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The increasing effect of temperature on vegetation productivity under climate manipulation and water table depth alteration in a temperate peatland.

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The global carbon cycle is highly affected by peatlands as they accumulate up to 40% of the soil carbon (C) stored globally. Gross primary productivity (GPP) is a key driver of this accumulation, it determines the amount of atmospheric CO_2 sequestered into biomass. One of the most widespread techniques to measure CO_2 exchange with the atmosphere are closed-chamber method, however, this technique is limited to small-scale studies and is dependent on spatial and temporal interpolations. A multi-model approach combining a water table depth (WTD) based model, classic rectangular hyperbolic (RH) models, modified RH models with temperature factors and an exponential model is used to study the effect of climate manipulation in a temperate peatland, selecting in each timestep the best model based on the Akaike Information Criterion corrected, p-value, root mean square error (RMSE) and R^2 results.

Climatic conditions are changing rapidly, affecting the peatlands' capability to sequester and store C, enhancing decomposition and changing vegetation cover and performance. Temperature and precipitation highly impact vegetation performance inducing stress, which is why climate manipulation experiments have increased over time following our concerns about climate change. The effect of temperature on vegetation productivity under warming and reduced precipitation conditions was observed after 3 years of climate manipulation in a temperate peatland. As shown by the partial least-squares regression while during the first year, the variance of GPP explained by temperature was 51% and 59% respectively, it increased to 73% for warming (W) and warming plus reduced precipitation (WP) sites and equally, the correlation between temperature and GPP rose from -0.81 (W) and -0.76 (WP) to -0.85. Additionally, when the annual average values of WTD increased from -19.3 ± 7.4 cm in 2018 to -16.7 ± 6.8 cm in 2021, the effect of 15-day average WTD oscillations in vegetation productivity became minor, from 63% of GPP variance explained by WTD to just 18% as more water was available. The effects are also visible in GPP annual cumulative values, increasing from -671 g CO_2-C $m^{-2}y^{-1}$ and -672 g CO_2-C m^{-2} y^{-1} in 2019 to -883 g CO_2-C m^{-2} y^{-1} and -963 g CO_2-C m^{-2} y^{-1} in 2021 respectively for W and WP sites. It is undeniable that the effect of climate manipulation has induced changes in vegetation composition which produce the changes in temperature and WTD response of GPP and at the same time, the cumulative GPP yearly. The changes in vegetation composition can be observed through the comparison with control plots where the WTD effect remained significant, explaining still in 2021 24.5% of the GPP variance while

it is 16% and 13% for W and WP, probably with vegetation less adapted to climate extremes and more WTD-dependent.

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