European Environment Agency

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European Biodiversity Partnership

Ministry of Environment of Denmark
Environmental Protection Agency

Webinar “Mapping habitats by combining satellite and other data »

Co-organised by the EEA, the Danish Environment Agency and Biodiversa+

20th of January 2023 – 10am to 3pm CET

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Part 1- EU section

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Welcome words and purpose of the meeting

By the EEA, Danish Environmental Protection Agency and Biodiversa+

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Environmental Protection Agency

Short Introduction to Eionet and the new ways of working

Online Webinar - Mapping habitats by combining satellite & other data

20th January 2023

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Timeline – EEA and Eionet History

1972
- Stockholm Conference
- 1st EAP

1990
Regulation on the EEA and Eionet adopted

1993
Entering into force after a decision to locate the EEA in Copenhagen

1994
Domingo Jiménez-Beltrán becomes first ED

1995
- The Dobris Assessment
- First SOER
- First ETCs established

1997
- Installation of the Eionet telematics network
- Extension of the Eionet to the entire PHARE area

1999
- Second SOER: Environment in the European Union at the turn of the century
- Amendment to the regulation

2000
Bosnia and Herzegovina, Serbia and North Macedonia become cooperating countries

2002
- The EEA is the first EU body to take in the Central and Eastern European countries as members. 11 countries join the EEA: Bulgaria, Slovak Republic, Slovenia, Latvia, Czech Republic, Hungary, Estonia, Lithuania, Romania, Malta and Cyprus
- Albania and Montenegro become cooperating countries
- Gordon McInnes becomes interim ED

2003
- Jacqueline McGlade starts as ED, Gordon McInnes becomes Deputy Director
- Turkey and Poland become an EEA member countries
- Third SOER

2004
The first Core Set of Indicators is launched

2006
Switzerland becomes an EEA member country

2008
Work to establish a Shared Environmental Information System (SEIS) starts in earnest

2010
- Fourth SOER
- EEA participates in the GMES

2011
Kosovo becomes a cooperating country

2012
External evaluation of the EEA

2013
- Hans Bruyninckx starts as ED
- Croatia becomes an EEA member country

2015
Fifth SOER

2018
NRC Review

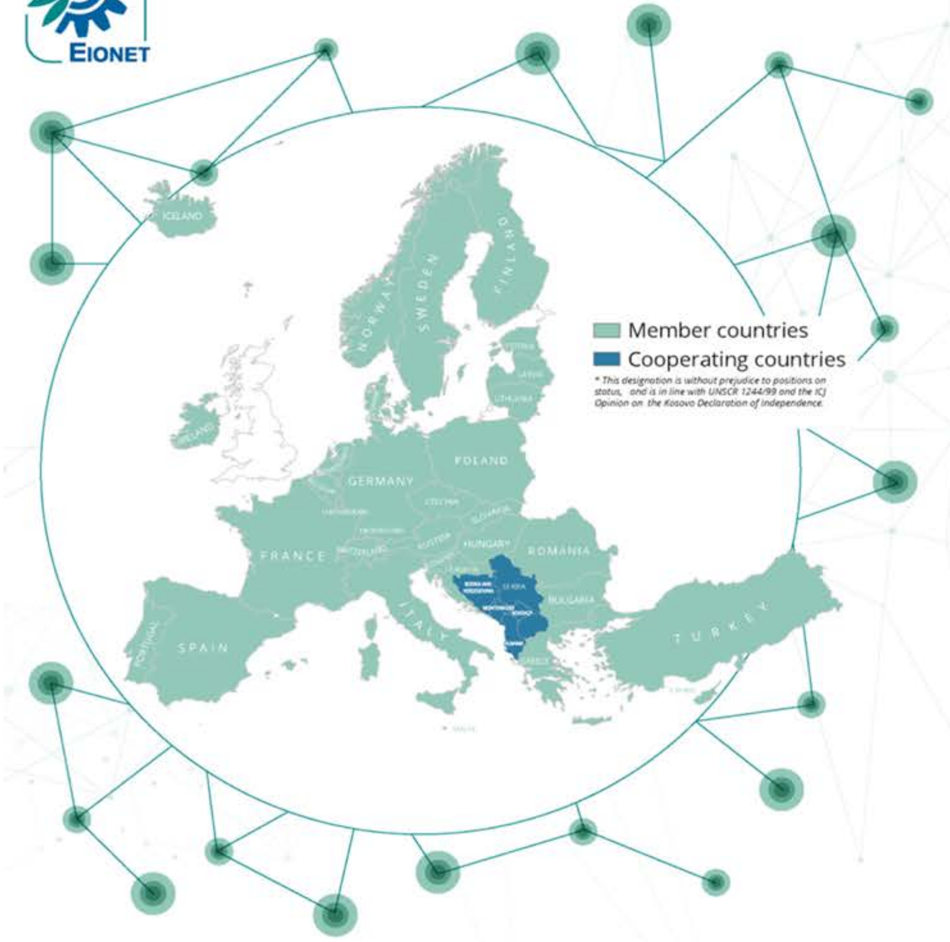
2019
- Sixth SOER
- The new European Commission under President Ursula von der Leyen sets climate and environment protection as top priority

2020
Eionet modernisation process started

2021
- The UK leaves the EEA
- New EEA – Eionet Strategy 2021-2030 enters into force

2022
Implementation of the Eionet modernisation outcomes

European Environment Information & Observation Network - Eionet



Who we are

38 countries

More than **400 institutions**

Around **2,000 experts**

Organised in **13 Eionet groups**

Supported by experts in **8 European Topic Centres**

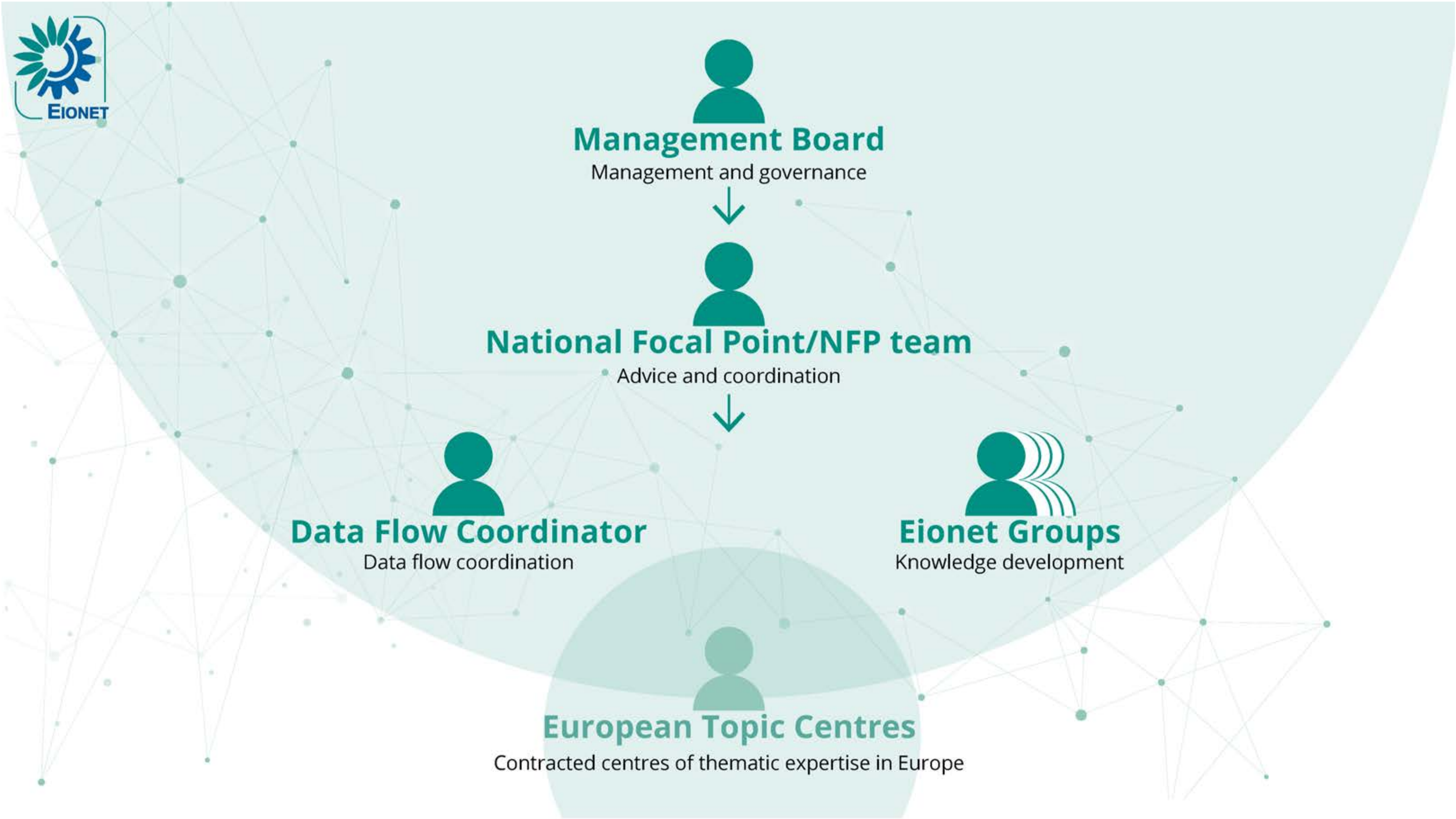
What we do

Delivering **data, information and knowledge**

The European environment — state and outlook

Support for **EU and National policy**

Eionet governance



Eionet Groups, Thematic & Working Groups

Eionet Groups

- reflect the EEA Eionet Strategy's five Work Areas, and their integrative /systemic nature,
- better connect the strong country level expertise to the European level,
- facilitate sharing of policy relevant knowledge across EEA member countries, and
- strengthen the network's added value for countries and the EEA.

- Expert **Thematic Groups** - defined within some Eionet groups to assist countries with the transition to a more integrated thematic structure.

- Flexible **Working Groups -** designed to work on specific joint projects by interested countries.

European Environment Information & Observation Network - Eionet

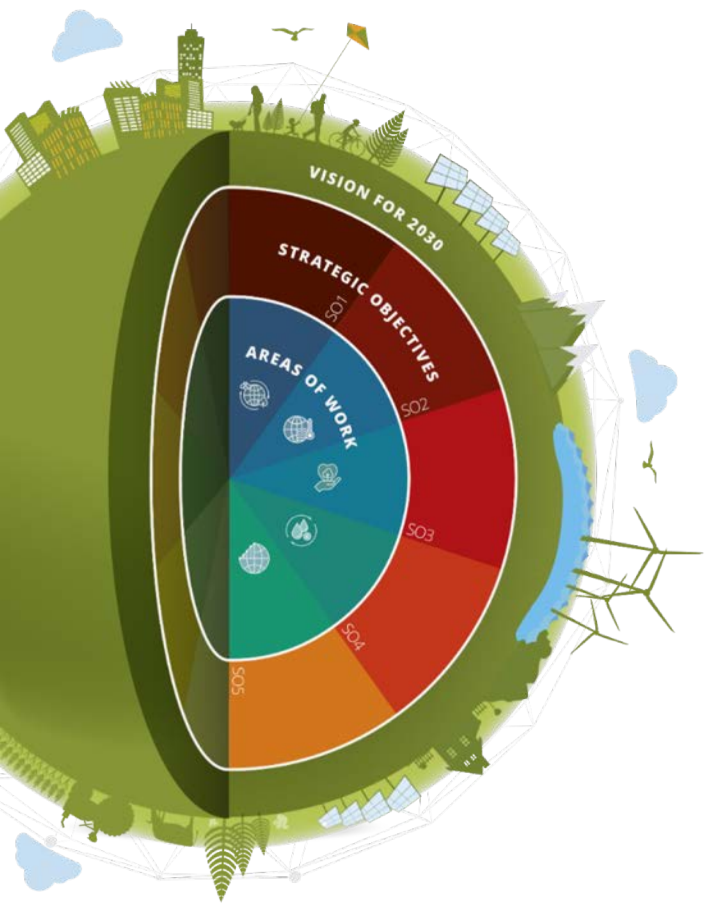
Areas of work

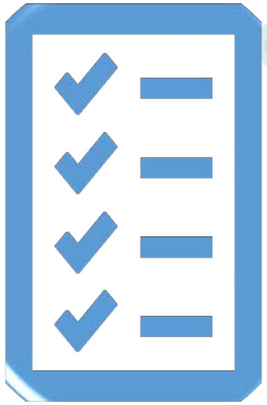
13 groups

ETG Biodiversity Monitoring
ETG Water
ETG Marine
ETG Sustainable Forests

- Biodiversity and Ecosystems 1 **Integration of knowledge for policies**
- Biodiversity and Ecosystems 2 **Cumulative pressures and solutions**
- Circular Economy and Resource Use
- Climate Change Impacts, Vulnerability and Adaptation
- Climate Change Mitigation and Energy Systems
- Communication
- Data, technologies and digitalisation
- Food Systems
- Foresight
- Human Health and Environment
- Land Systems
- Mobility Systems
- State of the Environment

Roles and Responsibilities within EIONET





EEA

- Providing policy guidance, strategic direction
- Facilitation of co-creation process
- Ensuring link with EEA-Eionet

Countries

- Identification of national priorities and stakeholders
- Mobilization of experts
- Ensuring link with national priorities and projects

Shared

- Initiation of co-creation
- Prioritization of co-creation projects,
- Co-leading co-creation projects
- Identification of best practices, sharing good examples and lessons learnt

ETC Involvement:

In case a co-creation project involves an ETC, involvement of that ETC in that specific co-creation project should be embedded in the ETC annual workplan.

Eionet Governance within the Biodiversity and Ecosystem Programme

4 Eionet groups instead of 7 NRC

- Eionet Group B&E #1 – Integration of knowledge for policies
- Eionet Group B&E #2 – Drivers of change and solutions


Biodiversity related:

- Eionet Group Food system
- Eionet Group Land system

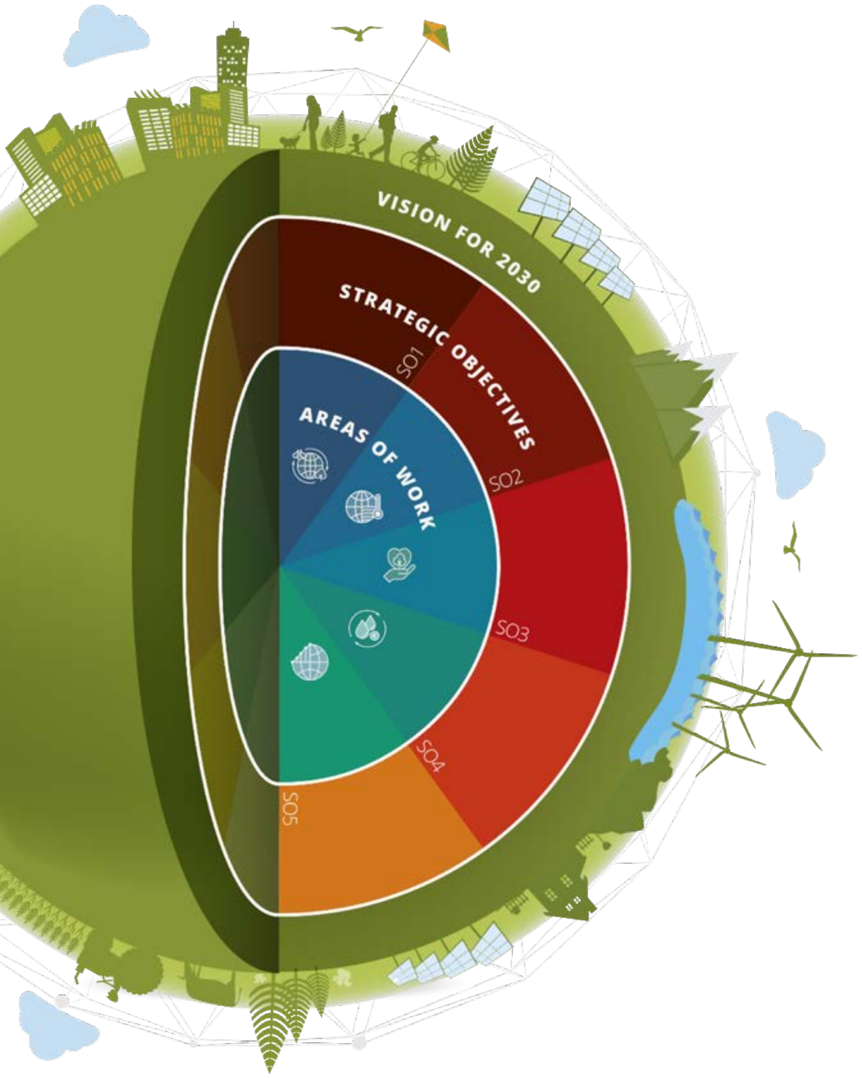




4 Eionet Thematic groups under B&E #1 :

- Biodiversity monitoring (former NRC biodiversity – Indicators systems, innovation in monitoring, data integration)
- Water (former NRC Water emissions, NRC Water quality, NRC Water quantity – Data acquisition beyond environmental acquis)
- Marine/oceans (former NRC Marine – marine and transitional waters, ocean protection)
- Forest ecosystems (former NRC Forest – Forest information and monitoring)

Modernised Eionet network

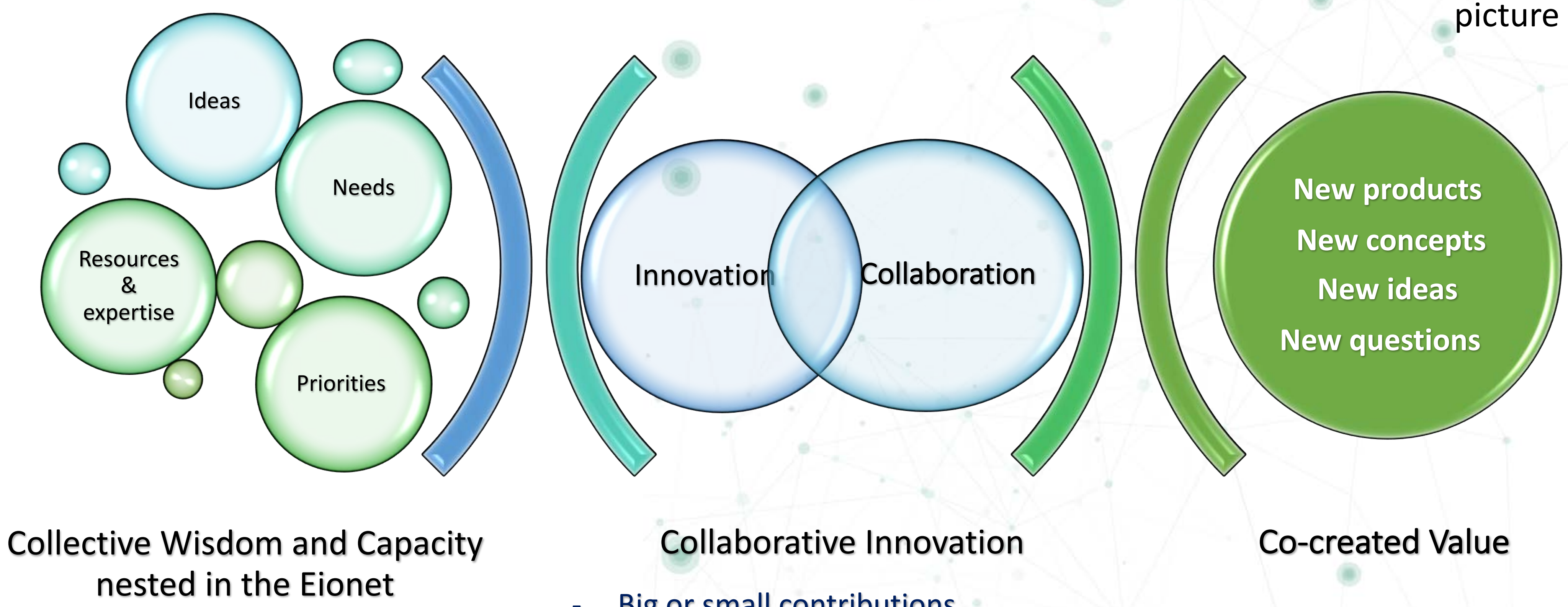


- **New priorities.** EEA-Eionet Strategy: increasing capacities on **solutions towards sustainability**
- **New working methods**. Encouraging **flexibility**, **responsiveness**, joint learning, innovation, **co-creation…**

Ensure greater and clearer **added value for the countries** - *develop a more joint/co-led network community*

What is Co-creation?

Solutions and innovations lay not in one institution or one viewpoint, but in the bigger picture of collective intelligence.



- Big or small contributions
- Different levels of engagement
- Takes time, dedication, and space for trial and error

Building from the previous Eionet meetings

March
What are the most interesting areas for more information/ action/ involvement?
Specific and open questions: AP 2022 and challenges and issues in 2022 and beyond

Between March and July
Proposal for a workshop to look at BE with NFP

June
Exploration of 1st set of priority issues: presentations, Q&A
Challenges, opportunities, collaboration ideas

October
Exploration of 2nd set of priority issues, Q&A
Challenges, opportunities, collaboration ideas

2023
Use results to inform Eionet platform composition
Source experts for Eionet platform
Develop co-creation process for Eionet function

Set the **co-creation** spirit in motion

Start to define **priorities** together & **identify leaders** for specific work subjects

What countries are prioritising ?

What support is needed from the EAA?

What is the role of this group?

Huge interest from the group in many aspects of the **dataflows**.

High interest about involvement in relation to **consultations, indicators & assessments**.

Aspects such as **methodological aspects** , sourcing more and better data and **ensuring the application of emerging and leading-edge technology** will need to be in our Agendas.

2022 -2024 Eionet – BES EG1 Activities Overview

For a full overview check:

https://eea1.sharepoint.com/:w:/t/106InteractionswithEionet/Edcz7GZd07RPrkD6gCY01vsBTfc0vBccEn9T8SeScjFpDQ?e=h0sxEn

Preliminary Calendar

DATE	Meeting Title	Details
November 2022 (tbc)	Webinar for sharing knowledge about using artificial intelligence, remote sensing, machine-learning and similar to monitor habitats in Q4 2022.	Denmark and EEA leading. Norway, Italy, Spain have interest to present their own case studies
23/11 (tbc).	TG Biodiversity Monitoring –	Design the TG with 2 modules: overarching (similar to EGs and NFP sessions) and focused/pragmatic discussion on expert work on restoration. Management of expectation will be needed once the inception done.
January 2023 (tbc)	Kick-off meeting of TG W	Main goals are:

13

2022 -2024 Eionet – BES Activities EG1 Overview

Some examples:

DATAFLOWS

WISE SoE dataflows (WISE 1 – emissions to water; WISE 2 – biological data; WISE 3 – water quantity; WISE 5 – spatial data (non-WFD reporting countries); WISE 6 – water quality, etc.

INDICATORS

WAT 001 – Use of freshwater resources in Europe (Water exploitation index plus); CSI 019 - Oxygen-consuming substances in rivers; WAT 009 – Pesticides in rivers, lakes and groundwater;

ASSESSMENTS

Zero Pollution Action Plan Monitoring and Assessment Report (2024) - consultation scheduled Q4, 2023; 3rd river basin management plans;

OTHER CONSULTATIONS

Implementation of Artificial Intelligence in developing water balance in Europe; Developing the country profile on water resources, Antimicrobial resistance in the water environment; Organization of European Sea Forum

Resources considerations

The new concept of
“Projects of Eionet Priority (PEPs)”

- Have the potential to bring high added value for the entire Eionet
- Have a cross-cutting nature
- Strongly help to achieve strategic objectives set in EEA/Eionet strategy
- Involve all Eionet countries
- Are considered under SPD

Artificial Intelligence to Monitor Habitats

EEA's role in Habitat Mapping & EIONET involvement

Three things we would like to achieve today:

Countries:

- Sharing experience on what methods are used for habitat mapping
- Exploring how satellite data & digital methods can be used to enhance current approaches

EU level & Countries:

- Explaining the EU context and activities
- Exploring possibilities for working better together

Next steps:

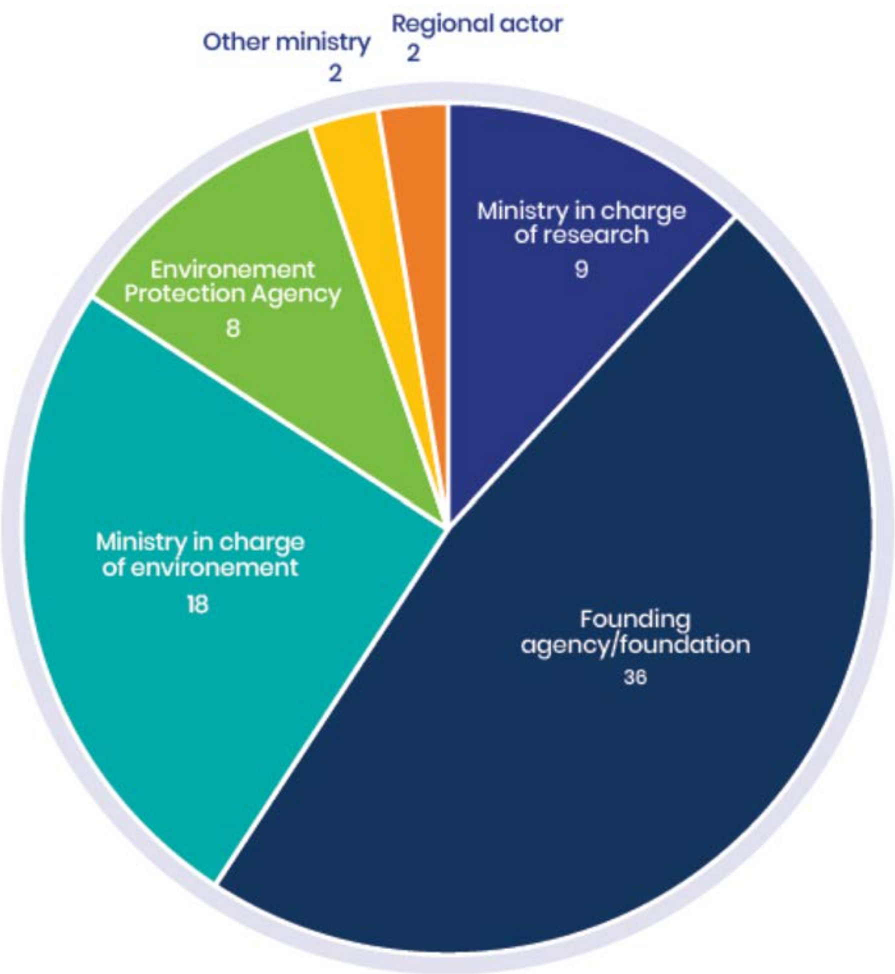
- Identifying the best ways of working together on this topic in the coming years
- Exploring policy use of habitat data, e.g. in nature restoration

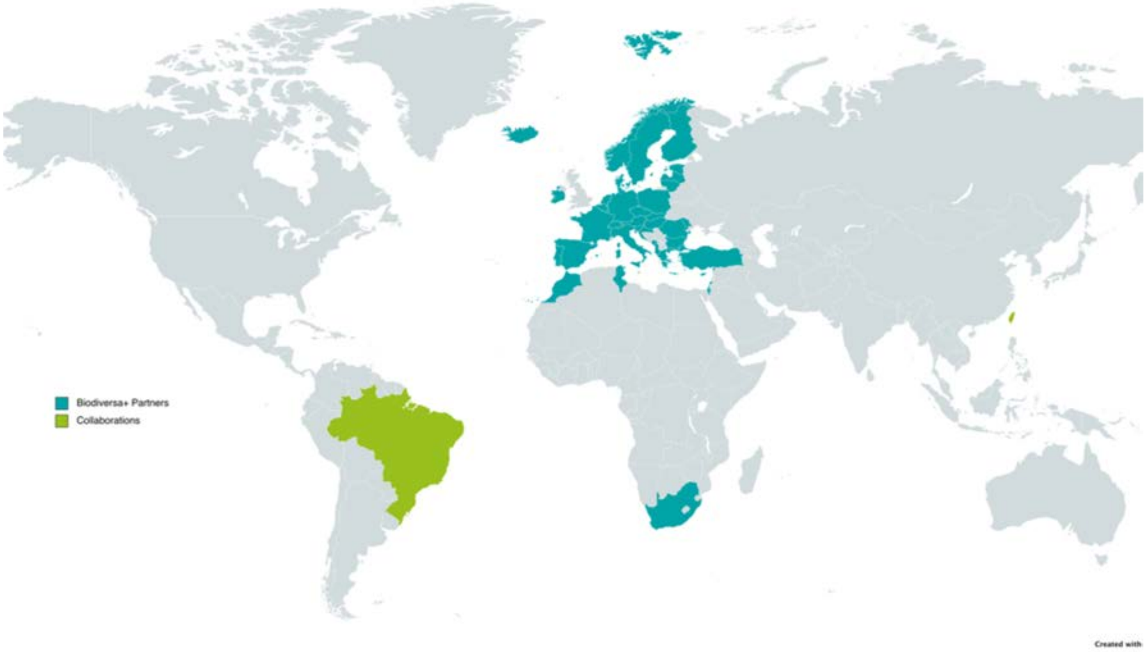
Thank you

Ana Tejedor | European Environment Agency

European Environment Agency

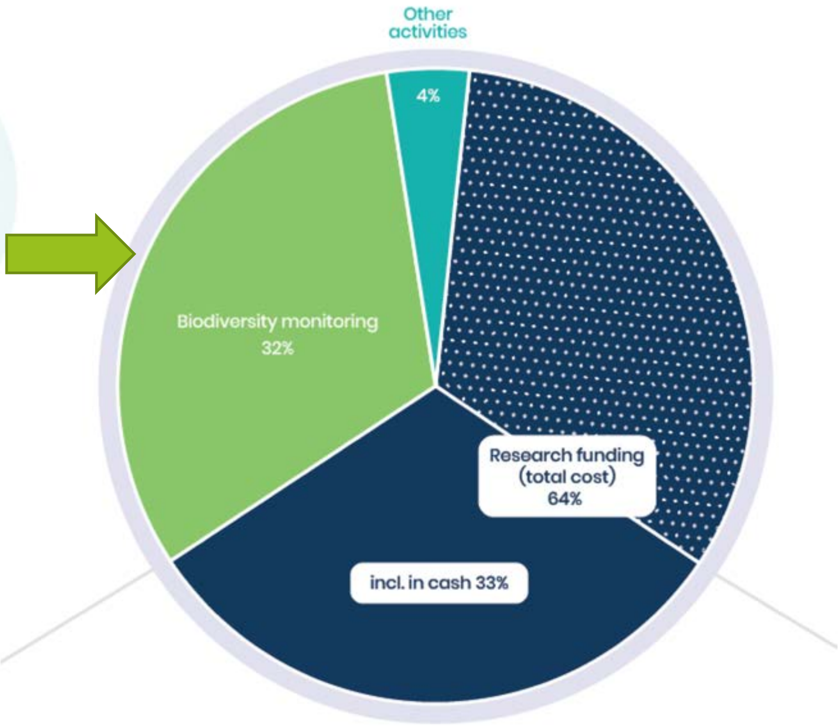
Biodiversa+ membership





Portfolio of activities and budget amplitude

Budget of >800 Mio € over 7 yrs, combining in-cash and in-kind resources from its Partners and including 165 Mio € by the European Commission



Co-funded by
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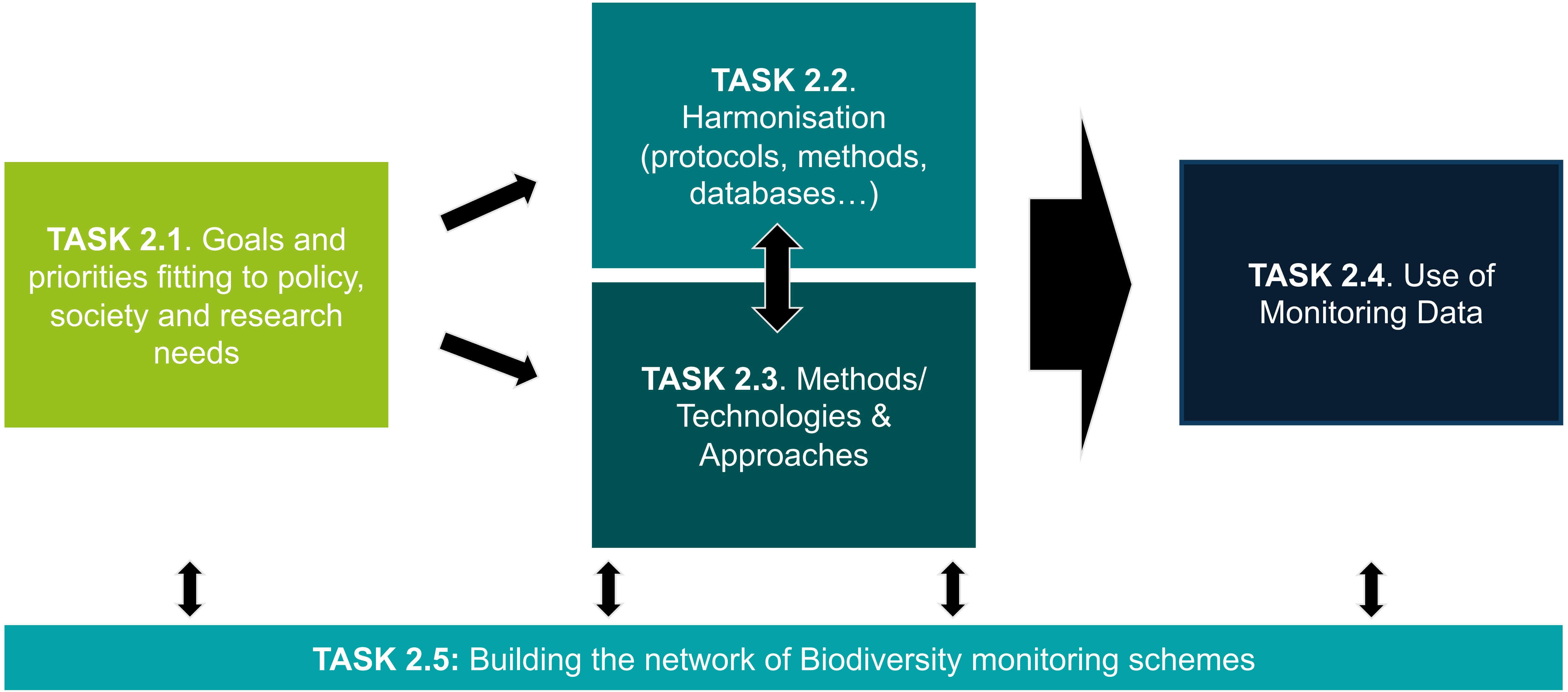
Workflow between Biodiversa+ tasks



Policy needs for habitat mapping data at EU level (overview and review of key data challenges)

By Jan-Erik Petersen, EEA

European Environment Agency

Ministry of Environment of Denmark
Environmental Protection Agency

Policy needs for habitat mapping data at EU level (overview and review of key data challenges)

Jan-Erik Petersen, EEA

European Environment Agency

1) What is habitat mapping for – an overview of functions

There are a wide range of analytical functions that habitat mapping data can have.

This presentation aims to give an overview of these functions and to discuss the data requirements associated with these different analytical uses. It is meant as a starting point for a further review of data needs, also in the context of EU discussions on future biodiversity and ecosystem monitoring.

Broadly speaking, one can distinguish four main functions:

a) Input to general environmental monitoring

b) Support to tracking (biodiversity) policy targets

c) Planning conservation actions / preventing habitat destruction

d) Enabling 'ecosystem-based management' / preserving natural capital & ESS

2) What are potential analytical purposes ?

1) Measuring trends in habitat extent and habitat condition – are these stable, increasing or decreasing => creates signals on the need to act (or not)

2) Identifying geographic areas of policy intervention – where habitats are at particular risk / decline => helps to direct policy programs + funding to areas of highest need

3) Directing concrete conservation and restoration action on the ground to achieve better conservation outcomes in specific locations (in N2000 areas & outside)

4) Integrating habitat protection into economic activities to achieve longer term sustainability => connects habitat data to socio-economic analysis / modelling

3) What are important data characteristics ?

1) Spatial detail and representativity: European, national, regional, local level ?
2) Ecological differentiation: EUNIS levels 2,3,4.., correspondence with Annex 1 of EU HD, correspondence with EU typology for ecosystem accounting, etc. ?
3) Estimated % accuracy of mapping exercise (for each patch / at NUTS or nat. level) ?
4) Regular data collection leading to stable time series ?
5) Other important quality criteria ?

4a) Which data characteristics for which analytical purpose ?

1) Signalling trends or threats
   - National level summary data can be enough
   - Stratified sampling or satellite-based extent mapping with 80-90% accuracy are fine
   - Such data are also useful in the context of reporting against policy targets
   - Precise ecological identification is important, spatial accuracy much less so (?)

2) Identifying geographic areas for policy intervention
   - Requires information at regional scale or below to be able to prioritise certain areas
   - Stratified sampling or satellite-based extent mapping of 80-90% accuracy are again ok as long as they enable comparing risk profiles of certain areas or habitat types against each other
   - Precise ecological identification is important, spatial accuracy needs to enable comparison between regions / locations (?)

4b) Which data characteristics for which analytical purpose ?

3) Directing concrete conservation and restoration action on the ground

- If habitat patches are small (e.g. up to a few ha) then spatial accuracy needs to match that (ie 10m grid or polygon level accuracy as likely minimum)
- In case of large ecosystem complexes (such as forest areas or high mountain pastures) then spatial accuracy can be coarser (?)
- Precise ecological identification is very important, otherwise wrong interventions can occur

=> low spatial and ecological accuracy bring a high risk of negative conservation outcomes !

4) Integrating habitat protection into economic activities

- In context of building or infrastructure development same standards apply as under 3)
- In context of building ecosystem accounts the requirements of statistical system apply
- When aiming to build a greener economy habitat data needs to be able to be linked to units or types of economic activity (eg specific farm & forestry enterprises or ‘pig production’ versus ‘extensive cattle systems’)

Thank you for your attention.

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Presentations on current EU level habitat mapping work, combining satellite with vegetation plot and other data

By Stephan Hennekens (WENR, The Netherlands)

European Environment Agency

Ministry of Environment of Denmark
Environmental Protection Agency

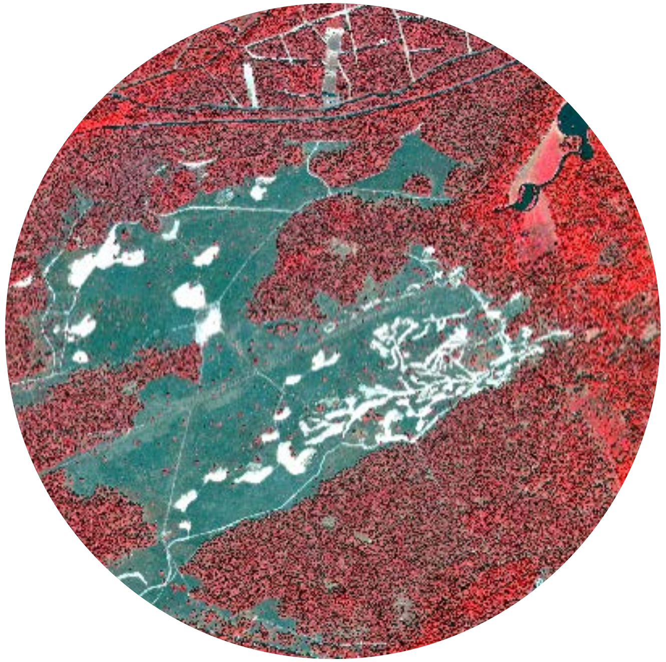
Modelling and Mapping Habitats at European and Regional Scale using AI/ML techniques

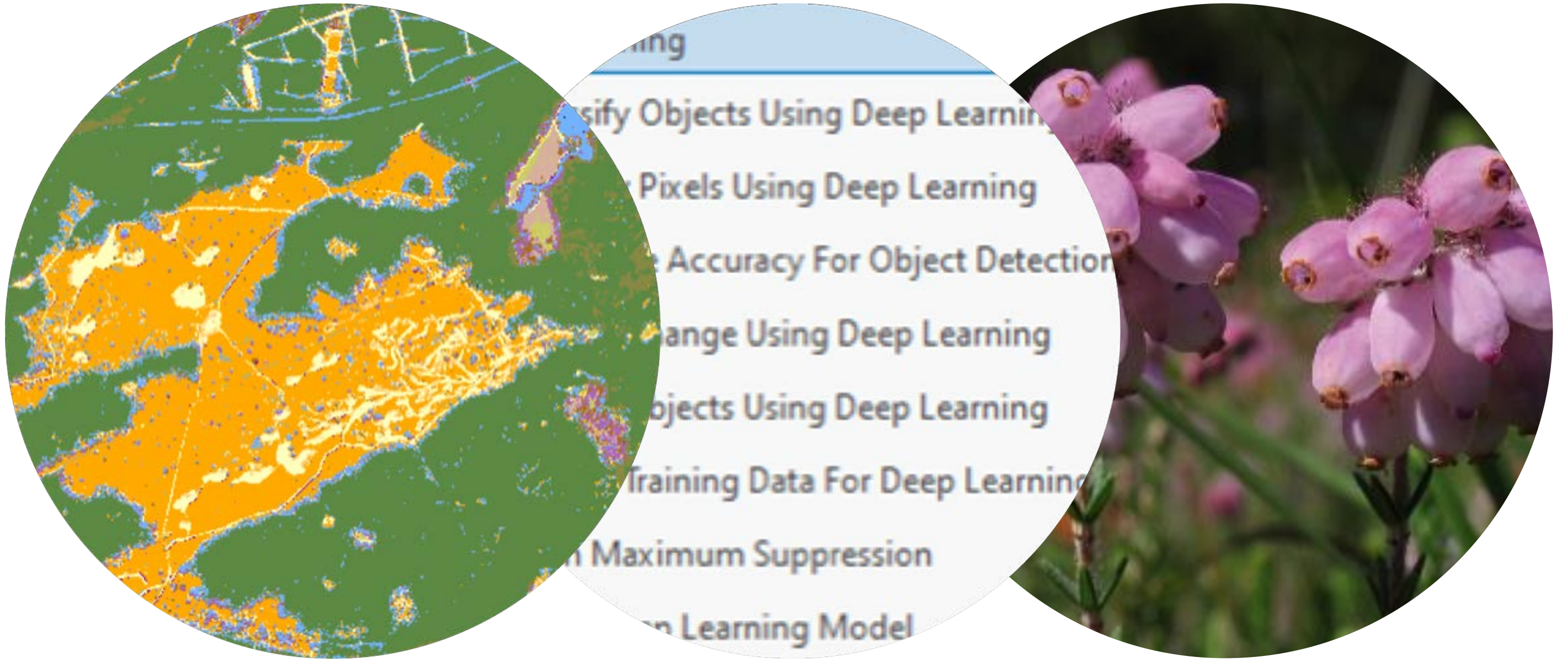
EIONET/DK EPA/Biodiversa+ webinar on 'Mapping habitats by combining satellite and other data', 20 January 2023

Sander Mucher[1]; Stephan Hennekens[1]; Bruno Smets[2]; Sara Simoussi[3]; Henk Kramer[1]; Rob Knapen[1]; Marcel Buchhorn[2]; Wilfried Thuiller[3]; Kristof Vantricht[2];

Stan Los[1], Yoann Cartier[3]

1 Wageningen University and Research, Netherlands; 2 VITO, Belgium; 3 CNRS, France





WAGENINGEN UNIVERSITY & RESEARCH

vito remote sensing

cnrs

Background & objectives

- Much more effort is needed to reverse current trends and to ensure resilient and healthy nature. The EU's biodiversity strategy for 2030 is a comprehensive, ambitious and long-term plan to protect nature and reverse the degradation of ecosystems.
- Therefore, understanding where habitats occur across Europe is a crucial element for understanding biodiversity conservation and taking specific actions.
- Artificial Intelligence (AI) techniques, such as Machine Learning (ML) and Neural Networks (NN) or Deep Learning (DL) methods could enable an improved monitoring of biodiversity and ecosystems with satellite based high-resolution datasets such as Copernicus High Resolution Vegetation Phenology Product (HR-VPP) to better support European policy making.
- Our overall objective is to exploit AI / Deep Learning classification methods for habitat mapping.
- Work performed mainly within EEA & ESA projects

Habitat mapping strategy

Two approaches:

1. **European** habitat suitability modelling at 100 meter resolution by using RS-enabled EBVs and other bioclimatic layers as predictors in MAXENT (Maximum Entropy) models, trained by exploiting *in situ* vegetation plot data from the European Vegetation Archive (EVA, http://euroveg.org/eva-database)
2. **Regional** habitat mapping using deep learning techniques at 10 or 20 meter resolution

In both approaches training data from the EVA database plays a central role

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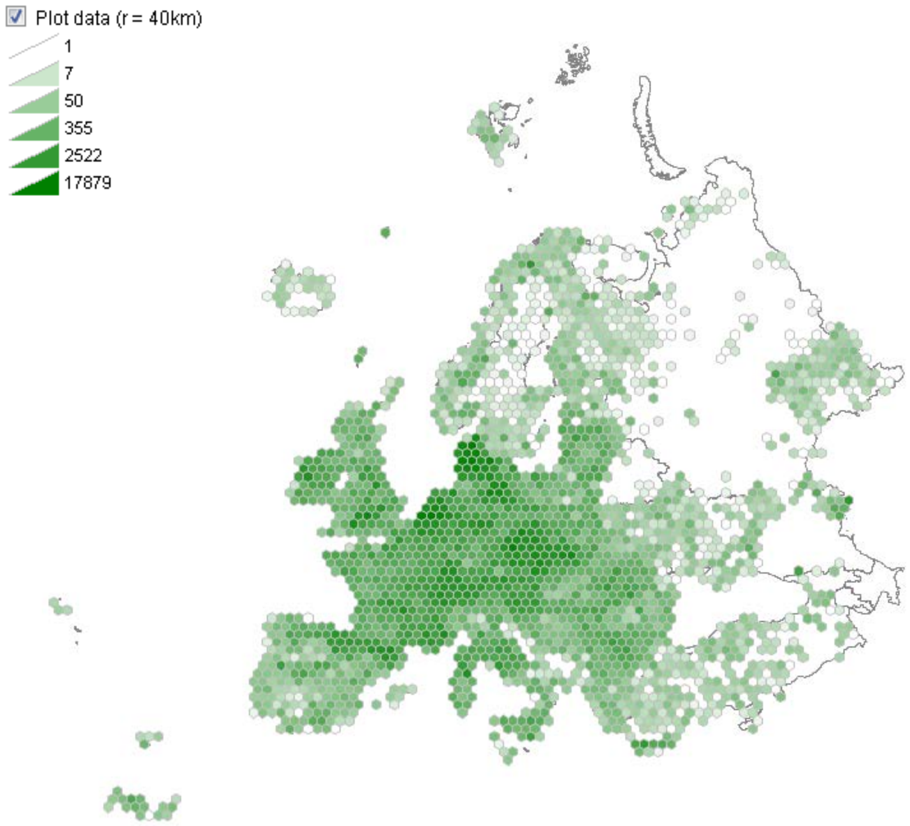
Method 1 European habitat modelling

- Input for the modelling are potentially 1,2M vegetation plot observations (derived from the European Vegetation Archive (EVA database) covering 203 EUNIS habitats.
- A model for each habitat type is executed using a selection of 22 predictors (comprising 5 climate parameters, 7 soil, 2 terrain parameters, 7 RS-EBVs and 1 topography parameter).
- For the habitat modelling open source software Maxent version 3.4.1 is used, by applying a machine-learning technique called Maximum Entropy Modelling.
- We ran MAXENT model to create European habitat suitability maps at 100 meter resolution for most EUNIS habitat types at level 3 (203 EUNIS classes).



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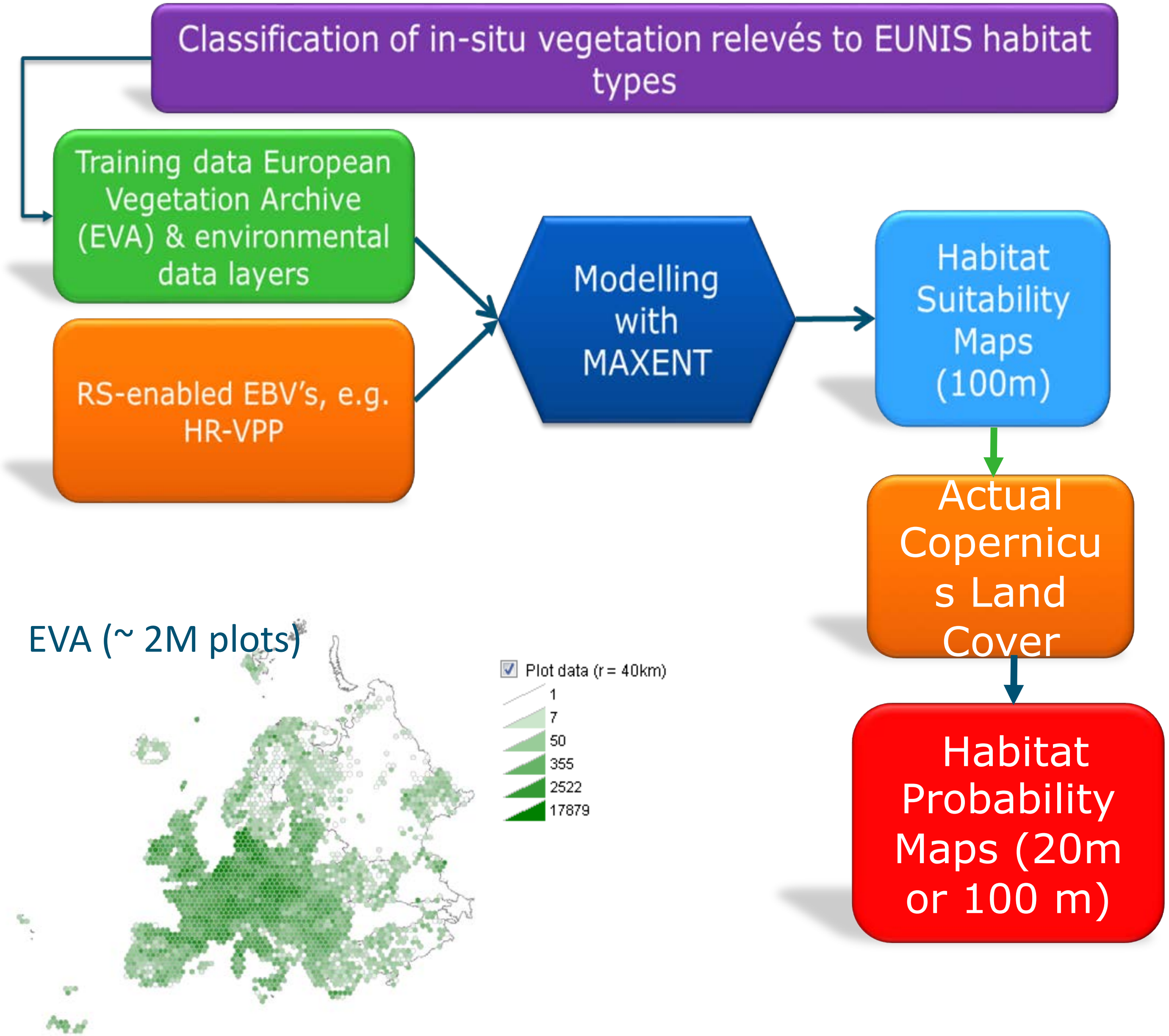
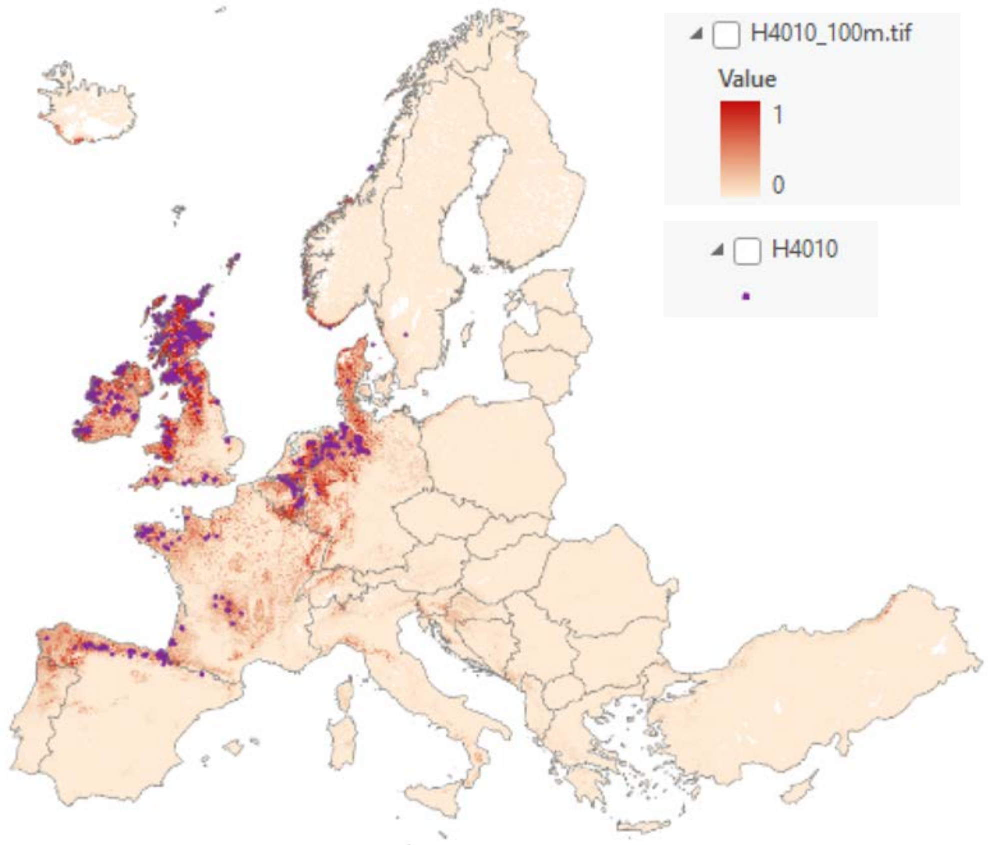
Flowchart European habitat modelling



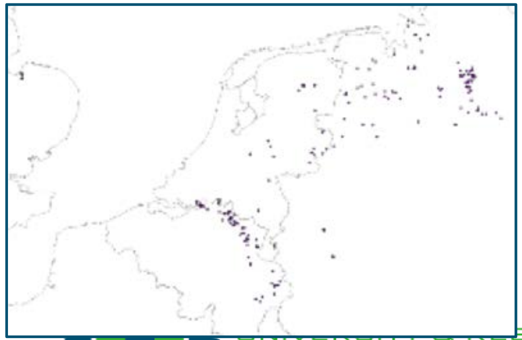
Suitability map EUNIS type S41: Wet heath *(training)*



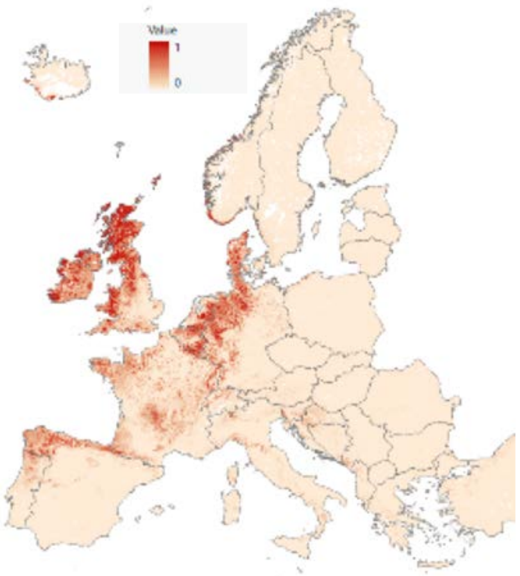
Example European habitat modelling: S41 Wet heath

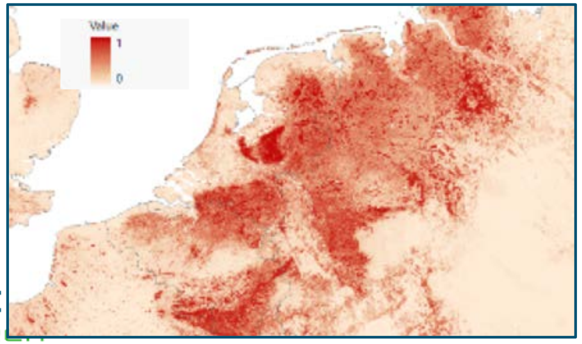
Distribution data

from European Vegetation Archive (EVA)

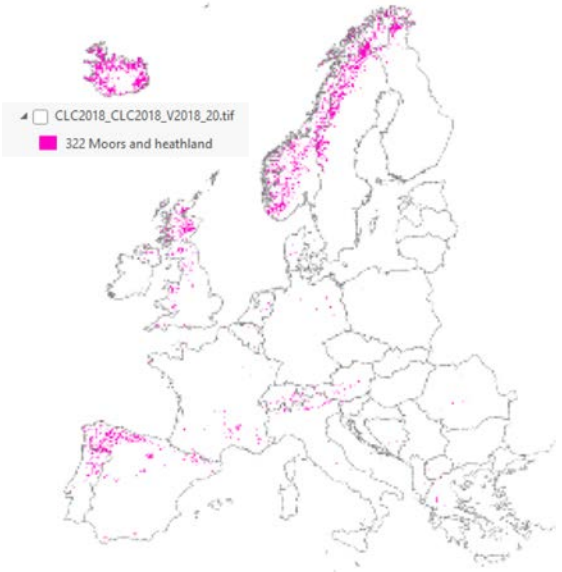


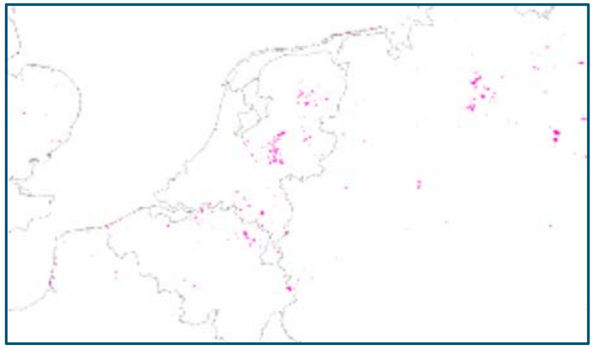
Habitat suitability map



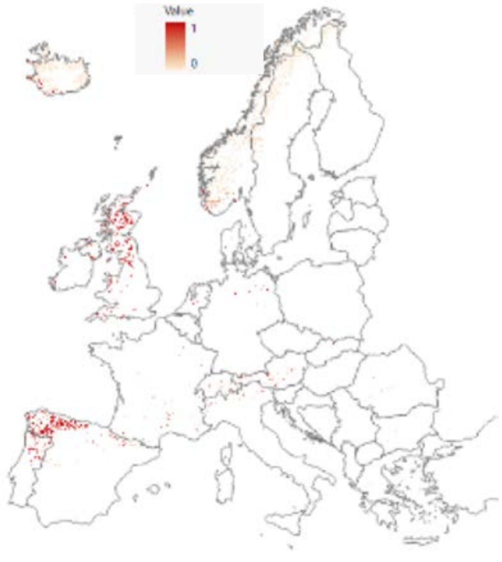


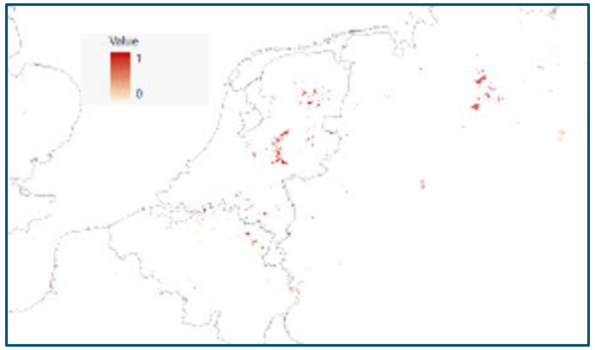
Land cover





Habitat probability map





Differences in accuracy models from BIOMOD2

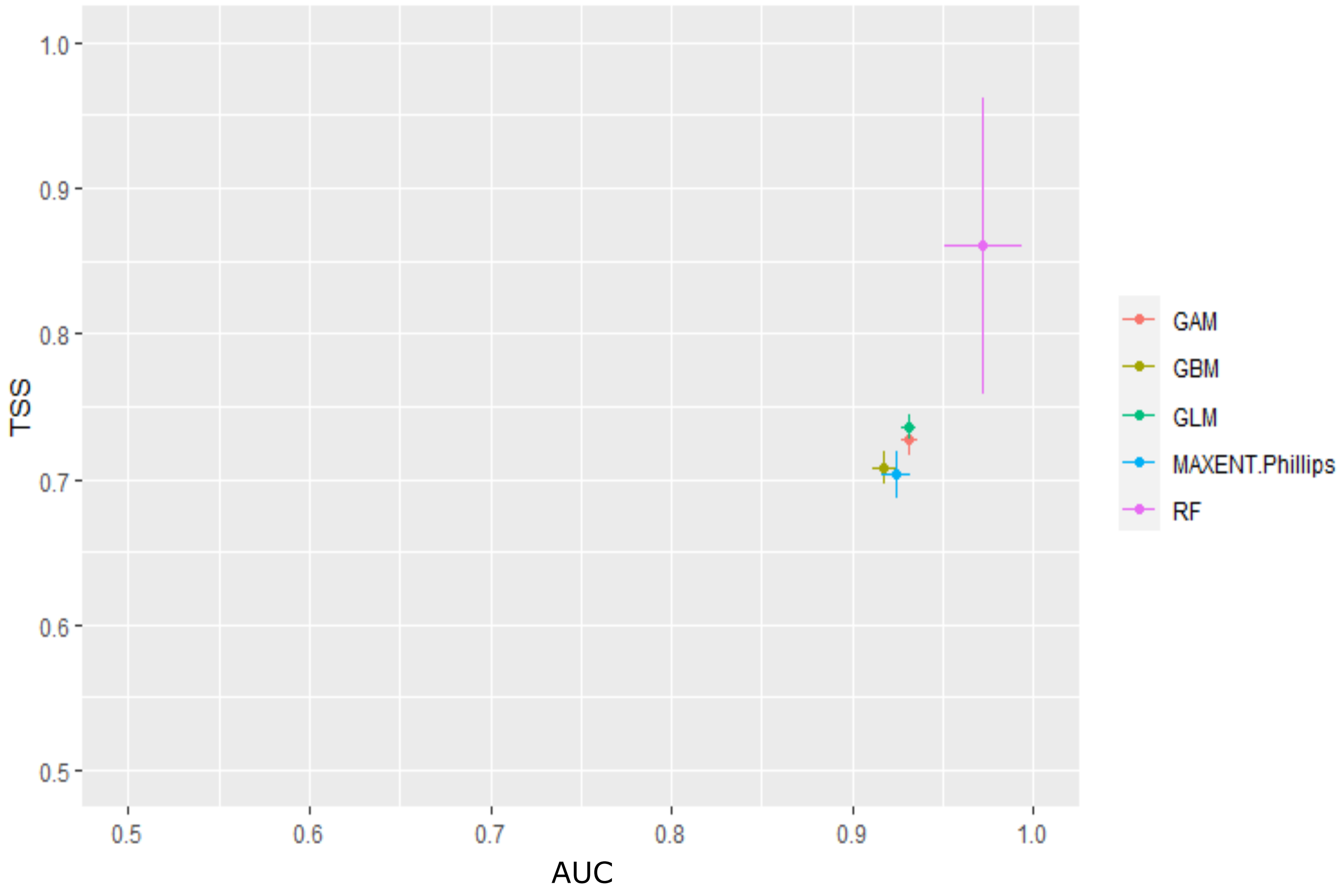


Figure Accuracy assessment for the different methods for habitat suitability modelling with same set of training data and set of predictors at 100 meter resolution. AUC = Accuracy Under the Curve. TSS = True Skill Statistics.

Random Forest performs with best accuracy, but takes too much time to run (> 200 hours for a single model and huge memory consumption). Modelling at European scale at 100m resolution currently only possible using Maxent.

Integration European habitat suitability maps towards wall-to-wall mapping

…

Overlay all habitat suitability maps for a specific habitat group (in this case forests) and extract habitat types with highest suitability (python scripts)

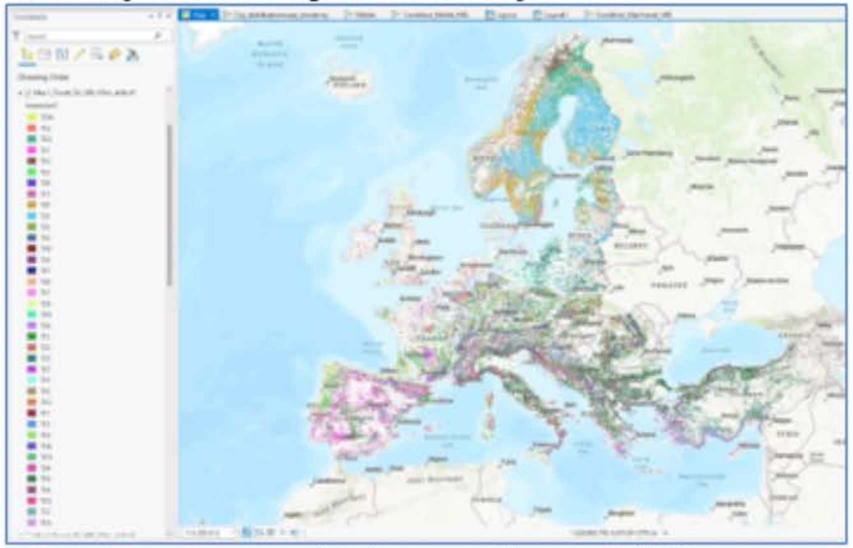
Forest types with the highest suitability per pixel (Max1_Foresttypes)

Forest types with the second best suitability score per pixel (Max2_Foresttypes)

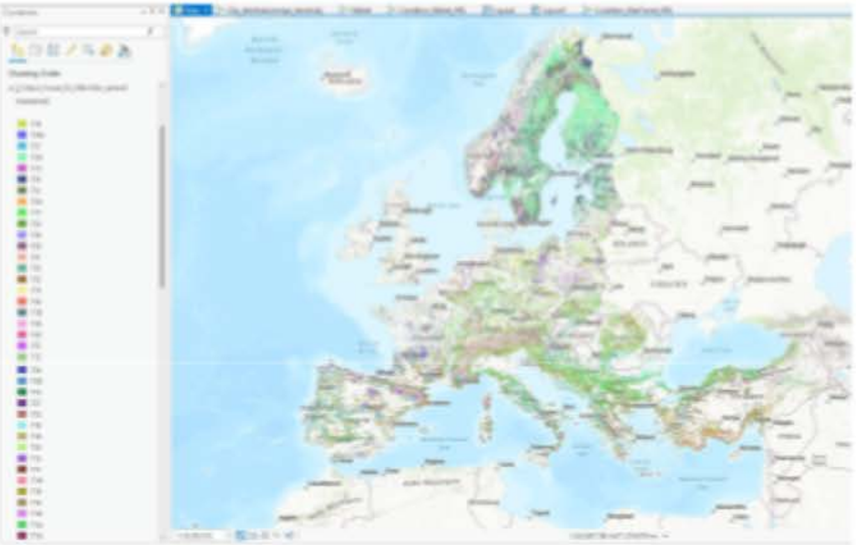
Forest types with the third best suitability score per pixel (Max3_Foresttypes)

Copernicus HR layer Forest (EEA)

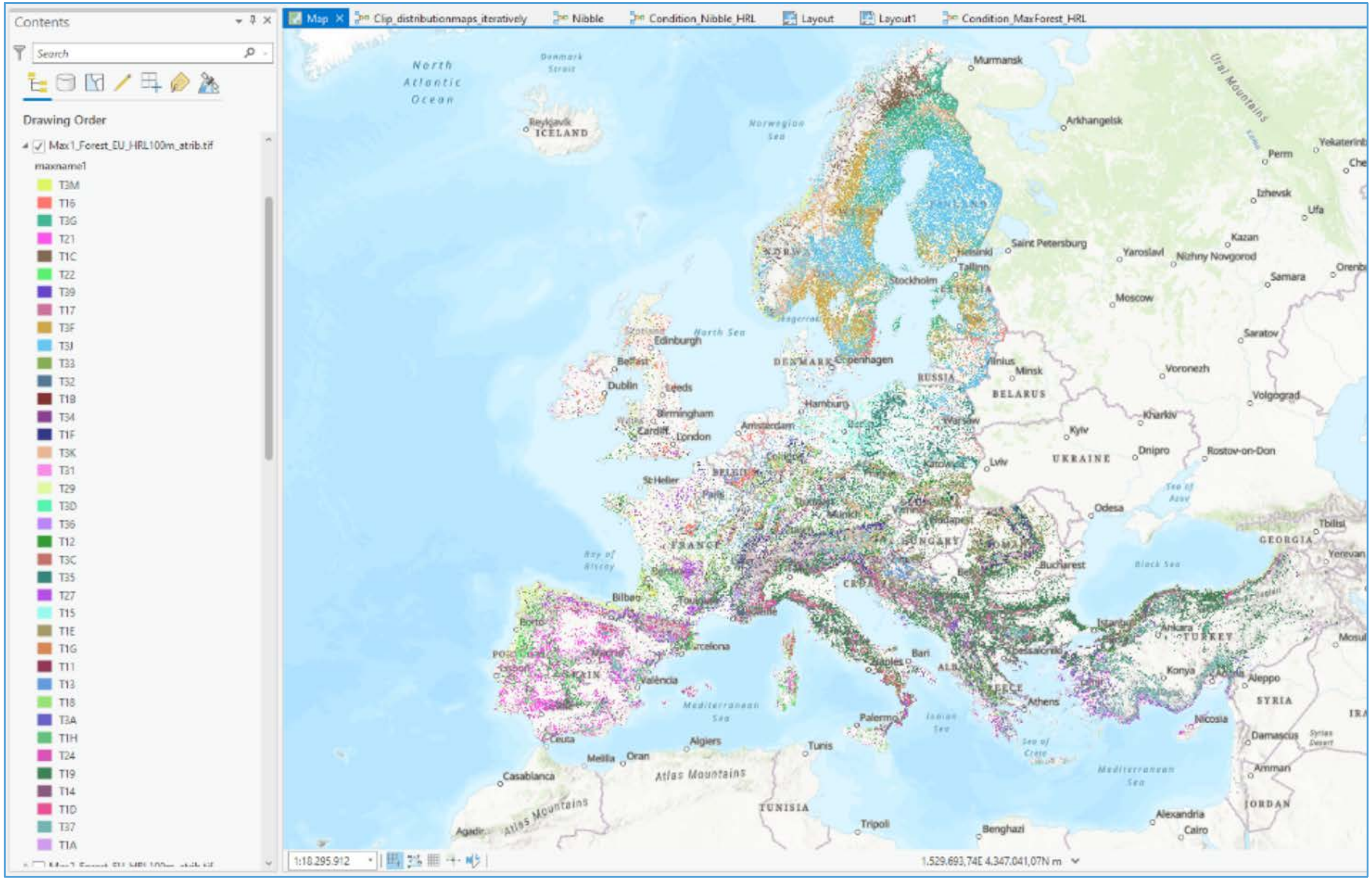
Clip the integrated EUNIS Forest habitat map (level 3) with the highest suitability with the Copernicus HR layer



Clipped forest types with the second best suitability score per pixel (Max2_Foresttypes)

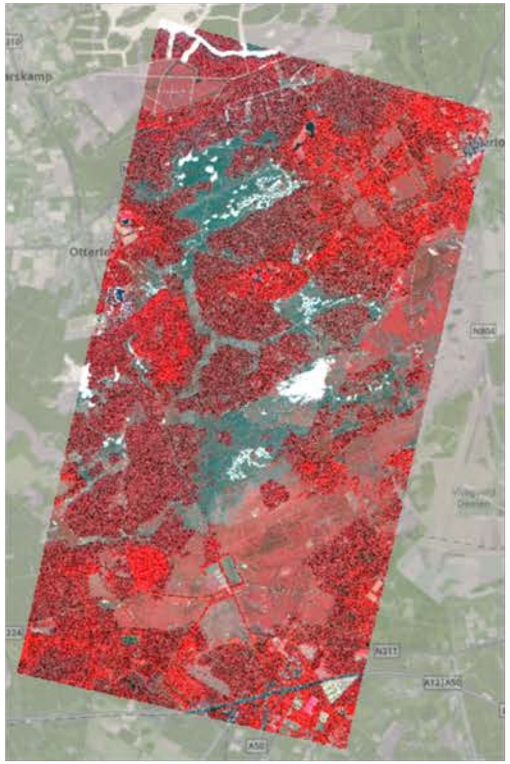


EUNIS Forest habitat map (level 3) with the highest suitability score for forest habitats clipped with the Copernicus HR layer Forest.

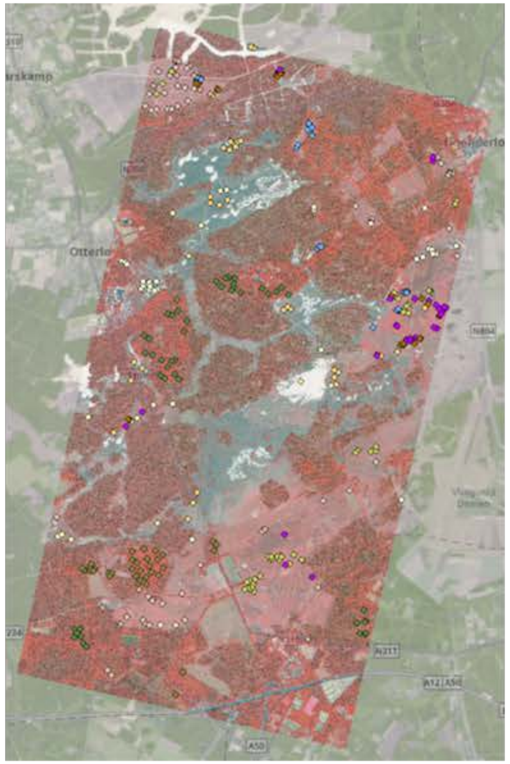


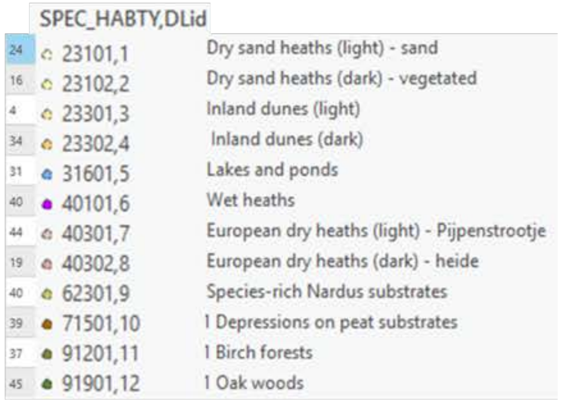
Method 2 Regional habitat mapping using deep learning techniques

- WENR & VITO are working on exploitation of deep-learning models for habitat mapping at regional and national scale. For example in National Park Veluwe, the Netherlands, using HR-VPP and Sentinel-2 at 10 meter resolution (next to Superview)


Superview 12-08-2020, False colour

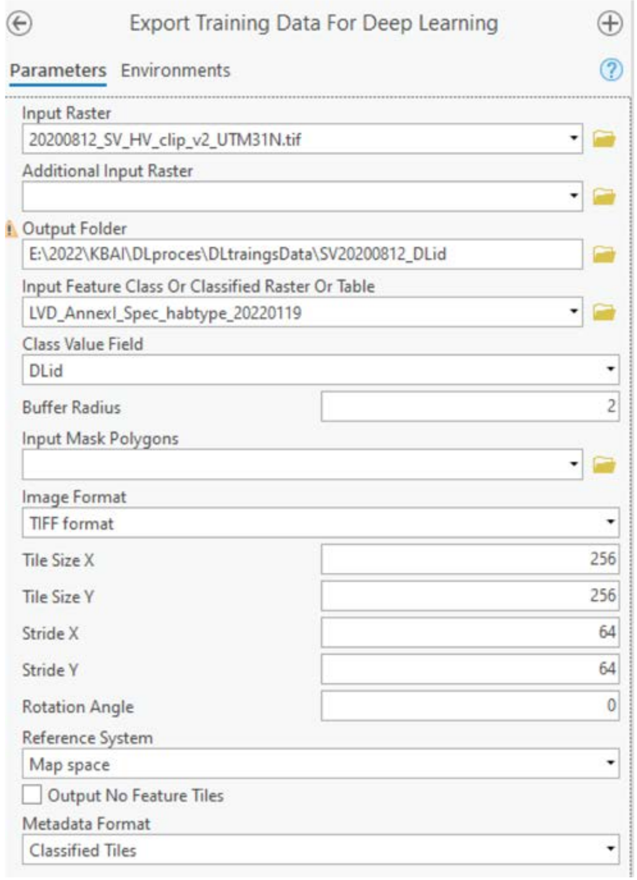

Sentinel 31-07-2020, False colour

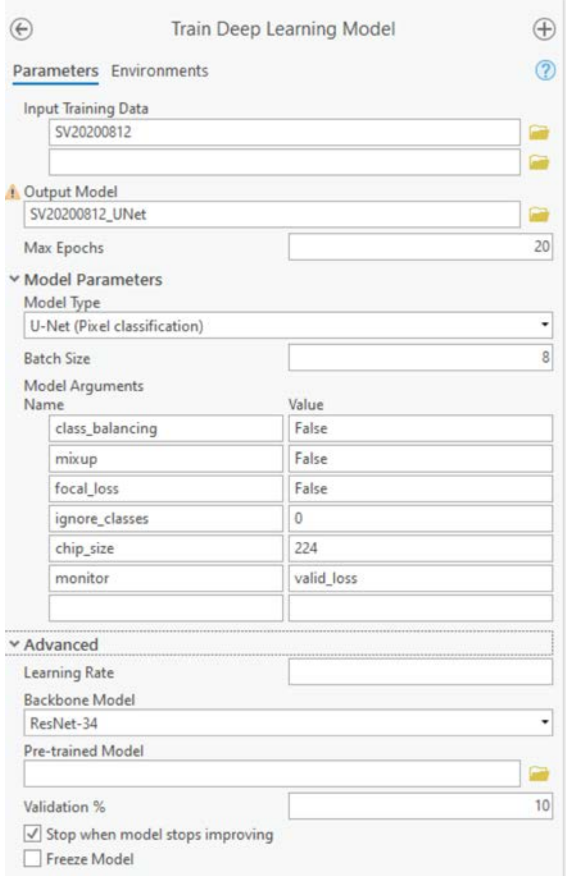

Selected LVD points in Hoge Veluwe test area

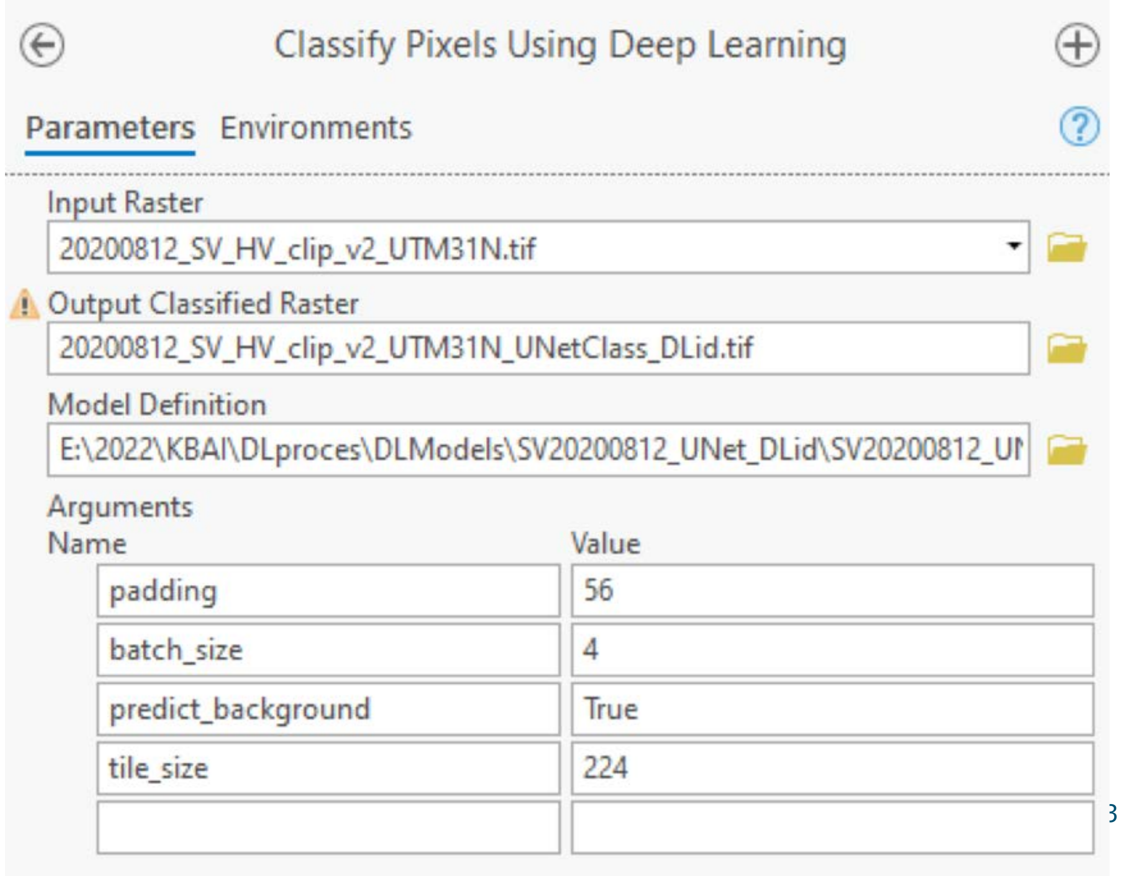


Method 2a Deep Learning (U-NET in ArcGIS PRO)

Step 1 Prepare Training Data	Step 2 Train a Model	Step 3 Use the Model

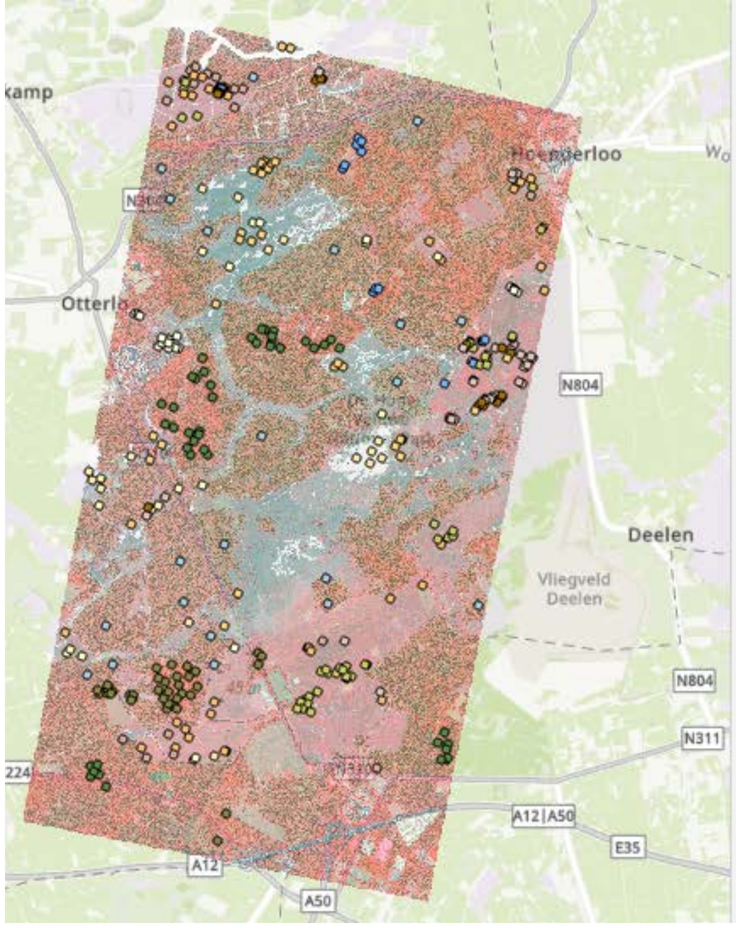






Deep Learning proces in ArcGIS PRO

Selected training points for Deep Learning process from the Dutch Vegetation Database



Classes | Scales

DLid — 13 symbol classes

Symbol	Value	Label	Count
○	1	1 Dry sand heaths (light) - sand	19
○	2	2 Dry sand heaths (dark) - vegetated	16
○	3	3 Inland dunes (light)	16
○	4	4 Inland dunes (dark)	33
○	5	5 Lakes and ponds	28
○	6	6 Wet heaths	39
○	7	7 European dry heaths (light) - Pijpenstrootje	35
○	8	8 European dry heaths (dark) - heide	19
○	9	9 Species-rich Nardus substrates	37
○	10	10 Depressions on peat substrates	33
○	11	11 Birch forests	37
○	12	12 Oak woods	44
○	13	13 Coniferous forest	21

AnnexI habitat types Dry sands heaths (2310), Inland dunes (2330) and European dry heaths (4030) were divided into two subclasses each because for these three habitat types both light and dark appearances in the satellite image can be seen.

All training points were checked on their class and geometric validity and edited if necessary. Additional points for Inland dunes (light) were digitized because there were only four points available from the Dutch Vegetation Database.

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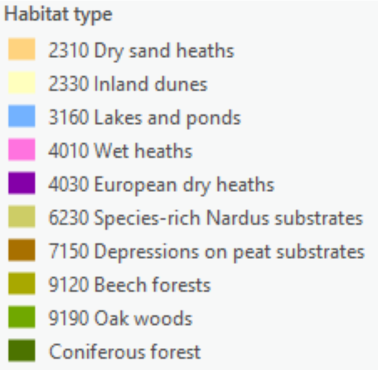
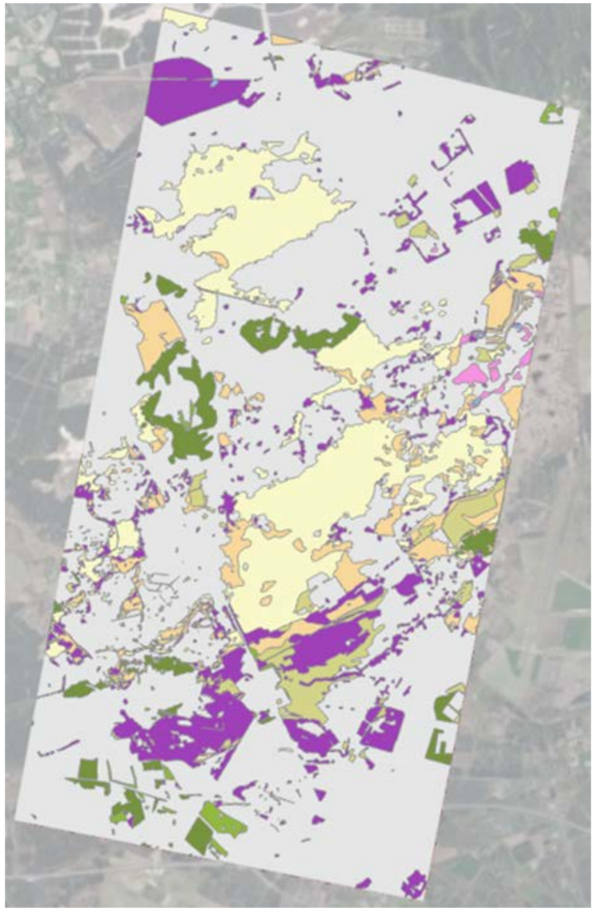
U-NET deep learning technique

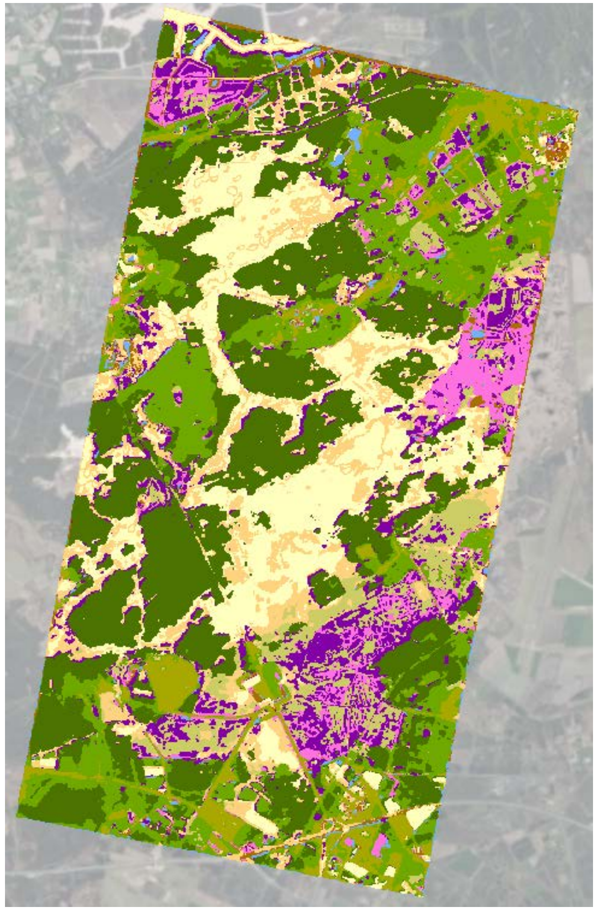


Ground-truth habitat map



Habitat map

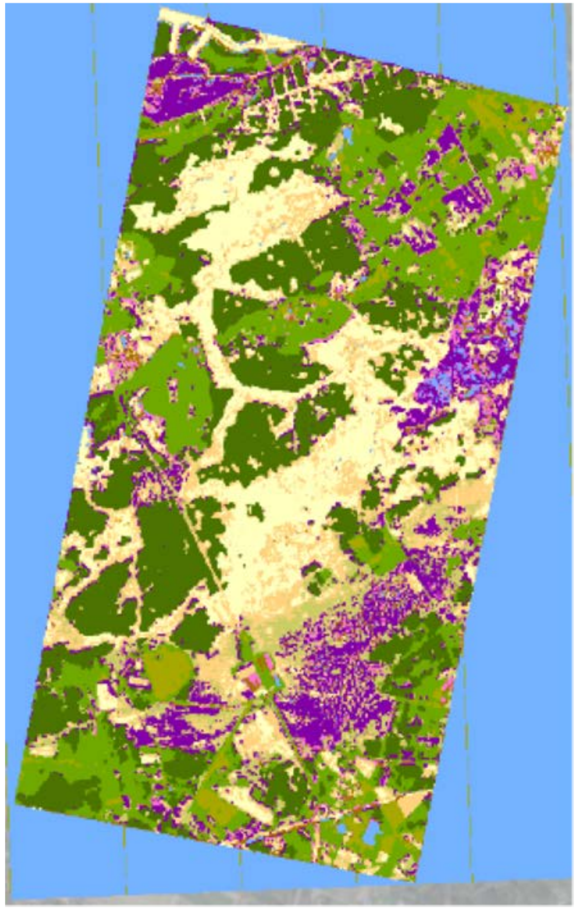
Result U-Net in ArcGIS Pro



Sentinel 2020 stack 7 images

07-02 07-05 14-09
23-03 26-06
15-04 31-07

Result U-Net in Pytorch



Sentinel 2020 stack 7 images
Classification in Pytorch

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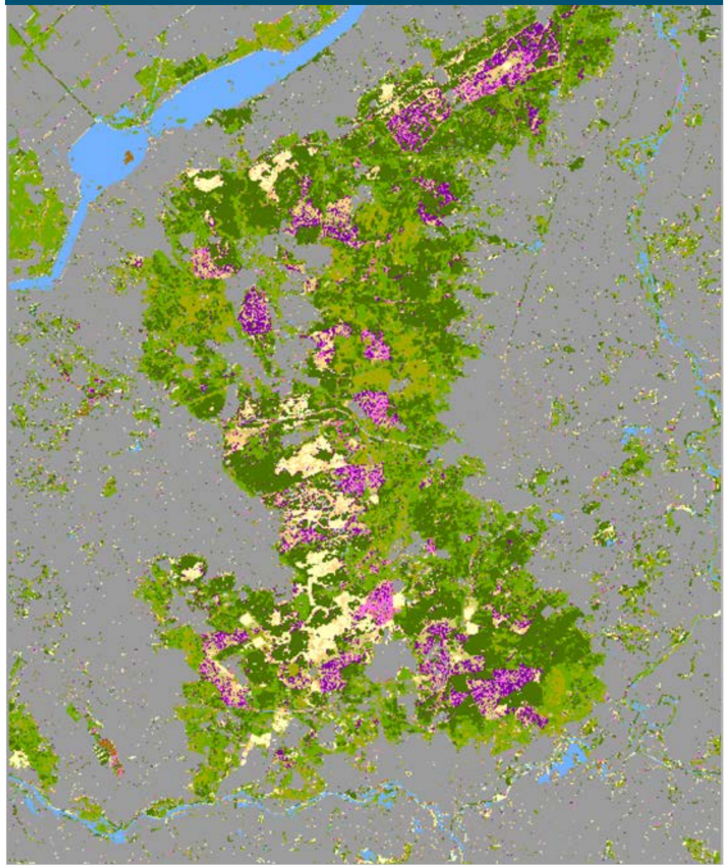
Validation (error or confusion matrix)

		classification result												
LDV training points	HABITATTYP	2310	2330	3160	4010	4030	6230	7150	9120	9190	s forest	total	producer accuracy	
dry sand and heaths	2310	23	5		1	1	5					35	66%	
inland dunes	2330	3	42		1		2	1				49	86%	
lakes and ponds	3160			26	1			1				28	93%	
wet heaths	4010	1			27	7		4				39	69%	
european dry heaths	4030	1			4	40	9					54	74%	
species-rich nardus substrates	6230				3	5	28			1		37	76%	
depression on peat substrates	7150				10	2		21				33	64%	
beech forest	9120								34	3		37	92%	
oak woods	9190						1		1	42		44	95%	
coniferous forest	13										21	21	100%	
	Grand total	**28**	**47**	**26**	**47**	**55**	**45**	**27**	**35**	**46**	**21**	**377**		
	user accuracy	82%	89%	100%	57%	73%	62%	78%	97%	91%	100%		**81%**	**overall accuracy**

KB-DDHT-2 AI for Remote Sensing

Upscaling trained DL model subset Hoge Veluwe to classification entire Veluwe using

Sentinel 2020 - 7 images

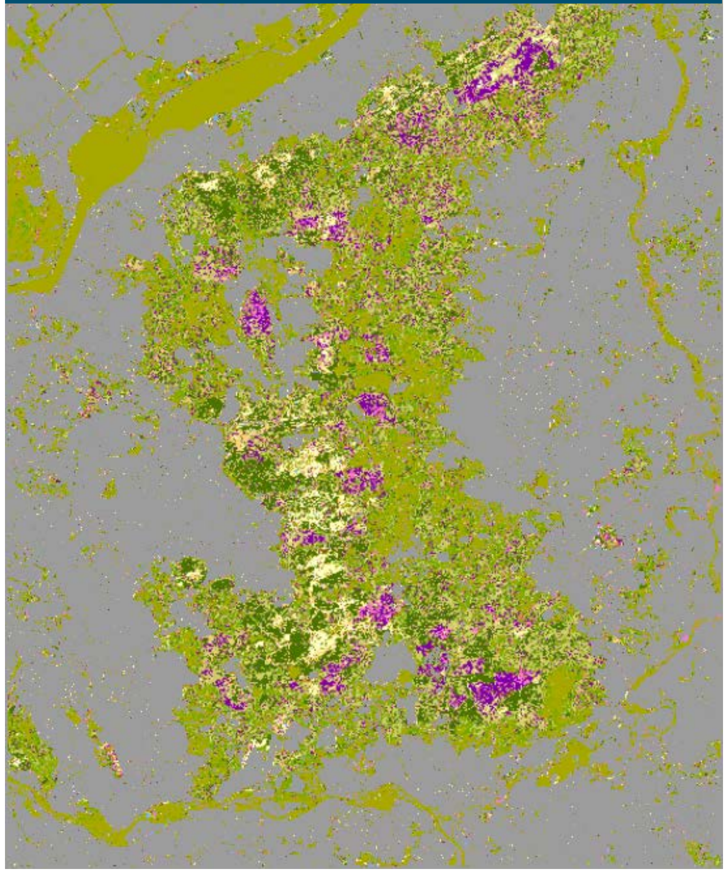


Deep-learning
with U-NET

Habitat type

- 2310 Dry sand heaths
- 2330 Inland dunes
- 3160 Lakes and ponds
- 4010 Wet heaths
- 4030 European dry heaths
- 6230 Species-rich Nardus substrates
- 7150 Depressions on peat substrates
- 9120 Beech forests
- 9190 Oak woods
- Coniferous forest

HR-VPP (High Resolution–Vegetation Phenology Product) – Sentinel 2



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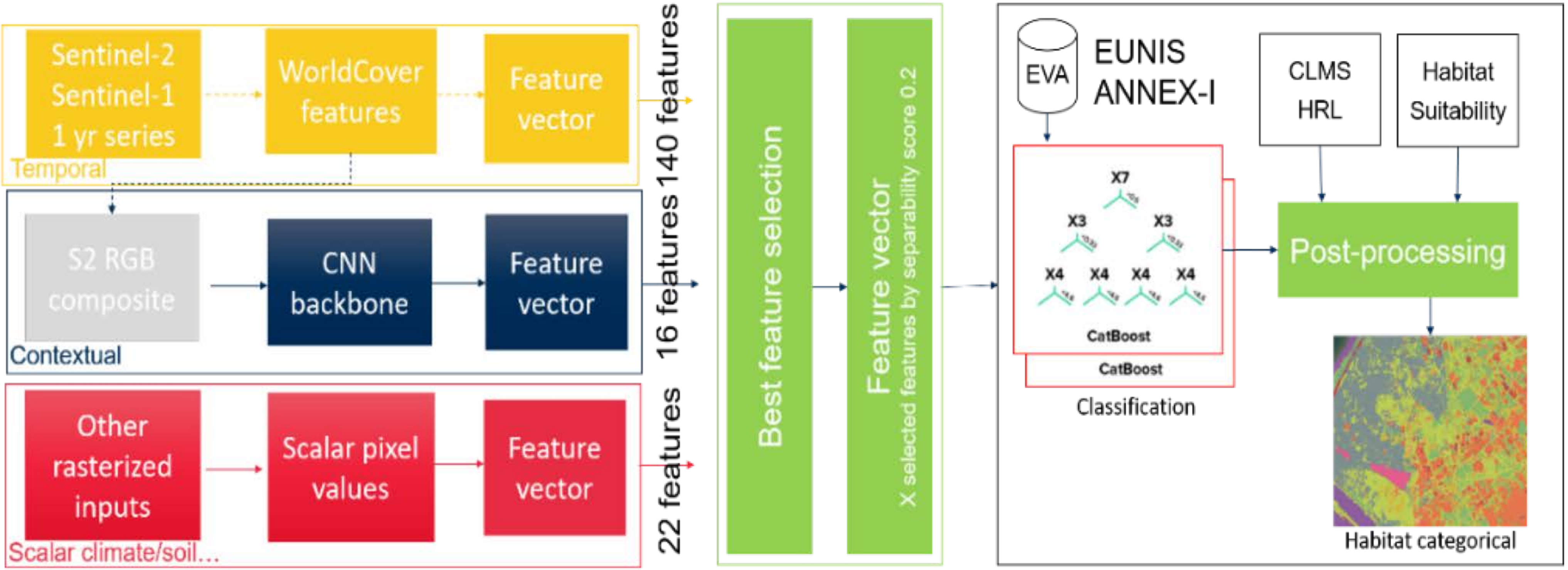
Sentinel 2020 stack 7 images: 07-02, 23-03, 15-04, 07-05, 26-06, 31-07, 14-09

CATBOOST AI automated, scalable workflow



Extend standard predictors (22 features) with

- Full time-series high-res EO features (140)
- Contextual features (16) through Conventional Neural Networks (CNN)

Regional optimization to train & classify

- Selecting best features per region
- Catboost ML for habitat class probabilities
- Post-processing to select ‘final’ habitat class

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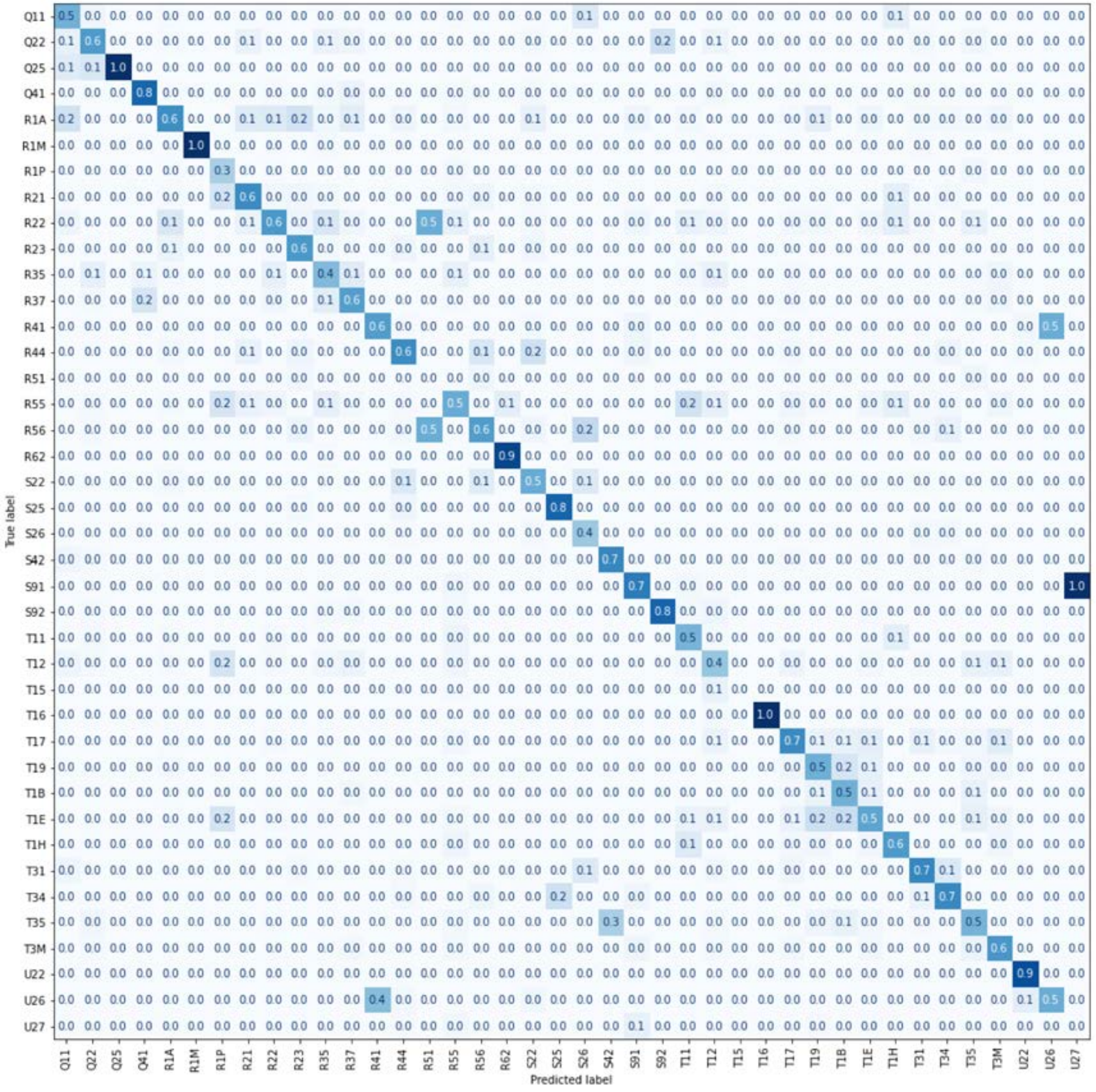
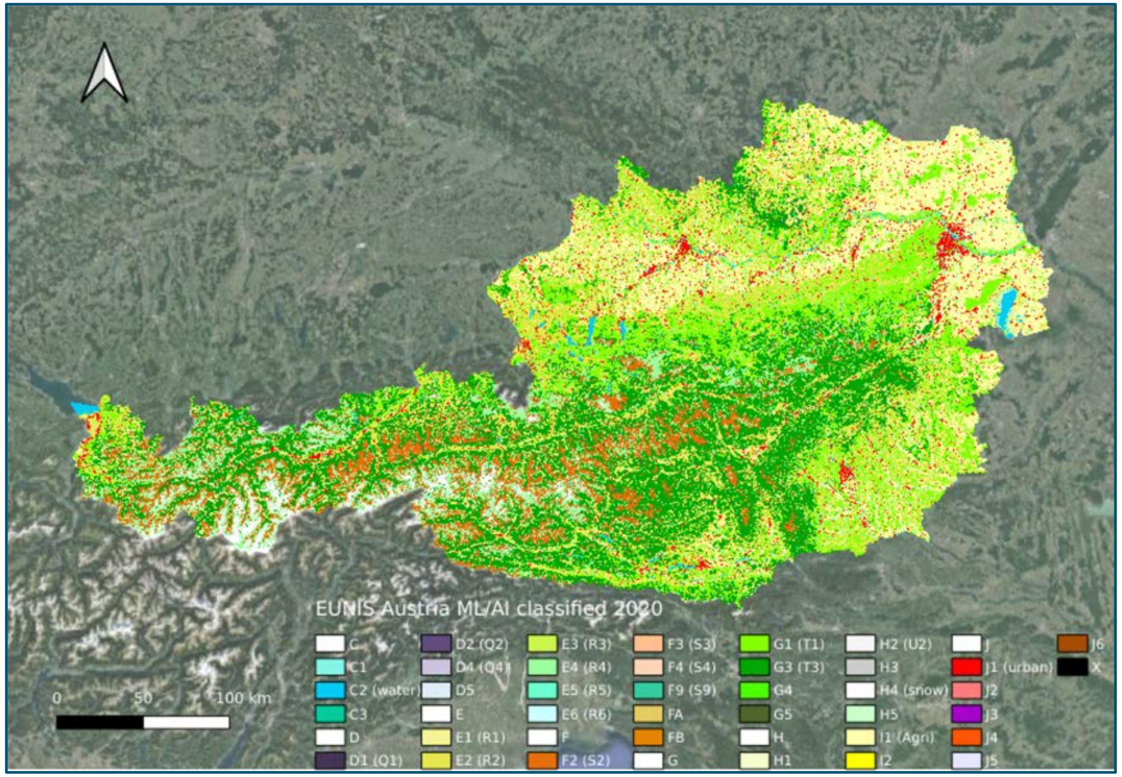
CATBOOST AI workflow results





Tested over 3 area's, wall-2-wall

- NL (43 habitats Annex-I), Austria (45 habitats EUNIS-L3), South-Portugal (16 habitats EUNIS-L2/L3)
- Selection of ~70 predictors per region, trained at ~70% weighted F1 score
- Accompanied with classification confidence layer

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Results & conclusions

- Validation of the European EUNIS habitat suitability maps show in general good overall accuracies, but the user accuracy (100% - commission error) needs to be improved. Integration with accurate land cover maps (into habitat probability maps) improves the UA.
- Integration of the individual European habitat suitability maps for wall-to-wall mapping could also be improved by using a multiclass ML approach.
- With deep learning techniques on multi-temporal satellite imagery (e.g. HR-VPP & multi-spectral) & ancillary data, we are able to map European habitats at regional scale. But there is still much room for improvements (sel. features /predictors & screening training data).
- However, upscaling with DL techniques requires much of data infrastructure with sufficient CPU en GPU capacity.
- Habitat mapping with deep learning techniques on remote sensing imagery & contextual layers is most likely the future and needs to be exploited further.
- The amount and quality of training data is crucial. Much time goes in the enhancement of training data.
- Selection of vegetation plot data (from e.g. EVA) for training AI/ML is more difficult than often thought – due to inaccuracies in locations.
- Enhancement of the training data is a crucial step that needs much attention !!

Break-out groups

Split into two groups

Group 1:

Discussion on policy needs

Group 2:

Review of methods and progress at EU level

Break-out 1: Policy needs for habitat mapping data - overview

1) identify key policies

2) discuss ecological detail needed

3) Review spatial detail needed

Break-out 1: Policy needs for habitat mapping data – reporting back

1) What are key policies – biodiversity policies [..], sector policies […], funding policies [regional funds, LIFE, CAP … ?], other ? [reseach]

2) What ecological detail is needed – EUNIS 3, 4, 5 ? HD Annex 1 ? Focus on N2000 only ? .. ?

3) Review spatial detail needed – national or NUTS 2 data? 1 ha grid, 10 m grid? Precise polygons in GIS system ?

4) What should be priority – eg ecol. or spatial accuracy first ?

Break-out 2: Review of methods and progress at EU level

- Which habitats were covered?
- What methods were tested?
- What was accuracy of results?
- What combination of input data, in situ, satellite, and ?

Break-out 2: Reporting on methods and progress at EU level

- Which habitats were covered? – *any habitat groups that worked better than others when satellite data or AI methods were tested?*
- What methods were tested? – *lessons learned? Should other methods / models be tested out too ?*
- What was accuracy of results? - *% accuracy approx., how to improve? Good enough for general national patterns and trends, also good enough for planning of restoration measures ?*
- What combination of input data, in situ, satellite, and ? - *what are key data bottlenecks? Any data processing constraints?*
- Other points to review – *eg better coordination of research and inst. Implementation ?*

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Feedback to plenary and next steps

Lunch breack

The webinar starts again at 1pm CET

Part 2- Country section

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European Environment Agency

Ministry of Environment of Denmark
Environmental Protection Agency

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Presentation on first results of country survey on habitat mapping approaches

By Jan-Erik Petersen, EEA

European Environment Agency

Ministry of Environment of Denmark
Environmental Protection Agency

Habitat mapping survey – first review of country responses (status of 19-01-23)

Jan-Erik Petersen, EEA

European Environment Agency

1) Country responses received – initial overview

	Total number	Countries
Responses received	16	IS, NO, DK, SE, FI NL, DE, LV, EE FR, CZ, ES, IT, RS, XK, BG
Of which complete		CZ, DE, DK, EE, ES, FI, (FR), IS, (IT), LV, NO, (RS), SE, XK
Other feedback available	2	BE, IE

2) Main data collection methods employed ?

Type of data used	No. of responses	Countries
Field survey	18	BE, BG, CZ, DE, DK, EE, ES, FI, FR, IE, IS, IT, LV, NL, NO, RS, SE, XK
Satellite data	11	(BE), DK, ES, FI, FR, IS, IT, (LV),NO, SE, (XK)
Other env. variables / data sets	15	BE, DE, DK, EE, ES, FI, FR, IE, IS, IT, LV, NO, NL, RS, SE

3) Any particular focus of habitat mapping ?

Thematic or geogr. focus	No. of responses	Countries
EUNIS classification	6	ES, (FR), IS, IT, LV, RS
Hab. Dir. Annex I	11	BE, BG, CZ, DK, EE, ES, FI, IE, NL, SE, XK
Natura 2000 areas	10	(BE), DE, DK, EE, FI, (FR), LV, NL, SE, (XK)
Other	Satellite used for northern forests	FI

4) Details on use of satellite data / methods

Type of satellite use	No. of responses	Countries	Comments
Active use	6	DK, FI, (FR), IS, IT, SE	
Optical data	11	BE, DK, ES, FI, FR, IE, IS, IT, LV, NO, SE	
LIDAR data	6	DK, FI, IE, LV, NO, SE	
Regular	2	DK, FI	
Pilots completed	7	BE, ES, FR, IE, IT, LV, NO	
Plans to use	8	DE, EE, ES, FR, (IE), LV, NO, XK	

5) Feedback on key bottlenecks

Type of bottleneck	No. of responses	Countries
(Training) data	5	DK, ES, FI, NO, XK
Methods	10	CZ, DK, ES, FI, FR, IS, LV, NO, SE, XK
Resources	7	CZ, EE, FR, IS, LV, NO, XK
Other		DE, IT, NO: Combining + availability of different expertise EE, IE: cloud cover FI, LV: further testing needed FR: accessibility of sample areas ES: update of EUNIS still ongoing, crosswalk to Annex I of HD

Thank you for your attention.

Jan-Erik.Petersen@eea.europa.eu

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Presentations of ongoing projects and experiences from EEA and Biodiversa+ member countries, focus on technology used, resolution, habitat types – potential and limitations discovered

European Environment Agency

Ministry of Environment of Denmark
Environmental Protection Agency

biodiversa+
European Biodiversity Partnership

Denmark

By Rasmus Fenger-Nielsen, Danish Environmental Protection Agency

European Environment Agency

Ministry of Environment of Denmark
Environmental Protection Agency

Digital mapping of habitats in Denmark

Based on Artificial intelligence (AI)
and Remote sensing

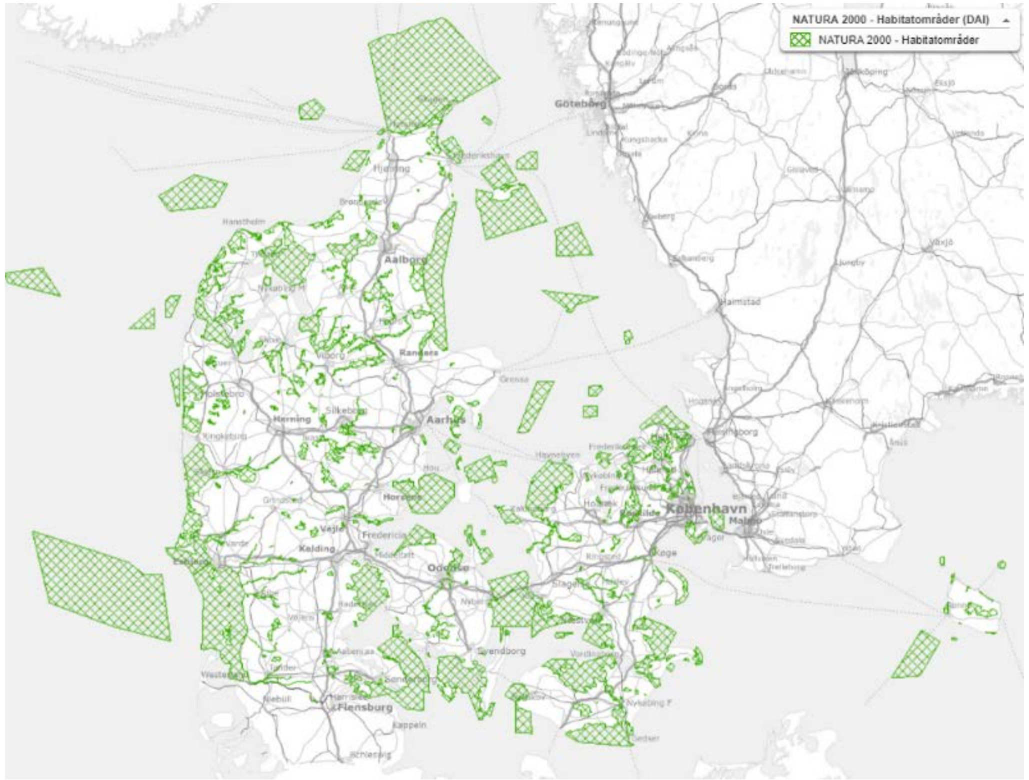
EEA-webinar

18. January 2022

Natura 2000 (SAC and SPA) in Denmark

- Denmark has 250 Natura 2000-areas (covering 9% of the land area).

- Data for the habitats (Annex 1, habitat directive) forms the basis for Natura 2000 planning.



Nature 2000 (SAC and SPA) in Denmark

How we did it – field based method

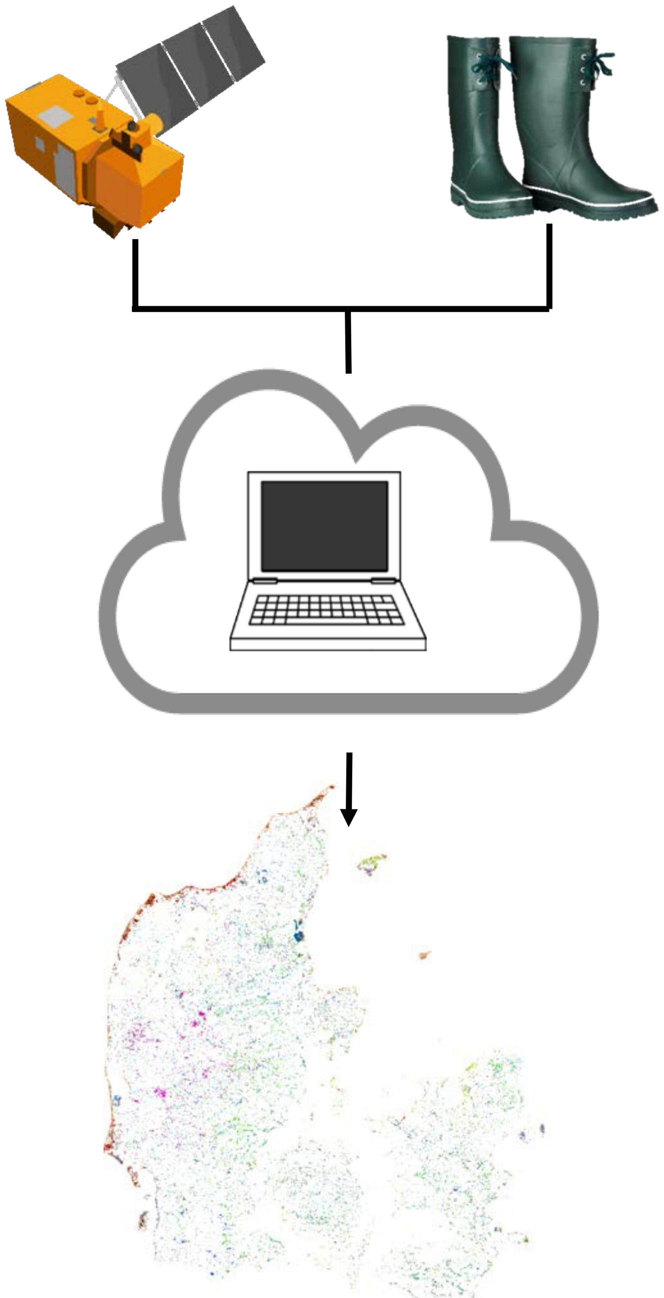
SPA DK00CX282 og SAC DK00CX037– Borris Moor

Challenges of field-based method

- Field-based mapping is a huge task
- Staffing can be a bottleneck during field season
- Include ‘rough’ assessments over large areas
- Increasing demand for updated data about nature in the entire country and not only in SACs and SPAs

How we intend to do it in the future

- Wall-to-wall mapping of nature using Remote Sensing data, AI and cloud computing
- Collect field-based data for training algorithms and validation of the digital maps.
- Develop and implement methods to determine vegetation structures and conditions of habitats

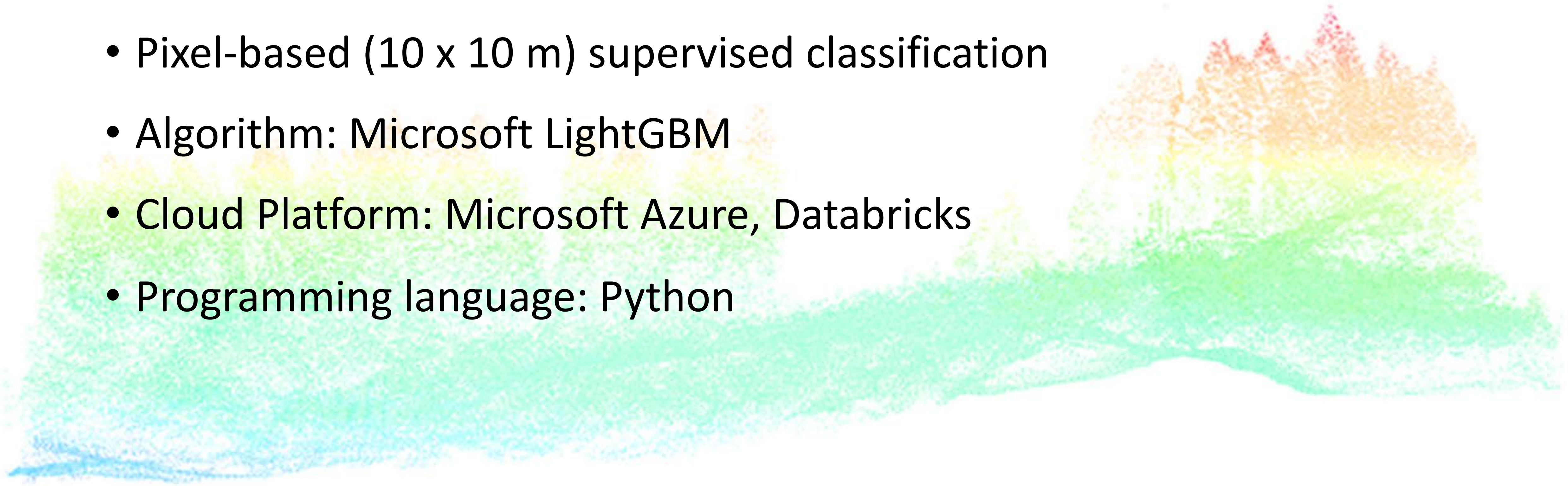


Input data to AI-model

Type of data	Description	
Nature type annotation	44 different nature type classes are our ”target” in training the AI-model.	Training data, manually collected
Soil type map	GEUS in 1:25:000	Static data
Distance map	Distance to coast	Static data
Aerial imagery (orthophotos)	Orthophotos with country-wide coverage from spring and summer. 12.5 cm pixel resolution.	Dynamic data
Airborne laser scanning data (LIDAR)	Point-cloud and derived products including Digital surface and terrain model, slope, orientation.	Dynamic data
Satellite data	Sentinel-2 data including derived products such as vegetation indices and phenology parameters. Sentinel-1 to come	Dynamic data
Near surface groundwater	Modeled product from GEUS	Dynamic data
Meteorological data	Aggregated data from Danish Meteorological Institute (DMI)	Dynamic data

Methods

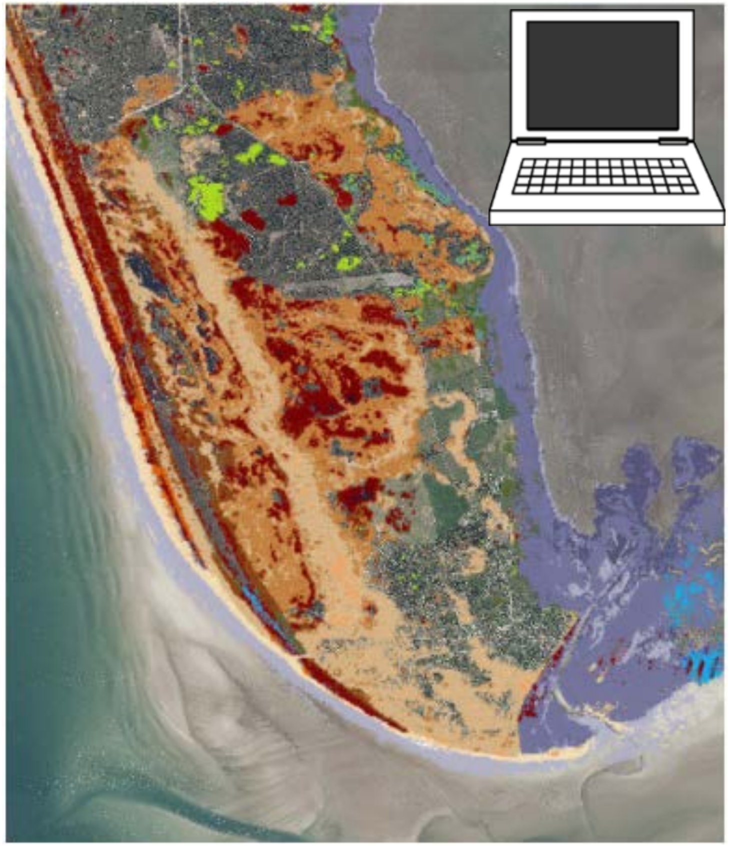
- Pixel-based (10 x 10 m) supervised classification
- Algorithm: Microsoft LightGBM
- Cloud Platform: Microsoft Azure, Databricks
- Programming language: Python

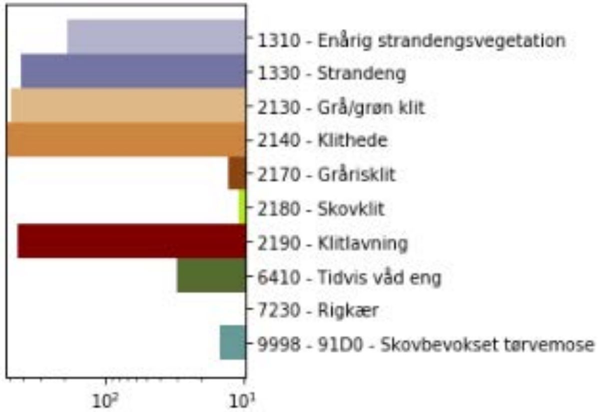


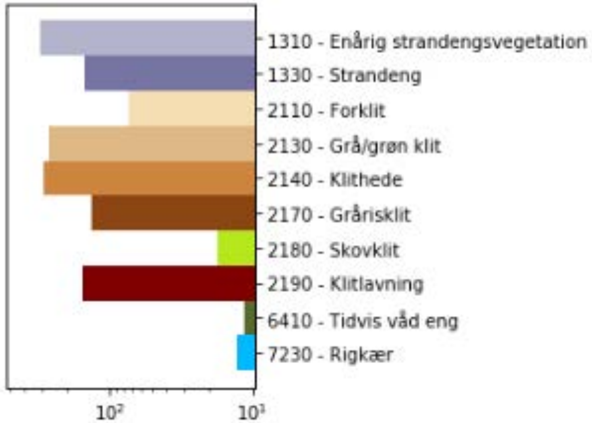
Comparison

Field-based vs Digital mapping

Fanø, Denmark







Learnings so far

- AI in combination with Remote Sensing is a very powerfull method for habitat mapping at country scale
- Not all nature types can be mapped with this approach
- Challenging to acquire enough training data of sufficient quality
- Evaluation of accuracy is not trivial
- A new digital method gives a new type of mapping result (e.g. scale)
- Cloud computing ensures efficient and flexible data processing


The end

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France

By Alexia Aussel, PatriNat

European Environment Agency

Ministry of Environment of Denmark
Environmental Protection Agency

PATRIMOINE NATUREL
CENTRE D'EXPERTISE ET DE DONNÉES
OFB · CNRS · MNHN

MINISTÈRE
DE LA TRANSITION
ÉCOLOGIQUE
ET DE LA COHÉSION
DES TERRITOIRES

OFB
OFFICE FRANÇAIS
DE LA BIODIVERSITÉ

CarHab program : Natural and semi-natural habitats mapping

Mapping habitats by combining satellite and other data
20/01/2023

MUSÉUM NAL HIST NATURELLE

cnrs
dépasser les frontières

IGN
INSTITUT NATIONAL
DE L'INFORMATION
GÉOGRAPHIQUE
ET FORESTIÈRE

cbn
CONSERVATOIRES
BOTANIQUES NATIONAUX

EVS
Environnement Ville Société
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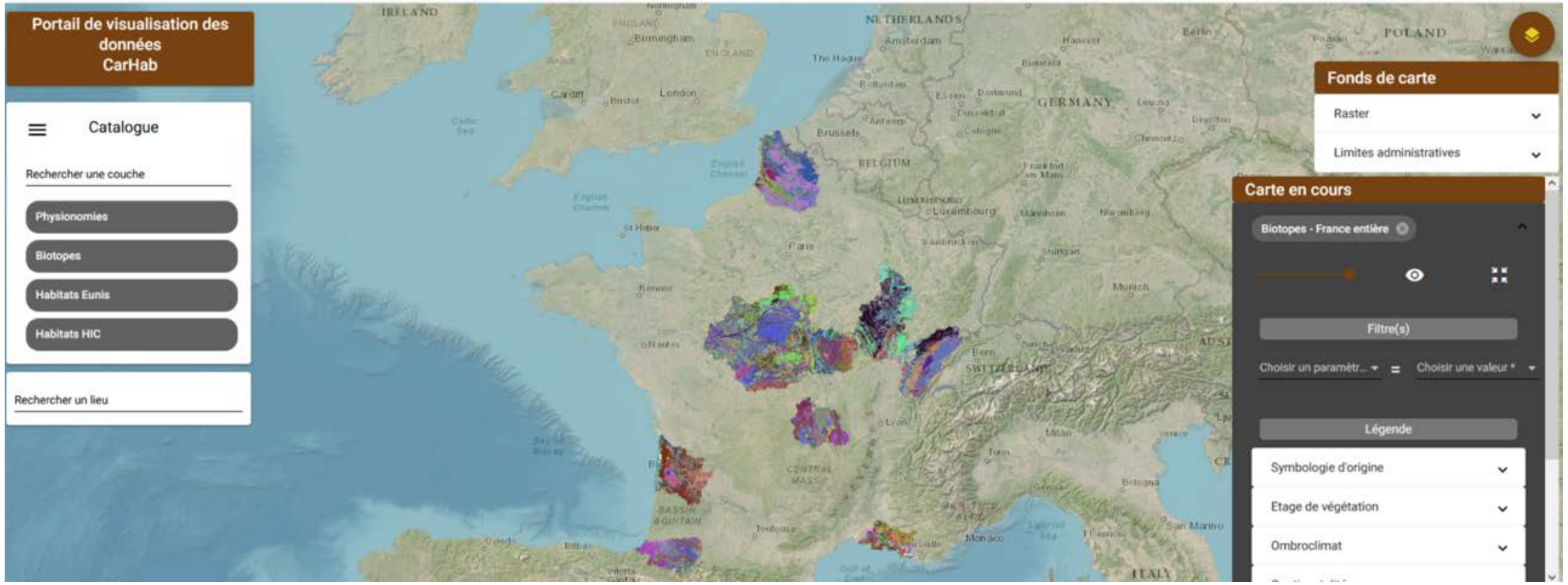
UMR 5600
UNIVERSITÉ
DE LYON

CarHab programm goals

- The CarHab program aims at locating and identifying natural habitats and in particular Annex I habitats for Natura 2000 .

- It identifies biodiversity issues and helps to take them into account to support public policies: NPAS, Green and Blue Infrastructure, Mitigation hierarchy, climate policies, IUCN Red Lists, etc..

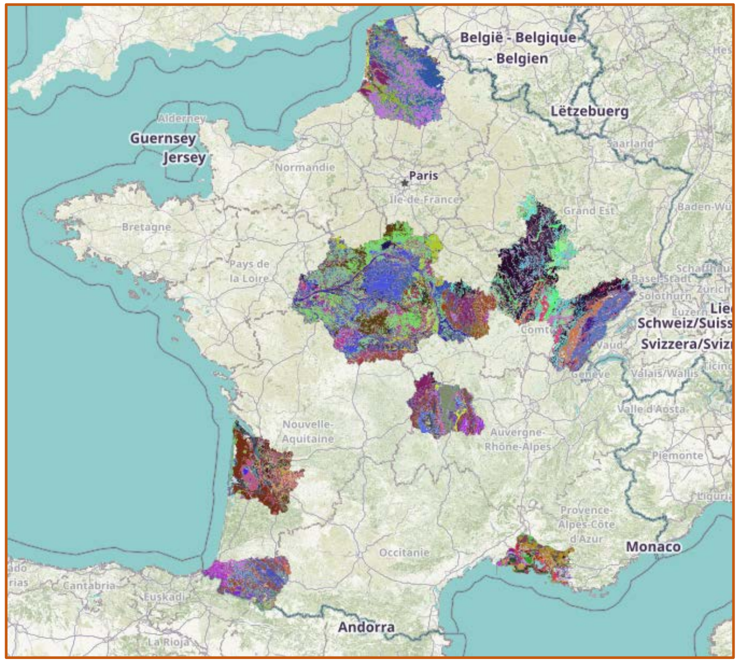


These data will be available via an online cartographic viewer on the Natural Heritage Inventory Information System (SINP) and on the Geoportal

- **These data can be used alone or compiled with other layers for cross-cutting issues.**

CarHab project (2020-2025)

- Project managed and funded by the French Ministry of Environment
- Goal : producing a geographic information system on natural and semi-natural terrestrial habitats
- Production of cartographic models at the scale of 1:25,000 on the potential presence of habitats
- Territories concerned: Metropolitan France and overseas departments
- Methodology: modeling by machine learning + expertise by the National Botanical Conservatories (*Conservatoires Botaniques Nationaux – CBN*)
- Experts involved:



1. Data production

Data produced and program organization

CONSERVATOIRE BOTANIQUE NATIONAL

Provides input data

Provides input data

Validates maps

Biotope predictive map

Vegetation physiognomies predictive map

- Reflects the "constant" ecological potential of the environment: a guide for reading the territory
- Stable information over time
- Data update planned

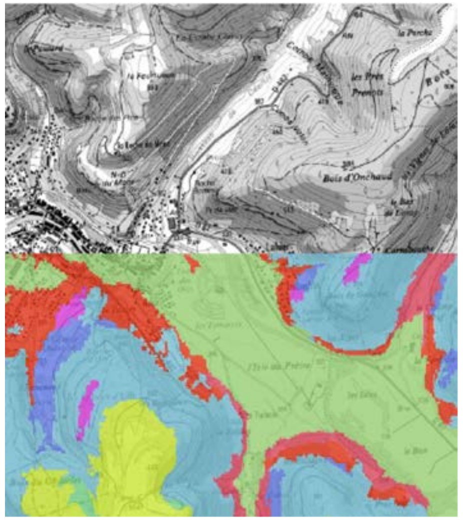
Habitats predictive map

- Description of the types of natural and semi-natural environments (forests, meadows...)
- Data update planned

- Map crossing information on the potentiality of environments and the stage of vegetation
- Derived in HIC and EUNIS potentiality maps

Biotopes

- Homogeneous areas : climate, soil, exposure, etc.
- Same potential for vegetation expression (vegetation series)
- Combination of 8 ecological parameters = 1 biotope
- National catalog of biotopes by combining the values of each of the 8 parameters

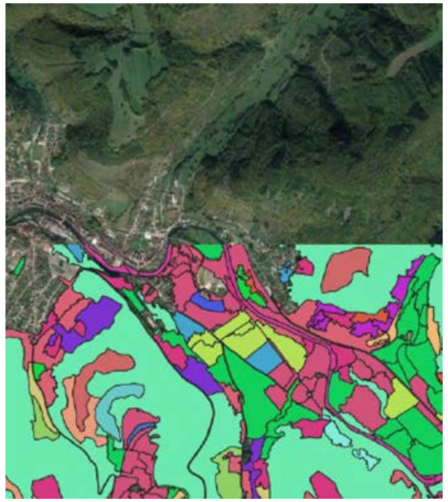


Vegetation levels	Ombroclimat	Continentalité	Variante bioclimatique	Edaphic acidity	Edaphic moisture	Littoralité	Snow cover
planitiaire	sec	hyperocéanique	aucune	très acide	hyperxérophile	façade littorale	nul à court (0 à 4 mois)
collinéen	subhumide	océanique	subméditaréenne	légèrement acide	perxérophile	position intérieure	moyen (5-6 mois) à déneigements hivernaux fréquents et/ou longs
[...]	[...]	[...]	[...]	[...]	[...]		[...]

The eight descriptive parameters of the biotopes of Metropolitan France and extract of the modalities by parameter.

Vegetation physiognomies

- A vegetation types typology organized in 4 nested levels.
- Restitution of the information at level 2 except for the distinction of grazed/lawned meadow and mature deciduous/silver forest (level 4)

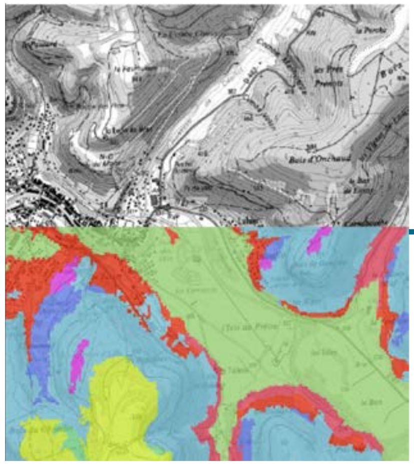


CD_HAB	LB_CODE	niveau	LB_HAB_FR
30265	**2200**	**II**	**Minéral non ou peu végétalisé indéterminé**
30264	220	III	Minéral non ou peu végétalisé
30266	2201	IV	Eboulis et écroulement non ou peu végétalisés
30267	2202	IV	Moraine non ou peu végétalisée
30268	2203	IV	Escarpement rocheux et dalle non ou peu végétalisés
30269	2204	IV	Zone sableuse, limoneuse ou argileuse non ou peu végétalisée
30270	2205	IV	Banc de graviers et galets non ou peu végétalisé
30280	3	I	Formation herbacée
30281	31	II	Pelouse
30282	310	III	Pelouse indéterminée
30283	**3100**	**II**	**Pelouse indéterminée**
30284	311	III	Pelouse permanente
30285	3110	III	Pelouse permanente indéterminée
30286	3111	IV	Pelouse permanente vivace
30287	3112	IV	Pelouse permanente de bas marais et tourbière
30290	**3200**	**II**	**Herbacé haut indéterminé**
30291	3201	IV	Roselière
30292	3202	IV	Cariçaie
30293	3203	IV	Mégaphorbiaie
30294	3204	IV	Ourlet
30295	3205	IV	Friche herbacée
30296	33	II	Prairie
30297	330	III	Prairie
30299	**3300**	**II**	**Prairie indéterminée**
30298	**3301**	**IV**	**Prairie fauchée**
30300	**3302**	**IV**	**Prairie pâturée**

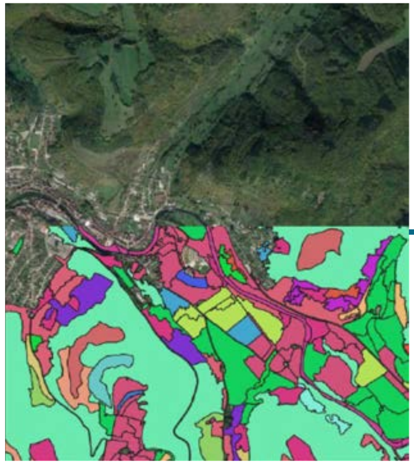
Extract from the vegetation type typology. **In bold**: the classes in the final product

Habitats CarHab

Biotopes

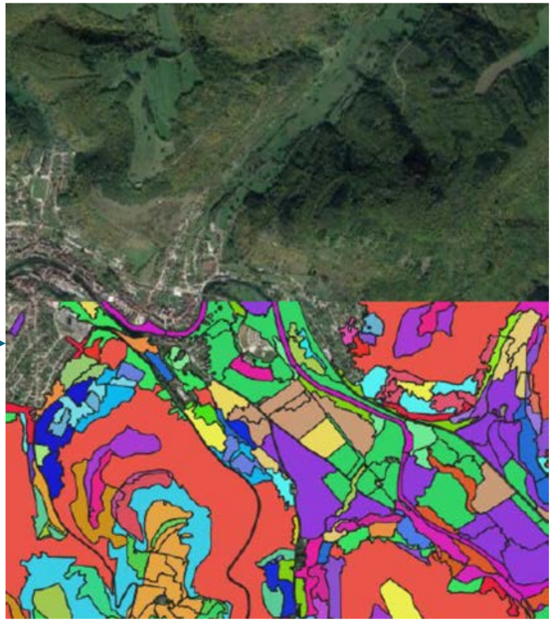


Vegetation physiognomies



Modelled maps are crossed

Habitats
scale 1:25000, minimum surface: 0,5 Ha



1 polygon = 1 vegetation type x 1 biotope

CarHab habitats

- The crossed information of biotope and vegetation physiognomies is defining a habitat for each point of the territory (excluding roads and railroads).
- Correspondence with the EUNIS habitat typology for natural and semi-natural habitats
- Correspondence with the Annex I habitats for Natura 2000 if applicable, associated with a probability of expression

Planitiary grassland on slightly acidic and mesophilic substratum (oceanic subhumid climate of sub-mediterranean variation)

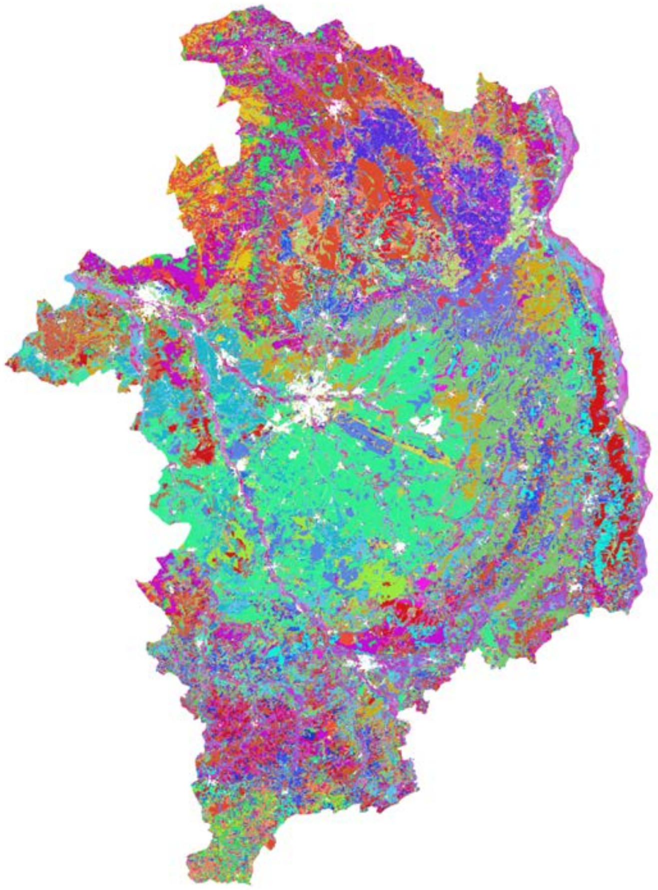
Translating into EUNIS Habitats through a regional catalog

E2.2 Low and medium altitude hay meadow

Translating into Annex I Natura 2000 Habitats through a regional catalog

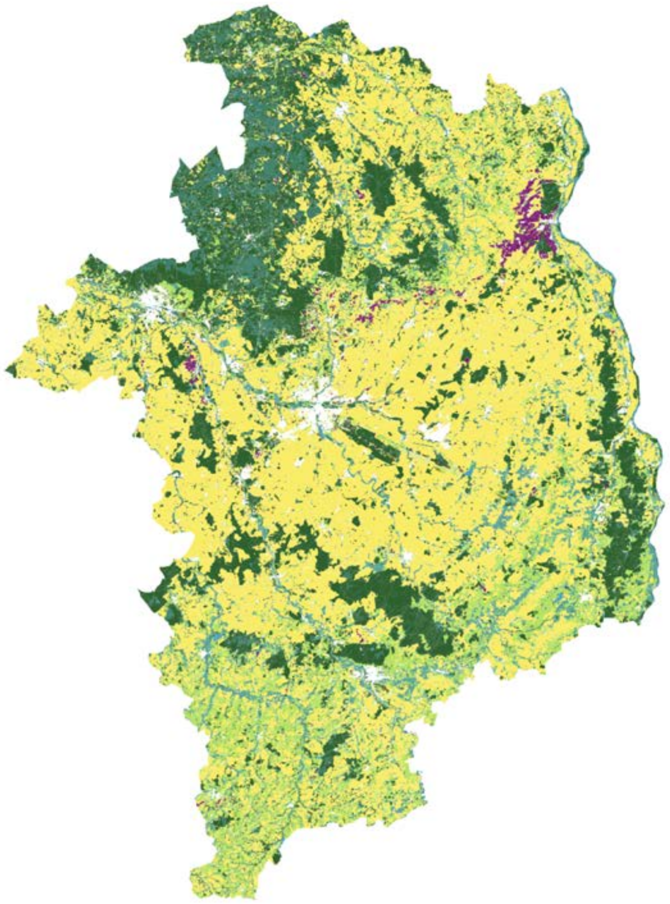
HIC 6510 Lowland hay meadows with low probability

CarHab habitats and transcriptions to EUNIS and HIC

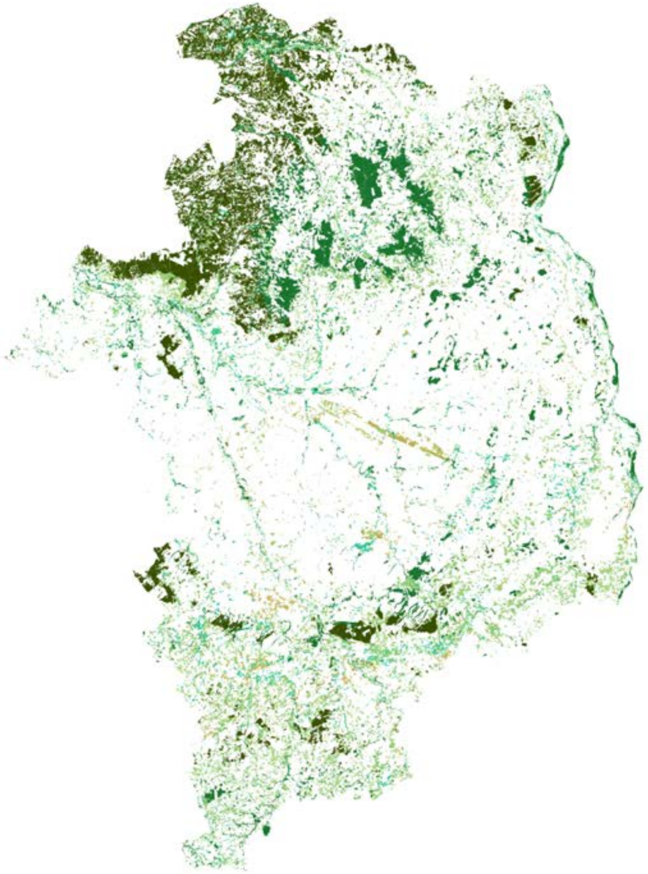


CarHab Habitats (Cher – 18)

Semiology in progress



EUNIS transcription (Cher – 18)



Natura 2000 transcription (Cher – 18)

2. Production process

Biotopes and vegetation physiognomies maps made with **supervised machine learning** and the **Random Forest algorithm**

DS1 – DS2

Sentinel-2 Data
From the Copernicus program

Variables :
NDVI, NDWI, Brightness

Vegetation types modelled

Variables calculation/computing

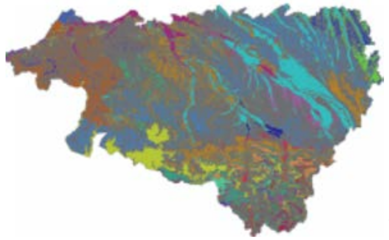
Model training

Model generalization

RGE Alti, Base AURELHY, Geology, pedology

Variables :
Insolation, slopes, …

Biotopes modelled



DS1 – DS2

Models validation

Validity of the models assessed by the National Botanical Conservatories (CBN):

- A field phase to identify what works well and what needs to be improved
- The generation of an improved training data set from the field (DS2)
- Creation of a V2 model based on the improved data set and a possible adjustment of the variables
- Modeling **metrics**

	Expert validation
Biotope A	**Consistent with local knowledge**
Biotope B	Underestimated
Physiognomie C	Overestimated
Physiognomie D	Non consistent with local knowledge

Final evaluation of the data produced by **experts** (CBN).

- Validation of the departmental map
- More detailed evaluations for certain biotopes and vegetation physiognomies in notes

3. Data strengths and limitations

Modelled maps

Biotope and Vegetation physiognomies Maps = Predictive Maps

→ The raw modeling maps give a probable expression of Biotopes and Vegetation physiognomies for each 100 m² pixel

→ This probability depends on the learning of the model and is related to the explanatory variables and the training data

To help understand the limitations:

→ Metrics + **CBN expertise** provide insight into the reliability of the prediction by class

→ The limits of the model and the map will be specified in an **accompanying note** to be read for any exploitation of the data

4. Next steps

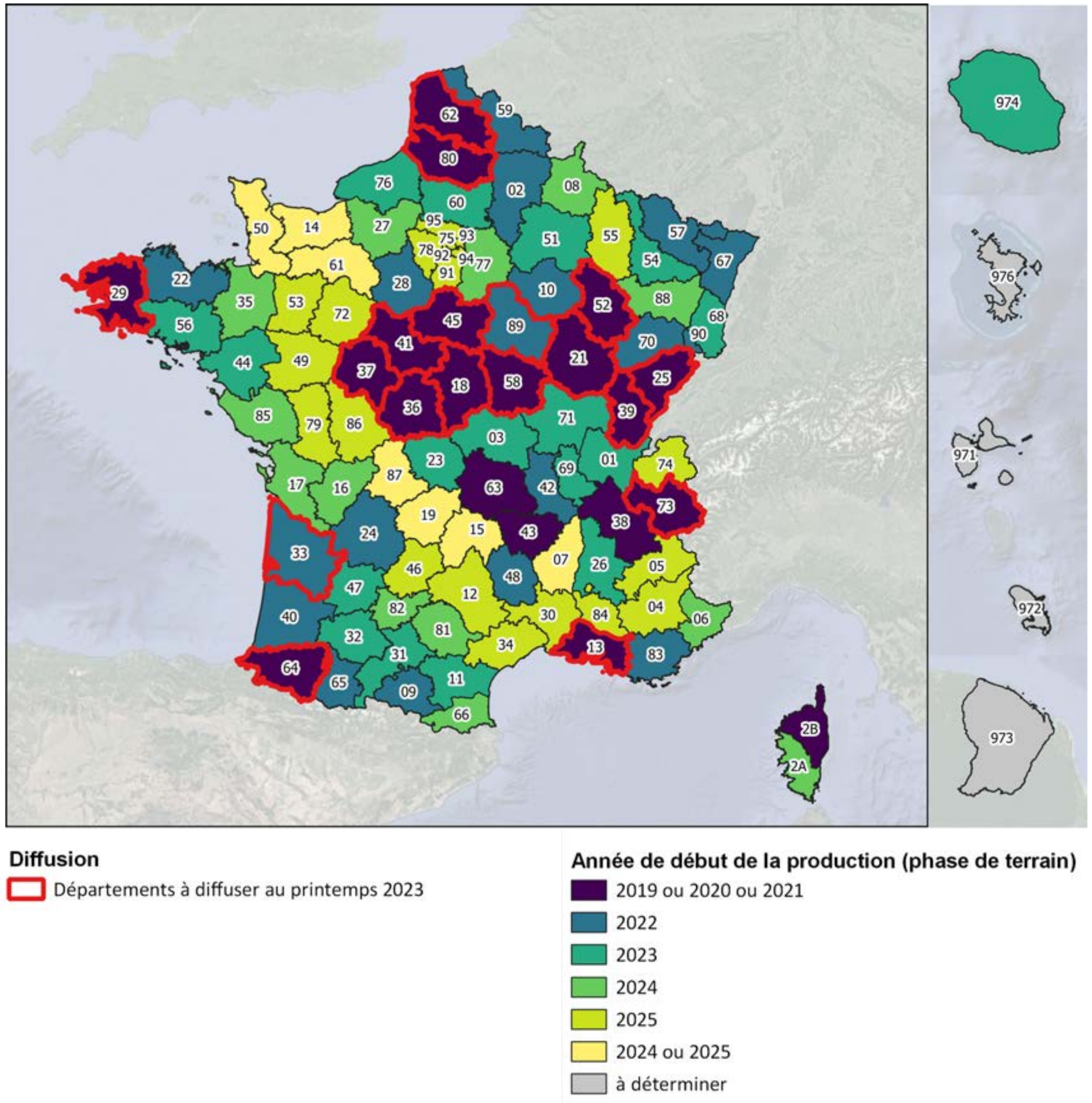
Next steps

Spring 2023:

- Release of about 15 departments
- Opening of the CarHab viewer to the public
- Release of accompanying notices (methodology and scope of use of the data) for each departments

End of 2023 :

- **CarHab Methodology guide** published
- Annual production of 15-20 departements



Call for expressions of interest

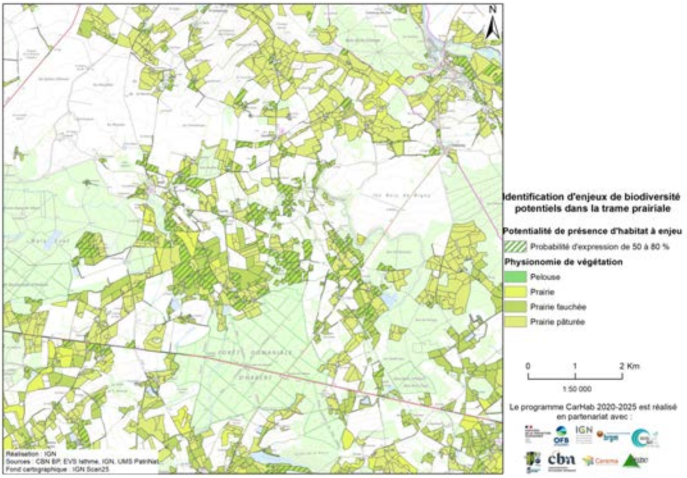
Spring 2023 :
Webinar for the **Call for expressions of interest** on CarHab data use launch

Land use planning

- Green and Blue Framework
- Mitigation hierarchy
- Revision of urban planning documents
- …

Biodiversity

- Species inventory tool
- Natura 2000 areas
- ZNIEFF
- National Protected Areas Strategy
- Ecological restoration
- …



Budget : 200 k€ for app. 8 projects

June 2023 : Candidates selection

Thank you for your attention

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biodiversa+
European Biodiversity Partnership

Spain

By Cristina Moreno Gutierrez, Ministry for the Ecological Transition and the Demographic Challenge

European Environment Agency

Ministry of Environment of Denmark
Environmental Protection Agency

Financiado por la Unión Europea
NextGenerationEU
Plan de Recuperación, Transformación y Resiliencia
GOBIERNO DE ESPAÑA
VICEPRESIDENCIA TERCERA DEL GOBIERNO
MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA Y EL RETO DEMOGRÁFICO

Habitat mapping at national level (SPAIN)

Cristina Moreno Gutiérrez

Nature Data Bank

Ministry for the Ecological Transition and the Demographic Challenge – SPAIN

cmgutierrez@miteco.es

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Index

- Digitalization and knowledge system for natural heritage monitoring – Generation Next fundings
- Regional habitat mapping
- National habitat mapping:
  - ✓ Objectives
  - ✓ Legend (from regions to Europe and UUNN)
  - ✓ Methodology
  - ✓ Challenges and future updates

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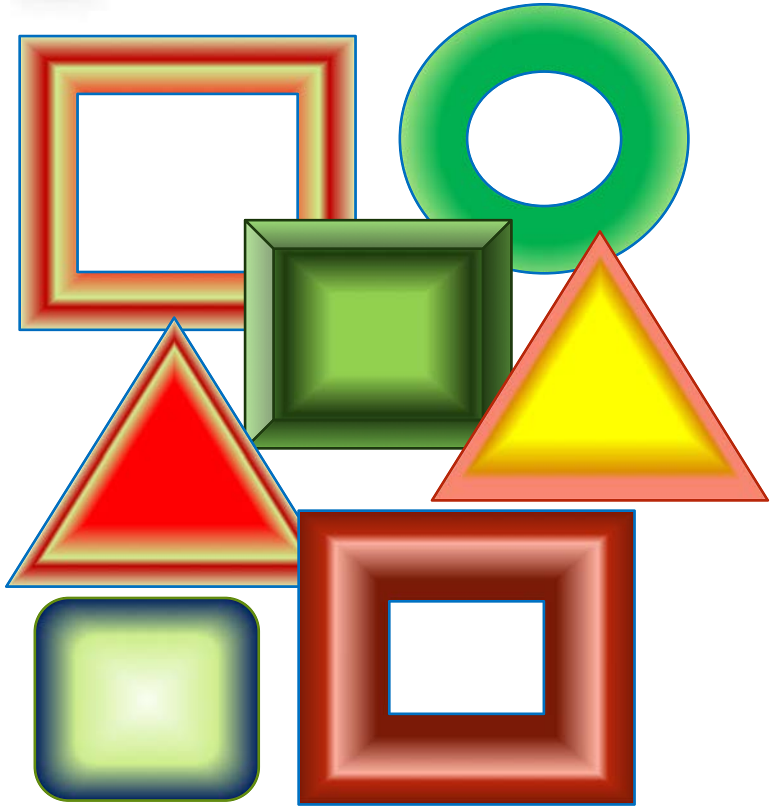
Digitalization and knowledge system for natural heritage monitoring – Generation Next fundings



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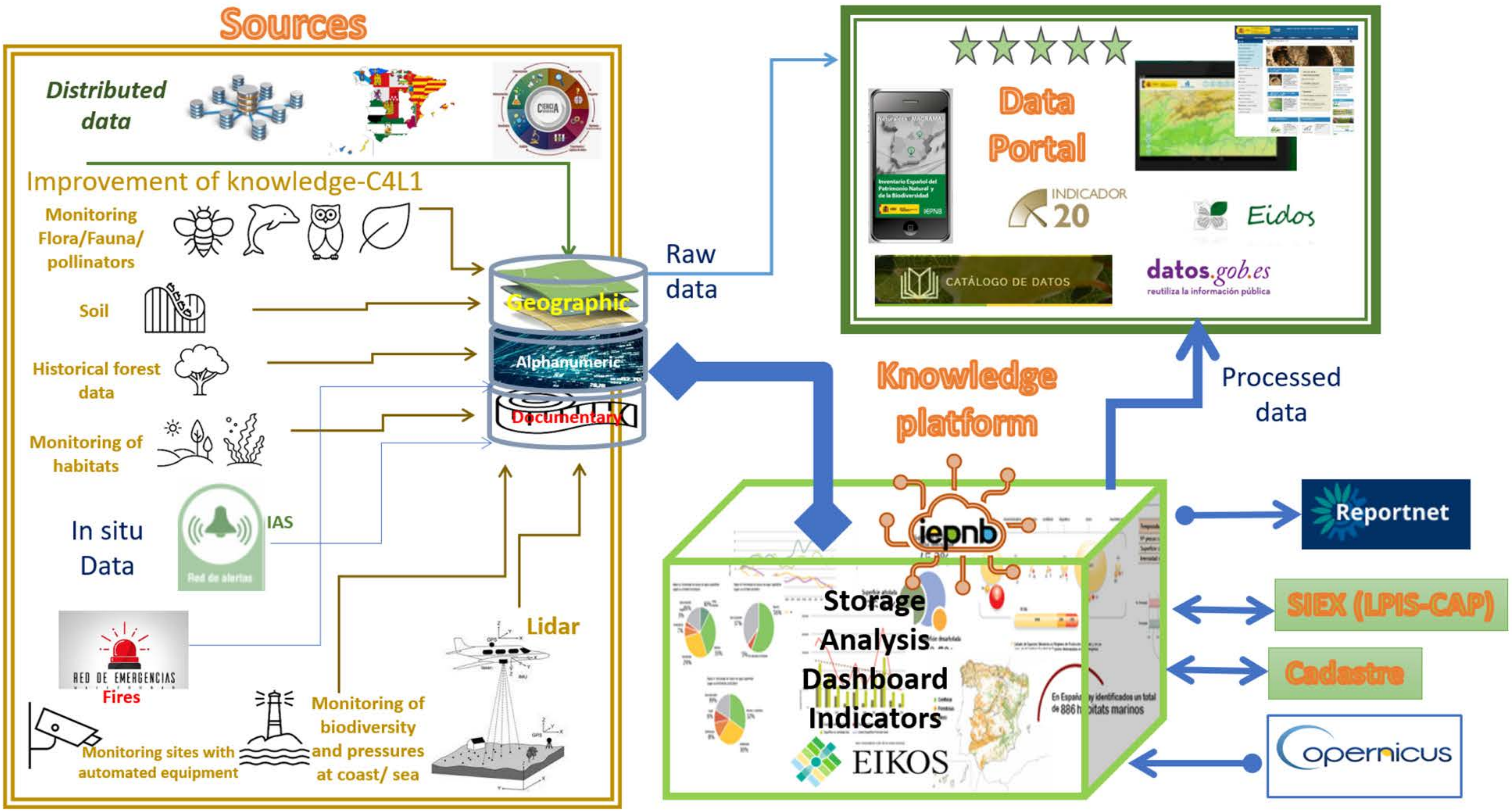
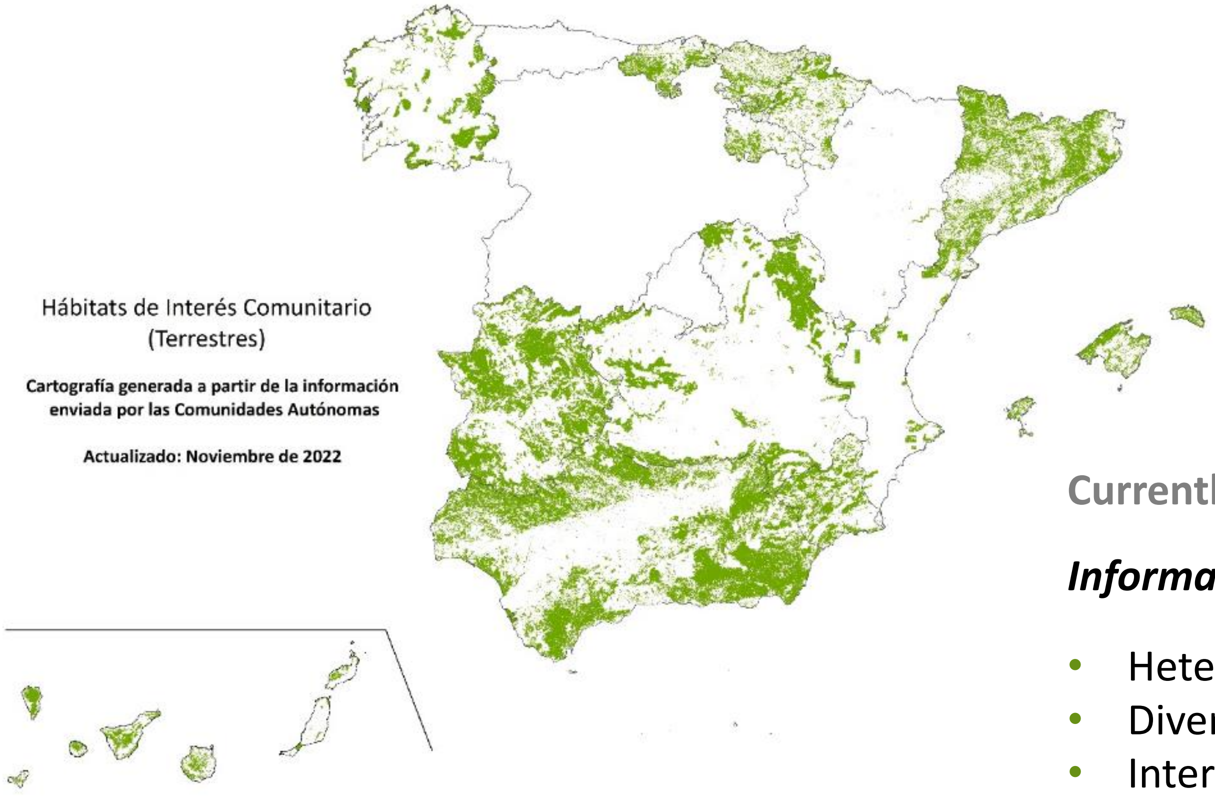
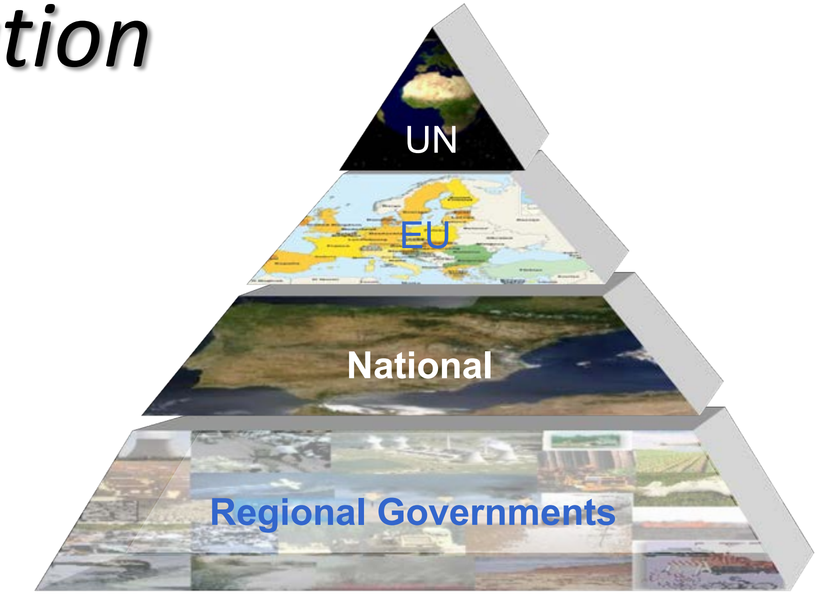
Digitalization and knowledge system for natural heritage monitoring – Data flows



Regional habitat mapping - compilation





Currently:

Informative but difficulties in their harmonization

- Heterogeneity in the set of habitat cartographies,
- Diversity of scales (autonomous, regional and local),
- Interpretation criteria,
- Typologies used,
- Timely update

✓ *Currently, there is no homogeneus and updated habitat mapping at national level*

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National habitat mapping - objectives

CARTOGRAFÍA DE HÁBITATS TERRESTRES: MEJORA DE LA INFORMACIÓN TERRITORIAL A ESCALA NACIONAL
EXPEDIENTE Nº 22BDES905

Plan de Recuperación, Transformación y Resiliencia
Financiado por la Unión Europea
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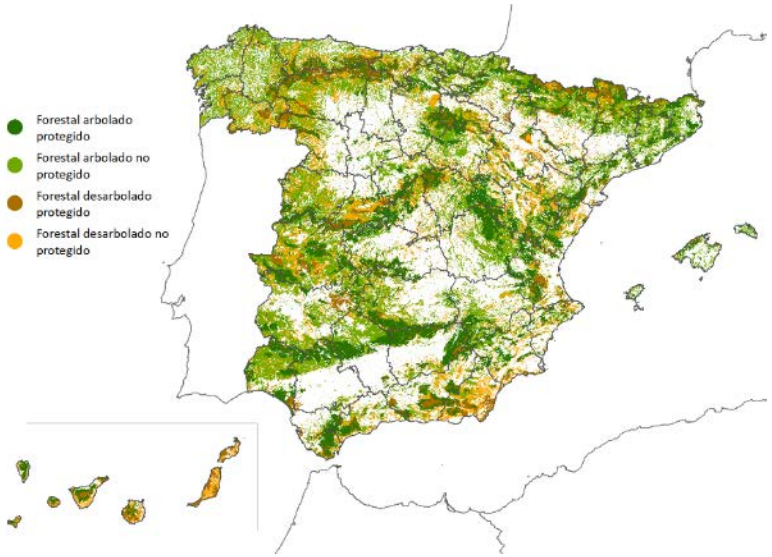

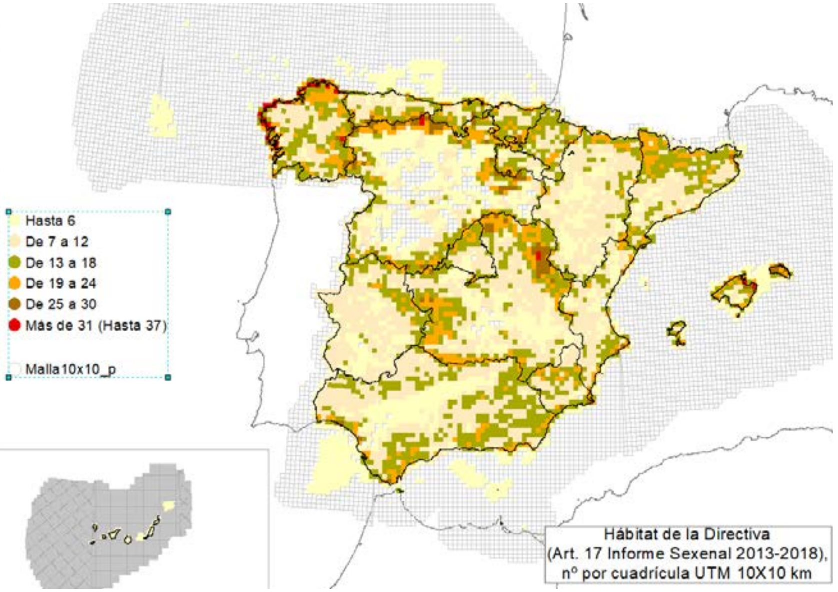

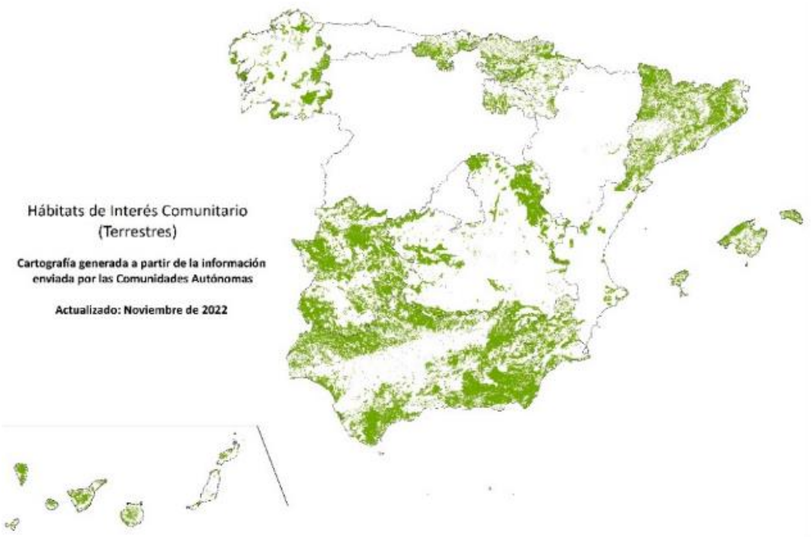

OBJETIVES:

- Homogeneous habitat mapping throughout the territory, based on pre-existing geographical information, coherent with the Forest Map of Spain and LPIS-CAP;
- Consistent scale: 1: 25,000; UPDATE TIMELY
- Update of national check list of habitats based on EUNIS classification.
- In order to meet national and international information requirements and contribute to the new challenges posed by the European Green Deal.

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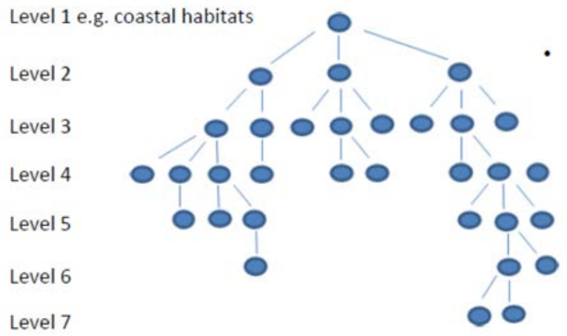
National habitat mapping - legend

Double legend

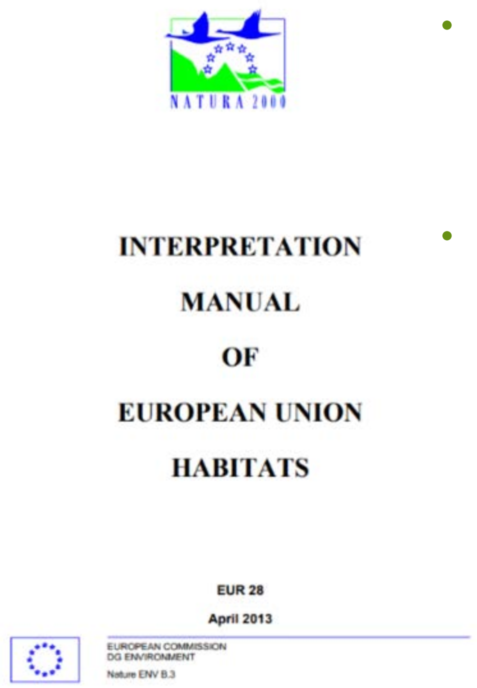
EUNIS (National check list)

- The classification is hierarchical and covers all types of habitats from natural to artificial, from terrestrial to freshwater and marine.
- The review of the terrestrial component of the EUNIS habitat classification was initiated in 2015. The review concerns the groups of **coastal habitats, grasslands, heathland, forest, sparsely vegetated and vegetated man-made habitats**. The remaining groups will be revised and published at a later stage.



M_Marine_2019
N_Coastal_2021
C_Inland waters_2012
D_Wetlands_2012
R_Grasslands_2021
S_Heathland_2021
T_Forest_2021
U_Sparsely vegetated habitats _2021
V_Vegetated man-made habitats_2021
J_Artificial_2012
X_Habitat complexes_2012

Habitats Directive 92/43/CEE Annex I



- EUNIS classification includes cross-walks at level 3 to Habitats Directive Annex I
- For this mapping, a double assignation of contents will be conducted

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National habitat mapping - methodology

- Agreed methodology with Regional Governments
- Based on reference geographical information (National Forest Map, LPIS-CAP)

Classification (DOUBLE LEGEND)	National controlled list-EUNIS (level 4 min.) and Habitats Directive Annex I
Type	Vectorial. Polygons from National Forest Map (based on field monitoring) [polygons modifiable only exceptionally]
More than one habitat per polygon	% of area (up to 100%)
Scale	1:25.000 (exceptions for azonal habitat types)
Minimum Mapping Units	– Riparian vegetation, costal habitats, wetlands: 0,5 ha – Forest, artificial, inland waters, grasslands, heathland: 1 ha – Agricultural: 2 ha
Use of pre-existing reference geographical information and other sources of information	National Forest Map, Habitat mapping of Comunidades Autónomas, compatible with LPIS-CAP, Cadastre…

Assignation and revision of habitats by experts per group of habitats:

- Zonal: FORESTS, HEATH AND SCRUB, GRASSLAND
- Azonal: COASTAL, STANDING WATER, RUNNING WATER, RAISED BOGS AND MIRES AND FENS, ROCKY HABITATS AND CAVES, RIPARIAN VEGETATION

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Challenges and future updates

The **Spanish Inventory of Natural Heritage and Biodiversity (IEPNB)** needs to strengthen **territorial information** within the Integrated Information System, for this purpose it will develop

EIKOS - ***Spanish Ecosystem monitoring and information System***

Knowledge platform

the best **cartographic information**

Analysis capacity

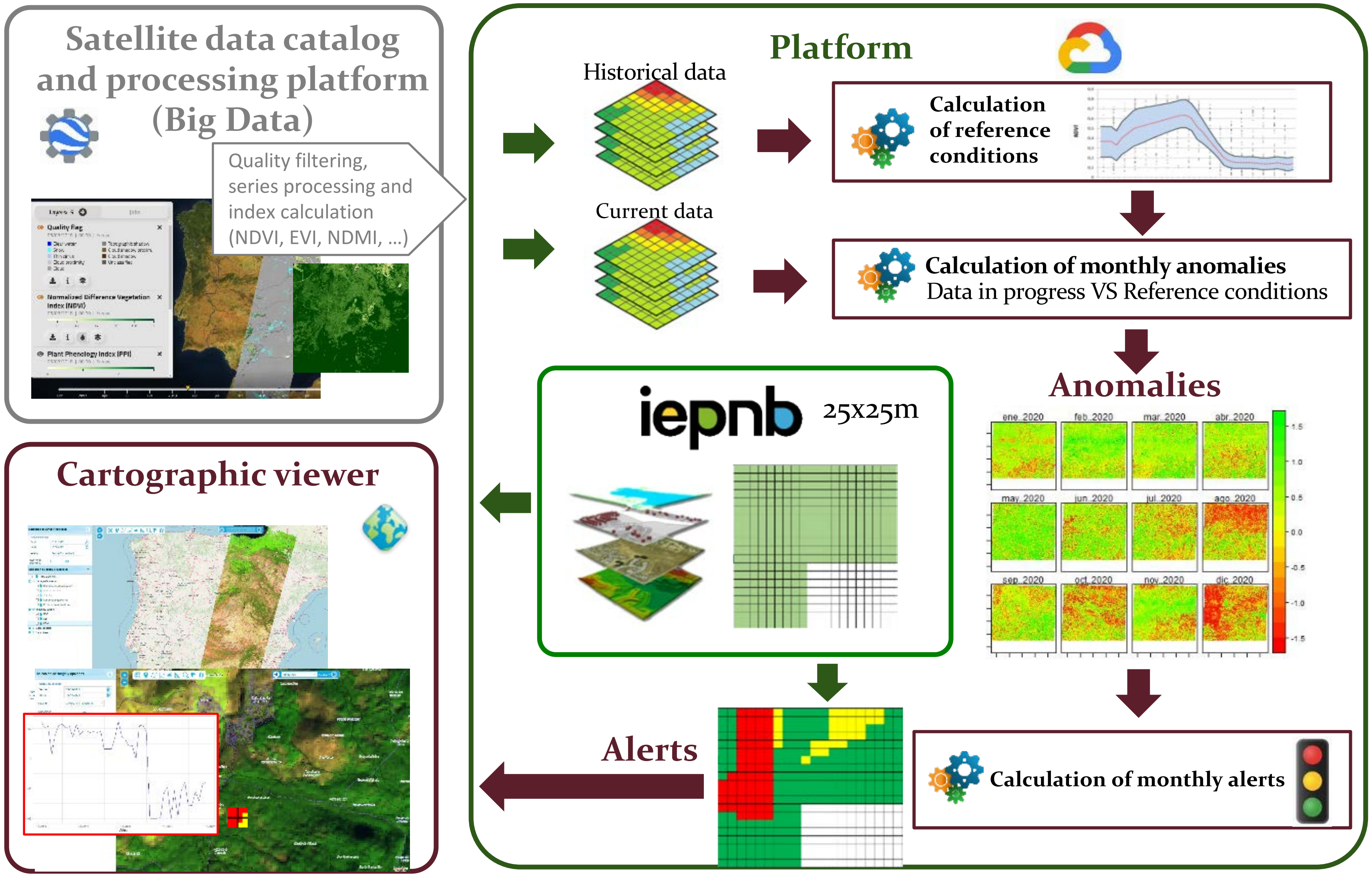
In order to have a…

Coherent territorial information, comparable in space and time

continuous monitoring and a change alert system

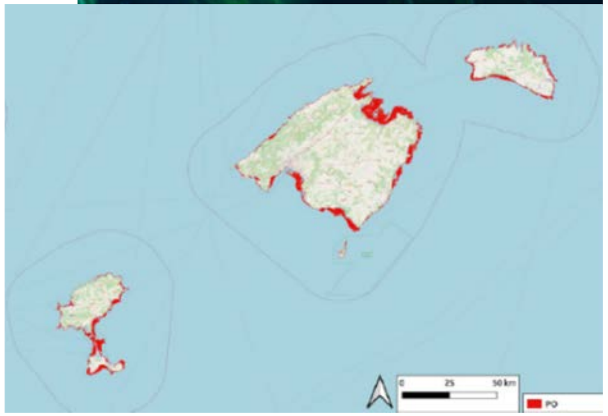
ability to perform **projections and simulations** in different scenarios

Anomalies and Early Alerts Module



Challenges and future updates- timely update

EIKOS



2 PILOT STUDIES:

- Identification of **Posidonia beds** in Mediterranean coast, using satellite images from Sentinel-2 combined with AI algorithms. → FIRST RESULTS: Good results at 10m precision. Further learning/training the algorithm is still needed, as it is influenced by environmental factors like turbidity.
- Probability mapping of **wetlands**. ETC-UMA. Applying SWOS (Satellite-based Wetlands Observation Service) methodology (combination of topographic indexes, soil characteristics and humidity indexes derived from remote sensing). → ONGOING

THANK YOU

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biodiversa+
European Biodiversity Partnership

Slovakia

By Ján Černecký, State Nature Conservancy of Slovak Republic

European Environment Agency

Ministry of Environment of Denmark
Environmental Protection Agency

Combing of earth observation and field data collection for habitat mapping in Slovakia

Mgr. Ján Černecký, Phd.

Institute of landscape ecology, Slovak academy of science

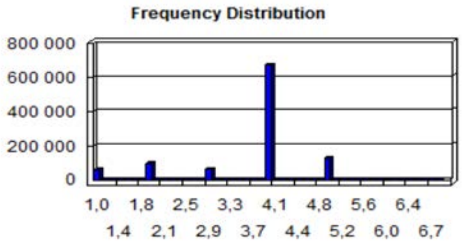
State nature conservancy of the Slovak Republic

1. Map of the ecosystems – combination of EO and field data

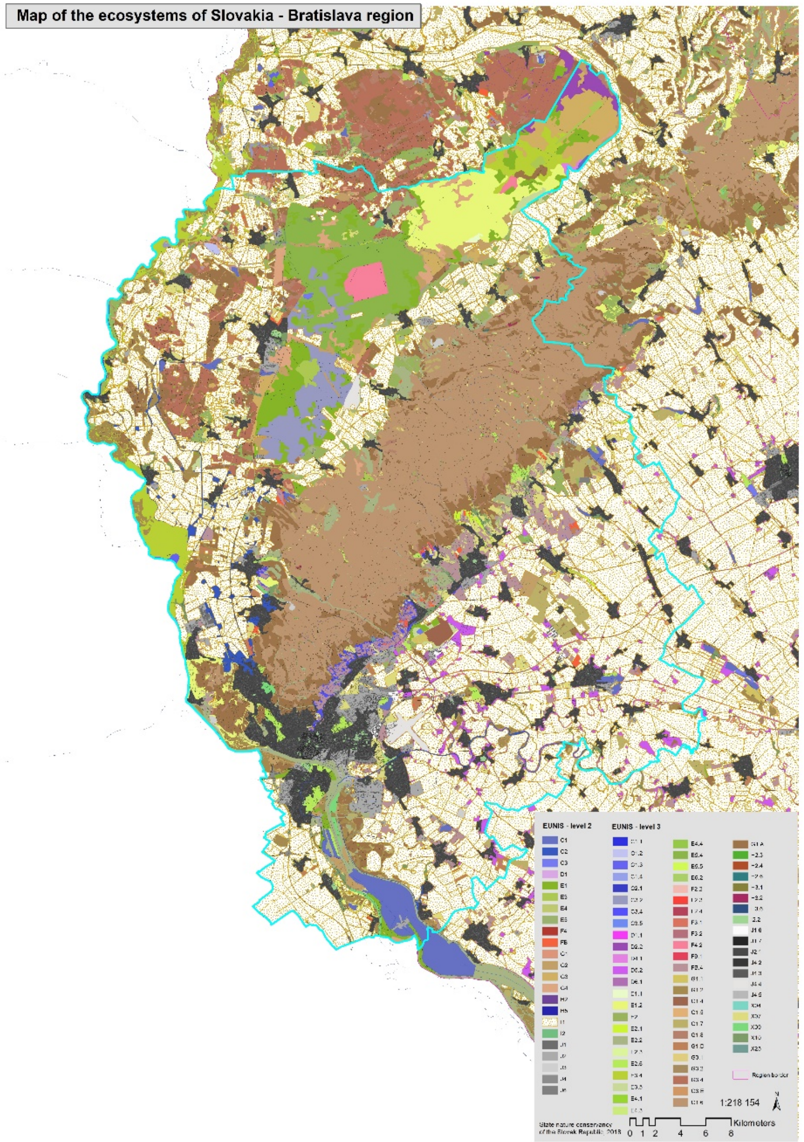
Published: Ján Černecký, Peter Gajdoš, Jana Špulerová, Ľuboš Halada, Peter Mederly, Libor Ulrych, Viktória Ďuricová, Juraj Švajda, Ľudmila Černecká, Peter Andráš & Rastislav Rybanič (2020) Ecosystems in Slovakia, Journal of Maps, 16:2, 28-35, DOI: 10.1080/17445647.2019.1689858

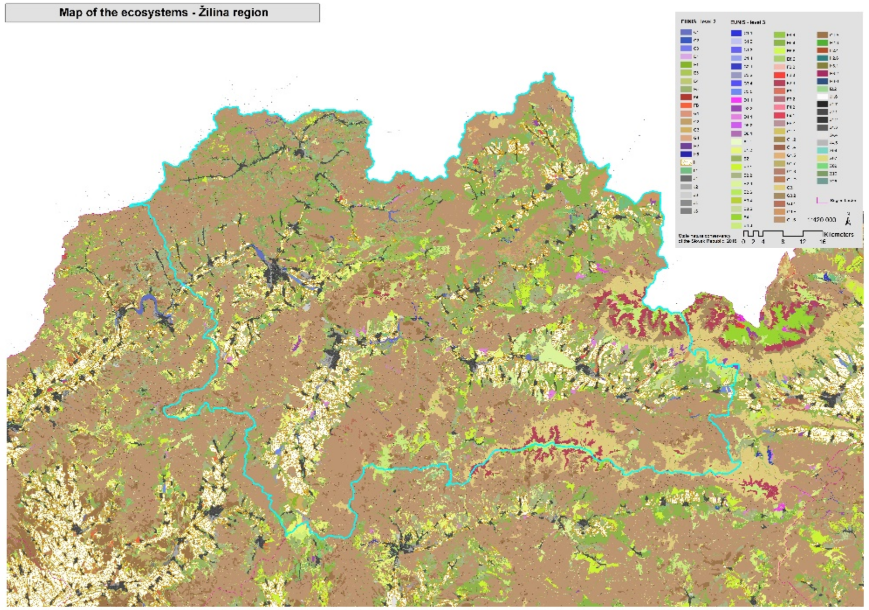
Map of the ecosystems

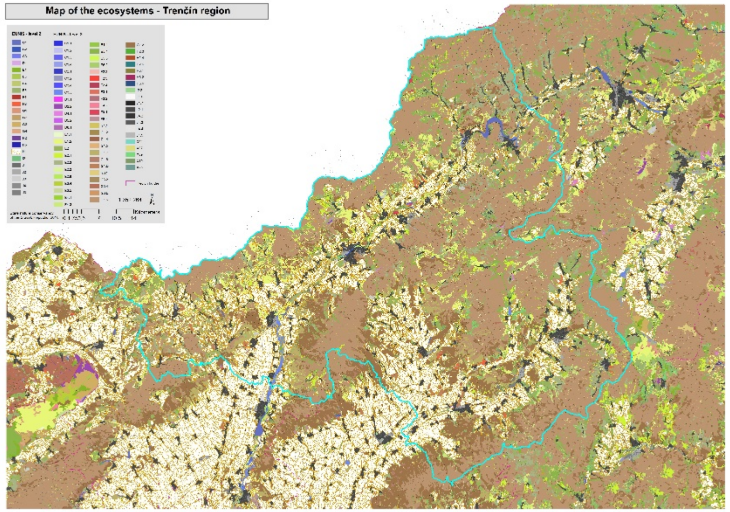
Habitat level (EUNIS)	Number of ecosystems
1	2
2	20
3	30
4	45
5	13
6	3
7	1



1. Regional level



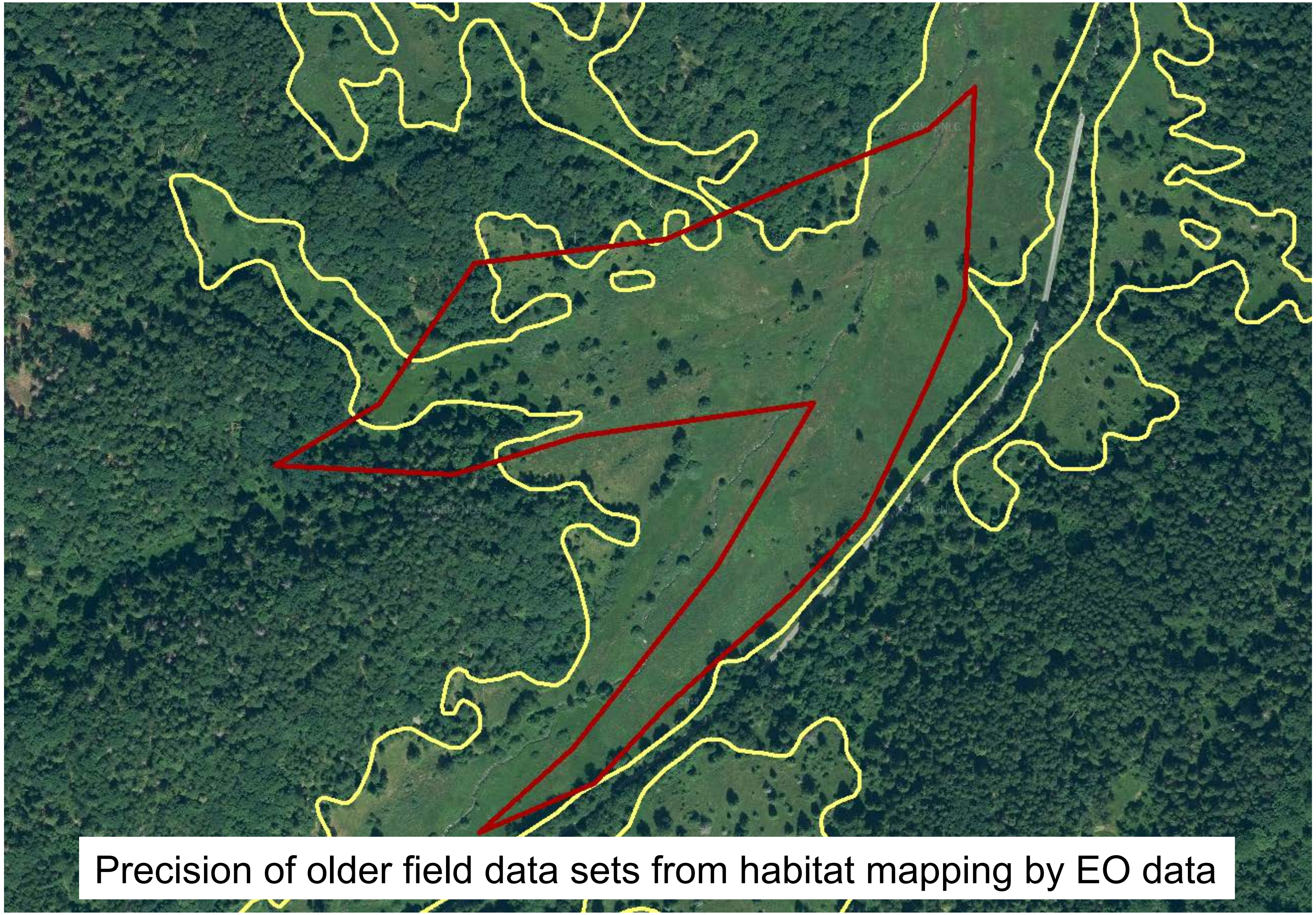




1. Map of the ecosystems – combination of EO and field data

- On the basis of the available databases of the comprehensive nature conservation information system (CNCIS), habitats mapping data and other background data were used as a basis for identifying ecosystems. Data on ongoing national monitoring of habitats of European interest and a list of permanent monitoring plots were used, out of which the necessary information on habitats and their quality was extracted (source: www.biomonitoring.sk) The attributes are mainly related to the conservation status assessment.
- The information on non-forest habitats were included from CNCIS into the data on land parcel identification system (LPIS, source: http://portal.vupop.sk/portal/apps/webappviewer/index.html?id=32beed691b01498d9ebe11bf8f9b7b04). LPIS is a geographic information system (GIS), which is a primary record of the use of agricultural land, It mainly contains attributes regarding the crops, but the main added value for the map is the precise spatial border of agricultural land mapped in the scale 1:5000. The attributes transferred were mainly related to identification of the habitat.
- Subsequently, data on spatial distribution of forest ecosystems was added (source: http://gis.nlcsk.org/lgis/). Forest information system is database covering 96% of Slovakia's forests with attributes defining i.e. age, tree composition, habitat identification etc. The level of precision is the scale 1:10 000.
- The information on forest habitats quality were included into the data on forest ecosystems from the list of permanent monitoring plots for forest habitats of European interest. The attributes from monitoring are mainly related to identification/confirmation of habitat type, quality assessment of structure and functions, future prospects and overall conservation status. All the data were subsequently spatially linked to a partial map of ecosystems.
- Corine Land Cover (2012) (source: https://land.copernicus.eu/pan-european/corine-land-cover/clc-2012) has been used as the basis for the remaining blank places in a map of ecosystems where there was no more accurate spatial data. (other sources use raster data on grids, which would not be appropriate for the precision of ecosystem spatial borders)
- The data on habitats quality based on field mapping and monitoring data (point 1) were added into the Corine Land Cover (2012). The added data attributes are related mainly to habitat identification and conservation status.
- Based on the Openstreetmap data (2015) (source: http://www.geofabrik.de/data/shapefiles.html), watercourses, road and railway infrastructure, and urban vegetation elements have been incorporated into the map to clarify detail and capture small-scale, but essential ecological and artificial features
- All layers and features were joined together to create a coherent polygonal map of Slovakia (Figure 1)
- National habitat categories were transferred to the EUNIS habitats (2012) habitat category

2. Example of habitat field mapping border precision and EO data (LPIS)

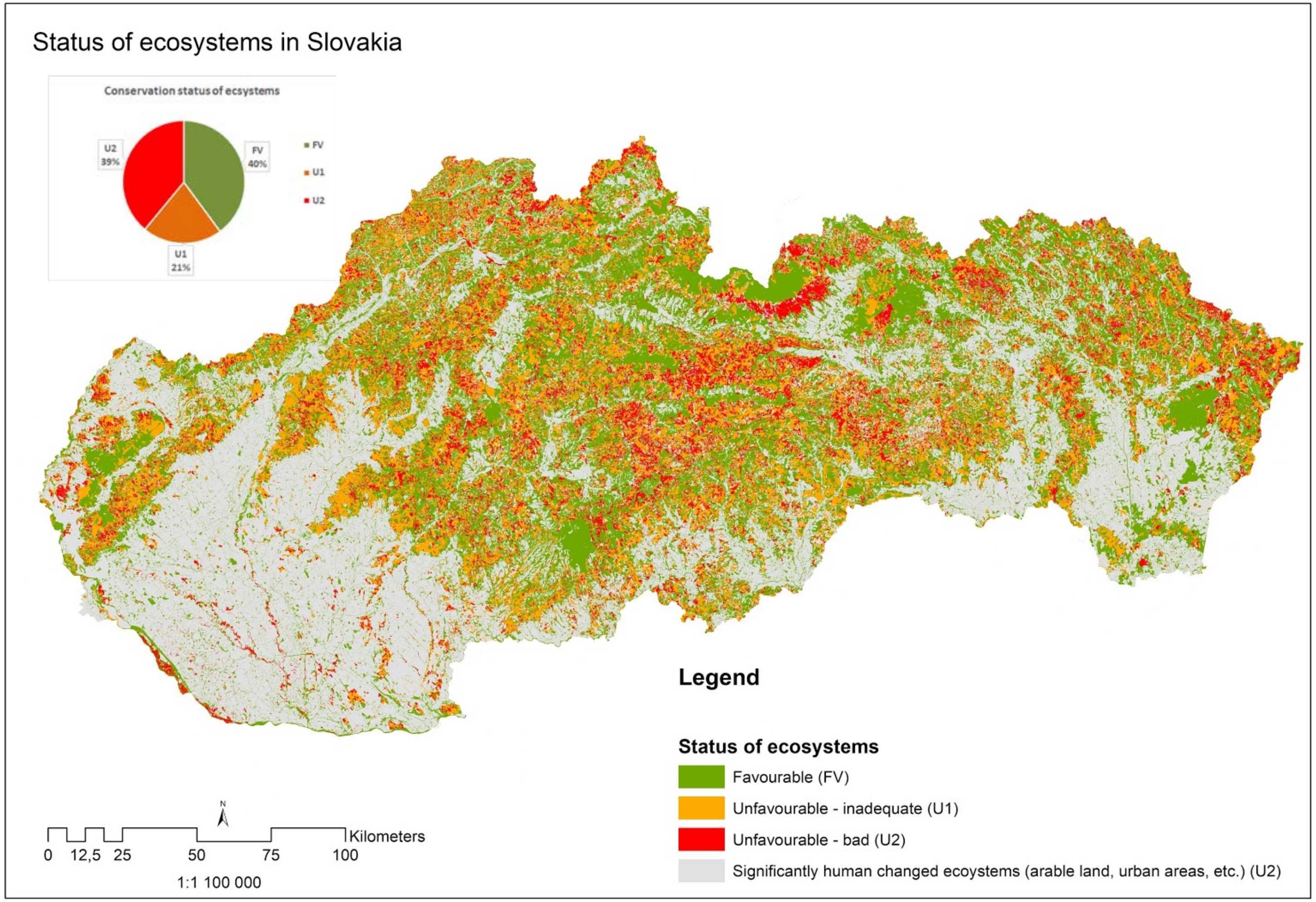


Precision of older field data sets from habitat mapping by EO data

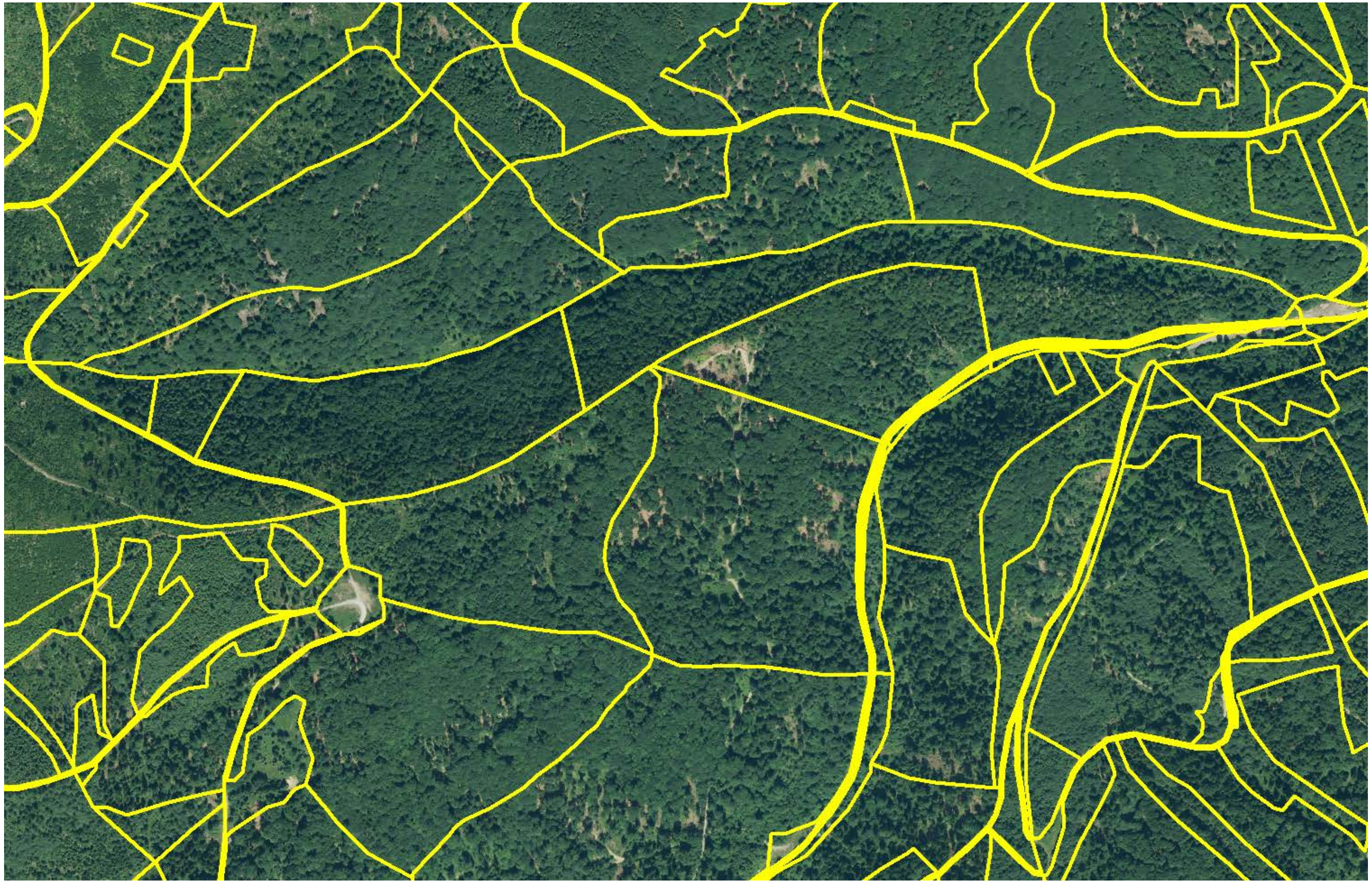
3. Habitat conservation status relation to ecosystem condition

Basic ecosystems	Basic quality parameters for ES evaluation	Retaining the original index value (FV)	Subtraction of one index point (U1)	Subtraction of two index points (U2)
Non-forest habitats	Secondary succession (EO)	0-10 %	10-50 %	Above 50 %
Forest habitats	Interventions in the stands (EO)	0-10 %	10-50 %	Above 50 %
	Age of the stands	100 years and older	50 – 100 years	Up to 50 years
Aquatic habitats	Ecological status of waters	Level 1 and 2	Level 3	Level 4 and 5
Arable land	Soil fertility	66,66 – 100 %	33,33 – 66,66 %	0-33,33 %
Habitats on permanent monitoring sites	Assessment of favorable state at the monitoring site	Favourable	Unfavourable	Bad
Other habitats for which no other data existed	Assessment of the favorable state at the level of the bioregion in the reporting according to Art. 17 of the Habitats Directive	Favourable	Unfavourable	Bad

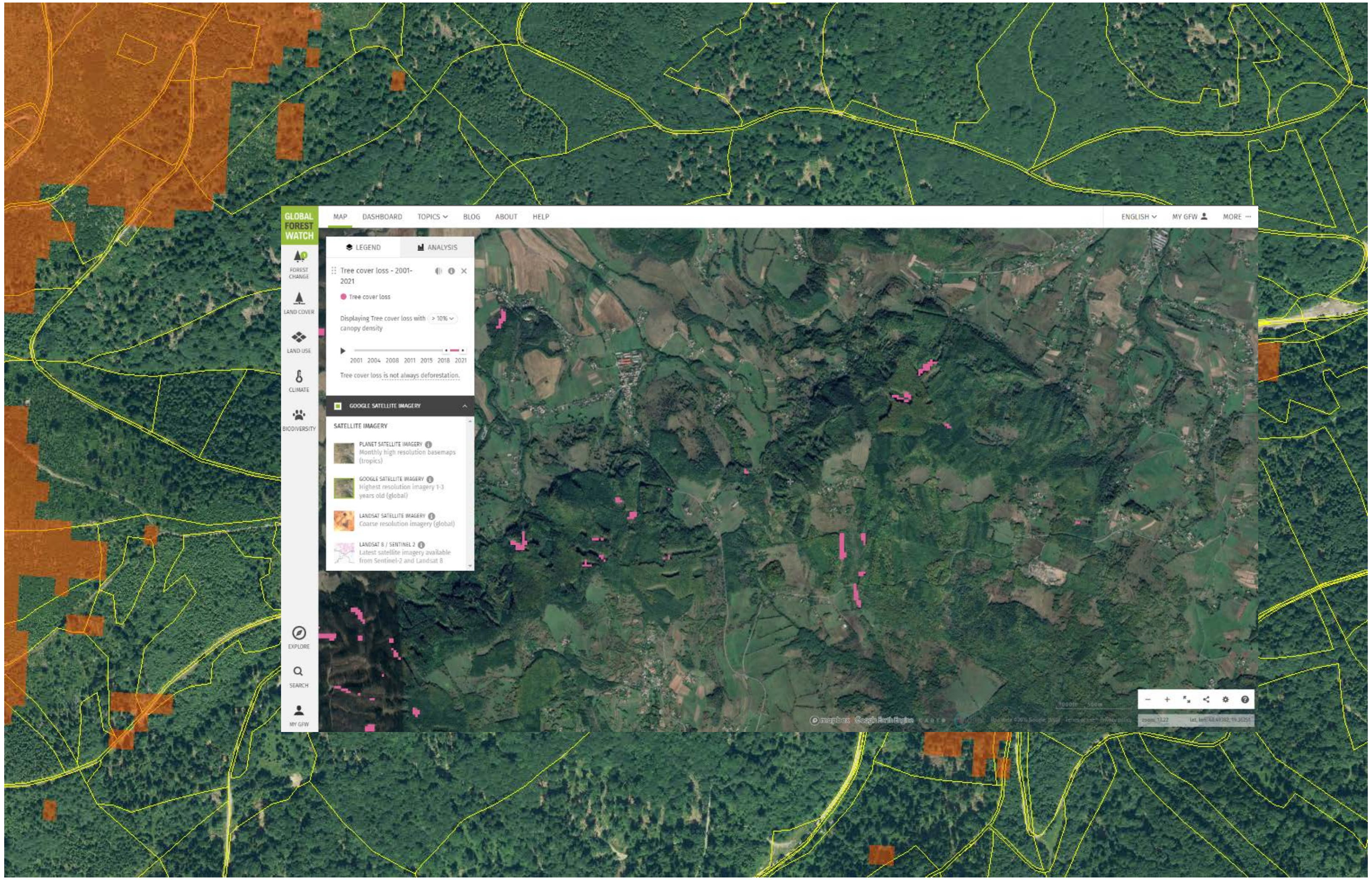
3. Habitat conservation status relation to ecosystem condition



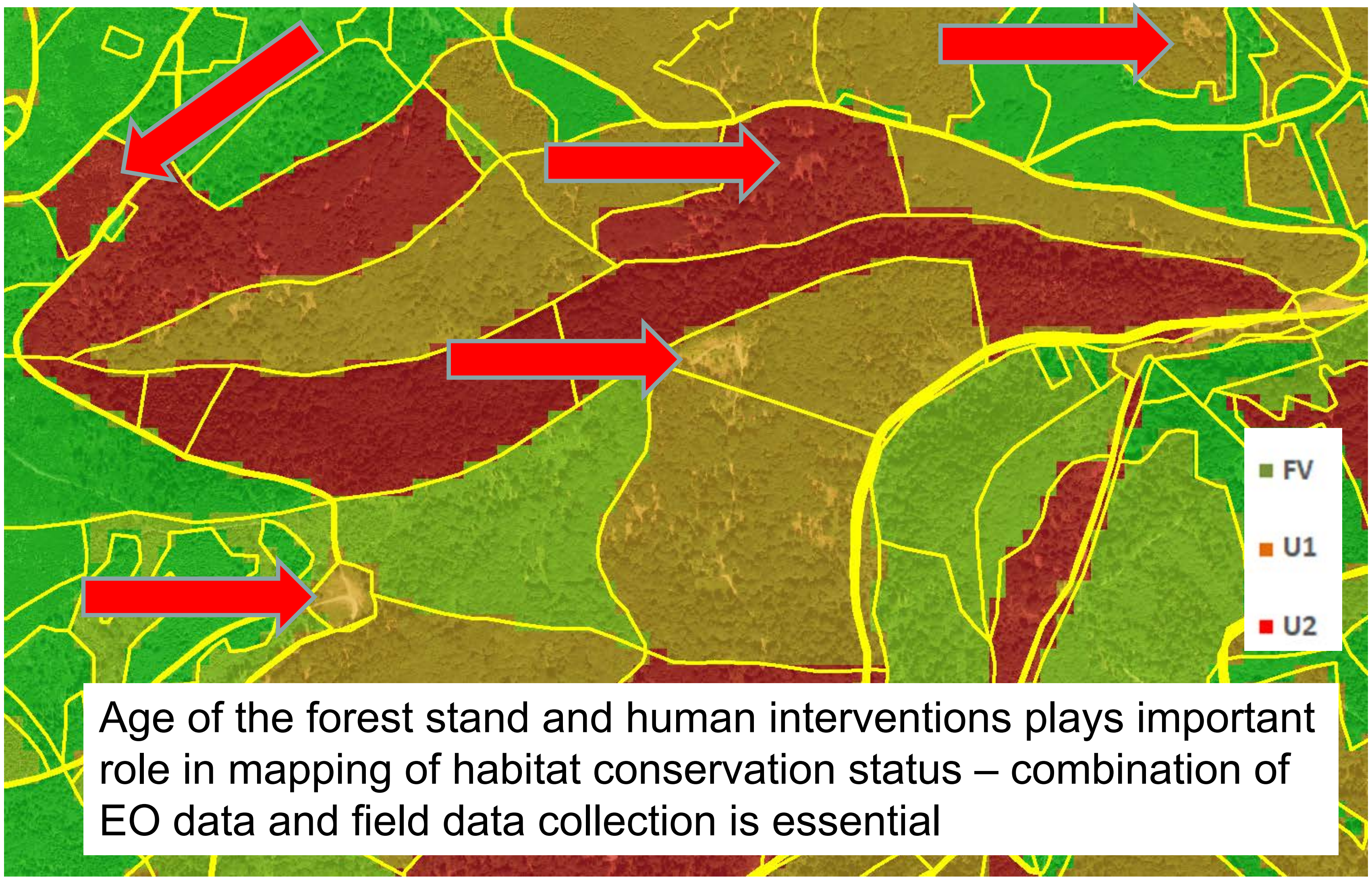
3. Draft version of significant factors limiting the ES supply based on the monitoring and other data sets



3. EO data - Global forest watch

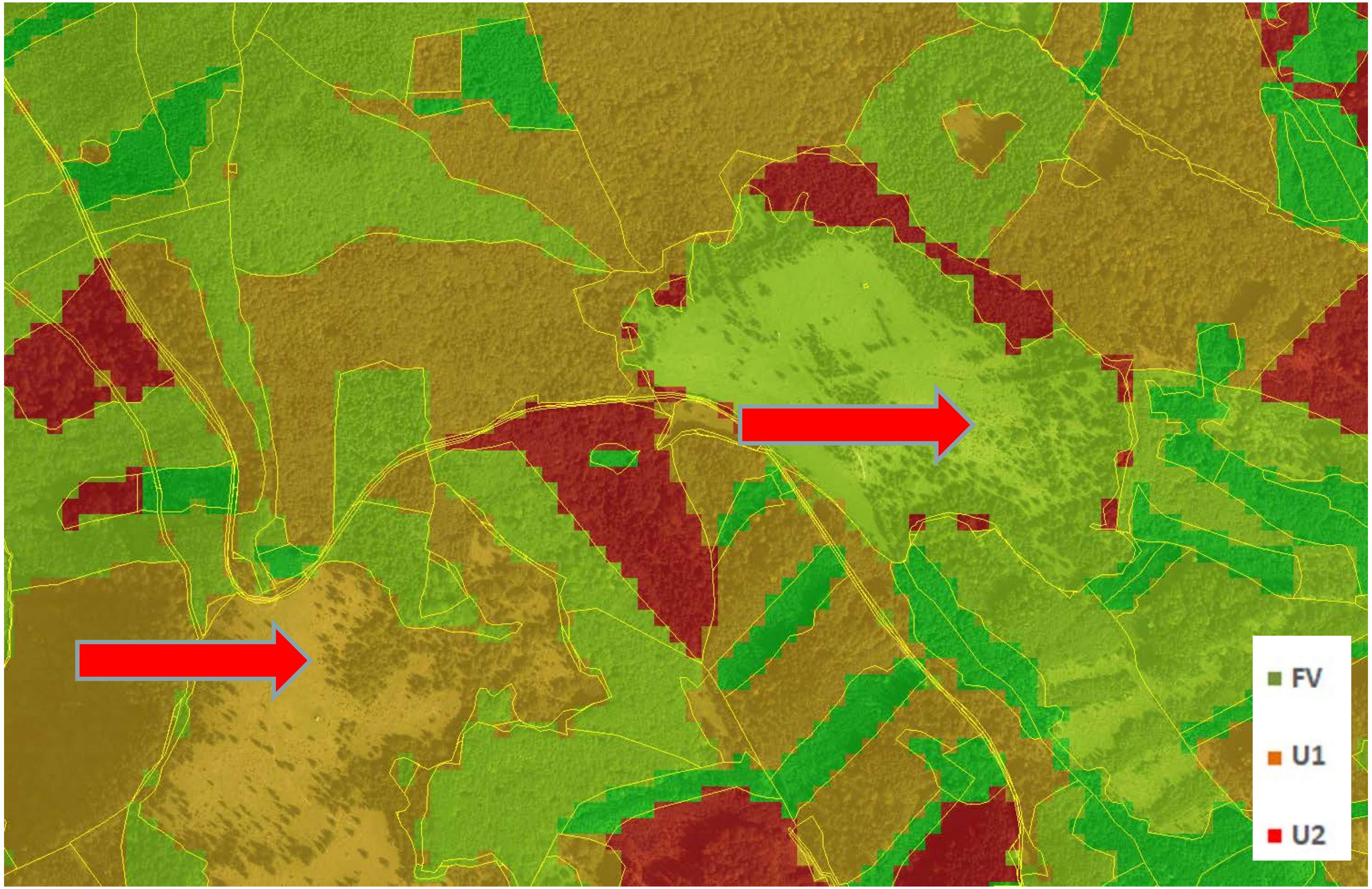


3. Ecosystem condition data combined with EO data (GFW) - Tree cover loss



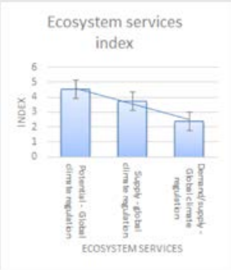
Age of the forest stand and human interventions plays important role in mapping of habitat conservation status – combination of EO data and field data collection is essential

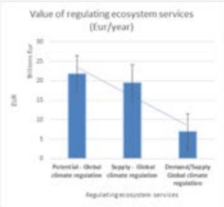
3. Grasslands – level of secondary succession – tree layer gain (EO)

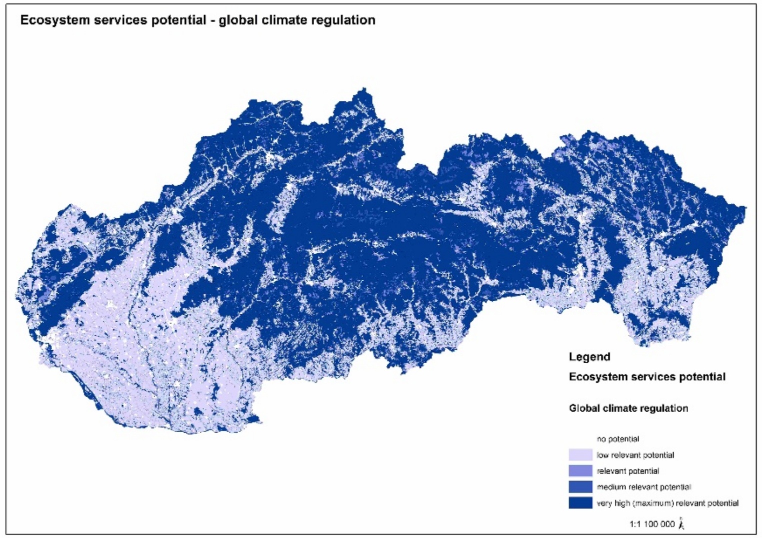


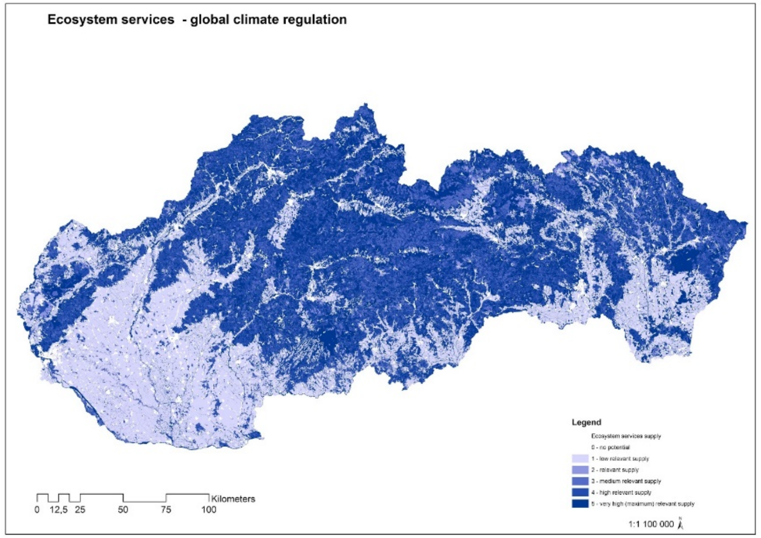
Project implementation – PEOPLE (ESA project in international consortium)

4. Global climate regulation – link to habitat mapping and EO

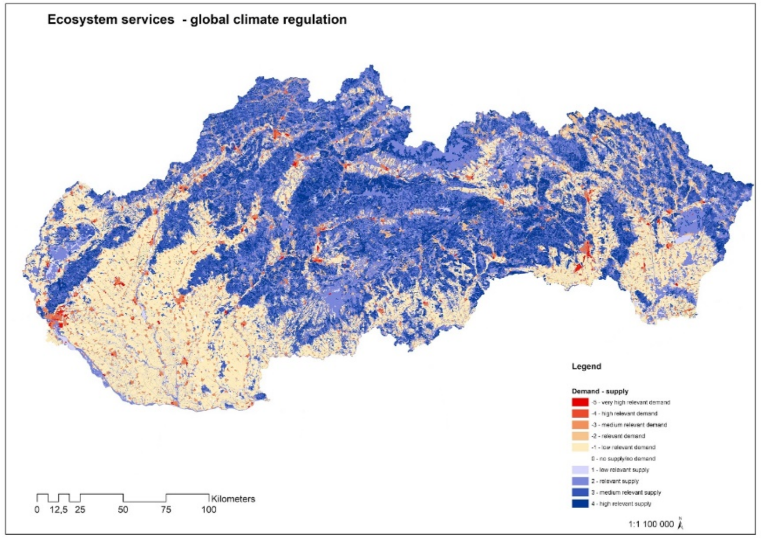






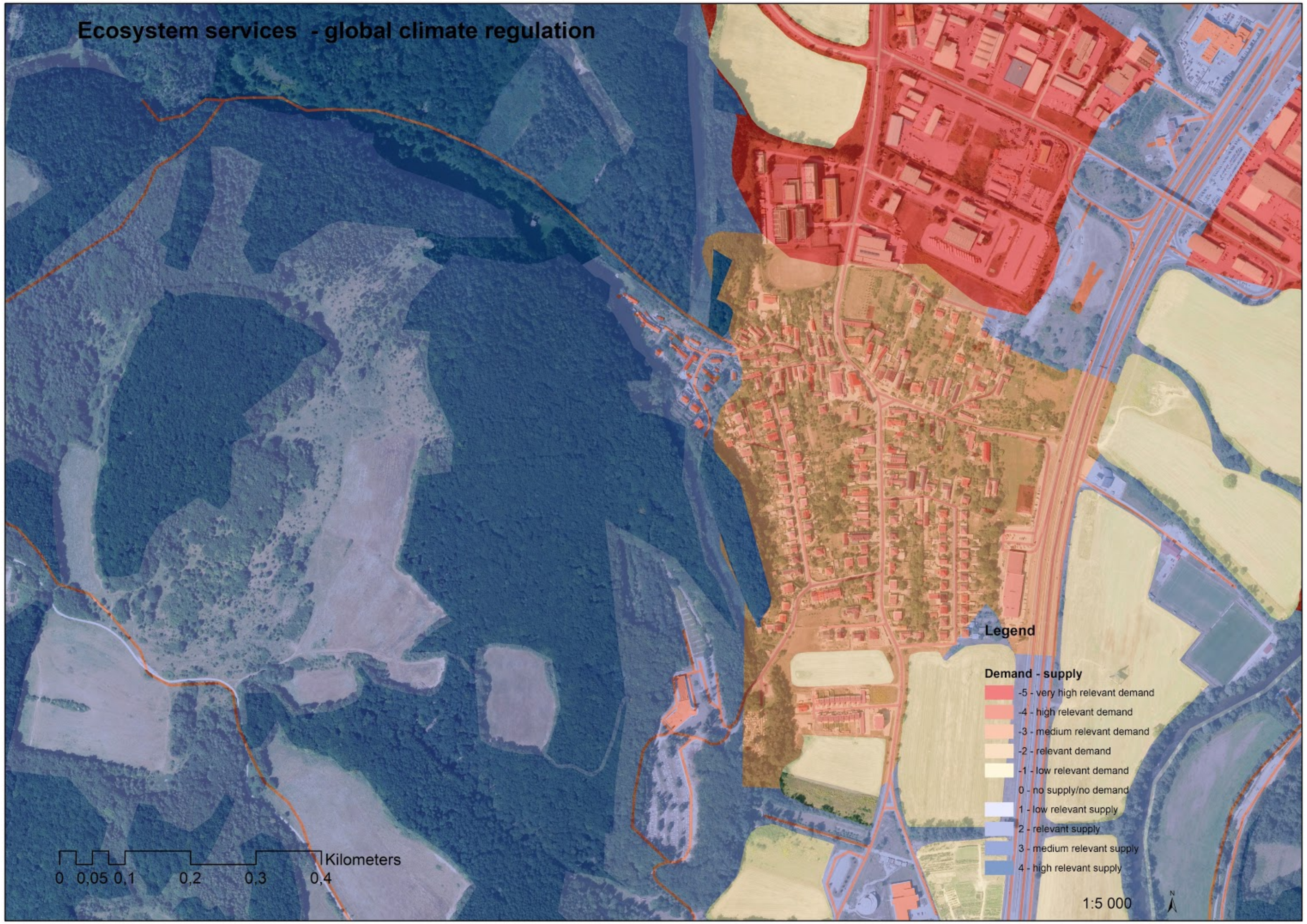


Global climate regulation	FREQUENCY	Area (ha)
-5	411	27568
-4	147	77849
-3	4676	198008
-2	15122	173980
-1	55086	1395148
Total area of demand (ha)		1872552
1	17745	119181
2	443455	1411462
3	211525	809615
4	257759	643832
5	0	0
Total area of real supply (ha)		2984089



Ecosystem category	Mean index of potencial Global climate regulation	Value (EUR) of potencial global climate regulation	Mean index of supply of global climate regulation	Value (EUR) of supply of global climate regulation	Mean index of demand/supply of Global climate regulation	Value (EUR) of demand/supply of Global climate regulation
C - Inland surface waters	0,27	104 625 459 €	0,25	96 152 855 €	0,98	103 452 414 €
D - Mires, bogs and fens	2,13	62 659 500 €	2,00	60 686 115 €	1,94	58 308 046 €
E - Grasslands and lands dominated by forbs, mosses or lichens	4,71	6 500 372 369 €	4,66	6 446 978 293 €	1,58	2 113 797 239 €
F - Heathland, scrub and tundra	1,78	197 137 790 €	1,74	195 282 596 €	0,74	65 810 641 €
G - Woodland, forest and other wooded land	4,99	12 876 396 746 €	3,92	10 580 324 938 €	2,92	7 965 948 775 €
H - Inland unvegetated or sparsely vegetated habitats	0,00	155 €	0,00	155 €	-0,01	-40 850 €
I - Regularly or recently cultivated agricultural, horticultural and domestic habitats	1,03	1 866 192 149 €	1,03	1 866 192 149 €	-0,90	-1 852 447 056 €
J - Constructed, industrial and other artificial habitats	0,00	0 €	0,00	0 €	-3,16	-1 383 675 766 €
X - Habitat complexes	1,08	228 557 834 €	1,08	228 557 834 €	-0,32	-164 130 165 €
Summary	**4,54**	**21 835 942 003 €**	**3,71**	**19 474 174 936 €**	**2,39**	6 907 023 277 €

4. Global climate regulation – local level



Reflections by organisers and next steps to take

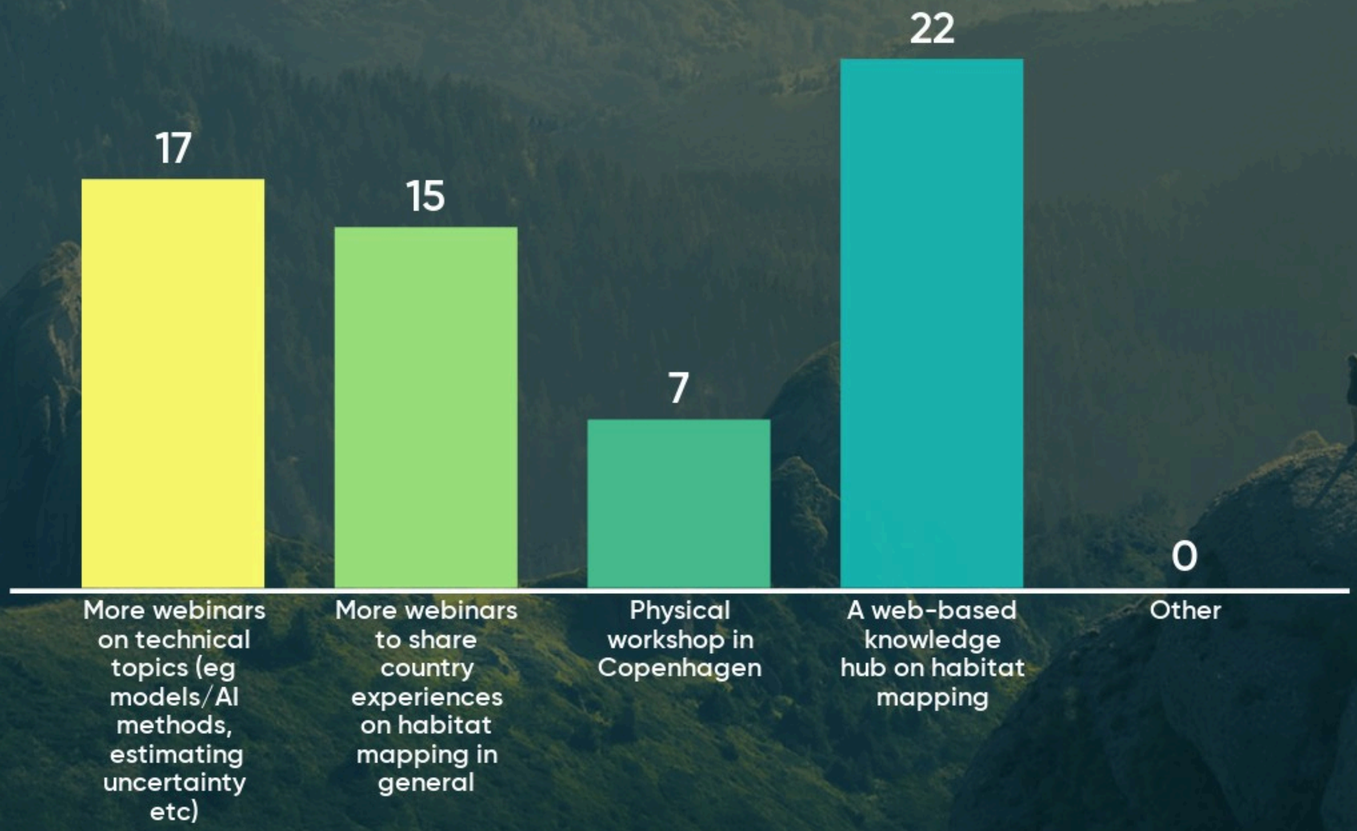
Ideas for sharing knowledge about monitoring across borders – vote!

- ✓ More webinars on technical topics (eg models/AI methods, estimating uncertainty etc)
- ✓ More webinars to share country experiences on habitat mapping in general
- ✓ Physical workshop in Copenhagen
- ✓ A web-based knowledge hub on habitat mapping
- ✓ Other [there will be a second question to provide other ideas]

Let us know in Mentimeter: https://www.menti.com/alt1iv6b1xfz

Sign up for network by contacting Ana T…

Future activities needed



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