Comment on acp-2021-494
Anonymous Referee #1

Referee comment on "The outflow of Asian biomass burning carbonaceous aerosol into the upper troposphere and lower stratosphere in spring: radiative effects seen in a global model" by Prashant Chavan et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-494-RC1, 2021

General comments:

The paper, basing on model simulations validated with satellite and ground observations, investigates the transport of carbonaceous BB to the Upper Troposphere – Lower Stratosphere during spring and its impact on the radiative balance. The manuscript is presented in a clear and well-structured manner, and the topic is of relevance. I therefore encourage its publication, provided some minor revisions:

Specific comments:

Lines 36-37: "It is one of the major sources of a large carbonaceous aerosol loading” This sentence needs to be more specific/referenced.

Lines 79-80: Are those all the references for the projects? It seems like one is missing.

Lines 105: is there any reference for AEROCOM-ACCMIP-II?

Lines 107-108: GICC, RETRO and GFED v2: are they summed/averaged? How are they used all together?

Lines 109-110: Many inventories are representative only of averages over specific periods: is there a reason why forest and grass fires emissions are mentioned specifically in this respect?

Lines 117: Is it necessary to mention sea salt and dust?

Lines 125-126: It is not clear how the setup of the simulations were made: what is meant in particular by "starting between 1 and 10 January 2012 and ending on 31 December 2013 to explore the variability due to the initial conditions.”? In which way do you vary the initial conditions? Are those variations the same between the members of the BMaerooff and the of BMaeroon?

Lines 141-143: The fire counts product is not properly presented and it remains unclear what does the mcd14d variable is representing. Where does it come from? Can the author
put a summary sentence about the basics on how these values are estimated?

Lines 210-211: Is there any existing inter-comparison study that explains/show such difference between the two products?

Fig 2: Is the amount of aerosol over the Himalaya indicated in the simulation expected to be a model overestimation, or can it be plausible? Why are there such low modelled values with respect to measurements in the region southerner than 10N? It seems quite a coherent pattern, is it related to any specific circulation feature?

Lines 250-252: Please, justify this statement more in depth.

Lines 381-382: This sentence is too generically formulated!

Line 411: This is the first time in the whole manuscript that the ENSO is mentioned. A) It is worth to have a short indication of the reason why this is relevant for the presented study B) If kept, since it is the only time it is referred, the acronym has to be rewritten in full extension.

Lines 421-426: those two sentences are somehow a repetition.

Lines 454-455: It would be useful here for the reader to have a more quantitative way to understand what “counterbalanced” means. Which are the typical values of stratospheric cooling by CO2?

**Technical comments:**

Fig.2 is a bit messy and non-coherent in all its panels' layout (sizes and position of panels and fonts). This is for example particularly evident when trying to compare the results of panels e and f. Also, it will be useful to specify in the title of those two panels which one is BMaeroon and which is from OSIRIS. Moreover, it will be better to have the same color scale.

I would also suggest making the caption lighter, moving the information with the location of the different stations in a separated table.

Fig.3: Is there any specific reason why the panel b, with the DUST anomaly, is not in the same domain as the others? It would be very useful to have the same, also, since we are missing otherwise the information on the high dust aod contribution over East-China that seems to be suggested from panel c. What is the purpose of the wind arrows of figure 3b?

S1: The caption should specify that those are *relative* anomalies

Line 285: ..reported A radiative forcing...

Figure 5: I would strongly suggest to report panel b and panel d in the same longitude range and size, to easily individuate the regions of uplift.

Figure 6: Please adjust the size of the figures, which looks vertically stretched.