Supplementary

Table S1. NGS and GS periods, duration and mean NEE and air temperature during each period.

NGS					GS				
Year	**NGS period**	**Duration** (days)	**Mean NEE** (g C/m²/day)	**Mean Air T** (°C)	**Year**	**GS period**	**Duration** (days)	**Mean NEE** (g C/m²/day)	**Mean Air T** (°C)
2005-2006	07.10. – 18.03.	162	0.22	-3.76	2006	19.03. – 23.08.	158	-0.32	10.9
2006-2007	24.08. – 26.04.	245	0.19	1.51	2007	27.04. – 20.09.	147	-0.61	12.7
2007-2008	21.09. – 28.04.	220	0.14	-0.07	2008	29.04. – 13.09.	138	-0.88	12.0
2008-2009	14.09. – 26.04.	223	0.20	-0.44	2009	27.04. – 20.09.	147	-0.62	13.2
2009-2010	21.09. – 03.05.	224	0.17	-4.31	2010	04.05. – 10.09.	130	-0.77	14.9
2010-2011	11.09. – 26.04.	227	0.19	-3.22	2011	27.04. – 25.10.	182	-0.66	12.7
2011-2012	26.10. – 28.04.	185	0.14	-2.50	2012	29.04. – 26.09.	152	-0.97	12.2
2012-2013	27.09. – 30.04.	214	0.24	-2.78	2013	01.05. – 17.09.	140	-1.04	14.8
2013-2014	18.09. – 21.04.	215	0.22	0.06	2014	22.04. – 20.09.	152	-0.92	13.5
2014-2015	21.09. – 29.04.	220	0.24	0.30	2015	30.04. – 15.09.	139	-0.88	12.7
2015-2016	16.09. – 01.06.	259	0.33	1.43	2016	02.06. – 21.09.	112	-0.51	14.2
2016-2017	22.09. – 19.05.	238	0.18	-0.66	2017	20.05. – 29.09.	133	-0.69	12.4
2017-2018	30.09. – 07.05.	219	0.23	-1.57	2018	08.05. – 29.07.	83	-0.65	16.7
2018-2019	30.07. – 04.05.	278	0.25	3.09	2019	05.05. – 03.09.	122	-0.62	14.3
2019-2020	04.09. – 11.05.	250	0.22	1.43	2020	12.05. – 02.09.	114	-0.74	14.6
2020-2021	03.09. – 26.04.	234	0.27	0.11	2021	27.4. – 10.9	136	-0.85	14.3

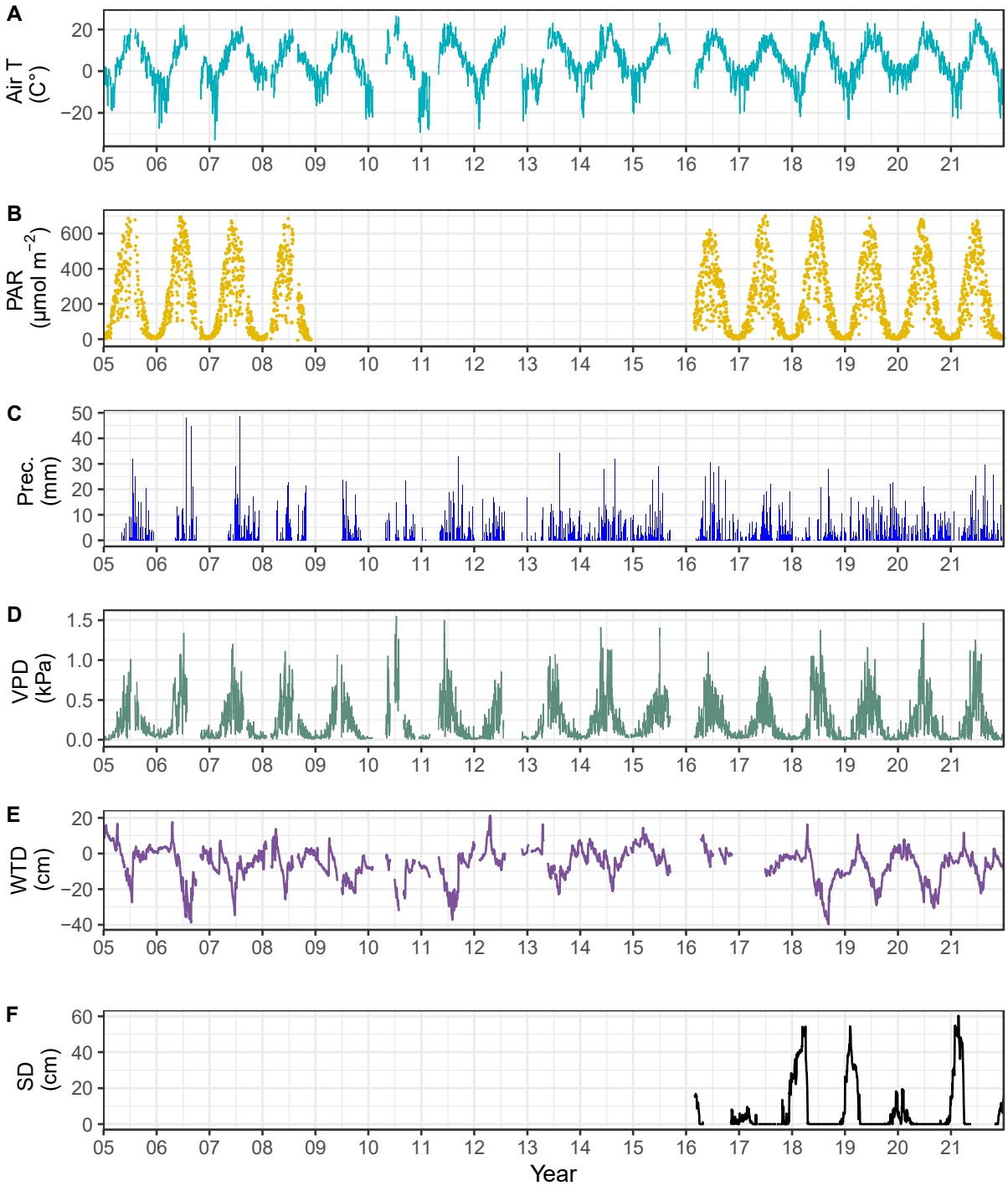

Figure S1. Time series of air temperature (A), precipitation (B), photosynthetically active radiation (C), vapor pressure deficit (D), water table depth (E) and snow depth (F) in 2005-2021. Precipitation is expressed as daily sums and is calculated from the hourly summed data. The other variables are expressed as daily means and are

calculated from hourly averaged data. Data for PAR in 2009-2015 was not used due to instrument malfunction. Snow depth measurements started at spring 2016. Precipitation data shown in the figure is measured with ARG-100 tipping bucket rain gauge in 2006-2016 and with OTT Pluvio2S weighing rain gauge in 2017-2021.

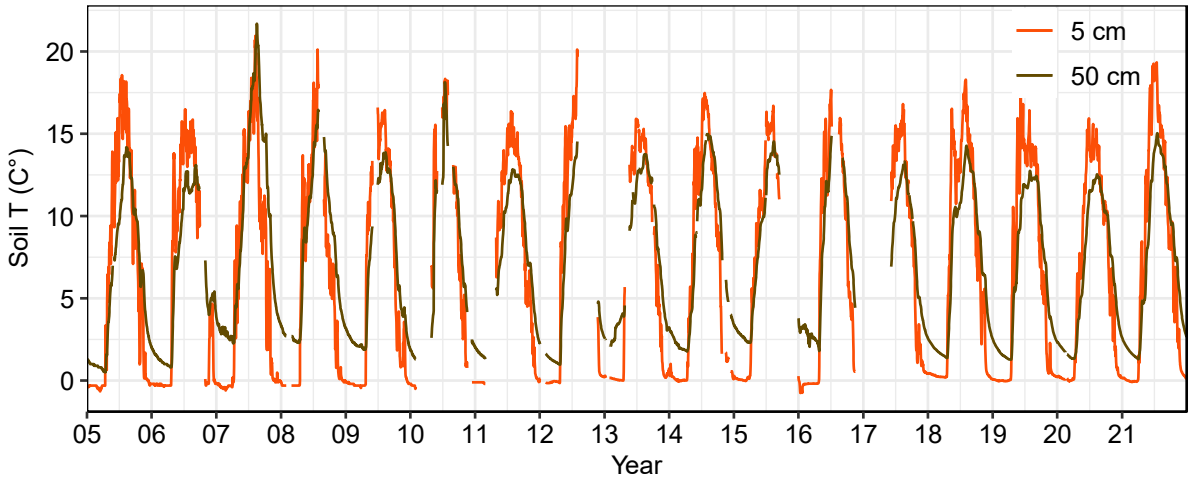

Figure S2. Time series of daily means of soil temperature at 5 cm depth (red line) and 50 cm depth (brown line). Daily means are calculated from hourly averaged data. The measurement practices changed in 2017, including the measurement depth. The figure of the time series of soil temperature at 50 cm depth includes the temperature measured at 50 cm depth for 2005-2016 and temperature measured at 45 cm depth for 2017-2021. The data for both measuring depths is from lawn microsite for 2005-2016 and an average of five microsites for 2017-2021.

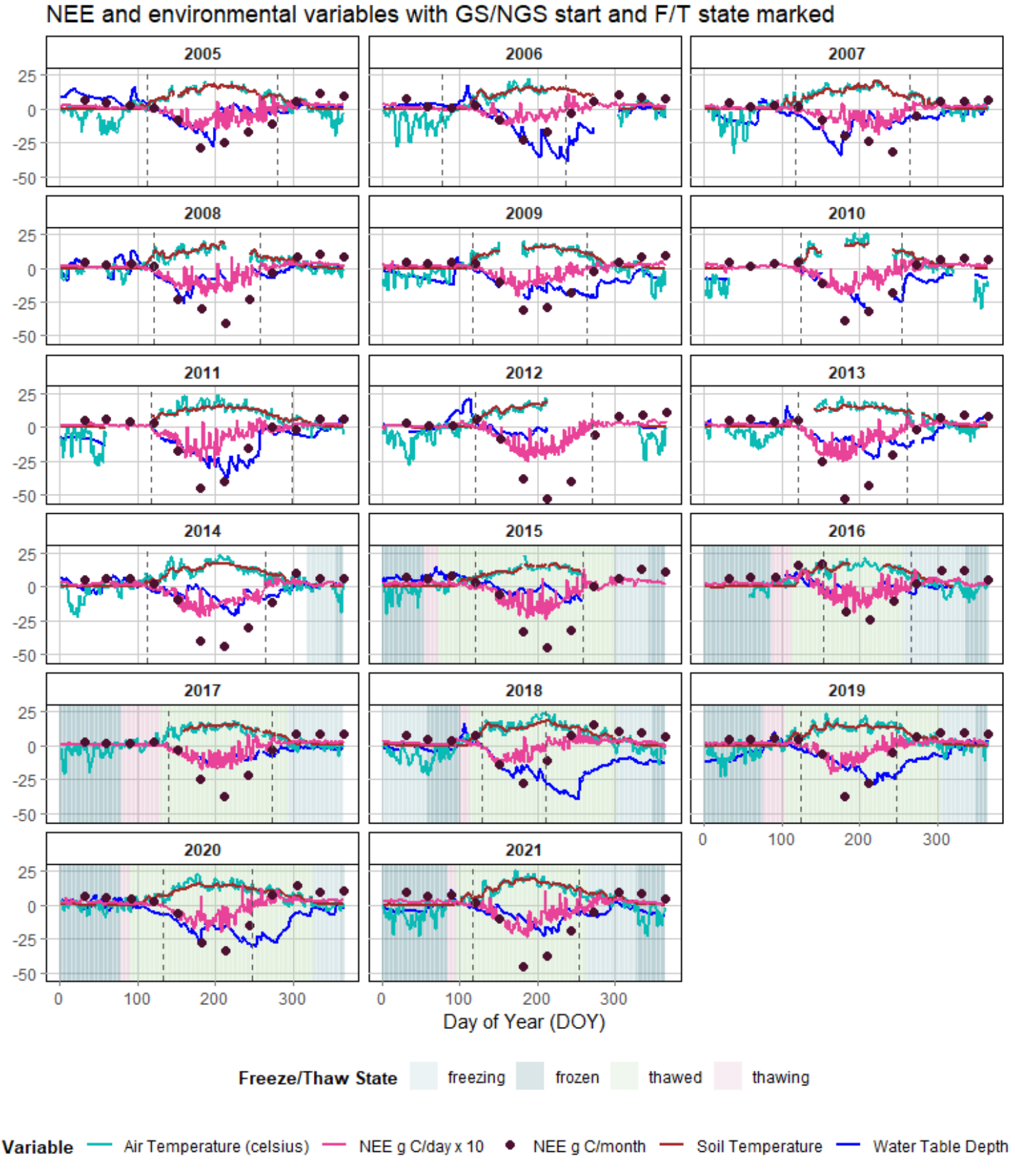
NEE and environmental variables with GS/NGS start and F/T state marked
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
25
0
-25
-50
0
100
200
300
Day of Year (DOY)
Freeze/Thaw State
freezing
frozen
thawed
thawing
Variable
Air Temperature (celsius)
NEE g C/day x 10
NEE g C/month
Soil Temperature
Water Table Depth

Figure S3. Daily sums of te Net ecosystem exchange of CO2 (NEE), air and soil temperature and water table depth during each year 2005-2021. The end and start of the NGS are marked with vertical dashed lines - first three days of negative NEE marked the end of NGS and first three consecutive days of positive NEE marked the start of NGS. Freeze-thaw status is marked with the background colour for the years 2014-2021. The status is determined for a 200meter radius from the Eddy Covariance mast and determined from Sentinel-1 IW GRD radar backscatter time series. Monthly sums of NEE are marked with a brown scatter. The daily values of NEE are multiplied by 10 for visibility.

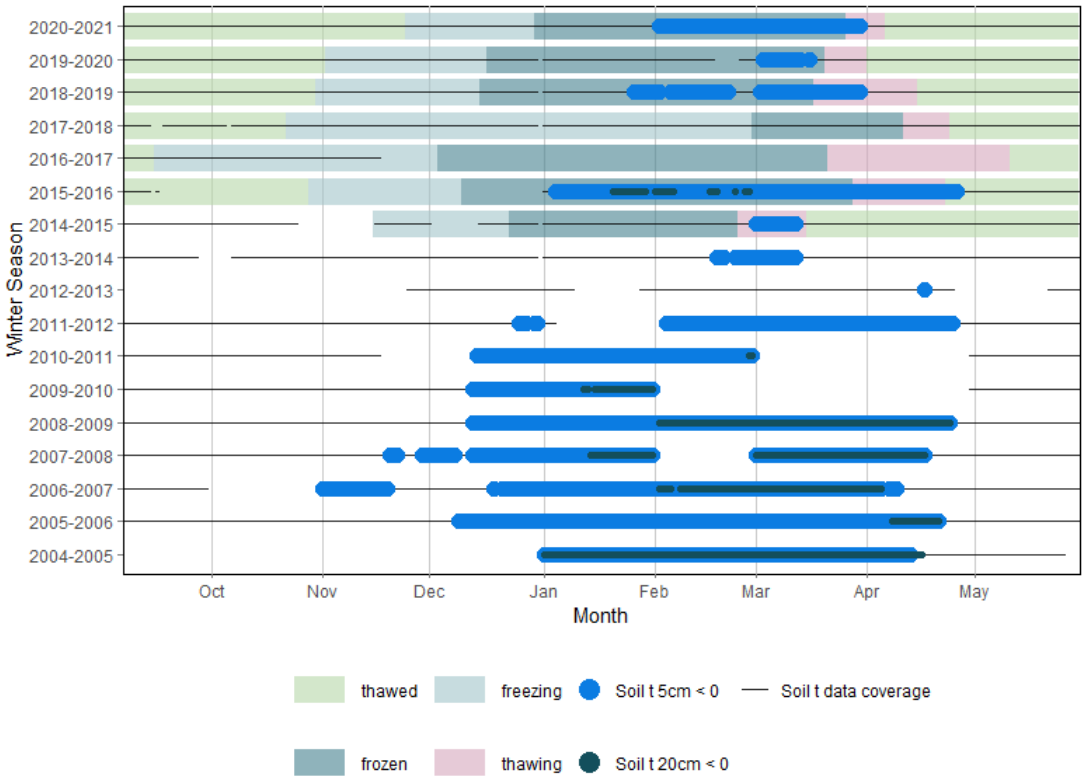

Figure S4. Freeze-thaw status and site-measured soil temperature (Soil t) below freezing temperatures during winter. The freeze-thaw status has been assigned for 200m radius around the eddy-Scovariance (EC) mas, and is determined from Sentinel-1 IW GRD radar backscatter time series. Soil temperature is measured on site. Daily mean soil temperature below 0◦C at 5 cm (light blue) and 20 cm (dark blue) depth are marked as thick lines.Horizontal line shows the data coverage for the soil temperature.

Table S2. Freezing, frozen and thawing periods for 2014-2021. The status is determined for a 200meter radius from EC mast. The freezing and thawing periods were determined from Sentinel-1 IW GRD radar backscatter time series (2014–2021) using visual inspection of median VV, VH, and VH/VV ratio trends from both orbit directions, supported by ground measurements of temperature, soil moisture, and snow depth.

Winter-Spring	Freezing Period	Frozen Period	Thawing Period	Freezing Duration (days)	Frozen Duration (days)	Thawing Duration (days)
2014-2015	15.11 – 22.12	23.12 – 23.02	24.02 – 14.03	38	63	19
2015-2016	28.10 – 09.12	10.12 – 26.03	27.03 – 21.04	43	108	26
2016-2017	14.09 – 01.12	02.12 – 20.03	21.03 – 10.05	79	109	51
2017-2018	22.10 – 27.02	28.02 – 10.04	11.04 – 23.04	129	42	13
2018-2019	30.10 – 14.12	15.12 – 16.03	17.03 – 14.04	46	92	29
2019-2020	02.11 – 16.12	17.12 – 18.03	19.03 – 30.03	45	93	12
2020-2021	23.11 – 28.12	29.12 – 25.03	26.03 – 05.04	36	87	11
2021-2022	21.09 – 24.11	-	-	65	-	-

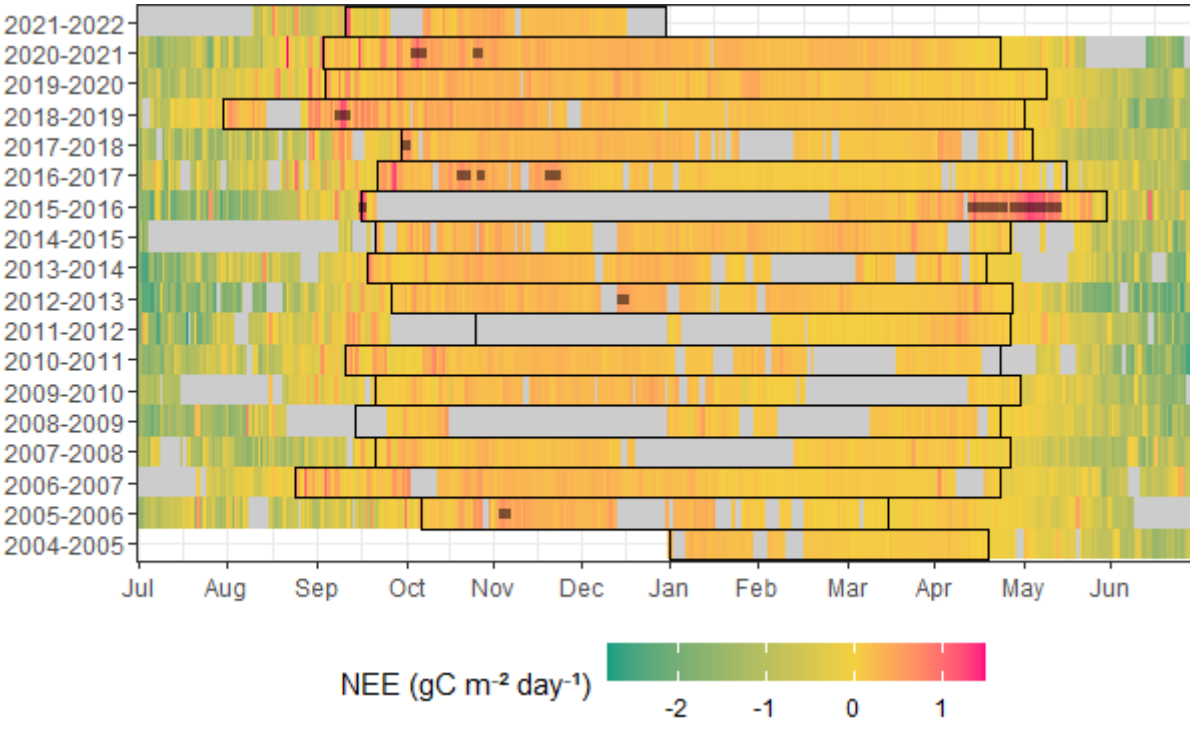

Figure S5. Daily net ecosystem exchange (NEE; gC m^{-2} day^{-1}) in 2005-2021 and the non-growing season (NGS) periods centered in the winter. Each row represents one year beginning in July and ending in June of the following year. Colors indicate daily mean NEE values, where yellow - green gradient reflects negative values (net carbon sink) and yellow - pink gradient reflects positive values (net carbon release). Black rectangular outlines mark the NGS periods, defined as the period beginning after the first three consecutive days of positive NEE and ending after the first three consecutive days of negative NEE. Black vertical lines mark the periods with three or more consecutive days with daily mean flux values exceeding the upper 95th percentile. The grey tiles

mark the days with less than 12 hourly observations, meaning that more than 12 of the hourly values are gapfilled.

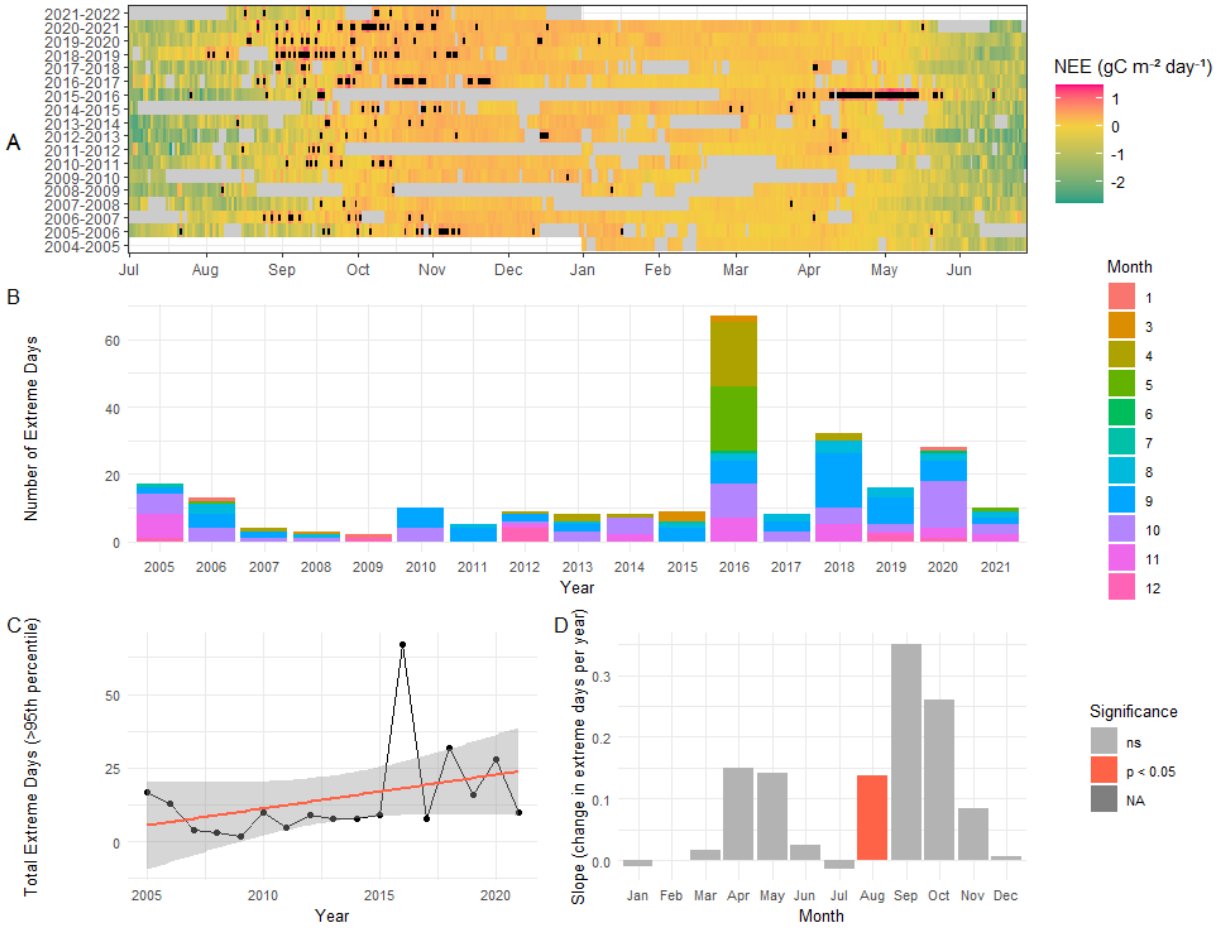

Figure S6. A) Daily net ecosystem exchange (NEE; gC m^{-2} day^{-1}) in 2005-2021 and the daily values exceeding the 95th percentile (black). Each row represents one year beginning in July and ending in June of the following year. Colors indicate daily mean NEE values, where yellow - green gradient reflects negative values (net carbon sink) and yellow - pink gradient reflects positive values (net carbon release). The grey tiles mark the days with less than 12 hourly observations, meaning that more than 12 of the hourly values are gapfilled. B) The Amount of days of daily NEE exceeding the 95th percentile by year, coloured by month. C) The amount of days of daily NEE exceeding the 95th percentile with a linear regression line fitted (red) and standard deviation marked as grey shading. D) The slope of change in extreme days per year aggregated by month. The colour of the bar indicates the significance of the change (grey=insignificant and red: significant).