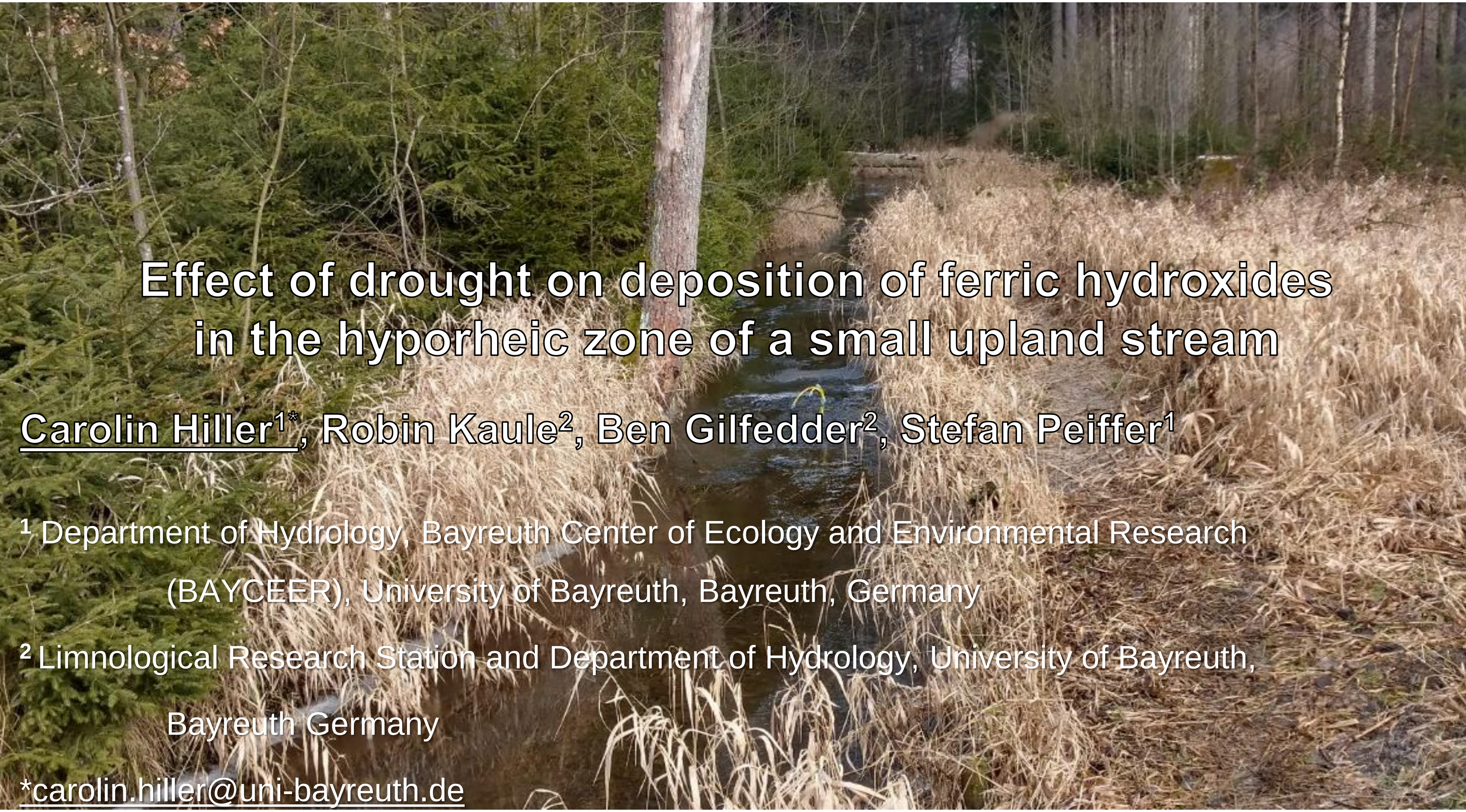

Effect of drought on deposition of ferric hydroxides in the hyporheic zone of a small upland stream

Carolin Hiller[1*], Robin Kaule[2], Ben Gilfedder[2], Stefan Peiffer[1]

[1] Department of Hydrology, Bayreuth Center of Ecology and Environmental Research (BAYCEER), University of Bayreuth, Bayreuth, Germany

[2] Limnological Research Station and Department of Hydrology, University of Bayreuth, Bayreuth Germany

*carolin.hiller@uni-bayreuth.de

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Motivation and Objectives

Motivation

Effects of climatic stressors (e.g. drought and altered precipitation patterns leading to low discharge) on biogeochemical processes within the hyporheic zone are poorly understood.

Objectives

- Gain data about the influence of hydrological changes on biogeochemical processes in the hyporheic zone on a reach-scale
- Focus on iron due to its concentration dependent toxicity for aquatic organisms (e.g. endangered pearl mussel)

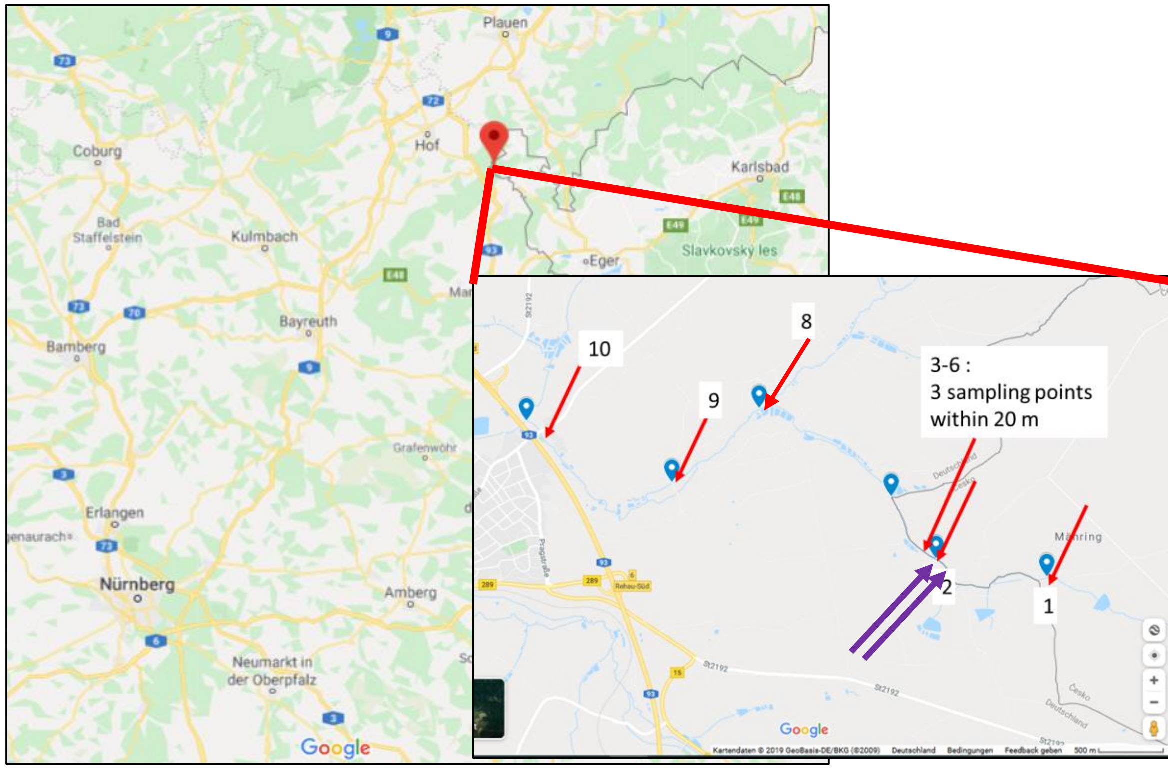
Hypothesis

Droughts and low flow hydrologic regimes lead to

- increases in temperature which is likely to drive an increase in the kinetics of organic carbon decomposition in the HZ, thus enhancing reducing conditions and Fe(II) release
- a biogeochemical system change due to hydrological dynamics e.g. increase in biogeochemical turnover due to upwelling of GW which transports anoxic water to the sediment surface

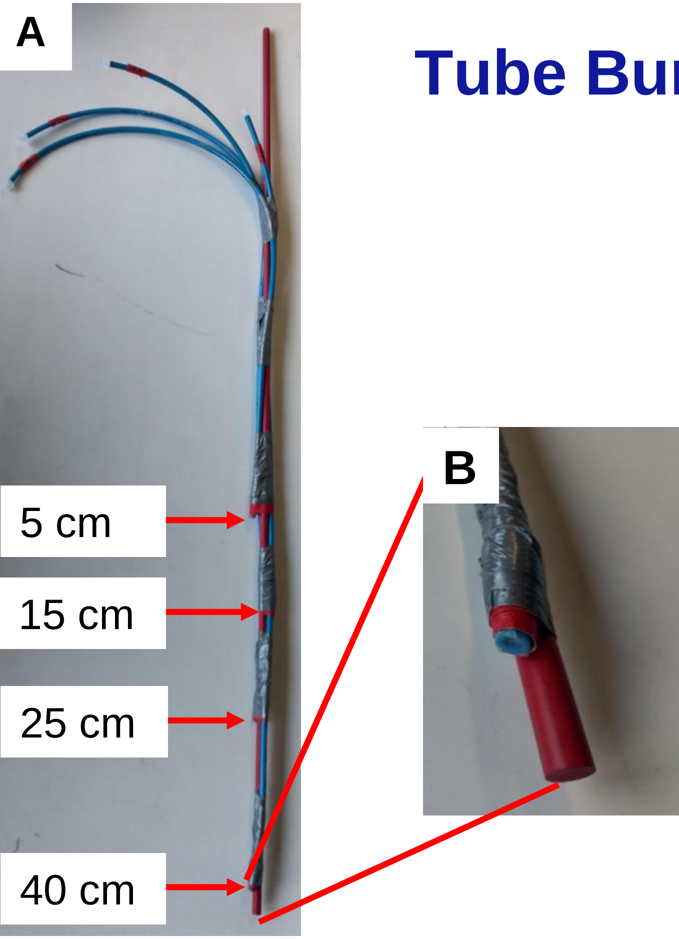
Site map and description

- 3rd order upland stream in Northern Bavaria
- silicate rich area
- home to the endangered pearl mussel
- 8 sampling points within about 6 km
- including a transect of 3 sampling points within 20 m



Location of River Mähringsbach and sampling spots. Sampling spots are indicated by red (Tube Bundles) and purple (Peeper) arrows.

Tube Bundles



Tube Bundle with sampling openings at 5, 15, 25 and 40 cm depth (**A**) covered with mesh (**B**)

Field application of tube bundle with 3-way-valves for closing

- Sampling about once a month with predominantly permanent installed tube bundles
- Good temporal resolution of biogeochemical changes within HZ

Peeper

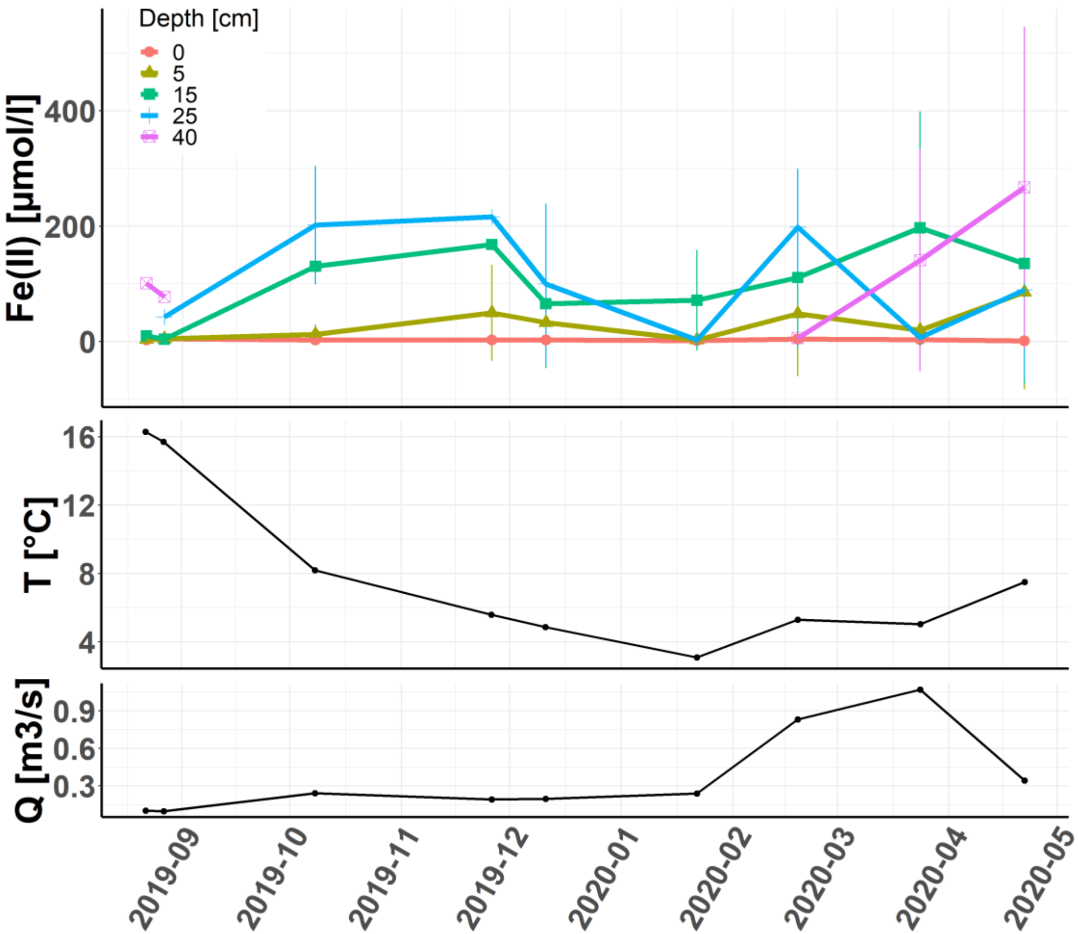
A

B

- Placed in the HZ every 2-3 month for at least 2 weeks
- Good depth resolution (14 cm with a resolution of 2 cm) but temporally integrated

A: Peeper Body with cavities. **B**: From sediment removed Peeper after sampling (white part is a filter pore size 0,2 µm) and sample chamber with holes screwed on peeper body

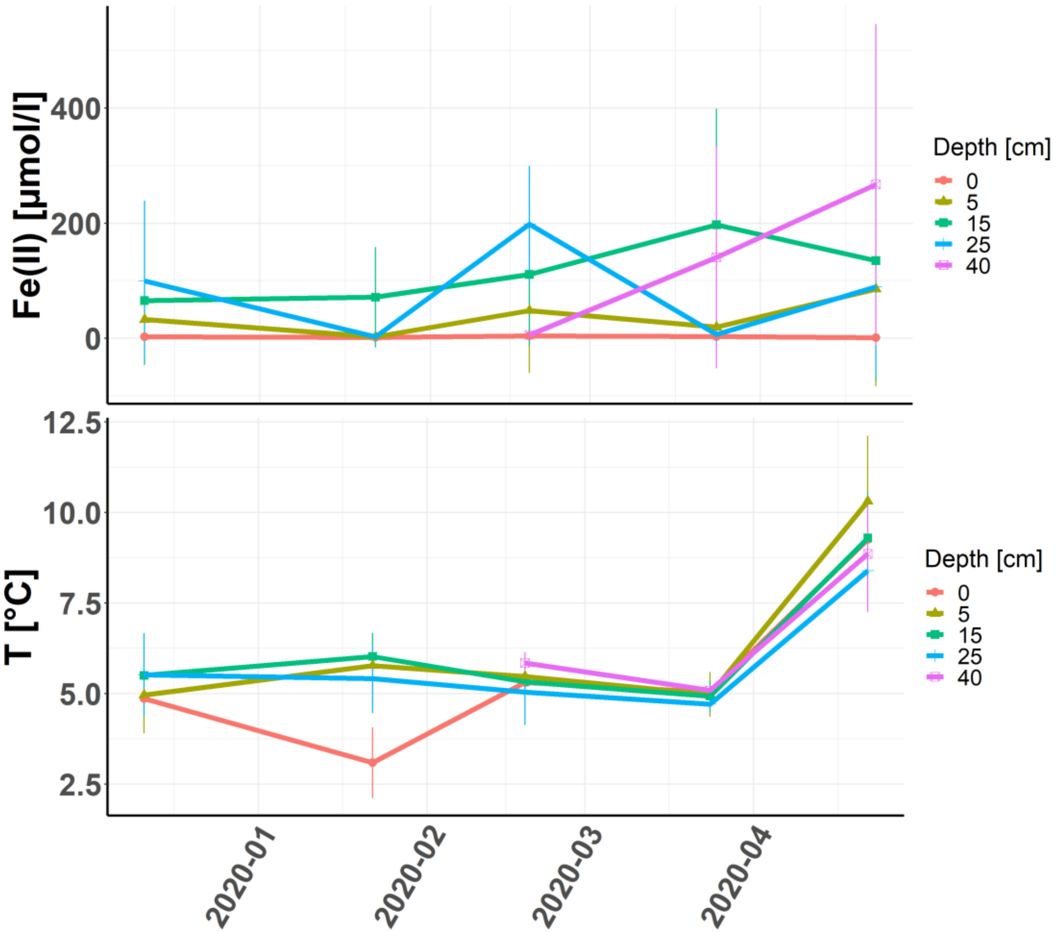
Relationship between stream properties and average Fe(II) concentrations in the hyporheic zone - **Tube Bundle Data**



- Fluctuations of average Fe(II) concentrations within the hyporheic zone
- Deeper layers exhibit stronger fluctuations
- No correlation between average Fe(II) concentrations and surface water temperature or discharge

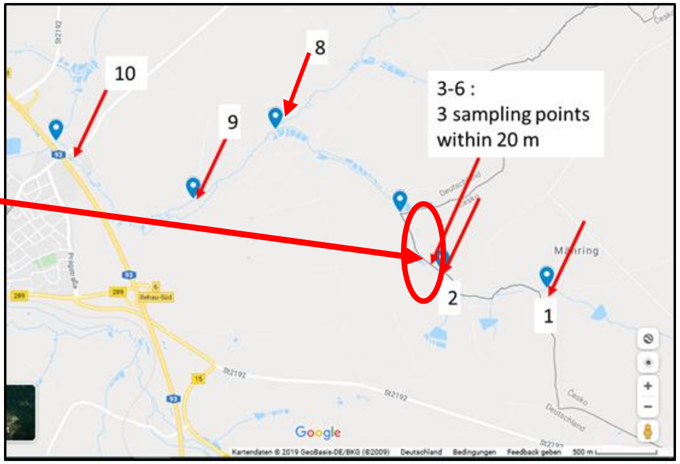
Reference for Q: www.lfu.bayern.de

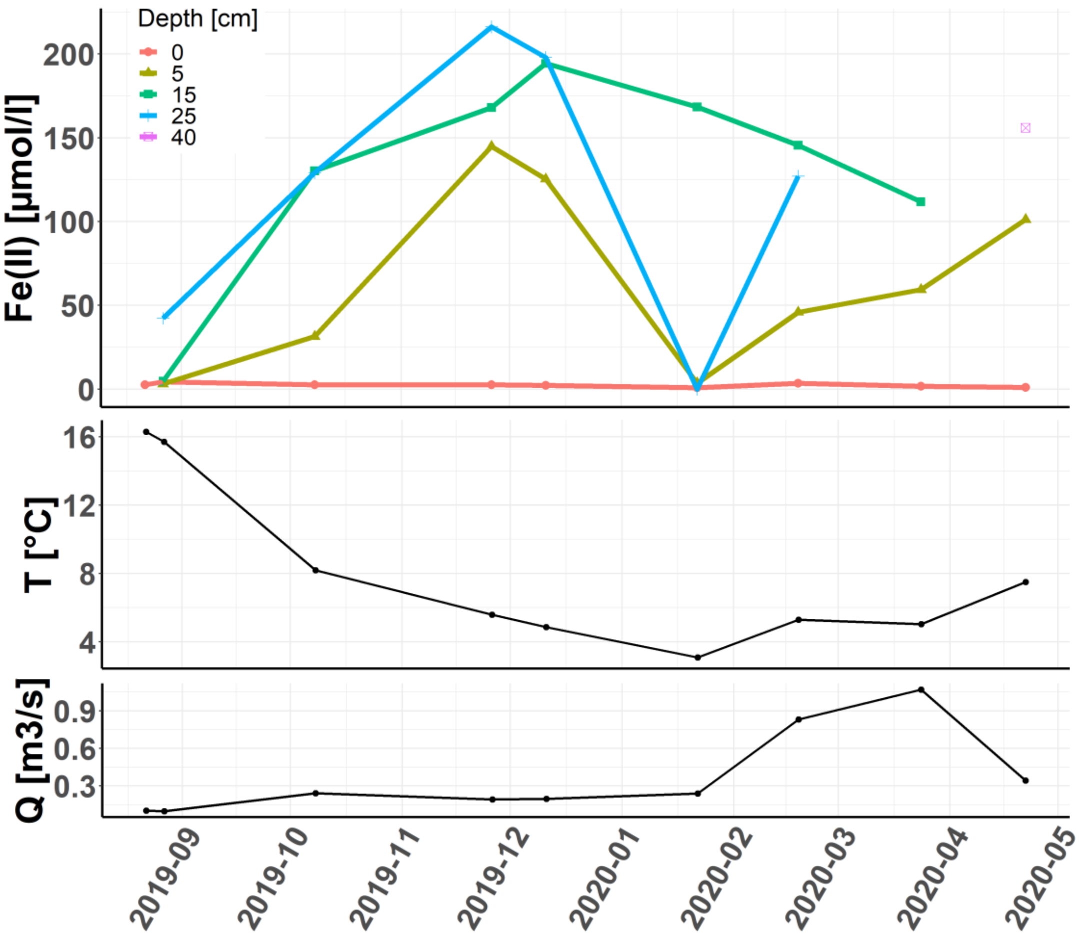
Relationship between river bed temperature and average Fe(II) concentrations in the hyporheic zone – **Tube Bundle Data**



- No correlation between average Fe(II) concentrations and corresponding average temperature of the water

Relationship between stream properties and Fe(II) concentrations at sampling point 6 - **Tube Bundle Data**

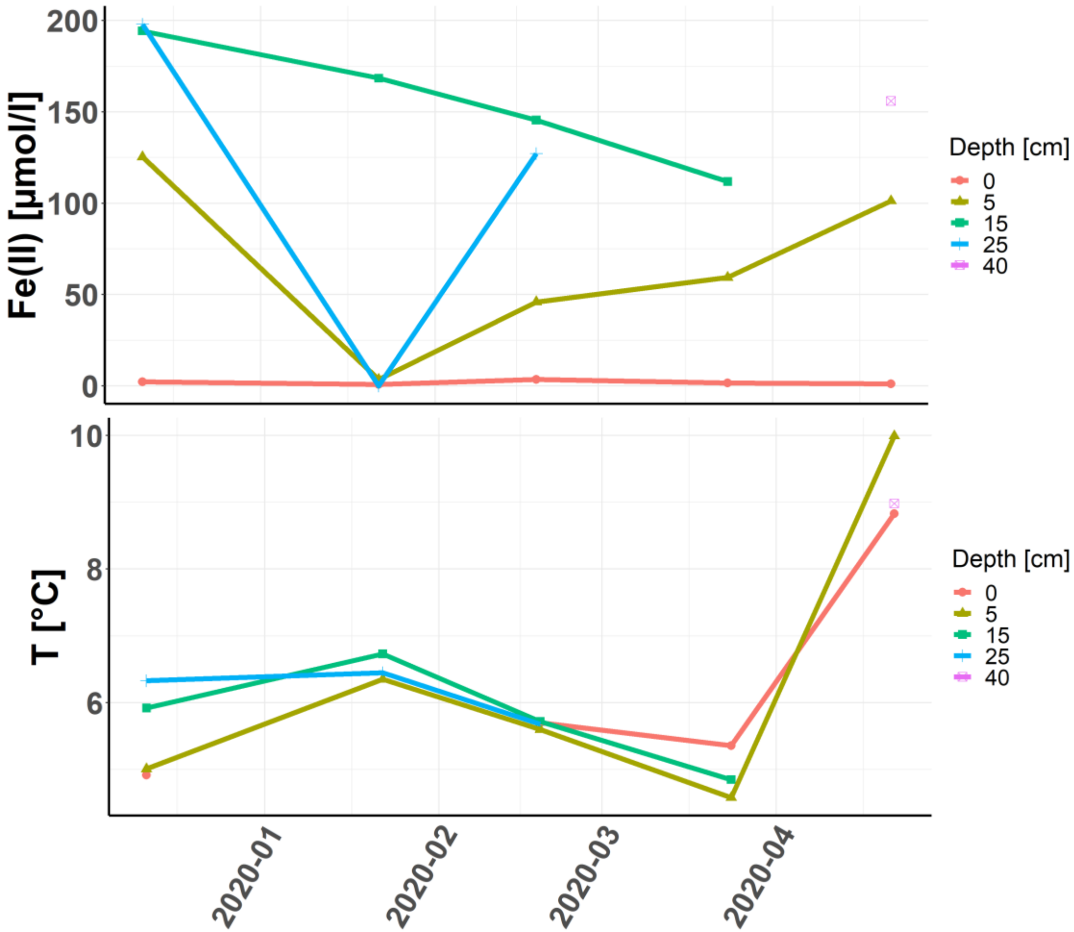




- Fluctuations of Fe(II) concentrations within the hyporheic zone
- No correlation between Fe(II) concentrations and surface water temperature or discharge

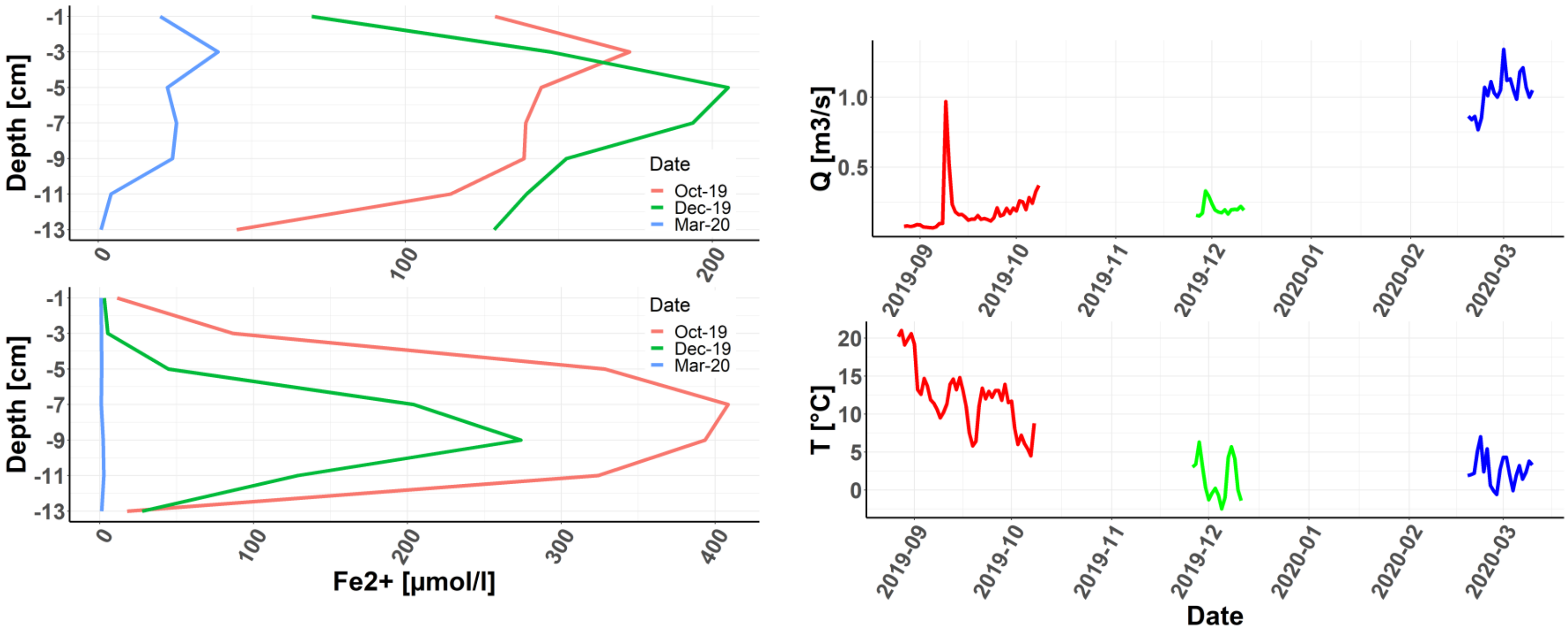
Reference for Q: www.lfu.bayern.de

Relationship between river bed temperature and Fe(II) concentrations at sampling point 6 - **Tube Bundle Data**



- No correlation between Fe(II) concentrations and corresponding average temperature of the water

Influence of discharge on pattern of Fe(II) concentrations in HZ at one single site – **Peeper Data**



- Maximum of Fe(II) concentrations close to sediment surface
- Low discharge shows a correlation with high Fe(II) concentrations
- No temperature effect

Conclusion and Outlook

- High Fe(II) concentrations indicate microbial Fe(II) reduction within the hyporheic zone
- An important driver for concentration changes of Fe(II) within the hyporheic zone could not be identified using Tube Bundles
- Hot spots of Fe(II) concentrations can be identified focusing on particular sampling points (e.g. sampling point 6)
- Peeper Data indicate that discharge has an influence on Fe(II) concentrations
- We assume that hyporheic exchange has an effect on the Fe(II) concentration fluctuation → Radon sampling to understand Fe(II) fluctuations
- Analysis of Iron-geochemistry of river sediment

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