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Geoscientific Model Development Discussions

Interactive comment on "Representation of the Community Earth System Model (CESM1) CAM4-chem within the Chemistry-ClimateModel Initiative (CCMI)" *by* S. Tilmes et al.

Anonymous Referee #1

Received and published: 8 February 2016

Manuscript Number: GMD-2015-237 Title: Representation of the Community Earth System Model (CESM1) CAM4-chem within the Chemistry-Climate Model Initiative (CCMI) Authors: Tilmes et al.

General Comments: This paper provides a nice overview of the CAM4-chem simulations that have been performed for CCMI. It describes the model configurations used, simulations conducted, and updates made to the model. Preliminary analyses of the model results relative to observations are also shown.

Detailed documentation of model simulations that will likely be used in a wide range of analyses through the CCMI effort is extremely useful. Someone wishing to use the model output from these simulations, but is otherwise unfamiliar with the details

concerning this model, will find this write-up to be a great reference when trying to understand how the CAM4-chem model differs from the other models participating in CCMI. All information included in this manuscript is relevant and complete for understanding the details of this model simulation, and the preliminary analysis of the results compared to observations is instructive. I therefore recommend the publication of this manuscript with minor revisions.

Specific Comments: The motivations for some of the specific changes to the model are unclear; a brief statement of why deviations from the previous version of the model or from a method described in the literature would be helpful. Instances where I'd like to see a bit more explanation include:

Page 2, Line 28 (Section 2.1): A brief mention of what issue is addressed by the improvements to the deep convection scheme (Richter and Rasch, 2008; Neale et al., 2008) would be instructive to a reader who is not so familiar with dynamics.

Page 5, Line 7 (Section 2.1.6): Is there a reason for using Leaf Area Index "from the previous model timestep instead of the average of the previous 10 days"? Is there any significant difference between biogenic emissions calculated this way versus calculated by the method of Guenther et al. (2012)?

Other Specific Comments: Page 5, Line 14 (Section 2.2): The synthetic tracers that are recommended by CCMI and included in these simulations are listed, then the O3S tracer is described. I understand that the reader could refer to the SPARC newsletter for a description of the remaining tracers, but it would be instructive to have those descriptions in this paper as well. They do not need to be defined individually, necessarily; a categorization or brief description of the usefulness of the tracers is sufficient.

Page 7, Line 25 (Section 3.1): "Differences in clouds and land surface temperatures" cause the differing VOC emissions between simulations. Prior to this, it is pointed out that REFC1SD had higher land temperatures; shouldn't higher temperatures generally lead to greater emissions of biogenic VOCs though? Does this mean clouds are

causing an even larger difference in emissions rates, if the effect of temperature is compensating? An explicit statement of why you think VOC emission rates in the SD run are so much lower than in the FR runs would be beneficial here.

Page 8, Line 16 (Section 3.2): A link between increasing methane emissions and increases in tropospheric OH is suggested here. However, the general view is that OH should decrease with increasing burdens of methane, since methane is a sink for OH. Perhaps this could be clarified.

Page 8, Line 23 (Section 3.2): "larger ozone mixing ratios in the upper troposphere in the REFC1SD experiment results in a higher oxidation capacity", however, primary production of OH in the upper troposphere is often limited by concentrations of water vapor, and so the UT has little influence on the oxidative capacity of the troposphere. Is there clear evidence in support of this conclusion? It would be helpful to state or show what led to this statement.

Page 10, Line 12 (Section 4.1.1): Why is the model overestimating winter ozone mixing ratios in the UT? STE?

Figure 1: Labels that define the colors, as in Figure 2, would be helpful here.

Technical Corrections: Page 1, Line 7 (Abstract): "observed period" is unclear; perhaps "satellite era" instead?

Page 1, Line 13 (Abstract): "has been" should be "is"

Page 2, Line 31 (Section 2.1): semi-colon between references should be an "and"

Page 3, Line 9 (Section 2.1.1): Meaning of "above 100 hPa" could be confused; suggest "at pressures less than 100 hPa" or something similar to make it absolutely clear

Page 4, Line 23 (Section 2.1.4): "black carbon and primary organic carbon, nitrates are..." should be "black carbon, primary organic carbon, and nitrates are..."

Page 5, Line 2 (Section 2.1.6): acronym used is "CLM" but was introduced as "CLM4.0"

Page 5, Line 30 (Section 2.2): Second "C" in "CAM4-Chem" should be lower case for consistency

Page 6, Line 3 (Section 2.2): semi-colon between references should be "and"

Page 6, Line 10 (Section 2.2): The "1" in "O1D" should be superscripted

Page 7, Line 5 (Section 2.3.1): Should "ran until 1959" be "ran through 1959"? The meaning conveyed is slightly different.

Page 8, Line 2 (Section 3.1): Methane lifetime due to OH reported in Supplement of Prather et al. is 11.2 years, not 11.3

Page 8, Line 7 (Section 3.1): "optical depth is with around 0.04 somewhat higher than..." should be "optical depth around 0.04 is somewhat higher than..."

Page 8, Line 15 (Section 3.2): Specify "increasing column ozone" as "increasing tropospheric column ozone"

Page 8, Line 26 (Section 3.2): Would like to see a reference here; there are plenty of candidate papers.

Page 9, Line 14 (Section 4.1.1): "altitudes below 900 hPa"âĂŤcan be confusing to mix altitude and pressure coordinates; same just below in Line 16

Page 9, Line 15 (Section 4.1.1): Definition of MOZAIC acronym is not correct, compared to website

Page 10, Line 9 (Section 4.1.1): Punctuation in "U.S. . REFC1/REFC2" should be fixed

Page 10, Line 30 (Section 4.1.2): "The ozone gradient... is to the most part well captured" should be "...is for the most part well captured".

Page 11, Line 25 (Section 4.2): "the model underestimate" should be "the model underestimates"

Page 12, Line 17 (Section 4.4): "over the remote region over the Pacific" should be

“over the remote region of the Pacific”

Page 13, Line 5 (Section 5): “investiaged” should be “investigated”

Page 13, Line 18 (Section 5): remove “rather”

Figure 5, Caption: time period (1995-2011) is not consistent with time period in the text (Pg. 10, Line 14: 1995-2010)

Table A1, Title: “semi-implicit (S)” should be “semi-implicit (I)”

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