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The estimation of evapotranspiration from wetland sites - the impact of soil physical properties near saturation

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The evapotranspiration (ET) is a significant process within the soil-plant-atmosphere continuum (SPAC). Especially on wetland sites ET is an important component of the water balance due to the high biomass and ET of wetland vegetation. Thus, comprehensive knowledge of all hydrological processes is the basis for a sustainable management of wetlands. Determining wetland ET still suffers from large uncertainties as it is notoriously difficult to measure directly due to its inherent complexities and small scale spatial and temporal variations. Consequently, there is a wide range of approaches to derive evapotranspiration losses indirectly from other parameters, but all have their significant assets and drawbacks. One of the commonly used methods is the interpretation of diurnal ground water fluctuations (DGF), which has been successfully applied to estimate the ET of phreatophytic vegetation (ET_{GW}). The basic idea behind this method is the assumption of a directly coupled system of incoming solar radiation, vegetation ET, water transport within the plants and water uptake by the root system of the phreatophytic vegetation from both the vadose zone and the groundwater. Such a system is characterised by a strong diurnal cycle and significant DGFs.

In the presented study, DGFs measured in a rewetted riverine fen in North-Eastern Germany were analysed to estimate ET_{GW}. With maximum daily values of 5.9 mm for reed (*Phragmites australis*) and 7.9 mm for willow (*Salix* spp.), the method yields generally plausible results. However, a comparison of the time series of ET_{GW} and ET according to the Penman-Monteith method (ET_{PM}) shows considerable discrepancies. Despite continuous sufficient water supply the ET_{GW} results fall up to 90 % below the results of ET_{PM}. The aim of the presented study was to identify processes explaining these differences. As a first step, we could identify a clear connection between these errors and the hydrological conditions: The difference between ET_{GW} and $ET_{PM}$is increasing with a decreasing depth to groundwater. Three working hypotheses might help to explain the observed differences between ET_{GW} and ET_{PM}: a) a depth-dependent specific yield, b) diurnal changes in the hysteresis of the water retention function and c) the presence of hydraulic lift as an active system of water uptake and release by the phreatophytic roots. These hypotheses are evaluated by field measurements of meteorological parameters, groundwater level, tension and soil water content. Additionally, results of laboratory tests – evaporation and multi-step outflow experiments – will be used to asses the hypotheses.

Here, we provide evidence for the influence of all these phenomenona on the results of ET_{GW} for the first time. The presentation will focus on their relevance for both the applicability of the DGF method to estimate ET and for the wetland SPAC in general.