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Identifying site-specific opportunities for implementing nutrient reduction measures in catchments

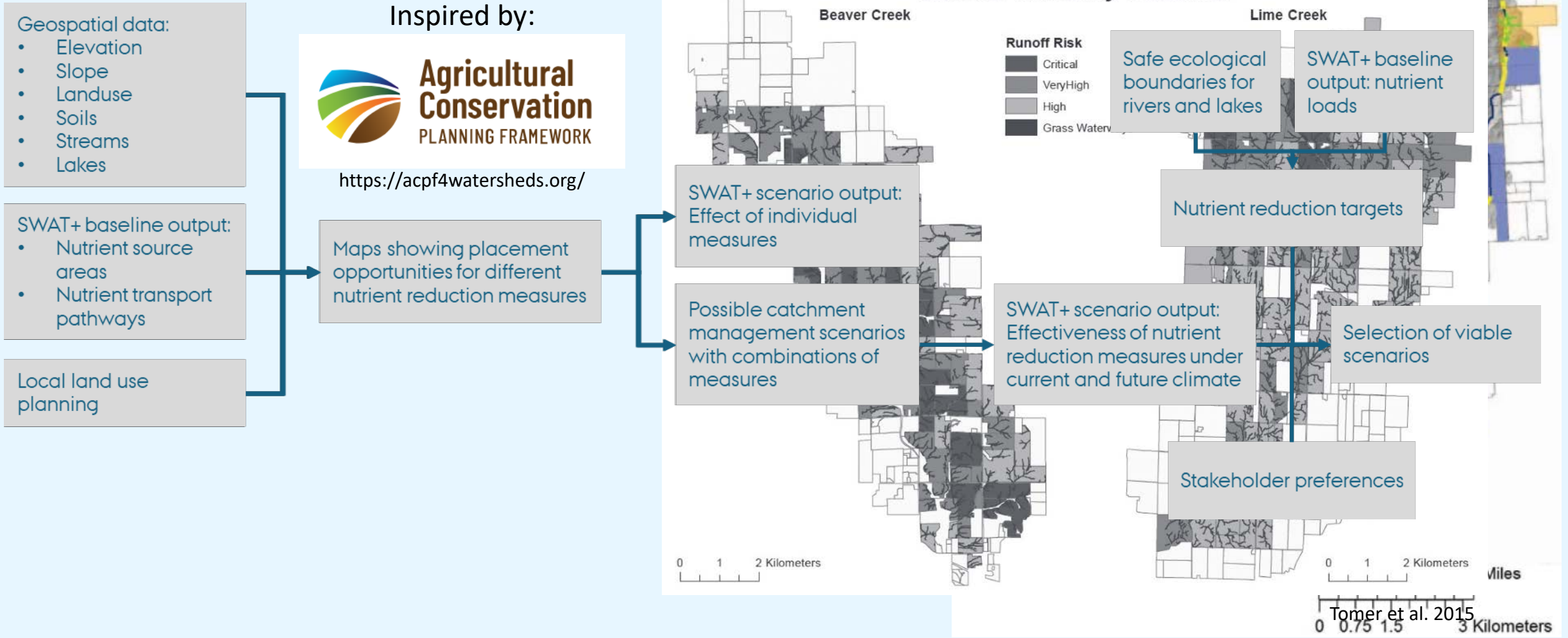
Katrin Bieger & Brian Kronvang



Introduction

- › In many countries, national guidelines for the use and dimensioning of nutrient reduction measures exist but...
- › ...guidance on the placement of nutrient reduction measures within a catchment is often lacking and implementation of measures is not planned at relevant spatial scales (e.g., catchment scale)
- › **Aim: Develop a tool for identifying site-specific opportunities for implementation of nutrient reduction measures**

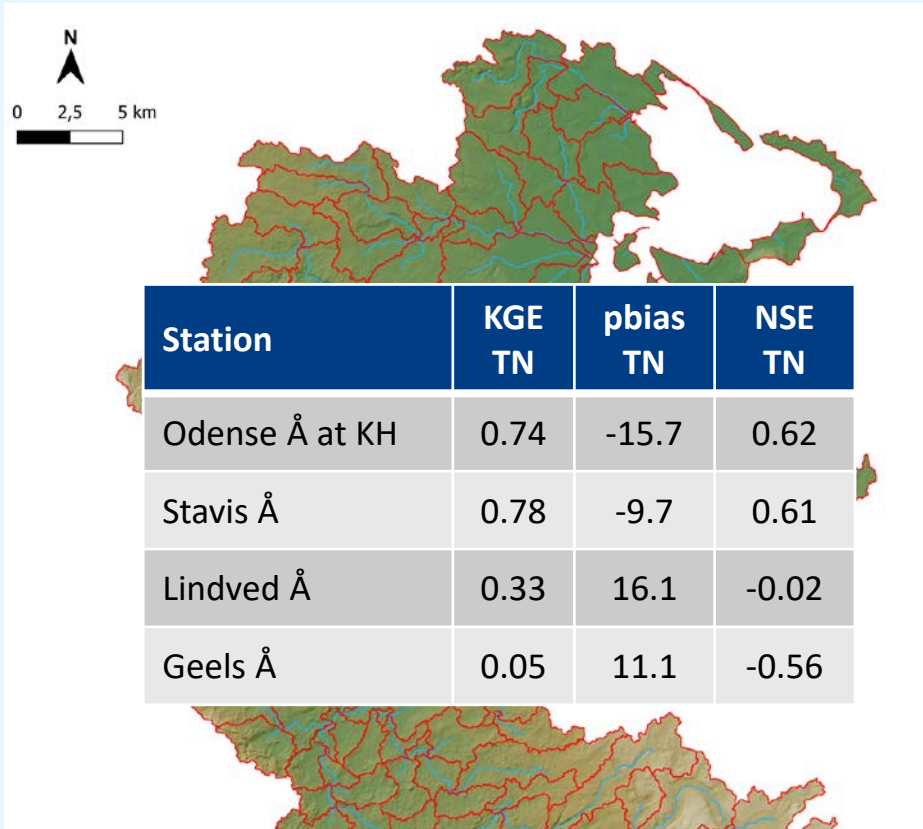
River Basin Management Support System



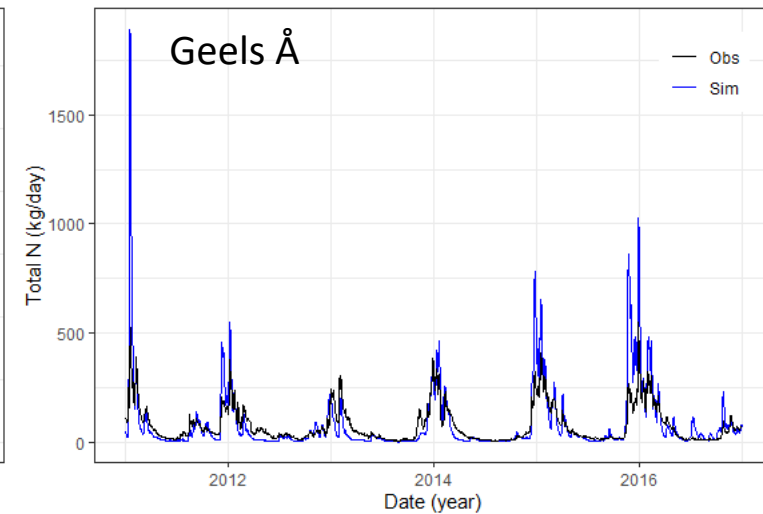
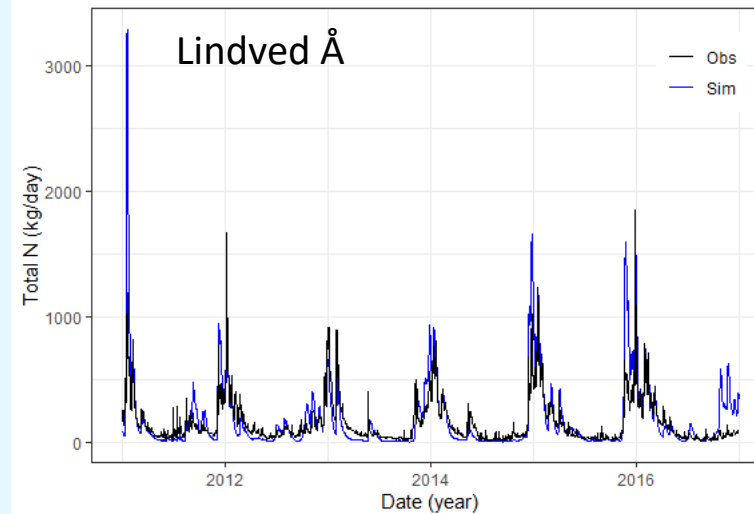
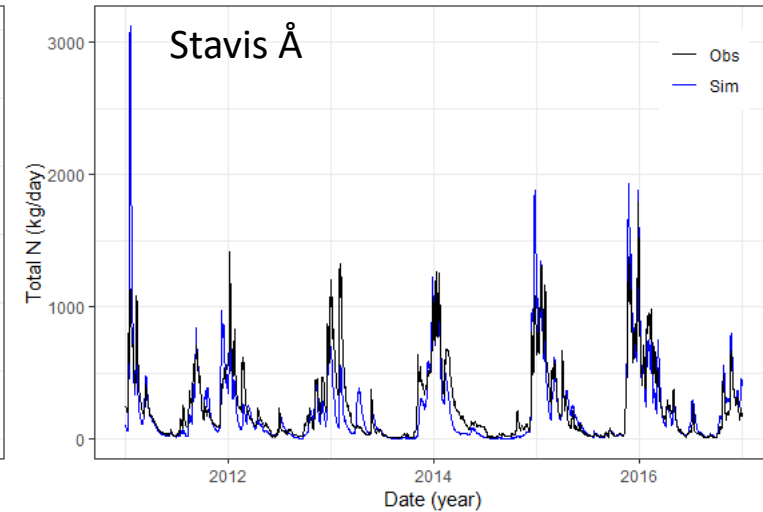
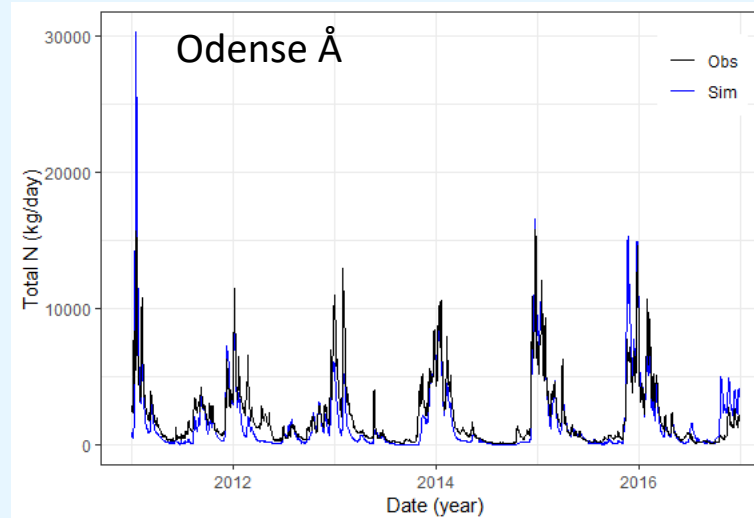
Tomer et al. 2015

(Tomer et al. 2013)

SWAT+ model for Odense Fjord Catchment



- Upland-Floodplain delineation
- Large lakes (>5 ha)
- 10 largest point sources
- Q and N calibration at 4 gauges



Co-creation of wetland scenarios

Step 1: Delineation of floodplains using the SWAT+ interface.

- Identification of potential areas for wetland restoration.

Step 2: Exclusion of urban areas (unsuitable for wetland restoration).

Step 3: Review of map during a workshop with the Odense Fjord Coastal Water Board.

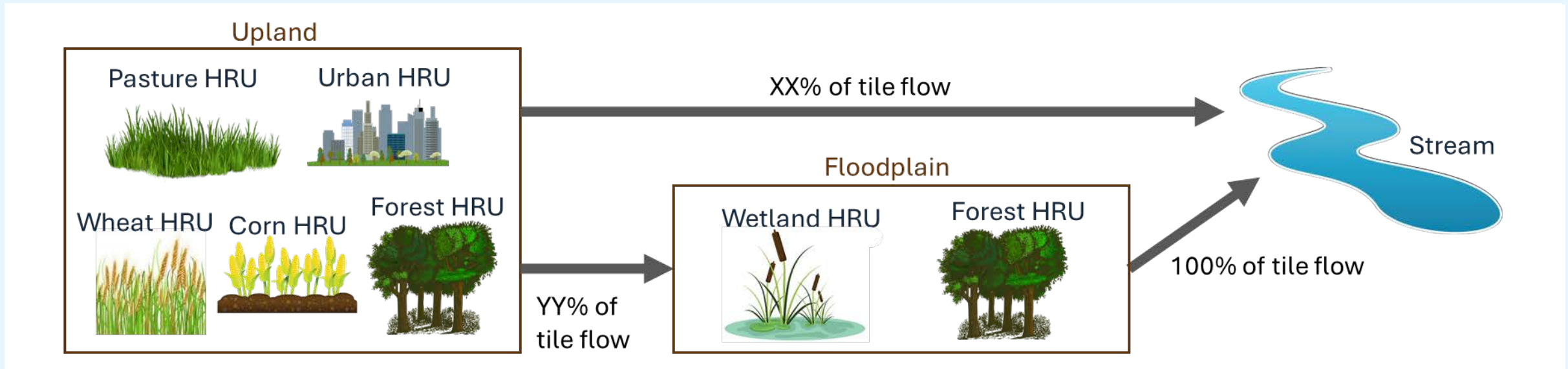
- Exclusion of additional areas that are unsuitable for wetland restoration due to local planning in the seven municipalities (partly) located in the Odense Fjord catchment.

Step 4: Development of an optimistic and a conservative scenario.



Implementation of scenarios in SWAT+

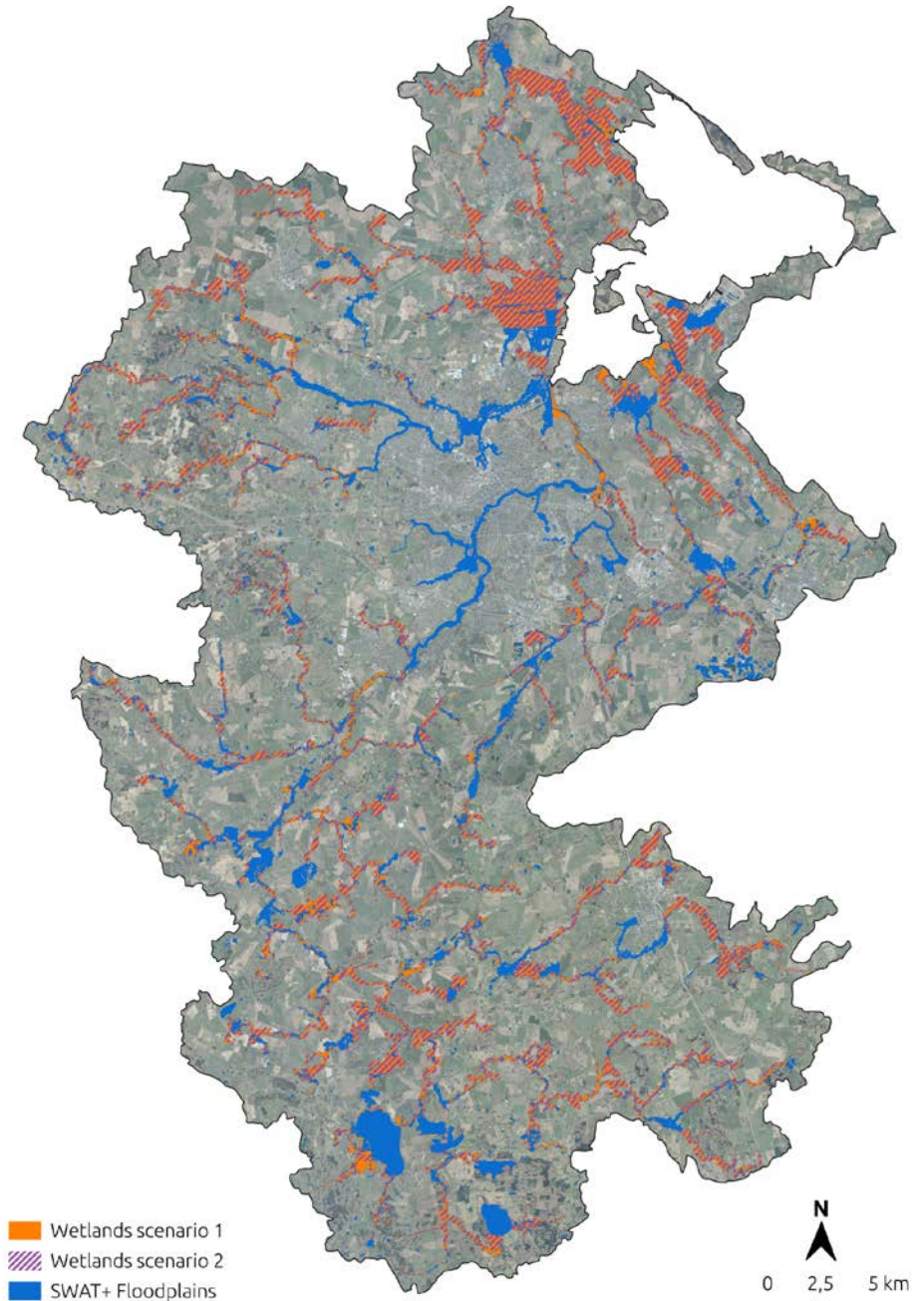
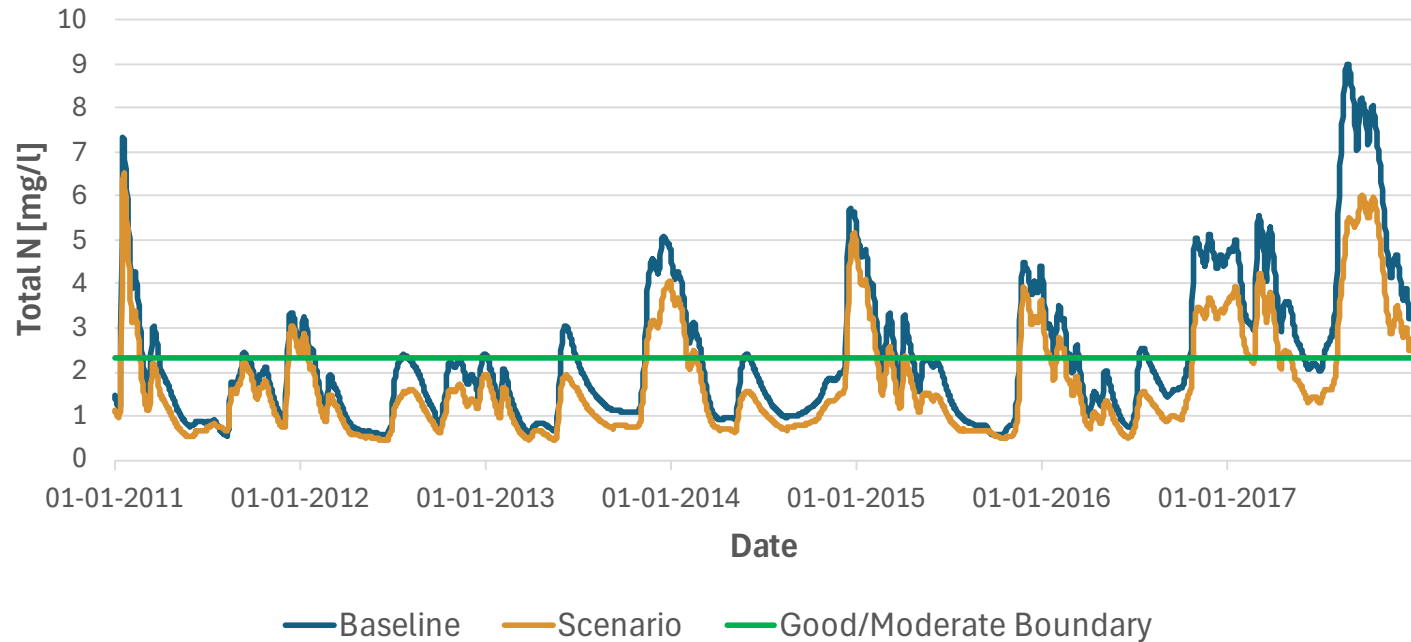
1. Overlay of the two scenario maps with SWAT+ Hydrologic Response Units.
2. Change of land use in “to be restored” HRUs to wetland.
3. Parameterization of wetland storage.
4. Change of tile flow connectivity from upland areas to floodplains and streams.



➤ Percentage of tile flow routed to the floodplain depends on extent of wetlands within the floodplain.

Scenario results

1. Assumptions about connectivity correct?
2. Simulation of overbank flow and floodplain inundation?
3. Are all relevant wetland processes simulated?
4. Should we calibrate concentrations instead of loads?



SWATmeasR

- › OPTAIN: A flexible tool to implement BMPs in SWAT+ model setups



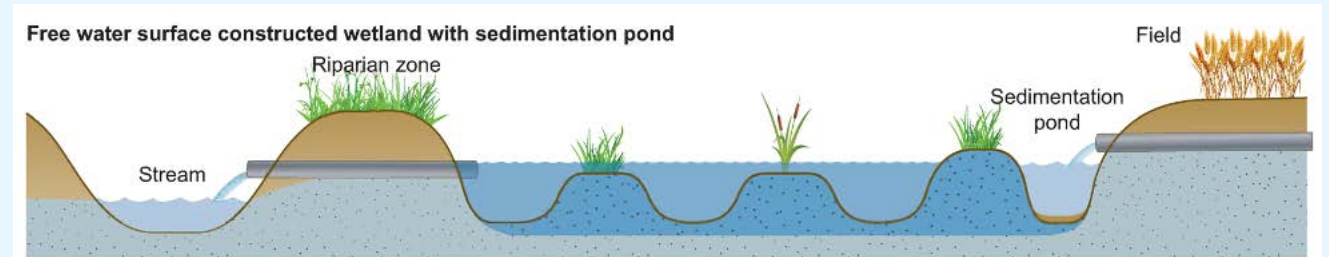
- › SABICAS: SWATmeasR for QSWAT+ setups



- › NORDBALT-ECOSAFE: Automatic selection of suitable locations for measures based on geospatial data and user-defined criteria

Constructed wetlands in DK

- › Edge-of-field
- › Treatment of tile flow
- › Not implemented in low-lying areas with carbon-rich soils

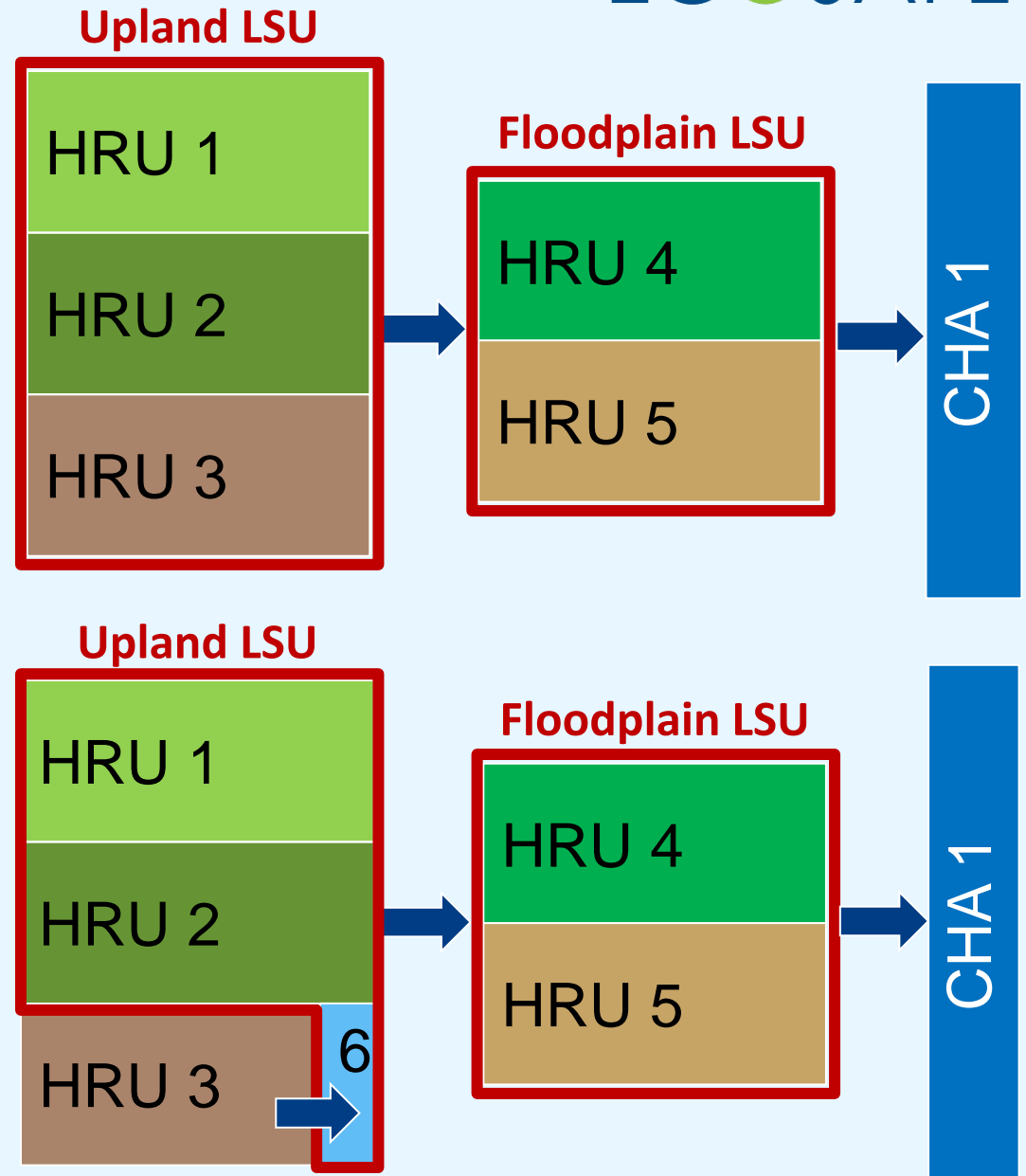


(Carstensen et al. 2020)

- › Criteria for drainage area:
 - › 80% must be in agricultural land use
 - › Must be dimensioned to achieve an average reduction of 300 kg N/ha of wetland
 - › At least 70% must be classified as “suitable” or “potentially suitable” and no more than 10% as “not suitable”. The rest may be unclassified.
 - › Must be at least 20 ha (without pump) or 50 ha (with pump)
- › Area ratio at least 1/100
- › Additional criteria if the more than 50% of the area is “potentially suitable”

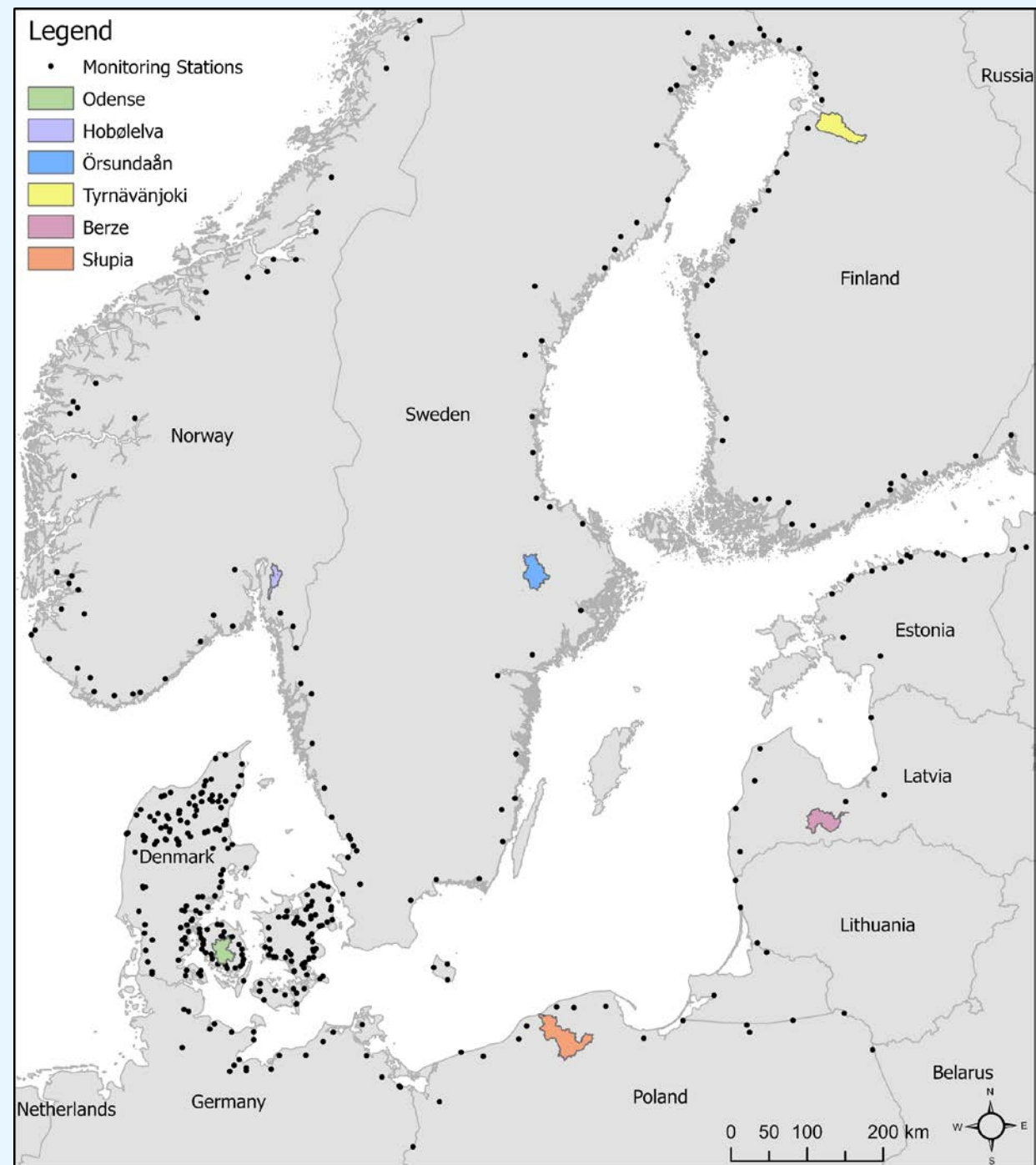
Workflow in SWATmeasR

1. Select tile-drained HRUs in upland LSU
 2. Identify HRUs with high N loads using a user-defined threshold
 3. Create random samples for different area fractions (0.2, 0.5, and 0.8)
 4. Change connectivity for selected HRUs in each scenario
 5. Run scenarios
- › Modeller: Prepare for major disappointment (N loads = 0 in all scenarios)



Next steps

- › Make it work!!!
- › Additional measures:
 - › Buffer strips
 - › Grassed waterways
 - › Catch crops
 - › New crop types/rotations
 - › Land use changes (afforestation, conversion of cropland to grassland)
 - › Reduced tillage in autumn
 - › Reduced fertilization
 - › Sedimentation ponds
 - › Restored wetlands





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Thank you!

Sessions S1.1 and S1.2: Finding solutions for a good ecological and chemical quality in freshwater and marine water bodies in the Baltic Sea, North Sea and Irish Sea regions

04/06/2025, 13:00-14:30 and 15:00-16:15

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