Introduction and scope

Cities are the hotspot for impacts and risks associated with climate change, but they are also crucial elements in the solution\(^1\). High risks of heatwaves, storms, droughts, and floods, causing casualties, losses, and damages. Integrate Nature-based solutions (NBS) in cities can help to safeguard urban biodiversity, provide multiple services to reduce climate risks and improve human well-being. Urban NBS can be parks, vegetated streets, green roofs. They contribute to flood regulation increasing the soil capacity to retain water and control storm-water runoff and peak flow. To increase the expected benefits, they should be strategically distributed and connected across the city.

This study aims to assess the effects of NBS (i.e., urban green areas) on pluvial flood risk in the city of Milan (Italy) by:

1. Analysing the existing network of green areas
2. Defining potential scenarios of network improvement, meant to increase connectivity, accessibility, and flood regulation.
3. Assessing the impacts of additional green spaces, in terms of economic damage and population exposed.

Analysis of existing network

**ESM 2017**\(^2\) (res 2.5m) used to map all existing urban green areas

Reclassified on a 100m-grid, cells with >25% of green coverage are considered part of the network.

Morphological Spatial Pattern Analysis\(^3\) to characterise green elements as nodes and links of the network.

Integrated Index of Connectivity\(^4\) to assess network connectivity and nodes contribution to the network.

Network improvement scenarios

Suitable areas for green conversion selected according to walking distance criteria: a green area every 5-10 mins.

3 scenarios of conversion:
- Green Buildings (GB): establish green roofs
- Green Spaces (GS): convert open spaces to green spaces
- Green City (GC): implementing both green roofs and spaces

Different percentage of conversion (25%, 50%, 75%, 100%) considered

Green Conversion = change in soil permeability according to the share of new potential green coverage

Criteria to characterise suitable areas and prioritise areas of interventions:
- Cumulative damage to buildings\(^5\)
- Residential population\(^6\)
- Share of open space convertible to green\(^7\)
- Share and impacts of potential green roofs\(^7\)

Criteria combined to rank areas to minimize direct damages to buildings and population exposed to floods:

**Main findings**

1. The city has a developed network of green areas in the peripheral zones of the city. Need to improve green network in the city centre. Overall low connectivity value (ICC = 0.1)
2. All scenarios of network improvement contribute to create connections across the city, already at the 25% green conversion.
3. In all scenarios of green conversion, the expected damage to buildings and population exposed – especially at higher class of water depth – decrease at the increasing of green coverage for all rain intensities. Spatially, areas with higher impacts for population exposed are mostly in the north, for damage top ranked areas are most distributed, but not in the very central zone.

References: