UNIVERSITÀ DEGLI STUDI FIRENZE

SCHOOL OF FORESTRY
SINCE 1869

Associazione Italiana di Telerilevamento

Accademia Italiana di Scienze Forestali

Società Italiana di Selvicoltura ed Ecologia Forestale

Selvicoltura di precision e nuove tecnologie per la gestione forestale sostenibile

Prof. Gherardo Chirici

geo LAB
Laboratory of Forest Geomatics

Precision forestry

- Recentemente, lo sviluppo delle tecnologie dell'informazione e della comunicazione (Ict) ha favorito l’applicazione al settore agricolo di nuove strategie e metodologie gestionali note nel loro complesso come Precision Agriculture (**Agricoltura di Precisione**).
- Con il termine **Precision Forestry** si identifica l’acquisizione e l’utilizzo di dati derivanti da tecnologie Ict a supporto di un uso sostenibile delle risorse forestali.
- In Italia, il termine Precision Forestry viene generalmente tradotto in “**selvicoltura di precisione**”, intendendo l’insieme di pratiche di monitoraggio, pianificazione, gestione e utilizzazione delle risorse forestali.

The building blocks of moving from traditional to precision forestry require a new approach.

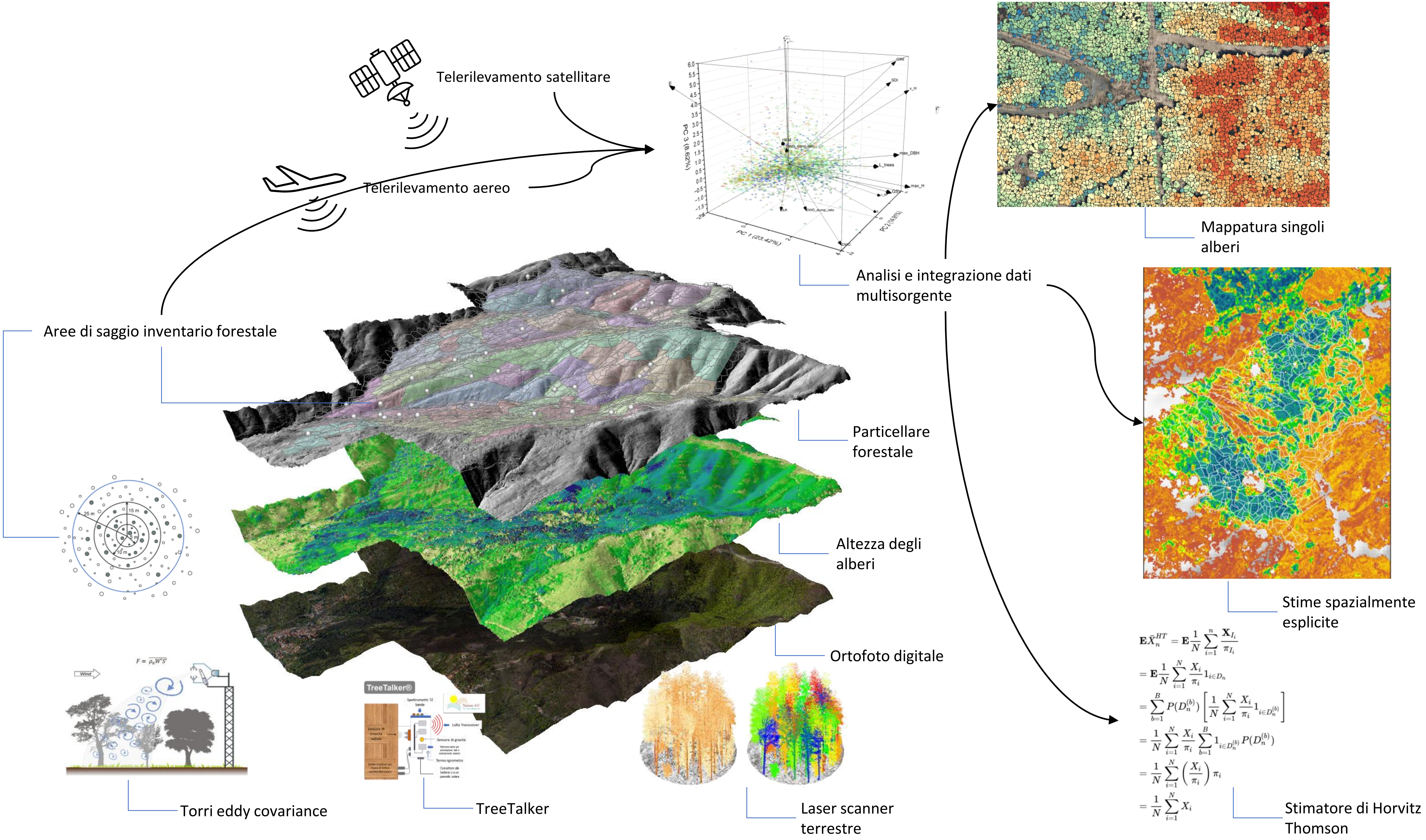
From:

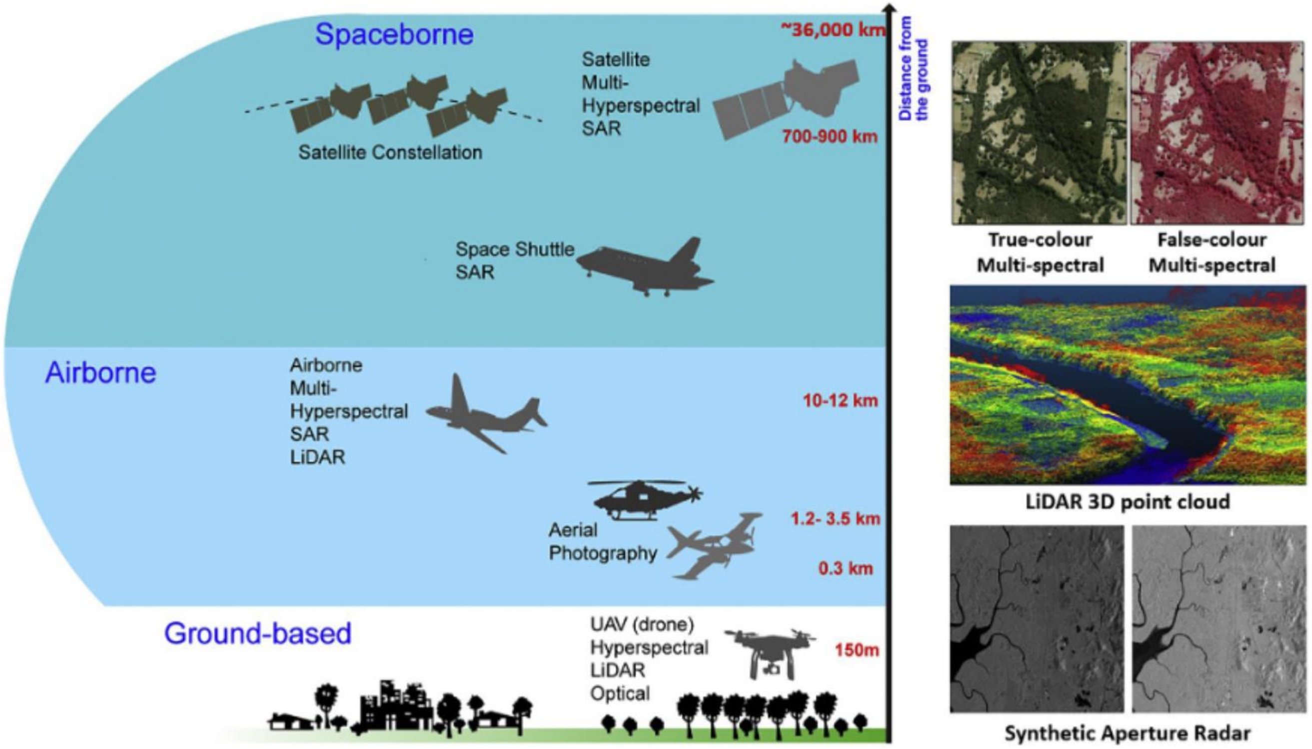
Traditional forestry systems involving highly manual and analog processes, "broad-brush" management prescriptions

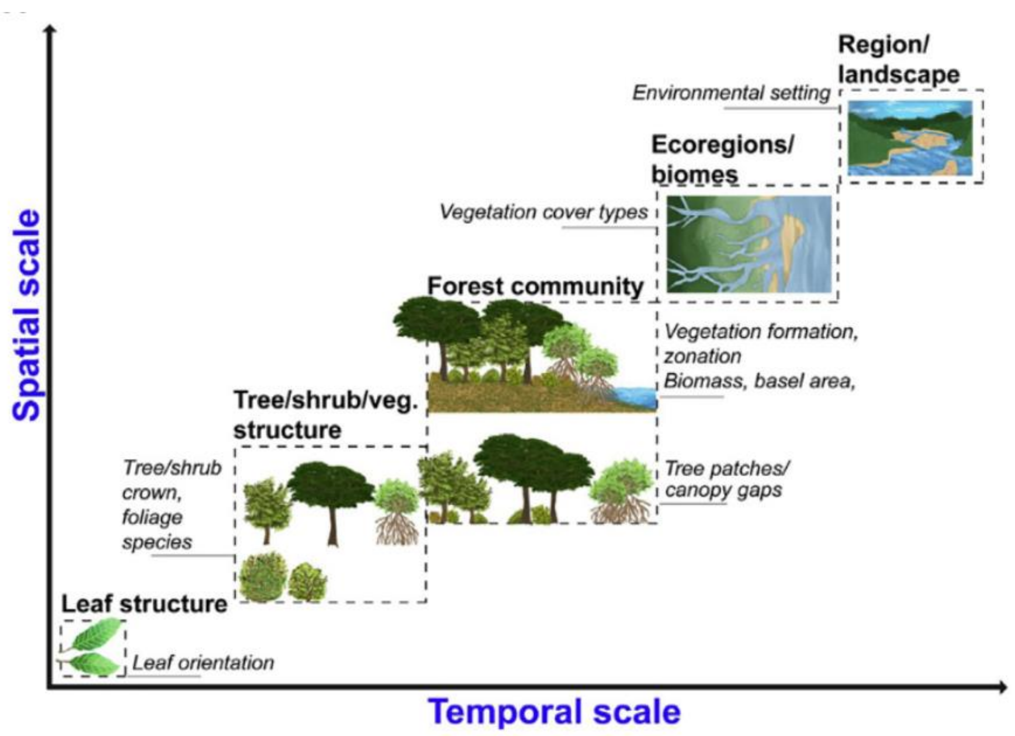
- Natural regeneration of forests with seed trees of same genetic material
- Use of 2–3 standard fertilization prescriptions depending on broad soil-type classifications
- Manual in-field forest inventory based on sampling to inform production planning
- Motor-manual harvesting with no data capture
- Reacting to forest fires detected only by direct observation

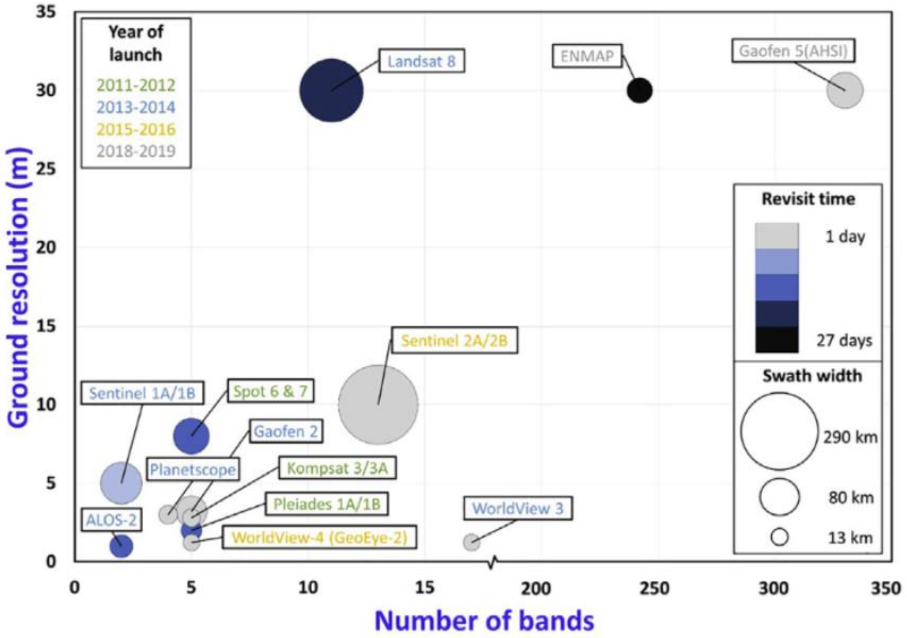
To:

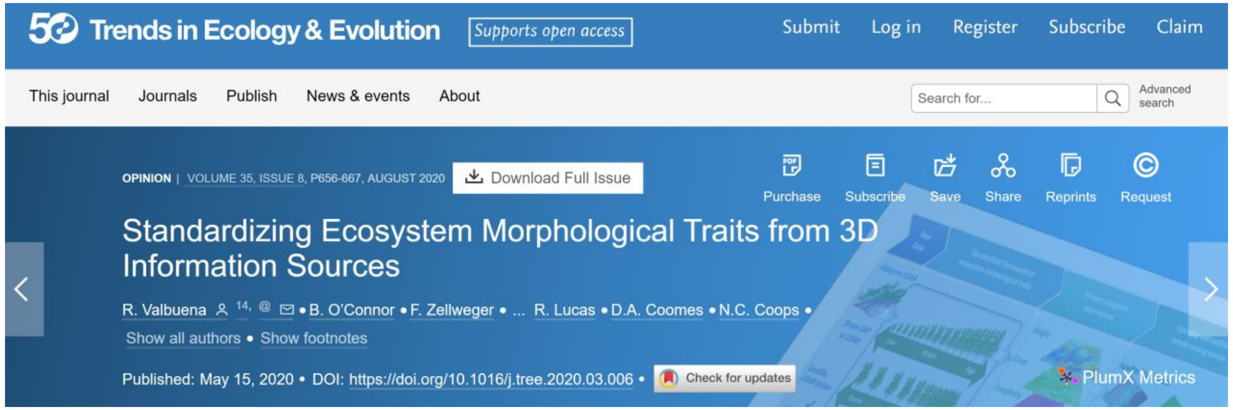
- Selectively bred and cloned seedlings, raised in nurseries under tightly controlled conditions
- Site-specific fertilization treatment based on granular assessment of soil nutrient deficiencies
- Digital forest inventory using drones and light detection and ranging (lidar), or in-forest scanning with smartphones
- Fully mechanized harvesting, integrated with supply-chain planning
- Satellites and drones to provide early fire detection and inform centrally planned response


Telerilevamento satellitare
Telerilevamento aereo
Analisi e integrazione dati multisorgente
Mappatura singoli alberi
Aree di saggio inventario forestale
Particellare forestale
Altezza degli alberi
Stime spazialmente esplicite
Ortofoto digitale
Torri eddy covariance
TreeTalker
Laser scanner terrestre
Stimatore di Horvitz Thomson


Spaceborne
~36,000 km
Distance from the ground
Satellite
Multi-
Hyperspectral
SAR
Satellite Constellation
700-900 km
Space Shuttle
SAR
Airborne
Airborne
Multi-
Hyperspectral
SAR
LiDAR
10-12 km
1.2- 3.5 km
Aerial
Photography
0.3 km
Ground-based
UAV (drone)
Hyperspectral
LiDAR
Optical
150m
True-colour
Multi-spectral
False-colour
Multi-spectral
LiDAR 3D point cloud
Synthetic Aperture Radar


Spatial scale
Temporal scale
Region/
landscape
Environmental setting
Ecoregions/
biomes
Vegetation cover types
Forest community
Vegetation formation,
zonation
Biomass, basal area,
Tree/shrub/veg.
structure
Tree/shrub
crown,
foliage
species
Tree patches/
canopy gaps
Leaf structure
Leaf orientation


Year of
launch
2011-2012
2013-2014
2015-2016
2018-2019
Landsat 8
ENMAP
Gaofen 5(AHSI)
Revisit time
1 day
27 days
Swath width
290 km
80 km
13 km
Sentinel 2A/2B
Sentinel 1A/1B
Spot 6 & 7
Gaofen 2
Planetscope
Kompsat 3/3A
Pleiades 1A/1B
ALOS-2
WorldView-4 (GeoEye-2)
WorldView 3
Ground resolution (m)
Number of bands
0
5
10
15
20
25
30
35
0
5
10
15
200
250
300
350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OPINION | VOLUME 35, ISSUE 8, P656-667, AUGUST 2020
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Standardizing Ecosystem Morphological Traits from 3D Information Sources
R. Valbuena • B. O'Connor • F. Zellweger • ... R. Lucas • D.A. Coomes • N.C. Coops •
Show all authors • Show footnotes
Published: May 15, 2020 • DOI: https://doi.org/10.1016/j.tree.2020.03.006 •
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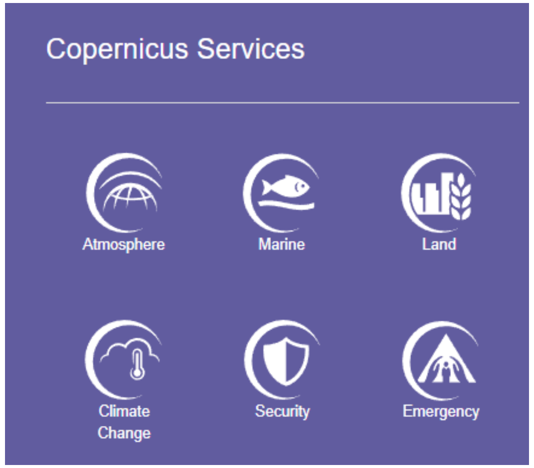
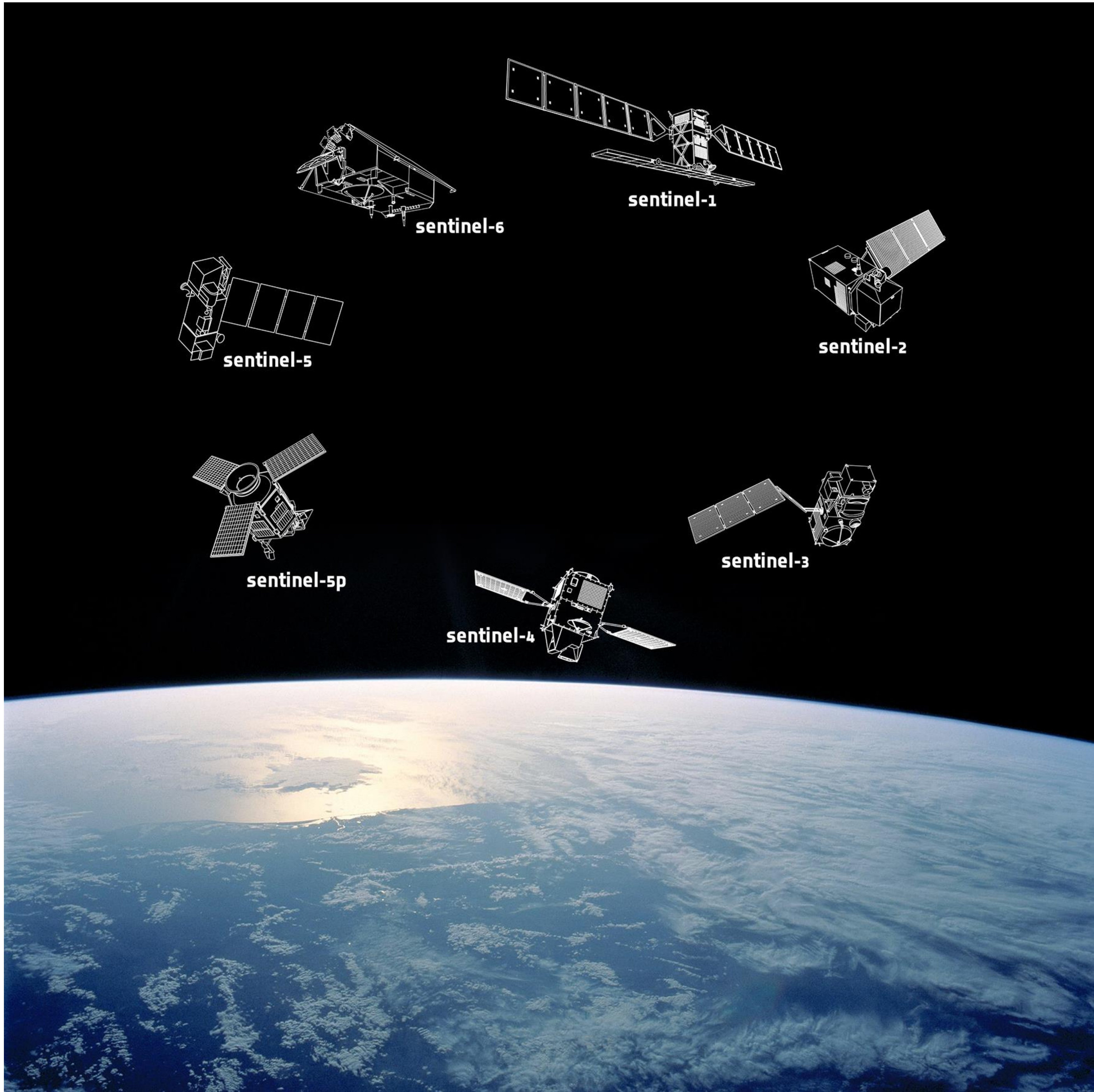
PlumX Metrics

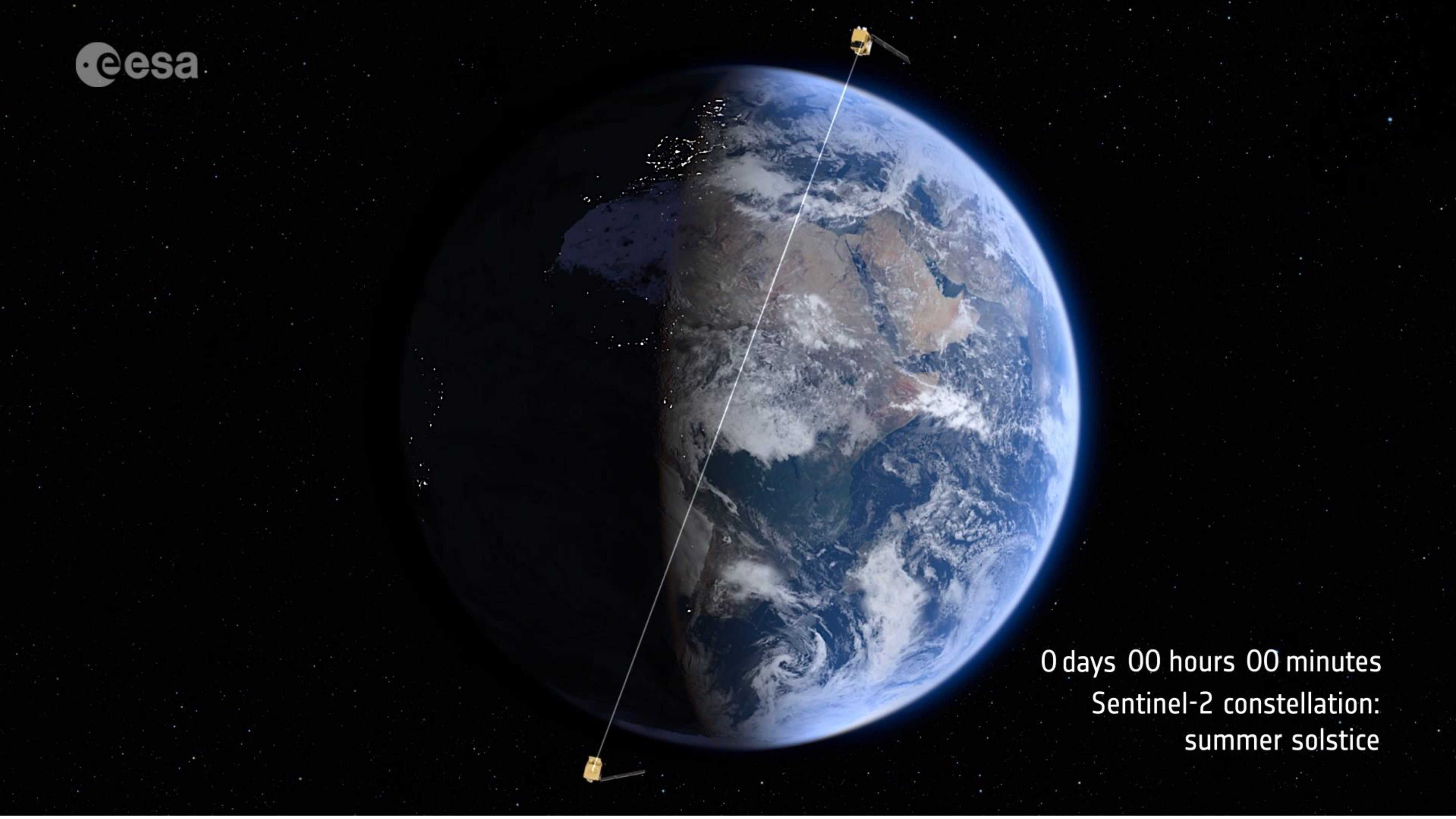

Colocated Data + Computation + APIs

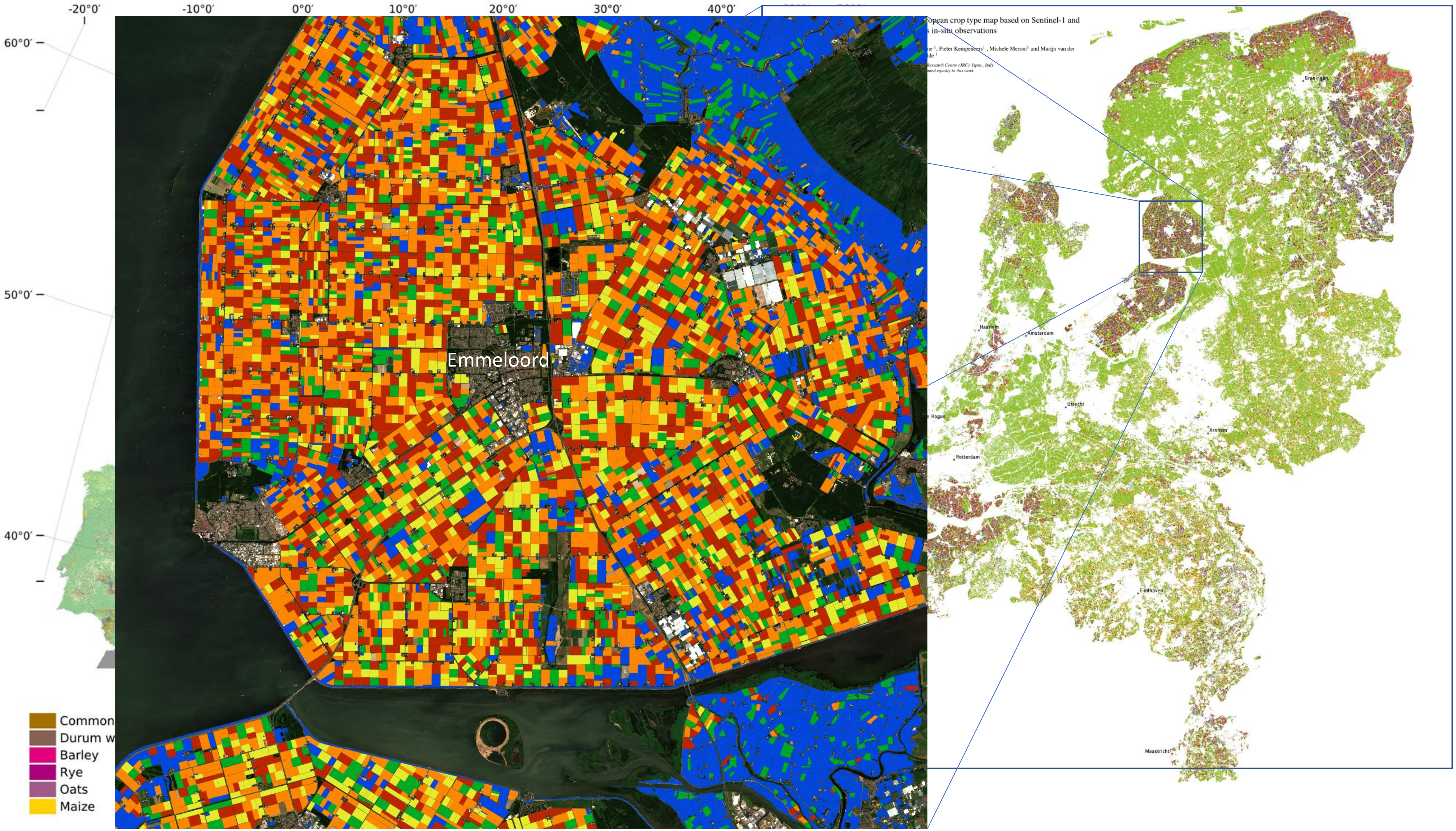
copernicus

Europe's eyes on Earth






esa
0 days 00 hours 00 minutes
Sentinel-2 constellation:
summer solstice



-20°0′
-10°0′
0°0′
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20°0′
30°0′
40°0′
60°0′
50°0′
40°0′
Common
Durum w
Barley
Rye
Oats
Maize
Emmeloord
opean crop type map based on Sentinel-1 and
s in-situ observations
Groningen
Haarlem
Amsterdam
Utrecht
Hague
Arnhem
Rotterdam
Eindhoven
Maastricht

s2gm.land.copernicus.eu/mosaic-hub

In pausa

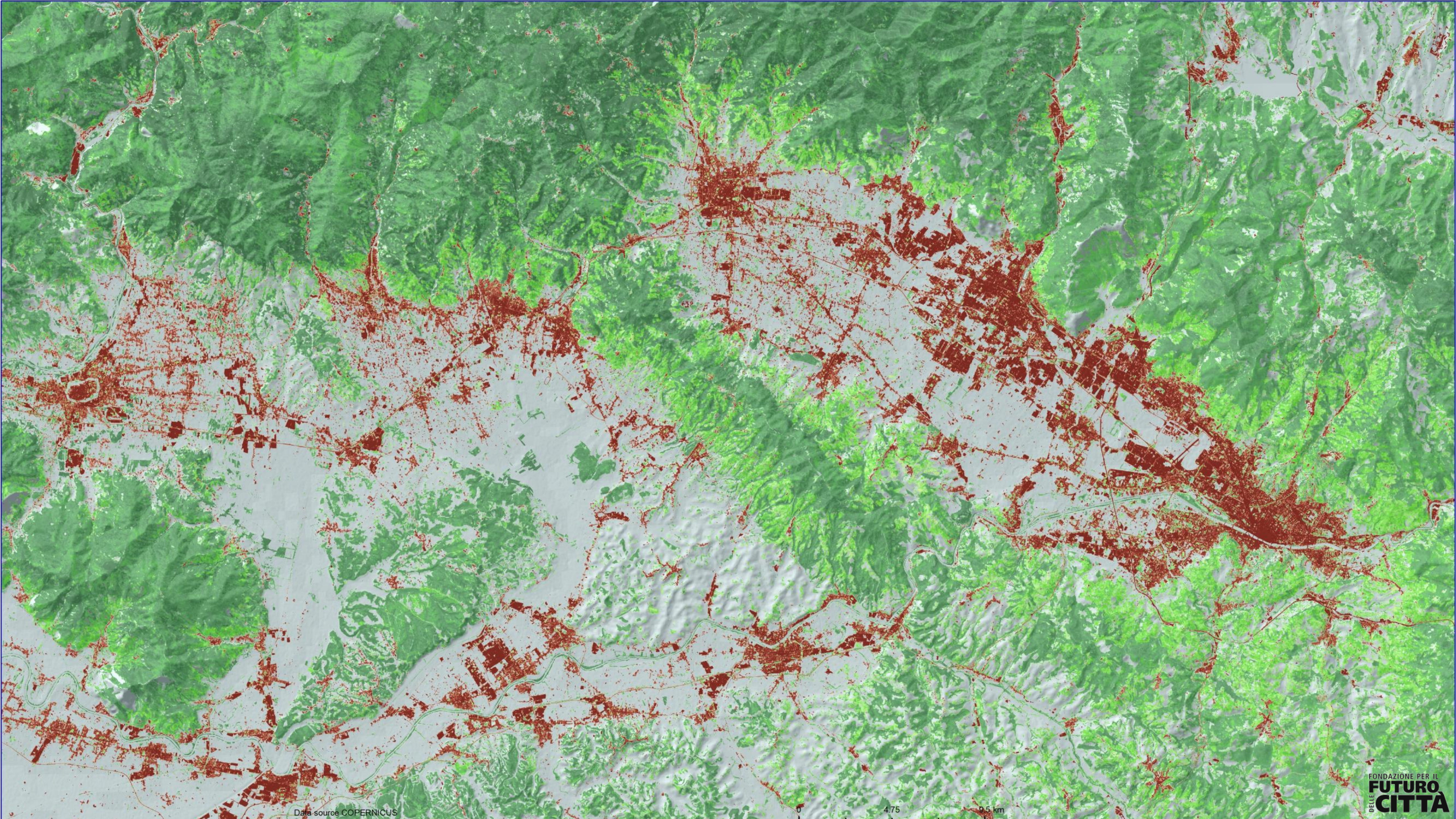
Copernicus Europe's eyes on Earth | Land Monitoring Service

BLOG | MOSAIC HUB | HELP

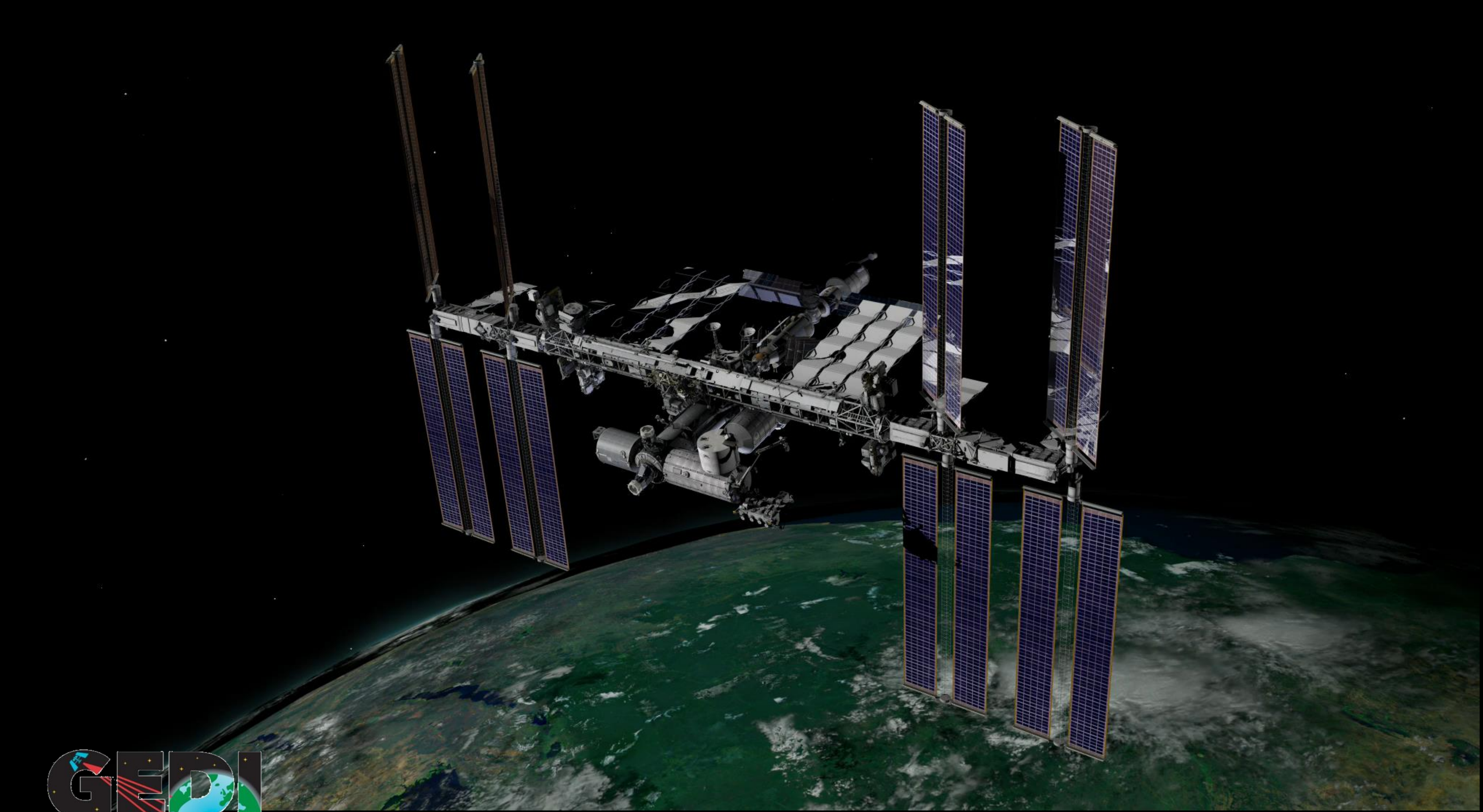
Basic

Welcome Gherardo

LOGOUT



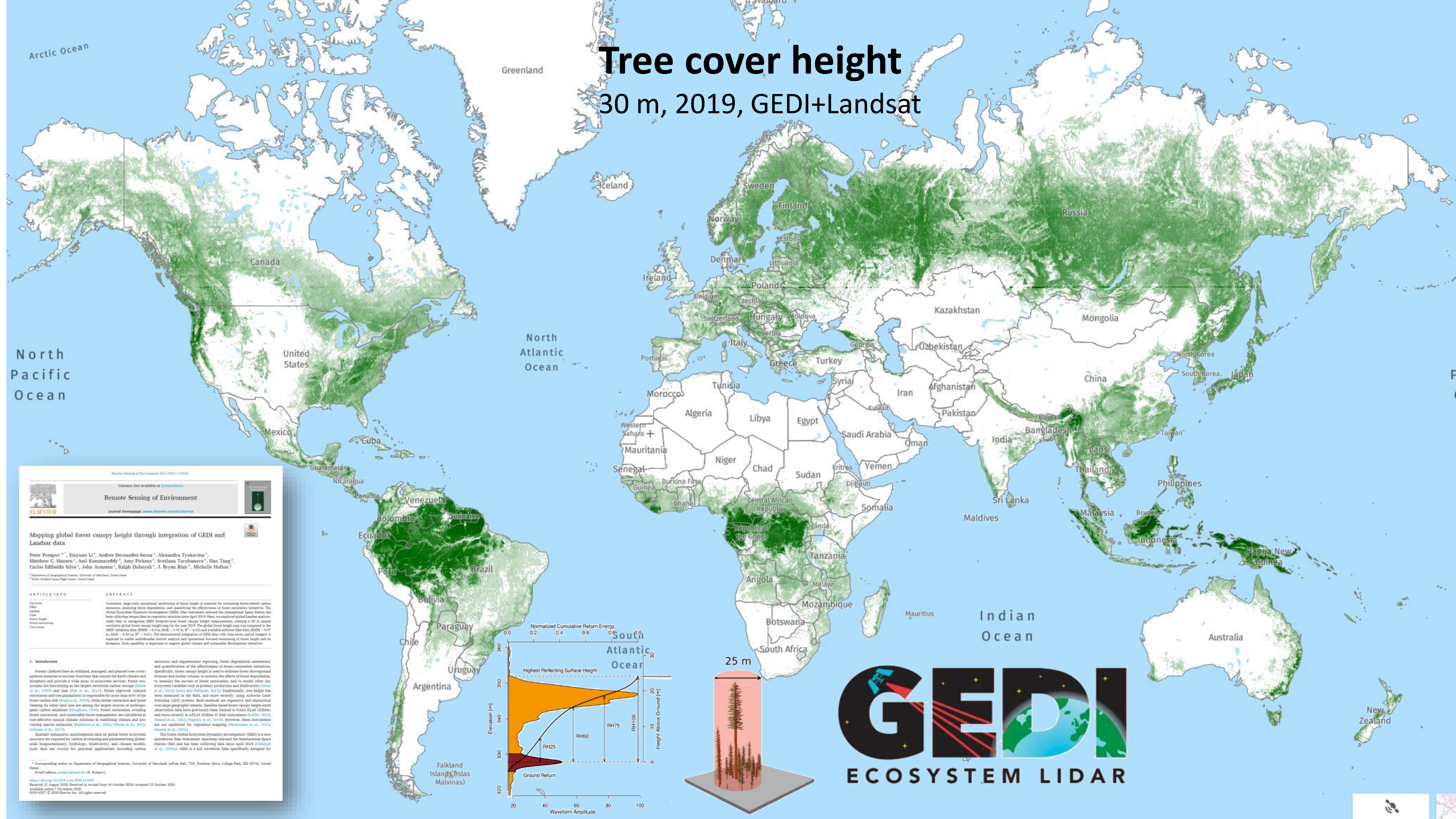
Data source COPERNICUS
0
4.75
9.5 km
FONDAZIONE PER IL FUTURO DELLE CITTÀ



GEDI
ECOSYSTEM LIDAR

Tree cover height

30 m, 2019, GEDI+Landsat



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

Mapping global forest canopy height through integration of GEDI and Landsat data

Peter Potapov[a,*], Xinyuan Li[a], Andres Hernandez-Serna[a], Alexandra Tyukavina[a], Matthew C. Hansen[a], Anil Kommareddy[a], Amy Pickens[a], Svetlana Turubanova[a], Hao Tang[a], Carlos Edibaldo Silva[a], John Armston[a], Ralph Dubayah[a], J. Bryan Blair[b], Michelle Hofton[a]

[a] Department of Geographical Sciences, University of Maryland, United States
[b] NASA Goddard Space Flight Center, United States

ARTICLE INFO

Keywords:
GEDI
Landsat
Lidar
Forest height
Forest monitoring
Time-series

ABSTRACT

Consistent, large-scale operational monitoring of forest height is essential for estimating forest-related carbon emissions, analyzing forest degradation, and quantifying the effectiveness of forest restoration initiatives. The Global Ecosystem Dynamics Investigation (GEDI) lidar instrument onboard the International Space Station has been collecting unique data on vegetation structure since April 2019. Here, we employed global Landsat analysis-ready data to extrapolate GEDI footprint-level forest canopy height measurements, creating a 30 m spatial resolution global forest canopy height map for the year 2019. The global forest height map was compared to the GEDI validation data (RMSE = 6.6 m; MAE = 4.45 m, R^2 = 0.62) and available airborne lidar data (RMSE = 9.07 m; MAE = 6.36 m, R^2 = 0.61). The demonstrated integration of GEDI data with time-series optical imagery is expected to enable multidecadal historic analysis and operational forward monitoring of forest height and its dynamics. Such capability is important to support global climate and sustainable development initiatives.

1. Introduction

Forests (defined here as wildland, managed, and planted tree cover) perform essential ecosystem functions that sustain the Earth climate and biosphere and provide a wide array of ecosystem services. Forest ecosystems are functioning as the largest terrestrial carbon storage (Dixon et al., 1994) and sink (Pan et al., 2011). Forest regrowth (natural restoration and tree plantations) is responsible for more than 60% of the forest carbon sink (Pugh et al., 2019), while timber extraction and forest clearing for other land uses are among the largest sources of anthropogenic carbon emissions (Houghton, 1999). Forest restoration, avoiding forest conversion, and sustainable forest management are considered as cost-effective natural climate solutions in stabilizing climate and preventing species extinction (Balmford et al., 2002; Gibson et al., 2011; Griscom et al., 2017).

Spatially exhaustive, multitemporal data on global forest ecosystem structure are required for carbon accounting and parameterizing global-scale biogeochemistry, hydrology, biodiversity, and climate models. Such data are crucial for practical applications including carbon emissions and sequestration reporting, forest degradation assessment, and quantification of the effectiveness of forest restoration initiatives. Specifically, forest canopy height is used to estimate forest aboveground biomass and timber volume, to monitor the effects of forest degradation, to measure the success of forest restoration, and to model other key ecosystem variables such as primary production and biodiversity (Asner et al., 2012; Goetz and Dubayah, 2011). Traditionally, tree height has been measured in the field, and more recently, using Airborne Laser Scanning (ALS) systems. Both methods are expensive and impractical over large geographic extents. Satellite-based forest canopy height earth observation data have previously been limited to NASA GLAS (ICESat) and more recently to ATLAS (ICESat-2) lidar instruments (Lefsky, 2010; Simard et al., 2011; Popescu et al., 2018). However, these instruments are not optimized for vegetation mapping (Montesano et al., 2015; Hansen et al., 2016).

The NASA Global Ecosystem Dynamics Investigation (GEDI) is a new spaceborne lidar instrument operating onboard the International Space Station (ISS) and has been collecting data since April 2019 (Dubayah et al., 2020a). GEDI is a full waveform lidar specifically designed for

* Corresponding author at: Department of Geographical Sciences, University of Maryland, LeFrak Hall, 7251 Preinkert Drive, College Park, MD 20742, United States.
E-mail address: potapov@umd.edu (P. Potapov).

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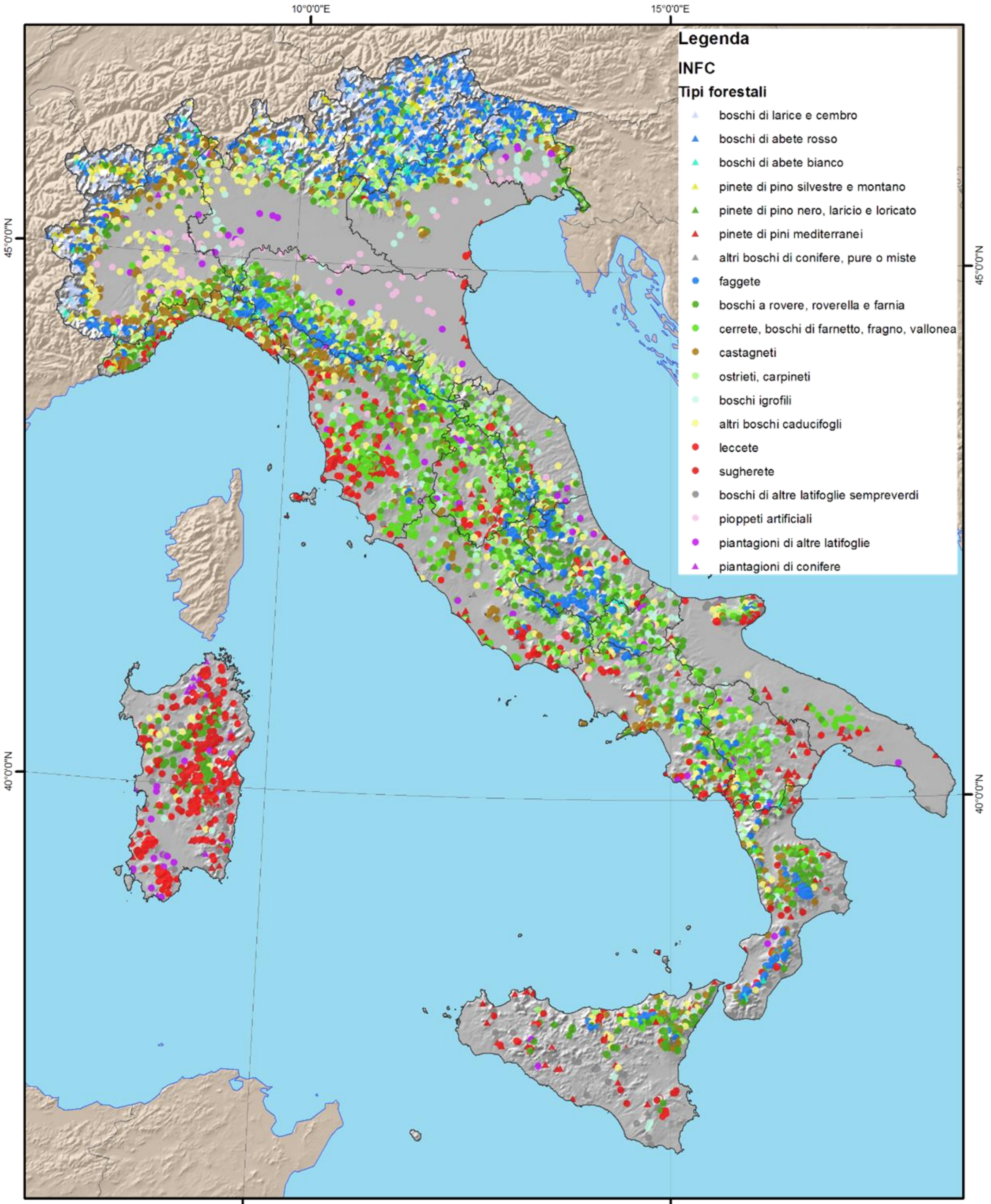
Available online 7 November 2020

GEDI
ECOSYSTEM LIDAR

Applicazioni in Italia

1-spazializzazione variabili forestali

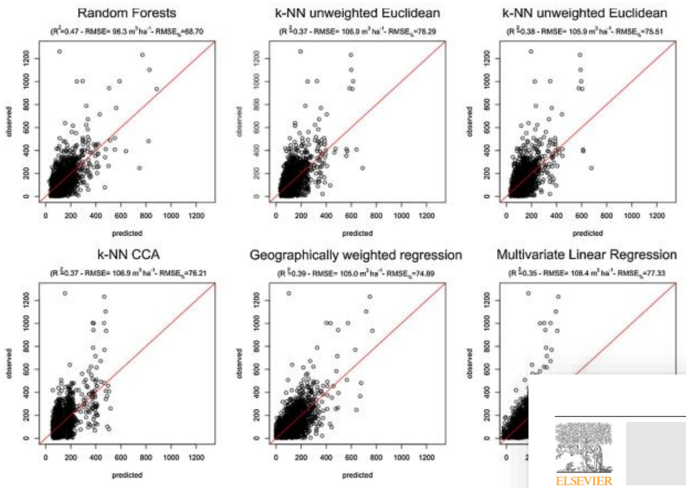
2-mappatura dei disturbi

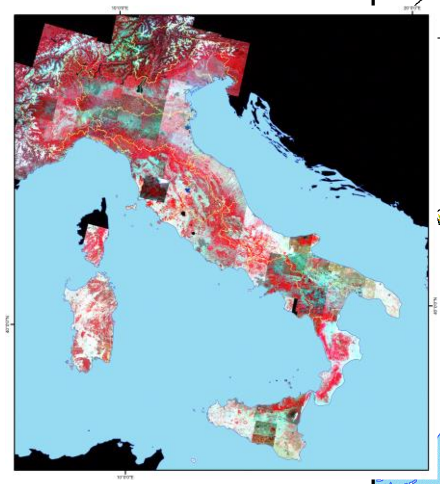


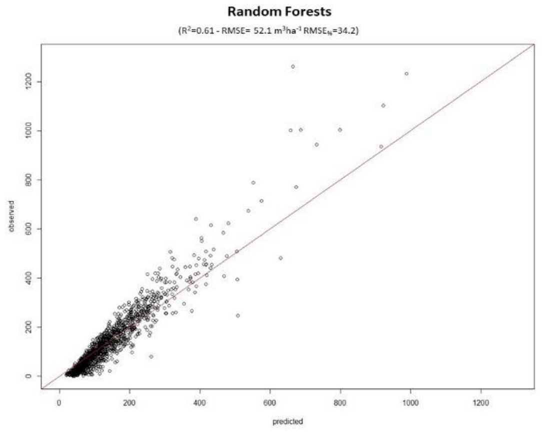
Esempio di applicazione sul dato INFC2005

National application

LOO $R^2 = 0.61$ and RMSE $\cong 52\ m^3ha^{-1}$







Int J Appl Earth Obs Geoinformation 84 (2020) 101959

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Wall-to-wall spatial prediction of growing stock volume based on Italian National Forest Inventory plots and remotely sensed data

Gherardo Chirici[a], Francesca Giannetti[a], Ronald E. McRoberts[b,c], Davide Travaglini[a], Matteo Pecchi[a], Fabio Maselli[d], Marta Chiesi[d], Piermaria Corona[e]

[a] Dipartimento di Scienze e Tecnologie Agrarie, Alimentari, Ambientali e Forestali, Università degli Studi di Firenze, 50145, Firenze, Italy
[b] Department of Forest Resources, University of Minnesota, Saint Paul, MN, 55108, USA
[c] Northern Research Station, U.S. Forest Service, Saint Paul, MN, 55108, USA
[d] CNR-IBE, Via Madonna del Piano, 10, 50019, Sesto Fiorentino, FI, Italy
[e] CREA, Research Centre for Forestry and Wood, viale Santa Margherita 80, 52100, Arezzo, Italy

ARTICLE INFO

Keywords:
National Forest Inventory
Spatial estimation
Growing stock
Landsat
Italy
Growing stock volume

ABSTRACT

Spatial predictions of forest variables are required for supporting modern national and sub-national forest planning strategies, especially in the framework of a climate change scenario. Nowadays methods for constructing wall-to-wall maps and calculating small-area estimates of forest parameters are becoming essential components of most advanced National Forest Inventory (NFI) programs. Such methods are based on the assumption of a relationship between the forest variables and predictor variables that are available for the entire forest area. Many commonly used predictors are based on data obtained from active or passive remote sensing technologies. Italy has almost 40% of its land area covered by forests. Because of the great diversity of Italian forests with respect to composition, structure and management and underlying climatic, morphological and soil conditions, a relevant question is whether methods successfully used in less complex temperate and boreal forests may be applied successfully at country level in Italy.

For a study area of more than 48,657 km^2 in central Italy of which 43% is covered by forest, the study presents the results of a test regarding wall-to-wall, spatially explicit estimation of forest growing stock volume (GSV) based on field measurement of 1350 plots during the last Italian NFI. For the same area, we used potential predictor variables that are available across the whole of Italy: cloud-free mosaics of multispectral optical satellite imagery (Landsat 5 TM), microwave sensor data (JAXA PALSAR), a canopy height model (CHM) from satellite LiDAR, and auxiliary variables from climate, temperature and precipitation maps, soil maps, and a digital terrain model.

Two non-parametric (random forests and k-NN) and two parametric (multiple linear regression and geographically weighted regression) prediction methods were tested to produce wall-to-wall map of growing stock volume at 23-m resolution. Pixel level predictions were used to produce small-area, province-level model-assisted estimates. The performances of all the methods were compared in terms of percent root mean-square error using a leave-one-out procedure and an independent dataset was used for validation. Results were comparable to those available for other ecological regions using similar predictors, but random forests produced the most accurate results with a pixel level $R^2 = 0.69$ and $RMSE_{\%} = 37.2\%$ against the independent validation dataset. Model-assisted estimates were more precise than the original design-based estimates provided by the NFI.

1. Introduction

Forest data are essential for multiple purposes including international and national forest monitoring programs, reporting and assessing forest resource distribution (e.g. Kyoto protocol) (Corona et al., 2011; FAO, 2010), monitoring biodiversity (Chirici et al., 2012; FOREST EUROPE, 2015), improving restoration programs (FAO and UNCCD, 2015; Smith et al., 2016) and managing at local scales to improve decision-making processes, silvicultural measures, harvesting and conservation activities.

Usually, in the context of international and national programs, this type of data is collected using sample-based National Forest Inventories (NFIs) that are designed to provide aggregated estimates of forest parameters such as forest area, growing stock volume, biomass, increments at national and regional levels (Brosofske et al., 2014; Kangas et al., 2018). These aggregated statistics are essential to support decision-making processes and to develop strategies over large areas only, because they just provide limited explicit geographic spatial detail, such as large sub-national regions. In these traditional NFIs, remote sensing is used for purposes such as initial stratification of sampling units

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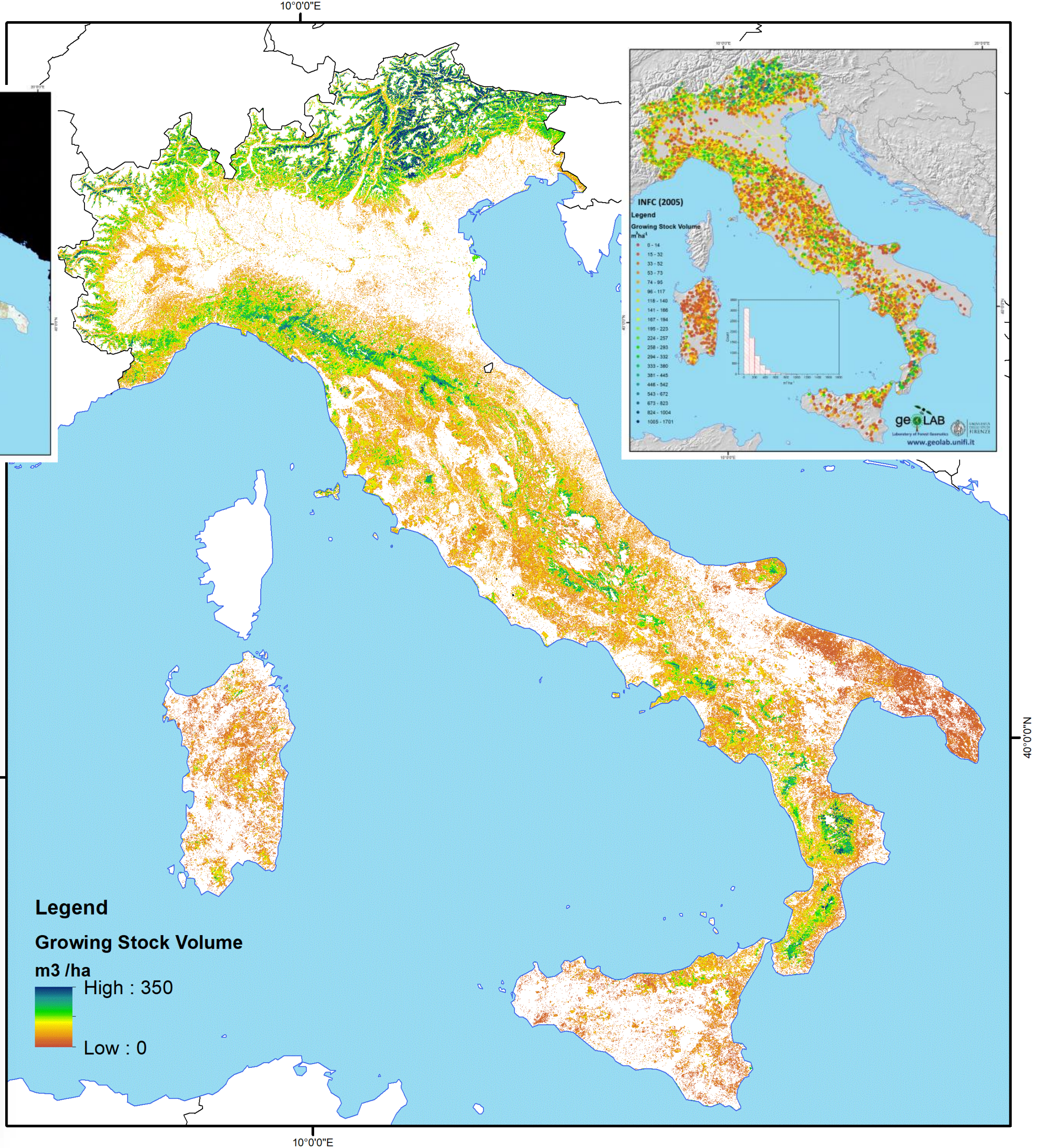
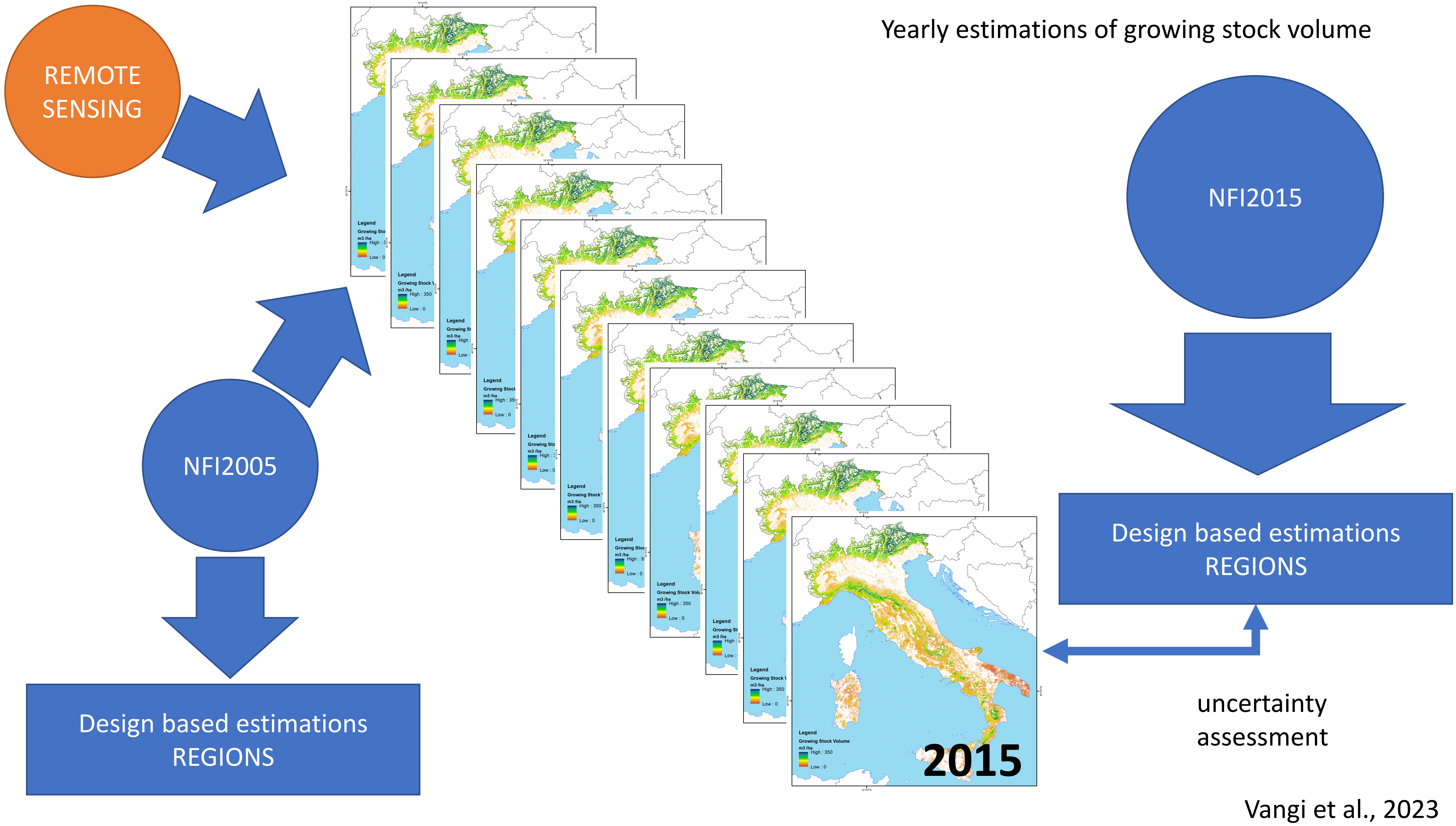
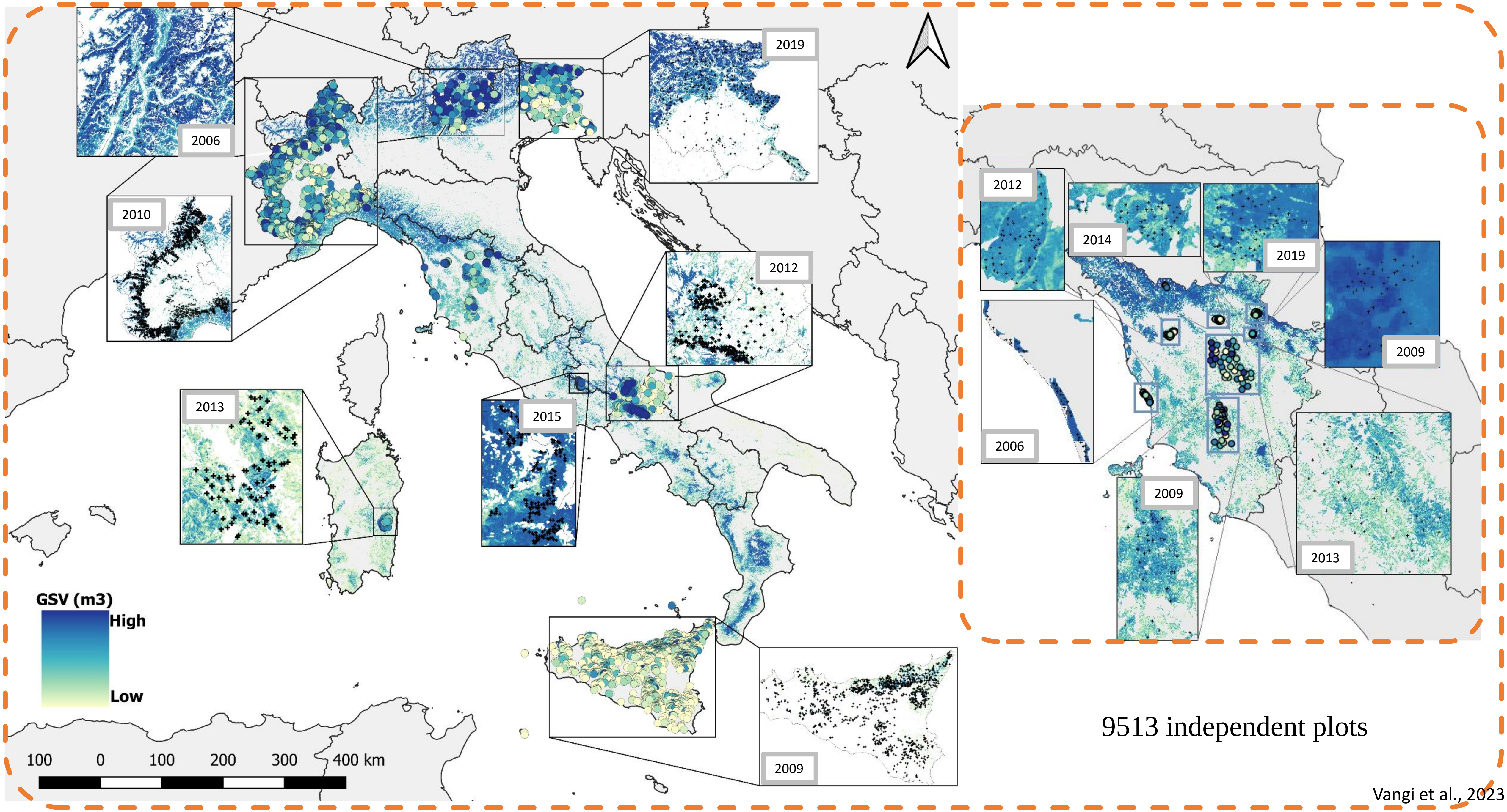
Available online 03 October 2019




Yearly estimations of growing stock volume
REMOTE SENSING
NFI2005
Design based estimations REGIONS
NFI2015
Design based estimations REGIONS
uncertainty assessment
2015
Legend
Growing Stock Volume
m3 /ha
High : 350
Low : 0
Vangi et al., 2023

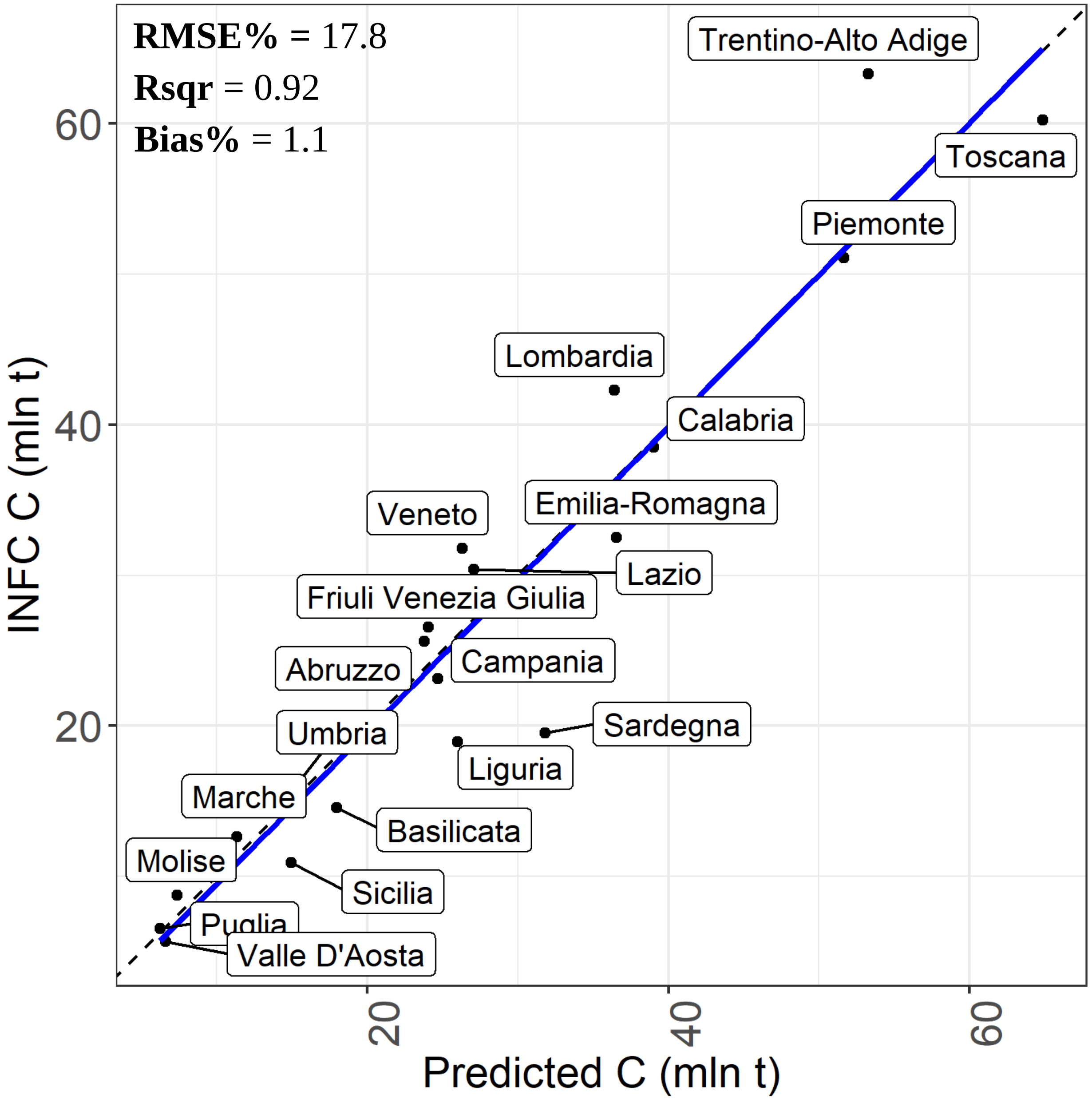
Validation against independent datasets



9513 independent plots

Vangi et al., 2023

Comparison results against INFC2015



Environmental Modelling and Software 159 (2023) 105580

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Environmental Modelling and Software

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ELSEVIER

Large-scale high-resolution yearly modeling of forest growing stock volume and above-ground carbon pool

Elia Vangi [a,b], Giovanni D'Amico [a,c,*], Saverio Francini [a,d], Costanza Borghi [a], Francesca Giannetti [a], Piermaria Corona [c], Marco Marchetti [b], Davide Travaglini [a], Guido Pellis [e], Marina Vitullo [e], Gherardo Chirici [a]

[a] Dipartimento di Scienze e Tecnologie Agrarie, Alimentari, Ambientali e Forestali, Università degli Studi di Firenze, Italy
[b] Dipartimento di Bioscienze e Territorio, Università degli Studi del Molise, Italy
[c] CREA Research Centre for Forestry and Wood, Italy
[d] Fondazione per il Futuro delle Città, Firenze, Italy
[e] Istituto Superiore per la Protezione e la Ricerca Ambientale, Italy

ARTICLE INFO

Keywords:
National forest inventory
GSV
Carbon stock
Forest modeling
Spatial modeling
Italy

ABSTRACT

Within the Paris Agreement's Enhanced Transparency Framework, consistent data collections are the prerequisite for a successful reporting of GHG emissions. For such purposes, NFIs are usually the primary source of information, even if they are frequently not designed for producing estimations on a yearly basis and in the form of wall-to-wall high-resolution maps. In this framework, we present a new spatial model to produce yearly growing stock volume (GSV), above-ground biomass (AGB), and carbon stock wall-to-wall estimates. We tested the model in Italy for the period 2005–2018, obtaining a time-series of yearly maps at 23 m spatial resolution. Results were validated against the 2015 Italian NFI reaching an average RMSE% of 19% for aggregated areas. Results were also compared against data reported by the Italian GHG inventory, reaching an RMSE% of 28% and 20% for GSV and carbon stock respectively.

We demonstrated that the modeling approach can be successfully used for setting up a forest monitoring system to meet the interests of governments in inventories of GHG emissions and private entities in carbon offset investments.

1. Introduction

Under the enhanced transparency framework of the Paris Agreement, each country Party must report every two years an inventory of their anthropogenic greenhouse gases (GHGs) emissions by sources and removals by sinks following the Intergovernmental Panel on Climate Change (IPCC) guidelines and guidance (IPCC et al., 2006). The GHG emission inventory has to fulfill the IPCC key principles: transparency, accuracy, completeness, consistency, and comparability while providing helpful information for assessing the climate impacts. The "Land Use, Land-Use Change and Forestry" (LULUCF) is exceptionally demanding, dealing with natural carbon dynamics and aiming to assess emissions and removals related to the impact of anthropogenic activities. The LULUCF sector is responsible for significant GHG emissions globally, mainly due to deforestation activities. In this framework, forests are pivotal ecosystems, being a substantial and growing atmospheric carbon sink (Sellers et al., 2018). Forests are estimated to sequester 30% of the total global CO_2 released into the atmosphere annually (Houghton and Nassikas, 2017), corresponding to 7.6 Gt CO_2 y^{-1}, reflecting a balance between gross carbon removals and gross emissions from deforestation and other disturbances (Harris et al., 202; Xu et al., 2021). Increasing the carbon stored in the above and below-ground forest biomass is a mitigation mechanism to fight climate change and offset anthropogenic emissions worldwide (Di Cosmo et al., 2016).

Despite the UNFCCC requirements related to the provision by Parties of biennial forestry-related carbon stock change, many National Forest Inventories (NFI) are not designed for continuous yearly reports and cannot cope with the required reporting frequency due to longer update cycles (McRoberts et al., 2018). Estimating carbon stock changes between consecutive NFIs is a pivotal step in accomplishing the reporting requirements. The methodology should be based on year-to-year measured forest variables or prediction models to extend NFI-based

* Corresponding author. Dipartimento di Scienze e Tecnologie Agrarie, Alimentari, Ambientali e Forestali, Università degli Studi di Firenze, Italy.
E-mail address: giovanni.damico@unifi.it (G. D'Amico).

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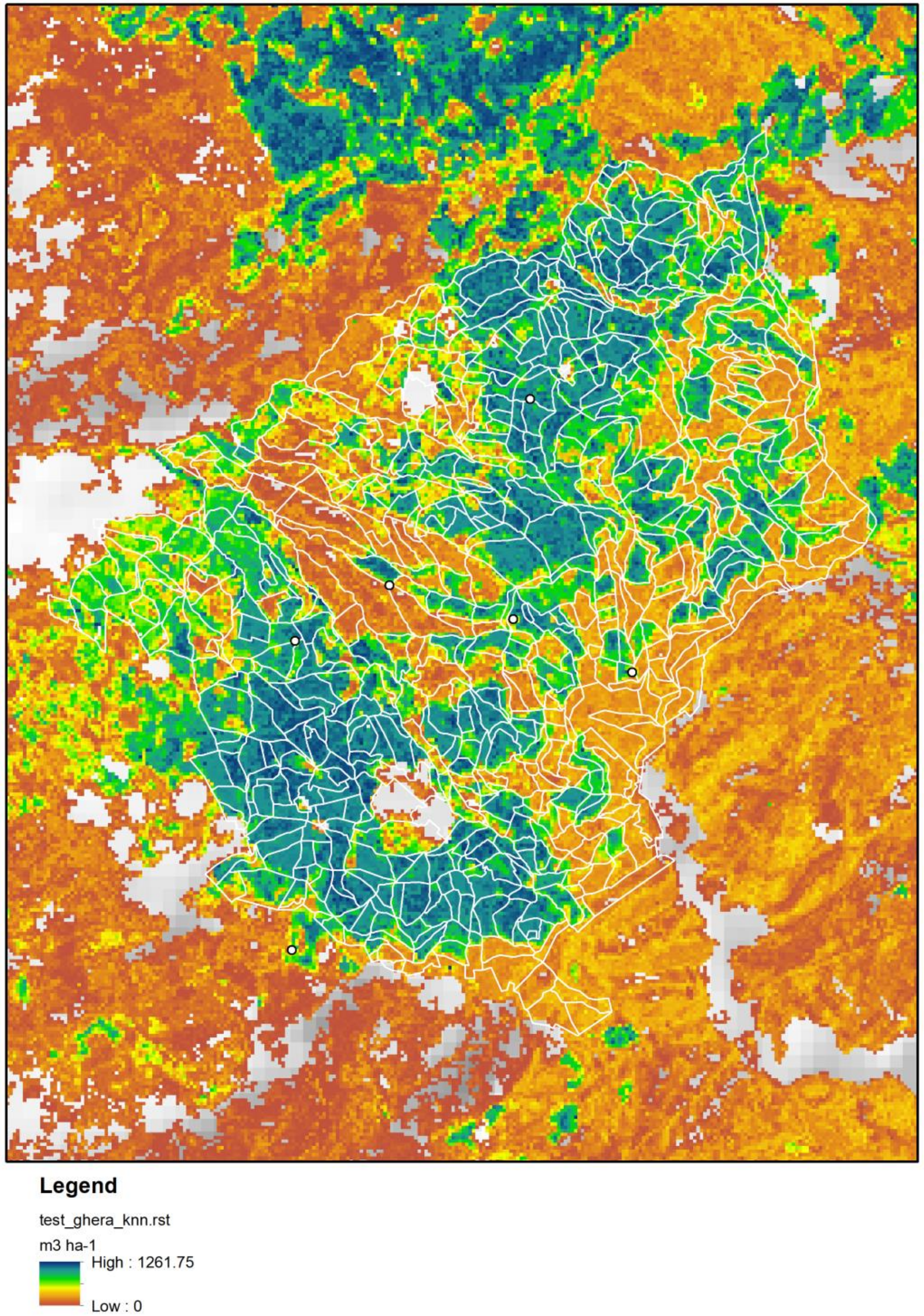
Available online 11 November 2022

Le mappe derivanti dalla spazializzazione possono essere utilizzate a supporto della gestione e della pianificazione forestale

Il risultato della spazializzazione dei dati inventariali permette di ottenere mappe per alcune delle principali variabili (provvigione, area basimetrica, numero di alberi ad ettaro, grado di copertura, biomassa, ecc.) per ogni pixel di bosco

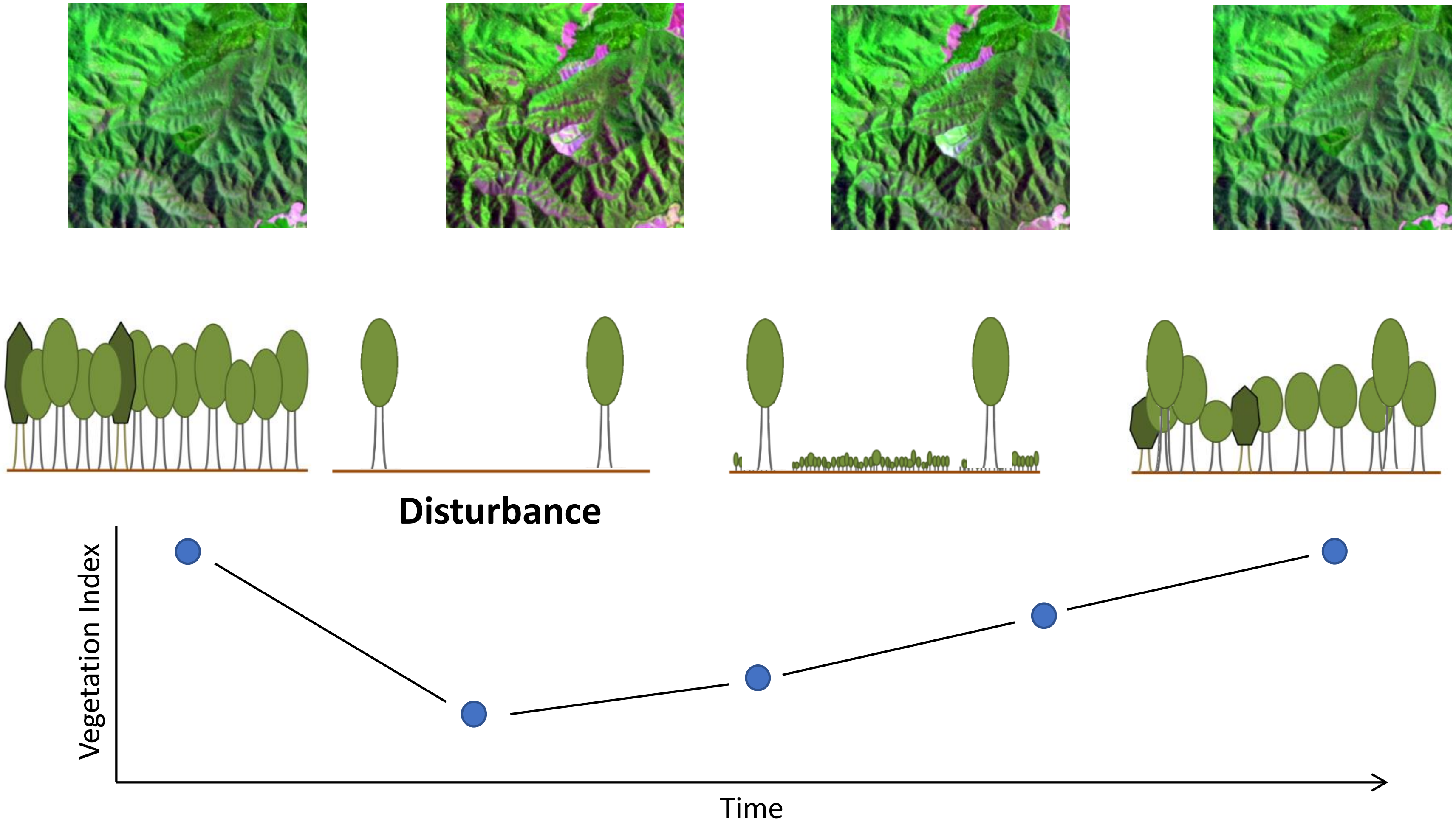
Le stime per pixel possono essere aggregate a livello di particellare forestale in piani di gestione o nei piani forestali d'indirizzo territoriale



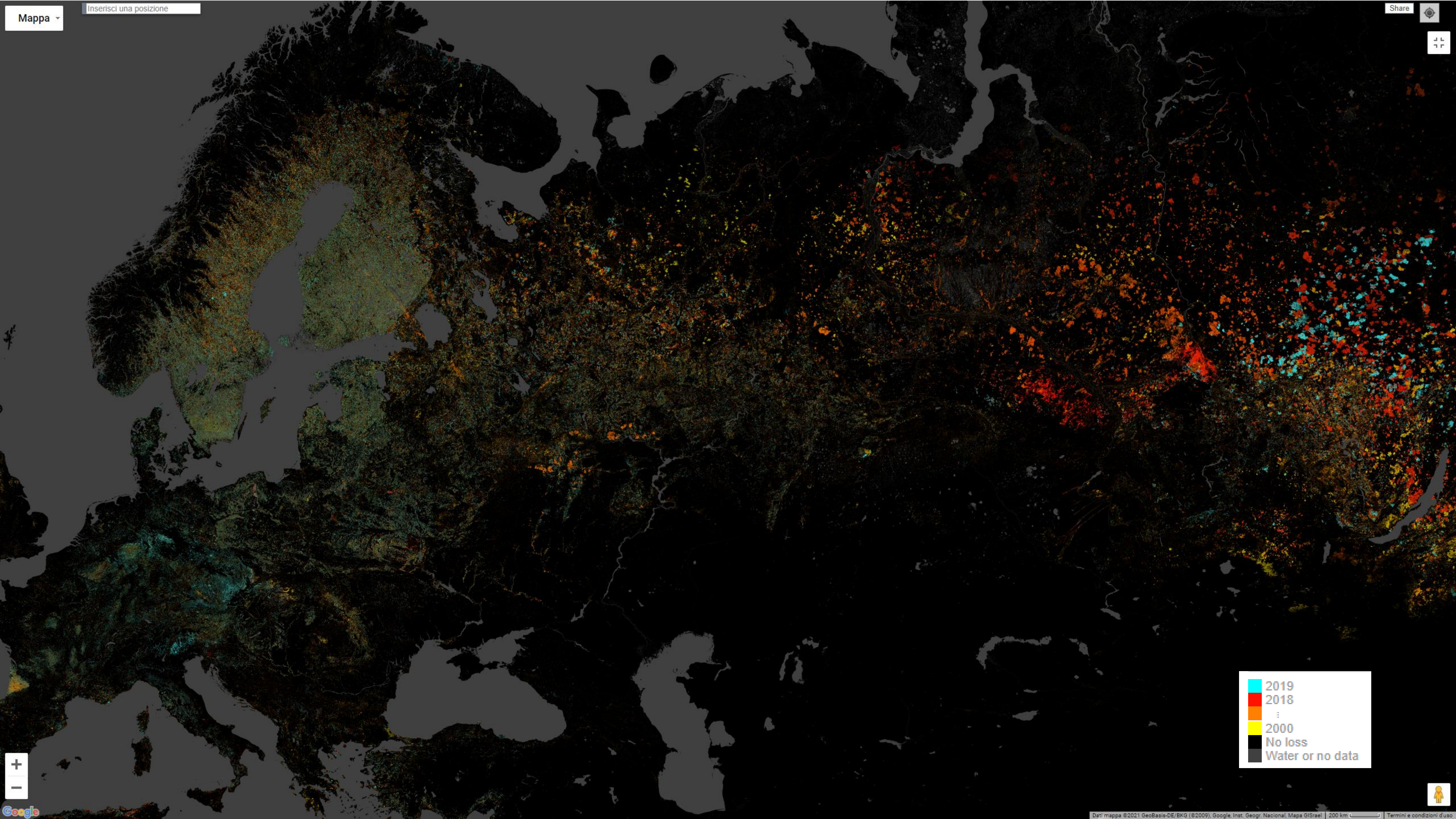
Esempio di stima della provvigione da INFC2005 (pixel di 23 m) sul particellare della foresta demaniale di Vallombrosa (FI)

forest disturbances

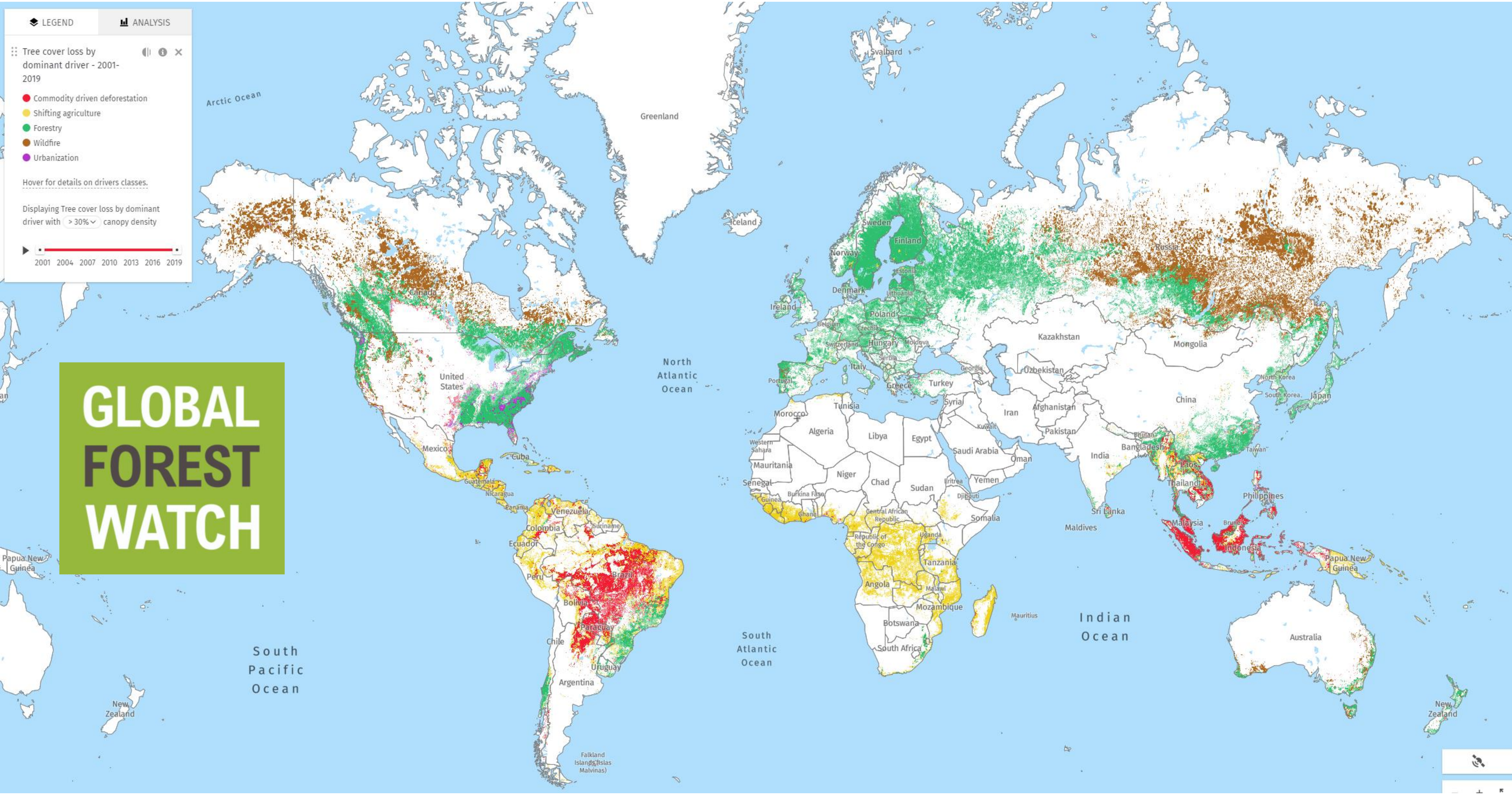
- Loggings
- Fires
- Windstorms
- Insects outbreaks



Disturbance
Vegetation Index
Time



Mappa
Inserisci una posizione
Share
2019
2018
2000
No loss
Water or no data
Google
Dati mappa ©2021 GeoBasis-DE/BKG (©2009), Google, Inst. Geogr. Nacional, Mapa GISrael
200 km
Termini e condizioni d'uso


LEGEND
ANALYSIS
Tree cover loss by dominant driver - 2001-2019
Commodity driven deforestation
Shifting agriculture
Forestry
Wildfire
Urbanization
Hover for details on drivers classes.
Displaying Tree cover loss by dominant driver with > 30% canopy density
2001 2004 2007 2010 2013 2016 2019
GLOBAL FOREST WATCH
Arctic Ocean
Greenland
North Atlantic Ocean
South Atlantic Ocean
South Pacific Ocean
Indian Ocean
Canada
United States
Mexico
Cuba
Venezuela
Colombia
Ecuador
Peru
Brazil
Bolivia
Paraguay
Chile
Uruguay
Argentina
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Norway
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India
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Angola
Tanzania
Mozambique
Botswana
South Africa
Somalia
Saudi Arabia
Thailand
Malaysia
Indonesia
Philippines
Japan
Papua New Guinea
Australia
New Zealand

Landtrendr

Contents lists available at ScienceDirect

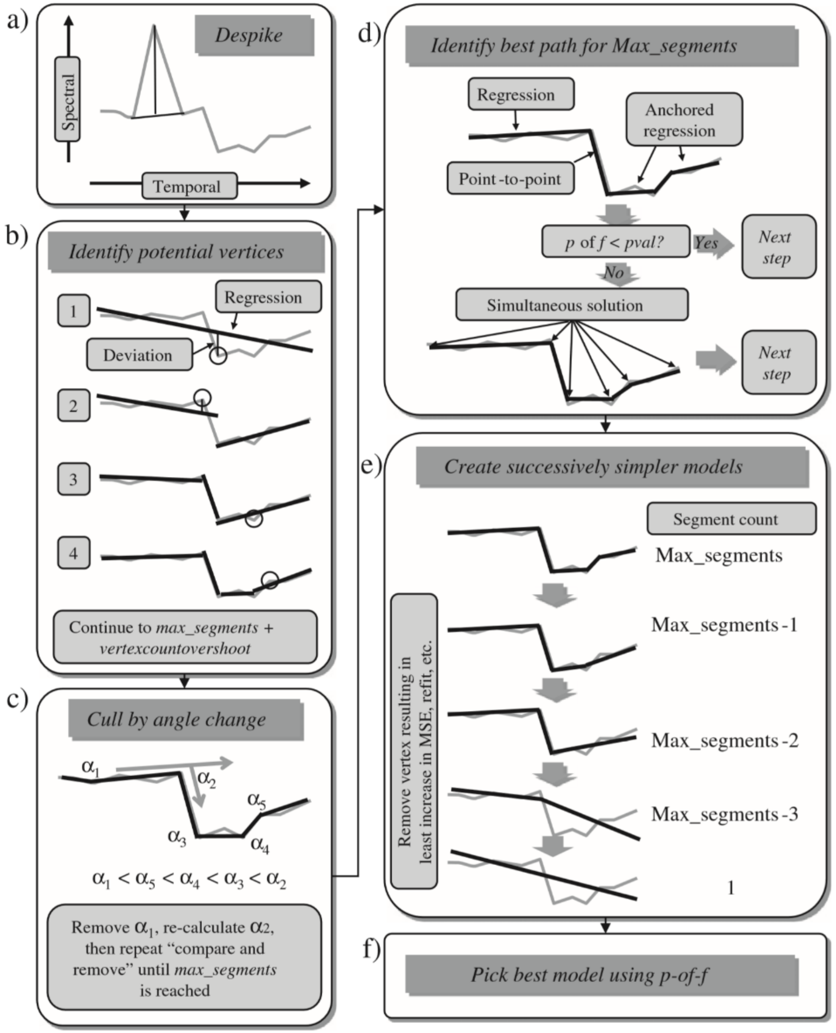
Remote Sensing of Environment

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

Detecting trends in forest disturbance and recovery using yearly Landsat time series: 1. LandTrendr — Temporal segmentation algorithms

Robert E. Kennedy [a,*], Zhiqiang Yang [a], Warren B. Cohen [b]

[a] Department of Forest Ecosystems and Society, Oregon State University, 321 Richardson Hall, Corvallis, OR 97331, United States
[b] Pacific Northwest Research Station, USDA Forest Service, Corvallis, OR 97331, United States



Analysis | Published: 14 September 2020

Mapping the forest disturbance regimes of Europe

Cornelius Senf & Rupert Seidl

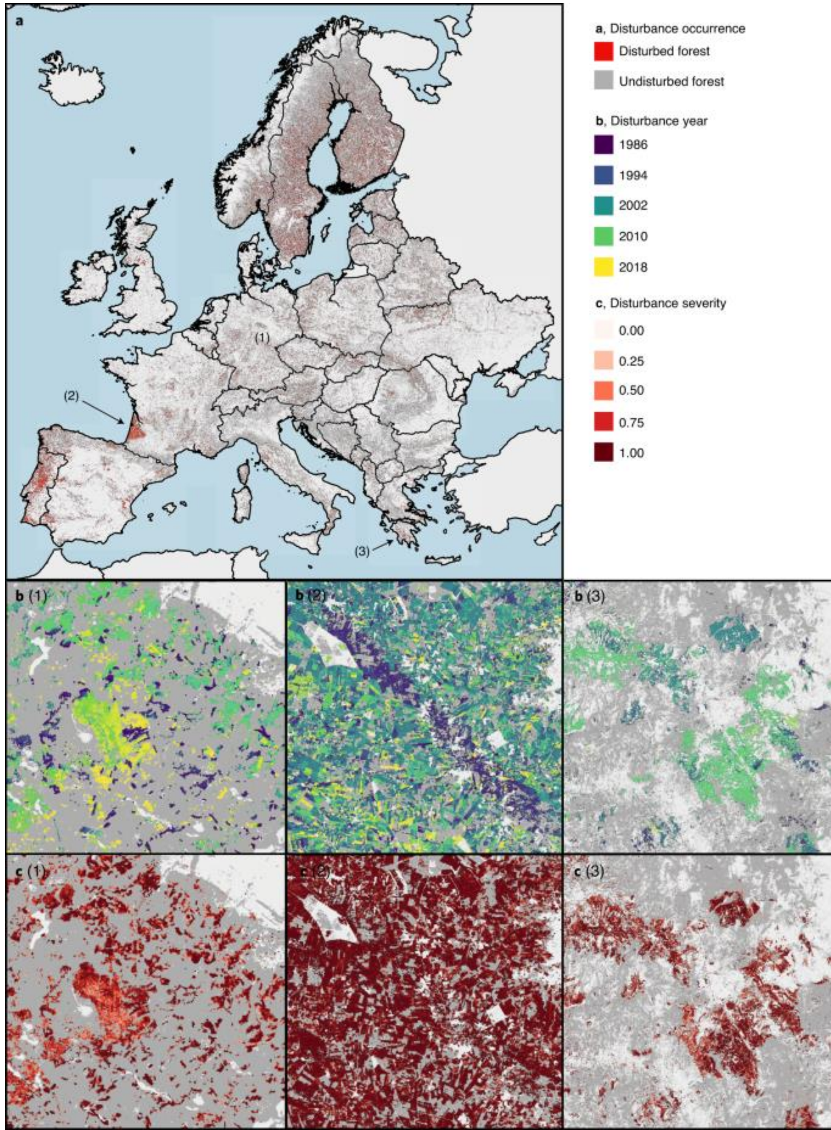
Nature Sustainability 4, 63–70(2021) | Cite this article

An Author Correction to this article was published on 09 February 2021

This article has been updated

Abstract

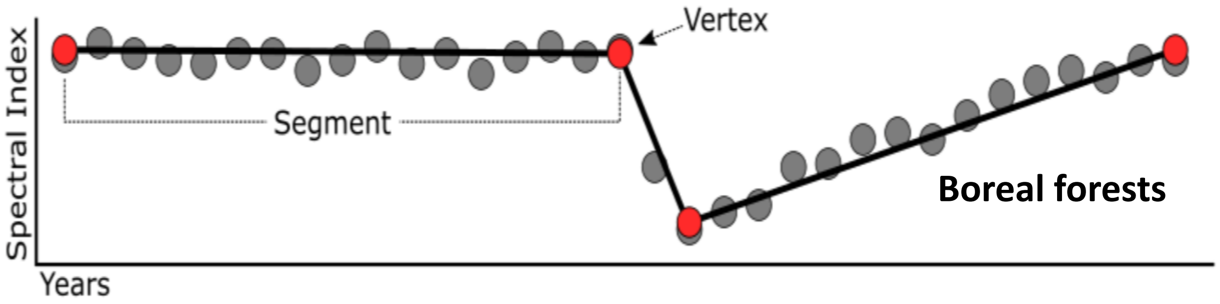
Changes in forest disturbances can have strong impacts on forests, yet we lack consistent data on Europe's forest disturbance regimes and their changes over time. Here we used satellite data to map three decades of forest disturbances across continental Europe, and analysed the patterns and trends in disturbance size, frequency and severity. Between 1986 and 2016, 17% of Europe's forest area was disturbed by anthropogenic and/or natural causes. We identified 36 million individual disturbance patches with a mean patch size of 1.09 ha, which equals an annual average of 0.52 disturbance patches per km^2 of forest area. The majority of disturbances were stand replacing. While trends in disturbance size were highly variable, disturbance frequency consistently increased and disturbance severity decreased. Here we present a continental-scale characterization of Europe's forest disturbance regimes and their changes over time, providing spatial information that is critical for understanding the ongoing changes in Europe's forests.

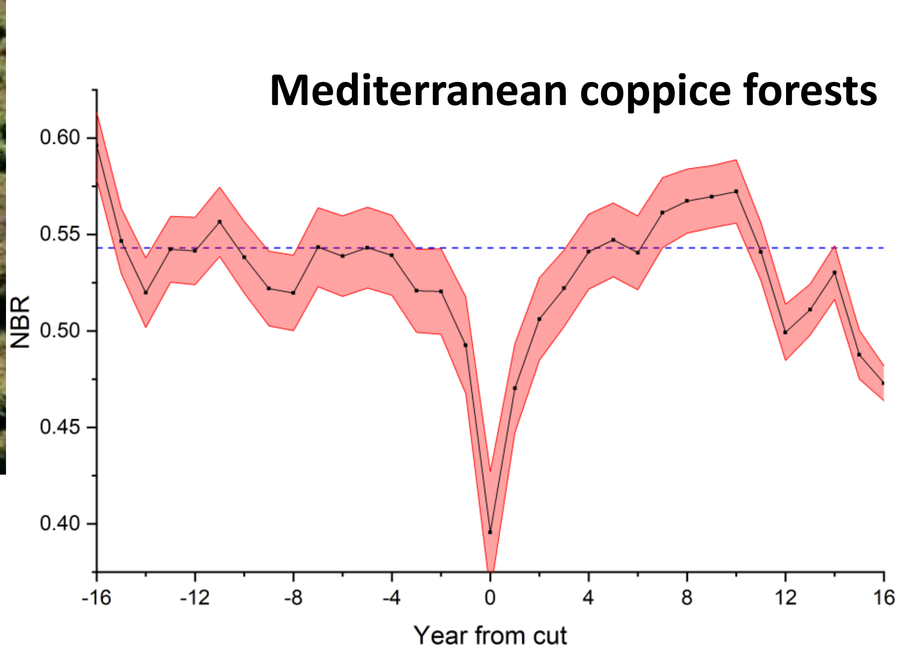


Documentation by Justin Braaten of Oregon State University's eMapR Lab, directed by Dr. Robert Kennedy

This site is a guide to the Google Earth Engine implementation of the LandTrendr spectral-temporal segmentation algorithm.

Differences between Boreal forests and Mediterranean coppice forests recovery rates





Annals of Forest Science (2020) 77: 40
https://doi.org/10.1007/s13595-020-00936-2

RESEARCH PAPER

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Monitoring clearcutting and subsequent rapid recovery in Mediterranean coppice forests with Landsat time series

Gherardo Chirici[1] · Francesca Giannetti[1] · Erica Mazza[1] · Saverio Francini[1] · Davide Travaglini[1] · Raffaello Pegna[1] · Joanne C. White[2]

Received: 17 January 2019 / Accepted: 3 March 2020 / Published online: 15 April 2020

Abstract
· ***Key message*** **This work analyses the rate of recovery of the spectral signal from clearcut areas of coppice Mediterranean forests using Landsat Time Series (LTS). The analysis revealed a more rapid rate of spectral signal recovery than what was found in previous investigations in boreal and temperate forests.**
· ***Context*** The rate of post-disturbance vegetation recovery is an important component of forest dynamics.
· ***Aims*** In this study, we analyze the recovery of the spectral signal from forest clearcut areas in Mediterranean conditions when the coppice system of forest management is applied.

remote sensing

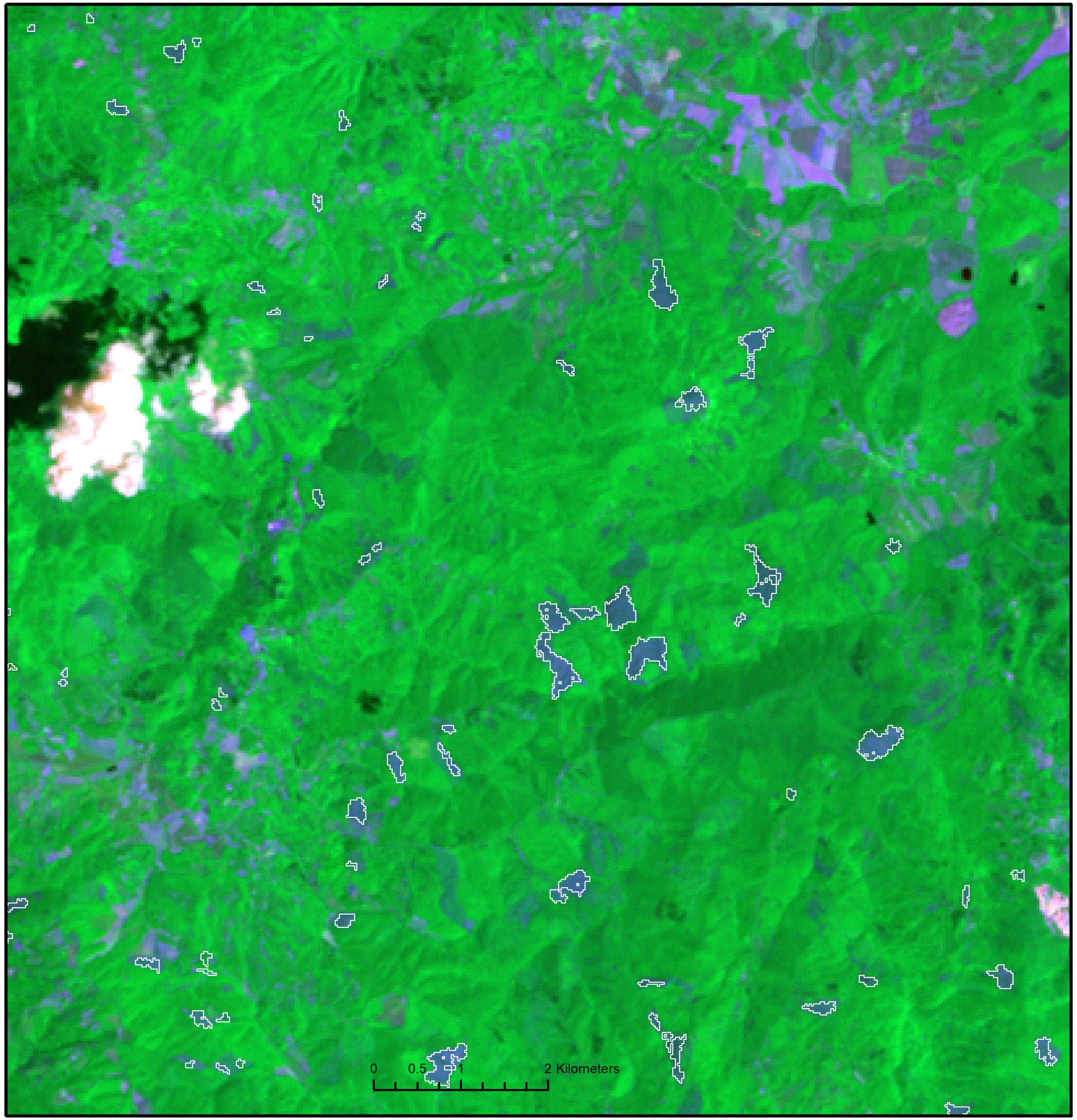
MDPI

Article

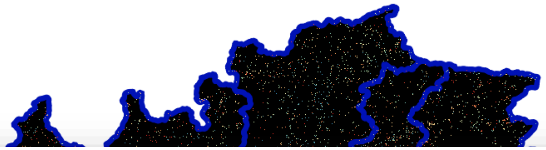
A New Method for Automated Clearcut Disturbance Detection in Mediterranean Coppice Forests Using Landsat Time Series

Francesca Giannetti [1,*], Raffaello Pegna [1], Saverio Francini [1], Ronald E. McRoberts [2,3], Davide Travaglini [1], Marco Marchetti [4], Giuseppe Scarascia Mugnozza [5] and Gherardo Chirici [1]

1 geoLAB—Laboratory of Forest Geomatics, Department of Agriculture, Food, Environment and Forestry, Università degli Studi di Firenze, Via San Bonaventura 13, 50145 Firenze, Italy; raffaellopegna@gmail.com (R.P.); saverio.francini@unifi.it (S.F.); davide.travaglini@unifi.it (D.T.); gherardo.chirici@unifi.it (G.C.)
2 Department of Forest Resources, University of Minnesota, Saint Paul, MN 55108, USA; mcrob001@umn.edu
3 Raspberry Ridge Analytics, Hugo, MN 55108, USA
4 Dipartimento di Bioscienze e Territorio, Università degli Studi del Molise, Via Francesco De Sanctis 1, 86100 Campobasso, Italy; marchettimarco@unimol.it
5 Department of Innovation in Biological, Agro-Food and Forest Systems, University of Tuscia,


0 0.5 1 2 Kilometers

Earth Engine



Data in Brief 42 (2022) 108297

Contents lists available at ScienceDirect

Data in Brief

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

Data Article

A Sentinel-2 derived dataset of forest disturbances occurred in Italy between 2017 and 2020

Saverio Francini [a,b,*], Gherardo Chirici [a,b]

[a] Department of Agriculture, Food, Environment and Forestry, Università degli Studi di Firenze, Via San Bonaventura, 13, 50145 Firenze, Italy
[b] Fondazione per il Futuro delle Città, Firenze, Italy

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Dataset link: A Sentinel-2 derived dataset of forest disturbance occurred in Italy between 2017 and 2020 (Original data)

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Open-access
Big data
Cloud computing
forest fires
wind damages
forest harvestings

ABSTRACT

Forests absorb 30% of human emissions associated with fossil fuel burning. For this reason, forest disturbances monitoring is needed for assessing greenhouse gas balance. However, in several countries, the information regarding the spatio-temporal distribution of forest disturbances is missing. Remote sensing data and the new Sentinel-2 satellite missions, in particular, represent a game-changer in this topic.
Here we provide a spatially explicit dataset (10-meters resolution) of Italian forest disturbances and magnitude from 2017 to 2020 constructed using Sentinel-2 level-1C imagery and exploiting the Google Earth Engine GEE implementation of the 3I3D algorithm. For each year between 2017 and 2020, we provide three datasets: (i) a magnitude of the change map (between 0 and 255), (ii) a categorical map of forest disturbances, and (iii) a categorical map obtained by stratification of the previous maps that can be used to estimate the areas of several different forest disturbances. The data we provide represent the state-of-the-art for Mediterranean ecosystems in terms of omission and commission errors, they support greenhouse gas balance, forest sustainability assessment, and decision-makers forest managing, they help forest companies to monitor forest harvestings activity over space

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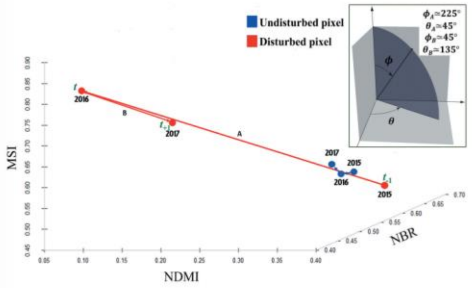
* Corresponding author.
E-mail address: Saverio.francini@unifi.it (S. Francini).
Social media: @saveriofrancini (S. Francini), @GherardoChirici (G. Chirici)

https://doi.org/10.1016/j.dib.2022.108297

Fig. 1. Forest disturbances predicted in Italy between 2017 and 2020 using the 3I3D algorithm. The percentage of the forests that were disturbed over Italy considering the whole period is shown in the largest panel using a pixel size of 1-km. The four smaller panels (a-d) show zooms of the disturbance boolean maps.



INTERNATIONAL JOURNAL OF REMOTE SENSING
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https://doi.org/10.1080/01431161.2021.1899334

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The Three Indices Three Dimensions (3I3D) algorithm: a new method for forest disturbance mapping and area estimation based on optical remotely sensed imagery

Saverio Francini [a,b,c], Ronald E. McRoberts [d], Francesca Giannetti [a], Marco Marchetti [b], Giuseppe Scarascia Mugnozza [c] and Gherardo Chirici [a]

[a] Department of Agriculture, Food, Environment and Forestry, Università Degli Studi Di Firenze, Firenze, Italy; [b] Dipartimento Di Bioscienze E Territorio, Università Degli Studi Del Molise, Isernia, Italy; [c] Dipartimento per l'Innovazione Dei Sistemi Biologici, Agroalimentari E Forestali, Università Degli Studi Della Tuscia, Viterbo, Italy; [d] Department of Forest Resources, University of Minnesota, Saint Paul, Minnesota, USA

ABSTRACT

Although estimating forest disturbance area is essential in the context of carbon cycle assessments and for strategic forest planning projects, official statistics are currently not available in several countries. Remotely sensed data are an efficient source of auxiliary information for meeting these needs, and multiple algorithms are commonly used worldwide for this purpose. However, both more accurate maps and precise area estimates are strongly required, especially in Mediterranean ecosystems, and scientific research in this topic area is anything but concluded.

In this study, we present the new Three Indices Three Dimensions (3I3D) algorithm for the automated prediction of forest disturbances using statistical analyses of Sentinel-2 data. We tested 3I3D in Tuscany, Italy, for the year 2016, and we compared the results to those obtained using the Global Forest Change Map (GFC), LandTrendr (LT), and the Two Thresholds Method (TTM). The 3I3D map was the most accurate (*omissions* = 27%, *commissions* = 30%) followed by TTM (*omissions* = 35%, *commissions* = 39%), LT (*omissions* = 41%, *commissions* = 43%) and lastly GFC with slightly fewer *omissions* than LT (39%) but with many more *commissions* (69%). We also presented a probability sampling framework to estimate the forest harvested area using a model-assisted estimator that can be used at an operational level to produce large-scale statistics. 3I3D and TTM produced the smallest standard errors of the area estimates (8%) followed by LT (13%) and GFC (17%).

ARTICLE HISTORY
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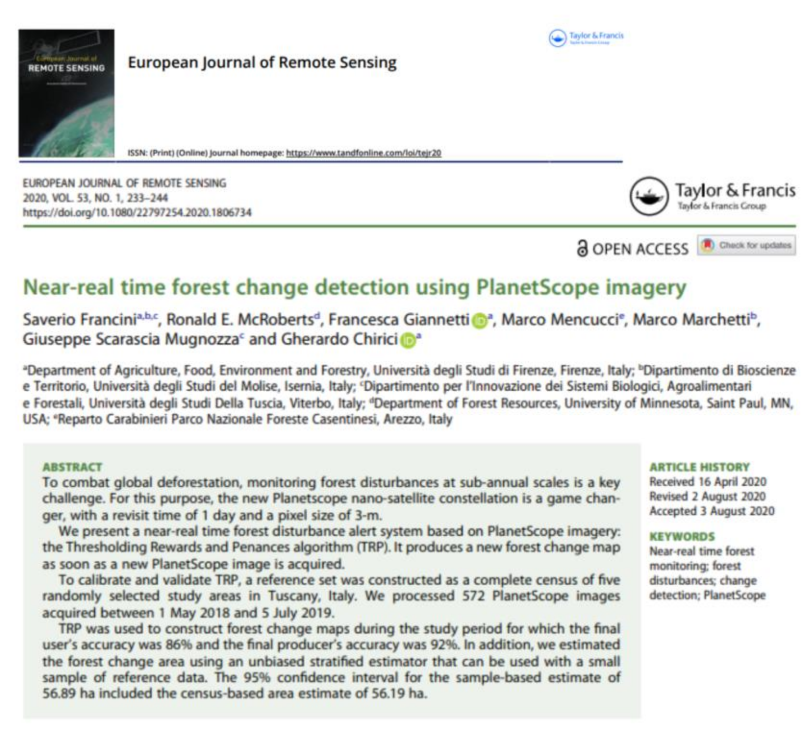
1. Introduction

Environmental problems arising from forest degradation, deforestation and human land use are greater than ever and are increasing rapidly (Ramankutty et al. 2007). In this context, and in view of climate change, sustainable management of forest ecosystems is essential (FAO, 2015) because forest growth offsets a substantial proportion of carbon

CONTACT Saverio Francini saverio.francini@unifi.it Dipartimento per l'Innovazione Dei Sistemi Biologici, Agroalimentari E Forestali, Università Degli Studi Della Tuscia, Via San Camillo De Lellis, Viterbo, Italy.
Supplemental data for this article can be accessed here.

Near real time monitoring with Planet imagery



European Journal of Remote Sensing

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/tejr20

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https://doi.org/10.1080/22797254.2020.1806734

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Near-real time forest change detection using PlanetScope imagery

Saverio Francini[a,b,c], Ronald E. McRoberts[d], Francesca Giannetti[a], Marco Mencucci[e], Marco Marchetti[b], Giuseppe Scarascia Mugnozza[c] and Gherardo Chirici[a]

[a]Department of Agriculture, Food, Environment and Forestry, Università degli Studi di Firenze, Firenze, Italy; [b]Dipartimento di Bioscienze e Territorio, Università degli Studi del Molise, Isernia, Italy; [c]Dipartimento per l'Innovazione dei Sistemi Biologici, Agroalimentari e Forestali, Università degli Studi Della Tuscia, Viterbo, Italy; [d]Department of Forest Resources, University of Minnesota, Saint Paul, MN, USA; [e]Reparto Carabinieri Parco Nazionale Foreste Casentinesi, Arezzo, Italy

ABSTRACT

To combat global deforestation, monitoring forest disturbances at sub-annual scales is a key challenge. For this purpose, the new Planetscope nano-satellite constellation is a game changer, with a revisit time of 1 day and a pixel size of 3-m.

We present a near-real time forest disturbance alert system based on PlanetScope imagery: the Thresholding Rewards and Penances algorithm (TRP). It produces a new forest change map as soon as a new PlanetScope image is acquired.

To calibrate and validate TRP, a reference set was constructed as a complete census of five randomly selected study areas in Tuscany, Italy. We processed 572 PlanetScope images acquired between 1 May 2018 and 5 July 2019.

TRP was used to construct forest change maps during the study period for which the final user's accuracy was 86% and the final producer's accuracy was 92%. In addition, we estimated the forest change area using an unbiased stratified estimator that can be used with a small sample of reference data. The 95% confidence interval for the sample-based estimate of 56.89 ha included the census-based area estimate of 56.19 ha.

ARTICLE HISTORY
Received 16 April 2020
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Accepted 3 August 2020

KEYWORDS
Near-real time forest monitoring; forest disturbances; change detection; PlanetScope

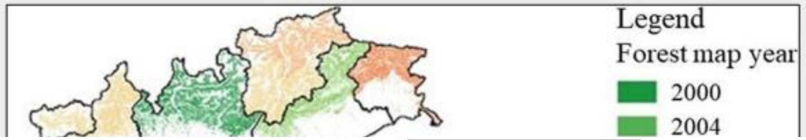
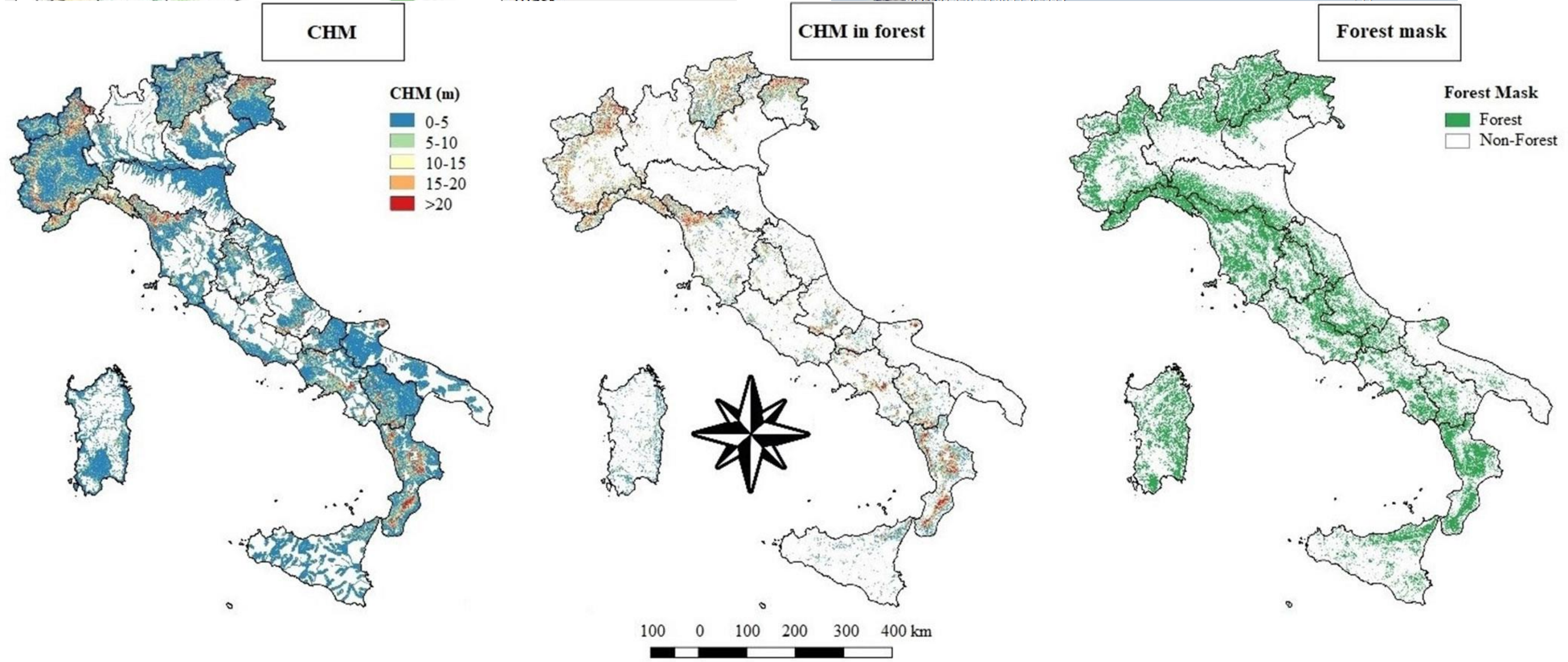
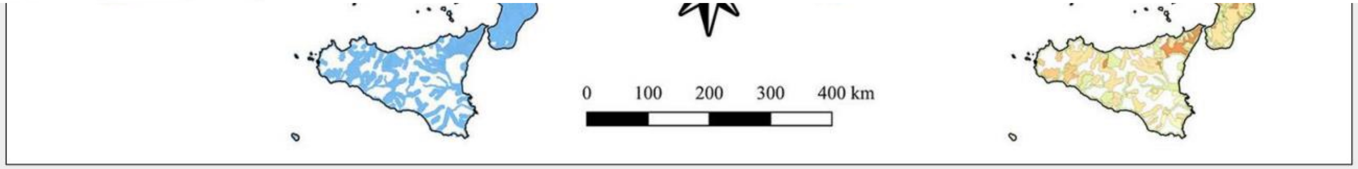


Fig. 1 - Acquisition year of local maps used to create the high resolution forest mask

iForest
Biogeosciences and Forestry
Research Article
doi: 10.3832/ifor3648-014
vol. 14, pp. 144-154





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Forest composition across Canada

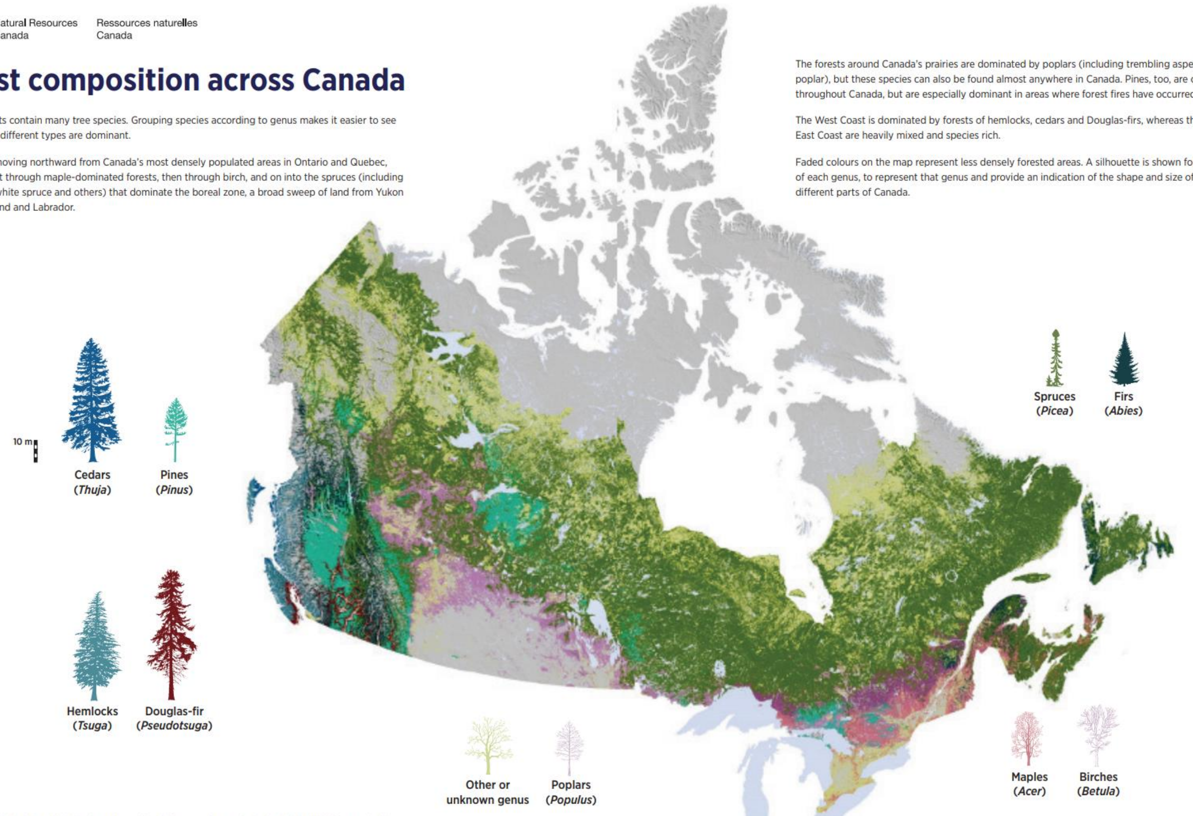
Canada's forests contain many tree species. Grouping species according to genus makes it easier to see where trees of different types are dominant.

For example, moving northward from Canada's most densely populated areas in Ontario and Quebec, one passes first through maple-dominated forests, then through birch, and on into the spruces (including black spruce, white spruce and others) that dominate the boreal zone, a broad sweep of land from Yukon to Newfoundland and Labrador.

The forests around Canada's prairies are dominated by poplars (including trembling aspen and balsam poplar), but these species can also be found almost anywhere in Canada. Pines, too, are common throughout Canada, but are especially dominant in areas where forest fires have occurred frequently.

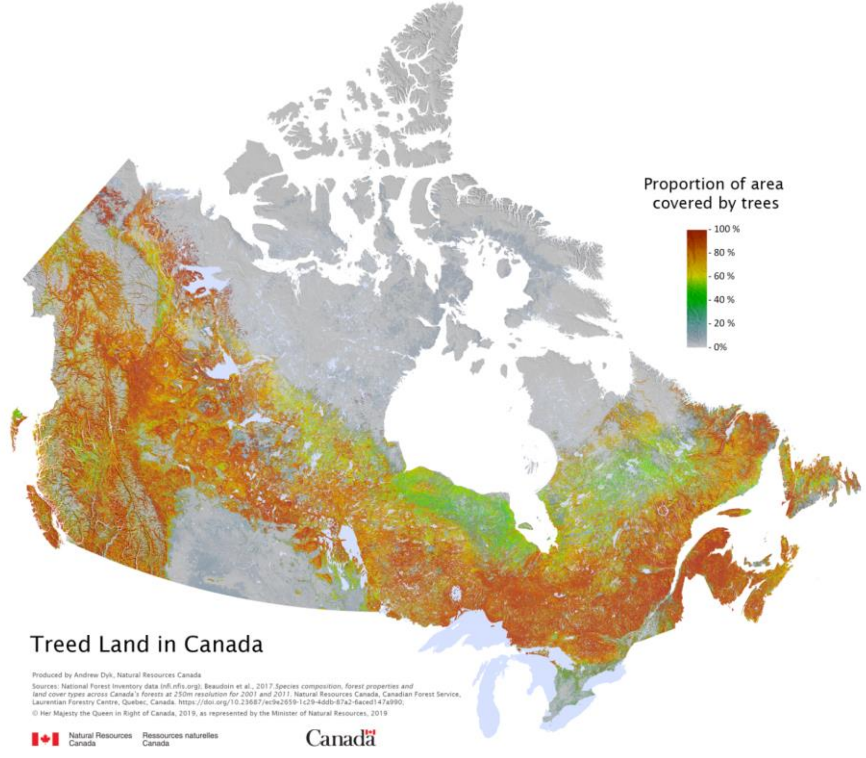
The West Coast is dominated by forests of hemlocks, cedars and Douglas-firs, whereas the forests of the East Coast are heavily mixed and species rich.

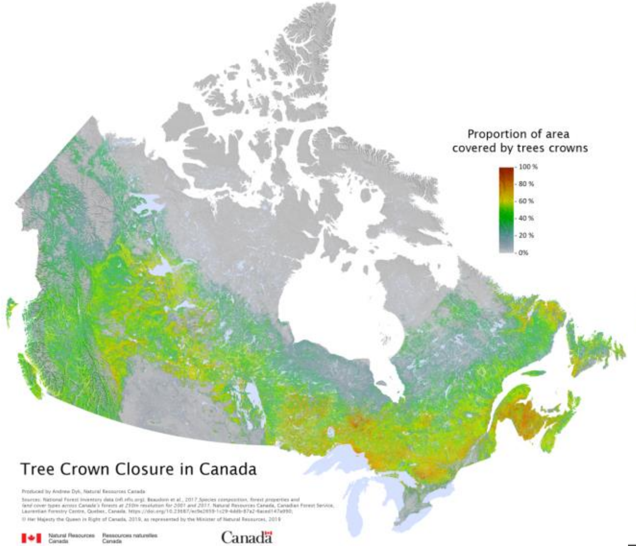
Faded colours on the map represent less densely forested areas. A silhouette is shown for one species of each genus, to represent that genus and provide an indication of the shape and size of trees found in different parts of Canada.

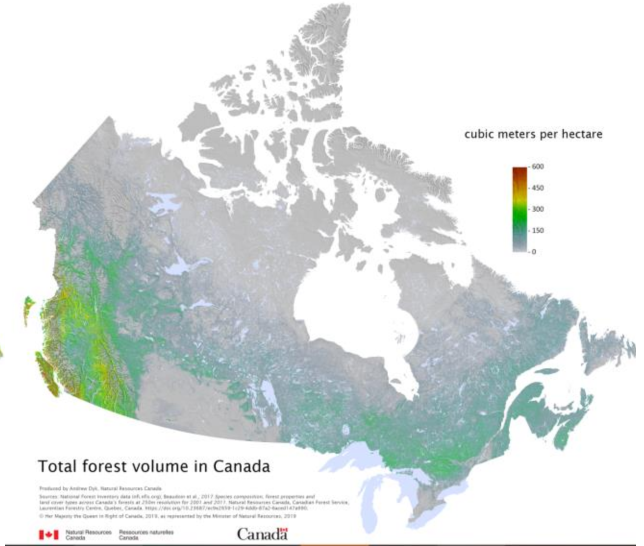


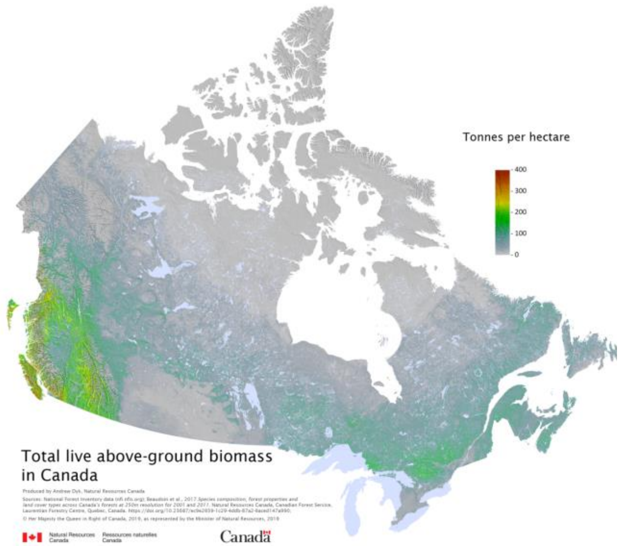
Sources: Beaudoin, A., Bernier, P., et al. 2014. Mapping attributes of Canada's forests at moderate resolution through kNN and MODIS imagery. *Canadian Journal of Forest Research*. DOI: 10.1139/cjfr-2013-0401; Canada's National Forest Inventory; Silhouettes reproduced from *Trees in Canada* by J.L. Farrar, 1995.

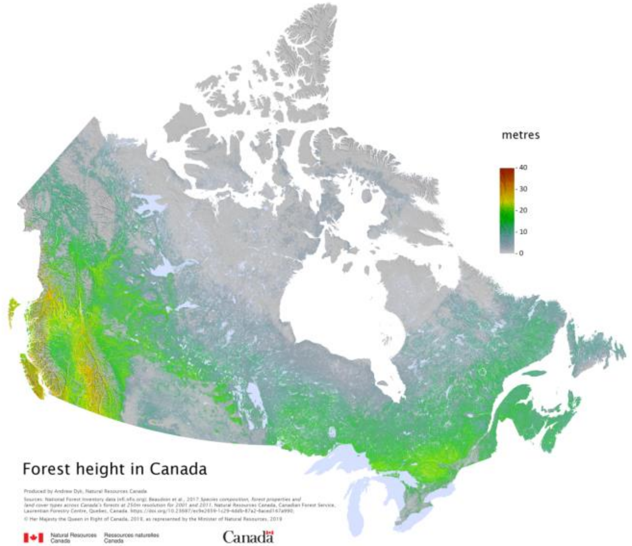
Canada









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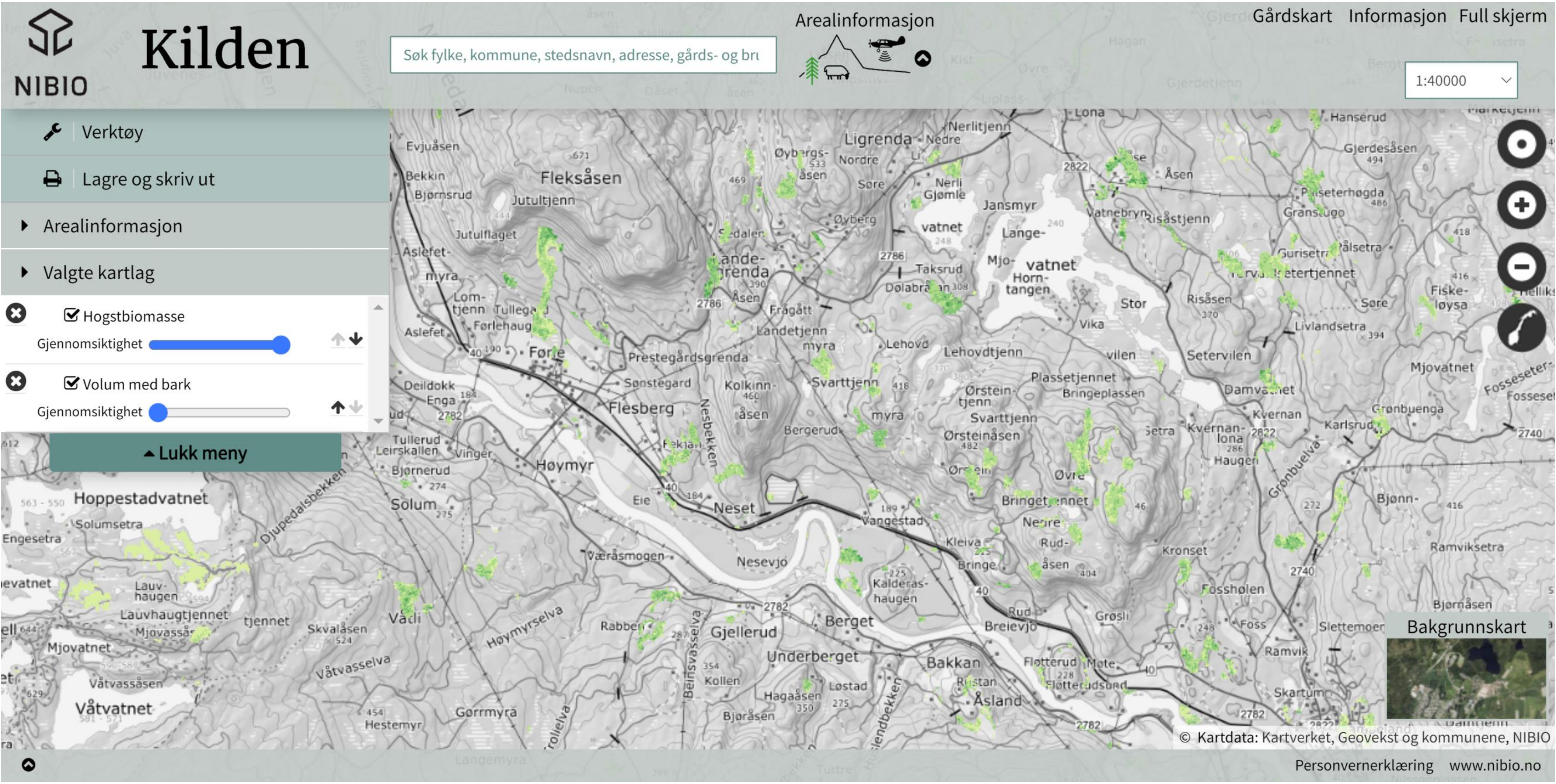
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Conclusioni

- Le nuove tecnologie di monitoraggio delle foreste mettono a disposizione dei gestori e dei pianificatori **più dati** a un minor costo
- I forestali devono essere in grado di trasformare questi nuovi dati in **informazioni**
- E' possibile l'impostazione di **modelli gestionali** più avanzati per una gestione forestale più capillare e distribuita