



Deltares



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From Rain to Runoff: Understanding Nutrient Dynamics in Dutch Agricultural Waters

#85

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An aerial photograph of a city, likely New York City, showing a wide river (the Hudson River) flowing through it. A large bridge with a white arch spans the river. The city is densely packed with buildings, and there are green spaces and roads visible. The sky is blue with some clouds.

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Independent knowledge institute
for water and the subsurface

Introduction



Visualization by Arte based on Eurostat

Country	Agricultural export (in billions)
United States	180 \$
Brazil	167 \$
Netherlands	134 \$
China	99 \$
Germany	81 \$



Introduction

Nutrient surplus in agriculture (1970 = 100)

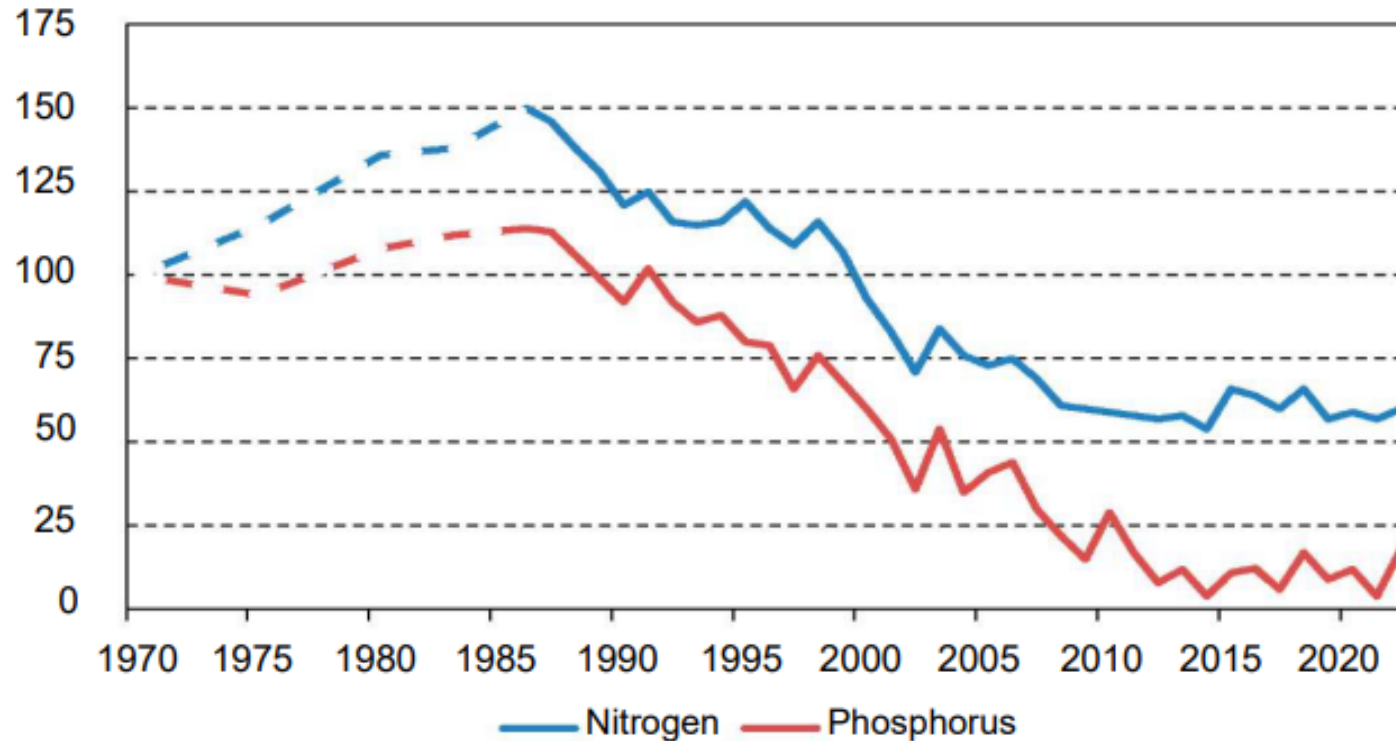


Figure S 1 Trend in the relative surpluses of nitrogen and phosphorus in Dutch agriculture. Value for 1970 indexed as 100. Annual measurements since 1986. Before that only in 1970, 1975, 1980 and 1983.

- 1986: Dutch Manure Law
- 1991: European Nitrate Directive
- 2000: Water Framework Directive



Monitoring network

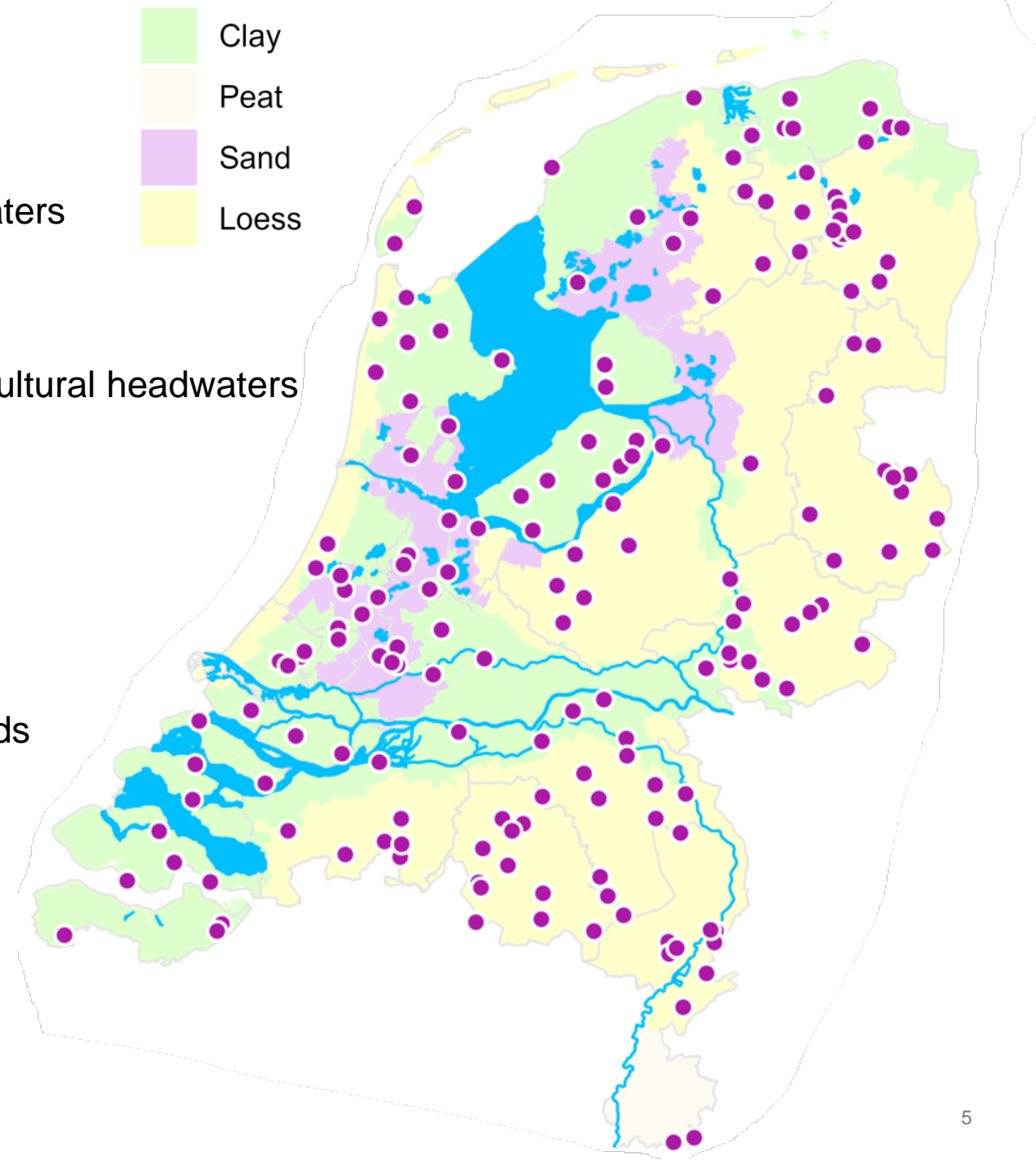
Nutrient Monitoring Network for Agriculture Specific Headwaters
(Dutch: **MNLSO**)

Goal:

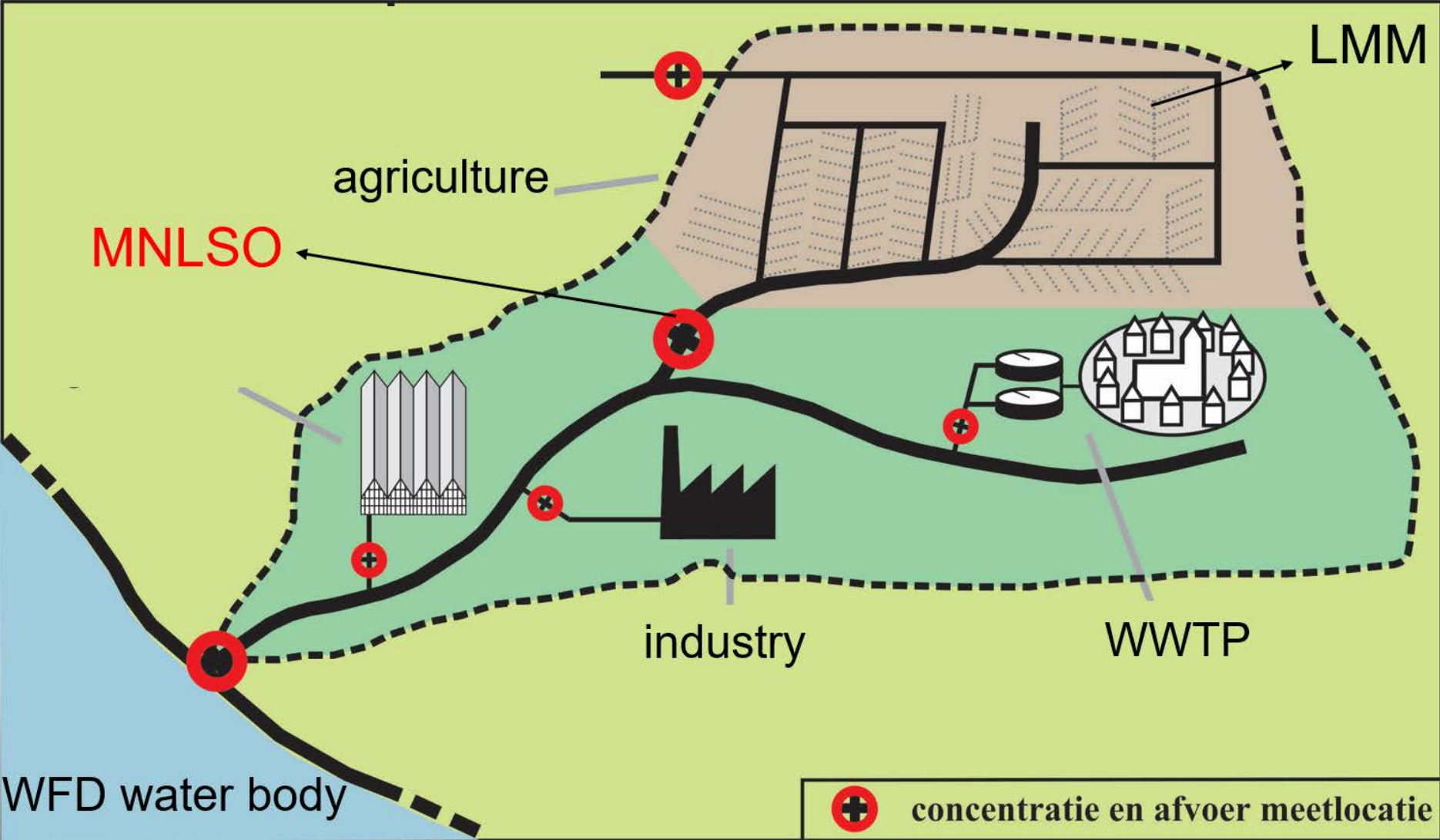
- Monitoring based assessment of the water quality in agricultural headwaters
- Compliance with water quality targets for nutrients
- Trends in nutrient concentrations

Characteristics:

- Operational since 2012
- 172 existing monitoring locations operated by Water Boards
- 145 trend locations with time series longer than 10 years
- Monthly measurements of N-tot, P-tot

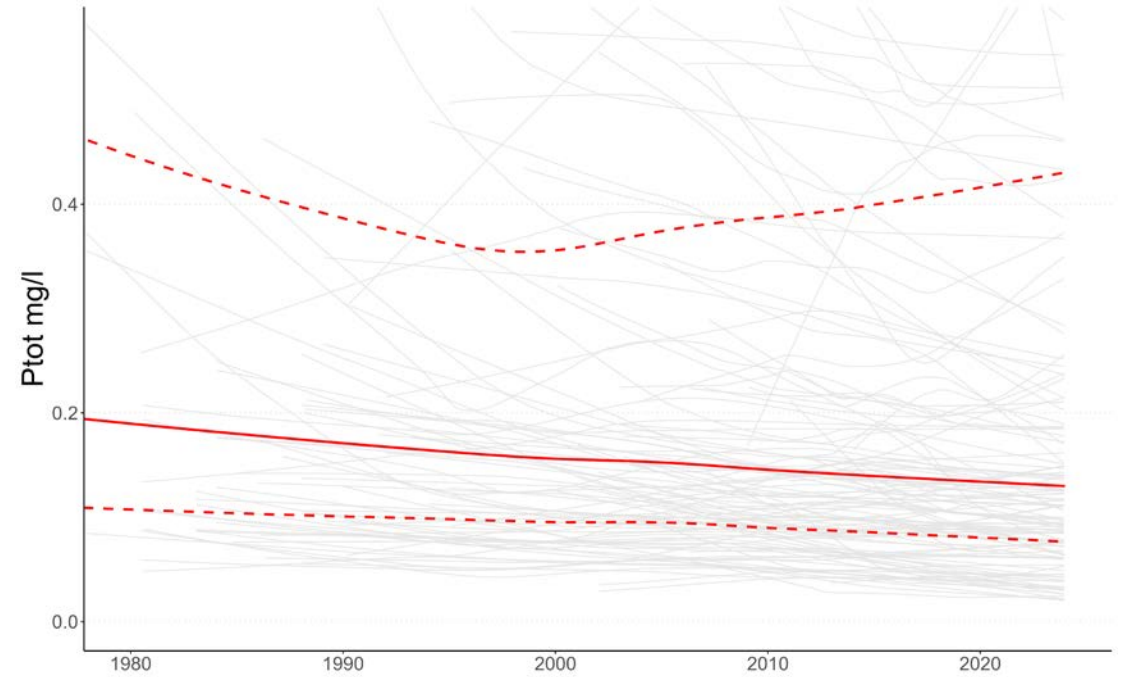
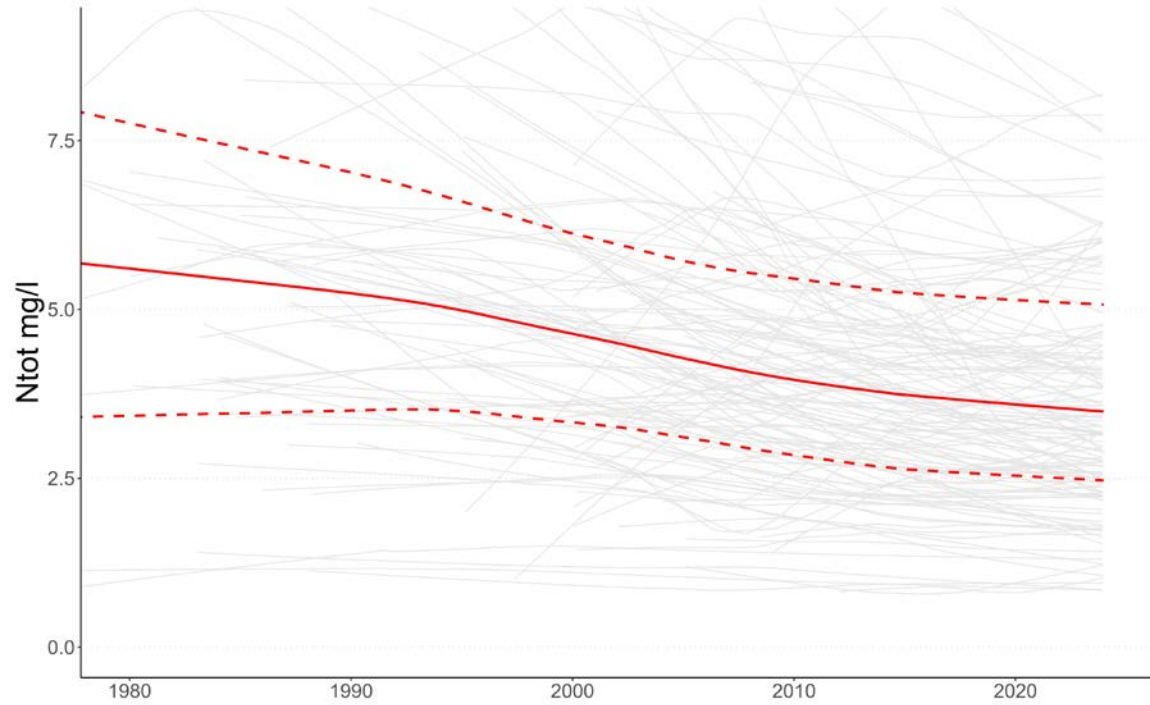


Coherence of monitoring networks

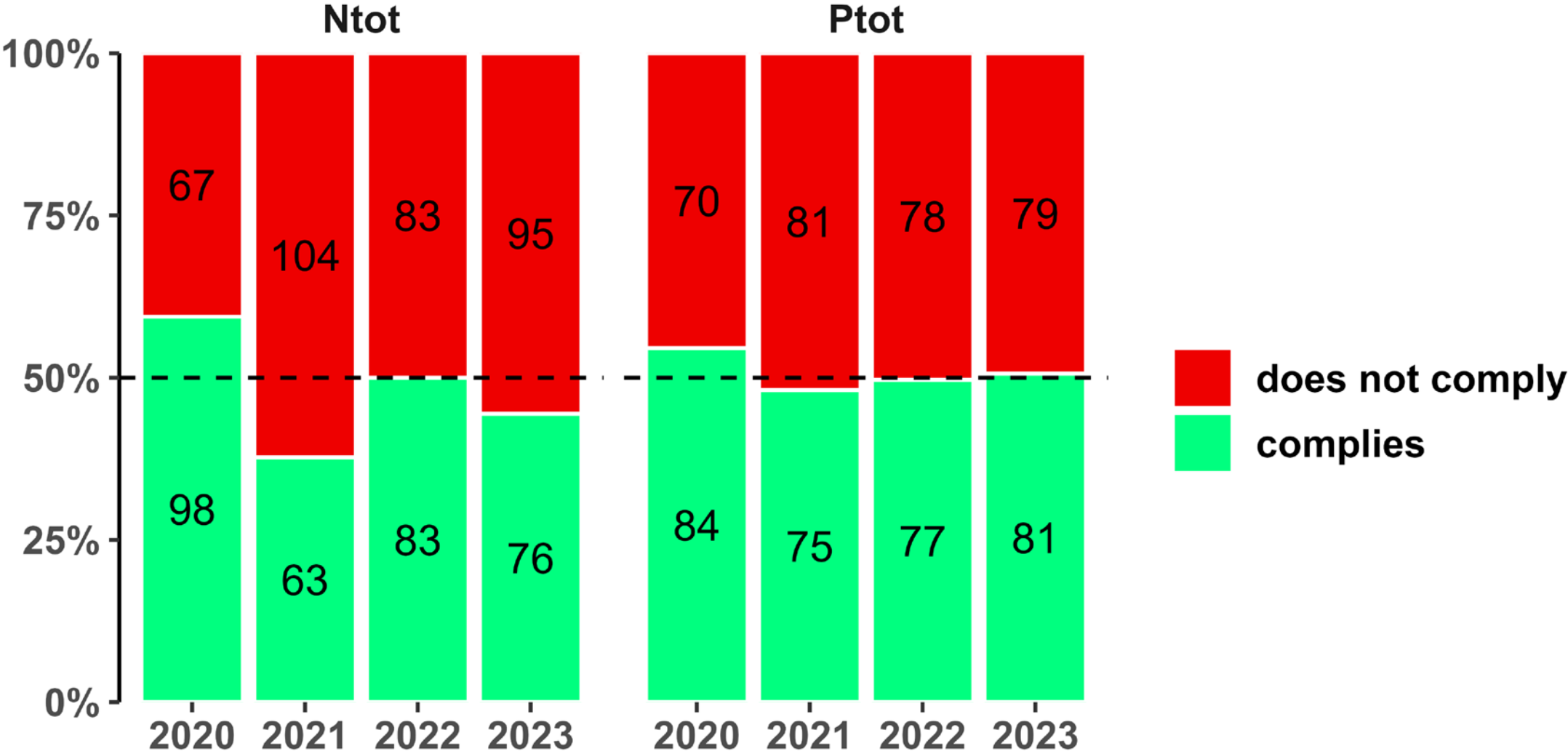


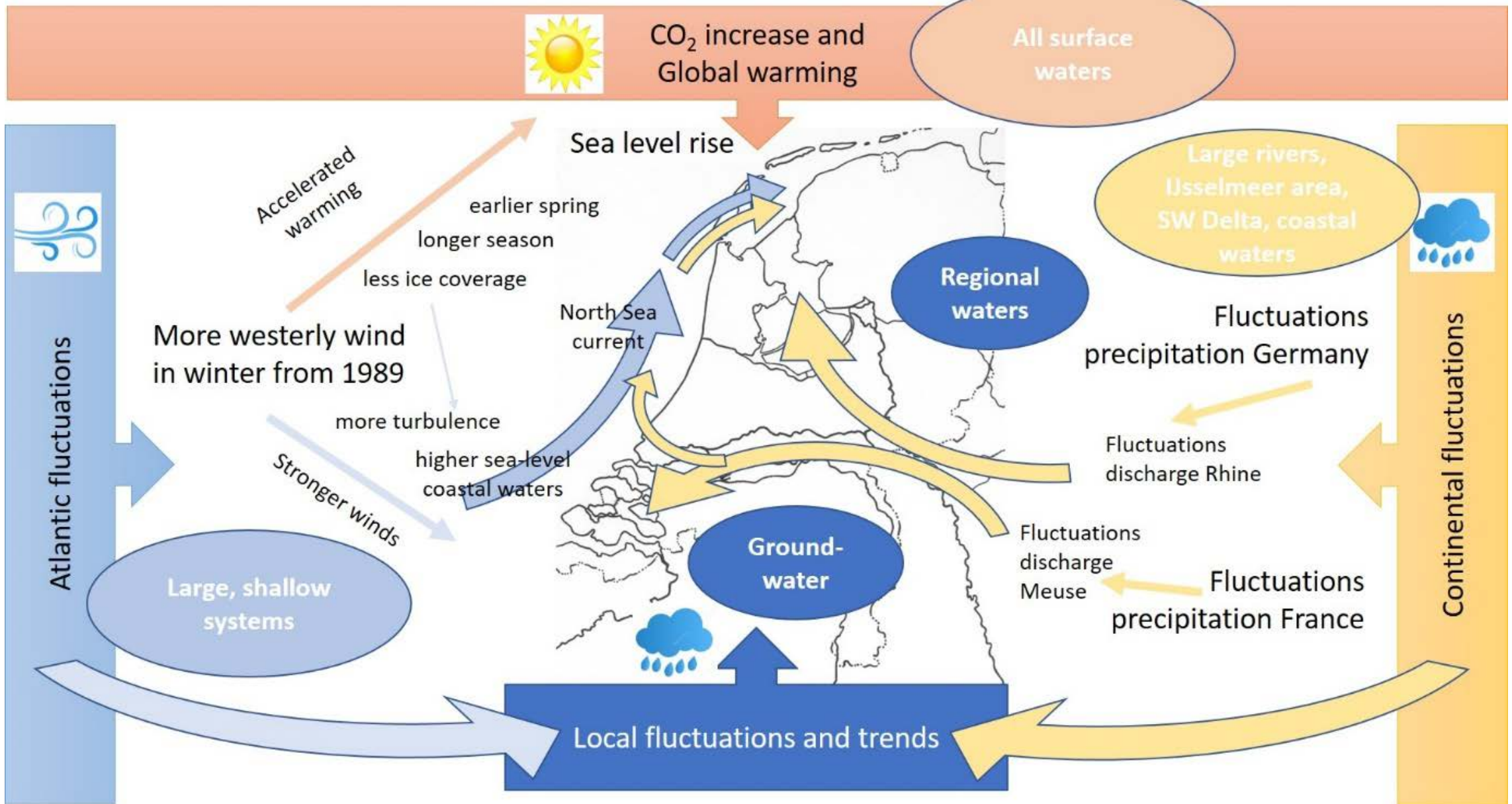
Trend results

- LOWESS-trendlines per location
- Aggregated LOWESS-trendline
- 25th- 75th percentile



Status





Source: Rozemeijer et al., 2021. *Climate variability effects on eutrophication of groundwater, lakes, rivers, and coastal waters in the Netherlands. STOTEN 771.*

Goal:

Exploit this surface water quality monitoring network

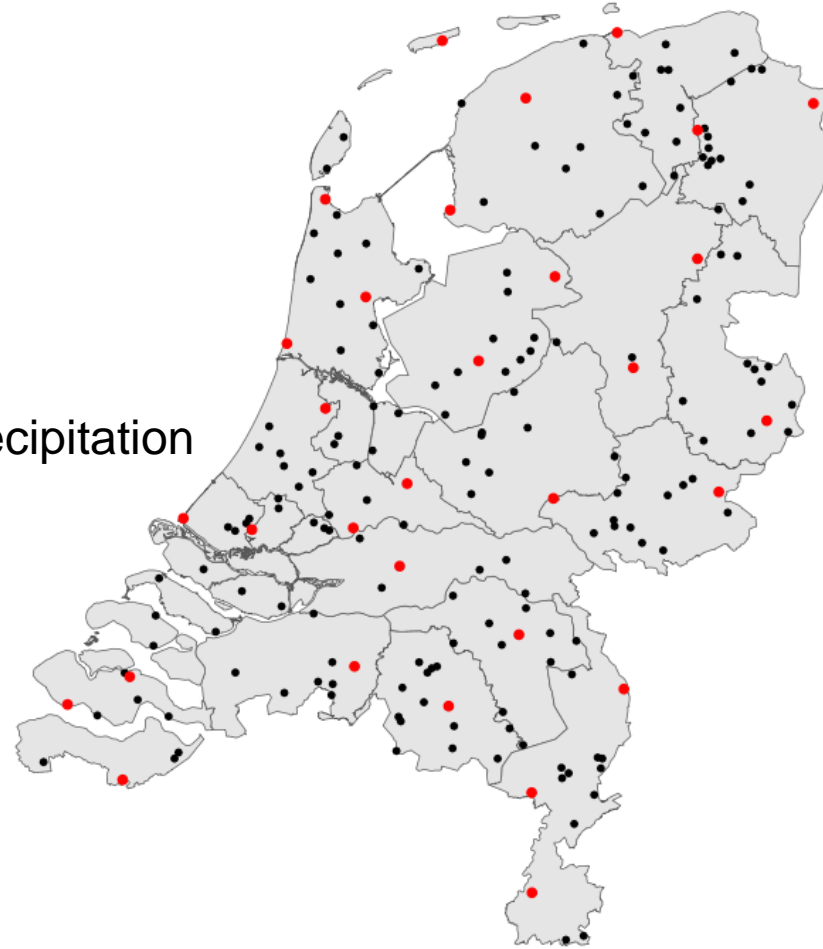
1. Investigate water quality trends
2. Explore response to climate extremes

Weather conditions:

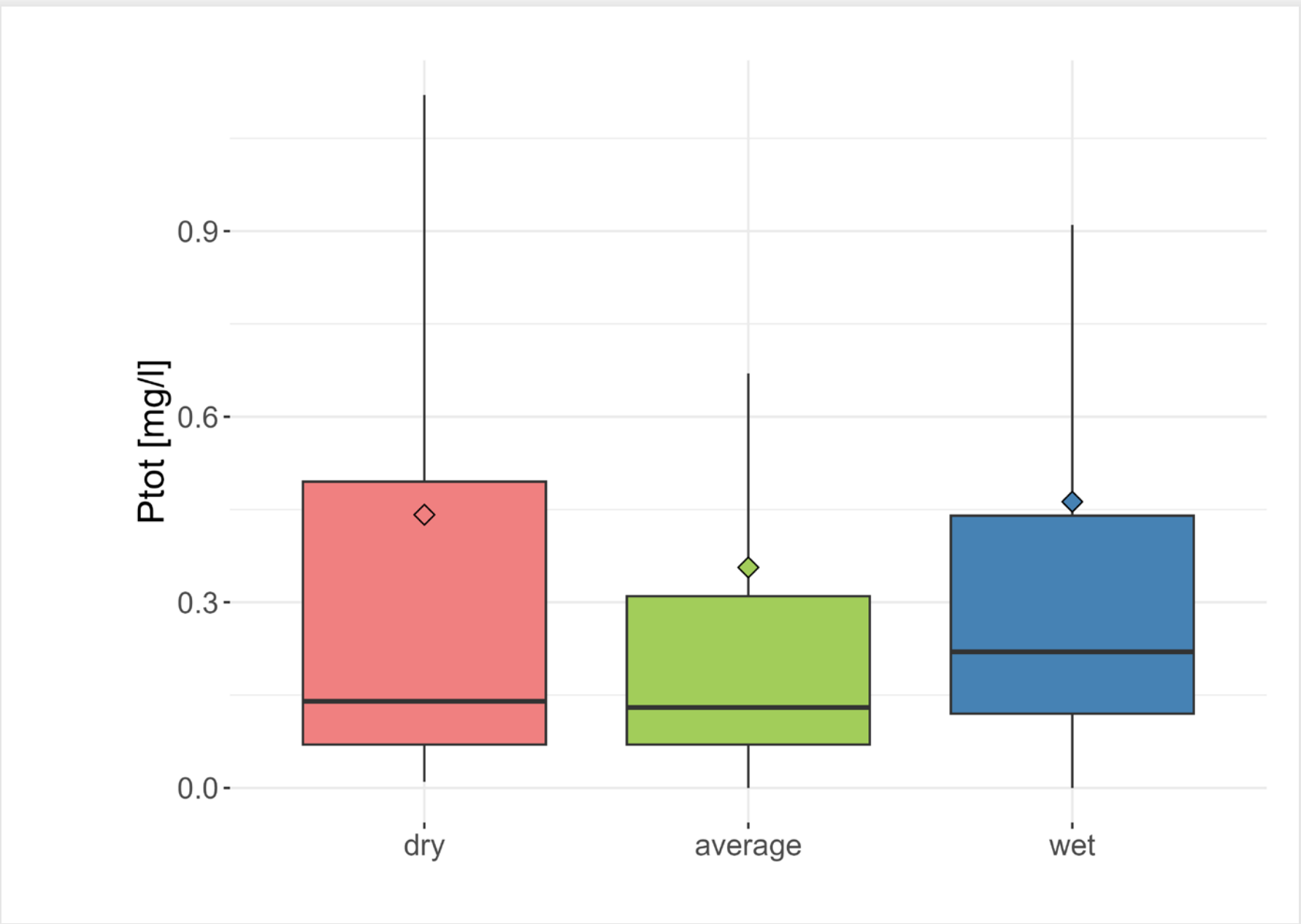
- Dry: >40 mm cumulative precipitation deficit
- Average: between -1 and 1 mm 10-day average net precipitation
- Wet: >4.5 mm 10-day average net precipitation

Line of thoughts:

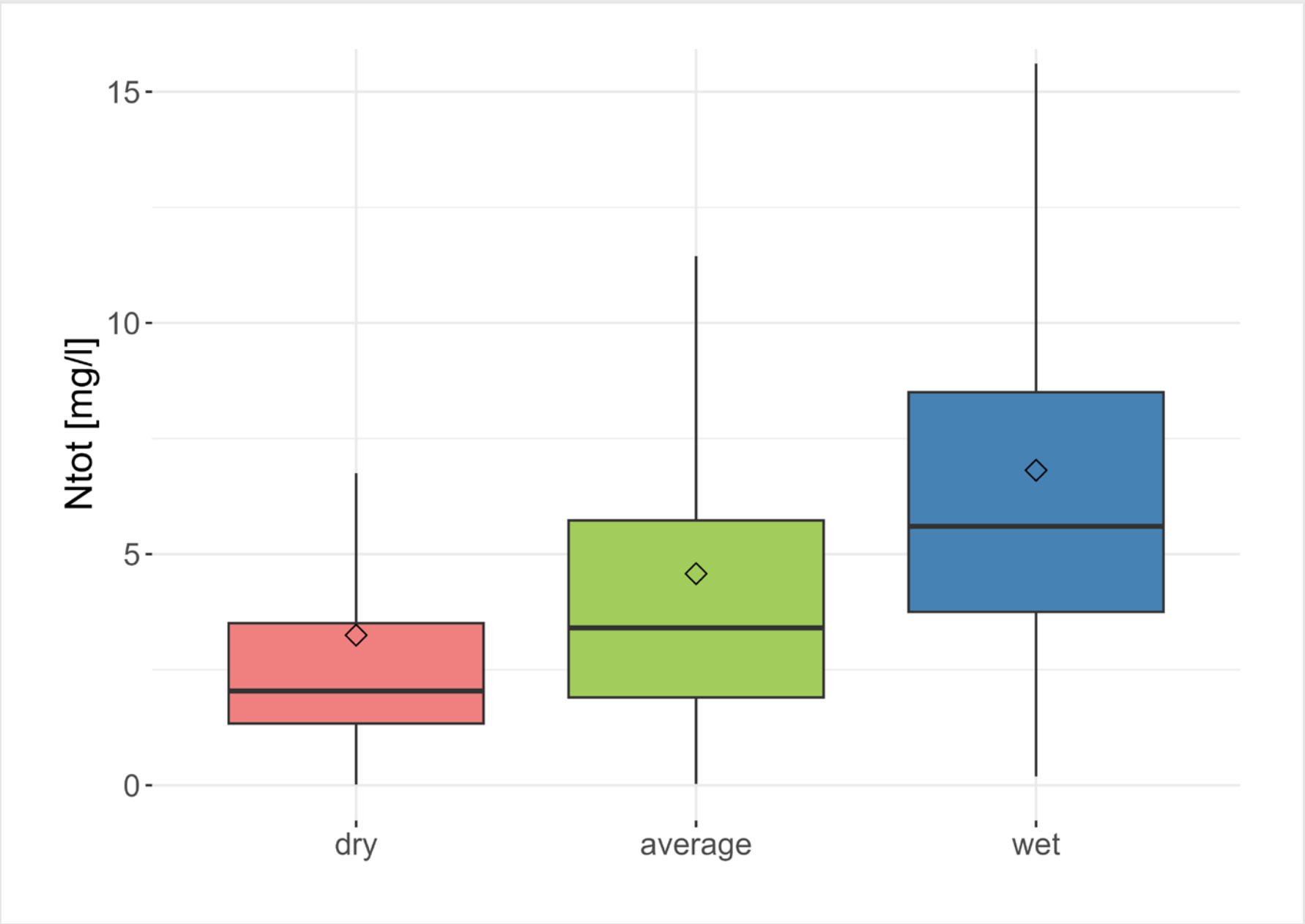
- Focus on nutrients + Cl & T for trends
- Increase in pressures expected
- Limited understanding about climate change effects on water quality
- What can we learn from the data?



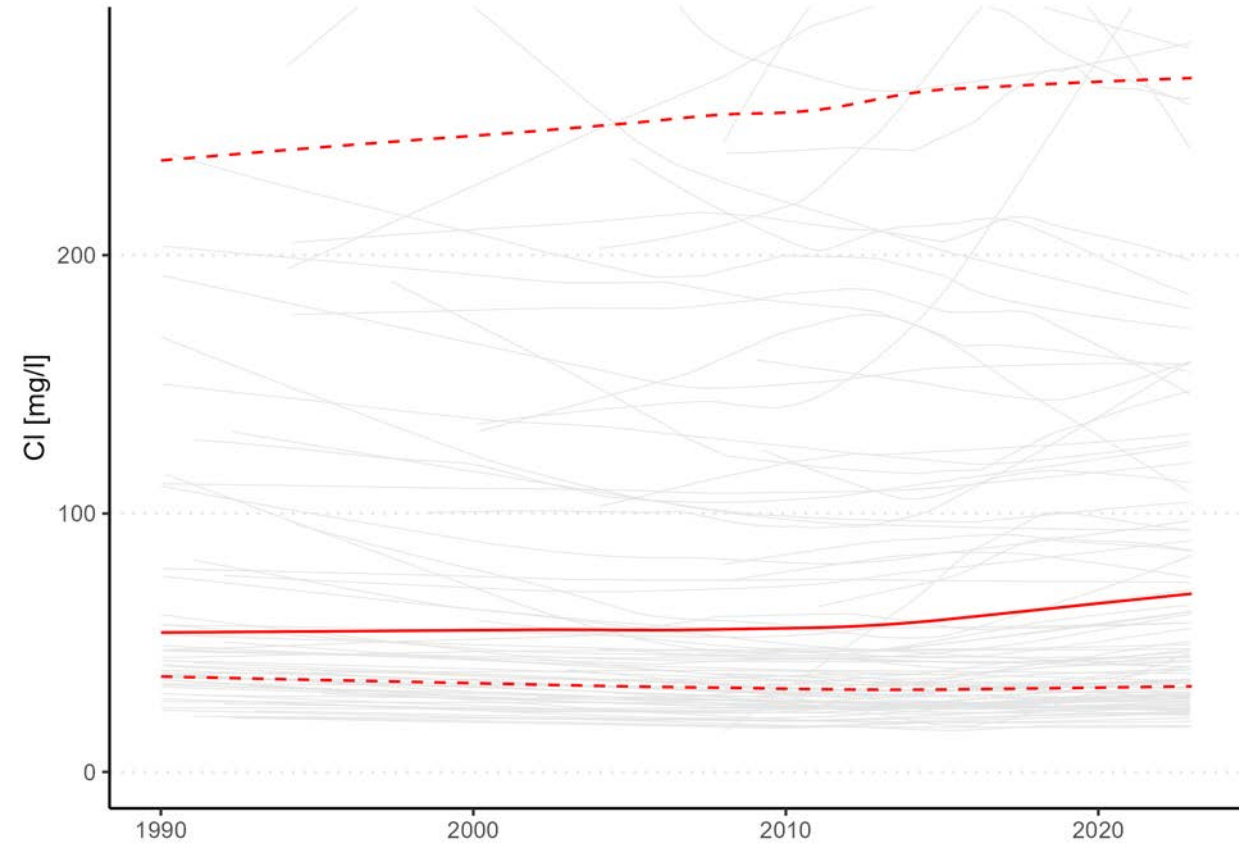
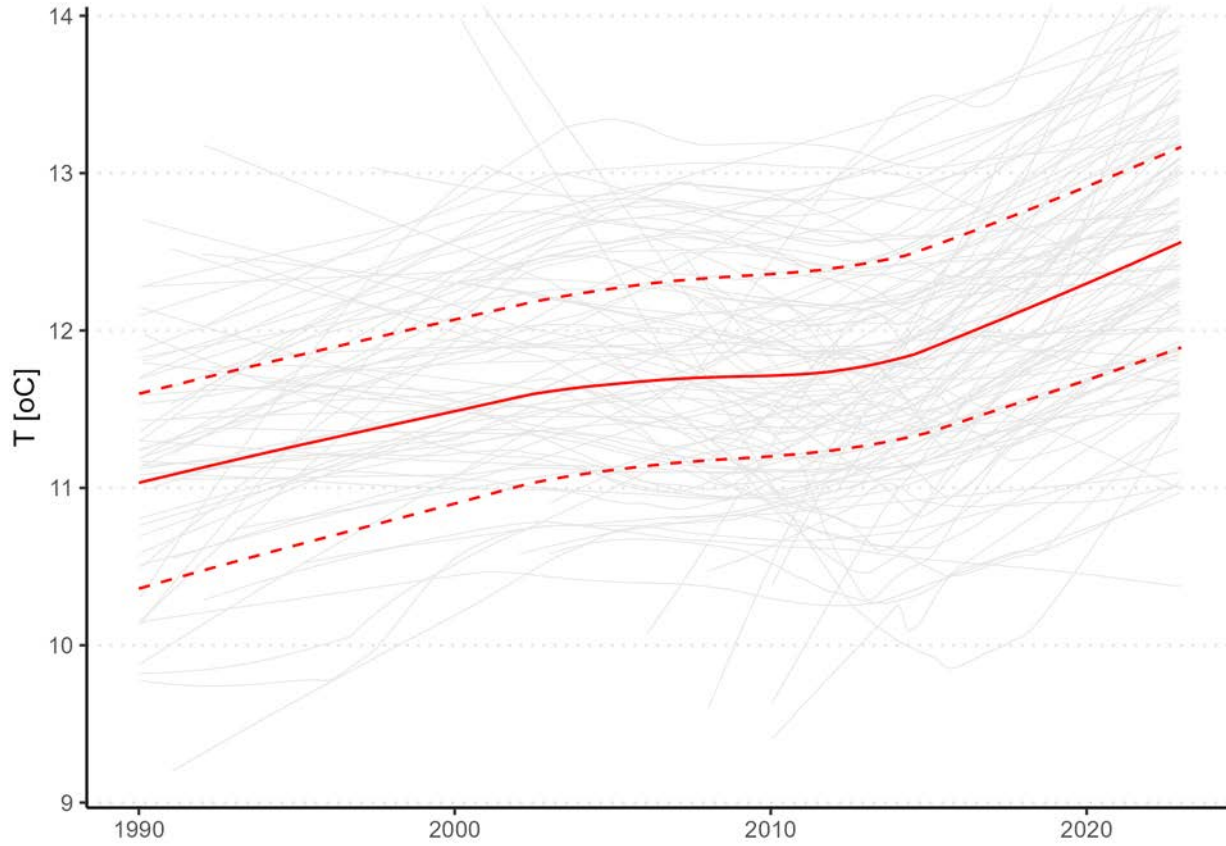
Dry versus wet: P_{tot}



Dry versus wet: Ntot

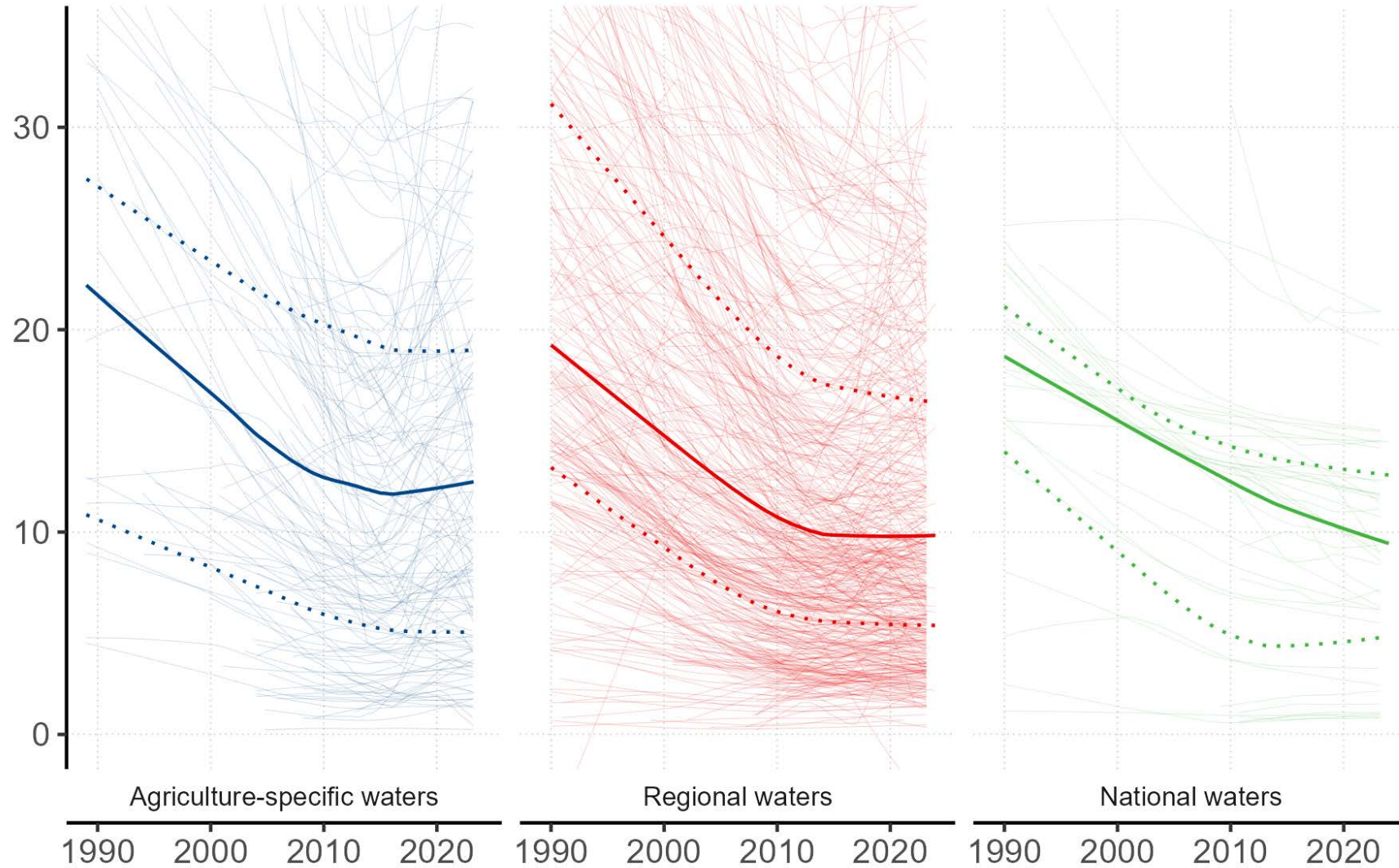


Trends - LOWESS:



Trends NO3 - winter:

Nitrate (mg/l)



Conclusions

Trends:

Downward trends for N_{tot} & P_{tot} (reduced inputs from agriculture)

Delayed upward trend for water temperature

Upward trend for CI since 2013

NO_3 winter concentrations seem to be increasing in agricultural waters

Extremes:

Dry: lower concentrations during drought, nitrate flush in first next wet episode

Wet: high nutrient concentrations and load pulses

Optimal agricultural nutrient uptake efficiency during average conditions



An aerial photograph of a Dutch delta landscape, featuring a network of waterways, green fields, and several traditional windmills. The scene is captured from a high angle, showing the intricate patterns of the water and land. A large, semi-transparent green circle is overlaid on the left side of the image, containing the text 'Deltares' and the logo for 'enabling delta life'.

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Anything else you'd like to ask?

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