LIFE URBANGREEN

SMART WATER MANAGEMENT IN URBAN FORESTS: THE APPROACH OF LIFE URBANGREEN

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R3GIS managing spaces · Anthea · Kraków Municipal Greenspace Authority · Università degli Studi di Milano · ProGea 4D

With the contribution of the LIFE Programme of the European Union. **LIFE17 CCA/IT/000079**

EFUF European Forum on Urban Forestry

Project coordination

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Degree in Tropical and Subtropical Agriculture

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LIFE UrbanGreen

R3GIS
managing spaces

R3GIS develops Web-GIS and mobile applications to manage geospatial data and provides innovative tools for the smart cities of the future.

Team of 20 people, based in Bolzano, South Tyrol, Italy

Operating in Italy, Austria, Germany, Switzerland, Poland, Finland, Slovenia, Hungary, Taiwan

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The LIFE URBANGREEN Project


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INNOVATIVE TECHNOLOGICAL PLATFORM TO IMPROVE MANAGEMENT OF GREEN AREAS FOR BETTER CLIMATE ADAPTATION
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ProGea
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managing spaces
Kraków
Municipal Greenspace
Authority
Rimini
Anthea
UNIVERSITÀ
DEGLI STUDI
DI MILANO
€ 2.5 M Total budget
€ 1.3 M EU contribution
07/2018
12/2021
EFUF

Three main project pillars

RESEARCH

- Leaf transpiration measurements
- Pollutant deposition analysis
- LiDAR survey
- Meteo data analysis
- IOT sensors integration
- Satellite data analysis

SOFTWARE TOOLS

- Ecosystem services calculation
- Meteo data integration
- **Smart irrigation tool**
- IOT sensors integration
- Improved job planning
- Public portal for citizens

TEST ON PILOT SITES

Test new tools and assess effect of best practices on trees:

- Target pruning
- Irrigation
- Soil decompaction
- Mulching

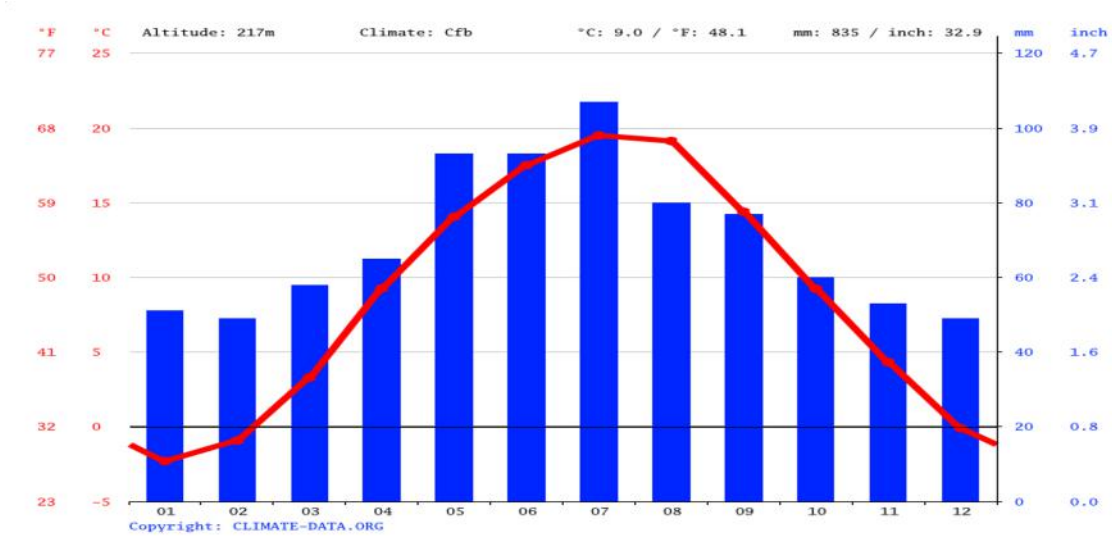
Sites and species

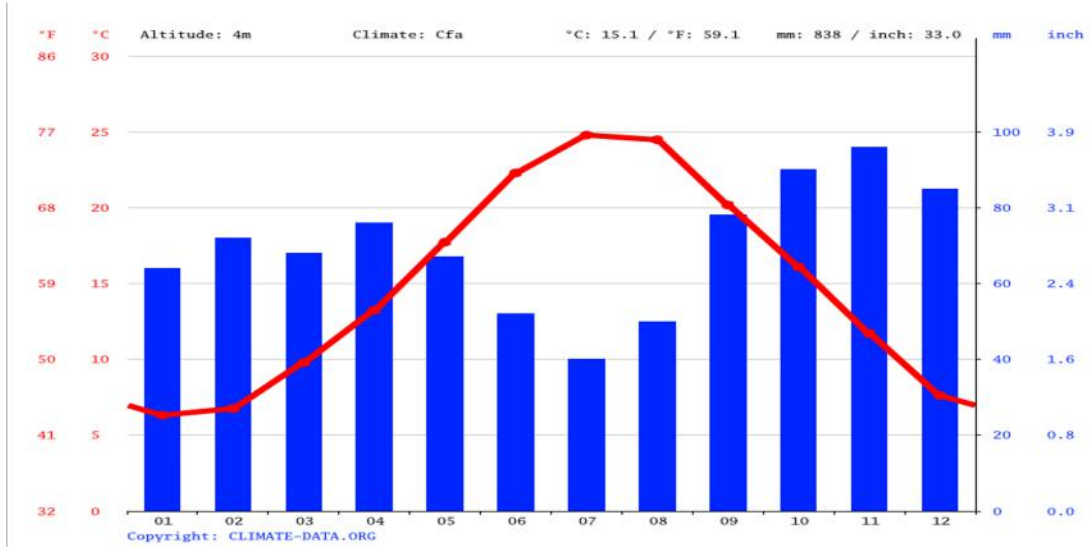
Kraków

Zarząd Zieleni Miejskiej w Krakowie

Comune di Rimini

Anthea





https://en.climate-data.org/europe/poland/lesser-poland-voivodeship/krakow-715022/#climate-graph

https://en.climate-data.org/europe/italy/emilia-romagna/rimini-1176/#climate-graph

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The studied species

Kraków (PL): 500 ha

Norway maple
Acer platanoides

Horse chestnut
Aesculus hippocastanum

European ash
Fraxinus excelsior

Rowan
Sorbus aucuparia

Little-leaf linden
Tilia cordata

Austrian pine
Pinus nigra

Pedunculate oak
Quercus robur

Black poplar
Populus nigra

European white elm
Ulmus laevis

White dogwood
Cornus alba

Rimini (IT): 250 ha

Platano
Platanus ×acerifolia

Ippocastano
Aesculus hippocastanum

Tiglio
Tilia ×europaea

Ligustro lucido
Ligustrum lucidum

Pino domestico
Pinus pinea

Farnia
Quercus robur

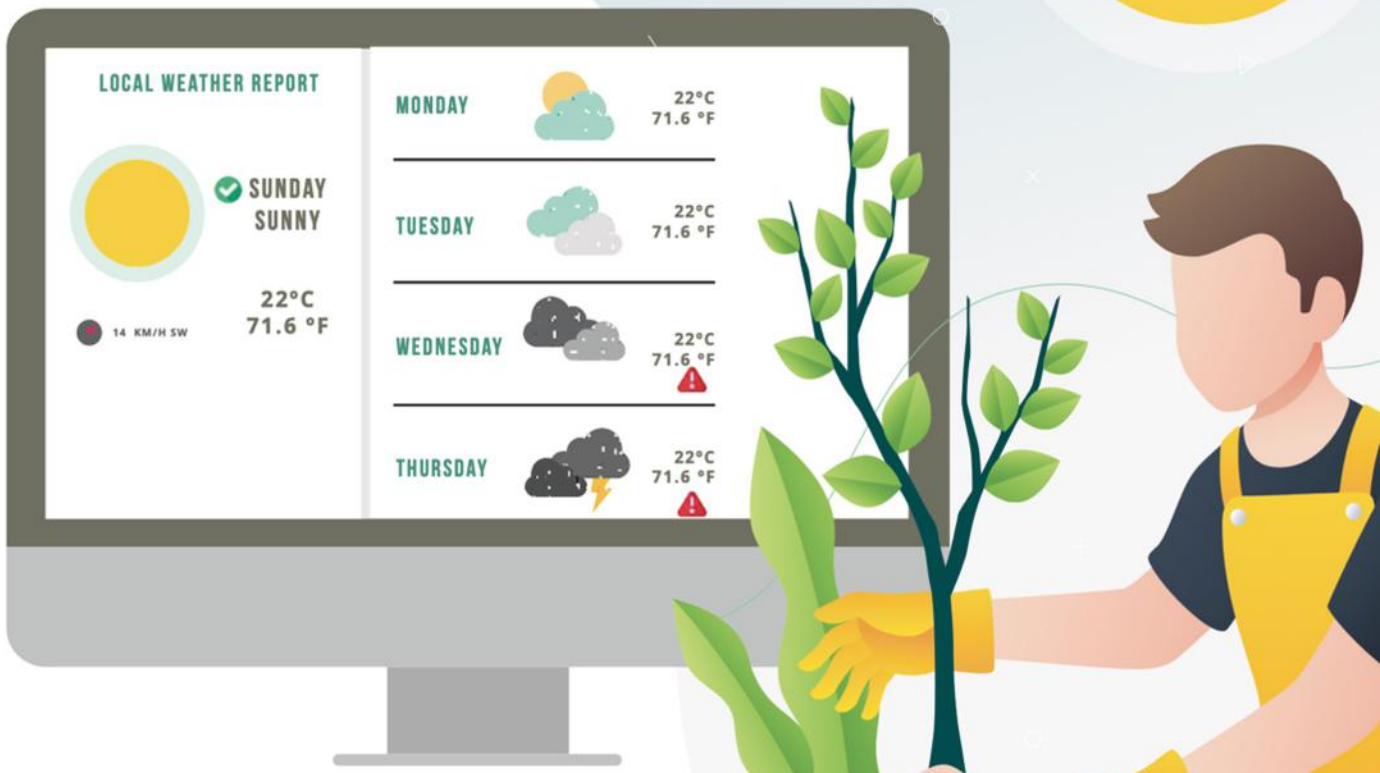
Acero americano
Acer negundo

Pioppo nero
Populus nigra

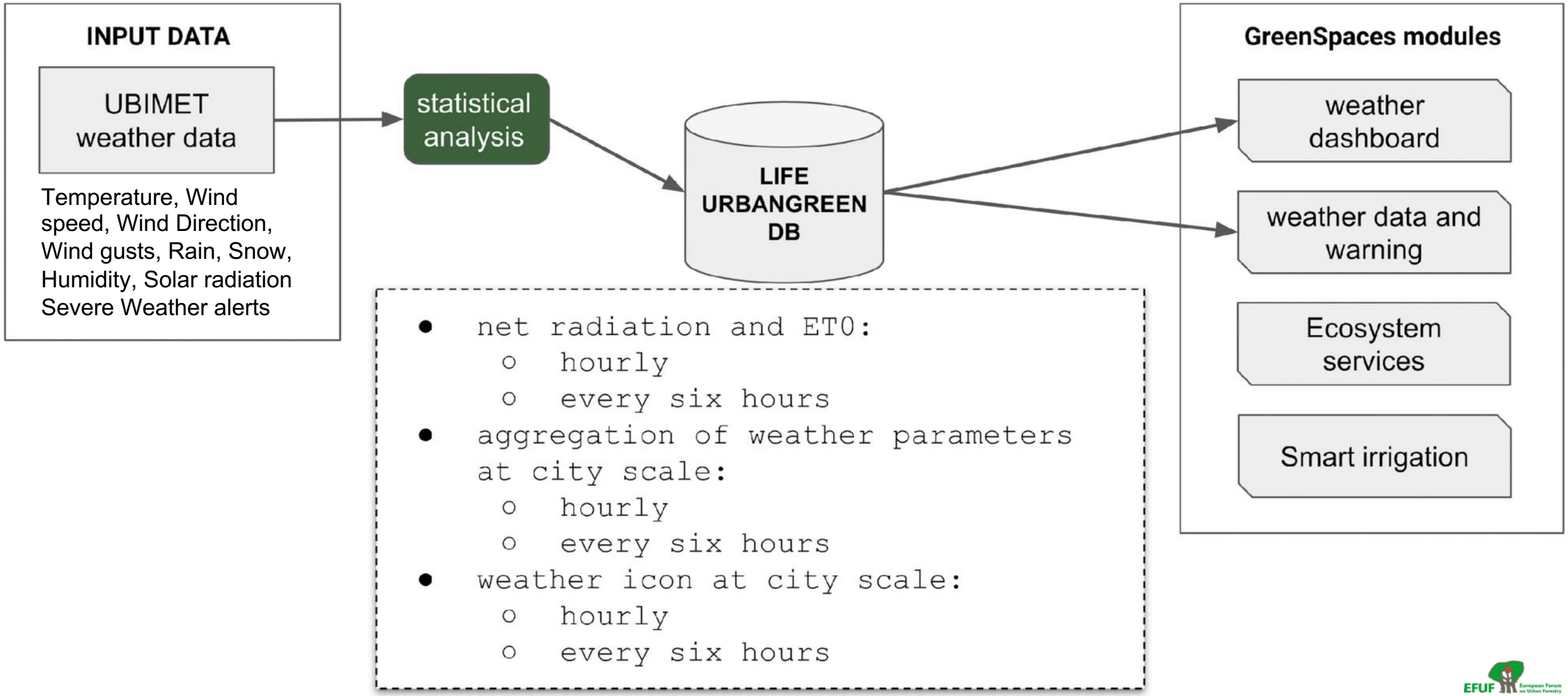
Leccio
Quercus ilex

Lauroceraso
Prunus laurocerasus

Use of meteorological data

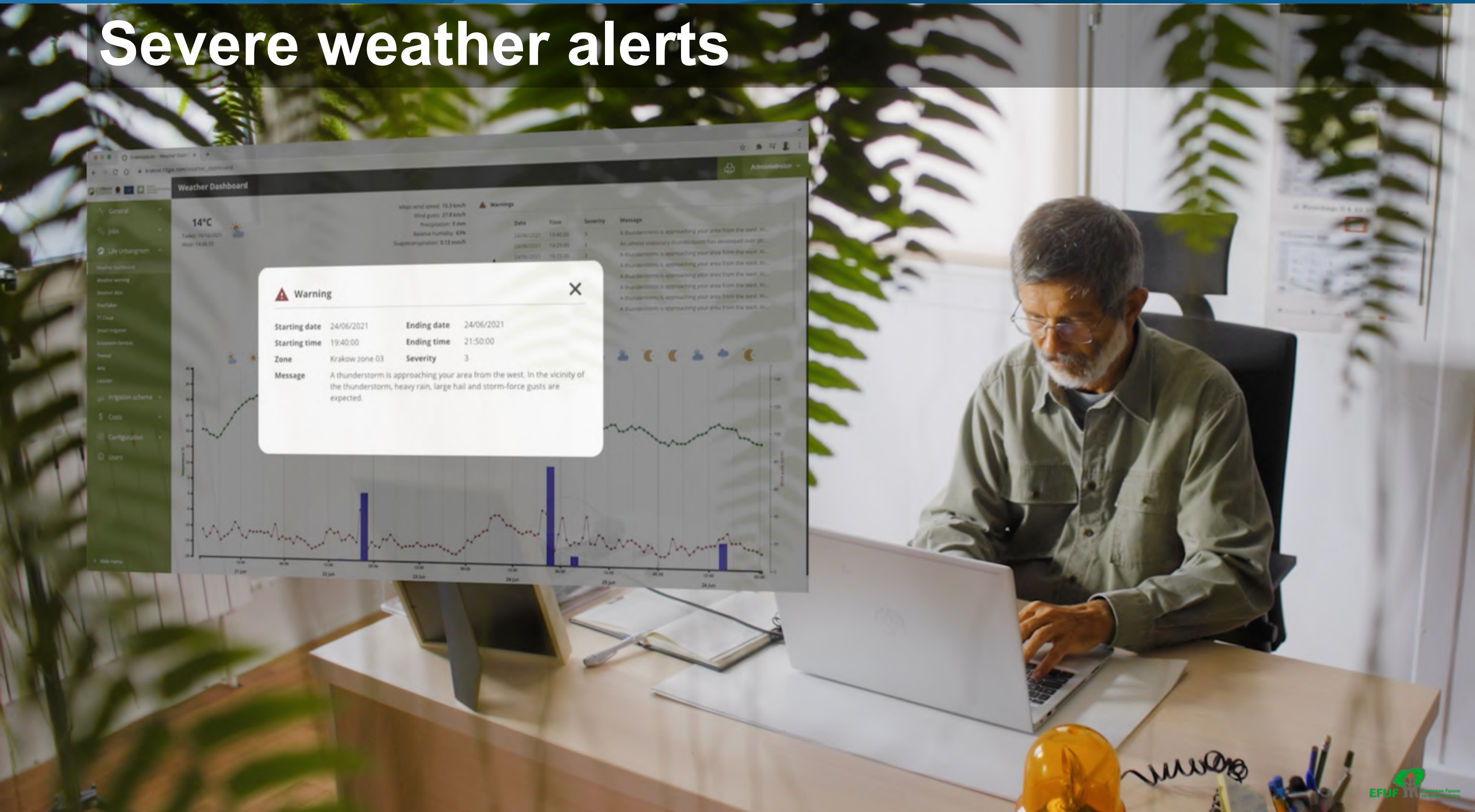


Weather data management



Weather dashboard

Severe weather alerts



Calculation of benefits of trees

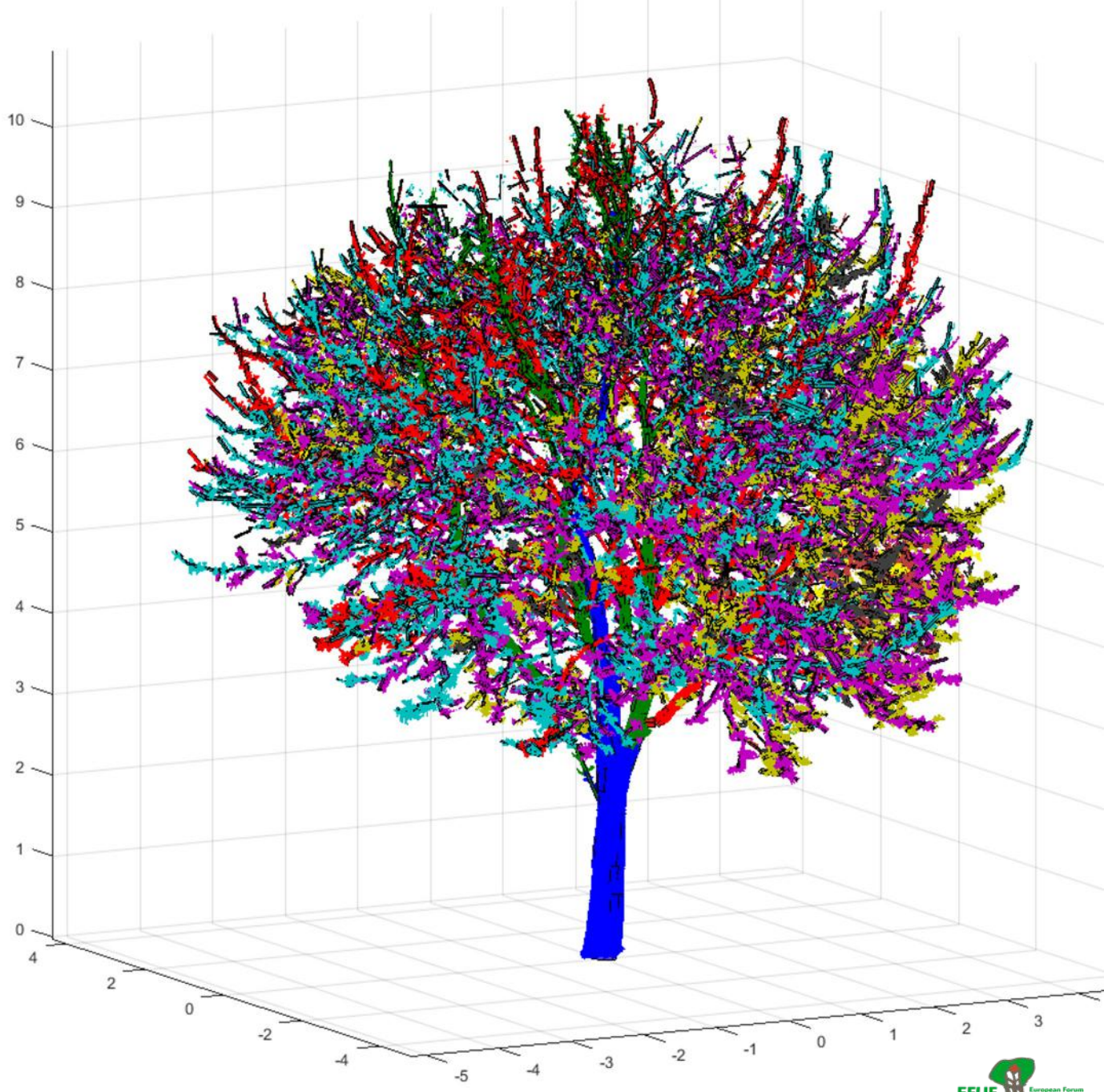
Measurement campaigns

- 500 trees in Rimini and Krakow
- Four growing seasons (2018-2021)
- 17 species (10 Rimini, 10 Krakow, 3 in common)
- More than 50% of the tree population of the two cities
- Leaf transpiration was measured to derive CO_2 adsorption and water transpiration
- LAI was measured by means of radiometric method

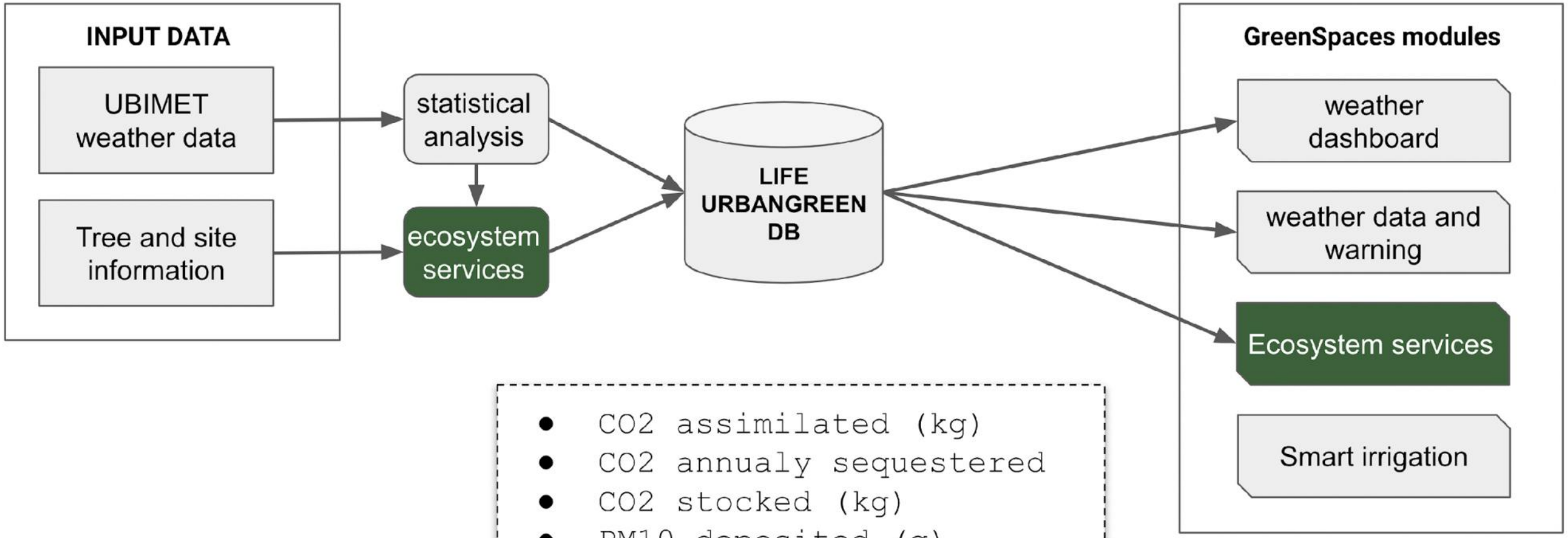
LiDAR TLS surveys

Accurate LiDAR measurement on selected trees was used to derive trunk volume, total leaf area and its distribution at different heights.

In addition, leaf samples were collected and analyzed in laboratory for deposition of pollutants (PM_{10}, $PM_{2.5}$).



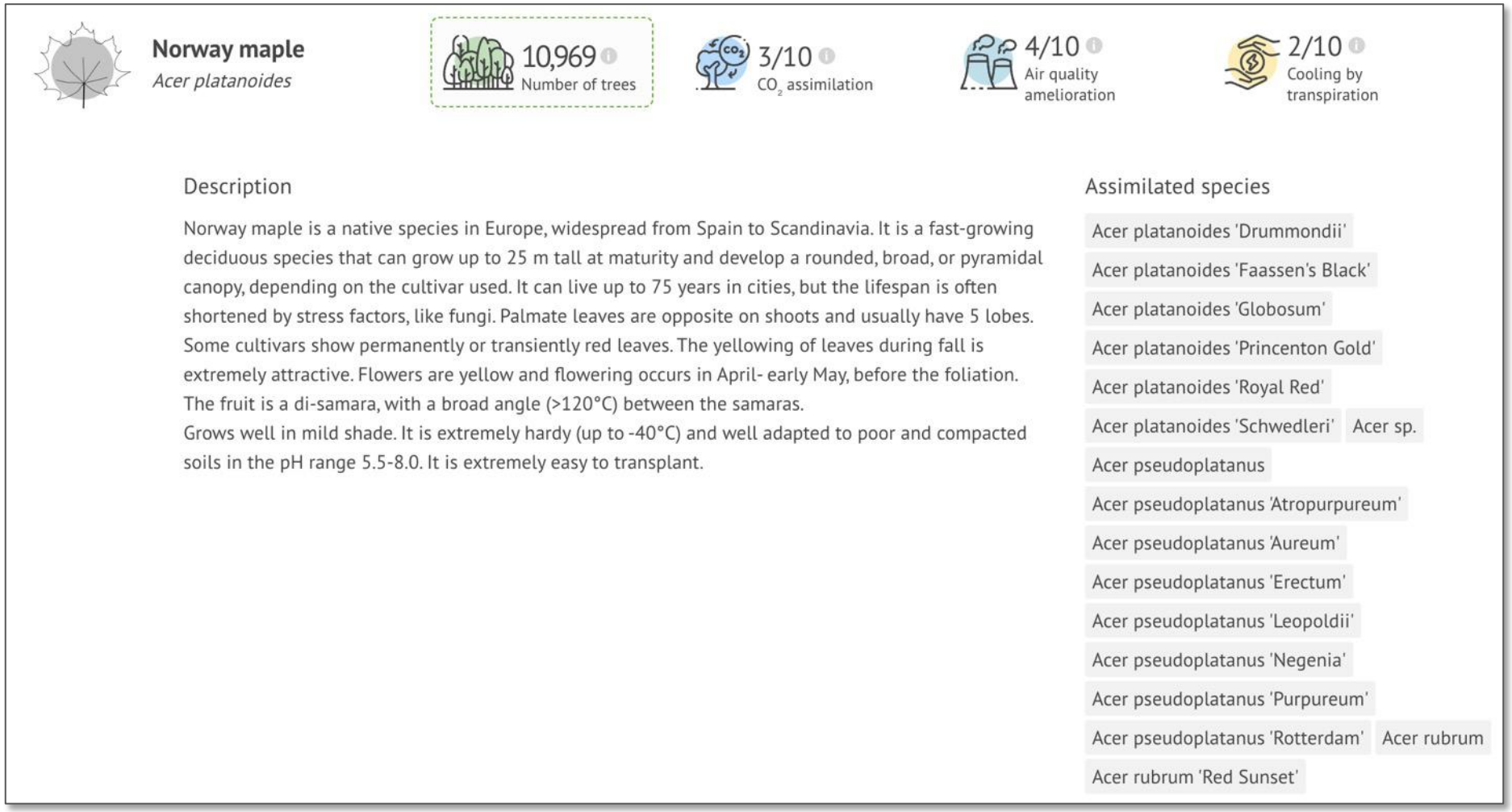
Ecosystem services calculation



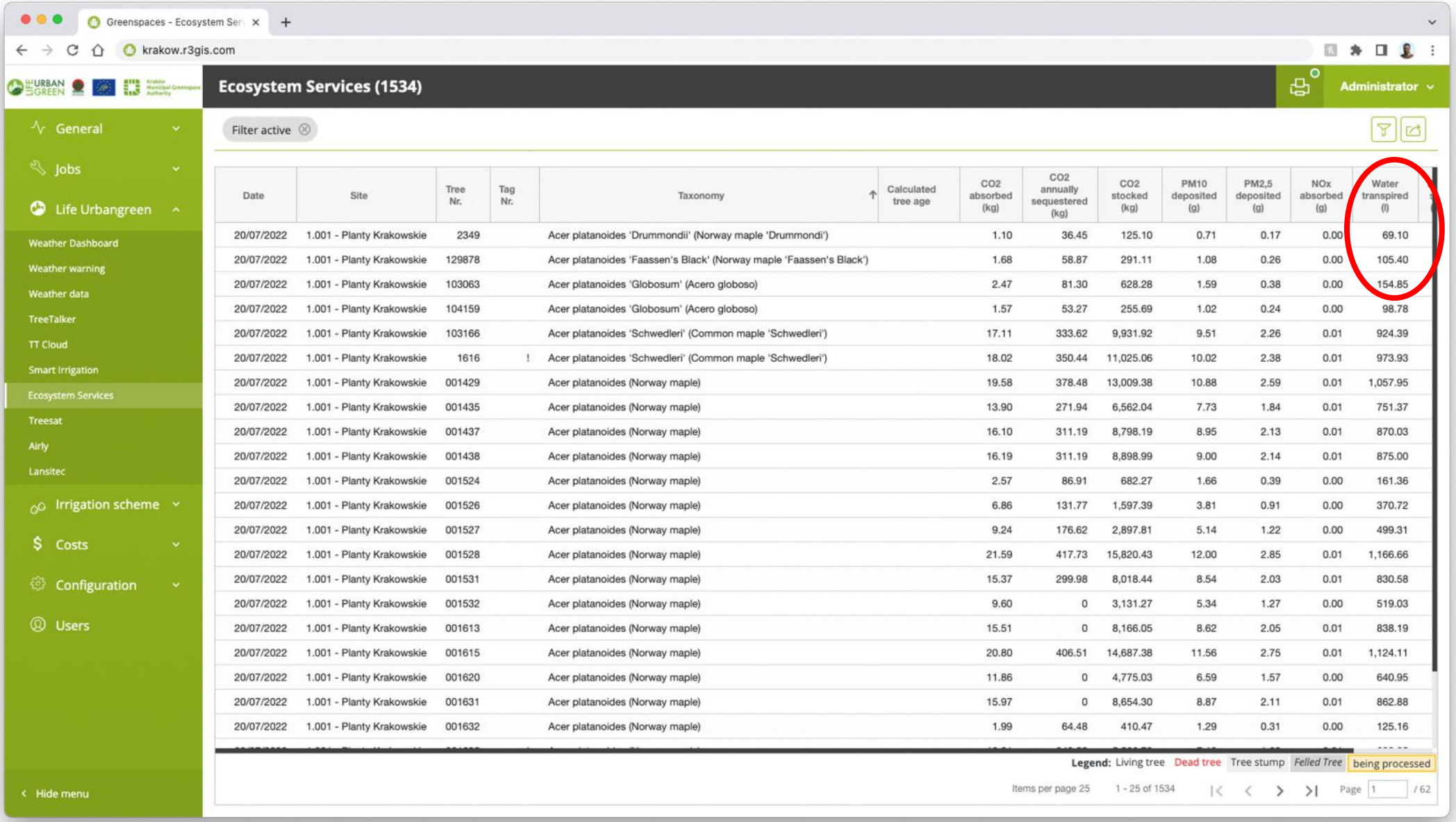
- CO2 assimilated (kg)
- CO2 annualy sequestered
- CO2 stocked (kg)
- PM10 deposited (g)
- PM2,5 deposited (g)
- Water transpired (l)
- Energy saved (kWh)

Tree benefits

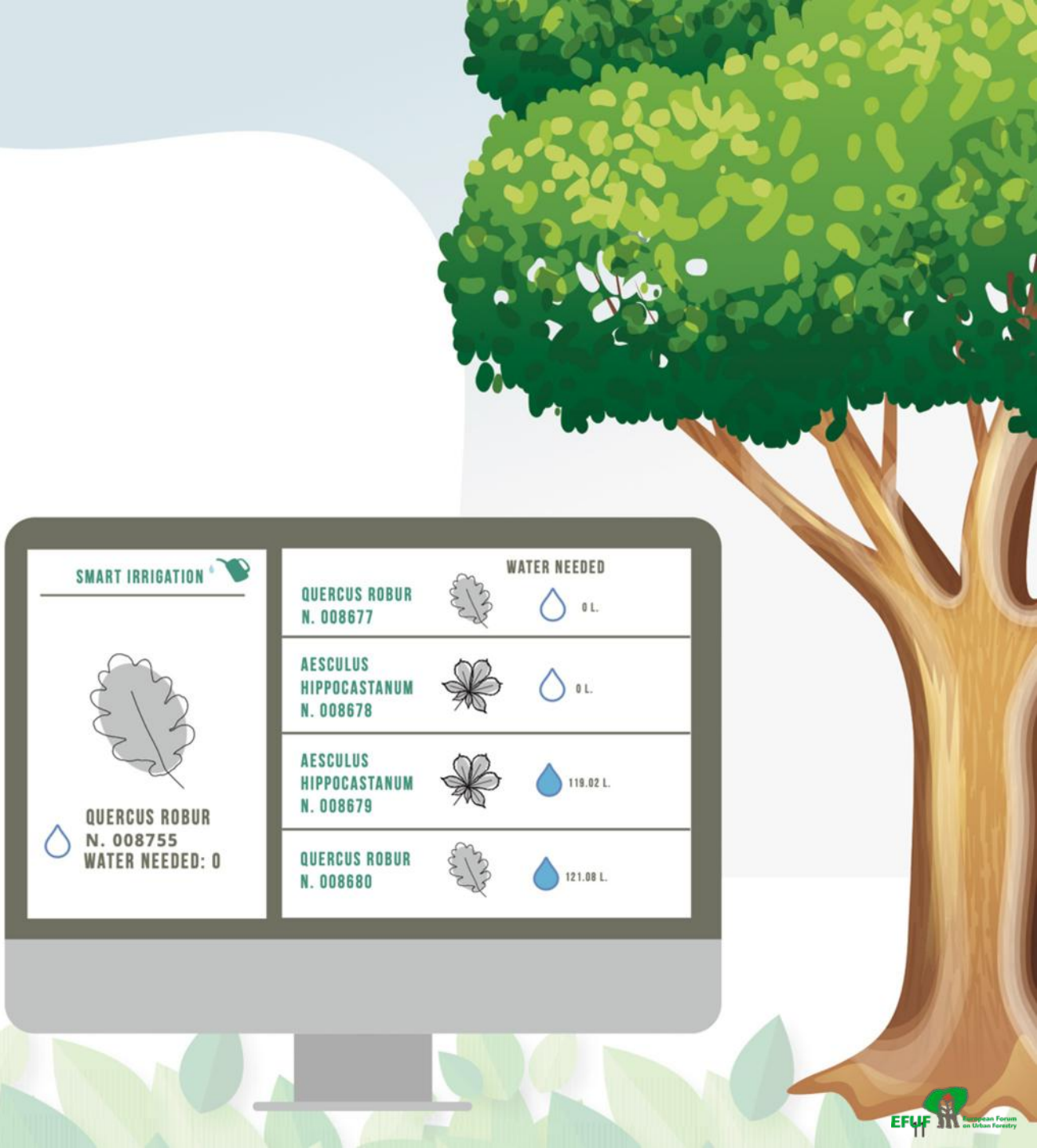
Benefits extended to other species with similar behaviour:



Tree benefits



Smart irrigation tool



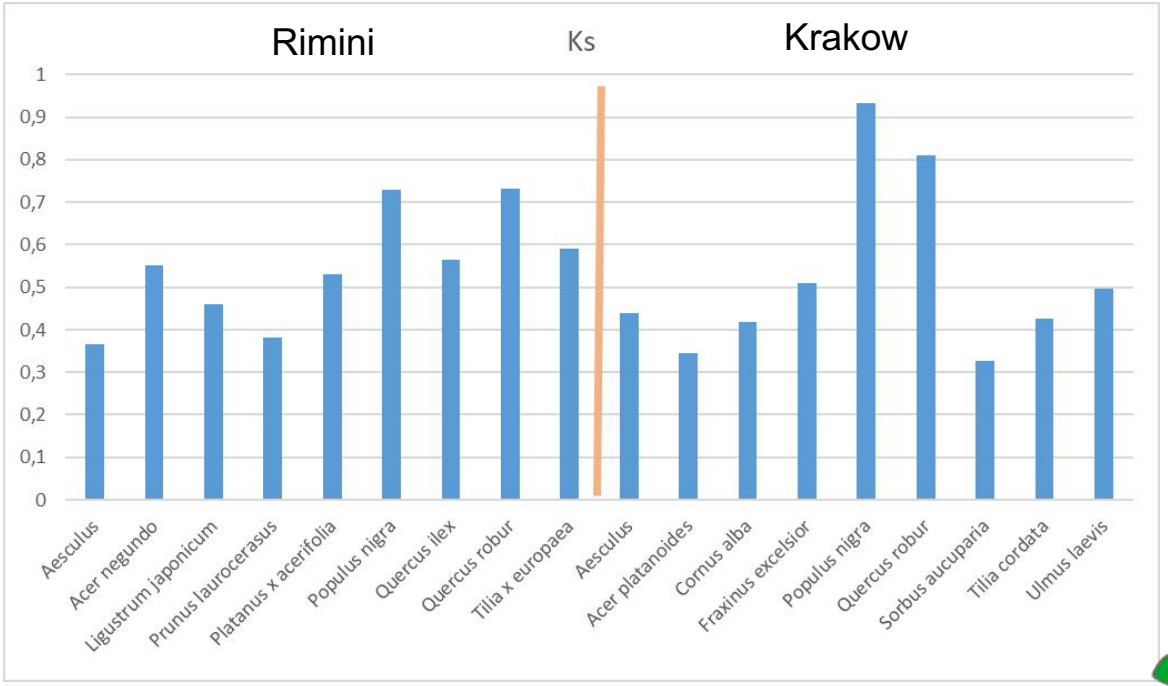
Irrigation requirements

- The ratio between whole tree water use (E_{tree}, $dm^3\ tree^{-1}\ h^{-1}$) and crown projection area (CPA, $m^2\ tree^{-1}$) yielded water use per unit CPA, or **effective transpiration**
  (E_{cpa} = ETE, $dm^3\ m^{-2}$ soil h^{-1} = mm h^{-1})

- Meteo data was used to calculate site-specific **potential evapotranspiration** (ET_0, mm h^{-1}) using the FAO modified Penman-Monteith equation.

- **Ks was calculated as ETE/ET_0**

Species	Ks Rimini	Ks Krakow
A. hippocastanum	0,367	0,438
Populus nigra	0,730	0,933
Q. robur	0,733	0,809
Acer spp.	0,551	0,344
Tilia spp.	0,590	0,426

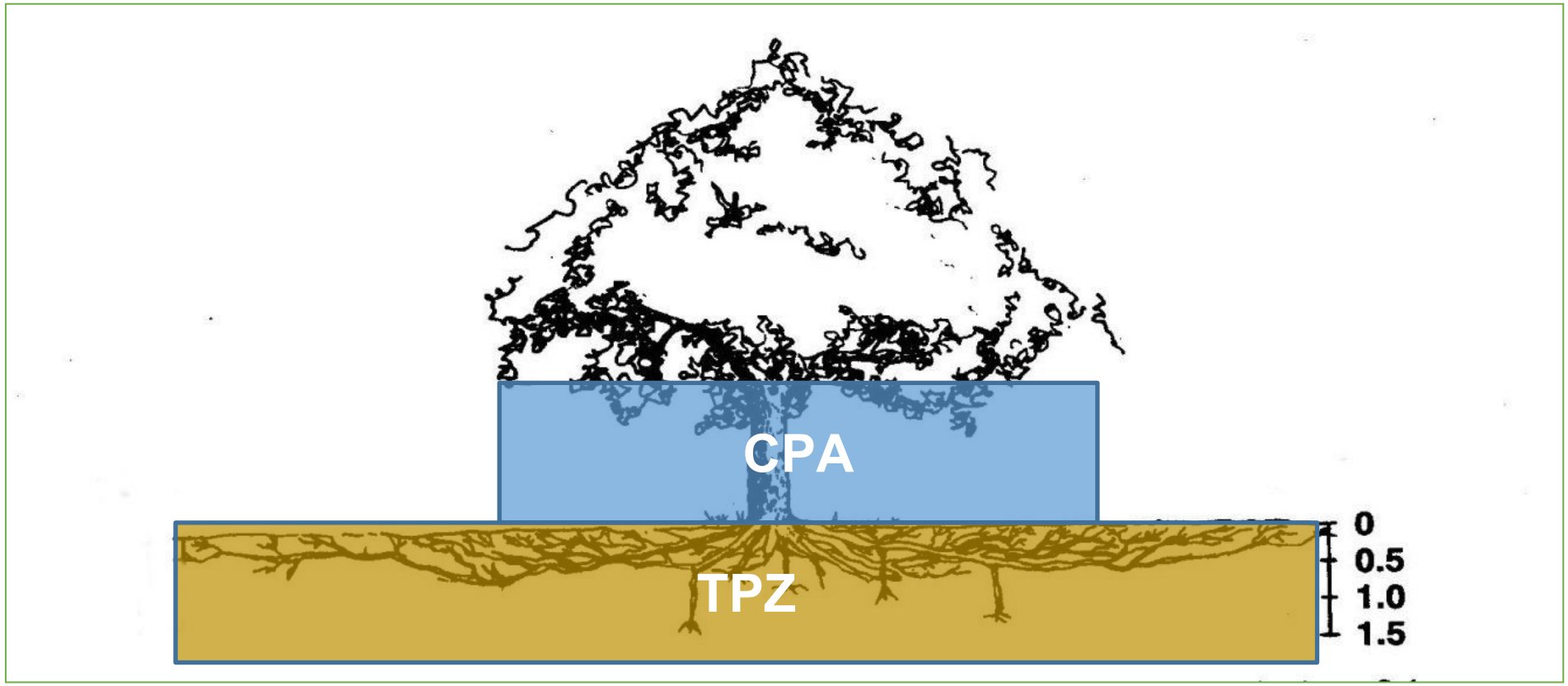


Irrigation requirements

Ks were used to estimate irrigation needs and to schedule the filling of water-bags

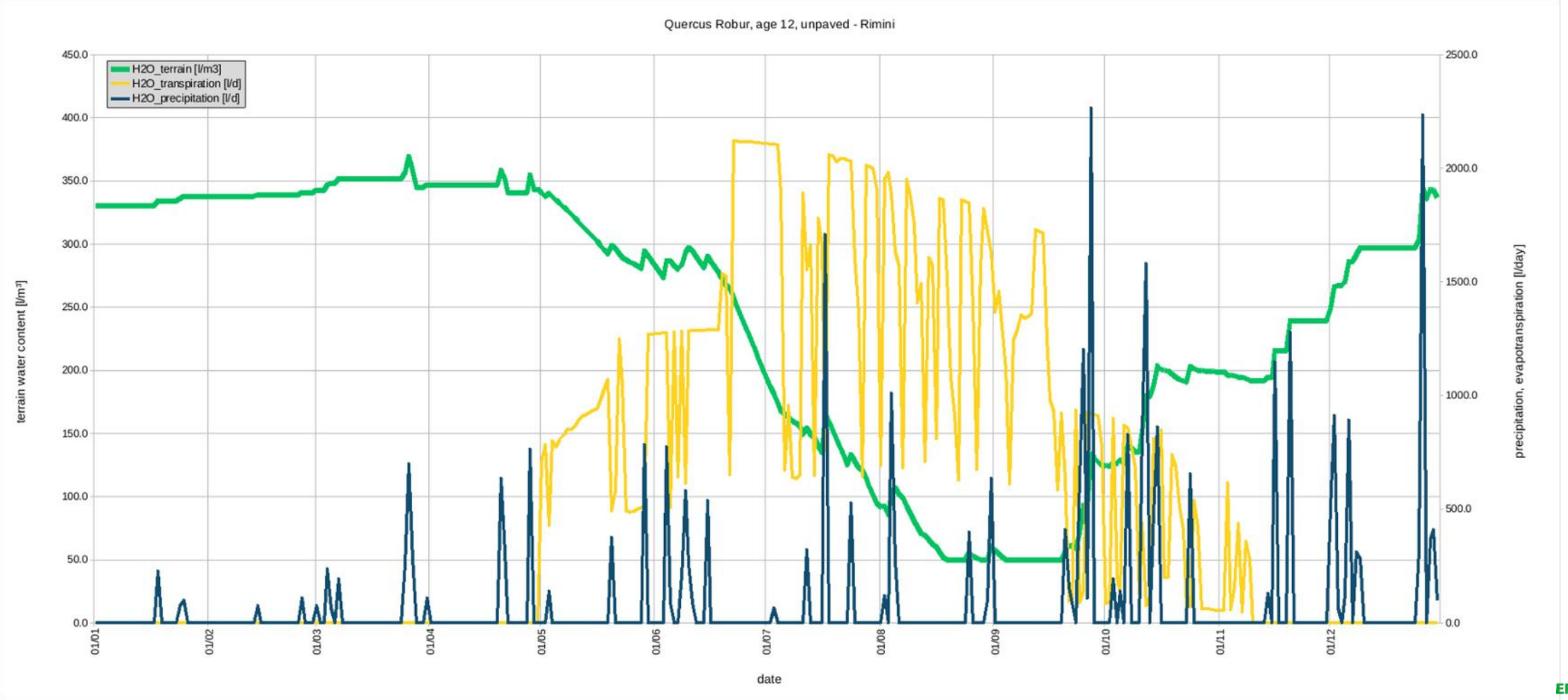
Ks * Et0 * CPA/TPZ

Where CPA/TPZ (i.e. the ratio between crown projection area and tree protection zone) takes into account the different absorbing and transpiring surface area of trees.
TPZ radius was estimated according to Day and Wieseman (2010)

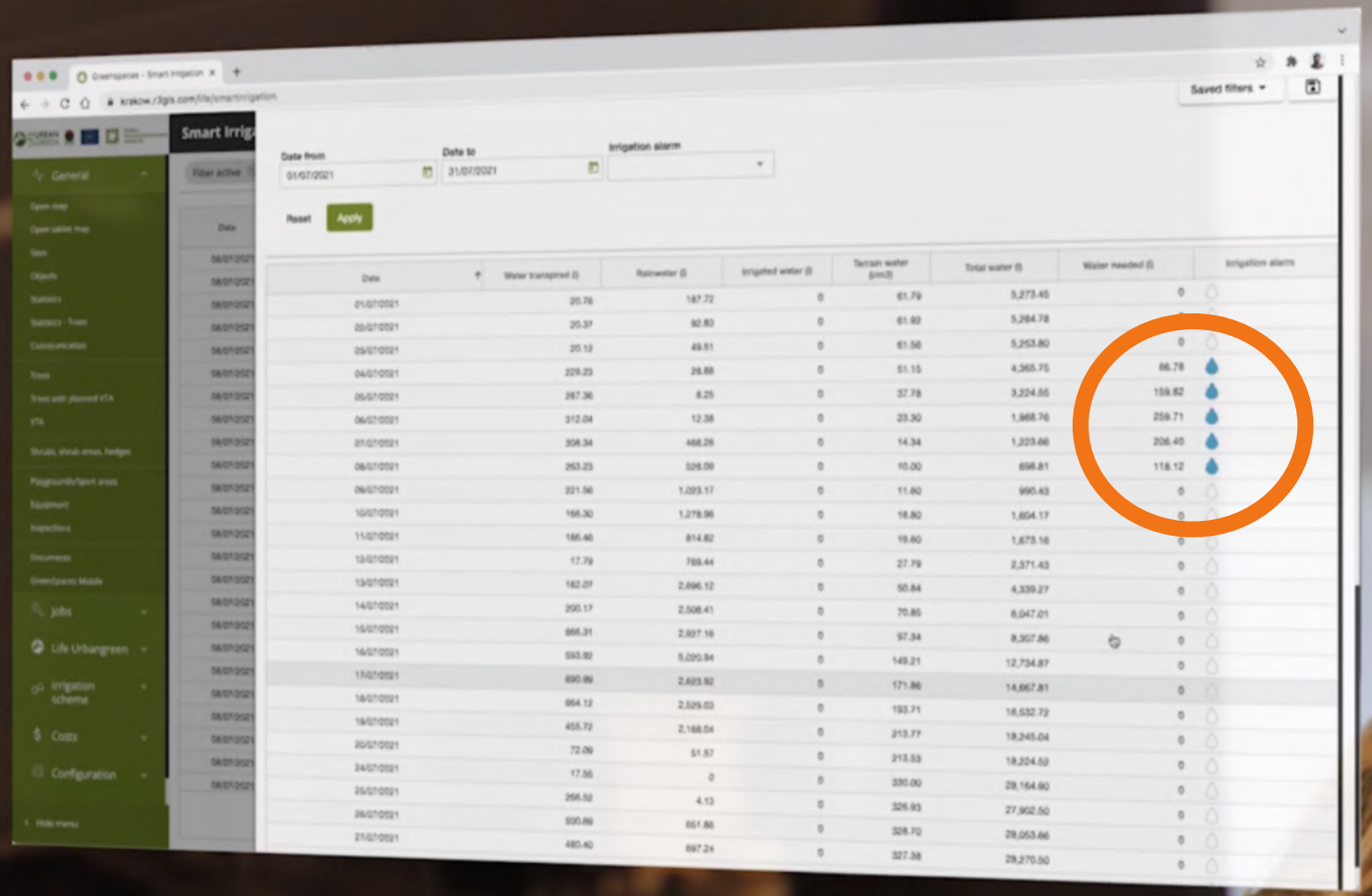


Smart irrigation

With transpiration, precipitation and irrigation GreenSpaces calculates the water available to the tree and when a tree needs water

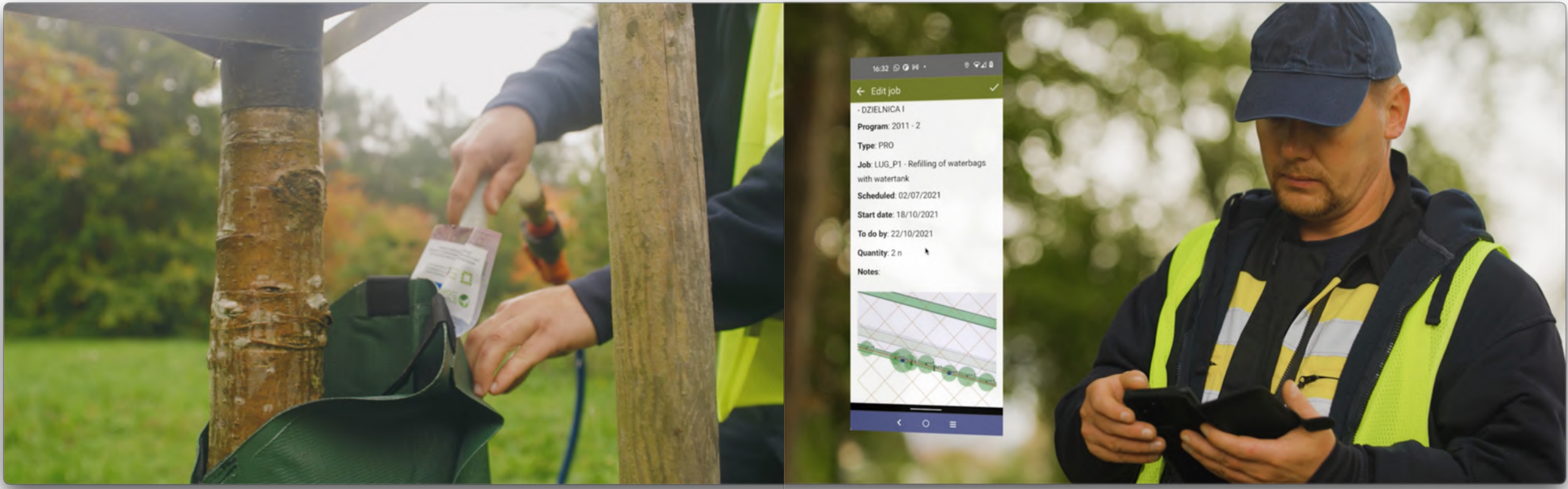


Smart irrigation

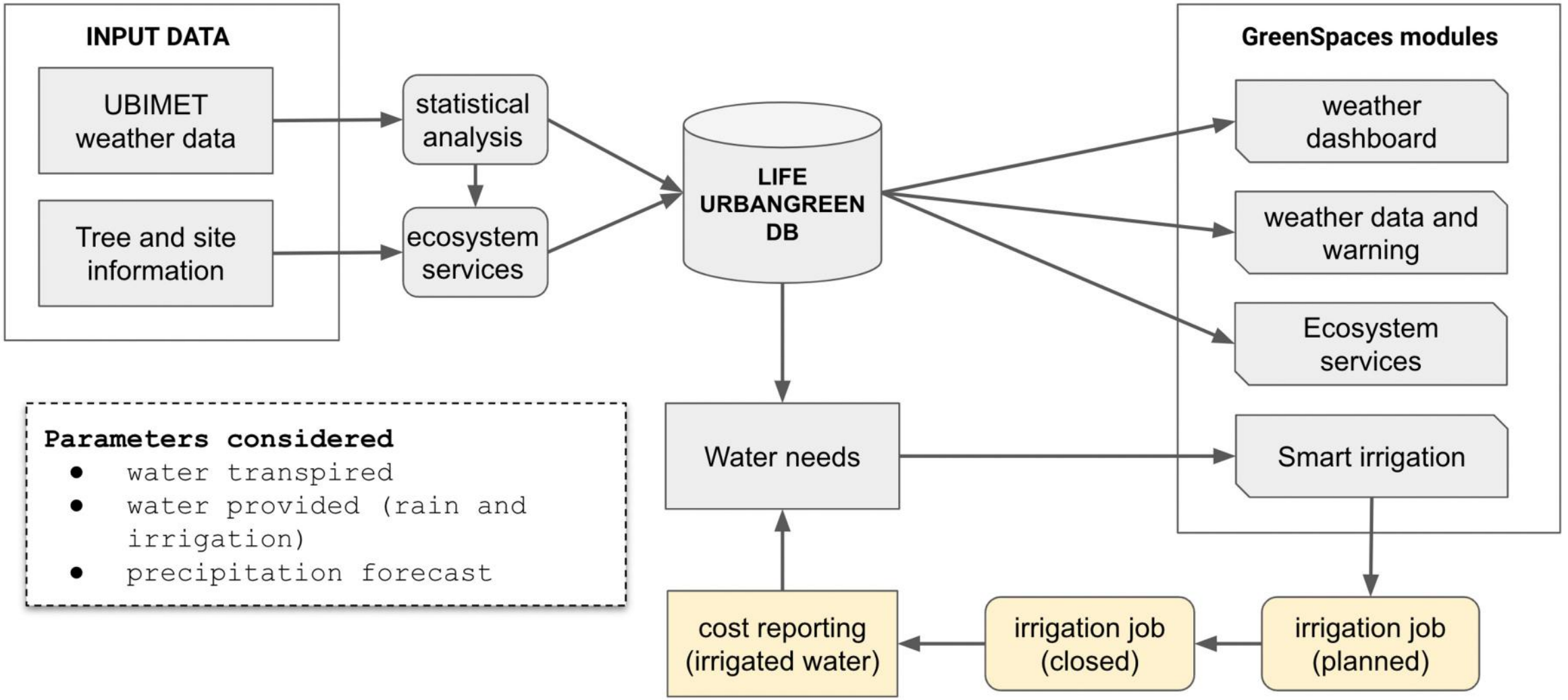


Smart irrigation

Based on the calculations of the smart irrigation tool trees are watered and the delivered amount of water is recorded.



Smart irrigation



Conclusions

Next steps

- Use of Open Meteo Data instead of proprietary data to calculate ecosystem services and irrigation needs.
- Test of different type of sensors to calibrate smart irrigation: TreeTalker and TreeSense sensors
- Extension of Ks calculation to new species and new climatic zones, with new research carrieds out by the University of Milano and the University of Firenze.

THANK YOU!

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www.r3gis.com/greenspaces

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