Long-term trajectories of Nitrogen and Phosphorus point sources to German river systems

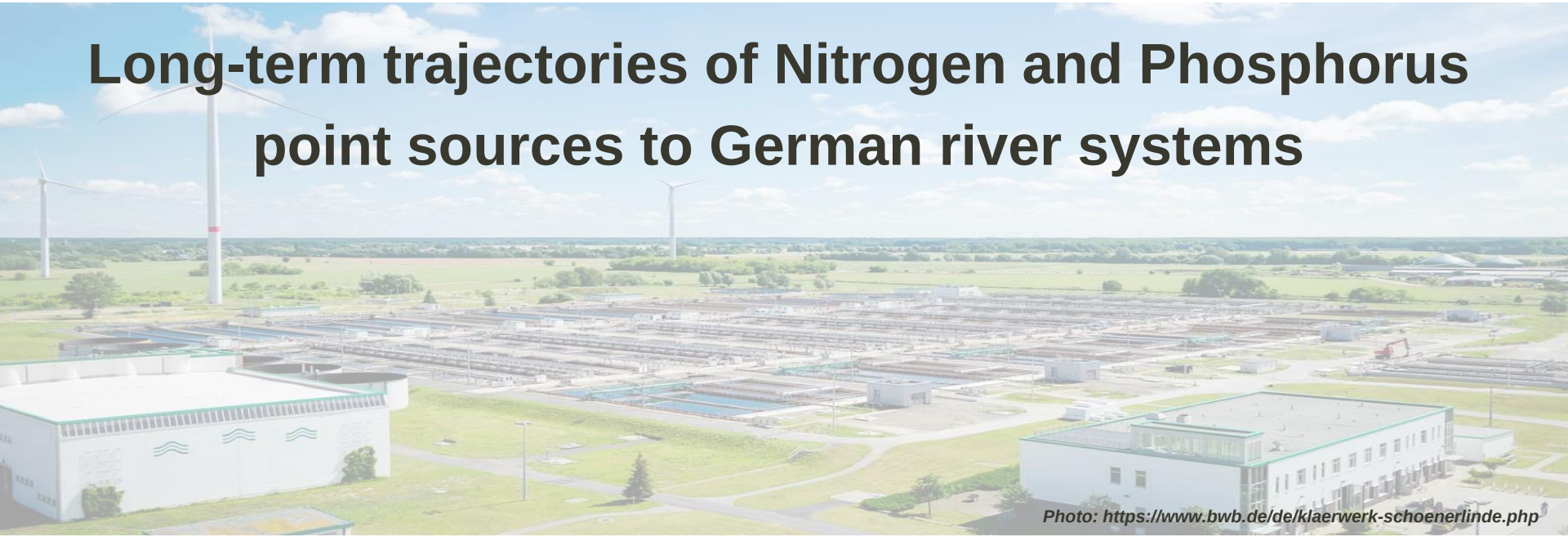

Photo: https://www.bwb.de/de/klaerwerk-schoenerlinde.php

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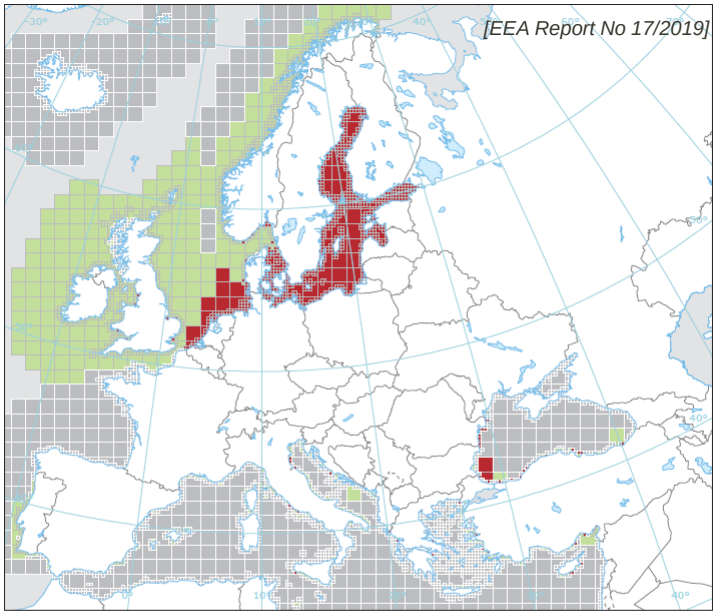
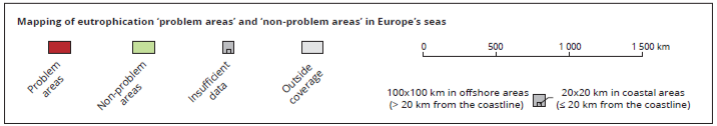
Nitrogen (N) and Phosphorus (P) point sources contribute to water quality degradation

Eutrophication problem in European seas





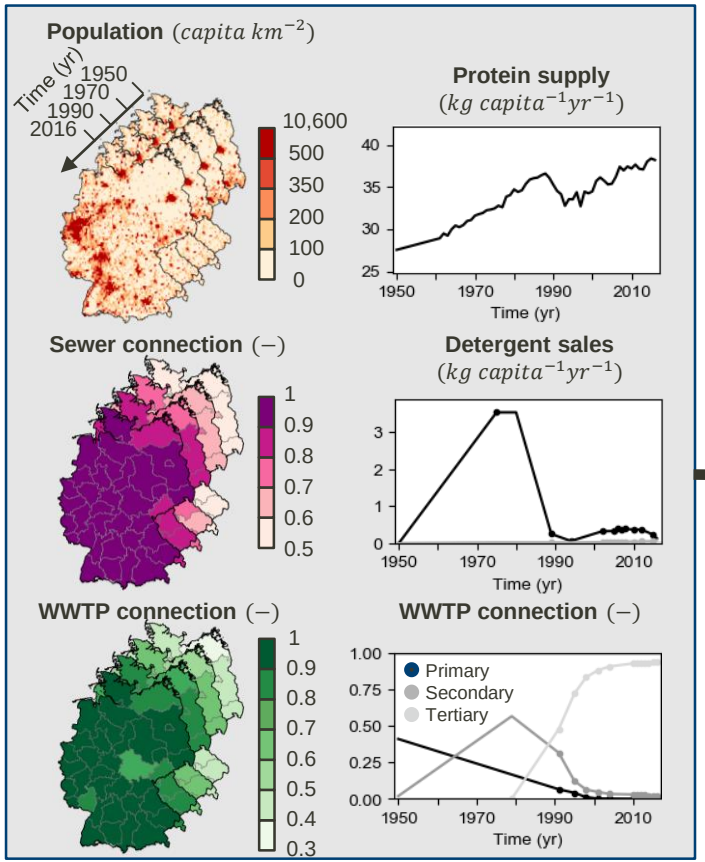
N and P contribute to eutrophication. These nutrients can originate from:

- Diffuse sources (e.g. fertilizer application)

- **Point sources (wastewater)**

→ To understand the impact of policies and technical developments regarding wastewater on eutrophication and water quality, we need to **characterize the long-term N and P point sources.**

We constructed gridded N and P point sources data for Germany (1950-2016)



Uncertain coefficients

- sewer losses fraction
- Treatment efficiency
- …

Gross N and P flow to wastewater

- Human N and P excreta
- Industrial N and P waste
- P detergents

N and P point sources to surface water

- **Untreated** N and P emissions from sewer
- **Treated** N and P emissions from Waste Water Treatment Plants

Other pathways for N and P

- Sewer losses
- Human excreta not collected by sewer
- …

We built on the methodology from Morée et al. (2013, Glob. Biogeochem. Cycles).

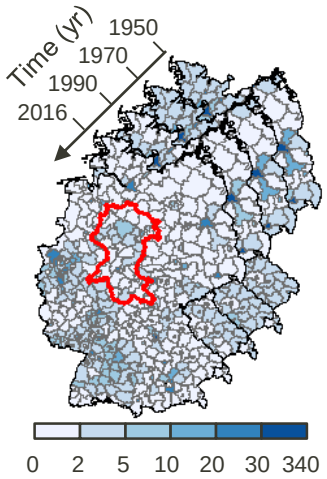
We collected a large range of data for Germany.

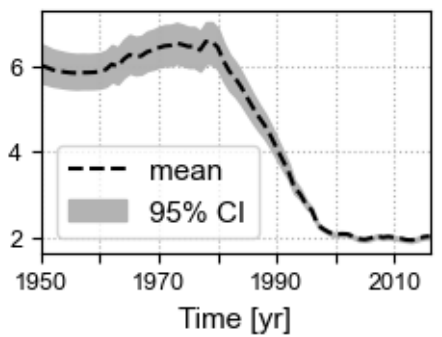
We accounted for **uncertainty** using **different sets of coefficient values** (latin hypercube sampling).

We selected sets that produce point sources realizations that are **consistent with data on recent Waste Water Treatment Plants emissions.**

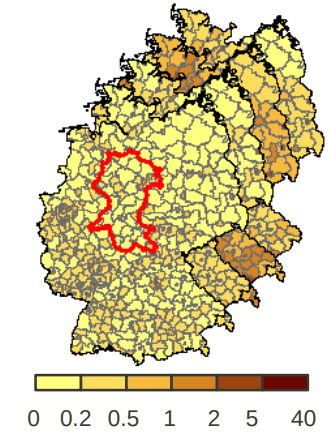
We analyzed the trajectories of N and P point sources in the Weser River Basin

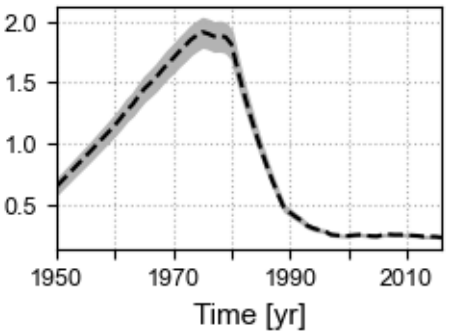
N point sources
$(kg\ ha^{-1}yr^{-1})$

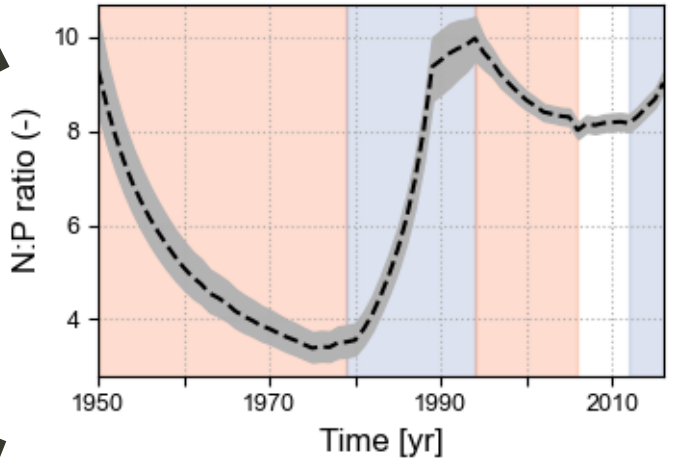




P point sources
$(kg\ ha^{-1}yr^{-1})$







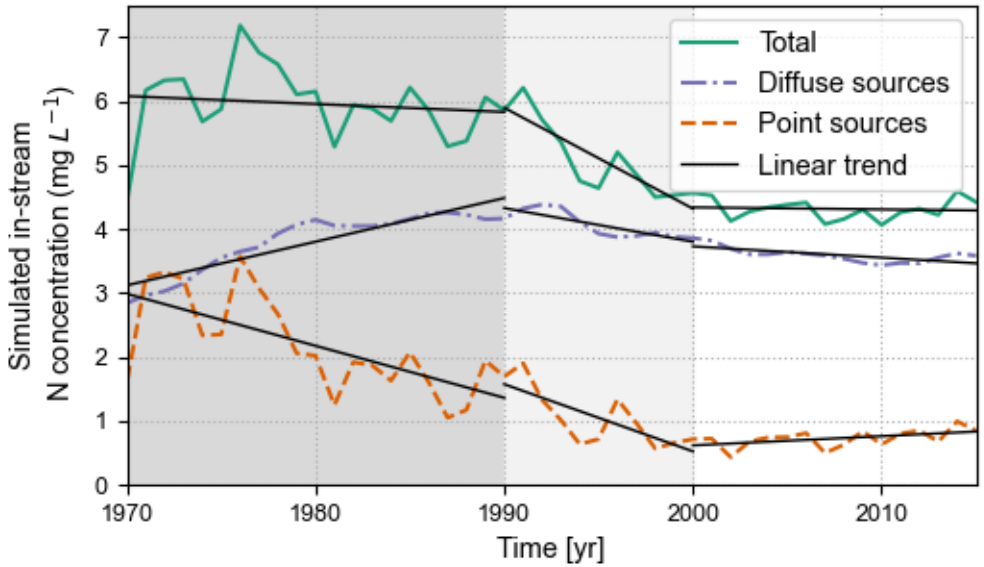
↑ P detergents

↓ P detergents

- **N and P point sources show large variations in time.**
- **N:P ratio dynamics are controlled by P detergents dynamics.**

Value of the constructed point sources data for water quality modelling

N modelling study over the Weser River Basin using the ELEMeNT model (median simulation ensemble)



- N point sources contribute to a large fraction of total in-stream N.
  (median value 1960-2015: around 29%)
- Changes in N point sources have an immediate impact on the in-stream concentration and can therefore strongly influence its trend.
- Assuming a **temporally constant** value of the point sources or **neglecting** them may produce **unrealistic** modelling results.
- It is critical to have **plausible estimates** of the point sources over the model **calibration period**.

Sarrazin, F. J., Kumar, R., Basu, N. B., Musolff, A., Weber, M., Van Meter, K. J., & Attinger, S. (2022). Characterizing catchment-scale nitrogen legacies and constraining their uncertainties. *Water Resources Research*, 58, e2021WR031587.