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Short term response of a peatland to warming and drought – climate manipulation experiment in W Poland

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Central European peatlands are highly vulnerable as potential sources of carbon (C) to the atmosphere under anticipated climate changes, namely warming and drought (Fenner & Freeman 2011). We carried out a field manipulation experiment at Rzecin peatland in Poland to assess how those changes impact carbon balance, vegetation and water chemistry. The field site consists of three times replicated treatments (control, CO; simulated warming, W; prolonged drought, D and warming & drought, W+D). Temperature (T) was increased year around with infrared heaters (400W $\times$ 4 per site, approx. 60 W·m^{-2} addition of LW radiation, Kimball 2005) and precipitation was reduced with automatic curtain during growth seasons at night. The manipulation was successful yielding up to 0.4 ^{o}C and 1.0 ^{o}C T increases in air (30 cm height) and soil (5 cm depth), respectively, as well as a 35 % lower precipitation (in 2015). To study the C exchange we developed an automatic mobile platform for measuring CO_2/CH_4/H_2O fluxes (LGR) as well as for $^{13}CO_2$ and $^{13}CH_4$ fluxes (PICARRO CRDS G2201-i) with dynamic ecosystem chambers (for NEE and Reco) and for simultaneous measurements of surface optical properties. Gap filling of the fluxes was done according to Hoffmann et al. 2015.

In the very dry 2015, Rzecin peatland was a net source of $CO_2$to the atmosphere (80 gC·m^{-2}yr^{-1}). Warming and drought considerably diminished the source strength (7 gC·m^{-2}yr^{-1}at the W+D site), due to lower cumulative respiration (Reco the smallest, 610 gC m^{-2}yr^{-1}, at W+D site). The highest CO_2 emissions were measured from the site that was only warmed (W site, Reco 680 gC·m^{-2}yr^{-1}), emphasizing the importance of drought in inhibiting respiration. Temperature increase also provoked the productivity (highest GPP at W site, -620 gC·m^{-2}yr^{-1}), while drought yielded the lowest productivity (lowest GPP at D site, -550 gC·m^{-2}yr^{-1}). Different vegetation parameters further support the C exchange estimates. Generally, warmer conditions led to increases in NDVI and LAI, whilst the site exposed to only drought exhibited the lowest LAI. Warming shifted the vegetation species composition by promoting vascular plants (mainly *Carex rostrata* and *C. limosa*), which result also correlates positively with nutrient (P_{tot}, Mn, F, Na, Zn) availability in the peat water.

Here, we report short-term responses to increased temperature and diminished precipitation, showing that the combination of these to stressors leads to very different scenario than their individual impacts. Our results further emphasize the need for long term records from field manipulation site on peatland response to climate changes.

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