Supporting Information

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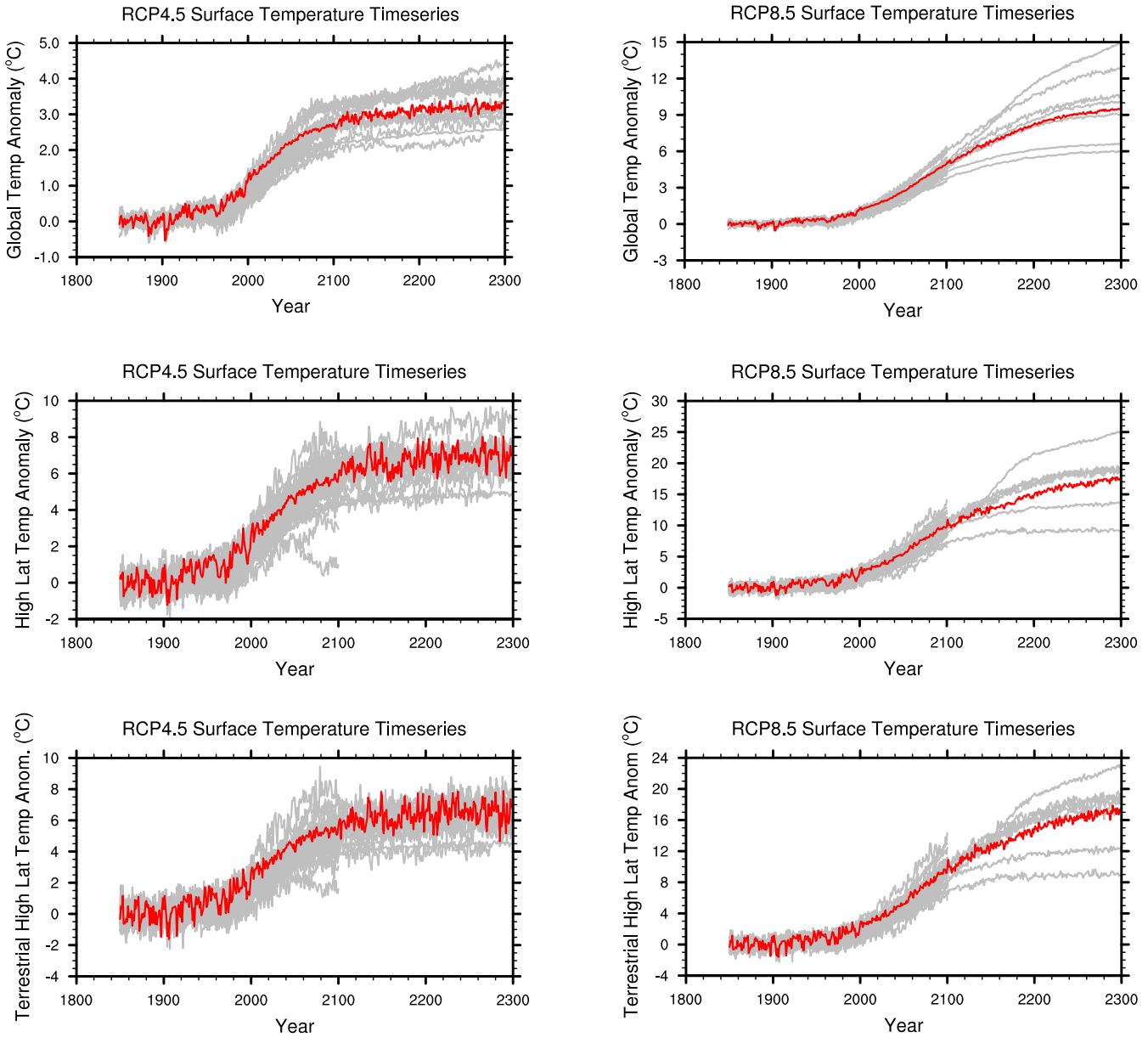

Fig. S1. Comparison of CCSM4 temperature anomalies to those of the CMIP5 archive. Temperature anomalies from 1850 to 2300 simulated by CCSM4 (red line) in comparison with those simulated by others models (gray lines) in the CMIP5 archive for representative concentration pathways 4.5 (RCP4.5, *Left* panels) and 8.5 (RCP8.5, *Right* panels) and for global (*Top* row), northern high latitude (*Middle* row), and terrestrial northern high latitude (*Bottom* row) spatial domains.

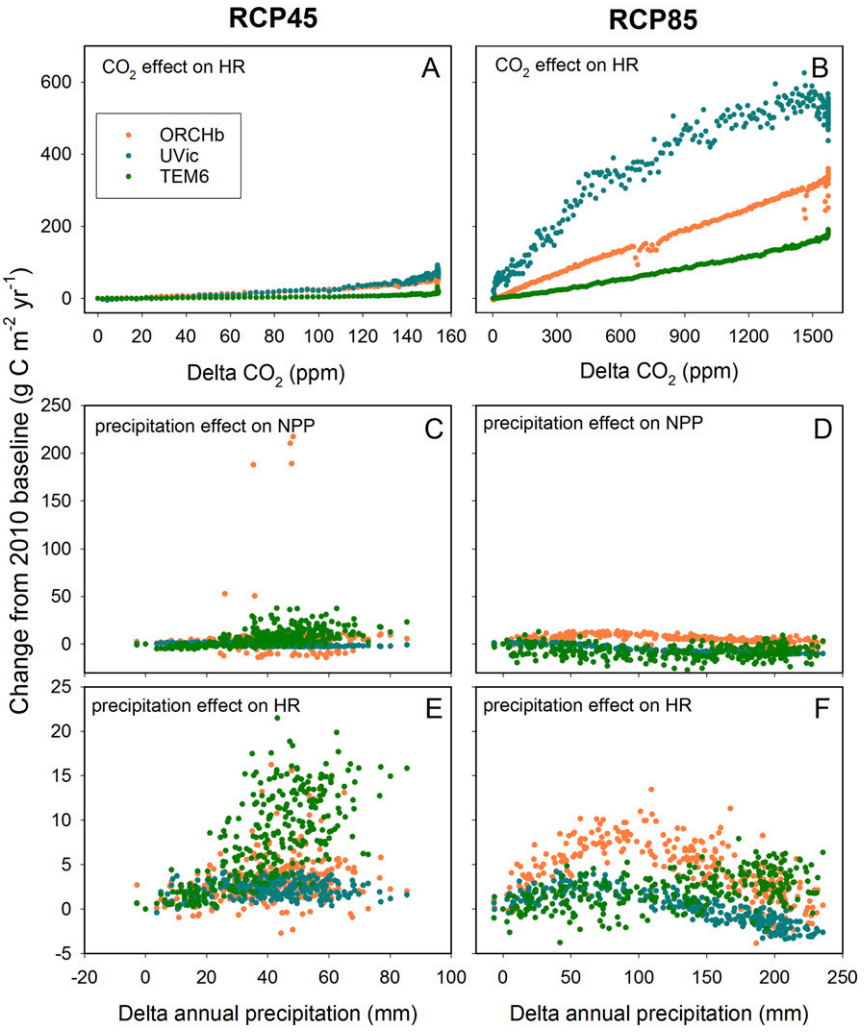

Fig. S2. The sensitivity of carbon dynamics to changes in atmospheric CO_2 and precipitation. The sensitivity of simulated (*A* and *B*) heterotrophic respiration (HR) to changes in atmospheric CO_2, (*C* and *D*) net primary production (NPP) to changes in annual precipitation, and (*E* and *F*) HR to changes in annual precipitation for the CCSM4 model (*Left* column) RCP4.5 and (*Right* column) RCP8.5 projections.

Table S1. Comparison of conceptual representation of permafrost dynamics among models

Model	Approach to modeling soil thermal dynamics	Depth, m	Moss insulation considered	Organic soil insulation considered*	Snow insulation considered	Effect of unfrozen water on phase change considered[†,‡]
CLM4.5	Multilayer finite difference heat diffusion	45.1	No	Yes	Yes (five layers max)	Yes
CoLM	Multilayer finite difference heat diffusion	3.4	No	No	Yes (five layers max)	No
JULES	Multilayer finite difference heat diffusion	3.0	No	No	Yes (three layers max)	Yes
ORCHb	1D Fourier solution	88.0	No	No	Yes (one layer)	Yes
UVic	Multilayer finite difference heat diffusion	250.0	No	Yes	Yes (one layer)	Yes
TEM6	Multilayer finite difference heat diffusion	36.0	Yes	No	Yes (one layer)	No
SiBCASA	Multilayer finite difference heat diffusion	15.0	No	Yes	Yes (five layers max)	Yes
GIPLb	Multilayer finite difference heat diffusion	200.0	Yes	Yes	Yes (one layer)	Yes

*Organic horizon thickness is prescribed and is not prognostic.
[†]Model implements algorithms for representing the effects of unfrozen water on phase change processes in frozen soil.
[‡]In all models, soil thermal conductivity is influenced by soil moisture.

Table S2. Comparison of conceptual representation of soil carbon dynamics among models

Model	General depth, m	Soil C storage explicitly treated with depth	Moss horizon C explicitly considered	Litter horizon C explicitly considered	Organic horizon C explicitly considered	BIO C-CH_4 losses considered	Disturbance losses considered	Lateral losses considered	Time step of flux estimates
CLM4.5	4.0	Yes	No	Yes	Yes	Yes	Fire	Land use	30 min
ORCHb	47	Yes	No	Yes	No	No	No	Land use	30 min to 1 d
UVic	3.35	Yes	No	No	Yes	No	No	Land use	1 h
TEM6	Variable to ~3	Yes	No	No	No	Yes	Yes	DOC export	1 mo
SiBCASA	3.0	Yes	No	Yes	Yes	Yes	No	No	30 min

All models consider soil carbon losses from heterotrophic respiration.