

Stable isotope techniques for assessing phosphorus fluxes in agricultural catchments

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Background: Phosphorus sources and transformations

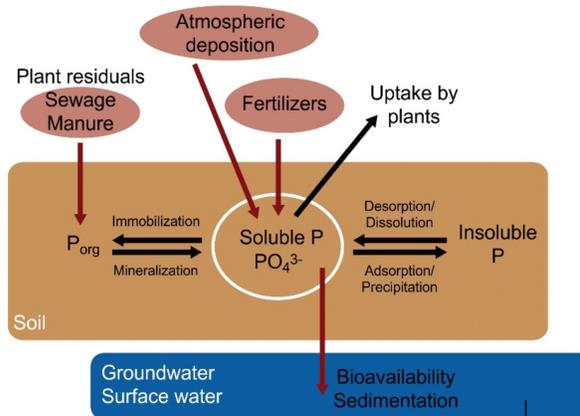
Eutrophication: enrichment of nutrients (nitrogen and phosphorus) in water bodies.

Problems:

- Algal blooms
- Anoxic conditions
- Reduced biodiversity in aquatic ecosystems
- Potential threats to human health
- Deterioration of drinking water



Phosphorus cycle



P-O bonds in P_i are resistant to inorganic hydrolysis under typical temperature, pressure and pH conditions of freshwater ecosystems.

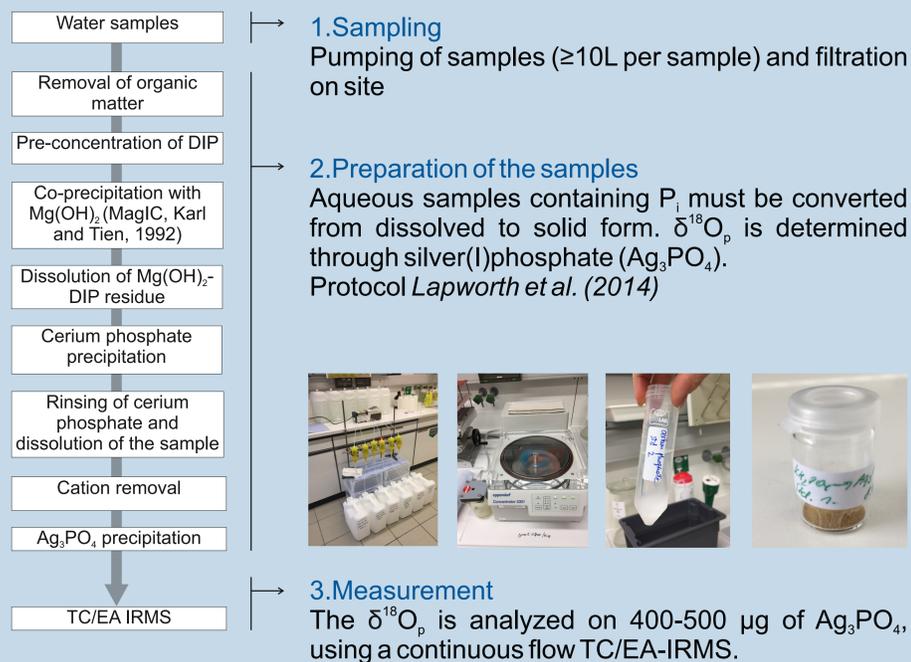
Biological mediation $\rightarrow \delta^{18}O_p$ in equilibrium with surrounding water (Chang & Blake, 2015):

$$\delta^{18}O_{PO_4} = (\delta^{18}O_{H_2O} + 1000) \times e^{[14.43 \times (1000/T) - 26.54] / 1000} - 1000$$

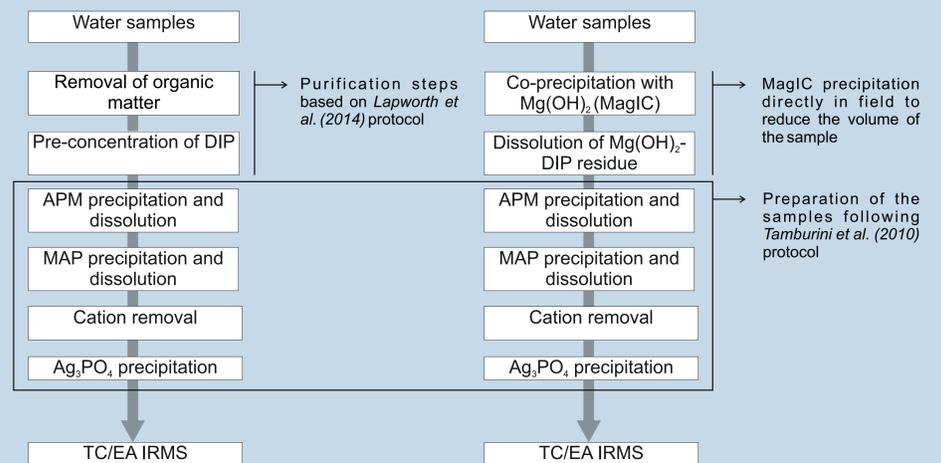
Investigation of P sources and biogeochemical cycle through $\delta^{18}O-PO_4^{3-}$

- Deviations from equilibrium $\delta^{18}O_p$:
- Distinct P sources
 - Distinct biogeochemical cycling

Methods: How to analyze $\delta^{18}O-PO_4^{3-}$ in freshwater samples

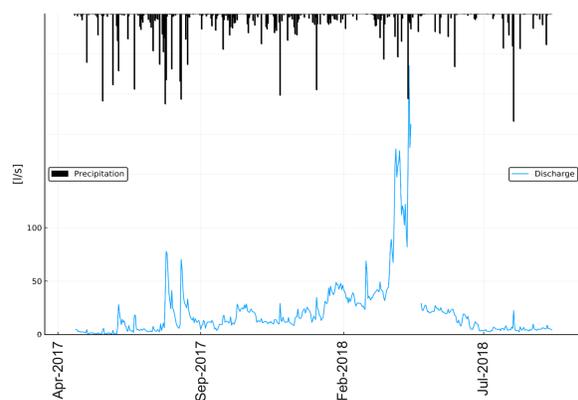
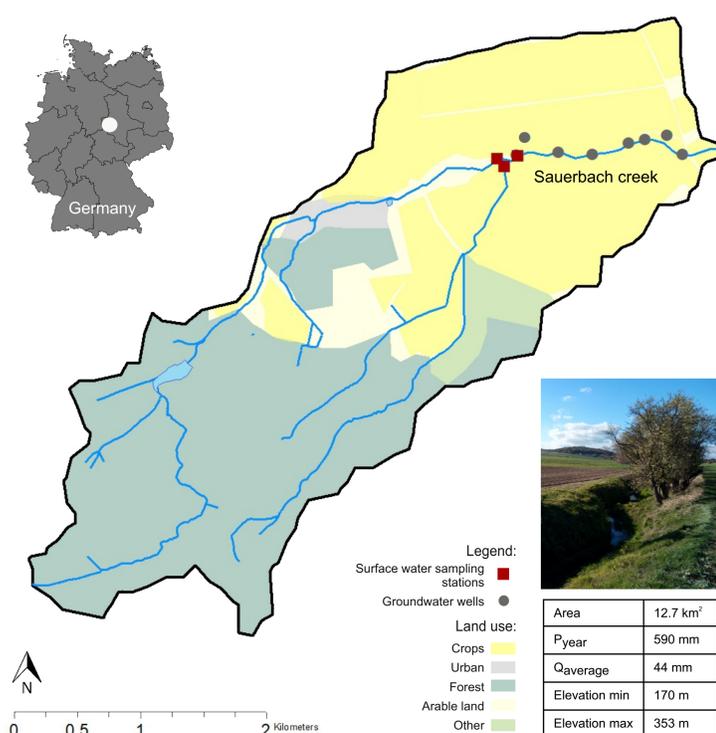


Possible alternatives?

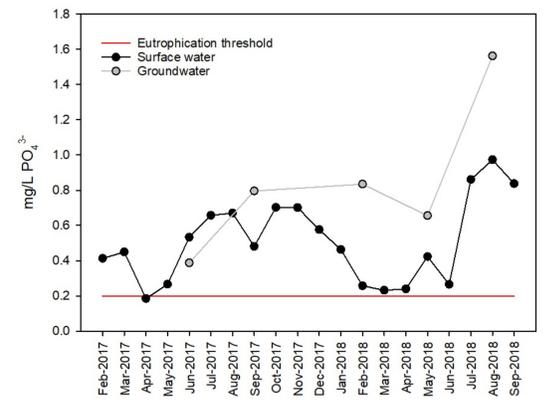


Could the combination of *Lapworth et al. (2014)* and *Tamburini et al. (2010)* protocols or the combination of the MagIC precipitation and *Tamburini et al. (2010)* protocol be possible alternative methods to analyze accurately freshwater samples?

Field site: Sauerbach am Meisdorf, Bode catchment



- Precipitation events generate a fast rise ($\sim 1-6$ h) in the creek runoff
- Seasonal trend: winter discharge > summer discharge



- $[P] \geq 0.2$ mg/L in both surface and groundwater for the whole year
- Seasonal trend: Summer $[P] >$ winter $[P]$

- Is it possible to see the seasonal trends in the $\delta^{18}O_p$ values?
- To better understand the P sources and faith it is also necessary to investigate other compartments \rightarrow What is the signature in soil/sediment?



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"This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 675120"

