Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2019-102-AC2, 2019


Geoscientific Model Development Discussions

# *Interactive comment on* "WAVETRISK-1.0: an adaptive wavelet hydrostatic dynamical core" *by* Nicholas K.-R. Kevlahan and Thomas Dubos

**Nicholas K.-R. Kevlahan and Thomas Dubos**

kevlahan@mcmaster.ca

Received and published: 24 September 2019

Thank you for your helpful comments, especially regarding improvements to the reporting of parallel performance. Please find our detailed responses below.

Significant changes to the manuscript (other than typo corrections) appear in BLUE in the revised version.

COMMENT: My main reservation regards the amount of details given for the performance of the model. The authors choose to give only relative performance data, either comparing the code with itself or with its previous non-adaptive incarnation, dynamico. Absolute performance should also be given: in particular, the number of integration timesteps, the wall-clock time and some details on the system on which the tests were



run (CPU type, memory etc.) must be added for each of the cases.

RESPONSE: We have added detailed performance information in the new table 2.

COMMENT: The order of the method is not clearly discussed. I assume it is spatially second-order. Some discussion on possible extensions to higher order should also be included.

RESPONSE: As mentioned, the model is based on DYNAMICO, which is based on the TRiSK scheme (which is second order). We now mention this on on page 3. We also mention that our adaptive method could be used any of flux-based scheme, indendent of order. Developing such higher order schemes is outside the scope of the paper, which focuses on making adaptive an existing scheme.

COMMENT: p.2 line 25: "To the best of our knowledge, no previous work has developed and evaluated AMR for complex three-dimensional atmospheric flows." This statement is too broad. There are many earlier references for adaptive three-dimensional atmospheric flows. By "atmospheric", the authors probably mean "global-scale atmospheric" flows. Also, as pointed out in one of the readers' comments, Popinet presented results of an adaptive Held-Suarez model at the "Multiscale Numerics of the Atmosphere and Ocean" Newton Institute program back in 2012.

RESPONSE: On page 2 we cite more previous work developing 3D atmospheric AMR codes. However, no other global 3D AMR method has appeared in a peer-reviewed publication. This is an important distinction since it is difficult to evaluate the robustness and state of development of codes that have been reported only in unpublished conference presentations or theses. For example, Ferguson's thesis notes explicitly that "Several stability problems were observed in both test cases that need to be better understood and corrected." and that the grid refinement criteria require more investigation (his code is based on the general purpose CHOMBO AMR library).

Similarly, the results reported in the conference publication by Popinet (cited in another comment) show obvious errors in the variance of the potential temperature for the Held-Suarez. It is possible that these issues can be easily resolved, but there is still some development work left to do. (We have discovered that with adaptive codes there is a big gap between "almost works" and "definitely works"...)

COMMENT: p.2 line 30: "However they do not find any "clear strategy for establishing the best general refinement criteria." In contrast, wavetrisk uses objective and clearly defined refinement criteria which control the multiscale relative error of the solution or of its tendencies as measured directly by the wavelet coefficients." Again, here the authors claim too much. The approach presented later in the paper is useful and interesting however it cannot really be said to be a "clear strategy for establishing the best general refinement criteria." Indeed, finding such a strategy is a tall order and has been the topic of numerous publications (and even entire conferences) dealing with "Uncertainty Quantification".

RESPONSE: On page 3 we have added additional text to make clear that we are not claiming that our approach has completely resolved the problem of error control.

COMMENT: Figure 4: Although "speedup curves" are a standard representation, they are a particularly poor way of characterising (parallel) performance. This should be replaced with a figure showing the "speed" or "computational time" per processing unit as a function of the number of processing units. Perfect scaling is then a constant and the value of this constant gives the absolute performance. This thus shows two important values (absolute speed and scalability) instead of one (scalability) and is immune to many of the biases of the "speedup curve" representation.

RESPONSE: We have added a figure with this more informative way of characterizing parallel scaling, along with accompanying text. However, we have decided to retain the the speed-up plot since it is nevertheless a standar representation and so allows for comparison with other methods.

COMMENT: p. 3 Section 4 typo: "applies the principle of wavelet-based adaptivity to



present the context."

RESPONSE: Corrected.

COMMENT: p.7 line 13. typo "Note that the primal grid of triangles remains nested on the sphere, which means that the restrictions of velocity, Bernoulli and circulation and straightforward."

RESPONSE: Corrected.

COMMENT: p. 8 line 22: "To remedy this we use a simple rebalancing algorithm to redistribute sub-domains amongst the cores to produce a more balanced load. This rebalancing is done at each checkpoint save." This is an extremely short description of a non-trivial and important algorithm. More details should be given and/or appropriate references given.

RESPONSE: We have added more details about the rebalancing algorithm on page 9.

COMMENT: Algorithm 1, typo: "at all vertical levels so final adapted grid is union of adapted grids over all vertical levels."

RESPONSE: Corrected.

COMMENT: p.16 line 7, typo: "on the cost of the multiscale runes"

RESPONSE: Corrected.

COMMENT: p. 24 line 3. typo: "The Held–Suarez general circulation experiment adds a qualitatively new aspect the Rossby wave and baroclinic instability tests we considered above:"

RESPONSE: Corrected.

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2019-102, 2019.