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URBAN HAZARD ADAPTATION: EFFICIENCY OF A GREEN INFRASTRUCTURE IN AN ITALIAN METROPOLIS

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1

Climate Change Adaptation



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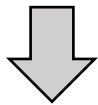
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CLIMATE CHANGE ADAPTATION

Which strategies can be implemented to fight climate change?

Focus on:
the potential of terrestrial/
freshwater ecosystems on mitigating
future climate change



URBAN SCALE



Credit: kwest/Shutterstock.com

2

Ecosystem Services (E.S.)



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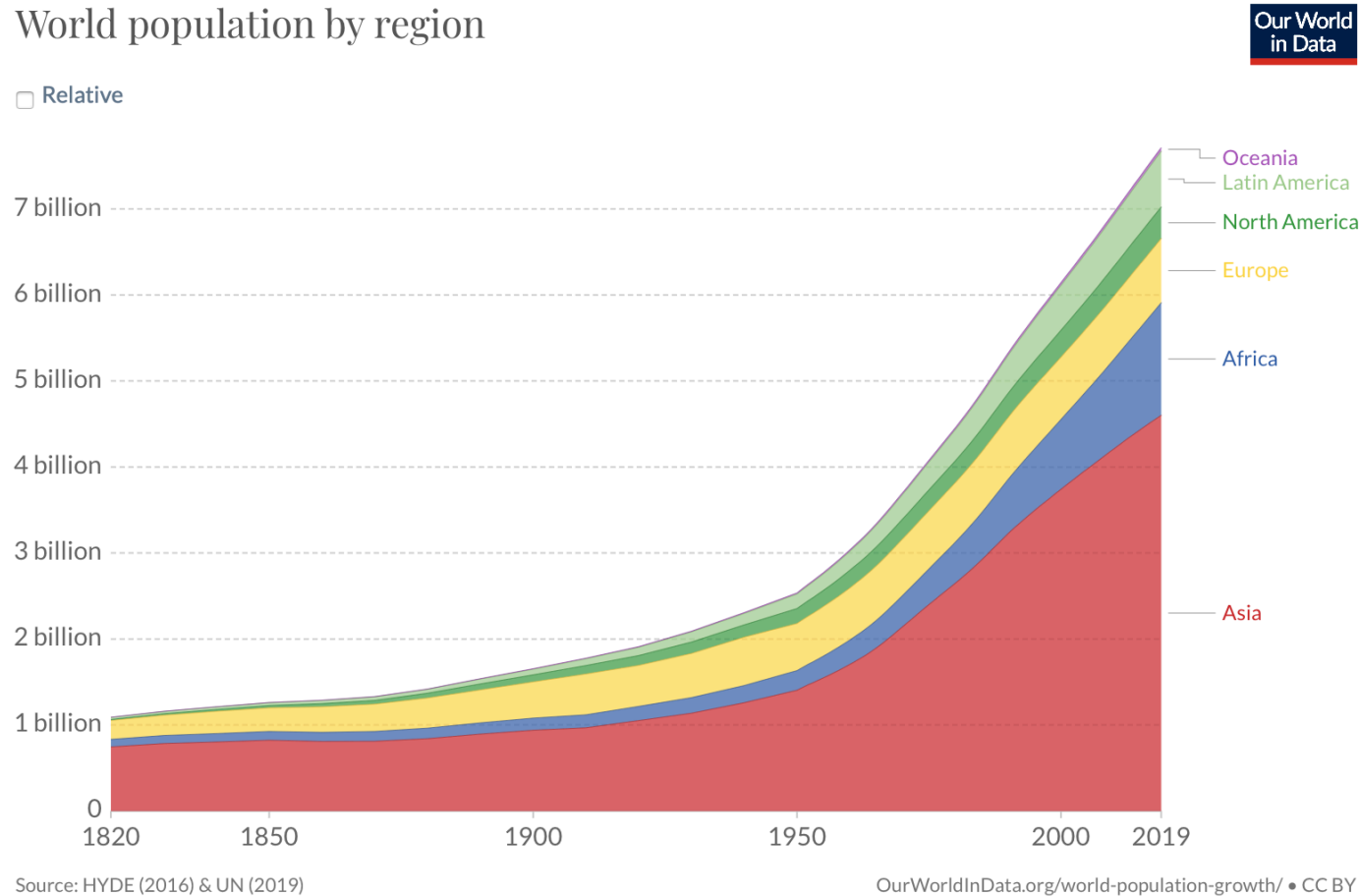
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Why study them

World population by region

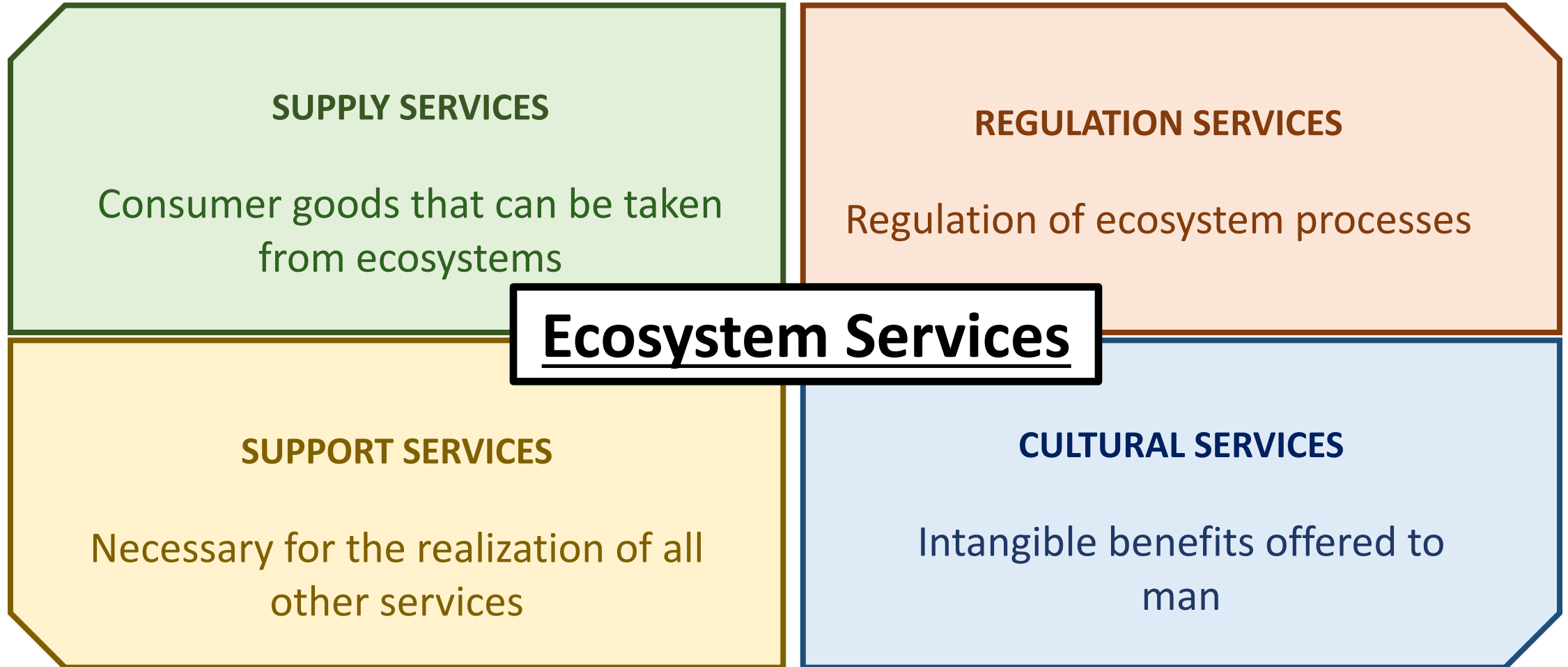


Demographic growth
Resource overexploitation
Land use change

Biodiversity loss
Climate change
Pollutants increase

The concept of
Ecosystem Services (E.S.)
Restoration was born

The multiple benefits provided by ecosystems to population (MEA, 2005)





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THE GLOBAL GOALS

For Sustainable Development

Credit: globalgoalsproject.eu

11 SUSTAINABLE CITIES
AND COMMUNITIES



3 GOOD HEALTH
AND WELL-BEING



15 LIFE
ON LAND



13 CLIMATE
ACTION



3

i-Tree



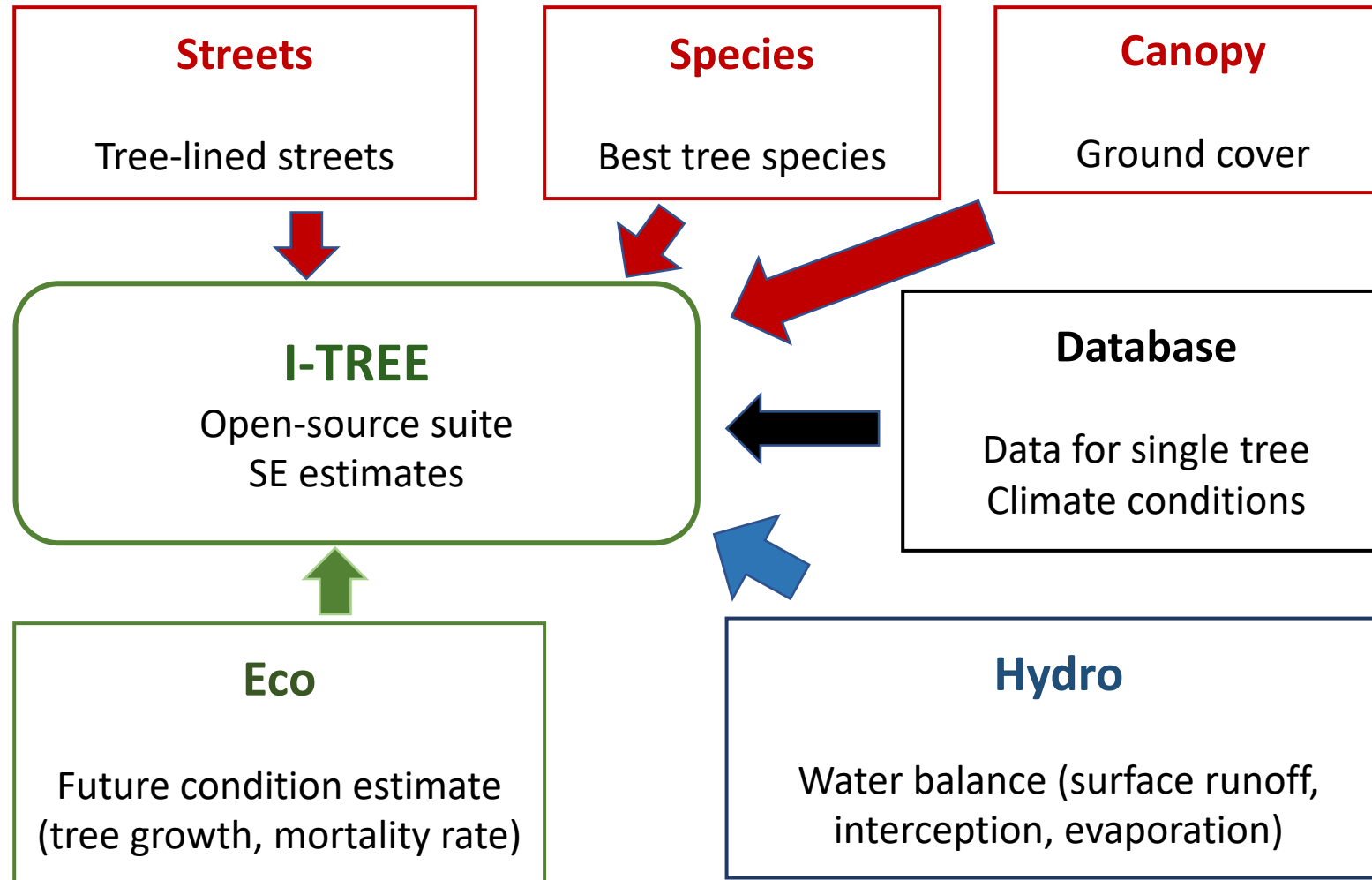
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I-TREE SOFTWARE

Credit: Second European i-Tree Conference, Treeconomics and Trädkonsult, 3-4 ottobre 2019.

USERS

PRIVATE



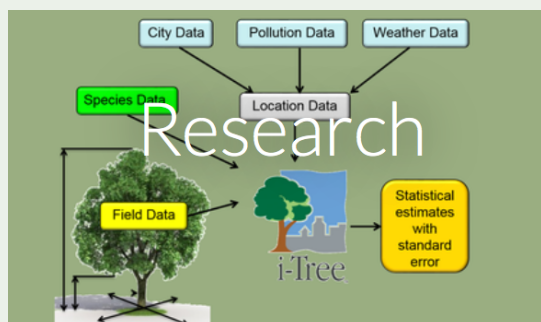
SCHOOL



BUSINESS



RESEARCH



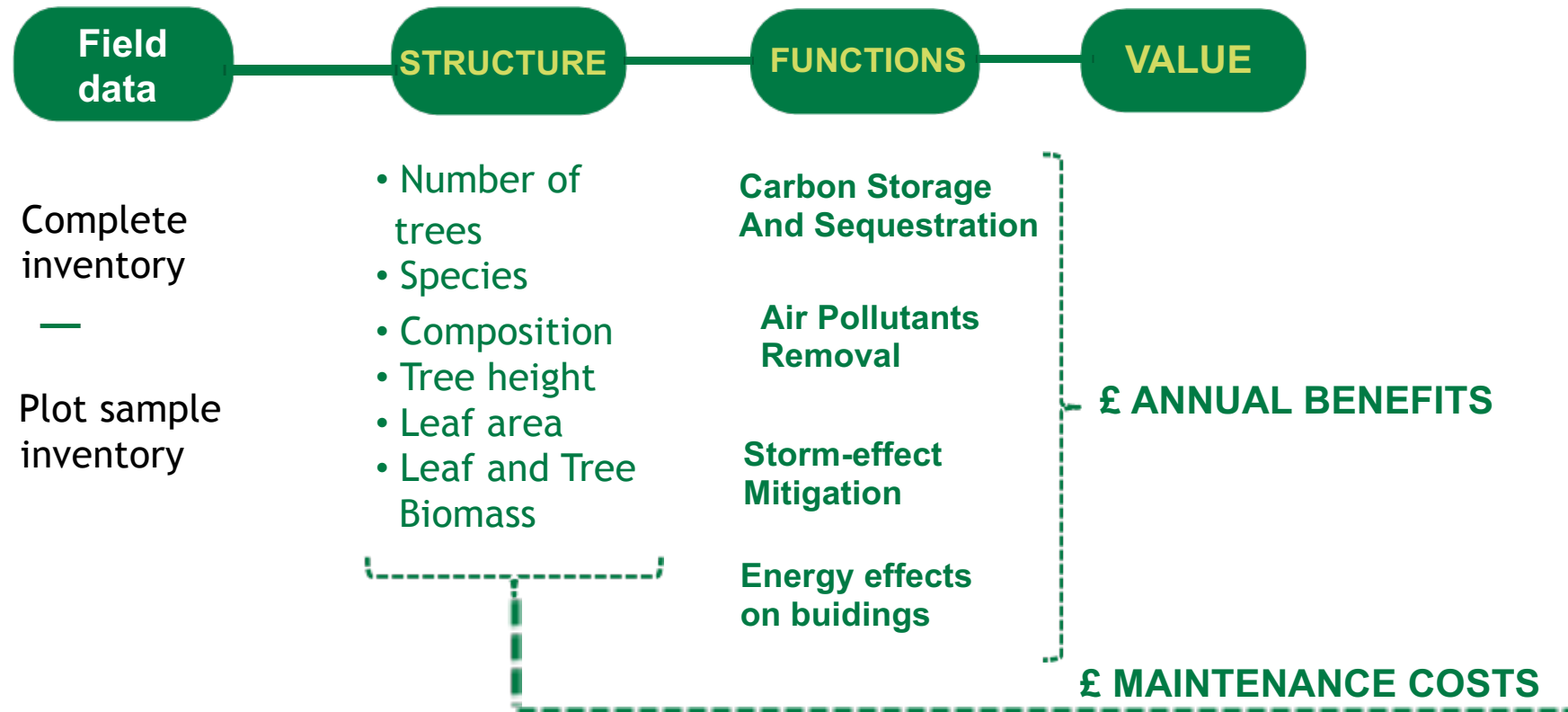
GOVERNMENT



EXTRA-US



How does *i-Tree* Eco work?



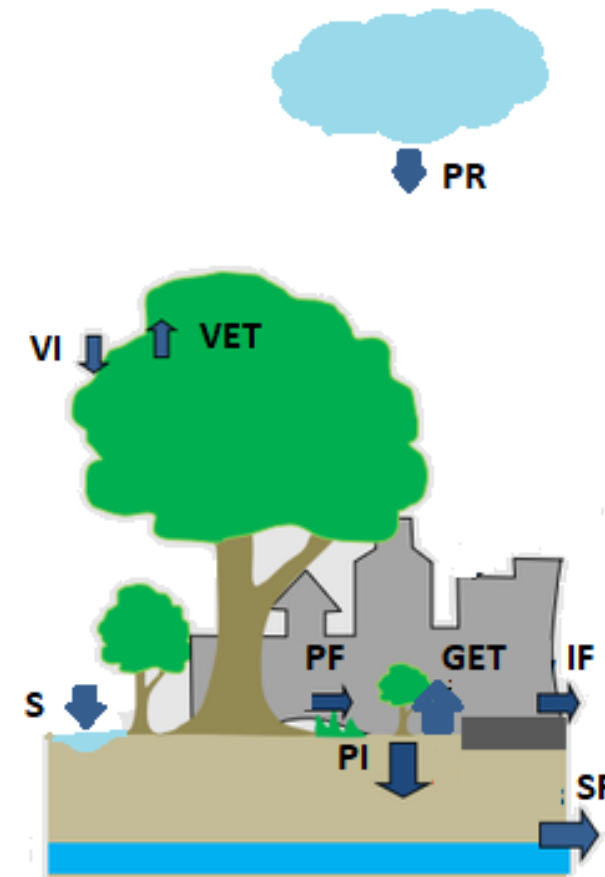
Credit: Second European i-Tree Conference, Treeconomics and Trädkonsult, 3-4 ottobre 2019.

Water balance

Green Infrastructure scale:

$$PR = VET + VI + S + PI + PF + IF + SF + GET$$

- PR (Precipitation),
- VET (Vegetation Evapotranspiration);
- VI (Vegetation Interception);
- S (Depression Storage);
- PI (Pervious Infiltration);
- PF (Pervious Flow);
- IF (Impervious Flow);
- SF (Subsurface Flow);
- GET (Ground Evapotranspiration).



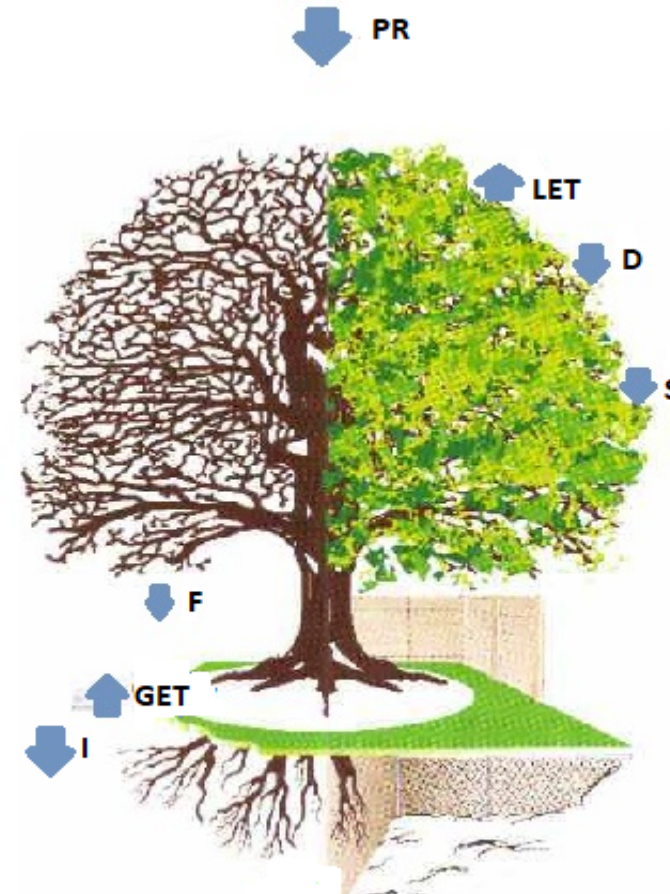
Adapted from
www.itreetools.org

Water balance

Tree scale:

$$PR = LET + D + S + F$$
$$F = GET + I$$

- PR (Precipitation);
- LET (Leaf Evapotranspiration);
- D (Leaf Deposition);
- S (Leaf Storage);
- F (Falling Water);
- GET (Ground Evapotranspiration);
- I (Infiltration).



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*An Urban Green Infrastructure:
'Le Vallere' Park
(Moncalieri/Torino)*



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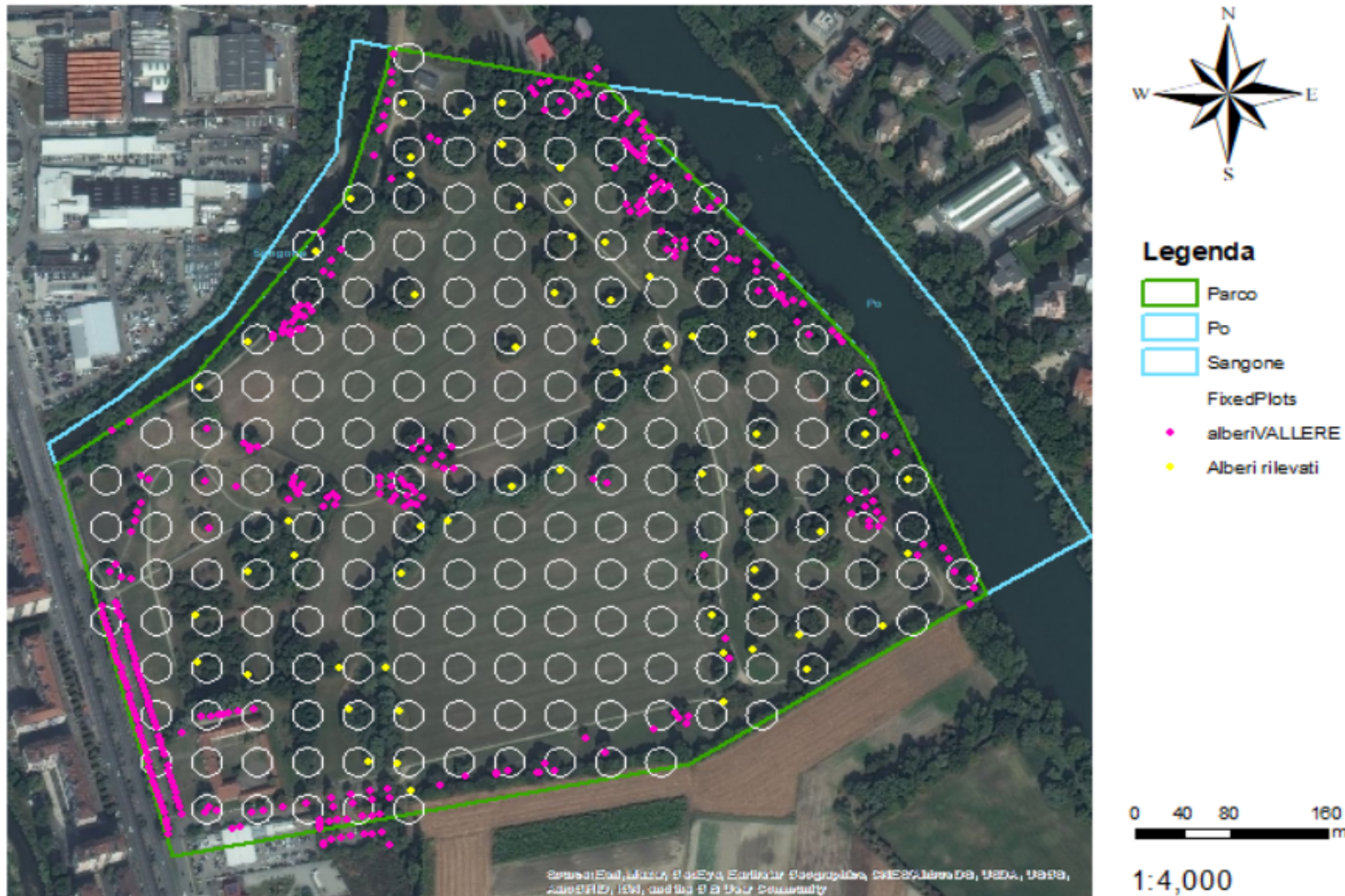
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Le Vallere Park



- ❖ Collaboration with management institution «**Ente di gestione delle Aree protette del Po piemontese**»
- ❖ Methodology – *i-Tree (Eco & Hydro)*
- ❖ Area: **340.000 m²**
- ❖ Weather station: Bric della Croce (Pecetto Torinese)
- ❖ Tree population ~ 500 (**25 different species**)

Le Vallere Park



■ *i-Tree Eco: Plot-Based Sample Inventory* (big area)

- 192 plots
- Fixed grid – wheelbase 42 m
- Plot 500 m² (radius 12,62 m)



Le Vallere Park

I
N
P
U
T

Vegetation Data

Measurement campaign (July 2020) and
VTA sheets (*Visual Tree Assessment*)



O
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T
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Anatomy of the Urban Forest



Biogenic Volatile Organic
Compounds (VOC) Emissions



Carbon Storage and Sequestration



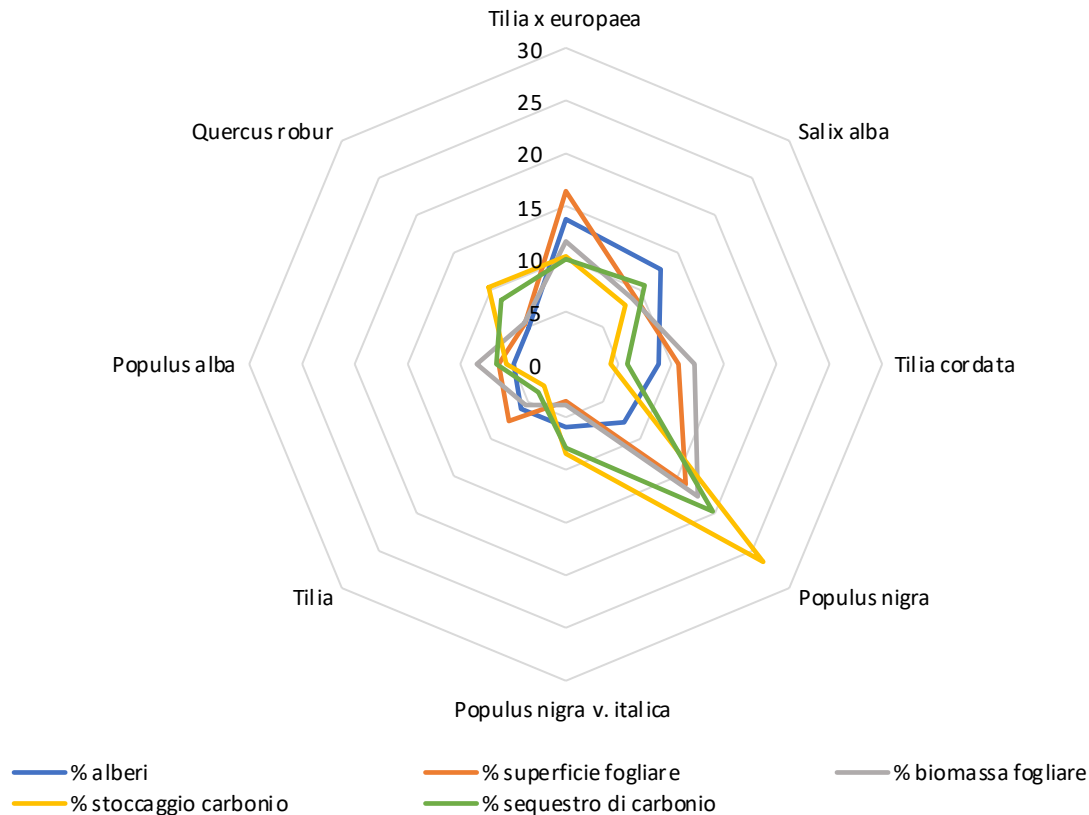
Dry Deposition of Air Pollution



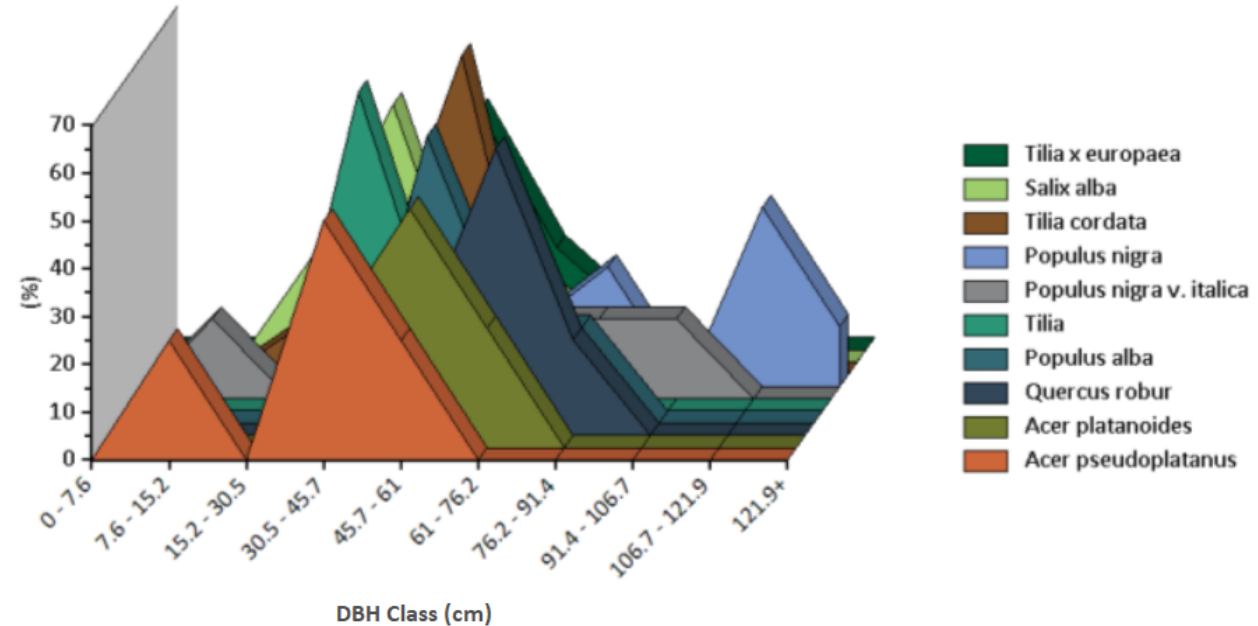
Energy Conservation

Le Vallere Park

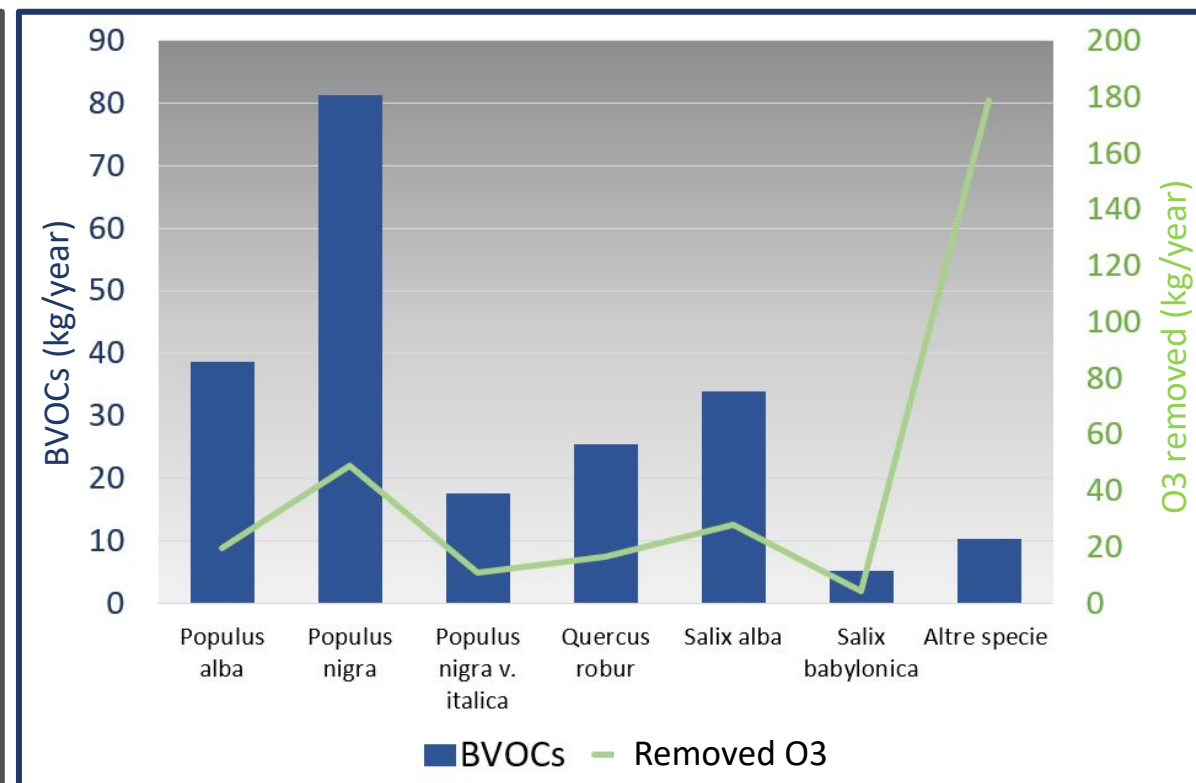
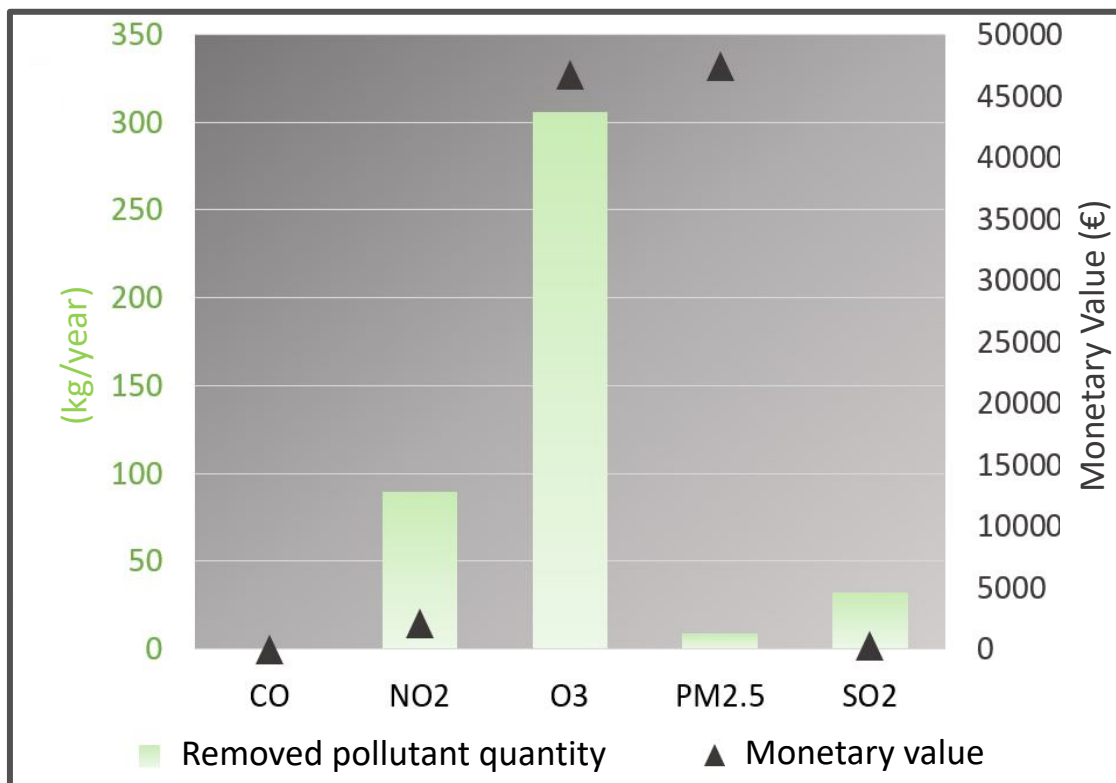
Tree population characteristics



i-Tree Eco



	Carbon storage	437 t	1200 €
	Carbon sequestration	13 t	40.000 €
	Pollutants removal	436 kg	96.500 €
	BVOCs emissions	212 kg	-



Le Vallere Park

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i-Tree Hydro Project



Watershed



non – Watershed

Area information

DEM, Meteorological data (ARPA Piemonte,
“Torino Vallere” station (Moncalieri, 2019)

Land cover data

% land cover (*i*-Tree Canopy), DCIA (*Directly Connected Impervious Area*), LAI (*Leaf Area Index*)

Hydrological parameters

q_0 (*Annual Average Flow of Project Area*), land type,
initial soil saturation, surface layer depth

Le Vallere Park

% Impervious Cover

Base case: 3,8%

Scenario 1: + 25% → 28,8%

Scenario 2: + 50% → 53,8%

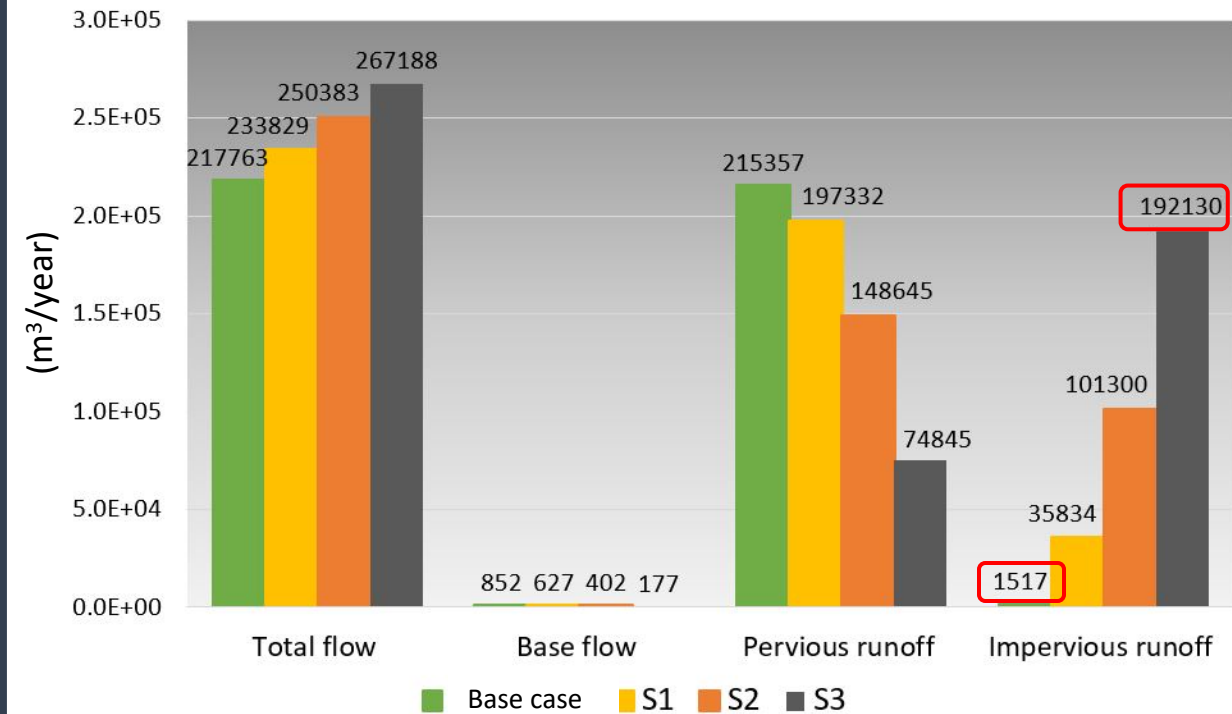
Scenario 3: + 75% → 78,8%

25% of these percentages were subtracted from the tree cover, the remaining part from the herbaceous cover

INPUT

OUTPUT

Water quantity

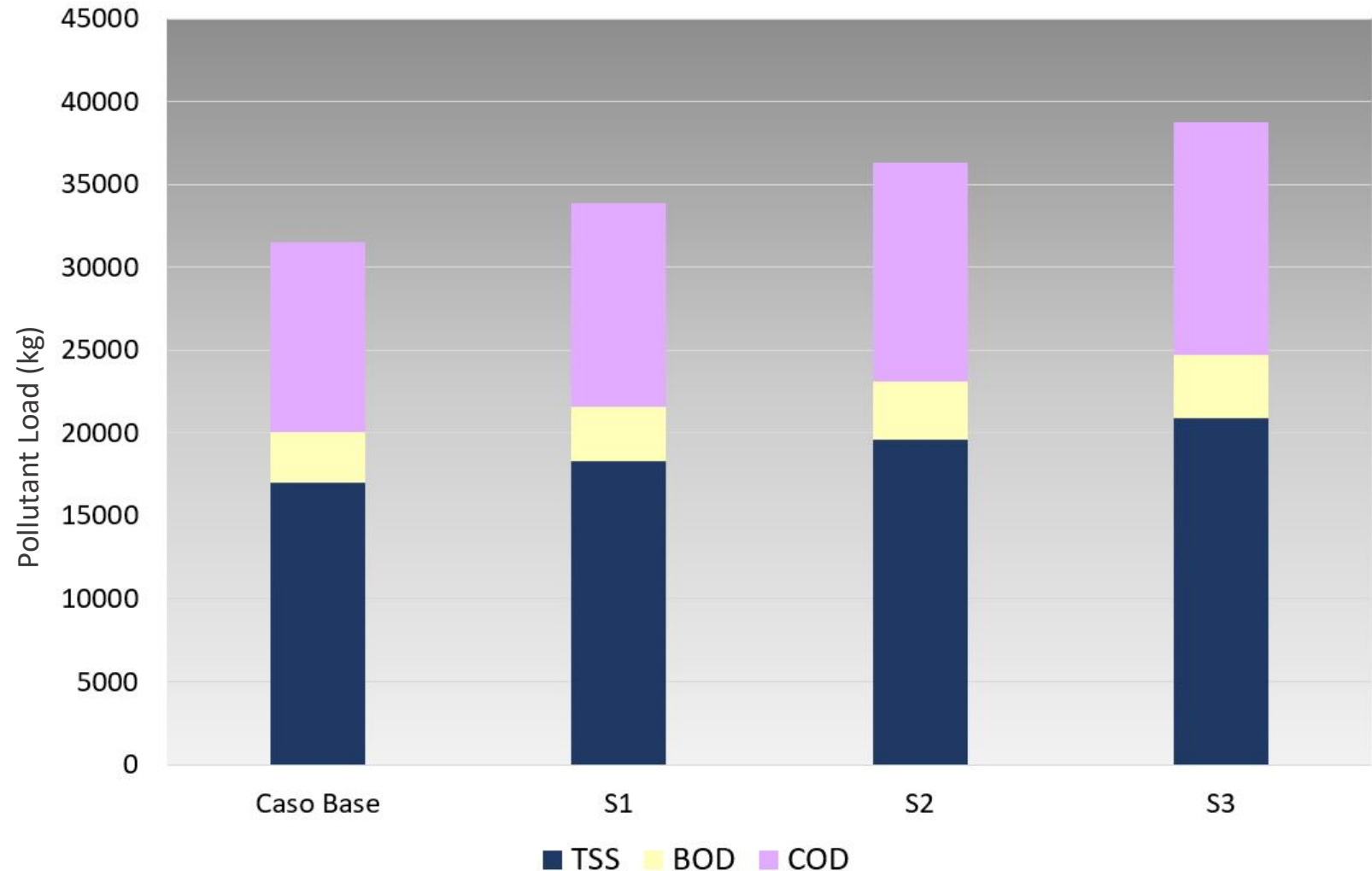


Le Vallere Park

OUTPUT

The **reduction of soil permeability** affects the **quality of surface runoff water**

TSS	BOD
COD	TKN
P totale	P solubile
Cu	Pb
Zn	NO ²⁻ , NO ³⁻



Climate change (2071-2100)

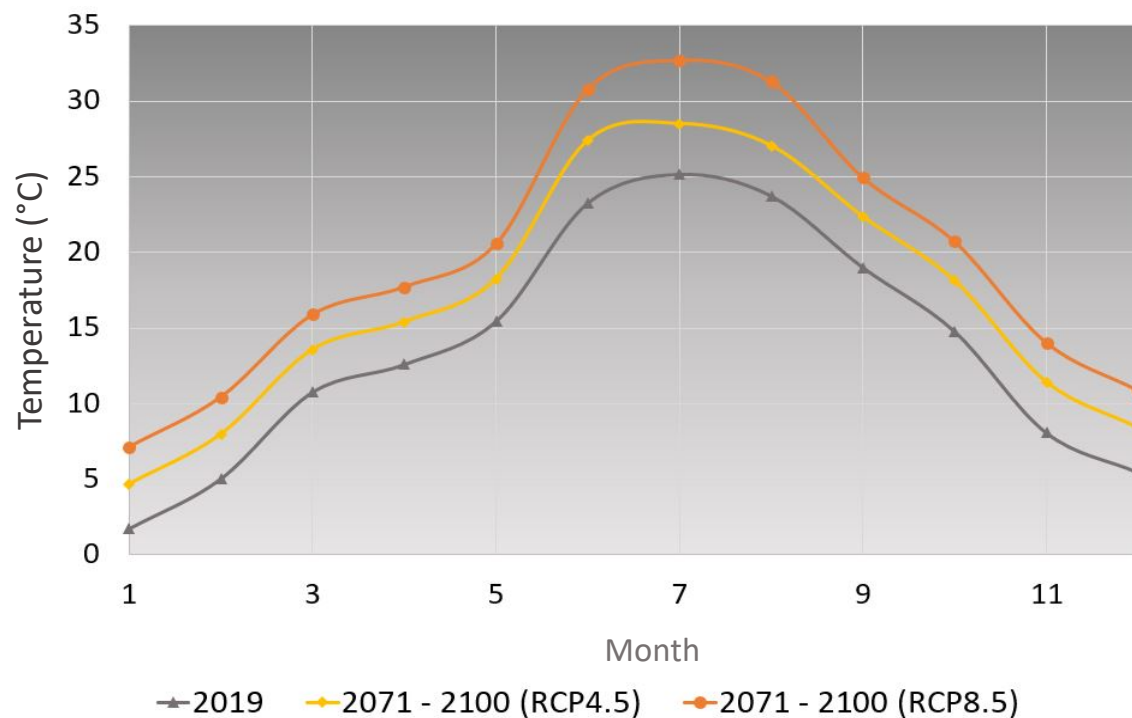
a) Temperature

RCP4.5

+ 3,30 °C

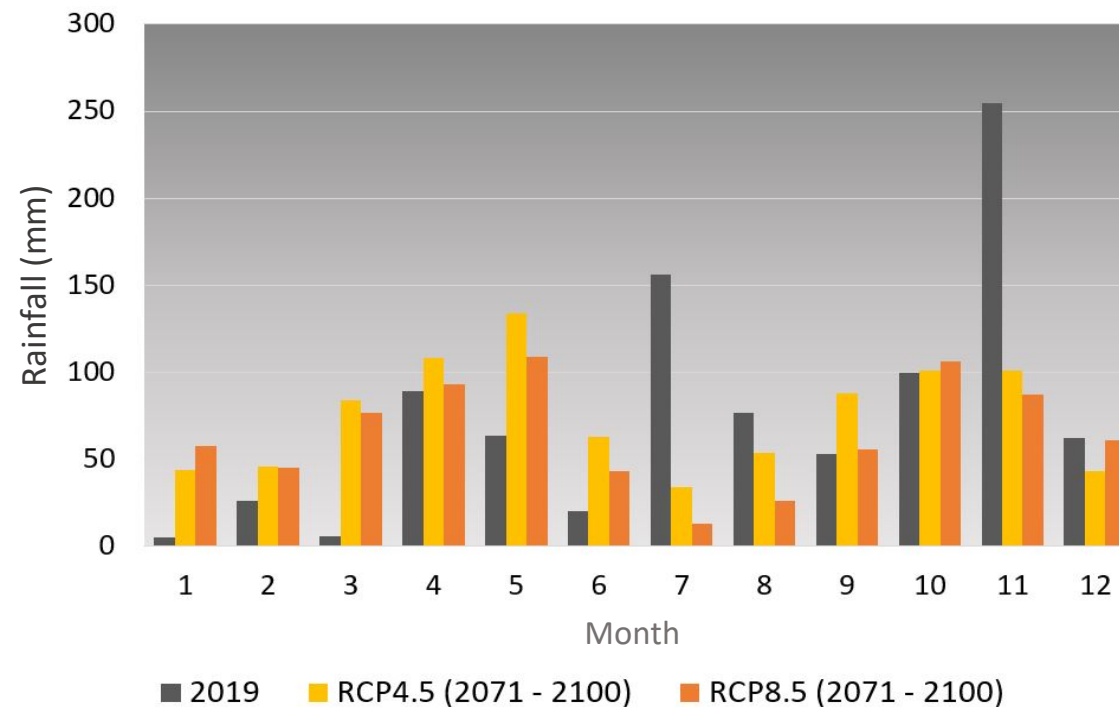
RCP8.5

+ 6,00 °C



b) Rainfall and number of rainy days

	2019	RCP4.5	RCP8.5
Rainfall (mm)	914,5	900	774
Rainy days	79	- 12	- 26



Climate change (2071-2100)

OUTPUT



Total flow

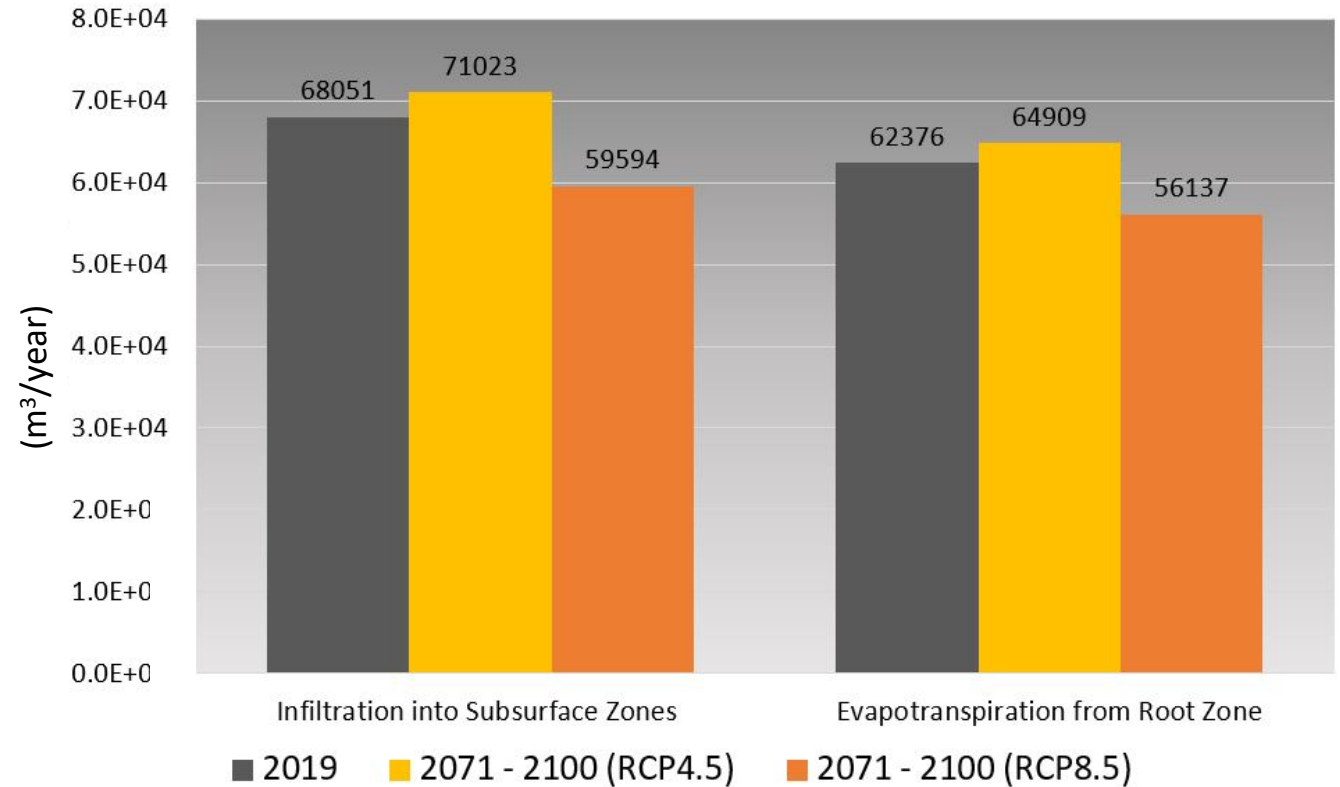


Vegetation hydrology
flow



Water quality
deterioration

Soil hydrology



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Future Developments



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STUDY DEVELOPMENT AT URBANE SCALE: QUANTIFICATION OF E.S. OF CITY OF TURIN

- Air pollutants reduction (CO, O₃, PM2.5, ..)
- Water quality improvement (Pb, NO₂⁻, ..)
- Surface runoff avoided
- Carbon storage and sequestration
- O₂ production

SUPPORTING
TOOL FOR URBAN
PLANNING





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cielipiemontesi.it

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