

Contribution of Earth Observation and geostatistics on information needs related to eco-criminal acts

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4 Networks Conference

Carabinieri School, Rome 28-29/09/2023

Introduction

- Environmental disturbance and geospatial intelligence
- Air pollution from industrial and waste management sites fires
- Water pollutants dispersal
- Monitor forest disturbances using of EO technology
- Use geospatial information to identify violations
- Illegal logging
- Overview of IMPEL Geospatial Intelligence for Environmental Damage Assessment (GIEDA) project

Environmental disturbance

“Any discrete event in time that disrupts ecosystem, community or population structure and changes resources, substrate availability, or the physical environment”

Pickett and White (1985)

Represents a temporary change in environmental conditions that causes a pronounced change in an ecosystem

Disturbance of physical environment

- Atmosphere
- Water



Disturbance on ecosystem

- Forests



Geospatial intelligence

“Geospatial intelligence encompasses all aspects of imagery and geospatial information and services. It includes, but is not limited to the analysis of literal imagery; geospatial data; and information technically derived from the processing, exploitation, literal, and non-literal analysis of spectral, spatial, and temporal fused products. These types of data can be collected on stationary and moving targets by electro-optical, synthetic aperture radar, related sensor programs, and non-technical means (to include geospatial information acquired by personnel in the field).”

Retired Air Force Lt. Gen. James R. Clapper, October 2005

Operational Center for Environmental Monitoring

Italian National Centre for Environmental Crisis, Emergency and Damage Control
(ISPRA CRE-CSA)

Activities

- Supports response during environmental emergency activation and supports ecosystem damage assessment evaluation
- Identify anomalies related to natural and anthropic disturbances, to characterize typology, spatial extent and temporal dynamic
- Develop methodologies to map natural disturbances and forest ecosystems
- Integrates in situ data, predictive numerical model and Earth Observation (EO) for environmental monitoring and surveillance
- Developing emergency preparedness for effective environmental emergency response!

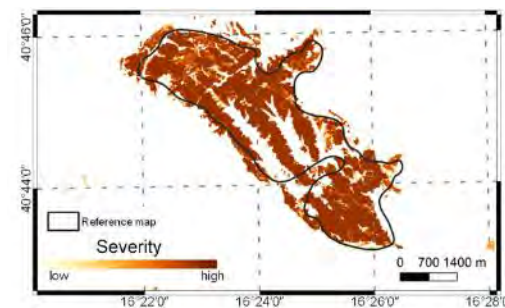
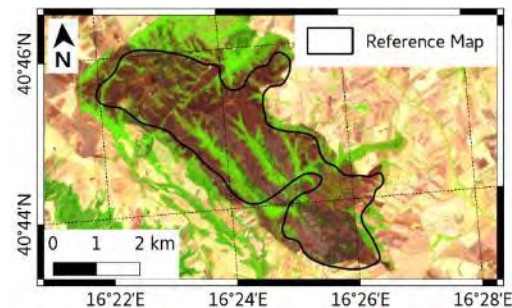
Operational Center for Environmental Monitoring

Italian National Centre for Environmental Crisis, Emergency and Damage Control (ISPRA CRE-CSA)

Scopes

- Forecast situations of possible environmental crisis
- Monitor the evolution of phenomena

Earth Observation time series represent **primary information** for environmental monitoring and surveillance



Need to convert data into information!

Geospatial intelligence: satellite Earth Observation

*Satellite Earth Observation represents a valuable tool for the assessment of **pre-existing environmental conditions**, allowing to produce **a posteriori evidences**.*

*Synergic use of earth observation data and geostatistics allows to **qualitatively and quantitatively** assess environmental conditions, prior and after an investigated eco-criminal act.*

*Algorithms can exploit **dense time series at high spatial resolution**. Recent satellites constellations (e.g. **Copernicus Sentinels**), whose high revisit frequency, observation scenario and **guaranteed continuity** encourages the development of operational monitoring services.*

Air pollution from industrial and waste management sites fires

Earth observation satellite data represent a technological tool for **monitoring accidental events**, providing useful information to guide security actions.

Can provide prompt information about **dispersal patterns of atmospheric plumes** generated from **industrial and waste management sites fires**.

Mapping products can support numerical models for estimating concentrations of pollutants in the atmospheric plume and their area of deposition to the ground, as well as identifying sampling sites for pollutant monitoring.

Used data are MSG SEVIRI, acquired by satellites on geostationary orbit every 5-15 minutes.

Methods are based on the analysis of radiometric absorption with respect to a reference acquisition.

Limitations of the instrument are:

- presence of **cloud cover**, which does not allow identification of the radiometric anomaly generated by the atmospheric plume
- inability to generate mapping products in the absence of solar radiation, and thus for monitoring during **nighttime** hours

Air pollution from waste management site fires

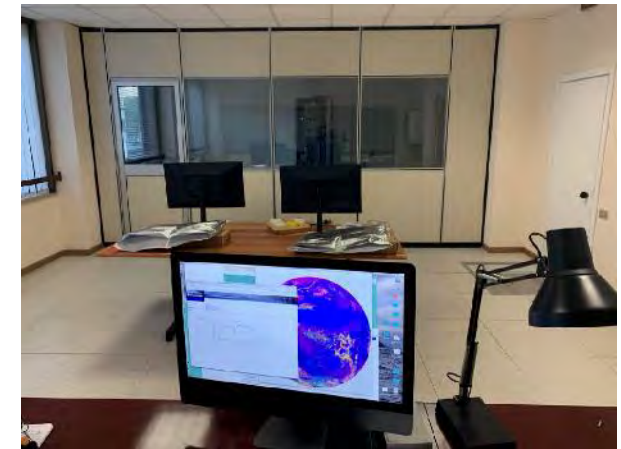
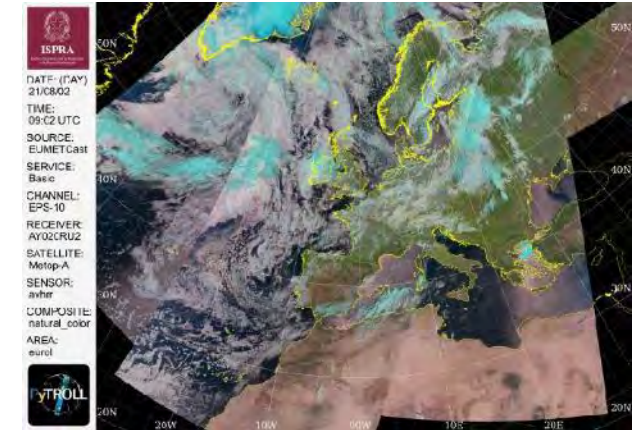


EUMETcast
NRT collection of
MSG and MTG
satellite acquisitions

2-m parabolic antenna



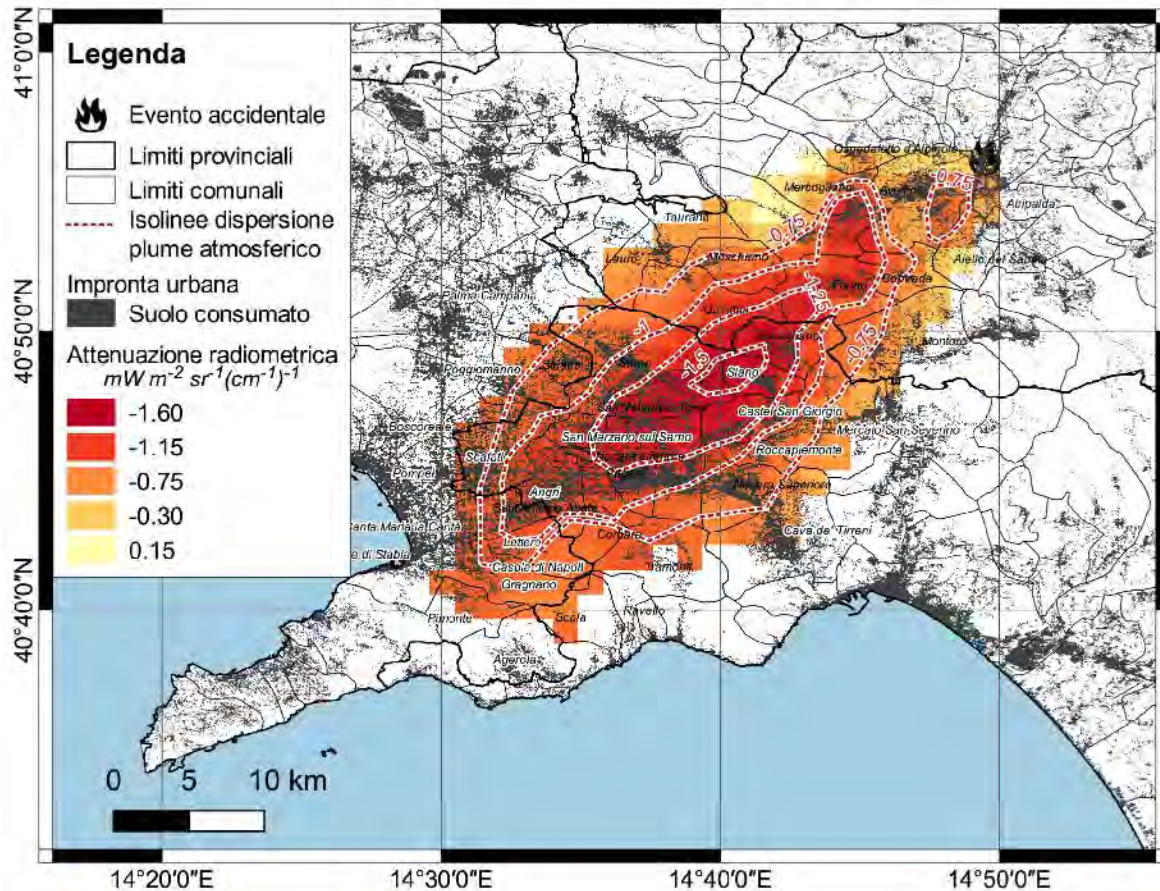
Aiecka SR1 Receiver
Data processing unit



Data are processed as soon as available.
Information are generated promptly for an
effective environmental emergency response

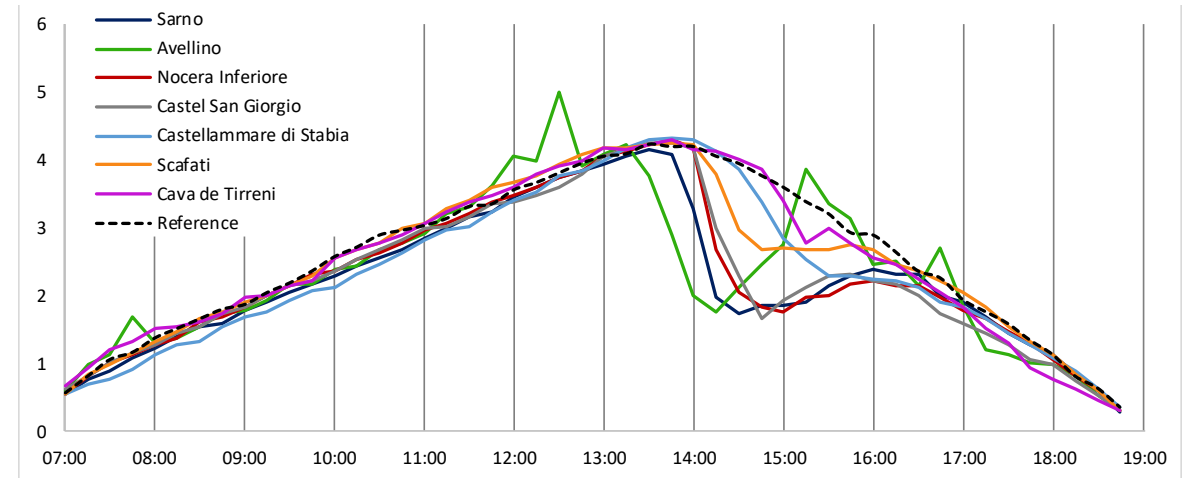
Air pollution from industrial sites fires

Cumulated radiometric absorption map on 13/09/2019



Mappa italia
con bbox

Radiometric absorption on 13/09/2019



Site: Plastic factory, Pianodardine (AV)
Date: 13/09/2019

Dispersal pattern of atmospheric plume
generated by fire affected 45 municipalities in
the provinces of Avellino, Napoli e Salerno.

Air pollution from waste management sites fires



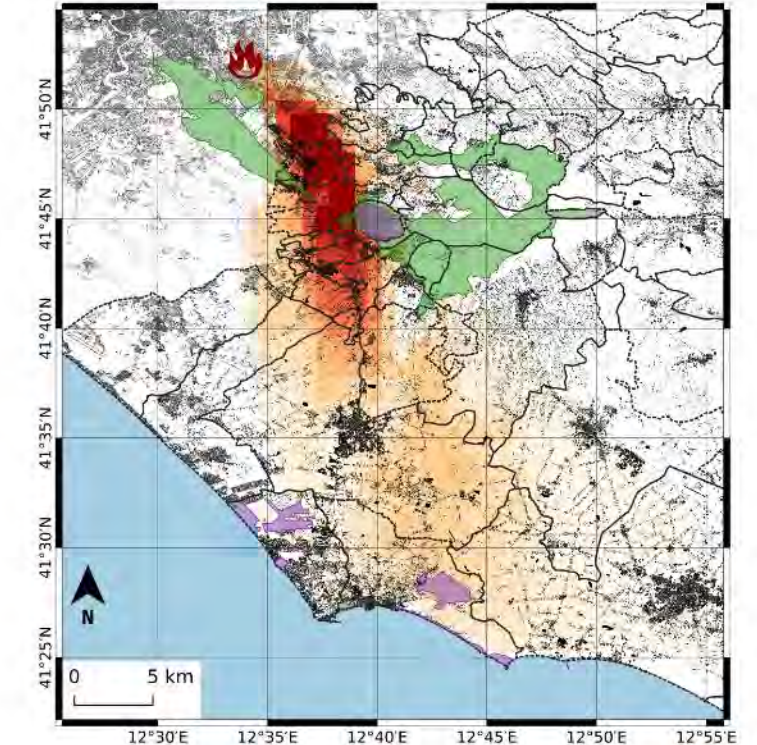
Site: Auto wrecker sites,
Rome (RM)

Date: 09/07/2022



Dispersal pattern
of atmospheric plume
generated by fire
affected 5 protected areas

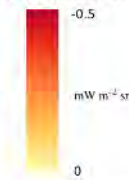
Areale di distribuzione dei fumi dispersi dall'incendio del 09/07/2022
in località Centocelle, Roma (RM)



Legenda

-  Evento accidentale
-  Limiti comunali
-  Sito Natura2000 ZSC
-  Area Protetta
-  Impronta urbana

Attenuazione radiometrica media
(2022-07-07 17:30 - 2022-07-09 20:00)



Dataset utilizzato per l'analisi: EUMETSAT MSG Seviri (canale HRV)
Elaborazione dati: ISPRA CRE-CSA

Legenda

-  Evento accidentale
-  Limiti comunali
-  Sito Natura2000 ZSC
-  Area Protetta
-  Impronta urbana

Attenuazione radiometrica



2022-07-09 17:30

0 20 km

Air pollution from waste management sites fires

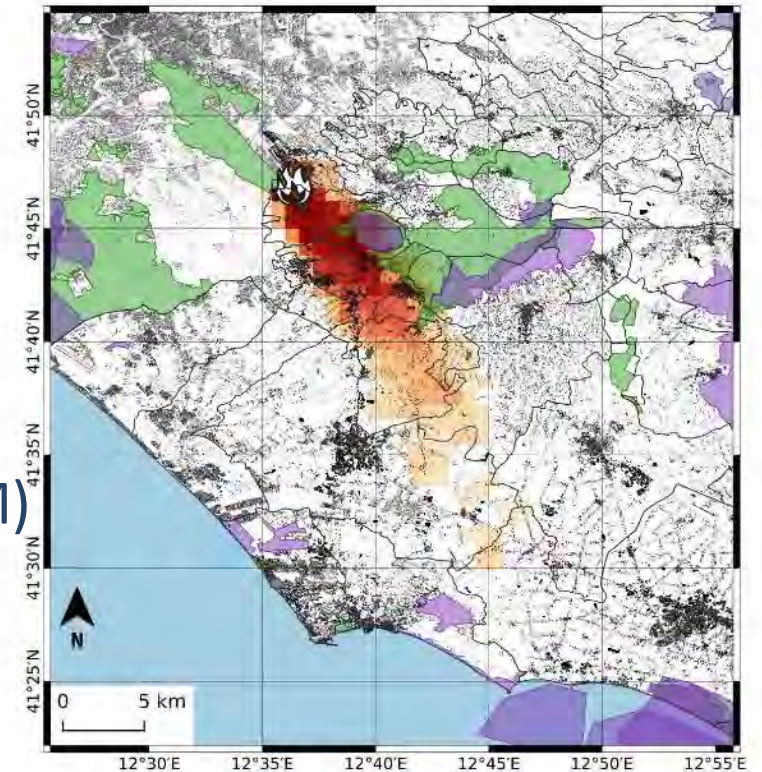


Source: www.agronline.it

Site: Waste management site Ciampino (RM)

Date: 29/07/2023

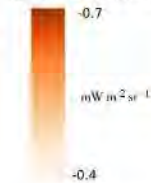
Areale di distribuzione dei fumi dispersi dall'incendio del 29/07/2023 in località Ciampino, Roma (RM)



Legenda


- Evento_accidentale
- Limiti comunali
- Sito Natura2000
- Area Protetta
- Impronta urbana


Attenuazione radiometrica media
(2023-07-29 09:00 - 2023-07-29 13:00)





Dataset utilizzato per l'analisi: EUMETSAT MSG3 Seviri (canale HRV)
Elaborazione dati: ISPRA CRE-CSA


Legenda

 Evento accidentale

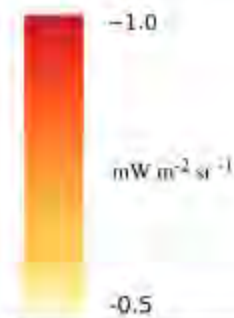
 Limiti comunali

 Sito Natura2000

 Area Protetta

 Impronta urbana

Attenuazione radiometrica



2023-07-29 07:15 UTC

0

20 km

Water pollutants dispersal

Environmental incident in May 2020 due to ineffective water treatment processing
Site: Canale Agnena, Mondragone (CE)



Sentinel-2A MSI

Immagine satellitare acquisita il 05/05/2020 alle ore 10:00:31 UTC

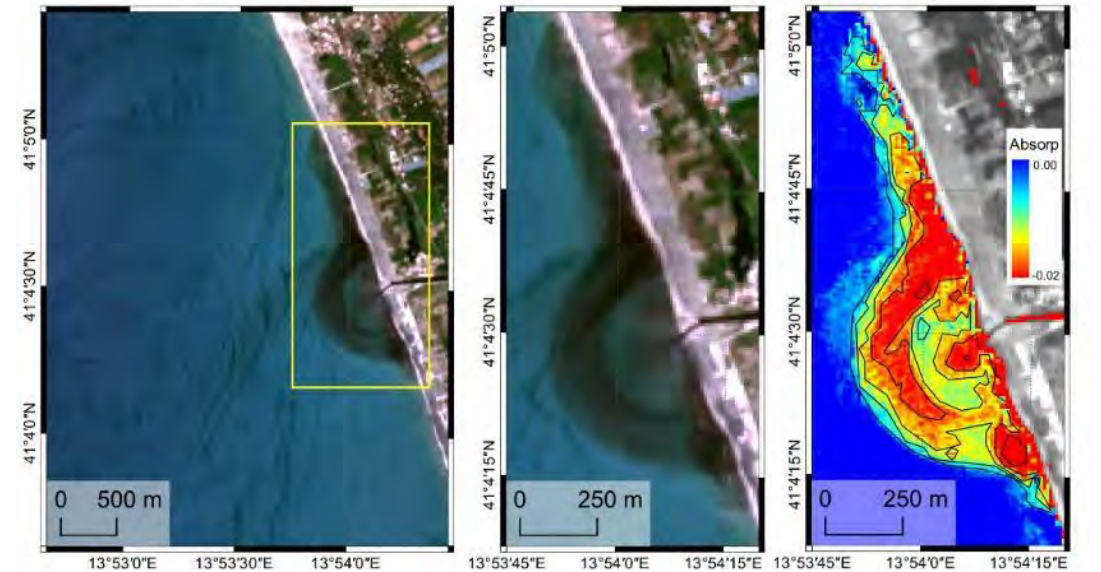


Immagine true color.

R: TOA reflectance at 664 nm

G: TOA reflectance at 560 nm

B: TOA reflectance at 497 nm

Dettaglio immagine true color

Attenuazione radiometrica (Absorp)
nelle bande spettrali del blu e del
verde (497 - 560 nm)

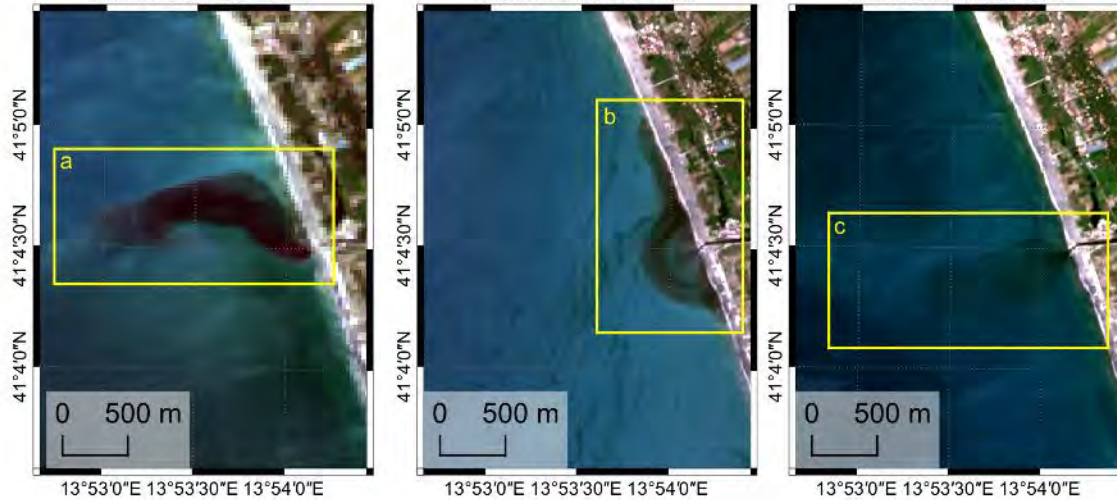
Methodology used: radiometric absorption
Data used: high spatial resolution optical multispectral
satellite data (multiple satellite constellation)

Water pollutants dispersal

LANDSAT8 OLI
acquisita il 04/05/2020
alle ore 09:46:37 UTC

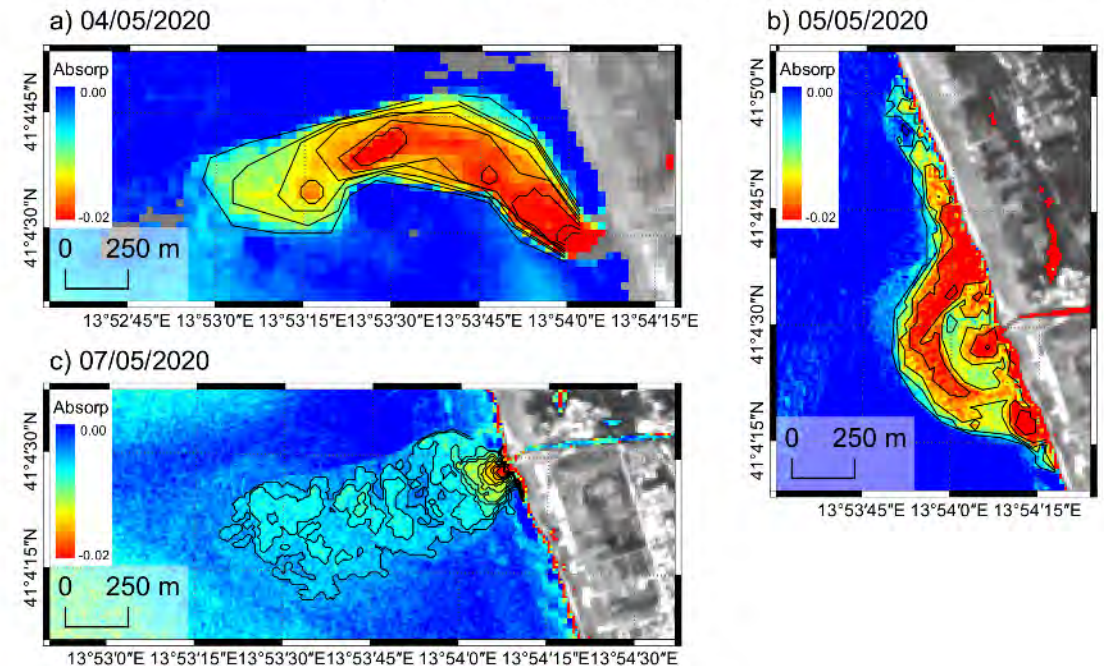
Sentinel-2A MSI
acquisita il 05/05/2020
alle ore 10:00:31 UTC

Sentinel-2B MSI
acquisita il 07/05/2020
alle ore 09:50:29 UTC



Assorbimento radiometrico

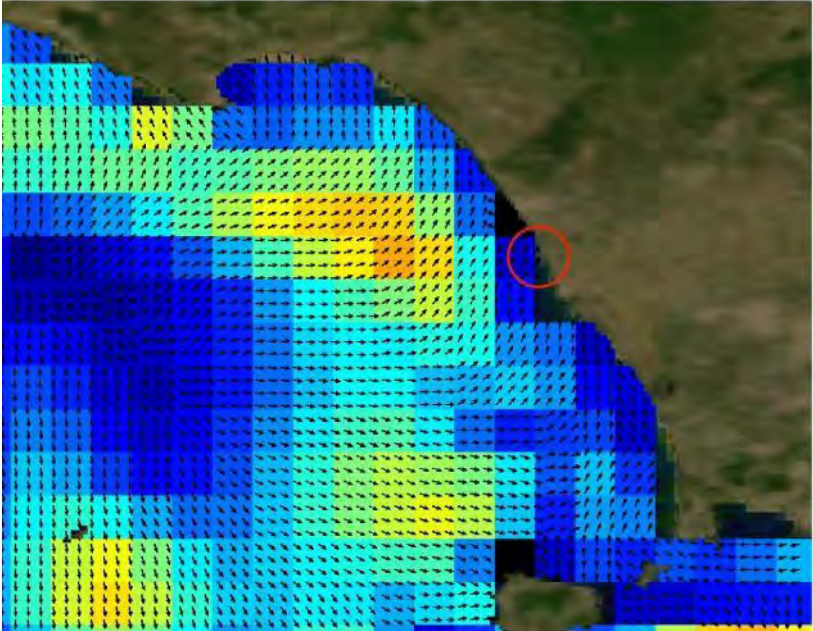
Mappe di dettaglio che mostrano l'assorbimento radiometrico del plume del Canale Agnena alle lunghezze d'onda del blu e del verde (490 - 560 nm)



Produce a posteriori information related to areal dispersal.
Can support inquiries, providing information related to damage assessment

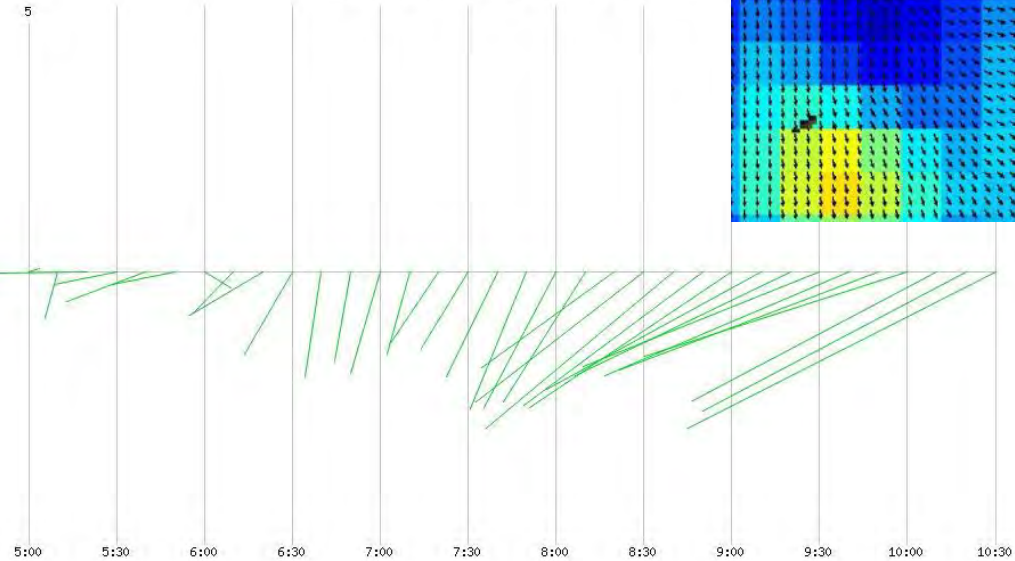
Water pollutants dispersal

Horizontal Velocity (3D) - Hourly Mean - time series
 sea water velocity
 Date: 2020-05-05 10:30 UTC
 Depth: 1.02m

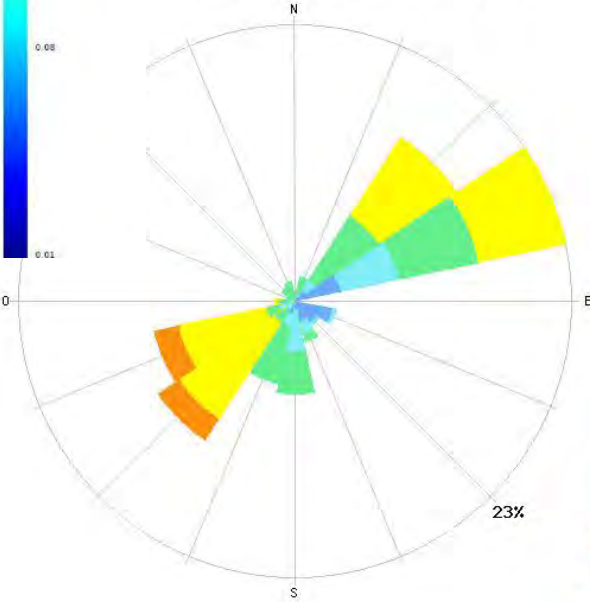


Integration with predictive numerical modeling and in situ measurements

RETE MAREOGRAFICA NAZIONALE
NAPOLI
 DIREZIONE E VELOCITA' VENTO
 05:00 05.05.2020 ÷ 10:30 05.05.2020 GMT



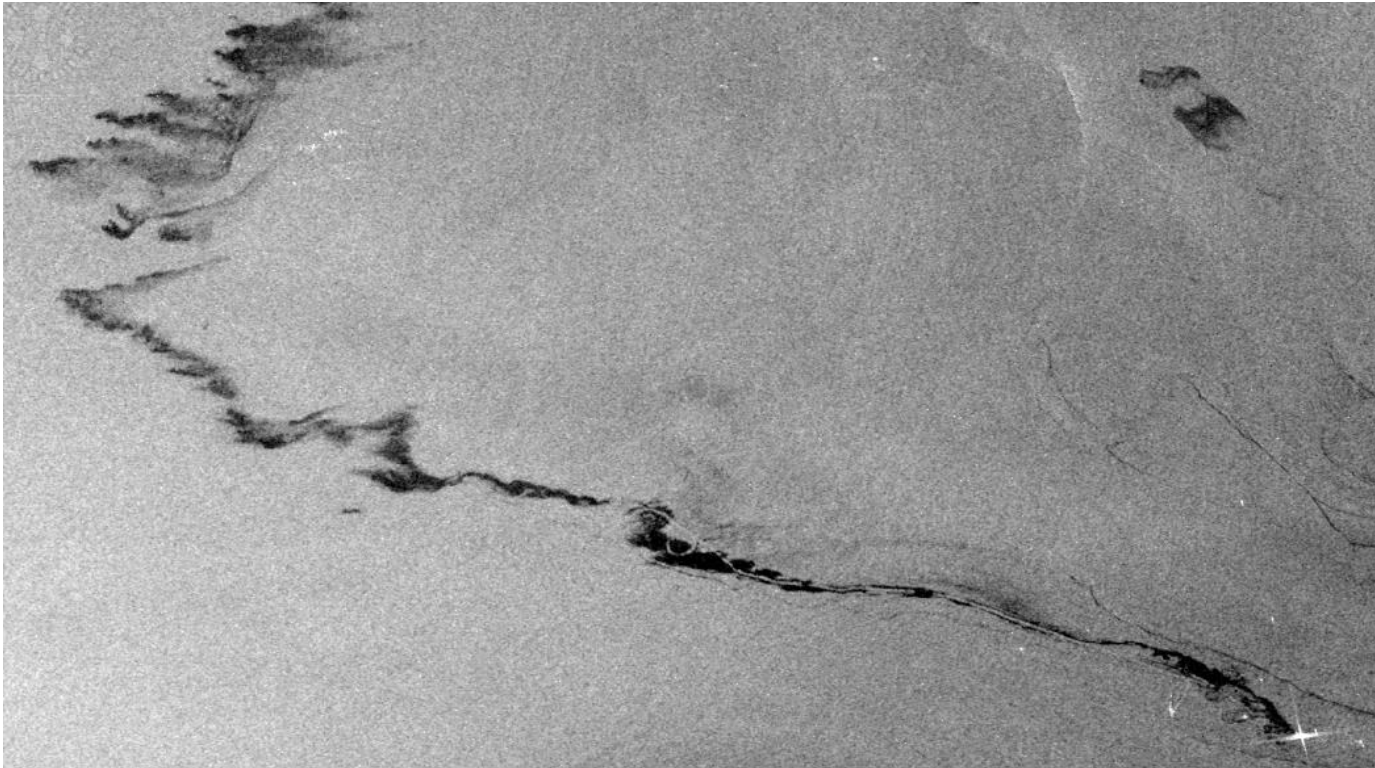
RETE MAREOGRAFICA NAZIONALE
NAPOLI
 DIREZIONE E VELOCITA' VENTO
 00:00 04.05.2020 ÷ 23:00 05.05.2020 GMT



- 0 ÷ 1 m/s
 - 1 ÷ 2 m/s
 - 2 ÷ 4 m/s
 - 4 ÷ 6 m/s
 - 6 ÷ 12 m/s
 - > 12 m/s
- DIREZIONE DI PROVENIENZA

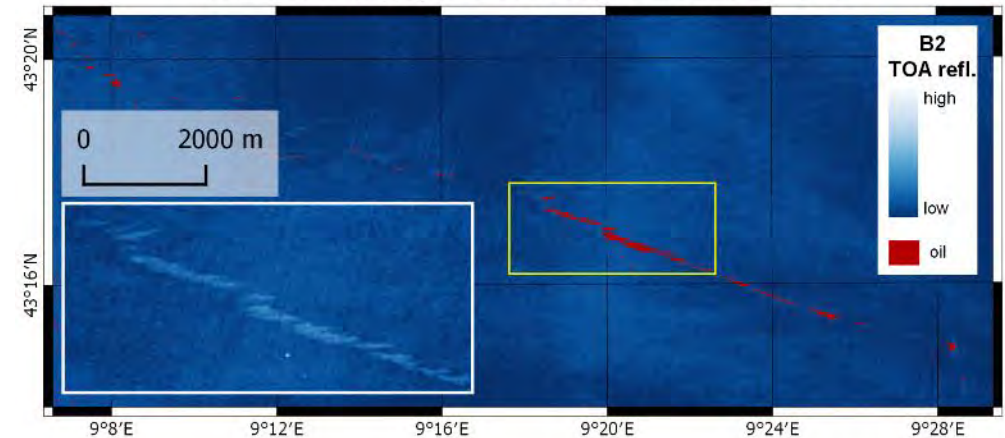
Water pollutants dispersal

Oil spill can be detected using Synthetic Aperture Radar (SAR) and optionally optical multispectral satellite acquisitions



Oil spill nel Mar Ligure

Sentinel-2A MSI acquisita il 09/10/2018 alle 10:20:21 UTC



Elaborazione dati: ISPRA 2020. Contains modified Copernicus data (2021).

Forest disturbance: overview

Natural abiotic disturbance agents

- Wildfires
- Windthrows
- Droughts
- Snowslides and ice
- Landslides

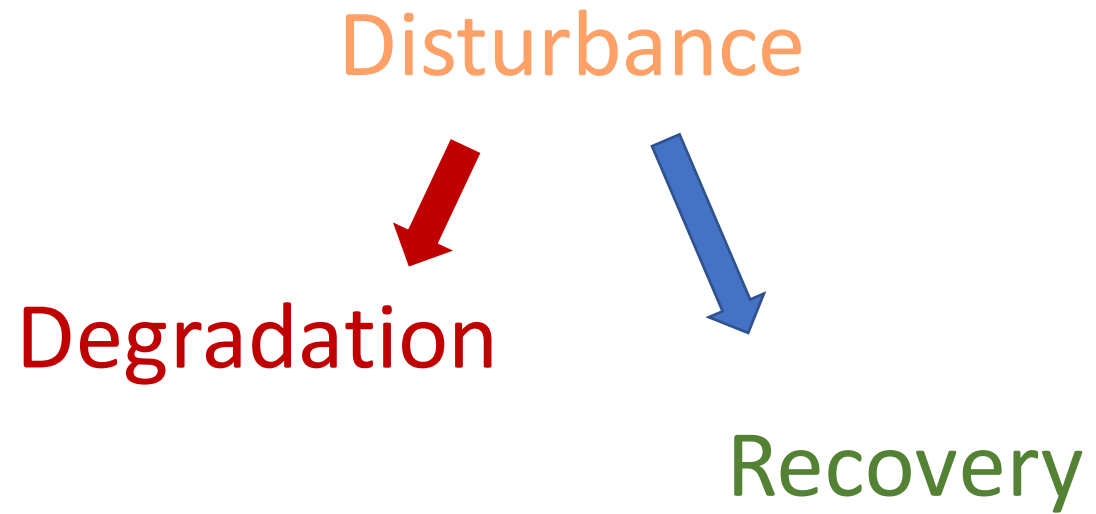
Natural biotic disturbance agents

- Insects and pathogens pest outbreaks
- Wildlife overgrazing

Anthropogenic disturbances

- Agricultural clearing
- Construction sealing
- Coppice, Logging
- Anthropogenic fires
- Chemical Pollution

- Disturbance is a single event with a short term impact and can be considered as part of natural forest dynamics
- Degradation refers to negative long-term impact, often as consequence of single or multiple disturbances
- Recovery is the regeneration processes of forests and vegetation, influenced by several environmental factors



Forest disturbances: use of EO technology

Identification

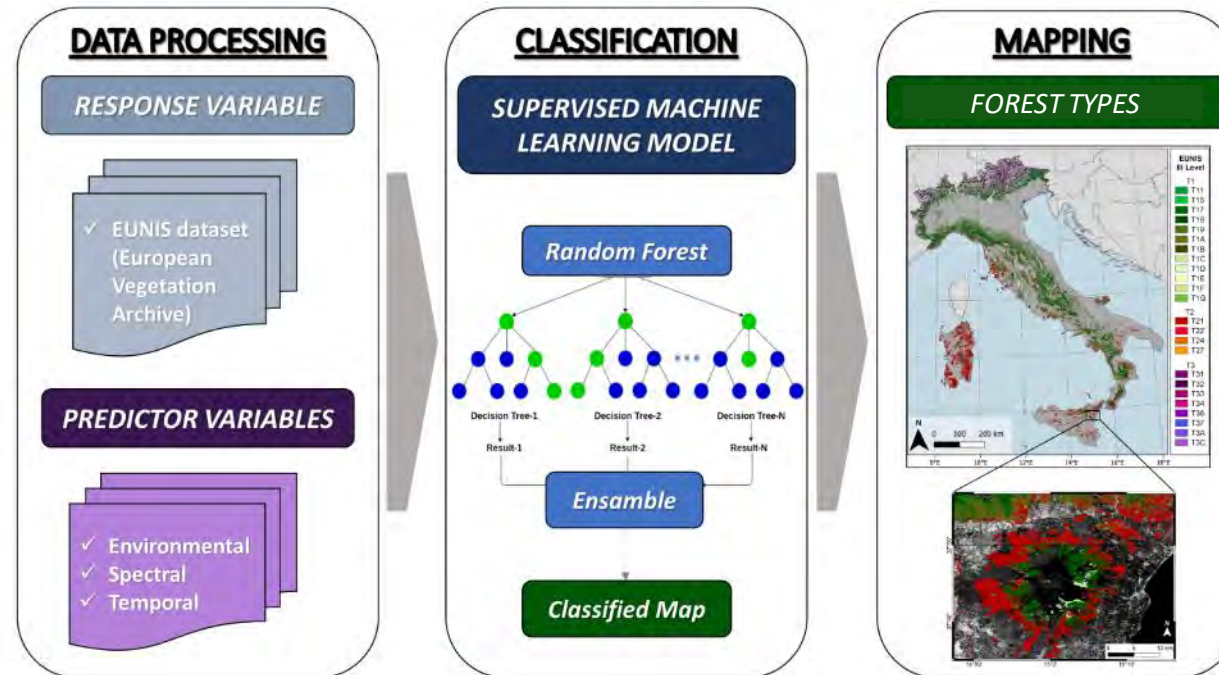
- Use EO time series to identify anomalies in spatio-temporal dimensions
- Identify gradual changes
 - Time series analysis
 - Anomaly detection
- Identify abrupt changes
 - Change detection analysis
 - BFAST algorithm
 - Time series probabilistic approach

Characterization

- Combine spatial thematic information to quantify disturbances
- Thematic quantitative information
 - Copernicus Services
- Above Ground Biomass Estimates
 - Online distributed (GlobBiomass)
 - Estimated from GEDI LiDAR and SAR
- Protected Area boundaries
 - Designed under European and National legislation
- Biophysical indices estimates
 - Leaf Area Index (LAI) estimated from Sentinel-2 MSI
- Forest ecosystems mapping product
 - Classified from EO time series and geoclimatic predictors

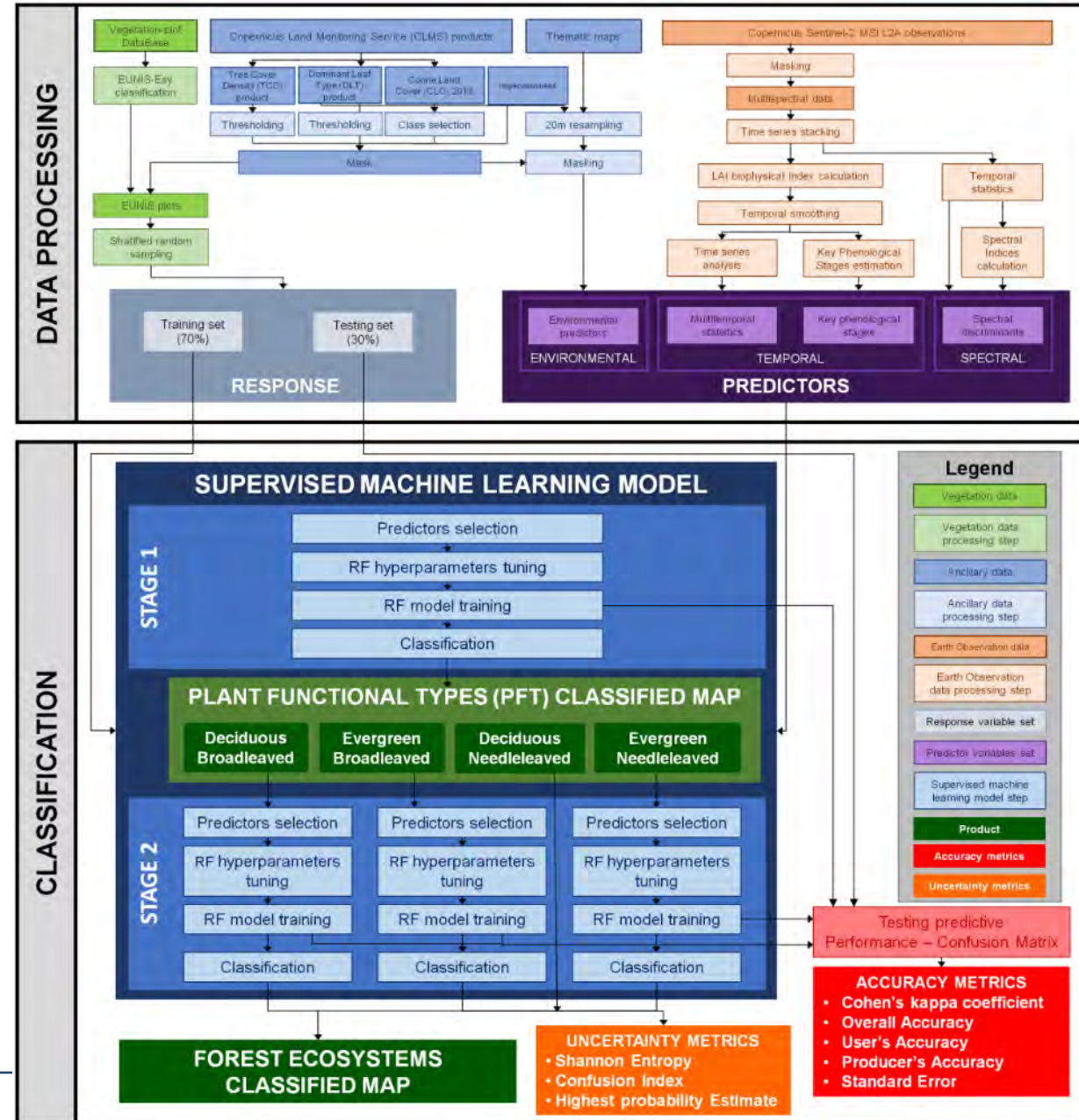
Forest ecosystems mapping

- 20 m forest types mapping using Sentinel-2 MSI time series
- Hierarchical levels based on plant functional types
- Base layer to characterize changes
- Habitat indicators (e.g. class area)



Forest ecosystems mapping

- **Supervised Machine Learning modeling**
Hierarchical classification using Random Forests
- **Response variable**
over 7000 points from European Vegetation Archive
- **Predictors**
Environmental variables (geomorphological, climatic, pedological)
Copernicus Land Monitoring Service products
Copernicus Sentinel-2 L2A time series
Phenological metrics
- **Uncertainty metrics**



Forest ecosystems mapping

Year 2020

PFT model

Accuracy: 90.34%
K: 0.832

DB model

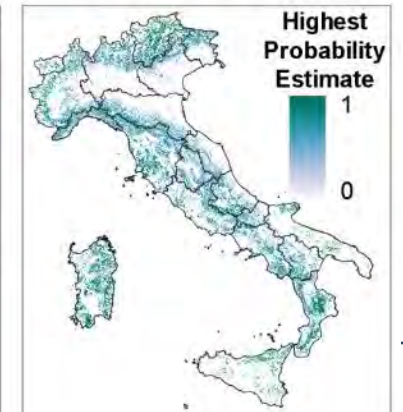
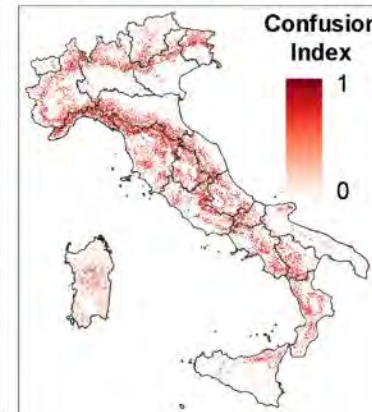
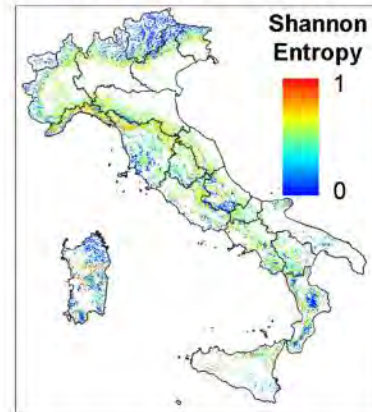
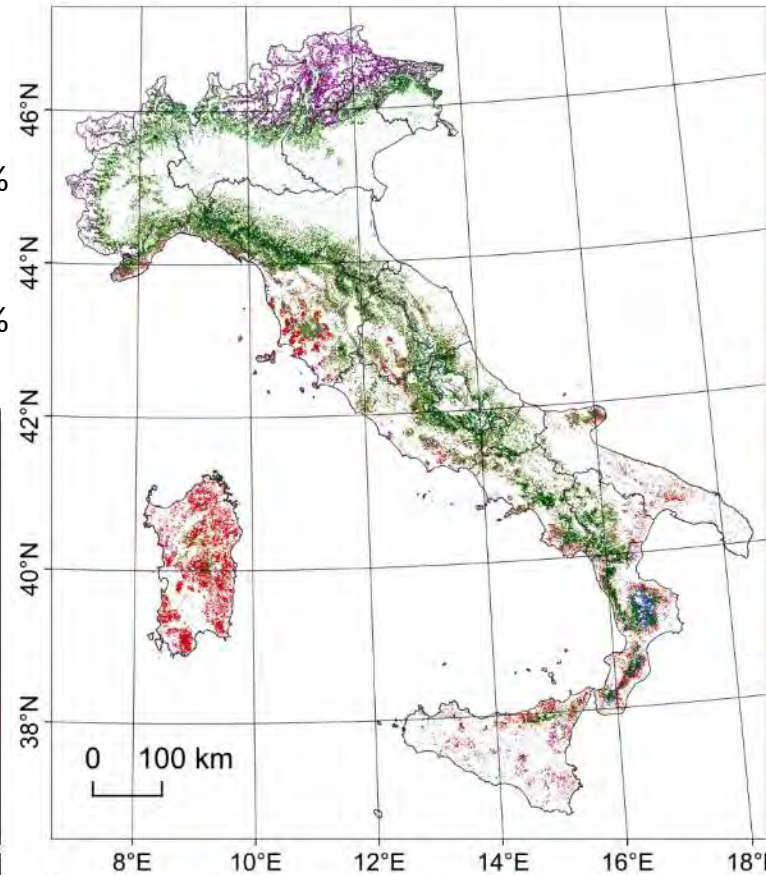
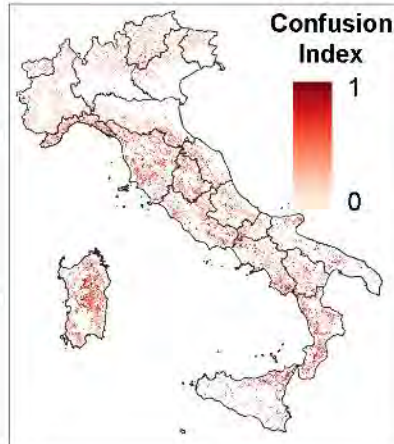
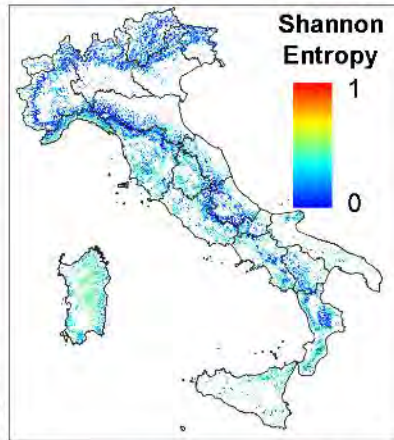
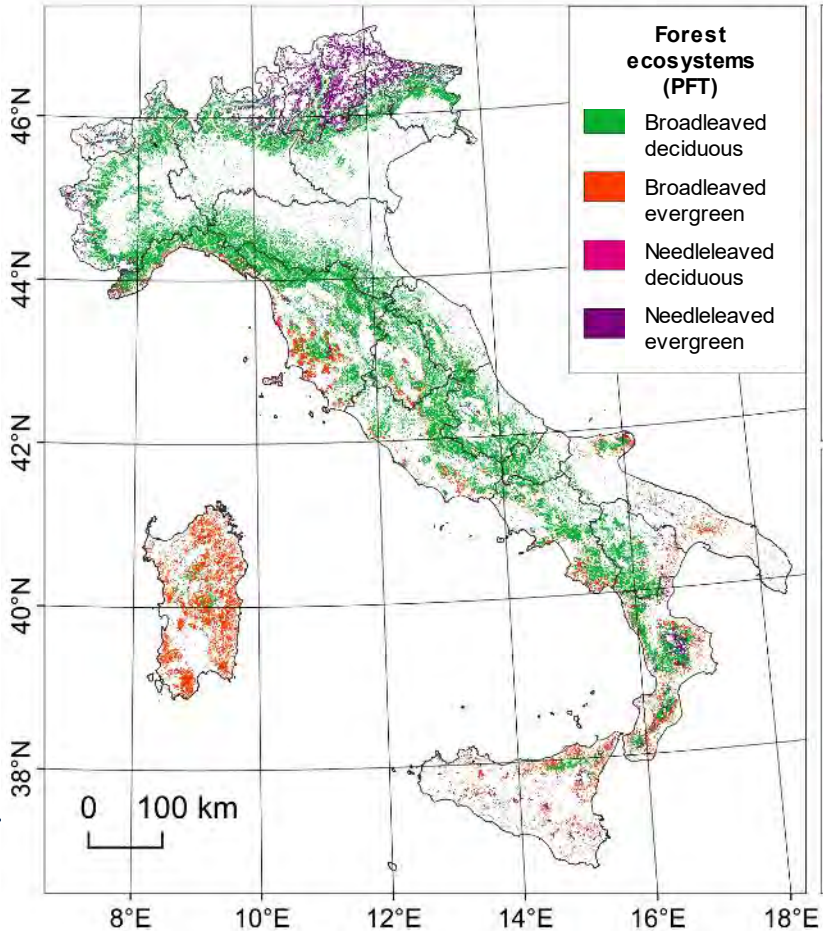
Accuracy: 71.34%
K: 0.5784

EN model

Accuracy: 99.20%
K: 0.9858

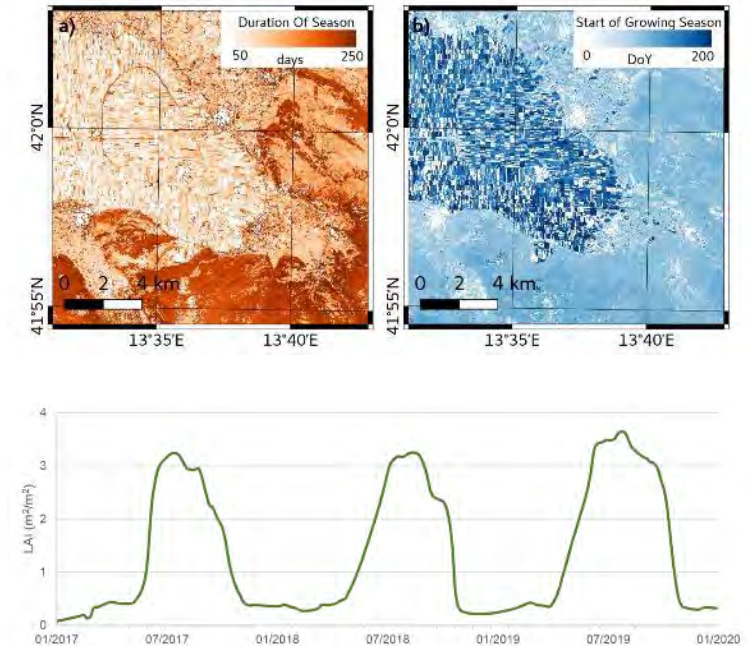
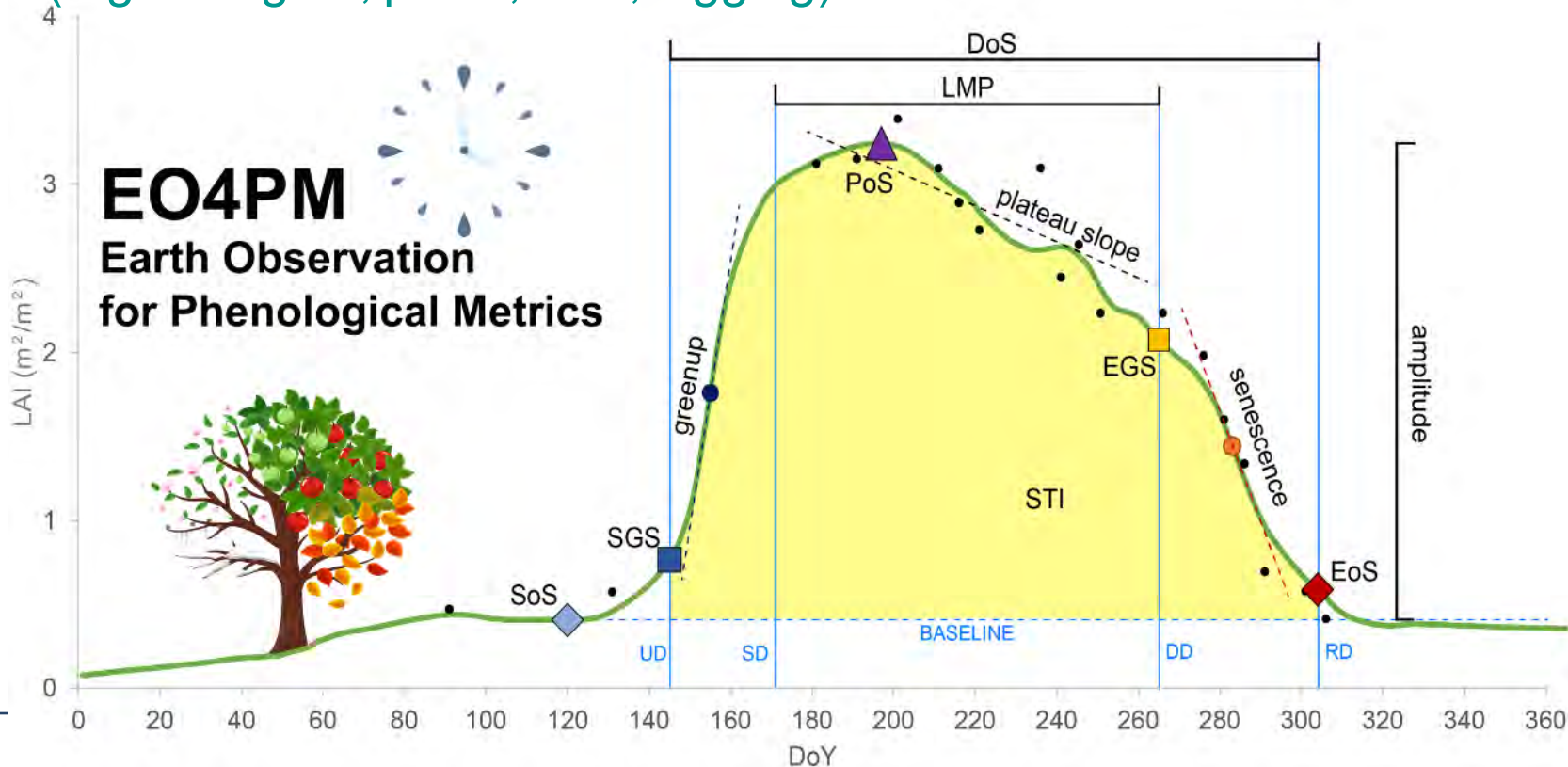
EB model

Accuracy: 97.00%
K: 0.596



Plant phenology

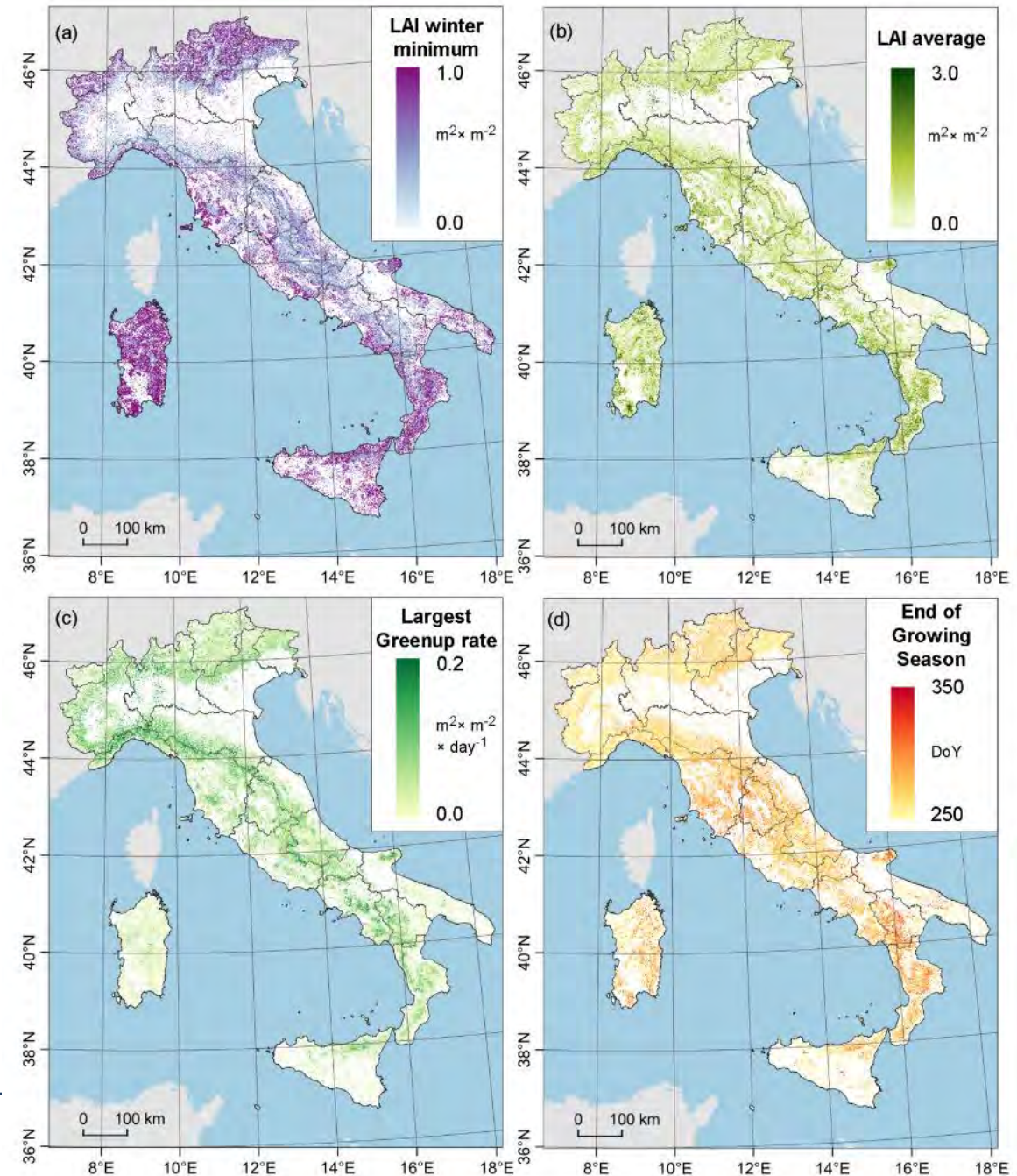
- Monitoring vegetation phenology
- Calculate time series statistics and estimate phenological metrics
- Primary information to identify anomalies related to plant disturbances (e.g. droughts, pests, fires, logging)



Plant phenology

EO4PM procedure

- Supports estimates from various vegetation indices (es. LAI, kNDVI, EVI, NDVI, FAPAR) and satellite sensors (at present Sentinel-2 MSI data are used)
- Rigorous image spatial co-registration of temporal series prior smoothing and temporal interpolation
- Daily temporal interpolation to deal with unevenly spaced time series
- Temporal statistics computation
- Phenological metrics estimation using Gu et al. 2009 methodology, that allow to reduce the required time series approximation
- Supports the use of virtual satellite constellation (e.g. Sentinel-2 MSI + Landsat8 OLI)
- Multicore processing to speed up computation



Plant phenology anomaly: pest outbreaks

Pine tortoise scale (*Toumeyella parvicornis*) pest outbreak occurred in the last two years in central and southern Italy (mostly in Lazio and Campania regions)

Toumeyella parvicornis is a soft scale insect and complete at least three generations life cycle per year

It is mostly affecting *Pinus pinea* tree species, while *Pinus pinaster* and *Pinus halepensis* are more resistant

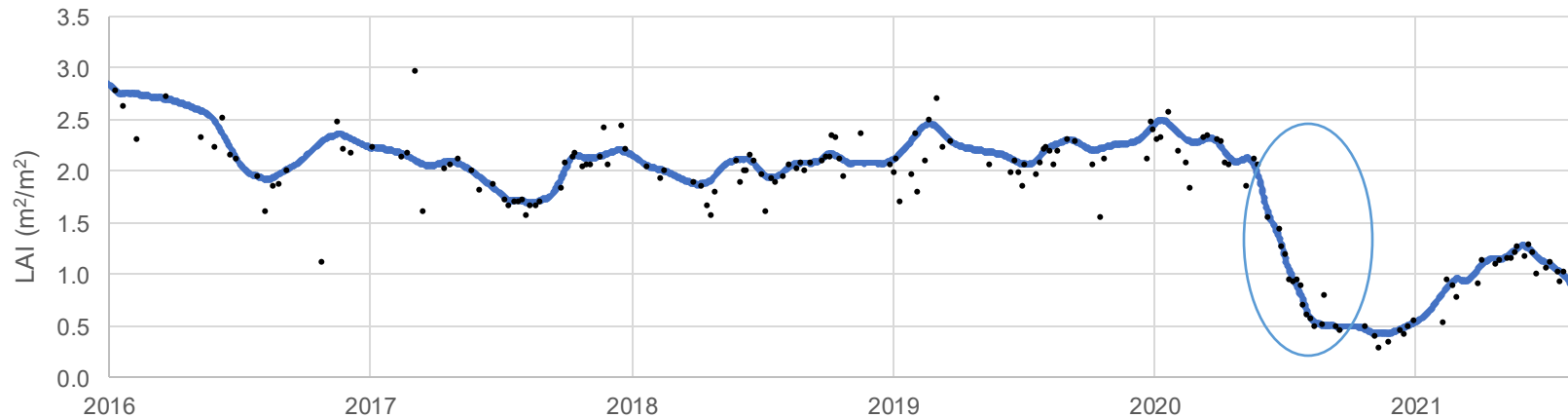


In the invaded areas low level of natural control was ineffective in preventing the dieback of pine *Pinus pinea*
Major threat to *Pinus pinea* in Southern Italy

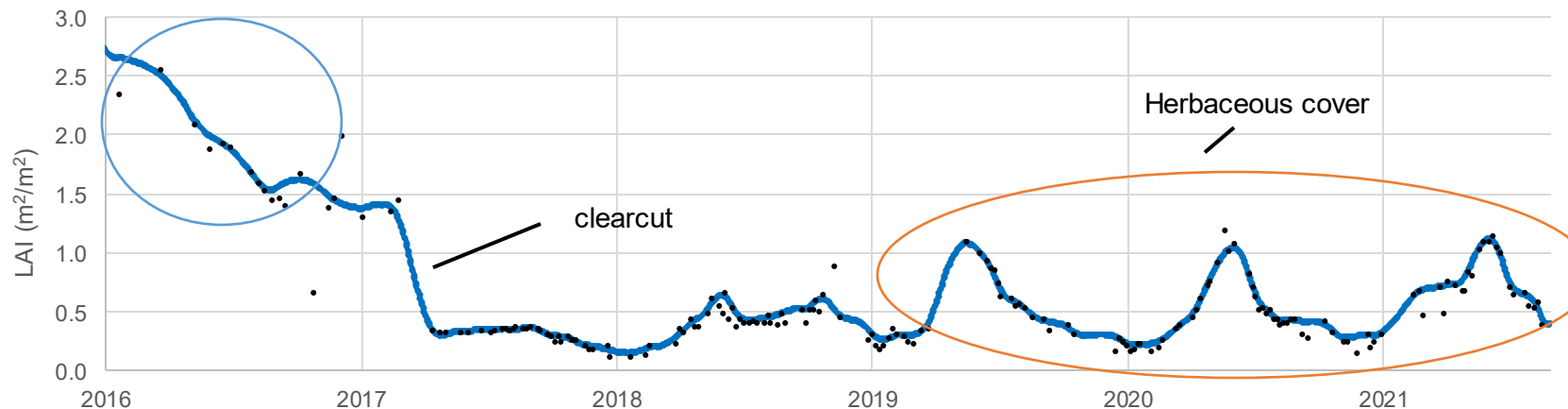
Plant phenology anomaly: pest outbreaks

Site: Tenuta Presidenziale di Castelporziano (Lazio, Italy)

- ▶ *Toumeyella parvicornis* pest outbreak started in early 2020



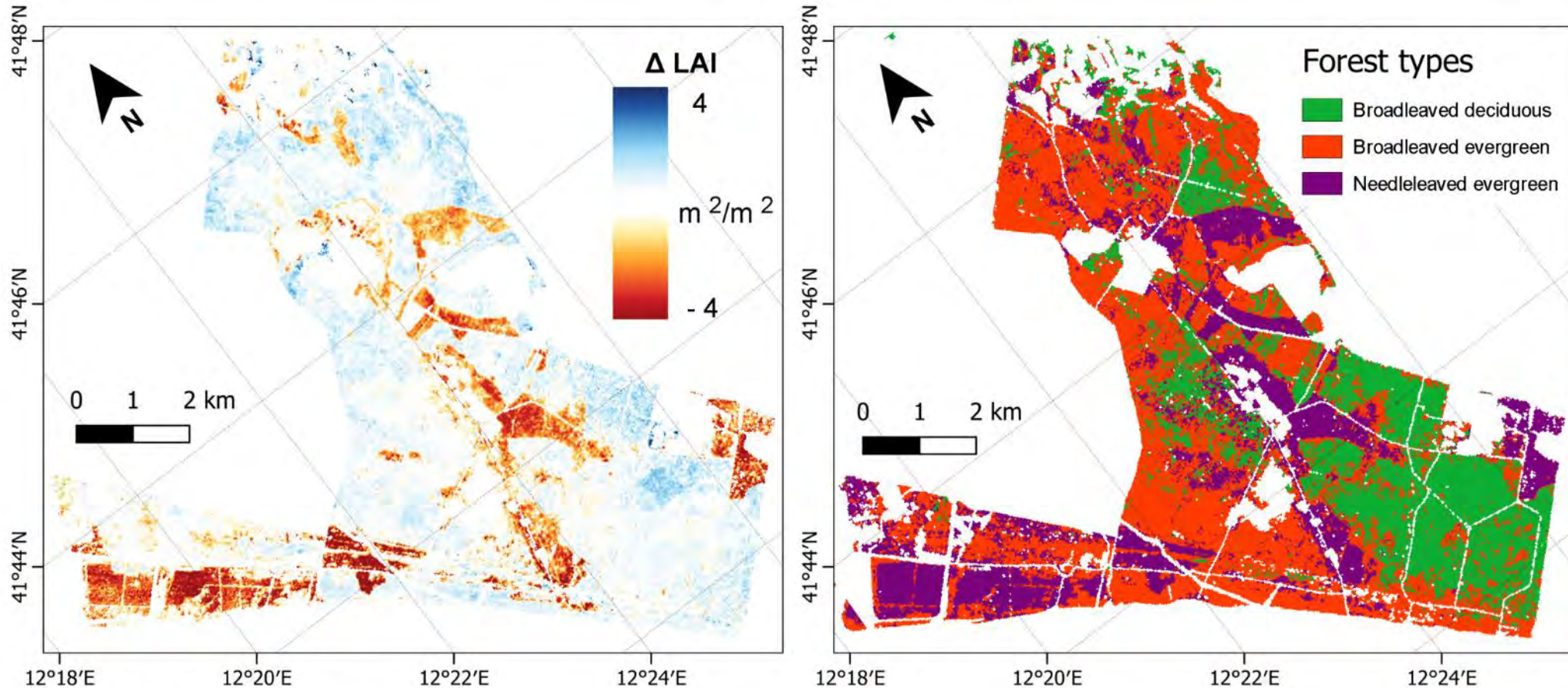
- ▶ *Pinus* species rapid decline already occurred in year 2016 due to *Tomicus destruens* pest outbreak



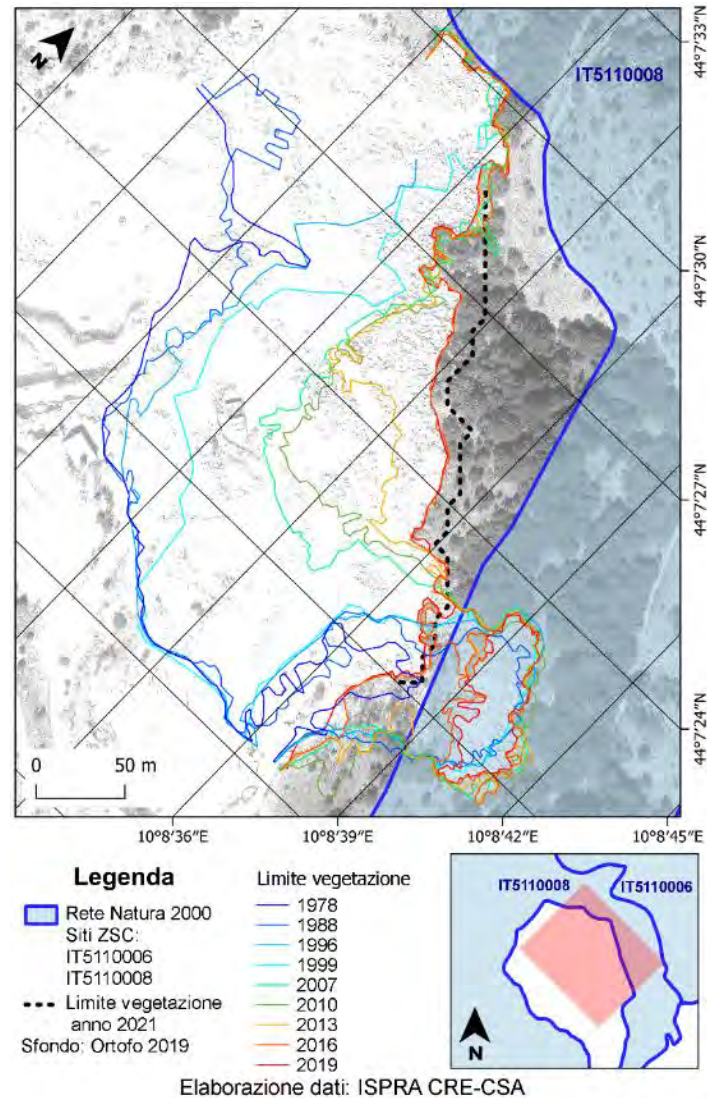
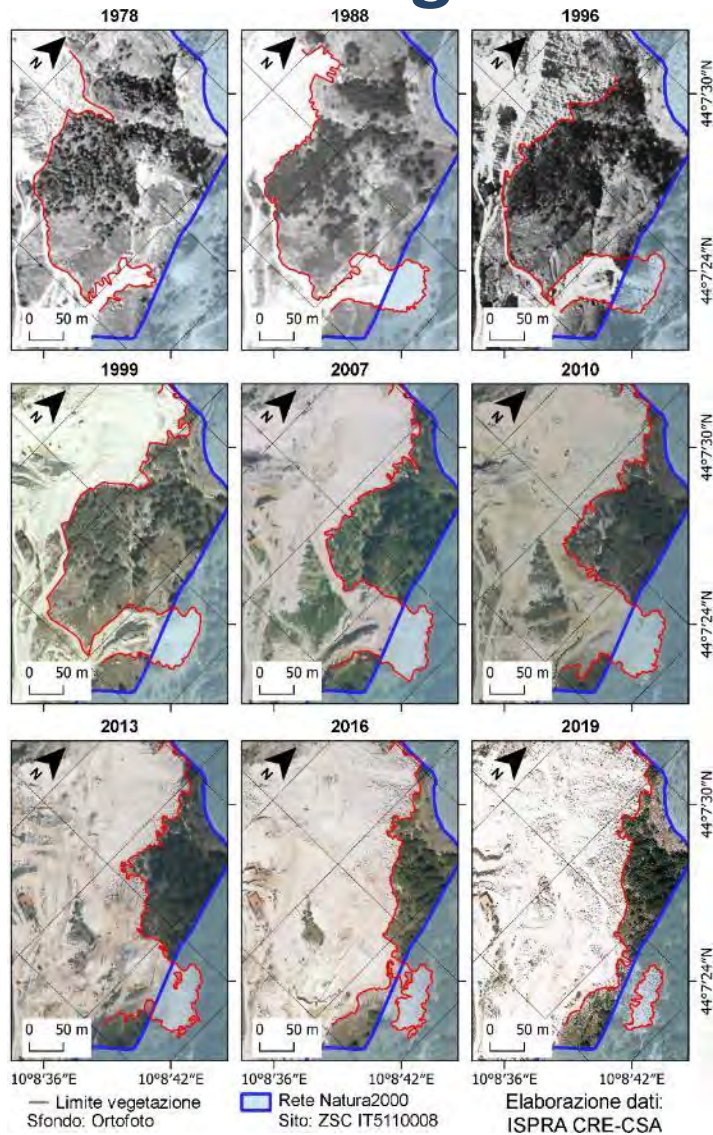
Plant phenology anomaly: pest outbreaks

Site: Tenuta Presidenziale di Castelporziano (Lazio, Italy)

LAI max difference (climatologies for periods 2020-2021 and 2016-2019)



Monitoring Nature 2000 sites

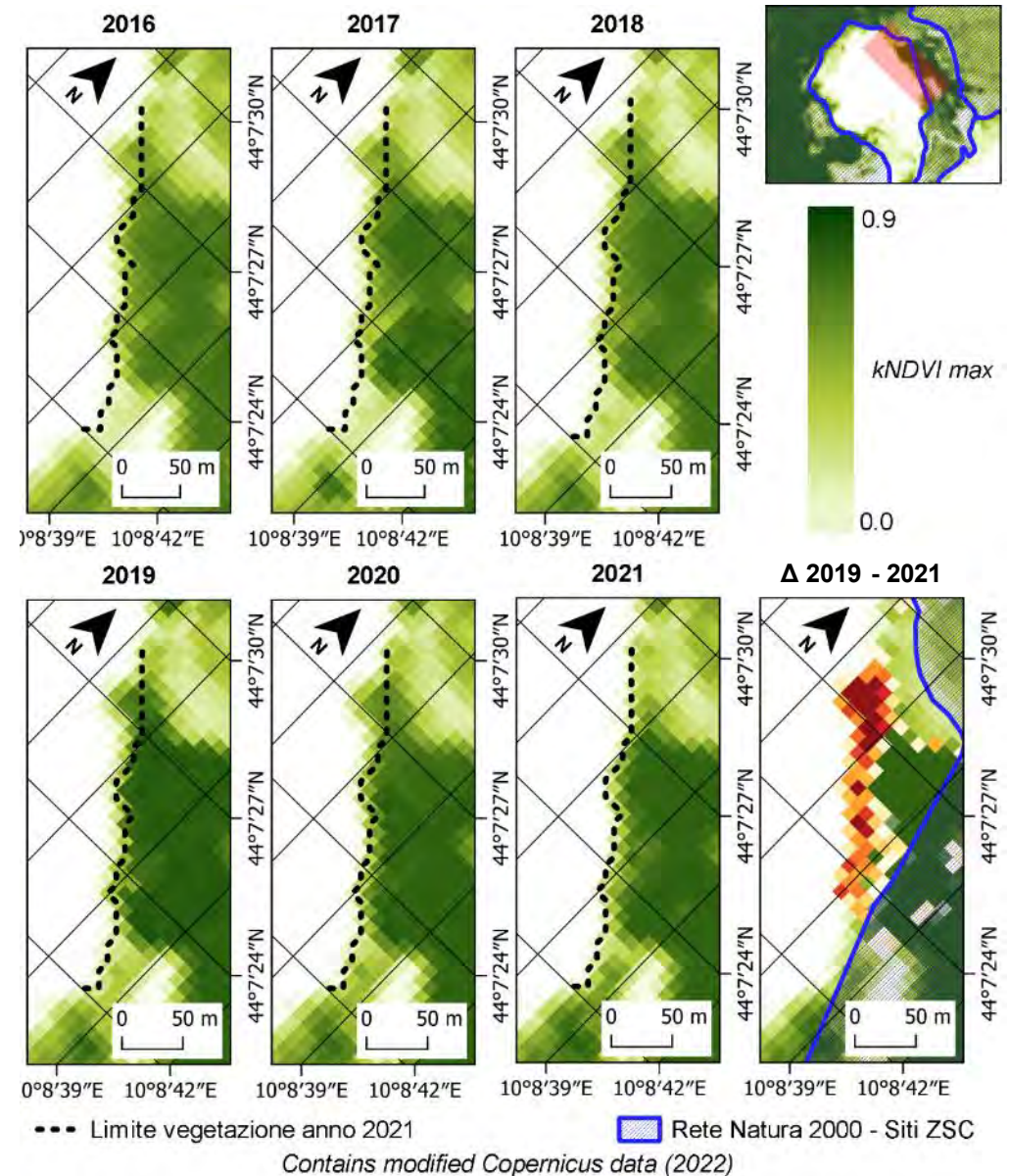


Time series of aerial imagery has been used to monitor Nature 2000 site IT5110008 surrounding a white marble cave

Monitoring Nature 2000 sites

Recent time series analysis of satellite imagery allows the monitoring with higher revisit time

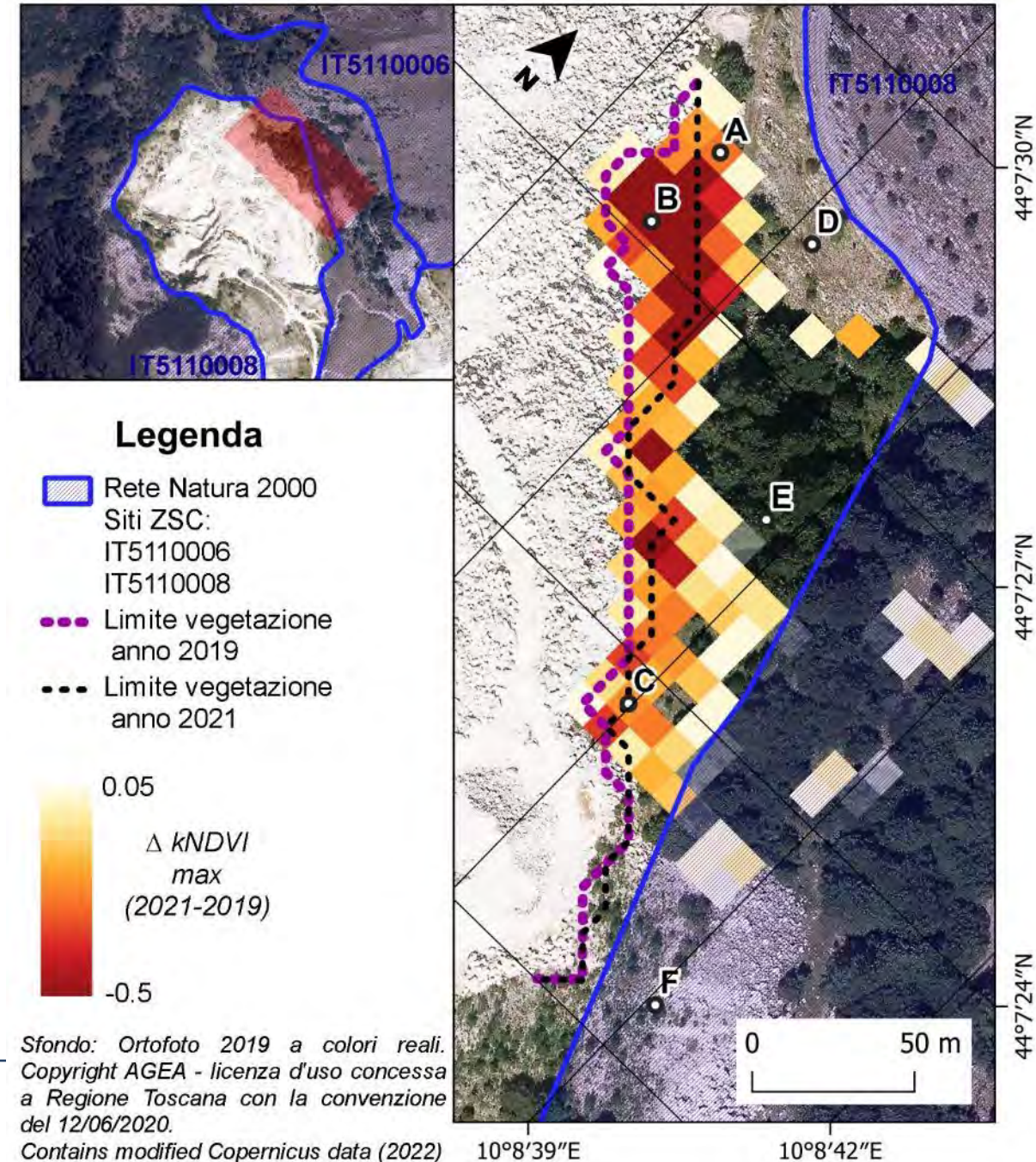
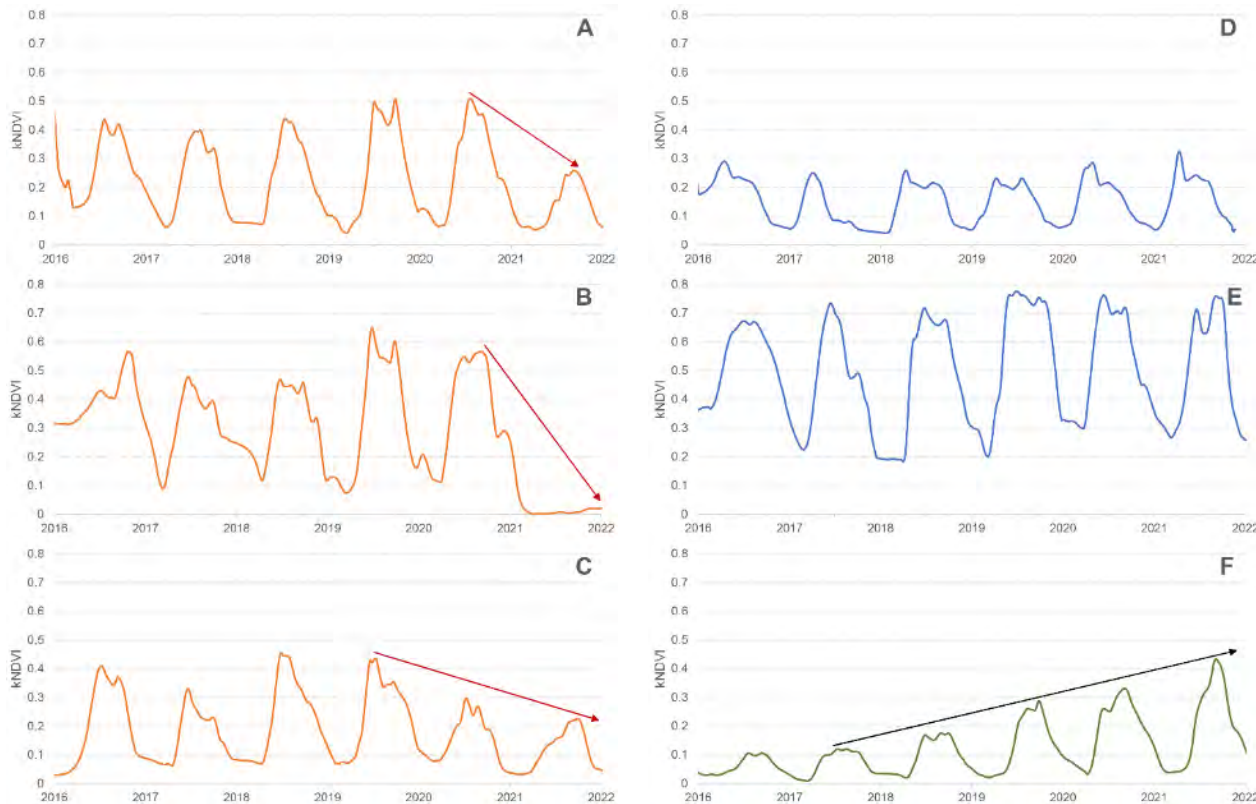
Copernicus Sentinel-2 MSI satellite data



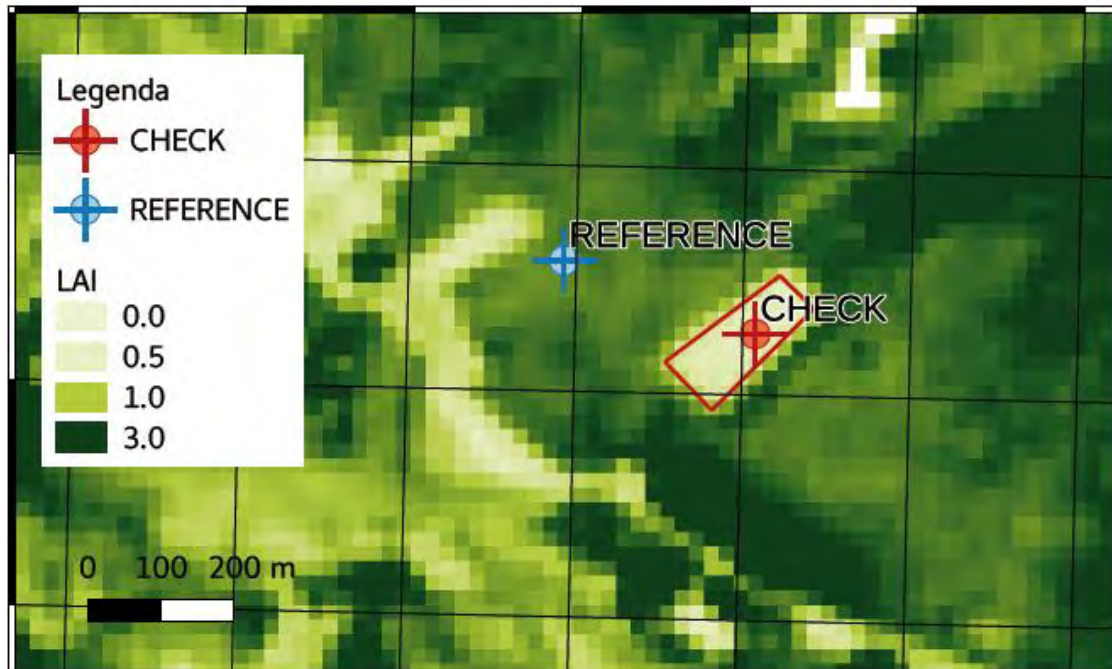
Monitoring Nature 2000 sites

Focus on changes in the period 2016-2021

Revealed the white marble cave debris flow approaching the surrounding Nature2000 site



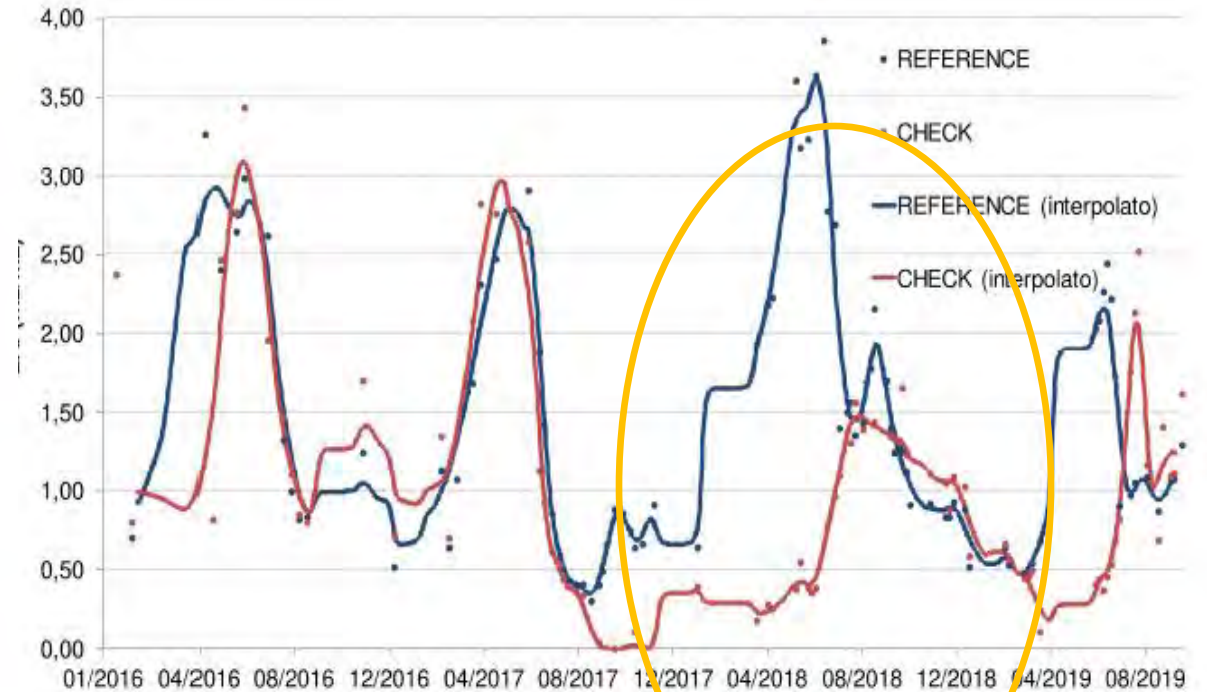
Identify violations in Nature 2000 sites



ZSC: IT6020014 – Piana di Rascino

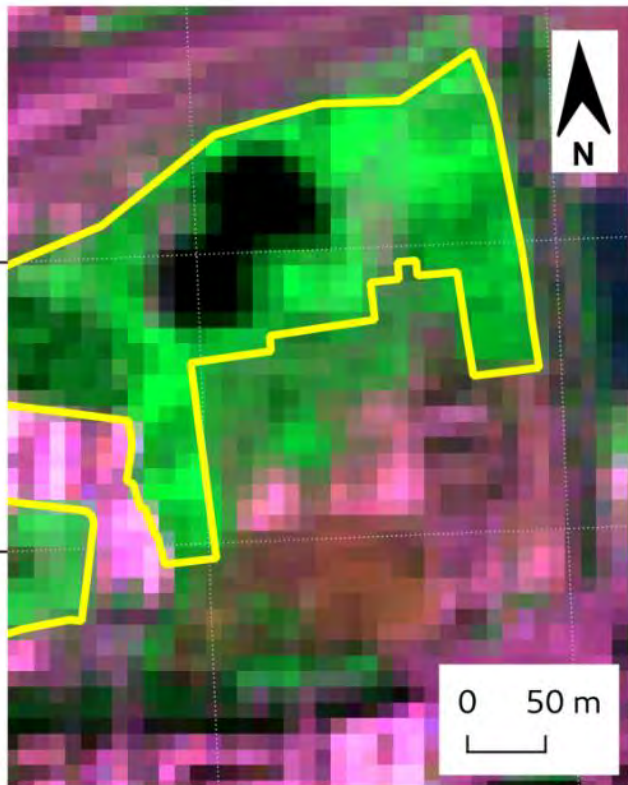
6210 - Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites)

Produce a posteriori information related to eco-criminal acts



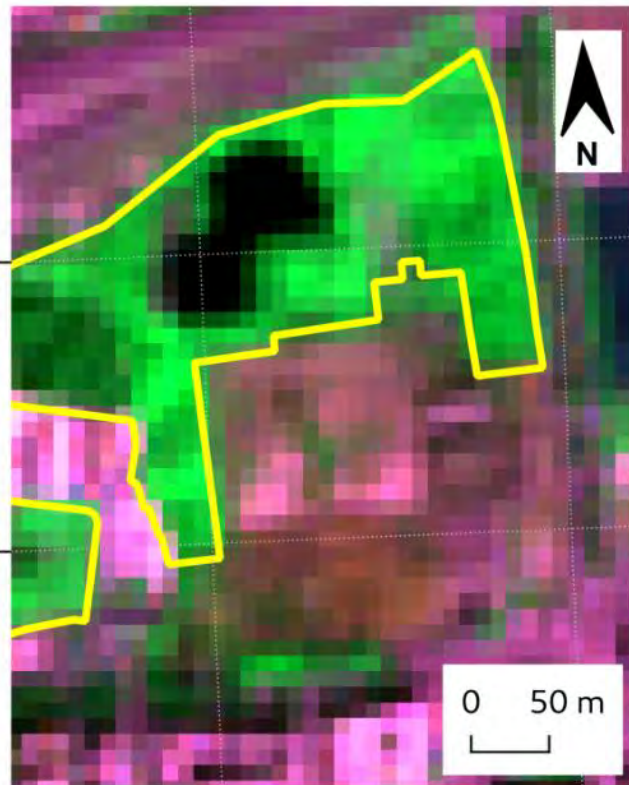
Change detection analysis – Protected areas

S2B 25/04/2021



12°32'20"E 12°32'30"E

S2A 30/04/2021



41°53'42"N
41°53'36"N

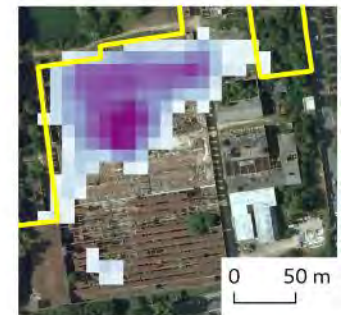
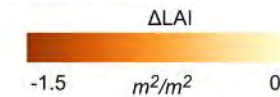
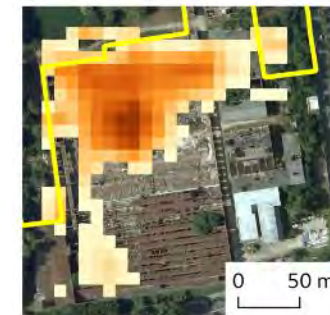
12°32'20"E 12°32'30"E

Perimetro Monumento Naturale Lago ex SNIA - Viscosa

Cambiamento 25/04/2021 - 30/04/2021



Perimetro Monumento Naturale Lago ex SNIA - Viscosa



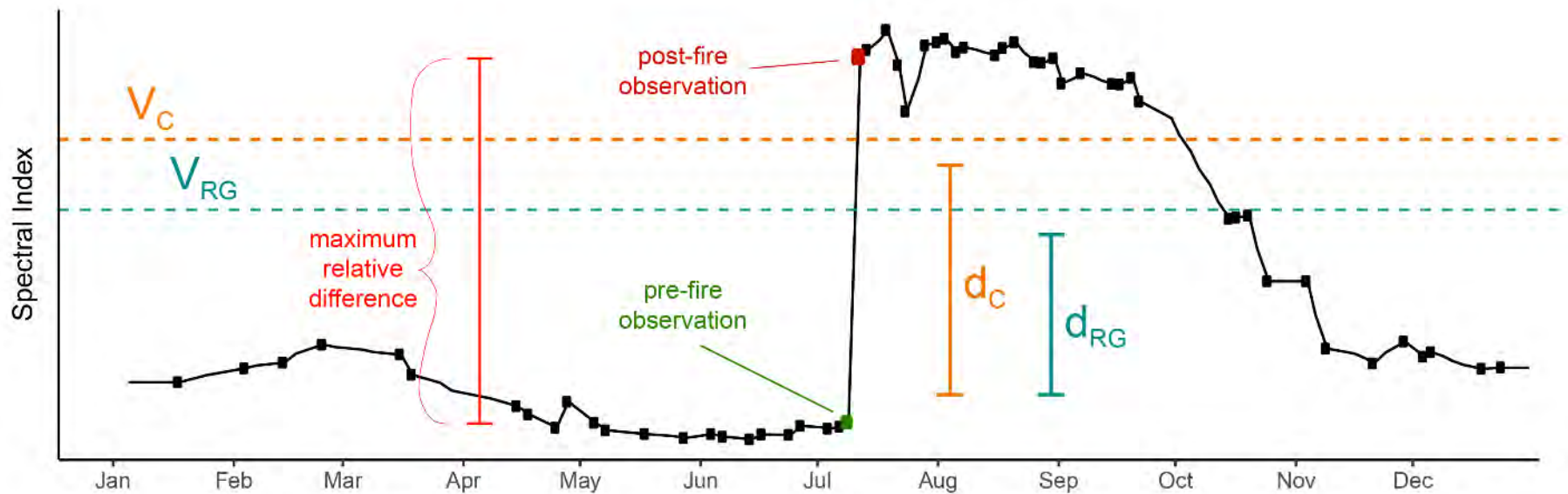
Sfondo: Ortofoto colori 2011 (Geoportale Nazionale)
Elaborazione dati: ISPRA CRE-CSA
Contains modified Copernicus data (2021)

Wildfires mapping

- Support response during environmental emergency activation and ecosystem damage assessment evaluation
- Burned area mapping capacity for national territory at 20 m spatial resolution using Sentinel-2 MSI and LANDSAT OLI satellite acquisitions
- Active fires identification from high SWIR bands emissivity
- Statistics on natural ecosystem thematic maps, biomass, protected areas, hydrogeological and hydraulic risk



Forest Fires Geoportal
Comando Unita' Forestali, Ambientali e Agroalimentari
dell'Arma dei Carabinieri (CUFAA)
Legge 155/2021



Illegal logging: overview

Illegal logging is the **harvesting of timber in contravention of the laws and regulations of the country of harvest**. It is a global problem with significant negative economic, environmental and social impact.

- results in **lost revenues** and other benefits
- is associated with **deforestation, climate change** and a **loss of biodiversity**
- is linked to conflicts over land and resources

Illegal activities also undermine the efforts of responsible operators by **making cheaper, but illegal timber** and timber products available.



Contents developed in the framework of Copernicus FPCUP - Geospatial Intelligence for Environment Protection against illegal activities

Illegal logging: regulations

New EU Forest Strategy for 2030

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021DC0572>

Stepping up implementation and enforcement of existing EU acquis

Illegal logging is particularly worrying when it concerns **primary** and **old growth forests** or **forest habitats** with very small areas left due to the irreversibility of the damage. A poor implementation of the relevant acquis may also cause **forest degradation** or a **lack of improvement in forest conservation status**.

FLEGT Action Plan

Forest Law Enforcement Governance and Trade Action Plan (EU Action to Protect and Restore the World's Forests)

Regulation on deforestation-free products (Regulation (EU) No 2023/1115), which repeals the EU Timber Regulation (Regulation (EU) No 995/2010)

The Italian National Forestry Strategy (NFS)

<https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2018-04-03;34>

Provides a long-term (20 year) framework for national and regional forestry policies in line with international and European commitments on **climate change**, **biodiversity protection** and **socio-economic development**. The strategy was approved recently in accordance with the mandate defined by the Legislative Decree No 34 of 3 April 2018 (Testo Unico in materia di Foreste e Filiere forestali).

Purpose:

- a) ensure the **conservation of forests** in their extension, distribution, geographical distribution and **ecological diversity**
- b) promote the active and **rational management of assets national forestry** in order to guarantee the environmental functions, economic and socio-cultural;
- c) to **promote** and protect the **forest economy**, the mountain economy and the respective production chains as well as the development of agro-forestry-pastoral activities;
- d) **protect the forest by promoting prevention actions** from natural and anthropic risks, hydrogeological defence, defence against fires and biotic and abiotic adversities, adaptation to climate change, recovery of degraded areas or damaged, carbon sequestration and other disbursement ecosystem services generated by sustainable forest management;
- e) promote programming and planning of **forest management interventions** in compliance with the role of the regions and local autonomies.

Illegal logging: interaction with users

Questionnaire to address:

- state of the art on current National/Regional regulations and policies;
- technical and administrative elements that hinder the identification/assessment of the investigated topic;
- the identification of criteria to detect the areas where to monitor illegal activities;
- the minimum requirement in term of spatial and temporal monitoring needs;
- the best delivery timeliness of the mapping products;
- any other relevant information needed to monitor the events.

Main obstacles (i.e. technical and administrative elements) that hinder the identification / assessment of illegal logging are:

- having a digital platform for planning and monitoring a forestry management
- general lack of surveillance of the territory
- high fragmentation of competence on permission and control, by different territorial authorities, on forestry authorizations issued
- timing on identification to ascertain the offence

Territorial Authorities	Competence level	Capabilities and Functions
National Park	National	Nature Conservation and Protection
Administrative Region	Regional	Government of the regional territory (i.e. forest management, environmental policies etc.)
Environmental Protection Agency	Regional	Environmental monitoring and verification of the application of environmental legislation

Illegal logging: user needs

- Over 30% of Italian user indicate illegal logging occurring outside concession boundaries of a forest management plan
- Ancillary information are required to identify illegal logging using satellite Earth Observation, to exclude authorized logging sites or areas of forest loss related to natural factors (i.e. wildfires, insect outbreaks, wind disturbance)
- Required minimum mapping unit: 1 to 5 hectares
- Optimal update frequency: from weekly to monthly
- Earth Observation products support planning of local authorities in-situ checks for the cases where there is really a high risk of infringement

Method to identify illegal logging

Identification of changes related to forest disturbances

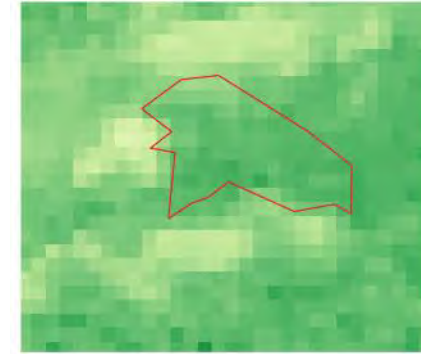
Characterization of changes
(based on spectral and spatio-temporal variability)

Forest logging identification

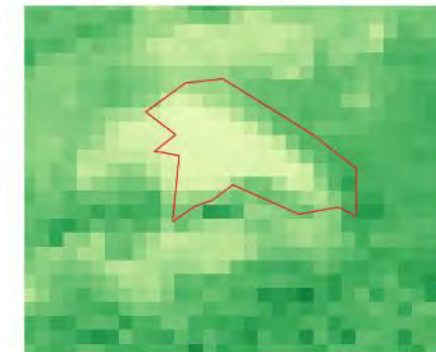
Comparison with authorized logging sites

Illegal logging detection

Pre-logging (2016)



Post-logging (2017)

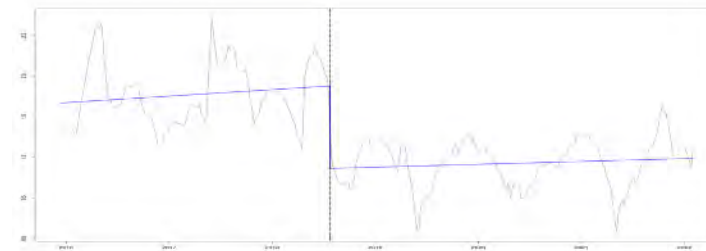


Satellite Earth Observation to identify and characterize illegal logging

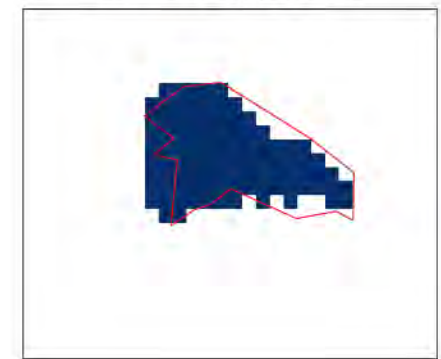
- *Data:* Copernicus Sentinel-2 MSI time series
Copernicus Sentinel-1 time series

Spatial resolution: 10- 20 m

Methodology: time series abrupt changes identification (Bfast),
spatio-temporal analysis of changes

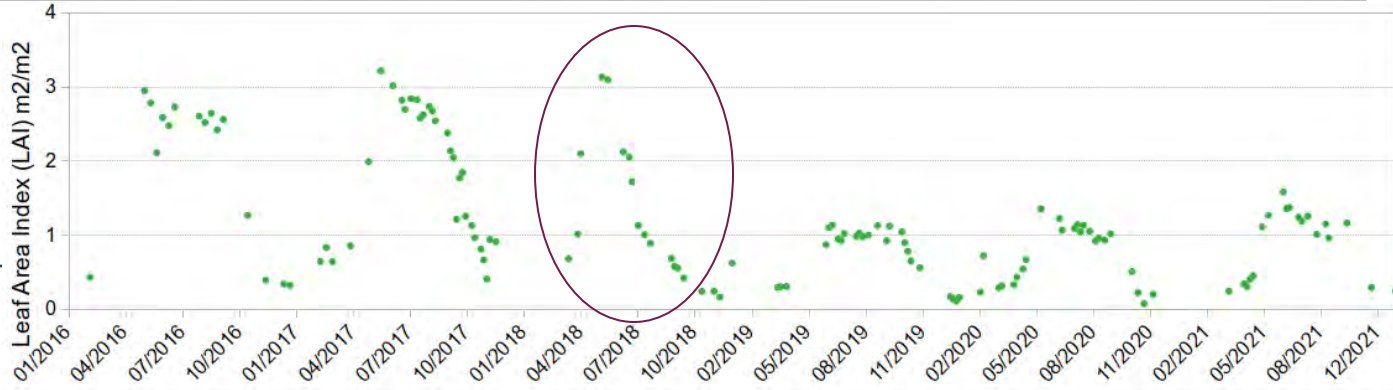
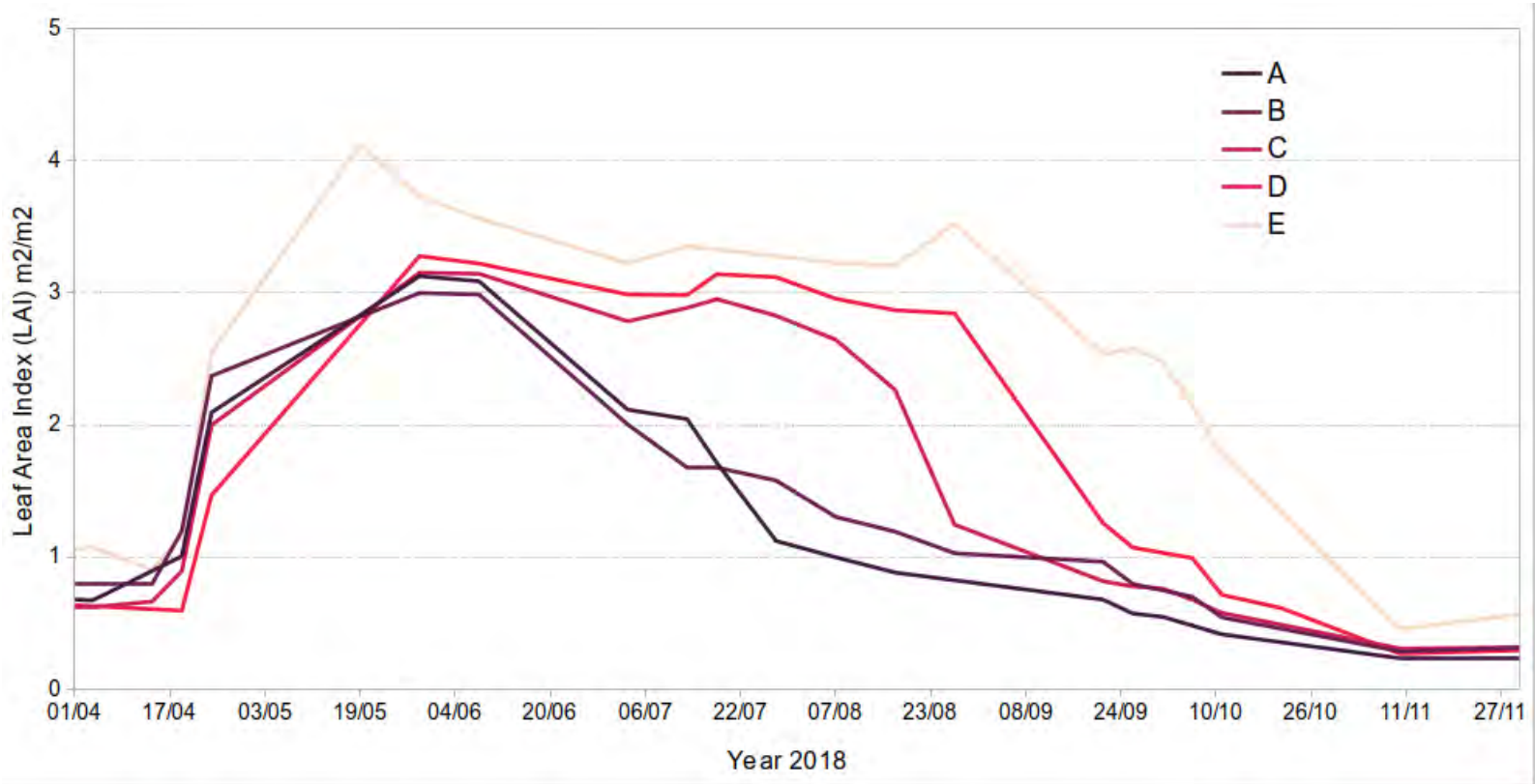
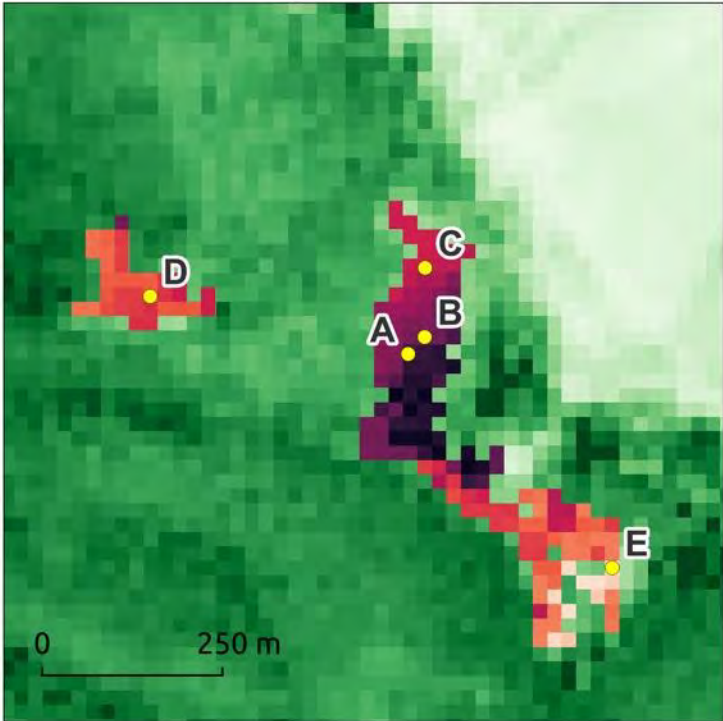


Identified logging area



Qualitative mapping product: illegal logging date

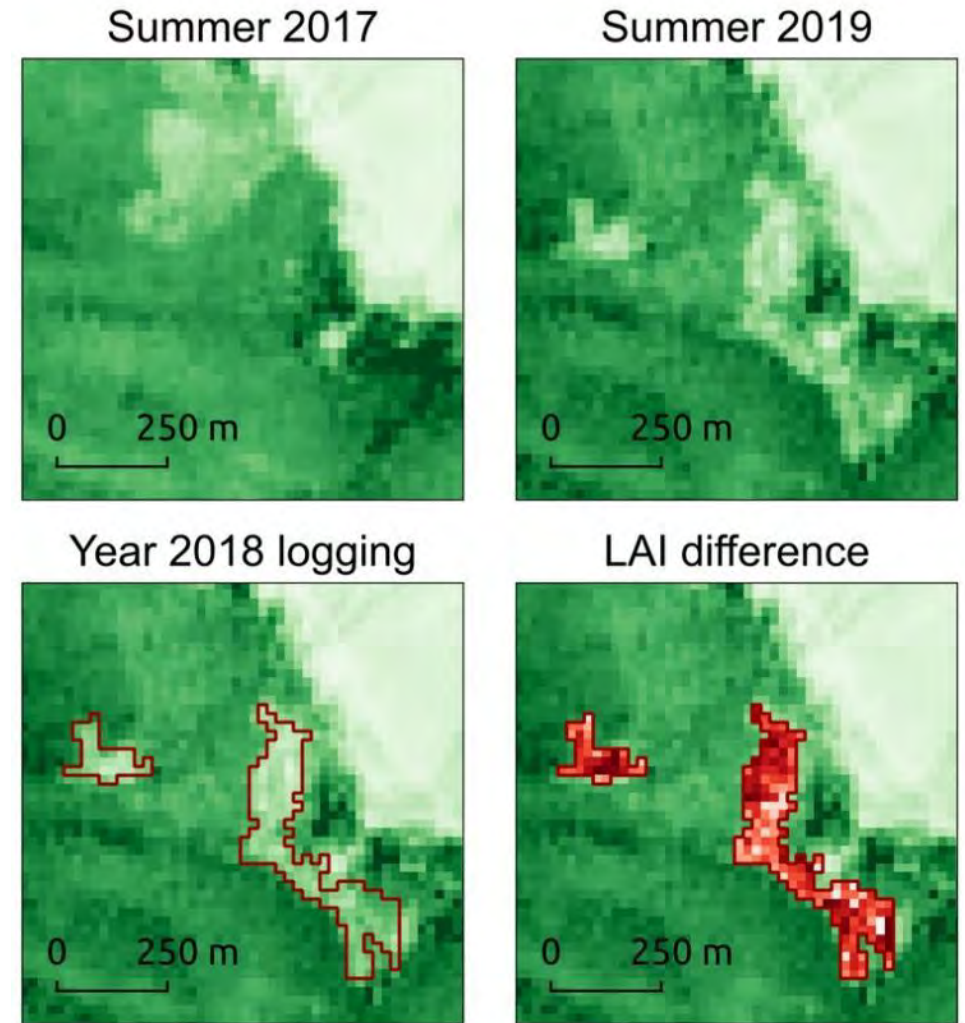
Year 2018 logging date



Quantitative mapping product: forest disturbance

Time series analysis allows
to quantify loss
in terms of biophysical parameters:

- Leaf Area Index (LAI)

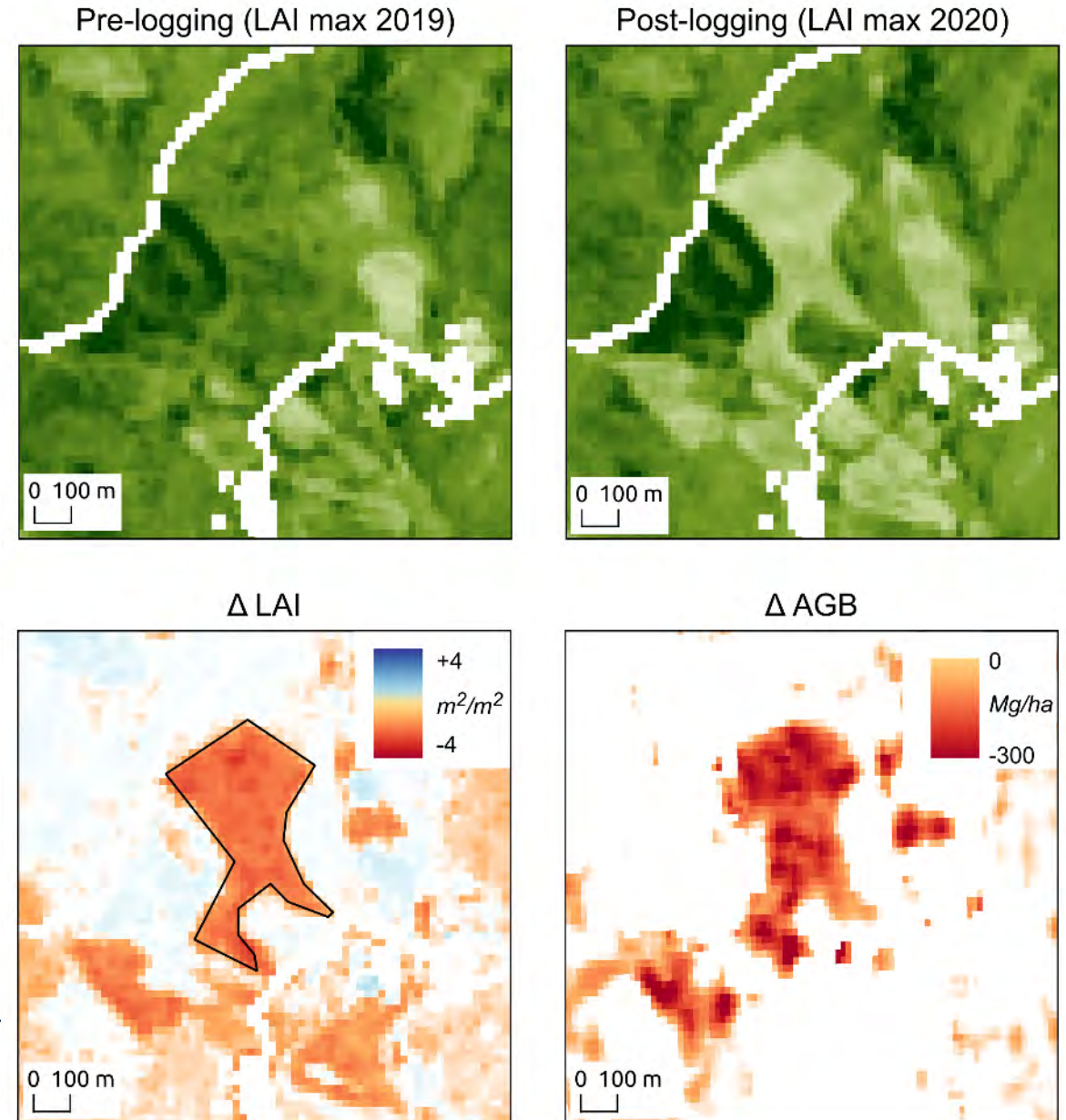


Leaf Area Index (LAI) m^2/m^2

Quantitative mapping product: forest disturbance

Time series analysis allows
to quantify loss
in terms of biophysical parameters:

- Above Ground Biomass (AGB)



Method to identify illegal logging

Strengths

- single time series required (e.g. vegetation index)
- works with both optical and Synthetic Aperture Radar (SAR) time series
- Very High Resolution (VHR) data can be used
- can deal with missing data in time series (due to e.g. cloud cover, snow cover, topographic shadow)
- enable to differentiate from other forest disturbances
- can be used for near-real time monitoring (e.g. to provide monthly mapping products)
- integrates quantitative estimation of biophysical parameters

Method to identify illegal logging

Weaknesses

- authorized logging sites map required to identify illegal ones
- spatial resolution is related to input dataset characteristics
- Very High Resolution data should be collected with a high revisit time
- pre-event acquisitions are required
- need for a high number of cases to compute accuracy metrics
- uncertainty estimates not yet developed

Proposed methodology allows detecting, characterizing and supporting the evaluation of environmental damage

Can be used to assess spatial extent of the affected area, identify temporal occurrence, and quantitatively estimate variations of specific biophysical parameters

Geospatial Intelligence for Environmental Damage Assessment (GIEDA)

The IMPEL GIEDA project aims **to contribute on information needs** related to illegal activities affecting the environmental matrices by reporting effective methodological approaches that use **geospatial intelligence**, based on the use of earth observation and geostatistical analysis. Main objective is **increasing agencies and regulators capacity**.

Legislative drivers:

Environmental Liability Directive 2004/35/EC

Environmental Crime Directive 2008/99/EC

Presented good practices for **reported real cases** contribute to share knowledge, and build technical and procedural capacity in **producing a posteriori evidences of environmental damage caused by environmental incidents** (e.g. responsible for water pollution), **violations** (e.g. unauthorized ploughing in protected sites), **eco-criminal acts** (e.g. illegal forest logging, illegal dumping), affecting various environmental matrices, like water and biodiversity.

Geospatial Intelligence for Environmental Damage Assessment (GIEDA)

Product of the project

Report on demonstration real cases, with description of the geospatial intelligence methodological approaches used to produce evidences and support the assessment of environmental damage

Contents of the report include:

- description of methodological approaches to detect, characterize and evaluate environmental damages through synergic use of earth observation data and geostatistics. Methodological approaches, selected to deal with specific real cases, consisting of up-to-date scientifically validated algorithms, allow to qualitatively and quantitatively assess environmental conditions and their variability in space and time domains.

Geospatial Intelligence for Environmental Damage Assessment (GIEDA)

Contents of the report include:

- specific focus on technical aspects of the methodologies, like: algorithm sensitivity; temporal domain, enabling the evaluation of conditions prior and after an investigated eco-criminal act; spatial resolution, allowing the identification of phenomena at required scale; strength and weaknesses of the approaches; and uncertainty estimates, to assess reliability of the produced information.
- description of organizational technical aspects and issues to be implemented (e.g. equipment, human resources, costs) in order to extend the use of geospatial intelligence technology to IMPEL members.
- juridical aspects and requirements in order to use evidences and information produced provided by geospatial intelligence in courts, **seeking necessary input from EUFJE and ENPE, IMPEL Networks.**
- recommendations to support guidelines definitions and the implementation of new regulations, therefore improving Environmental Compliance Assurance and Governance

Project duration: 18 months (July 2023 – December 2024)

Geospatial Intelligence for Environmental Damage Assessment (GIEDA)

24 active participants

14 organizations

11 countries

25 followers

16 organizations

13 countries

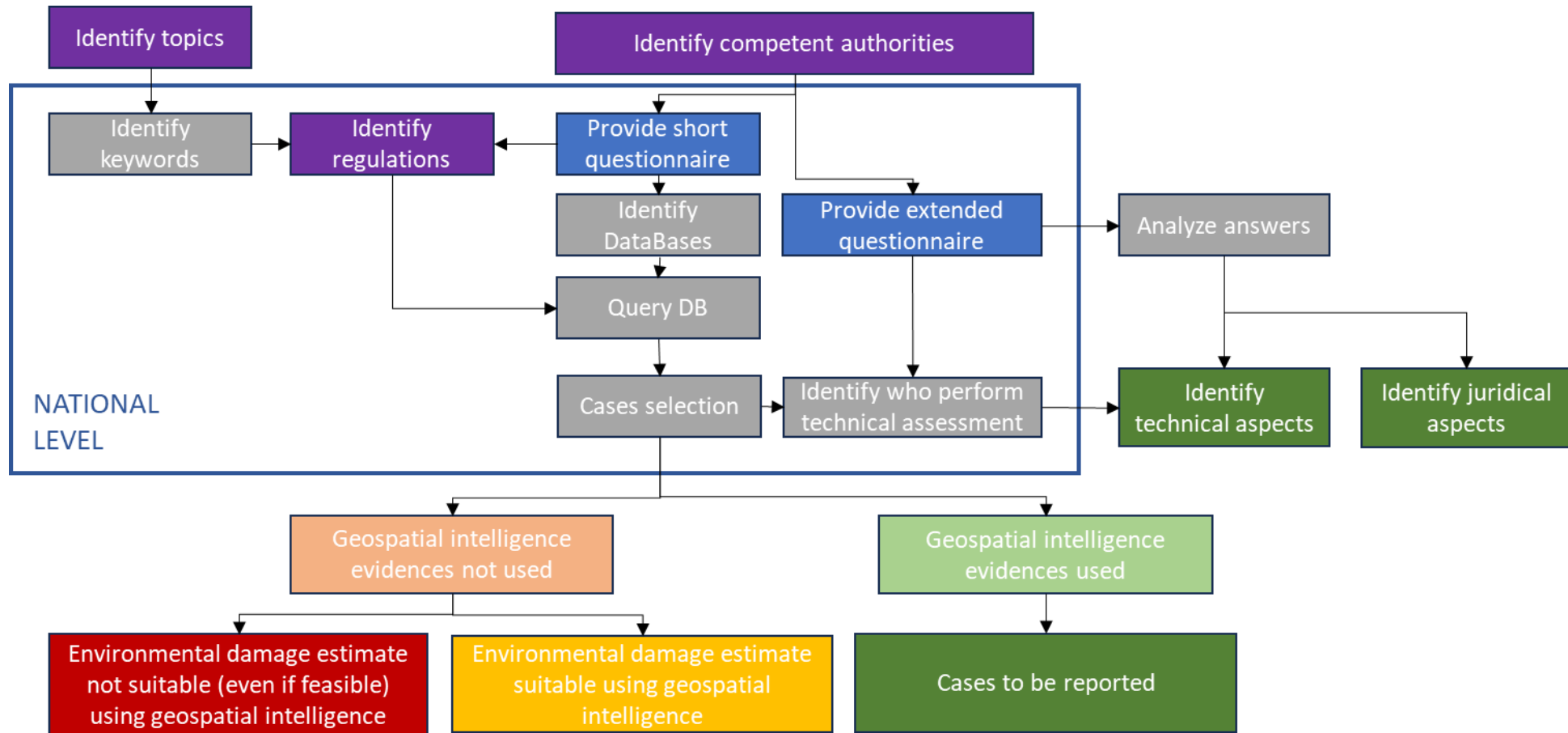
Geospatial Intelligence for Environmental Damage Assessment (GIEDA)

Questionnaire to boost cases collection

Objectives

- Identify national regulations implementing Environmental Liability Directive and Environmental Crime Directive
- Identify Databases to find cases for the reporting
- Identify juridical and technical aspects required for the use of geospatial intelligence

Geospatial Intelligence for Environmental Damage Assessment (GIEDA)



Acknowledgments

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Centro Operativo per la Sorveglianza ambientale

Contents developed in the framework of Copernicus FPCUP - Geospatial Intelligence for Environment
Protection against illegal activities

Tenuta Presidenziale di Castelporziano

Sorgente dati prodotti cartografici:

MASE National Geoportal

Copernicus Programme

NASA

EUMETSAT

ISPRA National Tidegauge Network

**Contribution of Earth Observation
and geostatistics on information needs
related to eco-criminal acts**

**Thanks for your attention
Questions?**

Filipponi Federico

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4 Networks Conference

Carabinieri School, Rome 28-29/09/2023