

## ***Interactive comment on “Multi-model study of HTAP II on sulphur and nitrogen deposition” by Jiani Tan et al.***

### **Anonymous Referee #1**

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Review comments for acp-2017-1121

This paper describes the global S and N emissions and deposition in a set of global models run for 2010 under a model intercomparison project (HTAP II) and compares the results with regional monitoring data and previous global modelling. The subject matter is of interest to air quality and ecosystem scientists, particularly those concerned with deposition to oceans, where there is little information from measurements or regional models. I recommend publication with minor revisions, with the most important being an expansion of the dry deposition discussion.

Specific comments:

Section 2.1: It isn't crucial, but it would be helpful to include a brief mention of any other

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papers (published or forthcoming) that describe additional results from this intercomparison project (e.g. ambient concentrations of particulate matter or O<sub>3</sub>). With virtual special issues, it's not always obvious where to find related papers.

Section 2.2: Can you explain why some values in Tables S1-S3 seem inconsistent? E.g., total S emission from the MMM is 91 Tg in Table S1, but from equation (2) it seems that it should be  $55+1+27=83$  Tg. Is this an error or am I missing something? Also, the same table seems to show that OsloCTM3 should be excluded for S based on the mass balance criteria described. It's unclear why it is kept. I'm assuming model values that did not meet the criteria are not listed in the tables, though I don't think that was explicitly stated.

I. 265: the 81% value in the text does not match Table 1, which says 61%. Which is correct?

II. 267-291 and Table 1: If possible, I suggest adding the number of stations for each comparison to Table 1 since that is likely different as well; where N is relatively low, the number and location of stations used could have a significant impact on the statistics.

Section 3.1.2: Additional discussion of dry deposition is warranted, given the large differences with the CASTNET inferential values. The difference between the CASTNET dry deposition calculations and those using the CAPMoN method are touched on (II. 300-303) but the implications for the models is not fleshed out. I recommend moving this discussion to the end of the section 3.1.2 and discussing the relevance to the ensemble-measurement comparison. How does the CASTNET dry deposition velocity parametrization compare with those used in the various models? How do the modelled air concentrations of SO<sub>2</sub>, HNO<sub>3</sub>, etc. compare with the CASTNET observations?

I. 347: Australia appears to receive higher coastal S deposition than E. Asia, so should be listed here as well.

I. 374: Why the 32% increase in ocean S emissions? Is that real or the result of

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improved emission budgets?

II. 520-536: There is discussion of the areas of increasing NH<sub>x</sub> ratio, but globally there appears to be a general decrease (e.g. over the oceans). Maybe add a comment on this.

Fig. 2: Observation (point) values are very difficult to see on these small plots. Can they be enlarged, since the discussion in 3.1.1 hinges on the regional comparison? Fig. 4 is better; I would suggest that size is the minimum needed.

Technical comments:

The manuscript would generally benefit from careful copyediting to correct minor issues with non-standard English usage. I've only highlighted errors where the meaning was somewhat unclear:

I. 53: change "shows that... increases" to "predicts that... will increase"

II. 67-90: previous results should all be in past tense

I. 123: The HTAP project? Task Force?

I. 130 and 146: update the Galmarini reference to the final ACP paper (2017)

I. 228: keeping with your sign convention in Table 1, the bias increases (or changes) from -160 to -300

I. 230 change "highest deposition" to "highest modelled deposition" if that is what is meant

II. 240-243: Reword; the stations do not underestimate/under-predict the deposition, the MMM underestimates deposition at those stations.

I. 300: Reword to "Schwede et al. (2011) compared CASTNET dry deposition estimates with those of the Canadian..."

I. 312: suggest changing "0.5-1 times" to "50-100%" for consistency

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II. 321-22: change end of sentence to "...but this gradient is much weaker in the inferential data."

Suggest changing title of 3.2 to "Total S deposition" and similar for 3.3

I. 351-352: change to "...S deposition to the ocean and coastal areas in 2010." Remove text in parentheses.

I. 449: remove "and Mexico" since it's part of N. America

I. 485: replace "positive changes" with "increases" to avoid the message that this is a desirable change

I. 571: "large net changes" could replace "large changes" for clarity

Tables 3-5: Merge the coastal numbers into a single cell. Add text to the caption to remind the reader that the values in parentheses are percentages (Tables 3 and 4).

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