WWU MÜNSTER

Rhizosphere Biogeochemistry | ILÖK Institute of Landscape Ecology

Open topics for Bachelor or Master theses

Priming effects of root exudates under anaerobic conditions

Background

Wetlands store about 20 % of the global organic ecosystem carbon despite covering only 1% of Earth's surface (Temmink et al. 2022). A driver against the long-term carbon stabilization in these ecosystems is the rhizosphere priming effect. Rhizosphere priming describes the change in soil organic carbon (SOC) decomposition in the presence of plants (Kuzyakov 2002). One important driver of rhizosphere priming is the input of labile root-derived organic compounds into the soil that lead to the microbial co-mineralization of SOC, because of the microbial N mining from recalcitrant C compounds (Craine et al. 2007). Plants release several root exudates like phenolic compounds or sucrose, which can provoke negative or positive priming effects (Zwetsloot et al. 2018). Additionally, the radial oxygen loss of roots can increase the activity of microbes in these oxygen limited systems promoting SOC mineralization (Wolf et al. 2008; Wang et al. 2018).

Study design

We will collect soil samples in several wetland ecosystems (peatlands, salt marshes, fens) with variable biogeochemical properties. We will simulate the priming effect through root exudates in incubation experiments using exudate surrogates like glucose, phenol or organic acids and by adding oxygen. The exudate surrogates will carry an isotopic ^{13}C label to calculate the proportion of exudate-C and SOC in the evolving gases in the headspace of the incubation jars. We will use a gas chromatograph to analyze the concentrations of CO_2 and CH_4 and a Picarro laser spectrometer to measure the $\delta^{13}C$ isotopic signature of these gases.

Research questions

- How is the SOC in the catotelm of wetlands affected by different root exudates?
- Which substrate properties determine the direction and magnitude of the priming effect?

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