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Geoscientific Model Development Discussions

Interactive comment on "Asynchronous Communication in Spectral Element and Discontinuous Galerkin Methods for Atmospheric Dynamics" *by* B. F. Jamroz and R. Klöfkorn

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We thank the reviewer for the helpful and constructive comments.

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Q: The authors should underline the specific situation in HOMME. In my understanding, HOMME was first designed for SE. Then, a DG dynamical core was implemented. Thus, it is maybe not surprising, that the new communication has a higher impact for the DG version (where the SE communication is naturally suboptimal).

A: We agree. While the DG method has lower connectivity which is beneficial for scalability it also suffers from a more severe time step restriction. However, our results

show that (in the DG case) more computation between send and receive increases the performance. We have revised section 4.3 accordingly.

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Q: More literature (besides the specific HOMME publications) should be provided: Is this communication approach already used for/in other (maybe similar) methods/projects? Or is this a novel approach?

A: We have added a survey of both, dynamical cores for NWP, e.g. NUMA, ICON, MPAS-A, and NICAM as well as other contemporary simulation software presented for the prestigious Gordon Bell price as part of the International Conference on High Performance Computing, Networking, Storage and Analysis.

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Q: line 1-24: what does it mean beyond 2k cores? Are there no higher scalability results available for DG as for SE?

A: We added a reference to another work showing scalability of both methods beyond the numbers presented here.

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Q: Yellowstone: it would be nice, to have more information about this supercomputer (some technical specifications), since runtimes might depend on machines and compiler settings.

A: The details on Yellowstone are available through the permanent link provided in the references. Compiler version and flags have been added to the code section.

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Q: The authors write: more internal vertices provide more data movement and therefore better communication hiding. Since HOMME also has some finite volume schemes

implemented, the authors should mention, if their approach would also work for these implementations, since the amount of communication data is much higher.

A: The approach is applicable to any point-to-point communication. An appropriate sentence was added.

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Q: line 9-4: ...produce accurate dynamics... I recommend to refer to section 5.2 (see also comment below).

A: The sentence has been changed to "reproduce the results obtained with the pre-existing communication strategy".

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Q: why is np and ne different for SE and DG? it is not clear to me, which np is used for the performance tests.

A: Throughout the paper we use np=4 for SE (the default also in CAM-SE) and np=6 for DG because for lower np the DG method is not stable for the baroclinic test case due to missing limiter or filter methods.

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Q: section 5.2.: Knowing that round off errors play an important role, good numerical schemes should be stable with respect to these errors. Thus, I think the bit-for-bit reproducibility is rather a numerical scheme property than a communication issue. The authors could mention this as well, which can be tested with the aid of statistical techniques. In the current version the reader gets the impression that this is an asynchronous communication problem - but in fact we also do not know if the SE solution is right.

A: We have added a reference to the work of Baker et al. (2015) where exactly this issue is addressed in the context of CESM. The results produced by the SE method

using the new communication are correct within the accepted norms. The bit-for-bit reproducibility is a to strict measure in this case.

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Q: Table 2: something is wrong with the caption description. (b) should be ne=120?

A: Fixed.

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Q: Minor: 1-10: ocean

A: Fixed.

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