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Comment on acp-2022-517

Anonymous Referee #1

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-RC1, 2022

In this paper the WRF-Chem atmospheric chemistry model is used to study the impact of biomass burning plumes in southeastern Asia. Overall the paper is well written. But there are a couple of major issues that need to be addressed before the paper considered for publication:

The fire plume rise and its simulation by WRF-Chem aren't discussed in the paper, thought there is extensive analysis of the vertical distribution of the biomass burning plumes. The fire plume rise is an important process by which aerosol and gaseous species from wildland fires are injected into the free troposphere, where they can be transported to long distances. WRF-Chem has an 1D plume rise parameterization (Freitas et al.). It isn't clear if this scheme was used, and how it performed, associated uncertainties and their imapact on the findings on the results presented here.

Figure 12 shows the effect of the smoke plume on cloud water. However, I can't find any description of the model configuration on how the aerosol feedback on the meteorology is simulated in this study. There are several feedback mechanisms of the aerosols on meteorology. Although WRF-Chem contains a few parameterizations to simulate these processes, large uncertainties remain with respect accurate representation of the aerosol-radiation-microphysics interactions. Authors present the results for such complex phenomena in a single graph without thorough discussion and sensitivity analysis (e.g. direct vs. indirect feedback). Moreover, given the relatively low aerosol concentrations in the smoke plumes analyzed here the sensitivity of the simulated cloud water concentrations to smoke plumes seem to be overly large.

The concluding statements (L575-579) aren't necessarily based on the findings from this study.

Minor comments:

It'd be helpful to add a Table to list the WRF-Chem model configuration. Some of the settings are listed in the text. Information on the lateral boundary conditions for the chemical species, their cycling between the subsequent simulations and fire plumerise are missing. How the wet removal of the gas and aerosol species are parameterized in the model?

The paper doesn't provide any information about the measurement uncertainties for the chemical species. For instance, the AMS data (OA, sulfate concentrations reported here) usually have significant uncertainty due to the collection efficiency and cutoff size (<1micron).

L156: For WRF-Chem the more recent paper (Powers et al.) can be also cited.

L272: What do you mean by "stable"?

Chapter 3.3: this chapter needs to be shortened.

References:

- R. Freitas, K. M. Longo, R. Chatfield, D. Latham, M. Dias, M. O. Andreae, et al.Including the sub-grid scale plume rise of vegetation fires in low resolution atmospheric transport models.Atmospheric Chemistry and Physics 2007 Vol. 7 Issue 13 Pages 3385-3398
- G. Powers, J. B. Klemp, W. C. Skamarock, C. A. Davis, J. Dudhia, D. O. Gill, et al.THE WEATHER RESEARCH AND FORECASTING MODEL Overview, System Efforts, and Future Directions.Bulletin of the American Meteorological Society 2017 Vol. 98 Issue 8 Pages 1717-1737