The study developed a global 30-m resolution forest burn severity database. Unlike most previous studies that focused on fire occurrence, this data is about the severity of fire disturbance, which is evaluated by the amounts of biomass that were consumed by fire. Although the method is quite simple and not very innovative, it is an impressive work to produce 30 m resolution data products at the global scale between 2003 and 2016. That's why I think the data is valuable. However, some problems also exist.

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**.

Major comments:

1) Can you compare your product with the Canadian Landsat Burn Severity (CanLaBS) product which is also produced using 30 m resolution Landsat images? Does your method have any advantage over CanLaBS product?

Respond: In the revised manuscript, we compared the fire severities of GFBS and MOSEV with the CanLaBS dataset for forest fires over Canada from 2003 to 2015. The results show that GFBS agreed well in representing the distribution of forest fire severity to those of CanLaBS over Canada, which represent a better agreement than the MOSEV dataset. In terms of the main advantages, both GFBS and CanLaBS are based on Landsat and the methods for deriving burn severity, e.g., dNBR, are similar, but GFBS dataset is global. As shown in Section 3, GFBS provides reasonable burn severity estimations not only in Canada, but also in fire prone areas globally, such as over CONUS and Australia, as validated in this study.

From line 190 to line 194 in the revised manuscript:

"In addition to validation against in-situ data., we also compared the fire severity magnitudes of GFBS with the CanLaBS dataset available over Canada. CanLaBS provides burn severity information for burned areas identified from the Canada Landsat Disturbance product at the level of individual 30m resolution pixels. The dataset was derived from Landsat imagery and uses values of pre-fire to post-fire differences in dNBRs for nearly 60 million hectares of burned areas across Canada's forests from 1985 to 2015. [Guindon et al., 2017; Guindon et al., 2018]."

References:

Guindon, L., P. Villemaire, R. St-Amant, P.Y. Bernier, A. Beaudoin, F. Caron, M.

Bonucelli and H. Dorion.: Canada Landsat Disturbance (CanLaD): a Canada-wide Landsat-based 30-m resolution product of fire and harvest detection and attribution since 1984. https://doi.org/10.23687/add1346b-f632-4eb9-a83d-a662b38655ad, 2017.

Guindon, L.; Bernier, P.Y.; Gauthier, S.; Stinson, G.; Villemaire, P.; Beaudoin, A.: Missing forest cover gains in boreal forests explained. Ecosphere, 9 (1), e02094. https://doi.org/10.1002/ecs2.2094, 2018.

From line 233 to line 259 in the revised manuscript:

3.2 Comparison between GFBS and CanLaBS over Canada

"In this section we describe the comparison of the fire severity maps of GFBS and MOSEV datasets to the ones from the CanLaBS dataset over Canada for an overlapped period from 2003 to 2015. Figure 6 shows the number and the trend of forest fires over Canada from 2003 to 2015, by CanLaBS data and GFBS products, while the vertical bar represents the number of forest fires recorded by both CanLaBS and GFBS each year. Due to the different sources and algorithms to map the burn area, the number of forest fires depicted by CanLaBS is larger than those by GFBS each year. Nevertheless, it is noted that GFBS agrees with CanLaBS in terms of the variations of forest fire activities, such as the intense forest fires in 2004 and 2015 and the relatively low number of forest fires in 2007 and 2008."

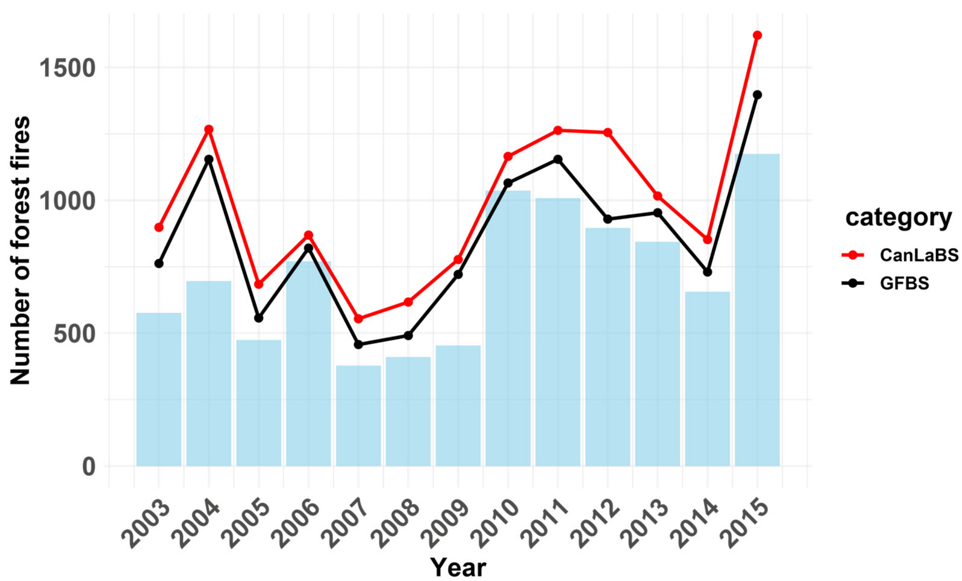
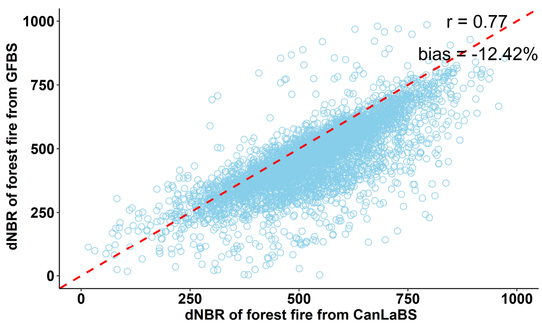
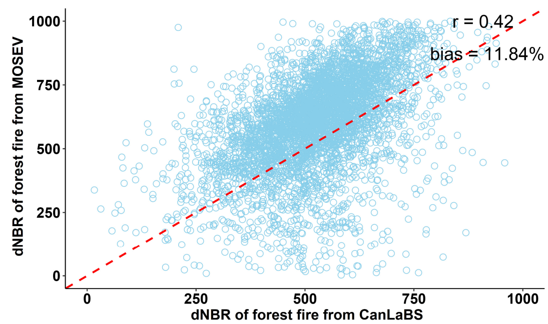


Figure 6. Number of forest fires by CanLaBS and GFBS dataset. Vertical bars show the number of overlapping forest fires.

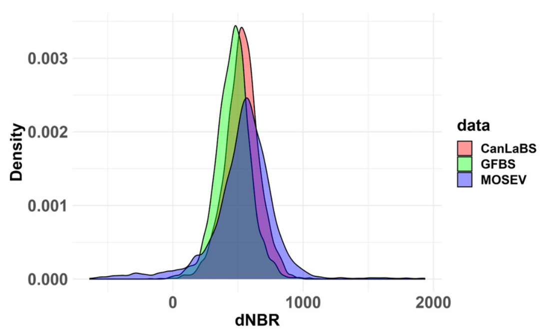
"Figure 7 illustrate the scatterplots of dNBR of forest fires from CanLaBS against those from GFBS (panel a) and MOSEV (panel b), for the period 2003 to 2015. Consistent to the results shown in Figure 6, dNBR from GFBS shows strong correlation with the dNBR from CanLaBS with r being 0.77 and a slightly underestimation of the overall dNBR for forest fires (bias = -12.42%). On the other hand, dNBR from MOSEV exhibited low correlation with the dNBR from CanLaBS (r = 0.42) and slight overestimation (bias = 11.84 %). Figure 7 (c) displays the probability density function (PDF) plots of CanLaBS dNBR, GFBS dNBR and MOSEV dNBR. It is noted the close PDFs of GFBS dNBR and CanLaBS dNBR, though the mode of GFBS distribution is at slightly lower dNBR value relative to the CanLaBS distribution. On the other hand, the distribution of MOSEV dNBR significantly deviates from CanLaBS dNBR, having a lower peak and larger tails."



(a)



(b)



(c)

Figure 7. Scatterplots of dNBR from CanLaBS against those from (a) GFBS and (b) MOSEV; (c) density plot of dNBR from CanLaBS, GFBS and MOSEV, for forest fires from 2003 to 2015 over Canada.

"Figure 8 presents the boxplots of distributions of dNBR from CanLaBS, GFBS and MOSEV separate by year. Consistent to the previous results, GFBS compares well with CanLaBS in terms of the dNBR distribution of annual forest fires and as well as the variations of dNBR over time, even though it provides slightly lower dNBR values compared to CanLaBS. On the other hand, MOSEV compared poorly with CanLaBS annual dNBR distributions, exhibiting overall larger dNBR values and larger anomalies over time."

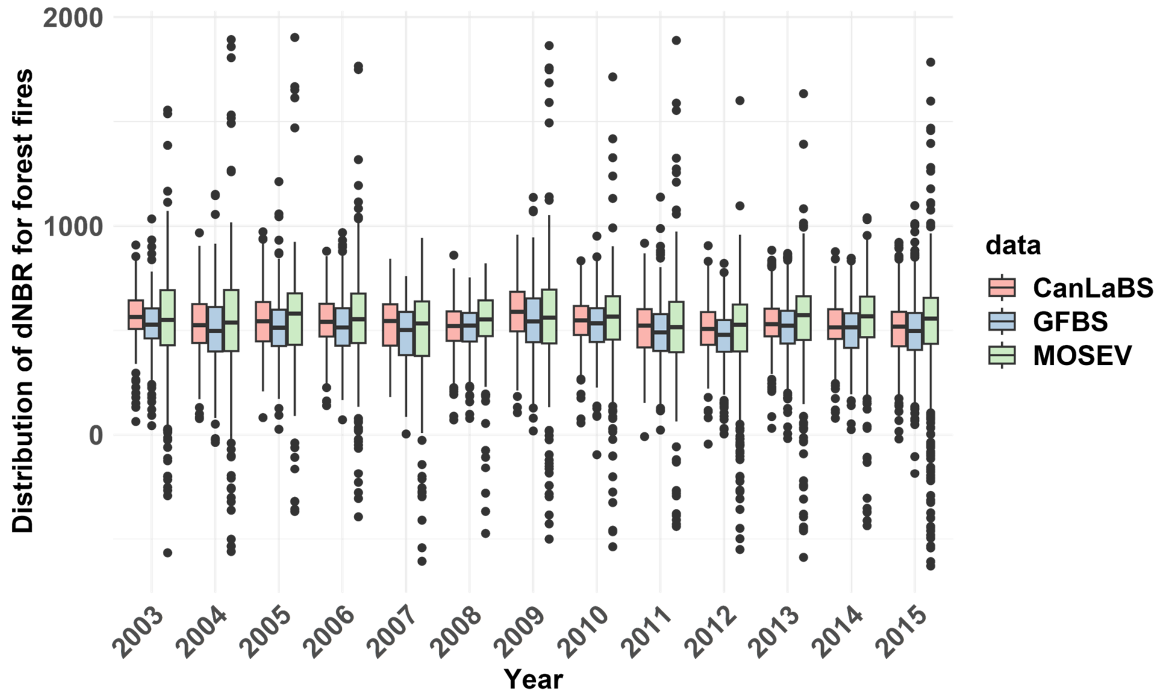


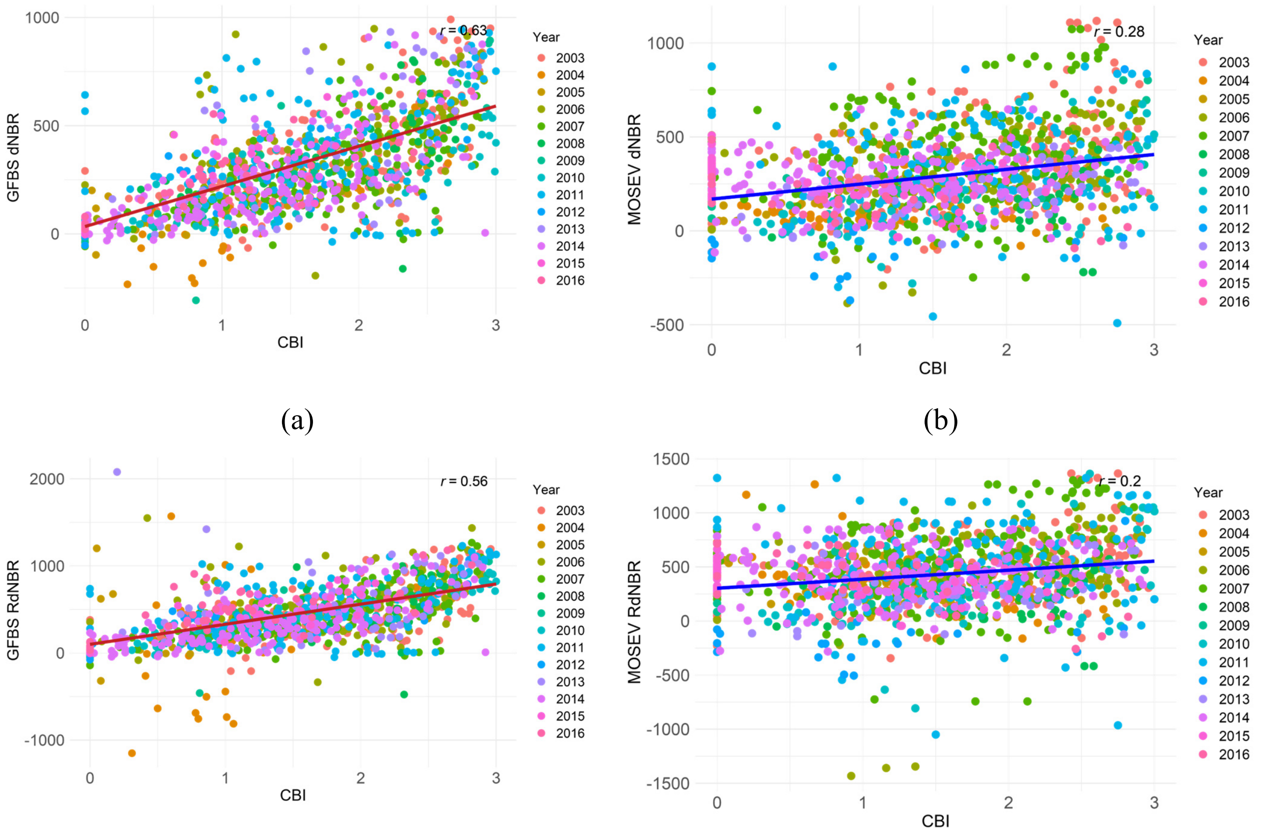
Figure 8. Boxplots of annual distributions of dNBR values from CanLaBS, GFBS and MOSEV for forest fires over Canada from 2003 to 2015.

2) Fig. 5 & Fig. 7: I think the number of data points in these figures is far from enough for you to conclude that your product is better than MOSEV. For example, in subfigure (b), there is only one low CBI value and one high CBI value. More data is needed for validation. Or, you can try other data sources such as statistical data to validate your data.

Respond: The scatterplots in Figure 5 (Figure 13 in the revised manuscript) and Figure 7 (Figure 15 in the revised manuscript) in the original manuscript show the validations of CBI against dNBR and RdNBR for some specific events, indicating GFBS correlated better with CBI than MOSEV and thus provided more reasonable burn severity estimates for these fire events. Figure 16 in the revised paper displays the validation results of CBI against dNBR and RdNBR from GFBS and MOSEV involving all CBIs over CONUS (around 1315). The results also show that GFBS has stronger correlations with CBI than MOSEV.

From line 386 to line 390 in the revised manuscript:

"Figure 16 (a) and (b) shows the scatterplots of CBI against dNBR from GFBS and MOSEV, respectively, for all forest fires from 2003 to 2016 over CONUS. Involving all ground validations, we found GFBS dNBR shows a stronger correlation with CBI (r = 0.63) than MOSEV dNBR (r = 0.28). Using RdNBR as the burn severity, Figure 16 (c) and (d) show that GFBS RdNBR (r=0.56) outperformed MOSEV RdNBR (r=0.20)."



(a) (b) (c) (d)

Figure 16. Scatterplots of CBI against (a) dNBR from GFBS, (b) dNBR from MOSEV, (c) RdNBR from GFBS, and (d) RdNBR from MOSEV for forest fires from 2003 to 2016 over CONUS.

Besides, in the revised manuscript, we compared the performances of GFBS and MOSEV over southeastern Australia using 112 field assessed burn severity category for the wildfires in 2013. We demonstrated that GFBS could provide burn severity estimation with clearer separation between high-severity class and moderate/low severity class, while such differences are blurred in MOSEV. This was mainly due to the finer spatial resolution of GFBS.

From 157 to line 160 in the revised manuscript:

"To validate the GFBS database, we used the 112 ground-verified burn severity category data following the Fire Extent and Severity Mapping (FESM) scheme for the 2013 wildfires over southeastern Australia. The FESM severity classes include unburnt, low severity (burnt understory, unburnt canopy), moderate severity (partial canopy scorch), high severity (complete canopy scorch, partial canopy consumption), and extreme severity (full canopy consumption)."

From 173 to line 178 in the revised manuscript:

"Figure 2 (a) shows the locations of the 112 ground-verified burn severity sites for the 2013 wildfires over southeastern Australia. Figure 2 (b) shows the locations of CBI observations over CONUS for the period from 2003 to 2016. Of the 1,315 ground-surveyed CBI reports for forest fires during that time, most came from western states, such as Arizona, Colorado, and Oregon, where forest fires are more frequent and severe. Fewer CBI records are available in eastern states, such as Florida and Georgia."

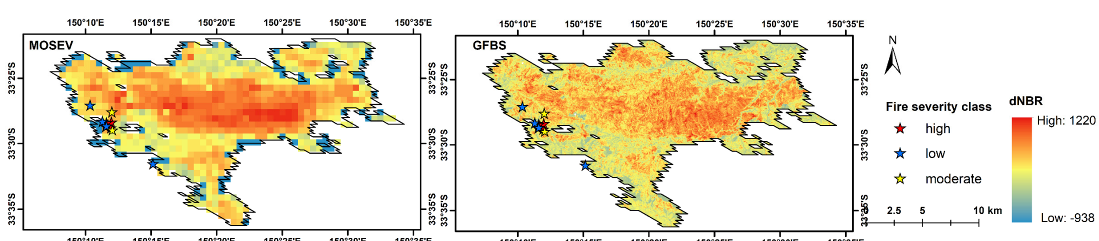
(a) (b)

Figure 2. Locations of (a) ground verification burn severity sites over southeastern Australia and (b) forest fire CBIs over CONUS.

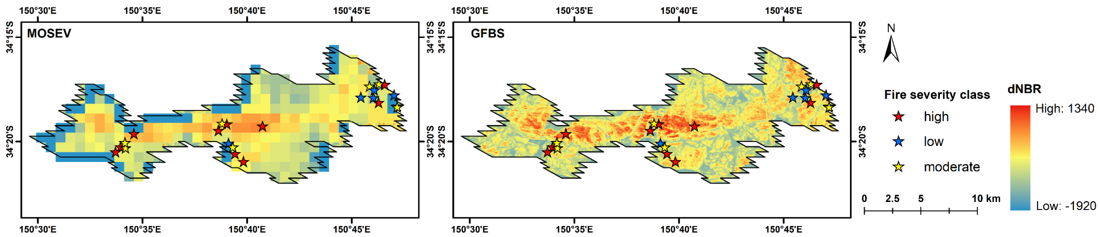
From 260 to line 302 in the revised manuscript:

3.3. Validation against in situ fire severity category over southeastern Australia

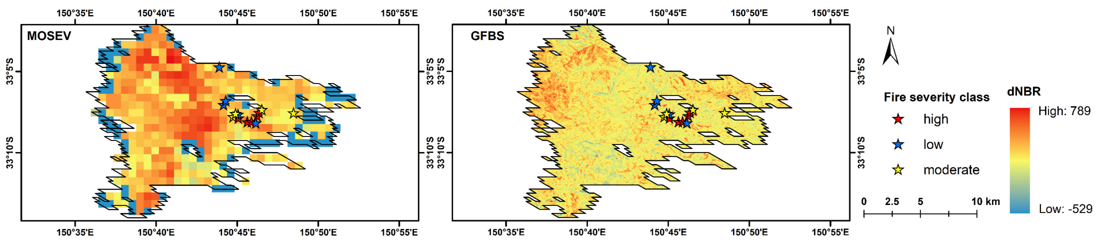
"Using as the ground truth the in-situ burn severity categorizations from the 2013 wildfires over southeastern Australia, we evaluate the performance of GFBS and MOSEV datasets. Figure 9 (a), (b) and (c) display the spatial patterns of GFBS dNBR and MOSEV dNBR for wildfires that happened on October 15 2023, October 17 2023 and October 21 2023, respectively, in southeastern Australia, where relatively dense in situ burn severity categorization data are available. It is noted that GFBS dNBR shows similar spatial patterns to the MOSEV dNBR in the events on October 15 2023 and October 17 2023, both showing significant fire centers where high dNBR are found. For the October 21 2023 event, however, the dNBR map from MOSEV shows a larger high burn severity area than GFBS."



(a)



(b)



(c)

Figure 9. Spatial patterns of dNBR for wildfires on (a) October 15 2023, (b) October 17 2023 and (c) October 21 2023, in southeastern Australia, derived from the GFBS and MOSEV datasets.

"The boxplots in Figure 10 (a), (b) and (c) display the corresponding distributions of dNBR from GFBS and MOSEV at different observed severity classes in the events on October 15 2023, October 17 2023 and October 21 2023, respectively. The severity classes, e.g. low, moderate and high, are categorized from the field assessed sites in the corresponding fire events. For the event on October 15 2023, dNBR from GFBS shows significant difference between the moderate/high and low severity class, and no difference between high and moderate severity class. The dNBR from MOSEV, however, presents lower dNBR at high severity class than those at moderate and low severity class. For the event on October 17 2023, both GFBS and MOSEV show significant discrepancies on dNBR between high and moderate/low severity class. For the event on October 21 2023, GFBS could clearly differentiate among high, moderate and low severity classes in terms of dNBR values, while MOSEV presents the lowest dNBR values at the moderate severity class, while exhibits small differences in dNBR values between the low and high severity classes. Figure 10 (d) shows the overall performances of dNBR from GFBS and MOSEV for the different severity classes, combining all 112 ground verification sites. More significant differences are shown in the GFBS dNBR boxplots between high, moderate and low severity classes than those from MOSEV, indicating a better skill of GFBS to distinguish between forest fires of different severity levels."

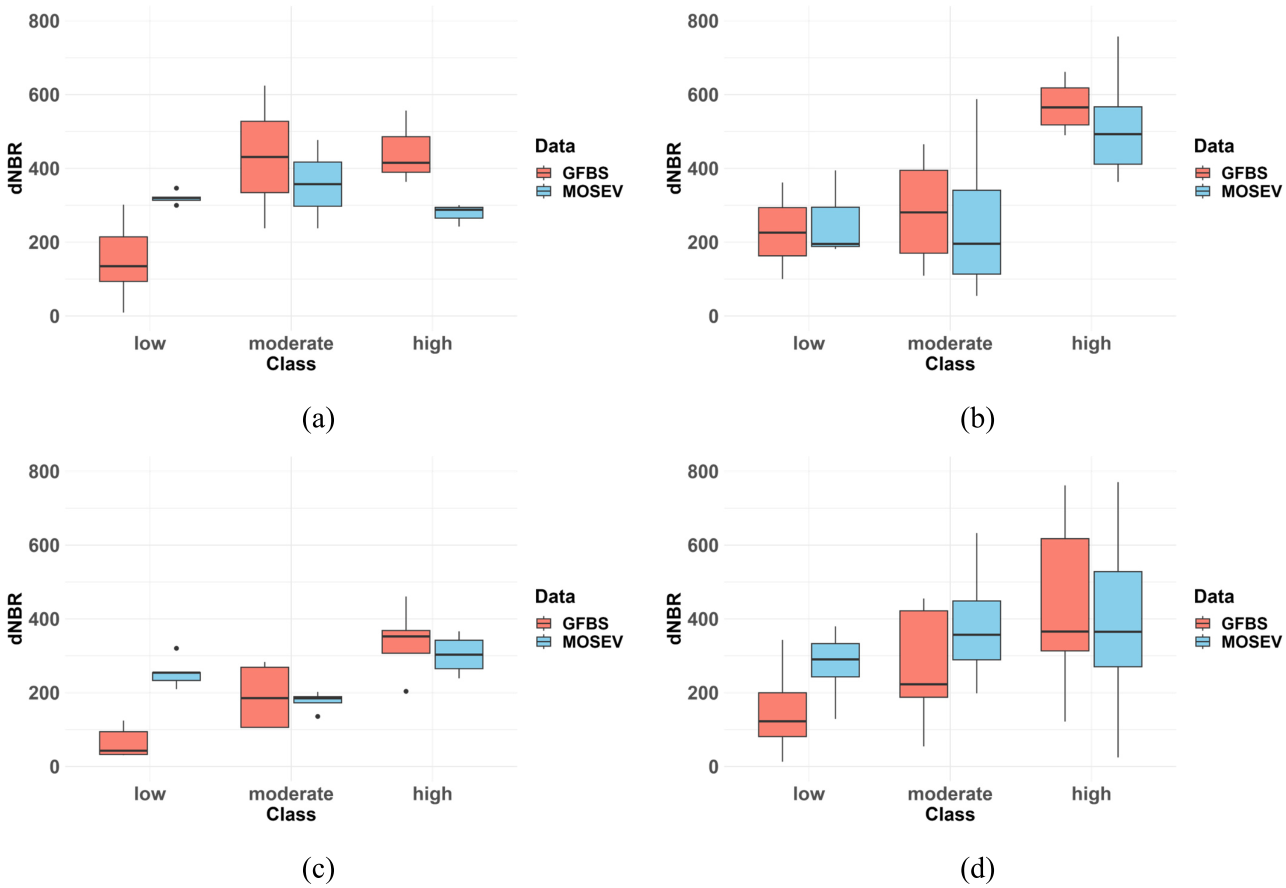
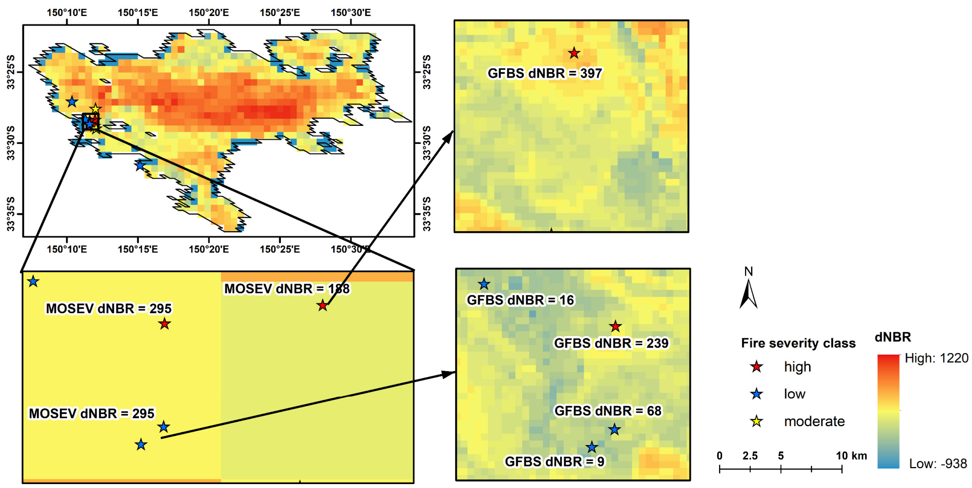


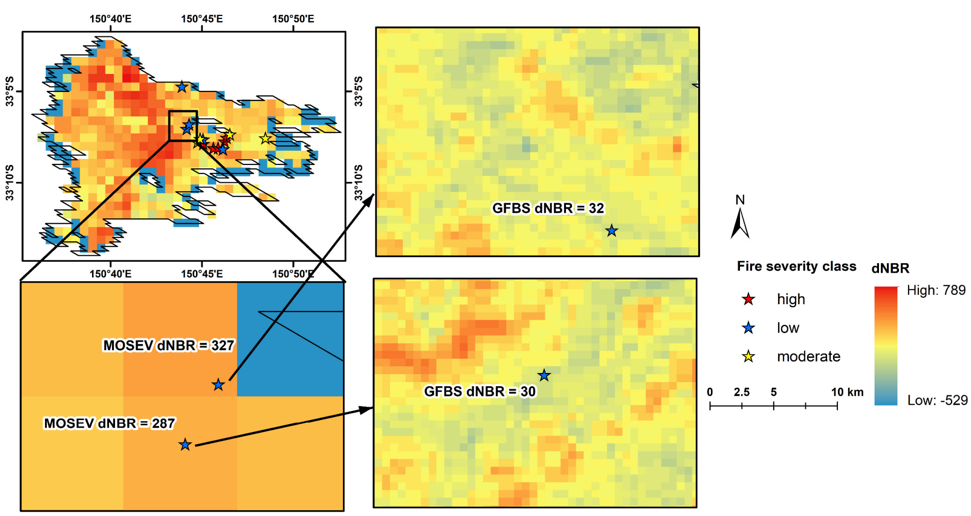
Figure 10. Boxplots of distributions of dNBR at different burn severity classes from the in situ data for (a) event on October 15 2023; (b) event on October 17 2023; (c) event on October 21 2023; and (d) combining all events with in situ data.

"As mentioned above, MOSEV gave relatively small dNBR values in the event on October 15 2023, where burn severity is classified from in situ measurement as high. Figure 11 (a) displays the location of the ground verification sites with the corresponding burn severity class and associated dNBR values from MOSEV and GFBS. It is noted that within one MOSEV grid cell (500 meter) four ground verification sites are located. The dNBR value from MOSEV is 295 for all four sites, while three of the sites are classified as low and only one site is classified as high severity. On the other hand, at GFBS resolution (30 meter), we can note significant spatial variation in dNBR, with GFBS dNBR being 239 for the site classified as high and 9, 16 and 68 for the sites classified as low severity. In a surrounding MOSEV pixel we note a site classified as high severity, but dNBR from MOSEV is 188 while dNBR from GFBS is 397. In the event on October 21 2023, we found that MOSEV gave relatively high dNBR values at ground verification sites that are classified as low severity. Figure 11 (b) shows the locations of ground verification sites with corresponding classified burn severity and associated dNBR values from MOSEV and GFBS. In the two adjacent MOSEV grids, the dNBR values from MOSEV are 287 and 327 respectively where both sites are classified as low severity. At

GFBS resolution more significant changes between high and low dNBR are found within the same MOSEV grid, resulting in dNBR values of 30 and 32 for the ground verification sites classified as low severity. The results demonstrate the significance of GFBS high resolution data in representing the small-scale variations of dNBR and providing more granular and reliable dNBR estimations.”



(a)



(b)

Figure 11. The location of ground verification sites with burn severity classes overlaid by dNBR values from GFBS and MOSEV for the fire event of (a) October 15 2023 and (b) October 21 2023.

3) In the discussion part, we suggest you to discuss on whether the incorporation of L-band SAR data (e.g., LSAR-2 ScanSAR Level 2.2 product) can facilitate the retrieval

of forest biomass before and after the fire.

Respond: Thanks for this suggestion. We have added the sentences in the discussion section addressing the use of SAR in burn severity mapping.

From line 474 to line 483 in the revised manuscript:

"With the development of radar-based techniques, Synthetic Aperture Radar (SAR) polarimetric images have been proven to be effective in burn severity mapping, owing to the strong correlation between SAR backscatter and burn severity [Czuchlewski and Weissel, 2005; Tanase et al., 2010; Tanase et al., 2011; Addisonand Oommen, 2018]. With the unique properties of L-band SAR, it is suitable for assessing and monitoring post-fire effects and burn severity [Tanase e al., 2010; Peacock et al., 2023]. For example, the frequency of L-band (1.26 GHz) allows it to penetrate through smoke, ash, and, to some extent, vegetation canopy. This capability makes L-band SAR particularly useful for assessing areas immediately after a fire, even in the presence of smoke or cloud cover that would obstruct optical sensors. The incorporation of L-band Synthetic Aperture Radar (SAR) data, such as the ALOS-2 PALSAR-2 ScanSAR Level 2.2 data (https://www.eorc.jaxa.jp/ALOS/en/alos-2/a2_about_e.htm) and and the incoming NASA-ISRO Synthetic Aperture Radar (NISAR,https://nisar.jpl.nasa.gov/), can also facilitate the retrieval of burn severity."

References:

Czuchlewski, K.R. and Weissel, J.K., Synthetic Aperture Radar (SAR)-based mapping of wildfire burn severity and recovery. In Proceedings. 2005 IEEE International Geoscience and Remote Sensing Symposium, 2005. IGARSS'05. (Vol. 1, pp. 4-pp). IEEE. 10.1109/IGARSS.2005.1526102, July 2005.

Tanase, M.A., Santoro, M., De La Riva, J., Fernando, P. and Le Toan, T. Sensitivity of X-, C-, and L-band SAR backscatter to burn severity in Mediterranean pine forests. IEEE Transactions on Geoscience and Remote Sensing, 48(10), pp.3663-3675. 10.1109/IGARSS52108.2023.10281609, 2010.

Tanase, M., de la Riva, J., Santoro, M., Pérez-Cabello, F. and Kasischke, E., 2011. Sensitivity of SAR data to post-fire forest regrowth in Mediterranean and boreal forests. Remote Sensing of Environment, 115(8), pp.2075-2085.

Tanase, M., de la Riva, J., Santoro, M., Pérez-Cabello, F. and Kasischke, E. Sensitivity of SAR data to post-fire forest regrowth in Mediterranean and boreal forests. Remote Sensing of Environment, 115(8), pp.2075-2085, https://doi.org/10.1016/j.rse.2011.04.009, 2011

Addison, P. and Oommen, T. Utilizing satellite radar remote sensing for burn severity estimation. International journal of applied earth observation and geoinformation, 73, pp.292-299, https://doi.org/10.1016/j.jag.2018.07.002, 2018

Addison, P. and Oommen, T., 2018. Utilizing satellite radar remote sensing for burn severity estimation. International journal of applied earth observation and geoinformation, 73, pp.292-299.

Peacock, A., Pinto, N. and Lou, Y.Burn Severity Mapping with L-band UAVSAR Observations Over Los Angeles' Largest Wildfire. In IGARSS 2023-2023 IEEE International Geoscience and Remote Sensing Symposium (pp. 3375-3378),10.1109/IGARSS52108.2023.10281609, July 2023.

Tanase, M., Santoro, M., de la Riva, J., Kasischke, E. and Korets, M.A. December. L-band SAR backscatter prospects for burn severity estimation in boreal forests. In Proc. ESA Living Planet Symp. December 2010.

4) Will the difference between band settings in Landsat-8 and Landsat5-7 induce temporal discontinuity in the burn severity product? Have you checked whether this product is suitable for long-term temporal analysis (e.g., the trend of burn severity). It's quite important information for users of this product.

Respond: This is a good point. The NBR composites use reflectance information from both Lansat 5,7 and 8 with different acquisition times, we presented the progress of how to process the NBR composites and compared the NBR obtained from Landsat 7, 8 with different acquisition times. The results demonstrate that the NBR composite has high spatial and temporal consistency with the NBR images closest to the start and end time of the fire event, despite different band settings used from Landsat 5, 7 and 8. Some studies have also shown that the differences are small when using reflectance values from sensors aboard the Landsat 5, 7, and 8 satellites to calculate burn severity.

From line 214 to line 232 in the revised paper:

"Figure 4 shows the data process for a single post-NBR Landsat composite for the fire event that ended on 17 September 2015 in north Washington. The first prior image for NBR calculation was on 20 September 2015 from Landsat 8 (as image 1). The cloud and shadows are removed in image 1 after applying the cloud/shadow mask. The next available image on 21 September 2015 from Landsat 7 (as image 2) was then used to fill those gaps in image 1 and obtain a new Landsat composite (phase 1). The third available image on 29 September 2015 from Landsat 8 (as image 3), image on 15 October 2015 if needed, was adopted sequentially to fill the un-scanned gap pixels in phase 1 and generate the final post NBR image for this event. The process for pre-NBR image calculation is the same but in a reversed time-order from the start time of the fire event."

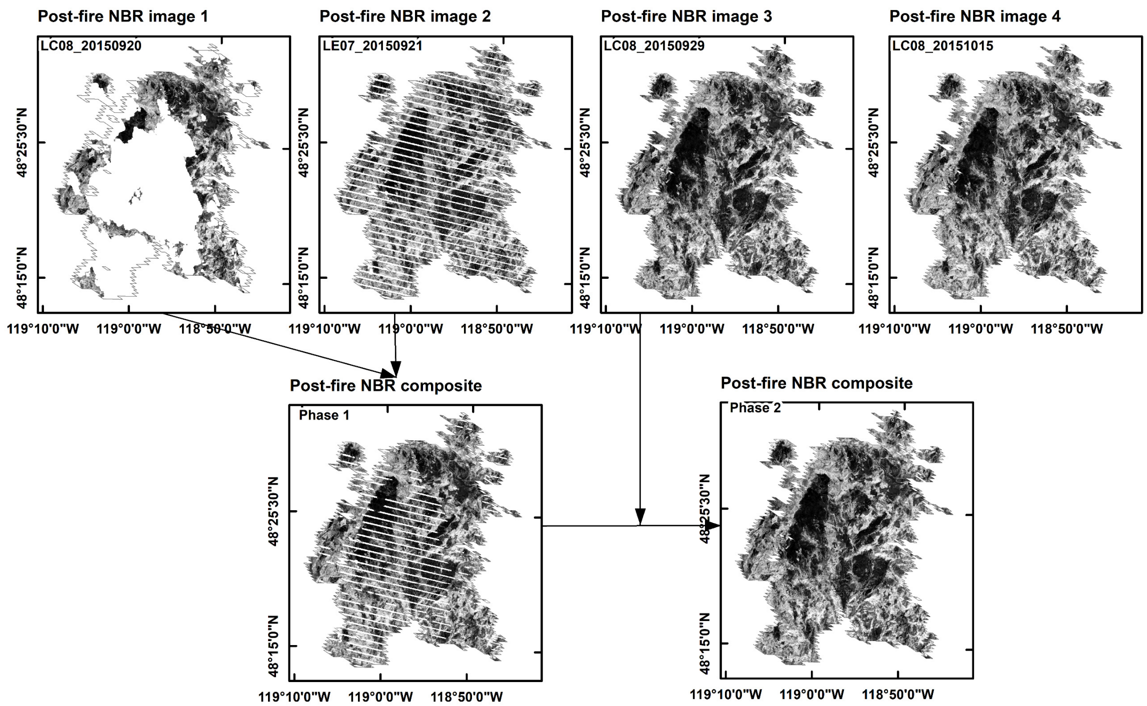
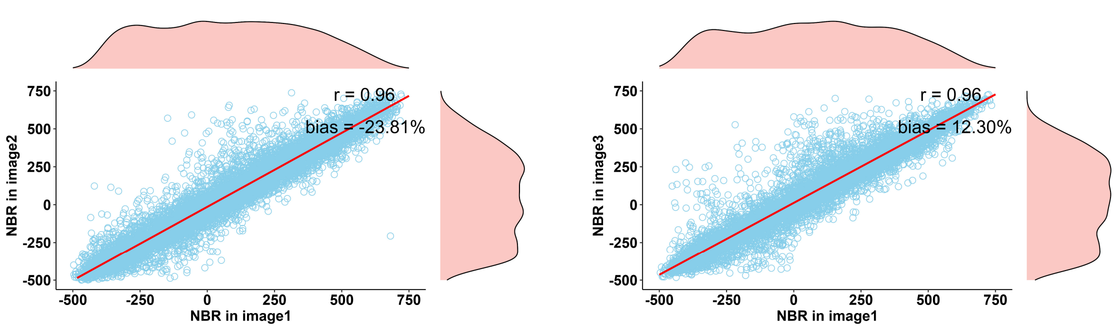


Figure 4. NBR image process for Landsat composite, for the fire event ended on 17 September 2015 in north Washington.

"The scatterplot in Figure 5 (a) shows the NBR values of the overlapping pixels in image 1 and image 2, with the associated distributions of NBR for the fire event. It is noted that NBR values in images 1 and 2 show high correlation (r = 0.96), relatively low bias (-23.81%) and similar probability densities, even though they are derived from two different Landsat images (Landsat 8 and Landsat 7). The scatterplot in Figure 5 (b) shows the NBR values of overlapping pixels in image 1 and image 3, with the associated distribution of NBR for the fire event. Similarly, NBR values in image 1 and image 3 have high correlation (r = 0.96) and low bias (12.30 %) and similar probability densities, even though they are derived from different times (9 days apart). The results indicate that the cloud-free NBR composite mosaicking of all available Landsat images has reasonable accuracy with high spatial and temporal consistency."



(a) (b)

Figure 5. Scatterplots of overlapped pixel values in (a) image 1 and image 2; (b) image 1 and image 3.

In addition, in the discussion part, we also discuss the application of Sentinel-2 images in burn severity mapping in the future work.

From line 460 to line 473 in the revised manuscript:

"This study has shown that combining all available Landsat images, including those from Landsat 5, 7, and 8, could significantly improve the probability of obtaining dense cloud-free NBR time series. The NBR composite shows high spatial and temporal consistency with the NBR images closest to the start and end time of the fire event, despite different band settings used from Landsat 5, 7 and 8. Studies by Koutsias and Pleniou (2015) and Chen et al. (2020) also have shown that differences are small when using reflectance values from sensors aboard the Landsat 5, 7, and 8 satellites to calculate burn severity over burned area. While studies (Mallinis et al., 2018; Howe et al. 2022) have demonstrated that Sentinel-2 generally performed as well as Landsat 8 in burn severity mapping, the further extension of this study will also incorporate images from Sentinel-2 to obtain dNBR composite, especially on extending the GFBS data set to the present. With the finer spatial resolution (10 meter) and more frequent revisit period (5 days), GFBS could provide improved burn severity information when incorporating Sentinel-2 images. The National Aeronautics and Space Administration (NASA) has lounched the Harmonized Landsat and Sentinel-2 (HLS) project aiming to produce a seamless surface reflectance record from the Operational Land Imager (OLI) and Multi-Spectral Instrument (MSI) aboard Landsat-8/9 and Sentinel-2A/B remote sensing satellites, respectively, which is an alternative source for extending the GFBS dataset (https://hls.gsfc.nasa.gov/)"

References:

Chen D., Loboda T.V., and Hall J.V. A systematic evaluation of influence of image selection process on remote sensing-based burn severity indices in North American boreal forest and tundra ecosystems. ISPRS J. Photogramm. Remote Sens. 159, 63–77, https://doi.org/10.1016/j.isprsjprs.2019.11.011, 2020.

Koutsias N. and Pleniou M. Comparing the spectral signal of burned surfaces between Landsat 7 ETM+ and Landsat 8 OLI sensors. Int. J. Remote Sens. 36(14), 3714–3732, https://doi.org/10.1080/01431161.2015.1070322, 2015.

Howe, A.A., Parks, S.A., Harvey, B.J., Saberi, S.J., Lutz, J.A. and Yocom, L.L. Comparing Sentinel-2 and Landsat 8 for burn severity mapping in Western North America. Remote Sensing, 14(20), 5249, https://doi.org/10.3390/rs14205249, 2022.

Mallinis, G., Mitsopoulos, I. and Chrysafi, I. Evaluating and comparing Sentinel 2A and Landsat-8 Operational Land Imager (OLI) spectral indices for estimating fire severity in a Mediterranean pine ecosystem of Greece. GIsci Remote Sens, 55(1), 1-18, https://doi.org/10.1080/15481603.2017.1354803, 2018.

As for the long-term temporal analysis based on GFBS, by comparing it with CanLaBS and validating it against some ground reference, we demonstrated reasonable and acceptable burn severity estimation from GFBS. While the method to generate the dNBR of GFBS remains consistent over time, the differences on band settings in Landsat are small, and GFBS provides comprehensive temporal coverage spanning from 2003 to 2016, which indicates that GFBS can be used to analyze long-term trends of forest burn severity.

From line 490 to line 495 in the revised manuscript:

"Despite the differences in number of forest fires, GFBS agreed well to CanLaBS in terms of the annual forest burn severity. While the method to generate GFBS remains consistent, with the small difference to be ignored in banding settings from Landsat 5,7 and 8, GFBS provides comprehensive temporal coverage spanning from 2003 to 2016 for forest burn severity, indicating the potential application of GFBS in long term analysis of burn severity for forest fires beyond Canada, i.e. regions over the globe, e.g. CONUS, Australia, where GFBS has been demonstrated to perform well against ground truth."

5) You should stress the usefulness of this product, for example, by pointing out some potential applications.

Respond: We have noted the future application of GFBS in some fields, like the long-term analysis of forest burn severity, regional forest planning and relation to climate change.

From line 491 to line 500 in the revised manuscript:

"While the method to generate GFBS remains consistent, with the small difference to be ignored in banding settings from Landsat 5,7 and 8, GFBS provides comprehensive temporal coverage spanning from 2003 to 2016 for forest burn severity, indicating the potential application of GFBS in long term analysis of burn severity for forest fires beyond Canada, i.e. regions over the globe, e.g. CONUS, Australia, where GFBS has been demonstrated to perform well against ground truth. Moreover, integrating the 30 meter GFBS into the regional forest planning can enhance fire resilience in vulnerable areas, shaping policies that prioritize the forest environment [Bradley et al., 2016]. As climate change exacerbates the frequency, intensity, and unpredictability of wildfires globally, the analysis on GFBS data can help to assess the impact of these fires on carbon emissions [Xu et al., 2020], forest recovery [Meng et al., 2018], and biodiversity [Huerta et al., 2022], which would in turn inform predictive models that project future fire behavior under various climate scenarios."

References:

Bradley, C.M., Hanson, C.T. and DellaSala, D.A. Does increased forest protection correspond to higher fire severity in frequent-fire forests of the western United States?. Ecosphere, 7(10), p.e01492, ttps://doi.org/10.1002/ecs2.1492, 2016.

Xu, W., He, H.S., Hawbaker, T.J., Zhu, Z. and Henne, P.D. Estimating burn severity and carbon emissions from a historic megafire in boreal forests of China. Science of the Total Environment, 716, p.136534, https://doi.org/10.1016/j.scitotenv.2020.136534, 2020.

Meng, R., Wu, J., Zhao, F., Cook, B.D., Hanavan, R.P. and Serbin, S.P. Measuring short-term post-fire forest recovery across a burn severity gradient in a mixed pine-oak forest using multi-sensor remote sensing techniques. Remote Sensing of Environment, 210, pp.282-296, https://doi.org/10.1016/j.rse.2018.03.019, 2018.

Huerta, S., Marcos, E., Fernández-García, V. and Calvo, L., 2022. Short-term effects of burn severity on ecosystem multifunctionality in the northwest Iberian Peninsula. Science of The Total Environment, 844, p.157193, https://doi.org/10.1016/j.scitotenv.2022.157193, 2022.

Minor comments:

1) Line 96-98: These sentences should be removed, as Lines 99~106 are already the abstract of the method, which is simple enough for readers to understand.

Respond: We have removed these sentences according to your suggestions.

2) Line 101: You should point out why NBR can reflect the biomass before or after the burn. References are also needed here.

Respond: Thanks for the suggestion. We have added the sentences in the revised manuscript to describe why NBR can reflect the biomass before or after the fire.

From line 112 to line 117:

"Healthy plants absorb most of the visible light (for photosynthesis) while reflecting a large portion of the near-infrared (NIR) light. In contrast, areas that have been burned exhibit low NIR reflectance and high shortwave-infrared (SWIR) reflectance [Key and

Benson, 2003; Montero et al., 2023]. This change in spectral properties is due to the loss of vegetation and the exposure of the underlying soil and charred material, which have different reflective characteristics. By computing this ratio for images taken before and after a fire, it's possible to determine the extent and severity of the burn [Cocke et al., 2005; Alcaras et al., 2022]."

References:

Alcaras, E., Costantino, D., Guastaferro, F., Parente, C. and Pepe, M.: Normalized Burn Ratio Plus (NBR+): a new index for sentinel-2 imagery. Remote Sensing, 14(7), p.1727, 2022.

Cocke, A.E., Fulé, P.Z. and Crouse, J.E.: Comparison of burn severity assessments using Differenced Normalized Burn Ratio and ground data. International Journal of Wildland Fire, 14(2), pp.189-198, 2005.

Key, C. H. and Benson, N.C.: The Normalized Burn Ratio (NBR): A Landsat TM radiometric measure of burn severity, US Department of the Interior. US Geological Survey, Northern Rocky Mountain Science Center. 2003.

Montero, D., Aybar, C., Mahecha, M.D., Martinuzzi, F., Söchting, M. and Wieneke, S.: A standardized catalogue of spectral indices to advance the use of remote sensing in Earth system research. Scientific Data, 10(1), p.197, 2023.

3) Line 133: It would be better if you can explain why the denominator is the square root the NBR before burn, rather than the NBR before burn.

Respond:. The purpose of square root transformation is primarily due to (1) normalization, removing the effects of magnitude in data comparison. For example, high pre-fire NBR values indicate dense vegetation. Without normalization, these high values could result in exaggerated differences after a fire, skewing burn severity assessments. (2) stabilization, making the variance of data more consistent across a range of values. For example, areas with denser vegetation might have more variability in how fires affect them. The square root transformation helps stabilize this variance, making the RdNBR more reliable across different vegetation densities and conditions.This is important because the goal of RdNBR is to measure the severity of the burn itself, not the pre-existing vegetation density. In addition, the square root transformation provides a more normalized scale for comparing burn severity across different regions and fire events.

From line 150 to line 152 in the revised manuscript:

"The RdNBR normalizes the dNBR to the square root of pre-fire NBR value, which helps in reducing the variability caused by pre-fire vegetation conditions and enhances the accuracy in assessing burn severity [Miller et al., 2009].”

References:

Miller, J.D., Knapp, E.E., Key, C.H., Skinner, C.N., Isbell, C.J., Creasy, R.M. and Sherlock, J.W.: Calibration and validation of the relative differenced Normalized Burn Ratio (RdNBR) to three measures of fire severity in the Sierra Nevada and Klamath Mountains, California, USA. Remote Sensing of Environment, 113(3), pp.645-656, 2009.

4) Line 136: I recommend you to mention how CBI is measured.

Respond: We have added the sentences in the revised manuscript,

from line 163 to line 167:

“It is determined through direct field observations after a fire when assessors visited various sites within the burned area to evaluate the effects of the fire on different components of the ecosystem, such as the degree of charring, percentage of foliage consumed, changes in ground cover, and mortality of plants. The CBI score for each site was calculated by averaging the scores of the different components. This overall score represents the burn severity at a specific site.”

5) Line 144: I recommend to change the title into: forest fire coverage of Landsat composites.

Respond: We have changed the name of subtitle

In line 179: “3.1. Forest fire coverage of Landsat composites”

6) Line 161-164: I recommend to move these sentences, including the figure, to section 2.4.

Respond: We have done it following your suggestion. Now these content are moved to section 2.4 in the revised manuscript.

7) Line 169 and afterwards: Do you think it’s better to move the comparisons with MOSEV to the Discussion part?

Respond: After discussing with the co-authors, we think these sentences are still describing the results from Figure 12, so we keep them in this section. More detailed comparisons with MOSEV are presented in the Discussion section.

8) Lines 166-184: You should change your expression. As your product is not always and absolutely more correct, you should not say “MOSEV overestimate or underestimate ...” so confidently. You could add “might”, for example.

Respond: Yes, you are correct. We have changed such expressions, instead of using overestimate or underestimate we only say that MOSEV dNBR is higher or lower compared to GFBS.

9) I think Fig. 8 appears more convincing than Fig. 5 and Fig. 7. At least the amount of in-situ data is adequate.

Respond: The reason we present Figure 5 and Figure 7 is that we want to show the scatterplots of validation against ground measurement for those specific fire events presented in Figure 4 and Figure 6, since we think those scatterplots could help to understand how MOSEV and GFBS product performs in those wildfire events. While in Figure 8, we present the validation of all 1315 CBIs against GFBS and MOSEV and to prove GFBS has better performance than MOSEV considering all those fire events, not only for the specific events.

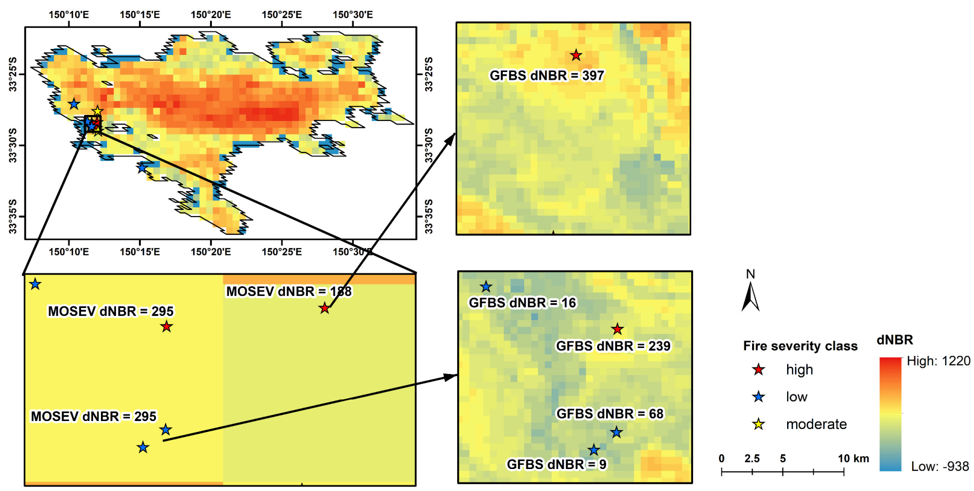
10) Lines 238~245: What are the potential explanations to these differences?

Respond: The difference between GFBS and MOSEV burn severity mainly comes from the gap in spatial resolution. The coarse resolution of MOSEV (500 m) impede it to present the localized variability of burn severity while GFBS can with the improved resolution (30 m). We have presented two cases as Figure 11 (a) and (b) in the revised manuscript to demonstrate that MOSEV tends to provide burn severity estimation with large uncertainty.

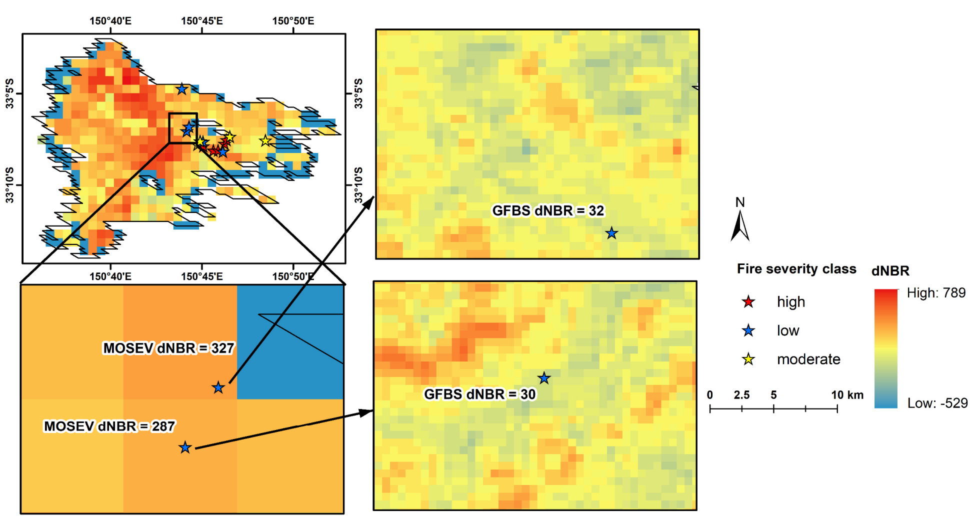
From line 285 to line 301 in the revised manuscript:

"As mentioned above, MOSEV gave relatively small dNBR values in the event on October 15 2023, where burn severity is classified from in situ measurement as high. Figure 11 (a) displays the location of the ground verification sites with the corresponding burn severity class and associated dNBR values from MOSEV and GFBS. It is noted that within one MOSEV grid cell (500 meter) four ground verification sites are located. The dNBR value from MOSEV is 295 for all four sites, while three of the sites are classified as low and only one site is classified as high severity. On the other hand, at GFBS resolution (30 meter), we can note significant spatial variation in dNBR, with GFBS dNBR being 239 for the site classified as high and 9, 16 and 68 for the sites classified as low severity. In a surrounding MOSEV pixel we note a site classified as high severity, but dNBR from MOSEV is 188 while dNBR from GFBS is 397. In the event on October 21 2023, we found that MOSEV gave relatively high dNBR values at ground verification sites that are classified as low severity. Figure 11 (b) shows the locations of ground verification sites with corresponding classified burn severity and associated dNBR values from MOSEV and GFBS. In the two adjacent MOSEV grids, the dNBR values from

MOSEV are 287 and 327 respectively where both sites are classified as low severity. At GFBS resolution more significant changes between high and low dNBR are found within the same MOSEV grid, resulting in dNBR values of 30 and 32 for the ground verification sites classified as low severity. The results demonstrate the significance of GFBS high resolution data in representing the small-scale variations of dNBR and providing more granular and reliable dNBR estimations."



(a)



(b)

Figure 11. The location of ground verification sites with burn severity classes overlaid by dNBR values from GFBS and MOSEV for the fire event of (a) October 15 2023 and (b) October 21 2023.

11) Line 253: How can the spatial pattern comparison lead to the conclusion that your product has improved accuracy than MOSEV? More explanations and proofs are

needed.

Respond: In the revised manuscript, we additionally compared GFBS and MOSEV with CanLaBs product over Canada and validated GFBS and MOSEV using the field assessed burn severity data over southeastern Australia, and presented those results in two new sections (section 3.2 and section 3.3). The results show that GFBS performed better than MOSEV in terms of burn severity distribution and burn severity categorization. Two fire cases presented in Figure 11 (a) and (b) show the gap between resolution of GFBS and MOSEV can lead to significantly different burn severity estimates, where GFBS was shown to be more agreeable to ground truth.

12) Line 259~261: You should provide more proof, such as references, to conclude that MOSEV has truly over/under-estimated the burn severity in these regions, which your product has avoided.

Respond: In the revised manuscript, we provided the comparison results between GFBS, MOSEV and CanLaBS over Canada, indicating a better agreement of GFBS to CanLaBS in terms of dNBR. Besides, we also provided the validation results of ground verified burn severity data against dNBR from GFBS and MOSEV over southeastern Australia, demonstrating a better ability of GFBS to differentiate the burn severity between different categories. A detailed comparison between GFBS and MOSEV at some field assessed burn severity sites shown that, MOSEV tends to overestimate the dNBR at the low severity and underestimate the dNBR at high severity site, while GFBS could provide more reasonable dNBR estimates at the field assessed site.

13) You should pay attention to the writing. For example, in Line 298, “CO2”. Please check and correct such errors.

Respond: We have corrected those errors in the revised manuscript.