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Supplementary Materials for

Accelerating rates of Arctic carbon cycling revealed by long-term atmospheric CO_2 measurements

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Table S1. Prior parameter value ranges.

Parameter	Description	Prior range
p_1	Productivity constant: equivalent to NPP per unit leaf area (m^2/m^2) per unit solar radiation ($MJ/m^2/day^{-1}$) at 0°C	0.01 – 100 gC m^{-2} $month^{-1}$
p_2	*T*emperature dependence constant: *NPP* factor increase per 10°C	1 – 10
p_3	*C* turnover at 0°C.	10^{-5} – 10^{-1} $month^{-1}$
p_4	Temperature dependence constant: *R* factor increase per 10°C.	1 – 10
C_0	Total active ecosystem carbon on January 1st 1979.	10^2 – 10^6 gC m^{-2}

Table S2. MsTMIP models in this study (BG1 simulations).

Model name	Affiliation
Biome-BGC	NASA Ames
CLASS-CTEM-N	McMaster University
CLM4	Oak Ridge National Lab
CLM4VIC	Pacific Northwest National Lab
DLEM	Auburn University
ISAM	University of Illinois Urbana Champaign
TEM6	Oak Ridge National Laboratory
TRIPLEX-GHG	University of Quebec at Montreal

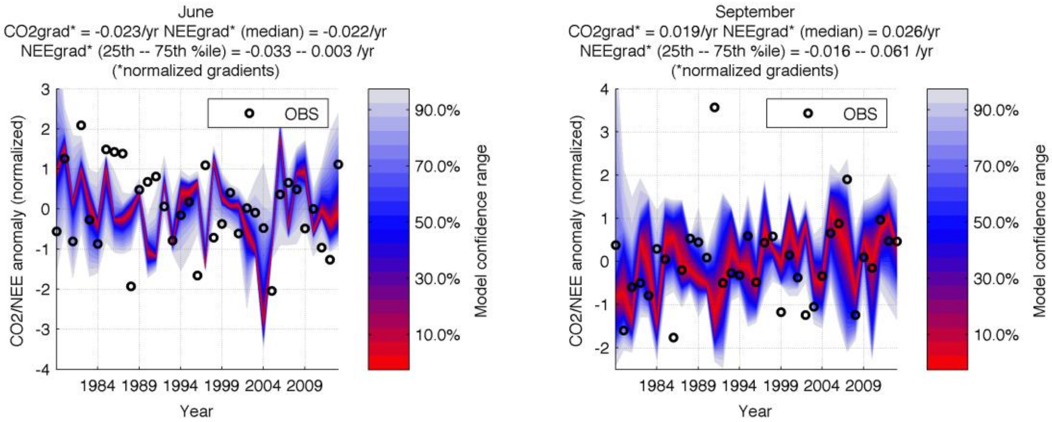

Fig. S1. Comparison between simulated NEE and observed ΔCO_2. June (left) and September (right) observed ΔCO_2 (black circles) and modeled NEE (red/blue confidence range bands) normalized anomalies.

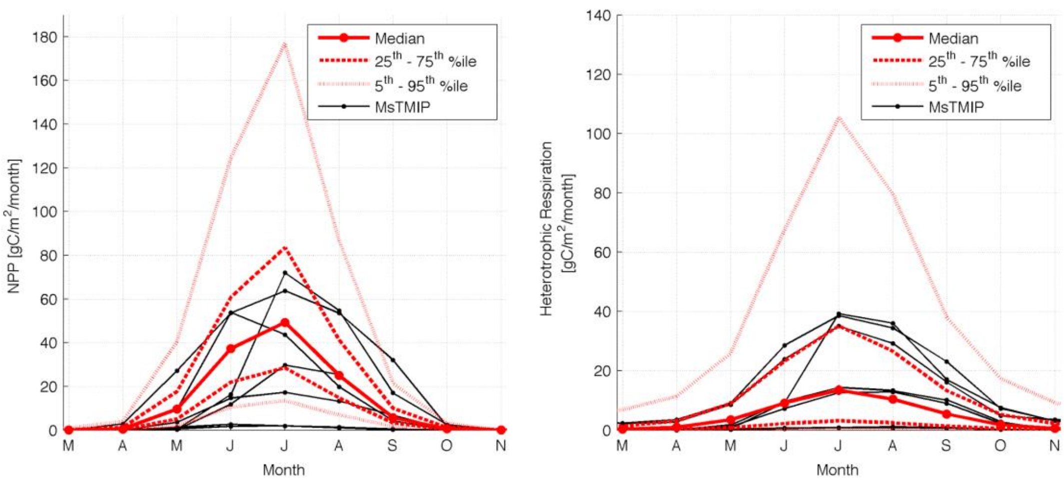

Fig. S2. Comparison of net primary productivity and heterotrophic respiration between optimized model and MsTMIP terrestrial biosphere models. Comparison of net primary productivity (NPP, left) and heterotrophic respiration (right) optimized model output (median, 5th, 25th, 75th and 95th percentiles) and MsTMIP terrestrial biosphere models (*39*).

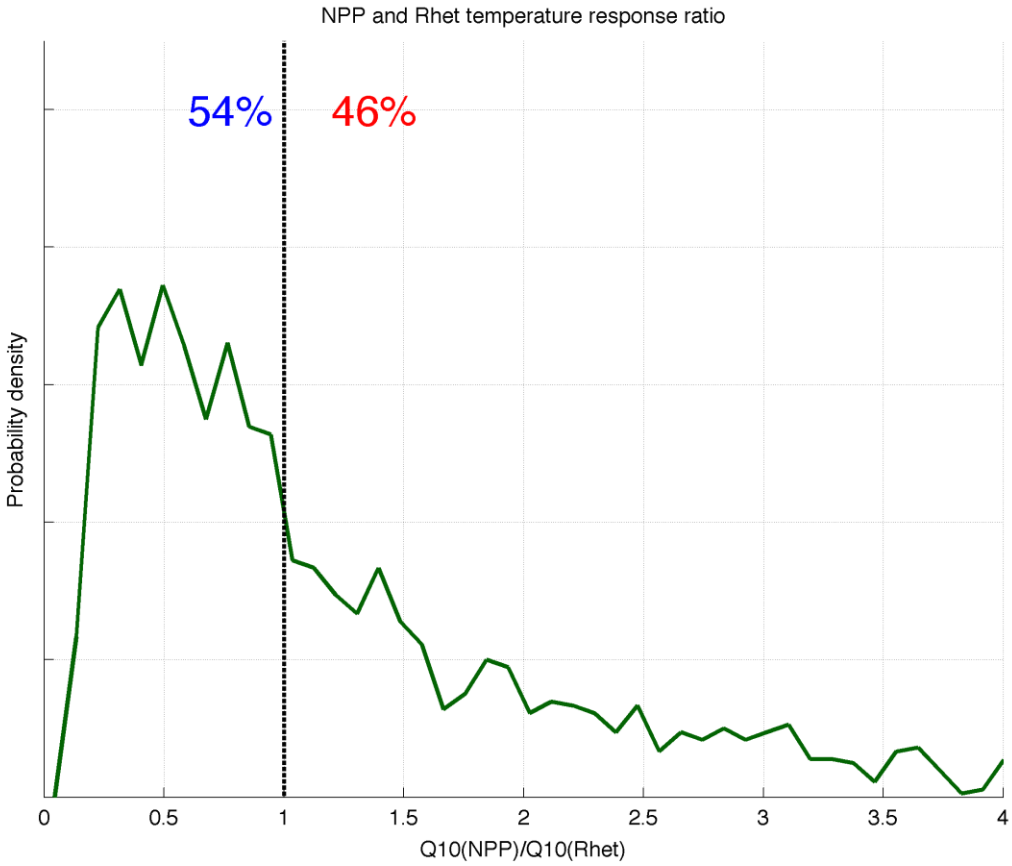

Fig. S3. Posterior probability distribution of the ratio of effective Q_{10} temperature sensitivity parameters p_2 (NPP) and p_4 (Rhet) [see Materials and Methods (Retrieved residence time change and temperature sensitivities) and table S1 for details]. Based on the posterior parameter samples, we find that the probability of $p_4 > p_2$ is 54%.

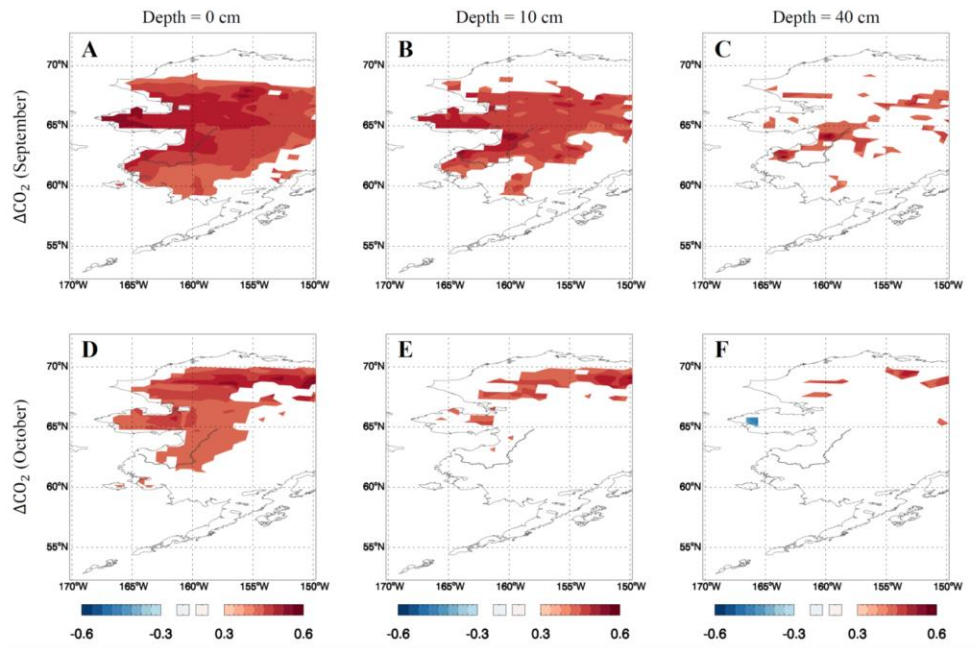

Fig. S4. Relationships between ΔCO_2 and soil temperature (0 to 40 cm). Correlation coefficients between detrended ΔCO_2 and detrended soil temperature for September and October, respectively. Regions with statistically significant correlations are only described. Soil temperature data comes from North American Regional Reanalysis (NARR) (*42*).

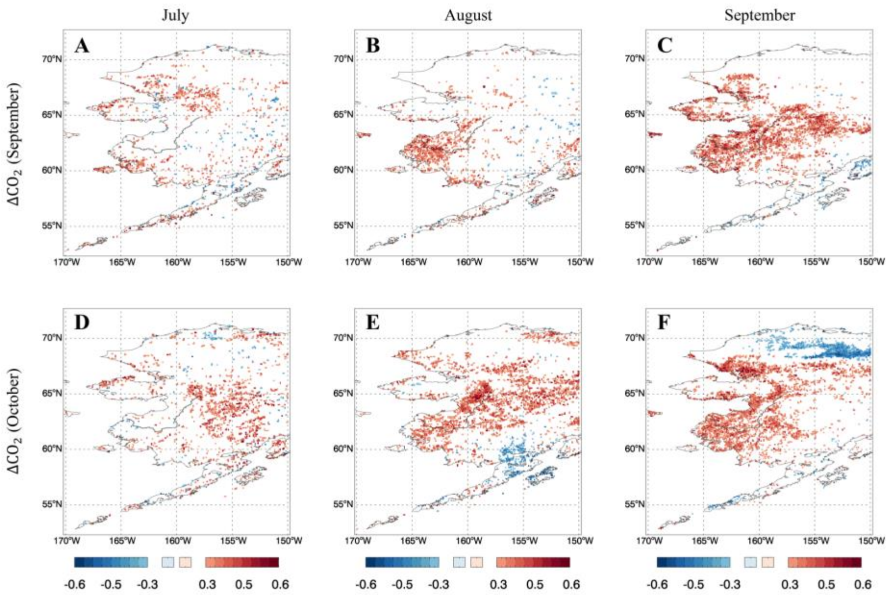

Fig. S5. Lagged (0 to 3 months) relationships between summertime vegetation greenness and autumn ΔCO_2. Correlation coefficients between detrended NDVI (July to September) and detrended ΔCO_2 for September (A-C) and October (D-F), respectively. Regions with statistically significant correlations are only described. Positive coefficients indicate increase (or decrease) in summer/autumn vegetation greenness, leading to an increase (or decrease) in ΔCO_2 during autumn. High resolution (8 km) NDVI data sets come from the new Global Inventory Modeling and Mapping Studies (GIMMS) NDVI3g data from the Advanced Very High Resolution Radiometer (AVHRR) sensors (*43*) that has been widely used for evaluating climate and ecosystem changes.