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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Closure on the single scattering albedo in the WRF-Chem framework using data from the MILAGRO campaign" *by* J. C. Barnard et al.

Anonymous Referee #1

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The manuscript focuses on the ability of the WRF-Chem aerosol chemical to optical properties module (CTOM) to predict aerosol optical properties at the T1 site during the MILAGRO field campaign. Ground based measurements of aerosol composition are used to estimate the aerosol refractive index and density for input to the module. Aerosol size distribution was estimated from total column measurements by AERONET. The results of these model predictions are compared to the observed aerosol optical properties in an attempt to achieve closure. While a comparison of measured values with those predicted by the model is a very important line of study, the results are only as good as the input and this study introduces some serious errors into the calculations.

The major source of error in this work is the use of total column aerosol size distribution derived from AERONET data with ground based chemical composition measurements as input to the module. The model output is then compared to ground based measurements of fine (<2.5 micron) aerosol optical properties. Aerosols are not well mixed in the atmosphere and the chemical composition of aerosols at the ground is not expected to be the same as that in the total column. Similarly, aerosol size distribution in the total column is not expected to be the same as that at ground level. In addition, although the size cutoff for the ground based optical measurements is reported to be 2.5 micron, the size cutoff for the chemical measurements used as input to the model is not discussed. Is it possible that the aerosol chemical composition includes a larger size range than the optical measurements? Considering these uncertainties, it is not surprising that there would be substantial differences in the observed and predicted aerosol optical properties. However, the magnitude of these differences are difficult to judge from the reported results due to the fact that the majority of the manuscript focuses on averages over the 12 day period. It is stated that the overall average values for Bs are within measurement uncertainties of the predicted values, yet the model overpredicts the average value for Ba. However, the comparison of the average diurnal variations of Ba and Bs show the opposite effect with the Ba diurnal variation being "captured quite well" while that for Bs "is not well suited". The reasons for the observed differences in these results are not discussed. The study period includes 2 very different meteorological regimes (as reported by Fast et al.) which are accompanied by large differences in aerosol input from local biomass burning. Averaging the results over the entire study period only serves to minimize any differences between the observed and predicted results and severely compromises the conclusions

Some additional concerns and comments:

Figure 2 is unnecessary and should be omitted. The locations of the MILAGRO sites have been shown many times in this special issue of ACP. A short description of the site location in the text is sufficient.

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Page 5015; Optical measurements: The uncertainty in the absorption and scattering measurements are given as 10% and 15%. How were these determined? What are the PAS instrumental uncertainties and what do they arise from?

Table 1: The aerosol size ranges for all measurements should be added to Table 1 and a complete discussion of their impact on modeling results should be added to the text. The measurement uncertainties for all measurements should also be added to the Table. List the references in a Table footnote for simplicity.

Page 5016, ln 15: Define OM. What physical quantity does it represent? How does the simple conversion chosen in this study compare to results reported by aerosol mass spectrometry measurements? (Aiken et al., 2008) How were these conversion values determined? What are the measurement errors involved?

Page 5016, ln 25: Explain "probably depends on the type of organic aerosol considered".

Figure 3: Show full study period instead of averages. Use a second y axis for PM measurements to expand the chemical composition plots. It would also be more informative to plot SO4 and NO3 separately combining only the crustal elements (Na, K, Ca, Mg)as these have very different profiles (see Salcedo et al., 2006).

NOTE: PM10 is not PM coarse (PMC)! PMC is PM10-PM2.5. This gets confused throughout the document. Substitute PMC for PM10 in Figures 3 and throughout the manuscript for clarity.

Table 2: Use a footnote to list the references to simplify the Table.

Figure 4 and 5: These Figures are the only report of the actual model output over the entire study period. However, plotting the actual variation of the observed and modeled quantities serves to minimize the differences. A better comparison of observed and modeled results would be to plot the differences (modeled – observed). In addition, the discussion of these Figures in the text should be more quantitative, avoiding com-

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parisons such as “The diurnal behavior of the observed ω is approximately captured” or “agree quite well”. The discussion should concentrate on the absolute range of the differences between modeled and observed SSA, Ba, and Bs and the time periods that they were found to be largest/smallest. Explain the observed variation. Less emphasis should be put on the overall average values. Omit plot titles and legends and explain these in the Figure caption.

Page 5026, ln 27: Coarse mass is PM10-PM2.5.

Table 3: Omit the references from the Table and add to a footnote and/or text. Omit the explanation of density uncertainties in the Table caption and explain this in the text instead. Explain in the Table caption why some numbers are in shown in bold font.

Page 5023, ln 13: Use PM10-PM2.5 instead of PM10.

In the current version, the manuscript does not represent a fair comparison between observed and modeled aerosol optical properties. It is difficult to determine wheather the suggested modifications would improve on the comparison in light of the fact that aerosol size distributions are unavailable at ground level.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 5009, 2009.