Land use, soil and nitrogen surplus data in estimating the potential to implement paludiculture and mitigate greenhouse gas emissions

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Background

Climate and nature protection policies urge to rewet drained peat soils to achieve climate goals and improve biodiversity. Peat soils are significant carbon stores and draining them leads to high emissions of the greenhouse gases (GHG) carbon dioxide (CO_2) and nitrous oxide (N_2O). Potential to reduce greenhouse gas emissions ranges up to >100 million tonnes of CO_2 equivalent in Europe.

Peatland rewetting can be targeted based on site properties and local needs e.g. in three land use options:

→**High-intensity paludiculture**: cultivation of wetland crops under intensive management with the goal to produce biomass;

→**Low-intensity paludiculture**: regular harvest from spontaneously established vegetation for biomass use;

→**Wet wilderness**: rewetting without biomass harvesting

The crops can be **reeds, cattail, willow, sedges, mosses** and many grass crops that have different requirements for site conditions and could be widely used to replace fossil materials in industries.

Research questions:

- What are the **effects of the three 'wet' land use options** on key EU biodiversity, climate, water and societal policy objectives? Are there synergies and trade-offs?
- How do **N loads influence** compliance with the policy objectives under different land use options?
- How do N loads determine which land use option optimizes between these policy objectives, are there **thresholds or tipping-points** for choosing between these land use options?

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Results

We were able to illustrate regional differences by identifying GHG hotspot regions in Europe based on high peatcover or high land use intensity (Fig. 1).

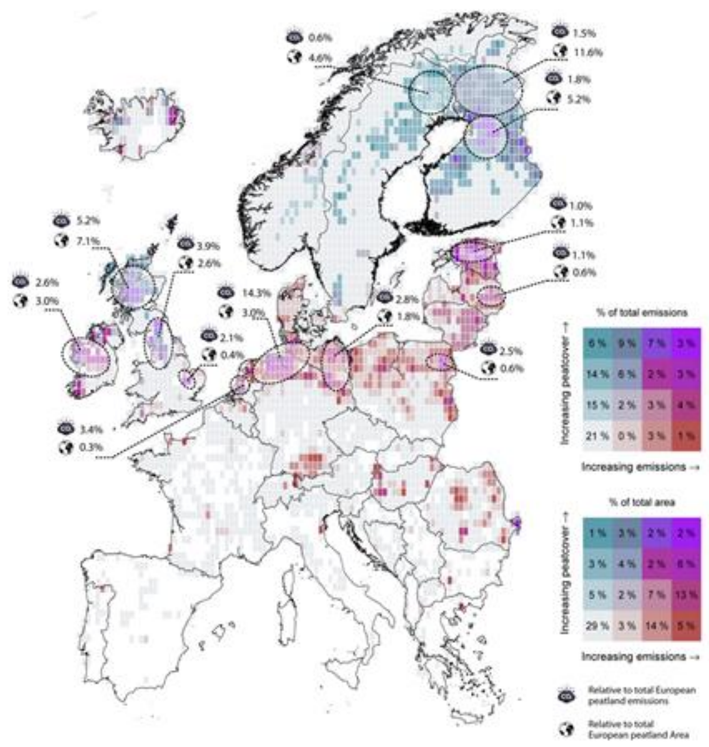

Fig. 1 *Peatland area and GHG emission density hotspot maps of drained peatlands in the EU+, in a 30x30 km² grid. Increased peat density is depicted in blue colors, increased emissions intensity in red. The simultaneous presence of an increased peatland area and increased emission is denoted in purple.* https://www.researchsquare.com/article/rs-4629642/v1

There was altogether 850 000 ha of area best suitable for wet wilderness, 2 900 000 ha for extensive paludiculture and 740 000 ha for intensive paludiculture in Europe suggesting high potential for GHG mitigation and biomass production. We will further specify this rewetting scenario and present the potential to mitigate greenhouse gas emissions and produce biomass in and discuss the potential to use the biomass in industries to improve sustainability of European agricultural and industrial production.

Methods

We combined soil data with the land use form to identify hotspots of GHG emissions and continue further by adding information of nitrogen load of surface waters of the catchments. We divided European catchments to three classes based on nitrogen load and calculated the area of peatland in land use classes cropland and grassland. The catchments with the lowest nitrogen load were assigned to "wet wilderness", those with medium nitrogen load to extensive paludiculture with occasional harvest and those with the highest nitrogen load to intensive paludiculture of crops requiring abundant nutrients.