Adaptive Tsunami Simulations With RKDG Schemes on Triangular Grids

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Abstract

Due to their potentially disastrous impact on environment and society the numerical simulation of Tsunami events demands for accurate and efficient algorithms. In this talk, two important aspects in this respect are discussed: dynamic mesh adaptivity and the treatment of inundation at the coast.

The local nature of the tsunami wave promotes the application of adaptive grid algorithms. Especially in the beginning, when the tsunami has just been generated by an earthquake, an accurate solution is only needed locally, and not for the whole ocean. In the presented framework the adaptive grid generator amatos [2] is applied, which uses triangular grids and a patch based refinement strategy that refines by bisection with no hanging nodes. A local error indicator controls the adaptivity of the grid.

Another important part in the numerical modeling of tsunami or storm surge events is the accurate and robust treatment of flooding and drying at the coast. Within the framework of the shallow water equations, such an algorithm should preserve the steady state of a fluid at rest, be mass conservative and should preserve the positivity of the fluid depth among other features of the exact solution. Here, we present a novel treatment for second-order Runge-Kutta-DG schemes which is based on a limiting approach [1]. The core of the method is a velocity based "limiting" of the momentum, which provides stable and accurate solutions in the computation of wetting and drying events. Additional limiting of the fluid depth ensures its positivity while preserving local mass conservation. A special flux modification in cells located at the wet/dry interface leads to a well-balanced method, which maintains the steady state at rest.

The performance of the method is verified by several analytical test cases and is finally applied to realistic tsunami test problems.

References

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