La observación remota aplicada al seguimiento de los ecosistemas

Valsaín, Segovia

25-27 de abril de 2022

COPERNICUS FOR ECOSYSTEM MONITORING:

from in-situ data to large-scale mapping

GOBIERNO DE ESPAÑA

VICEPRESIDENCIA TERCERA DEL GOBIERNO

MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA Y EL RETO DEMOGRÁFICO

EIKOS

SISTEMA DE SEGUIMIENTO TERRITORIAL DE LOS ECOSISTEMAS

iepnb

Inventario Español de Patrimonio Natural y de la Biodiversidad

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DE CANTABRIA
IH cantabria

IHCantabria & Copernicus

REMOTE SENSING APPLIED TO THE MANAGEMENT OF THE NATURAL ENVIRONMENT

At IHCantabria we apply space remote sensing and modelization techniques for the evaluation of environmental patterns and processes in terrestrial and aquatic environments. The data from the images and numerical models provide data at different temporary space scales, very useful for the design of management and conservation strategies in a changing world under the effects of global change.

Remote sensing is the technology that consists of acquiring information from the earth's surface without coming into physical contact with it, by means of sensors located on

Landscape Modelling

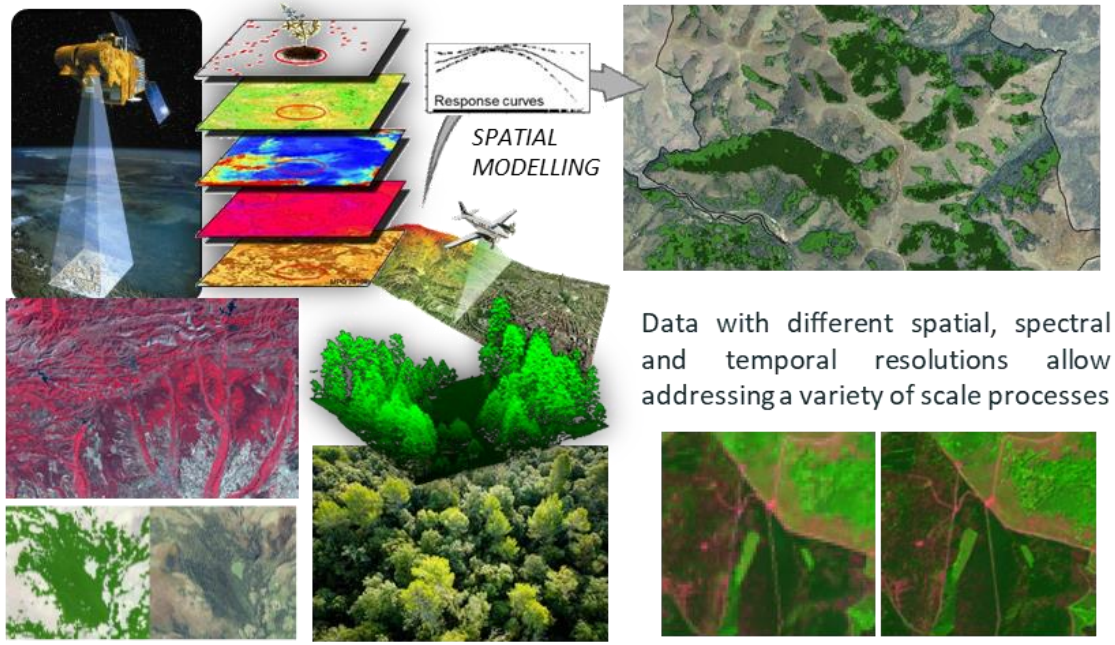
The research line follows the analysis of landscape elements at different levels, scales and purposes. The interaction of vegetation with soil and water resources under different scenarios of Global Change allows the assessment of a range of ecosystem services that extend getting simple answers to disentangle the multivariate relationships of complex reality across landscape continuum

Research Interests

1 From Remote Sensing to Habitat types

Application of spatial modeling techniques based on environmental limiting factors (topography, climate, soil) and remote sensing (satellite imagery, LiDAR, SAR, UAV) to predict the distribution, conservation status and future trends of ecosystems.

A current challenge of biodiversity and conservation for IUCN Red list, Habitats Directive, Common Agrarian Policy, Water Framework Directive and EU 2020Biodiversity Strategy.

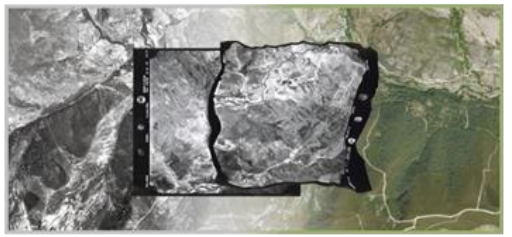


Data with different spatial, spectral and temporal resolutions allow addressing a variety of scale processes

2 LULCC and Global Change scenarios

Spatial modelling can simulate future land use and cover change using a time series of classified satellite imagery, environmental data and expert knowledge.

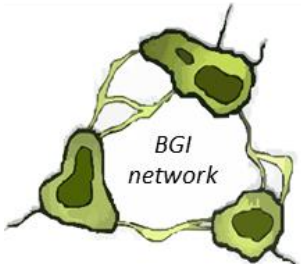
The combination of cellular automata, Markov chains and regression models allows simulating landscape dynamics under different climatic and socioeconomic scenarios defined under stakeholder participatory processes. Results are useful to inform restoration priorities and policy.



3 Blue-Green Infrastructures: forest for water

Land cover and soil properties largely determine how climatic and hydrological regimes interact and produce ecological impacts in aquatic systems.

Forestry and agricultural practices affect hydrology and water quality in order to meet EU Directives. There is a growing support for **land use and cover change** to help bridge the gap, with tree planting and rewilding as two strategies for **Blue-Green Infraestructure** development. BGI can reduce the delivery of human impacts (i.e. diffuse pollutant or sediment transport) to water bodies.



A well suited integrated catchment management may offer multiple benefits to nature and society, but it still requires the establishment of payment for ES to local landowners and managers.

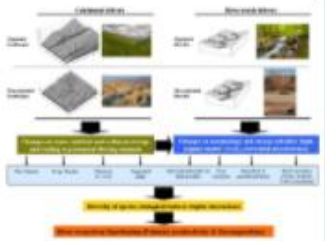
SIGNIFICANT PROYECTS

INTERREG ALICE.

Integrated landscape management that incorporates climate change and socio-economic scenarios is essential to guaranteeing the benefits of investments in Blue and Green infrastructure (BGI) and achieving the EU biodiversity objectives for 2020 in the Atlantic Region (AR).
Learn More

CENTINELA

The CENTINELA project has been implemented to determine the effects that global change (changes in land use, climatic conditions, etc.) have on the fluvial ecosystems of the Picos de Europa National Park.
Learn More



RIVERLANDS

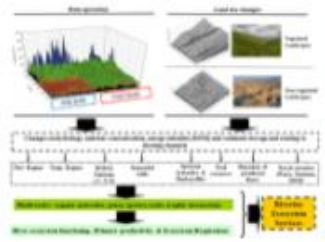
Integrated Watershed Management (IWM) is a discipline and an emerging process within the field of integrated assessment that attempts to address the demands of managers and decision makers for effective water and natural resource management.
Learn More

NANO

Spatio-temporal evaluation of Nanozostera noltii seagrass (habitat 1140) in the Cantabrian coast. Remote sensing is a tool with great potential, whose main advantages lie in its ability to provide very high resolution, homogeneous data.
Learn More

BIOGLOB

The BIOGLOB project, which was created to improve on the previous CENTINELA project, is designed to determine the effects that global change (changes in land uses, climatic conditions, etc.) have on the aquatic ecosystems of the Picos de Europa National Park.
Learn More



HYDRA

HYDRA will focus on how the operation of rivers and the supply of services are affected by the hydrological alteration (HA) of the operation of dams and changes in land use.These two factors are today the main sources of hydrological alteration worldwide.
Learn More

IVERCAM

In recent decades, changes in climate and land cover have led to a loss of biodiversity that is unprecedented in the history of mankind (global change).
Learn More

PRADERA

Monitoring network to characterize and evaluate the conservation status and spatio-temporal changes in the carbon deposits of the Zostera noltei grasslands in the Cantabrian coast.
Learn More

Improving the management of ATLANTIC LANDSCAPES: accouting for biodiversity and ecosystem services

ALICE

IHCantabria Waterlouvols

IVERCAM

DRYvER

Cop RIVER

LAND & WATER

Riparian Zones

DIVAQUA

MEJORANDO LA DIVERSIDAD ACUÁTICA EN PICOS DE EUROPA

RIVERLANDS

GOBIERNO DE ESPAÑA
MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD

Land use legacy effects on river processes: implications for integrated catchment management

A big team -- Continental Ecosystems (ECONT) N=15

La observación remota aplicada al seguimiento de los ecosistemas

Pepe Barquín (nº= 56 / H= 19 / Cites =1085)

Jose Manuel Álvarez-Martínez (32/12/392)

RS-Terrestrial

Freshwater

Francisco Peñas (22/9/259)

Laura Concostrina (13/8/271)

Ana Silió (8/7/169)

Alexia González (12/7/111)

Alejandra Goldenberg (5/3/53)

Amaia Angulo (8/4/21)

Mario Álvarez (24/10/304)

Gonzalo Hernández (0)

María Morán (3/2/18)

Elena Bustillo (0)

Fernando Rodríguez (0)

Ignacio Pérez (3/1/1)

Minh Hoang (0)

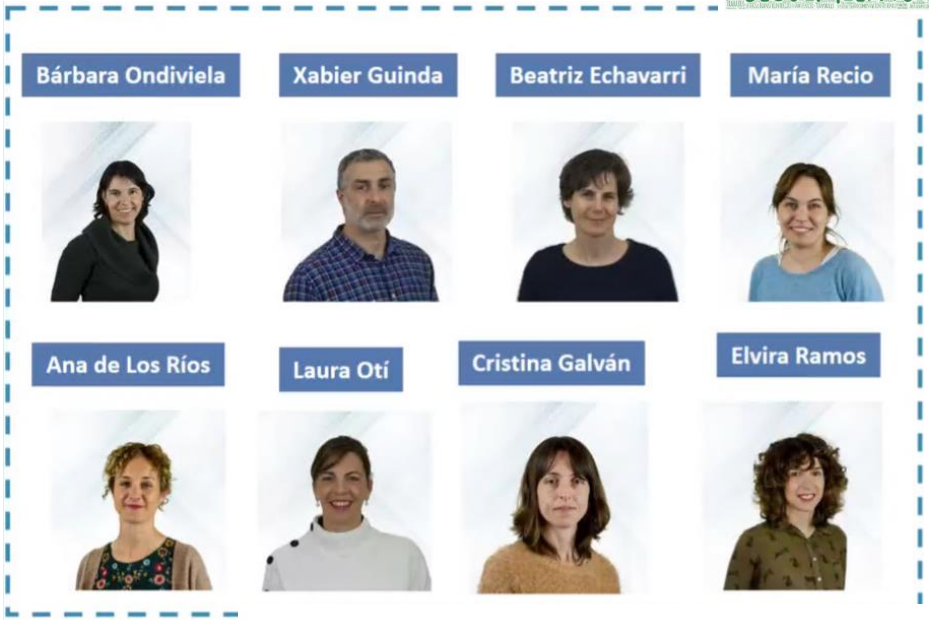
Cassia Rocha (0)

A big team -- Continental Ecosystems (ECONT)

La observación remota aplicada al seguimiento de los ecosistemas

A big team -- Another groups: LITO > IT > ADMIN N=15 / >50

La observación remota aplicada al seguimiento de los ecosistemas

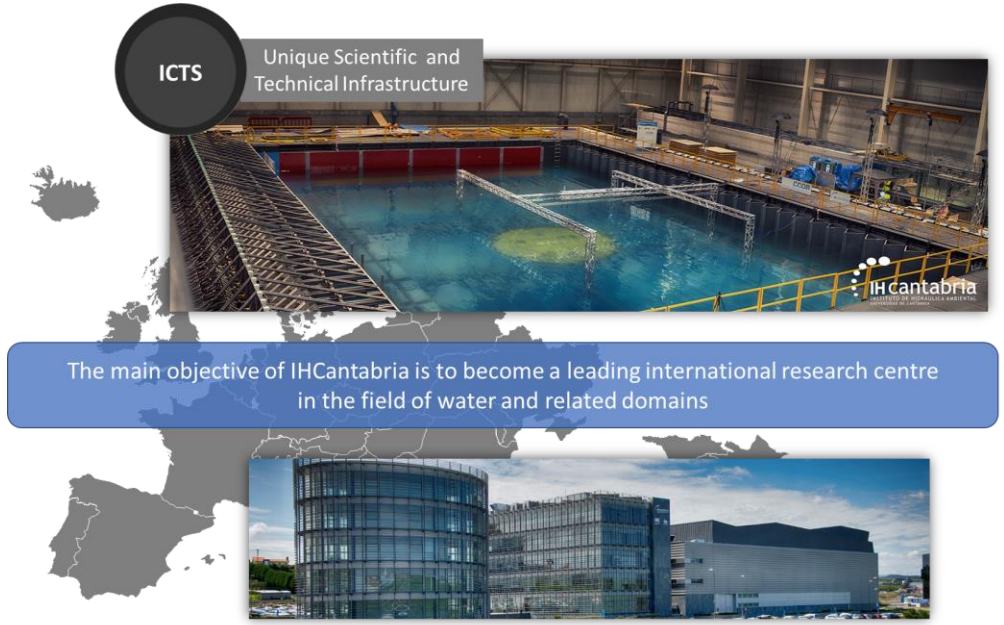


A big team -- All staff: 4 areas of knowledge

N=15 / >150

La observación remota aplicada al seguimiento de los ecosistemas

IHCantabria & Copernicus



User Uptake

Academy

Copernicus

A big team

IHCantabria & Copernicus -- user uptake

La observación remota aplicada al seguimiento de los ecosistemas

Framework Partnership Agreement for Copernicus User Uptake

Framework Partnership Agreement on Copernicus User Uptake

Explore the homepage to learn more about the user uptake activities of the 48 consortium partners. With current 70 running actions the EU-funded project aims at enhancing the user uptake of Copernicus data and products. You can also find materials available for download and information how you can get involved.

Information- & Trainingevents
National and multi-national information- & training-events
Read more

Building user dialogue
Building an active user dialogue
Read more

Applications
Developing and piloting downstream applications and services
Read more

Innovations
Promoting national and multi-national innovative actions
Read more

Resources
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News
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Highlights
Highlights and Success Stories
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Consortium
48 entities from 23 European countries
Read more

https://www.copernicus-user-uptake.eu/

FPCUP – 2018

COPTRAIN
APLICOP

FPCUP – 2019

LULUCF

FPCUP – 2020

CopRIVER
Cop2LAND
5+

FPCUP – 2021

Currently designing actions.

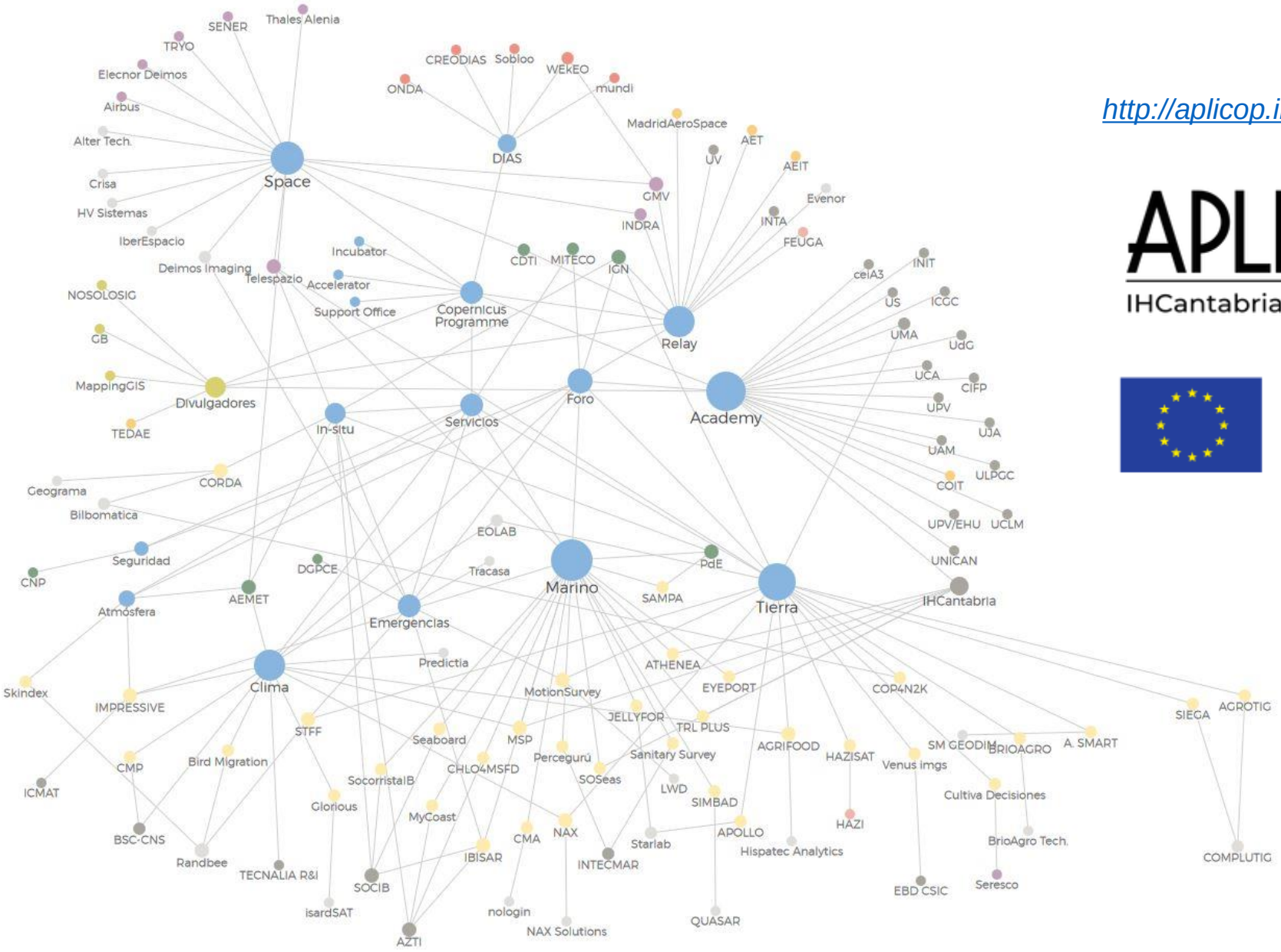
IHCantabria & Copernicus -- user uptake

ApliCop es un Proyecto financiado por la Comisión Europea a través del **Caroline Herschel Framework Partnership Agreement.**

El objetivo del Proyecto es establecer la red de actores del ecosistema Copernicus en España: empresas, administración, centros de investigación, etc. para fomentar la interacción y la explotación de datos Copernicus.

IHCantabria & Copernicus -- user uptake

La observación remota aplicada al seguimiento de los ecosistemas



http://aplicop.ihcantabria.es/network/

APLICOP
IHCantabria

Framework Partnership Agreement for Copernicus User Uptake

PROJECT DEVELOPMENT IN SPAIN

USER UPTAKE

www.lulucf.ihcantabria.com

PROJECT DEVELOPMENT IN SPAIN

ADVISORY RESEARCH WORKING GROUP

IH cantabria
INSTITUTO DE HIDRÁULICA AMBIENTAL
UNIVERSIDAD DE CANTABRIA

UNIVERSIDAD DE MÁLAGA

ETC UMA

Copernicus FPCUP

CREAF

UMIB
Unidad Mixta de Investigación en Biodiversidad

Copernicus Academy

Estación Biológica Doñana CSIC

CAESCG
CENTRO ANDALUZ PARA LA EVALUACIÓN Y SEGUIMIENTO DEL CAMBIO GLOBAL

agresta

itd
medioambiente

VNIVERSITAT DE VALÈNCIA

[ceseforest]

föra
forest technologies

cotesa

INSTITUTO TECNOLÓGICO AGRARIO DE CASTILLA Y LEÓN
itacyl

tecnosylva

FPACUP LULUCF project: LULC changes

INFORMATION NEEDS, GAP ANALYSIS

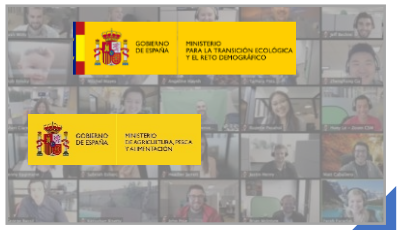
User Uptake process of CLMS data and specific RS-based solutions for LULC change mapping

2 core group meetings

- **Wish list**: Actual spatial data needs for LULUCF reporting and wish list

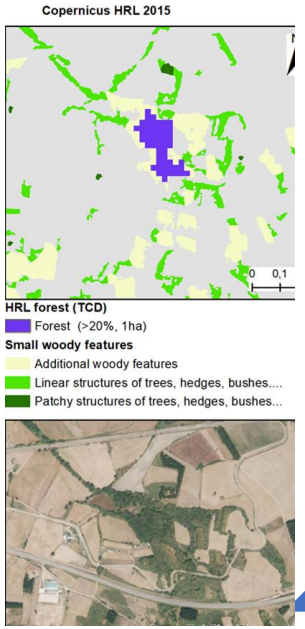
Data organisation

- IHC organised data to identify information gaps to be submitted to the Advisory Research Group



Ministry identified final information gaps

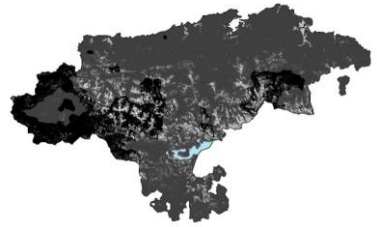
- **Series of working groups** per land use category
- Inter-ministerial participation



ETC-UMA reviews data gaps for coupling with **CLMS**

Discussion with Advisory Group and identification of **efficient solutions**

- Including survey among experts and bibliography - project reviews



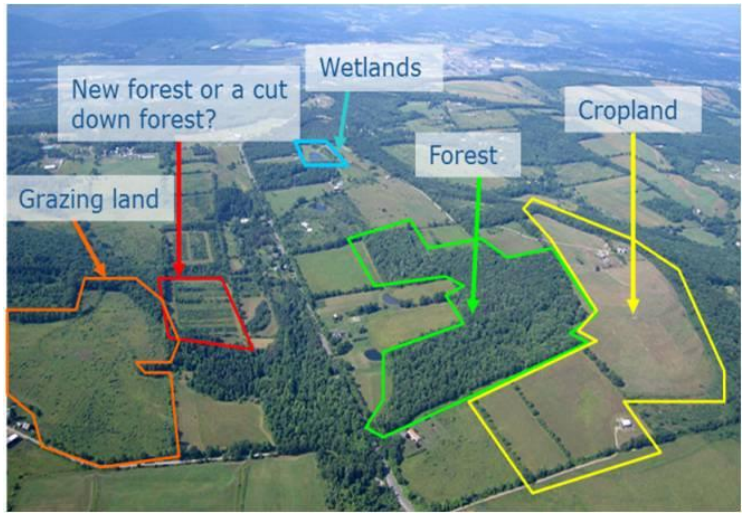
Presentation of **success stories** and potential funding of innovative approaches

Funding opportunities for *Copernicus User uptake*: project development and implementation in LULUCF sector and beyond

Framework Partnership Agreement for Copernicus User Uptake

Capitalizing research

LULUCF needs



Related policies

A big team… in Geospatial Analysis

N=15 / >300

La observación remota aplicada al seguimiento de los ecosistemas

Clúster Geoespacial de Cantabria

Santander, 21 Abril 2022

GOBIERNO de CANTABRIA
CONSEJERÍA DE INNOVACIÓN, INDUSTRIA, TURISMO Y COMERCIO

SODERCAN
Sociedad para el Desarrollo Regional de Cantabria

¿Por qué? ¿Qué capacidades tiene Cantabria?

Dos grandes ejes:

1. **Conocimiento**: el grupo de socios fundadores del clúster (FIHAC, IFCA, Universidad de Cantabria, IEO, Predictia, ITD, eDronica, Complutig, etc.) junto a responsables técnicos del Gobierno de Cantabria, aportan, en conjunto, una larga experiencia en investigación en múltiples campos de relevancia nacional e internacional.
2. **Expertos** de prestigio en Cambio Climático a nivel internacional- IPCC Coordinating Leading Author, 5th&6th Assessment Reports:

   Íñigo Losada (IHCantabria-UC) y **José Manuel Gutiérrez** (IFCA-UC).

Un contexto favorable: marco de desarrollo

1. **Programa Copernicus**, Programa de Observación de la Tierra de la Unión Europea, y **Sistema Mundial de Observación de los Océanos** (GOOS), entre otros.
2. **European Green Deal**, el Pacto Verde Europeo: hacia un continente climáticamente neutro, sostenible y digital.
3. **PERTE Agua**. 1.940 millones de euros para la gestión digital del ciclo hidrológico y lucha contra el cambio climático.
4. **PERTE Agroalimentario**. Inversión pública de unos 1.000 millones de euros hasta 2023, aunque se prevé que genere un impacto en la economía de unos 3.000 millones de euros.
5. **PERTE Aeroespacial.** 2.200 millones de euros para la carrera aeroespacial a nivel nacional (agencia propia) e internacional.
6. **RIS3 Cantabria**. Plan de Especialización Inteligente en Investigación e Innovación.
7. **Ciencias Marinas y Astrofísica.** Ministerio Ciencia e Innovación: Mayor inversión en proyectos de I+D en Cantabria. IFCA, IHCantabria e IEO.
8. **Cantabria Digital Innovation Hub.** Innovación y digitalización de empresas y administración para mejorar el tejido empresarial y la transferencia.

Misión del clúster

Contribuir al cambio de modelo productivo de la Comunidad Autónoma a través de tres vectores fundamentales:

- Fomento de la **investigación** y su **transferencia** al sector económico y social.
- Mejora de la **competitividad de las empresas** del sector y **creación de nuevo tejido productivo.**
- Modernización de la **Administración** y su digitalización.

Visión del clúster

Los desarrollos del clúster se vertebrarán en un entorno colaborativo formado por agentes de una **cuádruple hélice**:

- Academia
- Empresas
- Administración pública
- Ciudadanía

Los socios del clúster pertenecen a los 4 estratos y estarán coordinados en órganos de administración, gestión y comunicación para **cooperar, compartir y crear sinergias** en el ámbito académico empresarial y administrativo.

Oportunidades de acción del clúster

Clúster Geoespacial de Cantabria

Acciones prioritarias del clúster:

1. **Conservación** de la naturaleza
2. Gestión **forestal** y de montes, sector **agrario** y producción animal, **medio hídrico** continental y oceánico.
3. Ordenación del **territorio** y el **urbanismo**
4. Producción y análisis de **información climática**, así como su transferencia a la **respuesta hidrológica y dinámica oceánica** en los dominios continental, costero y marino
5. Producción y gestión de **información geográfica**
6. **Formación** y desarrollo de **jornadas técnicas**
7. Desarrollo de **proyectos piloto** en las oportunidades de acción

GOBIERNO de CANTABRIA
CONSEJERÍA DE INNOVACIÓN, INDUSTRIA, TURISMO Y COMERCIO

Partner asociado

Dptos. involucrados:

- Servicio de Conservación de la Naturaleza
- Servicio de Montes
- Servicio de Cartografía y Sistemas de Información Geográfica
- Servicios de Ordenación Territorial y de Urbanismo
- Servicios de Ayudas del Sector Agrario, de Producción Animal y Agricultura y Diversificación Rural, incluyendo el CIFA (y otras instituciones como el CIMA*…)

Gestión de infraestructuras científico-técnicas, modelización matemática e inteligencia artificial, GeoIA y GIS, computación avanzada, desarrollo de software y aplicaciones a usuario final.

Socios

Clúster Geoespacial de Cantabria

Centros de Investigación y transferencia

FUNDACION IH cantabria — UC UNIVERSIDAD DE CANTABRIA — IH cantabria

UC UNIVERSIDAD DE CANTABRIA

IFCA Instituto de Física de Cantabria

INSTITUTO ESPAÑOL DE OCEANOGRAFÍA

Empresas de base tecnológica

itd medioambiente

predictia INTELLIGENT DATA SOLUTIONS S.L.

eDrónica Tecnología para vehículos no tripulados

COMPLUTIG EMPRESA DE BASE TECNOLÓGICA DE LA UNIVERSIDAD DE ALCALÁ

...

Administración pública

GOBIERNO de CANTABRIA

CENTRO DE INVESTIGACIÓN Y FORMACIÓN AGRARIAS CIFA

CIMA CENTRO DE INVESTIGACIÓN DEL MEDIO AMBIENTE

- Servicio de Conservación de la Naturaleza
- Servicio de Montes
- Servicio de Cartografía y Sistemas de Información Geográfica
- Servicios de Ordenación Territorial y de Urbanismo
- Servicios de Ayudas del Sector Agrario, Producción Animal y Agricultura y Diversificación Rural

Colectivos sociales y corporativos

FORESTALES Ilustre Colegio Oficial de Ingenieros Técnicos Forestales y Graduados en Ingeniería Forestal y del Medio Natural

it. Colegio Oficial Ingenieros de Telecomunicación Cantabria

COLEGIO DE GEÓGRAFOS CANTABRIA

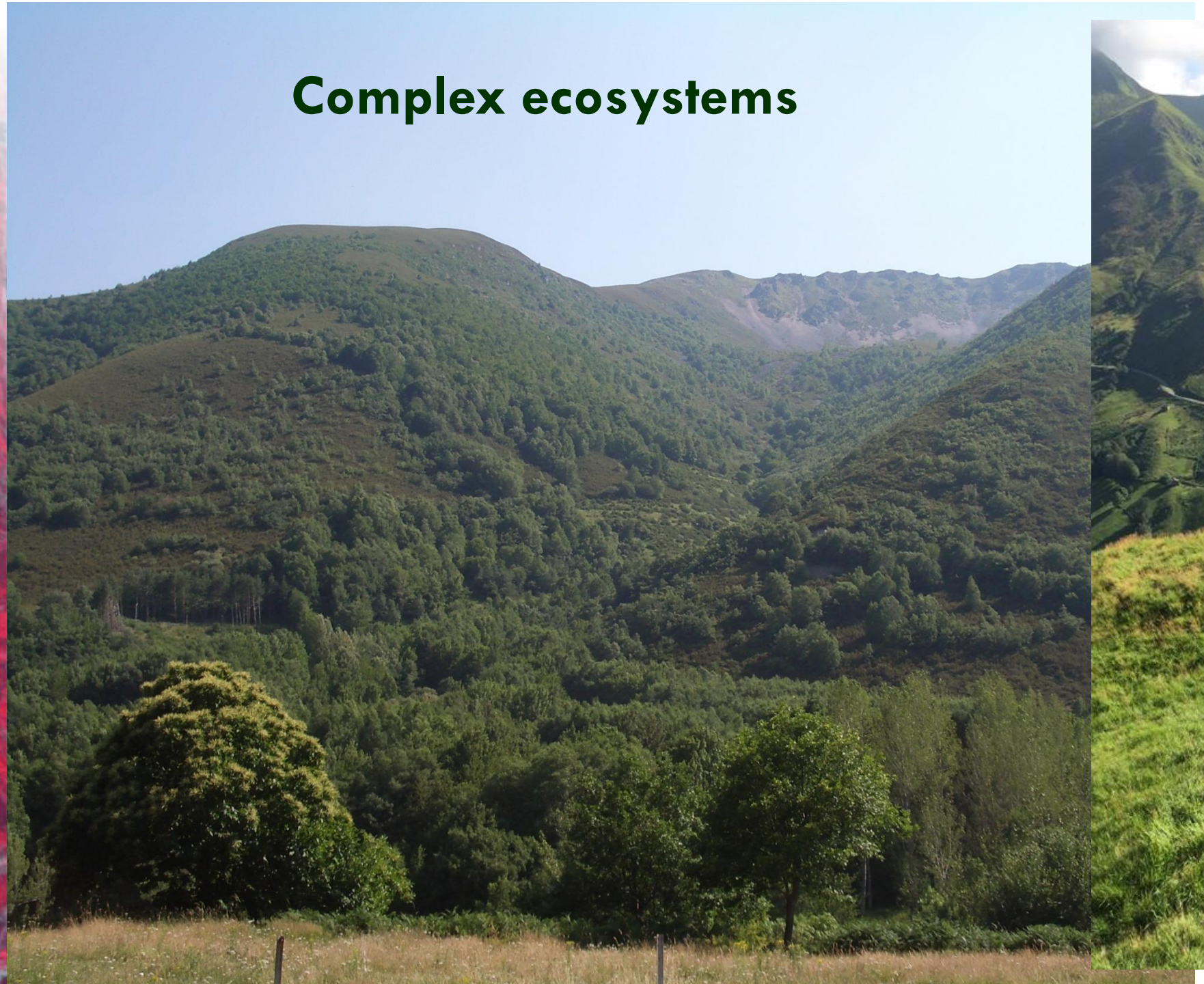
Colegio de Ingenieros de Caminos, Canales y Puertos Cantabria

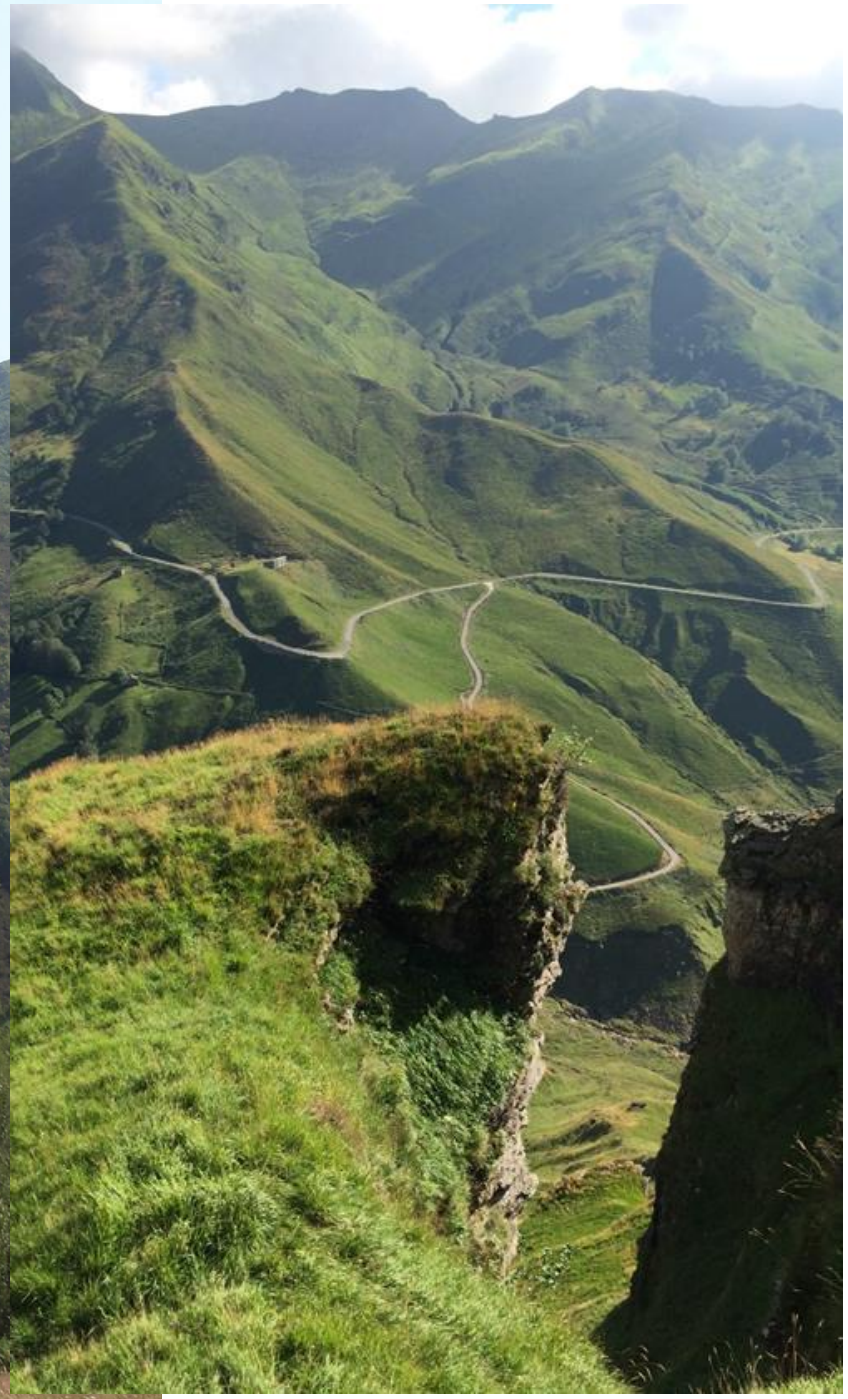
¿Qué es? Motivación

El término **Geoespacial** tiene traducción directa al inglés con "Geospatial", que engloba el conjunto de tecnologías que son el objetivo del clúster: **teledetección, GIS, Inteligencia Artificial Aplicada (GeoAI), etc.** y sus objetivos preferentes dirigidos al análisis y planificación de patrones, procesos, funciones y servicios relacionados con el medio ambiente de Cantabria, España y Europa.

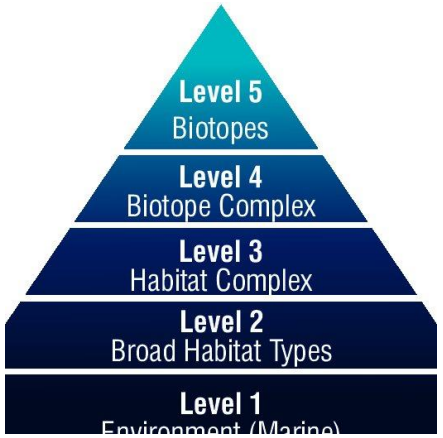
Unir fuerzas, compartir experiencias, crear sinergias y representar a Cantabria de forma armonizada en ámbitos nacionales e internacionales relacionados con el análisis geoespacial

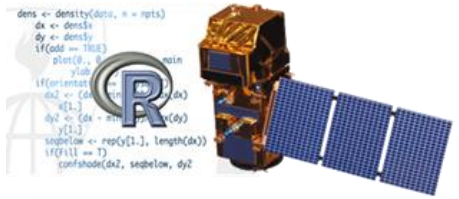
Complex ecosystems





Dynamic ecosystems





Mapping broad-scale vegetation patterns (EUNIS) in complex mountainous territories across time

Habitat maps using RS based modelling techniques in Natura 2000 Network in Cantabria (NW Spain)

ID	EUNIS	N	Descripción
1	A2	103	Littoral sediment
2	A2.61	37	Seagrass beds on littoral sediments
3	C1	271	Surface standing waters
4	C2.2	169	Permanent non-tidal, fast, turbulent waterc
5	D1.21	385	Hyperoceanic low-altitude blanket bogs, typ
6	E1.2	62	Perennial calcareous grassland and basic ste
7	E1.263	227	Middle European [Brachypodium] semidry g
8	E1.7	41	Closed non-Mediterranean dry acid and neut
9	E1.712	95	Sub-Atlantic [Nardus]-[Galium] grasslands
10	E1.721	131	Nemoral [Agrostis]-[Festuca] grasslands
11	E2.1	2430	Permanent mesotrophic pastures and aftermath-grazed meadow
12	E2.11	436	Unbroken pastures
13	E2.111	612	Ryegrass pastures
14	E2.112	171	Atlantic [Cynosurus]-[Centaurea] pastures
15	E2.2	328	Low and medium altitude hay meadows
16	E2.21	125	Atlantic hay meadows
17	E2.22	595	Sub-Atlantic lowland hay meadows
18	E5.31	40	Sub-Atlantic [Pteridium aquilinum] fields
19	F2.2	52	Evergreen alpine and subalpine heath and scrub
20	F2.231	73	Mountain [Juniperus nana] scrub
21	F3.13	31	Atlantic poor soil thickets
22	F3.17	125	[Corylus] thickets
23	F3.171	40	Atlantic and sub-Atlantic hazel thickets
24	F3.25	37	Piornales
25	F3.252	136	Northwestern Iberian [Genista florida] fields
26	F4.2	978	Dry heaths
27	F4.23	120	Atlantic [Erica]-[Ulex] heaths
28	F4.237	190	Cantabro-Pyrenean [Erica vagans]-[E. cinerea] heaths
29	F7.4	138	Hedgehog-heaths
30	F7.4451	834	Pyreneo-Cantabrian cushion-heaths
31	FA	46	Hedgerows
32	G1	40	Broadleaved deciduous Woodland
33	G1.21	252	Riverine [Fraxinus] - [Alnus] woodland, wet at
34	G1.2142	130	Pyreneo-Cantabrian alder galleries
35	G1.6	1343	[Fagus] woodland
36	G1.62	353	Atlantic acidophilous [Fagus] forests
37	G1.624	65	Pyreneo-Cantabrian acidophilous beech forests
38	G1.625	179	Western Cantabrian acidophilous beech forests
39	G1.64	247	Pyreneo-Cantabrian neutrophile [Fagus] forests

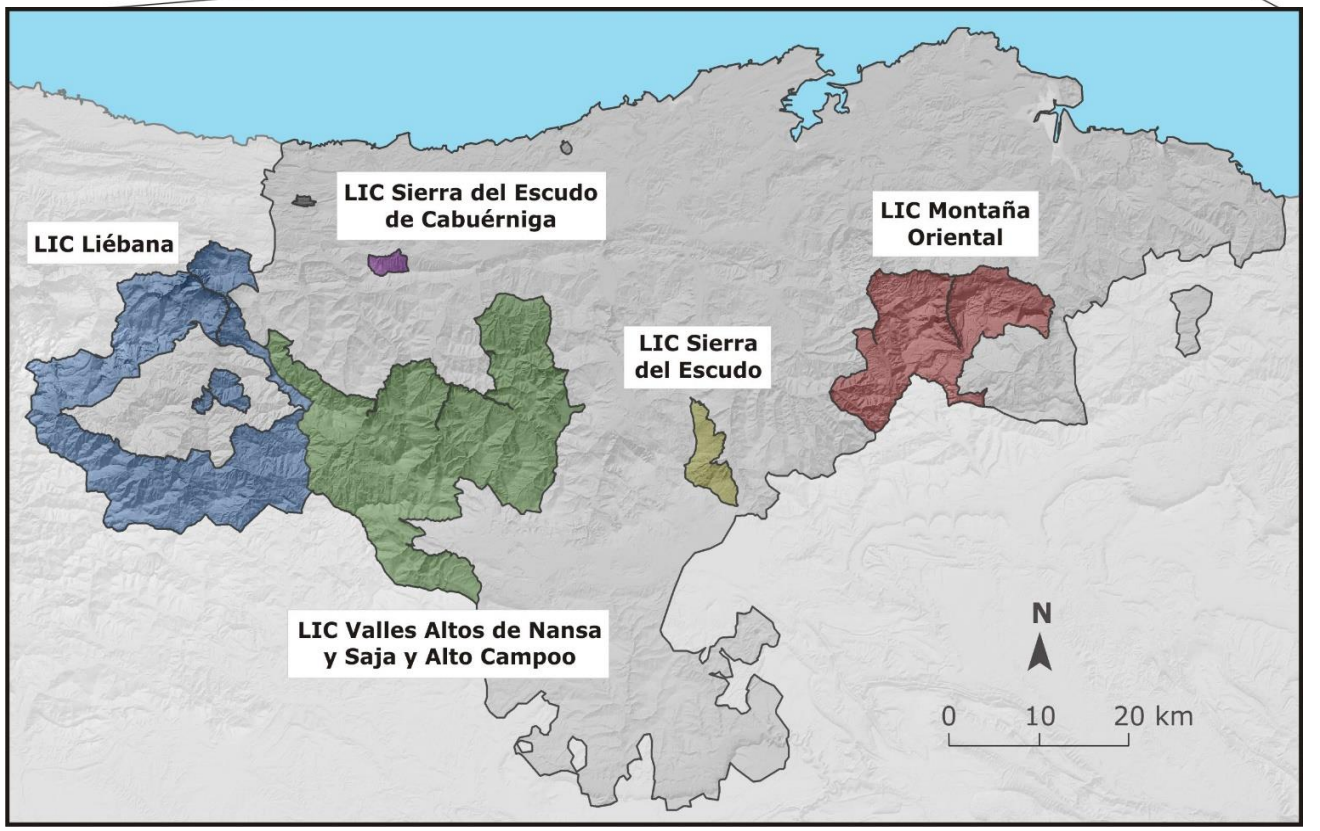
Mapping habitat (and spcs) types

Annex I HabDir

1. Spatial distribution

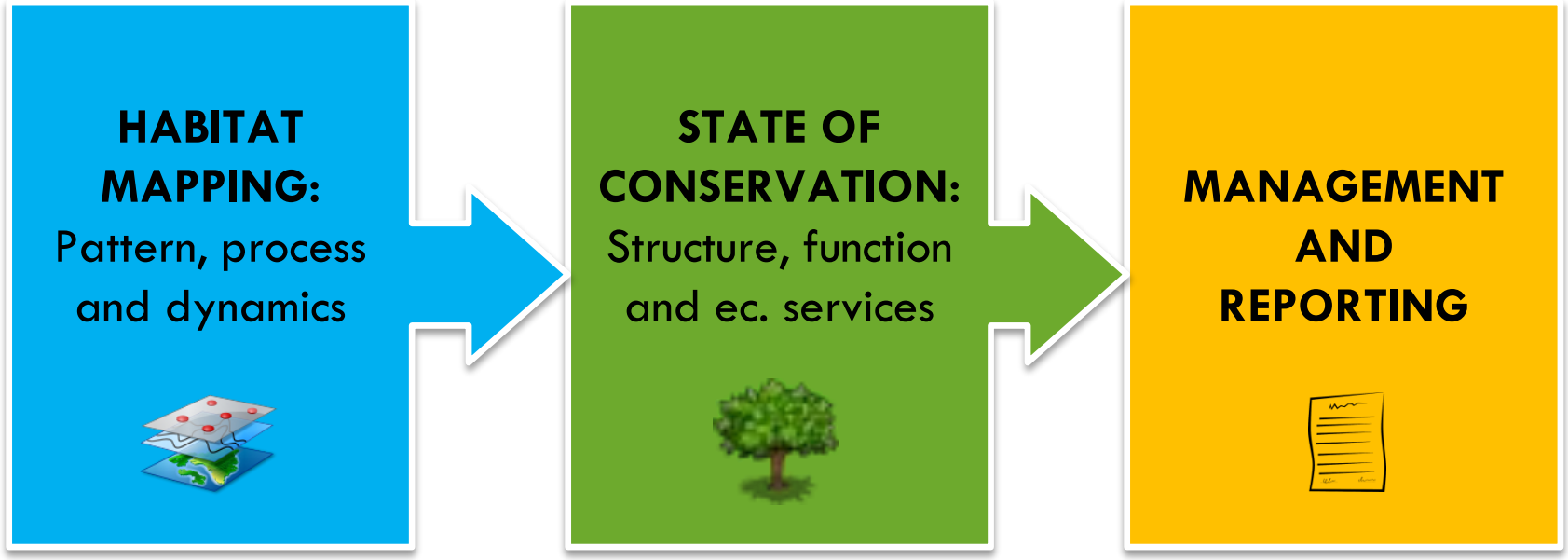
2. Conservation Status

3. Management Plan-Local actions



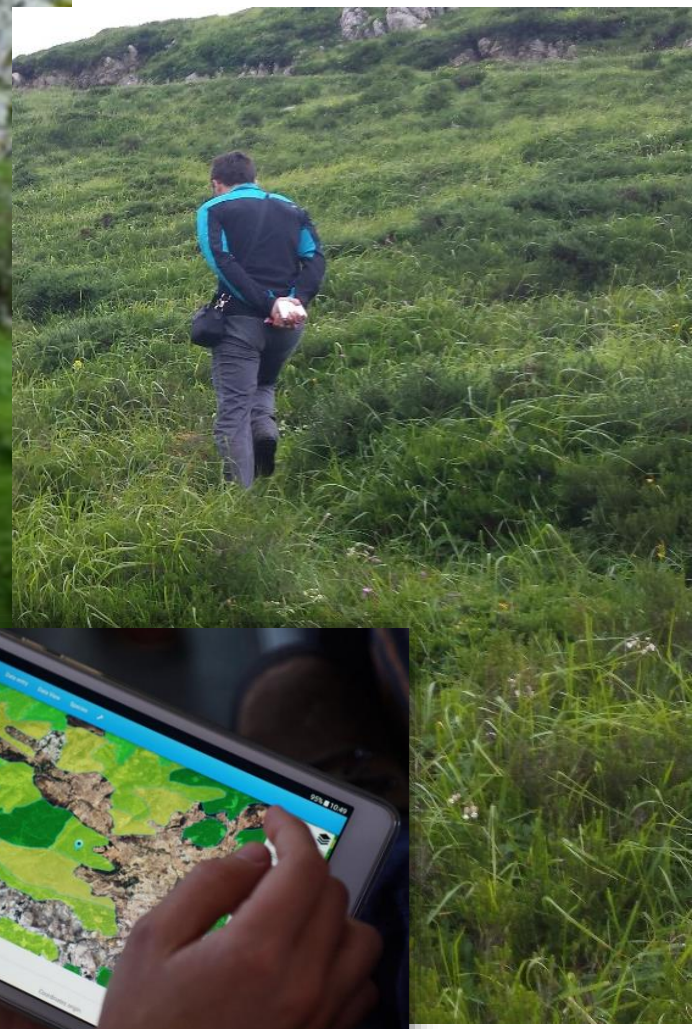
Álvarez-Martínez et al, 2018

Methods in Ecology and Evolution


HABITAT MAPPING:
Pattern, process and dynamics
STATE OF CONSERVATION:
Structure, function and ec. services
MANAGEMENT AND REPORTING

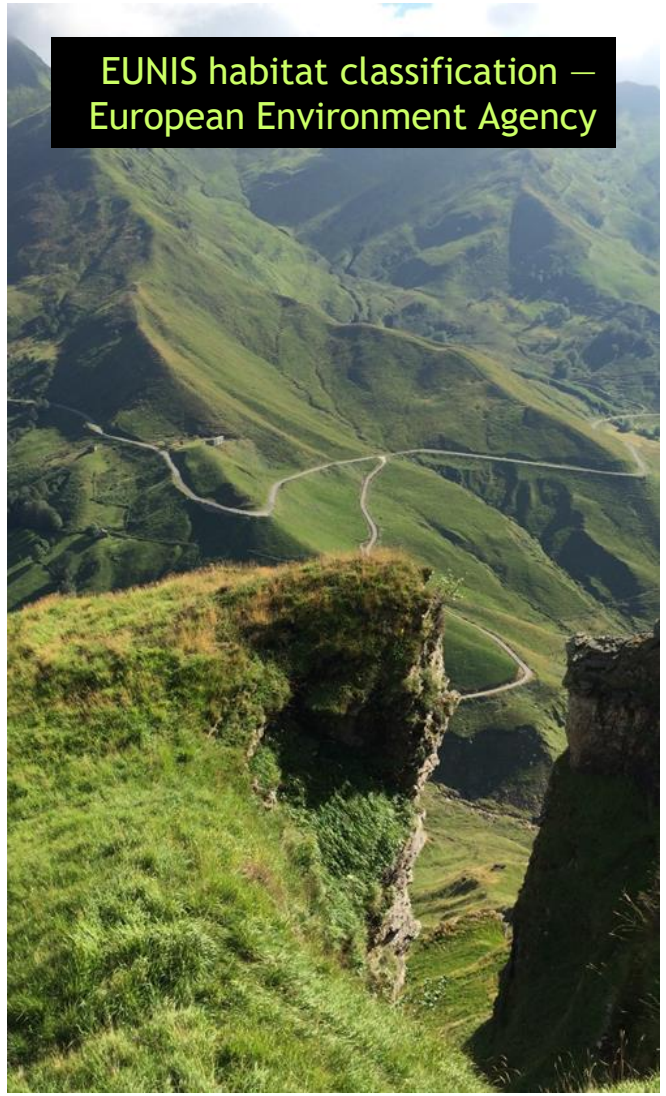

HABITAT MAPPING:
Pattern, process and dynamics
STATE OF CONSERVATION:
Structure, function and ec. services
MANAGEMENT AND REPORTING

A need for in situ data and expert knowledge



List of Spanish Habitat types
[Download from MITERD]

A need for in situ data and expert knowledge



Reference list of habitats - MITERD

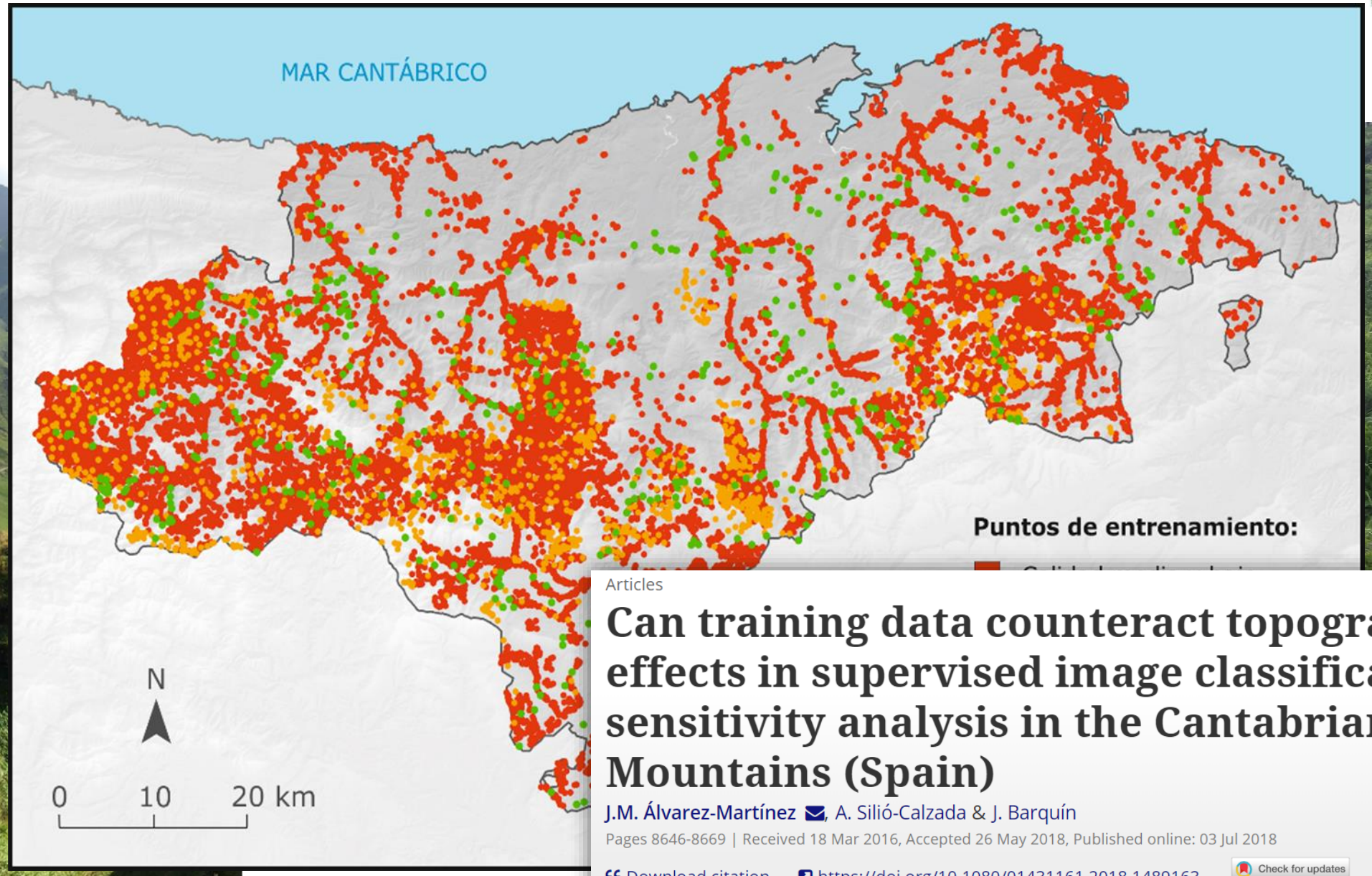
ID	EUNIS	N	Descripción
1	A2	103	Littoral sediment
2	A2.61	37	Seagrass beds on littoral sediments
3	C1	271	Surface standing waters
4	C2.2	169	Permanent non-tidal, fast, turbulent watercourses
5	D1.21	385	Hyperoceanic low-altitude blanket bogs, typically with dominant [Trichophorum]
6	E1.2	62	Perennial calcareous grassland and basic steppes
7	E1.263	227	Middle European [Brachypodium] semidry grasslands
8	E1.7	41	Closed non-Mediterranean dry acid and neutral grassland
9	E1.712	95	Sub-Atlantic [Nardus]-[Galium] grasslands
10	E1.721	131	Nemoral [Agrostis]-[Festuca] grasslands
11	E2.1	2430	Permanent mesotrophic pastures and aftermath-grazed meadows
12	E2.11	436	Unbroken pastures
13	E2.111	612	Ryegrass pastures
14	E2.112	171	Atlantic [Cynosurus]-[Centaurea] pastures
15	E2.2	328	Low and medium altitude hay meadows
16	E2.21	125	Atlantic hay meadows
17	E2.22	595	Sub-Atlantic lowland hay meadows
18	E5.31	40	Sub-Atlantic [Pteridium aquilinum] fields
19	F2.2	52	Evergreen alpine and subalpine heath and scrub
20	F2.231	73	Mountain [Juniperus nana] scrub
21	F3.13	31	Atlantic poor soil thickets
22	F3.17	125	[Corylus] thickets
23	F3.171	40	Atlantic and sub-Atlantic hazel thickets
24	F3.25	37	Piornales
25	F3.252	136	Northwestern Iberian [Genista florida] fields
26	F4.2	978	Dry heaths
27	F4.23	120	Atlantic [Erica]-[Ulex] heaths
28	F4.237	190	Cantabro-Pyrenean [Erica vagans]-[E. cinerea] heaths
29	F7.4	138	Hedgehog-heaths
30	F7.4451	834	Pyreneo-Cantabrian cushion-heaths
31	FA	46	Hedgerows
32	G1	40	Broadleaved deciduous Woodland
33	G1.21	252	Riverine [Fraxinus] - [Alnus] woodland, wet at high but not at low water
34	G1.2142	130	Pyreneo-Cantabrian alder galleries
35	G1.6	1343	[Fagus] woodland
36	G1.62	353	Atlantic acidophilous [Fagus] forests
37	G1.624	65	Pyreneo-Cantabrian acidophilous beech forests
38	G1.625	179	Western Cantabrian acidophilous beech forests
39	G1.64	247	Pyreneo-Cantabrian neutrophile [Fagus] forests

A need for in situ data and expert knowledge

Different EUNIS level when collecting data

40	G1.643	231	Sub-humid oro-Cantabrian beech forests
41	G1.662	55	North-western Iberian xerophile beech woods
42	G1.7	93	Thermophilous deciduous woodland
43	G1.7B	1089	[Quercus pyrenaica] forests
44	G1.7B2	370	Cantabrian [Quercus pyrenaica] forests
45	G1.7D	48	[Castanea sativa] woodland
46	G1.862	506	Cantabrian acidophilous oak forests
47	G1.8621	77	Eastern Cantabrian acidophilous oak forests
48	G1.8622	33	Western Cantabrian acidophilous oak forests
49	G1.8623	38	Oro-Cantabrian acidophilous oak forests
50	G1.91	24	[Betula] woodland not on marshy terrain
51	G1.9151	51	Cantabrian [Betula celtiberica] woodlands
52	G1.A	33	Meso- and eutrophic oak, hornbeam, ash, sycamore, lime, elm and related woodland;
53	G1.A1	31	[Quercus] - [Fraxinus] - [Carpinus betulus] woodland on eutrophic and mesotrophic soils
68	G4.F	67	Mixed forestry plantations (plantaciones mixtas de con├iferas y caducifolios)
69	G5	27	Lines of trees, small anthropogenic woodlands, recently felled woodland, early-stage woodland and coppice
70	H2.6	102	Calcareous and ultra-basic screes of warm exposures
71	H2.641	116	Canchales calc├íreos m├│viles orocant├íbricos
72	H2.65	34	Iberian calciphile fern screes
73	H3.21	159	Tyrrheno-Adriatic eumediterranean calcicolous chasmophyte communities
74	I	416	Regularly or recently cultivated agricultural, horticultural and domestic habitats
75	I1	101	Arable land and market gardens
76	I2	67	Cultivated areas of gardens and parks
77	I5.8	66	Comunidades alóctonas de Cortaderia, Baccharis, Buddleja, Phyllostachis, Reynoutria
78	J	132	Constructed, industrial and other artificial habitats
79	X1	115	Helechales
80	X2	31	Nanofruticedas cespitosas con G. pyrenaicum y H. sedenense

A need for in situ data and expert knowledge



Articles

Can training data counteract topographic effects in supervised image classification? A sensitivity analysis in the Cantabrian Mountains (Spain)

J.M. Álvarez-Martínez, A. Silió-Calzada & J. Barquín

Pages 8646-8669 | Received 18 Mar 2016, Accepted 26 May 2018, Published online: 03 Jul 2018

Download citation https://doi.org/10.1080/01431161.2018.1489163 Check for updates

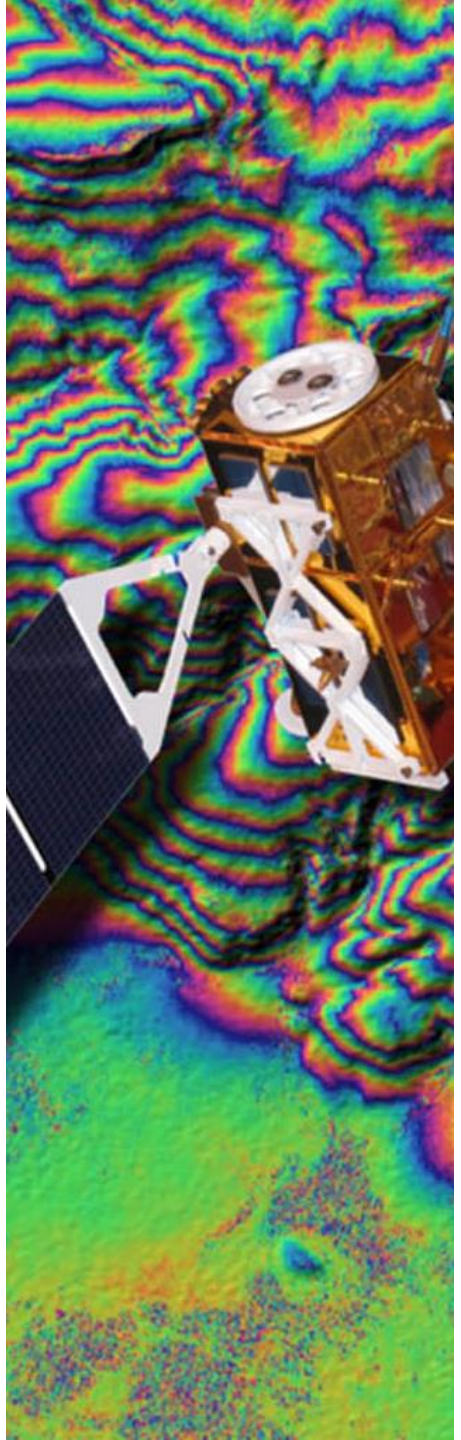
Opinion

An environmental crisis: science has failed; let us send in the machines

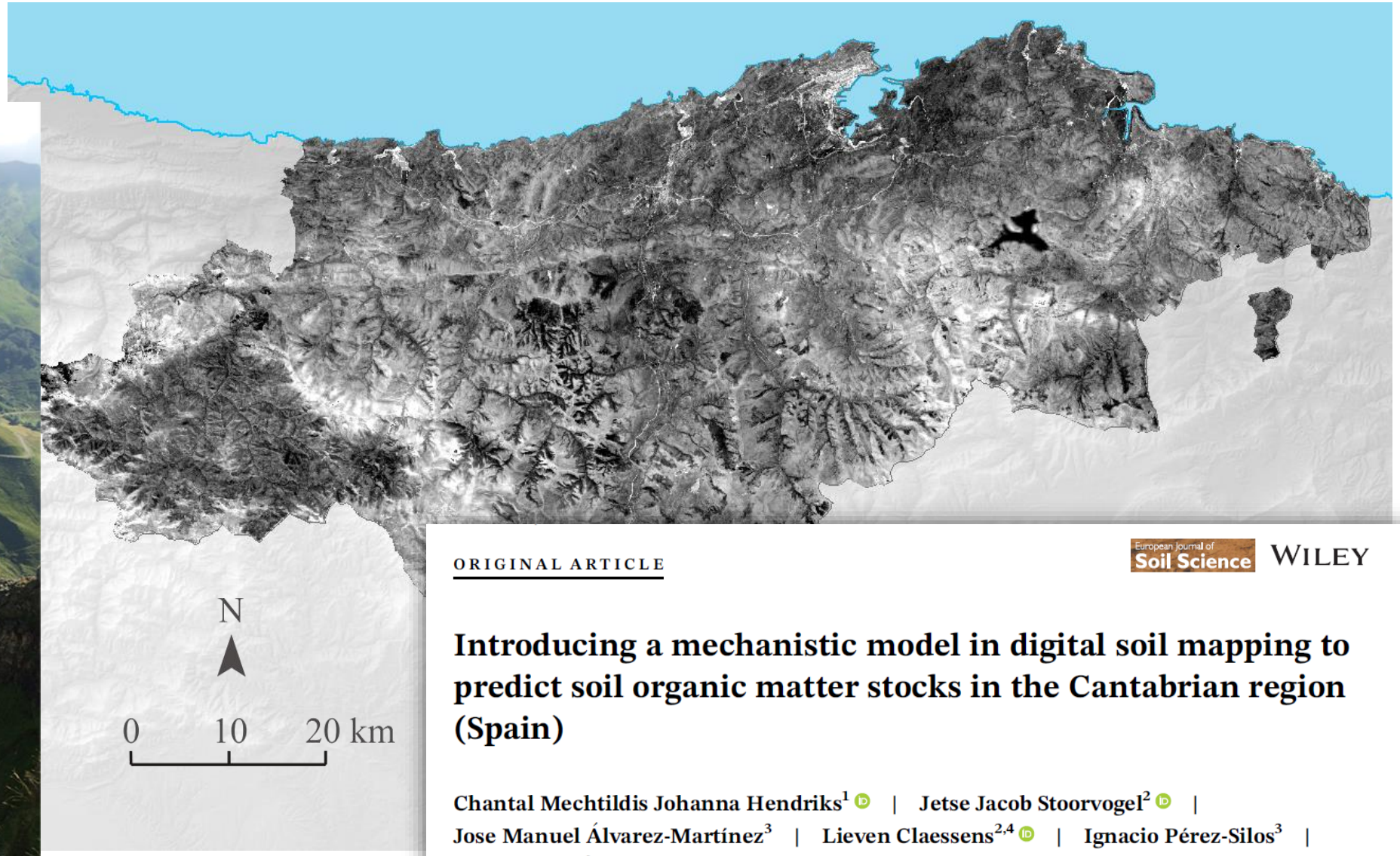
Russell G. Death*

The ecological condition of the world's waterways continues to decline under increasing pollution, human land use intensification, and/or demand for water abstraction. This is occurring despite the fact that freshwater ecologists and other water scientists have been investigating these environmental concerns for many years. Freshwater science has made considerable advances understanding the causes of this ecological decline, but we still appear to be further from halting that decline than ever before. Perhaps the scientific solutions are clear but political, social, legal or economic constraints intervene? Irrespective of the reasons, in my opinion freshwater science is failing to deal effectively with this environmental crisis. I believe that artificial intelligence devices and machine learning software may offer potential for dealing with the environmental crisis facing the world's freshwater. There are numerous, free and easy to use software packages that would enable freshwater ecologists to better understand some of the complex, nonlinear relationships in their data, and to potentially make better predictions about the effects of stressors and/or how best to mitigate them. I see a not too distant future where these devices will take over direct management of river reaches to hopefully provide more effective balancing of economic and environmental needs for water. I would like to encourage more scientists to embrace the ease and power of machine learning as a way to better interpret collected data, or at least provide an alternative perspective that may prove useful.

How to cite this article:
WIREs Water 2015, 2:595–600. doi: 10.1002/wat2.1102



A need for spatial predictors



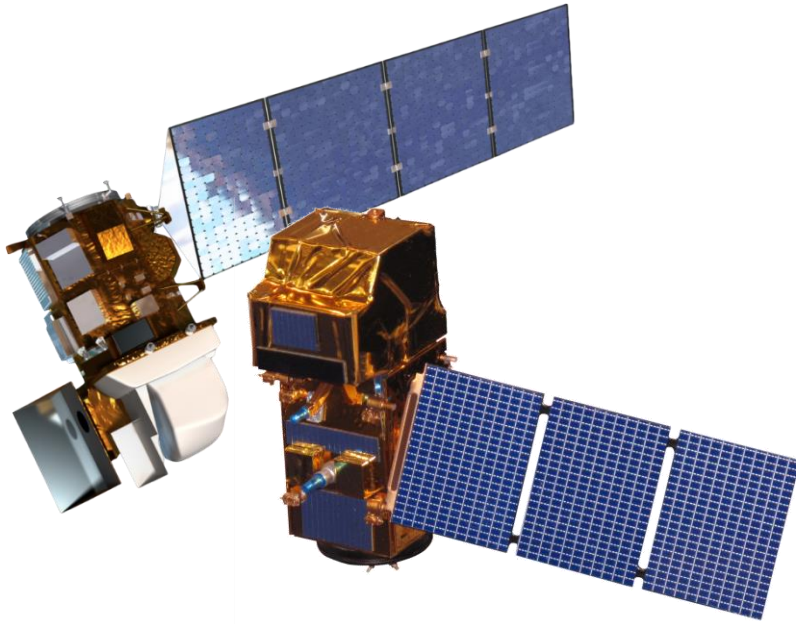
ORIGINAL ARTICLE

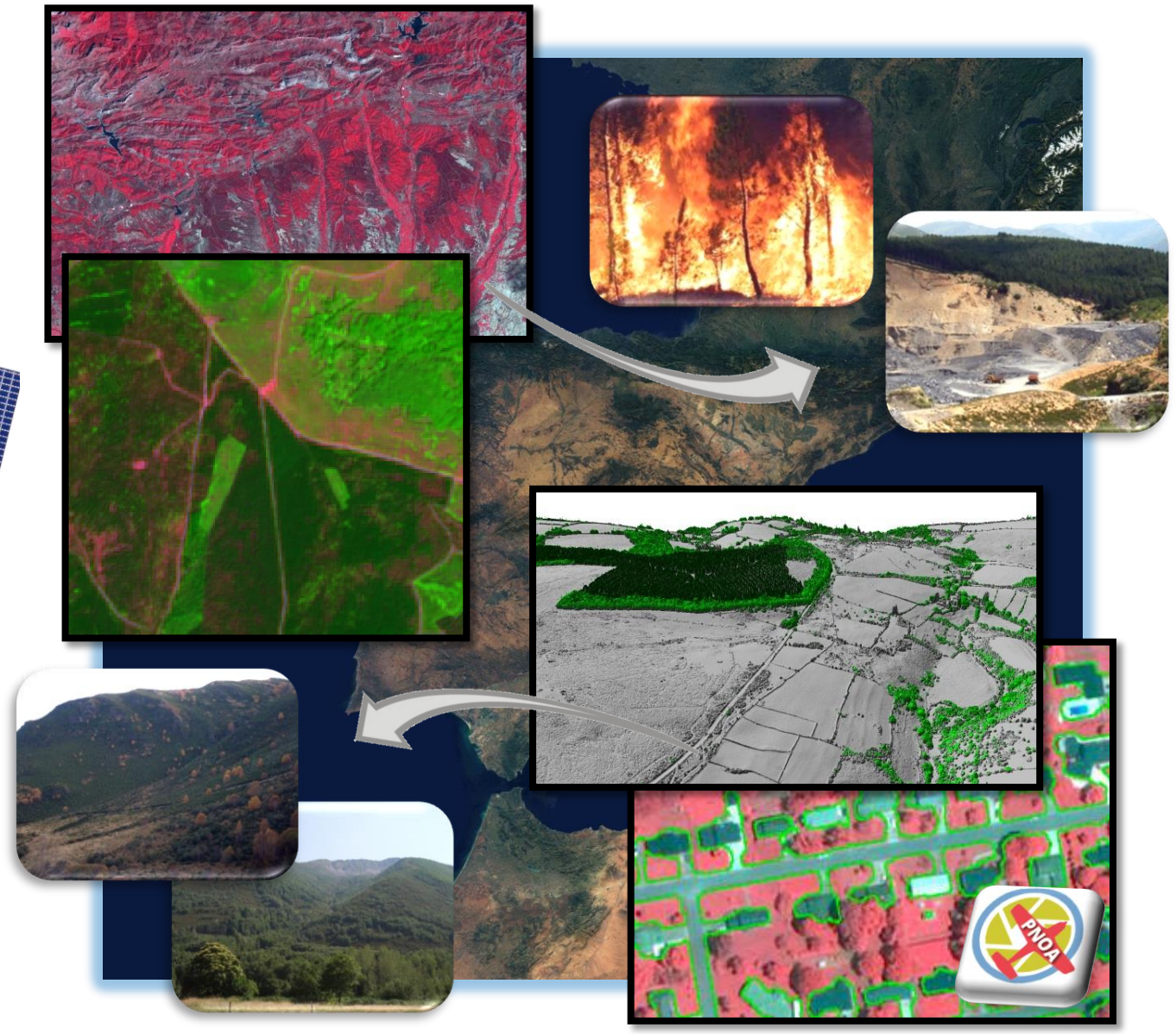
European Journal of Soil Science | WILEY

Introducing a mechanistic model in digital soil mapping to predict soil organic matter stocks in the Cantabrian region (Spain)

Chantal Mechtildis Johanna Hendriks[1] | Jetse Jacob Stoorvogel[2] | Jose Manuel Álvarez-Martínez[3] | Lieven Claessens[2,4] | Ignacio Pérez-Silos[3] | José Barquín[3]

A need for Remote Sensing – spatial, temporal, spectral



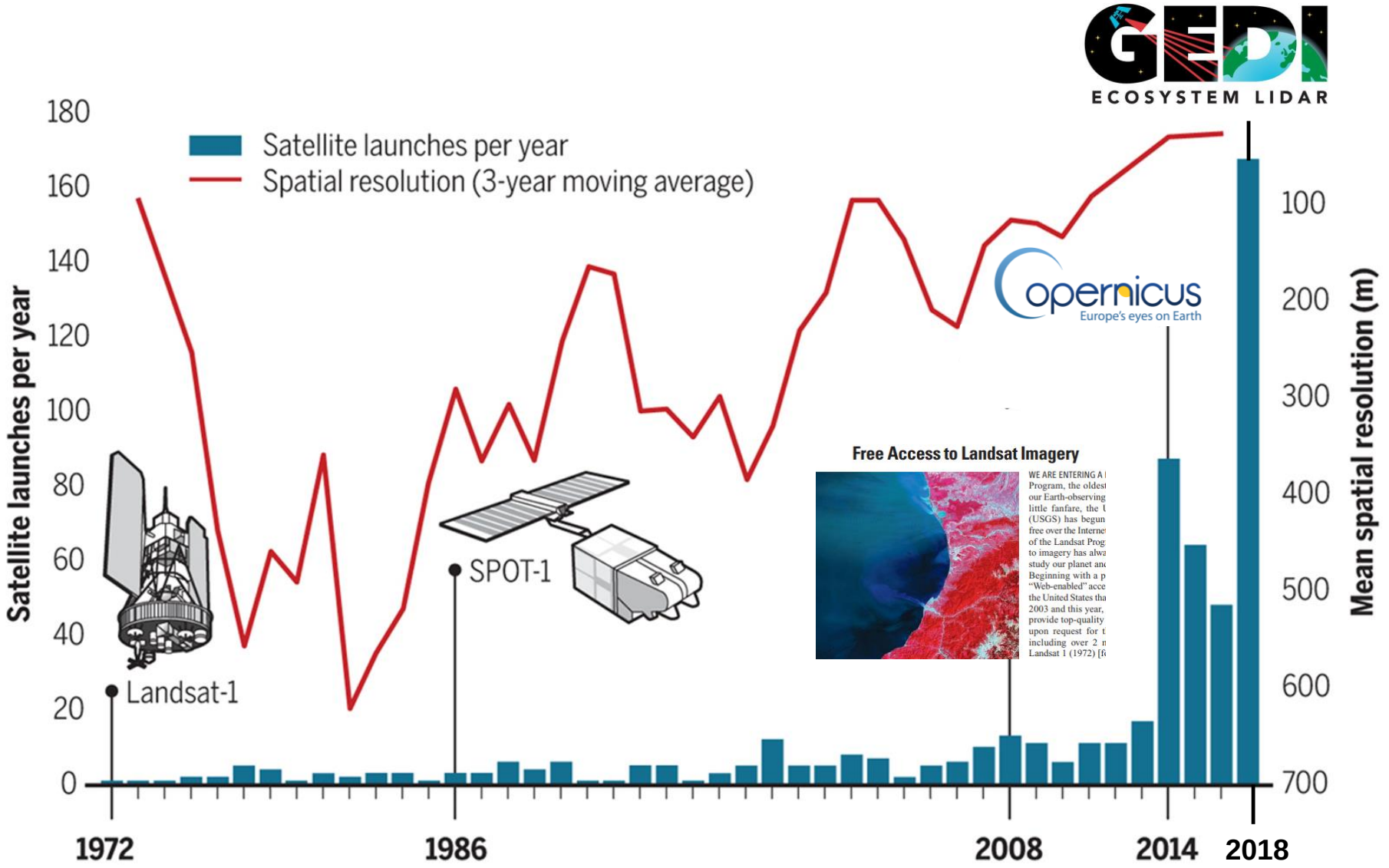


Satellite imagery: Landsat, Sentinel 1 / 2, VHR (<m) Hyperion, Chris-Proba (h*)

LiDAR and SAR data

Aerial imagery and UAV: old to current, high spatial resolution to GIS apps.

A need for Remote Sensing



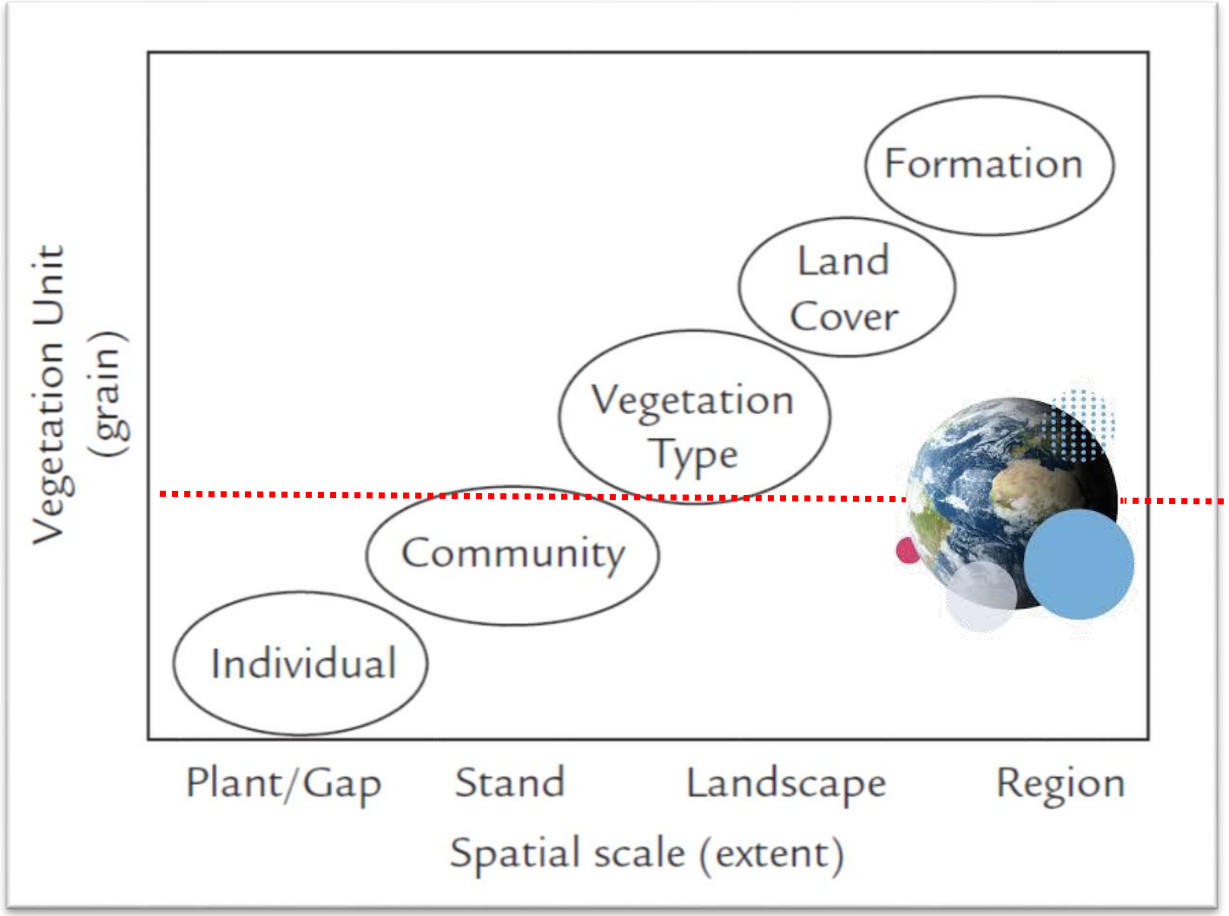
Copernicus_Contributing_Missions_overview

Ecosystem monitoring with Remote Sensing

Challenges

Opportunities

Mapping vegetation/habitats/ecosystems



10 km

1 m

Lack of maps at large scales with fine resolution

Franklin (2013). Mapping Vegetation from Landscape to Regional Scales. In: van der Maarel & Franklin (Ed.) Vegetation Ecology (pp. 486-508)

Chapter 16

Mapping Vegetation from Landscape to Regional Scales

Janet Franklin

Book Editor(s):Eddy van der Maarel, Janet Franklin

First published: 07 January 2013 | https://doi.org/10.1002/9781118452592.ch16 | Citations: 5

Consulte disponibilidad de texto completo en coleccion BUC

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Summary

This chapter covers mapping vegetation from landscape to regional scales, with sections on scale, data, methods, examples of recent maps illustrating their uses, dynamic mapping, and the future of vegetation mapping research.

Current challenges in large-scale mapping

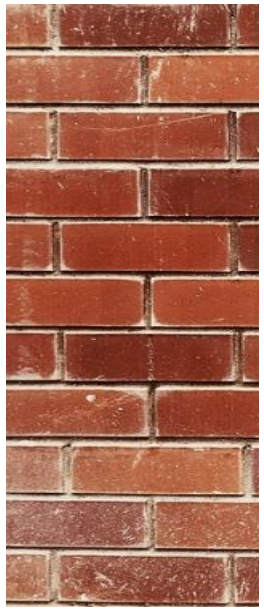
- Optimizing time and resources
- Methodological consistency
- Covering large-scales with high resolution
- Replicable in time (monitoring)
- Based on ground-truth data (GPS)
- Making use of remote-sensing data

European Environmental Agency (2014). Terrestrial habitat mapping in Europe: an overview. Joint report MNHN-EEA

Two different views in habitat mapping?

Local vegetation/habitat maps

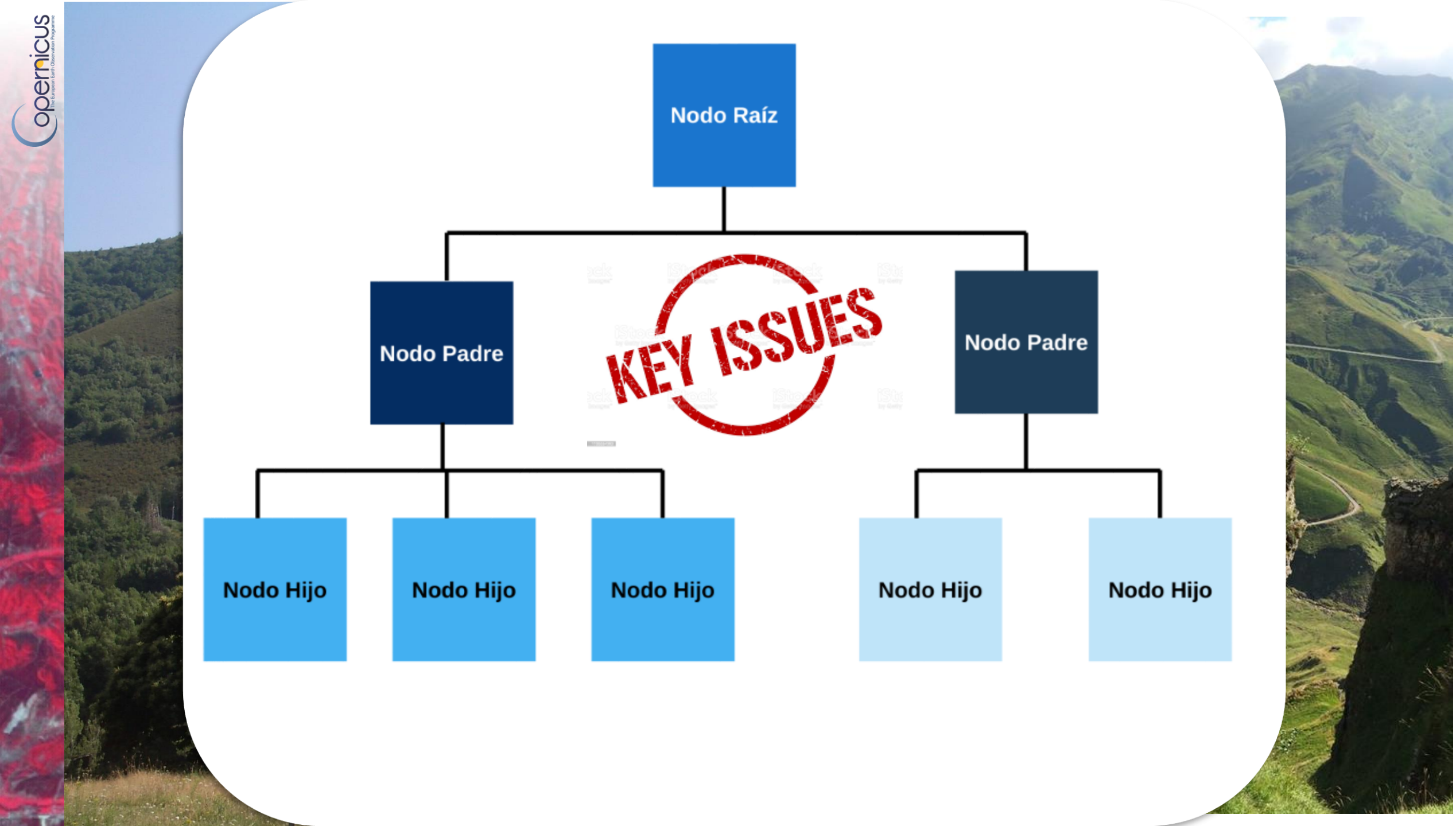
- For nature conservation
- High-resolution units
- Cost-time demanding



Remote sensing and modelling

- Science-based approaches
- Local studies
- Difficult to reproduce

Probabilistic vegetation mapping for large-scale conservation assessment
that needs to optimize available efforts/data


Nodo Raíz
Nodo Padre
KEY ISSUES
Nodo Padre
Nodo Hijo
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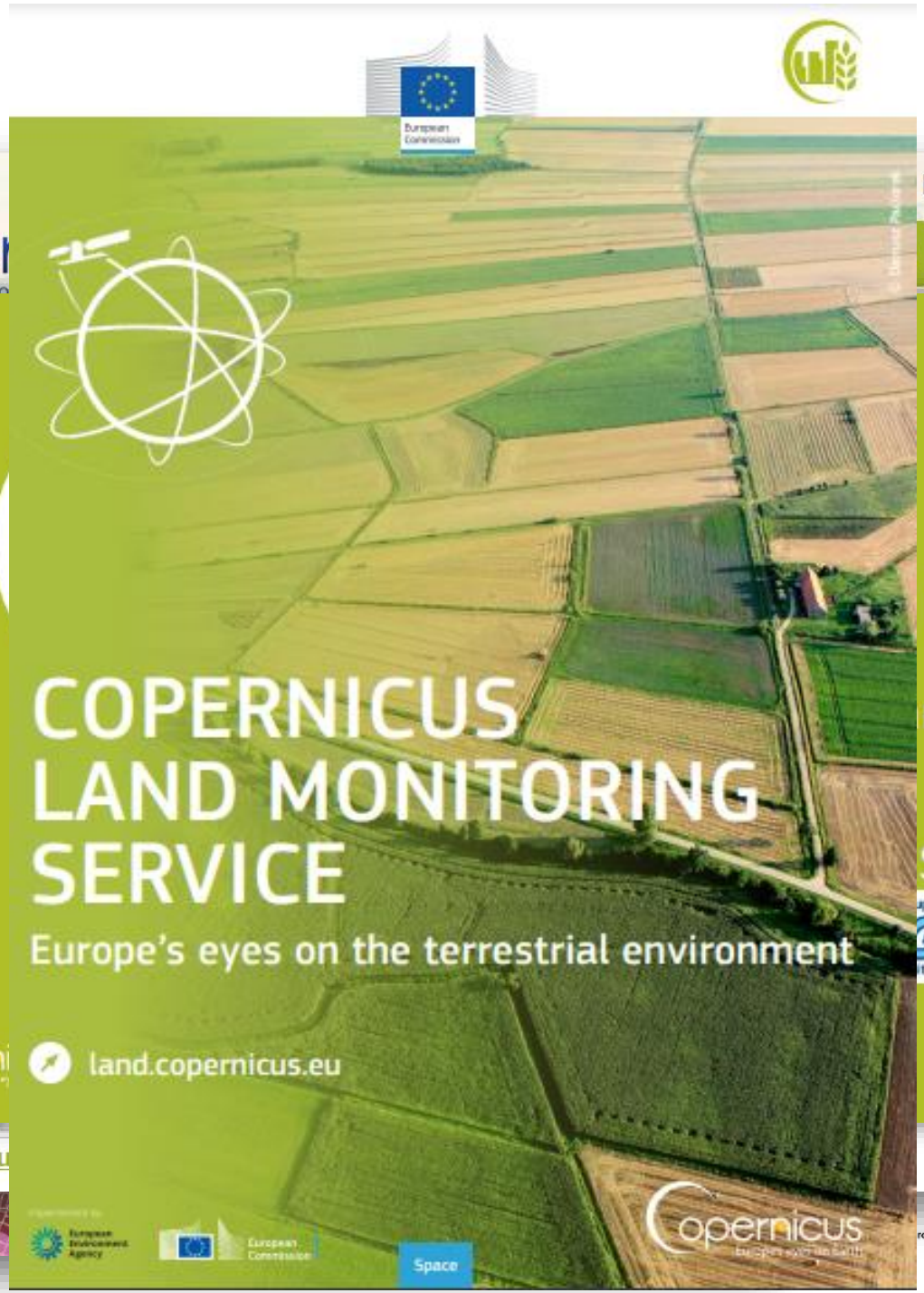
Nodo Hijo
Nodo Hijo


opernicus
CLIMATE CHANGE
MARINE MONITORING
ATMOSPHERE MONITORING
LAND MONITORING
SECURITY
EMERGENCY MANAGEMENT

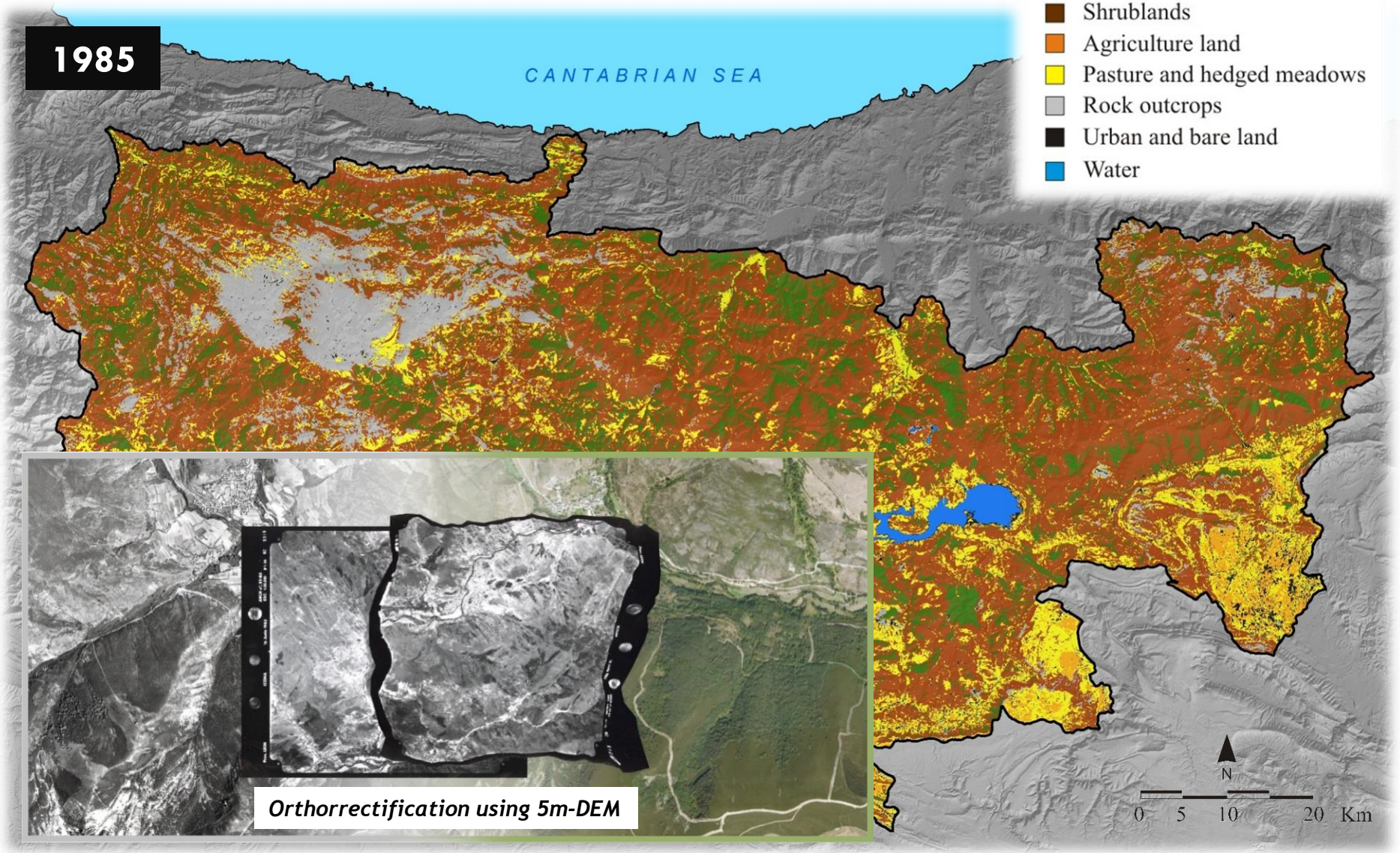
La observación remota aplicada al seguimiento de los ecosistemas



COPERNICUS

LULC mapping: 1980's

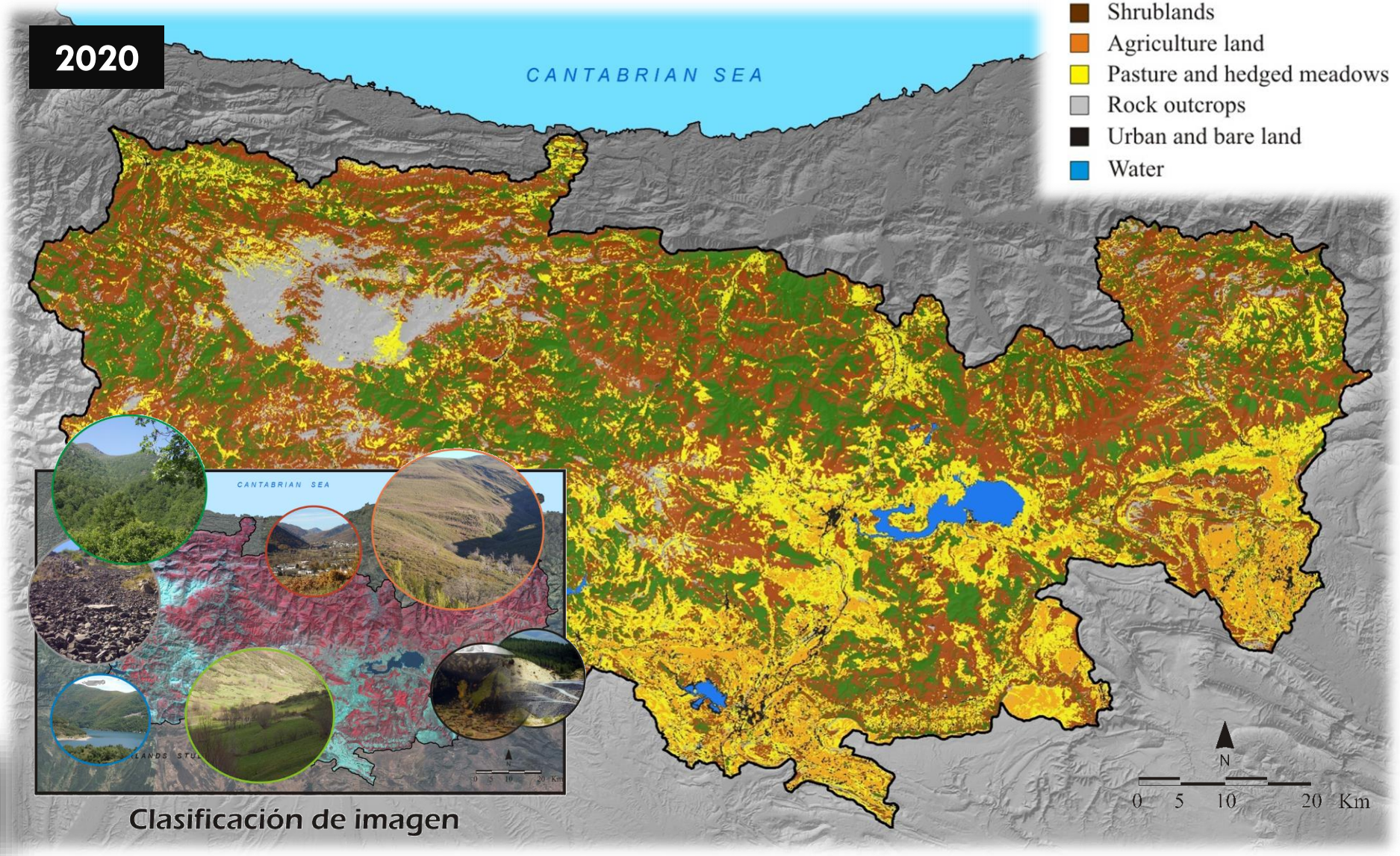
Collection of 1985 spectral signatures using old aerial imagery as ground data. Analysis of 1985 signatures



LULC mapping: now

sentinel-2

Hard classifiers. Accuracy >85%



LULC mapping: changes & dynamics

Science of the Total Environment 605–606 (2017) 527–540

Contents lists available at ScienceDirect

Science of the Total Environment

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

Long-term dynamics of a floodplain shallow lake in the Pantanal wetland: Is it all about climate?

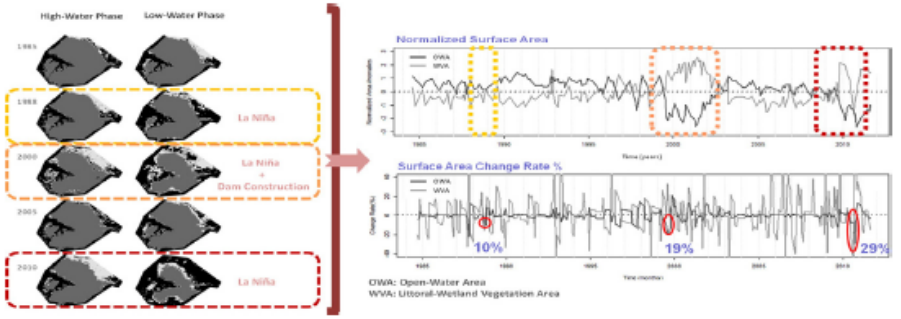
Ana Silio-Calzada [a,*], José Barquín [a], Vera L.M. Huszar [b], Nestor Mazzeo [c], Fernando Méndez [d], Jose Manuel Álvarez-Martínez [a]

[a] Environmental Hydraulics Institute "IH Cantabria of Universidad de Cantabria", C/ Isabel Torres n°15, Parque Científico y Tecnológico de Cantabria, 39011 Santander, Spain
[b] Museu Nacional, Quinta da Boa Vista, São Cristóvão, 20940-040 Rio de Janeiro, Brazil
[c] CURE-Facultad de Ciencias, Universidad de la República Oriental del Uruguay-UDELAR, Tacuarembó s/n, Maldonado, Uruguay
[d] Universidad de Cantabria, Escuela de Ingenieros de Caminos, Canales y Puertos, Av/ Los Castros, s/n. 39012, Santander, Spain

HIGHLIGHTS

- A new remote-sensing method to detect changes on floodplain lakes is presented.
- The lake dynamics are modulated by climate and river flow (natural and dam-affected).
- The floodplain ecosystem is suffering a progressive water loss.

GRAPHICAL ABSTRACT

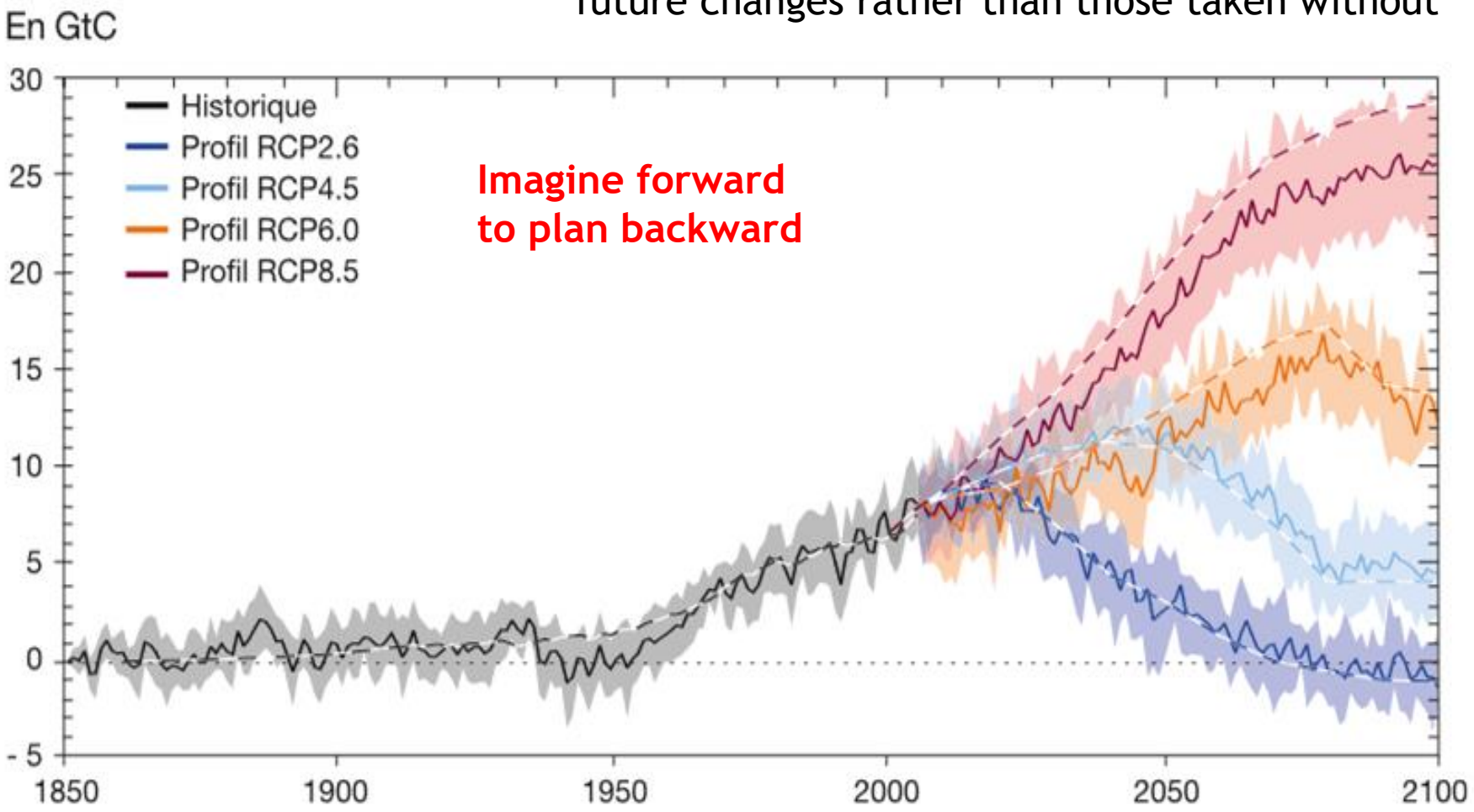


Broadleaf o
Conifer affo
Shrublands
Agriculture
Pasture and
Rock outcro
Urban and b
Water

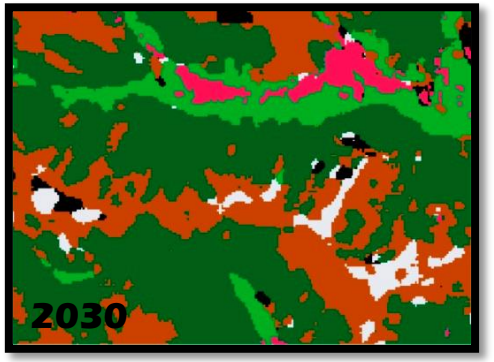
Susana Suárez-Seoane · Estanislao de Luis Calabuig

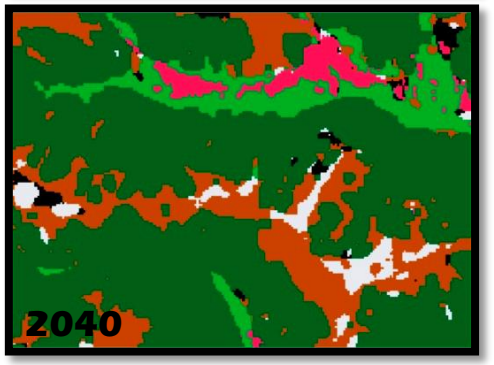
LULC mapping: future scenarios/global change

Decisions are more sustainable when considering possible future changes rather than those taken without



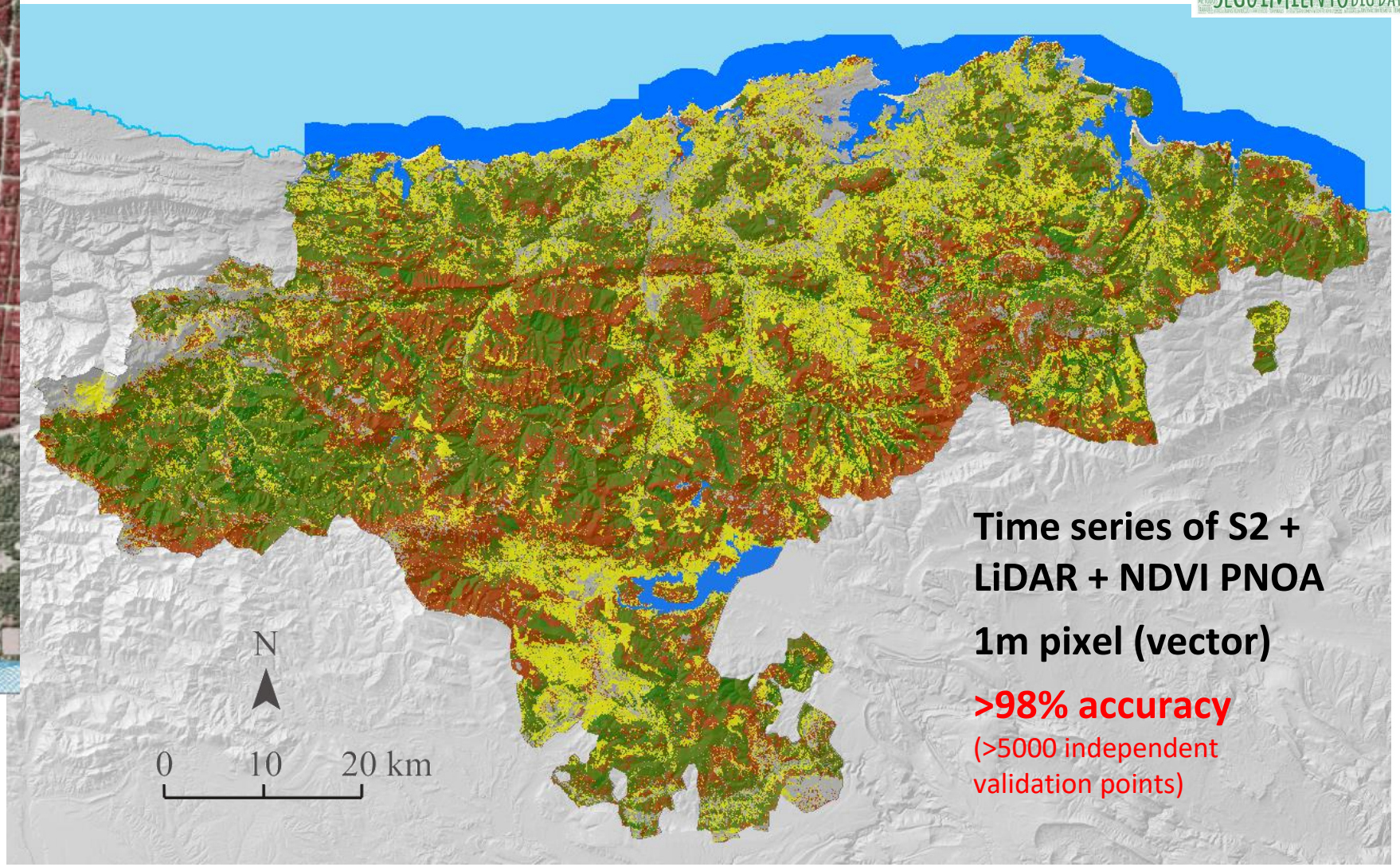
Future scenarios





LULC mapping: PROT map

La observación remota aplicada al seguimiento de los ecosistemas



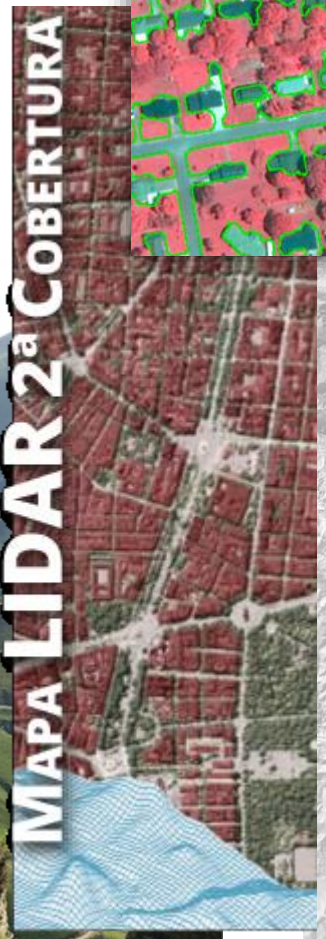
Gabriel Ortiz et al, 2021

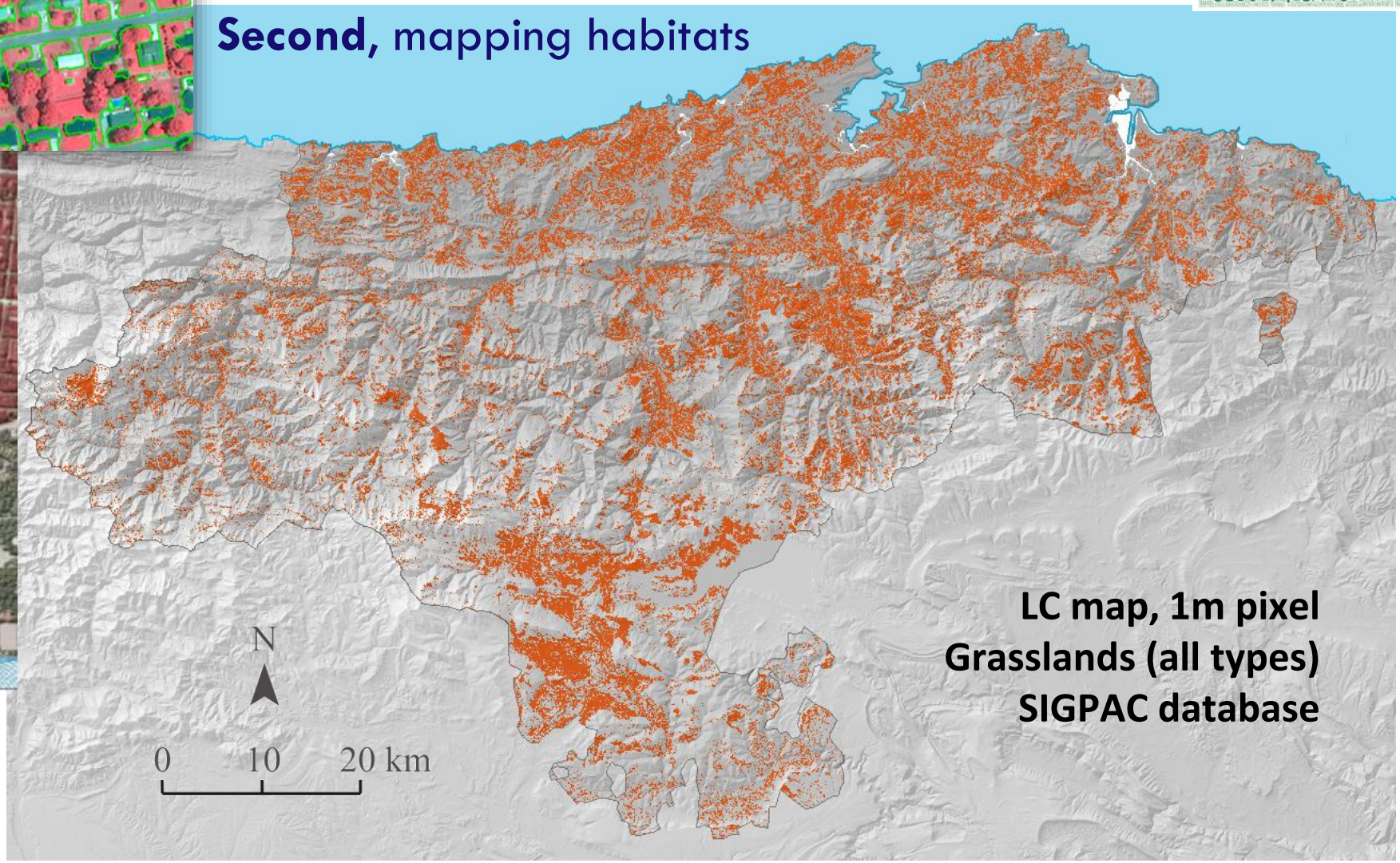
GOBIERNO de CANTABRIA — Mapas Cantabria Visualizador de Información Geográfica

La observación remota aplicada al seguimiento de los ecosistemas

First, Mapping LULC types

Second, mapping habitats





LC map, 1m pixel
Grasslands (all types)
SIGPAC database

Gabriel Ortiz et al, 2021

GOBIERNO de CANTABRIA — Mapas Cantabria Visualizador de Información Geográfica

First

Create LULC & grassland map

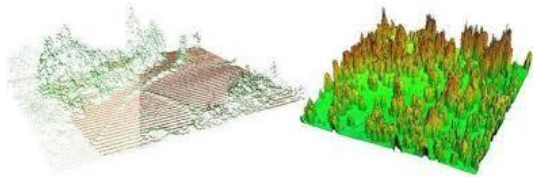
EUNIS points classification

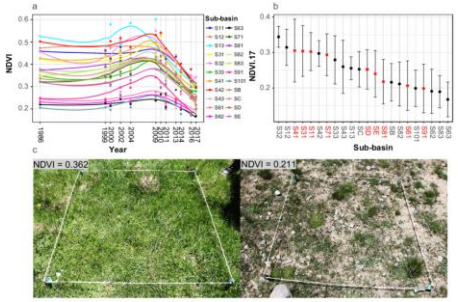
- Bioclimatic floor
- Subalpino – alpino (>1500m)
- Grassland typology
  - Naturals
  - Anthropogenic grasslands
    - Mowing
    - Livestock

EUNIS point selection

NDVI oscillation

ANOVA test *** (p<0,05)





Bioclimatic floor	Grassland typology		Mean NDVI oscillation value	
Colino	Natural		0.16834	
	Anthropized	mowing	0.23170	0.22630
		livestock		0.23190
Montano	Natural		0.29704	
	Anthropized	mowing	0.3462	0.37870
		livestock		0.31920
Subalpino-alpino	Natural		0.40090	
	Anthropized (livestock)		0.48300	

NDVI Oscillation classification (by pixel)

LULC map classification (by plot)

NDVI August values

PUERTO values

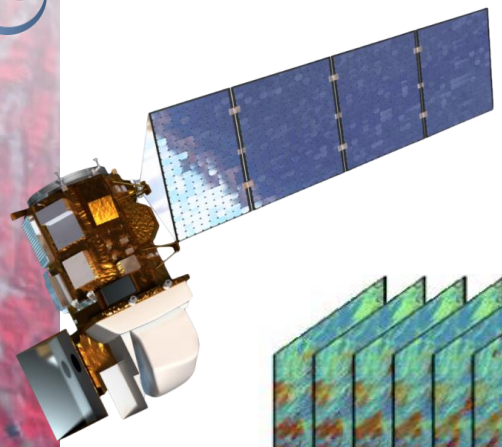
Bioclimatic floor	Grassland typology		August NDVI value		PUERTO value	
Colino	Natural		0,469267		0,724221	
	Anthropized	mowing	0,470261	0,469553	0,838499	0,850613
		livestock		0,470539		0,834068
Montano	Natural		0,483394		0,434023	
	Anthropized	mowing	0,44194	0,445353	0,459883	0,433544
		livestock		0,455190		0,415914
Subalpino-alpino	Natural		0,400784		0,186367	
	Anthropized (livestock)		0,39658		0,185262	

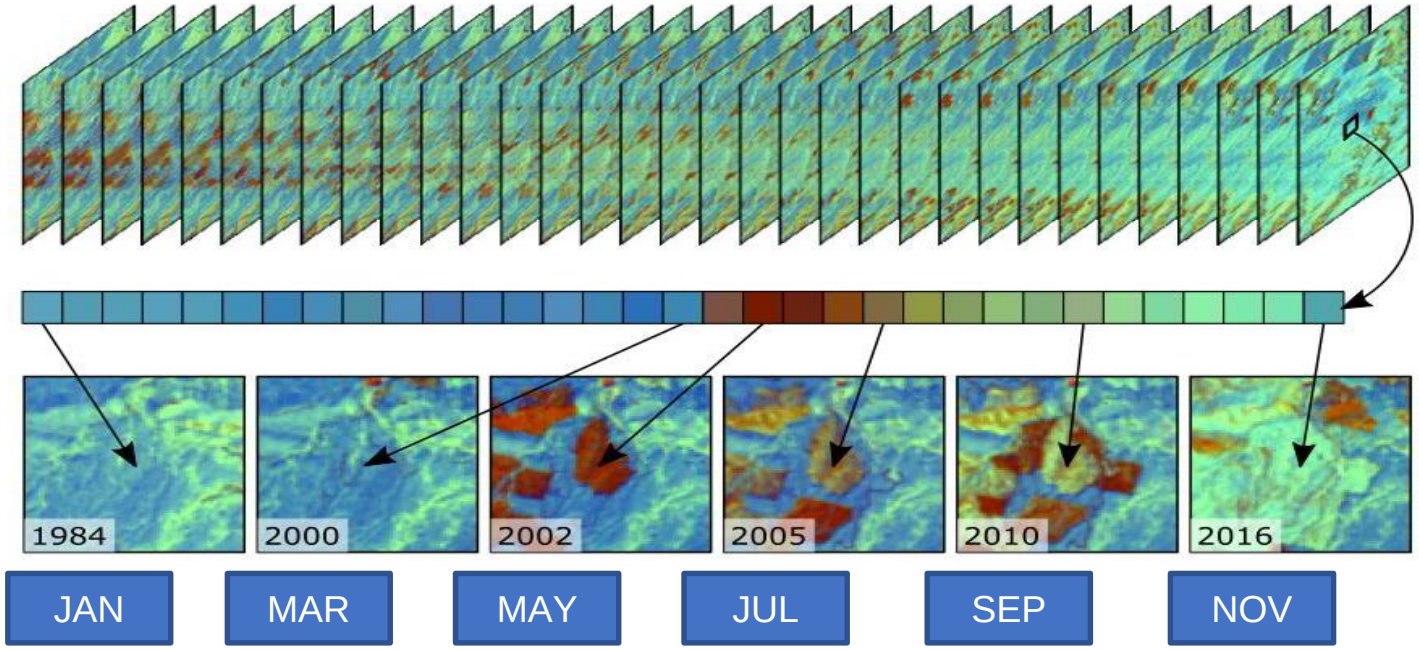
First, Mapping LULCC types

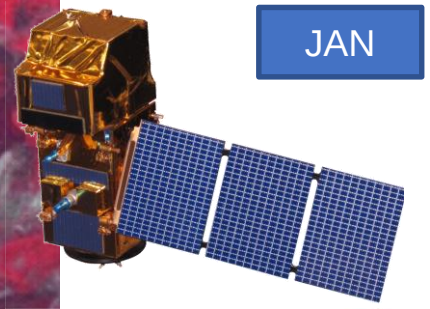
Second, mapping habitat types

NDVI oscillation

Time series analysis -- pipelines

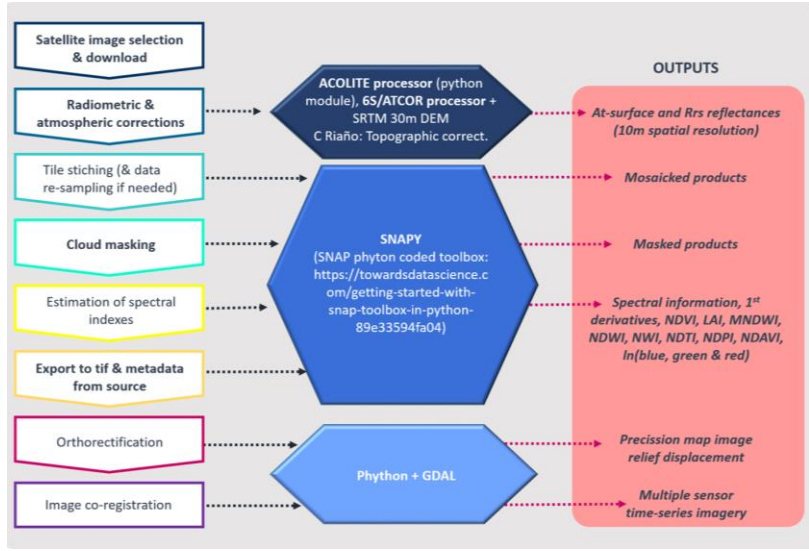






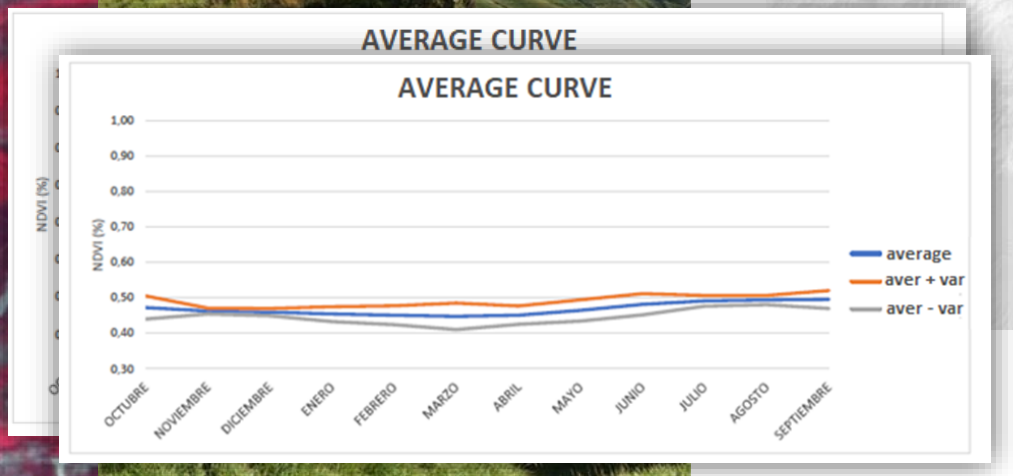
OPEN DATA CUBE

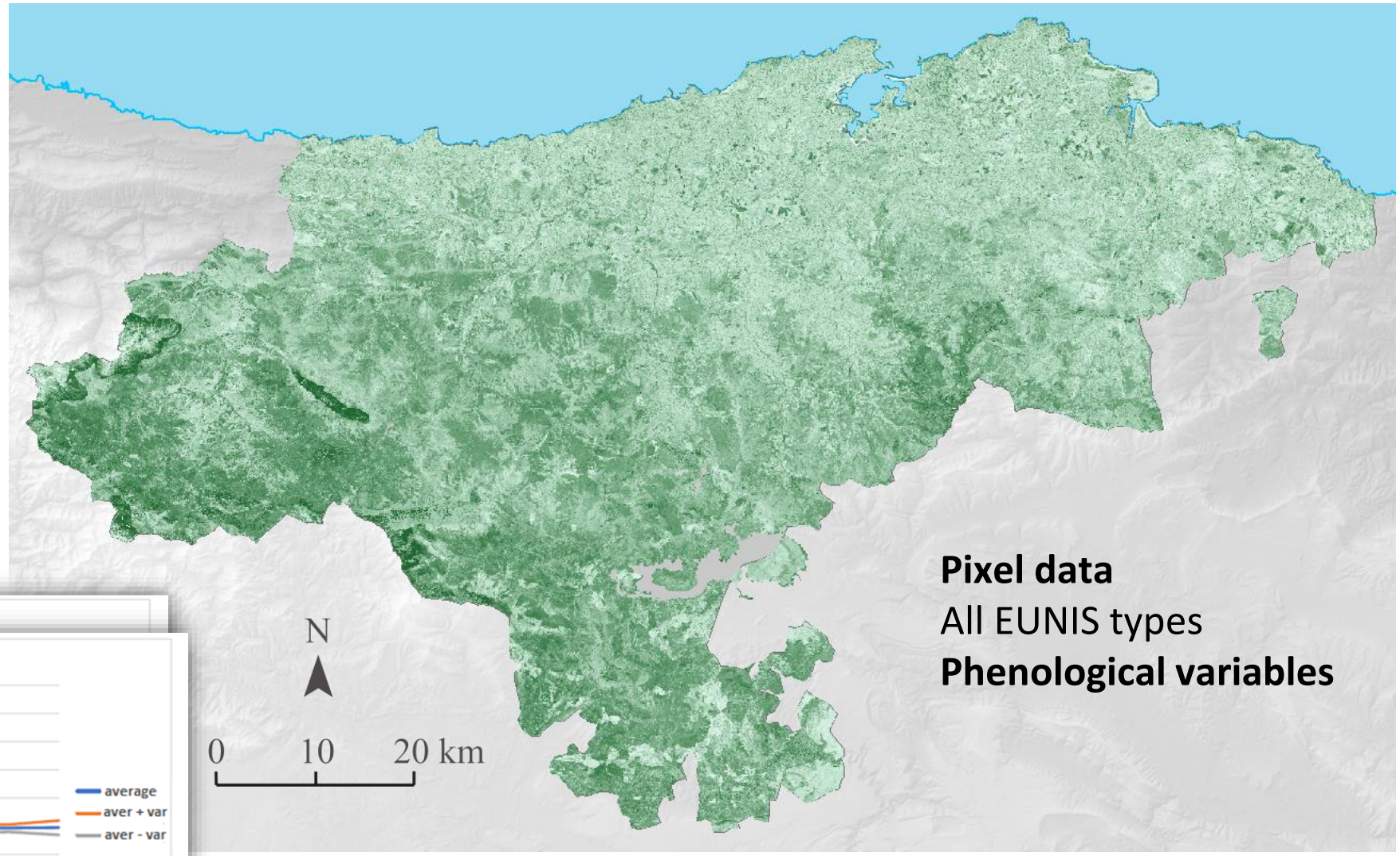
itd medioambiente



NDVI maximum oscillation (2017-2021)

Time series of S2 data for vegetation phenology





Pixel data

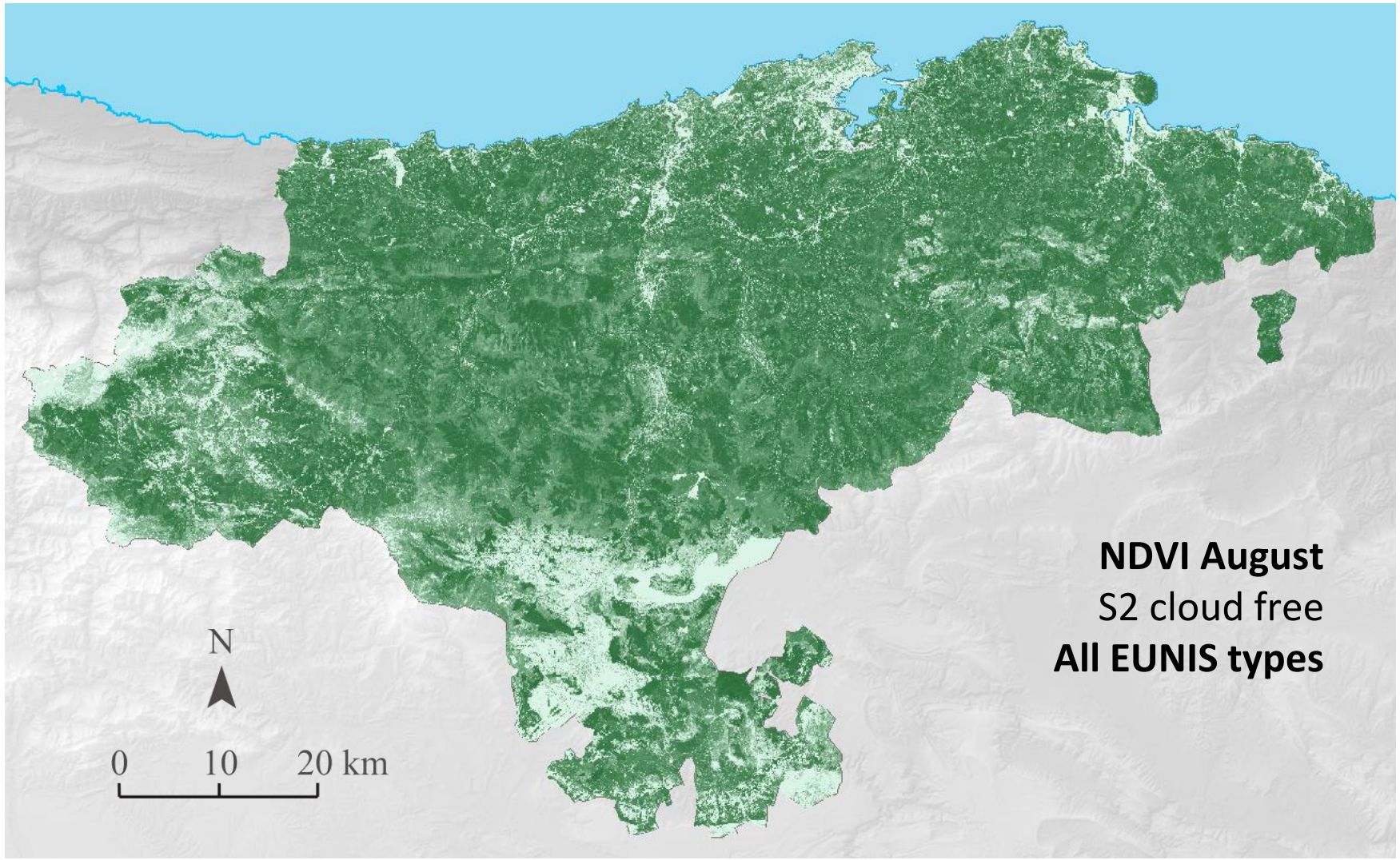
All EUNIS types

Phenological variables

low high

NDVI average value (monthly, seasonally)

Time series of S2 data for vegetation phenology



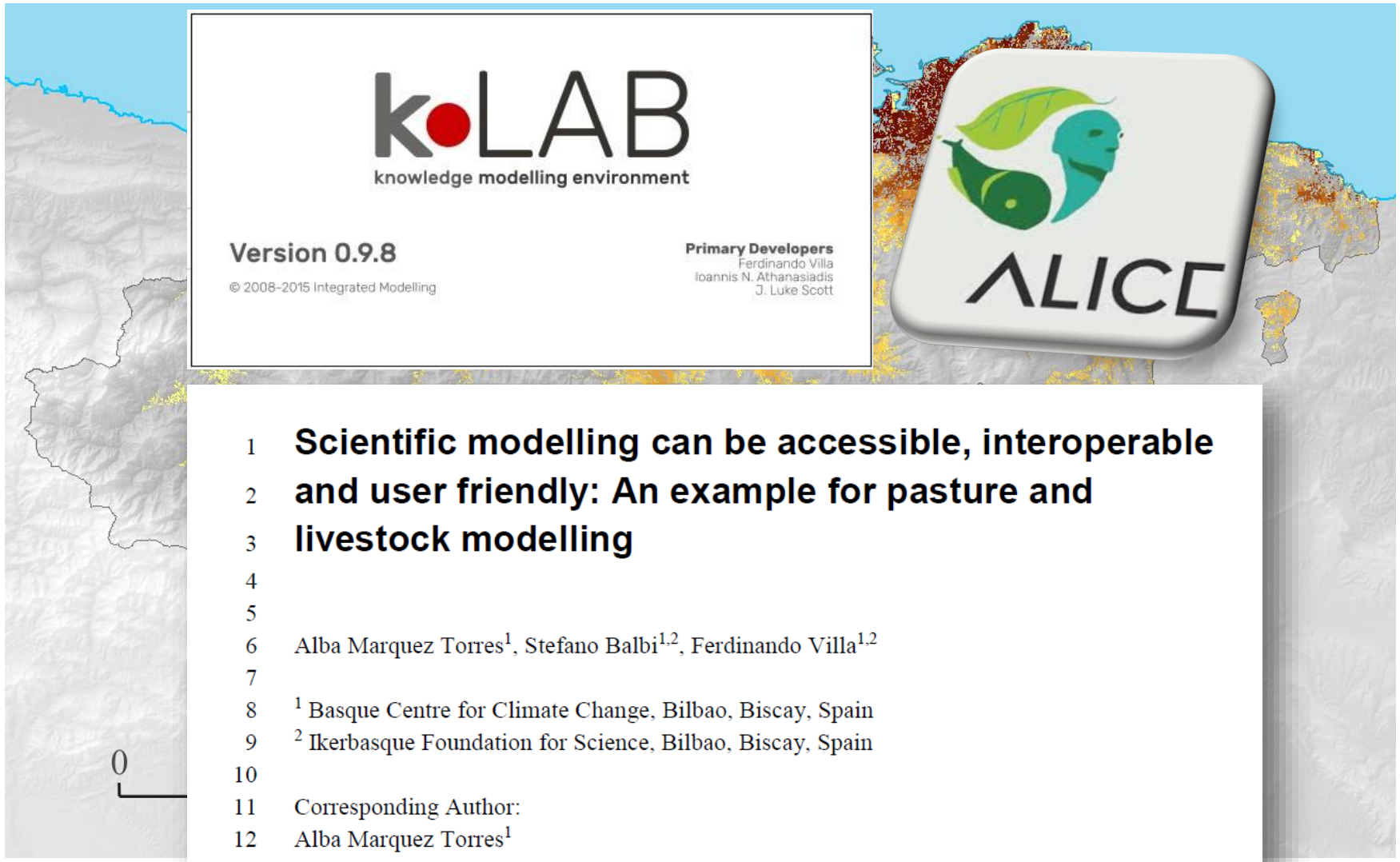
low high

PUERTO values

Grassland productivity

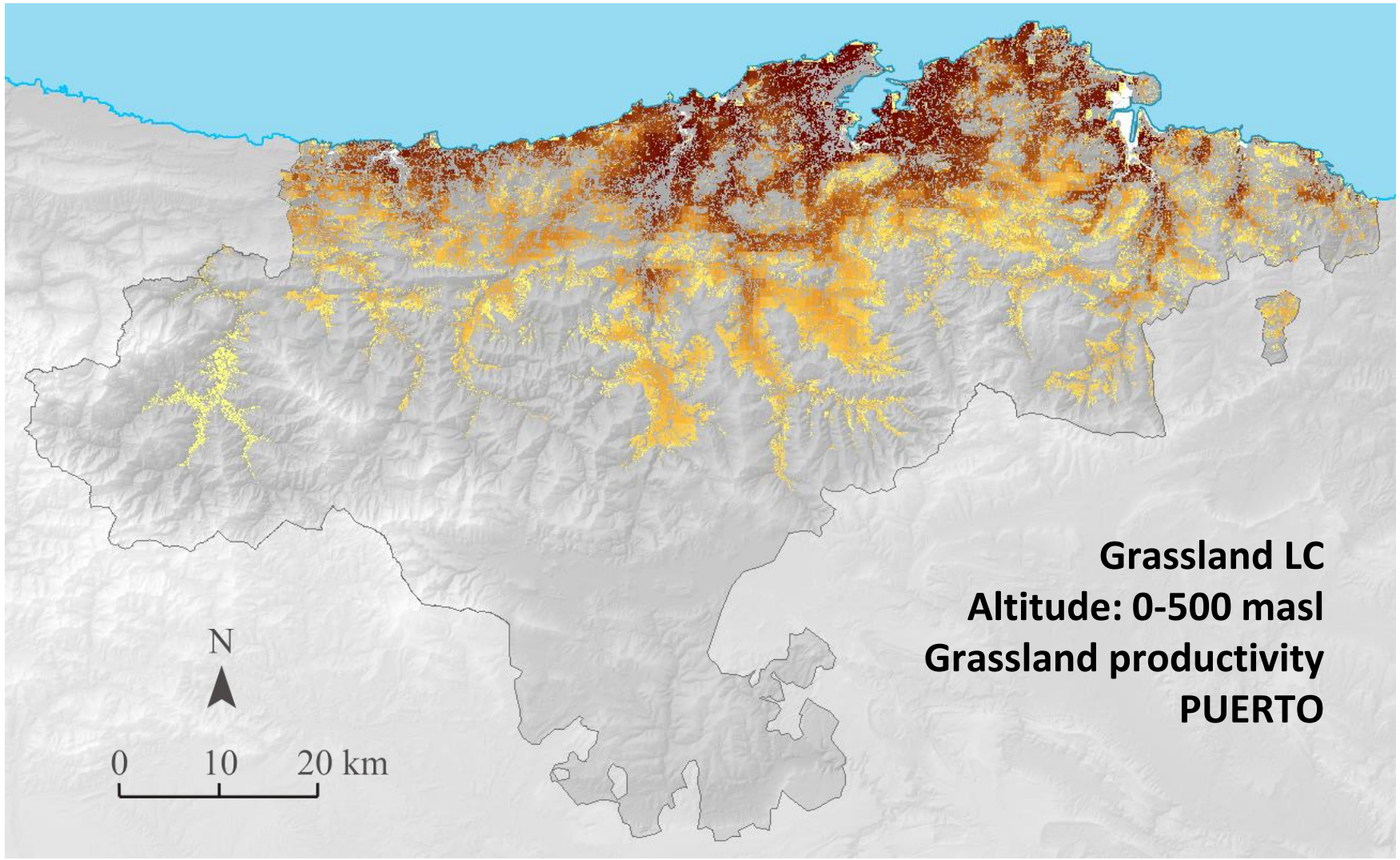
La observación remota aplicada al seguimiento de los ecosistemas

Mechanistic model of grasslands productivity

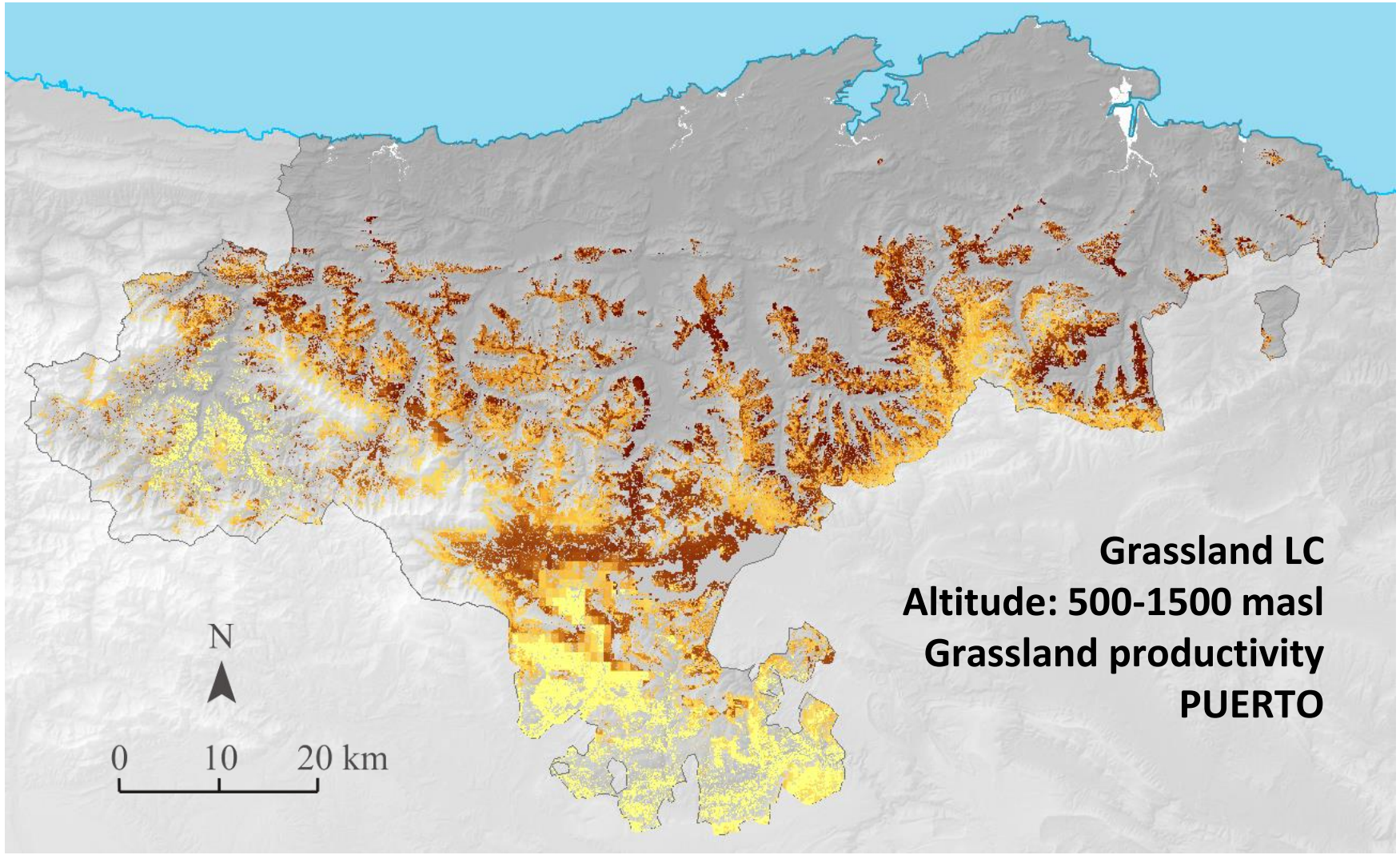


1 **Scientific modelling can be accessible, interoperable**
2 **and user friendly: An example for pasture and**
3 **livestock modelling**
4
5
6 Alba Marquez Torres[1], Stefano Balbi[1,2], Ferdinando Villa[1,2]
7
8 [1] Basque Centre for Climate Change, Bilbao, Biscay, Spain
9 [2] Ikerbasque Foundation for Science, Bilbao, Biscay, Spain
10
11 Corresponding Author:
12 Alba Marquez Torres[1]
13 Edificio Sede 1, 1º Planta 1 | Parque Cientifico UPV/EHU, 48940 Leioa, Biscay
14 Email address: alba.marquez@bc3research.org

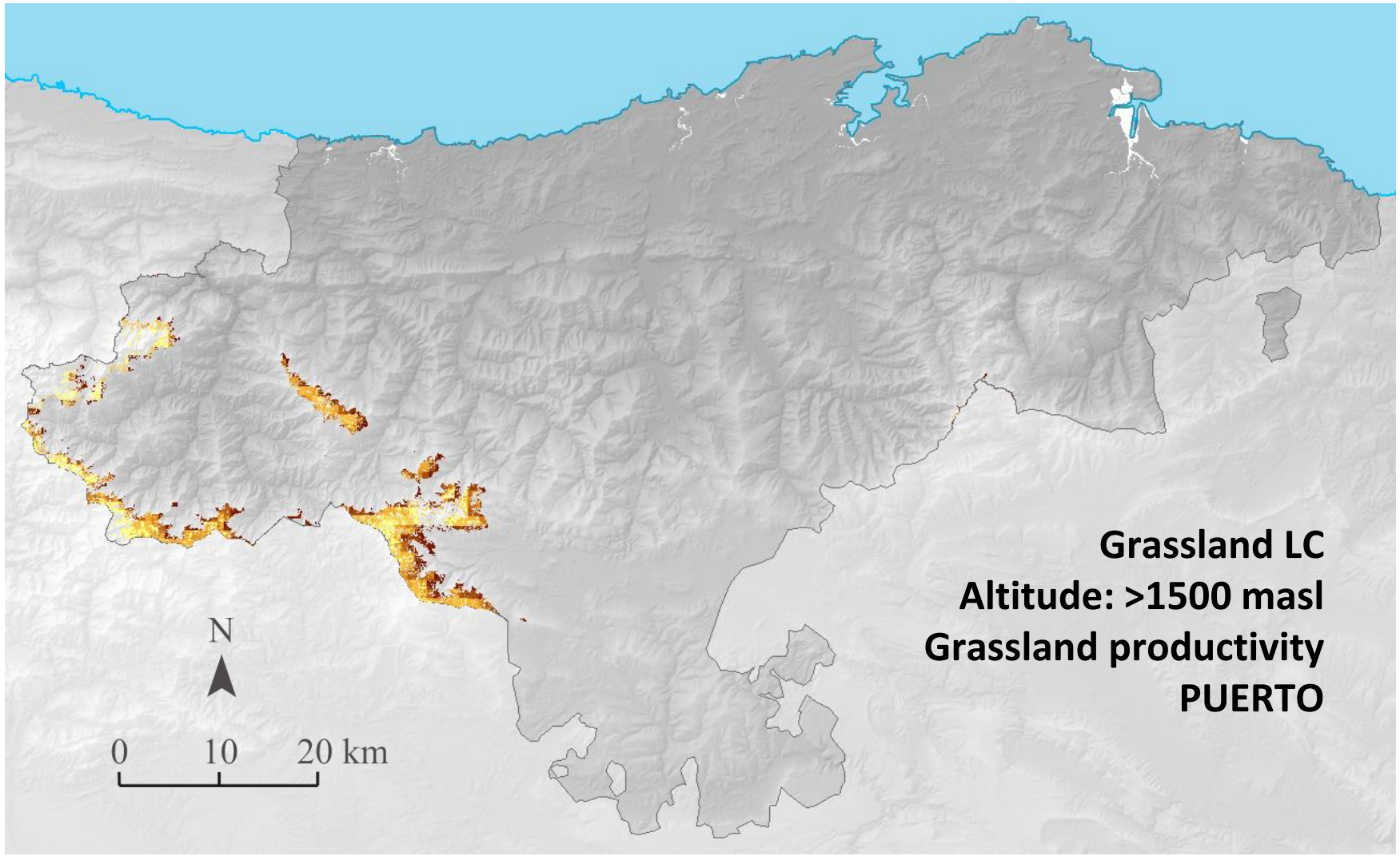
Grassland productivity



Grassland productivity



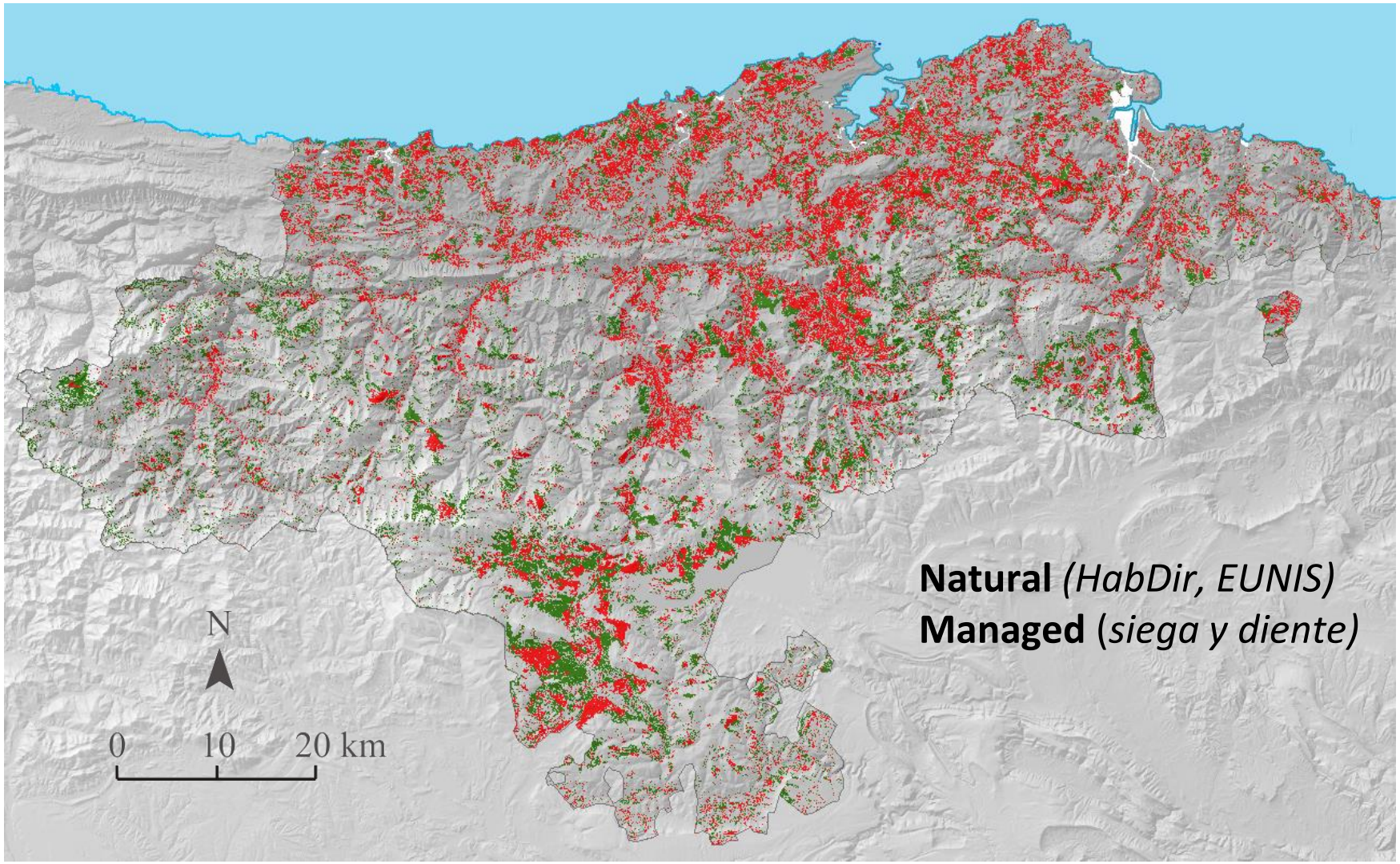
Grassland productivity



Multicriteria

Grassland mapping by land use and management

Red: managed meadows, **> NDVI osc, < NDVI Ag, > prodPUERTO**
Green: natural meadows, **< NDVI osc, >NDVI Ag, < prodPUERTO**

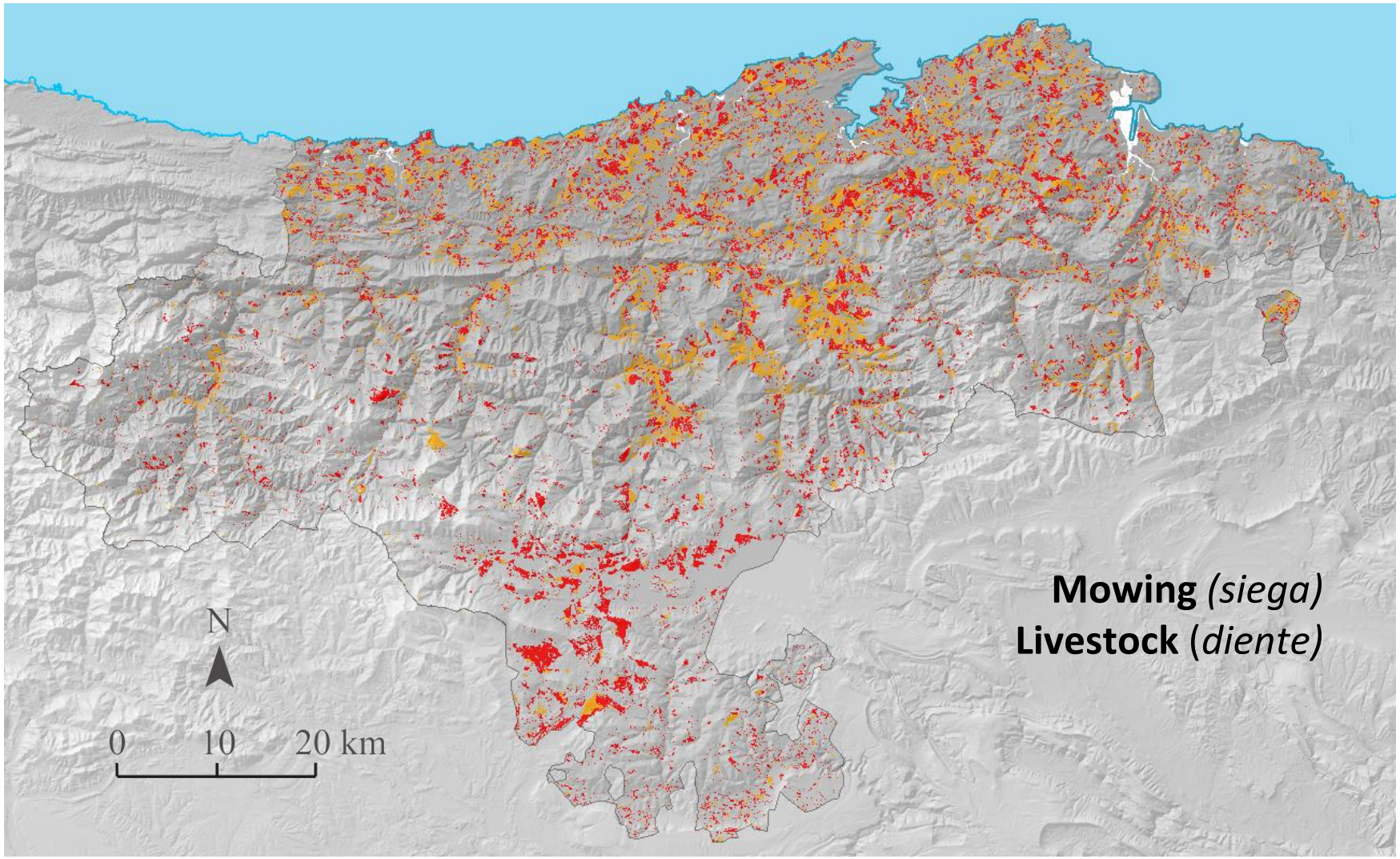


Multicriteria

Grassland mapping by land use and management

Red: livestock meadows, **> NDVI osc, < NDVI Ag, > prodPUERTO**

Orange: mowing meadows, **< NDVI osc, >NDVI Ag, < prodPUERTO**



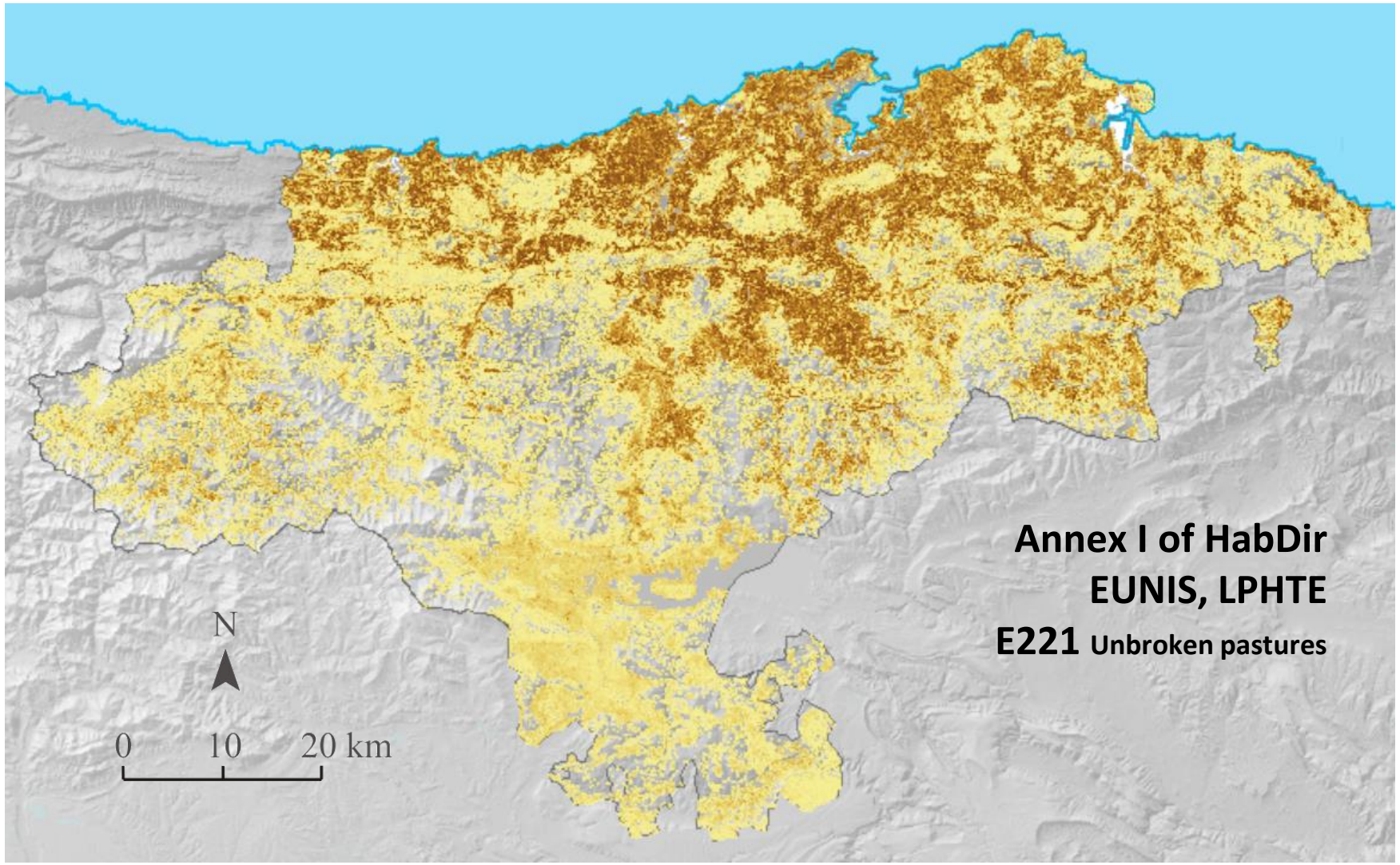
diente *siega*

Grassland (EUNIS) mapping

Second

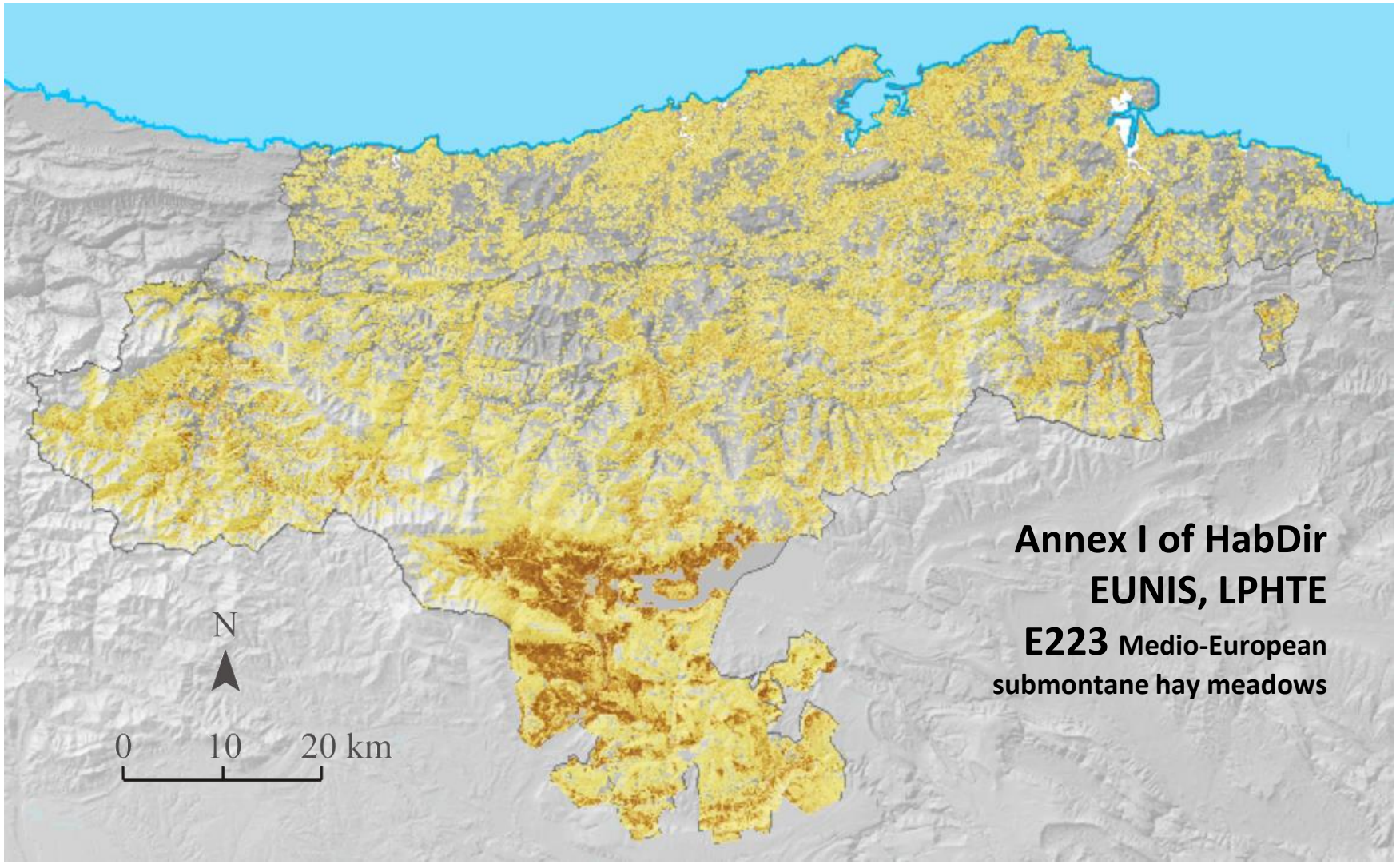
La observación remota aplicada al seguimiento de los ecosistemas

Modelling only within the corresponding LULC domain



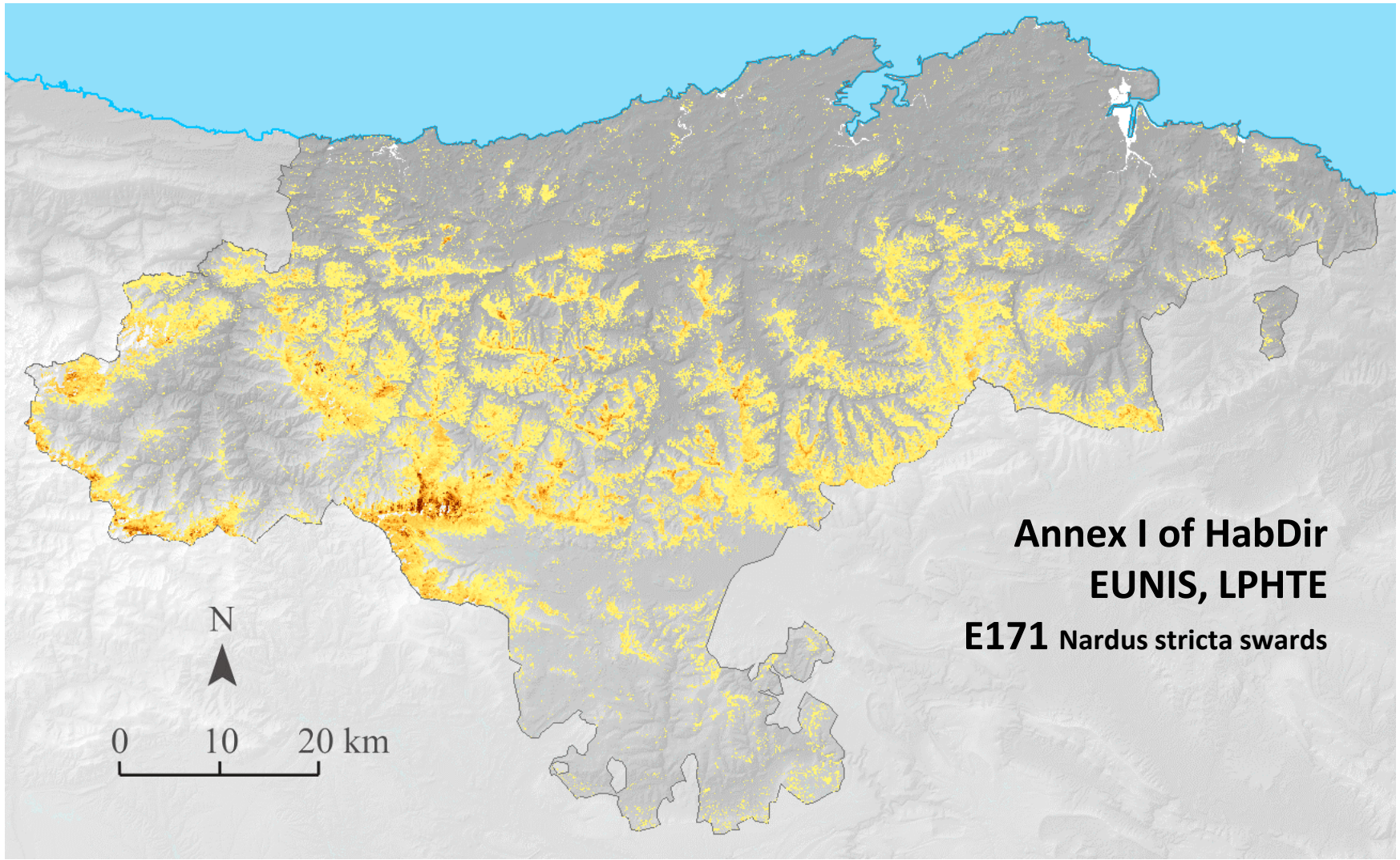
Grassland (EUNIS) mapping

Modelling only within the corresponding LULC domain



Grassland (EUNIS) mapping

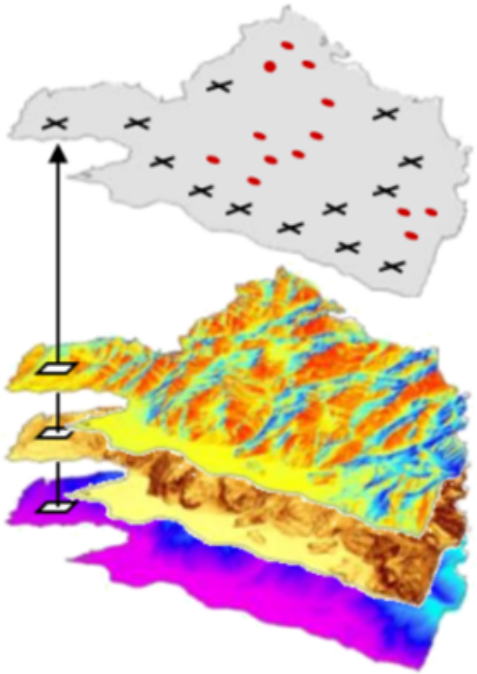
Modelling only within the corresponding LULC domain



Habitat mapping

From in situ data to large scale modelling

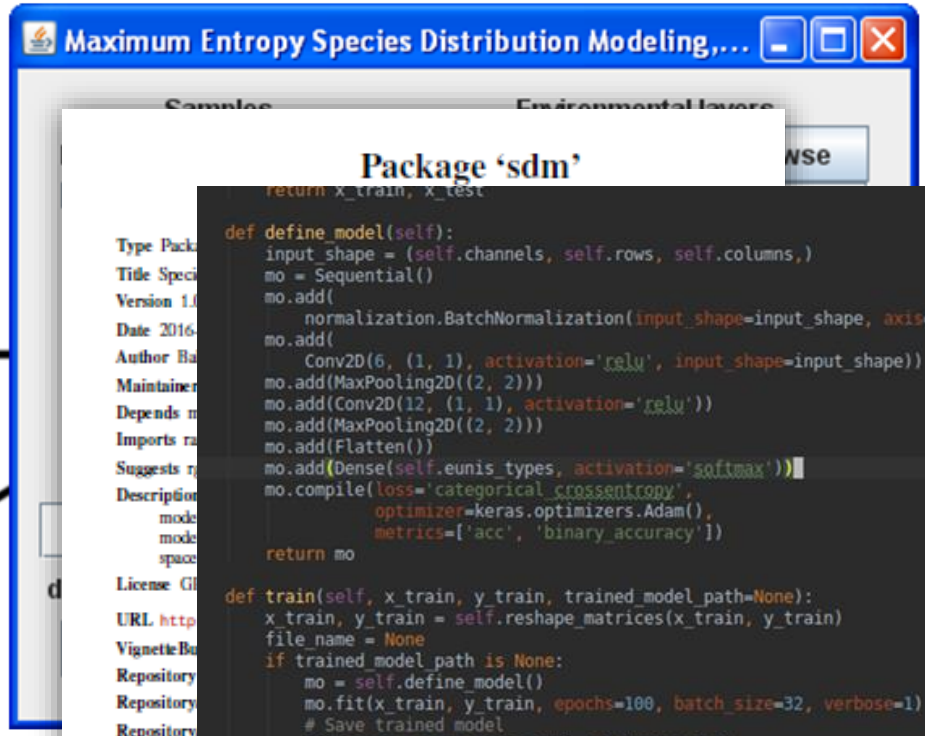
OCCURRENCE DATA



PREDICTORS

1

2

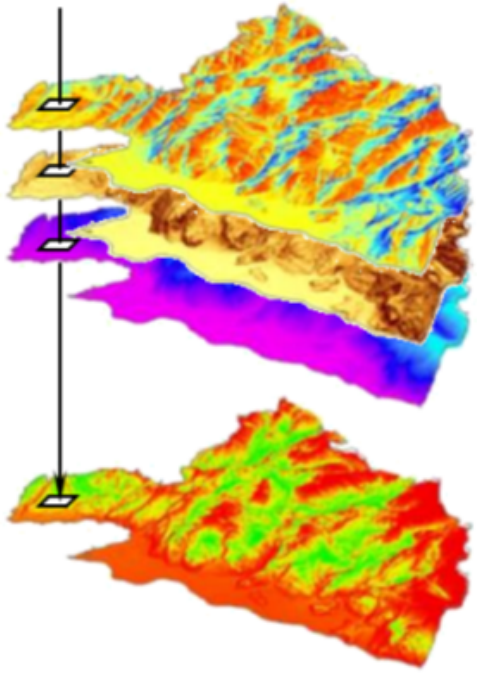



```
def define_model(self):
    input_shape = (self.channels, self.rows, self.columns,)
    mo = Sequential()
    mo.add(
        normalization.BatchNormalization(input_shape=input_shape, axis=1))
    mo.add(
        Conv2D(6, (1, 1), activation='relu', input_shape=input_shape))
    mo.add(MaxPooling2D((2, 2)))
    mo.add(Conv2D(12, (1, 1), activation='relu'))
    mo.add(MaxPooling2D((2, 2)))
    mo.add(Flatten())
    mo.add(Dense(self.eunis_types, activation='softmax'))
    mo.compile(loss='categorical_crossentropy',
               optimizer=keras.optimizers.Adam(),
               metrics=['acc', 'binary_accuracy'])
    return mo

def train(self, x_train, y_train, trained_model_path=None):
    x_train, y_train = self.reshape_matrices(x_train, y_train)
    file_name = None
    if trained_model_path is None:
        mo = self.define_model()
        mo.fit(x_train, y_train, epochs=100, batch_size=32, verbose=1)
        # Save trained model
        file_name = self.save_model_and_headers(mo)
    else:
        # load
        mo = load_model(trained_model_pa
    return mo, file_name
```

Deep learning

SPATIAL PREDICTIONS



MAPS

Habitat mapping – deep learning

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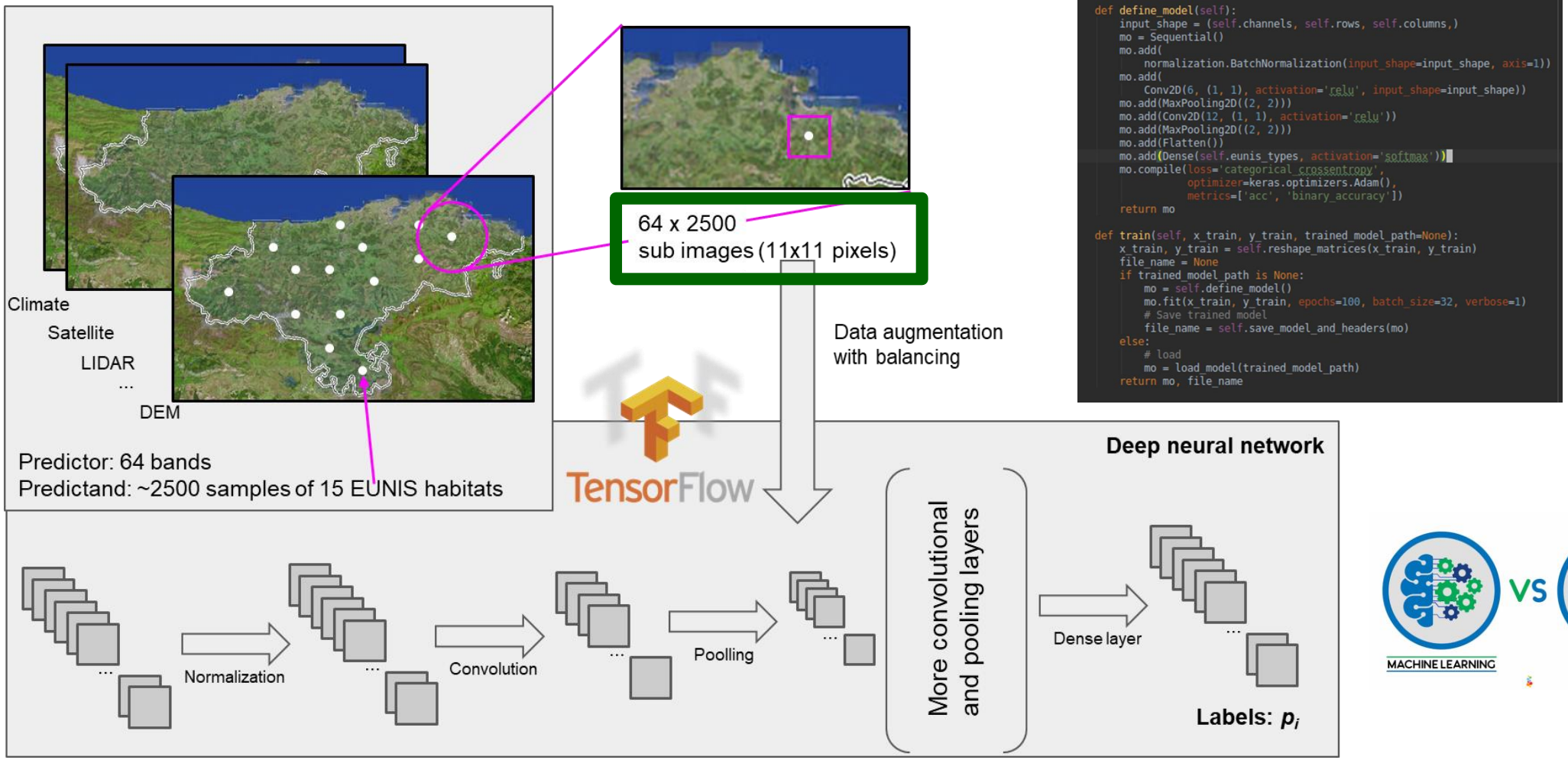


```
    return x_train, x_test

def define_model(self):
    input_shape = (self.channels, self.rows, self.columns,)
    mo = Sequential()
    mo.add(
        normalization.BatchNormalization(input_shape=input_shape, axis=1))
    mo.add(
        Conv2D(6, (1, 1), activation='relu', input_shape=input_shape))
    mo.add(MaxPooling2D((2, 2)))
    mo.add(Conv2D(12, (1, 1), activation='relu'))
    mo.add(MaxPooling2D((2, 2)))
    mo.add(Flatten())
    mo.add(Dense(self.eunis_types, activation='softmax'))
    mo.compile(loss='categorical_crossentropy',
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               metrics=['acc', 'binary_accuracy'])
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def train(self, x_train, y_train, trained_model_path=None):
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        # Save trained model
        file_name = self.save_model_and_headers(mo)
    else:
        # load
        mo = load_model(trained_model_path)
    return mo, file_name
```


Deep learning is a class of machine learning algorithm that use a cascade of multiple layers of nonlinear processing units for feature extraction and transformation to learn about the feature to represent by using supervised or unsupervised approaches

Habitat mapping – deep learning

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HOW TO USE DEEP LEARNING TO CREATE LAND USE MAPS MORE EFFICIENTLY

TUESDAY, MARCH 2, 2021

Monitoring agricultural lands, their use and evolution over time; analysing the growth and sustainability of forests and urban areas to plan their management; or developing policies that lay out the agricultural strategies of whole regions. Land management takes care of multiple facets of our environment and is performed through a miriad of institutions: public administrations, regional and national governments and societal platforms. Since their decisions impact whole regions over the course of decades, land management is a sector in continuous renovation, that adjusts measures as information gets updated. **Land use or land cover maps are the main tool** to do this. Detailed, high-resolution maps that classify locations depending on their type of soil, the vegetation or habitat they present, how that portion of land is used by humans and many other categories. However, **developing these maps can be a gruesome process.** Traditionally, it involves recurring field work and costly technology—like LiDAR flights— and covered only a portion of the land to be managed. At Predictia, **we have developed a Deep Neural Network to generate accurate vegetation maps**, using the satellite information provided by Copernicus. In collaboration with the IHCantabria, we have applied this model to develop a vegetation map of the region of Cantabria in Spain.

> Want to see the map in action? Explore our interactive Showcase!

Habitat mapping – deep learning

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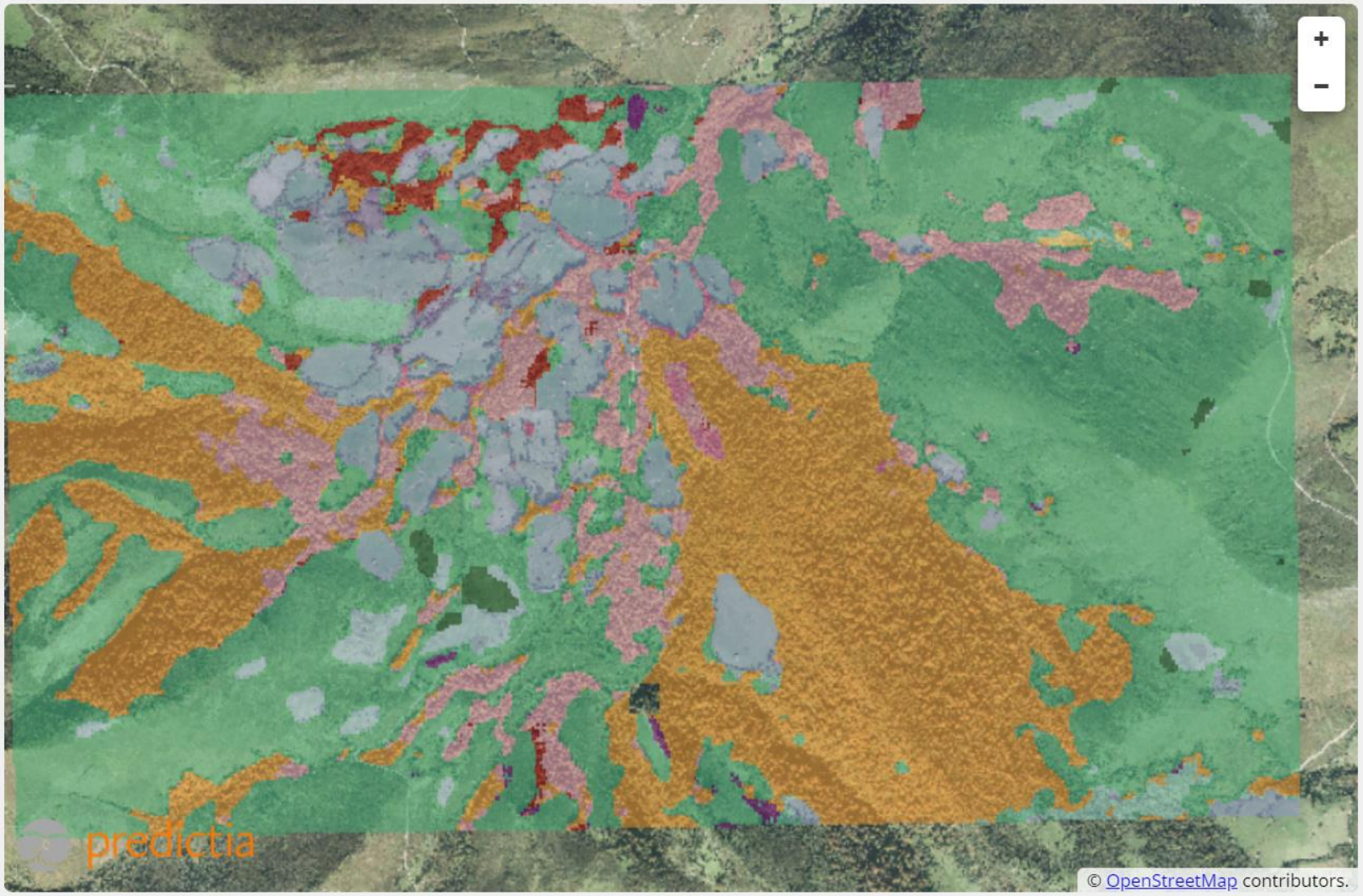
La observación remota aplicada al seguimiento de los ecosistemas



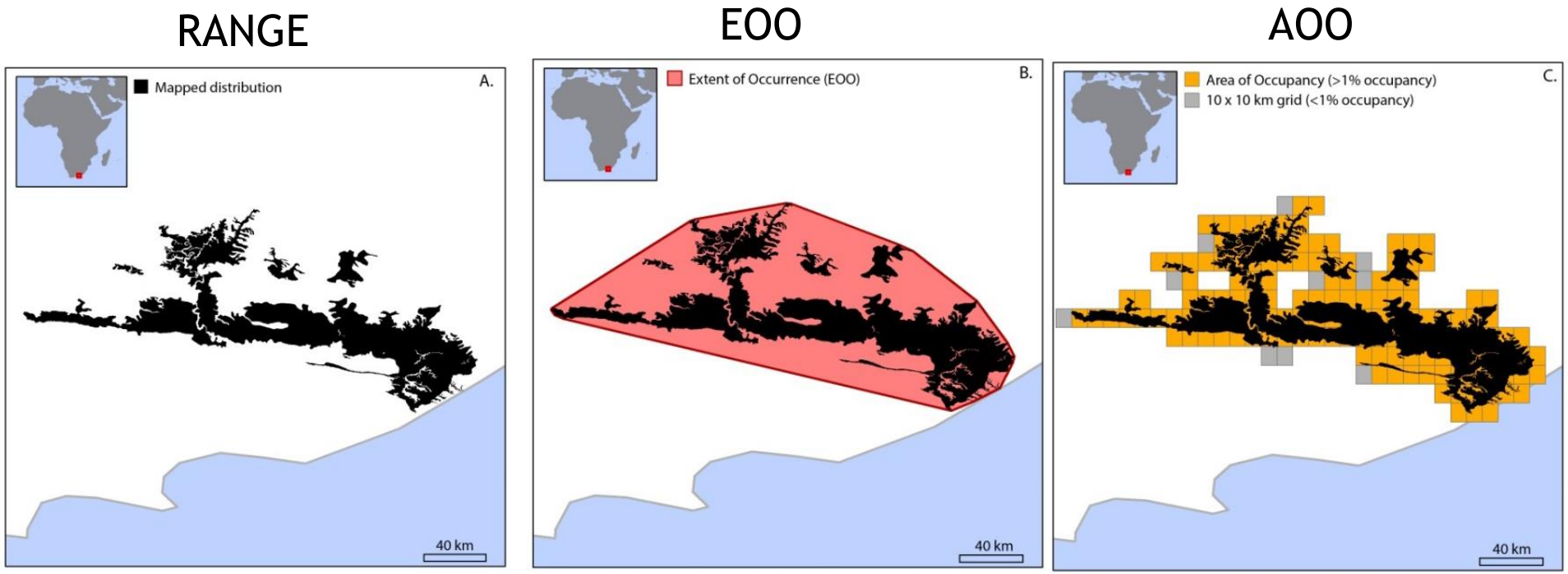
From satellite photos to comprehensive land use maps

- (ARBU) Calciphyte bushes
- (AULA) Rugh grass and Gorses
- (BREZ) Heaths
- (C11X) Permanent oligotrophic lakes, ponds and pools
- (C22X) Permanent non-tidal, fast, turbulent watercourses
- (D121) Hyper oceanic low-altitude blanket bogs
- (E171) Swards
- (E211) Unbroken pastures
- (E223) Medio-European submontane hay meadows
- (E531) Sub-Atlantic Pteridium aquilinum fields
- (ENCI) Holm/Kermes Oak forests
- (F223) Southern Palaearctic mountain dwarfscrub
- (F32X) Submediterranean deciduous thickets
- (F421) Sub-montane [Vaccinium]-[Calluna] heaths
- (F42Y) Dry heaths
- (G12X) Mixed riparian floodplain and gallery woodland
- (G17X) Thermophilous deciduous woodland
- (G18X) Acidophilous [Quercus] - dominated woodland X
- (G18Z) Acidophilous [Quercus] - dominated woodland Z
- (G1AX) Meso- and eutrophic oak, hornbeam, ash and rela...
- (G1C1) Highly artificial forestry plantations broad leaved d...
- (G281) Eucalyptus plantations
- (G3FX) Native conifer plantations

Habitat mapping -- The Area Of Occupancy (AOO)

IUCN CEM
IUCN Red List of Ecosystems

Criterion B for IUCN Red List of Ecosystems



Guidelines for the Application of IUCN Red List of Ecosystems Categories and Criteria (Bland et al. 2015, IUCN - CEM)

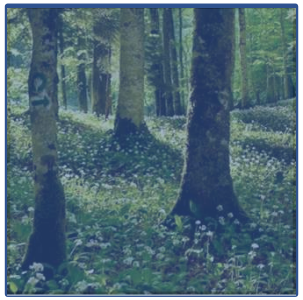
Habitat mapping -- The Area Of Occupancy (AOO)

The Potential AOO can be modelled at large scales

"An area/grid cell with suitable abiotic conditions for a given habitat type"

Suitability ~ temp + prec + soil + ... (SDMs applied to ecosystems)

10 km x 10 km (IUCN)

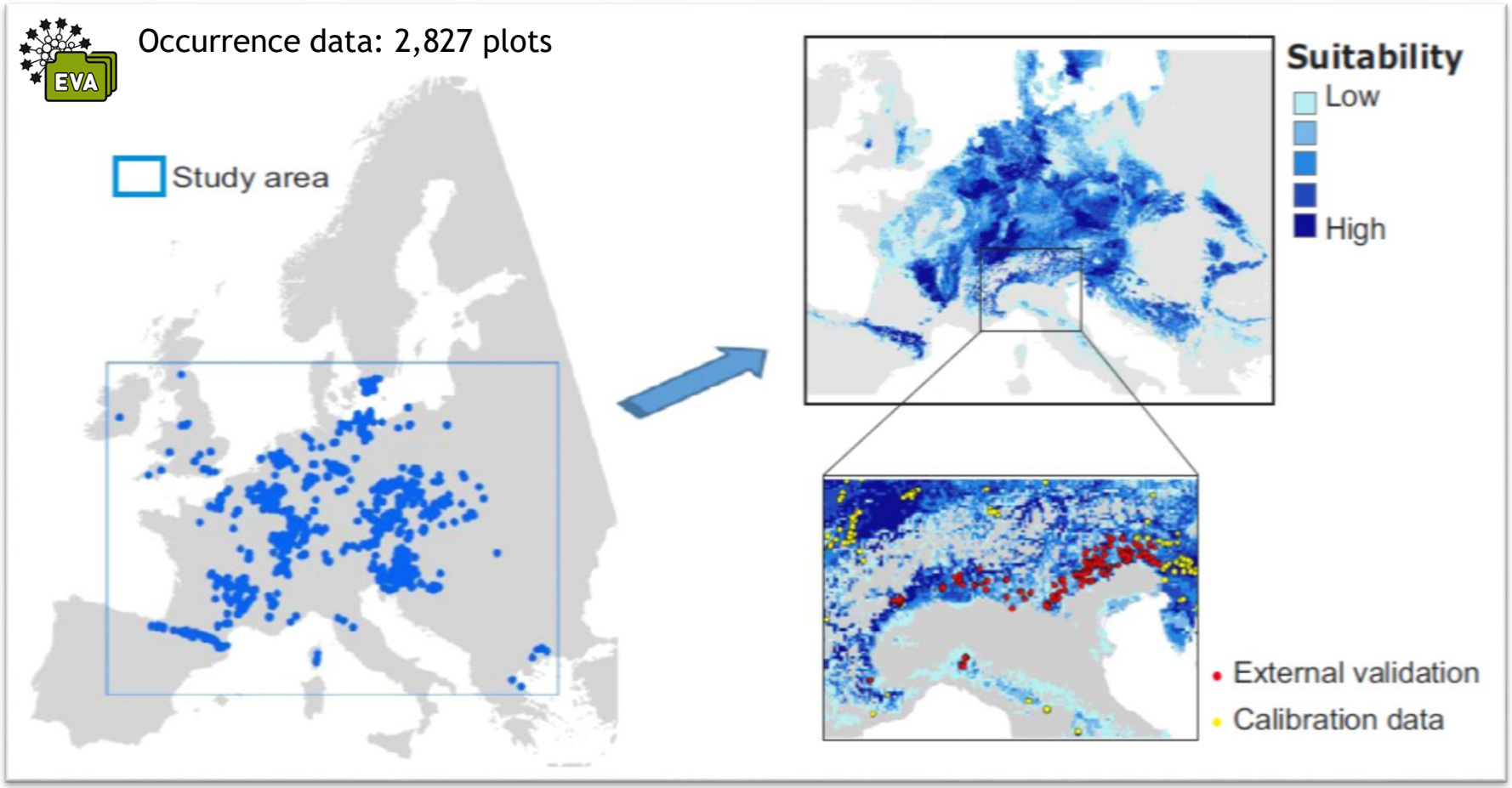


5 km x 5 km

1 km x 1 km

Habitat mapping -- The Area Of Occupancy (AOO)

Modelling the Potential AOO of acidophilous beech forests (EUNIS T.18, DH 9111) at 1 km x 1 km with Maxent

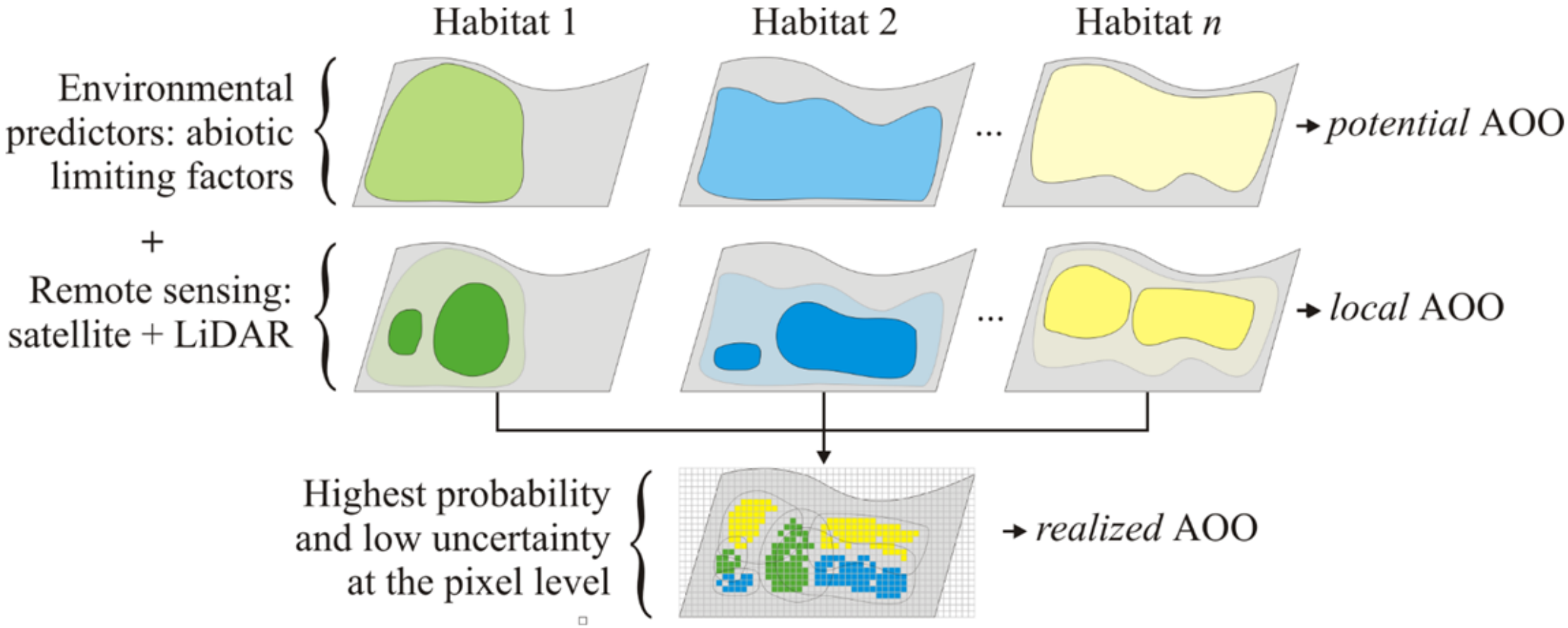


Jiménez-Alfaro et al. (2018) Diversity and Distributions 24: 978-990

Habitat mapping -- The Area Of Occupancy (AOO)

The Local/Realized AOO can be also modelled at large scales

"An area/grid cell with current distribution (suitability) for a given habitat type"

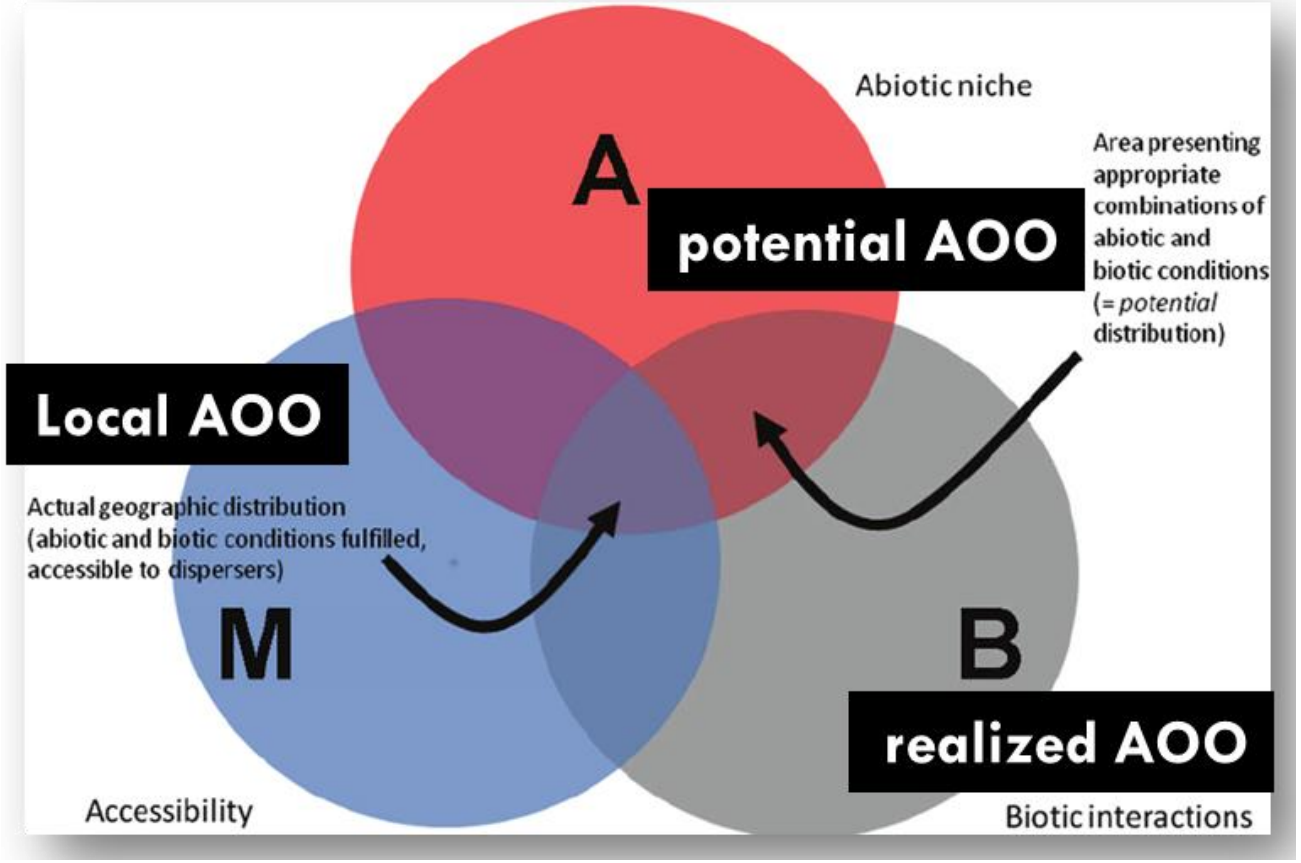


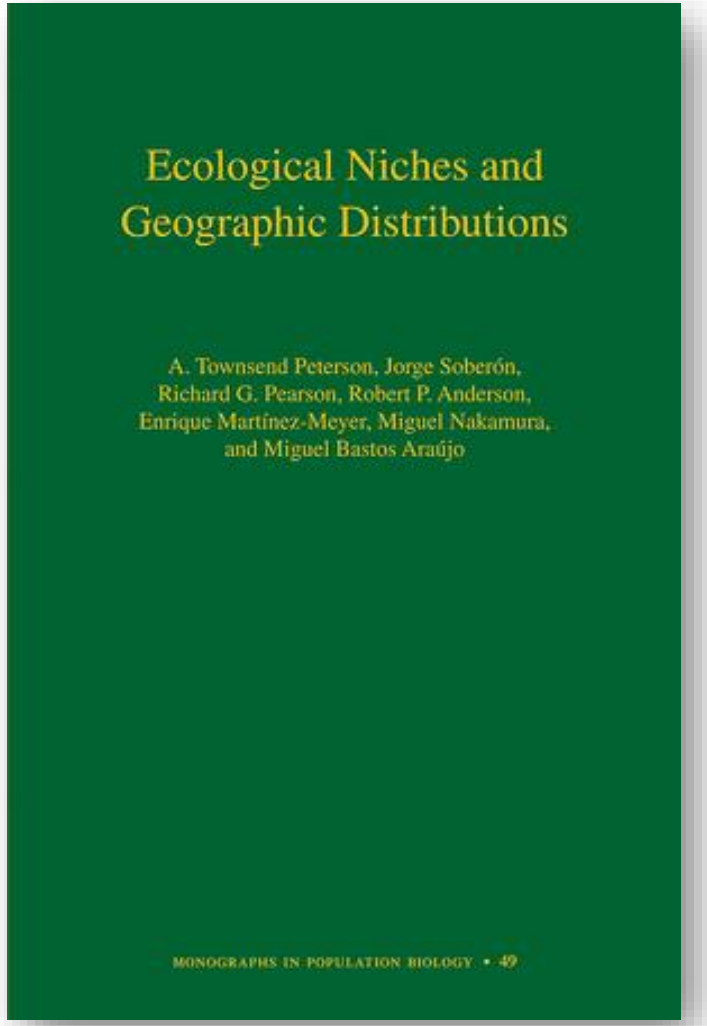
A hierarchical-modelling framework

Habitat mapping -- the Area Of Occupancy (AOO)

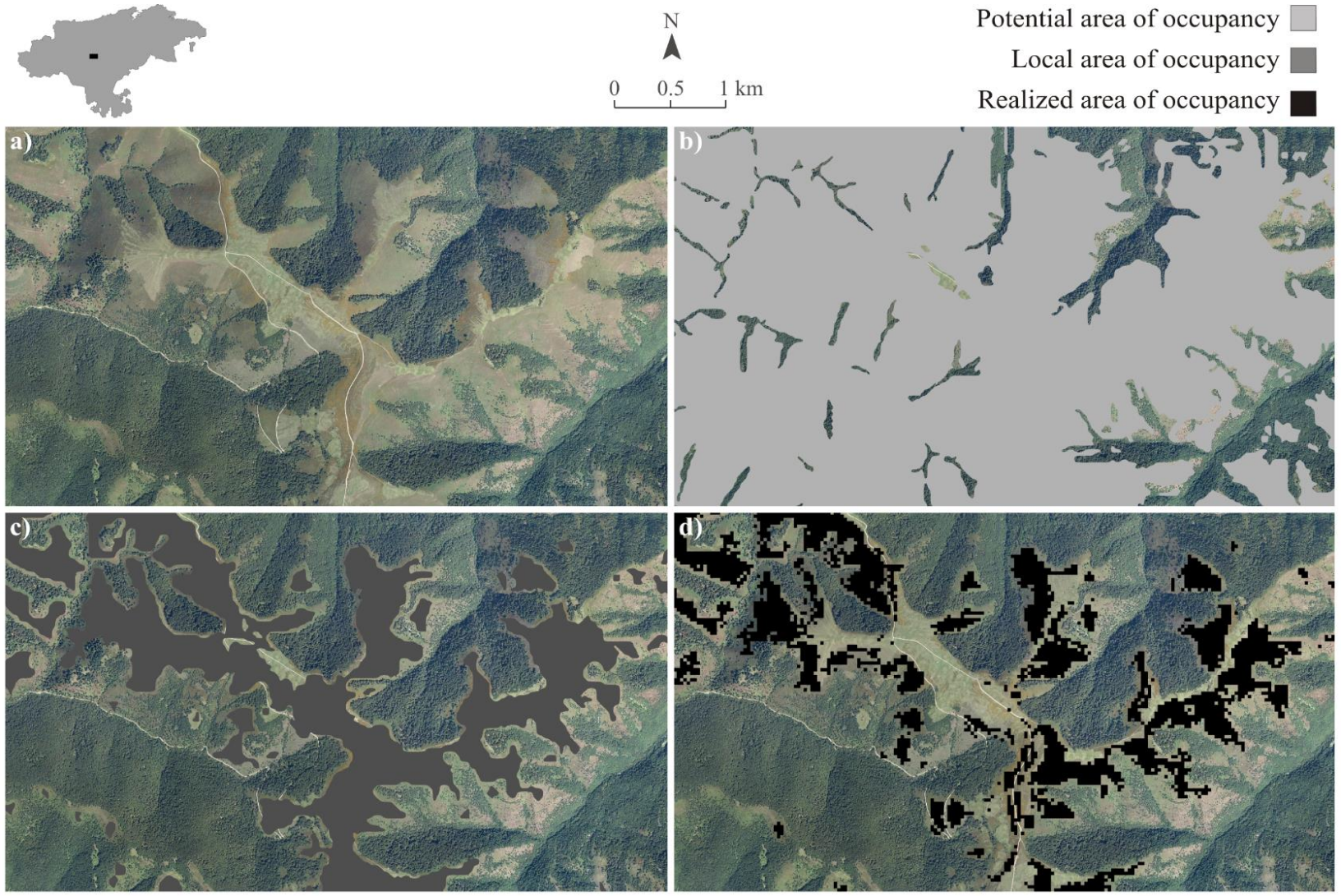
Suitability ~ abiotic + RS + *mapping* (RS-based SDMs applied to ecosystems)

BAM diagrams in SDM





Habitat mapping -- the Area Of Occupancy (AOO)

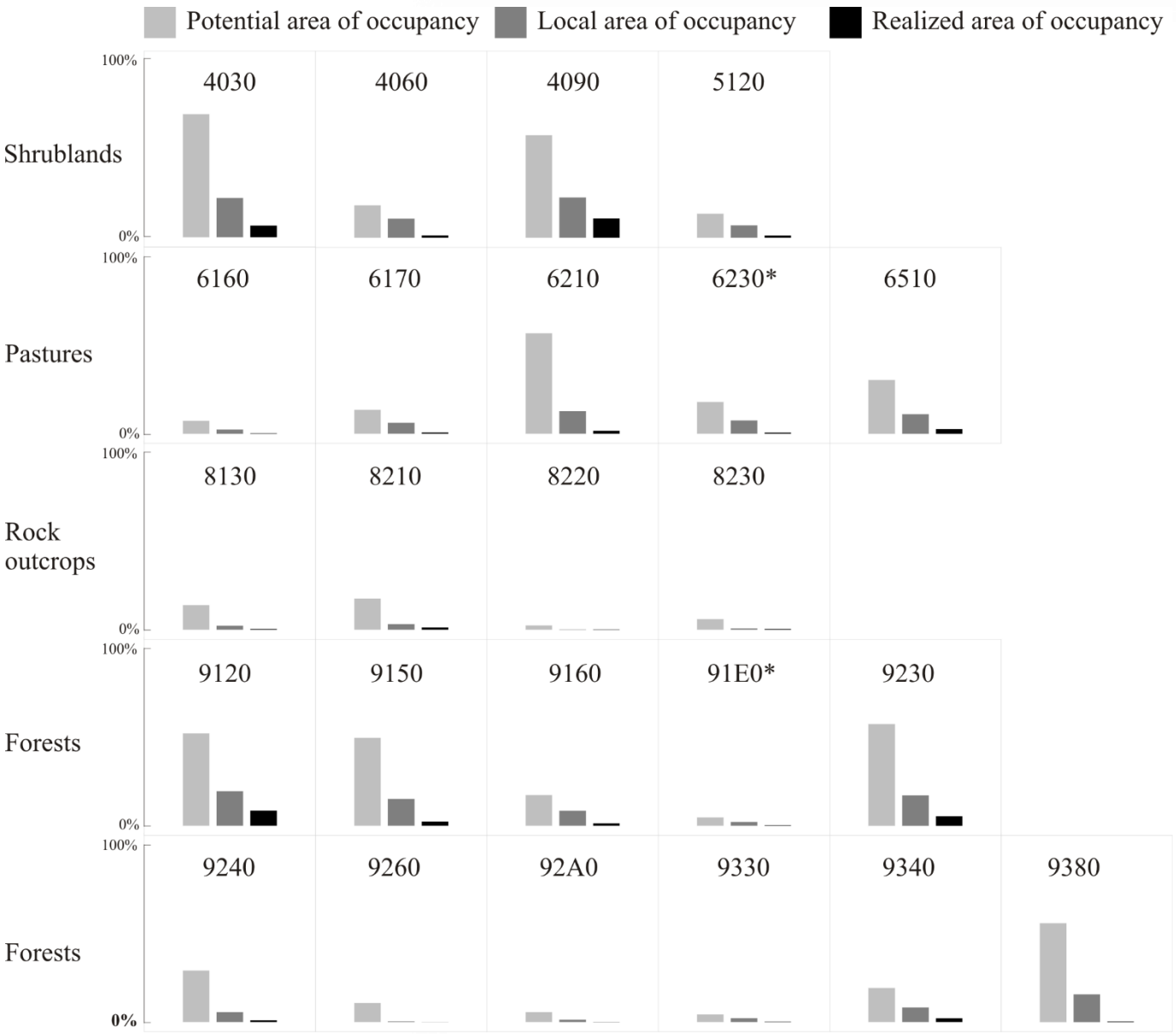


Detail of peripheral constriction from borders to core areas of habitat type 4030 (***European dry heathlands***) (a) when moving from potential AOO (b) to local (c) and realized AOO (d)

Local AOO

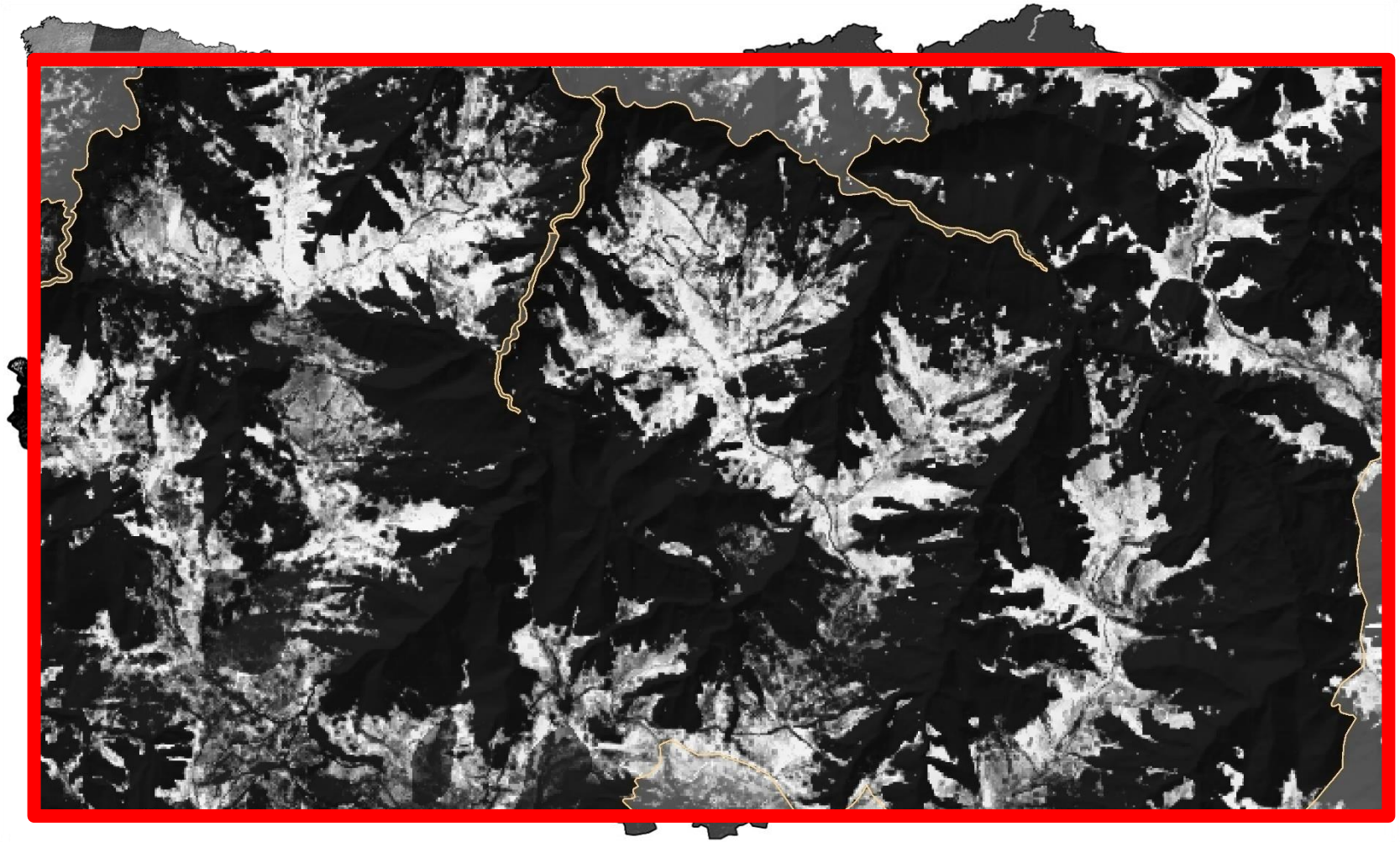
Realized AOO

Habitat mapping -- the Area Of Occupancy (AOO)



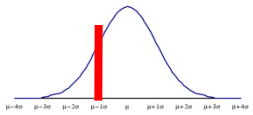
Habitat maps of study area representing distributional areas for the habitat type 4030 (European dry heaths), as an example. See the reduction of potential AOO when including remote sensing data (local AOO) and intra-class competition (realized AOO)

Habitat mapping -- local Area Of Occupancy (IAOO)



E 1:50 000

Local AOO



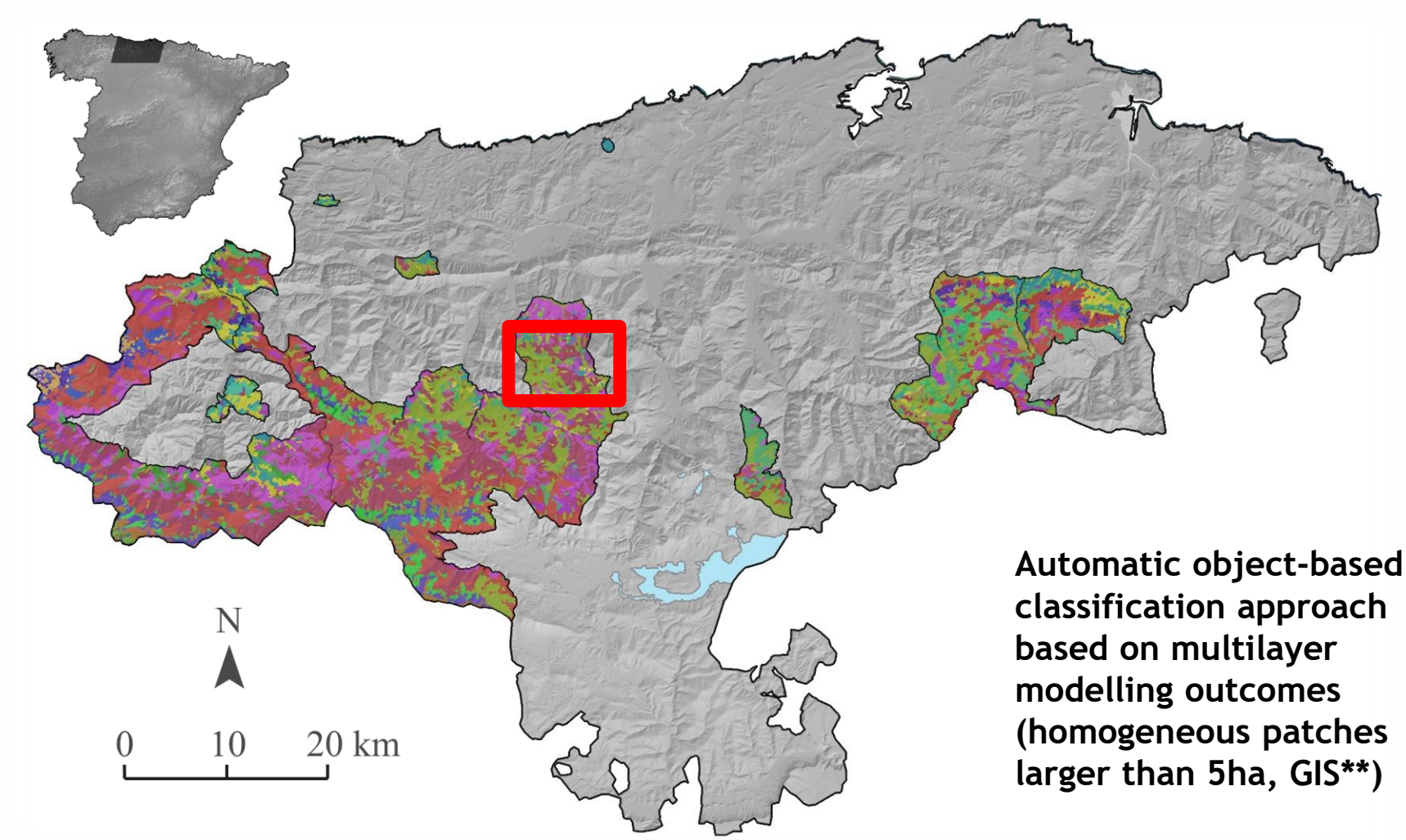
Habitat mapping -- local Area Of Occupancy (IAOO)

E 1:25 000 **Local AOO**

Habitat mapping -- local Area Of Occupancy (IAOO)

E 1:25 000 **DOMINANCE** + **UNCERTAINTY**

Habitat mapping -- realized Area Of Occupancy (rAOO)



Automatic object-based classification approach based on multilayer modelling outcomes (homogeneous patches larger than 5ha, GIS)**

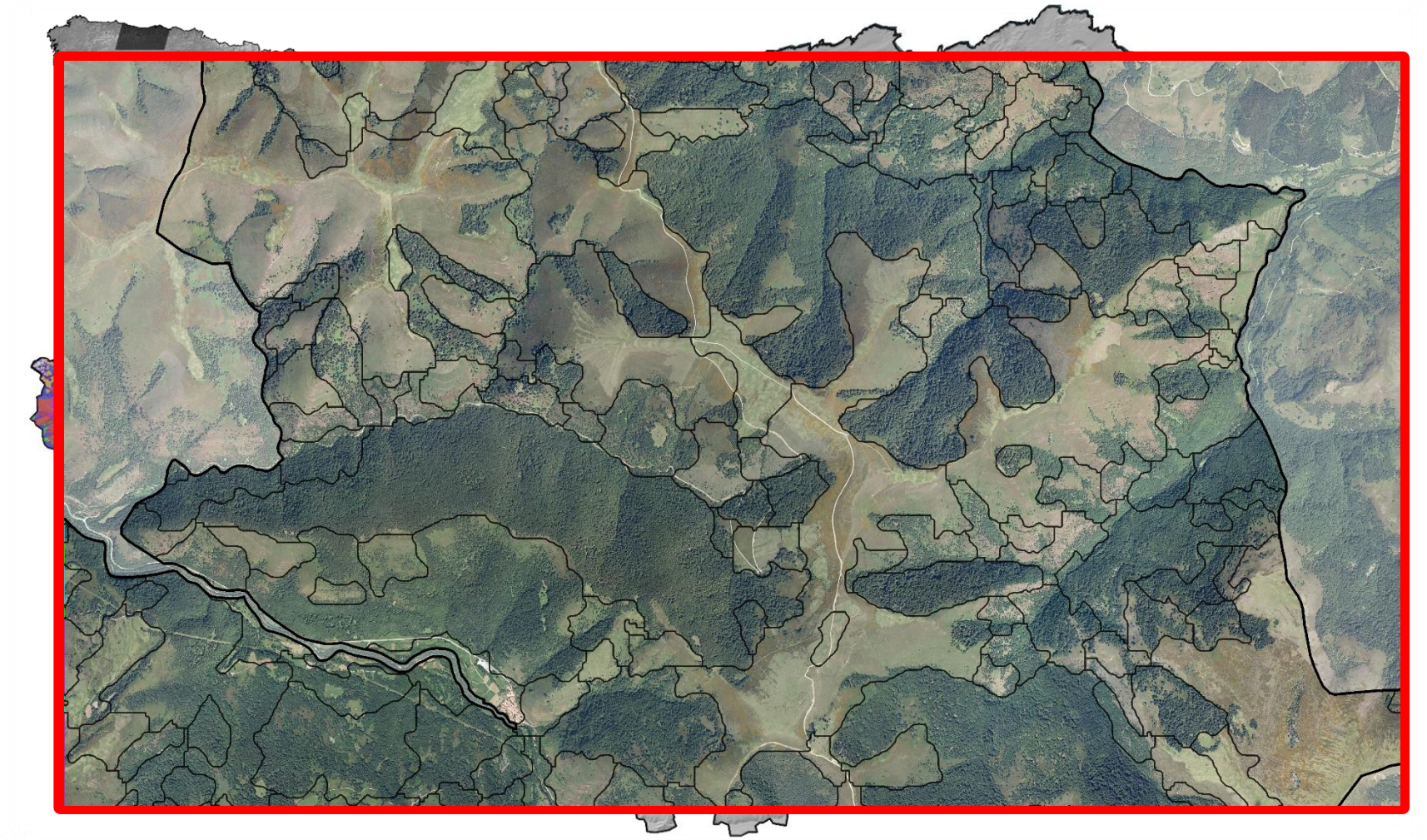
Automatic and objective: depends on the models

E 1:25 000

DOMINANCE

UNCERTAINTY

Habitat mapping -- realized Area Of Occupancy (rAOO)



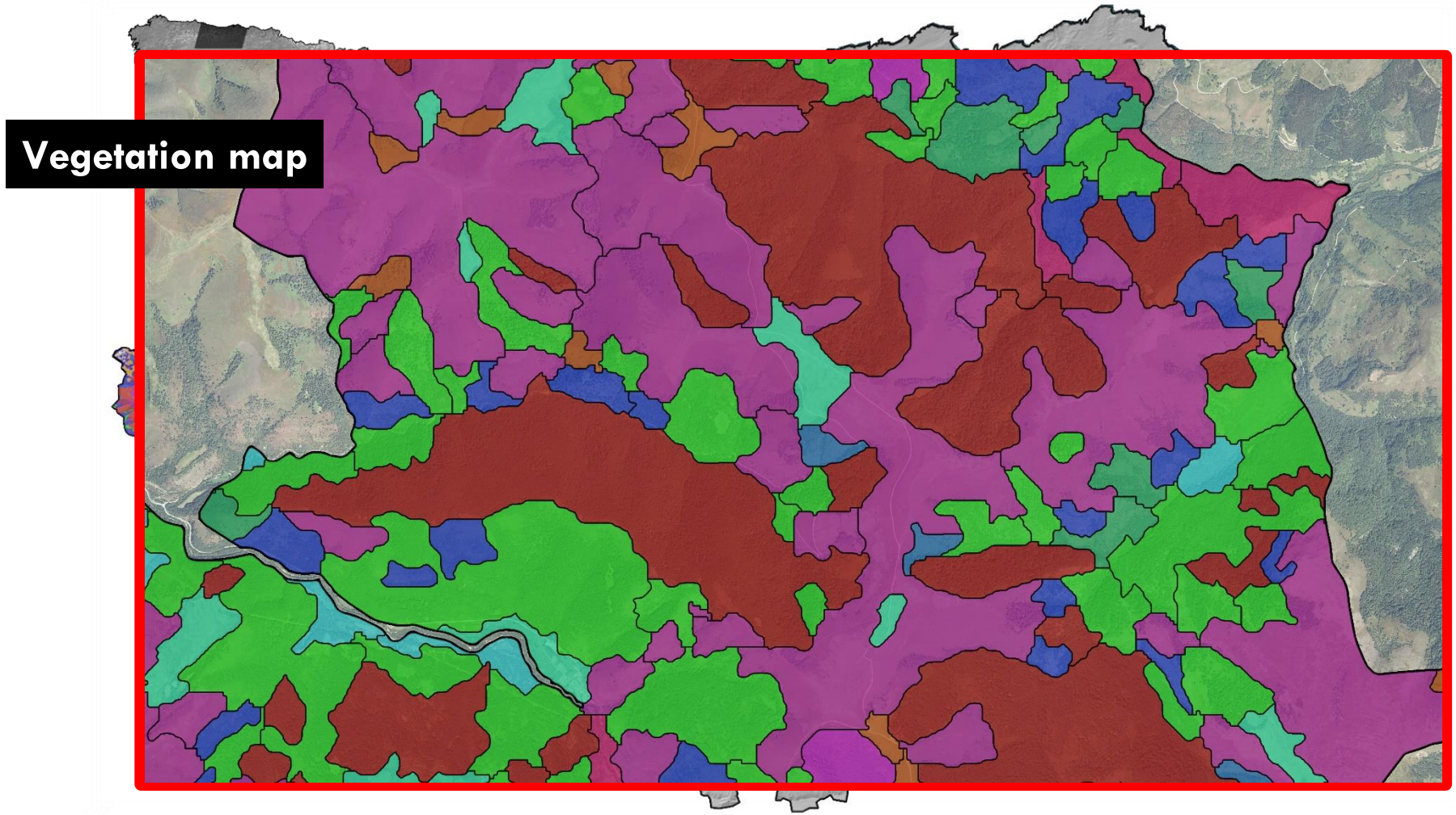
Automatic and objective: depends on the models

E 1:25 000

DOMINANCE

UNCERTAINTY

Habitat mapping -- realized Area Of Occupancy (rAOO)



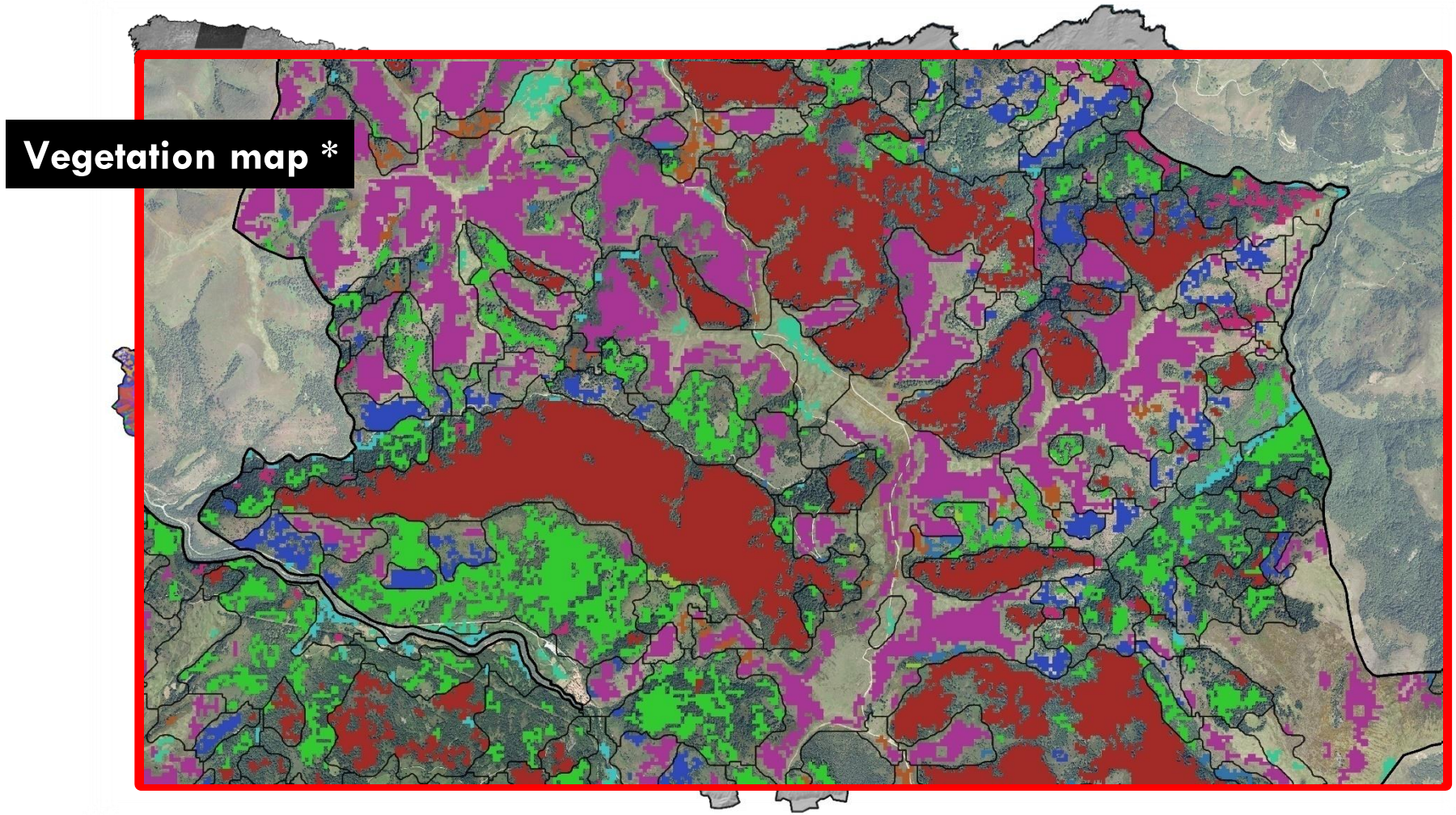
Automatic and objective: depends on the models

E 1:25 000

DOMINANCE

UNCERTAINTY

Habitat mapping -- realized Area Of Occupancy (rAOO)



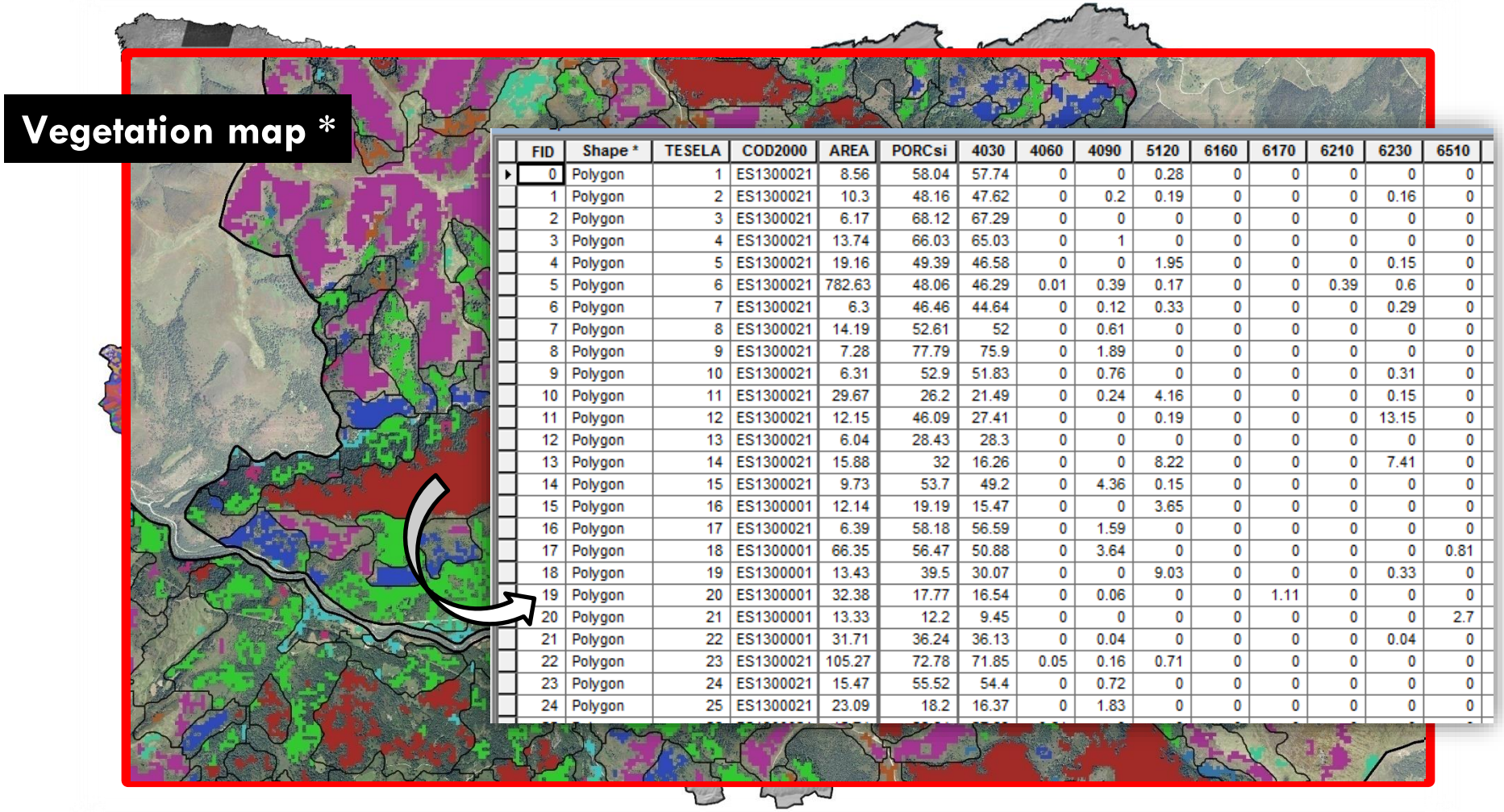
Automatic and objective: depends on the models

E 1:25 000

DOMINANCE

UNCERTAINTY

Habitat mapping -- realized Area Of Occupancy (rAOO)



FID	Shape *	TESELA	COD2000	AREA	PORCsi	4030	4060	4090	5120	6160	6170	6210	6230	6510
0	Polygon	1	ES1300021	8.56	58.04	57.74	0	0	0.28	0	0	0	0	0
1	Polygon	2	ES1300021	10.3	48.16	47.62	0	0.2	0.19	0	0	0	0.16	0
2	Polygon	3	ES1300021	6.17	68.12	67.29	0	0	0	0	0	0	0	0
3	Polygon	4	ES1300021	13.74	66.03	65.03	0	1	0	0	0	0	0	0
4	Polygon	5	ES1300021	19.16	49.39	46.58	0	0	1.95	0	0	0	0.15	0
5	Polygon	6	ES1300021	782.63	48.06	46.29	0.01	0.39	0.17	0	0	0.39	0.6	0
6	Polygon	7	ES1300021	6.3	46.46	44.64	0	0.12	0.33	0	0	0	0.29	0
7	Polygon	8	ES1300021	14.19	52.61	52	0	0.61	0	0	0	0	0	0
8	Polygon	9	ES1300021	7.28	77.79	75.9	0	1.89	0	0	0	0	0	0
9	Polygon	10	ES1300021	6.31	52.9	51.83	0	0.76	0	0	0	0	0.31	0
10	Polygon	11	ES1300021	29.67	26.2	21.49	0	0.24	4.16	0	0	0	0.15	0
11	Polygon	12	ES1300021	12.15	46.09	27.41	0	0	0.19	0	0	0	13.15	0
12	Polygon	13	ES1300021	6.04	28.43	28.3	0	0	0	0	0	0	0	0
13	Polygon	14	ES1300021	15.88	32	16.26	0	0	8.22	0	0	0	7.41	0
14	Polygon	15	ES1300021	9.73	53.7	49.2	0	4.36	0.15	0	0	0	0	0
15	Polygon	16	ES1300001	12.14	19.19	15.47	0	0	3.65	0	0	0	0	0
16	Polygon	17	ES1300021	6.39	58.18	56.59	0	1.59	0	0	0	0	0	0
17	Polygon	18	ES1300001	66.35	56.47	50.88	0	3.64	0	0	0	0	0	0.81
18	Polygon	19	ES1300001	13.43	39.5	30.07	0	0	9.03	0	0	0	0.33	0
19	Polygon	20	ES1300001	32.38	17.77	16.54	0	0.06	0	0	1.11	0	0	0
20	Polygon	21	ES1300001	13.33	12.2	9.45	0	0	0	0	0	0	0	2.7
21	Polygon	22	ES1300001	31.71	36.24	36.13	0	0.04	0	0	0	0	0.04	0
22	Polygon	23	ES1300021	105.27	72.78	71.85	0.05	0.16	0.71	0	0	0	0	0
23	Polygon	24	ES1300021	15.47	55.52	54.4	0	0.72	0	0	0	0	0	0
24	Polygon	25	ES1300021	23.09	18.2	16.37	0	1.83	0	0	0	0	0	0

Automatic and objective: depends on the models

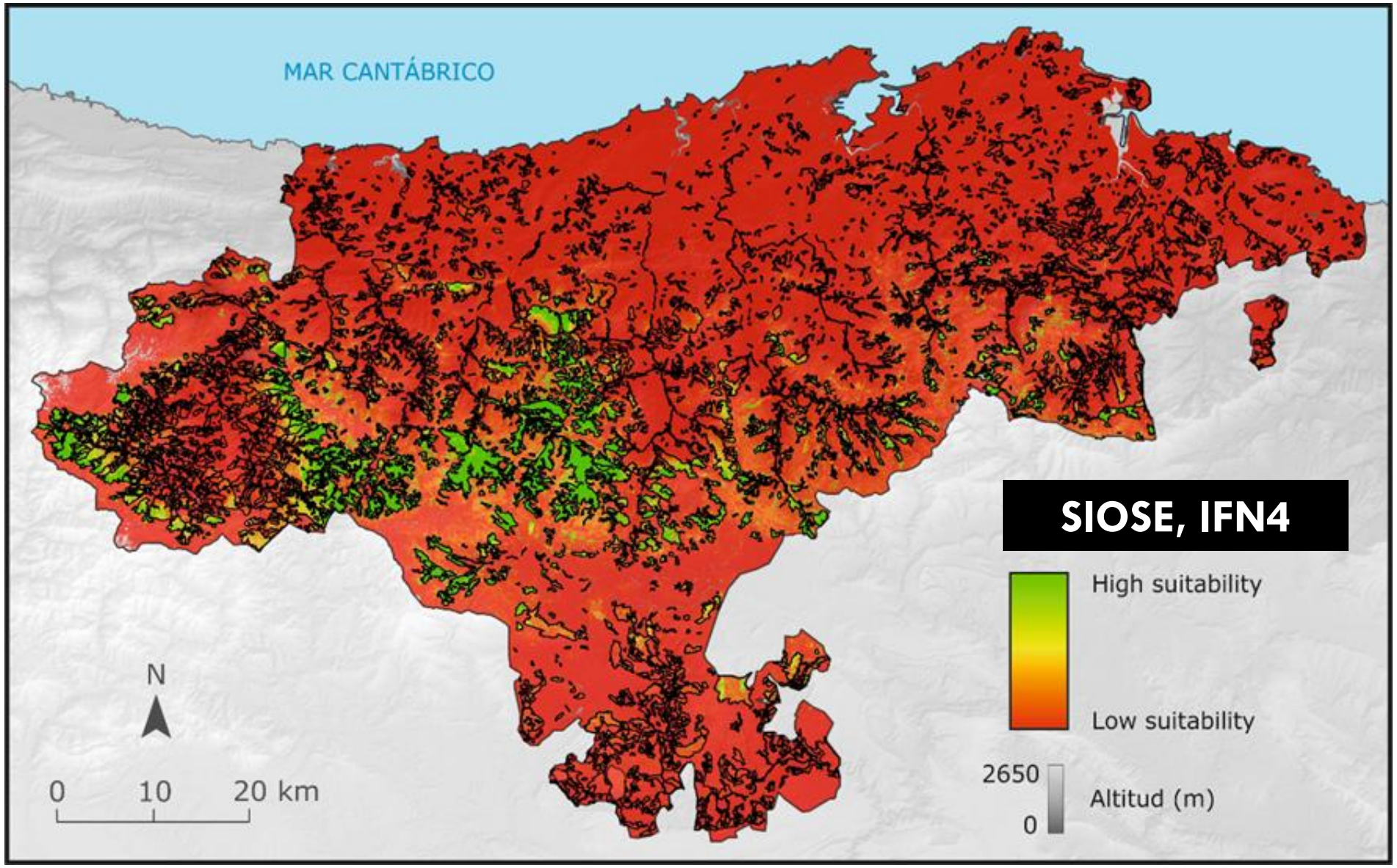
E 1:25 000

LAND PATCHES

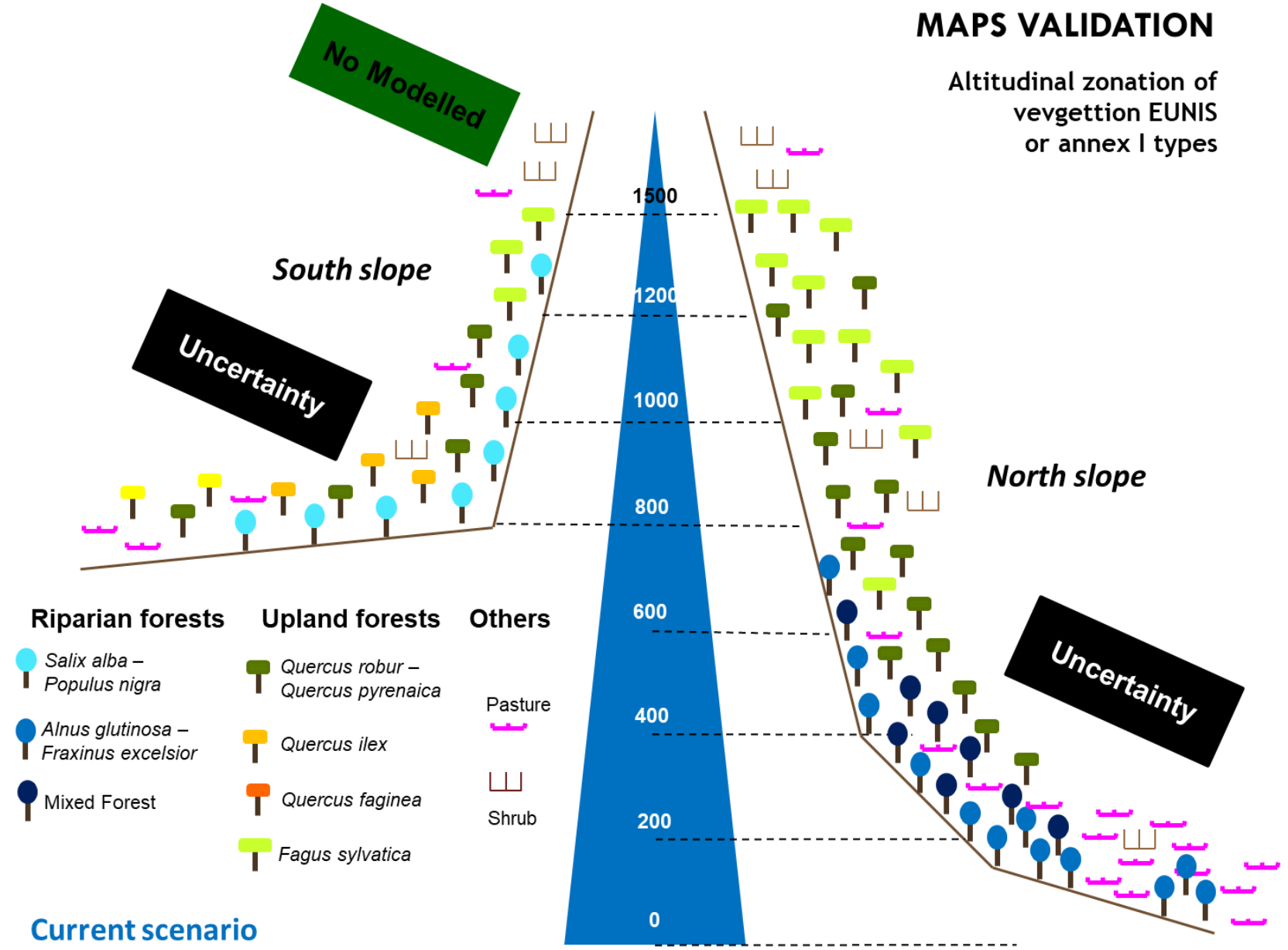
BETA DIVERSITY

Habitat mapping -- validation (reference maps)

Landscape features: crosswalks between categories



Habitat mapping – validation (digital vegetation maps)



Habitat mapping -- setting concepts

Received: 26 May 2017 | Accepted: 2
DOI: 10.1111/2041-210X.12925

RESEARCH ARTICLE

Modelling the a sensing

Jose Manuel Álvarez-M
Bárbara Ondiviela[1]

[1]Environmental Hydraulics Institute IH Cantabria, Parque Científico y Tecnológic Cantabria, Santander, Spain

[2]German Centre for Integrative Biodivers Research (iDiv) Halle-Jena-Leipzig, Leipzig Germany

[3]Geobotany and Botanical Garden, Institu of Biology, Martin Luther University Halle Wittenberg, Halle (Saale), Germany

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Handling Editor: Nick Isaac

Received: 16 May 2019 | Revised: 4 September 2019 | Accepted: 13 September 2019
DOI: 10.1111/avsc.12458

RESEARCH ARTICLE

Applied Vegetation Science
IAVS

Modelling riparian forest distribution and composition to entire river networks

Ignacio Pérez-Silos | José Manuel Álvarez-Martínez | José Barquín

Environmental Hydraulics Institute "IH Cantabria", University of Cantabria, Santander, Spain

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Email: ignacio.perez@unican.es

Funding information
Spanish Ministry of Science, Innovation and Universities, Grant/Award Number:

Abstract

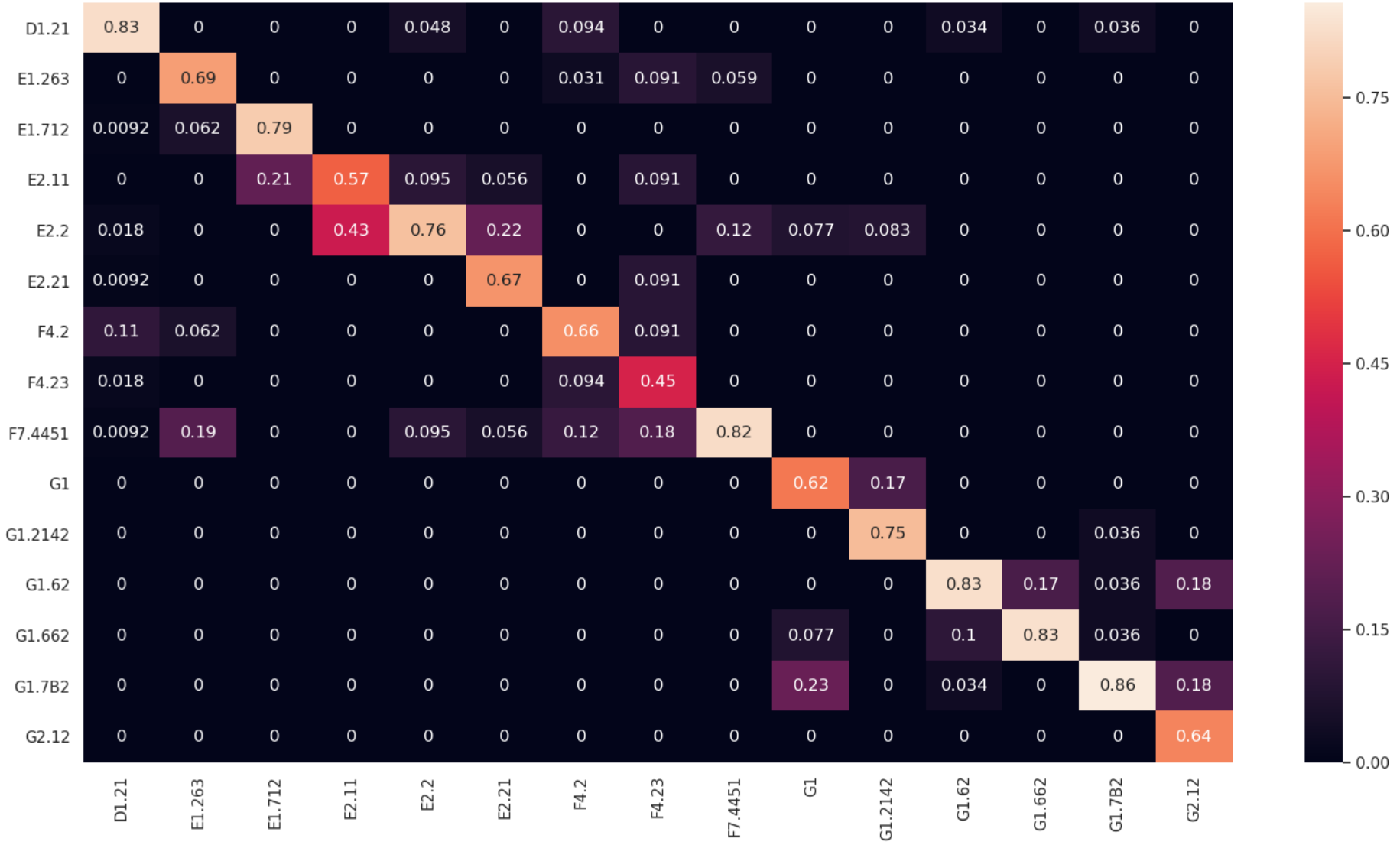
Aim: Developing a methodology to map the distribution of riparian forests to entire river networks and determining the main environmental factors controlling their spatial patterns.

Location: Cantabrian region, northern Spain.

Methods: We mapped the riparian forests at a physiognomic and phytosociological level by delimiting riparian zones and generating vegetation distribution models based on remote sensing data (Landsat 8 OLI and LiDAR PNOA). We built virtual watersheds to define a spatial framework where the catchment environmental in-

mate, resulting in broad AOO estimates that are subsequently downscaled to the *local* AOO with remote sensing. The combination of individual *local* AOO estimates

Complex landscapes -- uncertainty



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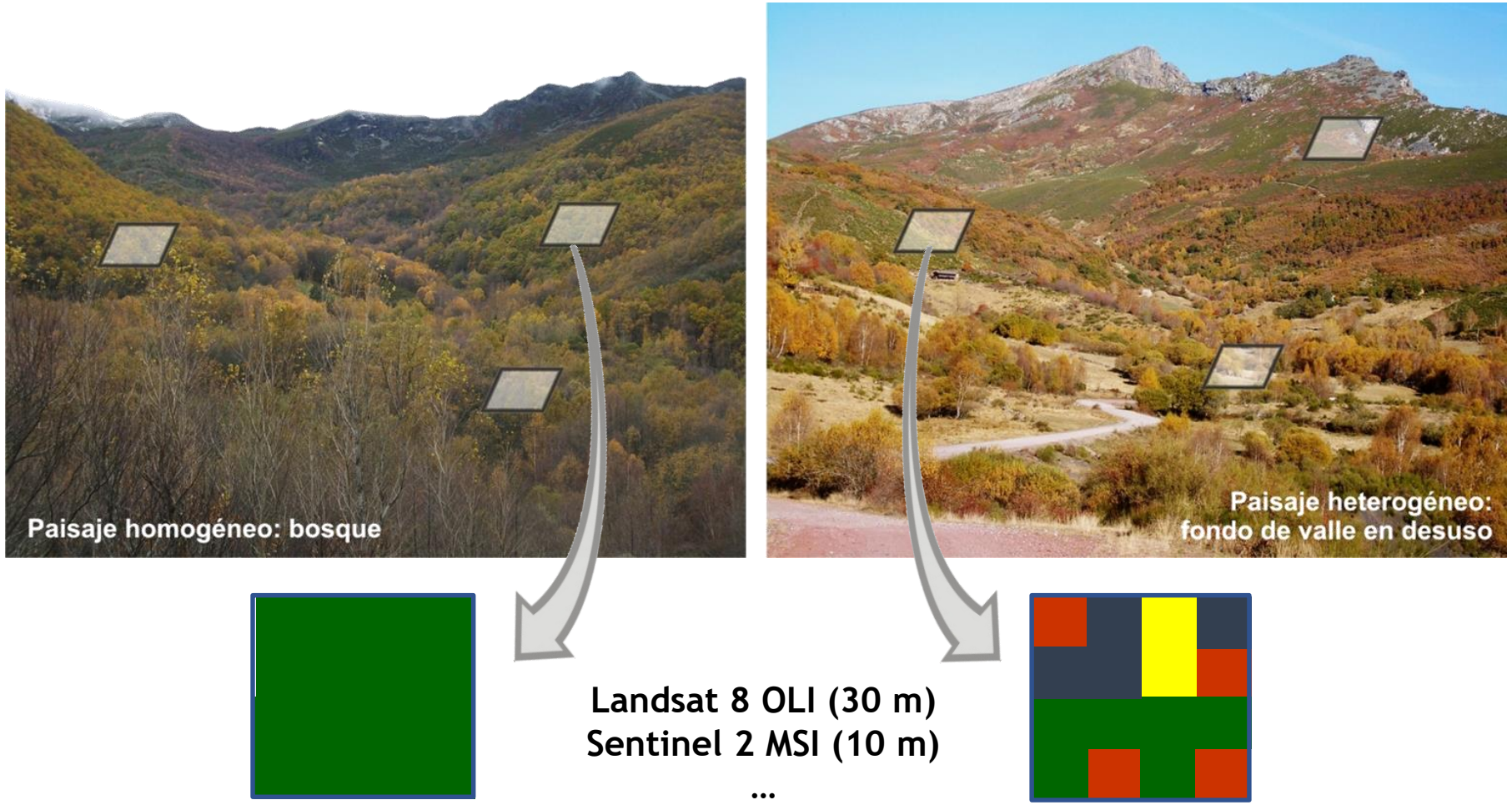

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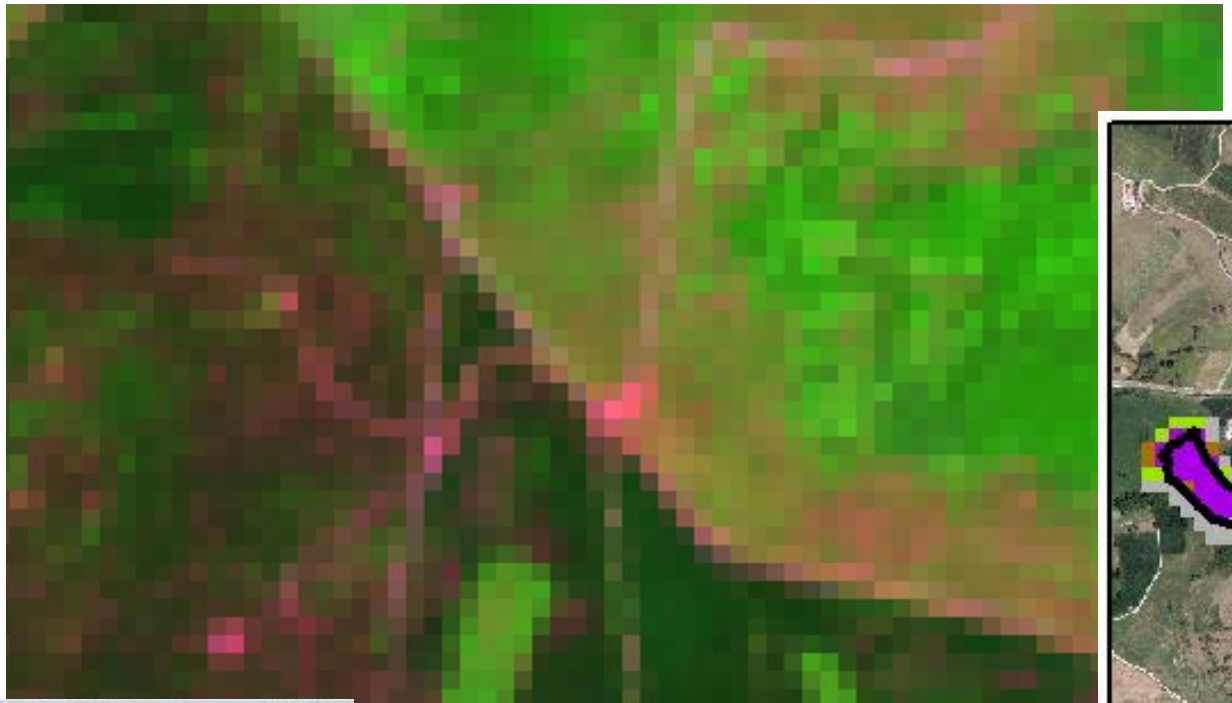
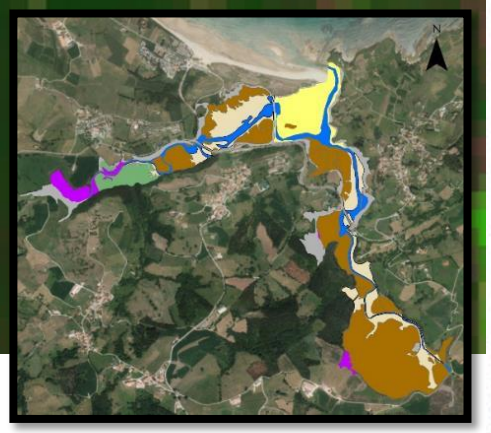
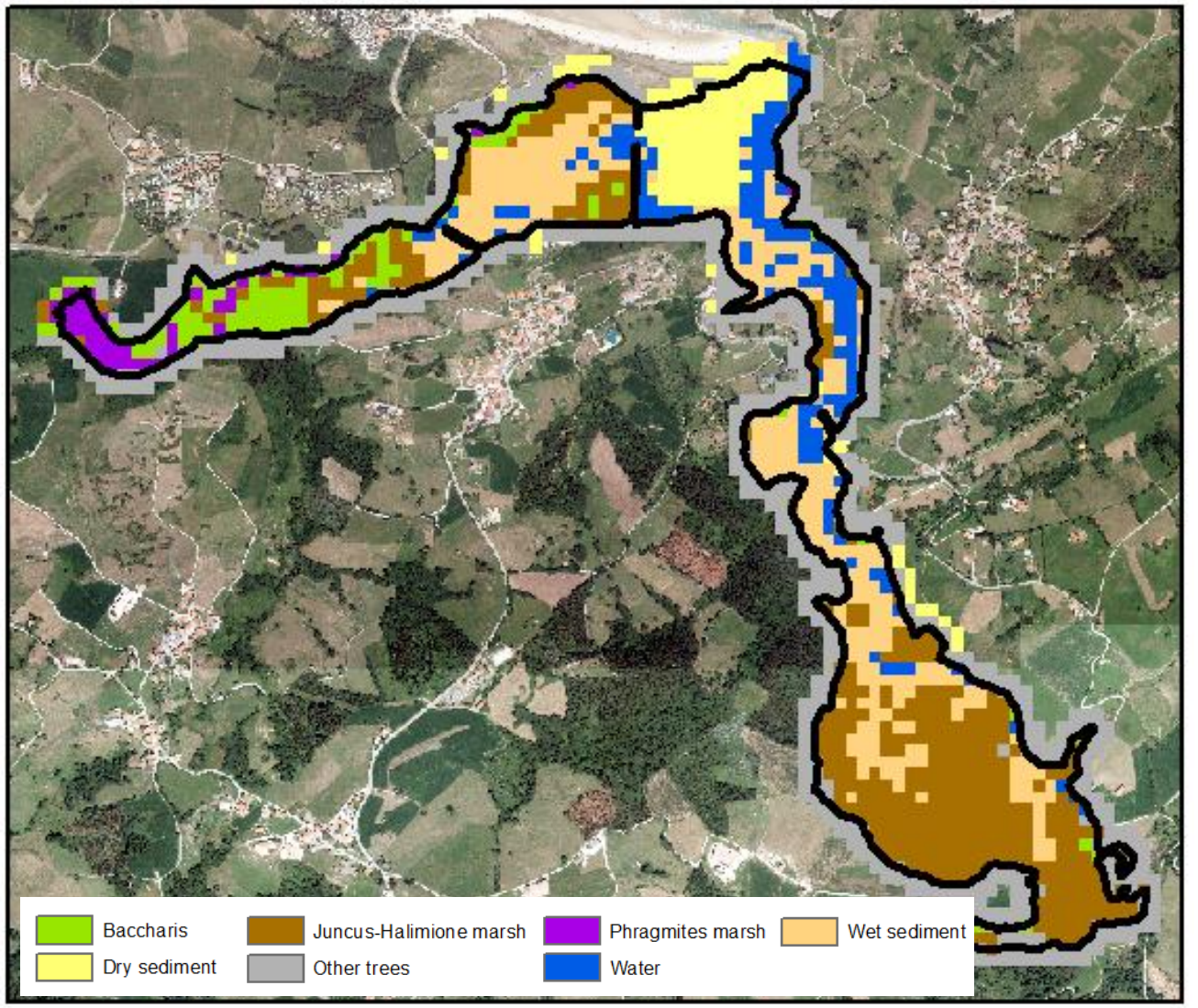
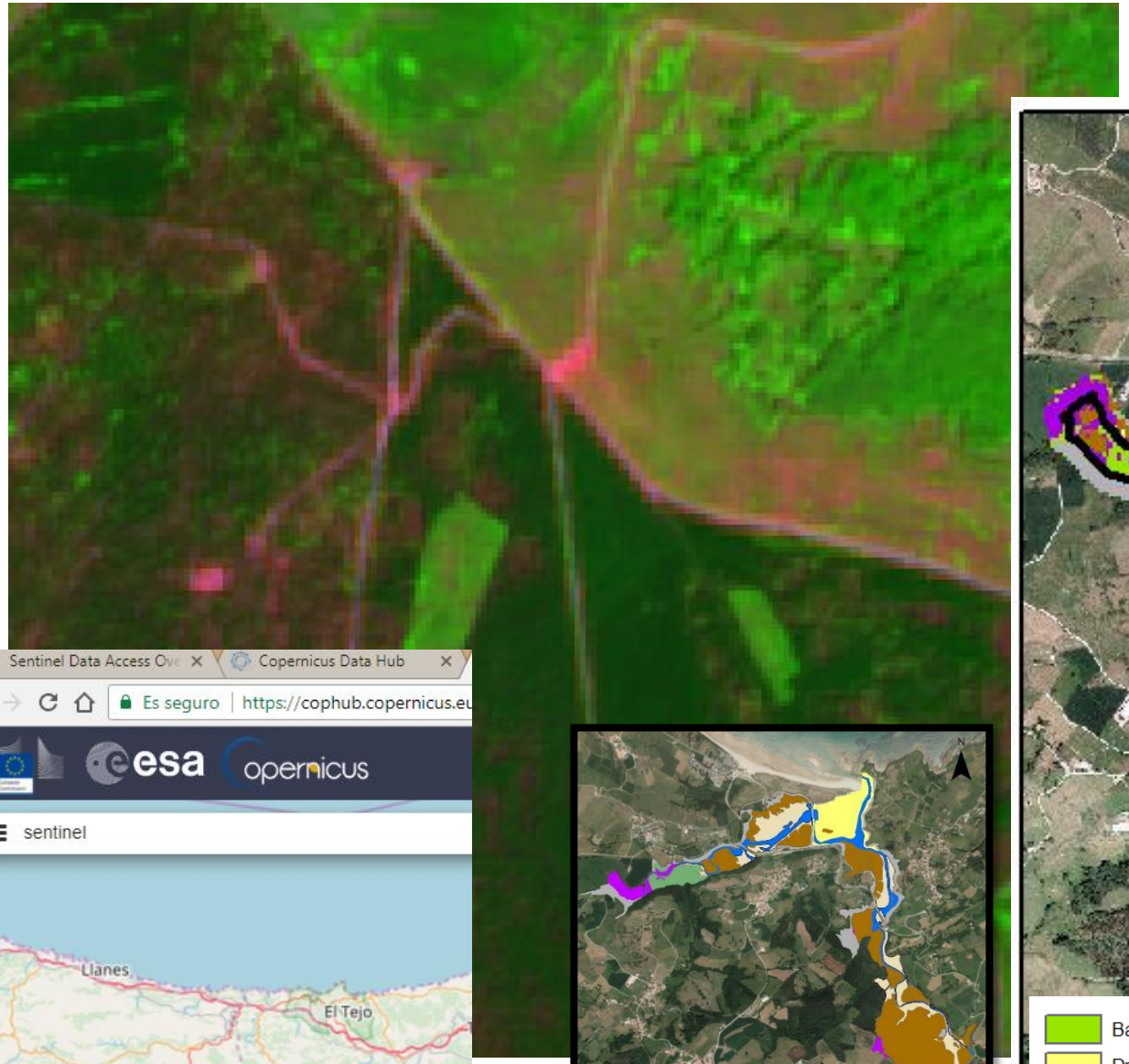
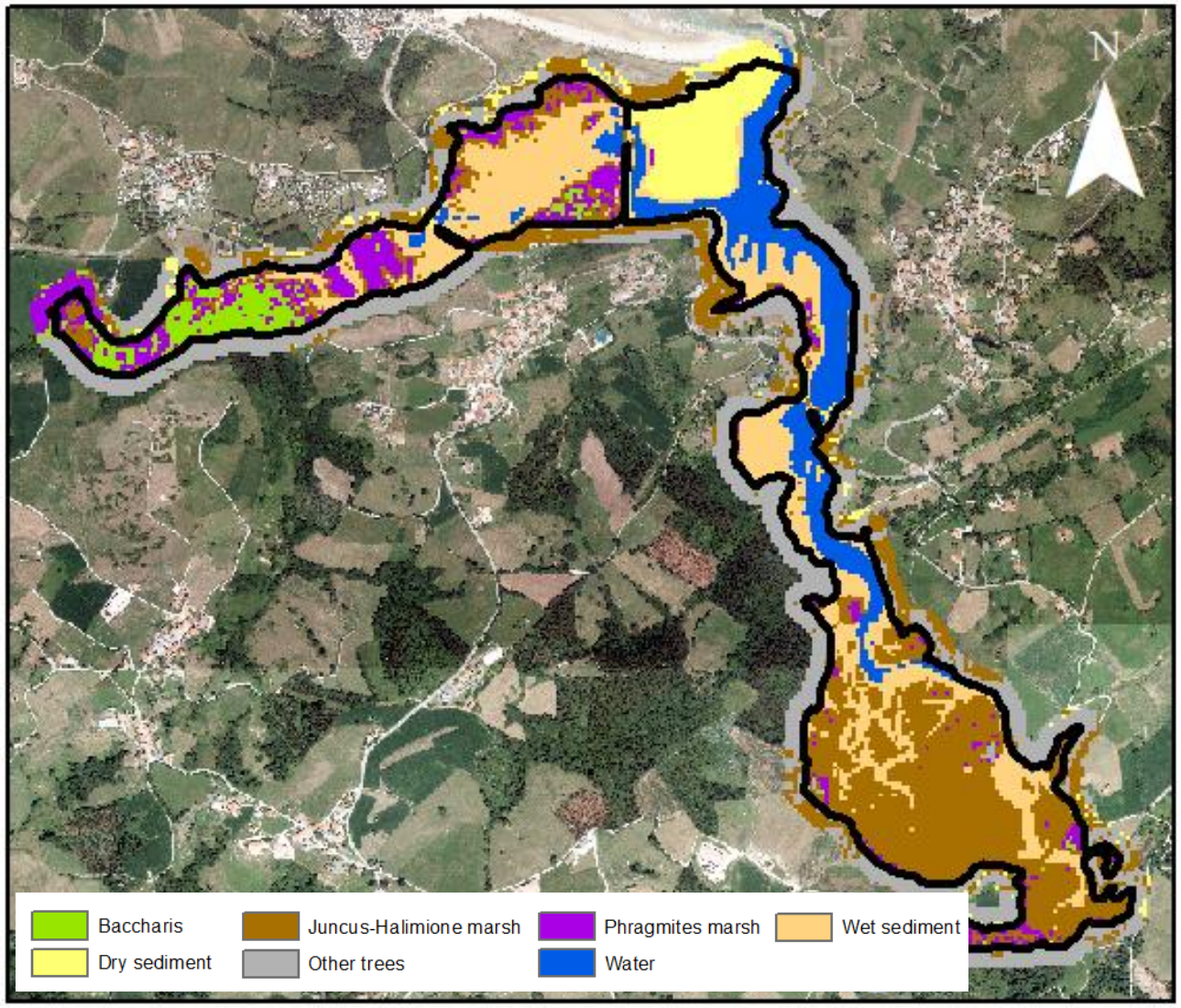






Complex landscapes -- uncertainty





Complex landscapes -- uncertainty

GEOSAT-2 (former Deimos-2)

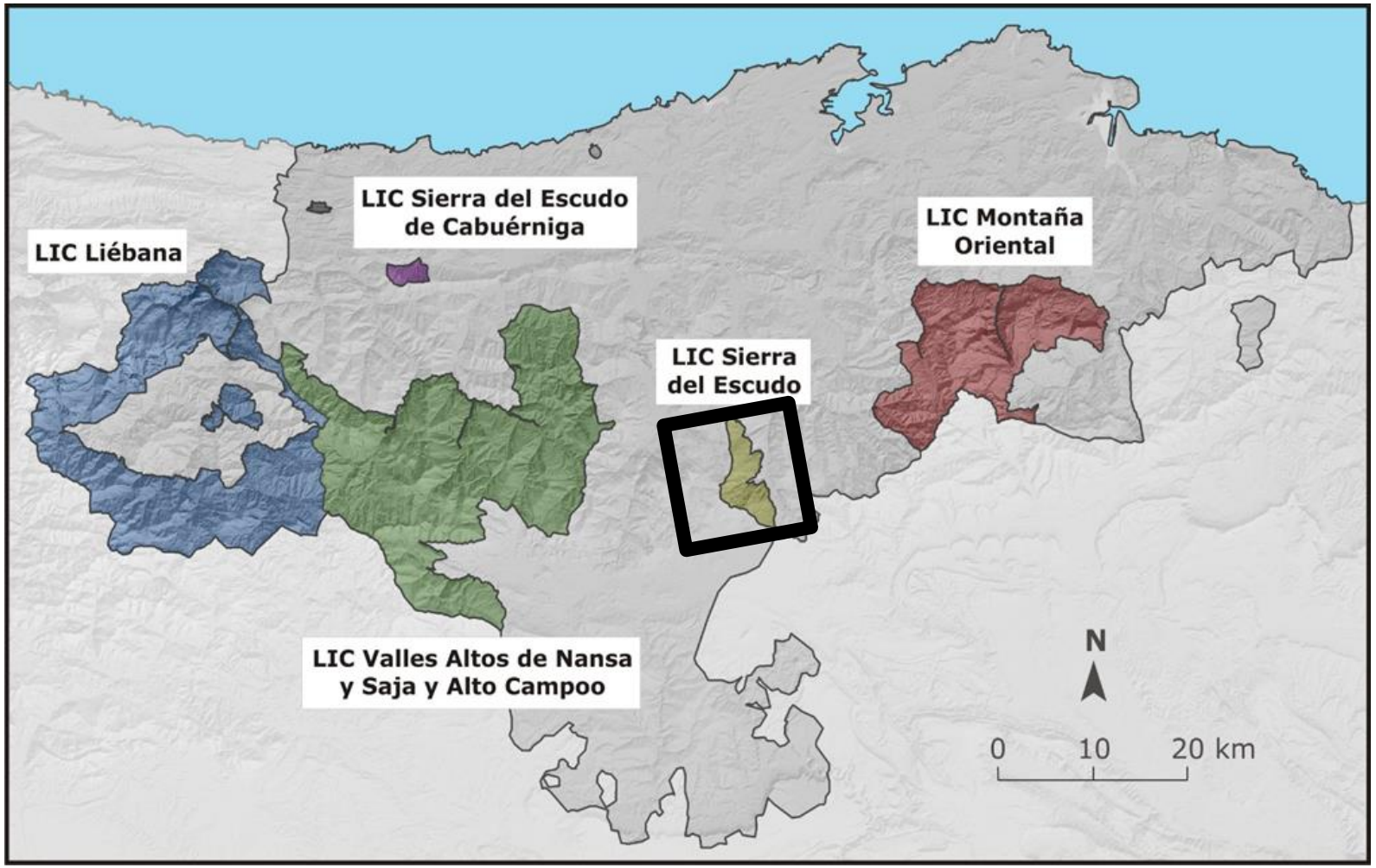
Complex landscapes -- uncertainty

Study area: Sierra del Escudo (Natura 2000)

Vegetation maps at a high scale

Extensive survey for acid fens, lowland hay meadows, shrubs and forests

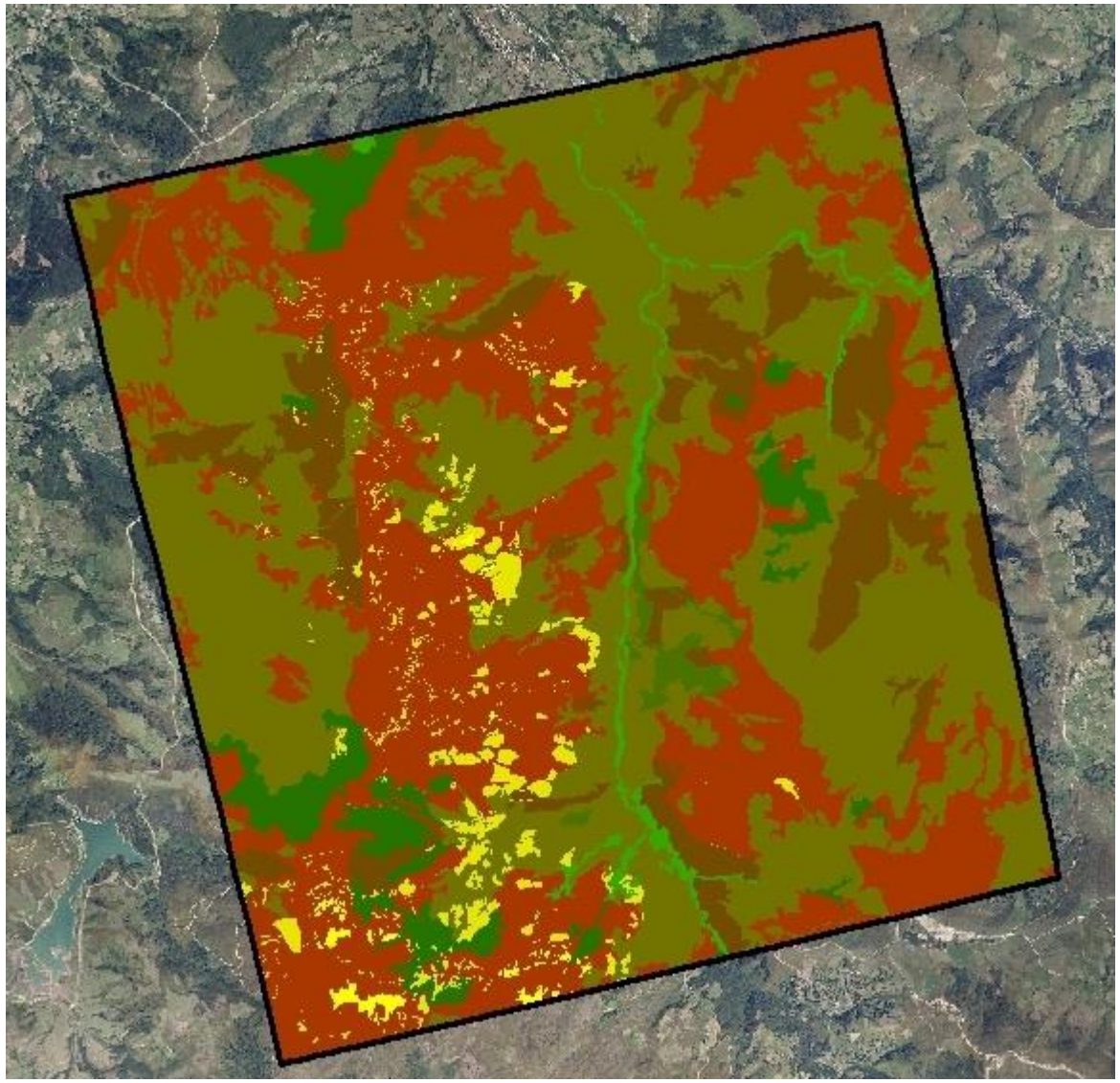
Field campaings in 2017-2018



Complex landscapes -- wetlands (acid fens)

Vegetation (habitat) types:

- Oligotrophic waters
- European dry heaths
- Lowland hay meadows
- * Blanket bogs
- Transition mires and quaking bogs
- Undefined bog habitat type
- Atlantic acidophilous beech forests with Ilex and Taxus
- * Alluvial forests with Alnus glutinosa and Fraxinus excelsior
- Forests of Quercus pyrenaica y robledales de Quercus robur
- Forests of castanea sativa
- Other shrub habitat types (not Annex I)
- Other forest habita types (not Annex I)



Training data (n=250):
ACID FENS larger that 0.1ha
Types 7130 and 7140

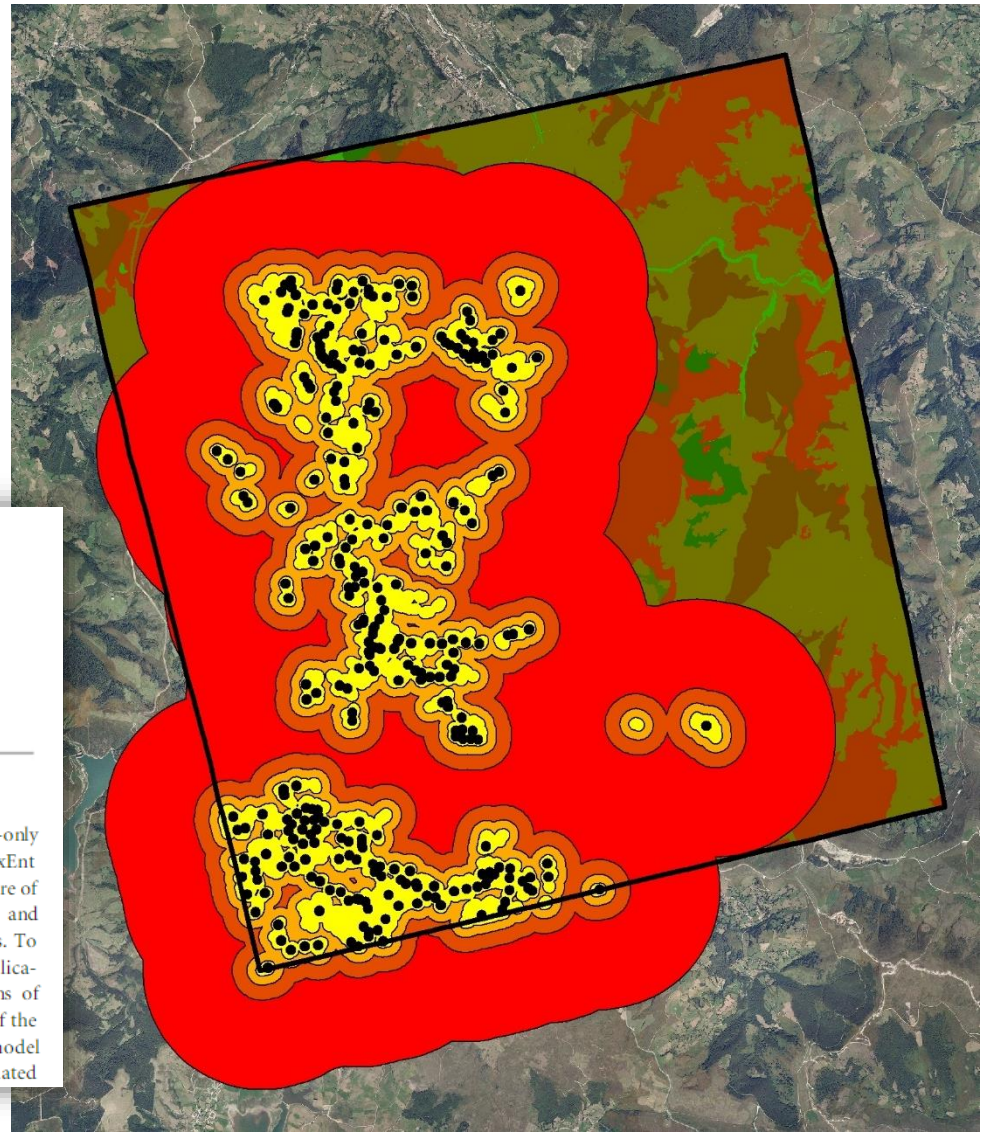
Other vegetation types

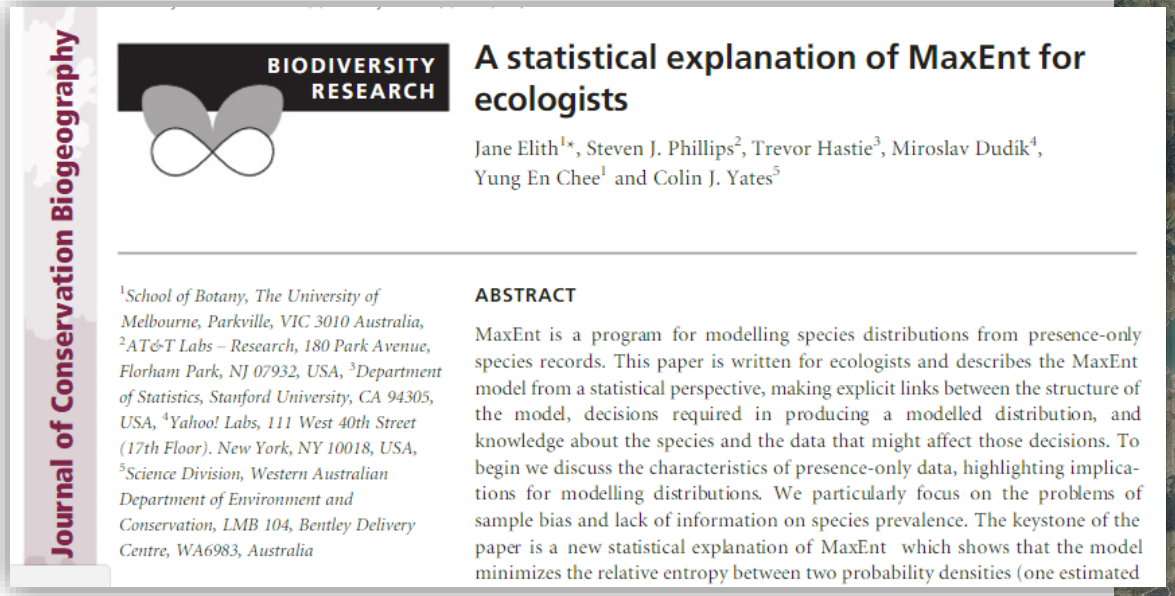
Complex landscapes -- wetlands (acid fens)

Study area: Sierra del Escudo (SAC Natura2000)

Training-validation: 4 levels,
- 250 meters
- 500 meters
- 1000 meters
- 2000 meters,
around selected bogs

Random points
spread out 100 meters, excluding training





Journal of Conservation Biogeography

BIODIVERSITY RESEARCH

A statistical explanation of MaxEnt for ecologists

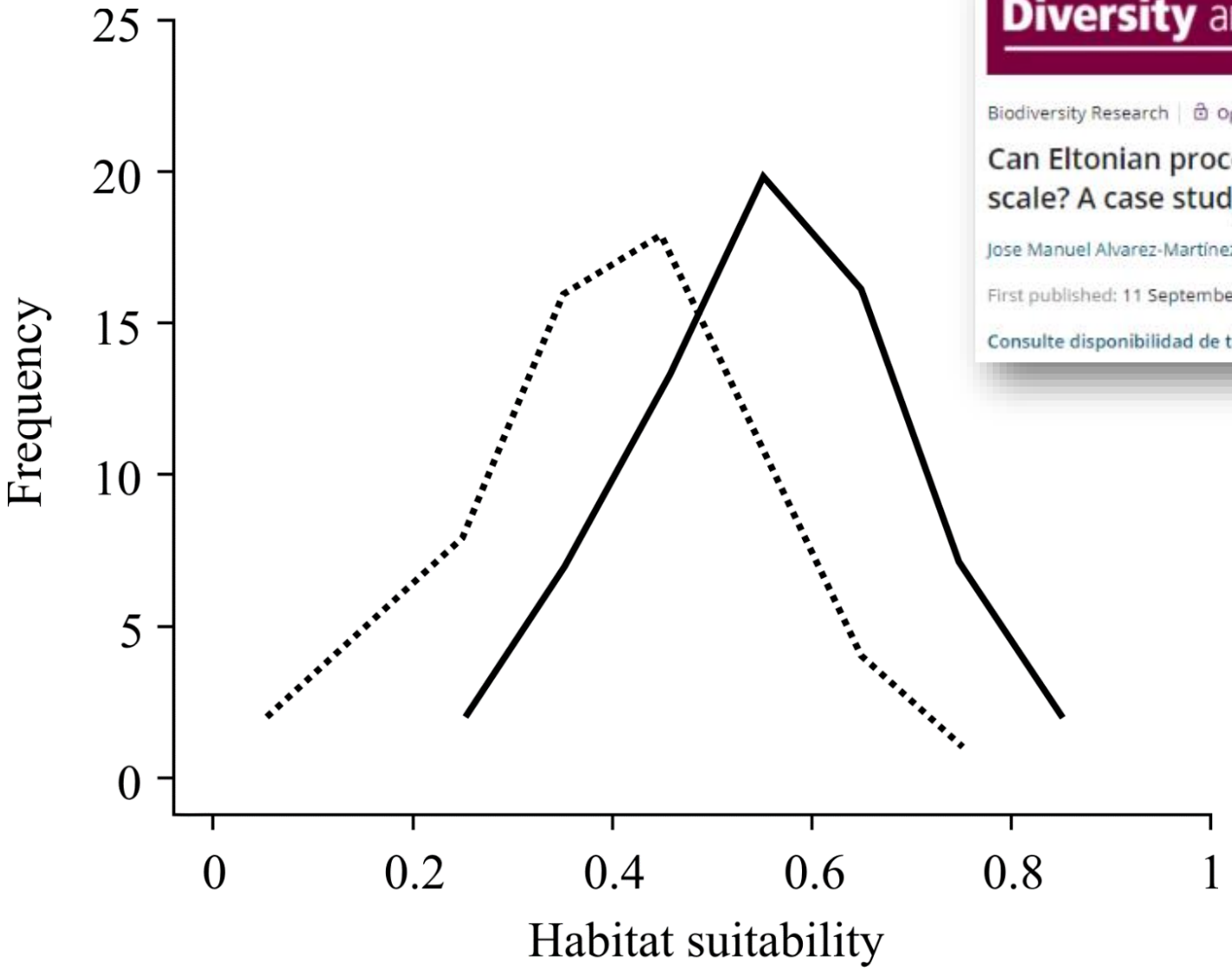
Jane Elith[1]*, Steven J. Phillips[2], Trevor Hastie[3], Miroslav Dudík[4], Yung En Chee[1] and Colin J. Yates[5]

[1]*School of Botany, The University of Melbourne, Parkville, VIC 3010 Australia,* [2]*AT&T Labs – Research, 180 Park Avenue, Florham Park, NJ 07932, USA,* [3]*Department of Statistics, Stanford University, CA 94305, USA,* [4]*Yahoo! Labs, 111 West 40th Street (17th Floor). New York, NY 10018, USA,* [5]*Science Division, Western Australian Department of Environment and Conservation, LMB 104, Bentley Delivery Centre, WA6983, Australia*

ABSTRACT

MaxEnt is a program for modelling species distributions from presence-only species records. This paper is written for ecologists and describes the MaxEnt model from a statistical perspective, making explicit links between the structure of the model, decisions required in producing a modelled distribution, and knowledge about the species and the data that might affect those decisions. To begin we discuss the characteristics of presence-only data, highlighting implications for modelling distributions. We particularly focus on the problems of sample bias and lack of information on species prevalence. The keystone of the paper is a new statistical explanation of MaxEnt which shows that the model minimizes the relative entropy between two probability densities (one estimated

Complex landscapes -- wetlands (acid fens)



Diversity and Distributions
A Journal of Conservation Biogeography
Biodiversity Research | Open Access

Can Eltonian processes explain species distributions at large scale? A case study with Great Bustard (*Otis tarda*)

Jose Manuel Alvarez-Martínez, Susana Suárez-Seoane, Carlos Palacín, Julia Sanz, Juan C. Alonso

First published: 11 September 2014 | https://doi.org/10.1111/ddi.12256 | Citations: 14

Sensititivy
vs.
Specificity

Frequency histograms

Complex landscapes -- wetlands (acid fens)

Landsat8
Sentinel2
Deimos2

&

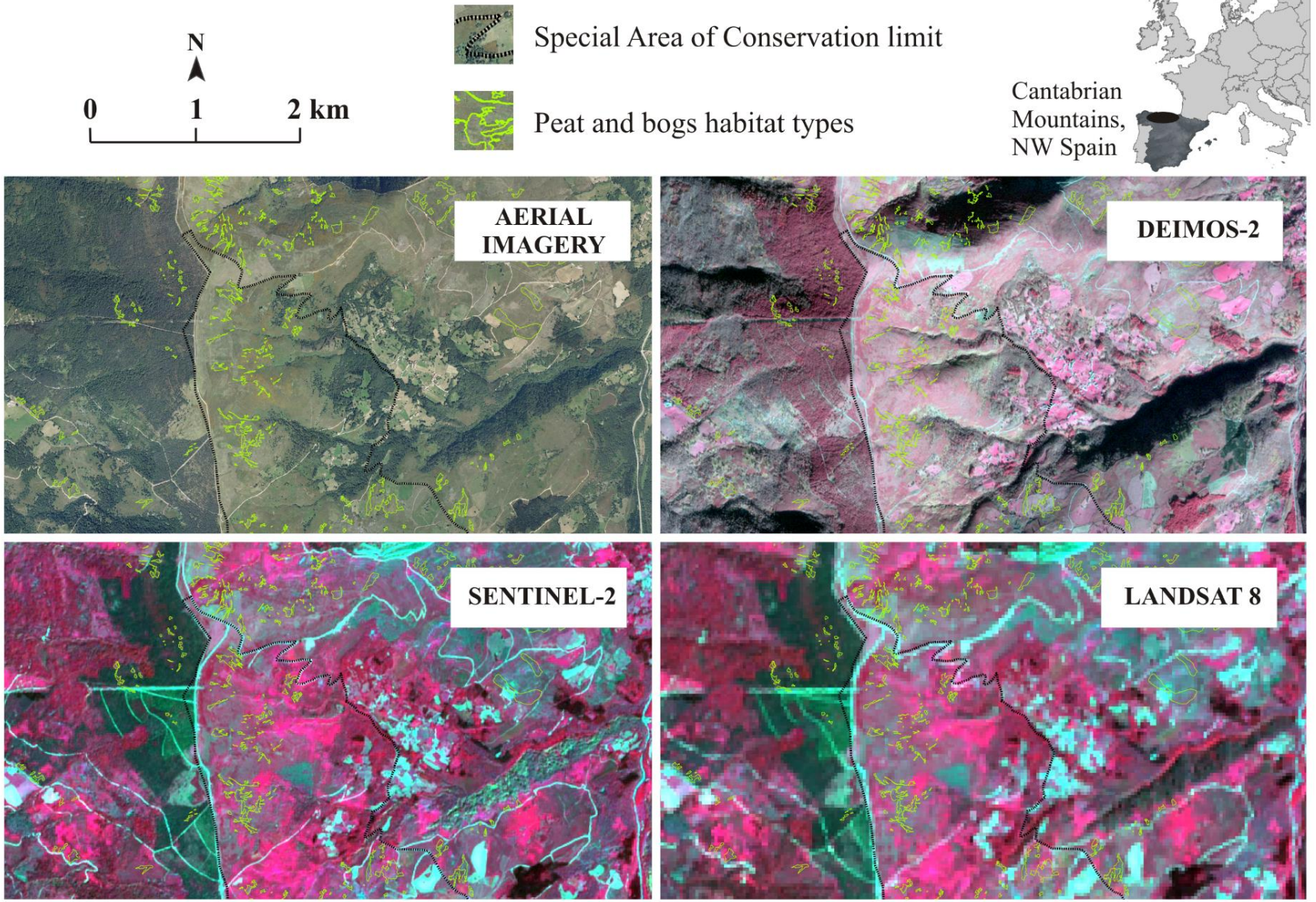
Temporal resolution (spring & summer)

&

All images together

&

DEM, DSM



Complex landscapes -- wetlands (acid fens)

Landsat 8 MVC

Landsat8 x2

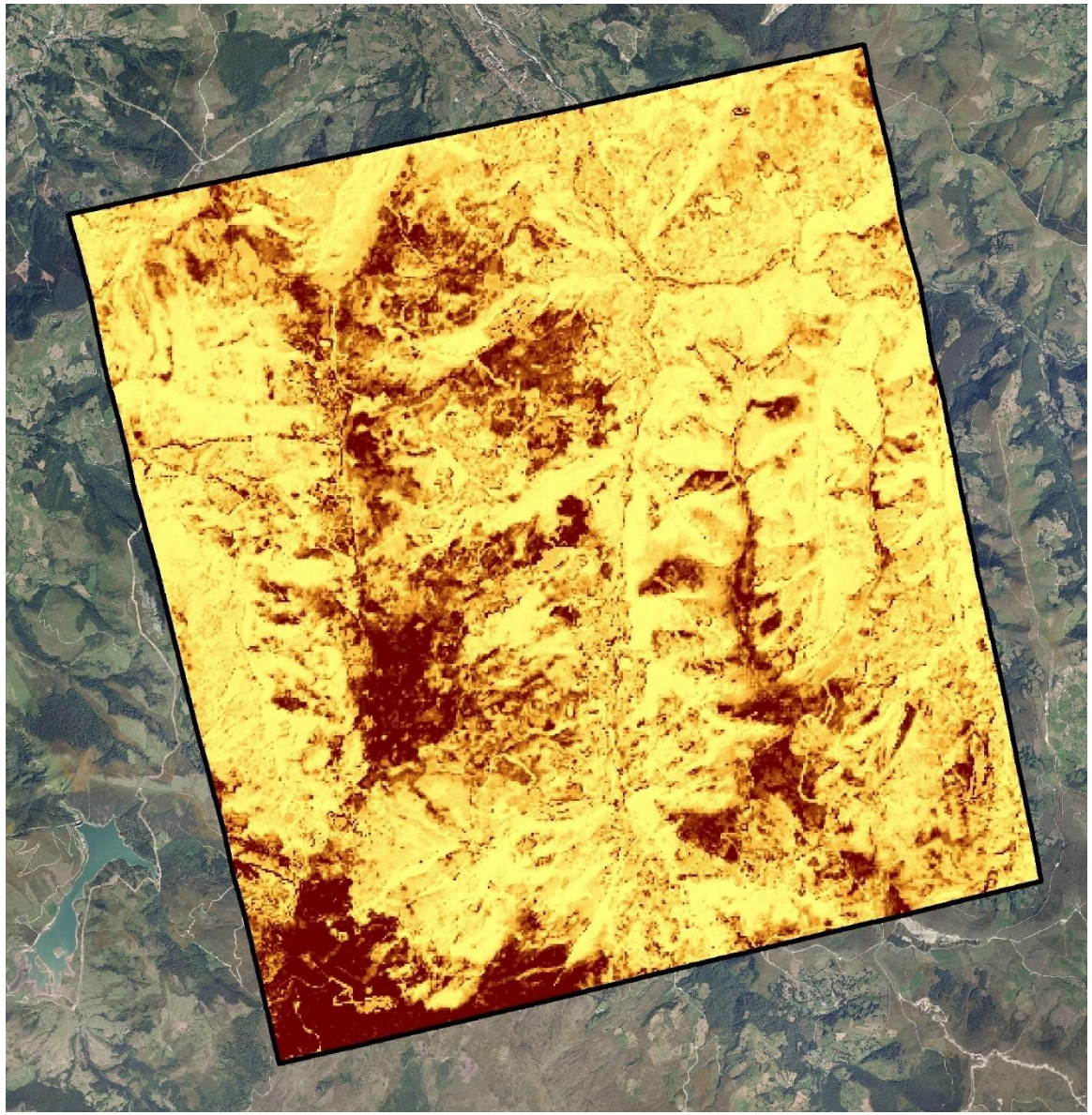
Sentinel2 x2

Deimos2 x2

+LiDAR +MDT

High suitability

Low suitability



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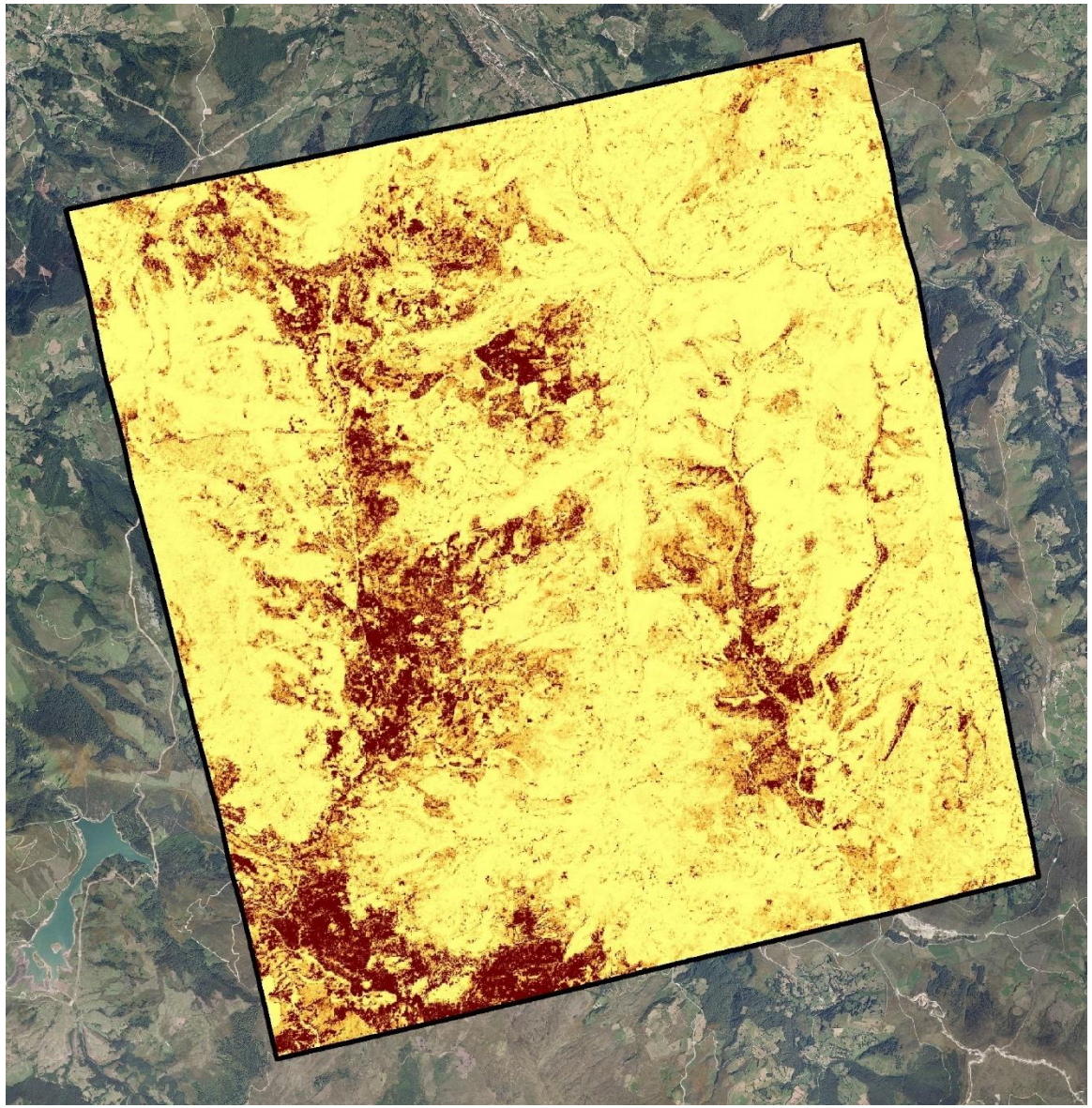

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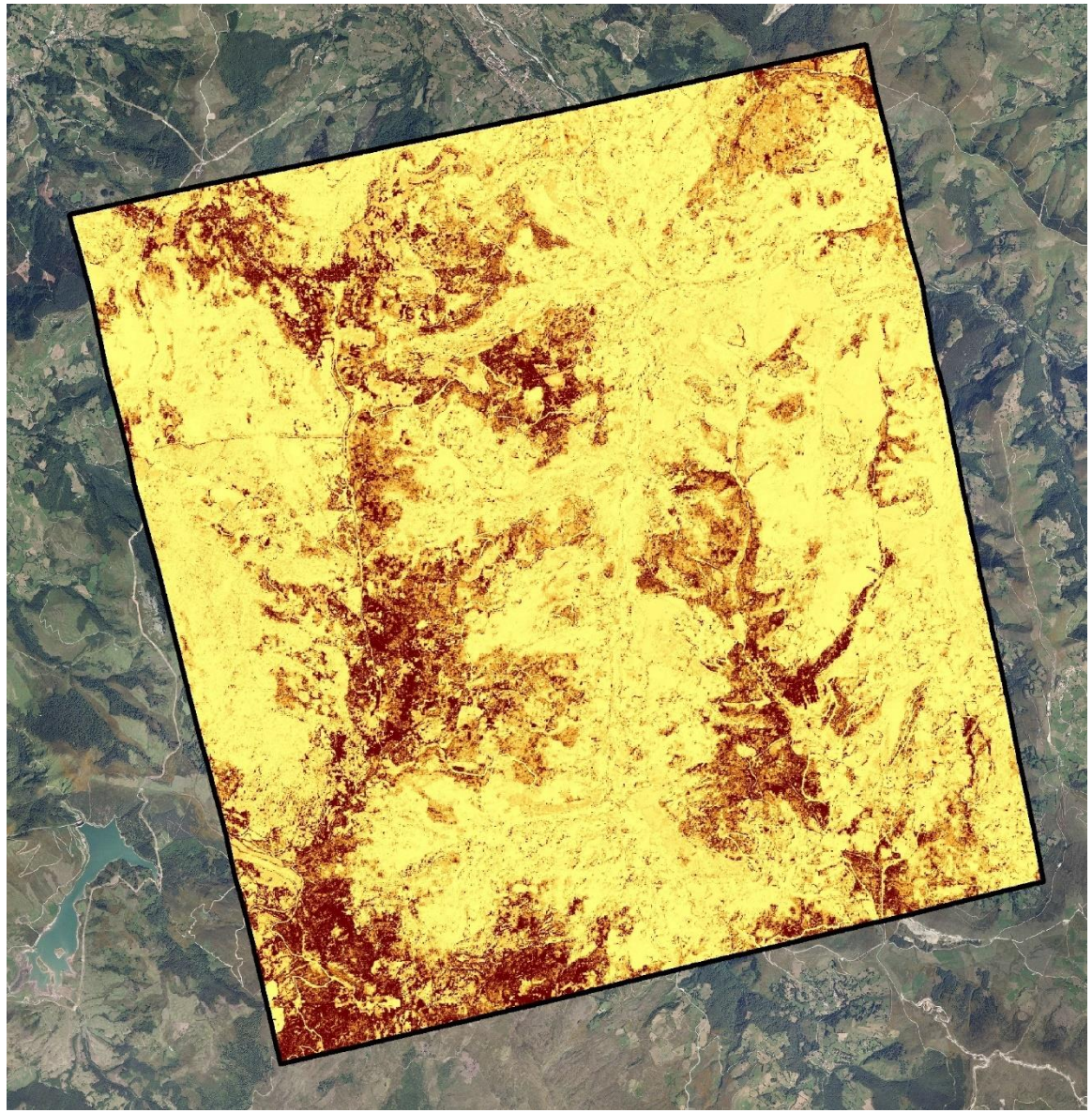

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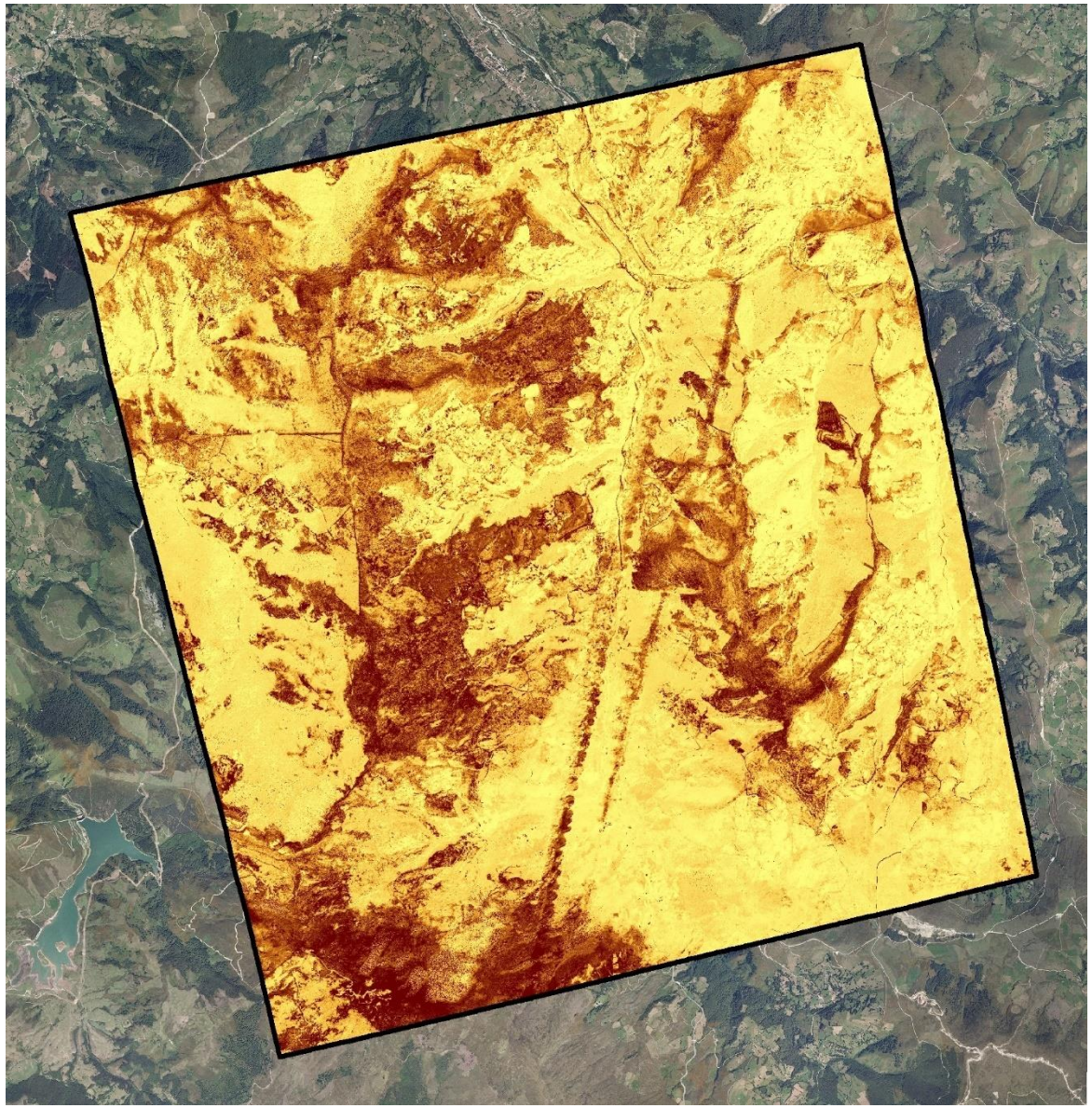

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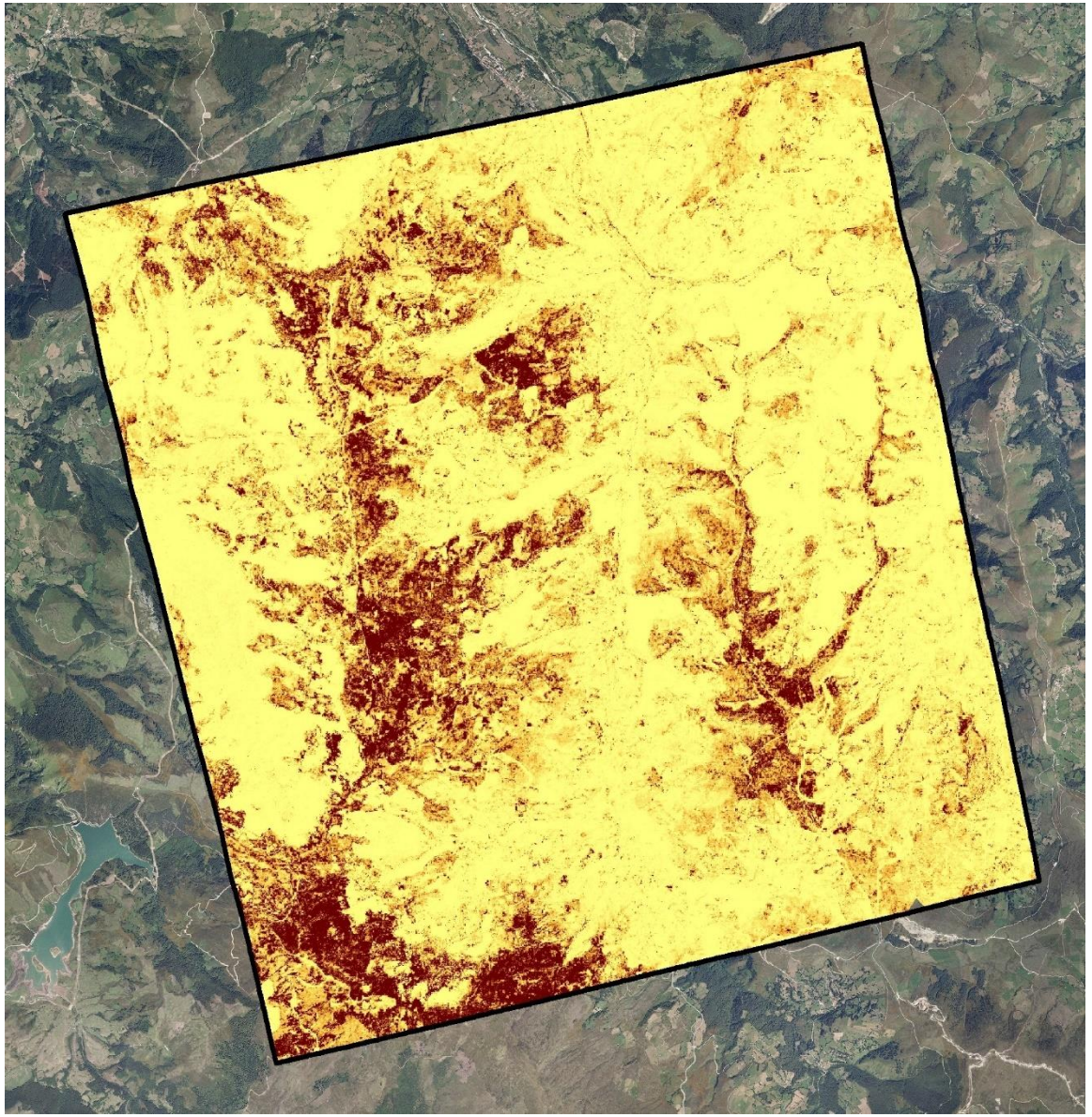

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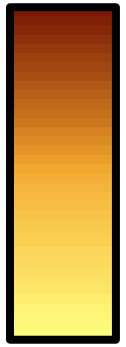
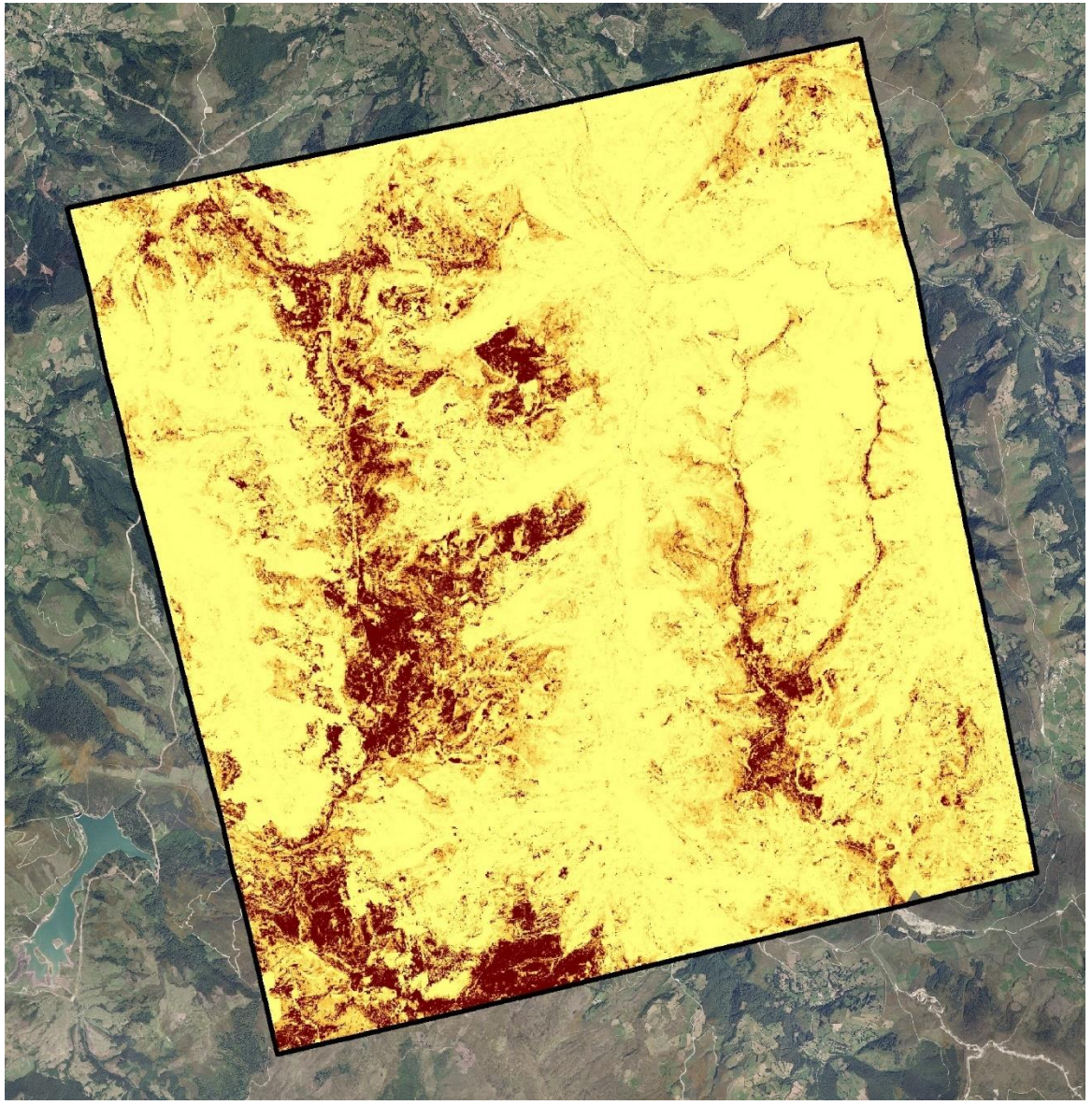


Low suitability



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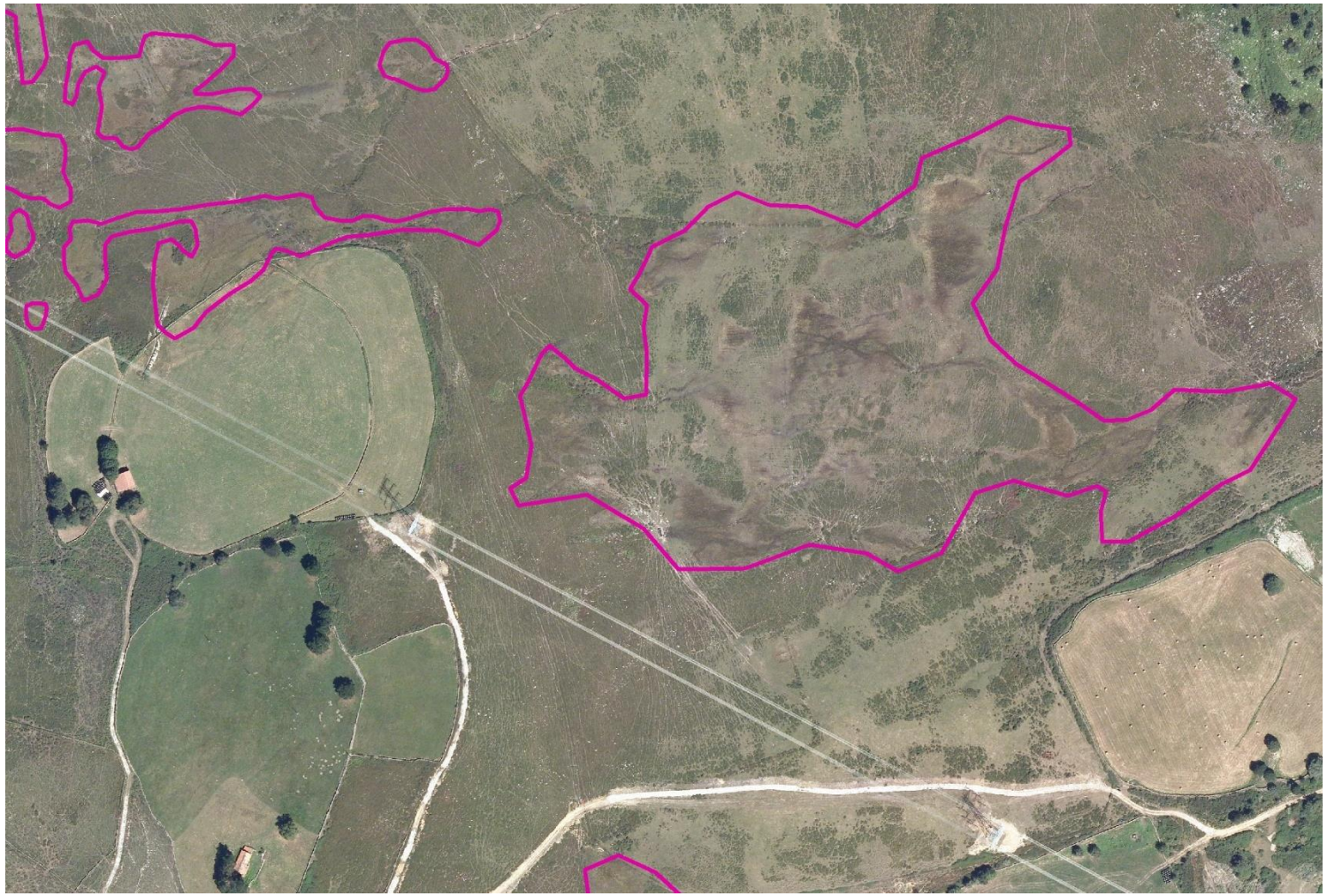
Locally monitored acid fens



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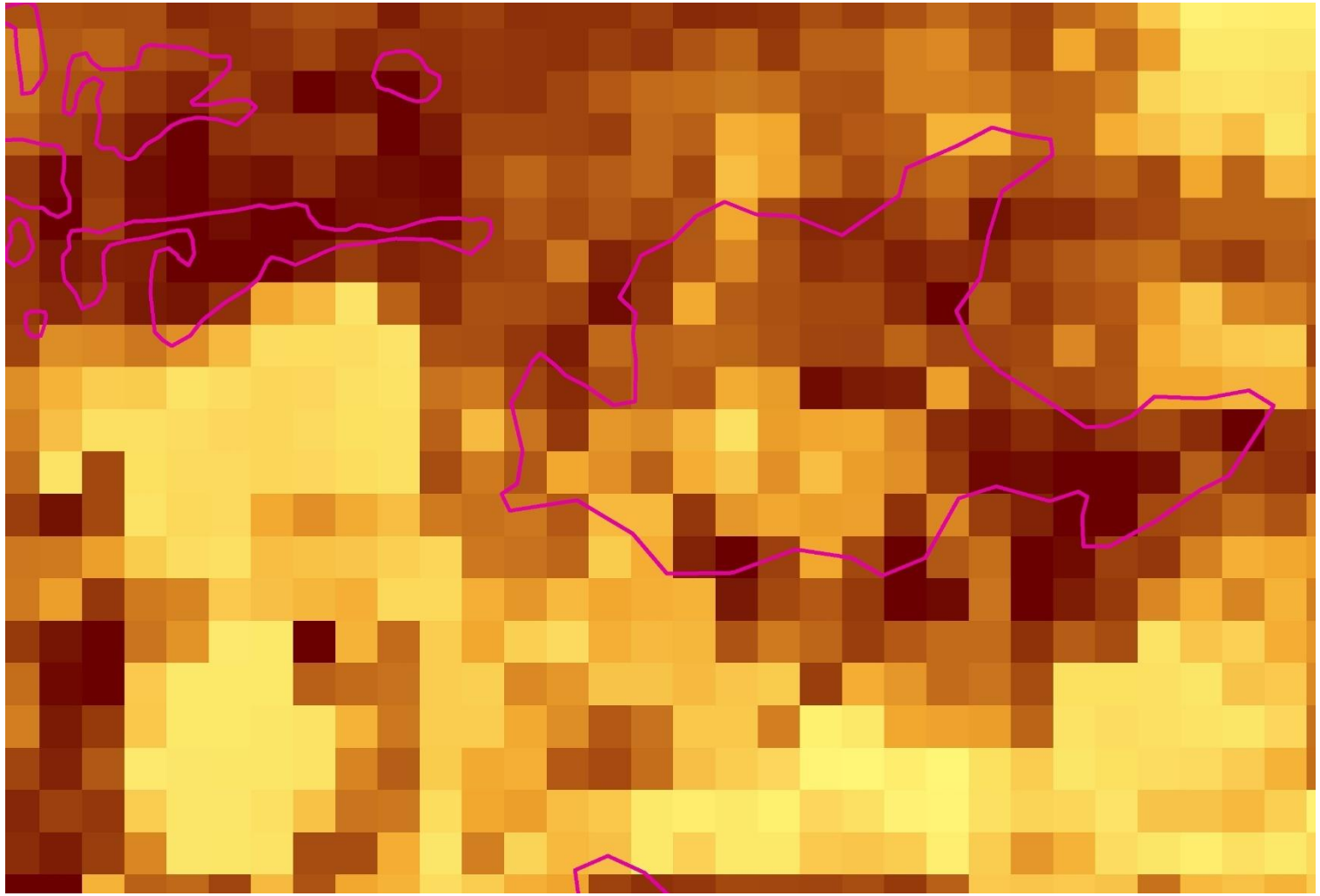

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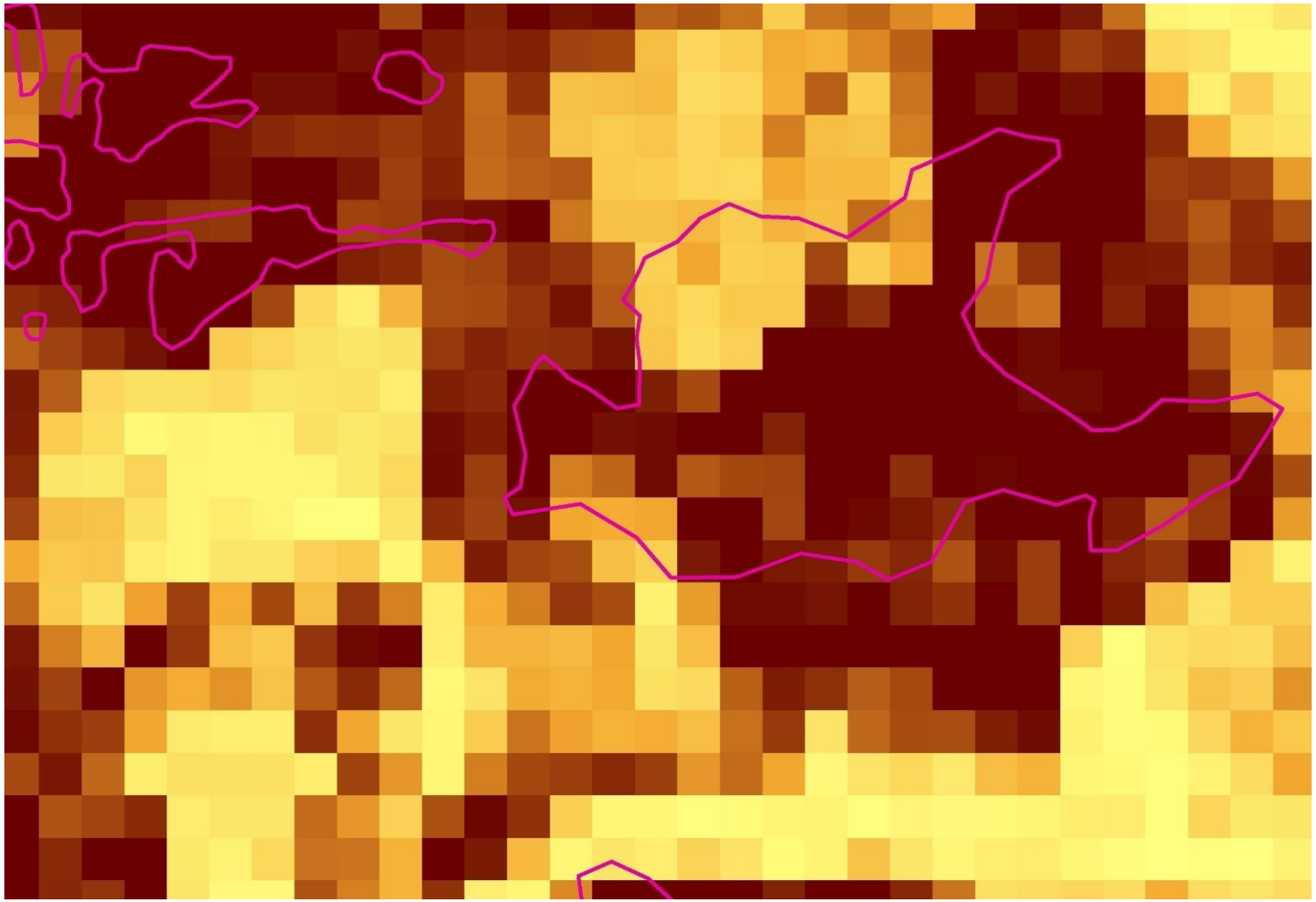

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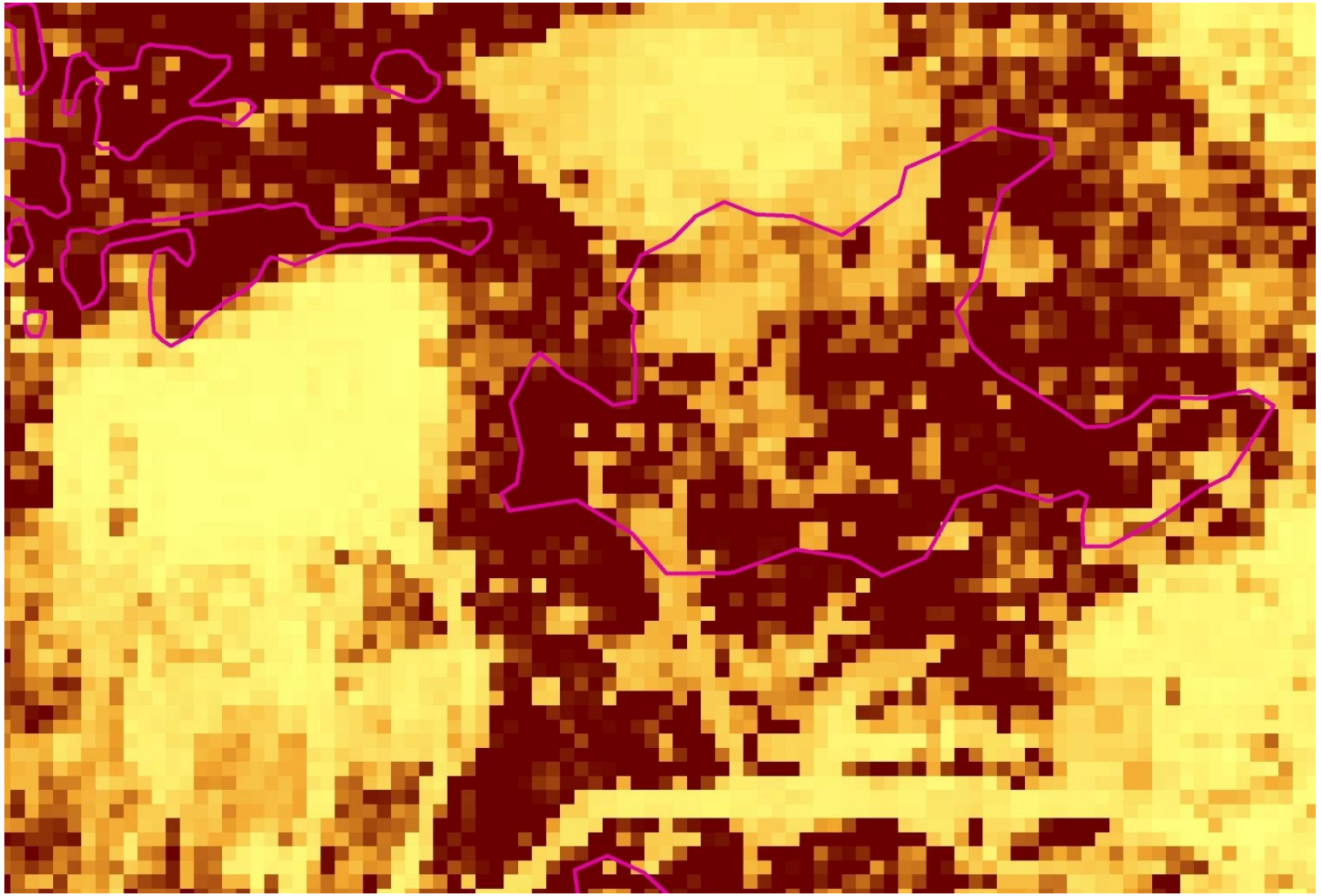

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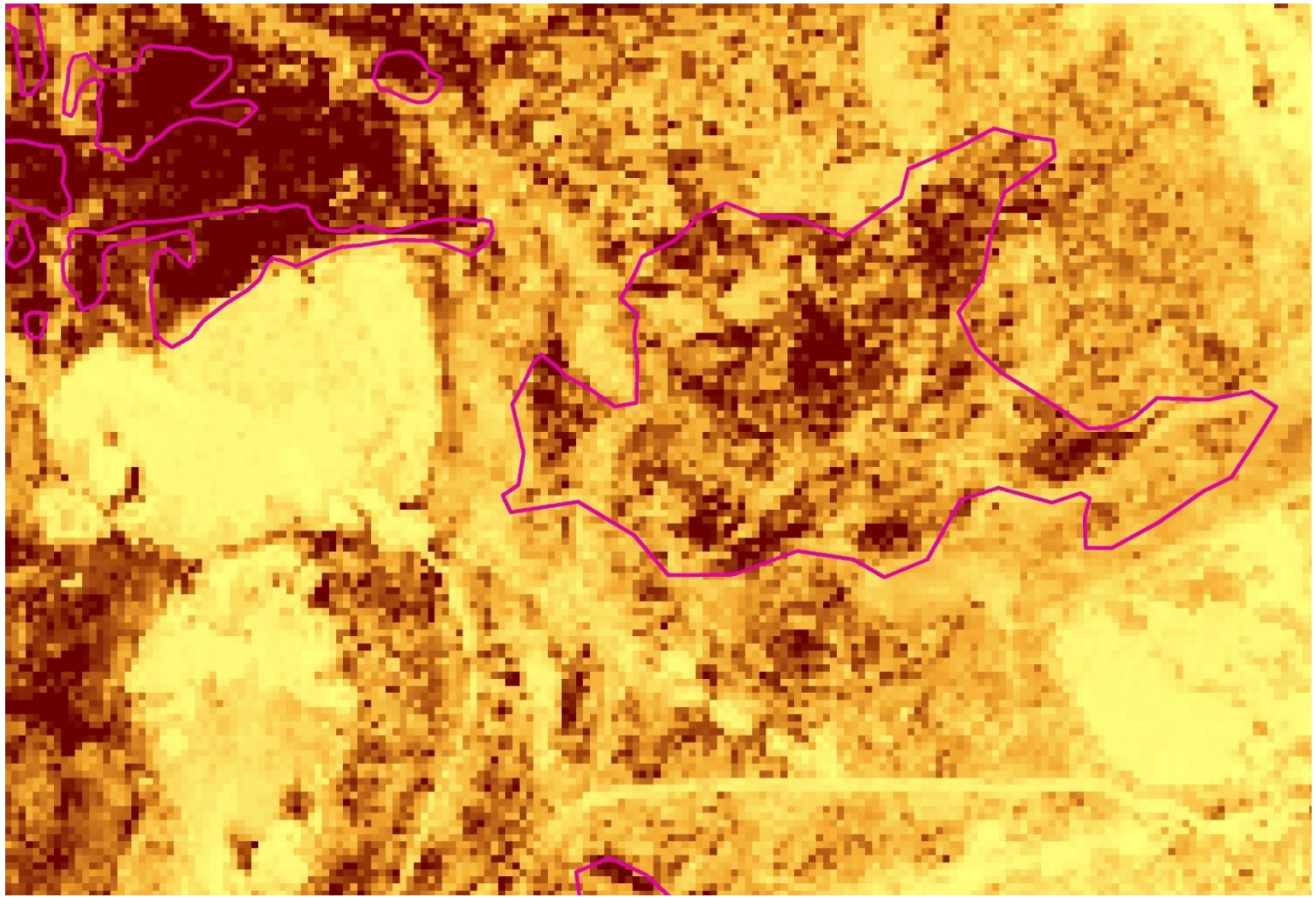

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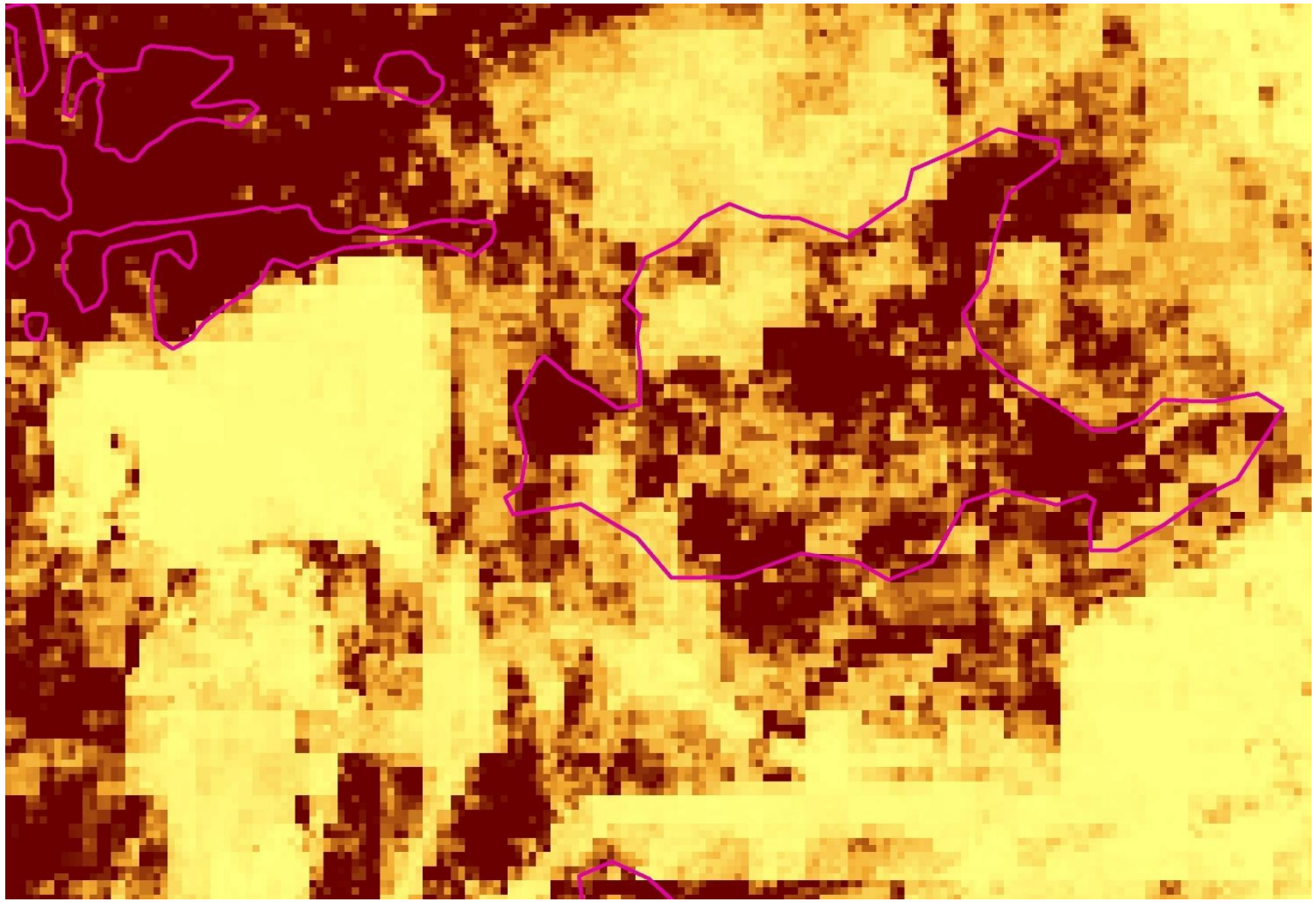
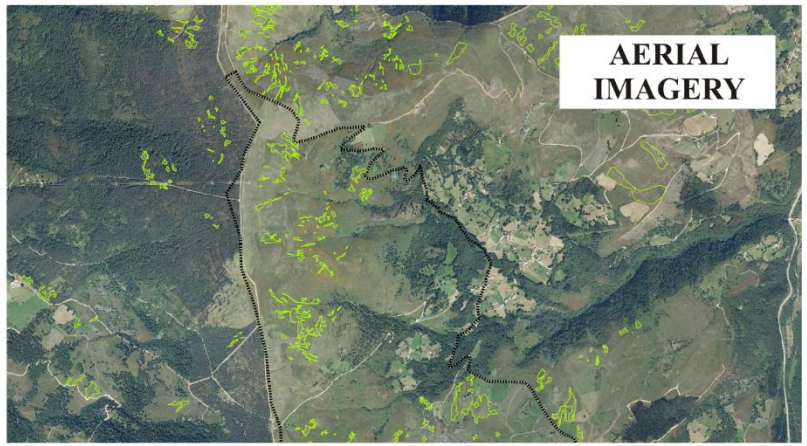
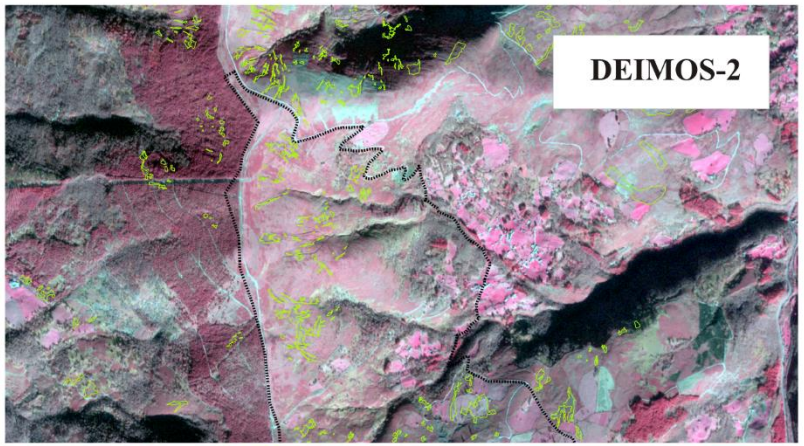


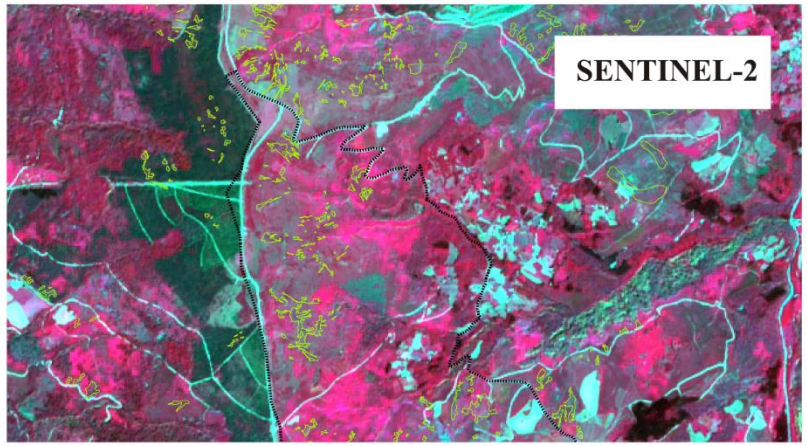
Complex landscapes -- wetlands (acid fens)

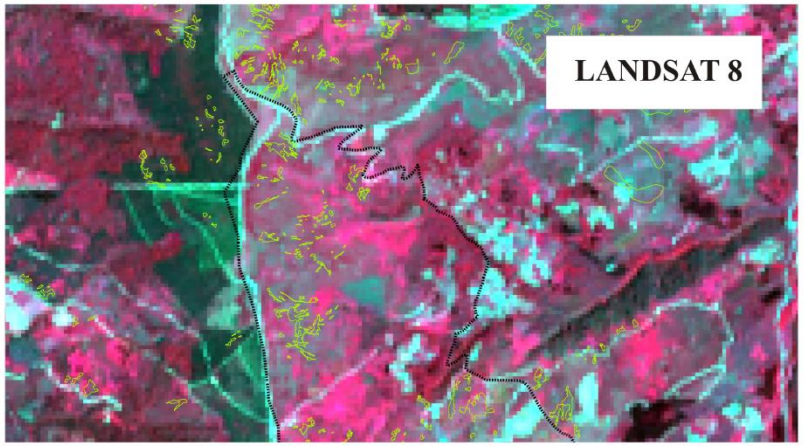
Special Area of Conservation limit

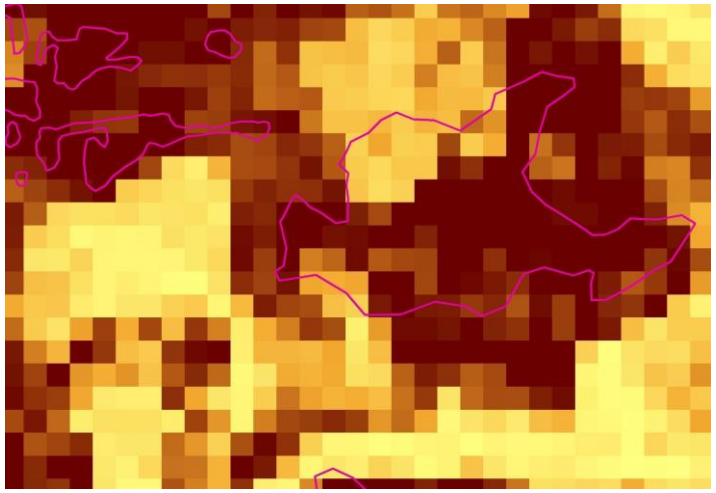
Peat and bogs habitat types

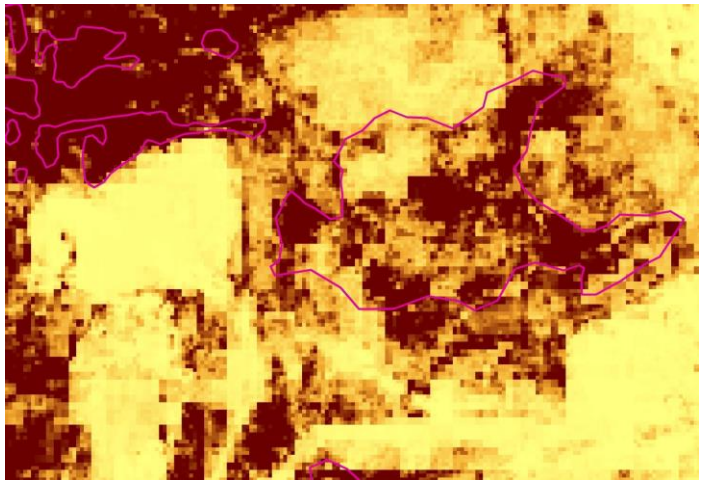










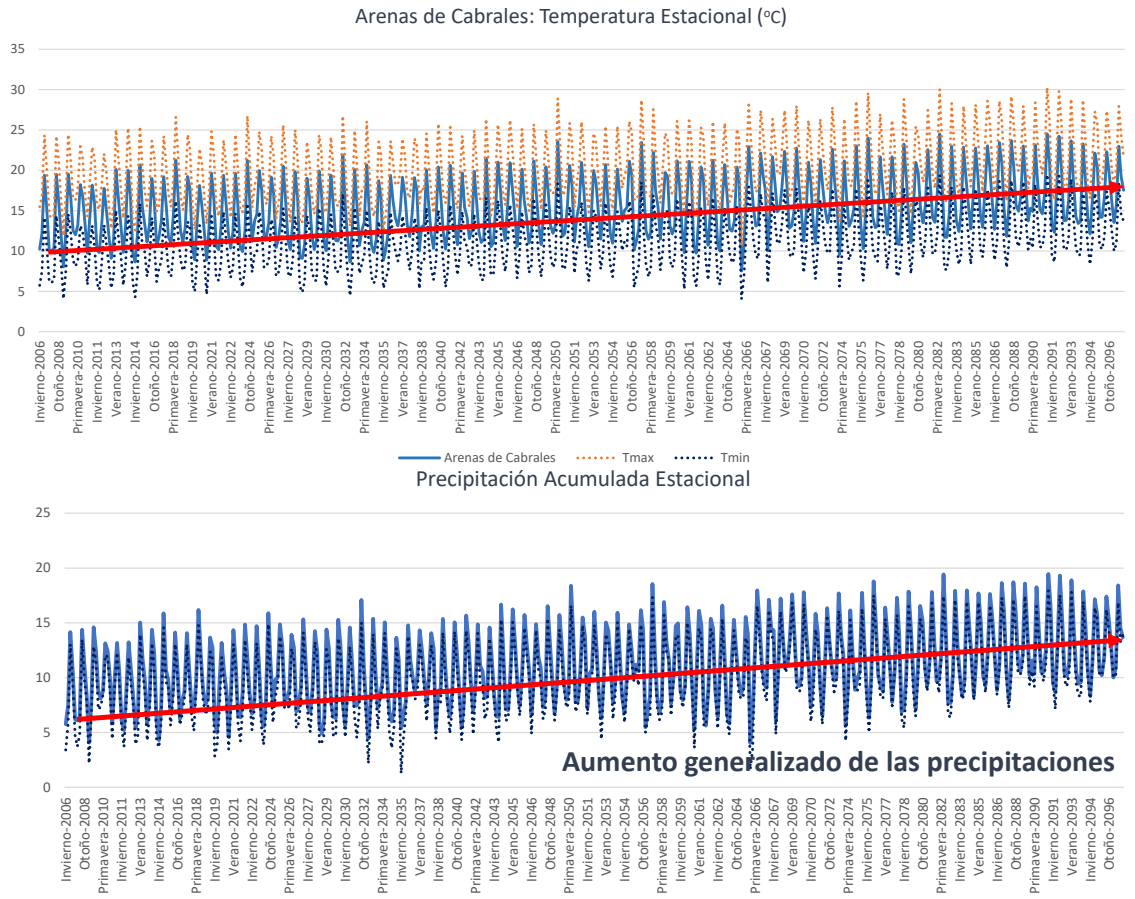


Aquatic ecosystems – rivers and climate change

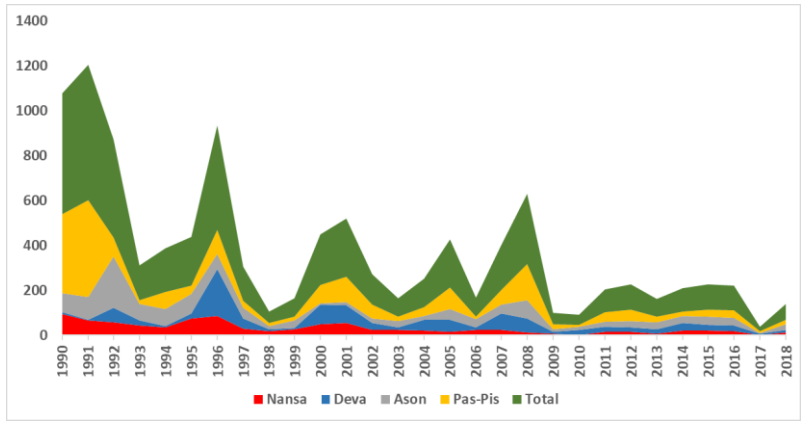
La observación remota aplicada al seguimiento de los ecosistemas

Parque Nacional de Picos de Europa

Aumento generalizado de las temperaturas media y mínima, y precipitaciones



Evidencias de los efectos del cambio climático: El salmón atlántico

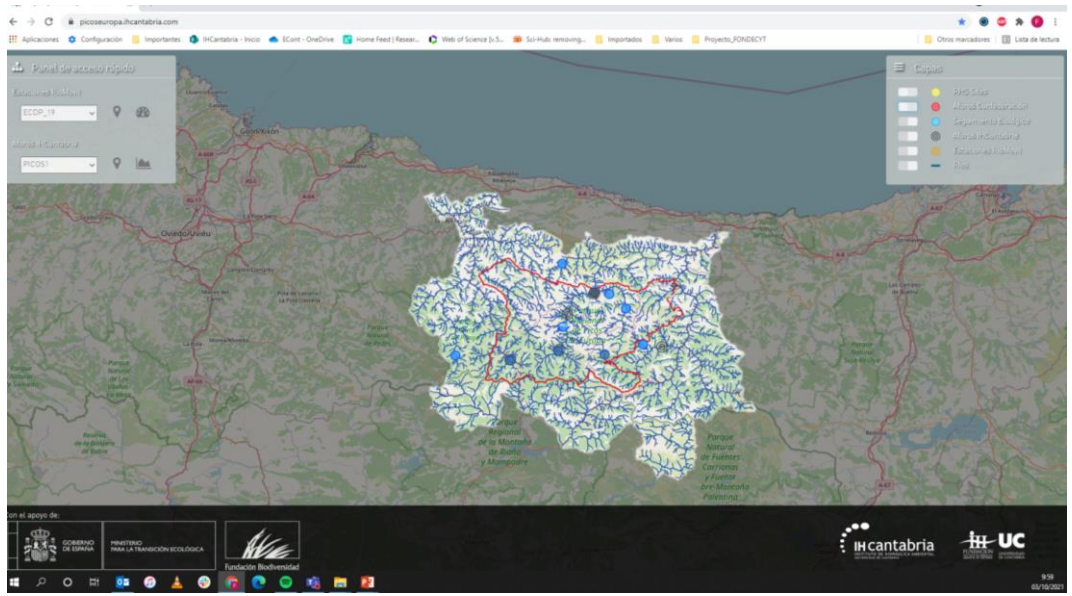


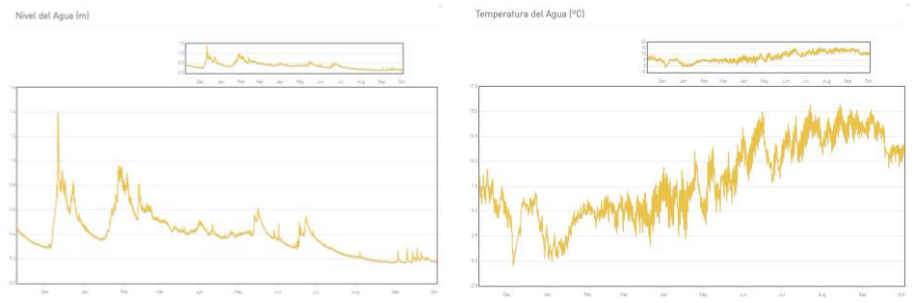
predictia

Aquatic ecosystems – rivers and climate change

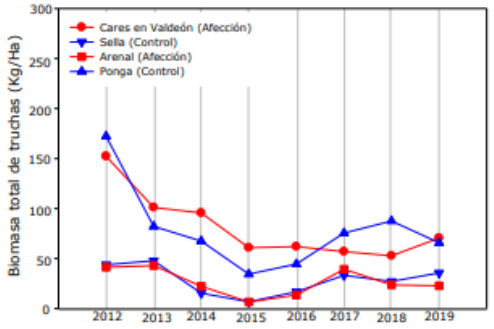
Seguimiento de ecosistemas fluviales de montaña a **largo plazo**

https://picoseuropa.ihcantabria.com/

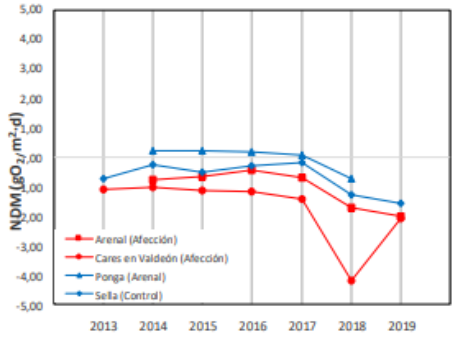




Biomasa de Peces

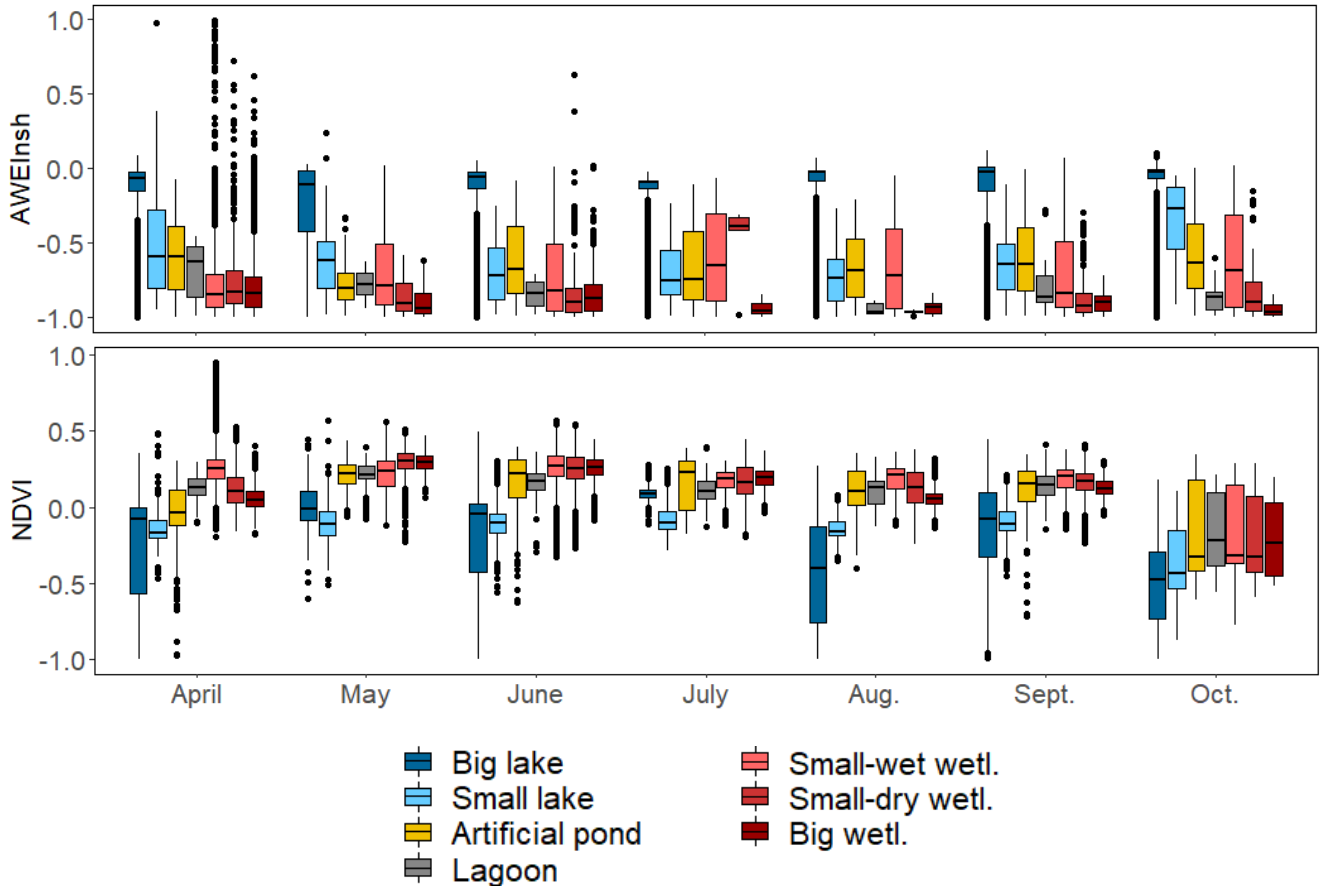


Metabolismo



Aquatic ecosystems -- wetlands and S2 dynamics

Most suitable **indices** providing key information about wetland dynamics



Boxes show the median and the 25 and 75 percentiles, black dots are outliers (1.5 times the height of the box)

Methods

Sentinel-2 satellite images
219 wetlands
51 scenes
17 dates (April to October, 2017-2020)
Spectral indices: AWEInsh, NDVI

Results

AWEInsh and NDVI captured the variability associated to ecosystem type and along the hydroperiod

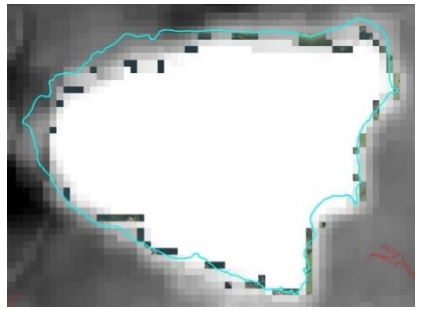
Project

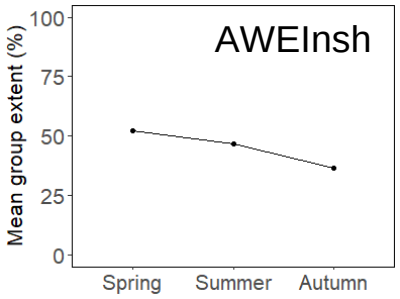
LIFE-DIVAQUA

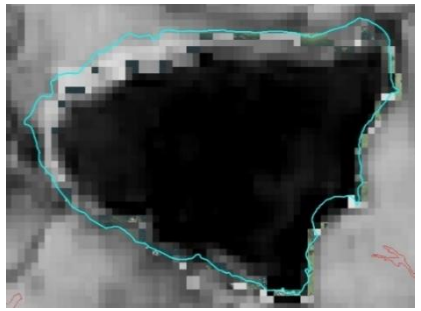
Aquatic ecosystems -- wetlands and S2 dynamics

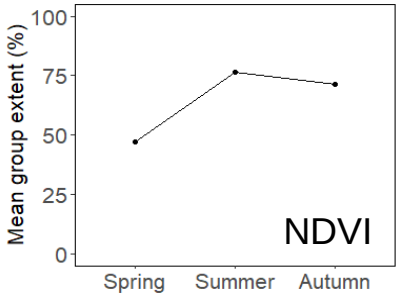
Most suitable **indices** providing key information about wetland dynamics

LAKES

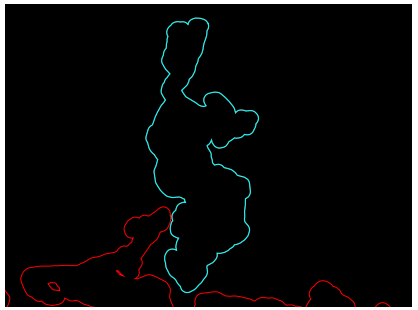


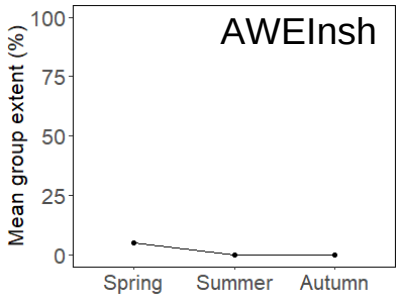


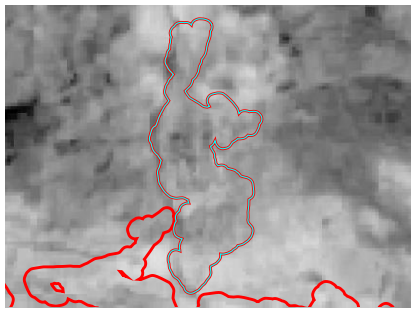


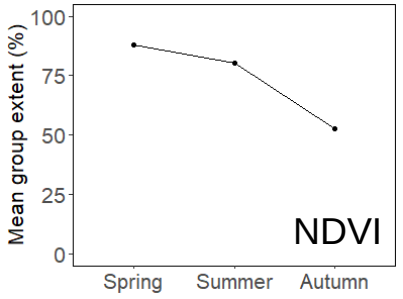


WETLANDS









Methods

Image reclassification (using statistics from previous step) to detect changes in wetlands extent

Results

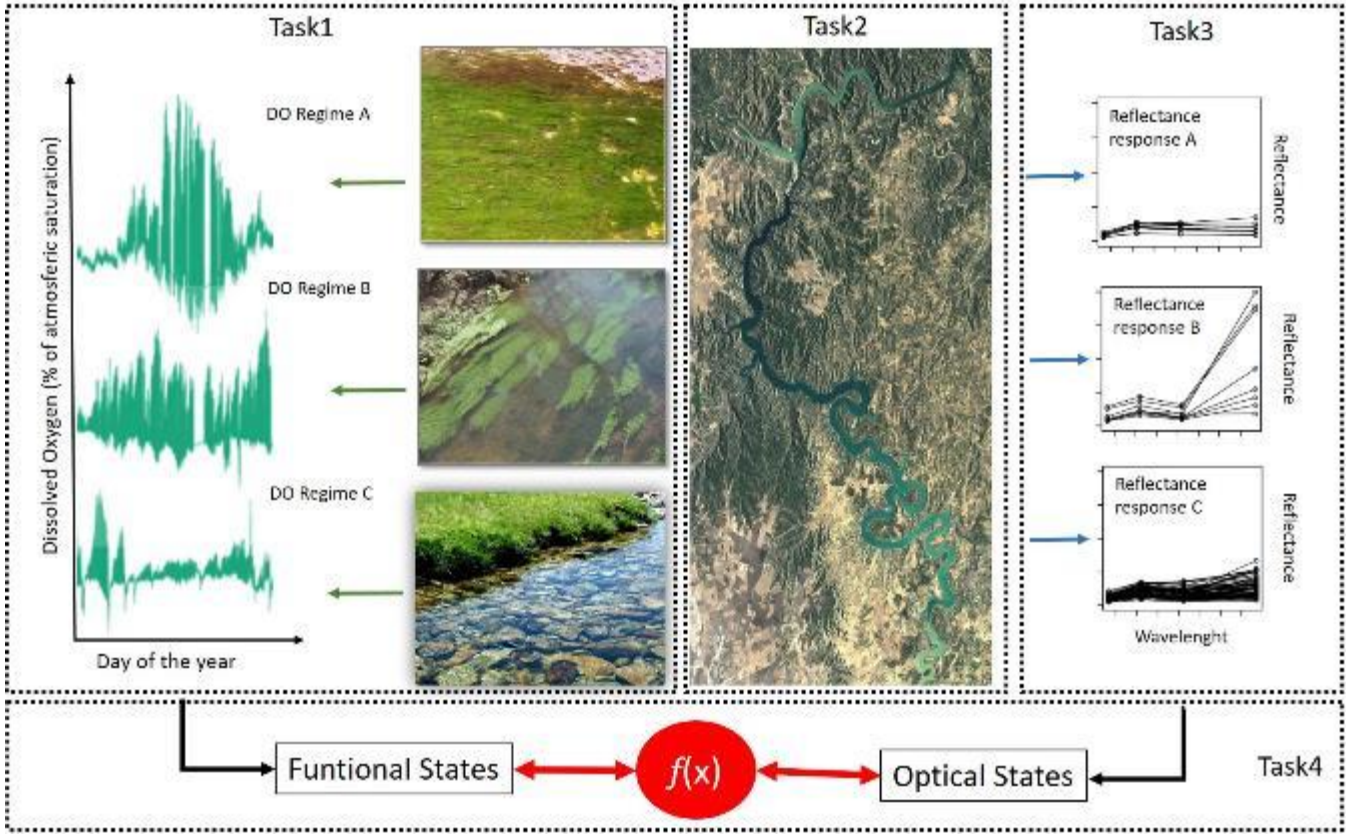
AWEInsh and NDVI detected variability associated to ecosystem type and along the hydroperiod

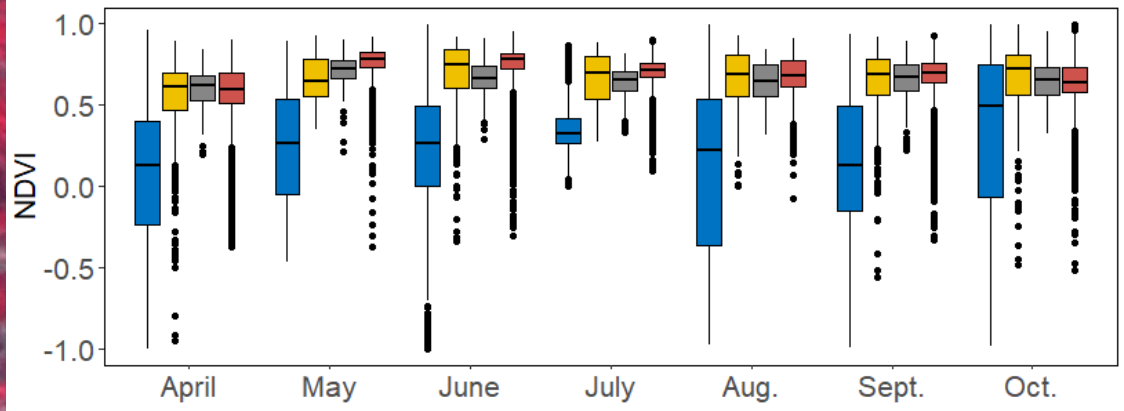
NDVI was better to detect changes in the extension of the lentic bodies, compared to AWEInsh, mainly due to the lower data availability for the latter after atmospheric correction)

Project

LIFE-DIVAQUA

Assessing wetland dynamics with Landsat imagery





Science of the Total Environment

Long-term dynamics of a floodplain shallow lake in the Pantanal wetland: Is it all about climate?

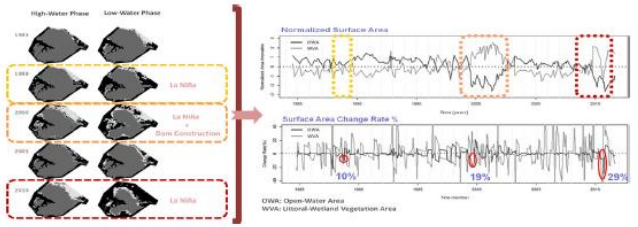
Ana Silio-Calzada [a,*], José Barquín [a], Vera L.M. Huszar [b], Nestor Mazzeo [c], Fernando Méndez [d], Jose Manuel Álvarez-Martínez [a]

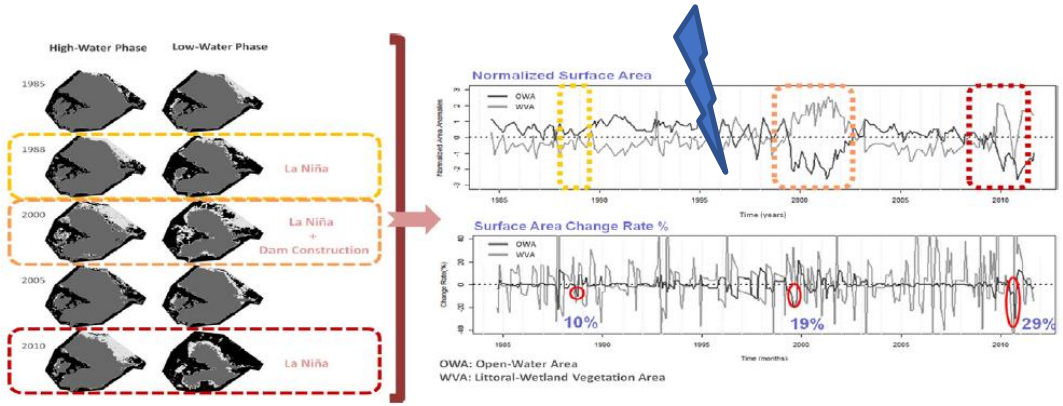
[a] Environmental Hydraulics Institute "IH Cantabria of Universidad de Cantabria", C/ Isabel Torres n°15, Parque Científico y Tecnológico de Cantabria, 39011 Santander, Spain
[b] Museu Nacional, Quinta da Boa Vista, São Cristóvão, 20940-040 Rio de Janeiro, Brazil
[c] CURE-Facultad de Ciencias, Universidad de la República Oriental del Uruguay-UDELAR, Tacuarembó s/n, Maldonado, Uruguay
[d] Universidad de Cantabria, Escuela de Ingenieros de Caminos, Canales y Puertos, Av/ Los Castros, s/n. 39012, Santander, Spain

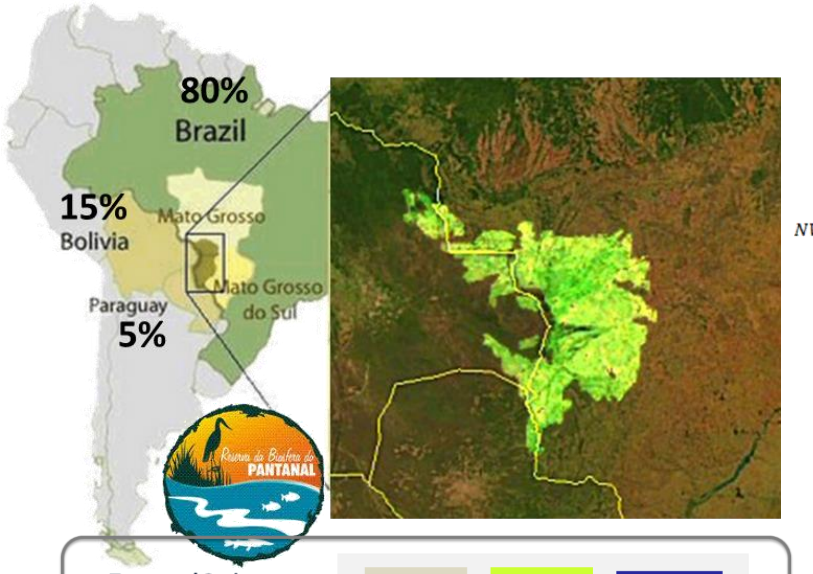
HIGHLIGHTS

- A new remote-sensing method to detect changes on floodplain lakes is presented.
- The lake dynamics are modulated by climate and river flow (natural and dam-affected).
- The floodplain ecosystem is suffering a progressive water loss.

GRAPHICAL ABSTRACT







$$NWI = \frac{\frac{1}{n}\sum_{i=1}^{n} VIS_i - \frac{1}{m}\sum_{j=1}^{m} IR_j}{\frac{1}{n}\sum_{i=1}^{n} VIS_i + \frac{1}{m}\sum_{j=1}^{m} IR_j}$$

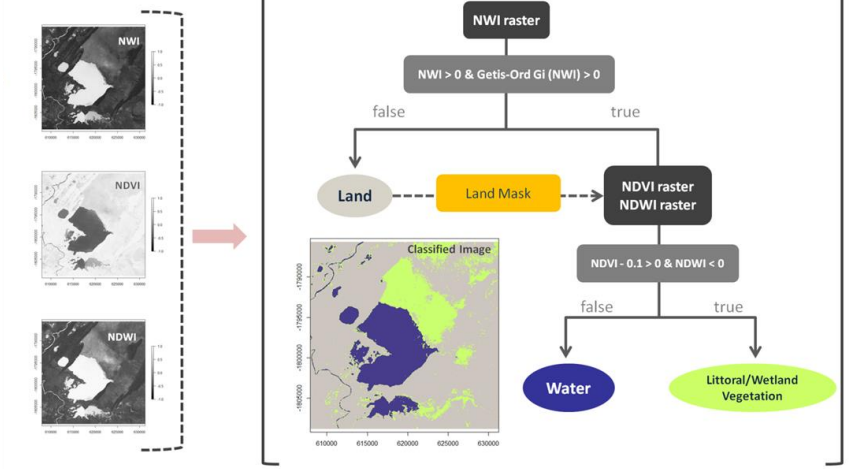
(Silio-Calzada *et al.*, 2017)

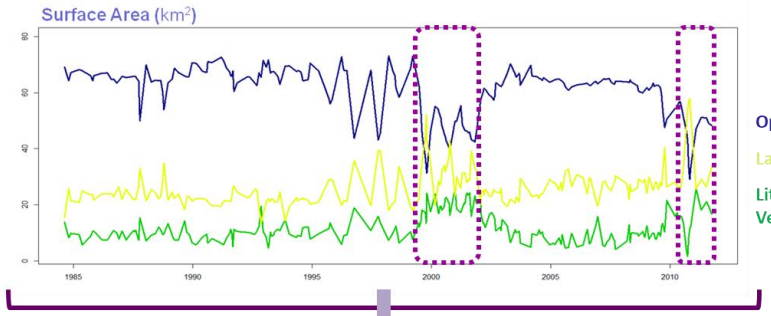
$$NDVI = \frac{NIR - Red}{NIR + Red}$$

(Tucker *et al.*, 1974)

$$NDWI = \frac{Green - NIR}{Green + NIR}$$

(McFeeters *et al.*, 1996)

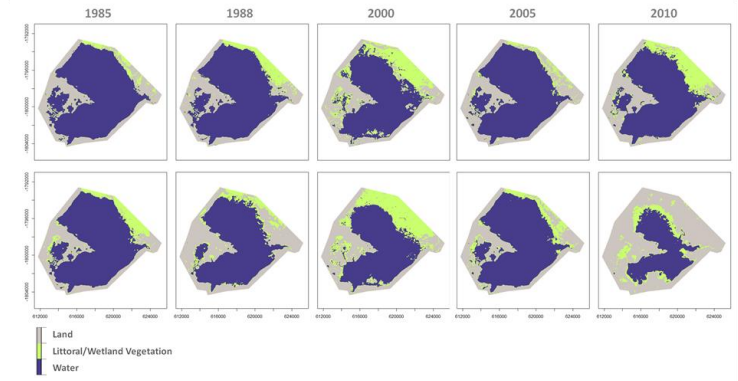




Open Water (OWA)

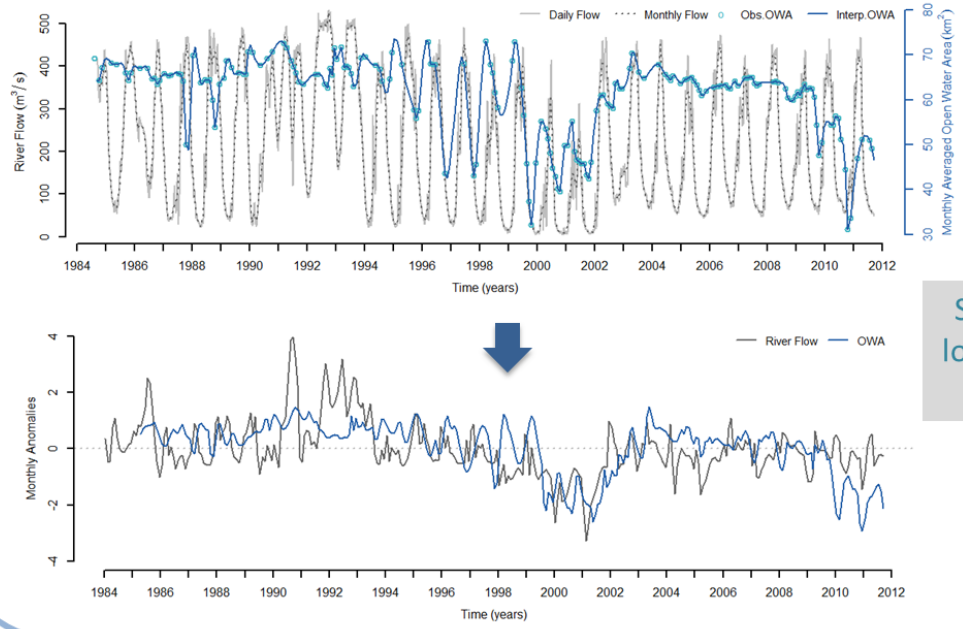
Land (LSA)

Littoral/Wetland Vegetation (WVA)



High-Water Phase

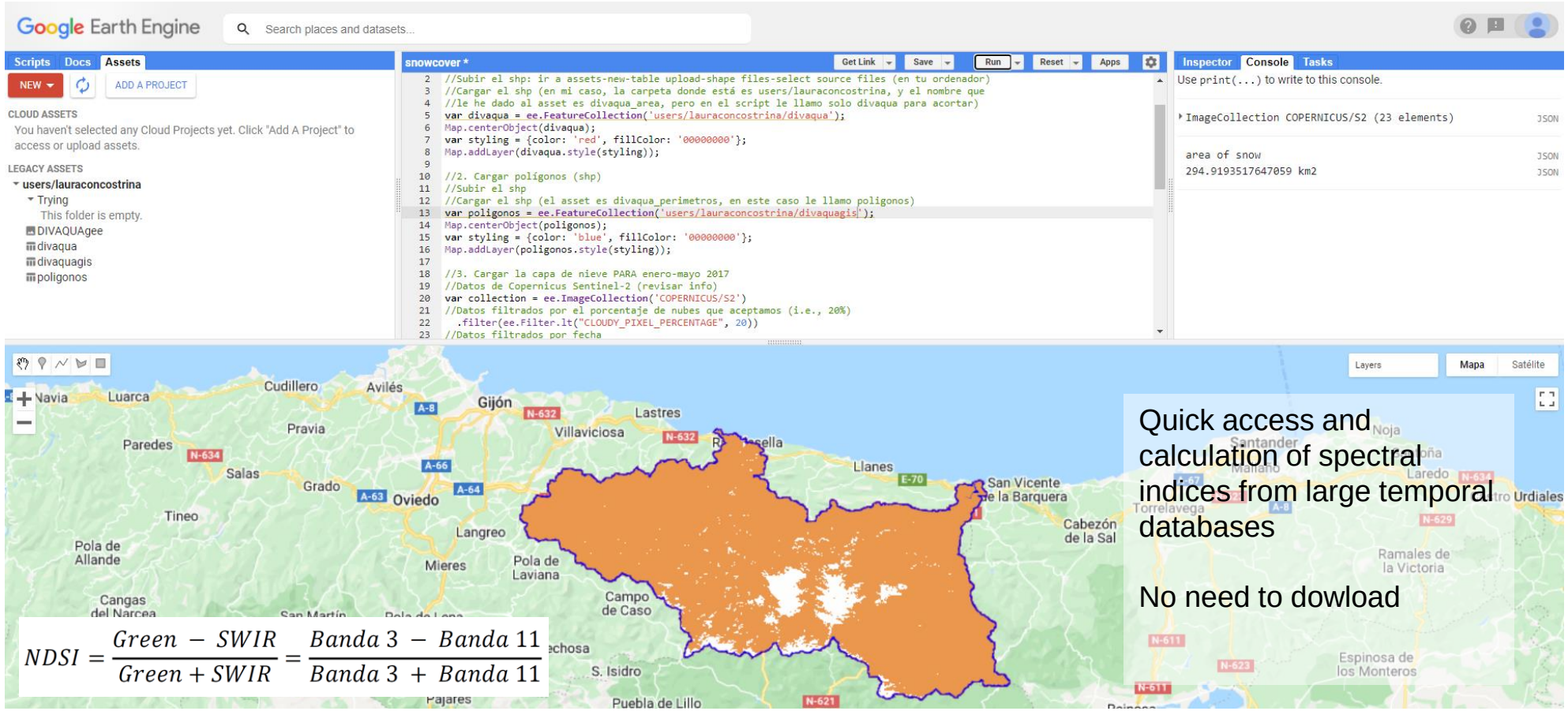
Low-Water Phase



Same analysis for local and upstream rainfall data

Snow cover monitoring with GEE & S2 imagery

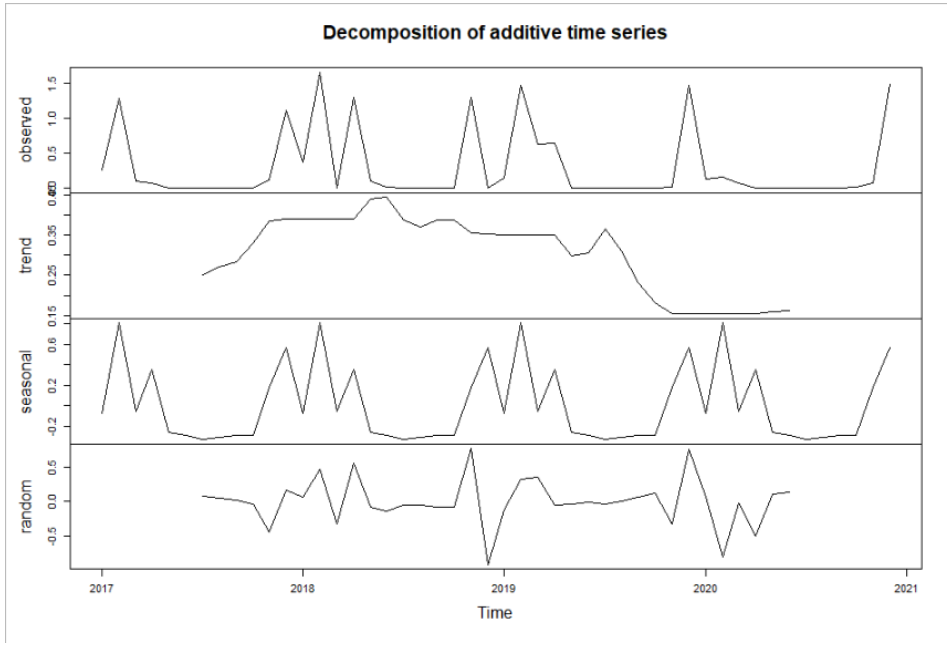
Use of the GEE platform to extract **snow cover maps** and **trends** to better understand wetland dynamics

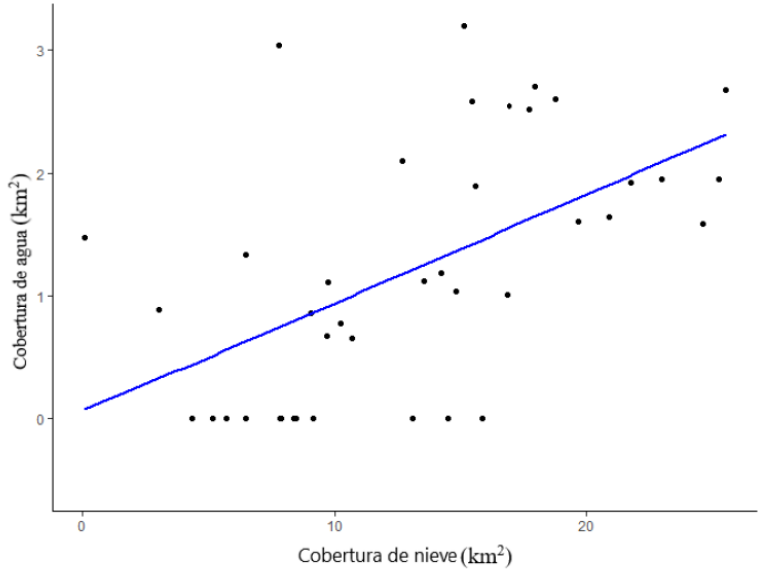


Snow cover monitoring with GEE & S2 imagery

La observación remota aplicada al seguimiento de los ecosistemas

Use of the GEE platform to extract **snow cover maps** and **trends** to better understand wetland dynamics





Methods

Sentinel-2 satellite images
Monthly data (2017-2020)
Spectral index:
Normalised Difference Snow Index (NDSI)

Results

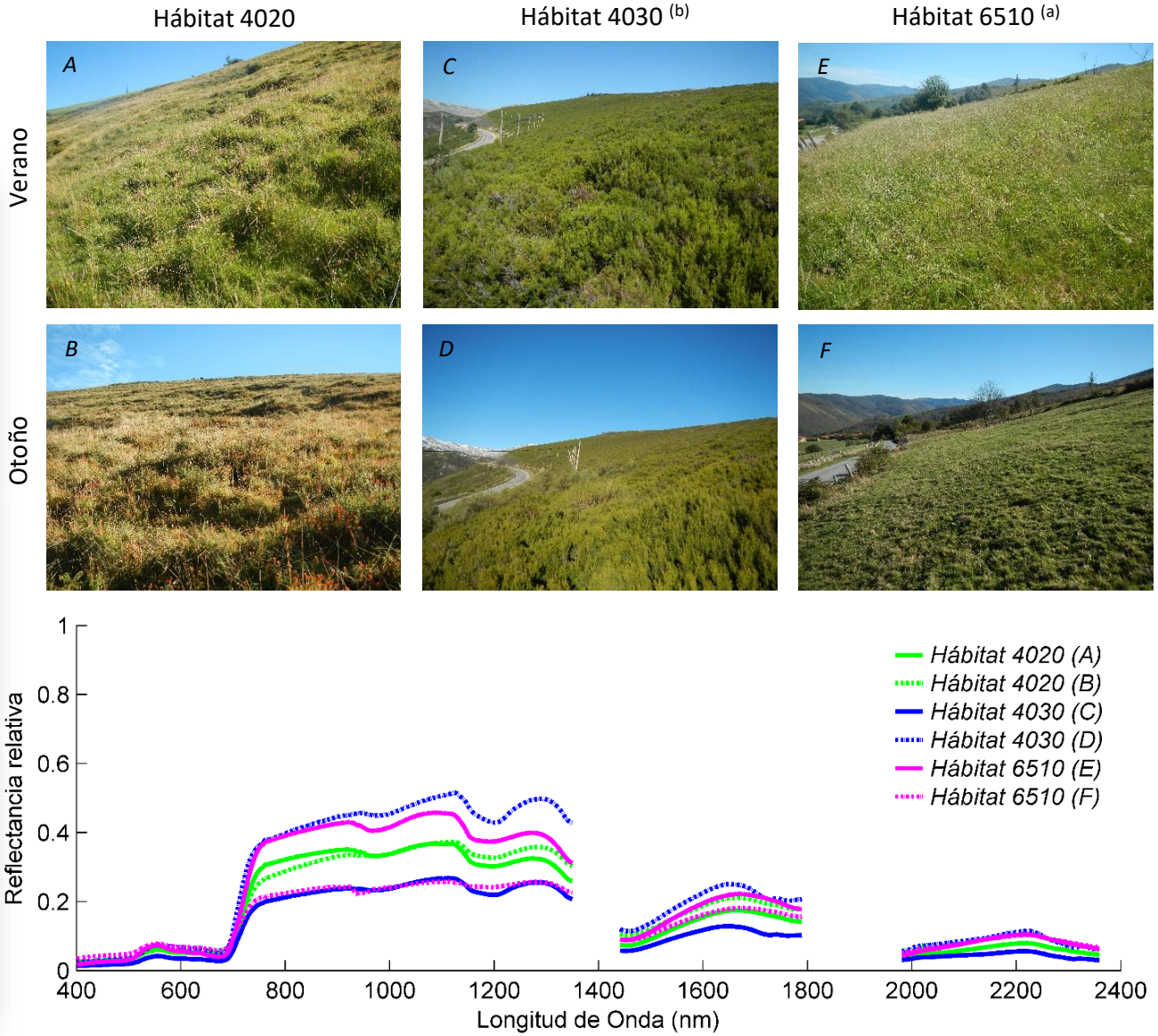
Snow cover shows its maximum total extent in February and a decreasing trend in the last 4 years (left)
Snow cover and total wetlands extent are coupled

Project

LIFE-DIVAQUA

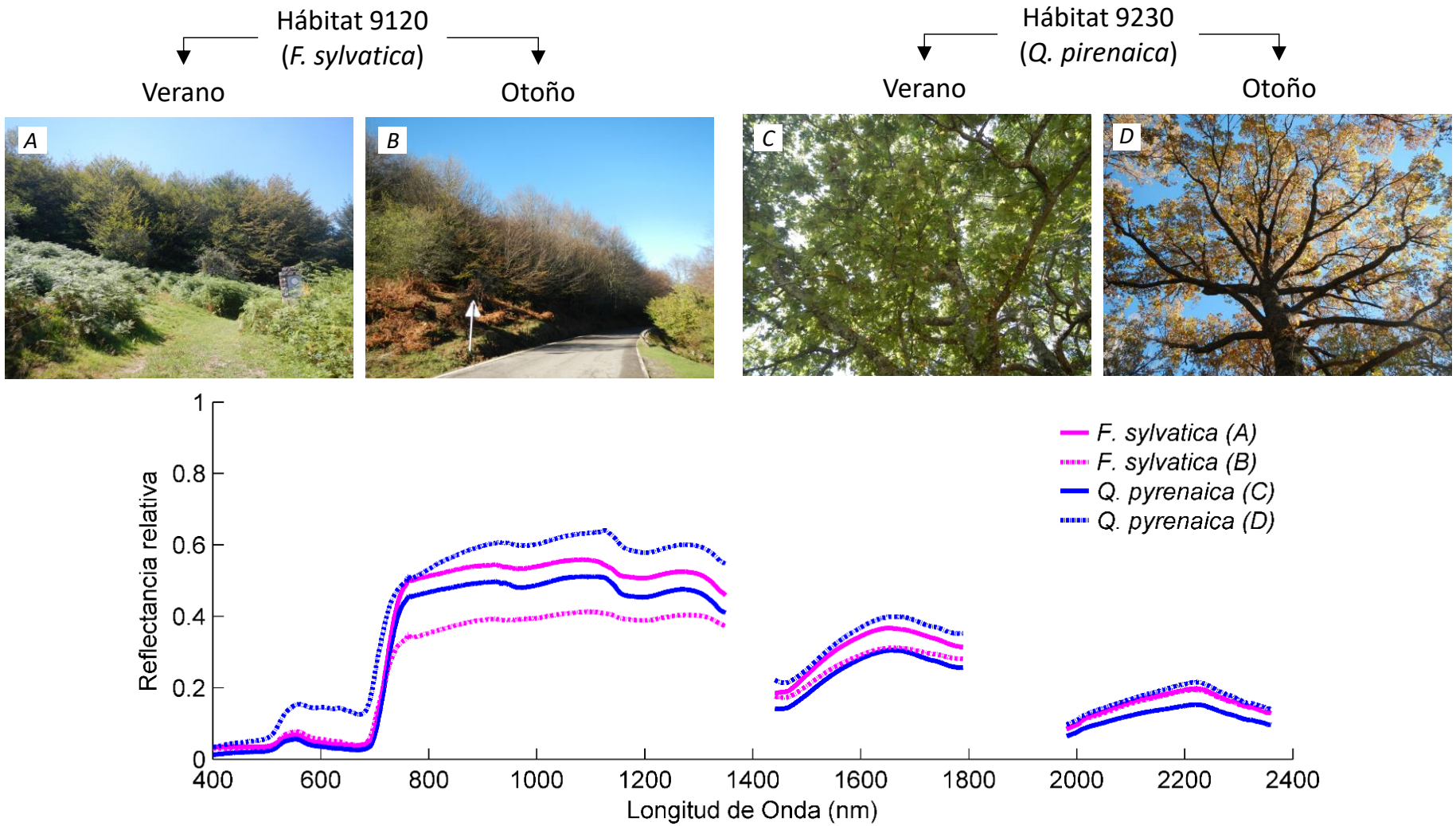
Hyperespectral signatures – the fingerprint

Spectral library:
PASTURES



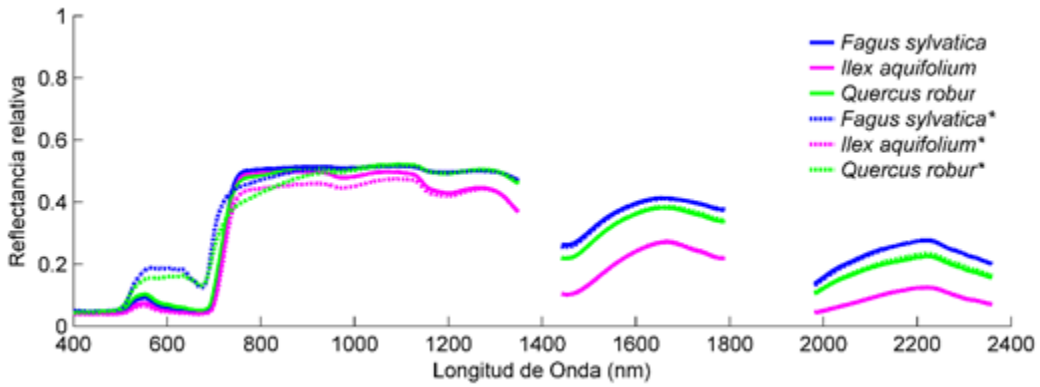
Hyperespectral signatures – the fingerprint

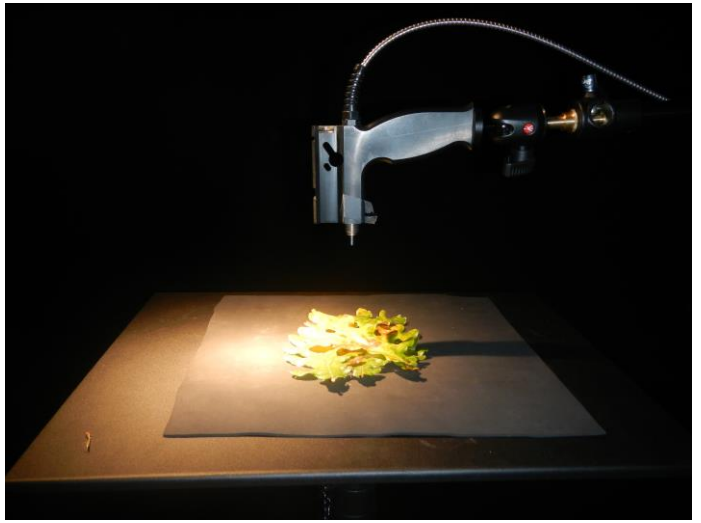
Spectral library: PHENOLOGY

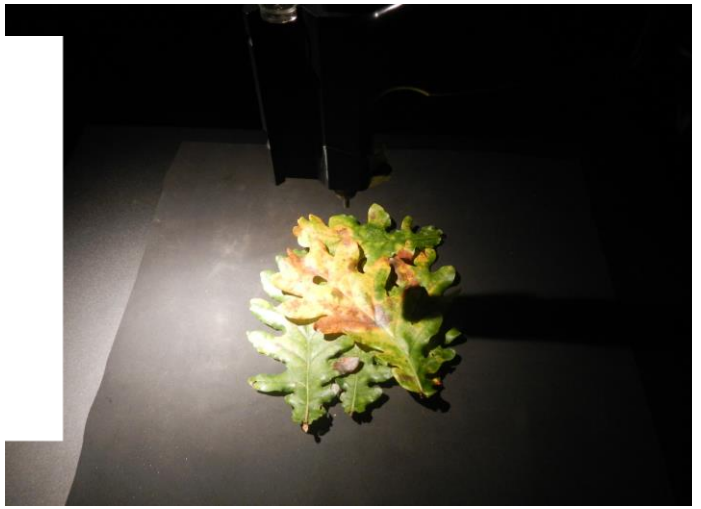


Hyperespectral signatures – the fingerprint

Spectral library: LAB ANALYSES

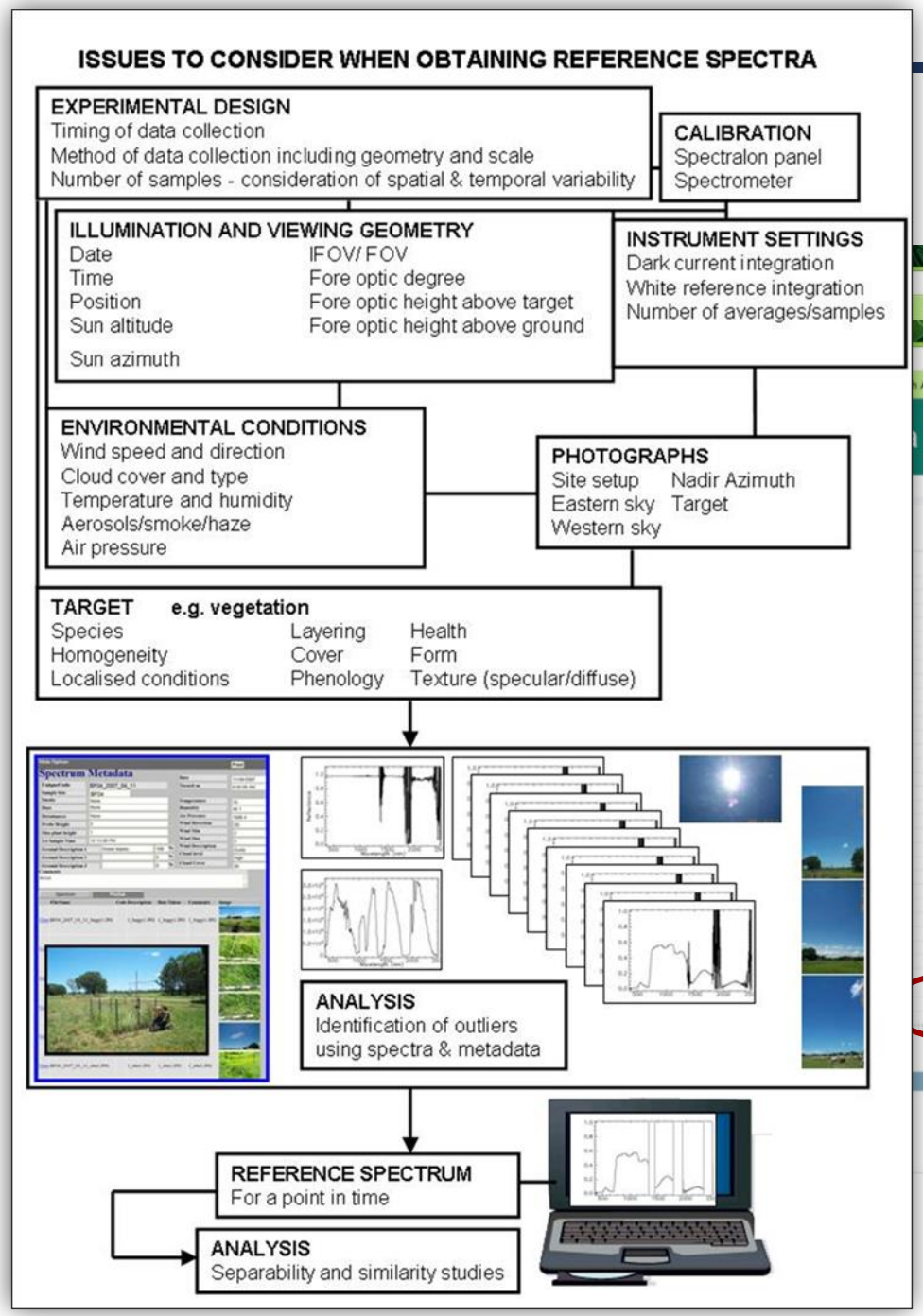


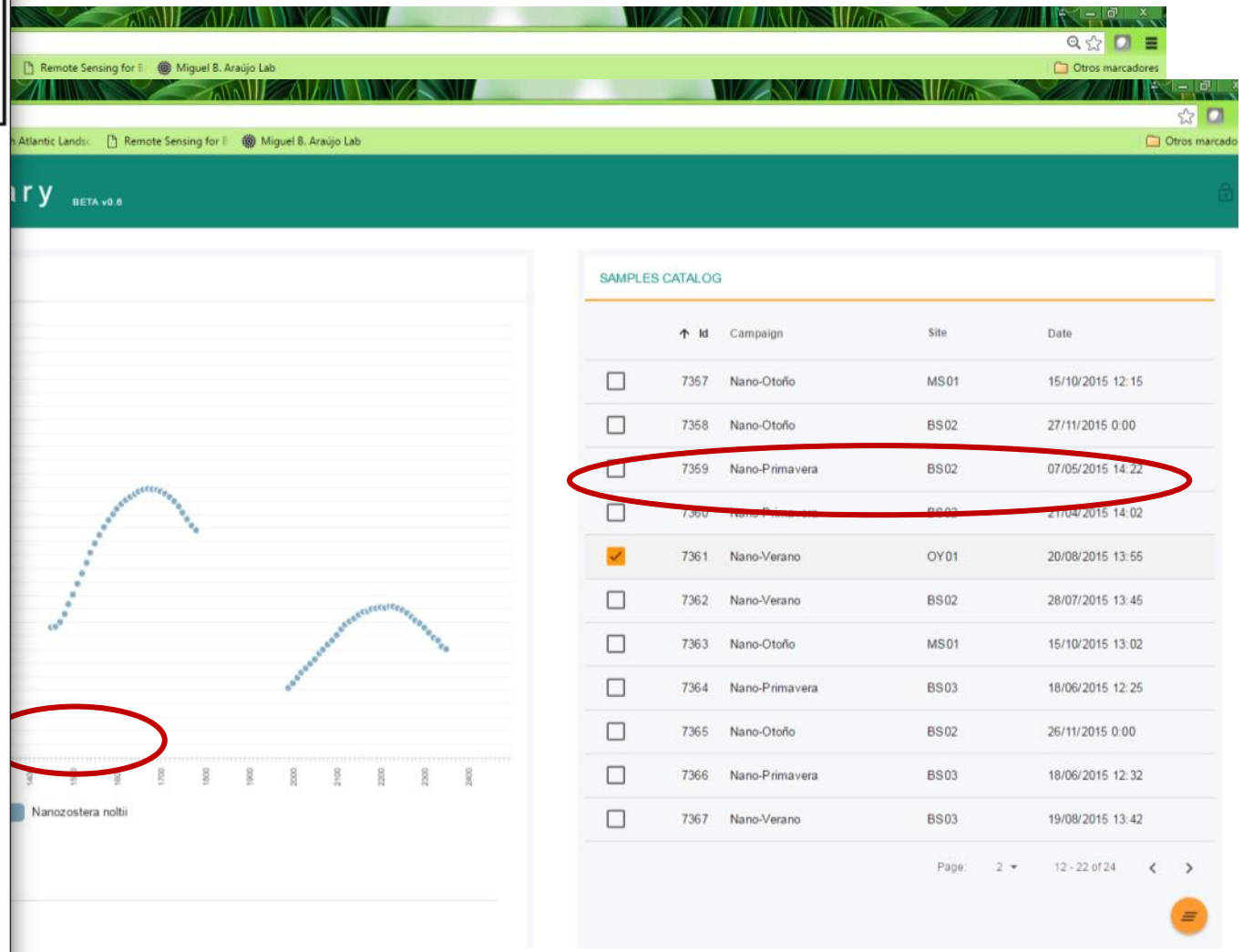




– the fingerprint

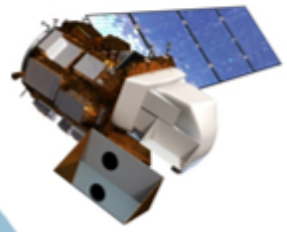
OBJECTIVE: To keep and organize spectral data of different habitats obtained by means of field radiometry or in the spectral radiometry laboratory





http://spectrallibrary.ihcantabria.com/

Hyperespectral signatures – the fingerprint




opernicus
CLIMATE CHANGE
MARINE MONITORING
ATMOSPHERE MONITORING
LAND MONITORING
SECURITY
EMERGENCY MANAGEMENT

Returning to Copernicus services -- the user uptake

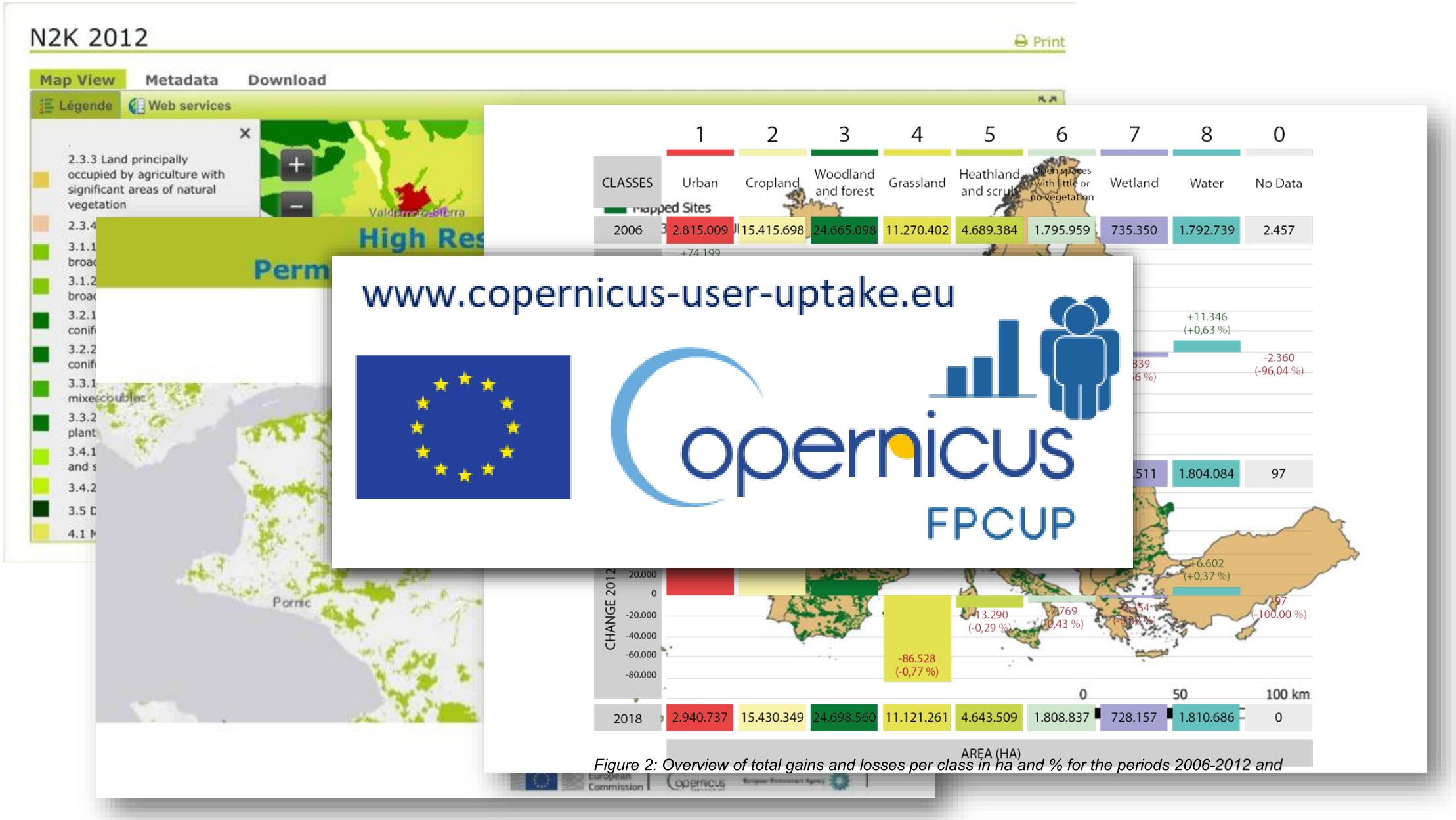
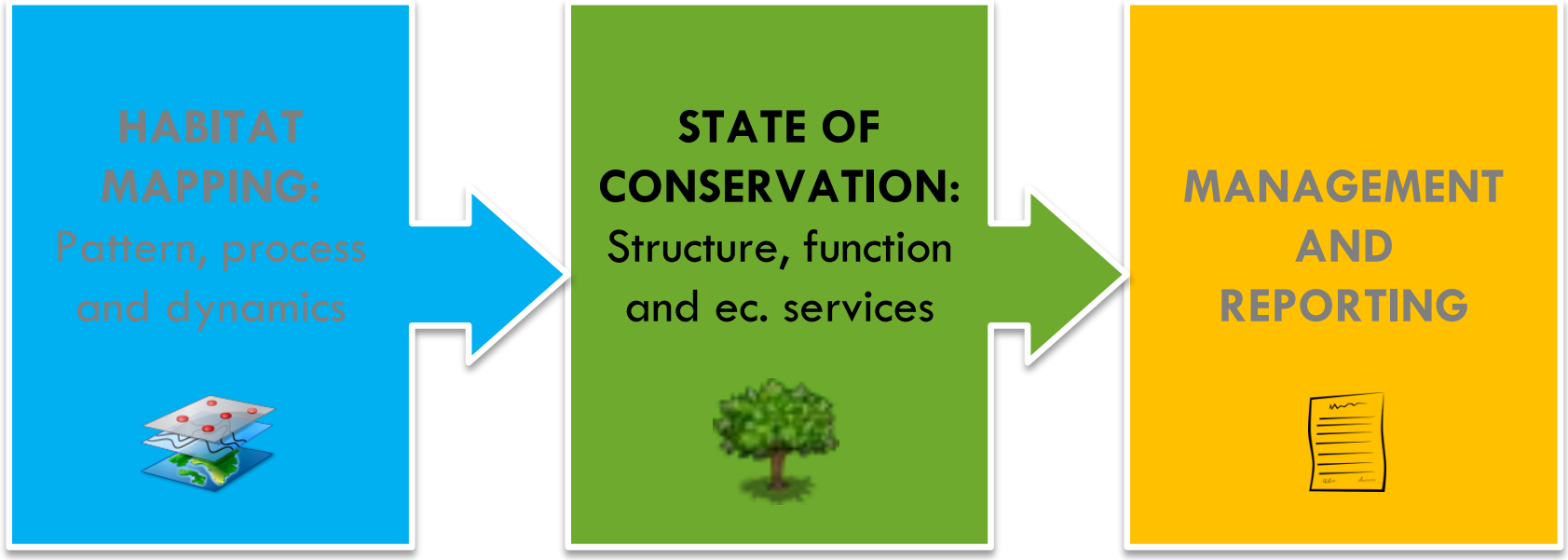


Figure 2: Overview of total gains and losses per class in ha and % for the periods 2006-2012 and


HABITAT MAPPING:
Pattern, process and dynamics
STATE OF CONSERVATION:
Structure, function and ec. services
MANAGEMENT AND REPORTING

Ecosystem monitoring

La observación remota aplicada al seguimiento de los ecosistemas

GOBIERNO DE ESPAÑA
VICEPRESIDENCIA CUARTA DEL GOBIERNO
MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA Y EL RETO DEMOGRÁFICO

Ministerio | Áreas de actividad | Particip | ne • Bienvenues | e electrónica | Sala de prensa

Inicio > Biodiversidad > Ecosistemas y conectividad

Temas

- Conservación de la Biodiversidad
- Espacios protegidos
- Ecosistemas y conectividad
- Conservación de especies
- Inventarios nacionales
- Recursos genéticos
- Días mundiales y fechas destacadas
- Servicios
- Ayudas y subvenciones
- Campañas
- Estadísticas
- Formación, congresos y jornadas
- Legislación

Seguimien

La biodiversida
Diversidad Biol
entendidos esto
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El Plan Estratég
Transición Ecol
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diferenciadas p
seminaturales',
determinada es

El Ministerio ha
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de los tipos de l
y diagnosticar s

Un resumen ge
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les como
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eguimiento
periódica,
de los tipos

Novedades

Listas patrón

El MAPAMA establece las Listas Patrón de las especies terrestres y marinas y de los hábitats terrestres...

+info

Preguntas frecuentes...

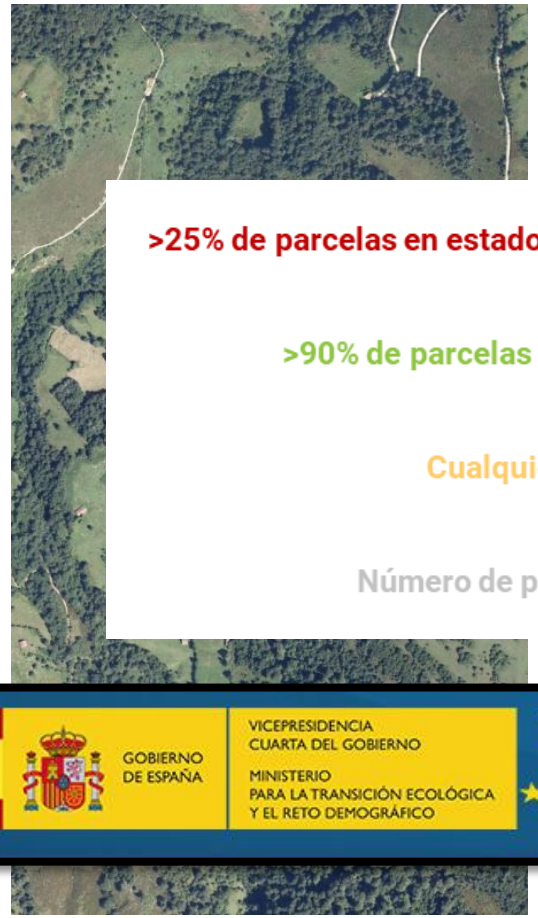
Acceso a los recursos genéticos y reparto de beneficios

+info

Noticias sobre Biodiversidad

Ecosystem monitoring -- official guidelines

FORESTS



Variable	Ponderación de la variable	Valores umbrales región alpina	Puntuación
$R_{i\ arbórea}$	1	≥3	2
		2	1
		≤1	0

>25% de parcelas en estado desfavorable-malo → Estado desfavorable-malo

>90% de parcelas en estado favorable → Estado favorable

Cualquier otra combinación → Estado Desfavorable-inadecuado

Número de parcelas inferior a 40 → No puede ser evaluado

$N\text{-}CA_i$	3	≥4	2
		[>2-<4]	1
		≤2	0

$$ECL = R_{i\ arbórea} + (3 * AB_i) + (5 * VCC_{i\ muerta}) + (3 * N\text{-}CD_i) + (3 * N\text{-}CA_i)$$

Rango ECL = 0 – 30

Umbrales: 0 | 10 | 20 | 30

Desfavorable-malo | Desfavorable-inadecuado | Favorable

GOBIERNO DE ESPAÑA
VICEPRESIDENCIA CUARTA DEL GOBIERNO
MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA Y EL RETO DEMOGRÁFICO

Ecosystem monitoring – RS-based methodology

MITERD proposed a series of indicators to monitor the ecological status of habitats and meet the requirements of the Habitats Directive. It has been studied which of these indicators can be calculated through remote sensing

Method

By calculating these indicators through RS, the aim is to obtain a value of the ecological status for each habitat type, following the integrated evaluation system proposed by MITERD. In this way, after obtaining a value of this ecological status with the data obtained through RS, they will be compared with the values obtained in the estimation made by MITERD, thus validating the results.

Result

Variables	Weighting of this variable	Threshold values	Score
Shrub species richness	1	≥5 [> 1 - < 5] ≤ 1	2 1 0
Tree density	3	≥300 [> 70 - < 300] ≤ 70	2 1 0
Regeneration density	3	≥5 [> 1 - < 5] ≤ 1	2 1 0
Diameter at breast height	2	≥20 [> 14 - < 20] ≤ 14	2 1 0

This is all part of the LICs project

Project

Table 1. Example of weighting, threshold values and score assigned to each variable proposed for the evaluation of the ecological status of a forest habitat type according to the methodology proposed by MITERD.

Ecosystem monitoring – RS-based methodology

Method

In order to generate a more complex view of the ecological status, **other sources of information** on the ecological status of habitats were also taken into account, such as the EBVs (including the proposal by Skidmore *et al*. (2021) to measure the EBVs through remote sensing), indicators used in other European countries to respond to the Habitats Directive, indicators proposed in the "Assessment and reporting under Article 17 of the Habitats Directive. Explanatory Notes & Guidelines for the period 2007-2012" by the European Topic Centre on Biological Diversity and several bibliographic searches.

Result

All these variables were **filtered and pooled**, leaving the variables that can function as indicators for ecological status measurable with remote sensing. In this way, a list of indicators can be provided to calculate the ecological status of forests, wetlands, peatlands, etc.

Sources of information used to assess the conservation status/ecological status		
EBVs	Skidmore *et al.* (2021) proposal to measure EBVs with RS	Indicators used in other European countries to respond to the Habitats Directive
EU indicators	Bibliographic searches	Indicators proposed by the European Topic Centre (Evans & Arvela, 2011)

Project

This is all part of the **LICs** project.

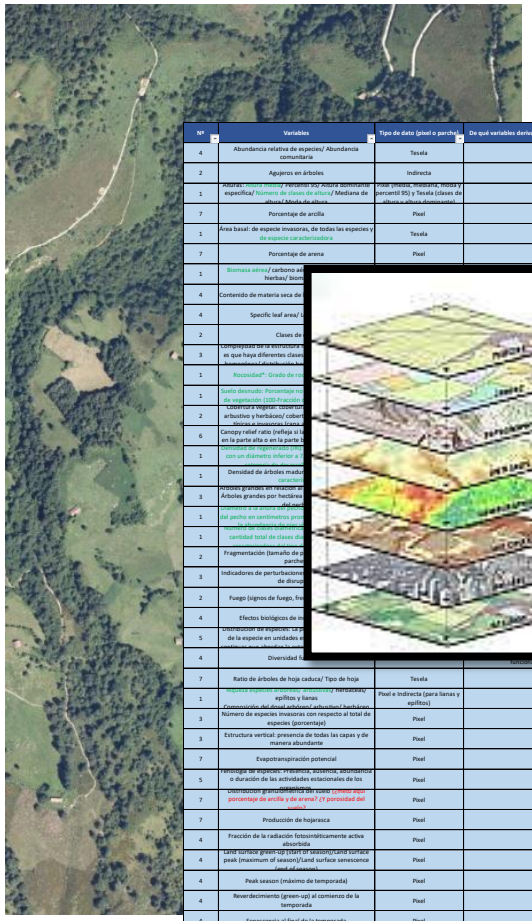
Table 2. Sources of information used to generate a list of ecological status indicators for the different habitat types

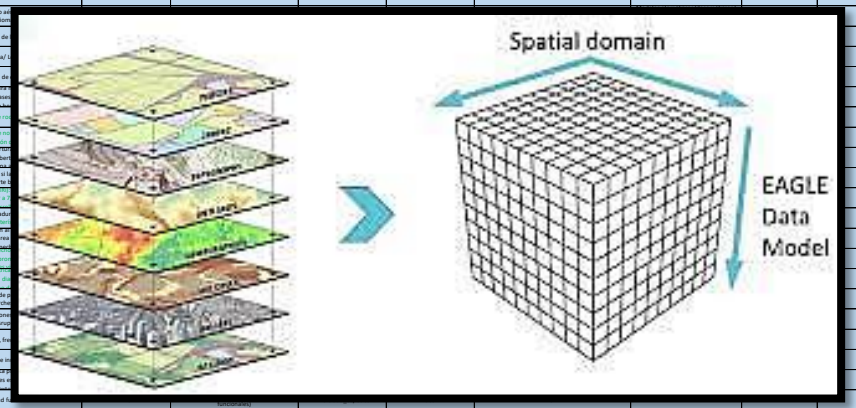
Ecosystem monitoring – RS-based methodology

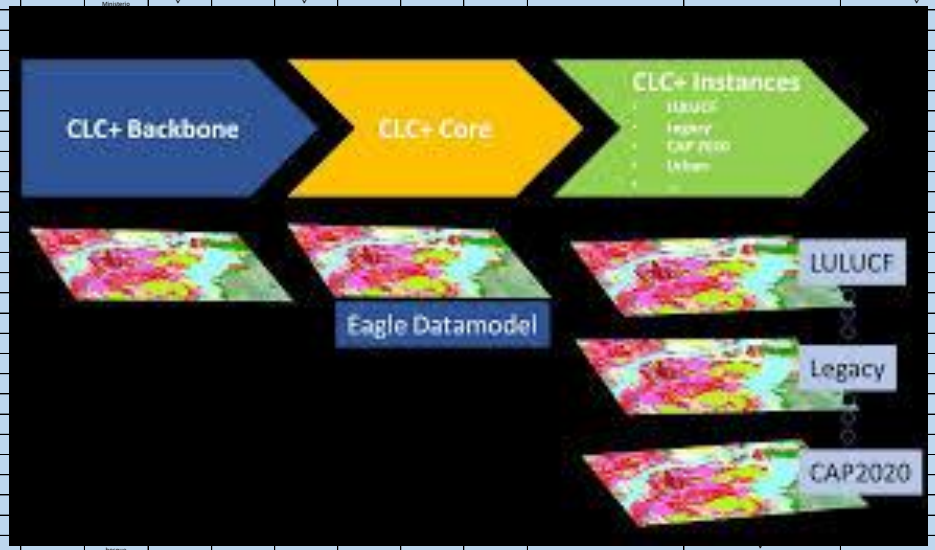
La observación remota aplicada al seguimiento de los ecosistemas

FORESTS (finished)

INDICATOR	VALUE	REMOTE SENSORS	CONSIDERATIONS
Surface	A: ↑ o =; B: ↓1- 5%; C: ↓↓>5%	Y	Acceptable reduction according to degree of sufficiency
Size (Fragmentation)	A: >300 ha; M: 50-300 ha; B: <50%	Y	For the calculation, in the case other type of native forest contact the patch, it would be considered a continuous plot.
Distance to nearest patch (Fragmentation)	A: < 200 m; M: 200-500 m; B: >500m	Y	
Shape: Area/perimeter (Edge effect)		Y	For the calculation, in the case other type of native forest contact the patch, it would be considered a continuous plot.
Area discounting an	FV: relationship between	Y	







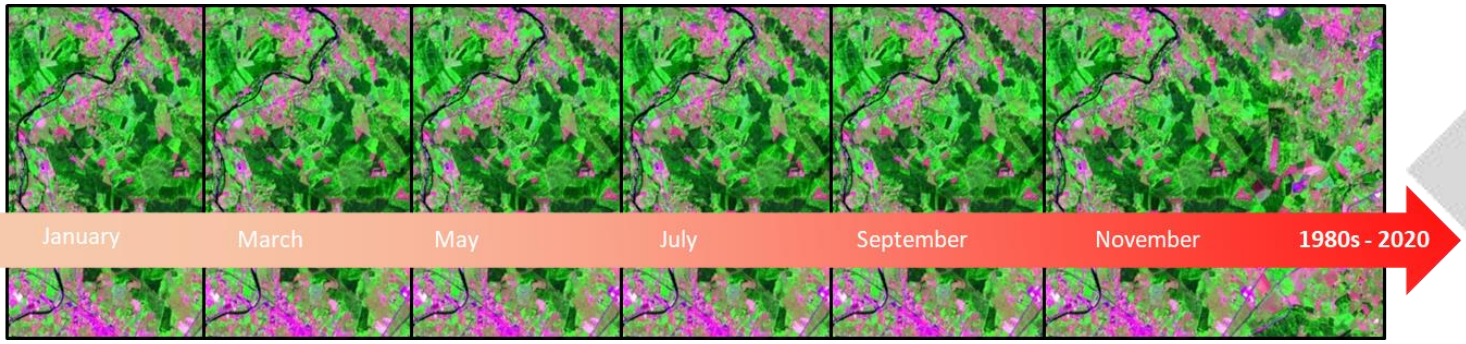
Ecosystem monitoring – RS-based methodology

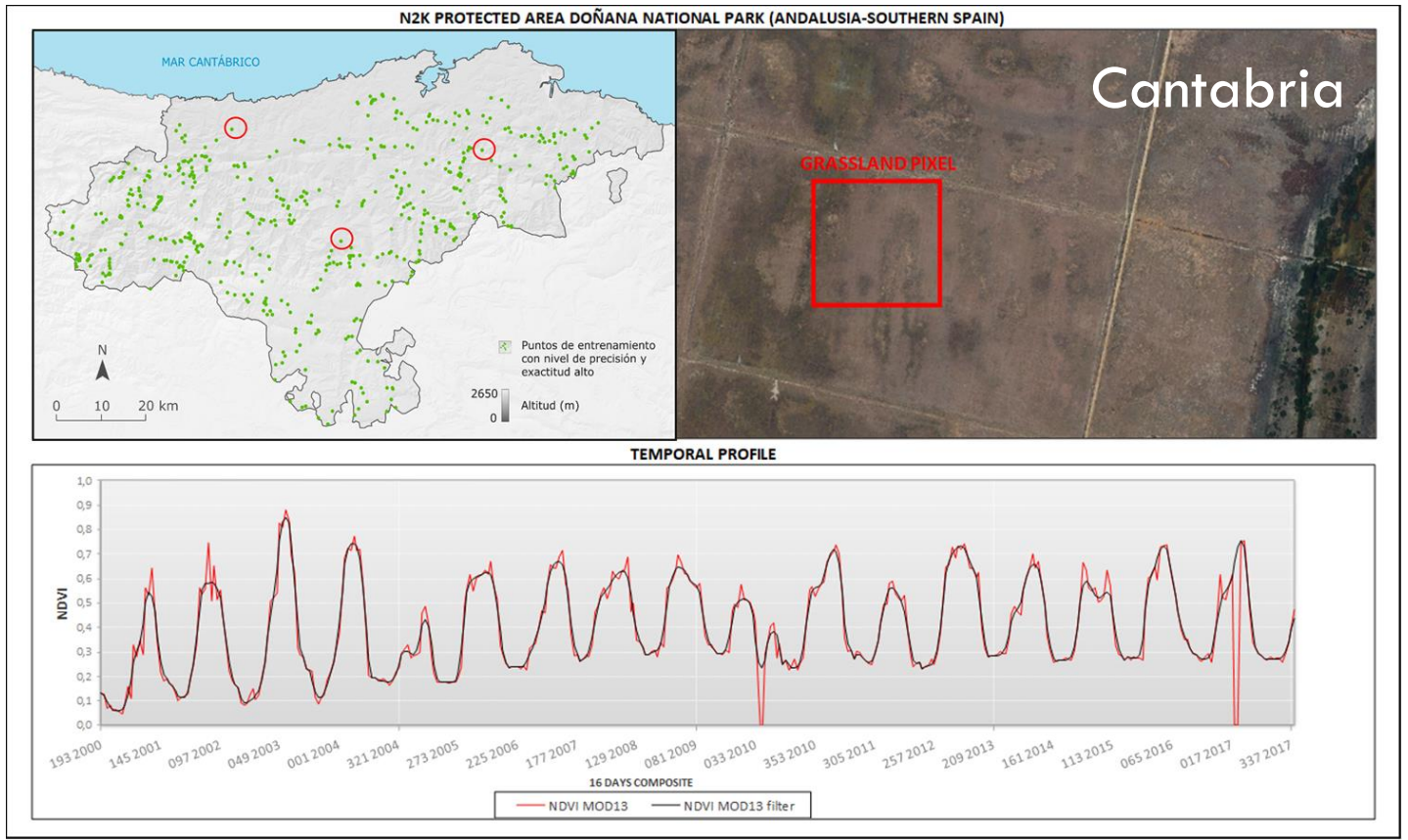
PASTURES/OTHERS (ongoing)

HABITAT	INDICATOR	VALUE	REMOTE SENSORS
6110, 6140, 6160, 6170, 6210, 6220, 6420, 6510,6520	Changes in surface by land use changes	FV: ↑ o =; U1: ↓1-5%; U2: ↓↓>5%	Y
	Relative cover of grasses	FV: >80%; U1: 60-80%; U2: < 60%	Y (LIDAR)
	Relative cover of shrubs	FV:< 15%; U1:15-30%; U2: >30%	Y (LIDAR)
	Increase of shrubs cover	FV:< 1; U1:1-5%; U2: >5%	
	Degradation of the soil (by erosion, compaction or other causes)	FV:<1%; U1:1-5%; U2: >5%	Y
	Height ofr grass		Y (LIDAR)
	flower richness		Y ?
	Primary productivity (EVI)	FV: >80% of reference U1: 60-80% of reference U2: < 60% of reference	
	Nitrophilous species (Peganum harmala, others)	FV:< 15%; U1:15-25%; U2: >25%	N
	Relative cover of chamaephytes/thorny	FV:< 15%; U1:15-25%; U2: >25%	N
6420	Wetland soil at a fixed depth		Y?

Ecosystem monitoring -- developing RS-based indicators

La observación remota aplicada al seguimiento de los ecosistemas





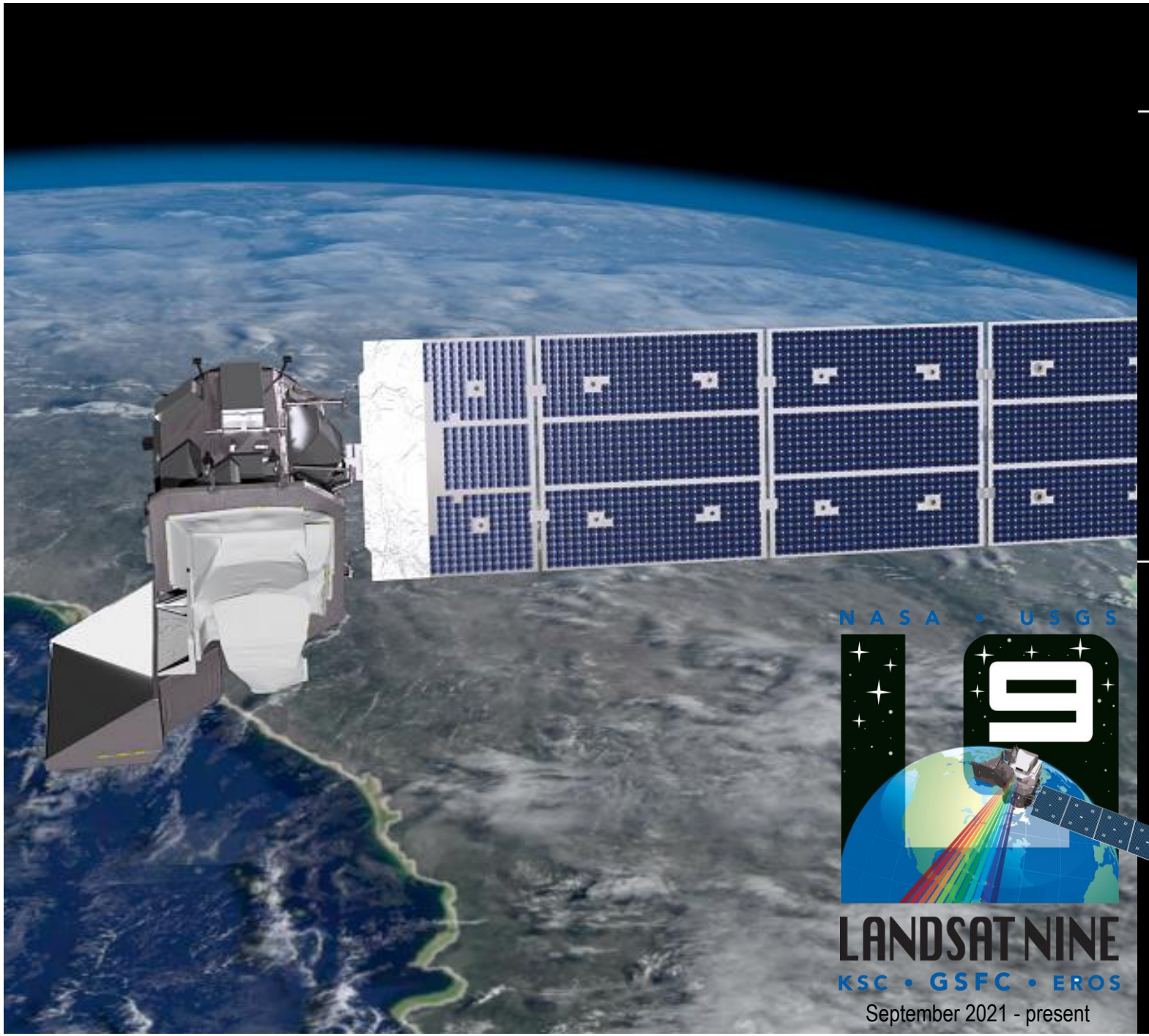
Spectrophenological curves S2 and Landsat

itd medioambiente > NEPTUNO

Processing in real time of data series of imagery

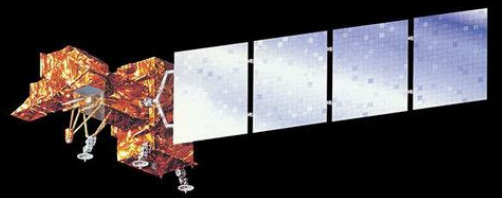
Landsat 5 8 9, MODIS and Sentinel 2

Data for 1980s - present period (**operational**)



Landsat 8

2013 - present



Landsat 7

1999 – present

Landsat 4 – 5

Landsat 4: 1982 – 1993
Landsat 5: 1984 – 2013

Landsat 1 – 3

Landsat 1: 1972 – 1978
Landsat 2: 1975 – 1982
Landsat 3: 1978 – 1983

NASA • USGS

LANDSAT NINE

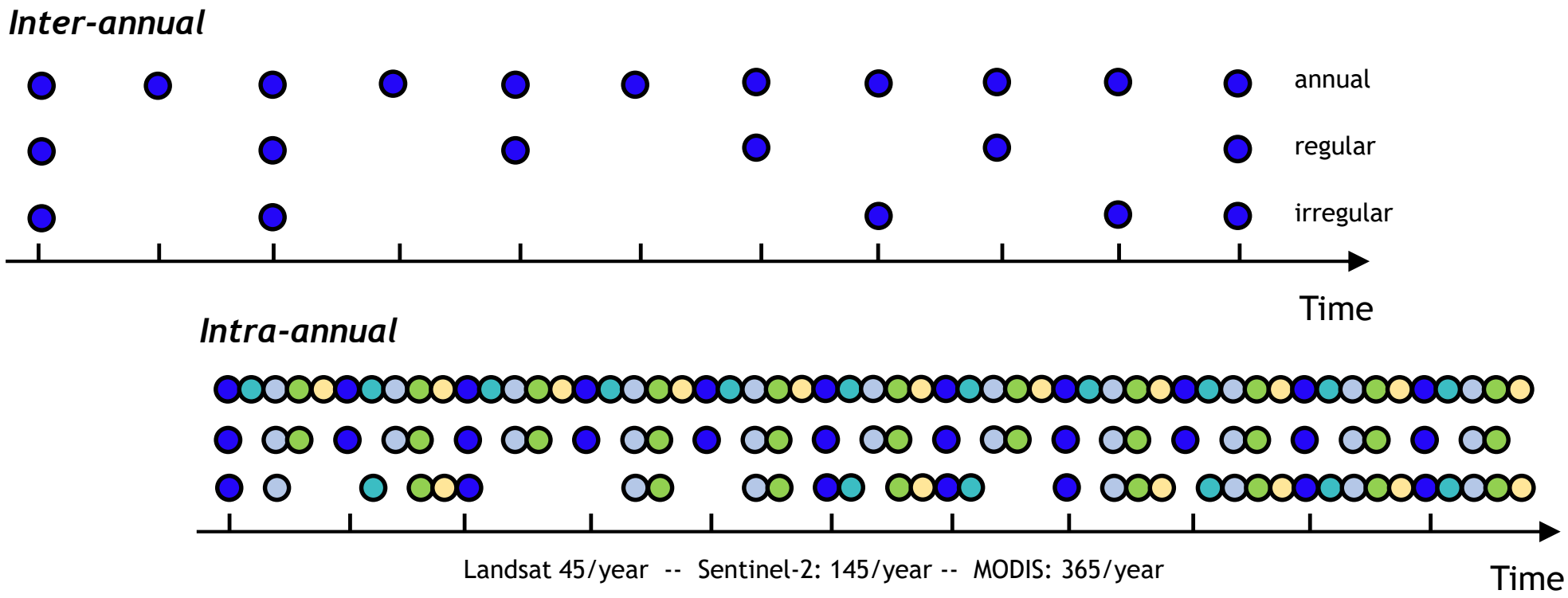
KSC • GSFC • EROS

September 2021 - present


European Commission
esa
European Space Agency
sentinel-2
→ COLOUR VISION
FOR COPERNICUS
opernicus


Los
Alcázares
opernicus
Europe's Eyes on Earth

Ecosystem monitoring -- Spectrophenology



Data availability and usability

- Clouds
- Instrument failure
- Haze, smoke, atmospheric effects

→ Missing pixels

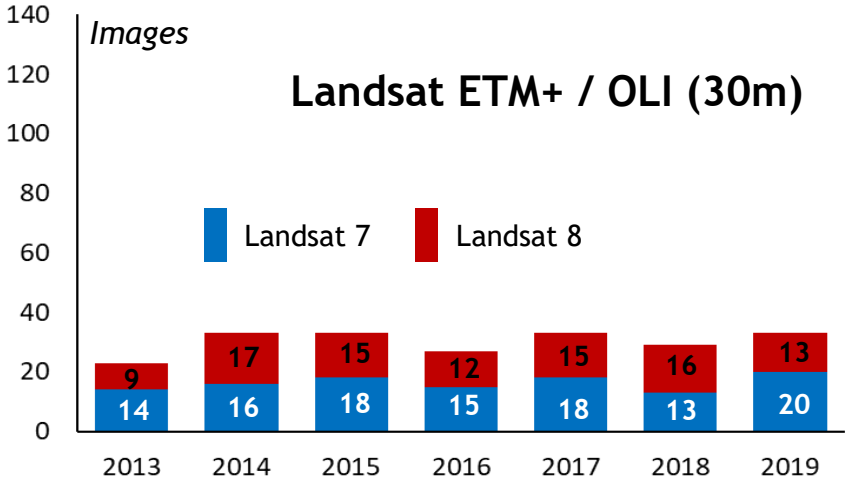
- **Storage** and **transmission** capacity
- Acquisition Plan priorities

→ **Missing scenes**

- Data policies (e.g. USGS Landsat archive)

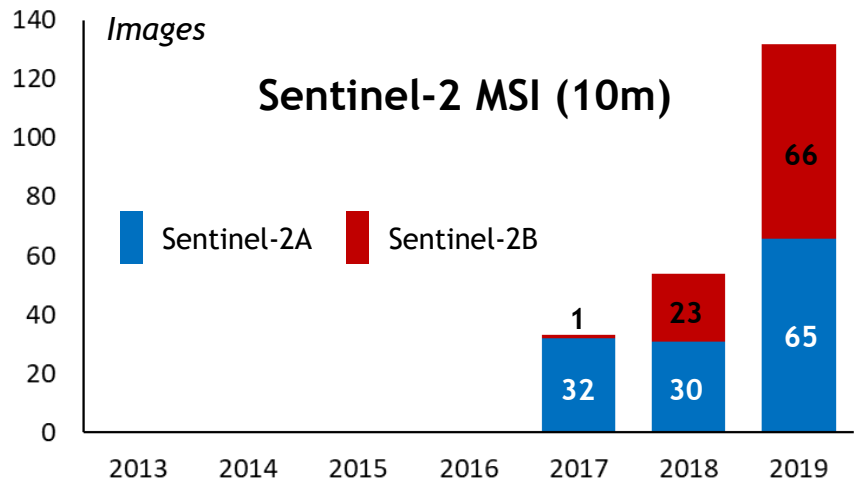
Ecosystem monitoring -- Spectrophenology

La observación remota aplicada al seguimiento de los ecosistemas



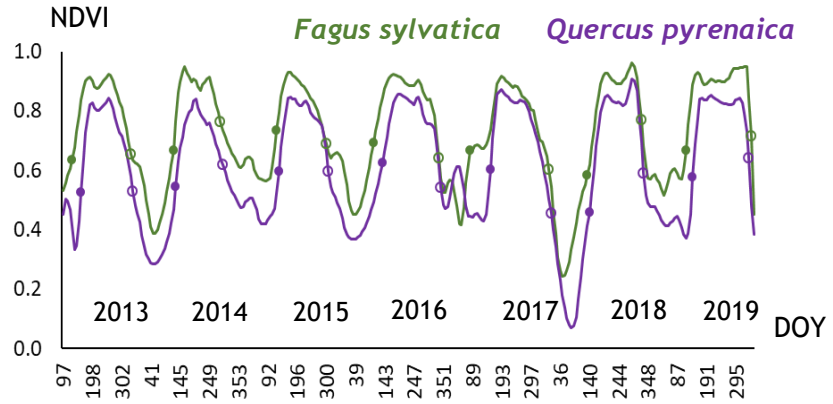
211 images
30 / season

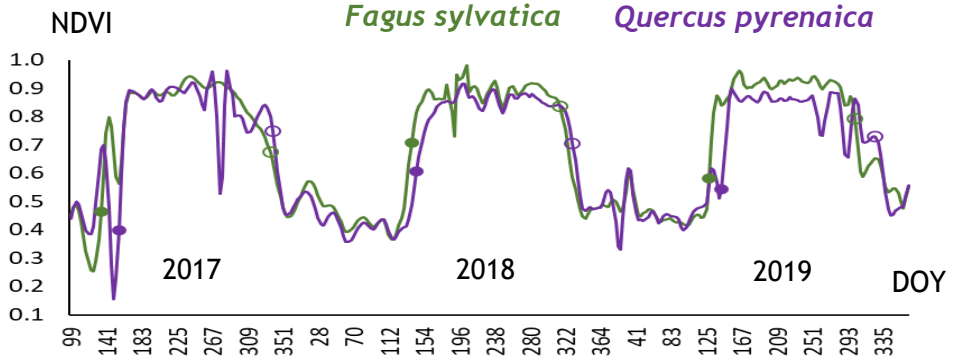
April 2013 - December 2019
Collection 1 level 2



217 images
70 / season

April 2017 - December 2019
MSIL2A





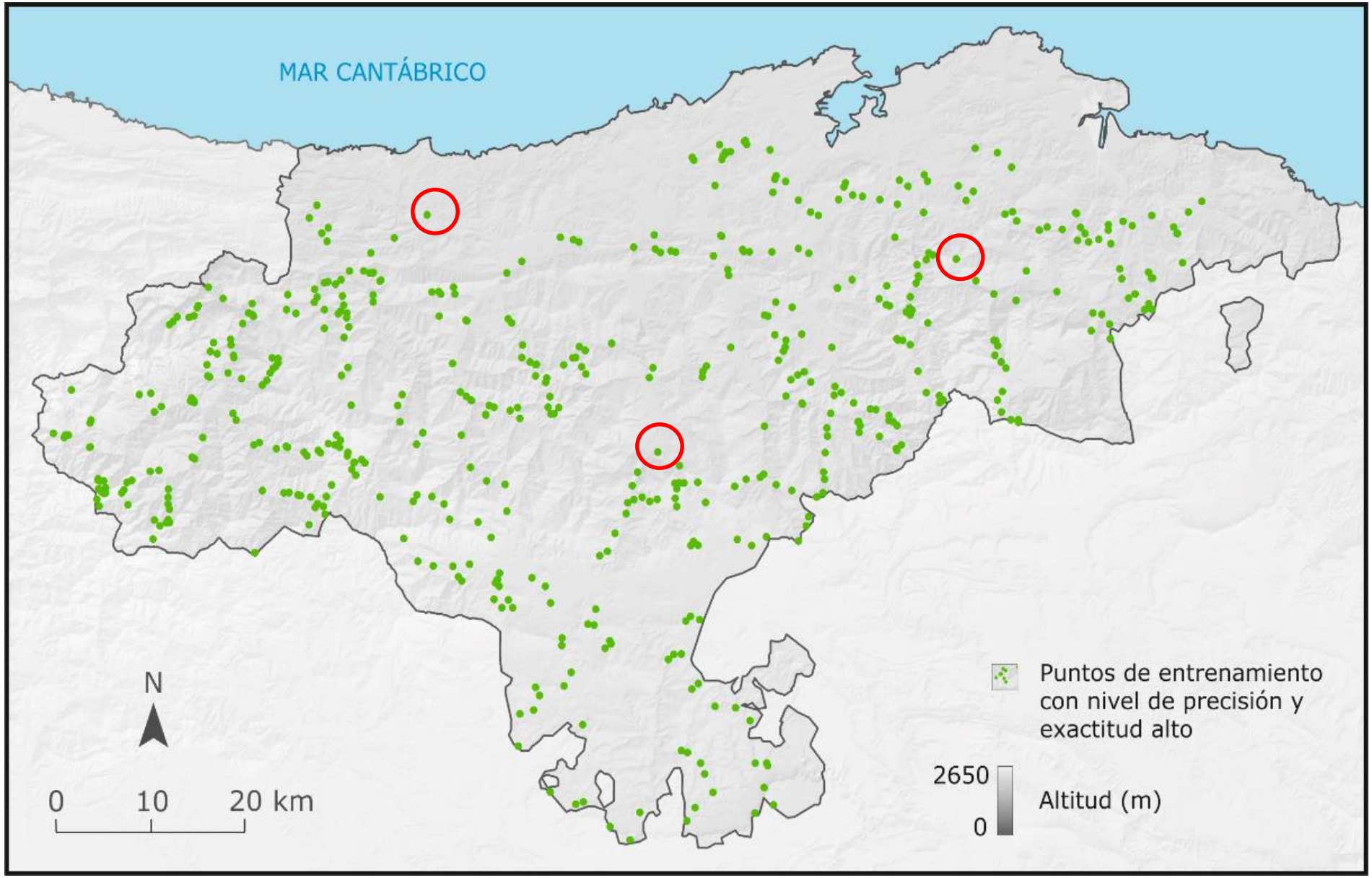
Start of Season End of Season

SOS: *Fagus sylvatica* earlier than *Quercus pyrenaica*
Length: *Fagus sylvatica* longer than *Quercus pyrenaica*

Cristina Gómez- AEET 2021

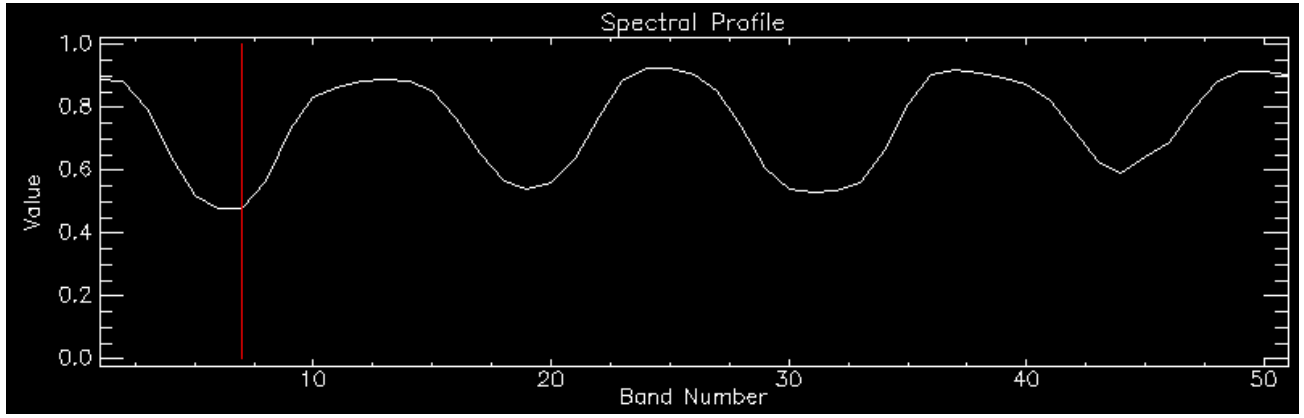
Ecosystem monitoring – Spectrophenology S2. GPS EUNIS

La observación remota aplicada al seguimiento de los ecosistemas

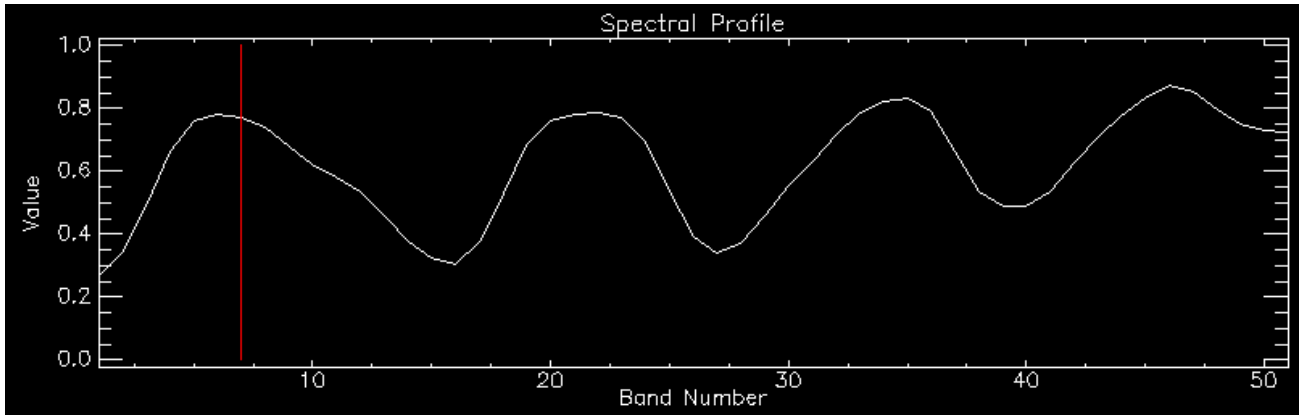


Ecosystem monitoring – Spectrophenology S2. GPS EUNIS

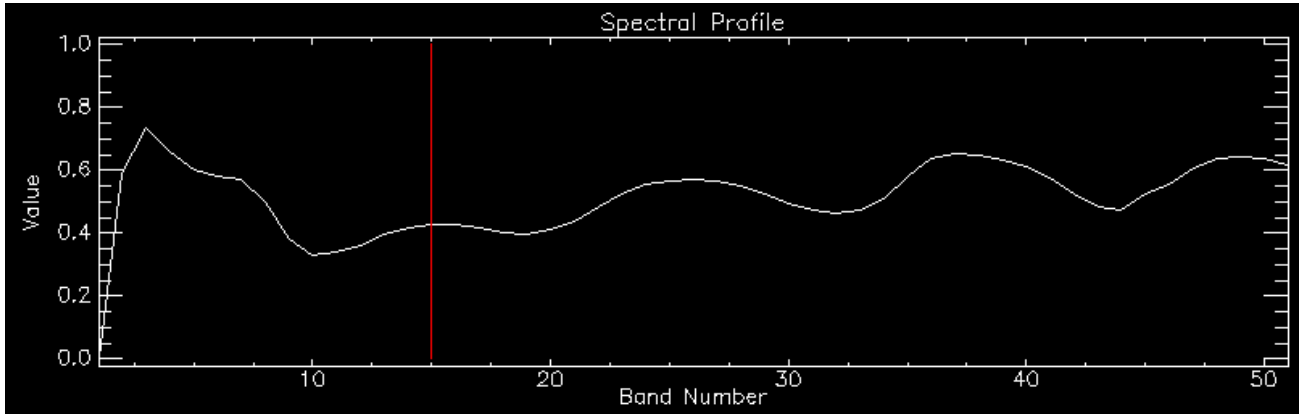
La observación remota aplicada al seguimiento de los ecosistemas



- Beech forest,
- Stable,
- Climatic variation



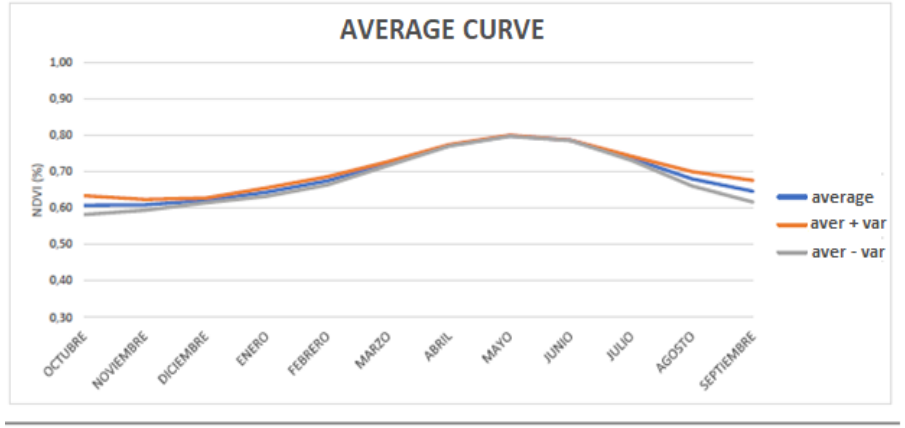
- Secondary succession
- Grassland decrease
- Higher minimums

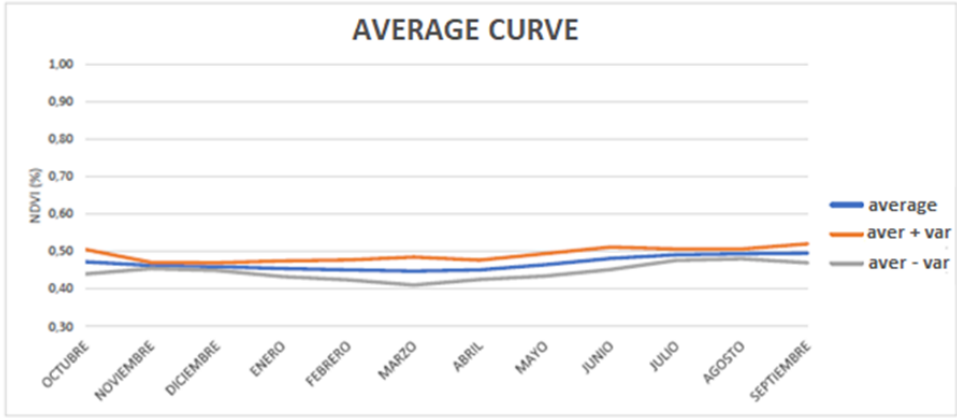


- Vegetation recovery after fire

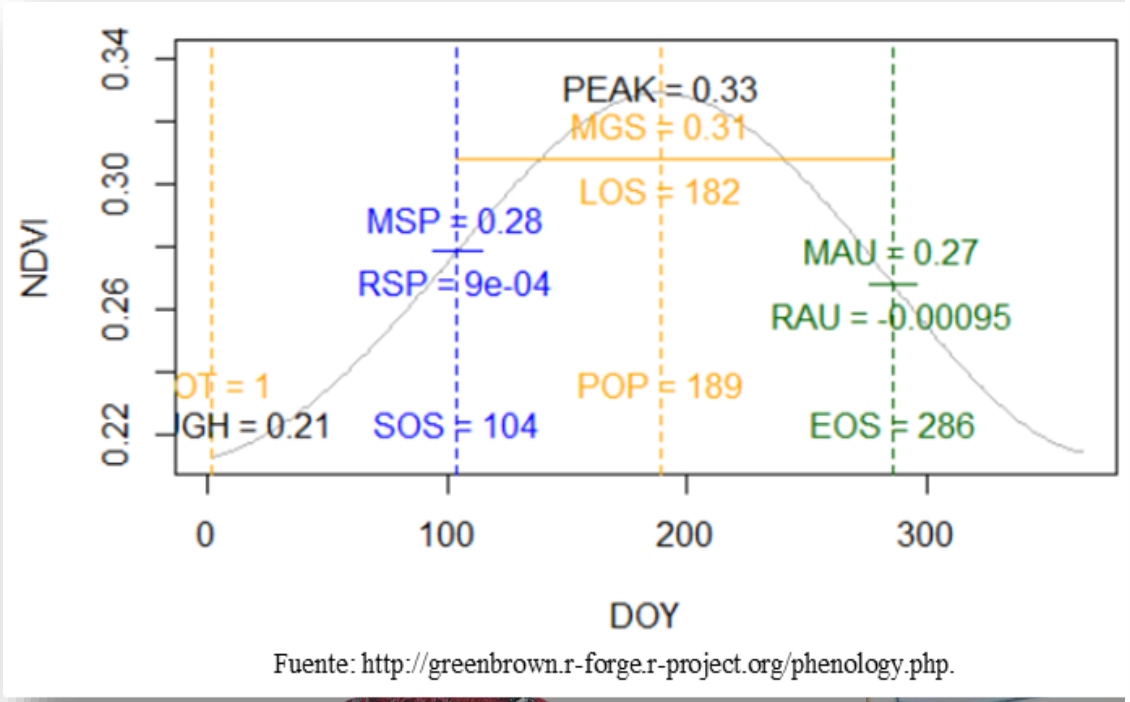
Ecosystem monitoring – Spectrophenology S2. Grasslands

La observación remota aplicada al seguimiento de los ecosistemas

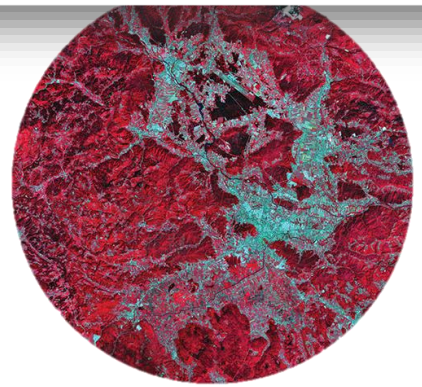


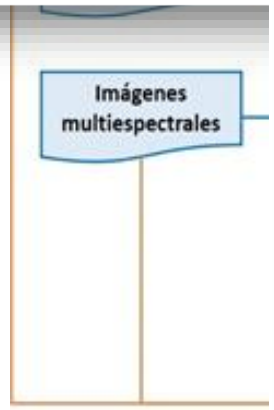


Ecosystem monitoring -- Spectroph

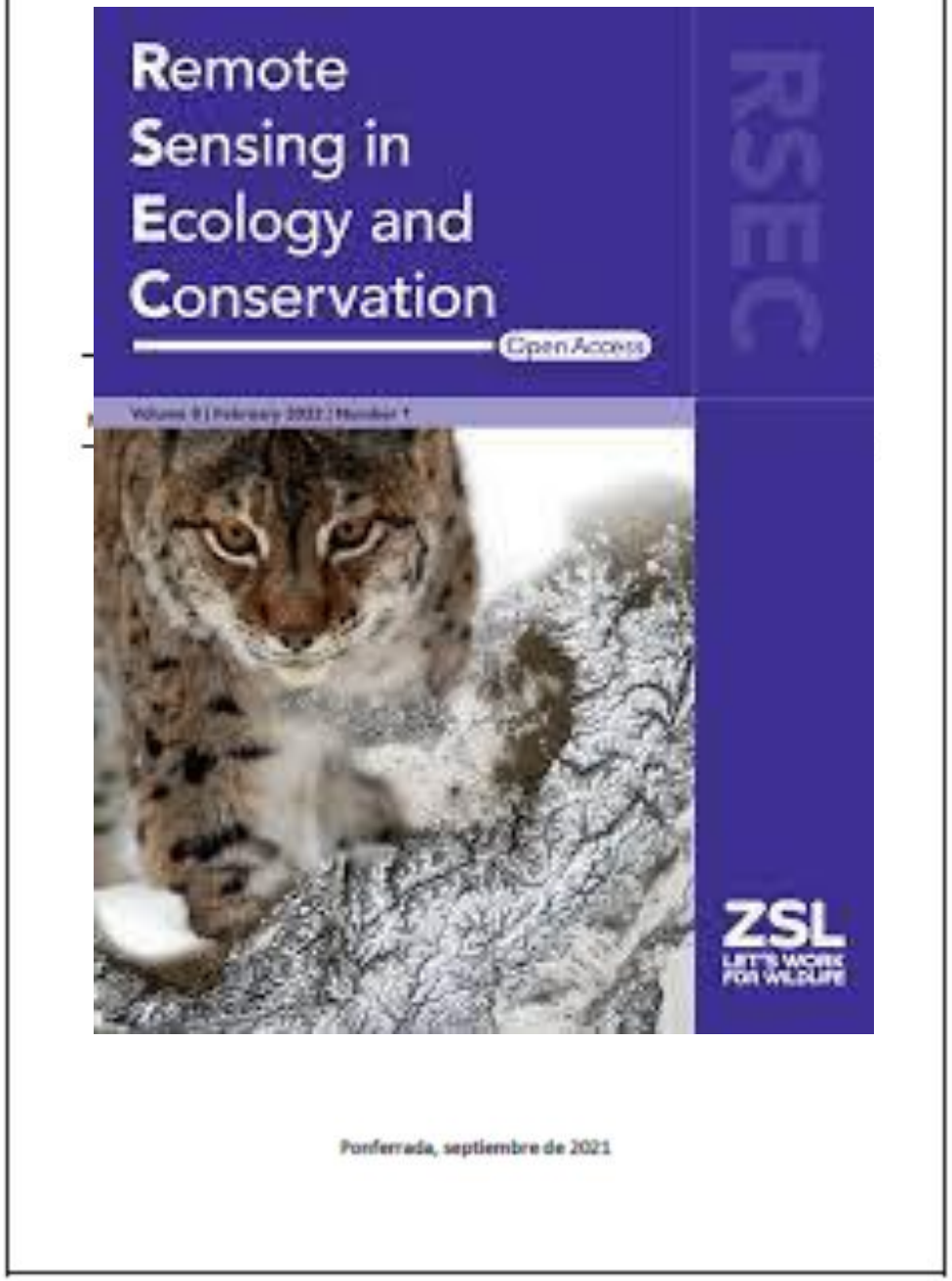


Fuente: http://greenbrown.r-forge.r-project.org/phenology.php.





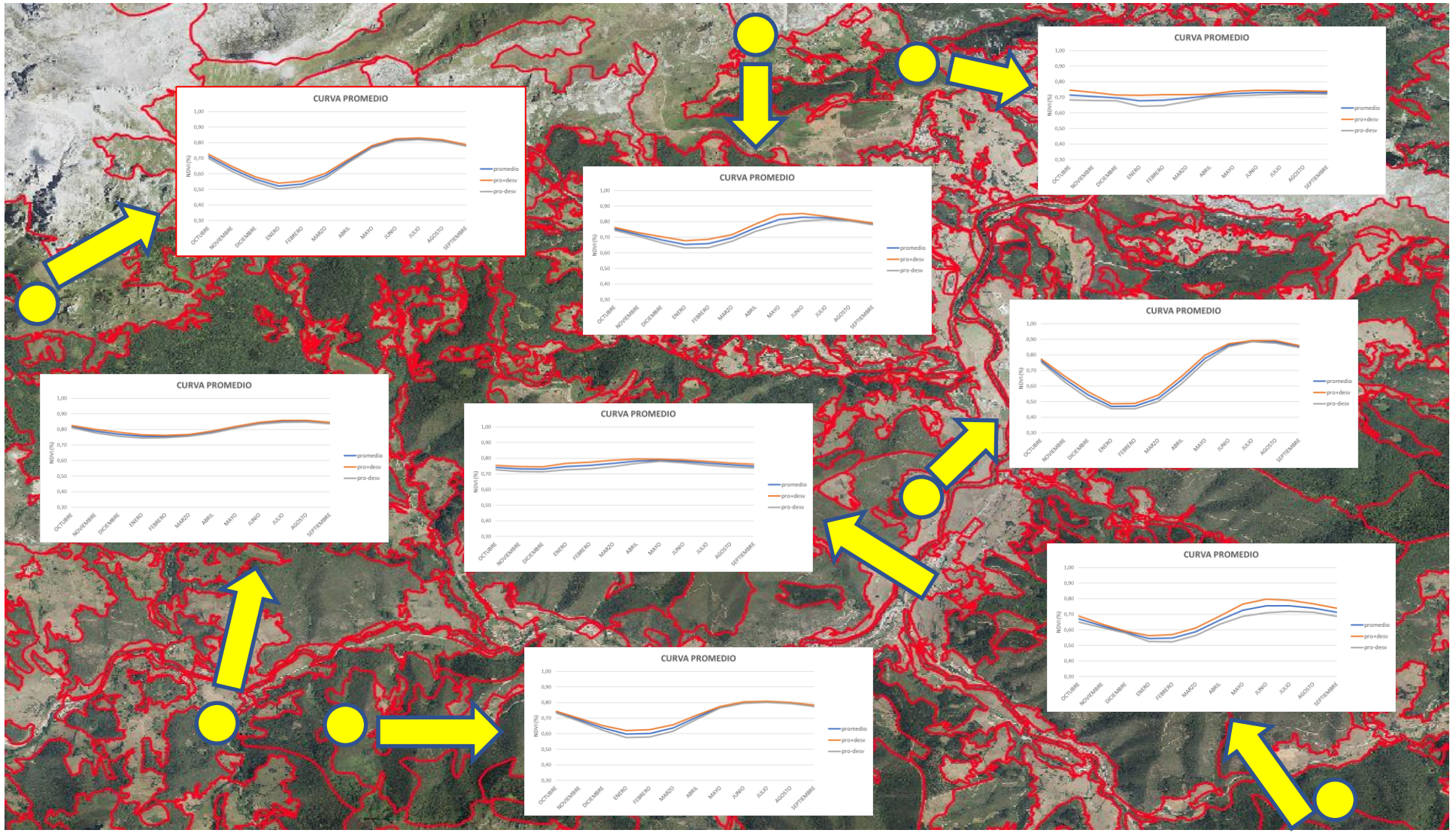
Spectrophenological metrics



Series temporales NDVI

Ecosystem monitoring – Spectrophenology S2. Forests

La observación remota aplicada al seguimiento de los ecosistemas



Ecosystem monitoring – Spectrophenology S2. Forests

ecosistemas

REVISTA CIENTÍFICA DE ECOLOGÍA Y MEDIO AMBIENTE

Espectrofenología con datos Sentinel 2: definición de curvas de referencia para la cartografía de ecosistemas forestales

En inglés: Spectrophenology from Sentinel 2 data: definition of reference curves for forest ecosystem mapping

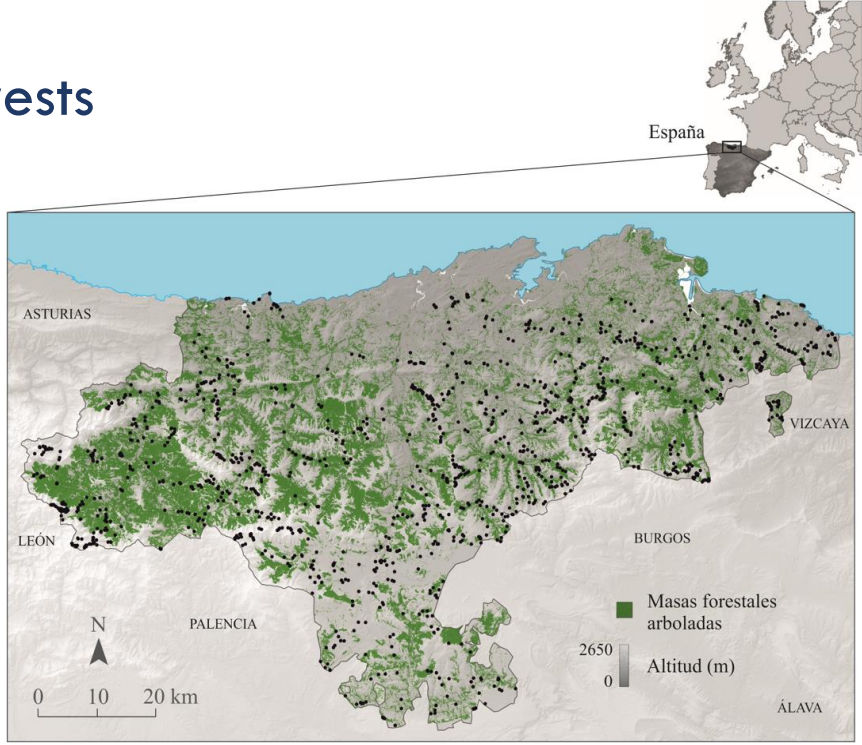
López Trullén David [1]*, Álvarez-Martínez Jose Manuel [2], Sanchez Labrador Jesús David[1], Jiménez-Alfaro Borja [3], Pérez Silos Ignacio [2], Hernández Romero Gonzalo [2], Barquín José [2]

(1) ITD MEDIOAMBIENTE, S.L., Isabel Torres, 11, Edificio 3000, Parque Científico y Tecnológico de Cantabria (PCTCAN), 39011 Santander, Cantabria, España.
(2) IHCantabria - Instituto de Hidráulica Ambiental de la Universidad de Cantabria, Parque Científico y Tecnológico de Cantabria (PCTCAN), C/ Isabel Torres, Nº 15, 39011 Santander, Cantabria, España.
(3) UMIB…

*Autor de correspondencia: D. López (david@itdmedioambiente.com)

Formación vegetal (Códigos EUNIS4)	Nº de puntos de muestreo
G162	61
G17B	58
G186	38
G26	13
E531	23
F315	37
Total	230

Códigos EUNIS 4: Hayedos oligótrofos (G162), rebollares acidófilos (G17B), bosques oligotrofos de carbayo (G186), acebedas (G26), helechales (E531), tojales de Ulex europaeus (F315).



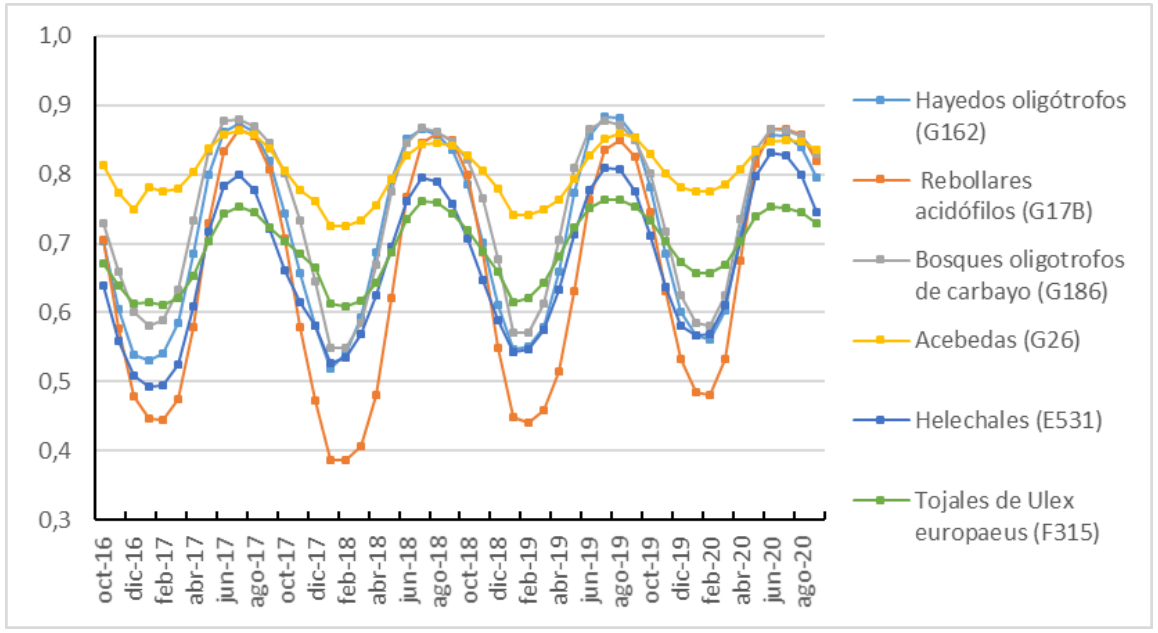
2017-2021

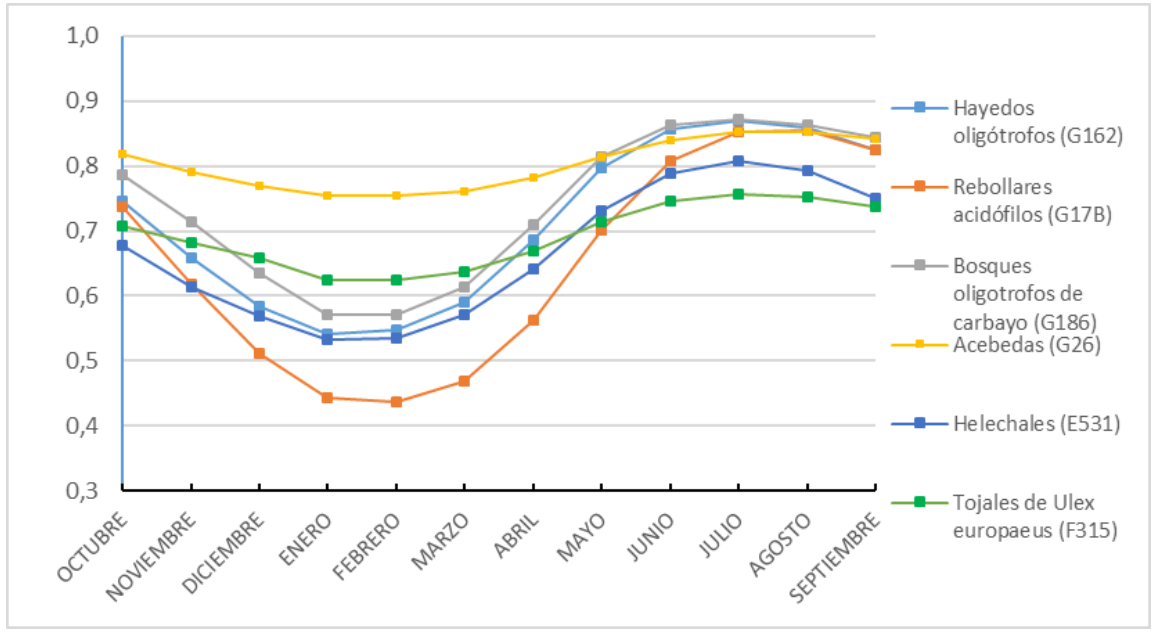
		NDVI MENSUAL											
		O	N	D	E	F	M	A	M	J	J	A	S
G162 (n=61)	μ	0,75	0,66	0,58	0,54	0,55	0,59	0,69	0,80	0,86	0,87	0,86	0,83
	σ	0,01	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,01	0,01	0,01	0,01
G17B (n=58)	μ	0,74	0,62	0,51	0,44	0,44	0,47	0,56	0,70	0,81	0,85	0,86	0,83
	σ	0,01	0,01	0,01	0,01	0,01	0,01	0,02	0,02	0,01	0,01	0,01	0,01
G186 (n=38)	μ	0,79	0,71	0,64	0,57	0,57	0,61	0,71	0,81	0,86	0,87	0,86	0,84
	σ	0,01	0,02	0,02	0,02	0,02	0,02	0,02	0,01	0,00	0,00	0,00	0,01
G26 (n=13)	μ	0,82	0,79	0,77	0,76	0,75	0,76	0,78	0,81	0,84	0,85	0,85	0,84
	σ	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,00
E531 (n=23)	μ	0,68	0,61	0,57	0,53	0,54	0,57	0,64	0,73	0,79	0,81	0,79	0,75
	σ	0,02	0,02	0,01	0,01	0,01	0,01	0,02	0,03	0,03	0,02	0,01	0,01
F315 (n=37)	μ	0,71	0,68	0,66	0,63	0,62	0,64	0,67	0,71	0,75	0,76	0,75	0,74
	σ	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,00	0,01	0,01	0,01	0,00

Ecosystem monitoring – Spectrophenology S2. Forests

Ecuaciones obtenidas mediante ajuste al modelo de Fourier de cinco términos y ajuste mediante coeficiente de correlación de Pearson para todas las formaciones analizadas

	Ecuación	Coef. corr. Pearson
G162	0,7137 + 0,109*cos(x*1) -0,1336*sin(x*1) -0,006405*cos(2*x*1) + 0,009965*sin(2*x*1) + 0,007652*cos(3*x*1) + 0,003573*sin(3*x*1) + 0,0005647*cos(4*x*1) + -0,002937*sin(4*x*1) + 0,001458*cos(5*x*1) + 0,001188*sin(5*x*1)	9,99998E-01
G17B	0,6514 + 0,1724*cos(x*1) -0,1409*sin(x*1) -0,00555*cos(2*x*1) + 0,004188*sin(2*x*1) + 0,004704*cos(3*x*1) + 0,008983*sin(3*x*1) + 0,001748*cos(4*x*1) -0,00228*sin(4*x*1) + 0,001261*cos(5*x*1) + 0,00163*sin(5*x*1)	9,99993E-01
G186	0,7384 + 0,1081*cos(x*1) -0,1139*sin(x*1) -0,01006*cos(2*x*1) + 0,02095*sin(2*x*1) + 0,004557*cos(3*x*1) + 0,001927*sin(3*x*1) + 0,0007649*cos(4*x*1) -0,003549*sin(4*x*1) + 0,001935*cos(5*x*1) + 0,00147*sin(5*x*1)	9,99997E-01
G26	0,8025 + 0,03877*cos(x*1) -0,03452*sin(x*1) -0,001387*cos(2*x*1) -0,001379*sin(2*x*1) + 0,001217*cos(3*x*1) + 0,001401*sin(3*x*1) + 0,0004302*cos(4*x*1) -0,0003876*sin(4*x*1) + 8,871e-05*cos(5*x*1) + 0,0004174*sin(5*x*1)	9,99988E-01
E531	0,6677 + 0,0857*cos(x*1) -0,1117*sin(x*1) -0,009118*cos(2*x*1) -0,0005829*sin(2*x*1) + 0,003372*cos(3*x*1) - 0,0002574*sin(3*x*1) + 0,001702*cos(4*x*1) -0,001897*sin(4*x*1) + 0,001071*cos(5*x*1) + 0,001402*sin(5*x*1)	9,99990E-01
F315	0,6928 + 0,04926*cos(x*1) -0,04545*sin(x*1) - 0,006904*cos(2*x*1) + 0,001912*sin(2*x*1) - 0,0003256*cos(3*x*1) - 0,0004048*sin(3*x*1) + 0,002359*cos(4*x*1) - 0,001884*sin(4*x*1) + 0,001099*cos(5*x*1) + 0,001515*sin(5*x*1)	9,99948E-01

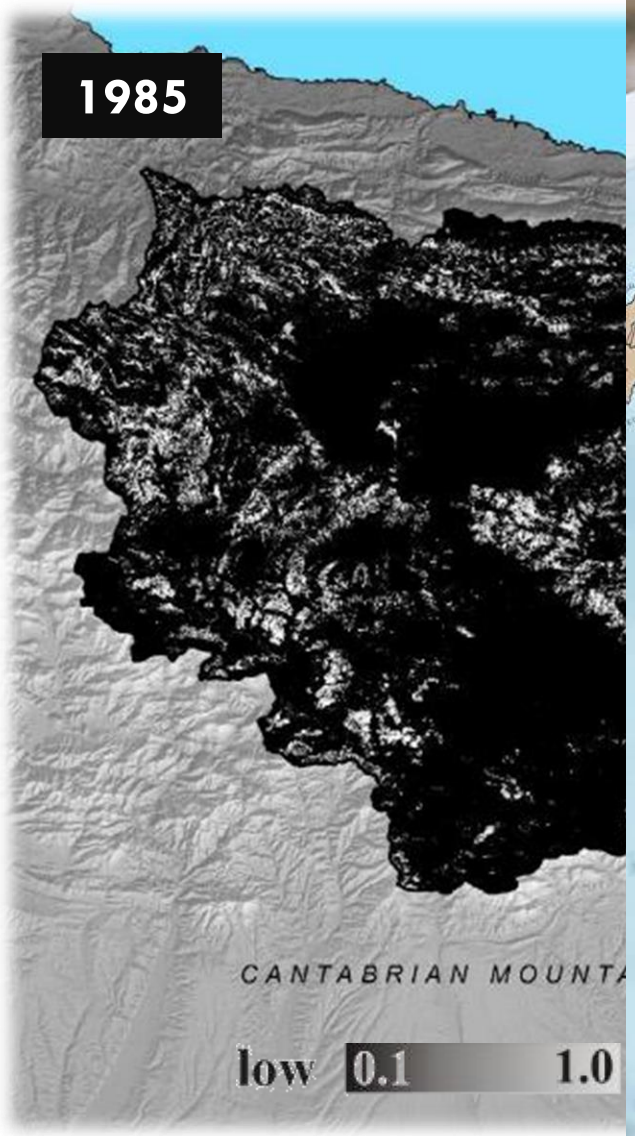


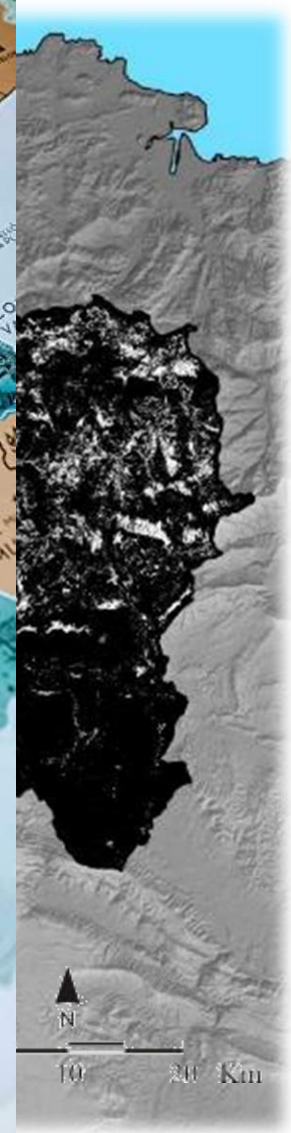



HABITAT MAPPING:
Pattern, process and dynamics
STATE OF CONSERVATION:
Structure, function and ec. services
MANAGEMENT AND REPORTING

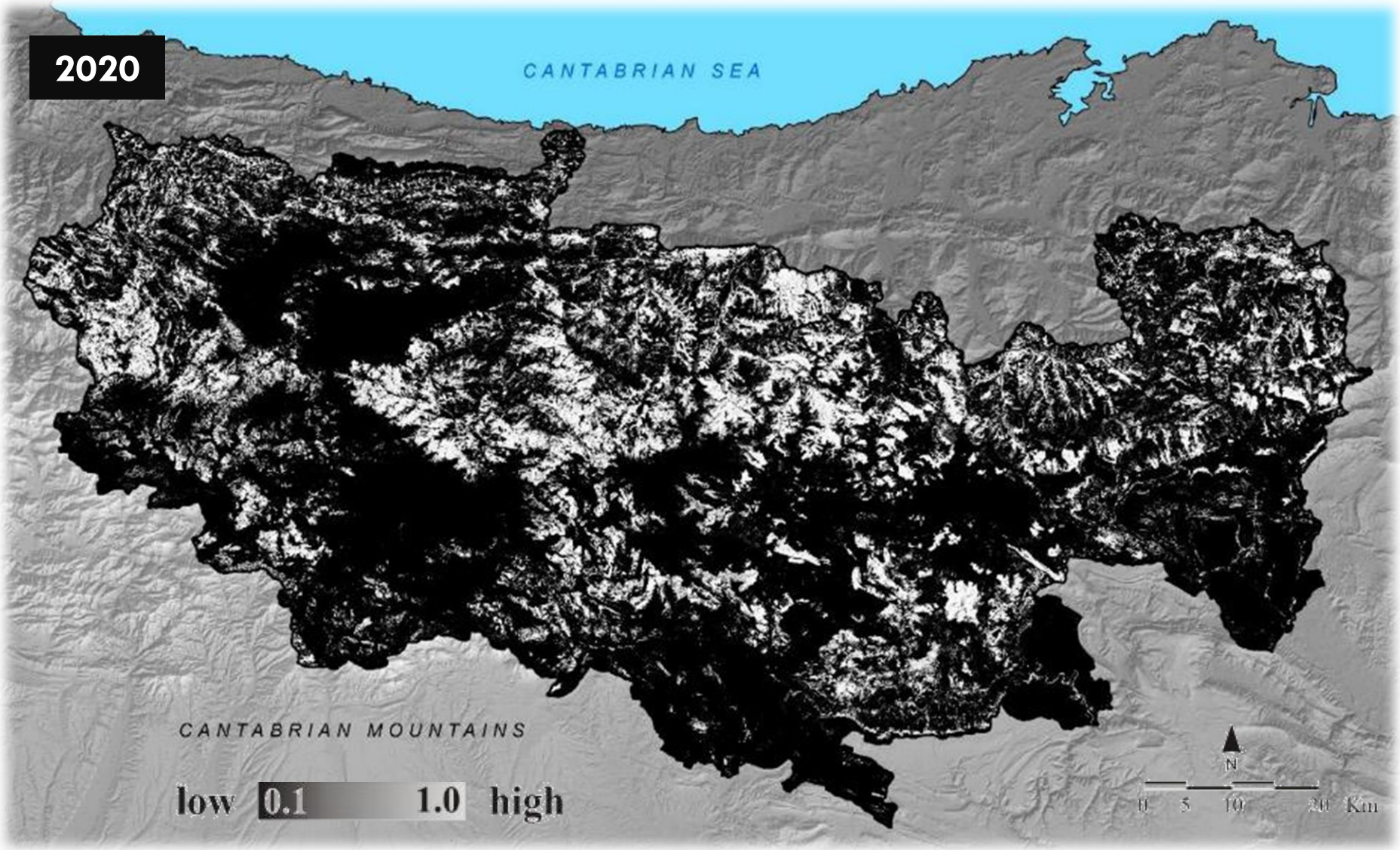
Landscape monitoring – R

La observación remota aplicada al seguimiento de los ecosistemas

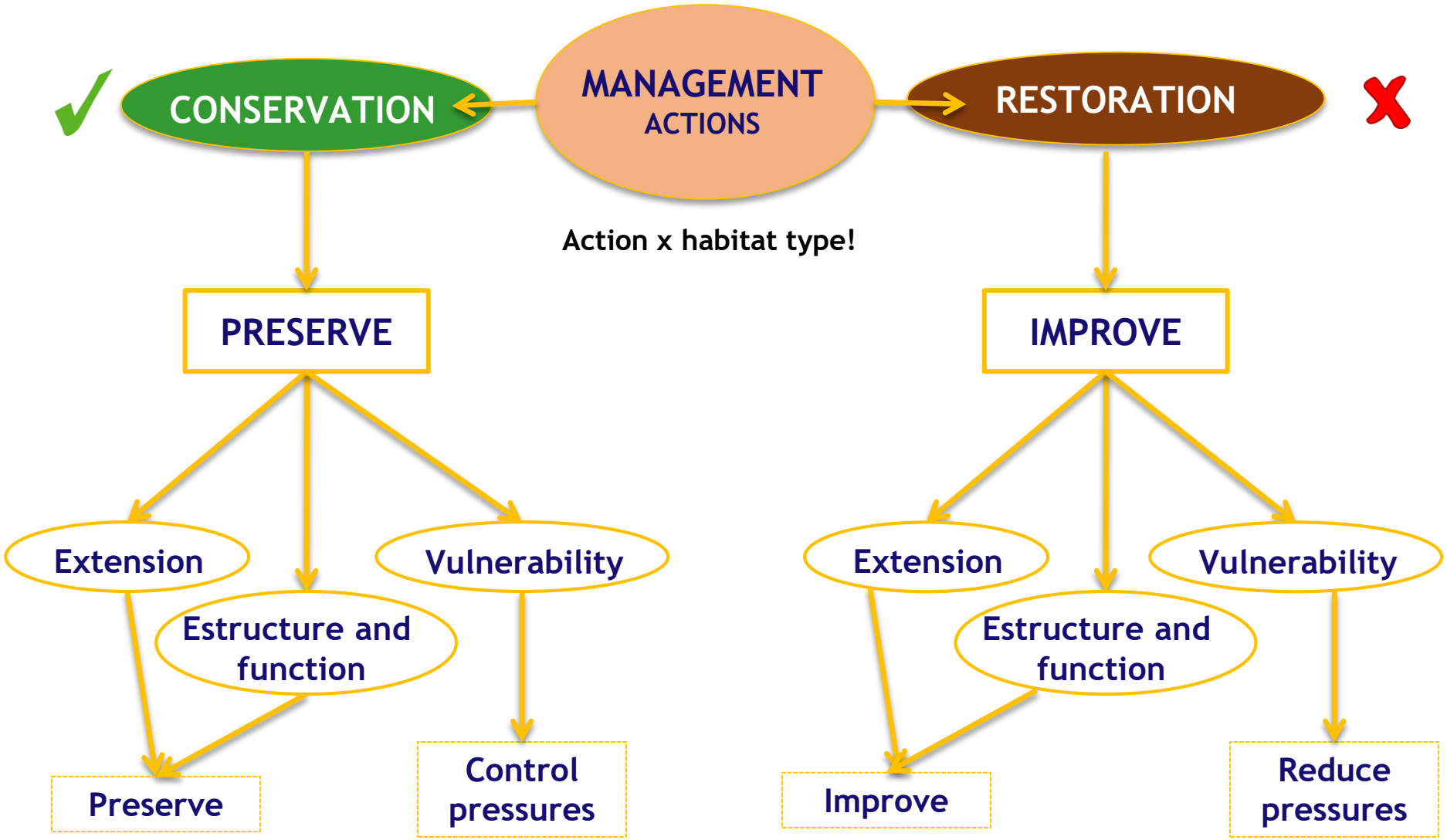




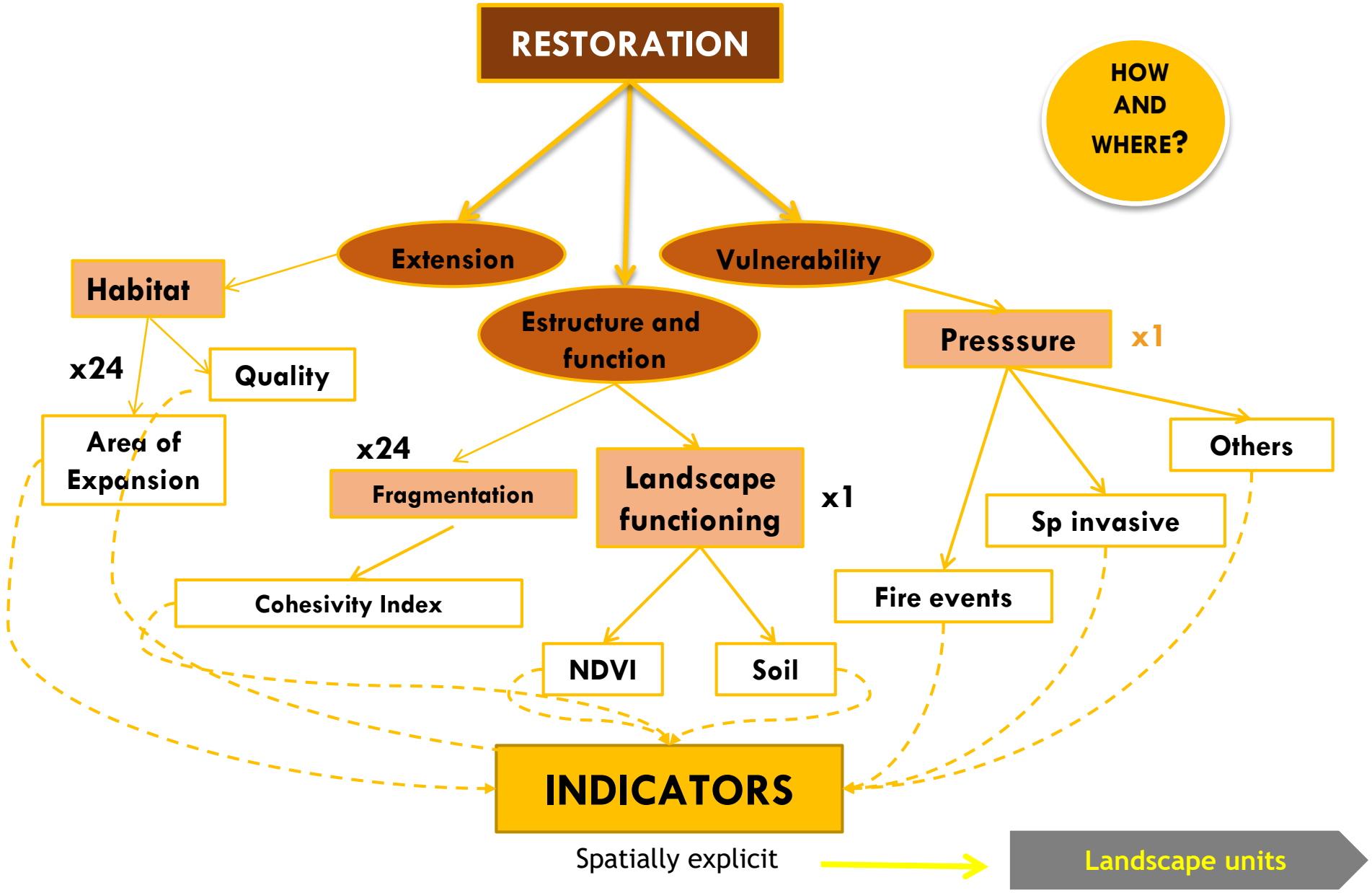
Landscape monitoring – RS-based indicators of EC



Landscape management – from pattern to process

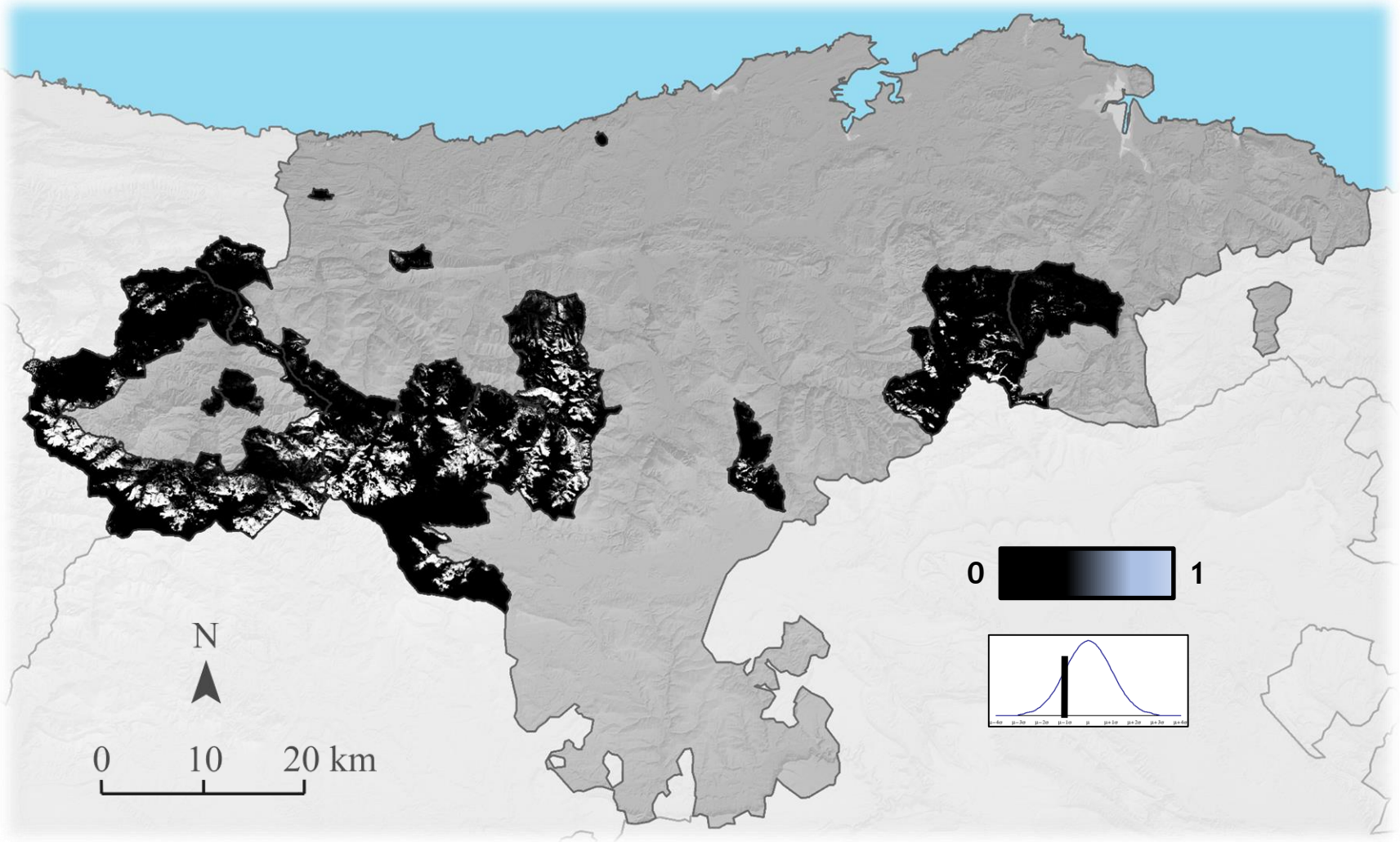


Landscape management – from pattern to process



Landscape management – from pattern to process

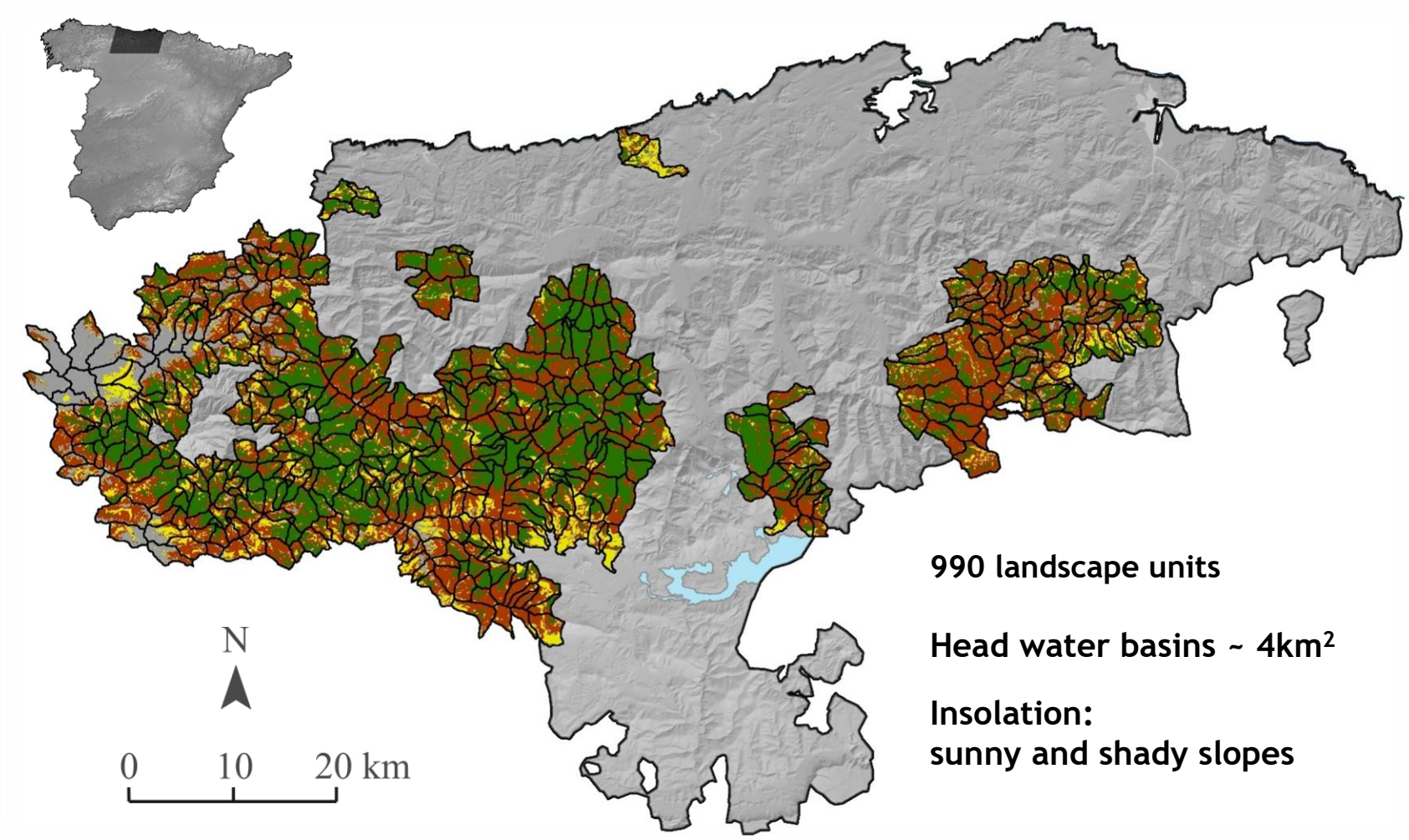
Habitat suitability models



Ejemplo: hábitat 9120

Landscape management – from pattern to process

Homogeneous units (structure and composition) driven by environmental limiting factors (topography and climate)



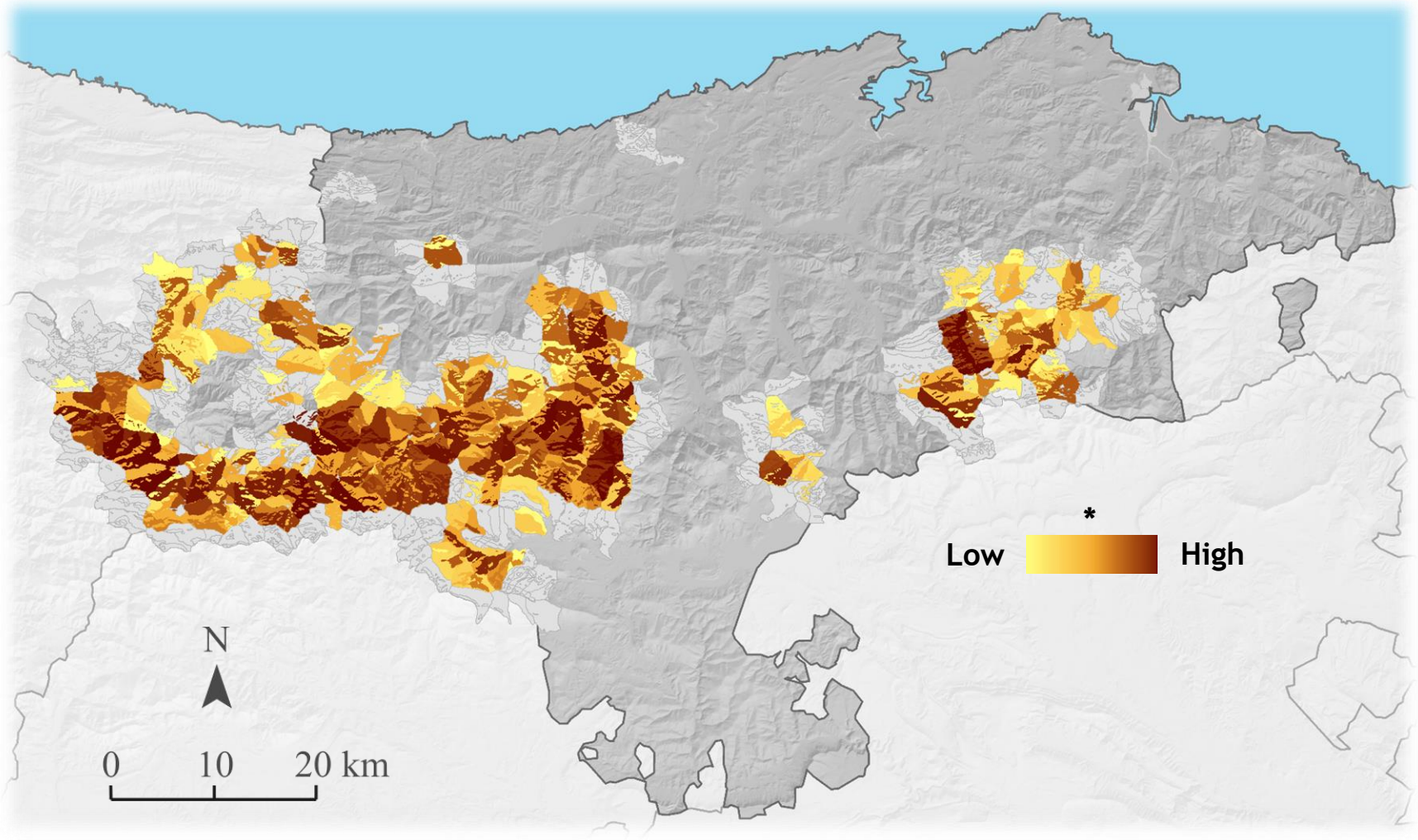
990 landscape units

Head water basins ~ 4km^2

Insolation:
sunny and shady slopes

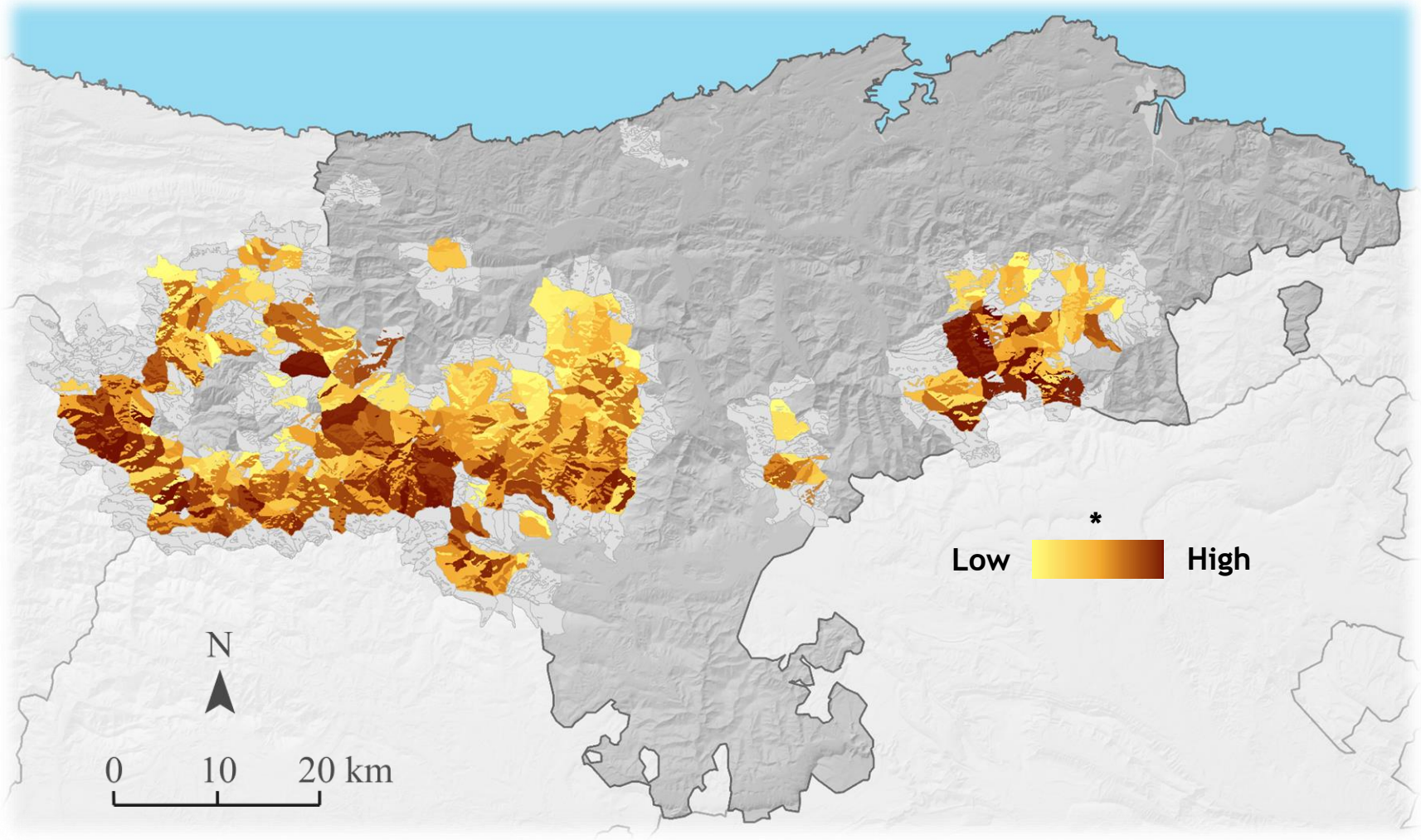
Landscape management – from pattern to process

Ecological status of habitats in management areas



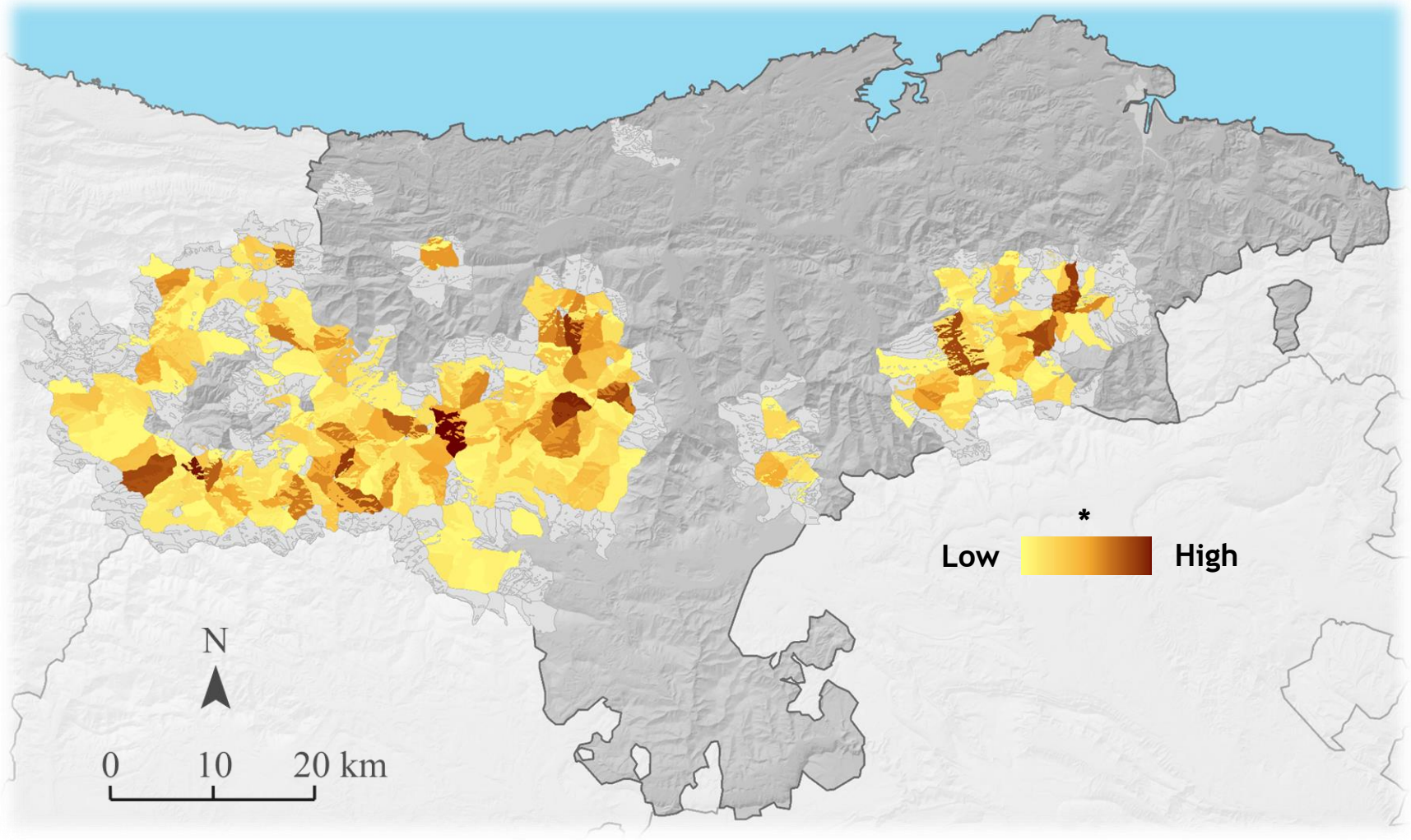
Landscape management – from pattern to process

Related to landscape dynamics: e.g. forest expansion



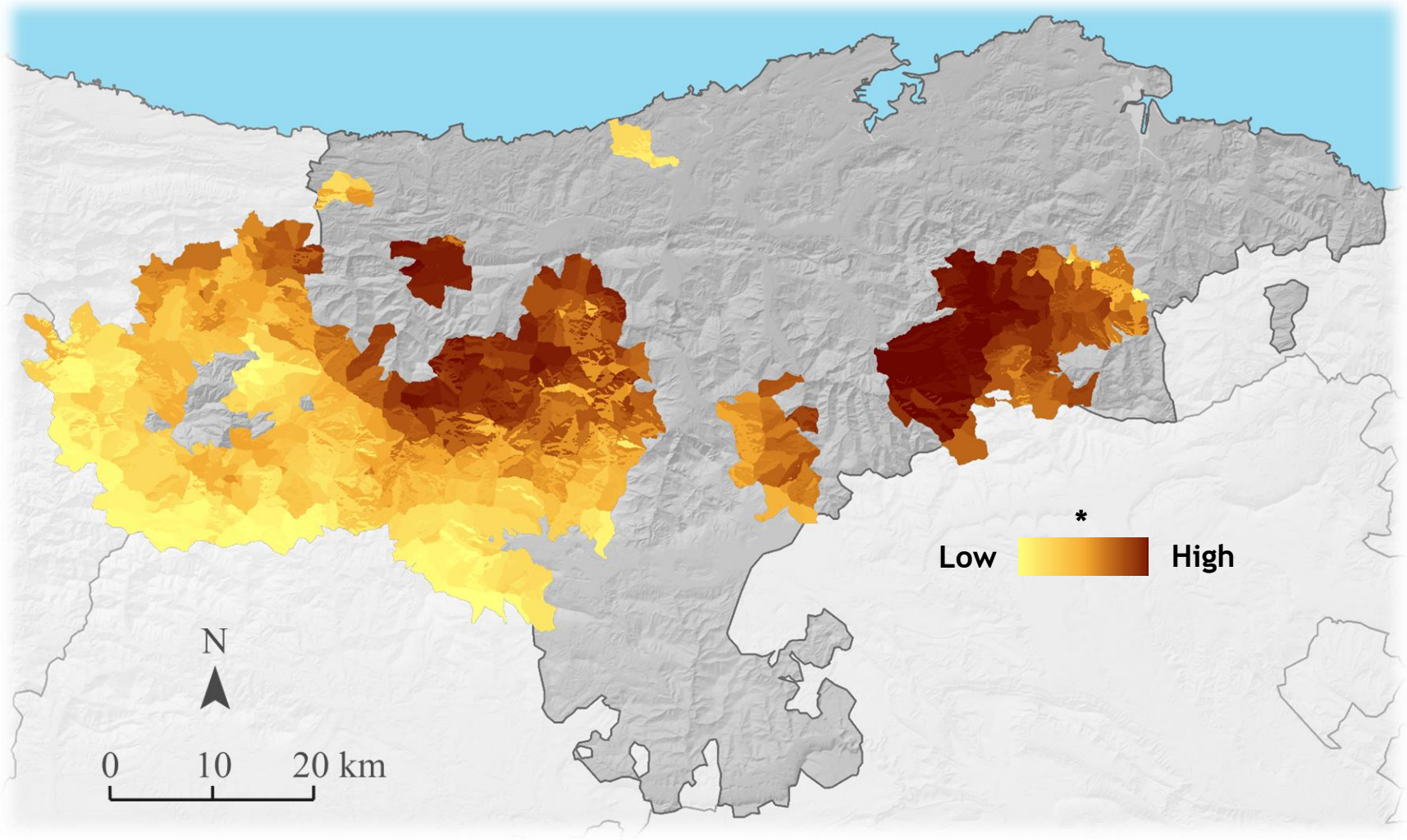
Landscape management – from pattern to process

Fragmentation: e.g. number of patches



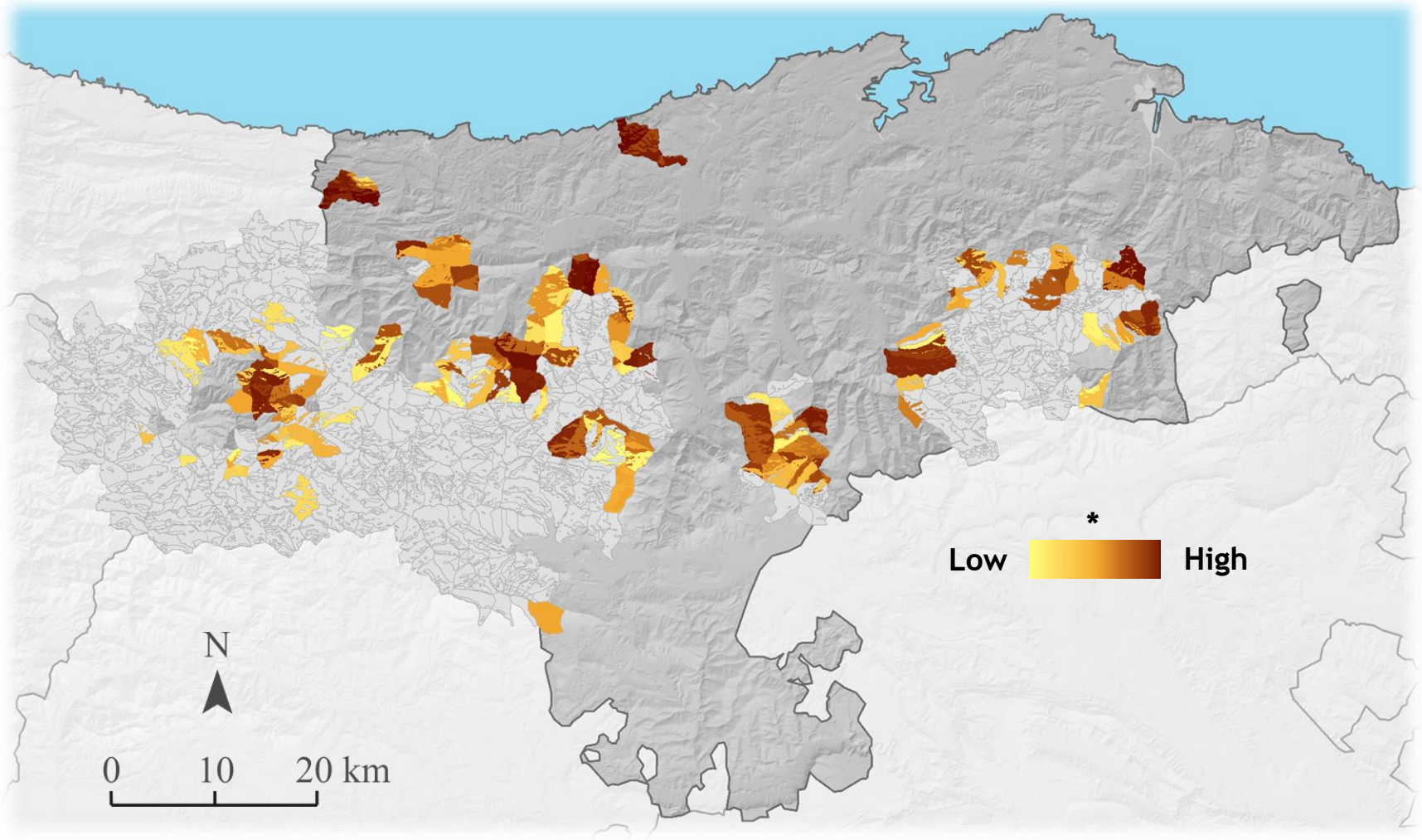
Landscape management – from pattern to process

Fire risk (integrated probability model)



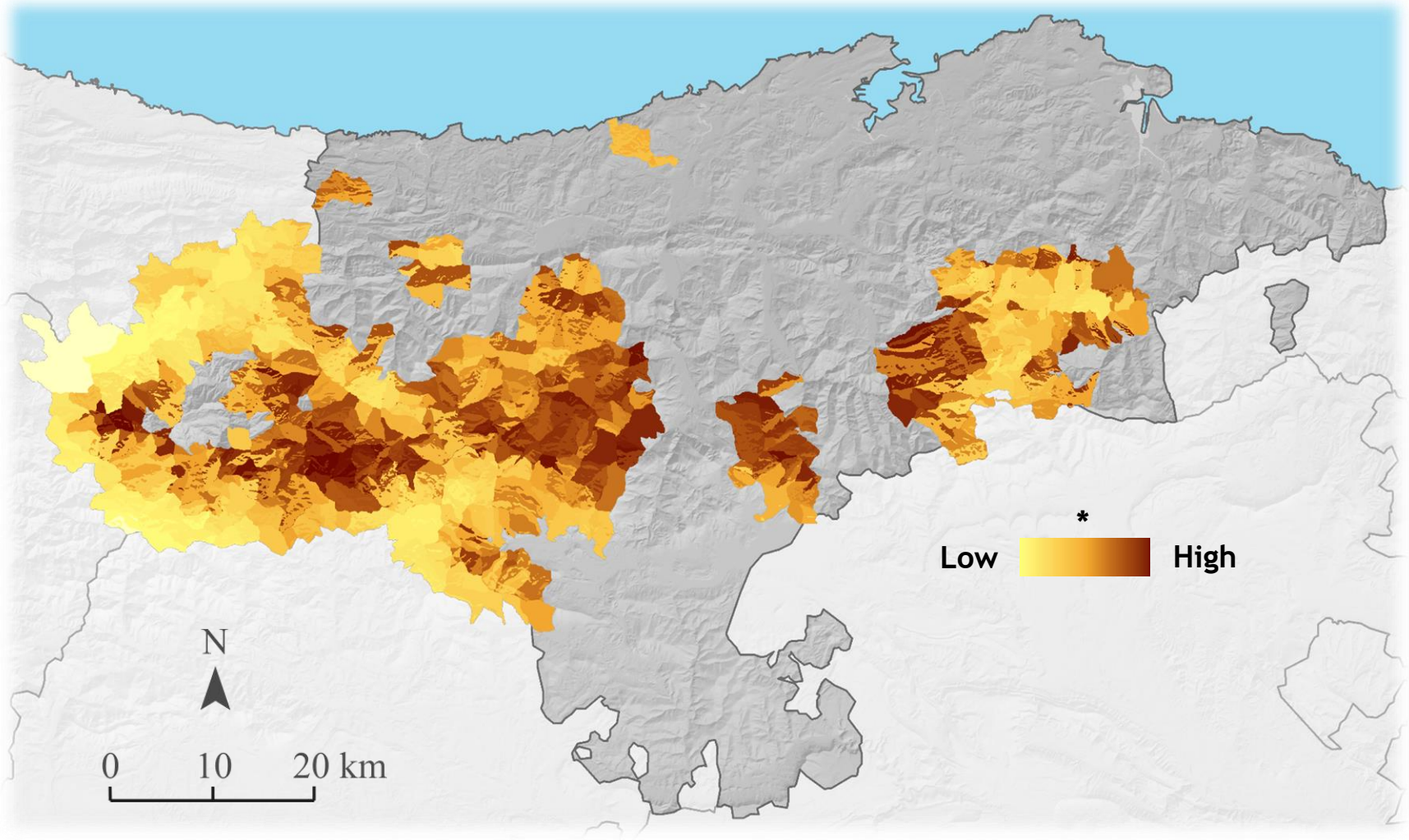
Landscape management – from pattern to process

Alien species: individual SDM models



Landscape management – from pattern to process

Primary production: e.g. NDVI averaged values



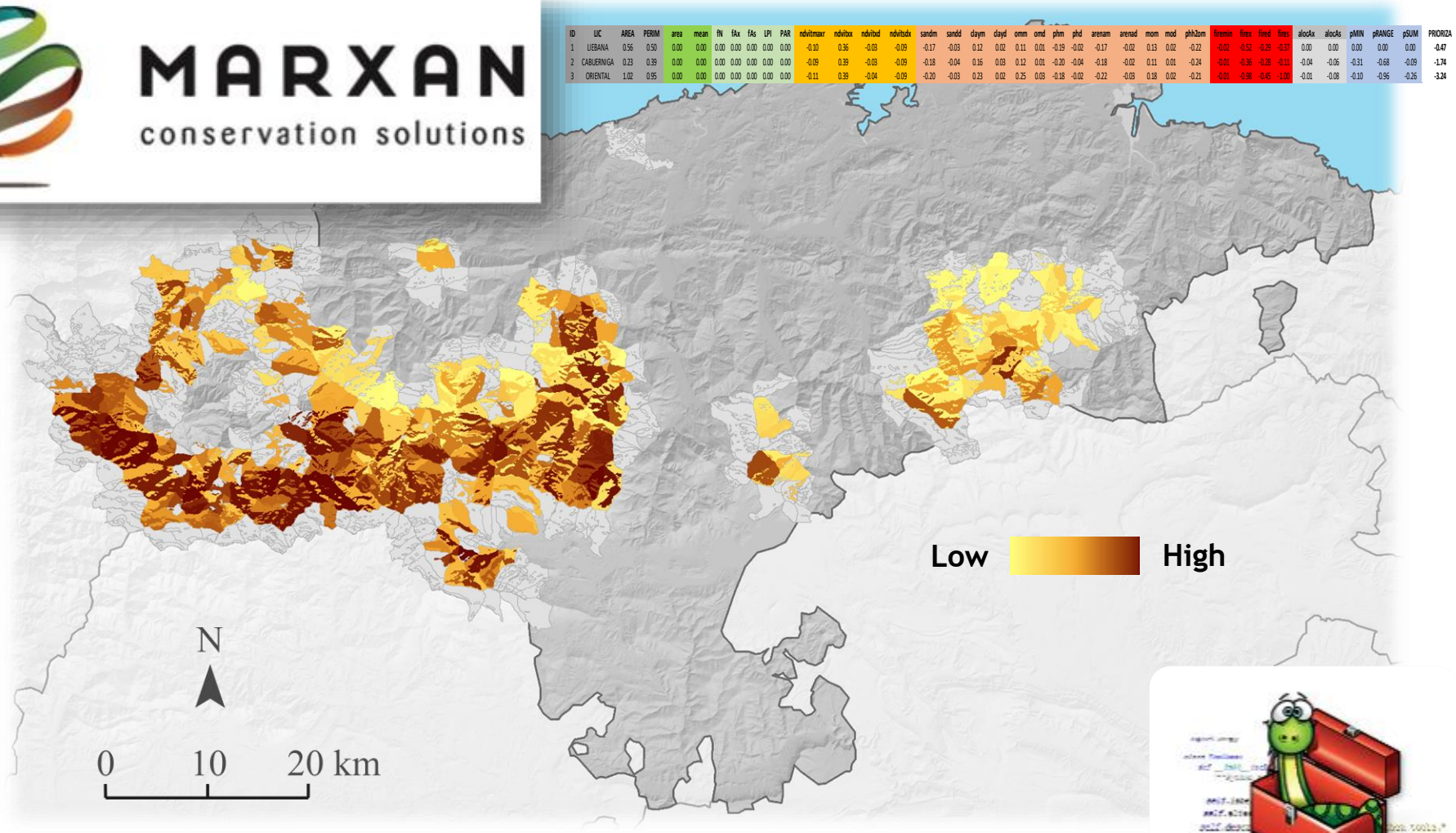
Landscape management – from pattern to process

La observación remota aplicada al seguimiento de los ecosistemas

PRIORITY INDEX (for all landscape units)

MARXAN conservation solutions

ID	LIC	AREA	PERIM	area	mean	fN	fAx	fAs	LPI	PAR	ndvitmaxr	ndvitbx	ndvitbxd	ndvitsdx	sandm	sandd	claym	clayd	omm	omd	phm	phd	arenam	arenad	mom	mod	phh2om	firemin	firex	fired	fires	alocAx	alocAs	pMIN	pRANGE	pSUM	PRIORIZA
1	LIEBANA	0.56	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.10	0.36	-0.03	-0.09	-0.17	-0.03	0.12	0.02	0.11	0.01	-0.19	-0.02	-0.17	-0.02	0.13	0.02	-0.22	-0.02	-0.52	-0.29	-0.37	0.00	0.00	0.00	0.00	0.00	-0.47
2	CABUERNIGA	0.23	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.09	0.39	-0.03	-0.09	-0.18	-0.04	0.16	0.03	0.12	0.01	-0.20	-0.04	-0.18	-0.02	0.11	0.01	-0.24	-0.01	-0.36	-0.28	-0.11	-0.04	-0.06	-0.31	-0.68	-0.09	-1.74
3	ORIENTAL	1.02	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.11	0.39	-0.04	-0.09	-0.20	-0.03	0.23	0.02	0.25	0.03	-0.18	-0.02	-0.22	-0.03	0.18	0.02	-0.21	-0.01	-0.98	-0.45	-1.00	-0.01	-0.08	-0.10	-0.96	-0.26	-3.24

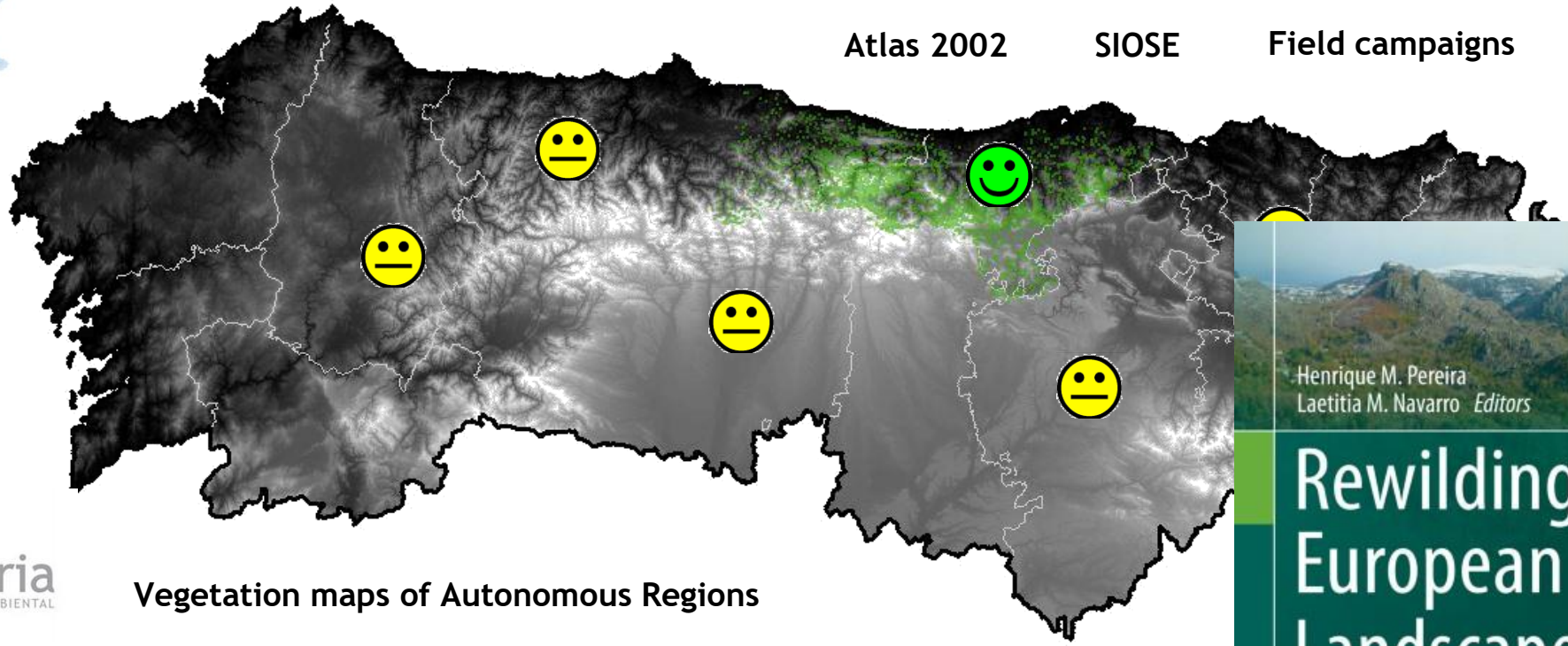


"LEGO" format tool: expandable to any variable

A need for (more) data about habitats

Data for modelling at the biogeographical region level
Different data quality → homogenization at the UENIS level

Atlas 2002 SIOSE Field campaigns



Vegetation maps of Autonomous Regions

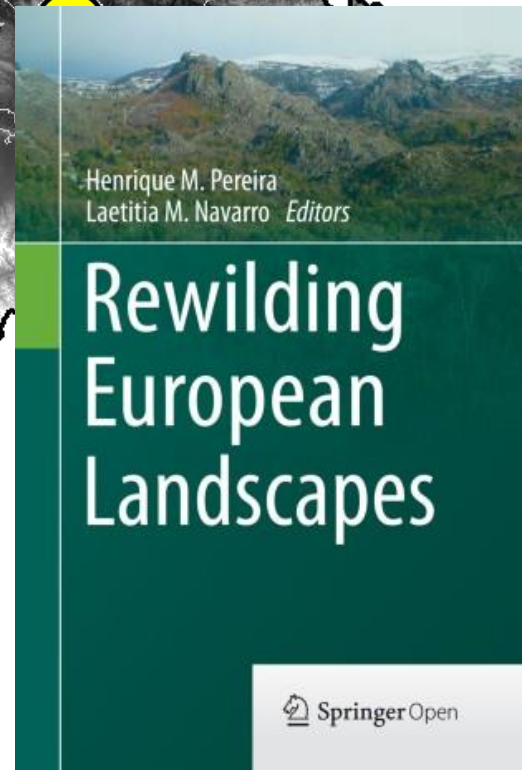
IHabitat

UC UNIVERSIDAD DE CANTABRIA

IH cantabria INSTITUTO DE HIDRÁULICA AMBIENTAL UNIVERSIDAD DE CANTABRIA

IMIB

AYUDAS PARA GRUPOS DE INVESTIGACIÓN DE ORGANISMOS DEL PRINCIPADO DE ASTURIAS DURANTE EL PERIODO 2021-2023
SV-PA-21-AYUD/2021/51261



A need for (more) data about habitats

Natura 2000 Gerekliliklerinin Uygulanması İçin Ulusal Doğa Koruma Sisteminin Güçlendirilmesi Projesi

A pilot area to check the methodology for the selection of Natura 2000 sites in Turkey

N2000 selection

- 1. Spatial distribution
- 2. Conservation Status
- 3. SAC definition

Annex I, II

NATURA 2000

A need for (more) data about habitats

Systematic Conservation Planning principles

+

Requirements of the Habitats Directive

⇩

METHODOLOGY FOR THE SELECTION OF NATURA 2000 SITES Europe Aid project - Turkey

What – how much – where

Santiago García, Begoña Matilla, Borja Jimenez Alfaro, Isaac Pozo & JM Álvarez-Martínez

A need for (more) data about habitats

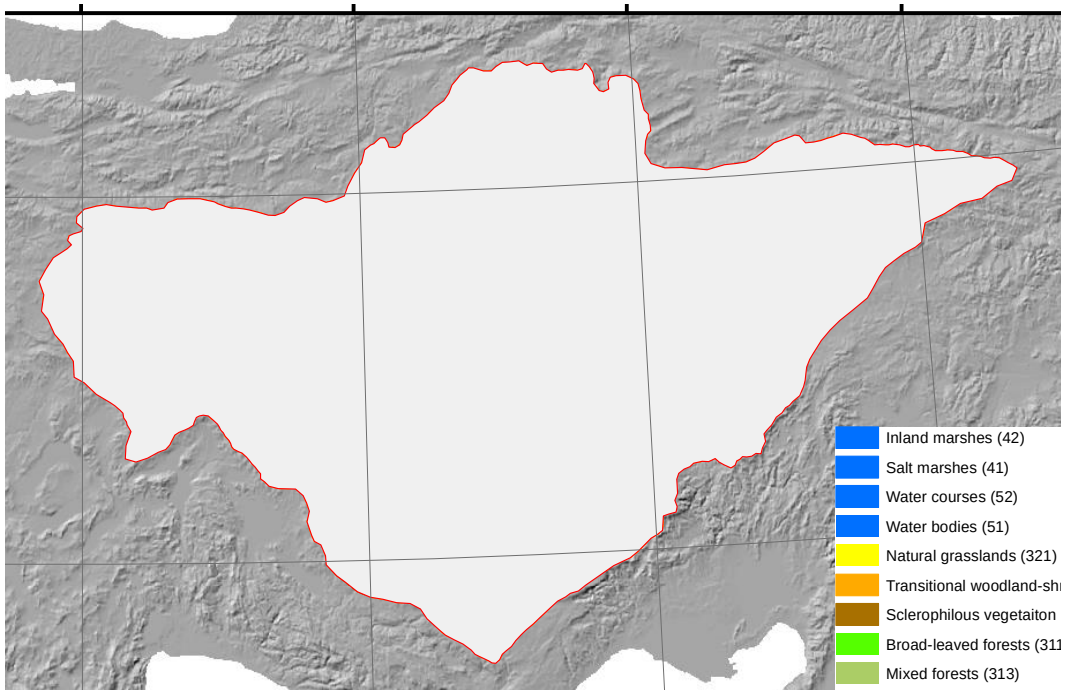
Occurrence data for 20 (dominant) vegetation types

EUNIS	Name	No. of Field points	No. of spatially filtered points
D61	Saltmarshes with dry and wet season	9056	902
E12A	Central Anatolian calcareous steppes	35561	6916
E12B	Central Anatolian marl steppes	3867	817
E12C	Central Anatolian gypsum steppes	5309	1159
E12D	Central Anatolian volcanic steppes	27800	5137
E12E	Central Anatolian serpentine steppes	1703	444
E12F	Central Anatolian steppes with mixed rocks	26675	4809
E62	Continental inland salt steppes	6363	1054
F31A	Juniperus communis scrub	265	805
F52B	Styrax officinalis or other maquis	591	112
F53B	Quercus-Juniperus pseudomaquis	3548	564
G11	Riparian and gallery woodland	2719	173
G17B	Quercus cerris woodlands	15196	2164
G17C	Quercus pubescens woodlands	22249	3985
G17D	Quercus macranthera woodlands	1865	283
G17E	Quercus vulcanica woodlands	930	171
G31A	Abies cilicica woodland	856	116
G34	[Pinus sylvestris] woodland	9460	1281
G35	[Pinus nigra] woodland	21169	3242
G39	Coniferous open woodland	11057	2018

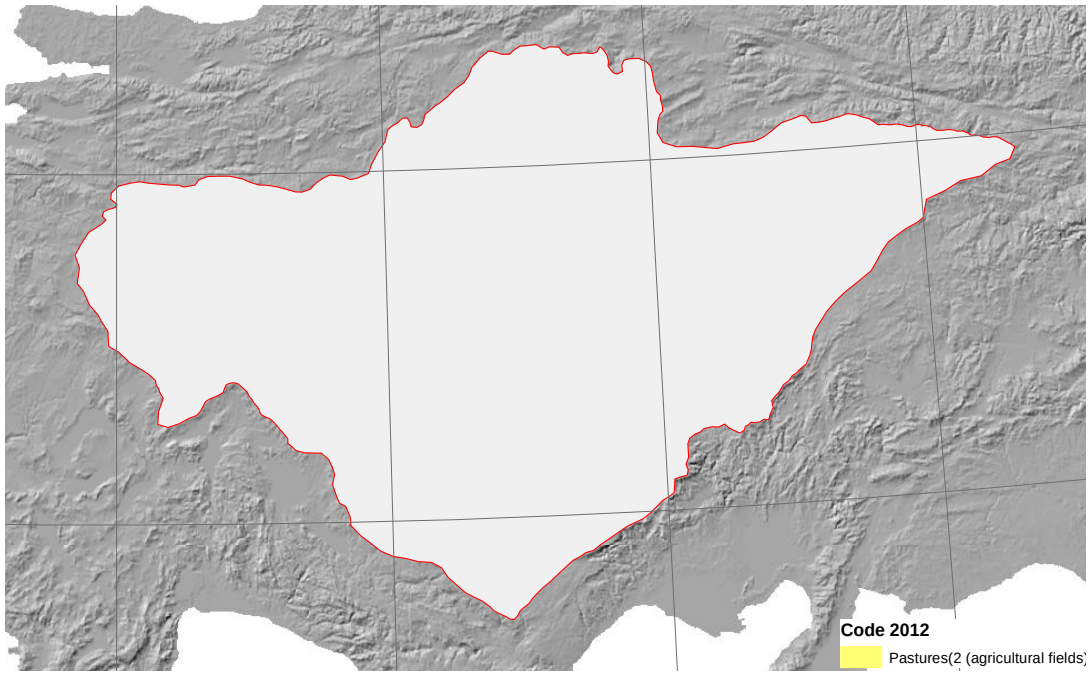
A need for (more) data about habitats

Central Anatolia (Turkey)

Central Anatolia (Atalay 2014, Ecoregions of Turkey. Meta Basim, Izmir)
Target regions from Corine Land Cover polygons (2012)



1) Natural areas



2) Agricultural pastures

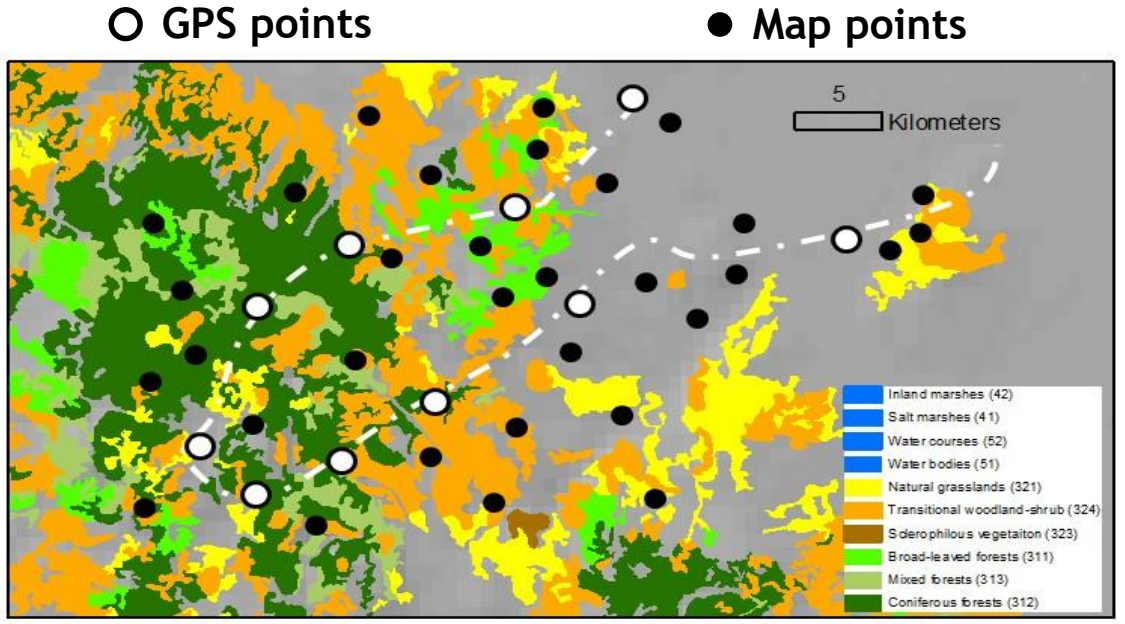
A need for (more) data about habitats

Central Anatolia (Turkey)

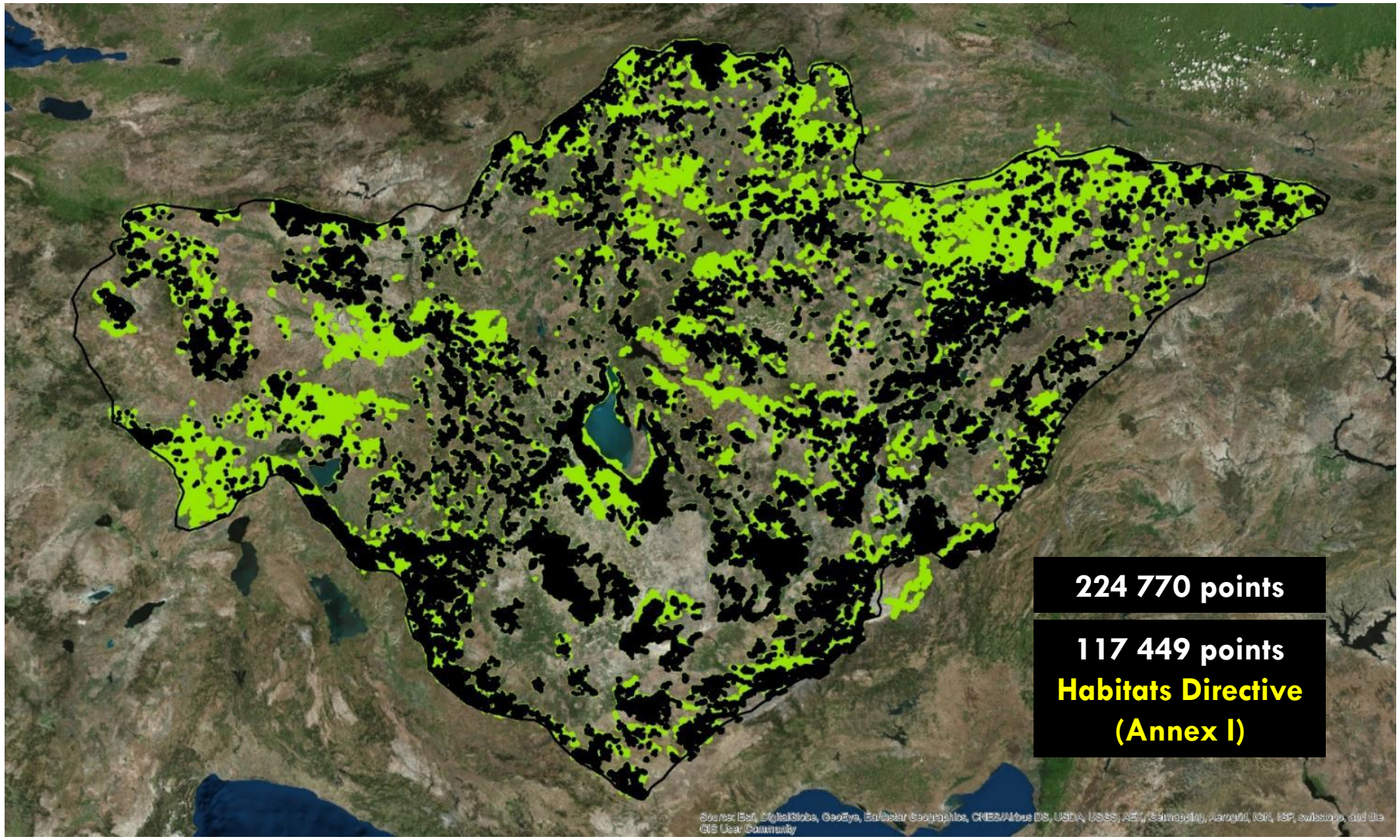
Training in habitat identification and sampling (tablet system)
22 field workers

Systematic field surveys (two seasons, 2016-2017)

60,000 GPS points
170,000 Map points

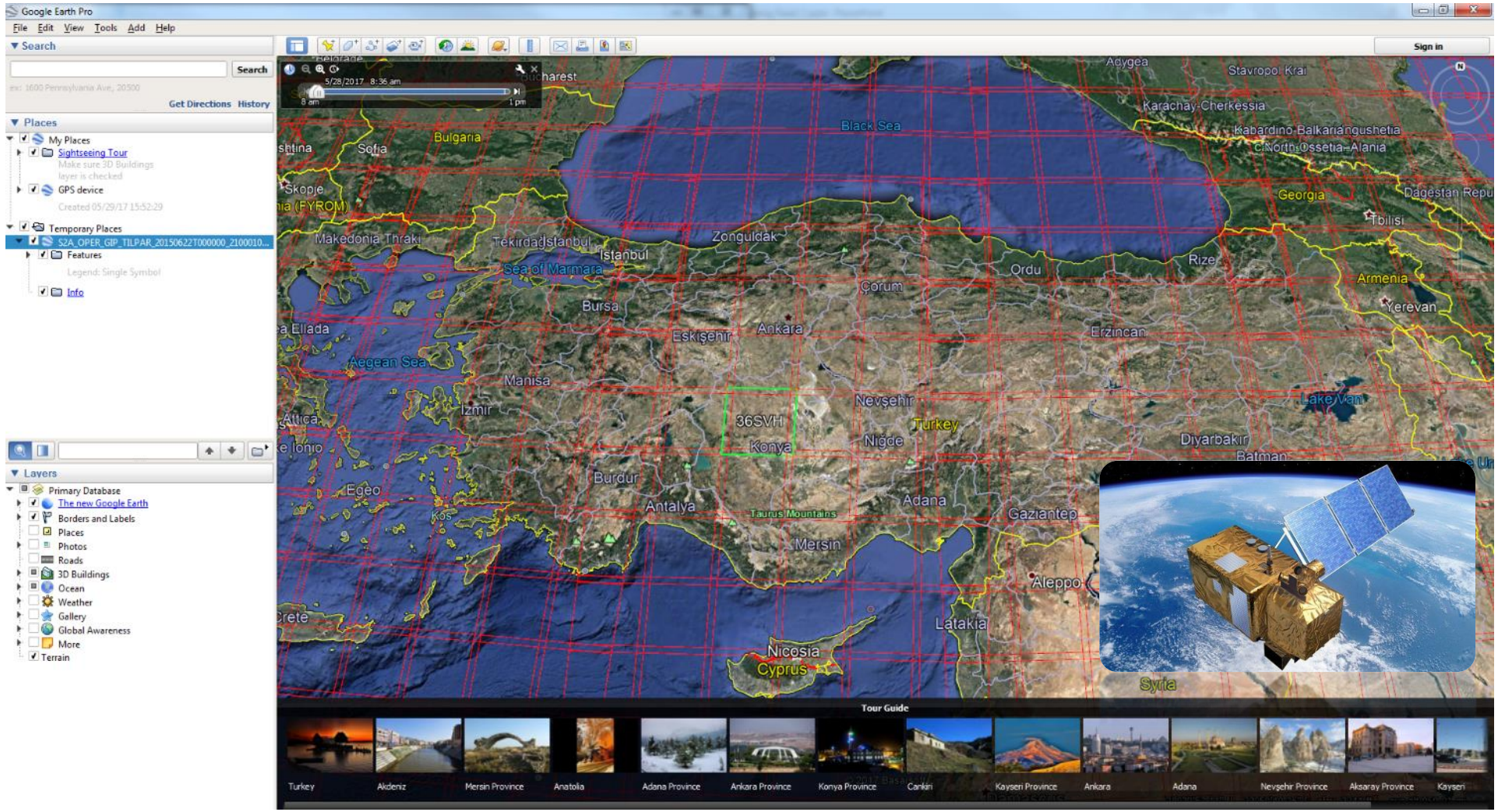


A need for (more) data about habitats



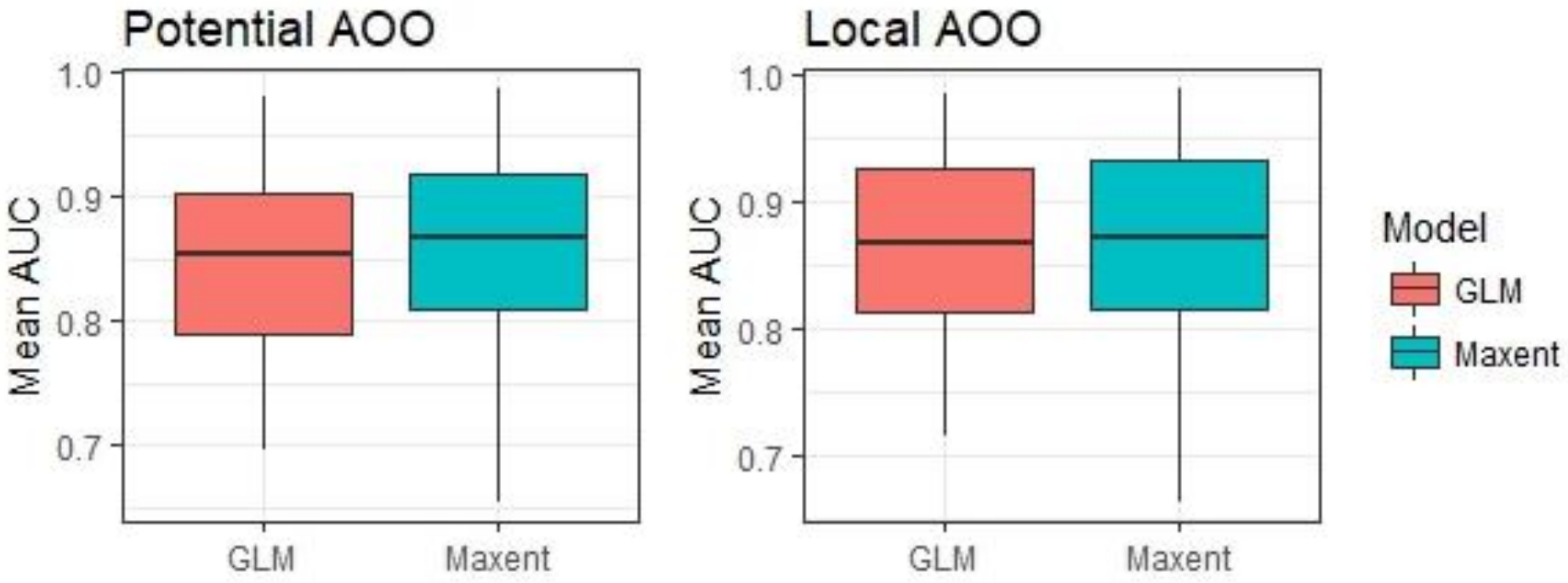
A need for (more) data about habitats

**35 Sentinel2A sub-scenes (20m). Sensitivity analyses with Landsat data (30m).
Final modelling: combined products (120m)**



A need for (more) data about habitats

Model performance (5-fold CV)



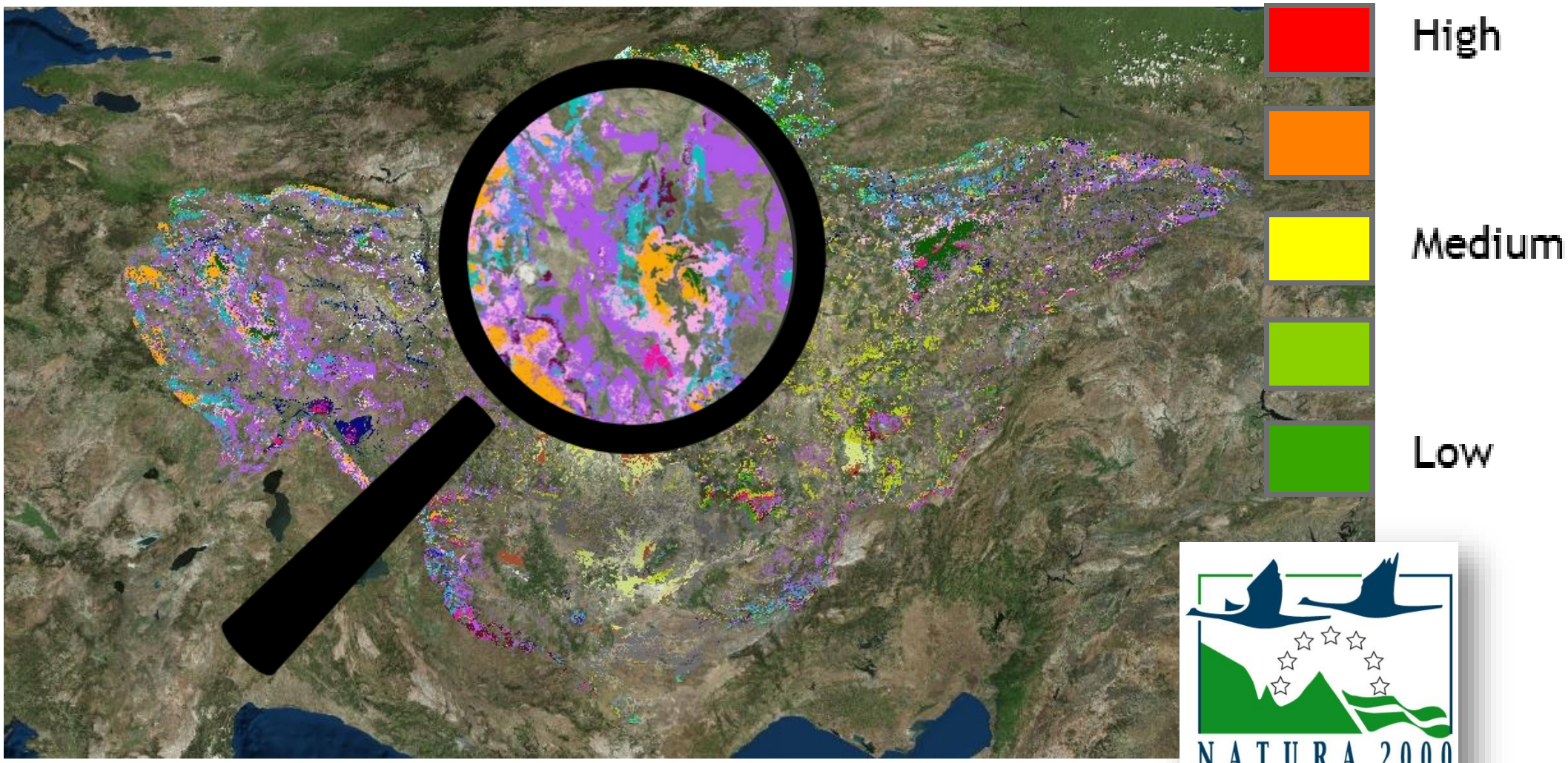
Predictors: Climate + Topography + Soil

Predictors: Climate + Topography + Soil + **Sentinel/Landsat**

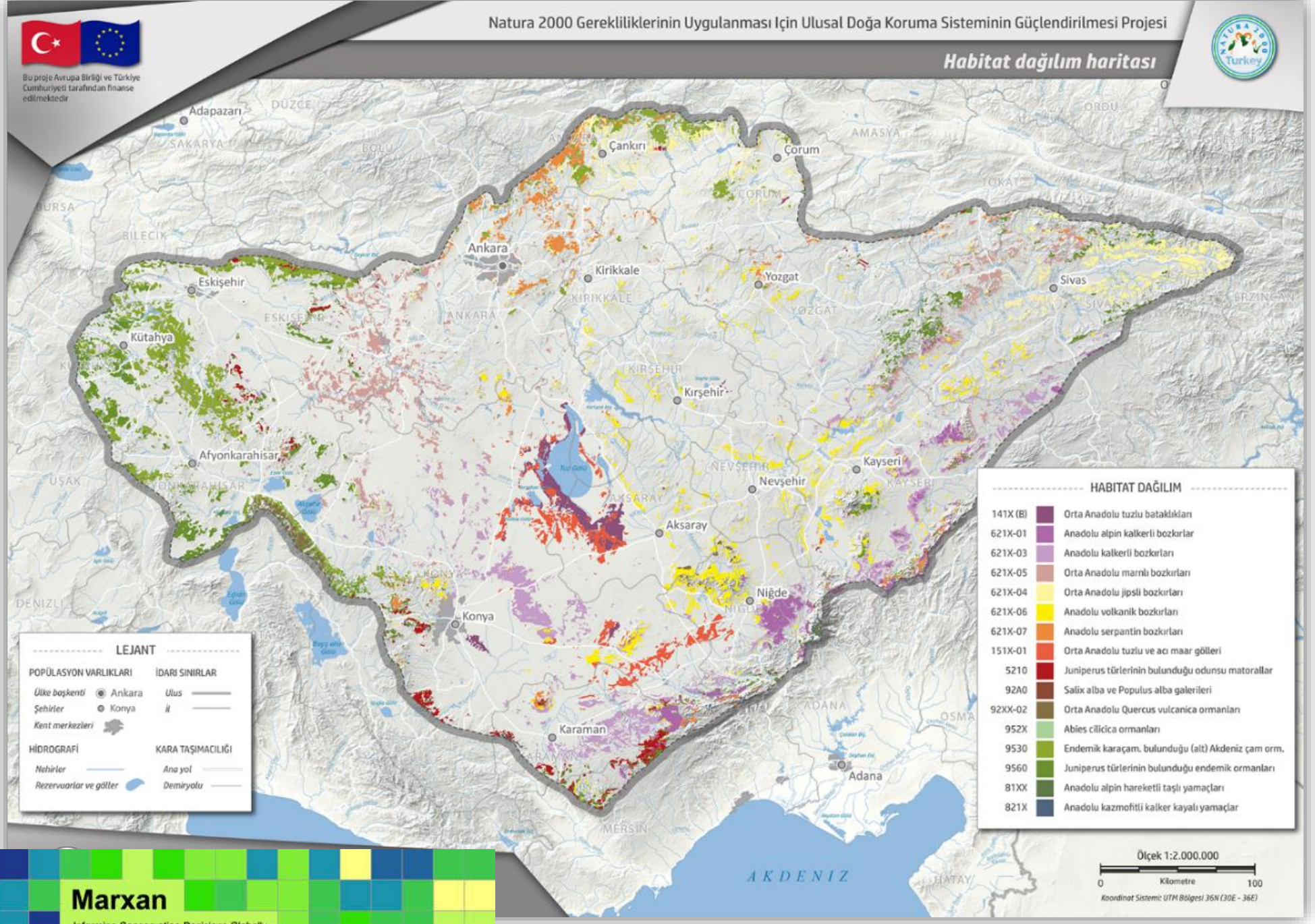
A need for (more) data about habitats

What to conserve?

44 habitats (EUNIS) → concurrence map (dominance+uncertainty)



NATURA 2000

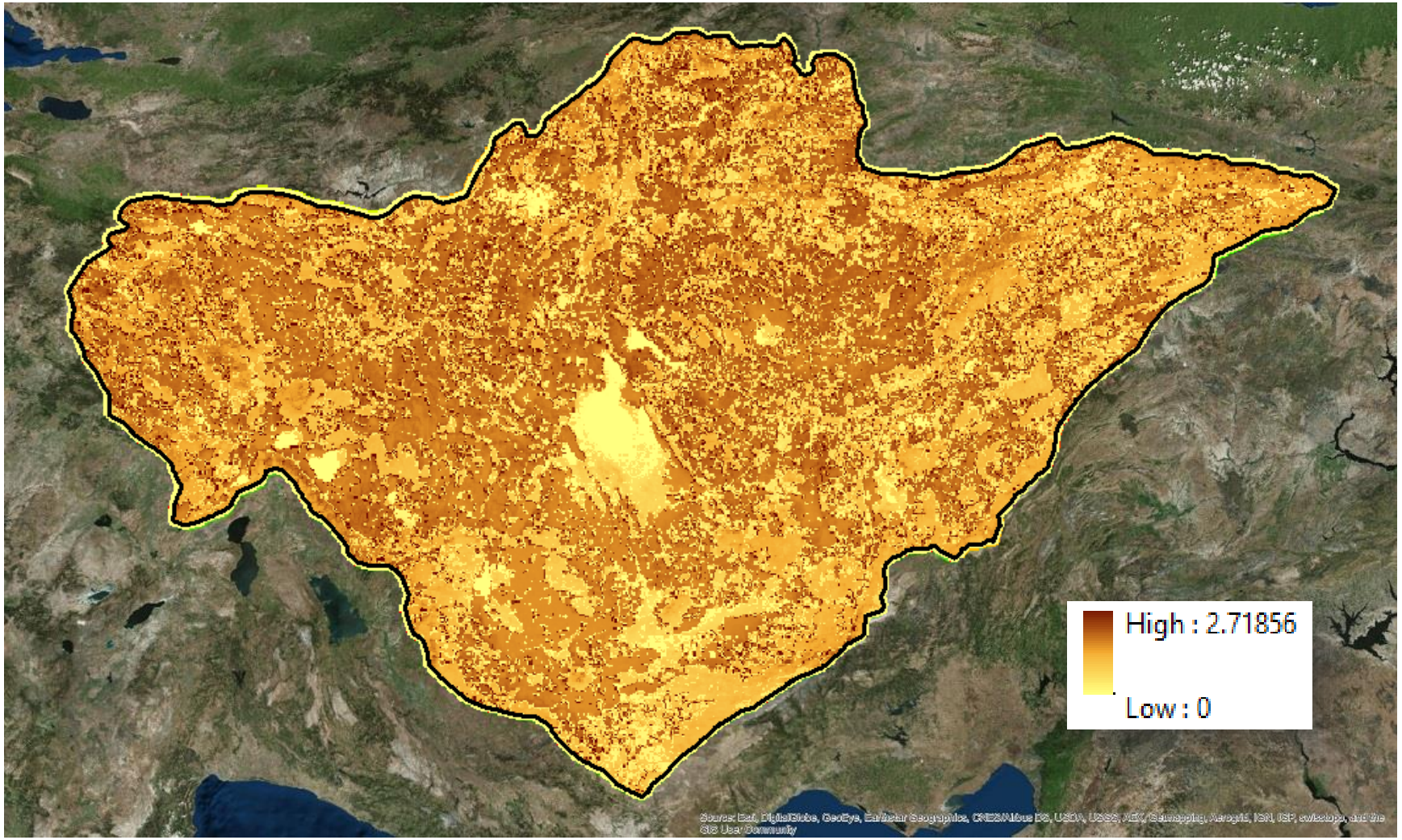


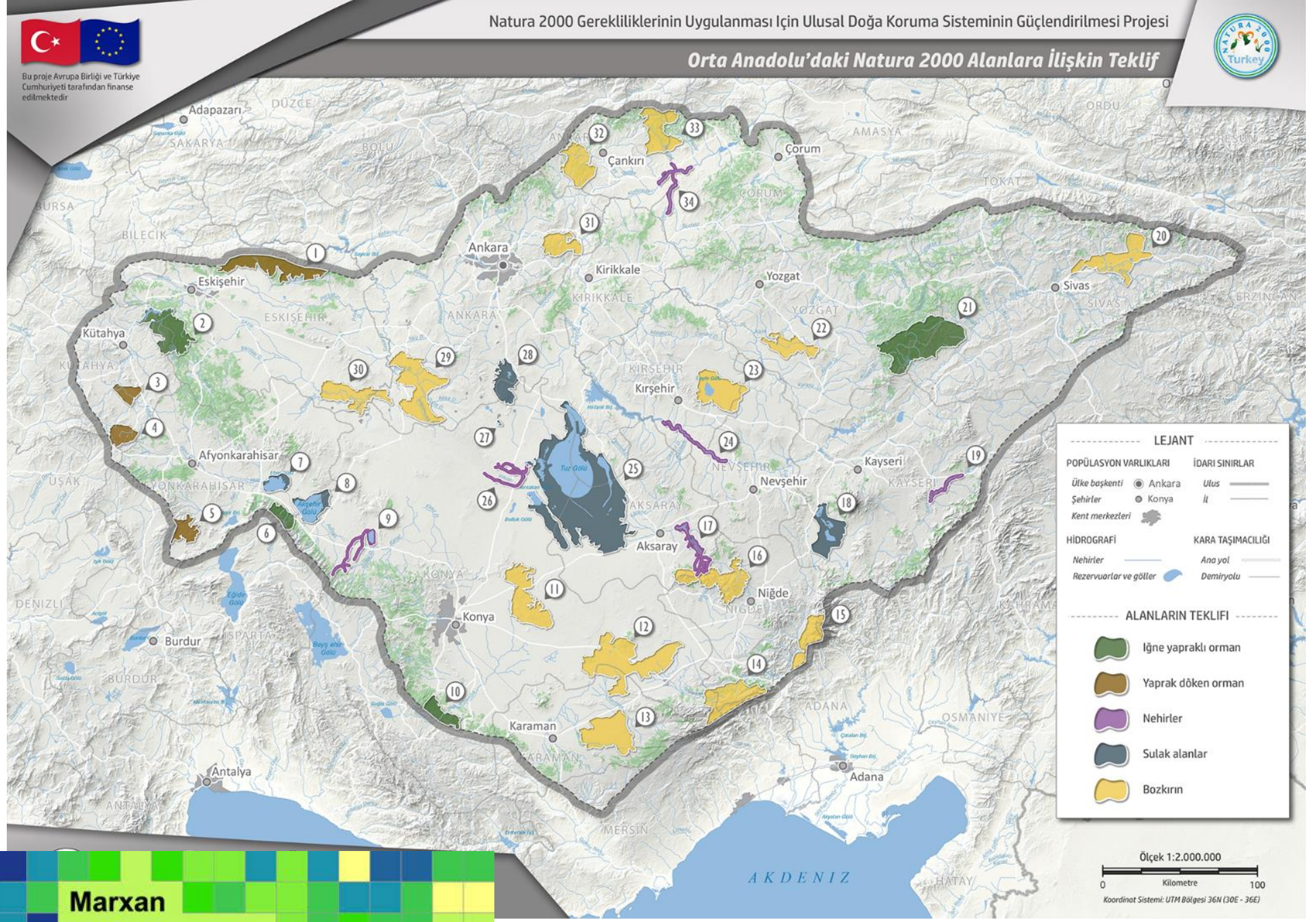
High resolution maps: 22 Habitats (Annex I) in Central Anatolia

A need for (more) data about habitats

Integration of ecological processes

Connectivity / Vegetation Sensitivity Index / Net primary productivity
Pollination / Evapotranspiration / Soil erosion protection





Marxan
Informing Conservation Decisions Globally

Natura 2000 potential sites in Central Anatolia

Ficha de ZEC

Driade: N2K management system

Close

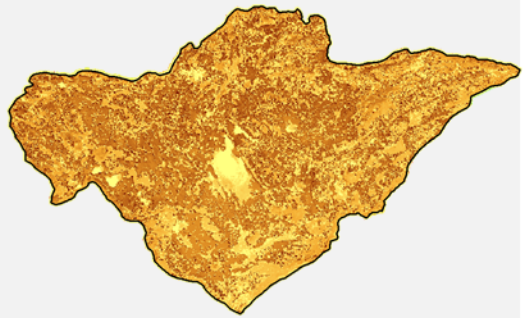
ZEC 00003 Code TR610002

Code 4210 Habitat Dry heathlands

Conservation status | Distribution area | Structure and Function | Future perspectives | Global Evaluation

Area: Ha

Mapa: Place | Region | Turkey | UE | Word



Last update:

Quality of the data

Tendency:

Obs:

Bibliography:
- Sanz-Azkue I. & I. Olariaga. Uribe-Echebarría P. M., I. Zorrakin, J. A. Campos & A. Domínguez.

Impacto negativo			
R	Código	Presión/Amenaza	O
A	A04.03	Abandono de los sistemas de pastoreo	
A	A08	Uso de fertilizantes	
M	D01.01	Sendas, pistas, carriles para bicicletas	
M	B02.04	Eliminación de árboles muertos o deteriorados	
B	G091.02.03	Conducción motorizada todoterreno	☑
B	G05.01	Pisoteo, uso excesivo	
A	J03.01	Disminución o pérdida de las características específicas de un hábitat	
B	K01.01	Erosión	
M	K02.01	Cambios en la composición de especies (sucesión)	☑
M	I01	Especies invasoras y especies alóctonas	
M	M02.03	Declive o extinción de especies	

I: Intensidad; O: Observaciones

Impacto positivo			
R	Código	Actividad/Gestión	O
A	A04.02.02	Pastoreo de ovejas no intensivo	☑
M	A04.02.03	Pastoreo de caballos no intensivo	☑
A	A06.01.02	Cultivos anuales no intensivos para producción de alimento	☑
M	B02.05	Sacas no intensivas (dejando madera muerta/ árboles viejos intactos)	☑

	F	I	M	D
Área de distribución				
Estructura y función				
Perspectivas futuras				
Evaluación Global				

F: Favorable
I: Inadecuada
M: Mala
D: Desconocida

Observaciones:

Management plan

Save

José Manuel Álvarez-Martínez *et al.*
jm.alvarez@unican.es

it's your job

Gracias!

Flor Álvarez Taboada - AEET 2021

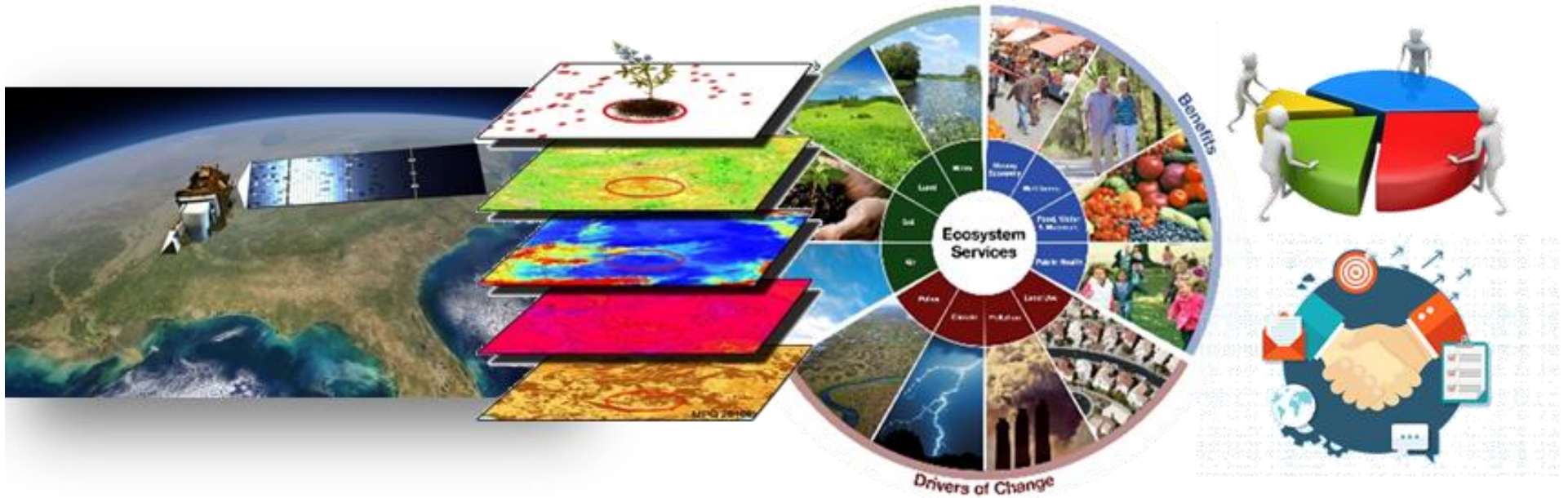
Jose Manuel Álvarez-Martínez
@JMAlvarezMtnez

Landscape management – from pattern to process & ES

www.project-alice.com

Improving the management of ATLANTIC LANDSCAPES: accouting for biodiversity and ecosystem services

ALICE



From satellite data to collaborative management

An innovative foundation sets **ALICE** apart from existing programs, by integrating social, economic and environmental analytical tools and models

Carlingford Lough

NORTHERN IRELAND

Located on the East Coast of Ireland straddling the border between Northern Ireland and the Republic of Ireland. The case study is a coastal embayment surrounded by mountains.

Paiva River

PORTUGAL

Paiva river is a tributary of the Douro, situated in Northern Portugal and it is considered one of the least polluted in Europe.

ALICE

4 KEY DEMONSTRATION SITES ACROSS THE ATLANTIC AREA

Couesnon Catchment and Estuary

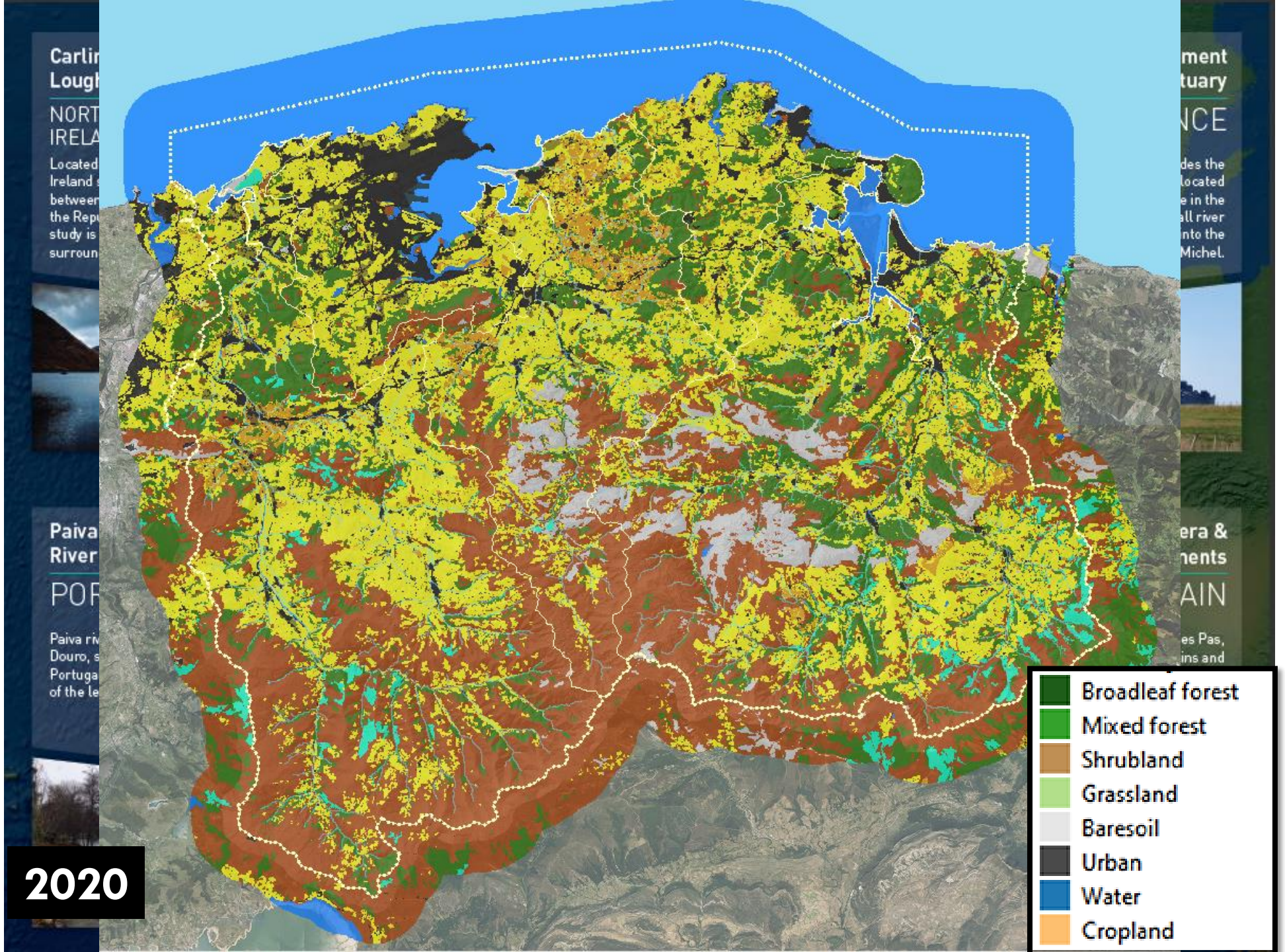
FRANCE

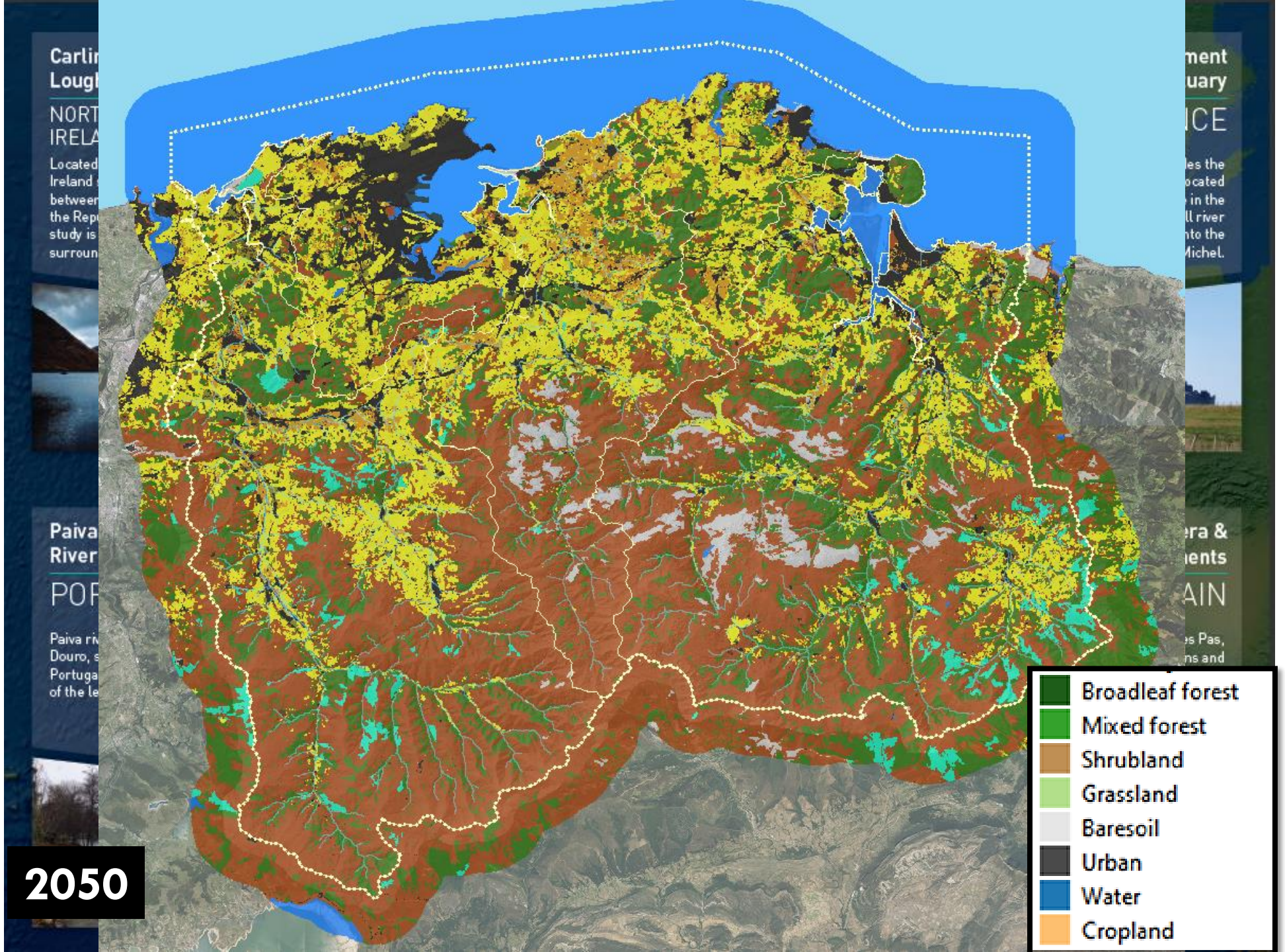
The Case Study includes the Couesnon river catchment located in North-Western France in the Armorican massif. This small river catchment discharges into the bay of Mont-Saint-Michel.

Pas, Miera & Asón Catchments

SPAIN

The study case encompasses Pas, Miera and Asón river basins and estuaries, located in Northern Spain. The basins are enclosed in the oriental part of the Cantabrian Cordillera.


2020
Broadleaf forest
Mixed forest
Shrubland
Grassland
Baresoil
Urban
Water
Cropland


2050
Broadleaf forest
Mixed forest
Shrubland
Grassland
Baresoil
Urban
Water
Cropland

Ecosystem Services Characterisation

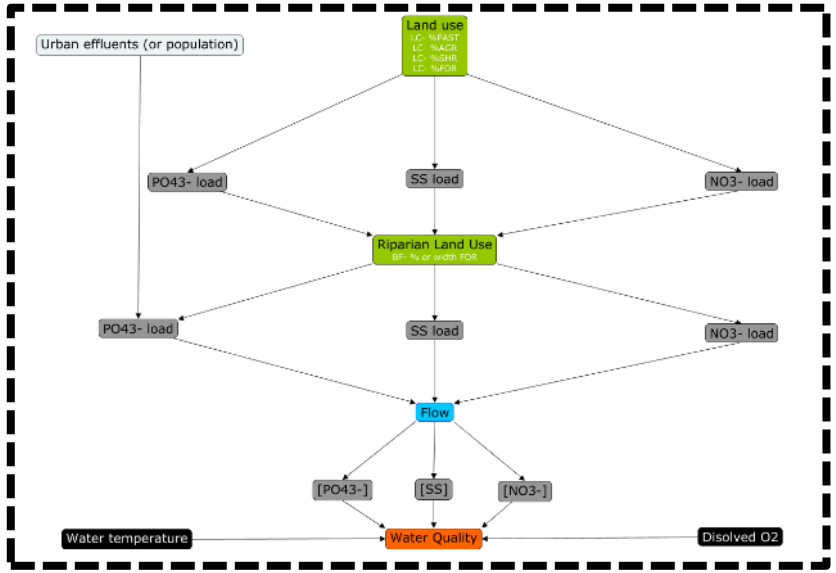
Terrestrial Ecosystem	River Ecosystem	Estuarine Ecosystem
1. Meat production	8. Water Quality	13. Water Quality
2. Milk production	9. Fisheries	14. Fisheries
3. Forestry products	10. Recreation / Tourism	15. Recreation / Tourism
4. Carbon uptake	11. Water purification	
5. Erosion Control	12. Flood protection	
6. Recreation / Tourism		
7. Amount of water		

Biodiversity / Conservation Diagnosis

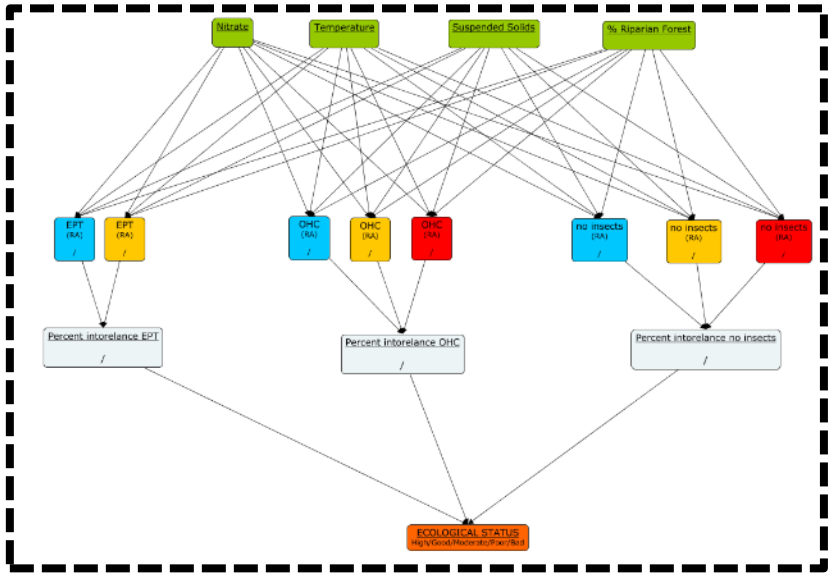
16. Terrestrial Biodiversity	20. Habitat Conservation Status
17. Freshwater Biodiversity	21. River Ecological Status
18. Estuarine Biodiversity	22. Estuarine Ecological Status
19. Heritage	

k.LAB
Knowledge Integrated Modelling

8. Water Quality



17 & 21. F. Biodiversity & Ecological status



BGINs – Different ES across the landscape

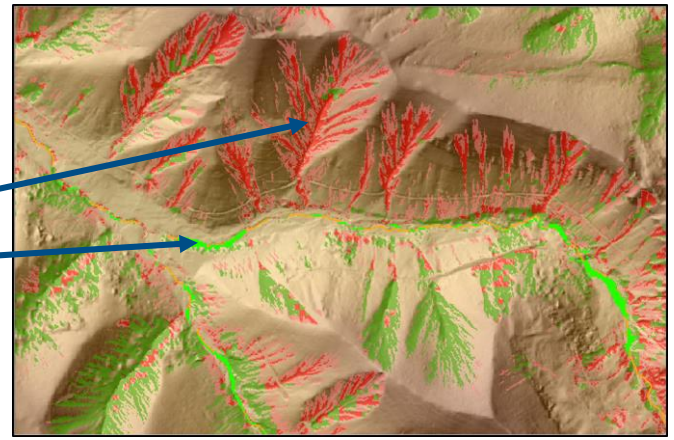
Identification of functional hotspots: provision of ES

Regulating ES

Erosion and soil loss

Hillside forest

Riparian forest



Flood protection and hydrological regulation

Hillside forest

Floodplains

Volumen of water stored (m^3)

High : 5.95067

Low : 0

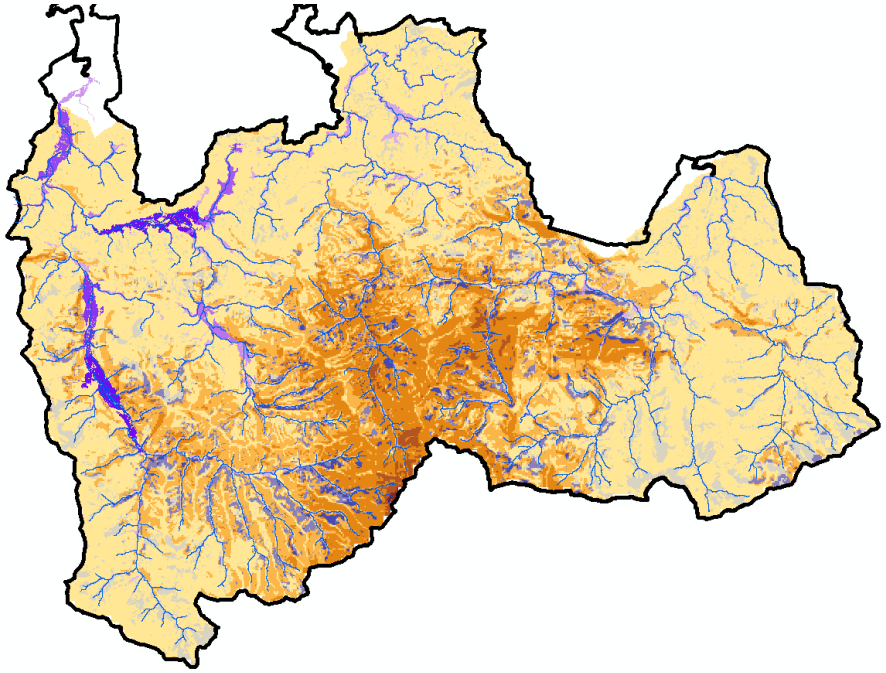
Protection Restoration

Runoff regulation index

-0.833925962 - -0.6
-0.6 - -0.3
-0.3 - -0.1
-0.099999999 - -0.05
-0.05 - 0
0 - 0.05
0.05 - 0.1
0.100000001 - 0.3
0.3 - 0.6
0.6 - 0.827385367

Lower Restoration

Higher Protection



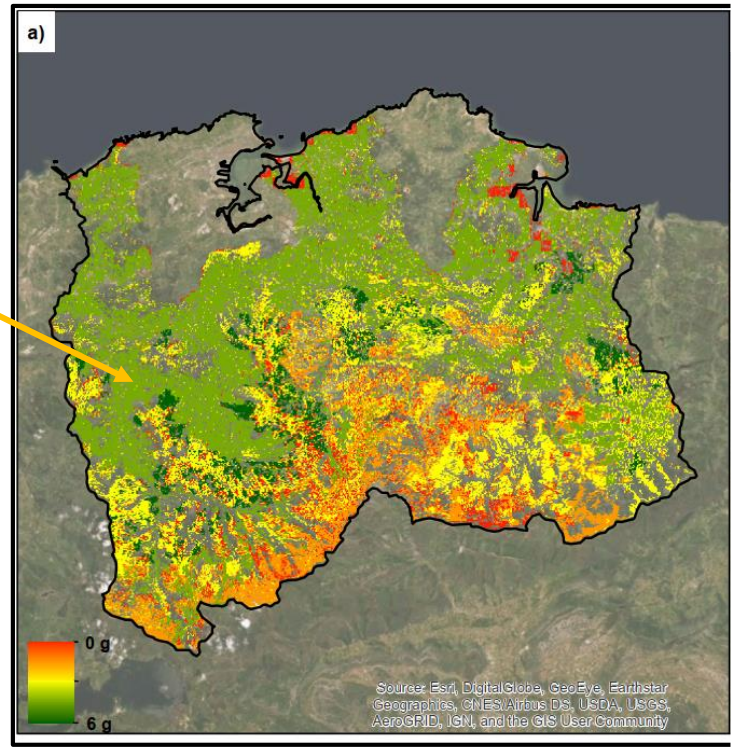
BGINs – Different ES across the landscape

Identification of functional hotspots: provision of ES

Provisioning ES

Livestock production

Pastures



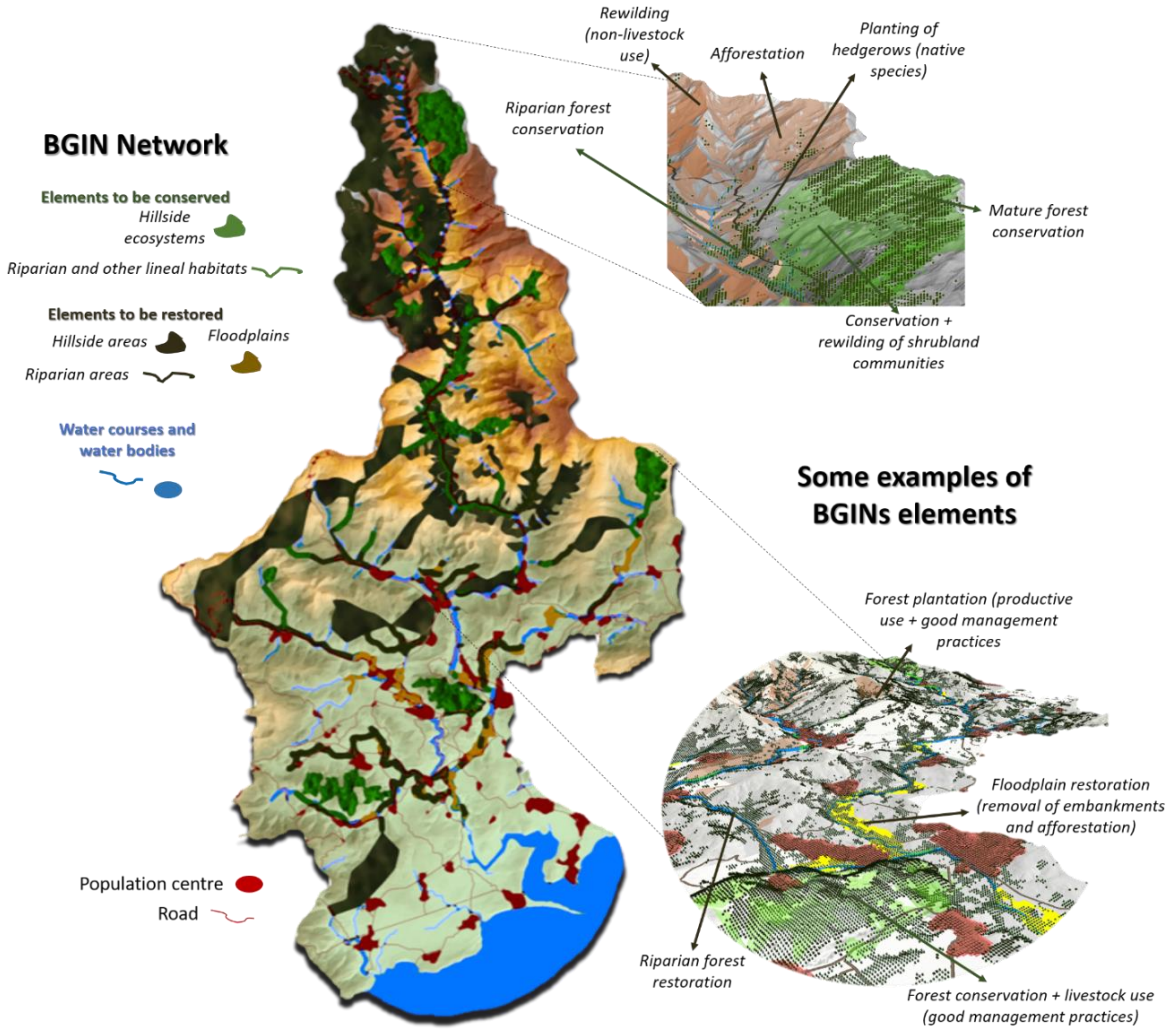
Crecimiento potencial de la vegetación herbácea
(restricciones topo-climáticas)

Protection

BGINs – Blue and Green Infrastructure Networks

Landscape planning instrument

Red de Infraestructura Azul y Verde:
Blue and Green Infrastructure Network (BGIN)



A strategically planned network of high quality natural and semi-natural ecosystems/ habitats that is designed and managed to

- deliver a wide range of Ecosystem Services (ES) and
- to protect biodiversity in both rural and urban settings.

Five main features:

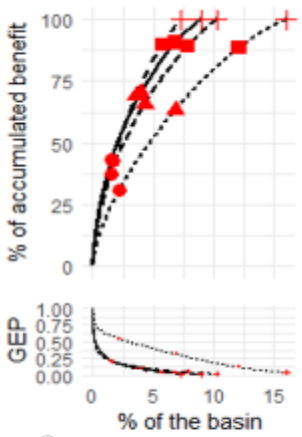
- Blue-Green nature. Constituted by Nature Based Solution (NBS)
- Multifunctionality. Ecosystem Services paradigm.
- Connectivity. Spatial coherence (biodiversity and functional).
- Multi-scale. Fractal structure
- Socio-ecosystems. Stakeholder engagement

BGINs – Functional hotspots across the landscape

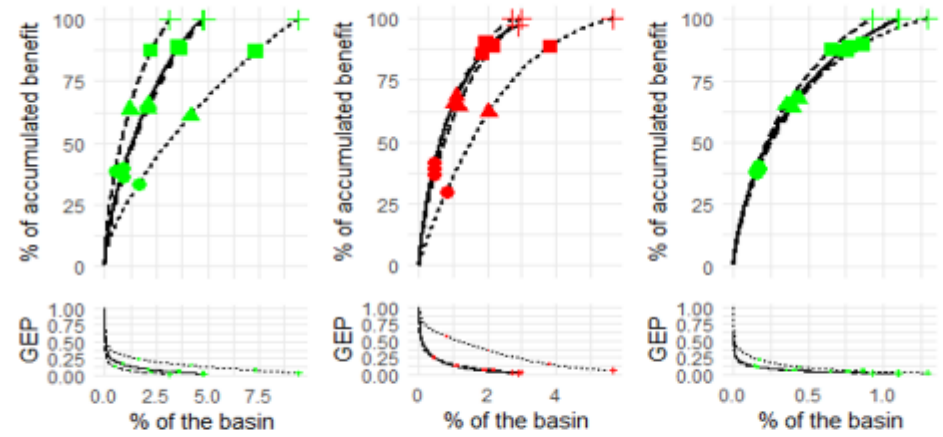
La observación remota aplicada al seguimiento de los ecosistemas

Identification of functional hotspots: provision of ES

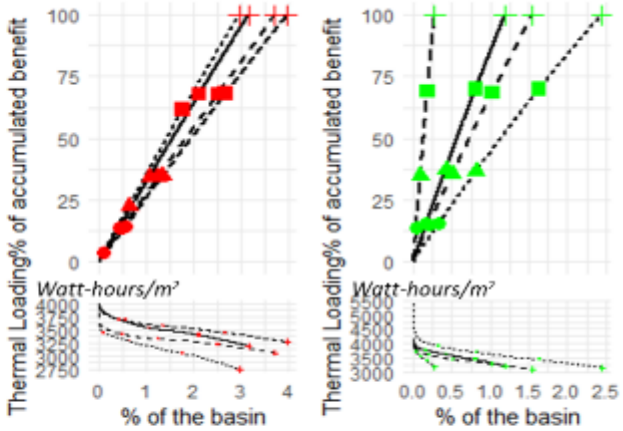
Erosion and soil loss

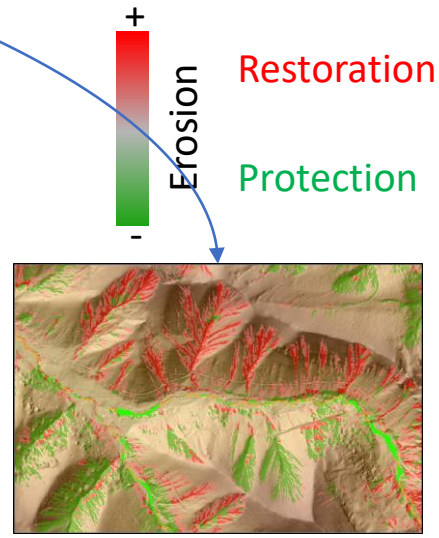


Sediment filtering

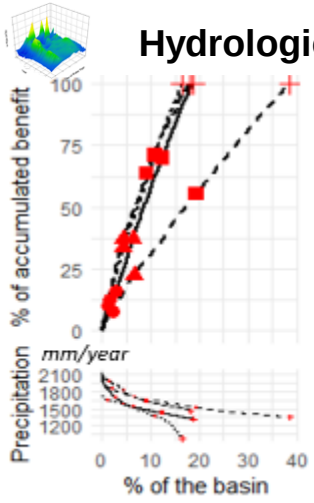


Water temperature

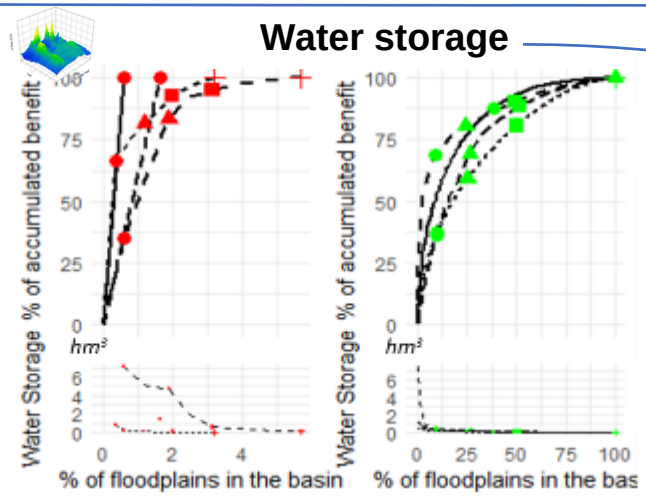




Hydrological response



Water storage

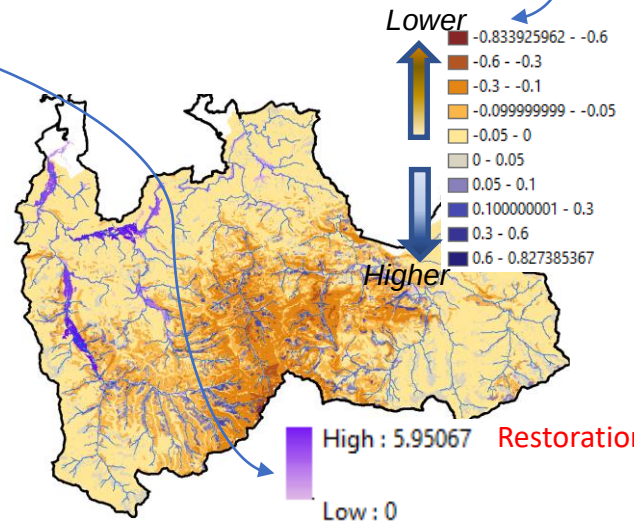


Catchments

- Deva
- Pas
- Miera
- Asón

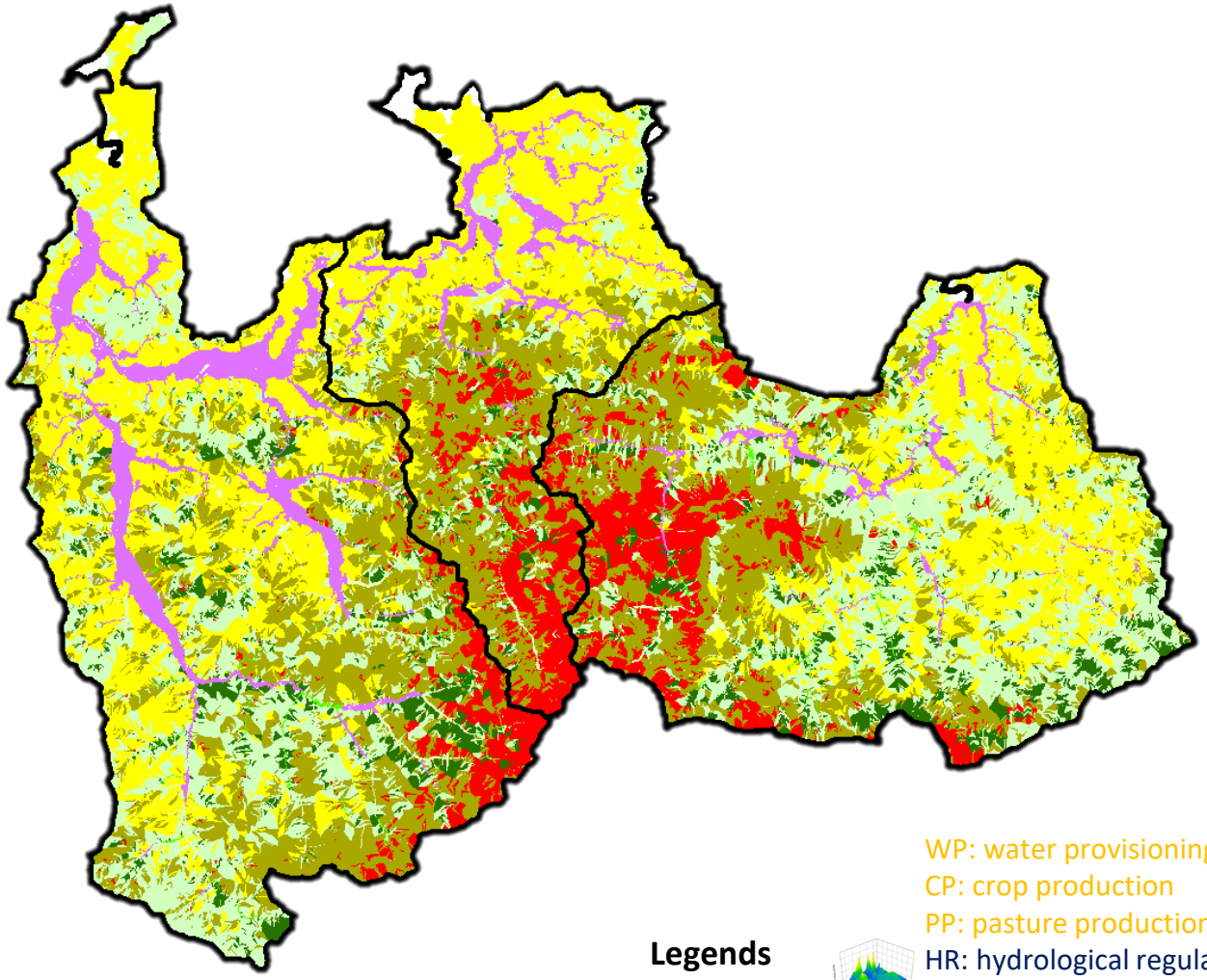
Prioritisation

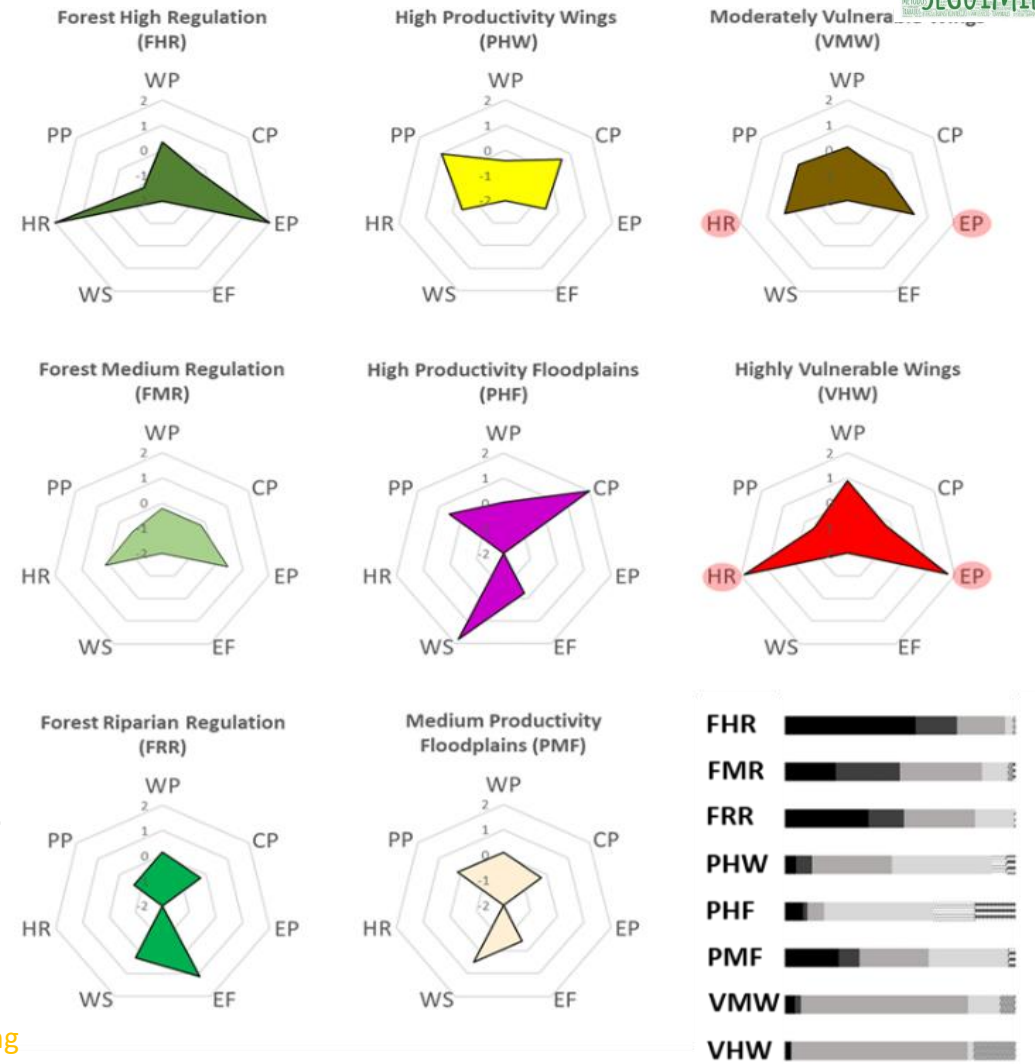
- p10
- p25
- p50
- p75



BGINs – Bundles of ES

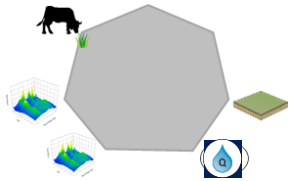
Spatial optimization: relationships between ES





Legends

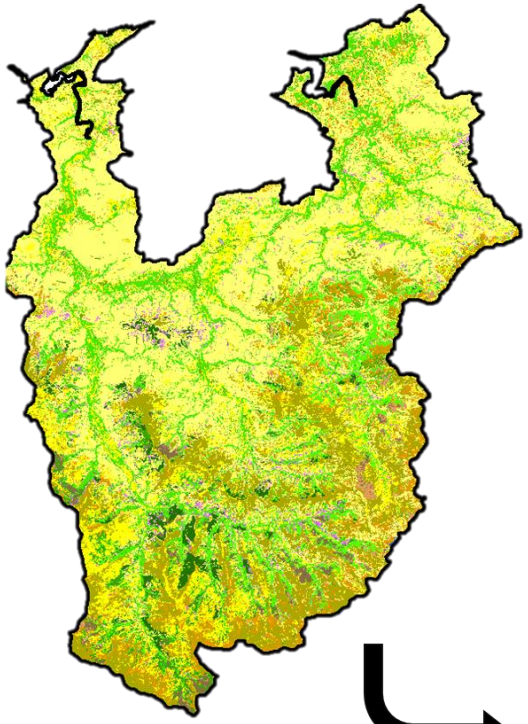
WP: water provisioning
CP: crop production
PP: pasture production
HR: hydrological regulation
WS: water storage
EF: erosion filtering
EP: erosion protection



Native forest
Forestry land
Shrubland
Grassland
Agricultural land
Rock
Urban land

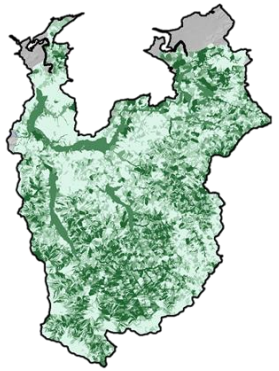
BGINs – Conservation of biodiversity

A) Biodiversity (habitats)



- Rugh grass and Gorses
- Nardus stricta wards
- Unbroken pastures
- Medio-European submontane hay meadows
- Sub-Atlantic Pteridium aquilinum fields
- Mowing grasses
- Healths
- Dry healths
- Southern Palearctic mountain dwarf scrub
- Calciphyte bushes
- Sub-montane [Vaccinium]-[Calluna] heaths
- Mixed riparian floodplain and gallery woodland
- Thermophilous deciduous woodland
- Acidophilous [Quercus]-dominated woodland
- Meso- and eutrophic oak hornbeam ash
- Beech forests
- Holm/Kermes Oak forests
- Eucalyptus plantations
- Native conifer plantations
- Oro-Cantabrian calcareous screes

Habitat diversity at landscape scale



nº habitats

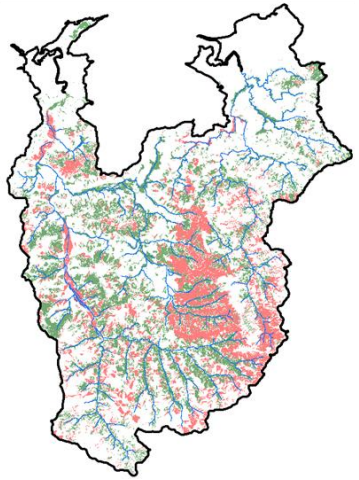
14

0

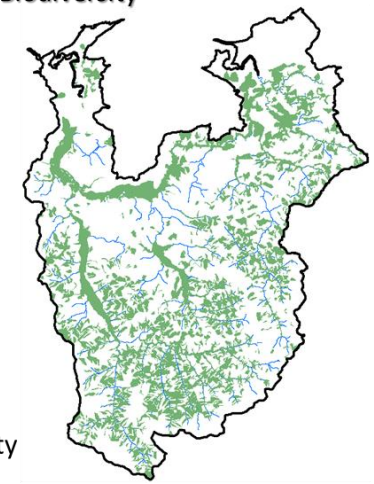
Biodiversity hotspots

B) Functional and multifunctional hotspots

Provision of ES ("Trend Optimized" scenario)



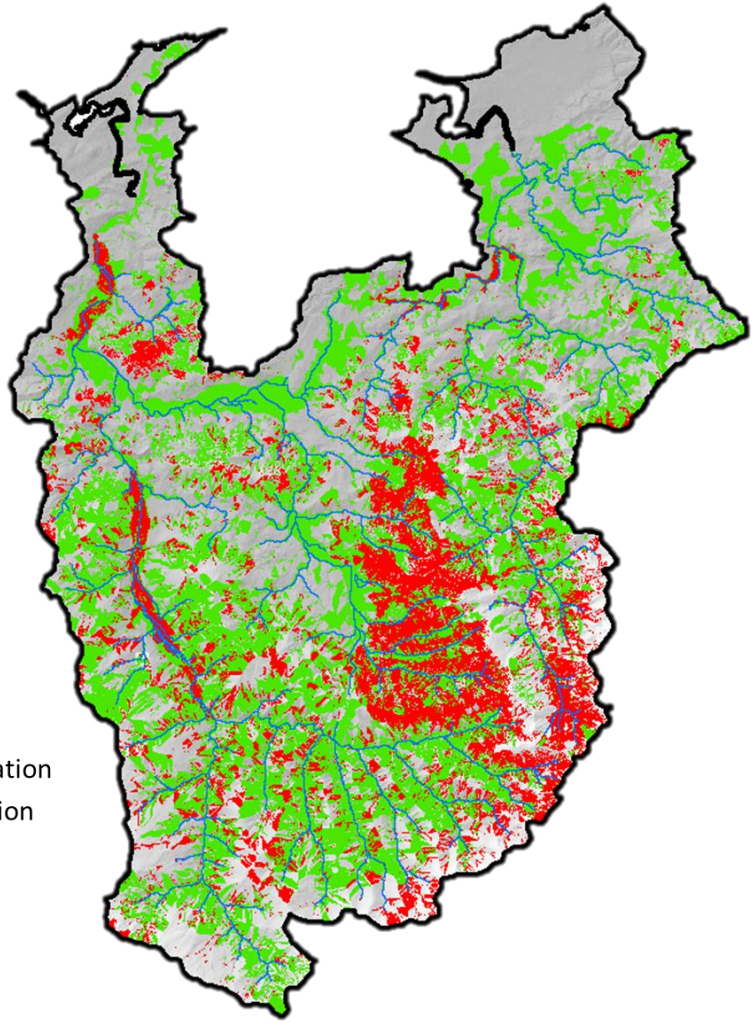
Biodiversity



Conservation

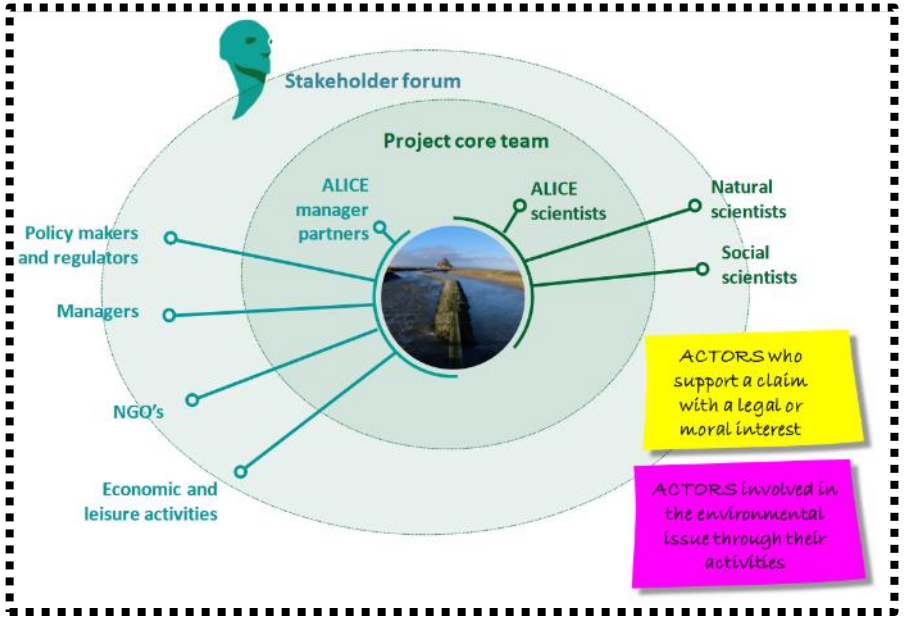
Restoration

BGIN



Stakeholder engagement processes: Towards participative learning

ALICE SH Forum



Stakeholder participation process in the 4 CS

W2: Barriers, BAU scenario, Local strategies

ALICE final congress

W1: Concept mapping

W3: BGIN scenario

Review of barriers and assessment of willingness to pay ecosystem services

Barrier type & Name	Strategy 1: Common lands	Strategy 2: Floods	Strategy 3: Forestry
Institutional & Governance			
Clear leadership	H	H	H
Roles and governance responsabilities	H	M	M
Interagency & Interinstitutional cooperation	M	H	M
Long term vision (Adaptive management)	H	M	H
Legislation & regulation	M	M	M
Lack of Climate Change policies	L	L	L
Competing priorities	H	H	H
Socio-cultural behaviour			
Cultural Behaviour	H	H	H
Societal perception of BGINs	H	H	H
Community Empowerment	H	M	M
Impacts on perceived actual and future LU	H	H	M
Lack of successful stories	L	L	M
Knowledge status			
Institutional experience	H	M	M
Negative experiences	L	L	L
Lack of general knowledge on BGINs	H	M	M
Lack of technical guidance	H	M	L
Lack of clear cause-effect relationships	M	M	L
Technical and Biophysical			
Onsite limitations	L	L	L
Design challenges	M	M	L
Construction challenges	M	M	L
Maintenance & performance challenges	M	H	M
Funding & Market			
Lack of funding	M	M	M
Linking providers and users	M	H	M
Estimating prices and costs	M	L	L
Finding appropriate PES & MES	H	H	M

ALICE has made a literature review about barriers for the implementation of NBS and BGINs (Deely *et al.*, 2020).

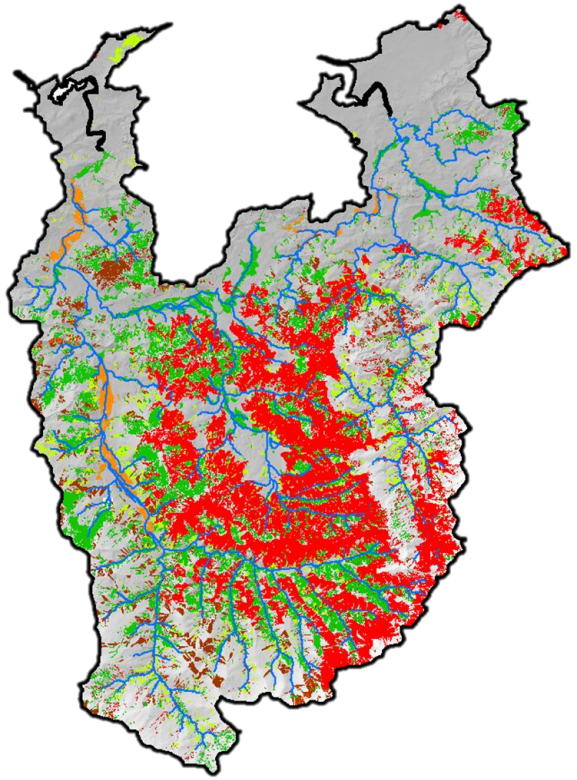
ALICE has also explored the willingness to pay for specific components of a BGIN in relation to the reduction on fire risk (Spain), flood risk (France & Northern Ireland).

BGINs – Blue and Green Infrastructure Networks 2.0

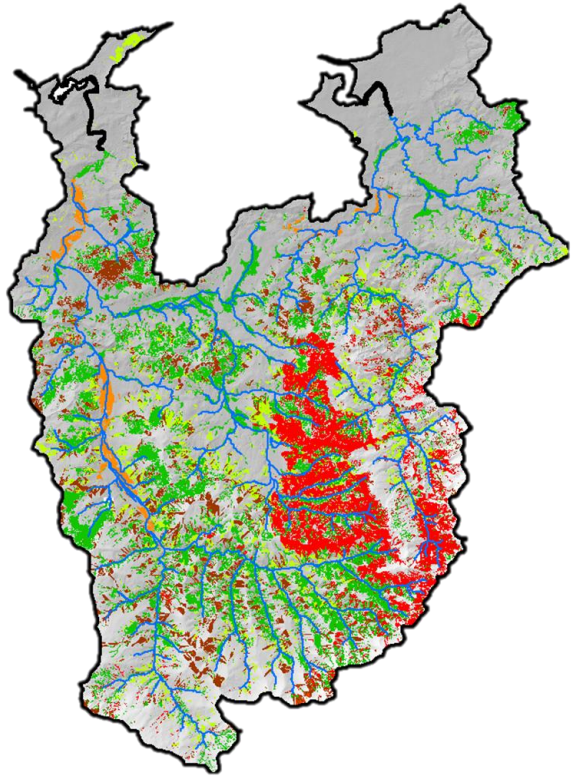
La observación remota aplicada al seguimiento de los ecosistemas

Design of BGIN: functional structure (provision of ES)

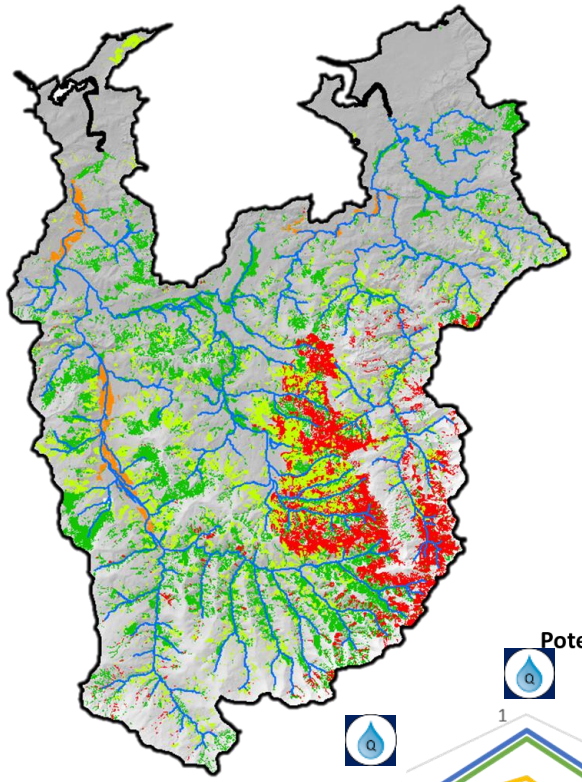
Maximum Potential



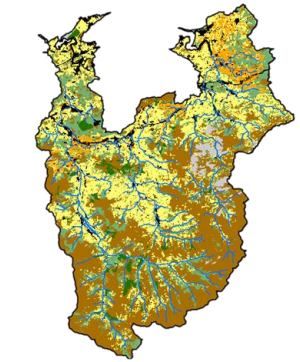
Trend Optimized



Productive Preservation



Current Situation



- Native broadleaf forest
- Plantation
- Shrubland
- Grassland
- Agricultural
- Baresoil
- Urban

Type of functional and multifunctional hotspots for Ecosystem Service provision

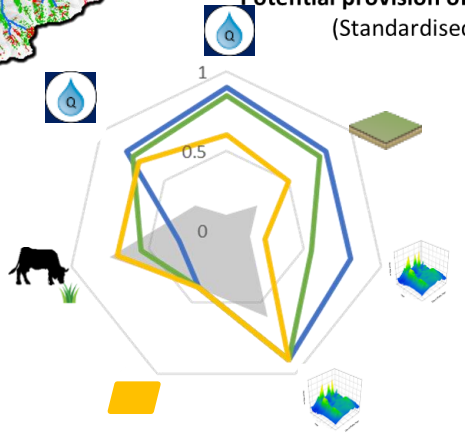
BGIN components

Core areas for ES

Functional linkers

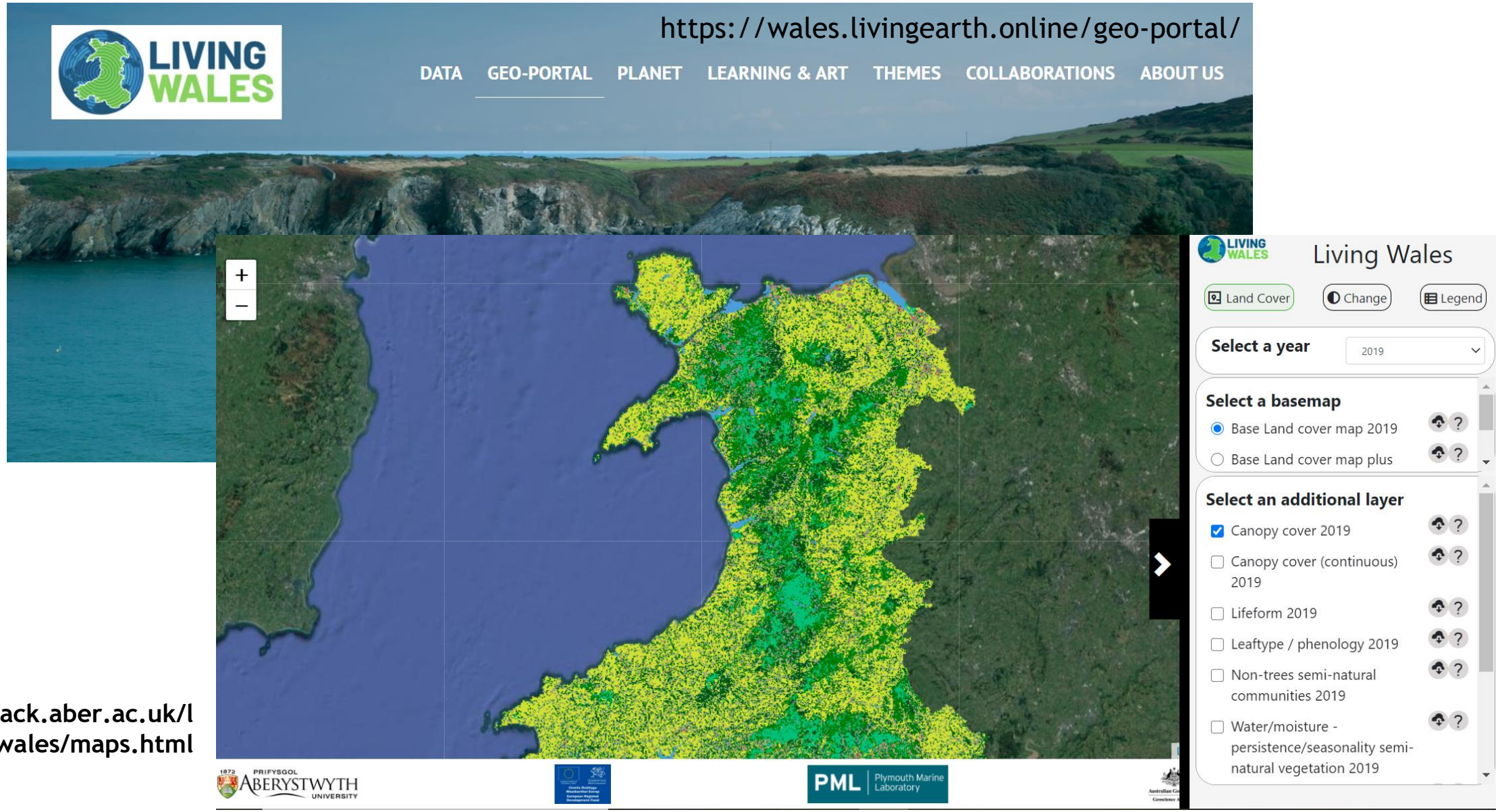
- Pasture conservation
- Forest and floodplain conservation
- Habitat restoration to forest
- Areas in rewilding (passive restoration to forest)
- Floodplain restoration (levee removal)
- River network

Potential provision of Ecosystem Services
(Standardised scale: 0-1)



TR: Riparian Thermal Buffer
SF: Riparian Sediment Filtering
EP: Erosion Protection
HR: Hydrological Regulation in hillsides
WS: Water Storage in floodplains
CP: Crop Production
PP: Pasture Production

IHCantabria & Copernicus – new web 2.0 (data and methods)



earthtrack.aber.ac.uk/livingwales/maps.html

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it's your job

Gracias!

Flor Álvarez Taboada - AEET 2021

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