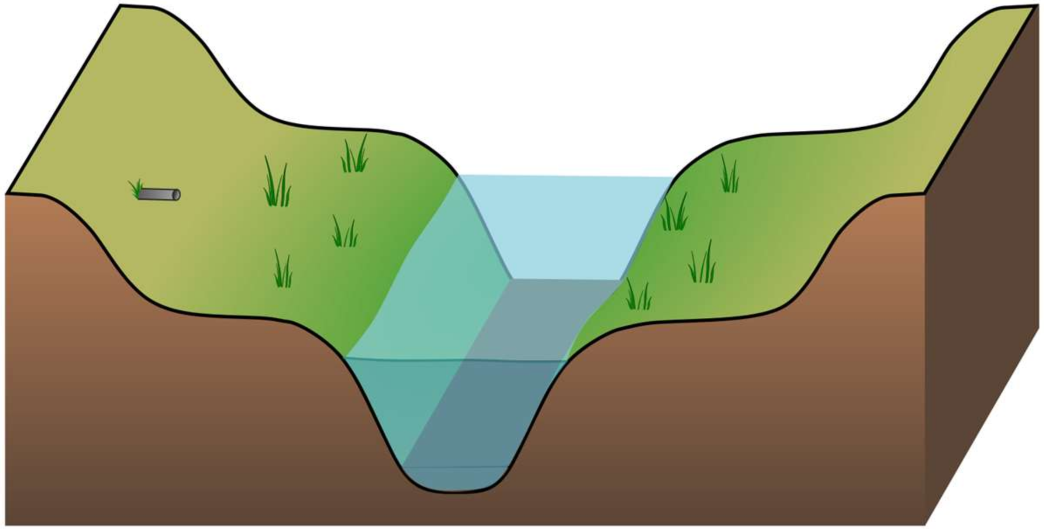
Two-stage ditches in Sweden

- Nutrient retention capacity of a stream remediation measure



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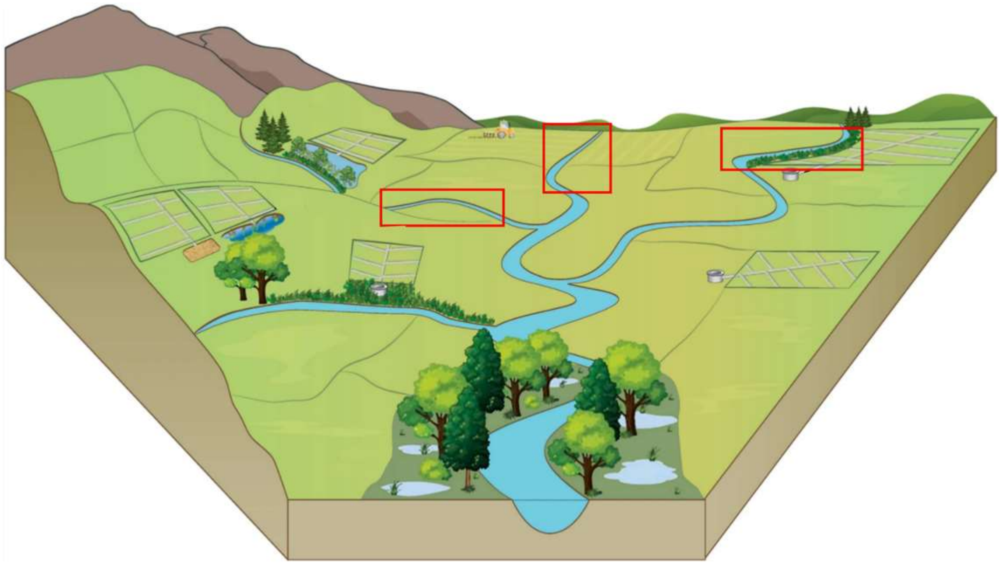
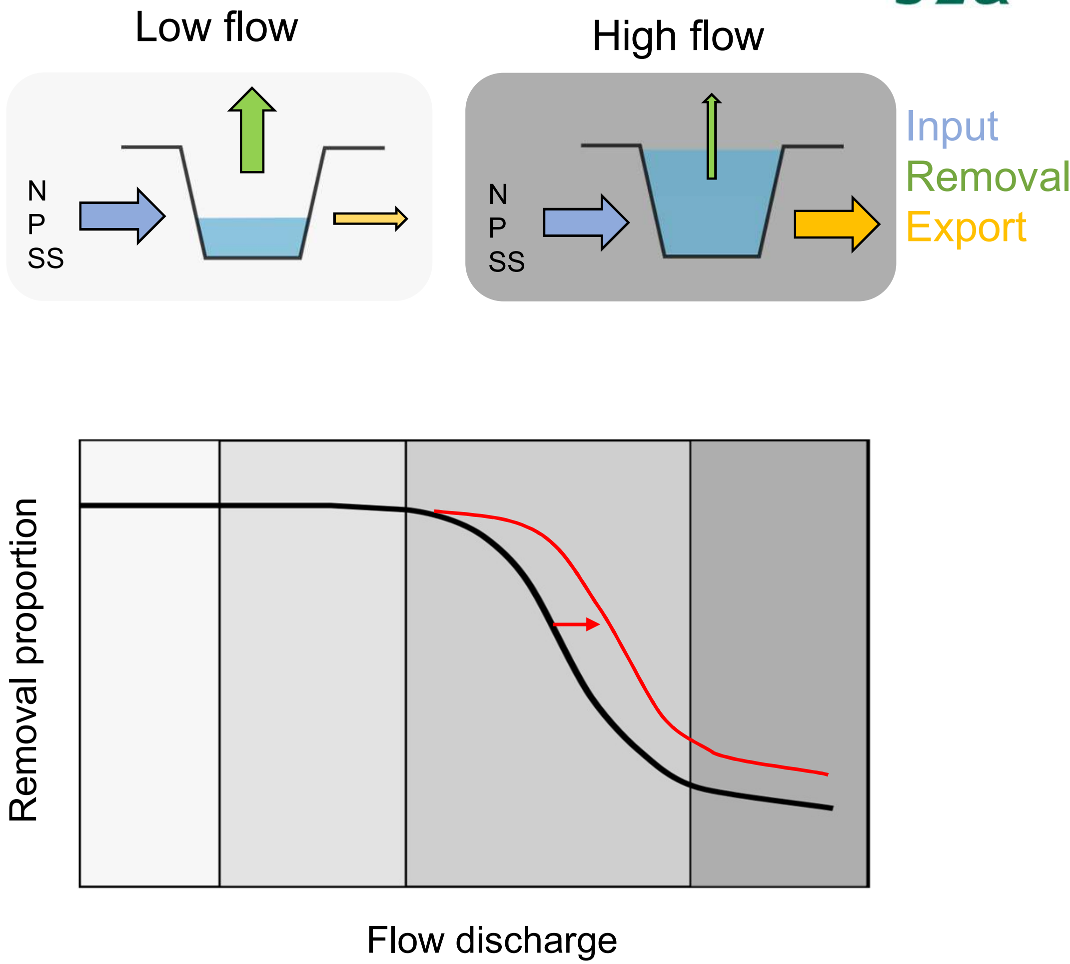
Swedish University of Agriculture, SLU

The role of headwater streams and ditches



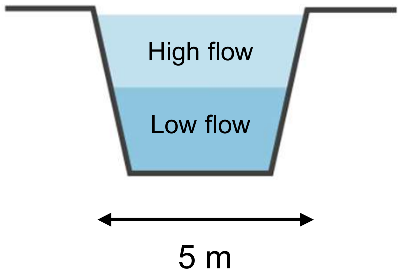
Modified from Carstensen et al., 2020 *Ambio*



Remediation of agricultural ditches

Trapezoidal ditch

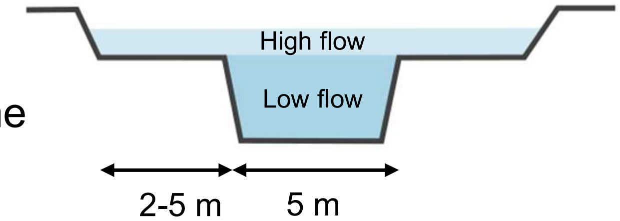
- Efficient water removal
- Low nutrient/sediment retention
- Prone to erosion



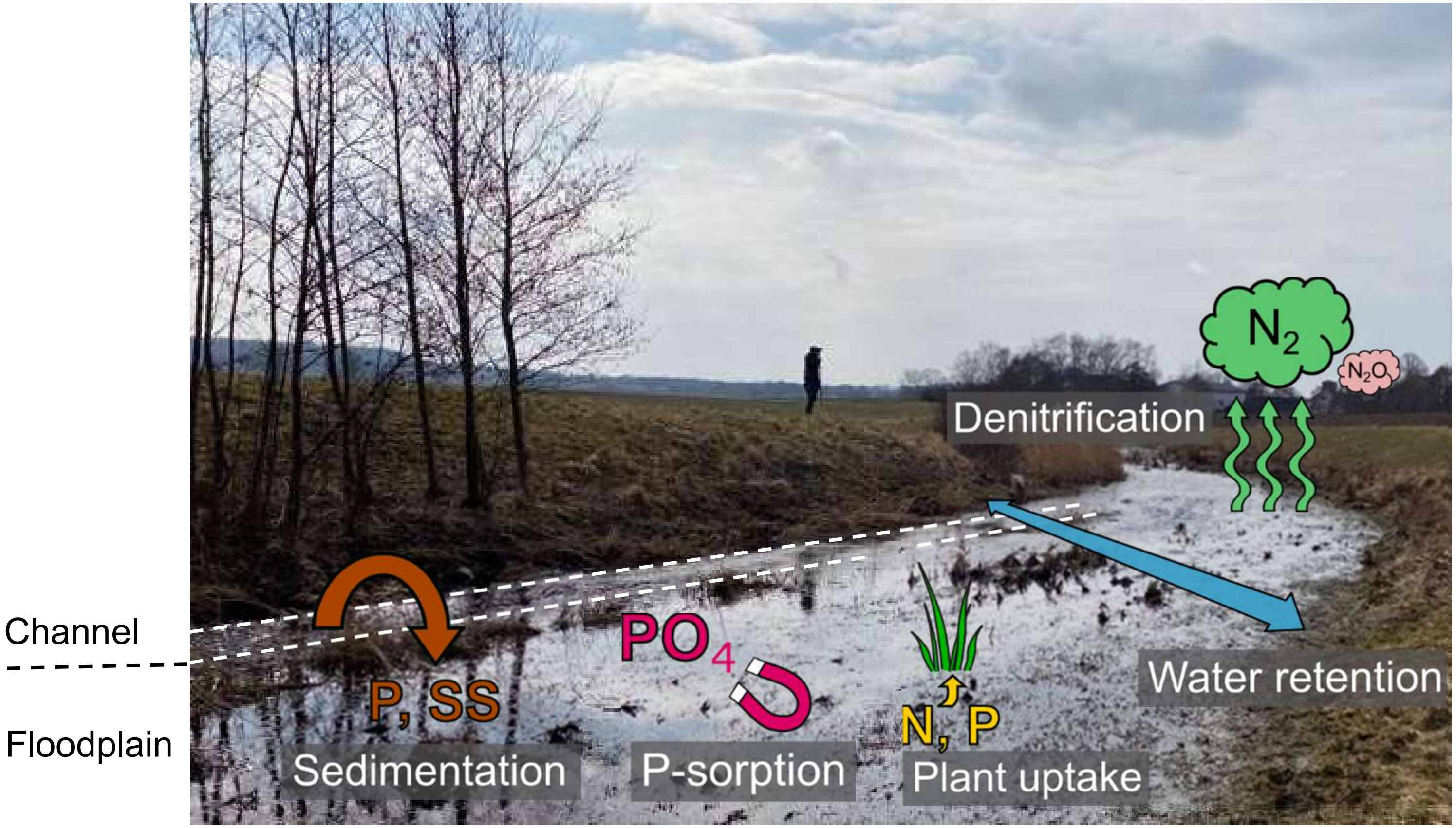
Jordbruksverket, 2018

Two-stage ditch

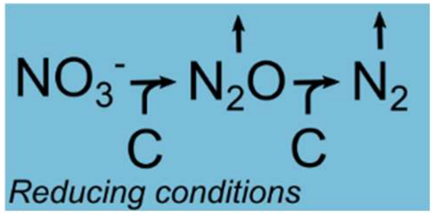
- Incised floodplains
- Larger cross-sectional volume



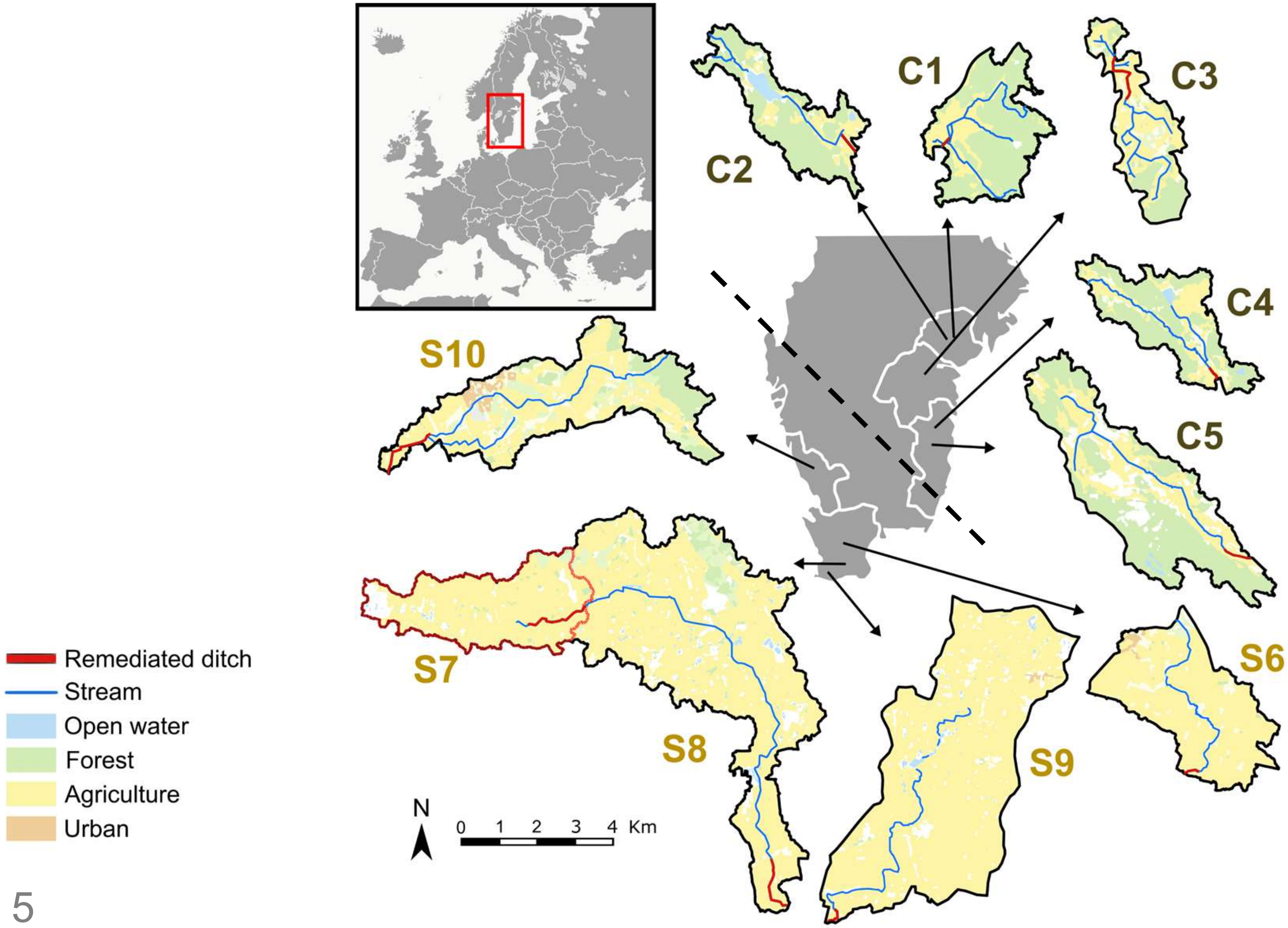
Retention and removal processes in two-stage ditches

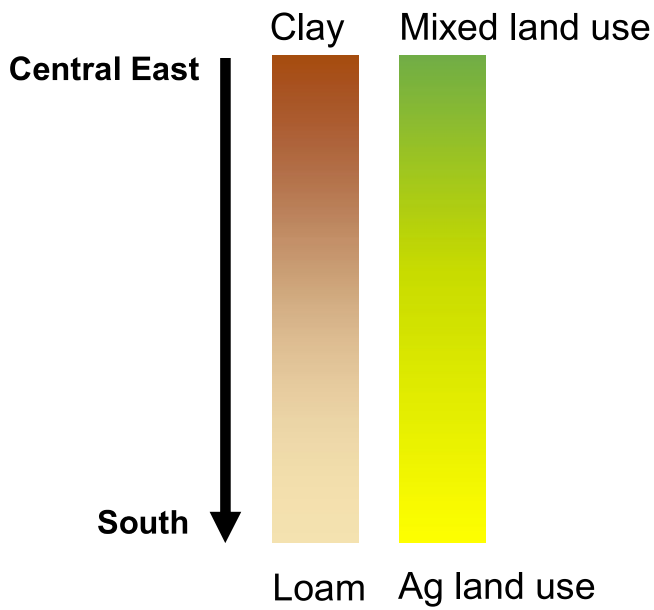


Denitrification

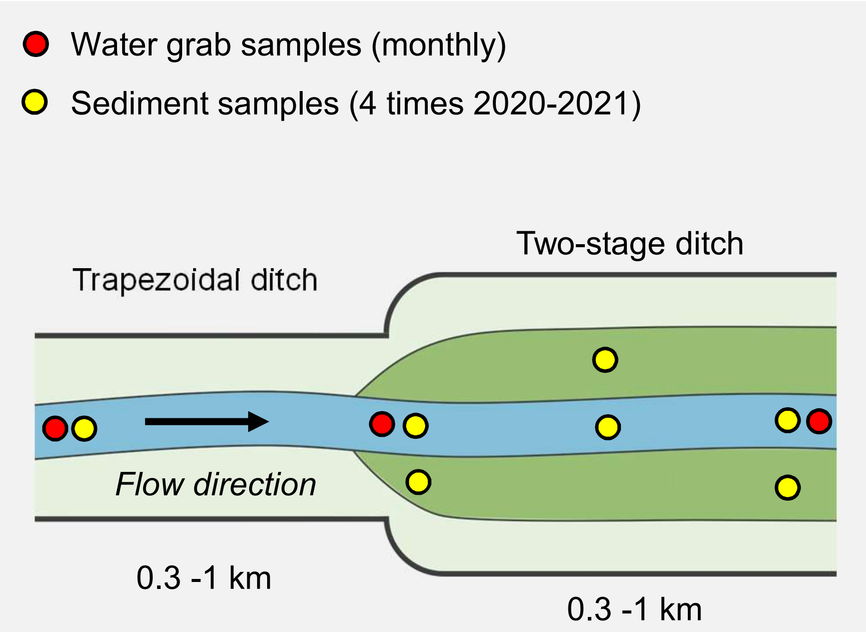


Study sites

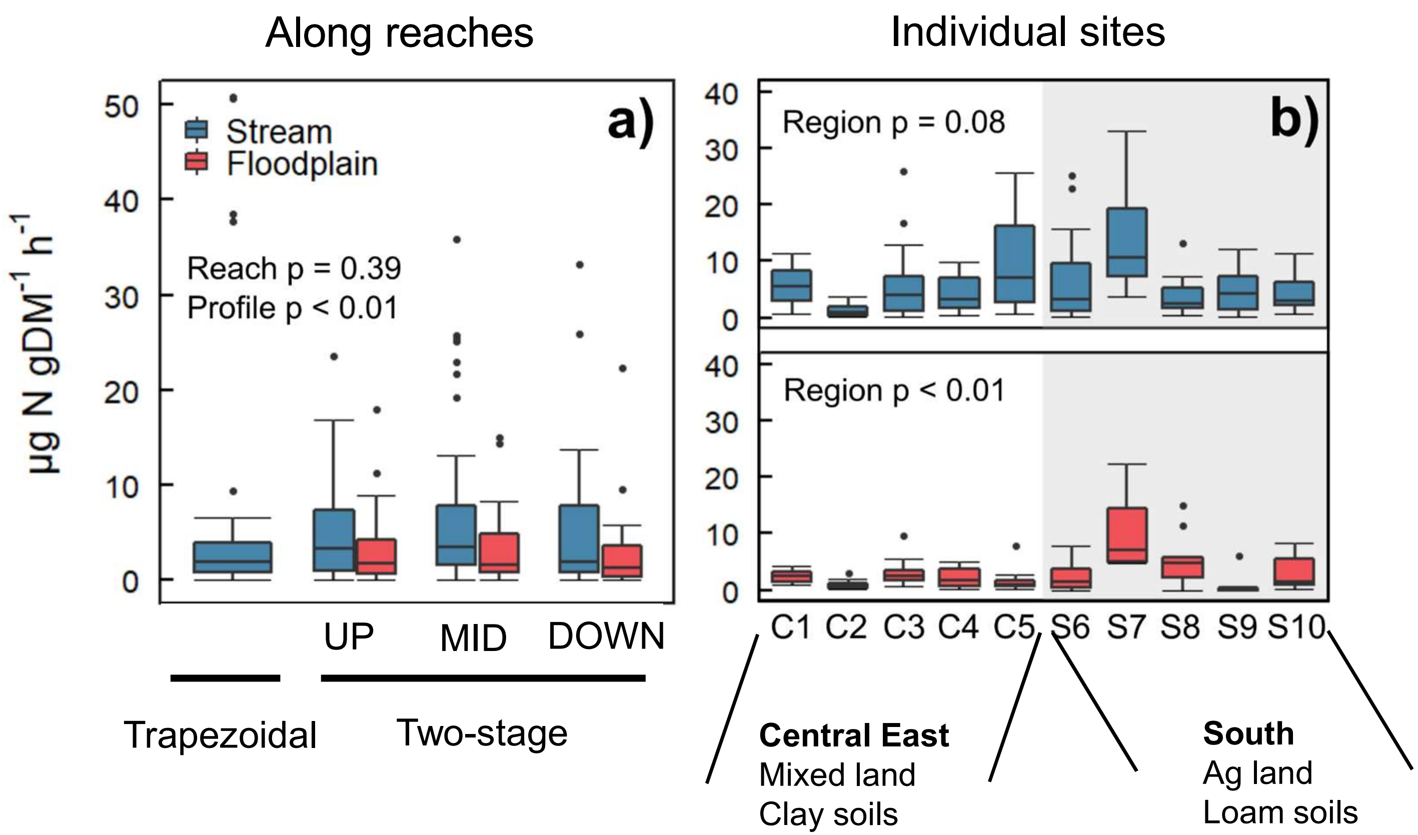

C1
C2
C3
C4
C5
S10
S7
S8
S9
S6
Remediated ditch
Stream
Open water
Forest
Agriculture
Urban
N
0 1 2 3 4 Km


Clay
Mixed land use
Central East
South
Loam
Ag land use

Study design



Denitrification rates ($N_2O + N_2$)

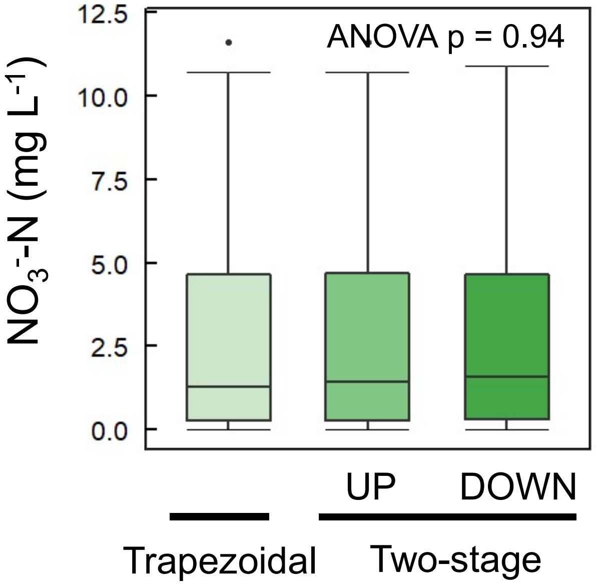


Hallberg et al., 2022. *Science of The Total Environment*

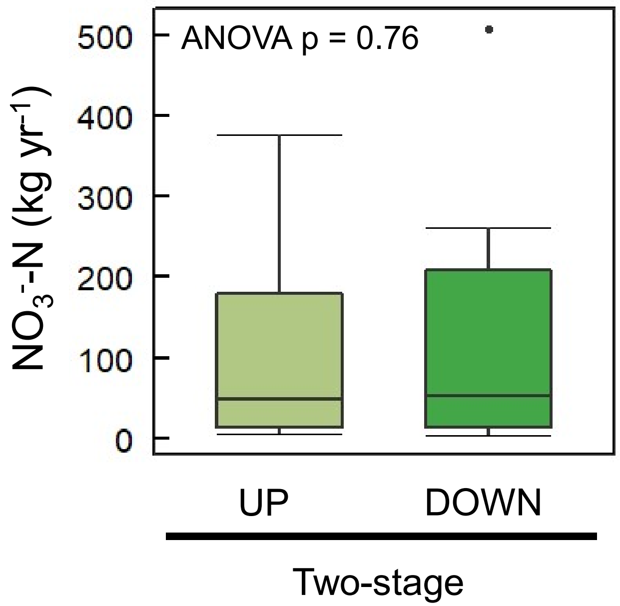
Nitrate removal

April 2020 - March 2022

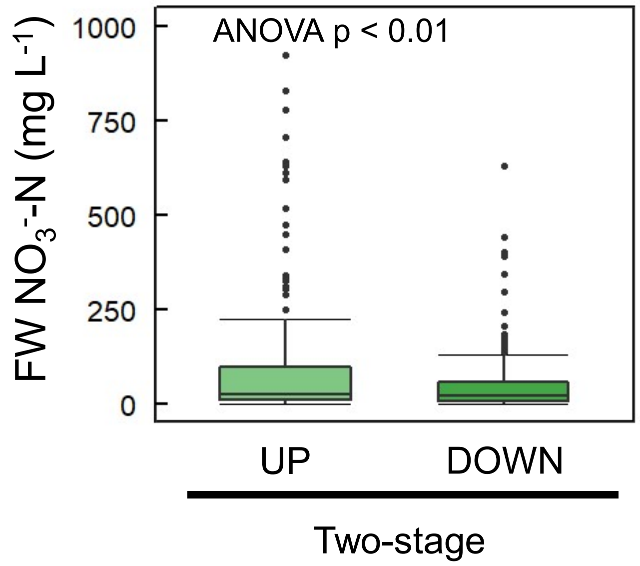
Concentrations



Loads



Flow-weighted concentrations



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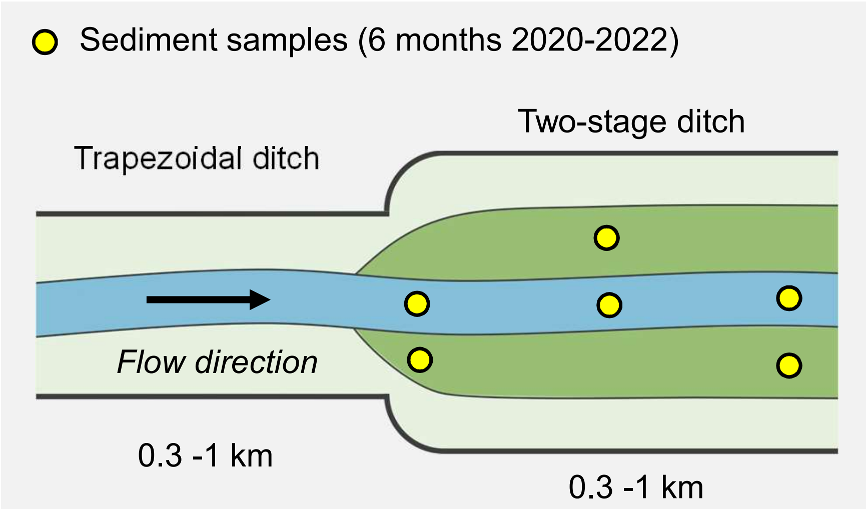
Phosphorus sedimentation

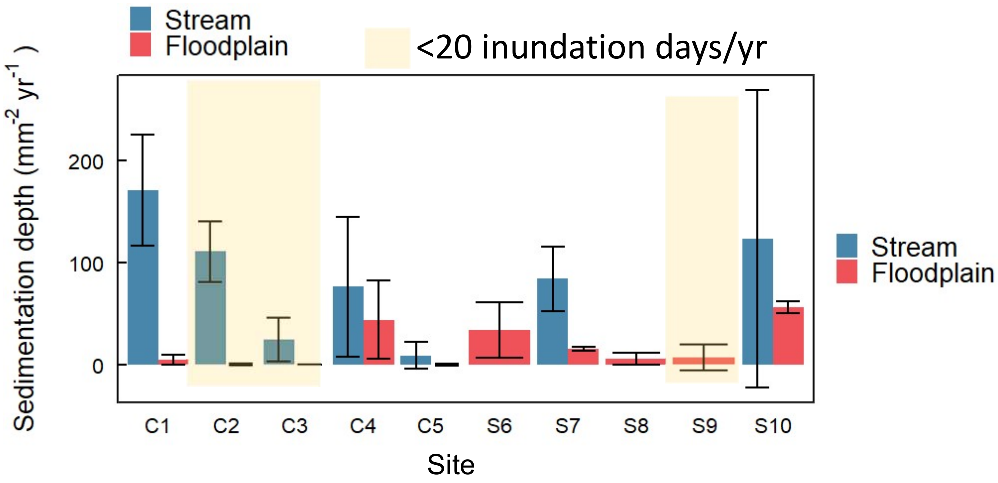
Sedimentation plates

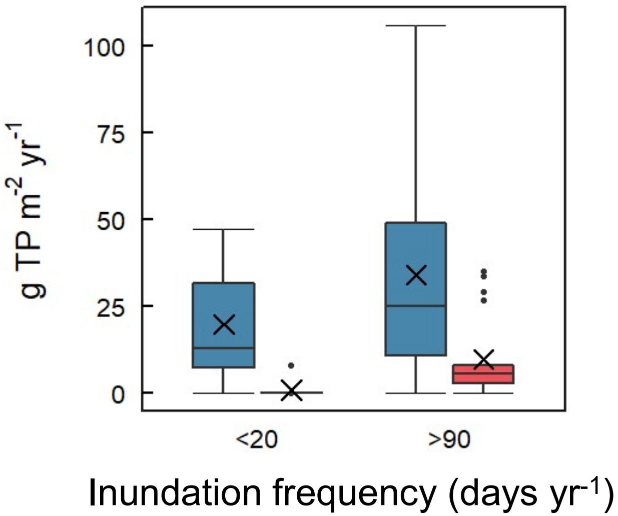


Stream

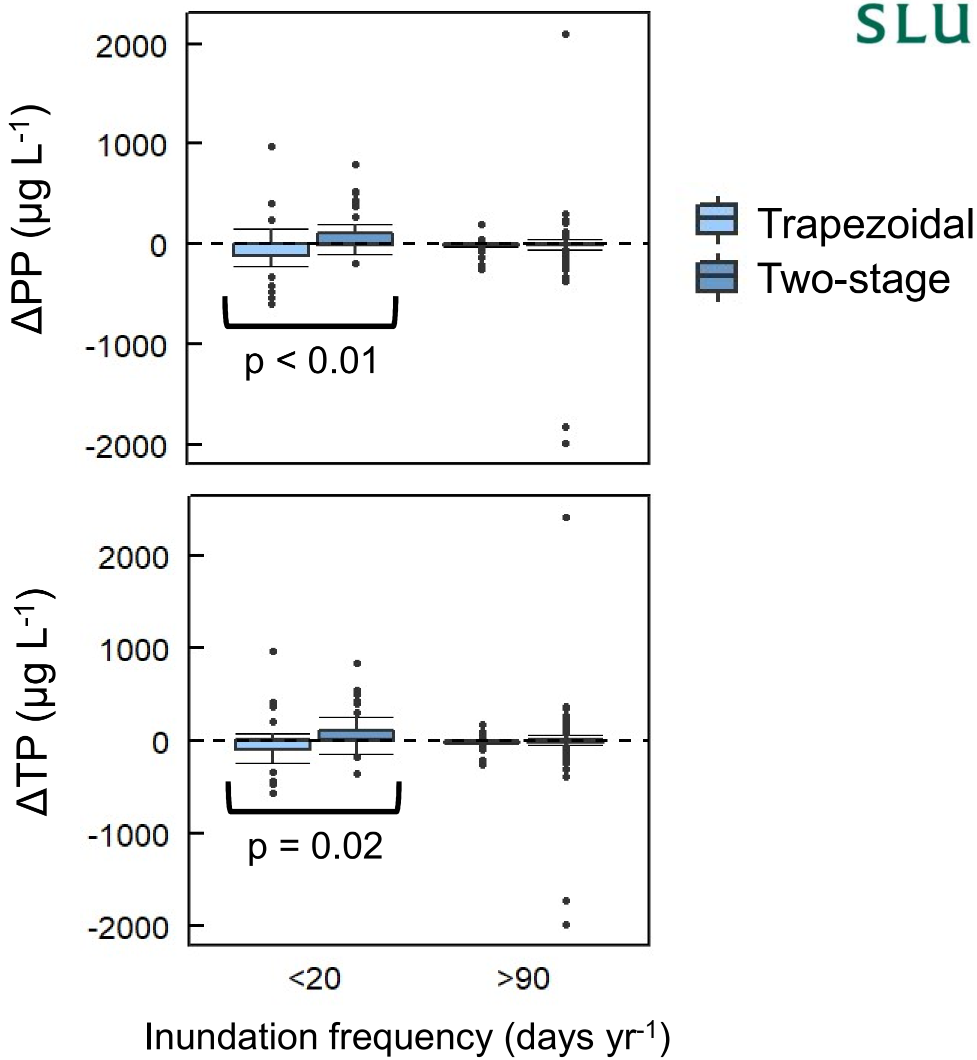
Floodplain

Phosphorus sedimentation



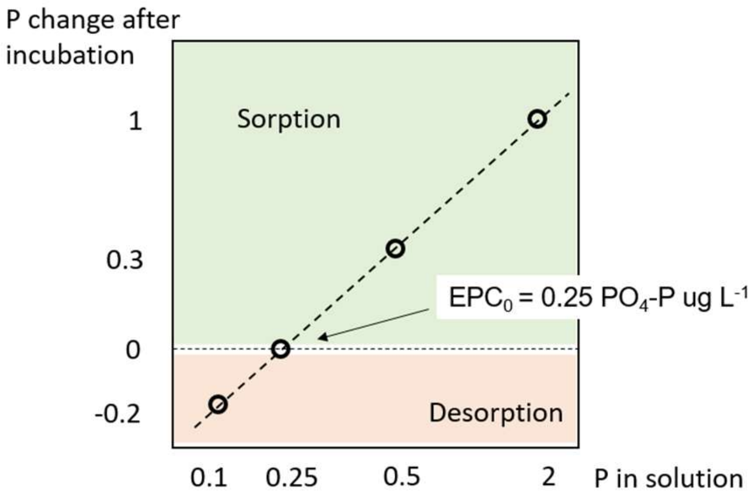


Retention of PP and TP

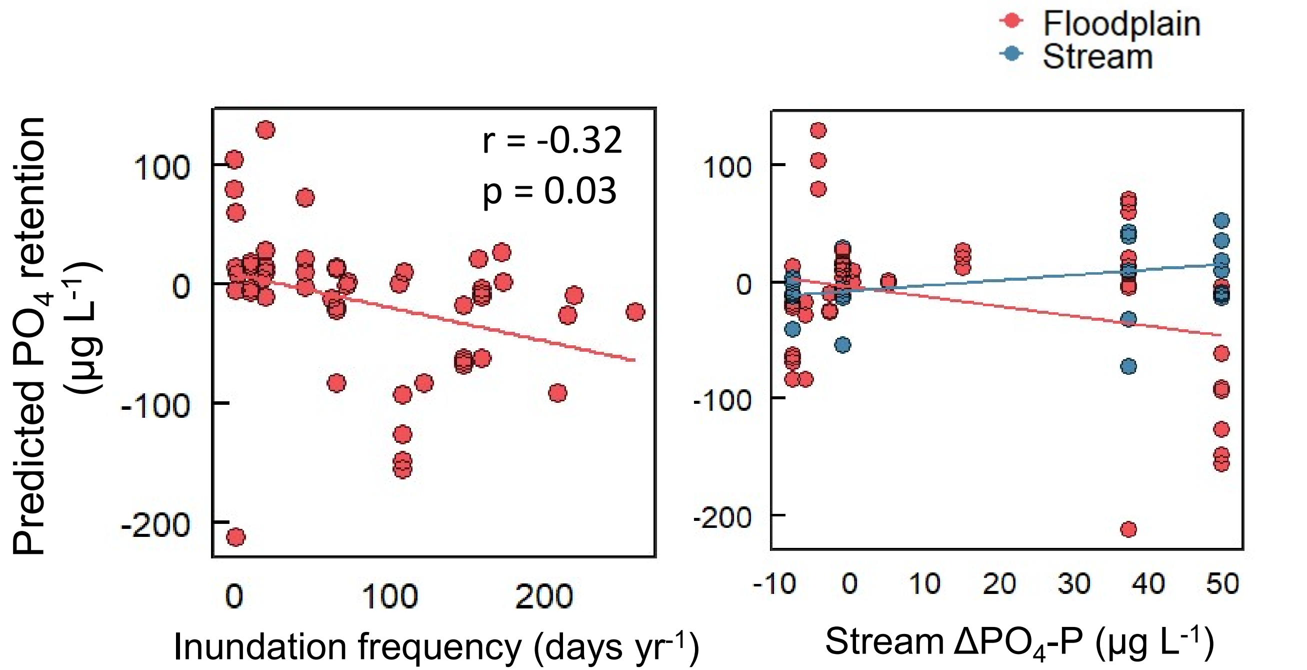


Phosphate retention

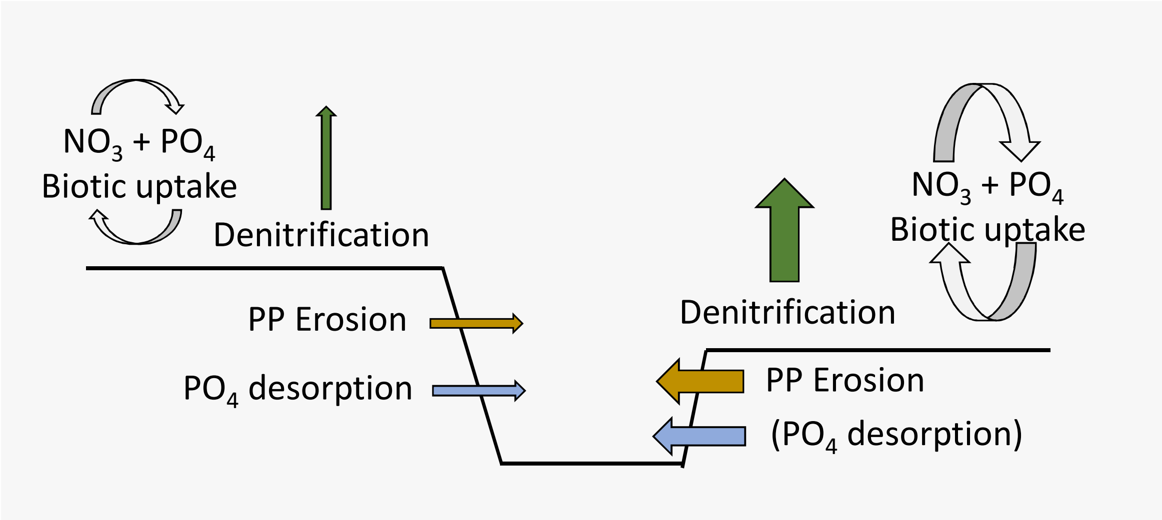
Equilibrium phosphorous concentration



- P-sorption isotherm
- P concentration where no sorption/desorption occurs



Conclusions



- Floodplains increase denitrification capacity with 50 %
- Higher denitrification in NO_3-delivering catchments
- Floodplain height determine PP or NO_3 mitigation
  - High floodplains control PP in erosion-prone ditches
  - Low floodplains increase NO_3 removal

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Catchment controls of denitrification and nitrous oxide production rates in headwater remediated agricultural streams

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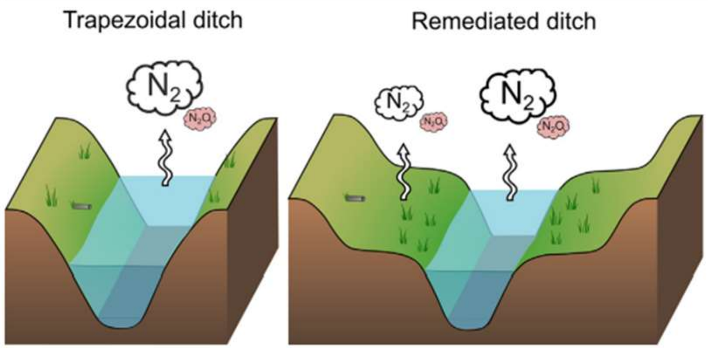
HIGHLIGHTS

- Floodplains increase total system denitrification by 50 %.
- Nitrous oxide production was lower in floodplains than in stream.
- Nitrate-rich catchments promote denitrification and suppress nitrous oxide yields.
- Catchment hydrological processes can override reach-scale nitrate retention.

GRAPHICAL ABSTRACT



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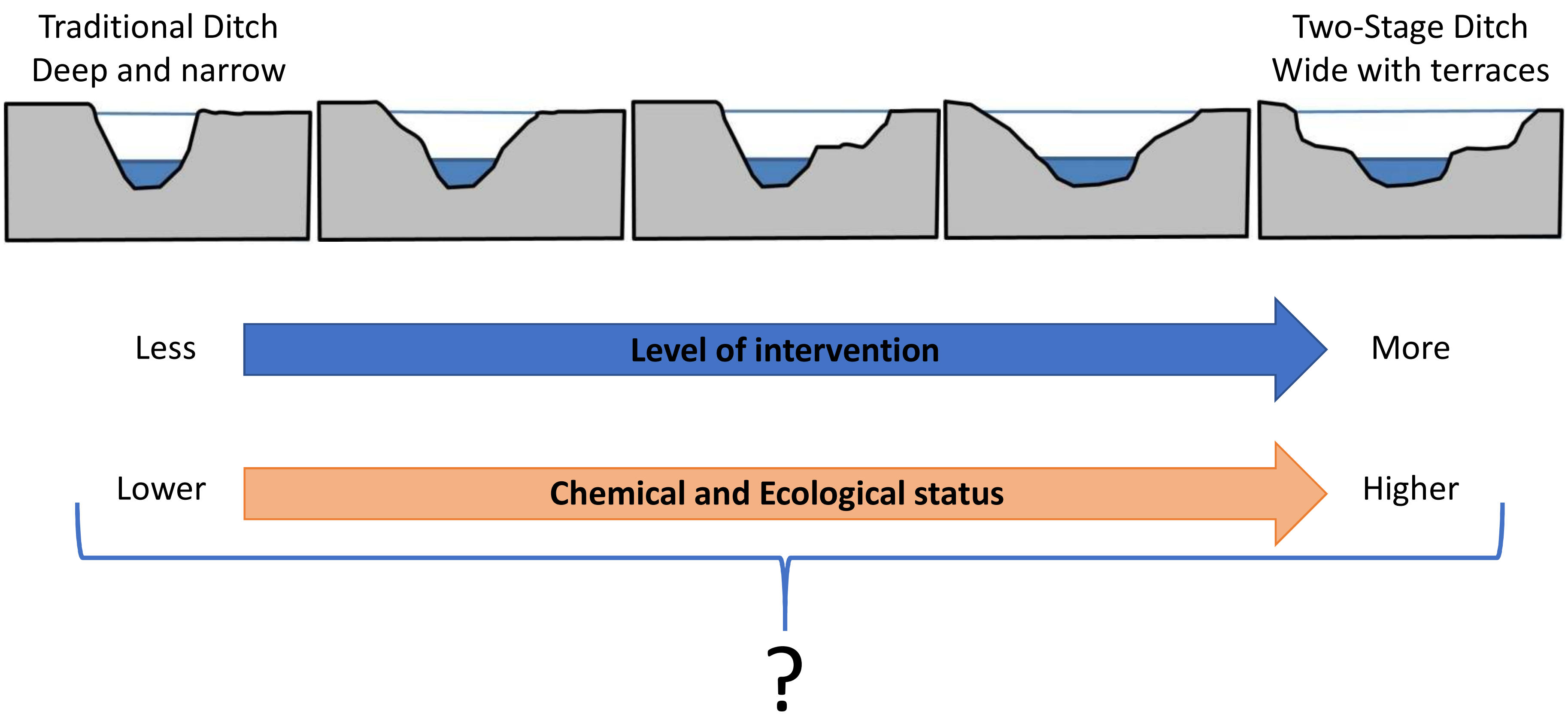
In the pipeline:

Comparison between two-stage and sloping of ditches

John Livsey, Post-doc at Dept. of Soil and Environment, SLU



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Faruk Djodjic *co-supervision*

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