Comment on acp-2022-517

Anonymous Referee #2

Referee comment on "Effects of transport on a biomass burning plume from Indochina during EMeRGe-Asia identified by WRF-Chem" by Chuan-Yao Lin et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-517-RC2, 2022

General comments:
 The authors present chemical signature and transport of biomass burning plumes originating from Indochina peninsula and extending to northeast, using WRF-Chem simulations supported with airborne observations during EMeRGe-Asia campaign in March 2018. The meteorological field and transport mechanism are well described. The model captures the enhanced CO, BC, and OA, by comparing the simulations with and without the biomass burning influences, but tended to overestimate observations, pointing to the possibility that the FINNv1.5 emission inventory had high biases. The model analysis was extended to J values, HOx radicals, and CCN formation to estimate contributions from biomass burning.
 Observational data to assess the regional impact of biomass burning plumes originating from Indochina peninsula have been still rare and thus the aircraft observations and the associated model simulations presented in this manuscript are important. However, more clarification is needed to justify some of the conclusions. First, the authors should be able to specify the locations and date of the fires likely affecting the studied events. Precipitation and cloud processes during the long-range transport should be mentioned even if negligible, to characterize potential loss of aerosol species and to fully attribute the differences to the emissions. The degrees of overestimation should be quantitatively assessed and mentioned in the abstract more clearly.
 Second, details of chemical pathways that enhanced the OH and HO2 levels in the model should be described. This part is purely from model results - to prvide associated observational evidence is recommended (also for J values, cloud condensation nuclei and cloud water). Overall, revisions are necessary before considering publication.

Specific comments.
1. Line 101. Similar to what?
2. Line 154. The authors state that OH and HO2 are listed in the HALO aircraft data but in fact they were not observed. (only HO2+RO2)
3. Line 178. Is acetone dominant for KET? For example, MACR and MVK from isoprene chemistry could also contribute? Emissions of acetone from anthropogenic and biomass burning should be briefly discussed.
4. Lines 184, 190, and 412. MICS-Asia III and TEDS emissions were used - for which year?
5. Line 200. Can the authors describe whether the intensity of biomass burning in

Indochina peninsula during this particular period in 2018 was at normal level or not, in comparison to other years?

6. Line 203. It seems that the center of the high pressure system is present over the Japan (Japan Sea), rather than Korea.

7. Line 269. SO_2 enhancement is attributed to Japan - perhaps volcanoes have contributed?

8. Line 311. Carmichael

9. Line 312. Figure 6b indicates biomass burning influence is spread to the north of 30 degN.

10. Line 338. As ACN and ACE contain oxygen and nitrogen in their molecules, they are not hydrocarbons.

11. Line 350 and 352. Use uppercase 1 for $J(O1D)$.

12. Lines 351 and 479. Whether aerosols increase or decrease $J(O1D)$ will be dependent on the assumed single-scattering albedo. Any evidence from direct observations of the J values?

13. Line 404. It is better to confirm that the CO hemispheric baseline is not overestimated.

14. Line 416. It is important to confirm that OA and BC have not been removed by wet deposition on the way of transport, to better attribute the model's overestimation to emissions.

15. Line 447. "detraining" is difficult to understand.

16. Line 457. The sentence starting with" The variation trend of PM2.5 ..." needs to be rewritten.

17. Line 471. Which processes were responsible for the OH and HO_2 enhancement? How well VOCs emissions and chemistry were treated to describe the OH and HO_2 budget?

18. Line 513. Any observational evidence of CCN or cloud water enhancement, attributable to the biomass burning plume?

19. Figure 3a, b: As the highest CO area is distant from Indochina peninsula on the day, the authors should be able to state the possible locations and date of fires producing the plumes.