Build and use a data foundation for EU extent accounts

Pavel Milenov & Jan-Erik Petersen, EEA
with support from ETC DI

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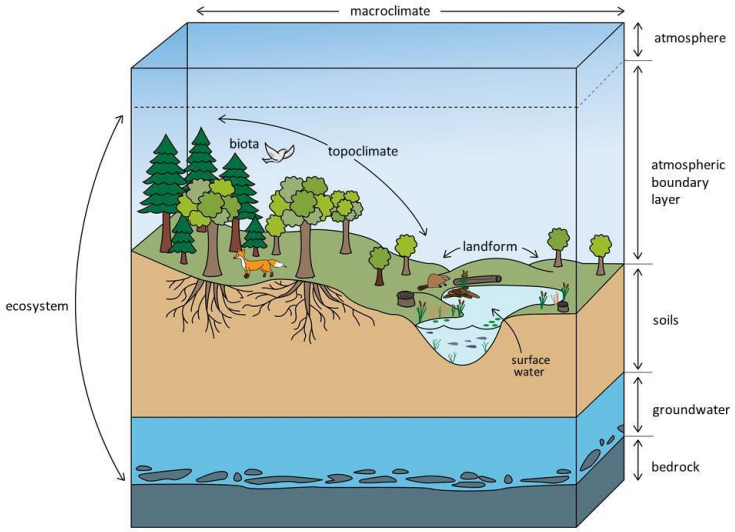
European Environment Agency

Framing the presentation

- Major technical challenges to operationalize ecosystem extent accounts for SEEA EA implementation
- Relevance of Earth Observation for ecosystem extent accounts
- Major issues to integrate Earth Observation data to operationalize ecosystem extent accounts
  - Do we have the right data?

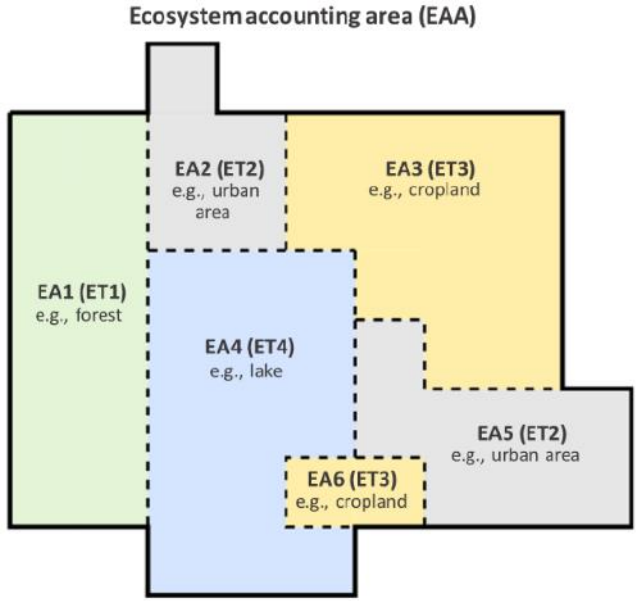
#1 Representation of complex reality in GIS

Reality (3D)



Source: Adapted from Bailey et al. (1996).

Representation (2D)



- **Ecosystem** is "a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit"
- **Ecosystem condition** is the quality of an ecosystem measured in terms of its abiotic and biotic characteristics.

- **Ecosystem assets (EAs)** are contiguous spaces of a specific ecosystem type characterized by a distinct set of biotic and abiotic components and their interactions
- **Ecosystem extent** is the size of an ecosystem asset.
- **Ecosystem condition variables** are quantitative metrics describing individual characteristics of an ecosystem asset

United Nations et al. (2021). System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA EA). White cover publication, pre-edited text subject to official editing. Available at: https://seea.un.org/ecosystem-accounting.

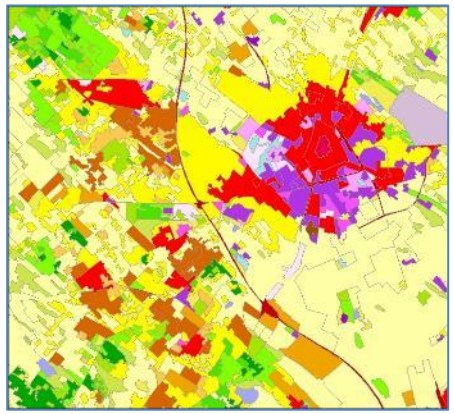
#2 Different user-driven product specifications

Spatial planning and analysis

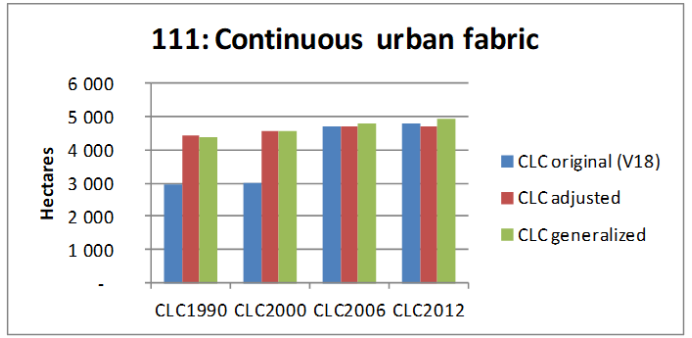
Ecosystem extent

Statistics and reporting

spatial outline, thematic detail, topology consistence

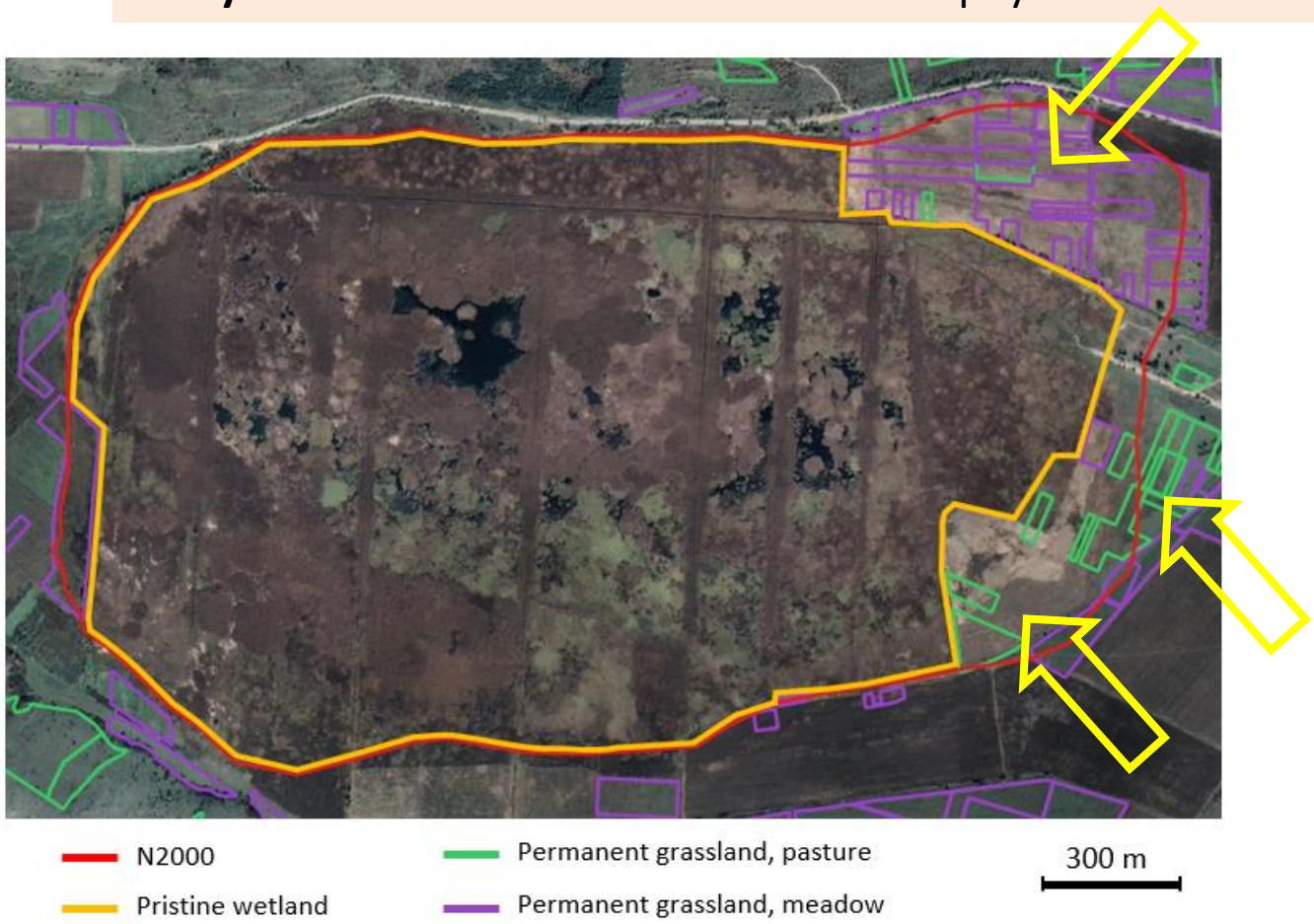


Temporal consistency, comparability in space and time

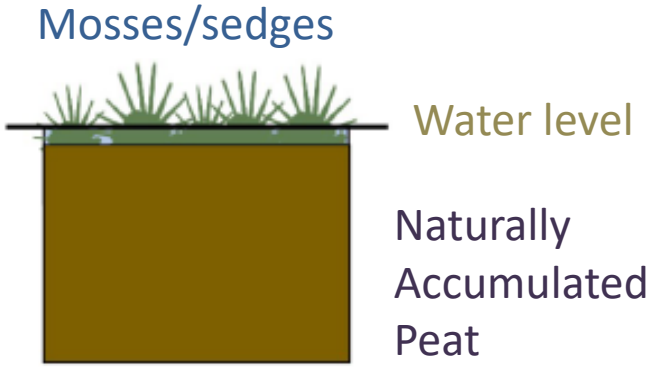


#3 Trade-off between change of ecosystem type and ecosystem condition

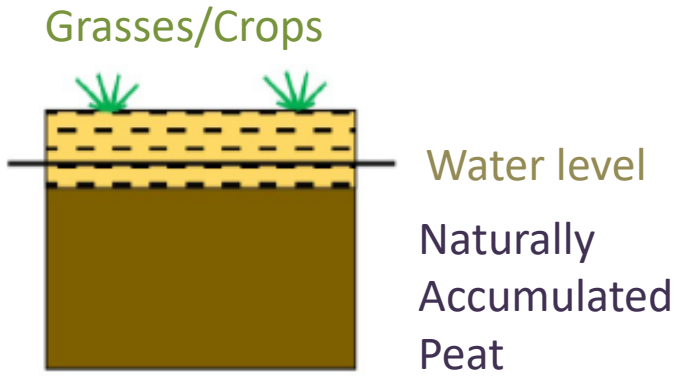
Change of ecosystem type -> 7.2 Mires, bogs and fens to 3.1 Sown pastures and other grass
OR
Ecosystem condition variable -> related to physical state



Natural Peatland



Managed Peatland



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#4 Influence of local-specific non-living environment

Same habitat type can be subject of **different local specifications**
(Example of 54.5 *Transition mires and quaking bogs*)

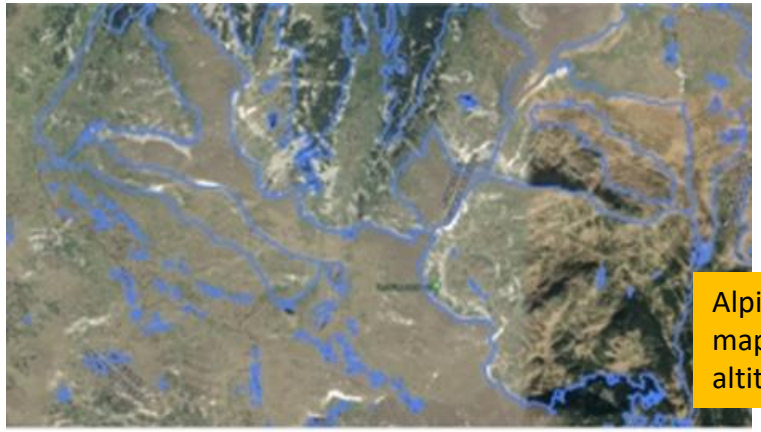
Landform	Mountain
	Hill
	Plateau
	Plain
Topography	Altitude
	Slope
Geography	Inland
	Coastal
Climate	Boreal
	Cold temperate dry
	Cold temperate wet
	Warm temperate dry
	Warm temperate moist
	Mediterranean

N2000 class 7140 - Latvia

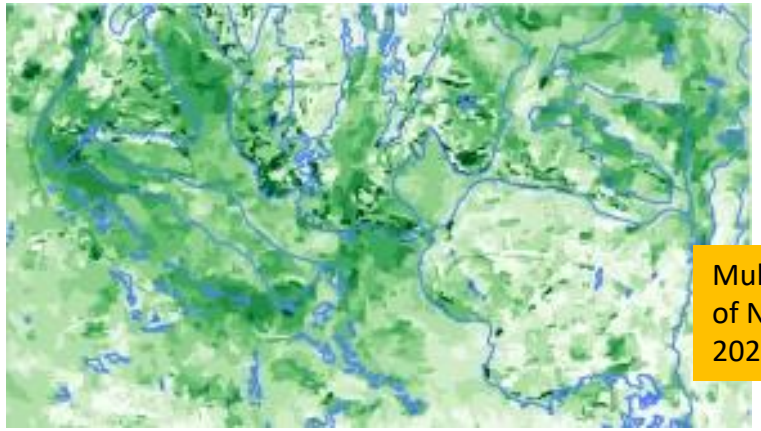
Landform	Mountain	
	Hill	
	Plateau	
	Plain	
Topography	Altitude	>1500
	Slope	>10%
Geography	Inland	
	Coastal	
Climate	Boreal	
	Cold temperate dry	
	Cold temperate wet	
	Warm temperate dry	
	Warm temperate moist	
	Mediterranean	

N2000 class 7140 - Bulgaria

Extent of some habitats cannot be **depicted with EO**
(Example of 37.31 *Molinia meadows on chalk and clay*)



Alpine peatlands in Bulgaria, mapped in blue (>2500m altitude)



Multitemporal segmentation of NDWI S2 observations in 2021

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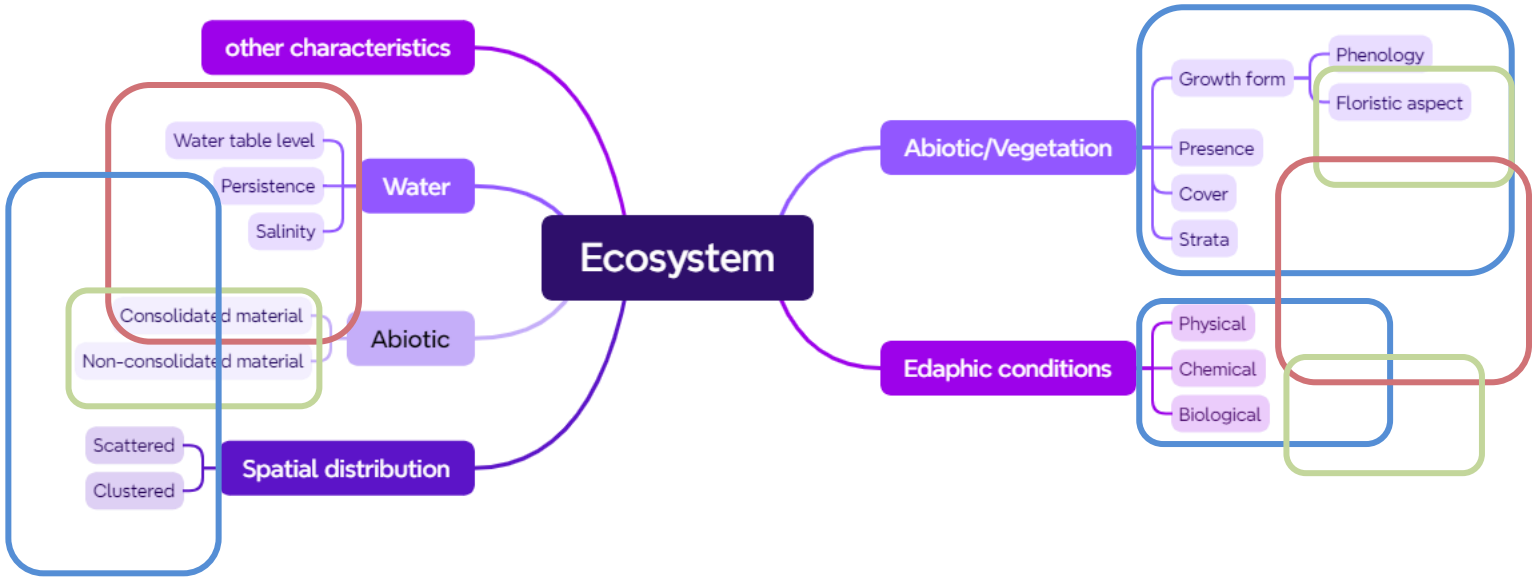
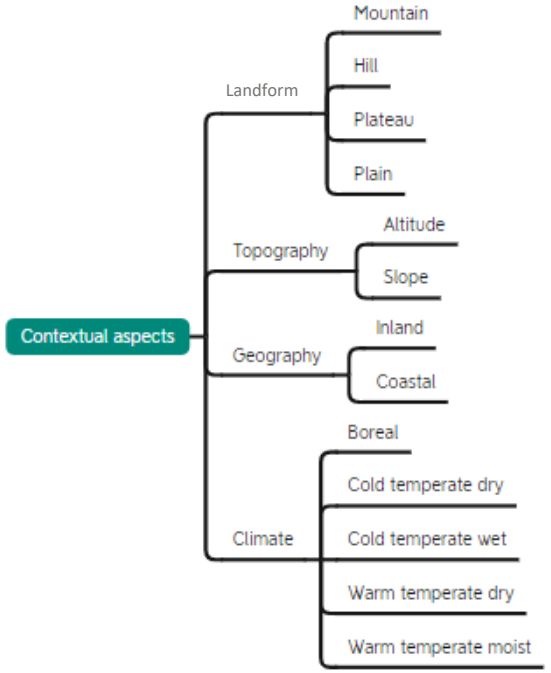
Role of EO data in ecosystem/habitat assessment and mapping

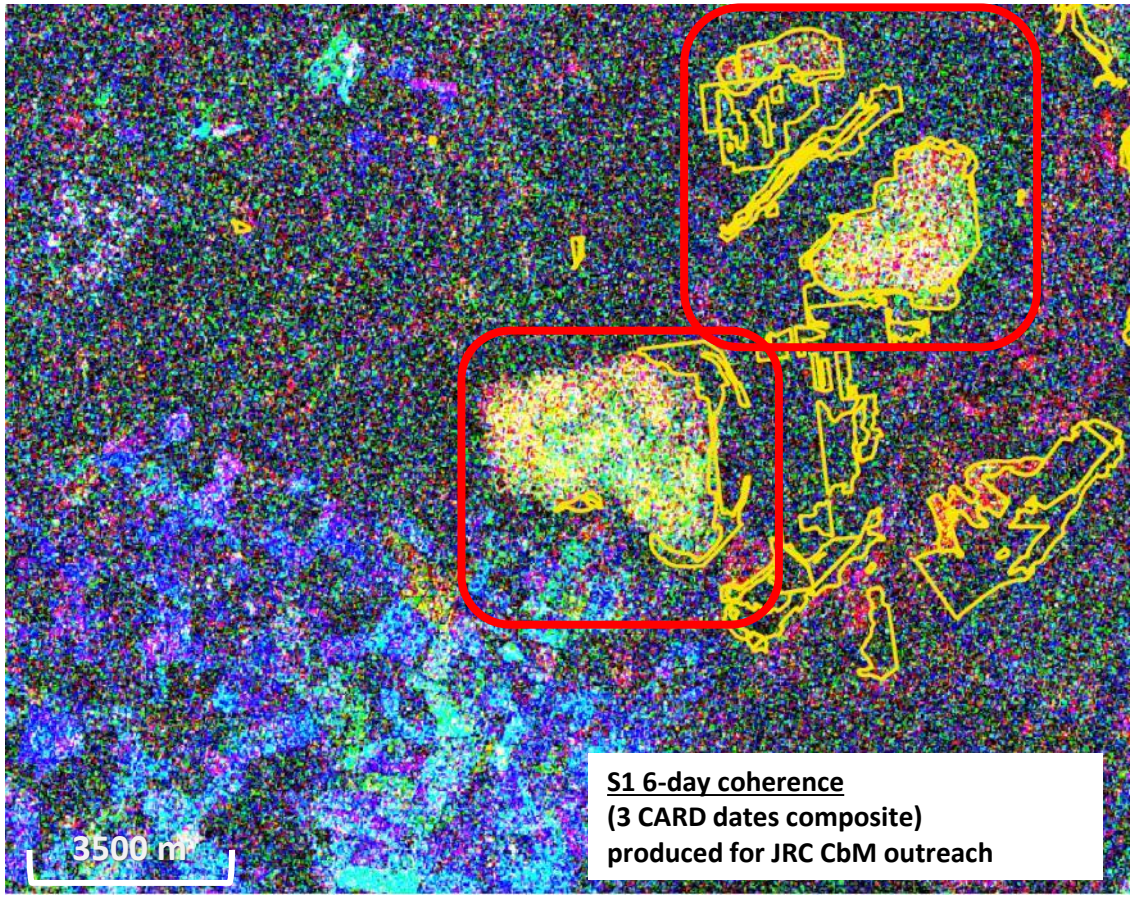




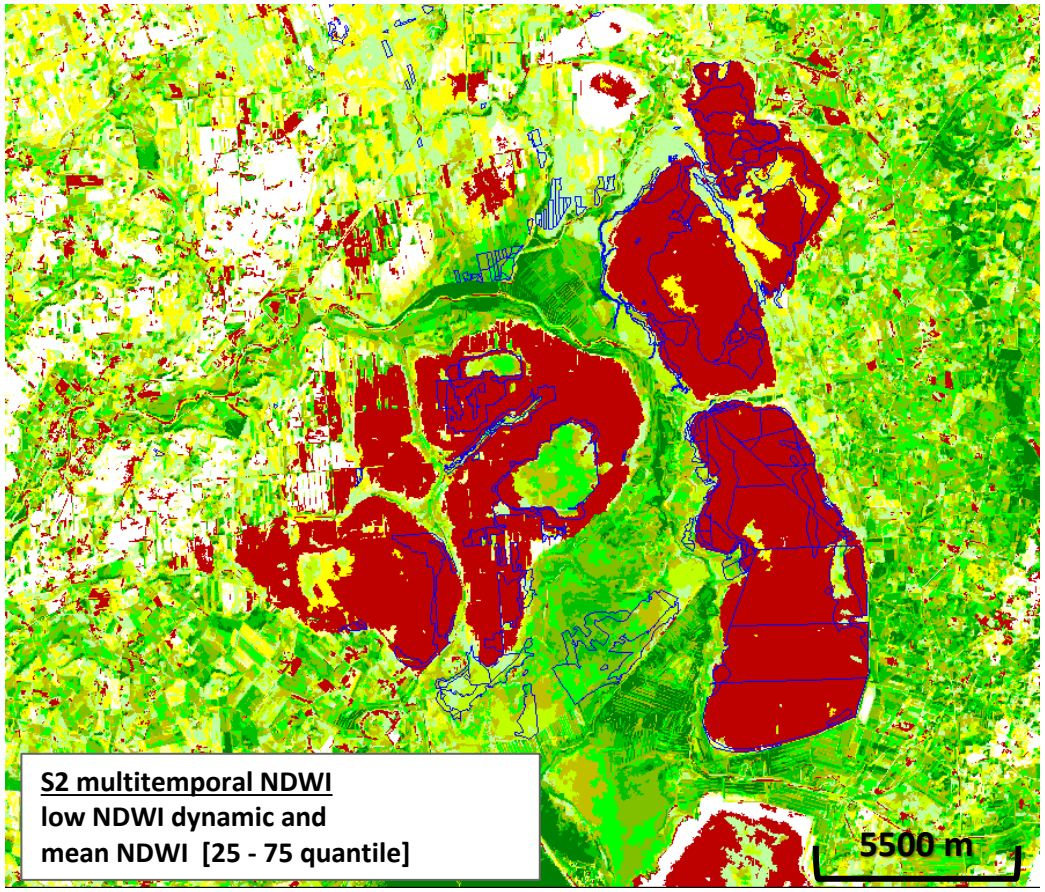
EO sensors

- Optical - Multispectral
- Optical - Hyperspectral
- SAR

Role of EO data in ecosystem extent mapping: example with peatland



S1 6-day coherence
(3 CARD dates composite)
produced for JRC CbM outreach

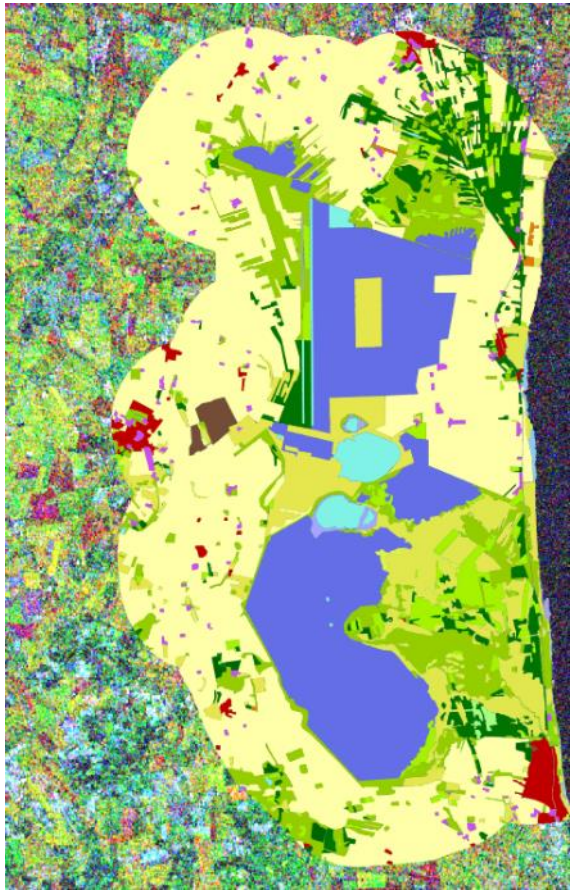


S2 multitemporal NDWI
low NDWI dynamic and
mean NDWI [25 - 75 quantile]

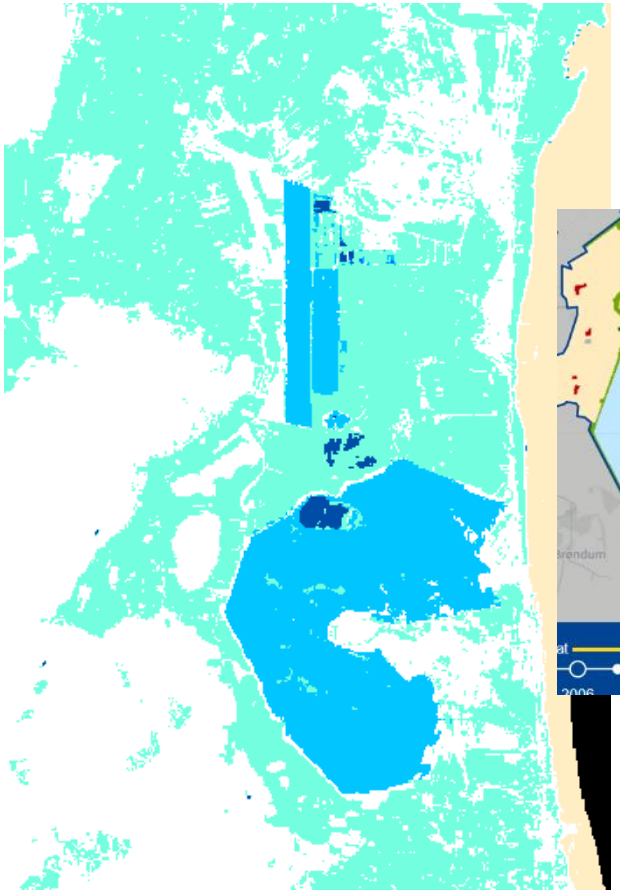
Complementary role of Copernicus LMS and EU Projects

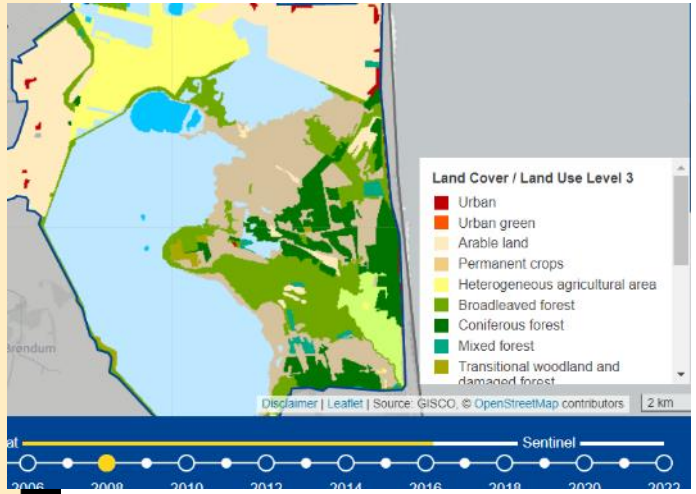
S1 coherence 2021
(3 CARD dates composite)

Copernicus CLMS
N2K 2018



Copernicus CLMS
Water & Wetness 2018





EU Grassland Watch
(prototype)

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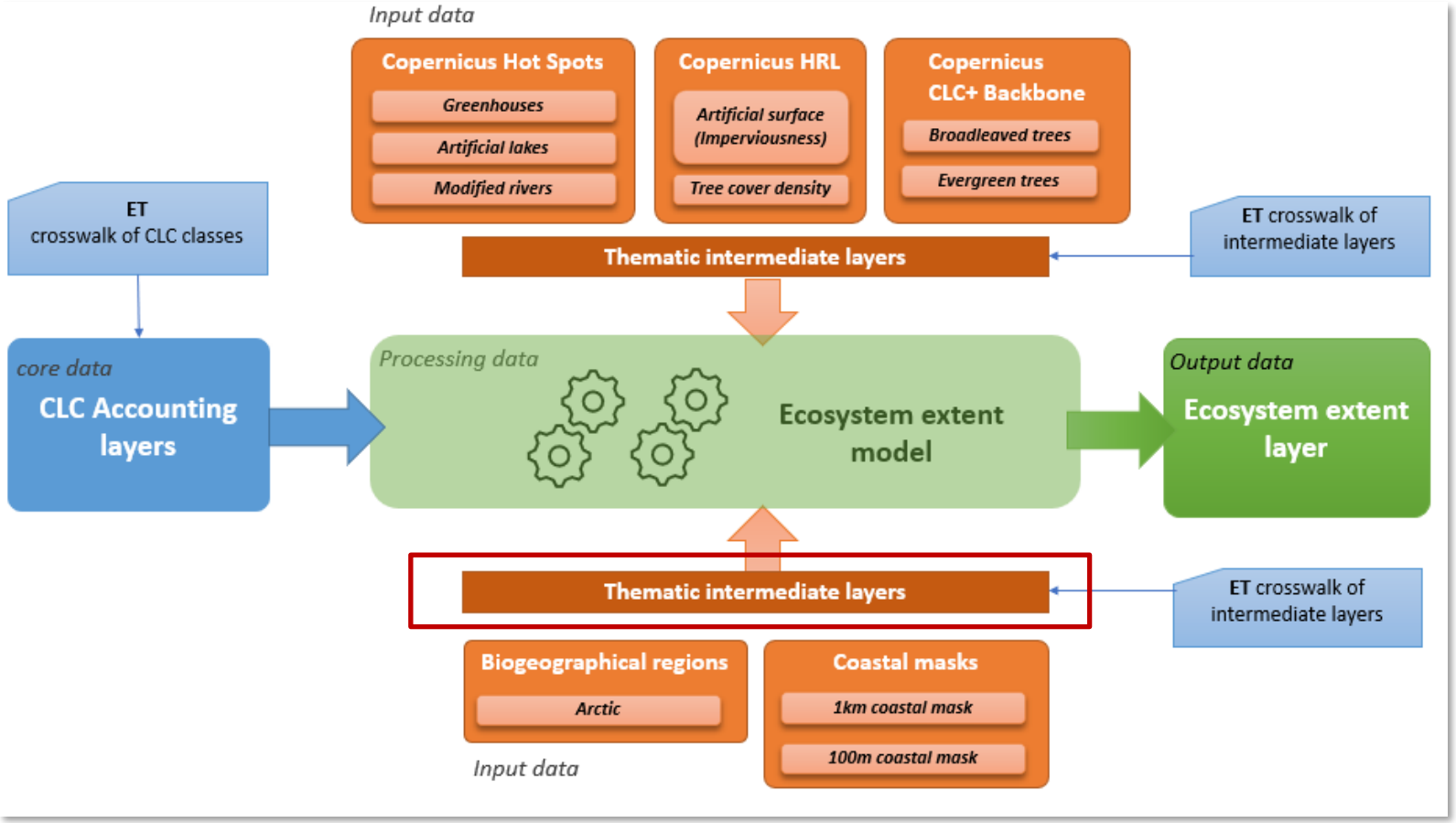
CARD produced for JRC CbM outreach project

CLMS - Copernicus Land Monitoring Services

EEA support for ecosystem extent accounts



Proposed dataflow to generate Level 2 ecosystem extent accounting datasets (layers)

	good match
	small inconsistency
	not sufficient information

2. Cropland		
2.1 Annual cropland	Partial match or mixed information	CLC 2.1.1 + 2.1.2 (+ part of 2.4.1)
2.2 Rice fields	Full match	CLC 2.1.3
2.3 Permanent crops	Partial match or mixed information	CLC 2.2.1 + 2.2.2 + 2.2.3 (+ part of 2.4.1)
2.4 Agro-forestry areas	Full match	CLC 2.4.4
2.5 Mixed farmland	Partial match or mixed information	CLC 2.4.2 +2.4.3 (+ part of 2.4.1)
2.6 Other farmland	no input / mixed info	Likely included in ET 2.1, 2.3, 4.2

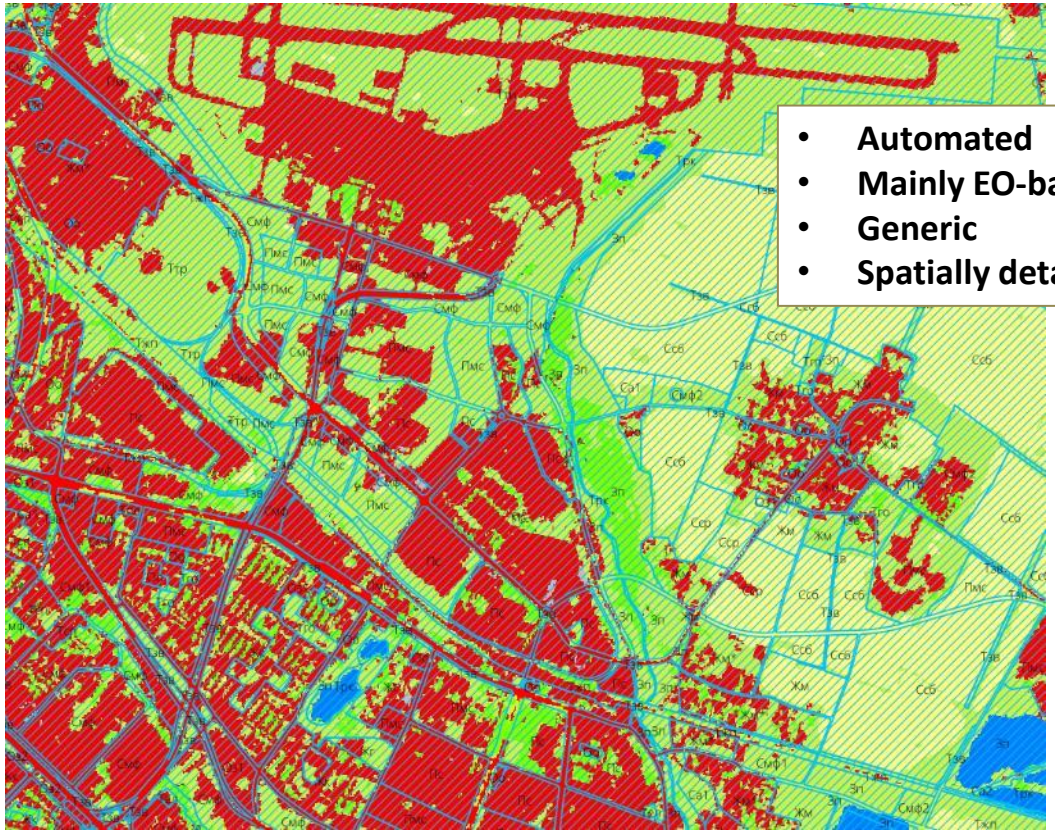
Feasibility of representing ET Level 2 with CLC alone

A		B	
Tree cover density	ET	Tree cover density	ET
<50%	2.1 Annual croplands	<30%	2.1 Annual croplands
>50%	2.3 Permanent crops	30<70%	2.5 Mixed farmland
		>70%	2.3 Permanent crops

Specific technical solutions with CLMS products related to single bio-physical variables (ex. TCD)

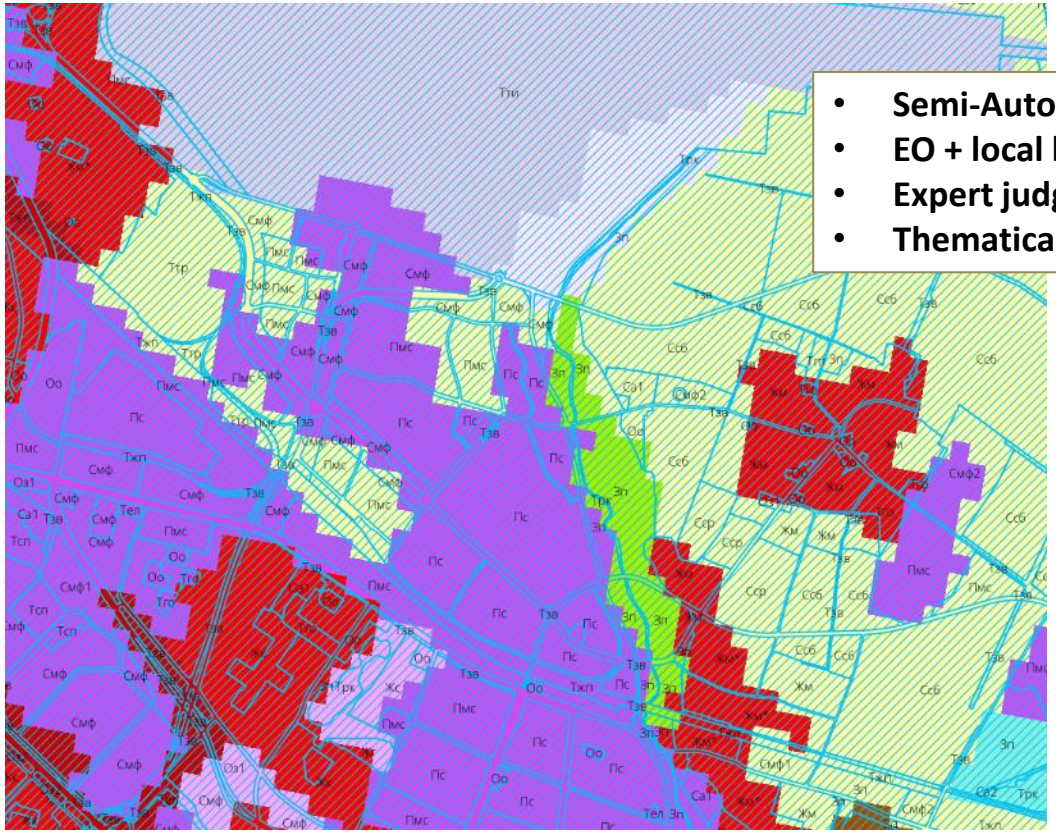
Challenges with the “mapping” of ecosystem extent with EO data

CLC+BB product - provides the predominant bio-physical characteristic for each pixel -> more related to the **concept of condition variable**



- **Automated**
- **Mainly EO-based**
- **Generic**
- **Spatially detailed**

CLC accounting product - provides the rasterized spatial extent of contiguous spaces -> more related to the **concept of ecosystem extent**



- **Semi-Automated**
- **EO + local knowledge**
- **Expert judgement**
- **Thematically detailed**

Functional zones in (peri) urban areas, each with its specific type of prescribed land use, according to the City Master Plan typology

https://sofiaplan.bg/portfolio/oup-sofia/

In-situ data as a source for local knowledge

Data available in Member State XYZ

Semantic assessment

Optimal data integration and processing flow

Interpreted (Thematic) data

- Habitat / vegetation maps
- Land cover/land use
- Ecosystem maps (MAES)
- IACS/LPIS
- Buildings
- Forest
- N2K
- CLC

Measurement (modelled continuous) data

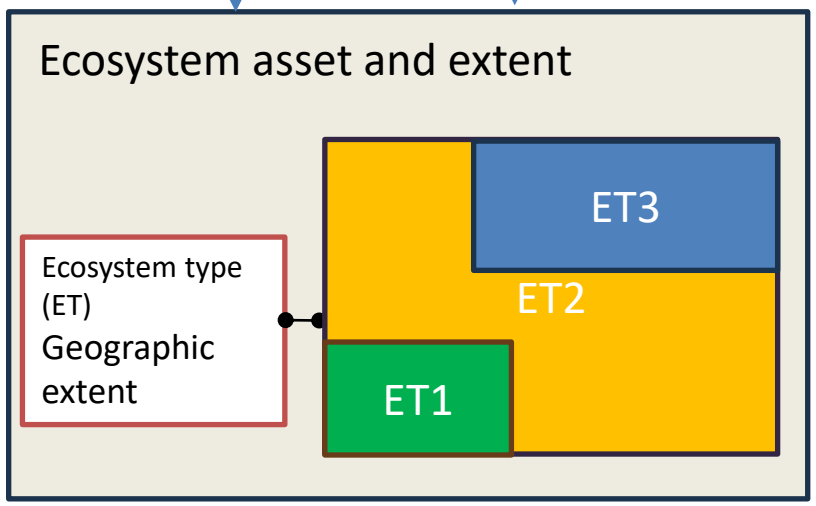
- Soil moisture/texture
- Canopy Water Content
- SOC
- DEM
- Orthophoto (optical)
- Canopy height
- Ground water
- Soil Acidity

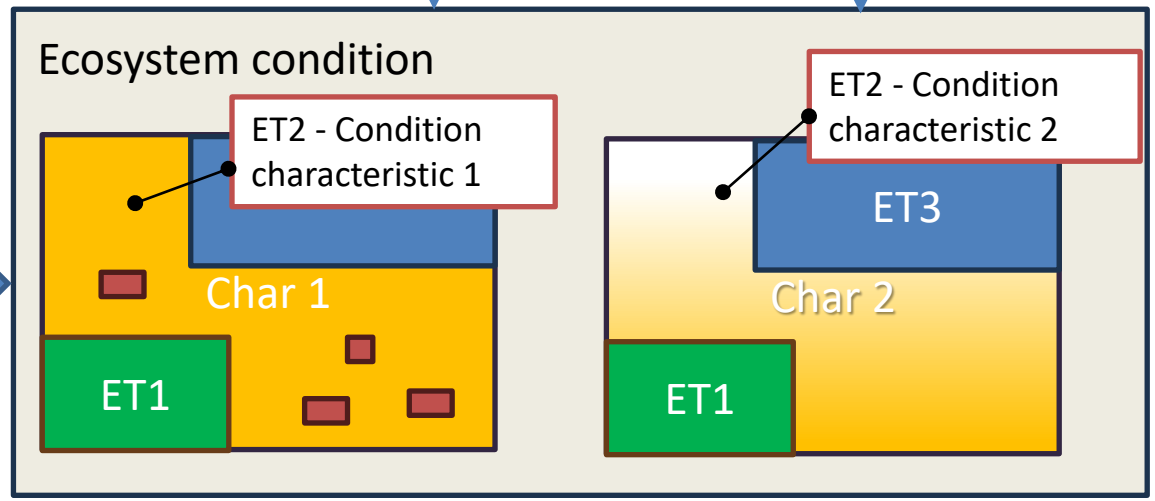
Outline

Threshold

Threshold

Statistic

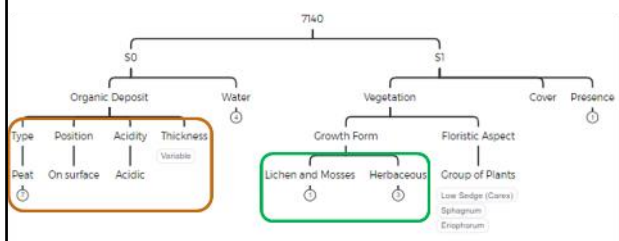




Linking in-situ with EO

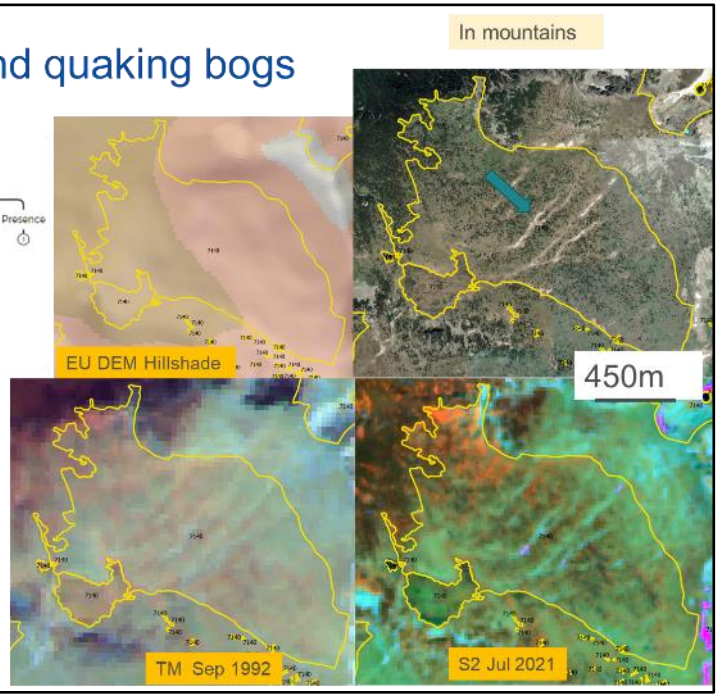
Common template for information exchange with local experts: Example with national habitat data from JRC SEPLA project

7140 Transition mires and quaking bogs

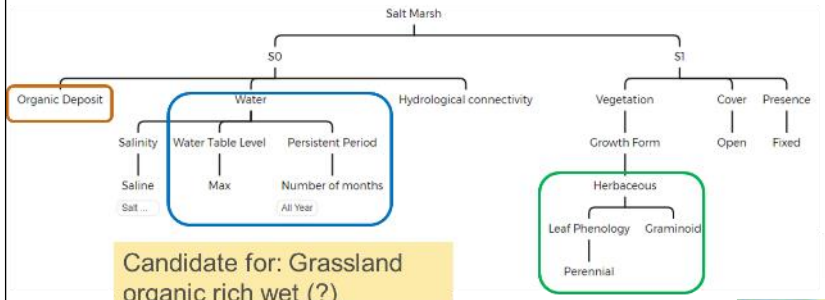


Characteristic	Status
Peat conditions	Present
Water	Present (seasonal)
Vegetation	Present – Stratum 1 grass, moss
Agricultural Use	Extensive grazing

Candidate for: Organic Wet

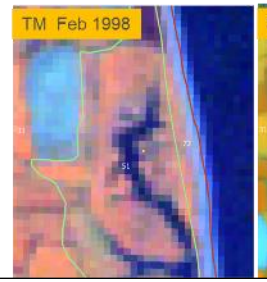


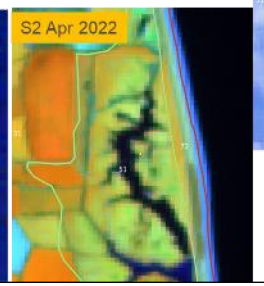
Salt Marsh



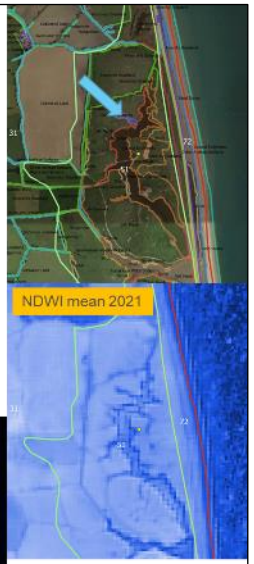
Candidate for: Grassland organic rich wet (?)

Characteristic	Status
Organic **soil**	Present
Water	Present
Vegetation	Present – Stratum 1, perm grass, open
Use	Available for grazing





350m



<u>Questions to answer:</u>

Do we have the right in-situ data for the given characteristic? Is it complete? Which is the associate EO signal? Does it allow for historic analysis? Is it enough spatially disaggregated? Where data enters the workflow?

Summary points (technical)

- Mapping of ecosystem extent is complex and challenging task
  - EO data is essential, but its full upscale requires **tailored methods**
  - These methods require **ecosystem-ready EO and in-situ data**
  - In-situ can often provide the **candidate for ecosystem extent outline**
- In-situ data needs
  - Careful inventory, collection, **compilation and translation**
  - Setting up of standards and tools for **data interoperability**
  - **Gaps to be fill in**!
  - To be **abundant enough** to allow training of AI solution

Summary points (organizational)

- Operational framework should
  - **Break down** issues into **manageable components** individually tested, and
  - **Prioritize** their processing according to **user information needs**
- Operational implementation requires
  - Long-term **strategy and coordination** at EU and national levels
  - **Adequate resources** (human, financial)
  - Engagement of **different actors**
  - **Diverse** community of practice
- Research and support activities can
  - ensure a level of **standardization and validation** of EO components
  - help shoulder **development costs**

Thank you for your attention!

Pavel.Milenov@eea.europa.eu