

Table 1. C:N ranges of leaves, fine roots, and stems/wood

PFT	Plant part	C:N Minimum	C:N Maximum
Broadleaf deciduous	leaves	20	50
	roots	40	70
	wood	200	500
Broadleaf Evergreen	leaves	20	40
	roots	40	70
	wood	150	300
Needleleaf Evergreen	leaves	30	60
	roots	40	60
	wood	400	800
C3 grass	leaves	20	40
	roots	40	50
	wood	40	80
C4 grass	leaves	20	60
	roots	60	100
	wood	60	100
shrub	leaves	20	40
	roots	40	70
	wood	200	400
tundra shrub	leaves	20	40
	roots	40	80
	wood	300	700

Table 2. Experimental design

100-year equilibrium	<i>Initial condition</i> ➔	Real-forcing simulation 1948-2007
<i>Fixed climatology forcing</i>		<i>Transient forcing</i>
Control experiment		<b>SSiB4:</b> Control experiment <b>DIPSN:</b> Nitrogen limitation on <b>photosynthesis(Vmax)</b> <b>DINPP:</b> Nitrogen limitation on photosynthesis( <b>NPP</b> ) <b>DIGPP:</b> Nitrogen limitation on photosynthesis( <b>GPP</b> ) <b>SSiB5:</b> including all four nitrogen processes

Table 3. Regional and Global GPP for (a) FLUXNET-MTE GPP, (b) SSiB4 (control), (c) NIPSN (N limitation on photosynthesis only) and (d) SSiB5 (N limitation on photosynthesis, autotrophic respiration, and phenology).

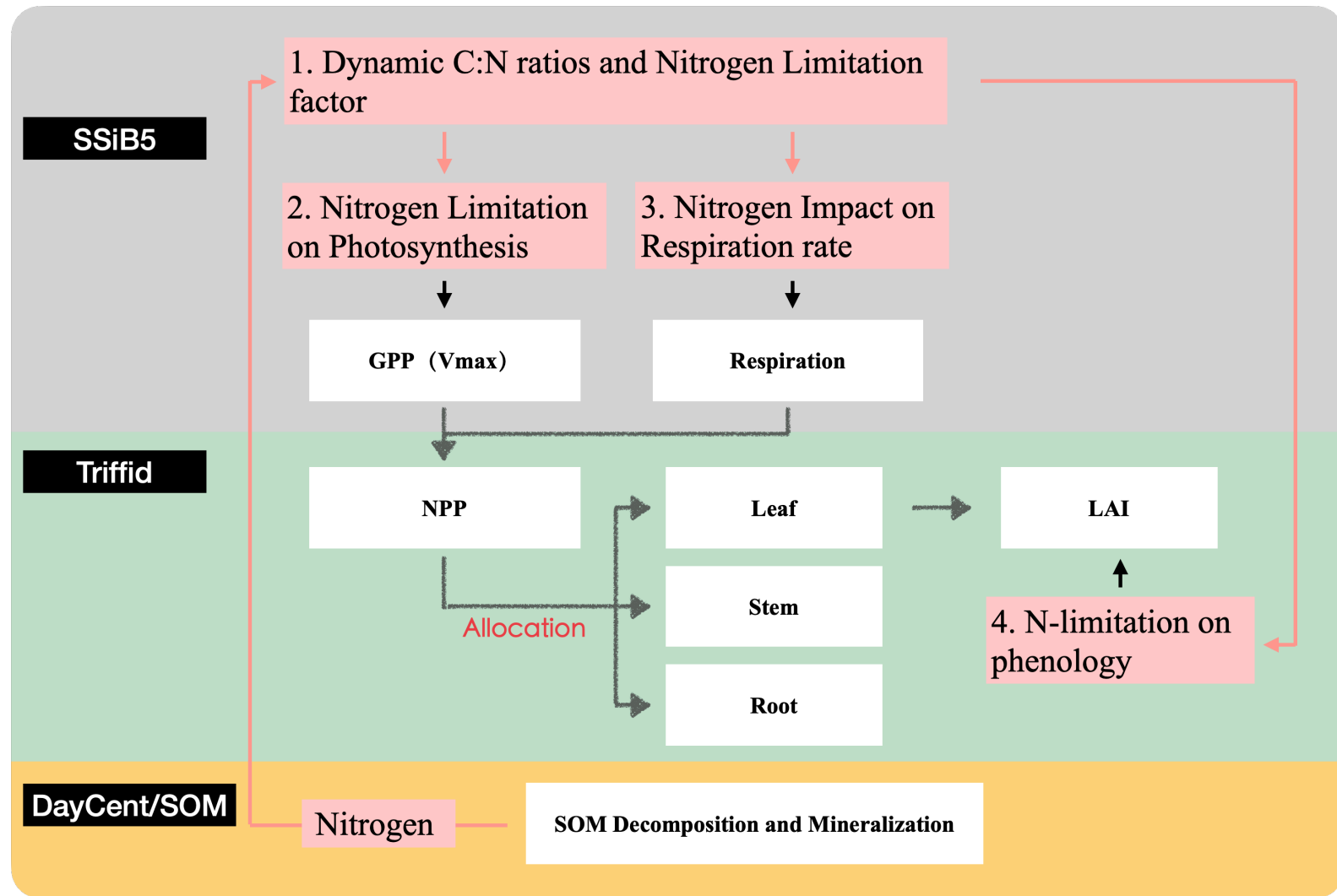
Regions	Sub-regions	GPP Mean (gC m <sup>-2</sup> yr <sup>-1</sup> )							
		MTE		SSiB4		NIPSN		SSiB5	
		mean	bias	mean	bias	mean	bias	mean	bias
<b>Arid and Semi-Arid Areas</b>	West Africa	893		1147	254(28.5%)	963	70(7.9%)	915	22(2.5%)
	West NA	438		549	111(25.4%)	454	16(3.5%)	431	-7(-1.6%)
	SA Savanna	1665		1860	195(11.7%)	1763	98(5.9%)	1675	10(0.6%)
	East Africa	1228		1533	306(24.9%)	1427	199(16.2%)	1356	128(10.4%)
	East Asian semi-arid	1440		1470	30(2.1%)	1199	-241(-16.7%)	1139	-301(-20.9%)
<b>NH High-Mid Latitude Areas</b>	NA High-Mid Latitude	552		814	262(47.6%)	700	149(27.0%)	665	114(20.6%)
	Eurasian High-Mid	844		966	122(14.5%)	871	27(3.2%)	827	16(-2.0%)
<b>Equator</b>	Amazon Basin	2993		2668	-326(-10.9%)	2631	-362(-12.1%)	2500	-494(-16.5%)
	Southeast Asia	2778		2540	-238(-8.6%)	2419	-359(-12.9%)	2298	-480(-17.3%)
	Equator Africa	2522		2645	123(4.9%)	2611	89(3.5%)	2481	-42(-1.7%)
<b>Subarctic Areas and Tibet</b>	NA Subarctic	234		364	130(55.7%)	240	6(2.4%)	228	-6(-2.7%)
	Eurasian Subarctic	331		484	153(46.2%)	328	-3(-1.0%)	311	-20(-6.0%)
	Tibet	409		561	153(37.3%)	298	-111(-27.2%)	283	126(-30.8%)
<b>Global</b>		<b>863</b>		<b>1082</b>	<b>220(25.4%)</b>	<b>991</b>	<b>129(14.9%)</b>	<b>942</b>	<b>79(9.1%)</b>

Note: the numbers in parentheses are relative biases

Table 4. Regional and Global LAI for (a) GIMMS LAI, (b) GLASS LAI, (c) SSiB4 (control), (d) NIPSN (N limitation on photosynthesis only) and (e) SSiB5 (N limitation on photosynthesis, autotrophic respiration, and phenology).

Regions	Sub-regions	LAI Mean (m <sup>2</sup> /m-2)									
		GIMMS		GLASS		SSiB4		NIPSN		SSiB5	
		mean	bias	mean	bias	mean	bias	mean	bias	mean	bias
<b>Arid and Semi-Arid Areas</b>	West Africa	1.08		1.01	-0.07(-6.5%)	2.04	0.96(88.9%)	1.89	0.81(75.0%)	1.73	0.65(60.2%)
	West NA	0.62		0.49	-0.13(-21.0%)	1.38	0.76(122.6%)	1.18	0.56(90.3%)	1.09	0.47(75.8%)
	SA Savanna	1.99		1.91	-0.18(-4.0%)	3.34	1.35(67.8%)	3.23	1.24(62.3%)	2.97	0.98(49.2%)
	East Africa	1.59		1.55	-0.04(-2.5%)	3.02	1.43(89.9%)	2.89	1.30(81.8%)	2.66	1.07(67.3%)
	East Asian semi-arid	1.60		1.36	-0.24(-15.0%)	3.35	1.75(109.4%)	2.84	1.24(77.5%)	2.61	1.01(63.1%)
<b>NH High-Mid Latitude Areas</b>	NA High-Mid Latitude	0.84		0.49	-0.35(-41.7%)	1.91	1.07(127.4%)	1.66	0.82(97.6%)	1.53	0.69(82.1%)
	Eurasian High-Mid	1.14		0.57	-0.57(-50.0%)	2.29	1.15(100.9%)	2.08	0.94(82.5%)	1.91	0.77(67.5%)
<b>Equator</b>	Amazon Basin	4.19		4.08	-0.11(-2.6%)	6.01	1.82(43.4%)	5.98	1.79(42.7%)	5.50	1.31(31.3%)
	Southeast Asia	3.93		3.88	-0.05(-1.3%)	4.68	0.75(19.1%)	4.68	0.75(19.1%)	4.31	0.38(9.7%)
	Equator Africa	3.83		3.76	-0.07(-1.8%)	5.74	1.91(49.9%)	5.72	1.89(49.3%)	5.27	1.44(37.6%)
<b>Subarctic Areas and Tibet</b>	NA Subarctic	0.32		0.14	-0.18(-56.3%)	0.71	0.39(121.9%)	0.51	0.19(59.4%)	0.47	0.15(46.9%)
	Eurasian Subarctic	0.33		0.12	-0.21(-63.6%)	0.87	0.54(163.6%)	0.65	0.32(97.0%)	0.60	0.27(81.8%)
	Tibet	0.64		0.54	-0.10(-15.6%)	1.36	0.72(112.5%)	0.81	0.17(26.6%)	0.75	0.11(17.2%)
<b>Global</b>		<b>1.18</b>		<b>1.00</b>	<b>-0.18(-15.3%)</b>	<b>2.44</b>	<b>1.26(110.8%)</b>	<b>2.31</b>	<b>1.13(95.8%)</b>	<b>2.12</b>	<b>0.94(79.7%)</b>

Note: the numbers in parentheses are relative biases



20 Figure 1. Schematic diagram of plant growth and nitrogen impacts in SSiB5/TRIFFID/DayCent-SOM.

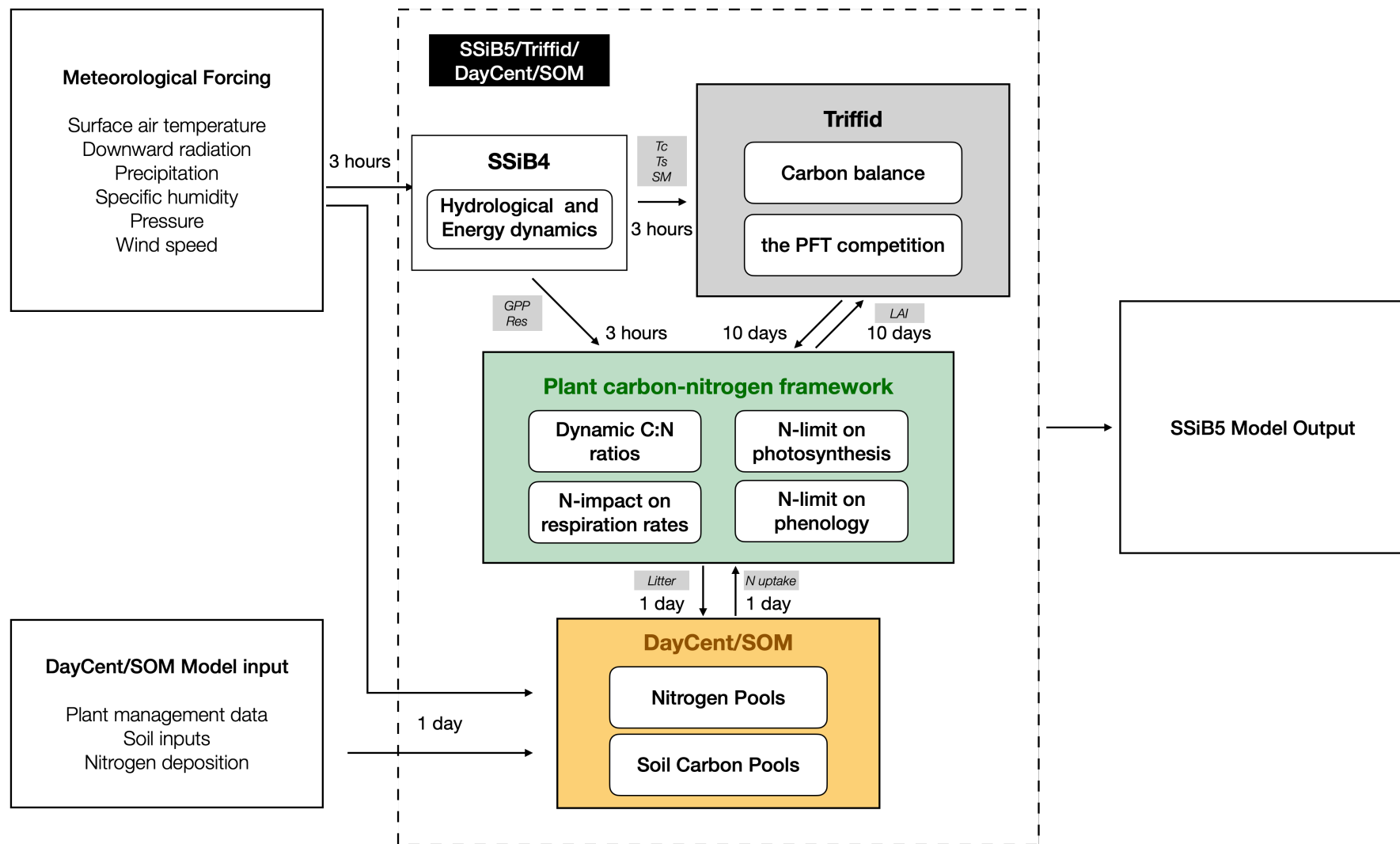


Figure 2. Schematic diagram of plant carbon-nitrogen interaction framework coupling in SSiB5/TRIFFID/DayCent-SOM, main variables are listed between two processes ( $T_c$ : canopy temperature;  $T_s$ : land surface temperature;  $SM$ : soil moisture;  $GPP$ : gross primary productivity;  $Res$ : autotrophic respiration)

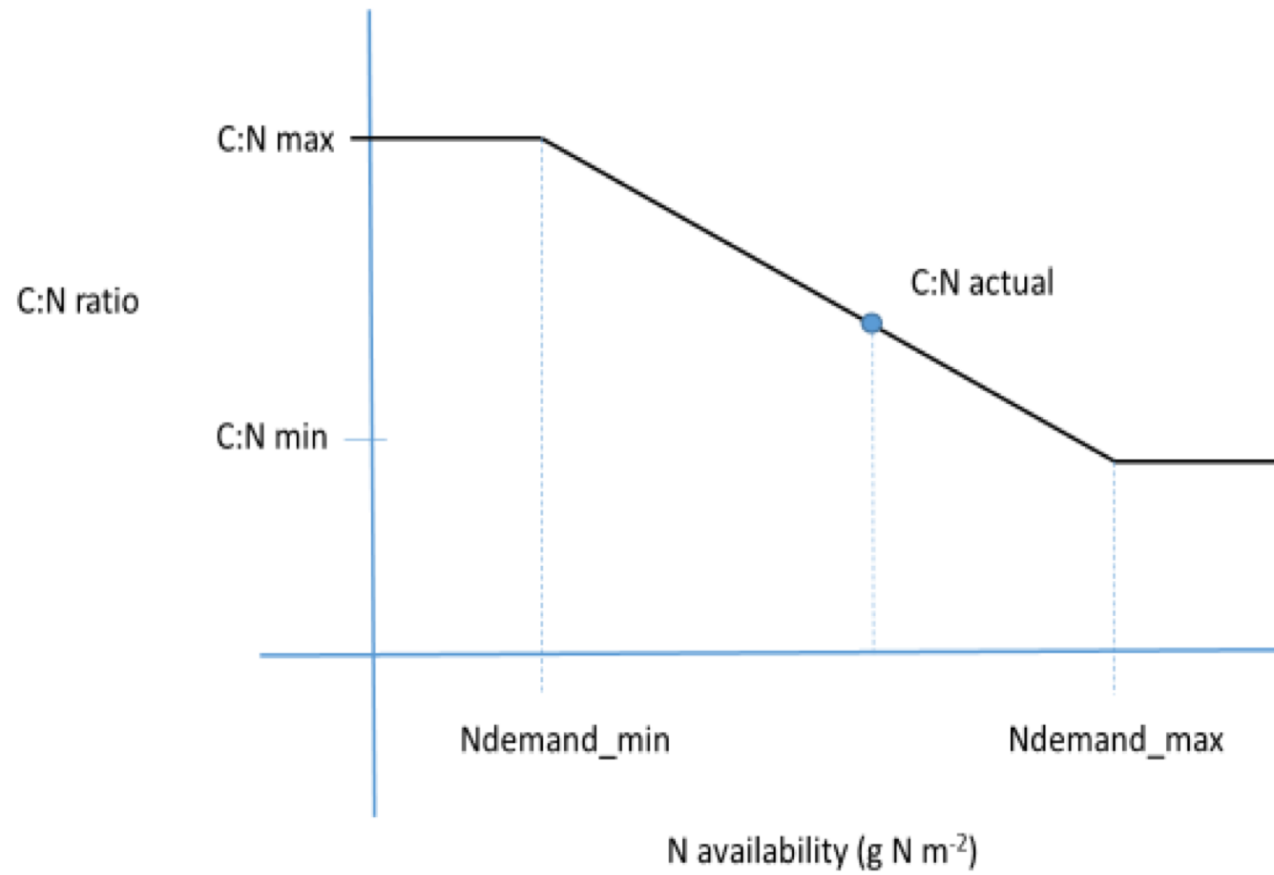
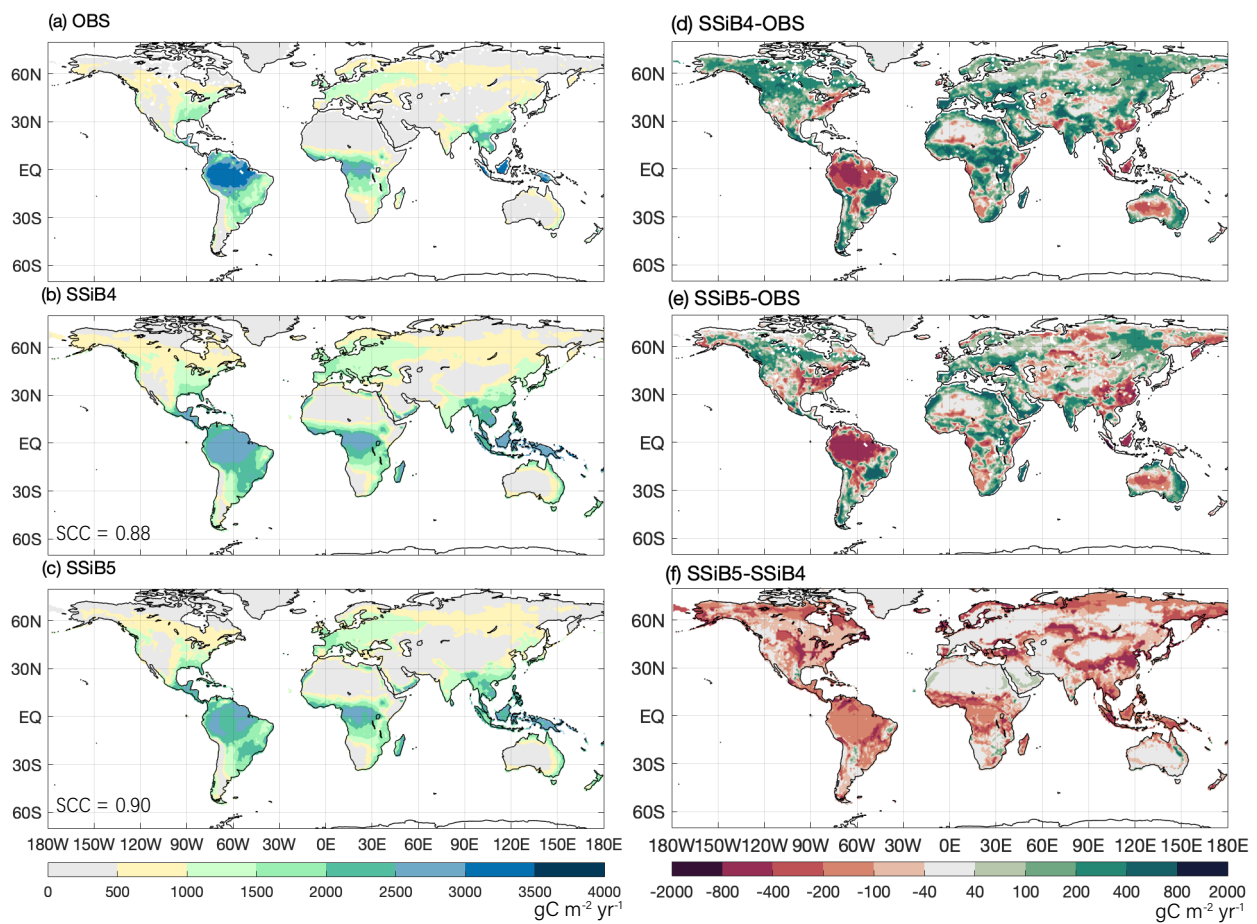
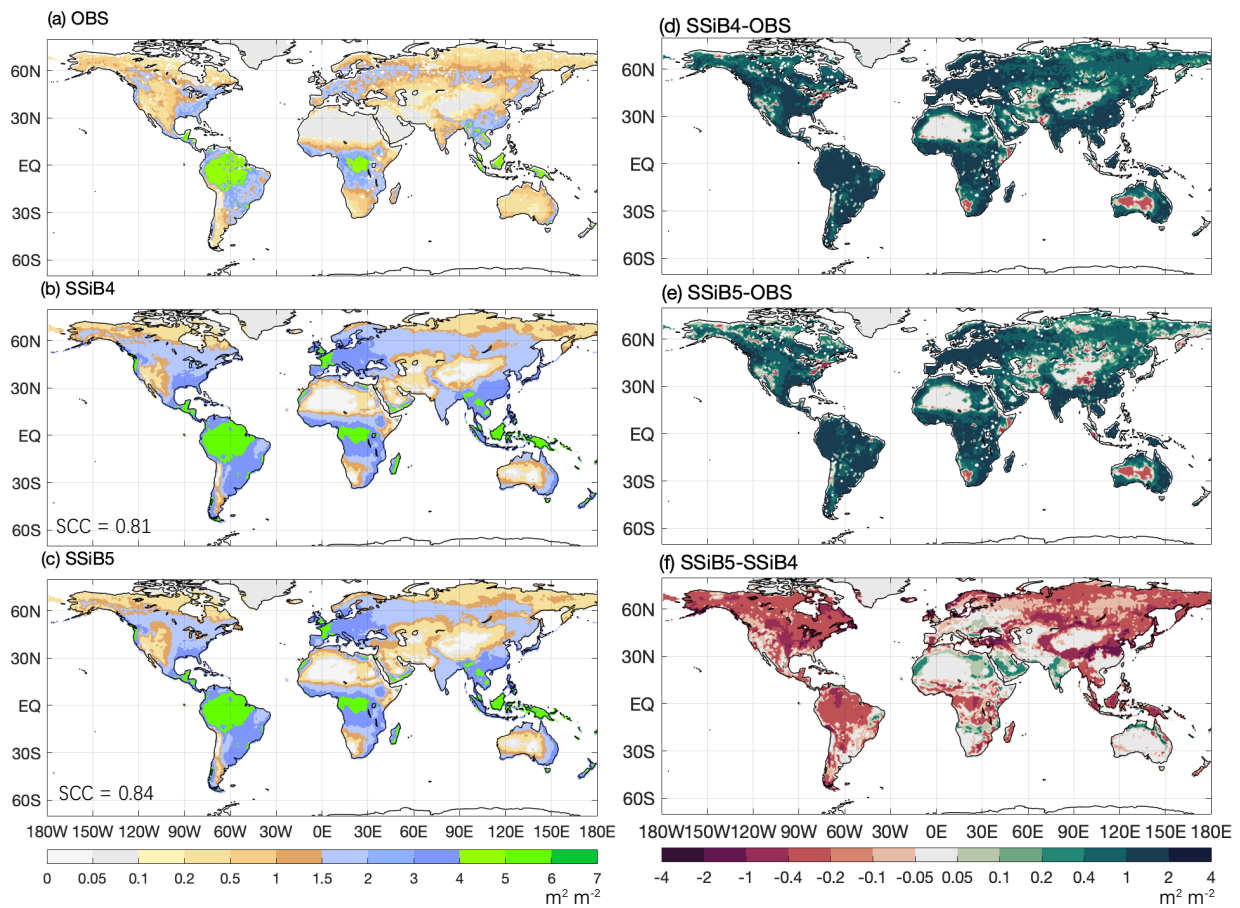


Figure 3. The relationship between the Nitrogen availability from soil to plant growth and plant carbon-nitrogen ratios

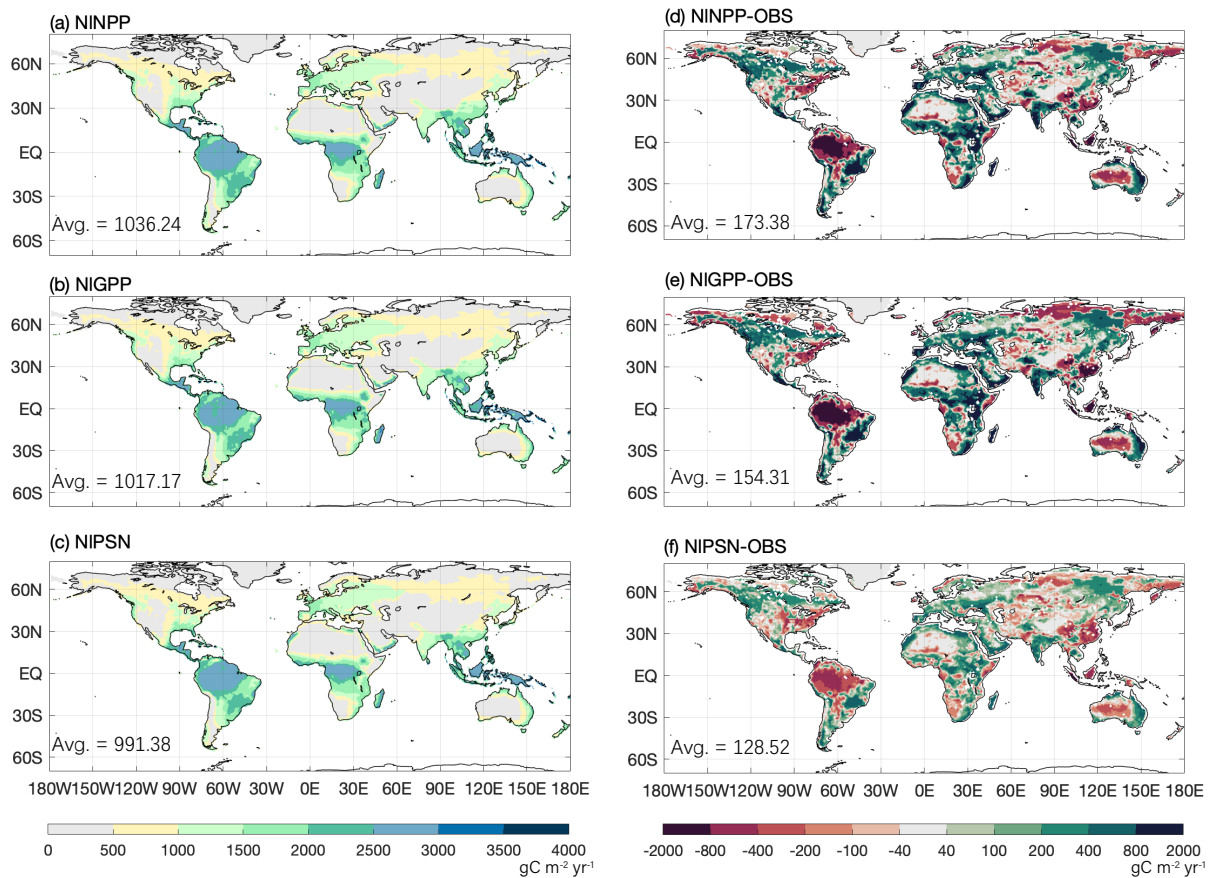


**Figure 4.** The 1982-2007 average gross primary production comparison for (a) FLUXNET-MTE GPP (OBS), (b) SSiB4/TRIFFID(SSiB4), and (c) SSiB5/TRIFFID/DayCent/SOM(SSiB5), and difference between (d) SSiB4-OBS, and (e) SSiB5-OBS, (f) SSiB5-SSiB4.



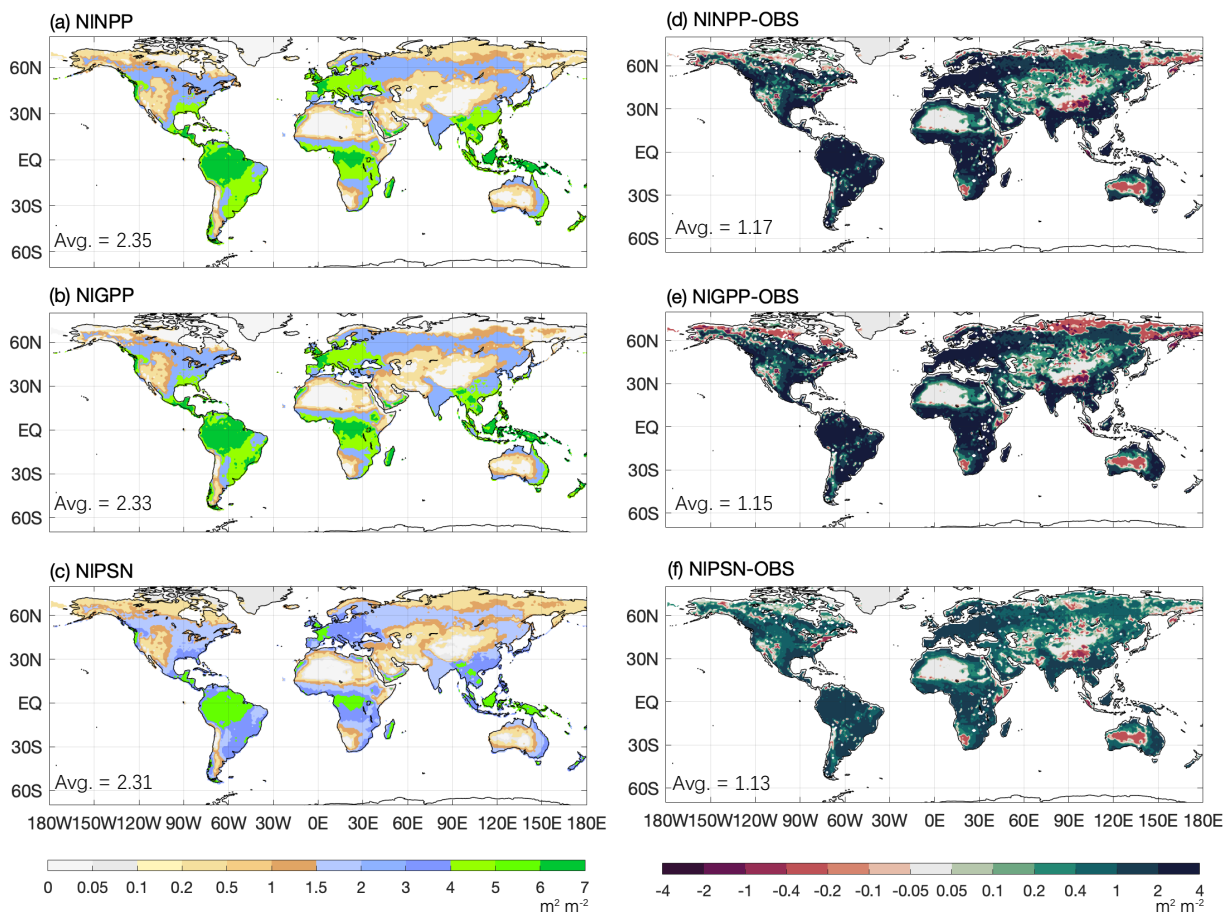
**Figure 5.** The 1982-2007 average leaf area index comparison for (a) GIMMS LAI(OBS), (b) SSiB4/TRIFFID (SSiB4), and (c) SSiB5/TRIFFID/DayCent/SOM(SSiB5), and difference between (d) SSiB4-OBS, (e) SSiB5-OBS, and (f) SSiB5-SSiB4.

**Note:** SCC indicates the spatial correlation coefficient between model simulation and GIMMS LAI (OBS).



**Figure 6** The 1982-2007 average gross primary production comparison for (a) NINPP, (b) NIGPP and (c) NIPSN, (d) NINPP-OBS, (e) NIGPP- OBS and (f) NIPSN- OBS.

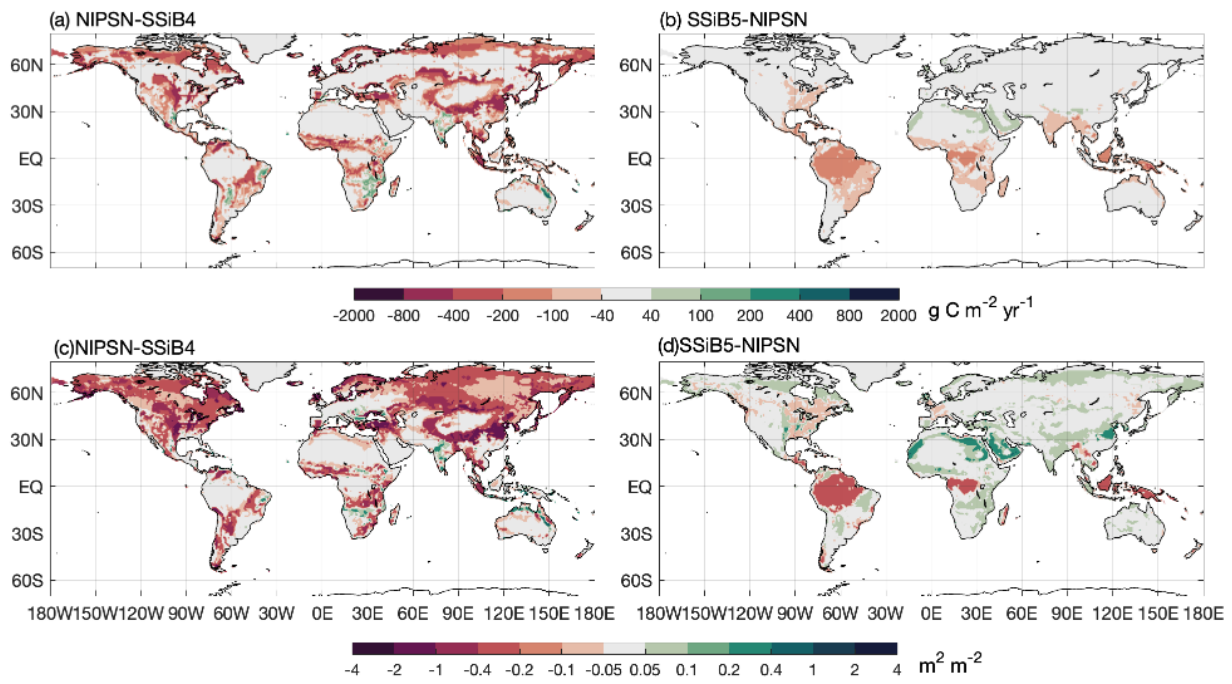
**Notes:** (1) NIPSN is N limitation on photosynthesis ( $V_{max}$ ) only; NINPP is N limitation on NPP only; and NIGPP is N limitation on GPP only. (2). OBS is FLUXNET-MTE GPP (OBS). (3). Avg. indicates the global average.



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**Figure 7. The 1982-2007 average leaf area index comparison for (a) NINPP, (b) NIGPP and (c) NIPSN, and difference between (d) NINPP- OBS, (e) NIGPP- OBS and (f) NIPSN- OBS.**

**Notes:** Same as the notes in Figure 6.



55 **Figure 8.** The 1982-2007 average gross primary production difference (a) NIPSN-SSiB4, (b) SSiB5-NIPSN, and leaf area index difference (c) NIPSN- SSiB4, (d) SSiB5- NIPSN

Note: NIPSN is N limitation on photosynthesis ( $V_{\text{max}}$ ) only.