
Supplementary information

Warming response of peatland CO₂ sink is sensitive to seasonality in warming trends

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Supplementary material for “Warming response of peatland CO₂ sink is sensitive to seasonality in warming trends”

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Tab. S1: List of locations, length of net ecosystem CO₂ exchange time series, mean annual air temperature (MAAT \pm one standard deviation) and mean annual precipitation (MAP \pm one standard deviation) for the period 1981-2010, observation years, data source, and reference for northern peatland observation sites used in this study. Superscripts in *Site* column refer to letters in Fig. 1.

Site	Latitude	Longitude	# of years	MAAT \pm 1 std	MAP \pm 1 std	Years	Source	Reference
	°N	°	-	°C	mm			
CA-ARB ⁱ	52.70	-83.95	5	-1.5 \pm 1.0	587 \pm 40	2011 - 2015	Database	Helbig et al., 2019 ²⁹
CA-ARF ⁱ	52.70	-83.96	5	-1.5 \pm 1.0	587 \pm 40	2011 - 2015	Database	Helbig et al., 2019 ²⁹
CA-MER ^r	45.41	-75.52	21	6.0 \pm 0.7	955 \pm 81	1998 - 2018	PI	Lafleur et al., 2003 ³⁵
CA-SCC ^c	61.31	-121.30	7	-2.7 \pm 1.0	383 \pm 67	2013 - 2019	Database	Helbig et al., 2017 ⁸
CA-WP1 ^f	54.95	-112.47	7	1.6 \pm 1.0	473 \pm 72	2003 - 2009	Database	Flanagan & Syed, 2010 ⁶⁸
FI-KAA ^e	69.14	27.27	9	-1.3 \pm 0.9	452 \pm 51	2000 - 2008	PI	Aurela et al., 2004 ⁶⁹
FI-LOM ^d	68.00	24.21	10	-0.2 \pm 0.9	419 \pm 51	2007 - 2016	PI	Aurela et al., 2009 ⁷⁰
FI-SI1 ^h	61.83	24.19	15	3.8 \pm 1.0	577 \pm 63	2005 - 2019	Database	Rinne et al., 2018 ⁷¹
IE-KIL ^t	51.97	-9.90	11	9.8 \pm 0.5	1584 \pm 177	2002 - 2012	Literature	McVeigh et al., 2014 ³⁷
NO-AND ^q	69.14	16.02	7	2.3 \pm 0.8	942 \pm 126	2008 - 2014	PI	Lund et al., 2015 ⁷²
SE-DEG ^k	64.18	19.55	19	1.7 \pm 1.0	658 \pm 83	2001 - 2019	Database	Peichl et al., 2014 ²⁸
SE-FAJ ⁿ	56.27	13.55	5	7.6 \pm 0.9	738 \pm 87	2005 - 2009	Database	Lund et al. 2012 ⁷³
UK-AMO ^p	55.79	-3.24	19	8.0 \pm 0.5	886 \pm 99	2002 - 2020	PI	Helfer et al., 2015 ¹²
US-MBP ^m	47.51	-93.49	11	4.2 \pm 1.0	713 \pm 73	2009 - 2019	PI	Olson et al., 2013 ⁷⁴
US-LTB ^a	64.70	-148.32	9	-2.1 \pm 0.9	296 \pm 46	2011 - 2019	PI	Euskirchen et al., 2014 ⁷⁵
US-LTF ^b	64.70	-148.31	9	-2.1 \pm 0.9	296 \pm 46	2011 - 2019	PI	Euskirchen et al., 2014 ⁷⁵
SE-STO ^l	68.36	19.05	6	-3.3 \pm 0.8	696 \pm 81	2014 - 2019	Database	Junttila et al., 2021 ⁷⁶
SE-MYK ^o	58.37	12.17	5	6.9 \pm 1.0	840 \pm 107	2016 - 2020	PI	Junttila et al., 2021 ⁷⁶
JP-BBY ^s	43.32	141.81	6	6.8 \pm 0.6	1172 \pm 145	2015 - 2020	PI	Ueyama et al., 2020 ⁷⁷
RU-ZOT ⁹	60.82	89.39	8	-2.3 \pm 1.1	568 \pm 65	2012-2019	PI	Park et al., 2021 ³²

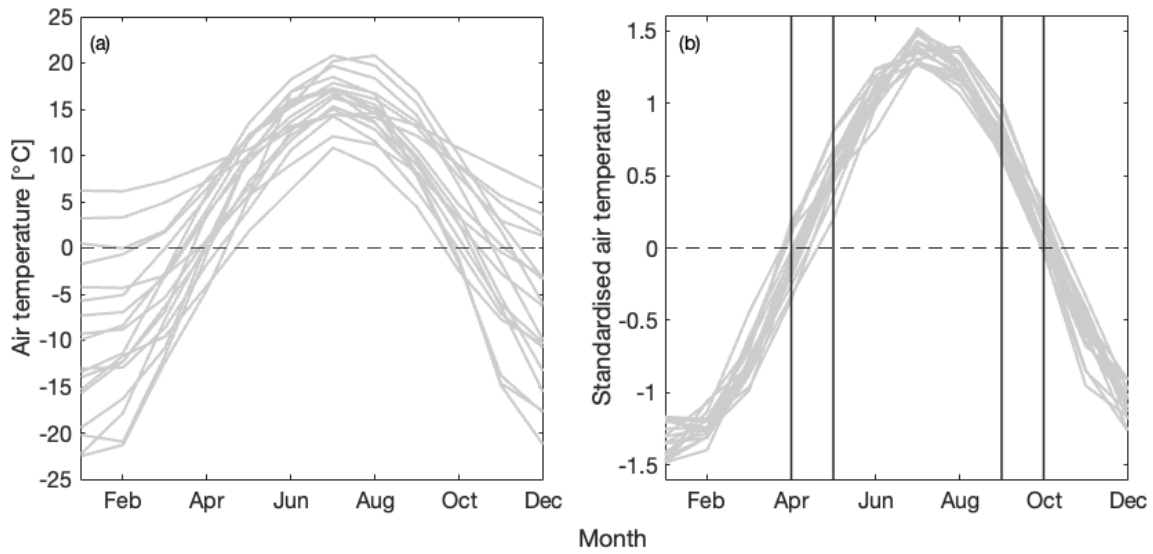


Fig. S1: (a) Mean monthly air temperature [°C] seasonality across all sites during the study period ($n = 20$). (b) Standardised mean monthly air temperature [unitless] seasonality across all sites ($n = 20$). Vertical black lines indicate identified spring and fall months (i.e., first and last month in which standardised temperature > 0).

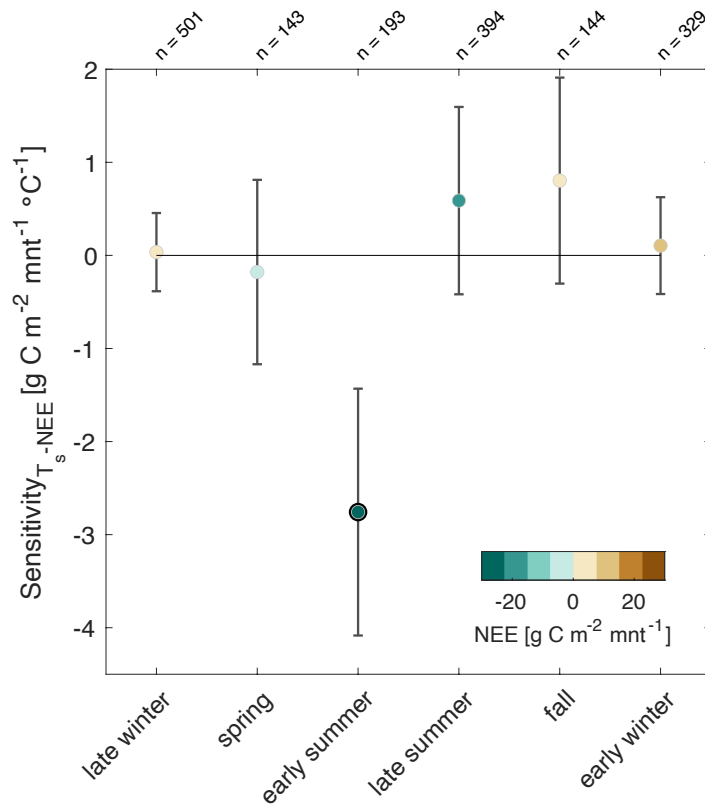


Fig. S2: Estimated fixed effect (i.e., near-surface soil temperature [T_s], < 10 cm) slopes in a linear mixed-effects regression model of monthly net ecosystem CO₂ exchange with sites considered as random effect. Linear mixed effect models are separately fitted to each period. Error bars show 95% confidence intervals of estimated slope parameters and bold black circles indicate statistical significance at $\alpha \leq 0.05$. Colors of circles show mean net ecosystem CO₂ exchange (NEE).

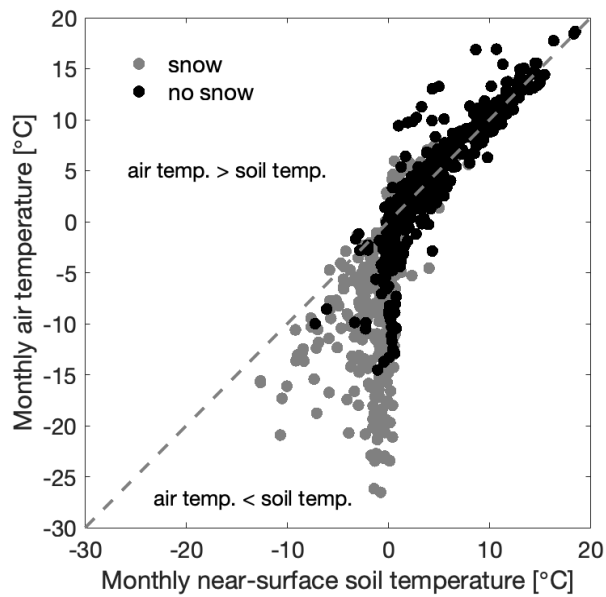


Fig. S3: Relationship between monthly near-surface soil (≤ 10 cm) and monthly air temperature across 18 peatland sites. Black circles show air and soil temperatures without snow on the ground while grey circles show air and soil temperatures with snow on the ground (i.e., monthly snow water equivalent > 5 mm). The dashed line is the 1:1 line.

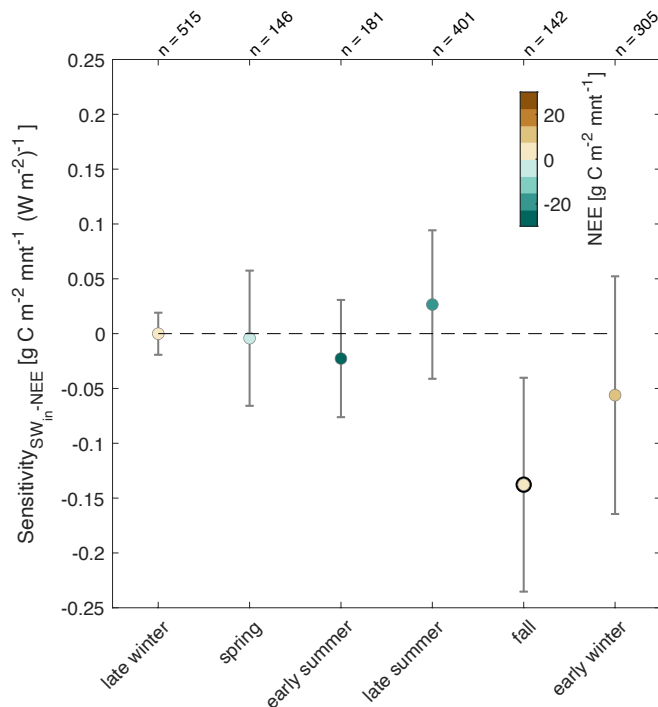


Fig. S4: Estimated fixed effect (i.e., incoming shortwave radiations [SW_{in}]) slopes in a linear mixed-effects regression model of monthly net ecosystem CO_2 exchange with sites considered as random effect. Linear mixed effect models are separately fitted to each period. Error bars show 95% confidence intervals of estimated slope parameters and bold black circles indicate statistical significance at $\alpha \leq 0.05$. Colors of circles show mean net ecosystem CO_2 exchange (NEE).

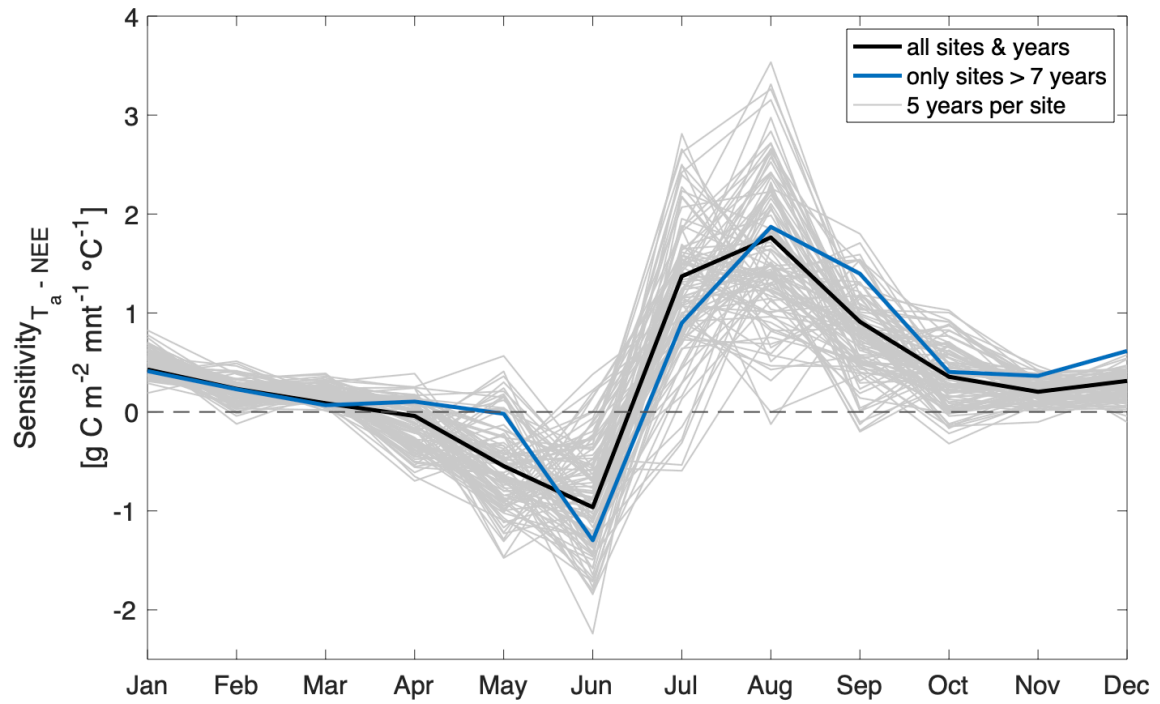


Fig. S5: Monthly estimated fixed effect (i.e., monthly air temperature [T_a]) slopes in linear mixed-effects regression models of monthly net ecosystem CO_2 exchange (NEE) with sites as random effect derived only from sites with time series longer than 7 years (blue line; $n = 11$), derived from 100 five-year subsets from all sites (grey lines; $n = 20$), and derived from the full dataset (black line; $n = 20$).