

Organic soils within the EU regulatory framework and climate related policies: current status and scientific challenges

Emanuele Lugato

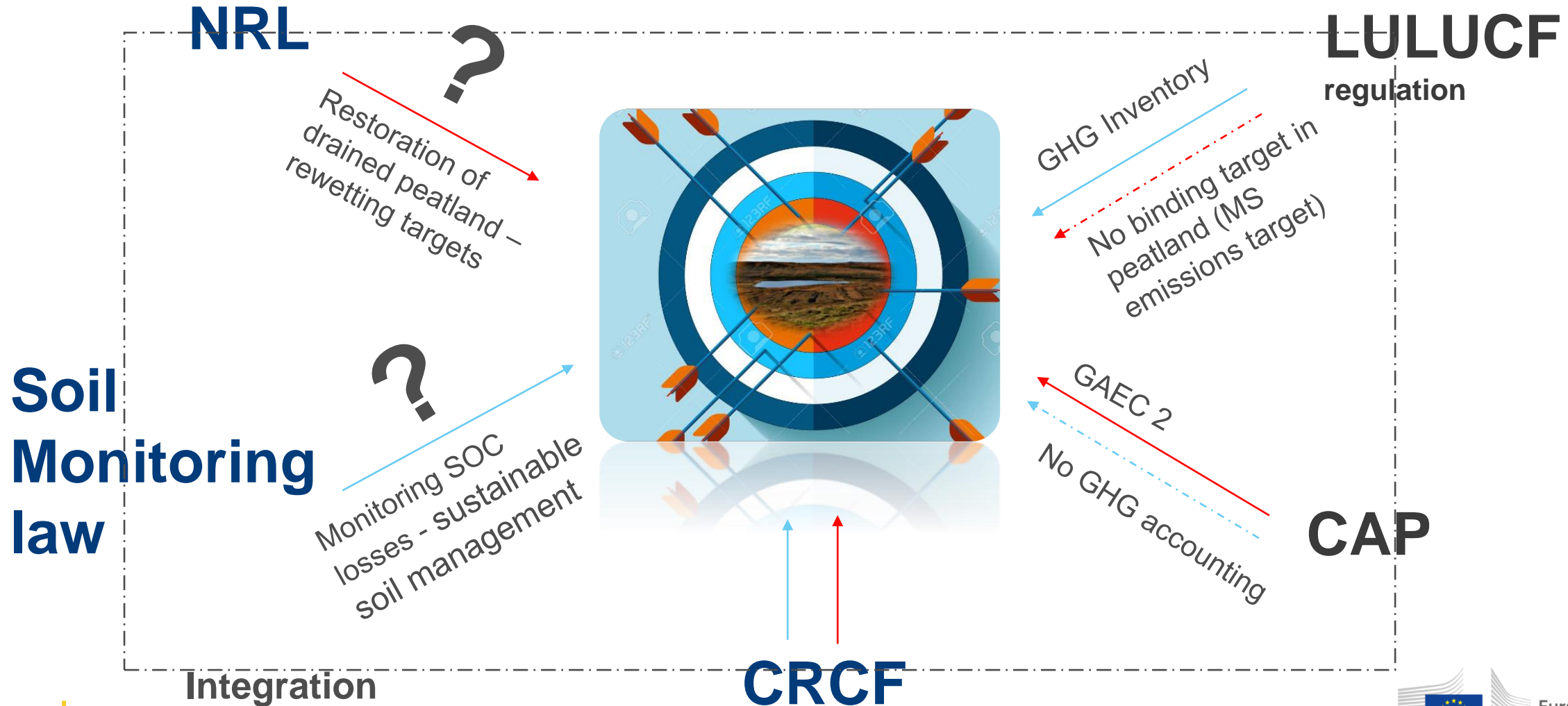
JRC - Unit D.5

Sustainable Resources Directorate



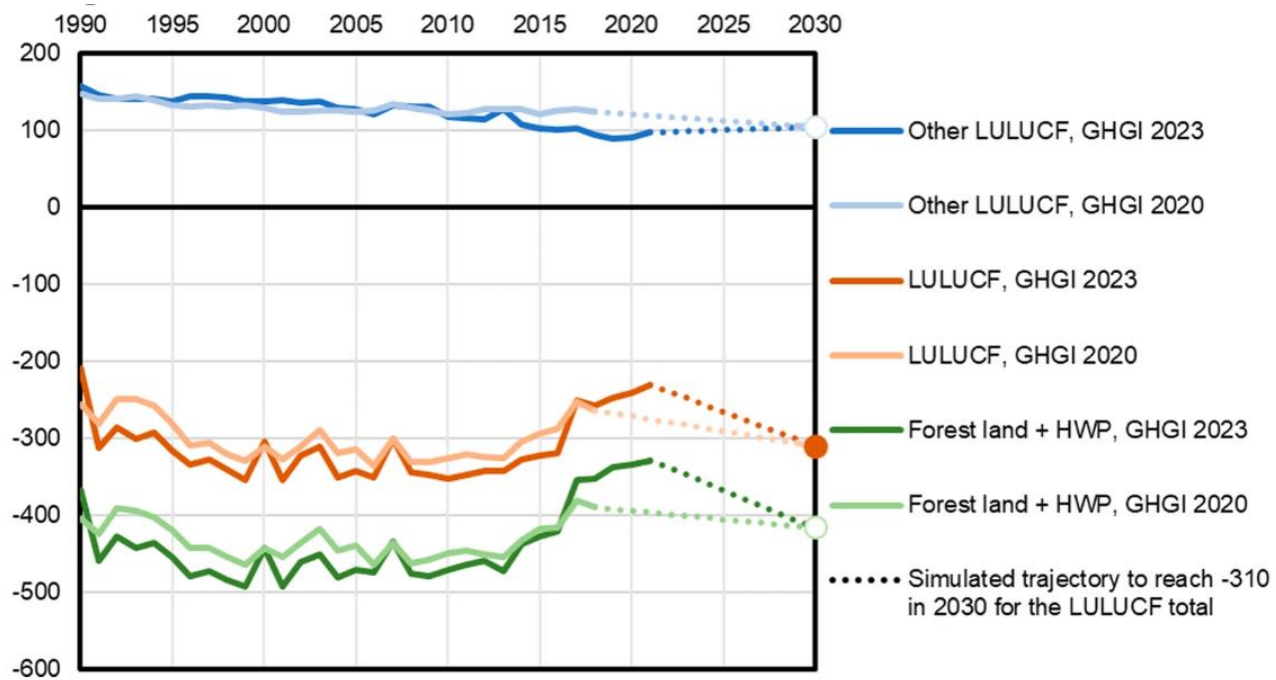
June 13-14, 2024. Latvia

Peatlands are targets of many EU policies



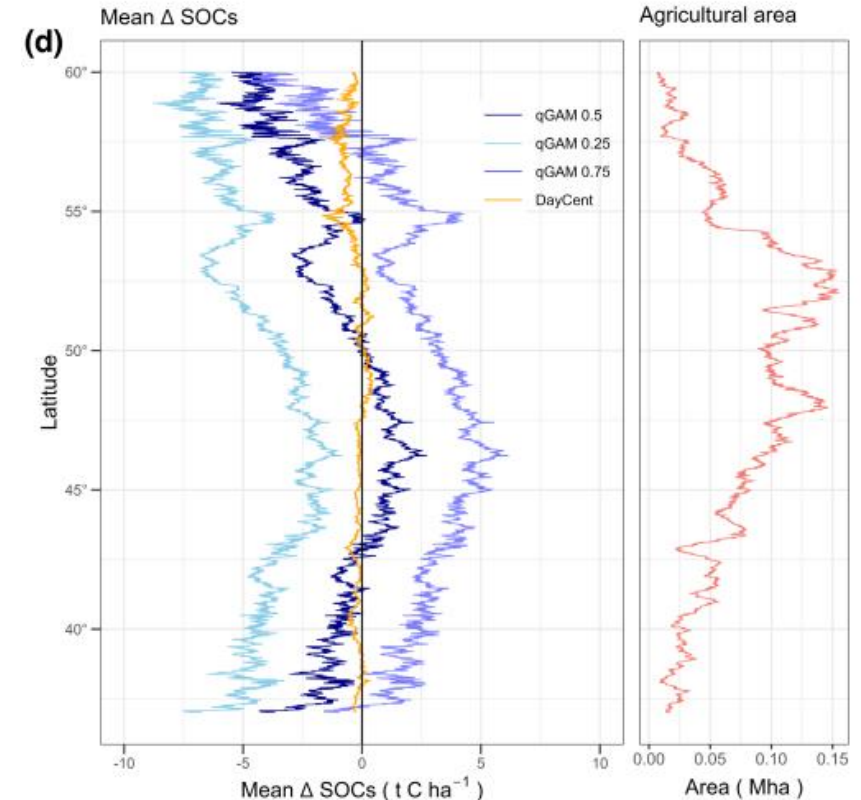
Pathway to climate neutrality

Trends of EU-27 net emissions and removals for LULUCF



Korosuo, A., Pilli, R., Abad Viñas, R. et al. The role of forests in the EU climate policy: are we on the right track?. Carbon Balance Manage 18, 15 (2023).

SOC losses in mineral soils 2018-09
= 9 - 28 Mt CO₂eq per year



De Rosa, D., Ballabio, C., Lugato, E., Fasiolo, M., Jones, A., Panagos, P. (2024). Soil organic carbon stocks in European croplands and grasslands: How much have we lost in the past decade? Global Change Biology, 30, e16992.

Organic soils: a key “special” issue

EU emissions from organic soils

17 Mha -> 95 Mt CO₂




60% area correction
40% EF



>160 Mt CO₂e

ORGANIC SOILS IN NATIONAL
INVENTORY SUBMISSIONS
OF EU COUNTRIES

Martin, N. & Couwenberg, J.

	Land use subcategory	Area (Kha)	ICECF (tC/ha)	Emissions from Org. Soils. (Kt CO ₂)
	4A1	12 264	[-2.60; 0.65]	13 631
	4A2	407		1 494
	4B1	1 242	[-10.01; -1.00]	25 813
	4B2	273		5 814
	4C1	4 132	[-6.80; 0.25]	42 150
	4C2	354		5 683

85%

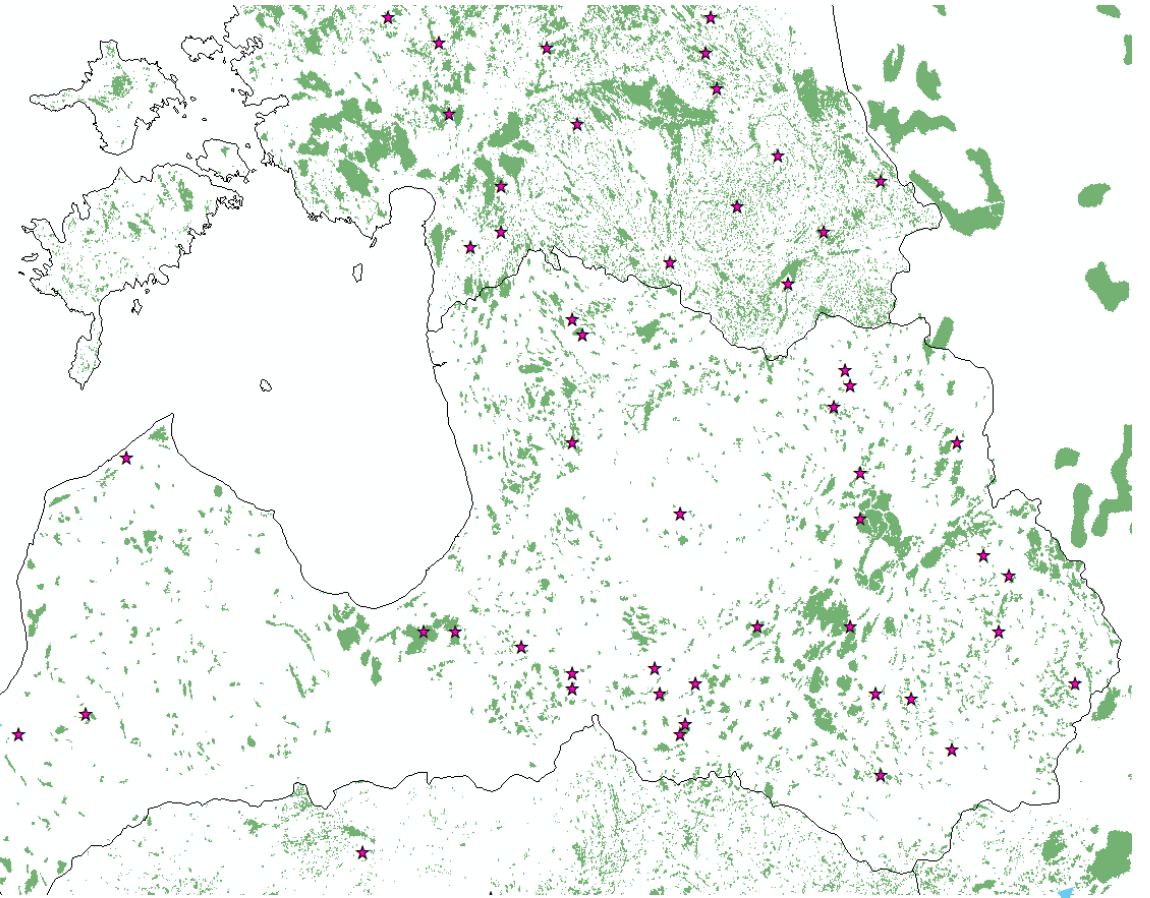
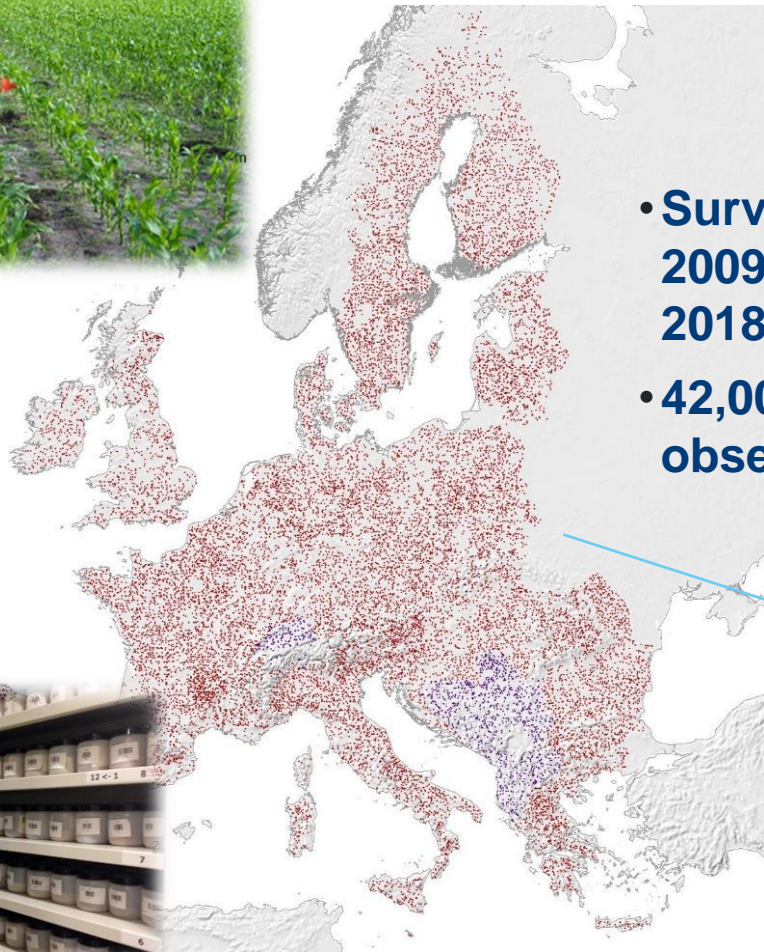
Annual European Union greenhouse gas inventory 1990–2018 and inventory report 2020

Large uncertainty EF

Moving from pan EU to local data



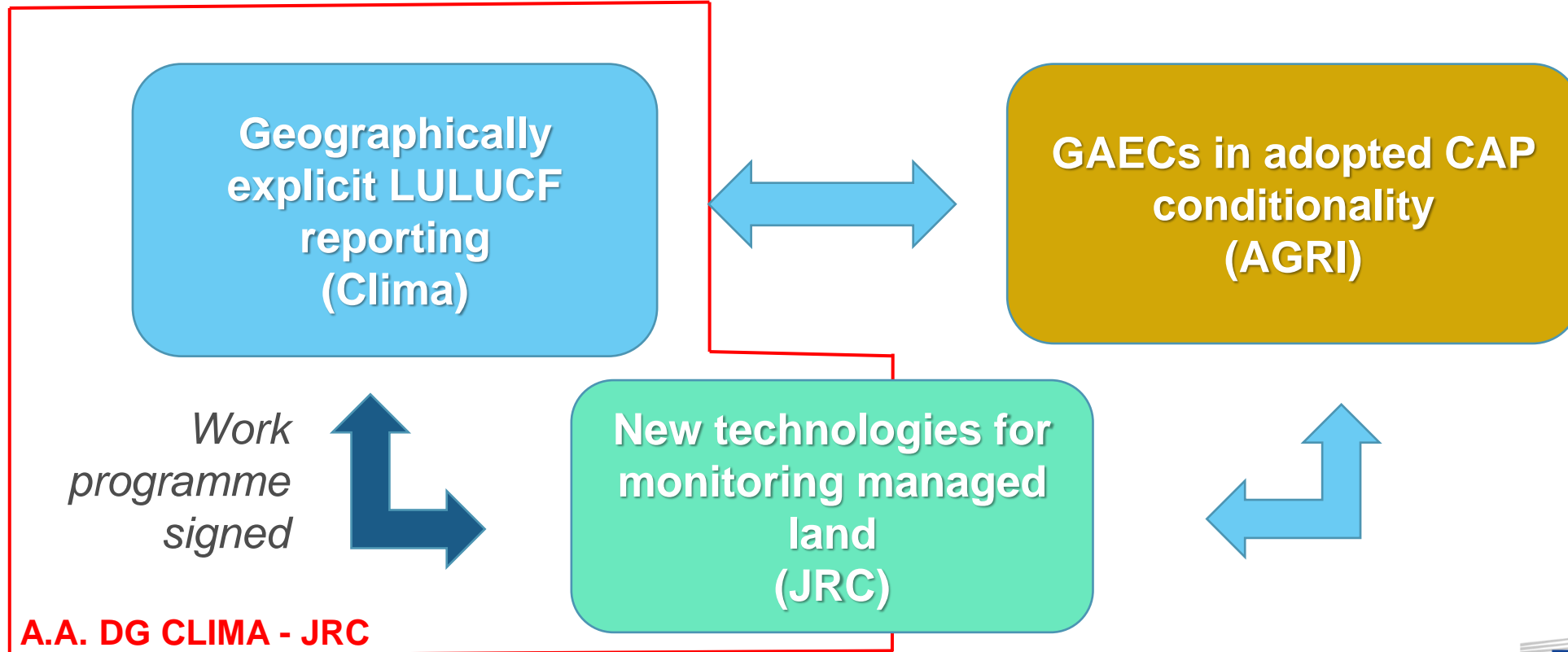
- Surveys in 2009, 2015, 2018, 2022
- 42,000 observation



Tanneberger et ., *The peatland map of Europe*

The context of SEPLA project

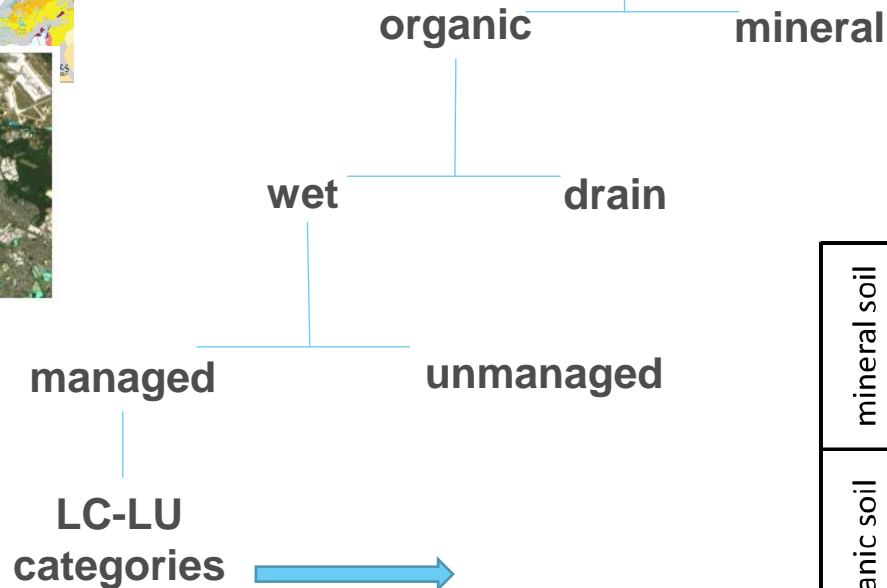
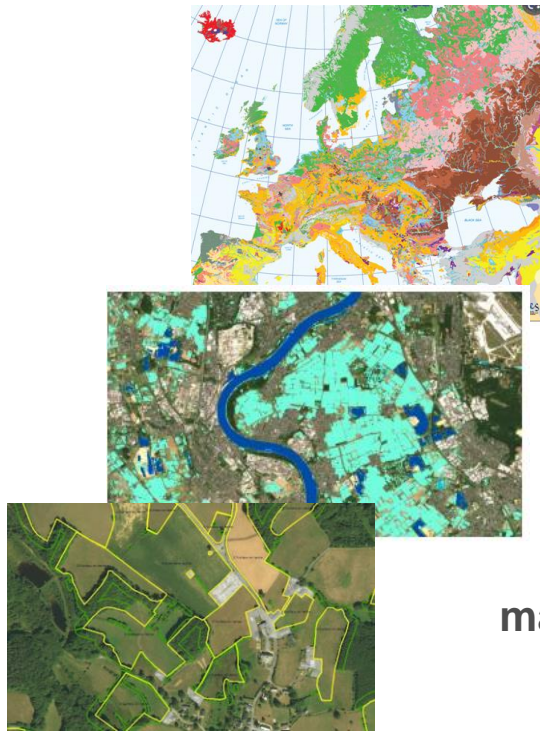
“Ensure comprehensive inventory of wetlands and peatlands and address the monitoring of their preservation and restoration through the use of remote sensing and regularly updated geographically explicit datasets.”



Best use of data available within MS

*Participatory approach
with 4 MS in a development phase
DK, LV, BG, IE*

Do we have the right data?
Is it complete?
Does it allow historic analysis?
Is it enough spatially disaggregated?
Where data enters the workflow?



IPCC wetland sub-categories

	Forest Land	Crop-land	Grass-land	Wet-lands	Settle-ments	Other Land
	inland	coastal	inland	coastal	inland	coastal
mineral soil	mineral drained	mineral drained	mineral drained	mineral drained	mineral drained	mineral drained
	mineral wet	mineral wet	mineral wet	mineral wet	mineral wet	mineral wet
organic soil	organic drained	organic drained	organic drained	organic drained	organic drained	organic drained
	organic wet	organic wet	organic wet	organic wet	organic wet	organic wet

What is a wetland?

*Ecosystem that is flooded by water,
either permanently or seasonally
(Fresh, brackish, salt water)*

Wetland

Swamp

Marsh

Peat

Growing peat - Mire

*Accumulation of organic material
(generally 30% OM in dw) different
stage of decomposition
(from fibric to sapric)*

bog

fen

- Ombrotrophic
- Acidic
- Mosses (sphagnum)

- Minerotrophic
- Less acidic
- Mosses, sedge

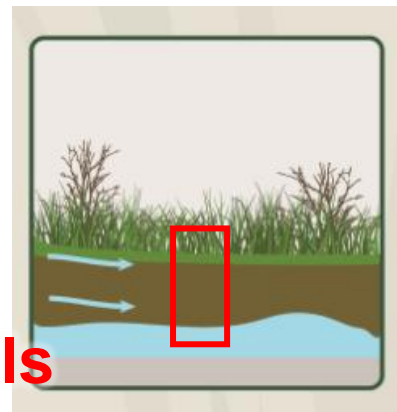


PEAT

ORGANIC-RICH



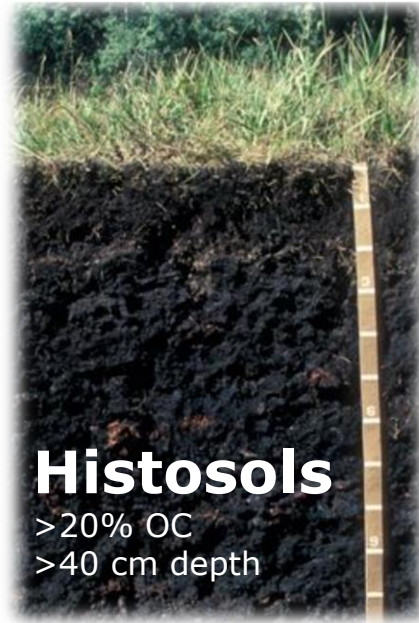
histosols



What is an organic soil?



What is an organic soil?



Histosols

>20% OC
>40 cm depth

Organic carbon



Is there a minimum depth?



Is an organic soil a peat?

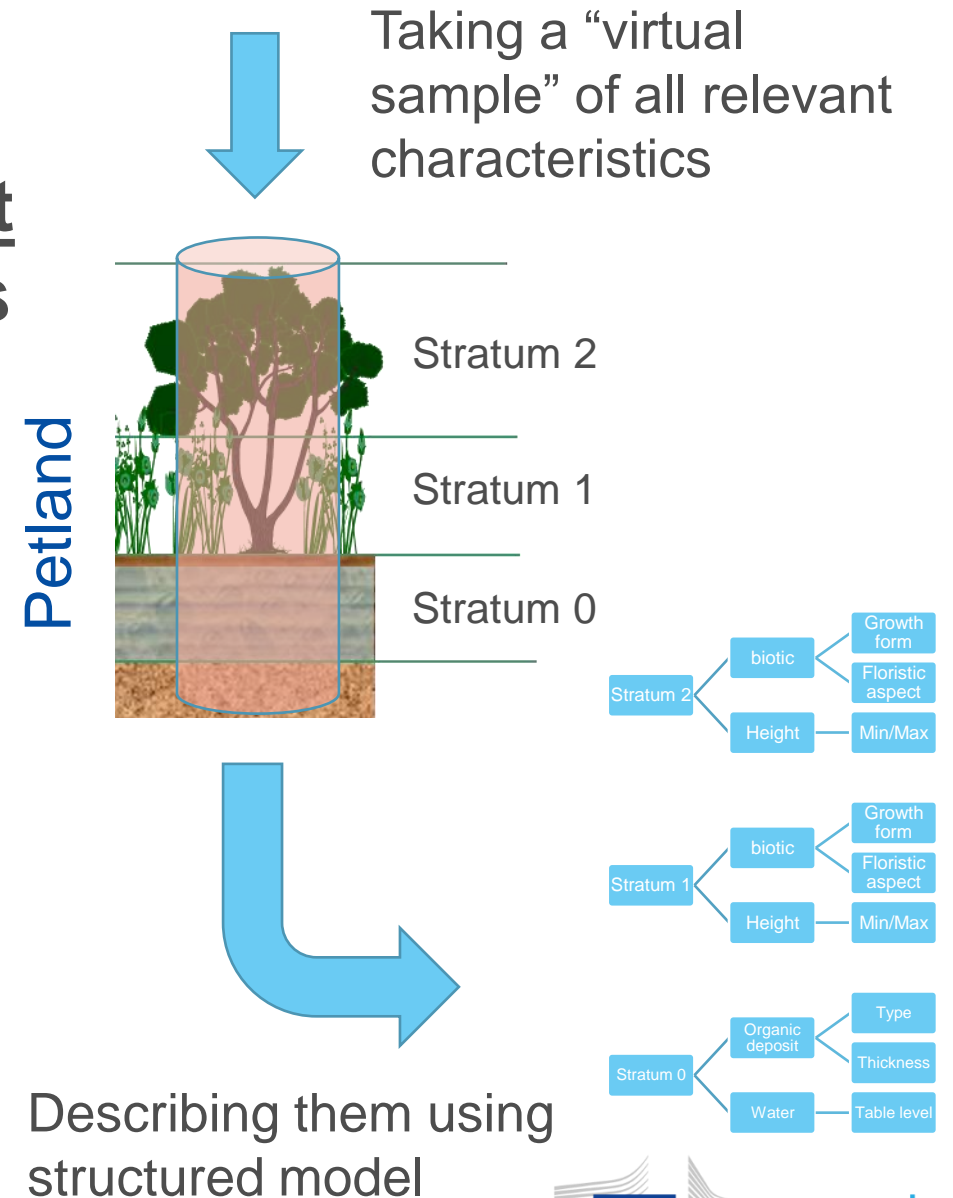


Is a peat soil a wetland?

Semantic Meta-Model

No common definition, but a common set of classifiers to describe local definitions

- Based on broadly accepted bio-physical characteristics
- Hierarchically structured by semantic logic
- From LCML, EAGLE
- Allowing the link between land cover and soil
- Retaining the relationship with land use



Semantic passport



land



Article

Enabling Spatial Data Interoperability through the Use of a Semantic Meta-Model—The Peatland Example from the JRC SEPLA Project

Pavel Milenov ^{1,†} , Aleksandra Sima ^{2,†} , Emanuele Lugato ³ , Wim Devos ³ and Philippe Loudjani ^{3,*}

Map the local definition and create a semantic passport

N2K class 7.1.2 Peat bog semantic passport

Stratum 1	Vegetation	Growth form	Woody	Tree	Leaf Type	Broadleaf	Needleleaf	Aphyllous	Deciduous	Evergreen
				Shrub						
				Leaf Phenology						
				Graminoid						
				Non-graminoid						
			Herbaceous	Leaf Phenology	Annual	Biennial	Perennial	One life cycle	Several life cycles	
				Lichen						
				Mosses						
		Floristic aspect	Group of Plants	Lichen and Mosses						
				Single Plant						
				Species name						
Stratum 0	Organic Deposit	Type	Litter (O horizon - Folie)	Decomposition	Undecomposed	L - Layer	Partially decomposed	F - Layer	Fully decomposed	H - Layer
			Peat (H horizon - Histic)	Decomposition	Undecomposed	Partially decomposed	Fully decomposed	Minerotrophic	Ombrotrophic	
	Water	Position	Thickening/Shrink	Acidity	Organic carbon content	Texture	CN ratio	Colour	Salinity	Water Table level
		Persistent Period	Number of months	Start month	End month	Mean	Max	Min	Impact on water level	No impact on water level

Copernicus N2K class 7.1.2 Peat bog definition

7.1. Inland wetlands are predominantly **water-logged** specific **plant** and animal communities supporting water regulation and peat-related processes.

This class includes natural or modified **mires, bogs and fens**, as well as peat extraction sites. Surfaces of **temporary water** are included in wetlands. According EUNIS guidelines (see table below), water-logged means

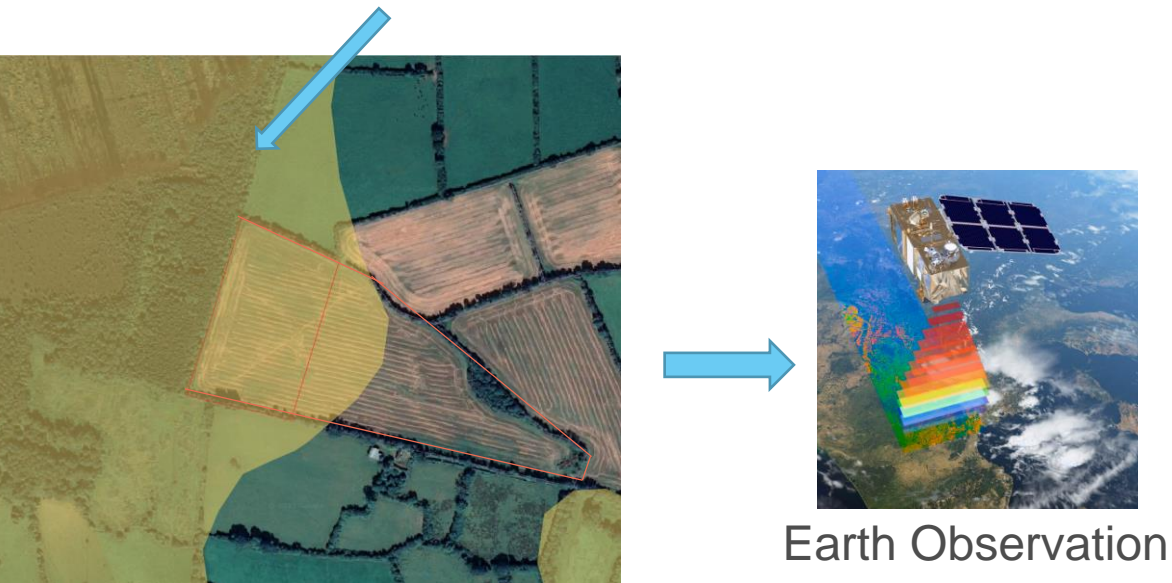
the presence of the water table at or above ground level for at least half of the year.

7.1.2 Peat bog

Mosses, dwarf shrub vegetation and herbaceous vegetation typical for hummock mires, lawn and carpet mires, mud-bottom mires

Development of EO-AI based monitoring

A reference (sub)parcel is partially overlaid by organic (wet/dry) dataset



Training and testing different ML model
in some test areas of Ireland



Response of the
vegetation (S1, S2,
VPPI, LST, DEM)

Response of the soil
(Ground Motion
Service)



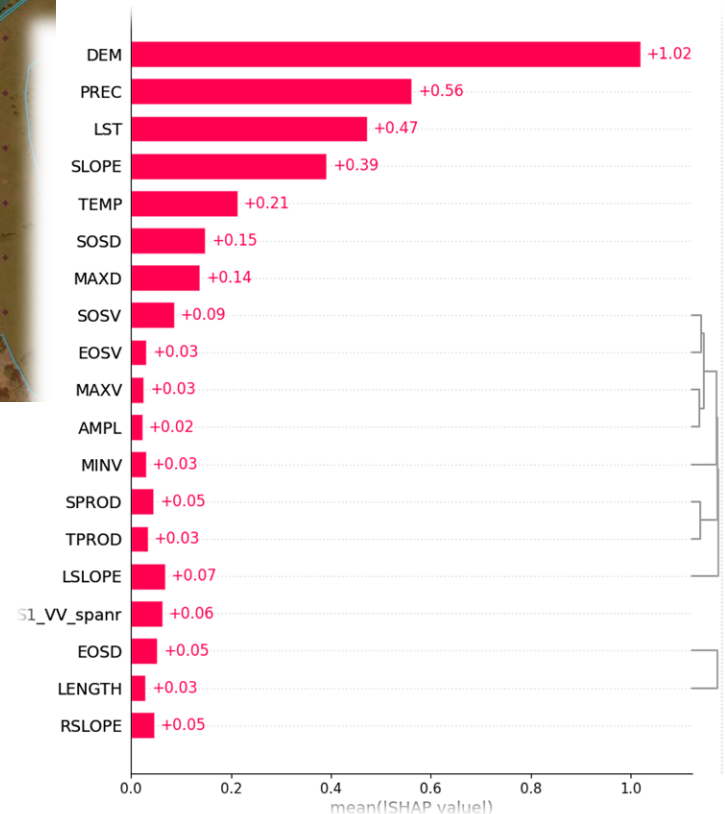
Visible properties of
surface/soil
(Segmentation)

Augmented mapping by AI



Virtual sampling (60 x 60 m grid)

Grassland GSA parcel (organic, mineral)



Data extraction

- VPPI index (Copernicus Sentinel2)
- Terrain (DEM, SLOPE)
- MAT, MAP, LST
- Sentinel S1

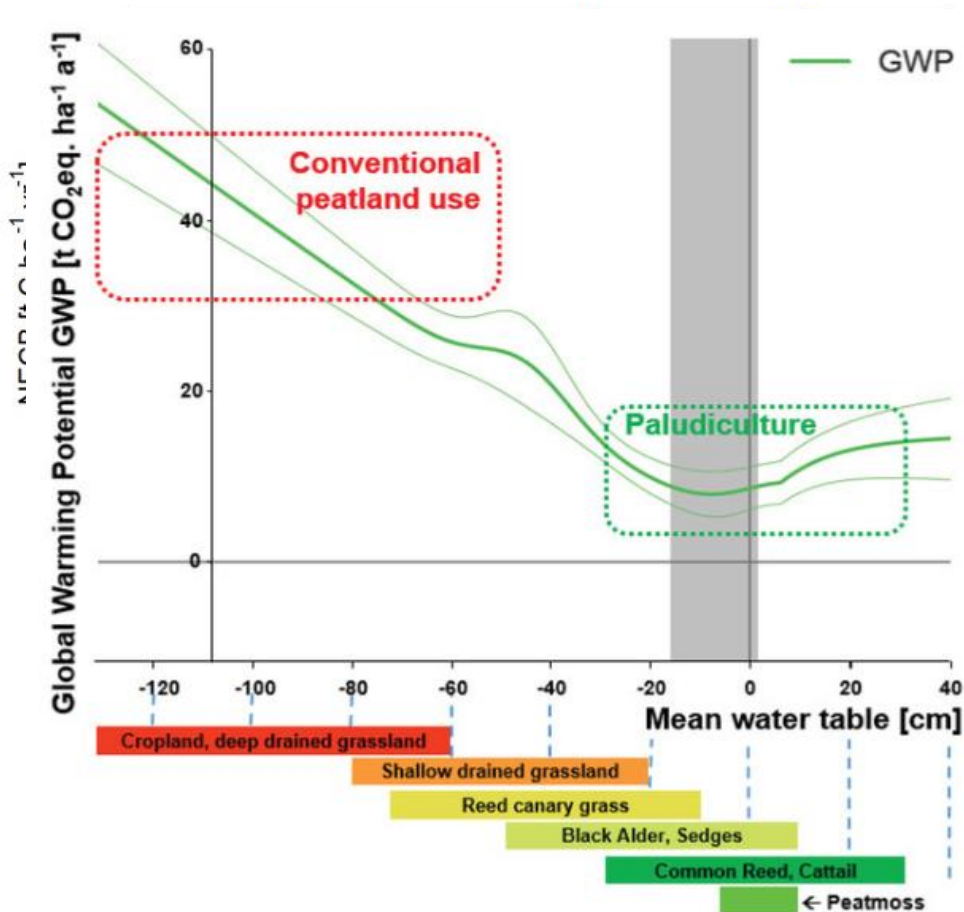


ML model

Peatland rewetting

The Power of Nature-Based Solutions: How Peatlands Can Help Us to Achieve Key EU Sustainability Objectives

Franziska Tanneberger ✉, Lea Appulo, Stefan Ewert, Sebastian Lakner, Niall Ó Brolcháin, Jan Peters, Wendelin Wichtmann



Article

Overriding water table control on managed peatland greenhouse gas emissions

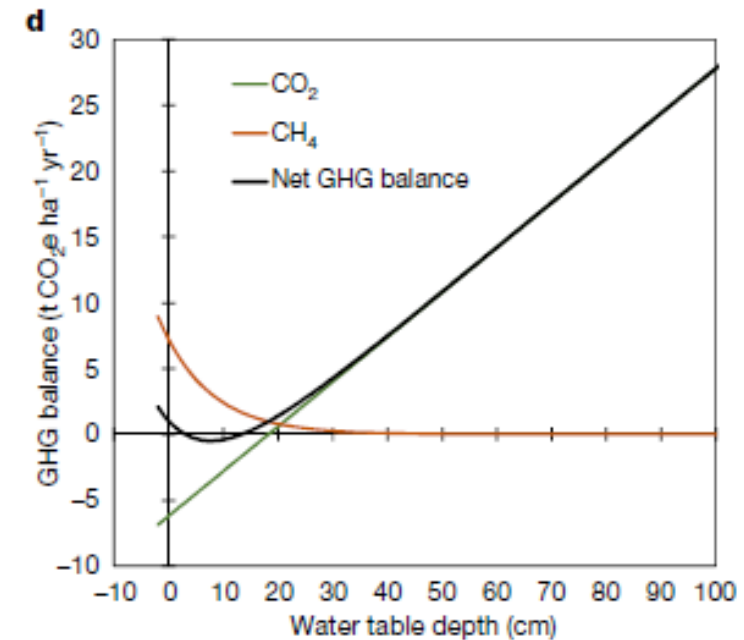
<https://doi.org/10.1038/s41586-021-03523-1>

Received: 6 November 2020

Accepted: 8 April 2021

Published online: 21 April 2021

C. D. Evans^{1,2,13}, M. Peacock², A. J. Baird³, R. E. Artz⁴, A. Burden¹, N. Callaghan¹, P. J. Chapman⁵, H. M. Cooper⁶, M. Coyle^{4,6}, E. Craig^{1,7}, A. Cumming⁸, S. Dixon⁹, V. Gauci⁹, R. P. Grayson³, C. Helfter⁴, C. M. Heppell¹⁰, J. Holden³, D. L. Jones^{2,12}, J. Kaduk¹², P. Levy⁶, R. Matthews¹⁴, N. P. McNamara¹⁵, T. Misselbrook¹⁴, S. Oakley¹⁵, S. E. Page¹³, M. Rayment¹, L. M. Ridley⁴, K. M. Stanley¹⁶, J. L. Williamson¹, F. Worrall⁴ & R. Morrison²



Conclusion and way forward

- More integration of policies to protect/restore peatlands
- Improved mapping and monitoring (ecosystems degraded)
- Importance of local knowledge
- Promising approach of AI
- Incentives (Carbon Farming) to promote effective actions (rewetting)

Thank you



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