

We would like to thank the reviewers again for their time and guidance on this manuscript. We address the specific revisions in the red text below:-

1. The authors acknowledged that thick smoke could obscure MODIS active fire detection, but did not address the first and more critical part of the question: whether GFED4.1s includes any retrospective burned-area adjustment to account for obscured fires. Please clarify this explicitly in the manuscript, and if no such correction exists in GFED4.1s, this should be acknowledged as an additional limitation that may partly explain the need for emission scaling and influence the interpretation of results.

This correction for burned area does not exist in GFED4.1s. While a lot of the need for scaling comes from the under-detection of fires, the obscuration of burned area by thick smoke is likely to be a minimal effect. This is indicated by larger fires, which would have thicker smoke (e.g. the 2020 Californian wildfires), requiring less scaling than smaller fires.

GFED4.1s uses MODIS Collection 5.1 for burned area. A more recent iteration of MODIS active fire detection, Collection 6, addresses the omissions of fires obscured by thick smoke (Giglio et al., 2016)

Giglio, L., Schroeder, W., and Justice, C. O.: The collection 6 MODIS active fire detection algorithm and fire products, *Remote Sensing of Environment*, 178, 31–41, <https://doi.org/10.1016/j.rse.2016.02.054>, 2016.

Added to line 506: ", which is addressed in the more recent MODIS active fire detection Collection 6 (Giglio et al., 2016). This is likely to be a minimal effect overall, as the larger fires, which would have thicker smoke (e.g. in western US and southeast Australia: Sect. 3.3.2 and 3.3.3) required less emissions scaling than the smaller fires."

2. While the authors explained the philosophy behind the DM-scaling approach, no explicit text was added to the manuscript discussing the limitations of the DM-scaling relationship across different fire ecosystems (e.g., savannah, boreal, small-patch fires). Please add a dedicated sentence or paragraph in either the methods or conclusions section explicitly acknowledging where this relationship may break down and how it affects the scope and transferability of the proposed approach.

The emission factor in the calculation of GFED4.1s emissions is dependent on the fire ecosystem. In the DM-scaling adjustment, different ecosystems are also broadly reflected in the difference in DM consumption. For example, the low fuel load small fires in savannahs have a lower DM (and thus higher scaling) than high fuel load large fires in the boreal.

The emission factors in GFED4.1s are static, whereas they have been shown to be dynamic across the savannah burning season, decreasing towards the latter end of the burning season (Vernooij et al., 2023). This limitation is partially mitigated by the DM-scaling factors, as early season fires tend to be smaller, consume less fuel, and therefore are scaled more, but does not account for other factors e.g. different weather conditions, or the moisture content of the fuel.

Vernooij, R., Eames, T., Russell-Smith, J., Yates, C., Beatty, R., Evans, J., Edwards, A., Ribeiro, N., Wooster, M., Strydom, T., Giongo, M. V., Borges, M. A., Menezes Costa, M., Barradas, A. C. S., van Wees, D., and Van der Werf, G. R.: Dynamic savanna burning emission factors based on satellite data using a machine learning approach, *Earth System Dynamics*, 14, 1039–1064, <https://doi.org/10.5194/esd-14-1039-2023>, 2023.

It is also worth noting that the majority of savannah emissions come from small fires, as illustrated in Fig. 4. This means that the scaling will mostly default to $2x$, the same as in FIRE_STAN. This is in contrast with boreal forest where a higher larger proportion of total emissions comes from large (high DM consumption) detectable fires, effectively differentiating the different fire ecosystems from each other.

Added to line 670: “The scaling method performs differently across different fire ecosystems as DM consumption varies with vegetation or fuel characteristics. In savannahs, little of the total emission comes from fires exceeding the specified DM threshold, so almost all emissions are scaled by $2x$ (as in FIRE_STAN). In boreal forest regions a substantial portion of total emissions are from pixels that do exceed these DM thresholds, so the scaling factor is typically closer to 1 and is more responsive to variability in fire sizes (pixel-level DM consumption). Alternative scaling strategies distinguishing between natural vegetation types are of course possible and for instance within UKESM1 could be based on the nine plant functional types (Sellar et al., 2019), but such methods may be less transferrable between models and are beyond the scope of this study.”