Spoke : VS1, WP2 - Flood Risk

PhD Days and Marchi lecture
Bari, 11-12 Sept. 2025

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The Impact of Input Data on the Modelling of Pluvial Flooding

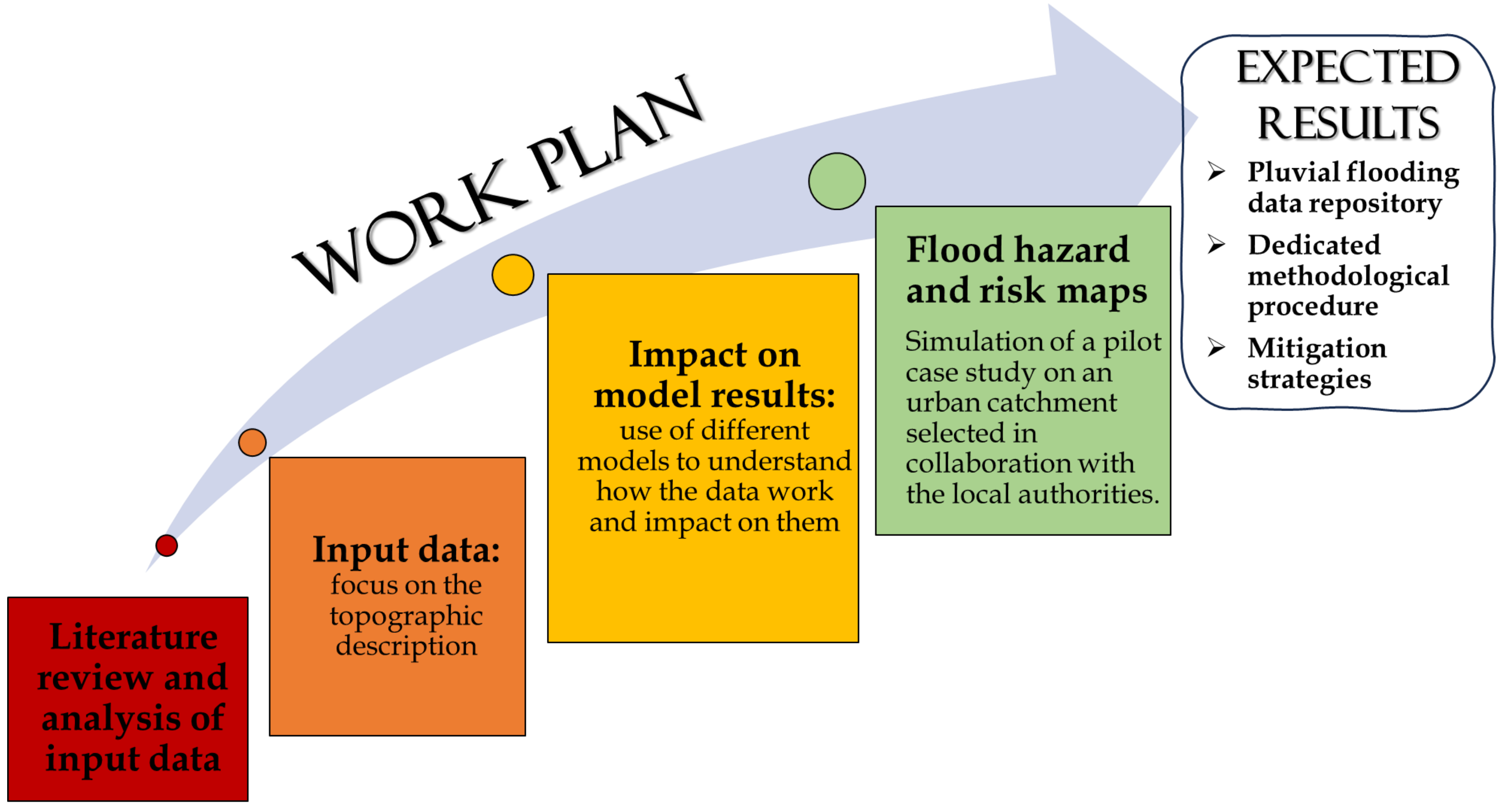
CONTEX

In recent years, climate change has significantly affected environmental systems and increased the frequency of extreme events, making them more difficult to predict and manage. One prominent example is pluvial flooding in urban areas, which has become an escalating concern—not only due to climate change but also as a consequence of rapid urbanization. In response, a wide range of software tools has been developed to model such events, employing one-dimensional (1D) and two-dimensional (2D) hydrodynamic methods, as well as integrated hydrological-hydraulic approaches capable of simulating both sewer and surface flows through coupled 1D/2D models (Henonin et al., 2013; Russo et al., 2015). Despite the availability of increasingly advanced models, several challenges remain—particularly concerning the quality of input data, such as topographic resolution and its integration with urban drainage networks (Acquilino et al., 2025).

Fig.1:Schematic map of the study area with points used for sensitivity analysis. Photo A and B: real event of 24/09/2022 (Primocanale)

CASE STUDY

To better analyze the influence of input data weighting within the models, a simplified case study was selected. The chosen area is a densely built urban zone within the Metropolitan Area of Genoa, Italy, which is frequently affected by pluvial flooding triggered by rainfall events with low return periods (T ranging between 1.5 and 3 years). The study area (Fig. 1) is located in the western part of Genoa, specifically in the Sampierdarena district, and encompasses a flat urban area of approximately 1 km². This district is an urban cluster situated between the commercial port and the left bank of the Polcevera River. The area includes three minor streams—Fosso Bartolomeo, Fosso Promontorio, and Fosso Belvedere—that are partially culverted.



WORK PLAN

Literature review and analysis of input data

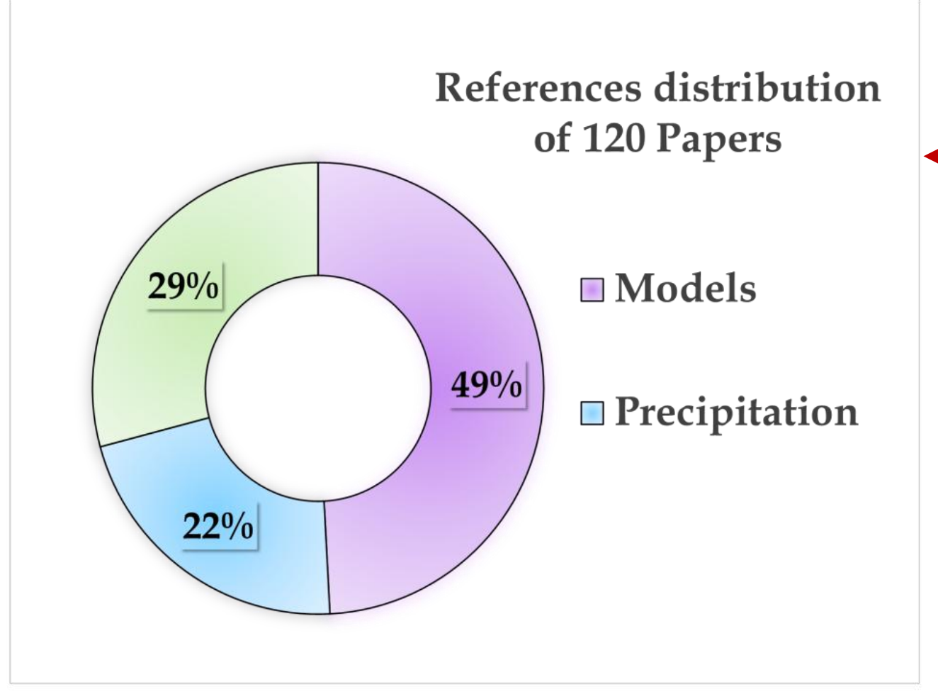
Input data: focus on the topographic description

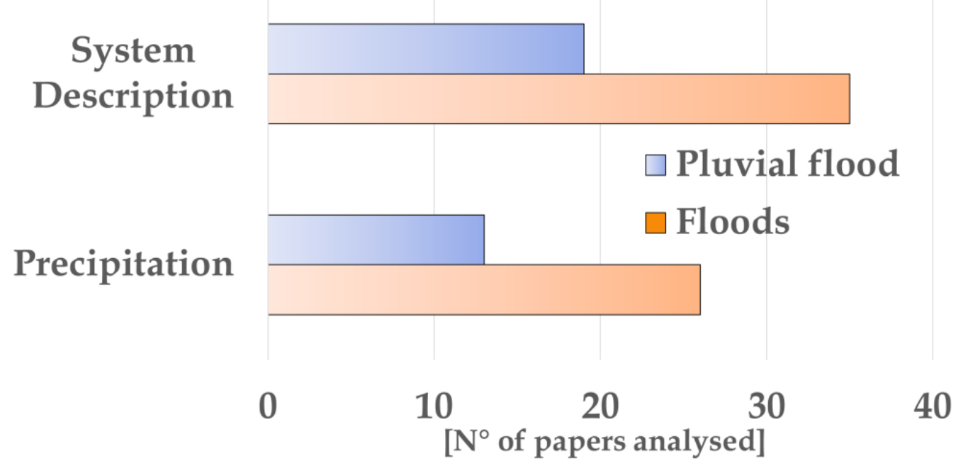
Impact on model results: use of different models to understand how the data work and impact on them

Flood hazard and risk maps
Simulation of a pilot case study on an urban catchment selected in collaboration with the local authorities.

EXPECTED RESULTS
- **Pluvial flooding data repository**
- **Dedicated methodological procedure**
- **Mitigation strategies**

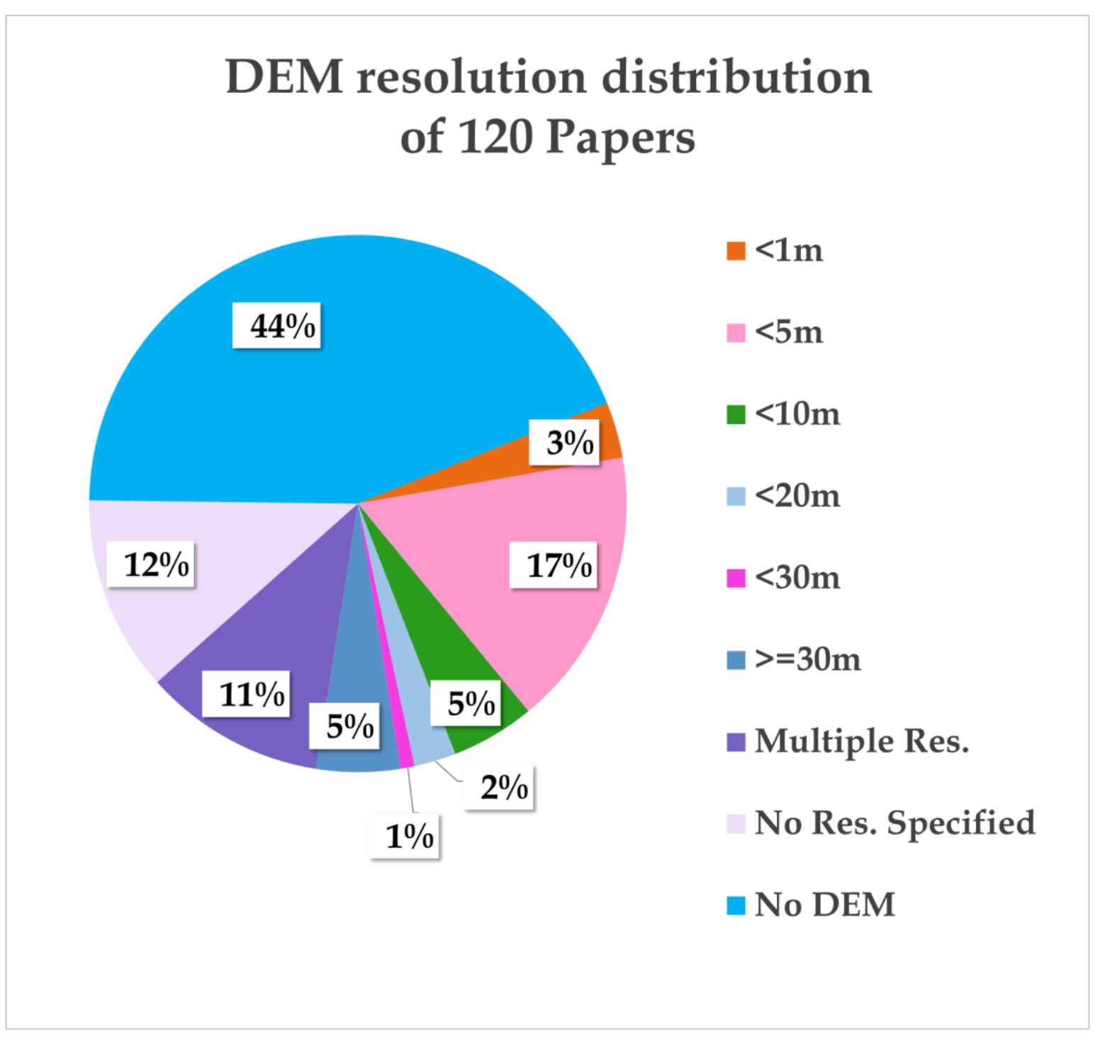
LITERATURE REVIEW and INPUT DATA





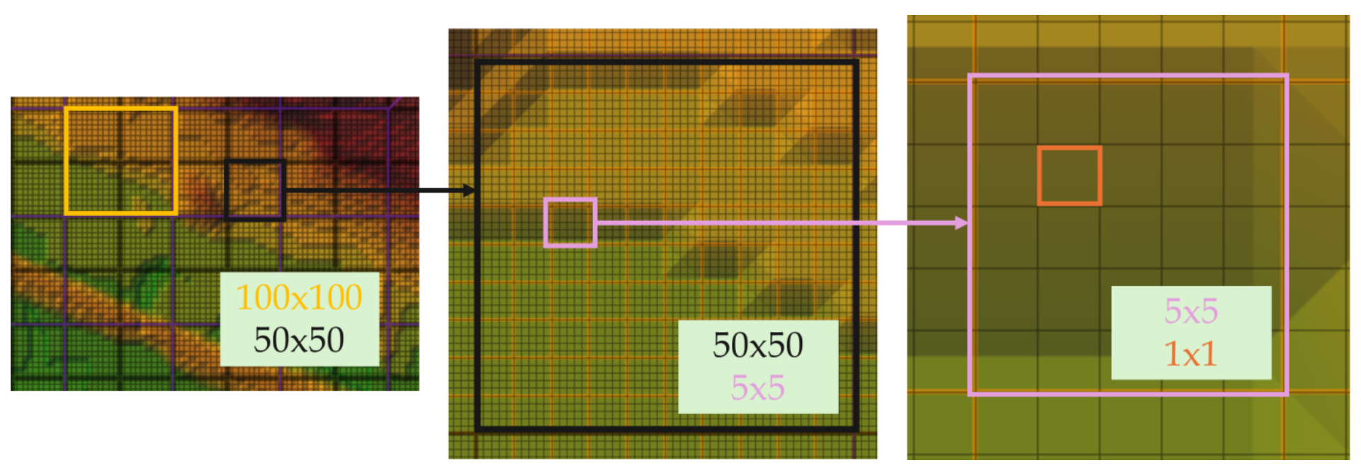
***Left*:** Schematic overview of a literature review (120 articles since 2020), focusing on input data characteristics.

Right: pie chart showing the distribution of topographic data usage in the analyzed studies.



FIRST RESULTS

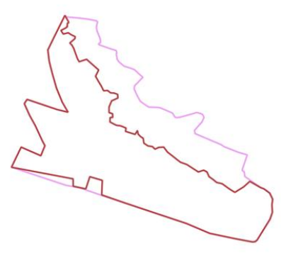
GRID RESOLUTION

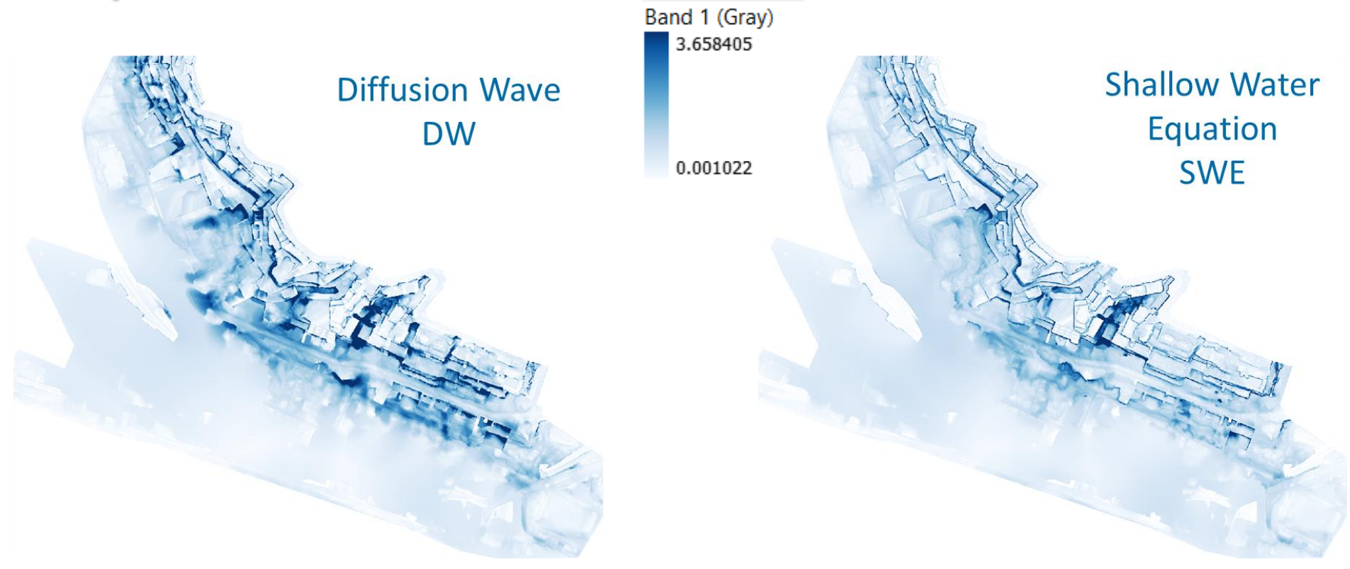


RAS

	Res 5m_grid 100x100	Res 5m_grid 100x100_mod	Res 5m_grid 50x50	Res 5m_grid 5x5	Res 5m_grid 1x1
Minimum value	0.001	0.001	0.001	0.001	0.001
Maximum value	4.363	3.852	4.655	3.658	4.233
Mean value	0.408	0.466	0.404	0.317	0.563

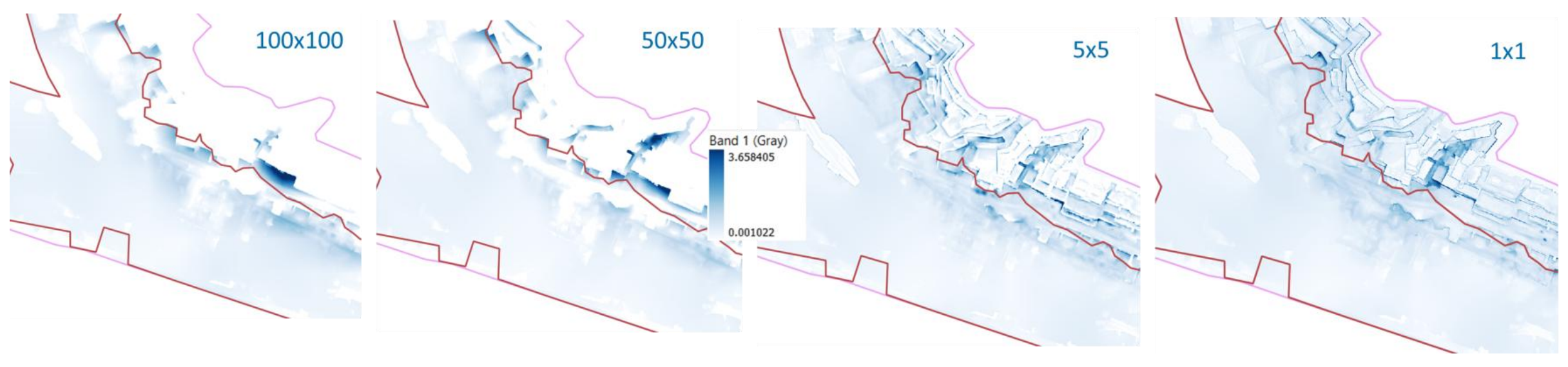
EQUATIONS





	TOT AREA		FLAT AREA	
	Res 1m_grid 1x1_DW	Res 1m_grid 1x1_SWE	Res 1m_grid 1x1_DW	Res 1m_grid 1x1_SWE
Minimum value	0.001	0.001	0.001	0.001
Maximum value	9.150	6.933	4.459	3.931
Mean value	0.451	0.392	0.351	0.323

GRID RESOLUTION: focus on flat area



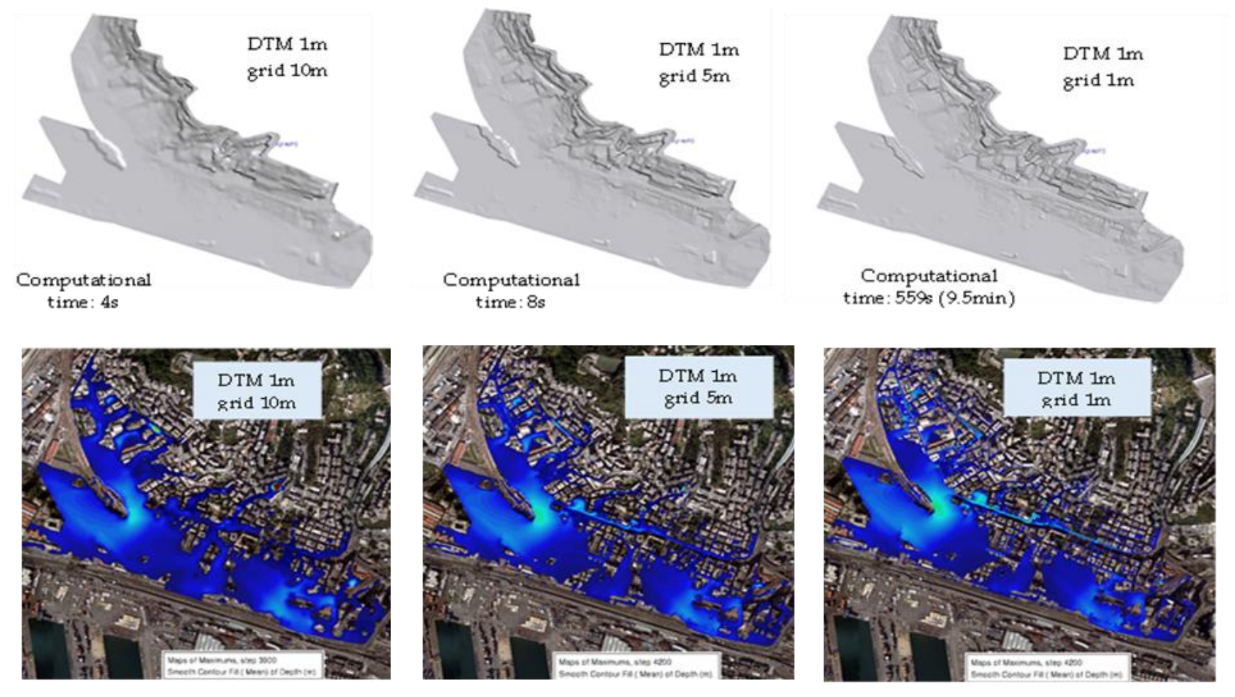
	Res 1m_grid 100x100	Res 1m_grid 50x50	Res 1m_grid 5x5	Res 1m_grid 1x1
Minimum value	0.001	0.001	0.001	0.001
Maximum value	2.700	3.084	3.370	3.931
Mean value	0.367	0.272	0.305	0.323

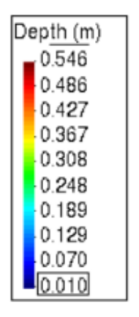
Iber

WHOLE AREA
(deflux area 0.96 km²)

Same DTM, different grid

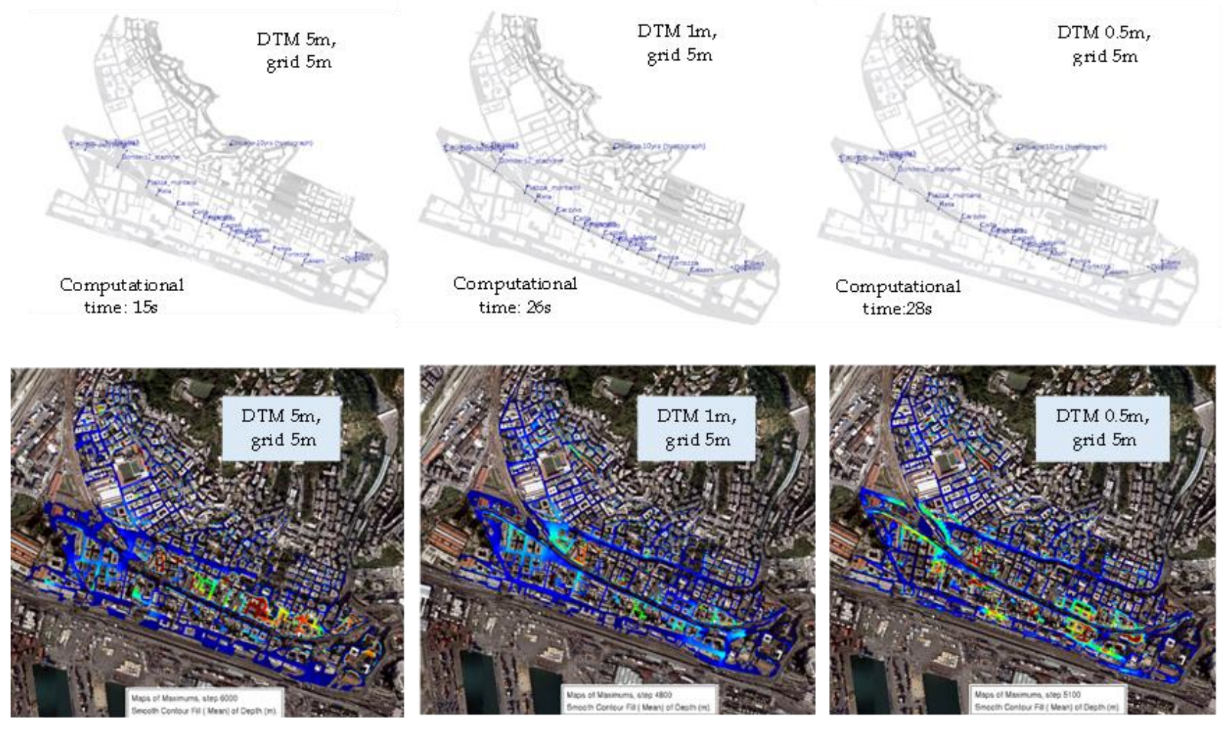
SENSITIVITY ANALYSIS
(Fig.1, points 2,3,4,5)





BUILDINGS AS HOLES
(deflux area 0.53 km²)

Same grid, different DTM. Simulation with streets under the bridge



FUTURE STEPS

In the near future, efforts will focus on integrating surface runoff simulations (2D), obtained using the IBER software, with subsurface flow modelling (1D), developed in SWMM by a separate research group (URCA! project). Subsequently, the results will be employed to simulate hazard and risk maps.

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