Atmos. Chem. Phys. Discuss., 15, C1537–C1541, 2015
www.atmos-chem-phys-discuss.net/15/C1537/2015/

Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Regional-scale transport of air pollutants: impacts of southern California emissions on Phoenix ground-level ozone concentrations" *by* J. Li et al.

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Received and published: 13 April 2015

The authors present the contribution to ground level ozone in Phoenix from local sources in Arizona and sources in southern California. The assessment is done using the WRF-CHEM coupled prognostic meteorology and chemistry modeling system. Emissions are based on the 2005 National Emission Inventory. The contribution assessment is done using brute-force emissions changes (zero-out) and comparing the results to the original baseline (control) simulation. All contributions are estimated using the 1.33 km domain covering southern California and Arizona to better capture air flow through important orographic features between the Los Angeles area and Phoenix.

Model application at such a fine scale to resolve important terrain features between 2 large cities to capture regional transport is useful and generally well presented in the Figures. The illustration of air flow through valleys in the vertical and horizontal dimensions is particularly notable. Overall this is a good analysis characterizing local and regional contribution to Phoenix.

The model results at 1.33 km suggest that WRF is adequately capturing important terrain features that channel ozone from southern California to Arizona. An interesting extension that would strengthen this manuscript would be to do a similar assessment using the 4 km and possibly 12 km domains to see how regional ozone transport is impacted by smoothing out terrain features. The authors make a compelling case that these features are important and a fine resolution is needed to resolve the terrain, but we have no context for direct comparison with the coarser simulations.

The presentation of the contribution information could be presented more clearly if the contributions were shown as the difference between the baseline scenario and the sensitivity simulation. In Figures 5 and 6 the readers are left to interpret the contributions by visualizing the difference between the baseline and the simulations where emissions have been zeroed out. It would also be helpful if the authors could clarify if the difference between the baseline simulation and the sum of the BEO, noAZ, and noCA should be only the chemical inflow into the 1.33 km domain or if that would include other sources of ozone. Spatial plots of contribution from southern California, Arizona, and the biogenics-only simulation would be very helpful in terms of understanding the amounts and gradients in contribution from these sources/areas when interpreting the results.

More emphasis is needed throughout the manuscript that these impacts are based on the 2005 National Emission Inventory and emissions have changed since 2005 in both California and Arizona. Also notable, emissions in these areas may be changing at different rates (e.g. more aggressive emission control programs in one place compared to the other, higher rate of vehicle fleet turnover in one area compared to the other, etc.). It would be ideal if the most recently available National Emission Inventory (NEI) was used to support the analysis, but in place of that the authors could strengthen the manuscript by providing a comparison of anthropogenic emissions in southern California and Phoenix that were used in this modeling assessment and the emissions for these areas from the 2011 NEI. This would be the best alternative to using newer emissions as part of the modeling since the authors correctly note (page 8370 lines 16-22) that making emissions adjustments to the 2005 NEI such that the model estimates of O3 match observations does not provide a better estimate of episode specific emissions but compensates for other model specific formulation deficiencies. The authors should also discuss any implications of the 2005 vs 2011 emissions comparison to the relative contributions of Arizona and California emissions to Phoenix ozone concentrations. If the emissions comparison between 2005 and 2011 suggests that the relative influence of emissions from these two regions has changed in the past 10 years, appropriate caveats should be added to the abstract and conclusions sections.

The U.S. Environmental Protection Agency has published modeling guidance in 2007 (U.S. Environmental Protection Agency, 2007) and more recently at the end of 2014 (U.S. Environmental Protection Agency, 2014) that should be used place of older guidance from 1991. As noted in the 2007 and 2014 modeling guidance documents U.S. EPA has no criteria for “acceptable” model performance (U.S. Environmental Protection Agency, 2007, 2014). The Agency recommends comparing model performance results (performance metrics such as bias and error) to those estimated in other similar contemporary model applications. The authors note quite a few relevant modeling studies done for the southwest U.S. in the introduction section so the most relevant model performance would be to compare the results here to those studies where possible. Additionally, in the absence of relevant contemporary studies, model performance results here could be compared to a recent review paper (Simon et al., 2012) that compiled model performance statistics for regional and local scale O3 and PM2.5 photochemical model simulations.

Since the goal of these simulations is to assess interstate transport from California to Arizona and that could take several days, the episodes seem rather short especially when combined with the exclusion of only a single day at the beginning of the episode for spin-up. Are these periods of elevated ozone only for a single day or would it be possible to relax some of the episode criteria and include more days in the analysis?

Some additional information regarding the methodology would be useful. Was analysis nudging used for any of the domains in WRF? If so, which domains and which variables were nudged (above and below PBL?). What is the vertical grid structure used in the analysis? Are the same boundary conditions used for both the 2005 and 2012 simulations? Was the MOZART simulation for 2005 or some other year?

I appreciate that this suggestion is generally outside the scope of this project, but since the authors made the effort to model Phoenix at 1.33 km grid resolution it would be interesting if some information could be presented about the urban gradients and variability in ozone on these episode days. Are local emissions features seen in the model results (e.g. large point sources, highways, etc.)? Spatial plots for the metropolitan area for the baseline simulation and the sensitivity simulations showing contribution from southern California and Arizona could be of interest.

Figure 1. The lower panel is nicely presented. However, the political boundaries are hard to make out.

Figure 2-4. There is a lot of useful information presented in these timeseries plots. However, the information is difficult to differentiate. Perhaps using different line types (dashed, etc.) could help make these easier to interpret or presenting the information as a time series of blox plots.

Figure 6. This may be easier for those less familiar with the material to interpret if there were only 3 sets of bars: observation, baseline (control) total, and then a stacked bar showing the contribution from BEO, noAZ, and noCA in different colors.

Figures 7, 8, 9, 11, and 12: These are really nice Figures. On some of them the political boundaries are a little hard to see. It would be really interesting to see comparable Figures with the 4 km and maybe even 12 km simulations to see how the lack of orographic resolution impacts these features (could be put in supporting information to avoid large re-writes to the manuscript).

Figures 12 and 13 look the same.

References

Simon, H., Baker, K.R., Phillips, S., 2012. Compilation and interpretation of photochemical model performance statistics published between 2006 and 2012. Atmospheric Environment 61, 124-139.

U.S. Environmental Protection Agency, 2007. Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze, EPA-454/B-07-002.

U.S. Environmental Protection Agency, 2014. Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze. http://www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 8361, 2015.