NAPSEA

N and P, source to sea

Blauw, A.N. & van der Heijden, L.H. (coordination team from Deltares)
with support from the whole consortium

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Horizon Europe under NAPSEA - Grant Agreement 101060418

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NAPSEA: Overview

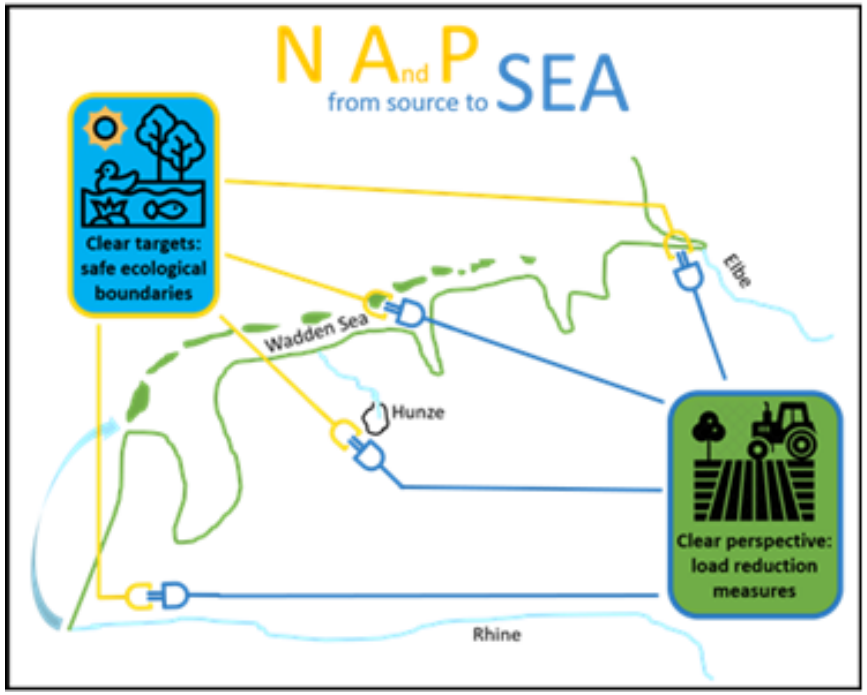
EU call: HORIZON-CL6-2021-ZEROPOLLUTION-01 Clean environment and zero pollution

"Project outcomes will contribute to maintaining nitrogen and phosphorus flows well within safe ecological boundaries at EU, regional and local scale and to restoring ecosystems."

3 perspectives:

- Governance
- Sources and pathways
- Safe ecological boundaries

- 4 case study areas:
  - Wadden Sea
  - Catchments of Rhine, Elbe, Hunze



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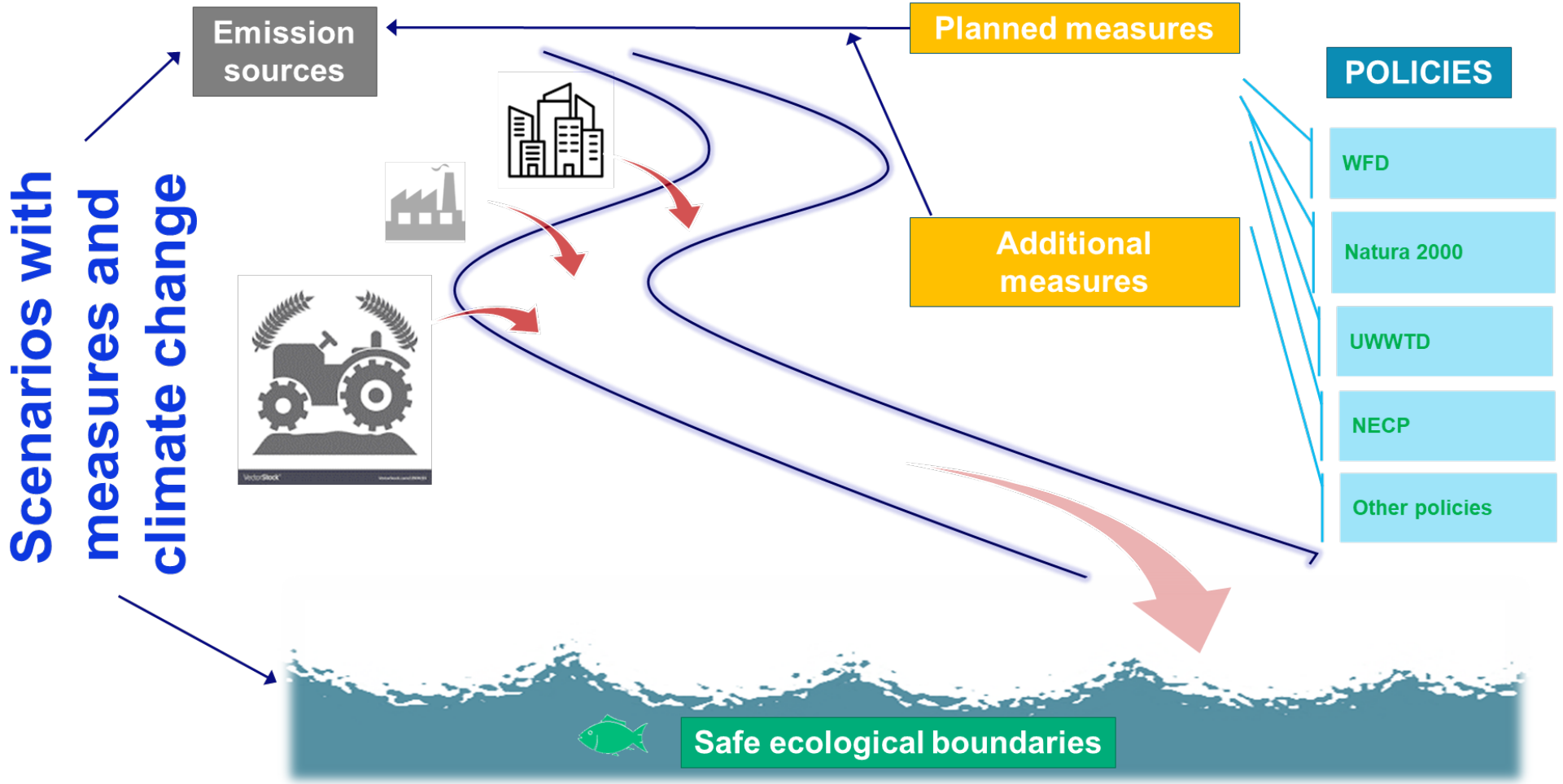
NAPSEA: Structure



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Defining safe ecological boundaries

- Current approach (OSPAR/MSFD/WFD):
  - Estimate pre-eutrophic nutrient loads
  - Estimate pre-eutrophic **nutrient and chlorophyll-a concentrations** in marine waters (coastal models)
  - Threshold = 1,5 x pre-eutrophic concentrations
  - WFD thresholds different between Germany and Netherlands

- Additionally analysed in NAPSEA:
  - Nutrient loads and chlorophyll-a concentrations allowing for **recovery of seagrass** in Wadden Sea
  - N/Si ratios in rivers leading to **nitrogen depletion** during spring bloom
  - Nutrient loads preventing **oxygen depletion** in Elbe estuary
  - Nutrient loads allowing abundance of **submerged vegetation** in Zuid-Laardermeer

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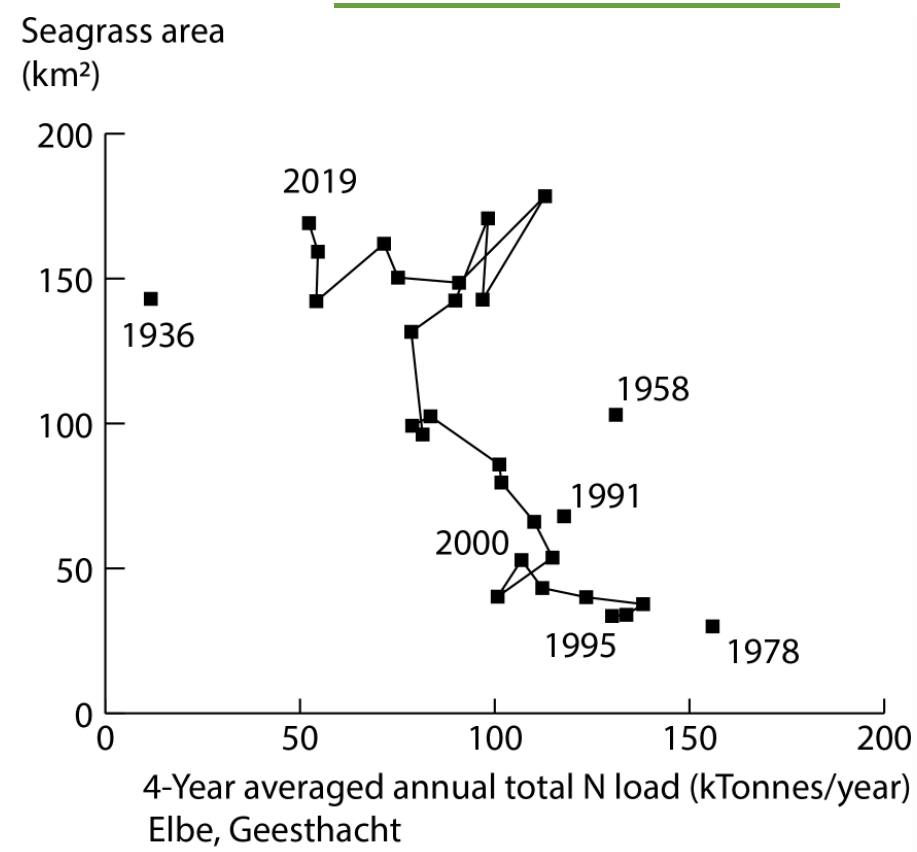
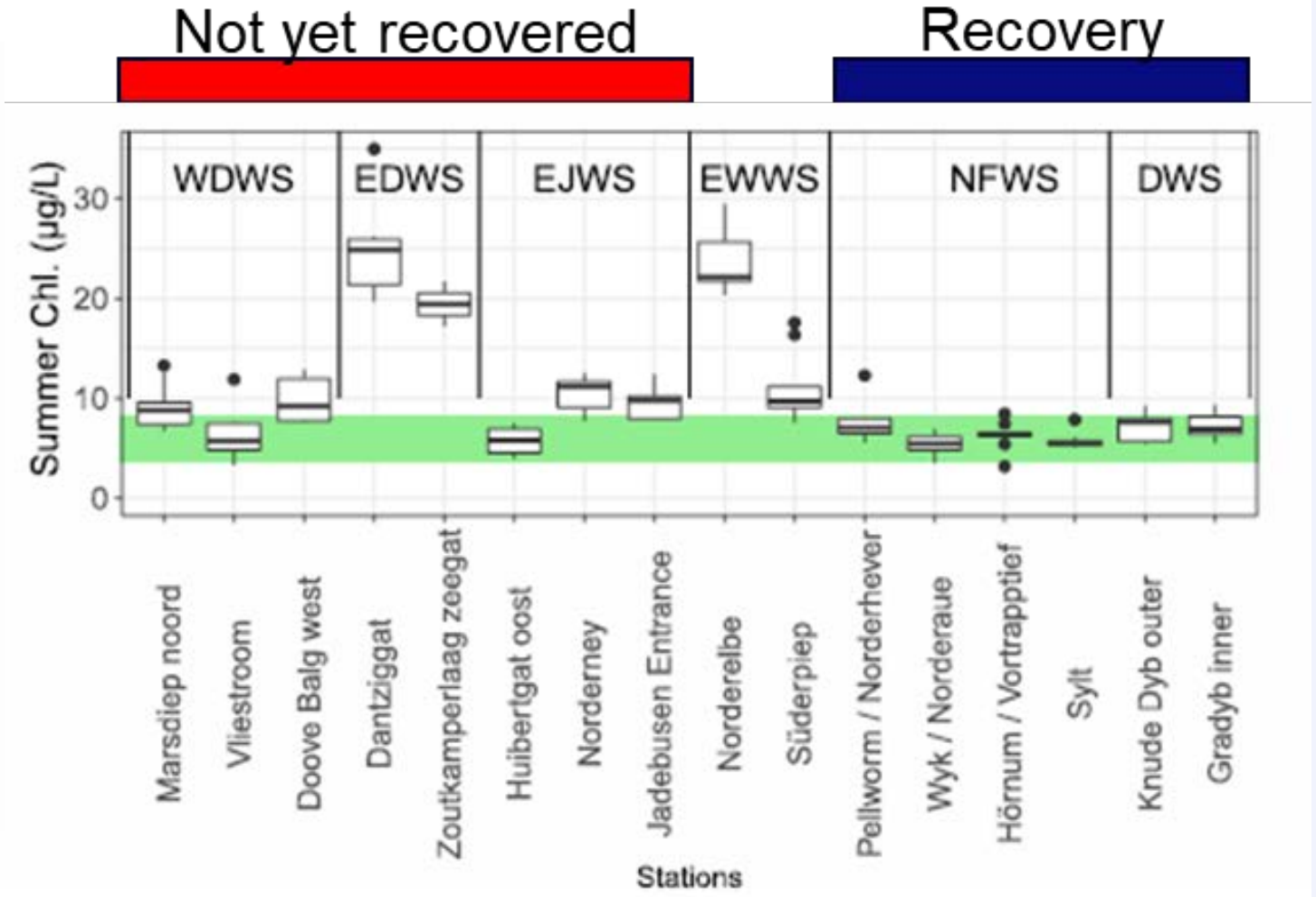
Example 1: Seagrass recovery in Wadden Sea





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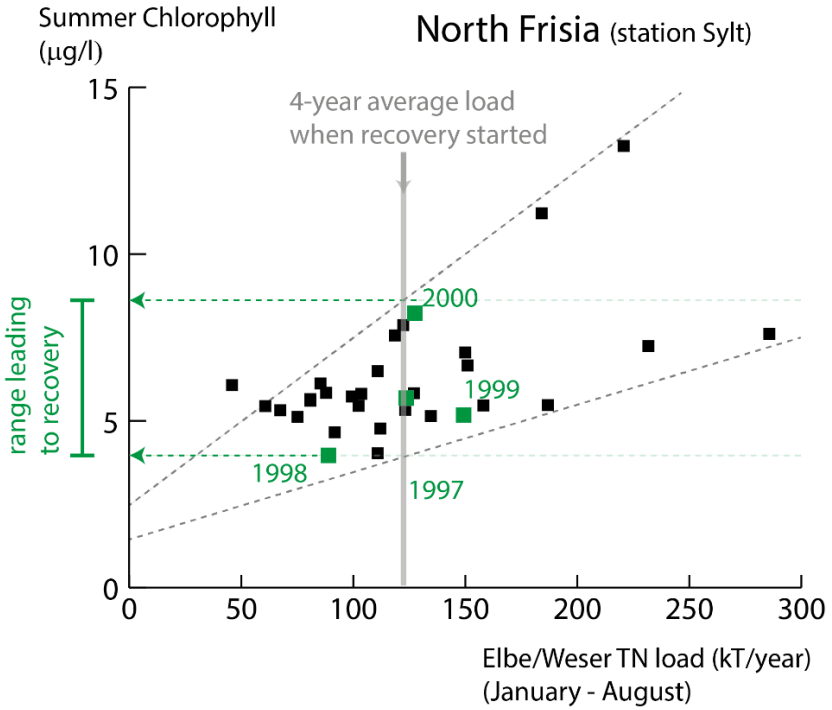
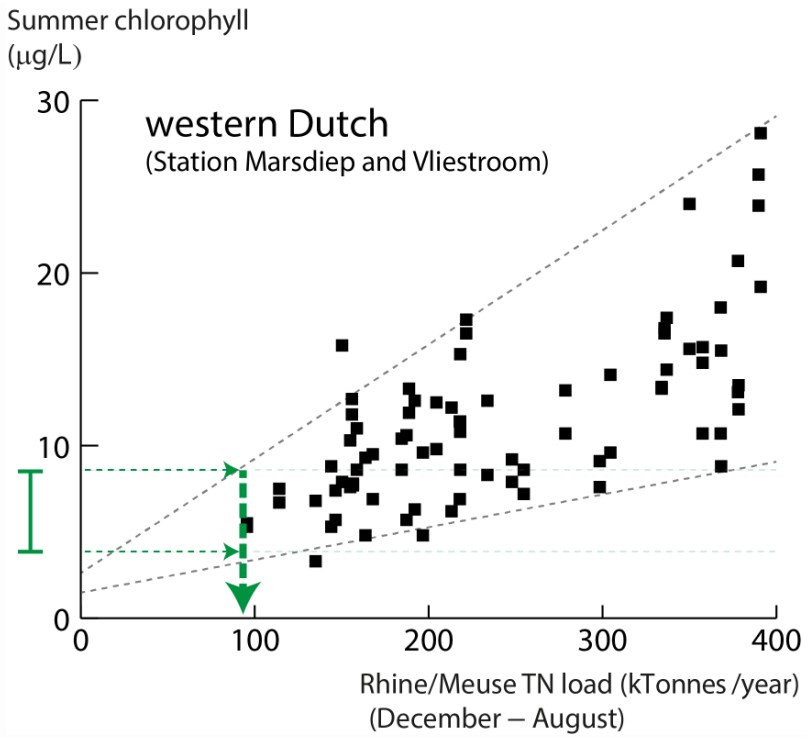
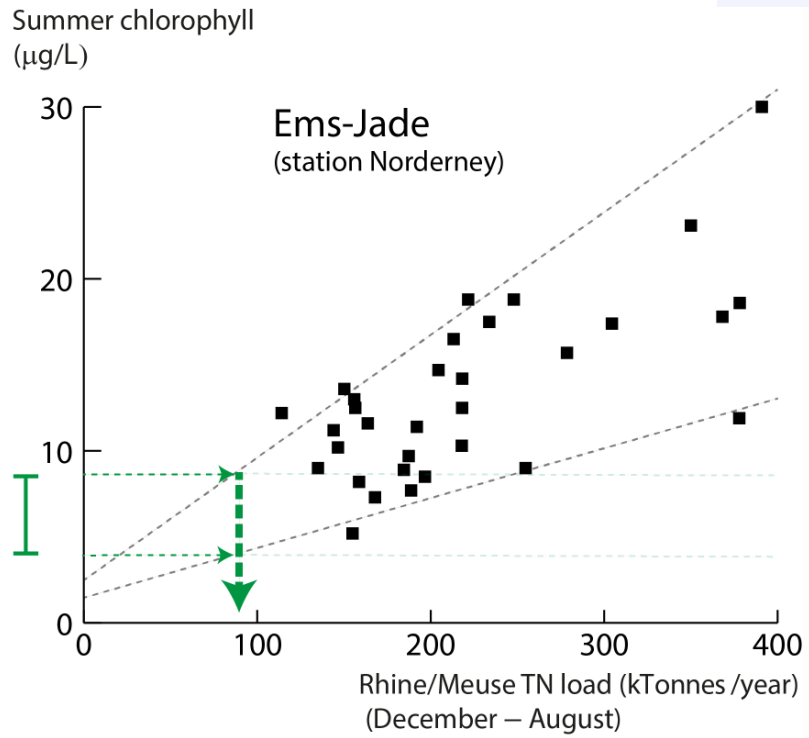
Example 1: Seagrass recovery in Wadden Sea







Nitrogen reduction in Rhine-Meuse to allow for seagrass recovery ranges from **34–43%** relative to ~2010–2017, but other habitat conditions also play a role

(van Katwijk, M. M., J. E. E. van Beusekom, E. O. Folmer, K. Kolbe, D. J. de Jong, and T. Dolch. 2024.)

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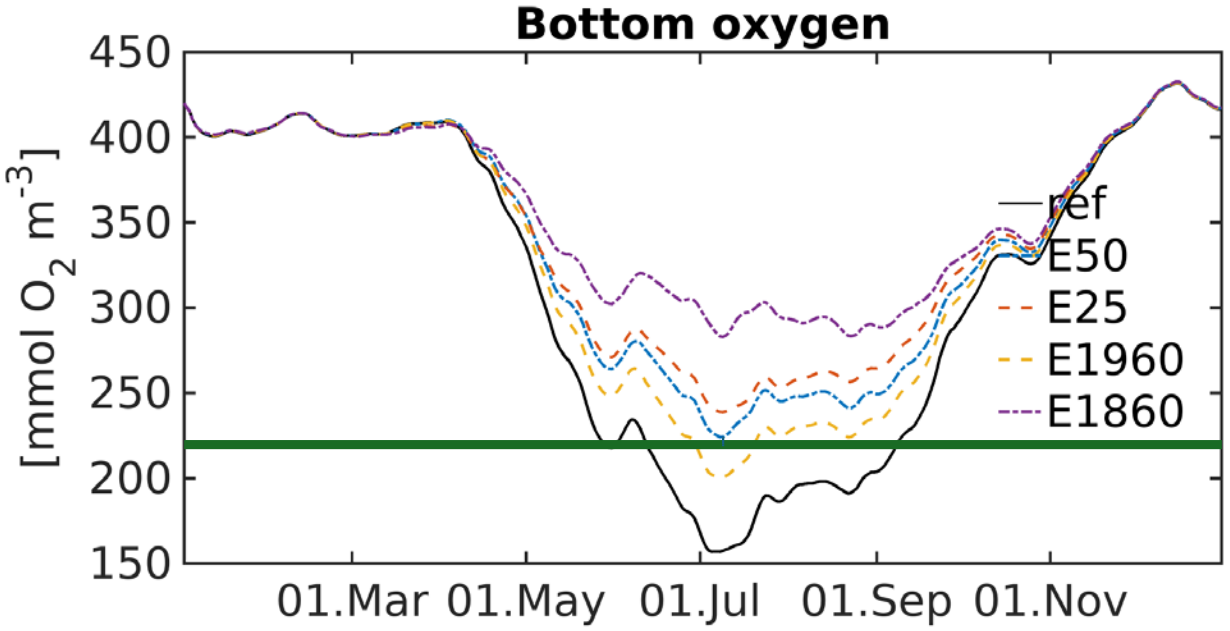
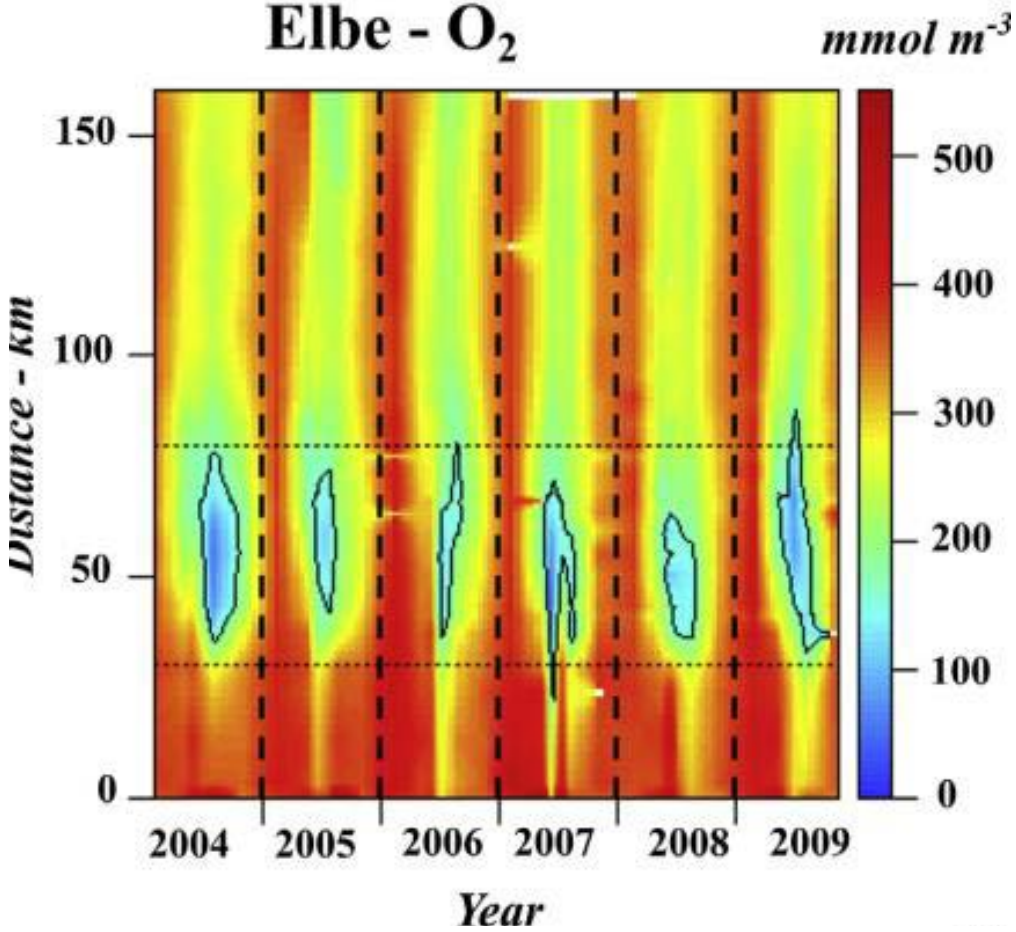
Example 2: Defining safe ecological boundaries Prevent oxygen depletion in Elbe estuary

- Oxygen threshold estuary: > 7 mg/l O_2 (219 µmol/l) according to German law
- Required reduction in N-load is modelled at **~45%**





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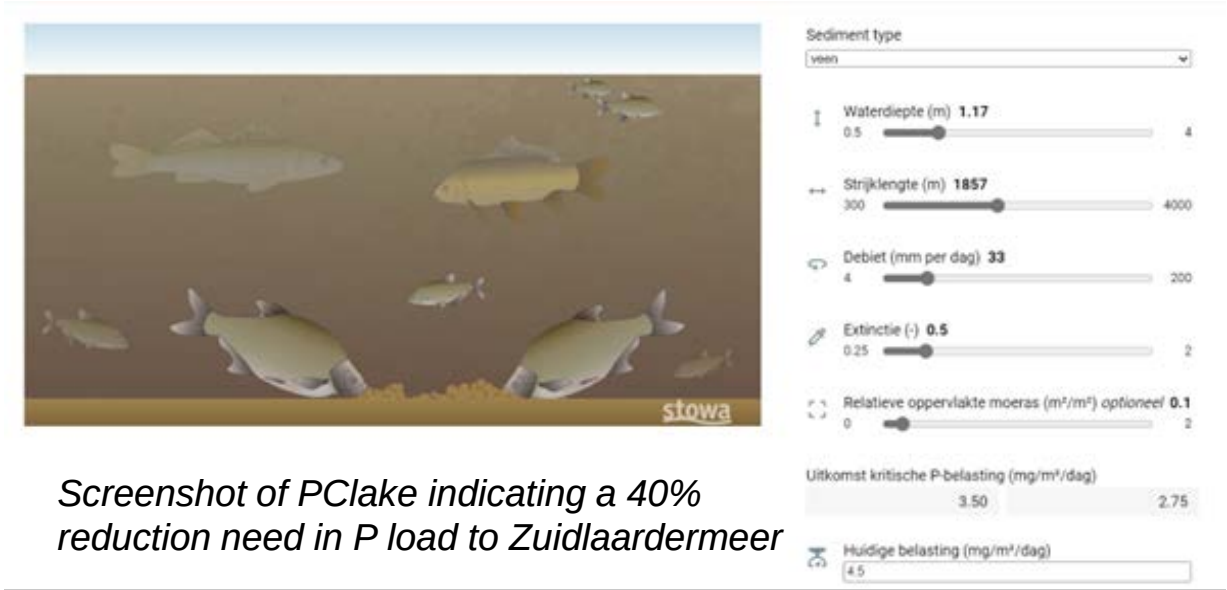
Example 3: Zuidlaardermeer + Hunze

- Local WFD targets for nutrients are already met
- Biological WFD targets are not met (fish and phytoplankton): reduction in P beyond WFD target needed
- High N loads in winter: reduction in winter N beyond summer WFD target needed
- Indicator for these biological targets is submerged vegetation



Screenshot of PClake indicating a 40% reduction need in P load to Zuidlaardermeer

Wadden Sea

Hunze catchment

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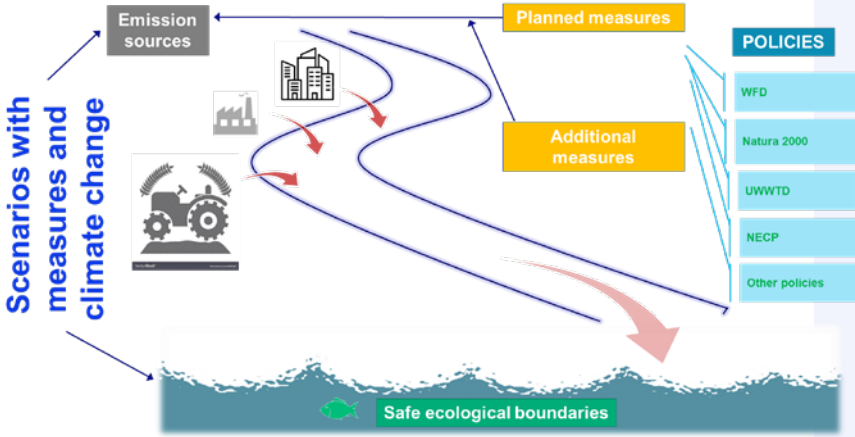
Scenarios to achieve required nutrient reductions

- Ref: Current reference scenario
- Scen 6: No measures, only climate change 2050 (RCP 4.5)



- Scen 5: all planned measures
  - Scen 1: Wastewater treatment (UWWTD)
  - Scen 2: Agriculture: Fertilizer Ordinance (DE), programs of measures (NL)
  - Scen 3: Atmospheric deposition (NEC and other regulations)
  - Scen 4: Nature-based solutions: riparian buffers and flood plains

- Scen 7: additional measures to reach safe ecological boundaries
  - 7A: more strict application of planned measures on wastewater, agriculture and atmospheric deposition
  - 7B: Scen 7A plus more extensive nature-based solutions
  - 7C: Scen 7B + additional measures in agriculture and atmospheric deposition

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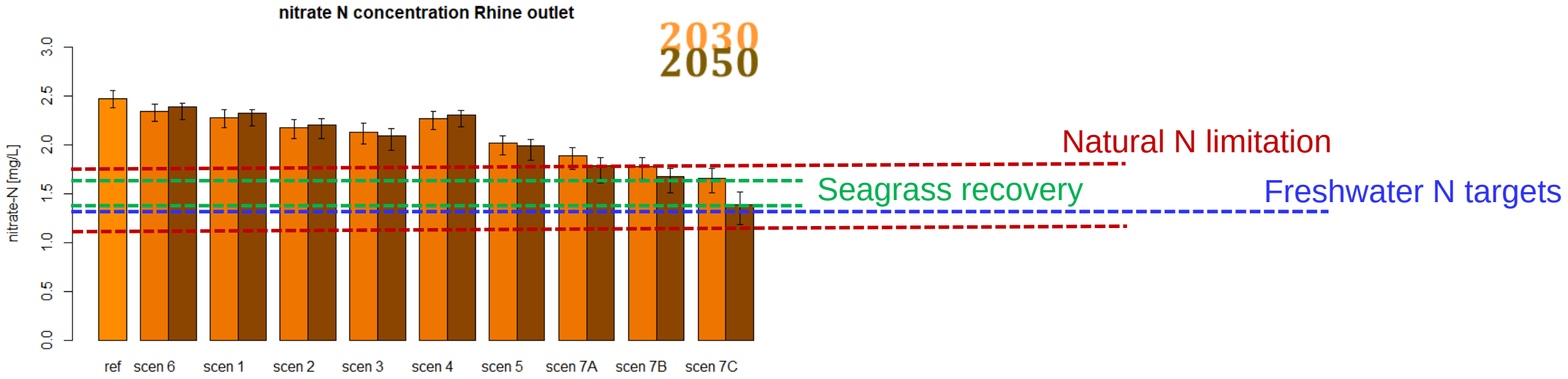
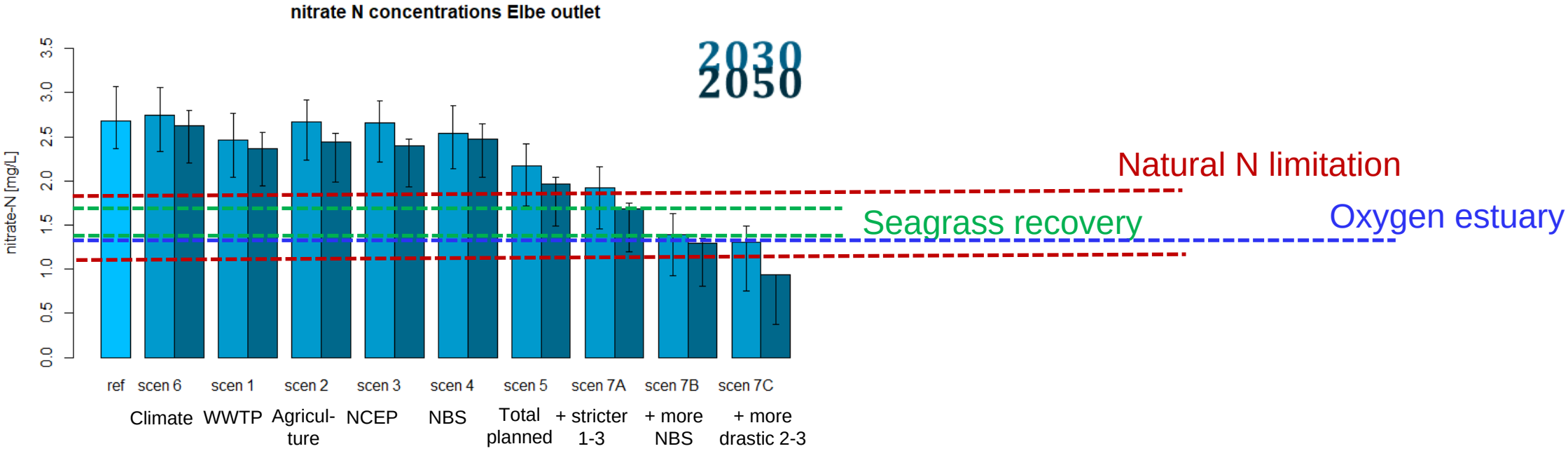
Scenario results: nitrogen Rhine Lobith and Elbe





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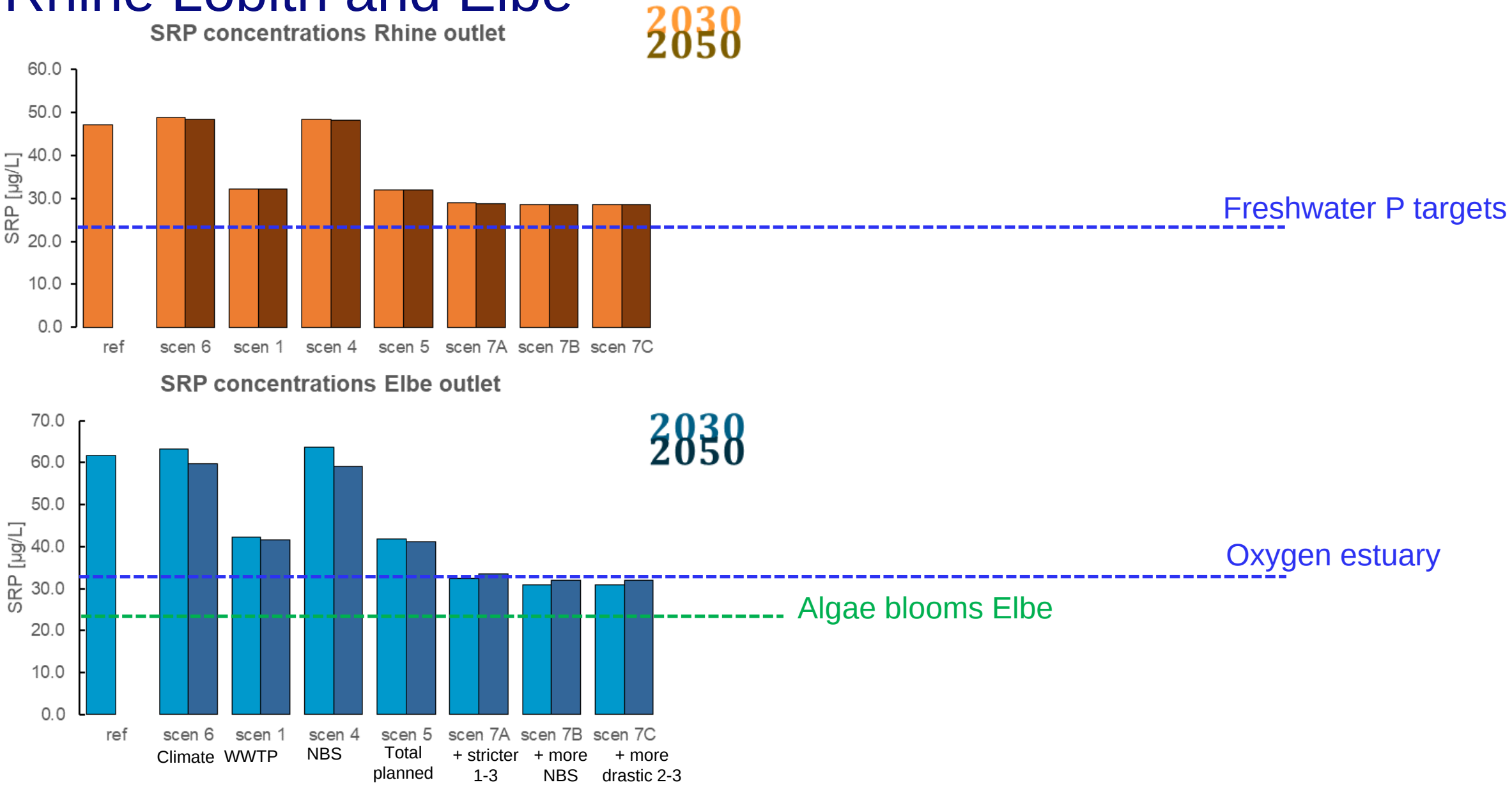
Scenario results: phosphorus (SRP) Rhine Lobith and Elbe



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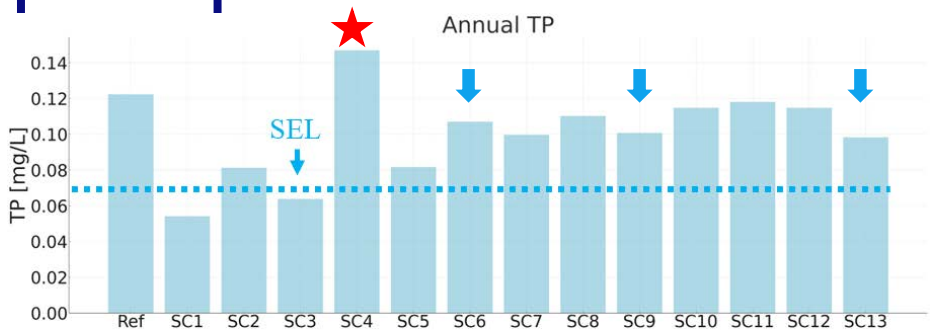
Scenario results: nitrogen and phosphorus Hunze

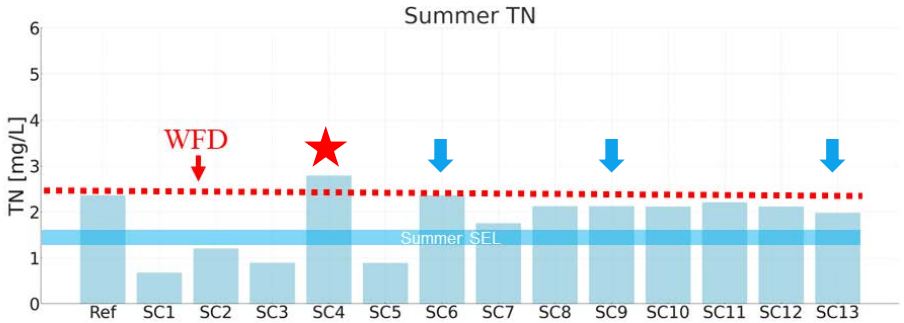
Hunze: small catchment with more detailed scenarios discussed with local stakeholders

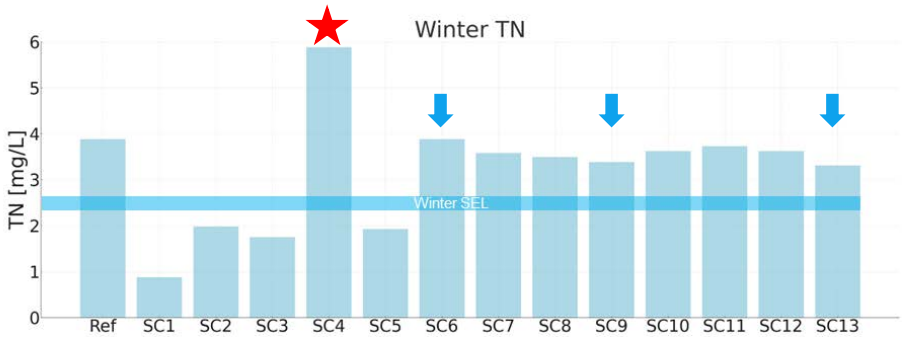
- Proposed safe ecological limits for summer TN are lower than current WFD thresholds

⬇ Planned measures (SC6, SC9 & SC 13) already bring the safe ecological limits (SEL) in sight, multiple options for last reduction step

★ Land use change from dairy (grassland) to arable (SC4) is a risk







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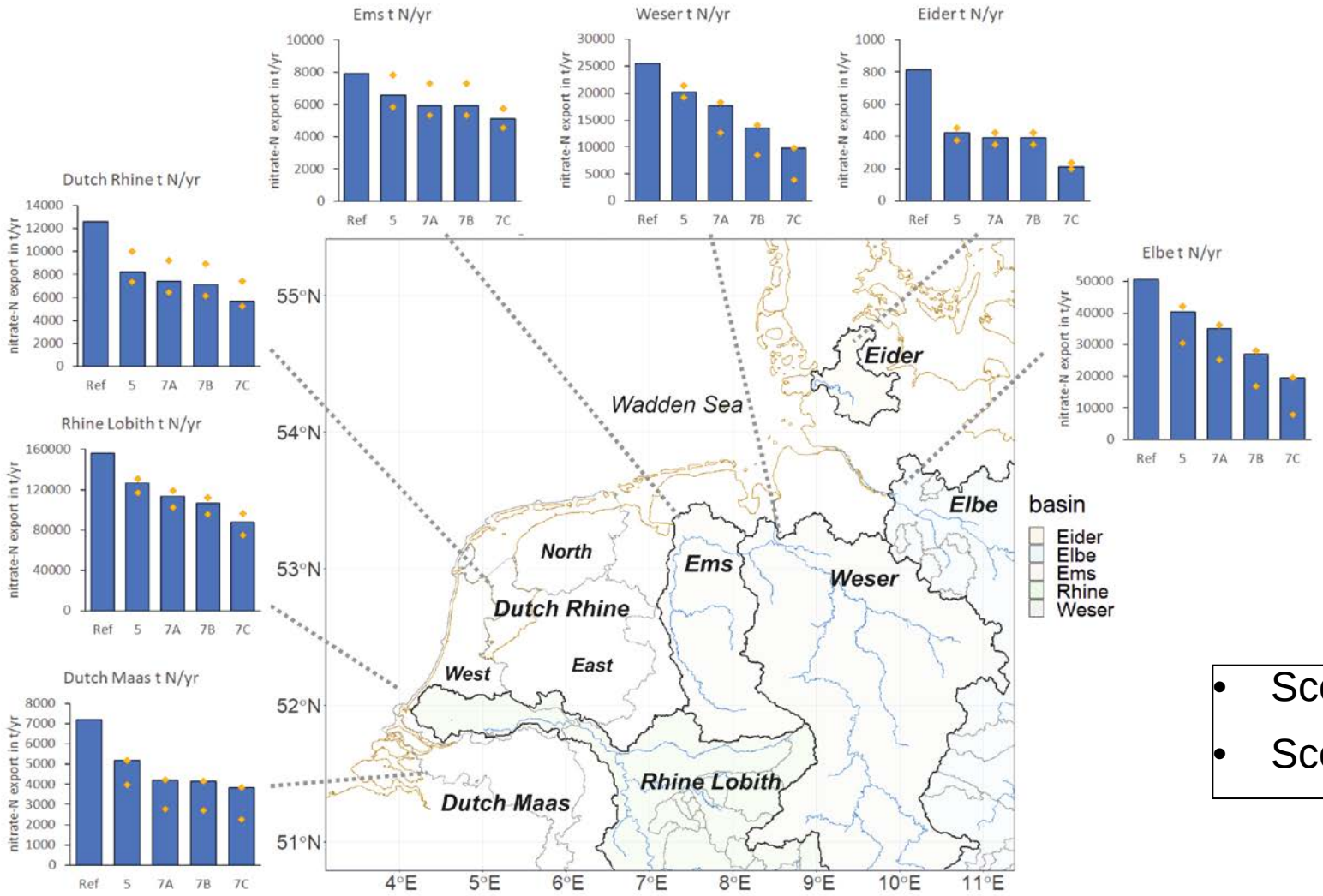
Scenario results for Nitrogen extrapolation: all basins contributing to Wadden Sea eutrophication



- Scen 5: Planned measures
- Scen 7: Additional measures

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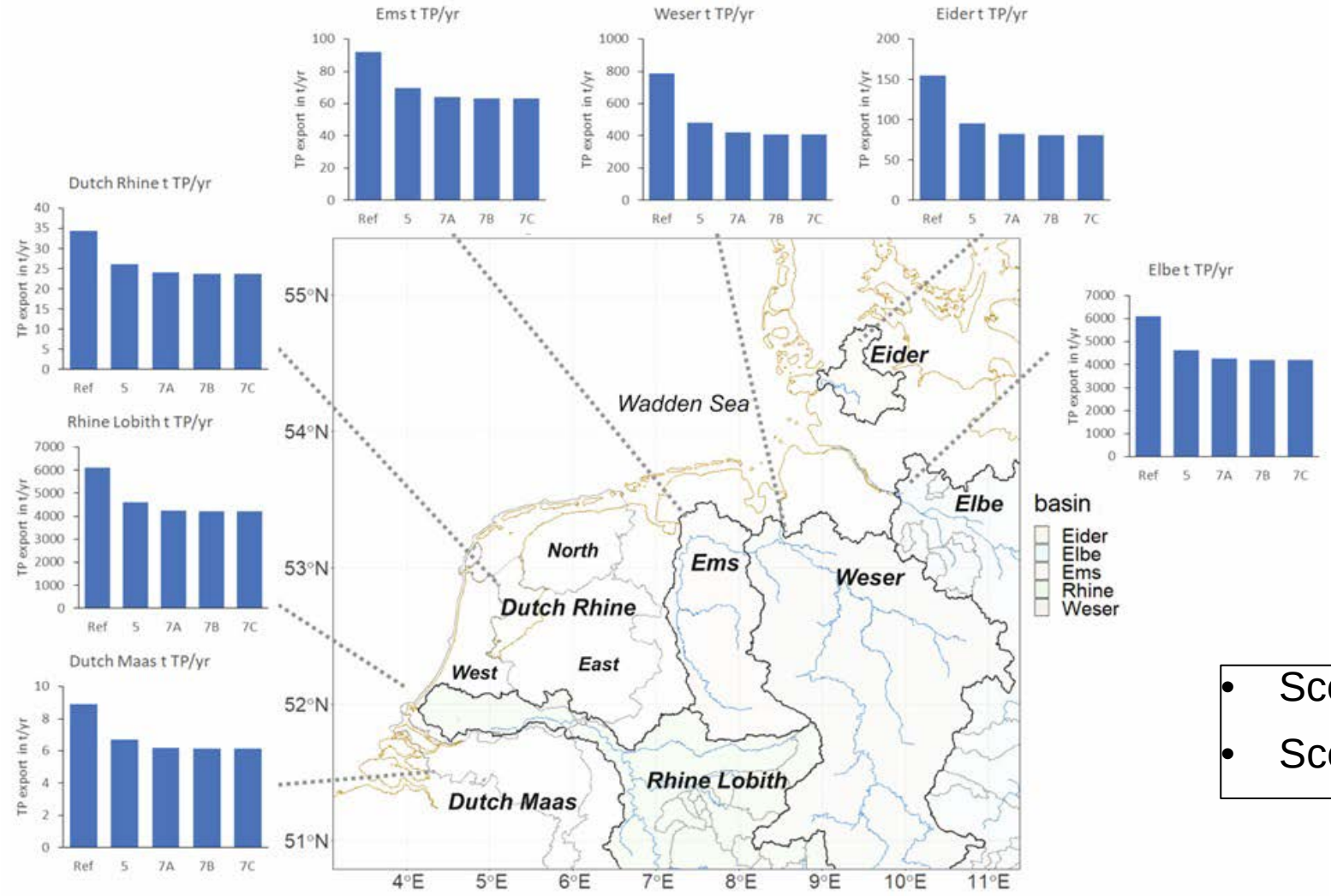
Scenario results for Phosphorus extrapolation: all basins contributing to Wadden Sea eutrophication



- Scen 5: Planned measures
- Scen 7: Additional measures

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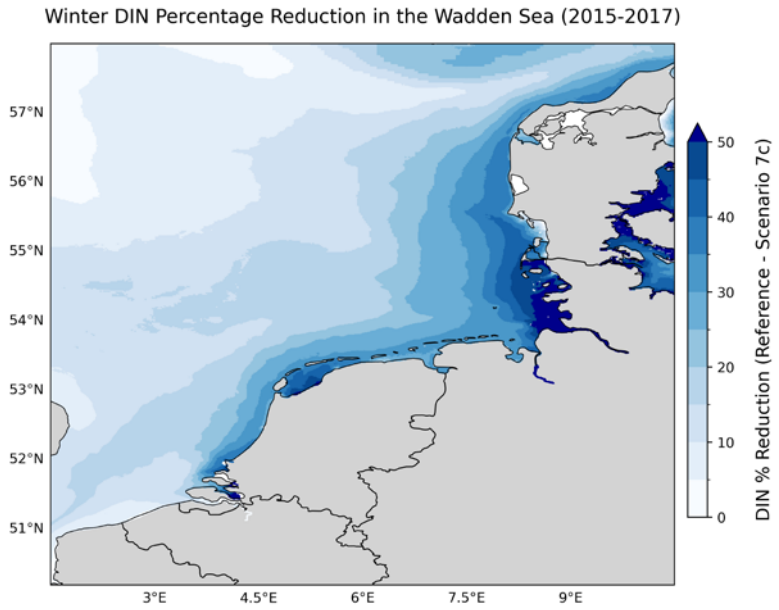
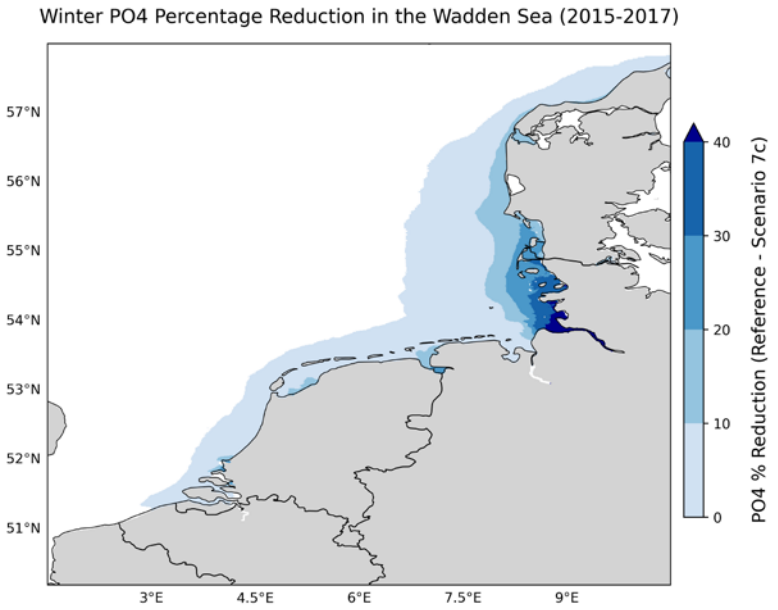
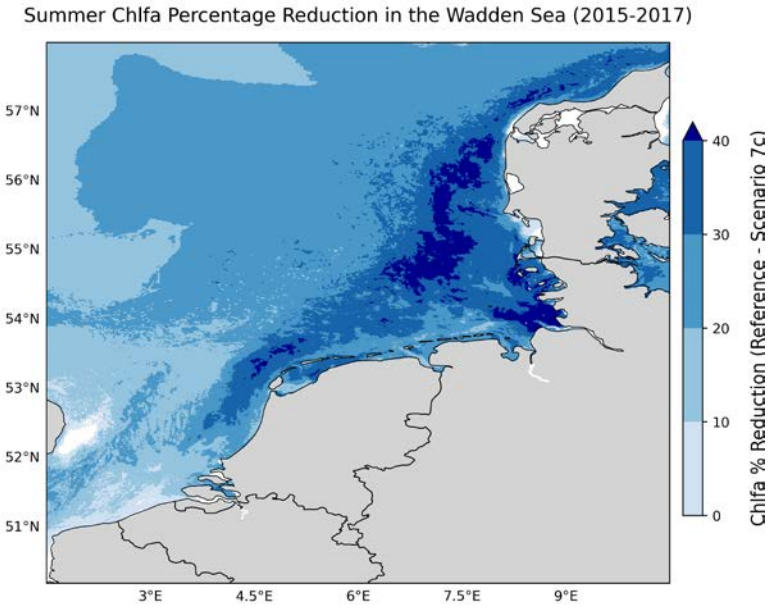
Impact of river load reduction scenarios on concentrations in Wadden Sea and coastal waters:

Results of marine eutrophication model (2015 – 2017), fed with reduced river loads (Scen 7C)

- Winter DIN and DIP (Dec – Feb), Summer chlorophyll-a (May – Sep)







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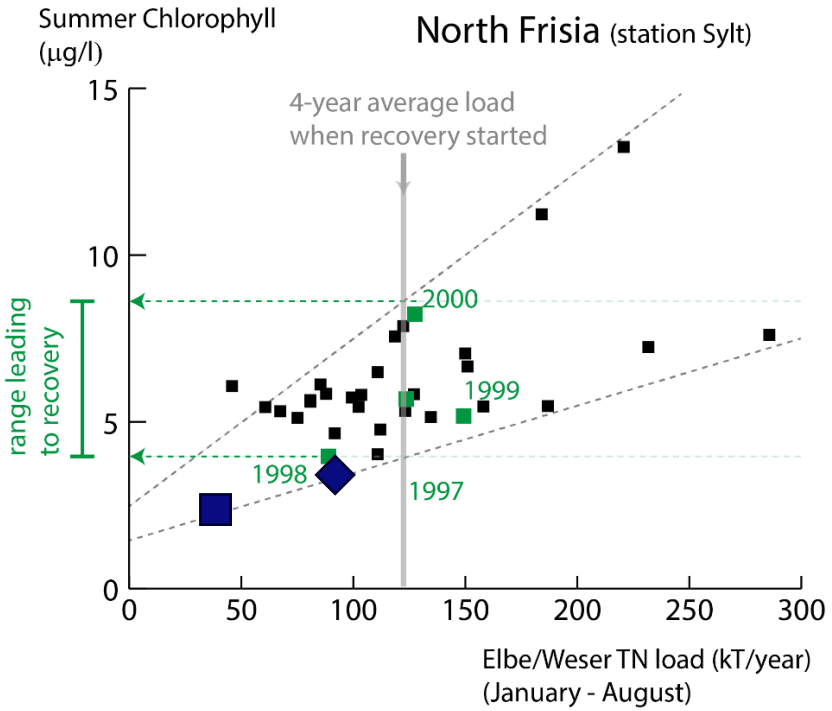
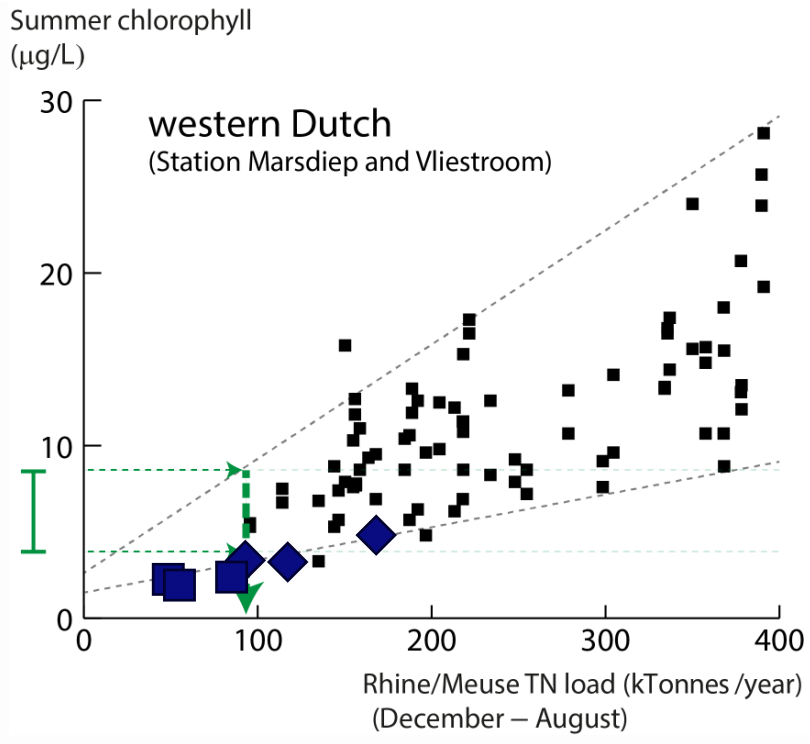
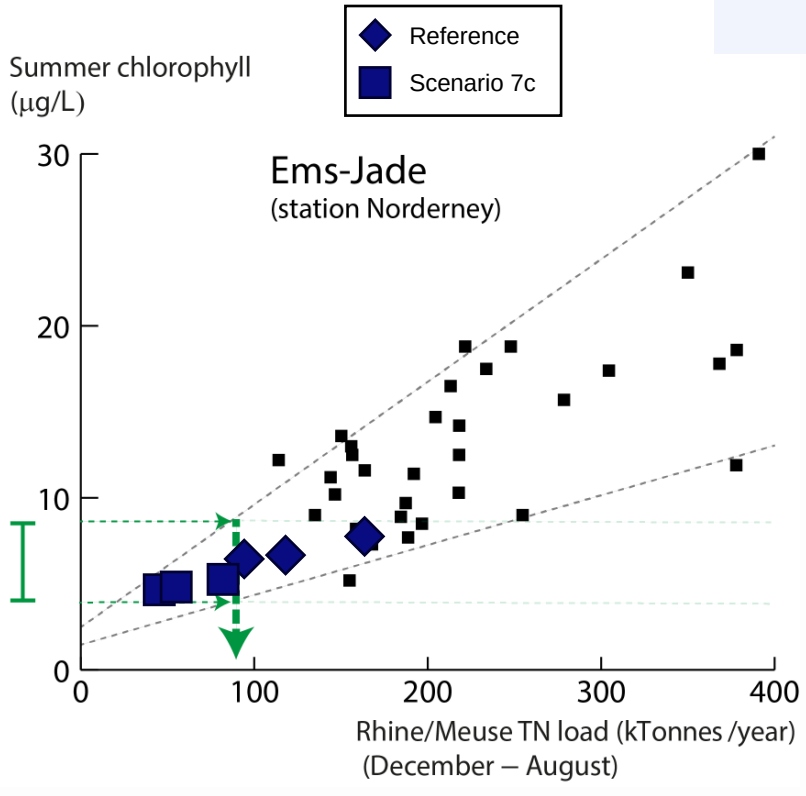
Impact of scenario 7c on nitrogen loads to Wadden Sea







Modelled TN loads and Chl-a
- Years 2015-2017

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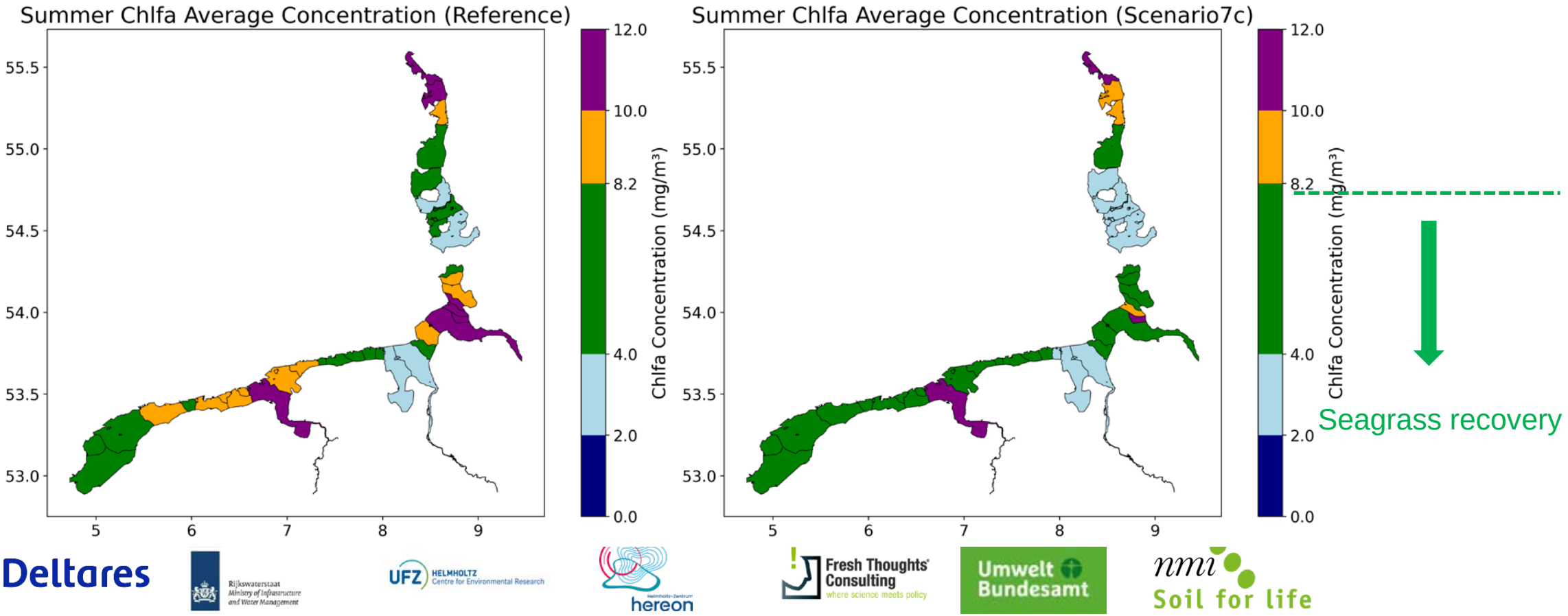
Model results summer chlorophyll-a and potential for seagrass recovery

Results of marine eutrophication model (2015 – 2017), fed with reduced river loads (**Scen 7C**: right) compared to river loads under current reference conditions (left)



In conclusion on safe ecological boundaries and reduction scenarios:

- Nutrient reductions for estimated safe ecological boundaries are largely in the same range
- Planned measures tend not to be sufficient to reach these safe ecological boundaries
- Additional measures, that are more drastic, can achieve the required nutrient reductions to reach safe ecological boundaries

BUT: How can these nutrient reductions be realized?

- Is the current policy framework sufficient?
- What would be needed to get more social acceptance and political support for measures?

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Policy analysis and recommendations

Eutrophication targets and objectives are:

- **coherent within** the inland water systems (WFD etc.) and **within** the marine system (MSFD etc.)
- **incoherent between** inland waters and marine waters

=> better coordination between regional sea conventions and river basin authorities

=> timely inform local authorities on latest scientific knowledge

- The latest CAP (update April 2024) reduces the environmental requirements to which farmers must abide to receive direct payments.

- Identified gap in regulations on Soil and its nutrient management could be closed by the proposed new Soil Monitoring Law: to protect and restore soils and ensure that they are used sustainably.

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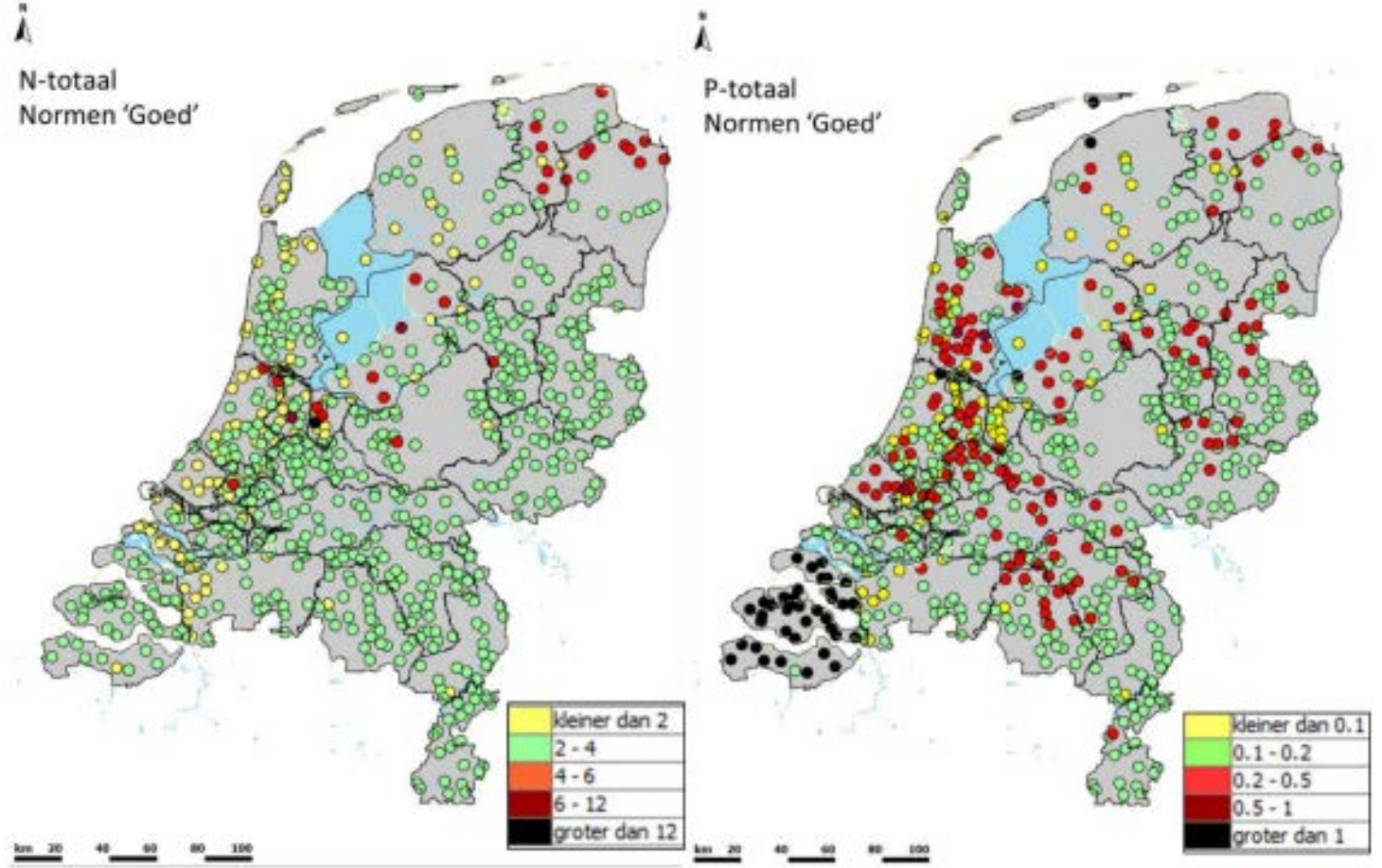
Review of currently used indicators, direct and indirect effects and nutrient targets

Comparison between indicators and thresholds for eutrophication

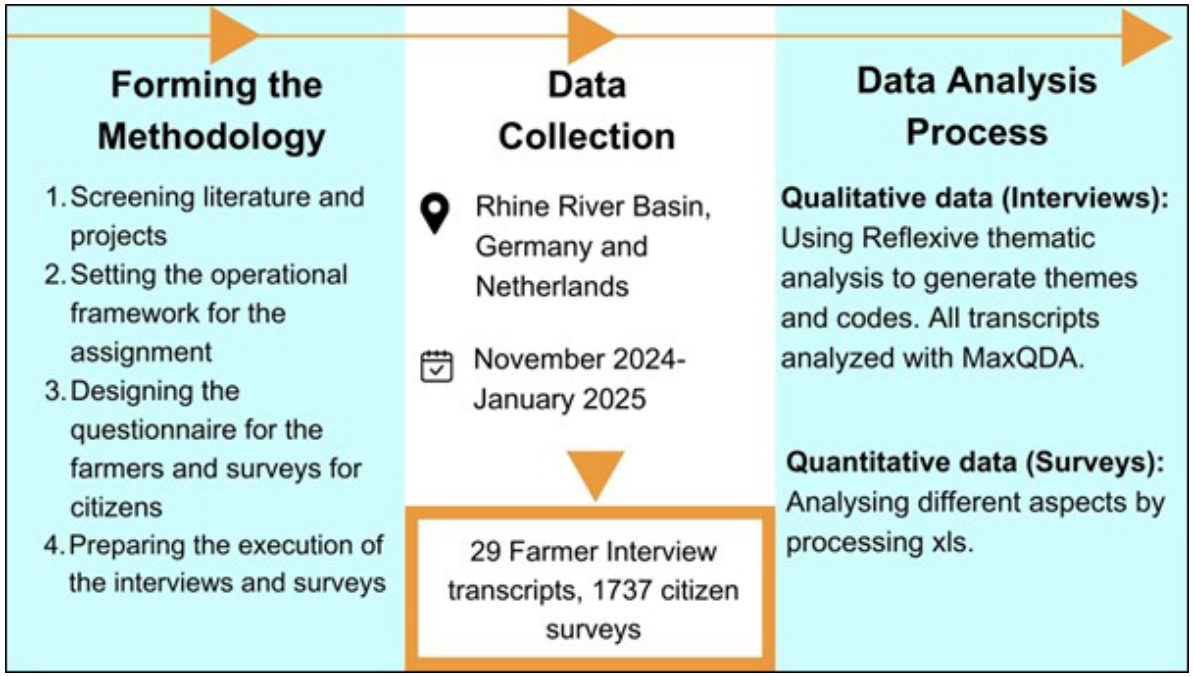
- in WFD and OSPAR/MSFD and
- between Germany and the Netherlands:
  - Do we use the same indicators?
  - Is there a logical sequence in the thresholds over the freshwater-marine gradient?
  - Nutrient targets/thresholds vary over Dutch system



Figuur 2.2 Normgrens goed-matig voor N-totaal links en P-totaal rechts in 2019 in mg/l.

Analysis of social acceptance of nutrient reduction measures

Methodological Process



Research Questions of the Study

- What is the level of social acceptability of the measure?
- What are the barriers for implementing the measures? (higher costs/ administrative work/ lack of evidence of effectiveness/ maintenance work etc.)
- Which factors can support the implementation of these measures?
- How aware is a farmer or citizen living far away from the Wadden Sea about the effects of their activities at the river Rhine (e.g. in Bavaria) have for the Wadden Sea and what are they willing to change?

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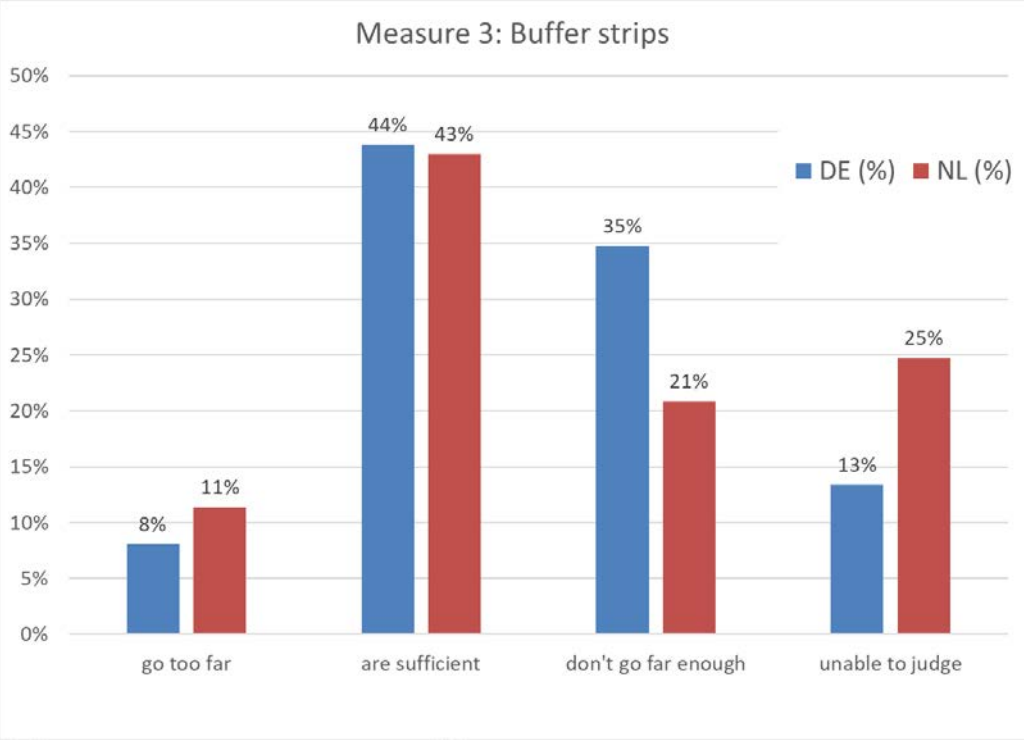
Social acceptance of nutrient reduction measures, analysis of survey results



Citizens assessment of regulations show large variation (example for buffer strips above)

Farmers implement nutrient-reduction measures for a mix of reasons, usually a combination of reasons:

- professional pride and good agricultural practice are the most frequently mentioned drivers,
- economic incentives and ecological concerns also play key roles,
- opinions vary on responsibility, fairness, and the effectiveness of current regulations.

Overall conclusions and recommendations NAPSEA

Source to sea approach supports integrated analysis of eutrophication drivers and measures

Social acceptance of measures would benefit from more transparency on their derivation

Transparency is currently hampered by:

- Limited observations on current nutrient loads:
  - Observations of water quality and discharges are rarely in the same location, near the outlet
- Incoherent monitoring efforts across Wadden Sea (data of sea grass, cyanobacteria, total N, silicate)
- Differences in thresholds between WFD and OSPAR/ MSFD
  - Unclear whether thresholds aim at local water quality or water quality downstream
- Quantification of uncertainties in estimations of safe ecological boundaries and effectiveness of measures


Thank you for your attention
Questions?