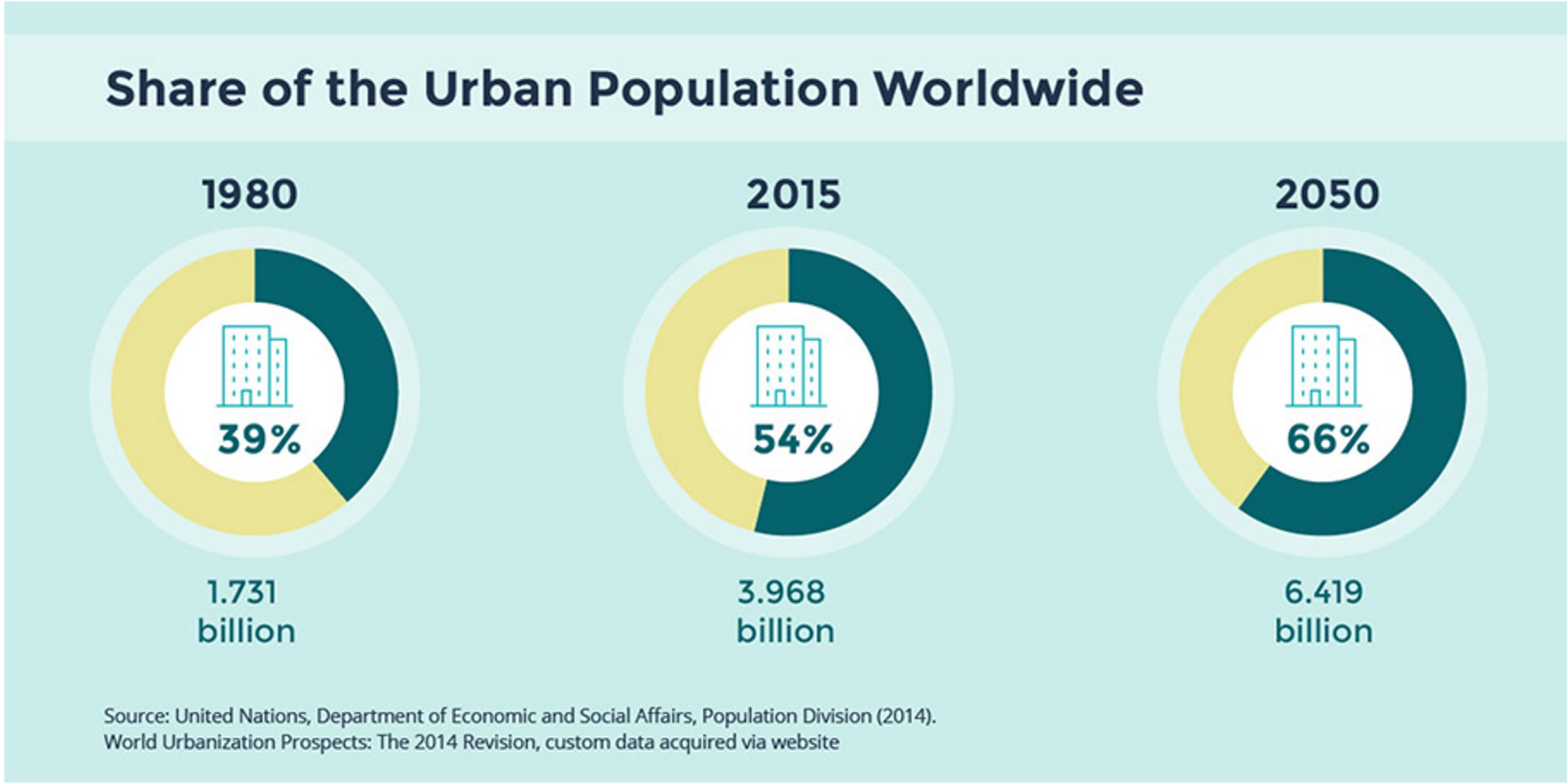
LIFE URBANGREEN

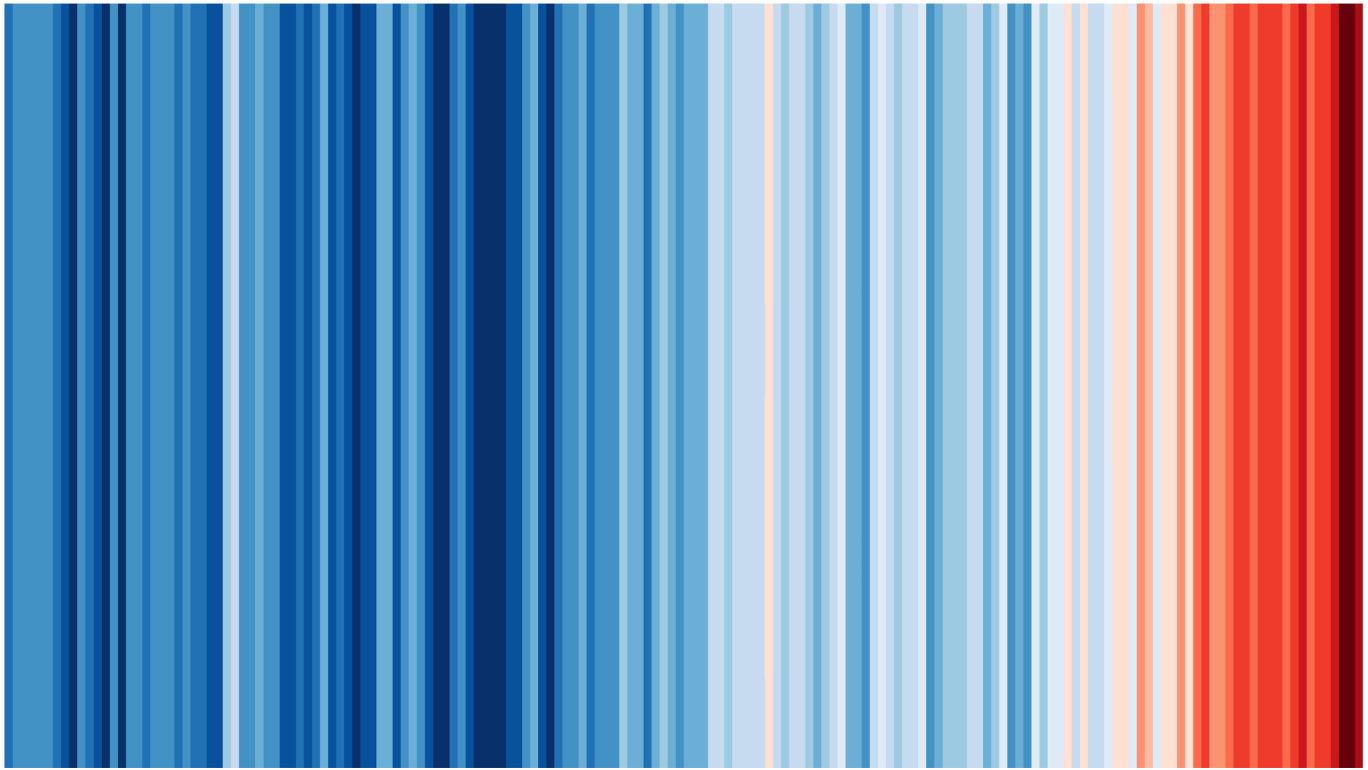
An innovative technological platform to improve management of green areas for better climate adaptation

With the contribution of the LIFE Programme of the European Union.
LIFE URBANGREEN (LIFE17 CCA/ITA/000079)

Urban population is growing



Global warming is affecting urban climate



Source: https://www.climate-lab-book.ac.uk/2018/warming-stripes/

Effects of global warming

Extreme weather events

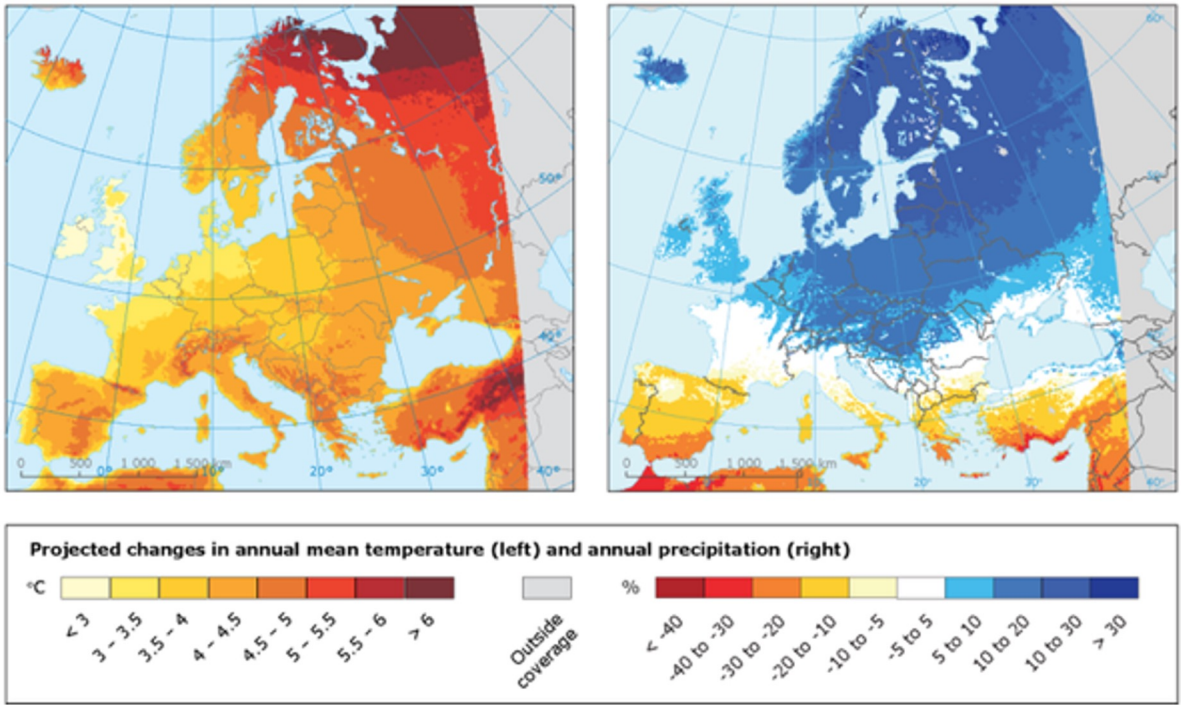
A changing climate leads to changes in frequency, intensity, spatial extent, duration and timing of extreme weather and climate events and can lead to unprecedented extreme weather and climate events. (IPCC)

Effects of global warming

Changes in temperature and precipitation

Effects on urban green spaces:

- Elevated diseases and parasites
- Water shortage
- Extreme weather events
- Control of urban trees becomes more complex

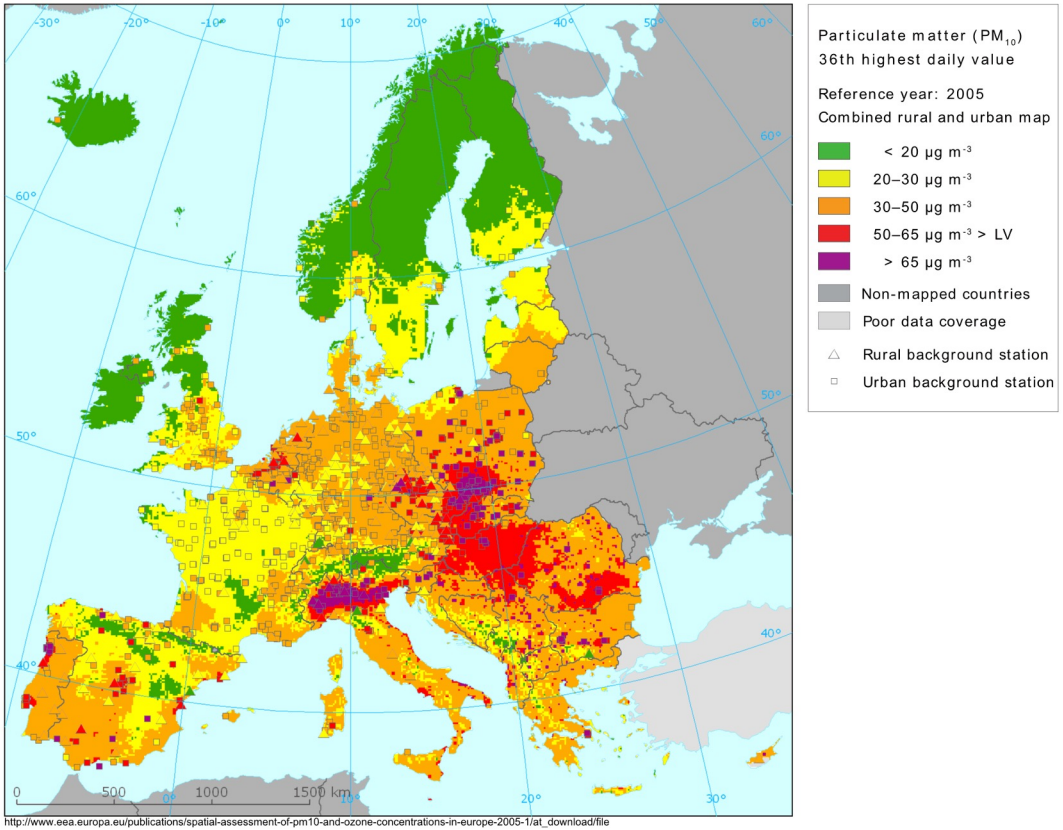


https://www.eea.europa.eu/data-and-maps/figures/projected-change-in-annual-mean

Air pollution

Air pollution costs EU 10% of GDP

90 percent of city dwellers are exposed to high levels of air pollution



http://www.eea.europa.eu/publications/spatial-assessment-of-pm10-and-ozone-concentrations-in-europe-2005-1/at_download/file

Green areas and quality of life in urban areas

How do green areas help cities adapt to climate change?

Mitigation

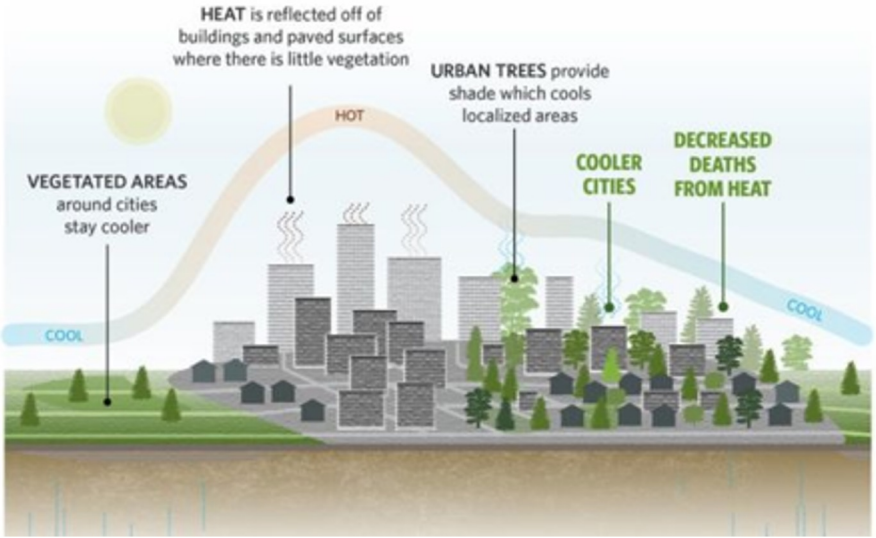
Storage of carbon in trees and green spaces in general

Adjustment

Cooling of the temperature in summer due to evaporation and shading

Protection against erosion during heavy rainfall

Effects on health and psyche



Source: https://www.bbc.com/news/science-environment-37813709

Reduction of CO_2 Emissions

Wood plants are an excellent and cheap carbon sink that can assimilate and store atmospheric CO_2:

Assimilation

Carbon is removed from the atmosphere by trees and converted into sugar by photosynthesis.

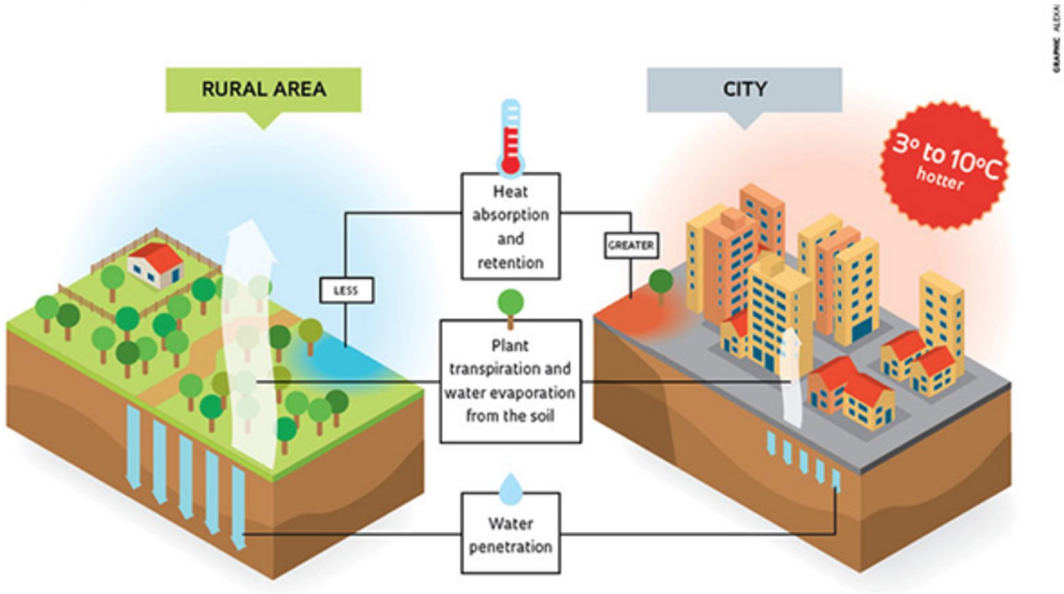
Storage

Parts of carbon that remain permanently in organic form as wood biomass until the death of the tree.

Source: http://regrow-trees.com/AboutTrees.aspx

Temperature cooling

It is estimated that in the USA 3 to 8% of the electricity consumption is due to the neutralization of the heat islands in cities.



Source: T E R I. 2017 Final Report on Urban Planning Characteristics to Mitigate Climate Change in Context of Urban Heat Island Effect

Protection from heavy rainfall

Source: http://www.deeproot.com/blog/wp-content/uploads/stories/2014/06/Stormwater-Quality-Benefits-of-Trees_Adelie-Freyja-Annabel.jpg

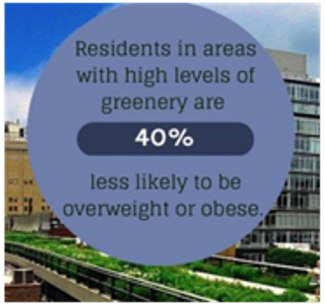
Trees slow down heavy rain by intercepting the rain with the leaves and then reducing the direct effect of the rain on the soil.

(Berlan et al., 2017)

Effects on physical and mental health

Makes, 2012. "The Economics of Biophilia." Terrapin Bright Green

Ellaway et al., 2005. British Medical Journal 331: 611-12



Bell et al. 2008. American Journal of Preventive Medicine. Vol 35 (5): 547-553)

Lovasi et al., 2008. Journal of Epidemiol Community Health 62: 647-49

Urban Green Areas are an Investment into the future

The total positive effects of green areas are much higher than their building costs:

- ❑ Increasing the value of buildings
- ❑ Impulse to trade
- ❑ Savings for cooling houses in summer and heating in winter
- ❑ .....

Source: https://www.chicago.gov/city/en/depts/dca/supp_info/millennium_park.html

The importance of maintenance

Municipalities spend a lot of money to maintain their green areas (Vienna 95M €/y, Berlin 150M €/y, Milano 20M €/y)

Maintenance of urban green areas is complex and requires many people, machines and material.
A correct maintenance is important to maximise the positive contribution of trees and extend the life cycle (Hauer, 2015)

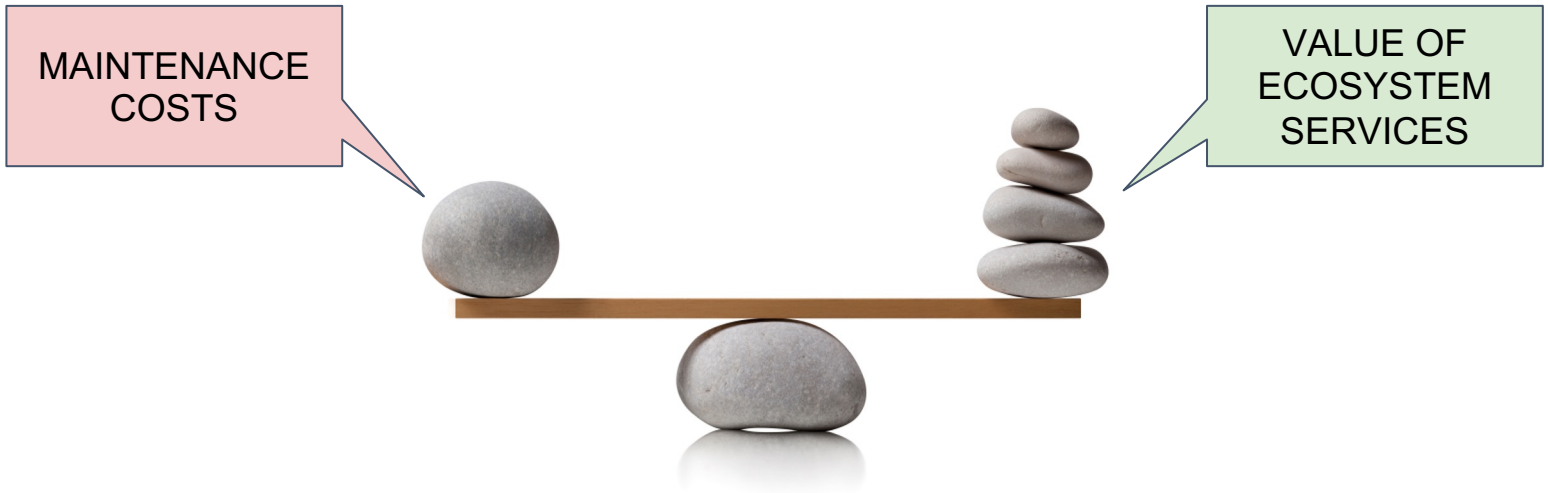
Maintenance tools are needed to help cities to organise and monitor their activities and at the same time maximise ecosystem services

R3 TREES®

Is a management platform used by 150 cities in Europe to organise, document and monitor the maintenance of urban green areas. LIFE URBANGREEN builds on R3 TREES.

Scarcity of resources

Green spaces are cost centres, but do not generate direct revenues. The funds for the maintenance of green areas are reduced annually. The total value of the green areas is not perceived.



LIFE URBANGREEN

LIFE Programme of the EU

The LIFE programme is the EU's funding instrument for the environment and climate action created in 1992. The current funding period 2014-2020 has a budget of €3.4 billion.

LIFE - Environment sub-programme:

- Nature and biodiversity
- Environment and resource efficiency
- Environmental governance and information

LIFE - Climate action sub-programme:

- Climate change mitigation
- Climate change adaptation
- Climate governance and information

https://ec.europa.eu/easme/en/life

LIFE URBANGREEN

LIFE URBANGREEN aims at improving an existing Urban Green Management-Plattform with **innovative Components**, to maximise the provision of **Ecosystem Services** through urban green areas and to improve the **efficiency of maintenance activities**.

The tools developed in the project are tested in **Rimini (Italy)**, **Krakow (Poland)** and **Taipei (Taiwan)**.

Project timeframe	01.07.2018 - 30.06.2021
Total budget	2,513,784.00 €
EU contribution	1,310,335.00 €

Project partners

R3 GIS srl – Bolzano (IT) - Project coordinator

Progea 4D – Krakow (PL)

University of Milano (IT)

University of Firenze (IT)

Anthea srl - Rimini (IT)

Zarzad Zieleni Miejskiej - Krakow (PL)

External Partners

City of Taipei (TW)

National Central University of Taiwan

Steering Committee

A steering committee ensures that the activities of the project are of interest and benefit to the participating cities and green spaces worldwide:

- Rimini City Councillor for the Environment (Anna Montini)
- Krakow City Commissioner for Climate Issues (Andrzej Łazęcki)
- European Representative nominated by the World Urban Parks Association (Jean Marie Rogel - City of Lione)

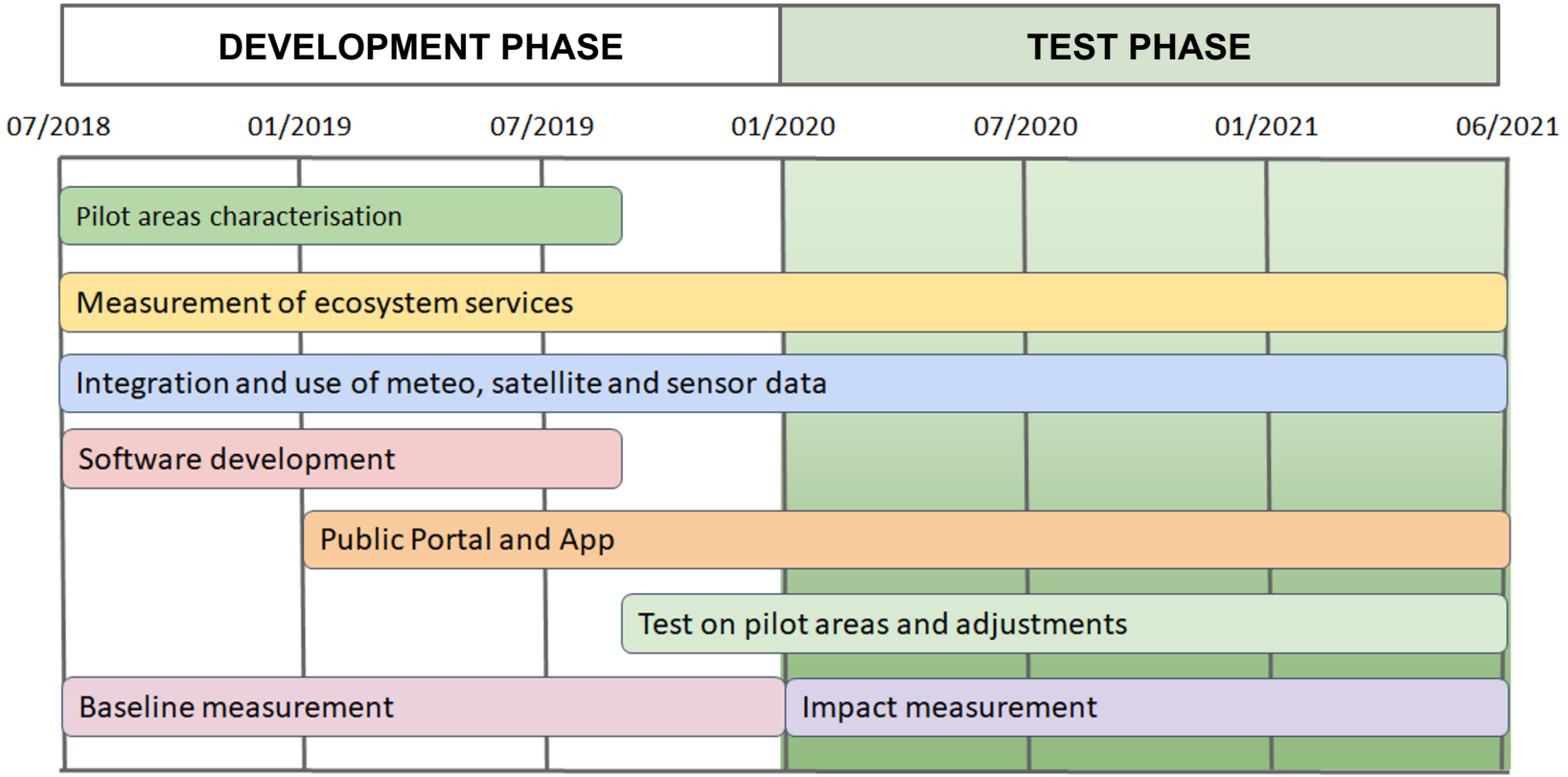
Comune di Rimini

Kraków

WORLD URBAN PARKS
the organisation for open space and recreation

Project cities (and pilot areas)

Project Actions



Pilot area characterization

OBJECTIVE: Selection of Pilot and Control areas in Krakow and Rimini to develop, test and demonstrate the LIFE URBANGREEN innovative management approach

Paved areas: tree lanes, parkings, trees located in defined planting holes with strong interaction between tree and built environment.

Unpaved areas: trees in parks and gardens, located on free soil, with few interaction with constructions.

Pilot area characterization

Selection of representative tree species

RIMINI

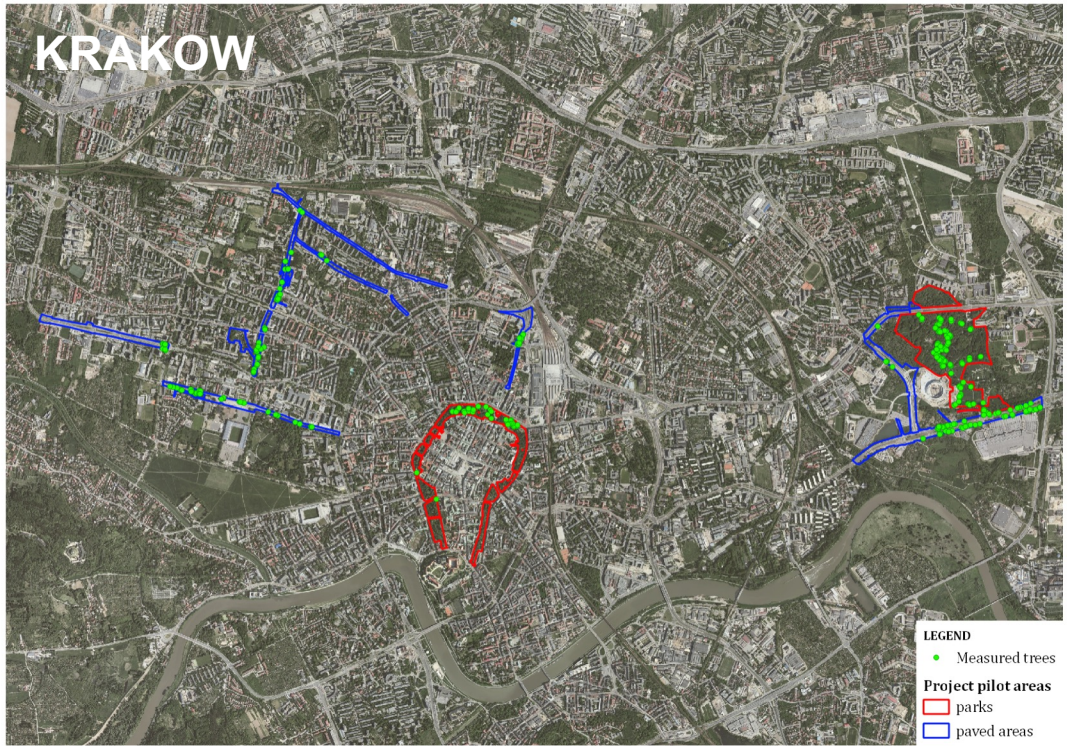
Specie	Habitus
Quercus robur	Big deciduous tree
Platanus x acerifolia	Big deciduous tree
Populus nigra	Big deciduous tree
Quercus ilex	Big evergreen broadleaf
Pinus pinea	Evergreen conifer
Tilia x europaea	Medium/big broadleaf tree
Aesculus hippocastanum	Medium/big broadleaf tree
Acer negundo	Medium broadleaf
Ligustrum lucidum	Small broadleaf
Prunus laurocerasus	Evergreen shrub

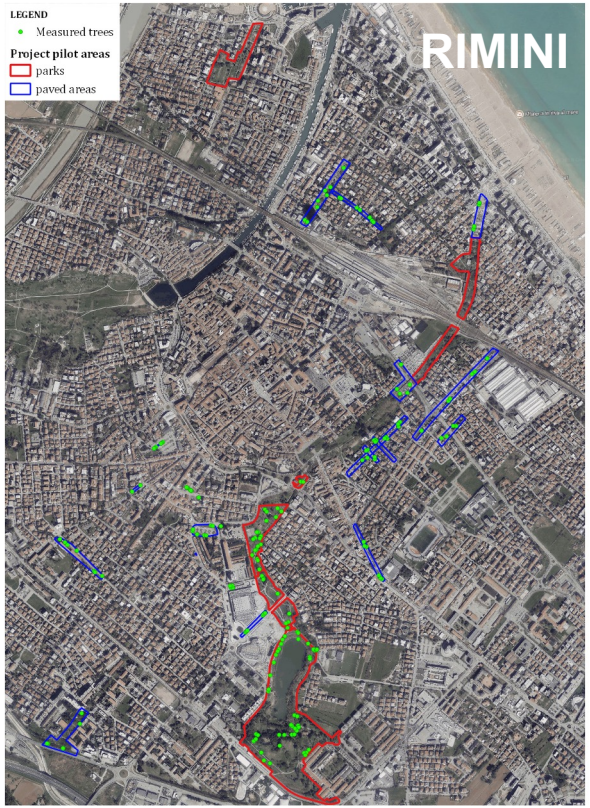
KRAKOW

Specie	Habitus
Quercus robur	Big deciduous tree
Fraxinus excelsior	Big deciduous tree
Populus nigra	Big deciduous tree
Ulmus laevis	Big deciduous tree
Pinus nigra	Evergreen conifer
Tilia cordata	Medium/big broadleaf tree
Aesculus hippocastanum	Medium/big broadleaf tree
Acer platanoides	Medium/big broadleaf tree
Sorbus aucuparia	Small broadleaf tree
Cornus alba	Deciduous shrub

Pilot area characterization

SELECTION OF PROJECT AREAS AND TREES

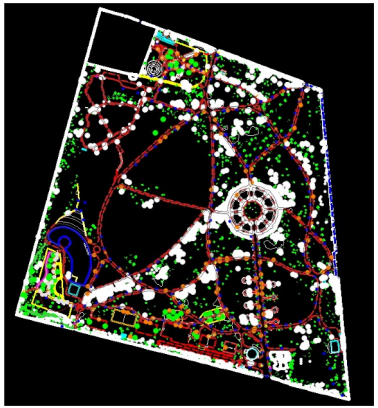




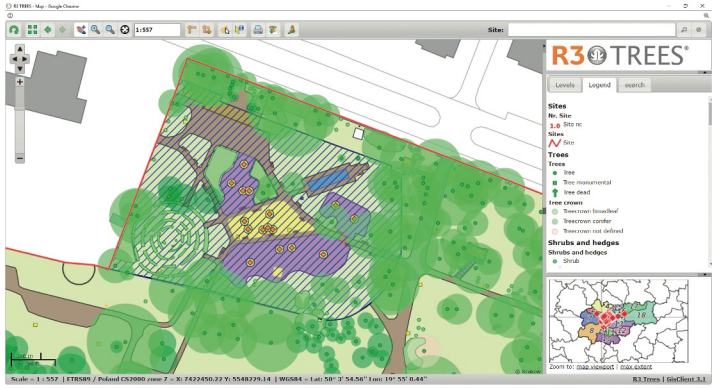
Pilot area in Taipei

Activities in Taipei are funded by the Taiwan Ministry of Science and Technology.

LIDAR (Light Detection And Ranging)



Laser scan technology is used to create a precise inventory of the urban green areas and quantify ecosystem services



Source images: Progea4D

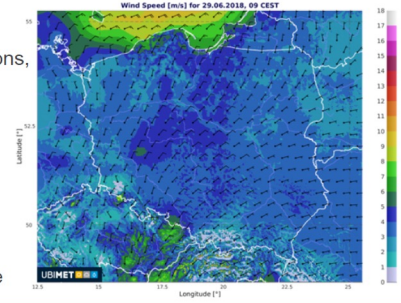
Smart irrigation system

OBJECTIVE: improvement of water resource delivery and management through the identification of critical thresholds based on climatic models, plant water requirements and meteo forecasts

Background: UBIMET Analysis HYDRA©

HYBRID DOWNSCALING BASED ON REGRESSION AND ANALYSIS

- Patended Algorithm
- Numerous input data (Weather Stations, Radar, Satellite, Lightning)
- Downscaling via „Fingerprints“:
  - Topographic effects
  - Hydrographic effects
  - Thermal effects
- Weighted spatial regression methode



UBIMET

MONITORED

temperature
wind speed
wind direction
gusts of wind
rainfall (mm)
snow (mm)
humidity
insulation diffuse
insulation direct

FORECAST

EVAPOTRANSPIRATION

Input for water requirement algorithm

Smart irrigation system

The water requirement calculation tool uses the University's weather data and research results to estimate water requirements and thus allows actual transpiration to be calculated and weather forecasts to be taken into account.

Species water requirement + Evapotranspiration + Landscape coefficient + Area conditions + Available water + Past and expected rain = GEOREFERENCED ALARM FOR IRRIGATION

Proposed route and best method

Smart irrigation system

ALERT ON TREES REQUIRING WATER

R3O TREES®

admin

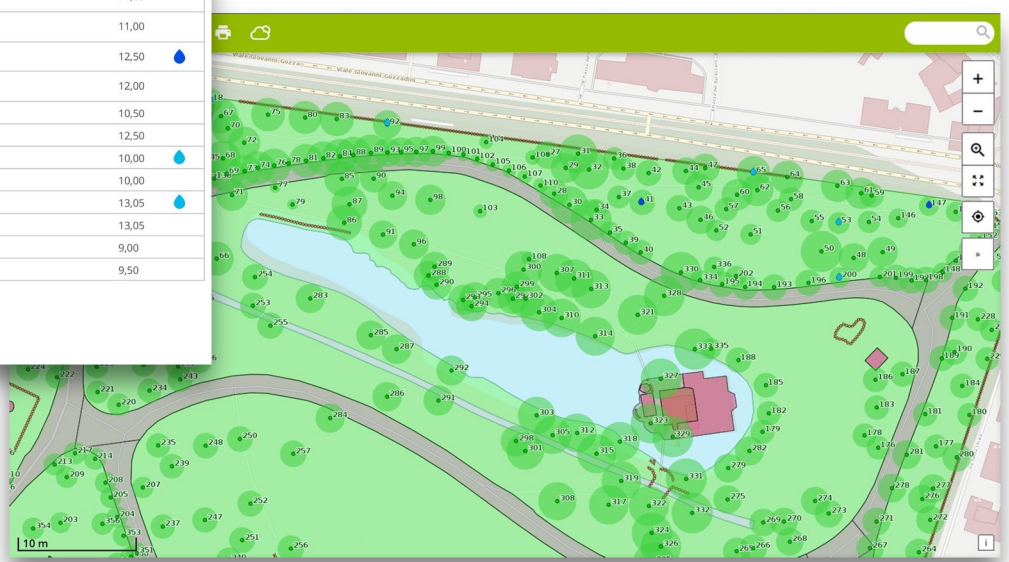
General

- Open map
- Weather Data
- Sites
- Objects
- Statistics
- Communications [0]
- Trees
- Plant with planned TRA
- TRA
- Shrubs, shrubs areas, hedges
- Playground/Sporting Area
- Equipment

Close menu

Trees

Site	Tree nr.	Tag Nr.	Taxonomy	Calculated tr..	Date TRA	Risk class	Height	Water
BIM1 - Centro Direzionale Piazza del Popoloparco	5	4680	Populus nigra Italica (Pioppo cipressino)	55			13,50	
BIM1 - Centro Direzionale Piazza del Popoloparco	15	4671	Quercus ilex (Leccio)	63			11,00	
BIM1 - Centro Direzionale Piazza del Popoloparco	23	4125	Tilia x europaea (Tiglio)	71			11,00	
BIM1 - Centro Direzionale Piazza del Popoloparco	53	4175	Pinus pinea (Pino domes...	68			12,50	
BIM1 - Centro Direzionale Piazza del Popoloparco	44	4002	Populus alba (Pioppo bia...	68			12,00	
BIM33 - Parco del Gelso	6	1339	Tilia x europaea (Tiglio)	70			10,50	
BIM33 - Parco del Gelso	10	1439	Pinus pinea (Pino domes...	-			12,50	
BIM33 - Parco del Gelso	50	2160	Celtis australis (Bagolaro)	-			10,00	
BIM33 - Parco del Gelso	50	2160	Celtis australis (Bagolaro)	44			10,00	
BIM33 - Parco del Gelso	33	2462	Quercus robur (Farnia)	50			13,05	
BIM33 - Parco del Gelso	42	2552	Pinus pinea (Pino domes...	50			13,05	
BIM33 - Parco del Gelso	88	3476	Tilia x europaea (Tiglio)	35			9,00	
BIM33 - Parco del Gelso	89	3477	Tilia x europaea (Tiglio)	36			9,50	

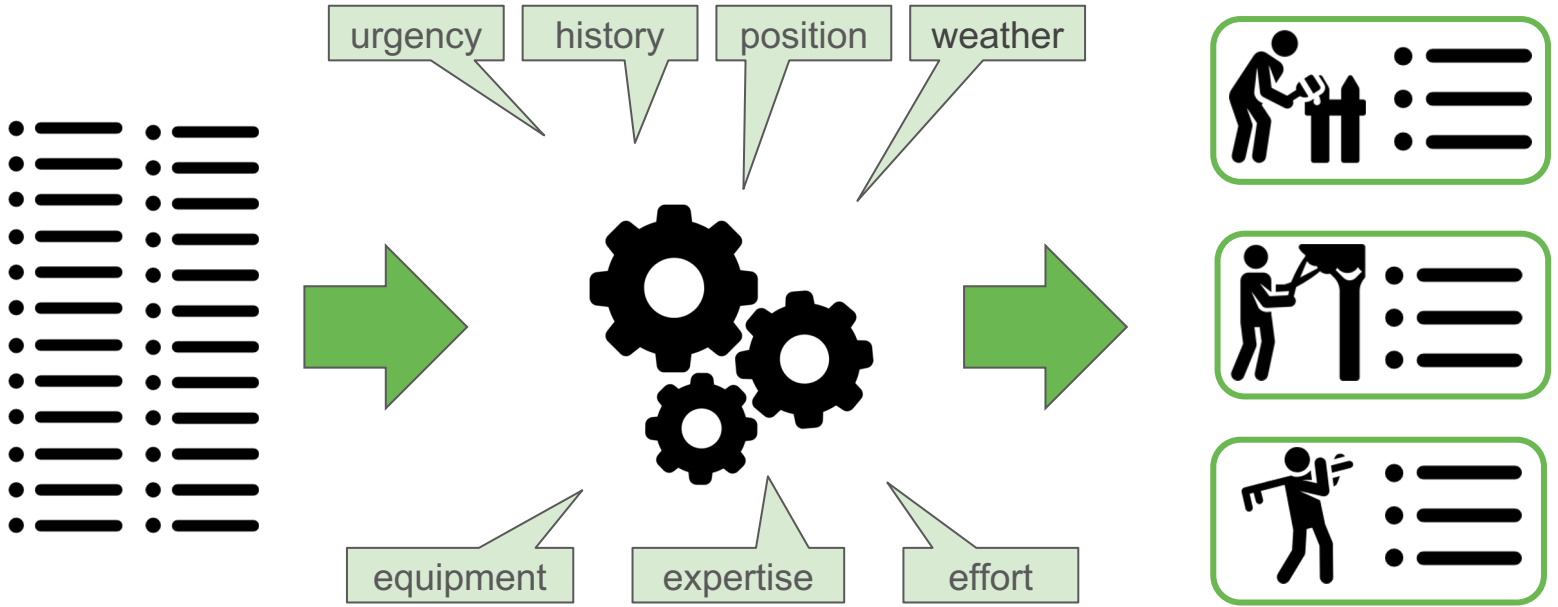


Smart irrigation system

Taking into account the efficiency of different irrigation methods when planning interventions

Efficient programming of jobs and control activities

OBJECTIVE: Determine the sequence of daily scheduled works to make maintenance activities more efficient and reduce their carbon footprint.

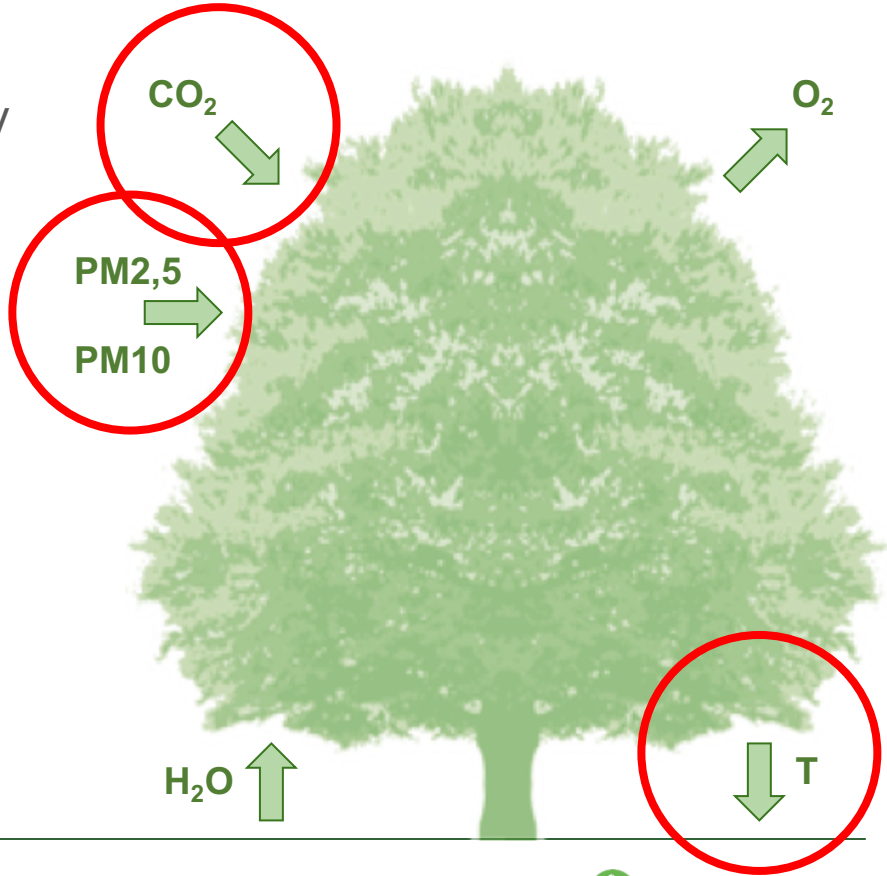


Ecosystem services calculation

OBJECTIVE: estimation of benefits of green areas for a sustainable and healthy urban environment

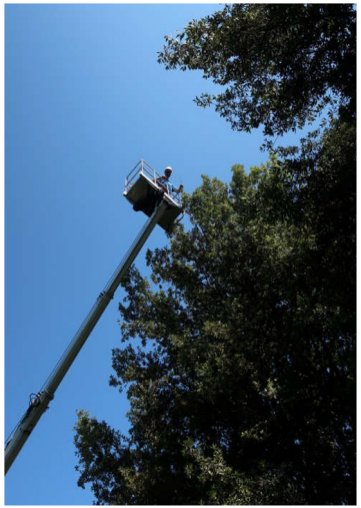
DESCRIPTION: Understand environmental benefits provided by selected tree species in the two cities

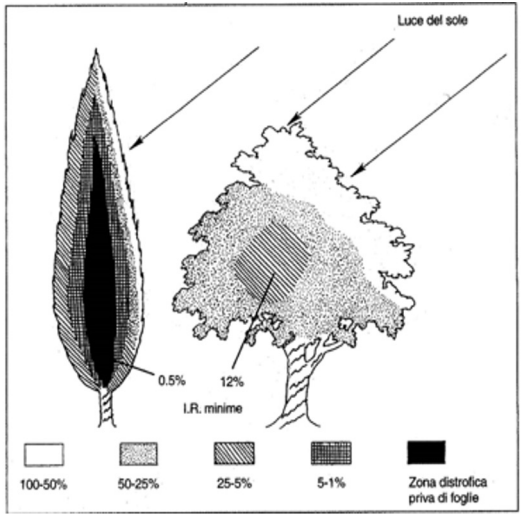
1- Carbon storage
2- Carbon assimilation
3- Pollution adsorption on leaves
4- Thermoregulation



Ecosystem services calculation

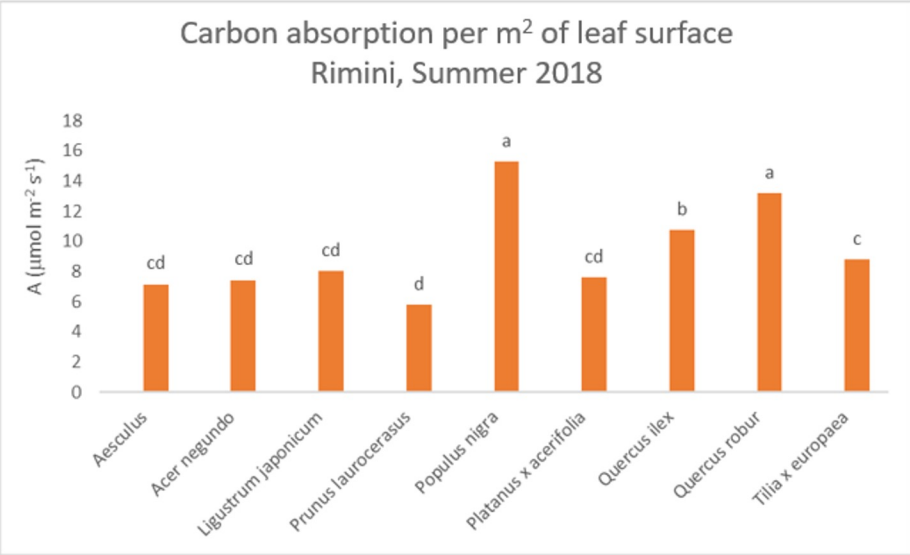
Measurements on the leaves determine the contribution of the plants in terms of CO2 stored and absorbed, pollutants captured by the leaves, microclimatic mitigation.

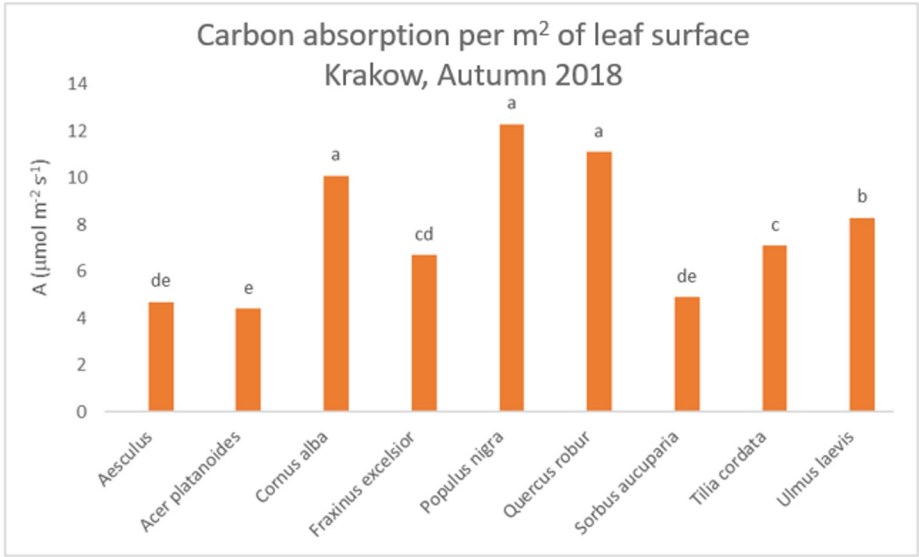




Ecosystem services calculation

PRELIMINARY RESULTS 2018

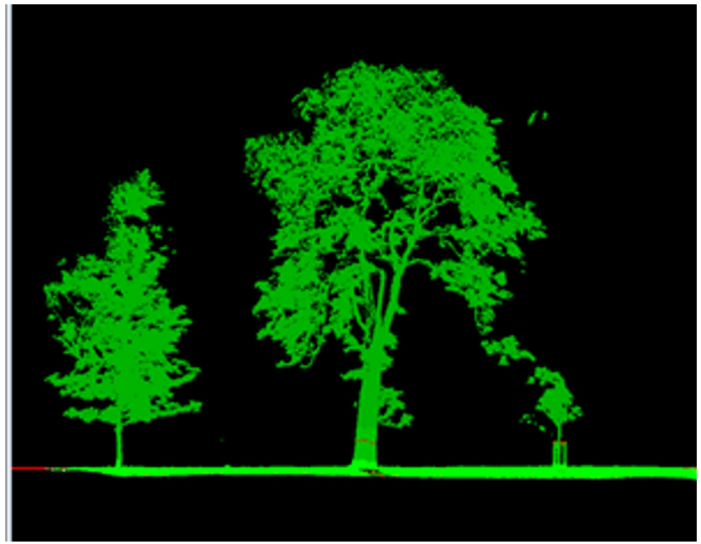




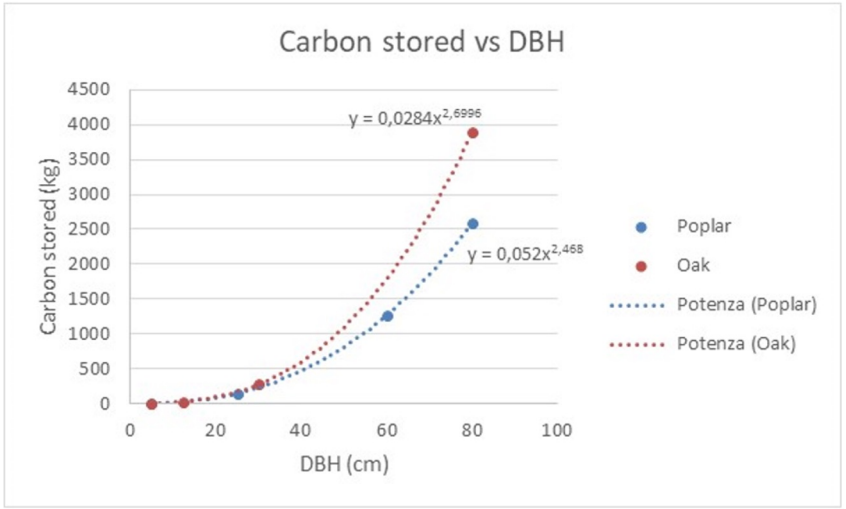
Ecosystem services calculation

DATA ANALYSIS

LiDAR data to relate stem diameter, leaf area, carbon stored and carbon absorbed

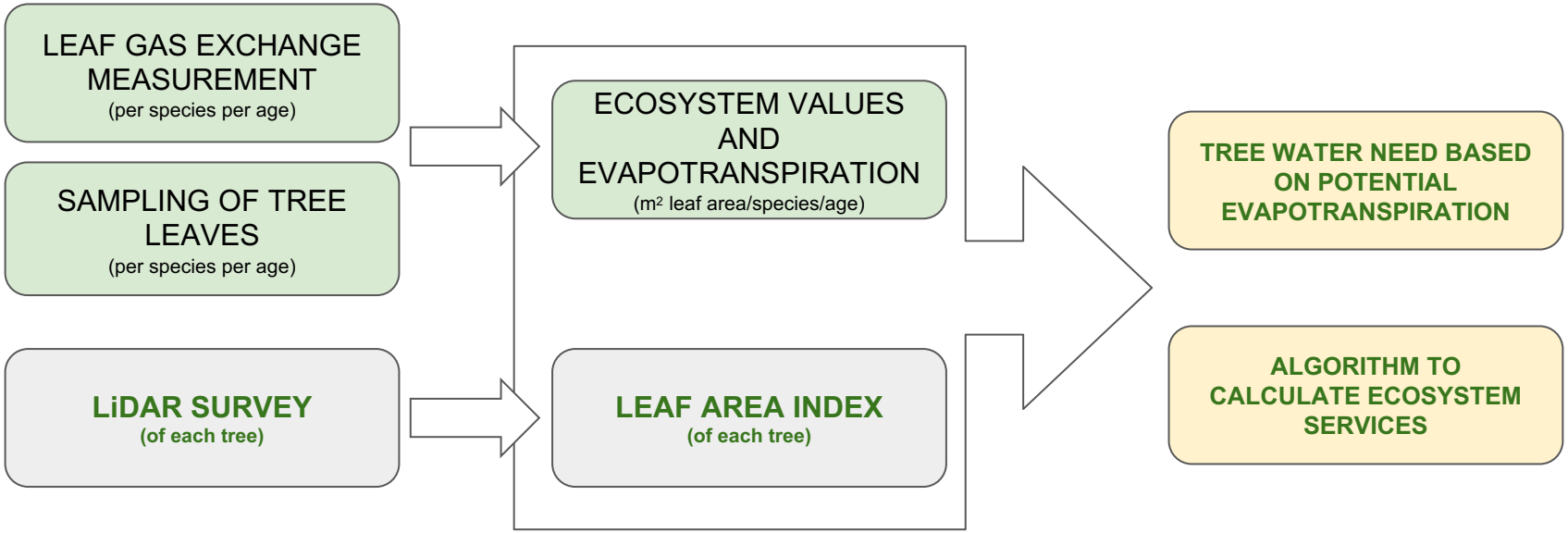


Source: Progea4D



Ecosystem services calculation

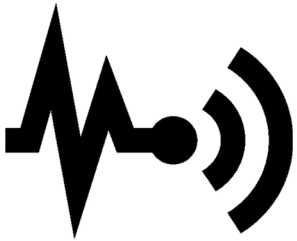
MEASUREMENT CAMPAIGN



Monitoring through IOT, meteo and RS data

Use weather, remote sensing and sensors data to improve green area management and maximise ecosystem services:

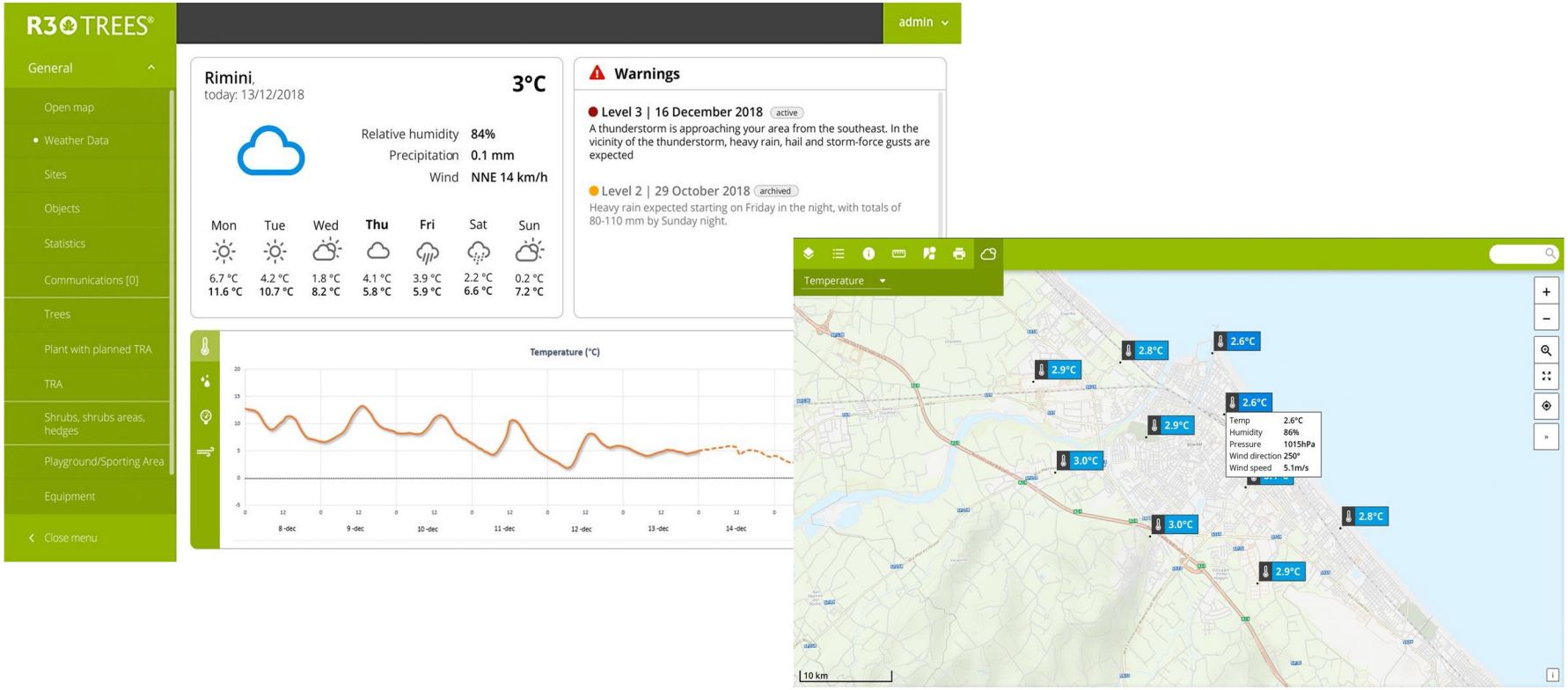
meteo-data for irrigation efficiency, work planning and severe weather alerts



IOT sensors to collect environmental and tree physiology data

RS data for tree health monitoring and vegetation assessment

Monitoring through IOT, meteo and RS data



Monitoring through IOT, meteo and RS data

Severe Weather Warnings

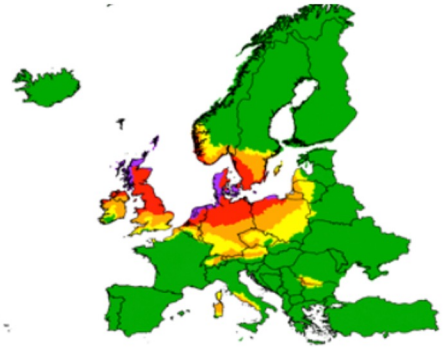
PRECISE WARNINGS TO PREVENT DAMAGE

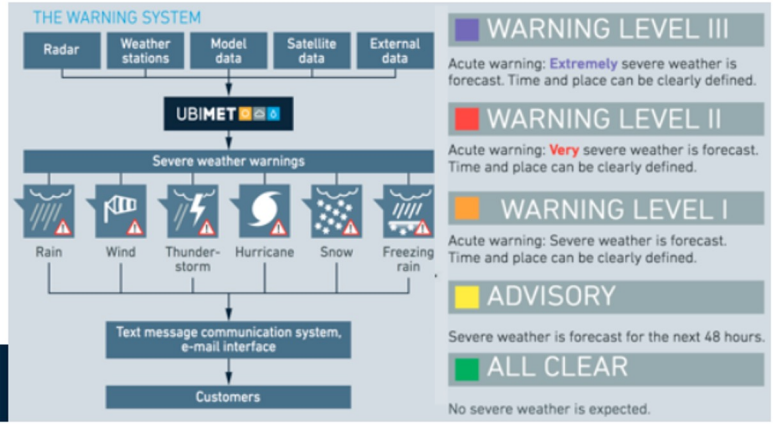
Features & Benefits

- Hyperlocal severe weather warnings via SMS/E-Mail
- Helps customers in preventing or reducing damage
- Warnings are sent out in advance (48 hours to 15 minutes prior to the event)
- 24x7 manned Severe Weather Centrale

UBIMET - SWC

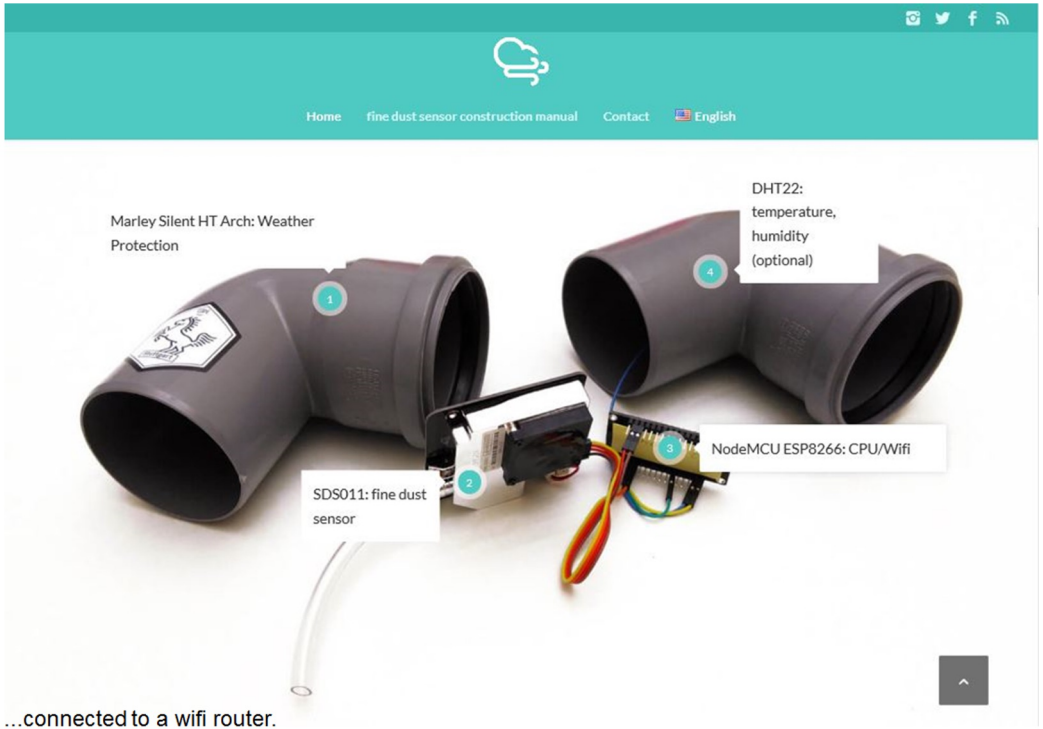
- 100 Mio. alerts in the last years
- 1 Mio. recipients in Europe





Monitoring through IOT, meteo and RS data

SENSORS MEASURING AIR POLLUTION (PM10, PM2,5, T, RH)



Monitoring through IOT, meteo and RS data

SENSORS MONITORING TREES

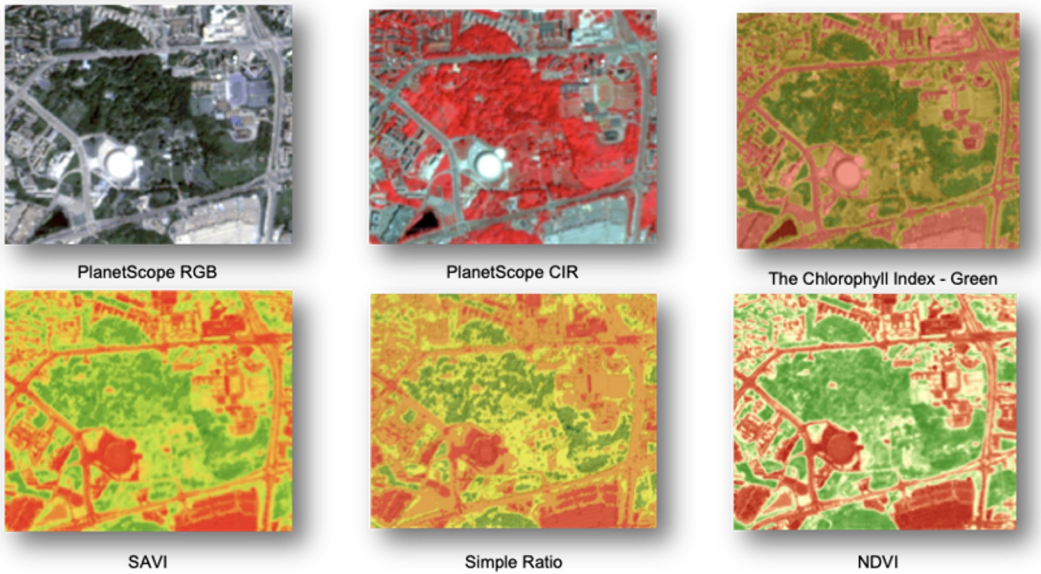
- Water transport in the tree
- Growth through diameter changes
- quantity and quality of foliage (light transmission in four spectral bands)
- Climate and soil parameters
- Tree stability with motion sensor
- Air temperature and humidity
- Data is transmitted to the cloud by radio

Monitoring through IOT, meteo and RS data

USE OF SATELLITE IMAGES

Through a weekly comparison of the pixels where the same tree species occur, health problems in trees should be detected early.

In addition, the satellite data will be used to determine further indicators for the entire vegetation of the urban area.



Monitoring through IOT, meteo and RS data

Use of weekly Planet Satellite data to monitor health of trees in urban green areas

Source: www.planet.com

planet.

Download Planet Imagery Data

Define API Key, AOI area, Start/End time of acquisition, Max. Cloud Cover and download imagery data

Delivery of Ranked VI Values

Calculate 10 quantiles in ranked order based on indicated VIs

Trees GeoDatabase

Multitemporal Monitoring Vegetation

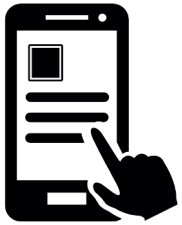
Calculate change detection based on developed scenarios. Delivery risk maps and alarmed trees.

Public engagement

Solicit social involvement of citizens in urban green area management. Two tools will be developed:

a web portal for the public, georeferenced visualization of data on green areas, such as:

- inventory of public green areas, trees and playgrounds,
- data monitored by the IoT networks
- ecosystem services of green areas



a mobile app allowing access to the same information in the field and feedback from citizens

Testing and demonstration of LIFE URBANGREEN

From October 2019 all tools developed during the previous months will be tested in daily management activities on pilot areas:

Best practices according to the LIFE URBANGREEN Platform to be applied in the pilot areas:

- **Smart Irrigation**
- **Target pruning**
- **Mulching**
- **Efficient programming of maintenance activities**
- **Monitoring through sensors and RS**

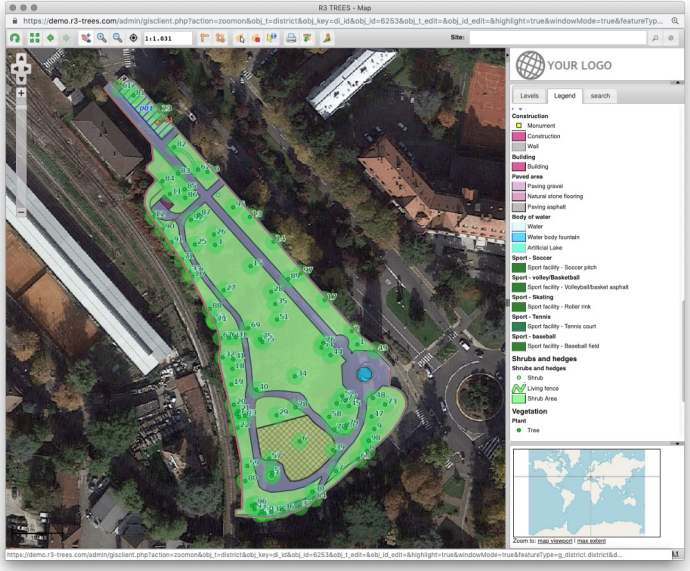
Traditional practices normally used in most cities, to be applied in the control areas:

- **No irrigation or irrigation based on traditional practice**
- **Topping**
- **No mulching**

LIFE URBANGREEN Results

INNOVATIVE TECHNOLOGICAL PLATFORM TO IMPROVE MANAGEMENT OF GREEN AREAS FOR BETTER CLIMATE ADAPTATION

- **SMART IRRIGATION**
- **EFFICIENT PROGRAMMING OF JOBS AND CONTROL ACTIVITIES**
- **EVALUATION OF ECOSYSTEM SERVICES**
- **MONITORING OF GREEN AREAS THROUGH IoT, RS AND METEO DATA**
- **PUBLIC PORTAL AND APP**



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With the contribution of the LIFE Programme of the European Union.
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