Calibration Report: High N Sedimentary Site Base Case

Kaveh Gholamhossein Siah

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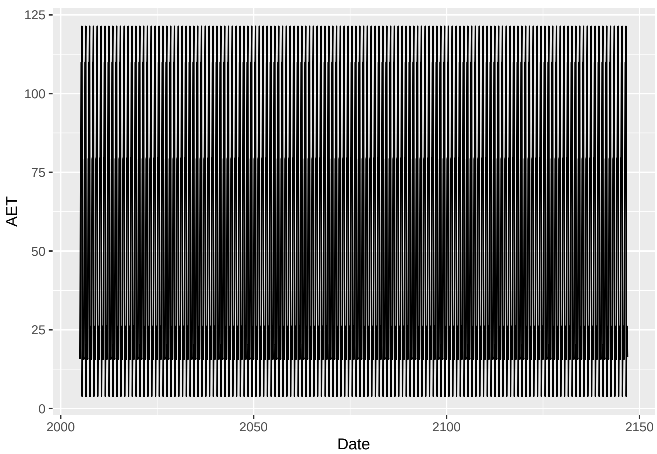
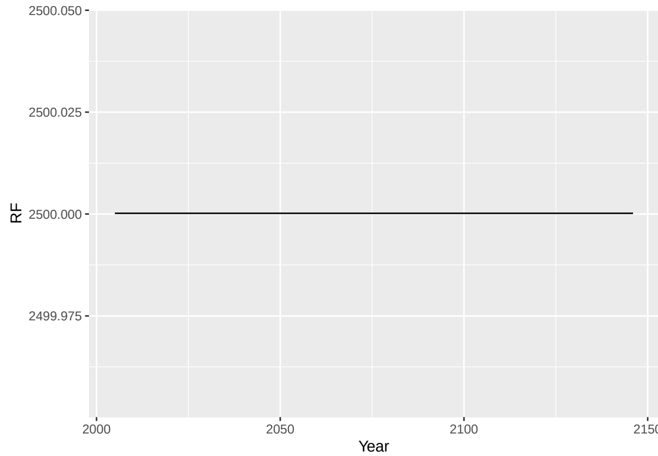
Hydrology





Soil Solution Results

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

	μmol/L														
Soil Layer	Ca	Mg	K	Na	NO3	NH4	SO4	Cl	PO4	DOC	Al	Si	H+	pH	R	HR
Layer 1	10.2	16.7	11.2	59.9	35.7	2.465	5.42	54.1	1.264	109	0.10643	71.0	42.04	4.38	69.0	39.9
Layer 2	14.4	22.8	13.5	76.1	47.9	0.432	5.72	61.0	0.713	134	0.10198	83.0	41.26	4.38	85.5	48.8
Layer 3	17.3	27.7	14.8	92.5	54.5	0.611	5.69	67.4	0.833	150	0.06342	90.5	33.68	4.47	98.6	51.5
Layer 4	17.9	28.5	10.8	98.7	50.9	3.956	7.71	67.4	0.966	128	0.02000	87.5	18.26	4.74	90.8	37.6
Layer 5	20.9	33.0	11.5	115.4	60.8	0.752	8.10	74.7	0.610	133	0.01244	91.7	13.98	4.85	97.7	35.5
Layer 6	19.4	32.1	11.0	127.9	62.5	6.366	8.08	82.0	0.684	136	0.01110	96.0	13.15	4.88	100.8	35.4
Layer 7	24.4	35.3	12.6	140.9	66.3	1.841	8.22	89.8	0.777	135	0.00430	100.6	6.53	5.19	108.6	26.6
Layer 8	26.9	31.9	15.4	149.3	68.3	1.353	8.14	94.8	0.673	131	0.00298	103.3	4.74	5.32	109.0	21.9

Table 2: Lysimeter Measured Soil Solution Concentrations of Reliable Months (2005)

Layer	Ca	Ca SD	Mg	Mg SD	K	K SD	Na	Na SD	NO3	NO3 SD	NH4	NH4 SD	SO4	SO4 SD	Cl	Cl SD	P^a	P SD	DOC	DOC SD	Al^b	Al SD	Si^c	Si SD	pH^d
1	26	12	39	14	21	19.9	184	53	71	40	1.20	0.23	17	5.7	209	59	1.2	0.33	127	32	6.7	3.9	0	0	4.5
2	26	12	39	14	21	19.9	184	53	71	40	1.20	0.23	17	5.7	209	59	1.2	0.33	127	32	6.7	3.9	0	0	4.6
3	26	12	39	14	21	19.9	184	53	71	40	1.20	0.23	17	5.7	209	59	1.2	0.33	127	32	6.7	3.9	0	0	4.8
4	17	10	30	13	15	8.8	203	55	71	75	0.97	0.20	19	4.0	194	55	1.5	1.01	54	16	4.9	6.0	0	0	5.2
5	17	10	30	13	15	8.8	203	55	71	75	0.97	0.20	19	4.0	194	55	1.5	1.01	54	16	4.9	6.0	0	0	5.5
6	17	10	30	13	15	8.8	203	55	71	75	0.97	0.20	19	4.0	194	55	1.5	1.01	54	16	4.9	6.0	0	0	5.8
7	17	10	30	13	15	8.8	203	55	71	75	0.97	0.20	19	4.0	194	55	1.5	1.01	54	16	4.9	6.0	0	0	6.1
8	17	10	30	13	15	8.8	203	55	71	75	0.97	0.20	19	4.0	194	55	1.5	1.01	54	16	4.9	6.0	0	0	6.3

[a] Average based on TP annual average

[b] Does not distinguish between organic-Al and free Al

[c] Model does not simulate Si uptake

[d] From Hynicka et al., 2017 (10-50cm) extrapolated to 1m

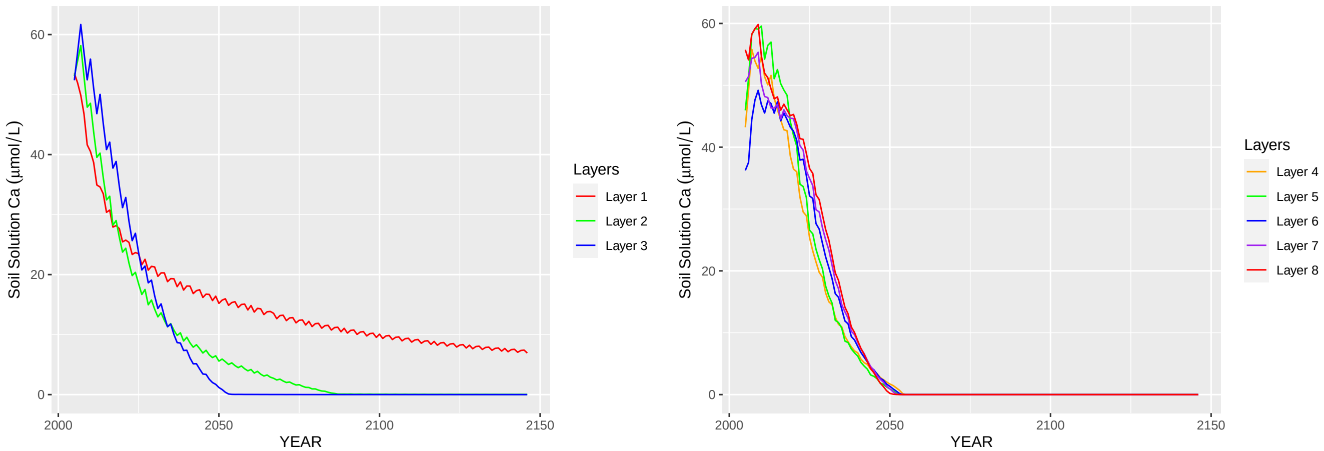


Figure 1: Monthly Calcium Concentrations by Soil Layer

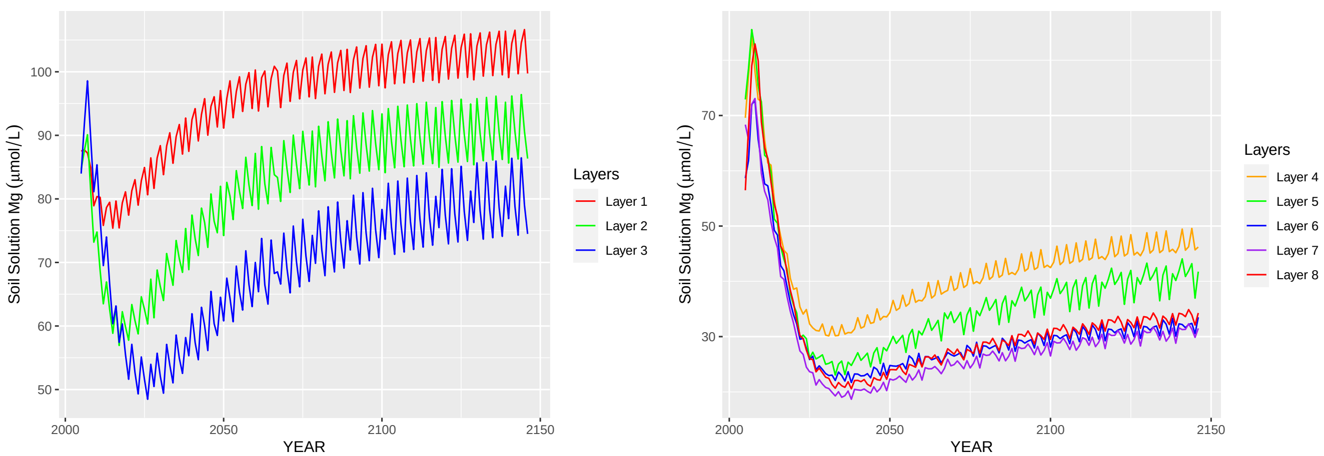


Figure 2: Monthly Magnesium Concentrations by Soil Layer

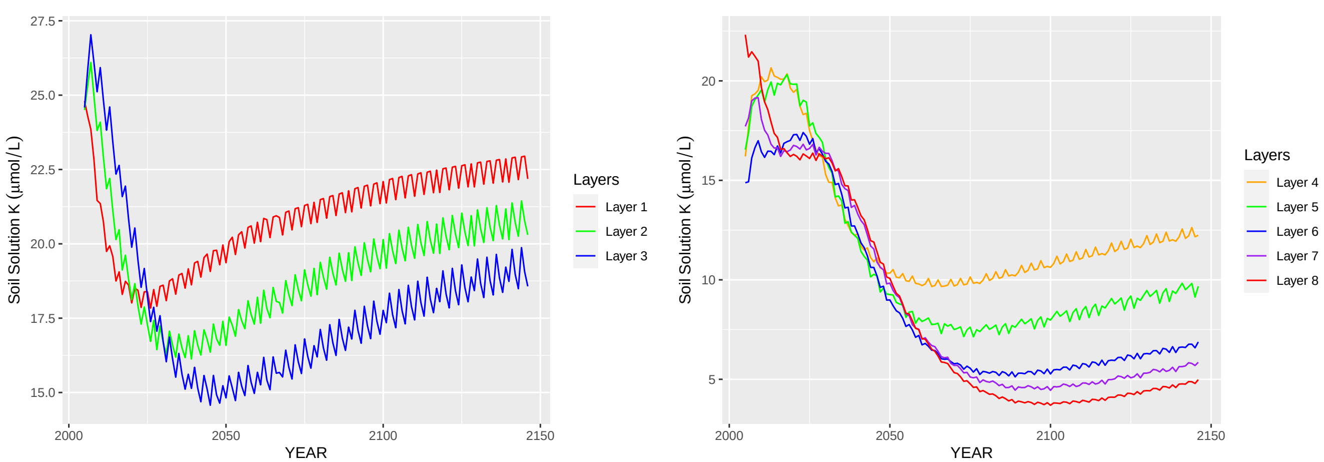


Figure 3: Monthly Potassium Concentrations by Soil Layer

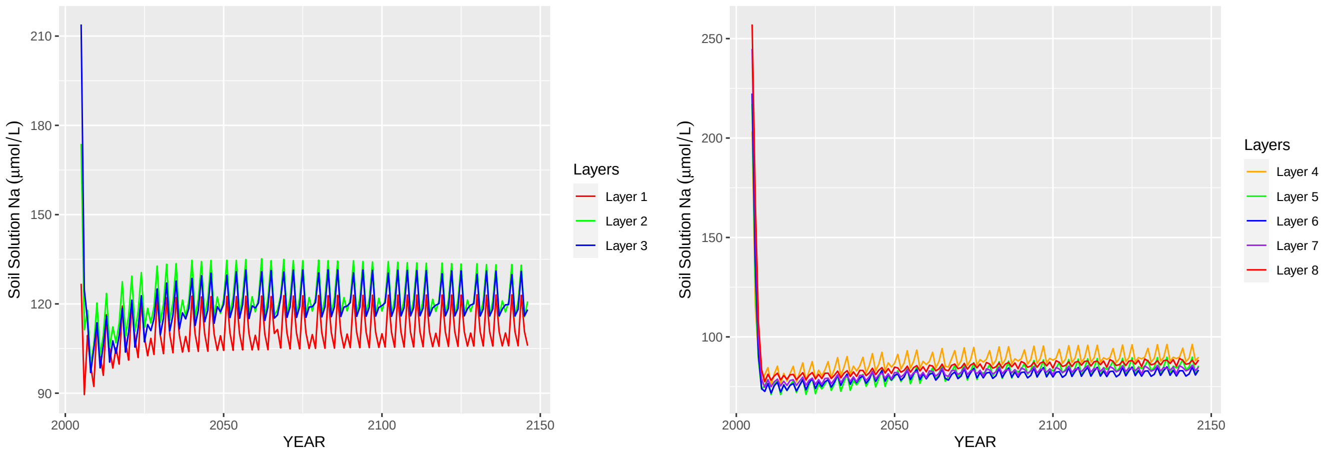


Figure 4: Monthly Sodium Concentrations by Soil Layer

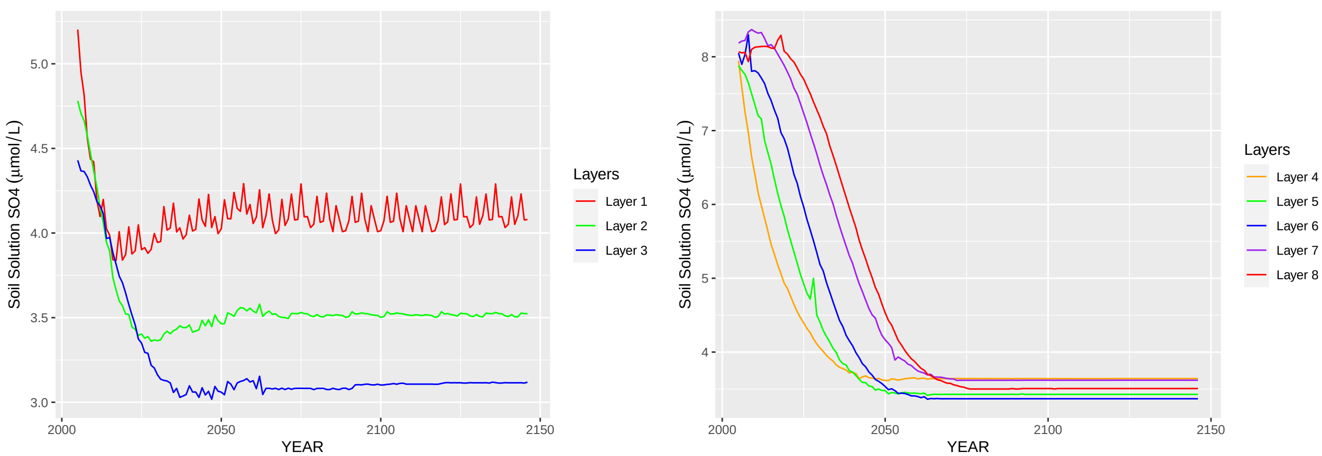


Figure 5: Monthly Sulfate Concentrations by Soil Layer

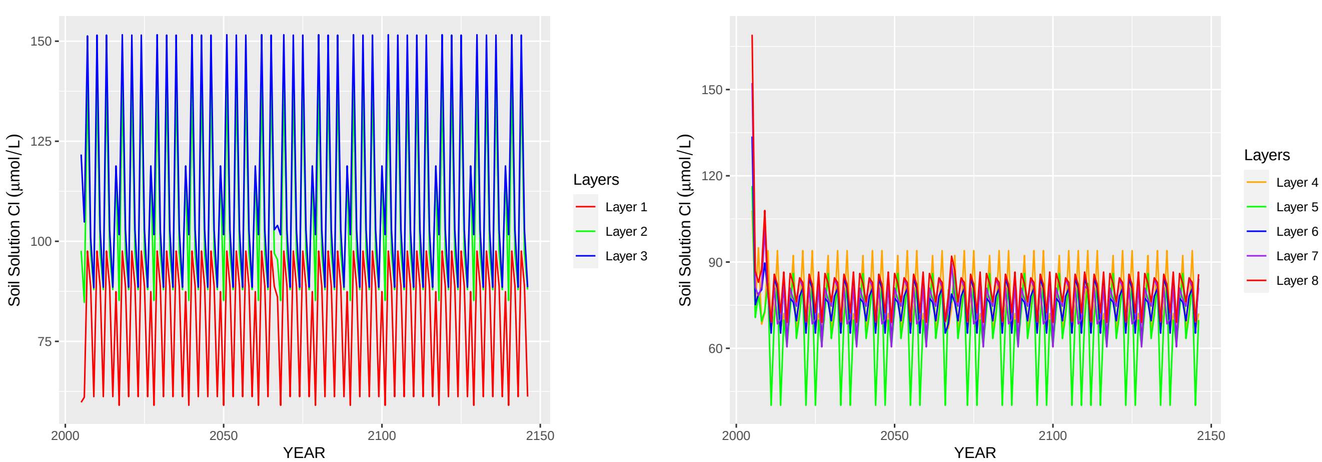


Figure 6: Monthly Chloride Concentrations by Soil Layer

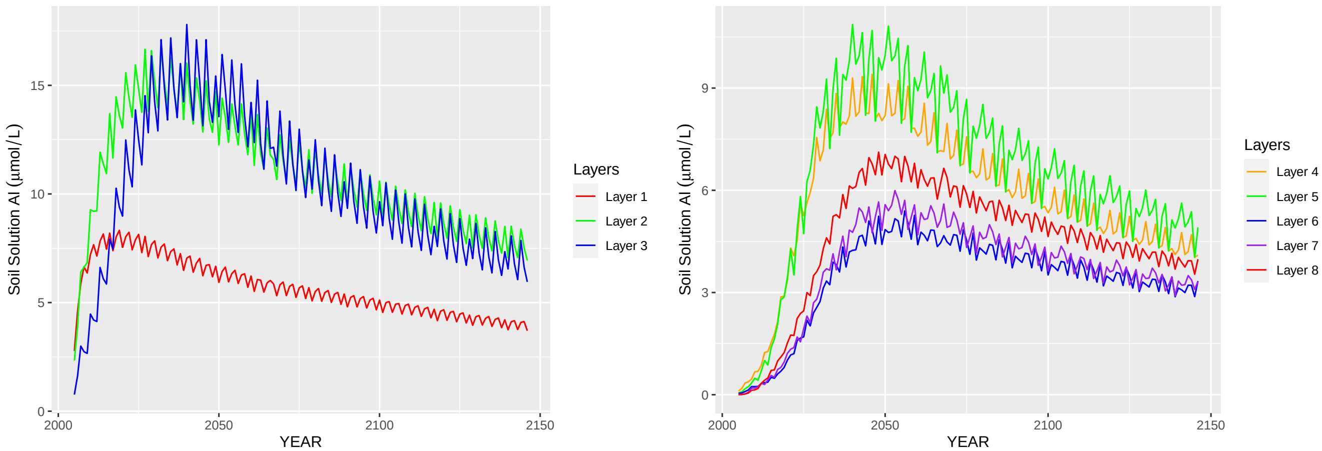


Figure 7: Monthly Aluminum Concentrations by Soil Layer

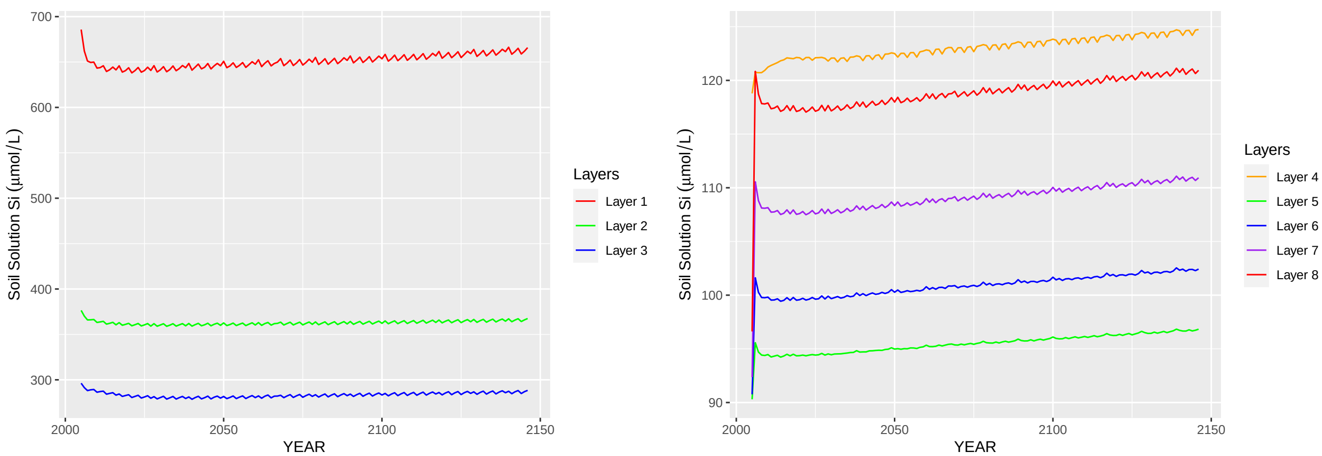


Figure 8: Monthly SiO2 Concentrations by Soil Layer

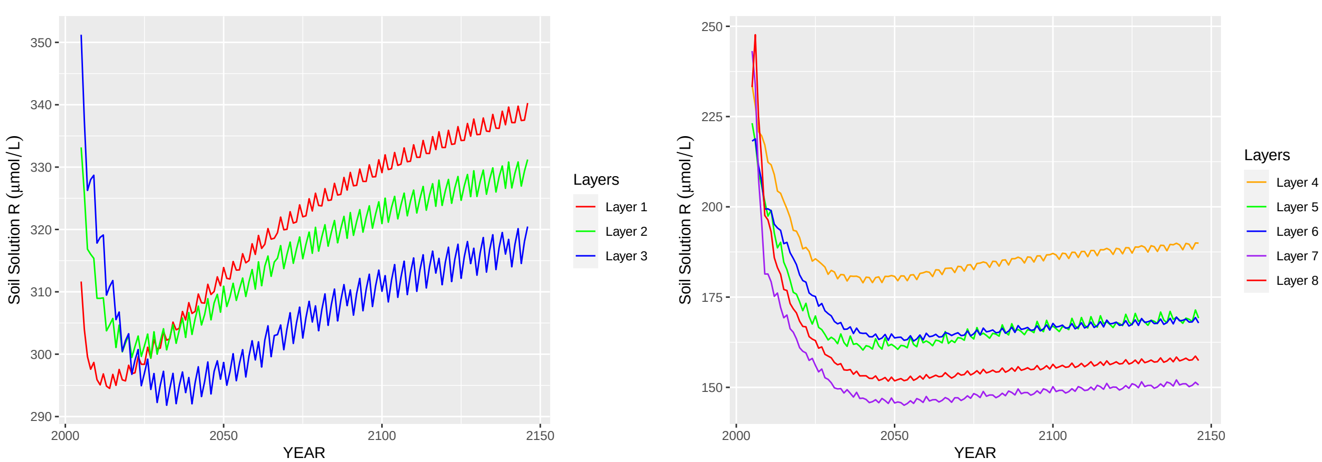


Figure 9: Monthly Organic Acid Base (R-) Concentrations by Soil Layer

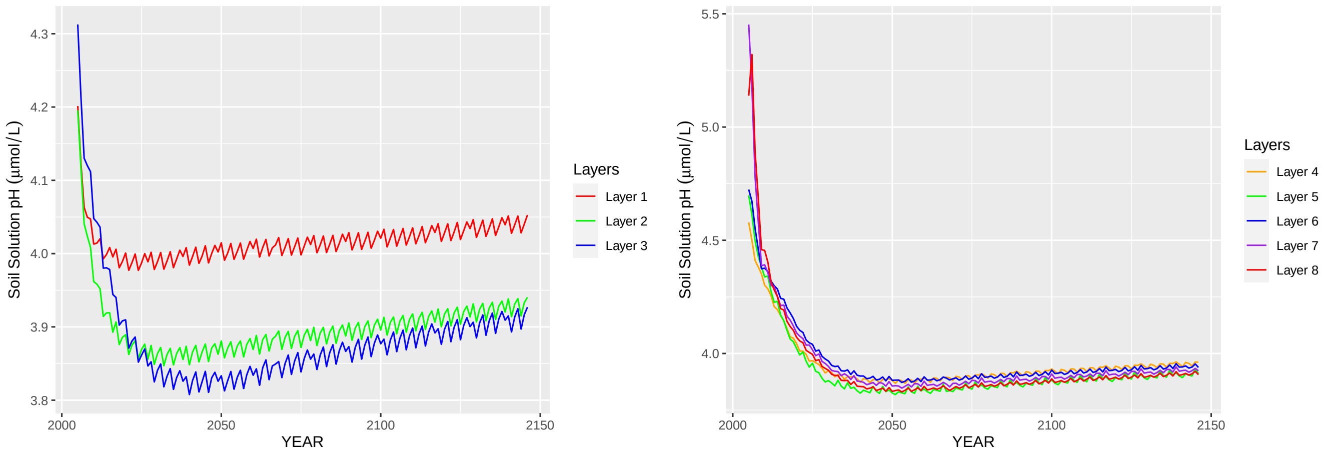


Figure 10: Monthly pH by Soil Layer

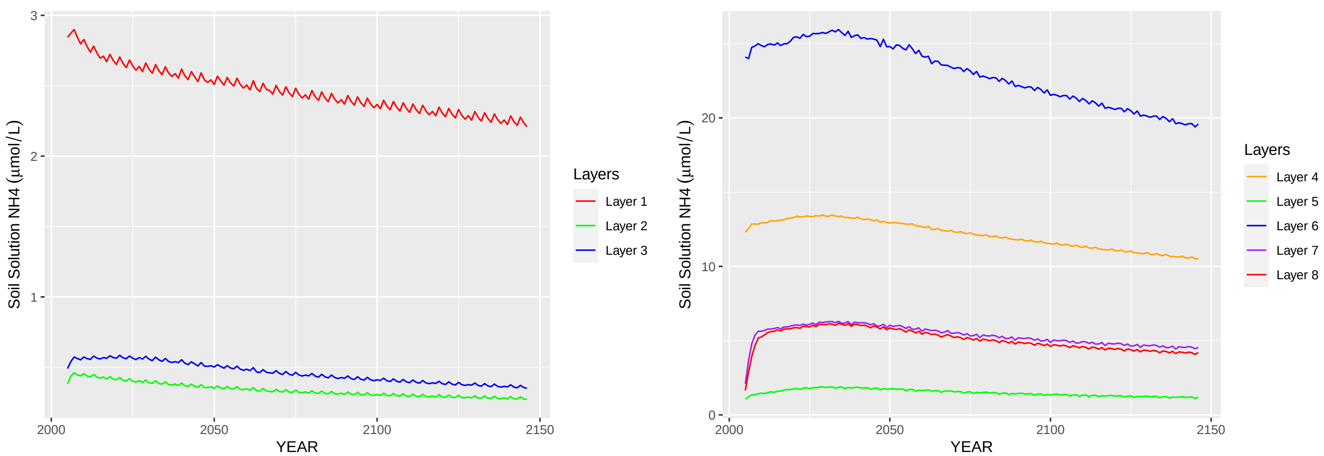


Figure 11: Yearly Ammonium concentration by Soil Layer

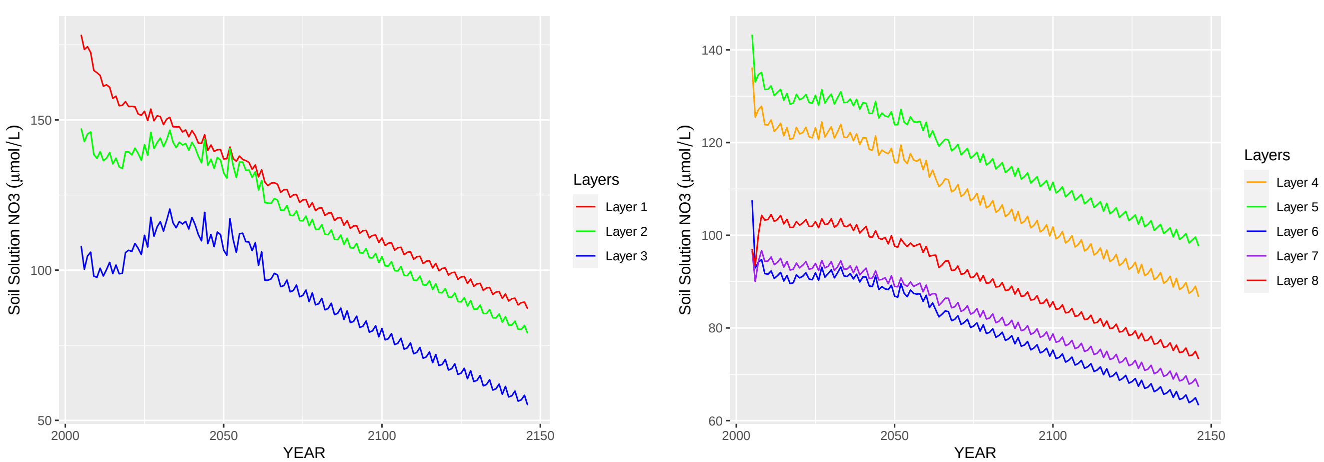


Figure 12: Yearly Nitrate concentration by Soil Layer

Lysimeter Comparisons

Table 3: Simulated Lysimeter Fluxes by Depth (2005-2006)

Depth	YEAR	Ca	Mg	K	Na	NO3	NH4	SO4	Cl	P	DOC	Al	Si
2	2005	7.7	7.5	7.2	29	9.2	0.078	2.7	35	0.24	22	0.0075	43
2	2006	8.1	7.7	7.4	19	8.1	0.090	2.6	30	0.24	21	0.0127	41
8	2005	13	8.8	7.5	51	13	0.16	3.2	53	0.16	19	2.6e-05	39
8	2006	13	10.5	7.2	33	12	0.32	3.2	30	0.16	20	2.0e-05	45

Table 4: Actual Average Lysimeter Fluxes (2005)

Depth	NH4	NH4.SD	NO3	NO3.SD	TN	TN.SD	DOC	DOC.SD	TP	TP.SD	Cl	Cl.SD	SO4	SO4.SD	Ca	Ca.SD	Mg	Mg.SD	K	K.SD	Na	Na.SD	Al	Al.SD
20	0.229397708	0.02625799	12.3058623	6.722478182	16.05235558	7.309006743	21.12339104	5.096905937	0.015397959	0.00398027	105.9925643	37.70978195	5.649289233	2.126040927	13.47783912	5.408656987	12.87762315	4.273119617	8.10235285	6.812182054	59.9514975	20.36448053	2.535789785	1.626778699
100	0.164329625	0.028797038	11.28300357	10.07491599	11.92369571	9.410848825	7.97038542	1.88597111	0.024684756	0.013652249	85.0476427	25.47478644	5.443988177	1.77087954	8.210009332	2.311254494	8.61409103	2.938574097	5.394473482	2.436873081	57.79132616	17.48643336	1.579743437	1.596641002

Weathering Results

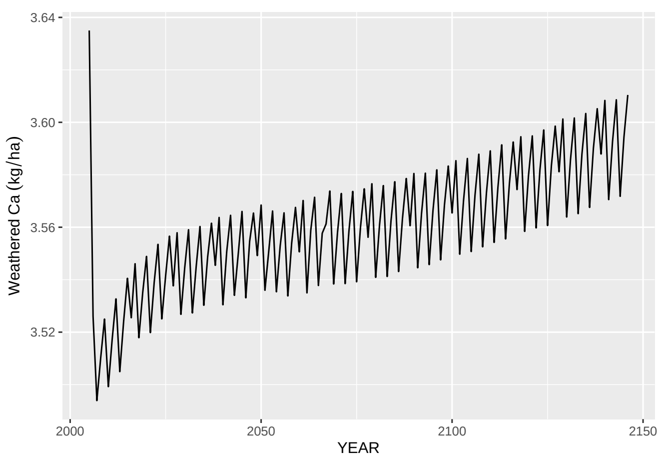


Figure 13: Calcium Weathering (All Layer)

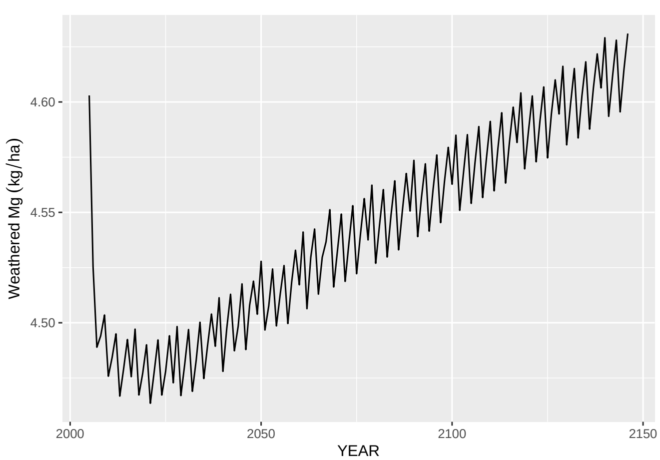


Figure 14: Magnesium Weathering (All Layer)

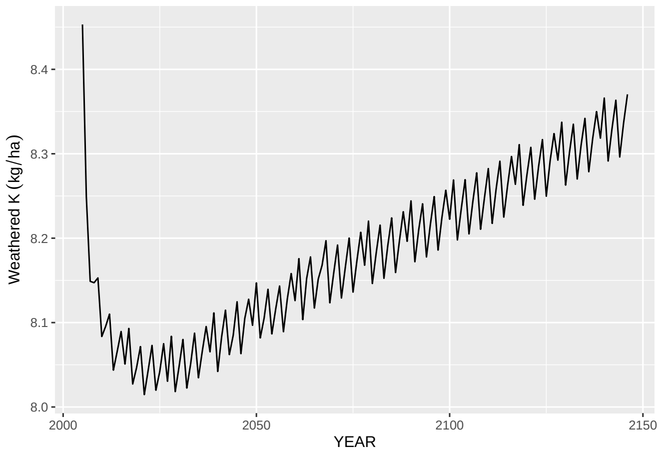


Figure 15: Potassium Weathering (All Layer)

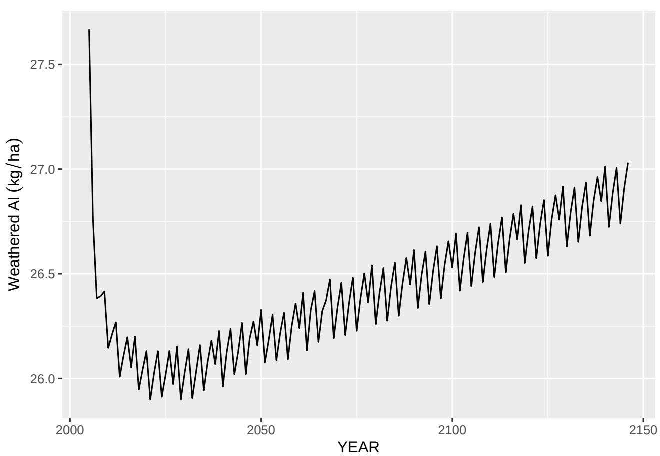


Figure 16: Aluminum Weathering (All Layer)

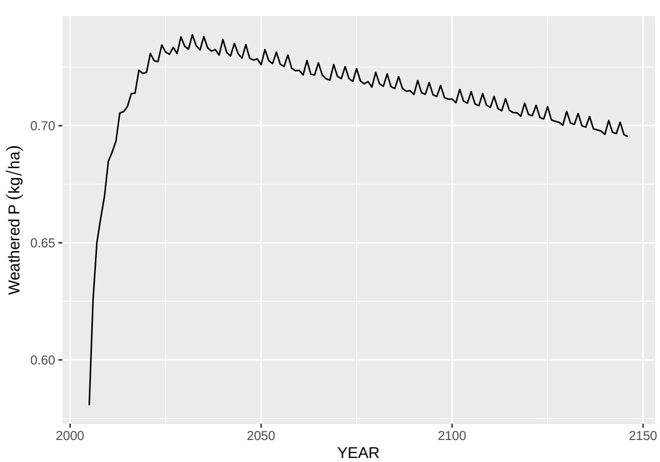


Figure 17: Phosphate Weathering (All Layer)

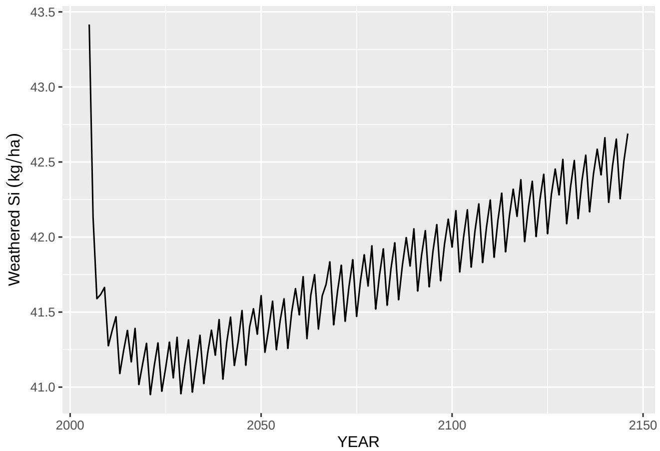


Figure 18: Silica Weathering (All Layer)

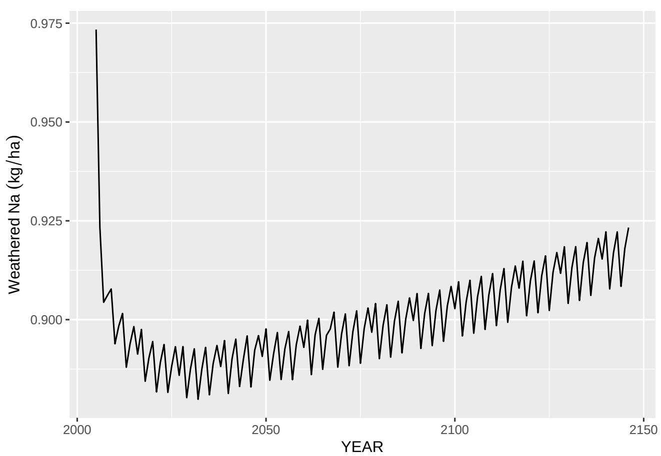
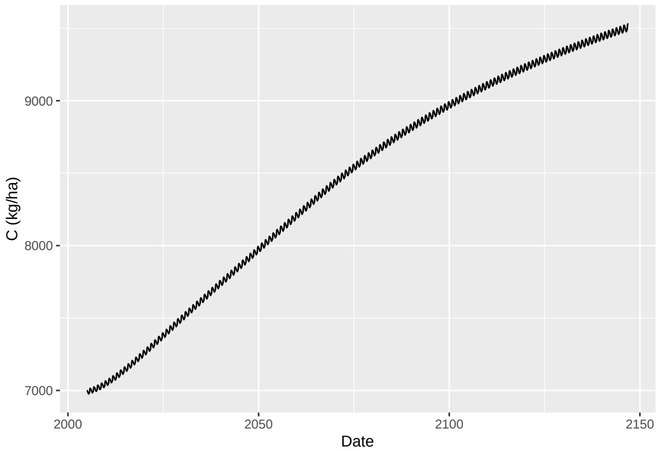


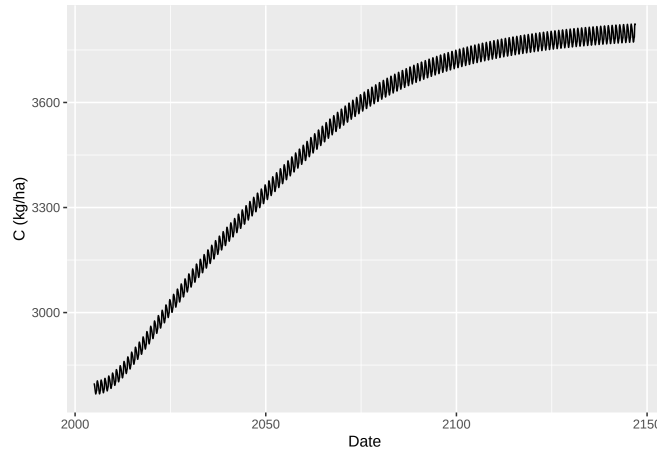
Figure 19: Sodium Weathering (All Layer)

These weathering results need to be calibrated, I just finished high N calibration so weathering is the next step.

Litter Pool Results

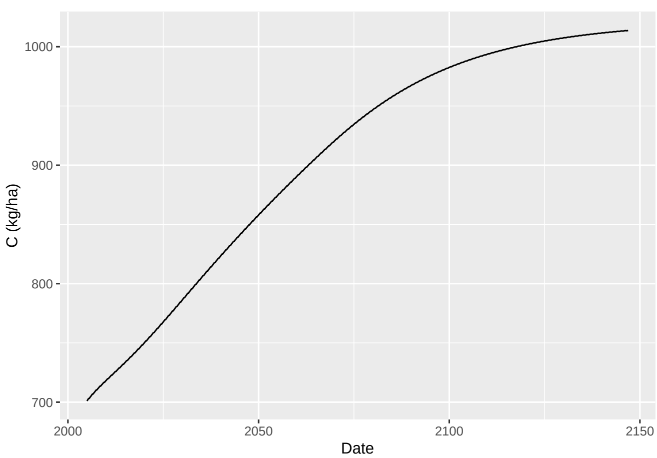


(a) Total forest floor carbon content (kg/ha)

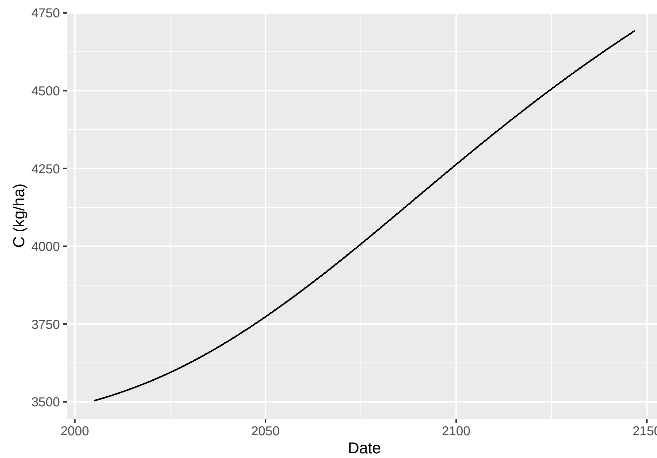


(b) Carbon content of coarse litter (kg/ha)

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



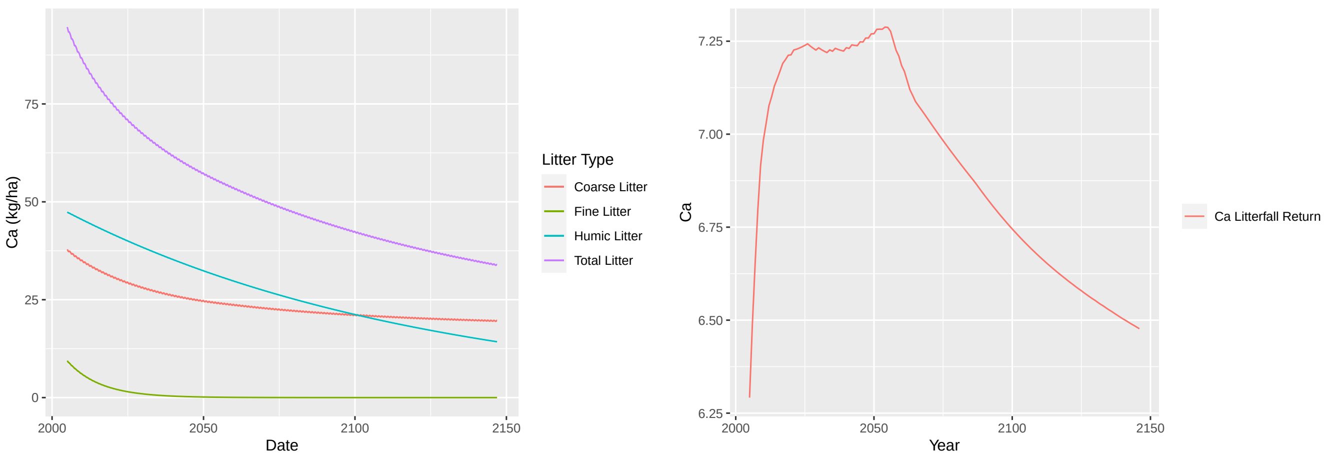
(a) Carbon content of fine litter (kg/ha)



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

Figure 21: 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.

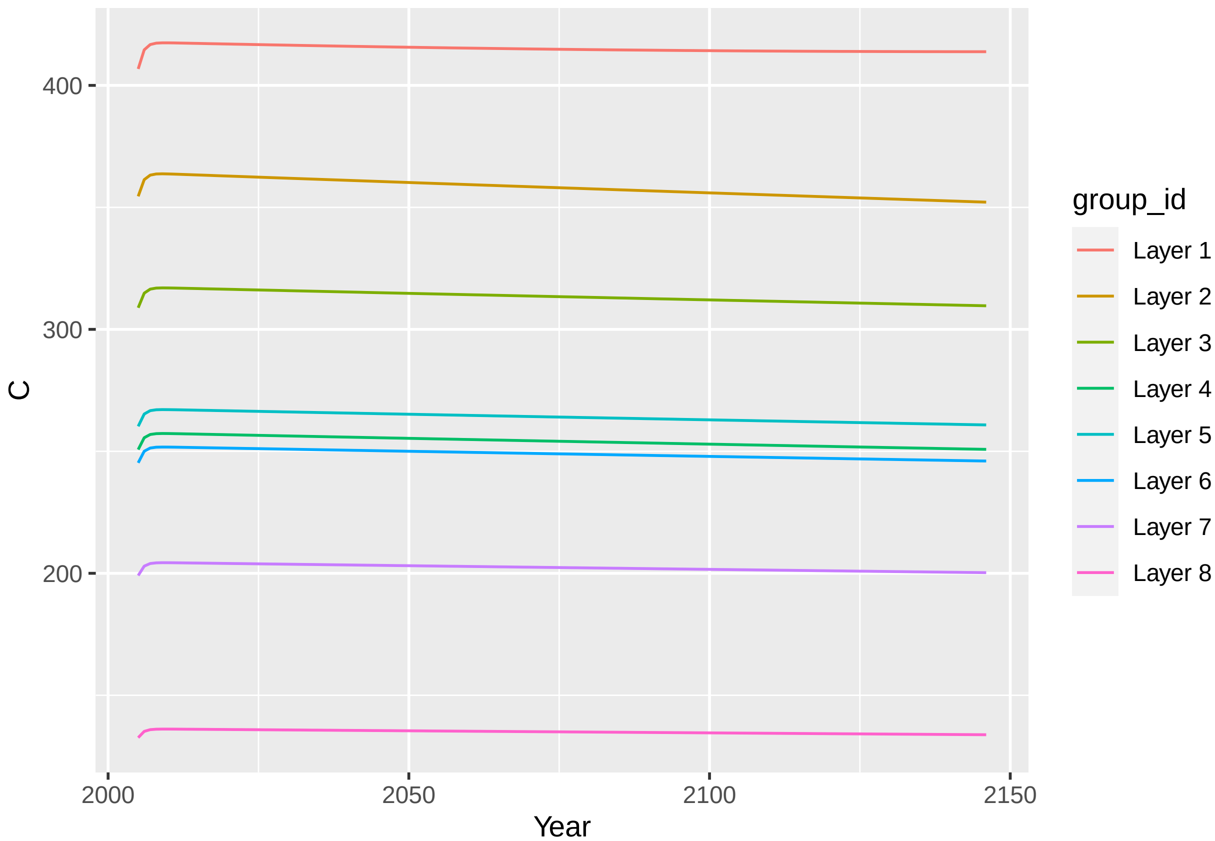


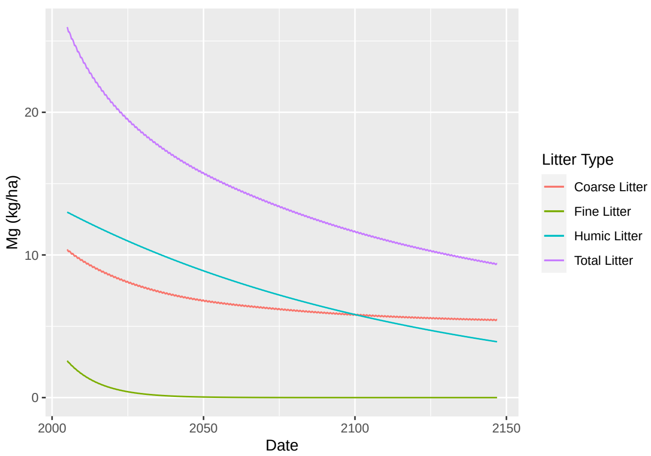
(a) Ca Content in each litter decomposition stage (kg/ha)

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

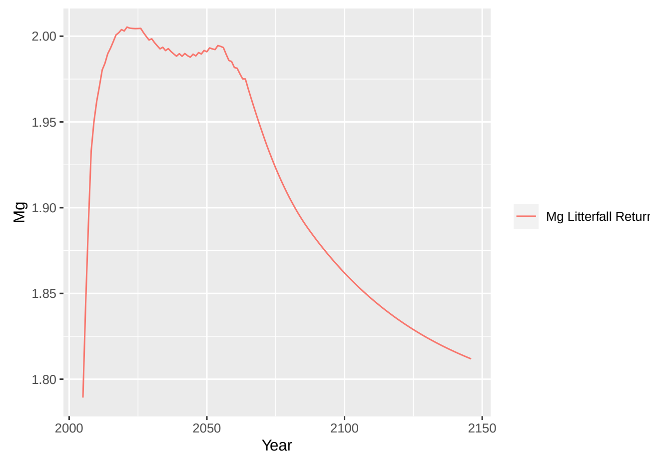
Figure 22: Forest Floor/O-horizon Ca content over time (a). and net annual Ca return in litterfall (b).

Soil Organic Matter Results



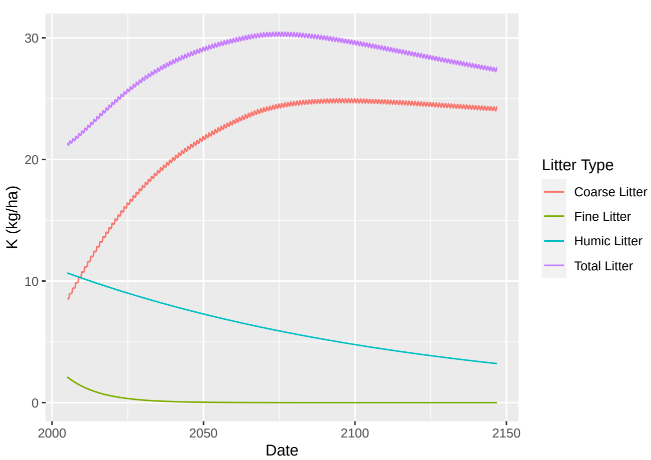


(a) Mg Content in each litter decomposition stage (kg/ha)

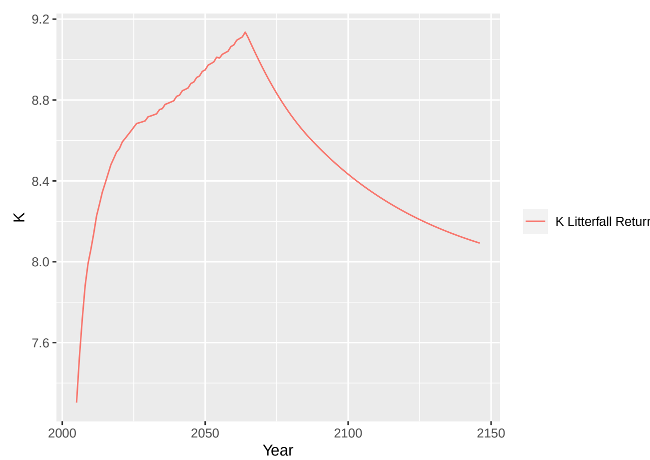


(b) Mg net annual return in litterfall (kg/ha)

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

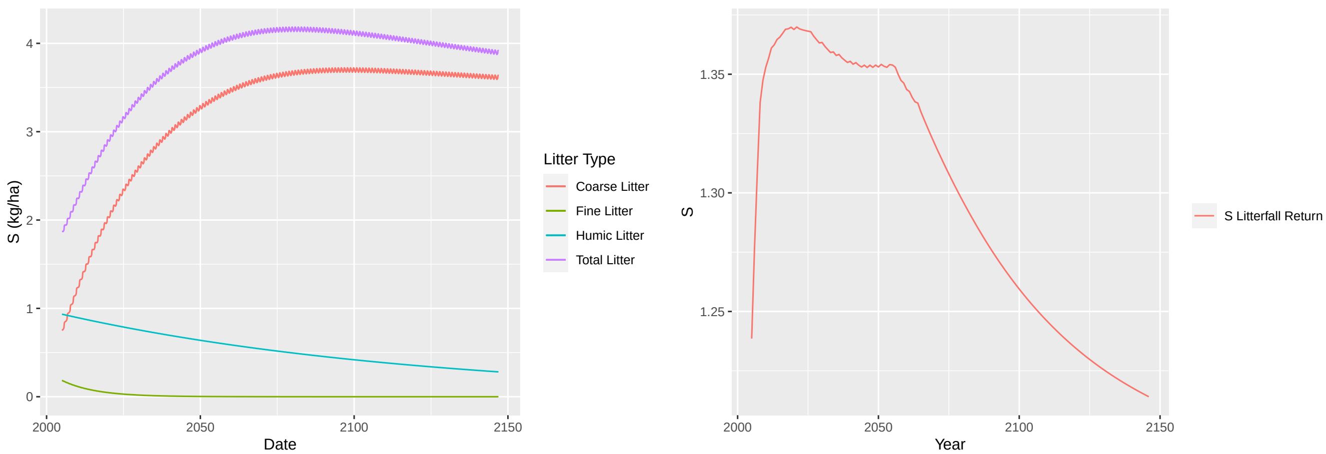


(a) K Content in each litter decomposition stage (kg/ha)



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

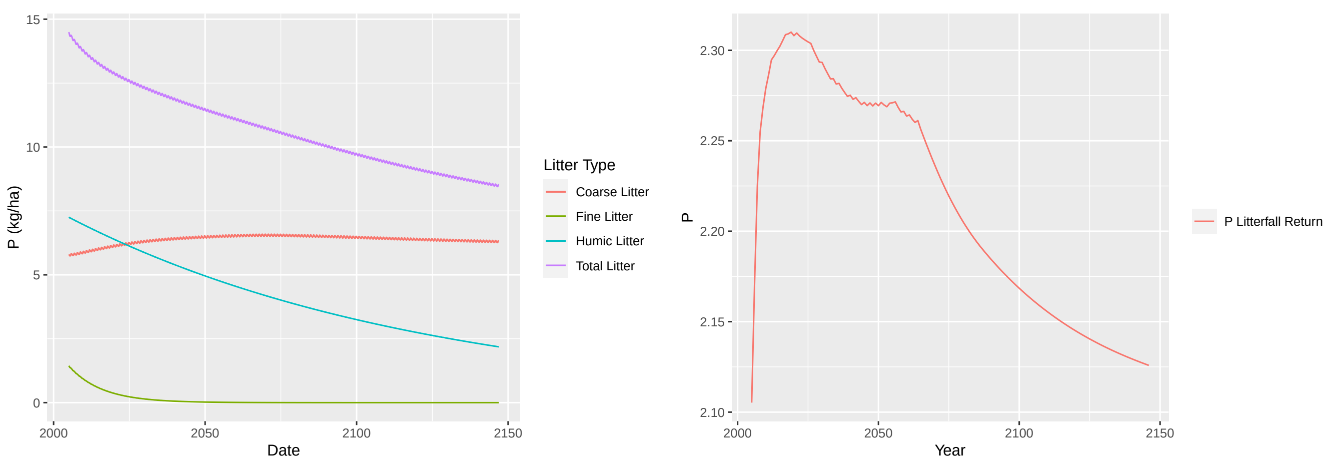
Figure 24: Forest Floor/O-horizon K content over time (a). and net annual K return in litterfall (b).



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

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

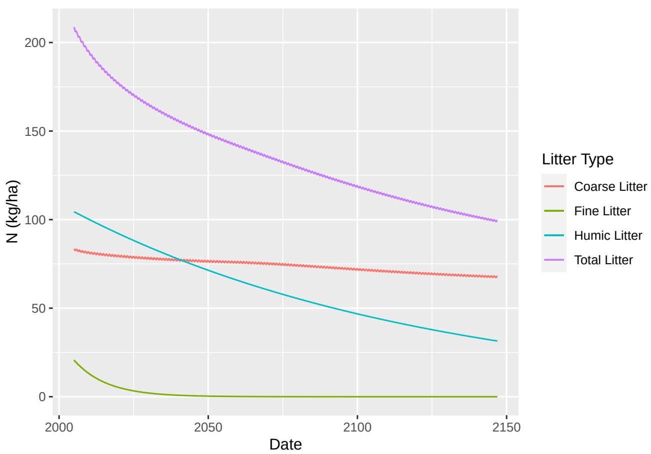
Figure 25: Forest Floor/O-horizon S content over time (a). and net annual S return in litterfall (b).



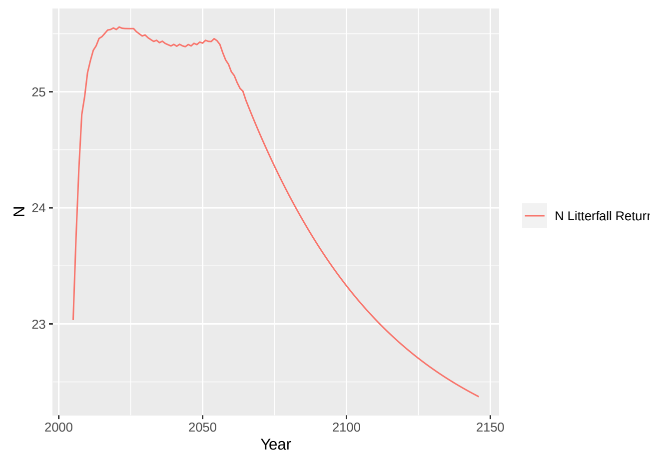
(a) P Content in each litter decomposition stage (kg/ha)

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

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



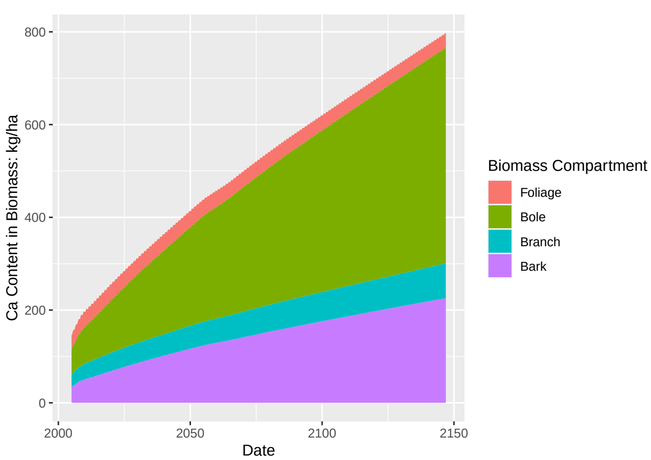
(a) N Content in each litter decomposition stage (kg/ha)



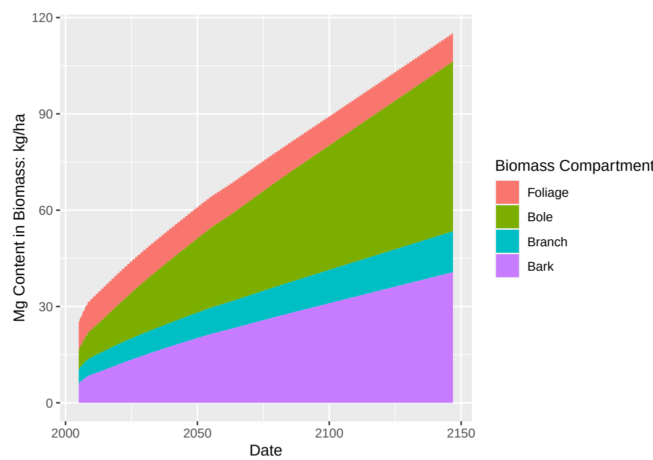
(b) N net annual return in litterfall (kg/ha)

Figure 27: Forest Floor/O-horizon N content over time (a). and net annual N return in litterfall (b).

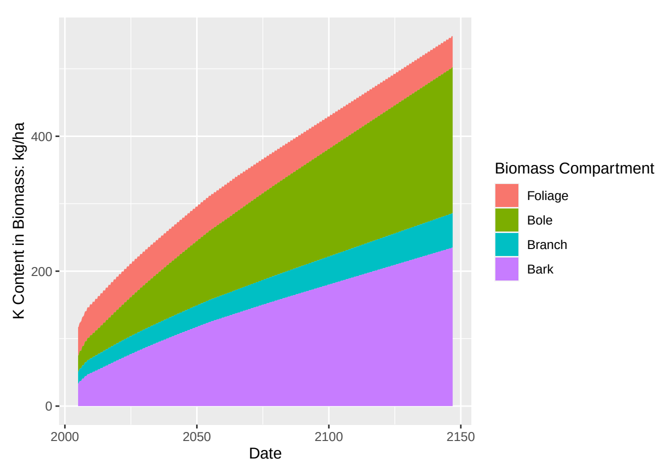
Tree Nutrient Content



(a) Calcium content in each biomass compartment

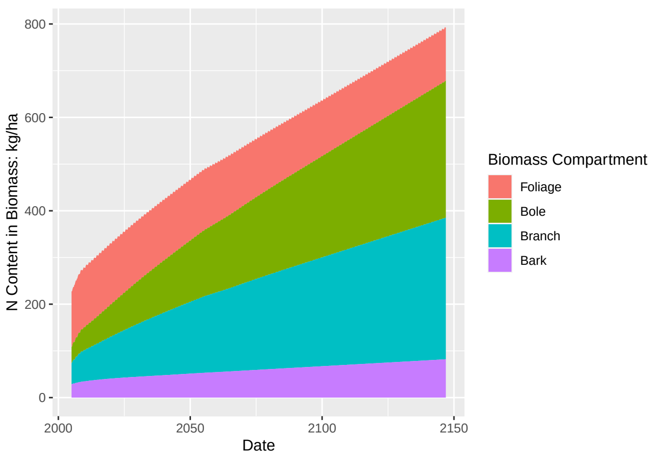


(b) Magnesium content in each biomass compartment

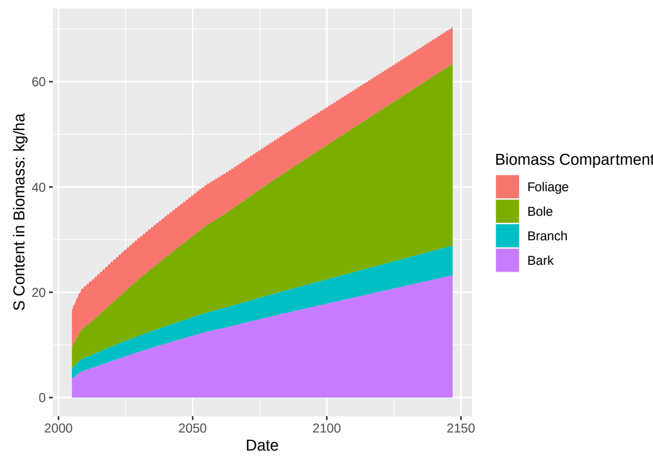


(c) Potassium content in each biomass compartment

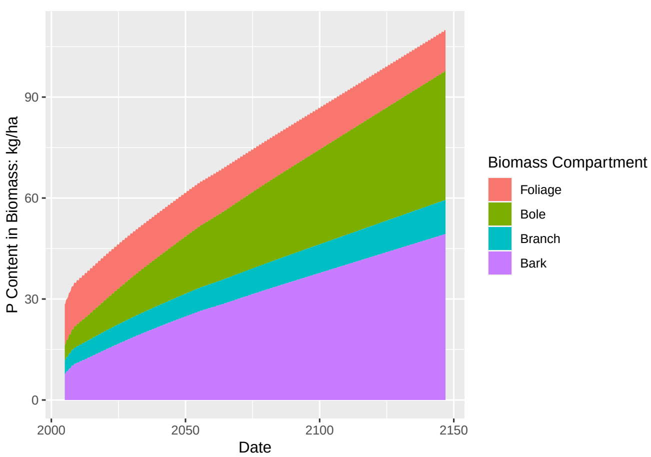
Figure 28: Base Cation Nutrient Content in Simulated Forest



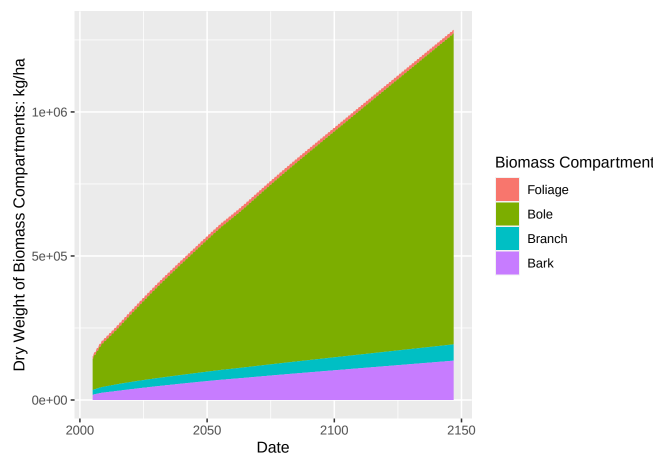
(a) Nitrogen content in each biomass compartment



(b) Sulfur content in each biomass compartment



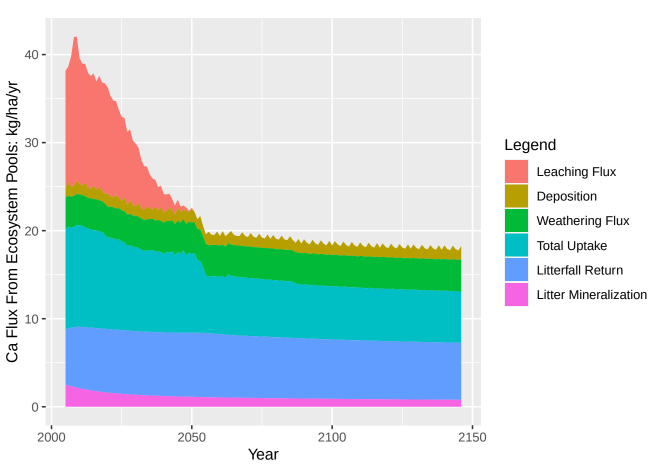
(c) Phosphorous content in each biomass compartment



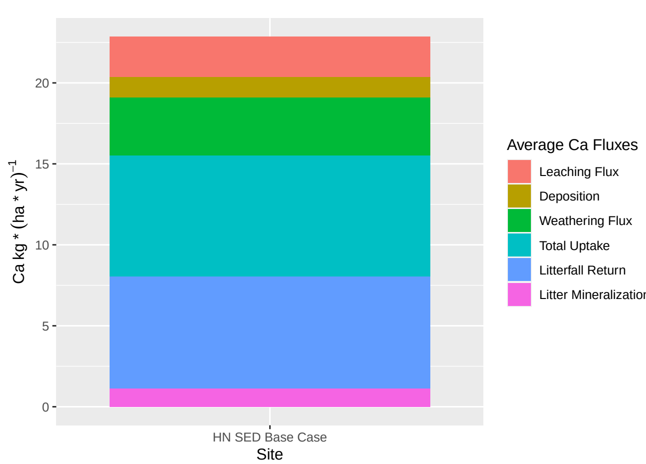
(d) Biomass of each compartment

Figure 29: N, S, and P Nutrient Contents and biomass per compartment

Analysis 1: Stack Flux Data

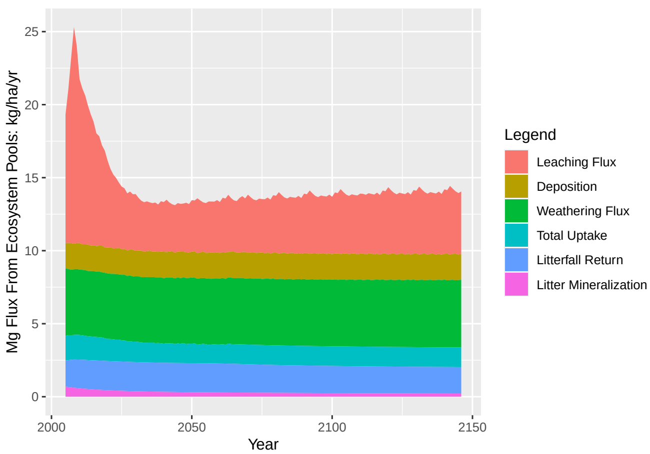


(a) Ca input and output fluxes over time

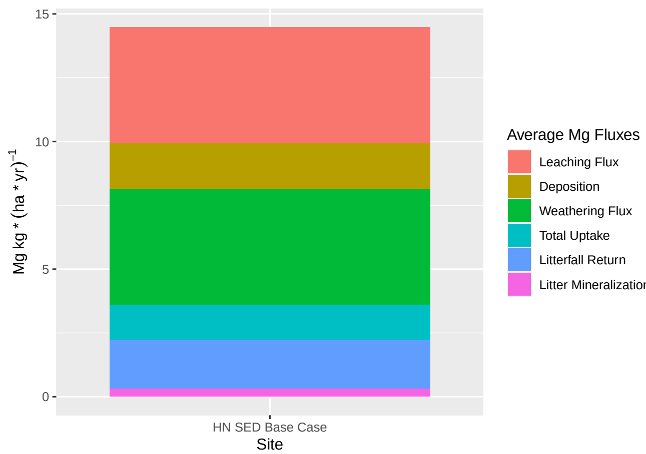


(b) Total Average Ca input and output fluxes

Figure 30: Calcium input and output comparison graphs

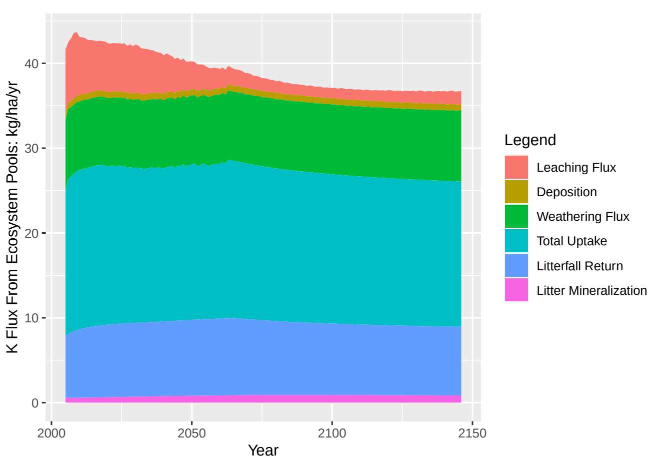


(a) Mg input and output fluxes over time

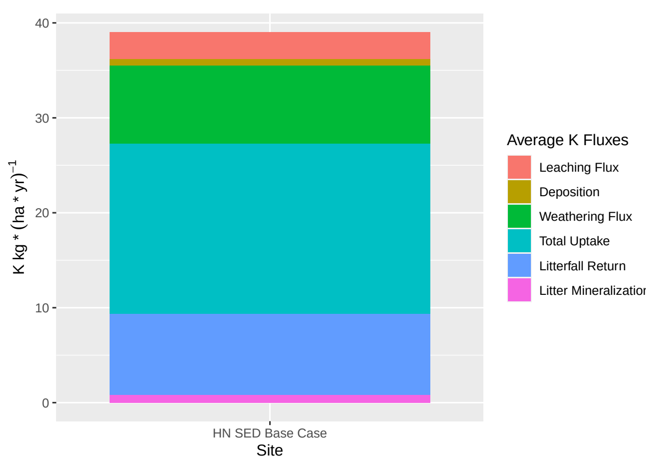


(b) Total Average Mg input and output fluxes

Figure 31: Magnesium input and output comparison graphs

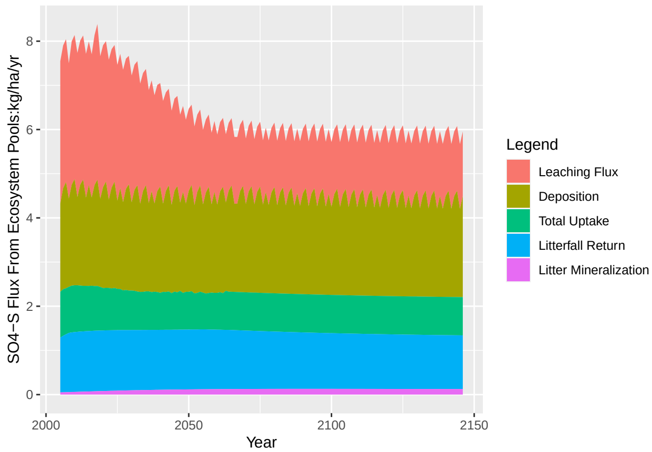


(a) K input and output fluxes over time

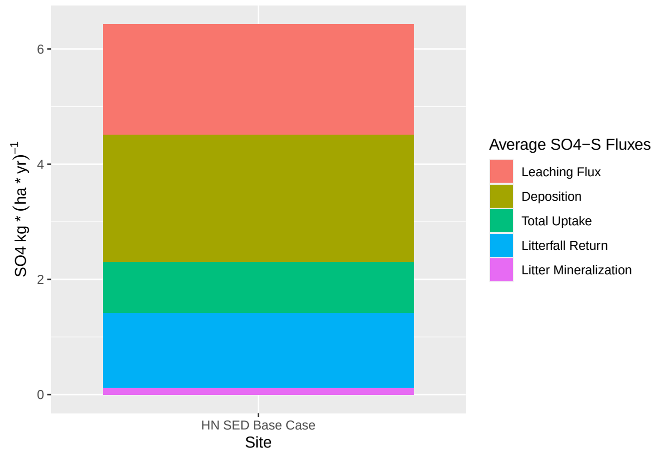


(b) Total Average K input and output fluxes

Figure 32: Potassium input and output comparison graphs



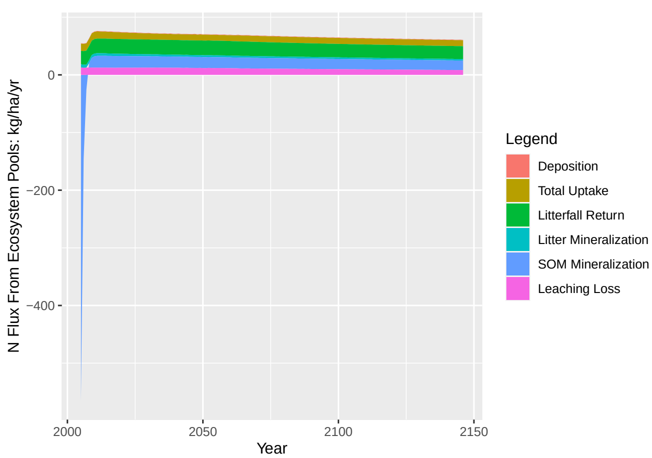
(a) S input and output fluxes over time



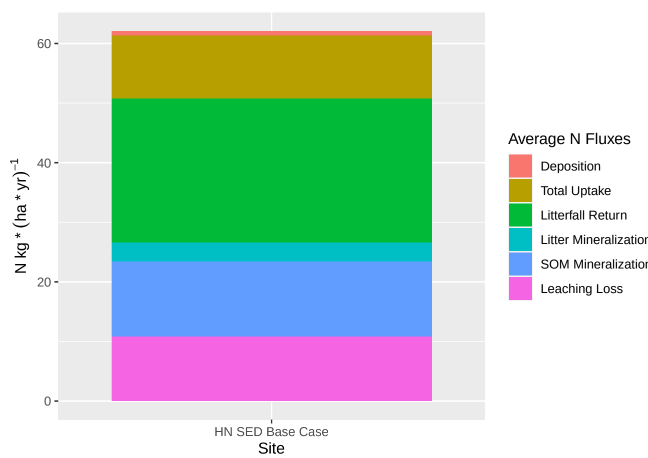
(b) Total Average S input and output fluxes

Figure 33: Sulfur input and output comparison graphs

The sulfate adsorbed pool depletes itself, the organic sulfur pool becomes increasingly dominant. This behavior is not unreasonable, however I would expect higher sulfate adsorption.



(a) N input and output fluxes over time



(b) Total Average N input and output fluxes

Figure 34: Nitrogen input and output comparison graphs

Notice how SOM mineralization starts off highly negative (-500+ kg/ha/yr N). This is strange as the SOM pool is set such that it starts with the same concentration of N (roughly a C:N of 18) as is entered for the microbial target concentration. It does not make sense that so much N would be initially uptaken into the SOM pool, this could be a coding error in NutsFor or an issue with initial parameter entry.

Cation Exchange Capacity

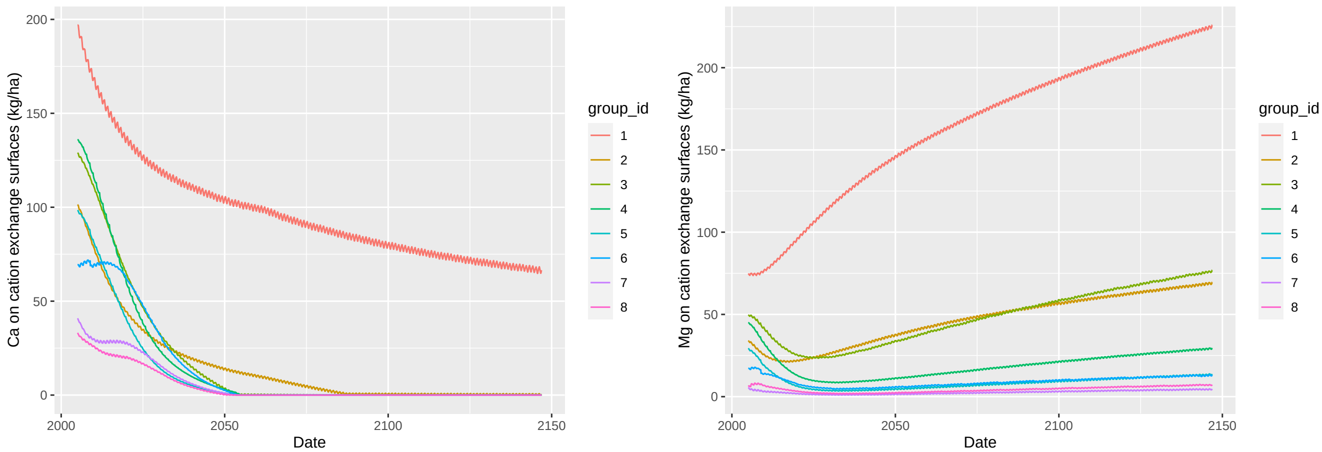


Figure 35: Calcium and Magnesium CEC adsorption over time

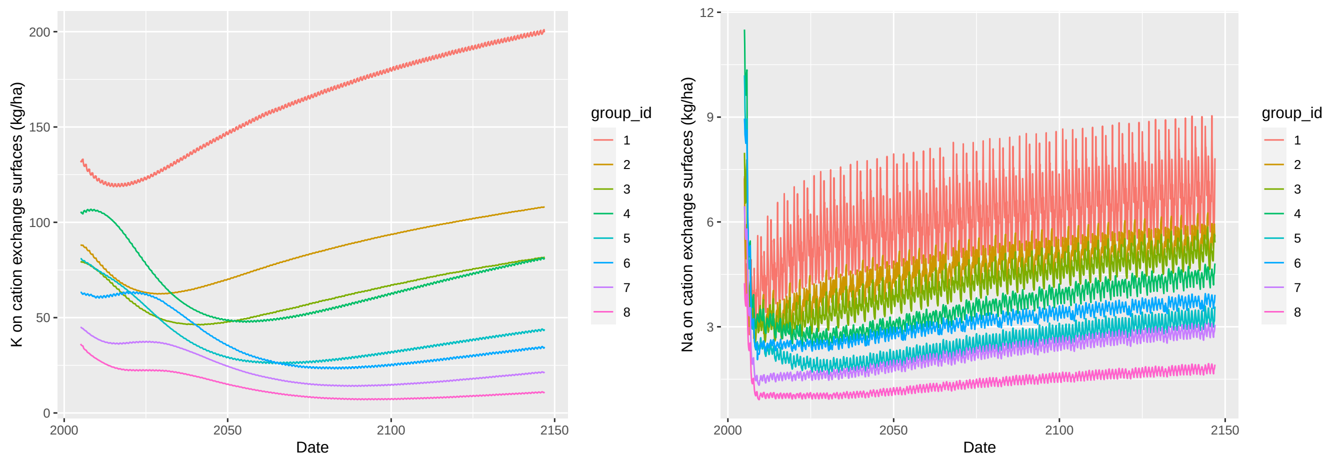


Figure 36: Potassium and Sodium CEC adsorption over time

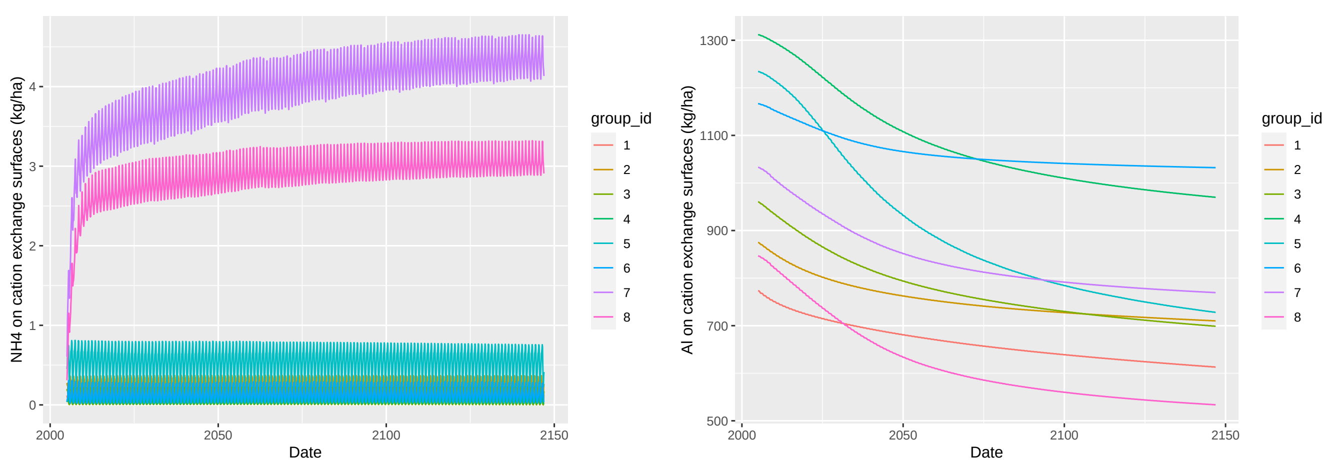
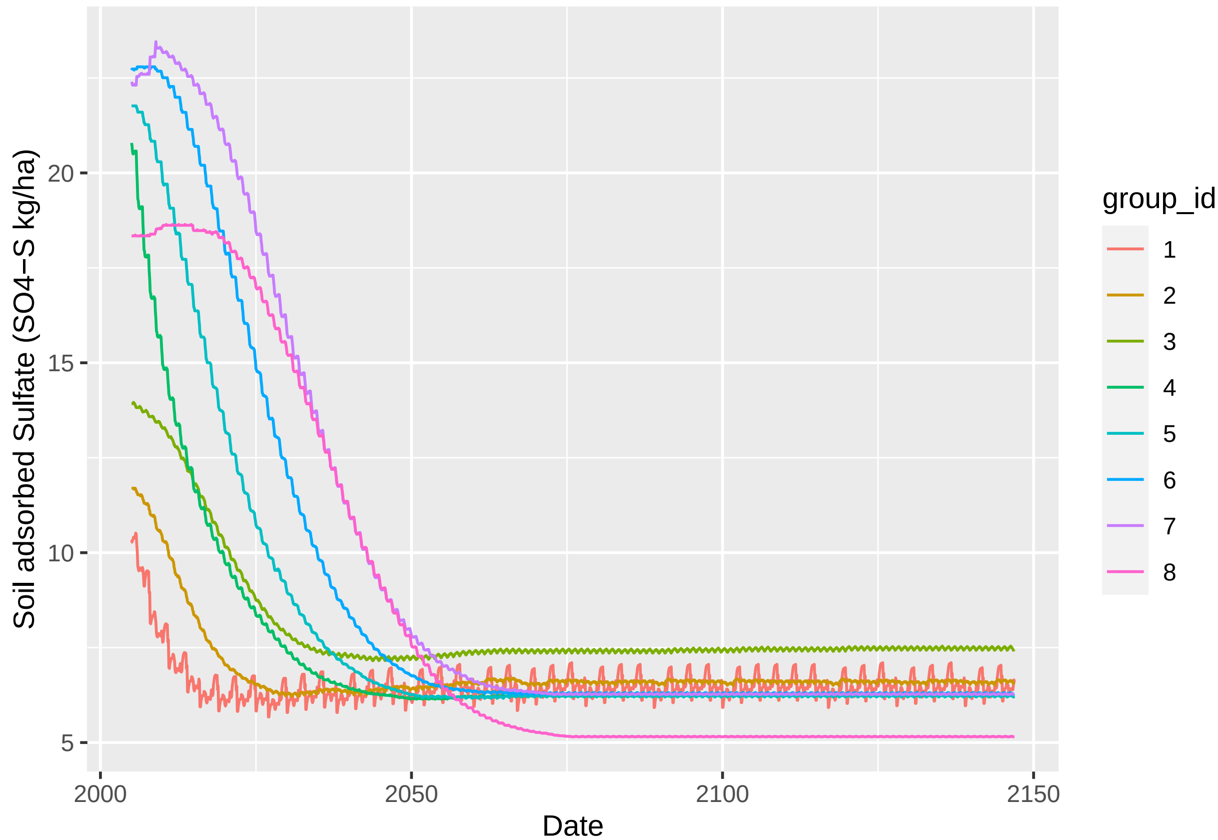
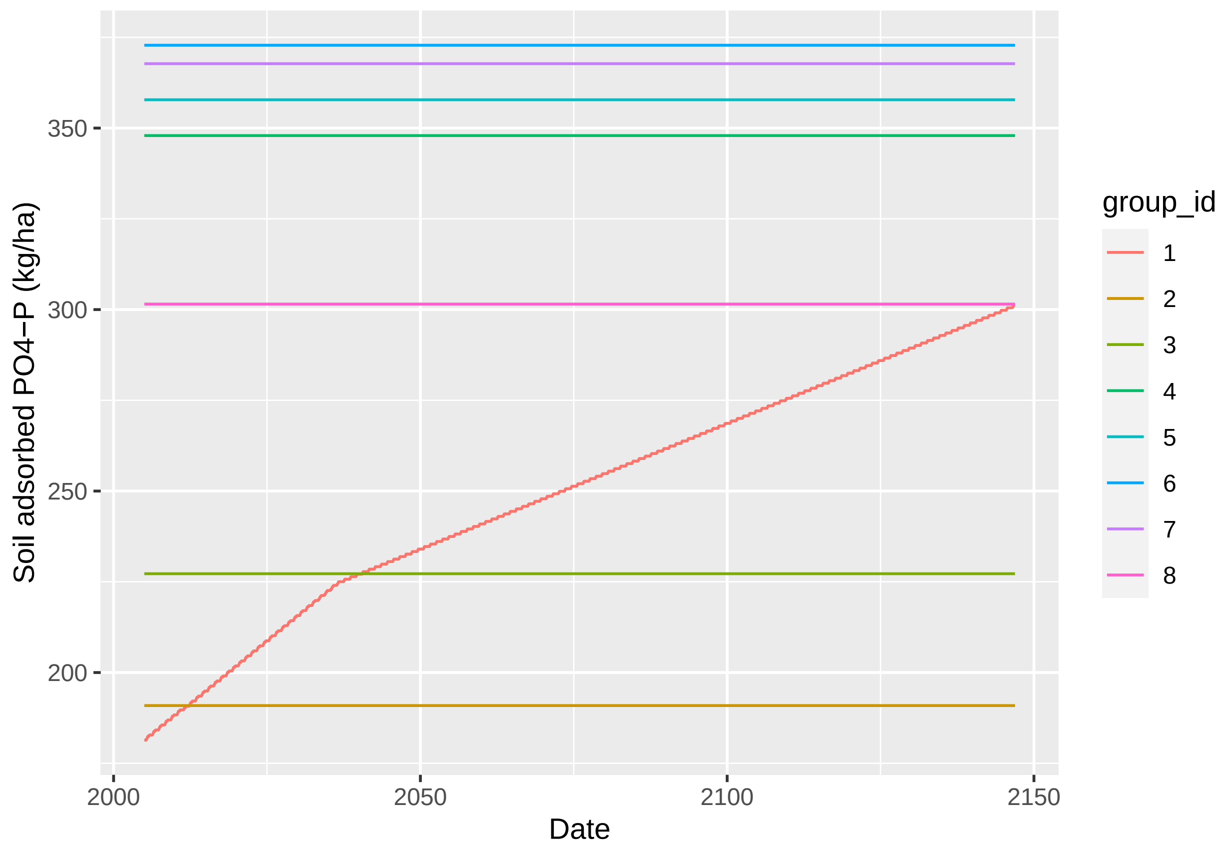
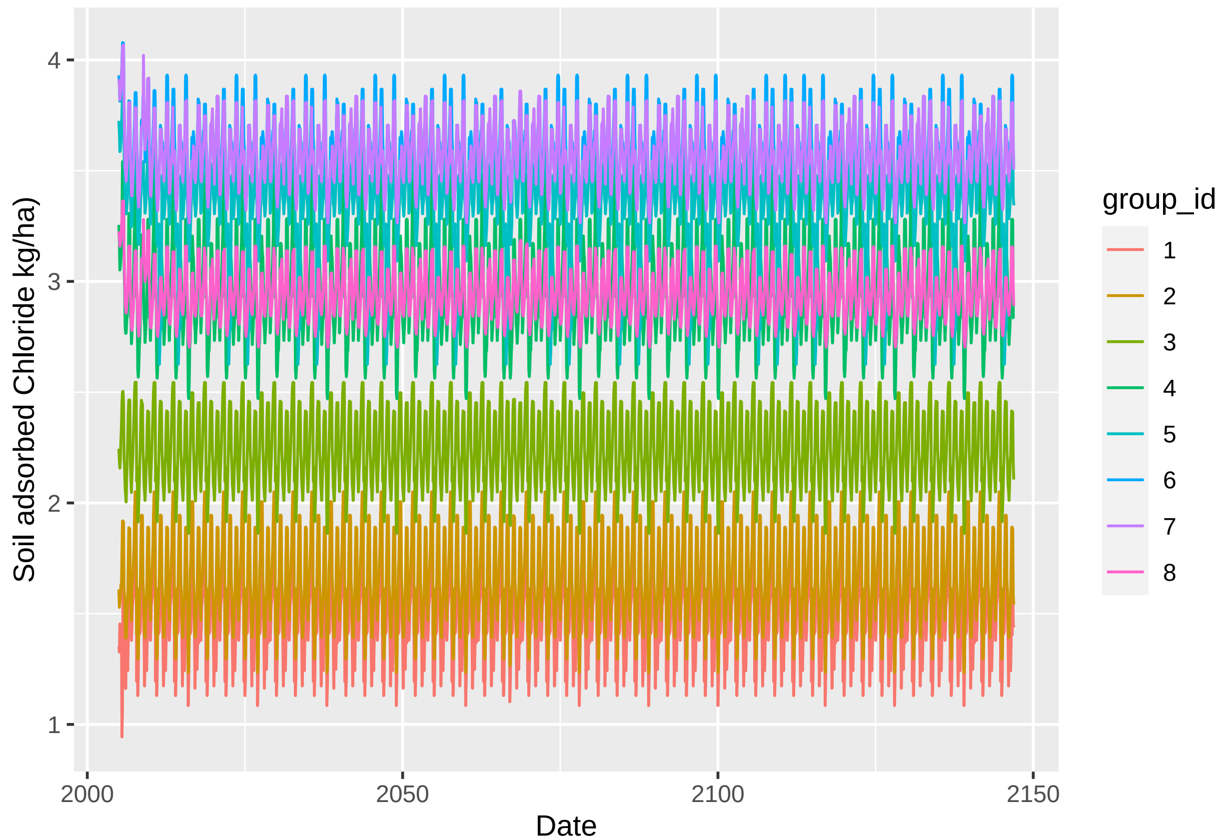


Figure 37: Ammonium and Aluminum CEC adsorption over time

Anion Exchange Capacity



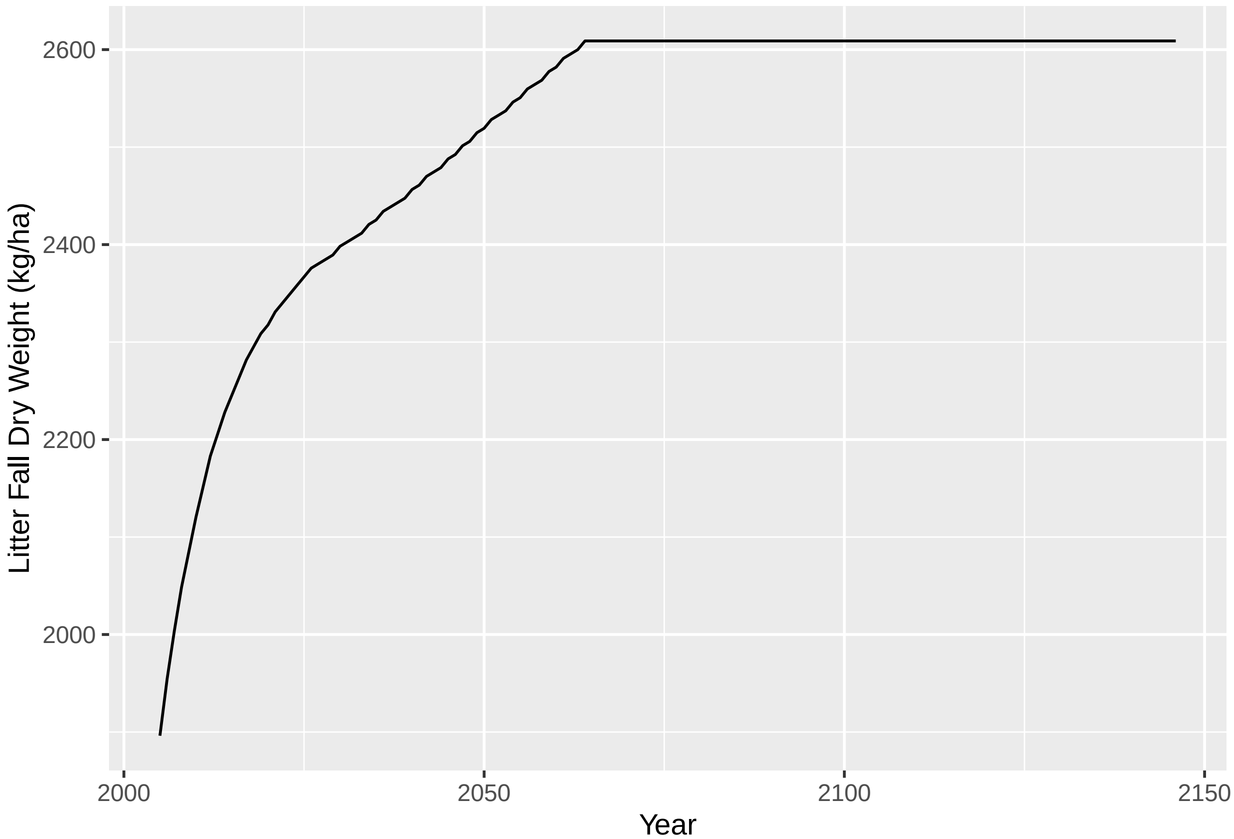




The phosphate adsorption is set from the original parameterization I received from Gregory. It tends to build up, which implies a high soil solution concentration (adsorption is determined by concentration).

Sulfate adsorption is weak and drains easily, I set a low adsorbed sulfate pool following IFS data from the Thompson site (glacial outwash, inceptisol). According to the book *Atmospheric Sulfur Deposition: Environmental and Health Impacts*, sulfur is mostly locked in organic compartments rather than on the adsorption surfaces. We might expect that sulfate, like phosphate, would increase on the AEC, however the input of sulfate relative to the adsorption and uptake of sulfate is likely too low to facilitate adsorption. This is well supported by IFS data that show low sulfate adsorption on potentially high capacity adsorbing soils. The higher sulfate concentrations observed at the high N site could well be due to a higher inherent sulfur pool, possibly a condition of higher sulfate-mineral weathering, or due to a competitive response with phosphate.

Other


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