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Interactive comment on "The FireWork v2.0 air quality forecast system with biomass burning emissions from the Canadian Forest Fire Emissions Prediction System v2.03" *by* Jack Chen et al.

Anonymous Referee #1

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The authors compare modeling system predictions of PM2.5, O3, and NO2 against routine surface measurement sites from 3 different forecasting systems: 1) a system with no wildfire, 2) the existing version of the Canadian forecasting system, and 3) the newly updated Canadian forecasting system. Simulations 2 and 3 include wildfire emissions, which are treated differently in each system. Multiple enhancements to simulating wildfire emissions were implemented in the new forecasting system compared to the existing system including emission factors, plume height, and vertical distribution of smoke emissions within the plume.

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Discussion paper

Wildfire impacts are important to provide so that the public can be better informed about potential or actual exposure to change behavior to try and minimize exposure. The work presented here is very relevant and important for the broader modeling community and providing confidence in the approach is important toward establishing confidence in the forecasting product being provided to the public to understand reliability in the forecast. Overall, the changes made to the approach for estimating wildfire emissions make sense and would seem to favor an improved forecast. It is not totally clear which changes make the most impact since they were not systematically evaluated. However, the main concern is that it is not clear based on the information provided how well the system is performing for capturing smoke impacts. This is important work and very useful information that should be published. Comments that follow are intended to provide a stronger evaluation to more clearly isolate how the improvements in the forecasting system improve performance, which is a challenge since many monitors will typically be largely impacted by non-wildfire sources.

Too many monitor locations and too long of a period were aggregated, which really limits our understanding of how much better the new system is at predicting smoke impacts on PM2.5, O3, and NO2. A clearer demonstration (maybe in addition to the broad evaluation provided) would be to focus on a specific area of monitors that were known to be impacted for a few days or weeks by wildfire and see how well each of the modeling systems capture this known episode. Another approach would be to provide the monitor comparisons only when the model is predicting smoke impacts (whether either of the systems with wildfire emissions predicted smoke impacts). The way the information is presented it is not clear at all how well each system captures fire impacts, in particular for O3 and NO2. This is because the model performance is likely dominated by other sources or regions and not by the wildfire and the new approaches for estimating smoke may simply be compensating for underrepresentation of other sources. So if the authors can focus on monitors with periods dominated by wildfire impacts that would help make the evaluation much clearer.

The literature review in the introduction misses a few newer papers that looked at the performance of the Briggs approach. In these papers the Briggs approach performed reasonably for wildfire when provided realistic information about the fire size and timing. It does not appear that the approach limits plume tops to the modeled PBL height or uniformly distributes emissions through the plume. These may simply be choices made by the model developers for their implementation of Briggs but it begs the question about why these limitations were imposed in this system (or the older version of the system). Briggs is a component of the CMAQ model used for air quality forecasts by NOAA so references for that system may be relevant for the modified Briggs approach (Baker et al., 2018; Zhou et al., 2018) and a very brief note that the modified Briggs has been implemented differently in other systems.

Using 2010 Canadian emissions and 2011 U.S. emissions to represent 2017 (and later) will result in an overestimation of pollutants due to significant reductions in mobile source emissions (fleet turnover, emissions standard in the U.S. implemented in 2017, and fuel standard implemented in the U.S. in 2017) during this period, plant shutdowns, and fuel switching by EGUs from coal to natural gas. The emissions should be updated for the forecasting system and adjusted to reflect broader sector reductions. For the purposes of this manuscript and evaluation, the authors do not need to re-do the entire evaluation with newer emissions but need to clearly recognize that the emissions are likely leading to large overestimates of some species (like NOX in particular) which confounds the evaluation since wildfire NOX may not make performance "look better".

It is not clear which emissions are used for each system. Are fuel and combustion specific emissions used in any of the simulations? Text suggests they may be in the analysis but other text and the Tables suggest otherwise. What is the source of the emission factors? Please provide the speciation profiles for the different combustion components for VOC and PM2.5 in the supporting information with a citation as that is important and would be valuable to others modeling wildfire.

References

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