Referee #2

Nobody knows the true values of biomass burning emissions. However, in my review I have referred to recent literature that points out that MODIS burned area misses a lot of burned area and thus has a strong bias. Possibly a factor two, much more than the difference between GFED4s and GFED3. All derived emission products, also when based on FRP or active fires but tuned to datasets derived from MODIS burned area, have the same issue. This is becoming well established and accepted by the community and it means that global burned area and thus emissions are substantially higher than at least four of the datasets indicate.

The authors introduce a new dataset that very likely contains the same bias as GFED, GFAS etc because it is based solely on a statistical technique ignoring the new insights I point towards in my review. From a methodological perspective the 3CH method might be interesting, but in my opinion it does not help the field forwards. In contrast, it presents a new dataset that suffers from the same issue as some of the older ones but claims its uncertainty is very low.

A final note, I disapprove of the comment "Additionally, can you provide the "true values" frequently mentioned in your comments? The detailed data sources including downloading links, citations, and user manuals are necessary. It is amazing that you have true global fire emission data for the past two decades. ". I fully understand the frustration of a negative review but it is up to the editor to decide whether it is a fair review or not. In my review I have pointed towards pieces of information that are as close to reliable estimates as we can come at this stage and I feel it is our duty to build on that.

Thanks for the comments. We improved the newly added Section "4.4 Caveats", which is shown below, to clarify the limitations of this study.

4.4 Caveats

Global fire carbon emission data are crucial to fire dynamics monitoring, carbon cycling, and climate change mitigation. However, the true global fire carbon emissions are still unknown. This study tries to evaluate the uncertainties of the existing fire emission products, including GFAS, GFED4.1s, QFED, FINN, FEER, and Xu et al. (2021) data, when the true values are unavailable. The six state-of-the-art satellite-based fire emission products are analyzed and merged using the TCH method, producing a new global fire emission dataset, FiTCH.

When using the TCH method, the different data sources are usually assumed to be independent. However, this assumption might be oversimplified. In this study, the six fire emission products may have some kind of correlation due to the fact that they used some common data such as the MODIS FRP and MODIS burned area. For example, GFAS, QFED, and FEER all employed the MODIS FRP to estimate fire emissions, though they had different strategies to optimize the FRP and emission coefficients. Both GFED4.1s and Xu

et al. (2021) used the MODIS burned area data, though GFED4.1s corrected the burned area by adding small fires. We agree that the assumption of independent data sources is a limitation. However, based on the BB4CMIP data, global fire emissions (10-year averages) varied between 1.8 and 2.3 Pg C yr^{-1} (1 Pg = 1000 Tg), which were close to the proposed FiTCH dataset (1978.47 Tg C yr^{-1}). Additionally, the BB4CMIP indicated that carbon emissions increased slightly and peaked during the 1990s, and after that they decreased gradually, which matched our results.

Due to the coarse spatial resolution of the MODIS data, small fires tend to be missed, resulting in an underestimation of the burned area and fire emissions. For example, at the global scale, the GFED4.1s produced 37% and 11% more burned area and fire emissions than the GFED3 due to the inclusion of small fires. Some regional studies (Ramo et al., 2021; van der Velde et al., 2021) also showed that the existing fire products underestimated the burned area and fire emissions. The proposed FiTCH dataset might have the same problem of underestimation as it still relies on these MODIS data-based fire products. However, the dilemma is that we do not know the true long-term fire carbon emissions at the global scale. Otherwise, the true uncertainties of these products can be quantified. This study is the first attempt to utilize the TCH method to assess the uncertainties of the six widely used fire emission products when the true values are unavailable. We agree that our results might not be perfect; however, they match the well-established dataset like the BB4CMIP. As we know, science is open-minded and welcomes diversity. We welcome more constructive ideas and suggestions about solving this problem.

References

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