Grid-based 2D-hydrodynamic modelling for heavy rainfall prevention: Impact of geospatial resolution and the assessment of urban infrastructure vulnerability to flash floods

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FloReST

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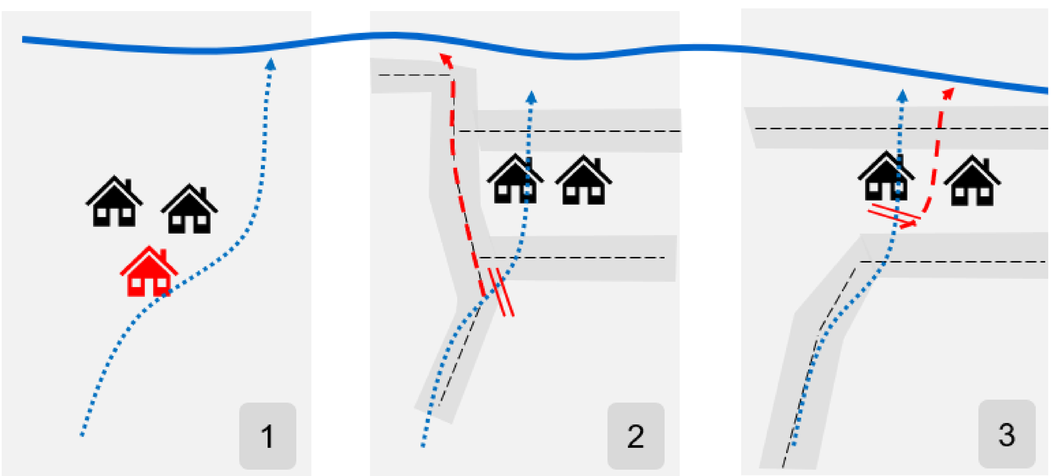
A Introduction

A water-sensitive urban development is one strategy to address flash floods in urban areas and to minimize their consequences. For this purpose, emergency-drainage routes are required in order to divert the water masses through urban areas with as little damage as possible. Therefore detailed flow path identification is required to allow a high-resolution planning of emergency drainage routes and measures to divert the water.



author: Ingenieurgesellschaft Dr. Siekmann & Partner mbH, Thür - Germany

(1) object-protection measures required
(2) emergency drainage route – streets
(3) emergency drainage route – new

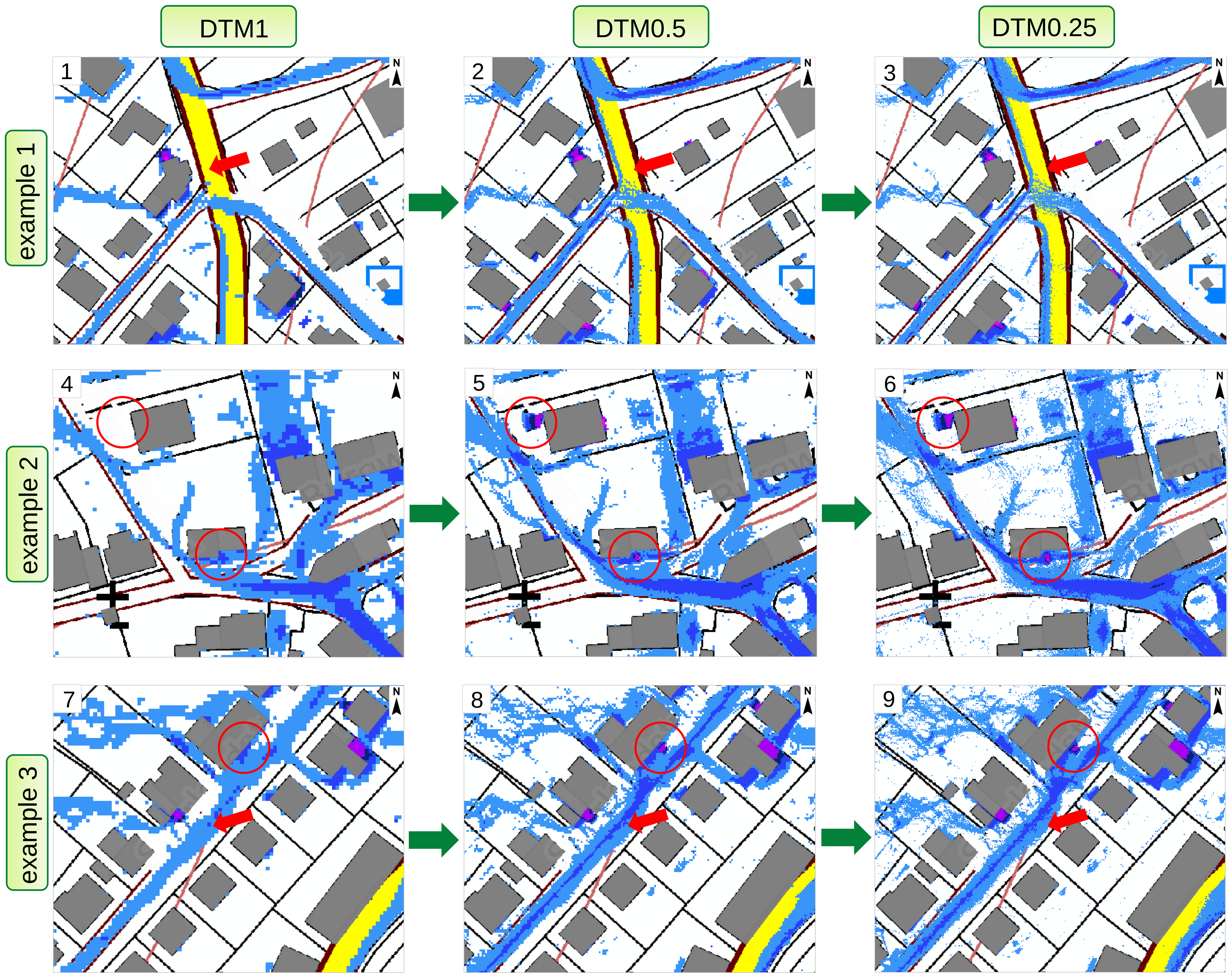
B Problem & Objective

- to identify detailed flow paths in urban areas a DTM1 is inadequate due to its limited spatial resolution
- local runoff-relevant structures, such as curbs and smaller walls, were either not covered or inadequately represented with this resolution
- these structures can have a significant impact on flow paths and flood vulnerability in urban areas

The objective is to assess the impact of spatial resolution on modelling results and derive the potential vulnerability of urban infrastructures to flash floods.

Therefore both load-independent and load-dependent grid-based analyses for flow path identification were conducted on digital terrain models (DTM) of varying spatial resolutions. This poster shows the results of load-dependent grid-based analyses.

C Grid-based 2D-hydrodynamic model results – maximum water depths of surface runoff –



max. water depth [m]
- 0 - 0.03
- 0.03 - 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- > 1.0

Figures 1-9: comparison of maximum water depths resulting from 2D-HN-modelling with varying spatial resolution

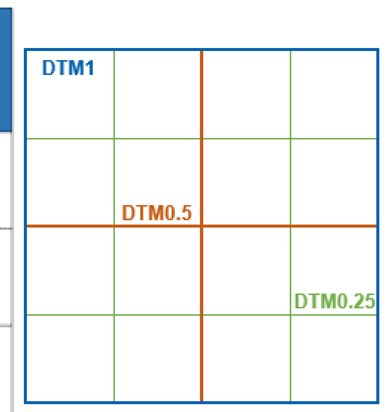
Varying spatial resolution:
- DTM1 (adjusted GeoTiff)
- DTM0.5 & DTM0.25 generated by processing raw data (LAS dataset)

Modelled scenario:
return period T = 100a, duration d = 60 min (KOSTRA-DWD 2020)

D Conclusion

- modelling on a DTM0.5 and DTM0.25 result in more detailed and also in additional flow paths
- especially local structures such as lower situated garage entrances are covered in a DTM0.5 and DTM0.25

	elevation information	computing time 2D-HN-model*
DTM1	factor 1	factor 1
DTM0.5	factor 4	factor 15
DTM0.25	factor 16	factor 100



*based on experience University of Applied Sciences Koblenz / depending on hardware, licences, model-parameters, etc.

- minor deviation in the spatial extent of flow paths in modelling DTM0.5 and DTM0.25
- difference in water depths is a few centimeters

impact on infrastructure can be assessed using higher-resolution modelling

advantage of DTM0.25-modelling over DTM0.5-modelling is only marginal in view of significantly longer computing times*

additional surveying is nevertheless necessary for the planning of measures!

*modelling in areas with large catchment areas and steep slopes. Results may look different for urban areas with low terrain gradients.

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