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Interactive comment on "Enhanced atmospheric oxidizing capacity in simulating air quality with updated emission inventories for power plants especially for haze periods over East China" *by* Lei Zhang et al.

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Review comments on "Enhanced atmospheric oxidizing capacity in simulating air quality with updated emission inventories for power plants especially for haze periods over East China" by Lei Zhang et al.

General comments:

This manuscript, using with and without an updated emission inventory of coal-fired power plants (UEIPP) in Multi-resolution Emission Inventory for China (MEIC) to drive

WRF-Chem model, analyzes impacts of emissions and the atmospheric oxidizing capacity on particulate and ozone precursors, especially PM2.5 episode in east China's Jiangsu Province. The UEIPP developed by collecting the online monitoring data from power plants (Zhang et al., 2015) is considered as a more realistic way to obtain accurate point emission data for East China. Based on the analysis of regional air quality impacts of change in power plant emissions, the study addresses that the uncertainty in the MEIC emission data can be partly reduced by improving the accuracy of the point source emission inventory which is one of key uncertainty sources influencing modeling results in East China. Power plant is one of five sectors (power, industry, transportation, residential, and agriculture) defined in MEIC system. The subject is important for atmospheric science community and environmental protection agencies to understand the importance of development of the completed emission inventory for evaluation of the effect of air pollution control measures. The results are interesting and scientifically meaningful. However, just one mechanism (WRF-Chem/CBM-Z) applied to the study may be not enough to study atmospheric oxidizing capacity because changes in OH and VOC oxidation in the presence of NOX are sensitive to chemistry mechanisms [Jimenez et al., 2009; Stockwell et al., 2011; Knote et al., 2015; Derwent, 2017]. The authors are encouraged to use more different chemistry mechanisms to validate the results.

In addition, the paper needs some English improvements for being written more precisely. Please have the manuscript examined by a native English speaker or ask for editor's help to improve the overall language of the paper. I recommend its publication basically in a revision in accordance with the review comments.

Major comments:

1. Please provide more references and discussions why the elevated emissions are able to lead to "more significant environmental effect through regional transport than the surface emissions" as stated at Line 80 – 83 on Page 4. Is that because elevated emitted particulate and ozone precursors get longer life cycles in upper air or are able

to be regionally transported or because of the both? All the more reason why to say so. Do you think power plant emissions considered as point source is more important than on-road emissions in studying of impacts of sources on local/regional air quality? Why?

2. For the initial and boundary conditions (IBC) for the WRF-Chem simulation for December 1 – 31, 2013, the "default initial and boundary chemistry profiles in the model were selected" according to statement at Line 125 on Page 6. Please define what the default initial and boundary conditions are, and clarify why "the default" IBC should be used. I wonder if the authors considered the time-varying chemical boundary conditions should be used because the simulation time period of about one month is longer enough to consider the impact of inflow and background concentrations of O3 and relatively long-lived VOCs on domain solutions.

3. To understand the difference between the two emission systems, it is better to replace the absolute quantity of emissions in MEIC and UEIPP in Fig. 2 by the emission difference between MEIC and UEIPP.

4. Please provide which version of WRF-Chem model was used for this study in Subsection 2.1 Model description and configuration.

5. The NMVOCs in UEIPP are translated to lumped VOC compounds in RADM2 mechanism according to the statements in the last paragraph of Subsection 2.3.1 on Page 8. However, WRF-Chem with CBMZ is likely used for the air quality modeling (refer to Line 117 on Page 6). I am wondering, in RADM2 and CBMZ, which gas phase mechanism is eventually used in the study.

6. Please clearly state which model domain (I think it should be 5-km domain) results were used for model performance evaluation in Section 3 Modeling evaluation.

7. It is well-known that win speed and wind direction are both determinant in the horizontal transport of air pollutants. The local concentration of air pollutants is affected by

not only wind speed but also wind direction. In Subsection 3.1 Meteorological evaluation, please provide solid reason(s) why the evaluation of wind direction is missed or ignored.

8. The discussions about the relationship between the overestimated SO2 and the underestimated sulfate in Page 12 are interesting. I hope the authors continue their investigation of this issue because sulfate is one of important precursors to secondary aerosol and PM2.5. On the conversion of SO2 to sulfate, authors may refer to the paper by He et al. (2014).

9. In subsection 4.1, I suggest the authors to take advantage of the result of VOC-limited in Section 4.2. It is helpful to understand why the enhanced O3 is caused by the increased VOC rather than decreased NO2 in UEIPP.

10. The arguments for the increased PM2.5 modeled by MOD2 in the last paragraph of Section 4.1 are very interesting but the more solid quantitative evidences are needed to support.

11. To further understand why modeled increase in sulfate, nitrate, and PM2.5 concentration is associated with reduction in emissions of SO2 and NOx in UEIPP, the authors may refer to a news report entitled "The Real Reasons China Is Struggling To Control Its Pollution Problem" at http://fortune.com/2017/01/10/china-red-alert-pollution-pm2-5/.

Minor comments:

1. Line 37 on Page 2: ". . . play a determinant role in deteriorating air quality . . ." might be ". . . play a key role in air quality,. . .".

2. Line 42 on Page 2: ''. . . emission inventories covering East China . . ." should be ". . . emission inventories for East China . . .".

3. Line 61 on Page 3: ". . . chemical reactions involving particle formations, SO2, NOX, O3 and oxidizing radicals." may be changed into ". . . chemical reactions involved in particle formation and O3 production due to emission changes in particle and ozone

precursors".

4. Line 65 – 67 on Page 3: "An understanding of the power plant emissions in East China and subsequently a reliable evaluation of their environmental changes and effects using air quality models largely depend on the accuracy of pollutant emission inventory" is better changed into "A studying focusing on the reliable power plant emission inventory for East China used for air quality models is helpful to understand the real situation of air pollution and quantitatively assess impacts of emission sources on air quality in East China".

5. Line 72 – 73 on Page 3 and 4: "the inaccuracy in estimating individual power plant emissions is always a defect that rendering intrinsic biases between observed and modeled air pollutant concentrations" might be "the inaccuracy of emissions from any local power plants can be considered as one of sources of uncertainty to lead to model bias".

6. Line 79 on Page 4: "shrouded this region in recent years, attracting wide scientific and governmental attention" can be written as "have shrouded this region in recent years and the poor air quality in China has attracted worldwide attention".

7. Line 86 on Page 4: "emitting over 1000 kilotons (kt) SO2 per year . . .". You mean SO2 emissions for Jiangsu province was over 1000 kt per year during the period from 2005 to 2010. Am I right? The number should be clarified and the sentence needs to be rewritten.

8. Line 89 -92 on Page 4: "China is endeavoring to control . . ." might be better to change into "Source control measures focus on power generation processes and facility-related measures to reduce emissions have been widely implemented in China. These measures include flue gas desulfurization (FGD), selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR), dust collector, etc. It is important to assess any potential air quality impacts from implementation of those mitigation measures."

9. Line 108 -110 on Page 5: For data source of NCEP reanalysis data, please cite a reference(s). It may be "Kalnay et al.,The NCEP/NCAR 40-year reanalysis project, Bull. Amer. Meteor. Soc., 77, 437-470, 1996".

10. Line 292 -294 on Page 14: The authors may consider to re-written those sentences because with large unmonitored area, from my point of view, it is hard to say differences in spatial distribution patterns caused by different emission inputs are evidences for the improvement of MOD2 simulation. The "improvements" here are still based on the results at monitoring sites. However, the evaluation of model performance over site by site has been well done and discussed.

11. Line 303 -305 on Page 14: ". . .,especially of O3, SO2, and NO2 according to the statistic validations and the spatial simulation performance compared with observations, which could conclude that a more realistic power emission was provided from UEIPP" can be re-written in ". . .,especially of O3, SO2, and NO2 according to model performance evaluation. It is therefore concluded that the power plant emissions from UEIPP is more realistic and reliable".

12. Line 278 – 281 on Page 13: "The underestimation of PM2.5 . . .changes of R and MFE" might be replaced by "MOD2 simulations show overall improvement for all species compared to MOD1 results. Although the both MOD1 and MOD2 underestimated PM2.5, CO, O3 and overestimated NO2 and SO2 as shown in Table 3, absolute MFBs for those species are reduced by 0.07, 0.21, 10.78, 3.6, and 8.26 percent respectively from MOD1 to MOD2." The statements after this line in the entire paragraph need to be rewritten because it is little bit difficult for me to understand.

13. What does "accident error" mean at Line 288 on Page 13?

14. Line 335 on Page 15: "Environmental Protection Agency (EPA) in China" should be "China Ministry of Environmental Protection" or "Ministry of Environmental Protection of the People's Republic of China".

15. Line 344 – 345 on Page 16: “. . . the declined emissions of primary PM2.5 could not enhance the ambient PM2.5 concentration . . .” might be “ . . . the declined emissions of primary PM2.5 could not improve the ambient P2.5 concentration . . .”.

References

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