Jin et al., 2023 present a comparison study of 8 biomass burning (BB) inventories using the Weather Research Forecasting model coupled with Chemistry (WRF-Chem) configured with the Model for Ozone and Related chemical Tracers (MOZART) and the Model for Simulating Aerosol Interactions and Chemistry (MOSAIC). They assess how these BB inventories impact aerosol optical properties (AOPs) such as, aerosol optical depth (AOD), aerosol absorption optical depth (AAOD), and aerosol extinction coefficients (AEC). Additionally, the direct radiative forcing (DRF) of BB aerosol was assessed. The AOPs were compared against ground and satellite-based measurements. This study is valuable to the ACP community as BB events increase in frequency, furthering the need to understand the biases certain BB inventories impose on AOPs. With that said, the authors need to address a number points prior to publication.

What is the rationale behind choosing March 2019 as the study timeframe? How does the fire season (March 2019) compare to other fire seasons in the region, was it representative of the average conditions (or anomalously high/low)?

The influence of external dust aerosol on AEC is mentioned in section 3.5, 4.2, and in the summary and conclusions. Can you provide more details on how external dust (or other inorganic aerosols e.g., sea salt aerosol) impacts the AEC profiles?

Lines 553 – 556, Jin et al. mention that when direct and indirect radiation feedbacks are included in WRF-Chem they improve the representation of AOPs, but indirect radiation feedbacks are not included in their simulations. Jin et al., mention that this, “may also lead to biases in the AOPs” (Line 556), but what specifically are those biases? Please expand on this point.

The semi-direct effect from absorbing aerosols (AAs) is another important process that impacts DRF. AAs are effective at absorbing shortwave radiation in the atmosphere and can burn-off clouds (impacting DRF). Is this process included in this modelling framework? A useful study for this may be Mallet et al., 2020.

Understanding more details of the aerosol composition in the BB inventories will be useful. How are aerosol mixing processes (external and internal mixed aerosol) included in your modelling framework? These mixing processes will impact the hygroscopicity of aerosols, impacting AOPs depending on the aerosol composition of each inventory.

Minor points are below.

Figures 3, 4, and 13 should have the inventories labelled on the top of the panel. This will make it easier to interpret the results.

Line 152 – is “gas” referring to SO_2 and NH_3 (as it is on line 310)? If so, I might suggest just stating SO_2 and NH_3 explicitly as “gas” is somewhat ambiguous.

Lines 321 – 322, Jin et al., mention that QFED exhibits a lower BC to OC ratio compared to the other inventories. Do you have any comments as to why this inventory leads to a lower BC/OC compared to the other inventories?

Line 493 – 494, “(with FINN2.5 MOSVIS reaching a maximum of 70 W m^{-2})” Please make it clearer what maximum you are referring to.

In table 1, I suggest changing the “Main EF” label to “EF reference (s)”. Make it clear that these are references.

(As an example) Line 45 uses “W/m^2”, please change all instances of this to “$W\ m^{-2}$”.

On figure S1, please remove the “figure” label at the top left.

Figure S2, make it clearer which letter labels refer to which of the 23 cities.

References:

Mallet, M., Solmon, F., Nabat, P., Elguindi, N., Waquet, F., Bouniol, D., Sayer, A. M., Meyer, K., Roehrig, R., Michou, M., Zuidema, P., Flamant, C., Redemann, J., and Formenti, P.: Direct and semi-direct radiative forcing of biomass-burning aerosols over the southeast Atlantic (SEA) and its sensitivity to absorbing properties: a regional climate modeling study, Atmos. Chem. Phys., 20, 13191–13216, https://doi.org/10.5194/acp-20-13191-2020, 2020.