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Comparison and Computational Performance of Tsunami-HySEA and MOST Models for the LANTEX 2013 scenario

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Tsunami-HySEA model is used to simulate the Caribbean LANTEX 2013 scenario (LANTEX is the acronym for Large AtlaNtic Tsunami EXercise, which is carried out annually). The numerical simulation of the propagation and inundation phases, is performed with both models but using different mesh resolutions and nested meshes.
Some comparisons with the MOST tsunami model available at the University of Puerto Rico (UPR) are made. Both models compare well for propagating tsunami waves in open sea, producing very similar results. In near-shore shallow waters, Tsunami-HySEA should be compared with the inundation version of MOST, since the propagation version of MOST is limited to deeper waters. Regarding the inundation phase, a 1 arc-sec (approximately 30 m) resolution mesh covering all of Puerto Rico, is used, and a three-level nested meshes technique implemented. In the inundation phase, larger differences between model results are observed.
Nevertheless, the most striking difference resides in computational time; Tsunami-HySEA is coded using the advantages of GPU architecture, and can produce a 4 h simulation in a 60 arcsec resolution grid for the whole Caribbean Sea in less than 4 min with a single general-purpose GPU and as fast as 11 s with 32 general-purpose GPUs.
In the inundation stage with nested meshes, approximately 8 hours of wall clock time is needed for a 2-h simulation in a single GPU (versus more than 2 days for the MOST inundation, running three different parts of the island—West, Center, East—at the same time due to memory limitations in MOST). When domain decomposition techniques are finally implemented by breaking up the computational domain into sub-domains and assigning a GPU to each sub-domain (multi-GPU Tsunami-HySEA version), we show that the wall clock time significantly decreases, allowing high-resolution inundation modelling in very short computational times, reducing, for example, if eight GPUs are used, the wall clock time to around 1 hour. Besides, these computational times are obtained using general-purpose GPU hardware.