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Validation and benchmarking of a distributed CPU+GPU high-performance model for tsunami propagation

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In numerical modelling, the quality of the computed solutions is generally bound to the spatial and temporal discretization detail across the domain of interest. For tsunami modelling, and particularly for impact forecast in urban environments, the ability to explicitly resolve most fluid-structure interactions is of utmost importance for a deep characterization of flow hydrodynamics and the associated inundation extents and severity (Conde et al., 2015).

At CEris – Instituto Superior Técnico, Universidade de Lisboa – a new STAV-2D shallow-water model has been under development (Canelas et al., 2013 & Conde et al., 2013), employing numerical techniques especially suited for strongly transient flows over complex and dynamic geometries. The model is based on an explicit, shock-capturing finite-volume scheme for unstructured body-fitting meshes.

STAV-2D was recently redesigned for distributed and heterogeneous computations. Specifically, this allows the model to gather the computational resources of multiple processors simultaneously, irrespectively of the hardware architecture: both Central and Graphics Processing Units are currently supported.

The present work aims at validating the STAV-2D model with an extensive set of benchmarking tests. Synolakis et al. (2007) presented a comprehensive guide for tsunami model validation, herein employed to assess model performance in a wide variety of tsunami modelling aspects. The proposed benchmarks range from basic hydrodynamic considerations and analytical solutions to experimental and field data comparisons. The computed solutions are closely in-line with benchmarking data, thus rendering STAV-2D as a robust tool for tsunami impact forecast.

This concludes the last stage of one main goal in STAV-2D: to provide a fast and reliable platform for tsunami modelling at all relevant scales, from source to run-up in both natural and built environments.

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