Peatland Restoration in a Changing Climate: **Risks and Chances of Salinization in Coastal Peatlands**

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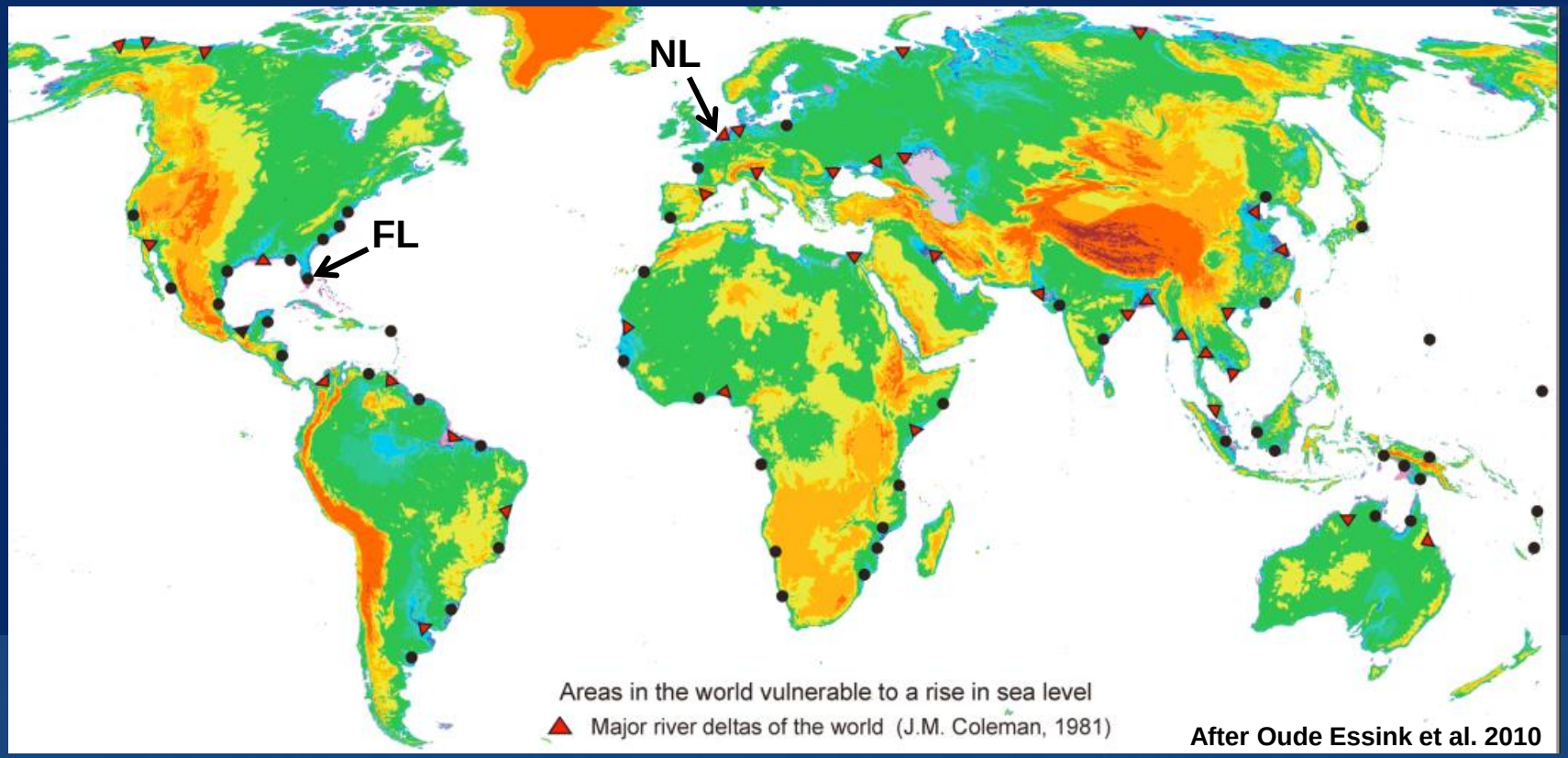
Introduction

- Large-scale problems in wetland management, such as
  - Eutrophication
  - Land subsidence
  - Desiccation
- Negative effects on peatland biodiversity and prospects for restoration

Introduction

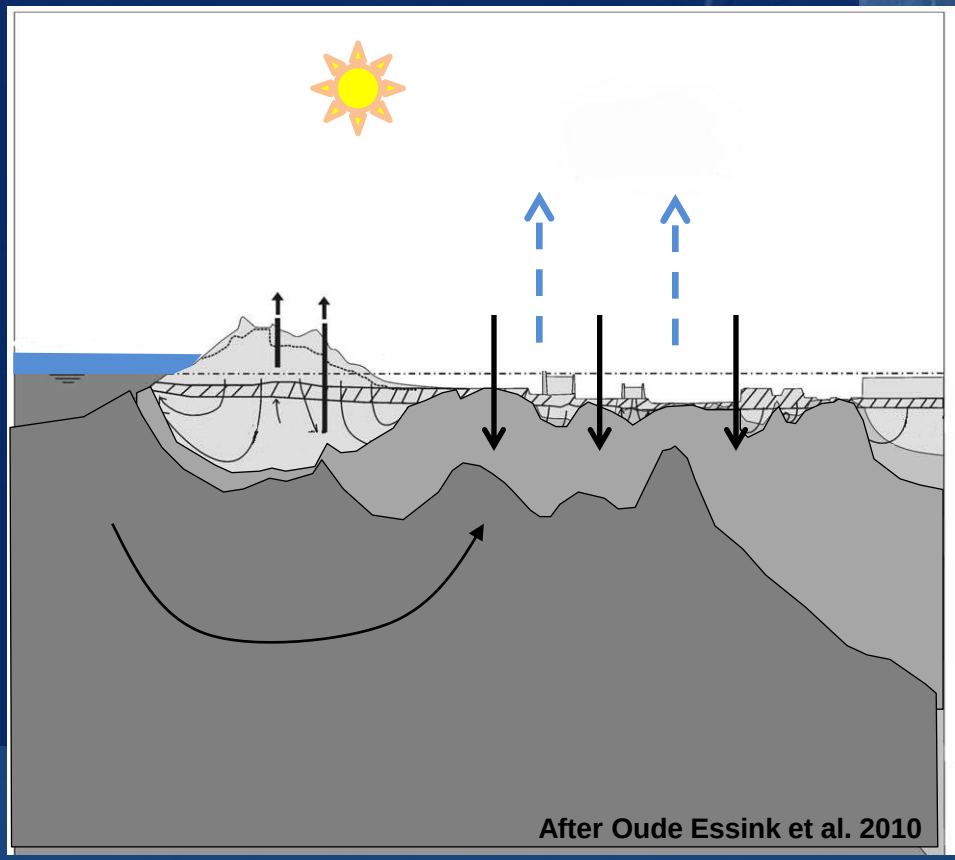
- At a global scale wetlands in deltas will be influenced by salinization



After Oude Essink et al. 2010

Introduction

- In European lowlands the chance of salinization in coastal peatlands increased due to
  - Land subsidence
  - Sea level rise
  - Decreased summer precipitation



Introduction

- Formerly brackish water peatlands are rare and transformed into freshwater peatlands, often in agricultural use

Introduction

- Salinization may impose risks on current freshwater peatlands
  - Physiological stress for freshwater biodiversity
  - Large effects on biogeochemistry
- Salinization may however also provide new opportunities to restore formerly brackish peatlands

Research questions

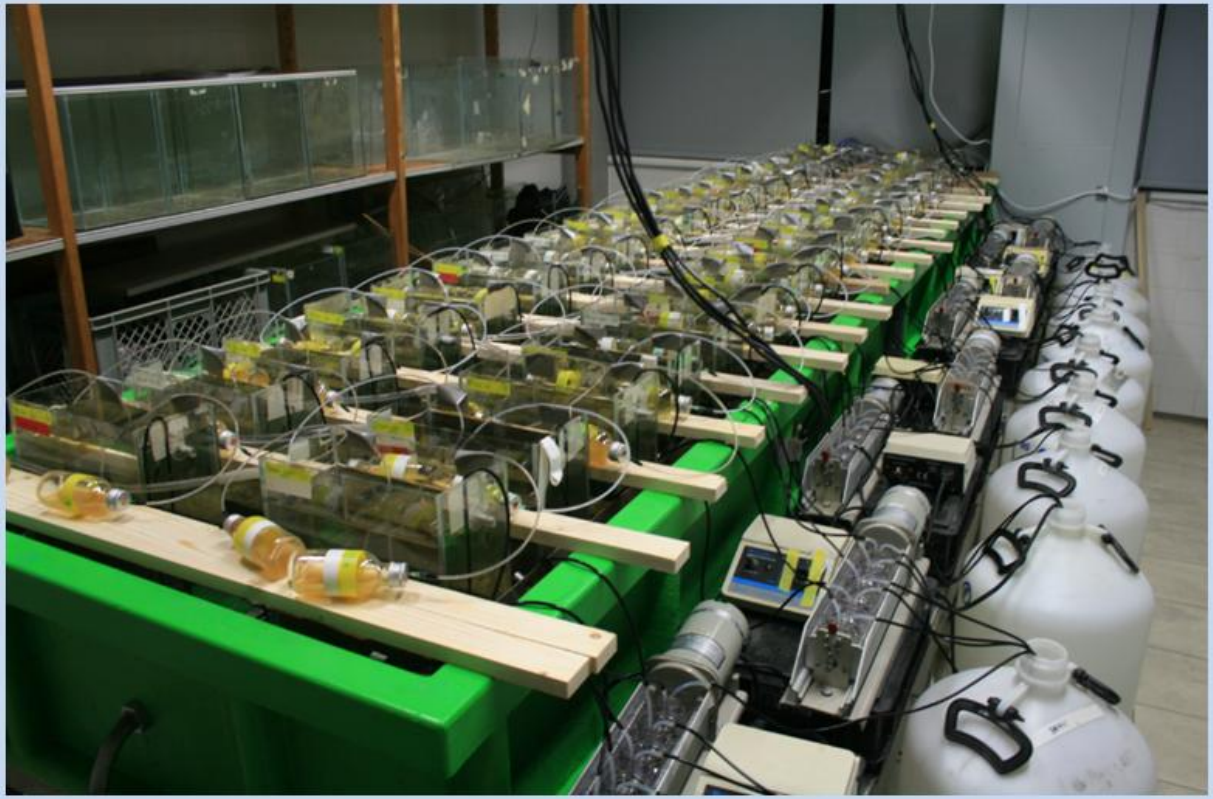
- How does salinization affect biogeochemical processes in the water and aquatic sediment of former brackish peatlands?
  - Effects on nutrients, greenhouse gas emissions
- How do the effects of constant salinization differ from a fluctuating salinity?

Experimental set-up

- Two experiments:
  - One controlled experiment in aquaria in the laboratory
  - One experiment in the field with enclosures

Exp. set-up aquarium exp.

Freshwater	Brackish water	Fluctuating fresh water & brackish water
5 mmol · L^{-1} Cl (2.5 gr · L^{-1})	70 mmol · L^{-1} Cl (2.5 gr · L^{-1})	1 month fresh water, 2 weeks

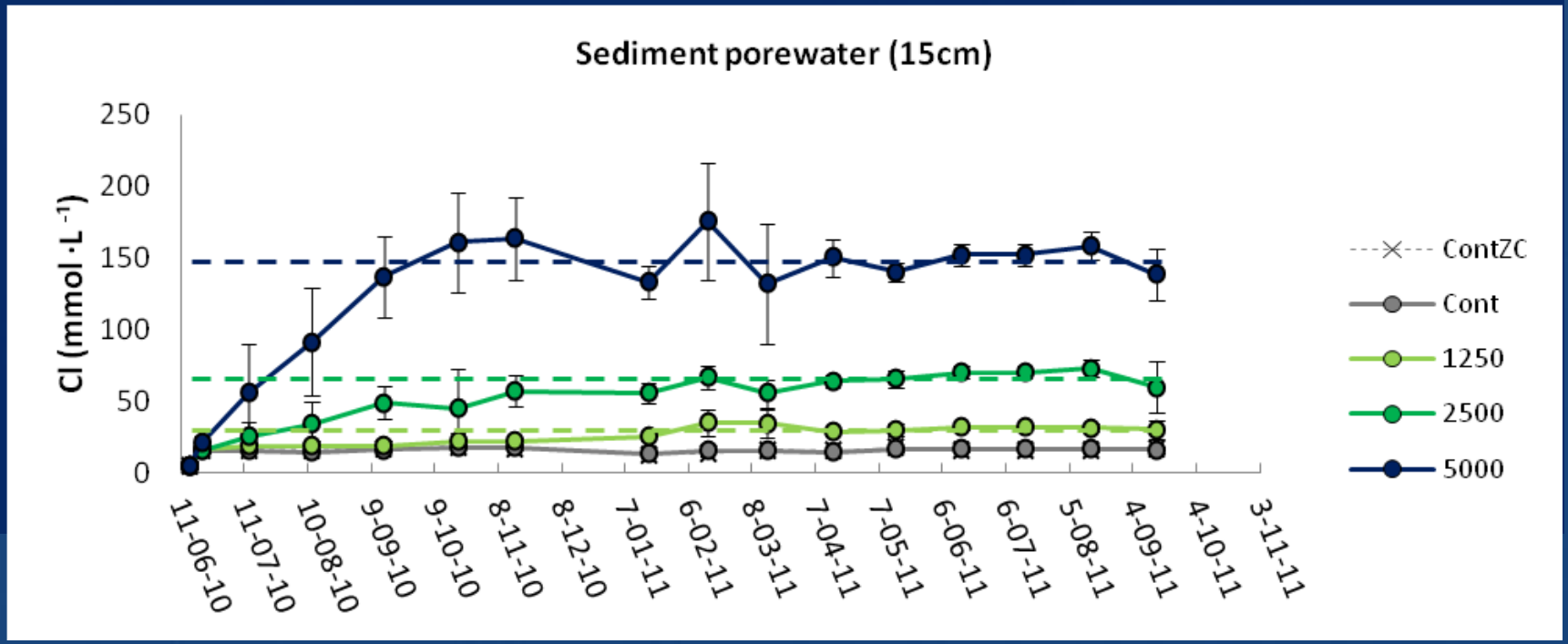


600 mg Cl/L **19 mmol Cl**	600 mg Cl/L **19 mmol Cl**	1250 mg Cl/L **35 mmol CL**	2500 mg Cl/L **70 mmol Cl**	5000 mg Cl/L **140 mmol Cl**

Results

- effects of salt -

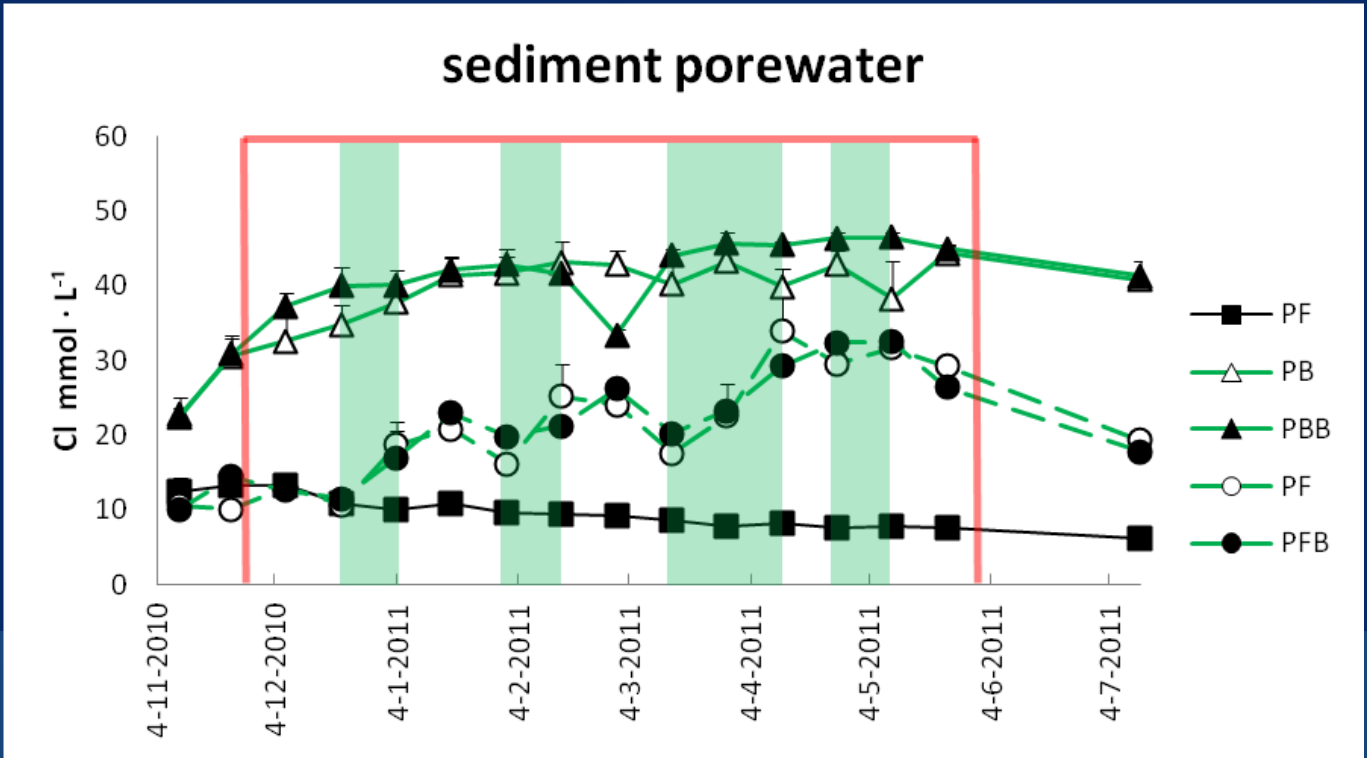
- Strong and fast salt intrusion in the aquatic sediment
- Mobilization of cations (incl. Ca)



Results

- effects of salt -

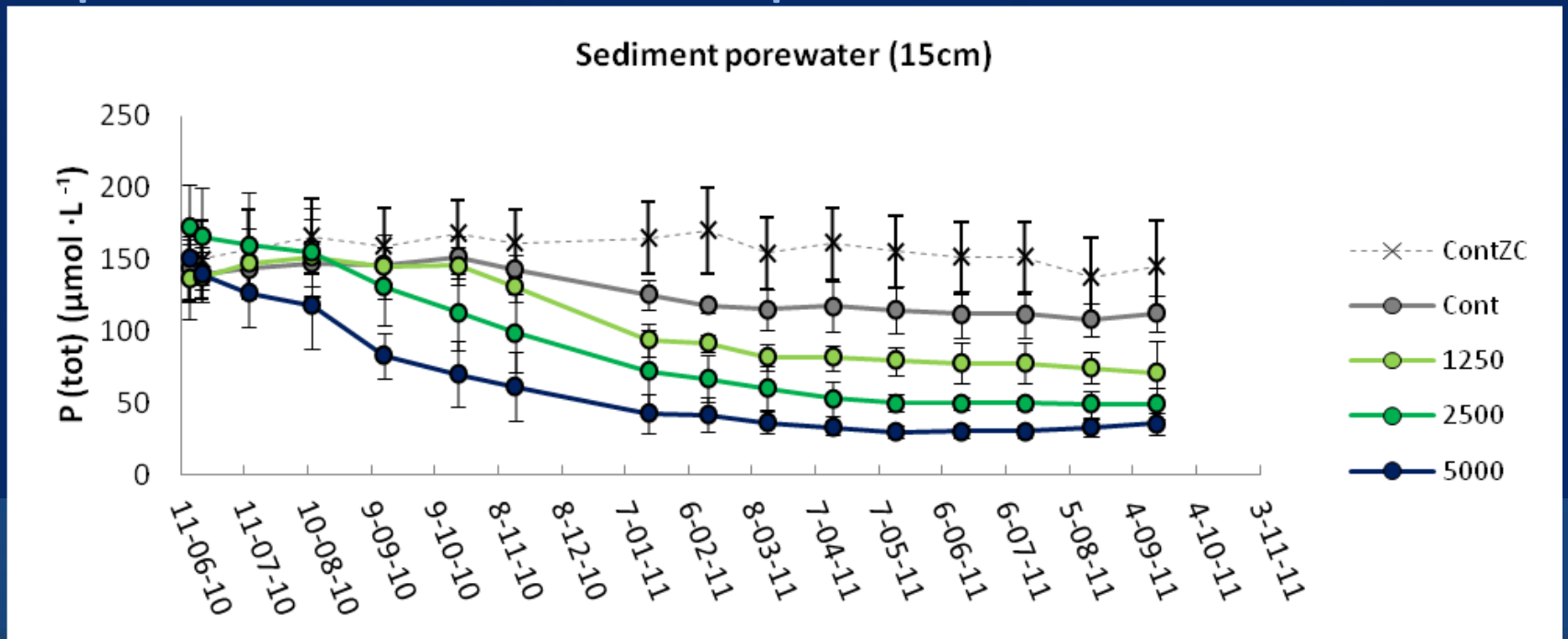
- Fluctuating salinity of the surface water has similar effects on the sediment on the long term



Results

- effects on nutrients -

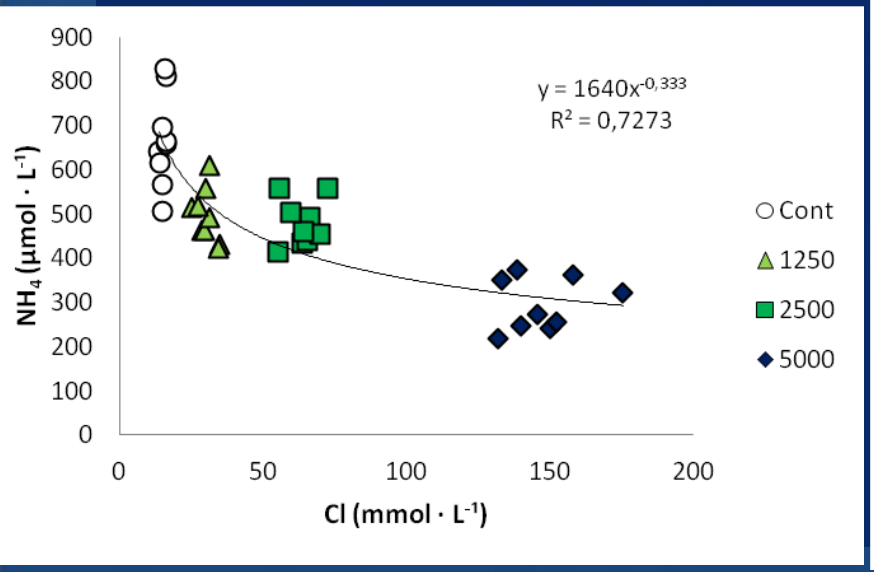
- Significant decrease in HPO_4^{2-} and $P_{(tot)}$ in the surface water and sediment porewater in both experiments, due to precipitation with Ca and possible lower decomposition

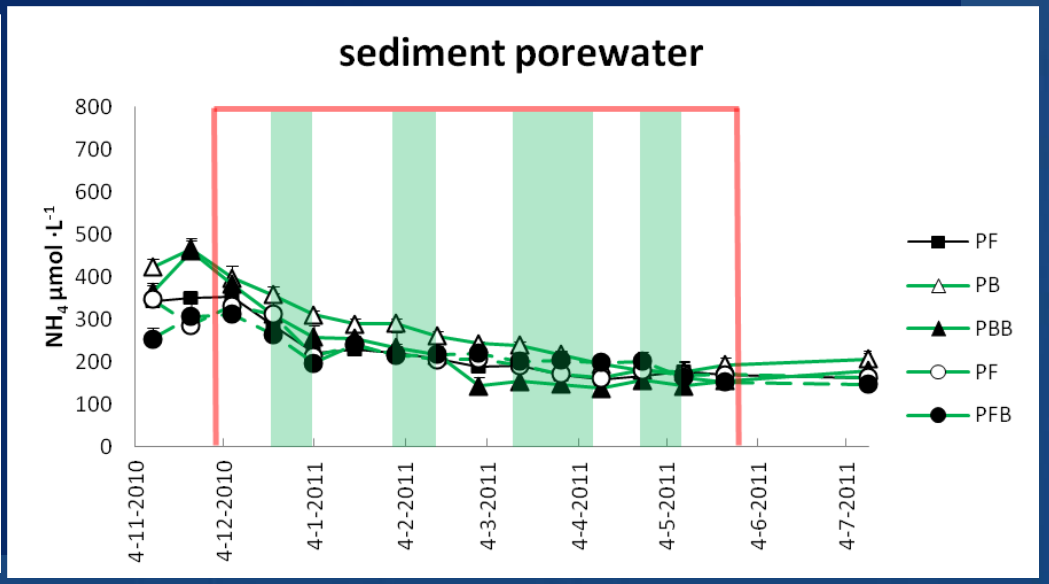


Results

- effects on nutrients -

- Significant decrease of NH_4^+ in peat soil and significant increase in clay soil





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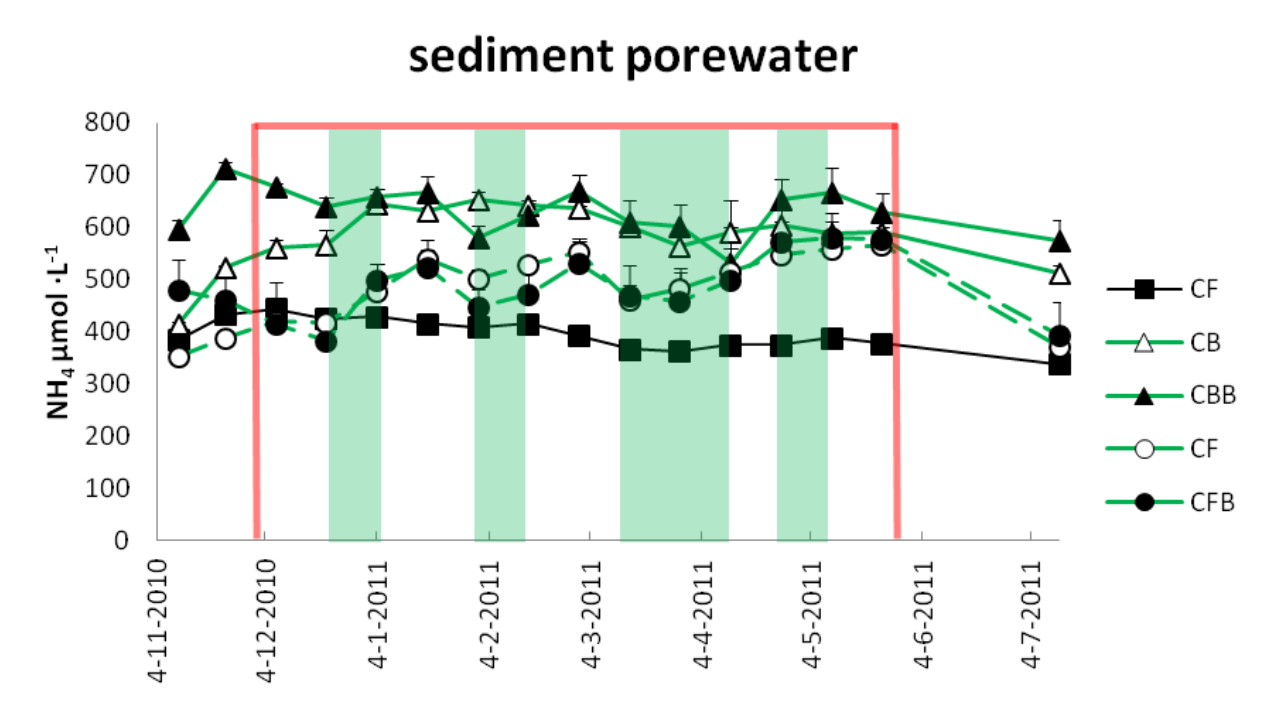


Results

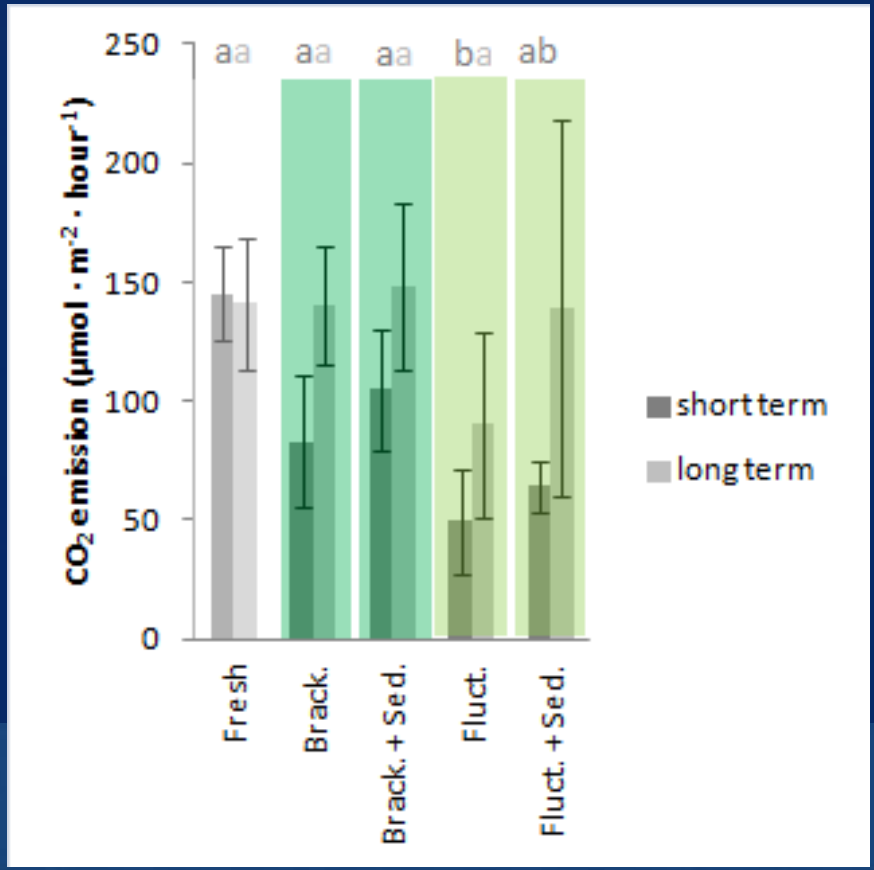
- effects on nutrients -

- Significant decrease of NH_4^+ in peat soil and significant increase in clay soil
- Mobilization due to Ca and Na, flux determines accumulation
- Decreased decomposition
- Fluctuating salinity on the long term similar effects

Results

- effects on decomposition -

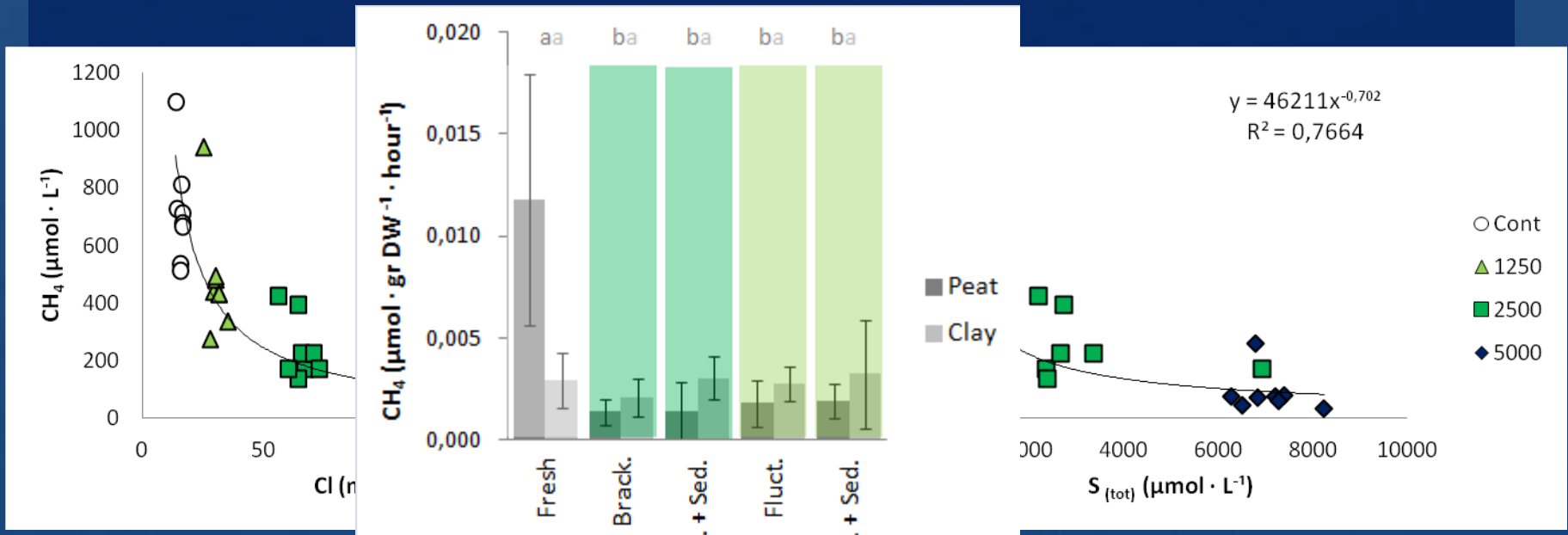
- Significant short term effects on CO_2 emission, but no sign. effects on semi-long term



Results

- effects on decomposition -

- Fast significant short term effects on CH_4 concentration and production
- Fluctuation has the same effect



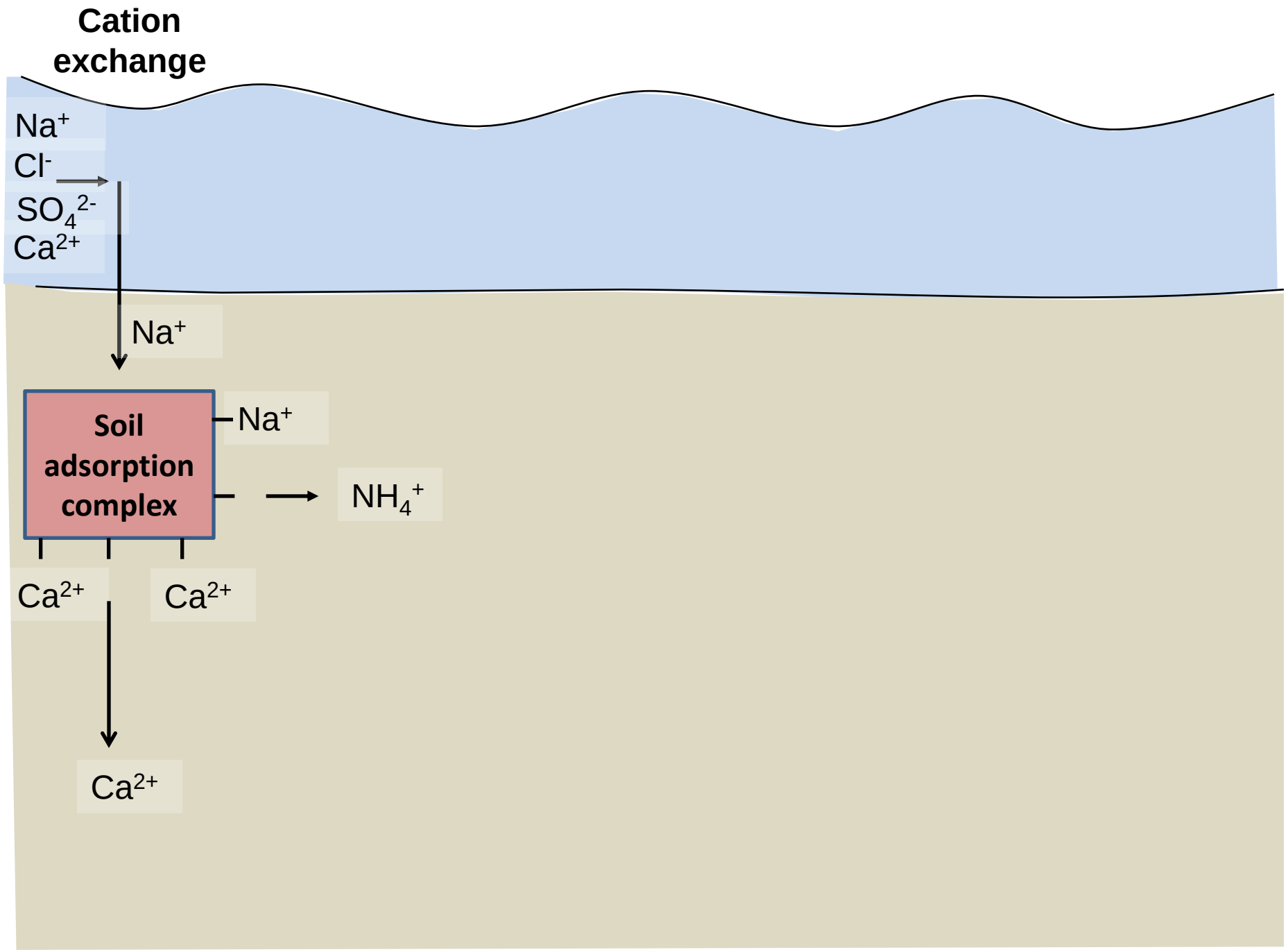
Results

- effects on decomposition -

- Fast significant short term effects on CH_4 concentration and production
- Fluctuation has the same effect
- Increased sulphate
  - causes SO_4^{2-} reduction and H_2S production
  - decreases CH_4 production
  - but does not increase P mobilization

Conclusions

- Eutrophication
  - Cation mobilization
  - Decrease in P
  - Decrease or increase in N depending on sediment type
  - Extra SO_4^{2-} does not cause nutrient mobilisation in formerly brackish peatlands
- Carbon cycling
  - Short term effect on CO_2, no semi-long term effects
  - Direct decrease of CH_4
  - $_f$Salinization can decrease greenhousegas emissions
- Fluctuating salinity can have similar effects on biogeochemistry as constant salinization


Cation exchange
Na^+
Cl^-
SO_4^{2-}
Ca^{2+}
Na^+
Soil adsorption complex
Na^+
NH_4^+
Ca^{2+}
Ca^{2+}
Ca^{2+}

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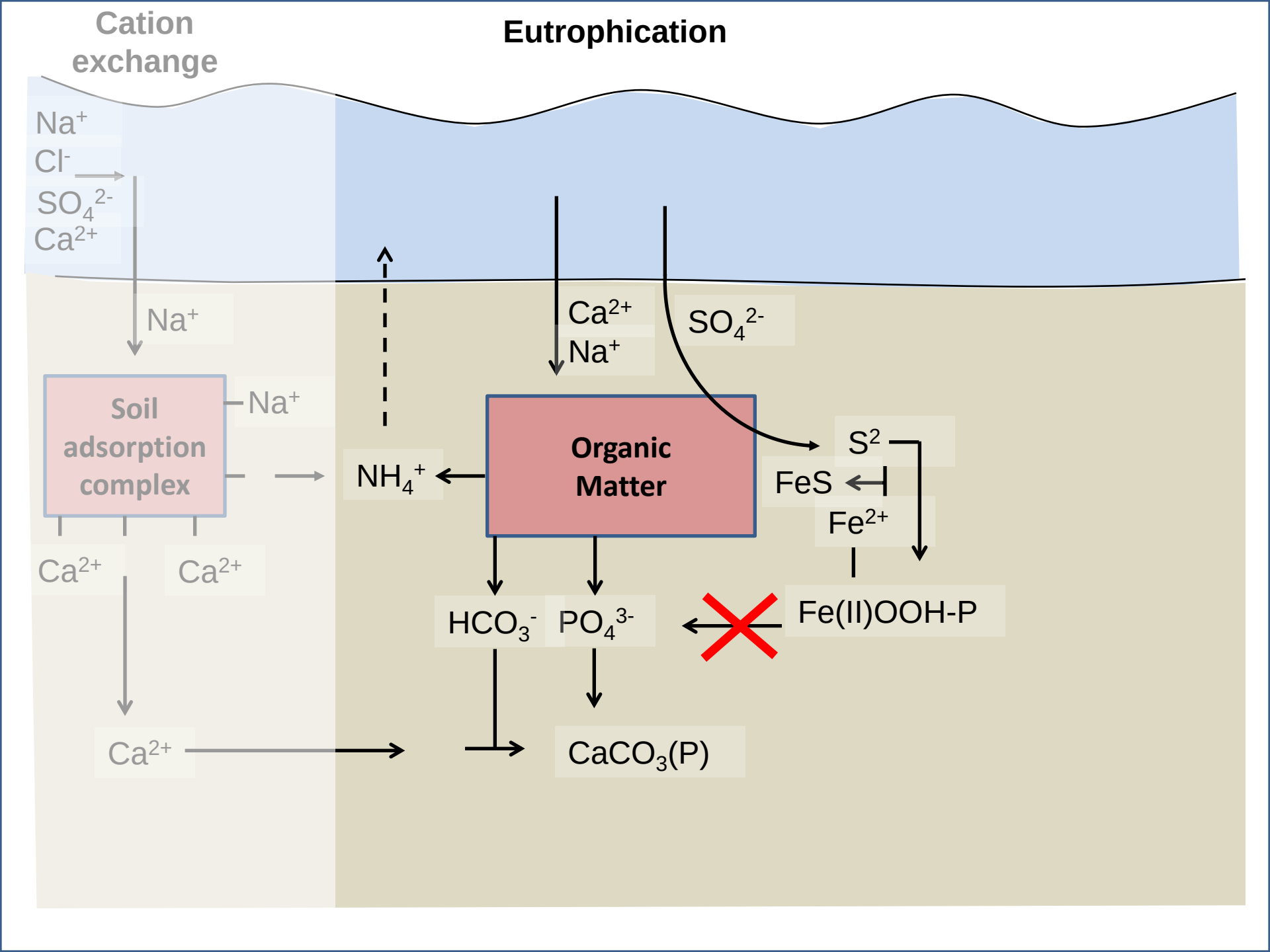
Cation exchange
Eutrophication
Na+
Cl-
SO4 2-
Ca2+
Na+
Soil adsorption complex
Na+
Ca2+
Ca2+
Ca2+
Ca2+
Na+
NH4+
Organic Matter
HCO3-
PO4 3-
S2
FeS
Fe2+
Fe(II)OOH-P
CaCO3(P)

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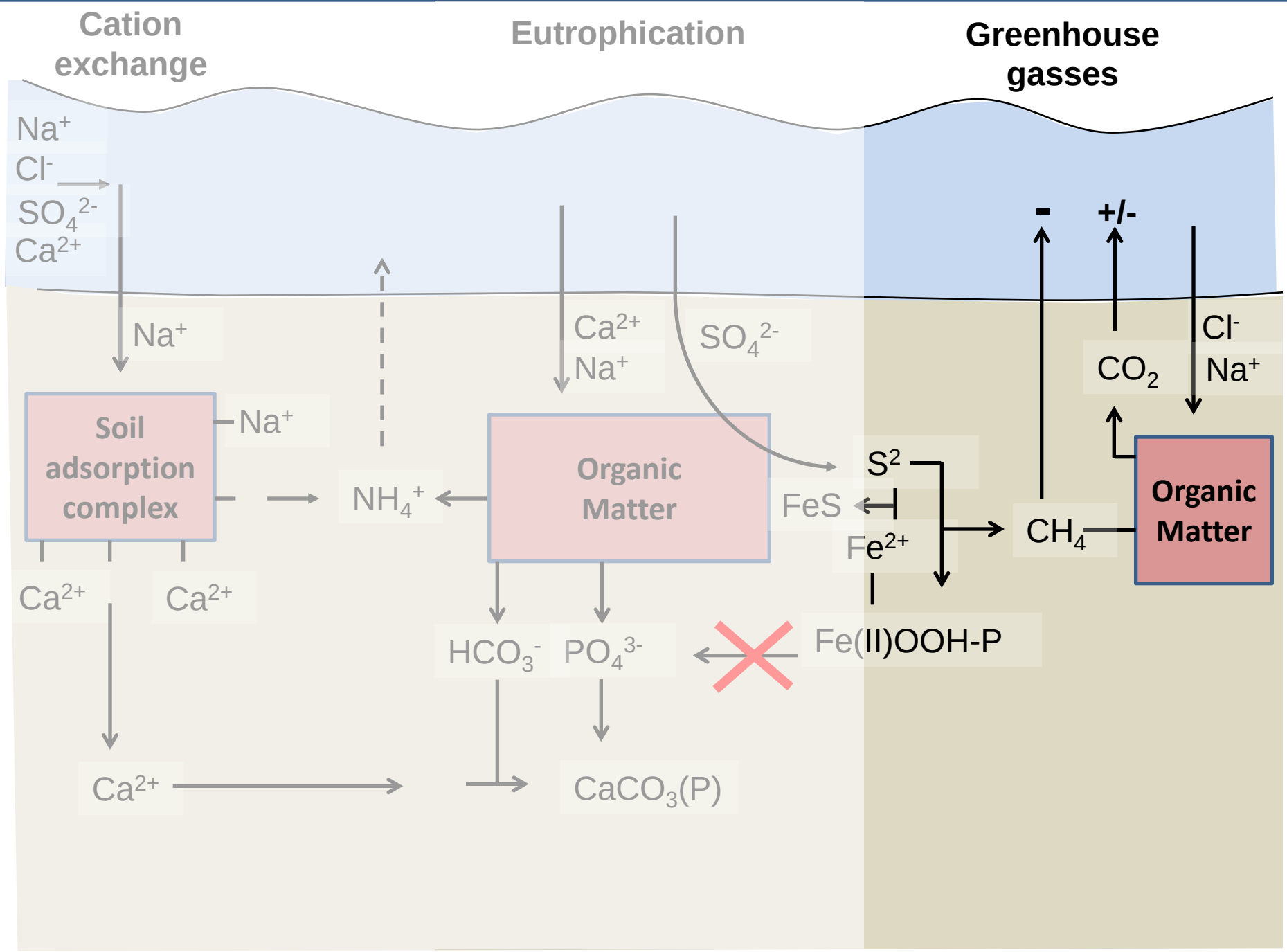
Cation exchange
Eutrophication
Greenhouse gasses
Na+
Cl-
SO4 2-
Ca2+
Na+
Ca2+
Na+
SO4 2-
-
+/-
Cl-
CO2
Na+
Soil adsorption complex
Na+
NH4+
Organic Matter
S2
FeS
Fe2+
CH4
Organic Matter
Ca2+
Ca2+
HCO3-
PO4 3-
Fe(II)OOH-P
Ca2+
CaCO3(P)

Conclusions

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  - Cation mobilization
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Conclusions

- Salinization of wetlands does not only have negative effects
- Salinization can be seen as a chance for the restoration of eutrophied formerly brackish peatlands
- Long term effects → further research
- Effects on biodiversity and effects on the ecosystems → further research

Thanks for the attention, time for questions!

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