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Interactive comment on "Earth System Chemistry Integrated Modelling (ESCiMo) with the Modular Earth Submodel System (MESSy, version 2.51)" *by* P. Jöckel et al.

Anonymous Referee #1

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The paper P. Joeckel et al. gives an overview of the CCMI experiments using the ECHAM/MESSy model. Altogether, the authors have done a great job in summarizing the configurations and setup of the experiments. There is a lot of detail that will be very useful to various readers. Besides summarizing technical aspects of the model, physical parameters, and capabilities of the model are summarized. Comparisons to observations are performed to demonstrate the general performance of the different configurations of the model. This paper is an important paper for the community and should be published in this journal. A few aspects of the paper could be improved to make it easier for the reader get the required information.

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Interactive Discussion
Discussion Paper

This paper currently addresses at least two different types of readers, those who want to run the ECHAM/MESSy model themselves and need to understand how to do this, and others, that are interested in performing multi-model comparison studies based on the results of this model. Section 2 is mostly of interest to the first group of readers. It is very technical and is mostly concerned with the model structure and less with the science. An overview of the physics and other details are described in Section 3. My feeling is that the second group of readers is not interested in the details in Section 2, and readers that want to just know how the model works would be less interested the remaining part of the paper. I would suggest moving Section 2 to the supplement, or to a separate technical report.

The discussions on different experiments and comparisons to observations are very comprehensive, however, sometimes difficult to follow. Less detail and figures and focusing on important results could improve the paper. The main problem to me was the naming of the different experiments that are not intuitive, and even reading the whole paper, I always had to go back and recall the specifics of the experiments. I would recommend changing the names of the experiments to make this more obvious, or improve Table 1 that summarizes the specifics of the experiments. Instead of little footnotes, it may be easier to have a row for each experiment and have the columns covering different categories, like vertical resolution, nudging, etc. To further guide the reader, it would be helpful in the text to point more often to the colors that are used to represent the different experiments so one easily identify differences in the plots. Sometimes it seems like difference between observations and models are discussed that may not be significant. It would be also helpful to give more explanations for the deviations between models and observations.

Finally, many different experiments have been performed. If all of those get submitted to the archive, the readers are left with making their own choices on what simulations to use for their analysis. Therefore for the conclusions, it would be very helpful if recommendations would be made on what experiment should be used in a multi-model

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comparison study for each reference experiment. Those conclusions can be made based on the comparisons to observations. For example, would be helpful to point out, if the 90L vs. 47L version should be used, or for what purposes the one or the other is preferable.

Specific Comments:

Introduction: Line 15: What about the chemical mechanism, are there more details later, please point to later sections.

Page 8644, Line 6: How long was the spin-up of the ocean, maybe refer to section 3.5.5?

Page 8645: Line 22. What TOA balance are you aiming for? Are these tests done for present day? How much do you think, will the non-interactive chemistry change those tuned parameters?

Section 3.5.1. How many reactive species are in the mechanism? How many reaction rates?

Page 8654: Line 14: Where are the observed mixing ratios taken from? Line 22: Are the calculated mixing ratios based on observed values, or on the recommended values from CCMI, or are you using the seasonal cycle and latitudinal gradient from observed values, but the mean values follow the CCMI recommendations?

Page 8655: Line 5: what aerosol scheme is used, bulk, modal, sectional?

Line 20, Does that mean, aerosols in the TTL (reaching up to 150hPa) are described with the stratospheric data set? Will this have an impact on the results of the simulation?

It would be helpful to move Section 3.10. after section 3.7, to continue describing aerosols.

Page 8654, Line 26: Please define RC1SD-base-10a, or point to Table 1.

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Figure 1 caption, change “in comparison with” to “and”

Section 3.9.1 and 3.9.2: It is hard to understand the differences between experiments that have not been defined up to this point in the text. Maybe add an overview of the setup of different experiments? I guess, looking at Table 1, one can infer what experiments were performed, but the naming of the experiments is not intuitive, so it is difficult to follow in what way experiments differ.

In general in the results section, pointing to colors of the lines of different experiments would help to identify them on the plot, since the labels are often very small in the Figures. Often, there is a discussion that differences occur due to vertical resolution, but there is no explanation why vertical resolution would cause the differences.

Page 8663: Dust emissions depend on the wind velocity. Why do the aero and the aecl experiments result in so different dust emissions? Are interactions with clouds changing the meteorology? What are you using for the prescribed simulations for dust?

Page 8669 Line: 17: change to present tense: We compare . . .

Page 8670: Section 4.1 is somewhat difficult to follow. The authors jump in the discussion between SD RC1 and RC2 experiments. It would be helpful to summarize what the differences between the experiments are and why there are these differences, instead of pointing out all the details. Line 5: Are there implications for the large temperature bias around the tropopause or high latitudes? How does this this impact water vapor in the stratosphere?

Figure 12: is too small to read what experiments are displayed.

Precipitation. To me, all the simulations are representing mean precipitation rather similar. The authors described differences of different experiments in great detail. However, the figure does not allow seeing those very well, other then the RC2 simulation outlier. Maybe pointing out line colors, like RC2 are purple, RC1 are red-ish etc. would help. I don’t think, there is a need to go into all the details, unless there is a good

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reason why different experiments perform differently, as the RC2 simulation. There, are the differences in precipitation compared to the data may be caused by a shift in ITCZ? Even though the paper was not intended to discuss uncertainties, if variability in the experiments is smaller than the uncertainty of the data set, what is the point in discussion those differences in much detail?

Page 8673: First paragraph: Why do these two SD simulations produce much less ozone deposition? How is tropospheric ozone behaving in those simulations? Is it largely underestimated, or what changes the dry deposition in these runs?

Page 8675, Equation 1: What is "t"? Is methane lifetime calculated for each year? How much does the difference in CH4 lifetime depend on the amount of ozone in the tropical troposphere besides temperature. O3 is the largest source of OH in that region.

Figure 19, 20, 21, 22: It would be helpful to show a plot with the standard deviation of the aircraft data, if available, to get some idea how significant the differences are.

Page 8678: Line 5ff, What figure or plot are you referring to, please point this out. The description was confusing to me, until I realized that you are plotting observations minus model results. Plotting model results minus observations would make it easier to follow the text. Deviations from the observations seem to be larger than 20%. Also, the model overestimates ozone (negative values in the plot) in 0-3km below the tropopause, I would not call this "low tropospheric" values.

Page 8679: Can the 5% difference between models and observations explained by the difference between prescribed fields and observations? How large do the surface values differ between model and observations? And further, are other differences at all significant? Again, at least stating the standard deviation of the measurements would be helpful.

Page 8686: Line 13,14. The lines in the discussed figure are difficult to distinguish, however, it looks like, if normalizing all the experiments to the same 1980 value, the

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recovery date between the 90 and 47 layer simulation is very similar, but maybe I am looking at the wrong lines?

Page 8687: Line 4: another important effect could be transport and mixing changes if the modeled meteorology has been nudged towards analysis. Convection changes alter ozone by itself, not only through the lack of lightning NOx production. Mixing processes and stratosphere and troposphere exchange may also play an important role.

Page 8690: Line 1: "...where the coupled ocean model has the largest impact" I am not sure what is meant here? Impact on what?

Interactive comment on Geosci. Model Dev. Discuss., 8, 8635, 2015.