Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2019-808-RC1, 2019

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Relative effects of open biomass and crop straw burning on haze formation over central and eastern China: modelling study driven by constrained emissions" *by* Khalid Mehmood et al.

Anonymous Referee #1

Received and published: 7 November 2019

General comments:
Open biomass burning (OBB) is one of the major air pollution sources in many regions including central and eastern China (CEC). However, it's challenging to accurately estimate its emission amounts using either bottom-up or top-down methods. The bottom-up method suffers from large uncertainties in estimation components such as surface fuel loading, fuel consumption, and emission factors, while the top-down method has difficulties in detecting small fires like open crop straw burning (OCSB) studied in this work. Here the authors used a two-way coupled chemical transport

model (WRF-CMAQ) as well as ground and satellite observations to constrain a presumably biased satellite-based fire emission inventory (FINNv1.5) for the CEC region during a pollution episode in June 2014. They also evaluated regional air quality impacts of biomass burning based on the optimized OBB/OCSB emissions. The topic is within the scope of the journal, and the manuscript is well-organized and -written. However, some concerns regarding the generalization of its method and results exist. Therefore, I suggest its publication in the journal after addressing the following issues.
(1) The first and the biggest concern is about its scientific significance. This study mainly focused on a short time period less than a month. The major OBB/OCSB burning episode is about 10 days in EP2 from June 5 to 14, 2014. The authors spent their most efforts on scaling fire emissions in three time periods (EP1-3) and different CEC regions (Henan, Anhui, and other provinces over CEC) to reduce the normalized mean bias (NMB) as a metric of modeling performance. Since the studying time period is relatively short, this approach tends to fall into the "overfitting" problem as a common modeling error. It's questionable how robust are these scaling factors as shown in Fig. 7 as they are even distinct in different studying time periods (EP2 vs. EP1/3). It would be more interesting to extend the time scale and produce more generalizable optimization of biomass burning emissions in CEC with increased scientific merit.
(2) Regarding the research methodology, the authors essentially used a "trial and error" method to approach an optimal estimate of regional OBB emissions that led to a relatively good agreement between PM2.5 simulations and ground observations. Though it is straightforward by tweaking adjustment coefficients of total OBB emissions, this method has several limitations such as computationally expensive and cumbersome, indistinguishable bias sources, and possible over-adjustment. Given large uncertainties in many aspects of PM2.5 simulations, it is easy to ascribe the modeling discrepancy to wrong causes and correct the model to get a good-looking result for some wrong reason. It is suggested to do more comprehensive model evaluation in terms of aerosol speciation (to help identify OBB/non-OBB source contributions) and spatial distributions (both horizontal and vertical) before correcting

OBB primary emissions.
(3) A two-way coupled WRF-CMAQ model was used in this study, which considered aerosol-radiation interactions inherently. However, there is no discussion about this at all in the results and discussion section. The authors list the advantages of this fully coupled model by referring to a series of previous studies in the method section, then this key feature seems to be forgotten in the following sections. Readers would be interested in many questions related with aerosol feedbacks, such as how important those aerosol-radiation interactions are in the regional pollution episode, can they affect local weather systems and pollution severity significantly, etc.

Some technical corrections are listed below.
(1) Please add specific values for these parameters in Eq. (1) and Eq. (2).
(2) In Fig. 4, please indicate which modeling experiment is the PM2.5 simulation based on.
(3) In Fig. 12, please add unit in the label bar.
(4) Table 1 looks fuzzy due to the low resolution. Please improve the presentation quality.