Is phosphorus export from beech forest stands transport- or source-limited?

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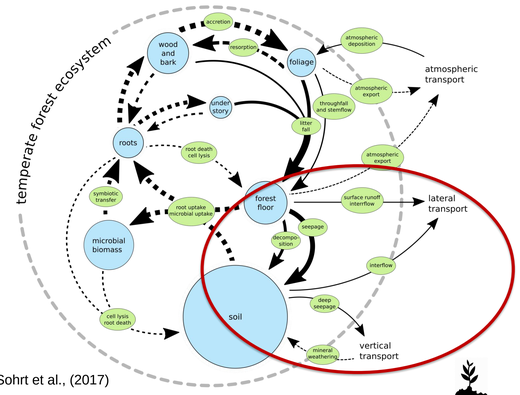
Aims & Objectives:

Hydrological effects on phosphorus (P) fluxes in beech forests

- Lateral & vertical subsurface flow (SSF)
- Major loss of P from the forest ecosystem



Sohrt et al., (2017)

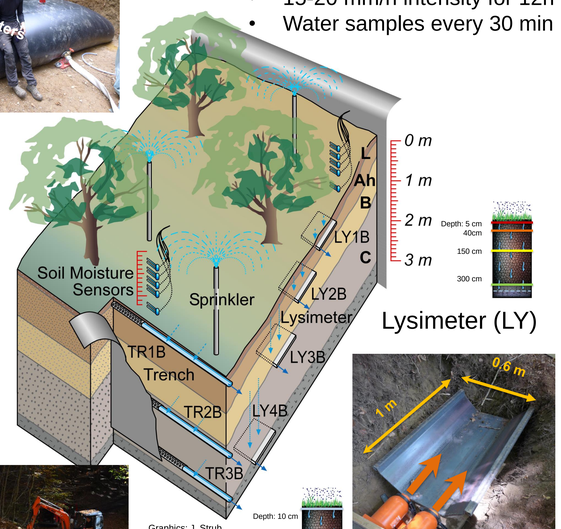
Experimental sites:

Three sites from P-rich to P-poor

- Mitterfels (MIT): Bavarian Forest
- Conventwald (CON): Black Forest
- Tuttlingen (TUT): Schwäbische Alb

Sprinkling experiments:

- 60.000 liters, deionized water
- 15-20 mm/h intensity for 12h
- Water samples every 30 min

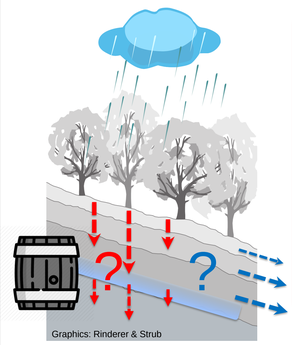


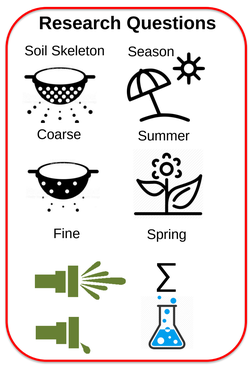
Lysimeter (LY)

Trench (TR)

Research Topics:

1) Lateral & vertical subsurface flow (SSF)
2) “Event” or pre-event” water
3) P concentration in SSF (nutrient flushing, dilution, chemostatic behavior)
4) P export from forest stands

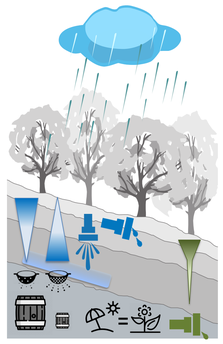


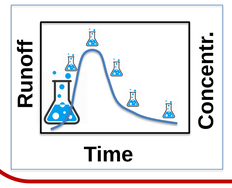


Hypotheses:

1) Higher skeleton content:
   - -> Predominantly vertical flow
   - -> High event water fraction
   - -> Larger P-losses at deeper depth
2) Seasonal differences;
   -> Summer higher P-losses (warmer, more P mineralization)

Syntheses:





Rinderer et al. (2020) (see below)

Biogeosciences Discussions

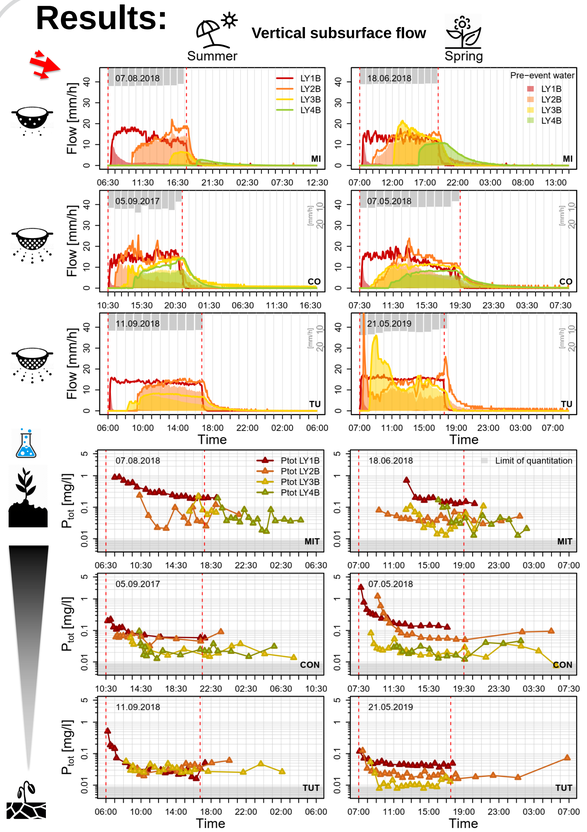
Runoff processes:

- Vertical SSF >> lateral SSF
- Coarse soils: increase in SSF with depth, small storage,
- Finer soils: large storage, less and delayed SSF at depth

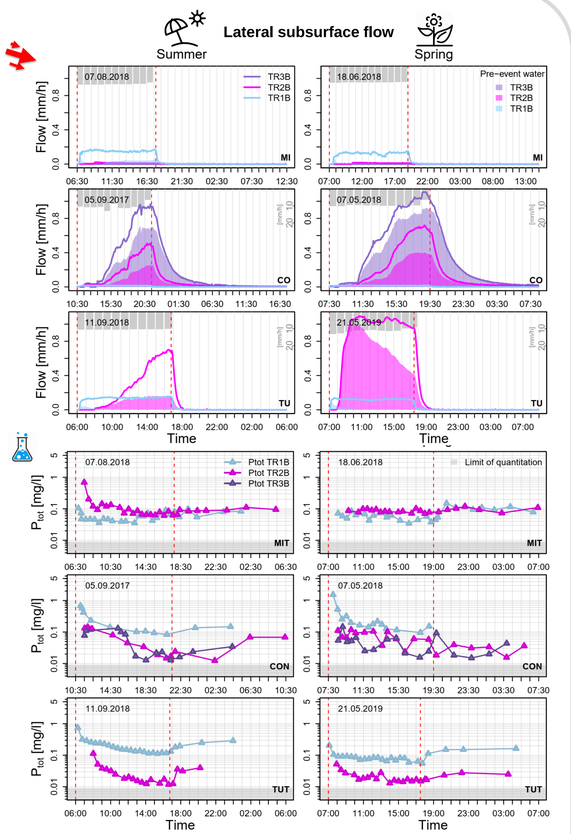
P concentration

- First flush with high P
- Chemostatic for the rest of event

Results:

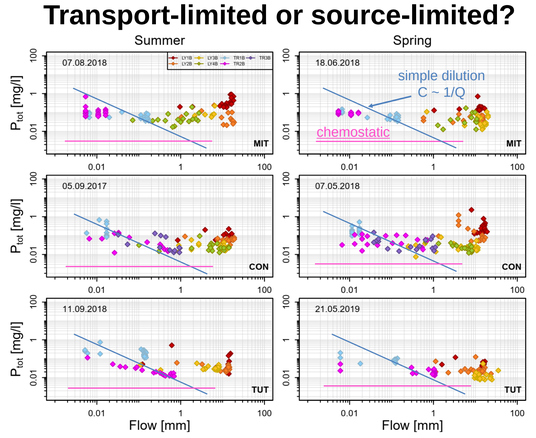


- Vertical SSF >> lateral SSF
- Pre-event water dominated



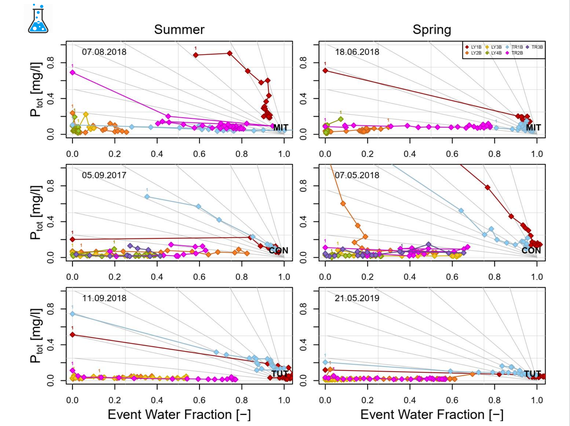
- Nutrient-flushing in the first 2 h
- Chemostatic conditions during the rest of the events (10-12h)

Transport-limited or source-limited?



P concentration:

- change in flow > change in P
- Datapoints aligned parallel to x-axis



- Small change in P with increasing event water fraction -> chemostatic conditions rather dilution

Rinderer M., Krüger J., Lang F., Puhlmann H., Weiler M (2020): Phosphorus Transport in Subsurface Flow at Beech Forest Stands: Does Phosphorus Mobilization Keep up with Transport? In: Biogeosciences Discussion https://doi.org/10.5194/bg-2020-118.

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