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Comment on acp-2022-33

Anonymous Referee #1

Referee comment on "Simulating wildfire emissions and plume rise using geostationary satellite fire radiative power measurements: a case study of the 2019 Williams Flats fire" by Aditya Kumar et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-33-RC1, 2022

This is a very interesting study to combine the WRF-Chem model and GOES-16 FRP-based emission and to comprehensively compare the model results with FIREX-AQ field campaign. By conducting the simulation based on the default emission module and newly-developed emissions, the authors provided a detailed analysis to interpret aerosol observations during the 2019 Williams Flats fire in Washington. Overall, I enjoy reading the manuscript, especially the introduction part which provides a really nice overview of the current emission inventory and model development for wildfire simulation. The experiments are well designed and the presented results are generally convinced. The topic is suitable for publication in ACP after addressing some specific comments listed below.

It seems that the authors used the weather forecast data GFS to drive the WRF model. How did the WRF model reproduce the meteorological parameters during the wildfire, like wind field and air temperature stratification, which are vital for plume rise and the dispersion and transport of smoke? There have been many studies demonstrating that intense fire pollution would greatly modify the weather pattern. I wonder if the initial/boundary conditions from forecasted GFS data can well capture the evolution of the weather pattern and meteorological conditions on both local and regional scales. Therefore, I recommend more evaluation on the model performance of meteorology during the fire.

Another, the authors conducted a great deal of work on the evaluations of AOD, BC and OC concentrations among different simulations. Regarding the AOD comparison, the satellite-detected AOD image could be employed to illustrate the distribution patterns in the real world. In addition to elaborating the disparities of WRF-Chem simulation using 3BEM and FRP emissions, I do think that the uncertainties in measurements ought to be briefly introduced. For instance, SP2 measurements tend to underestimate the BC concentration and it is somehow different from BC simulated in the model.

Another suggestion is to briefly describe the Williams Flats fire, air quality observations and the flight measurements before comparing the model results in detail. I am a little bit missing in Section 4.2, especially when the titles of each subsection are flight date. More information concerning the fire spots and flight date could be plotted on Figure 1. One may get a clearer picture if some general descriptions for each case are added before 4.2. Another, the set of figures (Fig.4-7, Fig. 8-11...) for each flight are quite similar, which are suggested to be diversified according to the main points from each comparison.

Minor comments:

The authors used the units μg/sm3 throughout the manuscript. Please double check sm3.

Figure 2, The time is suggested to be presented as UTC since UTC time is used throughout the manuscript.

Line 975-981: Since that GOCART does not resolve the size distribution of BC, OC and other secondary aerosol components, as mentioned in Line 217-219, a more comprehensive chemistry mechanism with size distribution treatment is also needed.

Table 1: add the units for BC and OC concentration