Dear authors, your work focused on the possibility of improving fire severity prediction through specific vegetation information and indexes in a wildfire-affected area in south-eastern Australia. The work is generally well written and I found it interesting.

Respond: We appreciate the reviewer's constructive comments on the manuscript to further improve the quality and the contribution of our work. Below are the authors' responses on all of the reviewer's questions and suggestions. The reviewer's comments are marked as **red**, while our responses are marked as **blue**.

In any case, different issues need to be considered in your revision:

- I have a first comment about the main focus on fire severity that characterizes your research: fire behavior (that is also described by fire severity), also depends on several other factors that jointly influence it over time. In particular, even if a brief discussion about it is presented in lines 355-363, I suggest better clarifying this issue, especially explaining the relevance of considering all these factors together in fire behavior analysis. For instance, no reference to the importance of the vertical structure of forested areas (DBH, Canopy Cover, CBH, CBD) in this kind of analysis is proposed in the manuscript. Please improve the respective section of the paper by looking at these suggestions.

  Respond: Thanks for the suggestions. We realize that vegetation structure can play an important role in fire behavior and it is a limitation of this study that did not include vegetation structure in the fire severity model. We consider this a future development based on some recent satellite data on vegetation height, which can extend the application of this model. We have added discussion in the revised paper regarding this point.

  From line 416 to 427 in the revised manuscript:

  "One limitation of this study is that it does not consider the vegetation vertical structure parameters in the fire severity model, which have been shown to influence fire behavior. Agee (1996) showed that manipulating forest structure can help to reduce the severity of fire events, e.g., by reducing the crown bulk density the high severity fire would be effectively limited. Fang et al. (2015) evaluated the influences and relative importance of fire weather, topography, and vegetation structure on fire size and fire severity, which showed fire weather was the dominant driving factor for fire size, while vegetation structure exerted stronger influences on fire severity. The study by Fernández-Guisuraga et al. (2021) indicated that severe ecosystem damage was mainly driven by vegetation structure rather than topography, for example high canopy density was the main driver of high burn severity. Detailed and accurate vegetation structure data require extensive field inventory and thus are mostly regionally restricted. With the development of Global Ecosystem Dynamics Investigation (GEDI) project, it is possible to derive reliable forest vertical structure parameters from satellite with relatively high spatial resolution and global coverage (Dubayah et al., 2020). An extension of this study should incorporate

data from GEDI into the fire severity model, which would represent an advancement in understanding and predicting the impact of wildfires."

Agee, James K. (1996). "The influence of forest structure on fire behavior." In Proceedings of the 17th annual forest vegetation management conference, pp. 52-68.

Fang, L., Yang, J., Zu, J., Li, G. and Zhang, J., (2015). Quantifying influences and relative importance of fire weather, topography, and vegetation on fire size and fire severity in a Chinese boreal forest landscape. Forest Ecology and Management, 356, pp.2-12.

Fernández-Guisuraga, J.M., Suárez-Seoane, S., García-Llamas, P. and Calvo, L., (2021). Vegetation structure parameters determine high burn severity likelihood in different ecosystem types: A case study in a burned Mediterranean landscape. Journal of environmental management, 288, p.112462.

Dubayah, R., Blair, J.B., Goetz, S., Fatoyinbo, L., Hansen, M., Healey, S., Hofton, M., Hurtt, G., Kellner, J., Luthcke, S. and Armston, J., 2020. The Global Ecosystem Dynamics Investigation: High-resolution laser ranging of the Earth's forests and topography. Science of remote sensing, 1, p.100002.

- Lines 114: here you mention the use of Sentinel 2 together with Landsat 8 data in obtaining pre-NBR. Why did you use both and how you considered the different resolutions of band products in your analysis is not clear or evidenced. Please clarify it by adding an explanation in the methodology section, specifying what satellite data you considered, when, and why also considering the post-processing procedure followed in L8 /S2 data-elaboration. In this regard, you should also improve the Discussion by focusing on other research based on satellite data processing and use in fire-behavior analysis.

Respond: To pre-process NBR data, we apply a cloud- and snow-masking algorithm to remove any snow, clouds, and their shadows from all Landsat imagery. Therefore, there will be many blank pixels with NaN value within the fire boundary. To fill the gaps, we adopt the pixel value from the Sentinel-2 image available in the same period. We have added the steps on how to obtain the dNBR image.

From line 112 to line 120 in the revised manuscript:

"The calculation of a dNBR-image is described as follows: (1) determine an individual fire from NPWS Fire History; (2) collect the most recent Landsat images based on the tags demarcating the start and end times of each individual fire; (3) apply a cloud- and snow-masking algorithm to remove snow, clouds, and their shadows from all imagery based on each sensor's pixel quality assessment band; (4) use the auxiliary satellite images (e.g., Sentinel-2) to fill the blank pixels in the cloud-free images from step (3) to obtain the pre and post NBR composites; (5) subtract pre- and post-NBR images to create a dNBR composite with the smallest possible cloud and shadow extent. The

dNBR typically ranges from -2 to +2, with high positive values indicating severe burn damage where the vegetation has been completely consumed. Values around zero suggest either unburned areas or areas where the fire had a very low impact. Negative values can indicate an increase in vegetation, which might be due to vegetation recovery over time or errors in the analysis."

- Line 168: why did you choose to consider *20* subsets of fire samples? Please justify this choice.

Respond: The reason we have 20 subsets of fire samples is that we derived the dNBR and the associated variables from the largest wildfire of each year from 2000 to 2019. In this way, we keep the balance between the sample size and the sample representative in the model.

From line 195 to line 197 in the revised manuscript:

"The fire samples from 2000 to 2019 are firstly divided into 20 subsets depending on the year the fire occurred, and this holdout method is repeated 20 times. Each subset represents the samples from the wildfire with the largest burn area in the corresponding year."

- Lines 41-54 should be moved to Discussion, where a comparison between your work and other research is needed looking at your paper outline and workflow.

Respond: Thanks for this suggestion. After discussing with the coauthors, we think we are doing the literature review in this paragraph. So we will keep these sentences in the introduction section.

- Please improve the final part of the Discussion citing the possibility to use also different data and tools (such as LiDAR or UAV-based multi-spectral data) in forest fire behavior analysis.

Respond: We have added a paragraph emphasizing the application of LiDAR and UAV in forest fire management in the revised paper.

From line 460 to line 465 in the revised manuscript:

"With the rapid development of new technologies such as LiDAR and Unmanned Aerial Vehicle (UAV), integration of data from these platforms can represent a promising avenue to enhance our understanding and management of wildfires. LiDAR technology, with its capability to produce high-resolution vegetation structural and topography information could facilitate the accurate modelling of fire severity (Hudak

et al., 2012; Hébert et al., 2017). On the other hand, the agility and precision of UAVs in data collection enable real-time monitoring of fire spreading, which significantly enhances our ability to map burn areas in real-time (Véga et al., 2018; Zheng et al., 2019). “

Hudak, A. T., Strand, E. K., Vierling, L. A., Byrne, J. C., Eitel, J. U., & Martinuzzi, S. 2012. Quantifying aboveground forest carbon pools and fluxes from repeat LiDAR surveys. Remote Sensing of Environment, 123, 25-40.

Hébert, F., & Mallet, C. 2017. Forest fire severity assessment using LiDAR in a Mediterranean environment. Remote Sensing, 9(9), 908.

Véga, C., Martín, M. P., López, F. J., García, A. M., & Pérez, J. A. (2018). Fire spread and vegetation monitoring by using a UAV system. Drones, 2(4), 31.

Zheng, D., Jiang, Y., & Cheng, T. (2019). UAV-based remote sensing technology in the rapid monitoring of forest fires. International Journal of Remote Sensing, 40(11), 4257-4275.

- There are no clear pieces of evidence about future challenges starting from your research. Please enrich the Conclusion in this regard.

Respond: We have added sentences addressing the future challenges of the study.

From line 487 to line 489 in the revised manuscript:

“Future challenges of this study include incorporating different variables, such as refined topography as well as weather and vegetation structure, from various data source to improve the accuracy of fire severity prediction, and scaling up the application of the developed model globally.”

Other minor comments are reported below:

- line 17: what did you mean by "fire weather"? please clarify

Respond: The fire weather means the weather condition during the fire season, like wind speed, air temperature, humidity. We have clarified it in the revised paper.

In line 17 in the revised manuscript:

“which is further used to predict fire severity using antecedent drought conditions, fire weather (i.e., wind speed, air temperature and atmospheric humidity), and topography of the fire season (November to March).”

- line 17: "topography *during* the fire season". Specify the duration of the fire season and add a reference (what months were considered as fire season?)

Respond: Fire season in Australia refers to the period of the year when wildfires, also known as bushfires in Australia. The fire season in the southern parts of the country, including regions such as New South Wales, Victoria, South Australia, and Tasmania, generally peaks during the warmer months, from late spring through to early autumn (approximately November to March). This is when the vegetation has dried out, and hot, dry, and often windy conditions prevail, making it easier for fires to start and spread rapidly.

From line 59 to line 62 in the revised manuscript:

"One such region is the southeast coast of Australia which is subject to annual fire seasons (from November to March, Collins et al., 2022) vary in extent and severity and has a high richness of endemic plant species adapted to particular fire regimes (Gallagher et al., 2021)."

Collins, L., Clarke, H., Clarke, M.F., McColl Gausden, S.C., Nolan, R.H., Penman, T. and Bradstock, R., 2022. Warmer and drier conditions have increased the potential for large and severe fire seasons across south-eastern Australia. Global Ecology and Biogeography, 31(10), pp.1933-1948.

Gallagher, R. V., Allen, S., Mackenzie, B. D., Yates, C. J., Gosper, C. R., Keith, D. A., ... & Auld, T. D. (2021). High fire frequency and the impact of the 2019–2020 megafires on Australian plant diversity. Diversity and Distributions, 27(7), 1166-1179.

- line 22: "forecasting /forecast" repetition. Please change one term

Respond: We use forecast throughout the paper.

- line 40: add a reference

Respond: A reference has been added for dNBR

Keeley, J.E., 2009. Fire intensity, fire severity and burn severity: a brief review and suggested usage. International journal of wildland fire, 18(1), pp.116-126.

- Figure 1: increase the size of the legend. Is also not clear if colors are only related to the years or also depends on fire extension (since polygons in the figure are different colored but have also different size). Please specify

Respond: We have redesigned the figure to make it clearer.

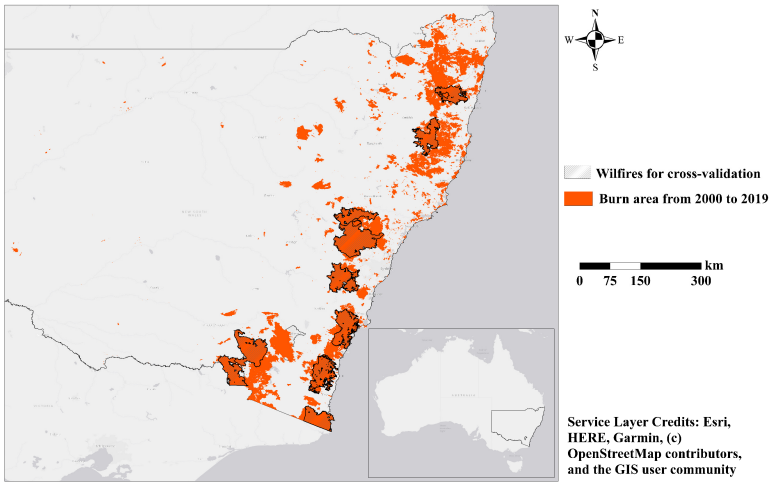


Figure 1. Locations of study wildfires over New South Wales (NSW), Australia. The burn area is from NSW National Parks and Wildlife Service (NPWS) Fire History – Wildfire and Prescribed Burns dataset.

- line 95, eq.1: add a reference about dNBR equation

Respond: A reference has been added.

Keeley, J.E., 2009. Fire intensity, fire severity and burn severity: a brief review and suggested usage. International journal of wildland fire, 18(1), pp.116-126.

- line 119: is there a repetition of "DEM"? Please clarify since is not clear

Respond: We apologize for the mistake, we have removed the repetition of DEM.

- line 124: "wildfire environment": what did you mean with "environment"? Please clarify and rephrase the sentence

Respond: We apologize for the confusion, we have rewritten this sentence.

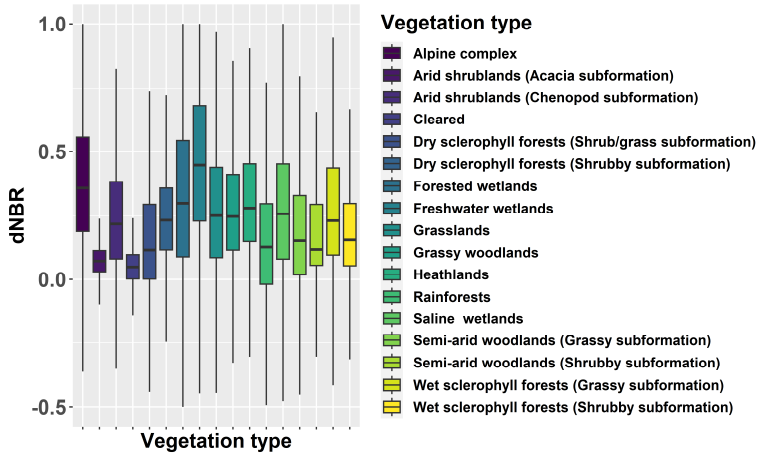
"In addition to fuels and terrain, weather is another important factor in wildfires."

- lines 206-213 and line 221: change "figure 2" with "figure 3"

Respond: We have revised it accordingly.

- Figure 3: increase the size of legends

Respond: We have revised it accordingly.



- line 223: add space "were_collected"

Respond: We have revised it accordingly.

- line 231: "Note that" seems quite colloquial, why not change it with something like "is important to consider that" or similar?

Respond: Thanks for the suggestion. We have changed this sentence to

"It is important to be aware that the classification step is merely used to improve the consecutive regression accuracy, rather than the final severity categorization result"

- lines 227-231: is not clear how the different percentages were adopted

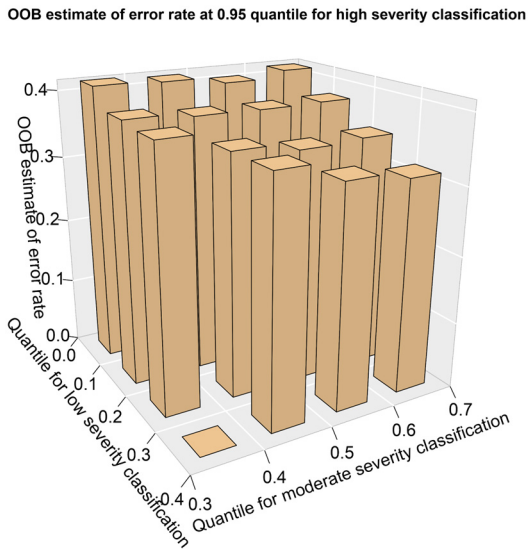
Respond: We have clarified this in the method section.

From line 162 to line 167 in the revised manuscript:

"The dNBR of all burnt pixels for each vegetation type are collected and a set of dNBR values at the quantiles varying from 5% to 35% representing the threshold for low severity classification, quantiles varying from 35% to 65% representing the threshold for moderate severity classification, and quantiles varying from 65% to 95% representing the threshold for high severity classification. For example, a classified burn severity sample can be obtained using the thresholds for high, moderate, and low severity at 85% quantile, 55% quantile and 25% quantile, respectively."

- Figure 4: legends and descriptions are too small

Respond: We have increased the size accordingly.



211

212 • Figure 5: as Figure 4

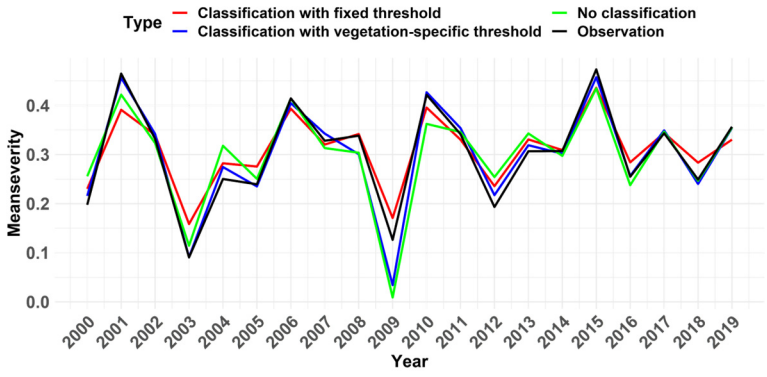
213 Respond: We have revised it accordingly.

214 • Figure 6: remove the term "The" in the caption

215 Respond: We have revised it accordingly.

216 • Figure 9: legends and items are too small

217 Respond: We have increased the size accordingly.



218

219 • lines 338-339: repetition of "method", please rephrase

220 Respond: We have removed the repetition word.

221 • line 366: "mis-classification" or "misclassification"?

Respond: It should be “misclassification”

- line 370: add space: "the_2002"

Respond: We have revised it accordingly.

Good work and best regards