



Year-to-year meteorological variability is amplified in the hydrological response of the peat soils

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Soil water regime along with nutrient supply is controlling the forest type and its productivity. Generally, increased water supply leads to prolonged periods of soil water logging and poor soil aeration that in turn inhibit successful development of most temperate tree species.

In this study we configured a Hydrus-1D soil water model for each of three specific wet forest plots in Latvia. Two year of soil-water regime observations were used for manual model calibration. In addition, forest plot-scale tree-ring chronology was used for model validation. To investigate the interaction between the soil properties and hydrological regime we explore “what-if” type scenarios, by implementing 0, 0.05, 0.15 and 0.45 m thick peat layer in the top of the soil column in each of the three models. In essence, increasing peat layer thickness increases soil water storage capacity as it replaces denser, less porous mineral soil in the root zone.

We find that increasing thickness of the peat layer leads to on average smaller depth to groundwater, smaller seasonal groundwater level fluctuations, and increasing correlation of year-to-year average groundwater level (temporal autocorrelation), that can be considered as a soil water memory effect. This memory effect is manifested as multi-year periods of low or high average groundwater depth that can lead to inherent instability of the soil hydrological regime amplifying the atmospheric (meteorological) variability. The soil water regime instability can have a range of ecosystem feedbacks such as adverse effects for the growth of certain tree species sensitive to soil water logging and fluctuations in greenhouse gas (CO₂ and CH₄) emissions from the forest soil.

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