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Geoscientific Model Development Discussions

Interactive comment on "Improving climate model coupling through a complete mesh representation: a case study with E3SM (v1) and MOAB (v5.x)" *by* Vijay S. Mahadevan et al.

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Dear Reviewer,

We kindly appreciate the detailed comments and suggestions for modifications to make the manuscript clearer. We have replied specifically to some of the question in the review below, and we are in the process of including the suggested modifications in the final manuscript.

1. Referee: The scheme at p.4 ll.7-17 and the following comparison in section 2 should clearly distinguish what features are available in distributed softwares or

have just been presented as conceptual algorithms (e.g. the advanced clipping: is it in Portage?) and what has been practically tested by the authors or just inferred from documentations (suggestion: avoid sentences like "It is also unclear whether" unless you add the source of your information. User guide, publications, application cases, ...

Author: The advanced clipping features of Portage have been inferred from the publications and we have not tested it for practical climate science remapping applications. We will rephrase the relevant sentences in literature survey.

2. Referee: From the user point of view, it is important to know beforehand the amount of information needed to describe the meshes, the decompositions, the fields and the treatments. In the comparison of the coupling approaches this point should be stressed.

   Author: Yes. We will include the relevant modifications in the text to stress this explicitly.

3. Referee: The MCT paradigm requires a very agile data description (in it's OASIS3 implementation, it is a commitment to be able to work without the connectivity description - at the price of being "oblivious" of some structures). Please assess somehow the user friendliness of the MOAB API's (in particular in their fortran version). A good anchor could be p.8 ll.18-19 where you mention the need of introducing extra calls to describe the details of the mesh to MOAB.

   Author: The MOAB Fortran API exposed through iMOAB interface provides routines to query, create, and manipulate meshes in memory from a native mesh representation in the component models. MOAB can work with a full mesh description and also with a notion of point clouds when needed. As you mentioned, extra calls would be needed to expose the mesh in MOAB format and we will include appropriate modifications to make this clear.

4. Referee: Please include considerations on the memory requirements for storing the MOAB data structures and the supermesh informations. Is there any extra-memory to be accounted for on the source and target processes if adaptive or moving meshes have to be enrolled runtime in MBTR? This assessment could make the last paragraph of section 3.1 more useful, since its aim is not very clear in the current paper. Refer also to step 5: of Algorithm 1.

   Author: The adaptive refinement provides localized changes in the mesh database and hence intersection mesh computation along with remapping weights are typically contained with a local compact support region during re-computation. The adaptive mesh modifications are imposed with new vertices and connectivity information. Additionally, apart from the additional memory required for the new DoF numbering and fields, MOAB does not have to explicitly store parent-child additional information in the remapping workflow unless more advanced constrained conservation techniques are required by the components.

5. Referee: Description in section 3 is fluctuating between the hub-and-spoke and the MOAB workflow (e.g. p.10 l.8) please state clearly what's the starting point, the reference for comparison and the new proposal.

   Author: We have received several comments about the description in this section. We will make appropriate modifications to make this clearer.

6. Referee: The potential of hybrid parallel implementations (MPI processes + threaded tasks) is not always consistently addressed neither in MBTR (e.g. for intersection computation) nor for comparison. Check that the use of process and task is coherent through the whole paper (in particular section 3.4), please

   Author: We will clarify the hybrid parallelism references throughout the manuscript.

7. Referee: In order not to restrain the scope of this paper to the replacement of ESMF in E3SM, how would you assess and compare the overall efficiency w.r.t.

   to a "non hub-andspoke" coupler interleaving computation and remapping on the same sets of processors (e.g. YAC, OASIS3-MCT) and with couplers already addressing the issue of online weights updates (YAC, C-COUPLER2)?

   Author: This is a harder comparison to make in terms of overall efficiency and performance characteristics without running the couplers on the same set of input grids to generate conservative remapping weights. We are open to suggestions in this front if there are ways we can add value to the manuscript with relevant comparisons.

   We welcome any additional comments on this topic although we realize that the discussions are closed at this point.

   Sincerely,

   Vijay Mahadevan, Robert Jacob, Iulian Grindeanu, Jason Sarich

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