Geoscientific
Model Development
Discussions

Interactive comment on "Evaluating Simplified Chemical Mechanisms within CESM Version 1.2 CAM-chem (CAM4): MOZART-4 vs. Reduced Hydrocarbon vs. Super-Fast Chemistry" *by* Benjamin Brown-Steiner et al.

Anonymous Referee #1

Received and published: 13 March 2018

Brown-Steiner et al present a study of how two reduced chemical mechanisms perform in a number of comparisons against the more comprehensive MOZART scheme (MO). The Reduced Hydrocarbon mechanism (RH) contains around half the number of MOZART reactions, whilst the Super-Fast mechanism (SF) is about 1/6 of MO. The work has been done to explore how much of a compromise it is by choosing one of these simple mechanisms over the more comprehensive scheme, when considering computational time gains versus accuracy of the chemical predictions.

The model runs have been conducted on a global scale for 25 years. This has enabled

the authors to pull out modelled data to compare with each other, and for the time periods and locations of ozonesonde, aircraft and CASTNET observations. Given how small SF is, it performs unexpectedly well, particularly against the CASTNET data, and in some cases better than the other two schemes. The RH scheme often tracks MO quite well, but with some exceptions, particularly for CO.

The Super-Fast mechanism could be used to explore chemical sensitivity studies in a fraction of the time it would take to run MOZART in locations of low biogenic activity.

I think the manuscript fits within the GMD journal remit and should be published. I have a few minor comments and queries.

General comments:

Please check throughout for the consistency about the length of the run. Page 6 line 1. 'we use MERRA.. for 25 years (1990 – 2014)'. However figure 1 plots maps for the year 2015, and figure 4 shows vertical distributions for 2015? Figure 6 also looks like it starts at 1991, not 1990 and carries on beyond 2014. Same applies to the statement on page 9, end of line 13 about the run being 1990-2014. Also figure 7 'for the full 1990-2015 time series', which is 26 years.

Section 2.2.1 MOZART-4. This section is very short and doesn't give the reader much information about MOZART other than to go searching through the suggested literature. I think a bit more information on what the scheme includes (e.g. how many alkanes/aromatics/biogenic species are considered explicitly) and omits would be useful, particularly as it is being used as the benchmark scheme.

Page 9 line 1. Please describe what 'BAM' means

Page 10. Line 20. There is a single line describing figure 6 and I then didn't fully understand the results drawn from it. My assumption is that the range of ozone at each time step in the model has been extracted for the region and the differences in the percentiles plotted here (although the figure caption says the CASTNET observations

are only for JJA?). The results say it takes 5-10 years for the models to stabilise, but the plots also show that the CASTNET observations themselves need 5-10 years to stabilise? If the models are behaving similarly to the observations, why would we need the spin up? There's a bit of a leap of understanding, so I think a bit more description is needed. I can see why you would expect the range in predicted ozone to settle as times goes on using constant emissions – but why also in the observations?

Page 14 line 16 spelling. 'mechanism', not 'mechanisms'.

Figures:

Figure 5, panels g,h and i. what does the 1x1 refer to?

Figure 7. Titles overlap with plots.

Figure 8. I'm struggling to see the orange N2O5 line in any of these plots. It could be that the line is hidden under the PAN+N2O5 line, but given the variation between PAN+N2O5 and N2O5 in the global ozone plot, I expected to see it?

Figure 8. Which single year are these seasonal cycles for? Why was this particular year chosen? How much variability is there between the first year run (1990) and the last (2014)?

Figure 9. Please give the location of the grid cell, (lon, lat).

Figure 10. please add units.

Figures, general comment:

About half way through the figures the colour scheme changes. In figures 2,3,5 and 6 MO is red, RH blue and SF is green. Later in figures 8 and 9, MO is black, RH is still blue but SF is now red. For the quick skimming reader, the assumption is that red is the benchmark scheme. It's a bit confusing.

C3

2018.