

Interactive comment on “Chemical modeling of the reactivity of short-lived greenhouse gases: a model inter-comparison prescribing a well-measured, remote troposphere” by Michael J. Prather et al.

Anonymous Referee #1

Received and published: 23 March 2018

Prather et al report a new modelling protocol for merging in situ measurements of reactive chemical species into 3D models that simulate their chemistry. The goal of this work is to enable new insight into how the chemistry schemes and processes in these 3D models affect the results of simulations performed with them by isolating (switching of) meteorological mixing, emissions and deposition. This protocol is tested with a synthetic (model derived) data stream in the current work but could be extended to a real observational data set when such a data set becomes available (i.e. from the ATom mission dataset).

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This is a very original idea – albeit an extension, in some way, of years of previous work using single box models. It is a neat idea and as a global modeller not involved in this work I will be working out how to apply this protocol to my model to test my model's results! I would recommend publication in AMT following the adoption of the following minor points.

My major annoyance with this paper was the constant reference in the main paper to figures and tables in the supporting information (SI). I would recommend large parts of the SI be moved into the main manuscript.

General comment:

- Many of the figures are low resolution. Please make sure that the final images are higher quality scalable vector images. In addition, many of the figures have no units on the axes. Please check them and add units where appropriate.
- Please also ensure consistent use of colours for models. There are many figures and it makes it easier to keep track if colour is used consistently. For example in Figure 2 NCAR is black but Figure S2 NCAR is magenta.

Specific comments:

Page 1, line 21: "the data" I think should be "these data".

Page 2, line 36: Are the regions being referred to spatial or chemical or both?

Page 2, line 60: Please add the information referenced in the SI on **Reactivities** to the main document.

Page 3, line 72: How large is large? Can this be quantified?

Page 3, line 75: This is a minor point but as I understand PhotoComp 2010 mainly

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assessed stratospheric chemistry? The work in this paper focuses on tropospheric reactivities. What relevance is this reference to the present work?

Page 4, line 118: I think this refers to Tables S1a and S1b not S1?

Page 5, line 131: I think it's important that the information referred to here from the SI be put into the main paper. This is a technique paper and it is painful to have to refer to the SI to actually find out about the technique in question.

Page 6, line 168: Define RMS.

Page 6, line 168: It's not clear why 3 different model years would be capable of defining a lower-limit for the RMS? Why not 2, 5 or 10 years?

Page 6, line 168: I'd suggest adding "(in blue in Table S2)" after "lower-limit rms". Page 7, line 206: Are there any references for this statement of "ambiguous choices"? Will other modelling groups know what you mean here. I'm afraid I don't.

Page 12, line 280: Correct the duplicate "that" typo.

Page 13, line 315: From Figure S6 it seems to me that GISS is an outlier for L-CH4. Can you clarify why you state it is not?

Page 15, line 376: Typo – "great" should be "greater".

Page 16, line 378: I would suggest adding "(solid line)" after "reference case".

Page 16, line 386: Looking at Figure S2 I don't see that the largest J-NO2 values are within clouds. It looks to me that J-NO2 follows J-O1D and increases to a maximum in the upper troposphere.

Page 16, Figure 3: Please add x and y axis information to the plots.

Page 17, Figure 4: I like the figure! But, the colours may be difficult for a colour blind person to interpret. I have had a go at uploading and examining the figure here (<http://www.color-blindness.com/coblis-color-blindness-simulator/>). As far as I can see this may be OK, but I would advise as a general note to consider the use of colour more.

Page 17, line 398: Why is this surprising?

Page 17, line 403: Remove typo "models".

Page 18, line 412: Please clarify that 8/16 is 16th August. As a non-American English

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user I was a bit confused but guessed this is what you meant?

Page 18, line 419: Are these small differences likely in all environments? Is this protocol only valid for the remote Pacific? What levels of NO3 and N2O are present and how would a more vigorous night-time chemistry effect these conclusions?

Page 18, line 435: Delete "out".

Page 18, line 437: I think "J-values" should be "J-value".

Page 19, line 440: I think removing "5x14,880" and replacing with "5 days that we consider 14,880 parcels per day," would make this a bit clearer for the reader.

Page 20, Figure 6: What is "Ud4"? in the legend? Delete "use of their" from the caption.

Page 21, line 495: Decapitalise "Overall".

SM-1: There is a typo in the units for P-O3.

SM-2: It is not clear how you have adopted the partitioning of collective species? For example, in my model I only have 3 NMVOC. My ATom or synthetic data set has 12 NMVOC. What should I do? I think it would be nice if the UCI data were made available as a data source for other modellers to use and then they can compare their results to this paper.

SM-4, Table S1b: Can the versions of codes to calculate photolysis rates be added? Similarly, can references for the chemistry schemes or the papers that describe the schemes be added. I'm sure GFDL have updated some of the rates that were in the original MOZART-2 scheme since it was developed. ASAD, as I understand is not so much a chemical mechanism but a software for integrating chemistry. What is meant by "Wild, FRSGC"? Is this a reference?

Table S6, S7 and S8: What is "R"?

Figure S1: There is a growing consensus that the rainbow/jet colour scale should not be used for quantitative inference (Hawkins et al., 2015). I would consider switching the colour scale used to something like the viridis colour scale.

Figure S1-S9: See general comment about consistent use of colour. NB I can not see a difference in colour between GFDL and GISS in the legend of Figure S8.

C4

Figure S11: What is "Ud4"?

Figure S12: Are the different dates important here? If not a hex-bin plot would be much nicer to help the reader see the relationships between the data.

References:

Hawkins, Ed. "Graphics: Scrap rainbow colour scales." *Nature* 519, no. 7543 (2015): 291.

Interactive comment on *Atmos. Meas. Tech. Discuss.*, doi:10.5194/amt-2017-470, 2018.