

Interactive comment on “Global evaluation of ammonia bi-directional exchange” by L. Zhu et al.

Anonymous Referee #1

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General comments

The GEOS-Chem model is modified for its treatment of ammonia surface fluxes by imposing diurnal variation to livestock emissions and adding a bidirectional exchange algorithm for soil and vegetation for NH_3 from fertilizer. The diurnal livestock emission variation is clearly more realistic than the constant assumption. While the bidirectional surface flux model is simpler than has been implemented in other models it still represents a significant advance of GEOS-Chem and global modeling. My main criticism of the paper is about the evaluation. None of the comparisons to surface NH_3 , Nitrate, or NH_4^+ wet deposition show any significant advantage of the bidirectional flux implementation. This is explained by noting that other parts of the ammonia emission inventory are likely underestimated by large amounts. It is demonstrated that results are improved by multiplying livestock emission by factors of 8 in April and 3 in October

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in the US. They also do sensitivity runs with reduced HNO_3 by 50% and 20%. It seems that they have identified some key areas for improvement that would have greater impact than the developments described in the paper. Most of the plots and much of the discussion are about the differences between the base and BIDI runs. I don't see much value to this since we cannot not say which result is better. The most interesting result is in the last plot which shows that the BIDI case has much larger area of influence of NH_3 emissions.

I suggest that the difference discussions and plots be reduced and more comparisons to observations be shown. If the conclusion is that meaningful evaluation cannot be made without further improvements to the emissions and/or model chemistry, then perhaps this analysis should wait for such improvements to be developed and implemented.

All spatial plots are much too small to see!

Specific Comments

P4826 In6: should spell out acronyms for first usage.

P4827 In21: Please give approximate grid spacing in km

P4831: The various emission inventories should be better explained and intercompared. For example, how can NEI be used for a global model when it is US only? How does NEI, Massgas and the original GEOS-Chem inventories compare?

P4831 In19: Should show a plot of these results (dynamic vs static) at SEARCH sites. It seems that the SEARCH sites and the TES comparisons are the only evaluation of the effects of the dynamic emissions. Why no plots of either results? Just showing differences as in Figs 2-4 is not enough especially since these plots are too small to see.

P4833 In20: Can't see feature in Russia.

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P4836 In1-2: It might be interesting to compare fertilizer rates for the US to EPIC simulations.

P4844 In6: what is IASA?

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 4823, 2015.