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Hydrogeological and geophysical investigations to evaluate groundwater influences on GHG emissions at the national research site Skogaryd

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The overall objective of the presented study is to explore the impact of groundwater fluctuations on greenhouse gas (GHG) emissions from peatlands and in particular from drained organic soils. The hypothesis is that drained organic soils react sensitively to changing water content, i.e. that frequent changes of groundwater level enhance the emissions of GHG from these soils and thus contribute significantly to global warming.
The area under investigation is based at the Skogaryd Research Catchment (within Swedish Infrastructure for Ecosystem Sciences, SITES) in western Sweden (Meyer, et al., 2013), which was recently assigned the status of a national research site by the Swedish research council (www.vr.se). Skogaryd is a unique place in Sweden for doing research on organic soils as the area was simultaneously afforested in the 1960s and the drained fertile soils have a different land-use history. The ditching for drainage purposes throughout the entire area has had and still has a huge influence on groundwater level, which in turn is assumed to trigger GHG emissions from the organic soils at Skogaryd.
To address the influence of groundwater dynamics on GHG emissions in this system, a characterisation of the subsurface using electrical resistivity and Ground Penetrating Radar (GPR) measurements was carried out. These geophysical measurements were combined with drilling along them to allow for ground truthing.
An average peat thickness of around 3 m was estimated for the field site. Below the peat follows a fine sand layer, which reaches a maximum thickness of around 1.0 m right at the valley borders and thins out significantly towards the middle of the valley. Below the fine sand layer follows a layer of marine clay, which extends down to the bedrock at depths between 12 and 15 m below ground surface.
The results show that the peat layer in Skogaryd forms an isolated hydraulic system without interaction with deeper or regional groundwater systems. The continuously extending clay layer hinders water moving downward or upward crossing the border of peat and clay. The peat layer is a fast reacting hydraulic system that shows immediate reaction to precipitation or drought and is independent from regional groundwater levels.
The study of groundwater controls on the GHG from the drained organic soils at Skogaryd can thus focus on the fast reacting peat layer. Future investigations will show if this conclusion can be generalized for similar situations in Sweden.
Geophysical measurements have proved to be a valuable method for estimating the peat thickness over a large area.

Meyer A, Tarvainen L, Nousratpour A, Björk RG, Ernfors M, Grelle A, Kasimir Klemedtsson Å, Lindroth A, Räntfors M, Rütting T, Wallin G, Weslien P, Klemedtsson L (2013) A fertile peatland forest does not constitute a major greenhouse gas sink. Biogeosciences 10: 7739-7758 DOI 10.5194/bg-10-7739-2013