Scenario analysis on the impact of green infrastructure on urban pluvial flood mitigation

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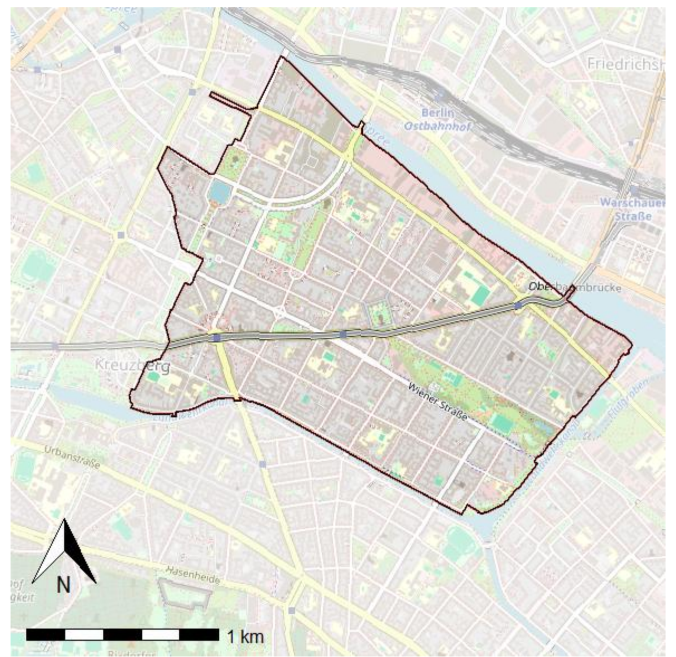
2) METHODS

Study area

- Berlin, Germany
- 3.3 km²
- Heavily sealed

Oranienstraße, Berlin.



Study area in Friedrichshain/Kreuzberg, Berlin (base map OpenStreetMap).

Rain scenarios

- 1h duration, Euler-II distribution
- KOSTRA [2] return periods: 1, 5, 10, 20, 50, 100 years (15, 25, 30, 35, 43, 49 mm)
- Extreme: 100 mm

Green and grey infrastructure scenarios

- Bio retention (max = 10%, med = 5%)
- Green roof (max = all buildings, med = 50% buildings)
- Pervious pavement (max = 50% roads, med = 25% roads)
- Combined (green roof max + bio retention max, green roof max + pervious pavement med)
- Gully (street drainage 16 mm/h)

The model chain

➢ **Hydrology: Storm Water Management Model**

Urban runoff generation based on the SCS Curve Number method and the modules for green infrastructure

➢ **Hydrodynamics: TELEMAC-2D**

Surface runoff concentration and resulting flood water depths and flow velocities [3]

➢ **Building damage: Flood Damage Estimation Tool**

A recursive partitioning tool developed with survey data representative of building damage caused by pluvial floods

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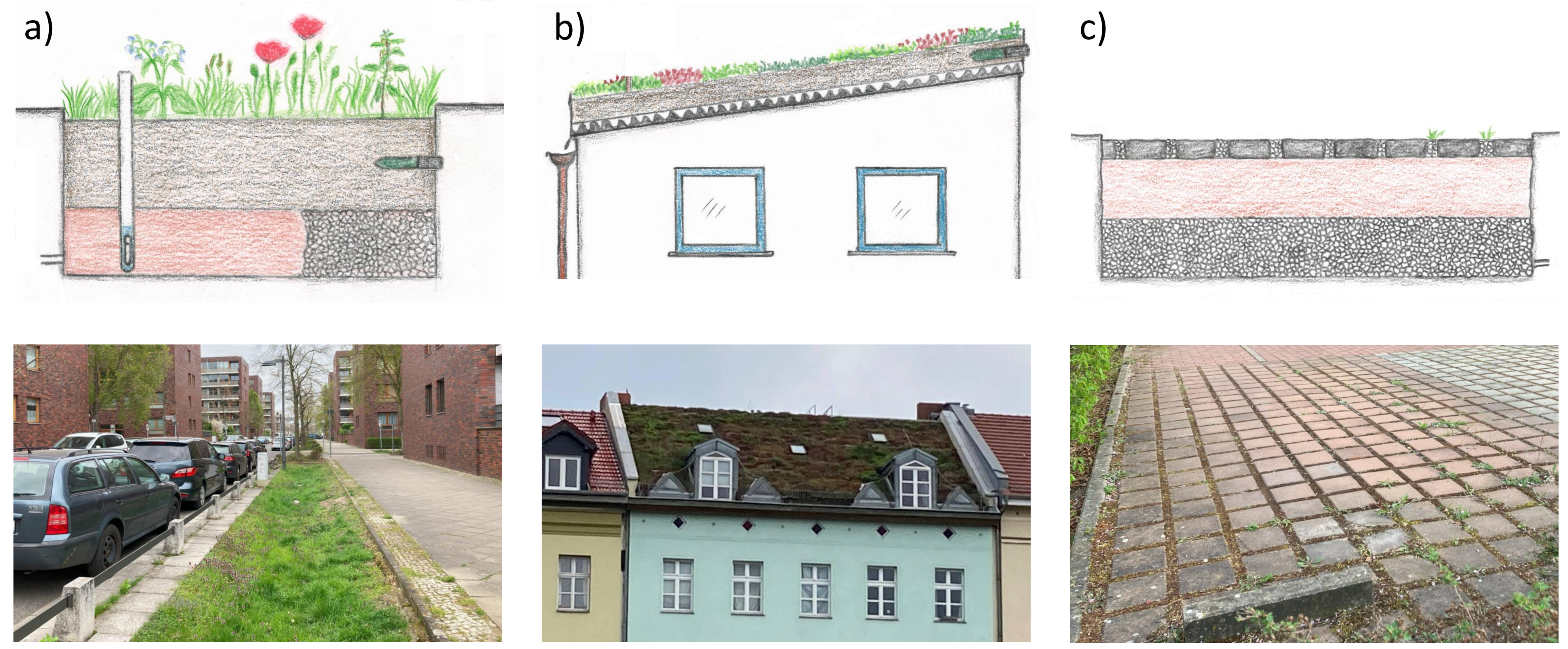
1) MOTIVATION

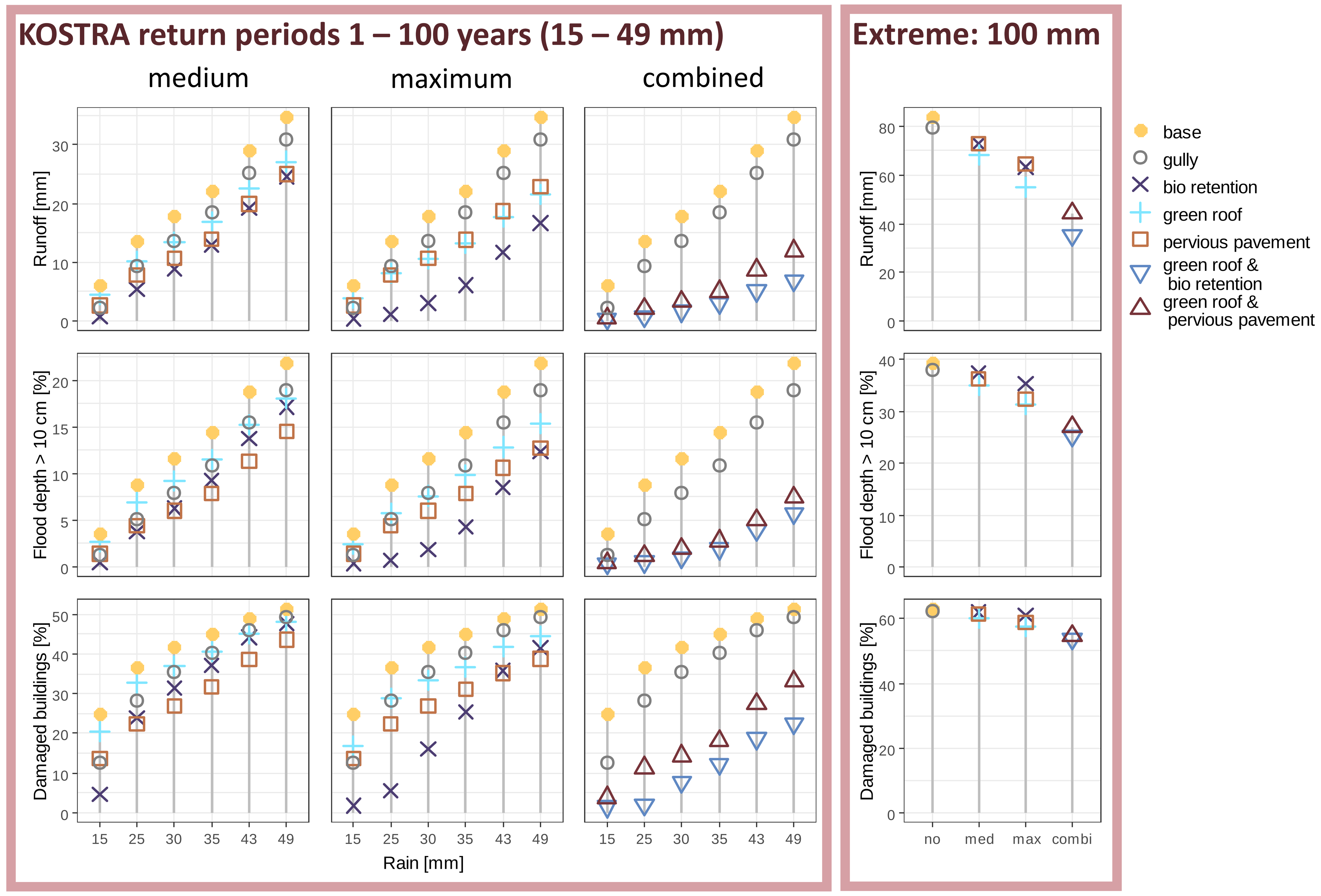
- 30 – 40 combined sewer overflows per year
- Green infrastructure measures can reduce urban flood risk by increasing infiltration, water storage and evapotranspiration
- Comparability in the existing literature is limited [1]

- **How much flood mitigation can we achieve?**
- **Use different mitigation indices: runoff, flood depth and building damage**
- **How does the impact respond to increasing rain totals?**
- **Limited urban space: what about space efficiency?**



Conceptual drawings and exemplary photos from Berlin showing a) bio retention, b) green roof and c) pervious pavement.

3) RESULTS



Comparing runoff, area with flood depth exceeding 10 cm and percentage of damaged building for the base scenario, green and grey infrastructure combined with different rainfall events.

4) CONCLUSIONS

The greener, the better

➢ The combined scenario green roof max + bio retention max occupies with 36% the highest percentage of the study area and achieves the highest absolute and relative reductions at all 3 modelling steps

➢ Especially for the higher rain totals, the combination scenarios show the best mitigation

➢ Most of the green infrastructure scenarios outperform the gully scenario

Nonlinear propagation of mitigation impact

➢ While the absolute runoff reduction is highest at the 100 mm event, flood depth reduced the most at 49 mm and building damage at 25 mm

Relative impact decreases with rain total

➢ This applies to all green infrastructure scenarios, however the level and its steepness differ among them

➢ Both bio retention scenarios can compete with the combined scenarios for the smallest events, however the relative reduction decreases strongly with increasing rain total

Space efficiency vs. maintaining usability

➢ Bio retention shows the highest mitigation per m²

➢ Green roofs and pervious pavement do not require extra space

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[1] Dobkowitz et al. (2025). Water retention by green infrastructure to mitigate urban flooding: a meta-analysis. Urban Water Journal.
[2] DWD (2020) Starkregenkatalog des Deutschen Wetterdienstes (www.openko.de).
[3] De Vos et al. (2024). Establishing Improved Modeling Practices of Segment-Tailored Boundary Conditions for Pluvial Urban Floods. Water.

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