Large Scale Flooding Scenario Simulation for Complex Geometries

V. Varduhn[1], **R.-P. Mundani**[1], **and E. Rank**[1]

Abstract: In order to predict the impact of flooding scenarios to coastal regions or whole cities, numerical simulations are inevitable. Such scenarios can originate from a Tsunami caused by an under sea earthquake or a braking dam and are highly relevant to nowadays research, as they influence and even drive the planning for future construction projects and enable the investigation and improvement of existing constructions.

Making such results available requires the usage of elaborate techniques from the field of high performance scientific computing. Beginning at the generation of a sufficient fine mesh, a resolution of hundreds of millions or even billions of cells has to be provided, in order to represent the complex geometry of the terrain and the buildings and infrastructure within accurately, since the used data basis contains the fully detailed geometric representation of buildings and constructions such as bridges.

On such a mesh, the shallow water equations, a dimension-reduced version of the Navier-Stokes equations, are solved using a finite-difference scheme. Due to the problem size, the exploitation of massive parallel computing power is inevitable and will be presented for a simulation, run on a BlueGene/P architecture equipped with more than 65 thousand processor cores and 64 Terra byte main memory.

To make these results valuable for users, a sufficient post processing has to be provided and is put into practice by parallel processing of the simulation results, following the domain decomposition of the parallelisation strategy of the simulation. These results are brought to a manageable size, by generating a sparse representation of the fields of interest and application of sufficient compression strategies before transfer.

In this work, we present the whole simulation pipeline for large scale simulations of flooding scenarios, ranging from sufficient fine mesh generation, the parallelisation of the simulation following a domain decomposition approach, and the fully parallel post processing of simulation results.

[1] Chair for Computation in Engineering
Faculty for Civil Engineering and Geodesy
Technische Universität München
Arcisstr. 21, 80290 München, Germany
varduhn@tum.de