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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Comparison of Chemical Lateral Boundary Conditions for Air Quality Predictions over the Contiguous United States during Intrusion Events" *by* Youhua Tang et al.

Anonymous Referee #1

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Review of Tang et al. "Comparison of Chemical Lateral Boundary Conditions for Air Quality Predictions over the Contiguous United States during Intrusion Events" In this paper, Tang et al., use a number of different methods to set boundary conditions for use in CMAQ as part of the US NOAAs forecasting system. While focusing on PM2.5, they also looked at ozone. Not surprisingly, they found that having boundary conditions that are more representative of actual conditions improved model performance. The manuscript needs to be thoroughly edited for grammar before resubmission. It is replete with incorrect inclusion or exclusion of articles (in the grammatical sense). They also inconsistently used plurals and singulars, including when the used the terms LBC(s) and CLBC(s). Given that you typically set more than one boundary condition,

it should almost alway6s be plural, but either way, be consistent. They tend to use ambiguous pronouns (e.g., its). After fighting through the manuscript, the third sentence of the Conclusion was: "The GEOS dynamic LBC showed the overall best score when comparing with the surface observations during the June-July 2015 while Saharan dust intrusion and Canadian wildfire events occurred." "LBC" should be "LBCs", "comparing" should be "compared", "the June" should be "June", "while" should be "when", "Saharan" should be "the Saharan" (at least I think those are appropriate). In the Introduction, they state that there are two roles "it" (actually they, i.e., CLBCs) play. The two are the same. They are setting values of the concentrations used in solving the differential equations that underlie the core of an air quality model. In such a way, they might be called constraints, but that is both awkward and imprecise, as they are not setting a range, but an actual value. This is exactly how external influences are brought in to the model. Using the precise definition of boundary condition leads to (1) and (2) being the same. Line 14: "Proper" is not the best word here. What defines proper? Do they mean accurate? How accurate? Line 26: Sentence beginning Tang et al.: What point is being made?. The description of the 5 model runs should be more clear, with specifics in a Table. ACP is an international journal, so the US NOAA should be used at least the first time and NOAA defined. Page 3 Line 34... Not sure what this is adding. The title should be a bit more explanatory as Intrusions can be stratospheric, still impacting lateral boundary conditions. Page 10, line 35. The surface stations reflect the wildfire intrusions just as well as VIIRs... at their location. The issue here is how well the surface stations provide more spatial coverage. Page 11, line 20: I do not think that "a high pressure system controlled western Canada" (the authors should look at that whole sentence). P3 L20-21. Why does the CMAQ_BASE simulation use a clean background for aerosols. According to the introduction, the NAQFC system currently uses NGAC for its aerosol LBCs? Does this not make the performance of the CMAQ_BASE simulation artificially worse than the current NAQFC system? And if your goal is to compare how new CLBCs impact the forecast, shouldn't the CMAQ_BASE simulation represent what is used in the current NAQFC system? It is not clear to me

if any of the 5 simulations listed in Table 1 use the same CLBCs as the current NAQFC system, though I think it may be NGAC-LBC. This should be clarified. Figure 7. There appears to be a discontinuity at the transition between the east and north boundaries. Is this correct, and if so, what could cause this?

If the details of the mapping are important, the chemical mapping is a bit haphazard. Putting all of the MVK in to ISPD would require that all of the MVK comes from isoprene. Splitting all of the INO2 using the coefficients in the ISOP+NO3 reaction would require that all of the species degrade at a similar rate, or that INO2 rapidly reacts to those products. ALK4 includes C4 and higher alkanes, so having it turned in to 4 PARs is biased low unless it is all butane isomers. A detailed understanding of both mechanisms are needed to do such a mapping directly if this step is important to be done in detail (which I am not sure it is... for boundary conditions, the important species are probably NO, NO2, O3, PM species, SO2, NH3, HCHO and a few others, but that is just a guess: they might check that out. Having to deal with large fires may lead to large fluxes of other organics that then become important.). They need to work on a better way of expressing their finding that setting better boundary conditions leads to a better simulation. That is generally the case. Can they be more prescriptive? The results from the AOT-derived LBC to be a more compelling idea and would have liked to see a comparison of CMAQ performance using the AOT-derived LBC and the dynamic LBC (GEOS-LBC and NGAL-LBC), but these were not modeled for the same time period as the AOT-NLBC case. Is the use of three or four significant figures justified? In the end, there are aspects of this paper of potential interest to ACP readers, but at this juncture, the grammar and some of the set up needs work before it should be further considered for publication in ACPD or elsewhere. The authors need to identify and highlight what is unique about their findings other than "better boundary conditions lead to better results." What is the best approach and why? (or, what are the positives and negatives of each approach and what is a general recommendation after weighing those attributes?) This should be stated concisely in the Abstract and the conclusions, backed up with specific study results.

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