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

**Anonymous Referee #3**

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This paper discusses a new non-blocking asynchronous communication for the High-Order Methods Modeling Environment (HOMME) and is therefore very specific to the underlying code and model situation.

The spectral element (SE) dynamical core implemented in HOMME is currently the default dynamical core of the state of the art climate model CESM (atmosphere component CAM). The authors compare two Galerkin schemes, the spectral element method and the discontinuous Galerkin method, on a standard baroclinic wave instability benchmark test. Obviously, their new communication pattern improves the runtime significantly (special for DG) and (maybe even more important) leads to the excellent scalability of HOMME (which was also the case for the synchronous communication).



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Discussion paper

In general, I recommend the publication, once the authors answer/complete the tasks below.

Comments: - 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).

- 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?

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

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

-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.

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

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

-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 tech-

niques. 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.

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

Minor: 1-10: ocean

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