Biomass for the bioeconomy

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Biomass for the bioeconomy

Increasing demand for biomass resources

Residues insufficient for meeting climate targets

New biomass plantations necessary

However…

Land on Earth is limited

Meeting biomass demands by *business-as-usual* land management probably impossible without accepting significant environmental impacts

This requires new perspectives on land use and land use change (LUC)

<u>Land use change is not necessarily negative – rather *necessary*</u>

Beneficial land use change

Beneficial LUC allow for increased biomass production while providing additional benefits:

- Supporting biodiversity
- Mitigating environmental impacts from current land use

Reasonable that beneficial LUC (and associated biomass) can receive compensation for additional societal benefits

Interesting objective for meeting future biomass demands

Pasture on cleared rainforest

Supports one cow per hectare

= not very efficient use of land

Degraded pastures => Oil palm plantations

Benefits:

- Increases aboveground carbon stock
- Partially reverses hydrological impacts from previous LUC
- Produces more vegetable oil per hectare than any other crop
- Displacement of food production avoidable
- Could also support one cow per hectare…

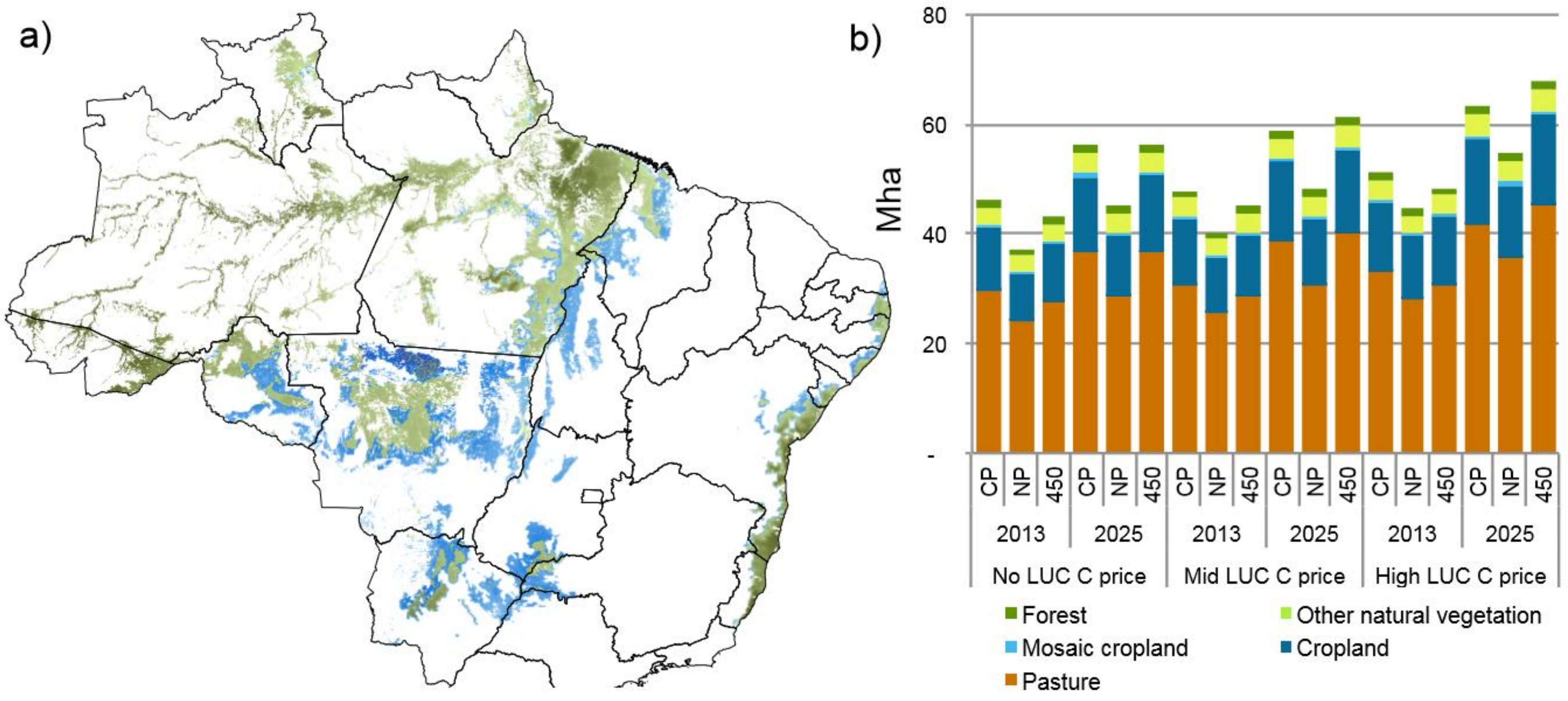
Oil palm for biodiesel in Brazil

Profitable on extensive areas

Risk of pressure on natural vegetation

40-60 Mha of land could support profitable biodiesel production

- ~10% of global petrodiesel demand
- No direct LUC carbon emissions
- No impingment on protected land
- Mainly at the expense of extensive pastures



Englund O, Berndes G, Persson M, and Sparovek G, 2015. Oil Palm for Biodiesel in Brazil – Risks and Opportunities. *Environmental Research Letters,* 10, 071002

Strategic perennialization

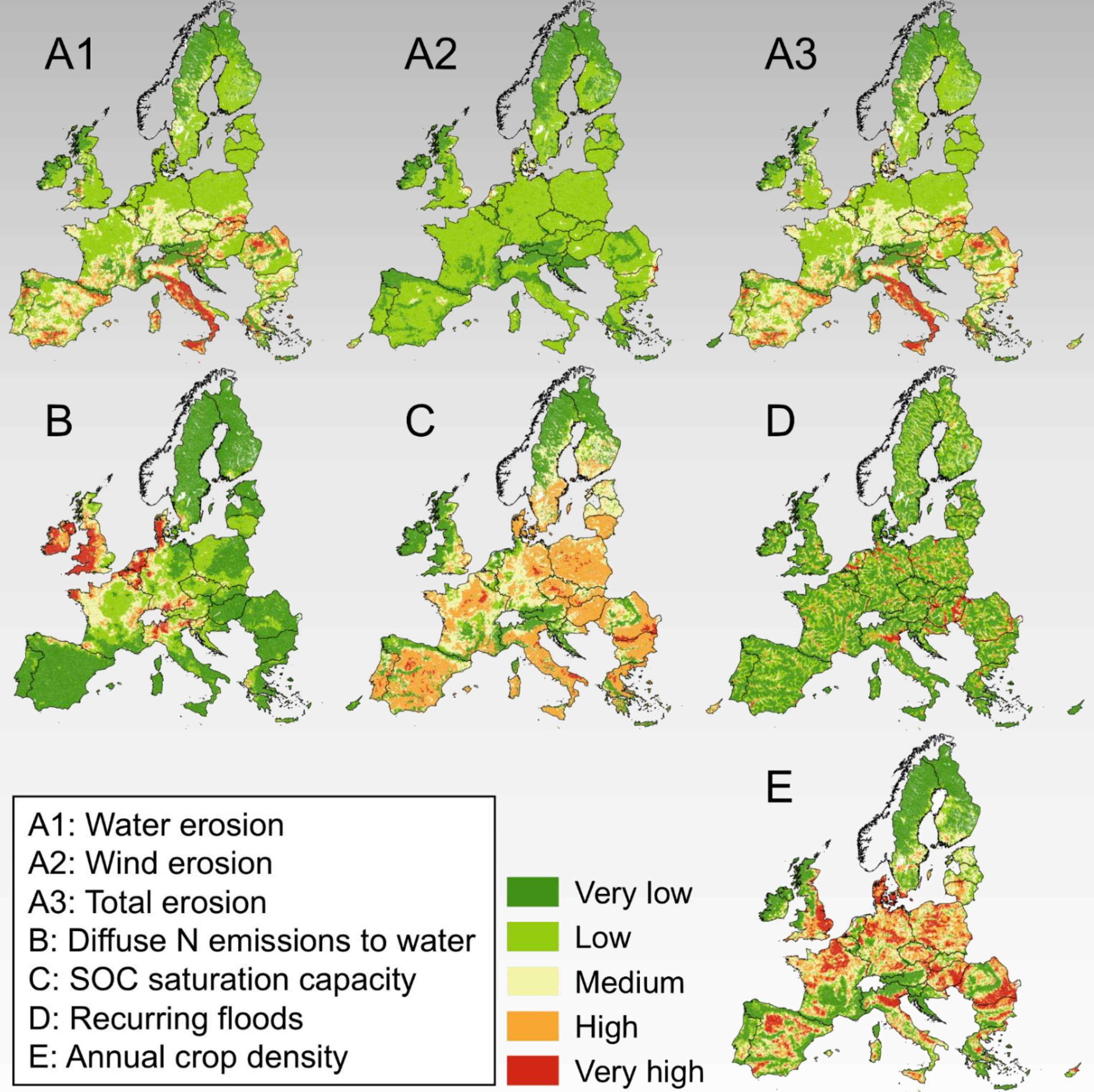
Strategic introduction of perennial crops into intensively managed arable landscapes can supply biomass while mitigating environmental impacts from current agriculture:

- Nutrient emissions to water
- Wind and water erosion
- Accumulated soil organic carbon losses
- Recurring flooding
- Etc.

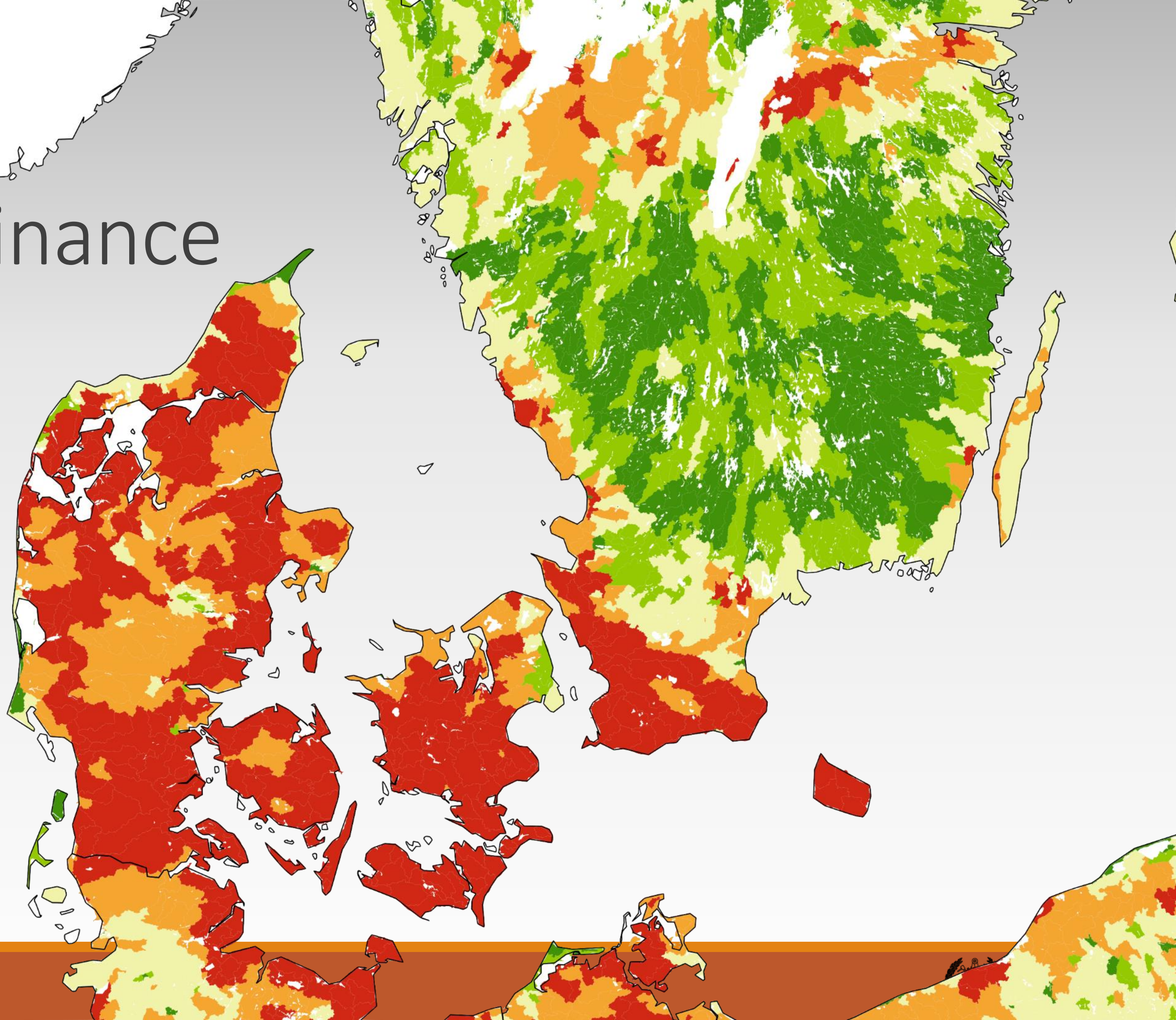
Strategic perennialization

Examples

Environmental impacts



Annual crop dominance



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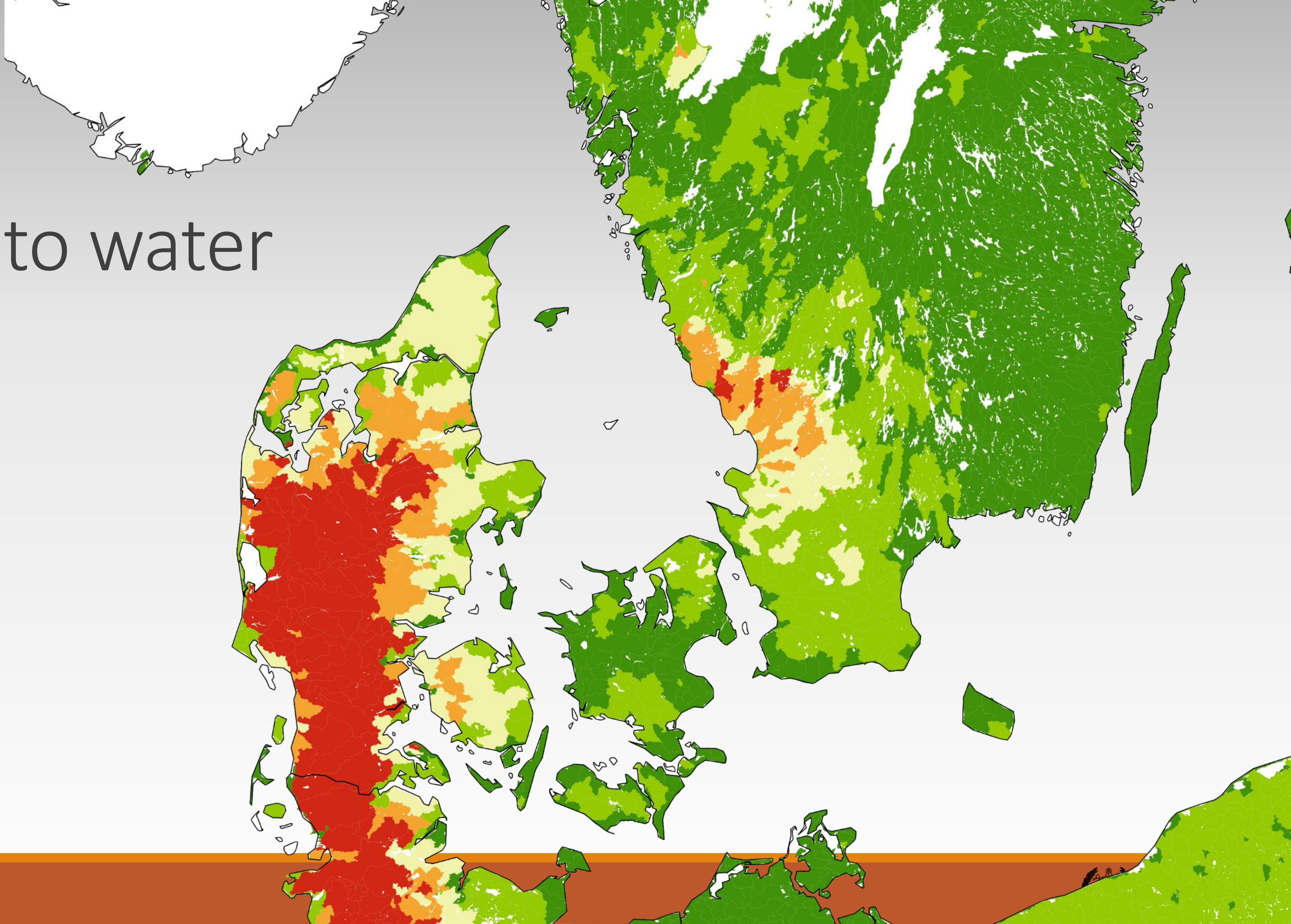
N leakage to water



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Water erosion

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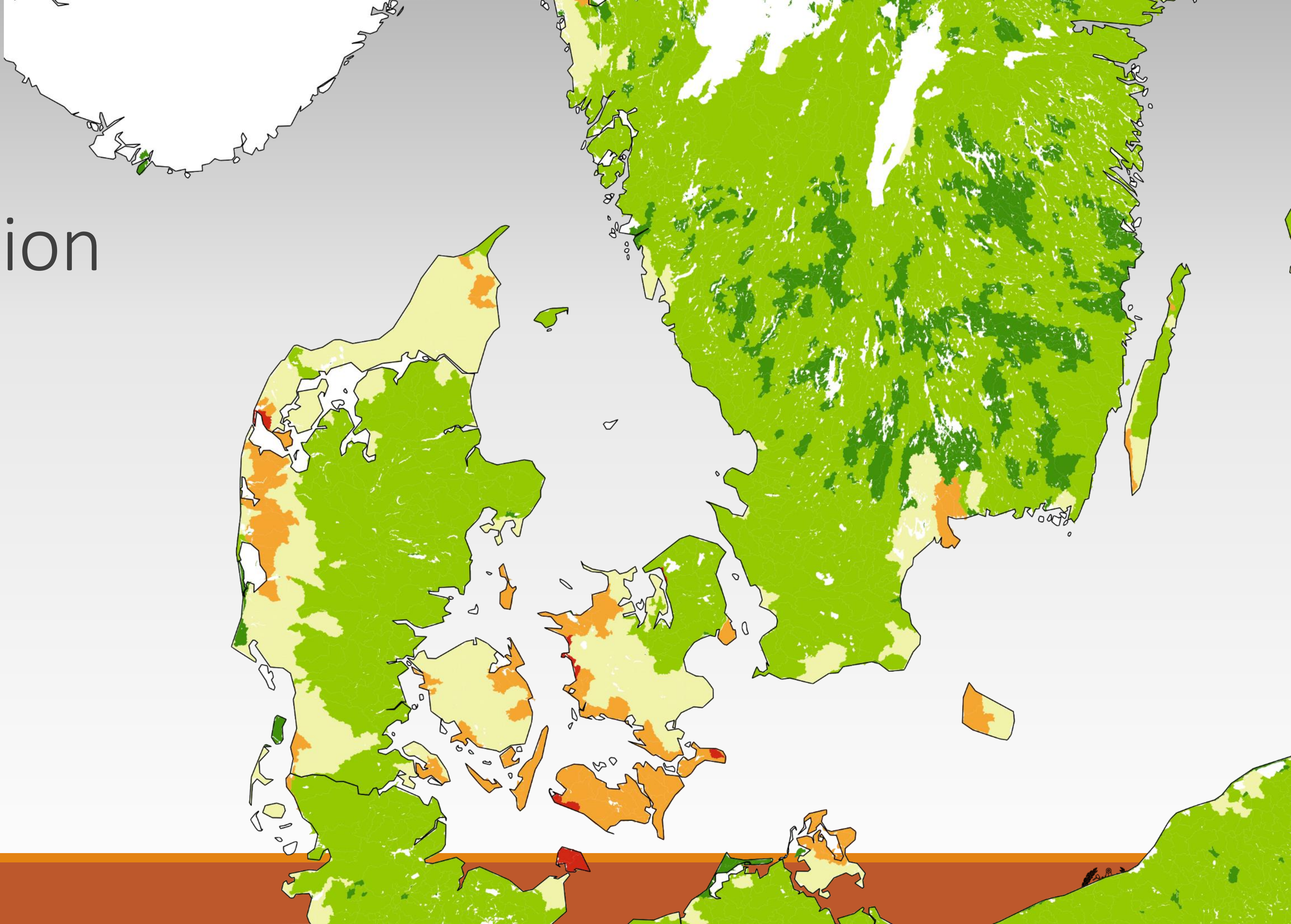
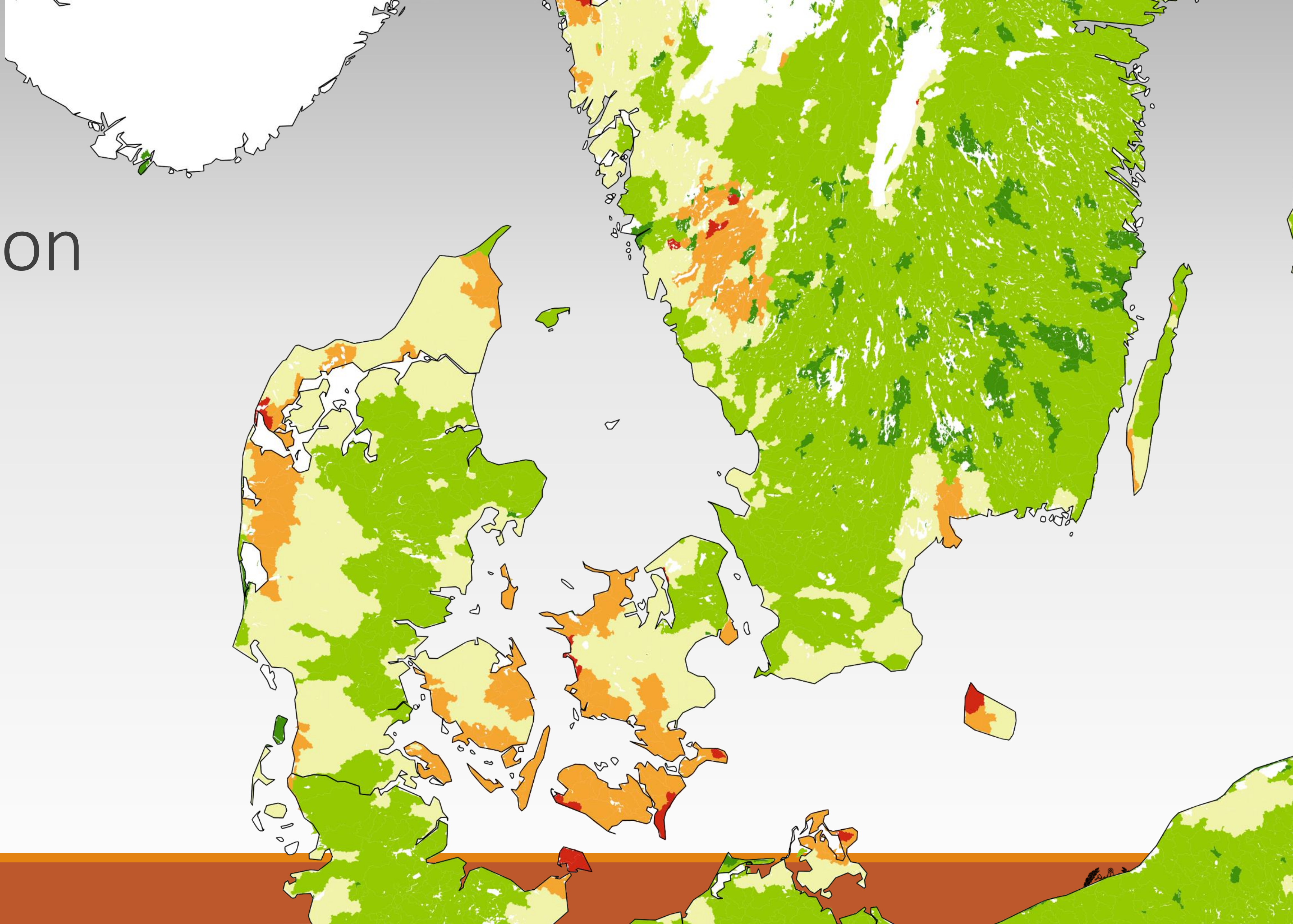
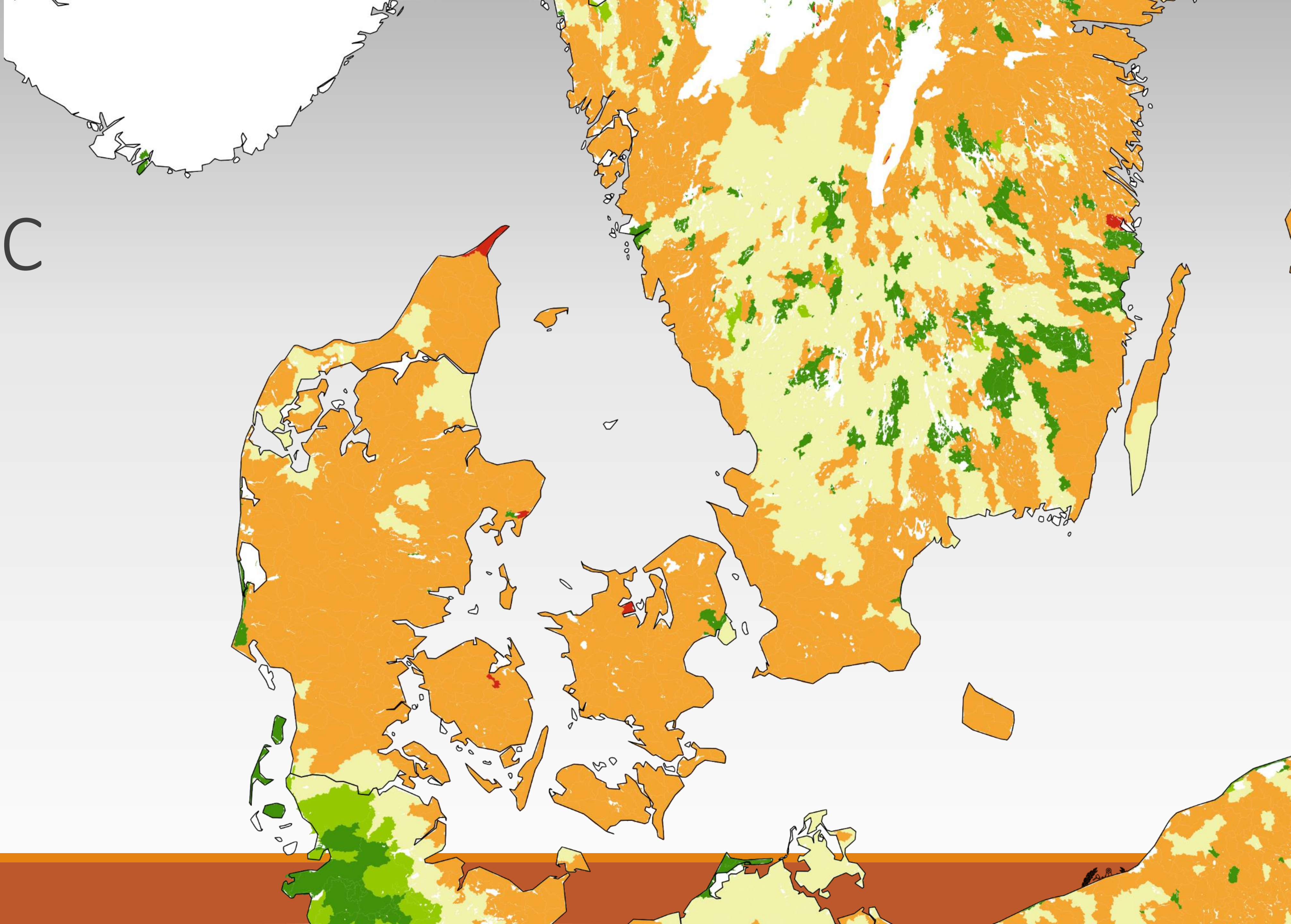
Wind erosion



Total erosion



Loss of SOC



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Recurring floods

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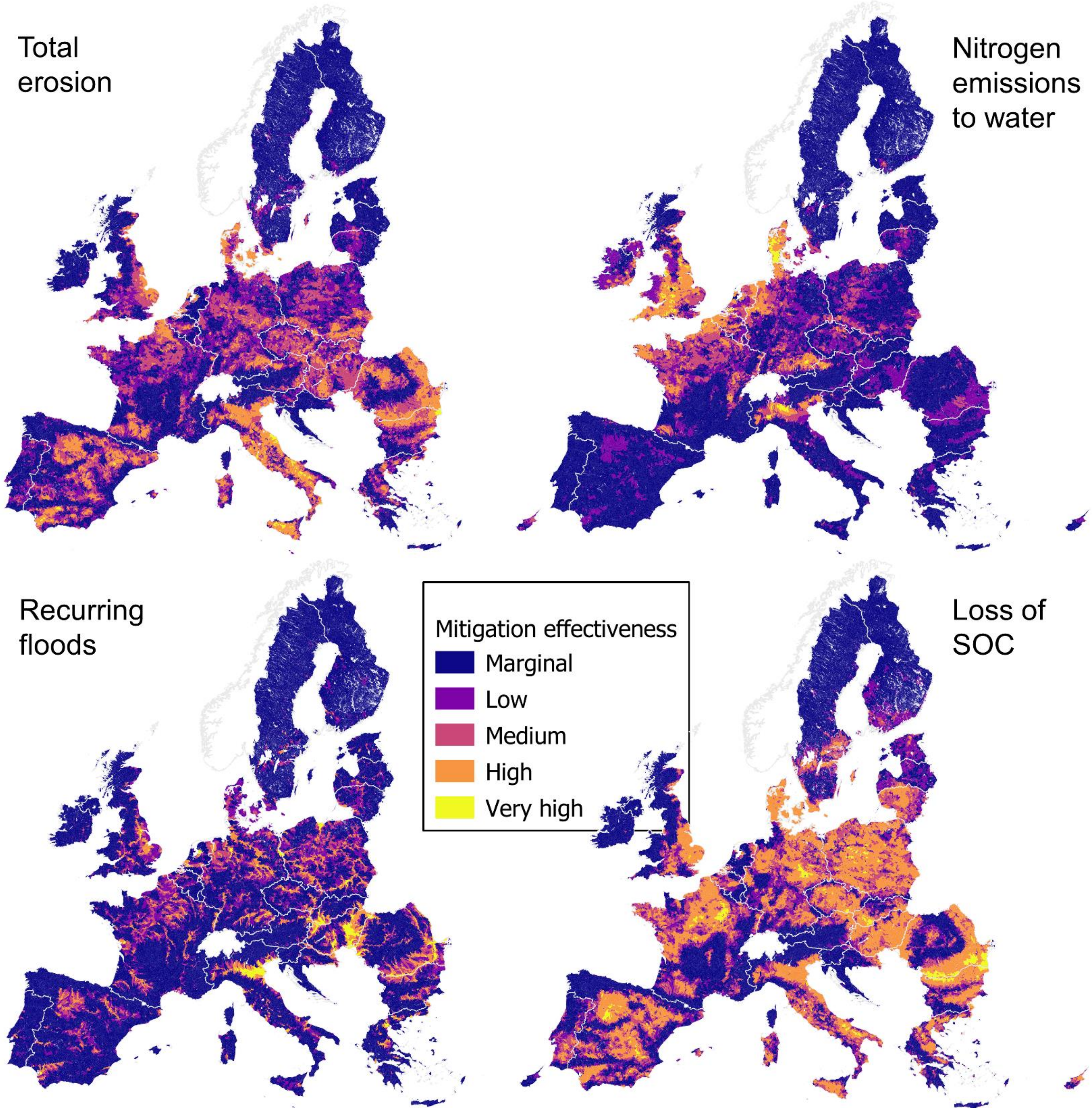
Effectiveness of perennialization



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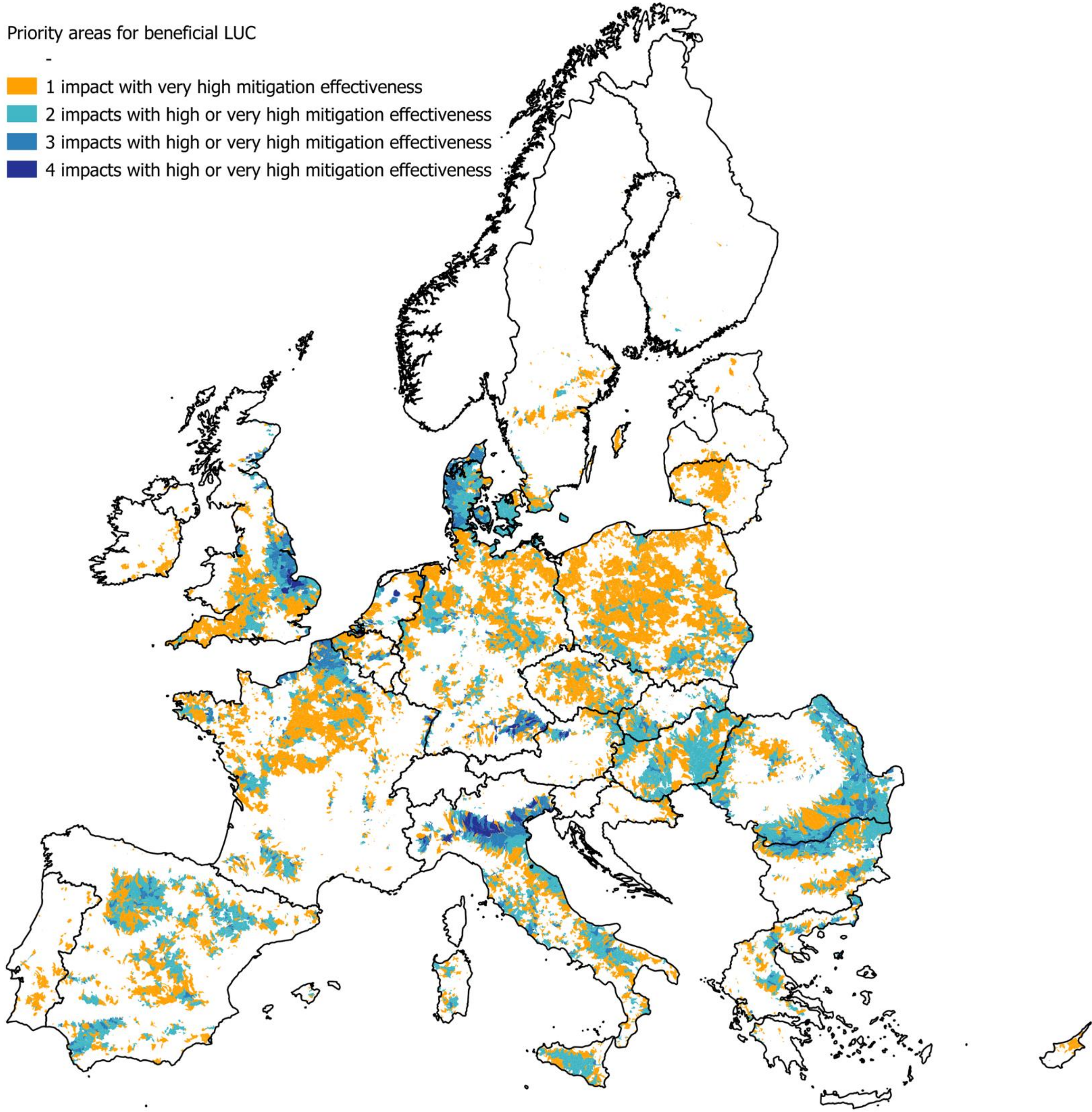
Priority areas



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Next steps

Identify concrete and suitable production systems for strategic perennialization

Model their introduction into individual landscapes and quantify corresponding biomass production

Quantify potential trade-offs

- Cropland displacement
- Water availability

Identify policy implications and economic factors

<u>Pending funding!</u>

(I probably don't have time to talk about)

Biomass "availability"

Availability of biomass resources depends on both biophysical and social factors

1. Biophysical factors and land management determine yields for crops and residues
   - Soil type, topography, temperature, precipitation
   - Crop choice, crop rotations, inputs, e.g., fertilizers and irrigation
2. Governance specifies what society *actually* asks for
   - Type of biomass?
   - How and where can it be produced?
   - *Acceptable* negative environmental and socio-economic impacts?
   - *Desired* positive effects of LUC?
3. Market aspects determine demand and willingness-to-pay
   - Location and size of biomass supply and demand
   - Logistic networks, transport distances, etc.
   - Restrictions and incentives by governance

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