General comments

1. The study entitled "A Global 30 m Landsat-based Dataset of Forest Fire Patches (GlobMap FFP v1.0) from 1984 to 2022" by He et al. reports a global forest fire area/patch dataset at 30 m for nearly four decades since 1984. By leveraging the computation power of GEE platform, the authors applied a BVI approach to reduce Landsat noises due clouds and shadows to generate pixel-level image composites, and used ANN models to map forest burned areas, which were further clustered into fire patches (or individual fire events), producing the final GlobMap product. The product was evaluated using independently derived burned area (BA) and by comparing with existing Landsat- and MODIS-based BA datasets.

A consistent, high-quality global fire area dataset at fine resolution would be very meaning for science communities and various applications. Aiming at this goal, there is no doubt that substantial efforts were put by the authors to produce a 30 m global fire area dataset across nearly four decades. As a data science paper, scientifically rigorous methods and high-quality data are critical. These two aspects are my main concerns for this manuscript.

Response:

We thank the reviewer for highlighting these important concerns. We appreciate the reviewer's recognition of the substantial effort required to generate a global multi-decadal Landsat-derived forest fire patch dataset. We agree that both methodological rigor and transparent characterization of dataset quality are critical for a global fire dataset.

In revising the manuscript, we substantially clarified the design rationale, methodological assumptions, and limitations of the product. We added a new subsection describing the conceptual framework and product design rationale, expanded the discussion of Landsat observational constraints, clarified the rationale behind key methodological choices (including image compositing and fire patch delineation), and strengthened the discussion of uncertainty sources and dataset limitations.

We also revised the overall framing of the manuscript. Rather than presenting GlobMap FFP as a complete global burned area inventory, we now emphasize its primary objective as providing a long-term, spatially explicit characterization of forest fire patches under heterogeneous Landsat observation conditions. We believe these revisions improve the transparency of the dataset, clarify its intended applications, and facilitate more appropriate interpretation of its strengths and limitations.

2. On one hand, the INTRO has done a good job describing the challenges to map global fires using Landsat data, yet the Methods part is mostly descriptive and fails to provide solid, quantitative evidence to demonstrate its superior performance in handling these challenges. The flow chat does help the reader to understand what steps have been taken to process the data. However, I don't see much demonstration and evidence to show any preferable advantages of the adopted approaches relative to existing approaches in literature.

Response:

We agree that the original manuscript focused primarily on describing the workflow and processing steps, while providing insufficient explanation of the rationale underlying several key methodological choices. We also recognize that the manuscript could be interpreted as

implying superior performance relative to existing approaches without presenting direct quantitative comparisons to support such a conclusion. Our intention, however, was not to demonstrate that the adopted workflow universally outperforms existing burned area mapping approaches. Rather, the objective of GlobMap FFP was to develop a globally scalable framework capable of reconstructing forest fire patches from the heterogeneous Landsat archive while balancing several competing constraints, including observation availability, cloud contamination, temporal representativeness, preservation of spatial detail, and computational feasibility.

To address this concern, we substantially revised both the **Introduction** and **Methods** sections to more clearly explain the motivations and trade-offs associated with the adopted methodological choices. Specifically, we now emphasize that the development of GlobMap FFP was guided by the practical challenges of global multi-decadal Landsat processing rather than by the objective of maximizing burned area detection completeness under all conditions.

In the revised manuscript, we clarify the rationale for several key methodological decisions. For example, the use of multi-year compositing is now explicitly described as a compromise between observation availability and temporal specificity, particularly in cloud-prone regions and during the early Landsat era when clear-sky observations were sparse (in **Lines 172-175**). Similarly, the minimum-BVI compositing strategy is motivated by the need to preserve burn-related spectral signals over extended compositing intervals while reducing the influence of cloud, shadow, and atmospheric contamination (in **Lines 177-188**). We also clarify that annual-scale fire patch reconstruction was adopted because globally consistent sub-annual fire chronology is often difficult to recover from heterogeneous Landsat observations (in **Lines 224-232**). These methodological choices are therefore presented as practical solutions to known limitations of the Landsat archive rather than as universally superior alternatives to existing approaches.

We further revised the **Introduction** to better frame the methodological context. The revised text now explicitly discusses the trade-offs among disturbance sensitivity, contamination robustness, temporal representativeness, and computational efficiency associated with different Landsat-based burned area mapping strategies (in **Lines 52-84**). We emphasize that globally scalable fire reconstruction requires balancing these competing objectives and that no single approach is optimal under all environmental and observation conditions.

Additionally, we expanded the **Discussion** section to acknowledge the limitations associated with the adopted workflow (in **Lines 501-534**), such as potential under-detection of short-lived fire signals, uncertainties related to multi-year compositing, and possible differences relative to alternative approaches. We believe these revisions provide a more balanced presentation of the methodology and clarify the practical considerations that motivated the design of GlobMap FFP.

3. More importantly, the underestimation of the proposed Globmap is surprisingly high. First, I would not call the comparisons of 30m Globmap with other 30m landsat-based BA datasets and even coarser-resolution MODIS BA a rigorous “validation” practice because higher spatial-resolution datasets are usually required as a reference for the validation purpose. Second, the relatively low omission errors (OE) and commission errors (CE) in all five forest types (Table 2) and the substantial BA underestimation compared with much coarser-resolution MODIS BA

(MCD64A1; Figs 6&7) are striking. The validation of the MODIS MCD64A1 BA product using 30m Landsat-based BA by the science team has shown that MCD64A1's OE is higher than 90% in temperate and tropical forests (Boschetti et al., 2019). In other words, MCD64A1 misses majority of fire areas in these two types of forests. Nevertheless, the 30m GlobMap BA is substantially lower than MCD64A1 is most global forests, except boreal North America (Figs 6&7), although this manuscript reports low OE and CE (Table 2). The authors attribute this underestimation in GlobMap (relative to MODIS BA) to MODIS' coarser footprint size (Fig.12). As other regional Landsat-based BA datasets have shown much higher BA estimates than MCD64A1, at least in U.S. (e.g., Hawbaker et al., 2020), I would not expect that the finer footprint size in Landsat relative to MODIS would be able to account for the substantial underestimation in the GlobMap. This eventually casts great doubts on the robustness of the proposed BA mapping methods and the quality of the final GlobMap BA dataset.

Response:

We thank the reviewer for this insightful comment. We agree that comparisons with existing burned area products cannot substitute for independent validation based on higher-resolution reference data. We also agree that the apparent inconsistency between the relatively low omission and commission errors reported in Table 2 and the substantially lower burned area estimates relative to MCD64A1 requires careful explanation.

First, we acknowledge that the evaluation presented in the original manuscript could be interpreted as a conventional accuracy assessment. In the revised manuscript, we have clarified that the reported metrics represent agreement between GlobMap FFP and separately generated Landsat-based reference samples rather than independent estimates of absolute burned area detection accuracy in **Lines 260 – 262, Lines 321 – 324** as below:

"*Because both datasets were derived from Landsat imagery and relied on related burned area detection procedures, these metrics should be interpreted as measures of internal consistency rather than fully independent estimates of product accuracy.*"

"*Yet, it is worth noting that the reported omission and commission errors characterize agreement between GlobMap FFP and the Landsat-based reference samples within evaluated locations where burned scars remained detectable in the available observations. These metrics quantify classification agreement conditional on burn detectability rather than the completeness of burned area reconstruction at regional or global scales.*"

We have also clarified the distinction between Landsat-based evaluation using reference samples and intercomparison with existing burned area products, and revised the terminology throughout the manuscript accordingly.

Second, we have clarified that the omission and commission errors reported in Table 2 should not be interpreted as a measure of global burned area completeness. These metrics are derived from sampled Landsat scenes and quantify agreement only within locations where burned scars remained detectable in the available Landsat observations. They therefore characterize classification agreement under Landsat observation conditions rather than the completeness of burned area reconstruction at regional or global scales. Consequently, relatively good agreement within sampled locations does not necessarily imply close correspondence in cumulative burned area estimates when products are aggregated across regions and decades.

We have revised the manuscript to explicitly discuss this distinction and to avoid interpreting the reported metrics as independent estimates of global product accuracy in **Lines 324 – 327** of the manuscript:

"*Fires that were not observable because of limited observation availability, persistent cloud cover, rapid post-fire vegetation recovery, or compositing effects are not represented in these statistics. Therefore, relatively low omission and commission errors within the evaluated samples do not necessarily imply complete recovery of burned area when estimates are aggregated across regions and decades.*"

Third, we agree that the lower burned area estimates of GlobMap FFP relative to MCD64A1 warrant further discussion. In the original manuscript, we primarily attributed these differences to the coarser spatial resolution of MODIS. We acknowledge that this explanation alone is insufficient. In the revised manuscript, we now emphasize that the discrepancy likely reflects the combined effects of multiple factors, including incomplete detection of short-lived fire signals under heterogeneous Landsat observation conditions, particularly in cloud-prone and rapidly recovering ecosystems; differences in image compositing and fire patch delineation procedures among products; and limited representation of repeated burning within compositing intervals. We therefore no longer attribute the observed discrepancies solely to spatial-resolution effects. We have added the following paragraph in the Discussion in **Lines 501 – 518**:

"*Several factors contribute to the differences between GlobMap FFP and existing burned area products, particularly MCD64A1. Spatial discrepancies partly reflect differences in sensor resolution. The coarser MODIS pixels tend to produce larger and more spatially continuous burned perimeters, whereas Landsat's 30 m observations better preserve small fires, patch boundaries, and within-fire heterogeneity (Robinson, 1991). Temporal discrepancies are mostly evident in tropical forests, where persistent cloud cover and rapid vegetation regrowth can cause burned signals to be missed by the relatively infrequent cloud-free Landsat observations. Since Landsat preferentially preserves persistent burn signals, this product is less effective at capturing short-lived fire effects, particularly in ecosystems characterized by rapid vegetation recovery or frequent low-severity burning, compared to the near-daily MODIS observations. Additional differences arise from the methodological choices adopted to achieve globally consistent fire patch reconstruction. The multi-year compositing strategy reduces the influence of cloud contamination, data gaps, and uneven observation availability while maintaining computational feasibility. Yet, because only a single observation is retained for each pixel within a compositing interval, repeated burning occurring at the same location during the same interval are not explicitly reconstructed. Fire recurrence may be underrepresented in frequently burned regions, and fire occurrence frequencies derived from the dataset should be interpreted with caution. Furthermore, the annual aggregation may merge temporally adjacent fires into a single fire patch, likely resulting in overestimated patch sizes and underestimated fire frequencies. Consequently, GlobMap FFP should be interpreted as a spatially explicit fire patch dataset rather than a complete inventory of all forest burned area, particularly in frequently burned tropical forests. Future work should evaluate how different compositing strategies influence fire patch reconstruction across contrasting fire regimes and compare the performance of BVI-based and NBR-based approaches under varying environmental*

conditions."

We also agree that the reported agreement metrics should not be interpreted as evidence that GlobMap FFP provides a complete reconstruction of global forest burned area. Rather, they indicate the degree of agreement between the mapped fire patches and independently generated Landsat-based reference samples within the evaluated locations. The revised manuscript explicitly acknowledges that substantial underestimation of burned area may occur in some regions where observation availability is limited and post-fire recovery is rapid in **Lines 520 – 527**:

"*First, the irregular availability of cloud- and snow-free Landsat observations constrains the temporal precision and completeness of burned area detection, particularly in moist tropical forests where short-lived fires may disappear before the next clear-sky acquisition. Frequent cloud cover in these regions reduces the effective temporal sampling frequency and limits the ability to identify burning dates accurately. Fast-recovering surface fires may also be missed if post-fire spectral signals disappear before the next cloud-free overpass (Hislop et al., 2018). Second, incomplete spatial coverage prior to the 2000s may contribute to regional underestimation of burned area. In parts of western and central Africa and boreal Eurasia, Landsat acquisitions prior to the 2000s were sparse because of historical limitations in data storage, ground-station reception, and data archiving (Feng and Wang, 2024).*"

To facilitate appropriate interpretation of the dataset, we have revised the positioning of both the manuscript and the product. The revised manuscript no longer presents GlobMap FFP as a complete global burned area inventory. Instead, the primary objective of the dataset is to provide a consistent, spatially explicit characterization of forest fire patches at 30 m resolution over nearly four decades. Its principal value lies in enabling analyses of fire patch geometry, spatial organization, patch-size distributions, and long-term changes in forest fire patch structure, while the limitations and uncertainty sources associated with burned area completeness are now discussed more explicitly throughout the manuscript.

References

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