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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Development of a high temporal–spatial resolution vehicle emission inventory based on NRT traffic data and its impact on air pollution in Beijing – Part 2: Impact of vehicle emission on urban air quality" *by* J. J. He et al.

Anonymous Referee #2

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My main concern is about the ammonium aerosol considered in this study. I do not see how NH3 is included the emission inventory. As we know, NH3 emissions from agriculture and other sectors cannot be ignored in East China, and the mass loading of ammonium should be a major contribution to PM2.5 in North China. On the other hand, the NH3 is an important factor that determines the formation of nitrate, which is another major aerosol species in PM2.5, through the reaction below: NH3(gas) + HNO3 (gas)

NH4NO3 (solid). Therefore, if the emission of NH3 was not correctly considered in this study, the simulation about nitrate and ammonium would be deeply affected. This will lead to two significant uncertainties: One is the uncertainties in the simulation of the total mass burden of PM2.5 in model domain. Even in Beijing, the transport of ammonia from surrounding region is important as well.

Another is the uncertainties of the nonlinearity in the processes of nitrate formation. Nitrate is a secondary aerosol component. The nonlinearity means if we cut down 50% the precursor NOx, the variation of secondary aerosol nitrate may not decrease 50% as well, and sometimes they can be enhanced (Burr and Zhang, 2011, APR). What's more, NOx is the major pollutant emitted from vehicle sources. Thus, the sensitivity tests in this study may provide unreasonable results because of the lack of description of ammonium. I suggest the authors conduct the simulation works with nearly compiled NH3 emissions from Song Yu (Beijing University), and the simulation results of nitrate should be provided at least, as it is the main secondary pollutant of vehicle sources.

Section 2.1, more description about the model should be provided, especially the chemical part. See my major comment about the nonlinearity.

Page 19244, line 9, "ammonia"? If here means one aerosol species, I think it should be ammonium. And how does the model treat this aerosol?

Page 19244, line 19, I cannot find the reference Li et al., 2013, should be 2014?

Page 19248, line 10-24, why the authors used the evaluation results of previous studies? All of them were the results in 2008? The evaluation of simulation results in 2013 should be provided here.

Page 19249, why not present the evaluation results in each observation stations? Why just presents the average results in Figure 2? More details can be seen if provided the evaluation results in each observation stations.

Page 19254, line 16-17, switch off/on one emission sector would also change the back-

ground pollutant concentrations and chemical processes. This point is similar with "zero-out" method. And this is beneficial to capture the nonlinear relationship between precursors and secondary pollutants. Here the statement should be modified.

In Figure 2(d), I did not see the blue line. Does it coincide with the red one?

In abstract and at Page 9 Line 11, it is noted that the update emission HTSVE used in this study was presented in Jing et al. (2015). Actually, I cannot get any volumes and issues information of Jing et al. (2015) from the REFERENCE part (Page 19 Line 12). The author should give the right citation of Jing et al. (2015). If Jing et al. (2015) has not been published yet, I suggest that this study should add the detail description of the update emission HTSVE or be reviewed after Jing et al., 2015 is published. The boundary conditions used in the simulations is from McKeen et al. (2002). I think this is inappropriate and may result in underestimates of the gas and aerosol concentration. The McKeen initial and boundary conditions are for the US. Western BC over the eastern Pacific Ocean and will be very low. I suggest rerunning the simulations using BC obtained from output from a global model. This study only evaluates the site average concentration of NO2 and PM2.5. However, the vehicle emission and other emissions are different at different sites. In addition, only comparison of NO2 and PM2.5 are still limited. I think it is necessary to present the comparison of model results with observations at each site and add comparison of other gas and aerosol concentration (e.g., NO, O3, NO3-, SO42-, BC, OC). Then, the model evaluation will be more comprehensive and convincing. At Page 11 Line 12, what is the reason for the low correlation of NO2? Is it related to the uncertainty of emissions or gas chemistry? The author should explain more for this. In Table 2, please add the update emission HTSVE. The CUACE emission is very different with other studied especially for CO and NOX according to Table 2, what about HTSVE? The author should discuss about the resulting uncertainty in this study. The author should present the comparison of meteorological condition and the statistical analysis in supplement file. At Page 14 Line 1, please explain more about Figure 7. Please discuss more about Figure 8 and

9 with distribution of vehicle emission and wind direction.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 19239, 2015.