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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Sources of nitrogen deposition in Federal Class I areas in the US" *by* H.-M. Lee et al.

Anonymous Referee #1

Received and published: 17 September 2015

General Comments: This manuscript looks at several different aspects of nitrogen deposition 8 different national parks. First, the authors focus on how well GEOS-Chem simulates deposition in the different national parks by season and they also look at the speciation of deposited nitrogen. The next section focuses on source attribution of nitrogen deposition to these class 1 areas both by emissions sector and region. There is also a discussion of how changes in emissions impact class 1 areas and the regions where emissions reductions would be needed to reduce the area of exceedance and the magnitude of exceedance. The authors conclude with a discussion of the uncertainty in ammonia emissions. The discussion and conclusion section is well written and easiest to follow. I think it would be helpful for the authors to look at how they explained things in the discussion and find a way to transfer some of that ease of reading and

explanation of concepts to the results sections where the reading feel cumbersome. I find that the presentation of results is confusing in many areas due to the cost functions. It would be much clearer and easier to follow if the cost function was described in the main text instead of using the Jx abbreviation. It also seems like the main goal of doing the cost functions are missing until you get to the discussion and conclusion section where they seem to be clearly explained.

Specific Comments: Line 184: what does “efficiency of emissions” mean?

Line 217: How do this line and the first line of the paragraph reconcile if oxidized Nr deposition was 24% less in the current study and wet HNO3/NO3 and dry NO3 were similar but are the majority components of oxidized Nr deposition?

Line 219: how much smaller?

Line 220: It is unclear if the discussion of HNO3 in the Zhang et al (2012) paper is about wet, dry or both types of deposition.

Line 223: I don’t understand the second part of the sentence and how it fits with the first part “and ambient HNO3 concentrations are overestimated” -where are they overestimated ?

Line 231: What are the differences models to get higher dry deposition of reduced N? Is it strange the difference is occurring only in 1 region?

Line 236: I understand the tracking of gas phase species in wet deposition to understand the source of the deposition but in Figure 4 I would like to see HNO3 and NO3- (and NH3 and NH4+) wet grouped together or at least plotted next to each other.

Line 237: The correlation of what? You have three variables plotted.

Line 239: The low correlation of JT is not in the next paragraph. I can’t find a discussion of the winter deposition at JT in the manuscript.

Line 242 and 243: Are both of these monthly values actually 1.3?

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Line 243: It would be much easier to read and follow the discussion if Jp wasn't used. I suggest either no abbreviation or one that makes sense (you think of simulated Nr deposition)Maybe measured Nr, modeled Nr, and modeled Nr+

Line 245-248: You already said this at the end of the previous paragraph (line 230). Can you add their data to Figure 3 to show the difference?

Line 254: What organics?

Line 261: Can you somehow identify which are in exceedance annually? Some of the sites are easy to see how this would be the case but for GT it might not be.

Line 273: The maps in Figure 5 are interesting but you don't really discuss them until you talk about Figure 7 and then you don't even discuss them directly. Are they necessary? I think they are interesting and an important component of the results and discussion. Is there a way to combine Figures 5 and 6? Color scale from oxidized/blue to reduced/red (or something) . . .

Line 286: The focus on RM seems to take away from the other sites more than it adds to the discussion.

Line 308: Remove efficiency from the section title. It doesn't make sense without more explanation.

Line 311: I'm not sure I understand how these results were calculated. Were the emissions actually changed?

Line 315: I don't see the northern signal at JT in the summer.

Line 322 – 325: The logic here doesn't make sense or I'm misunderstanding the analysis. There is limited NH4NO3 because there is less NH3 in the winter but NH4NO3 has a longer lifetime than NH3 and HNO3 and Nr deposits far beyond the park.

Line 348: I suggest adding a reference to Figure 11a here to make it clear which of the figures you are talking about. And a few lines later add one for Figure 11b.

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Line 374: Showing the difference between the Optimized NEI2005 and 2005 might more clearly make your point and the maps would be larger and easier to see.

Line 375: Please redefine Jp here.

Line 394: What is wet nitric acid?

Line 421: What are effective regions? Regions where emissions reductions would be effective in reducing N dep? Please clarify.

Line 430-433: Is there a place and benefit to discussing the importance of local versus long range transport at the different class 1 areas?

Figure 3: The legend is confusing. Is there a way to make it clearer that the model is the same as measurements while cost function includes extras. Model+? I know the difference is explained in the caption.

Figure 4. Can you combine figures 3 and 4? Height of bar is the blue diamond and you can use a light colored symbol for the model and measured. And put other deposition pathways that aren't in measured/modeled on the top of the bar?

Figure 5. Can you look in on the region of interest/extent of significant deposition (east or west half of US)? In the cation last sentence, Footprint values are scaled for visibility with scaling factor in parenthesis.

Figure 6. Please indicate the park location. This would also be interesting for GT. Could you do for all with reds/blues in Figure 5.

Figure 8. Can you add column titles to more clearly indicate summer and winter?

Figure 9. Can you inset the wind roses in Figure 8 maps? This would complement Figure 8 and make the explanation of results easier to follow.

Technical Corrections:

Line 160: with respect

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Line 244: Our model estimate - no “s”

Line 316: owing ?

Line 429: one instead of on

Line 452: lower case n

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 23089, 2015.

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