A decision approach to evaluate the design and implementation of green infrastructures in urban environments

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URBAG Integrated System Analysis of Urban Vegetation and Agriculture

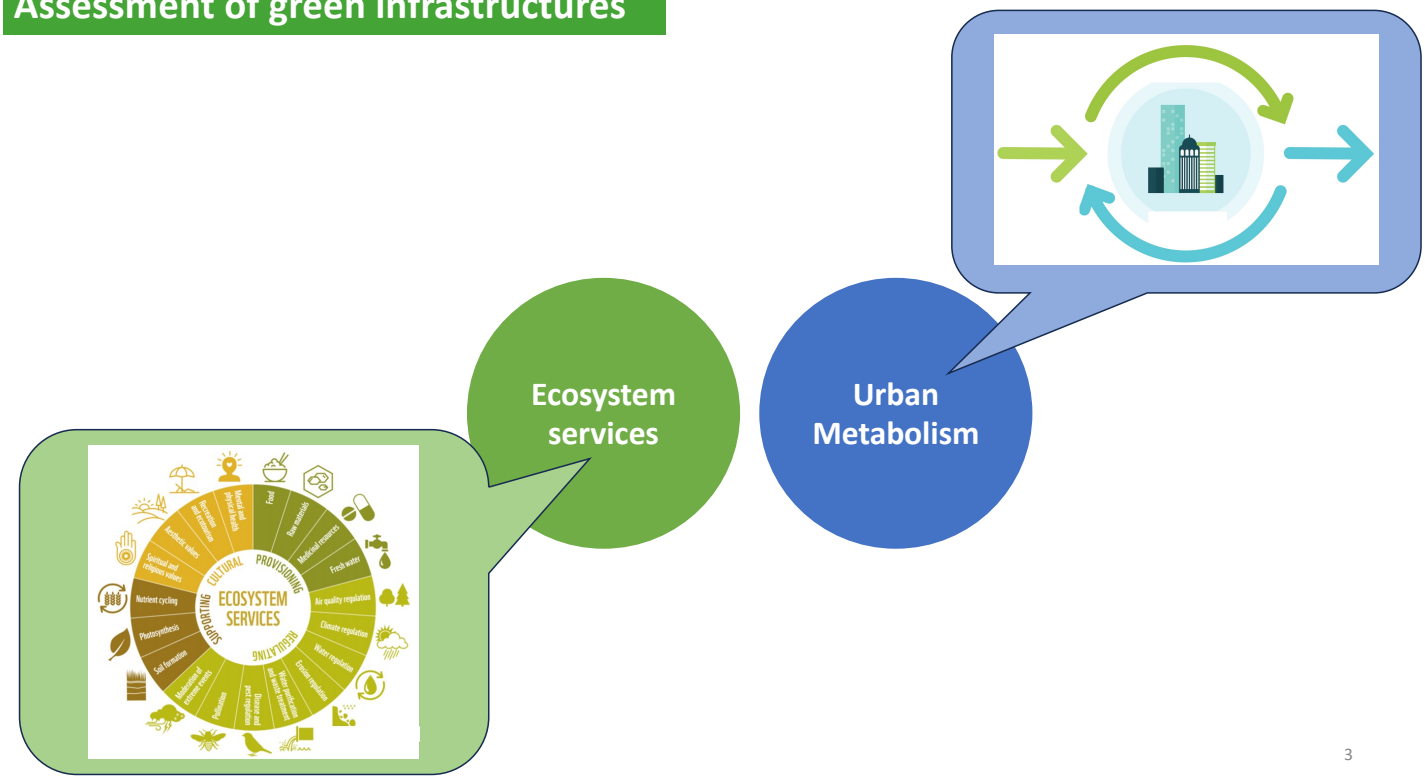
Green infrastructure: *a network of (semi-)natural areas which are protected and enhanced to deliver ecosystem services, while also benefiting biodiversity and society more widely.*





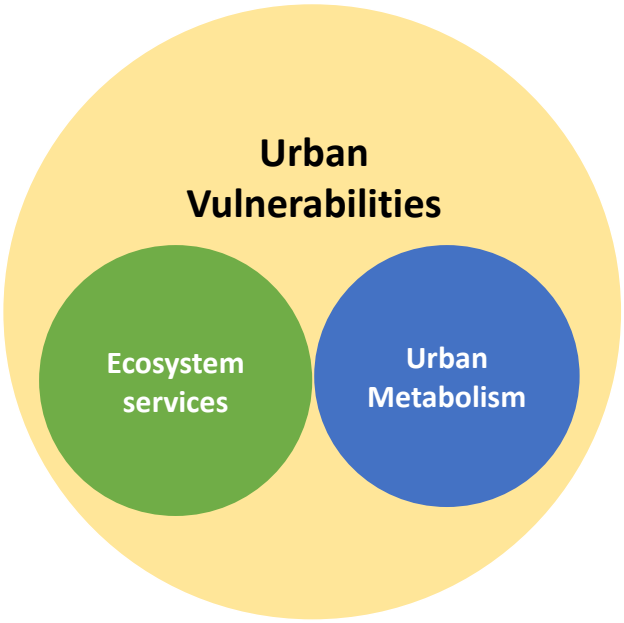



Assessment of green infrastructures



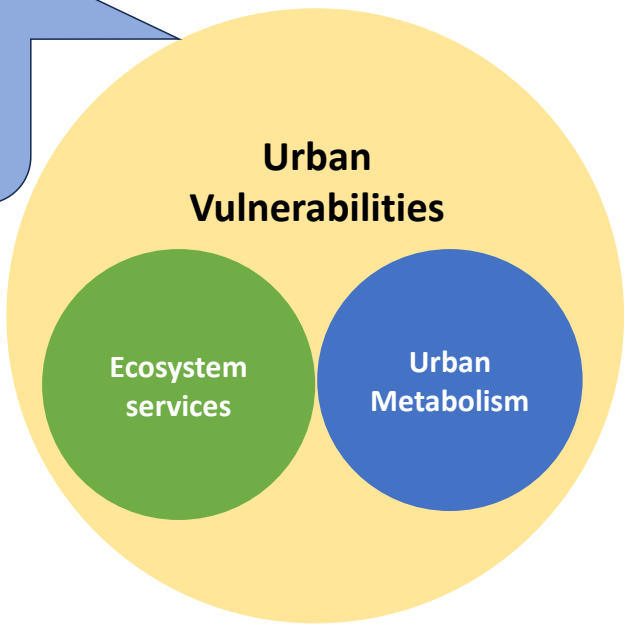
Assessment of green infrastructures

Vulnerability = f (exposure, sensitivity)



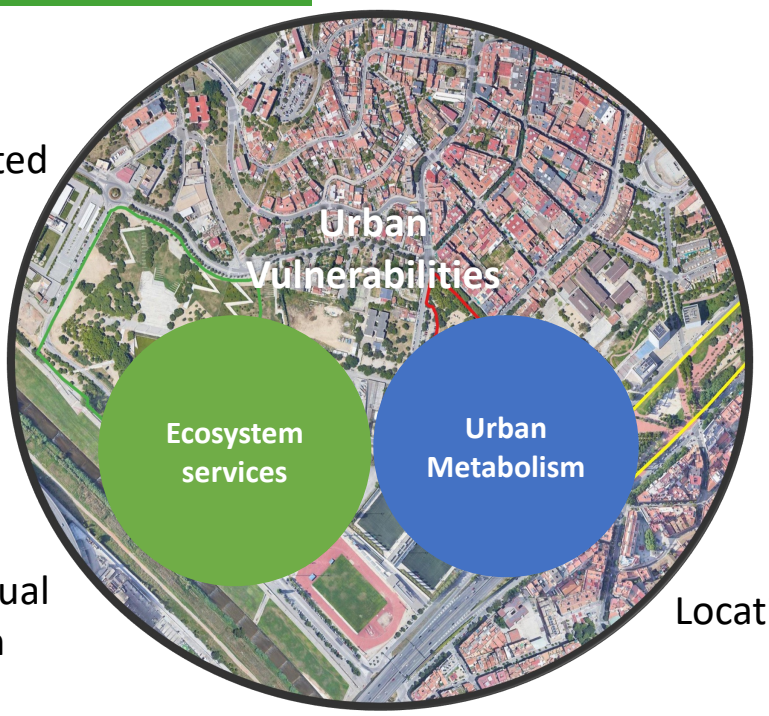
Assessment of green infrastructures

To what degree does the green infrastructure meet the environmental and social needs?



Assessment of green infrastructures

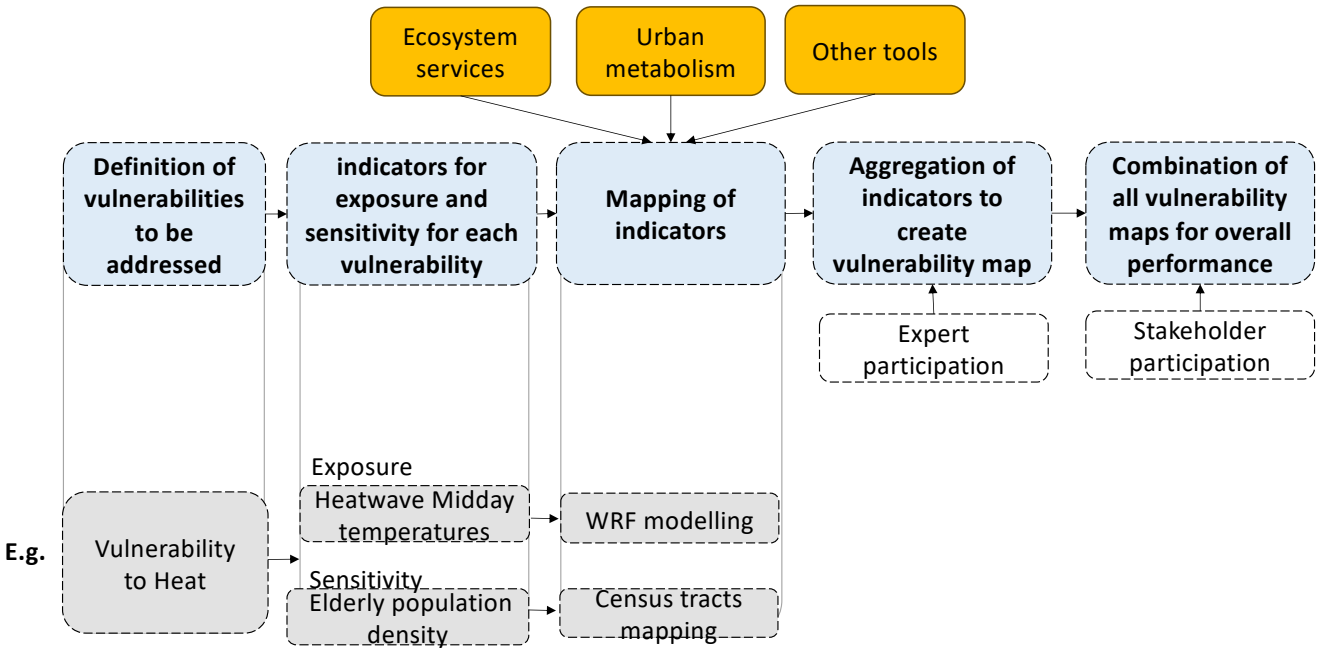
vulnerabilities are unevenly distributed



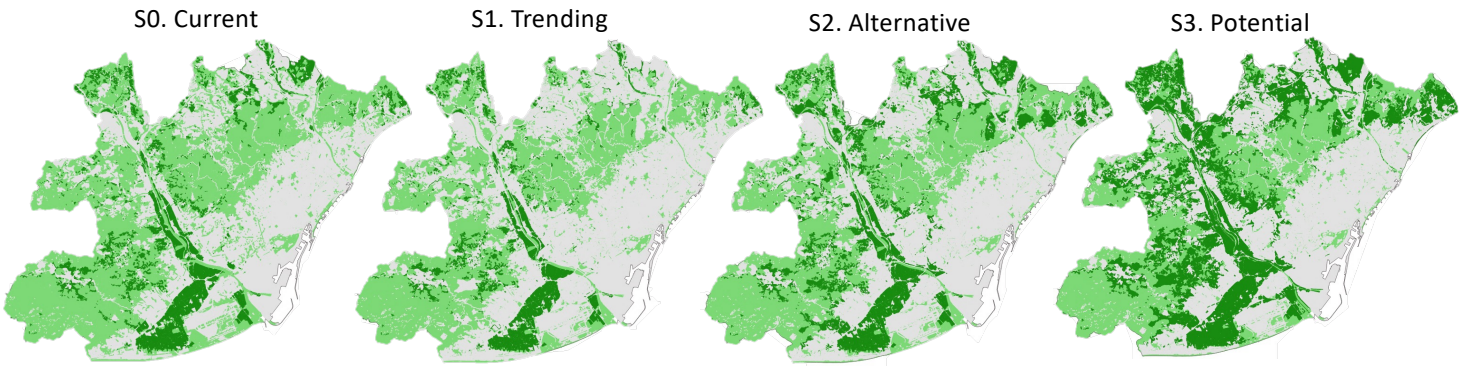
There are unequal needs for green infrastructure

Location matters

Integrated System Analysis of Urban Vegetation and Agriculture



Case study: urban agriculture in the Metropolitan Area of Barcelona



S0. Current	
Agriculture	8%
Other green	45%
Urban	47%

S1. Trending	
Agriculture	6%
Other green	40%
Urban	54%

S2. Alternative	
Agriculture	12%
Other green	40%
Urban	48%

S3. Potential	
Agriculture	20%
Other green	34%
Urban	46%

Case study: urban agriculture in the Metropolitan Area of Barcelona

Vulnerabilities

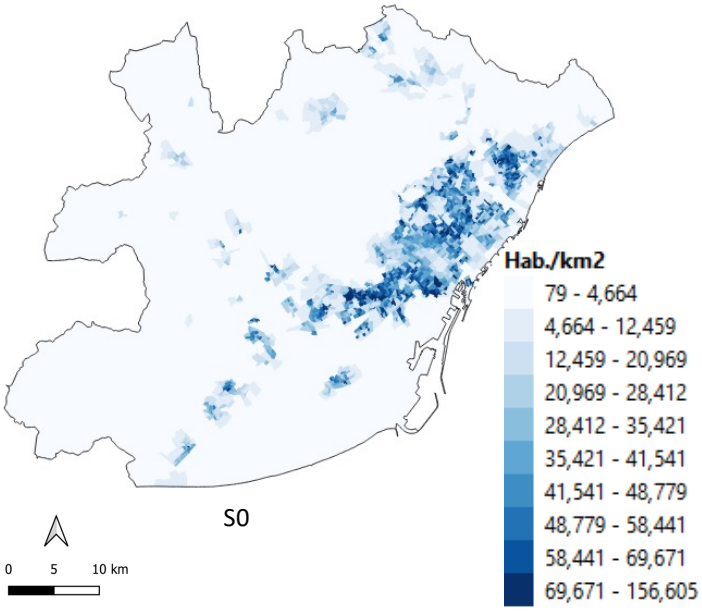
- Vulnerability to Heat (HEAT)
- Vulnerability of lacking recreational spaces (RECR)
- Vulnerability of biodiversity (BIOD)
- Vulnerability of lack of local food (FOOD)

Urban policies

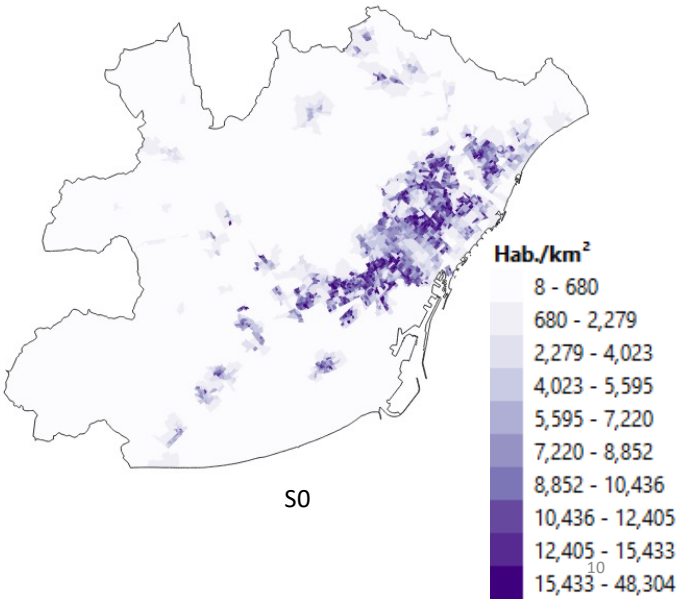
Case study: Vulnerability to Heat

Sensitivity indicators

Population density



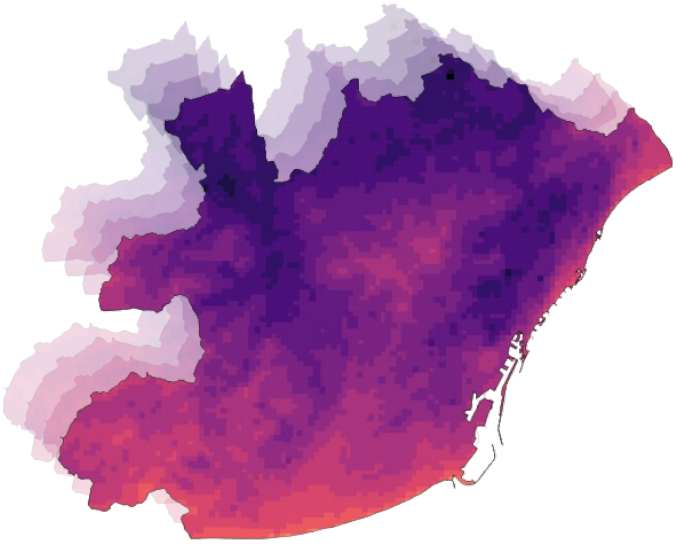
Elderly population



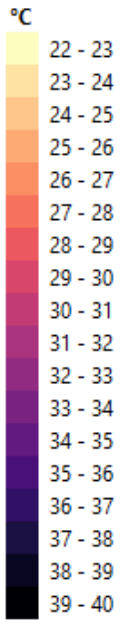
Case study: Vulnerability to Heat

Exposure indicators

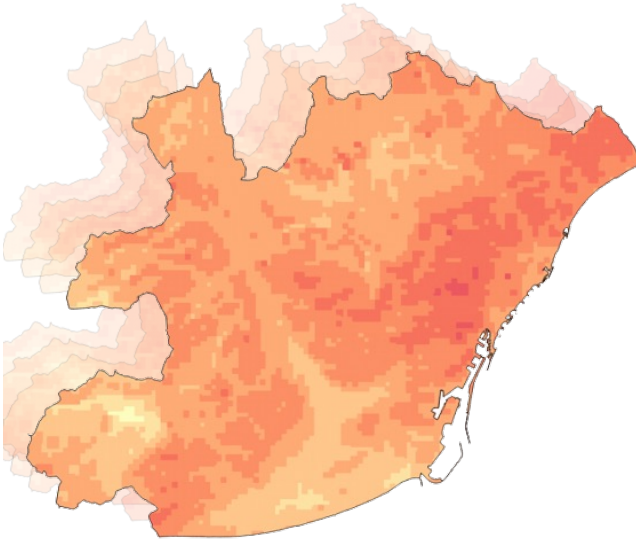
Heatwave temperatures 1-4pm



S0, S1, S2, S3



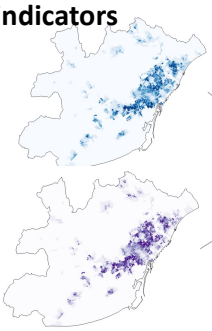
Heatwave temperatures 9pm-7am



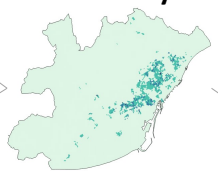
S0, S1, S2, S3

Case study: aggregation of indicators

Normalized sensitivity indicators



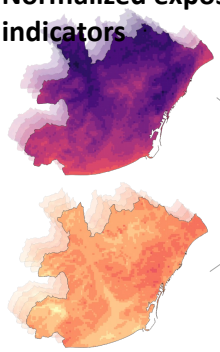
Aggregated Sensitivity



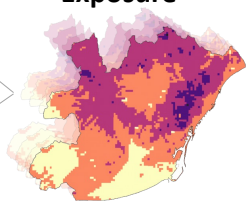
Expert weights

50%

Normalized exposure indicators

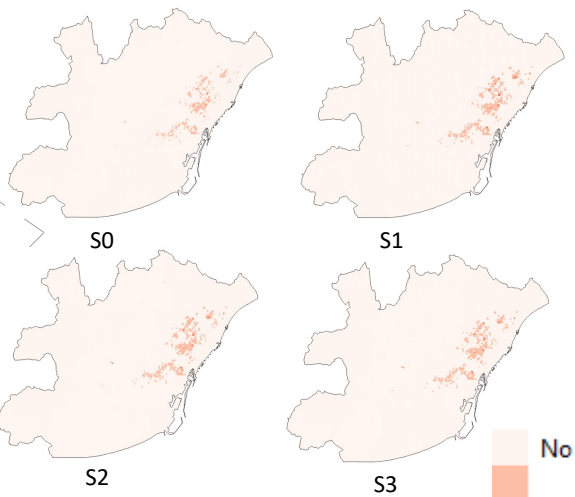


Aggregated Exposure



50%

Vulnerability to heat



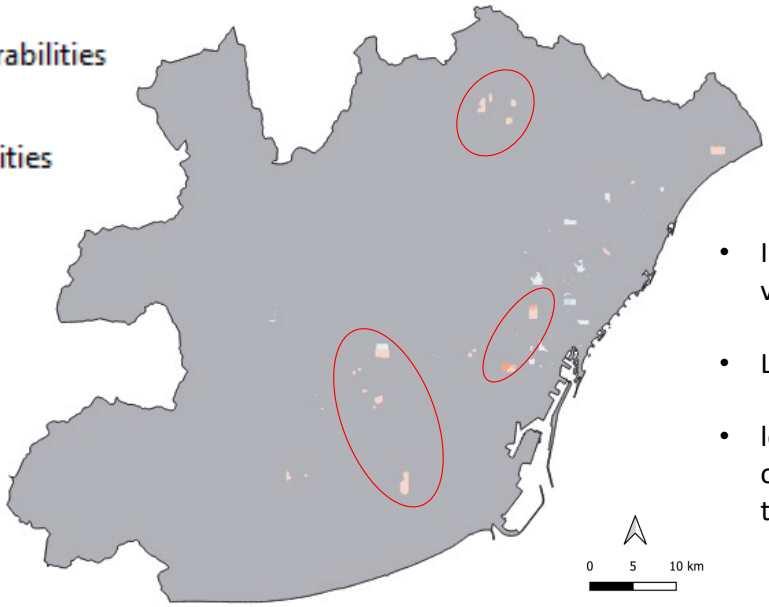
Case study: vulnerability to HEAT

Reduced vulnerabilities

No change in vulnerabilities

Increased vulnerabilities

From reference S0 to trending S1 scenario



- In general, S1 increases vulnerabilities to heat.
- Less than 0.5ºC
- low sensitivity areas that overlap with increases in temperatures

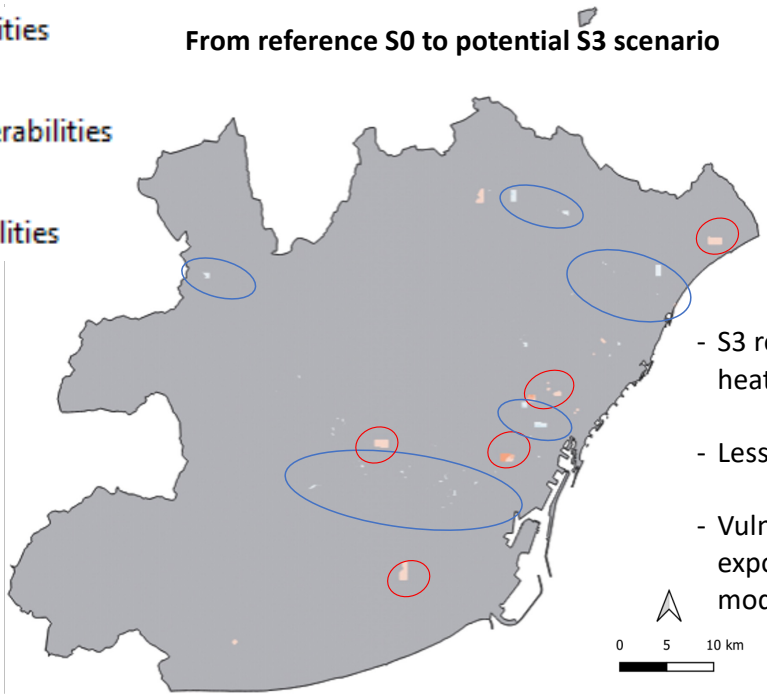
Case study: vulnerability to HEAT

Reduced vulnerabilities

No change in vulnerabilities

Increased vulnerabilities

From reference S0 to potential S3 scenario



- S3 reduces vulnerabilities to heat
- Less than 0.5ºC
- Vulnerabilities decrease when exposure is reduced in moderately sensitive areas

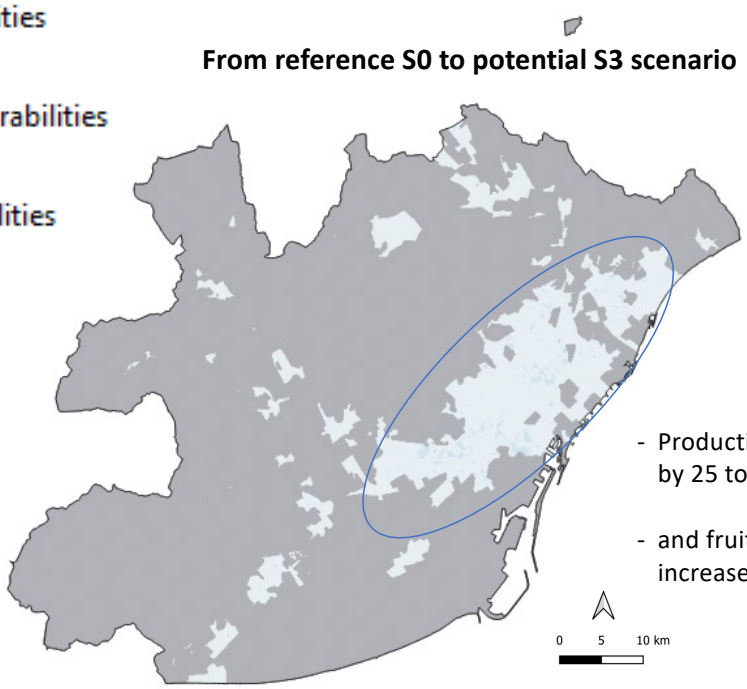
Case study: vulnerability to lack of local FOOD

Reduced vulnerabilities

No change in vulnerabilities

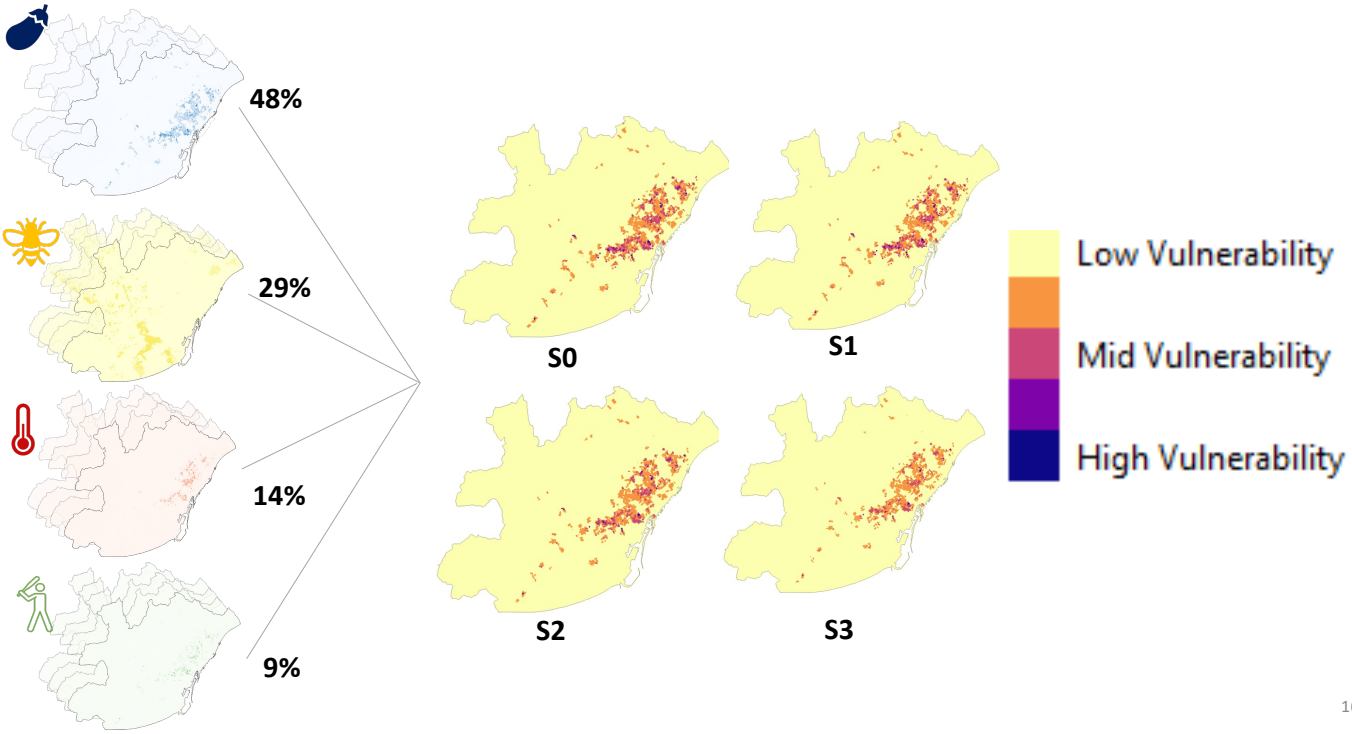
Increased vulnerabilities

From reference S0 to potential S3 scenario

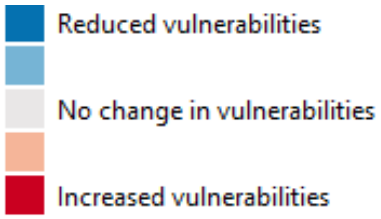


- Production of vegetables increases by 25 tons (increase of 64%)
- and fruits increase by 14 tons (140% increase)

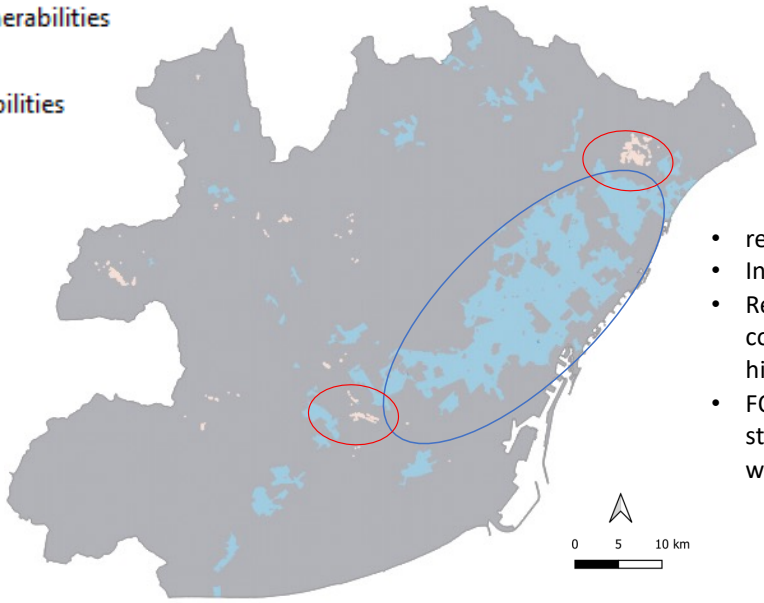
Case study: aggregation of vulnerabilities with stakeholder weights



Case study: aggregated vulnerabilities



From reference S0 to potential S3 scenario



- reduces overall vulnerabilities
- Increases vulnerability in BIOD
- Reduction in vulnerabilities is concentrated in Barcelona city with highest population density
- FOOD ranked highest importance by stakeholders, so FOOD vulnerability was reduced the most by S3

Case study: urban agriculture (UA) in the Metropolitan Area of Barcelona

HEAT: Urban agriculture has a modest effect on reducing HEAT vulnerability. Reductions in temperature do not coincide with sensitive areas, resulting in minor alterations in vulnerabilities.

RECR: Urban agriculture has a low effect on reducing RECR vulnerability. Urban agriculture is not evenly distributed nor is it close to highly dense areas which are most prone to RECR vulnerability.

BIOD: Urban agriculture results in a low increase of BIOD vulnerability. Phosphorous discharges increase and spatially align with sensitive areas, but the impact is very low given the short residence time of P in fresh water for the AMB.

FOOD: Urban agriculture significantly reducsed vulnerability oin FOOD. Even when high sensitivity areas does not coincide with the increase in food production, vulnerabilities are reduced as overall food production in city is considered for the spatial analysis.

Aggregated vulnerability: improved by increases in urban agriculture based on stakeholders' perception (FOOD being the most relevant vulnerability / RECR the least relevant).

Results: methodological advantages

- Novel methodology that includes: (1) changes in spatially explicit vulnerabilities and (2) urban metabolism and ecosystem services approaches.
- A way to evaluate how potential green infrastructure scenarios address urban vulnerabilities.
- Suitable for urban policy and governance for its capacity to relate the objectives of urban agendas with impact assessments.
- Versatile, as the URBAG framework can be applicable to other green infrastructures besides urban agriculture.

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Thank you

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