The fate of carbon input into a peatland:

a matrix-based model intercomparison analysis

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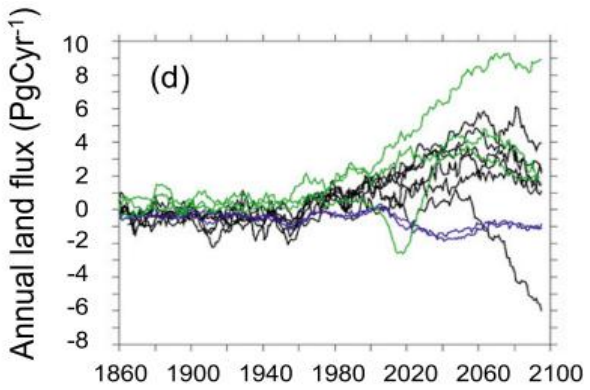
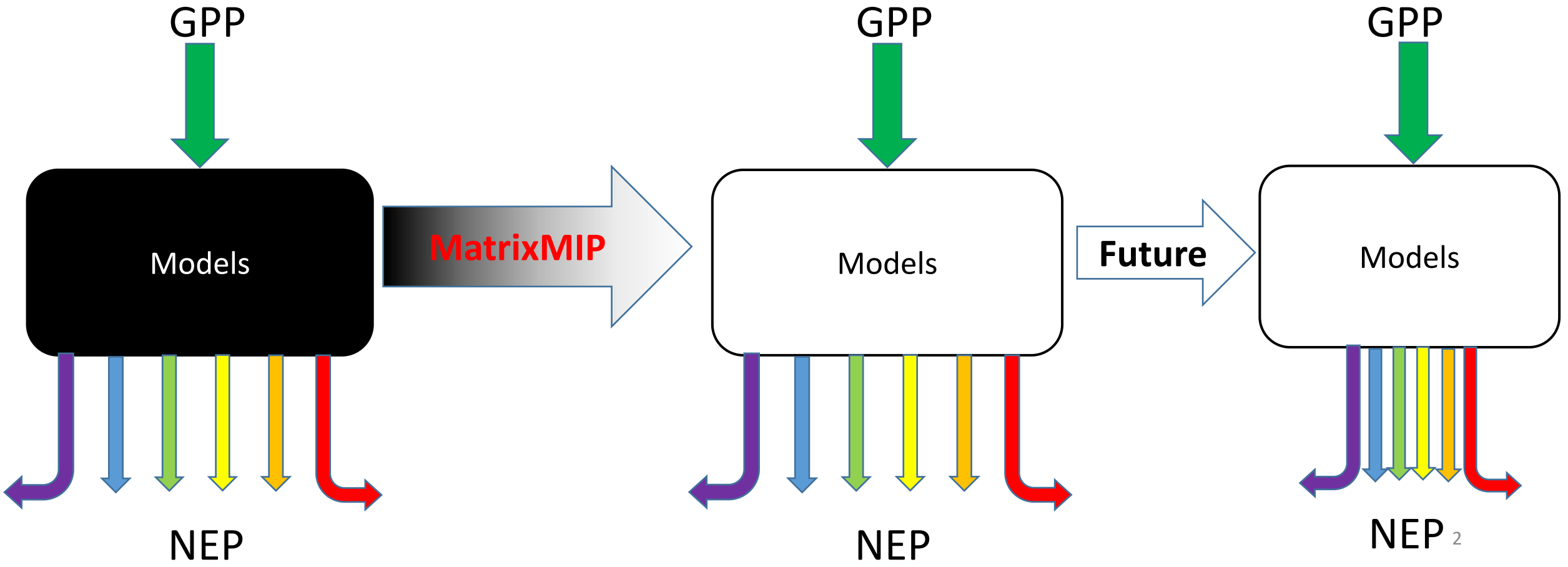


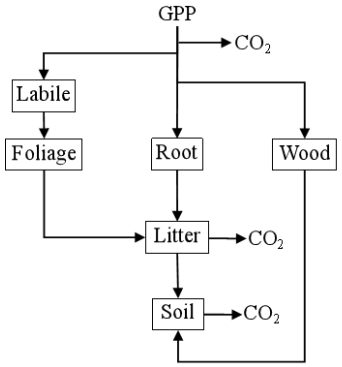
CMIP5; Friedling et al. (2014)

The need of reducing model uncertainty and Matrix-based Model Intercomparison (MatrixMIP)

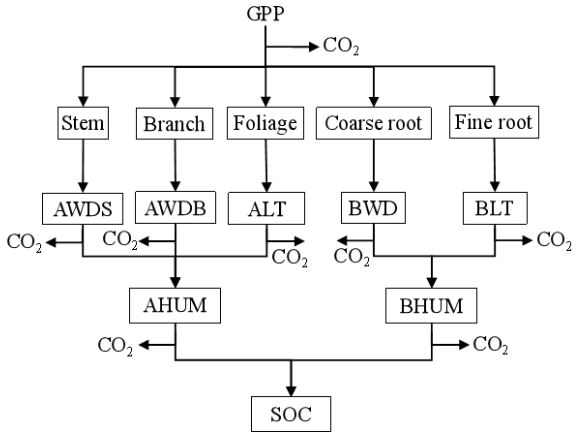


Six models for MatrixMIP

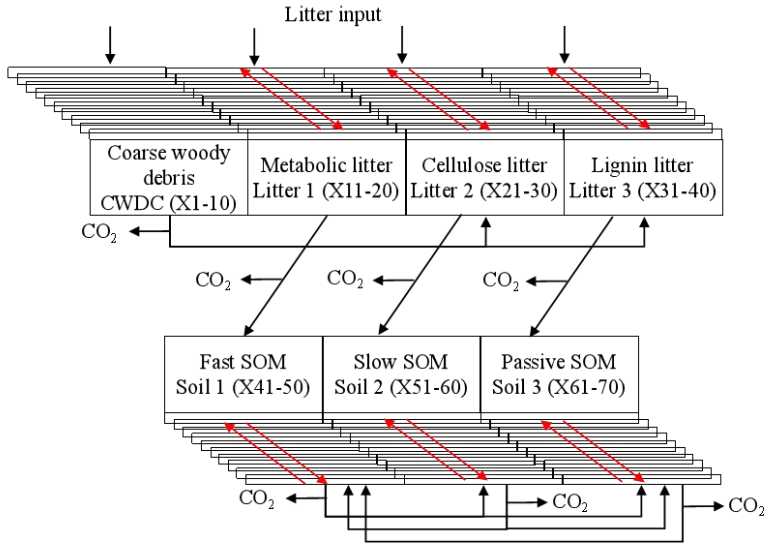
DALEC2 (6 pools)



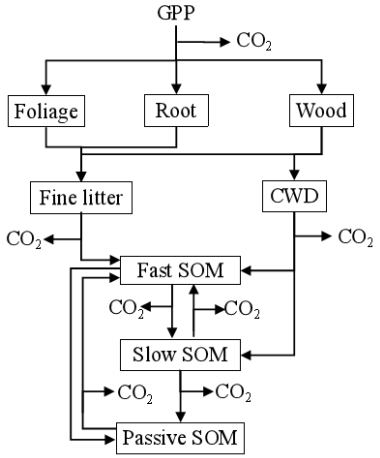
FDBC (13 pools)



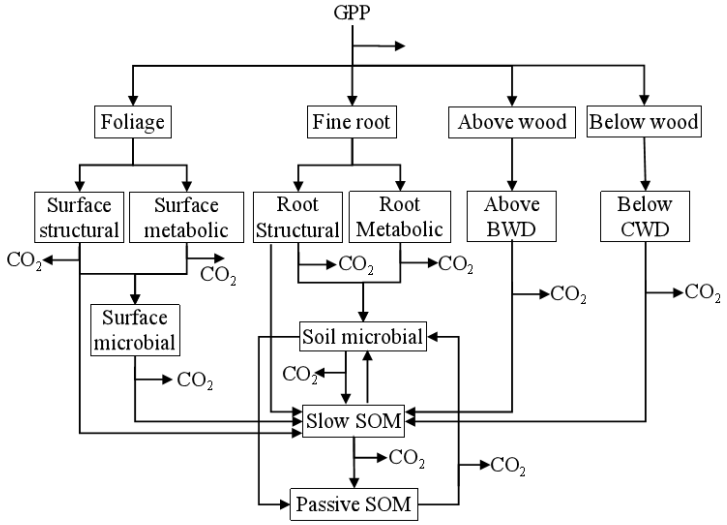
CLM4.5 (70 pools)



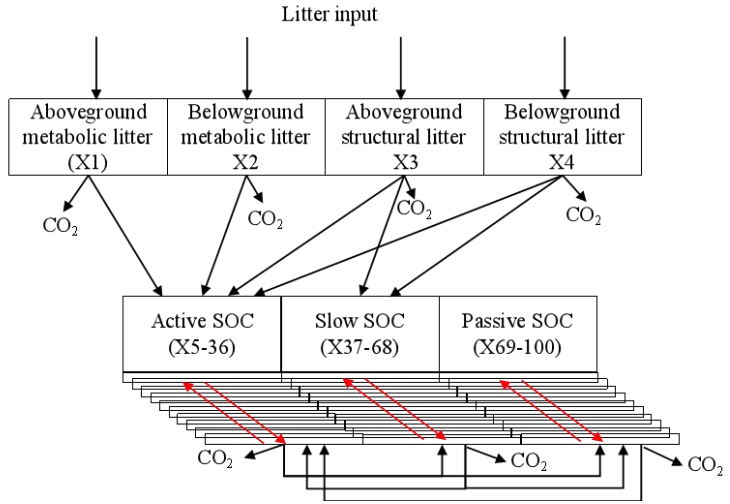
TECO (8 pools)



CASA (14 pools)



ORCHIDEE (100 pools)



All model in a unified matrix form (TECO as an example)

Allocation

B
0.35
0.1
0
0
0
0
0

Carbon input

Date	GPP
1/1/2011	0
1/2/2011	0.0032
1/3/2011	4.00E-04
1/4/2011	0.0054
1/5/2011	0.0091
1/6/2011	0.0022
1/7/2011	9.00E-04
1/8/2011	0.0046
1/9/2011	0.0085
1/10/2011	0.0093

Transfer among C pools

A_1	A_2	A_3	A_4	A_5	A_6	A_7
1	0	0	0	0	0	0
0	1	0	0	0	0	0
-0.71	0	1	0	0	0	0
-0.29	-1	0	1	0	0	0
0	0	-0.45	-0.28	1	-0.42	-0.45
0	0	0	-0.28	-0.3	1	0
0	0	0	0	-0	-0.03	1

Baseline C turnover rate

K_1	K_2	K_3	K_4	K_5	K_6	K_7
2.74E-03	0	0	0	0	0	0
0	6.84E-05	0	0	0	0	0
0	0	9.13E-03	0	0	0	0
0	0	0	4.72E-04	0	0	0
0	0	0	0	6.84E-03	0	0
0	0	0	0	0	5.48E-05	0
0	0	0	0	0	0	1.37E-06

$$\frac{dX(t)}{dt} = B \times u(t) - (A\xi K + V) \times X(t)$$

C change rate

C pool

Date	Non_woo	Woody	Fine_litte	CWD	Fast_SOC	Slow_SO	Passive_S
1/1/2011	398.159	4560.67	85.1473	1327.14	100.297	6849.03	10221.8
1/2/2011	397.835	4560.58	85.1471	1327.14	100.297	6849.03	10221.8
1/3/2011	397.51	4560.48	85.1467	1327.14	100.297	6849.03	10221.8
1/4/2011	397.187	4560.39	85.1462	1327.14	100.297	6849.03	10221.8
1/5/2011	396.866	4560.3	85.1454	1327.13	100.297	6849.03	10221.8
1/6/2011	396.542	4560.21	85.1445	1327.13	100.297	6849.03	10221.8
1/7/2011	396.219	4560.11	85.1433	1327.13	100.297	6849.03	10221.8
1/8/2011	395.897	4560.02	85.142	1327.13	100.297	6849.03	10221.8
1/9/2011	395.576	4559.93	85.1405	1327.13	100.297	6849.03	10221.8
1/10/2011	395.252	4559.84	85.1389	1327.13	100.297	6849.03	10221.8

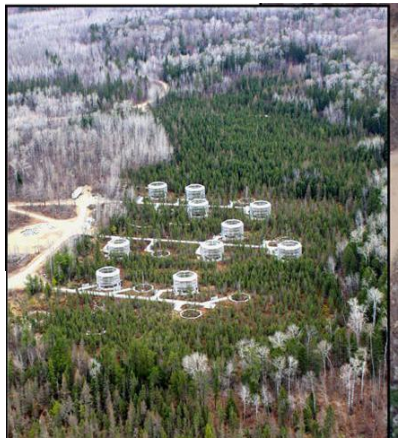
Vertical mix

Tr_1	Tr_2	Tr_3	Tr_4	Tr_5	Tr_6	Tr_7
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

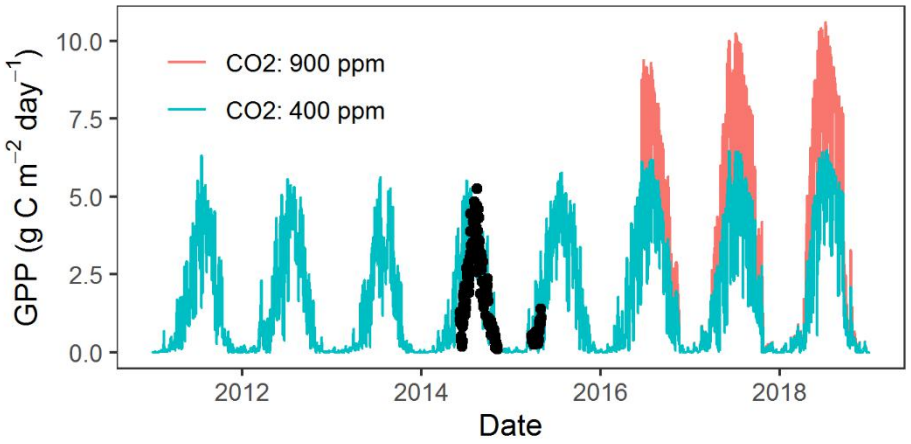
Date	Scaler1	Scaler2	Scaler3	Scaler4	Scaler5	Scaler6	Scaler7
1/1/2011	0.29812	0.29812	0.29812	0.29812	0.29812	0.29812	0.29812
1/2/2011	0.29812	0.29812	0.29812	0.29812	0.29812	0.29812	0.29812
1/3/2011	0.29812	0.29812	0.29812	0.29812	0.29812	0.29812	0.29812
1/4/2011	0.29812	0.29812	0.29812	0.29812	0.29812	0.29812	0.29812
1/5/2011	0.29812	0.29812	0.29812	0.29812	0.29812	0.29812	0.29812
1/6/2011	0.29812	0.29812	0.29812	0.29812	0.29812	0.29812	0.29812
1/7/2011	0.29812	0.29812	0.29812	0.29812	0.29812	0.29812	0.29812
1/8/2011	0.29812	0.29812	0.29812	0.29812	0.29812	0.29812	0.29812

Environmental scaler

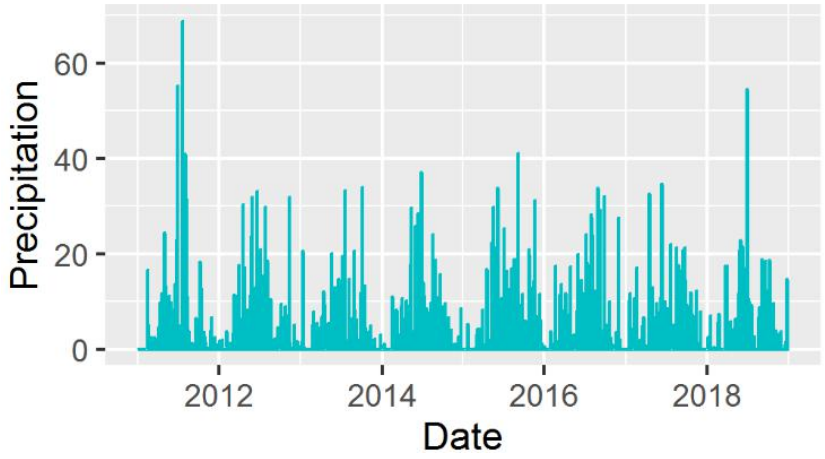
Study site and model forcing for MatrixMIP



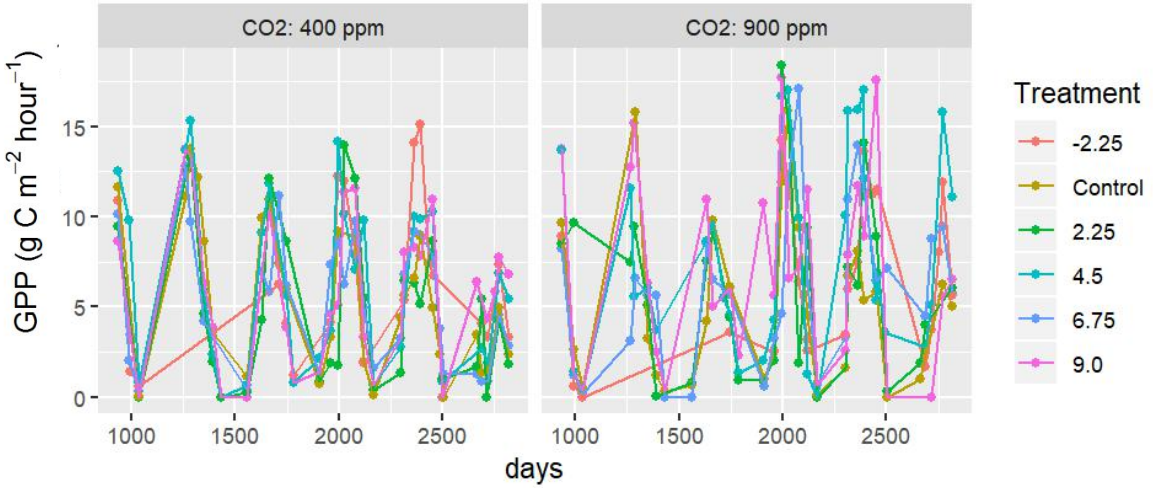
Black points: measurements from Walker et al. (2017)
Colored lines are simulated values by TECO simulator

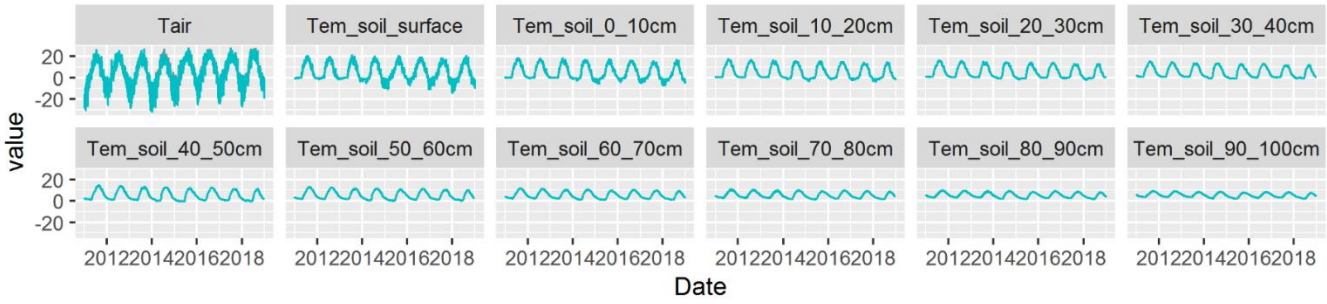


June 2016: eCO_2 (900ppm) initiated



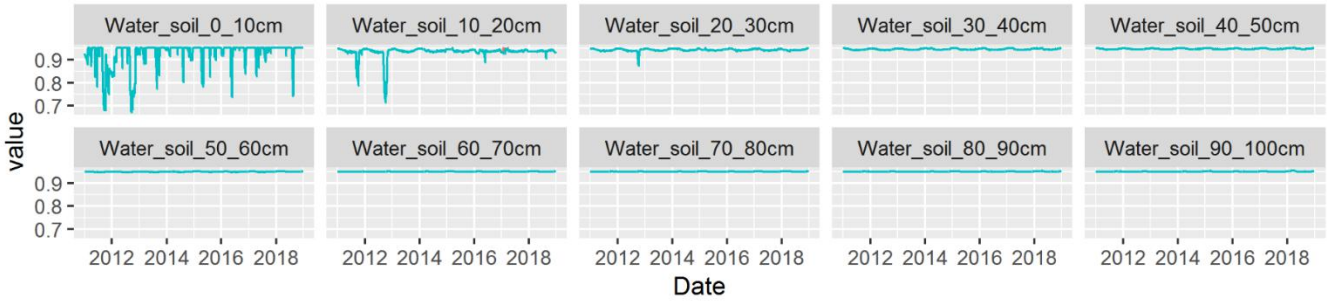
Hourly GPP measurements from SPRUCE project





Temperature

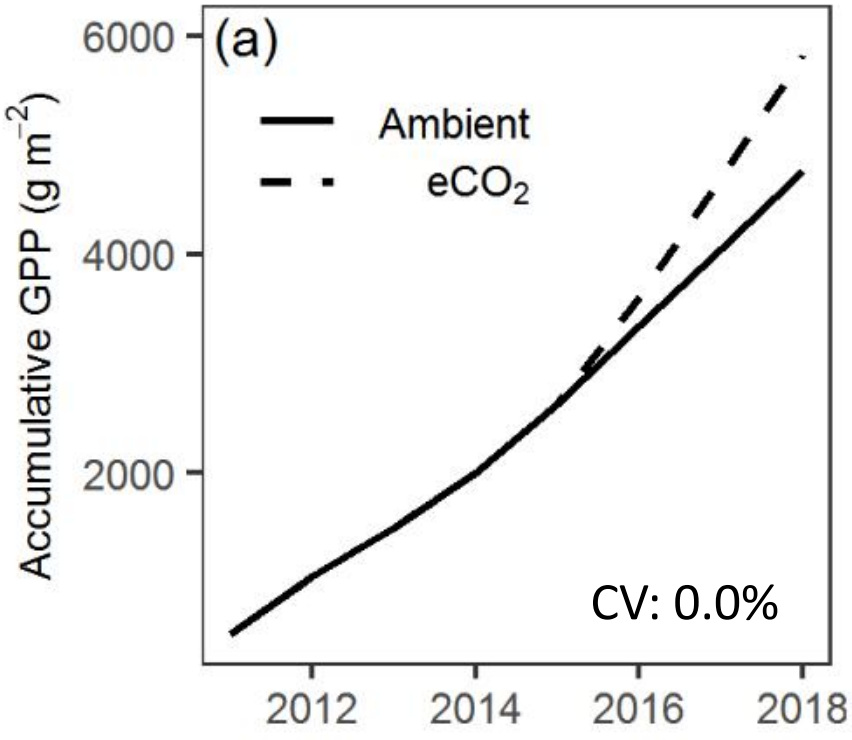
co2level
CO2: 400 ppm
CO2: 900 ppm

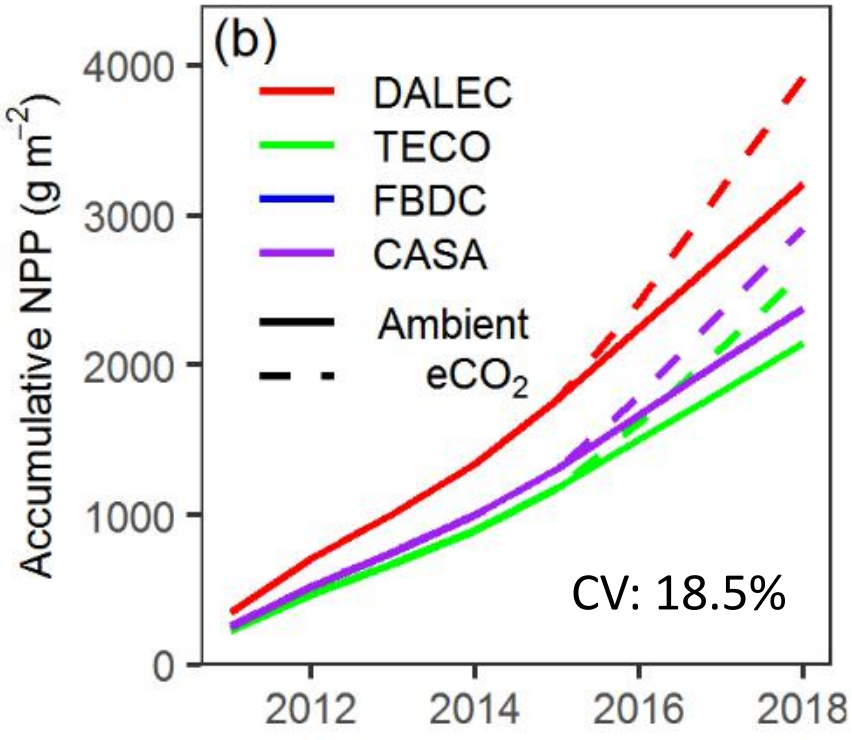


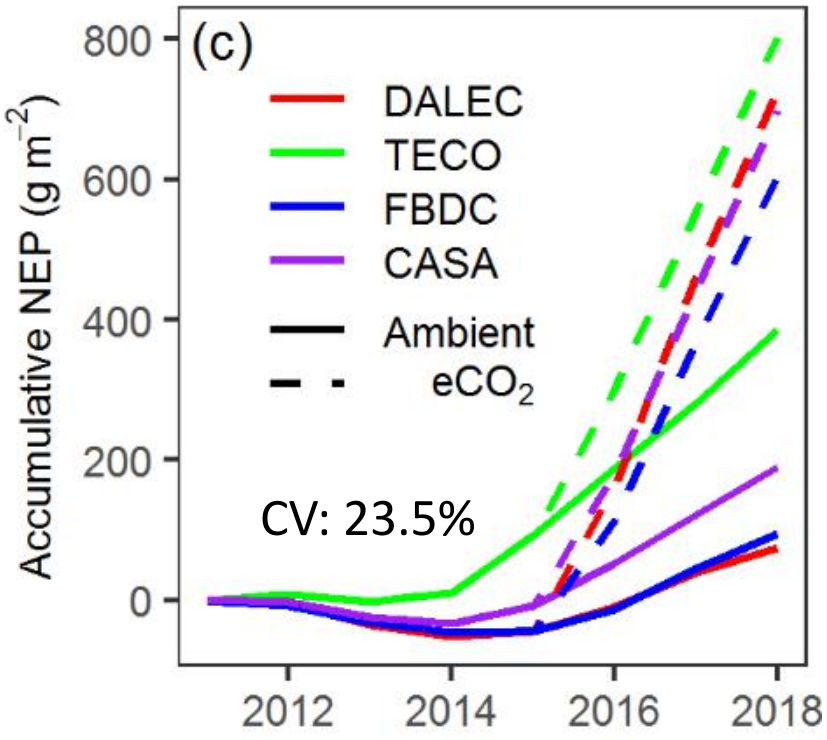
Soil water

co2level
CO2: 400 ppm
CO2: 900 ppm

Same GPP, divergent NPP, and more divergent NEP



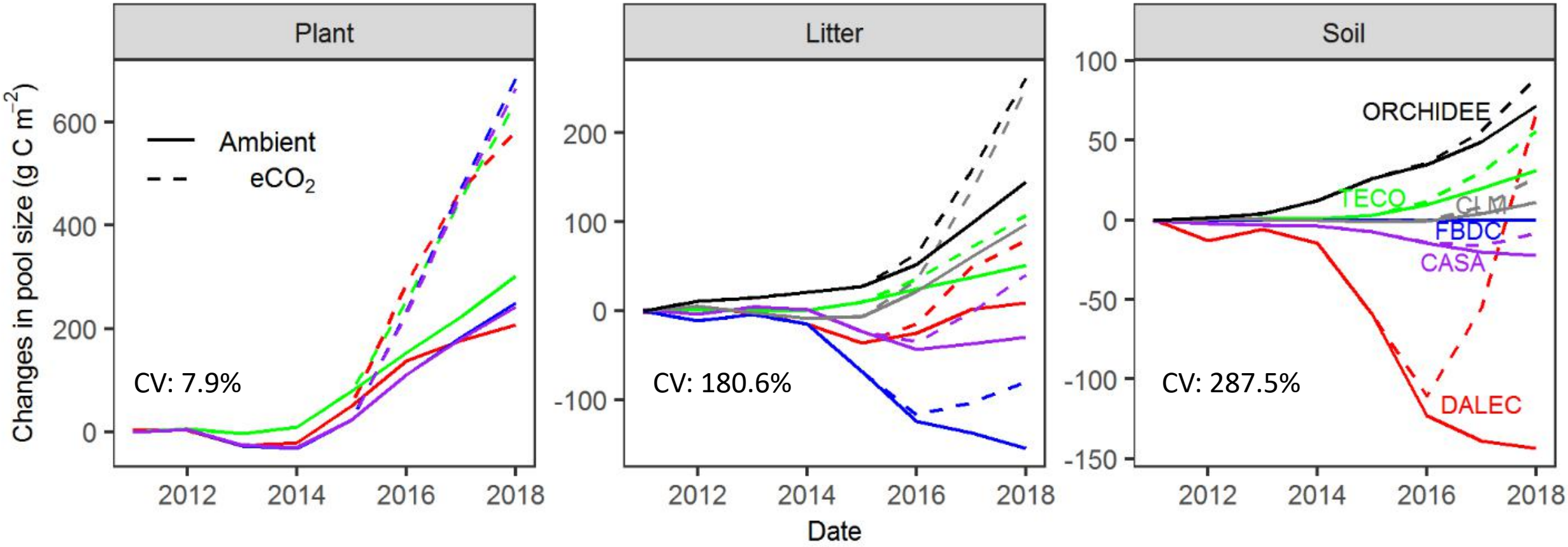




Coefficient of variation (CV) among models (average of two treatments)

increase from GPP to NPP and further to NPP

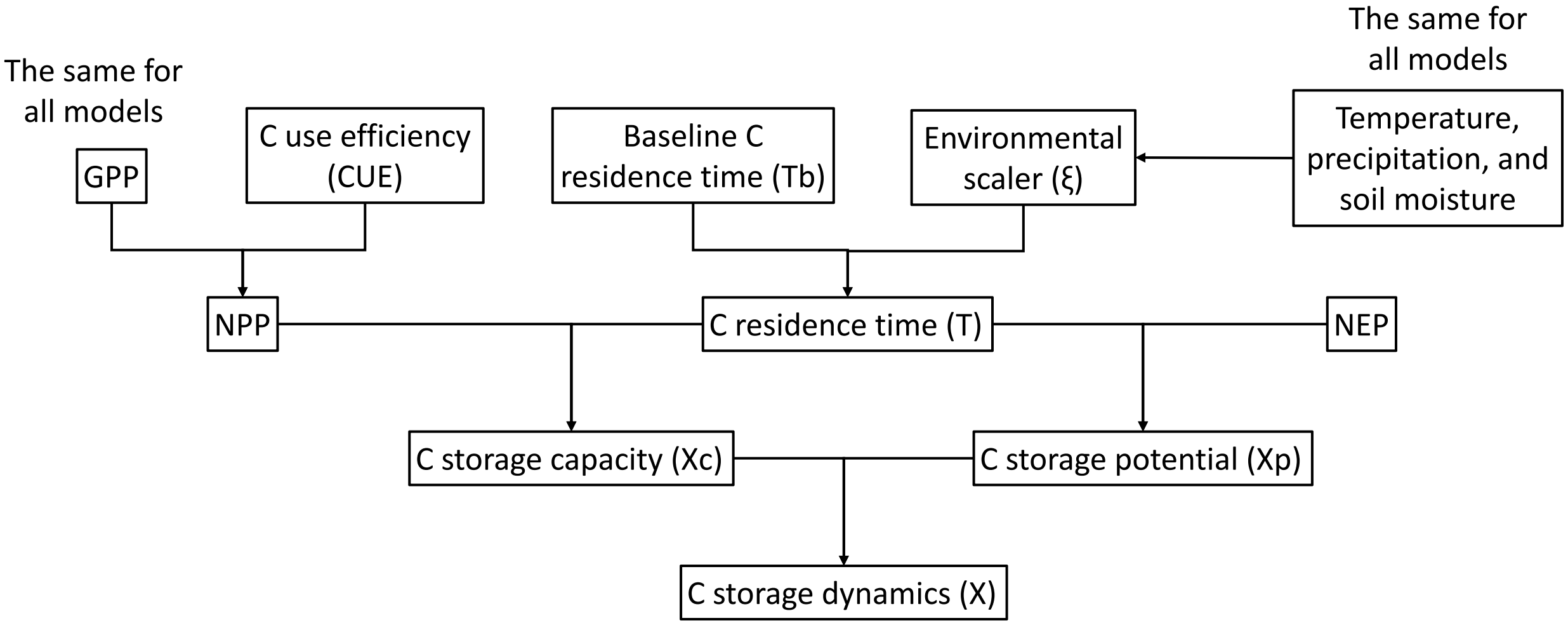
Variation among models (averaged across CO_2 treatment)



More divergence after separated into three ecosystem components.

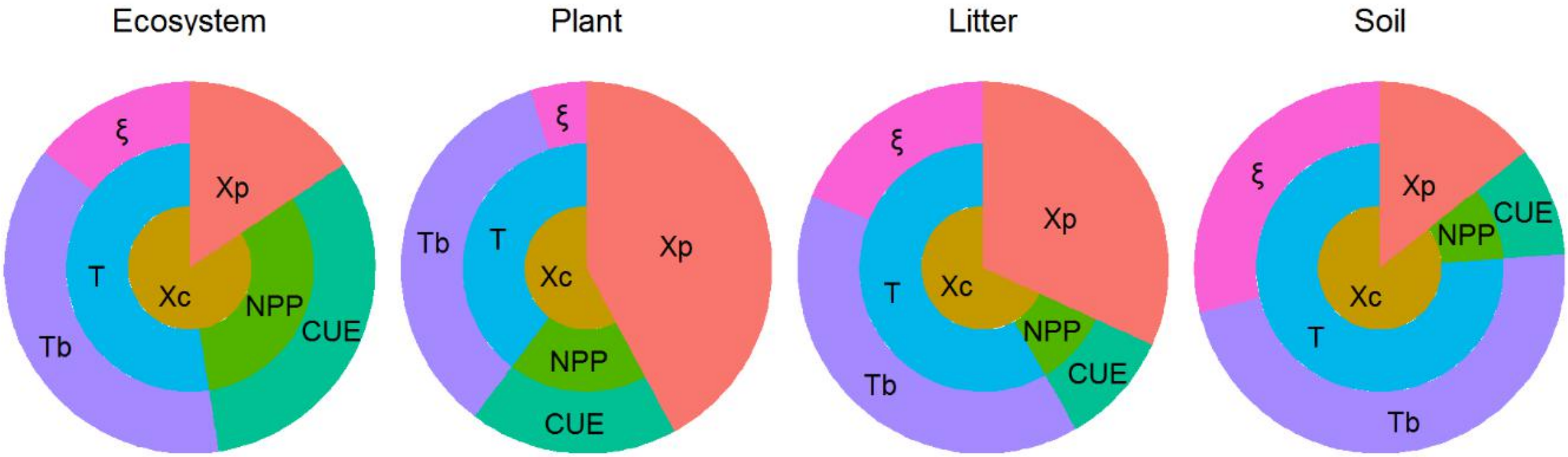
Variability order: Soil > Litter > Plant.

Traceability analysis of transient C dynamics



Jiang et al. (2017) JAMES; Zhou et al. (2020), preprint.

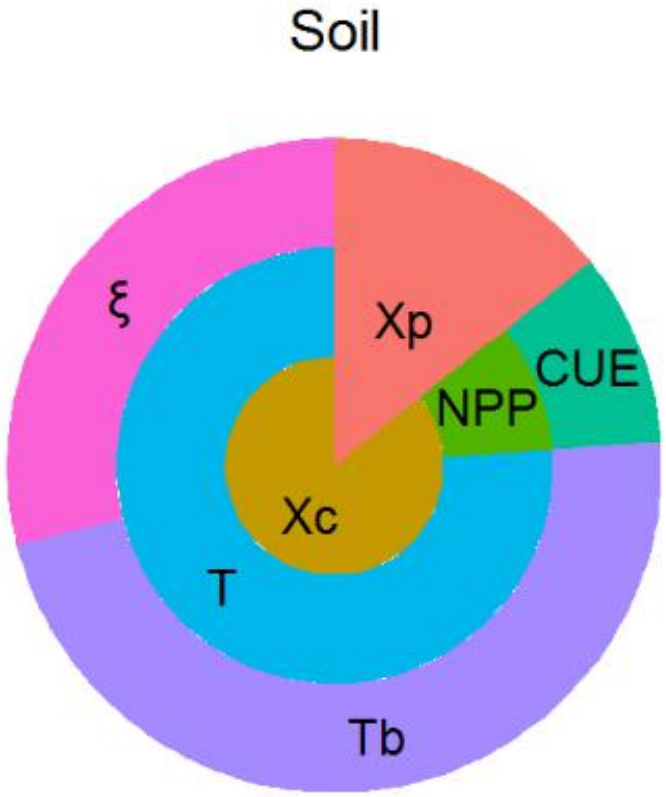
Quantifying the relative importance of parameters

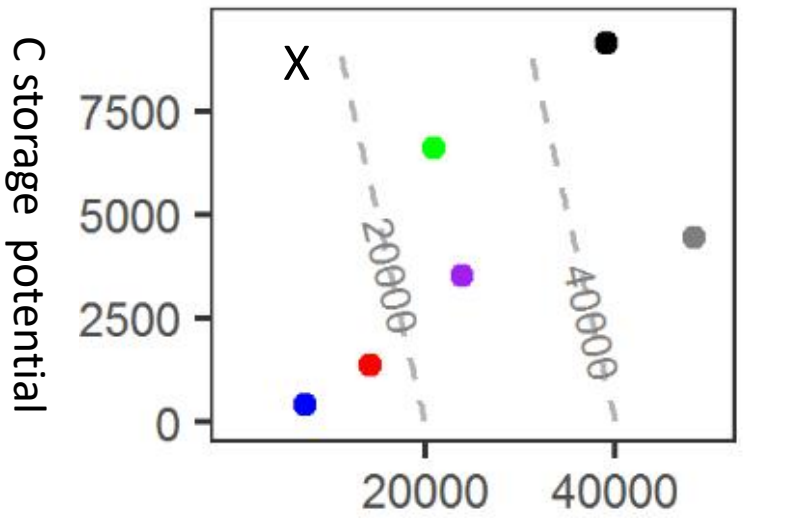


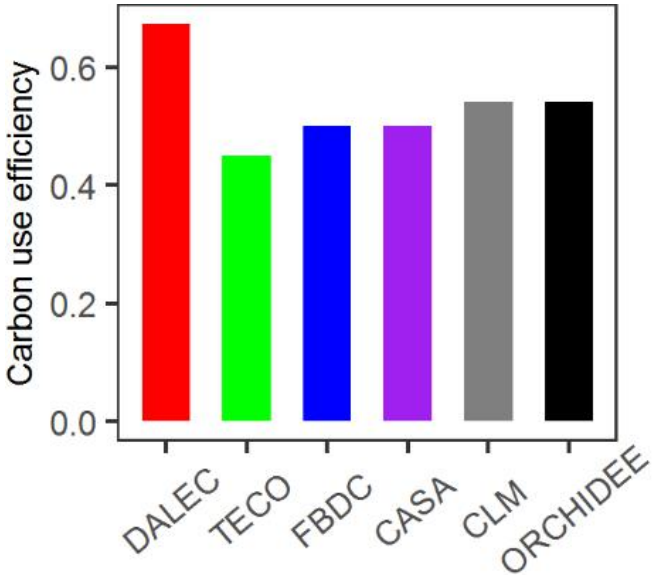
Xc: C storage capacity. Xp: C storage potential. T: C residence time.

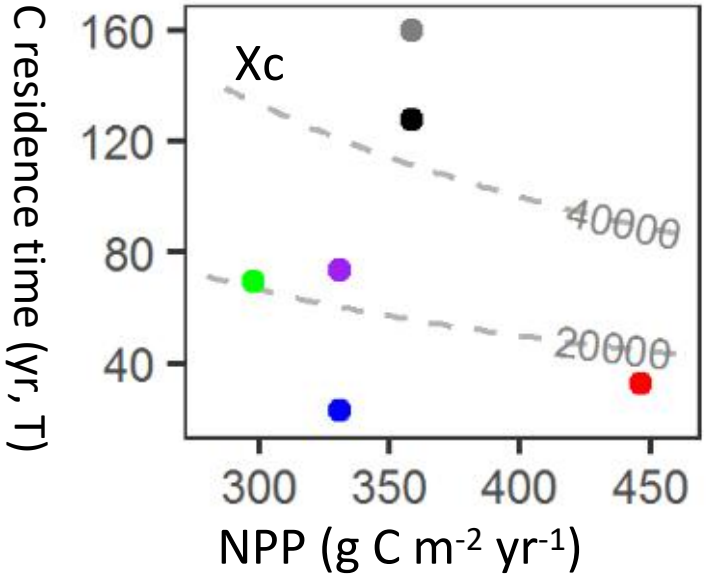
Tb: baseline C residence time. ξ: environmental scaler. CUE: plant C use efficiency.

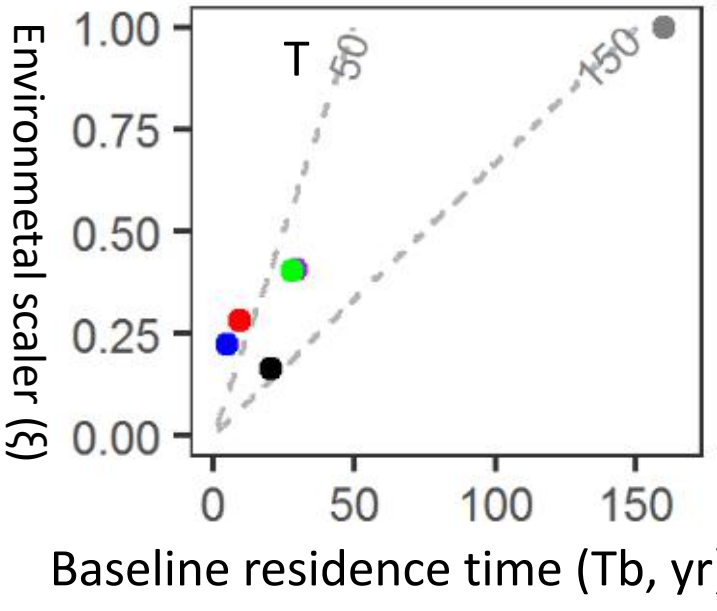
Traceability analysis of soil C change as an example











Summary

- C cycle in six land models were converted into a unified matrix form for comparison.
- Divergent NPP among models, due to different plant C use efficiency assigned.
- More divergent NEP, mainly due to different C residence times among models.
- Even more divergent C changes in plant, litter, and soil, given the different parameter values and model structure.
- Unified matrix-based models facilitate model intercomparison.