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The quantification of water storage capacity of peatlands across different hydroclimatic settings using a simple rainfall event to water-table response ratio method

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In wetlands, the water budget is traditionally quantified by measuring the hydrologic components including precipitation, evapotranspiration and surface water-groundwater inflows and outflows. However, the reliability of measurements is often questioned due to the difficulty of rigorously monitoring all components of the water budget. Quantifying the rainfall event to water table response ratio is an alternative approach with minimal need for data commonly collected in peatland studies. However, the method has been used only in a limited number of biophysical settings including different microforms, hydroclimatic and hydrogeological settings. The objectives of this study are to quantify the reactivity of the water table to precipitation for different pristine peatlands located in different hydroclimatic conditions and to provide quantitative assessments of water storage of as many peatlands as possible. To do so, site-specific hourly water table and precipitation measurements was collected from northern peatlands worldwide. In total, data from more than 30 sites were retrieved from 8 research groups. For all peatlands, water-table depths varied between 80 cm below the peat surface and 10 cm above the peat surface. The results highlight that the hydrology of all peatlands is characterized by a shift from an environment that can store water to an environment that contributes to rapid outflow, and this is a uniform feature across sites. However, for peatlands with the lowest water storage capacities, this shift occurs during relatively moderate rainfall events (40 mm) or successive small rainfall events. Blanket peat bog best embodied this type of hydrological response. For peatlands with the highest water storage capacity, this shift occurs following multiple moderate to large precipitation events (40

mm – 80 mm) and it is strongly enhanced by the shift from high to low evaporative periods. The peatlands with the highest storage capacity are raised bogs with deep water-table. These conditions are best observed in peatlands located in geographical settings with high evaporation rates. Among all the peatlands, maximum water storage capacity for given rainfall events was equal to ≈150 mm. These analyses also confirm that the water table rise caused by precipitation events contain sufficient information to constrain water storage variations around monitored wells peatlands for a wide array of biophysical settings.