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The influence of topographic and mesh resolution in 2D hydrodynamic modelling for floodplains and urban areas

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Especially for inundated urban areas, hydrodynamic modelling relies on a good choice for the spatial resolution. Mesh size and topography resolution have decisive impact on the model results (e.g. Yu and Lane, 2006, Horritt et. al. 2006, Hardy et al. 1999). This presented approach identifies from which resolution on a certain physical quantity deviates unacceptably from the true solution. Various physical quantities can have different corresponding critical mesh resolutions. Especially for the implementation of further model components e.g. for sedimentation or erosion an a priori selection of the mesh size is indispensable.

A two-dimensional hydraulic model for urban areas and floodplains was generated in the framework of the project “Development of a Decision Support System for the distribution and risk assessment of pollutants during extreme flood events in the Mulde floodplain (Germany)” (RIMAX , 2007) using the TELEMAC modelling system. An airborne laser scanning data set with a grid size of 1m was used to interpolate heights to different finite element meshes. Results from the coarser meshes are compared with a high resolution mesh, in which buildings and streets are represented in detail. About 1000 buildings are included in the mesh. The hydraulic simulations were performed using an extreme flood scenario based on data from the disastrous summer 2002 flood in the river Elbe and river Mulde catchment.

The results confirm that the time of inundation and the detailed path of the inundation are strongly influenced by the mesh resolution in the floodplain and in the urban area. The calculated magnitude of velocities shows that even small changes in mesh topography may cause considerable effects. In respect to the calculated water level, the influence of mesh resolution exceeds the influence of the interpolation algorithm

used to transfer the heights from the Digital Elevation Model (DEM) to the finite element grid. In comparison to the effect of the mesh resolution, the uncertainties of the DEM itself (plus minus 15 cm) can be neglected.

References

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