,000 raster cells for each day.**

Day	TP	FP	FN	TN	Omission error	Commission error	Jaccard (IoU)
Day 1	288	1071	1348	47293	0.824	0.788	0.106
Day 2	3272	3291	2659	40778	0.448	0.501	0.355
Day 3	3676	6637	1356	38331	0.269	0.644	0.315

For the interpretation of the table, we suggest replacing lines 431-434 with the following:

130 “Table F1 of the Appendix [here, Table AC1 1] presents the confusion-matrix results and validation metrics for the comparison between simulated fire spread and satellite-based active-fire detections. Metrics utilising TN, such as overall accuracy were not considered, as they would give deceptively large values, due to the over-prominence of TN.”

We also recommend adding to Section 4.2 of the Discussion, after line 529:

135 “On Day 1, the model shows very limited correspondence with the areas identified from VIIRS/MODIS detections, reflected in the high omission (0.824) and commission (0.788) errors. Consequently, the Jaccard similarity is low (0.106), indicating only minor spatial overlap between modelled and detection-based fire areas. On Day 2, the model reproduces the general spatial pattern of fire spread more successfully, with substantially higher Jaccard similarity (0.355). Both omission (0.448) and commission (0.501) errors remain moderate, suggesting that while the model captures a considerable portion of the observed burning, it still both misses and overpredicts parts of the burned area. On Day 3, omission error decreases further (0.269), indicating that most of the detection-based fire areas are captured by the simulation. However, commission error increases
140 (0.644) and FP are much higher than Day 2, reflecting a tendency of the model to overestimate the spatial extent of fire spread.

Overall, these results suggest that the model captures the general progression of the wildfire during the later stages of the event, although notable discrepancies between simulated and observed fire extents remain.”

145 *While the manuscript's presentation is really thorough, its flow can be much improved by trimming repetitive information and excessive data about some of the methods which delve too deeply in technical descriptions of well-known tools such as FlamMap and background on fuel models. Importantly, the results contain much superfluous information as each sub section tends to begin with description of methods (e.g., lines 352-353, lines 404-429, 440-445, 462-470) and/or a detailed description of the figures that should be left to the caption (e.g., lines 353-354, lines 323-326). It will be much easier to follow if results are simply described, following with a pointer to the relevant figure. Methods should not be described in the results section.*
150 *Moreover, the results section contains some discussion materials which are out of place (e.g., lines 361-369). In general, a clearer distinction between the methods, results and discussion sections is needed.*

The authors agree with the recommended structure and the suggestions will be implemented accordingly.

Specific comments

155

Line 16: " ... to create an interactive wildfire exposure map"

We will change this as suggested.

Line 24: since the map was tested with audiences, there should be a sentence that mentions the results of this test at the end of the abstract.
160

We propose the following inclusion to account for this:

The interactive wildfire exposure map was tested with the general audience and local stakeholders for its usability and usefulness. Based on 50 questionnaire responses, participants generally rated the map as easy to use and were able to interpret the bivariate legend correctly in most cases, while also providing suggestions for improvements to support potential applications in monitoring and management of the national park. We generally found ...
165

Line 29: a reference is needed to support the claim that wildfires are increasing in the WUI. For example: Radeloff, V.C., Helmers, D.P., Kramer, H.A., Mockrin, M.H., Alexandre, P.M., Bar-Massada, A., Butsic, V., Hawbaker, T.J., Martinuzzi, S., Syphard, A.D., Stewart, S.I. (2018) Rapid growth of the U.S. Wildland Urban Interface raises wildfire risk. Proceedings of the National Academy of Sciences 115:3314-3319.
170

We thank the reviewer for this recommendation and will insert the reference. We also found the Guo et al. (2024) paper which also supports this claim. Additionally, we recommend also moving the Bowman et al. (2016) reference, as we believe it more closely supports the statement that climate change causes an increase to extreme wildfires. Further restructuring could also be

implemented to better frame the Ursino and Romano (2014) paper. The first paragraph of the Introduction would thus look as follows:

175 “In recent years, destructive wildfires have expanded far beyond the regions where they have traditionally occurred, becoming a global and escalating phenomenon linked to climate change (Abatzoglou et al., 2025; Bowman et al., 2017; Jones et al., 2022, 2024). At the same time, the rapid expansion of the wildland–urban interface (WUI), where human settlements are intermixed with natural vegetation, has increased the exposure of human settlements to wildfire risk (Guo et al., 2024; Radeloff et al., 2018). In addition, land-use change and the abandonment of agricultural and silvicultural practices contribute to fuel accumulation and increased wildfire activity in many regions (Ursino and Romano, 2014). The expansion of the WUI, combined with the worsening effects of climate change, render WUI wildfires even more potentially disastrous (Oliveira et al., 2020; Trnka et al., 2020). Wildfires in the WUIs can have a significant impact on both natural and human environments, and they pose unique challenges to traditional firefighting approaches due to their complexity and the interface between different land uses (Caballero and Beltrán, 2003).”

Lines 36-37: How many buildings were destroyed in these settlements? This is important for context.

More specific information was found from corresponding references and implemented as follows:

190 “Even temperate countries like those in Central Europe, which have historically been spared from destructive wildfires in the WUI (Heisig et al., 2022) have recently experienced wildfires with direct impacts on the built environment. In 2022, three houses burned down in Mezná, Czech Republic (Almeida et al., 2024) while in Falkenberg/Elster, Germany, a fire spread to built structures and burned part of a piglet-breeding facility; nearby single-family houses were also seriously threatened (Ministerium des Innern und für Kommunales des Landes Brandenburg, 2023)”.

195 Accordingly, line 97 will be changed to “...and destroyed three houses in the Czech village of Mezná.”

Line 76: "we aim to provide a quantification of the" is cumbersome. Perhaps replace with: "we aimed to quantify wildfire exposure for different settlements in the region"

We will change this as suggested.

200

Lines 79-81: This text is unnecessary and may be deleted.

We will delete this text as suggested.

205 *Lines 89-91: These two sentences can be combined and written more concisely, e.g., "The study area also includes several settlements that are not part of the conservation area of saxon switzerland but are surrounded by it (Figure 1)."*

We will change this as suggested.

Line 94: Good, but figure 1 shows many historical fire ignitions. Please describe the fire regime of the study area, i.e., how many fires per year, fire size characteristics, main ignition sources.

210 We agree that additional context on the local fire regime would improve the manuscript. We therefore suggest the following two changes to the manuscript.

First, to avoid confusion between historical ignitions in the study region and the expanded ignition dataset used for simulations (described later in Sect. 2.3.1), we revised Figure 1 to display only historical wildfire ignition locations. Accordingly, we removed the sentence “These can be seen in Figure 1” from lines 154-155.

215 Second, we propose adding a new paragraph in Sect. 2.1, starting right after line 93, describing the historical fire regime based on the available datasets:

“Based on the historical ignition datasets described in Sect. 2.3.1, wildfire occurrence in the study area is predominantly human-caused. For the German (Saxon) part, the most frequently reported ignition category is open fires by other persons (41.7%), followed by unknown or unclear causes (26.6% combined), while lightning accounts for 10% of cases. For the Czech
220 part, the dominant ignition categories are setting fires in the countryside/burning grass (44.2%) and smoking (37.4%), whereas lightning represents 3.1% of cases (other natural causes <2%). Based on the available records used in this study, the Czech dataset (2016–2020) includes 163 ignitions (32.6 per year), while the German dataset (2008–2020) includes 60 ignitions (~4.6 per year). Seasonality differs between the two sides of the border: in Saxony, ignitions are strongly concentrated in late spring and summer (April to August: 80% of cases; May to June alone: 50%), whereas in Czech Republic ignitions are more broadly
225 distributed across the year (April to August: 67.5%), with a secondary contribution in October and November (~16.6%). The available records do not include burned-area information; therefore, fire size statistics could not be derived”.

Line 99: If the ignition cause of the 2022 fire is known, it should be stated.

To address this, we suggest changing Line 96 to:

230 The fire caused by an arson started in the Czech National Park (Beetz, 2023).

Figure 1: The caption should mention the range of years for these ignitions.

The caption will be changed to:

235 *Figure 1: Study Area. The study area consists of two National Parks and two Conservation Areas at the border between the Czech Republic and Germany, and experienced a large wildfire in 2022. Historical ignitions for the period 2008 – 2020 are also shown.*

Line 125: Did the model account for the potential of spotting? In principle, FlamMap can do so but was it implemented in this study? This is important because spotting is a major driver of fire spread under extreme weather conditions.

240 Thank you for this important comment. In this study, spotting was not simulated in FlamMap. In FlamMap/MTT, spotting requires that passive or active crown fires are modelled; without crown fire, spot-fire ignitions are not produced. In our

modelling setup, crown fires were not modelled because the fire-modelling landscape lacked the required canopy layers (canopy height, canopy base height, and canopy bulk density).

We did consider incorporating these layers using the European-wide canopy/fuel dataset produced within the European Commission's FIRE-RES project (Kutchartt et al., 2024; Pirotti et al., 2023), which provides these canopy variables for our study area. However, these canopy data represent conditions around 2020, whereas the study area experienced substantial bark-beetle-related canopy degradation between 2020 and the 2022 wildfire. Without site-specific validation (e.g., field-based verification of canopy structure as in Heisig et al., 2022), using these canopy layers risked introducing uncontrolled bias in crown-fire (and hence spotting) occurrence. Given the scope of the study, we therefore did not include crown-fire/spotting and explicitly acknowledge this as a limitation on lines 542-543 of the Limitations. For better clarity, we recommend rephrasing this part to:

“As up-to-date data on canopy structure that is representative of bark-beetle-affected conditions were not available, crown fires and thus spotting were not modelled. Consequently, fire spread and intensity may be underestimated under extreme weather, especially where firebrand transport could enable rapid downwind growth or cross-barrier spread.”

255

Lines 142-144: Random ignitions are not the standard in informed fire simulations, so there's no need to write why they weren't used. In the real world, fire ignitions are never randomly distributed. It's sufficient to start by stating that historical fire ignitions were used, and these had a clear spatial pattern in the study area.

We will change this as suggested. Specifically, the part from line 140 will be changed to:

260

“To start fire spread simulations, ignition locations are needed. We here first describe the required input datasets, except for the fuel models, which are covered in the next section. For the ignition points we used historical fires, which reveal clear spatial patterns of fire occurrence and ignitions in the study area, mainly along the Elbe valley and forests north of the city of Děčín and along some common hiking trails and points of interests in both National Parks (Figure 1).”

265

Line 144: How many years does 'historical' reflect?

We will change this as suggested. Specifically, the corresponding parts from line 144 will be changed to:

“Historical forest fire ignition data (60 ignitions, spanning 2008-2020) for the German part of the study area were provided by the Saxon State Authority for Forestry (Staatsbetrieb Sachsenforst, 2023). ... Ignition locations from the Czech part (163 ignitions, spanning 2016-2020) were acquired ...”

270

Lines 152-155: Unclear. Are you balancing the total number of ignitions or ignition density (N/Area)? The former is only correct if both parts have the same area.

Thank you for pointing this out. We indeed intended to balance ignition density (N/km²), not the absolute number of ignitions, because the German and Czech parts differ in area. To clarify this, we suggest the following change for lines 152-155:

275 “To balance ignition density between the German and Czech parts of the study area (i.e., number of ignitions per km²), we used the lower density Czech side as the reference and randomly subsampled the German ignition locations so that the German ignition density matched the Czech one. The final number of ignition points was 363.”

Section 2.3.3: This is unrelated to the modeling stage and should be moved to the beginning of the exposure assessment section.

280 We thank the reviewer for this comment. While Section 2.3.3 is not directly related to the fire modelling stage, Section 2.3 was designed as a general “Datasets” section, covering all input data used in the study, including those for hazard modelling as well as exposure assessment and support capability indicators. For this reason, Section 2.3.3 was retained within this section. We nevertheless recommend changing its name to “Ancillary datasets” for clarity.

285 *Line 272: How many fires were modelled overall to facilitate the calculation of burn probability per simulation? Is this the number of ignitions? In general, are all ignitions occurring in any single model run or each model run is using one ignition point? Please clarify.*

Indeed, for each of the 27 scenario simulations (wind - duration - WBI), the FlamMap-MTT algorithm used the same fire list as input, containing 363 ignition locations (Sect. 2.3.1). In this setup, each ignition location initiates a separate single-ignition
290 fire, and burn probability was derived from the fraction of these simulated fires that burn each grid cell. To clarify this, we suggest adding the following text to line 272:

“In each of these simulations, burn probability was computed using the same fire list containing the 363 ignition locations (Sect. 2.3.1). The 363 ignition locations were treated as independent single-ignition fires in MTT, and burn probability represents the fraction of these fires that burned each cell in each simulation.”

295

Lines 343-344: Is the lack of fires crossing the river due to a missing spotting component in the model, or an outcome of the width of the river combined with prevailing wind directions?

As spotting was not considered in the model, this is the main reason why fires did not cross the river Elbe in the simulations. However also in reality, forest stands are separated by 200 to 400 m distance on both sides of the river and with ignitions being
300 mostly at the eastern bank with prevailing west winds, make fires at the western bank less likely.

“Finally, a consistent pattern across the scenarios is that wildfires rarely cross the Elbe River. While high BP values can be observed along both banks, they often do not extend across the river. This can be assumed to be an outcome of the prevailing western winds and ignitions at the eastern bank as well as the lack of a spotting component in the modelling”.

305 *Figure 3: it would be clearer if WBI numbers were replaced by names, i.e., Medium, High, and Very High.*

We will change this as suggested.

Lines 352-353: See my major comment above. This sentence belongs in the methods and not here (and if it repeats info from the methods, it can simply be deleted).

310 We will delete this sentence.

Lines 353-355: There's no need to describe the contents of a figure anywhere outside its caption.

We agree and recommend restructuring section 3.2, as follows:

315 “Following the methodology described in Sect. 2.6, we assessed wildfire exposure at the scale of the Home Ignition Zone (HIZ) for residential buildings and aggregated the results to the municipal level.”

[Figure 4 repositioned to here]

“The results reveal a clear pattern: municipalities on the Czech side of the border ...”

320

Lines 361-369: This paragraph belongs in the discussion section.

This paragraph will be moved to section 4.2.

325 *Figure 5. Perhaps mention in the main text the large variation around the median BP in the case of Sebnitz. Also, in the caption, mention the number of simulations from which the median and range were calculated.*

Thank you, this is a good point. We recommend the following in the main text, starting on line 365, to emphasize the higher within-municipality heterogeneity in exposure. “Moreover, the spread of BP values across HIZs is much larger for Sebnitz across all simulations than for the Czech municipalities, which is caused by the administrative structure of Sebnitz (many smaller villages of different sizes and different WUI structure belonging to the same municipality).”

330 For Figure 5, we suggest changing the caption to:

335 “Figure 5: The five municipalities of the study area with the highest median burn probabilities and flame lengths, based on their residential home ignition zones, for two scenarios: an extreme scenario (WBI = 5, duration = 3 days; shown in red) and a mild scenario (WBI = 3, duration = 1 day; shown in grey). Each scenario is based on three FlamMap-MTT runs (one per dominant wind direction) with 363 independent single-ignition fires per run (n = 1089 fires per scenario). Median values are indicated with points, and vertical lines show the 5th to 95th percentile range.”

Lines 404-429: This is all methods

This section can become the new methodology section 2.8 “Methodology for the evaluation of wildfire modelling”.

340 *Lines 440-445: This is all methods*

Lines 462-470: This is all methods

We suggest moving these two sections describing the methodology used for the evaluation questionnaires, to the Methodology. Along with the paragraph from lines 300-308, they would serve as the new section 2.7 “Interactive web map and questionnaire design”.

345

Technical corrections

Lines 71-81: This paragraph should be in past tense.

We agree with the reviewer that these lines should be written in the past tense, as they describe the completed objectives and activities of the study. We therefore suggest:

350

“The objective of this study was to assess wildfire exposure for the Bohemian-Saxon Switzerland trans-boundary WUI region in Central Europe, where ongoing changes in land use —such as declining forest management, increasing protection of natural processes, and increasing attractiveness for tourism— have been reinforced by the founding of two National Parks (NP Saxon Switzerland in Germany in 1990, NP Bohemian Switzerland in Czech Republic in 2000). Firstly, we aimed to produce an interactive wildfire exposure map that includes two support capability indicators, namely, the locations of fire stations and local transportation infrastructure. Secondly, we aimed to provide a quantification of the wildfire exposure for different settlements in the region. Thirdly, we performed a qualitative user study to assess the usability of the map by the general audience and usefulness by local stakeholders.”

355

360 *Line 91: "Mio" is Million?*

Yes, this will be replaced with “million” for clarity.

Lines 170-171: Append to the end of the previous paragraph (a paragraph cannot contain a single sentence).

We will change this as suggested.

365

Line 271: "ran FlamMap"

We will change this as suggested.

Line 338: hazard, not exposure. The outputs of FlamMap do not consider values at risk which are required to map exposure.

370

We will replace “exposure” with “hazard”.

Figure 3 caption: should be "wildfire hazard rasters"

We will replace “exposure” with “hazard”.

375 *Figure 4 caption: The caption is in the wrong order. It should start by explaining the general purpose of the figure, e.g., "Hazard values (BP, FL) for different municipalities based on their residential home ignition zone under the extreme weather scenario. The five municipalities with the highest BP and FL are highlighted in red."*

An alternative, clearer caption similar to the suggested one will be implemented.

380 *Line 491: replace exposure with hazard.*

We will replace “exposure” with “hazard”.

References

385 Abatzoglou, J. T., Kolden, C. A., Cullen, A. C., Sadegh, M., Williams, E. L., Turco, M., and Jones, M. W.: Climate change has increased the odds of extreme regional forest fire years globally, *Nat Commun*, 16, 6390, <https://doi.org/10.1038/s41467-025-61608-1>, 2025.

390 Almeida, M., Soviev, M., San-Miguel, J., Durrant, T., Oom, D., Branco, A., Ferrari, D., Boca, R., Maianti, P., De, R. D., Suarez-Moreno, M., Roglia, E., Scionti, N., Broglia, M., Alves, D., Matos, C., Ribeiro, L. M., Viegas, D. X., Ribeiro, C., Rodrigues, T., Chuvieco, E., Oliva, P., Garcia, M., Velea, R., Laterza, R., De, L. M., Lorenzoni, P., Arca, B., Salis, M., Bacciu, V., Del, G. L., Pelizzaro, G., Duce, P., Marrs, C., Forkel, M., Beetz, K., Koszczor, E., Podebradska, M., Politi, N., Sfetsos, A., Vlachogiannis, D., Eftychidis, G., Stavrakoudis, D., Varela, V., Gitas, I. Z., Sjostrom, J., Petrila, M., Lorent, A., Drobinikova, N., Vasilev, V., Tsvetkova, N., Yanko, B., Gospodinov, I., Zibtsev, S., Goldammer, J., Myroniuk, V., Sydorenko, S., Soshenskyi, O., Bogomolov, V., and Borsuk, O.: Report on the large wildfires of 2022 in Europe, Joint Research Centre, <https://doi.org/10.2760/19760>, 2024.

395 Beetz, K.: Forest fires in the Bohemian-Saxon Switzerland in 2022: Mapping and analysis of fuel types, fire dynamics and severity using remote sensing data [Unpublished master’s thesis], TU Dresden, 2023.

Beetz, K., Forkel, M., Marrs, C., Busse, A., Poděbradská, M., Kinalczyk, D., and Kranz, J.: Role of bark beetle disturbance and fuel types on fire radiative power and burn severity in the Bohemian-Saxon Switzerland - Data and Material. (Version 1.0), <https://doi.org/10.5281/zenodo.8159023>, 2024.

400 Bowman, D. M. J. S., Williamson, G. J., Abatzoglou, J. T., Kolden, C. A., Cochrane, M. A., and Smith, A. M. S.: Human exposure and sensitivity to globally extreme wildfire events, *Nat Ecol Evol*, 1, 0058, <https://doi.org/10.1038/s41559-016-0058>, 2017.

Caballero, D. and Beltrán, I.: Concepts and ideas of assessing settlement fire vulnerability in the W-UI zone, International Workshop Forest Fires in the Wildland-Urban Interface and Rural Areas in Europe Athens, Greece 15-16 May 2003, 2003.

405 Guo, Y., Wang, J., Ge, Y., and Zhou, C.: Global expansion of wildland-urban interface intensifies human exposure to wildfire risk in the 21st century, *Science Advances*, 10, eado9587, <https://doi.org/10.1126/sciadv.ado9587>, 2024.

Heisig, J., Olson, E., and Pebesma, E.: Predicting Wildfire Fuels and Hazard in a Central European Temperate Forest Using Active and Passive Remote Sensing, *Fire*, 5, 29, <https://doi.org/10.3390/fire5010029>, 2022.

- 410 Jones, M. W., Abatzoglou, J. T., Veraverbeke, S., Andela, N., Lasslop, G., Forkel, M., Smith, A. J. P., Burton, C., Betts, R. A., van der Werf, G. R., Sitch, S., Canadell, J. G., Santín, C., Kolden, C., Doerr, S. H., and Le Quéré, C.: Global and Regional Trends and Drivers of Fire Under Climate Change, *Reviews of Geophysics*, 60, e2020RG000726, <https://doi.org/10.1029/2020RG000726>, 2022.
- 415 Jones, M. W., Kelley, D. I., Burton, C. A., Di Giuseppe, F., Barbosa, M. L. F., Brambleby, E., Hartley, A. J., Lombardi, A., Mataveli, G., McNorton, J. R., Spuler, F. R., Wessel, J. B., Abatzoglou, J. T., Anderson, L. O., Andela, N., Archibald, S., Armenteras, D., Burke, E., Carmenta, R., Chuvieco, E., Clarke, H., Doerr, S. H., Fernandes, P. M., Giglio, L., Hamilton, D. S., Hantson, S., Harris, S., Jain, P., Kolden, C. A., Kurvits, T., Lampe, S., Meier, S., New, S., Parrington, M., Perron, M. M. G., Qu, Y., Ribeiro, N. S., Saharjo, B. H., San-Miguel-Ayanz, J., Shuman, J. K., Tanpipat, V., van der Werf, G. R., Veraverbeke, S., and Xanthopoulos, G.: State of Wildfires 2023–2024, *Earth System Science Data*, 16, 3601–3685, <https://doi.org/10.5194/essd-16-3601-2024>, 2024.
- 420 Kudláčková, L., Poděbradská, M., Bláhová, M., Cienciala, E., Beranová, J., McHugh, C., Finney, M., Novotný, J., Zahradníček, P., Štěpánek, P., Linda, R., Píkl, M., Věbrová, D., Možný, M., Surový, P., Žalud, Z., and Trnka, M.: Using FlamMap to assess wildfire behavior in Bohemian Switzerland National Park, *Nat Hazards*, 120, 3943–3977, <https://doi.org/10.1007/s11069-023-06361-8>, 2024.
- 425 Kutchartt, E., González-Olabarria, J. R., Aquilué, N., Garcia-Gonzalo, J., Trasobares, A., Botequim, B., Hauglin, M., Palaiologou, P., Vassilev, V., Cardil, A., Navarrete, M. A., Orazio, C., and Pirotti, F.: Pan-European fuel map server: An open-geodata portal for supporting fire risk assessment, *Geomatica*, 76, 100036, <https://doi.org/10.1016/j.geomat.2024.100036>, 2024.
- Ministerium des Innern und für Kommunales des Landes Brandenburg: Großwaldbrände im Land Brandenburg – Bericht zur Waldbrandsaison 2022, Landesschule und Technische Einrichtung für Brand- und Katastrophenschutz, Potsdam, 2023.
- 430 Oliveira, S., Gonçalves, A., Benali, A., Sá, A., Zêzere, J. L., and Pereira, J. M.: Assessing Risk and Prioritizing Safety Interventions in Human Settlements Affected by Large Wildfires, *Forests*, 11, 859, <https://doi.org/10.3390/f11080859>, 2020.
- Pirotti, F., Kutchartt, E., Gonzalez Olabarria, J. R., and Granja, L. M.: Fuel model input raster data EU, <https://doi.org/10.5281/zenodo.8420046>, 2023.
- 435 Radeloff, V. C., Helmers, D. P., Kramer, H. A., Mockrin, M. H., Alexandre, P. M., Bar-Massada, A., Butsic, V., Hawbaker, T. J., Martinuzzi, S., Syphard, A. D., and Stewart, S. I.: Rapid growth of the US wildland-urban interface raises wildfire risk, *Proceedings of the National Academy of Sciences*, 115, 3314–3319, <https://doi.org/10.1073/pnas.1718850115>, 2018.
- Staatsbetrieb Sachsenforst: <https://www.sbs.sachsen.de>, last access: 24 October 2023.
- 440 Trnka, M., Balek, J., Možný, M., Cienciala, E., Čermák, P., Semerádová, D., Jurecka, F., Hlavinka, P., Štěpánek, P., Farda, A., Skalák, P., Beranová, J., Chuchma, F., Zahradníček, P., Janouš, D., Žalud, Z., Dubrovsky, M., Kindlmann, P., Křenová, Z., Fischer, M., Hruška, J., and Brázdil, R.: Observed and expected changes in wildfire-conducive weather and fire events in peri-urban zones and key nature reserves of the Czech Republic, *Climate Research*, 82, 33–54, <https://doi.org/10.3354/cr01617>, 2020.
- Ursino, N. and Romano, N.: Wild forest fire regime following land abandonment in the Mediterranean region, *Geophysical Research Letters*, 41, 8359–8368, <https://doi.org/10.1002/2014GL061560>, 2014.