FACTSHEET RISK ASSESSMENT AND MAPPING ACTIVITIES

Heavy rain hazard map (hydrodynamic simulations with HiPIMS)

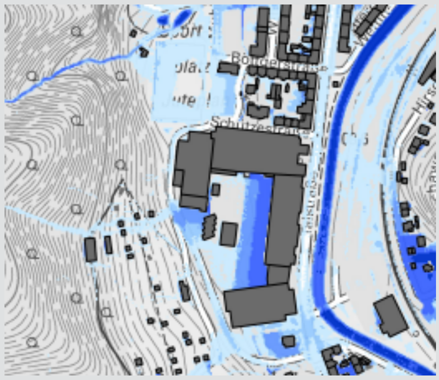
Where was it implemented?

Germany, Saxony, Meißen

Problem/background

Parts of the city of Meißen were affected by an intensive heavy rainfall event on May 27th 2014 that caused damages in the range of more than 4 million €. Future events of a comparable intensity in other parts of the city are possible. Currently there exist no information on the spatial distribution of water levels and flow velocities resulting from a heavy rain event. To help especially the city planning department when dealing with new developments, hazard maps are recognised as useful tools during the planning process.

Map example:



Description of methodological background and outcomes

The hydrodynamic model HiPIMS solves the fully dynamic form of the shallow water equation based on a finite volume approach on a regular grid. Details about the model and examples are given in Smith & Liang (2013), Liang & Smith (2014), Smith et al. (2015) and Liang et al. (2016).

A uniform or gridded rain is used as driving input and routed over the surface of a digital elevation model. Currently there is no infiltration approach implemented, i.e. the runoff coefficient is 1. To account for losses, a global drainage/loss rate can be set. The Gauckler-Manning-Strickler hydraulic roughness value can be set for the whole domain or on a raster basis.

The model runs on CPU as well as on GPU. The runtimes on GPU are very fast (minutes to hours) compared to “classic” hydraulic models of the same class (hours to days).

Area and event characterisation

Area type Rural and urban	**Topography** Hilly
Land cover/land use distribution 30 % forest, 30 % cropland, 40 % built-up	**Event** Observed event (27.5.2014), synthetic events (synthetic Euler II rains for 60 min HN10, 30 and 100 based on KOSTRA-DWD)
Receptors Buildings and streets visualised in map	**Flood type** Flash flood with mud/debris component

Specifications of method/measure and data demands and outputs	
Level of complexity	3
Addressed SPRC element	S/P
Method group	Process-based approach
Spatial scale(s) of application	Raster width 1 to 5 meters, total area limited only by computer memory
Time scale/resolution	Calculation time steps: flexible/automatic, output time steps: flexible, minutes to hours
Input datasets (type and scale/resolution)	Digital Terrain Model DTM (raster, 2 m) Gauckler-Manning-Strickler hydraulic roughness (global/raster) Precipitation time series (single point/global, 5 min; raster, 500 m, 5 min)
Output datasets (type and scale/resolution)	Water levels (raster, 2 m, flexible output time steps) Flow velocities in x and y direction (raster, 2 m, flexible output time steps) Maximum water levels (raster, 2 m, flexible output time steps)

Description of implementation	
Implementation • 3/2018 to 6/2019	**Users (reported/designated)** • City planning department
Initiator/responsible • IOER/RAINMAN	**Involved stakeholders** • City planning department • Civil security department • Building department

Lessons-learned	
Main success factor: • Good agreement between simulated and observed flow patterns creates confidence on the model/approach.	**Main challenge:** • Integration of retention basin and changed surface morphology.
Synergies/beneficial aspects: • The hydrodynamic approach gives the opportunity to simulate the effects of selected measures e.g. dams/barriers, deepening/widening of channels, … • The model runs very quick (approx. 2 hours) and enables multiple runs with different variants (measures, parameter values, events, …)	**Conflicts/Constraints:** • The model results have a strong dependency on the up-to-dateness of the surface data. • Future events will differ from the historic as well as from the synthetic events.

Key message to others starting with a similar task	Contact
"The quality of the digital elevation model has the greatest influence on the results." "Event documentation is very valuable for the evaluation of the model outputs."	Dr. Axel Sauer Leibniz Institute of Ecological Urban and Regional Development (IOER) a.sauer@ioer.de

References

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