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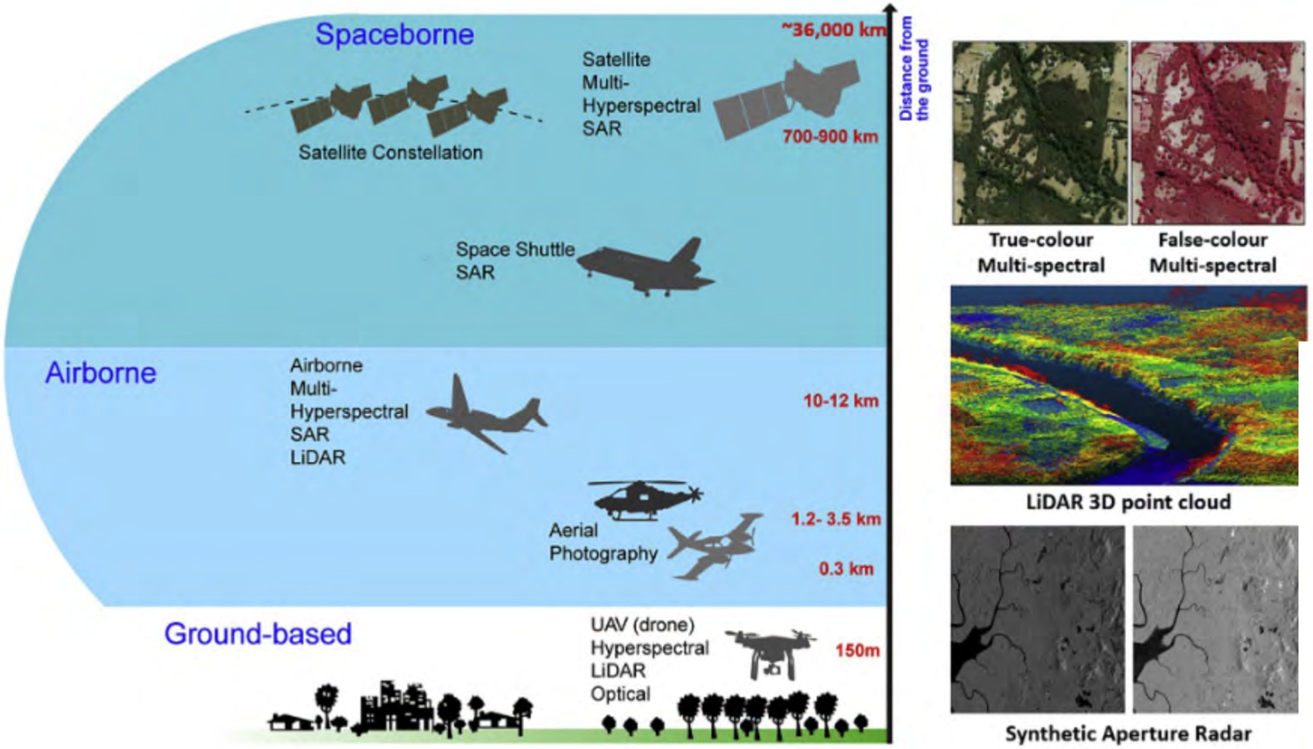
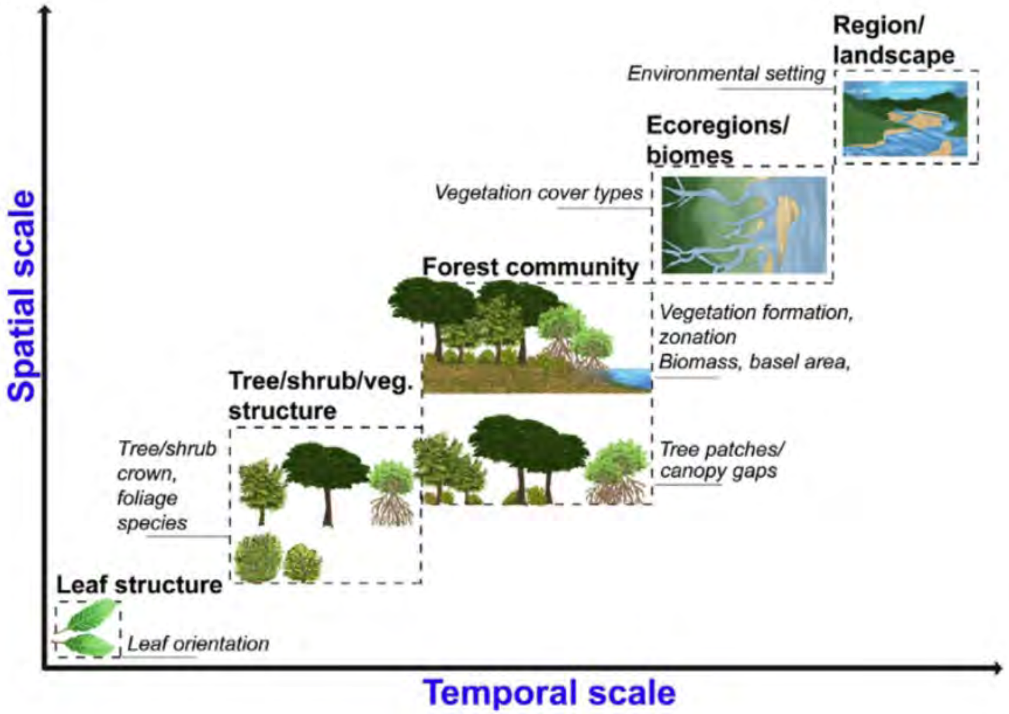
Società Italiana di Selvicoltura ed Ecologia Forestale

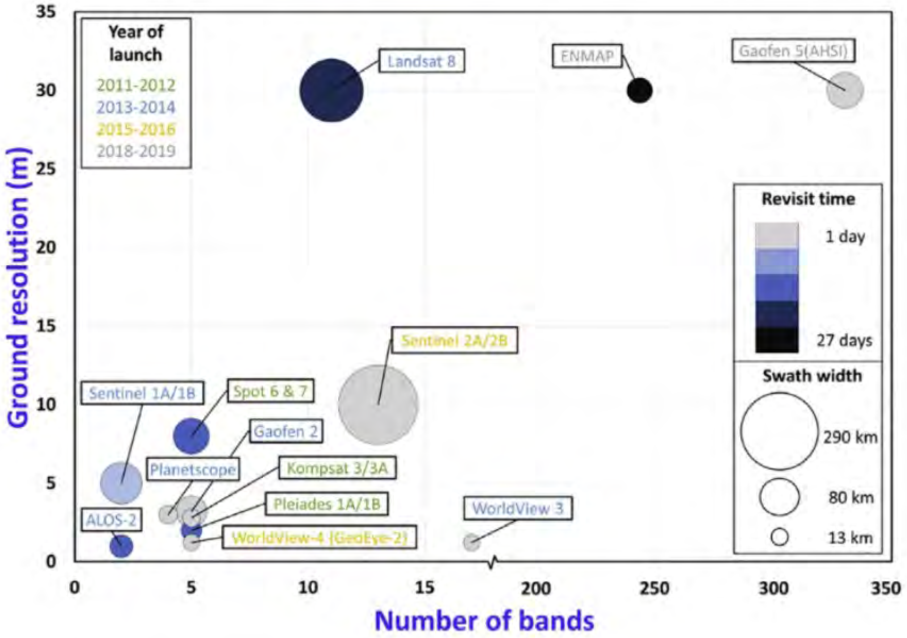
Nuovi strumenti per il monitoraggio e l’inventariazione forestale

Prof. Gherardo Chirici

geo LAB
Laboratory of Forest Geomatics







Applications in Remote Sensing to Forest Ecology and Management

Alex M. Lechner,[1,*] Giles M. Foody,[2] and Doreen S. Boyd[2]
[1]School of Environmental and Geographical Sciences, University of Nottingham Malaysia, Jalan Broga, 43500 Semenyih, Selangor, Malaysia
[2]School of Geography, University of Nottingham, University Park, Nottingham NG7 2RD, UK
*Correspondence: alex.lechner@nottingham.edu.my
https://doi.org/10.1016/j.oneear.2020.05.001


Colocated Data + Computation + APIs
Google

Remote Sensing of Environment 202 (2017) 18–27

Contents lists available at ScienceDirect

Remote Sensing of Environment

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

Google Earth Engine: Planetary-scale geospatial analysis for everyone

Noel Gorelick [a,*], Matt Hancher [b], Mike Dixon [b], Simon Ilyushchenko [b], David Thau [b], Rebecca Moore [b]

[a] Google Switzerland, Brandschenkestrasse 110, Zurich 8002, Switzerland
[b] Google Inc., 1600 Amphitheater Parkway, Mountain View, CA, 94043, USA

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Data democratization
Earth Engine

ABSTRACT

Google Earth Engine is a cloud-based platform for planetary-scale geospatial analysis that brings Google's massive computational capabilities to bear on a variety of high-impact societal issues including deforestation, drought, disaster, disease, food security, water management, climate monitoring and environmental protection. It is unique in the field as an integrated platform designed to empower not only traditional remote sensing scientists, but also a much wider audience that lacks the technical capacity needed to utilize traditional supercomputers or large-scale commodity cloud computing resources.

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Forestry Ma

MORRIS GOLDBERG,
MAYER ALVO, AND GE

Invited Paper

I. INTRODUCTION

Document type
Review
Source type
Journal
ISSN
02624079
View more

Will Google help save the planet?

Biever, Celeste

Abstract
Indexed keywords
SciVal Topics

Abstract

The geographers and environmentalists expect that a new set of images made freely available by the search engines Google and MSN Search will help to preserve the planet Earth. The release of Google Earth, a collection of photographs covering every inch of the planet, is likely to open up

Remote Sensing of Environment 209 (2018) 90–106

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Remote Sensing of Environment

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

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Large-area mapping of Canadian boreal forest cover, height, biomass and other structural attributes using Landsat composites and lidar plots

Giona Matasci[a,*], Txomin Hermosilla[a], Michael A. Wulder[b], Joanne C. White[b], Nicholas C. Coops[a], Geordie W. Hobart[b], Harold S.J. Zald[c]

[a] Integrated Remote Sensing Studio, Department of Forest Resources Management, University of British Columbia, 2424 Main Mall, Vancouv

[b] Canadian Forest Service (Pacific Forestry Centre), Natural Resources Canada, 506 West Burnside Road, Victoria, BC, V8Z 1M5, Canada

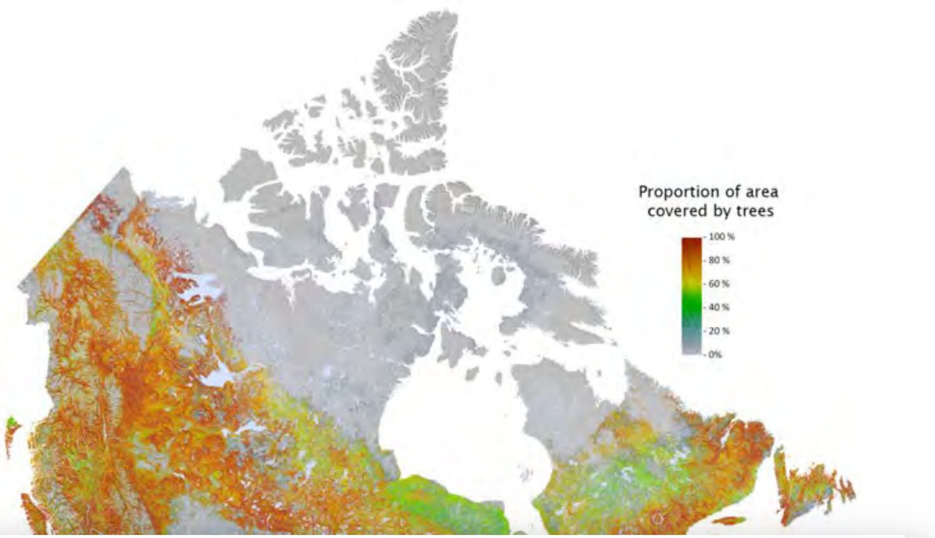
[c] Department of Forestry and Wildland Resources, Humboldt State University, 1 Harpst St., Arcata, CA 95521, USA

ARTICLE INFO

Keywords:
Lidar
Landsat
Forest structure
Monitoring
Imputation
Random Forest

ABSTRACT

Passive optical remotely sensed images such as those from the L
spatially comprehensive, well-calibrated reflectance measures that
as an alternative to field plot data, the use of Light Detection and Ra
validation purposes in combination with such satellite reflectance
response variables has become well established. In this research, we
forest structural attributes over the ~552 million ha boreal fores
dependent validation we utilize airborne lidar-derived measuremen
plots) obtained in 2010 via a > 25,000 km transect-based national
lidar plot structural variables to wall-to-wall 30-m spatial resolution



Canadian Journal of Remote Sensing, 42:619–641, 2016
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ISSN: 0703-8992 print / 1712-7971 online
DOI: 10.1080/07038992.2016.1207484

Taylor & Francis
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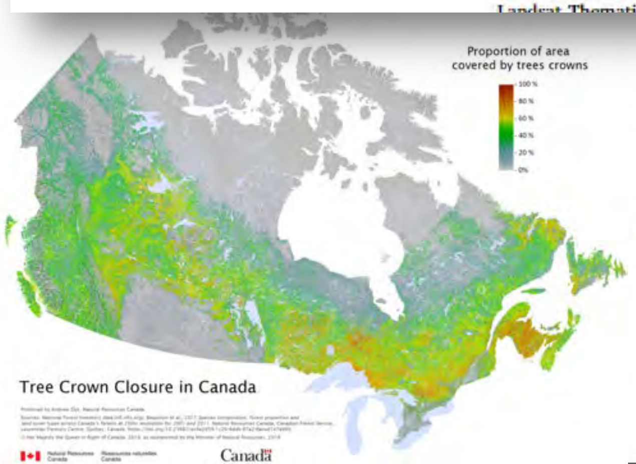
Remote Sensing Technologies for Enhancing Forest Inventories: A Review

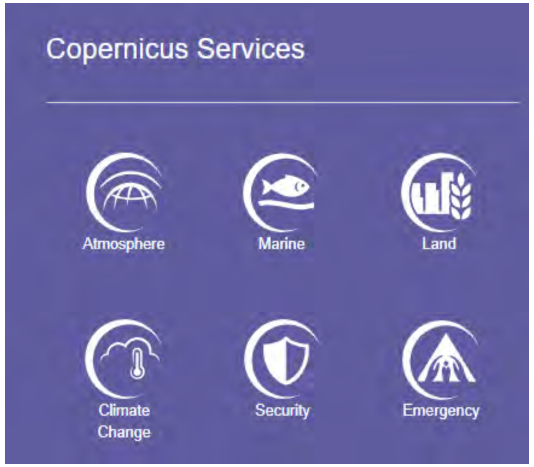
Joanne C. White[1,*], Nicholas C. Coops[2], Michael A. Wulder[1], Mikko Vastaranta[3], Thomas Hilker[4], and Piotr Tompalski[2]

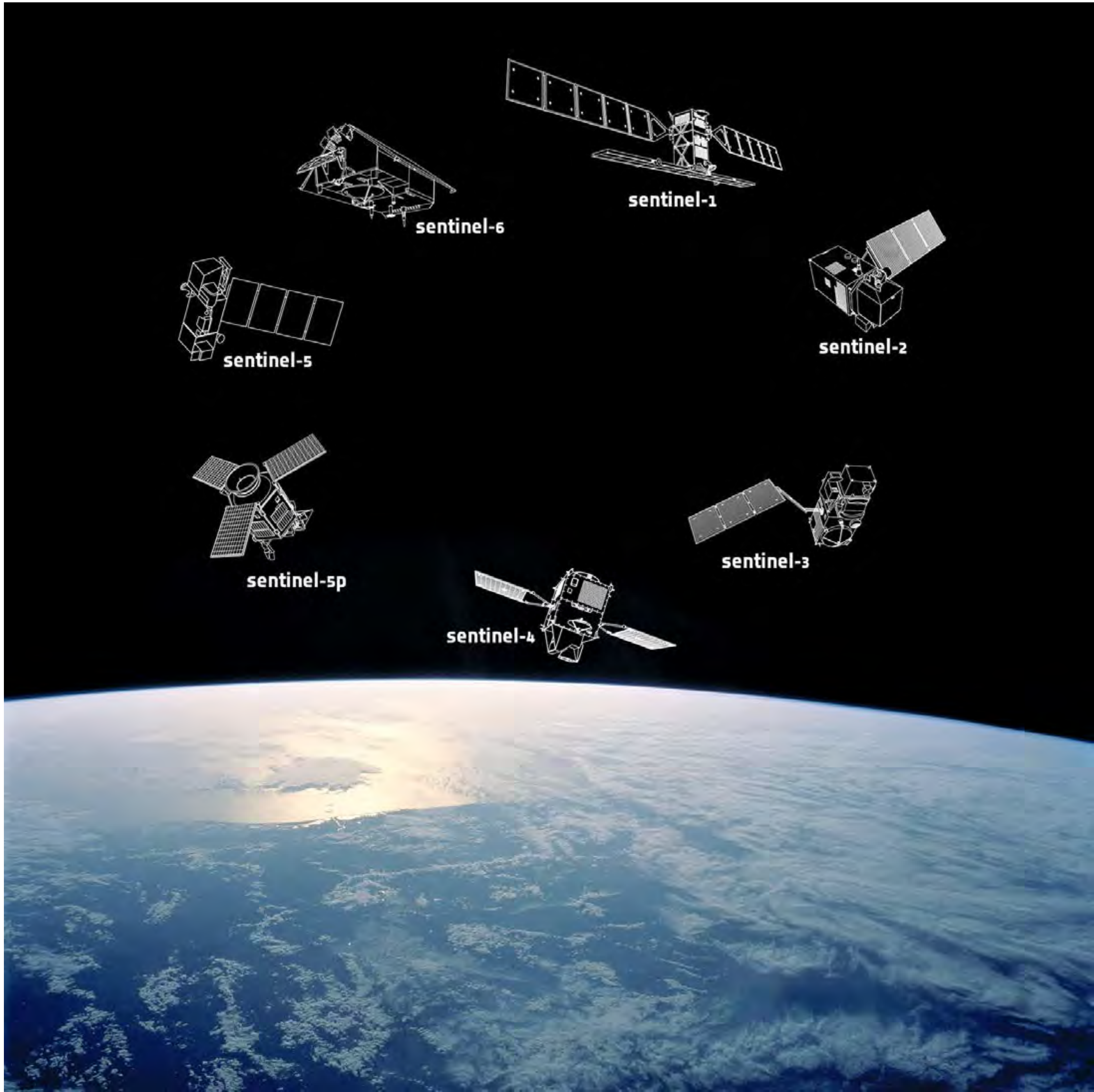
[1]Canadian Forest Service (Pacific Forestry Centre), Natural Resources Canada, 506 West Burnside Road, Victoria, BC, V8Z 1M5, Canada
[2]Faculty of Forestry, University of British Columbia, 2424 Main Mall, Vancouver, BC, V6T 1Z4, Canada
[3]Department of Forest Sciences, University of Helsinki, FI-00014 Helsinki, Finland
[4]College of Forestry, Oregon State University, Corvallis, OR 97331, USA

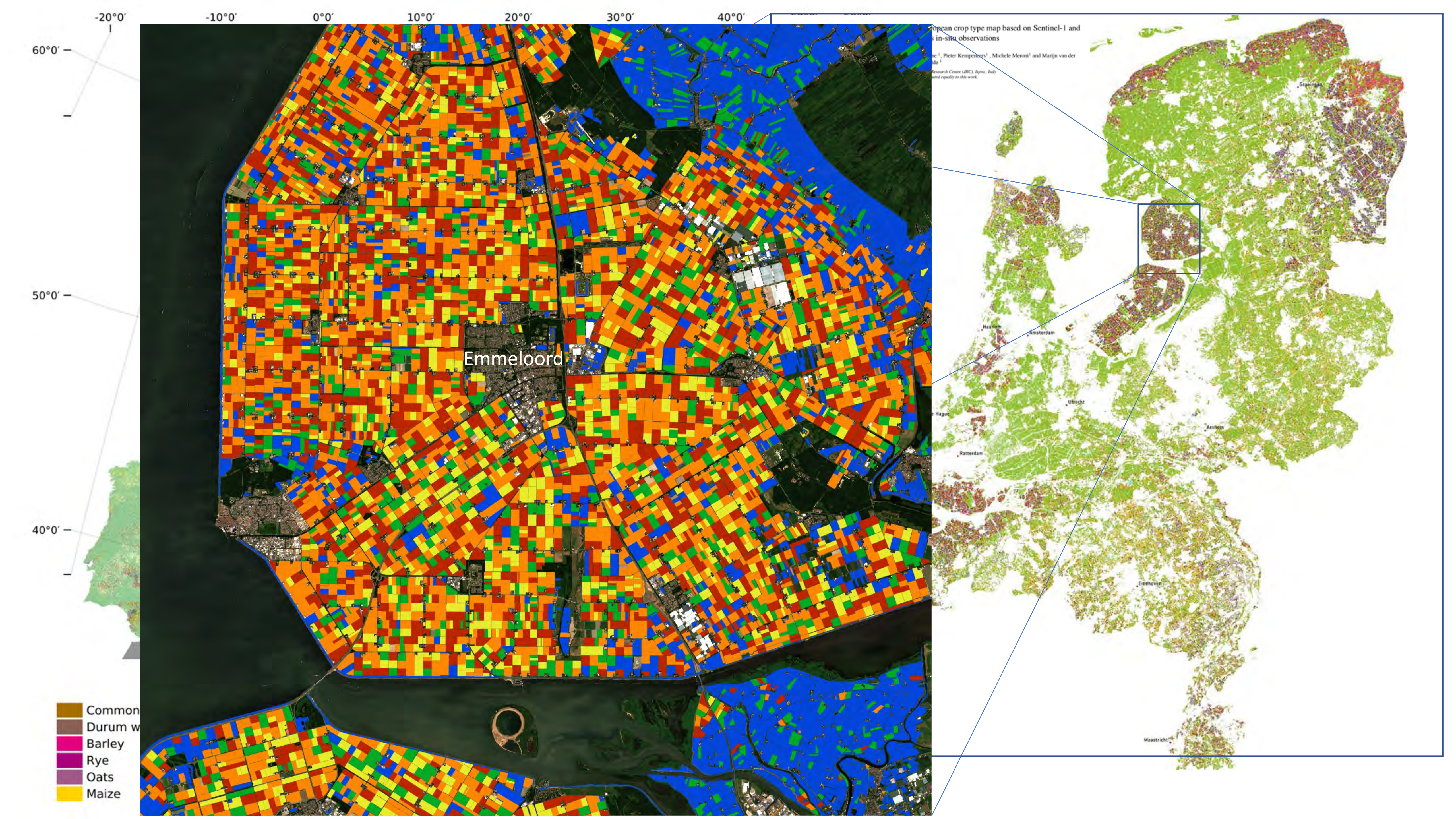
Abstract. Forest inventory and management requirements are changing rapidly in the context of an increasingly complex set of economic, environmental, and social policy objectives. Advanced remote sensing technologies provide data to assist in addressing these escalating information needs and to support the subsequent development and parameterization of models for an even broader range of information needs. This special issue contains papers that use a variety of remote sensing technologies to derive forest inventory or inventory-related information. Herein, we review the potential of 4 advanced remote sensing technologies,



Copernicus
Europe's eyes on Earth






-20°0′
-10°0′
0°0′
10°0′
20°0′
30°0′
40°0′
60°0′
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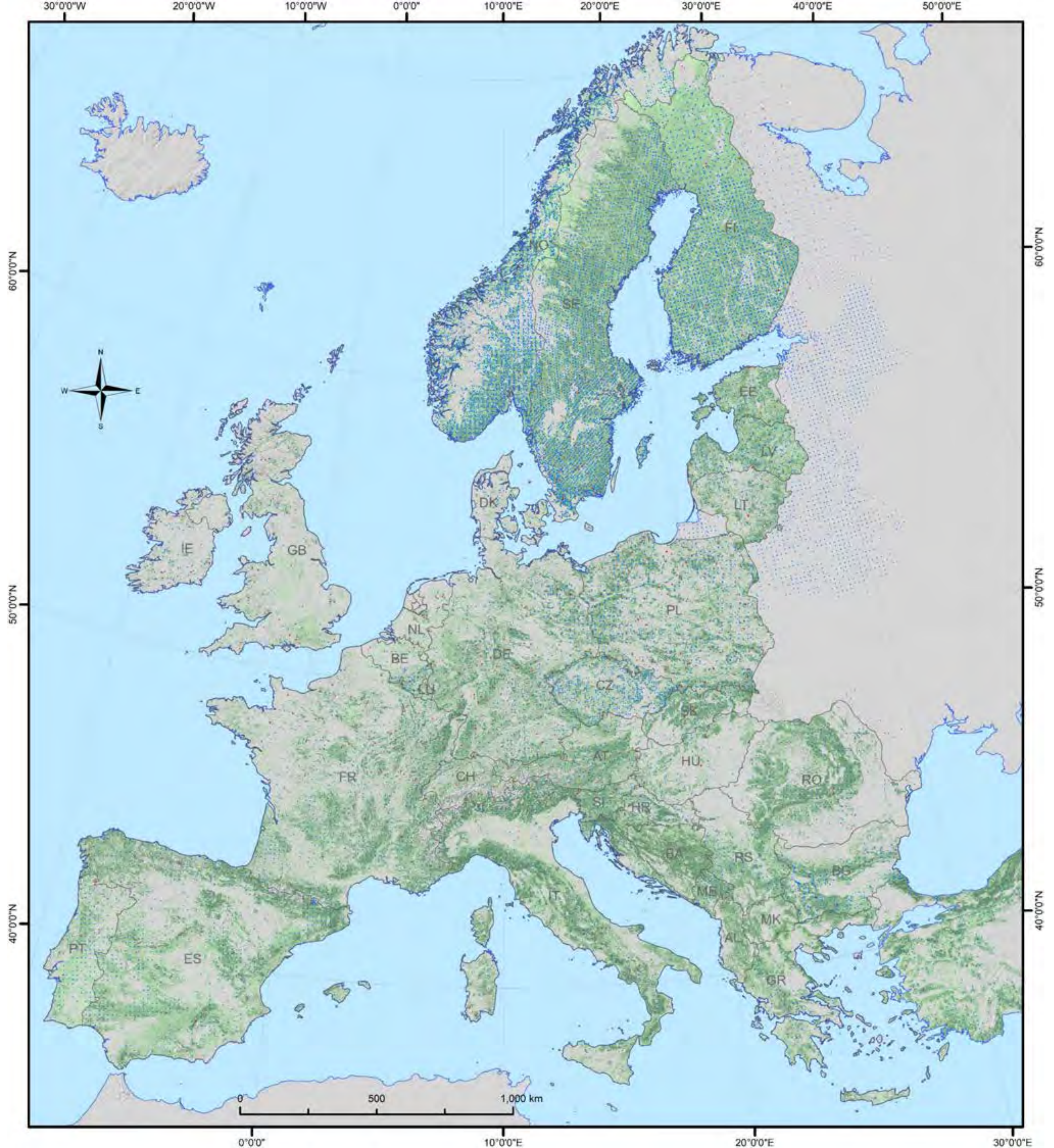
Emmeloord
Groningen
Haarlem
Amsterdam
Utrecht
Hague
Arnhem
Rotterdam
Eindhoven
Maastricht
Common
Durum w
Barley
Rye
Oats
Maize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NO
SE
FI
EE
LV
LT
DK
IE
GB
NL
BE
LU
DE
PL
CZ
SK
AT
HU
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HR
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ME
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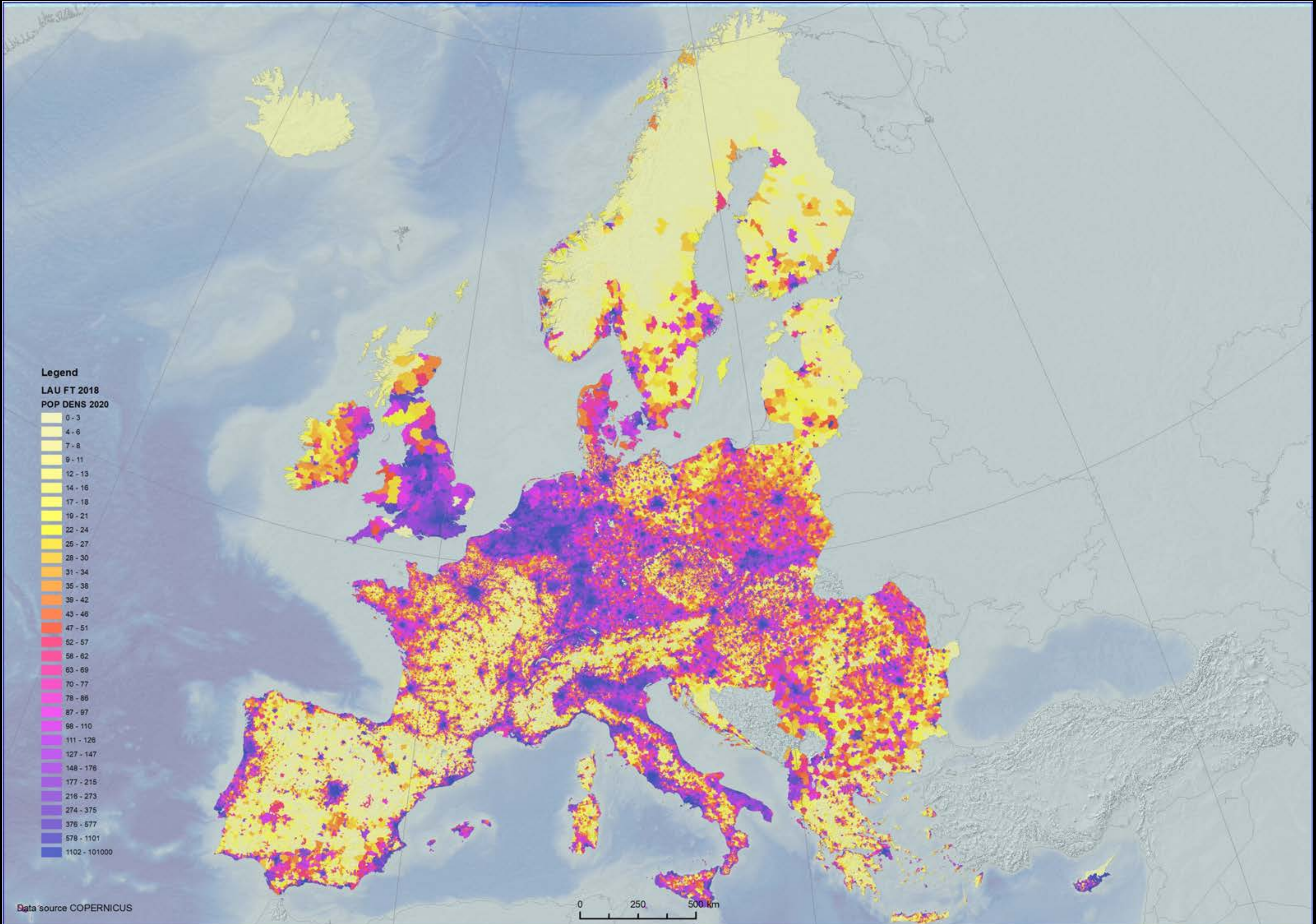
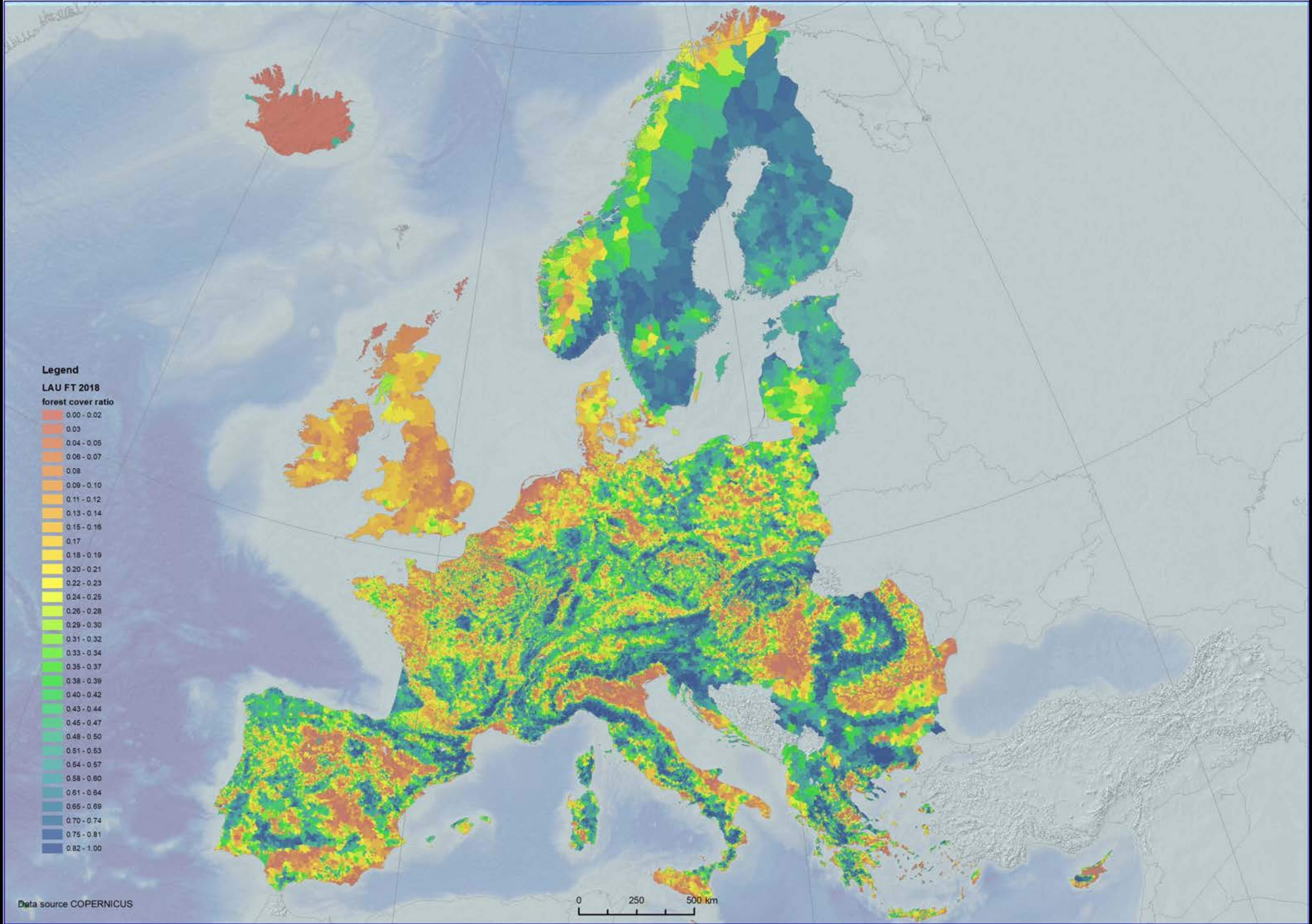
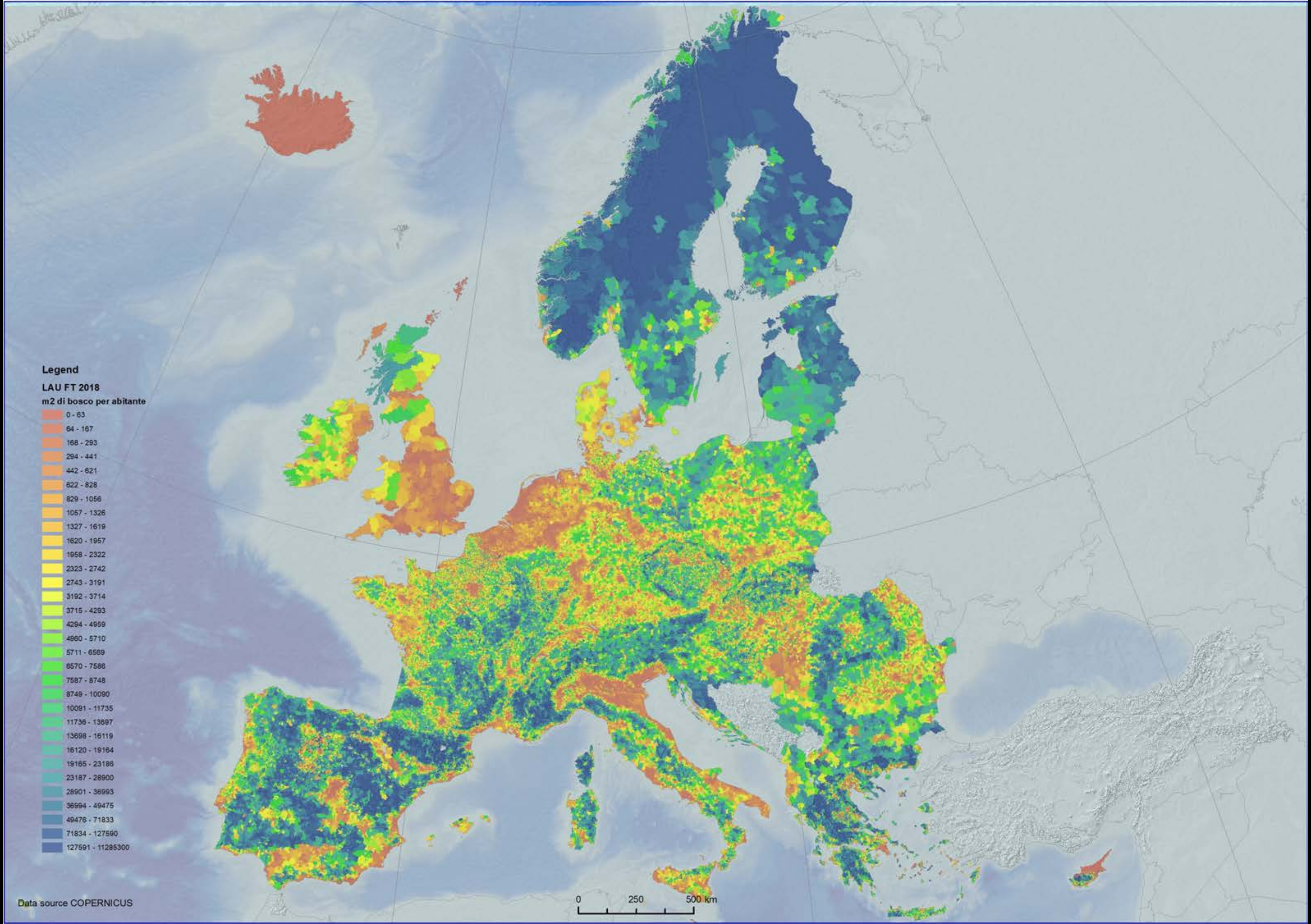
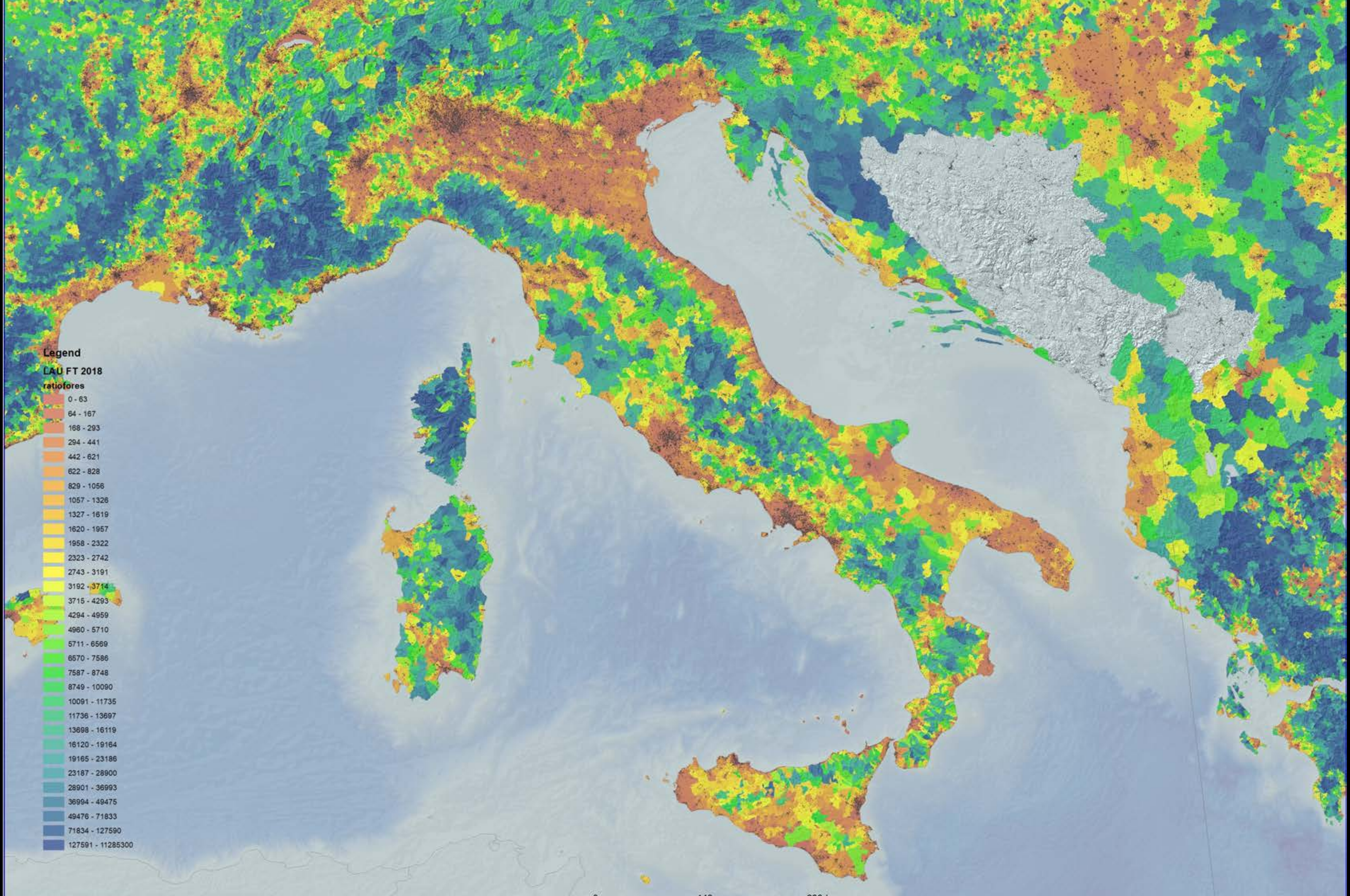
AL
GR
IT
PT
ES
0
500
1,000 km



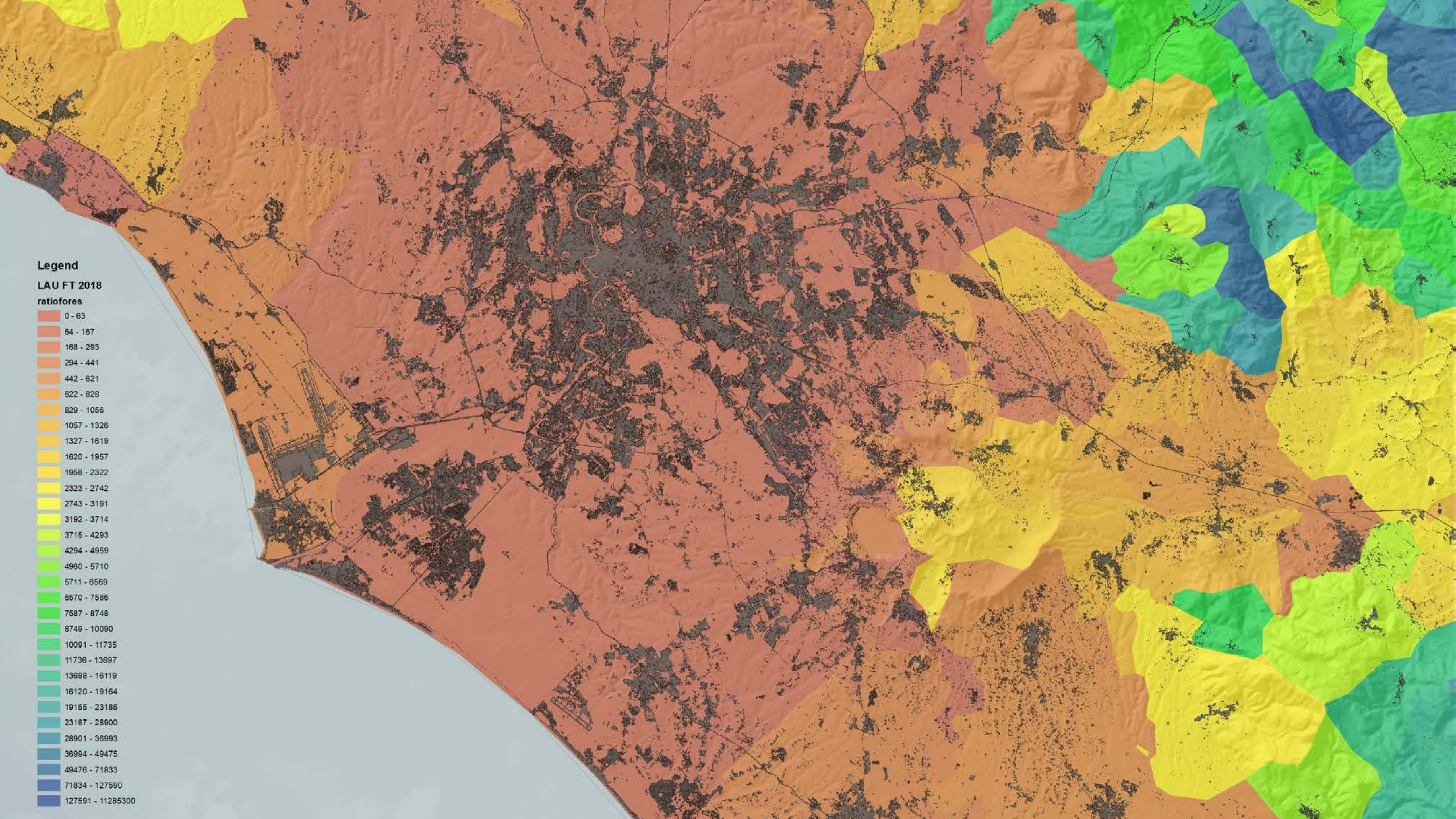
Legend
LAU FT 2018
POP DENS 2020
0 - 3
4 - 6
7 - 8
9 - 11
12 - 13
14 - 16
17 - 18
19 - 21
22 - 24
25 - 27
28 - 30
31 - 34
35 - 38
39 - 42
43 - 46
47 - 51
52 - 57
58 - 62
63 - 69
70 - 77
78 - 86
87 - 97
98 - 110
111 - 126
127 - 147
148 - 176
177 - 215
216 - 273
274 - 375
376 - 577
578 - 1101
1102 - 101000
Data source COPERNICUS
0
250
500 km


Legend
LAU FT 2018
forest cover ratio
0.00 - 0.02
0.03
0.04 - 0.05
0.06 - 0.07
0.08
0.09 - 0.10
0.11 - 0.12
0.13 - 0.14
0.15 - 0.16
0.17
0.18 - 0.19
0.20 - 0.21
0.22 - 0.23
0.24 - 0.25
0.26 - 0.28
0.29 - 0.30
0.31 - 0.32
0.33 - 0.34
0.35 - 0.37
0.38 - 0.39
0.40 - 0.42
0.43 - 0.44
0.45 - 0.47
0.48 - 0.50
0.51 - 0.53
0.54 - 0.57
0.58 - 0.60
0.61 - 0.64
0.65 - 0.69
0.70 - 0.74
0.75 - 0.81
0.82 - 1.00
Data source COPERNICUS
0
250
500 km


Legend
LAU FT 2018
m2 di bosco per abitante
0 - 63
64 - 167
168 - 293
294 - 441
442 - 621
622 - 828
829 - 1056
1057 - 1326
1327 - 1619
1620 - 1957
1958 - 2322
2323 - 2742
2743 - 3191
3192 - 3714
3715 - 4293
4294 - 4959
4960 - 5710
5711 - 6569
6570 - 7586
7587 - 8748
8749 - 10090
10091 - 11735
11736 - 13697
13698 - 16119
16120 - 19164
19165 - 23186
23187 - 28900
28901 - 36993
36994 - 49475
49476 - 71833
71834 - 127590
127591 - 11285300
0
250
500 km
Data source COPERNICUS



FONDAZIONE PER IL FUTURO DELLE CITTÀ


Legend
LAU FT 2018
ratiofores
0 - 63
64 - 167
168 - 293
294 - 441
442 - 621
622 - 828
829 - 1056
1057 - 1326
1327 - 1619
1620 - 1957
1958 - 2322
2323 - 2742
2743 - 3191
3192 - 3714
3715 - 4293
4294 - 4959
4960 - 5710
5711 - 6569
6570 - 7586
7587 - 8748
8749 - 10090
10091 - 11735
11736 - 13697
13698 - 16119
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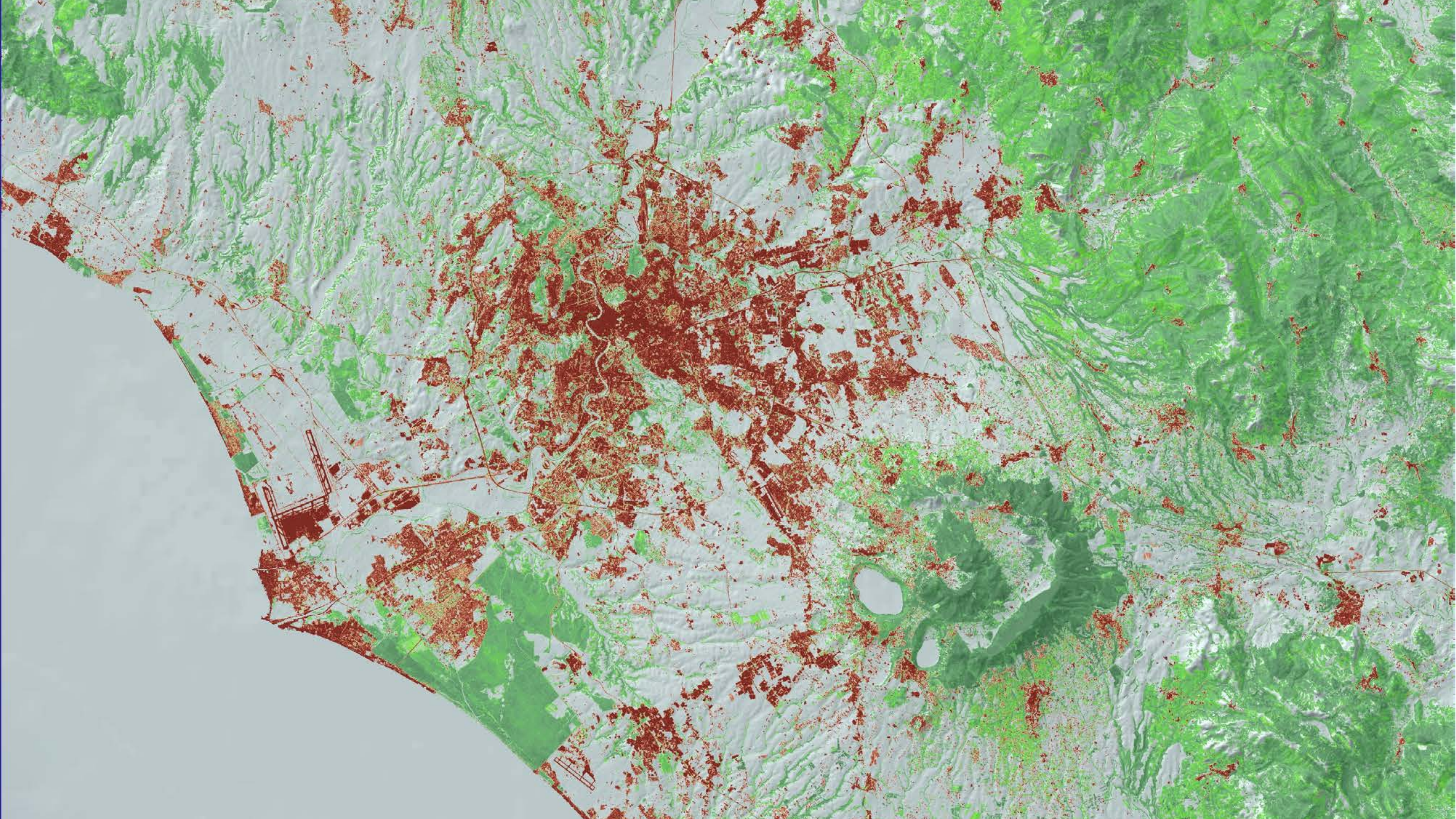
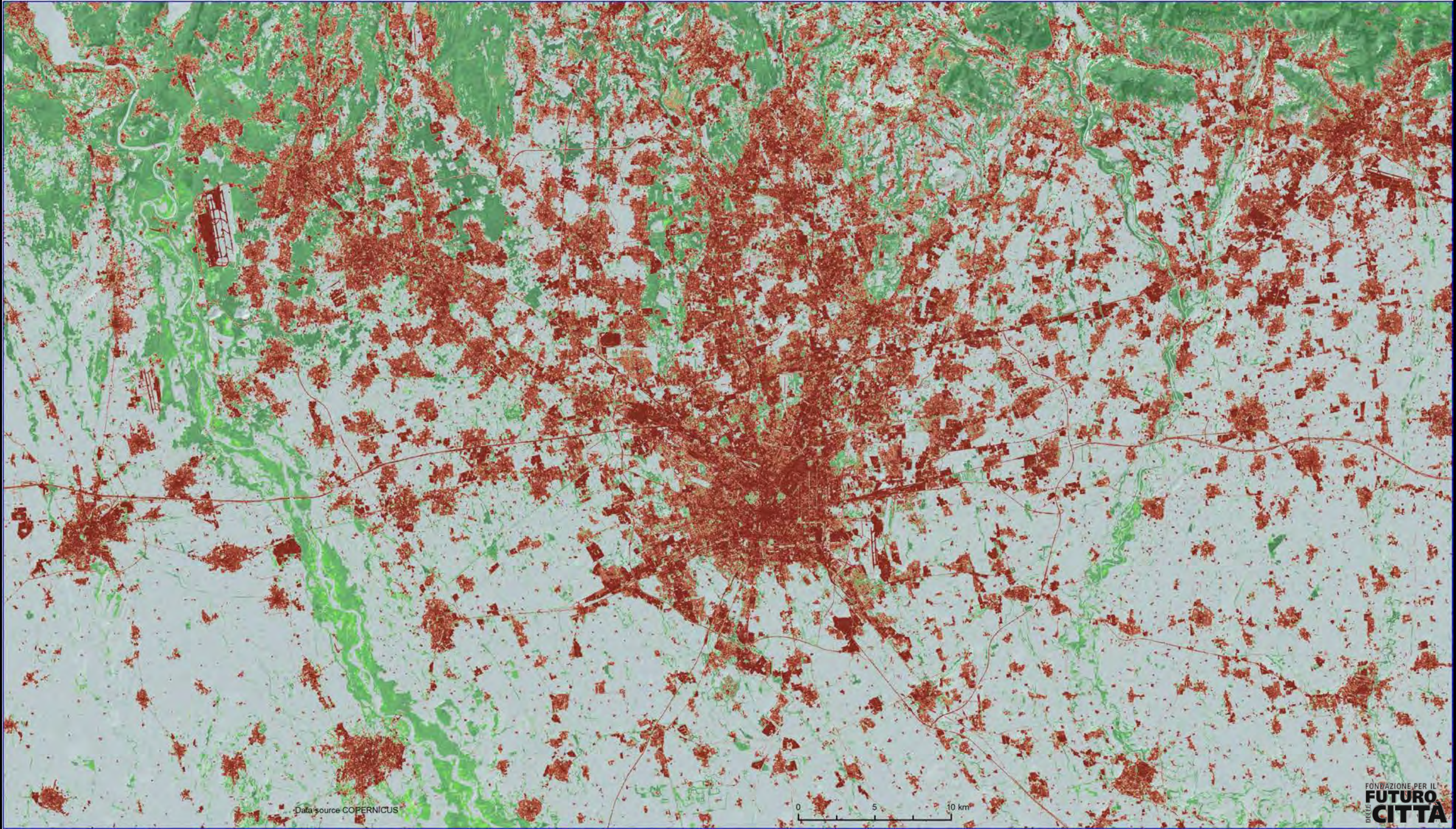
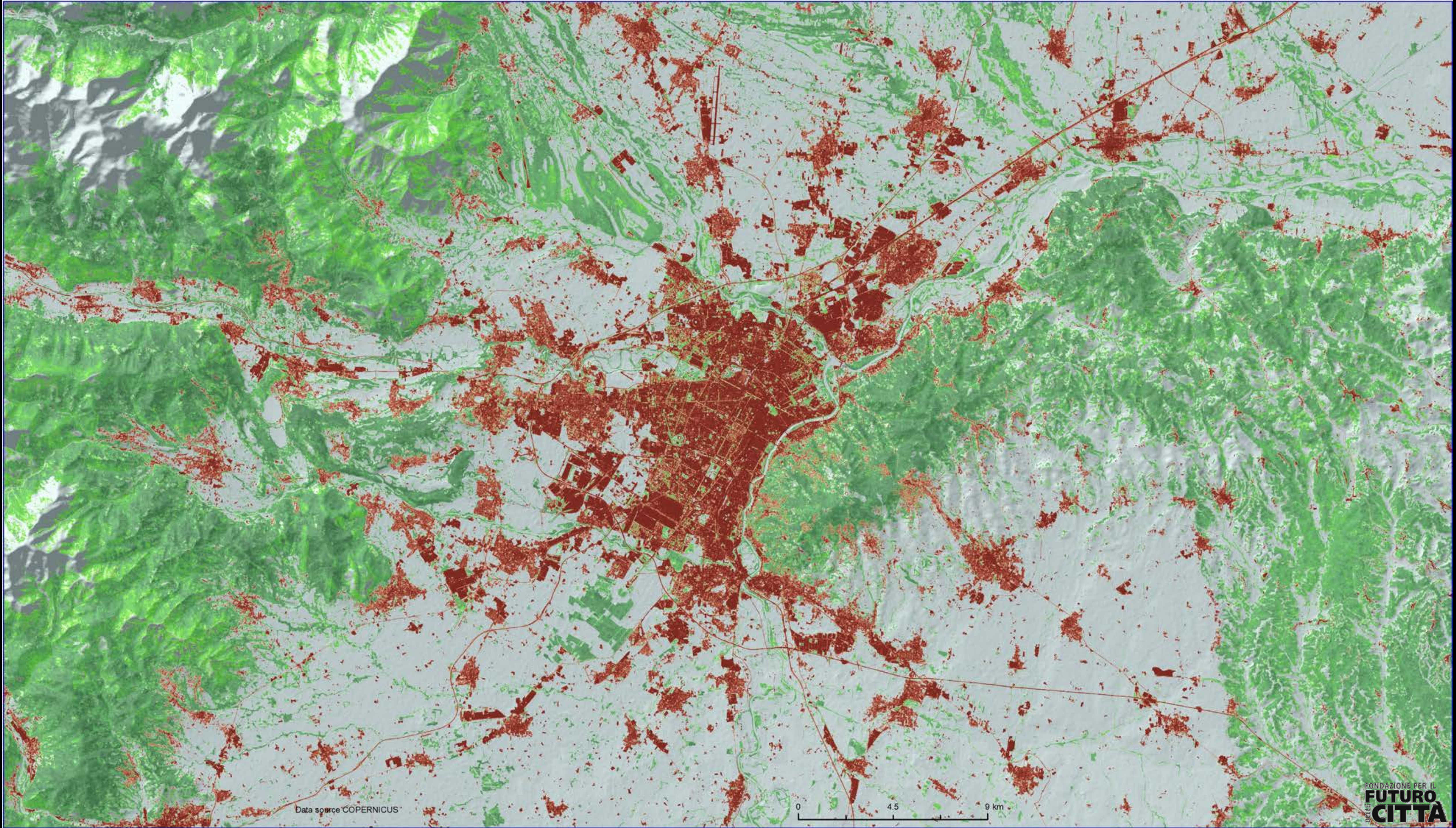
71834 - 127590
127591 - 11285300




Data source COPERNICUS
0
5
10 km
FONDAZIONE PER IL FUTURO DELLE CITTÀ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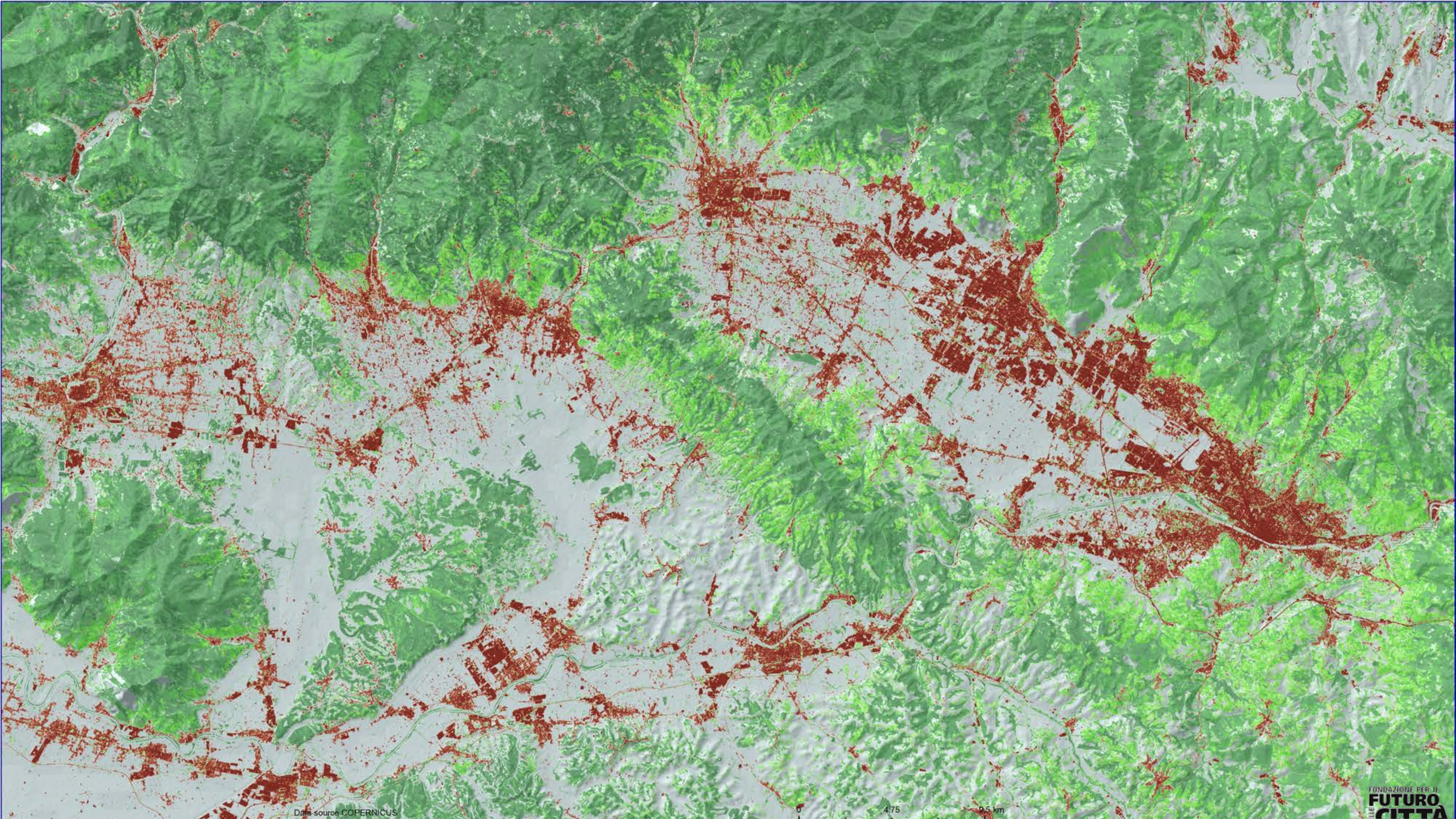
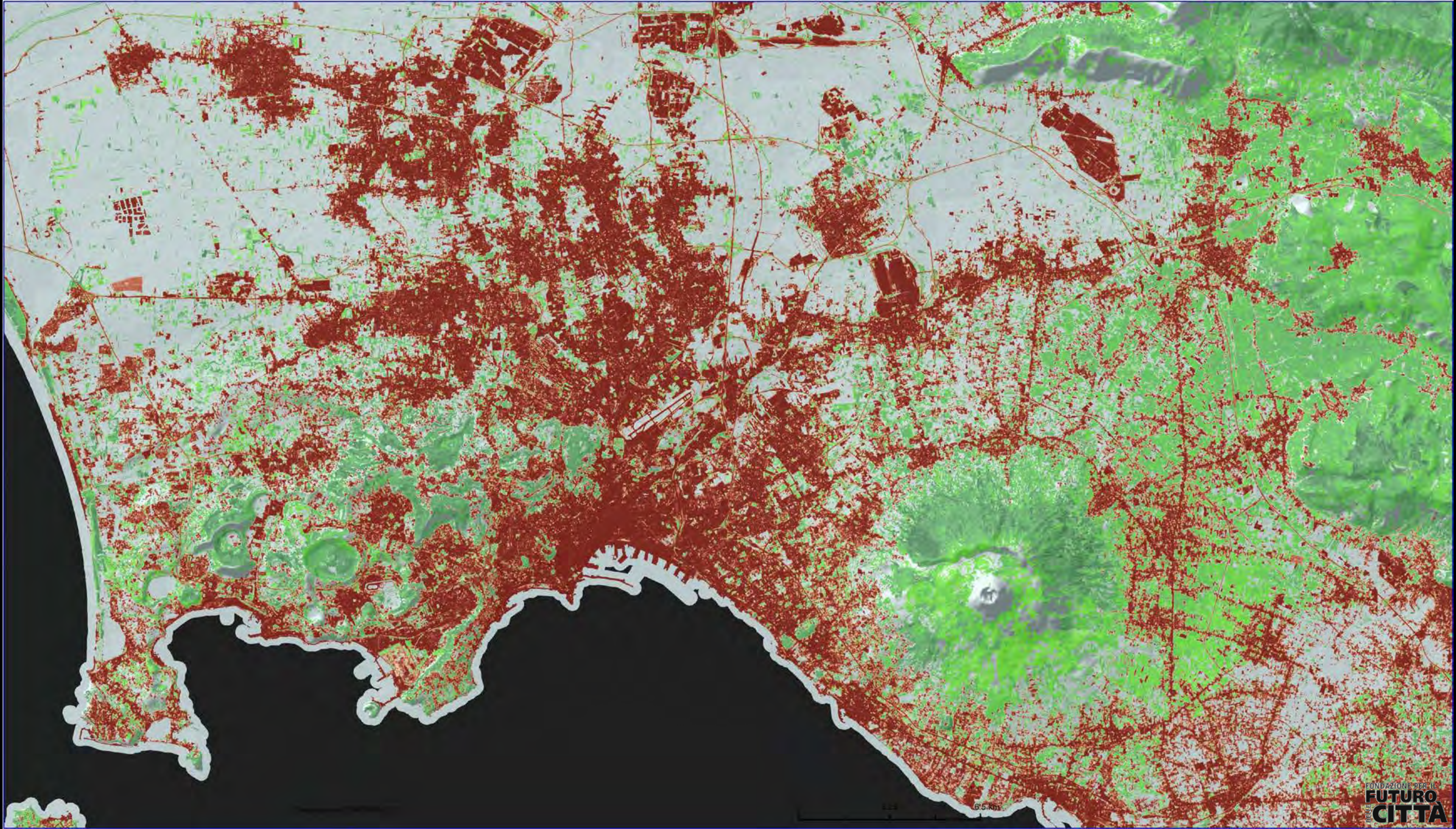
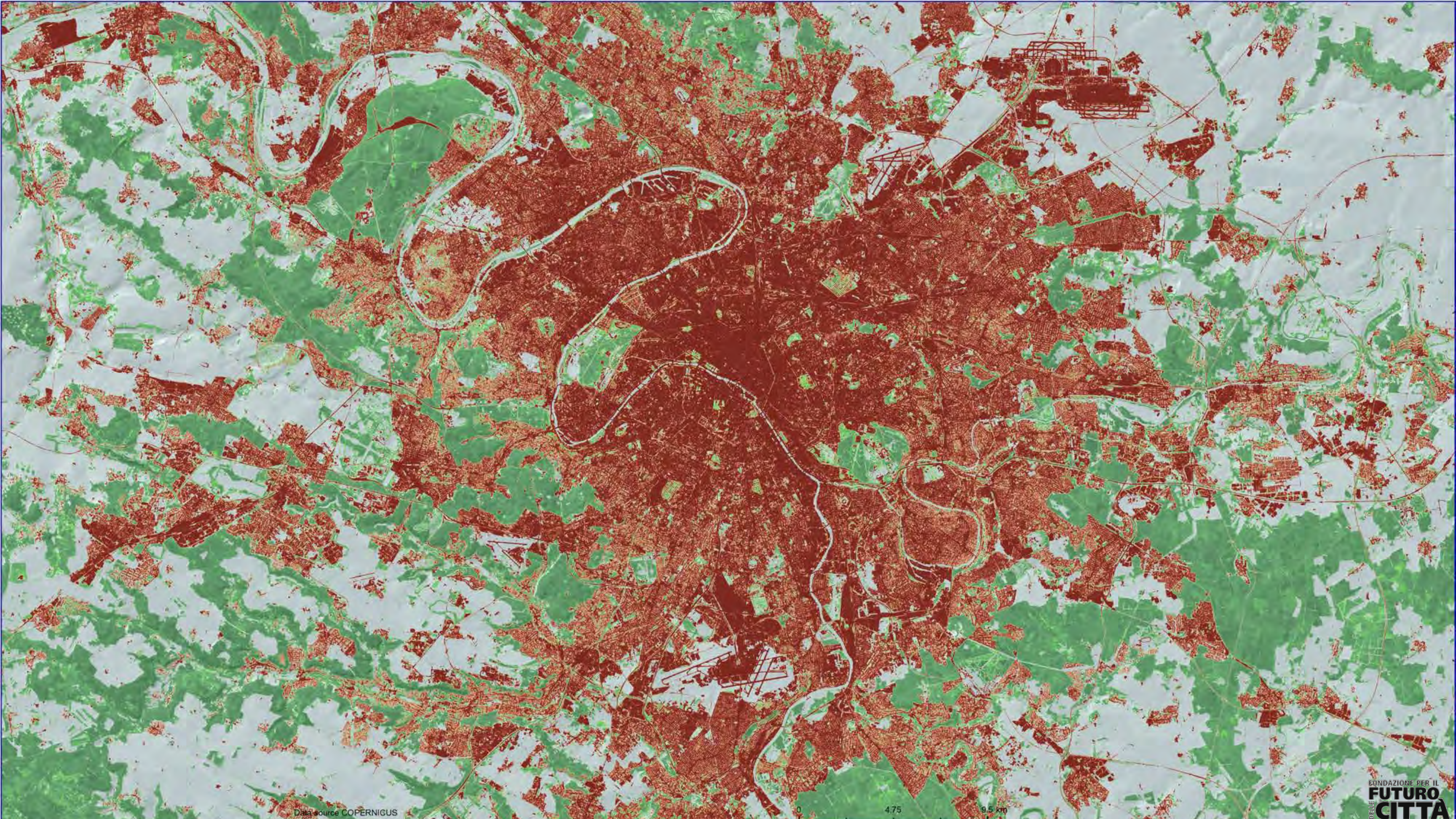
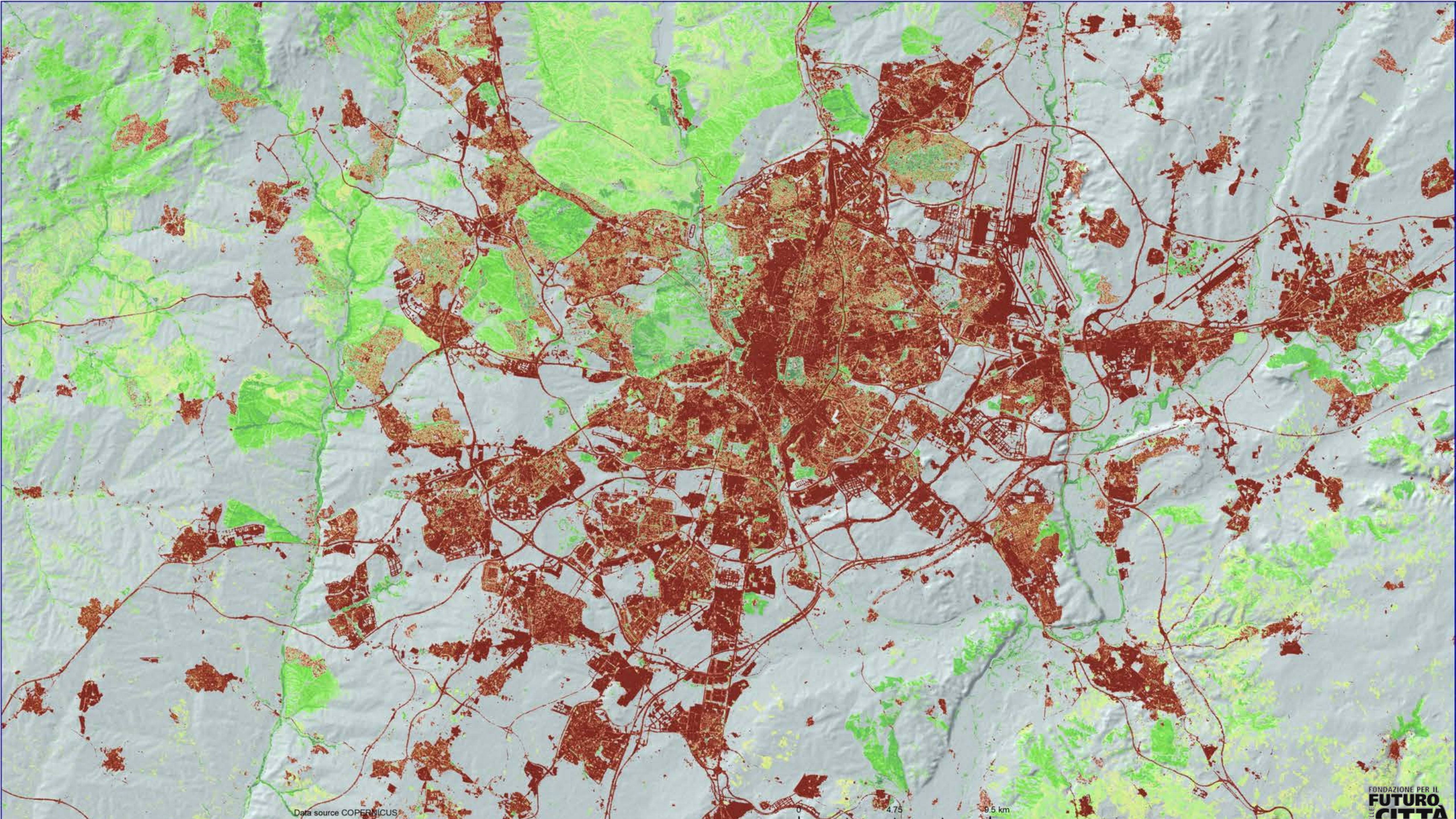
0
4.5
9 km

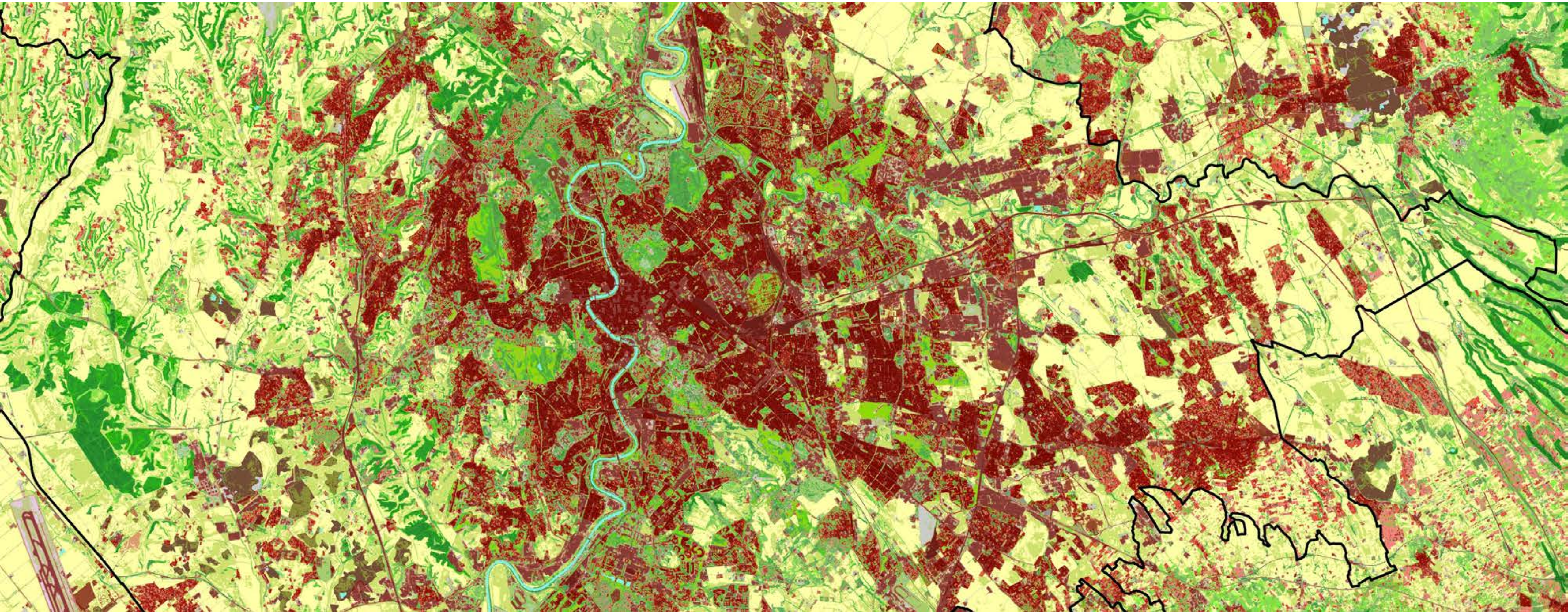

Data source COPERNICUS
0
4.75
9.5 km


6.5 Km
FONDAZIONE PER IL FUTURO DELLE CITTÀ

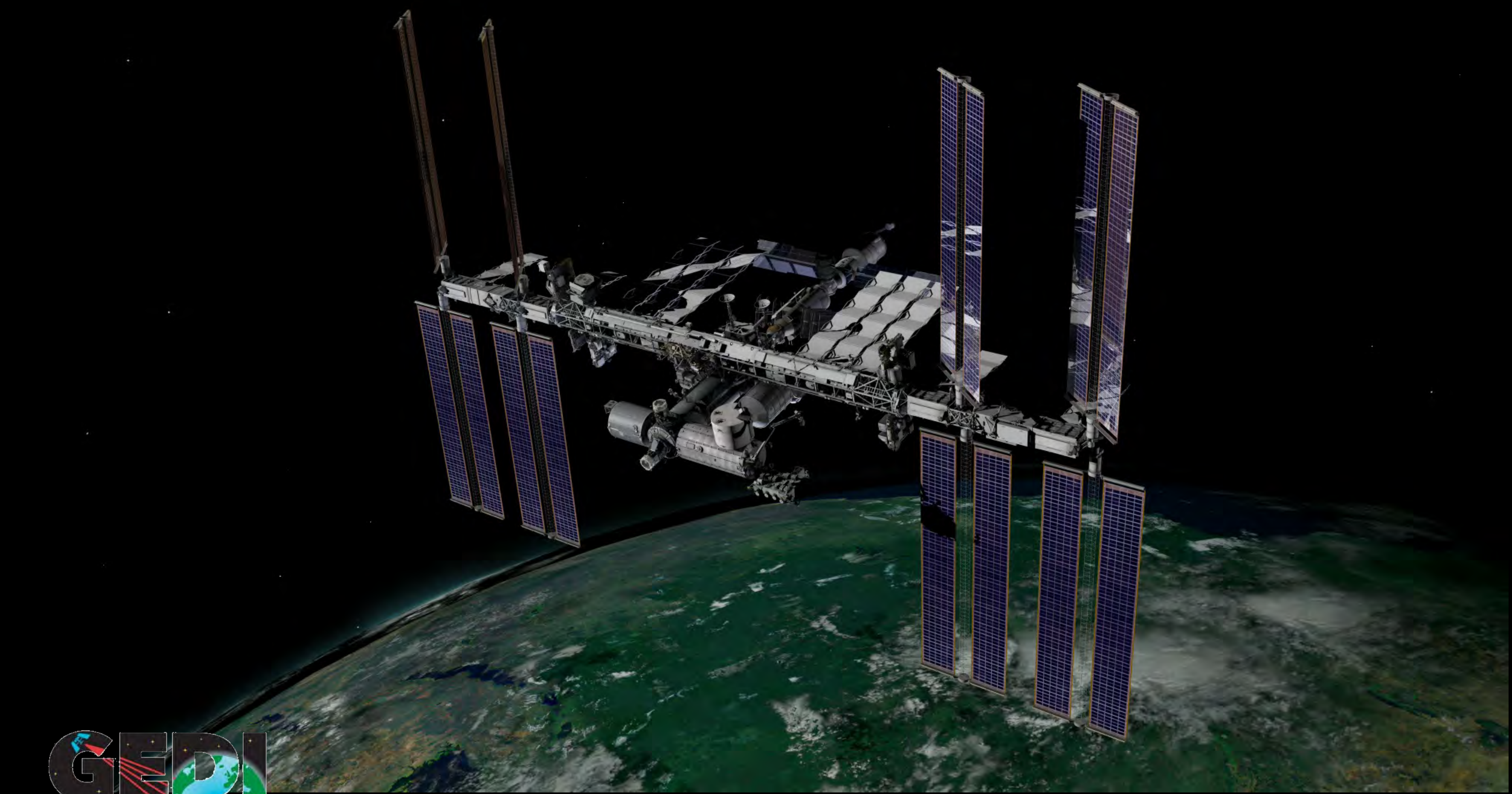

Data source COPERNICUS
0
4.75
9.5 km
FONDAZIONE PER IL FUTURO DELLE CITTÀ


Data source COPERNICUS
0
5
10 km
FONDAZIONE PER IL
FUTURO
CITTÀ


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



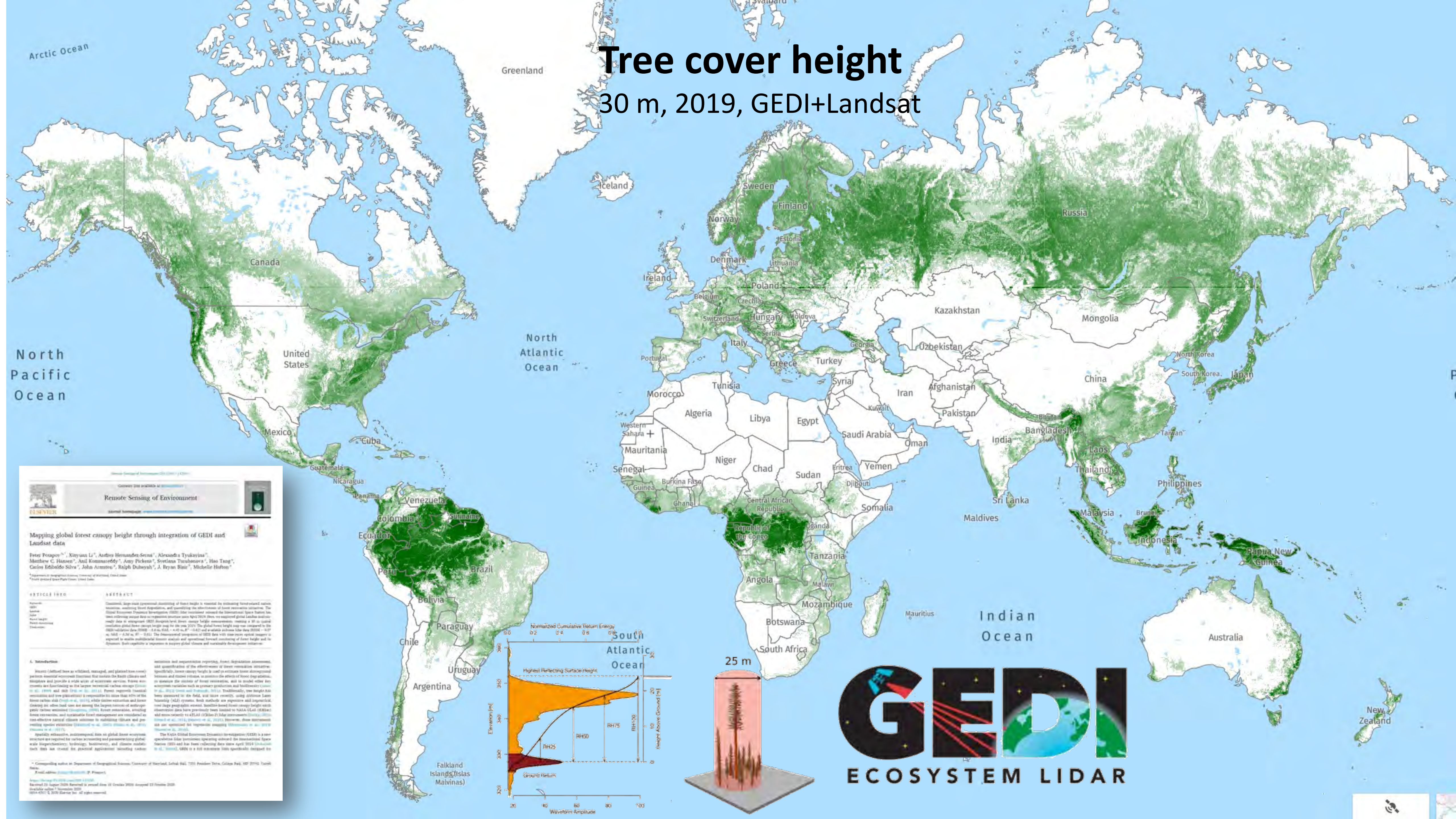
FONDAZIONE PER IL FUTURO DELLE CITTÀ



GEDI
ECOSYSTEM LIDAR

Tree cover height

30 m, 2019, GEDI+Landsat



Remote Sensing of Environment

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

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

ARTICLE INFO

ABSTRACT

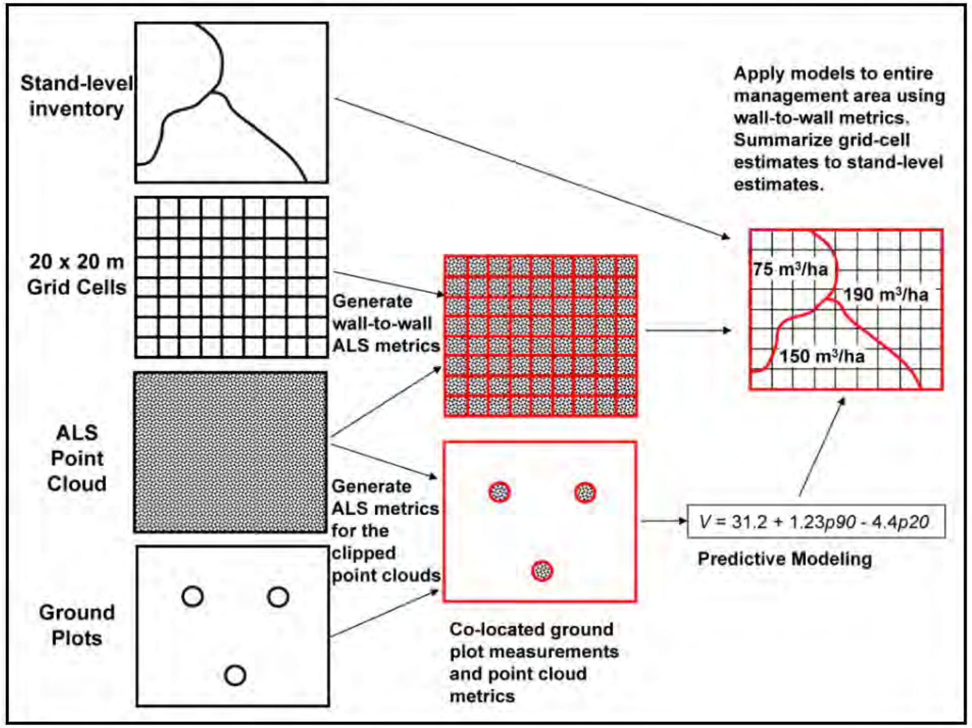
1. Introduction

GEDI

ECOSYSTEM LIDAR

Integrazione INFC nel Sistema Informativo Forestale Nazionale

- Mappatura dei tipi forestali
- Mappatura dei disturbi
- Mappatura stima variabili inventariali
- Mappatura disturbi
- Allarme in tempo reale
- Accesso on line
- Open access

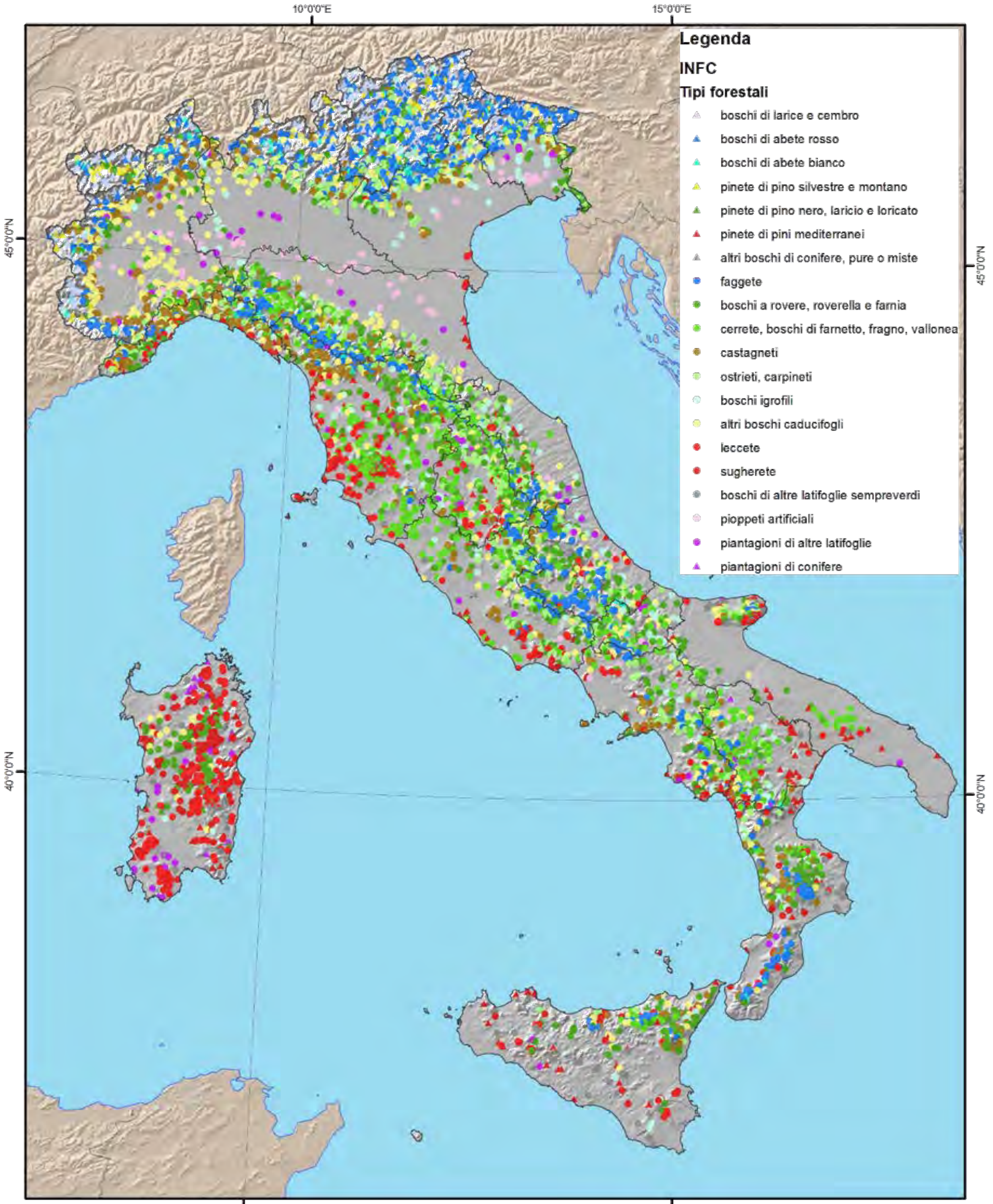


Integrazioni multisorgente con BIG DATA analytics

Applicazioni in Italia

1-spazializzazione variabili forestali

2-mappatura dei disturbi



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

A R T I C L E I N F O

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Accepted 16 May 2022
Available online 21 May 2022

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

Keywords:
Google Earth Engine
Remote Sensing
Open-access
Big data
Cloud computing
forest fires
wind damages
forest harvestings

A B S T R A C T

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

DOI of original article: 10.1016/j.jag.2021.102663
* 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

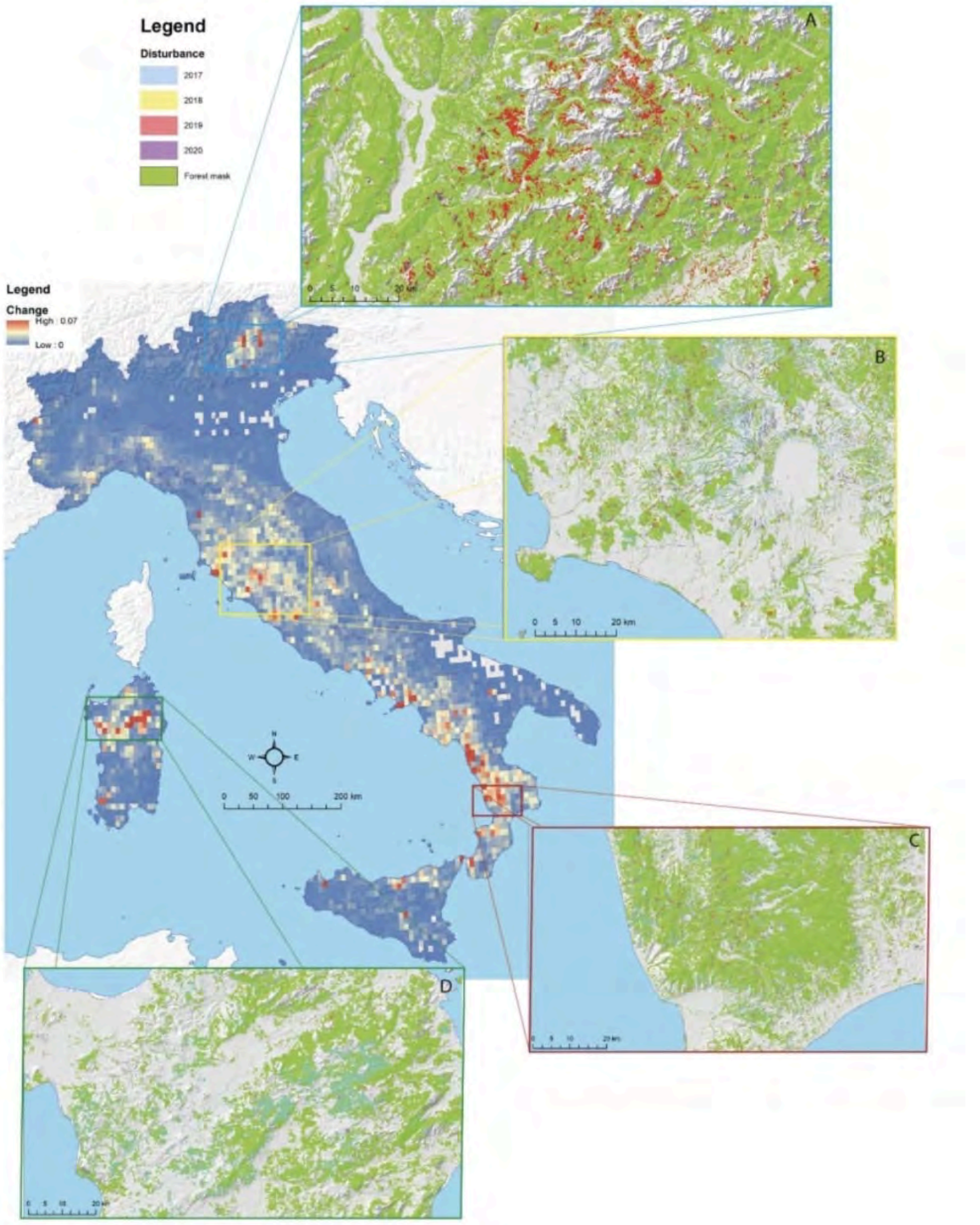
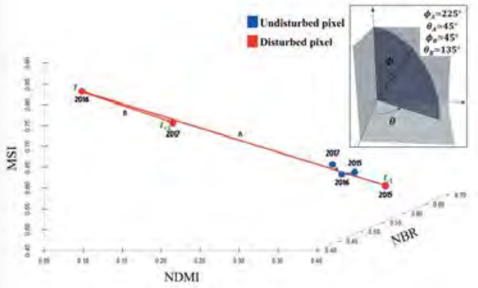


Fig. 1. Forest disturbances predicted in Italy between 2017 and 2020 using the 3I3D algorithm. The percentage of the forests that were disturbed over Italy considering the whole period is shown in the largest panel using a pixel size of 1-km. The four smaller panels (a-d) show zooms of the disturbance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



INTERNATIONAL JOURNAL OF REMOTE SENSING
2021, VOL. 42, NO. 12, 4693–4711
https://doi.org/10.1080/01431161.2021.1899334

Taylor & Francis
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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

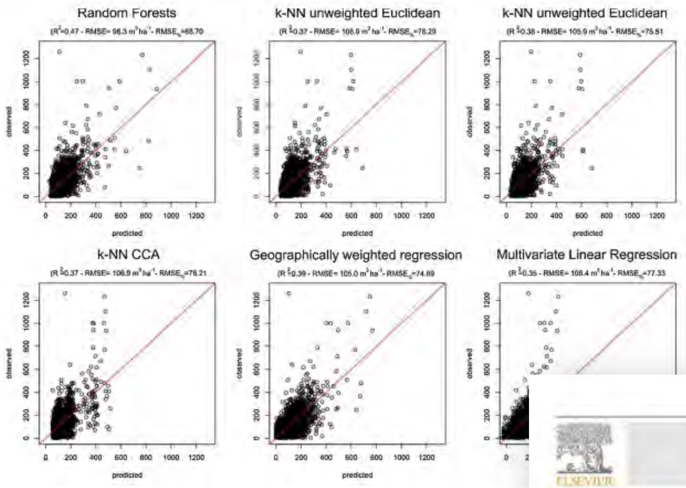
Environmental problems arising from forest degradation, deforestation and human land use are greater than ever and are increasing rapidly (Ramankutty et al. 2007). In this context, and in view of climate change, sustainable management of forest ecosystems is essential (FAO, 2015) because forest growth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

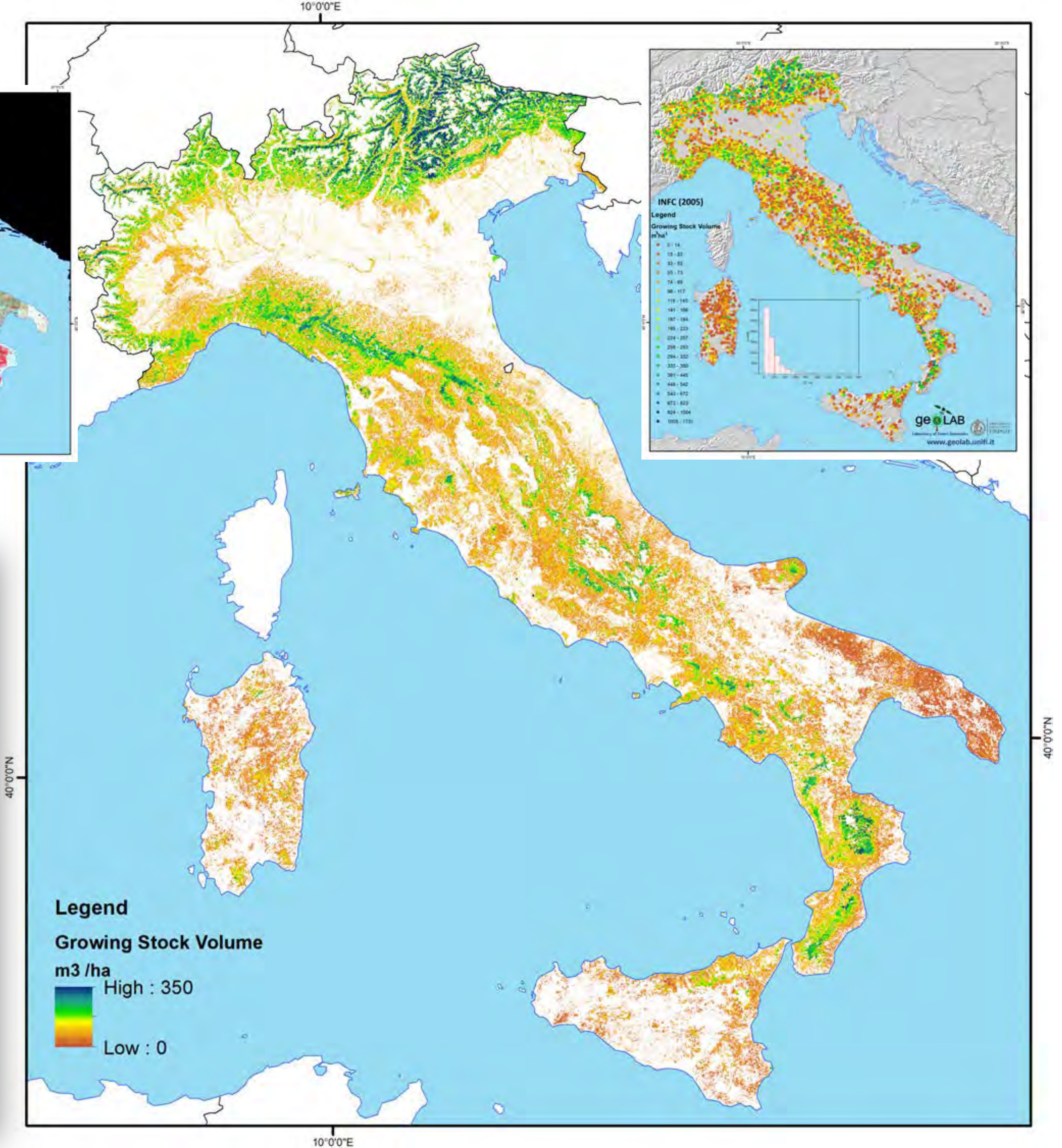
CONTACT Saverio Francini saverio.francini@unifi.it Dipartimento per l'Innovazione Dei Sistemi Biologici, Agroalimentari E Forestali, Università Degli Studi Della Tuscia, Via San Camillo De Lellis, Viterbo, Italy.
Supplemental data for this article can be accessed here.

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

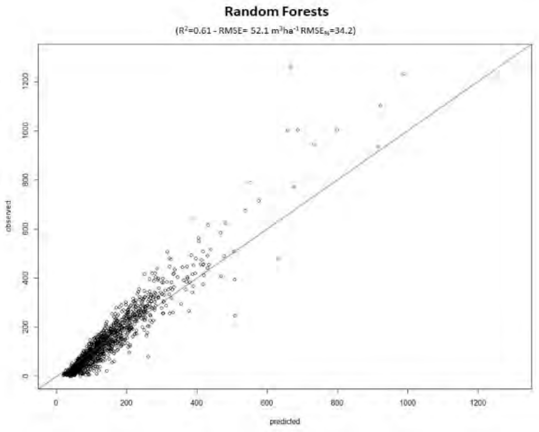
Wall-to-wall spatial prediction of growing stock volume based on Italian National Forest Inventory plots and remotely sensed data

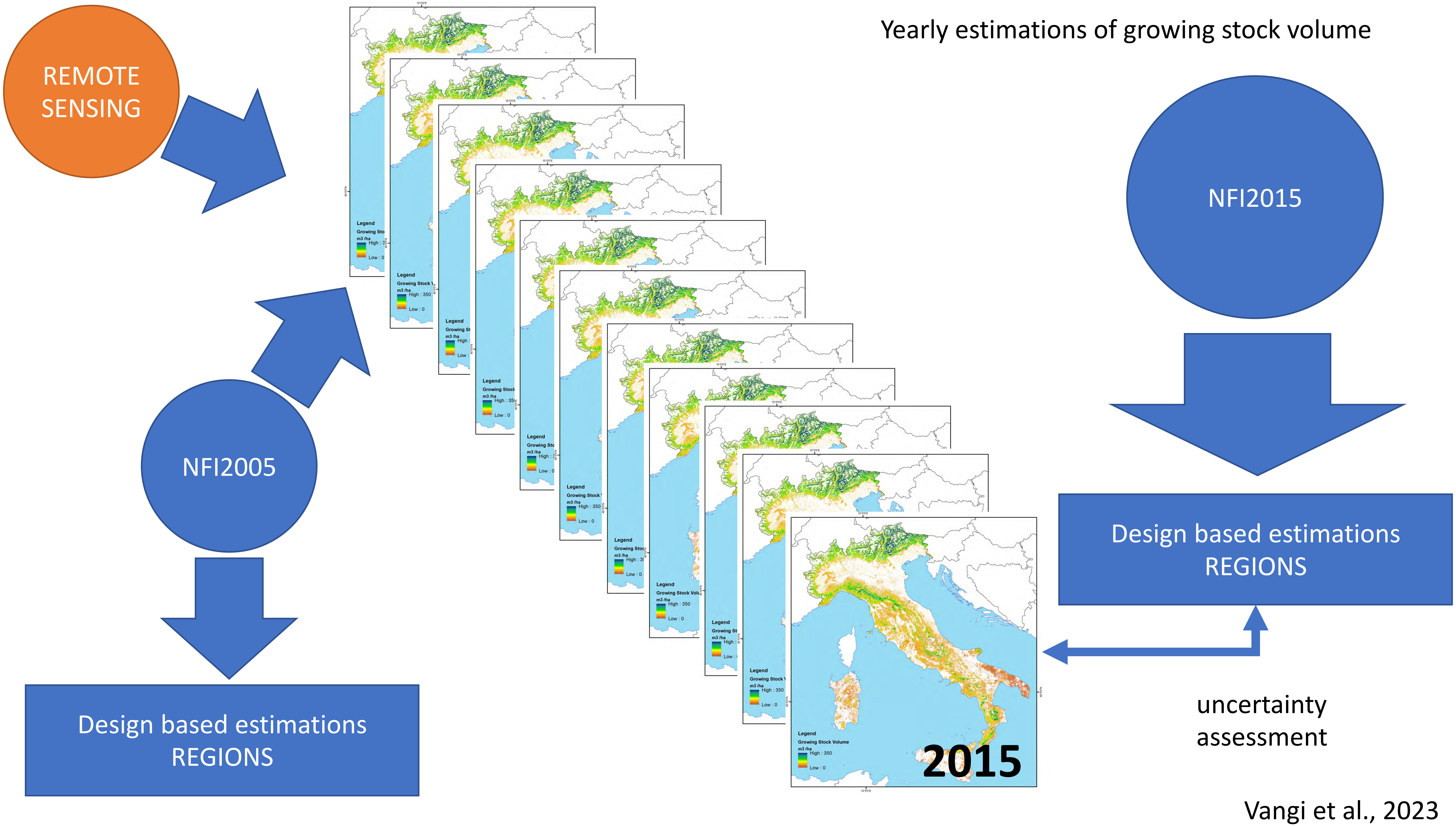
Gherardo Chirici, Francesca Giannetti, Ronald E. McRoberts, Davide Travaglini, Matteo Pecchi, Fabio Maselli, Marta Chiesi, Piermaria Corona

ARTICLE INFO

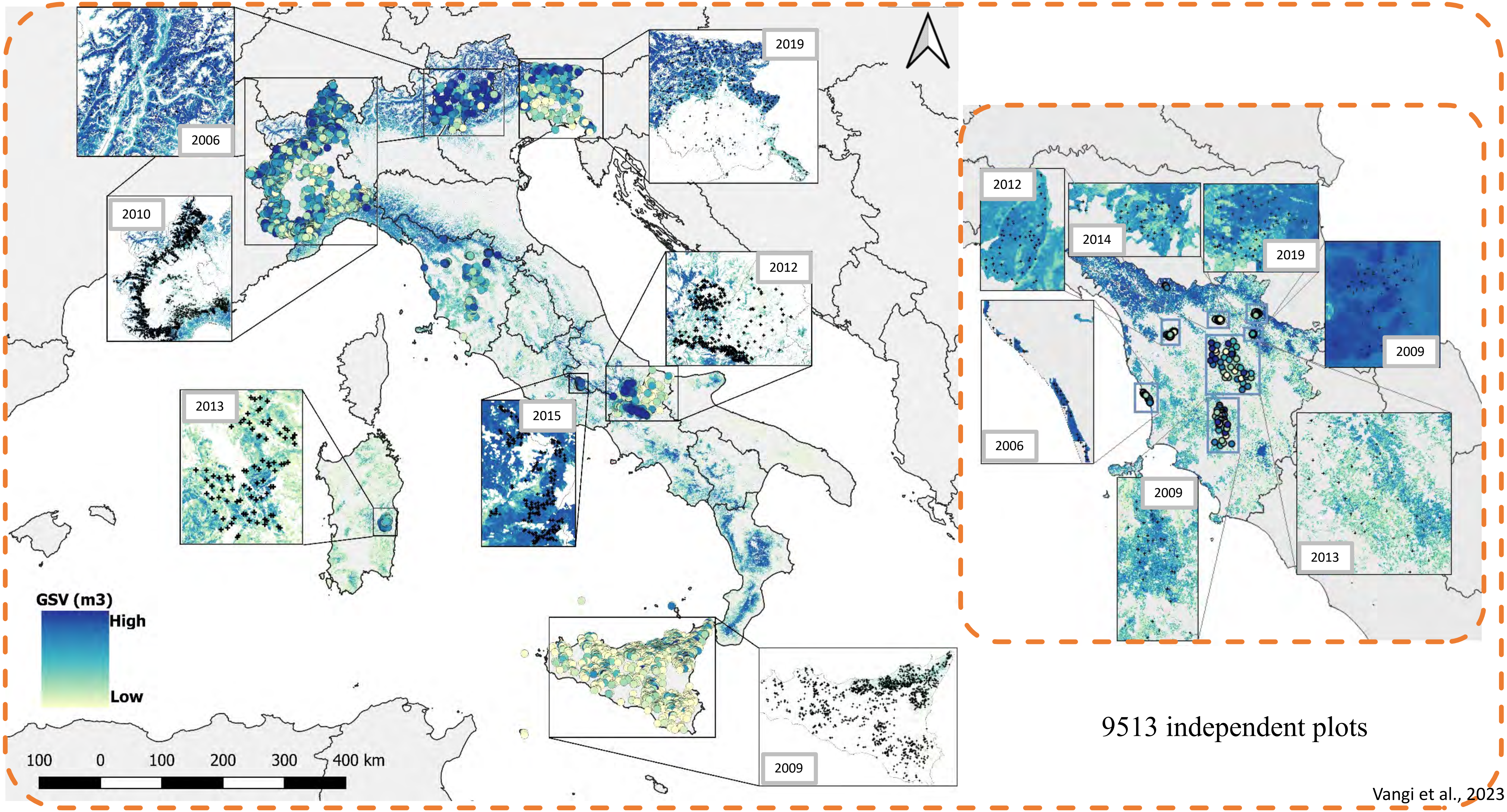
ABSTRACT

1. Introduction




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

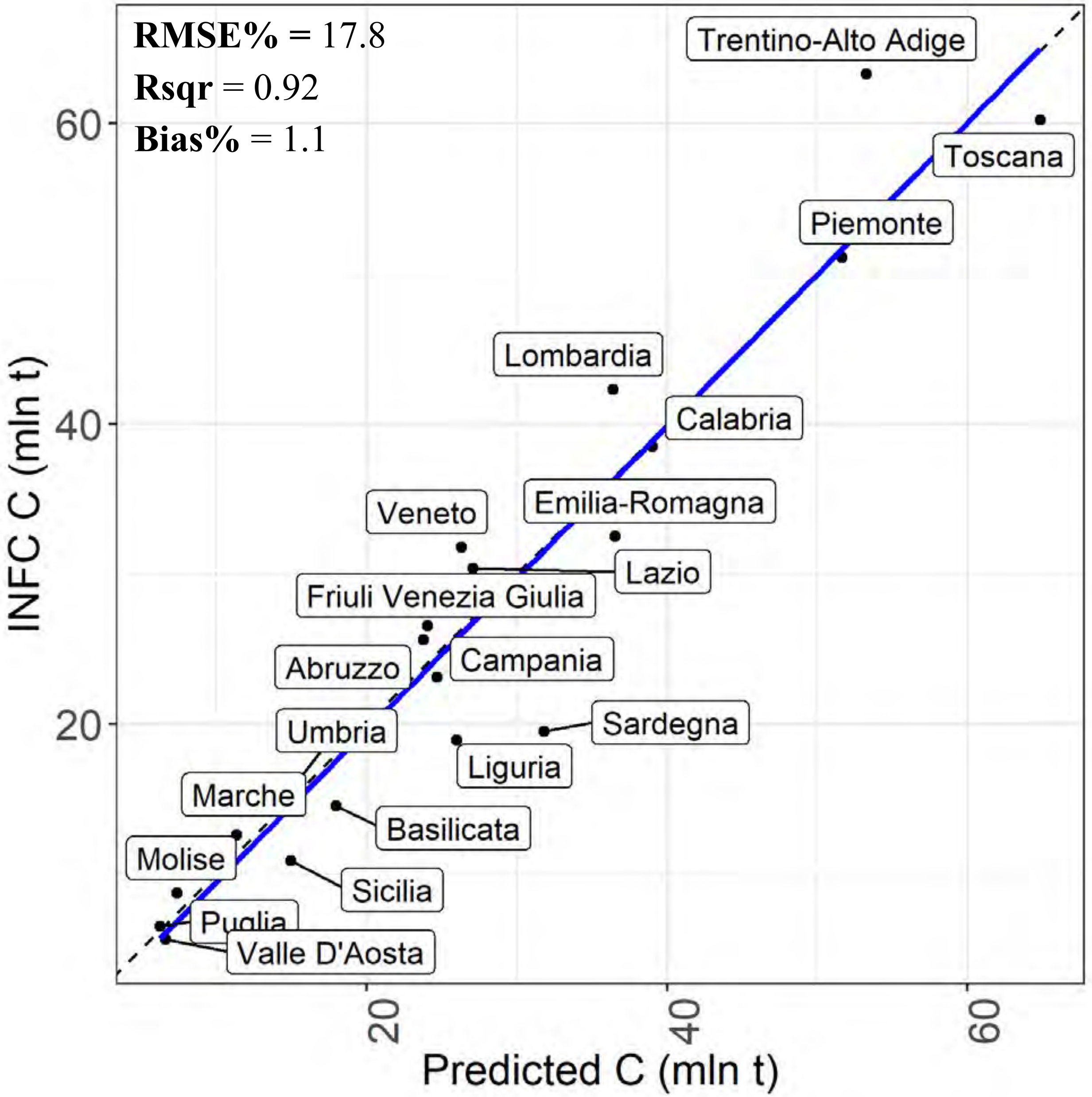
Validation against independent datasets



9513 independent plots

Vangi et al., 2023

Comparison results against INFC2015



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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*

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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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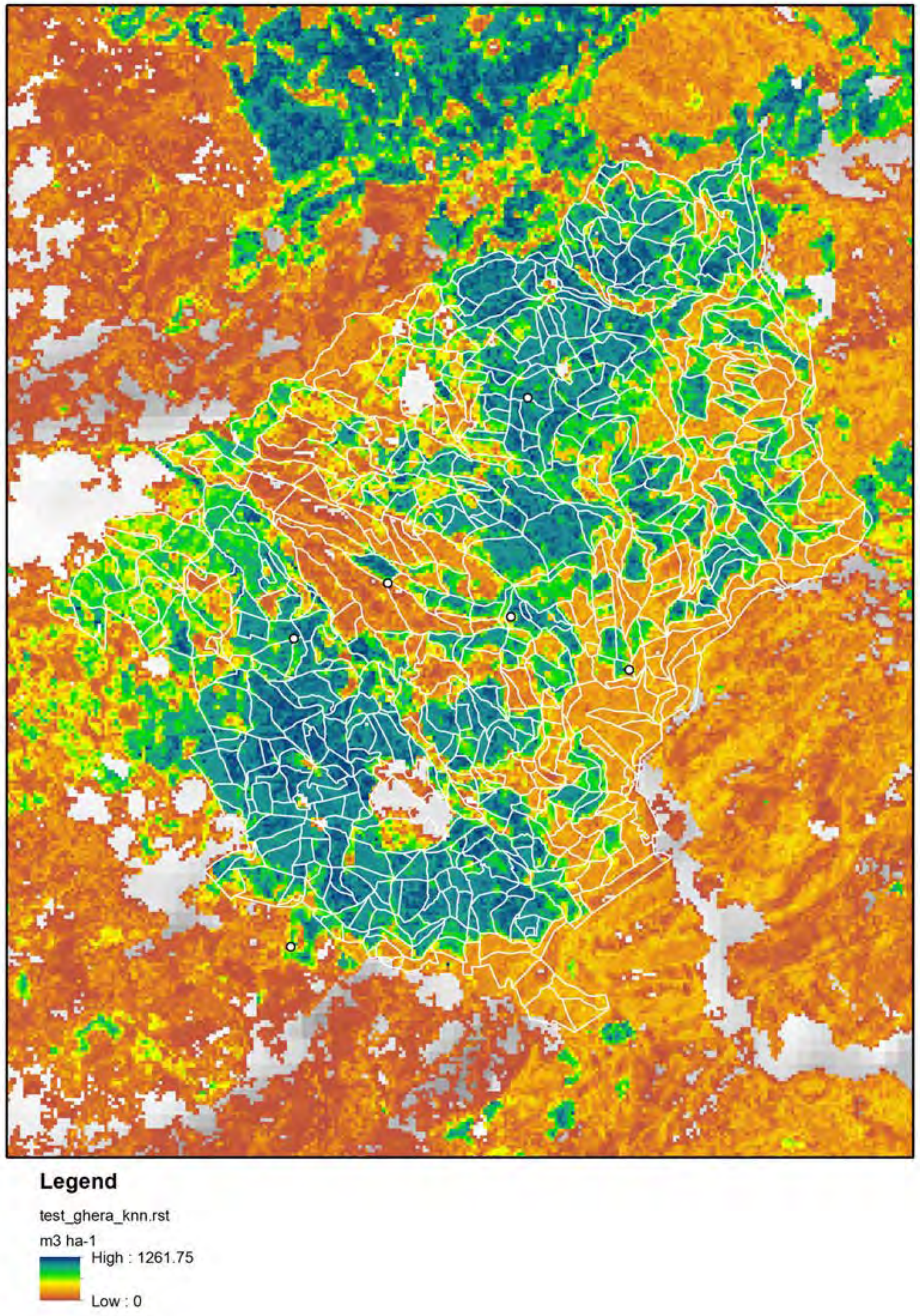
Available online 11 November 2022

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)

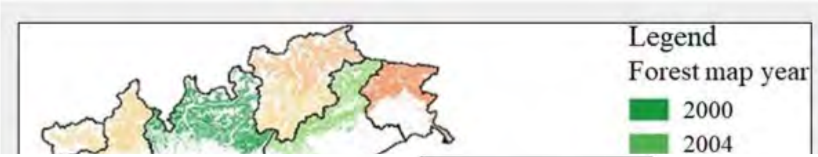


Fig. 1 - Acquisition year of local maps used to create the high resolution forest mask

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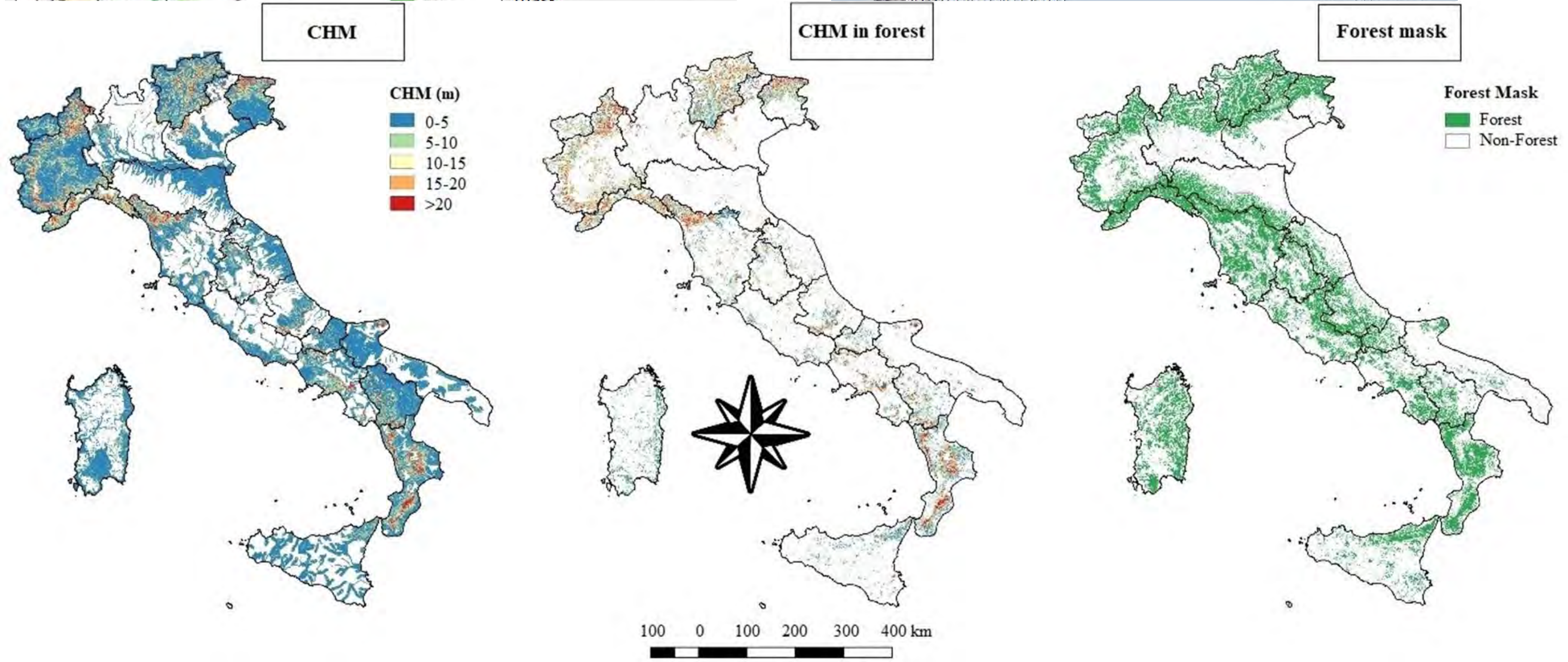

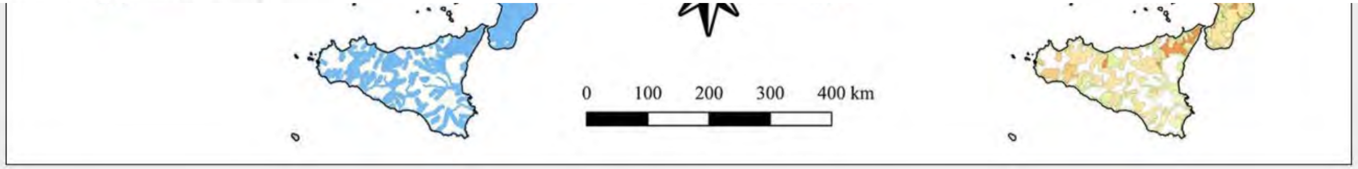

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Conclusioni

- Integrazione INFC e Sistema Informativo Forestale Nazionale -> produzione di cartografie con telerilevamento
- Passaggio a un programma permanente INFC con attività annuale
- Utilizzo nuove missioni: PLANET, IRIDE
- E’ necessario il completamento delle informazioni di base: LiDAR e **carta forestale**

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