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	12.29	16.2	16.2	42.7	1.417	0.643	22.6	55.2	1.022	332	0.01832	14.8	19.14	4.72	34.0	13.5
Layer 2	16.45	22.6	19.2	53.2	1.043	0.374	26.3	63.0	0.896	579	0.03004	32.6	24.12	4.62	57.3	25.4
Layer 3	22.53	26.6	22.1	49.2	0.628	0.218	24.7	69.1	0.725	648	0.01653	44.7	17.35	4.76	67.0	25.6
Layer 4	9.84	17.0	15.1	48.4	0.404	0.425	19.4	65.6	0.404	398	0.03572	54.0	25.39	4.60	38.5	18.4
Layer 5	14.09	23.2	15.6	52.6	0.401	1.037	19.3	71.1	0.185	403	0.00726	56.0	10.16	4.99	43.9	13.7
Layer 6	13.22	21.1	17.8	55.6	0.418	1.298	19.3	76.5	0.229	369	0.00891	59.8	11.82	4.93	39.7	13.0
Layer 7	16.76	22.9	16.6	62.4	0.455	1.974	19.4	82.6	0.302	415	0.00522	64.2	7.94	5.10	46.5	12.8
Layer 8	16.51	21.2	19.0	69.9	0.483	2.419	19.3	87.0	0.226	414	0.00405	66.6	6.50	5.19	47.3	11.8

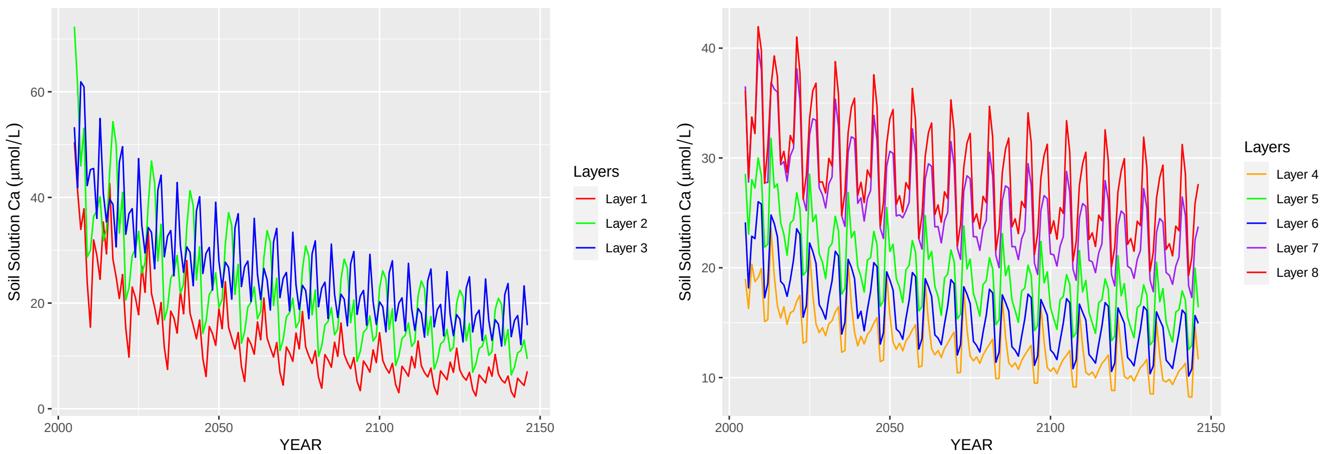


Figure 1: Monthly Calcium Concentrations by Soil Layer

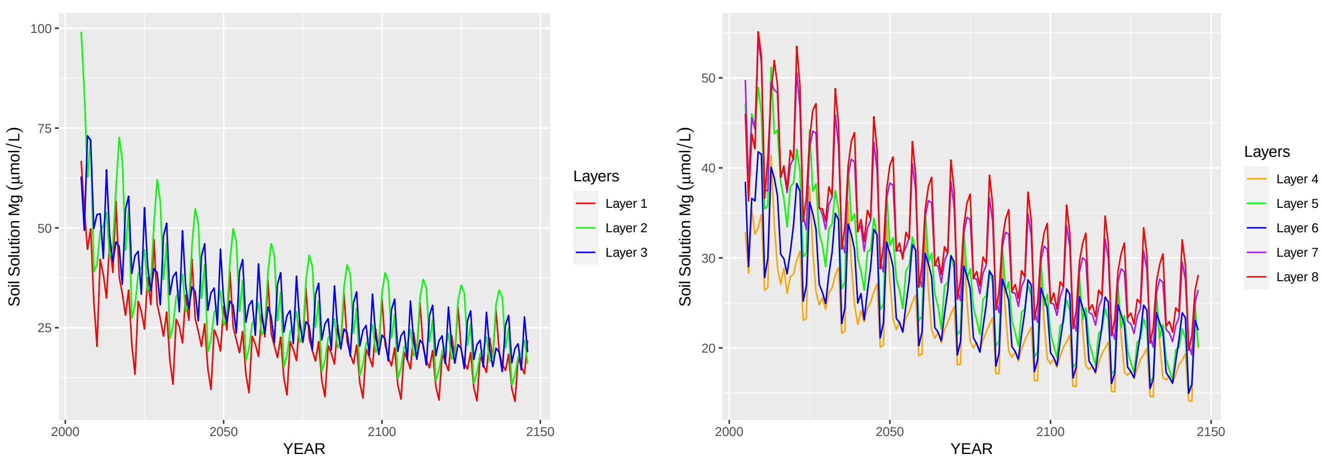


Figure 2: Monthly Magnesium Concentrations by Soil Layer

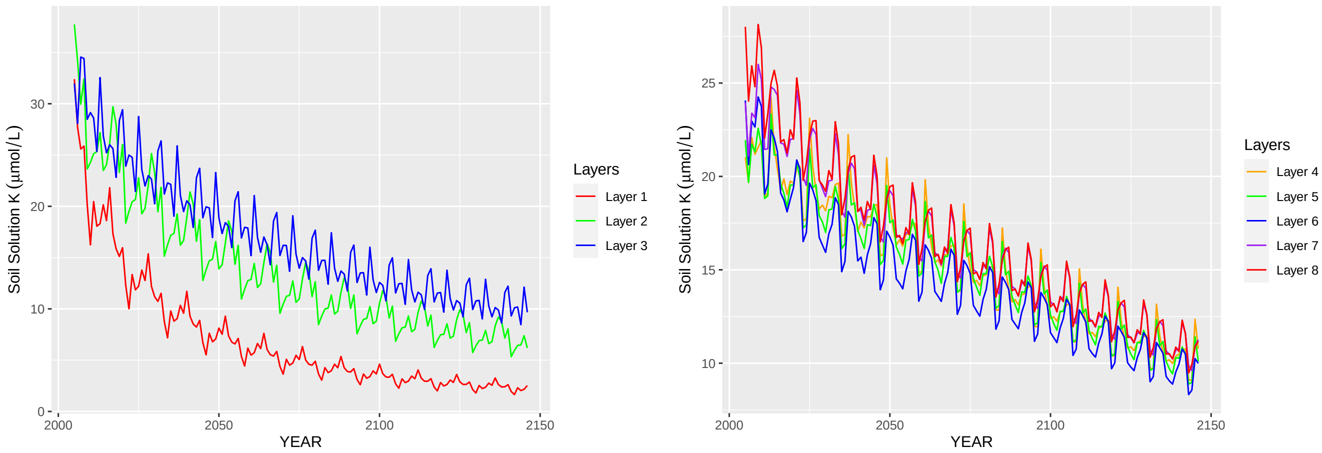


Figure 3: Monthly Potassium Concentrations by Soil Layer

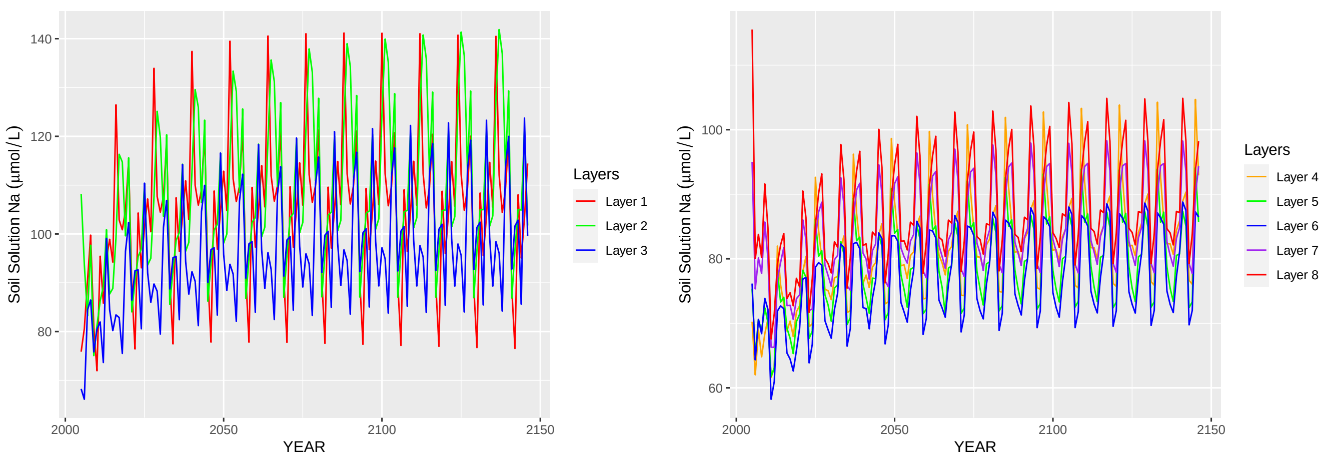


Figure 4: Monthly Sodium Concentrations by Soil Layer

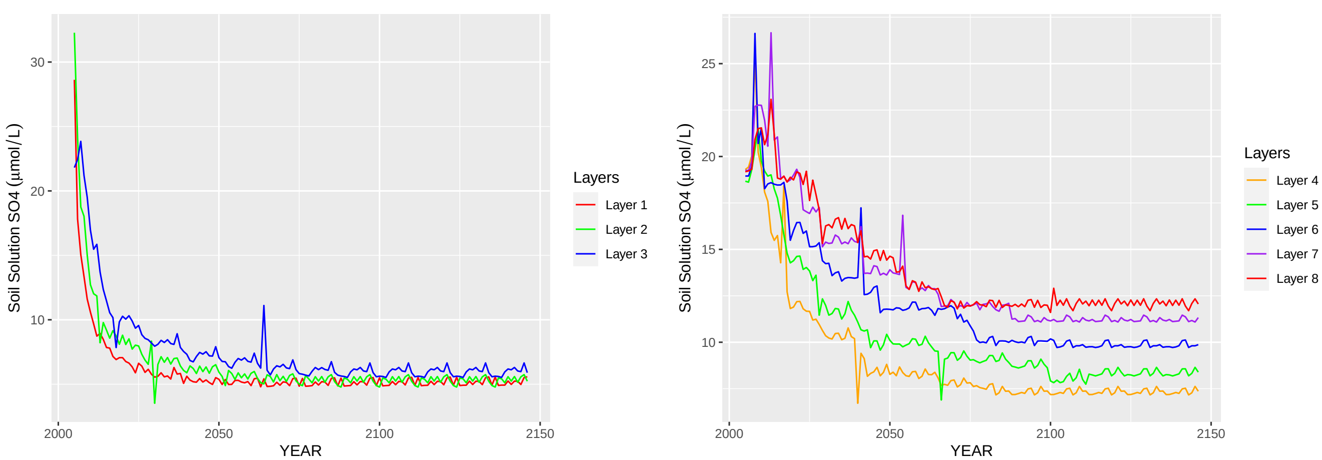


Figure 5: Monthly Sulfate Concentrations by Soil Layer

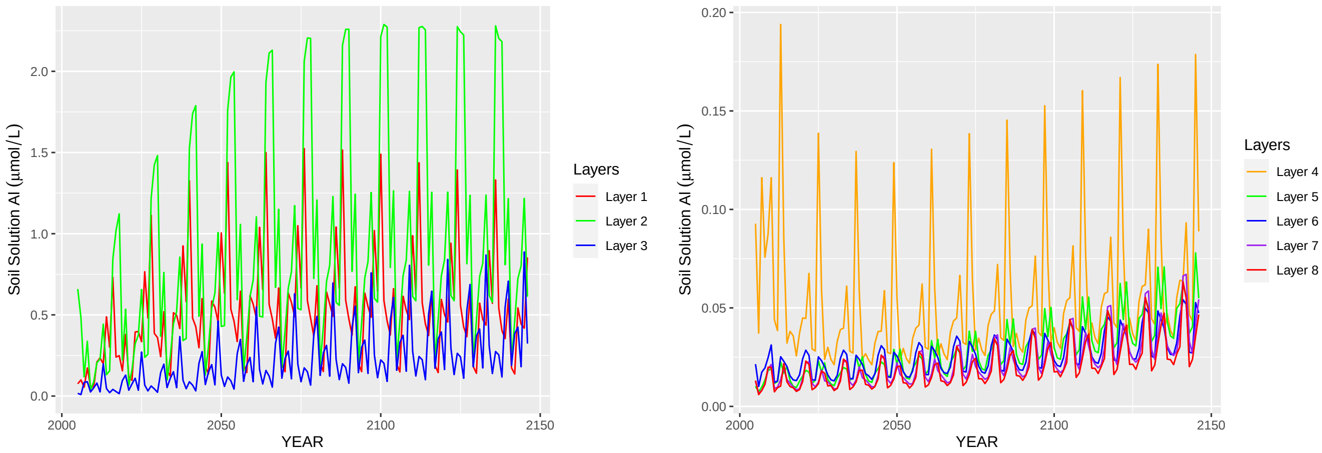


Figure 6: Monthly Aluminum Concentrations by Soil Layer

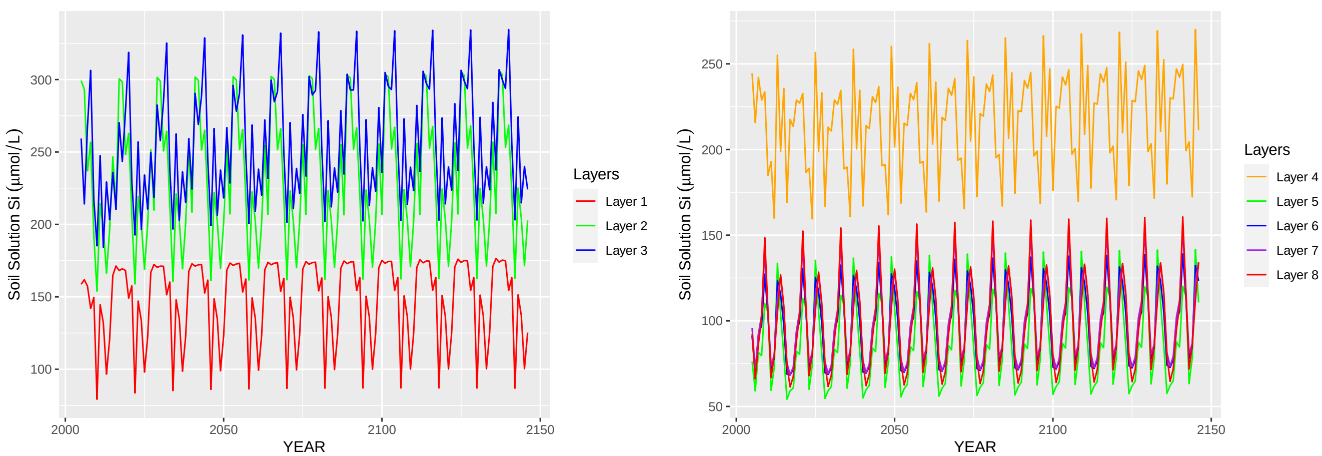


Figure 7: Monthly SiO2 Concentrations by Soil Layer

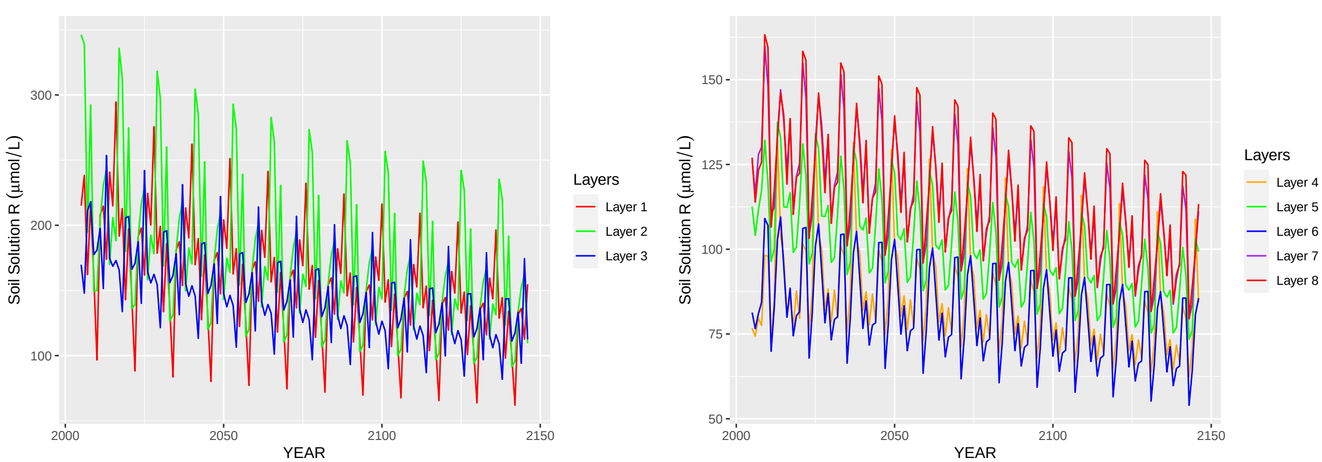


Figure 8: Monthly Organic Acid Base (R-) Concentrations by Soil Layer

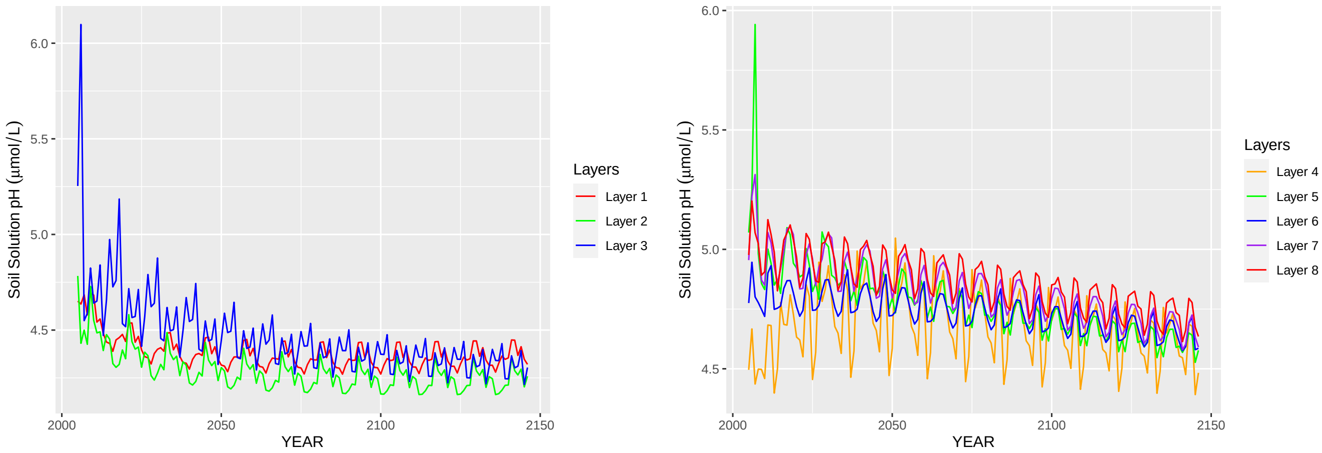


Figure 9: Monthly pH by Soil Layer

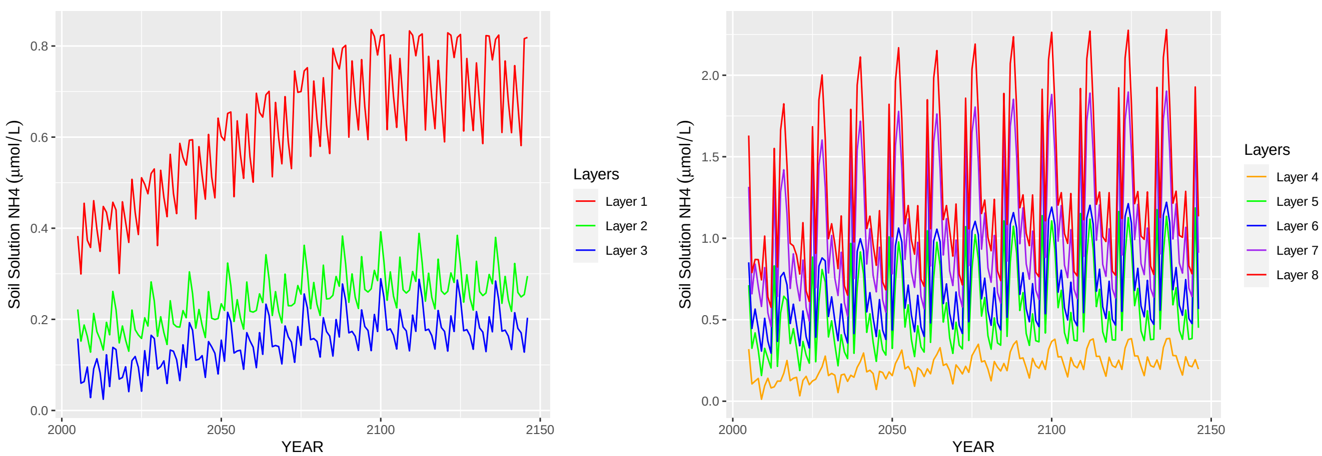


Figure 10: Yearly Ammonium concentration by Soil Layer

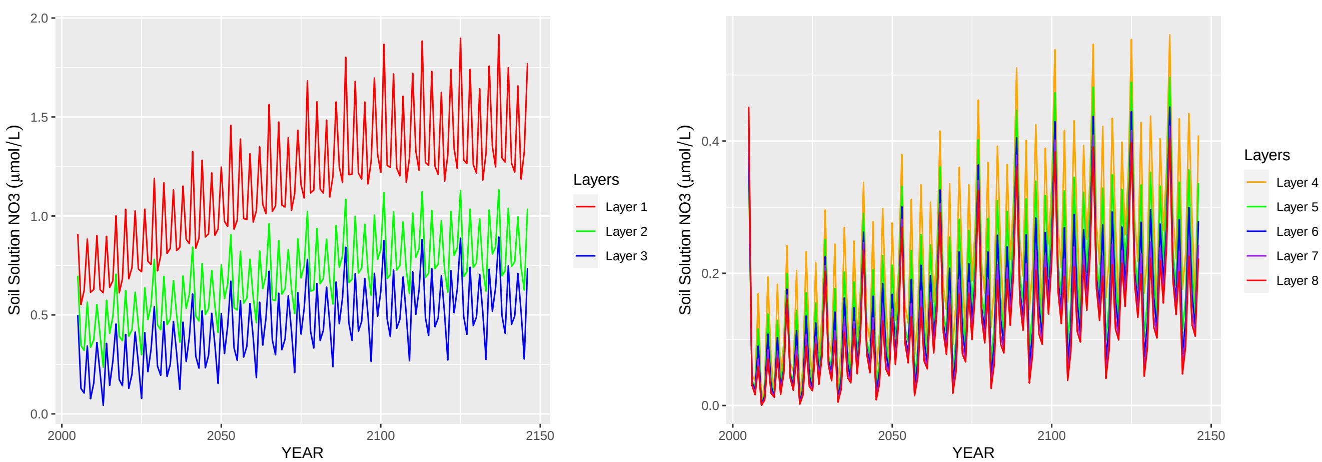


Figure 11: Yearly Nitrate concentration by Soil Layer

Weathering Results

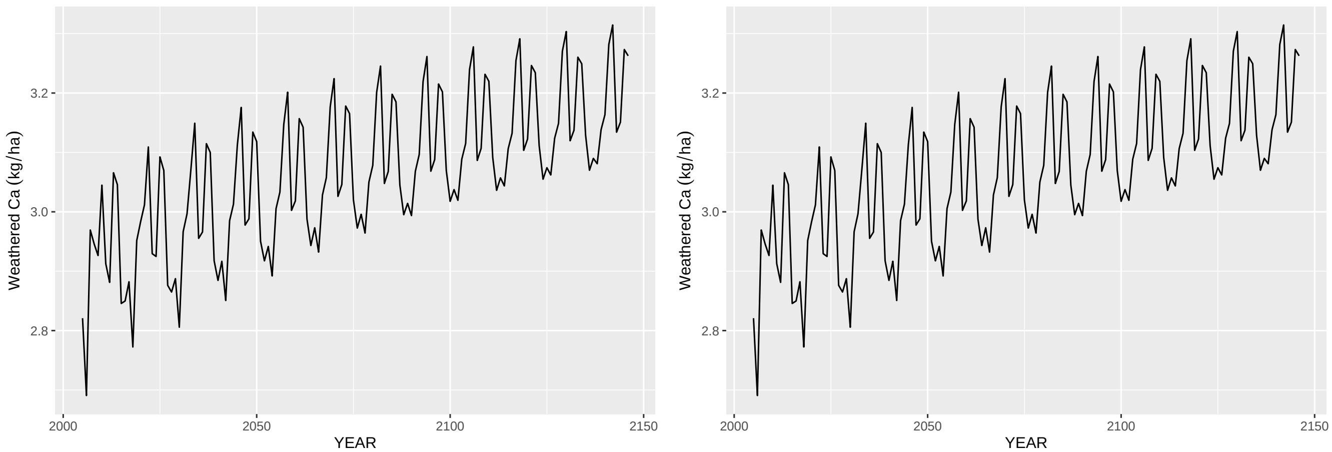


Figure 12: Calcium Weathering (All Layer)

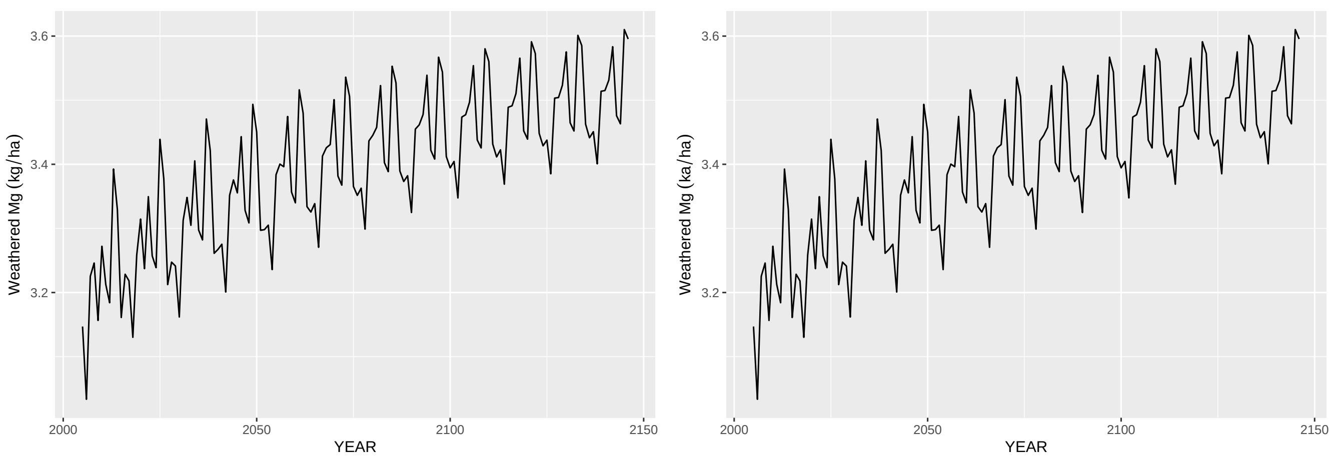


Figure 13: Magnesium Weathering (All Layer)

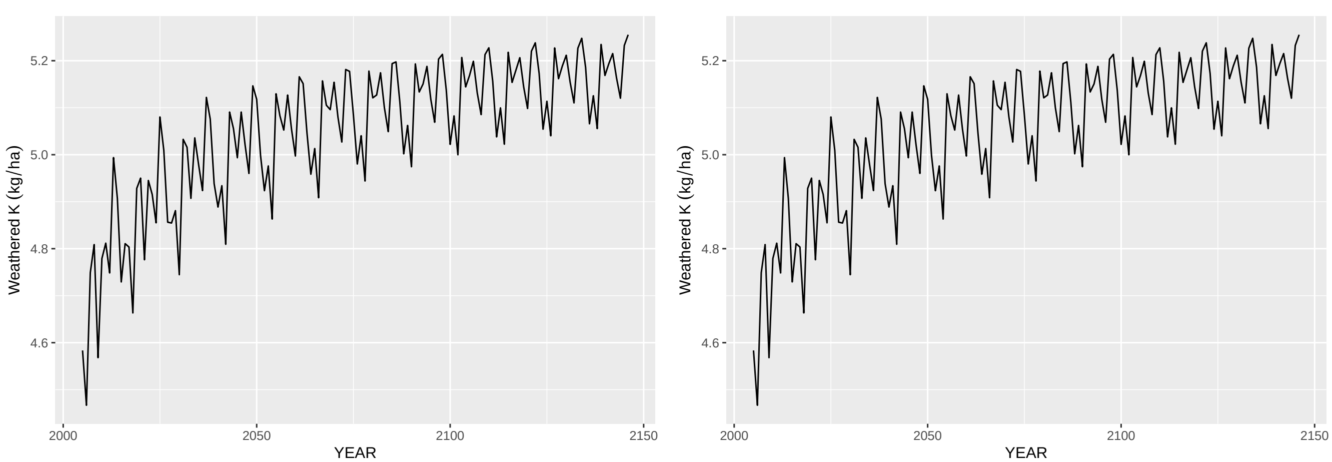


Figure 14: Potassium Weathering (All Layer)

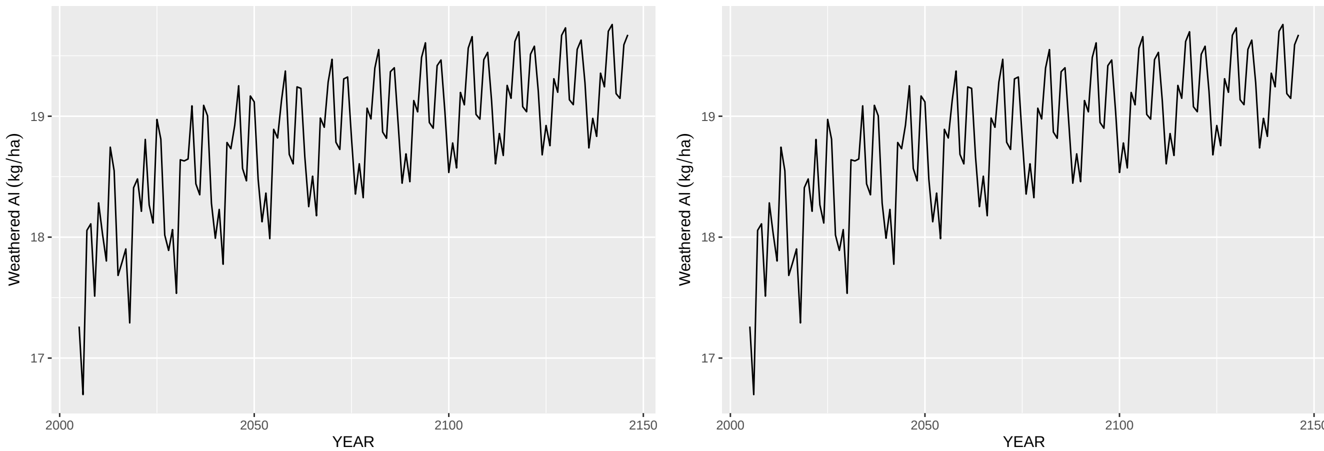


Figure 15: Aluminum Weathering (All Layer)

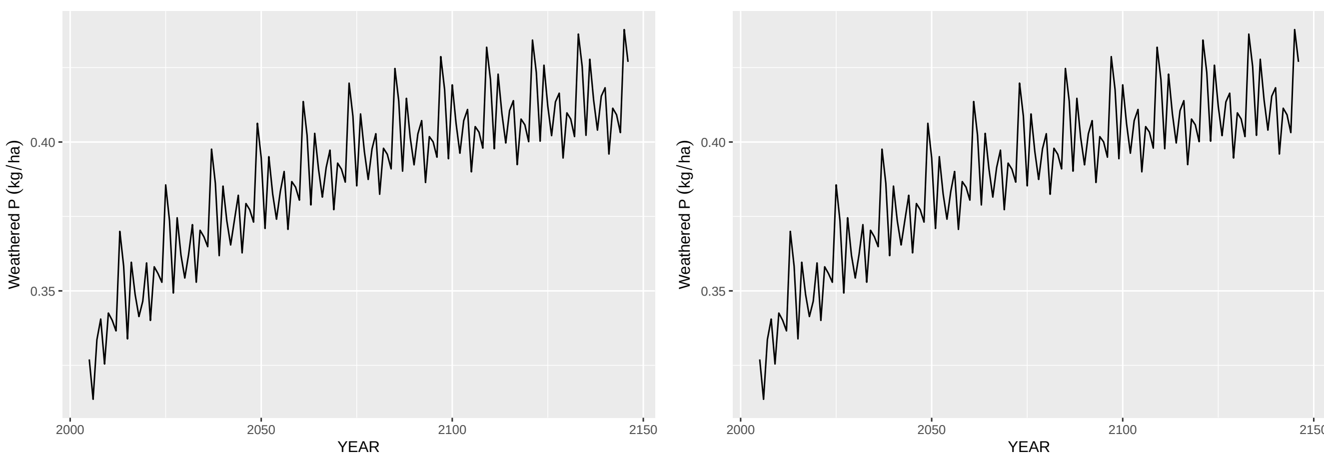


Figure 16: Phosphate Weathering (All Layer)

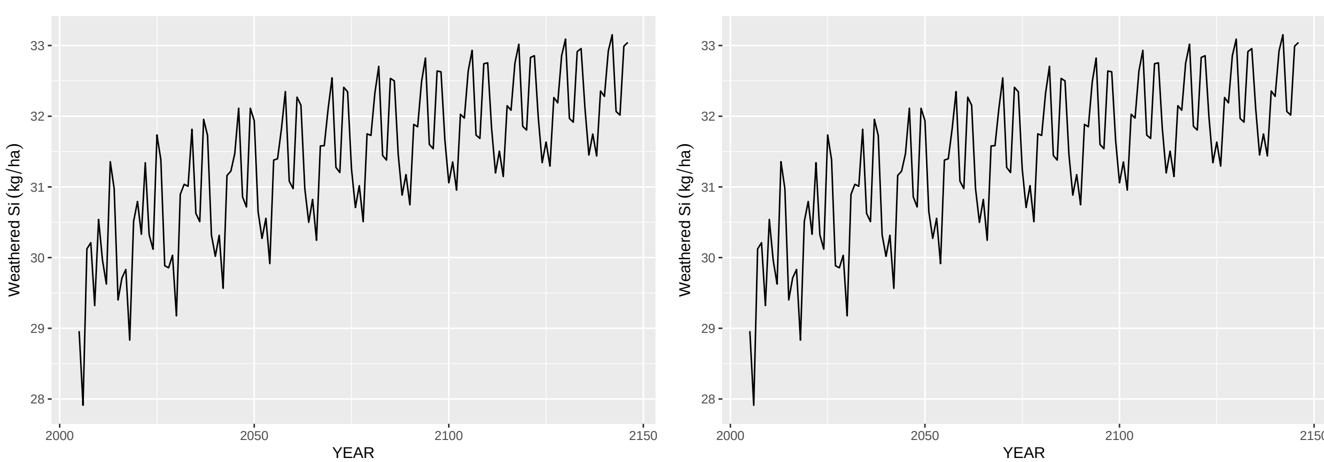


Figure 17: Silica Weathering (All Layer)

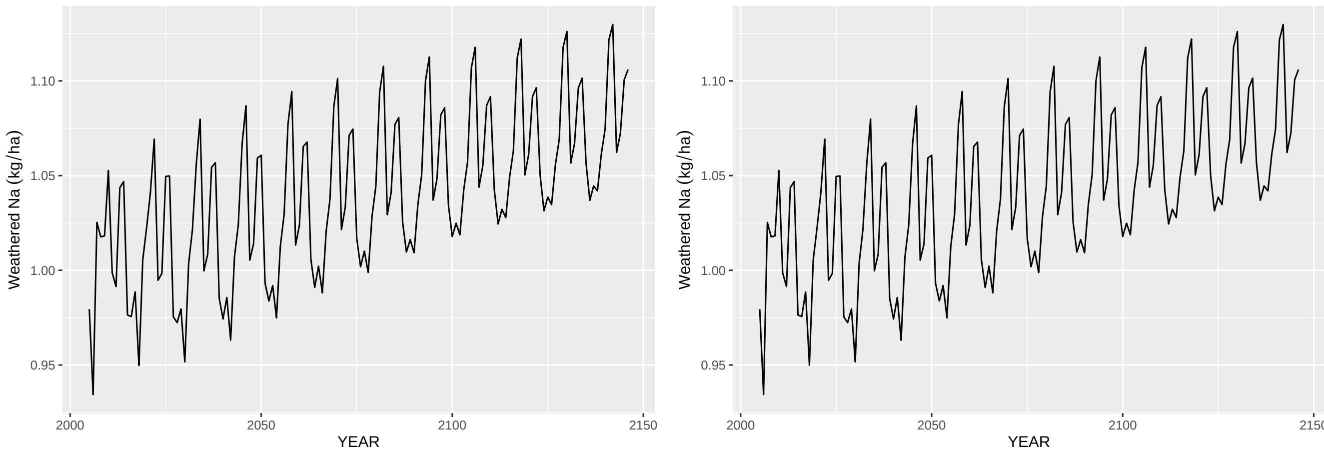
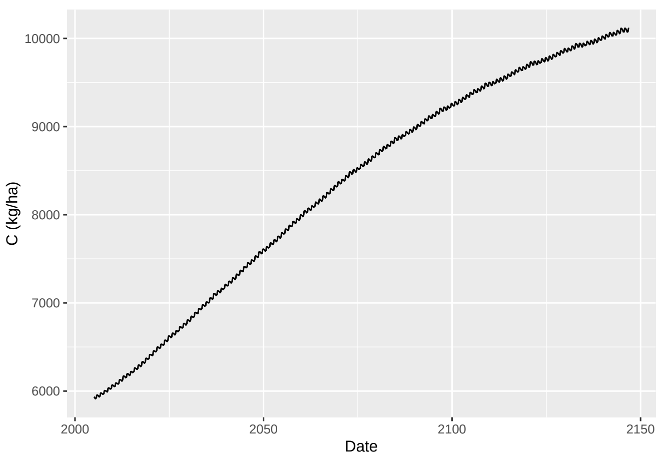
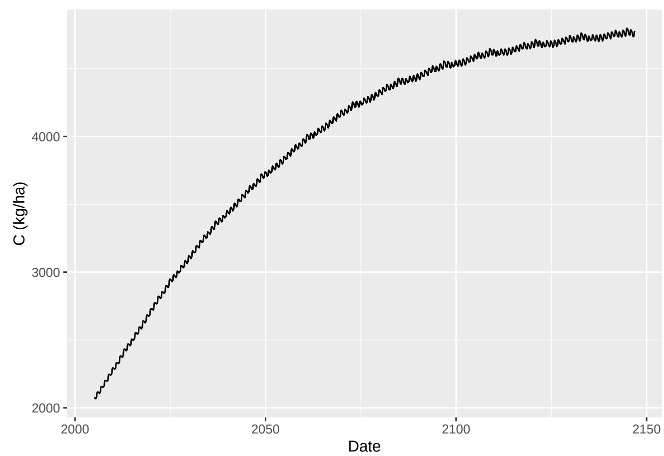


Figure 18: Sodium Weathering (All Layer)

Litter Pool Results

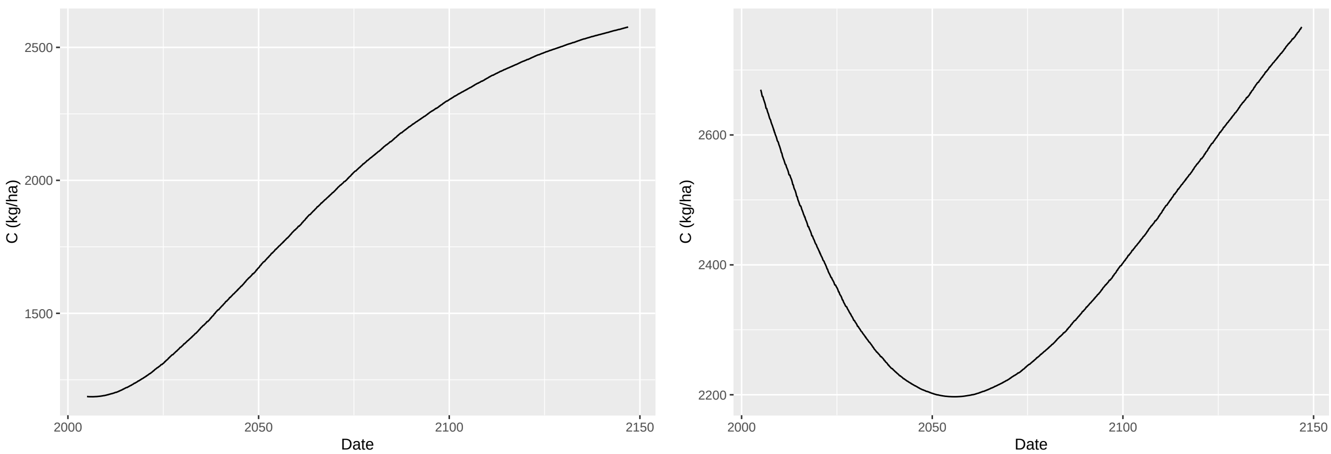


(a) Total forest floor carbon content (kg/ha)



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

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

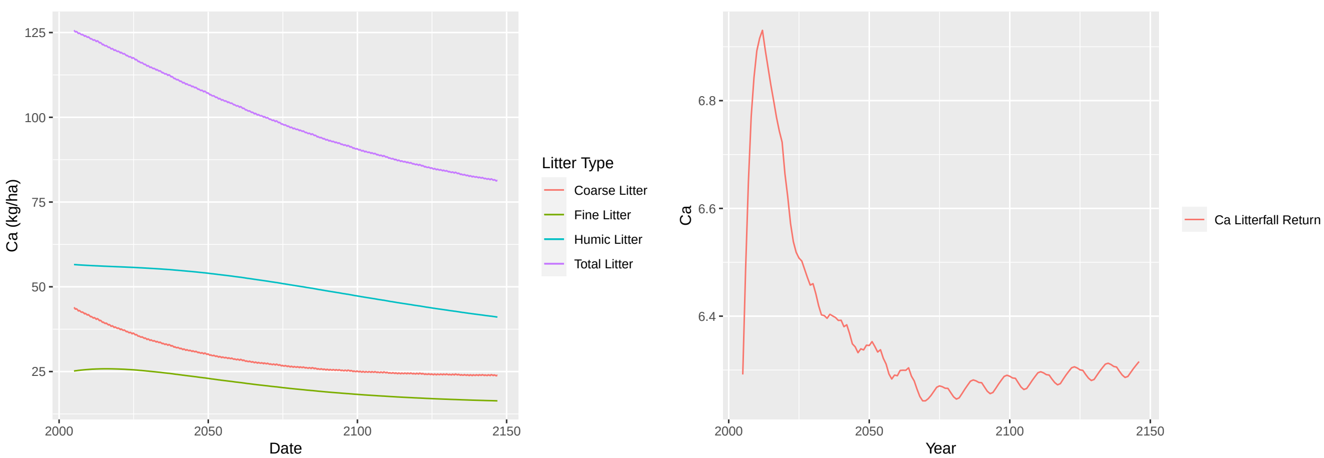


(a) Carbon content of fine litter (kg/ha)

(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.

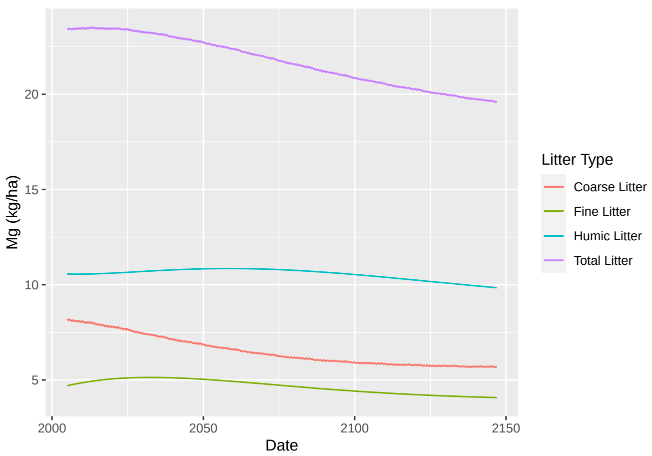


(a) Ca Content in each litter decomposition stage (kg/ha)

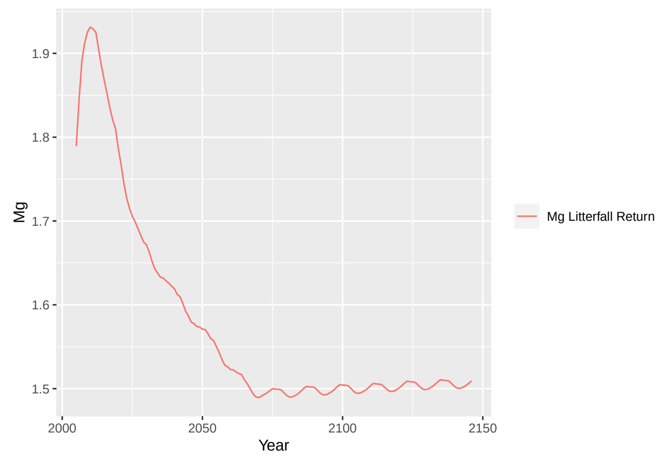
(b) Ca net annual return in litterfall (kg/ha)

Figure 21: Forest Floor/O-horizon Ca content over time (a). and net annual Ca return in litterfall (b).

Discuss

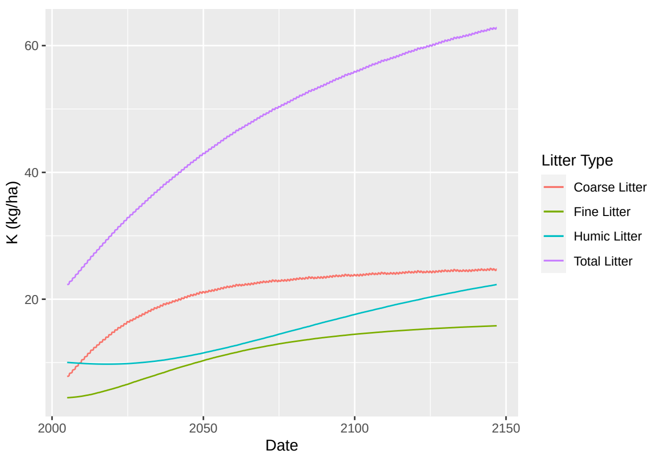


(a) Mg Content in each litter decomposition stage (kg/ha)

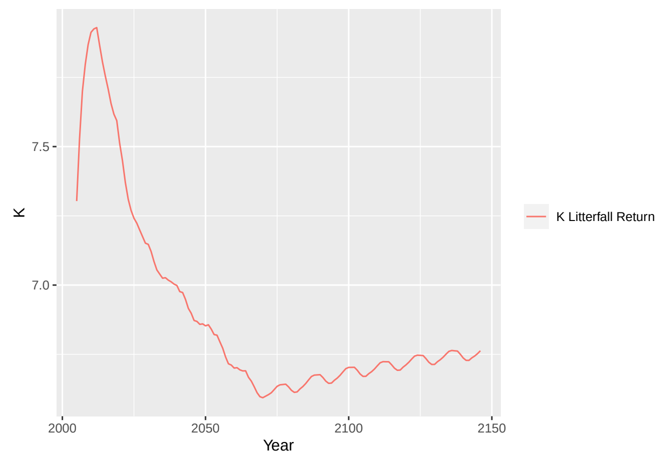


(b) Mg net annual return in litterfall (kg/ha)

Figure 22: Forest Floor/O-horizon Mg content over time (a). and net annual Mg return in litterfall (b).

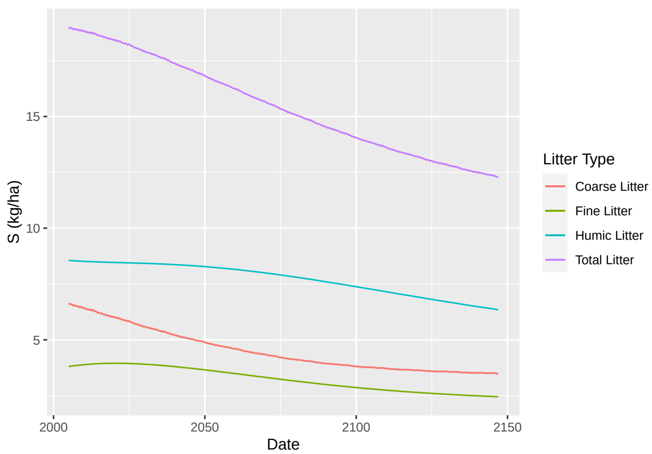


(a) K Content in each litter decomposition stage (kg/ha)

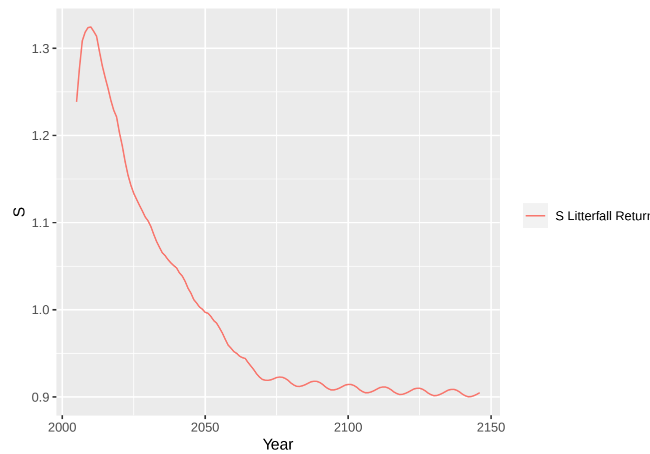


(b) K net annual return in litterfall (kg/ha)

Figure 23: Forest Floor/O-horizon K content over time (a). and net annual K return in litterfall (b).

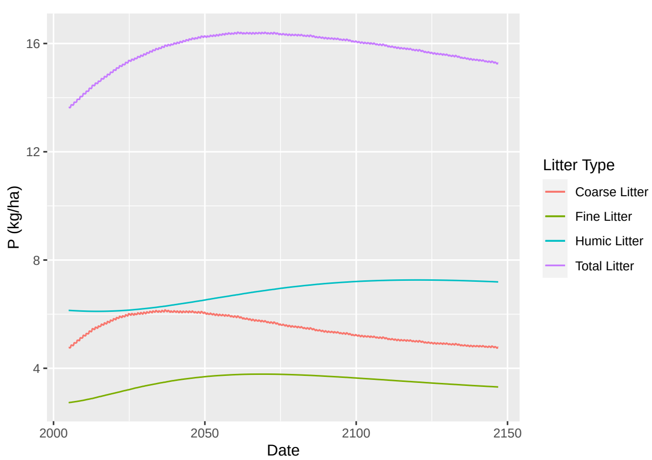


(a) S Content in each litter decomposition stage (kg/ha)

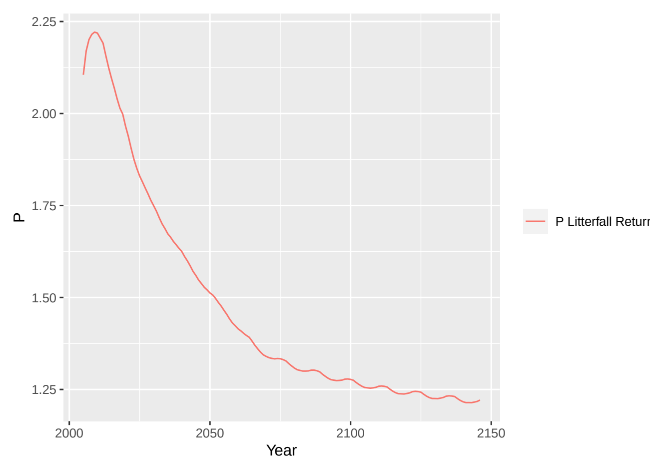


(b) S net annual return in litterfall (kg/ha)

Figure 24: Forest Floor/O-horizon S content over time (a). and net annual S return in litterfall (b).

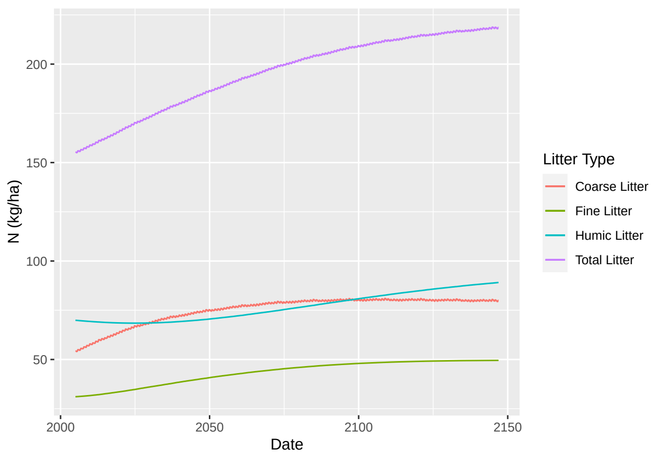


(a) P Content in each litter decomposition stage (kg/ha)

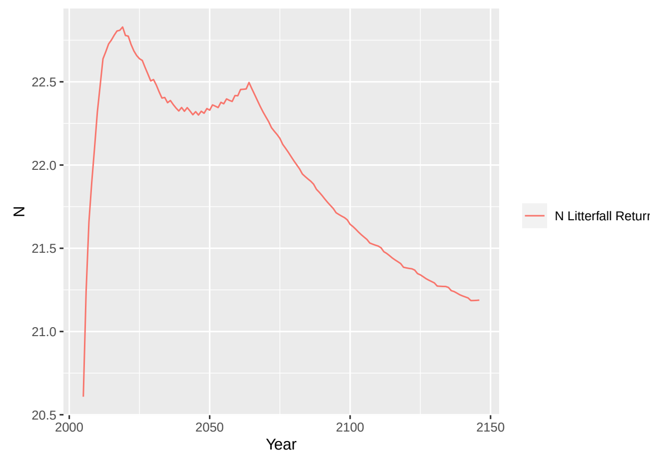


(b) P net annual return in litterfall (kg/ha)

Figure 25: Forest Floor/O-horizon P content over time (a). and net annual P return in litterfall (b).



(a) N Content in each litter decomposition stage (kg/ha)

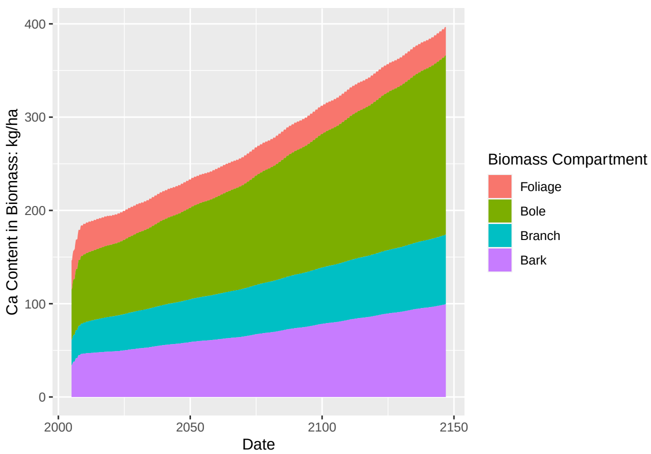


(b) N net annual return in litterfall (kg/ha)

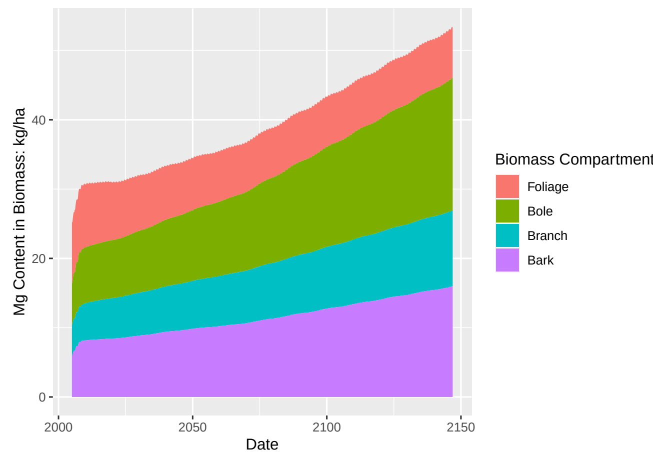
Figure 26: Forest Floor/O-horizon N content over time (a). and net annual N return in litterfall (b).

I plotted the litterfall return rate and the O-horizons next to each other to show that the inability of the O-horizon to build up certain nutrients is not an issue with nutrient release (these values can be set to be very low, such as 0.05 for Ca and Mg, and losses are still observed), but likely due to a gradual depletion of the soil for specific nutrients. The site builds up with N in the O-horizon, and this likely implies that the system is not limited by N, but that base cations are becoming increasingly limited over time, with the exception of K.

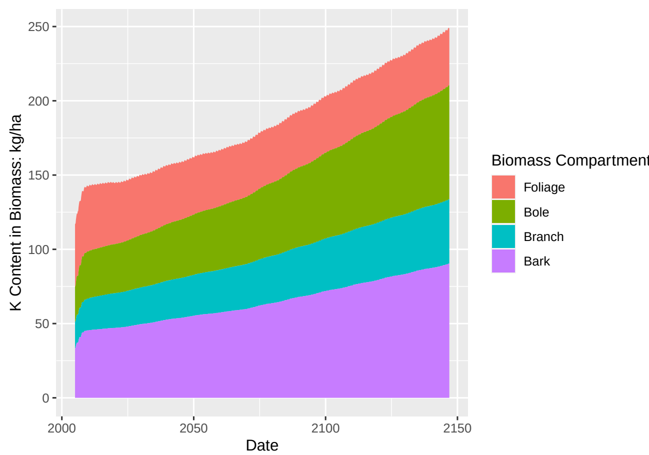
Tree Nutrient Content



(a) Calcium content in each biomass compartment

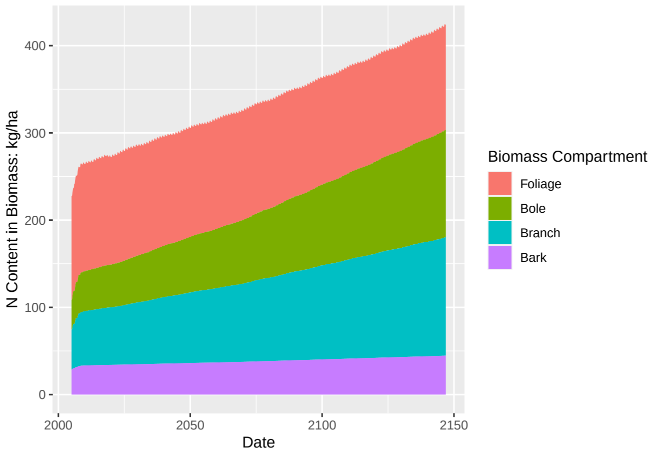


(b) Magnesium content in each biomass compartment

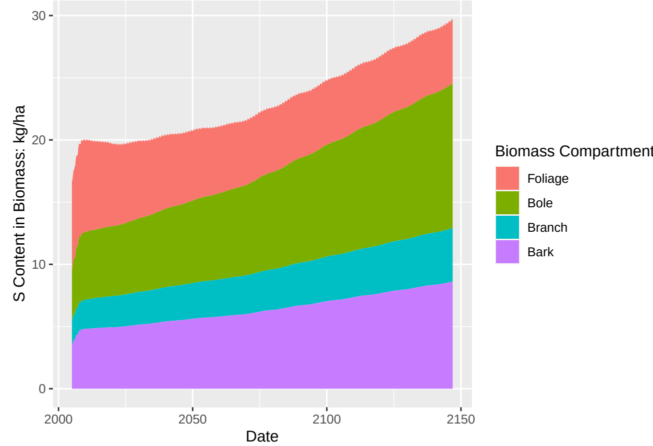


(c) Potassium content in each biomass compartment

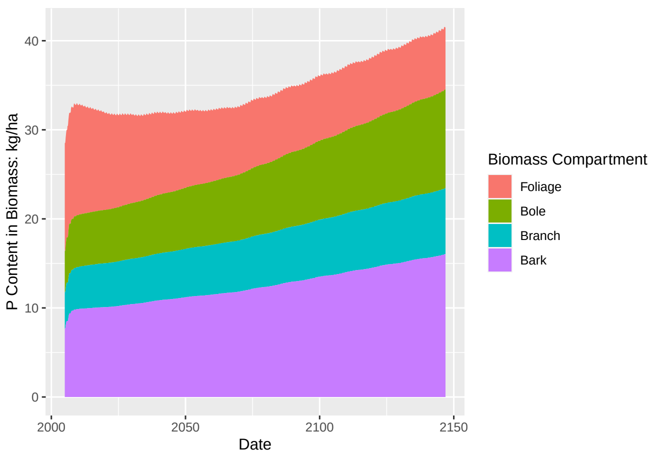
Figure 27: Base Cation Nutrient Content in Simulated Forest



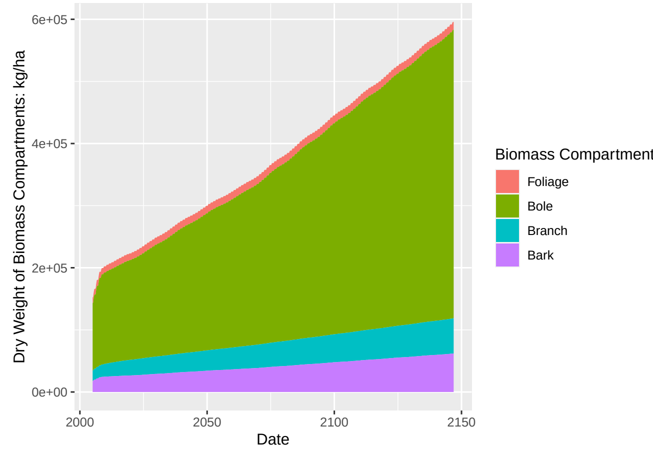
(a) Nitrogen content in each biomass compartment



(b) Sulfur content in each biomass compartment



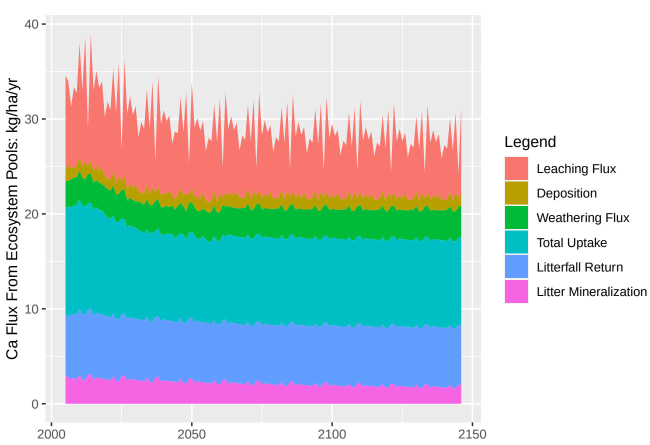
(c) Phosphorous content in each biomass compartment



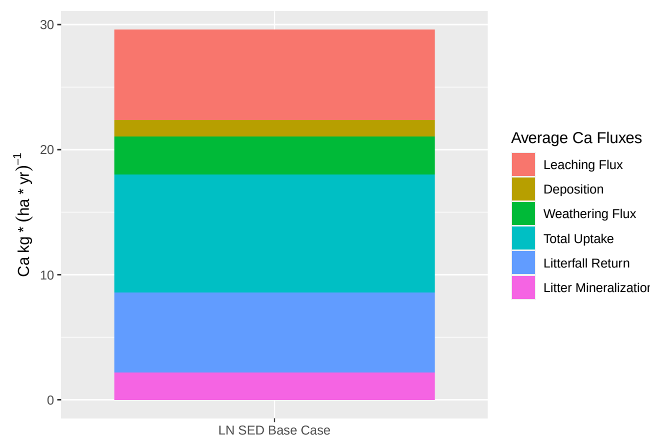
(d) Biomass of each compartment

Figure 28: N, S, and P Nutrient Contents and biomass per compartment

Analysis 1: Stack Flux Data

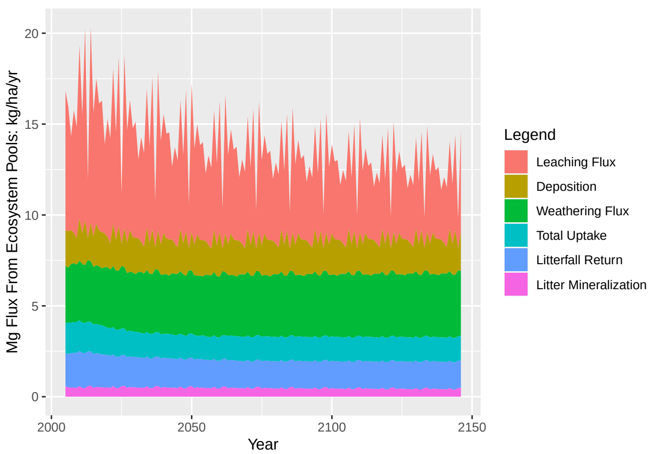


(a) Ca input and output fluxes over time

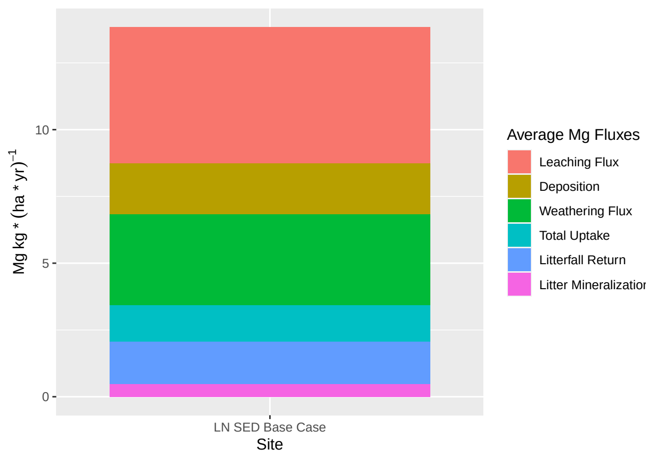


(b) Total Average Ca input and output fluxes

Figure 29: Calcium input and output comparison graphs

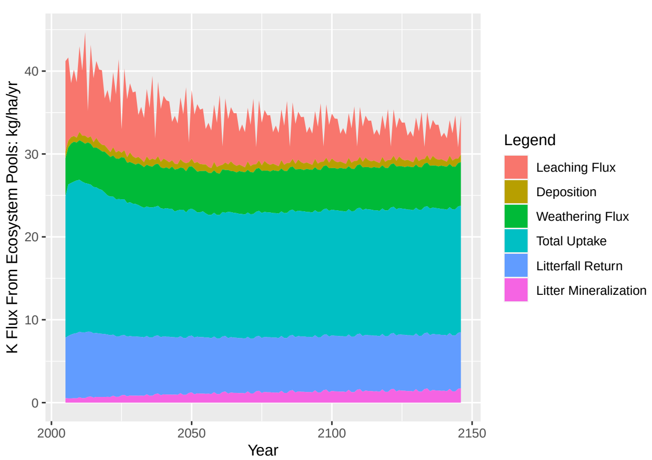


(a) Mg input and output fluxes over time

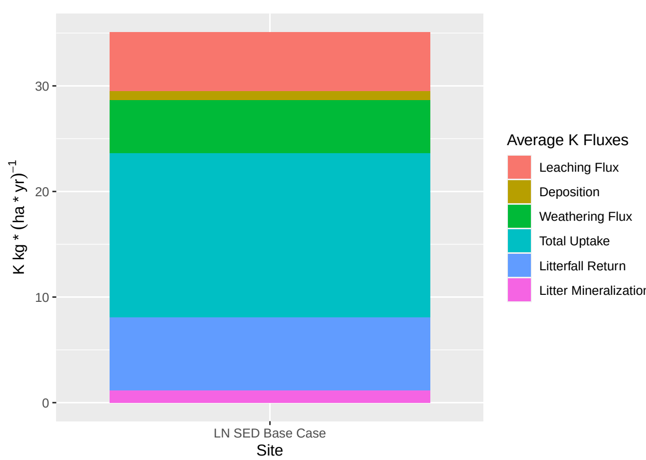


(b) Total Average Mg input and output fluxes

Figure 30: Magnesium input and output comparison graphs

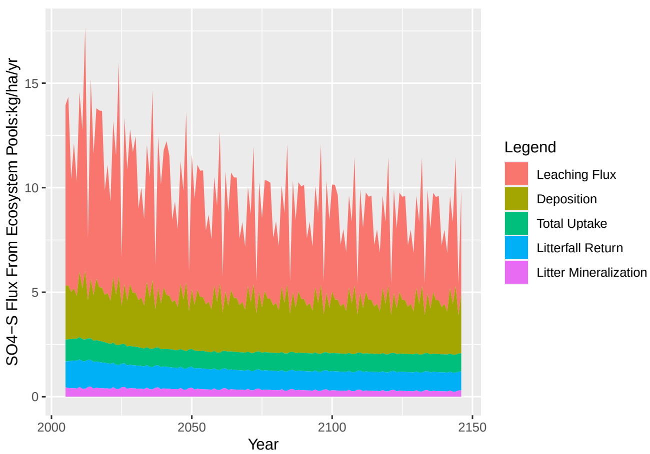


(a) K input and output fluxes over time

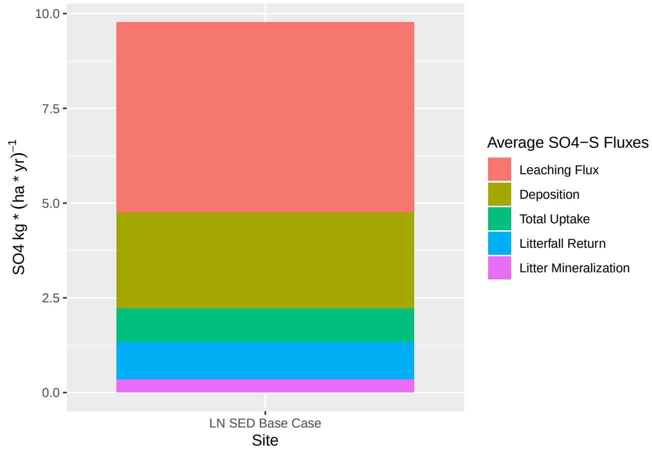


(b) Total Average K input and output fluxes

Figure 31: Potassium input and output comparison graphs



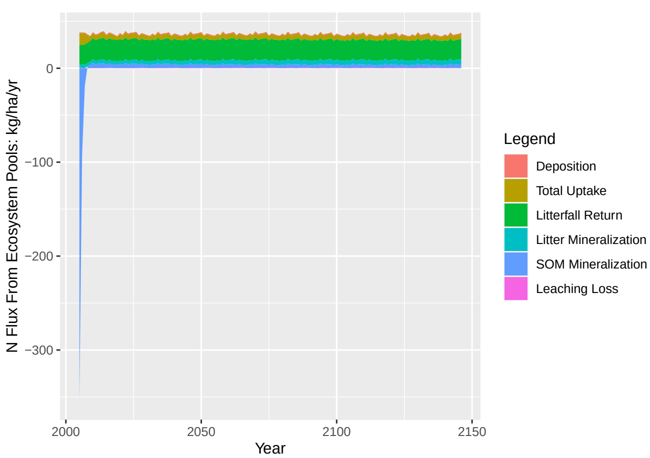
(a) S input and output fluxes over time



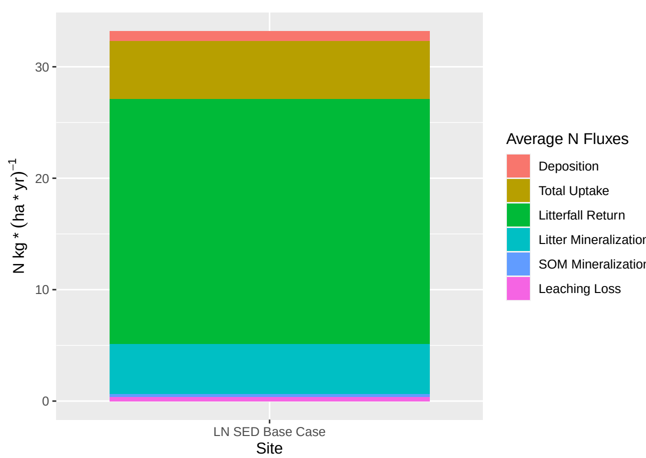
(b) Total Average S input and output fluxes

Figure 32: Sulfur input and output comparison graphs

I added back a reasonably large sulfate pool, this caused enhanced S losses which were unrealistic. This likely implies that the system had too much S going through it.



(a) N input and output fluxes over time



(b) Total Average N input and output fluxes

Figure 33: 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

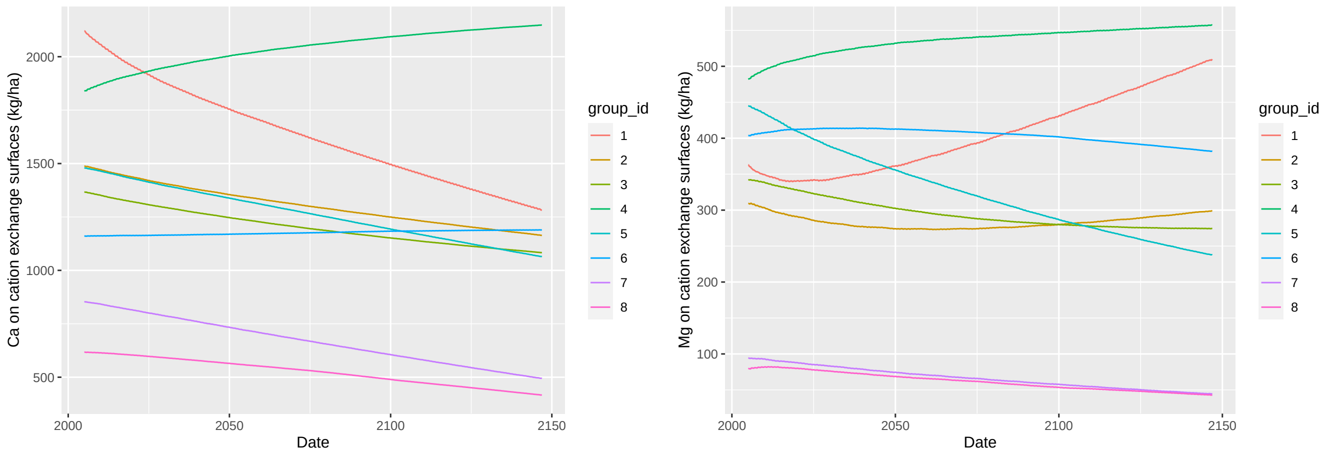


Figure 34: Calcium and Magnesium CEC adsorption over time

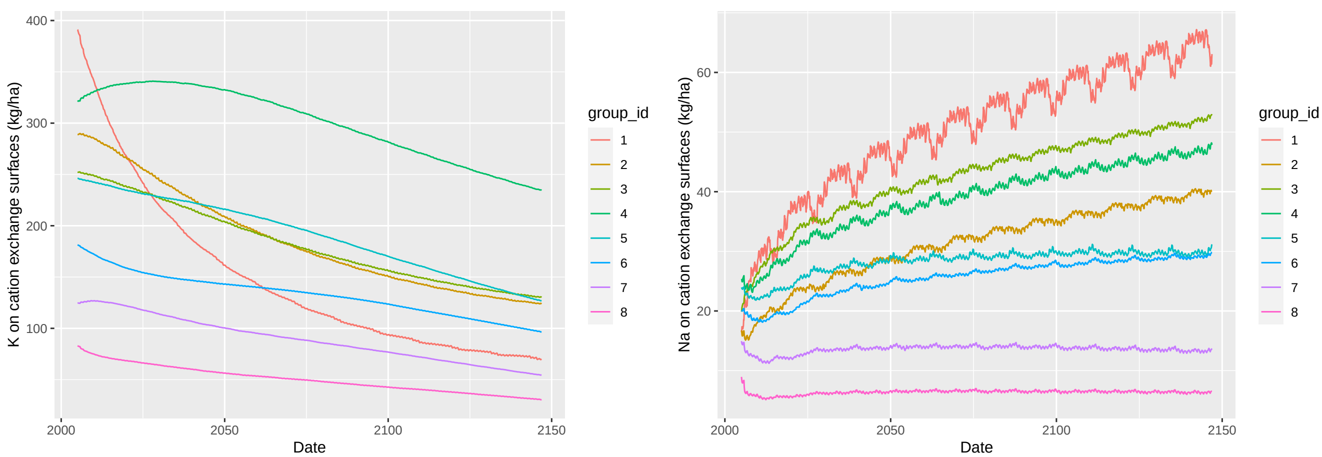


Figure 35: Potassium and Sodium CEC adsorption over time

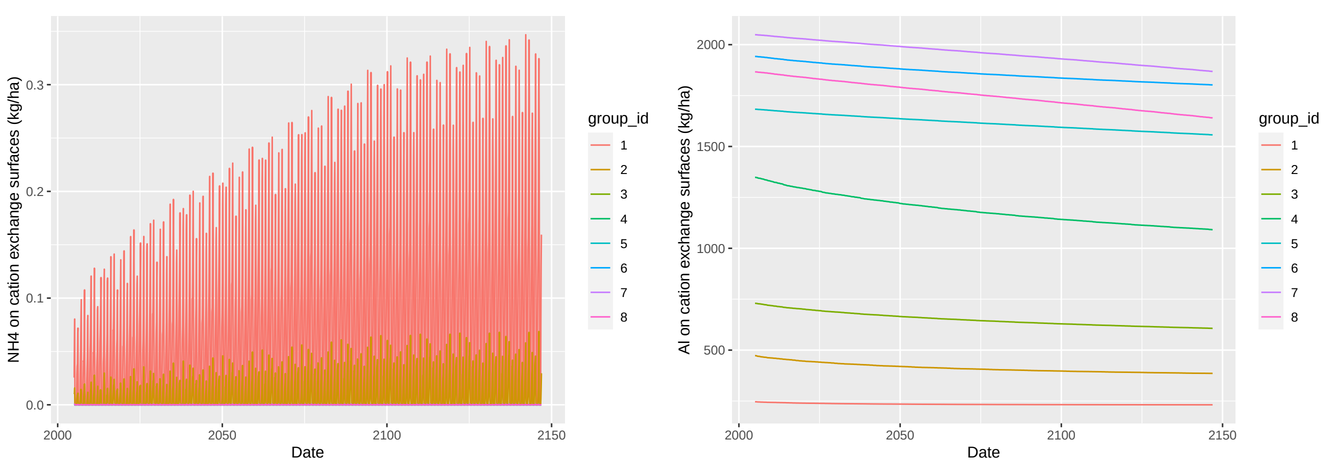
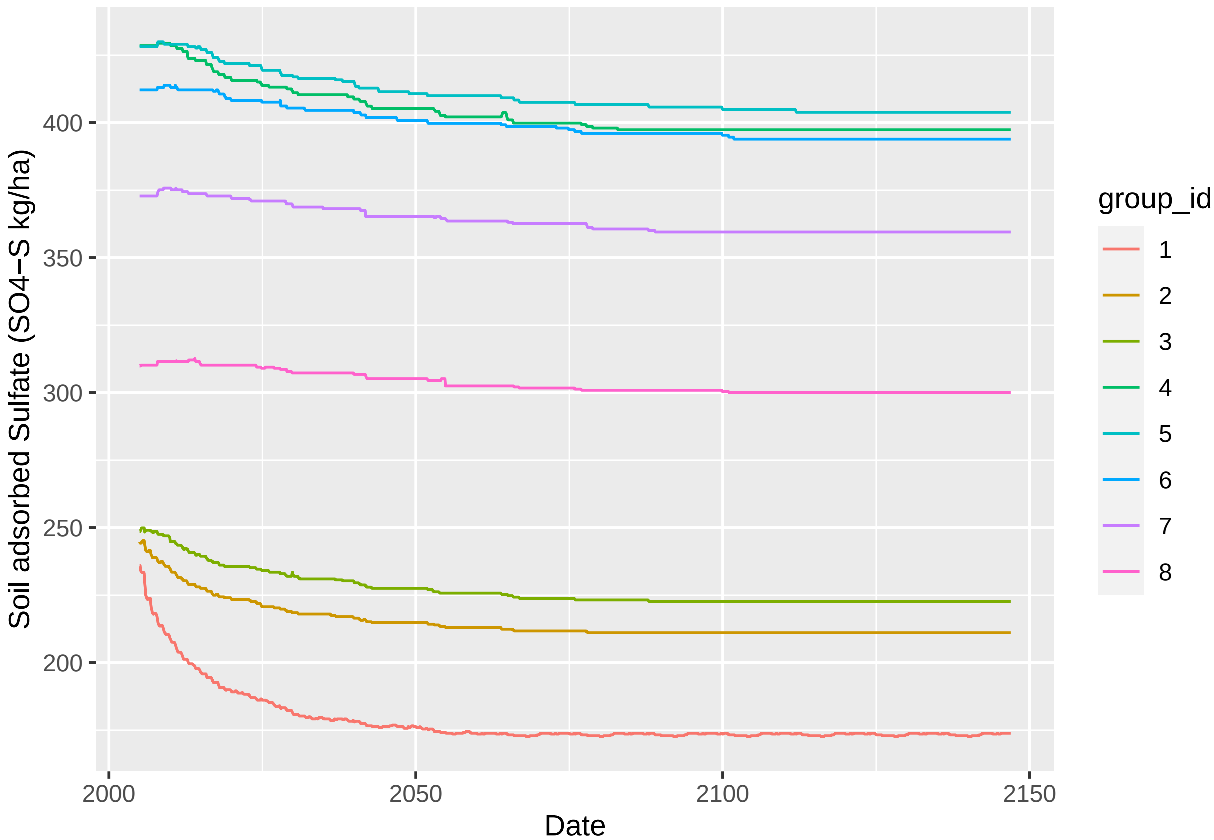
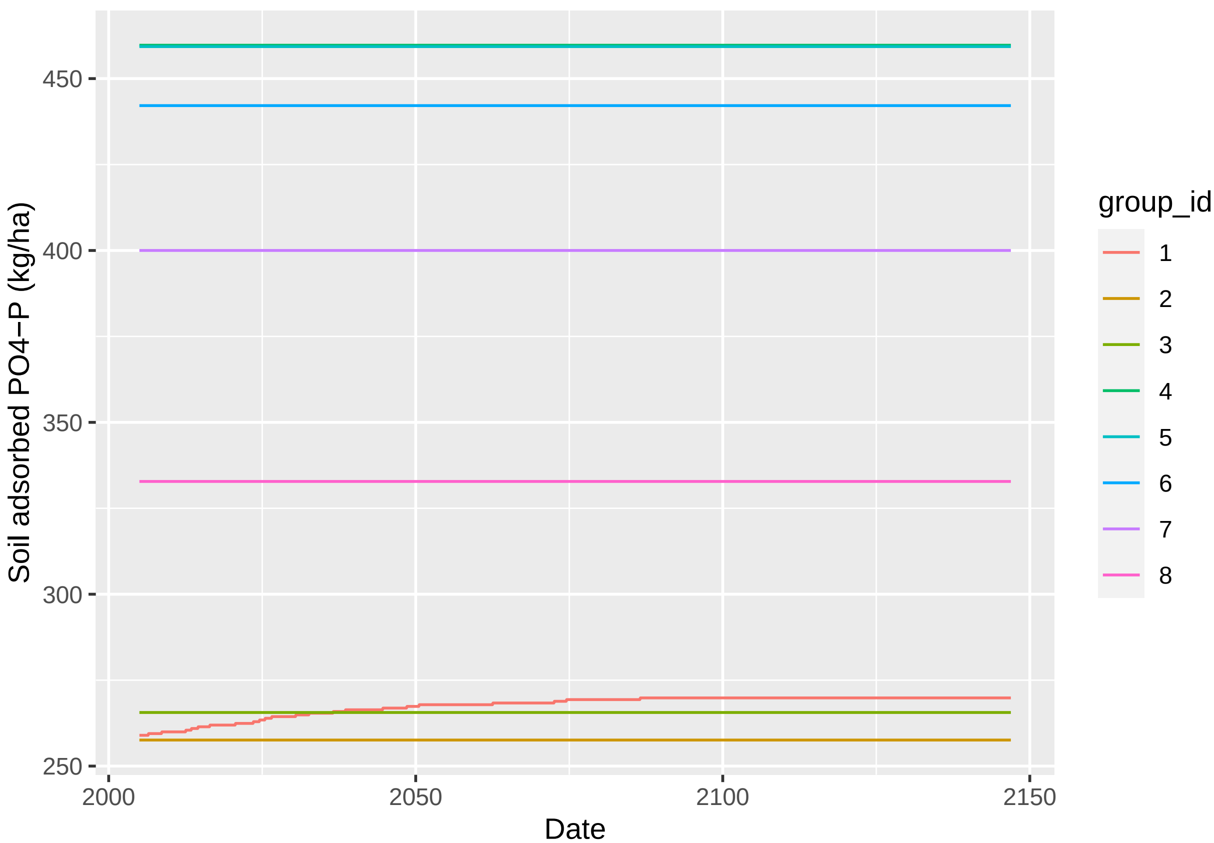
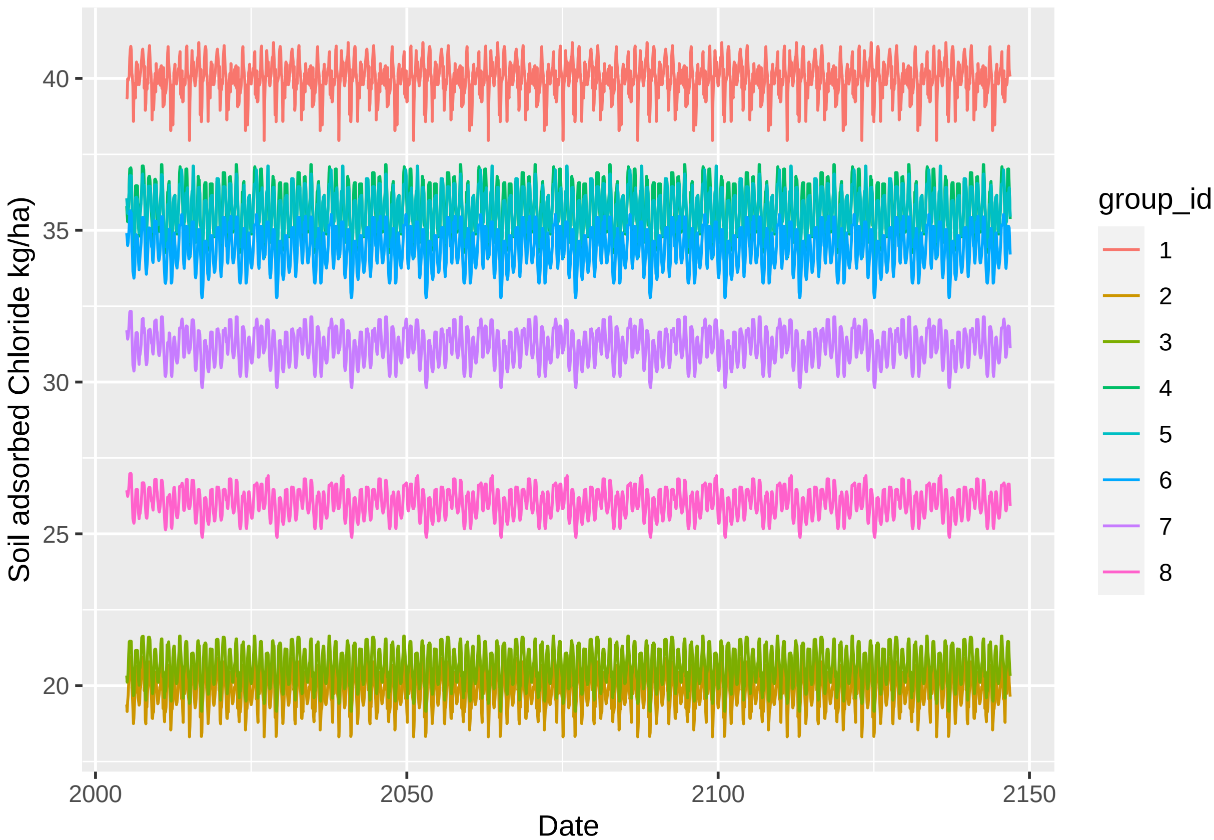


Figure 36: Ammonium and Aluminum CEC adsorption over time

Anion Exchange Capacity



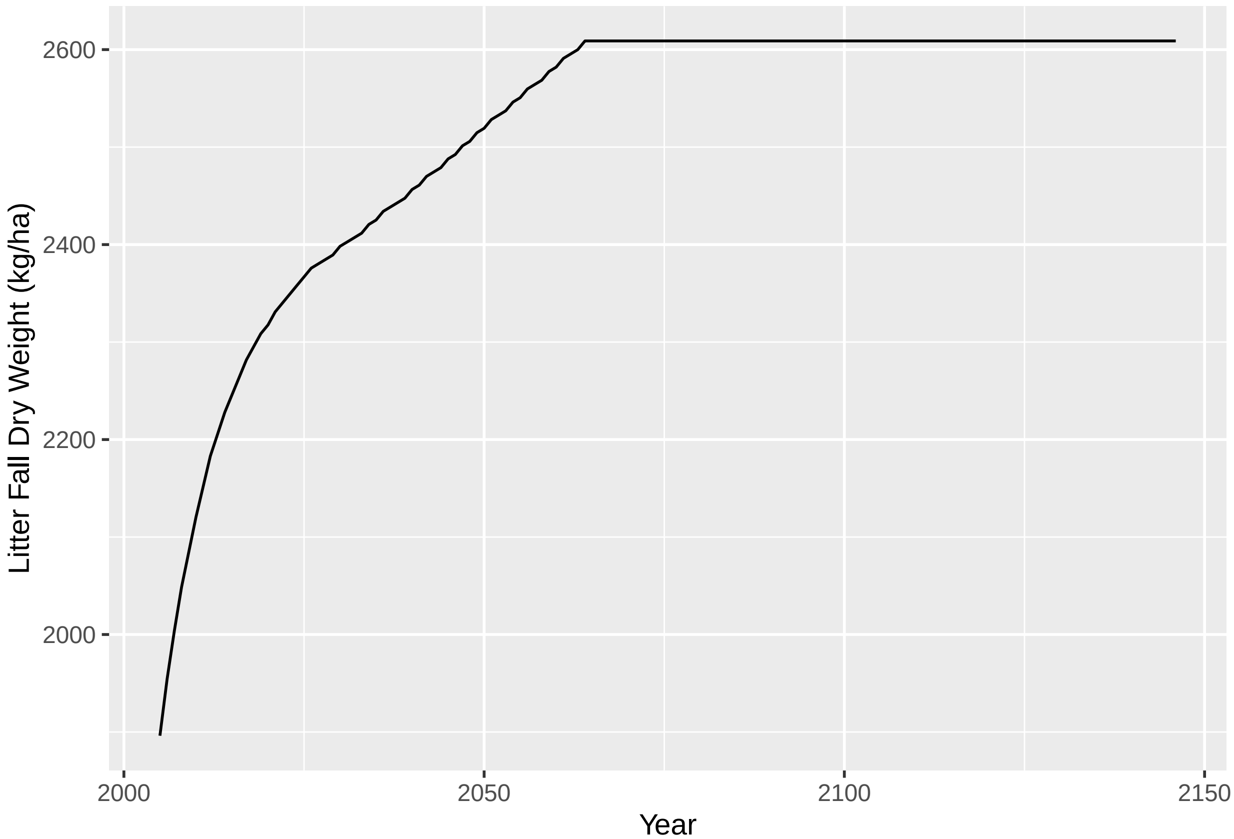




Phosphate seems stable, generally. It should be noted that P uptake is not being modeled in the foliage (it should remain constant so far) and that phosphate adsorption parameters are completely borrowed from the Burgundy site. As for sulfate, I purged the model of the AEC sulfate pool and relegated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



2600
2400
2200
2000
Litter Fall Dry Weight (kg/ha)
2000
2050
2100
2150
Year