Parallel adaptive tsunami modelling with triangular discontinuous Galerkin schemes

STEFAN VATER (Universität Hamburg, stefan.vater@zmaw.de),

KAVEH RAHNEMA (Technische Universität München, rahnema@in.tum.de),

JÖRN BEHRENS (Universität Hamburg, joern.behrens@zmaw.de),

MICHAEL BADER (Technische Universität München, bader@in.tum.de)

February 1, 2014

A tsunami simulation framework is presented, which is based on adaptive triangular meshes and a finite element discontiuous Galerkin discretization. This approach allows for high local resolution and geometric accuracy, while maintaining the ability to simulate large spatial domains. The dynamically adaptive mesh is based on a conforming tree based refinement strategy, which allows to optimize the code for high-performance computing architectures.

While the tsunami propagation in the deep ocean is usually well represented by the nonlinear shallow water equations, special interest is given to the near-shore characteristics of the flow. For this purpose a new mass-conservative well-balanced inundation scheme is developed. We present results of several test cases, in which we study the robustness of the scheme and its applicability to tsunami problems. The computational framework applies an approach that combines Sierpinski space-filling curves with bisection-based refinement of triangular meshes to obtain an algorithm that is inherently cache efficient and exploits the in-built space-filling curve order for efficient hybrid MPI+OpenMP parallelization.

This work is part of the ASCETE (Advanced Simulation of Coupled Earthquake and Tsunami Events) project, which aims to better understand the generation of tsunami events. In this course, a parallel simulation framework is developed which couples physics-based rupture generation with hydrodynamic tsunami propagation and inundation.