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GROUNDWATER DYNAMICS AND ECOHYDROLOGICAL RESPONSES IN AN EXTRACTED PEATLAND IN CENTRAL LATVIA: HIGH-FREQUENCY MONI-TORING AND GEST CLASSIFICATION

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Introduction

Peatlands are globally significant ecosystems, covering only ~3% of the Earth's land surface but storing nearly one-third of global soil carbon. Their hydrological func-tioning depends on persistently high water tables, which sustain anoxic conditions, suppress decomposition, and enable peat accumulation. High water levels also regulate catchment runoff, sustain baseflow, and buffer extremes. When water tables decline, peatlands shift from carbon sinks to carbon sources, releasing CO_2 through aerobic ox-idation and altering CH_4 fluxes, with major implications for climate feedbacks.

The aim of this study is to evaluate how groundwater dynamics in an extracted peatland in central Latvia respond to rainfall events and contrasting land cover situa-tions. Particular emphasis is placed on the influence of spontaneous vegetation succes-sion and drainage legacies on evapotranspiration and recharge. We hypothesize that:

- Spontaneous colonization by vascular plants (reed stands, GEST 15) increases evapotranspiration and amplifies groundwater drawdowns compared with bare peat or ditch surfaces.
- Rainfall recharge responses differ among GEST classes, with ditches (GEST 20) showing the fastest recovery and lawns/depressions (GEST 5–6) showing slower or muted responses due to peat degradation.
- GEST classification provides a reliable ecohydrological framework to predict water table depth and evapotranspiration in degraded peatlands.

Materials and Methods

The study was conducted in a ~16 ha section of the Kaigu peatland (56°43′N, 23°35′E) in central Latvia, located within the boreo-nemoral zone. The Kaigu complex covers 1546 ha, of which 774 ha are currently used for horticultural peat extraction, with reserves expected to support operations for at least another 80 years. The selected site represents a cut-over area where extraction has ceased. Vegetation cover is heteroge-neous, with patches of bare peat and drainage ditches alongside areas colonized by common reed, birch, Scots pine, and mixed regrowth.

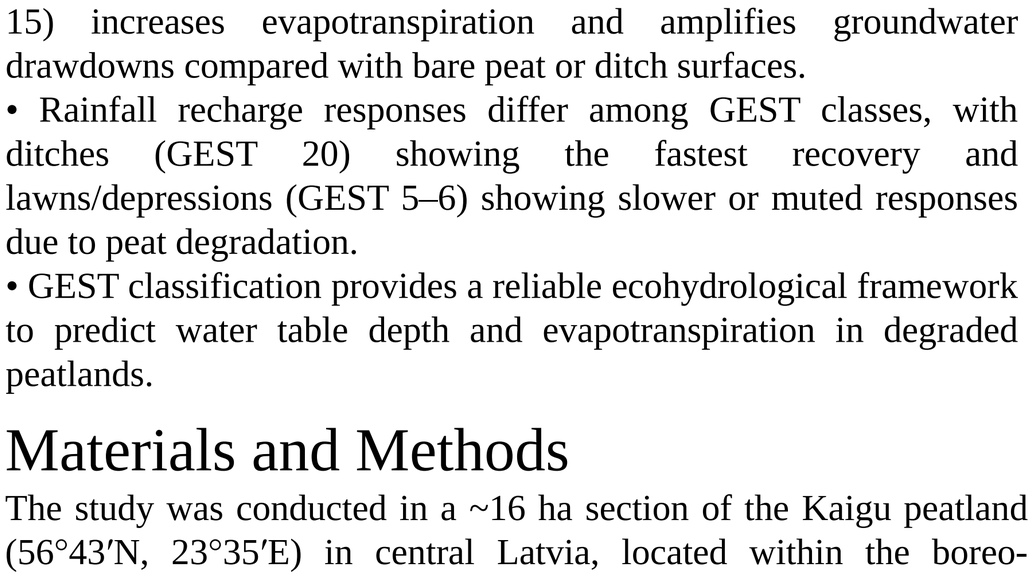

Figure 1. Location of study site within Europe (A) and closeup with study field where water monitoring wells (B).

The study utilized non-parametric statistical techniques to assess differences in evapotranspiration (ETg) and groundwater recharge among various groundwater evapotranspiration system types (GEST types). Specifically, the Kruskal-Wallis test was applied to compare these difference

Results and Discussions

Water levels ranged from −219.9 cm to +64.7 cm relative to the ground surface, with above-ground conditions recorded at three wells (Table 1). WTD1, located in the drainage ditch, showed the shallowest and most variable regime, fluctuating between −71.3 cm and +64.7 cm. Ponding occurred on 574 days, representing 79% of the study period. By contrast, WTD2 (50 m from the ditch) exhibited predominantly sub-surface conditions (−107.0 to +9.6 cm), with only nine days of inundation. WTD3 and WTD4, located further from the ditch (128 m and 226 m respectively), remained entirely below the surface (ranges −219.9 to −19.2 cm and −124.0 to −6.5 cm), reflecting persistently dry regimes. WTD5 and WTD6 (167 m and 130 m) generally remained below ground but recorded occasional shallow water tables, with WTD5 showing five days of ponding (maximum +23.7 cm).

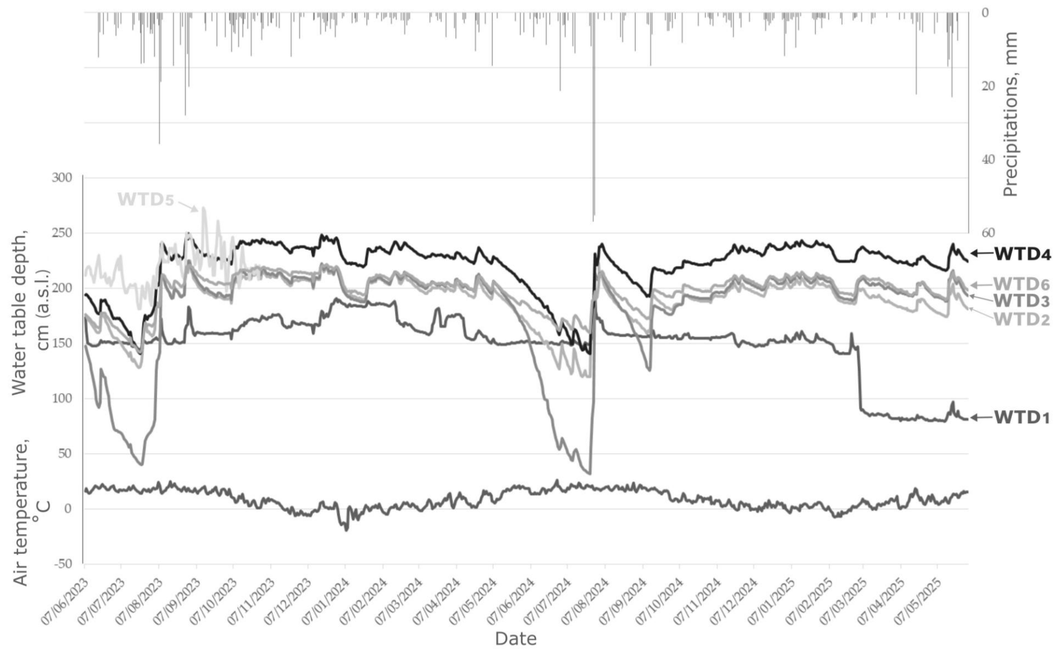

Figure 2. Groundwater table dynamics and precipitations during 2023 to 2025 in Kaigu peatland.

Conclusion

Hydrological heterogeneity is strong. Water levels ranged from - permanent in-undation in ditches (GEST 20) to persistently deep drawdowns in reed-dominated areas (GEST 15) further away from ditches, while GEST 5 and 6 sites exhibited intermediate regimes. This gradient reflects the combined influence of drainage legacy, microto-pography, and vegetation succession.

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