Geoscientific Model Development Discussions

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Comment on gmd-2022-208

Anonymous Referee #2

Referee comment on "SERGHEI (SERGHEI-SWE) v1.0: a performance-portable high-performance parallel-computing shallow-water solver for hydrology and environmental hydraulics" by Daniel Caviedes-Voullième et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2022-208-RC2, 2022

The paper deals with the development of, what the authors call, Simulation Environment for Geomorphology, Hydrodynamics and Ecohydrology (SERGHEI) - Shallow Water Equation (SWE) for hydrodynamics, ecohydrology, morphodynamics simulations. Although there are many shallow water equation models in the world, I think the SERGHEI-SWE is new in that it can handle even exa-scale problem such as with 122000000 computational cells (dx=0.5m) for the rainfall-runoff processes at lower Triangle region in the East River Watershed with fast parallel computing.

My impression of the overall contents of the paper was that actually the contents is basically for the evaluation of shallow water model, however, the authors are emphasizing more on the broad view of SERGHEI that it can handle hydrology and environmental hydraulics problems. I had a feeling that you could simply describe the importance of SERGHEI for the future of pure shallow water equation modelling in the paper, but you didn’t. Likewise, you do not have to say fluvial or urban flood modelling as classical engineering problem. If you model fluvial or urban flood modelling with e.g. 100 m resolution, you may be justified to say that it is established engineering problem, but I think it is still new if you model them with one-digit resolution and large area with scientific scope such as considering sub, super-critical flow distinction. In this sense, turbulent modelling may be interesting to add more scientific essence in the analysis. Anyway, I would appreciate it very much if you could explain more why the exa-scale handling is necessary for the shallow water modelling. Lower Triangle region is 14.82km2 which is small. Why do you need to model such catchment with 0.5m resolution? What is your vision for the exa-scale modelling using a shallow water equation?

In addition, it is little hard to follow all the benchmark cases one by one. The total number of page is 44. You can remain for example only the essential benchmark for readers’ sake. If you say, that every benchmark is necessary for the true evaluation of the shallow water model by SERGHEI, then you can remain all of them, but you can as well keep them in the appendix for example. Please consider them. Please sharpen the contents for what you really want to convey.

Overall, I think there are shallow water models which can simulate benchmarks with the same level accuracy with SERGHEI-SWE except that those are slower than SERGHEI-SWE. But other shallow water models could be more user-friendly. Likewise, the users of other shallow water models may consider that they do not need exa-scale computation for their purpose. The authors need to explain the vision how the SERGHEI-SWE needs to be used in the near future.

The authors do not necessary needs to write the answers to the above questions in the paper itself but I would like to know the vision of exa-scale computing.