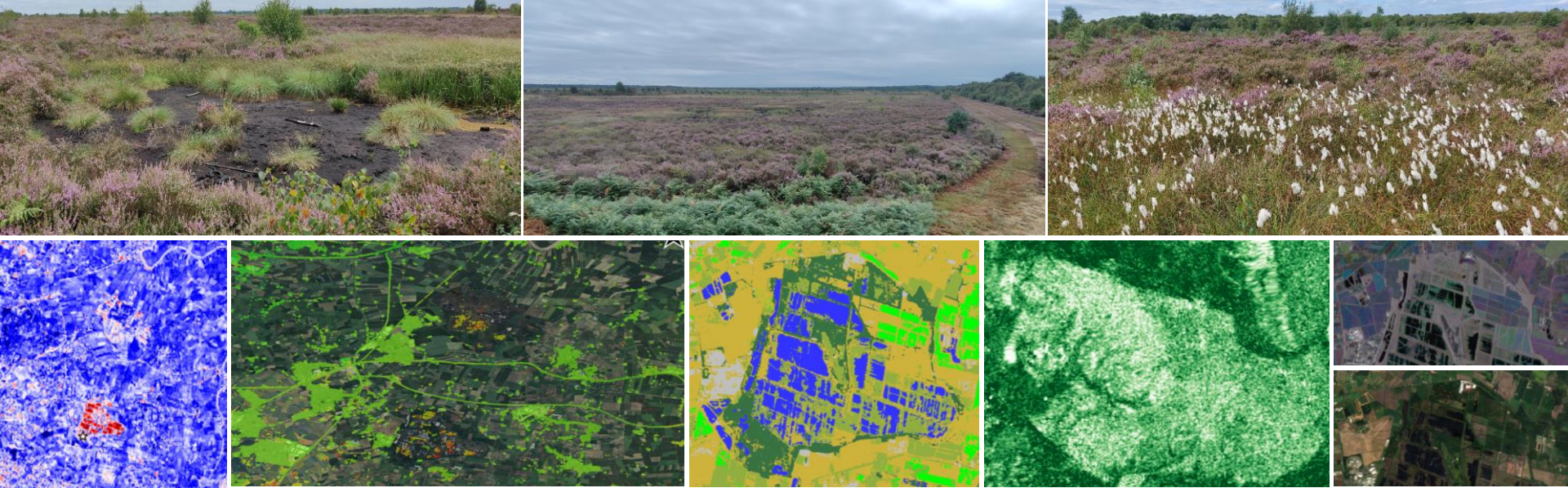


Peatlands – a carbon rich environment

Session: EO Derived Products in Support of MRV Activities

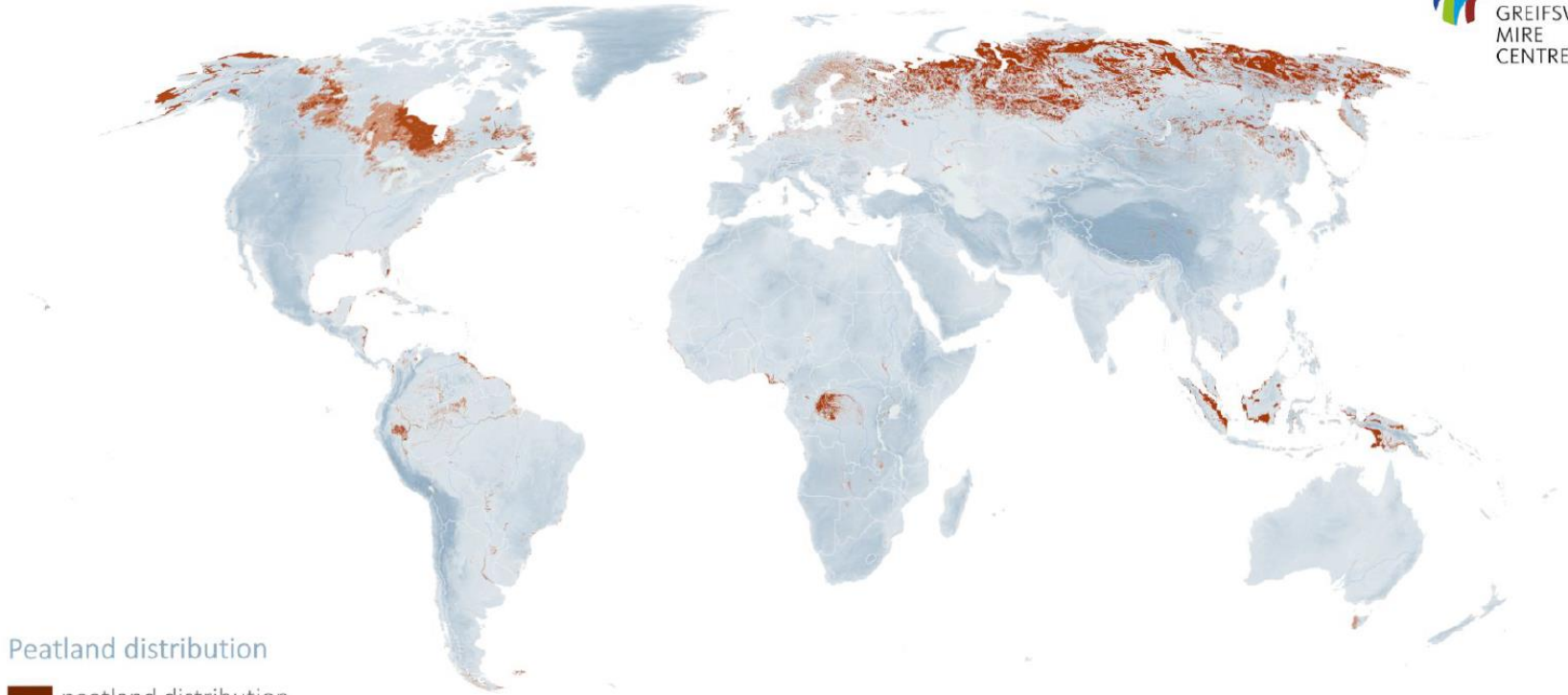
European Environmental Agency Conference: Earth Observation for Monitoring, Reporting, and Validation of Carbon Removals





Gerardo Lopez-Saldana
Assimila

Peatlands cover only 3–4% of the Earth's surface, but they store nearly 30% of global soil carbon stock...

Peatland distribution



Peatland distribution

-  peatland distribution
-  peat in soil mosaic

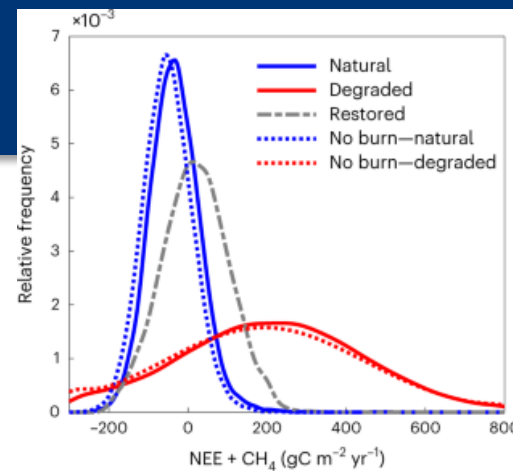
Boundaries: United Nations Geoportal, 2021. The boundaries and names shown, and the designations used on this map do not imply official endorsement or acceptance by the United Nations.
Peatland distribution: Global Peatland Database, 2022.
Elevation: Jarvis et al. 2008. SRTM for the globe version 4.



Based on a donation of the German Bundestag.

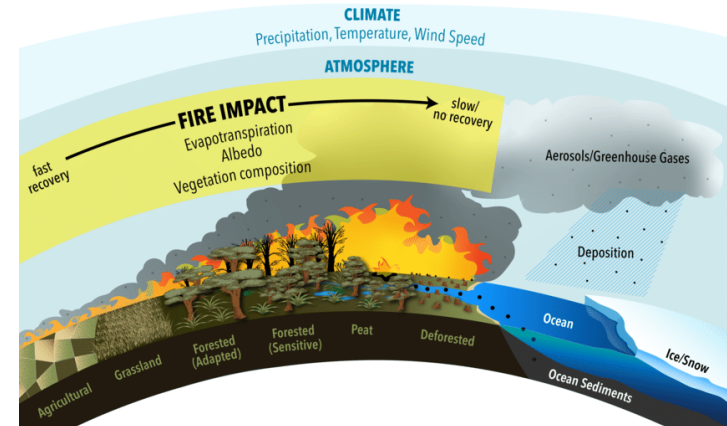
Threats to peatlands and Carbon emissions

- Degradation and Draining
 - Anthropogenic impacts: agriculture, forestry, and infrastructure
 - Increased emissions when peatlands dry up
- Climate Change Impact
 - Altered hydrology and wildfire risk increase



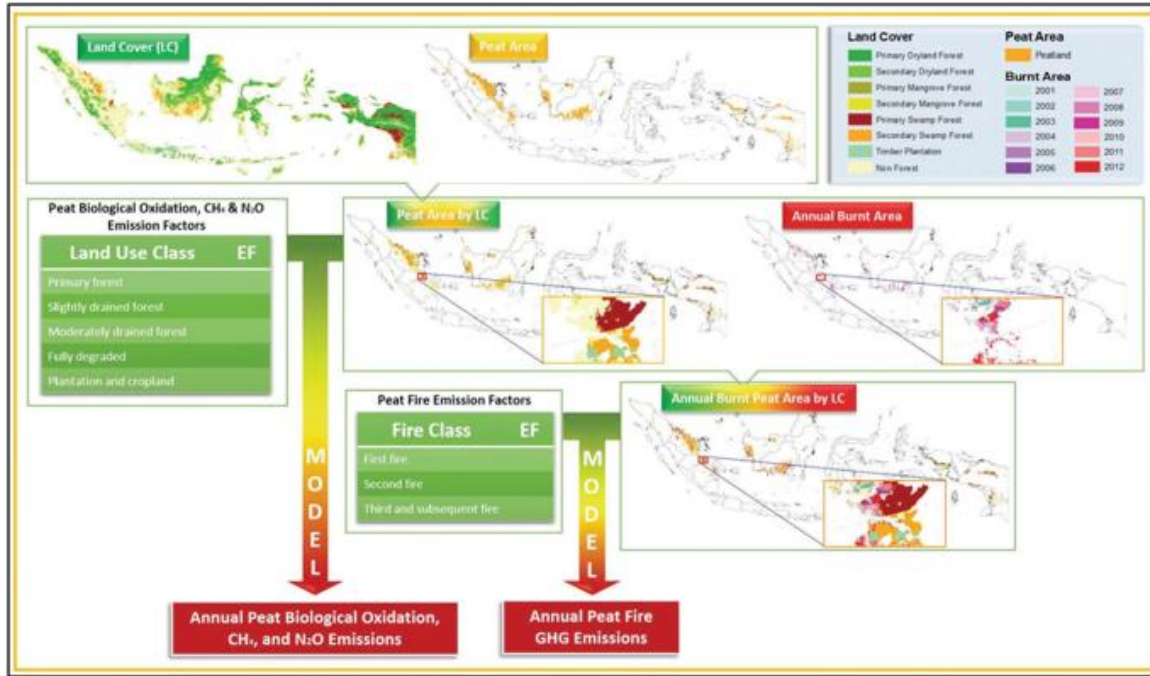
Distribution of NEE + CH₄ fluxes.

Wilkinson, S.L., Andersen, R., Moore, P.A. *et al.* Wildfire and degradation accelerate northern peatland carbon release. *Nat. Clim. Chang.* **13**, 456–461 (2023). <https://doi.org/10.1038/s41558-023-01657-w>



Lasslop, G., Coppola, A.I., Voulgarakis, A., Yue, C. and Veraverbeke, S., 2019. Influence of fire on the carbon cycle and climate. *Current Climate Change Reports*, **5**, pp.112-123.

MRV requirements for peatland Carbon accounting



- Role of MRV (Monitoring, Reporting, Validation) in Peatland Management
 - UNFCCC guidelines for carbon inventories
 - Accurate, consistent and systematic data on carbon stocks and emissions.

Krisnawati, H., Adinugroho, W.C., Imanuddin, R. (2021). Climate-Responsible Management of Tropical Peatlands: The Need for Integrated MRV for Tropical Peatland Ecosystem. In: Osaki, M., Tsuji, N., Foead, N., Rieley, J. (eds) Tropical Peatland Eco-management. Springer, Singapore. https://doi.org/10.1007/978-981-33-4654-3_15

What could be the role of EO to support peatlands MRV?

Damaged peatland

Bare burned peat after Saddleworth Moor fire



Functioning peatland

Sphagnum moss is the main peat forming plant



Restoration



Dark surfaces



Green surfaces

Dry surfaces



Wet surfaces

Warm surfaces



Cool surfaces

Surface recession



Aggradation

GHG sources

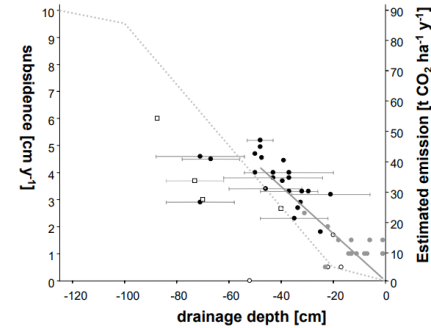
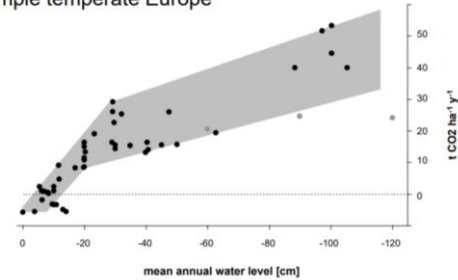


GHG sinks

Some Earth Observation products supporting MRV

- Soil moisture -> proxy to water level
- Surface motion / ground deformation
- Vegetation bio-geophysical parameters

Good proxy for CO₂ emissions:
Example temperate Europe



2-, 2+, 2-	(3+/2+) 3+	4+/3+	4+	5+/4+	5+	6+
0	0.5	0.5	5			
13	9	2	2			
13	9.5	3.5				

water level class	CO ₂ emission in t CO ₂ -eq. ha ⁻¹ a ⁻¹
10	10
8	8
2	2
0	0
2	2

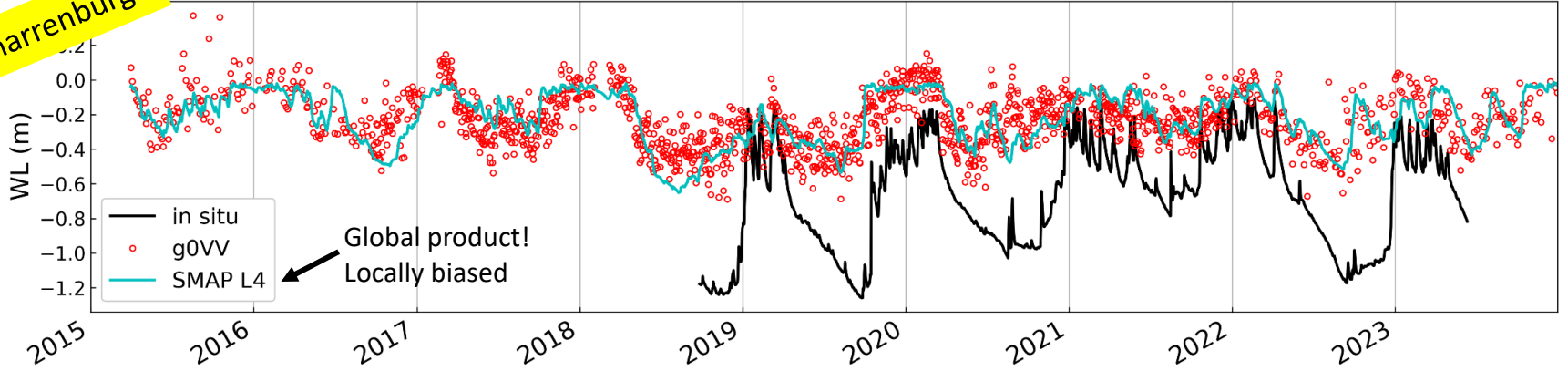
GESTs:
Greenhouse gas Emission Site Types

3+ (3~)	4+/3+	4+	5+/4+	5+	6+

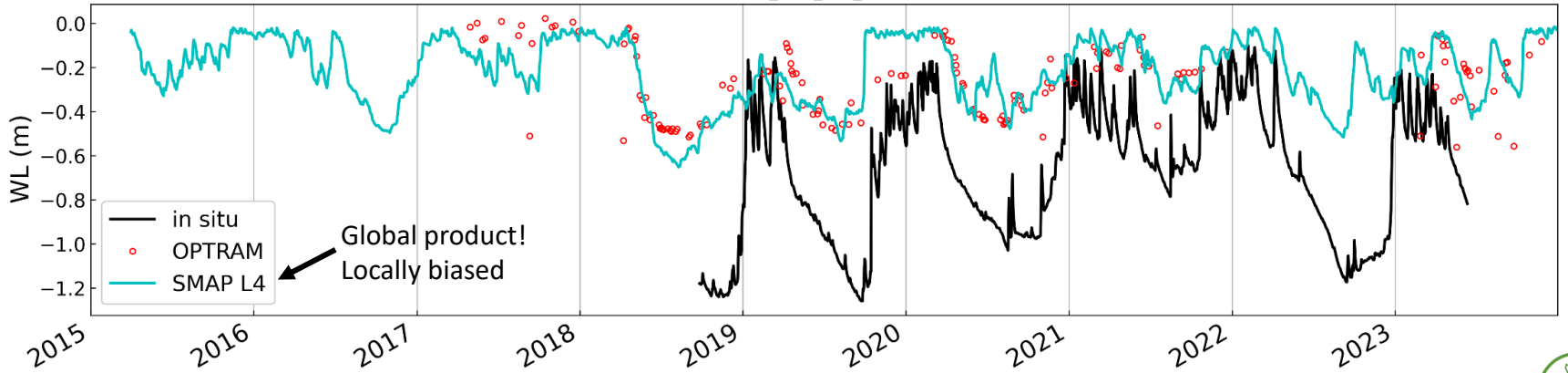
WorldPeatland – Hydrology products

Gnarrenburg

DE_GNA_gn1_site1



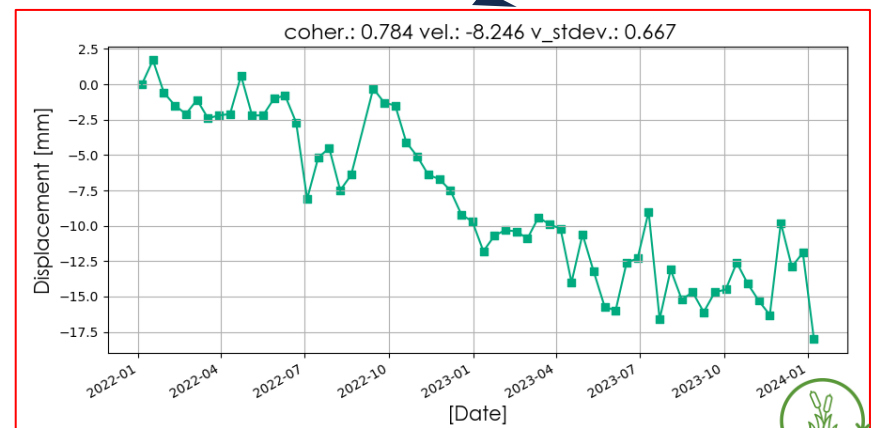
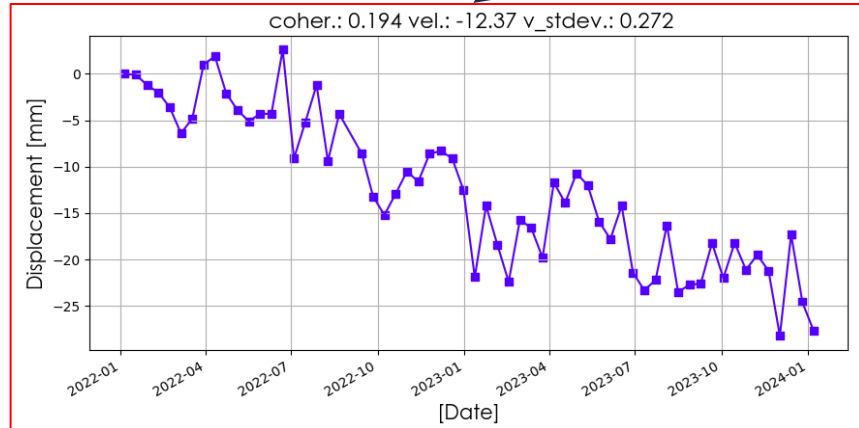
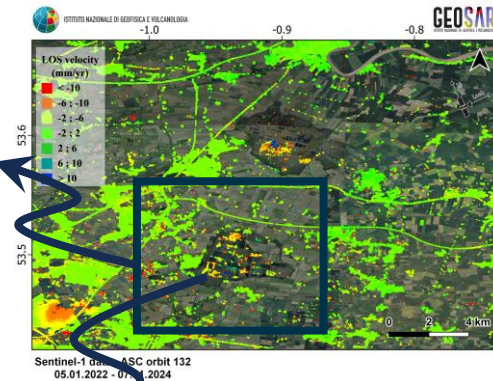
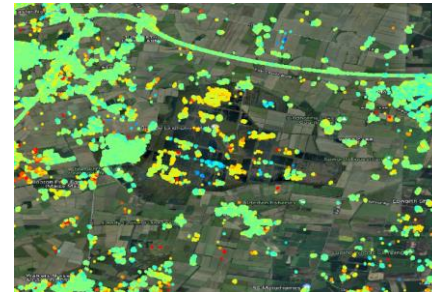
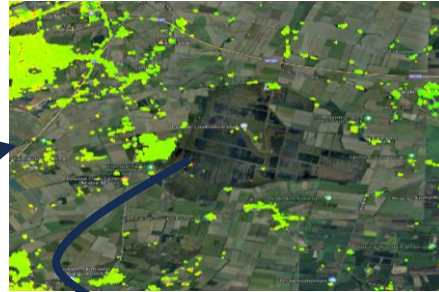
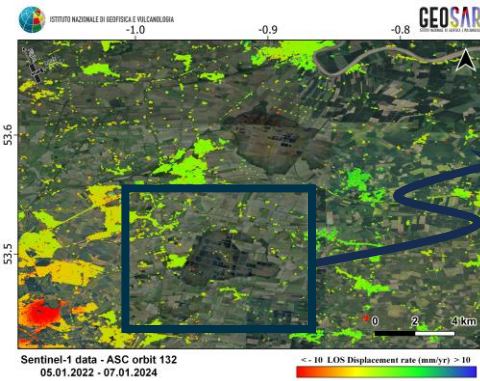
DE_GNA_gn1_site1



WorldPeatland – surface motion products

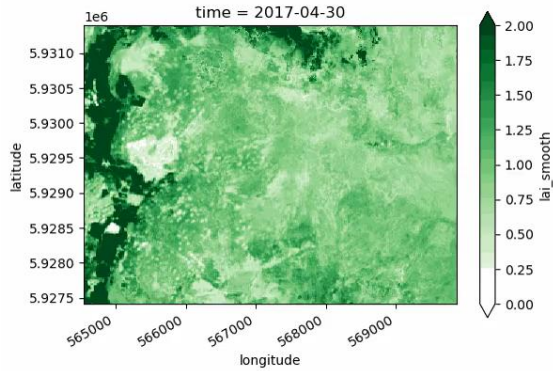
I-SBAS method

E-PS method

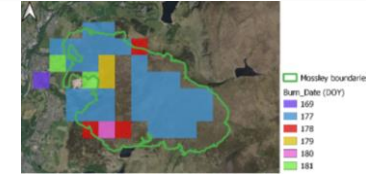
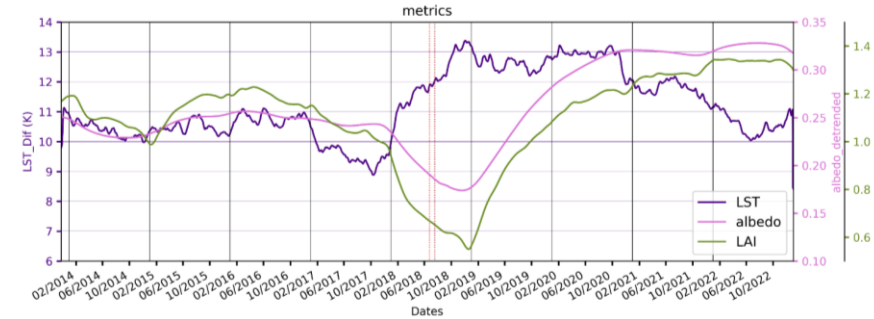
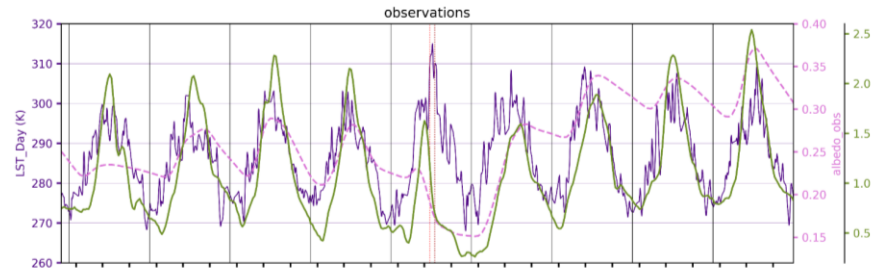
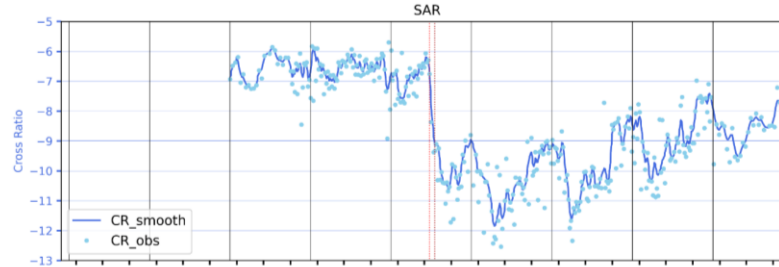
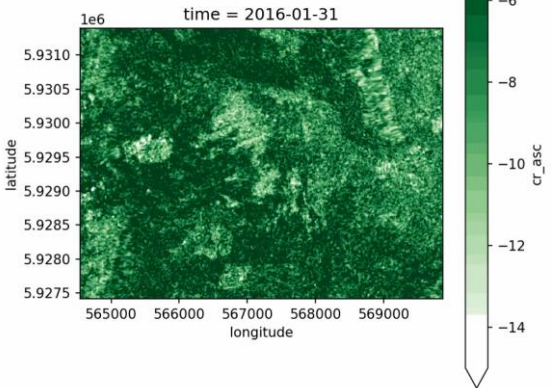


WorldPeatland – Vegetation biogeophysical params.

LAI – Sentinel-2



Cross-polarisation ratio – S1



Active fires identified on different Days of Year (DOY) over Saddleworth, UK in 2018.

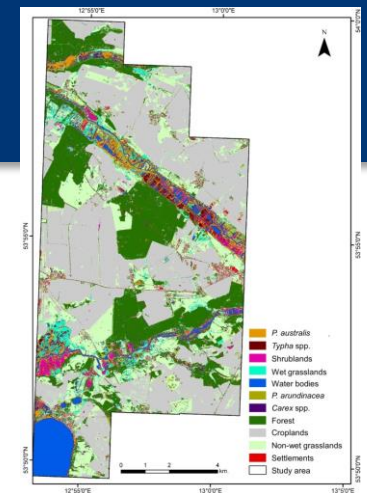
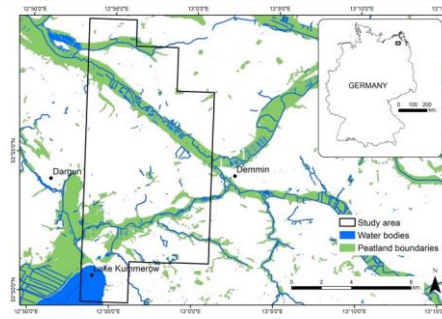
Temporal behaviour of different variables (CR, LAI, LST & albedo) on the peatland area affected by fire.



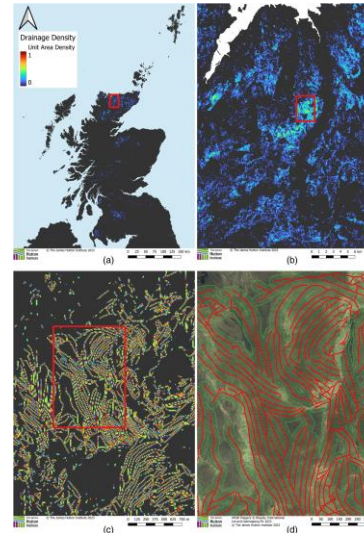
We need to keep innovating

Very high-res classification map of peatland vegetation communities.

- Hyperspectral imaging for detailed biomass and carbon stock assessments
- Integration with machine learning and AI for improved accuracy
- Combining in situ data with models driven by EO for enhanced soil carbon retrievals.



Arasumani, M., Thiel, F., Pham, V.D., Hellmann, C., Kaiser, M. and van der Linden, S., 2023. Advancing peatland vegetation mapping by spaceborne imaging spectroscopy. *Ecological Indicators*, 154, p.110665.



Drainage density at (a) 500m, (b) 100m, and (c) 10cm and (d) individual drains (red polylines)

Macfarlane, F., Robb, C., Coull, M., McKeen, M., Wardell-Johnson, D., Miller, D., Parker, T.C., Artz, R.R., Matthews, K. and Aitkenhead, M.J., 2024. A deep learning approach for high-resolution mapping of Scottish peatland degradation. *European Journal of Soil Science*, 75(4), p.e13538.

Peatlands and MRV

- Peatlands are crucial for carbon storage but vulnerable to degradation.
- EO provides powerful tools for MRV, enabling better carbon inventory management
- Need for integrating new EO data sources and advancing MRV methods for peatland preservation
- Collaborative opportunities between governments, industry, and research institutions

