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Atmospheric Chemistry and Physics Discussions

Interactive comment on "High-resolution Hybrid Inversion of IASI Ammonia Columns to Constrain U.S. Ammonia Emissions Using the CMAQ Adjoint Model" *by* Yilin Chen et al.

Anonymous Referee #2

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This manuscript applied a hybrid inversion approach, which combines a coarse-resolution mass balance inversion and a fine-resolution 4D-VAR inversion, to optimize NH3 emission estimates from the 2011 National emission inventory (2011 NEI) for the U.S. based on the satellite observations of the Infrared Atmospheric Sounding Interferometer NH3 column density (IASI-NH3) and the numerical simulations using the CMAQ v5.0 and its multiphase adjoint model. The optimized NH3 emission inventory suggests the underestimation in the 2011 NEI, especially the NH3 emission amount in April. The study demonstrated the robustness of the inversed NH3 emission inventory by evaluating the CMAQ modeling performance of ambient NH3 concentrations and NH4+ wet deposition, analyzed the potential factors accounting to the differences be-

tween the NH3 emissions in 2011 NEI and the optimized estimates, and assessed the influences of the optimized NH3 emissions to the simulations of ambient aerosol concentrations as well as to the nitrogen deposition exceedances in the U.S. The results are presented in a clear way and the manuscript stands in a good structure. I would recommend publication in Atmospheric Chemistry and Physics after consideration of the following comments.

Specific comments

1. The adjustment to the a priori emissions of NH3 is driven by the difference between the observed NH3 column density and the simulated one, which requires that the uncertainty in the a priori emissions is the dominant explanatory factor for the bias in the simulated NH3 column density. As we know, several factors other than NH3 emissions might affect the uncertainty of the simulated NH3 column density, such as the meteorological fields, the simulated concentrations of other related species, and even other primary emissions. The performance of the WRF model and the CMAQ model in the study are suggested to be introduced in the section 2.3. The influences of these factors on the inversion of NH3 emissions are also suggested to be discussed in the evaluation of the optimized emission estimates.

2. In section 3.3, lines 301-306: Do the outputs of the WRF/CMAQ model present the large transported plume from the central U.S. to Pennsylvania on April 14th and 15th? Do other data or analysis (such as wind observations at high altitude, trajectory analysis) support the possibility of this transport?

3. As shown in Figure 4, the optimized NH3 emission reduces the negative NMB when comparing the CMAQ outputs with AMoN NH3 concentrations, but increases the NRMSE and decreases the correlation. In my opinion, the optimized NH3 inventory does not greatly improve the agreement between CMAQ simulated NH3 concentrations and the observations. The near ground ambient NH3 concentrations might reflect more direct signal of the NH3 emissions than the NH3 column density. If the ambient NH3

measurements together with the satellite observations are used to inverse the NH3 emissions, we would obtain more reasonable optimized emission estimates.

Technical comments

1. In lines 434-436 and lines 541-542: Please add the journals which the references are submitted to.

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