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Interactive comment on "Global Storm Tide Modeling with ADCIRC v55: Unstructured Mesh Design and Performance" *by* William J. Pringle et al.

Anonymous Referee #2

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<General comment> This paper presents the performance of a new version of ADCIRC on simulating global tides and storm surges, highlighting a mesh design with key parameters identified through experiments, capability of local refinements for extreme events, and improved efficiency brought by updated numerical treatment.

The paper is well organized, and the topic is in line with the scope of GMD. The clear improvement over earlier versions of ADCIRC is surely of interest to existing and potential ADCIRC users. The conclusions and recommendations drawn from the experiments on mesh design and local mesh refinement are valuable for unstructured-grid modelers in general.

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Discussion paper

There are a few items to be clarified and issues to be addressed (listed below), and my recommendation is “minor revisions”.

<Specific comments>

1) Stability constraint

The paragraph starting from Line 303 mentions that smaller time steps are required for locally refined meshes used in the Katrina and Haiyan simulations. How did you decide on an appropriate dt for each simulation? For ADCIRC users, what is an effective way to find the optimal dt for a mesh with local refinements?

Clearly defining the stability condition is generally difficult for complex models, but the users may need a bit more guidance and reference in choosing the time step. If you have additional benchmark tests or applications (done by ADCIRC v55) besides the three configurations mentioned on Line 305-307, please list their grid resolutions and time steps in a table (maybe in the supplemental materials).

Also, consider mentioning the typical grid resolution for global simulations on Line 101. Mention the typical resolution of the refined meshes on Line 384.

2) Solution variability with time step

When model simulations are stable, is there any solution variability with time step? For example, if two simulations are conducted on a same locally refined mesh, one with dt=90 s and another with dt=25 s (values chosen from the suggested range on Line 384), would there be any noticeable difference in the model results (e.g., the timing and elevation of the simulated storm peak)? If not, please add one or two sentences where appropriate to note this.

3) Solution variability with mesh resolution

The effect of mesh resolution on peak elevation and timing is mentioned multiple times in the paper (“Abstract”, Section 3.2.2, and “Conclusion”). Do you have any hypothesis on the mechanism behind this? Could it be that the wave speeds are slightly different due to the difference in model bathymetry (because the resolutions of the mesh are different); or the numerical scheme behaves differently under different Courant numbers?

4) Improved accuracy compared to the prior version

The “Discussion” section focuses on mesh configuration but does not explain the clear improvement between the two model versions on a same ref mesh (Fig. 6ab). Among the numerical improvements from v54 to v55, how does each of them contribute to the improved accuracy (mentioned in Section 3.1.1)? Which one is the main factor? Please add a few sentences or a paragraph to discuss this.

5) Local model error

I agree with Anonymous Referee #1 on that the large local errors (especially those nearshore) need to be discussed and explained, so that the readers/users can have a good understanding of the limitation of this model.

<Technical comments>

Line 29: “FMV” should be “FVM”.

Line 252: “match”.

Line 357: “are able to”.

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