

Geosci. Model Dev. Discuss., author comment AC1  
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## Reply on RC1

Yangyang Yu et al.

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Author comment on "Characterizing uncertainties of Earth system modeling with heterogeneous many-core architecture computing" by Yangyang Yu et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2022-71-AC1>, 2022

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This paper presents a method for identifying and understanding the characteristics of computation uncertainties of Earth system modeling in heterogeneous architectures. The computation uncertainties and acceptable error tolerances in GPU-based high-performance computing and Sunway systems have been analyzed. The development of the Earth system models in heterogeneous systems is becoming more and more popular. This paper provides foundation support for developing and porting Earth system models in heterogeneous high-performance computing systems. The paper reads well and can be accepted after minor revision. See the below:

RE: Thanks for the reviewer's thorough examination of our manuscript (MS) and positive comments. We all agree that the comments are very constructive for us to improve the presentation of the MS, and all the major comments and other points have been fully addressed in the revision. Specifically, in the revision, we have added: 1) more detailed descriptions of the difference in codes between homogeneous and heterogeneous computing environments, 2) more detailed descriptions of the mixed-precision experiments, 3) more detailed descriptions of Table 3, etc.

The point-by-point replies are followed.

In the introduction, I am confused about the sentence "regular increases in the number of supercomputing processors came to a stop roughly one decade ago." However, the number of supercomputing processors has been increasing in the recent year. I suggest to change it to "regular increases in the processing frequency of supercomputing processors came to a stop roughly one decade ago."

RE: Thanks for the good suggestion. We have changed the sentence to "regular increases in the processing frequency of supercomputing processors came to a stop roughly one decade ago." Please see lines 32-34. Thanks.

Figure 3 shows a lot of similar codes. I hope the authors state clearly the difference in codes between homogeneous and heterogeneous computing environments.

RE: We have added the description of the difference in codes between homogeneous and heterogeneous computing environments. Please see lines 124-127. Thanks.

In Table 2, I am confused about the results that the mean SAT values are different between Intel\_C\_64 and Intel\_C\_32 modes in the tenth significant digit. However, the 32-bit variables have only 7 significant digits. Please state clearly the experimental results.

RE: In the mixed-precision experiments, only the variable precision in the Goff-Gratch function is changed to 32-bit. The main program is still with the 64-bit variables and is used for output. We have added the description of the mixed-precision experiments. Please see lines 207-213. Thanks.

Table 3 lists seven simple model modes applied to homogeneous and heterogeneous computing environments and the Intel mode is not shown in the later experiments. I hope the authors state clearly the role of the Intel mode.

RE: The Intel mode is with homogeneous computing on a trusted machine. The uncertainties are RMSE and MAPE of ensemble mean scores between different modes which are listed in Table 3. We have added the description of the Intel mode. Please see lines 242-244. Thanks.

I hope the authors point out the types and versions of all compilers in Section 3.3

RE: We have added the description of all compilers in Table 3 and cited Table 3 in Section 3.3. Please see lines 238-244. Thanks.