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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Physical and chemical properties of the regional mixed layer of Mexico's Megapolis – Part 2: Evaluation of measured and modeled trace gases and particle size distributions" *by* C. Ochoa et al.

Anonymous Referee #2

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Review of "Physical and chemical properties of the regional mixed layer of Mexico's Megapolis – Part 2: Evaluation of measured and modeled trace gases and particle size distributions" by Ochoa, Baumgardner, Allan, Fast, and Rappenglucek for ACP

Measurements and calculations of temperature, water vapor, CN, CO, SO2, O3, PANs, and sub micro-meter aerosol size distributions (SO42-, NO3-, NH4+, and organics) are presented for several days during the Milagro field campaign at the high altitude site, Altzomoni. As the day progress, this site is engulfed by a polluted boundary layer coming from Mexico City, Cuautia, or Texmelucan according to synoptic flow condi-

tions. There is clear evidence of increased gas phase pollutants that accompany the arrival of the polluted boundary layer. Meteorological variables and gas phase pollutants are presented primarily to provide confidence in the models ability to simulate transport and thereby give credence to the comparison between calculated and observed aerosol size distributions. There is complex terrain which adds to the difficulty of the simulation. Still, I am concerned about the accuracy of the simulations. On 6 of 10 days pollutants are from the East. Peak observed CO is 220 ppb, measured (at time of peak) is 150 ppb. Peak observed ozone is 90 ppb, measured is 50 ppb. One or two hour shifts in time as suggested in the text do not change this qualitative picture. These differences would be significantly higher if pollutants in excess of background were being compared. I leave it as open question as to whether these comparisons are good, bad, or in-between. Differences in aerosol concentration between calculation and observation are in some cases larger and in some cases smaller than for the trace gasses. The most robust feature of the aerosol comparison is the appearance of a mode peak at about 200 nm, except in the calculations soon after the region is impacted by the regional mixed layer.

Normalizing aerosol concentrations to CO would improve the model – observation comparison in some cases, and in other cases make it worse. Observed ammonium concentrations are too high in relation to sulfate and nitrate.

Most of the comments below are directed towards improving clarity. These should be implemented before publication. I see no easy way to improve the analysis, measurements, or calculations. Differences are there and others can learn from that.

Mexico City was notable for its high concentrations of organic aerosol. What is the observed and calculated partitioning between compounds at Altzomoni?

P 9816, line 23-25. "... mixed layer also known as the convective boundary layer is the upper portion of the boundary layer .." Typo? Is the lower portion of the boundary layer not convective and not part of the mixed layer?

Regional mixed layer. I was not familiar with this term. The top 20 or so Google entries are from papers written by the same group as the ACPD article under review. It seems to be a worthwhile concept, and one that you get an intuitive feeling for as the article progresses. However, it could use a fuller definition when it first appears. A comparison to the boundary layer observation of Herndon et al GRL (2008) at Pico de Tres Padres might be useful?

P 9820, line 12-13 no major sources to the east of Mexico City Are you restricting domain by mountains to the east? Else there is Puebla in next valley to the east.

P 9823, line 15. "aerosol layer that forms at the top of the RML" Do you mean aerosol layer found at the top of the RML? Aerosol at top could have been formed at any depth.

P9824, lines 19-24 It would be helpful to reader to note that the timing of CN will be returned to in discussions of time sequences of other pollutants.

P 9825 "rations" Typo. Should be "ratios".

P9825, line 11-13 Is agreement for E and SW better than for WNW. Observation – calculation difference for black line appears to be about as good as for red line.

P 9826, line 11 model results are shifted by two hours SW data shifted by one hour.

Section 3.4 Discussion of size distributions presented in Figs 5 - 8 is hard to follow. There are 12 panels, each one of which contains 6 curves. Each curve has 3 attributes, shape, Dp at peak, and amplitude. That is a lot of information to keep in short term memory cache. It might help to consolidate material on Aitken mode, rather than strictly following a species by species description.

P9832 line 10-13 13:1 dilution for CO Could you present number from which this dilution factor is calculated.

P9836, line 21-22 "there were no clouds" How does this impact earlier statement that oxidation of SO2 is enhanced by higher humidity? Is model creating clouds?

P 9833, line 6-7, ozone is a factor of 3 lower Concentrations and figure numbers would be useful.

P 9833, line 14 "measured O3" where and when?

Fig. 4a and c. Measured CO and O3 for WNW flow stop at 15:00. Text refers to measured CO at 18:00 (Page 9832, line 3-4)

Fig 7. Observed concentrations of NH4+ are too high in comparison to SO4= and NO3- . I will neglect changes in peak width. Consider WNW flow in Figs, 5a, 6a, 7a. The equivalence ratio, NH4+/(2 SO4= + NO3-) is $\sim$ [1.2]/18 / (2 * [0.5]/96 + [1.2]/62) = 2.2. Fully neutralized H2SO4 plus HNO3 has an equivalence ratio of 1. The equivalence ratio from the calculations is 0.73. The difference between this number and one may be real or may be due to approximating concentration by peak height.

Fig. 9 caption I am having trouble with horizontal bars. It would be helpful to indicate the figures in which the concentrations for the bars are presented. A mark on that figure would be valuable. Or if not in any figure, indicate that.

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