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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Nitrogen deposition to the United States: distribution, sources, and processes" *by* L. Zhang et al.

T. Butler (Referee)

tjb2@cornell.edu

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Overall this is an excellent paper. Nitrogen deposition is an important topic that is difficult to accurately quantify. Some consider it "the pursuit of the unknowable"! The authors present a reasonable model and compare results with other independent estimates (CASTNET, NADP, CAPMoN, Harvard Forest etc.). The manuscript does a good job of clearly documenting the assumptions, the limitations, and the digressions from other deposition estimates by the model. They proceed to make all the relevant comparisons (wet vs dry deposition, importance of individual N-species contribution, oxidized vs reduced N sources and deposition, anthropogenic vs natural sources of N etc.), and relate their findings to ecological impact (e.g. N critical loads). While the results relating to dry deposition come with some error associated with their es-

timates, their findings demonstrate a reasonable estimate of the relative importance of the various N-species to overall N-deposition. Future research will no doubt refine these deposition estimates. Frankly, this manuscript is very close to final form for publication. The authors may want to look at Sparks et al. (Global Change Biology (2008) 14, 768–781, doi: 10.1111/j.1365-2486.2007.01526.x) for a ground truth comparison of dry N measurements (at Duke Experimental Forest in 2003) as they have done for Harvard Forest. More ground truthing of model results with measured values, especially where there is little information (e.g. NOy), certainly helps in model validation. An area in the manuscript that was not entirely clear was the treatment of bi-directional flow for NH3 (and NO2). On pg.246, lines 25 to 27, it is stated that it "is treated here as uncoupled emission and deposition processes." Does this mean the deposition velocity (Vd) is a "net" Vd because the NH3 flux back to the atmosphere is counted in the emissions? I am guessing this is the case judging from the Table 1 V(d) for NH3. The CMAQ model (Version 5.0), which incorporates a bi-directional NH3 flux, reduces the NH3 deposition significantly in the northeast compared to earlier CMAQ runs, which do not incorporate a bi-directional flux. Another possible improvement to the manuscript would be to compare the model results presented here, with the CMAQ model which also attempts to quantify total N deposition by species. This may be a large undertaking and may be appropriate for a separate manuscript, but some overall comparisons here might be useful. There appears to be a minor error on pg 249 line 22. "CASTNET" should be replaced by "NADP/NTN and CAPMoN". Overall this is a clearly presented and well documented paper that can serve as a benchmark for future N deposition comparisons in the USA. I enthusiastically support its publication. Tom Butler Cornell University, Ithaca NY and the Cary Institute of Ecosystem Studies, Millbrook, NY

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