



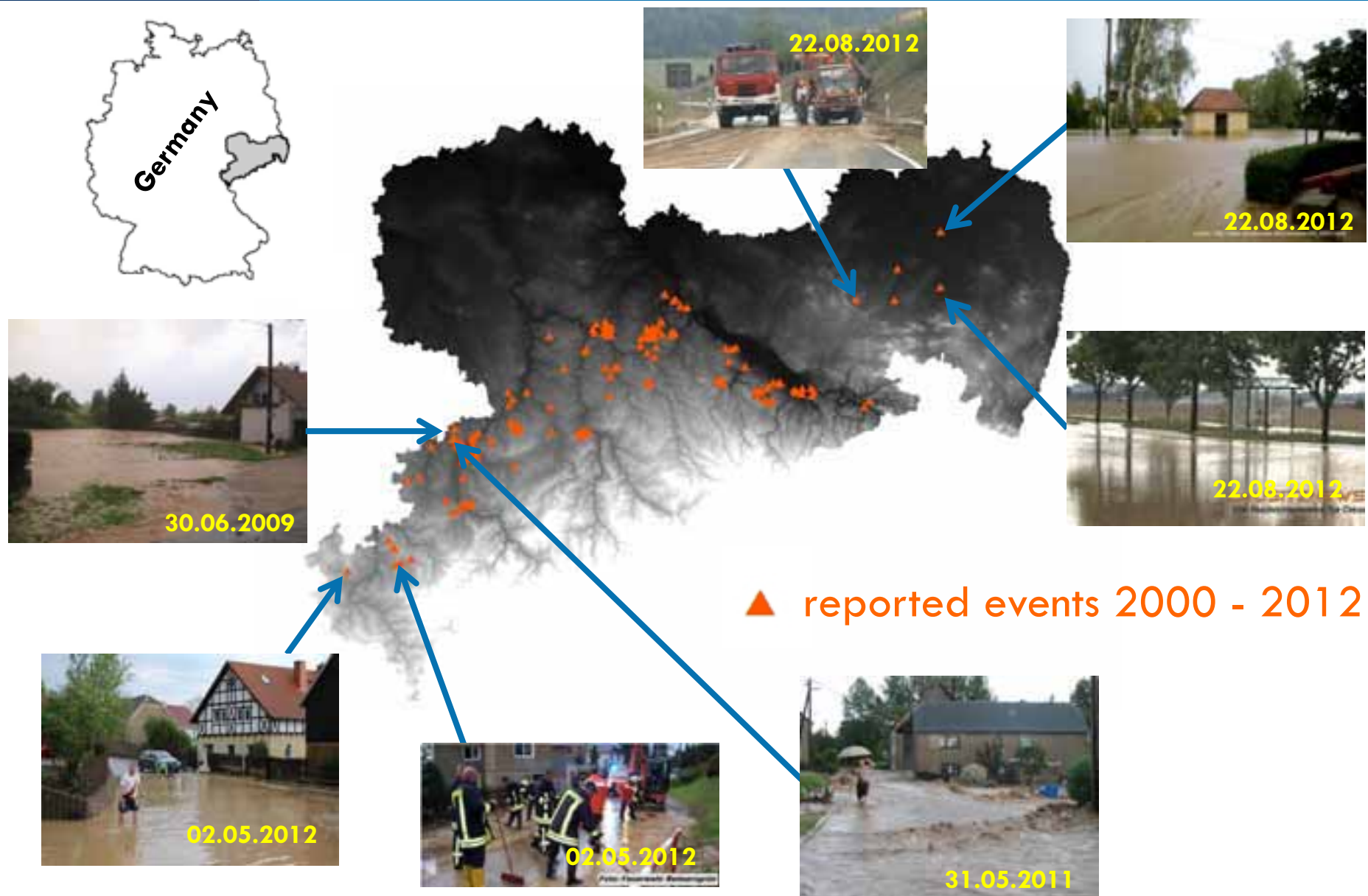
High Resolution Modelling of Sediment-loaded Runoff into Urban Areas

Sarah Annika Arévalo

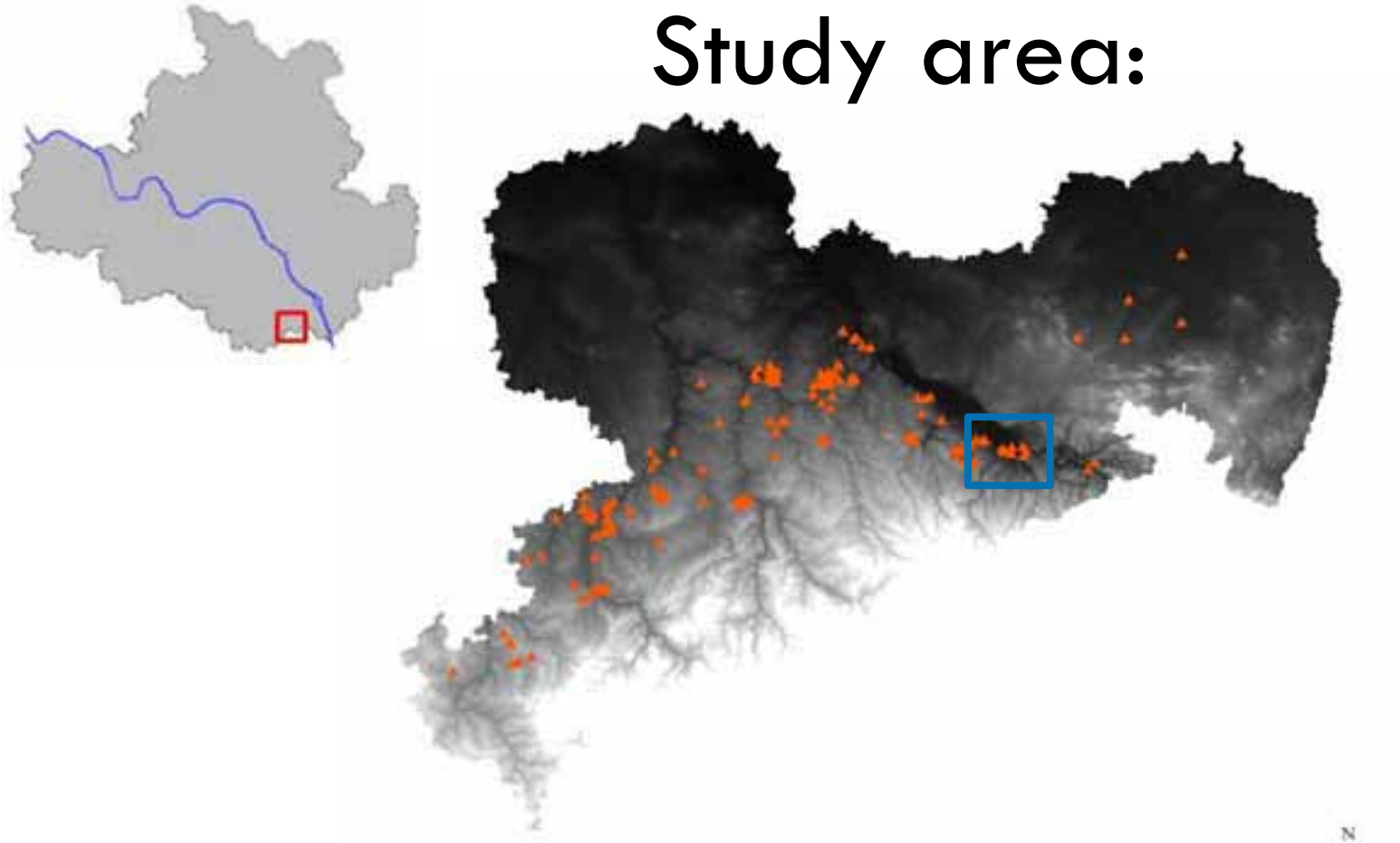
Jürgen Schmidt

November 15th, 2012

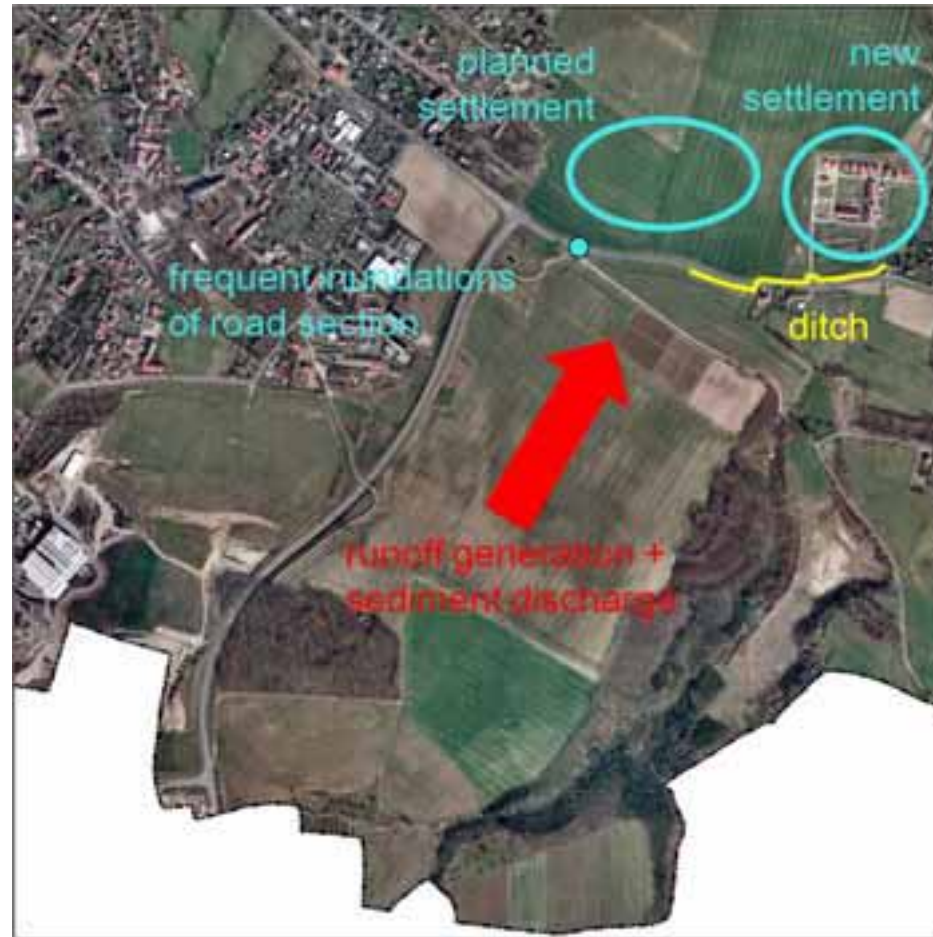




Study area:



Study area:



Processes based modelling:



- ▶ Event and raster-based physical soil erosion model (cellular automata type)

- ▶ Processes:

Infiltration - - - - ➔ Green & Ampt

Runoff - - - - ➔ FD8 routing algorithm, kinematic wave

Sediment detachment

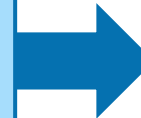
Sediment transport

Sediment deposition

} Momentum flux approach by Schmidt (1996)

Model input-parameters:

- Relief data
- Rainfall data
- Soil parameters

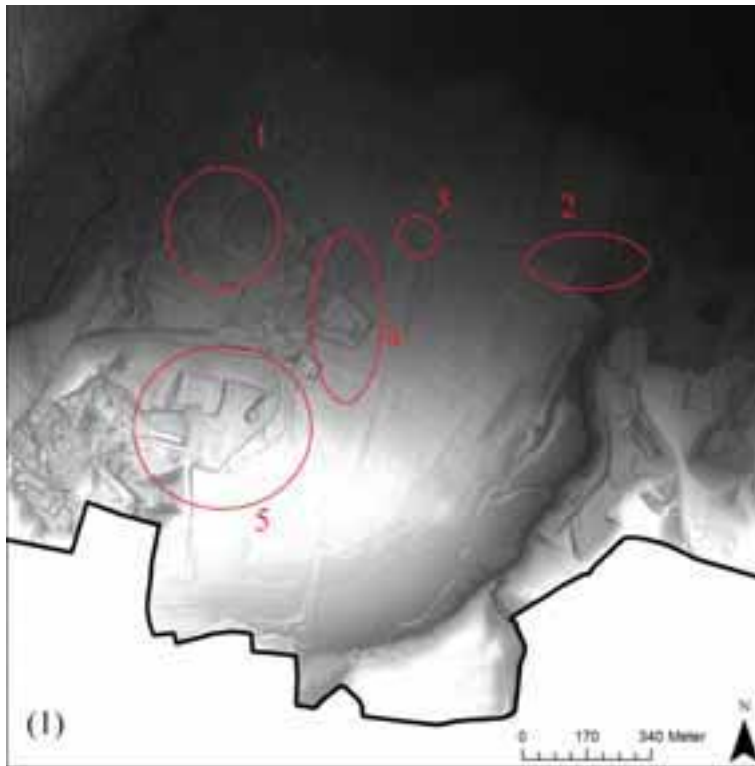


Model output-parameters:

- total runoff
- transported sediment
- erosion / deposition

Relief input data: DEM

1m Laserscan-DEM

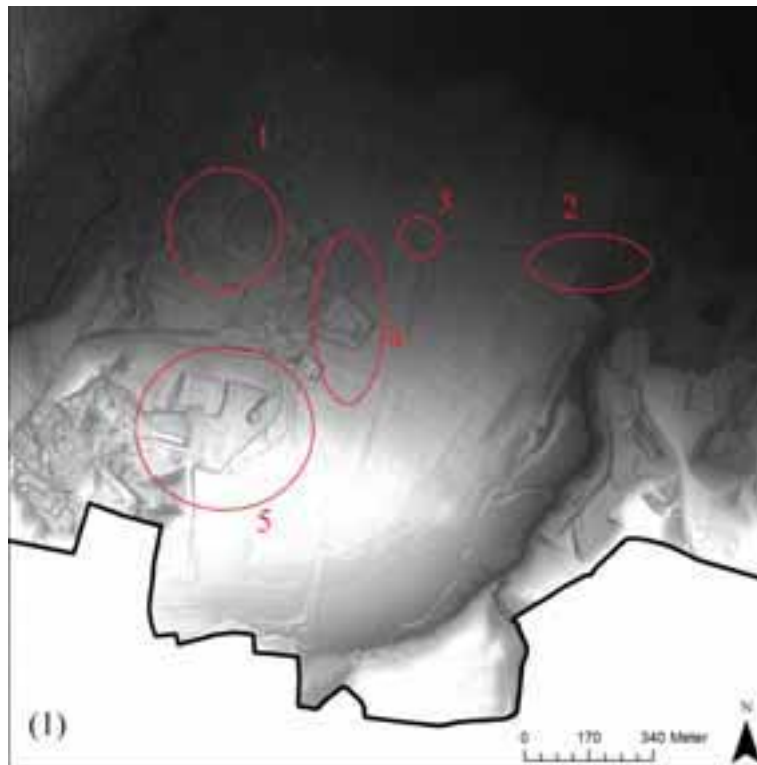


Difficulties for runoff modelling:

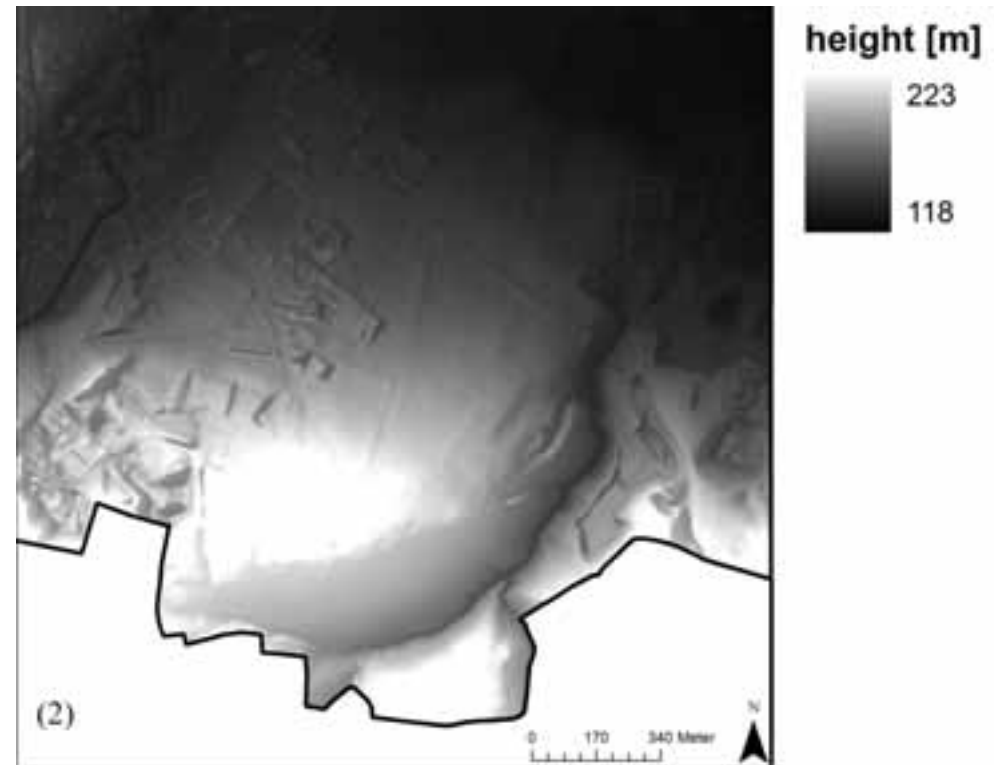
1. buildings, gardens
→ rough and unstructured surface
2. not represented structures:
e.g.: ditches, bridges, tubes
3. wrong corrections:
e.g.: grassed earth damms
4. + 5. new constructions

Relief input data: DEM

1m Laserscan-DEM

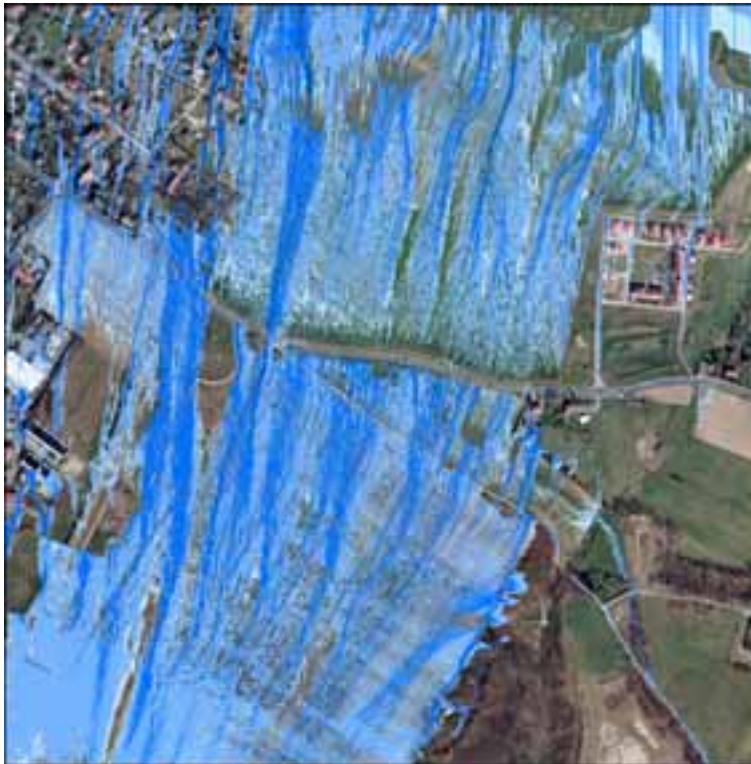


Modified DEM

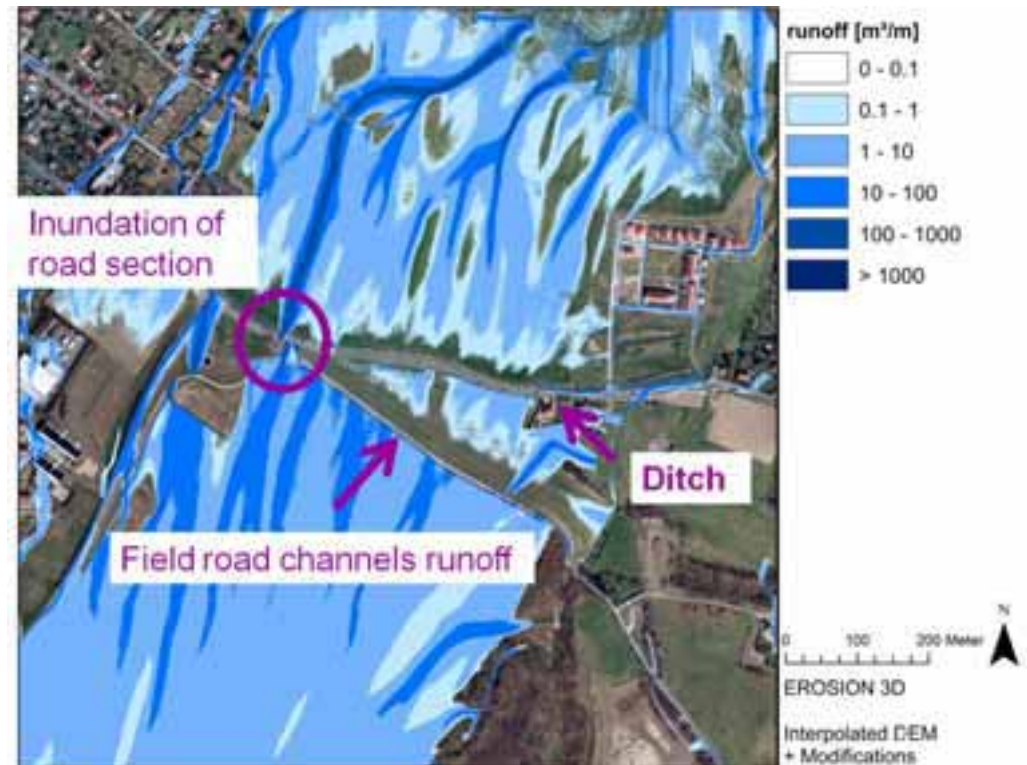


Results: total runoff

1m Laserscan-DEM

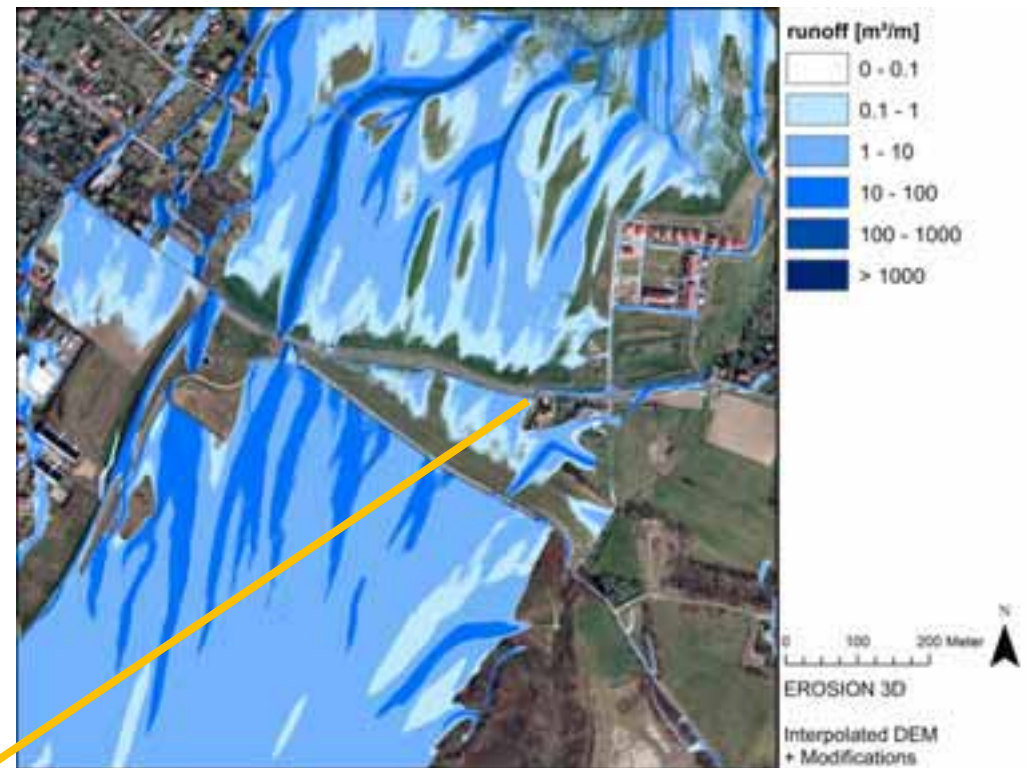
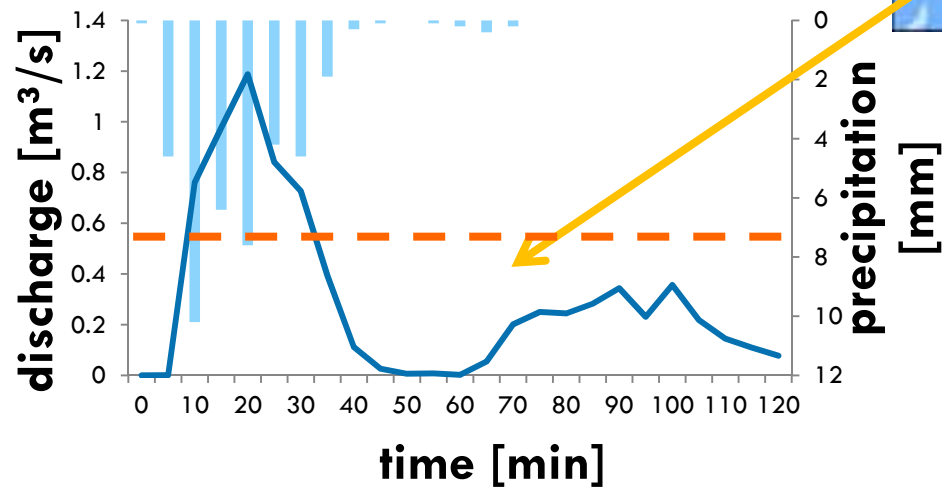


Modified DEM



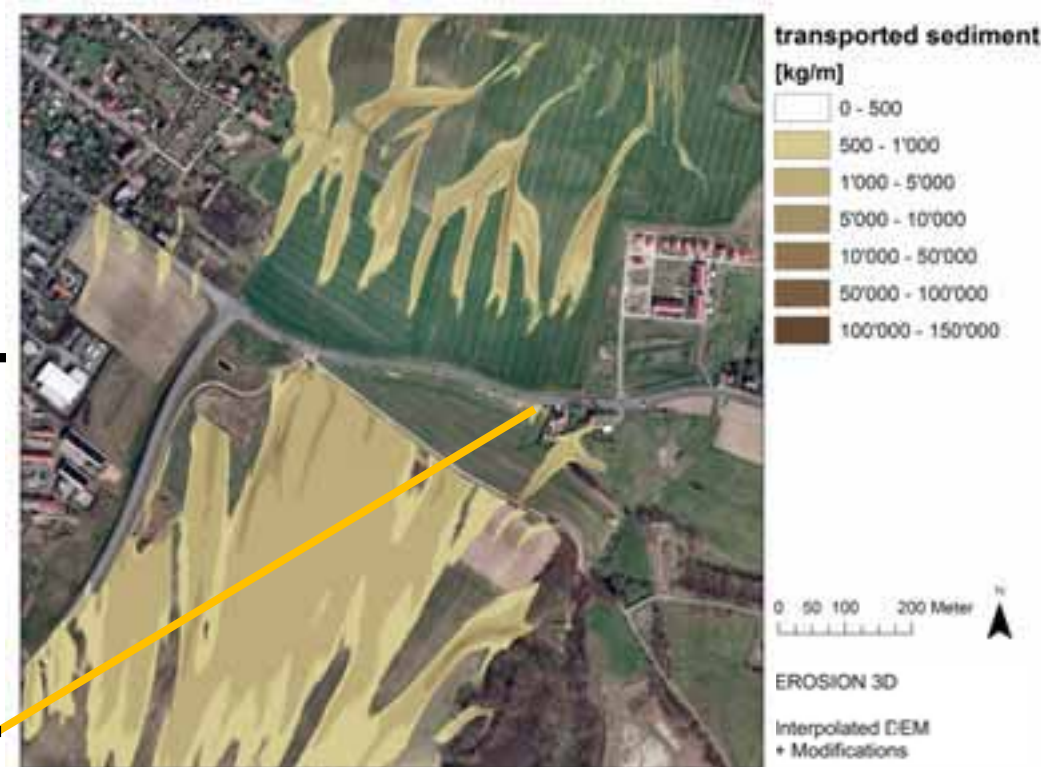
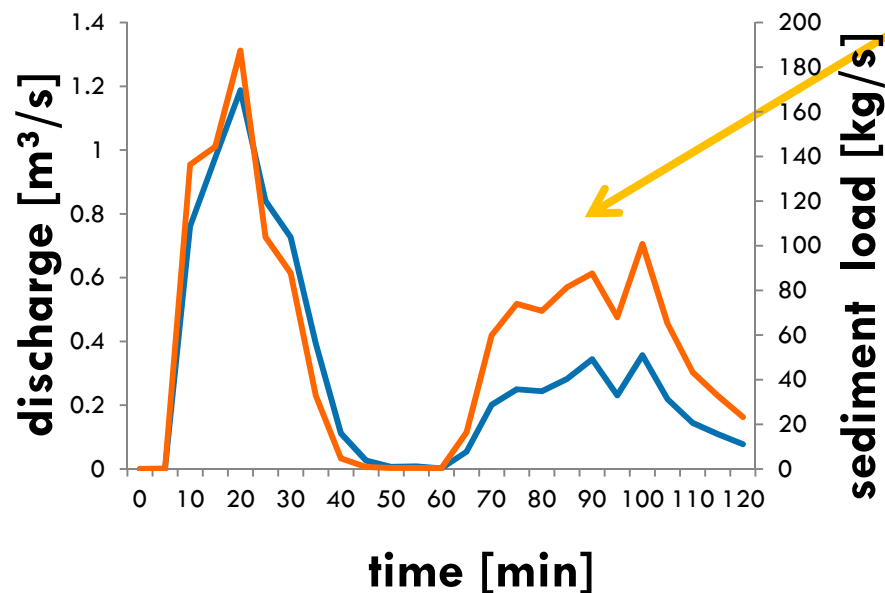
Results:

runoff



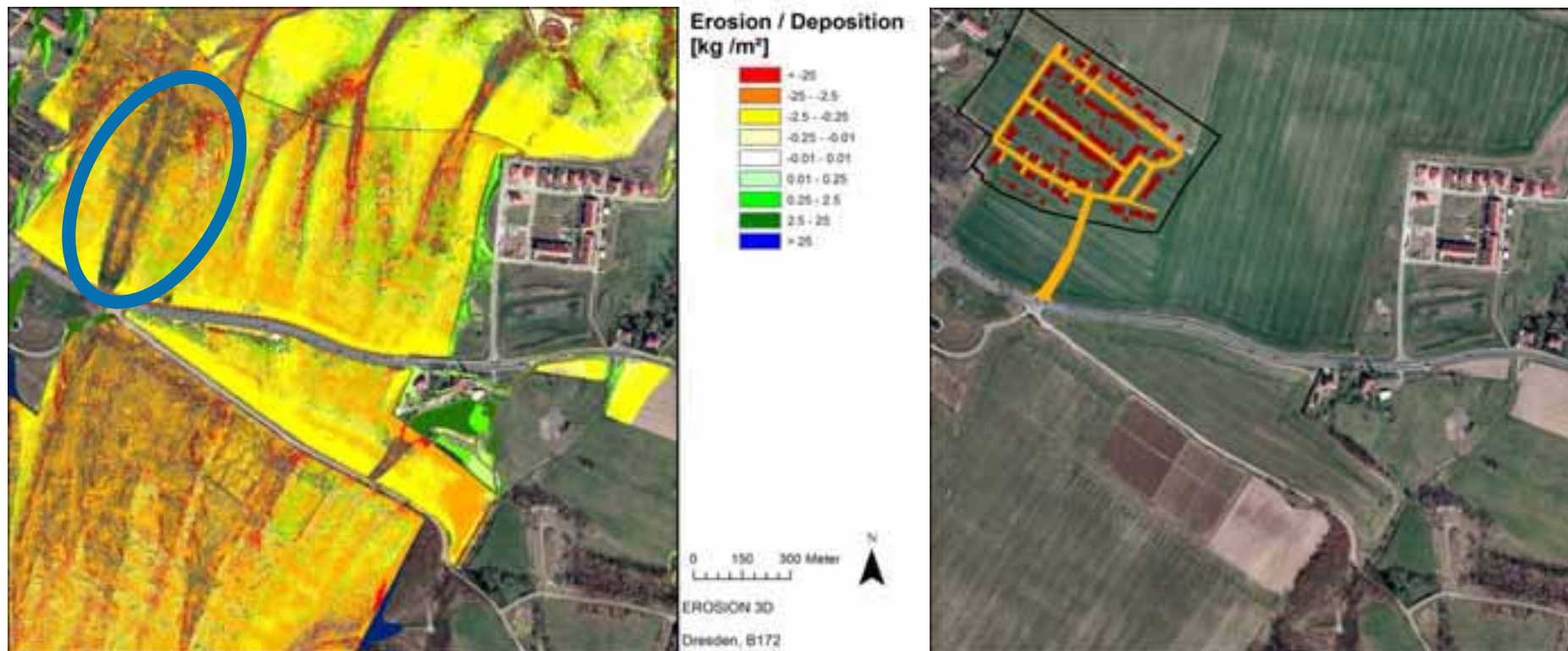
Results:

sediment transport



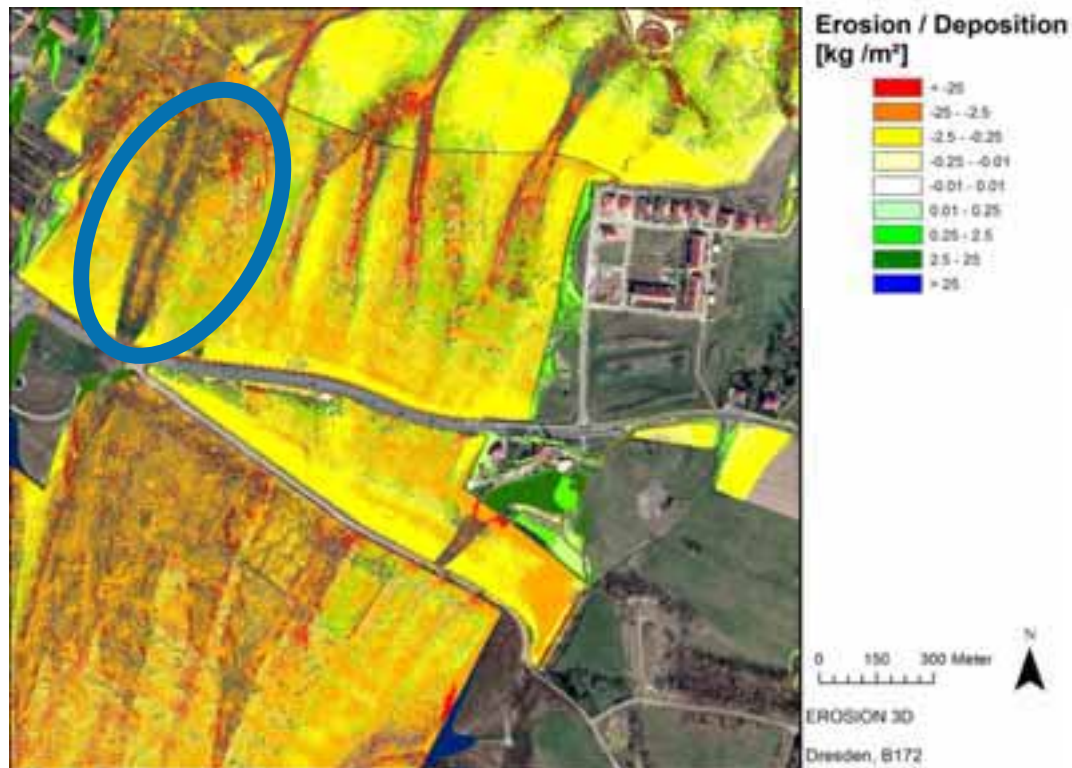
Results: sediment deposition

No sediment deposition due to high transport capacity



Results: sediment deposition

No sediment deposition due to high transport capacity



Sediment depositions



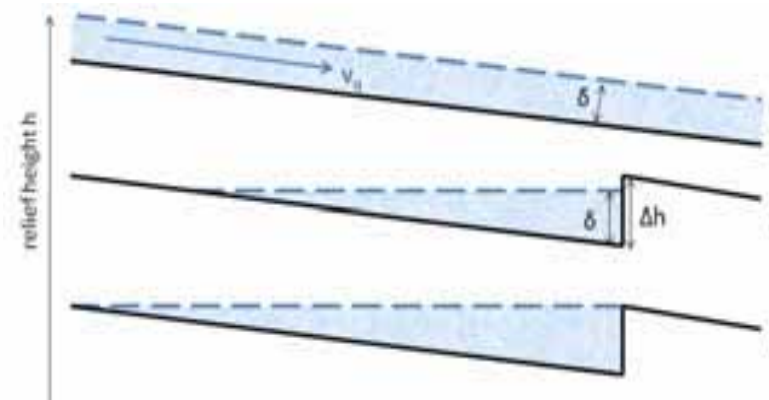
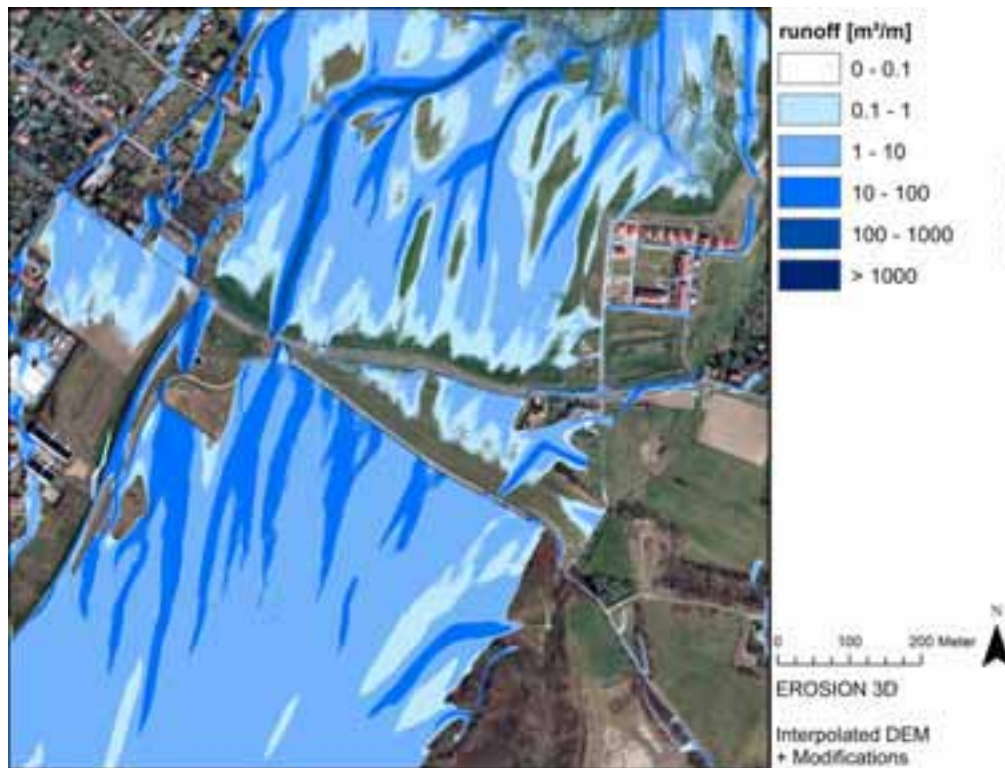
Discussion

- The model EROSION 3D can be applied to model
 - ✓ surface runoff
 - ✓ transported sediment
 - ✓ sediment deposition

for muddy flood events in urban areas.

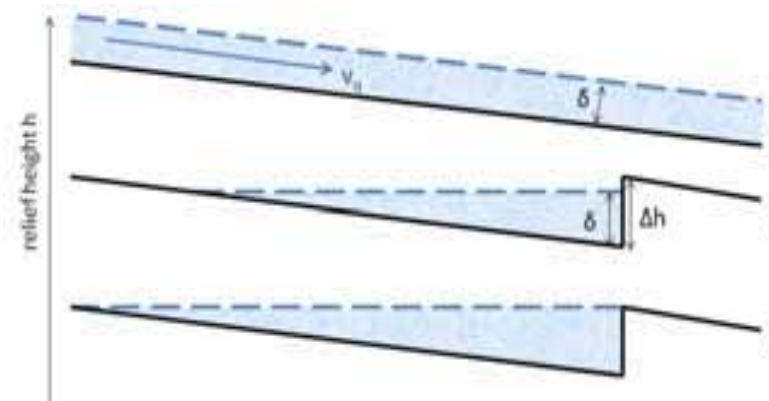
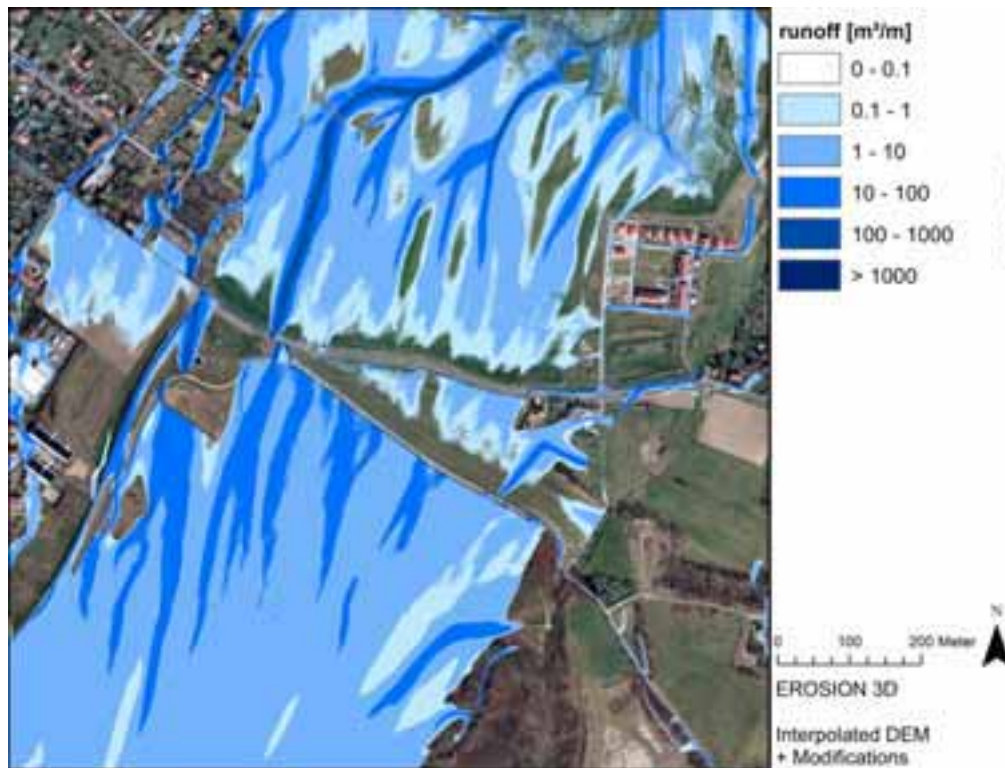
- Advantage modified DEM:
 - hydraulic surface
 - up to date
 - include planned constructions

Outlook: enhanced surface routing



23.26		23.16		22.10
	-0.78	-1.01	0.04	
22.83	-0.68	22.15	-0.01	22.16
	-0.14	0.05	0.20	
22.35		22.10		21.87

Outlook: enhanced surface routing



layer thickness from Manning equation:

$$\delta = \left(\frac{v_q \times \eta}{S^{1/2}} \right)^{3/5}$$

δ : layer thickness [m]

S : slope inclination [m/m]

v_q : runoff velocity [m/s]

η : hydraulic roughness [s/m^{1/3}]



Thank you for your attention!

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