Calibration Report: Low N Sedimentary Site Base Case

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Soil Solution Results

Table 1: Average Soil Solution Concentrations of Reliable Months (2005-2006)

	$\\mu$mol/L														
Soil Layer	Ca	Mg	K	Na	NO3	NH4	SO4	Cl	PO4	DOC	Al	Si	H+	pH	R	HR
Layer 1	10.9	14.4	15.1	41.3	1.435	0.672	15.5	55.2	1.011	336	0.01395	13.2	15.51	4.81	35.6	12.41
Layer 2	14.7	20.2	18.2	52.4	1.065	0.392	16.5	63.0	0.894	582	0.02229	30.6	18.77	4.73	61.3	21.87
Layer 3	21.1	24.8	21.3	46.9	0.651	0.229	15.5	69.1	0.718	651	0.01323	42.1	13.62	4.87	71.9	21.11
Layer 4	9.5	16.5	14.8	46.7	0.412	0.433	14.0	65.6	0.395	400	0.03200	50.8	20.83	4.68	40.8	16.31
Layer 5	13.7	22.5	15.3	50.7	0.405	1.043	14.0	71.1	0.185	404	0.00532	53.2	7.34	5.13	46.8	11.00
Layer 6	13.0	20.7	17.6	54.3	0.421	1.303	13.9	76.5	0.228	370	0.00639	56.9	8.08	5.09	43.1	9.79
Layer 7	16.4	22.4	16.4	61.3	0.458	1.977	13.9	82.6	0.301	416	0.00348	61.4	5.30	5.28	49.9	9.47
Layer 8	16.3	20.9	18.8	69.0	0.484	2.421	13.7	87.0	0.226	414	0.00257	63.7	4.10	5.39	51.2	7.96

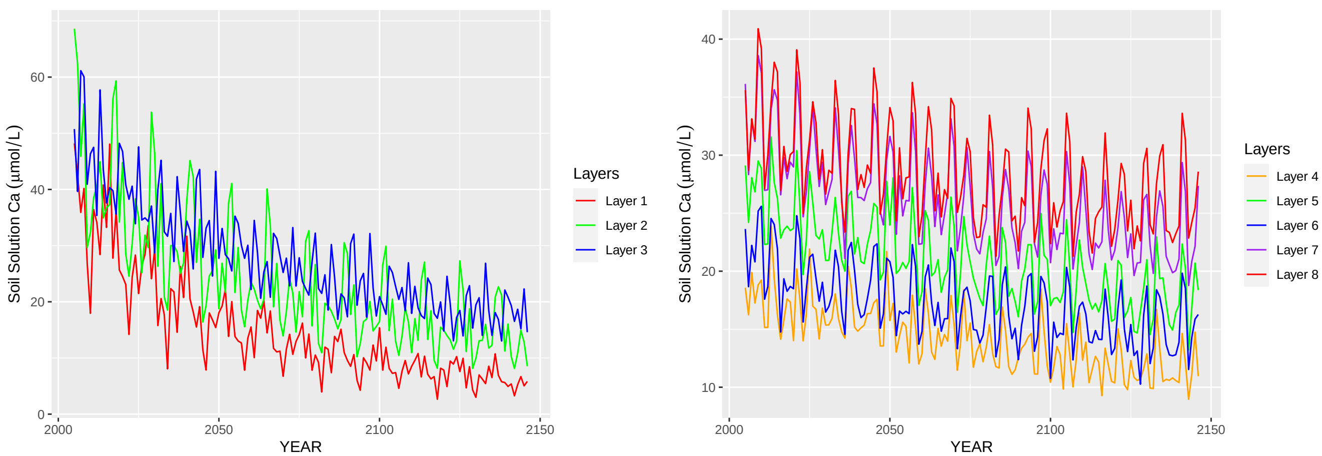


Figure 1: Monthly Calcium Concentrations by Soil Layer

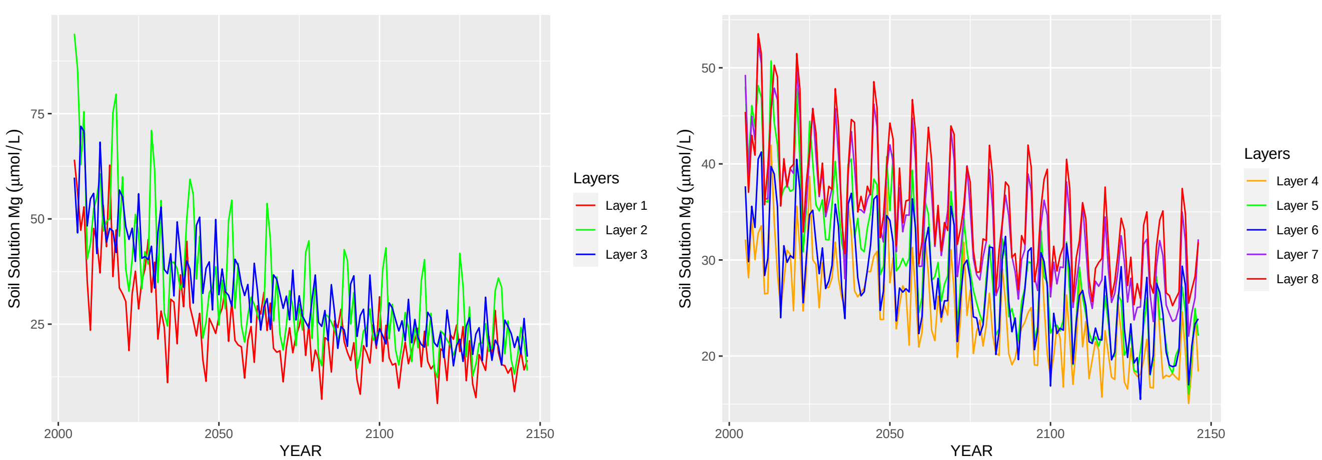


Figure 2: Monthly Magnesium Concentrations by Soil Layer

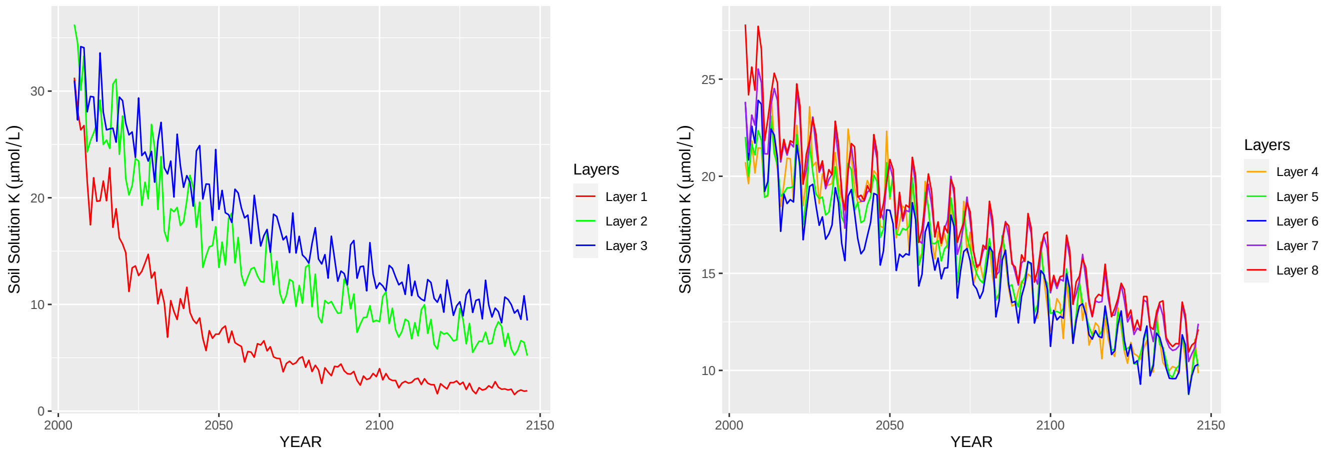


Figure 3: Monthly Potassium Concentrations by Soil Layer

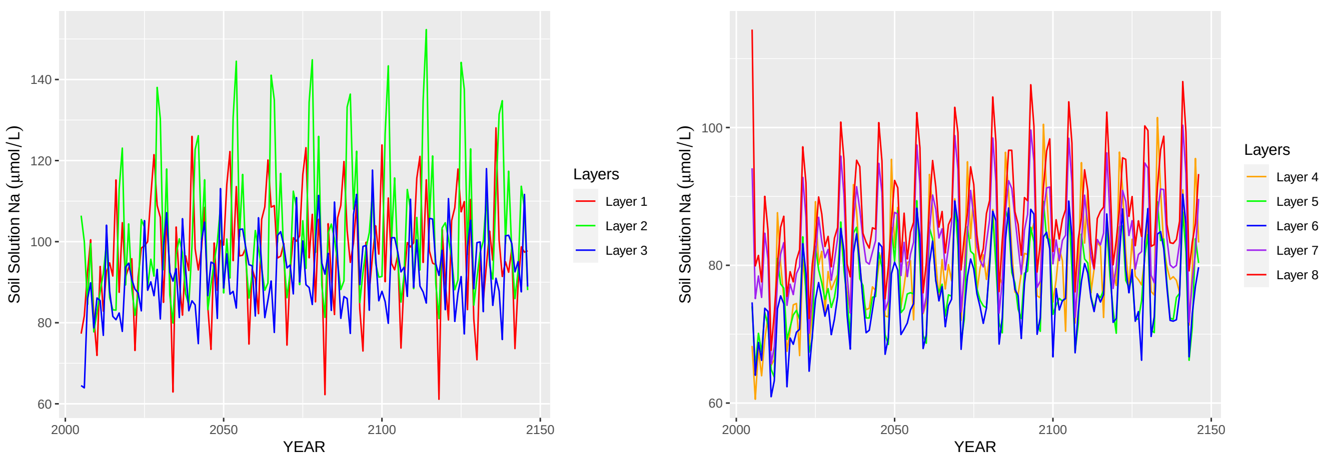


Figure 4: Monthly Sodium Concentrations by Soil Layer

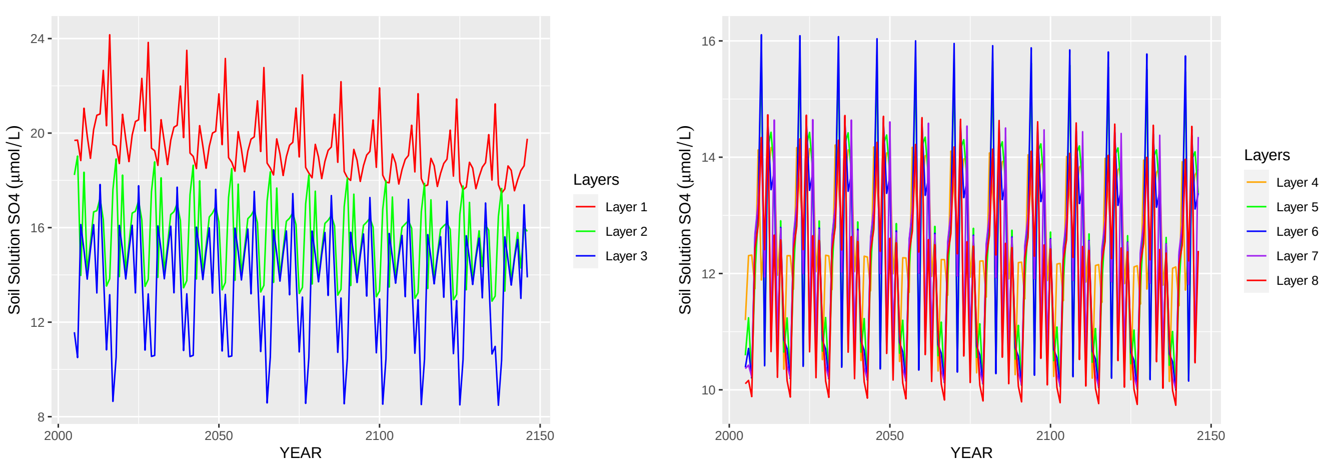


Figure 5: Monthly Sulfate Concentrations by Soil Layer

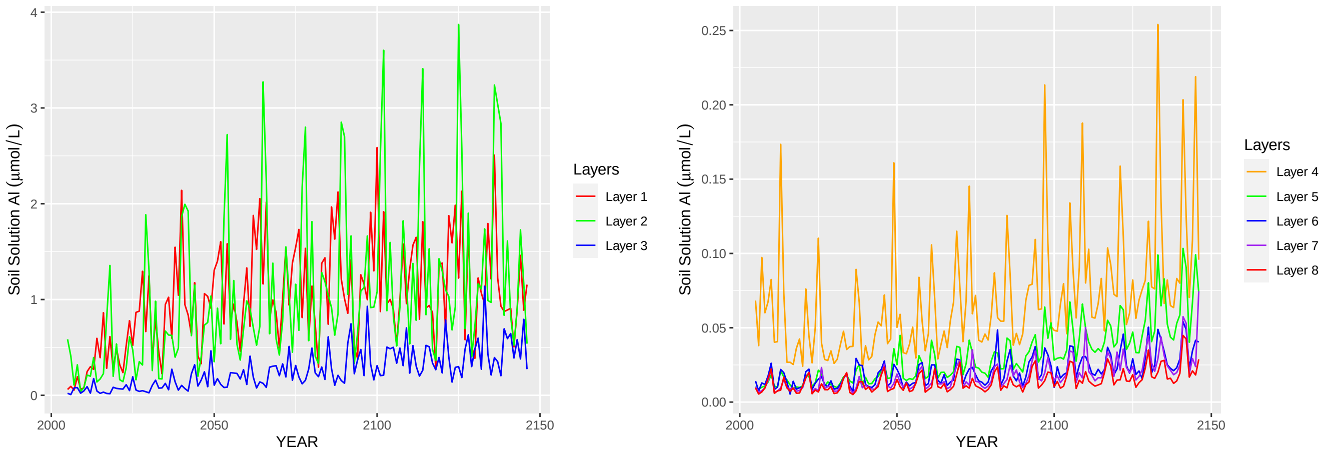


Figure 6: Monthly Aluminum Concentrations by Soil Layer

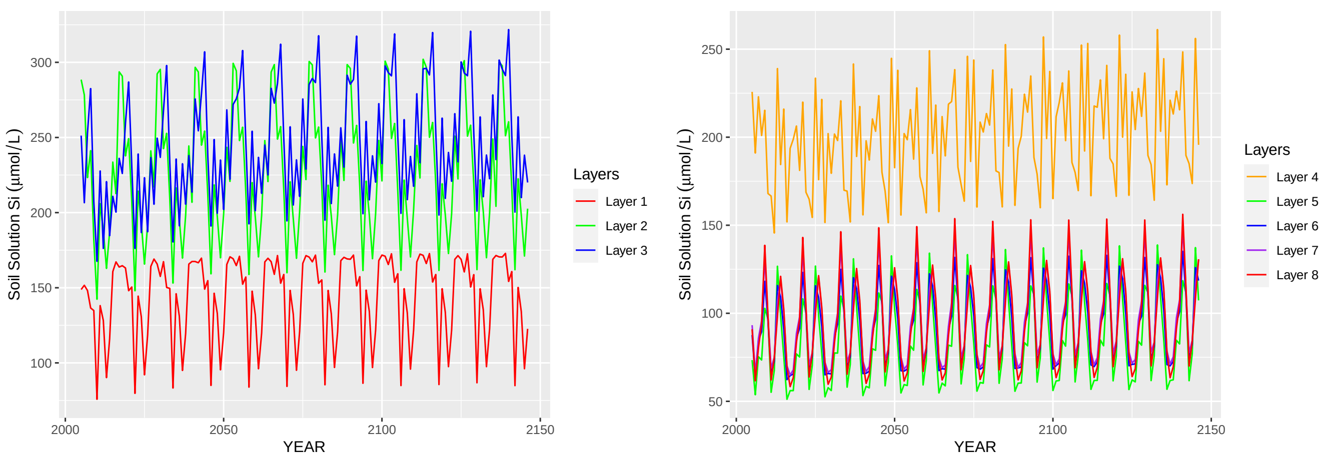


Figure 7: Monthly SiO2 Concentrations by Soil Layer

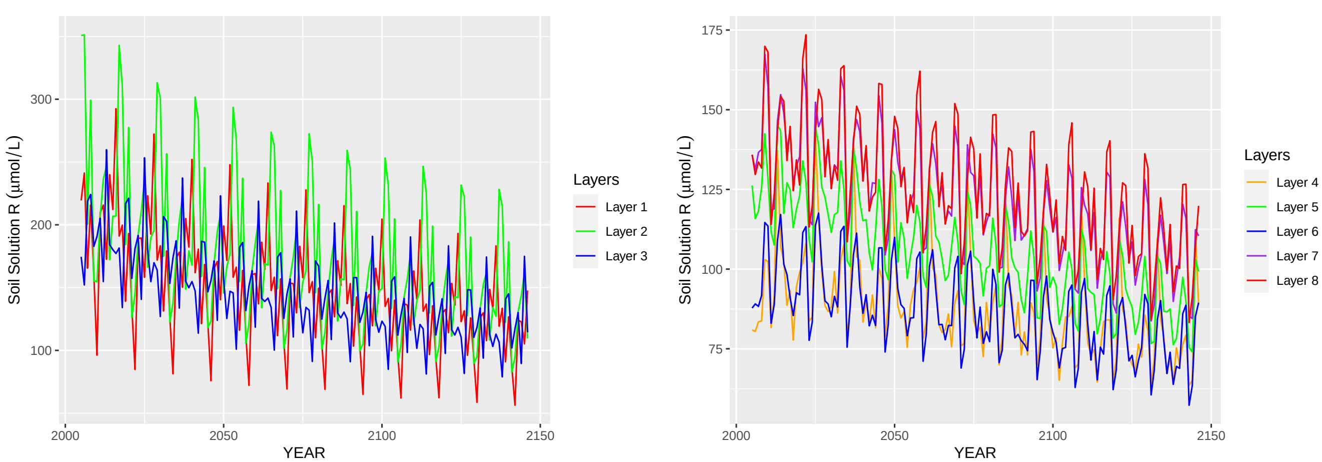


Figure 8: Monthly Organic Acid Base (R-) Concentrations by Soil Layer

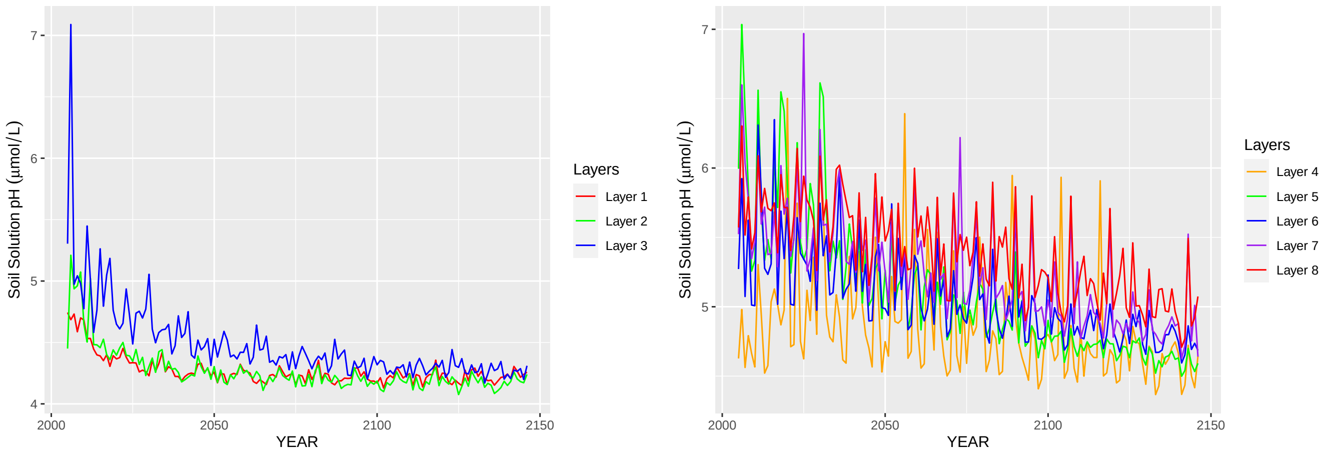


Figure 9: Monthly pH by Soil Layer

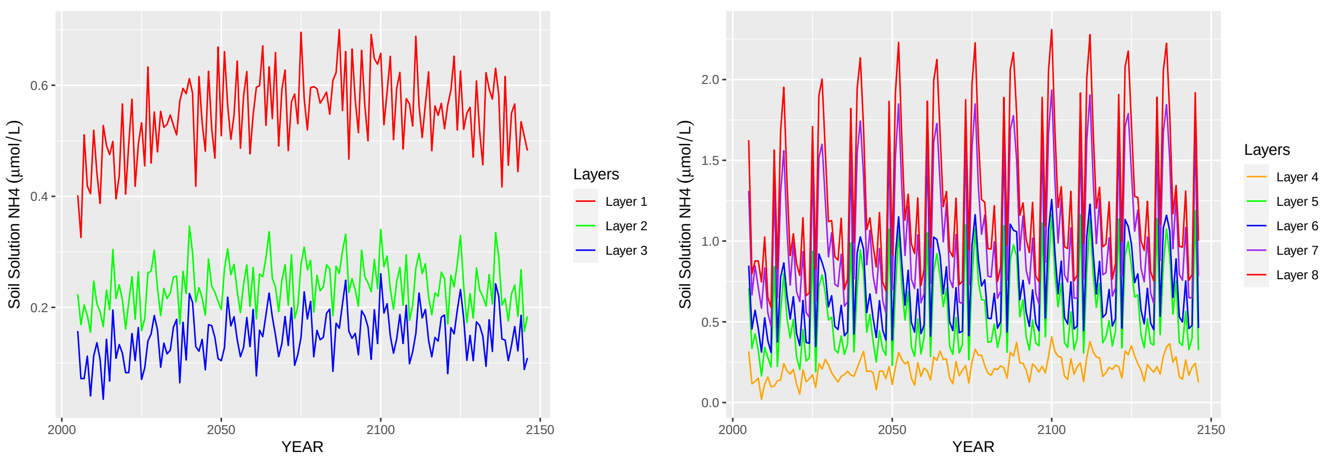


Figure 10: Yearly Ammonium concentration by Soil Layer

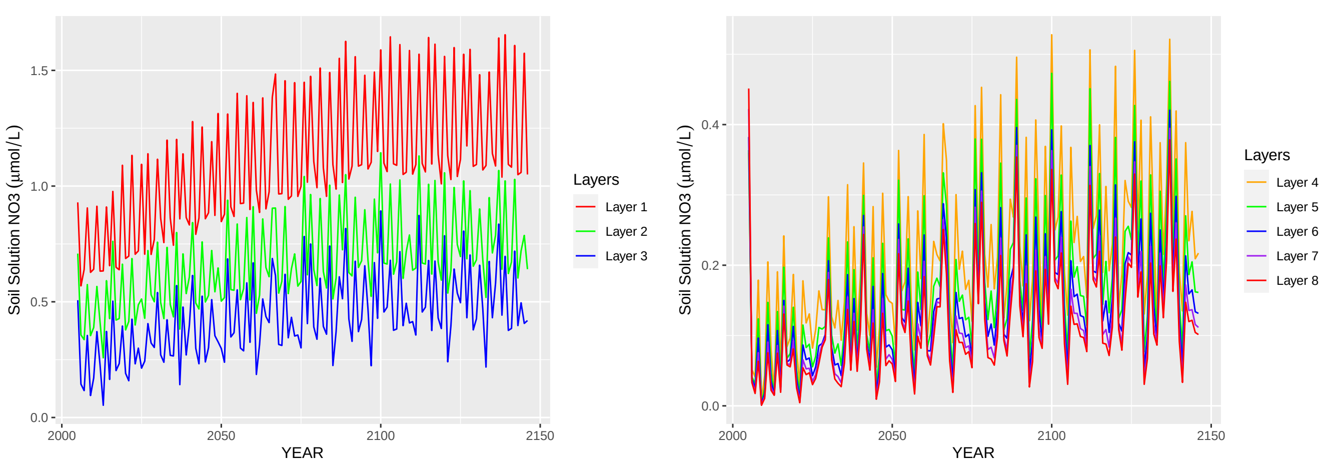


Figure 11: Yearly Nitrate concentration by Soil Layer

Weathering Results

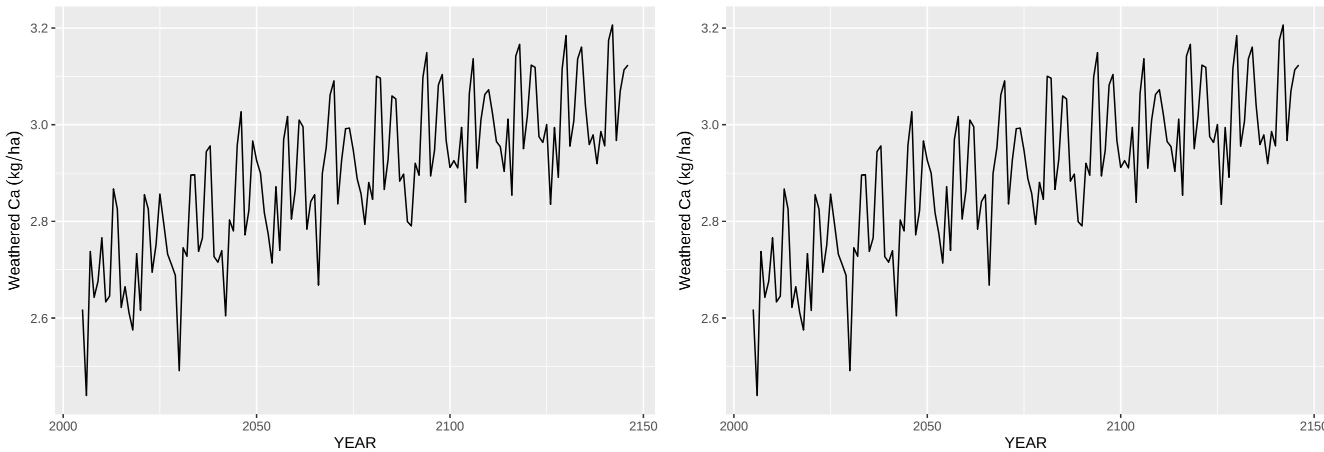


Figure 12: Calcium Weathering (All Layer)

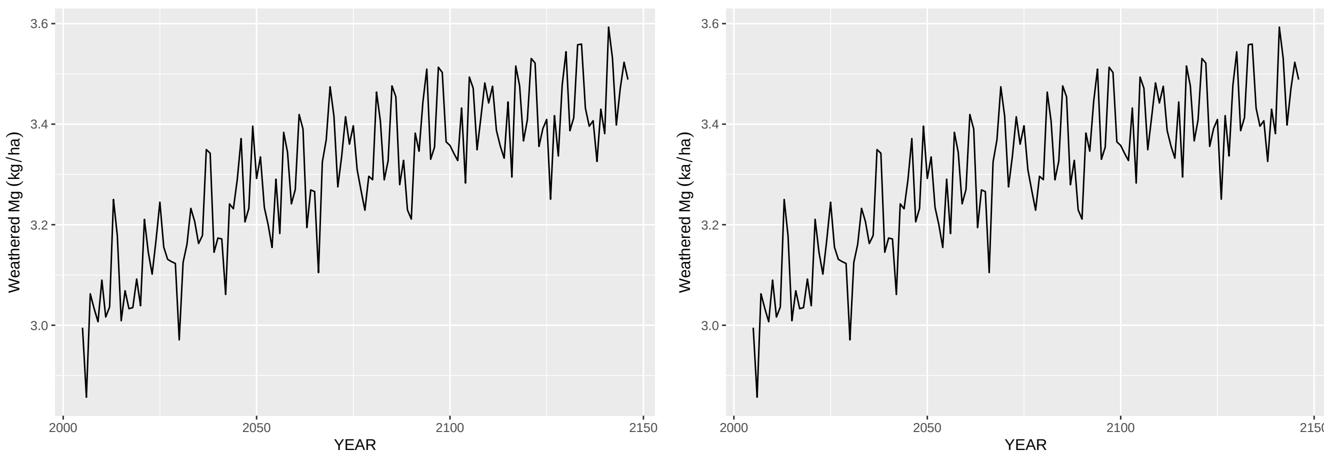


Figure 13: Magnesium Weathering (All Layer)

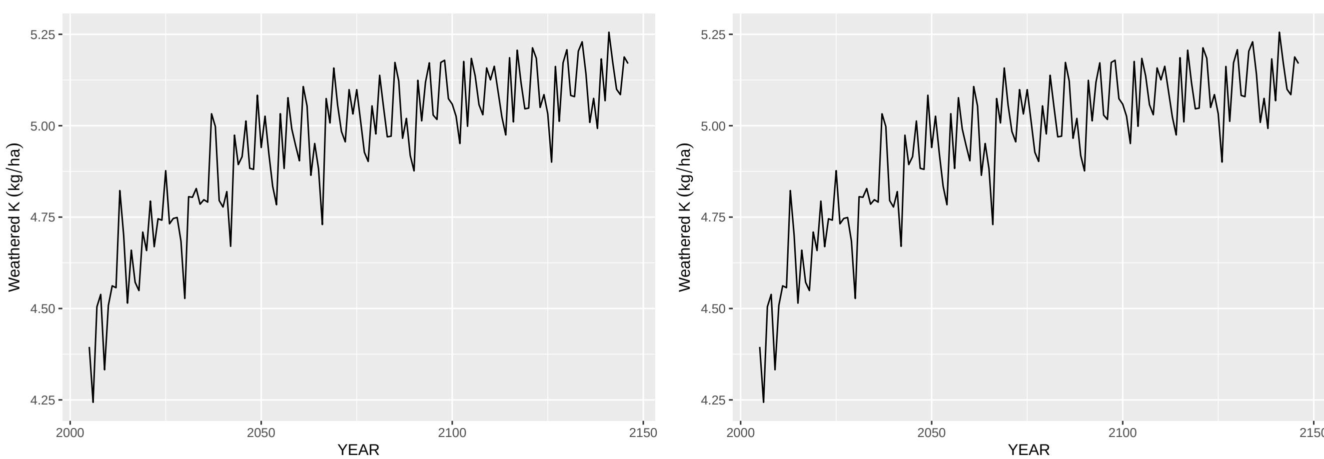


Figure 14: Potassium Weathering (All Layer)

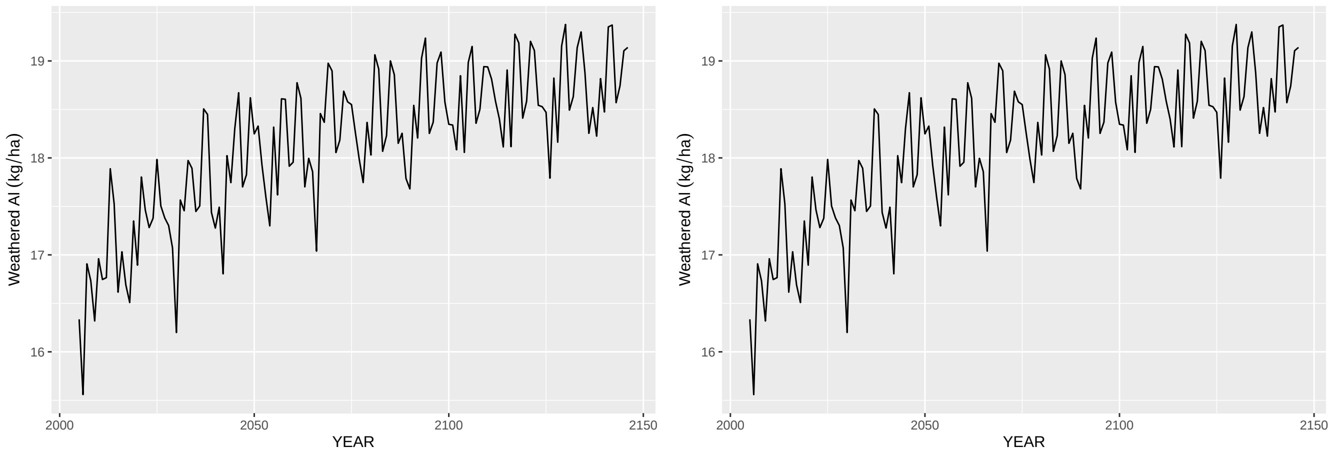


Figure 15: Aluminum Weathering (All Layer)

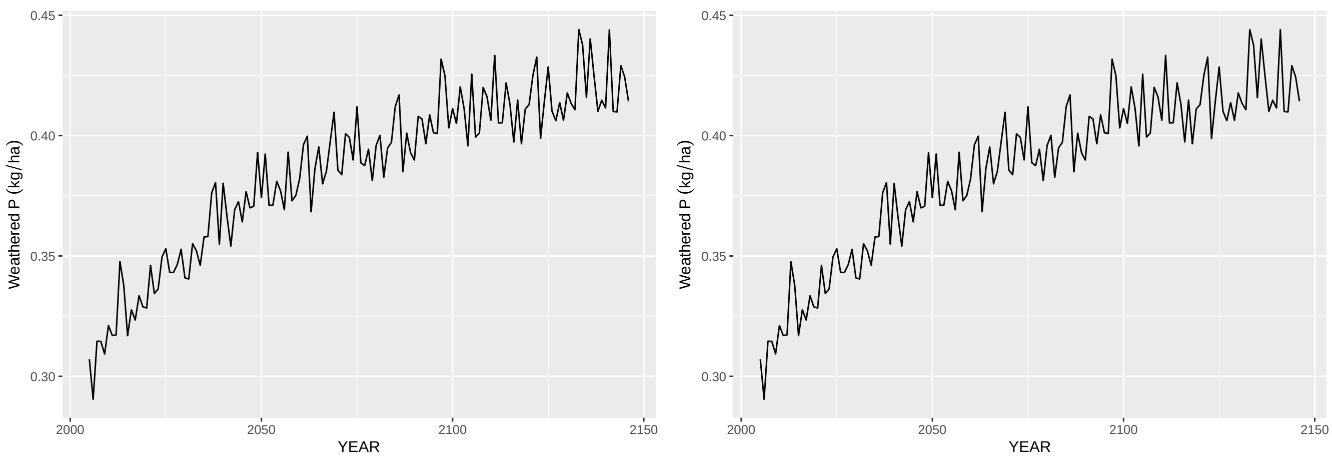


Figure 16: Phosphate Weathering (All Layer)

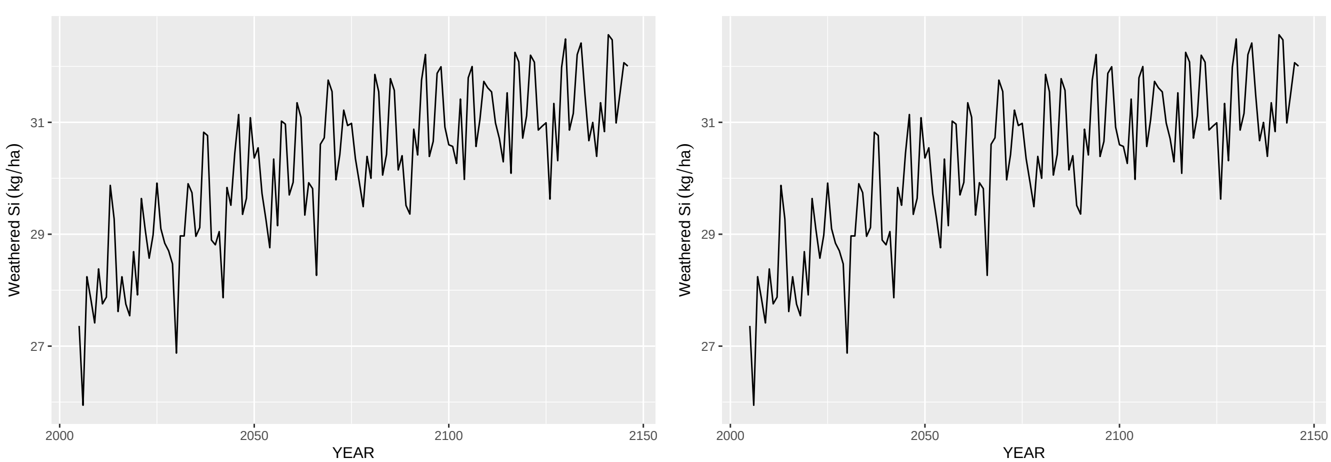


Figure 17: Silica Weathering (All Layer)

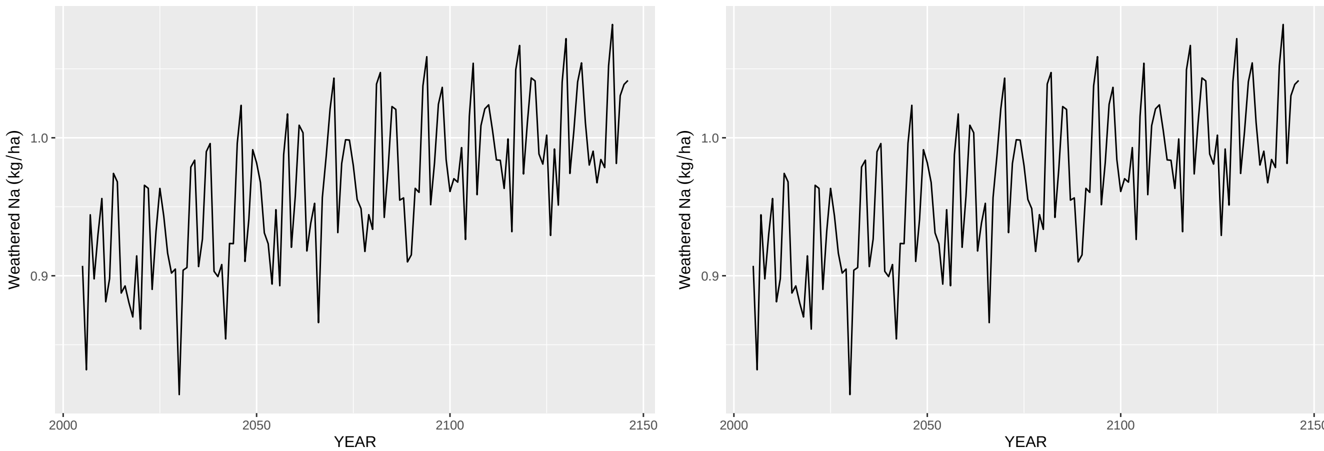
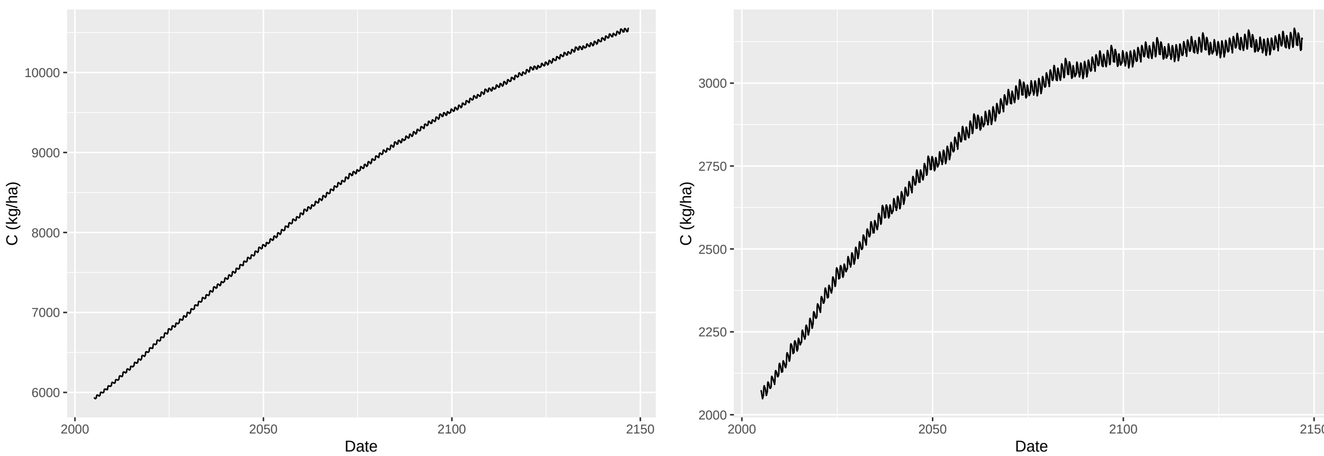


Figure 18: Sodium Weathering (All Layer)

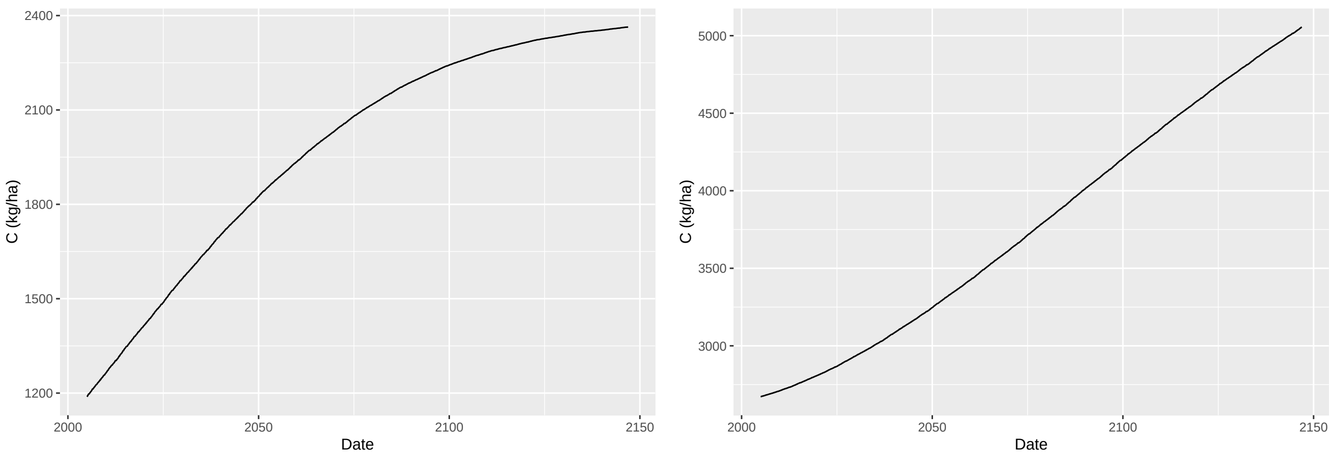
Litter Pool Results



(a) Total forest floor carbon content (kg/ha)

(b) Carbon content of coarse litter (kg/ha)

Figure 19: Forest Floor (O-Layer) Carbon Content Over Simulation Period

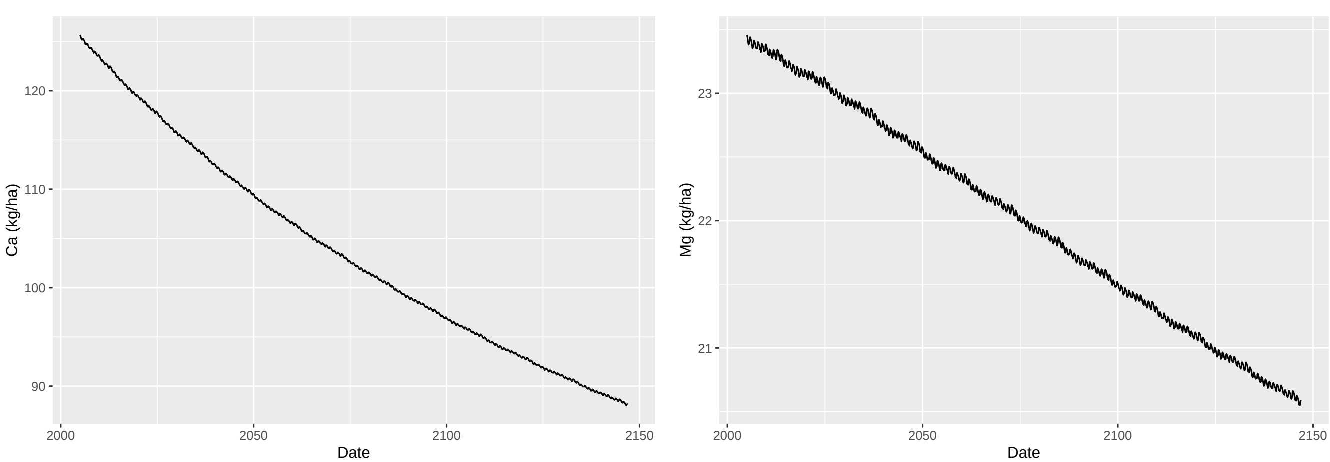


(a) Carbon content of fine litter (kg/ha)

(b) Carbon content of humic litter (kg/ha)

Figure 20: Forest Floor (O-Layer) Carbon Content Over Simulation Period

Note that the fine litter pool (the stage between humus and fresh/coarse litter) is growing in this model. This might deviate from observed behavior.



(a) Litter Calcium Content

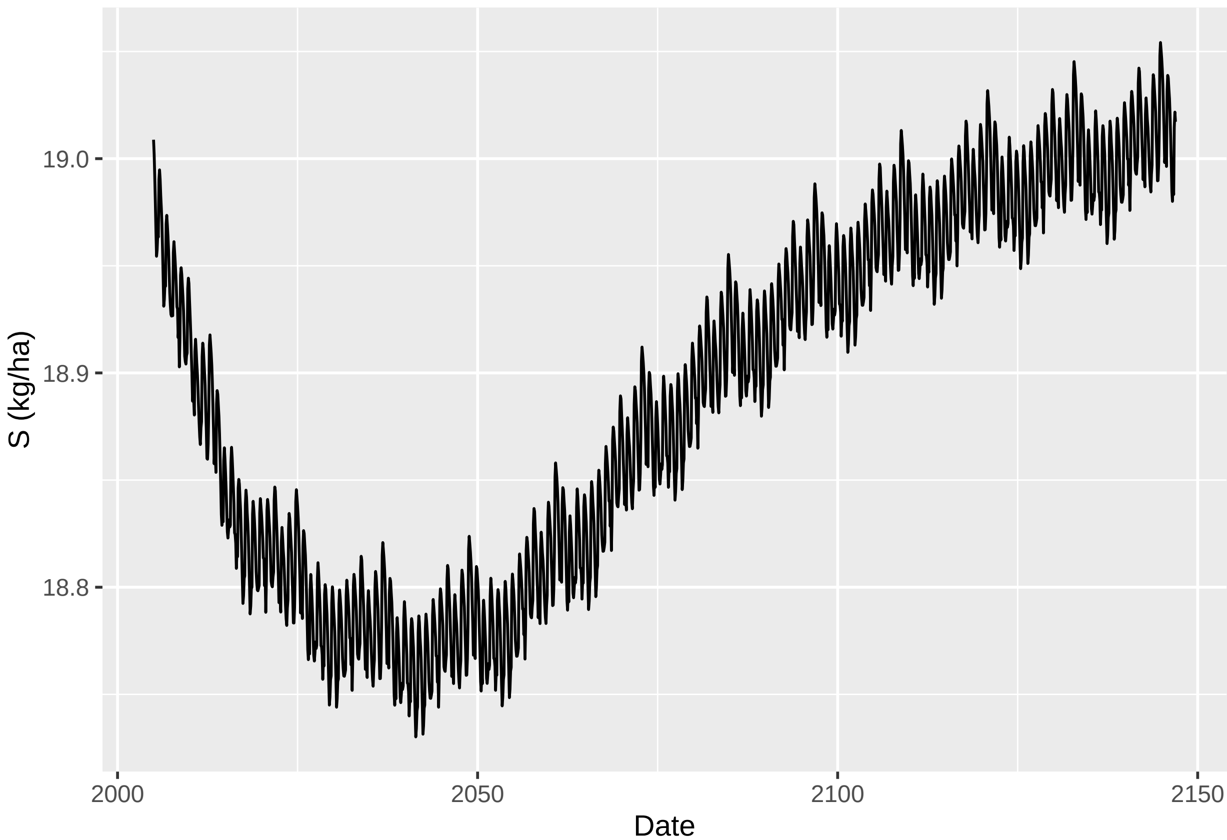
(b) Litter Magnesium Content

Figure 21: Litter Pool Nutrient Content Over Simulation Period

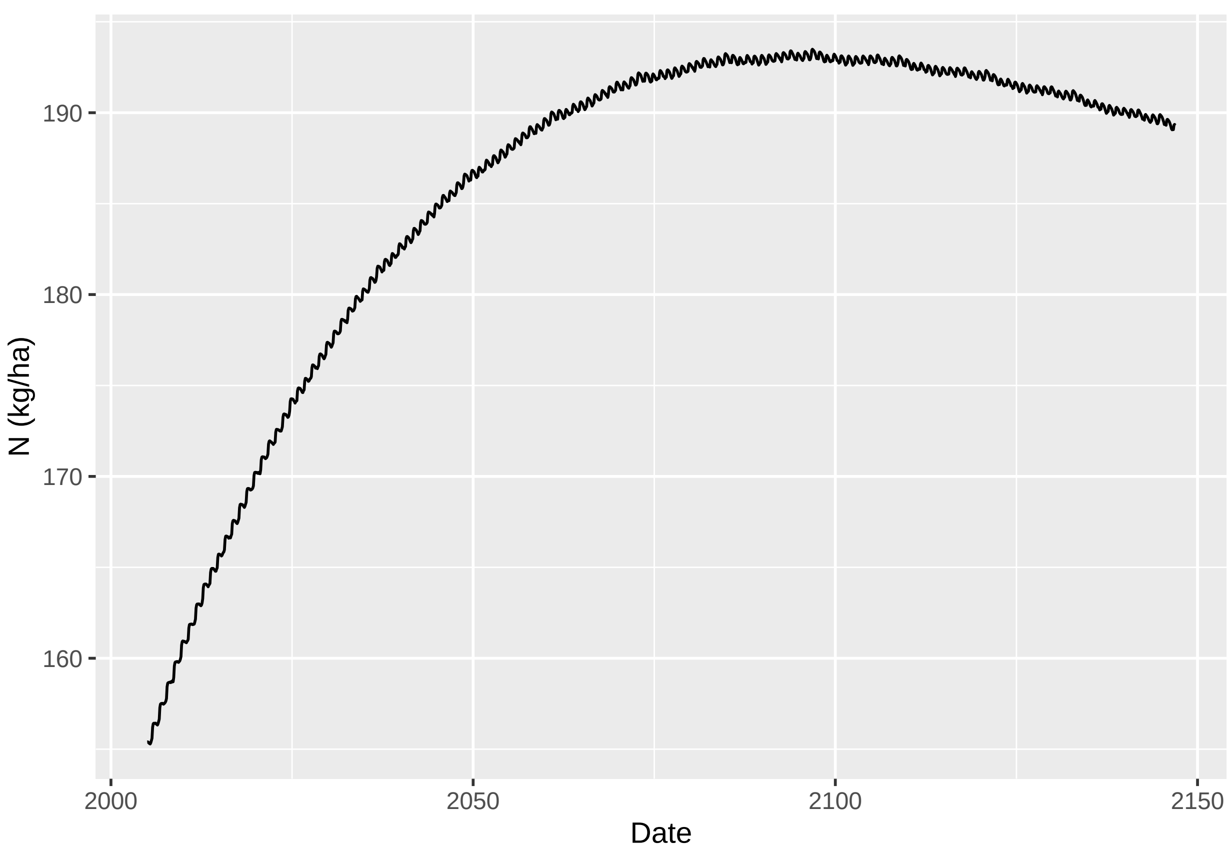
Obtaining stable and or increasing litter pool nutrient content was achieved by lowering the release factor from 1 to .25. This means that instead of decomposition occurring proportional to the litter concentration, it occurs at 25% of the litter concentration. The decomposition rate values were also calibrated from approximate values, until the model showed net C gain in the forest floor/organic horizon rather than net loss.

As of now, forest floor carbon content and carbon sequestration over time is in line with published literature (if we use certain sites as a kind of rough chronosequence; I will describe more of this in a later update). Furthermore, fine and coarse litter pools seem to be approaching steady state, which is expected of old growth forests, assuming that litterfall quantity stabilizes over the whole stand over time.

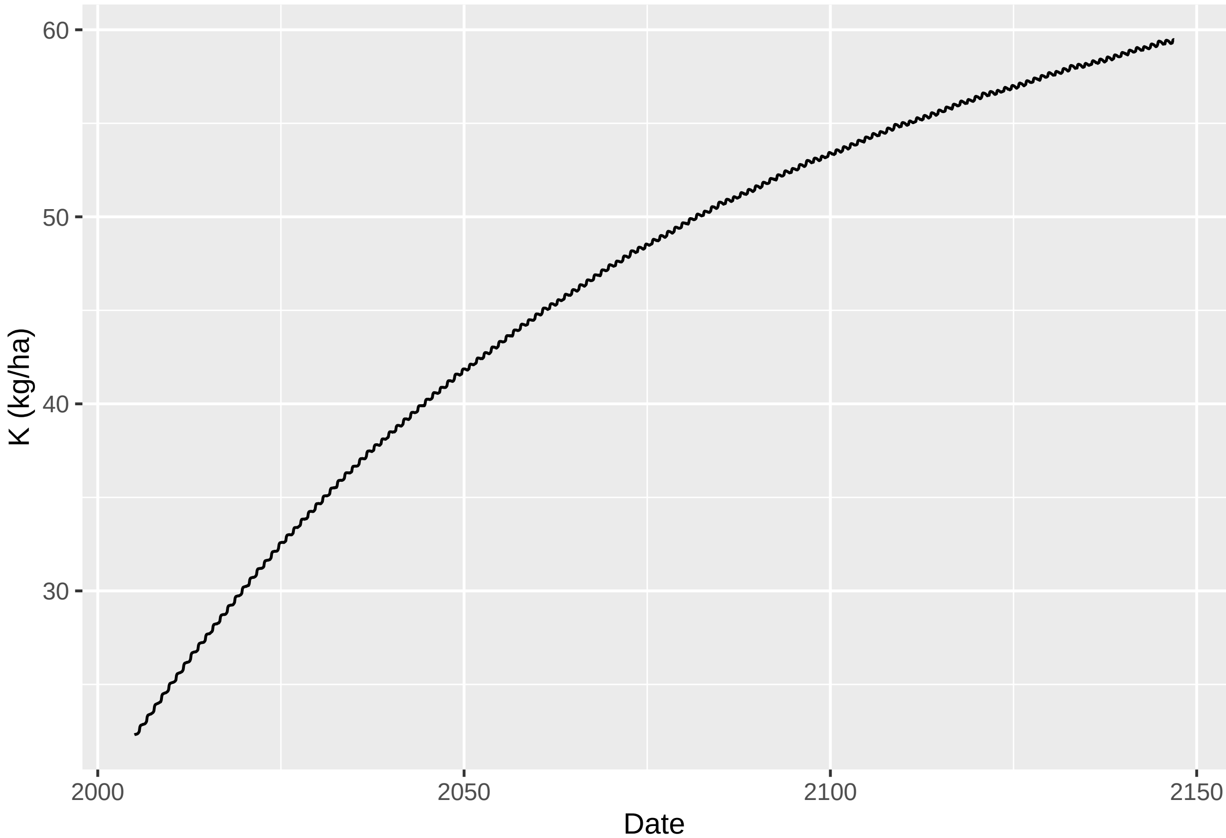
The next step was to see how greater litter retention affected S and P dynamics specifically, which have ecosystem retention issues.

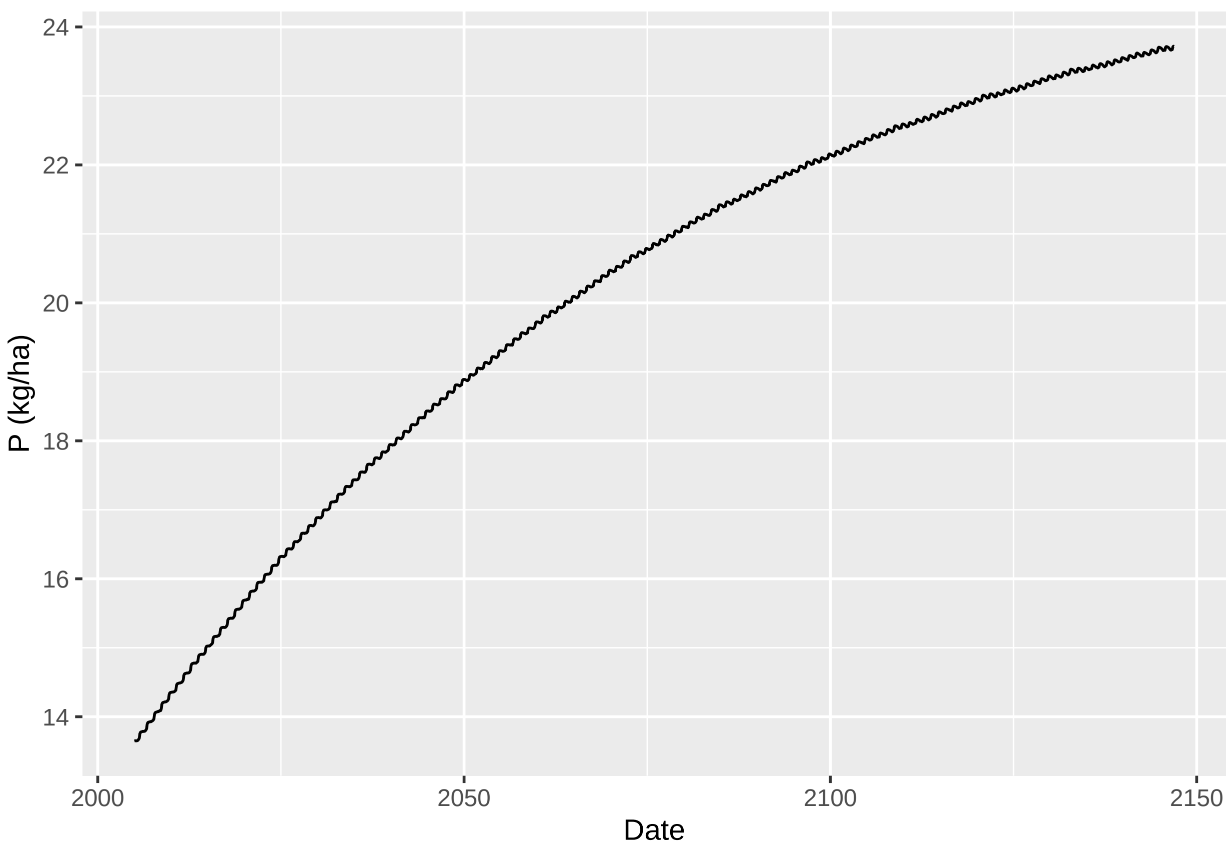


S (kg/ha)
19.0
18.9
18.8
2000
2050
2100
2150
Date

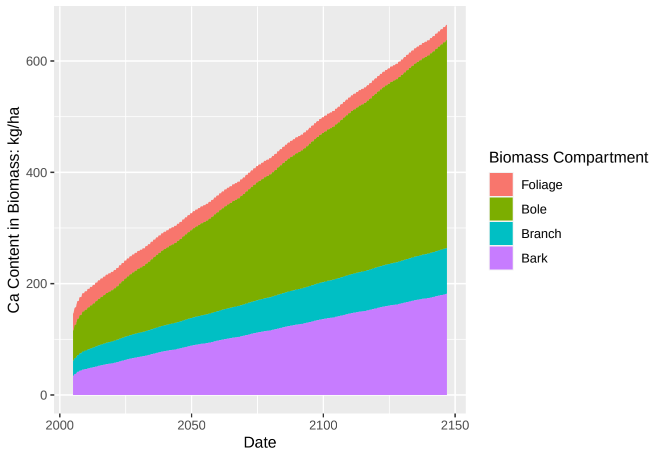


N (kg/ha)
190
180
170
160
2000
2050
2100
2150
Date

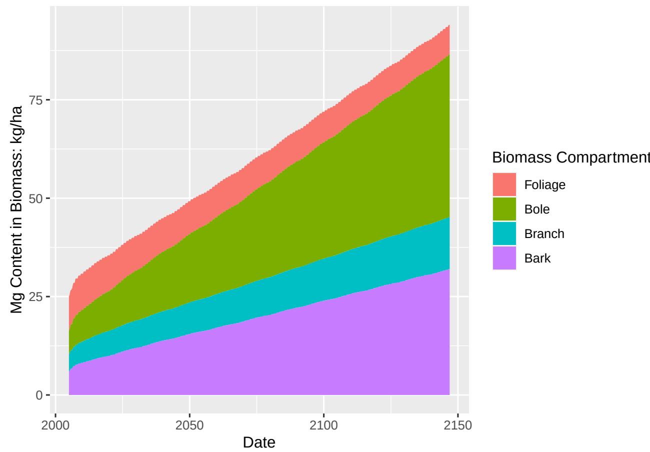

60
50
40
30
K (kg/ha)
2000
2050
2100
2150
Date


24
22
20
18
16
14
P (kg/ha)
2000
2050
2100
2150
Date

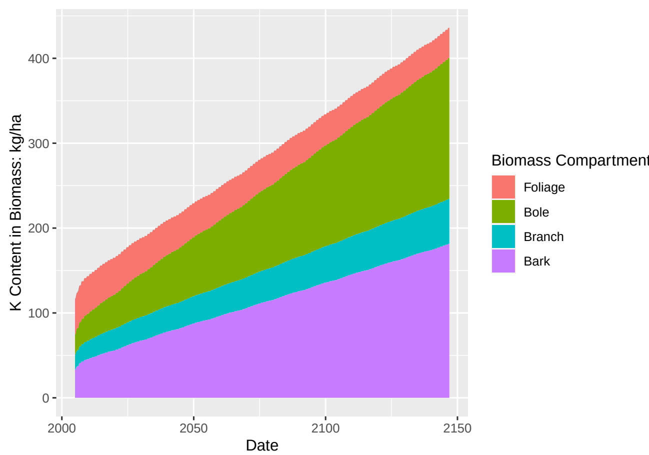
Tree Nutrient Content



(a) Calcium content in each biomass compartment

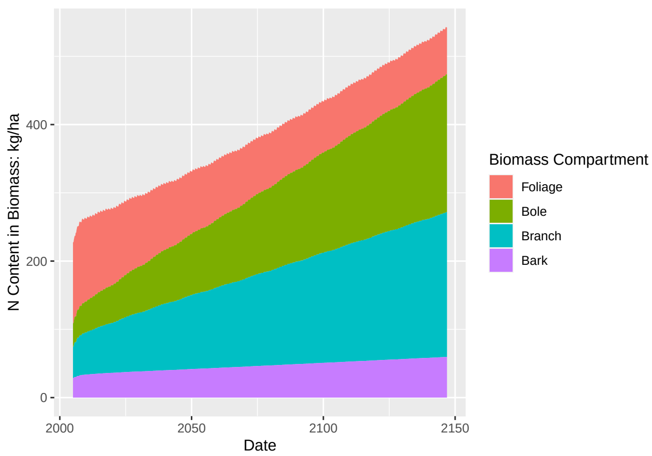


(b) Magnesium content in each biomass compartment

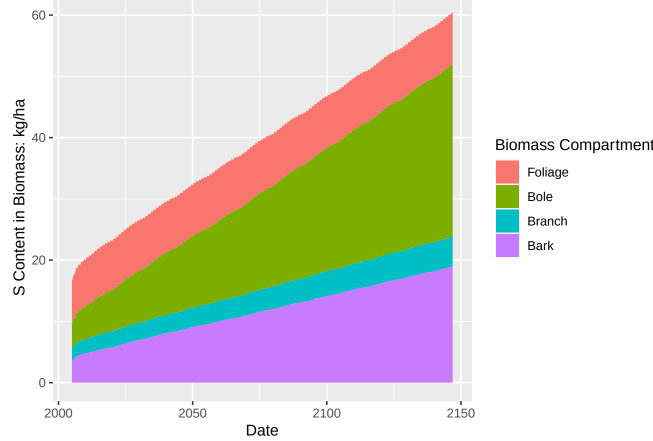


(c) Potassium content in each biomass compartment

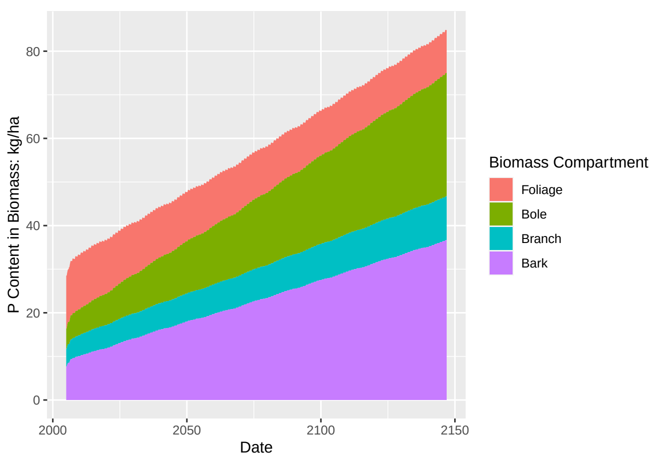
Figure 22: Base Cation Nutrient Content in Simulated Forest



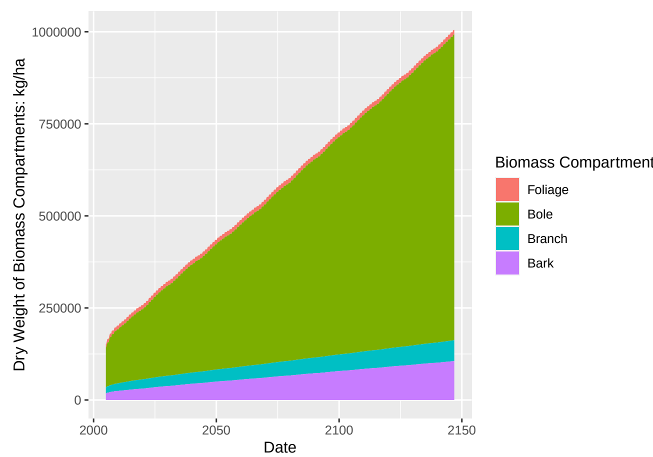
(a) Nitrogen content in each biomass compartment



(b) Sulfur content in each biomass compartment



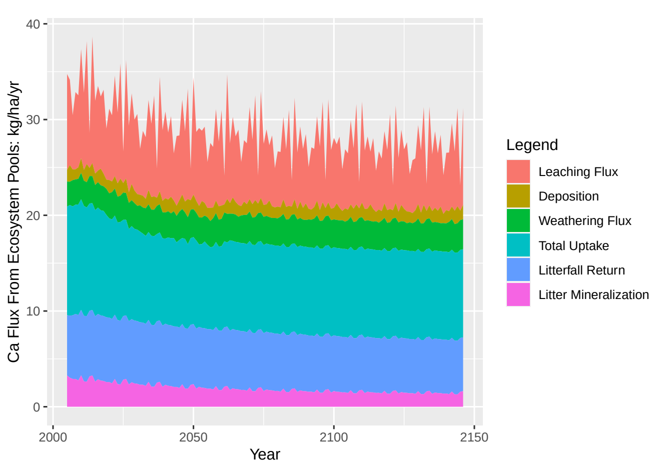
(c) Phosphorous content in each biomass compartment



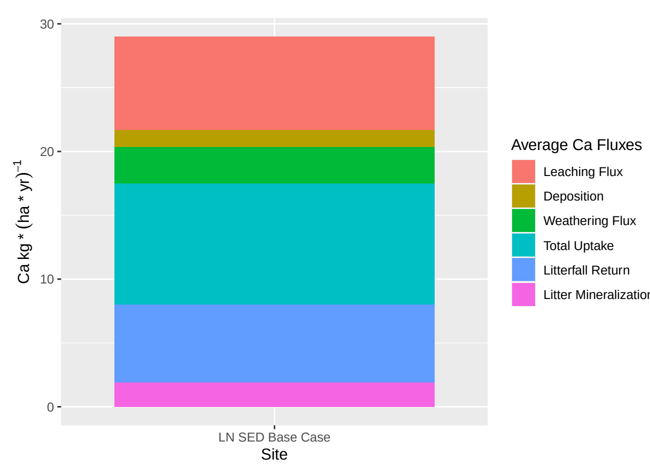
(d) Biomass of each compartment

Figure 23: N, S, and P Nutrient Contents and biomass per compartment

Analysis 1: Stack Flux Data

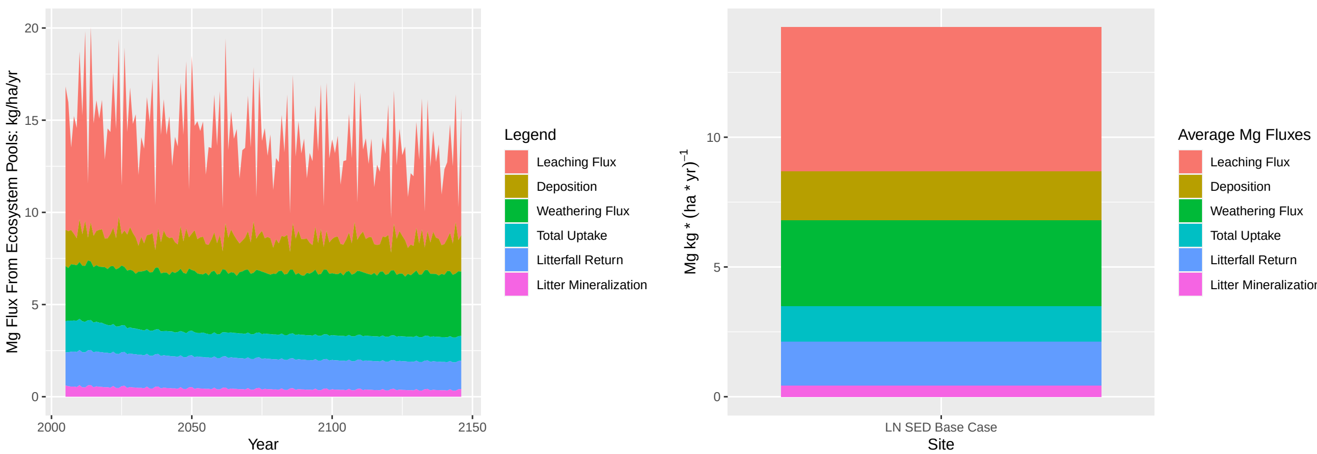


(a) Ca input and output fluxes over time



(b) Total Average Ca input and output fluxes

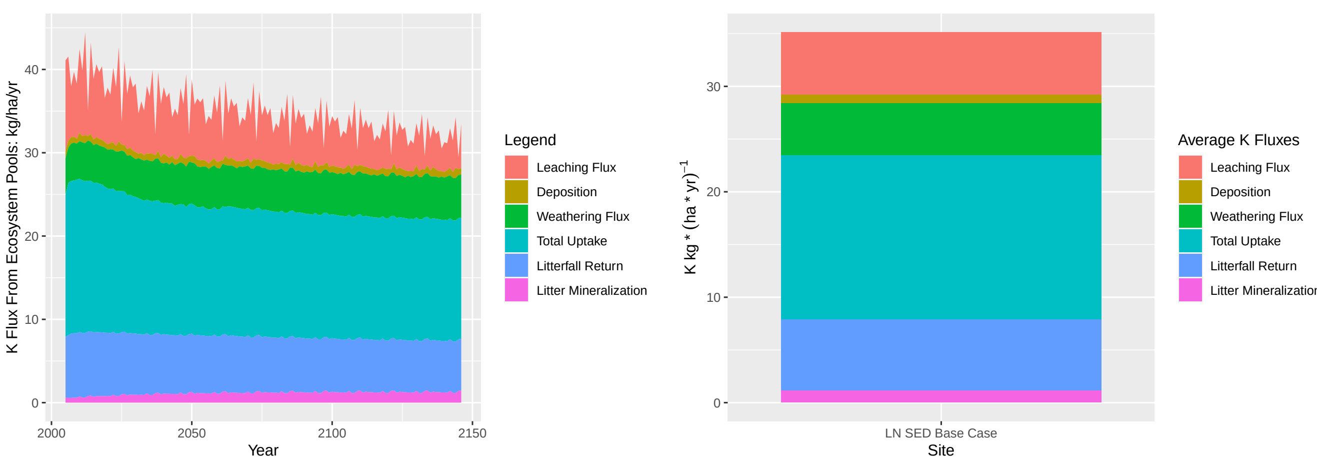
Figure 24: Calcium input and output comparison graphs



(a) Mg input and output fluxes over time

(b) Total Average Mg input and output fluxes

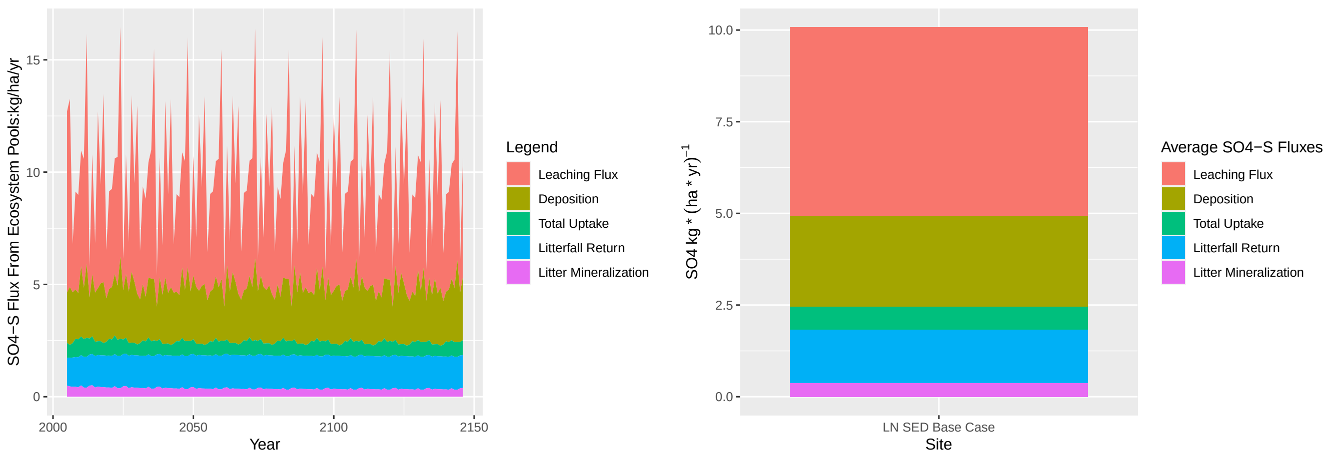
Figure 25: Magnesium input and output comparison graphs



(a) K input and output fluxes over time

(b) Total Average K input and output fluxes

Figure 26: Potassium input and output comparison graphs

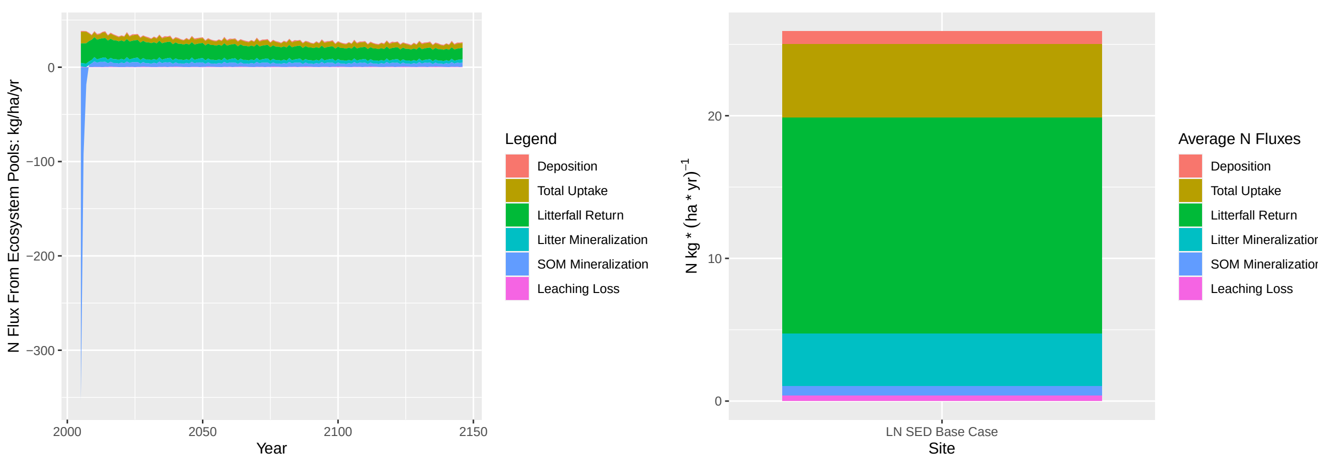


(a) S input and output fluxes over time

(b) Total Average S input and output fluxes

Figure 27: Sulfur input and output comparison graphs

I tested sulfate by getting rid of absorbed sulfate altogether and only allowing for atmospheric input and uptake dominate SO4 dynamics. This seemed to allow for easy calibration of SO4 concentrations.



(a) N input and output fluxes over time

(b) Total Average N input and output fluxes

Figure 28: Nitrogen input and output comparison graphs

Notice how SOM mineralization starts off highly negative (-358 kg/ha/yr N); implying a large net N uptake in the microbial pool. The mineralization then balances out and steadily returns N to the soil over time, behaving normally. I do need the microbial pool to help calibrate the N cycle, but I may need to reduce the CEC stabilized N and decrease the N-uptake in the microbial pool. These results likely imply too much N is going through the system and that the microbial pool is too large of an N pool.

Cation Exchange Capacity

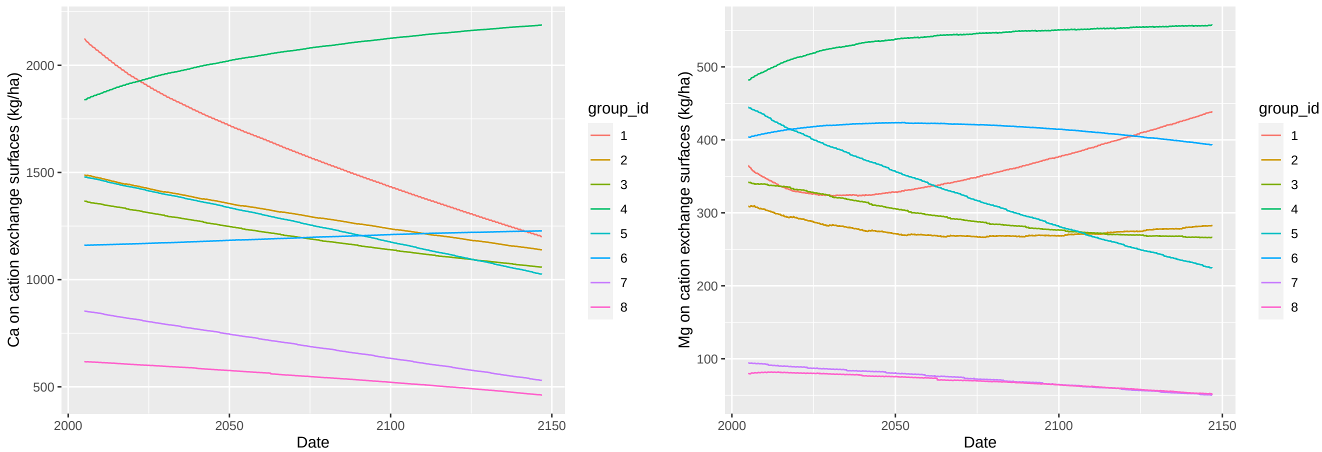


Figure 29: Calcium and Magnesium CEC adsorption over time

Figure 30: Potassium and Sodium CEC adsorption over time

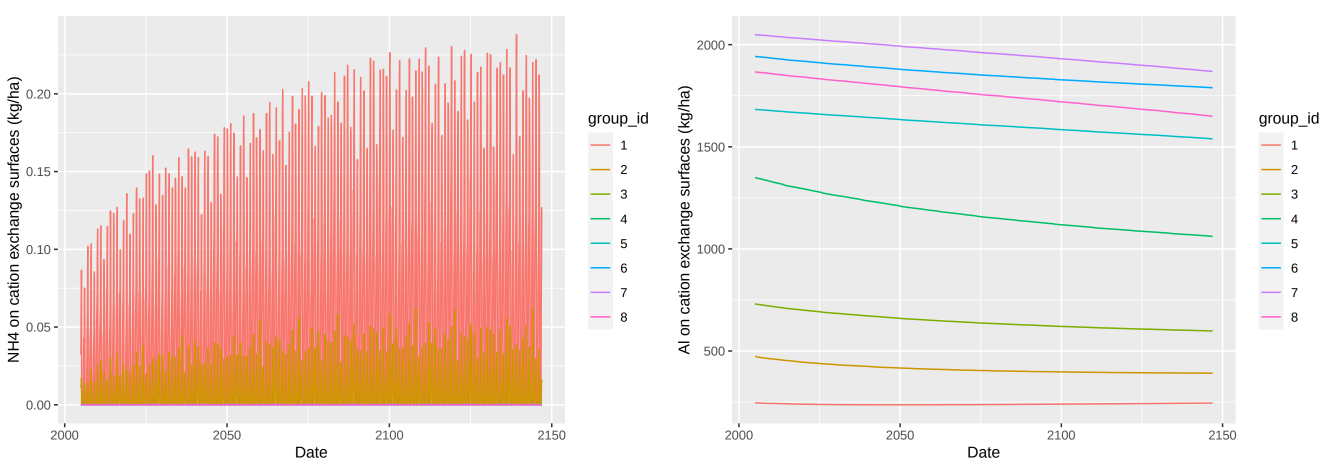


Figure 31: Ammonium and Aluminum CEC adsorption over time

Anion Exchange Capacity

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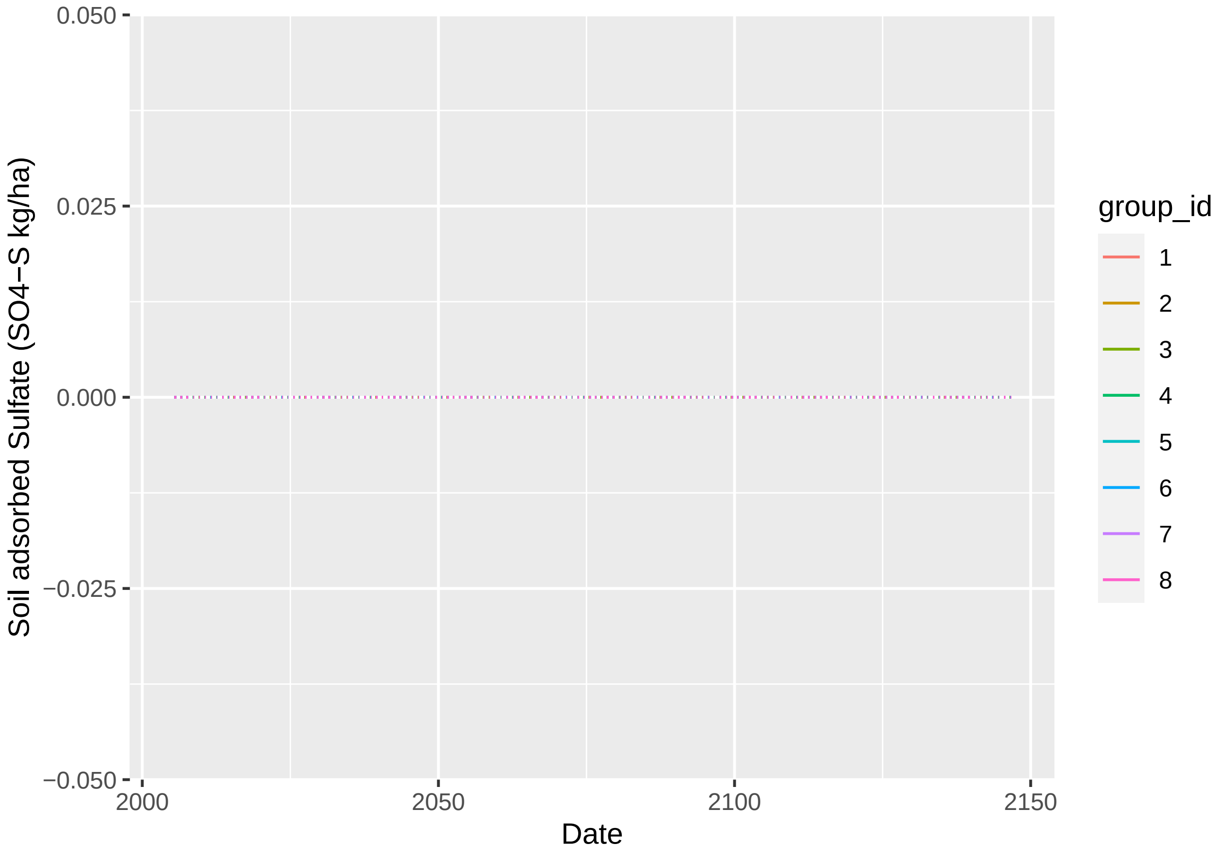

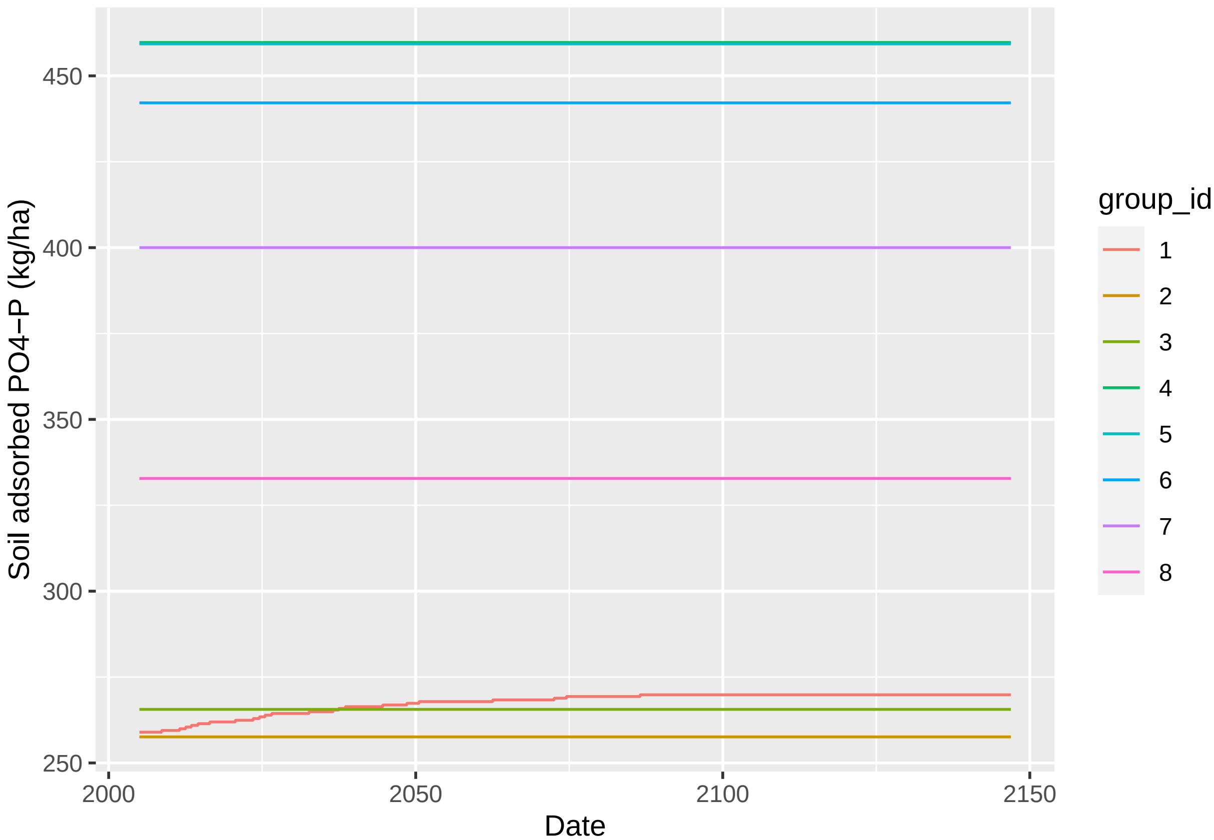

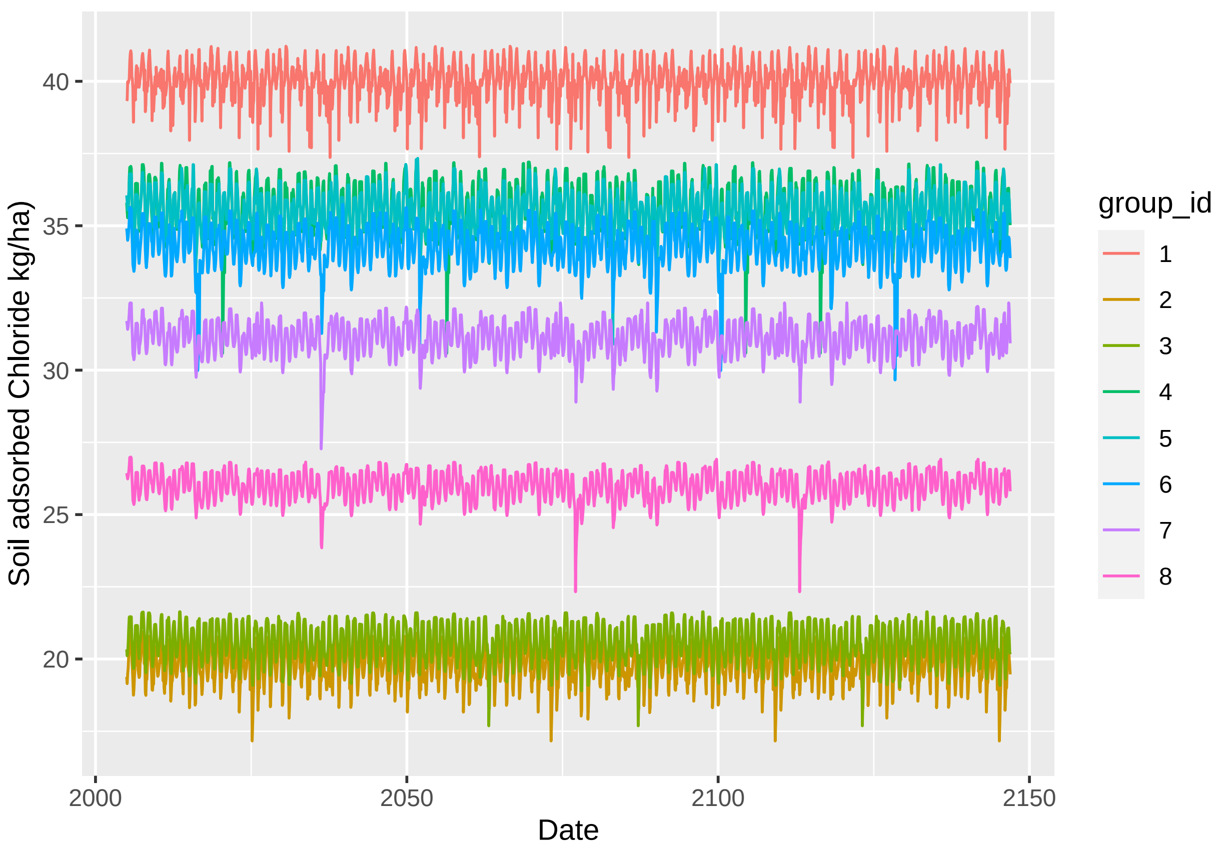

Phosphate seems stable, generally. It should be noted that P uptake is not being modeled in the foliage (it should remain constant so far) and that phosphate adsorption parameters are completely borrowed from the Burgundy site. As for sulfate, I purged the model of the AEC sulfate pool and relegated all soil S to the SOM organic pool.

I further note that the ALSEA rain chemistry seems to be lacking in Na and Cl, when I completely take away Cl adsorption, I don't get anywhere near the concentration of Cl measured in the lysimeters, like I do for sulfate.

Other