

Reply to reviewer 1

We thank the reviewer for the careful reading and sensible suggestions to improve the manuscript. Follows are point-by-point replies to the comments. Replies are in italic font.

L203: It would be useful to have a figure to illustrate the European and North American domains.

The figure has been added to the text

L229-231: I do not understand what the authors mean by 'hourly speciated files'. Please clarify.

This has been corrected, thank for pointing it out. The new section of text now reads:

"These EMP were used by the US EPA to generate 8 different hourly files of speciated emissions for each day in 2010 (1 gridded file with low-level emissions and files with elevated sources from 7 different sectors) and 9 different hourly speciated files for each day in 2016 (1 gridded file with low-level emissions and files with elevated sources from 8 different sectors) which were then shared with all participants."

L320-330: Suggested text modification from (units s cm⁻¹) to (units = s cm⁻¹)

Done.

Figure 3: The resolution of this figure is generally poor and in particular the text for the x-axes tick labels is difficult to read (in fact unintelligible for 3a and 3d). This should be improved before final publication.

This correction has been implemented.

Can the authors explain why there is a smaller effective conductance for soil (and possibly lcan and cut, although it is difficult to tell from the figure) at 06:00?

Note that the former Figure 3 is now Figure 4. We have added the following paragraph of text to the document to address this point:

"Also with reference to Figure 4, it should be noted that the effective conductances and effective fluxes show the relative contributions of the pathway towards the total deposition or the total flux at any given time, and that the net surface resistance appearing in the denominator of these terms may drive the time variation. For example, the soil effective conductance of Fig. 4 e minimizes at 6 AM – however, the factors contributing to the soil pathway itself for the model used in this example (see Appendix Table B1) are relatively time-invariant (seasonally varying). The temporal variation is driven by hourly variation in the stomatal term, and hence the relative importance of the soil conductance varies with time in Fig. 4 e. "

Table 5: The format of this table should be improved. It might be better in landscape as all the columns could do with being a bit wider.

The original table included as its second column the AQMEII4 variable name. We realized that name was repeated in the original table's 3rd column. We got rid of the original table's second column as being redundant, in order to clear up more space, and have re-titled the column with the formulae "AQMEII-4 Name = resistance diagram variable or formula". Ditto for Table 6.

Tables 5 and 6: For ease of comparison, would it possible to situate Fig 2a in closer proximity to Table 5?

The table and figure organization rest with the ACP's copyediting and typesetting department, We are sure they will accommodate the most readable solution

L524-526: 'In this example, note that the branch containing the rdc term has been designated as the lower canopy pathway, due to the presence of the canopy buoyant convection term rdc (i.e., closest analogy to Wesely's setup is to have the pathway involving deposition to "soil" pathway is designated as a "lower canopy" pathway).'

=> Consider re-wording this sentence from 'the branch containing the rdc term' to 'the branch representing deposition to soil' or similar to avoid confusion about the two slightly different usages of rdc in this sentence.

Changed to: "In this example, note that the branch representing deposition to soil is designated as the lower canopy pathway, due to the presence of the canopy buoyant convection term rdc (i.e., closest analogy to Wesely's setup is to have the pathway involving deposition to "soil" pathway designated as a "lower canopy pathway").

Table A1: Should the units for the water vapour column be changed from $\text{cm}^3 \text{cm}^{-2}$ to $\text{cm}^3 \text{cm}^{-2}$? Units for RHO (Air density of lowest model layer)?

We apologies but we do not really understand the request as the units proposed are the same as those adopted. One possibility we noted was that the initial "3" in "cm³" lacked the superscript (it's possible that the reviewer's original version had this change and was lost in copying to ACPD's web portal) – this has been corrected in the final version.

Table A2: Change 'Number concentration of PM_{2.5} at ground, cm^{-3} ' to 'Number concentration of PM_{2.5} at ground, cm^{-3} '. Units of eq ha^{-1} ?

The issue has been corrected.

Table A2: Could the authors please provide a description of the units eq ha^{-1} .

Also this has been fixed, thanks for pointing it out. New text has been added which reads, “Note that the units of nitrogen and sulphur deposition in Table A3 are “equivalents” per hectare per year, where the “equivalent” refers to the product of moles and the oxidized charge associated with the deposited species. All species depositing sulphur are assumed to have a charge of 2, all species depositing nitrogen to have a charge of 1. These units are used in the calculation of exceedances of critical loads, where the annual charge balance and flux of charge to ecosystems is used to estimate potential ecosystem impacts. “

Appendix tables B1 – B7: I think the formatting could be improved across these tables and importantly, made consistent. E.g. Font formatting, equation layout (for preference, the equations should be as in Table B6, represented as fractions rather than as (xxxx)-1, but consistency is the main thing). In some cases the tables may be better displayed in landscape so that equations can be presented on one line. Table B6 is nicely laid out, although the text in column one is too small to read easily.

The tables have been corrected as per the reviewer’s suggestion to use fractions rather than (xxxx)-1, though we note again the publishing office may also modify the equations according to their internal policies. Thank you for your concern

Table B2 and B3: Should RES – SURF be RES-SURF?

Corrected thanks

Figure B3 and B4: Should these be the same?

Thanks for picking up on this! We carefully went over all Figures and Tables in the Appendix again. We consulted with our LOTOS-EUROS co-author, and have corrected Figure B4 and Table B4 to match the LOTOS-EUROS model. We have also revised Table B3 – some of the formulae needed to be corrected, based on our check and discussion with participant co-authors.

Appendix C, Equations 8 and 9: These are hard to decipher, please consider improving their layout

The equations in Appendix C and some of the associated description have been revised to improve clarity of the description. We have revised the text to make the changes more clear with regards to the three bidirectional NH₃ flux algorithms presented, along with revising the equation format to match that of the tables; using fractions more clearly. All of the formula in the Tables have been revised to be represented as fractions

L958: Fix reference formatting for Yi (2008) and Bash et al., (2010)

Corrected