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Atmospheric Chemistry and Physics Discussions

Interactive comment on "An evaluation of European nitrogen and sulfur wet deposition and their trends estimated by six chemistry transport models for the period 1990–2010" *by* Mark R. Theobald et al.

Anonymous Referee #1

Received and published: 2 October 2018

This paper presents an evaluation of modeled trends in wet deposition of sulfur and nitrogen compared to observations from the EMEP network for the periods 1990-2000 and 2000-2010. The paper provides a very detailed analysis of the trends, including examining factors contributing to model performance. Overall, the paper is well written, but in some sections becomes a bit if a recitation of statistics with little analysis. Section 3.6 is probably one of the more important sections, yet it is one of the shortest. Understanding why the observed trends are (or aren't) reproduced by the models is important. Page numbers or continuous line numbering would have been helpful.

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Discussion paper

Specific comments are as follows:

Page 3: What is the difference between the Collette et al. (2016) work and the Torseth et al. (2012) analysis?

Page 3, line 5: Consider a comma after “periods”

Page 3, line 6: Consider a comma before “but”

Page 3 - 4: There are several multi-model studies that are cited. It is impractical to provide the list of models and citations in this paper. It would be helpful to know, though, if the models used in the present study were included in those studies as well.

Page 6, line 10: If the other models were run with a lat-long grid, why wasn’t CMAQ?

Page 7: Did any of the models include the bidirectional flux of NH3? This is noted in Table S2, but not discussed in the text. What is the impact on the model results of not considering this?

Page 7, line 7: Organic species were included in the modeled estimates of wet deposition. Are they included in the measurements? What about NO, NO2 and N2O5?

Page 7, line 13: Doesn’t the CMAQ model provide information to distinguish sea-salt sulfate?

Page 7, line 20: consider rewording “network data of”

Page 8, line 13: Note that these criteria were developed for atmospheric concentrations and not deposition values.

Page 8, line 17-18: Clarify what the observed and modelled trends are for on line 17 and what trends on line 18 are more difficult to evaluate compared to annual wet deposition.

Page 8, lines 20-23: suggest splitting the sentence at “then” on line 20.

Page 8, line 21: “were” should be “was” as it refers to magnitude

Page 9, line 2: How were the tau values determined?

Page 9, line 24: Does “European” start a new paragraph?

Page 9, lines 25-30: Specific information is given from Sutton et al. (2003) about why NH3 emissions decreased but he same level of detail is not provided for other species.

Page 10, line 15: Consider listing the meteorological models

Page 10, line 19: Consider specifying “meteorological models” rather than just models.

Page 10, line 25: It seems odd that one WRF run (used for CMAQ) would have such very different precipitation compared to the other WRF runs. What was different about the WRF runs? It might be helpful to have a table in the supplemental that provides details on the meteorological models.

Page15, section 23.5: This section seems to repeat information that was presented earlier.

Page 21, lines 30-33: Do these studies use different versions of the EMP model? Please indicate what versions were used.

Page 22, line 13: Why is the trend for observed WNOx for 1990-200 in Figure 16 so different than the emissions trend? Is this realistic?

Page 24, line18-19: what would be the effect on mass conservation of doing a bias correction?

Figures 4 and 9: The legend text is too small.

Figure 12: Are these period (i.e. seasonal) totals values?

Table S2: - Consider adding a table with specifics of the met model runs - Are the vertical layers for the CTM or the met model? - For Chimere, CMAQ, and MINNI, give an approximate value for the 1st model layer. - CMAQ description is incomplete and incorrect. No citation is given for the dry deposition of gases. CMAQ does include a

bidirectional NH3 model (but maybe it wasn't used). Wesely (1989) is not the correct reference for the stomatal resistance. This is calculated in the Pleim-Xu land surface model and is described in papers by Pleim and Xu.

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