Supplementary Information for

Effects of permafrost thaw on seasonal soil CO2 efflux dynamics in a boreal forest site

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Supplemental Figures (9)

Supplemental Tables (1)

Table S1. Soil texture, measured for each plot (i.e. LiCor chamber). Texture was measured via hydrometer method at the University of Wisconsin Soil and Forage Lab. These results represent composite samples across sampling dates (20g dry soil from each date: Sept_2022 + Jun_2023 + Feb_2023) for each chamber and soil layer.

Chamber	Disturbance	Soil layer	Sand, %	Silt, %	Clay, %	Soil Texture
1	Undisturbed	Subsoil	43	50	7	Silt loam
2	Undisturbed	Subsoil	39	52	9	Silt loam
3	Undisturbed	Subsoil	31	60	9	Silt loam
4	Undisturbed	Subsoil	29	60	11	Silt loam
1	Undisturbed	Topsoil	41	48	11	Loam
2	Undisturbed	Topsoil	45	46	9	Loam
3	Undisturbed	Topsoil	29	60	11	Silt loam
4	Undisturbed	Topsoil	45	46	9	Loam
5	Disturbed	Subsoil	31	58	11	Silt loam
6	Disturbed	Subsoil	37	54	9	Silt loam
7	Disturbed	Subsoil	25	62	13	Silt loam
8	Disturbed	Subsoil	25	66	9	Silt loam
5	Disturbed	Topsoil	45	48	7	Loam
6	Disturbed	Topsoil	53	40	7	Sandy loam
7	Disturbed	Topsoil	37	50	13	Silt loam
8	Disturbed	Topsoil	41	50	9	Silt loam
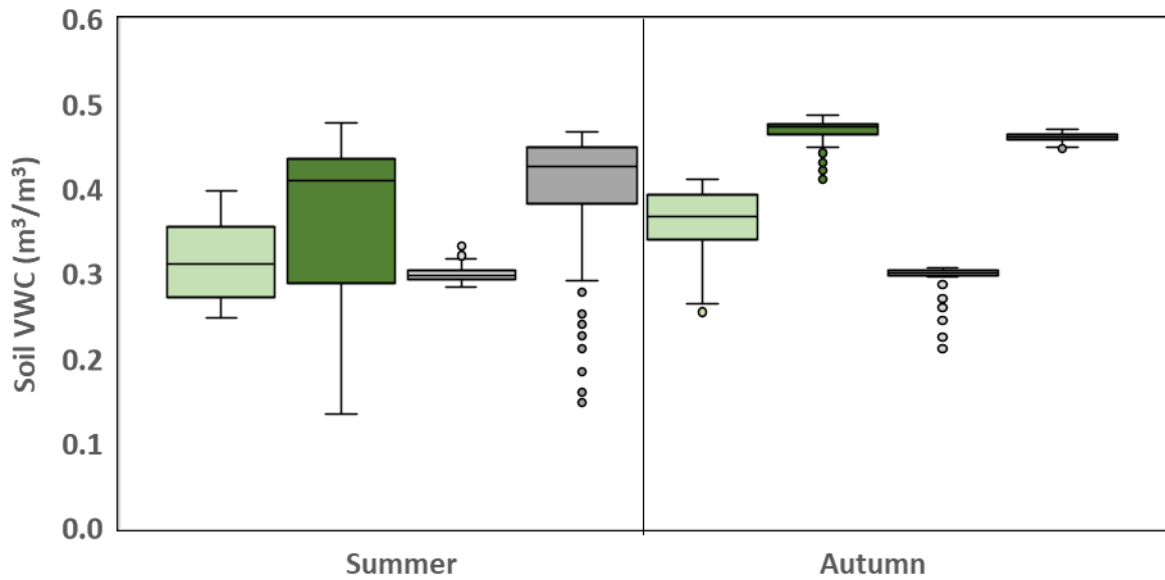
Figure S1. Summer and autumn soil VWC patterns. VWC measurements were restricted to the summer (Jun–Aug) and autumn (Sep and Oct) seasons due to the sensors' operational constraints, which required temperatures to remain above freezing. Soil VWC are average daily values from the topsoil and subsoil layers at the 8 chamber plots: 4 at the undisturbed site and 4 at the disturbed site. The boxplot range indicates the first and third quartiles; the middle line denotes the median. Box whiskers indicate minimum and maximum values, excluding outliers indicated by circles.
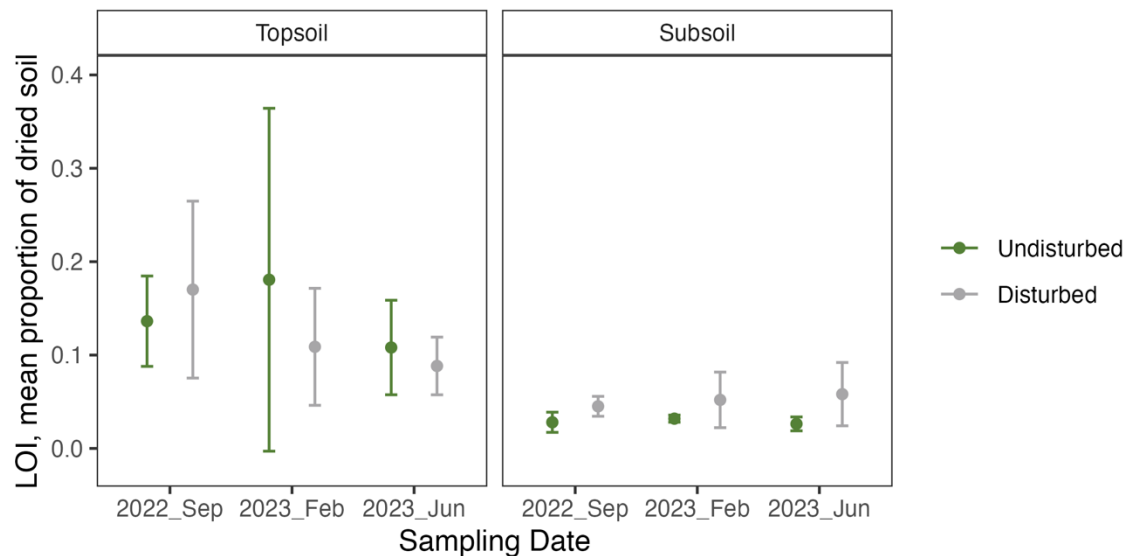
Figure S2. Loss on ignition (LOI), a proxy for soil organic matter content) by disturbance treatment and sampling date, faceted by soil layer. Error bars are 95% confidence intervals (1.96*standard error).
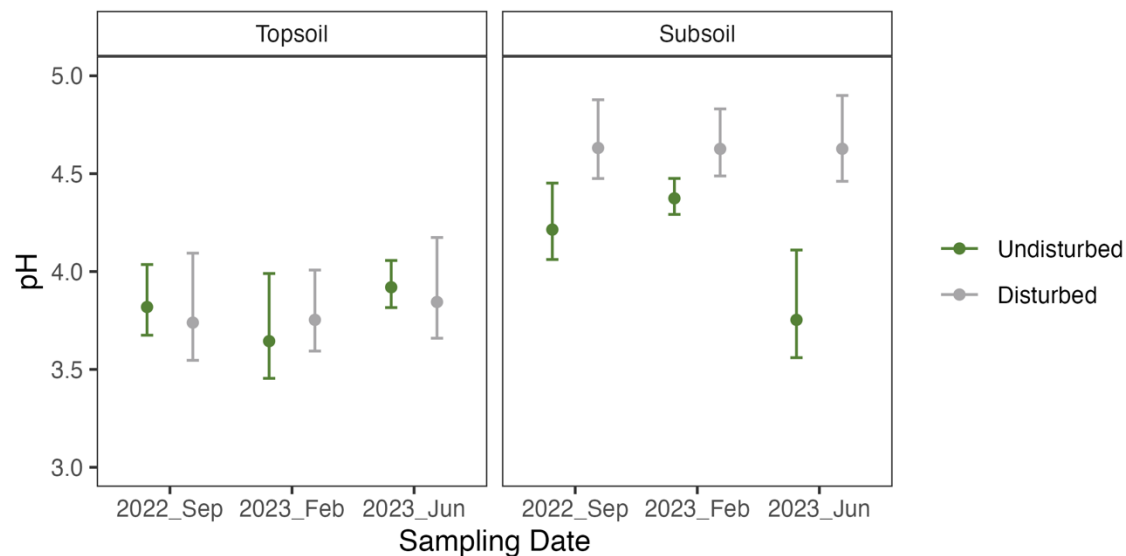
Figure S3. Soil pH, by disturbance and sampling date, faceted by soil layer. pH was significantly higher in the subsoil layer for the disturbed treatment compared to the undisturbed treatment ($p < 0.01$; ANOVA). Error bars are standard error.
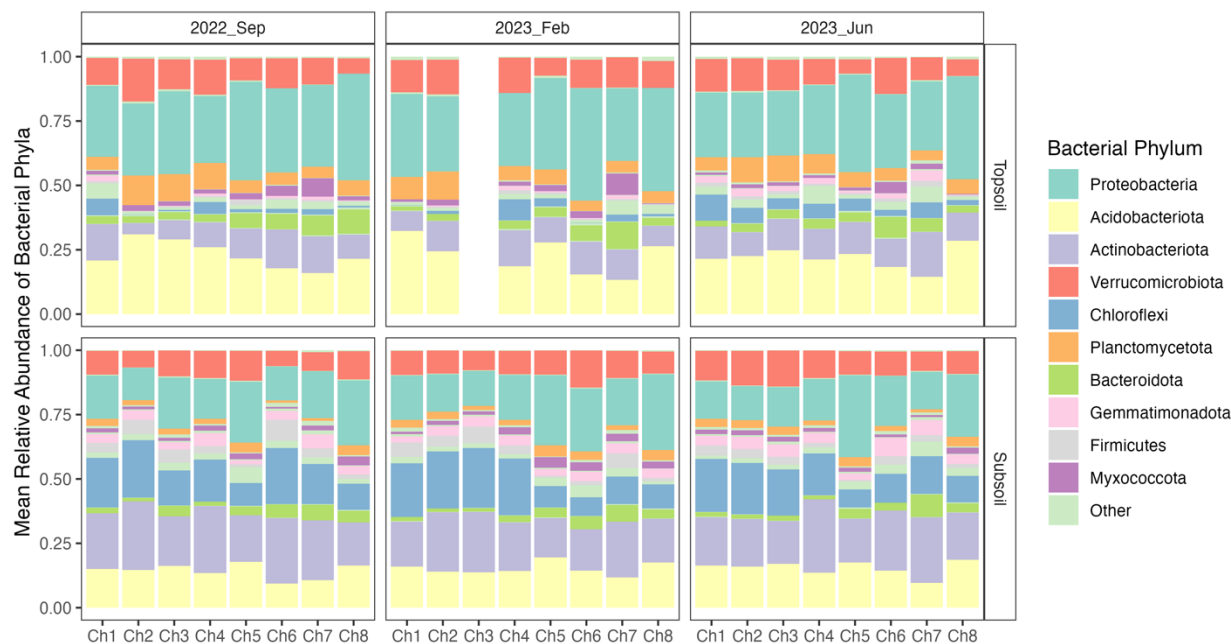
Figure S4. Relative abundances of dominant bacterial phyla, faceted by sampling date and soil layer. Each plot is named for LiCor chamber (Ch1 through Ch8); Ch1, Ch2, Ch3, Ch4 are undisturbed plots, and Ch5, Ch6, Ch7, Ch8 are disturbed plots. One sample was excluded from analysis (2023_Feb, Chamber 3, Topsoil).

Figure S5. Relative abundances of dominant fungal classes, faceted by sampling date and soil layer. Each plot is named for LiCor chamber (Ch1 through Ch8); Ch1, Ch2, Ch3, Ch4 are undisturbed plots, and Ch5, Ch6, Ch7, Ch8 are disturbed plots. One sample was excluded from analysis (2023_Feb, Chamber 3, Topsoil).
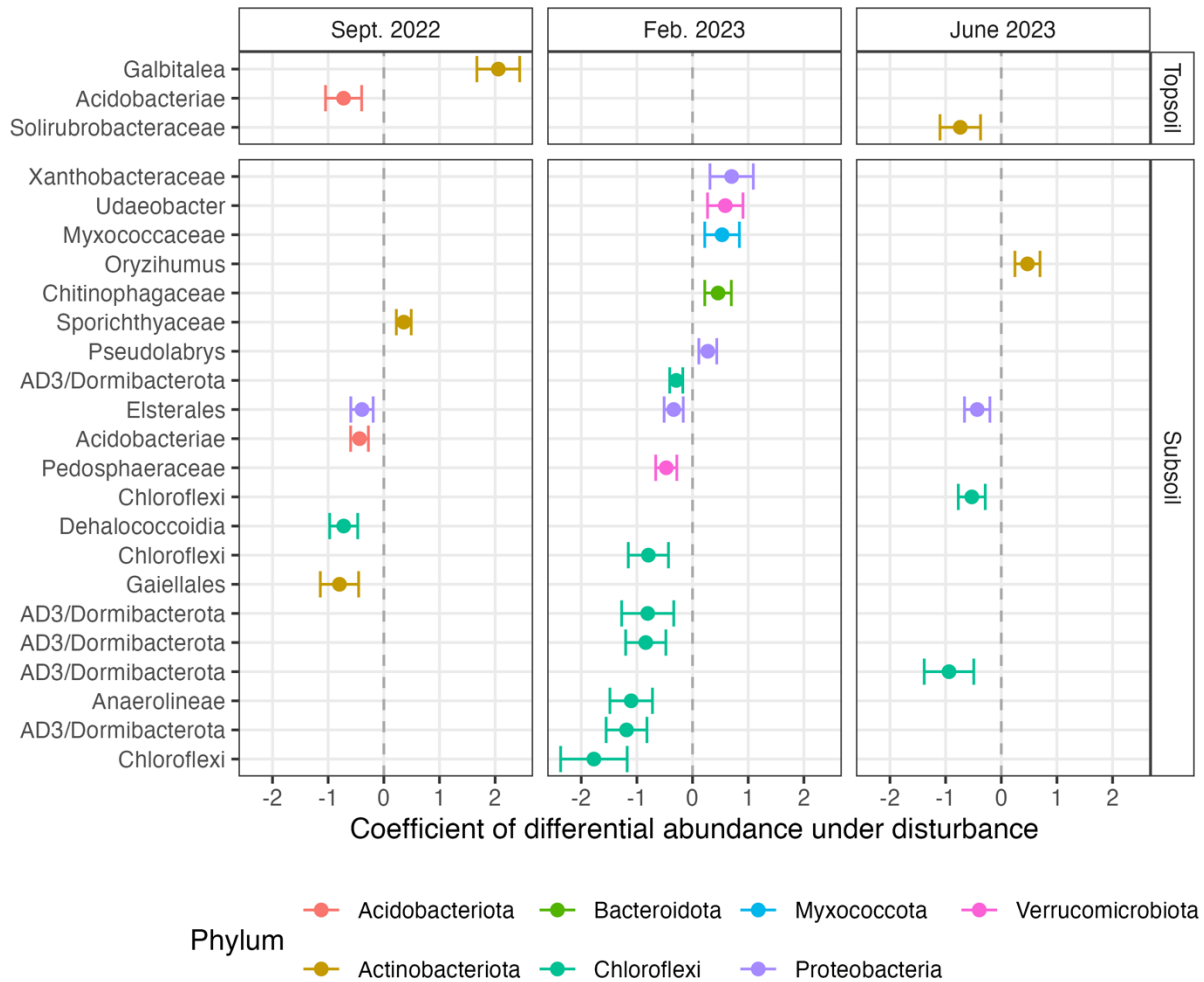
Figure S6. Differentially abundant bacterial taxa for disturbed (vs. undisturbed) plots, within sampling date and subsoil vs. topsoil layers. The x-axis is the coefficient of differential abundance; positive coefficients denote enrichment whereas negative coefficients denote depletion. Each point represents a single ASV, colored by phylum, and labelled on the y-axis with the finest available taxonomy; thus—there may be more than one ASV definable to the same name and level of taxonomy. Error bars represent ± 1.96 SE.
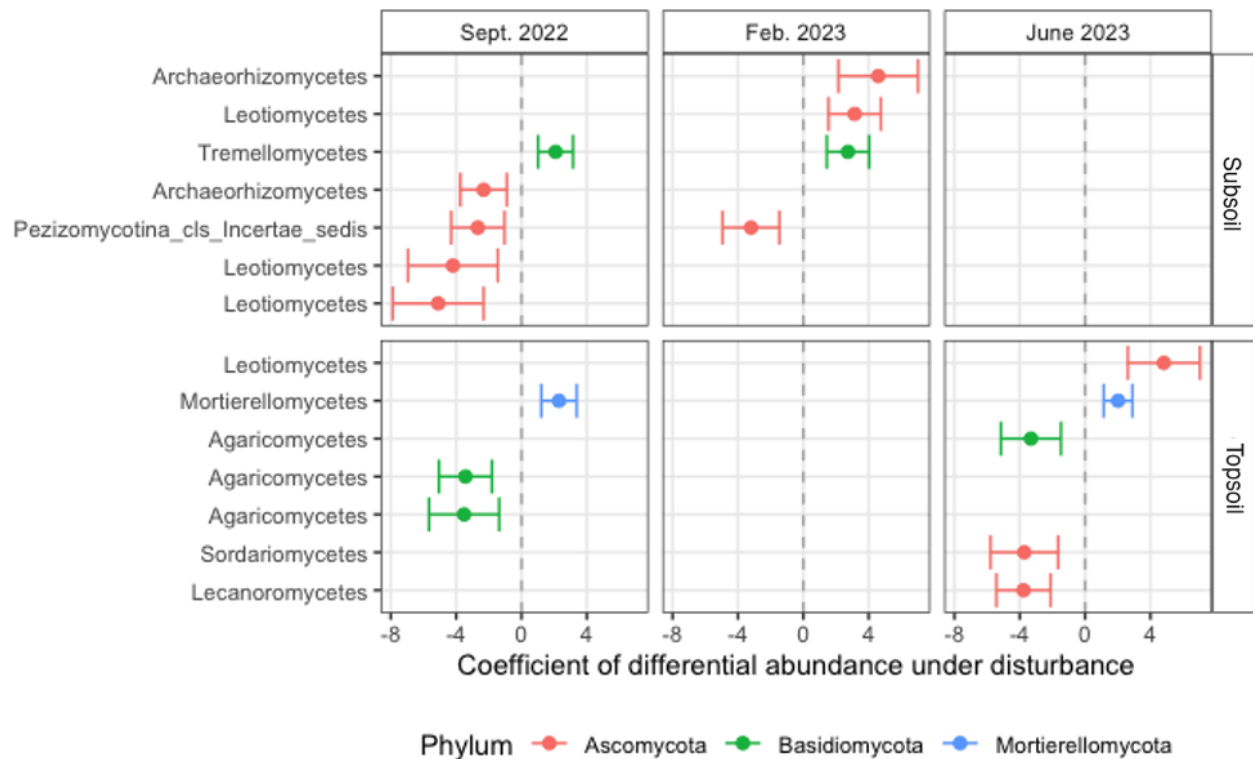
Figure S7. Differentially abundant fungal taxa for disturbed (vs. undisturbed) plots, within sampling date and subsoil vs. topsoil layers. The x-axis is the coefficient of differential abundance; positive coefficients denote enrichment whereas negative coefficients denote depletion. Each point represents a single ASV, colored by phylum, and labelled on the y-axis by taxonomic class. The same class name may be repeated for different ASVs of that same class. Error bars represent ± 1.96 SE.
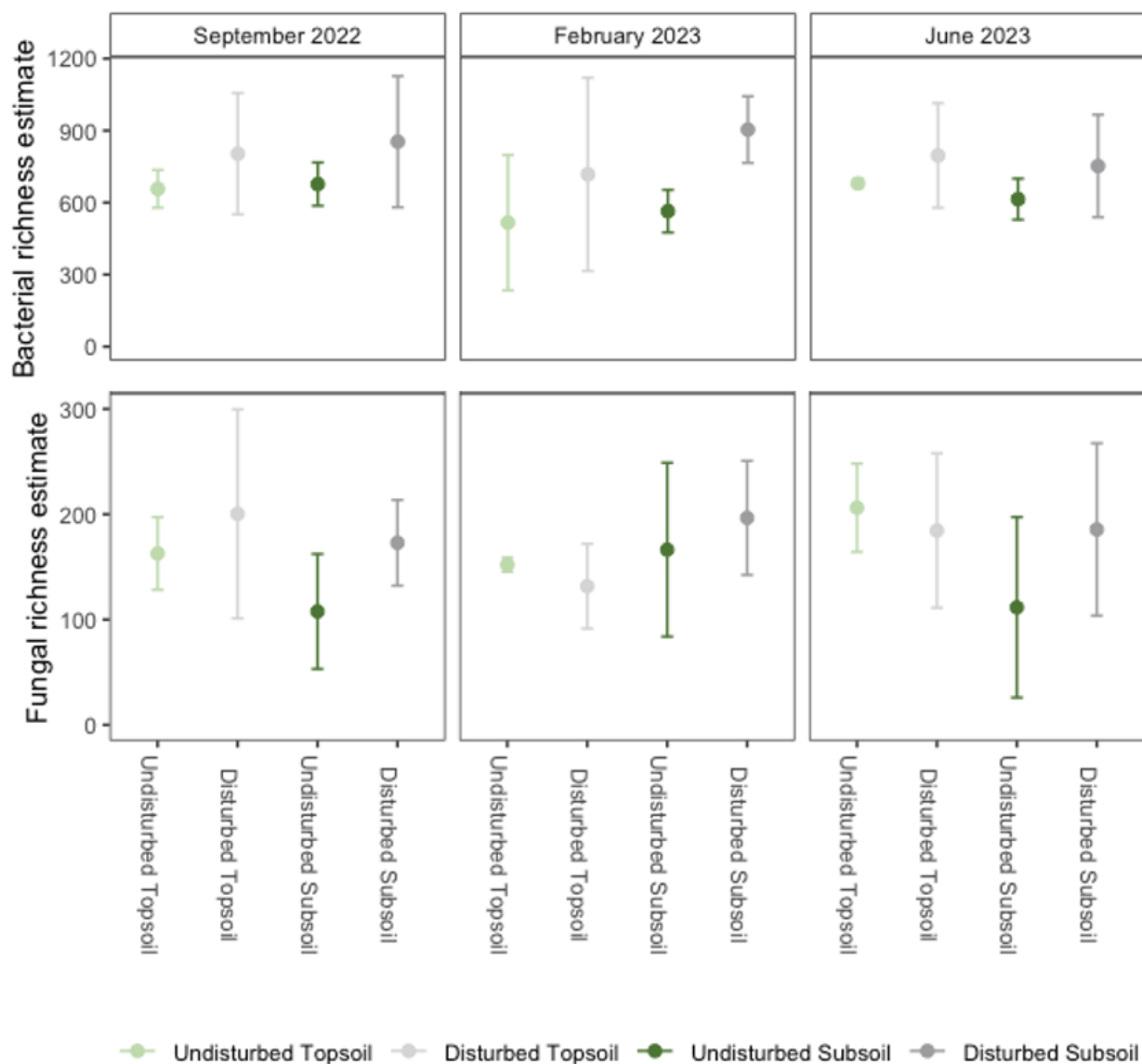
Figure S8. ASV richness estimates across disturbance regimes, soil layers, and sampling dates. Richness was estimated using the weighted linear regression model of OTU richness estimates, which weights observations based on variance. Error bars represent ± 1.96 SE.
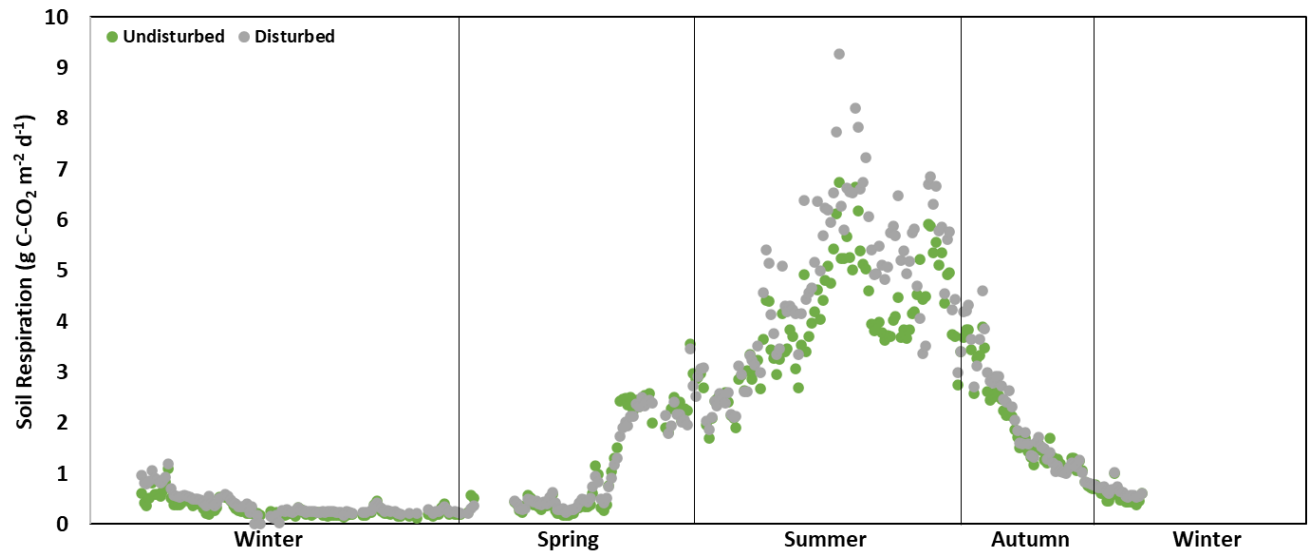
Figure S9. Soil respiration fluxes at the undisturbed and disturbed sites from 4 Nov 2022 to 9 Nov 2023. Soil respiration emissions are average daily fluxes from the 8 long-term chambers: 4 at undisturbed site and 4 at disturbed site.