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Geoscientific Model Development Discussions

Interactive comment on "WRF-GC: online coupling of WRF and GEOS-Chem for regional atmospheric chemistry modeling, Part 1: description of the one-way model (v1.0)" *by* Haipeng Lin et al.

Anonymous Referee #1

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The manuscript 'WRF-GC: online coupling of WRF and GEOS-Chem for regional atmospheric chemistry modeling, Part 1: description of the one-way model (v1.0)' written by Haipeng Liu and group team presented the development of regional chemical transport model coupled with global chemistry model of GEOS-Chem. The authors described the method of coupling of GEOS-Chem to WRF, and further conducted the test case over China, and compared model performances and computational time. Although I would like to consider the publication of this attractive research to develop the sophisticated regional chemical transport models, I hope the manuscript is fully revised to address following comments.

Major comments:

Introduction:

As the introduction in this study, the authors well summarized CTMs in terms of off-line and on-line models, and also picked up some models such as CMAQ and WRF-Chem to discuss. Because the application of WRF-GC to show the performance improvements was just conducted in comparison with GEOS-Chem Classic, and without the direct comparison with other CTMs summarized in Table 1 (especially WRF-Chem as well stated in the manuscript), it is not appropriate to emphasize the superiority of WRF-GC model. I would like to suggest to focus only on GEOS-Chem Classic model in introduction section. For example, it seems to be one of the significant point in terms of the necessity of fine-scale simulation beyond the Classic nested version. In addition, I am not GEOS-Chem user, but the statement posed me some biases in GEOS-Chem. Especially, some criticism on WRF-Chem model can be avoided as much as possible without appropriate evidences.

Application:

Related above mentioned comment, without the evaluation to other models, this study should keep focus on the comparison between GEOS-Chem Classic and developed WRF-GC in terms of the model superiority. In addition, the application is just one case over China and only six days, it should be noted and soften the conclusion derived in this study. In this application, I have following two comments.

1. Sections 4.1 and 4.2:

GEOS-Chem Classic nested version includes 47 layers with 7 levels in the bottom of 1 km, whereas WRF-GC had 50 layers with 7 levels in the bottom of 1 km. Are these 7 levels (or surface level) identical? Even a few meters differences could cause the modeling performance difference, and I am suspicious the conclusion attributed to the behavior of planetary boundary layer. If the configuration of boundary layer is identi-

cal, the height of planetary boundary layer could be one reason as model difference; however, what are other basic meteorological parameters such as wind speed and its direction, temperature, relative humidity, and precipitation (related to wet scavenging)? More investigations on meteorological fields are required in this part.

2. Section 5.1:

Again, what is the configuration of vertical layer in this WRF-GC? Without the identical setting of it, the comparison in computational performance is not appropriate. Under the same configuration of both models, the performance differences can be attributed to the importance of online and offline simulation. In addition to the behavior of meteorological fields, how about the importance of online and offline model?

Minor comments:

P6, L175-L179: Does WRF-GC cover both yield model and VBS model for SOA? It is not explicitly stated which is available.

P6, L179-180: What is size bins for sulfate, nitrate, ammonium, black carbon, and POA and SOA? Only dust and sea salt is described here.

P7, L203: How can we prepare the initial and boundary conditions for chemical variables? It is not well stated in the current document.

P7, L206: What is the "choice of chemical species"? In P6, L163-164, it is only stated "241 chemical species and 981 reactions". Do we need to set chemical species in model simulation?

P7, L206: What is the "chemical mechanisms"? In P6, L160-161, we can see "the standard chemical mechanism in GEOS-Chem", but what is other options in GEOS-Chem?

P7, L206: What is the meaning of diagnostics? This wording is ambiguous.

P8, L230: This means that WRF-GC only supports the newly established WRF vertical

grids, and does not have the choice to old terrain-following grids?

P10, L310-311: So what is the available lightning NOx emissions in current WRF-GC? It is not available, or using climatorogical value?

P11, L317-319 and P11, L328-335: From these paragraphs, I understand that the WRF-GC simulation have the limitations in the selection of various WRF options. This information is necessary to understand the limitation of applicability of WRF-GC model. Therefore, I would like to strongly suggest to put table for the summary of available options in WRF for WRF-GC.

P11, L327: For WRF model itself, the land cover can be obtained by both USGS and MODIS, but WRF-GC can be available both datasets? Please explicitly stated for the available land cover information.

P13, L391 and P25, L460: I understand that this is one test case, but the comparison should not be "preliminary".

L13, L391-L402 and Figure 4: This paragraph needs amendments in its expression. There is two expressions of "GEOS-FP dataset" and "GEOS-Chem Classic nested-China". I understand that GEOS-Chem model uses GEOS-FP; however, it seems to be better to unify its expression for readability.

P14, L424-431: I guess that this WRF-GC model for the discussion of scalability is same model in Section 5.1. If so, this paragraph contains some redundant information. Please clarify and repetition should be avoided.

Figure 1: In left corner of "WRF-GC input", there is the statement on "emissions". What is the difference of this emissions and HEMCO?

Figures 2 and 4: The map line is thinner, so please enhance the map line for readability.

Figure 6: Gray lines is hard to see. Please change the thickness of lines, or change into black color for readability.

Technical comments:

L2 in the caption of Figure 3: Need space (“theGEOS-Chem”).

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