Review of "Isoprene chemistry in pristine and polluted Amazon environments: Eulerian and Lagrangian model frameworks and the strong bearing they have on our understanding of surface ozone and predictions of rainforest exposure to this priority pollutant," Levine et al. (2015) ACP

Summary

This manuscript uses two different models to simulate a series of airborne observations taken over the central Amazon in 2012. A variety of sensitivity studies are used to show that model output is relatively insensitive to the choice of chemical mechanism, somewhat sensitive to the resolution of emission fields, and very sensitive to the treatment of transport/mixing. Results are used to demonstrate in impact of model framework on calculation of rainforest ozone exposure.

The results presented are novel and interesting. Comparison of different model frameworks is a valuable exercise that will hopefully temper future model interpretations. The number of figures is appropriate relative to the detail in the text, though some of them could be modified to better support the discussion. The English is fine. Publication is recommended after considering the following minor revisions.

General Comments

Figures 4-11 are almost exclusively time series. While this is the simplest way to present the results, it may not be the best way to support the discussion in some cases. Moreover, some of these are very cluttered, making interpretation difficult. The authors might consider whether some time series could be replaced with other types of figures (vertical profiles, histograms, etc) to reduce monotony/clutter and aid in quick interpretation. Some specific examples are discussed below.

In the conclusions, it is stated that "The choice of model framework therefore has a strong bearing on prediction of the exposure of tropical forest to ground-level ozone,…". The results of this study demonstrate this point well, but the natural extension of this argument is not stated: namely, that *any* model must be validated against observations before it is used predictively. Are there any examples in the literature of O3 exposure calculations/predictions that might be very, very wrong because of the model framework? If so, it would be worthwhile to call these out here – both to strengthen the value of the paper and to encourage others to re-evaluate their methodologies.

Specific Comments

P.24254, L7: The WMO citation is 20 years old. Is there anything newer? Or have NMVOC emissions not changed that much in 20 years?

P24255: An alternative explanation for the model-measurement mismatch in OH during GABRIEL is that the measurements contained a positive artifact. The LIF technique is now known to suffer from such

issues, especially in biogenic-rich environments (Mao et al., 2012). This possibility cannot be ruled out for the GABRIEL data and should be mentioned here.

P24258, L29: This is not quite correct. O3 might be titrated at night by NO + O3, but during the day O3 production is limited by OH + NO2 -> HNO3 under high NOx conditions.

P24260, L.23: It would be helpful to mention here what the starting times are for the Manaus trajectories. Also, why 7 days (as opposed to less or more days)?

P24273, L10: The variability of observations and model output in Fig. 5 makes this a very difficult picture to interpret. Given that most of the discussion compares/contrasts high and low-altitude segments, perhaps averaged vertical profiles would be more appropriate here? These could be added as panels to the right of the time series if the authors feel it necessary to show the latter.

P24274: CiTTyCAT is predicting 20-40 ppbv isoprene at low altitudes. Is it possible that this is partially titrating ozone, contributing to the under-prediction discussed in the previous paragraph? It might be worth considering how this compares to the effects of no vertical mixing.

P24275, L14: It seems unlikely that excess isoprene oxidation could explain a 100 ppb over-prediction of CO, but perhaps the reviewer just does not have a good feeling for this. Is there an easy way to estimate the source contributions to CO?

Sect. 3.2-3.4 and Figs 8-10: The relevant results here might be more succinctly represented by vertical profiles, or by plotting differences relative to the base simulations. Just something to consider.

P24276, L6: How much does OH increase between CheT and CheT2?

P24277, L21: Flight B735 appears to have more back-trajectories over the Atlantic. Could this explain the apparent exception?

P24279, L1: It is surprising that imparting an additional lifetime of ~9h to isoprene (Table 1) would have such a dramatic effect. What is the chemical lifetime of isoprene in the model(s)?

P24279, L18: What is the range of applicability of these mixing parameter values? Are they limited to this particular time/location? How would one choose them a priori or with limited information (e.g. in a prognostic application)?

Technical Comments

P24254, L15: “aggravant” is French. Please consider an English alternative.

P24254, L17: “photosynthesize”

P24264, L4: how many model layers are in the boundary layer (roughly)?

P24265, L22: Please mention spatial resolution of wind fields

P24271, L19: replace “data” with “output” (this is a nitpicky point, but the word “data” should be reserved for observations)

P24275, L6: The span/zero data in Fig. 7 should just be removed from the figure.

Figures 1-3: The text is very hard to read. Please modify so that all figures are legible at 100% magnification.

Figure 2 does not seem to be necessary for any of the subsequent discussion or interpretation. Suggest moving this to supplement.

References

Mao, J., Ren, X., Brune, W. H., Van Duin, D. M., Cohen, R. C., Park, J. H., Goldstein, A. H., Paulot, F., Beaver, M. R., Crounse, J. D., Wennberg, P. O., DiGangi, J. P., Henry, S. B., Keutsch, F. N., Park, C., Schade, G. W., Wolfe, G. M., and Thornton, J. A.: Insights into hydroxyl measurements and atmospheric oxidation in a California forest, Atmos. Chem. Phys., 12, 8009-8020, doi: 10.5194/acp-12-8009-2012, 2012.