

Effects of intermittency and land use on the in-stream phosphorus and organic carbon uptake

Gabriele Weigelhofer and Matthias Pucher

University of Natural Resources and Life Sciences Vienna, Austria

and WasserCluster Lunz GmbH Austria

gabriele.weigelhofer@wcl.ac.at

Effects of drying and re-wetting on P uptake/release

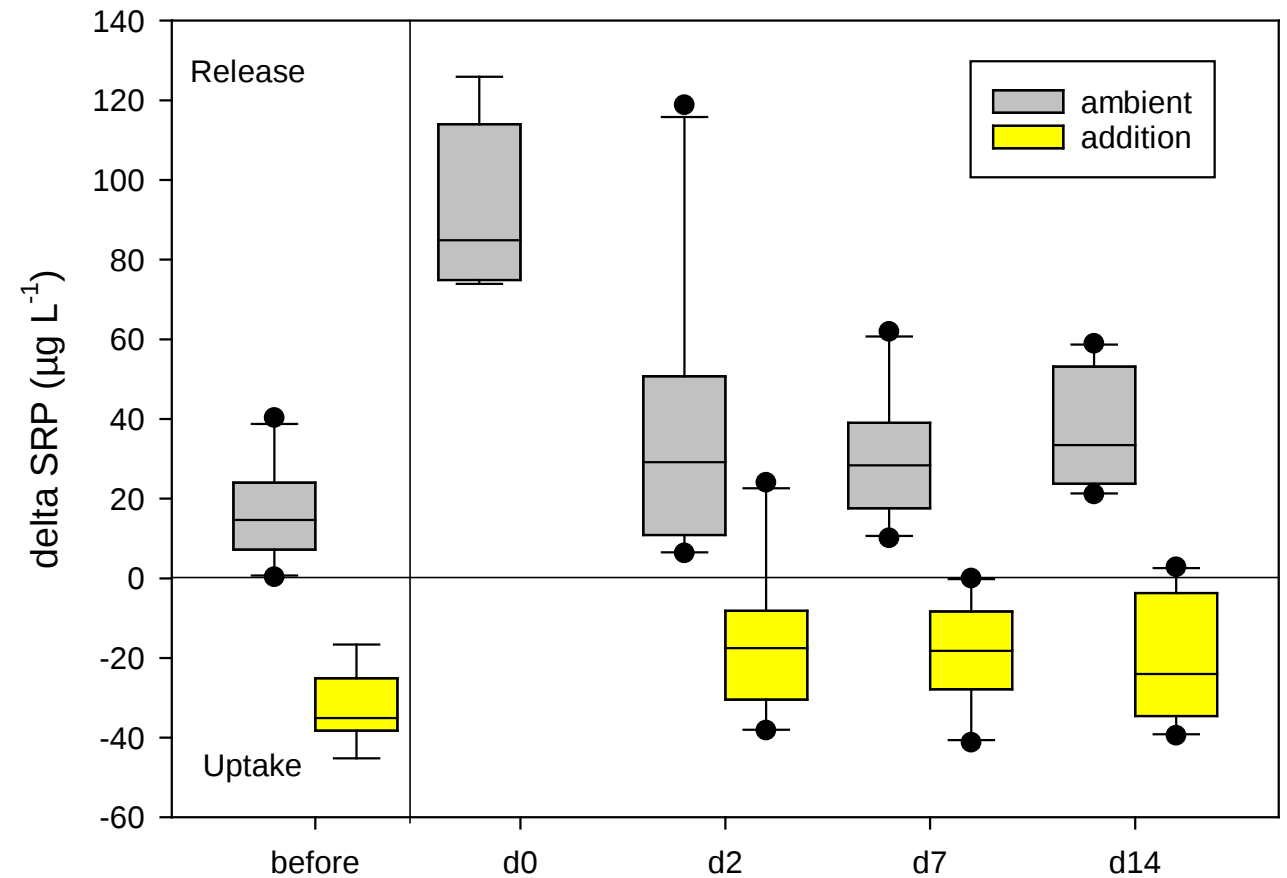
Laboratory experiment:

- ▶ Hyporheic sediments from 20 streams along a land use gradient
- ▶ Acclimatisation in upflow-reactors
- ▶ Drying for 7 weeks and rewetting for 2 weeks
- ▶ Sampling of SRP, DOC, and DIN before drying and 1 h, 2d, 7d, and 14d after rewetting at the inlet and outlet
- ▶ SRP, DOC, and NH_4 additions before drying and 2d, 7d, and 14d after rewetting



Results

- ▶ Hyporheic sediments generally released SRP (grey boxes)
- ▶ SRP release increased by 2-3 times immediately after rewetting (grey boxes)
- ▶ Under enriched conditions, sediments showed SRP uptake (yellow boxes)
- ▶ Uptake was recovered latest 2 days after rewetting



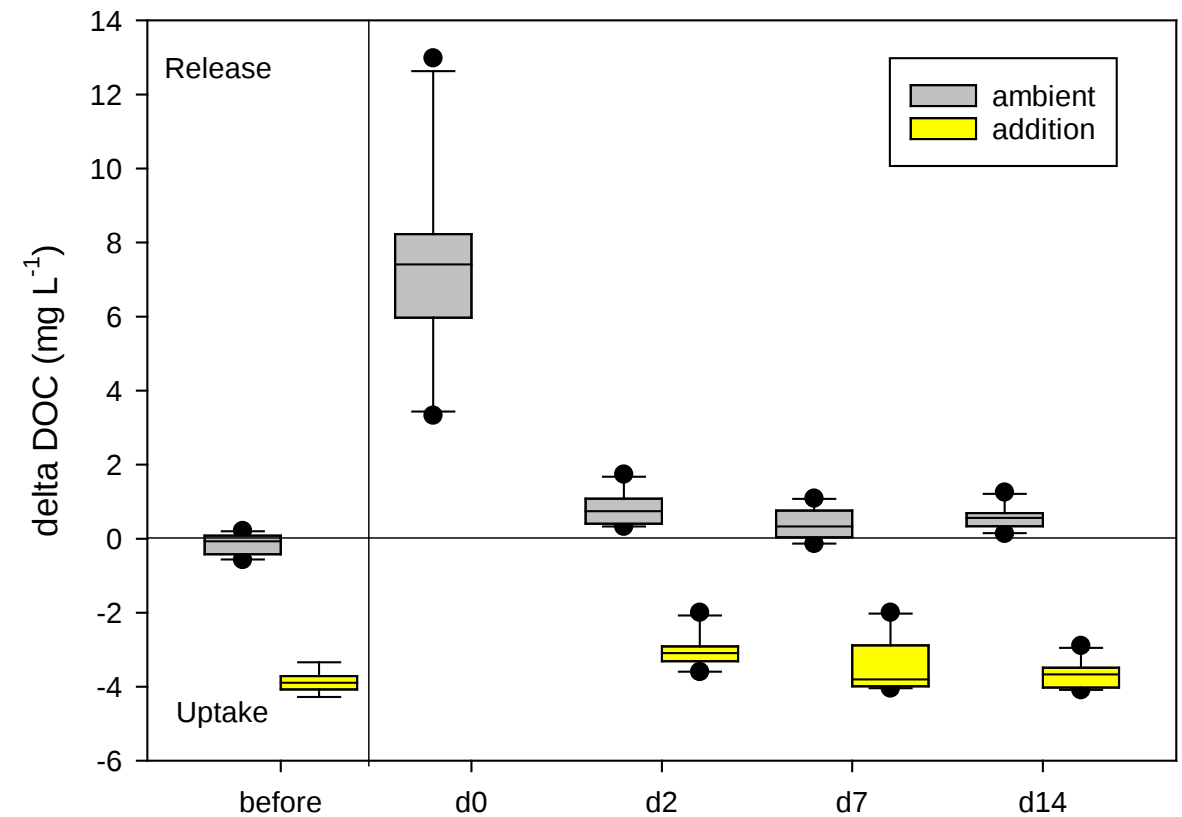
Results

- ▶ DOC and NH₄ showed larger impacts of drying than SRP, with higher release (both) and reduced uptake (NH₄) after rewetting

-> Effects of drying on hyporheic SRP uptake small and short-term due to

a) high remaining water content which maintains hyporheic microbial communities

b) release of C and N which may increase P demand in P-limited systems



Interaction between organic carbon and phosphorus uptake

Short-term nutrient addition experiments:

- ▶ 5 additions in headwater stream with acetate, SRP and NH_4 in summer 2018: nutrients alone, nutrients + acetate, acetate alone
- ▶ Sampling of water along stream reach during plateau conditions
- ▶ Calculation of uptake parameters according to Stream Solute Workshop for P and N

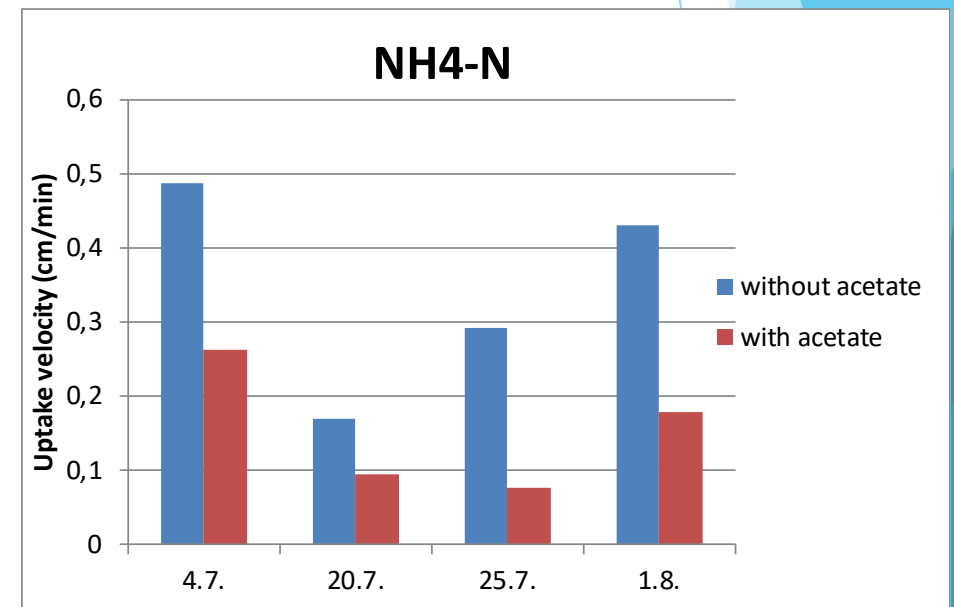
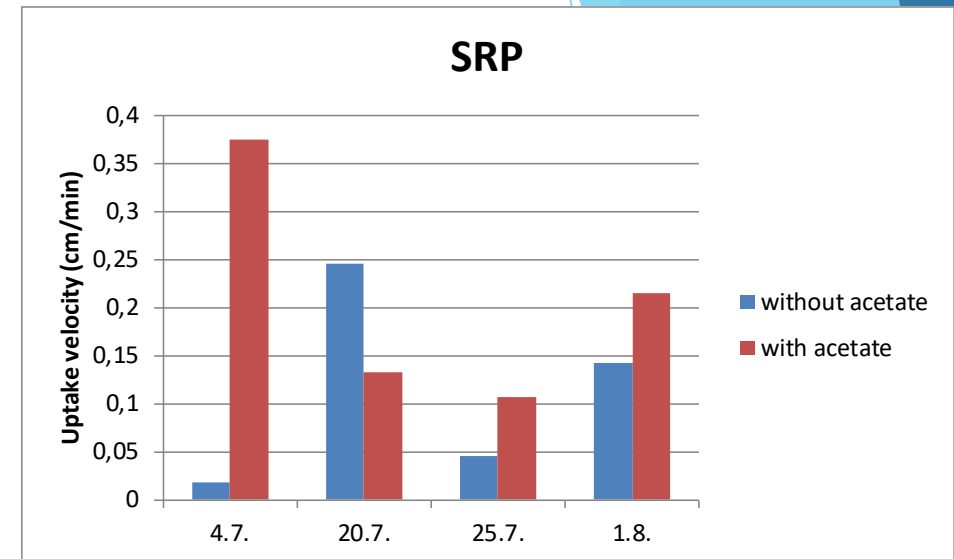


Results

- ▶ SRP uptake mostly increased during addition with acetate compared to addition without acetate
- ▶ In contrast, ammonium uptake is higher without acetate than with acetate

-> Coupling of SRP uptake to organic carbon availability in a P-limited system

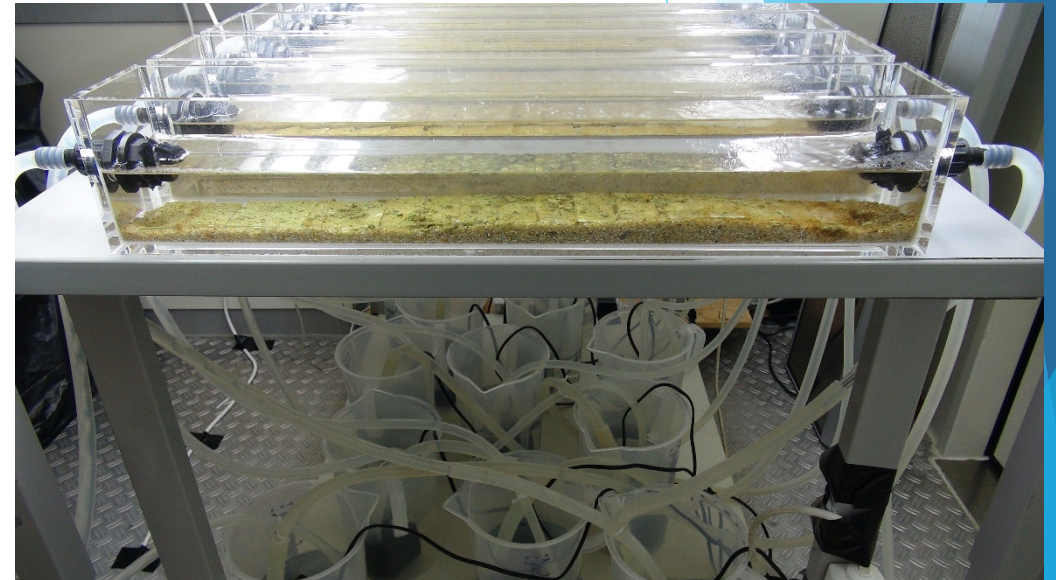
-> ? Interaction of autotrophs (stimulated by P) and heterotrophs (stimulated by C)?



Interaction between organic carbon and phosphorus uptake

Laboratory flume experiment:

- ▶ Additions of leachates of leaves, maize leaves, and cow dung (manure) to flumes under light (autotrophic) and shaded (heterotrophic) conditions
- ▶ Determination of OC uptake in dependance of OM quality (P and N content and spectroscopic properties)



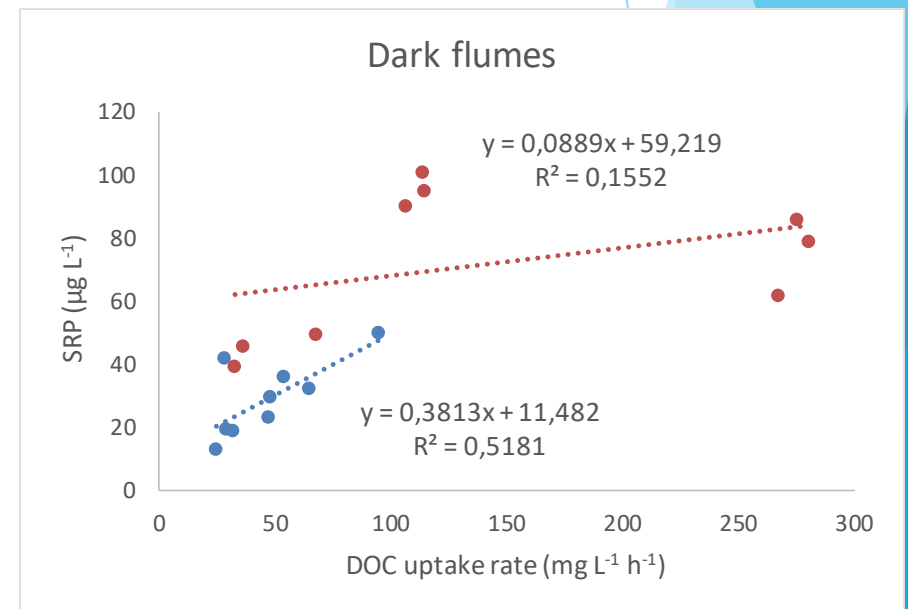
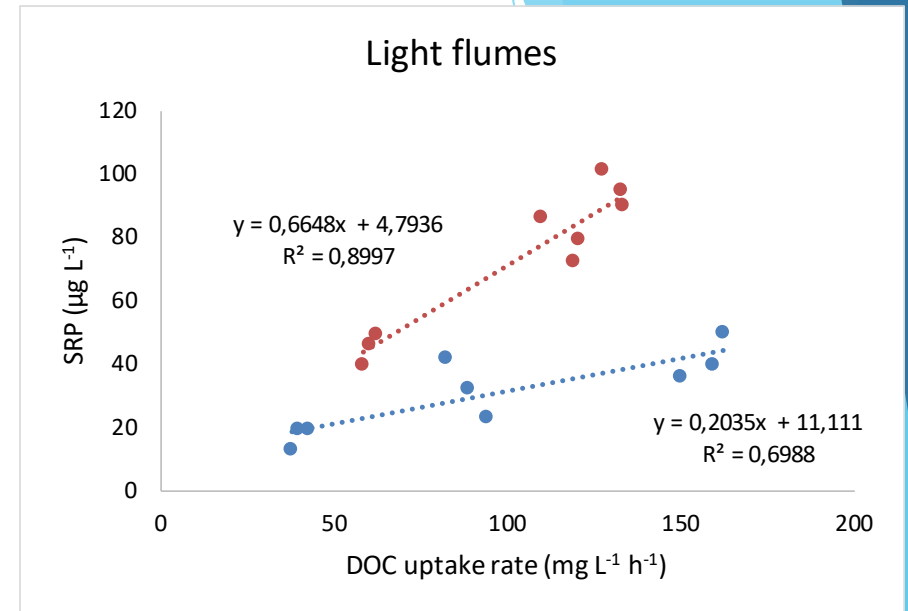
Results

- ▶ SRP showed high uptake in autotrophic flumes: no SRP detectable 4 h after the additions, increase of P content in autotrophic biofilms
- ▶ In contrast, heterotrophic flumes had low SRP uptake, heterotrophic biofilms showed no increase in P

-> autotrophs outcompeted heterotrophs regarding P uptake

- ▶ DOC uptake was strongly correlated with initial SRP content of the leachates (higher in autotrophic biofilms)

-> DOC and SRP uptake are correlated via the interaction of autotrophs and heterotrophs



Conclusions

- ▶ Strong coupling of DOC and P depends on the composition of the biofilm and the interaction between autotrophs and heterotrophs
- ▶ Drying and rewetting has small effects on P uptake in P-limited systems due to potential stimulation of microbial processes

Acknowledgements

Funding:



Thank you