Biophysical analysis of public trees in Padova (Italy): biodiversity and ecosystem services

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"Enhancing Resilience of urban ecosystems through green infrastructure"

the city lab

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PLANES
Planning for Ecosystem Services

UNIVERSITÀ DEGLI STUDI DI TRENTO

- 210,000 inhabitants

- > 40,000 public trees managed by the municipality

- 255 tree species, cultivar and selections

- How are ecosystems services and disservices from public trees **distributed** around the city?

- How much do public trees **enhance** the environmental quality of the city?

- May a careful **selection** of tree species make the difference in optimizing ecosystem services distribution?

- understand whether ecosystem services and disservices form public trees are equally distributed across the city

- develop a tree selection system that delivers enhanced ecosystem services AND respects the tree needs

- maintain, and possibly improve, biodiversity

Continuously updated GIS database of public trees
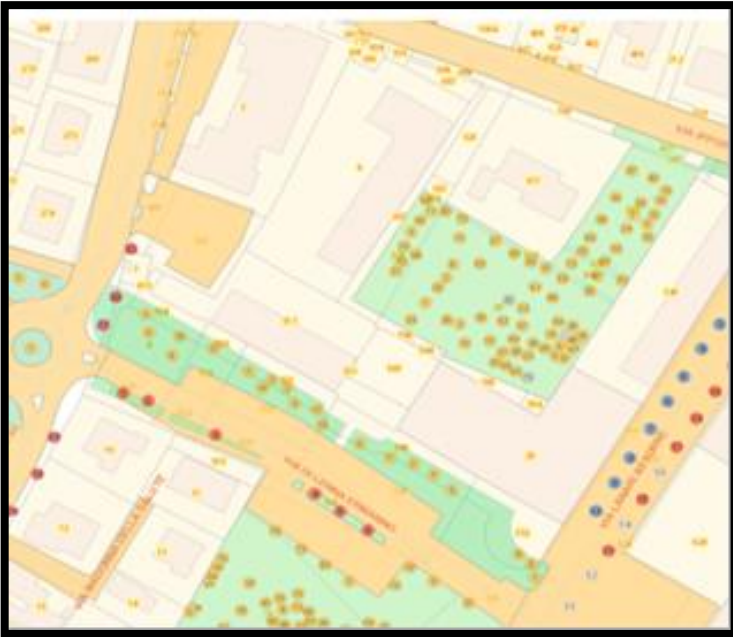
TREE ID

LOCATION
- xy coordinates
- Neighborhood
- street /area

TREE
- Species
- Planting date
- DBH class
- Height class
- canopy

HEALTH CONDITIONS
- condition
- visual assessment
- advanced assessment

MAINTENANCE
- date
- type of maintenance

DEFINING ES AND FUNCTIONAL TRAITS OF INTEREST

- assessing of a set of key ES and ED, together with specific tree needs and morphological traits
- defining appropriate indicators and measurement scales

LINKING SPECIES TO FUNCTIONAL TRAITS
Integration of the existing database, by linking species to functional traits and related ES/ED

SPATIAL ANALYSIS
in order to understand the data distribution

ES AND ED: REVIEW OF SCIENTIFIC LITERATURE

TREE SPECIES	PM capturing	VOCs emission	BIODIVERSITY VALUE	GROWTH RATE	WOOD DENSITY
Acer campestre	++	+	++	+	+++
Acer platanoides	++	+		+++	++
Acer pseudoplatanus	++	+++	+++	+	+++
Aesculus hippocastanum	++		+	+	++
Alnus glutinosa		+	++	++	+
Carpinus betulus	++		+	+	+++
Catalpa bignonoides					+
Cedrus atlantica					+
Chamaeciparys lawsoniana		+			+
Corylus colurna		++	++	++	++
Pyrus calleriana chanticleer	++			+++	+++
Platanus hybrida			+	++	+++
Tilia x europaea		++	++	++	+

O'Sullivan et al., Optimising UK urban road verge contributions to biodiversity and ecosystem services with cost-effective management, J. E. M. , 2017

https://citree.ddns.net/index.php?language=en

functional traits	assessment	ecosystem services
honey plant	Y/N	pollination
bird feeding	Y/N	biodiversity support
ornamental blossom	Y/N	aesthetic quality
ornamental fruit	Y/N	
autumn coloring of deciduous	Y/N	
particulate deposition	low/medium/high	air quality regulation
nitrous and ozone absorption	low/medium/high	
carbon sequestration	low/medium/high	global climate regulation
cooling potential	low/medium/high	

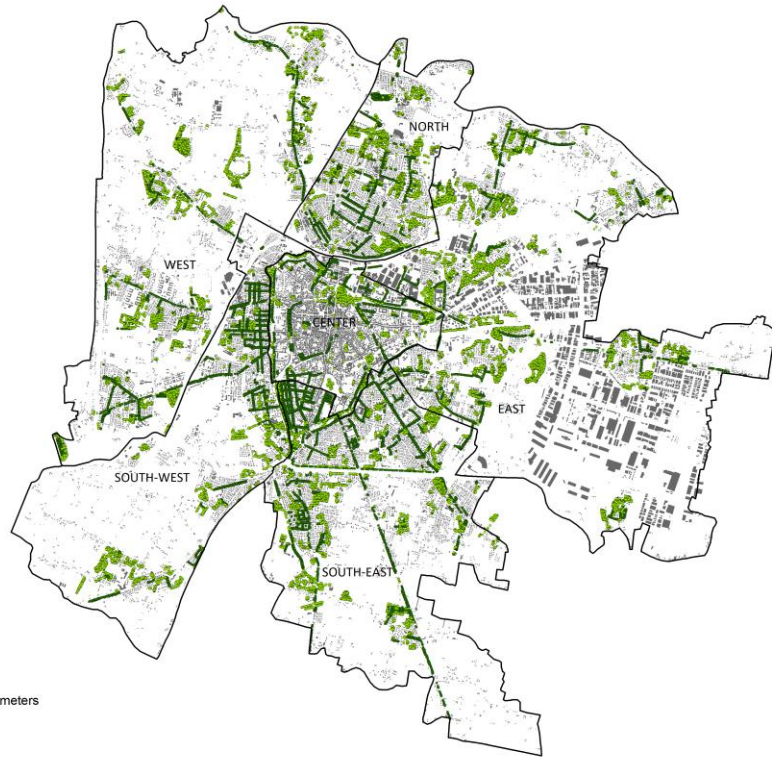| functional traits	assessment	ecosystem disservices
allergenic potential	low/medium/high	negative health effects
toxicity potential	low/medium/high	
damages by roots	low/medium/high	damages (e.g. to road paving)
odor nuisance	Yes/no	unpleasant experience

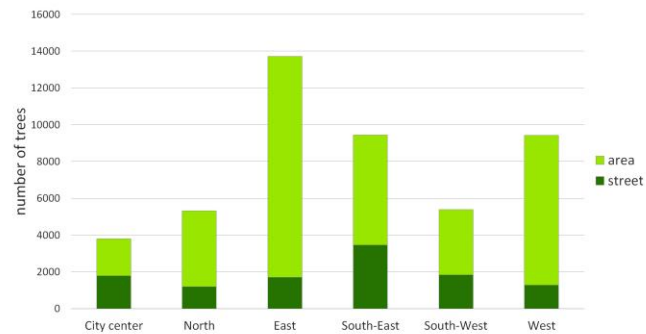| functional traits	assessment	additional info
Overall maintenance requirements	low/medium/high	maintenance requirements
Overall stability risk	low/medium/high/very high	
tolerance to drought	low/medium/high	vulnerability to "urban" stresses
tolerance to cold temperature	low/medium/high	

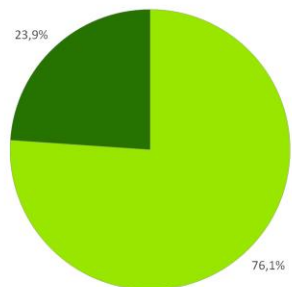https://www.itreetools.org/eco/overview.php
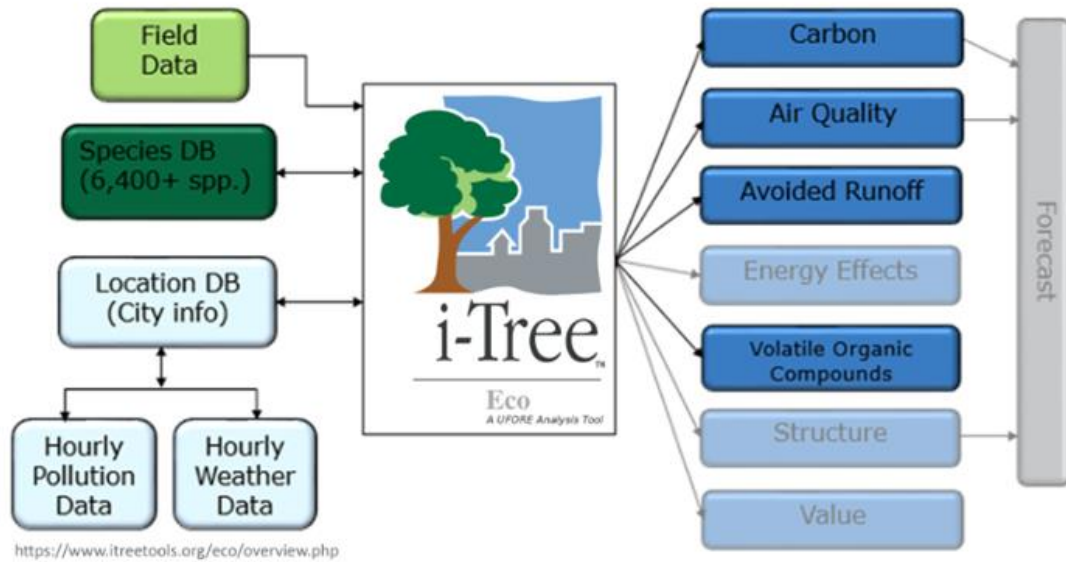
indicator	Measurement unit
Pollution removal	tonne/year
VOC emissions	Kg/year
Carbon storage	tonne
Gross carbon sequestration	tonne/year
Avoided runoff (interception)	m^3/year

LOCATION OF PUBLIC TREES

- tree inside green areas
- street tree

districts

NORTH
WEST
CENTER
EAST
SOUTH-WEST
SOUTH-EAST

0 0,5 1   2   3
Kilometers

Distribution of public trees in the city

23,9%

76,1%

number of trees

16000
14000
12000
10000
8000
6000
4000
2000
0

City center   North   East   South-East   South-West   West

- area
- street

CARBON SEQUESTRATION

- low
- medium
- high

☐ districts

DISTRIBUTION OF HONEY PLANTS

non-honey plant

honey plant

districts

0   0,5   1   2   3 Kilometers

STABILITY RISK

- low
- medium
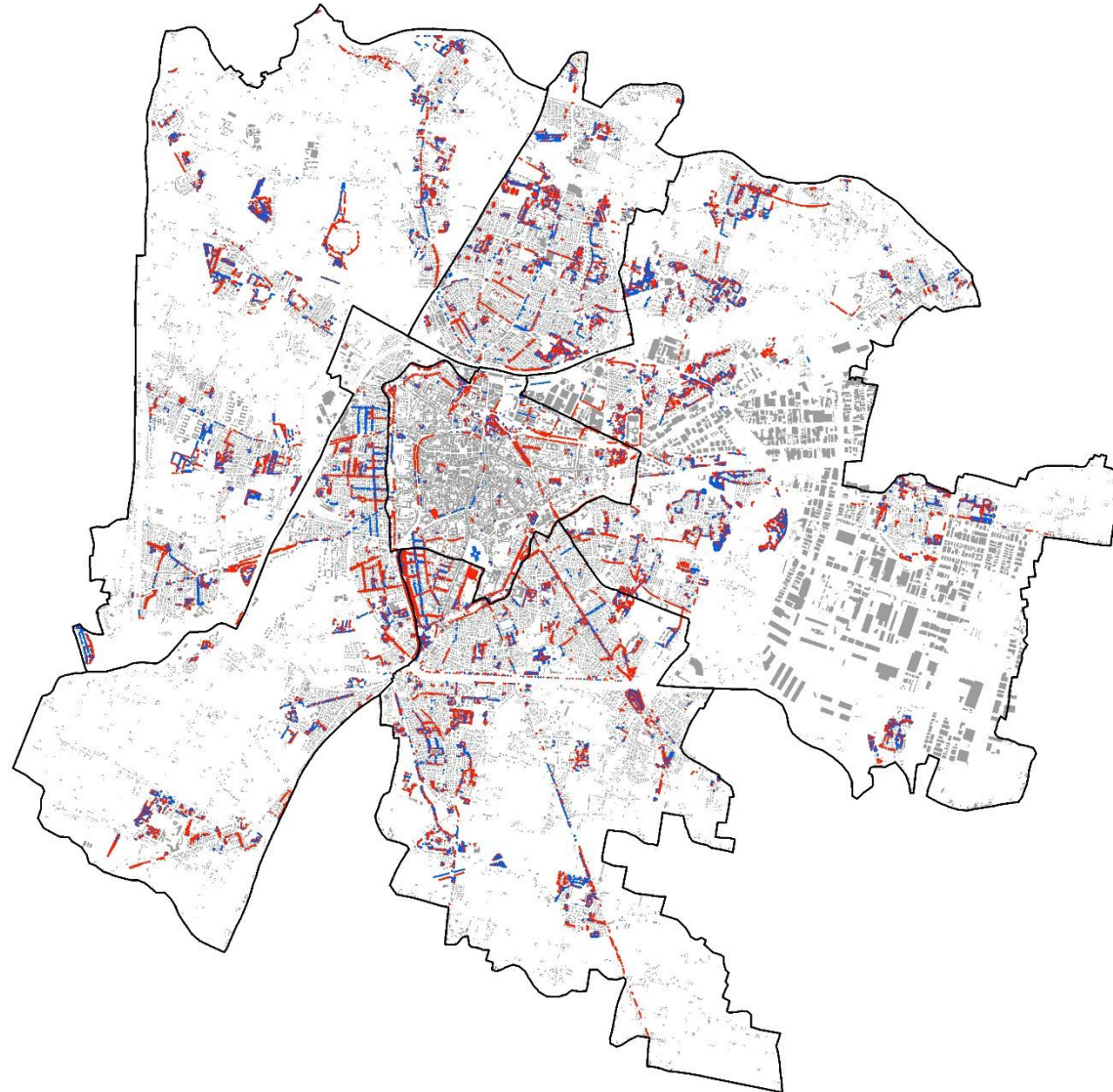- high
- very high

districts

0   0,5   1   2   3 Kilometers

**ROOT DAMAGE RISK**

- no
- yes

districts

0 0,5 1 2 3
Kilometers

- A constantly **upgraded database** is essential to organize management activities and is useful in planning a solid future development of Padova urban green infrastructure

- **Identifying specific goals** to achieve in different areas of the city can be a guide in selecting the appropriate tree species

- **Space criteria** are mandatory traits when selecting tree species: only healthy and vigorous trees can provide environmental benefits
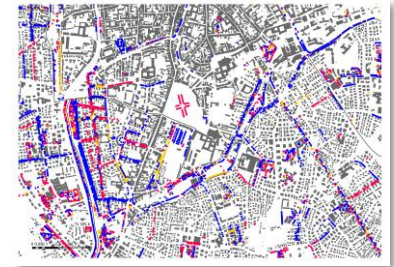
- Identification of **differences** in the provision of ecosystem services at the city scale and highlighting of areas that can be targeted by **future interventions** aimed at enhancing ES

- Site-specific **prioritization** of tree species to match specific needs and requirements of ES in different parts of the city

- Impact **assessment** of land use and climate changes on ecosystem services
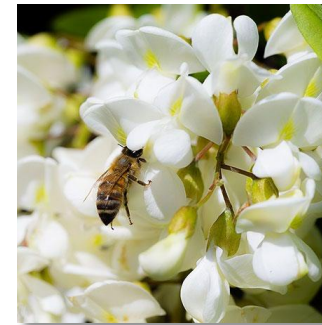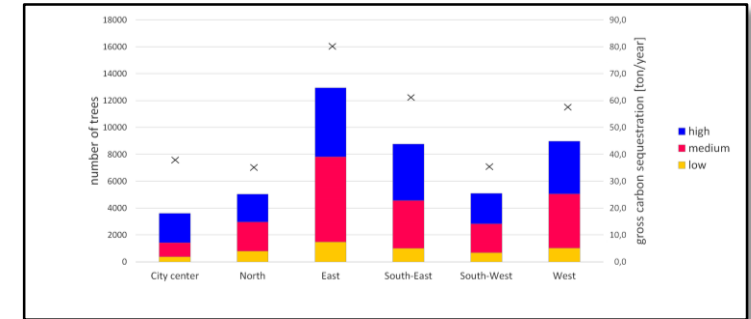
2018, summer: something changed

(bio)diversity is the greatest strength

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