

Dear Editor,

Thank you so much for your patience and efforts on our manuscript. We appreciated your meticulous guidance for improving the language of our paper. We have followed your advice and revised paper.

In addition, we also did three more revisions in the manuscript:

1. In page 9, line 11, we added the number of horizontal grids of test case in the description of test case as: "The horizontal resolution is 15 km with 339*432 grid boxes."

2. We added one more paragraph into the Conclusion Section about CTM test results as:

"The results of CTM test with the *fast=1* option show that the MP CBM-Z leads to a speedup of 3.32 and 1.96 for the gas-phase chemistry module and the CTM on Intel Xeon E5-2680 platform, respectively. Moreover, on the new Intel Xeon Gold 6132 platform, the MP CBM-Z gains 4.90x and 2.22x speedups for the gas-phase chemistry module and the whole CTM. For the KNL, the MP CBM-Z enables a 3.52x speedup for the gas-phase chemistry module, but the whole model lost 24.10% performance compared to the CPU platform due to the poor performance of other modules. Since this optimization seeks to improve the utilization of the VPU, the model is more suitable for the new generation processors adopting the more advanced SIMD technology. The results of our tests already show that the benefit of updating CPU improved by about 47% by using the MP CBM-Z since the optimized code has better adaptability for the new hardware. "

3. In the part (c) of figure 3, the original figure misses two lines codes. So we had revised this part by adding them back.

Some detailed changes are presented as follow.

Thank you for submitting a revised manuscript and for largely addressing the reviewers' comments. As one of the reviewers said, the quality of the language could be better and I include below a detailed list of corrections to address this. In future, I would strongly suggest that you seek advice on the language when drafting a paper; it will improve the readability of your papers and help the review process.

Response: Thank you so much for your advice. We really appreciated the reviewers' constructive comments and spent about four months addressing the reviewers' concerns. We would like to thank two reviewers and the editor for your patience during this long process.

We also sincerely express our gratitude to the editor for your guidance on improving our poor language of the manuscript. We have addressed all language issues you mentioned in the manuscript, and we would pay more attention to this aspect in the future. To save the space, we response all language issue comments here at one time, but for some specific comments, we would response them point to point as follow.

I ask that you implement these corrections. Also, it wasn't clear to me that you'd altered the Figure 4 caption in response to one of the reviewers. Can you please do so? Once you've done these changes, I'll be happy to recommend that your paper be accepted and published in GMD.

Response: Thank you so much for your comments. We appreciate your hard works on our manuscript. We have added more description in the caption of Figure 4 as you asked:

"Figure 1. Comparison of the time-series concentrations of O₃, NO, NO₂, H₂O₂, SO₂, OH, HO₂, RO₂ and H₂SO₄ ((a)-(i)) from the baseline and optimized CBM-Z simulation with diverse -fp-model options. The simulation results by the baseline code with the **-fp-model precise** compile flag was as the benchmark. The solid lines show the time-series concentrations of the species from different experiments and the dashed lines showed the Relative Errors (RE) of simulated concentrations between the benchmark and the results by other combinations of the code and -fp-model options."

30. Method Description, page 3, line 15: I suggest that you change "too many branches and unbalanced calculations" to "too many options and poor load balancing" as readers unfamiliar with the structure of CBM-Z will not understand what it meant by "branches". It's also a word commonly used to add new code to a model that isn't included in the release and so, probably isn't appropriate until you've introduced CBM-Z in Section 2.1.

Response: We appreciate your precious comments. We have followed your advice and changed the corresponding line in the manuscript as:

"In this module, too many options and poor load balancing within the model grid boxes make it a challenge to improve its performance on a vectorization level."

42. Section 2.2, page 4, line 29: Change "the model grids" to "the model grid boxes". This requested change occurs on this line but elsewhere throughout section 2.2

Response: Thank you so much for your comments. We have changed "the model grids" to "the model grid boxes" in the line you mentioned and the rest part of manuscript.

47. Section 2.2, page 5, line 15: the line "The VLEN number grids contain ..." is very unclear and I would ask that you re-write this with more clarity

Response: We appreciate your constructive comments. We have re-written this sentence as:

"A set of grid boxes with the number of VLEN (16 in this study) would perform the operation simultaneously, and the variable **pmask** signed the valid grid boxes."

91. Section 3.2, page 7, line 6: I felt that this line is repetitive and could be removed. However, the point about the meteorology seems to contradict what was stated in 3.2.1. Was the meteorology constant or updated?

Response: Thank you for your precious comments. We apologize for the mistake here since the meteorological conditions is constant for the single grid box simulation. We have followed your suggestion and removed this line from the manuscript.

173. Section 3.3, page 9, line 17: There are many places where you refer to the "old" CBM-Z. I suggest that you remove all references to "old" and replace with either "unoptimized" or "benchmark" or "baseline". Whichever you choose, use consistently throughout the manuscript

Response: Thank you for your constructive comments. We have replaced the word "old" with "baseline" in the manuscript. We also followed your suggestion and used "baseline" consistently throughout the whole manuscript.