NEW TECHNOLOGIES IN FORESTRY

Integrate Network
facilitated by EFI

UNIVERSITÀ DEGLI STUDI DEL MOLISE

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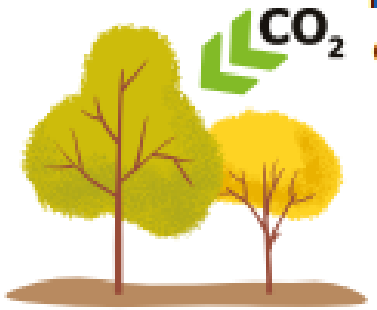
Dip. Agricoltura, Ambiente e Alimenti

9th Annual Meeting of the European Integrate Network – Luxembourg 5th October 2023

Forest resources & benefits

Forests cover
35%
of Europe's total land area



155 million tonnes
of carbon per year

The forest sector contributed about 0.7% to GDP in Europe

The forest sector is an important source of income for mountains and inner areas

Forest Europe growing life

Main threats to forests

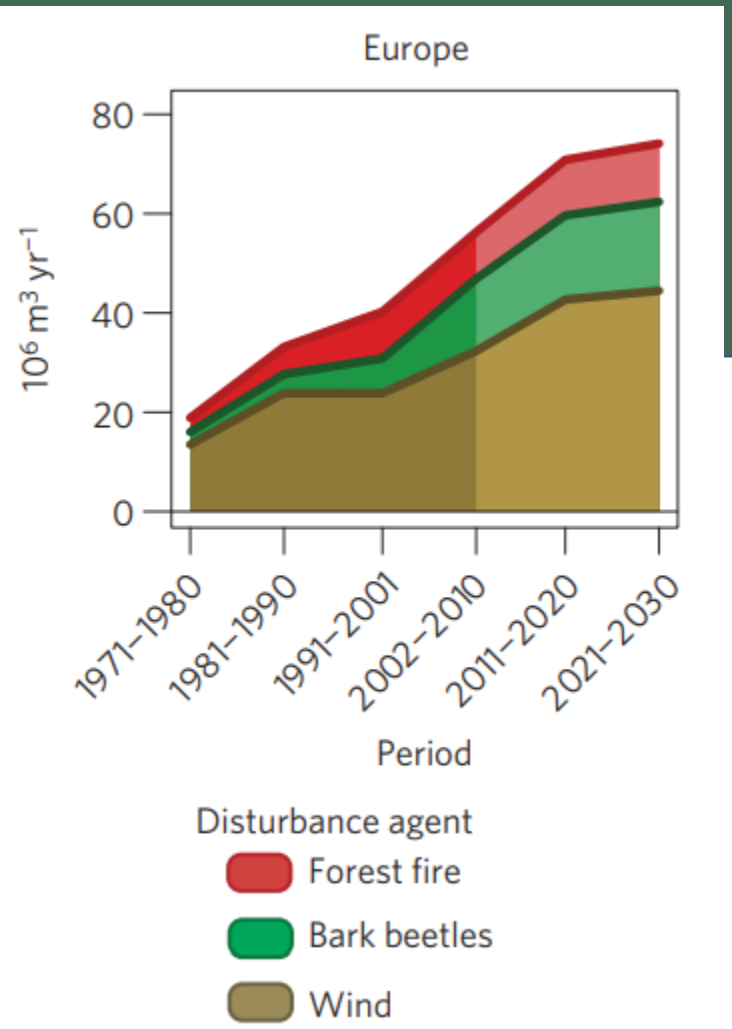
LETTERS
PUBLISHED ONLINE: 3 AUGUST 2014 | DOI: 10.1038/NCLIMATE2318
nature climate change

Increasing forest disturbances in Europe and their impact on carbon storage

Rupert Seidl[1]*, Mart-Jan Schelhaas[2], Werner Rammer[1] and Pieter Johannes Verkerk[3]

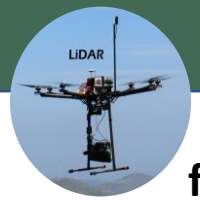
Disturbances from wind, bark beetles and wildfires have increased in Europe's forests throughout the twentieth century[1]. Climatic changes were identified as a key driver

European forest C sink recently[5]. A further increase in disturbance damage in the future might thus pose a major risk for Europe's climate change mitigation efforts, as it could counteract the efforts



Not only carbon storage, but also biodiversity and other ecosystem services

To reduce the loss of



Monitoring forest variables

Promote resilience of forests

Enhance forest biodiversity

Decision

Synthesizin

Analysing

Summarising

Organizing

Collecting

C1 - Forest Resources & Global Carbon Cycles

1.1 - Forest area
1.2 - Growing stock
1.3 - Age structure and/or diameter distribution
1.4 - Carbon stock

C2 - Forest Ecosystem Health and Vitality

2.1 - Deposition of air pollutants
2.2 - Soil condition
2.3 - Defoliation
2.4 - Forest damage
2.5 - Forest land degradation

C3 - Productive Functions of Forests

3.1 - Increment and fellings
3.2 - Roundwood
3.3 - Non-wood goods
3.4 – Services

C4 - Forests Biological Diversity

4.1 - Diversity of tree species
4.2 - Regeneration
4.3 - Naturalness
4.4 - Introduced tree species
4.5 – Deadwood
4.6 - Genetic resources
4.7 - Forest fragmentation
4.8 - Threatened forest species
4.9 - Protected forests
4.10 - Common forest bird species

C5 - Protective Functions (Soil & Water)

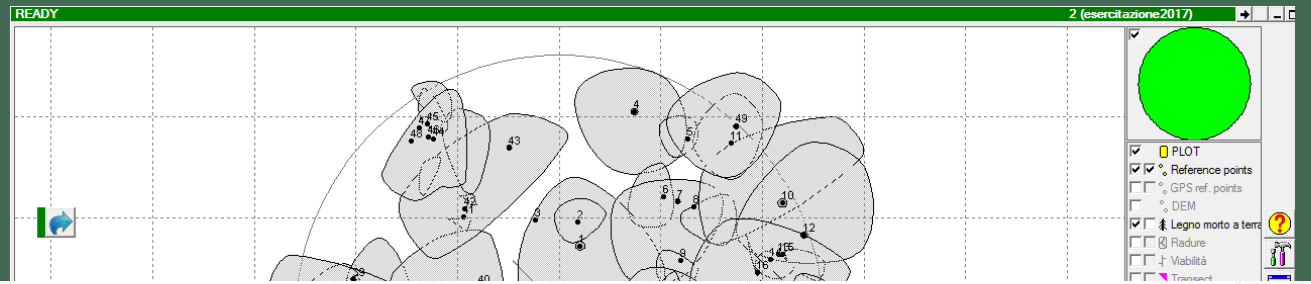
5.1 - Protective forests - soil, water and other ecosystem functions - infrastructure and managed natural resources

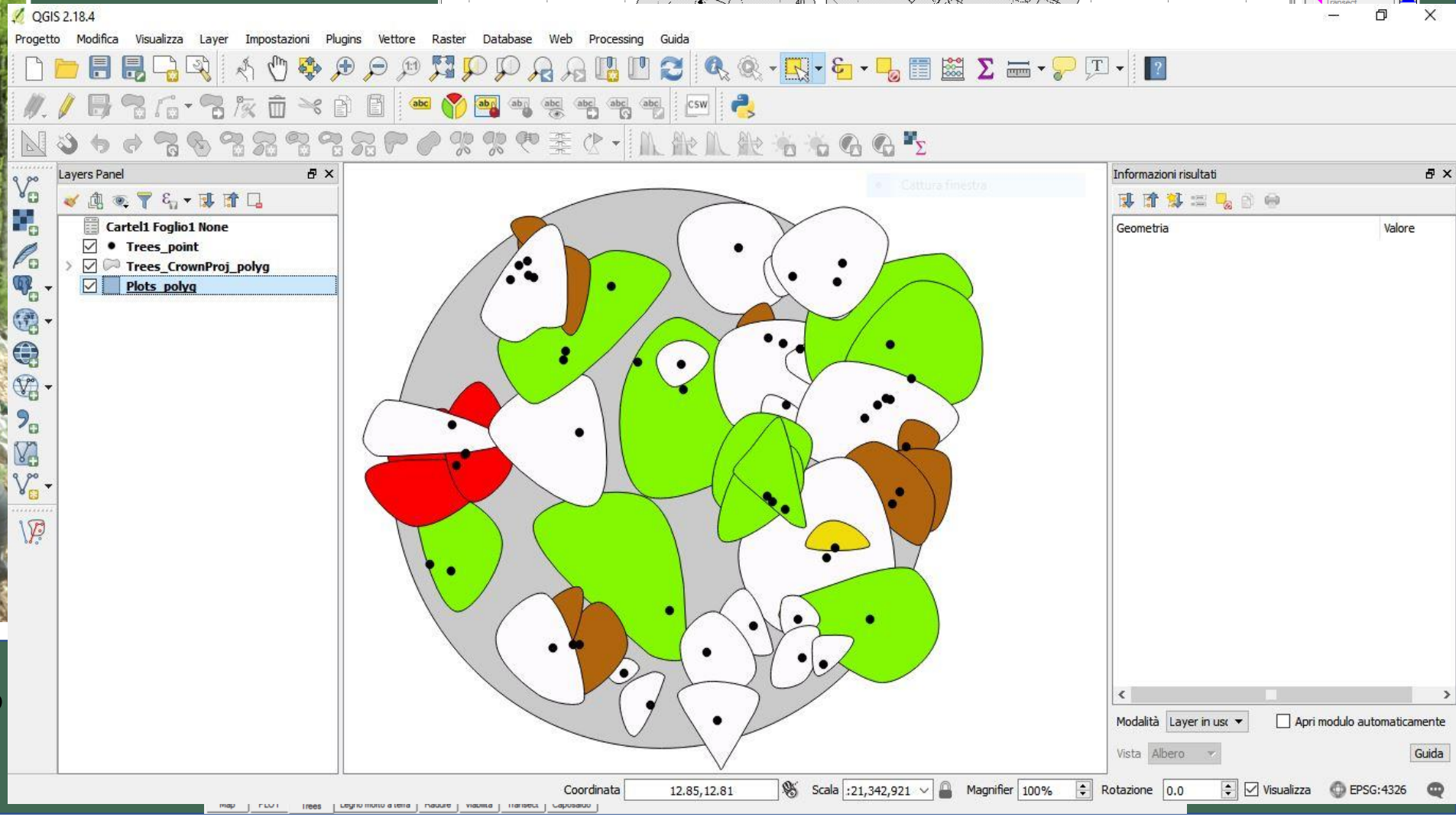
C6 - Socioeconomic Functions

6.1 - Forest holdings
6.2 - Contribution of forest sector to GDP
6.3 - Net revenue
6.4 - Investments in forests and forestry
6.5 - Forest sector workforce
6.6 - Occupational safety and health
6.7 - Wood consumption
6.8 - Trade in wood
6.9 - Wood energy
6.10 – Recreation in forests

Data collection

Data collection





FieldMap → field GIS

www.ifer.cz

Data collection eBee UAV

multispectral sensor for mapping SFM indicators

FRESh LIFE14 ENV/IT/000414

Demonstrating Remote Sensing integration in sustainable forest management

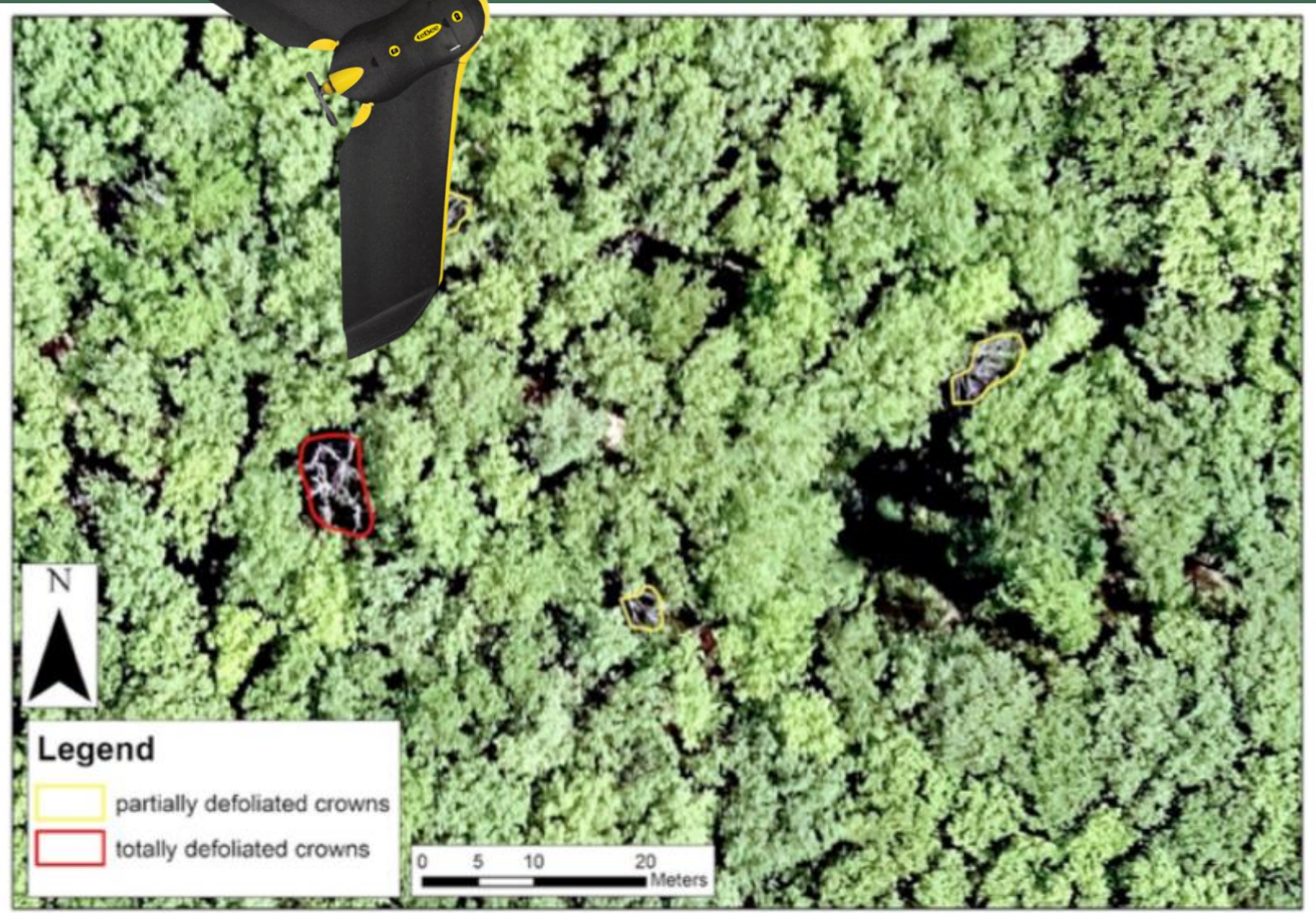
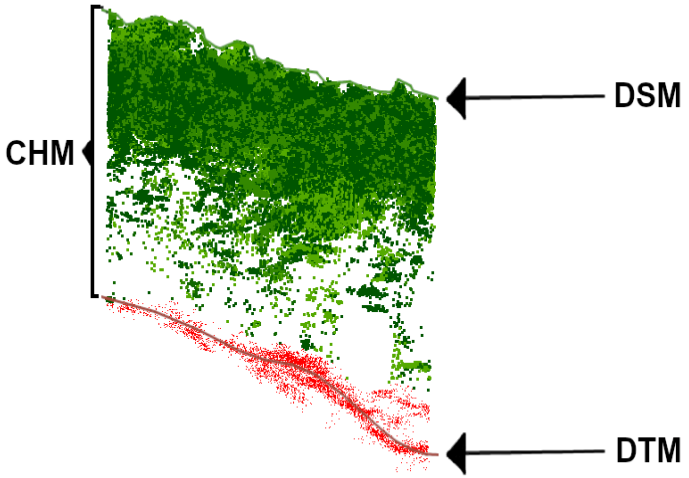
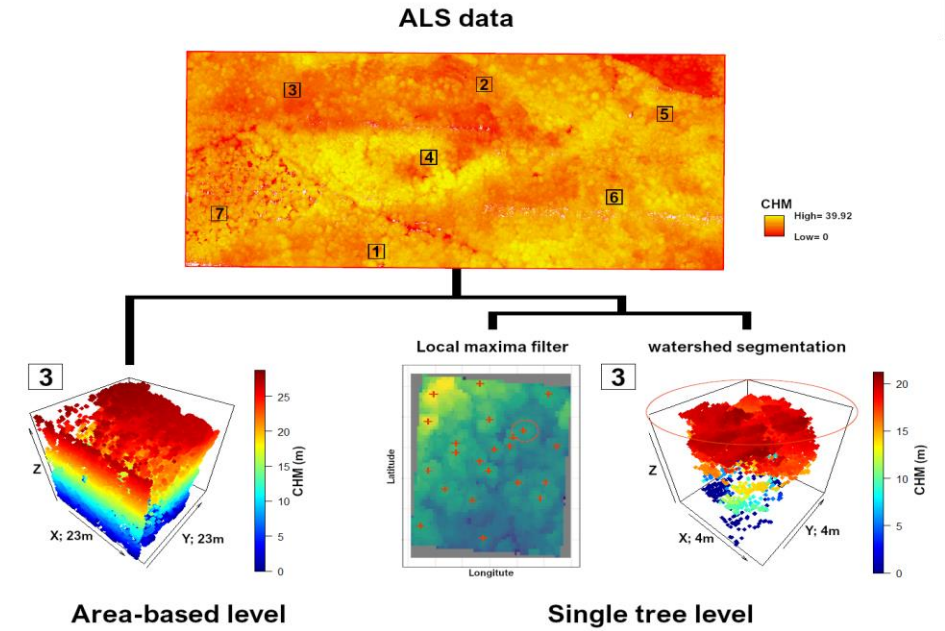
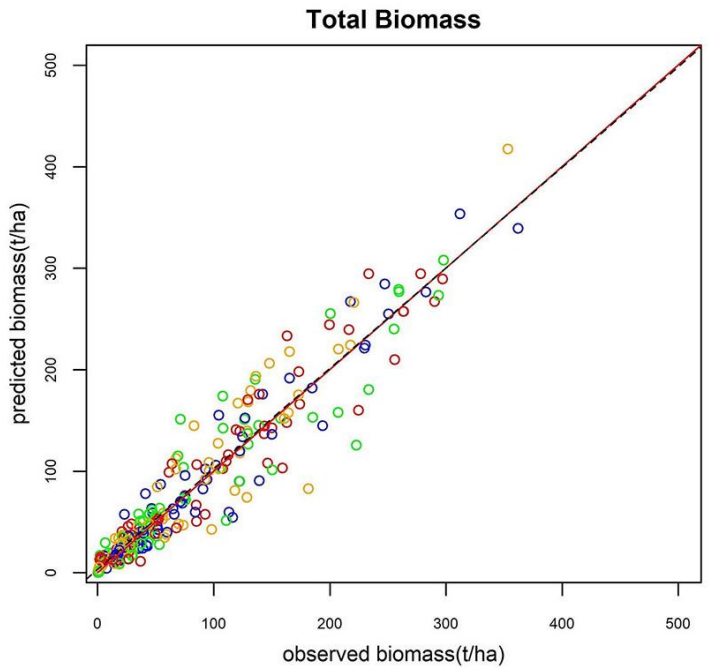


Figure 4 - An example of partially and totally defoliated crowns identified by visual interpretation of the RGB orthomosaic of the study area of Caprarola

Data collection - LiDAR ALS







Assessing SFM indicators

Data collection - LiDAR ALS

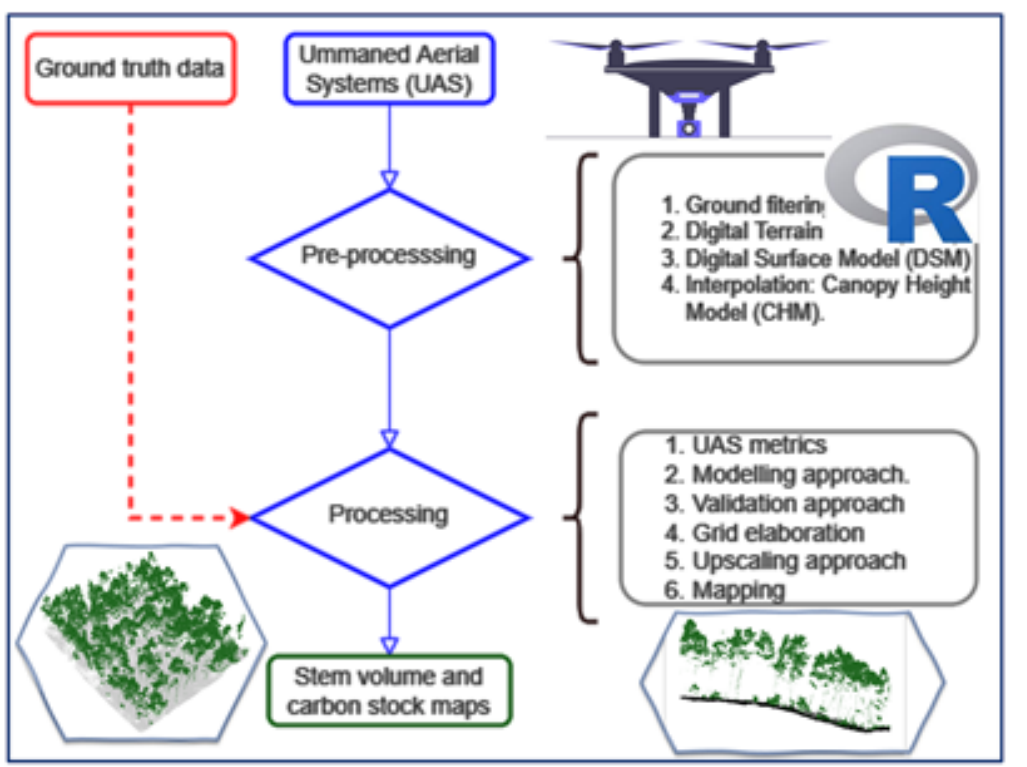


Figura 2: Approccio metodologico per l'analisi dei dati LiDAR (Light Detection and Ranging). La tecnologia LiDAR usata per la raccolta di dati attraverso un drone è comunemente definita UAS (Ummaned Aerial Systems)

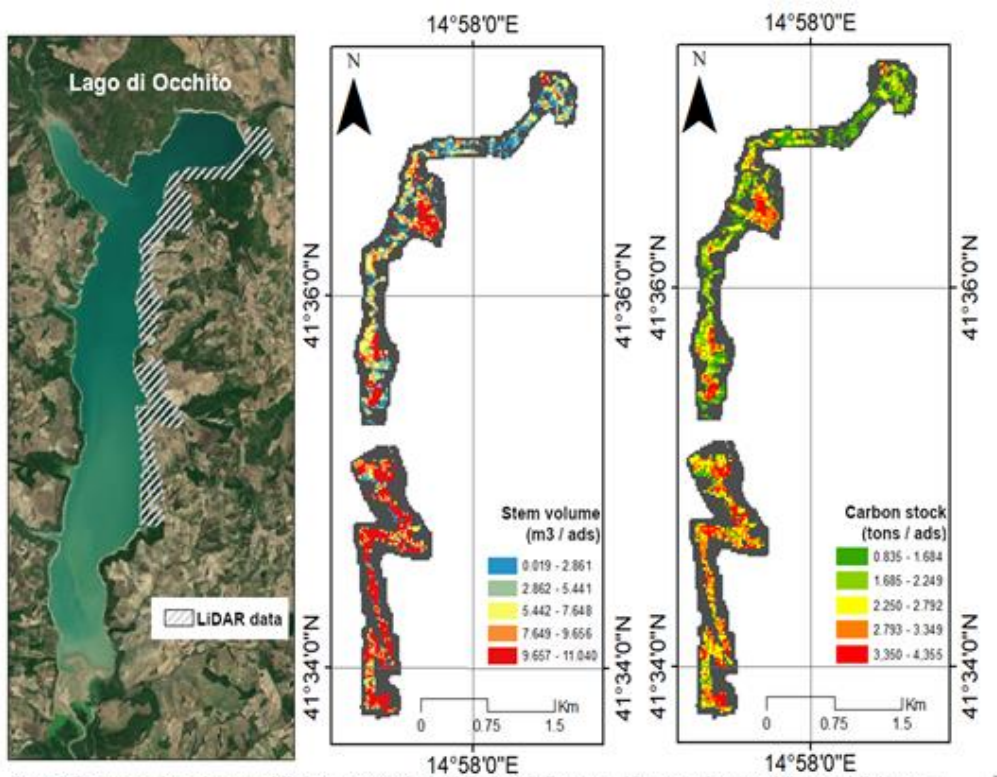


Figura 3: Da sinistra a destra, la mappa della foresta coperta dai dati LiDAR (Light Detetion and Ranging) e la mappa della stima della biomassa (Stem volume m3/ads) e dello stock di carbonio (carbon stock tons/ads) di tale foresta. Le aree di saggio 'ads' erano di 529m2.

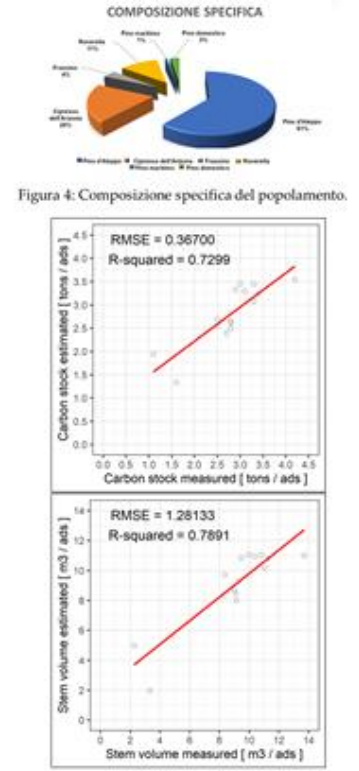


Figura 4: Composizione specifica del popolamento.

Figura 5: Confronto tra variabile osservata e predetta.

Forest management plan

Data collection - LiDAR ALS

remote sensing

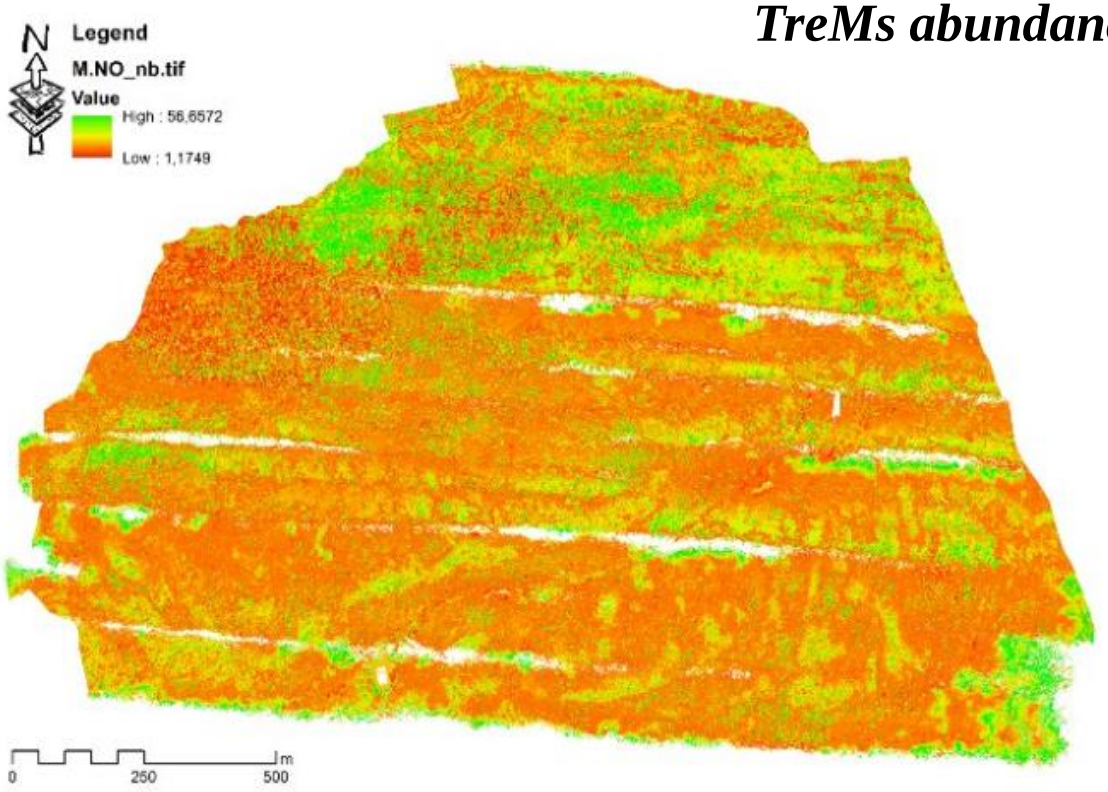
MDPI

Article

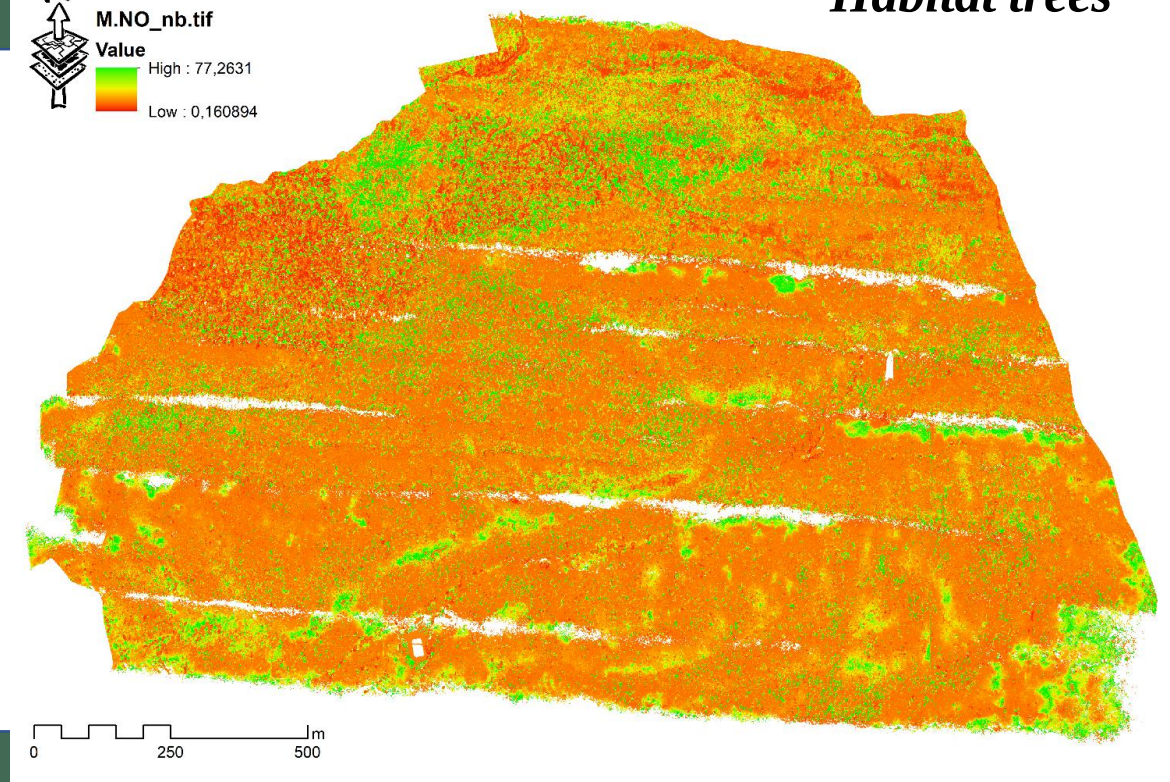
Machine Learning Algorithms to Predict Tree-Related Microhabitats using Airborne Laser Scanning

Giovanni Santopuoli [1,*], Mirko Di Febbraro [2], Mauro Maesano [3], Marco Balsi [4], Marco Marchetti [2] and Bruno Lasserre [2]

TreMs abundance



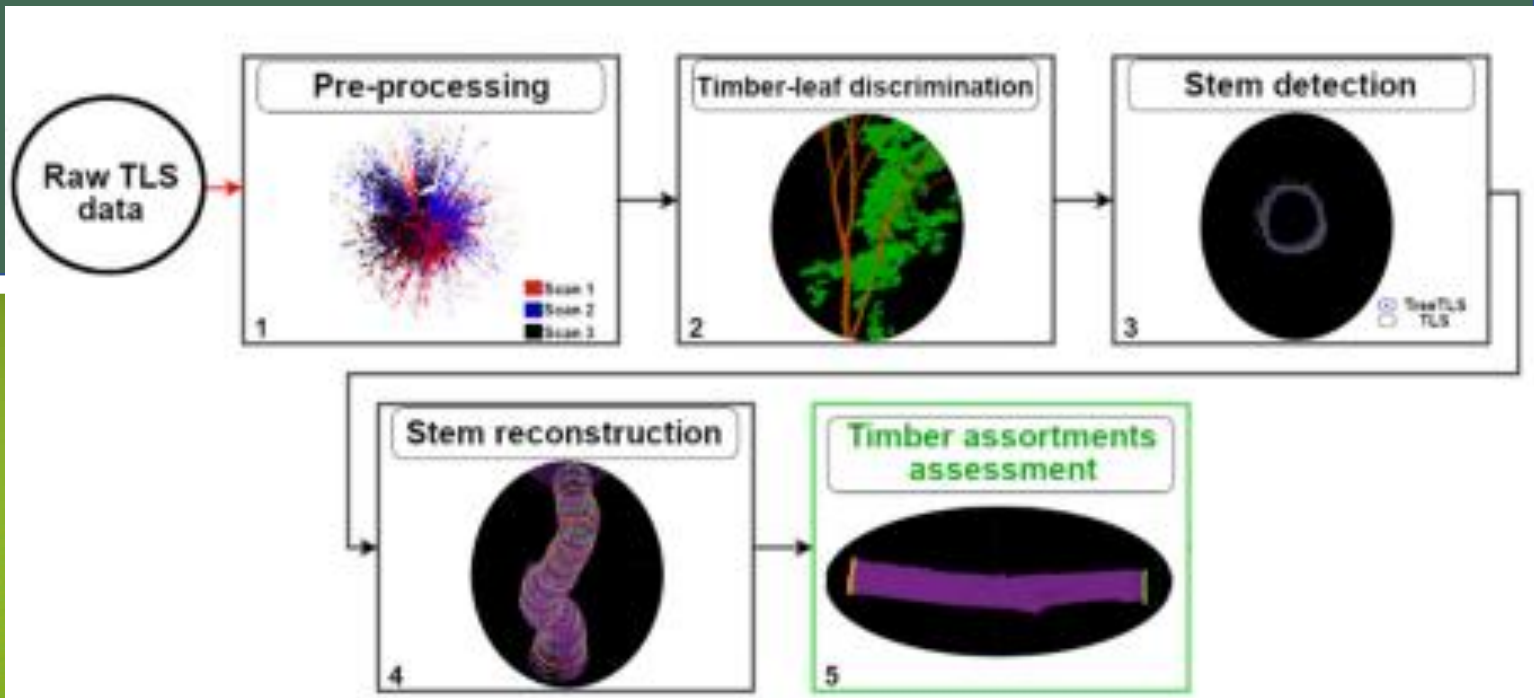
Habitat trees



TreMs – Habitat Trees prediction

Data collection - LiDAR TLS

Data collection - LiDAR TLS



remote sensing

MDPI

Article

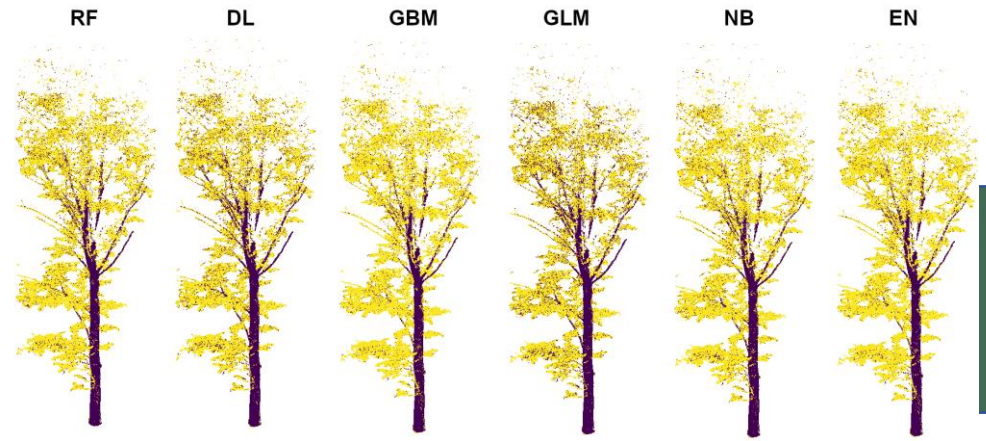
Terrestrial Laser Scanning for Quantifying Timber Assortments from Standing Trees in a Mixed and Multi-Layered Mediterranean Forest

Cesar Alvites [1,*], Giovanni Santopuoli [2], Markus Hollaus [3], Norbert Pfeifer [3], Mauro Maesano [4], Federico Valerio Moresi [4], Marco Marchetti [1] and Bruno Lasserre [1]

Data collection - LiDAR TLS

accurate evaluation of:

- forest structural variables
- SFM indicators
- vegetation index,



remote sensing

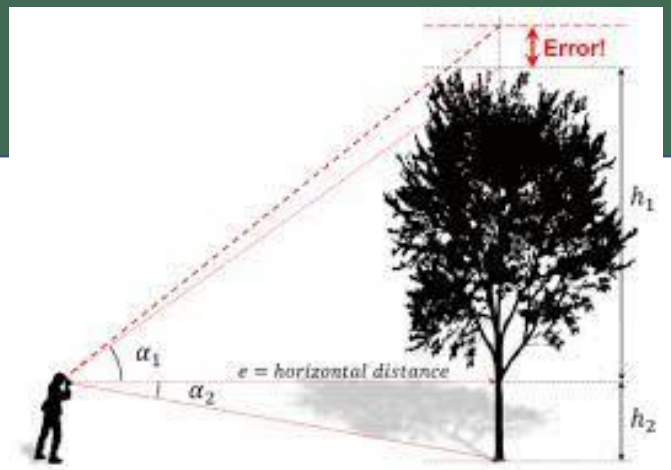
MDPI

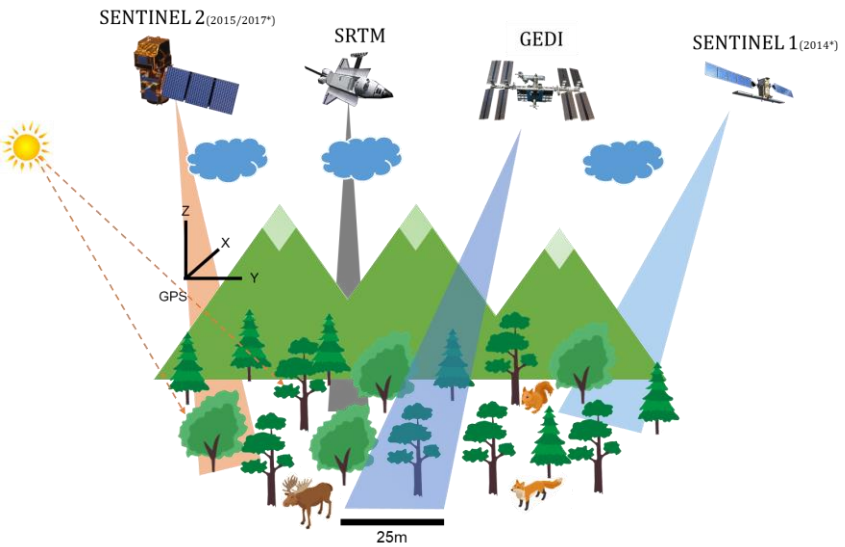
Article

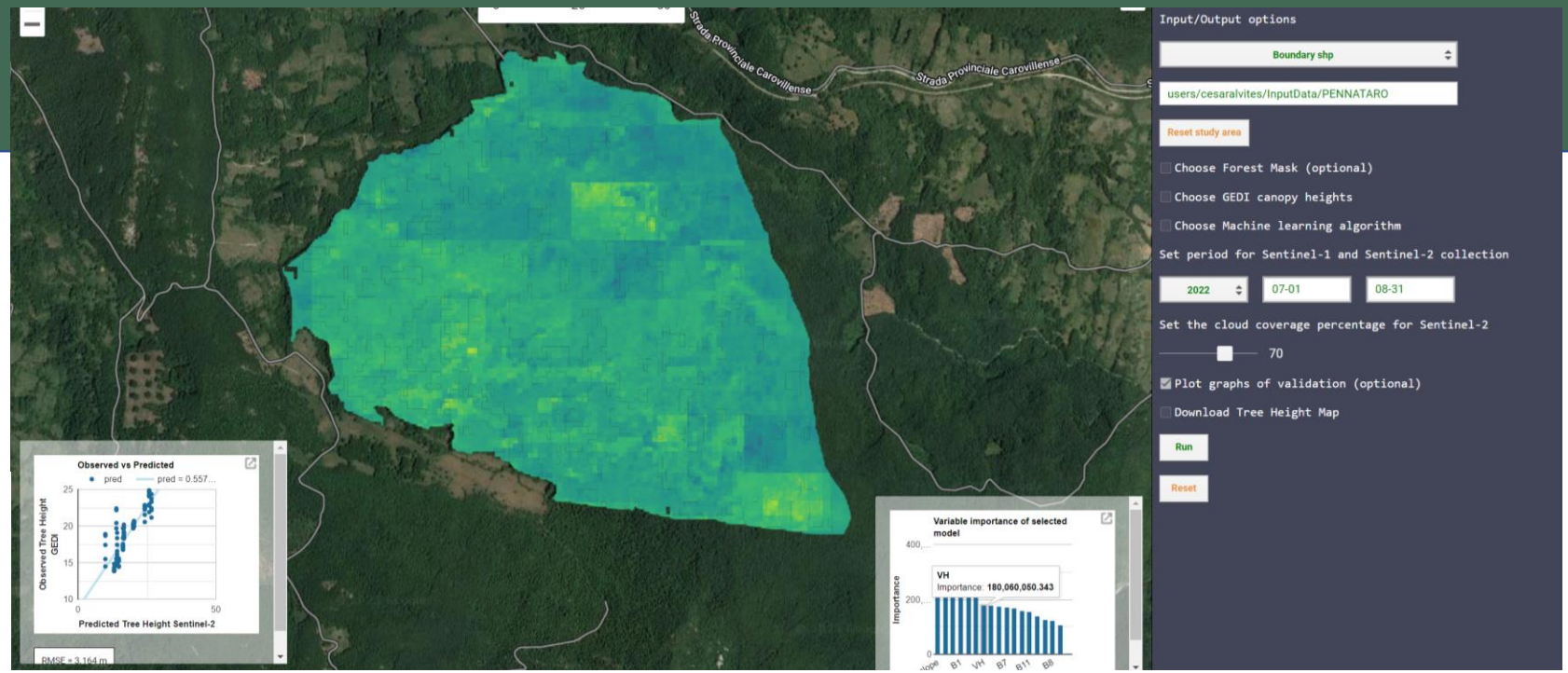
Discrimination of Leaves in a Multi-Layered Mediterranean Forest through Machine Learning Algorithms

Cesar Alvites [1,*], Mauro Maesano [2], Juan Alberto Molina-Valero [3], Bruno Lasserre [1], Marco Marchetti [1] and Giovanni Santopuoli [4]

Data collection - LiDAR



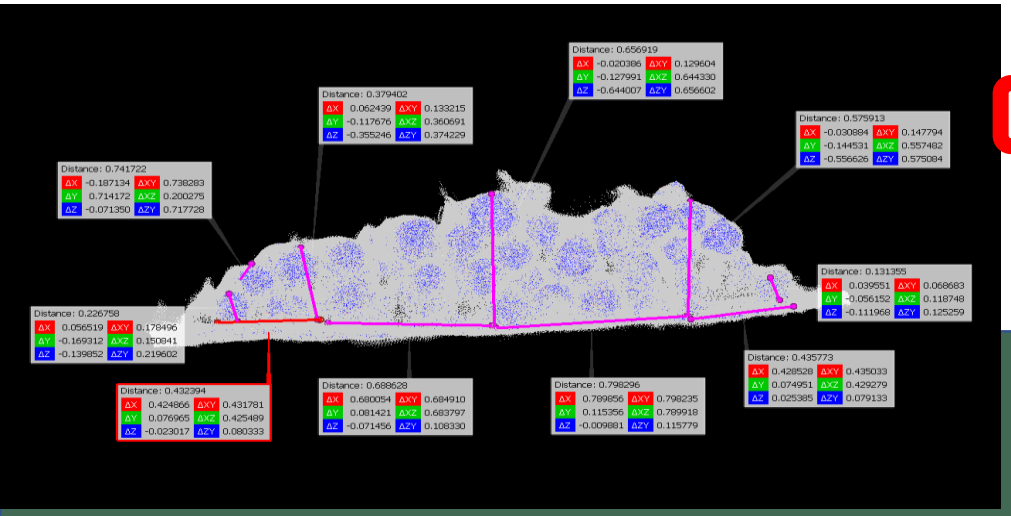


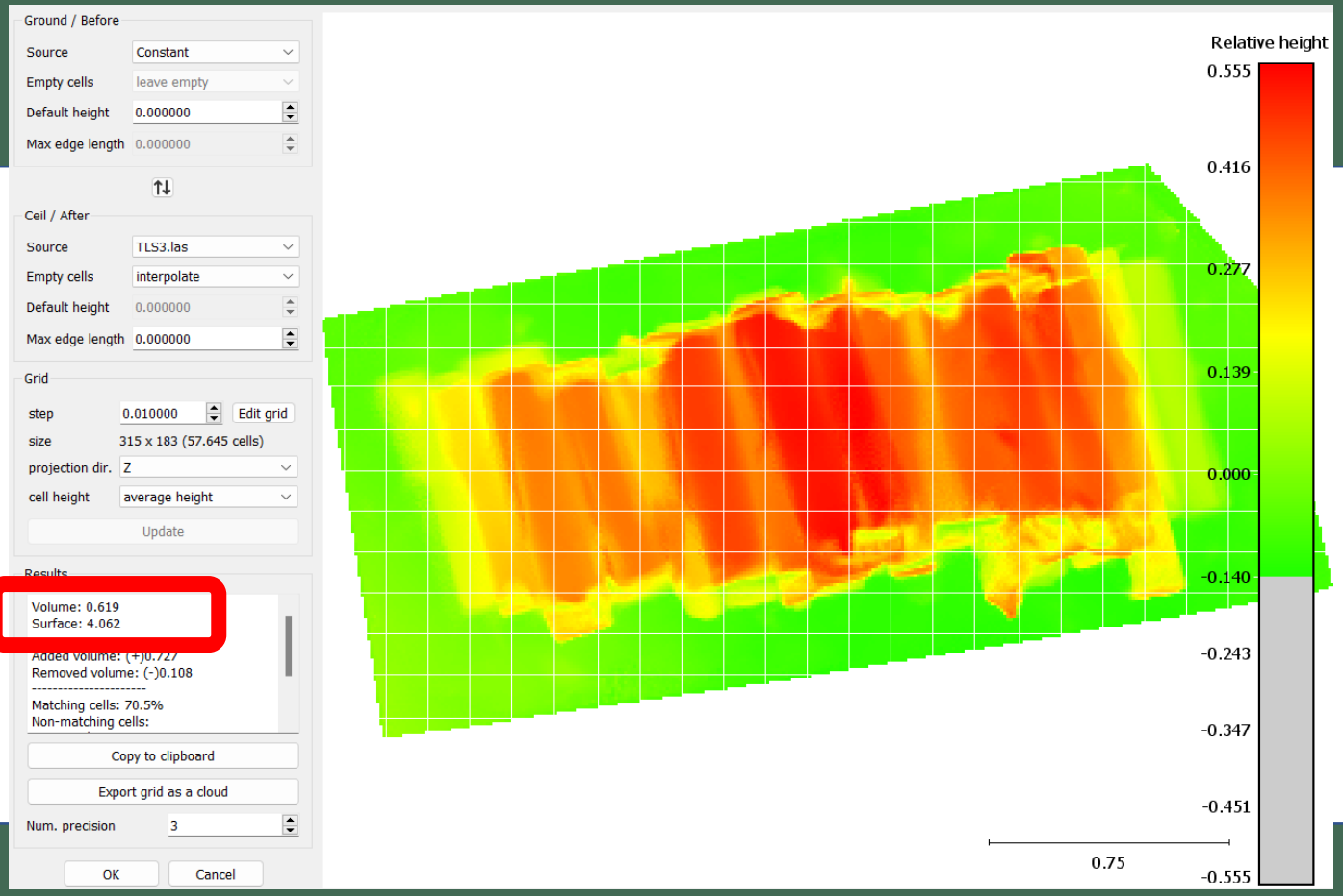


Alvites et al., 202X

Tree height assessments combining LiDAr and GEDI [Global Ecosystem Dynamics Investigation]

Data collection - LiDAR iPhone





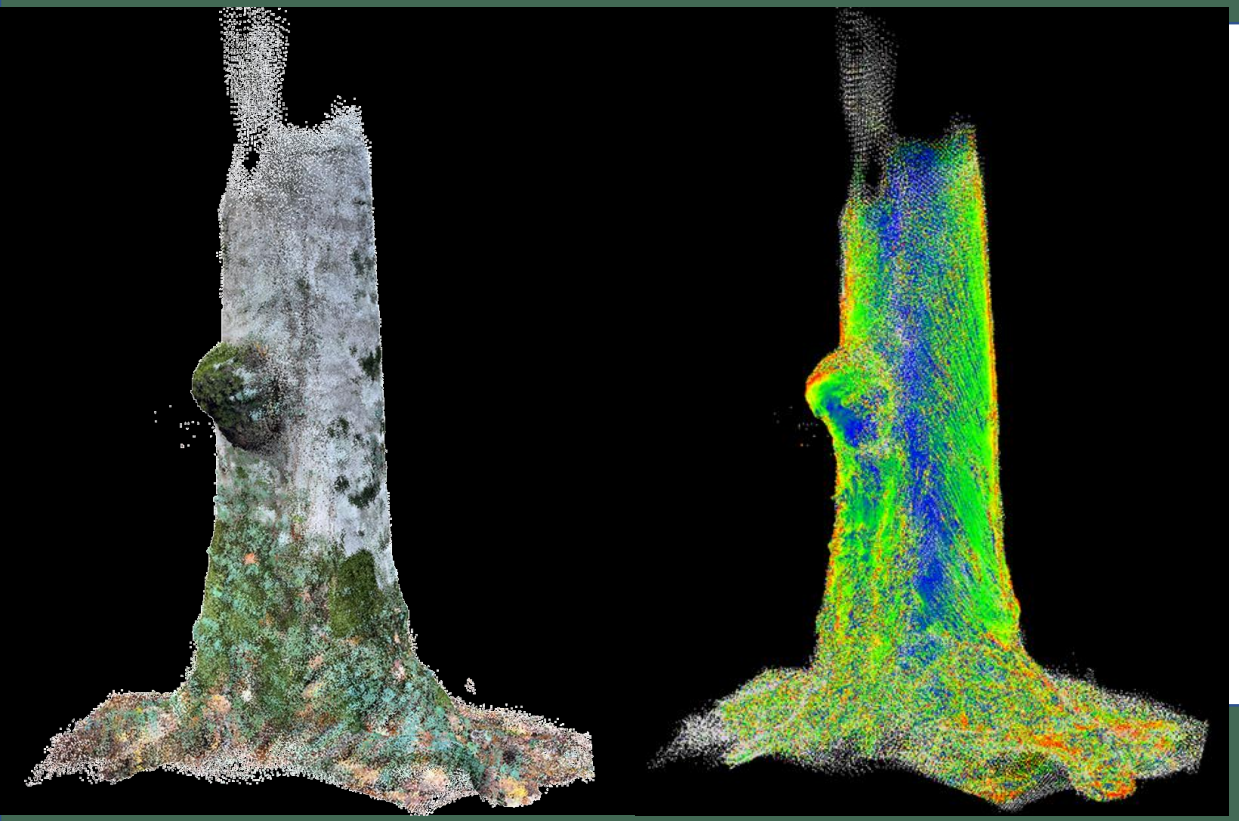
Timber Staked volume

Data collection - LiDAR iPhone

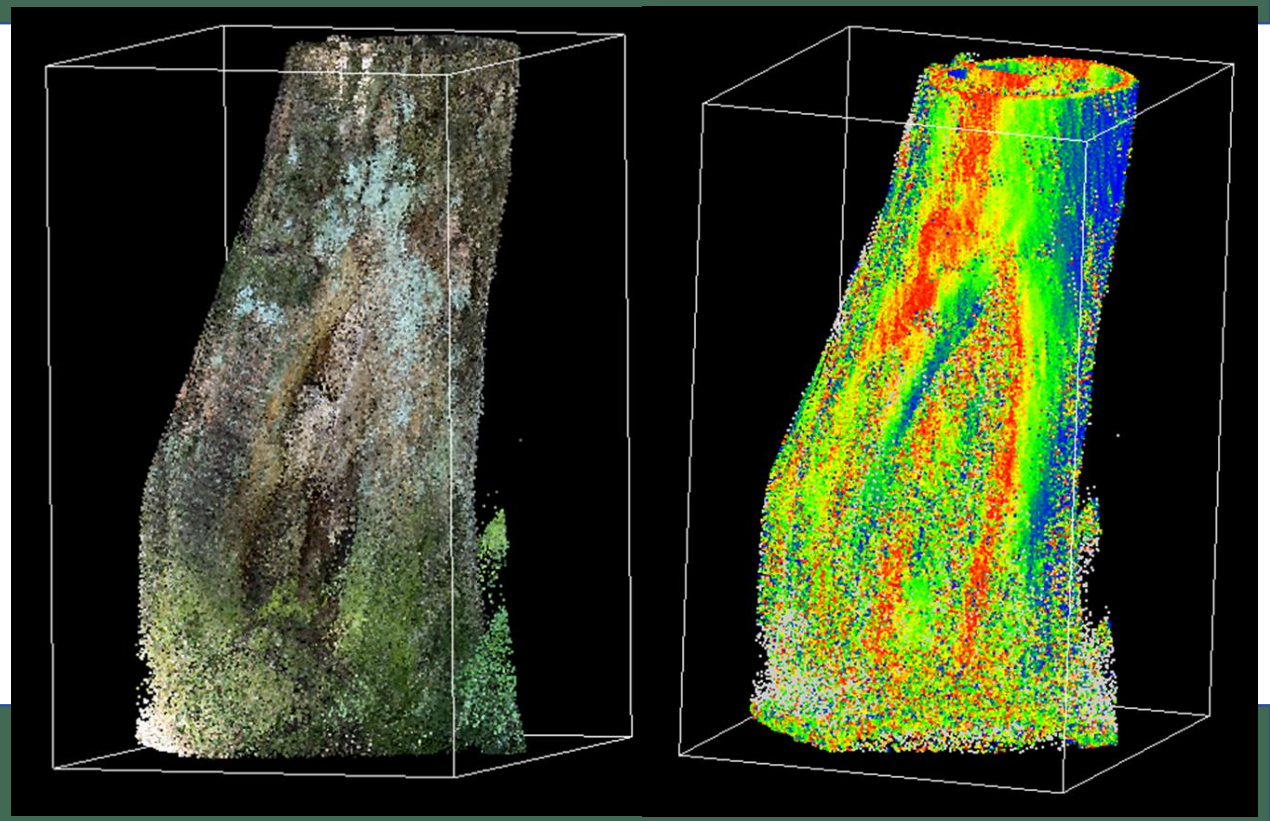
Deadwood and TreMs

Data collection - LiDAR iPhone

GR31



CV24



TreMs

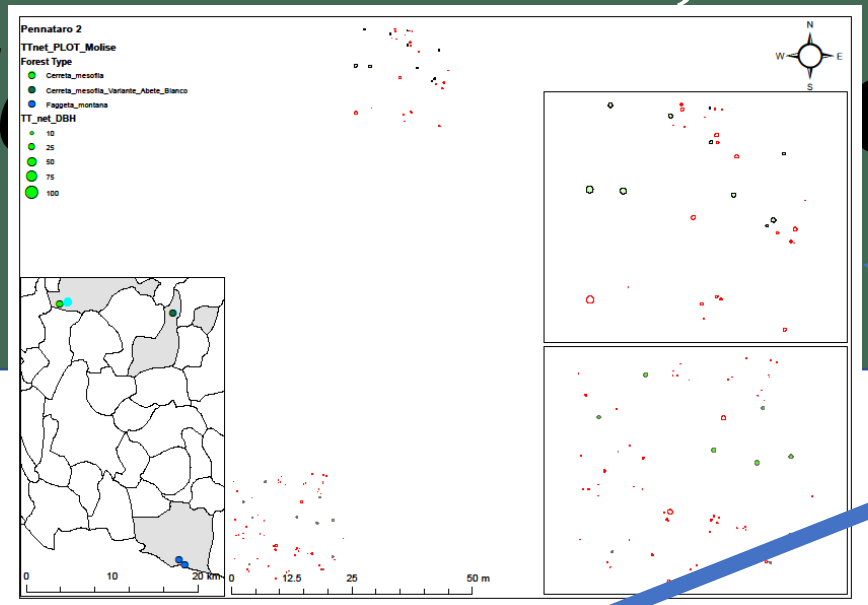
iTT-Net Italian Tree-Talker network

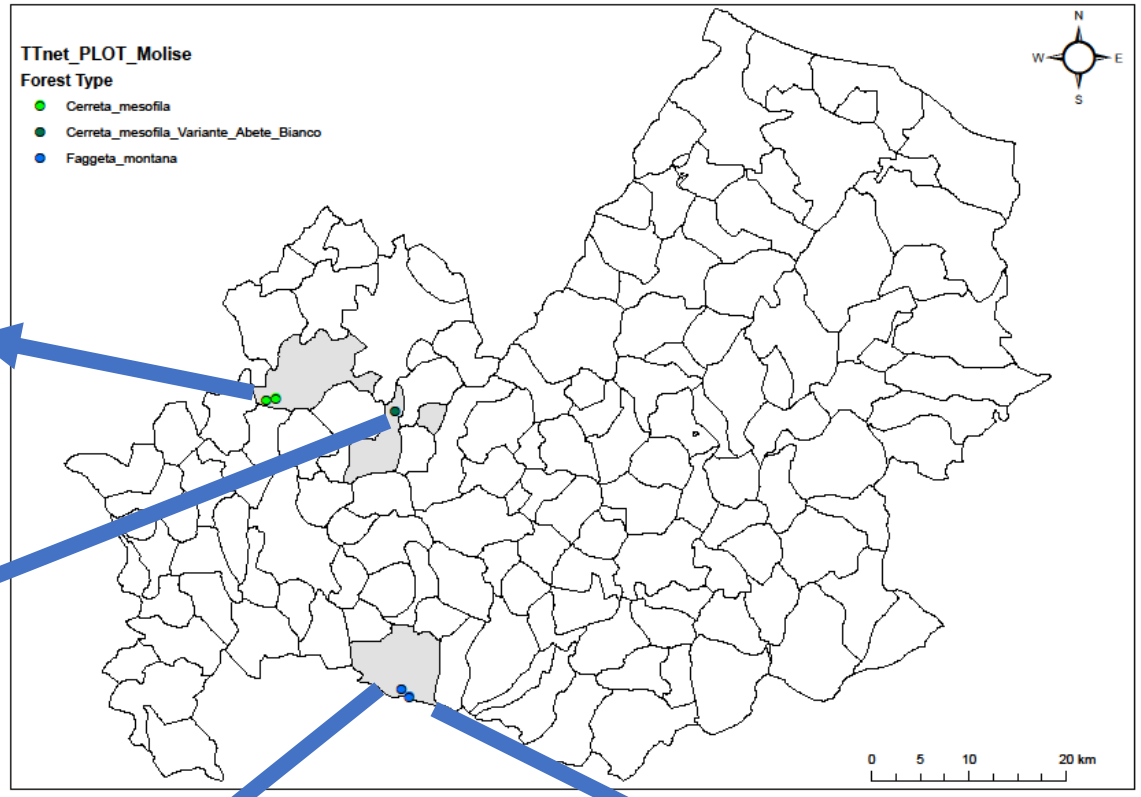
6 Universities
480 TreeTalker installed
480 Trees monitored

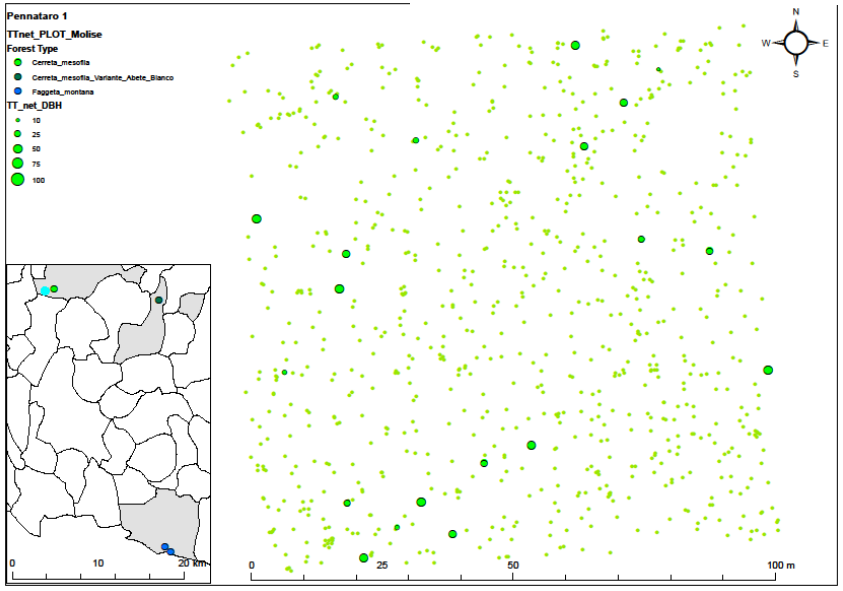
ITT-Net

iTT-N

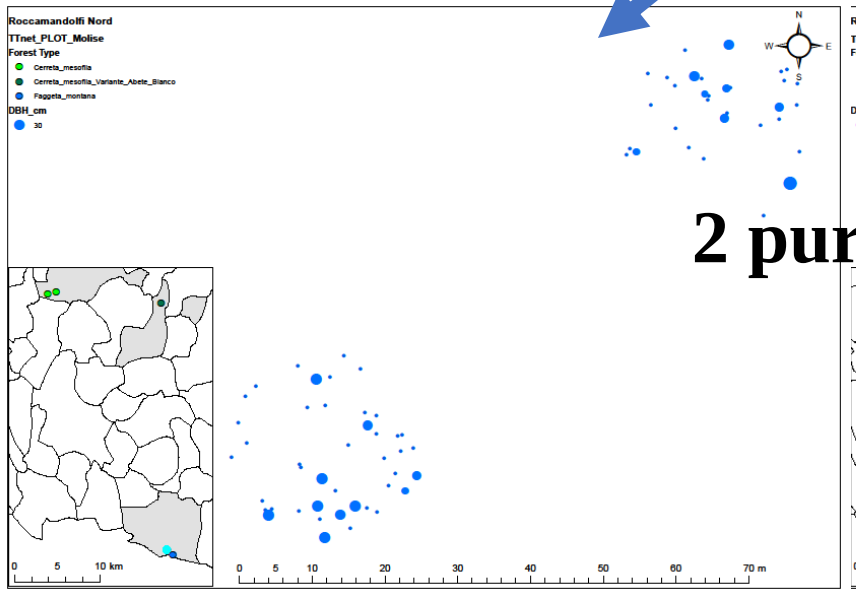
2 mixed beech, oak

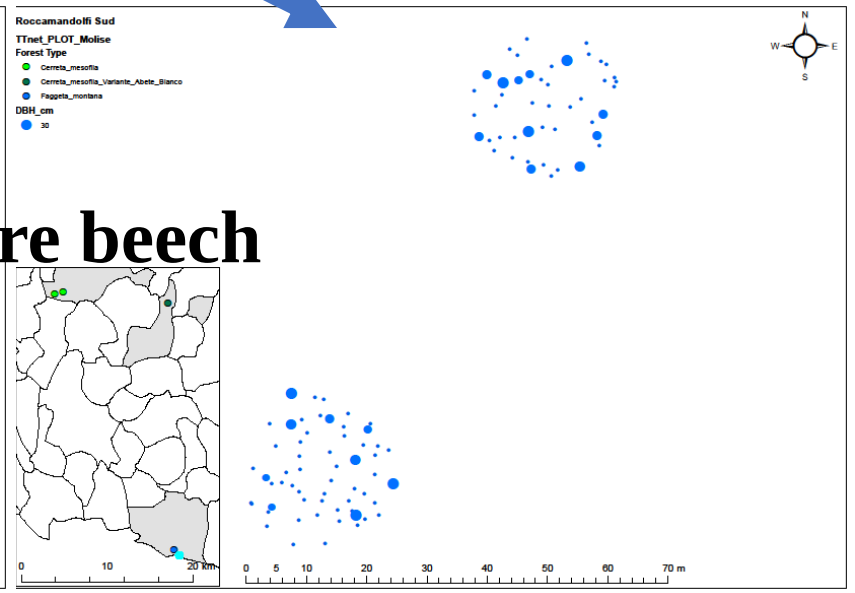






1 mixed oak, fir



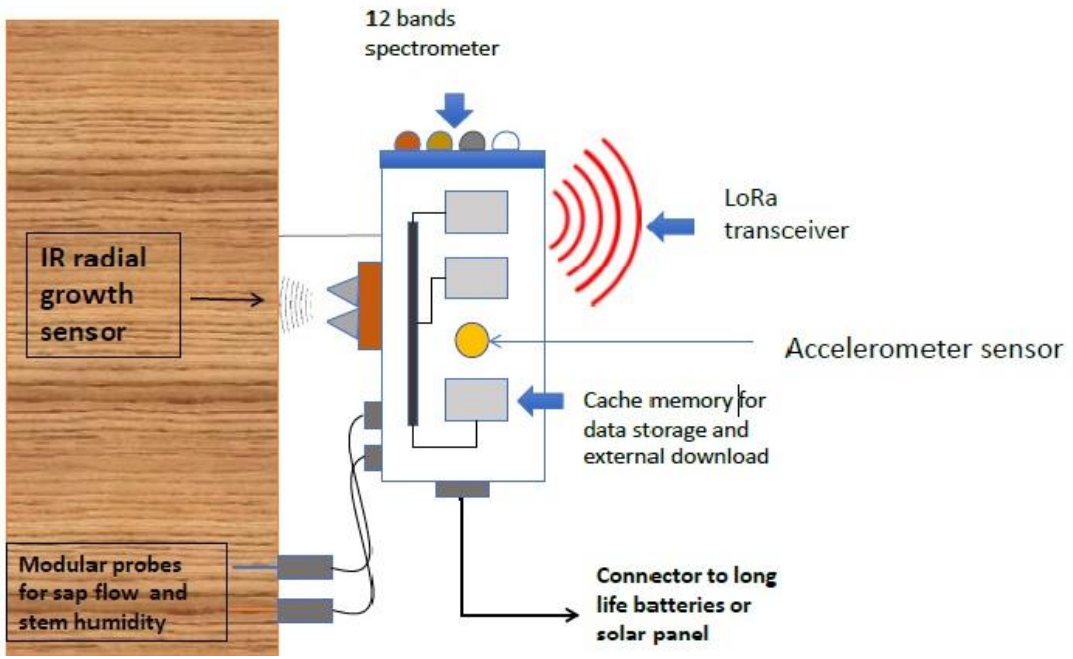


2 pure beech

iTT-Net Italian Tree-Talker network

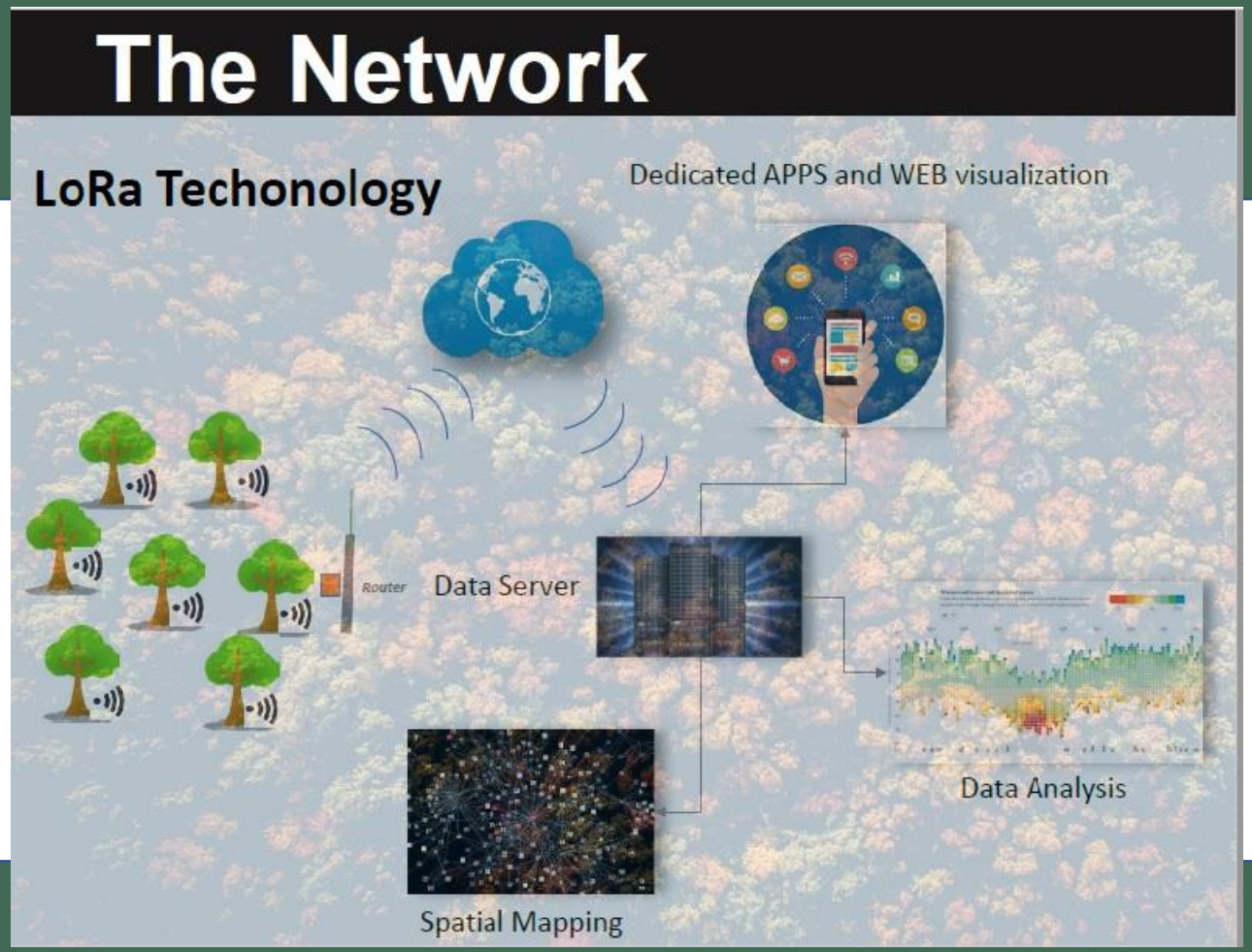
TT installation

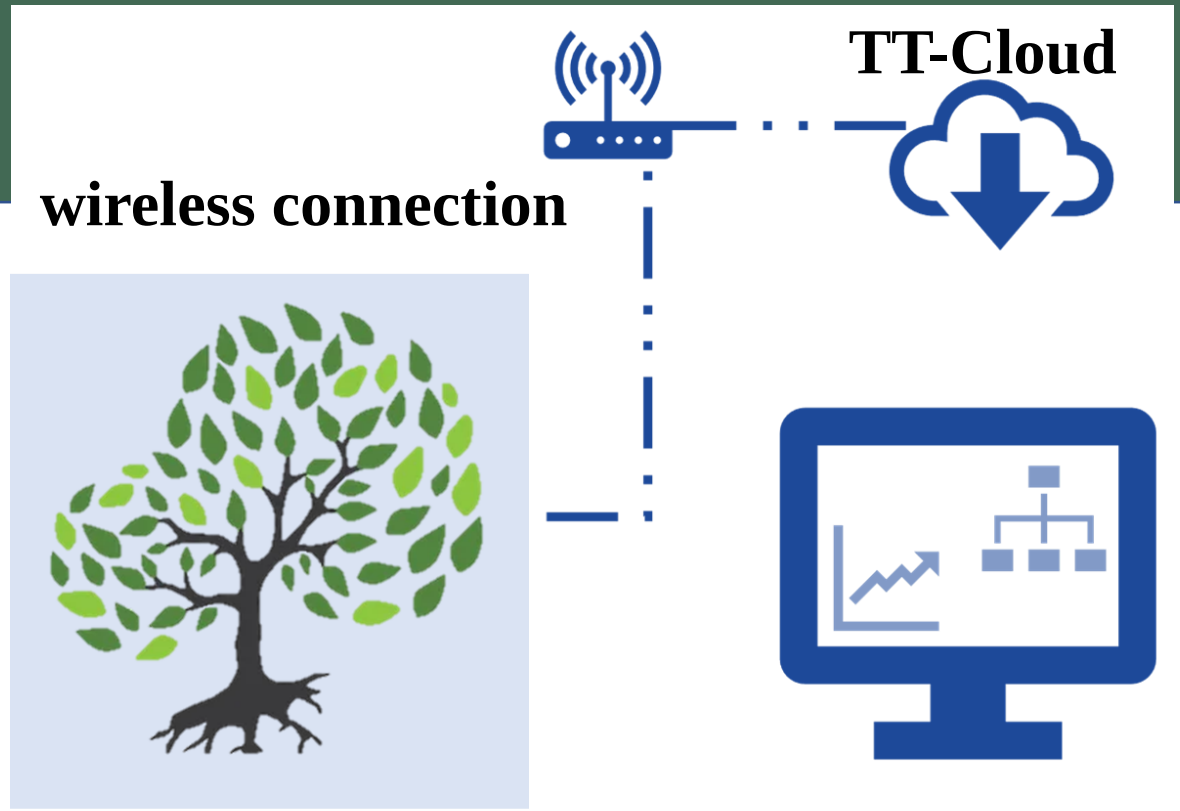
iTT-Net Italian Tree-Talker network



1 hour sampling rate
Transpiration (sap-flow)
Stem humidity (SWC)
Multispectral signature of light transmitted through the canopy
Tree radial growth
Accelerations along a 3D coordinate system used to detect tree movements
Air temperature and relative humidity

iTT-Net Italian Tree-Talker network





TT-Cloud is in turn connected to the internet via the GPRS network and sends data to a computer server

iTT-Net Italian Tree-Talker network

ittn.altervista.org/C0200094/ttclo

Non sicuro | ittn.altervista.org/C0200094/ttcloud.txt

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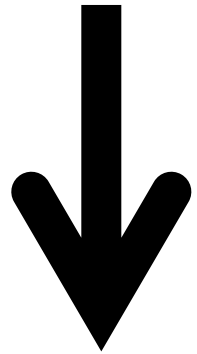
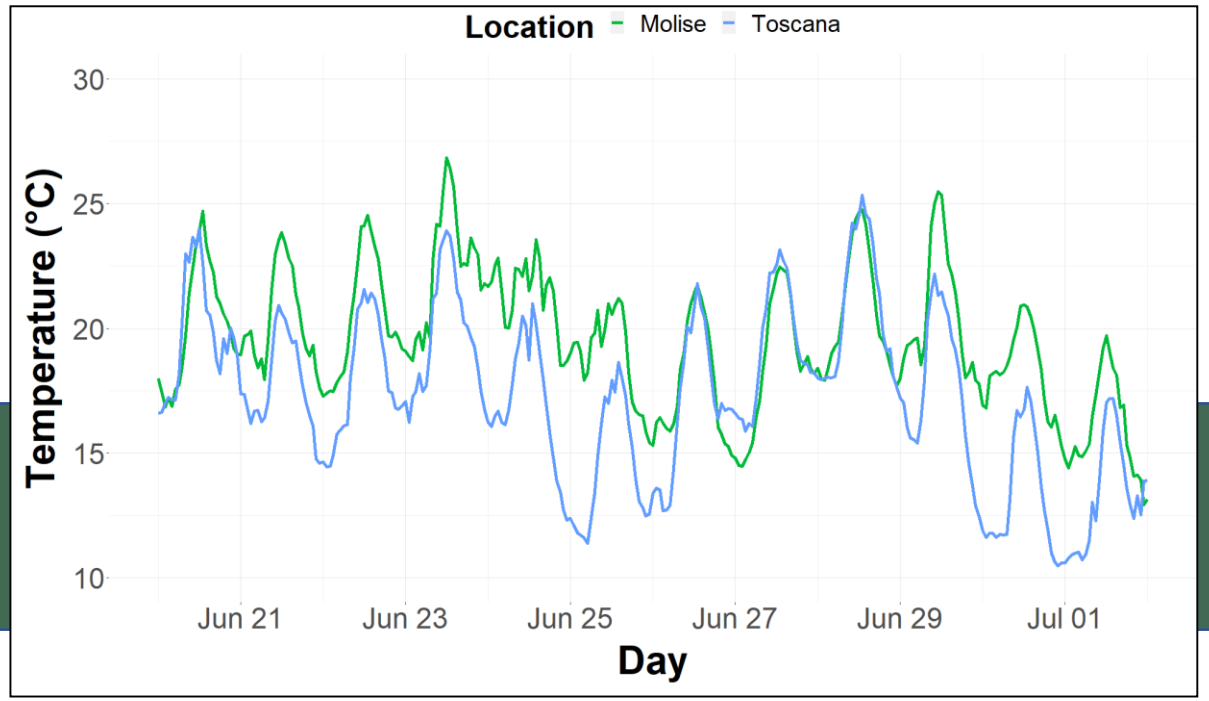
Data server

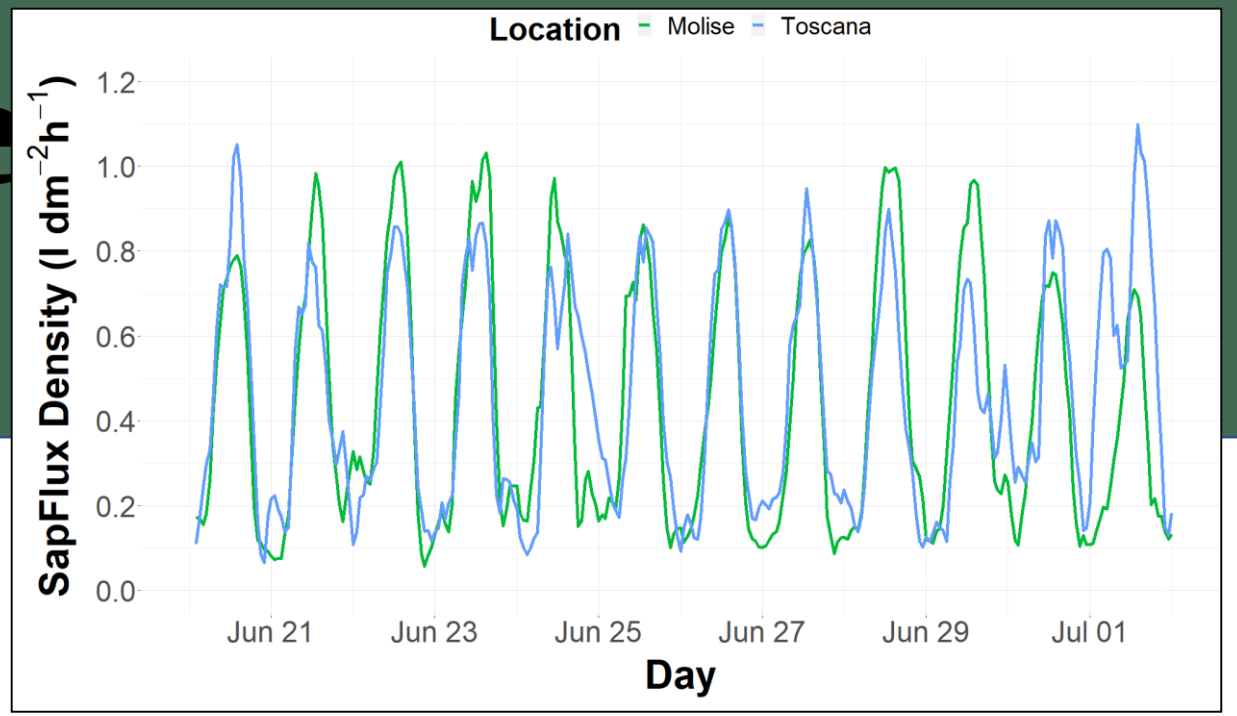


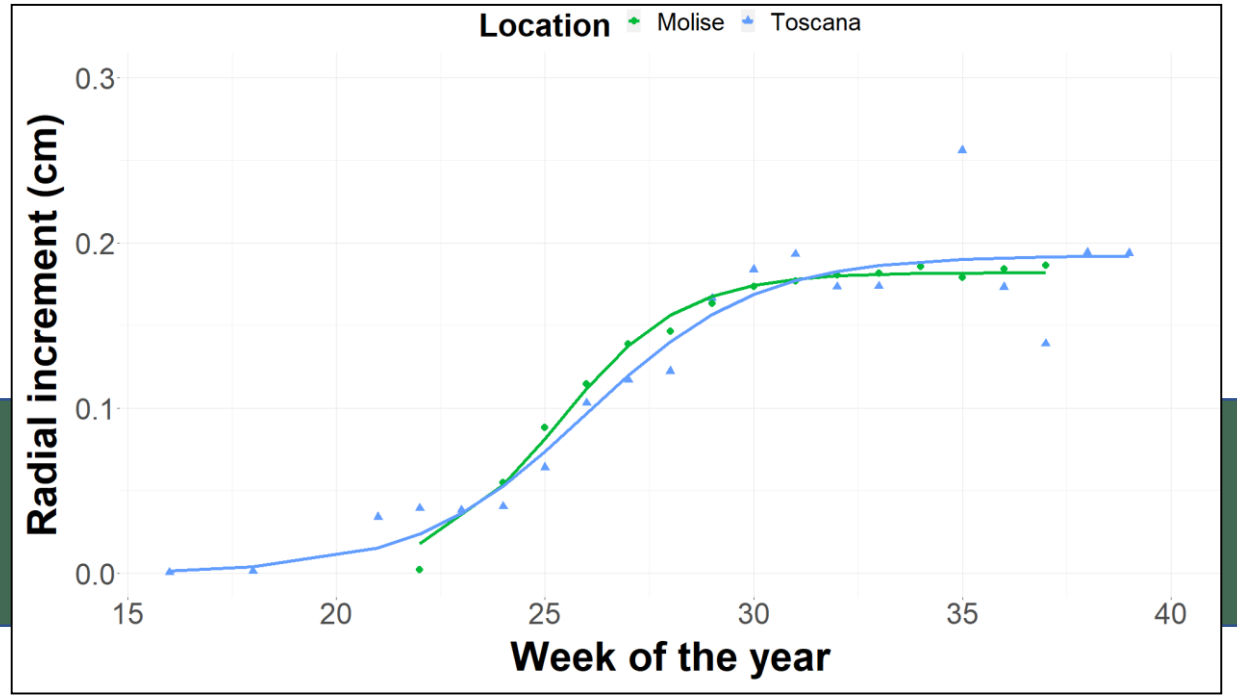
iTT-Net Italian Tre

Comparison between two sites in Italy

- ***Temperature,***
- ***SapFlux,***
- ***radial growth.***







iTT-Net Italian Tree-Talker network

Ecological Informatics 66 (2021) 101433

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journal homepage: www.elsevier.com/locate/ecolinf

The TreeTalkersCheck R package: An automatic daily routine to check physiological traits of trees in the forest

Ilaria Zorzi [a], Saverio Francini [a,b,c,*], Gherardo Chirici [a], Claudia Cocozza [a]

Battery

Temperature

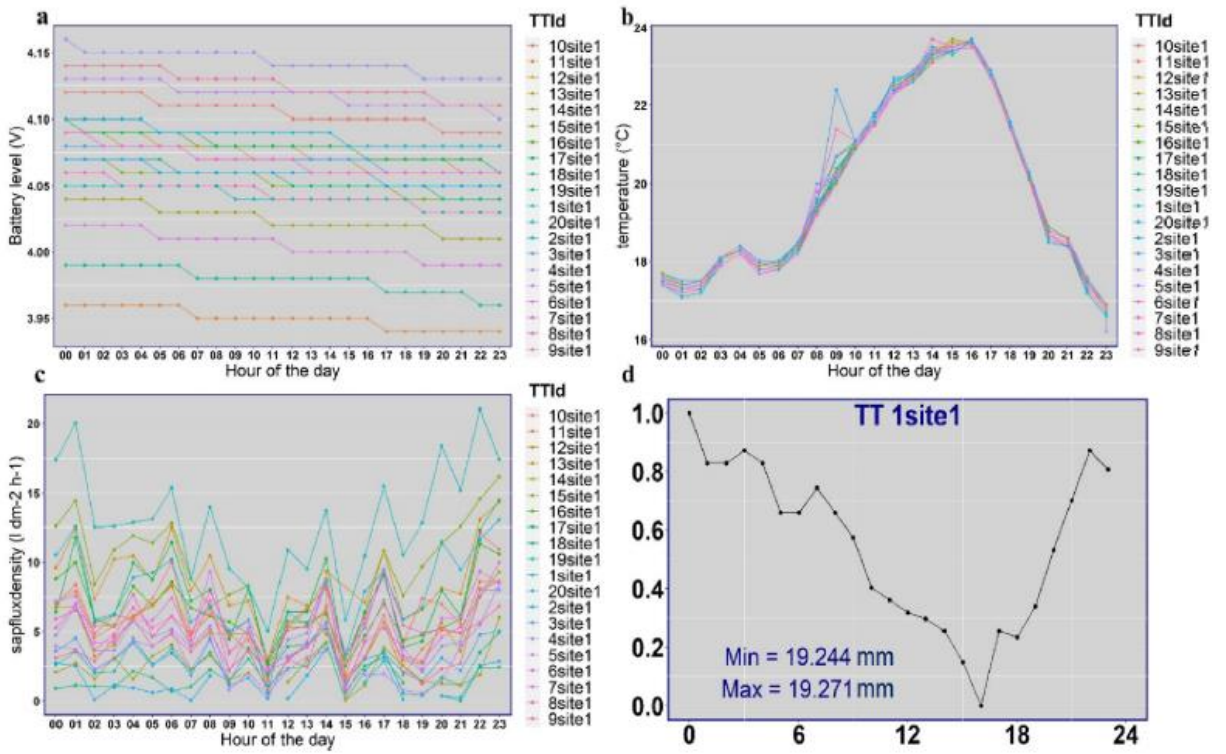

Fig. 2. Example of daily graphs produced by the `TreeTalkersCheck` R package in a site with 20 TTs: (a) battery level; (b) air temperature; (c) sap flux density; (d) stem diameter variation of TT number 1, while in the report there is one graph per each TT.

Sap flux

Stem diameter

iTT-Net Italian Tree-Talker network

forests

MDPI

Article

Toward a Unified TreeTalker Data Curation Process

Enrico Tomelleri [1,*], Luca Belelli Marchesini [2], Alexey Yaroslavtsev [3], Shahla Asgharinia [4] and Riccardo Valentini [4]

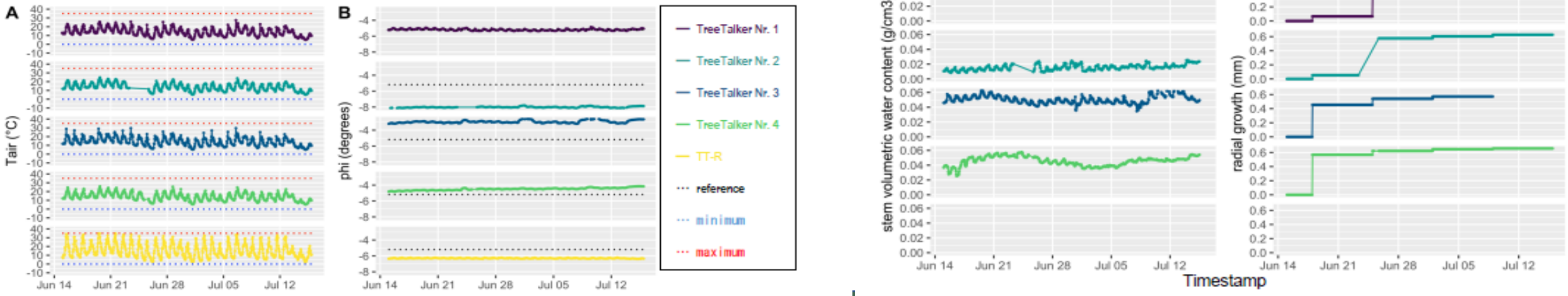

Figure 5. Output of the "ttalkR" plotting utility. (**A**) Air temperature with the reference minimum (dashed blue line) and maximum temperature (dashed red line); (**B**) inclination of the devices; (**C**) stem volumetric content; (**D**) radial growth. The example data refer to four TreeTalkers and a TT-R for the period between 14 June 2021 and 14 July 2021.

iTT-Net Italian

A customizable and use friendly R package to process big data from the Tree Talker system

Jerzy Piotr Kabala[1], Francesco Niccoli[1], Giovanna Battipaglia[1]

[1] *Department of Environmental, Biological and Pharmaceutical Sciences and Technologies, University of Campania "L. Vanvitelli", Via Vivaldi 43, 81100, Caserta, Italy*

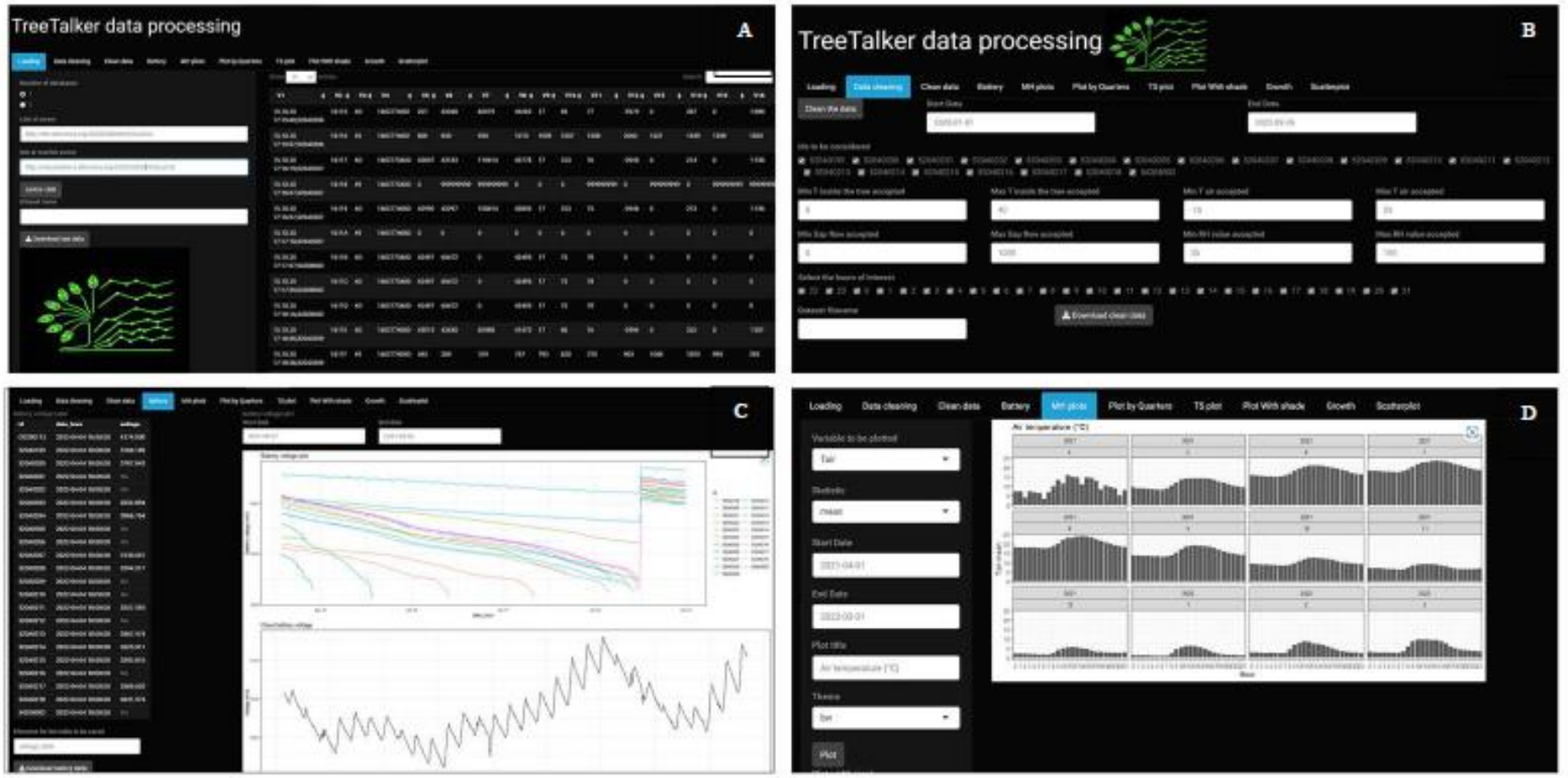

Figure 3 screenshot of the GUI of the package. A) Data loading tab, B) Data cleaning and filtering tab, C) battery voltage table, D) Monthly summary of air temperature

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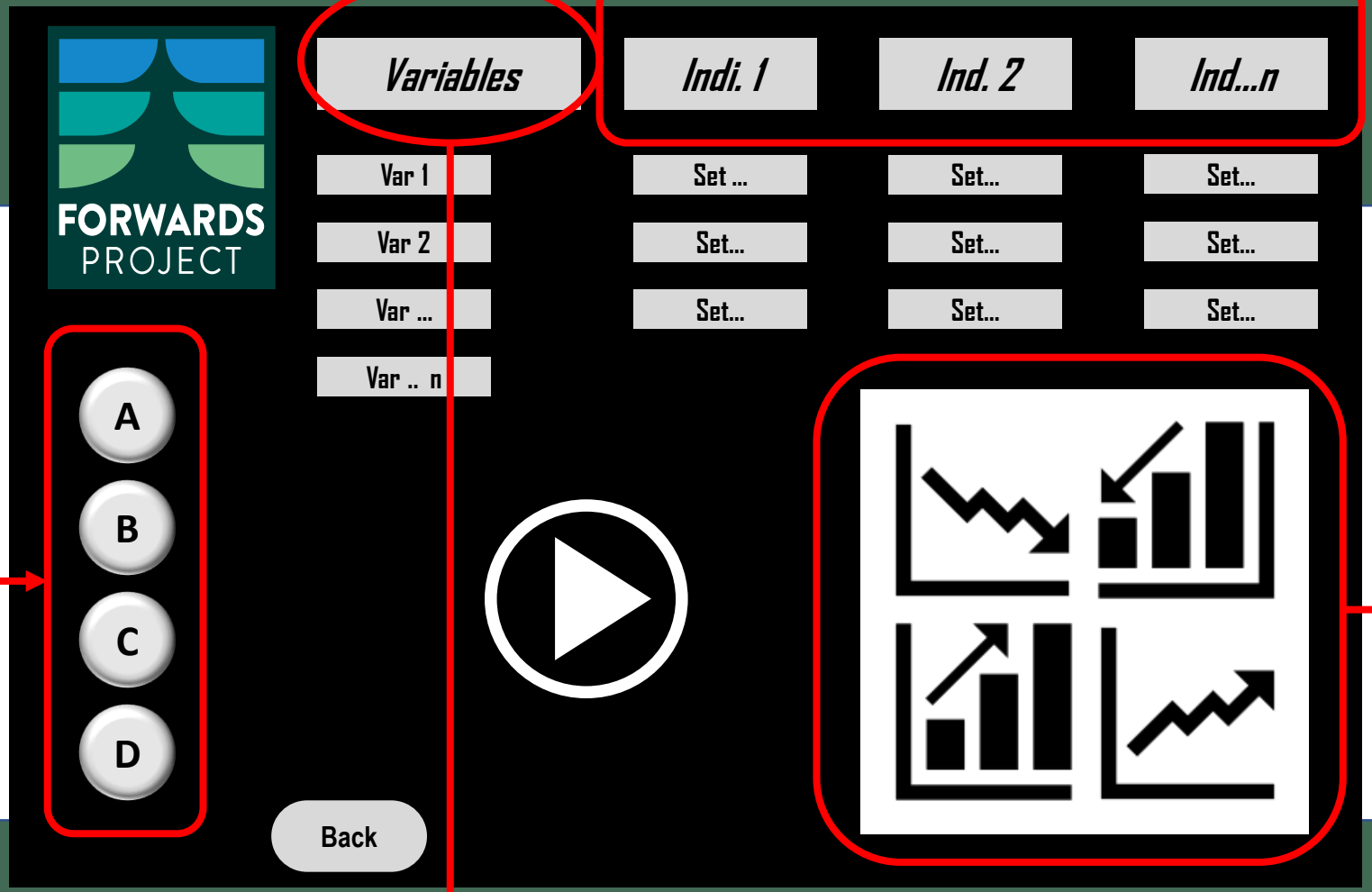
Damaged sensors

We replaced some sensors and TTs

Water effect

FORWARDS - The ForestWard Observatory to Secure Resilience of European Forests



Indicators set

- Growing stock
- Carbon stock
- Increment/felling
- Specie composition
- Forest damage
- etc..
- etc...

Management objective

- Productive
- Protective
- Biodiversity
- Carbon stock
- Mitigation
- Etc..

Output overview

Field or remote data available

FORWARDS

Thank you!

PhD. Serena Antonucci

PhD. Cesar Alvites

Ph.D student Pierdomenico Spina

Ph.D student Diana Alfieri

Ph.D student Concetta Lisella

http://www.ecogeofor.unimol.it/

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