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COM A CIÊNCIA
E TECNOLOGIA
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2-4 Centro de
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Understanding how urban green infrastructure and its biodiversity can be used to optimize the provision of Ecosystem Services towards more liveable and resilient cities

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Cristiana Aleixo | Paula Matos | Margarida Santos-Reis | Cristina Branquinho

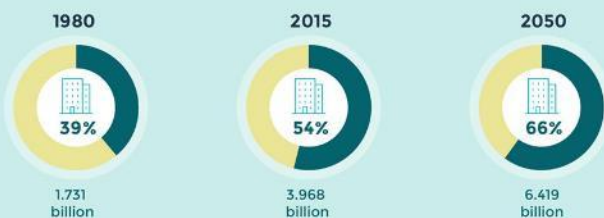
World Population



1980		4.439 billion
2014		7.349 billion
2050		9.725 billion

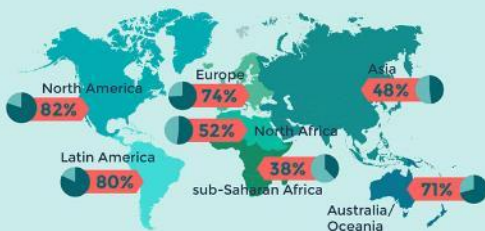
Source: United Nations, Department of Economic and Social Affairs, Population Division (2014).
World Urbanization Prospects: The 2014 Revision, custom data acquired via website

Share of the Urban Population Worldwide



Source: United Nations, Department of Economic and Social Affairs, Population Division (2014).
World Urbanization Prospects: The 2014 Revision, custom data acquired via website

Share of Urban Population on all Continents



Source: United Nations Department of Economic and Social Affairs (UNDESA) 2016, online database

NEW URBAN AGENDA





SUSTAINABLE DEVELOPMENT KNOWLEDGE PLATFORM

SUSTAINABLE DEVELOPMENT GOAL 11

Make cities and human settlements inclusive, safe, resilient and sustainable





Sustainable cities and communities



Challenges

The **RAPID** and often **UNPLANNED URBANIZATION** witnessed worldwide has led to **INCREASED PRESSURE ON THE ENVIRONMENT**



Our cities account for up to **80% OF ENERGY CONSUMPTION** as well as **75% OF GLOBAL WASTE AND CARBON EMISSIONS**

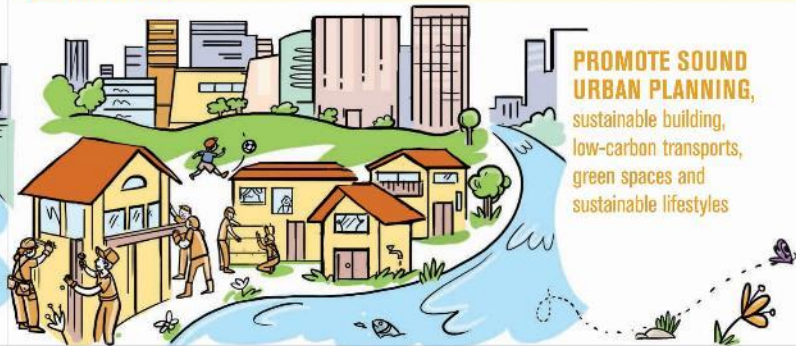


Due to the high concentration of people, infrastructure, housing and economic activities, **CITIES ARE PARTICULARLY VULNERABLE** to climate change and natural disasters



Solutions

PROMOTE SOUND URBAN PLANNING, sustainable building, low-carbon transports, green spaces and sustainable lifestyles



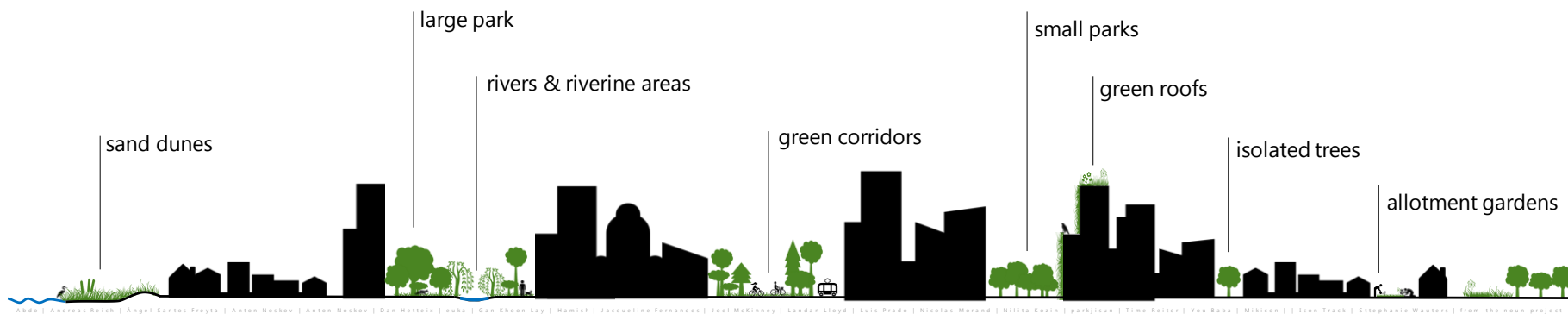
INVEST IN RENEWABLE ENERGY, waste management, sustainable and green infrastructure



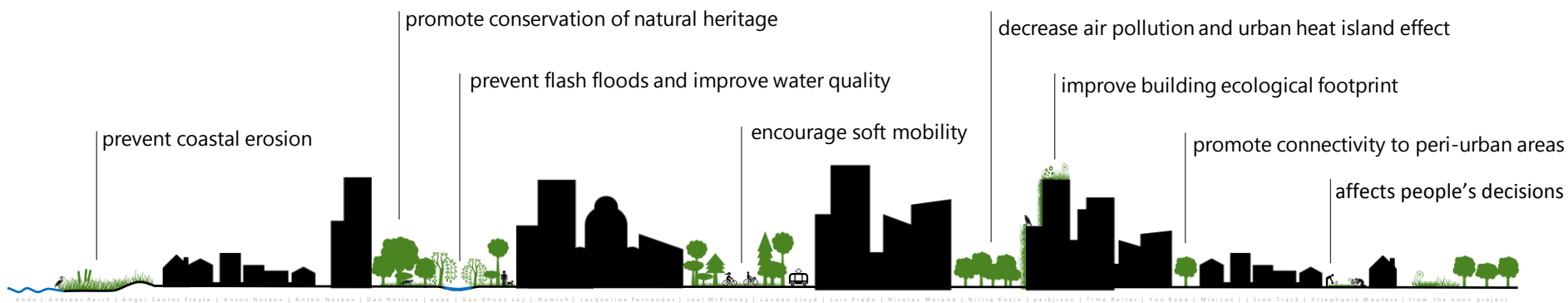
PROTECT CITIES - which are important social, cultural and economic centres - from environmental and climate threats



cities green and blue infrastructure

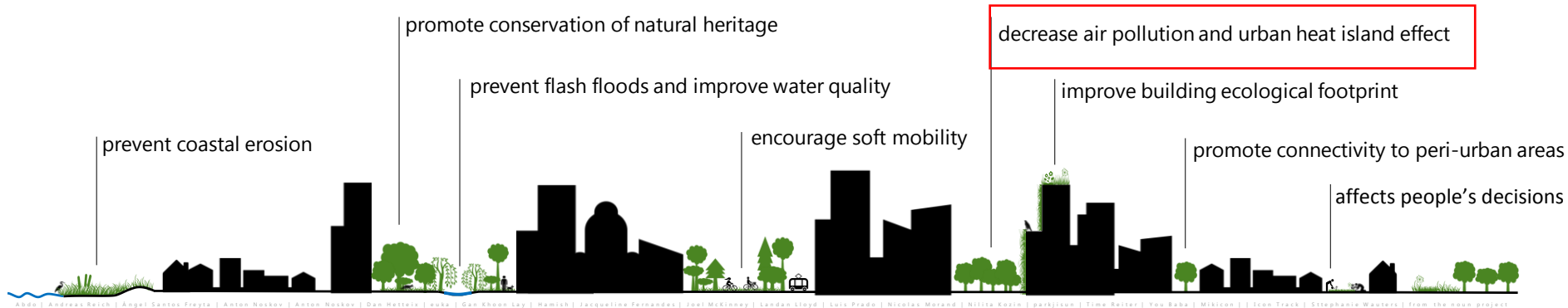


restoring or reclaiming land to promote ecosystem services in urban areas to fulfil SDG 11 targets



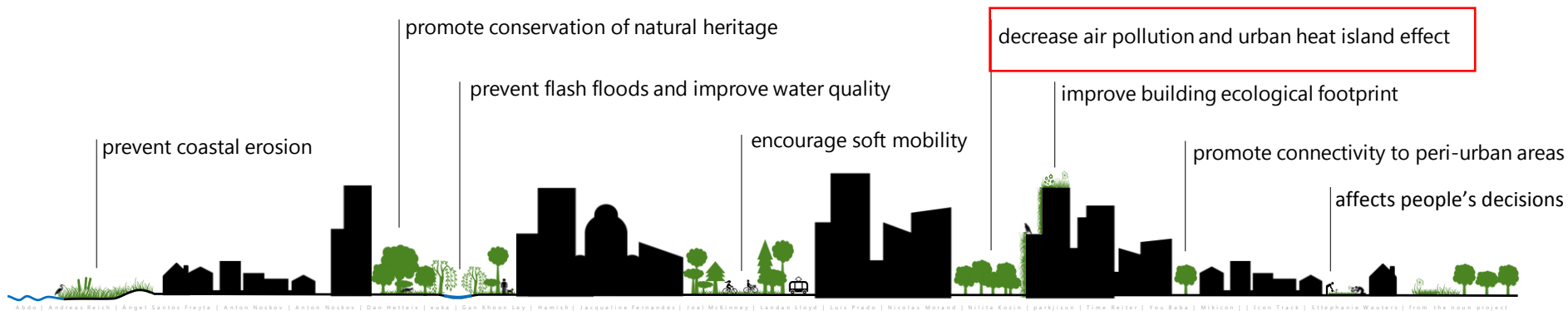
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2. green areas promote air quality
3. people require green areas
4. increasing ecosystem connectivity in urban areas
5. trade-offs in ecosystem services

restoring or reclaiming land to promote ecosystem services in urban areas to fulfil SDG 11 targets



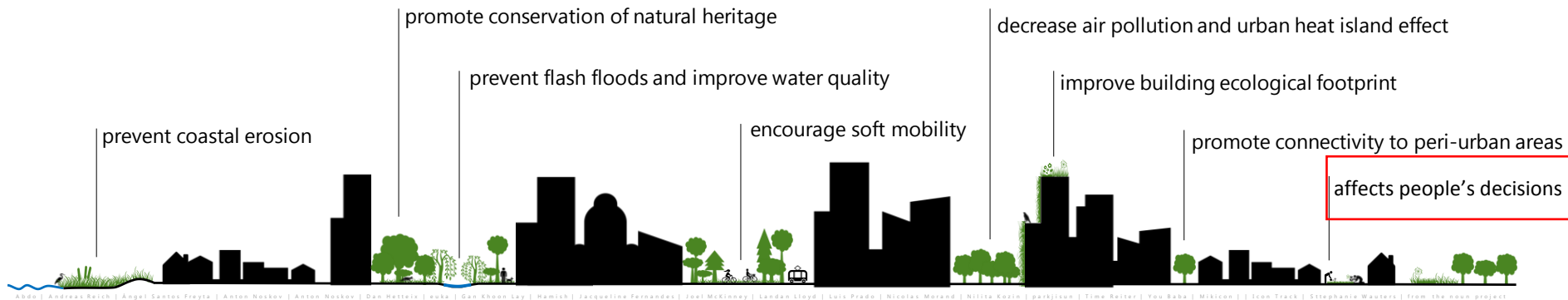
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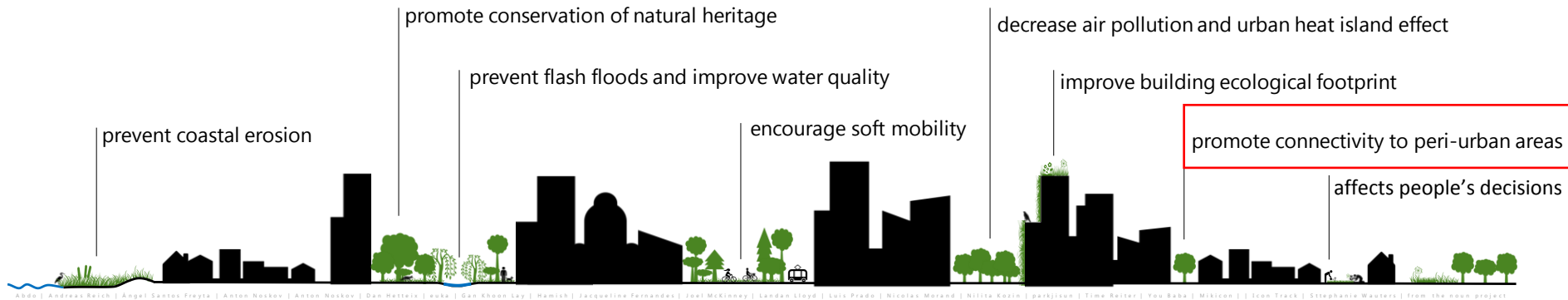
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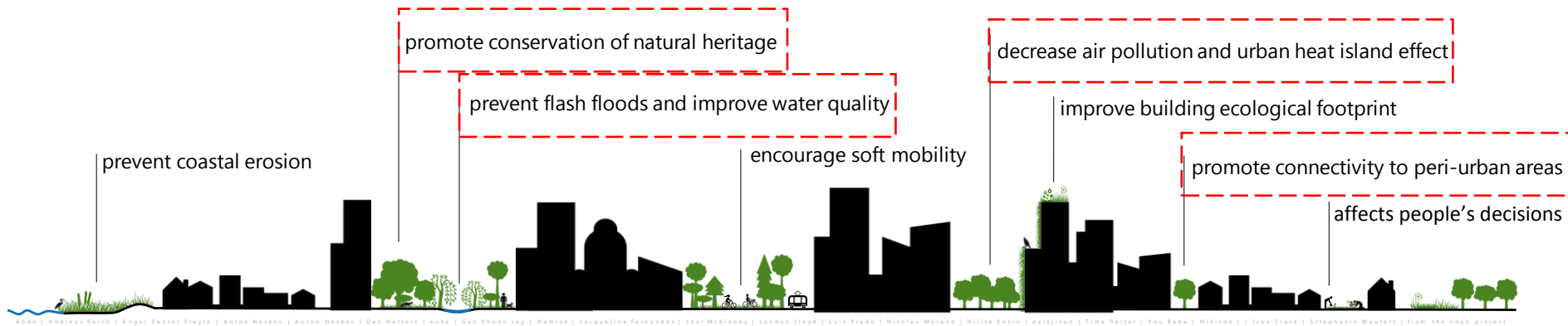
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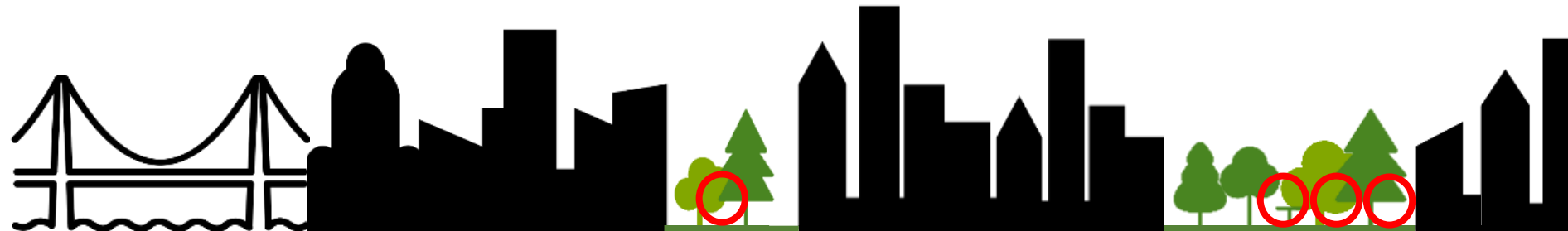
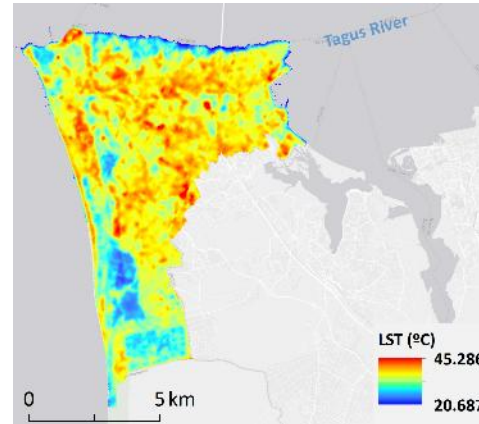
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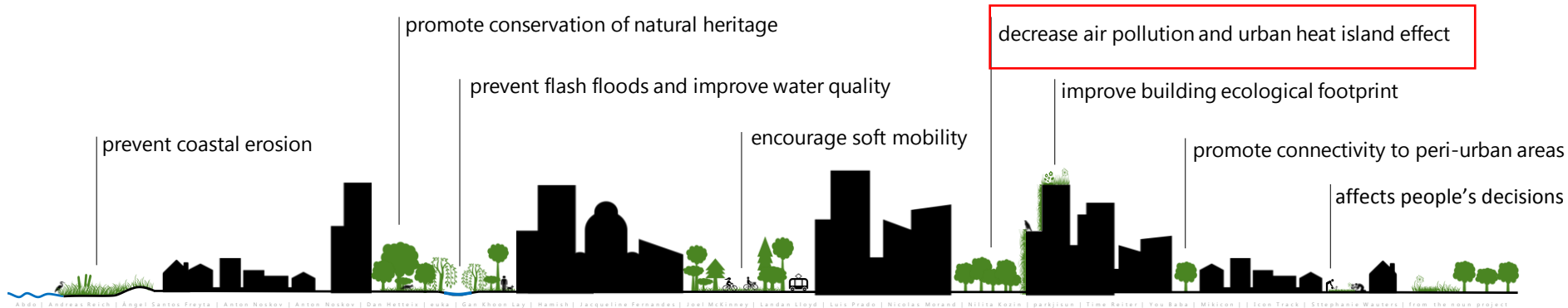




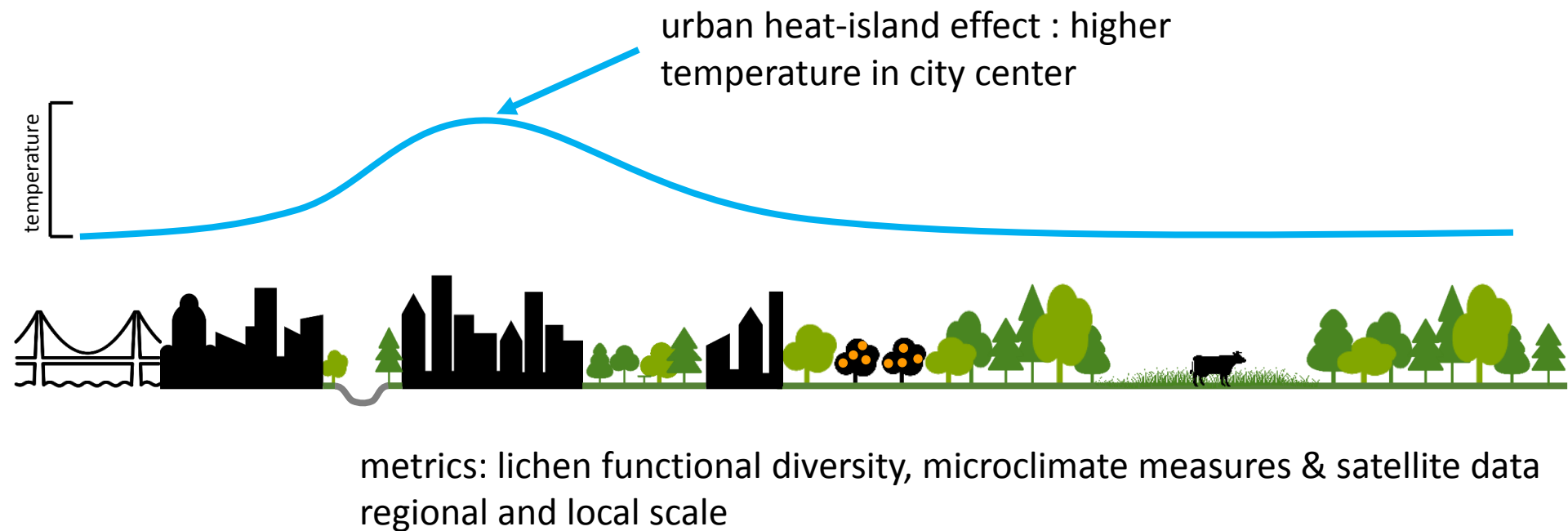
metrics: lichen biodiversity & pollutants concentration in lichens
microclimate sensors & remote sensing data

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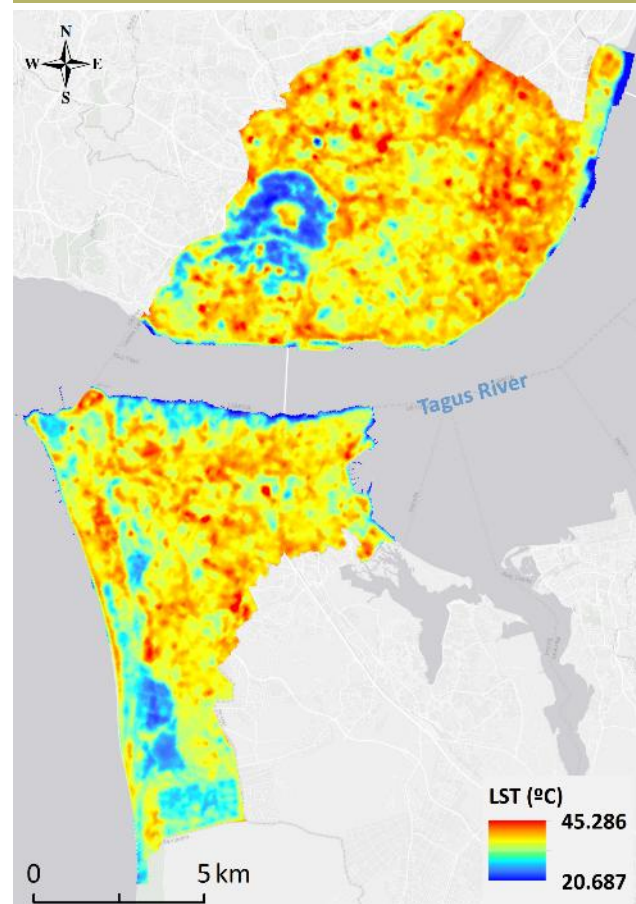


green areas promote microclimate regulation

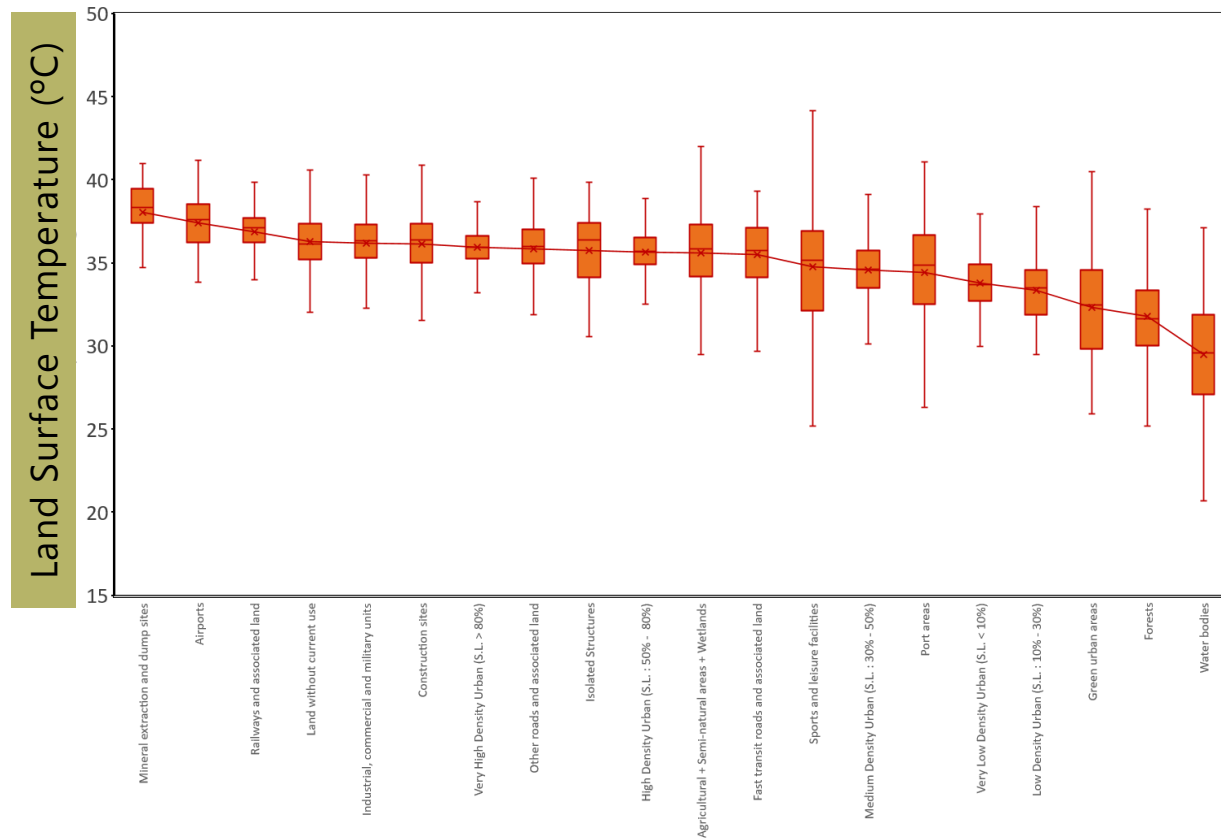


green areas promote microclimate regulation

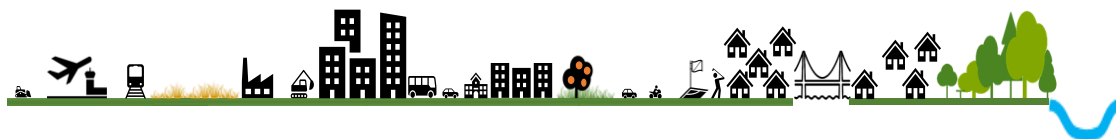
Land Surface Temperature for 2017-07-01, 11:14



Mean Surface Temperature by land-use class



Land-cover classes (urban atlas)



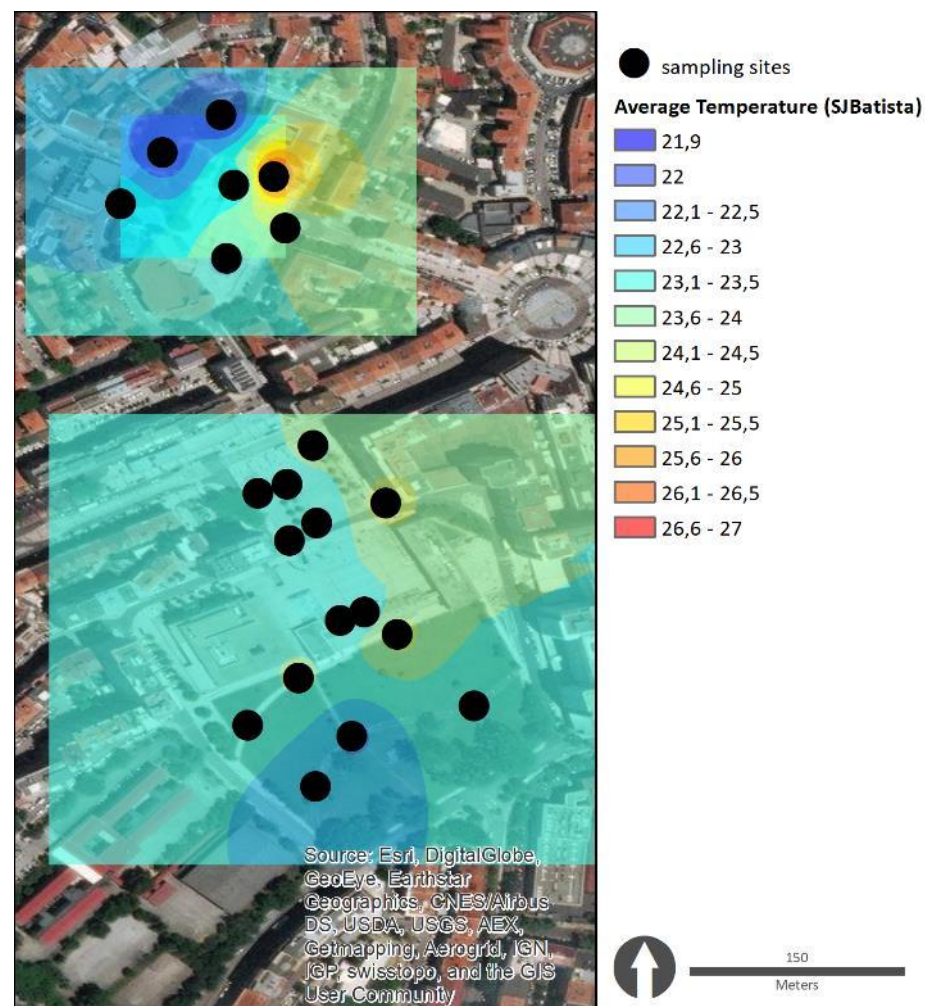
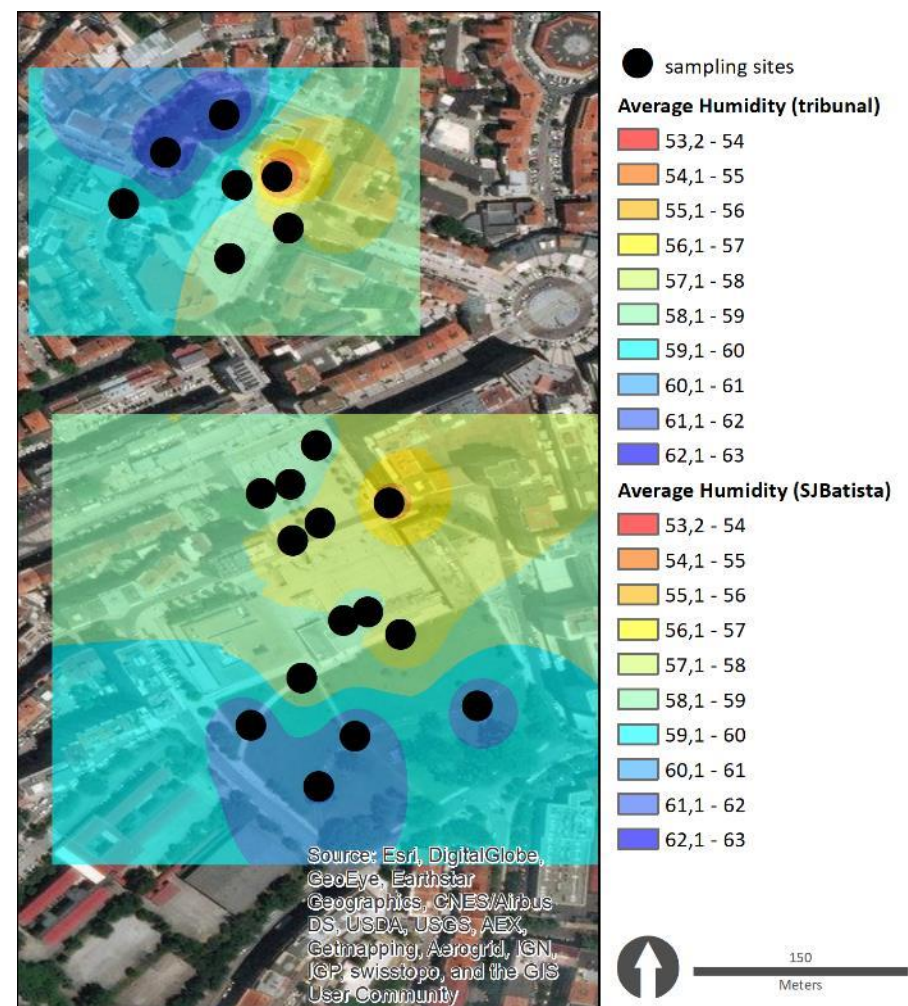
forest as provider of climate regulation



Sensores iButton

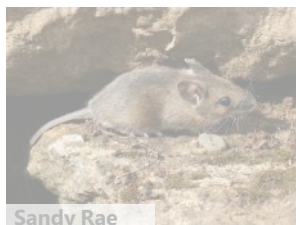


green areas promote microclimate regulation



functional diversity: from drivers to effects

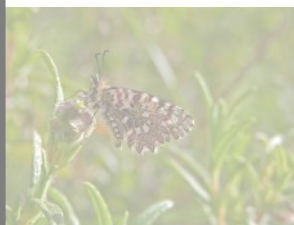
species
abundance



Sandy Rae



Henry Mühlpfordt



less tolerant

more tolerant

trait-based
functional
groups



higrophytic



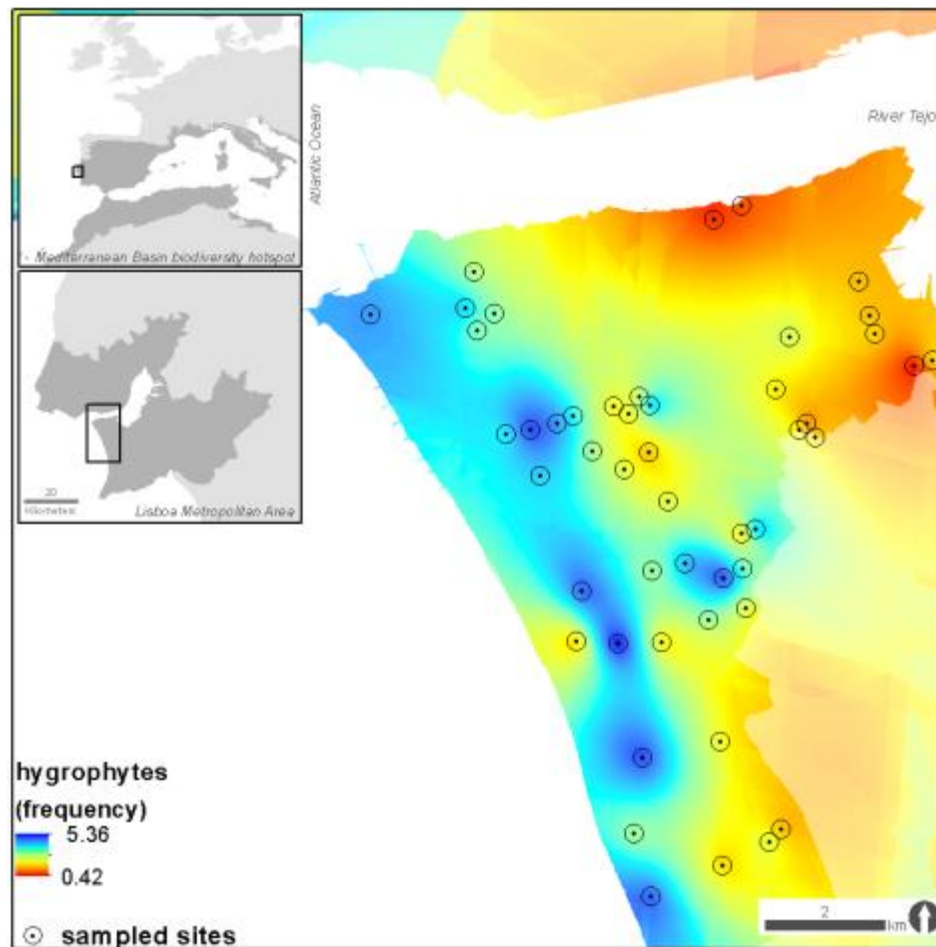
meso-higrophytic



xerophytic

based on a priory expert-knowledge classification

green areas promote microclimate regulation

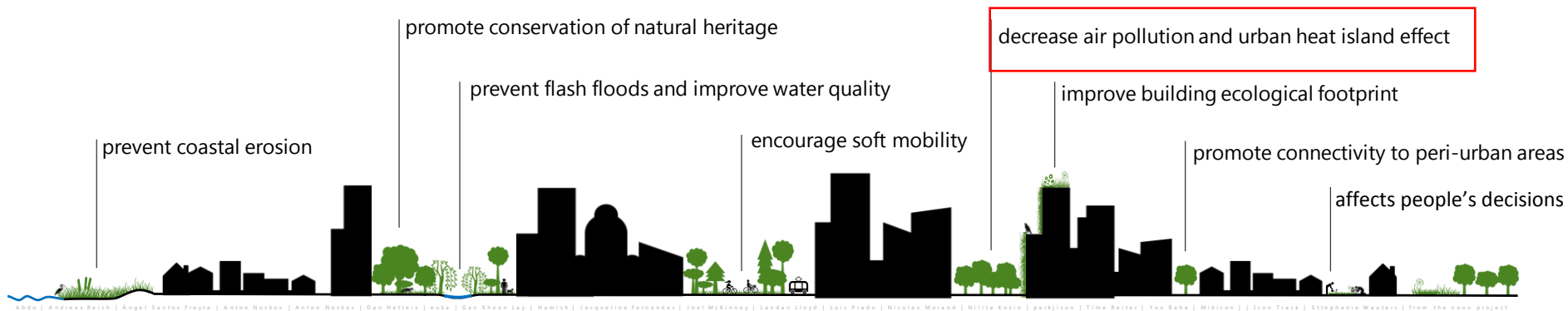


dry-tolerant functional diversity

dry-sensitive functional diversity

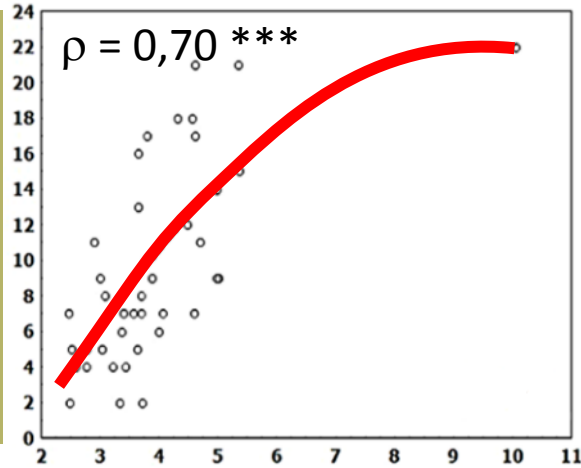
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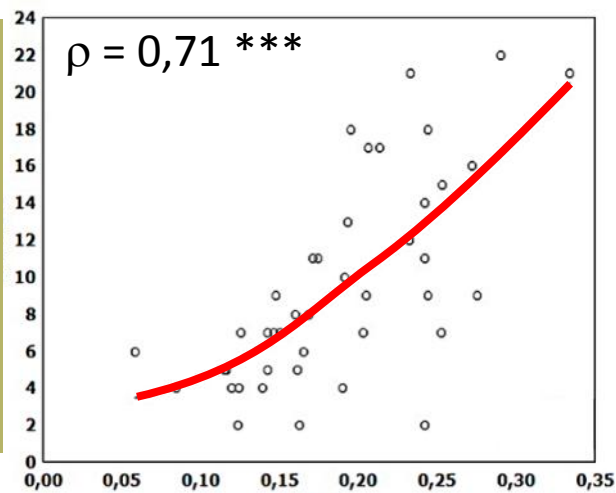
green areas promote air quality

species richness

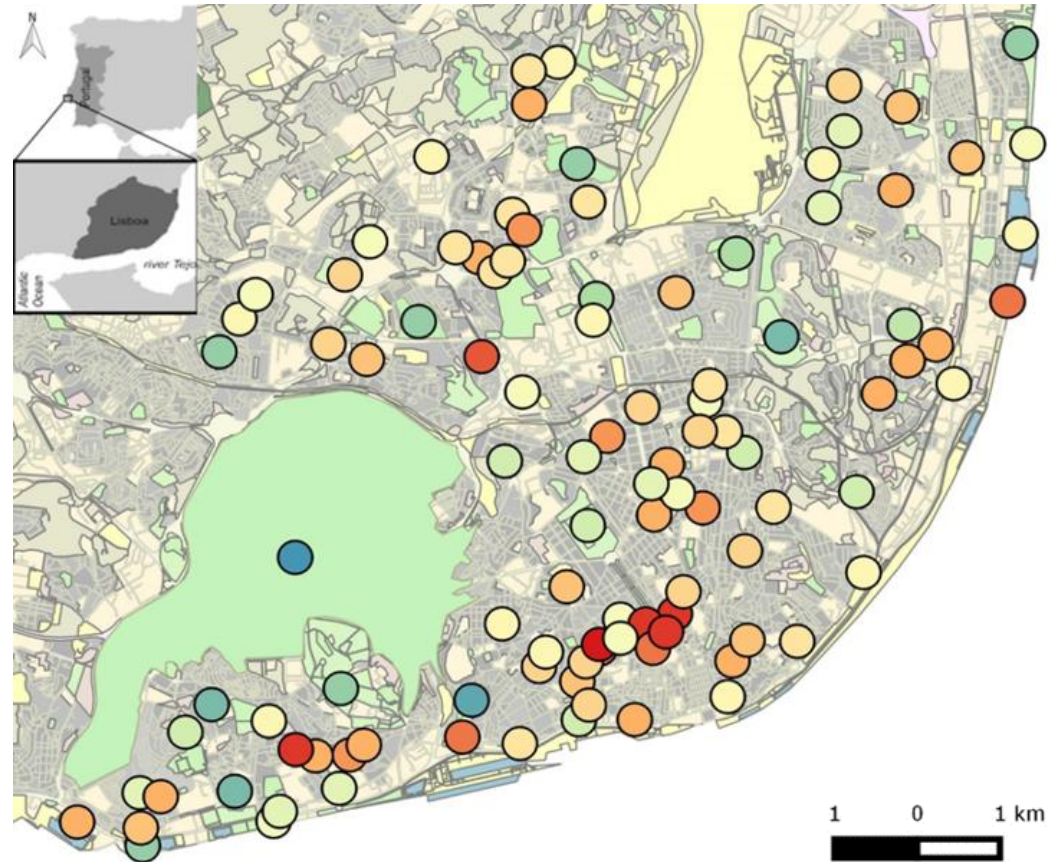


park area (log m²)

species richness

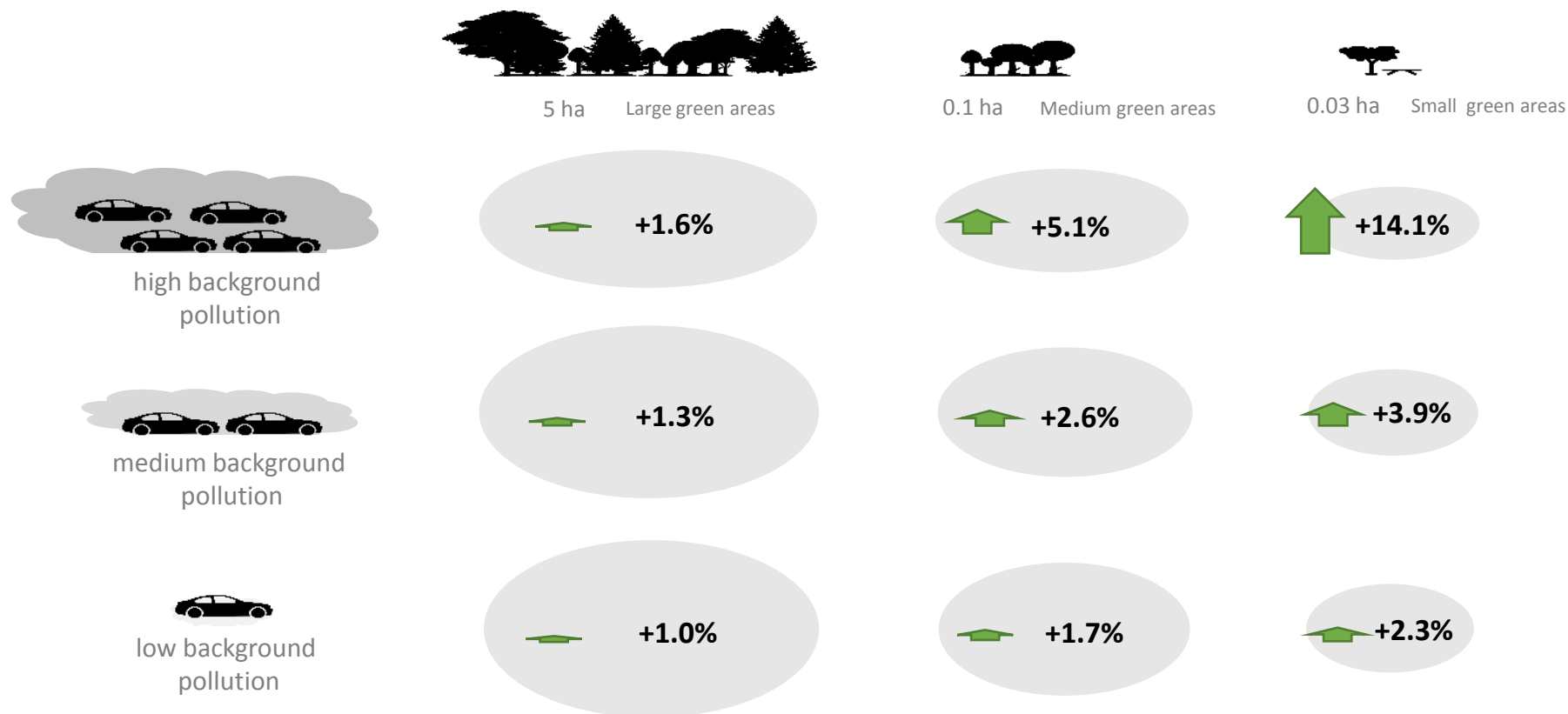


NDVI (100m buffer)



lichen species richness (air quality)

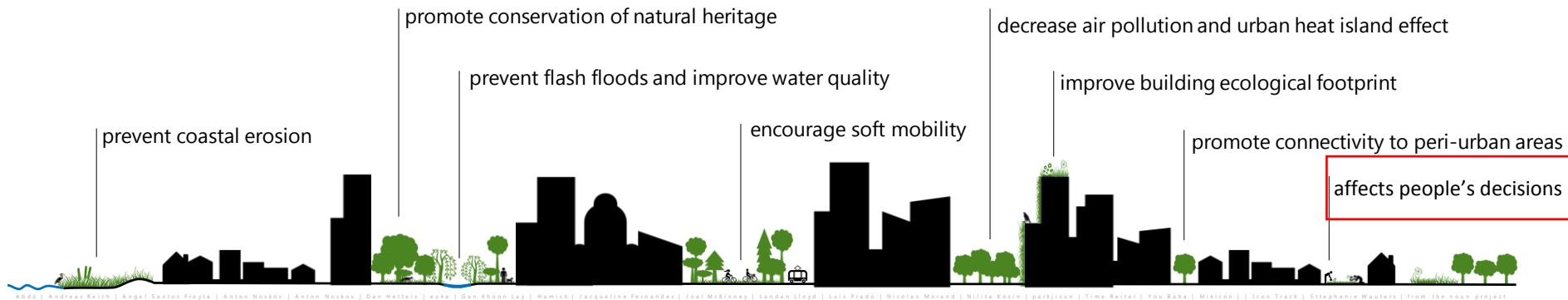
green areas promote air quality



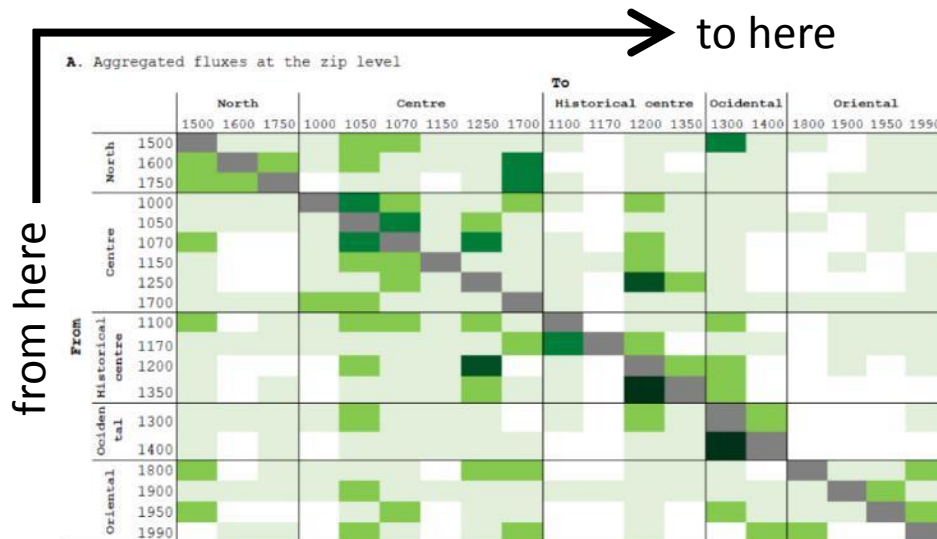
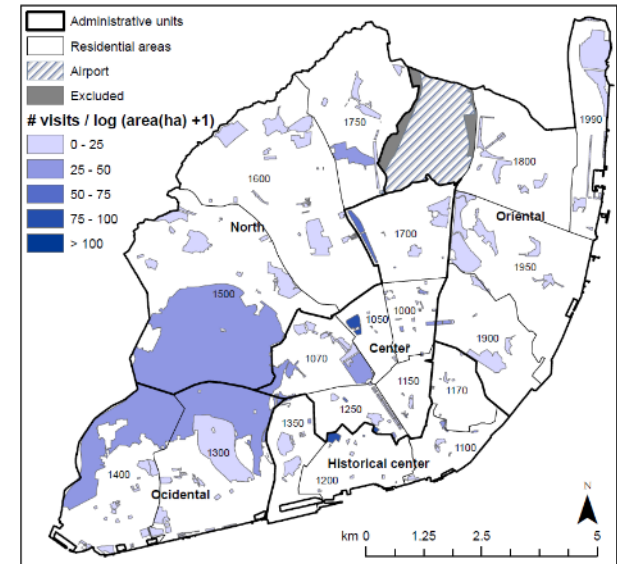
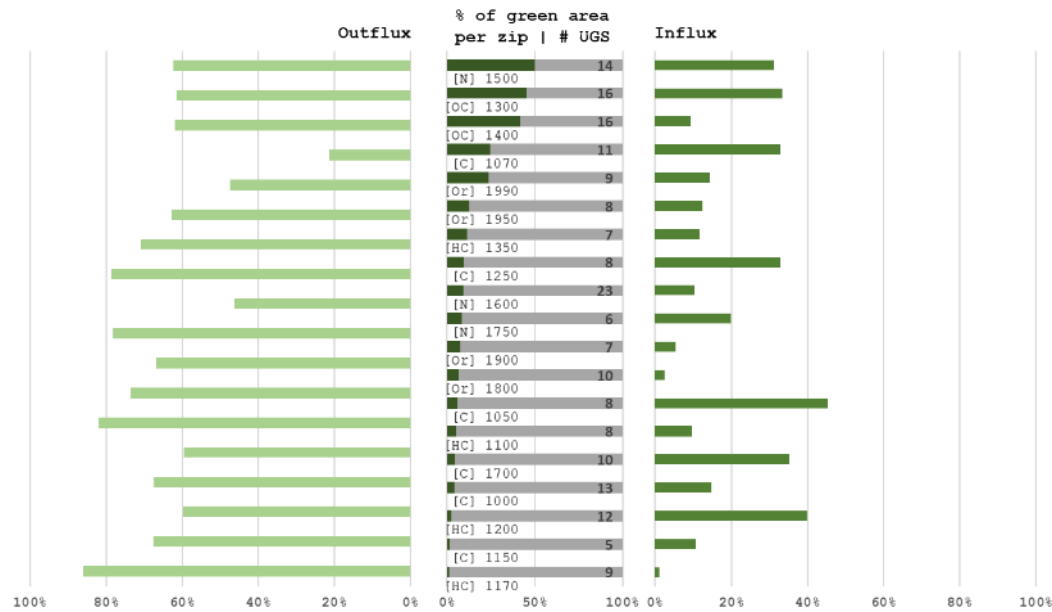
Icons from the Noun project: Alwx, Camilla Anderson, Ahmed Elzahra, James Keuning, Kamaksh Gangani

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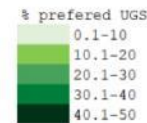
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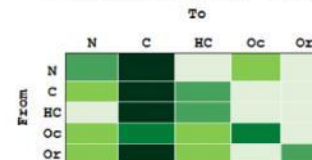
people value green areas



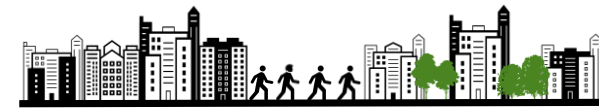
to here



B. Aggregated fluxes at the UTI level

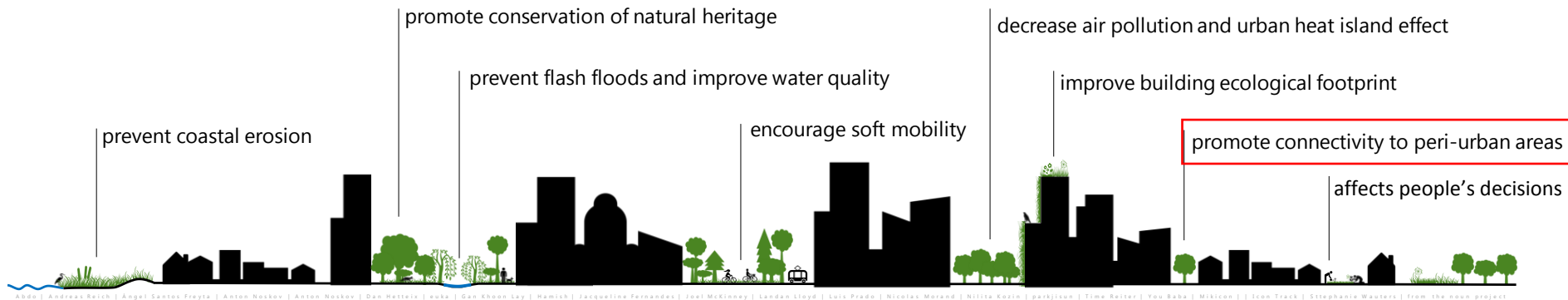


★ SHOULD I STAY OR SHOULD I GO ★ MODELLING THE
FLUXES OF POPULATION TO VISIT URBAN GREEN SPACES ★



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the use of functional diversity in large urban areas

lichens

65 species



butterflies

20 species



► total of 136 species of lichens, butterflies, birds and mammals and 18 orders of other-invertebrates

other-invertebrates

18 orders



birds

47 species



Henry Mühlpfordt

mammals

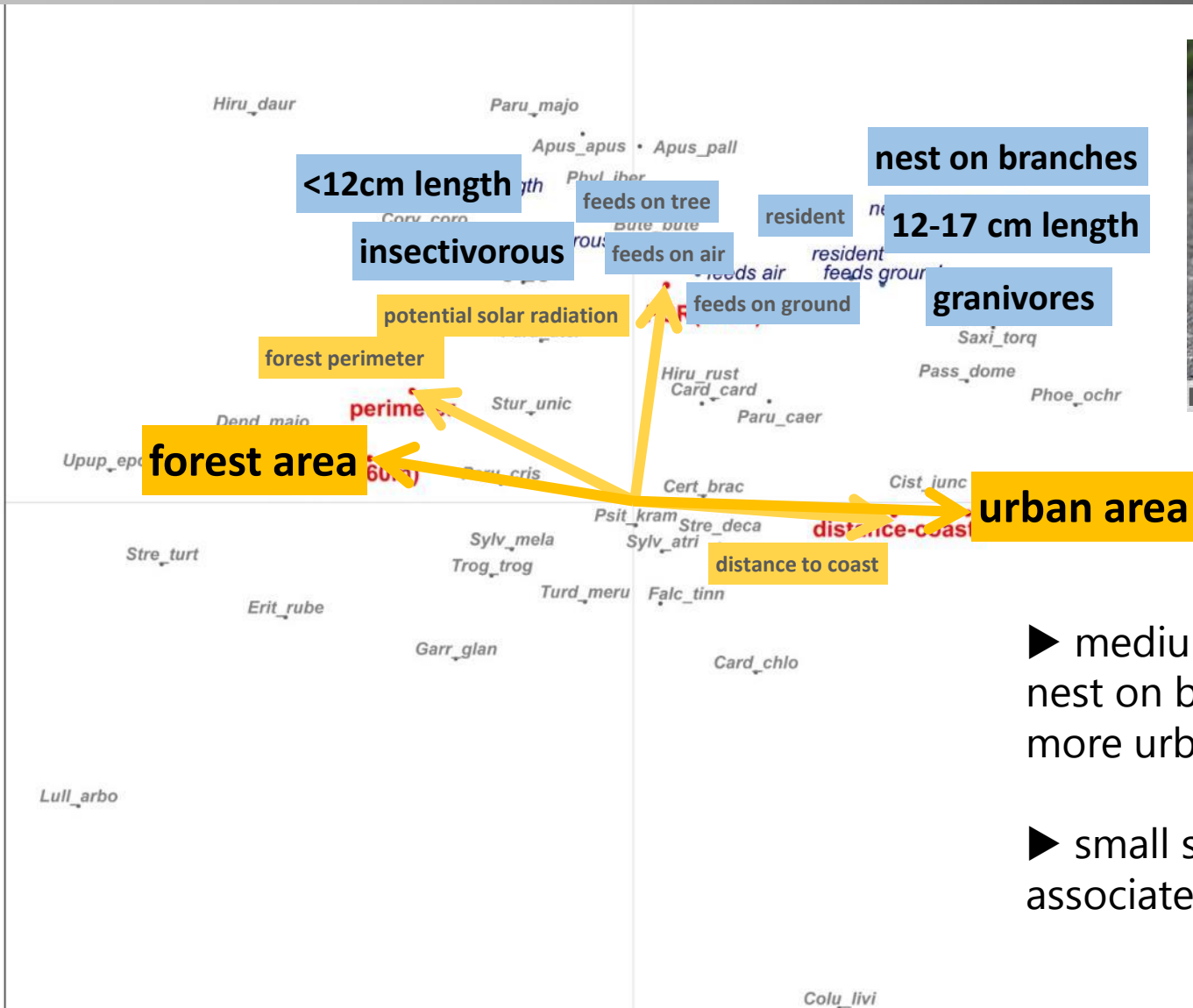
4 species



Sandy Rae

the use of functional diversity in large urban areas

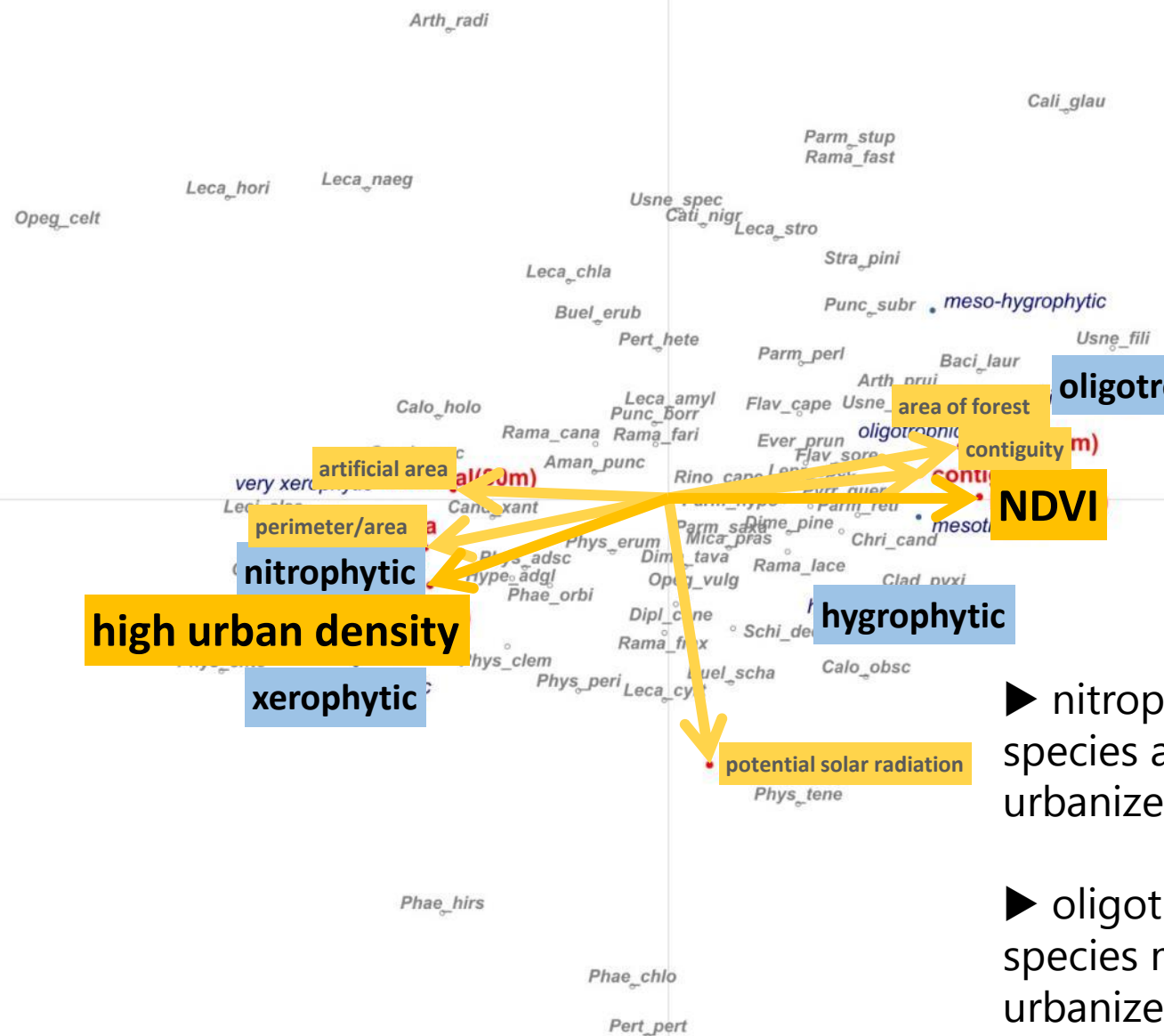
Colu_palu



Henry Mühlpfordt

- ▶ medium size granivores that nest on branches associated to more urbanized areas
- ▶ small size insectivorous birds associated to more forested areas

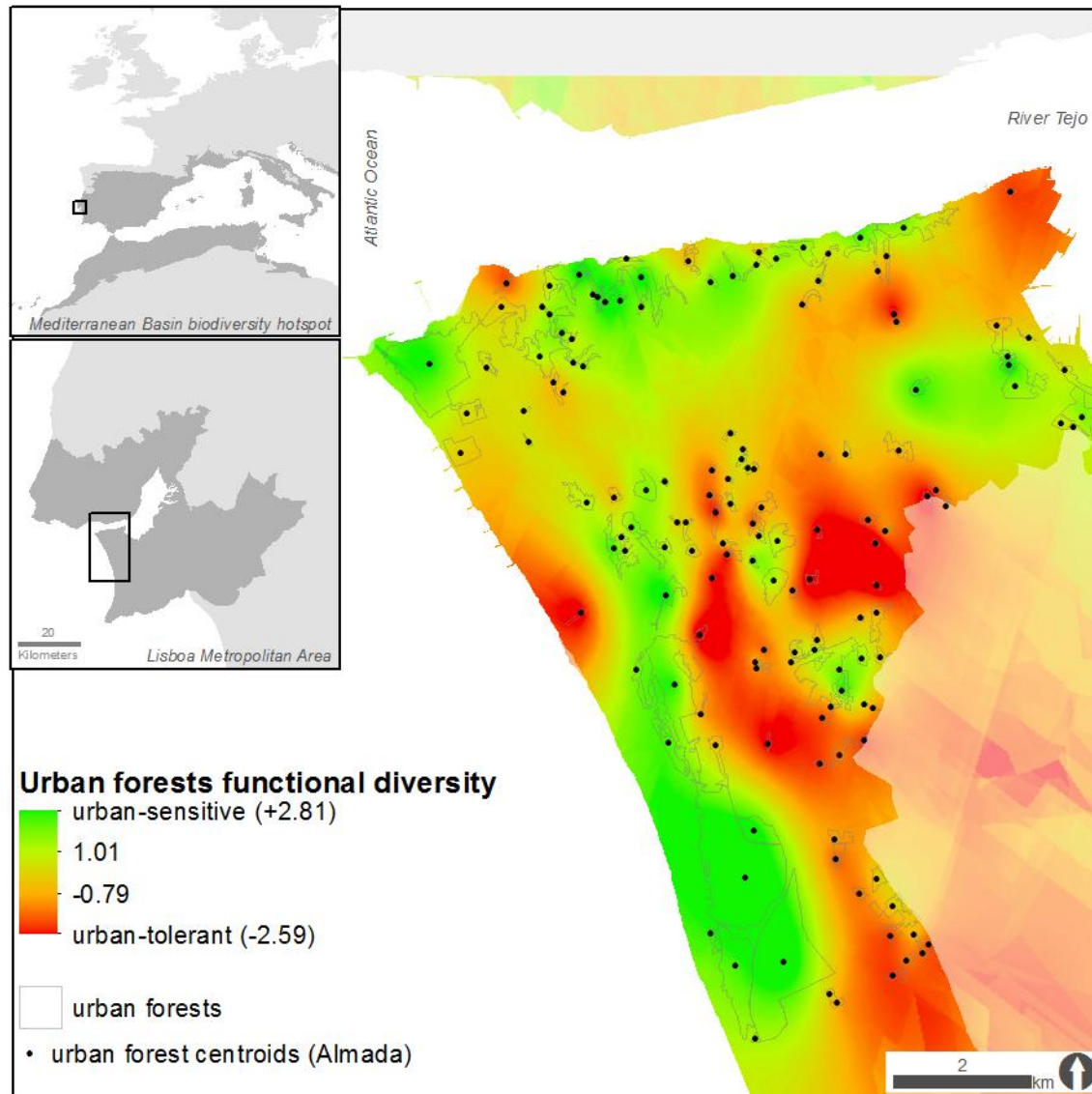
the use of functional diversity in large urban areas



► nitrophytic and xerophytic species associated to more urbanized areas

► oligotrophic and hygrophytic species more associated to less urbanized areas

the use of functional diversity in large urban areas



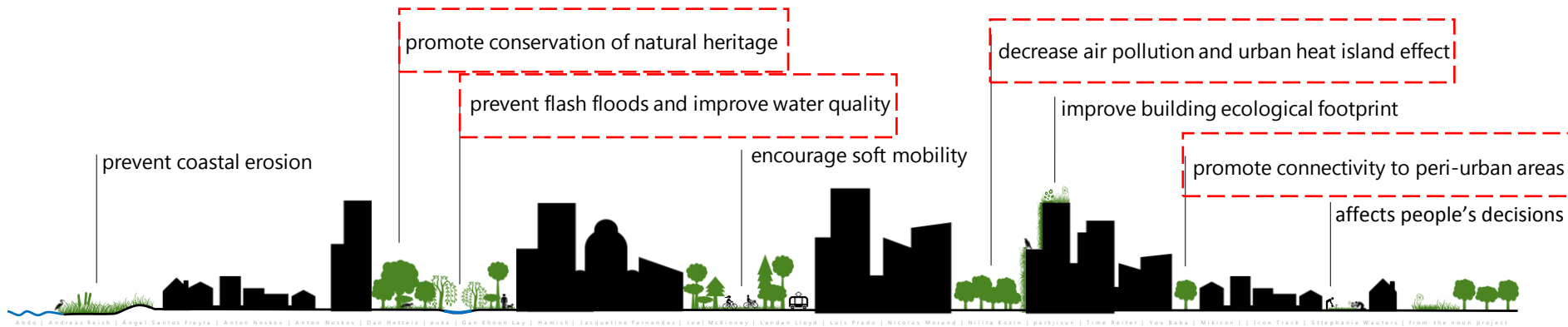
► index of urban diversity can be interpolated within the study area

► it highlights the area with more a biodiversity more close to the "forest" type, and the gaps between those forests

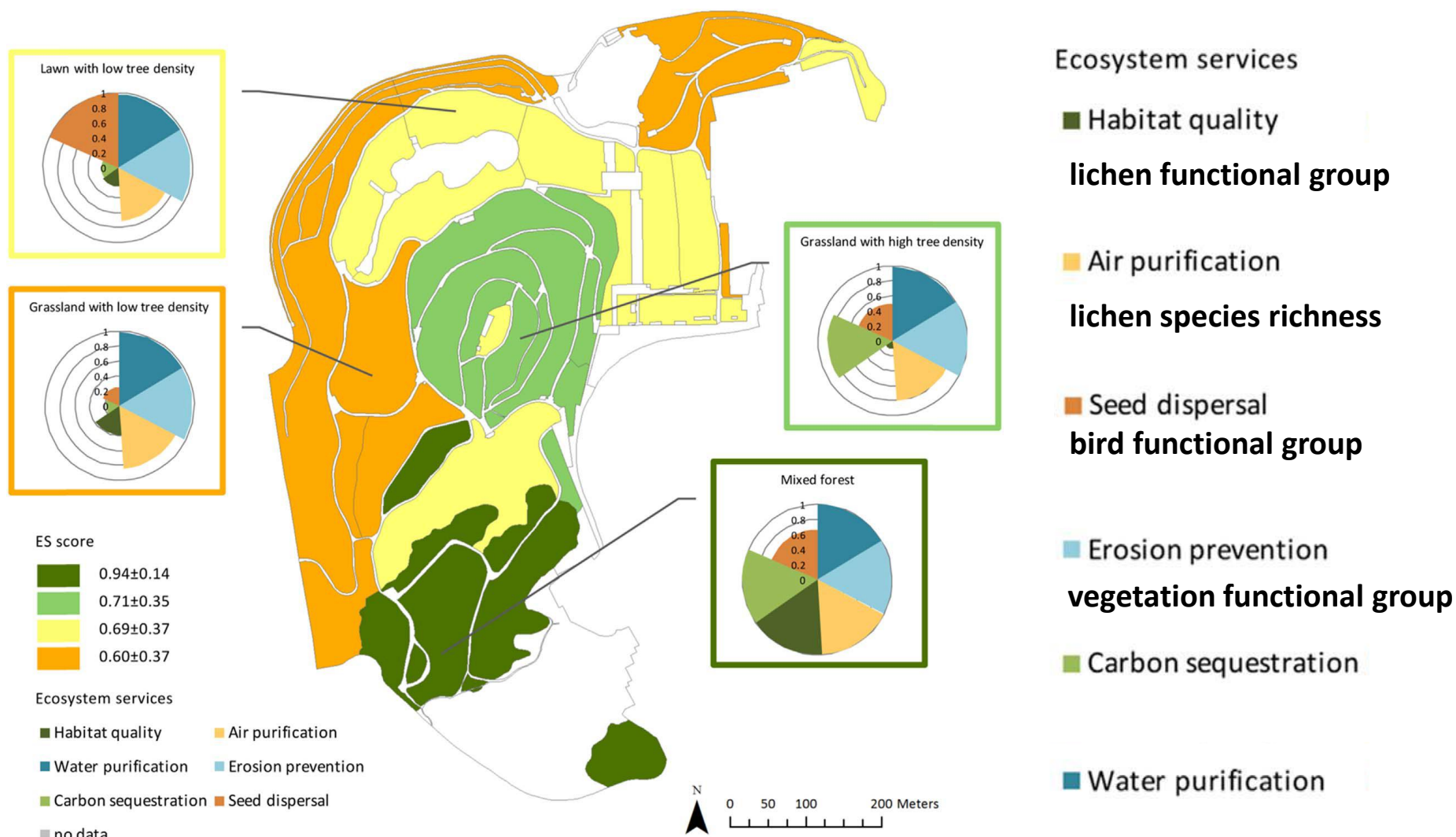
► it provides a view on how to make green infrastructure more functional

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trade-offs in ecosystem services



Mexia T, Vieira J, Príncipe A, Anjos A, Silva P, Lopes N, Freitas C, Santos -Reis M, Correia O, Branquinho C, Pinho P. 2018. Ecosystem services in urban parks under magnifying lens. *Environmental Research* 160: 469–478 [link](#)

Vieira J, Matos P, Mexia T, Silva P, Lopes N, Freitas C, Correia O, Santos-Reis M, Branquinho C, Pinho P. 2018. Green spaces are not all the same for the provision of ecosystem services: the case of air purification and climate regulation. *Environmental Research* 160: 306-313 [link](#)

Tartu, **Estonia**

Poznań, **Poland**

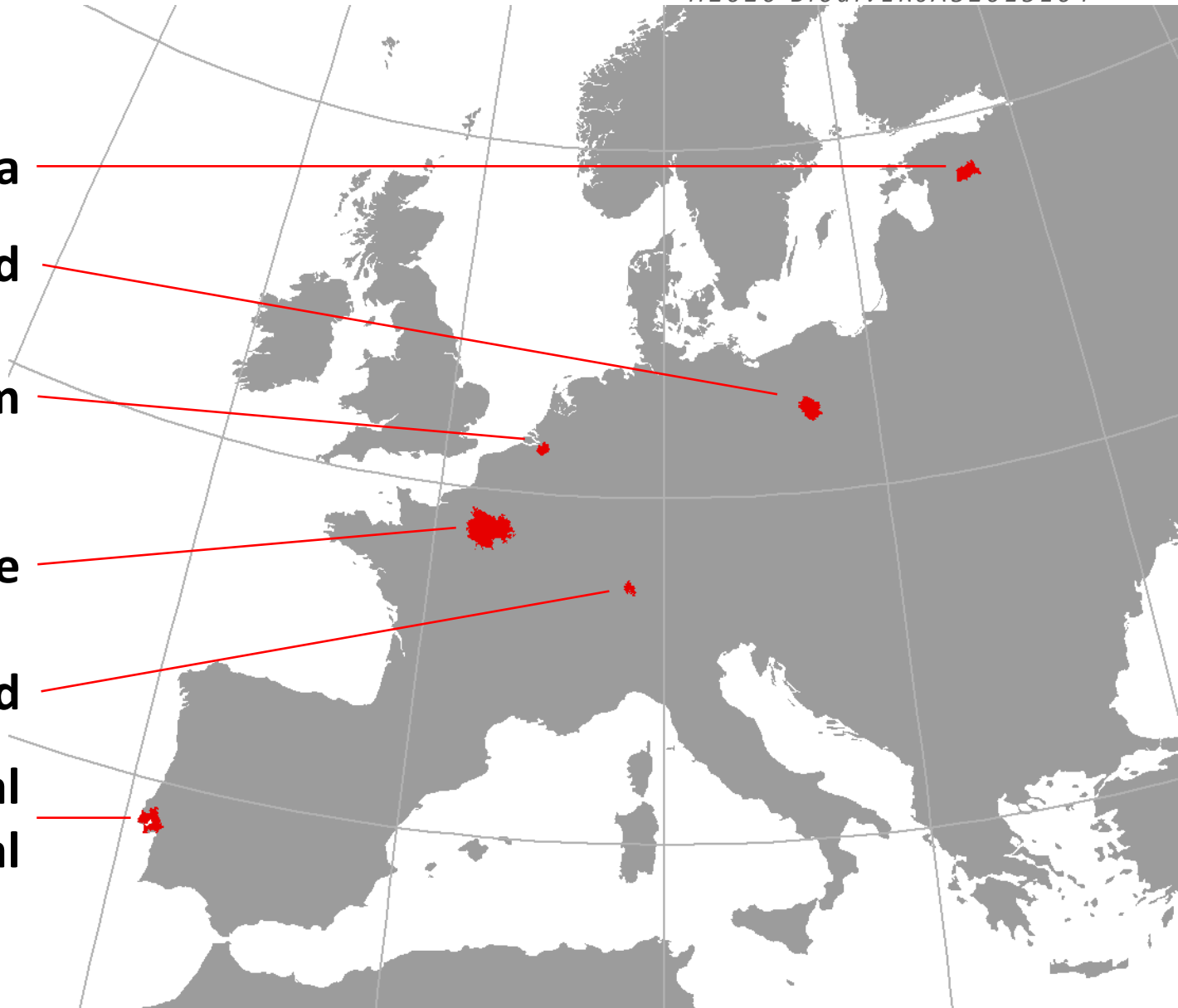
Antwerp, **Belgium**

Paris, **France**

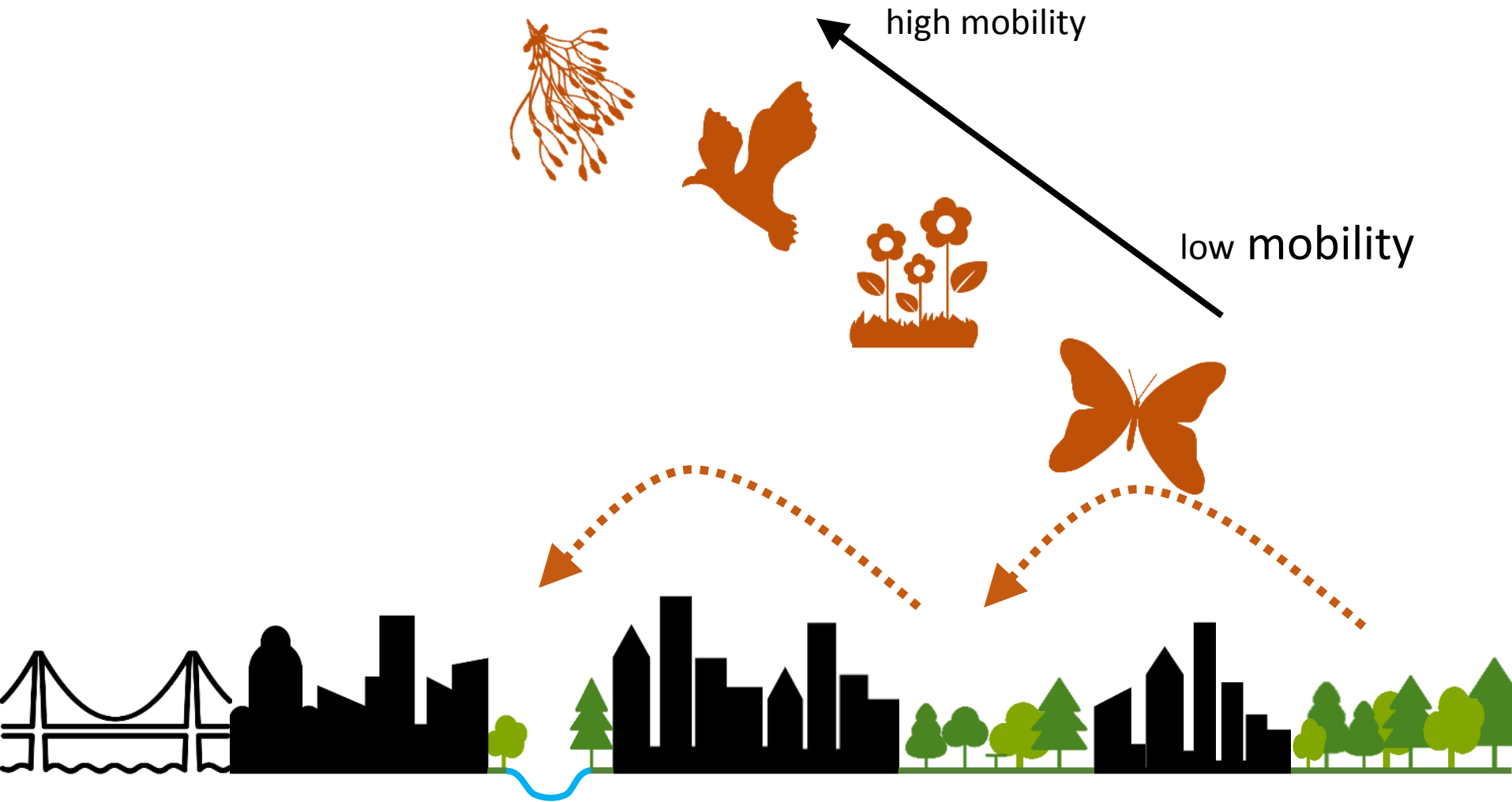
Zurich, **Switzerland**

Lisboa, **Portugal**

Almada, **Portugal**



Functional Diversity & Ecosystem Services ~ Fragmentation



FCT

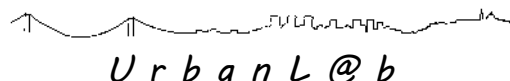
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BIOVEINS

H2020 BiodivERsA32015104



Brignole D, Drava G, Minganti V, Giordani P, Samson R, Vieira J, Pinho P, Branquinho C. 2018. Chemical and Magnetic Analyses on Tree Bark as an Effective Tool for Biomonitoring: A Case Study in Lisbon (Portugal). *Chemosphere* 195:508-514. [link](#)

Llop E, Pinho P, Matos P, Pereira MJ, Branquinho C. 2012. The use of lichen functional groups as indicators of air quality in a Mediterranean urban environment. *Ecological Indicators* 13: 215-221. [link](#)

Llop E, Pinho P, Ribeiro MC, João-Pereira M, Branquinho C. 2017. Traffic represents the main source of pollution in small Mediterranean urban areas as seen by lichen functional groups. *Environmental Science and Pollution Research*. [link](#)

Santos A, Pinho P, Munzi S, Botelho MJ, Palma-Oliveira J, Branquinho C. 2017. The role of forest in mitigating the impact of atmospheric dust pollution in a mixed landscape. *Environmental Science and Pollution Research* 24: 12038-12048 [link](#)

Pinho P, Correia O, Lecoq M, Munzi S, Vasconcelos S, Gonçalves P, Rebelo R, Antunes C, Silva P, Freitas C, Lopes N, Santos-Reis M, Branquinho C. 2016. Evaluating green infrastructure in urban environments using a multi-taxa and functional diversity approach. *Environmental Research*. 147: 601–610 [link](#)

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Munzi S, Correia O, Silva P, Lopes N, Freitas C, Branquinho C, Pinho P. 2014. Lichens as ecological indicators in urban areas: beyond the effects of pollutants. *Journal of Applied Ecology* 51: 1750–1757 [link](#)