

Interactive comment on “C-Coupler1: a Chinese community coupler for Earth System Modelling” by L. Liu et al.

Anonymous Referee #1

Received and published: 27 June 2014

General Comments

This is an interesting overview paper of a new climate model coupler. It provides some context on current implementations elsewhere and recognizes various benefits and challenges in those other implementations. The approach in the C-Coupler attempts to leverage benefits of various other couplers in a single instance. The paper has limited technical descriptions and at times, goes beyond some of the technical aspects of the coupler or coupling infrastructure to include discussions of how the coupler implementation interacts with the build and run system, how cases are setup, and how different model instantiations are generated. These aspects are somewhat related to the coupling infrastructure. However, I would like to see greater emphasis on the technical implementation and less focus on the build and run aspects. A number of technical is-

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sues are highlighted below. In spite of the lack of detailed technical content, this paper has merit as it is the first description of the C-Coupler within the community and will be of interest within the community. It also has some new features such as 3-D coupling capability that are generally lacking in other coupled models.

Scientific Comments

There is little discussion of technical details such as how coupling fields are defined in the system, how they are reconciled between models, how models are advanced in time in an orderly fashion, or how sequencing/concurrency/lags are established between models. Some discussion needs to be added of these aspects.

Can the C-Coupler infrastructure handle unstructured grids?

It's suggested in the description and implementation that CPL6 served as a starting point for much of the work, and that models that were running with CPL6 were modified to run with the C-Coupler. In many ways, the C-Coupler seems to have been built to plug in where CPL6 existed. What is missing is a discussion of what changes had to be made to the component models to allow them to couple with the C-Coupler. In addition, what is required of new components to allow them to couple with the C-Coupler?

The implementation seems extremely flexible but also quite complex. Can the authors provide some addition insight regarding what's working well and what is more difficult than expected. How difficult is the C-Coupler to use and how steep is the learning curve? How robust is the system?

How expensive is the remapping weights generation in the C-Coupler, is it parallel, and does the performance scale?

It would be interesting to discuss how the 3-D interpolation is setup. I expect it's just a large linear weights matrix. Please clarify that point. How is the vertical spline interpolation handled? How will further non-linear or equation solving be handled? Will those methods scale well?

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Is it possible to provide some more content about scaling to high processor counts, even if just qualitatively. Have tests been carried out on large (ie. high resolution) grids?

Please provide additional technical details in the performance results. In 5.5.1 and 5.5.2, please clarify what is being coupled/remapped. Is it a single field with 400,000 horizontal grid points? Is it a 3-D field? How are the different vertical scales reconciled if there is no regridding? Can performance at higher processor counts be provided. At 48 processors, the decomposition is still extremely coarse (about 10,000 points per processor). 400,000 horizontal grid cells is relatively large. Scaling performance out to 100 or 1000 gridcells per processor should be shown (ie. 100s of processors). It's typical for the scaling to level off or even turn over for communication dominated kernels, please show that.

Technical Corrections

The English writing quality is somewhat variable. Some sections are reasonable, others less so. I encourage the authors to seek help from a native English speaker as part of the revision process. Some detailed feedback is below, but it's not complete. Text in quotes (""") below are suggested changes.

In several places the word coupler needs an "A" in front of it. "a coupler", "couplers" and "the C-Coupler1" should be used consistently.

The use of etc and e.g. are a bit excessive in the document. That should be cleaned up.

pg 3890: Line 2: "A coupler is..."

pg 3890: Line 6: "...same (bit-identical) results..."

pg 3890: Line 13: Remove "Now" at the start of the sentence

pg 3891: Line 1: "A coupler is ..."

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pg 3891: Line 5: "constructed with a coupler."

pg 3891: Line 7: "a coupler"

pg 3892: Line 19: "which will introduce more complexity to the code version control of the atmosphere model"

pg 3892: Line 21: "a coupler"

pg 3892: Line 23: "a coupler"

pg 3892: Line 26: "...scientists may use various combinations of a single-column model of physical processes, a standalone atmosphere model, an air-sea model, a fully coupled model, nested models, CSM's or ESMs."

pg 3893: Line 2: "researches" -> "research"

pg 3893: Line 2: "a coupler"

pg 3893: Line 2: "enable" -> "be able"

pg 3893: Line 5: "In the future, a coupler..."

pg 3893: Line 6: "a coupler"

pg 3893: Line 10: "gets higher and higher" -> "continues to increase"

pg 3893: Line 18: "(we call it the C-Coupler platform)"

pg 3895: Line 24: "can be viewed as a library"

pg 3897: Line 1: "from GFDL use..."

pg 3898: Line 8: "...and CPL7 coupler cannot generally interpolate in 3-D due to a lack of remapping weights."

pg 3899: Line 8: "Similarly, we are concerned about the ..."

pg 3902: Line 8: "... how each component gets the input fields and provides the output

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fields"

pg 3902: Line 15: "...can be viewed as a common ..."

pg 3902: Line 18: "auniform" -> "uniform"

pg 3903: Line 4: " including a commmunication manager, grid manager, ..."

pg 3904: Line 4: not sure what "which will introduce a lot of works to do" means. Are you saying that it takes a large effort to create the runtime configuration files and you are proposing to automate that step?

pg 3906: Line 11: "...because most Fortran versions do not ..."

pg 3906: Line 13: ".. through this API does not have parameters or return values"

pg 3908: Line 11: "... makes the C-Coupler1 more flexible in 3-D interpolation than ..."

pg 3908: Line 19: "... that require equation group solving such as splines."

pg 3908: Line 20: Instead of "Now,", consider using "At the present time," Is the timer manager really a manager of performance timers as well as a manager of model time (calendars)? Please clarify.

pg 3910: Line 19: Remove "The" in "The multiple fields"

pg 3911: The specific implementation of the parallel remapping algorithm is guaranted to reproduce bit identical answers, but comes at some performance cost. Leveraging the partial sums can significantly improve performance in some cases.

pg 3916: Line 19: Change "aformentioned" to "mentioned"

pg 3917: Line 4: "... the GAMIL2 are provided by other component models,..."

pg 3917: Line 7: "are origin from" -> "are provided by"

pg 3917: Line 9: what is "intra"?

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pg 3919: Section 5.5.2, Please clarify the sizes of the grids that you are remapping between. Could you show scaling out to several hundred processes?

pg 3919: Line 17: Get rid of "Now,"

pg 3919: Line 18: "... we hope more and more scientists and engineers will use it and contribute to it ..."

pg 3919: Line 21: change "wish more and more" to "hope more"

pg 3919: Line 22: "...new requirements about... and model groups will be considered into the future plan..."

pg 3920: Line 2: "... we will consider the following aspects:"

pg 3920: Line 5: "have" -> "has"

pg 3921: Line 2: "...to support one-way or two-way model nesting..."

pg 3921: Line 9: "In the future, ..."

pg 3921: Line 10: "selections" -> "options"

pg 3921: Line 11: "researches" -> "researchers"

pg 3921: Line 25: "Now we start" -> "We are starting"

Interactive comment on Geosci. Model Dev. Discuss., 7, 3889, 2014.

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