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Geoscientific Model Development Discussions

Interactive comment on "Improving data transfer for model coupling" *by* C. Zhang et al.

C. Zhang et al.

zhang-cheng09@mails.tsinghua.edu.cn

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We thank the reviewer very much for the comments and suggestions. We'd like to reply them as follows.

1. Grammar and syntax needs to be considered much more carefully.

Response: Thanks for this suggestion. We will try to improve grammar and syntax when revising the manuscript.

2. The software does not contain any version number.

Response: We will add the version number when revising the manuscript.

3. In the introduction the authors raise the impression that they address high-resolution climate model applications running on modern high-performance compute systems

where a single model employs several thousand processors or cores. Later on the algorithmic approach is investigated with test cases at very coarse resolution o(2 degrees) on a comparatively low number of cores (192) and leave the reader alone with any guess about the scalability of their approach.

Response: In the manuscript, we use the high-performance computer Tansuo100 that has about 8400 cores to run the experiment. However, we can only use less that 500 cores because there are a lot users competing for the processor cores on Tansuo100. Thanks a lot for this comment. It is very reasonable that we should use much finer resolution and more processor cores for the performance evaluation. In the revised version, we will try to measure the performance of our approach with thousands of processor cores.

4. P8983,L1: Is it the number of coupled models or the number of coupled model configurations the authors have in mind?

Response: It means the number of coupled model configurations.

5. P8984,L27: Do you believe or are you convinced?

Response: The library has been imported into C-Coupler1. This conclusion is drawn from our experience. However, it has not been imported into other couplers. The sentence should be modified as "we believe it can also be used to improve the performance of data transfer in other couplers".

6. The main - if not the only - purpose of section 2 is to provide the reader with an overview about the communication algorithms which are used in existing coupling software. In essence this section is telling us that all existing coupling software products use P2P communication. I wonder why I have to read approx. 85 lines to arrive at this. An overview of existing coupler software has already been published elsewhere – among the GMD - and the author should be able to reference those rather than providing another overview.

Response: Thanks for this suggestion. We will shrink section 2 accordingly.

7. In section 4 the headline raises the expectation that we can learn how the butterfly algorithm works. The reader is not really guided through this section. Is the numbered list in sec 4.1 based on findings by the authors? In this case some piece of information is missing which guides the reader to this statement. In case it is not based on the authors findings a reference is missing. Fig. 6 (and likewise Fig 8) does not help me at all to learn how the butterfly algorithm works. If each of the 8 processes P0 to P8 already has all data D0 to D8 I cannot see any necessity for communication. What is the information that shall be transported to the reader with the colours?

Response: In the revised version, we will give an example to explain the numbered list in section 4.1. Meanwhile, we will add more information to Fig 6 and Fig 8 to help the understanding of the butterfly implementation.

8. I would have loved to be guided through Fig 7 in the text a little bit. If this Figure is not important at all it should be removed.

Response: We will give detailed explanation of Fig 7 when revising the manuscript.

9. In section 5 it remains unclear (to me at least) how the adaptive process works and I would appreciate if this was clarified in a revised version. Does this work as a kind of self-learning algorithm where the optimal path is determined of the first n data exchanges of a model integration or is this part of the initialisation procedure beforehand and made available already for the first data exchange?

Response: The adaptive process works as a kind of self-learning algorithm where the optimal path is determined of the first n data exchanges of a model integration. We will explain this point in the revised version.

10. The first sentence of section 6 does not make sense to me. Having read the previous sections the authors put the focus of the reader to the adaptive transfer library. Now the authors propose the butterfly implementation as well. Later we learn that the

butterfly approach can be outperformed. At the end of the section the authors show that for coupled climate models the P2P communication is as good as the adaptive transfer library, probably because the adaptive transfer library completely switches to P2P in the latter case. I think that this is an important finding and should be emphasised. It tells us that the P2P which is used in existing coupler software is not that bad. But is also tell me that the paper is severely suffering from a clear structure. If my conclusion (P2P is sufficient) is wrong the authors will need to put more effort in getting the reader onto the correct track.

Response: Thanks a lot for the suggestion. It should be true that the structure is not good enough and it may mislead readers. We will restructure of the manuscript when revising it.

11. Table 1 and Fig 10 are not really addressed. Are they required to understand the adaptive data transfer library? These can be removed of shifted to the user guide.

Response: We will shift Table 1 and Fig 10 to the user guide.

12. Could Fig 9 be replaced by a real flow chart rather than providing pseudo code?

Response: We will give a real flow chart when revising the manuscript.

13. In section 6 the performance of the data transfer is evaluated by using a coupled climate model with roughly 2 degree grid horizontal grid spacing using 192 processes. As there are 8400 cores available Tansuo100 I would have expected to see an evaluation of the performance at least with a toy model and exploring the scalability of the adaptive data transfer library up to several thousand cores. Unless there are sound arguments why this cannot be done this raises the impression that the authors are trying to hide something. The dynamical core sets an upper limit to the number of cores that can reasonably be employed - when the communication starts dominating over the computing part (MPI messages required for the boundary exchange required for advection and diffusion operators versus the time for the forward integration of the

less and less points left on a single core). With roughly 2 degree resolution we have probably reached this point with 192 processes. Here it would be nice to know how much percentage of the overall compute time is consumed by the data exchange, and how much wall clock time can be gained for a single run of the coupled model. Last but not least, how important is the load imbalance between the processes as the boundary exchange between the model components (atmosphere and ocean) provides a synchronisation point, either explicitly or implicitly, where the components have to wait for each others.

Response: In the revised version, we will employ thousands of processor cores and design a reasonable a toy model that considers the upper limits of the number of cores of models, to measure the performance of our approach with thousands of processor cores. This manuscript only focuses on the performance of data transfer in model coupling, while we will try to discuss the overheads in parallel execution of models.

14. The conclusions are weak if not misleading. Fig. 17 does not really confirm the last statement, that "the adaptive transfer library can effectively improve the performance of data transfer in model coupling. What can we conclude or expect for model with higher resolution than those investigated in this study?

Response: In the revised version, we will use more processor cores and higher resolutions of models for the performance evaluation.

Interactive comment on Geosci. Model Dev. Discuss., 8, 8981, 2015.