Anonymous Referee #1

This study developed a global daily emission inventory of OBB with 1km×1km based on global fire point monitoring data from the Chinese Fengyun-3D satellite, fuel loading, combustion factor and emission factor. Considering the scientific impact of each study, several analysis is needed to substantiate the conclusions in your manuscript. Firstly, the manuscript emphasizes that the compared with MODIS, significant advantage of using the FY-3D fire detection product is the ability to enhance the detection of small fires, but the analysis of the results does not show how much the use of the FY-3D detection product has increased the emission estimates of small fires? Secondly, in the section about verification, the manuscript emphasizes the consistency with other datasets, but does not quantify the advantages of this study. Thirdly, the advance of activity data selected in this study needs to be verified, such as the quality and the resolution of the data. The manuscript can be considered for publication if the issues mentioned above and following specific comment could be addressed.

We thank the Reviewer for the constructive comments and suggestions. We shall revise the manuscript accordingly, and we address the comments as follows.

Specific comments：

P1 line23-25: The full name are not given for some regions (e.g., BONA), and them are given for some regions (e.g., SHSA).

We added full name for other regions.

"72.71 (Boreal North America; BONA), 165.7 (Temperate North America, TENA), 34.1 (Central America; CEAM), 42.9 (Northern Hemisphere South America; NHSA), 520.5 (Southern Hemisphere South America; SHSA), 13 (Europe; EURO), 8.4 (Middle East; MIDE), 394.3 (Northern Hemisphere Africa; NHAF), 847 (Southern Hemisphere Africa; SHAF), 167.4 (Boreal Asia; BOAS), 27.9 (Central Asia; CEAS), 197.3 (Southeast Asia; SEAS), 13.2 (Equatorial Asia; EQAS), and 82.4 (Australia and New Zealand; AUST) Tg".

P2 line64-65: The detection accuracy of MODIS and other related indexes should be clearly given to facilitate readers to compare directly. As well as the comparison with MODIS, other commonly used polar-orbiting satellite sensors (SNPP-VIIRS, Landsat-8, etc.) can be considered for comparison to highlight the advantages of FY-3D.

We revised according to the reviewer's comment. We added comparisons with other product. The changes are as follows.

"Furthermore, the Global Fire Monitoring (GFR) product with FY–3D employs optimized automatic identification algorithms for fire spots (Tianchan and Wei, 2022), leading to an improved accuracy of fire point detection. This resulted in an impressive overall accuracy rate of 79.43% and an exclusion omission error accuracy of 88.50%, surpassing the capabilities of MODIS satellite products (Chen et al., 2022; Xian et al., 2021), based on field–collected references throughout 2020 in China. The cross–verification between MODIS and FY–3D shows the highest consistency results (over 80%) in Africa and Asia, while America, Europe, and Oceania demonstrate consistency exceeding 70% (Chen et al., 2022). In July, August, and September, the number of fire spots was higher, with a mean consistency of over 85% between MODIS and FY–3D fire products (Chen et al., 2022). Although Landsat Fire and Thermal Anomaly (LFTA) product has finer spatial resolution, its lower temporal resolution typically allows global coverage only every 16 days, which does not allow for frequent detection of biomass burning activity. Therefore, employing the FY–3D GFR product and allocation approaches for small fires is expected to yield reliable estimates of OBB emissions."

Furthermore, we added the comparison of parameters related to MERSI–II, MODIS, and VIIRS. Please refer to Table 1.

P4 line128: It is suggested that formulas could be transferred to the manuscript from SI, with the supplement of corresponding unit of the variable.

We revised according to the reviewer's comment. We transferred the formulas to the manuscript from SI, with the supplement of corresponding unit of the variable. Please refer to Line 149.

P5 line148: Source of the constant 0.013 in the formula? Empirical values should give literature. The fitted values should depict the fitting process and significance test results.

We revised according to the reviewer's comment. We added the reference to the constant 0.013 in the formula.

P5 line152: There are other products (MODIS) of NDVI with a time interval of 8d. Why the products of 16d was selected in this study?

The 8d product is based on mod09 calculations and because it is measured in the absence of atmospheric scattering or absorption, the product contains lower data, as well as cloud cover. The 16-day product was derived from the 8-day product, offering advantages such as an enhanced signal-to-noise ratio and reduced cloud contamination. This is achieved through a longer temporal composite period, leading to more dependable and precise assessments of vegetation health and productivity.

In the process of assessing vegetation conditions, the accuracy and completeness of the data are prioritized over the requirement for event resolution. Therefore, we opt to utilize the 16-day product.

P6 Table 1: The EF for specific biomass (e.g., crop) is fixed value for different regions with various crop distribution characteristic. Regional or crop differences should be reflected in EF values.

We made a distinction in the CF for different types of fire event emissions in different regions, and the EF was only used as a factor between the pollutant emitted and the type of fire.

Table 2. Emission factor (g/kg) of different species.

Species	Grasslands and Savannas	Woody Savanna or Shrubs	Tropical Forest	Temperate Forest	Boreal Forest	Temperate Evergreen Forest	Crop			
							Maize	Sugar	Sugar	Wheat
C	488.31	489.41	491.77	468.31	478.88	493.18	687.09	323.35	368.04	429.17
CO_2	1,686[a]	1,681[a]	1,643[a]	1,510[a]	1,565[b]	1,623[a]	2,327[c]	1,130[c]	1,177[c]	1,470[e]
CO	63.00[a]	67.00[a]	93.00[a]	122.00[a]	111.00[b]	112.00[a]	114.70[c]	34.70[c]	93.00[c]	60.00[e]

CH_4	2.00[a]	3.00[a]	5.10[a]	5.61[a]	6.00[b]	3.40[a]	4.40[c]	0.40[c]	9.59[c]	3.40[e]
NO_X	3.90[a]	3.65[a]	2.60[a]	1.04[a]	0.95[b]	1.96[a]	4.30[c]	2.60[c]	2.28[c]	3.30[e]
SO_2	0.90[a]	0.68[a]	0.40[a]	1.10[a]	1.00[b]	1.10[a]	0.44[c]	0.22[c]	0.18[c]	0.85[e]
OC	2.60[a]	3.70[a]	4.70[a]	7.60[a]	7.80[b]	7.60[a]	2.25[c]	3.30[c]	2.99[c]	3.90[d]
BC	0.37[a]	1.31[a]	0.52[a]	0.56[a]	0.20[b]	0.56[a]	0.78[d]	0.82[d]	0.52[d]	0.52[d]
NH_3	0.56[a]	1.20[a]	1.30[a]	2.47[a]	1.80[b]	1.17[a]	0.68[c]	1.00[c]	4.10[c]	0.37[e]
NO_2	3.22[a]	2.58[a]	3.60[a]	2.34[a]	0.63[b]	2.34[a]	2.99[f]			
$PM_{2.5}$	7.17[a]	7.10[a]	9.90[a]	15.00[a]	18.40[b]	17.90[a]	6.43[f]			
PM_{10}	7.20[a]	11.4[a]	18.50[a]	16.97[a]	18.40[b]	18.40[a]	7.02[f]			

All the value of C were Calculated by CO_2, CO, and CH_4.

[a] is average value from (Akagi et al., 2011).

[b] is average from (Akagi et al., 2011) and (Urbanski, 2014).

[c] is average from (Akagi et al., 2011; Fang et al., 2017; Liu et al., 2016; Santiago-De La Rosa et al., 2018; Stockwell et al., 2015).

[d] is from (Kanabkaew and Kim Oanh, 2011).

[e] is from (Cao et al., 2008).

[f] is from (Li et al., 2007).

P11 line269: What does "intensify both the frequency and frequency of fires in the area" mean?

We changed "intensify both the frequency and frequency of fires in the area" to "intensify frequency of fires in the area" make it clear to understand.

P15 line352: Why the dataset is not include FINN (e.g., FINNv2.5)? The resolution of it is the same with the dataset developed in this study (1km, 1d).

The analytical discussion in this study is based on the example of Carbon, for which no estimation exists in FINN (FINNv2.5, 0.1 degree), so there is no FINN product. In SI, we added the comparison results with FINN for CO2 analysis in different regions.

P16 line377-379: There is a lack of clarity in the explanation of how FY-3D can capture small fires more effectively compared to MODIS, and how the difference in transit times between the two satellites affects the detection of agricultural small fires. More data analysis is needed to support this question.

P18 line410: The article should add a comparative analysis of how much the addition of FY-3D improves emission estimates for small fires, which is a key factor in determining the innovativeness of the study.

We added Comparison of parameters related to MERSI–II, MODIS, and VIIRS to explain the advantages of the FY-3D for fire point detection at the hardware level. Please refer to Table 1. Furthermore, we added more details about FY-3D GFR product to support FY-3D can capture small fires more effectively.

Table 1. Comparison of parameters related to MERSI–II, MODIS, and VIIRS.

	MERSI–II (FY–3D)	MODIS (AQUA)	VIIRS ((NOAA–20))
Orbit altitude (km)	836	705	824
Equator Crossing time	14:00 LT	13:30 LT	14:20 LT
Swath (km)	2900	2330	3060
Pixel resolution at nadir (km)	1	1	0.75/0.375
Pixel resolution at the edge (km)	>6	4	1.5/0.75
ID MIR Band (s)	21	21/22	M–13/I–4
Spectral range (μm)	3.973–4.128	3.929–3.989 3.940–4.001	3.973–4.128 3.550–3.930
TMAX (SNR–NEΔT on orbit)	380 K (0.25)	500 K (0.183) 331 K (0.019)	634 K (0.04)
ID TIR Band (s)	24	31	M–15/I–5
Spectral range (μm)	10.300–11.300	10.780–11.280	10.263–11.263 10.500–12.400
TMAX (SNR–NEΔT on orbit)	330 K (0.4)	400 K (0.017)	343 K (0.03)

"…Compared to MODIS, FY–3D fire products have been optimized in terms of auxiliary parameters, fire identification and re–identification. Firstly, FY–3D introduces the adaptive threshold and eliminates the limitations by fixed thresholds of MODIS and VIIRS algorithms by automatic identification algorithms for fire spot detection (Chen et al., 2022). Secondly, FY–3D uses a re–identification index reflecting varying geographical latitude and underlying surfaces types, together with the effect by cloud, water, and bare land (Zheng et al., 2020). The integration of multiple influencing factors increases the accuracy of fire detection. For example, the influences of factory thermal anomalies and high reflectance of photovoltaic power plants are greatly removed. Finally, the far–infrared channel employed in FY–3D has a high resolution of 250 m, higher than MODIS with 1 km, resulting in higher accuracy in big fire detection (Zheng and Chen, 2020). Overall, the FY–3D GFR product achieves an accuracy of 94.0% globally, with accuracies of 94.6%, 94.1%, 90.6%, 91.8%, and 92.7% in south–central Africa, east central south America, Siberia, Australia and Indochinese Peninsula (Chen et al., 2022), respectively. Specifically, due to the removal of underlying surface interference in China, the FY-3D achieves accuracies of 79.43% and 88.50% for accuracy and accuracy without omission, respectively, both of which are higher than the accuracies of 74.23% and 79.69% achieved by MODIS (Chen et al., 2022)."

P19 line435: What is the difference between the 1° spatial resolution of FY-3D mentioned here and the 1km mentioned previously (line 106)?

We changed “1 degree” to “1 km”.

Anonymous Referee #2

The authors claim that "the GFR product, which was integrated with the MERSI–2 instrument, exhibited superior judgment accuracy" (Line 102-103), "Consequently, our inventory yielded accurate assessment results and captured the spatial variation and heterogeneity of minor OBB emissions effectively" (Line 358-359), and "the accuracy of the OBB carbon emissions assessment significantly improved" (Line 417-418). In my opinion, these claims are not sufficiently justified in the manuscript. First, the superiority of MERSI-2 over MODIS in detecting active fires is not well explained. MERSI-2 on FY-3D has higher spatial resolution than MODIS in the visible and NIR bands. However, the active fire algorithm mainly uses the mid-infrared band, where both MERSI-2 and MODIS have a spatial resolution of 1km. The authors cited a number of previous papers (such as Dong et al. 2022 and Chen et al., 2022) to show better fire detection accuracy from MERSI-2 than from MODIS. However, these studies were mostly based on comparisons with limited data samples from manual inspection, and are not very convincing to me. Second, there are many limitations in the algorithm that are not mentioned in the manuscript. For example, this study used AGB as the fuel load, completely ignoring the emissions from soil organic matter burning. The omission error of active fires due to cloud cover/thick smoke is also not quantified. Third, this emissions dataset was derived from FY-3D active fires, but many MODIS products are still needed to generate GEIOBB. The use of MODIS products, which include MOD44B, MODIS NDVI, and MODIS land cover type data, may hinder the effect of quantifying global fire emissions after Terra and Aqua are gone. This potential problem should also be addressed in this paper.

We thank the Reviewer for the constructive comments and suggestions. We shall revise the manuscript accordingly, and we address the comments as follows.

1. We added more details about FY-3D to support FY-3D can capture small fires more effectively. Please refer to line 136 and Table 1.
2. Soil organic matter is also a contributor to the total OBB. However, a very small proportion of emissions can be found in most forest and grassland except in peatland burning in Indonesia. After calculation, we found the carbon emissions in Indonesia was very low since the drought and human induced fires detected were very low during 2020-2022.

   Additionally, we analyzed the omission error of active fires due to cloud cover/thick smoke.

   "The detected active fires were also underestimated due to cloud cover/thick smoke, with an omission error of approximately from 10%–30% (Schroeder et al., 2008; Roberts et al., 2009; Giglio et al., 2006)."
3. In this study, MODIS provide globally commonly used available products including the tree cover, land cover, NDVI to generate OBB emissions worldwide. Other available high-resolution and multi-year products will be used in our study to produce more reliable emission inventory.

Many statements are incorrect or lacking scientific support.

The estimation method and the use of fuel loading (F) are not clearly described. While the authors mention in the manuscript that three data sources, NDVI, TC, and AGB are used for fuel loading, the approach for combining different data streams and forming the fuel loading is embedded in the supporting text only. This formula was *presented without any scientific justification or explanation (there are also some errors in the description of this formula, e.g., 2020 should be corrected to 2010).*

We revised according to the reviewer's comment. We added a description of fuel compliance with fuel loading in the main text and added references related to the formula. We corrected the misdescription in the formula. Please refer to line 149.

The use of emission factors (EF) is also ambiguously described in the manuscript. In section 2.4, the authors simply listed a table of EFs without indicating the specific data sources. Although references to various studies and some locally measured data are cited, the specific methodology employed to construct Table 1 remains undisclosed.

We add data sources for EF in Table 1. Please refer to Table 2.

Table 2. Emission factor (g/kg) of different species.

Species	Grasslands and Savannas	Woody Savanna or Shrubs	Tropical Forest	Temperate Forest	Boreal Forest	Temperate Evergreen Forest	Crop			
							Maize	Sugar	Sugar	Wheat
C	488.31	489.41	491.77	468.31	478.88	493.18	687.09	323.35	368.04	429.17
CO_2	1,686[a]	1,681[a]	1,643[a]	1,510[a]	1,565[b]	1,623[a]	2,327[c]	1,130[c]	1,177[c]	1,470[e]
CO	63.00[a]	67.00[a]	93.00[a]	122.00[a]	111.00[b]	112.00[a]	114.70[c]	34.70[c]	93.00[c]	60.00[e]
CH_4	2.00[a]	3.00[a]	5.10[a]	5.61[a]	6.00[b]	3.40[a]	4.40[c]	0.40[c]	9.59[c]	3.40[e]
NO_X	3.90[a]	3.65[a]	2.60[a]	1.04[a]	0.95[b]	1.96[a]	4.30[c]	2.60[c]	2.28[c]	3.30[e]
SO_2	0.90[a]	0.68[a]	0.40[a]	1.10[a]	1.00[b]	1.10[a]	0.44[c]	0.22[c]	0.18[c]	0.85[e]
OC	2.60[a]	3.70[a]	4.70[a]	7.60[a]	7.80[b]	7.60[a]	2.25[c]	3.30[c]	2.99[c]	3.90[d]
BC	0.37[a]	1.31[a]	0.52[a]	0.56[a]	0.20[b]	0.56[a]	0.78[d]	0.82[d]	0.52[d]	0.52[d]
NH_3	0.56[a]	1.20[a]	1.30[a]	2.47[a]	1.80[b]	1.17[a]	0.68[c]	1.00[c]	4.10[c]	0.37[e]
NO_2	3.22[a]	2.58[a]	3.60[a]	2.34[a]	0.63[b]	2.34[a]	2.99[f]			
$PM_{2.5}$	7.17[a]	7.10[a]	9.90[a]	15.00[a]	18.40[b]	17.90[a]	6.43[f]			
PM_{10}	7.20[a]	11.4[a]	18.50[a]	16.97[a]	18.40[b]	18.40[a]	7.02[f]			

All the value of C were Calculated by CO_2, CO, and CH_4.

[a] is average value from (Akagi et al., 2011).

[b] is average from (Akagi et al., 2011) and (Urbanski, 2014).

[c] is average from (Akagi et al., 2011; Fang et al., 2017; Liu et al., 2016; Santiago-De La Rosa et al., 2018; Stockwell et al., 2015).

[d] is from (Kanabkaew and Kim Oanh, 2011).

[e] is from (Cao et al., 2008).

[f] is from (Li et al., 2007).

Line 27-29: "Moreover, notable seasonal variability characterizes the OBB carbon emissions, with marked increases observed in July and August. This surge in carbon emissions is chiefly attributed to fires in the savanna grasslands, woody savanna/shrubs, and tropical forests of SHAF, SHSA, and NHAF." The peak burning month for NHAF is in boreal winter months. How can the burning in this region contribute to the surge in carbon emissions in July and August?

We changed the content.

"Moreover, notable seasonal variability characterizes the OBB carbon emissions, with marked increases observed in August and September, and lower emissions in winter. These carbon emissions are chiefly attributed to fires in the savanna grasslands, woody savanna/shrubs, and tropical forests of SHAF, SHSA, and NHAF."

Line 166: "EF denotes the amount of pollutants released during burning." This seems not the correct definition or description of the emission factor (EF).

We changed the descriptions of EF.

"EF denotes the amount of pollutants released per unit of fuel burned during burning."

Line 181-182: "significant spatial variations in the OBB carbon emissions were observed across Africa, and certain regions in the Americas and Asia.". How do you define 'significant'? Based on Figure 1, I think the spatial variations in all continents are big.

We changed the content.

"…obvious spatial variations in the OBB carbon emissions were observed across Africa, and certain regions in the Americas and Asia."

Line 215: "According to GFED". Which version of GFED data are you using? Please be more specific.

We revised according to the reviewer's comment. We added version of GFED about GFED data. We changed "GFED" to "GFED4.1s".

Line 230: "This suggests relative homogeneity in the NHAF's biomass–burning emission sources". I don't understand how did you get this conclusion based on the previous results "In the NHAF, the predominant source of OBB was savanna grasslands (Roberts et al., 2009), contributing 76.14% to the region's total biomass–burning carbon emissions, averaging 300.21 Tg/year."

We deleted this ambiguous expression to make it clearer to understand.

Line 233: "...leading to increased OBB and carbon emissions in this region". In fact in this region (NHAF), the emissions from biomass burning have been decreasing during the past 2 decades.

We deleted this ambiguous expression to make it clearer to understand.

"…are the major factors in this region."

Line 257-258: "emissions from SHSA decreased at a rate of 105.22 Tg per year from 2020 to 2022, with peak monthly emissions over the 3 years reaching 184.63, 222.12, and 123.98, respectively, consistent with Griffin et al. (2023)". Griffin et al. (2023) explored the wildfire CO emissions. But it's unclear to me which part of your results is "consistent with" with that paper.

We changed the content to make it clearer to understand.

"…emissions from SHSA decreased at a rate of 105.22 Tg per year from 2020 to 2022, with peak monthly emissions over the 3 years reaching 184.63, 222.12, and 123.98, respectively, size and status of emissions consistent with Griffin et al. (2023)"

Line 259: "NHAF also exhibited a decreasing trend in annual emissions, … over the 3 years". 3 years are too short for deriving meaningful trends in annual emissions.

We changed "NHAF also exhibited a decreasing trend in annual emissions, … over the 3 years" to "annual C emissions in NHAF also declined, …over the 3 years".

Line 316-317: "The top three major emitting regions were SHAF, SHSA, and NHAF, which exhibited emission patterns that aligned closely with global emission trends over time". The comparison between Figure 5 and Figure 6 does not seem to support this conclusion. NHAF emissions have a very different seasonal cycle than SHAF and SHSA. The interannual variability of emissions in these regions is also different.

We changed "The top three major emitting regions were SHAF, SHSA, and NHAF, which exhibited emission patterns that aligned closely with global emission trends over time" to "The top three major emitting regions were SHAF, SHSA, and NHAF, which were closely associated with global emission trends, representing the main source of the emission peak in August and the emission during the winter months."

Line 379: "However, the use of FY–3D, which captures data at 14:00, was highly effective in capturing such events." This is also a statement without supporting evidence. Similar to Terra and Aqua, FY-3D also records data twice a day for a given location and cannot detect short-lived fires. The local time difference between FY-3D and Aqua is only 30 minutes (13:30 vs 14:00), which won't make much difference in the ability to detect agricultural fires.

We changed the description of FY-3D product. Please refer to Line 136.

There are many citations in this manuscript that do not support the text before the citation. It seems that the authors didn't really read and try to understand these references, but just made the citation based on some related keywords. Below is a partial list of inappropriate citations I have found. Please carefully double check the citations throughout the manuscript.

Line 39: (Hussain and Reza, 2023) is not a good citation here; it studied the detrimental impact on global health by general environmental damages, not specifically from open biomass burning. There are many studies in literature about

this topic which can be used for citation here.
Response:
We changed the references.
“and have profound impacts on the global carbon cycle, climate change, and air quality, thus exerting a significant influence on the global environment and human health (Wu et al., 2022).”

Line 40-41: (Estrellan and Iino, 2010) reviewed toxic emissions from open burning. It did not provide evidence for “major fire types worldwide”. So it is also not a good citation.
Response:
We changed the references.
“Forest clearing, accidental fires, firewood burning, agricultural residue burning, peatland burning and straw burning are among the major fire types worldwide (van der Werf et al., 2017).”

Line 42: (Manisalidis et al., 2020) is a review of environmental and health impacts of air pollution. It did not talk about the specific impacts from “open burning activities”.
Response:
We changed the references.
“These open burning activities severely impact air quality and ecosystems and exacerbate climate change and air pollution issues (Anon, 2017).”

Line 44: (Ma et al., 2022) studied wildfires in Amazon during 2019 only. The paper does not support the claim “regions worldwide are experiencing a notable increase in fire incidents”.
Response:
We changed the references.
“…the Amazon rainforest fires (Pivello, 2011) …”

Line 45: (You and Xu, 2023) investigated how delayed wildfires in 2020 promote snowpack melting in the western US. Same as above, this paper does not support the ‘increase in fire accidents’.
We changed the references.
“…wildfires in the United States (Burke et al., 2021) …”

Line 56: (Lv et al., 2020) studies CO2 mixing ratio using satellite observations. They used the GFED dataset for CO2 emissions from biomass burning. This study does not support the previous sentence “Alternatively, a method based on the fire radiative power can effectively enhance the assessment of small fire events, thereby addressing this issue to a certain extent.”
We deleted it. Please refer to Line
“... For example, similar approaches have been employed in Fire Emissions and Energy Research (FEER) and the

Global Fire Assimilation System (GFAS)"

Line 128: (Spawn and Gibbs, sssss2020). Remove the sssss here.
We Remove the sssss here.

Line 255: (Russell-Smith et al., 2021) focus on opportunities and challenges for savanna burning emissions abatement. It did not provide sufficient evidence to support the conclusion "In August, specific meteorological conditions, such as high temperatures and low humidity facilitated the increased combustibility of biomass, resulting in a peak in carbon emissions".
We changed the references to support.
"In August, specific meteorological conditions, such as high temperatures and low humidity facilitated the increased combustibility of biomass, resulting in a peak in carbon emissions (Shea et al., 1996)."

Line 297: (Wiggins et al., 2020) presented estimates of fire emissions in the USA using data from the FIREX-AQ mission. It has little connection to the text preceding the citation.
We changed the references to support.
"typically experience high levels of OBB emissions because of the prevalence of both natural and anthropogenic fire activities (Williams et al., 2019; Zheng et al., 2021)."

Line 308: (Thackeray et al., 2022) did study the precipitation change under global warming, but the main topic of this paper was precipitation extremes. It does not support the statement in this manuscript "an overall augmentation in annual precipitation played a key role".
We changed it.
"… however, an overall augmentation in annual precipitation led to a reduction in the degree of drought (Thackeray et al., 2022; Zhang et al., 2023a)."

There are also many cases where the presentation is poorly structured, vague, or inconsistent.
Line 23-26: The presentations of region names within the parentheses are inconsistent; the full name is shown for some regions, but not shown for other regions.
We added full name for other regions.
"72.71 (Boreal North America; BONA), 165.7 (Temperate North America, TENA), 34.1 (Central America; CEAM), 42.9 (Northern Hemisphere South America; NHSA), 520.5 (Southern Hemisphere South America; SHSA), 13 (Europe; EURO), 8.4 (Middle East; MIDE), 394.3 (Northern Hemisphere Africa; NHAF), 847 (Southern Hemisphere Africa; SHAF), 167.4 (Boreal Asia; BOAS), 27.9 (Central Asia; CEAS), 197.3 (Southeast Asia; SEAS), 13.2 (Equatorial Asia; EQAS), and 82.4 (Australia and New Zealand; AUST) Tg".

Line 27-28: "...notable seasonal variability characterizes the OBB carbon emissions, with marked increases observed *in July and August." Although I understand the meaning of this sentence, it is not well organized. For example, what is the object of comparison when you say 'marked increase'?*

We changed "...notable seasonal variability characterizes the OBB carbon emissions, with marked increases observed in July and August." to "... notable seasonal variability characterizes the OBB carbon emissions, with marked increases observed in August and September (annual average 441.32 Tg C) compared to other months (annual average 170.42 Tg C)."

Line 41-42: "These open burning activities severely impact air quality and ecosystems and exacerbate climate change and air pollution issues." In this sentence "severely impact air quality" and "exacerbate…air pollution" are basically referring to the same thing.

We changed it.

"These open burning activities severely impact air quality and ecosystems ..."

Line 46-47: "These fires release substantial amounts of harmful particulate matter and organic pollutants, posing serious threats to air quality and potentially causing health problems". I don't understand why this sentence is here. Does it represent the same meaning as the first sentence in this paragraph?

We deleted this ambiguous expression to make it clearer to understand.

Line 51: "The burned area method…". I believe most readers don't know what the 'burned area method' is. A short definition or introduction to this method needs to be presented here.

We added a short introduction to this method.

"The burned area method demonstrated good accuracy in quantifying larger fire events, which is based on the burned area, the available biomass fuels burned in fields, the fuel-related combustion efficiency, and emission factors."

Line 52-53: "Shi et al. (2020) estimated OBB emissions in tropical continents from 2001 to 2017 using widely used inventory data, such as the Global Fire Emissions Database (GFED) and the Fire INventory from NCAR (FINN)". I don't think Shi et al. (2020) estimated OBB emissions using GFED and FINN, since GFED and FINN are themselves global emissions datasets.

We changed this ambiguous expression to make it clearer to understand.

"Shi et al. (2020) estimated OBB emissions in tropical continents from 2001 to 2017. As well as other open-access databases, such as the Global Fire Emissions Database (GFED) and the Fire INventory from NCAR (FINN)"

Line 103: "... exhibited superior judgment accuracy". What is 'judgment accuracy' referring to?

We changed the description of FY-3D product. Please refer to Line 136.

Line 117-118: "In contrast, satellite data cover the entire globe and provide surface parameters, thereby enabling biomass estimation." This is a potentially confusing sentence; Ground observations can also "provide surface *parameters and enables biomass estimation".*

We changed it.

"In contrast, satellite data cover the entire globe and provide surface parameters worldwide, thereby enabling biomass estimation."

Line 126-128: "Global AGB for other years was generated based on the global aboveground and belowground biomass carbon density maps for the 2010 product". While I now understand the method by reading the SI, the sentence is not very clear in its current form. It's better to day that in 2010 the Spawn and Gibbs product was used and then say that in other years the AGB was estimated using a scalar based on TC and NDVI. BTW, AGB stands for "above ground biomass"; how did you derive the 'below ground' biomass?

We changed it.

"we combined the "global aboveground and belowground biomass carbon density maps for the 2010" product provided by Spawn and Gibbs(2020), annual TC, and NDVI data, and obtained by linear stretching the fuel loading for other years"

The below ground biomass is also provided by "global aboveground and belowground biomass carbon density maps for the 2010" product.

Line 136: "the subsurface condition" should mean the below ground condition, but I suspect that you are referring to 'surface condition' here.

We changed "the subsurface condition" to "surface condition".

Line 171-172: "the EF for the following seven land types were updated". It's not clear to me what original EF data were used and what data were used to replace (update) them.

We have changed the previous expression.

"…the EF for the following seven land types of other database were updated:"

We also added the reference of the EF data in Table 2.

Line 178-181: Please combine/simplify these three sentences.

We combined these sentences.

"Taking carbon as an example, the annual carbon emissions from OBB were estimated for the period of 2020–2022 (Figure 1) and the total OBB carbon emissions reached 7760.63 Tg C."

Line 261: "Cumulatively, these territories represent…". What are "these territories". Based on the previous paragraph, they should probably include SHAF and NHAF. But these should be explicitly stated.

We changed "these territories" to "SHAF, SHSA, and NHAF ...".

Line 317: "Over the past 3 years". The 'past 3 years' can change depending on the reference year. This kind of *description should be more specific.*

We changed “Over the past 3 years” to “During 2020 to 2022”.

Line 427: What are “substrate types”?

We changed incorrect description.

“To address the varying fire conditions, we performed a detailed subdivision based on different fire types.”

There are other minor issues, including potential errors or typos

Line 60: “MEIRSI–2” should be “MERSI-2”

We corrected it.

Figure 2: If these geographical regions are the same to that in GFED, you probably need to acknowledge/cite the GFED group/paper.

We've added citation information.

Line 269: “intensify both the frequency and frequency of fires in the area”. One ‘frequency’ should be removed or changed to other words.

We removed it.

Line 280: “in the Tropical Eastern North America (TENA) region”. As shown in Figure 2, TENA should be ‘Temperate North America’.

We changed “in the Tropical Eastern North America (TENA) region” to “in the Temperate North America (TENA) region”.

Line 435-436: “Although the FY–3D GFR dataset is reliable for most OBB events, its resolution of 1 degree…” Shouldn’t the resolution of FY-3D GFR dataset 1 km?

We changed “1 degree” to “1 km”.

References

Abbasi, B., Qin, Z., Du, W., Fan, J., Zhao, C., Hang, Q., Zhao, S., and Li, S.: An Algorithm to Retrieve Total Precipitable Water Vapor in the Atmosphere from FengYun 3D Medium Resolution Spectral Imager 2 (FY-3D MERSI-2) Data, Remote Sensing, 12, 3469, https://doi.org/10.3390/rs12213469, 2020.

Akagi, S. K., Yokelson, R. J., Wiedinmyer, C., Alvarado, M. J., Reid, J. S., Karl, T., Crounse, J. D., and Wennberg, P. O.: Emission factors for open and domestic biomass burning for use in atmospheric models, Atmospheric Chemistry and Physics, 11, 4039–4072, https://doi.org/10.5194/acp-11-4039-2011, 2011.

Archibald, S., Roy, D. P., Van WILGEN, B. W., and Scholes, R. J.: What limits fire? An examination of drivers of burnt area in Southern Africa, Global Change Biology, 15, 613–630, https://doi.org/10.1111/j.1365-2486.2008.01754.x, 2009.

Cao, G., Zhang, X., Wang, Y., and Zheng, F.: Estimation of emissions from field burning of crop straw in China, Chin. Sci. Bull., 53, 784–790, https://doi.org/10.1007/s11434-008-0145-4, 2008.

Chen, J., Yao, Q., Chen, Z., Li, M., Hao, Z., Liu, C., Zheng, W., Xu, M., Chen, X., Yang, J., Lv, Q., and Gao, B.: The Fengyun-3D (FY-3D) global active fire product: principle, methodology and validation, Earth System Science Data, 14, 3489–3508, https://doi.org/10.5194/essd-14-3489-2022, 2022.

Dong, Z., Yu, J., An, S., Zhang, J., Li, J., and Xu, D.: Forest Fire Detection of FY-3D Using Genetic Algorithm and Brightness Temperature Change, Forests, 13, 963, https://doi.org/10.3390/f13060963, 2022.

Fang, Z., Deng, W., Zhang, Y., Ding, X., Tang, M., Liu, T., Hu, Q., Zhu, M., Wang, Z., Yang, W., Huang, Z., Song, W., Bi, X., Chen, J., Sun, Y., George, C., and Wang, X.: Open burning of rice, corn and wheat straws: primary emissions, photochemical aging, and secondary organic aerosol formation, Atmospheric Chemistry and Physics, 17, 14821–14839, https://doi.org/10.5194/acp-17-14821-2017, 2017.

Freitas, S. R., Longo, K. M., Silva Dias, M. A. F., Silva Dias, P. L., Chatfield, R., Prins, E., Artaxo, P., Grell, G. A., and Recuero, F. S.: Monitoring the transport of biomass burning emissions in South America, Environ Fluid Mech, 5, 135–167, https://doi.org/10.1007/s10652-005-0243-7, 2005.

Giglio, L.: Characterization of the tropical diurnal fire cycle using VIRS and MODIS observations, Remote Sensing of Environment, 108, 407–421, https://doi.org/10.1016/j.rse.2006.11.018, 2007.

Giglio, L., Randerson, J. T., van der Werf, G. R., Kasibhatla, P. S., Collatz, G. J., Morton, D. C., and DeFries, R. S.: Assessing variability and long-term trends in burned area by merging multiple satellite fire products, Biogeosciences, 7, 1171–1186, https://doi.org/10.5194/bg-7-1171-2010, 2010.

Kanabkaew, T. and Kim Oanh, N. T.: Development of Spatial and Temporal Emission Inventory for Crop Residue Field

Burning, Environ Model Assess, 16, 453–464, https://doi.org/10.1007/s10666-010-9244-0, 2011.

Le Page, Y., Pereira, J. M. C., Trigo, R., da Camara, C., Oom, D., and Mota, B.: Global fire activity patterns (1996–2006) and climatic influence: an analysis using the World Fire Atlas, Atmospheric Chemistry and Physics, 8, 1911–1924, https://doi.org/10.5194/acp-8-1911-2008, 2008.

Li, S. and Banerjee, T.: Spatial and temporal pattern of wildfires in California from 2000 to 2019, Sci Rep, 11, 8779, https://doi.org/10.1038/s41598-021-88131-9, 2021.

Li, X., Wang, S., Duan, L., Hao, J., Li, C., Chen, Y., and Yang, L.: Particulate and Trace Gas Emissions from Open Burning of Wheat Straw and Corn Stover in China, Environ. Sci. Technol., 41, 6052–6058, https://doi.org/10.1021/es0705137, 2007.

Liu, X., Zhang, Y., Huey, L. G., Yokelson, R. J., Wang, Y., Jimenez, J. L., Campuzano-Jost, P., Beyersdorf, A. J., Blake, D. R., Choi, Y., St. Clair, J. M., Crounse, J. D., Day, D. A., Diskin, G. S., Fried, A., Hall, S. R., Hanisco, T. F., King, L. E., Meinardi, S., Mikoviny, T., Palm, B. B., Peischl, J., Perring, A. E., Pollack, I. B., Ryerson, T. B., Sachse, G., Schwarz, J. P., Simpson, I. J., Tanner, D. J., Thornhill, K. L., Ullmann, K., Weber, R. J., Wennberg, P. O., Wisthaler, A., Wolfe, G. M., and Ziemba, L. D.: Agricultural fires in the southeastern U.S. during SEAC4RS: Emissions of trace gases and particles and evolution of ozone, reactive nitrogen, and organic aerosol, Journal of Geophysical Research: Atmospheres, 121, 7383–7414, https://doi.org/10.1002/2016JD025040, 2016.

Santiago-De La Rosa, N., González-Cardoso, G., Figueroa-Lara, J. de J., Gutiérrez-Arzaluz, M., Octaviano-Villasana, C., Ramírez-Hernández, I. F., and Mugica-Álvarez, V.: Emission factors of atmospheric and climatic pollutants from crop residues burning, Journal of the Air & Waste Management Association, 68, 849–865, https://doi.org/10.1080/10962247.2018.1459326, 2018.

Shi, Y. and Yamaguchi, Y.: A high-resolution and multi-year emissions inventory for biomass burning in Southeast Asia during 2001–2010, Atmospheric Environment, 98, 8–16, https://doi.org/10.1016/j.atmosenv.2014.08.050, 2014.

Stockwell, C. E., Veres, P. R., Williams, J., and Yokelson, R. J.: Characterization of biomass burning emissions from cooking fires, peat, crop residue, and other fuels with high-resolution proton-transfer-reaction time-of-flight mass spectrometry, Atmospheric Chemistry and Physics, 15, 845–865, https://doi.org/10.5194/acp-15-845-2015, 2015.

Urbanski, S.: Wildland fire emissions, carbon, and climate: Emission factors, Forest Ecology and Management. 317: 51-60., 51–60, https://doi.org/10.1016/j.foreco.2013.05.045, 2014.