AARHUS UNIVERSITY
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A new monitoring approach in streams for detection of N emissions

from agricultural areas to surface waters

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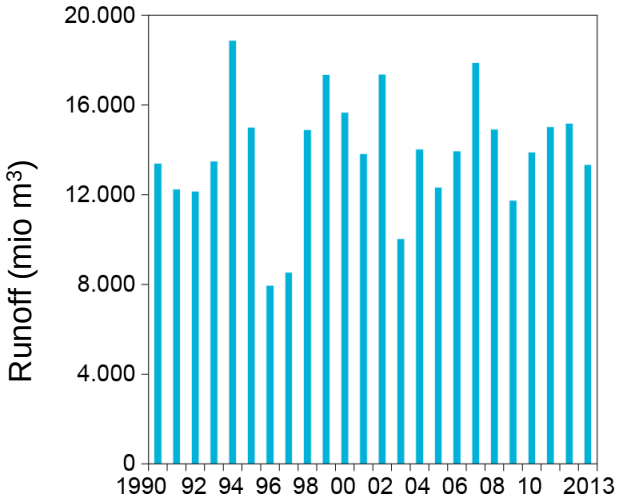
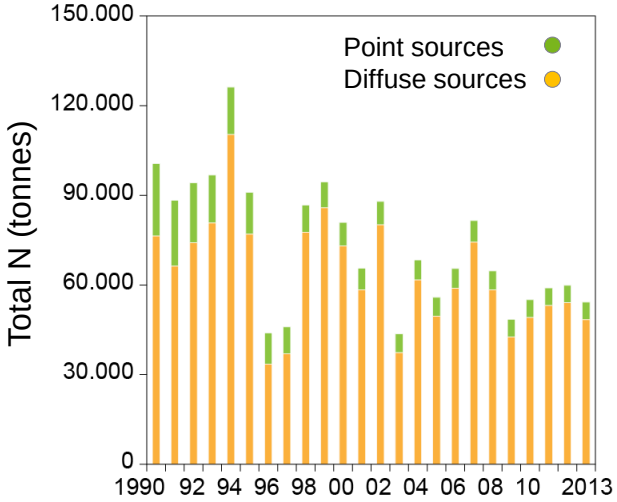
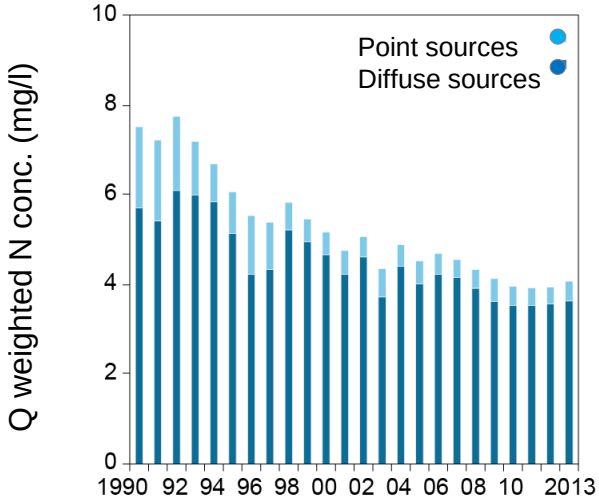
MOTIVATION

› Denmark has successfully reduced N emissions from diffuse sources to surface waters with app. 40% (ca. 30,000 t) since 1990 by general regulations in agricultural production.







› BUT a further reduction amounting to 7,800 tonnes N is required for WFD II → calls for new approaches for regulations of agricultural N-emissions !

OBJECTIVES

Develop a monitoring design that can constitute the basis for regulation of nutrient emissions to surface waters at **micro catchment scale**

› **i)** Design a stream monitoring program, to quantify N emissions at micro catchment scale (10 - 30 km^2).

› **ii)** Test the monitoring design by intensive N and discharge measurements in three pilot catchments for a three year period.

SELECTION OF CATCHMENTS SUITABLE FOR N-EMISSION REGULATIONS

› Three overall factors chosen:

› **Increase in runoff across catchment**

› **Travel time, oxidized gw particles**

› **Retention sinks (wetlands, lakes, streams)**

› DK subdivided into catchments app. 15 km^2

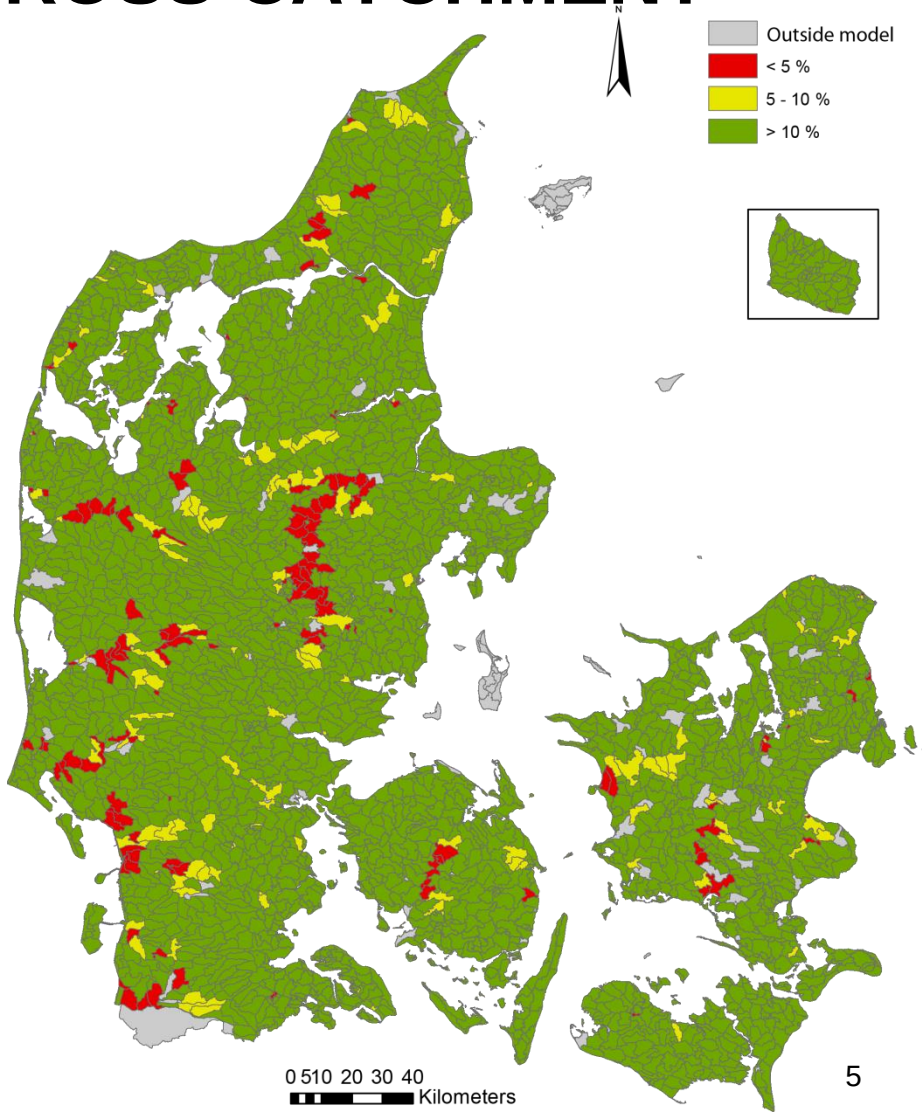
INCREASE IN RUNOFF ACROSS CATCHMENT

› ΔQ = outflow – inflow

› Data comes from the national rainfall-runoff model

Green = 88%

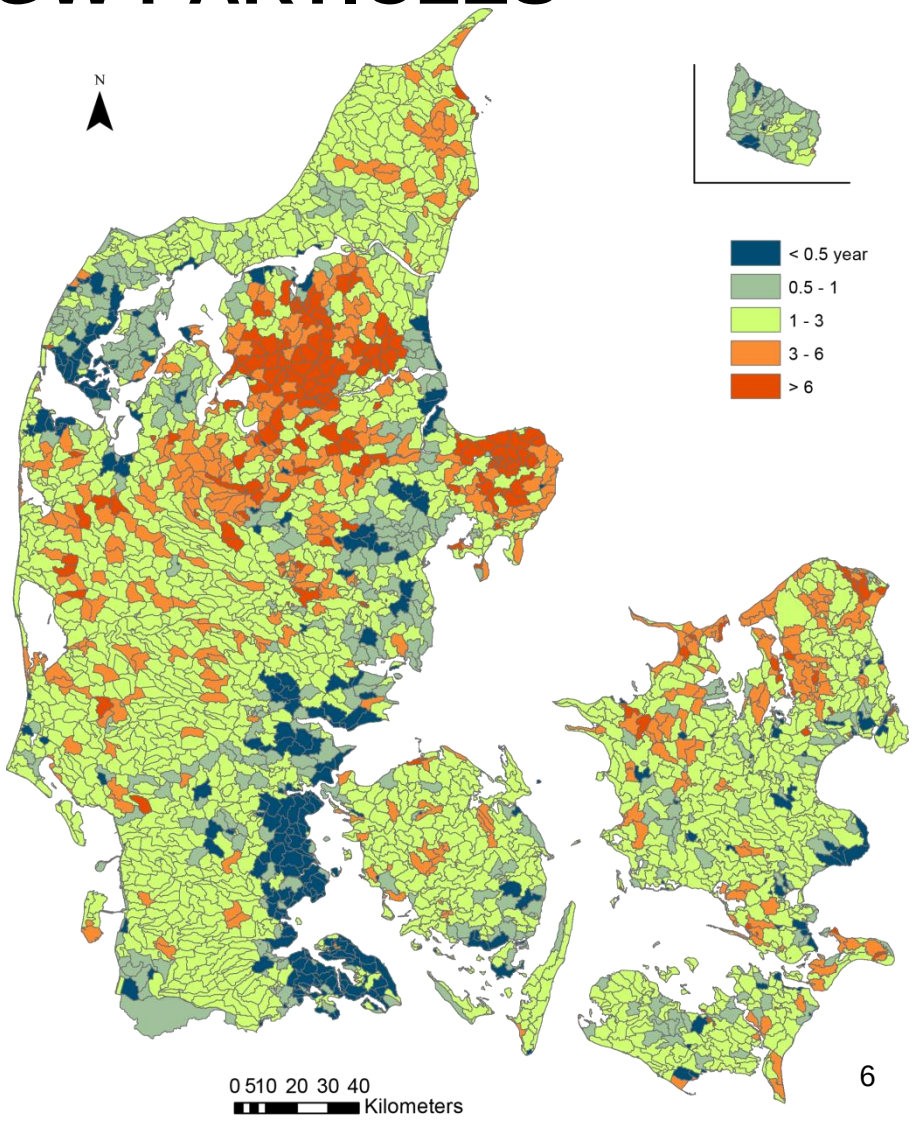
ΔQ → ongoing analysis to decide when ΔQ is large enough to be detected with reasonable (?) uncertainty



TRAVEL TIME, OXIDIZED GW PARTICLES

› Number of years it takes for 90% of the oxidized gw particles to travel from the root zone to the stream.

› Based on results from a new national N retention map.

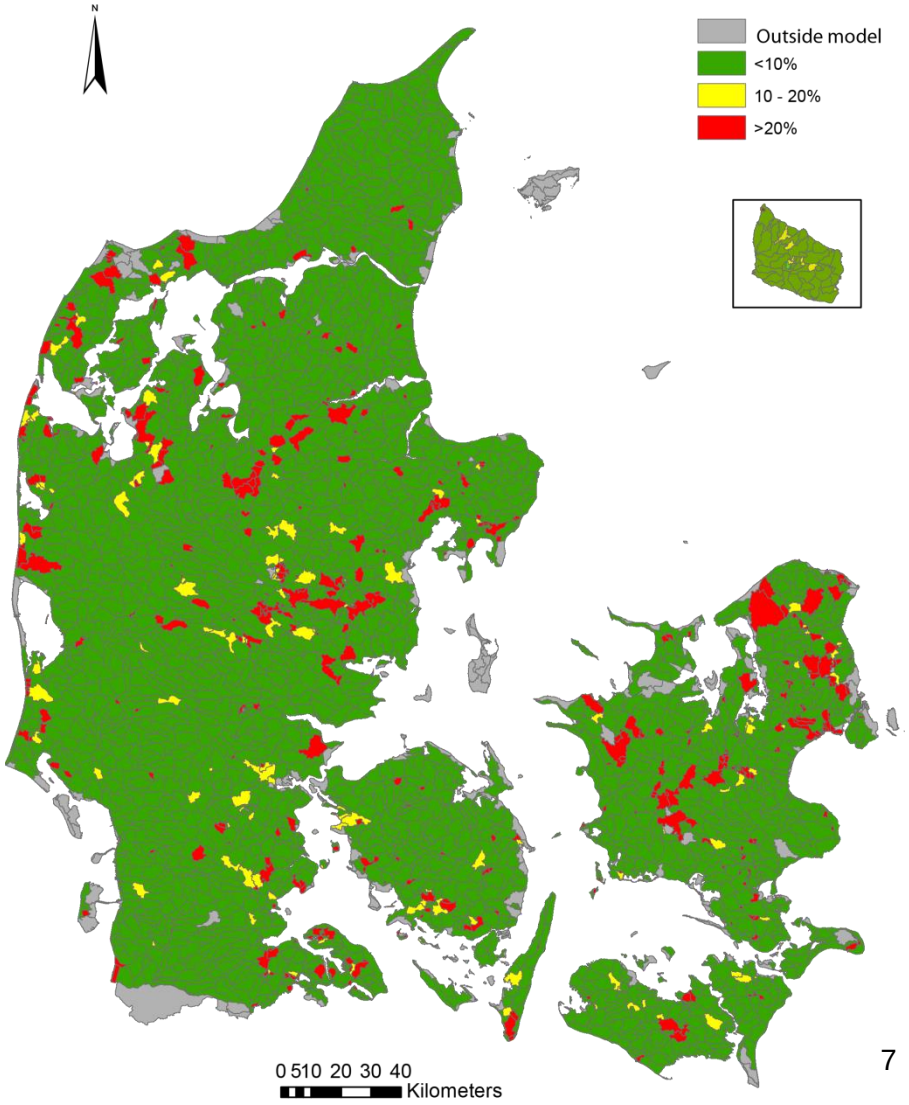


N-RETENTION SINKS (WETLANDS, LAKES, STREAMS)

› Percentage of N retention within each 15 km^2 catchment

› Based on model estimates from a new national N retention model

Green = 86%



”TRAFFIC LIGHT” MAP

Preliminary subdivision of Denmark, into areas suitable for stream monitoring.

Green = Suitable (65%)
Yellow = Possibly suitable
Red = Not suitable

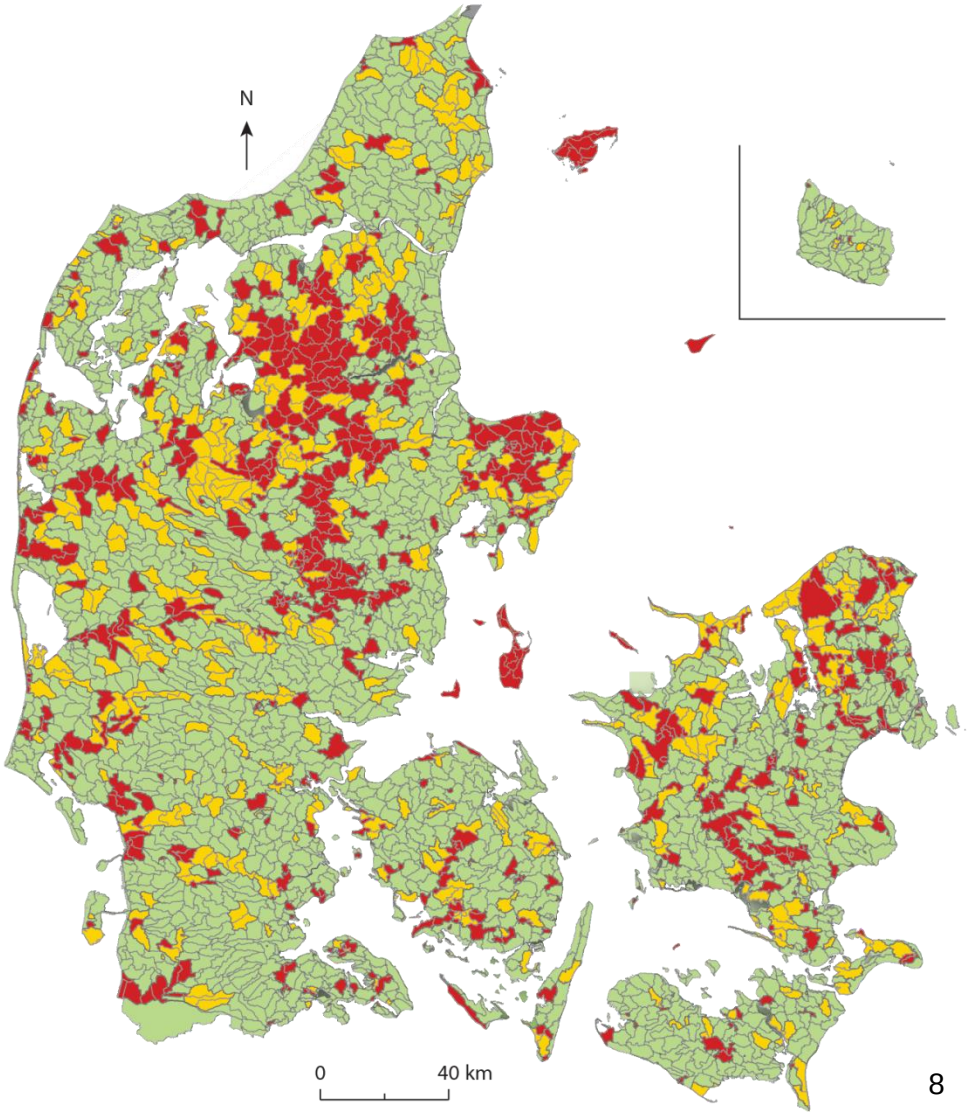


Table 1. Criteria that form the background for construction of the map in Fig. 1.

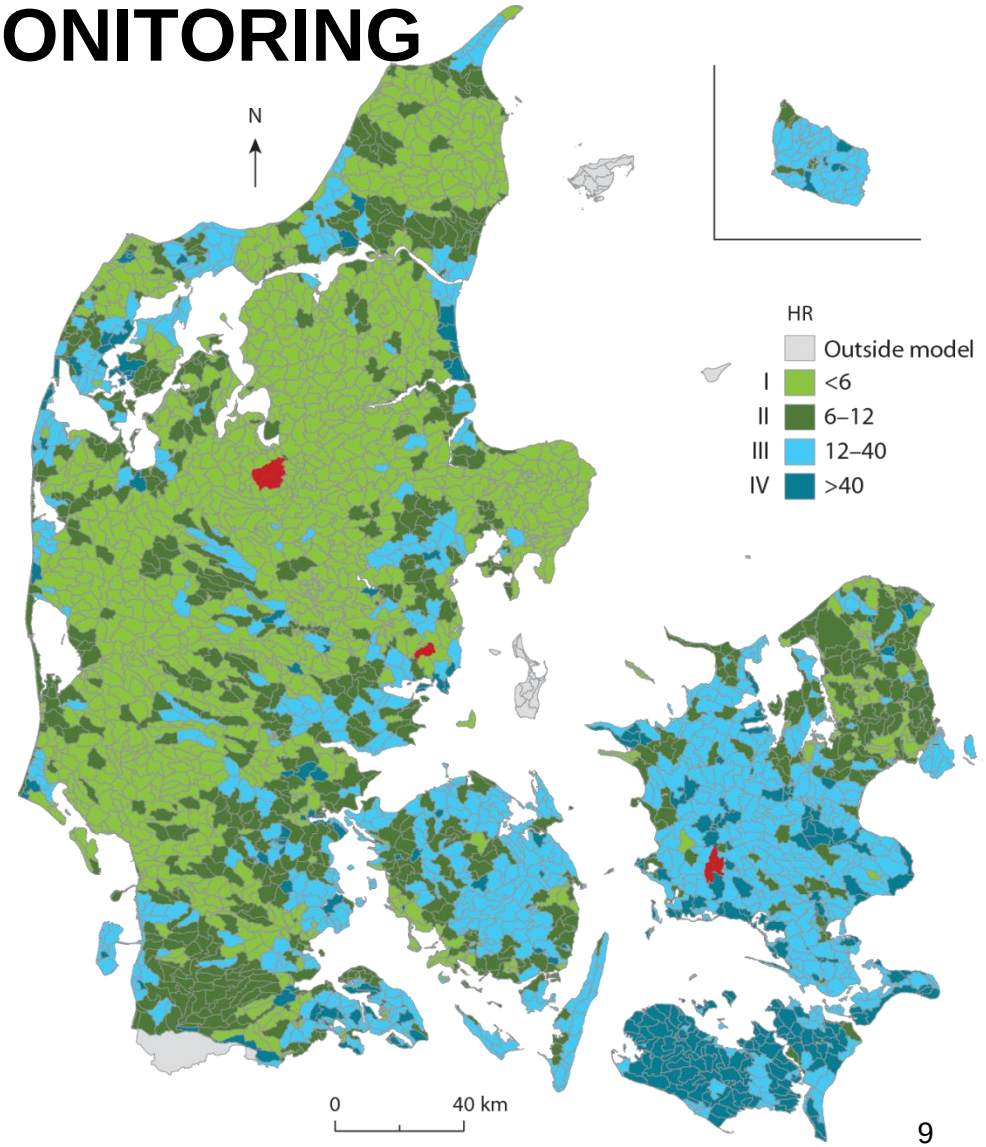
	Total retention in catchment surface waters (%)	Transport time for oxidized water (groundwater) (yr)	Increase in runoff across catchment (%)
Red	>20	>3	<5
Yellow	10-20	3-6	5-10
Green	<10	<3	>10

HOW TO DESIGN THE MONITORING PROGRAMS?

› The design of monitoring program is expected to be highly influenced by hydraulic regime (HR).

› HR = Q_{max}/Q_{min}

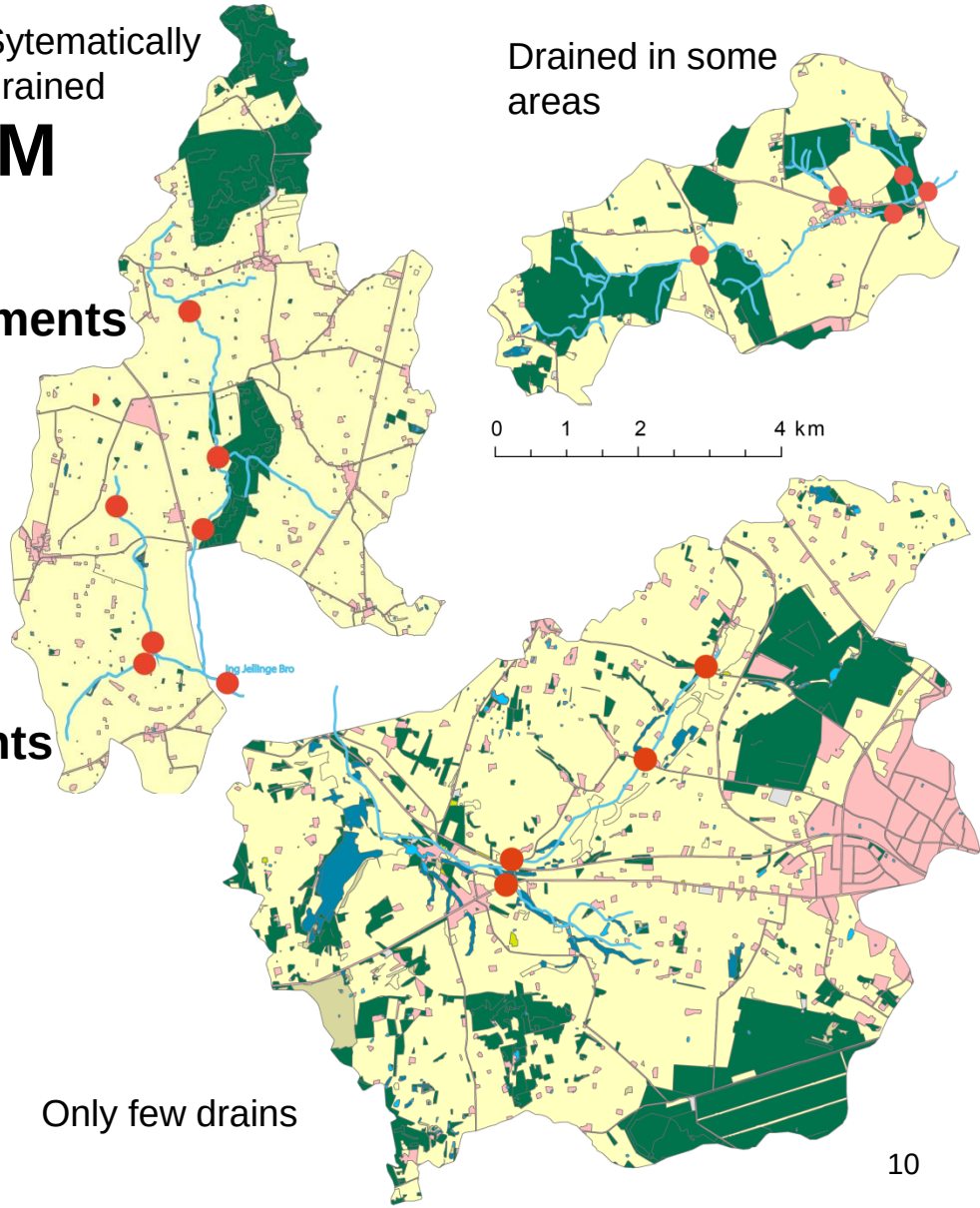
› Monthly estimated Q_{max} and Q_{min} values 1990-2010



MONITORING PROMGRAM

Sytematically drained

Drained in some areas



› **Main stations at outlet of micro-catchments**

Composite (3 h) daily water samples
Hourly water stage
Weekly discharge measurements
Weekly grab samples

› **Stations draining sub-micro catchments**

Weekly grab samples
Biweekly discharge measurements

Water samples analysed for N and TN

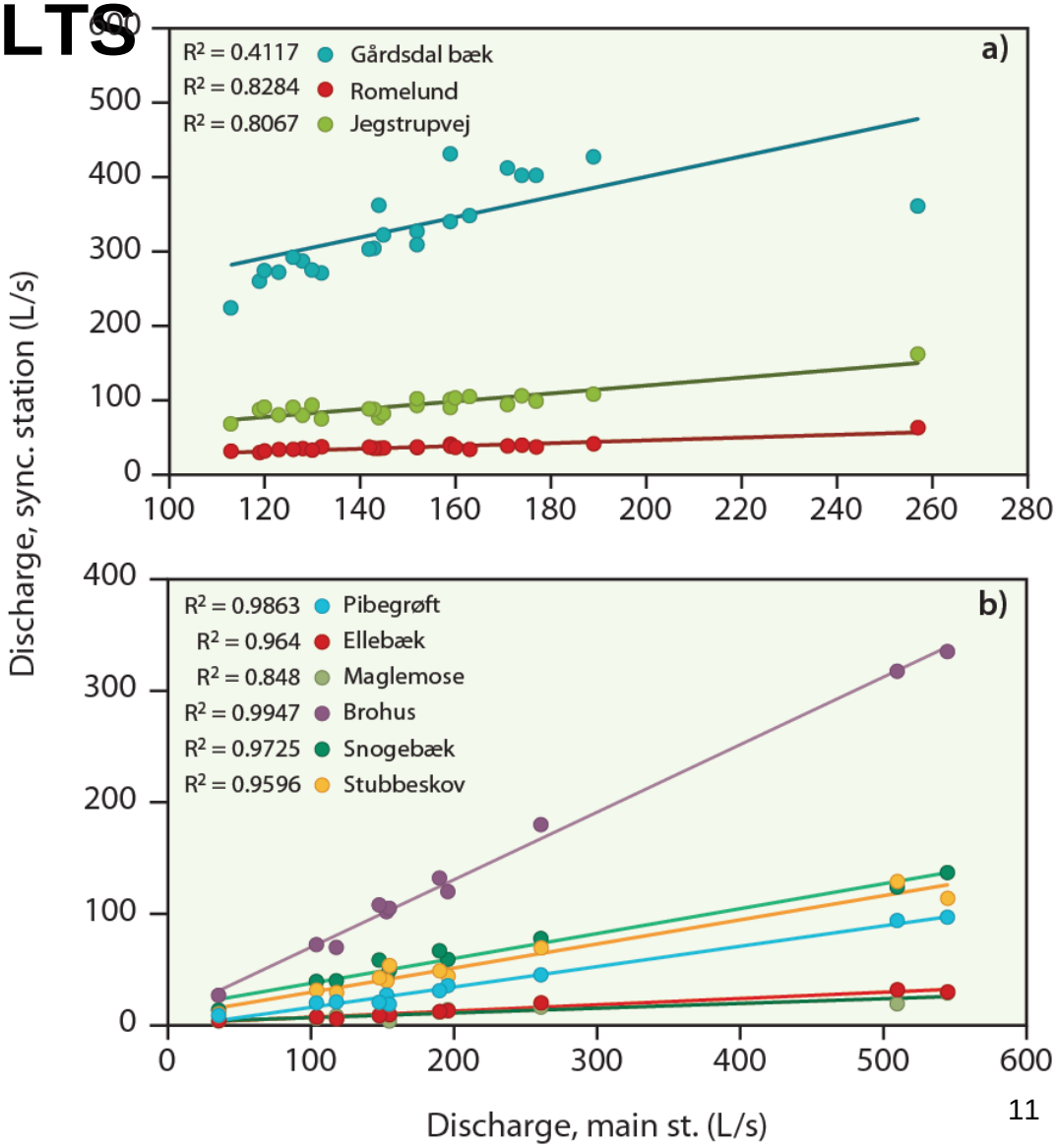
Only few drains

PRELIMINARY RESULTS
QQ RELATIONS

› Q measurements at main stations and up-stream stations

a) Not drained catchment

b) Systematically drained catchment

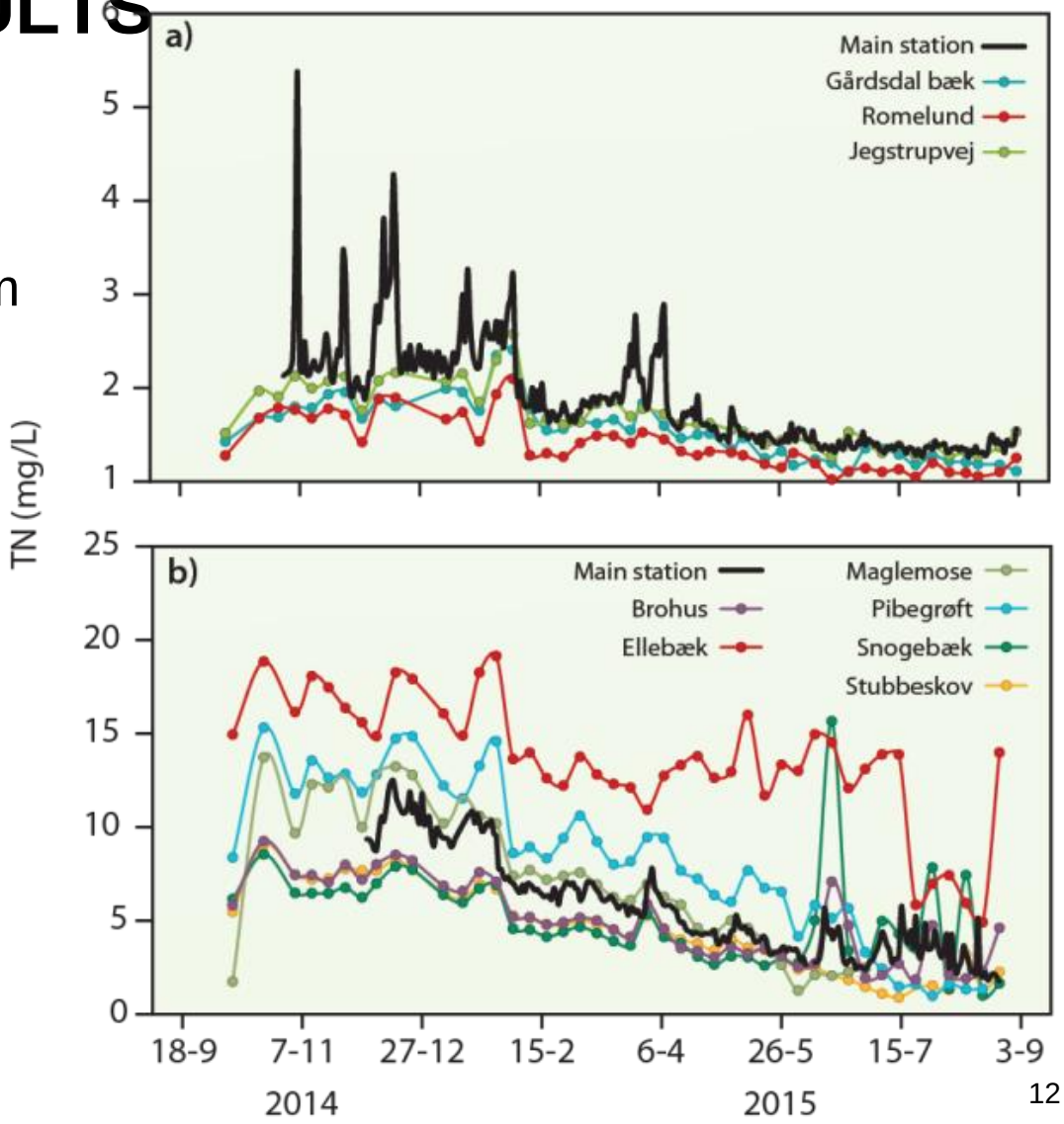


PRELIMINARY RESULTS
N CONCENTRATIONS

› TN concentrations at main stations (daily) and up-stream stations (weekly)

a) Not drained catchment

b) Systematically drained catchment



CONCLUSION

- A concept for the design of monitoring of agricultural N-emissions are being drawn as a guideline for farmers.
- Preliminary results show that 65% DK area will potentially be suitable for a stream monitoring program.
- Sampling and data analysis continues in the coming 3 years including a model component.
- The future regulation of N-emissions from Danish agriculture will surely change in the coming years – but where to ?

Thank you for your attention!

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