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Geoscientific Model Development Discussions
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Interactive comment on "Firedrake-Fluids v0.1: numerical modelling of shallow water flows using a performance-portable automated solution framework" *by* C. T. Jacobs and M. D. Piggott

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General comments:

* This manuscript presents a new model based on the novel Firedrake framework for solving the (nonlinear) shallow water equations. The model is tested on a number of established test cases.

* The manuscript is well-written and structured and the figures are appropriate.

* The manuscript strongly emphasizes the performance benefits of Firedrake in the introduction (∼page 5702, L5-16). It is clear that the Firedrake strategy shows promise,

but large-scale performance and performance portability has not yet been demonstrated. Therefore, the claims presented in this manuscript ("Firedrake provides enhanced performance benefits...", "Firedrake is at least as fast, if not faster than ...") seems lacking of nuance and too strongly biased. I would recommmend that the authors seek to refine this presentation.

* The use of block preconditioning is an active research topic and one of substantial interest to the research field. Please include more detail regarding the fieldsplit preconditioners, their set-up, choice of parameter values et cetera. Also, please include at least one example documenting the performance of the iterative solvers (including iteration numbers versus system size and parallel scaling).

* I recommend that the authors include a subsection in Section 3 describing the Smagorinsky LES model and its implementation in Firedrake fluids, thus moving and extending the description in Section 4.5.

* The manuscript strongly emphasizes the performance portability of the underlying framework, however, there is no mention of the performance of the Firedrake-fluid model nor how and on which architectures the presented test cases are run. The manuscript would benefit substantially from remedying this mismatch. Please include - information on the architecture and run-times for the numerical experiments - one experiment that demonstrates performance portability across at least two backends.

Specific comments:

* P5702, L3-4: This example (caching of matrices) is not appropriate as an argument for the advantages of Firedrake vs FEniCS as both easily support this construction.

* Pp5704, L6: I assume that u also depends on time in addition to the spatial coordinates (x, y). Please consider specifying.

* Eq (1): Please specify the norm ||.||

* Eq (1) & (3): Please specify the unknowns (u, h?), initial and boundary conditions.

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* The motivation and implications of Footnote 1 are not entirely clear. Please upgrade this footnote and elaborate. In particular, for u \in DG0, grad u = 0 and thus T = 0?

* Solving PDEs such as (1) + (3) in Firedrake/FEniCS requires a temporal and spatial discretization of the PDE, as reflected by the code example in Fig 2. Please clarify this in the 1st paragraph of Section 3.1

* P5705: Footnote 2: Please indicate the precise version of this "modified FFC" used and preferably a reference for the sake of reproducibility.

* Examining Figure 6b, it seems that the convergence of the P2 velocity field is indeed higher than 2nd order. Please comment.

* The implicit Euler scheme is expected to yield first order convergence in time; the second order convergence(s) observed thus indicates that the spatial error dominates. Please comment.

Technical corrections:

* P5701, L10-11: it is unclear what the partial sentence "..., rather than by hand" refers back to

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Interactive comment on Geosci. Model Dev. Discuss., 7, 5699, 2014.

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Interactive Comment