

**Permafrost Degradation Diminishes Terrestrial Ecosystem Carbon Sequestration
Capacity on the Qinghai-Tibetan Plateau**

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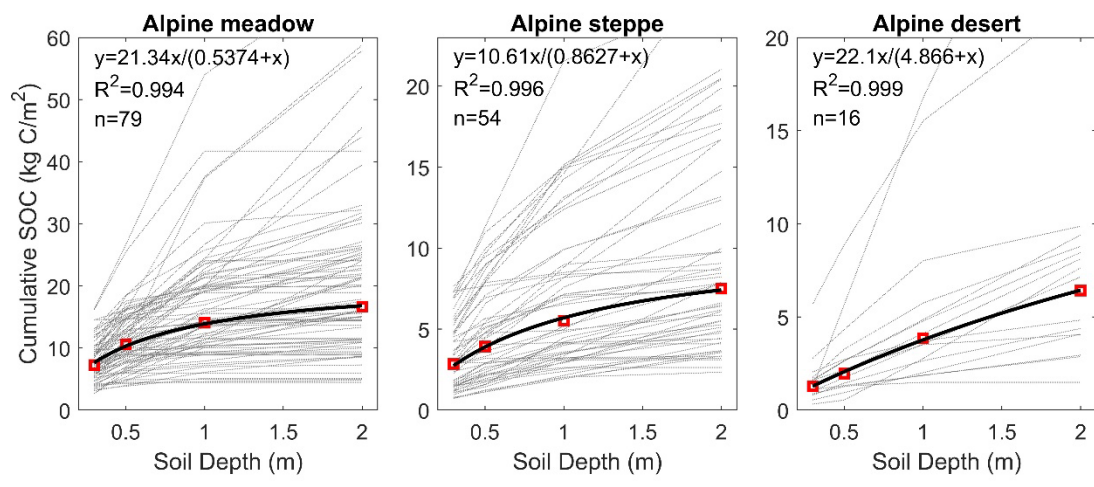


Figure S1. Changes of cumulative SOC with soil depth in alpine meadow, alpine steppe and alpine desert ecosystems in the permafrost region of the QTP. The dotted gray lines denote observation results; the red rectangles represent the median value of every soil depths; and the thick black lines are regression curves. 'n' in each panel is the number of observation sites. Observation data derived from Zhao et al. (2018).

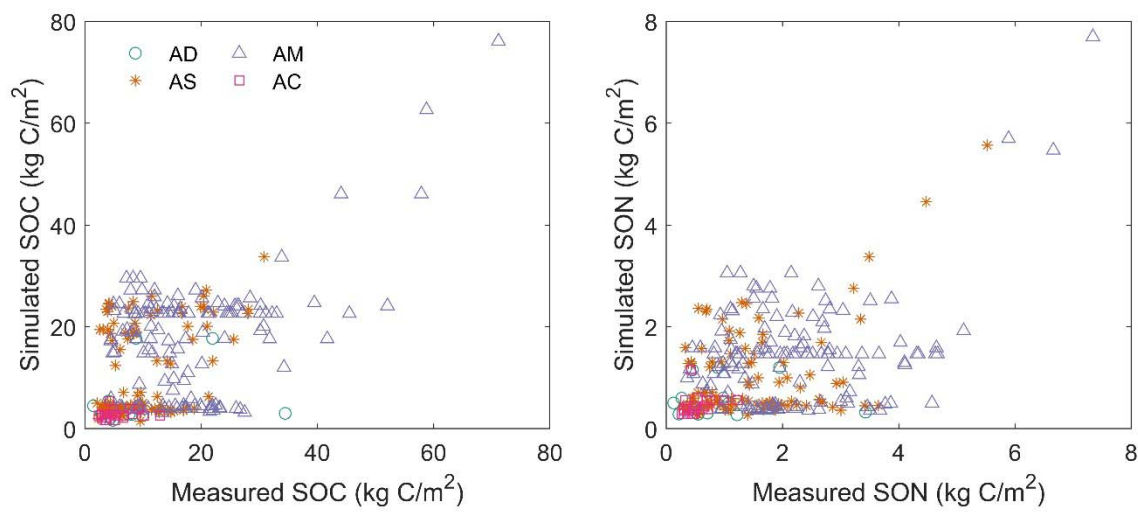


Figure S2. Validation of simulated SOC and SON vs. 289 observations on the QTP. AD, AS, AM, and AC represent alpine desert, alpine steppe, alpine meadow, and alpine cushion, respectively.

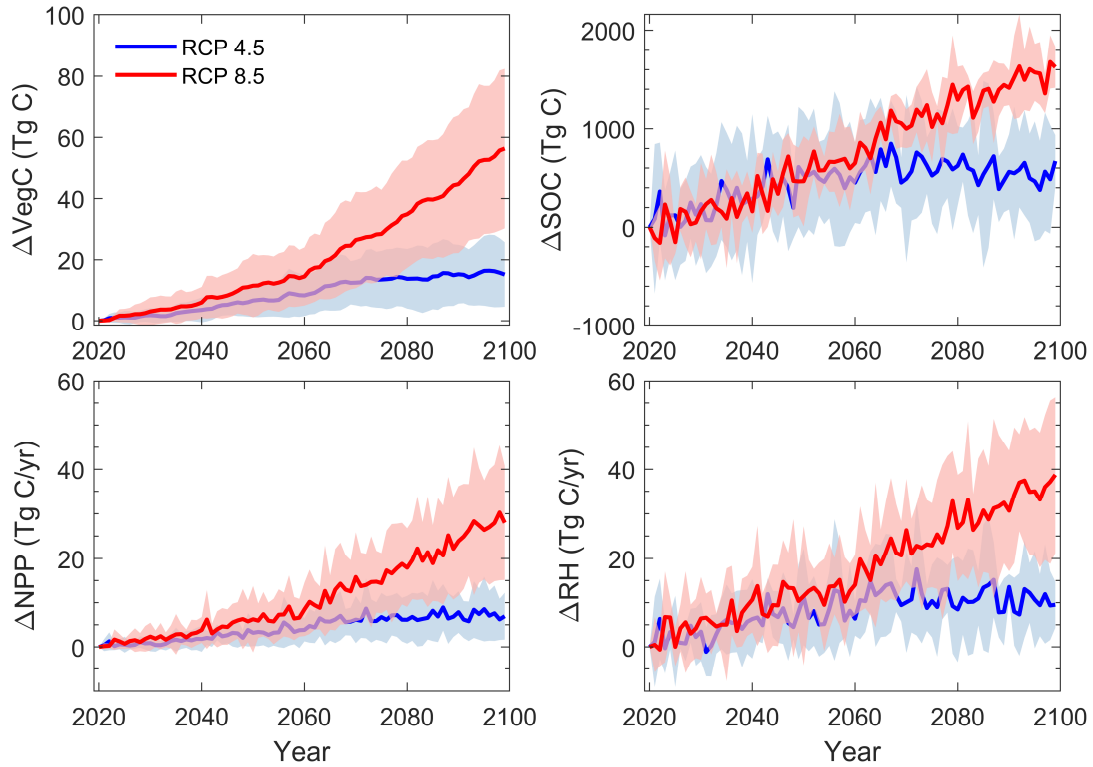


Figure S3. Effects of ALT deepening on ecosystem C balance of permafrost regions on the QTP under the RCP 4.5 and RCP 8.5 scenarios. Δ means the difference between the results of ST and SR (ST-SR).

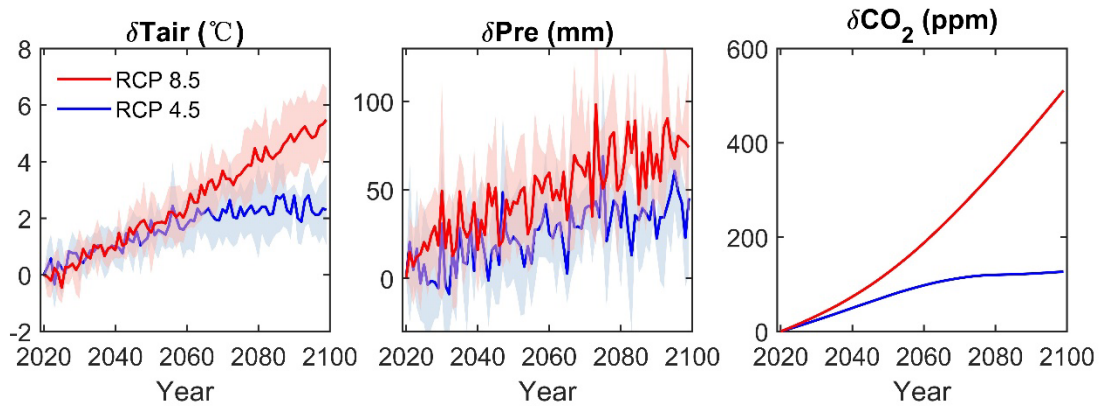


Figure S4. Changes in air temperature (T_{air}), precipitation (Pre), and atmospheric CO_2 concentration of the permafrost region on the QTP based on 2020.

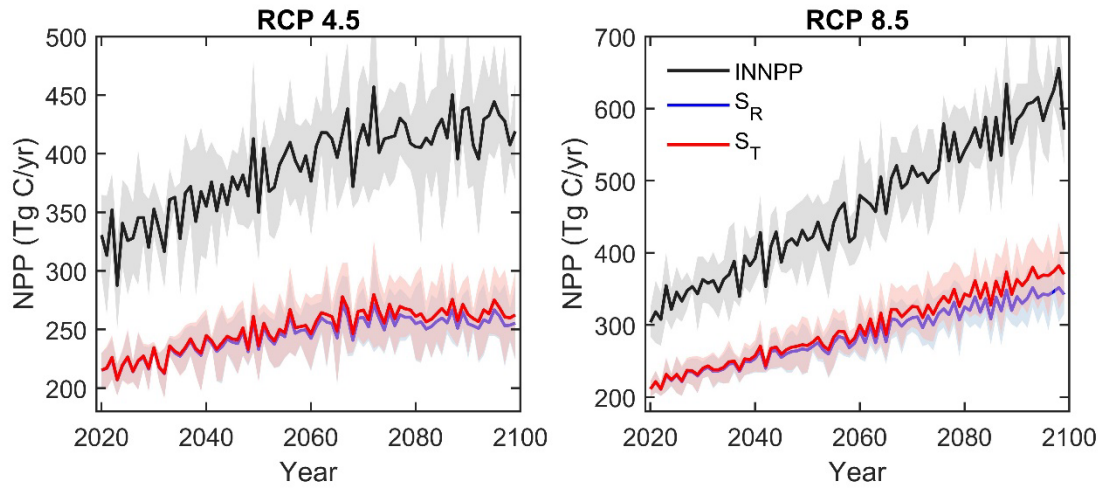


Figure S5. Changes in NPP in ST and SR simulations and changes in INNPP during 2020-2100 under the RCP 4.5 and RCP 8.5. INNPP is the NPP estimated by TEM that is not constrained by N supply but only regulated by climate.

Steppe	Meadow	Sparse	Desert	Shrubland	Forest	Others
0.8627 [*]	0.5374 [*]	0.5937 ^{**}	4.866 [*]	1.2553 ^{**}	0.4746 ^{**}	0.6920 ^{**}

Table S1. The value of parameter b in eq. (2) for each ecosystem in the permafrost region of QTP.

Notes: * denotes the data calculated from observation data (Fig. S1); ** denotes data derived from Kicklighter et al. (2019).

Ecosystem	Alpine meadow	Alpine steppe	Alpine shrubland
Site	Zoige	NamCo	Haibei
Latitude	33°53' N	30°46' N	37°37' N
Longitude	102°8' E	90°57' E	101°19' E
Elevation (m)	3423	4730	3190
SOC obs [*]	30895.51	4698.55	23440.00
(g C/m ²) sim [*]	30329.27±37.4	4723.02±5.57	22581.90±14.97
SON obs [*]	1984.78	399.04	2616.20
(g N/m ²) sim [*]	2032.76±1.83	398.78±0.25	2793.79±0.40
Reference	Huo et al., 2013; Shang et al., 2016	Ding et al., 2016; Kou et al., 2019; Nieberding et al., 2020	Tao et al., 2007; Fu et al., 2018; ChinaFLUX ^{**}

Table S2. Information of observation sites for model validation.

Notes: *: obs and sim denote observation and simulation, respectively; **: <http://www.chinaflux.org/gczd/index.aspx?nodeid=1003>