Geoscientific
Model Development
Discussions

Interactive comment on "Coupling Library Jcup3: Its philosophy and application" *by* Takashi Arakawa et al.

Anonymous Referee #1

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This publication attempts to document the Jcup coupling library used, for example, to couple the NICAM atmosphere with the COCO ocean. Unfortunately, this submission does not provide enough detail to adequately understand or evaluate the work. As the title suggests, the authors spend a lot of time on philosophy and explanation and not so much on implementation. There is quite a bit of superfluous background for a GMD audience, but very few implementation details. For example, they don't even mention what language or programming model is used, what algorithms are used for the library functionality or what choices they made in data structures - I got all that from browsing the source and not from the manuscript itself. While they provide some tables of a few interfaces, an architecture diagram might have been helpful to see how exactly a user would adopt this library and what functionality they could expect. There is a bit more

detail in the referenced 2011 paper (though still not enough even there) and this paper does not seem to add anything new beyond what was published there, other than some newer applications of the library.

In terms of advancing the field, most of the functionality reported here already exists in nearly all ESM coupling frameworks. For example, time representation appears to be using integer time intervals to avoid roundoff, similar to the more comprehensive Earth System Modeling Framework (ESMF) time manager that many groups use or have copied. The interpolation formulation uses a linear, static, sparse-matrix multiply (shown in 3 redundant code fragments in pp. 13-15) that is already used by essentially all other frameworks (e.g. MCT, OASIS, TEMPEST, ESMF). Much of the leading-edge work in this area is moving toward non-linear property-preserving remappings that utilize higher-order interpolation while enforcing monotonicity, vector properties (div, curl) as well as standard conservation constraints.

The authors make the claim that they have created a more general library, but as in most frameworks, the more general the functionality, the more burden is placed on the user. So in fact, the specific algorithms used to compute interpolation weights are left to the user as are other aspects of the coupling presented here. While again, more detail would allow a better judgement of this, it appears the cost of this generality is passed to the component model and this has more of a flavor of interface standard rather than a library. While not exhaustive, some browsing of the code appears to confirm that many of the interfaces are at a somewhat lower level of abstraction than is seen in many current couplers. At the same time, they have made some curiously restrictive assumptions like always moving data to the destination grid for remapping, where a more optimal choice would be to minimize data motion by performing calculations closer to the finer-resolution grid, whether that's the source or destination mesh.

The application section also lacked significant detail, including on what sort of architecture the the tests were run. The model sizes and mesh points/node also seemed to be in a very inefficient regime and well beyond a strong scaling limit in some cases. The

analysis was also somewhat inadequate. While the conclusions are probably correct, the timing profile was a bit too coarse to come to their conclusions definitively and they could have added additional timers to really isolate computational time and message latency vs. load imbalance (barrier time).

There are some additional minor nits here and there - like using lattice for mesh, conservativity rather than conservation, and CLF in place of CFL that are, I suspect, a result of non-native language translation.

I apologize if this review is very harsh. It would be great to see a proper documentation of the authors' approach in the literature. A paper that spent more time on some of the details of their library and a more thorough evaluation of their approach in real production configurations would be preferable over this submission.