Differentiated nitrogen retention mapping

to reduce nitrate leaching with a more targeted and cost-efficient N-mitigation strategy.

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Project is founded by :

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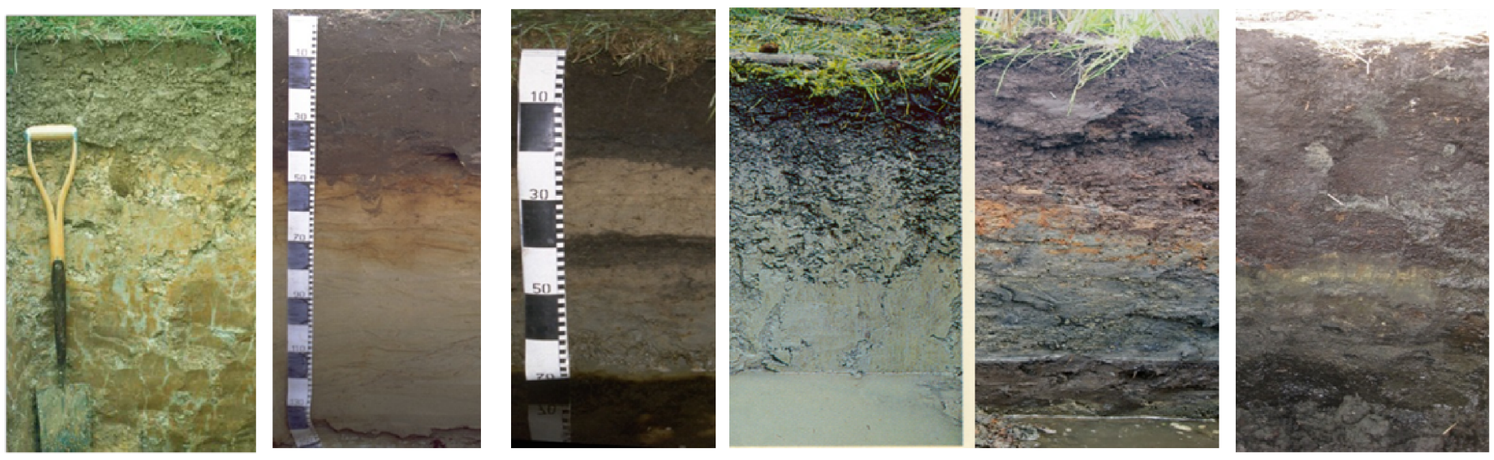
Related literature

- Mahmood, H., Schneider, R., Frederiksen, R., Christiansen, A., and Stisen, S.: Assessing the physical controls of simulated drain flow dynamics, in: EGU General Assembly 2022, 6315.
- Schneider, R., Mahmood, H., Frederiksen, R. R., Højberg, A. L., and Stisen, S.: Prediction of drain flow fraction at high spatial resolution by combining physically based models and machine learning, in: EGU General Assembly 2022, 3694.

Piezometer installed at two field sites from 0-5 meter. In total 180 piezometer were installed.



Introduction

The current nitrogen regulation in Denmark does not consider the large variation in N-retention within catchments leading to nutrient losses and unfavorable agriculture practices. The retention within a catchment can vary from <20% to 100% due to differences in drain transport, and hydrological and geochemical conditions.

OBJECTIVE

The retention mapping aims to achieve a cost-effective aquatic environment effort through an increased targeting of the N-mitigation strategy by knowledge of more detailed N-retention in the root zone and to understand the drain flow fraction.

METHODOLOGY

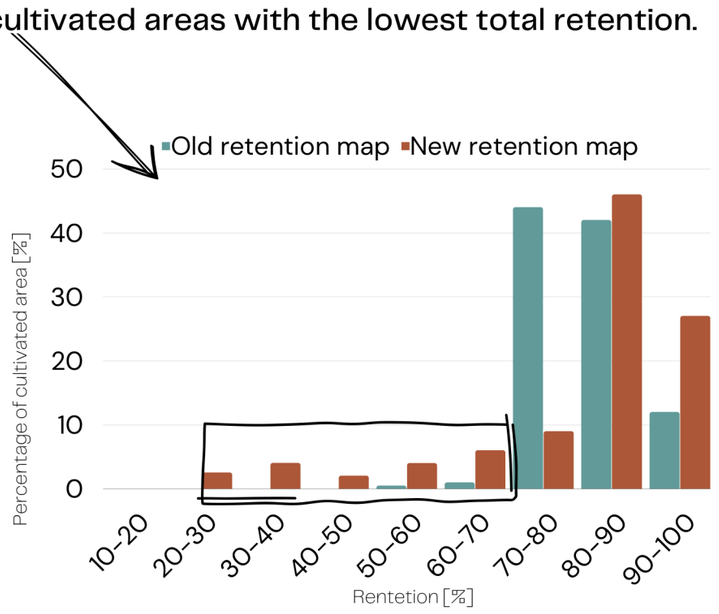
The core of the project is 1) to further develop the Ejlskov redox probe to map the redox potential in the root zone, 2) to use geophysical mapping methods to map the spatial geology and water saturation profile with drainage geometry to develop hydrological models that describe water level dynamics and drainage runoff, 3) develop an operational and scalable model for mapping spatially differentiated N-retention classes within catchments, and 4) demonstrate the environmental and economic effects of a differentiated targeted mitigation measure effort with field and drainage mitigation measures.

RESULTS

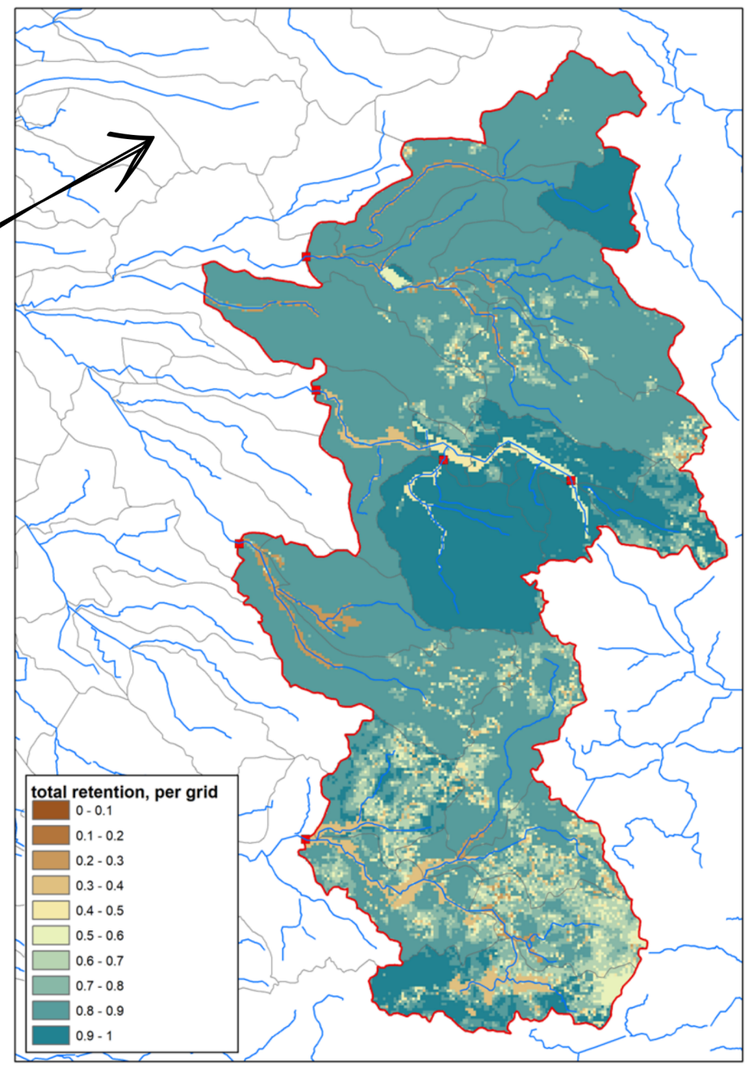
With the new highly detailed N-retention map, it is possible to demonstrate the economic and environmental costs of various mitigation measures, both field measures and end-off drainage measures, by considering the large variation in N-retention within the catchments.

Analysis

1. Redox-probe measurements are conducted – no clear redox-zone in the upper 1-2 meters – more clear from 5 meters under terrain.
2. A reliable and calibrated model that can predict drain flow dynamics accurately is achived during the project. In further work it can feed in to better understanding of drain flow dynamics and help to improve diffenrentiated retention map.
3. A groundwater retention model for Skjern Å on 100 m resolution is set up in MIKE SHE. The new model is improved with ML drain fraction map + redox zone for groundwater.
4. Based on the new differentiated retention map, the economic and environmental effects of targeting catch crops are demonstrated in the cultivated areas with the lowest total retention.



Area distribution in retention classes in procentage. Green shows distribution on the old map with average resolution 1500 ha. Red shows distribution on the new retention map with average resolution on 1 ha.



Total retention map for Skjern Å catchment with the new diffenrentiated 100 m resolution.

Conclusion

- The potential in targeting depends on the variation in retention.
  - The higher the resolution – the greater the variation – the greater the potential.
  - Important to find the cultivated areas with low retention.
- The absolute effect of targeting is greater where surface water retention is low; but the relative effect is independent of surface water retention.
- Economic potential in targeting increases strongly with increasing demands.