29 MAY 2024

NATUREFIRST

HABITAT MAPPING

Boris Hinojo / Federico Cheda - 3edata

3edata

Funded by
the European Union

WHY MAPPING HABITATS

Automating the process

More than a map

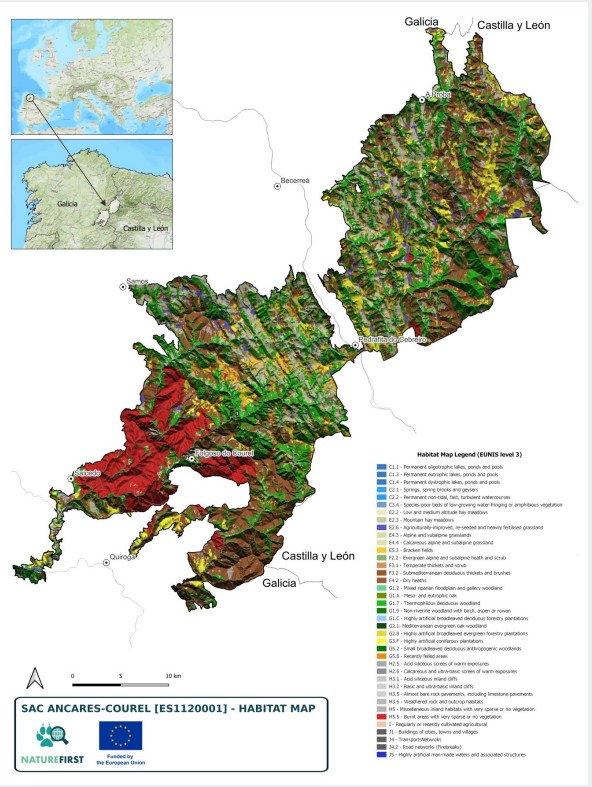
A **Model** for Habitat Mapping and Assessment

NATUREFIRST

- **Automatic classification** of multi-spectral images
- Integration of **previous thematic cartography**
- **Validation rules** and **habitat definition Manager**

- **Integration** of information on pressures and threats
- Calculation of variables for **assessing conservation status**
- Facilitate the **definition of conservation objectives** (SSCOs)

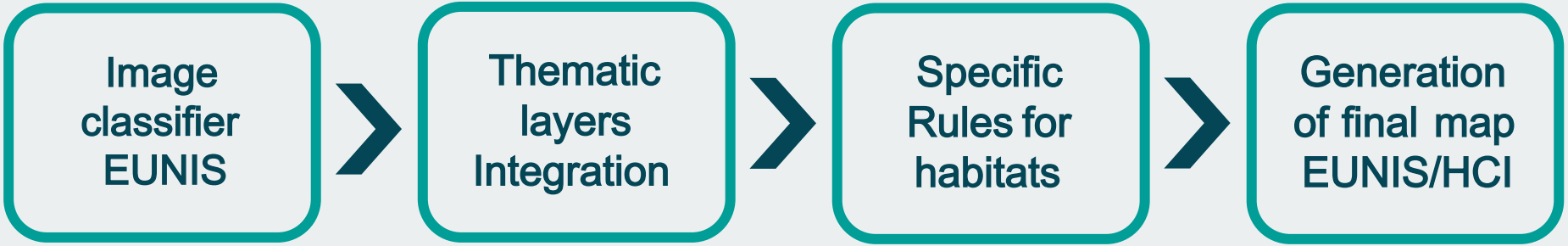
- **Reduce costs** of production, **updating** and **data management**.



Internal Functioning of the Model

General scheme. **Mapping**

NATUREFIRST



Based on multispectral images and **Training Areas** network (TA).

Incorporation of habitats through **thematic layers** (DTL).

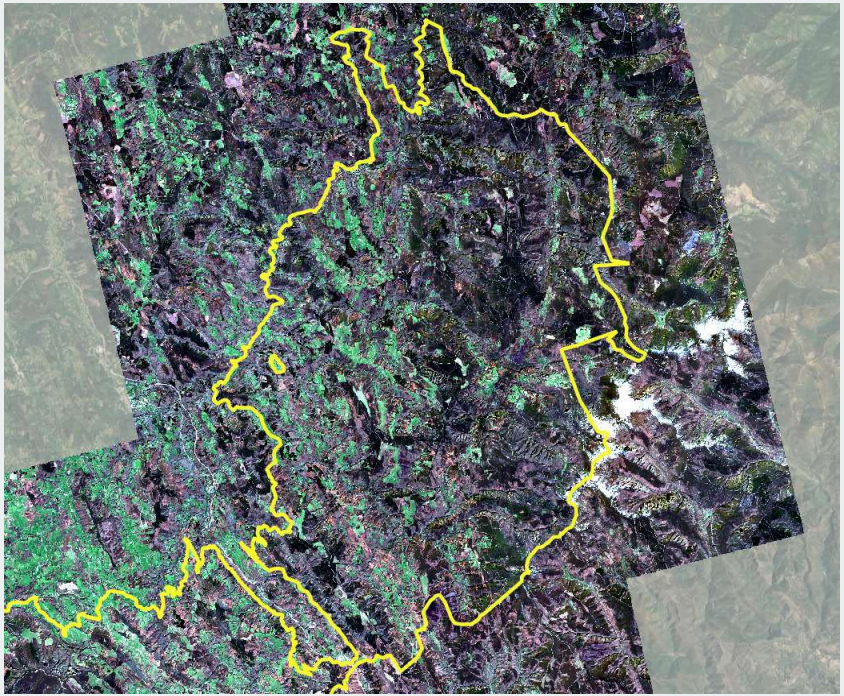
Determination of habitats using a **decision tree** (RTL).

Structure of the **information** and export of **results**.

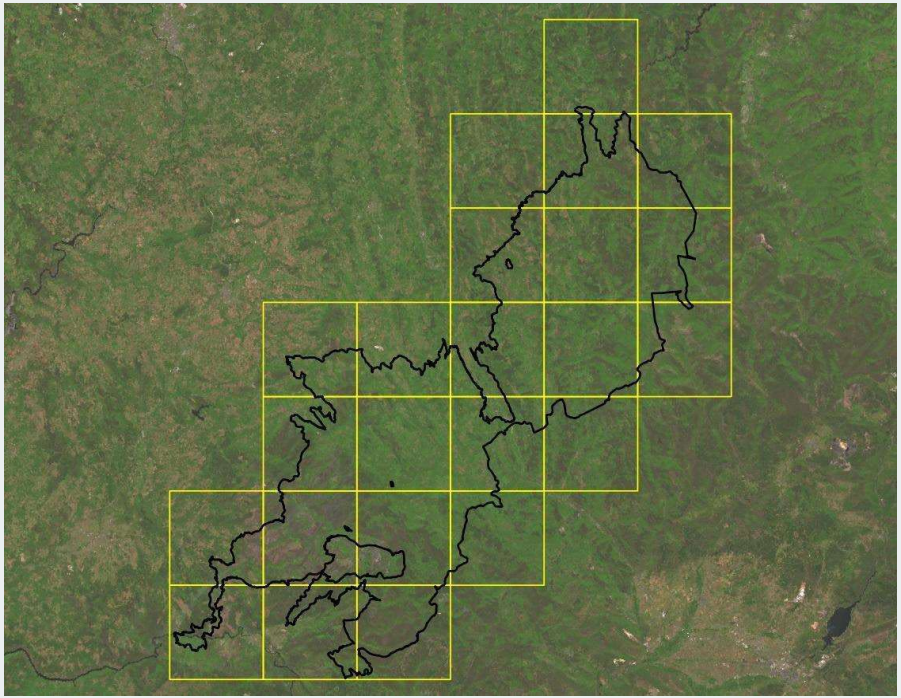
Internal Functioning of the Model

Minimal unit of analysis

NATUREFIRST



Multispectral image mosaics.
Classification system based on N images

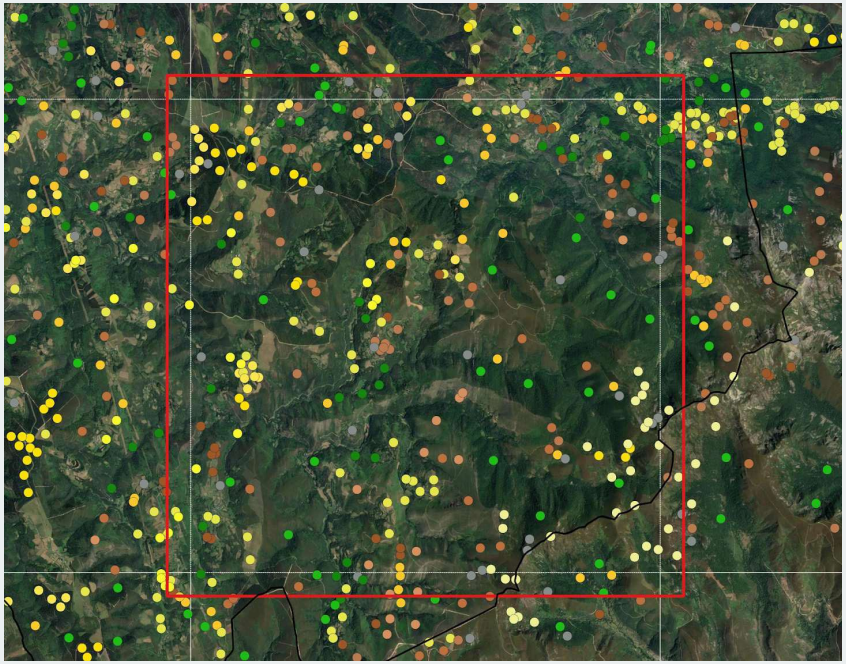


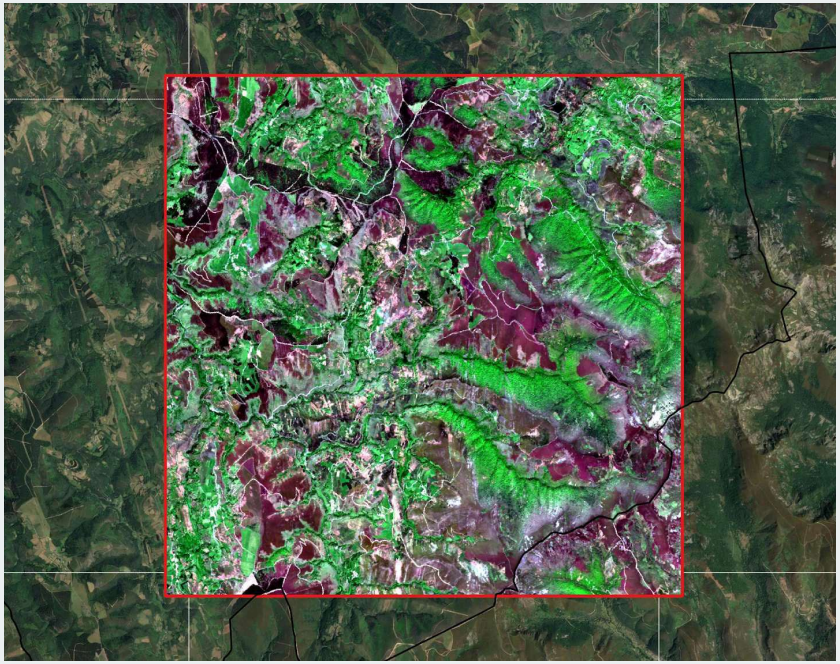
Basic unit of analysis (cells) 10x10km grid for Sentinel 2 imagery

Internal Functioning of the Model

The importance of the Ground Truth

NATUREFIRST



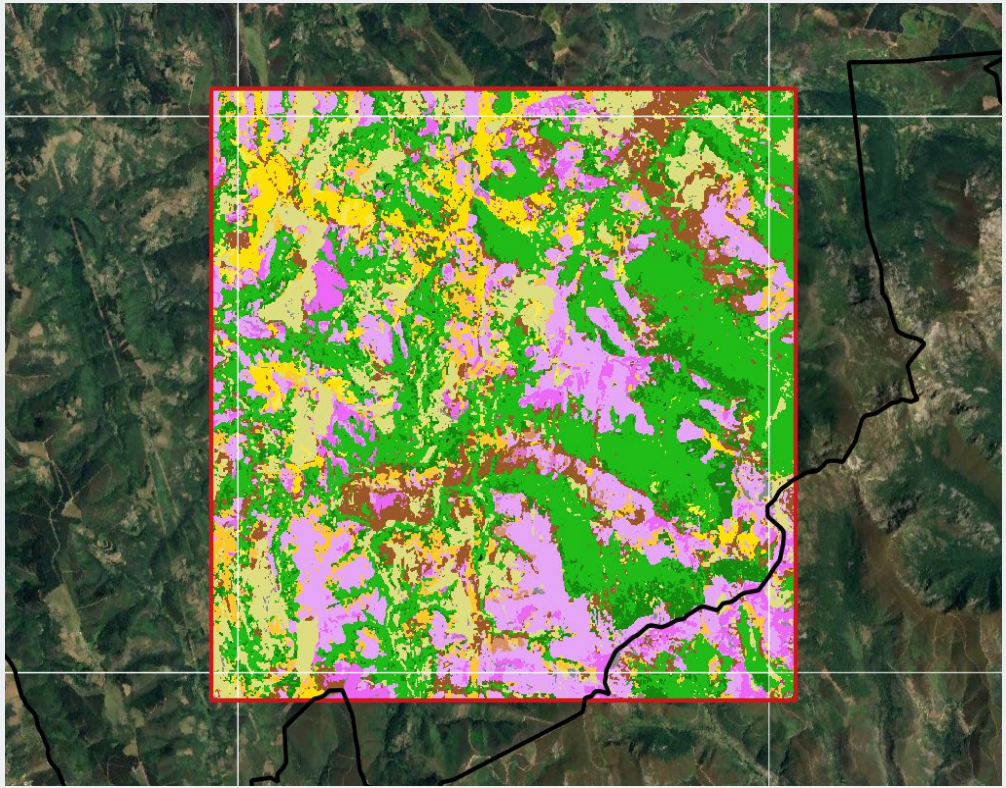


Network of **Training Areas**. Labelled with maximum known level of EUNIS classification.
Densification and determination of classes adapted to each cell 10x10km.

Internal Functioning of the Model

Spectral response of a habitat

NATUREFIRST



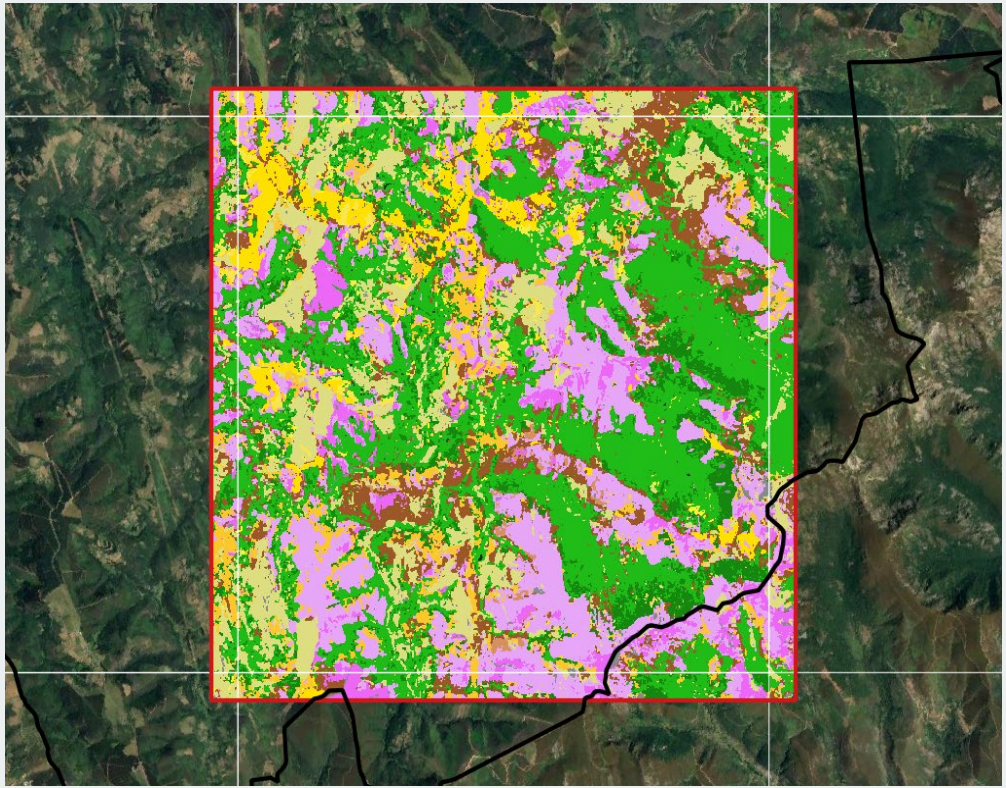
EUNIS classes in the Image Classifier product (Raster format)

- E-Grasslands
- E5.31-Sub-Atlantic bracken fields
- F3.15-Gorse thickets
- F3.25-Piornales
- F4.2-Dry heaths
- F4.2421-Luso-Galician collinar heaths
- F4.2441-Galicio-Leonese [Erica aragonensis] heaths
- G1.7B2-Cantabrian Pyrenean oak forests
- G1.7D-Chestnut woodland
- G1.9151 - Cantabrian [Betula celtiberica] woodlands
- G1.C-Highly artificial broadleaved deciduous forestry plantations
- G2.12 - Holm-oak woodland
- G2.81-Eucalyptus plantations
- G3-Coniferous woodland
- G3.F-Highly artificial coniferous plantations
- H-Unvegetated

Internal Functioning of the Model

Validation Systems . Improving

NATUREFIRST



-Confusion matrix for each basic **cell**
-Confusion matrix for the whole **site**

CARTOGRAFÍA

FOTOINTERPRETE	HERBACEO	HELECHO	TOJO	PIORNO	BREZO	ROBLE	CASTAÑO	ABEDUL	ACACIA	ENCINA	EUCALIPTO	PINO	S DESNUDO		
	> 0,05ha	E2	E5.31	F3.15	F3.25	F4.2	G1.782	G1.7D	G1.9151	G1.C	G2.12	G2.81	G3	H2		%
HERBACEO	E2	1598971	7194	0	8417	57720	2067	631	0	0	0	55	399	285	1675739	95,4
HELECHO	E5.31	9	197560	0	17	10	17	188	0	0	0	5	97	0	197909	99,8
TOJO	F3.15	1778	10	8053	12101	242051	1528	1035	0	0	0	0	1630	0	268234	3,0
PIORNO	F3.25	6617	863	1827	128107	22764	903	21	0	0	0	1793	21614	0	184509	69,4
BREZO	F4.2	8725	259	1181	1842	2164531	925	0	0	0	0	0	14368	9596	2201427	98,3
ROBLE	G1.782	7553	454	0	10132	4760	407499	67820	2699	884	0	58	1259	293	503411	80,9
CASTAÑO	G1.7D	1260	2246	0	2547	386	22804	206919	0	2	0	250	0	78	236492	87,5
ABEDUL	G1.9151	88	0	0	886	0	27210	1357	15631	0	0	93	0	0	45265	34,5
ACACIA	G1.C	44	0	0	539	328	19	0	0	12933	0	0	0	45	13908	93,0
ENCINA	G2.12	8078	12	0	97722	65989	8855	6049	0	7809	21946	1562	12470	0	230492	9,5
EUCALIPTO	G2.81	1209	208	0	359	2575	183	0	0	0	0	38088	9771	0	52393	72,7
PINO	G3	964	28	0	46980	122028	18453	261	0	486	0	3889	1210683	0	1403772	86,2
S DESNUDO	H2	2663	4362	0	1428	28768	229	0	0	0	0	163	14569	514692	566870	90,8
		1637959	213210	11061	311077	2711950	490692	284281	18330	22114	21946	45956	1286856	524989	7580421	
	%	97,6	92,7	72,8	41,2	79,8	83,0	72,8	85,3	58,5	100,0	82,9	94,1	98,0		
	5% smpl	81898	10661	553	15554	135598	24535	14214	917	1106	1097	2298	64343	26249		
	10% smpl	163796	21321	1106	31108	271195	49069	28428	1833	2211	2195	4596	128686	52499		
	20% smpl	327592	42642	2212	62215	542390	98138	56856	3666	4423	4389	9191	257371	104998		

	HERBACEO	HELECHO	TOJO	PIORNO	BREZO	ROBLE	CASTAÑO	ABEDUL	ACACIA	ENCINA	EUCALIPTO	PINO	CANCHAL	
P.P	97,6	92,7	72,8	41,2	79,8	83,0	72,8	85,3	58,5	100,0	82,9	94,1	98,0	
E.O	2,4	7,3	27,2	58,8	20,2	17,0	27,2	14,7	41,5	0,0	17,1	5,9	2,0	
producto	2,74479E+12	4219617890	2966936274	57396506193	5,97016E+12	2,4702E+11	67230182252	829707450	307561512	505837432	2407772708	1,80645E+12	2,97601E+11	
kappa fila	0,94	1,00	0,03	0,68	0,97	0,80	0,87	0,34	0,93	0,09	0,73	0,83	0,90	
kappa col	0,97	0,92	0,72	0,40	0,72	0,82	0,72	0,85	0,58	1,00	0,83	0,93	0,98	
														Coef priori
														Coef posteriori

Internal Functioning of the Model

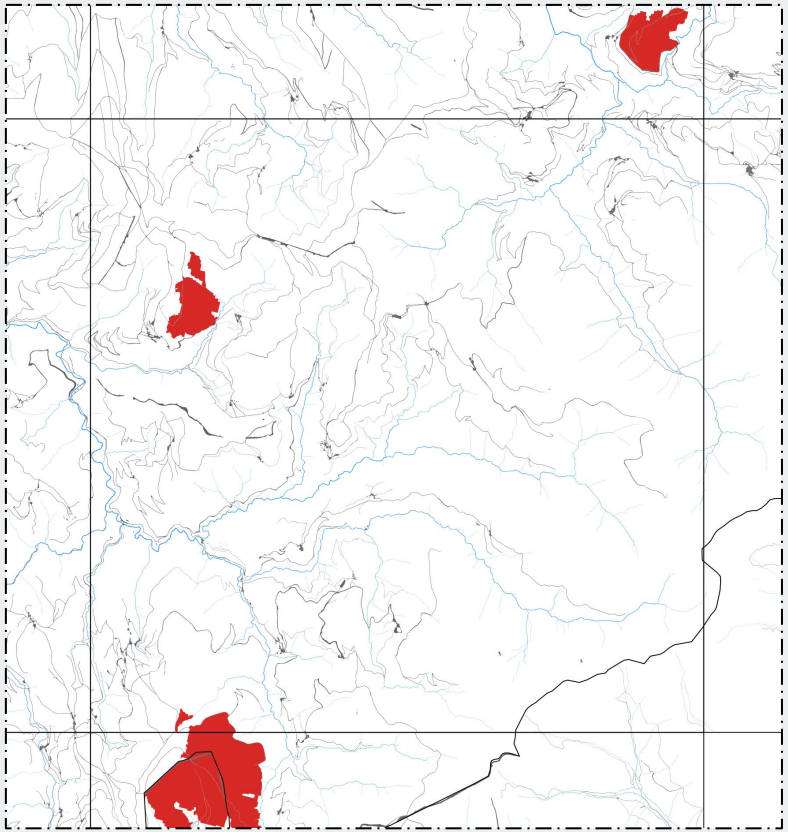
Thematic layers Integration [DTL]

NATUREFIRST

Integration of previous reference cartography.
Classes easily assimilated with a EUNIS category,
with proven accuracy and reliability. Examples:

- ❑ Water bodies and river channels
- ❑ Buildings/Urbanizations
- ❑ Communication
- ❑ Infrastructures
- ❑ Burnt areas

EUNIS DTL
C1 - Surface standing waters
C1.1 - Permanent oligotrophic lakes, ponds and pools
C1.3 - Permanent eutrophic lakes, ponds and pools
C1.4 - Permanent dystrophic lakes, ponds and pools
C3.4 - Species-poor beds of low-growing water-fringing or amphibious vegetation
C2 - Surface running waters
C2.1 - Springs, spring brooks and geysers
C2.2 - Permanent non-tidal, fast, turbulent watercourses
H3 - Inland cliffs, rock pavements and outcrops
H5.51 - Unvegetated recently burnt ground
J1 - Buildings of cities, towns and villages
J4 - Transport networks and other constructed hard-surfaced areas
J4.2 - Road networks
J5 - Highly artificial man-made waters and associated structures



Internal Functioning of the Model

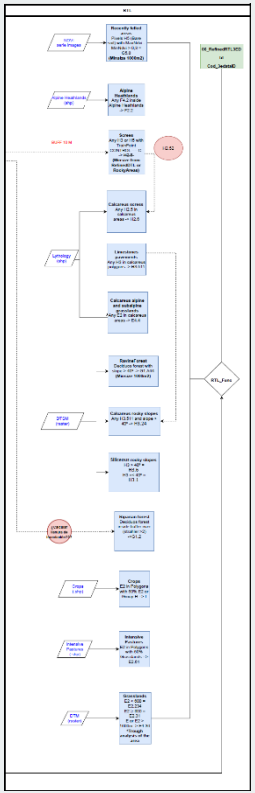
Specific Rules for habitats [RTL]

NATUREFIRST

Analysis of previous cartography and biogeographic information.
Definition of rules for assigning new EUNIS categories not previously identified.
Examples:

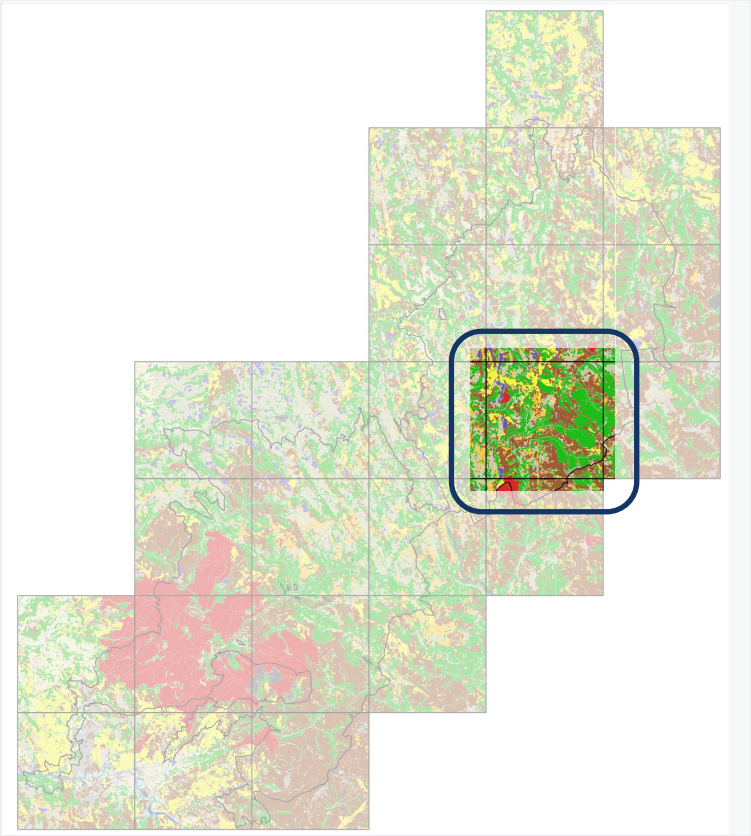
- ❑ Altitude map
- ❑ Slope map
- ❑ Geologic map
- ❑ Agrarian maps (CAP)

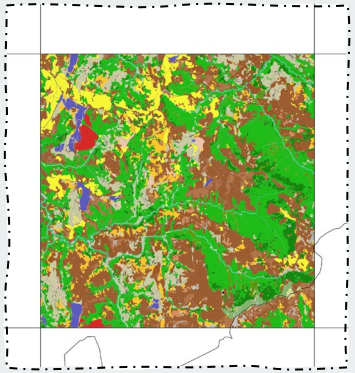
EUNIS RTL
E2.234 - Northern Iberian submontane hay meadows
E2.31 - Alpic mountain hay meadows
E2.61 - Dry or moist agriculturally-improved grassland
E4.36 - Oro-Iberian acidophilous grassland
E4.4 - Calcareous alpine and subalpine grassland
F2.2 - Evergreen alpine and subalpine heath and scrub
G1.2 - Mixed riparian floodplain and gallery woodland
G1.A44 - Pyreneo-Cantabrian mixed elm - oak forests
G5.8 - Recently felled areas
H2.5 - Acid siliceous screes of warm exposures
H2.6 - Calcareous and ultra-basic screes of warm exposures
H3.1 - Acid siliceous inland cliffs
H3.24 - Western mediterraneo-montane chasmophyte communities
H3.511 - Limestone pavements
H3.6 - Weathered rock and outcrop habitats
I - Regularly or recently cultivated agricultural, horticultural and domestic habitats



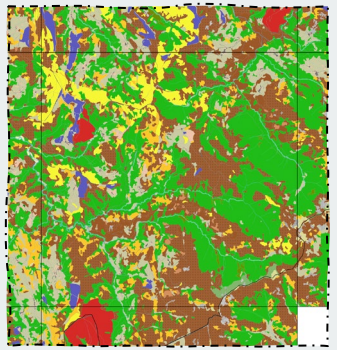
Internal Functioning of the Model

Generation of final map

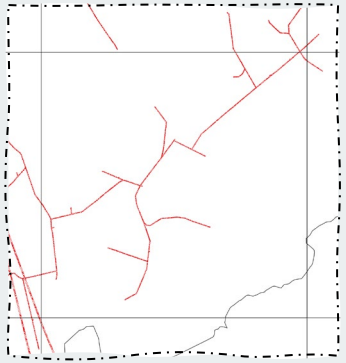




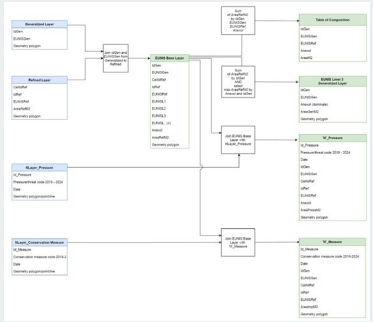
EUNIS base layer



EUNIS Level 3



Pressures (power line)



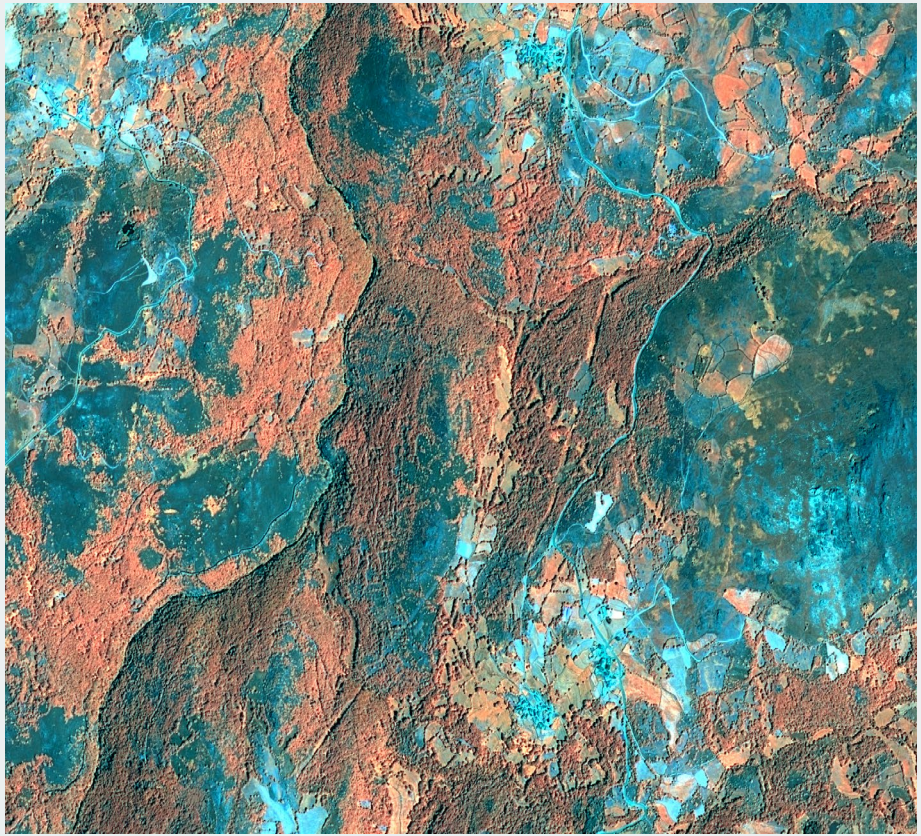
Relationship structure

Internal Functioning of the Model

Habitat monitoring . Assessment of conservation status

NATUREFIRST

- **Updating** of the habitat mapping.
- Automatic **change detection**.
- Analysis of the **dynamics of occupation**.
- Processes of **continuous improvement** of the Model.
- Improve the capacity for **multi-scale analysis**.



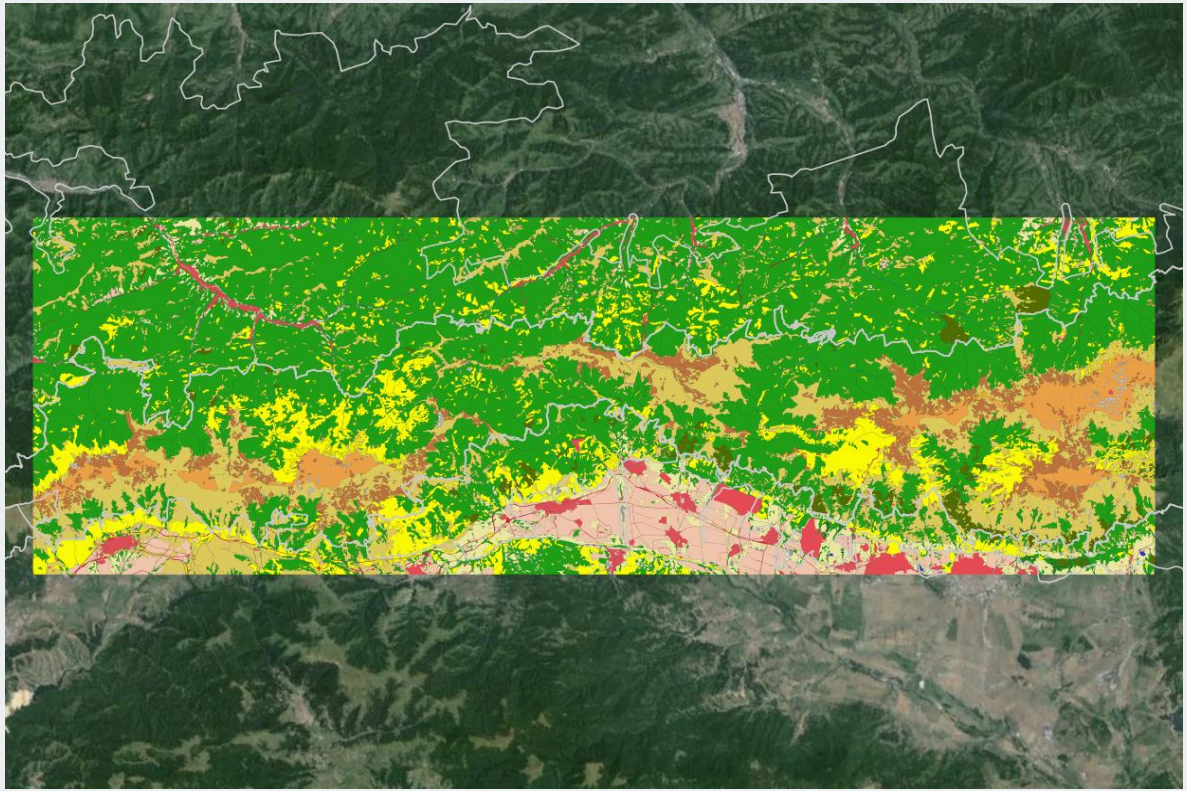
WORKFLOW

Producing the Habitat Map

Through the Habitat Mapping Model

Workflow. Interaction process

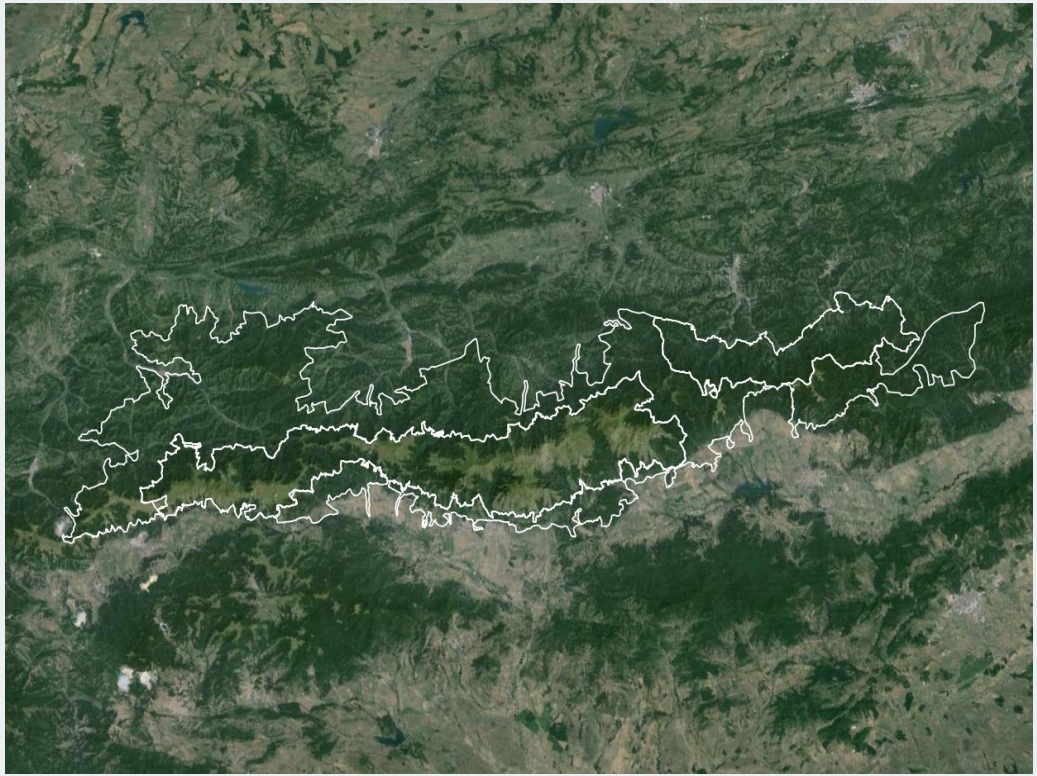
Use case: Tsentralen Balkan



- Habitat Mapping request (BAS)
- Analysis , resources & objectives (BAS & 3EDATA)
- Training Areas Network (TAN) (BAS & 3EDATA)
- 1st iteration of HM-Model (3EDATA)
- Improvements to the TAN and HM-Model (BAS & 3EDATA)
- 2nd iteration of HM-Model (3EDATA)
- Habitat Map Results

Workflow. Interaction process

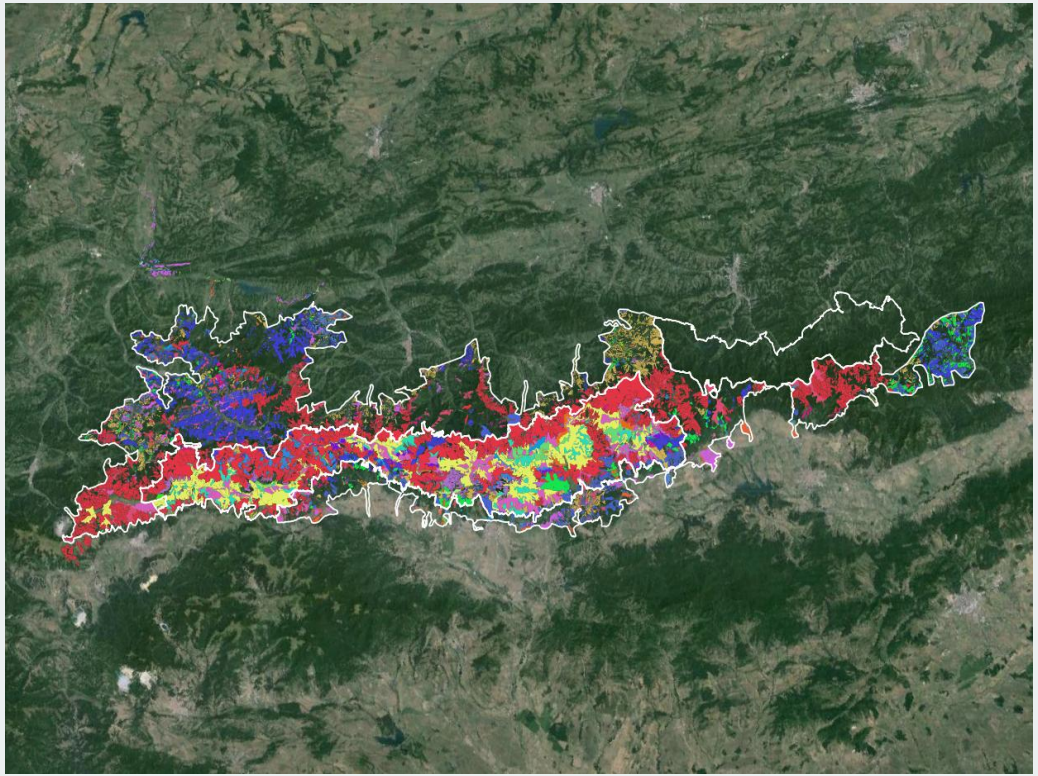
Use case: Tsentralen Balkan



- **Habitat Mapping request (BAS)**
- Analysis , resources & objectives (BAS & 3EDATA)
- Training Areas Network (TAN) (BAS & 3EDATA)
- 1st iteration of HM-Model (3EDATA)
- Improvements to the TAN and HM-Model (BAS & 3EDATA)
- 2nd iteration of HM-Model (3EDATA)
- Habitat Map Results

Workflow. Interaction process

Use case: Tsentralen Balkan

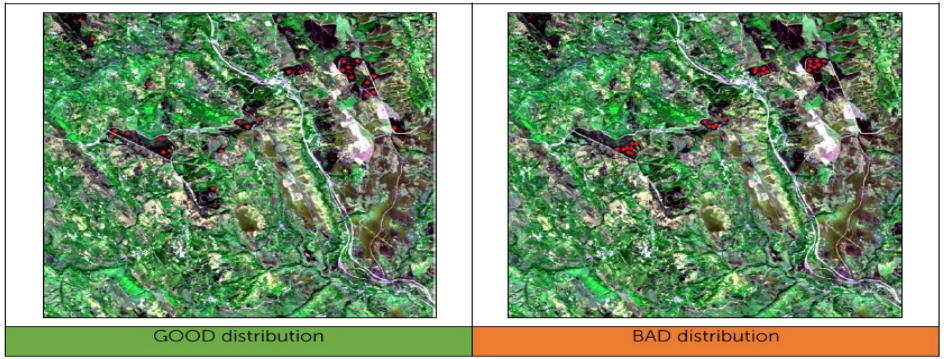


- Habitat Mapping request (BAS)
- **Analysis , resources & objectives (BAS & 3EDATA)**
- Training Areas Network (TAN) (BAS & 3EDATA)
- 1st iteration of HM-Model (3EDATA)
- Improvements to the TAN and HM-Model (BAS & 3EDATA)
- 2nd iteration of HM-Model (3EDATA)
- Habitat Map Results

Workflow. Interaction process

Use case: Tsentralen Balkan

- The goal is to include 20 well-distributed points for each class of EUNIS you are interested in classifying (as long as possible).



GOOD distribution | BAD distribution

- Select the point in homogeneous areas of a certain size, NEVER select the point in very small areas so as not to overlap with other classes.

GOOD SELECTION in a rocky area | BAD SELECTION in a rocky area

3edata

NATURE FIRST

Manual for the creation of training areas

Habitat Mapping request (BAS)

Analysis , resources & objectives (BAS & 3EDATA)

Training Areas Network (TAN) (BAS & 3EDATA)

1st iteration of HM-Model (3EDATA)

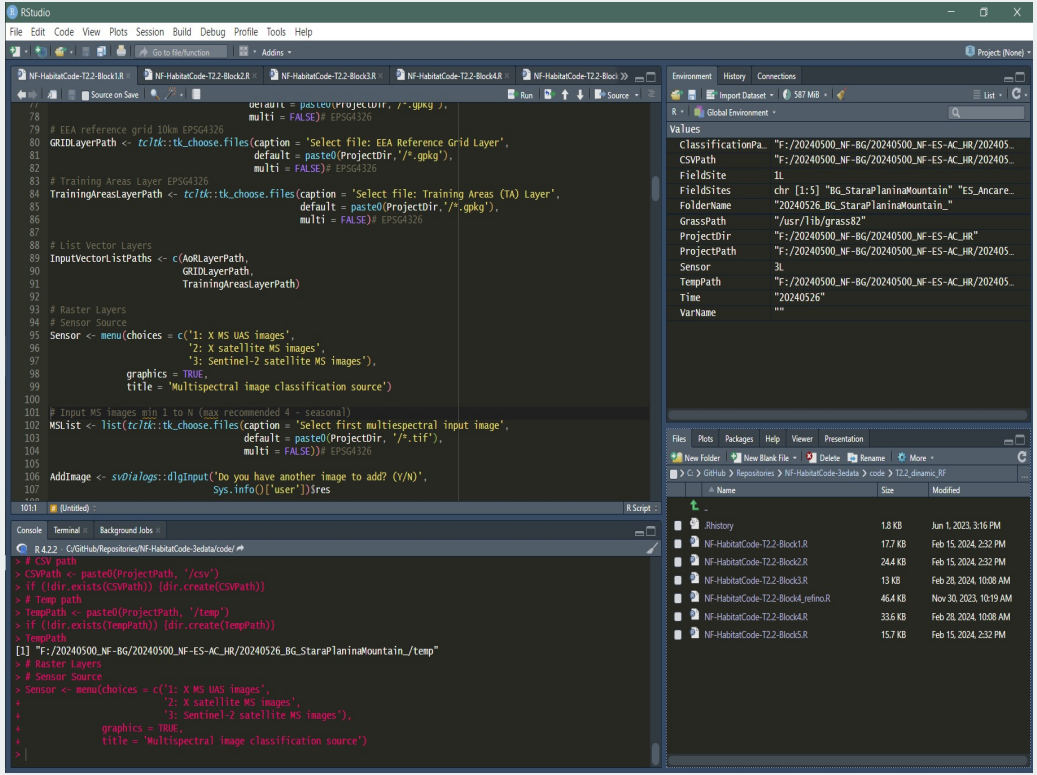
Improvements to the TAN and HM-Model (BAS & 3EDATA)

2nd iteration of HM-Model (3EDATA)

Habitat Map Results

Workflow. Interaction process

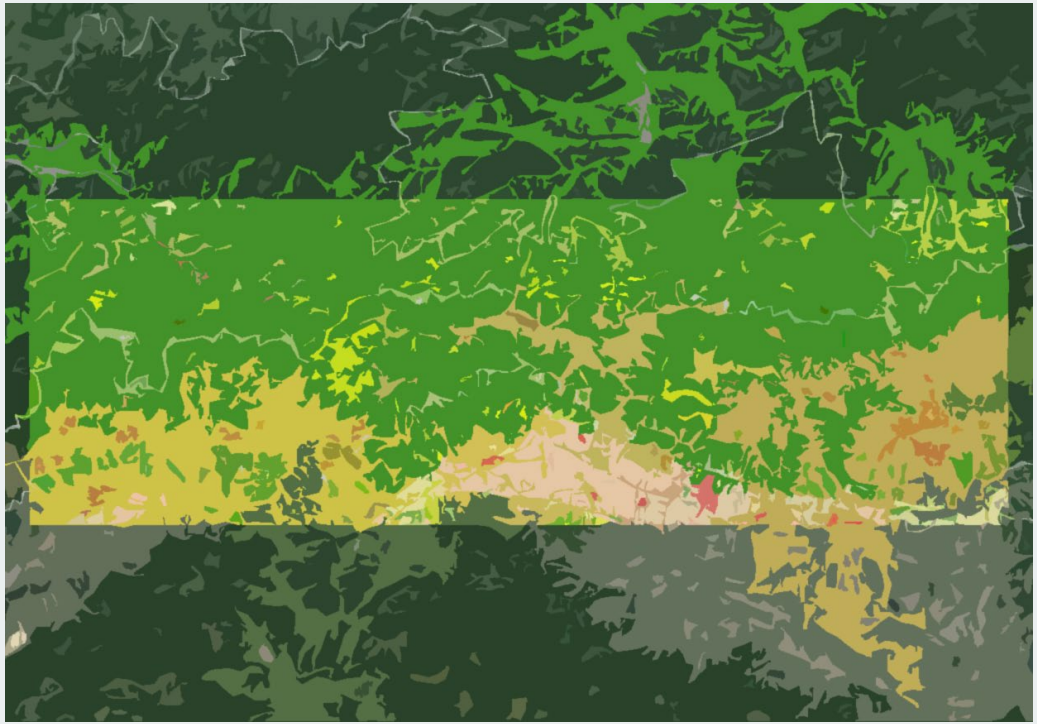
Use case: Tsentralen Balkan



- Habitat Mapping request (BAS)
- Analysis , resources & objectives (BAS & 3EDATA)
- Training Areas Network (TAN) (BAS & 3EDATA)
- **1st iteration of HM-Model (3EDATA)**
- Improvements to the TAN and HM-Model (BAS & 3EDATA)
- 2nd iteration of HM-Model (3EDATA)
- Habitat Map Results

Workflow. Interaction process

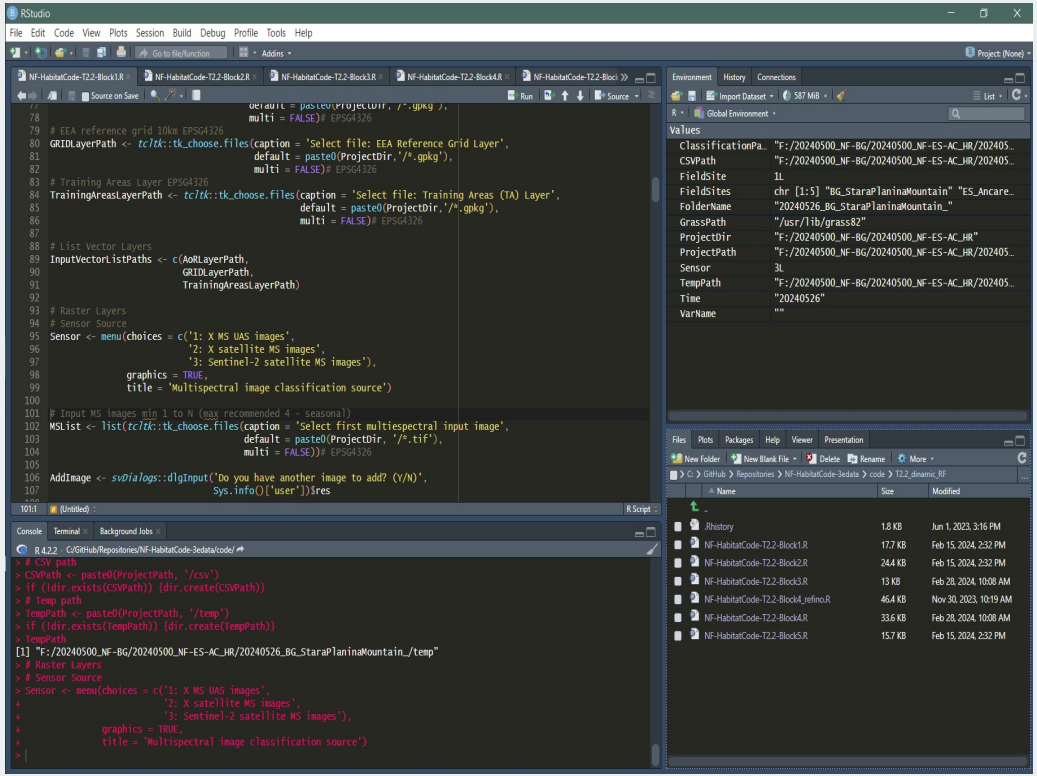
Use case: Tsentralen Balkan



- Habitat Mapping request (BAS)
- Analysis , resources & objectives (BAS & 3EDATA)
- Training Areas Network (TAN) (BAS & 3EDATA)
- 1st iteration of HM-Model (3EDATA)
- **Improvements to the TAN and HM-Model (BAS & 3EDATA)**
- 2nd iteration of HM-Model (3EDATA)
- Habitat Map Results

Workflow. Interaction process

Use case: Tsentralen Balkan



Habitat Mapping request (BAS)

Analysis , resources & objectives (BAS & 3EDATA)

Training Areas Network (TAN) (BAS & 3EDATA)

1st iteration of HM-Model (3EDATA)

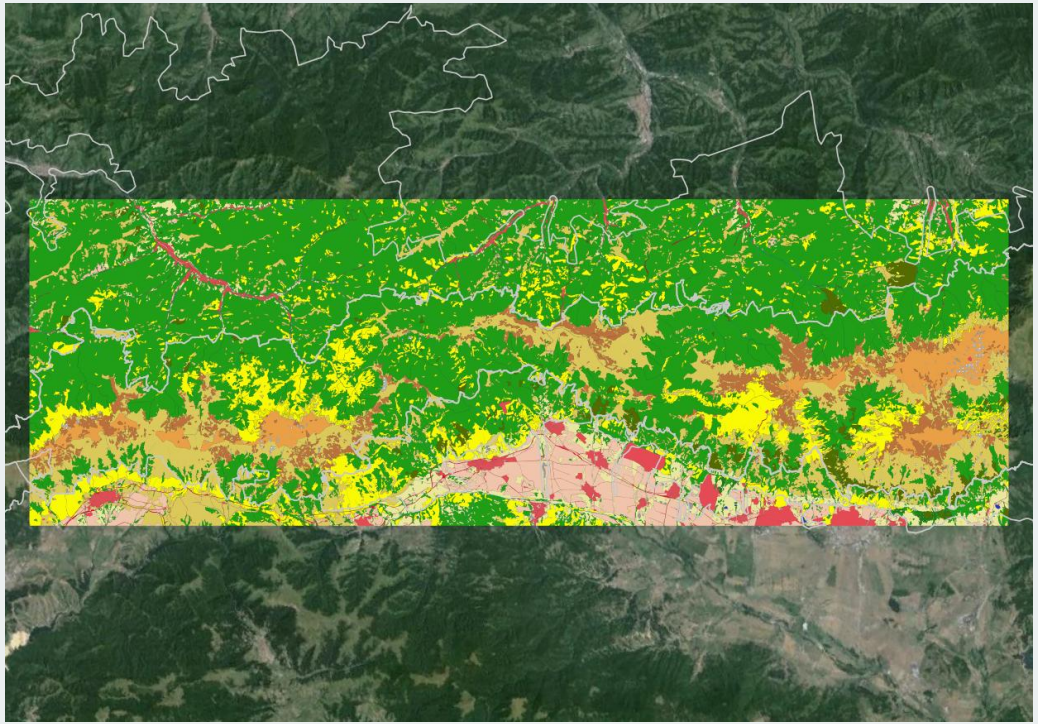
Improvements to the TAN and HM-Model (BAS & 3EDATA)

2nd iteration of HM-Model (3EDATA)

Habitat Map Results

Workflow. Interaction process

Use case: Tsentralen Balkan



	C2.1	C2.1 - Springs, spring brooks and geysers
	C2.2	C2.2 - Permanent non-tidal, fast, turbulent watercourses
	E2.2	E2.2 - Low and medium altitude hay meadows
	E2.3	E2.3 - Mountain hay meadows
	E4.3	E4.3 - Acid alpine and subalpine grassland
	F2.2	F2.2 - Evergreen alpine and subalpine heath and scrub
	G1.2	G1.2 - Mixed riparian floodplain and gallery woodland
	G1.6	G1.6 - Fagus_woodland
	G1.7	G1.7 - Thermophilous deciduous woodland
	G1.A	G1.A - Meso- and eutrophic Quercus, Carpinus, Fraxinus, Acer, Tilia, Ulmus and related woodland
	G3.1	G3.1 - Abies and Picea woodland
	G3.4	G3.4 - Scots pine woodland south of the taiga
	G3.5	G3.5 - Black pine ([Pinus nigra]) woodland
	G3.6	G3.6 - Subalpine mediterranean pine woodland
	H3.1	H3.1 - Acid siliceous inland cliffs
	H3.6	H3.6 - Weathered rock and outcrop habitats
	H5	H5 - Miscellaneous inland habitats with very sparse or no vegetation
	I	I - Regularly or recently cultivated agricultural
	J1	J1 - Buildings of cities, towns and villages
	J4	J4 - Transport networks and other constructed hard-surfaced areas
	J5	J5 - Highly artificial man-made waters and associated structures

Habitat Mapping request (BAS)

2nd iteration of HM-Model (3EDATA)

Habitat Map Results

HABITAT MAPPING MODEL

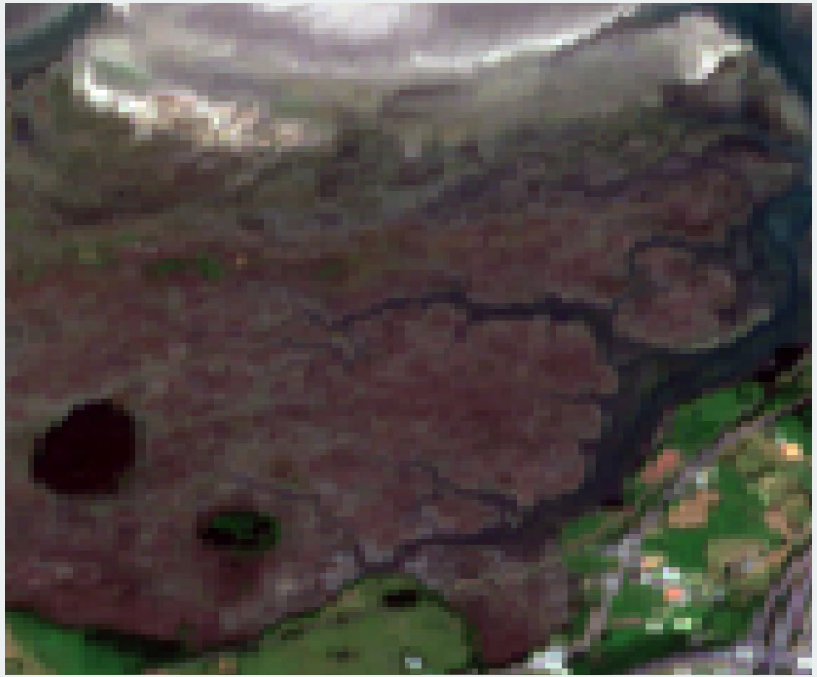
Very High Resolution Images

VHR Habitat Map

Use case: Spain-Ortigueira .

Coastal Habitat Mapping (HM)

- A - Marine habitats
- A2.4 - Littoral mixed sediments
- A2.527 - Atlantic salt scrubs
- A2.531 - Atlantic upper shore communities
- A2.554 - Flat-leaved [Spartina] swards
- A2.6 - Littoral sediments dominated by aquatic angiosperms
- A5.42 - Sublittoral mixed sediment in variable salinity (estuaries)
- B1.2 - Sand beaches above the driftline
- B1.3 - Shifting coastal dunes
- B1.43 - Mediterraneo-Atlantic fixed grey dunes
- F3.15 - Gorse thickets
- G1.214 - Northern Iberian [Alnus] galleries
- G2.81 - Eucalyptus plantations
- G3.F2 - Exotic conifer plantations
- A2.551 - [Salicornia], [Suaeda] and [Salsola] pioneer saltmarshes
- B1.84 - Dune-slack grassland and heaths
- B1.48 - Tethyan dune deep sand therophyte communities



NATUREFIRST

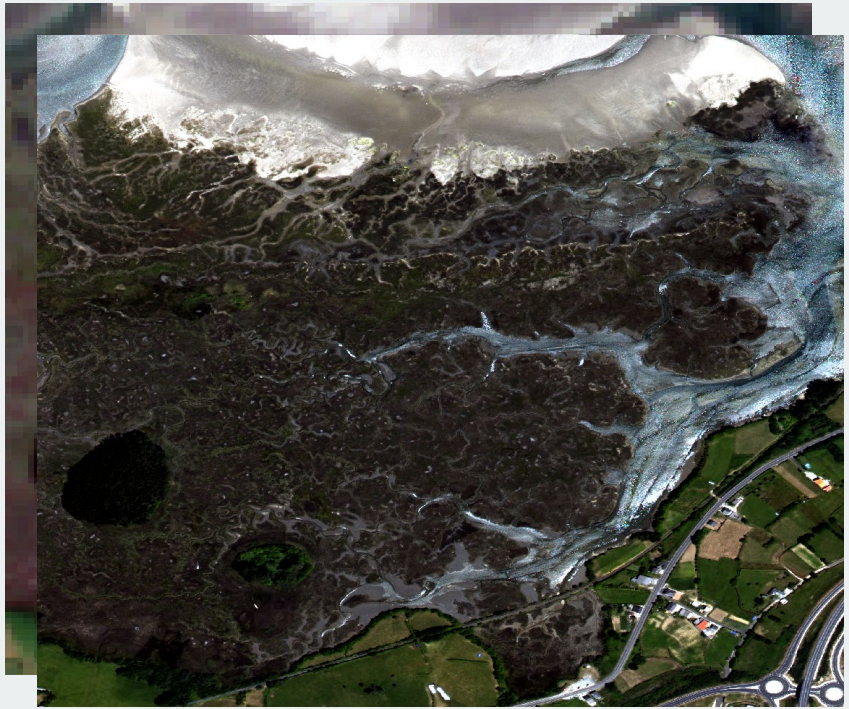
copernicus sentinel

VHR Habitat Map

Use case: Spain-Ortigueira .

Coastal Habitat Mapping (HM)

- A - Marine habitats
- A2.4 - Littoral mixed sediments
- A2.527 - Atlantic salt scrubs
- A2.531 - Atlantic upper shore communities
- A2.554 - Flat-leaved [Spartina] swards
- A2.6 - Littoral sediments dominated by aquatic angiosperms
- A5.42 - Sublittoral mixed sediment in variable salinity (estuaries)
- B1.2 - Sand beaches above the driftline
- B1.3 - Shifting coastal dunes
- B1.43 - Mediterraneo-Atlantic fixed grey dunes
- F3.15 - Gorse thickets
- G1.214 - Northern Iberian [Alnus] galleries
- G2.81 - Eucalyptus plantations
- G3.F2 - Exotic conifer plantations
- A2.551 - [Salicornia], [Suaeda] and [Salsola] pioneer saltmarshes
- B1.84 - Dune-slack grassland and heaths
- B1.48 - Tethyan dune deep sand therophyte communities



NATUREFIRST

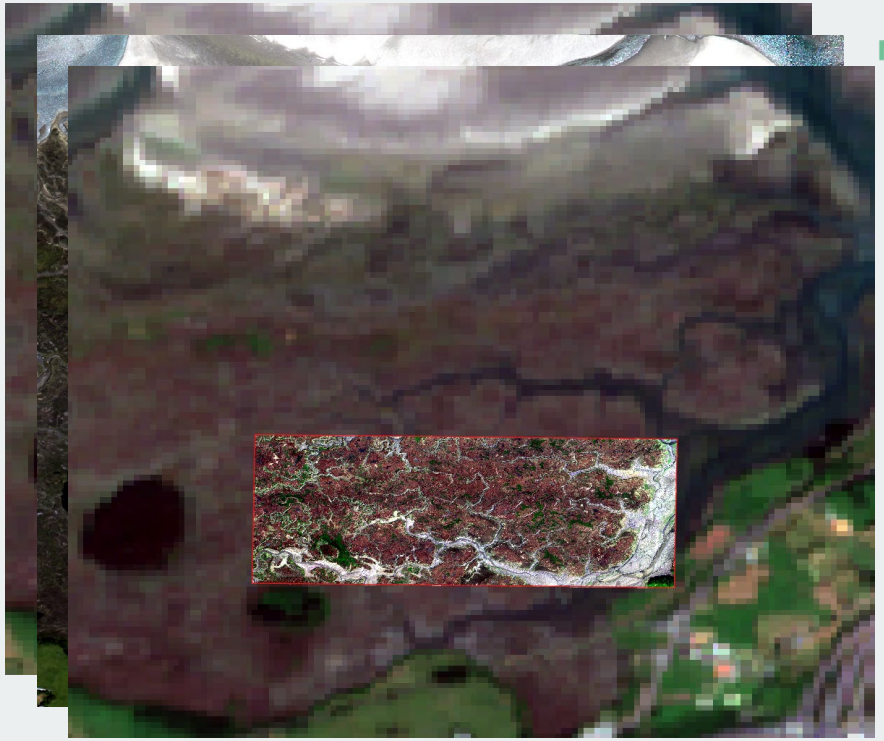
WorldView 3
DigitalGlobe

VHR Habitat Map

Use case: Spain-Ortigueira .

Coastal Habitat Mapping (HM)

- A - Marine habitats
- A2.4 - Littoral mixed sediments
- A2.527 - Atlantic salt scrubs
- A2.531 - Atlantic upper shore communities
- A2.554 - Flat-leaved [Spartina] swards
- A2.6 - Littoral sediments dominated by aquatic angiosperms
- A5.42 - Sublittoral mixed sediment in variable salinity (estuaries)
- B1.2 - Sand beaches above the driftline
- B1.3 - Shifting coastal dunes
- B1.43 - Mediterraneo-Atlantic fixed grey dunes
- F3.15 - Gorse thickets
- G1.214 - Northern Iberian [Alnus] galleries
- G2.81 - Eucalyptus plantations
- G3.F2 - Exotic conifer plantations
- A2.551 - [Salicornia], [Suaeda] and [Salsola] pioneer saltmarshes
- B1.84 - Dune-slack grassland and heaths
- B1.48 - Tethyan dune deep sand therophyte communities



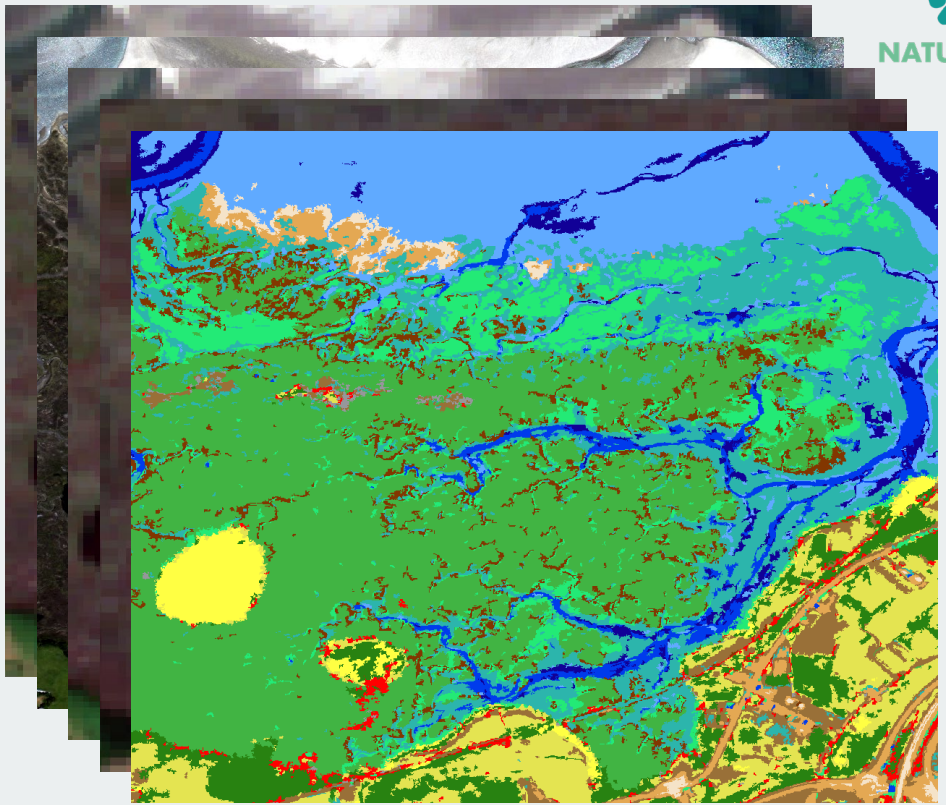
NATUREFIRST

VHR Habitat Map

Use case: Spain-Ortigueira .

Coastal Habitat Mapping (HM)

- A - Marine habitats
- A2.4 - Littoral mixed sediments
- A2.527 - Atlantic salt scrubs
- A2.531 - Atlantic upper shore communities
- A2.554 - Flat-leaved [Spartina] swards
- A2.6 - Littoral sediments dominated by aquatic angiosperms
- A5.42 - Sublittoral mixed sediment in variable salinity (estuaries)
- B1.2 - Sand beaches above the driftline
- B1.3 - Shifting coastal dunes
- B1.43 - Mediterraneo-Atlantic fixed grey dunes
- F3.15 - Gorse thickets
- G1.214 - Northern Iberian [Alnus] galleries
- G2.81 - Eucalyptus plantations
- G3.F2 - Exotic conifer plantations
- A2.551 - [Salicornia], [Suaeda] and [Salsola] pioneer saltmarshes
- B1.84 - Dune-slack grassland and heaths
- B1.48 - Tethyan dune deep sand therophyte communities



NATUREFIRST

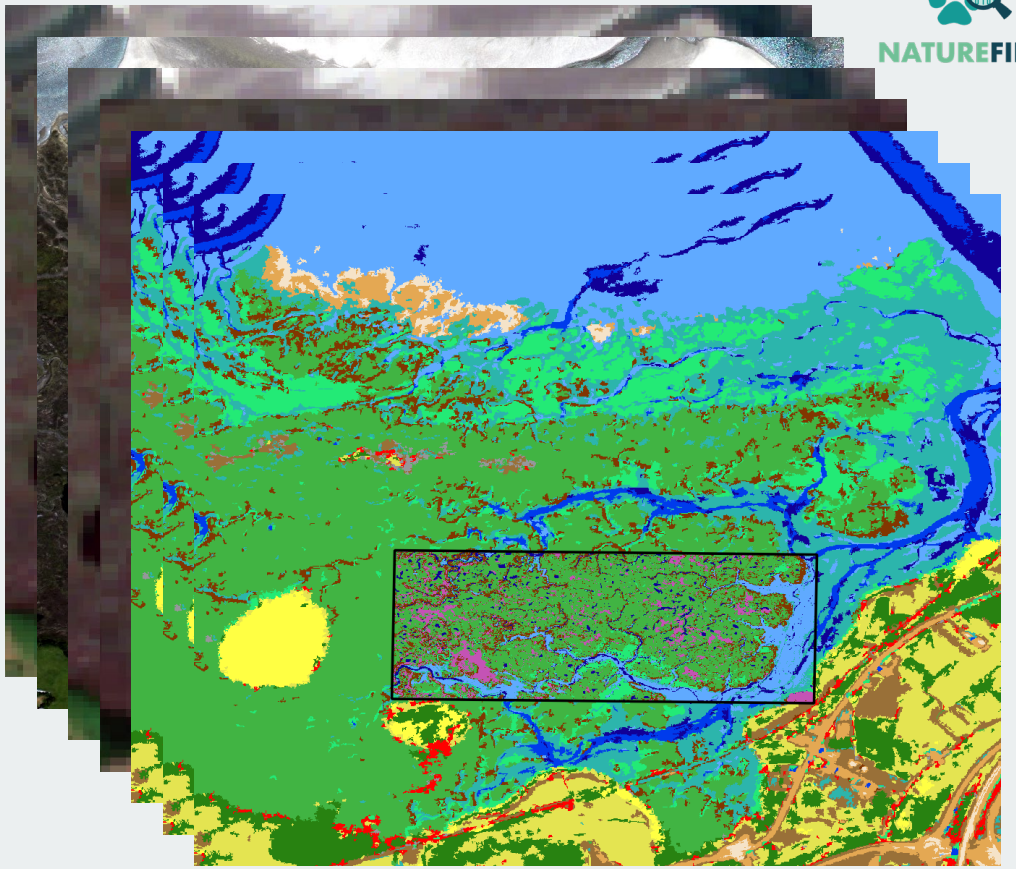
WorldView 3
DigitalGlobe

VHR Habitat Map

Use case: Spain-Ortigueira .

Coastal Habitat Mapping (HM)

- A - Marine habitats
- A2.4 - Littoral mixed sediments
- A2.527 - Atlantic salt scrubs
- A2.531 - Atlantic upper shore communities
- A2.554 - Flat-leaved [Spartina] swards
- A2.6 - Littoral sediments dominated by aquatic angiosperms
- A5.42 - Sublittoral mixed sediment in variable salinity (estuaries)
- B1.2 - Sand beaches above the driftline
- B1.3 - Shifting coastal dunes
- B1.43 - Mediterraneo-Atlantic fixed grey dunes
- F3.15 - Gorse thickets
- G1.214 - Northern Iberian [Alnus] galleries
- G2.81 - Eucalyptus plantations
- G3.F2 - Exotic conifer plantations
- A2.551 - [Salicornia], [Suaeda] and [Salsola] pioneer saltmarshes
- B1.84 - Dune-slack grassland and heaths
- B1.48 - Tethyan dune deep sand therophyte communities



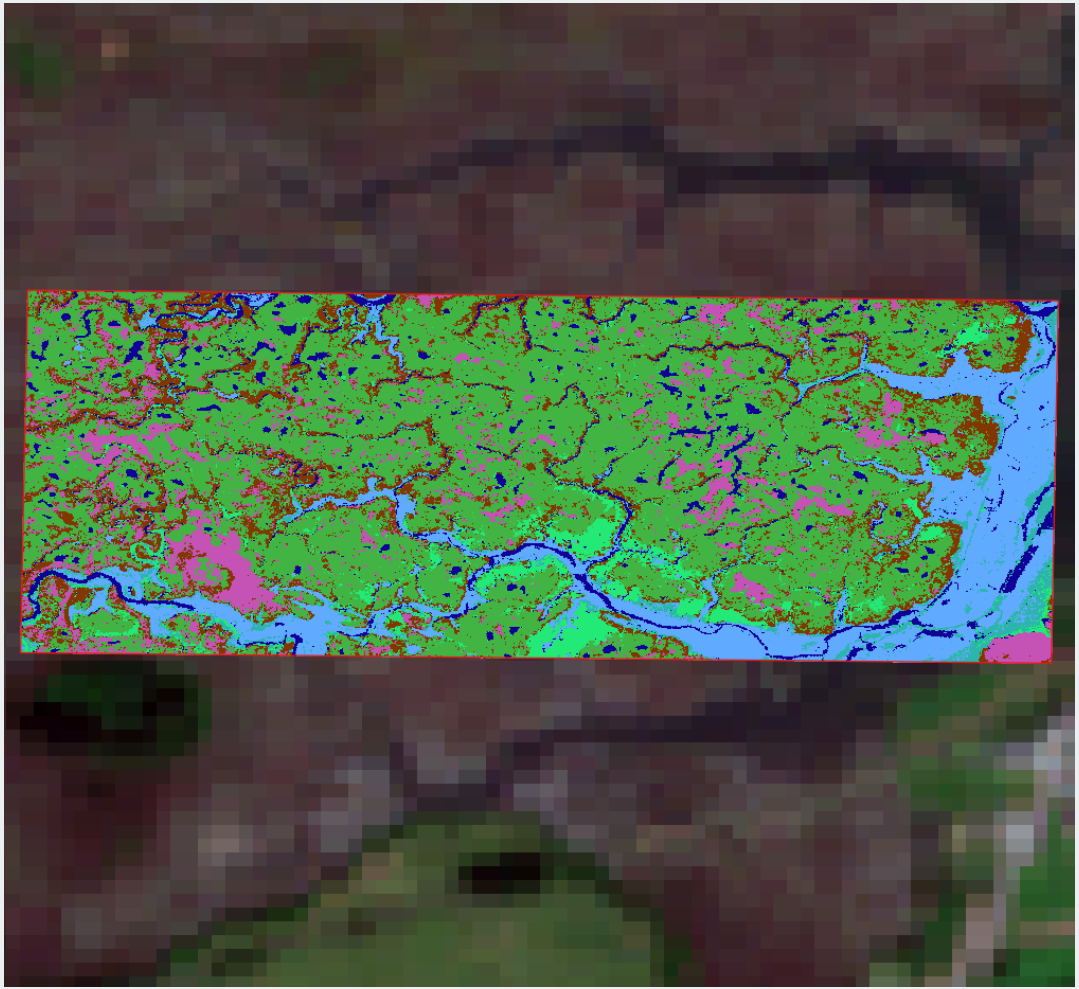
NATUREFIRST

VHR Habitat Map

Use case: Spain-Ortigueira .

Coastal Habitat Mapping (HM)

- A - Marine habitats
- A2.4 - Littoral mixed sediments
- A2.527 - Atlantic salt scrubs
- A2.531 - Atlantic upper shore communities
- A2.554 - Flat-leaved [Spartina] swards
- A2.6 - Littoral sediments dominated by aquatic angiosperms
- A5.42 - Sublittoral mixed sediment in variable salinity (estuaries)
- B1.2 - Sand beaches above the driftline
- B1.3 - Shifting coastal dunes
- B1.43 - Mediterraneo-Atlantic fixed grey dunes
- F3.15 - Gorse thickets
- G1.214 - Northern Iberian [Alnus] galleries
- G2.81 - Eucalyptus plantations
- G3.F2 - Exotic conifer plantations
- A2.551 - [Salicornia], [Suaeda] and [Salsola] pioneer saltmarshes
- B1.84 - Dune-slack grassland and heaths
- B1.48 - Tethyan dune deep sand therophyte communities



CHANGE DETECTION

Monitoring Changes on protected Habitats with Satellite Imagery

Change Detection

Habitat Monitoring

NATUREFIRST

1

Objectives

What is happening on the site near to real-time?

- Changes Detection and assessing their impact
  - Degenerative Changes (DC)
  - Regenerative Changes (RC)
- Detect illegal activities (e.g. unauthorised logging)
- Be useful for management and action plans

2

Inter-comparison results

Certification of results in subsequent iterations

- Monthly update (if MSI is available)
- Comparison of results with previous iteration and certification of these (M0, M-1, M-2)
- Qualification of results according to detection date
  - DC first detection
  - DC previous detected
  - DC without prior data

3

Deliverables

Simultaneous Change Detection layer in three temporal states

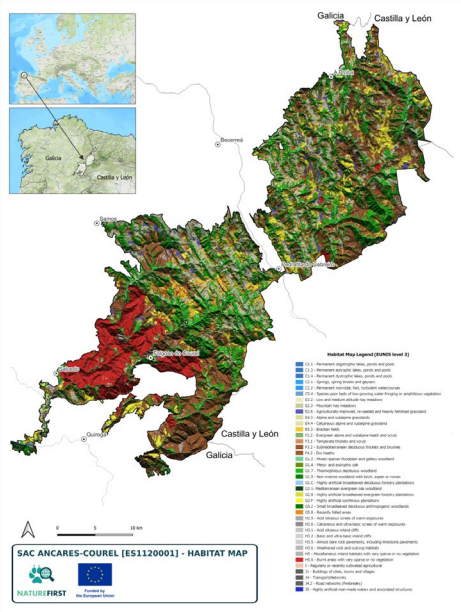
- CD M0: Detected changes near real-time for the analysis date
- CD M-1: Changes detected in the previous analysis (one month ago) that are detected again at this date
- CD M-2: Changes detected in the previous analysis (two month ago) that are detected again at this date

Change Detection

Habitat Monitoring

NATUREFIRST

Use case: ***Spain Ancares-Courel. Natura 2000 site***

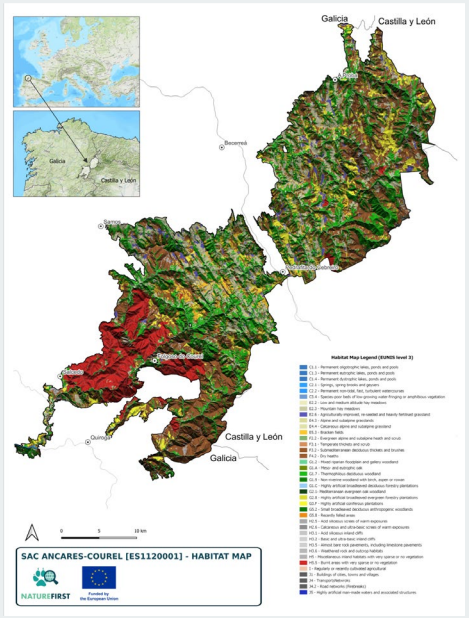


Change Detection

Habitat Monitoring

NATUREFIRST

Use case: ***Spain Ancares-Courel. Natura 2000 site***

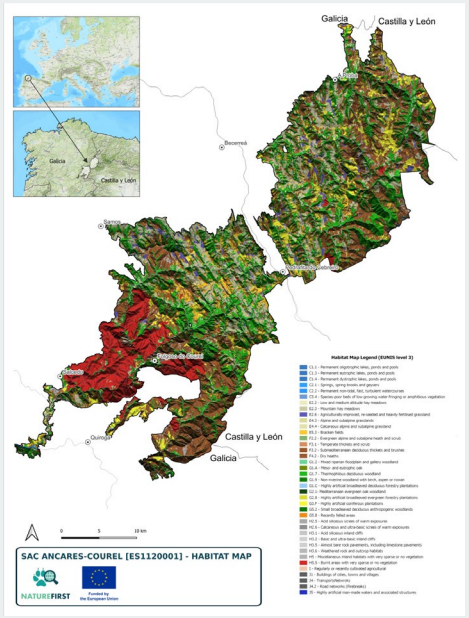


Change Detection

Habitat Monitoring

NATUREFIRST

Use case: ***Spain Ancares-Courel. Natura 2000 site***

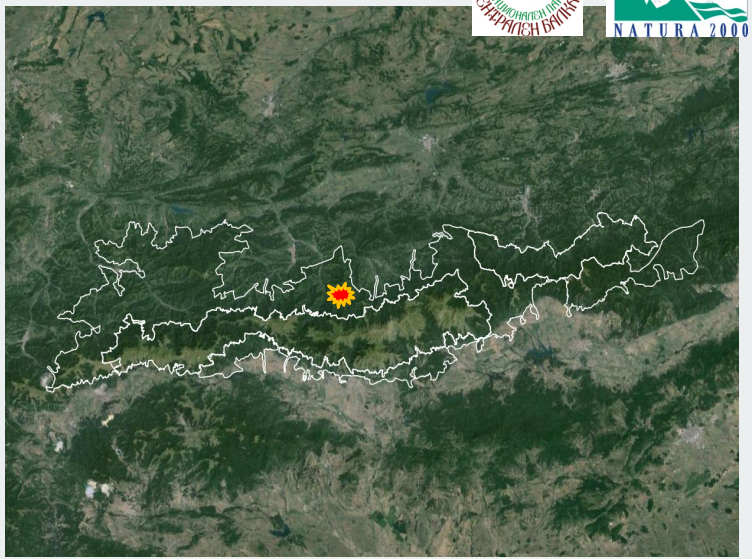


Change Detection

Habitat Monitoring

NATUREFIRST

Use case: ***Bulgaria Tsentralen Balkan.***

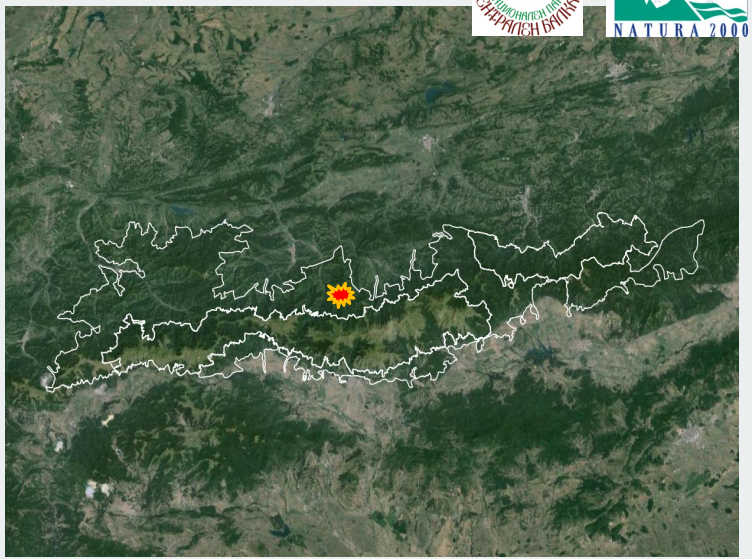


Change Detection

Habitat Monitoring

NATUREFIRST

Use case: ***Bulgaria Tsentralen Balkan.***

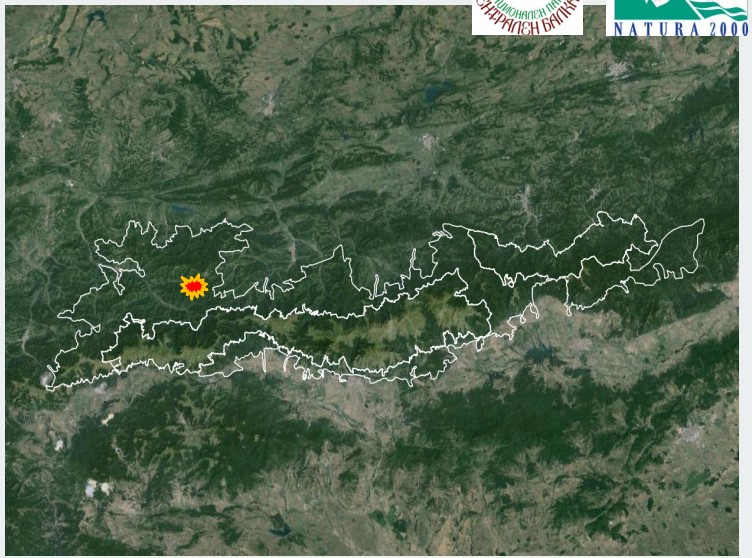


Change Detection

Habitat Monitoring

NATUREFIRST

Use case: ***Bulgaria Tsentralen Balkan.***

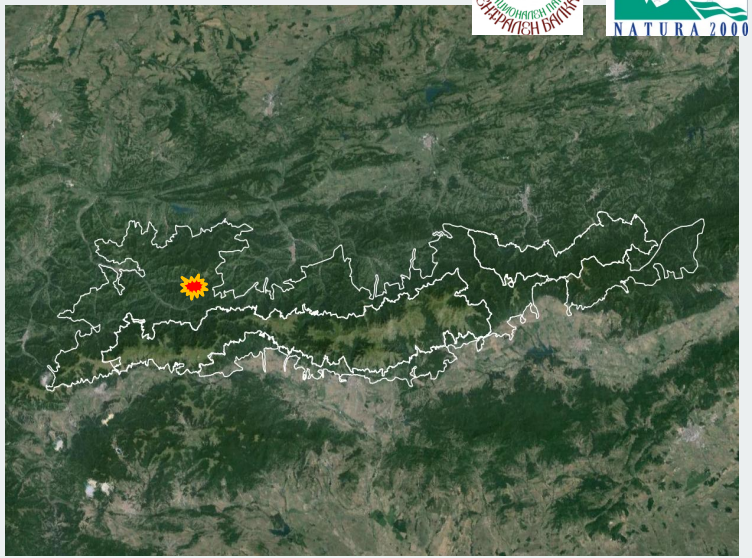


Change Detection

Habitat Monitoring

NATUREFIRST

Use case: ***Bulgaria Tsentralen Balkan.***



NEXT

Variables of Conservation Status of Habitats.

THANK YOU

NATUREFIRST

www.naturefirst.info
boris.hinojo@3edata.es

Funded by
the European Union