

H13J-1832 Safer_RAIN: a Fast-Processing DEM-Based Algorithm for Pluvial Flood Hazard Assessment Across Large Urban Areas

Attilio Castellarin¹ (attilio.castellarin@unibo.it); Caterina Samela¹; Simone Persiano¹; Stefano Bagli²; Valerio Luzzi²; Paolo Mazzoli²; Jaroslav Mysiak³; Günter Humer⁴; Andreas Reithofer⁴

¹ University of Bologna

² GECOSitema Srl

³ CMCC – Centro Euro-Mediterraneo sui Cambiamenti Climatici

⁴ Dipl.-Ing. Günter Humer GmbH



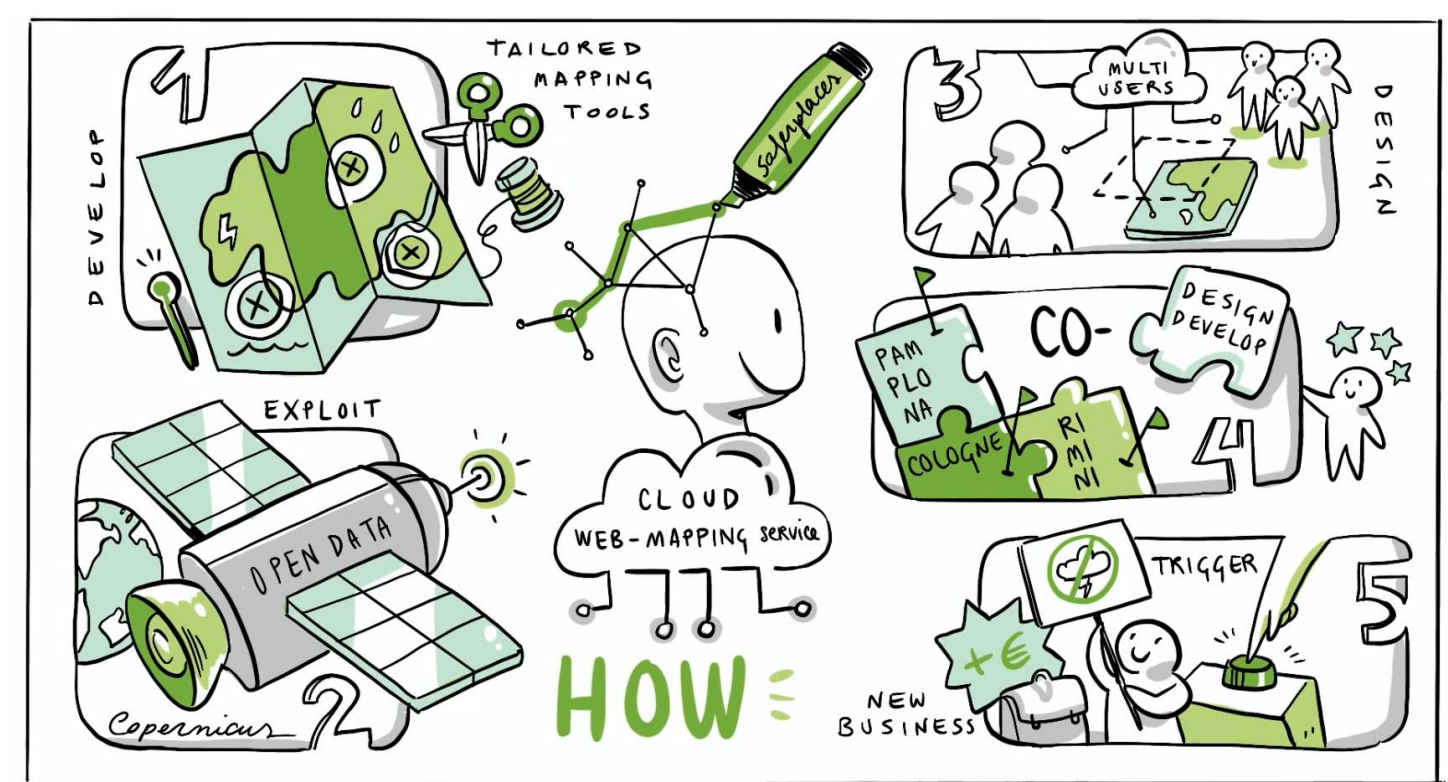
Climate-KIC
Climate-KIC is supported by the EIT, a body of the European Union

1. SaferPlaces <https://saferplaces.co/> Climate-KIC Demonstrator Project

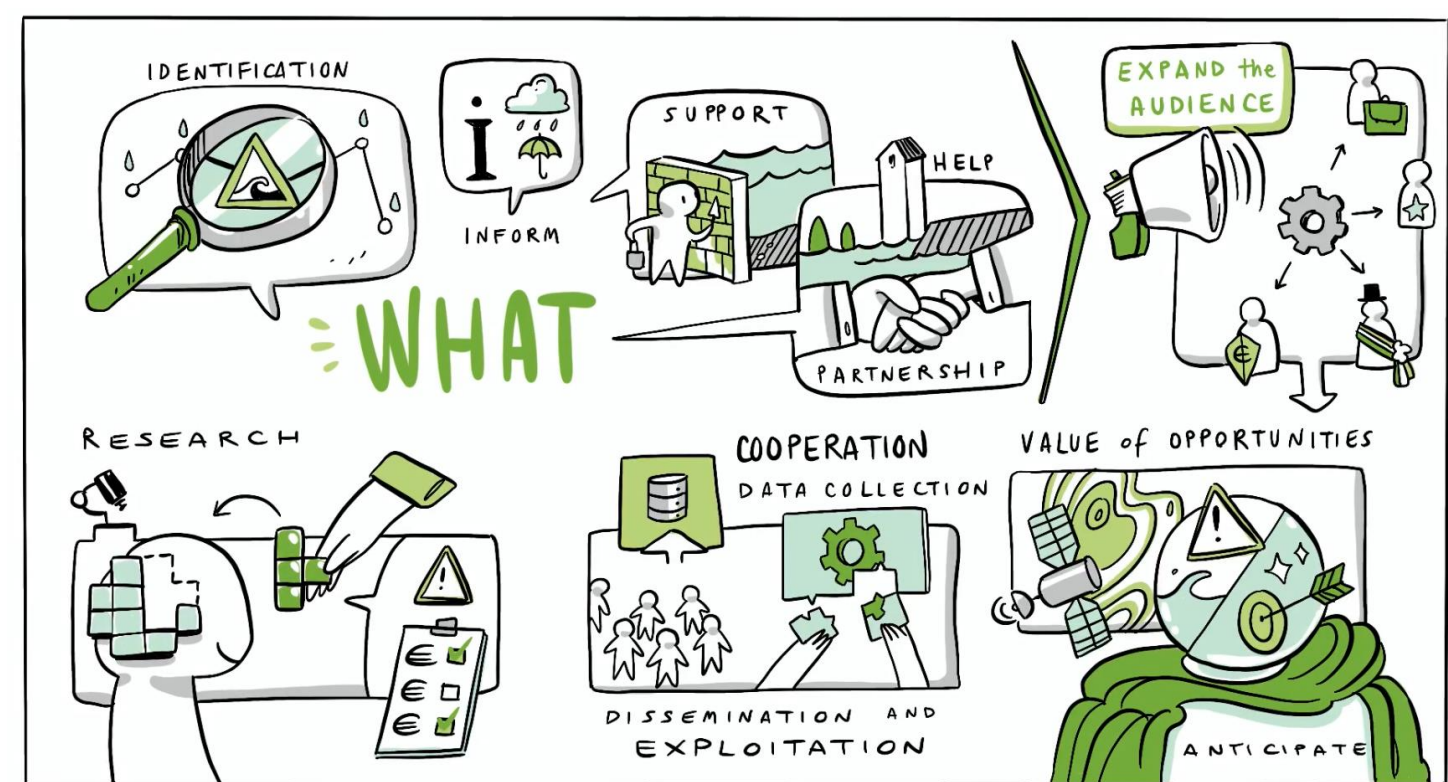
SaferPLACES - Improved assessment of pluvial, fluvial and coastal flood hazards and risks in European cities as a means for building safer and more resilient communities



WHY: CITIES ARE FLOODING!
Anthropogenic pressure (soil sealing, land subsidence) and increasing in occurrence of Extreme weather events (Pluvial, Fluvial and Coastal Hazards)
NEED FOR INNOVATION in urban flood-proofing tools and data.



HOW: IMPROVE ASSESSMENT
New simplified and Computationally efficient tools
exploiting open data and high-resolution DEM for Real-time analysis of multiple scenarios for supporting intelligence-led climate service, resilience and adaptation in our cities



WHAT:
CLOUD-WEB PLATFORM TAILORED FOR MAPPING FLOOD HAZARDS AND RISK IN URBAN AREAS



Follow us!

Twitter: @SaferPlacesCKIC

Hashtag: #SAFERPLACES_CKIC



2. Safer_RAIN Algorithm

Poster's focus: Pluvial-flooding in urban areas



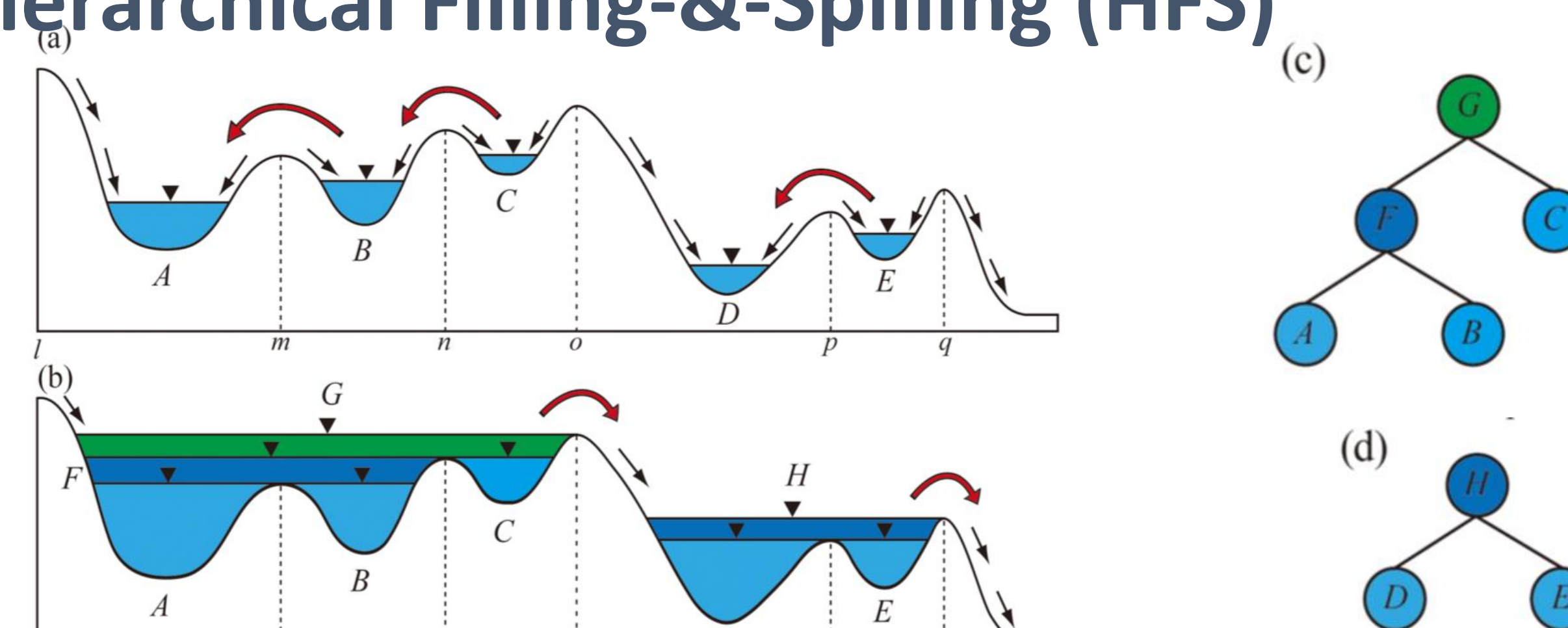
Why pluvial flooding?

Relative to fluvial and coastal flooding:

localized damages
yet
higher frequency

Non-negligible
Expected
yearly losses

Safer_RAIN Algorithm: Hierarchical Filling-&-Spilling (HFS)

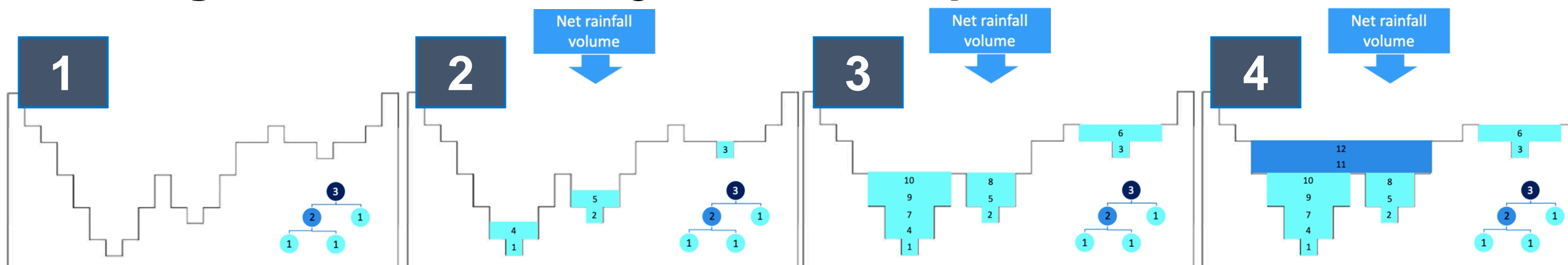


DEM PRE-PROCESSING (STATE OF THE ART)

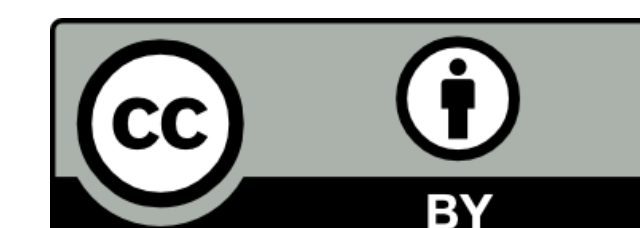
1. Definition of **horizontal hydrological hierarchy**: identification of blue-spots (first-level depressions, **G** and **H**) through **DEM pit-filling**, and corresponding pour-point and contributing watersheds;
2. Definition of **vertical hierarchical structure within each blue-spot**, the higher-level depressions (**A, B, C, D, E**, and **F**), their hierarchical relationship and water-level / volume relationship through **Top-down level-set method**, Wu et al., 2018)

FLOODING PHASE (NEW)

3. Identification of **flooded areas for a given rainfall volume**, partial filling is addressed through a **Bottom-up level-set method**



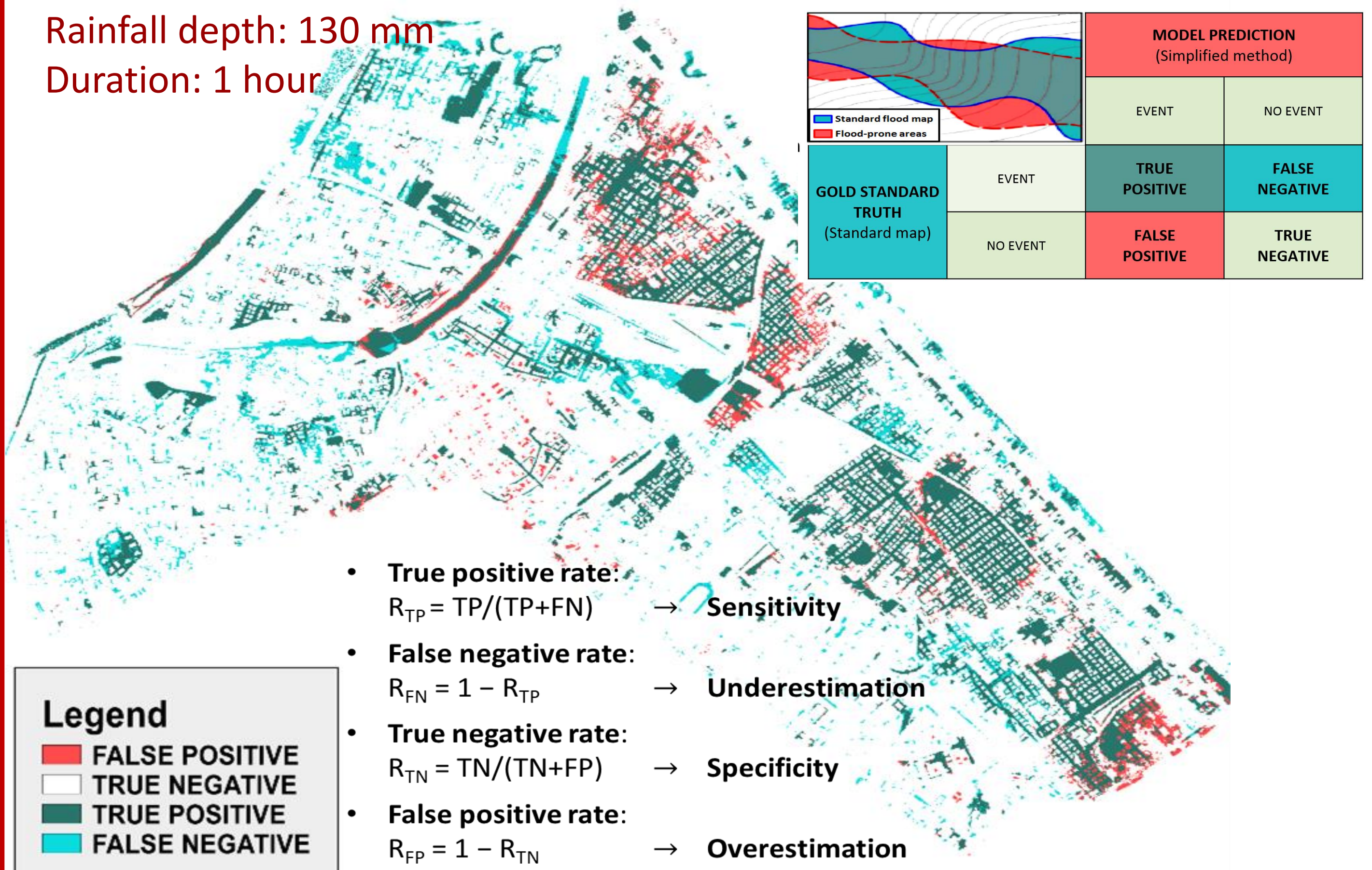
Wu and Lane, HESS, 2017
Wu et al., JAWRA, 2018



3. Safer_RAIN Applications (A & B)

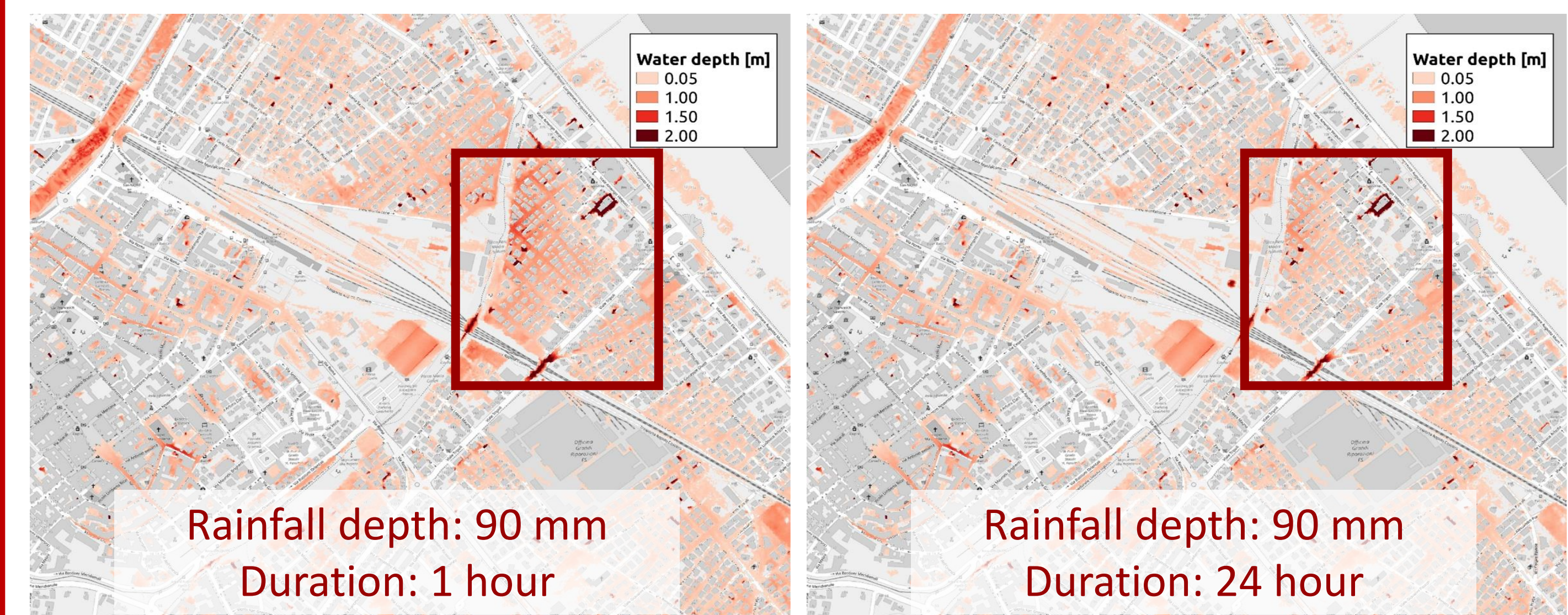
A. Benchmarking on Rimini pluvial flooding

(Available DEM: 2m LiDAR, hypothesis: completely impervious surface) relative to water depth at 180 min simulated through a fully-2D hydrological-hydrodynamic model (<https://ib-humer.at/en/>)



Rainfall [mm]	Sensitivity (TPR)	Underestimation (FNR)	Specificity (TNR)	Overestimation (FPR)
130	70%	30%	98%	2%

B. Green-Ampt pixel-based infiltration



Wrap-up

Limitation: flooding dynamics is not modelled

Advantage: fast-processing and computationally effective (quick tests on multiple hazard scenarios); pixel-based spatially variable net-precipitation; reliable detection of pluvial-hazard hotspots

Efficient tool for urban flood-proofing (e.g. optimal location of detention tanks/ponds)