SMOS

Land Cover Monitoring System for Portugal

Mário Caetano

Deputy Director-General

d·gTerritório
Direção-Geral do Território

The traditional way to do land cover land use maps

Visual
and manual interpretation of
aerial or satellite images

The traditional way to do land cover land use maps

Visual
and manual interpretation of
aerial or satellite images

The producer perspective

An analyst draw polygon lines around landscape units that share the same land cover land use

The traditional way to do land cover land use maps

Visual
and manual interpretation of
aerial or satellite images

The complexity of the landscape is lost

The user perspective

- Artificial land
- Agriculture
- Cork and Holm oak
- Eucalytus
- Other broadleaves
- Maritime pine
- Stone pine
- Other conifers
- Shrubland
- Spontaneous grassland
- Bare soil
- Wetlands
- Water

COS – National Land Cover Land Use Map

5 editions

1995

2007

2010

2015

2018

d.gTerritório
Direção-Geral do Território

Land cover Land use maps are the geographical thematic information most used

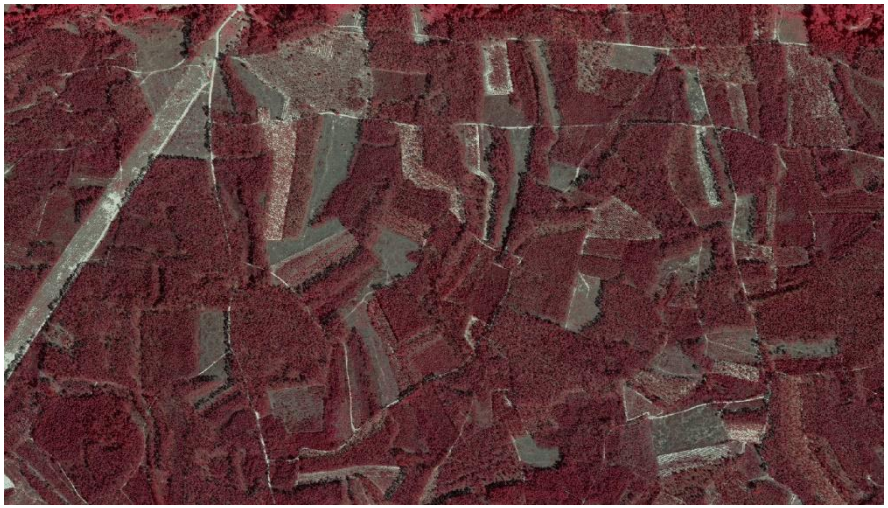
But.... traditional maps

The production is very expensive and very time consuming

Long updating cycles

These maps do not meet all user requirements

Substantial generalisation (e.g. we do not map single trees or single buildings)



Traditional maps do not capture land cover dynamics (e.g. we do not map forest clear cuts)

We need:

- Less map generalisation
- Continuous monitoring for capturing land cover dynamics
- New products

How?

Through New data and new tools

data

Copernicus
Europe's eyes on Earth

Sentinel satellites

Paradigm shift in Earth Observation

- High frequency of image acquisition
- High spatial resolution
- Free access data policy

Sentinel 2 satellite

Images every 5 days

Pixels – 10 m

High frequency of image acquisition

High spatial resolution

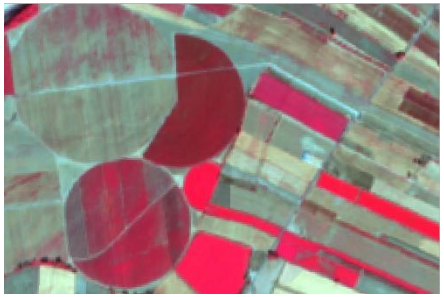
Free access data policy

opernicus

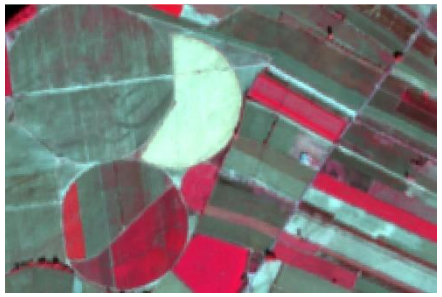
Europe's eyes on Earth

Multi-temporal image data

January



February



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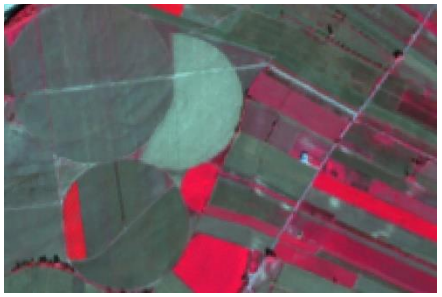

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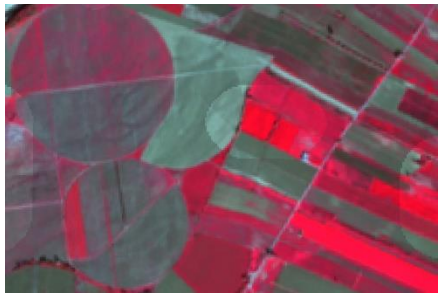

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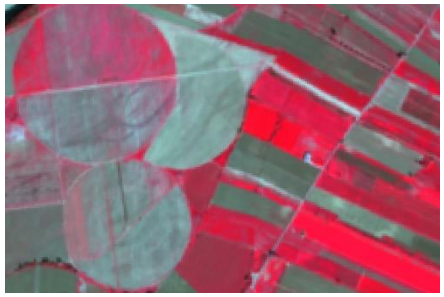

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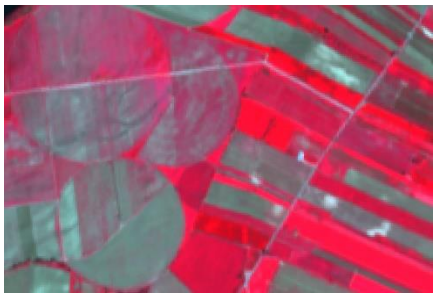

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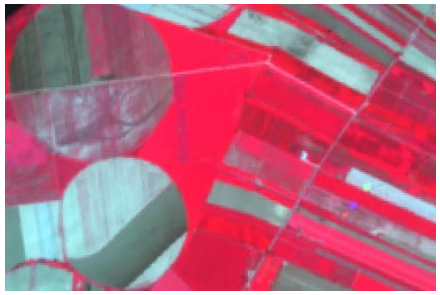
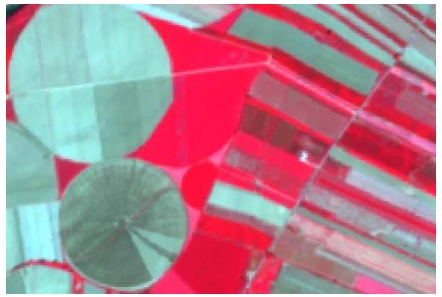


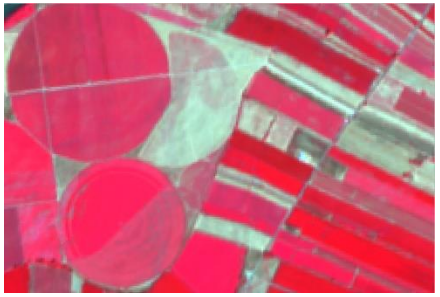
August



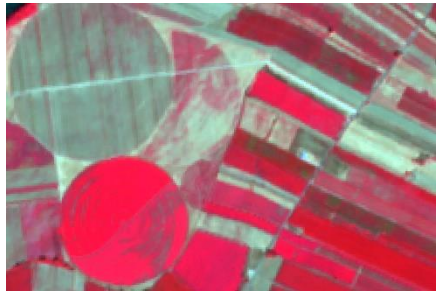
September

October

November



December



Satellite image data has three dimensions

geographical

Portugal has
1600 millions of S2 Pixels of 10 m

spectral

S2 has 10 spectral variables

temporal

S2 acquires images every 5 days

1 year = 75 images

1 year of S2 images for PT

1.2 billion data values

1.3 Tby per year

big data

Traditional algorithms do not fully explore big data

Artificial Intelligence

data

Free and open data policy

Tools and the now-how in DGT

R&D

AI

Purpose

Societal needs

e.g. The definition, implementation and monitoring of Public policies require reliable and updated data

The perfect combination

National Mapping Agency

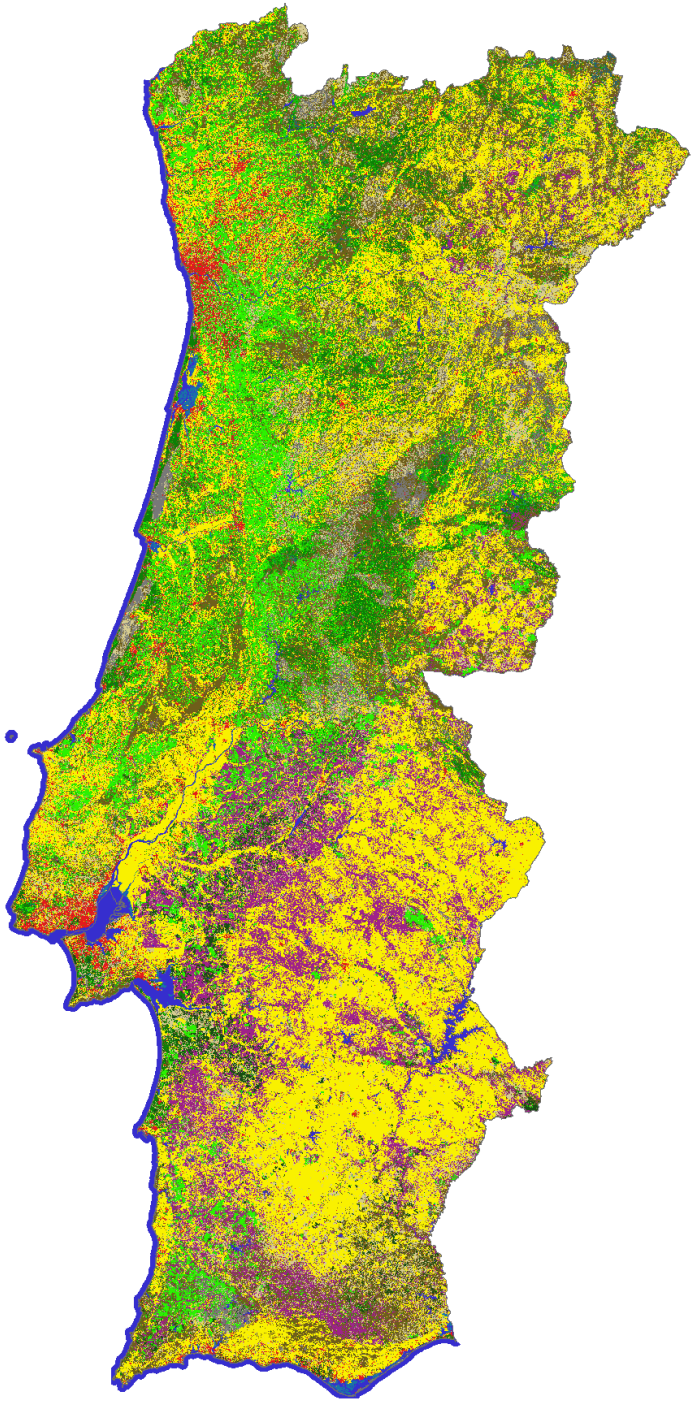
Operational land cover monitoring with satellite data and AI

Official land cover maps

SMOS.PT

Land Cover Monitoring System for Portugal

		Data	Methods	Thematic detail	Spatial detail	Periodicity
COS	Land Cover Land Use map	Aerial photography	Manual	83 classes	1 ha	3 years
COSsim	Simplified Land cover map	Satellite	Automatic	13 classes	100 m2	1 year
MIAEV	Vegetation status map	satellite	Automatic	Quantitative	100 m2	1 month



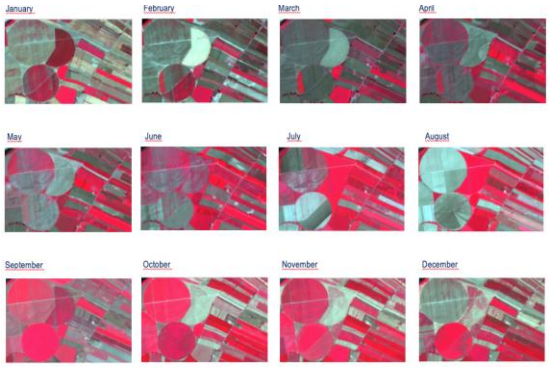
COSsim

2018

pixel – 10 m

Nomenclature – 13 classes

- Artificial land
- Agriculture
- Cork and Holm oak
- Eucalytus
- Other broadleaves
- Maritime pine
- Stone pine
- Other conifers
- Shrubland
- Spontaneous grassland
- Bare soil
- Wetlands
- Water



AI

Overall accuracy – 83%

Traditional map

COS

Visual interpretation of aerial photos

vs

New map

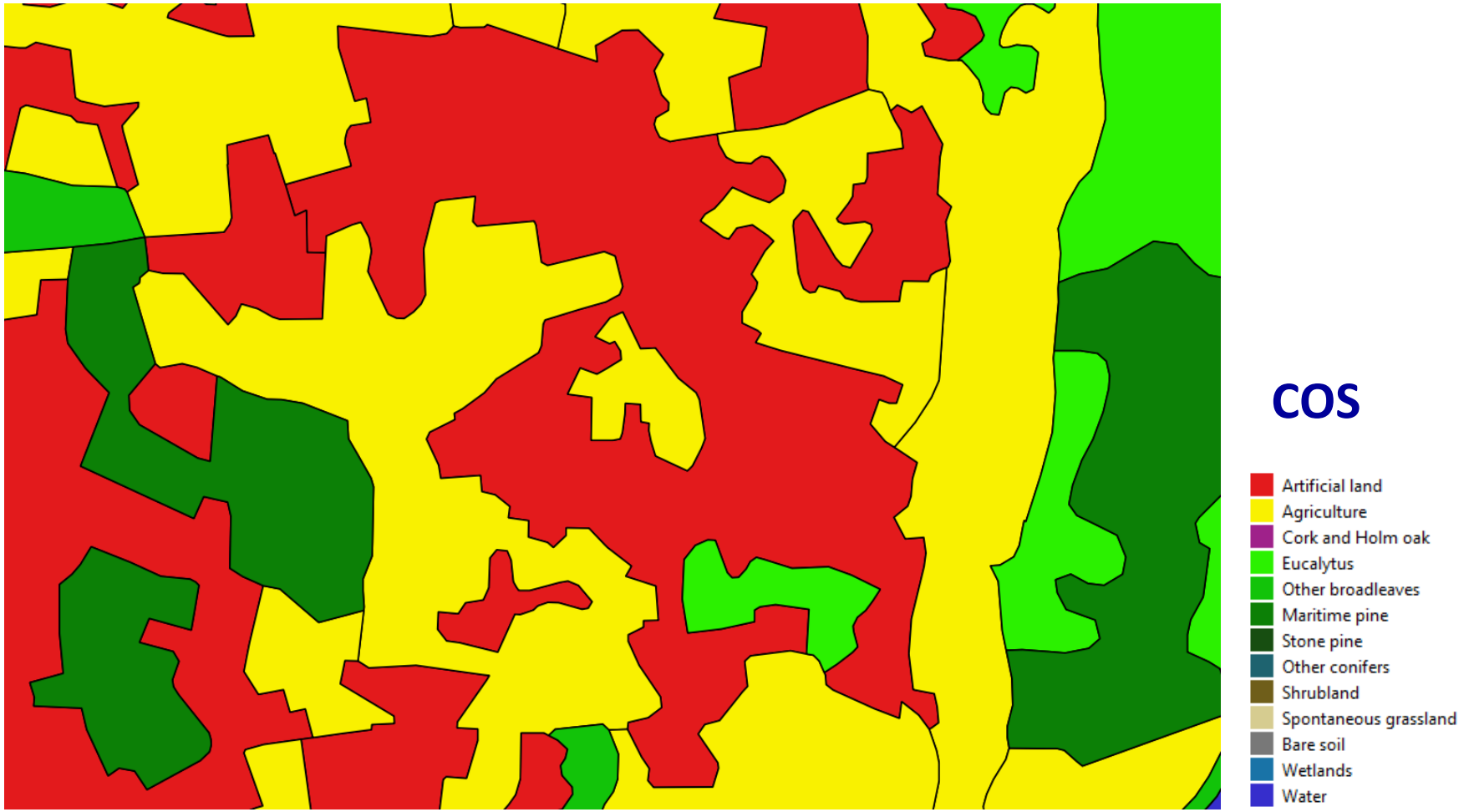
COSsim

Automatic classification of satellite images

COSsim captures the landscape heterogeneity better than COS

Discontinuous urban areas

COS


COS
Artificial land
Agriculture
Cork and Holm oak
Eucalytus
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Shrubland
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Water


Território artificializado
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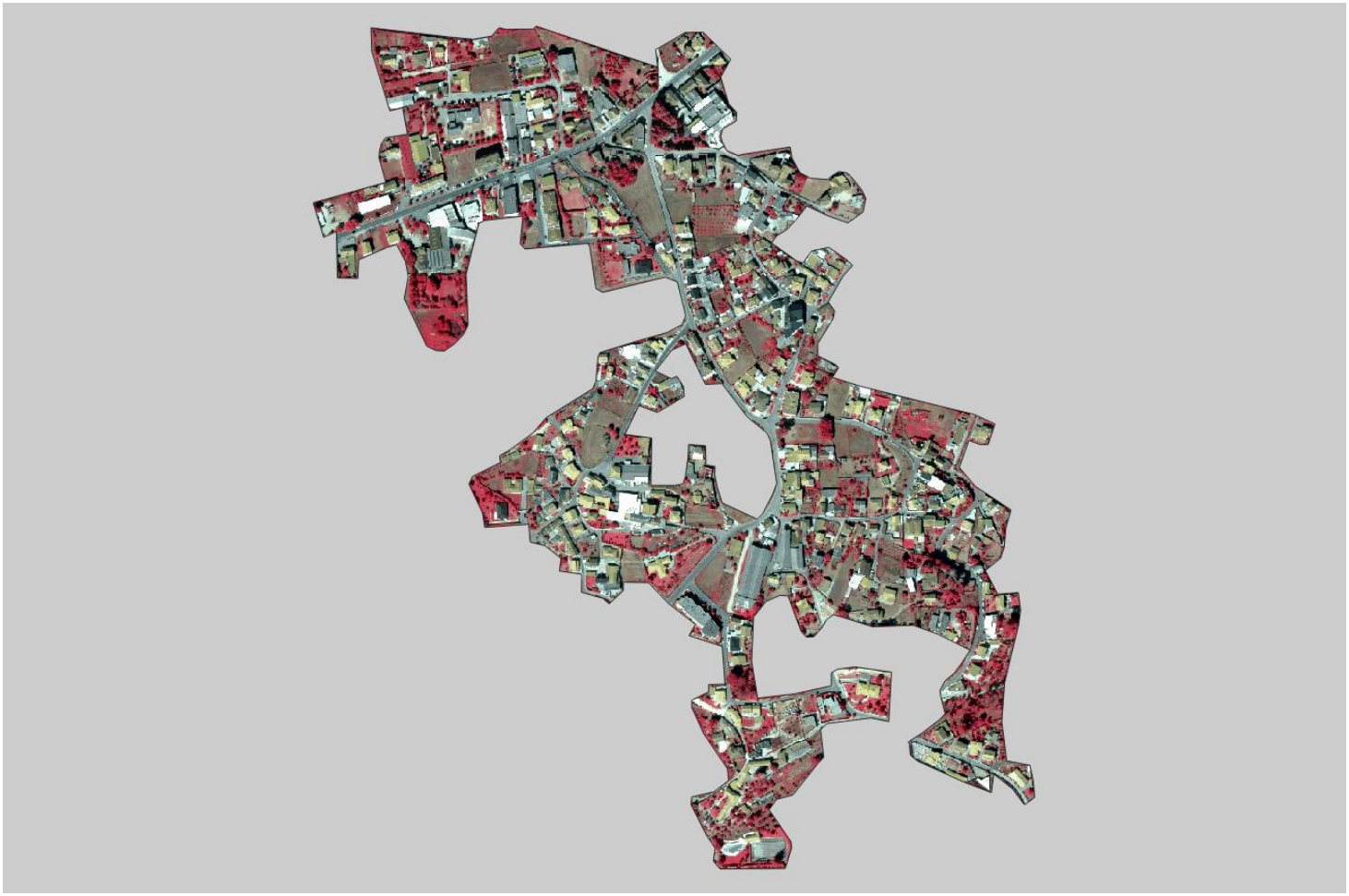

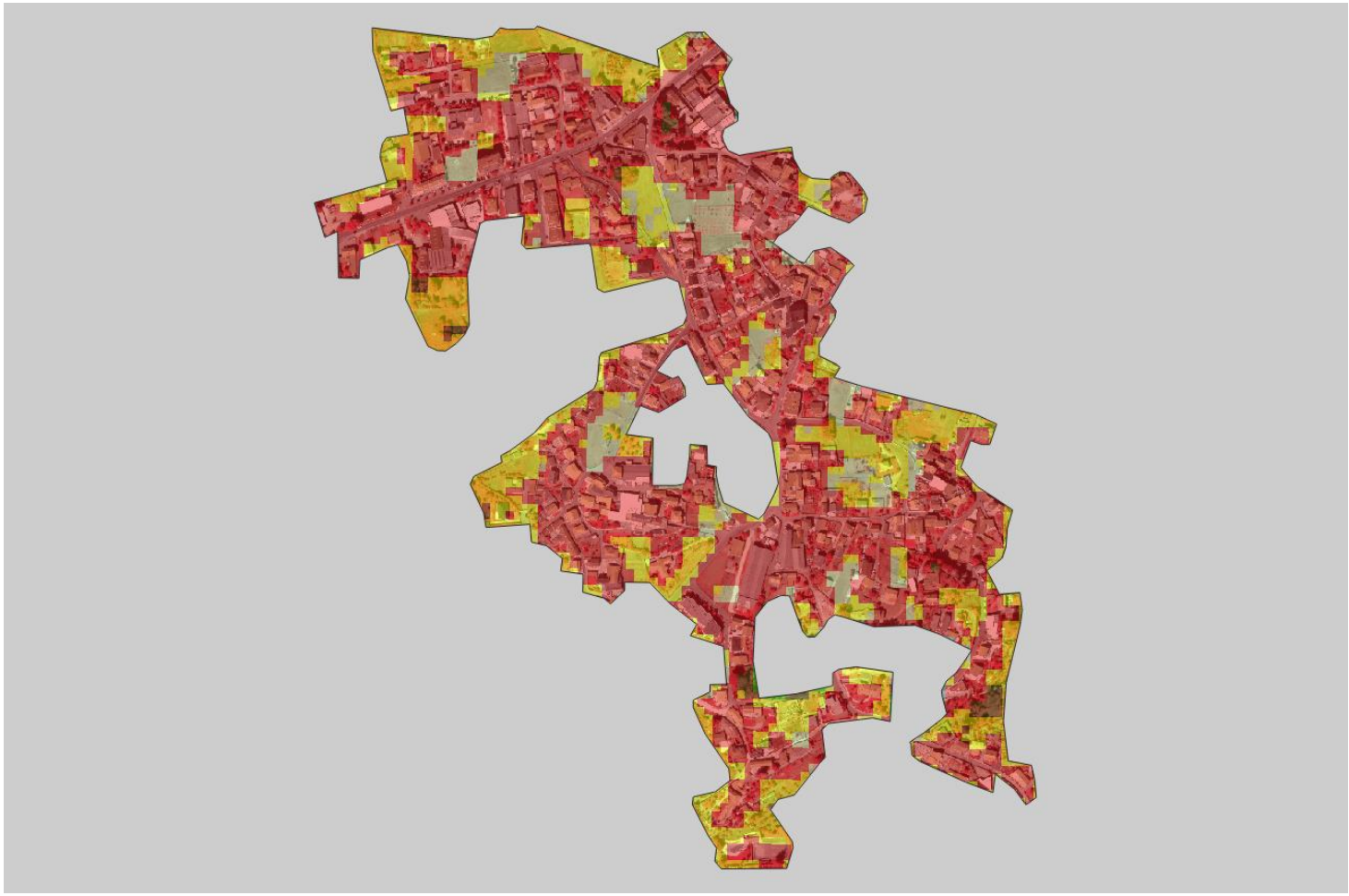
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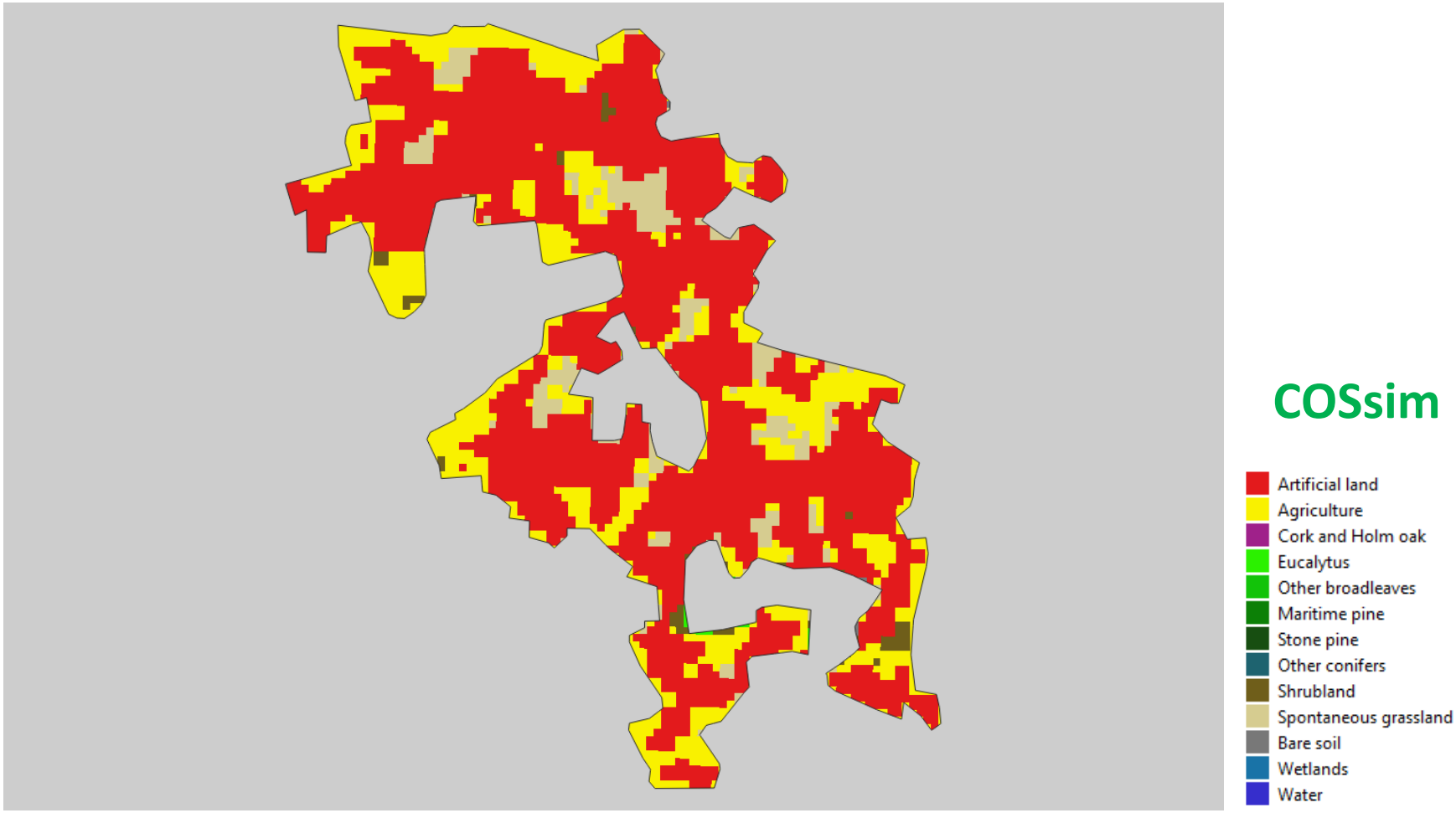
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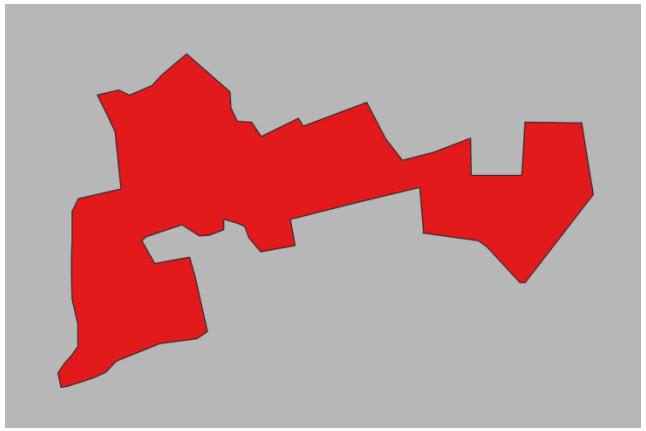

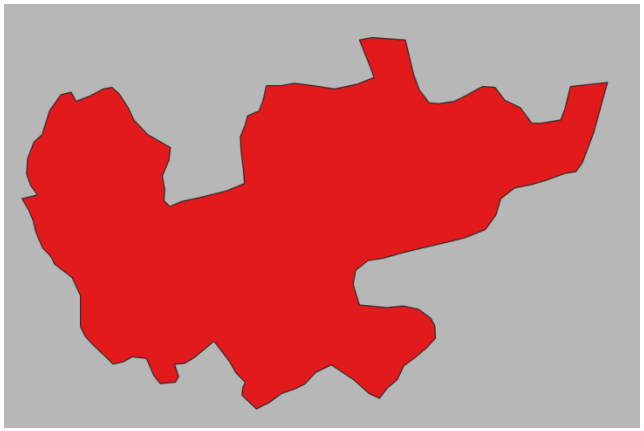

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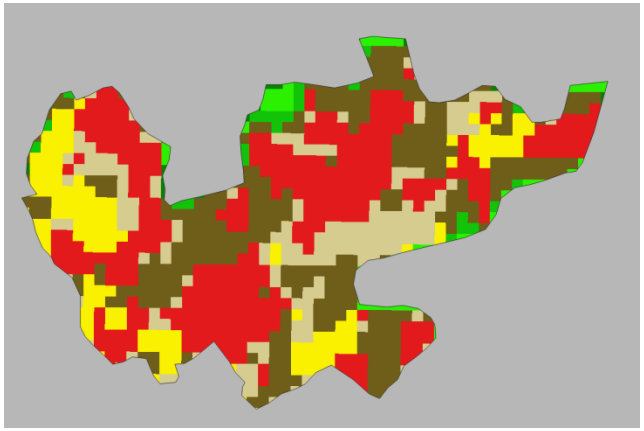


Flood risk

Fire risk

Urban planning

Traditional map

COS

Visual interpretation of aerial photos

vs

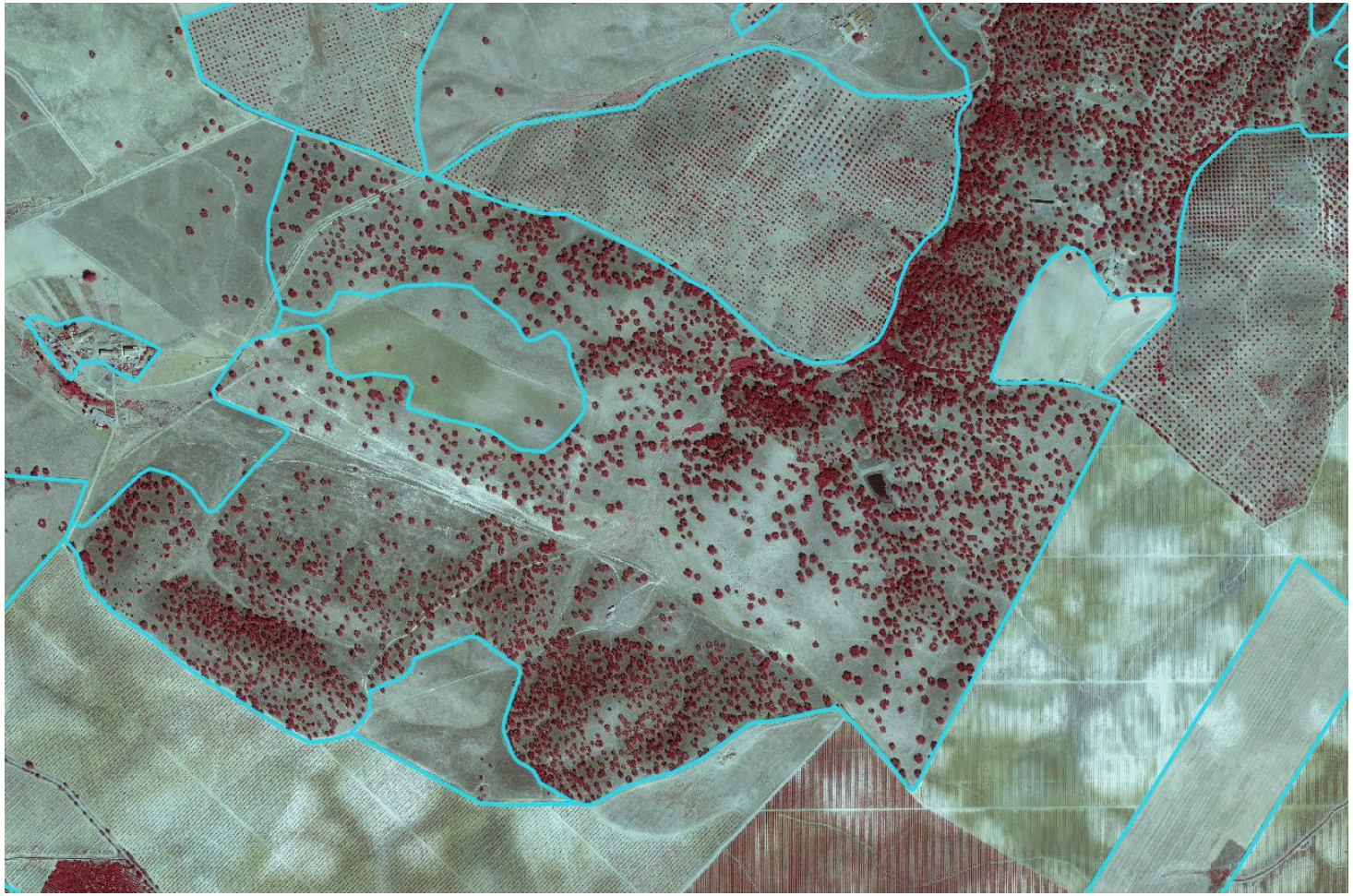
New map

COSsim

Automatic classification of satellite images

COSsim captures the landscape heterogeneity better than COS

Agroforestry areas



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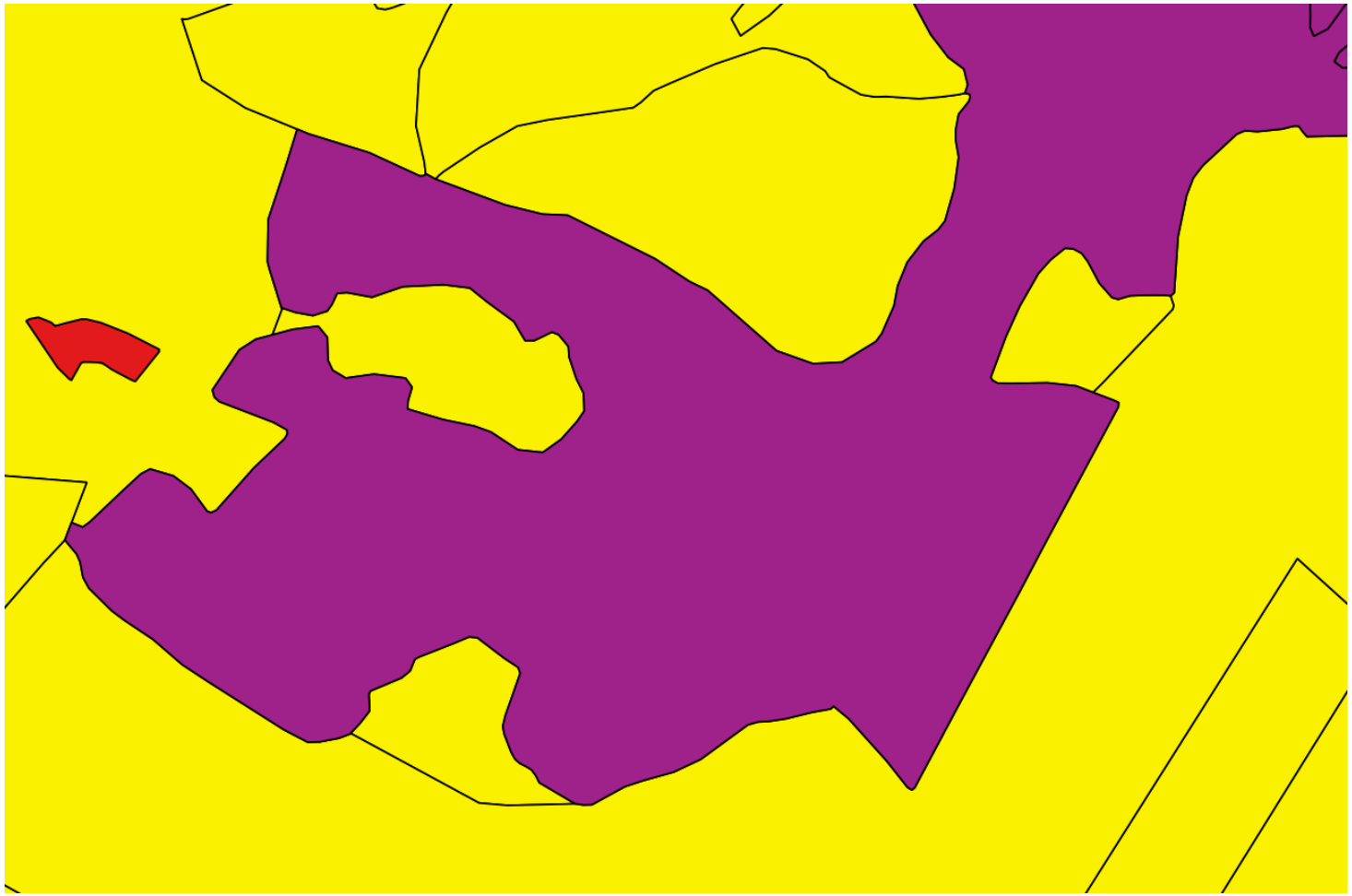

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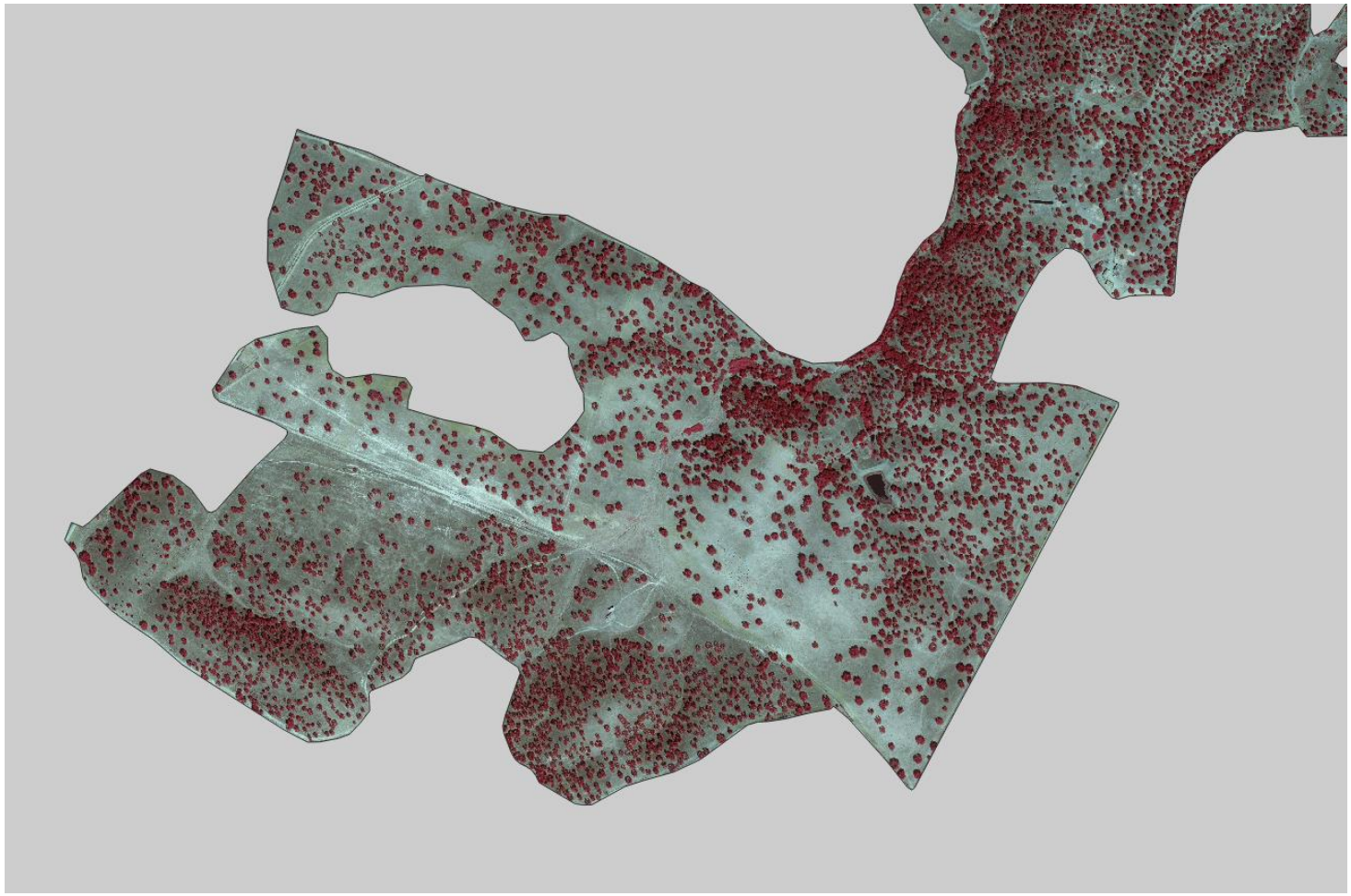

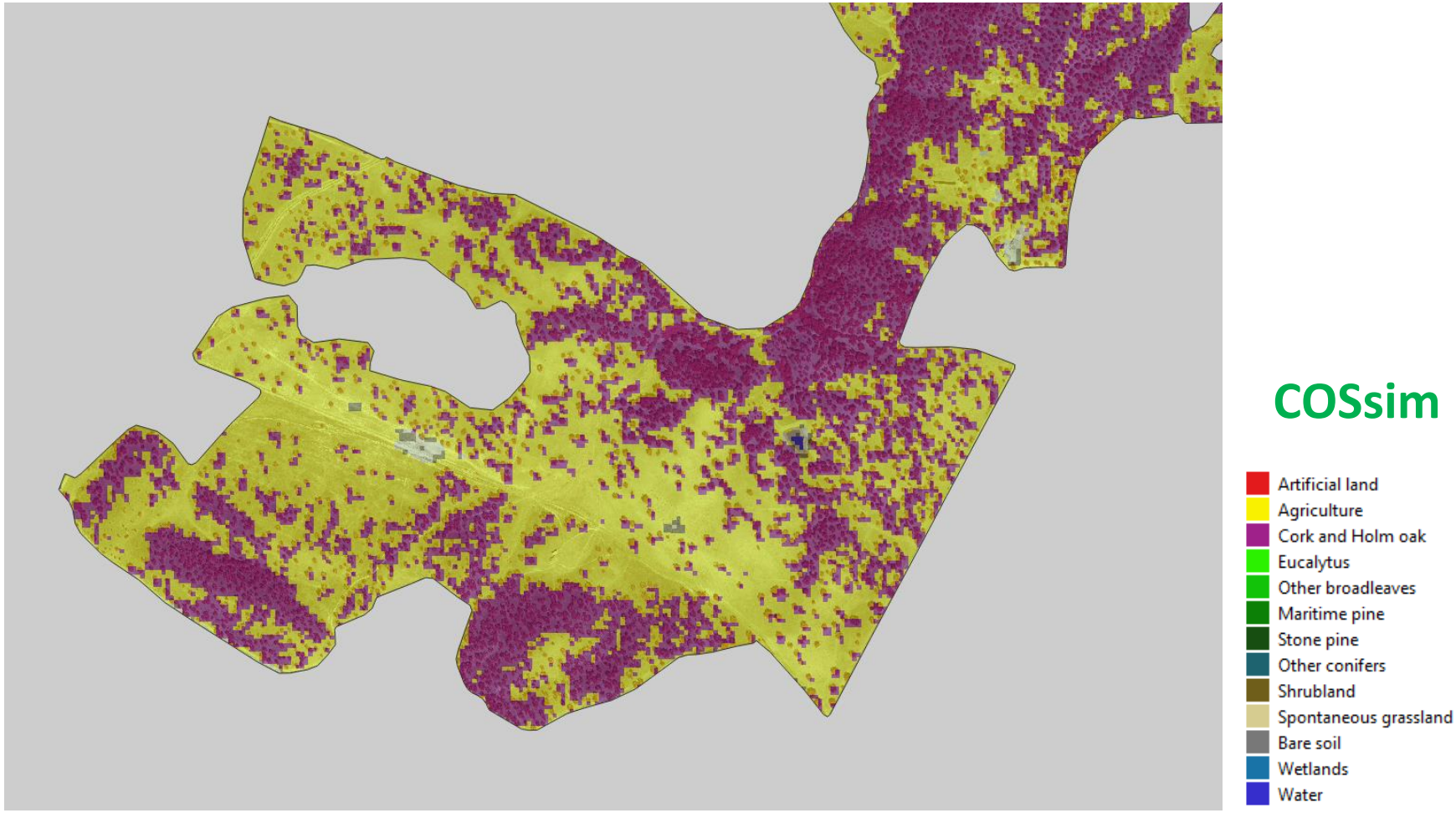
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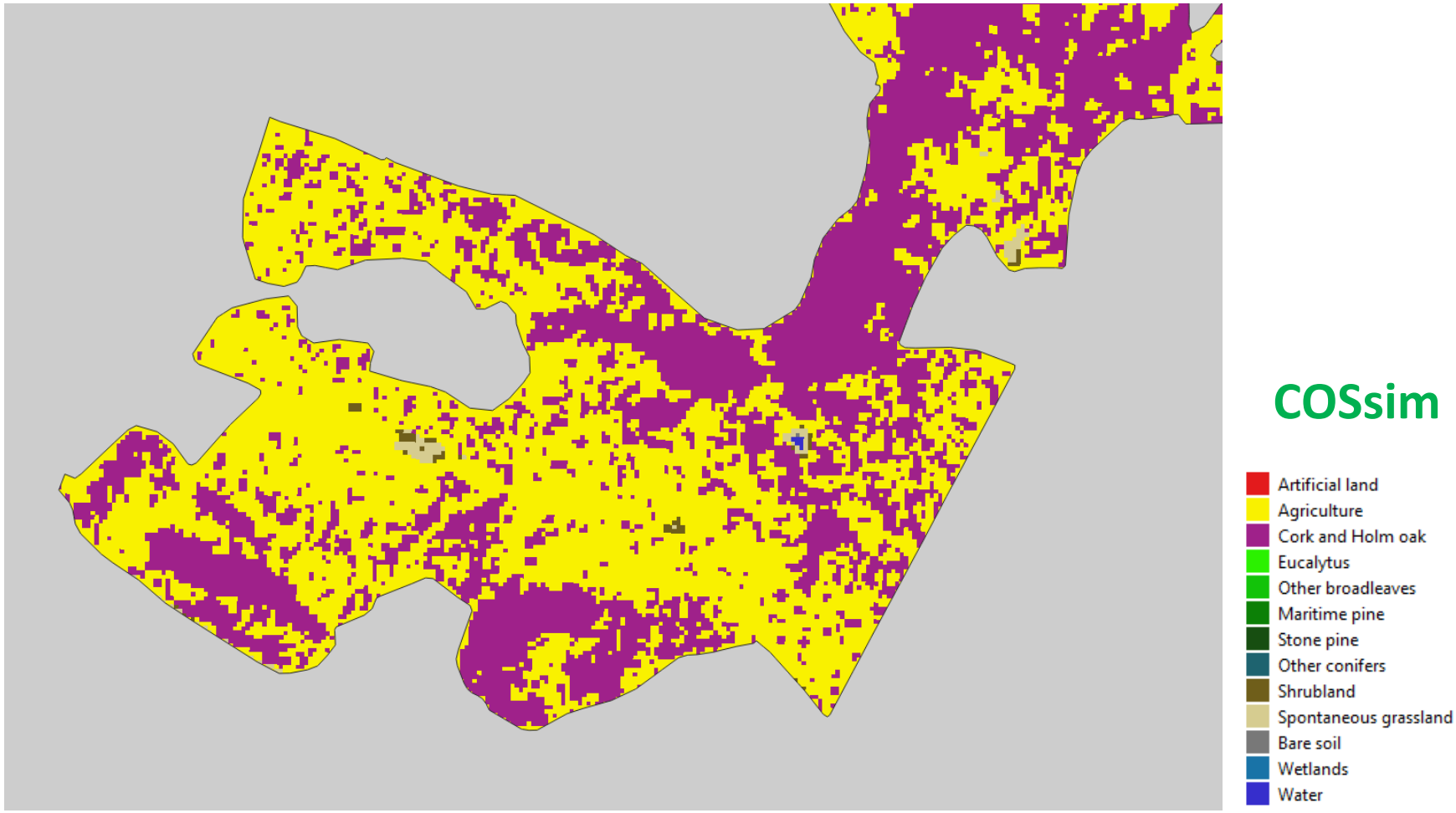
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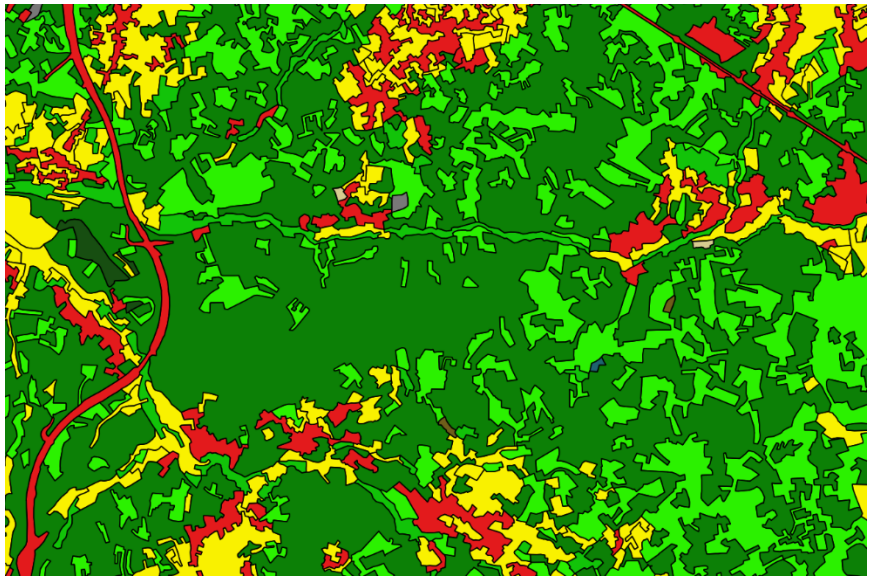
SMOS.PT
for forest



COS

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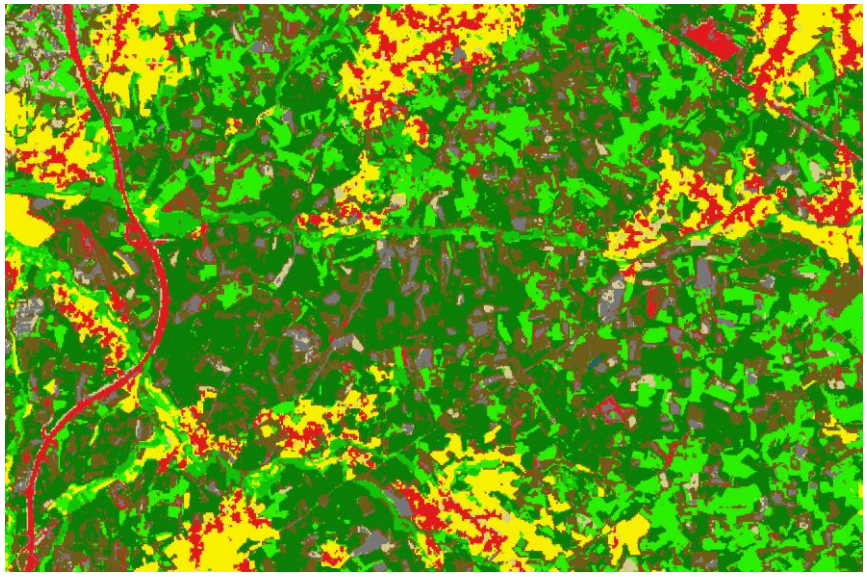

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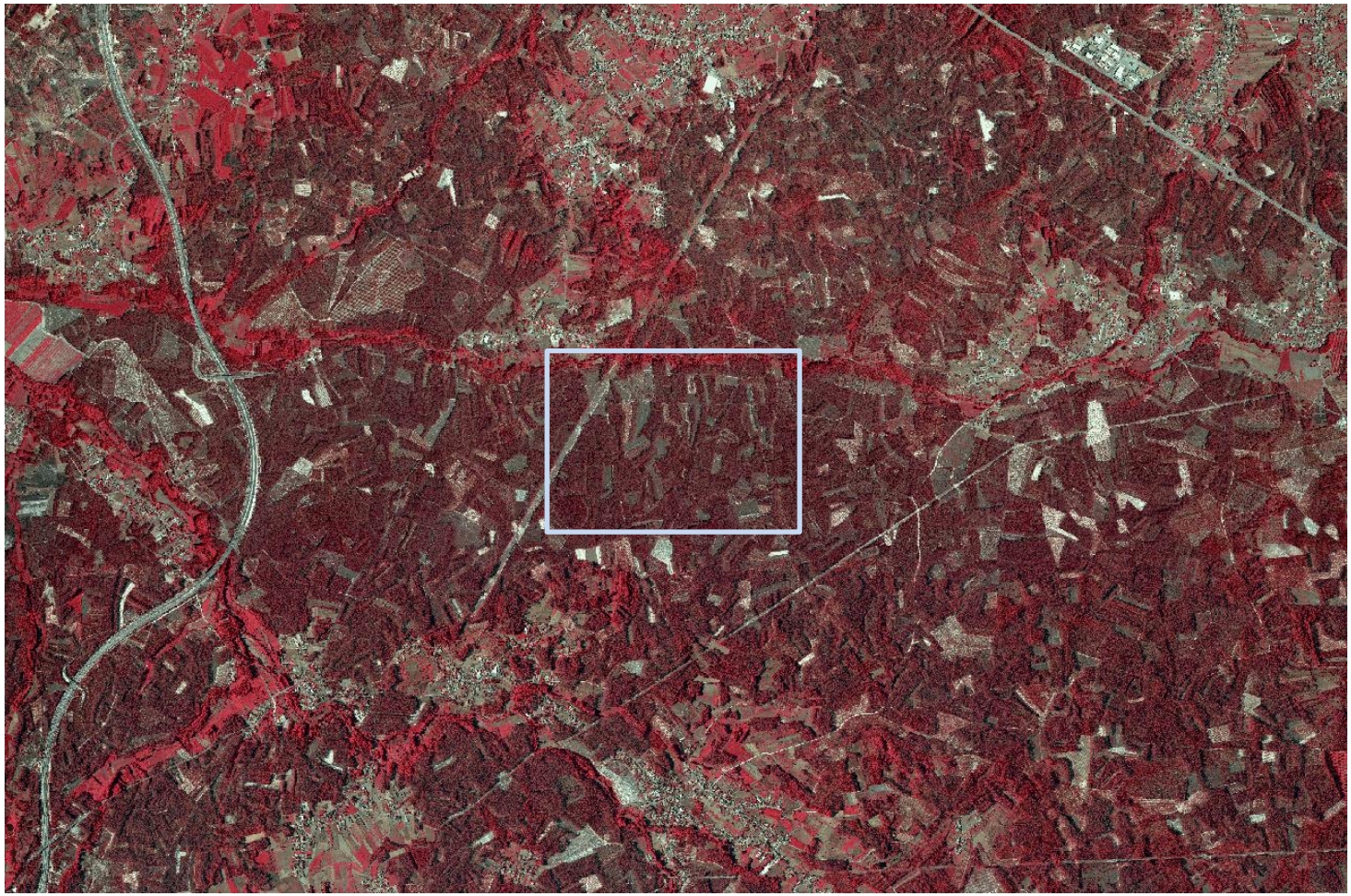
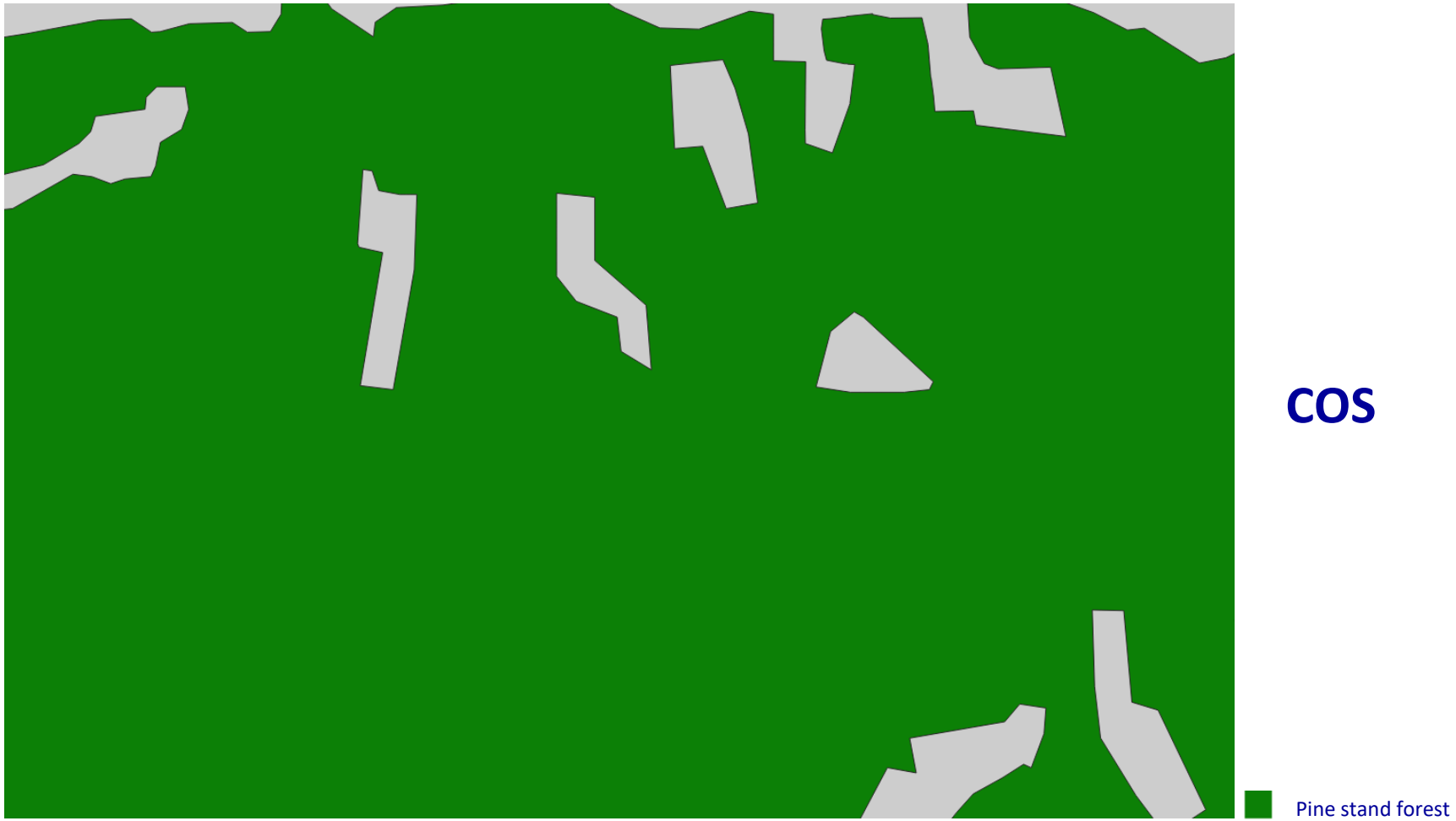
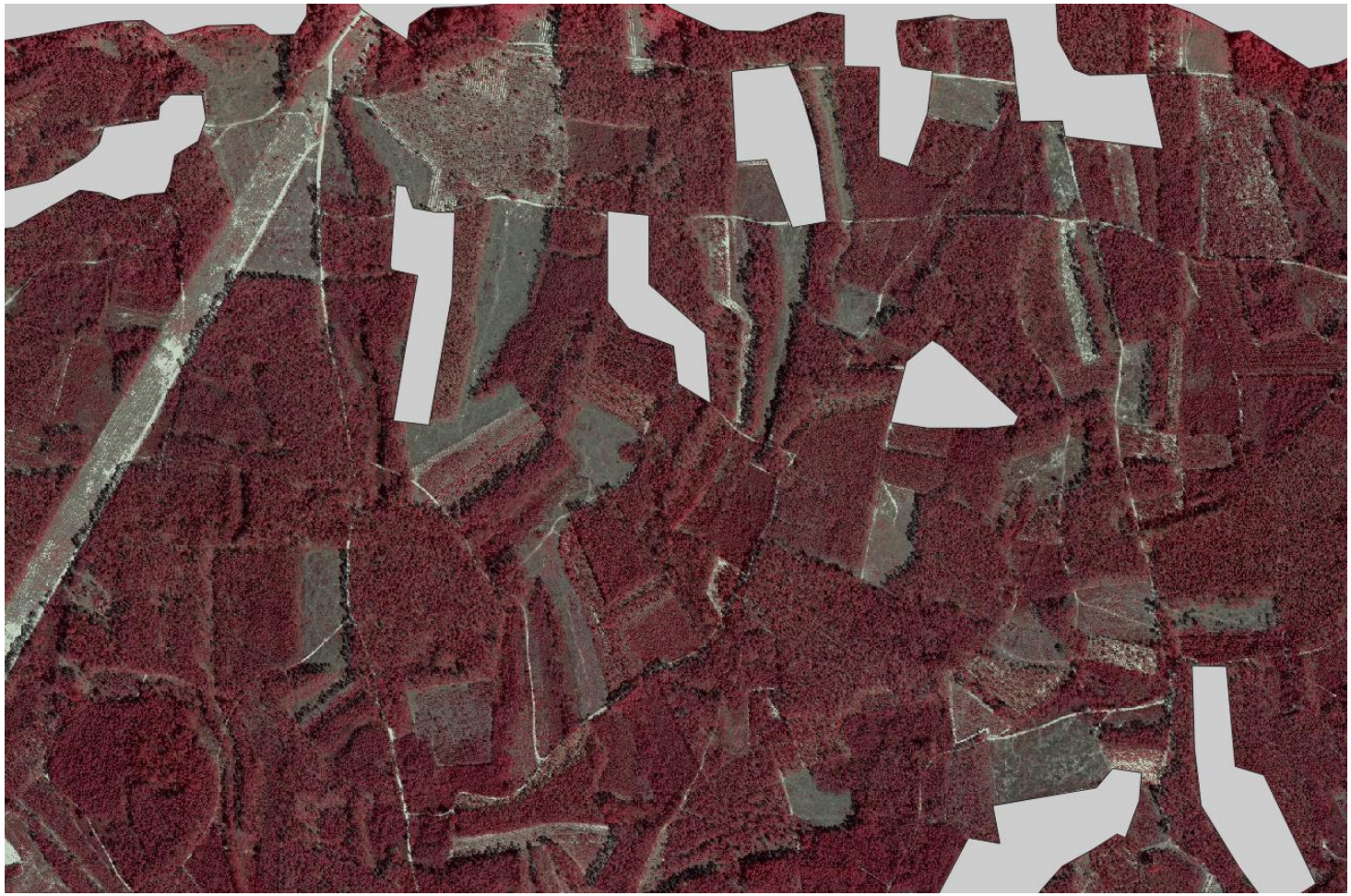



COS
Pine stand forest

The same land use (e.g. pine forest) can have different land cover, e.g. trees and herbaceous (after clear cuts)



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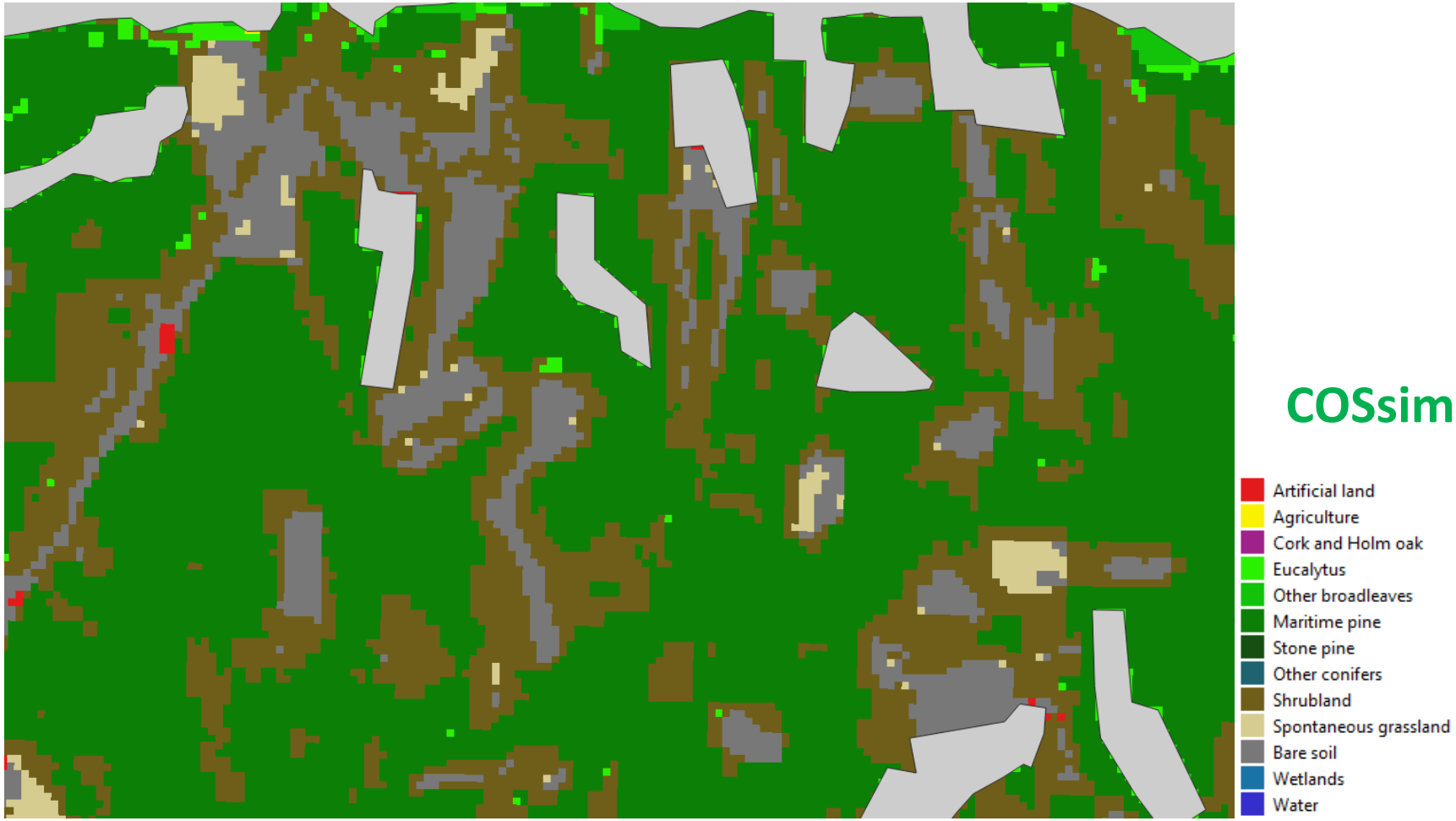

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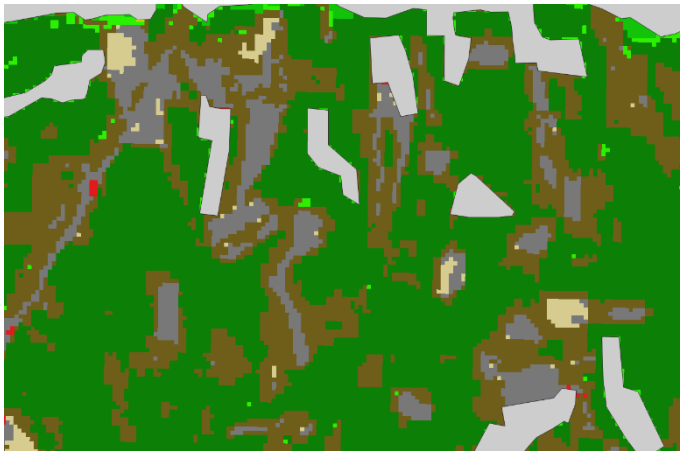

COS

Land use

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- Cork and Holm oak
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- Wetlands
- Water

COSsim

Land cover

Free and open data policy

AI

1 image every 5 days

Forest monitoring

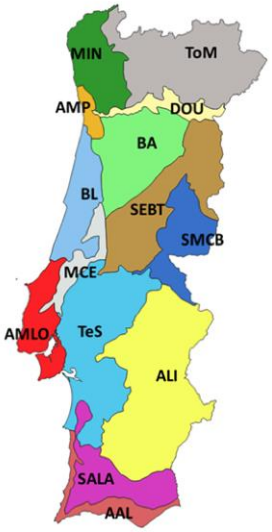
Legislation compliance verification

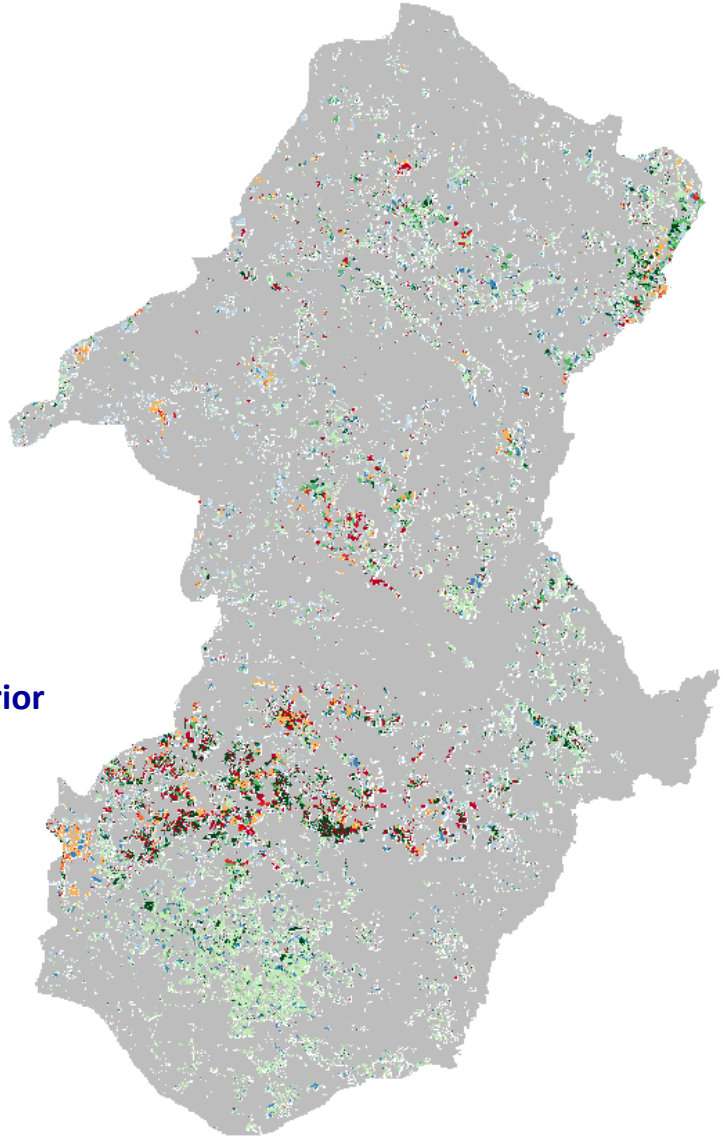
Timber yield estimation

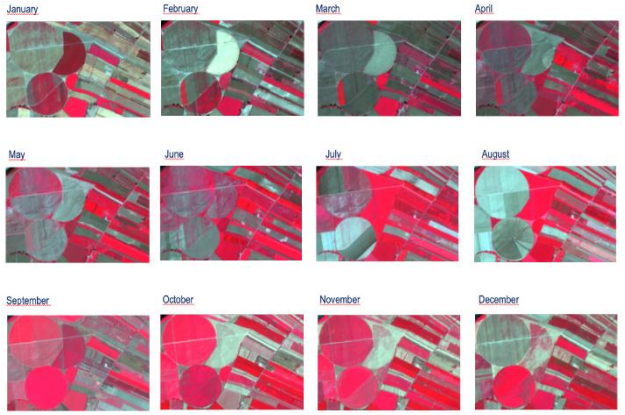
Carbon stock monitoring

SMOS.PT for agriculture

Crop maps

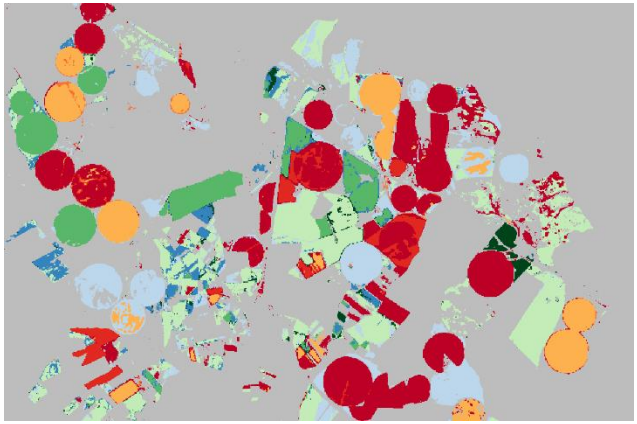




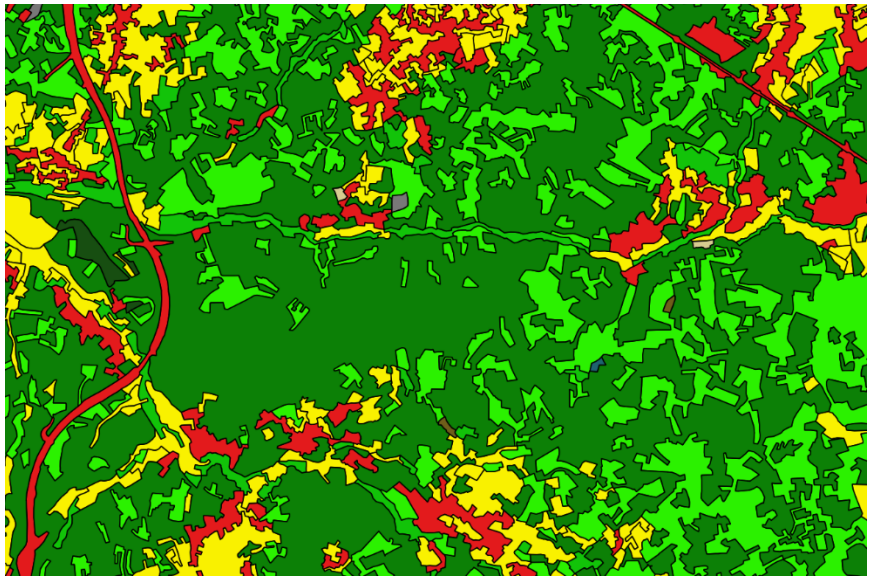


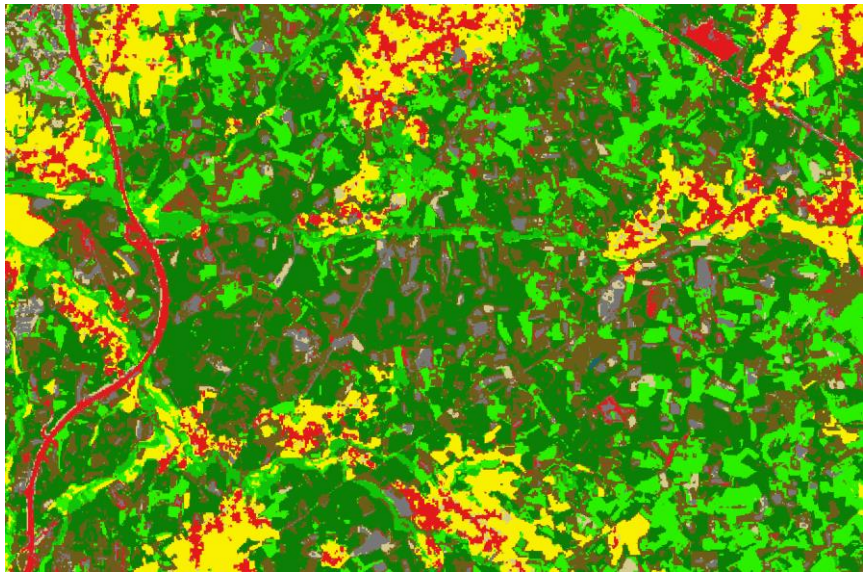
UP: Alentejo Interior

- Oat
- Wheat
- Barley
- Ryegrass
- Triticale
- Rye
- Maize
- Rice
- Tomato
- Sunflower



SMOS.PT
for
fire risk assessment and management





COS

Land use map

Fire risk mapping

Fire spread modelling

Fire fighting

COSsim

Land cover

- Artificial land
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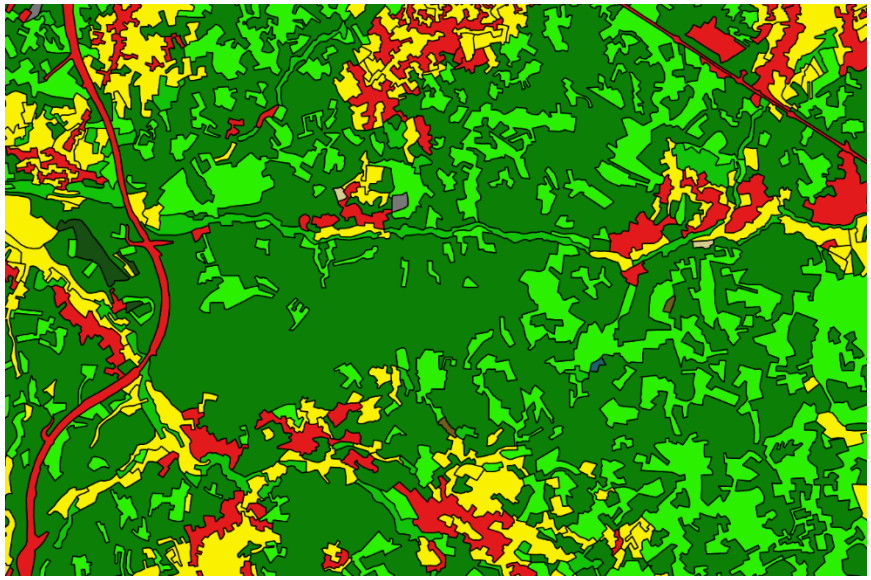

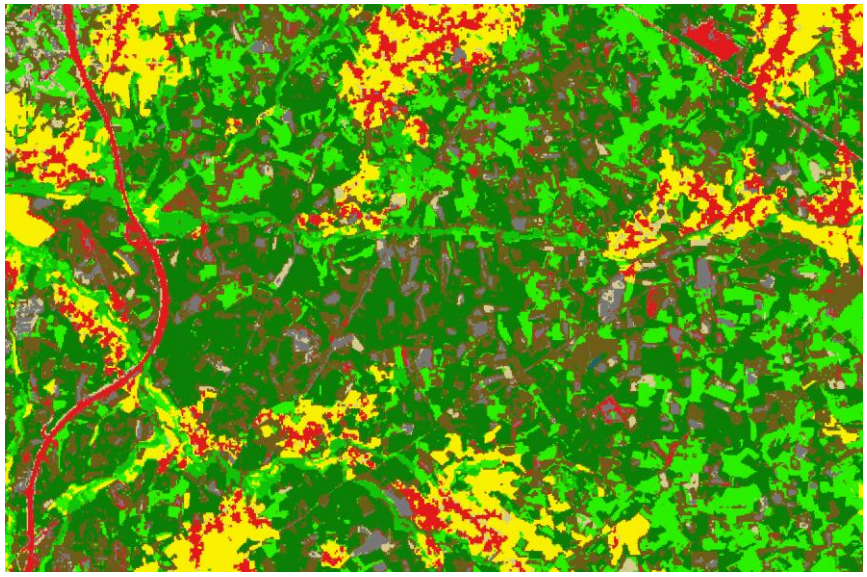

COS

Land use map

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Fire risk mapping

Fire spread modelling

Fire fighting

SMOS.PT
for cadastre / land register

Cadastre parcel:

- Land cover land use characterization
- Land cover land use history

Traditional map

New map

COS

vs

COSsim

Visual interpretation of aerial photos

Automatic classification of satellite images

Space technology and AI for Land cover mapping

- Do it faster
- Do it with better spatial detail (less generalisation)
- Do it more times (dynamics monitoring)

- Do new products

- Much less expensive

SMOS.PT

Land Cover Monitoring System

Production and dissemination of reliable, public and open land cover land use information

Why is this possible now?

1

opernicus
Europe's eyes on Earth

Free and open data policy

2

R&D

esa

FCT
Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR

d.gTerritório

Public Administration **Competence Centre** for satellite image processing for the territory

Big data

AI

3

User involvement

- Public Administration
- Academy
- Private sector

- Citizen

SMOS.PT

Land Cover Monitoring System

Production and dissemination of reliable, public and open land cover land use information

User involvement

Our challenge now

- Citizen

Geoportal for making these data available to the citizen in a user-friendly and easy way (simplex measure)

SMOS

Land Cover Monitoring System for Portugal

mario.caetano@dgterritorio.pt

Deputy Director-General

d·gTerritório
Direção-Geral do Território