

# Supplement of 'Impacts of Shrub Coverage for Arctic Ecosystem Carbon Uptake and Storage'

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Table S1: Absolute change of GPP (gC m<sup>-2</sup> yr<sup>-1</sup>) comparing the three sensitivity simulations ShrubNOfert, ShrubNOfertC, ShrubConly with the reference simulation (shrub) at all sites

	BON	TVC	SAM	ISK	YAK	STR	ABI	RAI	XHE	WLF	LET	SIL	IGA	SEI	FAI	IMN
ShrubNOfert - Shrub	-17.17	-10.29	-6.63	-2.59	-39.47	-2.43	-1.99	-0.84	-0.83	-9.12	-30.61	-28.28	-8.37	-9.58	-14.18	-6.7
ShrubNOfertC - Shrub	93.00	166.6	171.5	213.1	-55.0	102.8	97.5	252.9	332.4	310.7	369.2	374.7	394.4	390.4	364.2	362.5
ShrubConly - Shrub	196.0	150.6	258.1	291.2	26.62	152.9	148.3	316.0	420.5	375.6	417.4	412.3	461.6	458.2	448.2	431.7

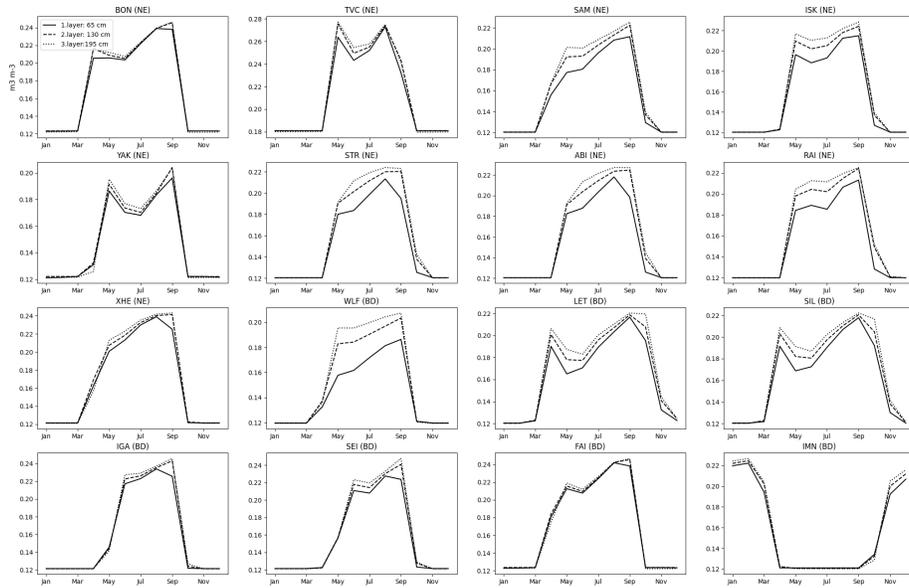


Figure S1: Multi-year mean seasonal cycle of soil water at 65, 130 and 195 cm depth per site.

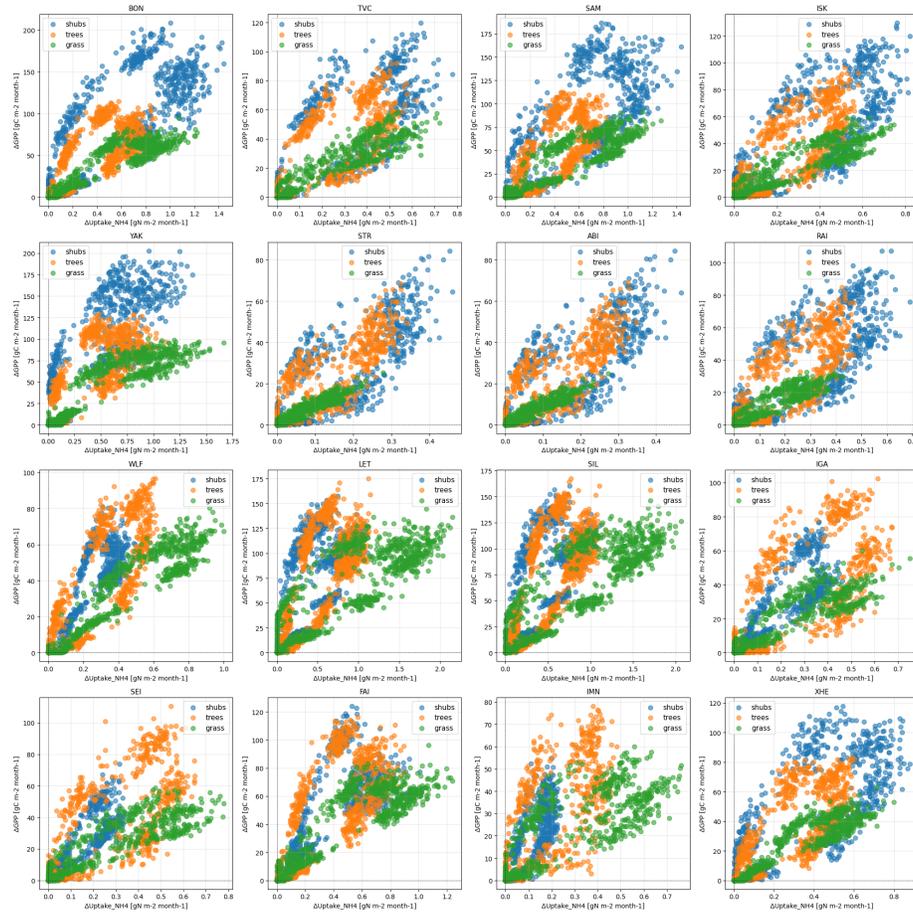


Figure S2: Scatter plot of GPP [gC m<sup>-2</sup> month<sup>-1</sup>] vs. NH<sub>4</sub><sup>+</sup> uptake [gN m<sup>-2</sup> month<sup>-1</sup>] comparing trees, shrubs and grasses respectively per site.

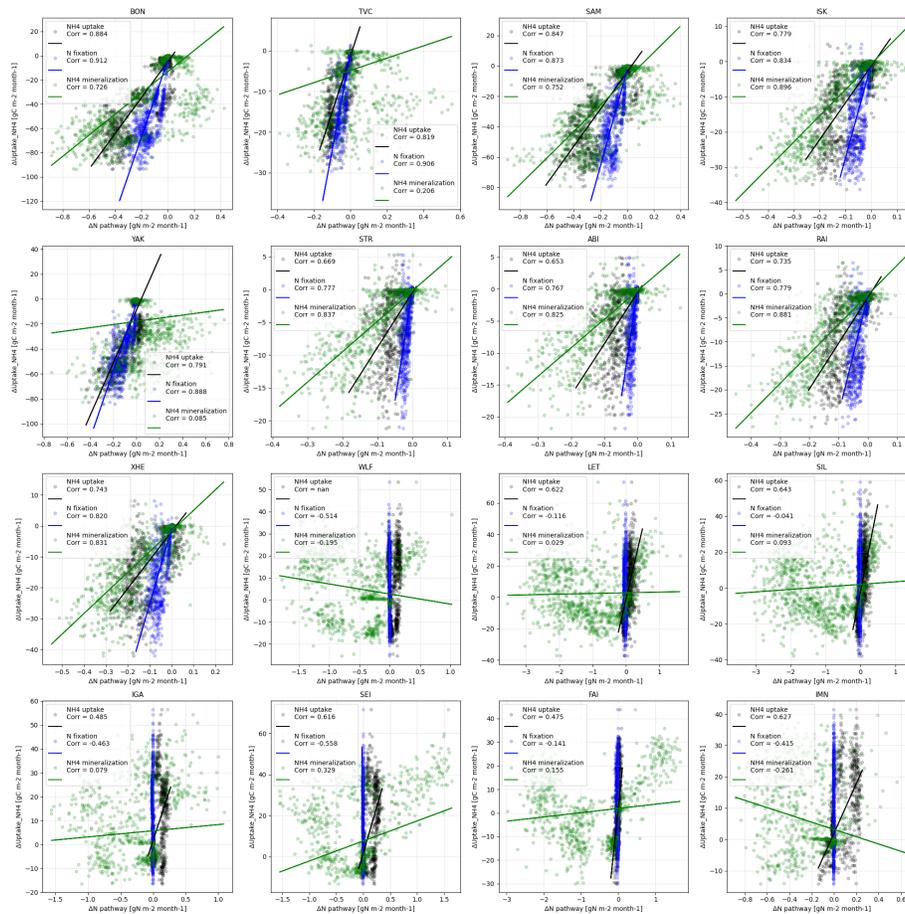


Figure S3: Scatter plot of GPP changes [gC m<sup>-2</sup> month<sup>-1</sup>] (*Trees-Shrubs*) vs. NH<sub>4</sub><sup>+</sup> uptake, N fixation and NH<sub>4</sub><sup>+</sup> net mineralization changes [gN m<sup>-2</sup> month<sup>-1</sup>] comparing trees with shrubs respectively per site. The Pearson correlation coefficient is included in the legend.

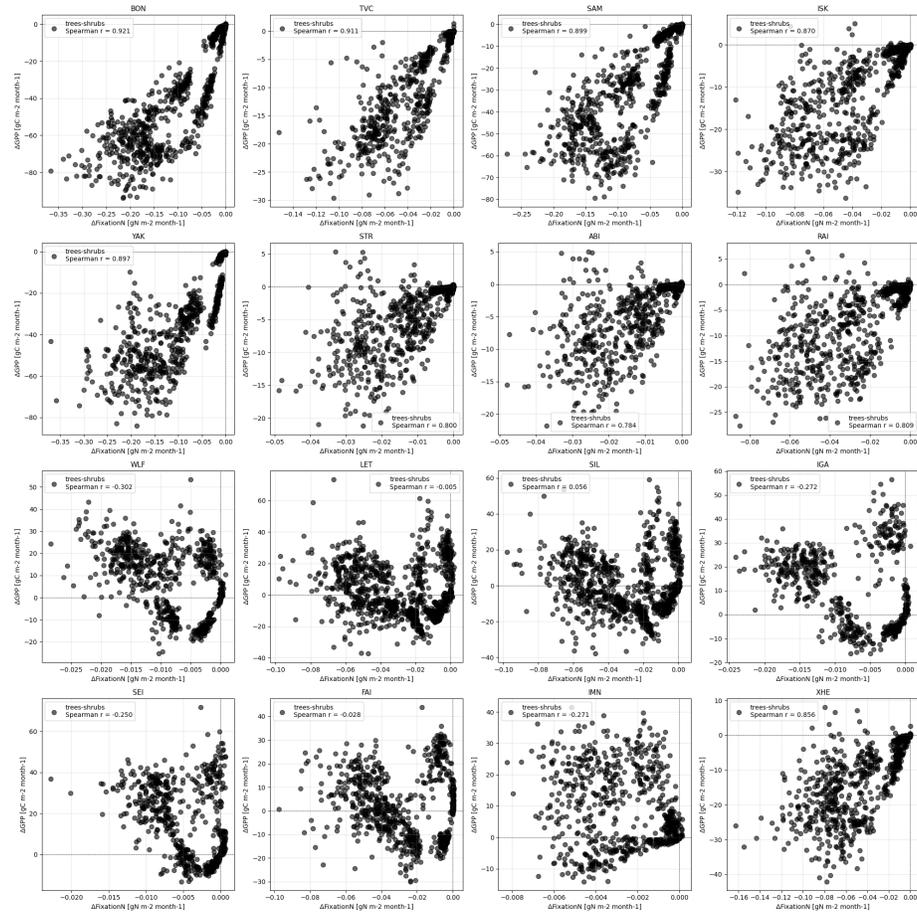


Figure S4: Scatter plot of GPP changes [gC m<sup>-2</sup> month<sup>-1</sup>] vs. N (plant) fixation changes [gN m<sup>-2</sup> month<sup>-1</sup>] comparing trees with shrubs respectively per site. The spearman correlation coefficient is included in the legend.

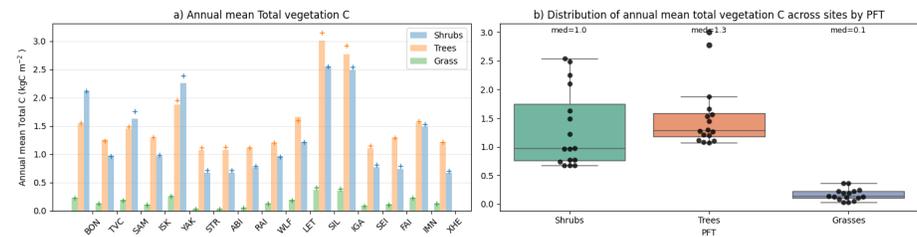


Figure S5: Multi-year annual mean total vegetation C and (b) distribution of multi-year annual mean total vegetation C per PFT in [kgC m<sup>-2</sup>].

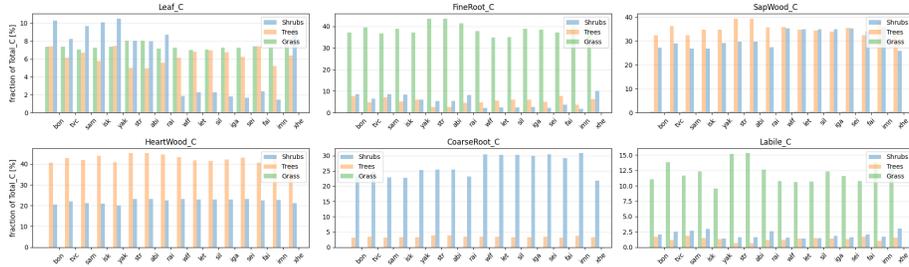


Figure S6: Fractions of multi-year annual vegetation C pools of the multi-year annual total vegetation C in shrubs, trees and grasses per site in [%].

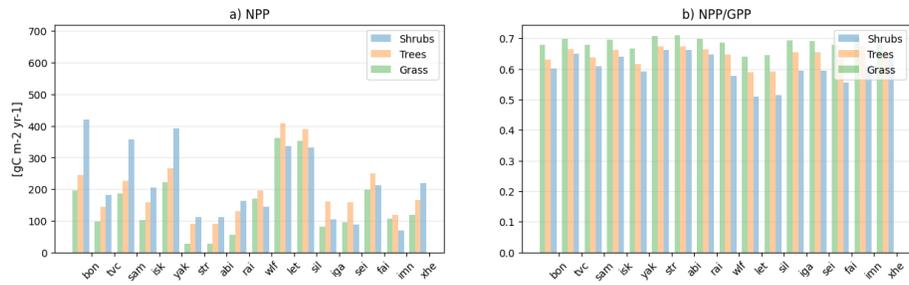


Figure S7: Multi-year (1990-2010) annual mean GPP  $[gC\ m^{-2}\ yr^{-1}]$  and (b) NPP/GPP ratio [-] for shrubs, trees and grasses at the 16 sites.

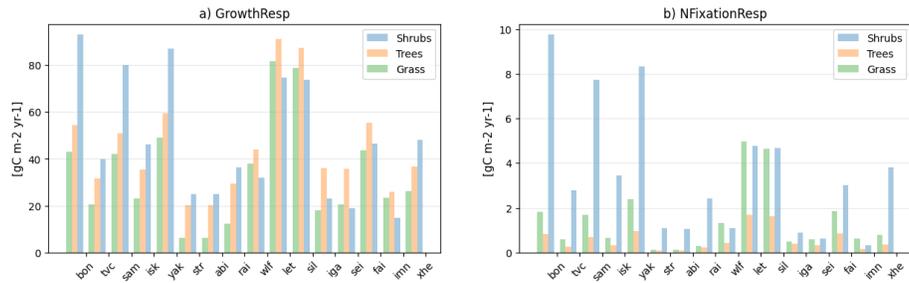


Figure S8: Multi-year (1990-2010) annual mean growth respiration  $[gC\ m^{-2}\ yr^{-1}]$  and (b) N fixation respiration  $[gC\ m^{-2}\ yr^{-1}]$  for shrubs, trees and grasses at the 16 sites.

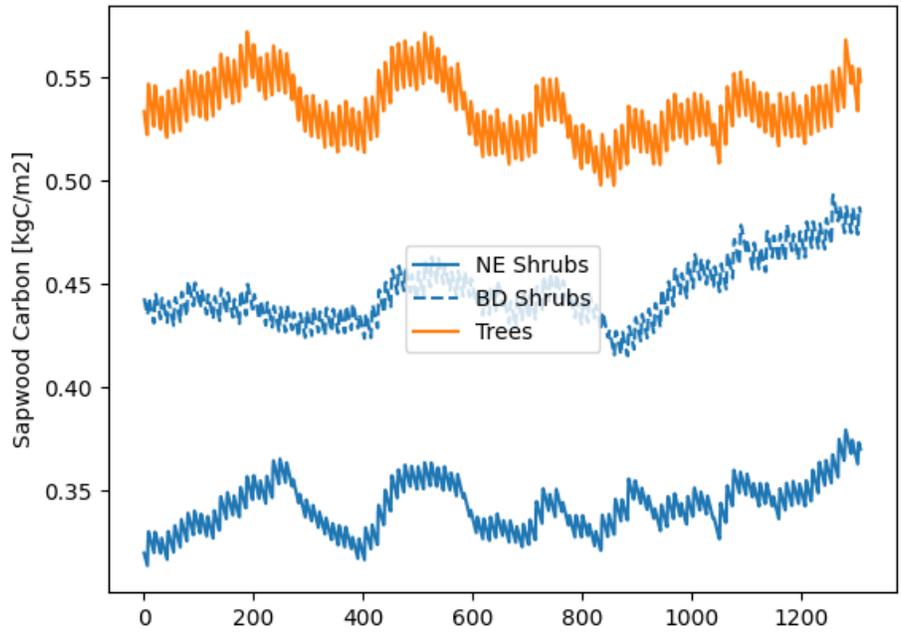


Figure S9: Sapwood C from 1901-2010 at shrubs and trees (average over all sites).

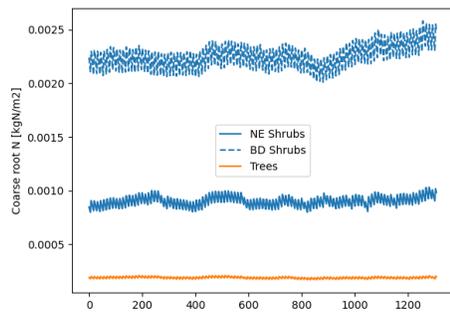


Figure S10: Coarse root N from 1901-2010 at shrubs and trees (average over all sites).

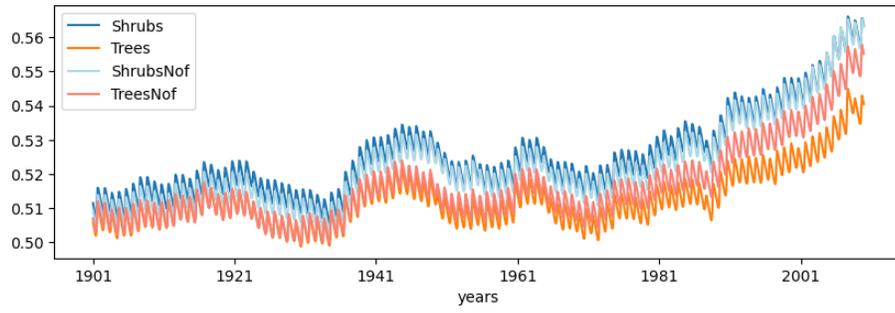


Figure S11: Time evolution of foliage projection cover at shrubs and trees with different model versions.

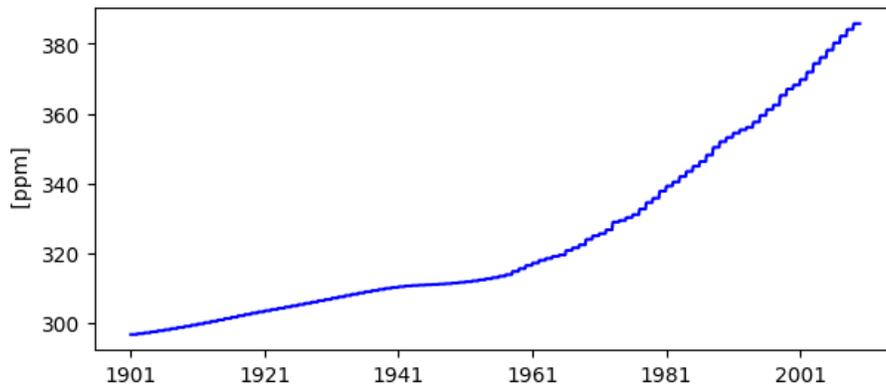


Figure S12: Atmospheric CO<sub>2</sub> from 1901 until 2009 [ppm].

Figure S13: Multi sites average 15-years rolling mean total changes (a,b) and CO<sub>2</sub> fertilization and climate effect (c,d) in total vegetation C relative to 1901-1911 [gC m<sup>-2</sup> yr<sup>-1</sup>] carried out with the N dynamic and in C-only model configuration, respectively.

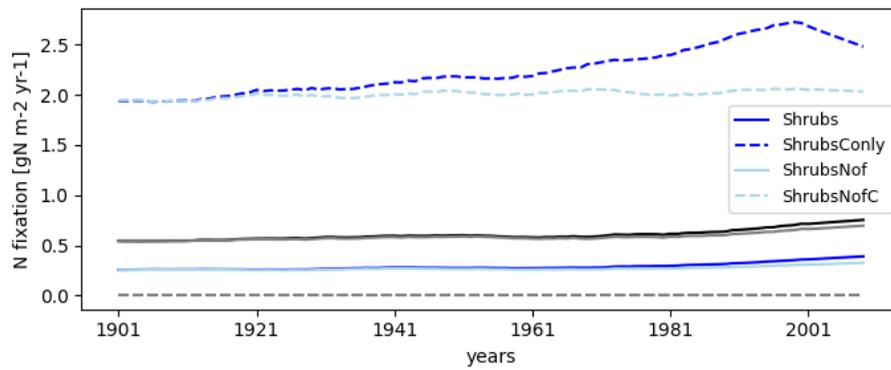
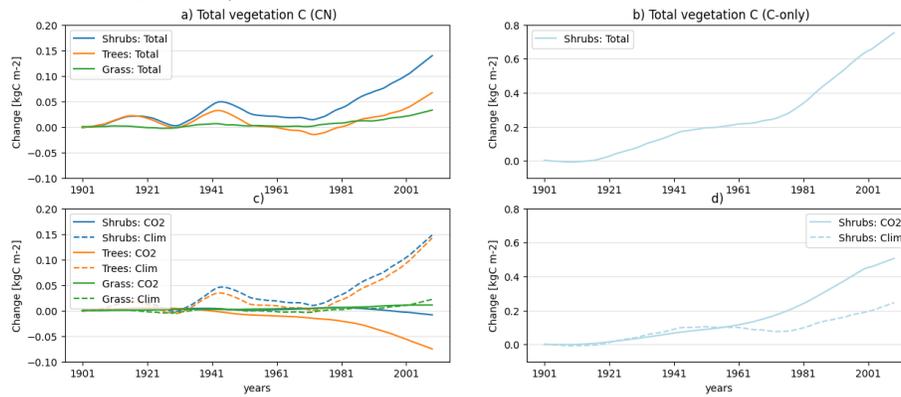


Figure S14: 15-yr rolling mean of biological nitrogen fixation from 1901 until 2009 [gN m<sup>-2</sup> yr<sup>-1</sup>].

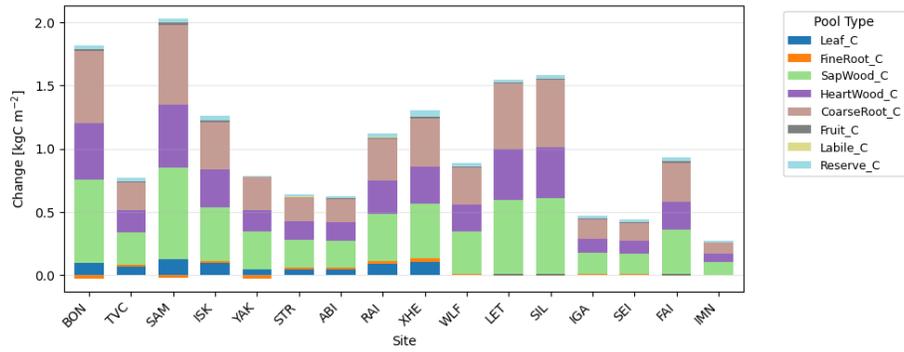


Figure S15: Multi-year (1990-2010) mean absolute change (*ShrubPM-Shrub*) of the veg C pools [kgC m<sup>-2</sup>] at 16 different stations.

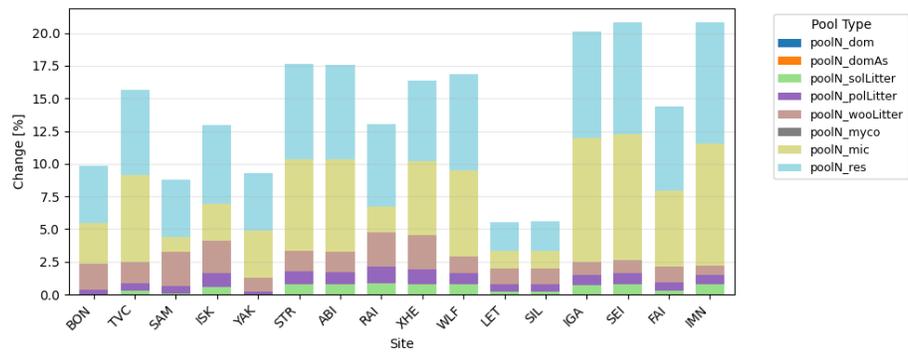


Figure S16: Multi-year (1990-2010) mean relative change (*ShrubPM-Shrub*) of the soil N pools at 16 different stations.

Figure S17: Seasonal cycle of GPP [ $\text{gC m}^{-2} \text{ month}^{-1}$ ] by the versions CN, C-only and ShrubPM.

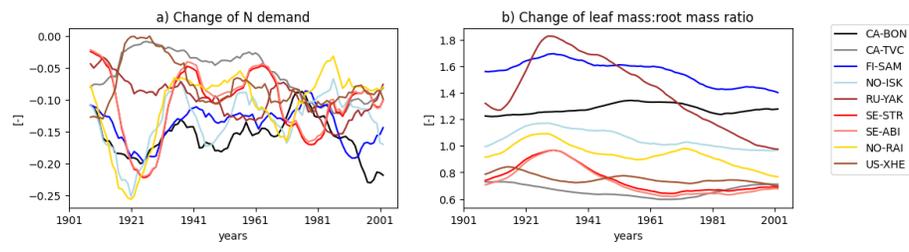
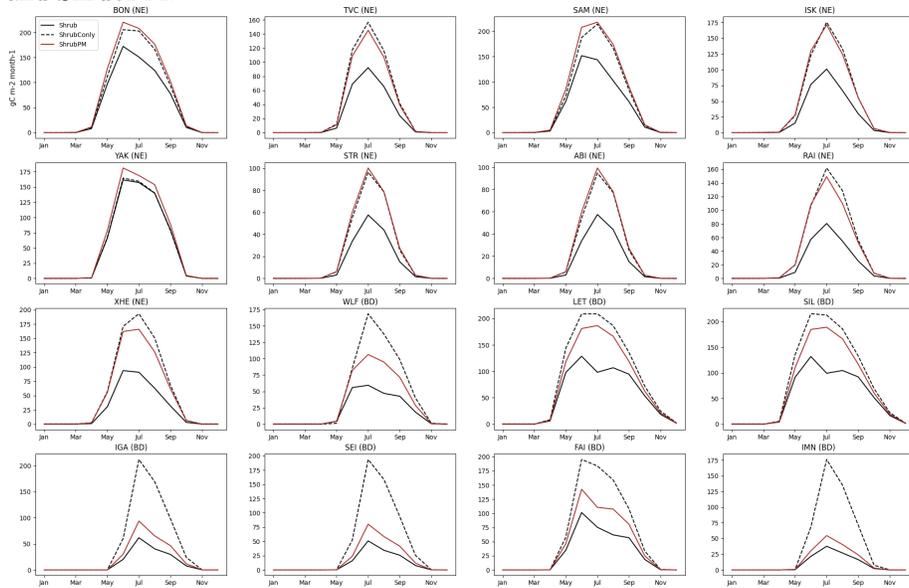


Figure S18: The annual mean change (ShrubPM-Shrub) of (a) N demand and (b) leaf to root mass ratio in NE shrubs.