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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modeling natural emissions in the Community Multiscale Air Quality (CMAQ) model – Part 2: Modifications for simulating natural emissions" *by* S. F. Mueller et al.

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(1) Effects of adding anthropogenic emissions to the emissions modeling data base – While it is not possible to know exactly how the addition of anthropogenic emissions to natural emissions would change the magnitude of natural emission impacts on air pollutant levels (CMAQ has no built-in tracking mechanism for reporting relative air quality contributions from specific emission subsets), we did model all emissions together and describe the results in detail in a subsequent paper. The amount of information produced by this modeling is prodigious and was deemed to be too much to

include in the current paper. However, I will add some additional description (new section 4.4) of highlights from the joint natural-anthropogenic modeling to better convey the relative roles of the two sets of emissions. (2) Interaction between coarse and fine mode and implications for modeling the sulfate impacts on secondary organic aerosol (SOA) formation – It is true that the aerosol module in CMAQ does not allow interactions between the coarse and fine particle modes. Addressing whether fine acidic aerosols affect particle mass in either mode is beyond the scope of this paper. Text will be added to the lead-in of section 4 (preceding section 4.1) to acknowledge the model limitation on mass size-mode exchange. (3) Temporal ozone behavior – Both reviewers question the presented explanation for the grid-average ozone peak in the March-April time frame. This response is to both comments. Since submitting the manuscript for this paper I have obtained more information than was available when it was originally written. The issue of the ozone signal attributable to boundary conditions is a complex one. I agree that meteorological differences between seasons are capable of contributing to the signal. Some of that signal may be natural and realistic and some may be artificial (i.e., caused by model inaccuracies). Although some of the spring peak is associated with ozone over higher terrain in the western U.S., ozone is also relatively high across portions of the east where elevations are low. There is strong evidence that the amount of ozone and/or ozone precursors (e.g., NOx) being transported into the model domain across the model boundaries is higher in winter and spring than in summer and autumn. Blaming all of the imported pollutants on transport from Asia is inaccurate, though. In fact, it appears that in April and May some of the extra ozone, especially across the southern and eastern U.S., is associated with pollution transported into the southern part of North America from Central America. I see enhanced ozone along the southern boundary reaching a peak monthly average of 33 ppb in April. In contrast, ozone over the Pacific Ocean is at a maximum (30 ppb) in January, steadily decreases to a minimum in July (10 ppb) and recovers to values of 15-20 ppb in autumn. A big reason for the drop in grid-average ozone in the latter part of the year is a drop in ozone over the northern portion of the domain (i.e., Canada).

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This is likely controlled by meteorology coupled with a decrease in pollution transport from the west. When plotting monthly-average ozone I expected to see a December ozone plot that looked more like the one for January. However, this is not the case and it suggests there was something quite different in the global meteorological patterns for January and December 2002 that significantly affected global ozone formation and/or transport into the high latitudes of North America. The paper discussion of this seasonal phenomenon will, therefore, be modified (section 4.1) to reflect the more complex behavior described above. This new text will include Fig. 11 (attached to these comments). (4) Boundary condition averaging & effects from re-circulated anthropogenic emissions – The CMAQ model boundary conditions (BCs) were based on monthly average GEOS-Chem results. Thus, the BCs were updated monthly. The influence of anthropogenic emissions was included in the BCs. The largest influences should have occurred along the southern boundary from emissions in southern Mexico and Central America. As stated in my response to an earlier comment, the influence of pollutants crossing into the domain across the southern boundary were likely the primary cause of the elevated spring ozone. A secondary effectâĂŤthough much smallerâĂŤshould have occurred due to re-circulated anthropogenic emissions from eastern Canada and the U.S. crossing into the modeling domain along the eastern boundary. The monthly averaging and persistence of middle latitude westerly winds would have minimized these man-made influences. (5) Changes will be made in the text to specific editorial comments made by the reviewer, as follows: (6) Section 2.1/p. 4 – Text to be modified to reflect the source of the windblown dust emissions used in our modeling. (7) Section 3.1.5/p. 11 – To be added. (8) Section 3.1.5/p. 12 – To be corrected. (9) Section 4.1/p. 22 – To be added. (10) References/pp. 32 and 34 – To be corrected. (11) Table 2 – Will correct typographic error. (12) Table 3 – Will be corrected. Should have been Atkinson et al., 2006. (13) Figure 1 – I do not see a problem with the y-axis label. It is “Sulfate Production Rate, M s-1” and refers to sulfate formation within cloud water. Thus, “M s-1” denotes moles per liter (M) per second.

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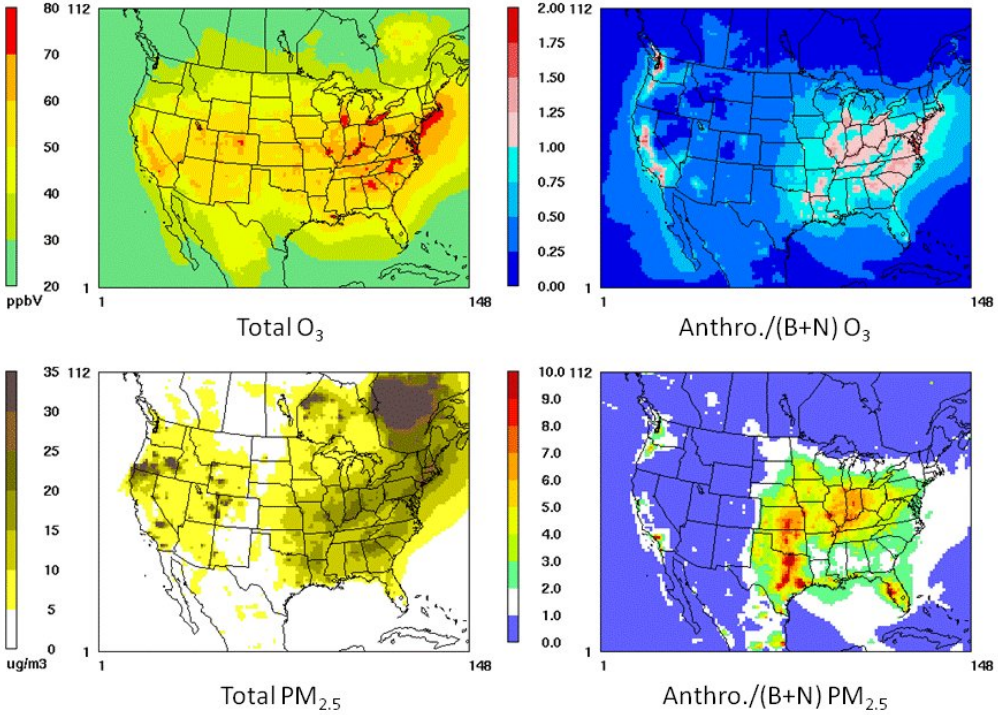

Fig. 1. Fig. 11. Mean July 2002 simulated surface values representing total (natural and anthropogenic) maximum daily 8-h average O3 (upper left), PM2.5 (lower left), and the ratios of anthropogenic to backg

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