

# REVIEW, “A subgrid method for the linear inertial equations of a compound flood model”

ORMONDT, LEIJNSE, GOEDE, NEDEROFF, DONGEREN

## General Comments

In the manuscript, “A subgrid method for the linear inertial equations of a compound flood model,” the authors describe a new subgrid model for use in improving the accuracy and efficiency of the coastal flooding model SFINCS. They found that the addition of subgrid corrections significantly improved model skill when compared to not using subgrid corrections, and only added minor computational expense. However, this added expense was insignificant when compared to the reduced computational cost of running on coarsened numerical grids. The authors also presented potential solutions to some of the problems often associated with running subgrid models on coarsened computational grids.

It is this reviewer’s recommendation that the manuscript be accepted with minor revisions.

This manuscript is well written, and the following comments are suggestions for improving and clarifying the work.

This reviewer has the following questions and suggestions for the authors:

## Specific Comments

1. Line 41-44: Although some full physics models have higher computational expense, that does not necessarily limit their application. For example ADCIRC is used to predict flooding on ocean and global scale numerical meshes in real time. This reviewer is not sure if the computational expense is actually limiting, it simply requires more computing power. Please revise this statement.
2. Line 48-49: The authors state that reduced the reduced-complexity models ‘solve only the essential terms in the momentum equations’. How do the authors define essential? Instead, this reviewer would recommend changing this statement to ‘These models solve reduced forms of the momentum...’. In addition, the authors compare to ‘conventional models’ at the end of the sentence, please change ‘conventional’ to ‘full complexity’ so that this doesn’t get confused with the non-subgrid SFINCS model further into the paper. This reviewer would also like it if the specific momentum terms that are left out of a model like SFINCS are given as an example here.
3. Line 75: This reviewer believes V. Casulli’s 2019 paper “Computational grid, subgrid, and pixels” was the first to introduce cell clones into a subgrid model. Consider citing this as well as Begmohammadi et al (2021) throughout the paper.
4. Line 197: The use of 20 levels between zmin and zmax of a subgrid area would likely work well for locations where there is only a few meters of difference in zmin and zmax. How many levels would the authors recommend for a much larger difference in zmin and zmax similar to what you might find if the subgrid area straddled a deep channel with a high bluff?
5. Lines 384-385: This reviewer would like to see a larger discussion on the computational expense of the subgrid code. What are the file sizes of the lookup tables? What file

type is used? NetCDF? Does the computational cost scale linearly with the grid/file size?

6. Lines 475: Why is there a range for the computational speed up from the 100 m to 25 m grid? Also in Table 2, why is the run time of the subgrid 50m less than the regular 50m? This seems inconsistent with the discussion. I would be nice to see the computational cost increase added to a table.

## Technical Comments

- Line 29-30: Suggest removing ‘Furthermore, flood... save lives.’
- Remove empty box in Equations 3, 4, 17, 18, 22, 24 and Line 242.
- Make the averaging brackets in Equations 10, 11, and 13 larger to encompass entire term.
- Figure 1, 3, 5: consider changing color maps from rainbow.
- Line 241, 243 and 244: Need to add subscripts to ‘zu’, ‘nu’, and ‘phiu’.
- Lines 361-369: For some reason the pdf made these lines bold with different vertical line spacing.
- Line 345: The authors mention the 25, 50, 100, 200, and 500 m test cases, but not the 1000 m test case listed in Table 1. Consider removing the 1000 m from the table.
- Line 370: Formatting error where line starts with ‘Table 1).’.
- Lines 374-380: Formatting issues.
- Line 381: Formatting error where line starts with ‘Table 1).’.
- Line 413: Add ‘the’ between ‘on’ and ‘Sebastian’.
- Line 421: Could the authors please give the equation for the NSE in the discussion for reference?
- Figure 10: Could the authors use different markers/colors for the USGS stream gauges and HWMs on the map. The current ones are hard to see.
- Line 489: Again, I would consider citing Casulli 2019.
- Line 490: What do the authors mean by ‘snapped’?
- Line 512: Add ‘s’ to ‘subgrid correction’.
- Line 513: Consider adding comma after ‘channel’.
- Line 521: Consider changing ‘subgrid corrections’ benefits’ to ‘benefits of subgrid corrections’.