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# Biodiversa+ workshop of the candidate biodiversity monitoring pilot “Habitat quality and mapping”

24-25 May 2023
Helsinki, Finland

DAY 1: from 13.30pm to 5.30pm EET

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# Welcoming words and introduction

By Petteri Vihervaara, MoE_FI and Mona Naeslund, SEPA

**Posting about the biodiversity monitoring workshops on social media?**

**Don't forget to tag @BiodiversaPlus**

# Practical information

**WiFi name**: ReittiPublic

**Password:**

REC

The morning session meeting is being recorded, only for internal purposes

PPT

The slides will be shared after the workshop

# Any questions?

Helsinki attendees: raise your hand

Zoom attendees: use the chat

# Agenda of the workshop

**Wednesday**

13:30 – 13.45: Welcoming words and introduction

By Petteri Vihervaara, MoE_Fi and Mona Naeslund, SEPA

· Aims of the workshop

· Background and context of the pilot

**Section I - The need for an EU-wide harmonisation to assess quality of habitats**

13.45 - 14.00: **Experiences with combining in situ and satellite data for habitat mapping at EU level**

By Jan Erik Petersen, EEA

14.00 - 14.15: **Habitat mapping with Remote Sensing: Showcase for European Biodiversity Monitoring within the EuropaBON project**

By Marcel Buchhorn and Borja Gonzales,VITO (presenting) in collaboration with Jose Manuel, Giorgia Milli, Bruno Smets, Helge Bruelheide, Ute Jandt and Nestor Fernandez

# Agenda of the workshop

**Section II - Examples from Biodiversa+ partners**

14.15 - 14.30: **Monitoring and development of indicators of quality of habitats**

By Åsa Ranlund SLU, Swedish Agricultural University

14.30 - 14.45: **Remote sensing of habitats - experiences from Finnish Lapland**

By Saku Anttila, Finnish Environment Institute (Syke)

14.45 - 14.55: Q&A

14.55 – 15.00: Instructions for the Breakout groups

By Aino Lipsanen, MoE_FI

# Agenda of the workshop

**Section III - Breakout group discussions**

15:30 - 17.00: Breakout groups (4) discussion

The aim of the discussions in the 4 breakout groups is to refine the focus of the candidate pilot topic according to Biodiversa+ partner's experiences and priorities.

First part of the breakout group discussion: **Focus on module 1, habitat quality indicators**.

Questions to discuss: What habitats/habitat groups (annex 1 habitats/habitat groups) do the partners wish to use as showcases for a habitat quality indicator? What method should we use in the pilot to showcase possible harmonisation and/or refinement of indicators for habitat quality? Discussion of the presented examples.

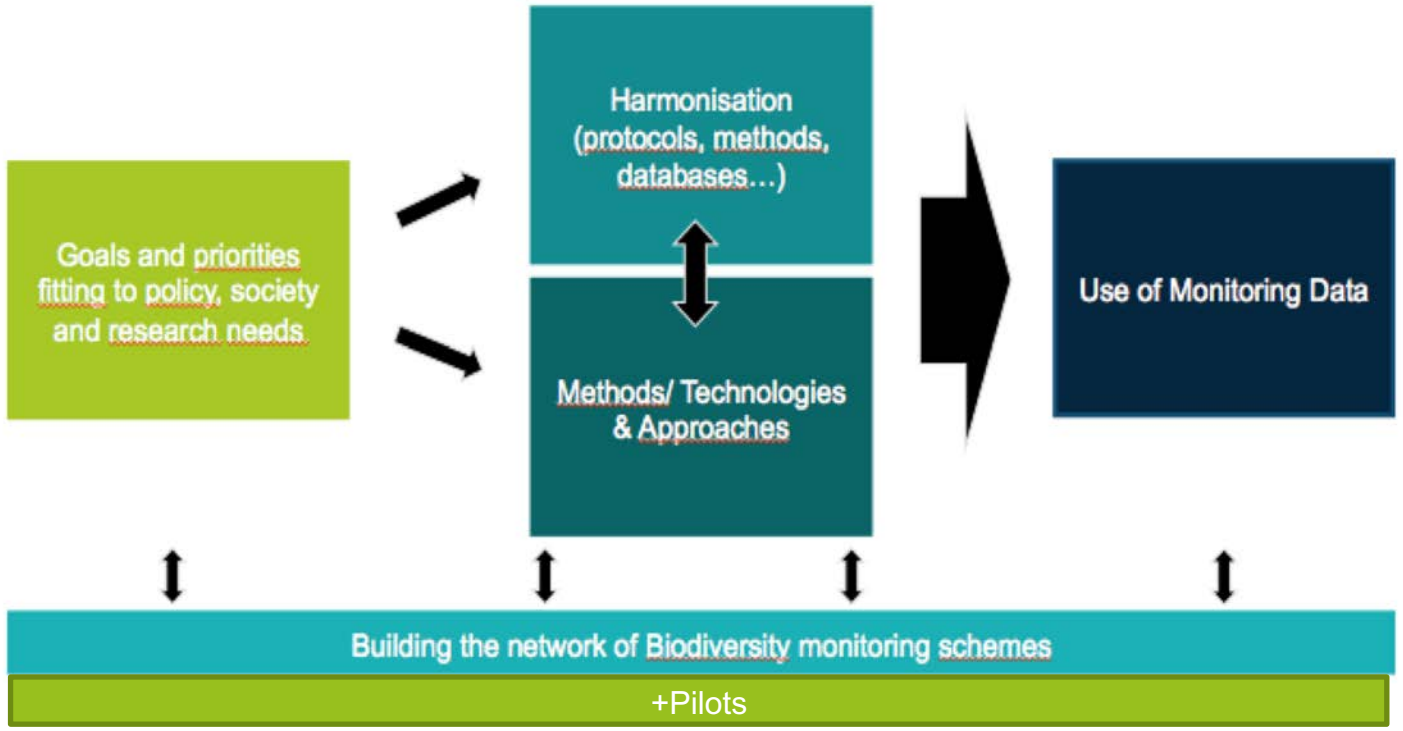
Second part of the breakout group discussion: **Focus on module 2, exploring the use of remote sensing techniques for mapping and support to evaluate the quality of habitats**.

Questions to discuss: Possible methods to be used in the pilot to showcase possible harmonisation and/or refinement of remote sensing techniques for mapping and support to evaluate the quality of indicators. Discussion of the presented examples. What habitats/habitat groups (annex 1 habitats/habitat groups) and/or quality parameters do the partners wish to use as showcases?

**Section IV - In plenary, first day closure** 17:00 – 17.20: Summary from breakout groups

# Biodiversa+

- ✓ *Promoting & Supporting transnational biodiversity monitoring*
- ✓ *Biodiversity monitoring better articulated with R&I and policy*
- ✓ *New tools & approaches for biodiversity monitoring*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Knowledge Centre for Biodiversity

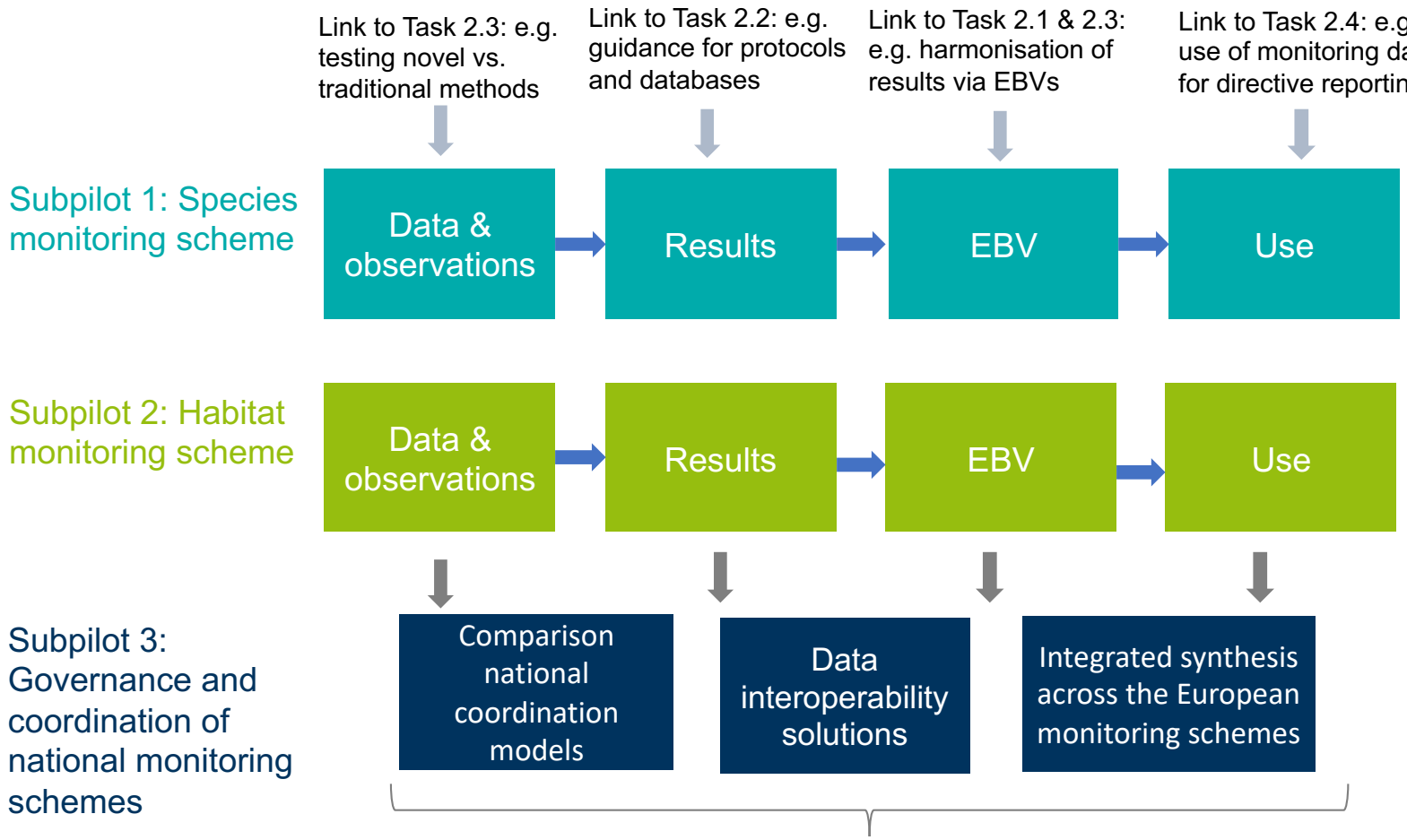
# Objectives of a Biodiversa+ biodiversity monitoring pilot

Objectives:

- ✓ Move towards a **harmonisation** in biodiversity monitoring programmes in different countries (Biodiversa+ Partners)
- ✓ Increase availability of **biodiversity data** in time and space across EU and fill taxa gaps
- ✓ Align with the **needs of the Biodiversa+ Partners** and existing needs in the biodiversity monitoring landscape
- ✓ Tackle some of the **biodiversity monitoring priorities** identified by Biodiversa+
- ✓ Engage the broadest range of Partners and countries

→ Synergies with other initiatives (e.g. EuropaBON, existing pilots and others, as needed) will be explored when designing & implementing the pilot.

# Conceptual overview of the biodiversity monitoring pilots




Pilot tested in ~5 countries, not necessary all steps in every country.

Pilot tested in ~5 countries, not necessary all steps in every country.

Pilot conducted based on experiences from 5-10 countries, and supported by pilots 1 and 2.

# Objective of a candidate pilot topic

## Be one step ahead of the game!

By:
-Developing for the September General Assembly a workplan for each candidate pilot topic

-Convincing the Biodiversa+ partners to support their topic (topic selection will take place in September during the General Assembly, launch of the topic activities will start in January 2024)

Estimated number of new pilot topics to be launched in Y3/Y4 of Biodiversa+: up to 3

# 6 candidate pilot topics

- ✓ Toward a European **Rocky reef Fish** Monitoring Network (**OFB**)
- ✓ Monitoring **marine non-indigenous species** through introduction sites (**TAGEM**)
- ✓ Automated monitoring of **birds, bats** and **nocturnal insects** through sound and image recognition(**MoE of DK**)
- ✓ **Habitat quality & mapping** – Habitat quality indicators, and exploring the use of remote sensing techniques (**SEPA** and **MoE_FI**)
- ✓ Mapping status and trends of biodiversity in **urban**, peri-urban and urban fluvial environments (**FB**)
- ✓ Building a common biodiversity monitoring programme **EBV-based dashboard** (**OFB**)

# Roles in the pilots


**General coordinator**: Coordination of the pilot and of one sub-pilot and active participation in the activities of the pilot.

- Overarching view on the ongoing sub-pilots
- Encourage links when relevant between sub-pilots & links with the activities of Biodiversa+
- Draft lessons learned form the pilot

**Coordinator**: Coordination of one sub-pilot and active participation in the activities of the pilot.

- Leading role for the set-up of the sub-pilot work plan
- Lead the work of the sub-pilots : make sure to keep the schedule, encourage partners to work together, etc.
- Ensure a link with general pilot coordinator

**Active contributor**: contribution in the activities of one or several sub-pilots. Bugdet to participate in all these activities will be covered, as far as possible, fully through Biodiversa+ money. In kind contribution from partners is welcome

**Advisor**: Same role as an active partner in a Biodiversa+ task. No implementation of the activities of the pilot, yet possible to attend the working group meeting and provide feedback.

# Aims of the workshop

- Give background information about the habitat mapping, habitat quality/condition indicators, and use of remote sensing to provide data in Europe
- Co-design a workable plan for this candidate pilot to make it competitive proposal to be voted by the General Assembly for the pilots for Y3-4
  - Build on the background document
  - Flexible enough but still comparable approach

- Pay attention to
  - selection of habitats (all vs. few), upscaling
  - quality indicator applicability
  - use of available methods (in situ, remote sensing, models)

# Background to Pilot on Habitat Quality and mapping

Mona Naeslund and Ola Inghe SEPA, Petteri Vihervaara MoE Fi

# Background and aim of pilot

## Background

Lack of EU-wide harmonisation to assess the quality of habitats causes:

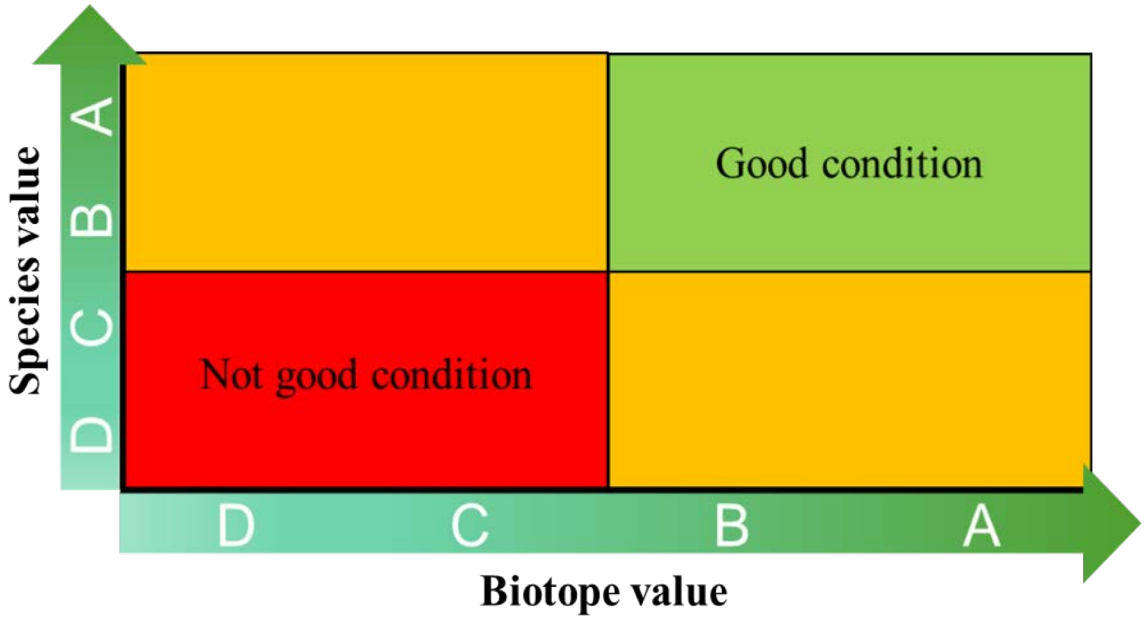
- incoherent reporting and evaluation of quality in EU
- difficulties to assess restoration needs

## Aim and suggested pilot

- Module 1: Harmonise methods for habitat quality assessment, and create indicators based on species, biotope, and landscape value.
- Module 2: Assess restoration needs on a landscape scale using remote sensing techniques.

# Module 1: Methods to Measure Quality of Habitats- Example from Sweden

- Indicator combines species- and biotope values.
- Good condition requires both high species and high biotope value
- Species value= number, frequency, and area of typical and/or functional species
- Biotope value: structural and functional variables (ex. Deadwood, grazing intensity, hydrology)




*Picture from Toräng et al. 2022**

- Species value and Biotope value are measured in-situ in sample plots, from which national/regional value of the area in good condition can be calculated.

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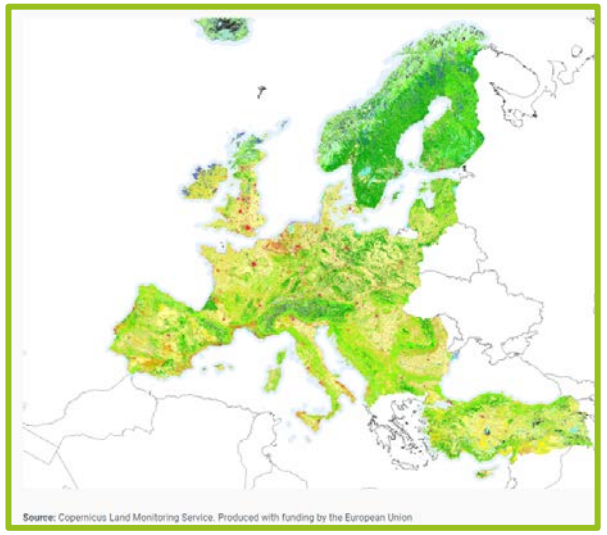
**Toräng et al. 2022 Indicators and thresholds for the assessment of ecological condition in terrestrial habitats – a pilot study. Manuscript.*

# Module 2: Assess restoration needs on a landscape scale using remote sensing techniques

- The surrounding landscape influences the local habitat quality

- Remote sensing techniques can give:
  - Ecosystems, habitat types, and some annex 1 habitats
  - Habitat connectivity/ fragmentation
  - Large-scale pressures such as urbanisation, forestation/ deforestation
  - Suitable areas for restoration




# Section I - The need for an EU-wide harmonisation to assess quality of habitats

# Experiences with combining in situ and satellite data for habitat mapping at EU level

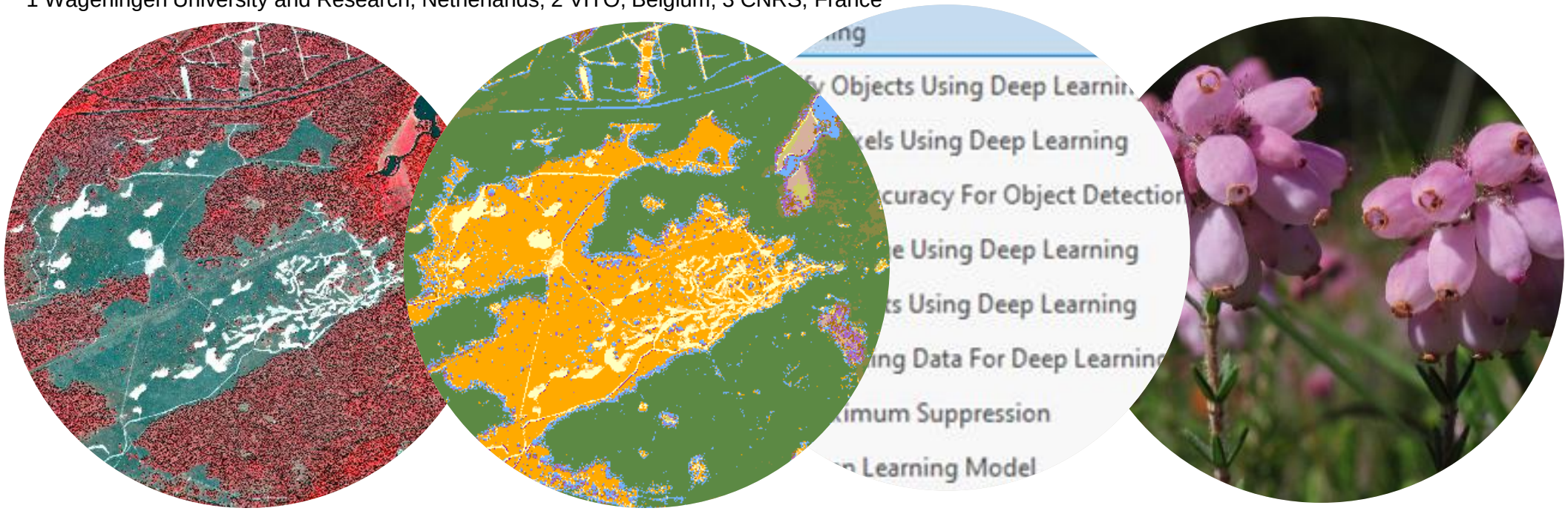
By *By Jan Erik Petersen, EEA*

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

## Biodiversa+ workshop on 'Mapping habitat quality – exploring the use of remote sensing data', 24 May 2023

Building on work by: 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



# Habitat mapping pilot studies

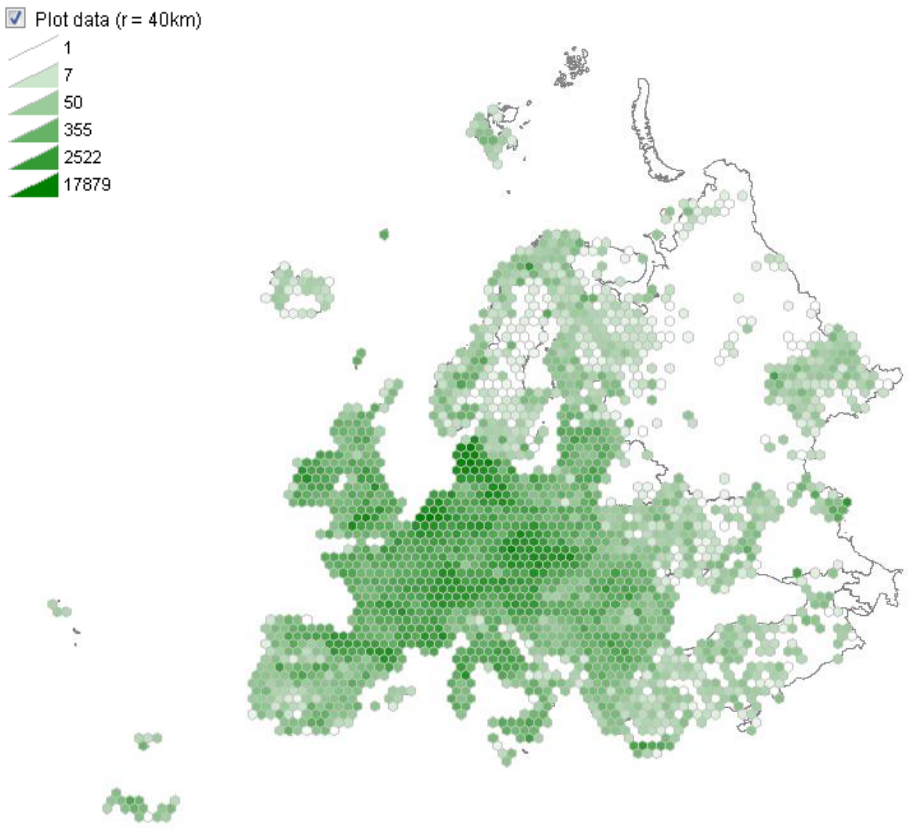
Two approaches:

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

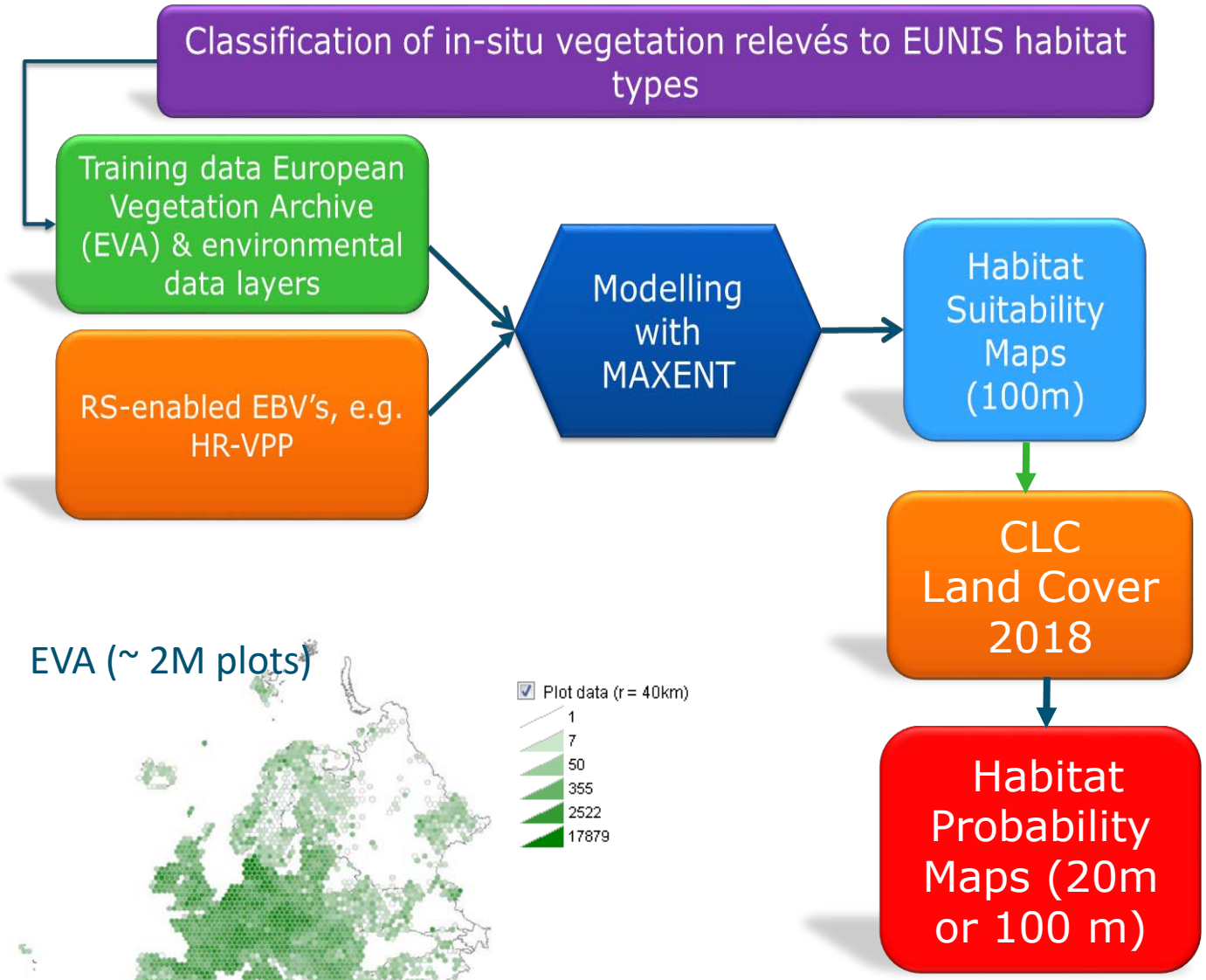
In both approaches training data from the EVA database plays a central role

# Method 1 European habitat modelling

- Input for the modelling are potentially 1.2 million 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).



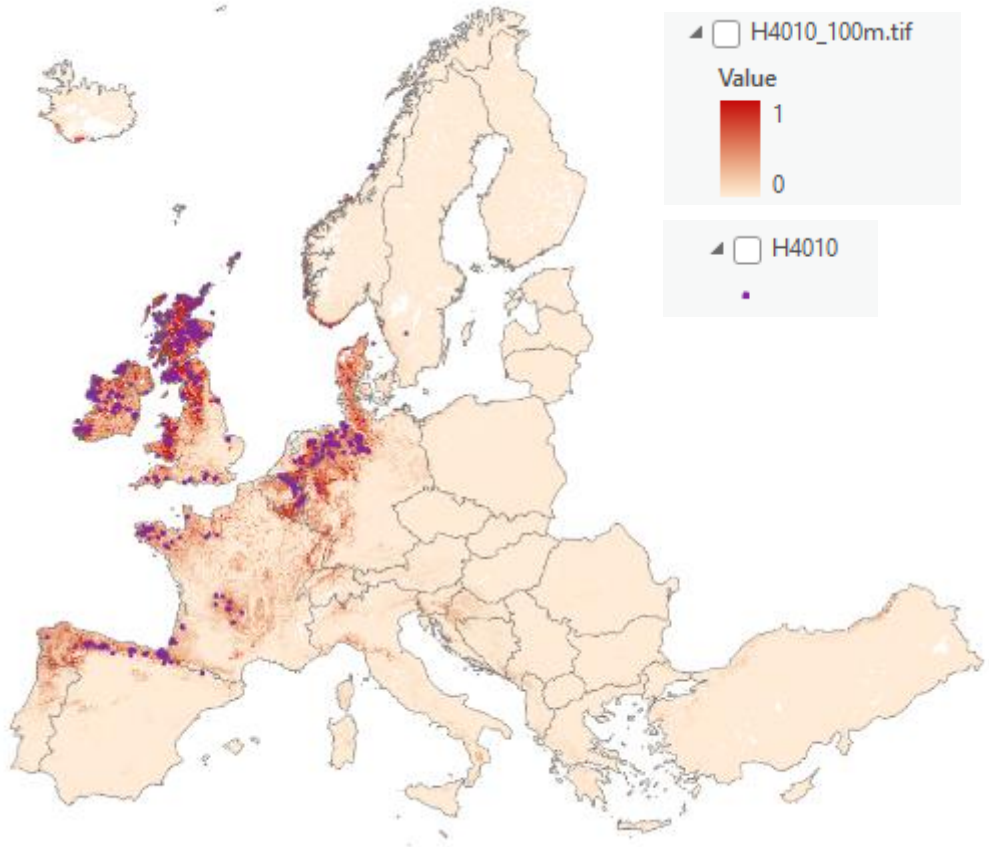
# Flowchart European habitat modelling




EVA (~ 2M plots)



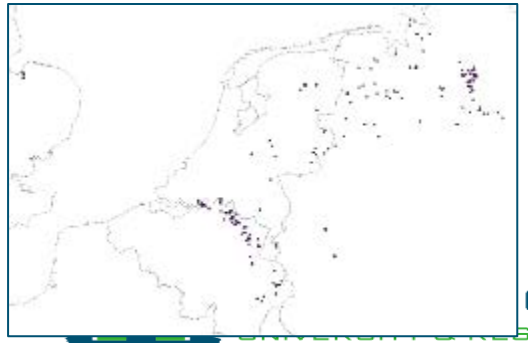

Suitability map EUNIS type S41: Wet heath *(training)*



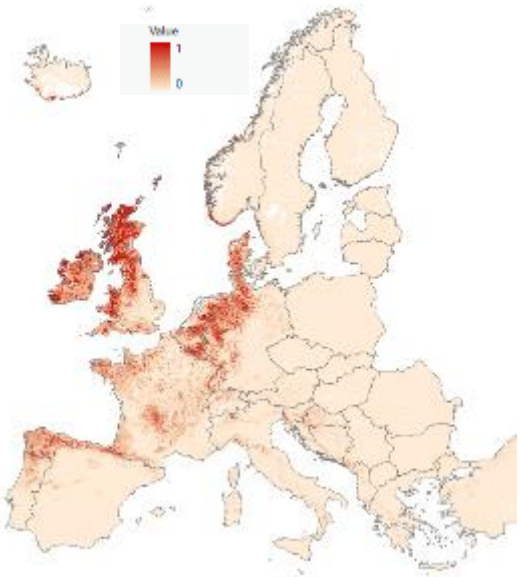
# Example European habitat modelling: S41 Wet heath

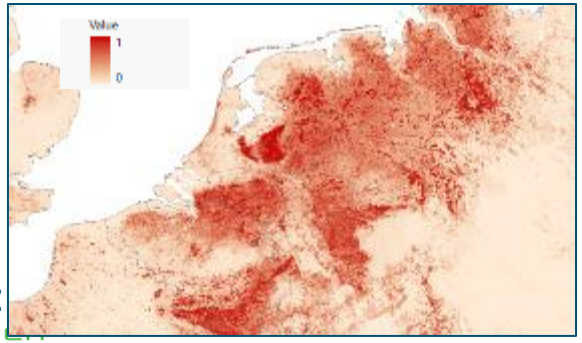
## Distribution data

from European Vegetation Archive (EVA)

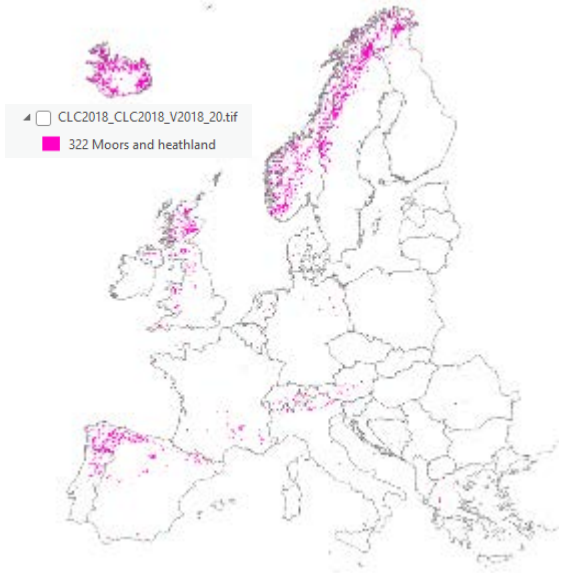


## Habitat suitability map

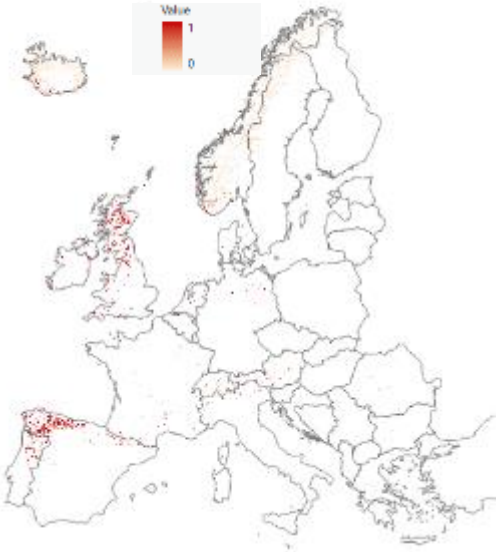


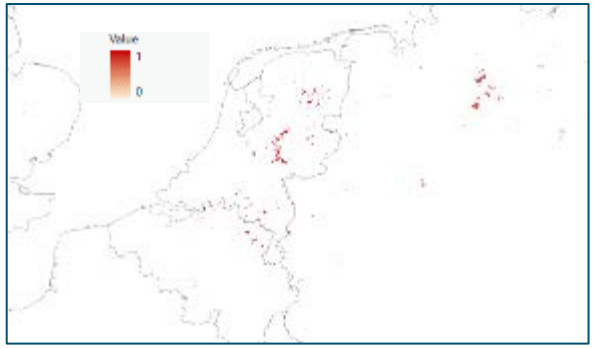




## Land cover



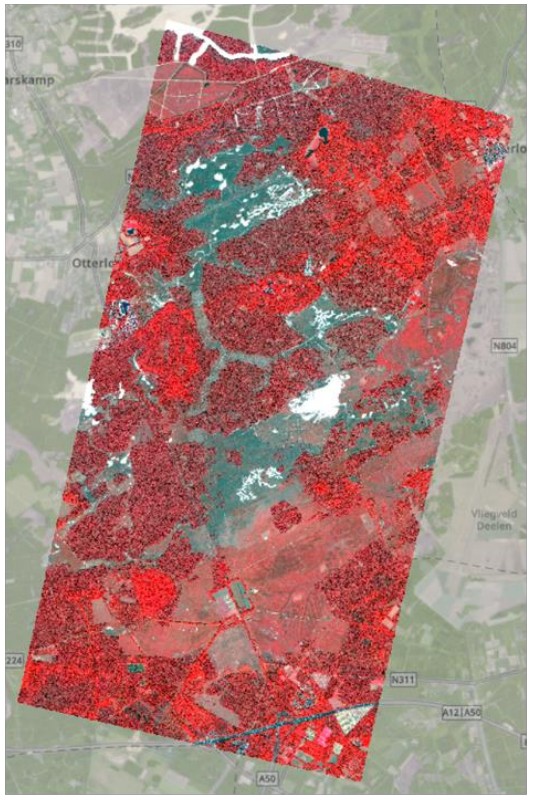

## Habitat probability map



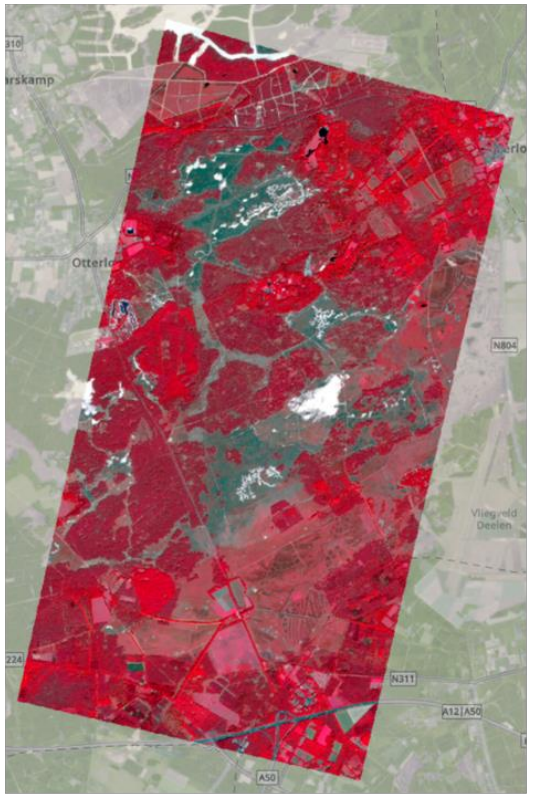



# Method 2 Regional habitat mapping using deep learning techniques

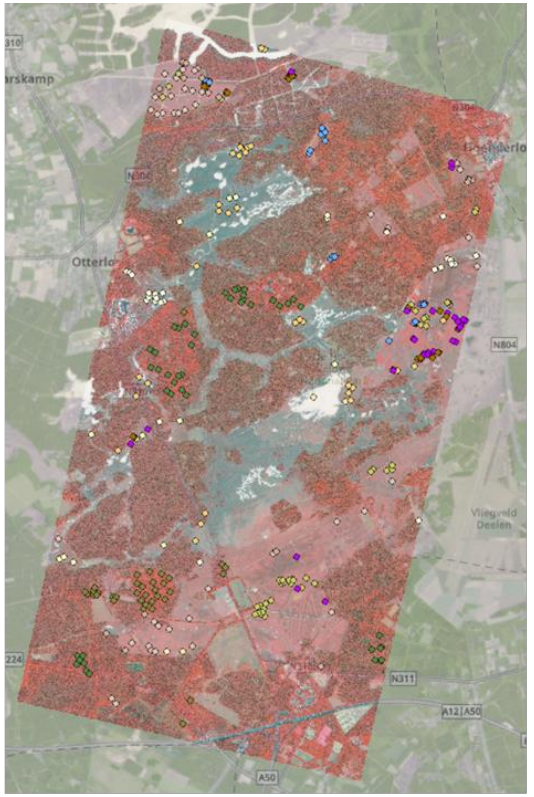
- WENR & VITO are working on exploitation of deep-learning models for habitat mapping at regional and national scale. For example in National Park Veluwe, the Netherlands, using HR-VPP and Sentinel-2 at 10 meter resolution (next to Superview)



Superview 12-08-2020, False colour



Sentinel 31-07-2020, False colour



Selected LVD points in Hoge Veluwe test area

| | SPEC_HABTY,DLid | |
|---|---|---|
| 24 | 23101,1 | Dry sand heaths (light) - sand |
| 16 | 23102,2 | Dry sand heaths (dark) - vegetated |
| 4 | 23301,3 | Inland dunes (light) |
| 34 | 23302,4 | Inland dunes (dark) |
| 31 | 31601,5 | Lakes and ponds |
| 40 | 40101,6 | Wet heaths |
| 44 | 40301,7 | European dry heaths (light) - Pijpenstrootje |
| 19 | 40302,8 | European dry heaths (dark) - heide |
| 40 | 62301,9 | Species-rich Nardus substrates |
| 39 | 71501,10 | 1 Depressions on peat substrates |
| 37 | 91201,11 | 1 Birch forests |
| 45 | 91901,12 | 1 Oak woods |

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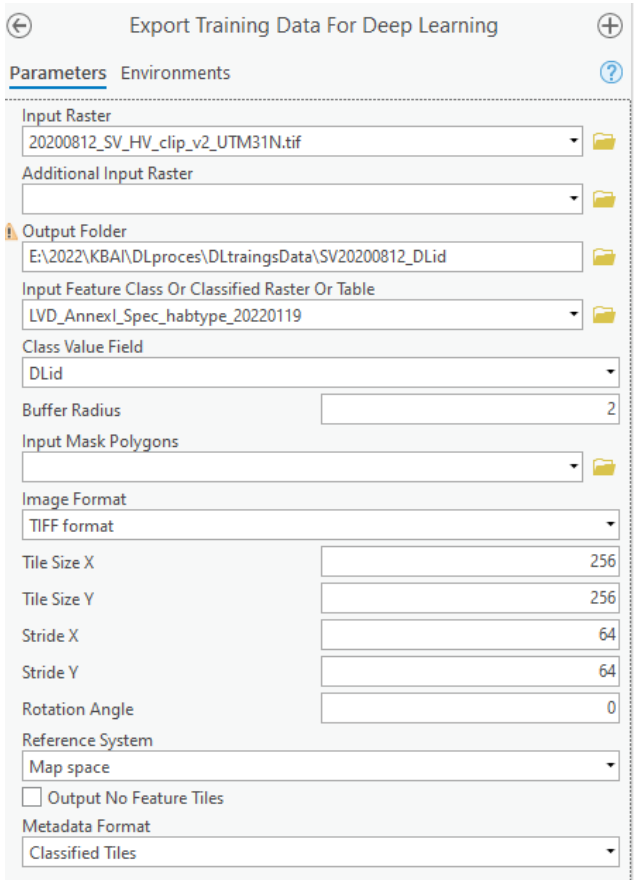
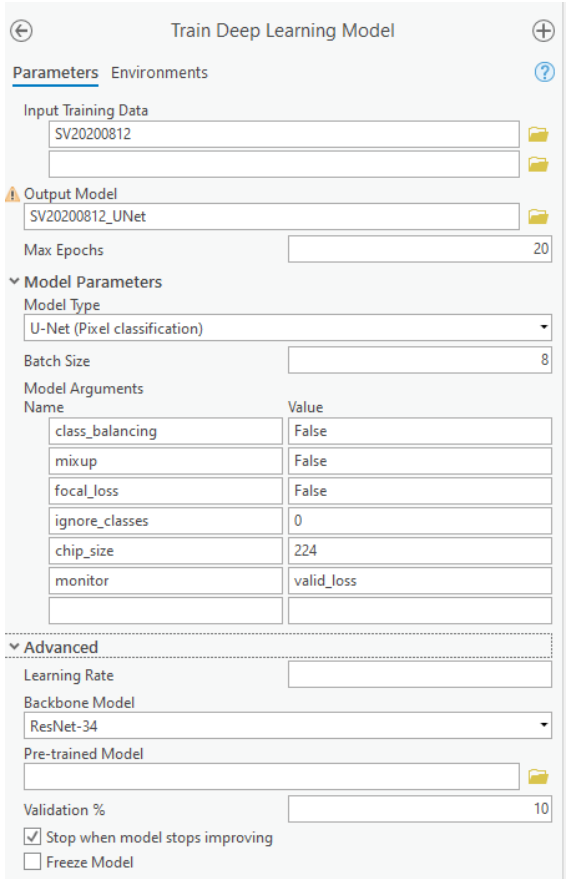
# Method 2a Deep Learning (U-NET in ArcGIS PRO)

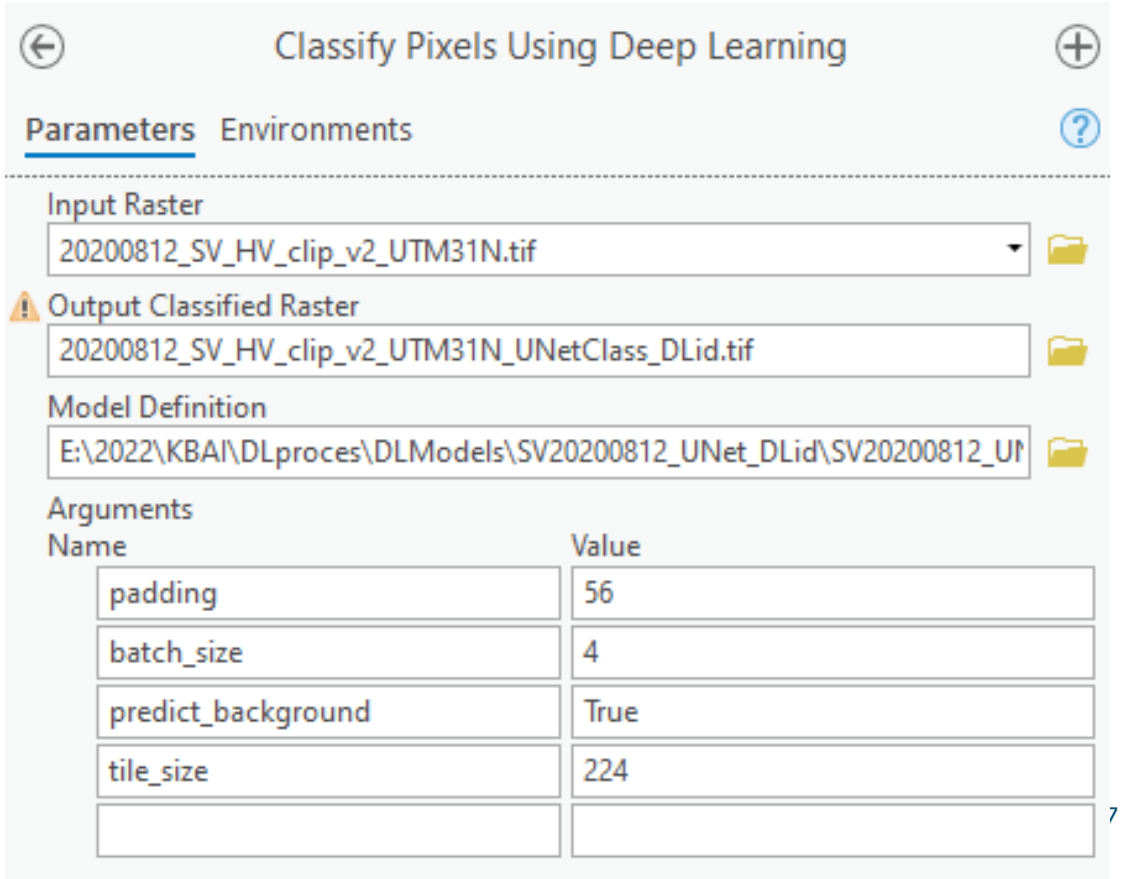
**Step 1**
**Prepare Training Data**

**Step 2**
**Train a Model**

**Step 3**
**Use the Model**

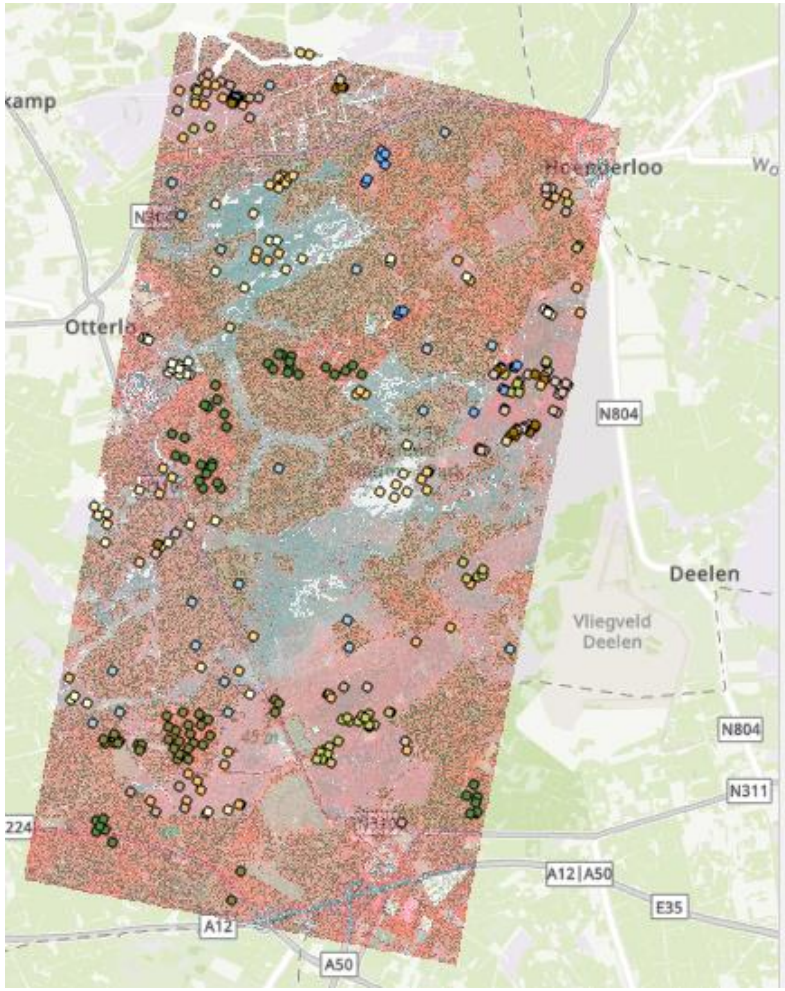


# Deep Learning proces in ArcGIS PRO

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




Classes | Scales

| Symbol | Value | Label | Count |
|---|---|---|---|
| DLid | | 13 symbol classes | |
| | 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 |

Annex I 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.

# Results & conclusions

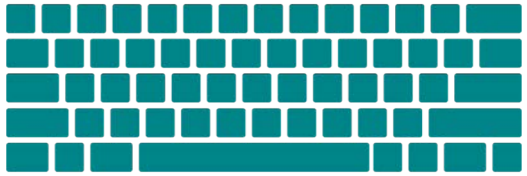
- Validation of the European EUNIS habitat suitability maps shows in general good overall accuracies, but the user accuracy (100% - commission error) needs to be improved. Integration with accurate land cover maps (into habitat probability maps) improves the user accuracy.
- Integration of the individual European habitat suitability maps for wall-to-wall mapping could also be improved by using a differentiated ML approach, ie developing individual algorithms for different European regions.
- 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 a strong data infrastructure with sufficient CPU and 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.
- Selection of vegetation plot data (from e.g. EVA) for training AI/ML is more difficult than often thought – due to inaccuracies in locations.
- The amount and quality of training data is crucial. Enhancement of the training data is a crucial step that needs much attention !!

Thank you for your attention.

Jan-Erik.Petersen@eea.europa.eu

# Any questions?

Helsinki attendees: raise your hand



Zoom attendees: use the chat

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# Habitat mapping with Remote Sensing. Showcase for European Biodiversity Monitoring within the EUROPABON project

By Marcel Buchhorn and Borja Gonzales,VITO (presenting) in collaboration with Jose Manuel, Giorgia Milli, Bruno Smets, Helge Bruelheide, Ute Jandt and Nestor Fernandez

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# Habitat mapping with Remote Sensing

## Showcase for European Biodiversity Monitoring within the EUROPABON project

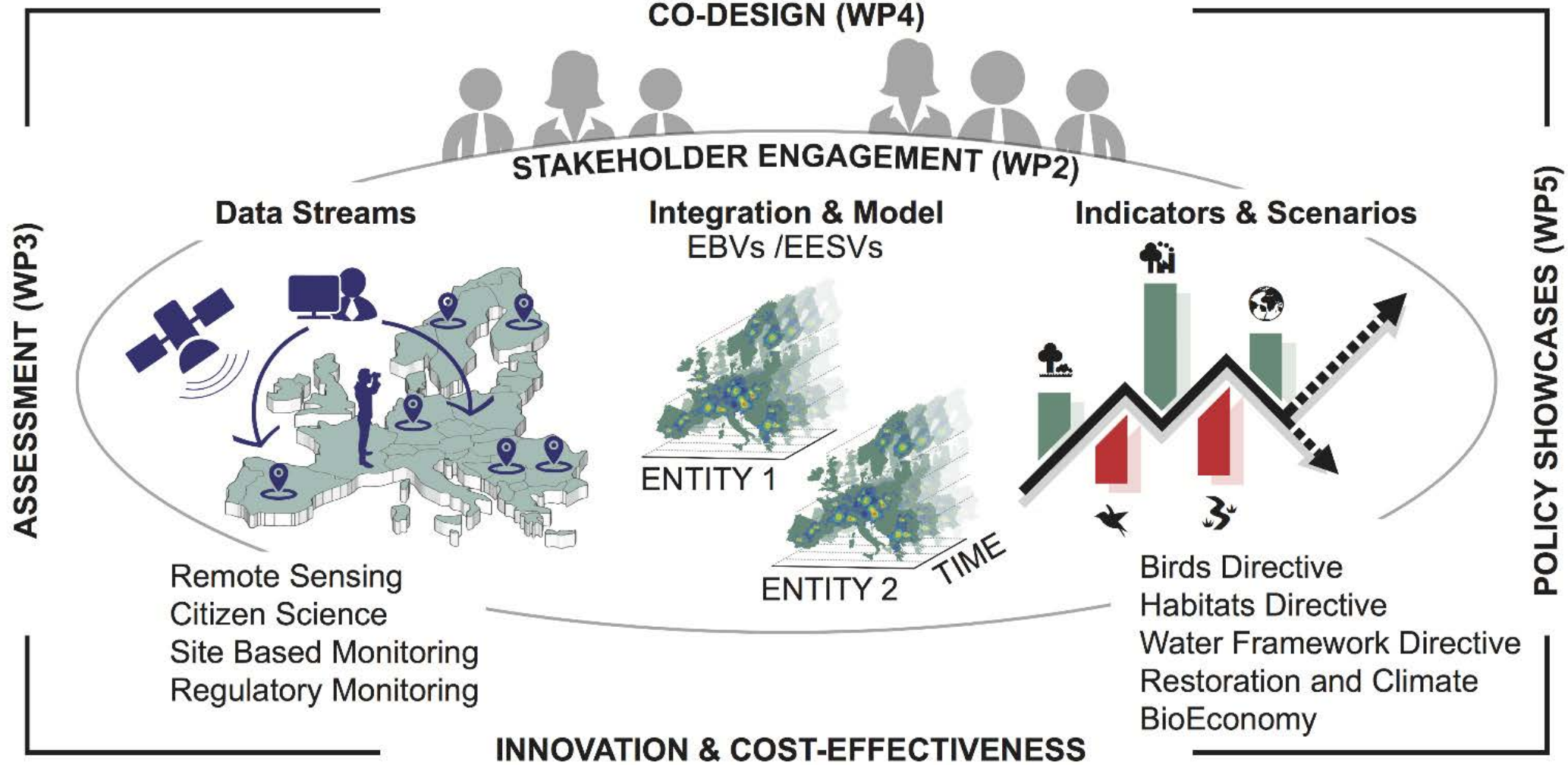
**Marcel Buchhorn, Borja Jiménez-Alfaro, Jose Manuel Álvarez, Giorgia Milli, Bruno Smets**
**in collaboration with Helge Bruelheide, Ute Jandt, Nestor Fernandez**

May 24th, **2023; Workshop of the Biodiversa+ candidate pilot, Helsinki (Finland)**

vito
MARTIN-LUTHER UNIVERSITÄT HALLE-WITTENBERG
Universidad de Oviedo
iDiv

This project receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101007492.

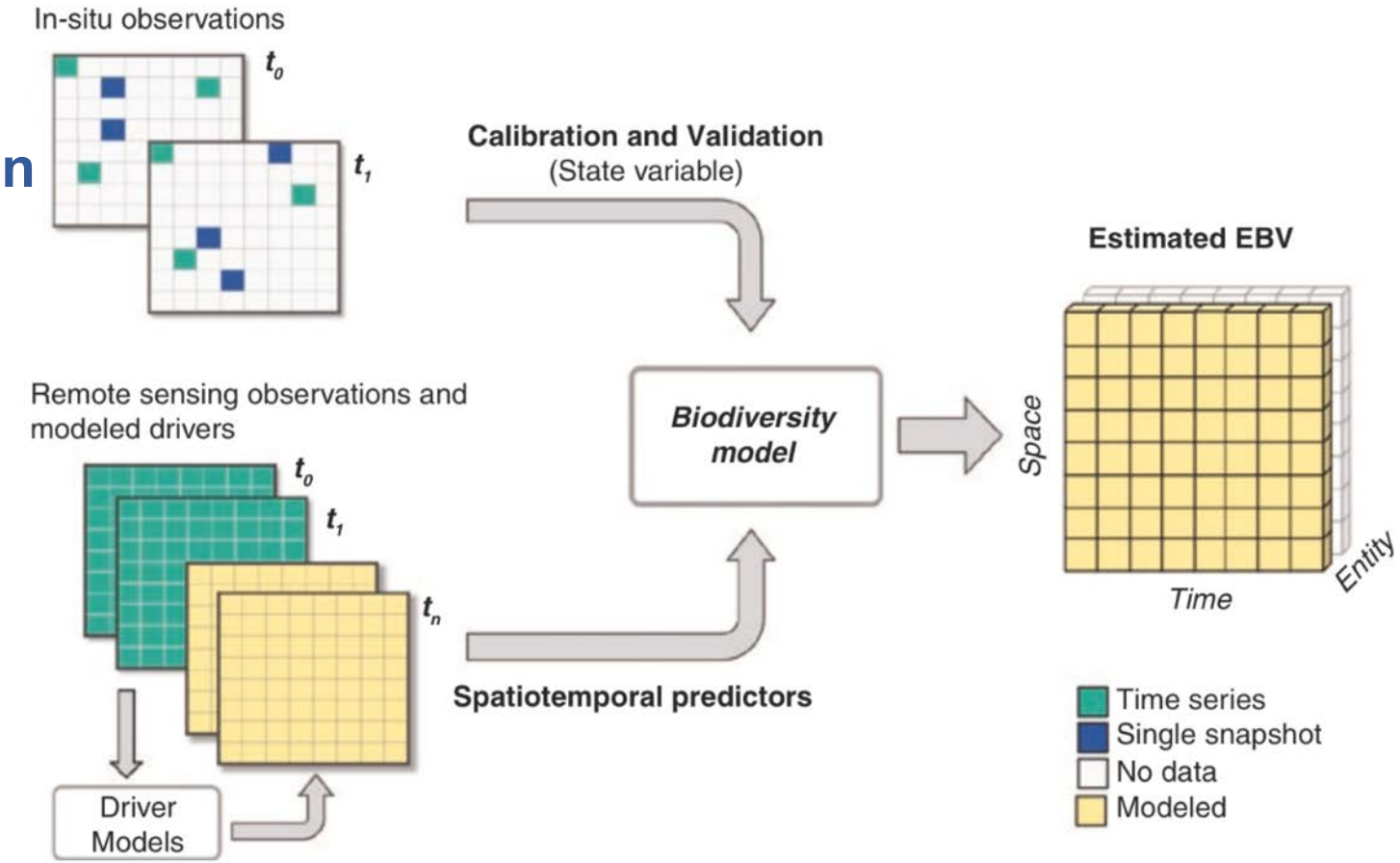
# The EuropaBON project:
## Designing an EU-wide framework for monitoring biodiversity



# Designing a Biodiversity Observation Network

## Monitoring design

How to design sampling?
What models to use?




## EBV Selection

Which EBV are needed for each policy question?

## EBV Specification

What taxa and ecosystems?
What spatial and temporal resolution

EUROPABON

Fernández ... Pereira (2020) in Remote Sensing of Plant Biodiversity

# EuropaBON Showcases

**OBJECTIVES**

- Address **data uses and needs** with stakeholders
- **Showcase EBV workflows** integrating data across monitoring networks
- Explore applications of **EBV–derived indicators**

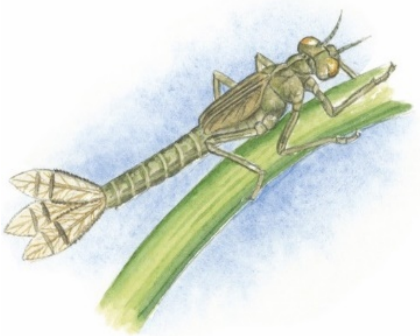
**STATE OF NATURE**

**Birds Directive**

©Lisa Pannek / EBBA2

**Habitats Directive**

**Water framework directive**



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**CROSS-SECTORIAL POLICIES**

**Bioeconomy**

**Soil restoration**

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# Showcase Habitats Directive – 1st test cases: Cantabrian Mountains (Spain)

**6230 | *Species-rich *Nardus* grasslands**

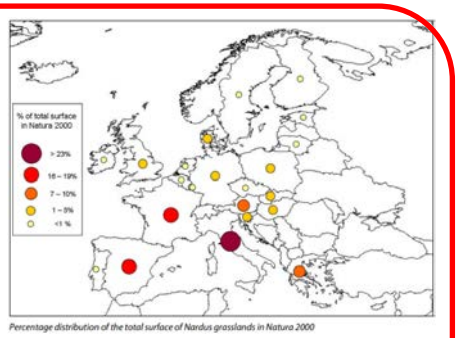
*Species-rich Nardus grassland in Western Carpathians – Velka Raca. Photo: J. Seffer.*

NATURA 2000

62 – Semi-natural dry grasslands and scrubland facies

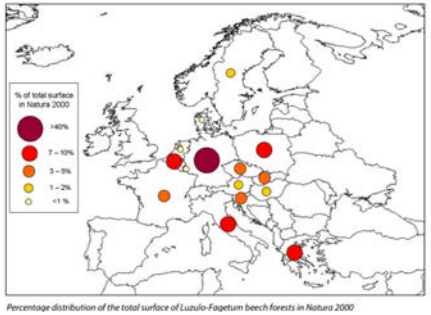
EUNIS classification:
E4.3 Acid alpine and subalpine grassland
E1.7 Non-Mediterranean dry acid and neutral closed grassland

* Priority habitat



*Percentage distribution of the total surface of Nardus grasslands in Natura 2000*

***R42 / R43***
***R1M***



*Percentage distribution of the total surface of Luzulo-Fagetum beech forests in Natura 2000*

**9110 | *Luzulo-Fagetum* beech forests**

*Luzulo-Fagetum beech forest, Söderåsens nationalpark, Sweden. Photo: Oddvar Fiskesjö*

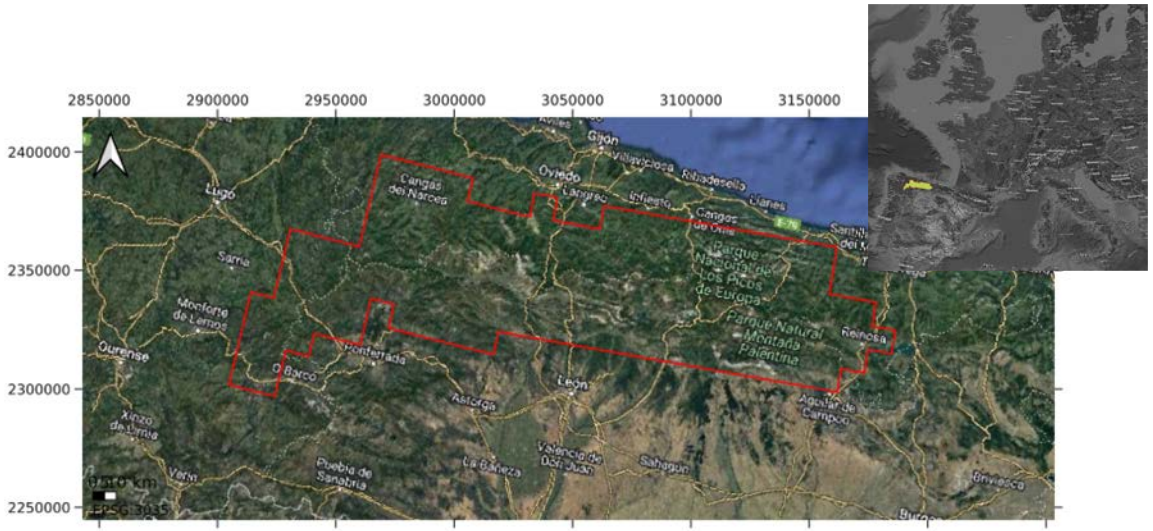
NATURA 2000

91- Forest of temperate Europe

EUNIS Classification:
G1.61 - Medio-European acidophilous forests

***T17 / T18***

Main task: exploit the possibilities in habitat mapping with RS on two sample habitats (Nardus & beech forest)




**1 491 889 ha**

## STUDY AREA

Four Spanish regions (distinct management)
High biodiversity (from 200 to 2500 m)
Eight UNESCO Reserve Biospheres
One national park, six regional parks
30% of all European habitats (EUNIS level III)
Good coverage of regional habitat maps

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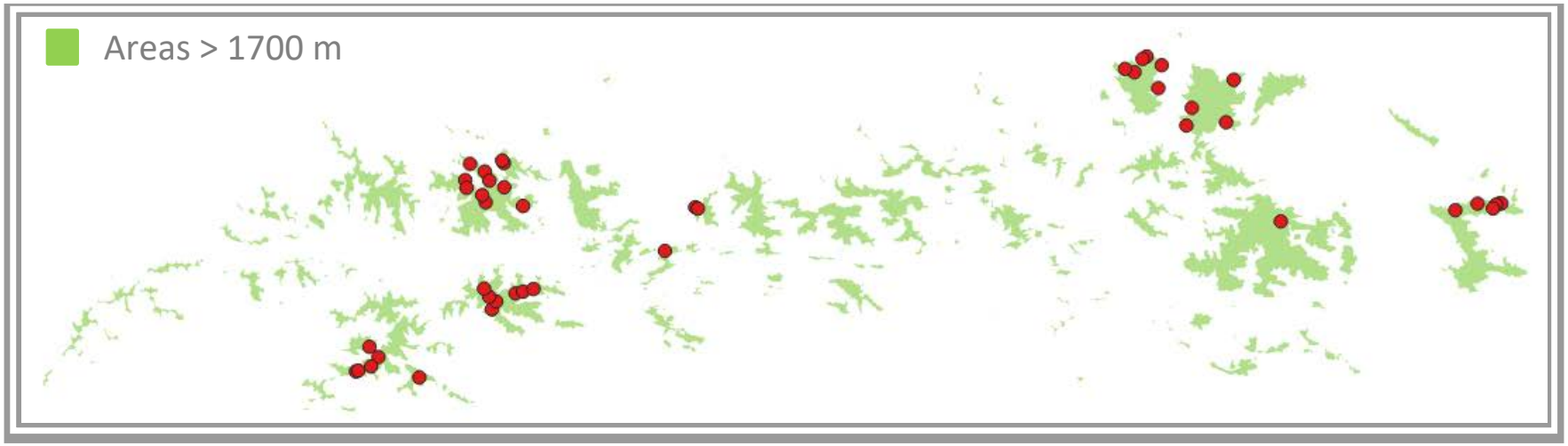
# How - workflow requirements

- **Scalability**
  - Spatial resolution
  - Area size
  - Temporal resolution
  - Input features (feature pool)
  - Habitat types (/typology)

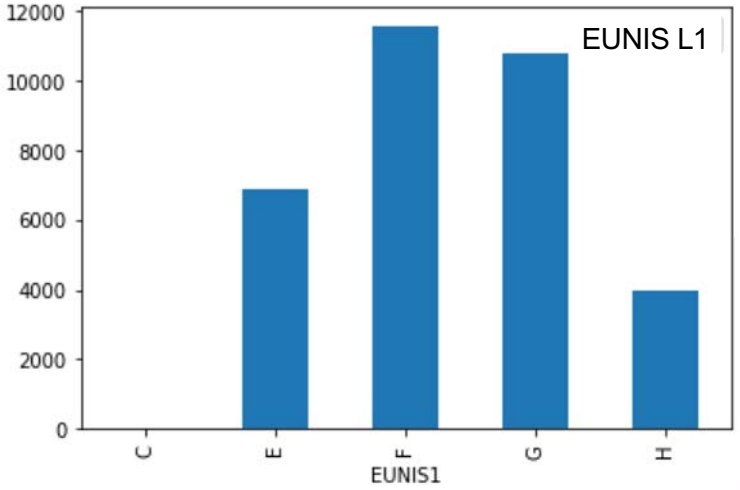
- **Automation & Parallelized processing**

- **Quality Indicators**
  - Habitat classification : suitability versus occurrence
  - Detected changes

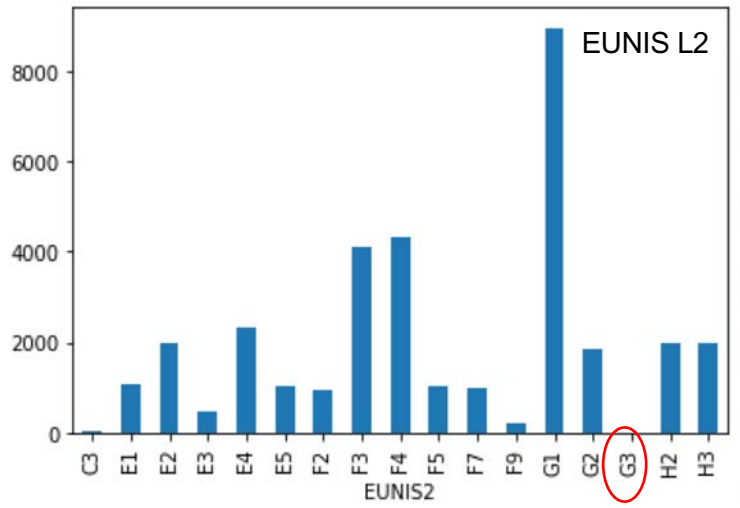
# Training data collection

| | Region 1 (Asturias) | Region 2 (Castilla y León) | Region 3 (Cantabria) |
|---|---|---|---|
| MAP LEGEND | Own units | Phytosociology | EUNIS-2012 |
| HARMONIZATION | | **EUNIS-21** | |
| EXPERT CONTROL | R431 (E43): Alpic Nardus stricta swards and related communities (6230) | | |
| SAMPLING |  | | |

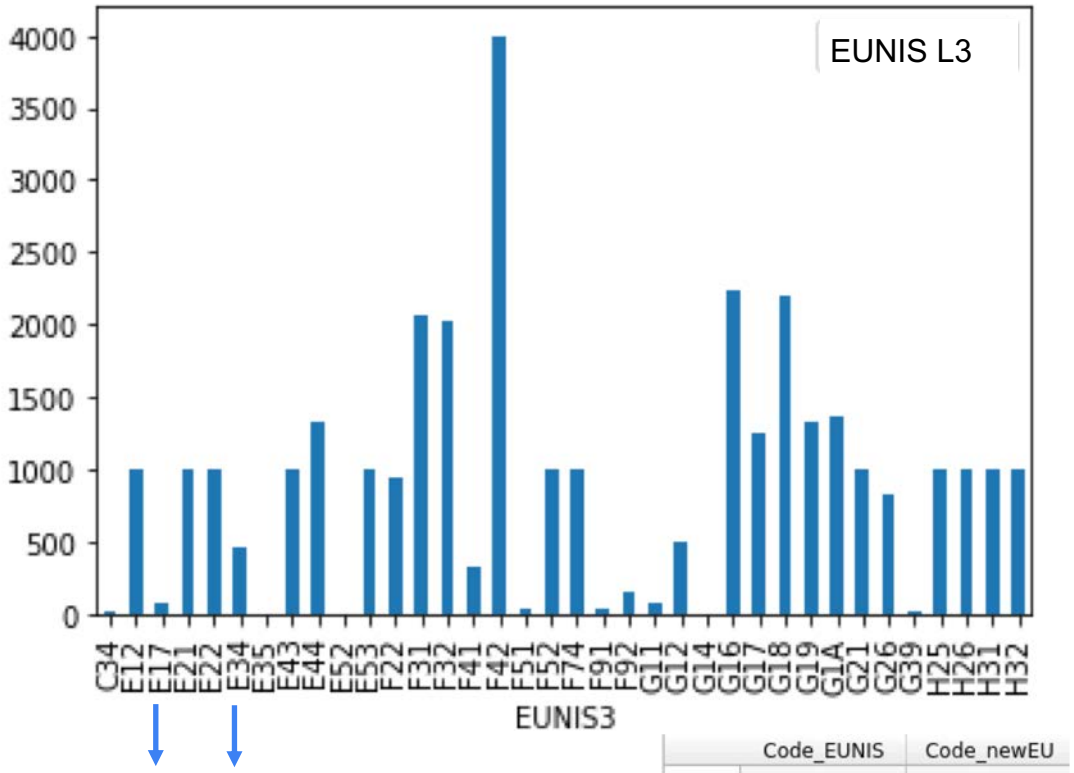
# Training Cantabrian Mts - EUNIS-2012




| EUNIS1 | | |
|---|---|---|
| C | 8 | Inland surface waters |
| E | 6877 | Grasslands and lands dominated by forms, mosse... |
| F | 11580 | Heatland, scrub and trundra (new S) |
| G | 10813 | Woodland, forest and other wooded land (new T) |
| H | 4000 | Inland unvegetated or sparsely vegetated (new U) |




| EUNIS2 | | | |
|---|---|---|---|
| C3 | 8 | 8 | Littoral zone of inland surface waterbodies |
| E1 | 1076 | 1076 | Dry grasslands |
| E2 | 2000 | 2000 | Mesic grasslands |
| E3 | 465 | 465 | Seasonally wet and wet grasslands |
| E4 | 2332 | 2332 | Alpine and subalpine grasslands |
| E5 | 1004 | 1004 | Woodland fringes and clearings and tall forb s... |
| F2 | 938 | 938 | Arctic, alpine and subalpine scrub |
| F3 | 4095 | 4095 | Temperate and mediterranean-montane scrub |
| F4 | 4332 | 4332 | Temperate shrub heathland |
| F5 | 1033 | 1033 | Maquis, arborescent matorral and thermo-Medite... |
| F7 | 1000 | 1000 | Spiny Mediterranean heaths (phrygana, hedgehog... |
| F9 | 182 | 182 | Riverine and fen scrubs |
| G1 | 8970 | 8970 | Broadleaved deciduous woodland |
| G2 | 1837 | 1837 | Broadleaved evergreen woodland |
| G3 | 6 | 6 | Coniferous woodland |
| H2 | 2000 | 2000 | Screes |
| H3 | 2000 | 2000 | Inland cliffs, rock pavements and outcrops |




Nardus grasslands (6230)

| | Code_EUNIS | Code_newEU |
|---|---|---|
| 3550 | E4.31.BPA | E43X |
| 3551 | E4.31.BPA | E43X |
| 3552 | E4.31.BPA | E43X |
| 3553 | E4.3 | E43X |
| 3554 | E4.3 | E43X |
| 3555 | E4.3611 | E43X |
| 3556 | E4.3 | E43X |
| 3557 | E4.3 | E43X |
| 3558 | E4.31.BPA | E43X |
| 3559 | E4.31.BPA | E43X |

Expert knowledge needed to group sub-classes

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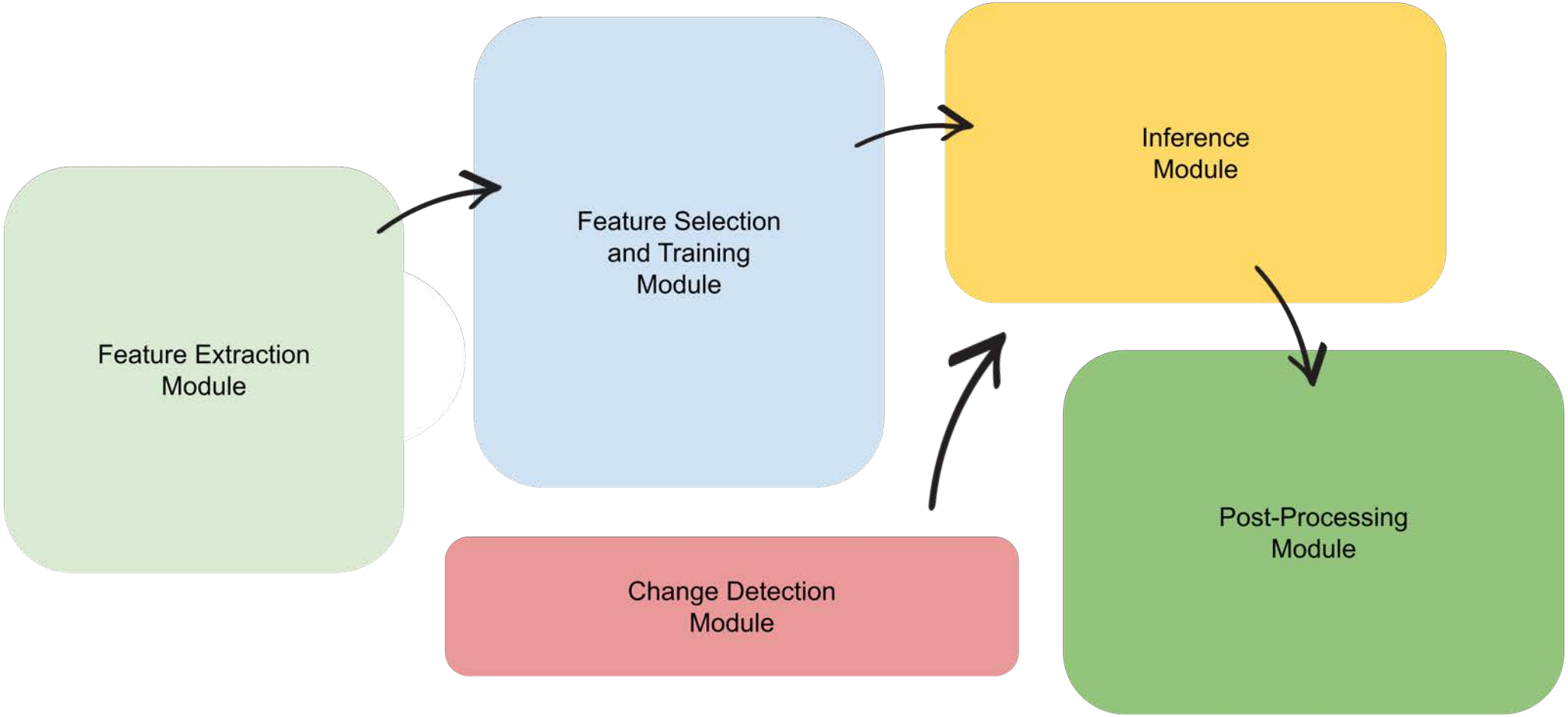
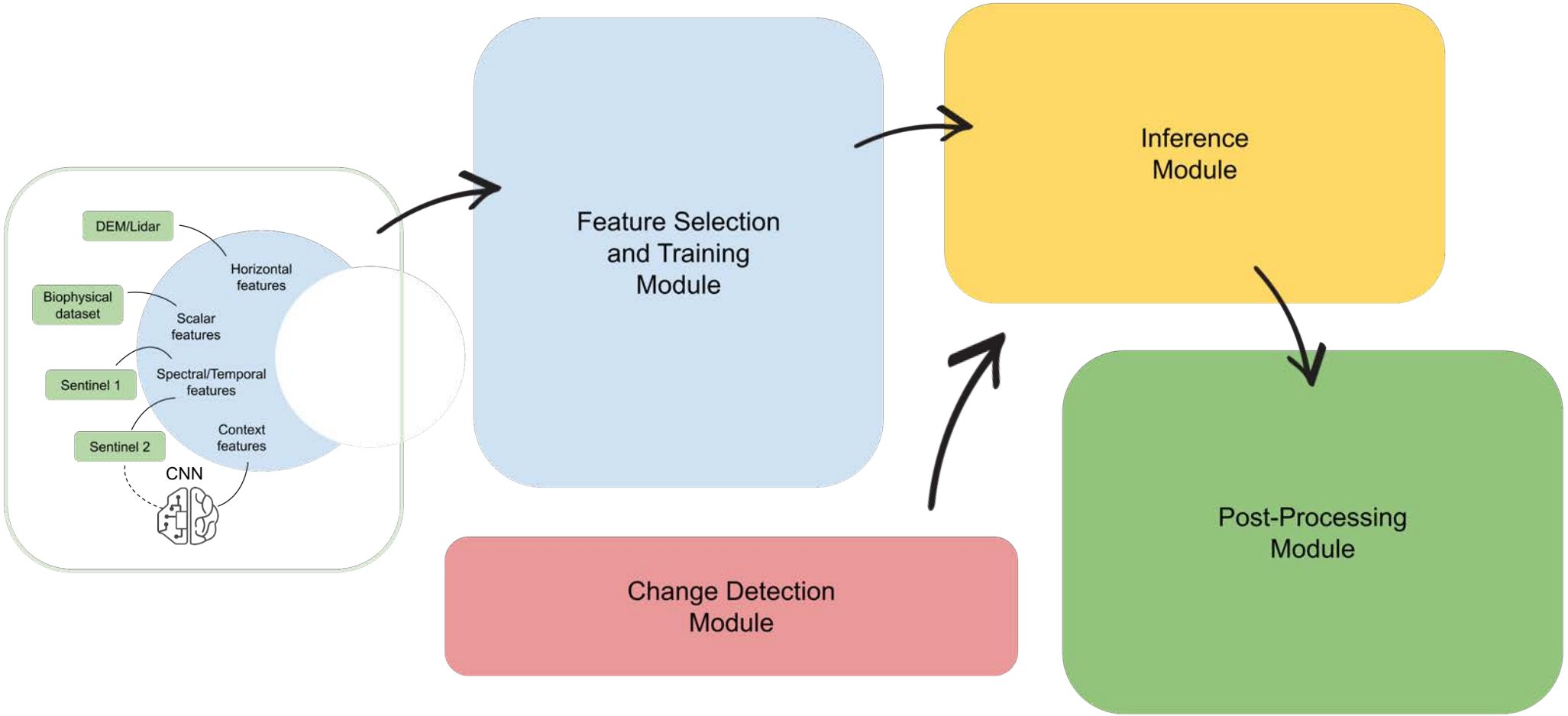
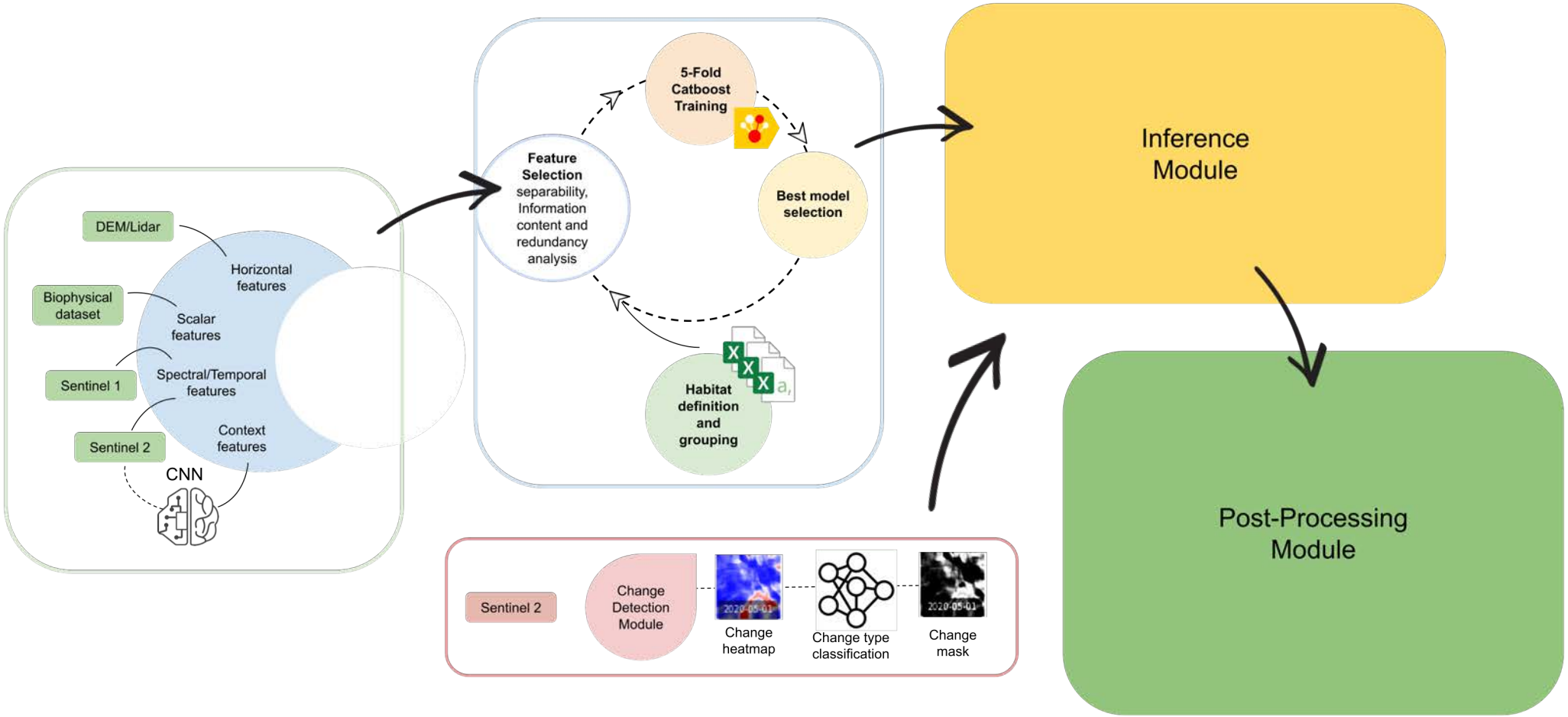
# Modelling approach (simplified)



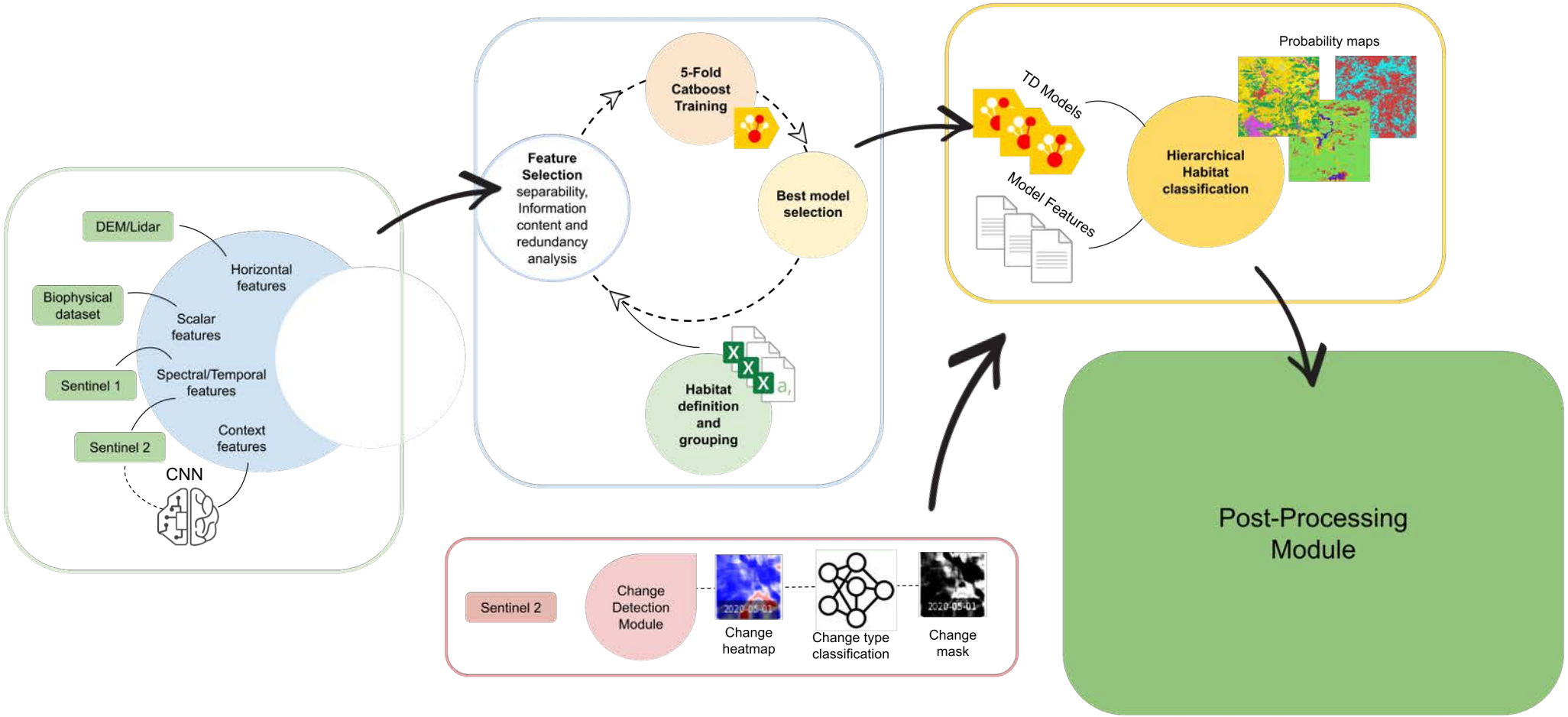
# Modelling approach (1/4)



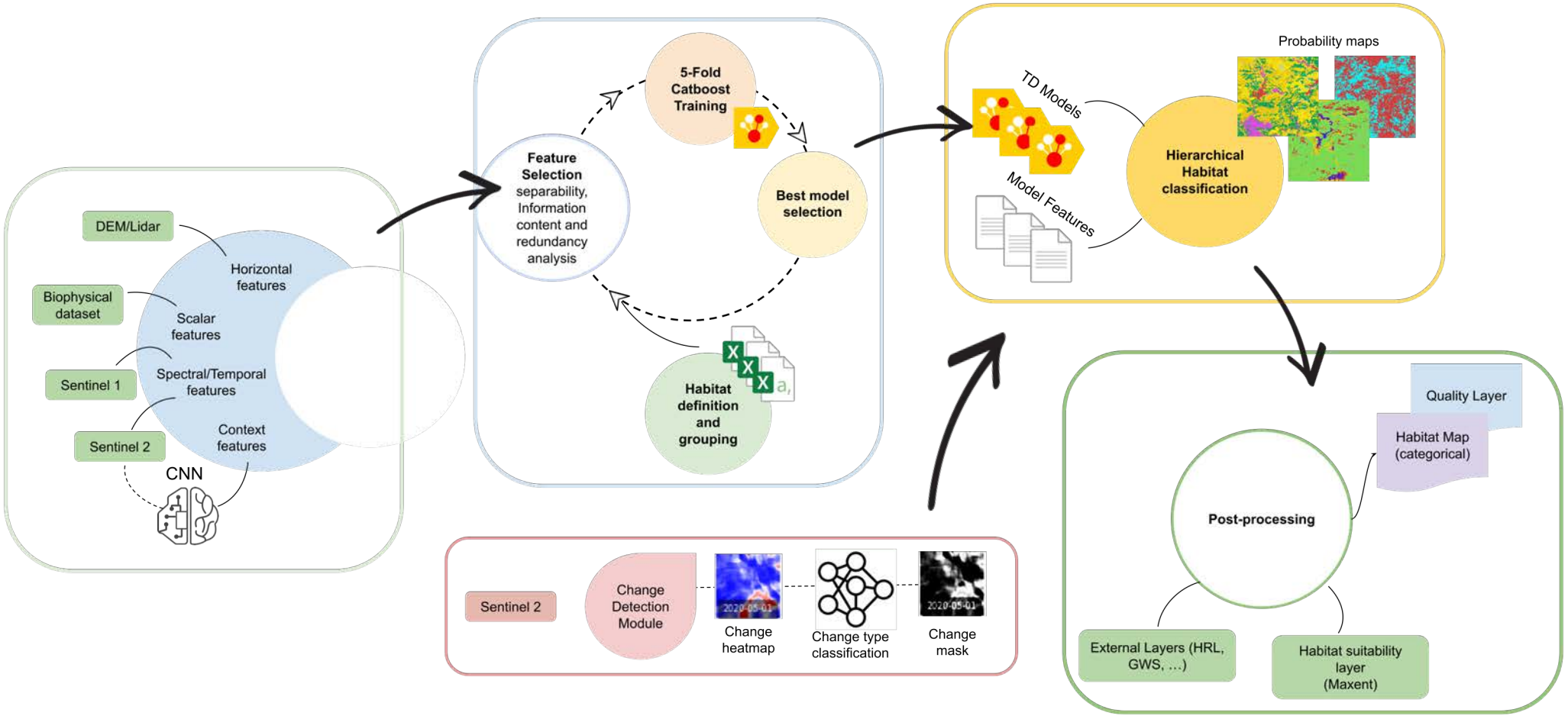
# Modelling approach (2/4)



# Modelling approach (3/4)



# Modelling approach (4/4)

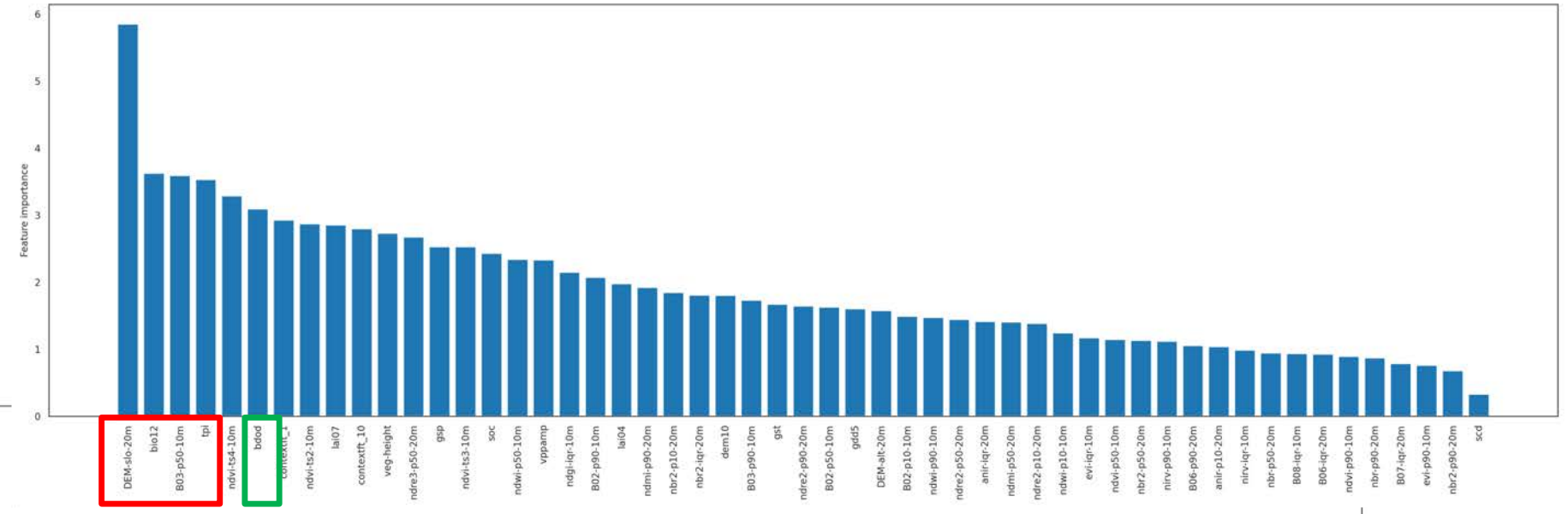


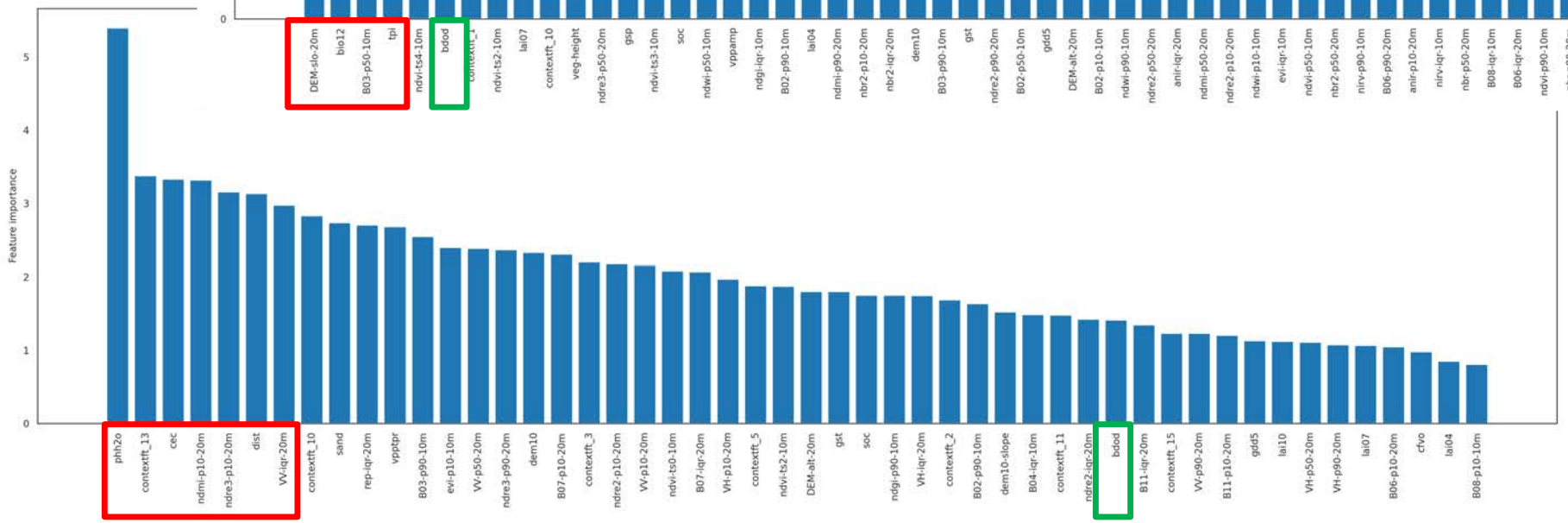
# Feature Importance in hierarchical classification approach

## Level 1

Missing in the other level

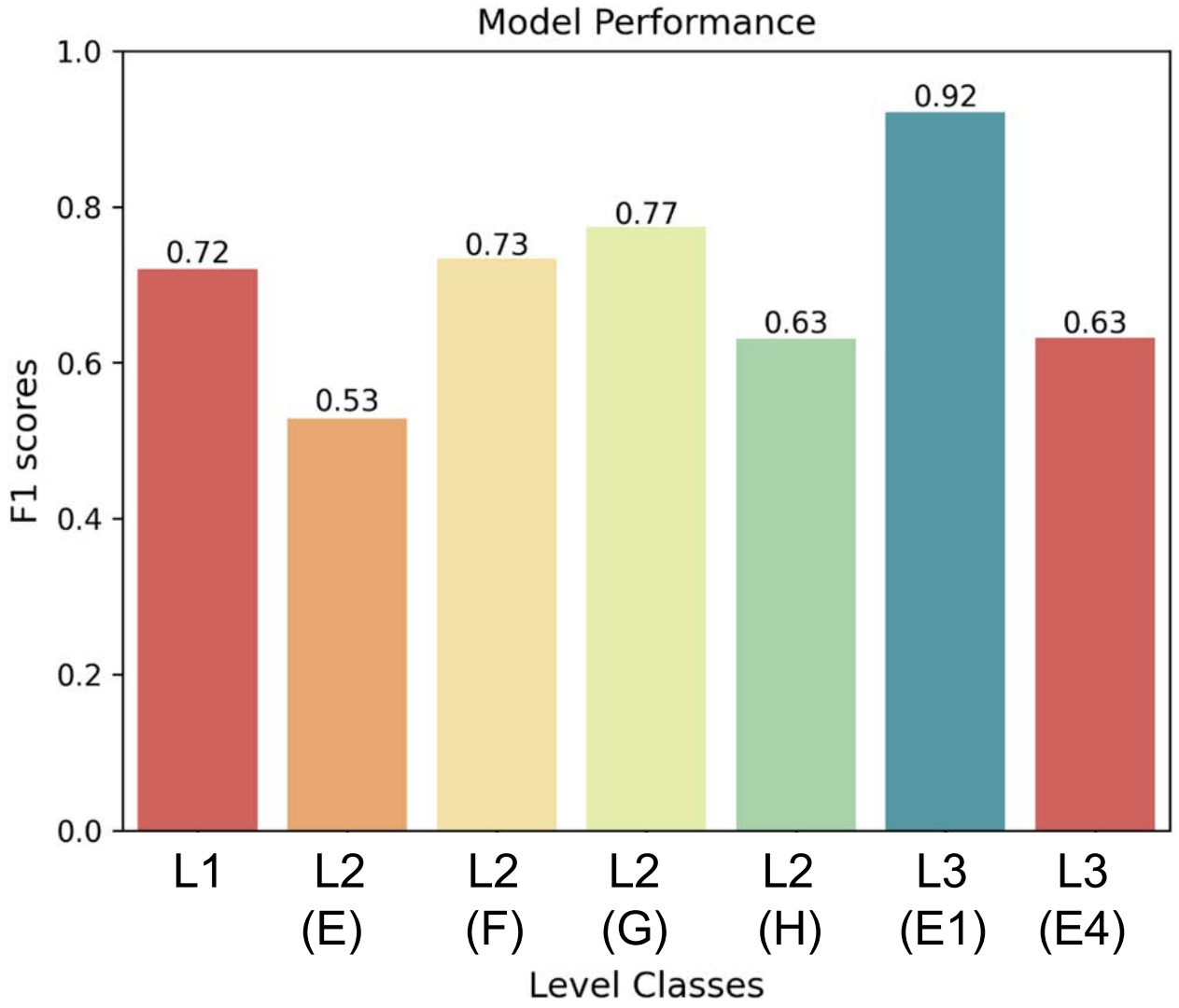
Different importance




## Level 2 Class G

# Model Performance (hierarchical approach)




**Two-step approach:**
Stratified random split of training data for parameter optimization and model performance test
70% - 15% - 15%

1. 5-folded cross-validation with stratified shuffle split for parameter optimization with 85% of training data
2. Model performance estimation with independent 15% training dataset

## Mapping results

# Work in progress

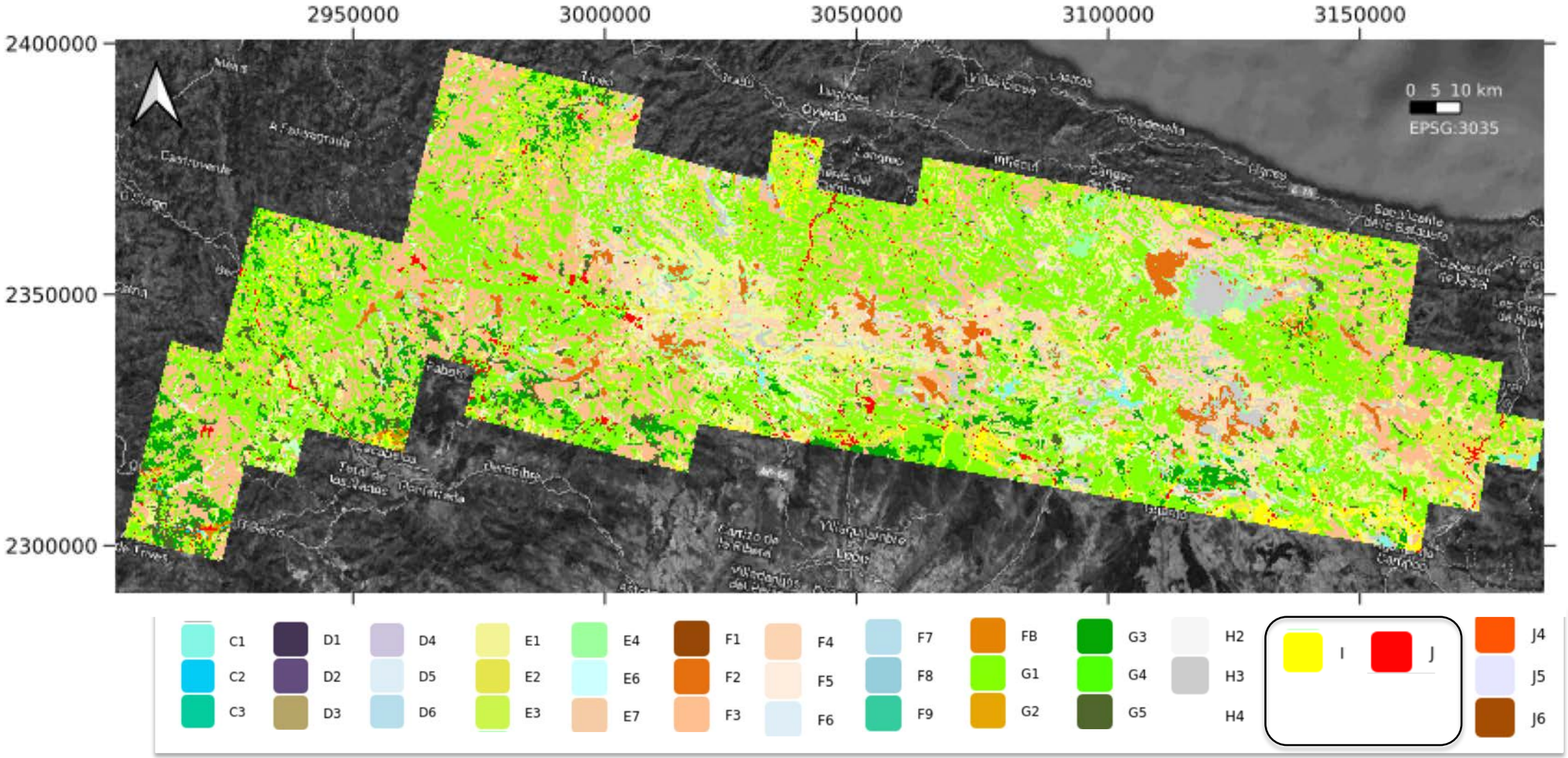
- Hierarchical classification approach:
  - L1 (1 model splitting EUNIS level 1)
  - L2 (5 models for each EUNIS level 1 to split into level 2)
  - L3 (2 models to split out the nardus grassland habitats (EUNIS level 3))
- Simple post-processor (no integration of suitability models and aux data, yet)
- Processing (for 9 S2 tiles covering the Cantabrian Mtn)
  - Feature extraction : ~5TB Sentinel input data + other (climate, soil, distance, phenology, …)
  - Tile-based (9 tiles at 100x100km$^2$ or 120Million pixels/tile)

  → EUROPE is more than >1000 tiles (multiply data amount with 100)
  ~75.000 CPU/h total → more than 6 TB of output data

- Validation
  - First visual comparison to EU EUNIS L2 map (100m) (EEA prototype)
  - Waiting for local map

# EEA 2012 example map (EUNIS Level2, 100m)

**Accuracy not known, waiting for local map**

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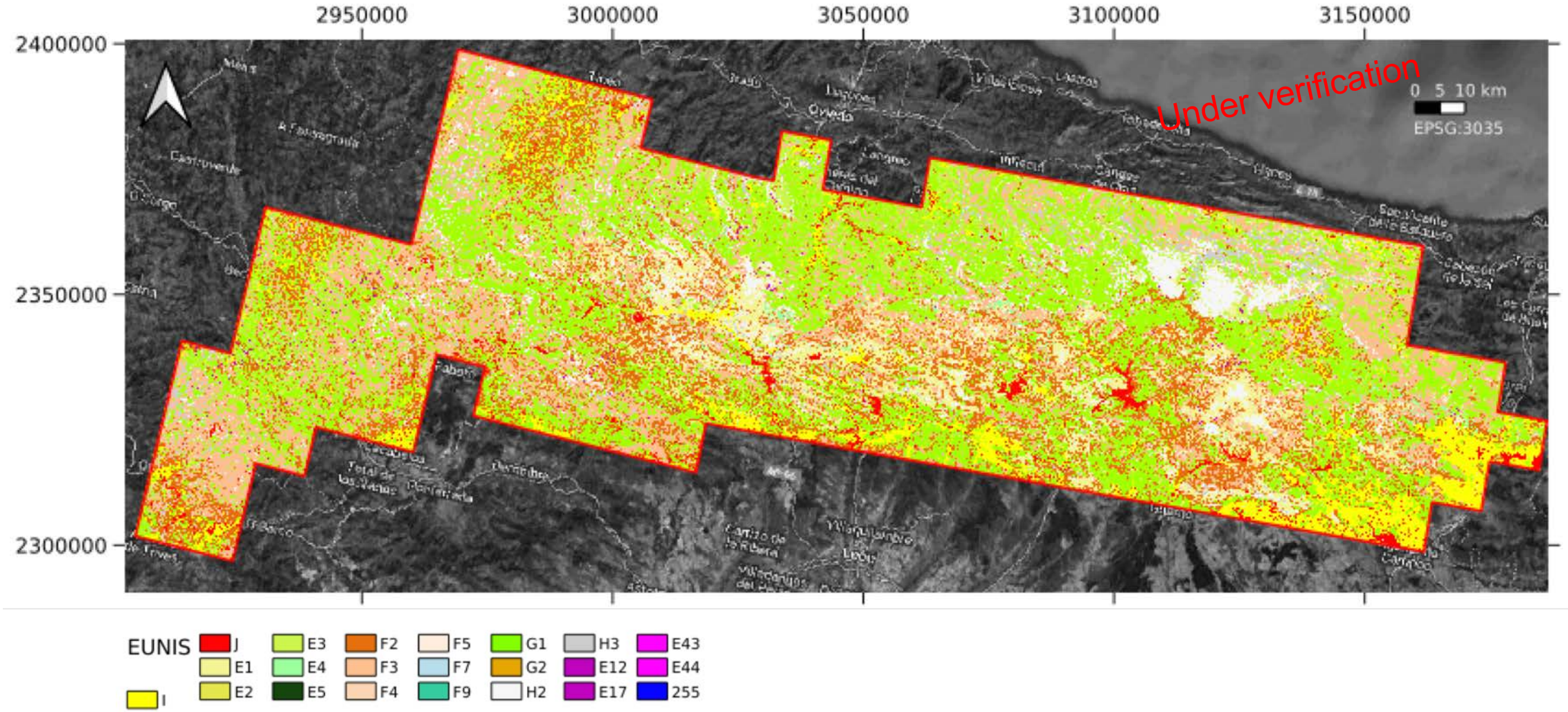
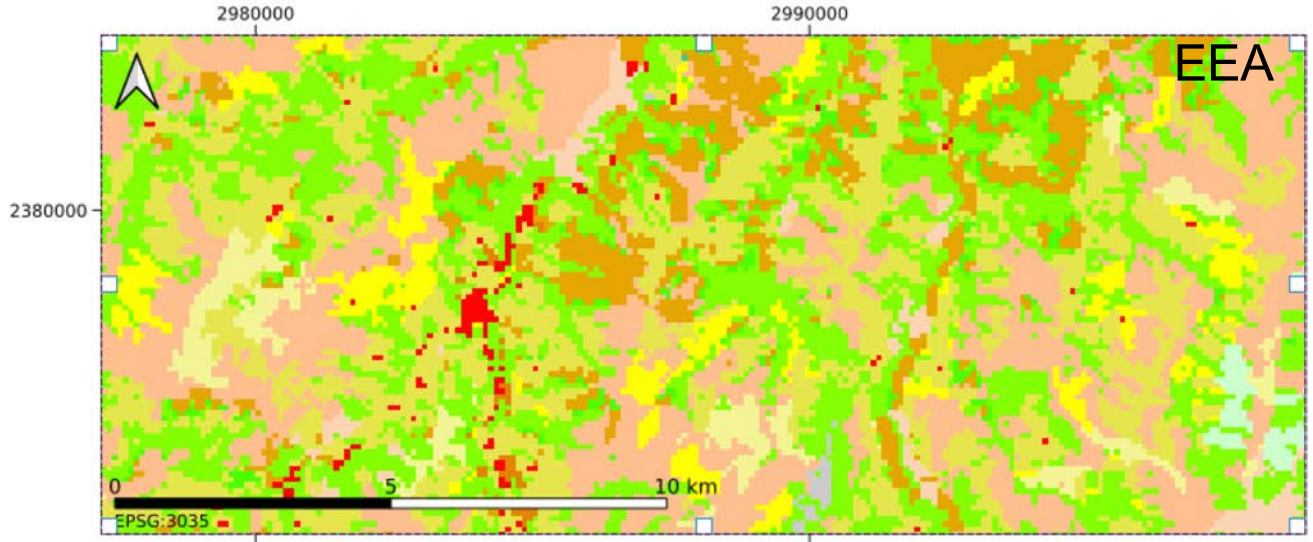
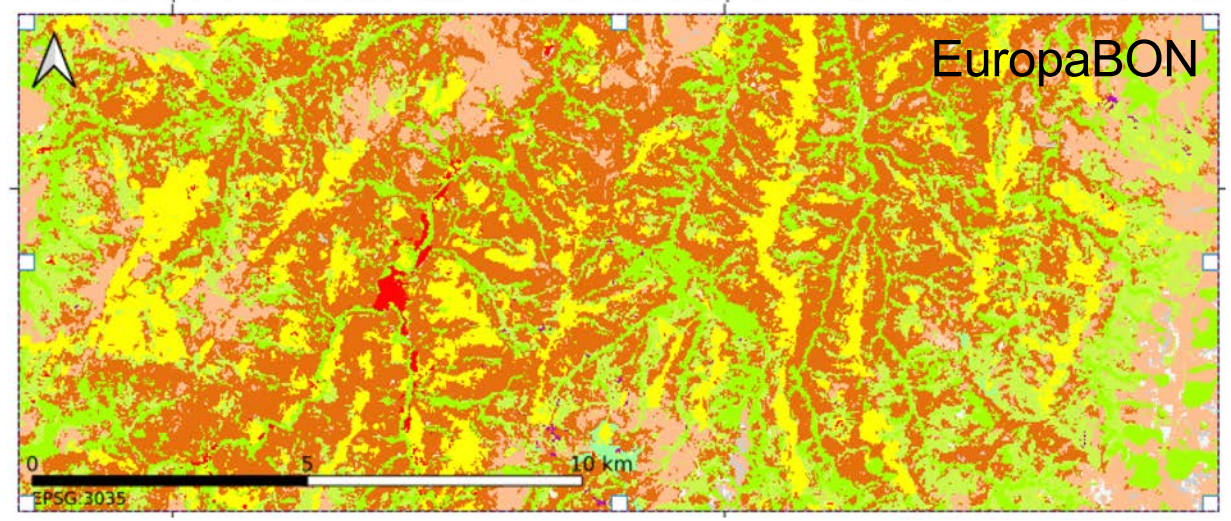
# EuropaBON preliminary results – hierarchical classification; simple merge



# ZOOM-1 : Level-2







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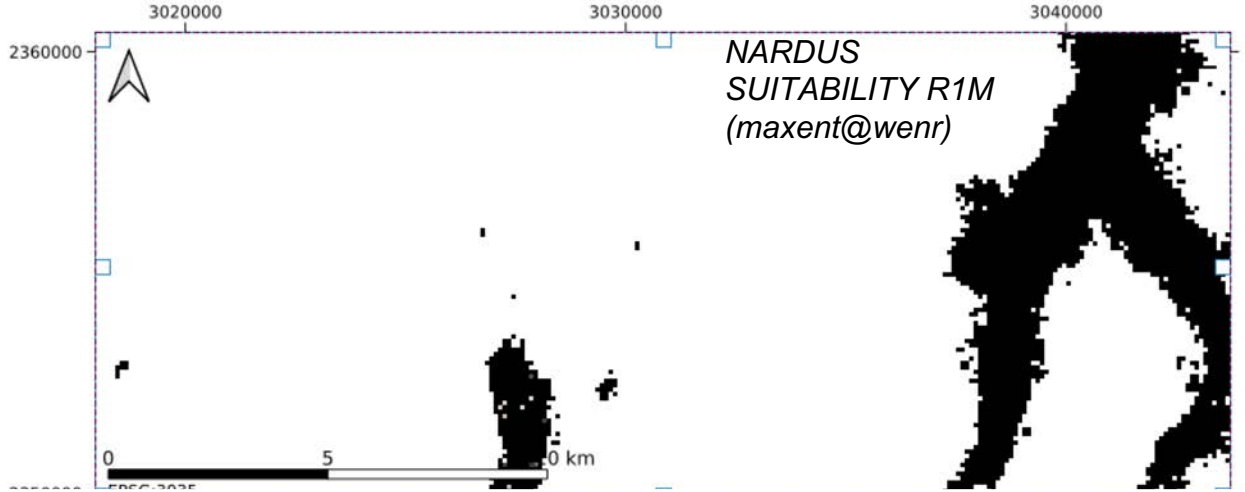
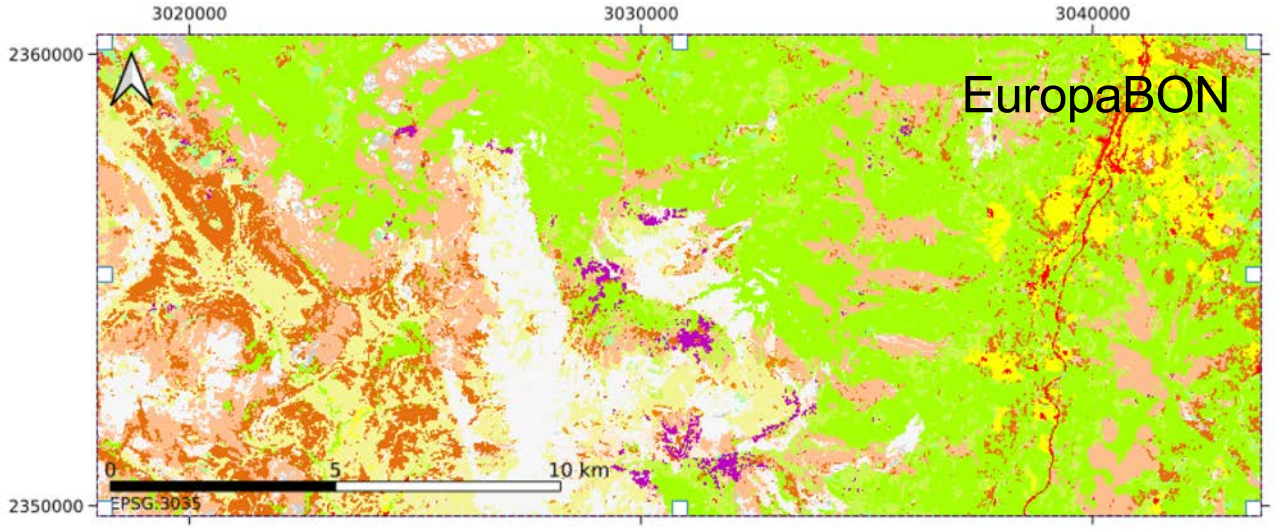
# ZOOM-2 : Level-3 Nardus

No Level-3 available as reference









nardus

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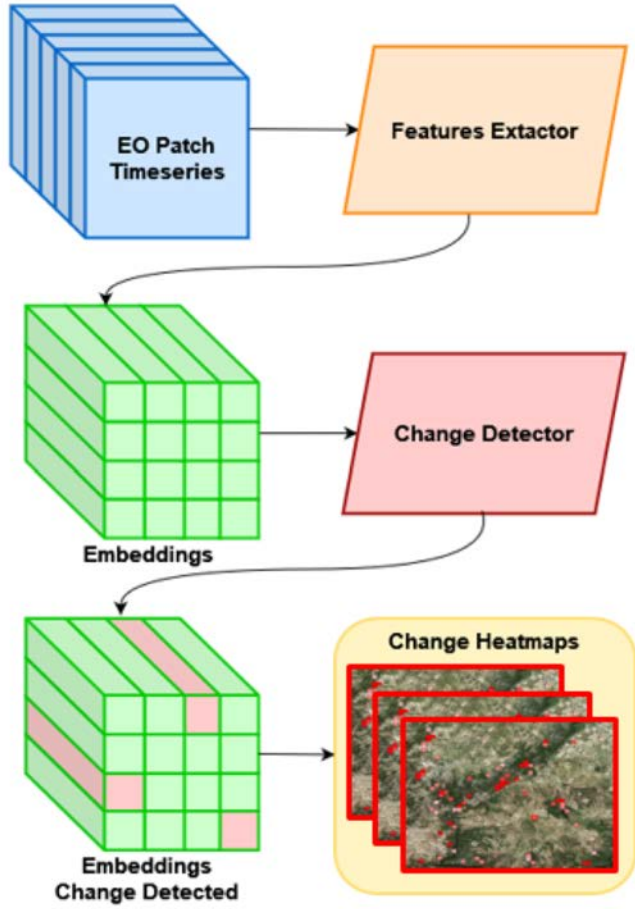
# Change model approach (AI)

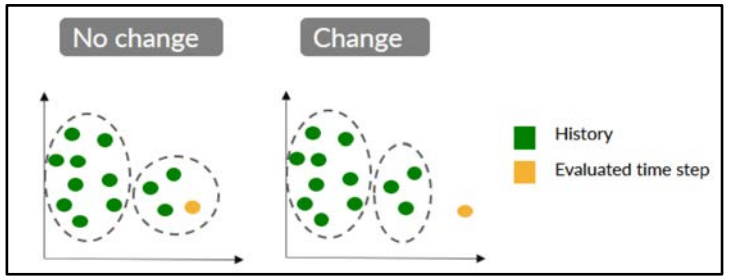
- Model features
  - Variations in pixels (illum, climate, seas)
  - Use series & context information (60x60p)

- Two steps:
  - Compress to latent vectors
    (Tile2Vec: triplet loss function – Jean et al. 2019)
  - Detect differences by comparing vectors
    (Agglomerative clustering with persistence score)

*Unsupervised learning*







# Change model – preliminary results

**Fire occurred on 2017-08-14** and is **detected** as a change


| | |
|---|---|
| 2017-06-15 | 0.0 |
| 2017-07-15 | 0.0 |
| 2017-08-14 | 1.0 |
| 2017-09-13 | 0.0 |
| 2017-10-13 | 0.0 |
| 2017-11-12 | 0.0 |
| 2017-12-12 | 0.0 |
| 2018-01-11 | 0.0 |
| 2018-02-10 | 0.0 |
| 2018-03-12 | 0.0 |
| 2018-04-11 | 0.0 |
| 2018-05-11 | 0.0 |
| 2018-06-10 | 0.0 |
| 2018-07-10 | 0.0 |

# lessons learned - Training data

- Number of training points per class is crucial for achieving good performance (area weighted random stratified sampling);
- High resolution training points & good location accuracy is needed;
- Each hierarchical level should include all possible classes;
- Weighing the classes helps to prevent the classifier to be strongly biased towards most numerous classes;
- Feature importance is independent on the hierarchy level;
- External test set needed to assess the real potential of the trained model

# Lessons learned - mapping

- Hierarchical approach provides flexibility, upper-level quality defines lower-level
- Quality of "base" layer is key -> accuracy per class & uncertainty : need 'local expert' maps
- Quality of "base" layer highly depends to accuracy of training (in situ) data -> harmonized schemes across admin regions can reduce cost
- Workflow is scalable, need cloud knowledge
- Inclusion of suitability layers in post-processing can improve accuracy & confidence -> per pixel quality layer, MMU (10 -> 100m?), link to Habitats Directive reporting

# Change Detection - Strengths and Weaknesses

- Many hyperparameter to be set manually in order to regulate the sensitivity of the methodology to changes;
- Challenging to detect gradual and long changes (successions);
- Additional pre-processing/downstream strategies might be needed to guide tile2vec change detection (e.g., snow mask)
- Tile2Vec retains only important information of the input so is more robust to noise;
- No annotations needed but the quality of the training set is crucial to obtain a robust model

# Lesson learned for European monitoring system (1/2)

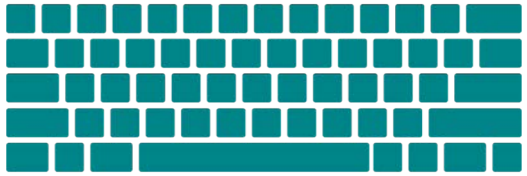
- For a European monitoring a harmonized European classification scheme (i.e. EUNIS) is essential → can reduce the costs compared to regional mapping
- Not only the “searched” habitats have to be mapped in-situ, to allow a good separation via RS data also the non-needed habitats are of equal importance (otherwise the “searched” class will be always overestimated in a RS workflow) → “not-searched” habitats do not need to be complete – we need a representative sample or links to other databases (e.g. urban training points could be extracted from cadaster info)
- In a hierarchical habitat mapping workflow with RS data, the first class level should split by features good observable by RS data (like artificial, water, forest, volume differences, …) → good start is natural vs. non-natural habitats
- Reference points should be always mapped to the end of the hierarchy. Otherwise, the training point could be only used up to the separation of this level in the hierarchy

# Lesson learned for European monitoring system (2/2)

- Not all EUNIS classes at level 3, 4 and 5 can be mapped with RS → need experts in the field (RS can mainly see the overstory – hard to distinguish habitats defined only by understory, e.g. Central European lichen pine forests vs. Blue berry pine forest)
- In the habitat class description, a part about RS separability should be included. What specific features (plant species, …) set this specific habitat aside from other habitats in the same group/class (vegetation height of plant species, colors, texture, soil properties, soil wetness or standing water, horizontal structure, phenological cycle, special non-natural features, human interaction,…) → that would allow a re-grouping by RS domains (optical, radar, lidar) and signal content (plant structure, volume, water content, height) to generate pre-classifications
- Some habitat classes can be better mapped with lower spatial resolution than with high spatial resolution, the habitat class description should include information about the habitat scale (is the habitat defined within a small or bigger area) and its diversity
- Habitat mapping requires a multi-disciplinary approach, bringing the botanic expert together with the remote sensing expert. Creating detailed habitat maps will remain using RS maps (wall-2-wall) with local field experts (details).
- Habitat maps also important for natural capital (ecosystem) accounting – extent typology.

# Any questions?

Helsinki attendees: raise your hand



Zoom attendees: use the chat

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# Section II - Examples from Biodiversa+ partners

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# Monitoring and development of indicators of quality of habitats

By Åsa Ranlund SLU, Swedish Agricultural University


SLU
SCIENCE AND EDUCATION FOR SUSTAINABLE LIFE

# Monitoring and development of quality indicators for habitats

Åsa Ranlund
Division of Landscape Analysis,
Department of Forest Resource Management

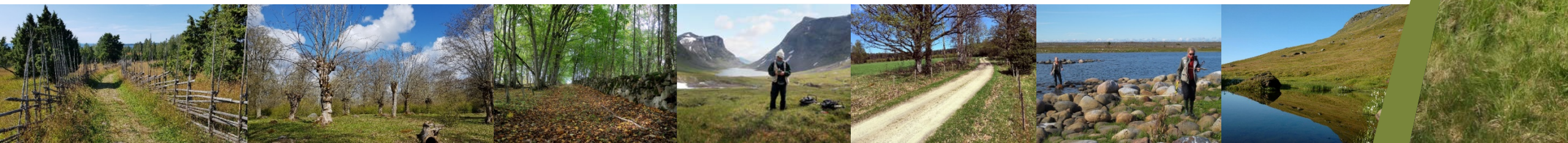
# National Inventories of Landscapes in Sweden

NILS Alpine (2003) 2021 –

NILS Deciduous forest 2020 –

NILS Grassland 2020 –

THUF Sea shore (2012) 2021 –



# Measurable targets

Estimate the area and quality of habitats

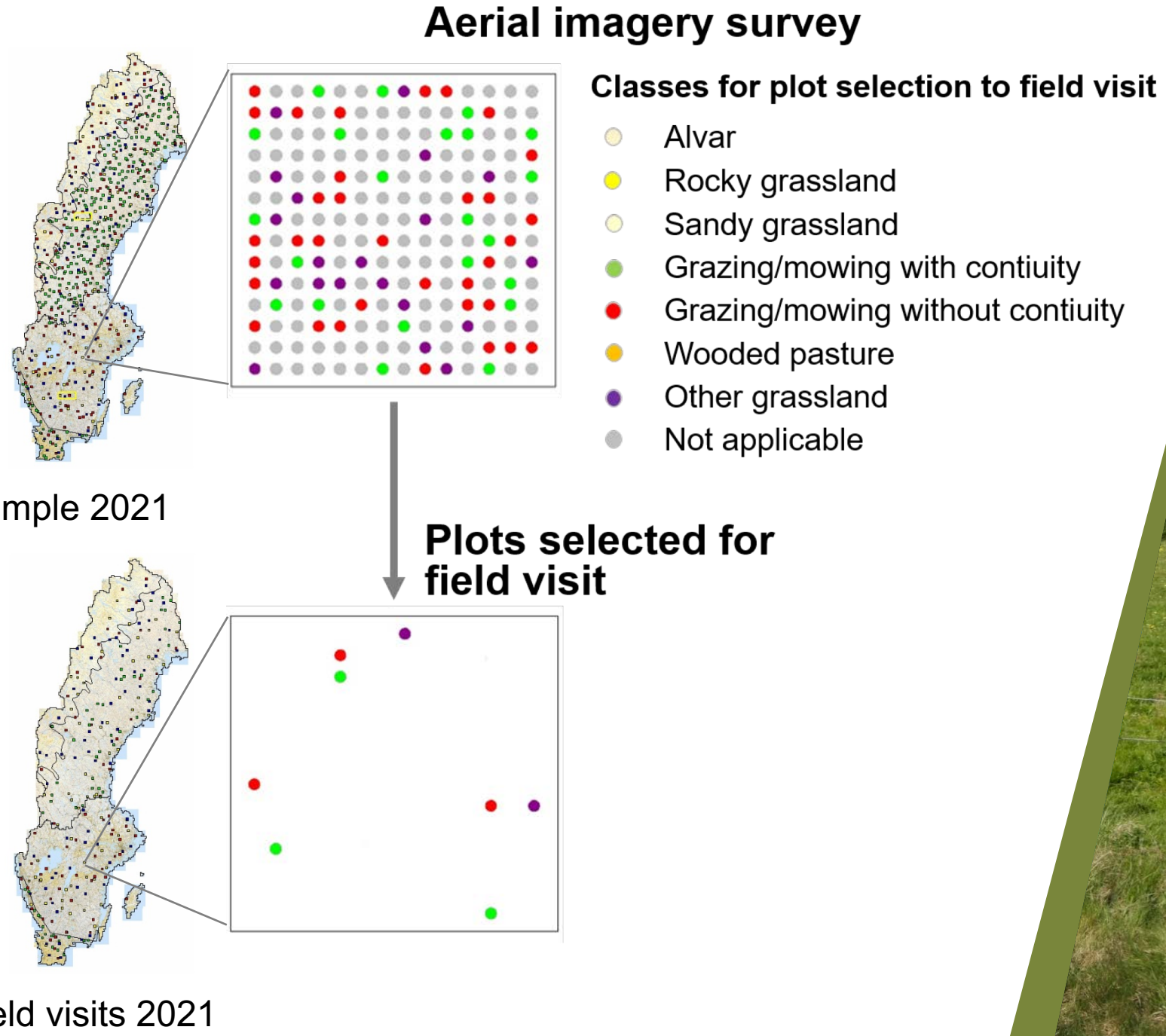
- What level of precision do we need?

Estimate change in area and quality of habitats

- How large changes should we be able to detect?
- With which statistical power?
- Over which time period?

# Sampling design in two steps

Example from the grassland inventory.

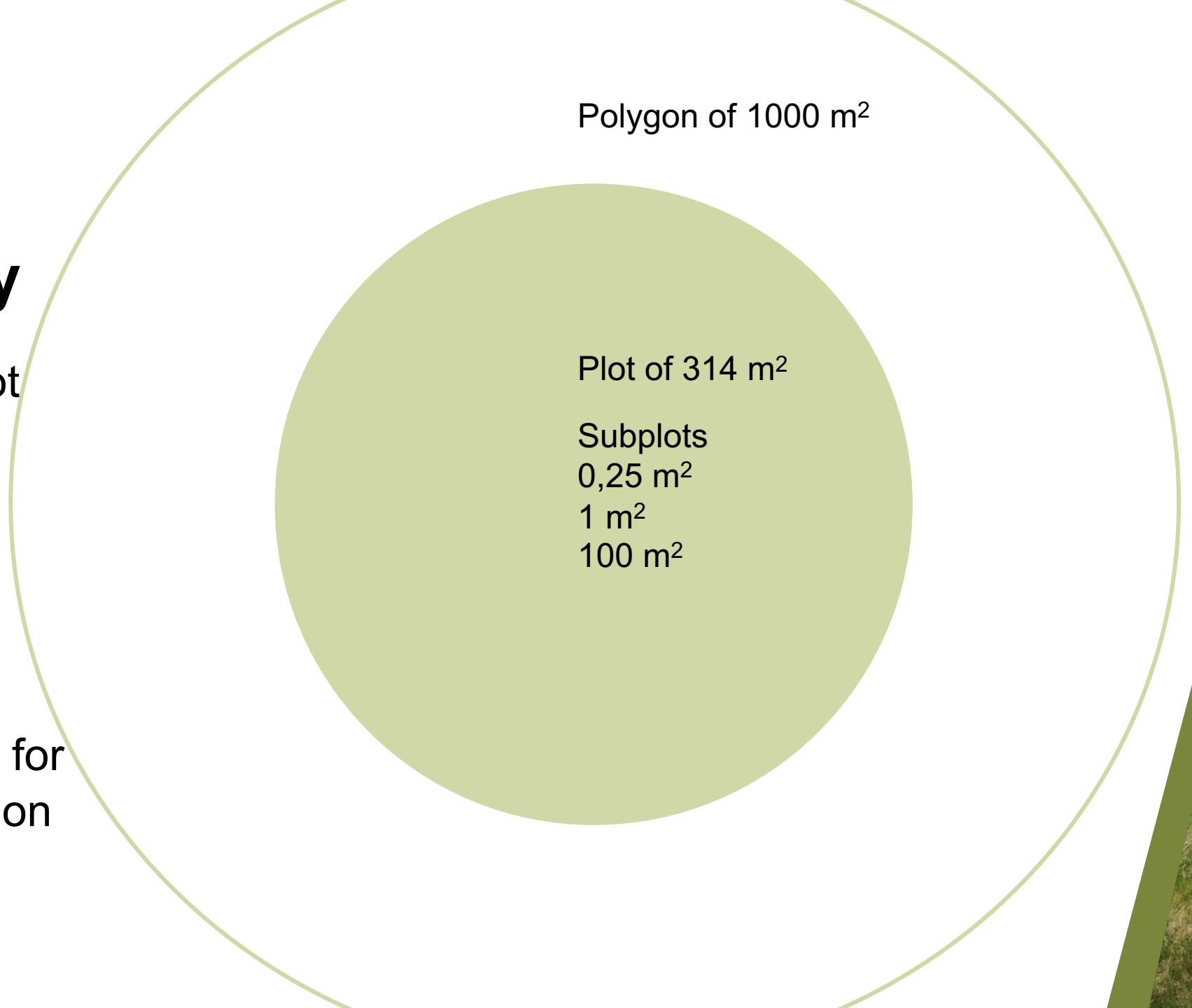


# Field survey

Sampling unit: plot with 10 m radius

Sub-plots for species and vegetation cover survey

Polygon of 0,1 ha for habitat classification and quality assessment




# Reporting habitats under Article 17

Range

Area

Structure and functions

Future prospects

Data provided by NILS

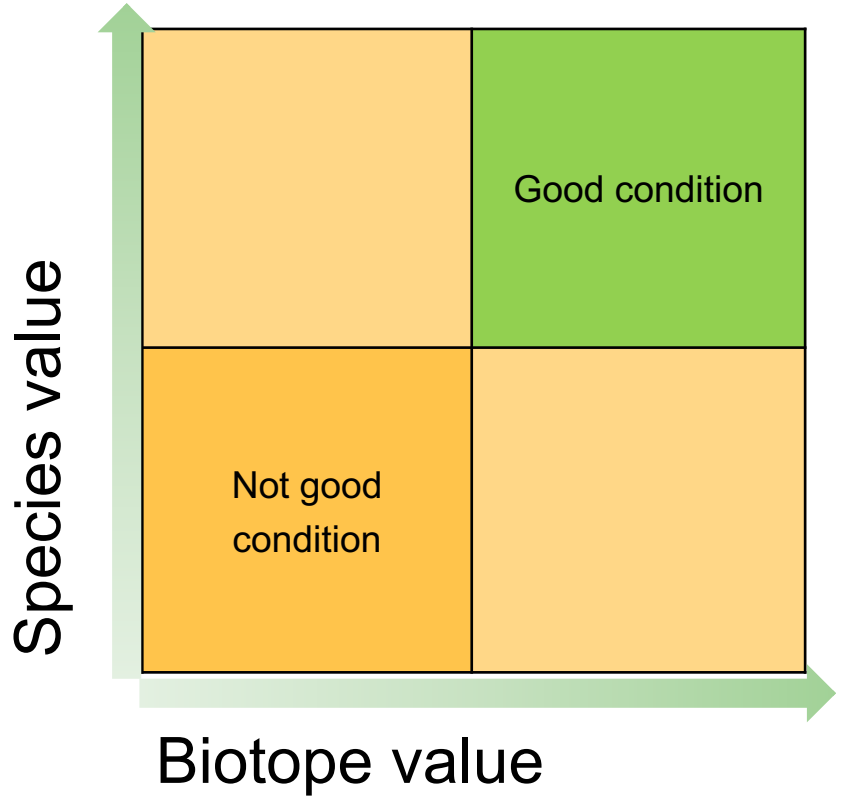
Swedish Species Information Center, SLU
Swedish Environmental Protection Agency

# Grassland quality field variables

- Characteristic species
- Graminoid litter
- Management history
- Negative indicator species
- Sward
- Grazing intensity
- Shrub cover
- Tree crown cover

# Conservation status: Structure & functions

- Value 1 for ”good” and 0 for ”not good”.
- Good condition in relation to structure and functions in the top right corner.




# Conservation status: Structure & functions

- Proportion of area (%) with conservation status according to species and biotope values.
- Value 1 for ”good” and 0 for ”not good”.
- Good condition in relation to structure and functions in the top right corner.

**6270** Fennoscandian lowland species-rich dry to mesic grasslands

| Species value | Biotope value 0 | Biotope value 1 |
|---|---|---|
| 1 | 28 % | 58 % |
| 0 | 6 % | 8 % |

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

| Species value | Biotope value 0 | Biotope value 1 |
|---|---|---|
| 1 | 34 % | 65 % |
| 0 | 2 % | 0 % |

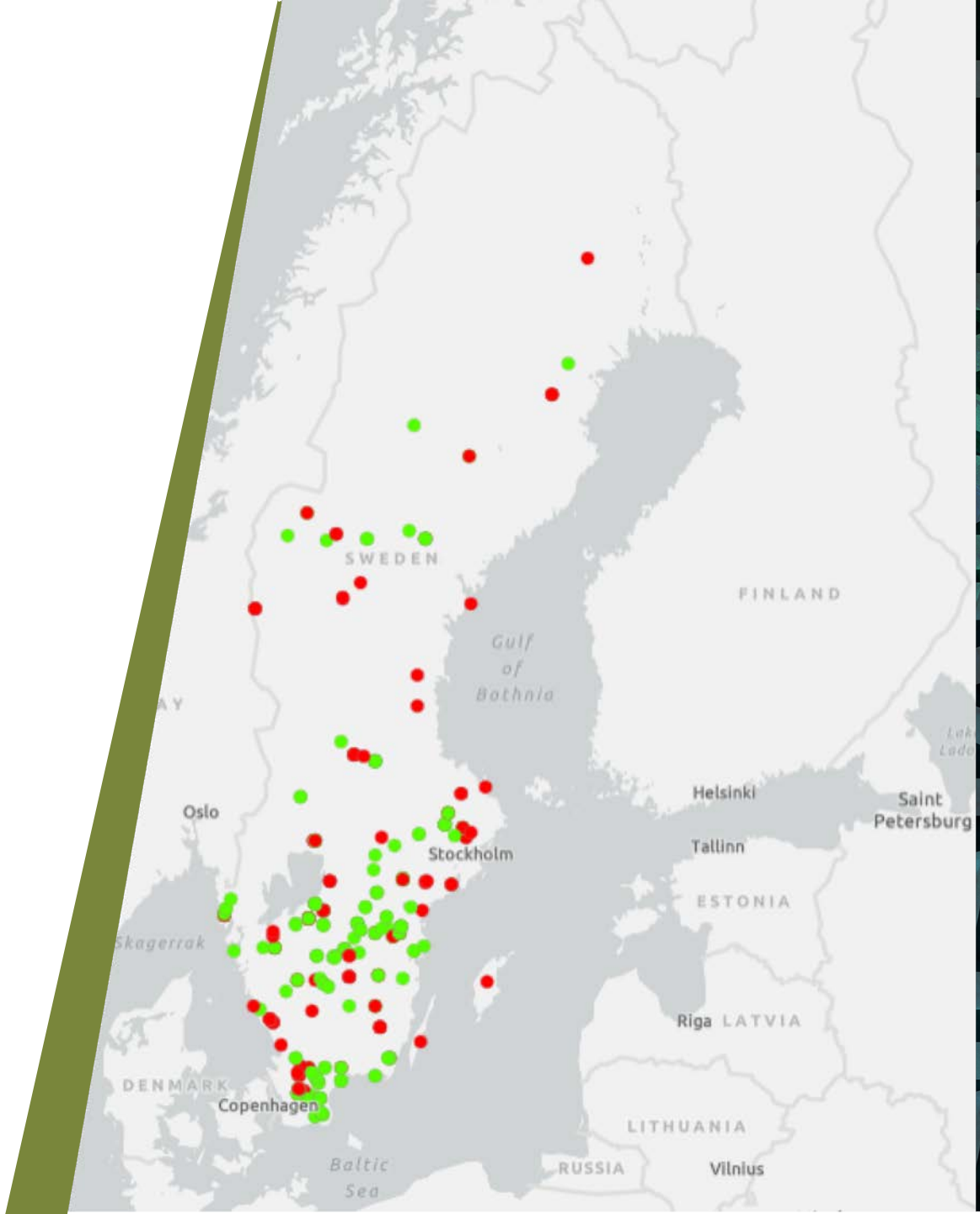
**6410** Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)

| Species value | Biotope value 0 | Biotope value 1 |
|---|---|---|
| 1 | 41 % | 43 % |
| 0 | 13 % | 3 % |

Biotope value

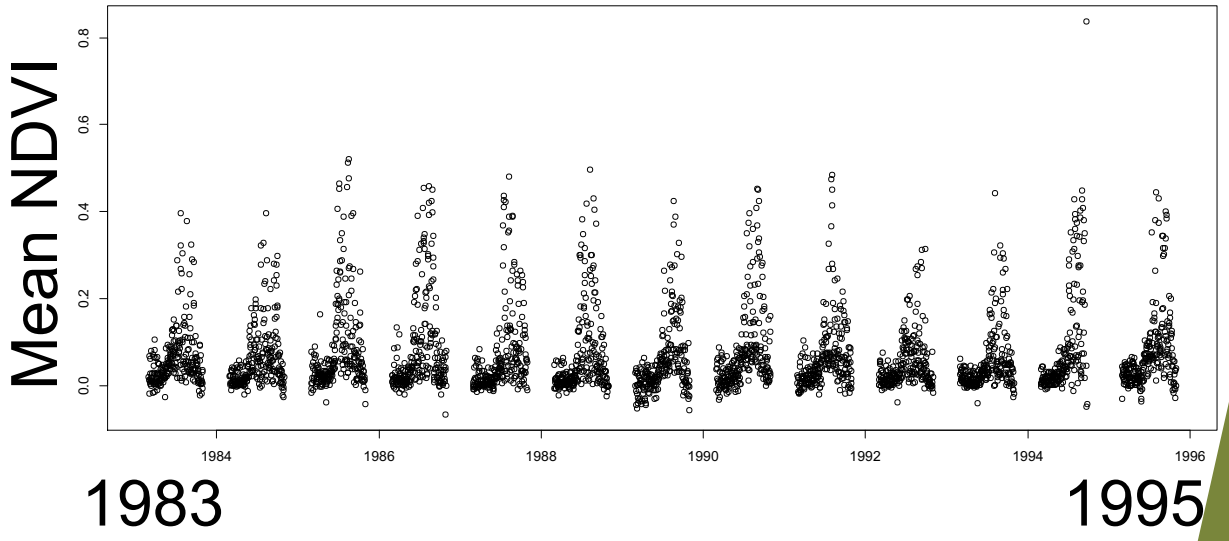
# What comes next?

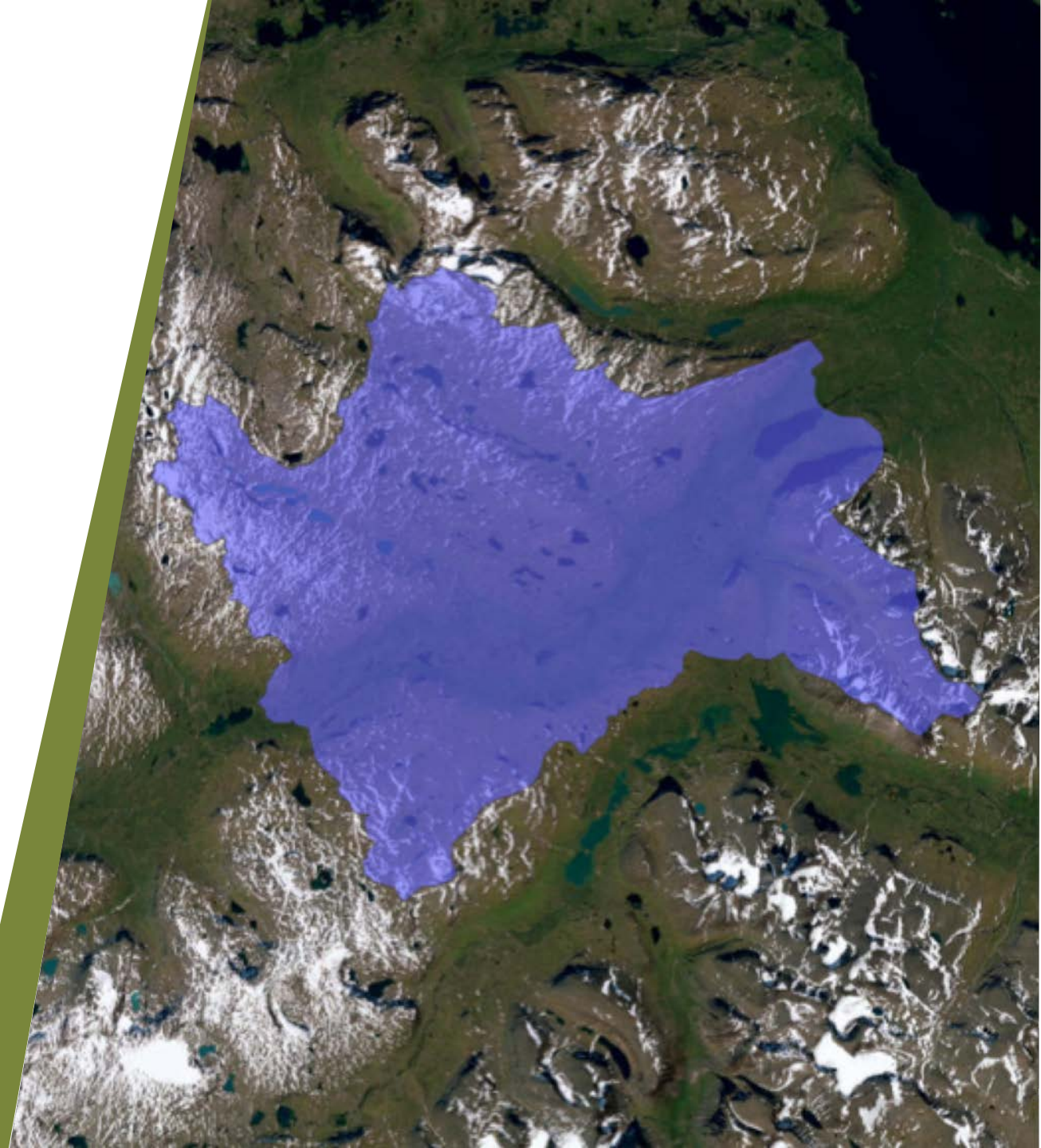
- Evaluation (P. Toräng & A. Jacobson, Species Information Center)
- Adjustment of indicator delineations
- Habitat-specific indicators
- Indicators for restoration needs



# What comes next?

- Changes in quality and remote sensing time series
- NOAA satellite polygon example, Sentinel, Aerial photos




Questions?
Thanks to Erik Cronvall for photos.

# Thank you!

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c/o Department of Ecology
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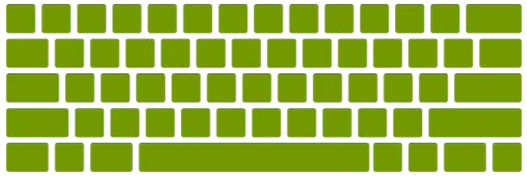
Tfn 090-7868223; 072-2298788

# Any questions?

Helsinki attendees: raise your hand



Zoom attendees: use the chat

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# Remote sensing of habitats - experiences from Finnish Lapland

By Saku Anttila, Finnish Environment Institute (Syke)

FEO

# Environmental and ecosystem data from remote sensing

## Examples from the Finnish Ecosystem Observatory and 'Ylä-Lapin kaukokartoitus' -projects

*Saku Anttila (SYKE)*

*SYKE: Pekka Härmä, Kristin Böttcher, Mikko Kervinen, Markus Törmä, Janne Mäyrä, Iida Autio, Minna Kallio, Pekka Hurskainen, Keto Vesa, Seppo Tuominen, Tytti Jussila, Mikko Impiö, Mika Heikkinen, Katariina Mäkelä, Aira Kokko, Sonja Kivinen, Tytti Kontula, Anne Raunio, Pekka Vanhala, Inka Keränen, Riitta Teiniranta, Peter Kullberg, Martin Forsius, Petteri Vihervaara, Aapo Ahola …*

*Metsähallitus: Anna Tammilehto, Elisa Pääkkö, Arto Saikkonen, Terhi Hultamo…*

Connected also to :
LUSEK, SUMI, IBC Carbon, Lumenviipymät Putte, WQMS, RantaPutte, eLTERPlus, eLTER plus, Mammutti…

# Earth Observation at SYKE

**Aquatic**: Water quality from the Baltic Sea, lakes and estuaries

- integrated to support EU reporting (WFD, MSFD), monitoring of events/pressures

**Terrestial**: Land cover/use, habitats and ecosystems, phenology

- support for endangered ecosystem & habitats monitoring, ecosystem accounting, carbon neutral land use

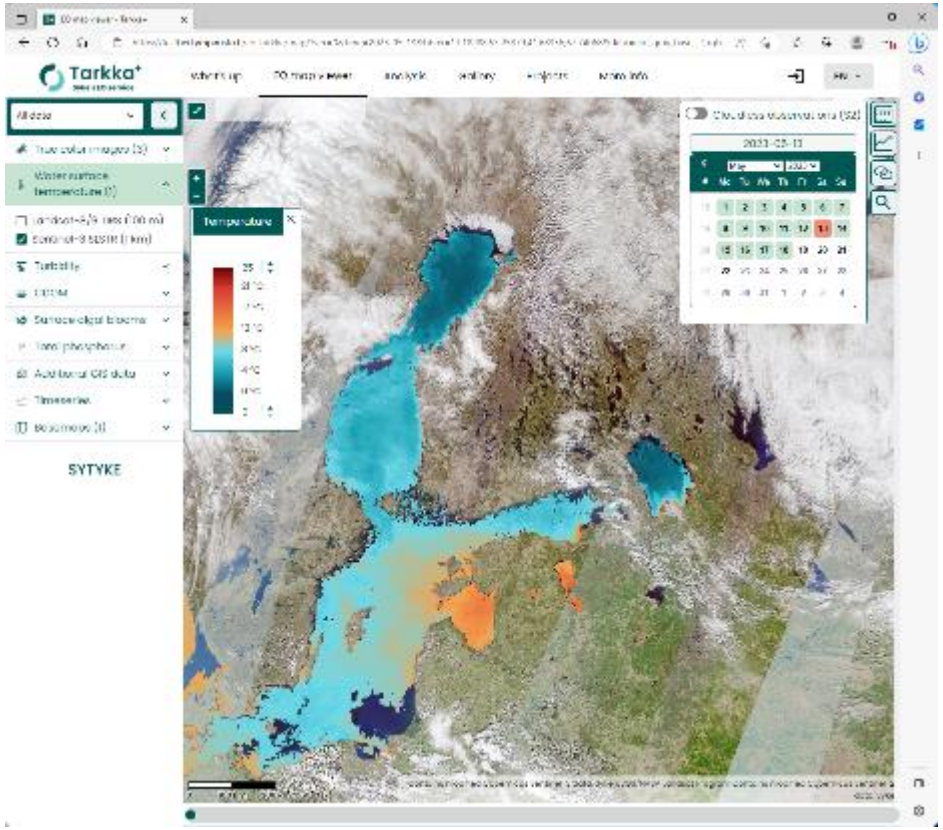
**Cryospheric**: Snow Covered Area, lake ice, long term changes

- Data provider for EU Copernicus Land services,
- Integrated to hydrological modelling

# Earth Observation at SYKE

**Technical capability**

- Provided operative EO based services from Finland since 2001
- Gradually moving to cloud based solutions (SentinelHub, AWS, ESA DIASes)
- www.syke.fi/tarkka highlights EO for env. Monitoring




Focus in capacity building: Linking EO, AI and modelling expertice for thematic research



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Finnish Environment Institute

# EO 4 Biodiversity in Syke

Advanced in several projects (highlights FEO WP4 and 'Remote sensing of Northern Finland's nature –projects)

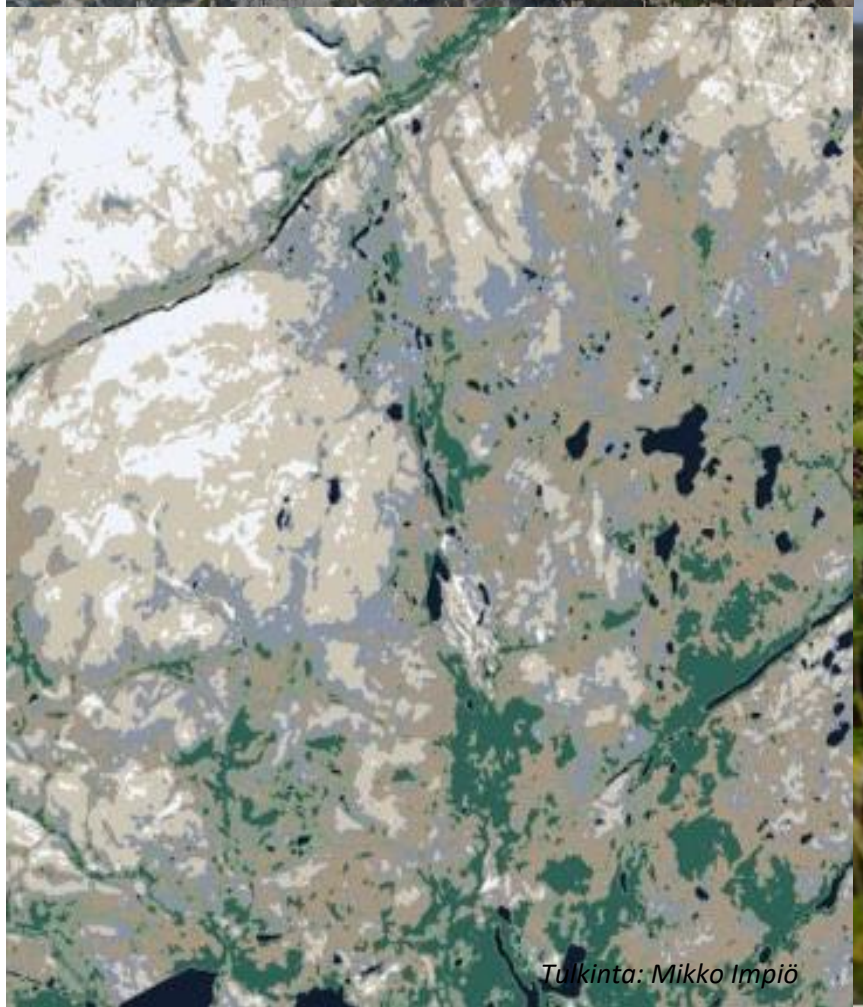
To support especially habitat monitoring in Finland with user-relevant and EO based:

a) Background & Thematic data
b) Habitat classifications

Focus in EU Nature directive monitoring and in respective

s.





*Tulkinta: Mikko Impiö*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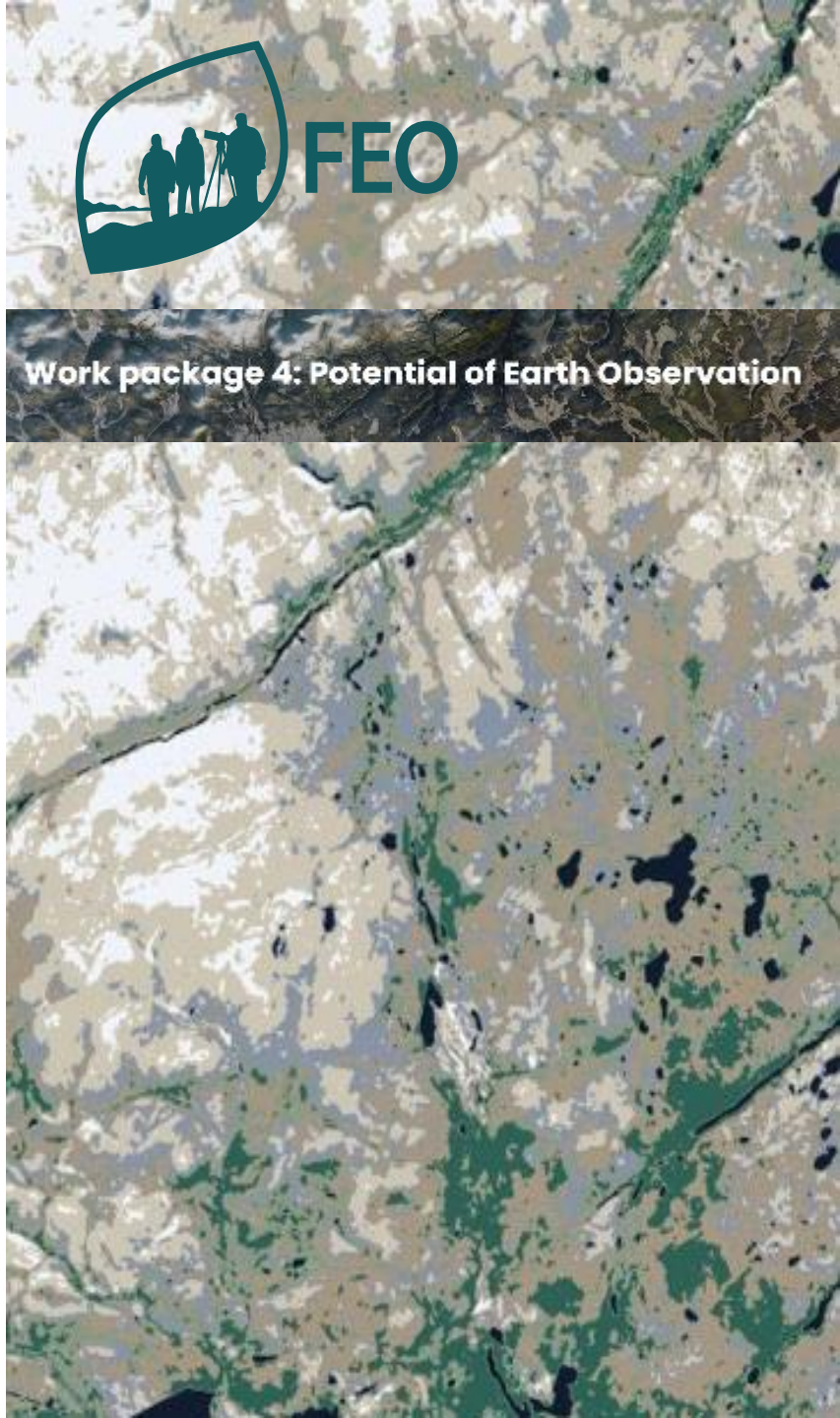
# EO based environmental data to support habitat assessment

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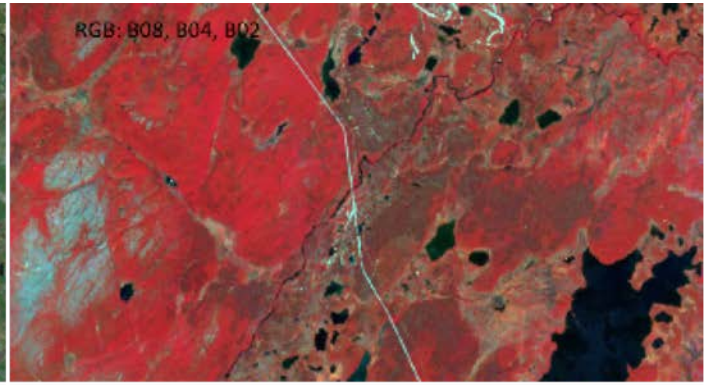
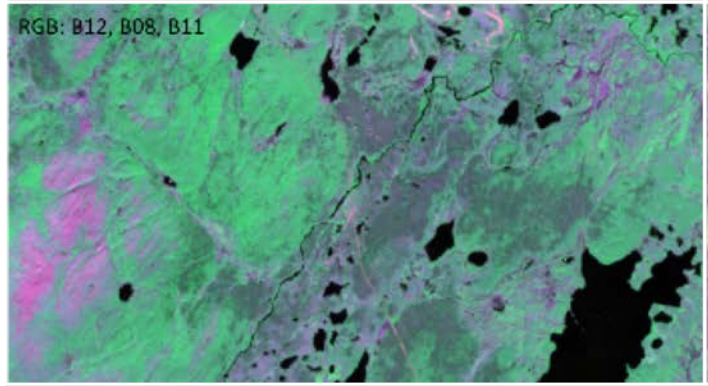
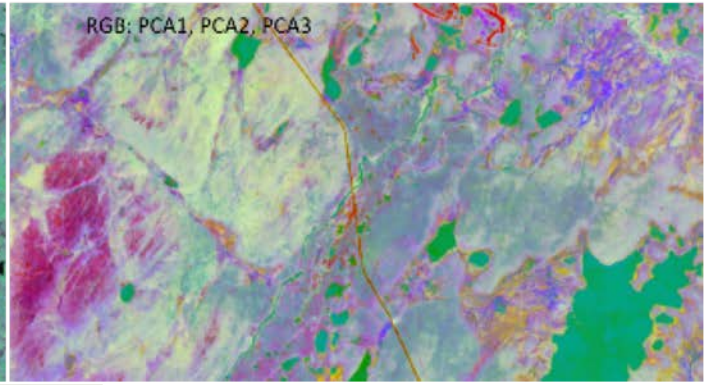
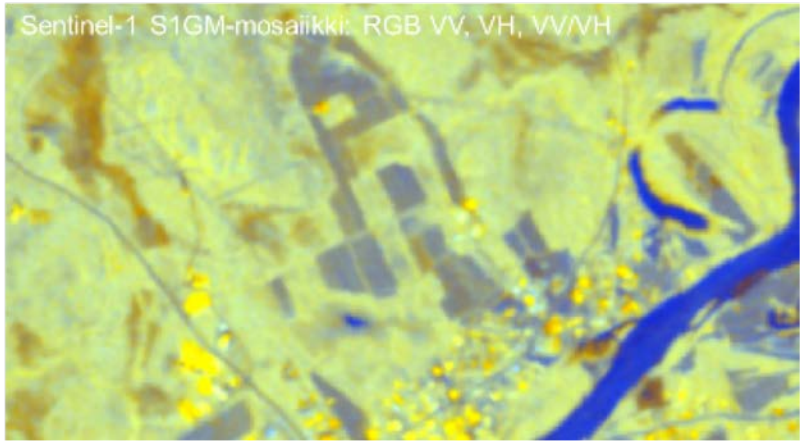
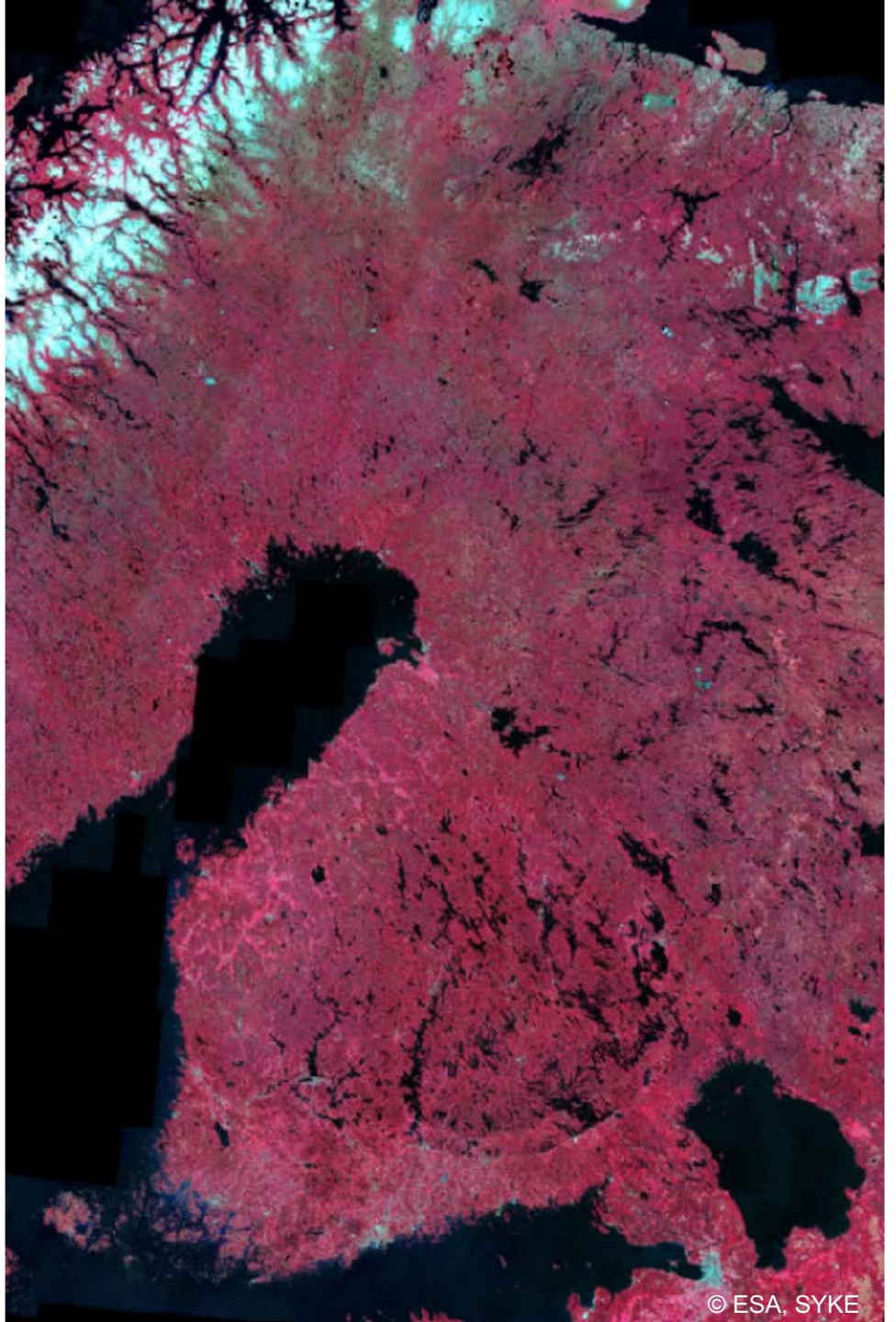
# EU/ESA, Sentinel 1 and 2

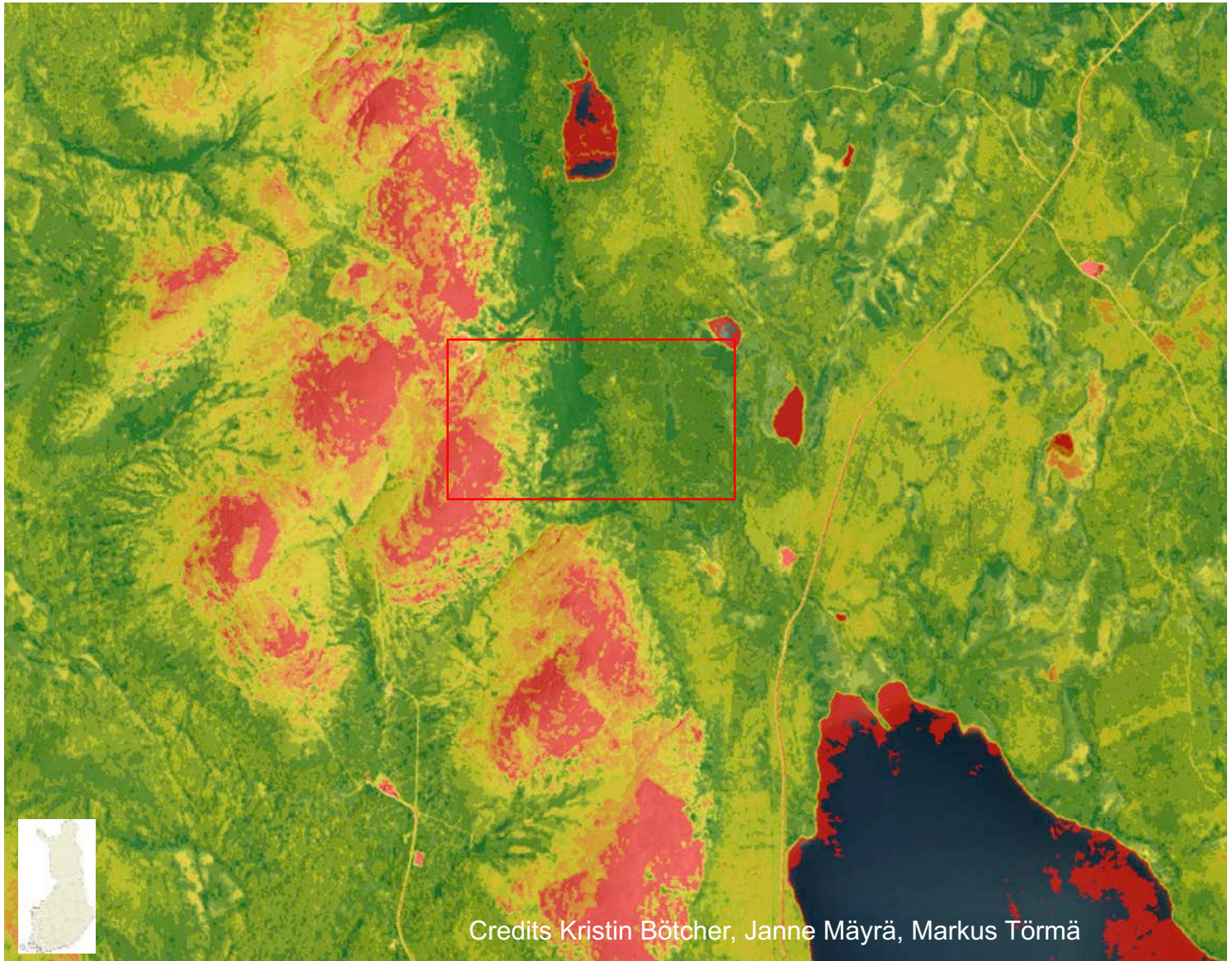



# Remote sensing indices and seasonal aggregates

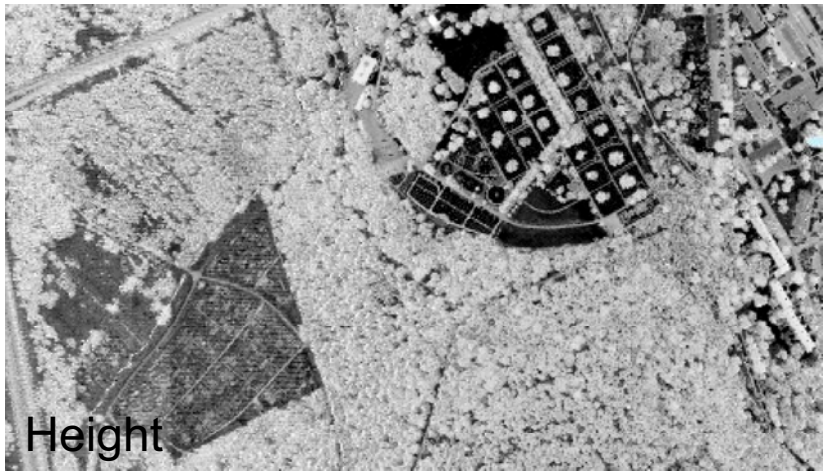
Example on the right seasonal maximum of NDVI (vegetation index) ->
Indication on the trophic level

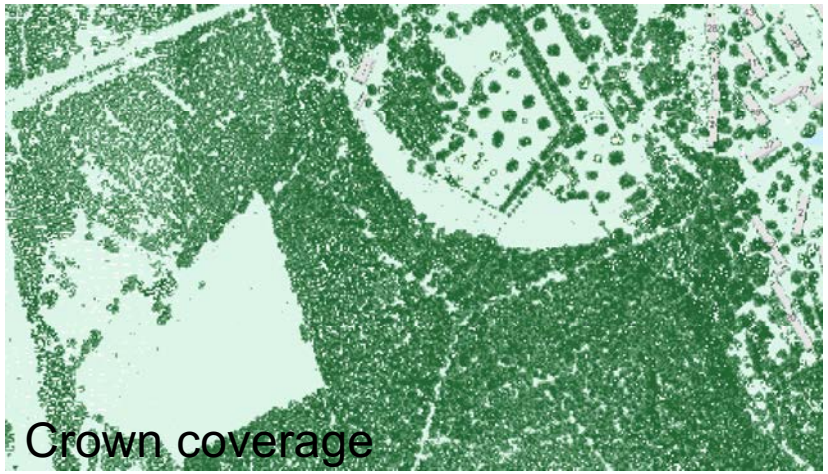
Various indices indicating vegetation amount, moisture, healt , snow, build environment etc. (NDMI, NDTI, NDSI, NDBI, EVI…)



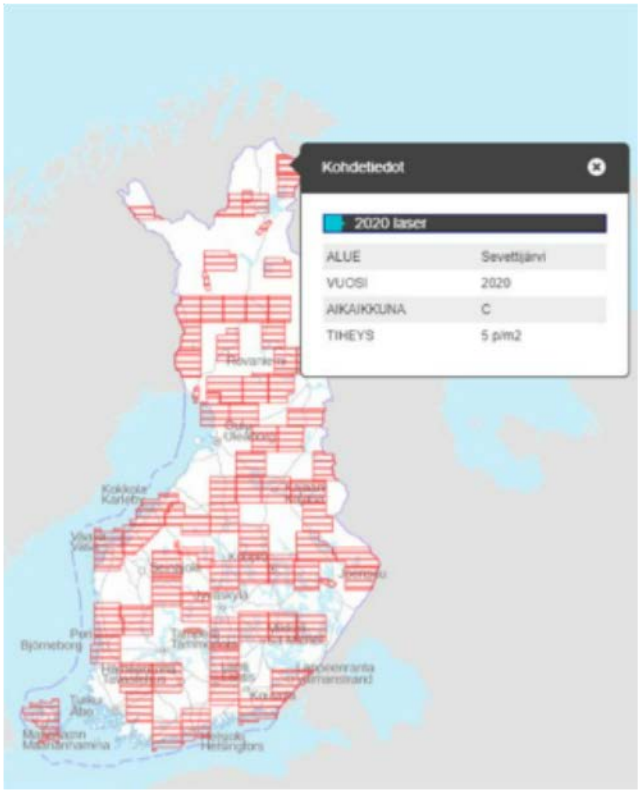
# National Laser Scanning data and derived products

- First 2008-2019 (0.5p/m2), second 2020-2026 (5p/m2)
- e.g. Vegetation height, crown coverage, vegetation coverage in different layers

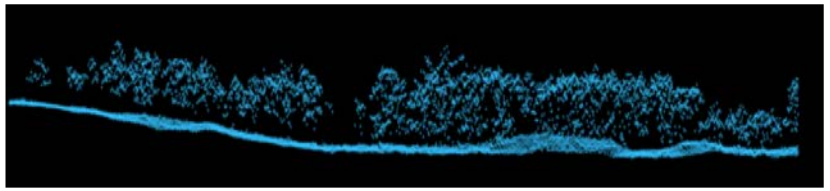


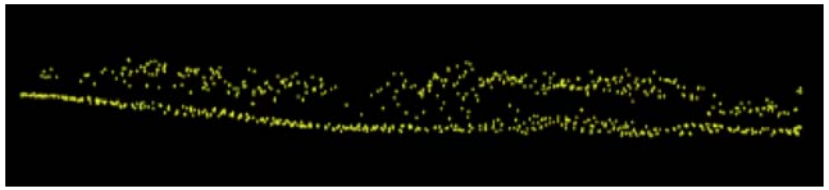

2020-2026 (5p/m2) LAS data




Credits: Mika Heikkinen, SYKE



0.5p/m2 LAS data



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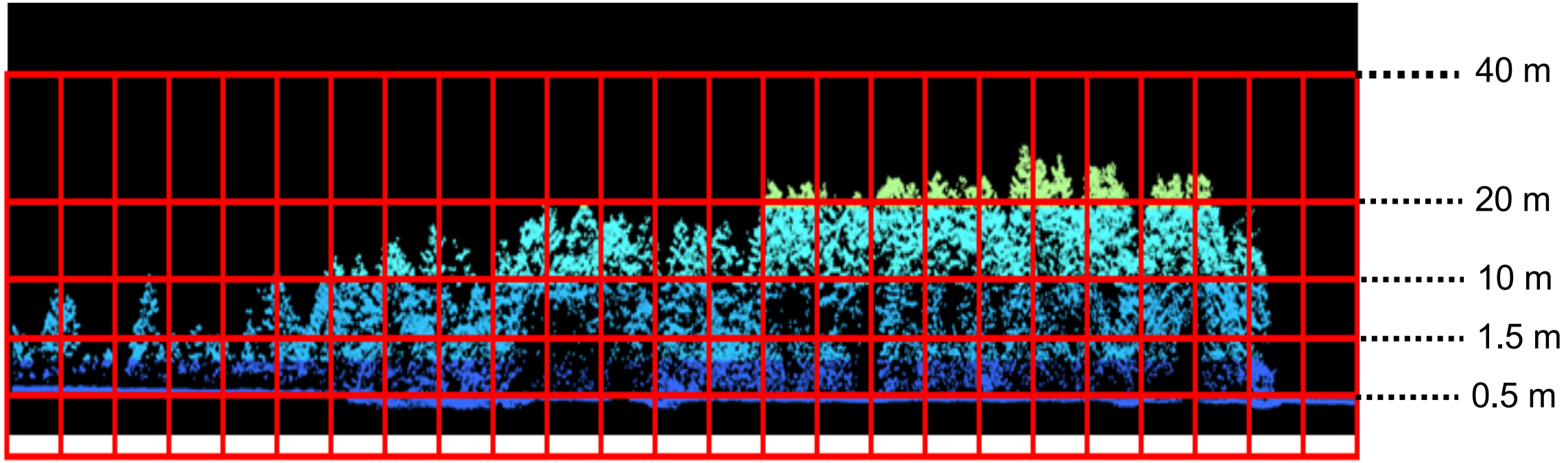
# Vegetation structure from the national LAS data






Credits: Mika Heikkinen, SYKE

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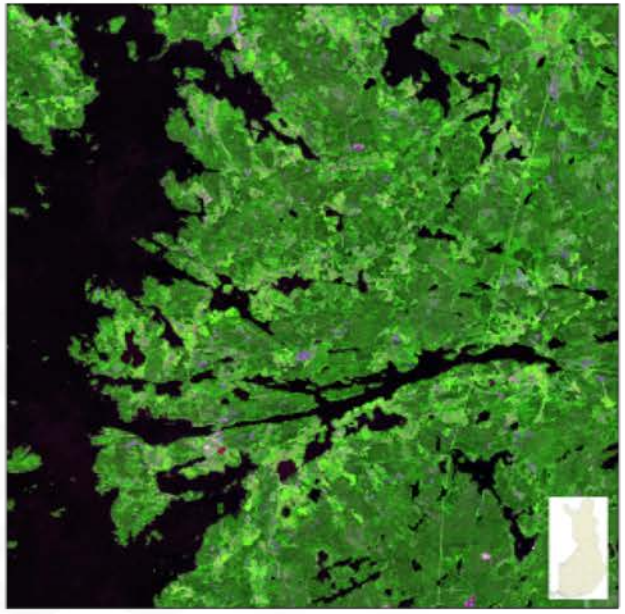
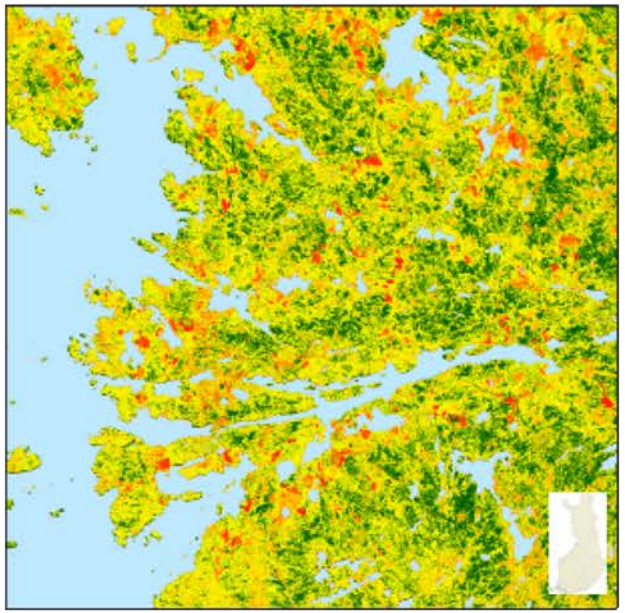
Sentinel 2 reflectances

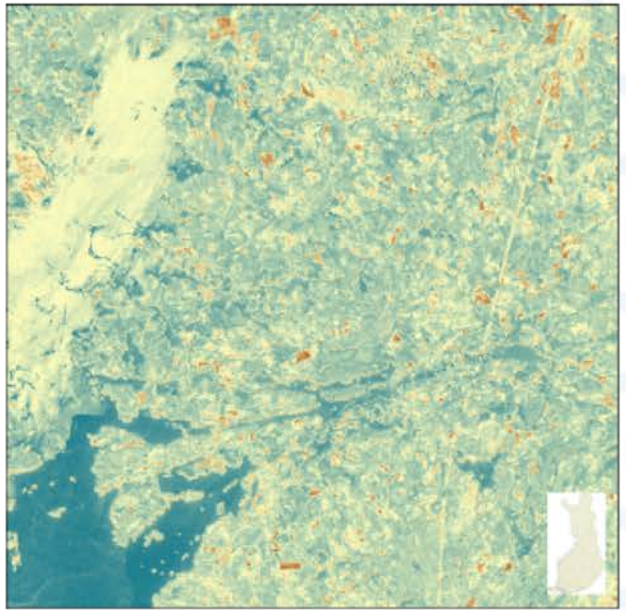


NDVI annual maximum (snow free months)

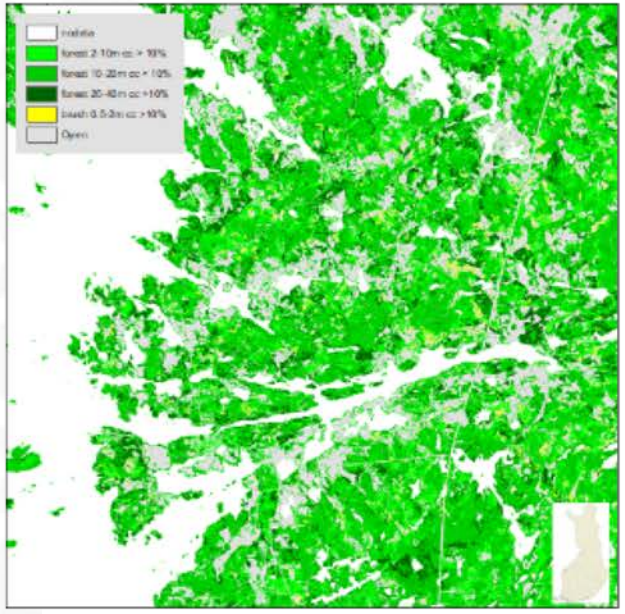
Copernicus High Resolution Vegetation Product (HRVPP, 2020)



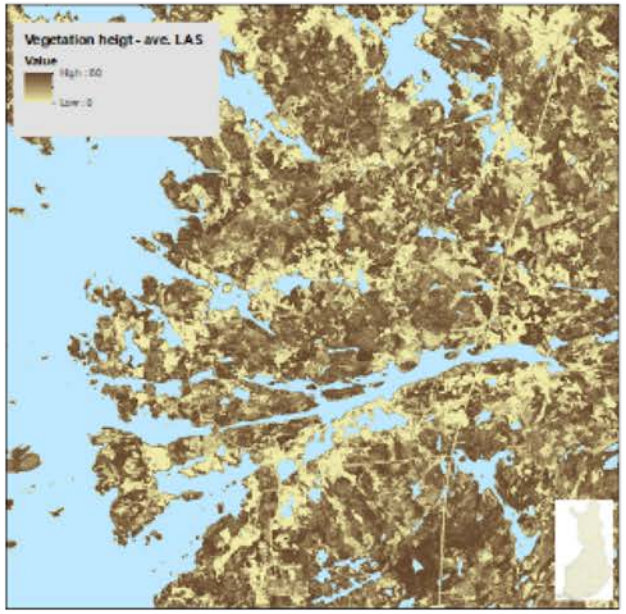
Normalized Difference Moisture Index (NDMI), Sentinel 2



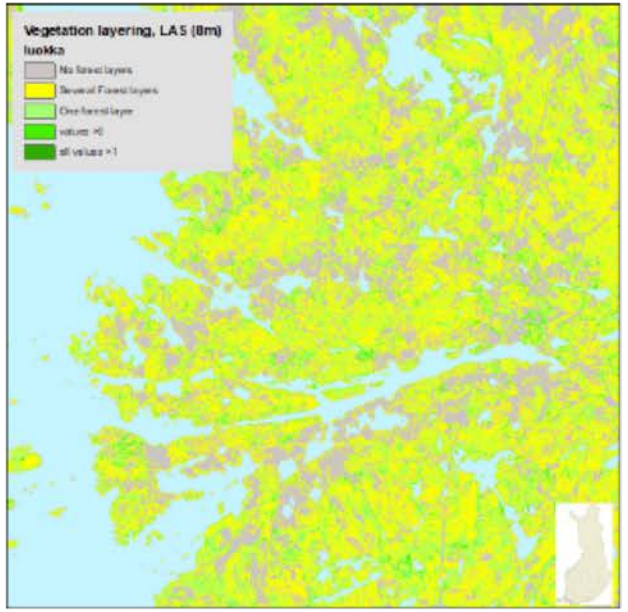
LAS product: forest - brush - open classes



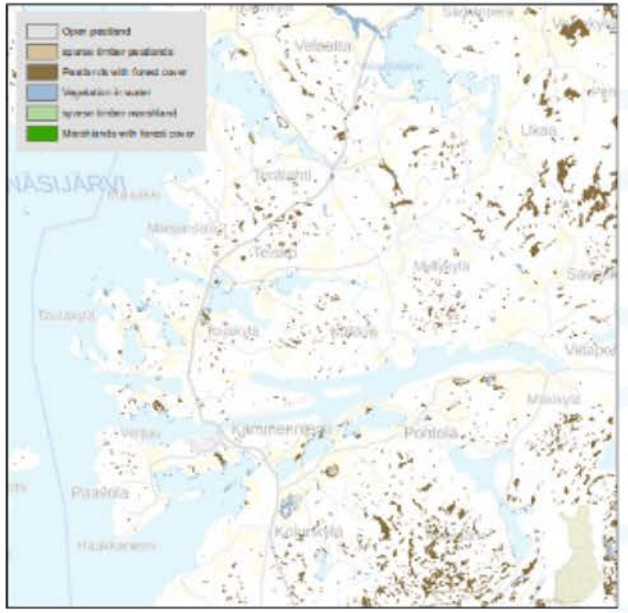
LAS product: Vegetation heigth




LAS product: Vegetation layering




Land Cover in peatlands and marshlands



Examples of EO based thematic data products that biodiversity monitoring experts have found informative and have explanaton power in further interpretations. All of the examples can be provided over large geographical areas.

# Ylä-Lapin luonnon kaukokartoitus -project

*Dryas octopetala*, NT

- Duration: 2020-2023 (3,5 years)
- Partners: National Parks Finland and Finnish Environment Institute (Data and information centre and Biodiversity centre)
- Annual budget: 300 000 €
- Funding: Ministry of the Environment and Finnish Environment Institute

## Project group

- National Parks Finland: **Anna Tammilehto**, Arto Saikkonen, Elisa Pääkkö, Kasper Koskela
- Finnish Environment Institute (Data and information centre): Pekka Härmä, Minna Kallio, Mikko Impiö, Mika Heikkinen, Markus Törmä, Mikko Kervinen, Saku Anttila
- Finnish Environment Institute (Biodiversity centre): Seppo Tuominen, Katariina Mäkelä, Aira Kokko

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SYKE

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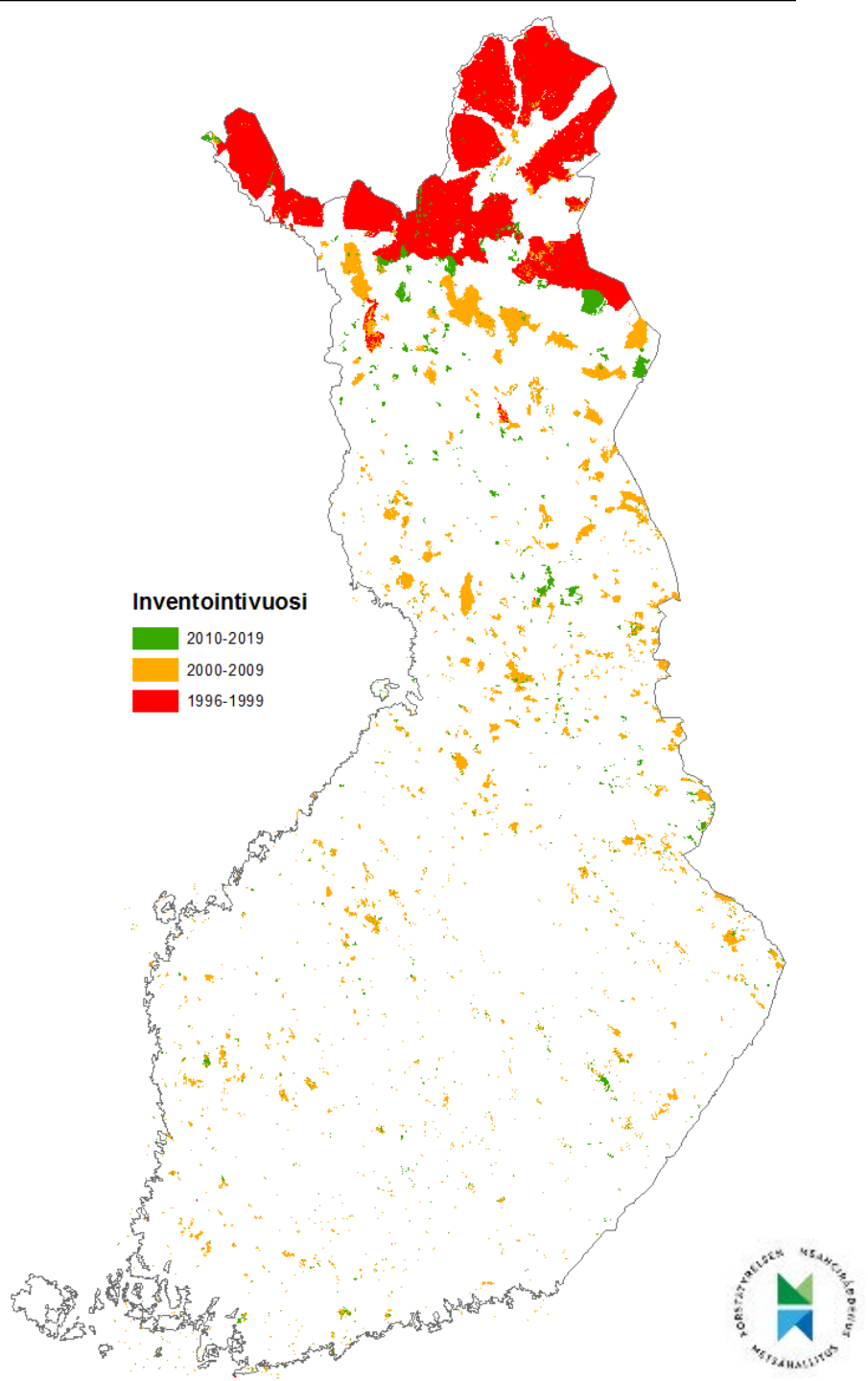
# Background and aims

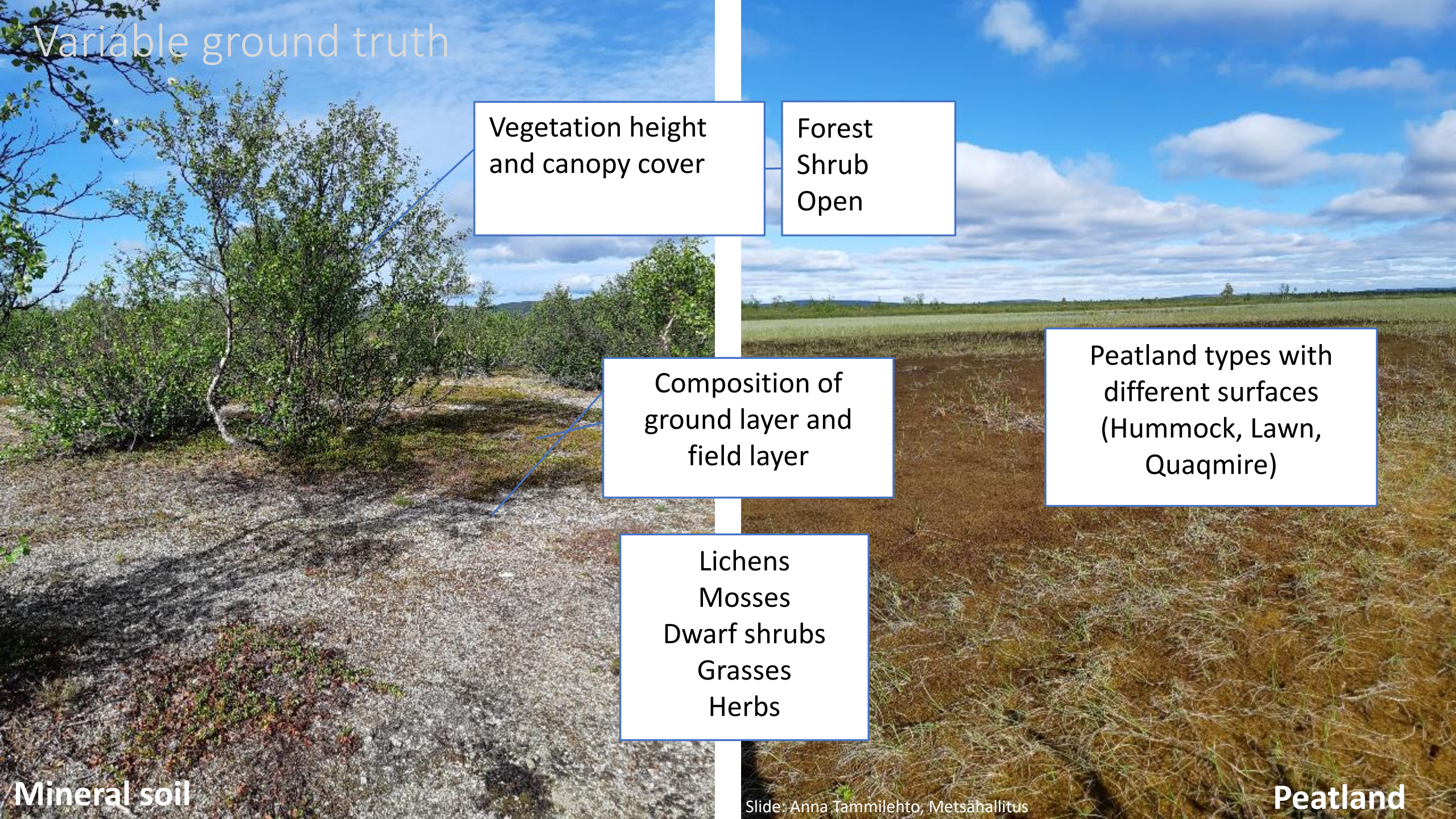
- Habitat data from the northernmost Finland is old (most red areas in the map)
  - Collected in LUOTI-project in 1996-2000
  - 20 % field observations and 80 % mapped using aerial photographs
  - Data is needed and used e.g. in Habitat´s directive reporting, assessment of threatened habitat types, land use planning
- Need for updating the data is urgent
  - Geographically vast area; 2,8 million hectares
  - Pressures on land use
  - Monitoring environmental change

  -> Earth observation




Slide: Anna Tammilehto, Metsähallitus

# Variable ground truth




Slide: Anna Tammilehto, Metsähallitus

# Work flow

EO data: collecting and processing

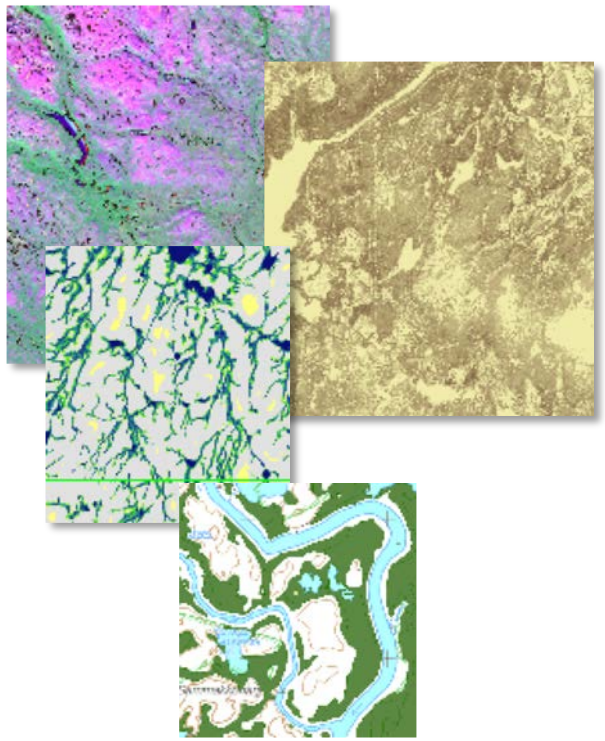
Field work (2020-2022)
>4500 plots

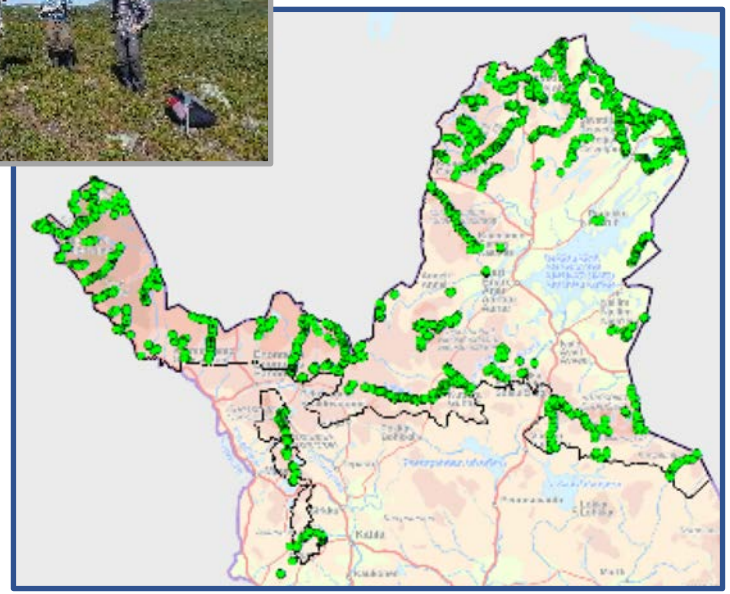
Classification models (random forest & deep learning)

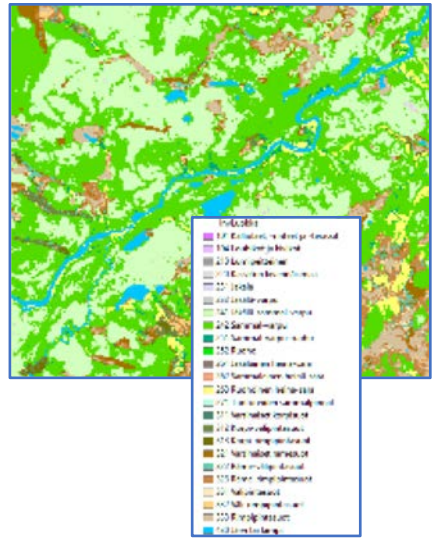
Validation

Habitat classification

Updating the habitat date





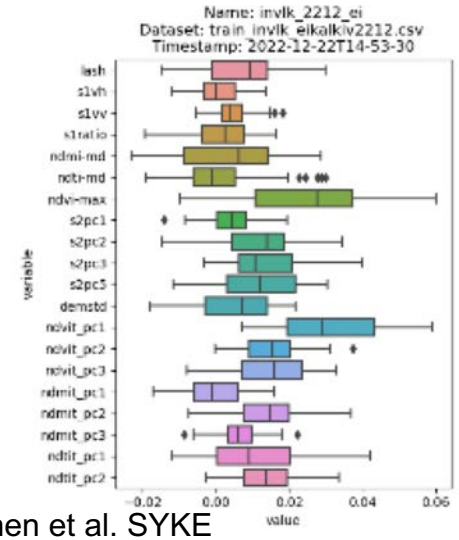


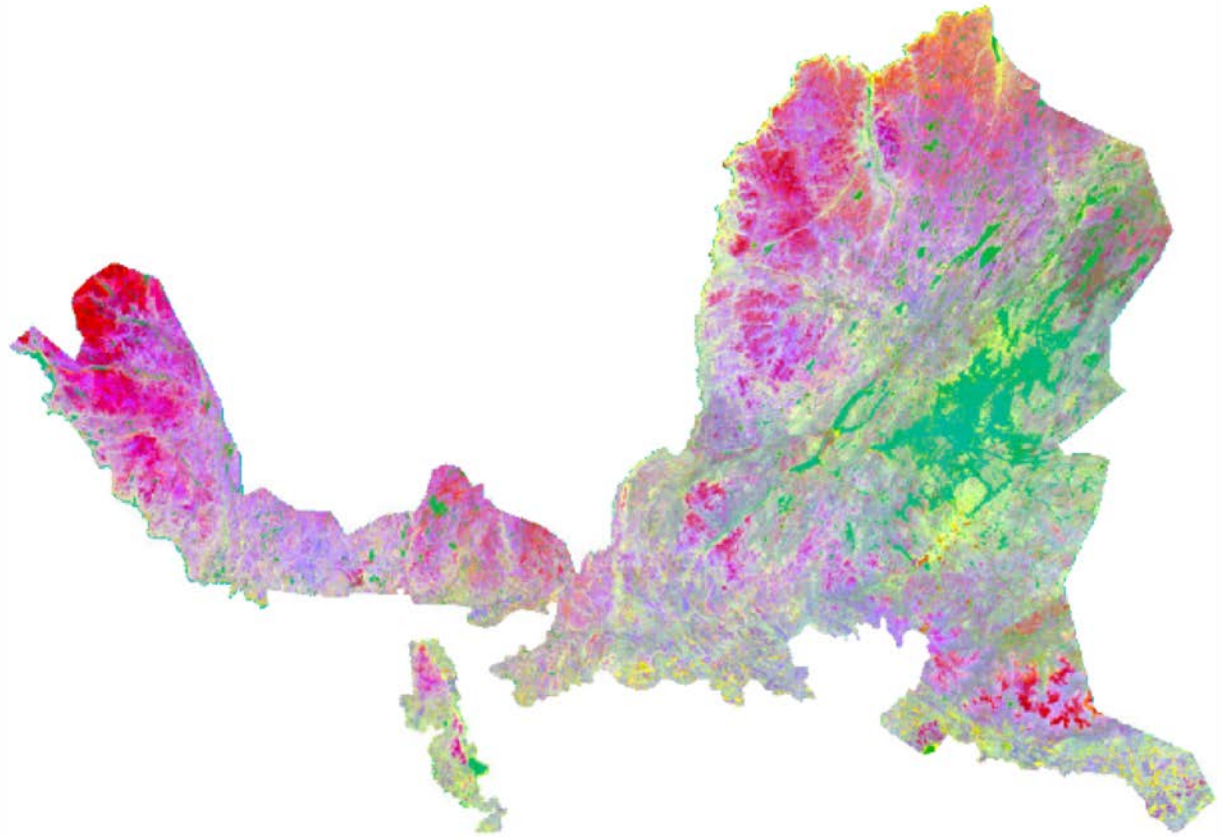
Edited from the slide by Anna Tammilehto, MH

# EO Features used in the classification

Over 20 features, including

- Sentinel 2 NDVI Max (2016-2022)
- Sentinel 2 index time series (2016-2022) NDVI, NDMI, NDTI
- LAS vegetation height and zones
- Sentinel 2 mosaic (July 2021)
- Sentinel 1 mosaic
- …





Credits: Markus Törmä, Pekka Härmä, Mika Heikkinen et al. SYKE

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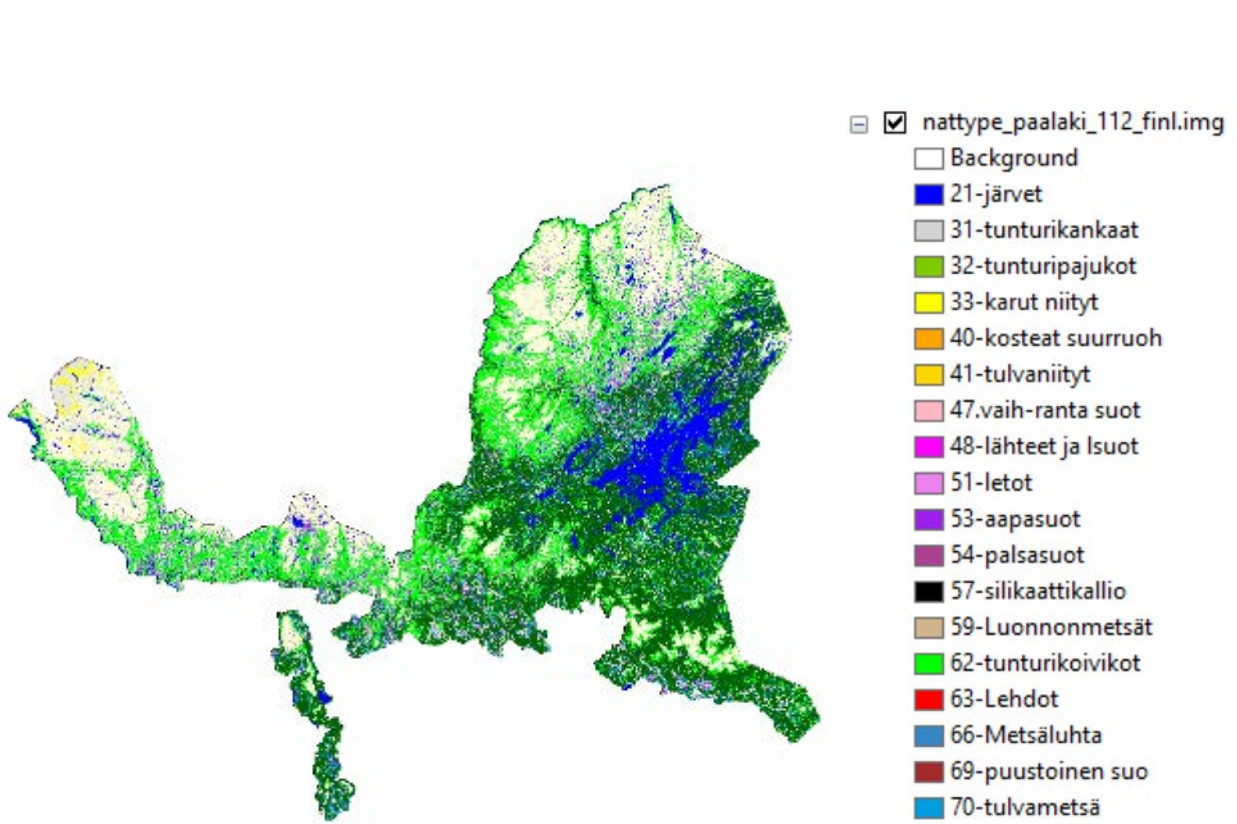
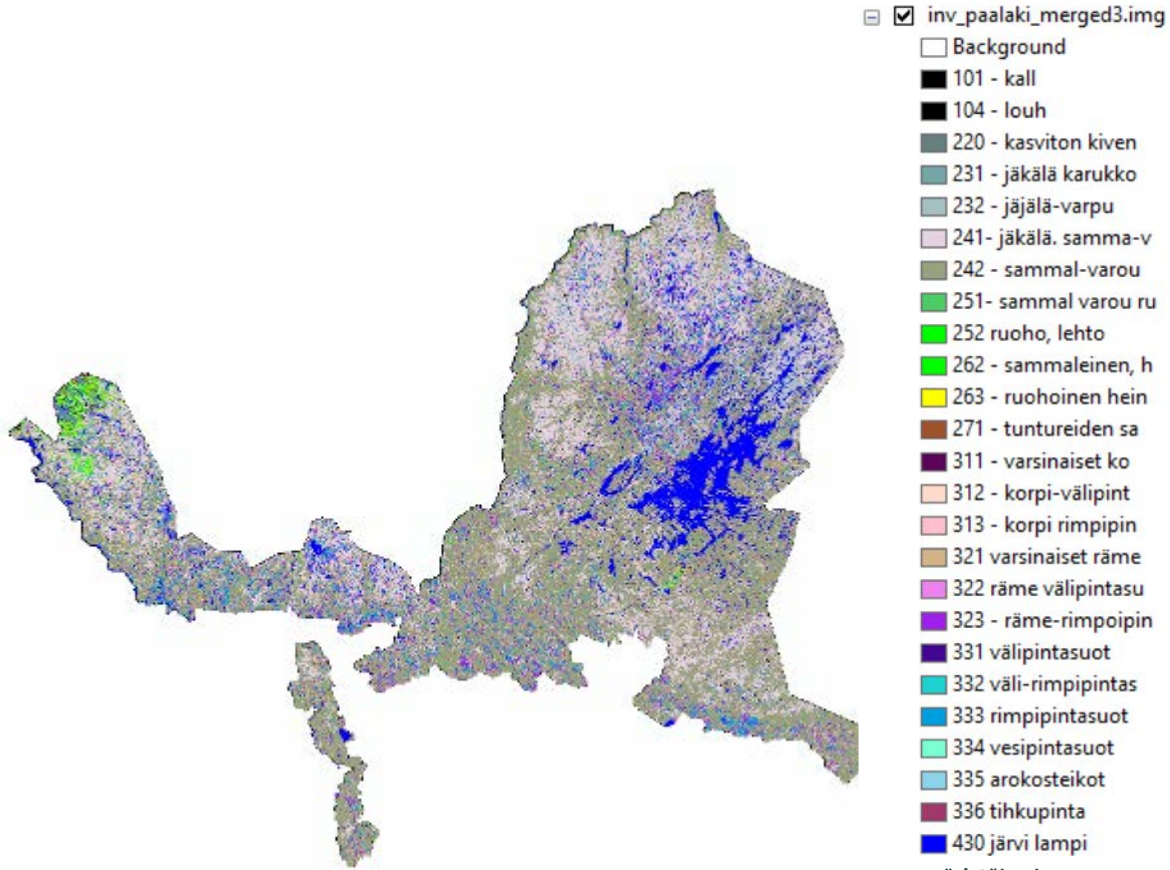
# Northern Finland habitat classification based on ML

Support for the Nature Dir and national habitat assessments

Classification accuracy depends on the target class, accuracy in mineral lands > peatlands, large areal coverage of classification with good accuracy, many ’close’ habitat types challenging

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Credits: Ylä- Lapin kaukokartoitus Pekka Härmä and Mikko Impiö

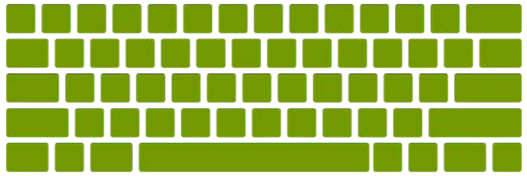
FEO

# Kiitos!

Saku.Anttila@syke.fi

# Any questions?

Helsinki attendees: raise your hand



Zoom attendees: use the chat

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# Instructions for the Breakout groups

By Aino Lipsanen, MoE_FI

**Let’s take a break!**

**We will be back at 15.30am CEST**

**@BiodiversaPlus**

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# Introduction of the breakout group objectives

By the breakout group facilitator

# Objectives of the breakout groups

- Help frame the candidate pilot and get as many Biodiversa+ partners on board

- How to help harmonise methods for evaluating quality in habitats and map habitats through remote sensing?

# Let’s start with

- A round table. Introduce yourself with your name, organisation name and country.

# What is your favourite summer holidays landscape?

# Individual thinking time

- 15min individual thinking. One idea per post-it
- Use the four post-it colours to answer the four questions

For habitat quality indicators: what habitats/habitat groups (annex 1 habitats/habitat groups) should we use as showcases for a habitat quality indicator?

For habitat quality indicators: what method should we use to showcase possible harmonisation and/or refinement of indicators for habitat quality?

For the use of remote sensing techniques for mapping: what habitats/habitat groups (annex 1 habitats/habitat groups) and/or quality parameters do the partners wish to use as showcases?

For the use of remote sensing techniques for mapping: what methods should we use to showcase possible harmonisation and/or refinement of remote sensing techniques?

# 25min Mini group thinking! Gather with 3 or 4 other participants

1. 10min for each question to share your ideas
2. 15min for each question, group your post-its rephrase them **on new post-its**

For habitat quality indicators: **what habitats/habitat groups** (annex 1 habitats/habitat groups) should we use as showcases for a habitat quality indicator?

For habitat quality indicators: **what method** should we use to showcase possible harmonisation and/or refinement of indicators for habitat quality?

For the use of remote sensing techniques for mapping: **what habitats/habitat** groups (annex 1 habitats/habitat groups) and/or quality parameters do the partners wish to use as showcases?

For the use of remote sensing techniques for mapping: **what methods** should we use to showcase possible harmonisation and/or refinement of remote sensing techniques?

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In your mini group, find a volunteer to present your ideas to the other mini groups

# Wrap-up for day 1 and dinner practicalities

By Petteri Vihervaara and Aino Lipsanen, MoE_FI

# Agenda for tomorrow

**Thursday**

9.00 - 9.15: Welcome, plan for the day, and instructions for breakout groups

By Mona Naeslund, SEPA

**Section V - Second breakout group discussions**

9.15 - 10.45: Continued discussions from day 1 and linking Module 1 and 2.

First part of the breakout group discussions: **Focus on module 1, habitat quality indicators, continued discussion from day 1.**

*Are there already available data sets that can be used for the pilot? Further discussion of possible methods, analysis and fieldwork. How can we link Module 1 and 2? Next steps, suggest needs for further discussion*

Second part of the breakout group discussions: **Focus on module 2, exploring the use of remote sensing techniques for mapping and support to evaluate the quality of habitats. Continued discussion from day 1.**

*Are there already available data sets that can be used for the pilot? Further discussion of possible methods, analysis and fieldwork. How can we link Module 1 and 2? Next steps, suggest needs for further discussion*

**Section VI - Plenary session and conclusion**

10.45 - 11.15: Summary from breakout groups, By the 4 breakout-group rapporteurs

11.30 - 12.00: Conclusion of the workshop and next steps, By Petteri Vihervaara, MoE_FI and Mona Naeslund, SEPA

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# Thank you!

**See you tomorrow!**

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communication@biodiversa.eu

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# Biodiversa+ workshop of the candidate biodiversity monitoring pilot “Habitat quality and mapping”

24-25 May 2023
Helsinki, Finland

**DAY 2**: from 9.00am to 12pm EET

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# Welcome words and detailed summary of the first day discussions

By Mona Naeslund, SEPA

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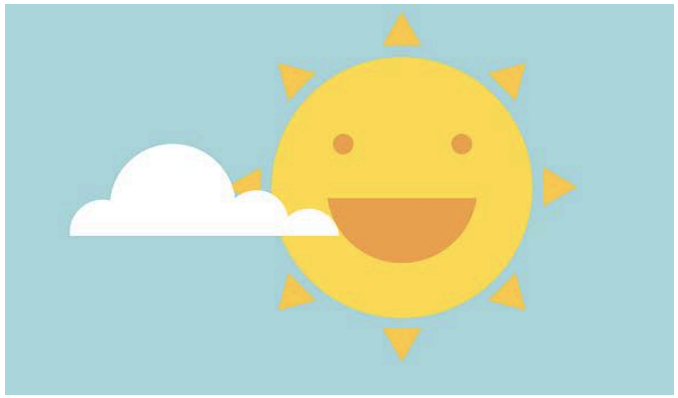
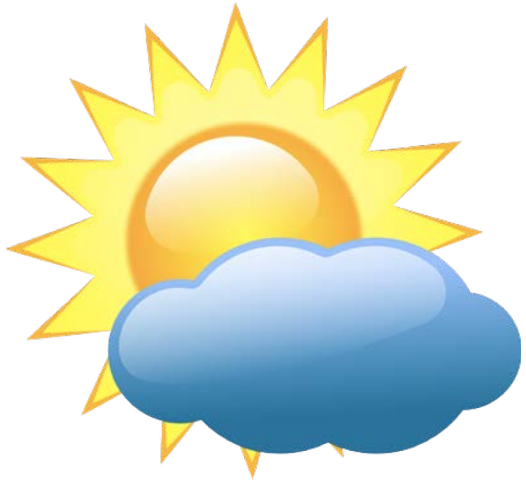
# Breakout group discussions

By the breakout facilitators

# How do you come to the workshop this morning?





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# Objectives of the breakout group

By the facilitator

# Objectives

- **Objective of the 2 days workshops**: How to help harmonise methods for evaluating quality in habitats and map habitats through remote sensing?

- **Our objective now**: For each habitat type identified yesterday, collaborative work to come up with ideas of ways to feed the candidate pilot workplan. For eg. are there already available data sets that can be used for the pilot? Deeper discussion on possible methods, analysis and fieldwork, what should be our next steps and how to link habitat quality indicator and habitat mapping through remote sensing?

# 15min individual thinking time

## Questions: for habitat quality indicators, focussing on the habitat types selected yesterday:

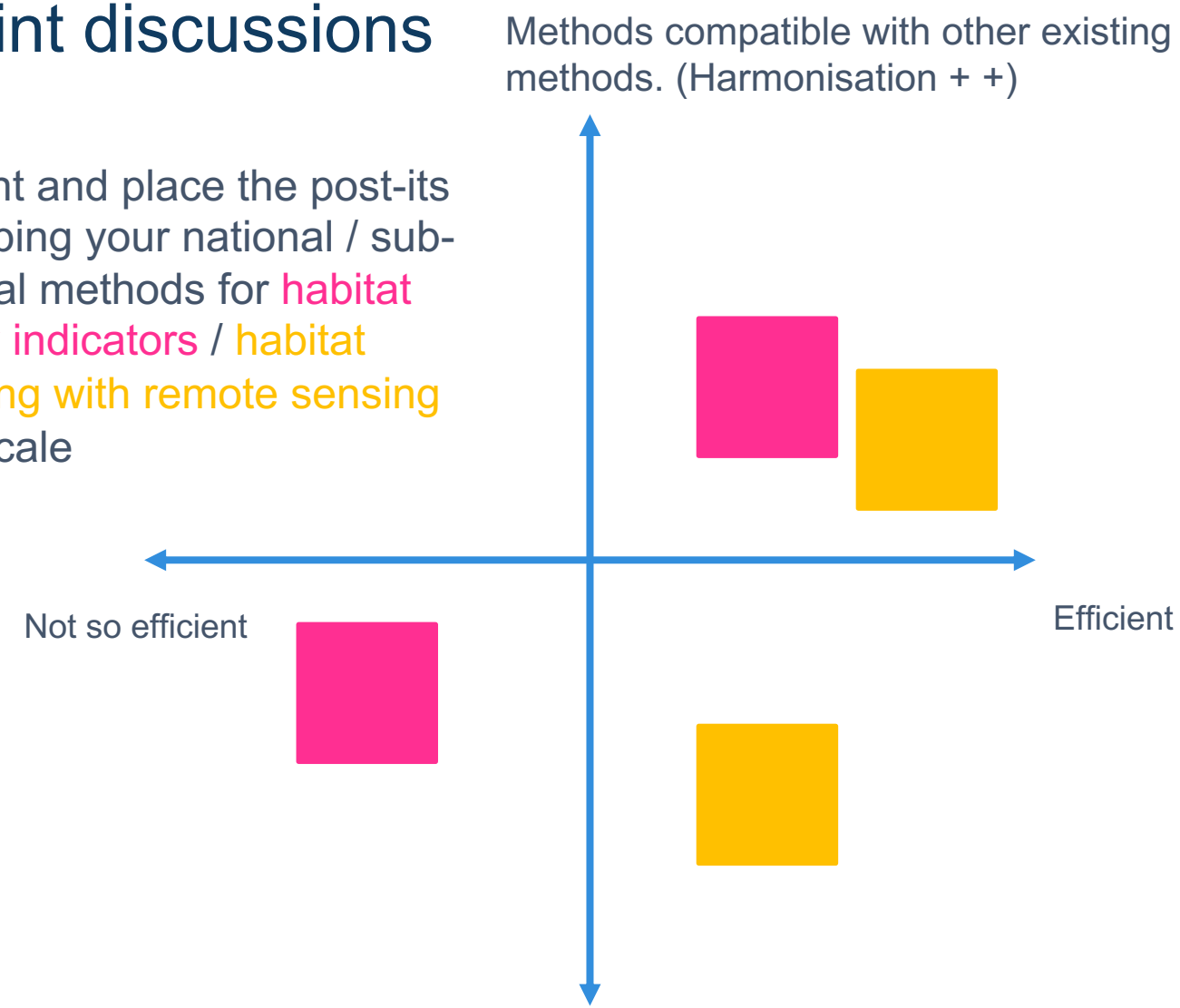
- Do you know if there are already available data sets that can be used for the pilot in your country of sub-region?
- For habitat mapping with remote sensing: Do you know if there are already available data sets that can be used for the pilot in your country or sub-region?
- Do you know what methods are used in your country or sub-region to produce habitat quality indicators?
- For habitat mapping with remote sensing: Do you know what methods are used in your country or sub-region to produce habitat quality indicators? You can also mention the methods mentioned yesterday

# 30min round table and joint discussions

Present post-its on availability of data sets for habitat quality indicators and habitat mapping with remote sensing

Add your country name in the post-its

Present and place the post-its describing your national / sub-national methods for habitat quality indicators / habitat mapping with remote sensing on a scale

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# Summary from the break-out groups

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# Conclusion of the workshop and next steps

*By Petteri Vihervaara, MoE_FI and Mona Naeslund, SEPA*

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# Thank you!

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