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Interactive comment on "A scaling analysis of ozone photochemistry: I Model development" *by* B. Ainslie and D. G. Steyn

Anonymous Referee #1

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Review of "A scaling analysis of ozone photochemistry: I Model development" by Ainslie and Steyn for Atmospheric Chemistry and Physics

I reviewed Parts I and II. This is the second review submitted but I have chosen to write it without looking at the first. This study meets all the criteria for publication and indeed could be published as is. Which is not to say that it could not be improved upon. The writing in places is crystal clear (i.e. "whether or not chemical mechanisms faithfully represent actual ozone formation is a difficult but different question") but as a whole I found the study difficult to follow. Many of my comments address that concern.

Modeling tropospheric O3 formation is a mature field so it is refreshing to see some-

thing entirely new come along. Whether or not the authors scaling analysis becomes a technique that others use and build upon is difficult to say. I can't see it take the place of the IER mode, which has lots of faults, but offers policy makers a way of deciding between NOx and VOC limited O3 production based on a few simple measurements. (I presume this not the authors intention.) I believe that the chances of this study being used will be enhanced by making it more accessible and including more linkages to current pictures of O3 production.

p12962 A table of non-dimensional quantities would make the text much easier to follow. Equation (1) is reasonably compact, but it does not include the new dimensionless groups formed out of the initial 7. It is very difficult to remember what the derived Pi's are as they have no intrinsic symbolism. I had to write the definitions in the margin.

Symbols are written out to avoid LATEX

p12962 Third we try a power law for Pi2 /Pi3 dependence. It is not clear until you see Eq. (5), that this sentence refers to the dependence of (Pi/Pi5) on (Pi2 /Pi5)

Presentation of equations: As an example consider p12964, Eq (5) It is clearly important to show the equations in terms of the Pi's. However, given that the Pi's don't call to mind any particular variables, it would be helpful to also spell out the equations using symbols that bring to mind the physical quantities. In this case, I would list in the Dimensionless Group Table that (Pi/Pi5) = scaled O3 which has its own symbol. Maybe a bar could stand for a scaled variable [O3 bar]max (I am limited in the symbols that I can create). Then under the original and perfectly correct (5), one could add:

[O3 bar]max = ([NOx bar]0)a f(R, j delta t, EOH/kT)

p12964 Equation (6) It would be helpful to add = f(R) or f(R, j delta t, EOH/kT), as appropriate

p 12966 Weibull transformed I have only the most cursory knowledge of what a Weibull function is. This is my fault, not the authors. But it may be an impediment to other

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readers. I googled the phrase "Weibull transformed" and came up with 32 hits, the first 2 of which (and at least one other) are Ainslie and Steyn Parts I and II. So, this is a somewhat idiosyncratic phrase. If you can make a connection to functions that are part of a larger communities vocabulary, this article will be more accessible. I am picturing a log normal function which when plotted on a probability axis yields a straight line. Two log normals, gives a line with a break. A related point concerns the shape parameter (α) that varies with R. Is there a way of picturing this using the functional form of a log normal.

P 12966 and Fig 3. At large R in the NOx only scaling regime, [O3]max is proportional to NOx0.6. In this regime I would expect that P(O3) is proportional to NO - and more or less NO is proportional to NOx. If P(O3) is proportional to NOx for the whole time evolution why isn't [O3]max proportional to NOx?

p 12971, 3 lines under Eq 10 should ln (R/b) $>$ 1.0 be ln (R/beta) $>$ 1.0 ?

p 12972, 8 parameter fit for OLT chemistry. Eight is a much smaller number than the number of parameters in a chemical mechanism. But is still a large number. How many parameters are needed without the light and temperature dependence? How many of these parameters change for a different VOC? Does the task of representing different VOCs become easier if a VOC reactivity axis is used in Figure 3?

Figure 1 There is much discussion of S shaped relations in Part II. Is the curve in this figure the prototypical S shaped relation? If so, you should explicitly call attention to the small hook on the bottom, which does not visually stand out.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 12957, 2005.