Choosing between Evils: Management Dilemmas in Sulfur-Rich Subsiding Peat Meadows

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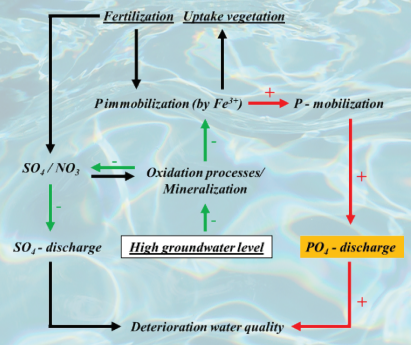
Background & Conclusions

In European coastal lowlands, peat meadows are intensively managed for agricultural use. Peat degradation is very common, leading to land subsidence and (internal) eutrophication. The peatlands near the coast are naturally enriched in reduced sulfur. Due to decades of drainage, decomposition processes and manure application, the oxidized top layers of the meadows have become relatively rich in iron and phosphorus, and poor in sulfur because of sulfate mobilization.

- High groundwater levels, desirable to prevent land subsidence, result in high mobility of phosphate and direct eutrophication of surface waters
- Low groundwater levels, on the other hand, stimulate aerobic peat decomposition, and mobilize sulfate which indirectly leads to eutrophication in surface waters
- Therefore, good management strategies without additional measures seem to be very challenging for sulfur-rich peat meadows

Dilemma 'high groundwater level'

- High groundwater levels (anaerobic conditions in the iron-rich top layer) lead to strong mobilization of phosphorus because of iron reduction.
- Mobilization of phosphorus in the ground-water enhances phosphate fluxes to the surface water.
- On the other hand, high groundwater levels decrease peat decomposition (oxidation processes) and therefore land subsidence.



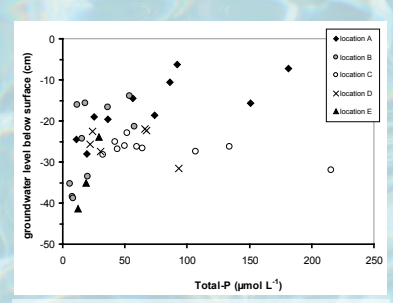


Fig 1. Total-P concentrations in the groundwater at different locations of sulfur-rich peat meadows

Methods

Since 2009, a large-scale field experiment has been carried out in Dutch peat meadows to investigate the effects of land use on the interactions between terrestrial and aquatic biogeochemical processes.

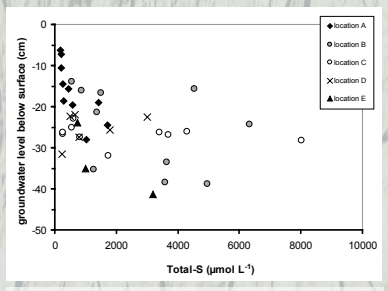
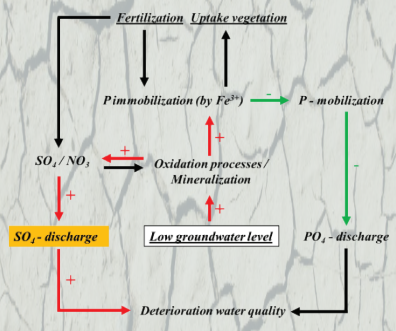


Fig 2. Total-S concentrations in the groundwater at different locations of sulfur-rich peat meadows



Dilemma 'low groundwater level'

- Low groundwater levels stimulate peat decomposition, leading to mineralization and land subsidence.
- Moreover, drainage and subsequent oxidation of sulfur-rich peat results in strong mobilization of sulfate in the groundwater.
- Sulfate is discharged into the surface water, where it provokes the mobilization of iron-bound phosphate from the sediment (internal eutrophication).
- However, P in the groundwater is immobilized very efficiently by ferric iron in the aerobic top layer, which decreases P fluxes to the surface water.

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