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Assessing the ecohydrological role of cryptic, forested wetlands in the Boreal Plain (Canada): Local-scale effects with a potential regional impact

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Northern wetlands represent a globally important carbon store (~455 to 600 Pg C) and are also instrumental for local to continental hydrological cycles. In the sub-humid Western Boreal Plain (WBP), forested wetlands (i.e. peatlands and swamps) increase runoff at local and regional scales. They are therefore fundamental for maintaining current and future water security as well as downstream ecosystems, and they likely affect vegetation productivity in their vicinity by acting as water sources. WBP landscapes consist of a mosaic of wetlands and forests on heterogeneous, glacial substrates. In this mosaic, forested wetlands of limited spatial extent (< 1 ha) are likely widespread, but often classed as upland systems due to scale limits of typical mapping approaches. The role of these "cryptic" wetlands in shaping the local – and in sum – regional ecohydrological functioning is unknown; they hence represent unique, unstudied features of the WBP. Combined pressures from high-latitude warming due to projected climate change, as well as human activities related to resource abstraction and agriculture, could severely alter composition and structure of their vegetation communities due to new or intensified hydroclimatic and disturbance regimes. Consequently, these systems may be vulnerable to a modification or loss of current function of unknown extent, especially when seen in the light of recently suggested risk of state-shifts for northern wetlands.

Here, our aim was to gain first insights on the ecohydrological role of these cryptic wetlands by identifying local-scale processes of water cycling and potential effects on productivity of adjacent systems. We investigated hydrological dynamics and concurrent tree responses within a forested wetland, across its interface and into an adjacent upland forest, focussing on two aspects: firstly, on assessing short-term tree sapflow responses to meteorological and hydro(pedo)logical conditions on daily to seasonal scales imposed by the wetland's characteristics, as evapotranspiration (ET) typically is the major water flux in WBP wetlands; secondly, whether identified dynamics translate to long-term patterns of tree growth in different locations in the wetland-upland complex, hinting at a local productivity-mediating effect provided by the wetland. To this end, we measured sapflow of four typical wetland and upland tree species across two growing seasons (2016 and 2017) along a wetland-upland transect. In combination with supporting environmental and subcanopy ET data this allowed inferring spatially and species-specific water-use. Further, we sampled 100 trees and established ring width records for two species with a stratified sampling approach, differentiating between wetland interface and upland. Initial analyses hint at interspecific – and to some extent intraspecific - differences in growth dynamics in response to hydroclimatic conditions (i.e. temperature and precipitation) between locations.

This work is a first step and important contribution toward assessing the ecohydrological role of cryptic (spatially limited) forested wetlands in the WBP. Further research on the quantification of water-use dynamics, location-specific, climate-growth relationships, and identification of water sources for trees in the wetland-upland complex is required.