

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)

Soil Layer	$\mu\text{mol/L}$															
	Ca	Mg	K	Na	NO ₃	NH ₄	SO ₄	Cl	PO ₄	DOC	Al	Si	H ⁺	pH	R	HR
Layer 1	12.3	16.4	16.3	44.5	1.475	0.800	23.6	55.2	1.026	341	0.01894	15.2	19.54	4.71	34.7	14.0
Layer 2	15.8	21.6	18.8	53.7	1.117	0.473	25.2	63.0	0.894	586	0.02951	32.9	24.66	4.61	57.8	25.9
Layer 3	22.4	26.4	22.0	48.7	0.712	0.285	25.3	69.1	0.726	655	0.01803	45.3	18.85	4.72	67.0	26.5
Layer 4	10.1	17.5	15.3	48.4	0.441	0.473	21.8	65.6	0.406	402	0.04382	54.7	28.44	4.55	38.3	19.1
Layer 5	14.8	24.4	16.0	52.8	0.425	1.088	21.9	71.1	0.185	406	0.00784	56.7	10.76	4.97	43.9	14.0
Layer 6	13.9	22.1	18.2	56.2	0.437	1.345	21.9	76.5	0.229	371	0.00961	60.4	12.43	4.91	39.7	13.3
Layer 7	17.5	23.9	17.0	63.2	0.471	2.014	21.9	82.6	0.302	417	0.00550	64.9	8.27	5.08	46.5	13.1
Layer 8	17.3	22.2	19.4	70.9	0.496	2.460	21.9	87.0	0.226	415	0.00427	67.2	6.79	5.17	47.3	12.1

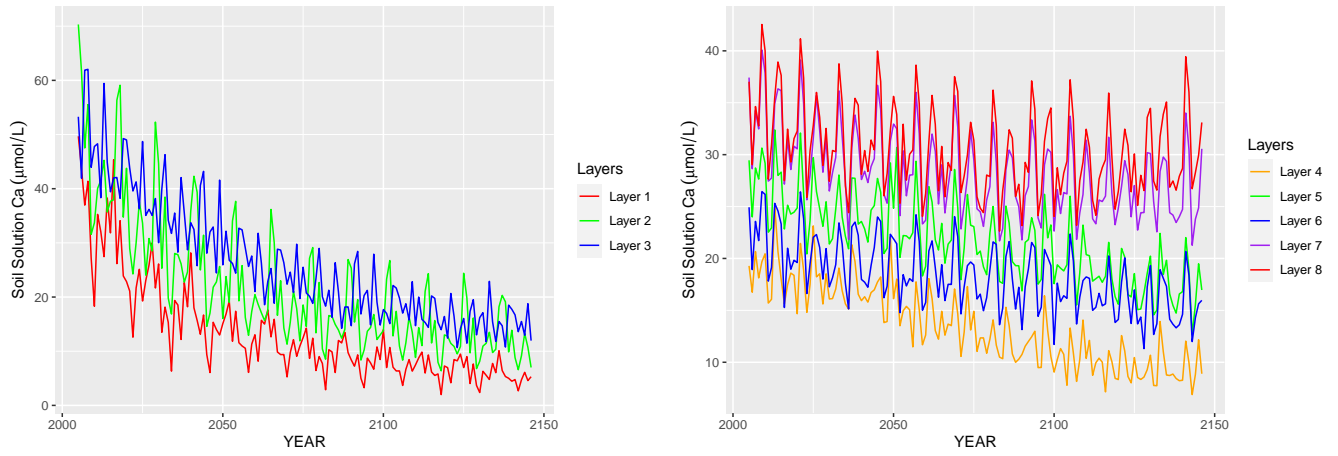


Figure 1: Monthly Calcium Concentrations by Soil Layer

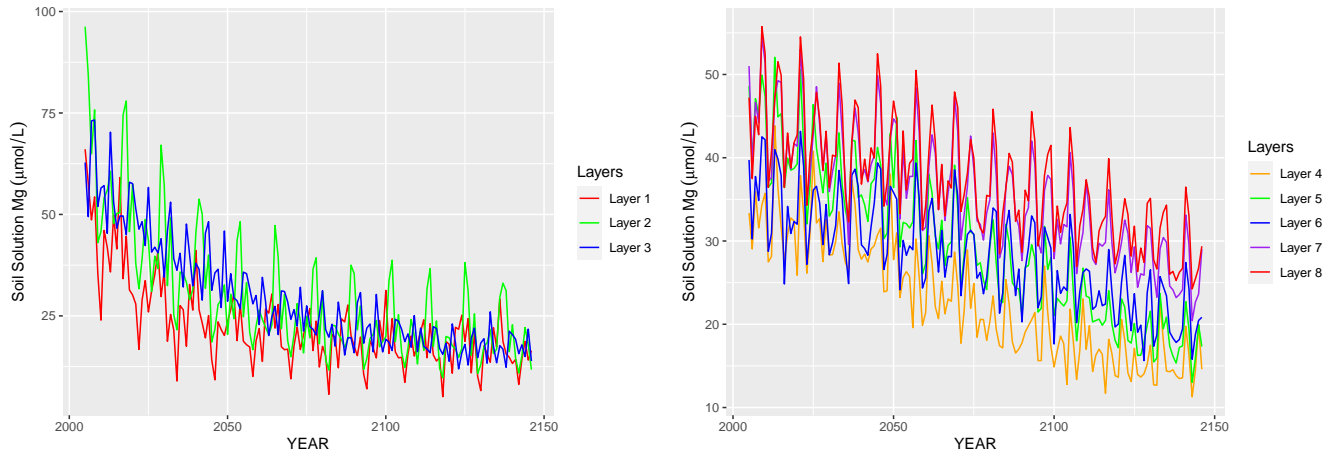


Figure 2: Monthly Magnesium Concentrations by Soil Layer

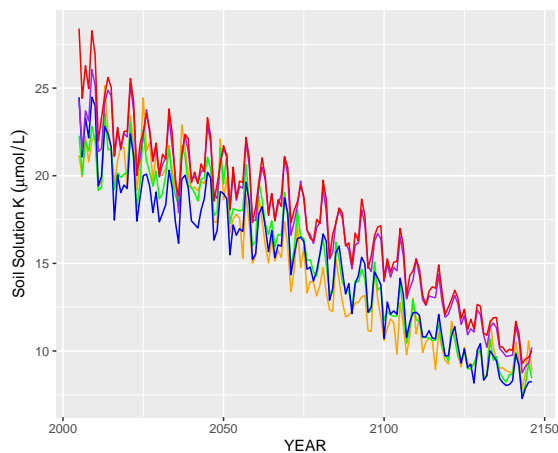
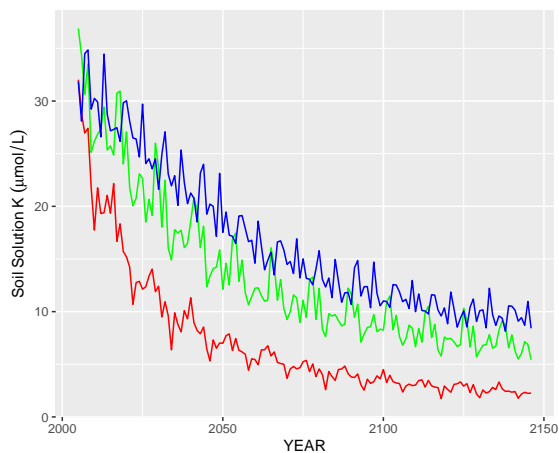


Figure 3: Monthly Potassium Concentrations by Soil Layer

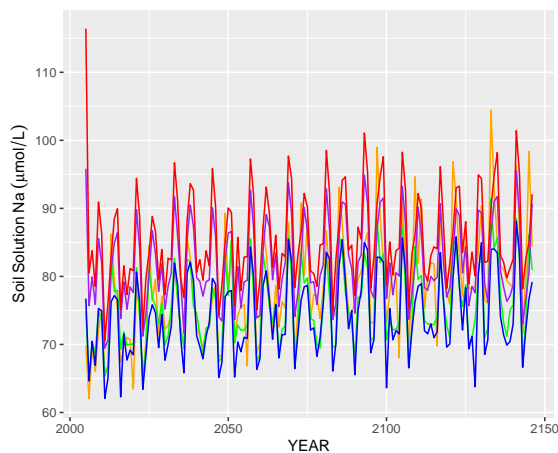
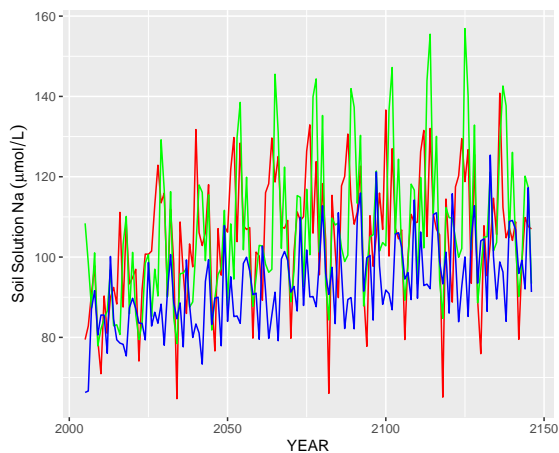


Figure 4: Monthly Sodium Concentrations by Soil Layer

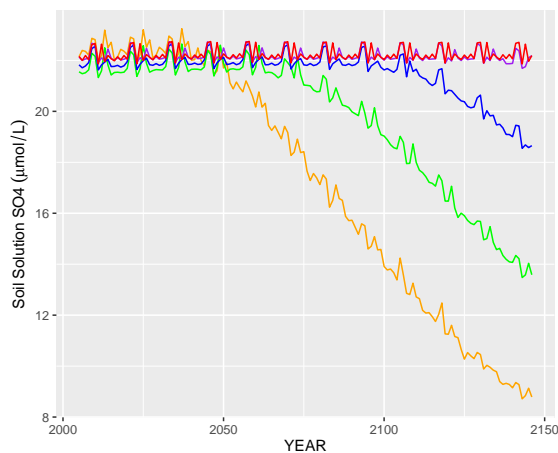
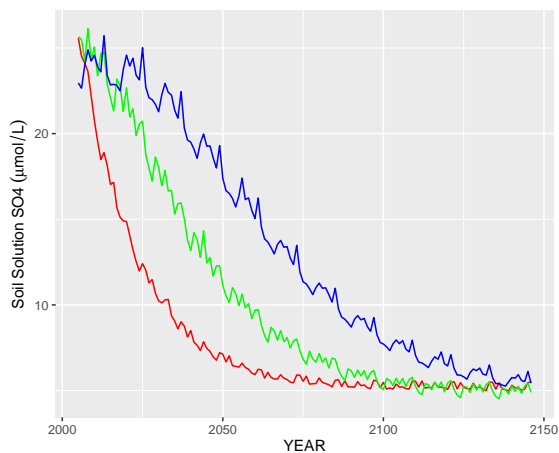


Figure 5: Monthly Sulfate Concentrations by Soil Layer

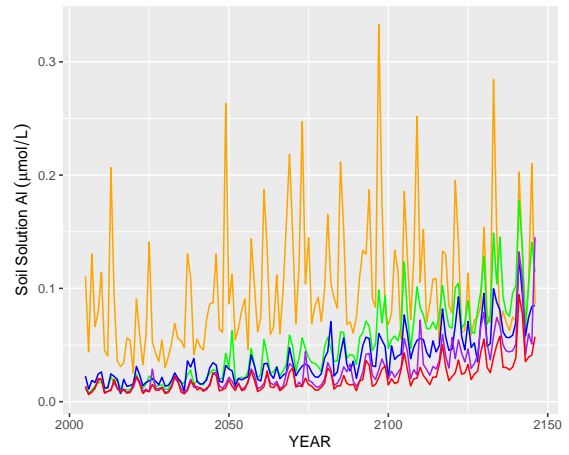
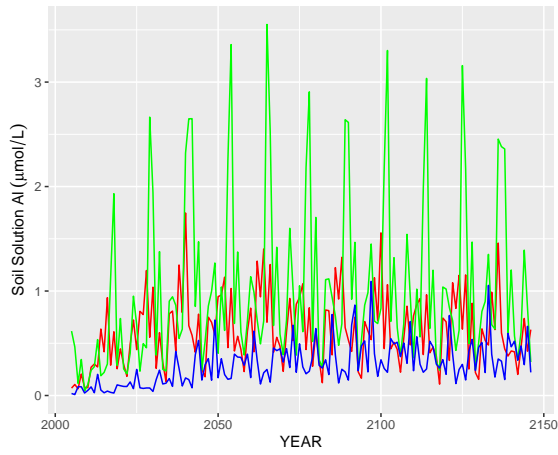


Figure 6: Monthly Aluminum Concentrations by Soil Layer

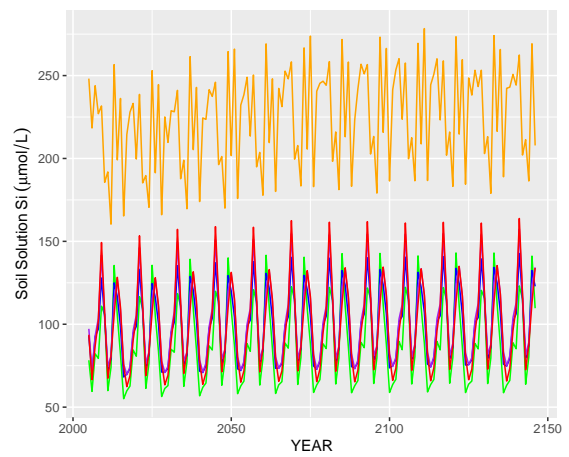
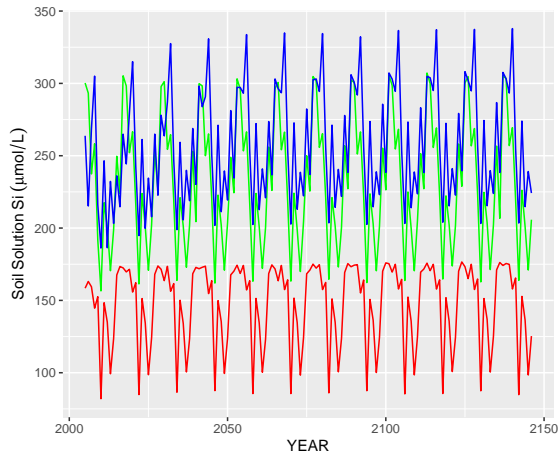


Figure 7: Monthly SiO_2 Concentrations by Soil Layer

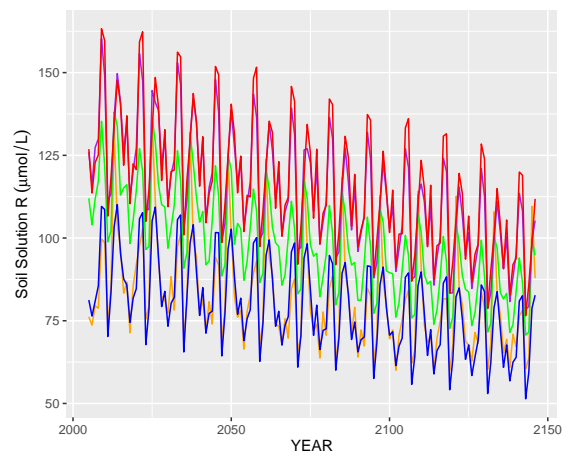
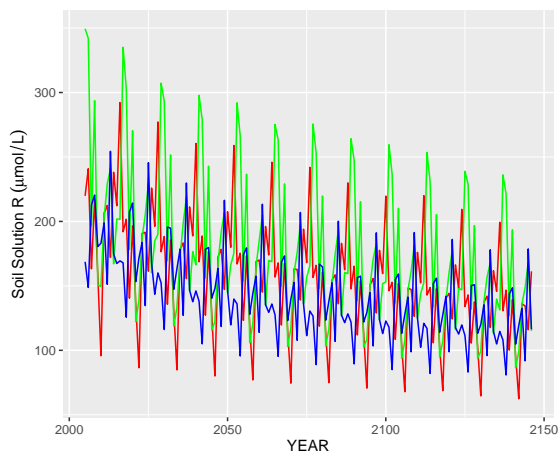


Figure 8: Monthly Organic Acid Base (R-) Concentrations by Soil Layer

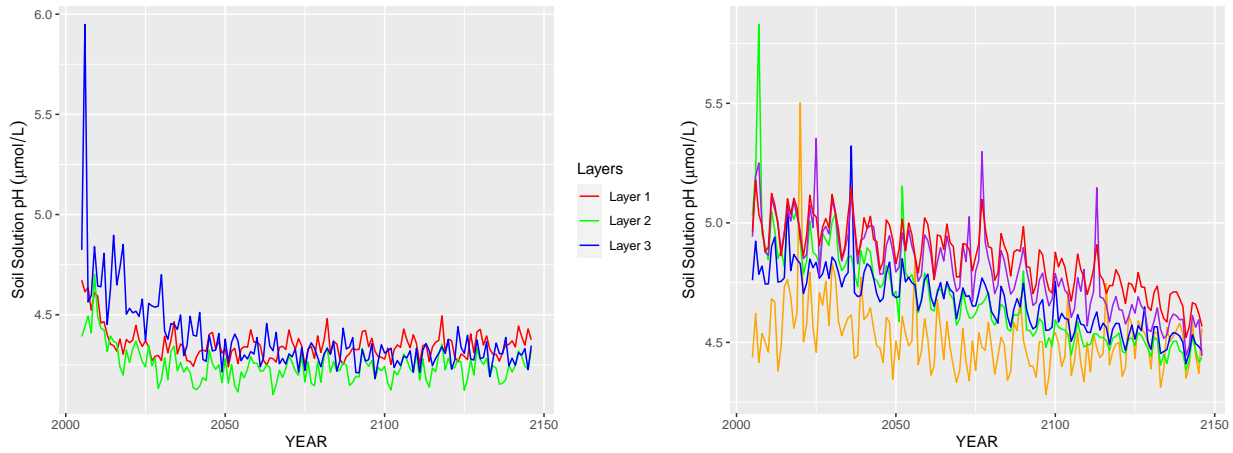


Figure 9: Monthly pH by Soil Layer

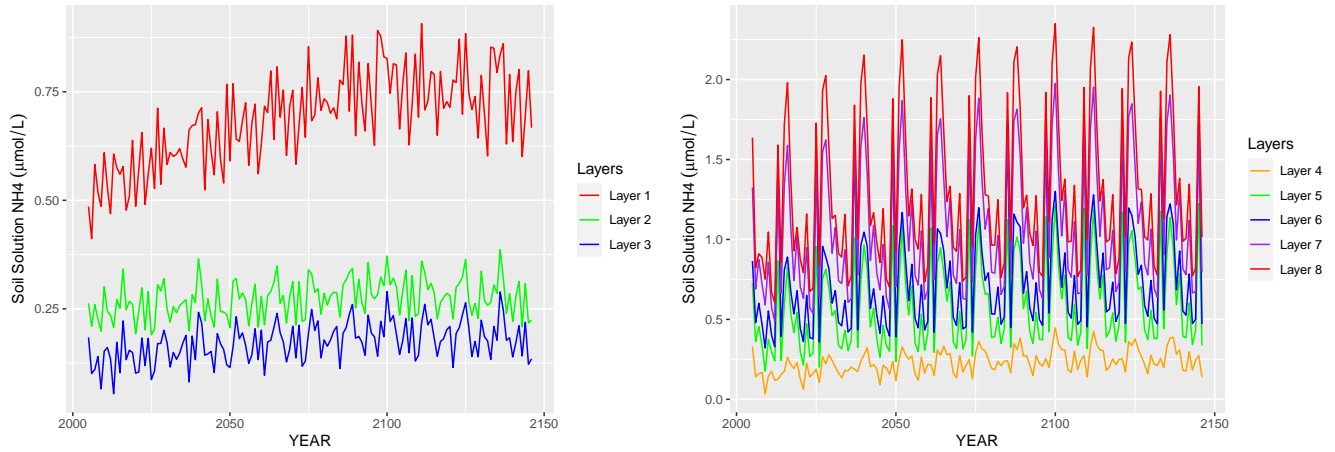


Figure 10: Yearly Ammonium concentration by Soil Layer

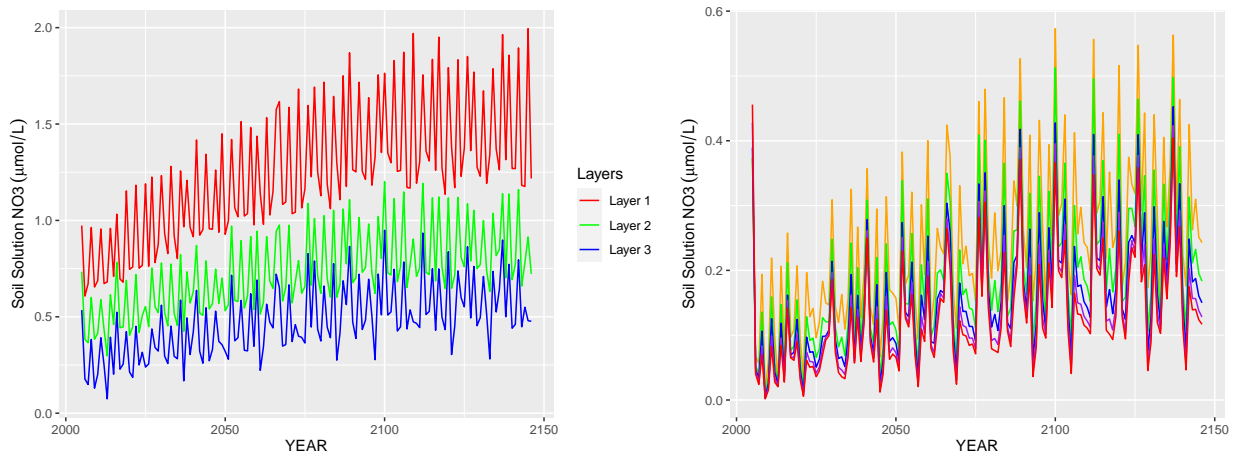


Figure 11: Yearly Nitrate concentration by Soil Layer

Weathering Results

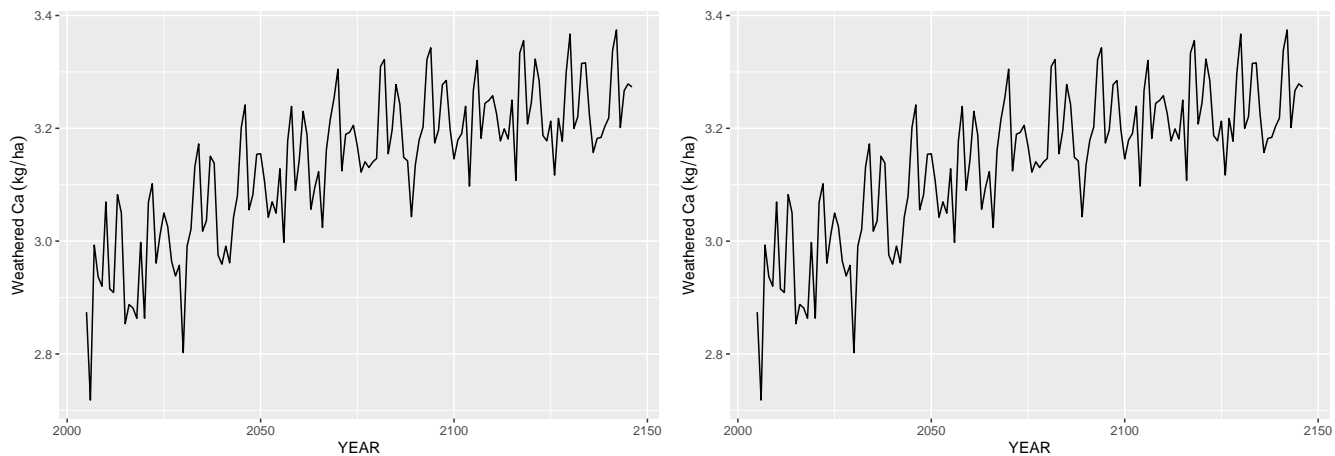


Figure 12: Calcium Weathering (All Layer)

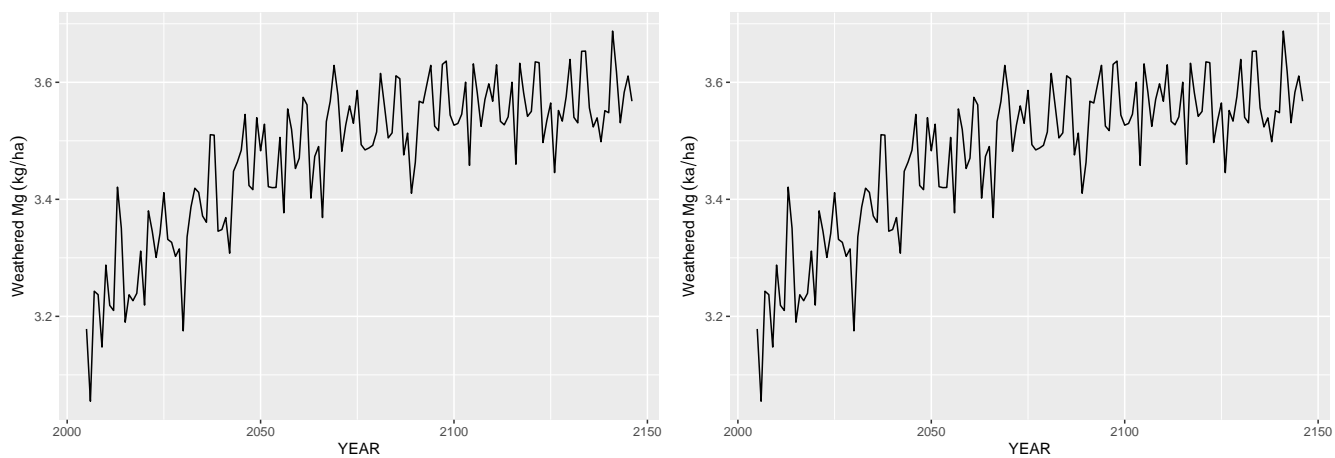


Figure 13: Magnesium Weathering (All Layer)

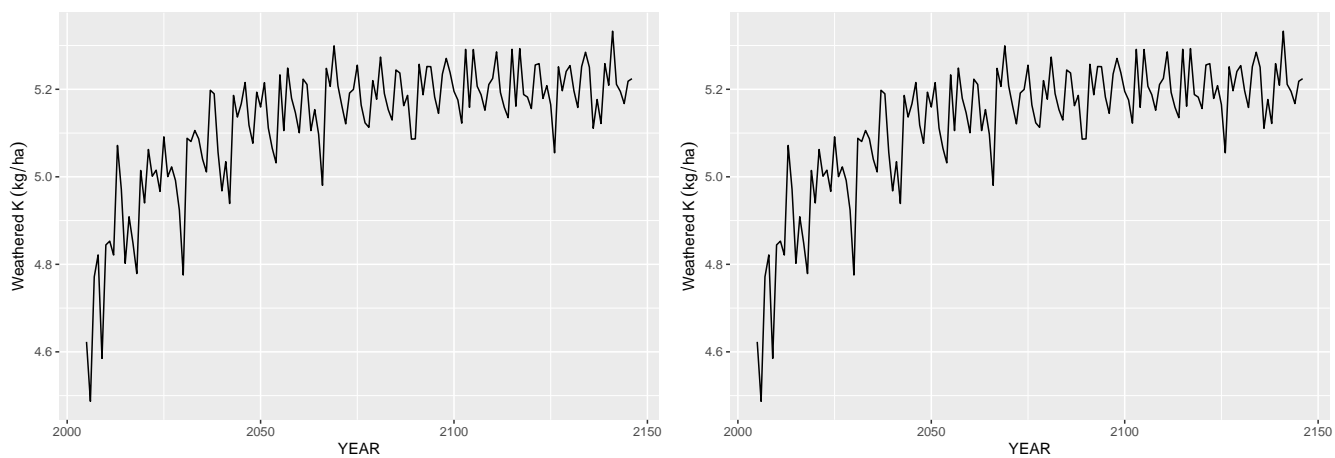


Figure 14: Potassium Weathering (All Layer)

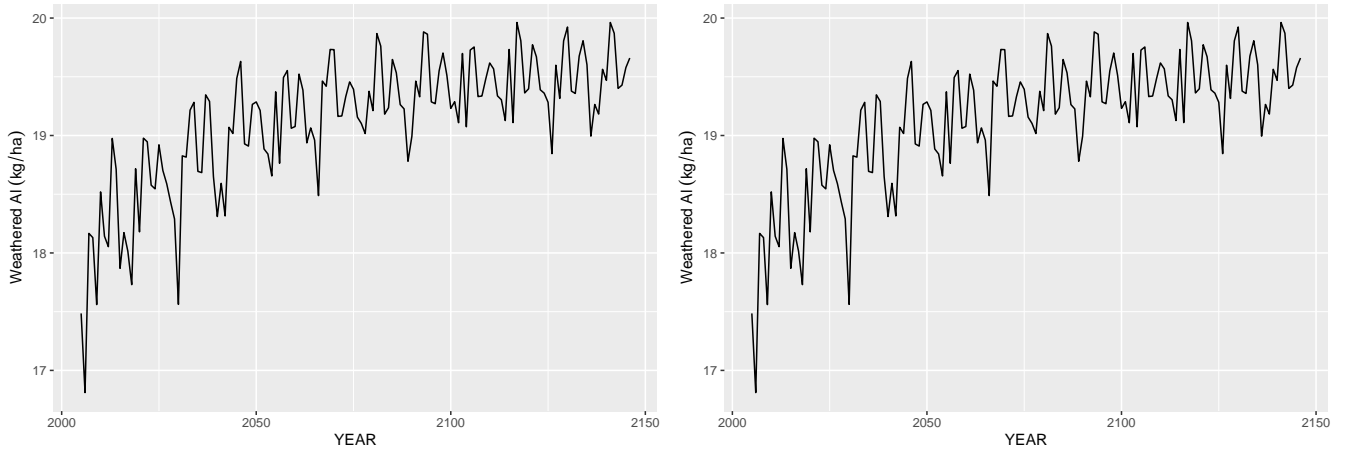


Figure 15: Aluminum Weathering (All Layer)

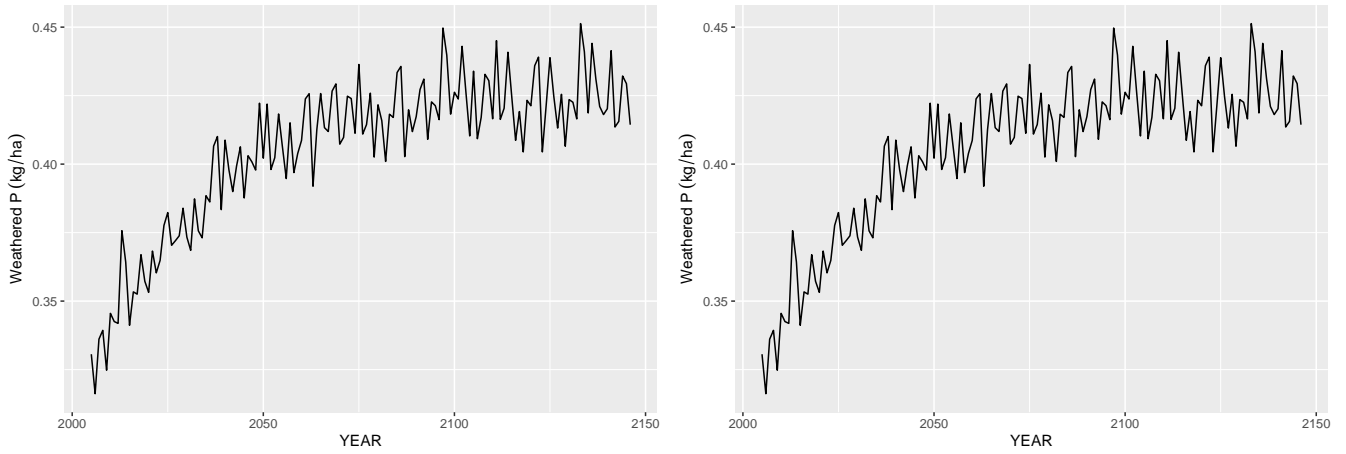


Figure 16: Phosphate Weathering (All Layer)

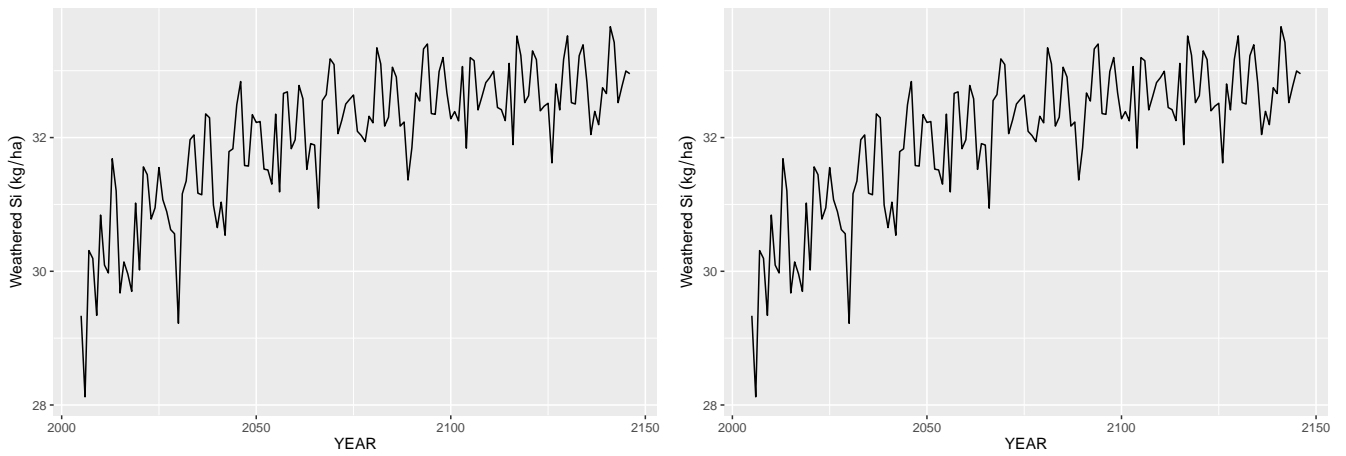


Figure 17: Silica Weathering (All Layer)

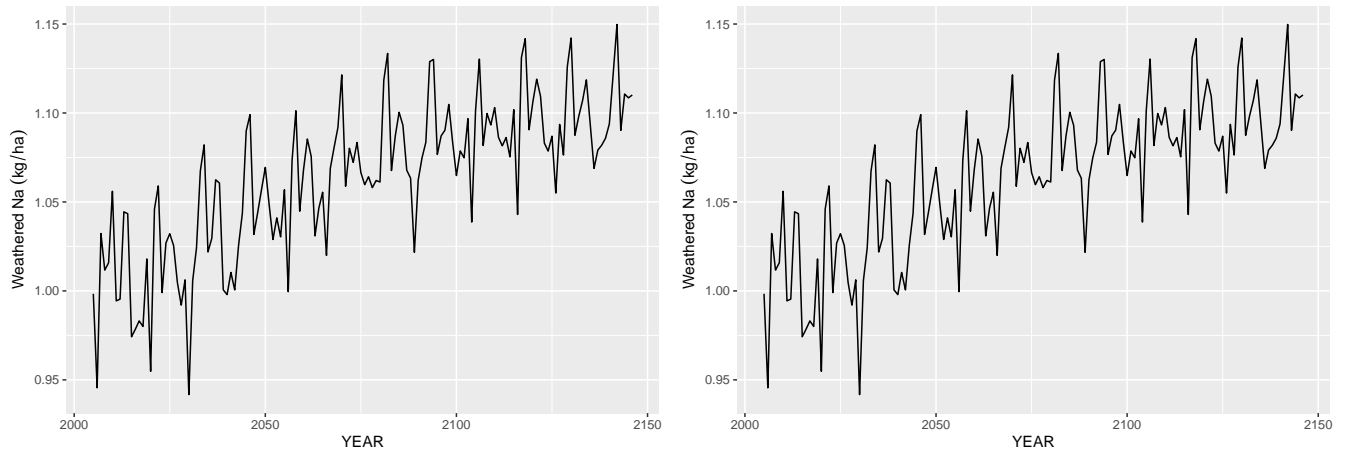


Figure 18: Sodium Weathering (All Layer)

Litter Pool Results

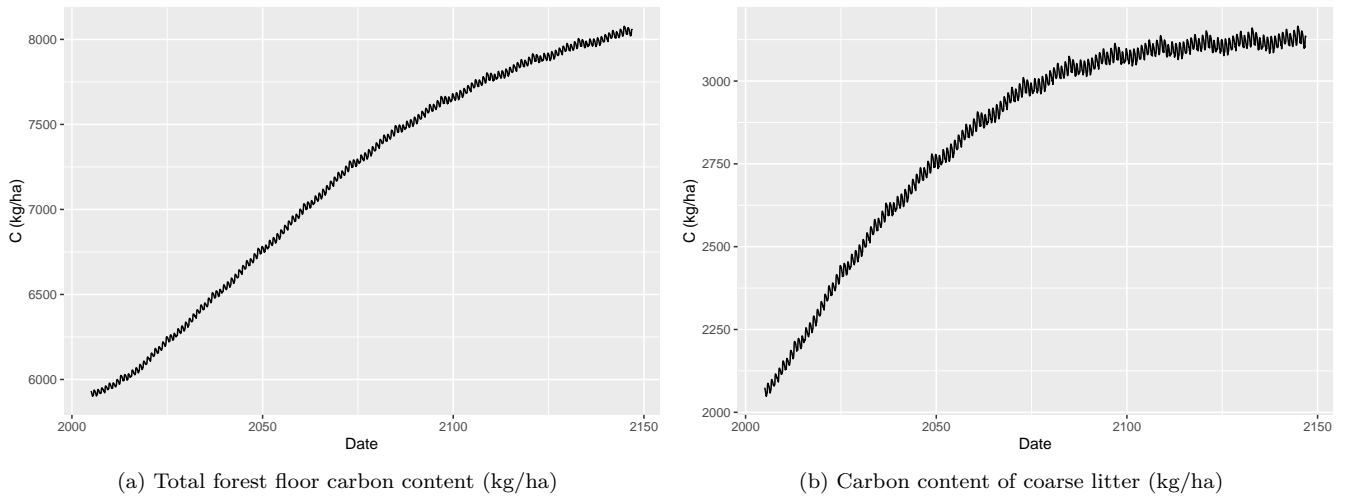


Figure 19: Forest Floor (O-Layer) Carbon Content Over Simulation Period

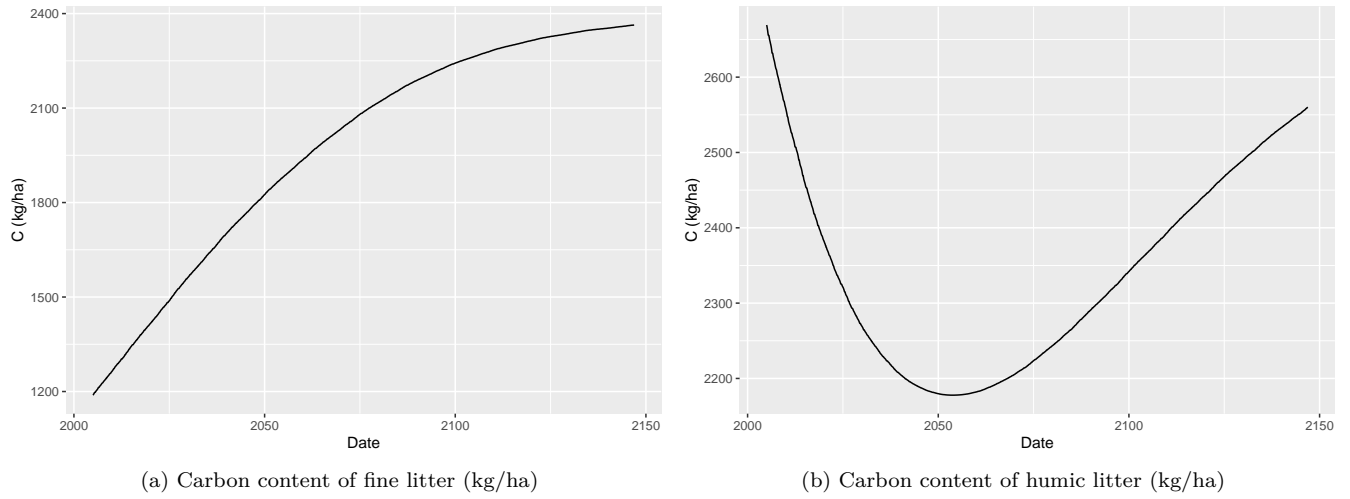
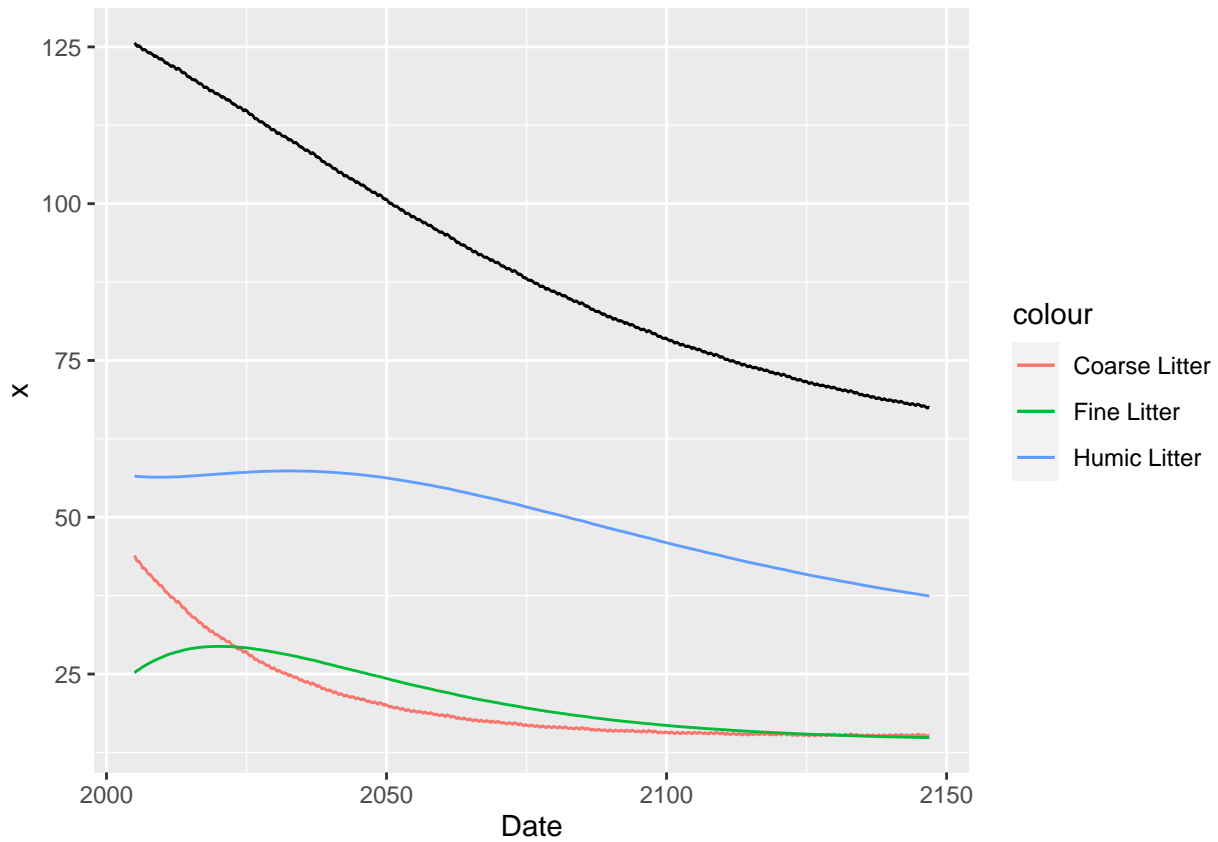


Figure 20: Forest Floor (O-Layer) Carbon Content Over Simulation Period

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.



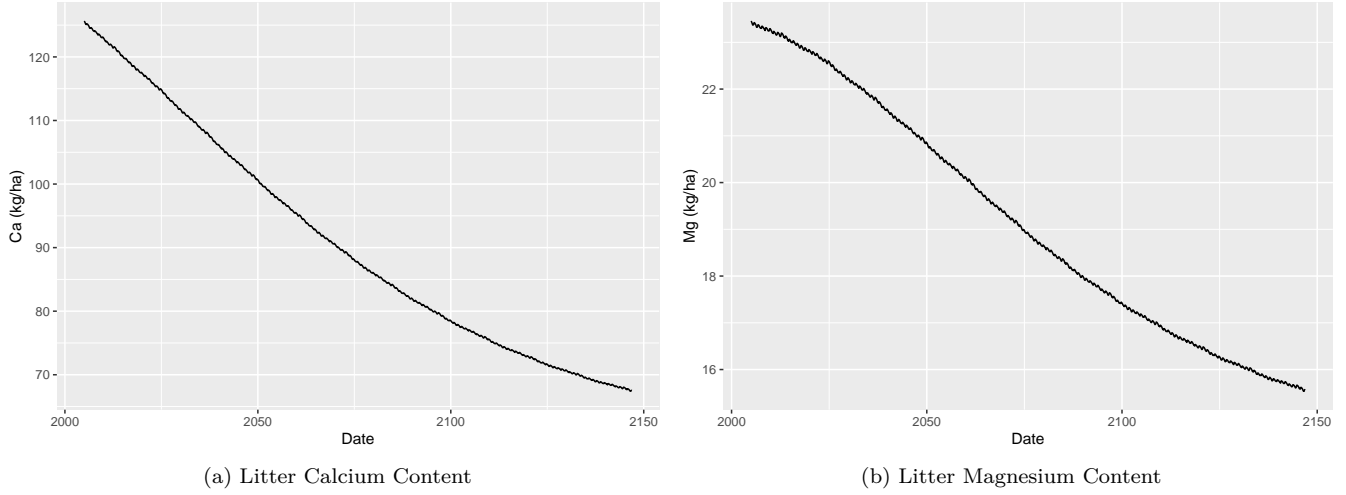
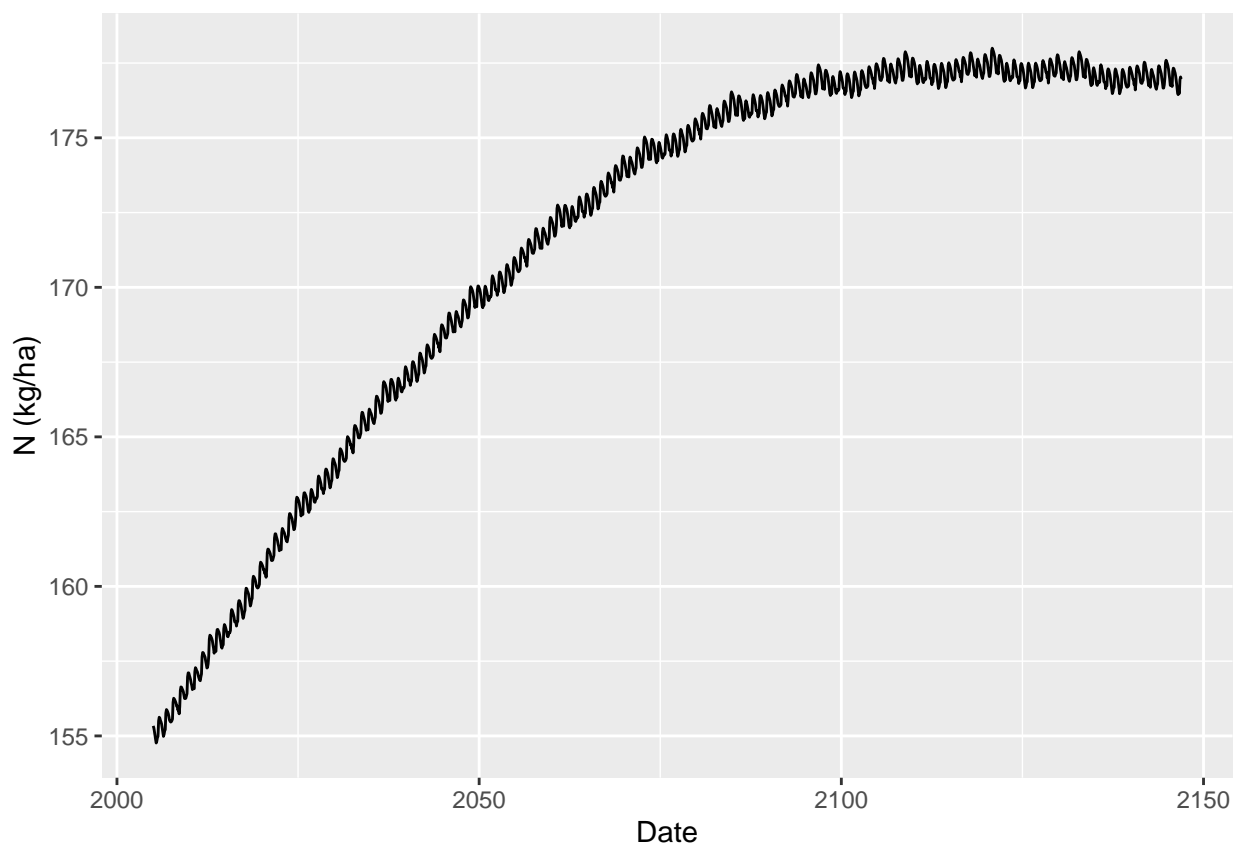
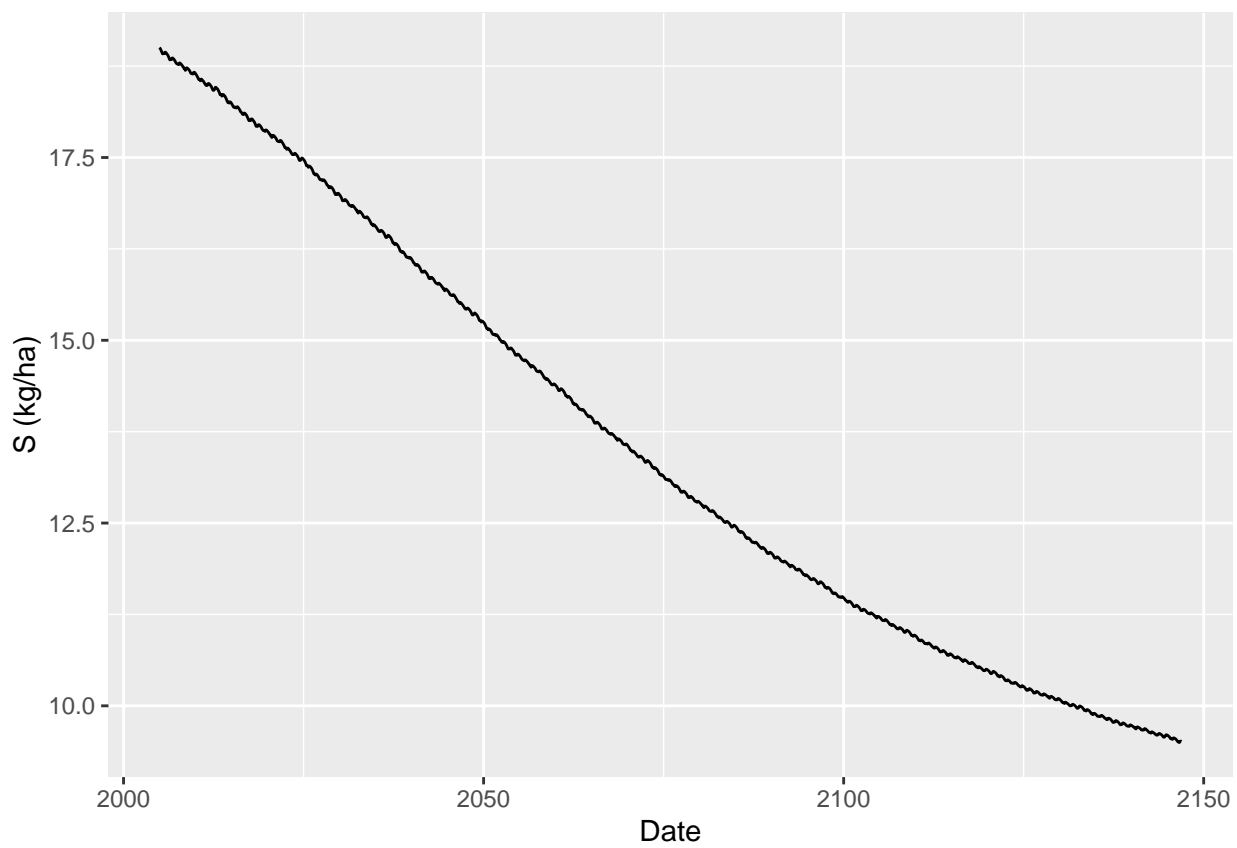


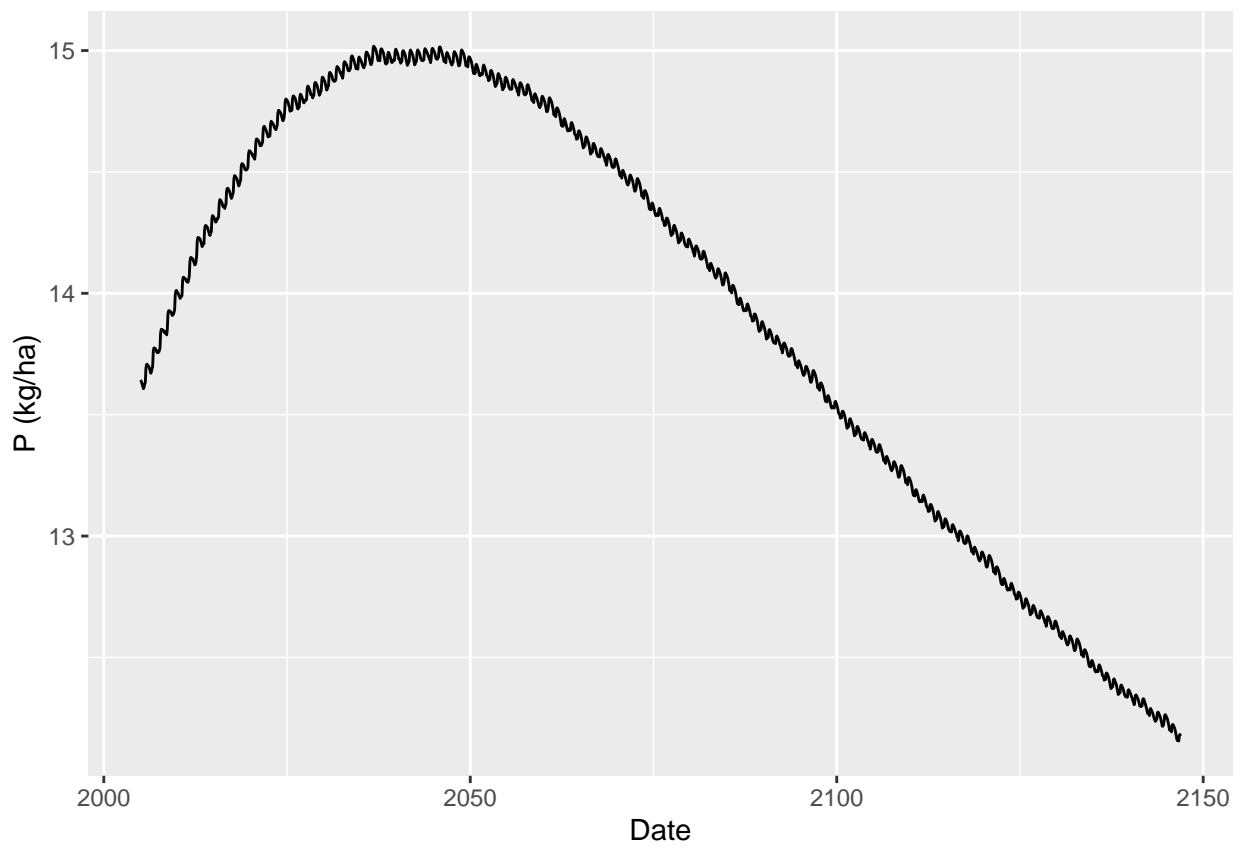
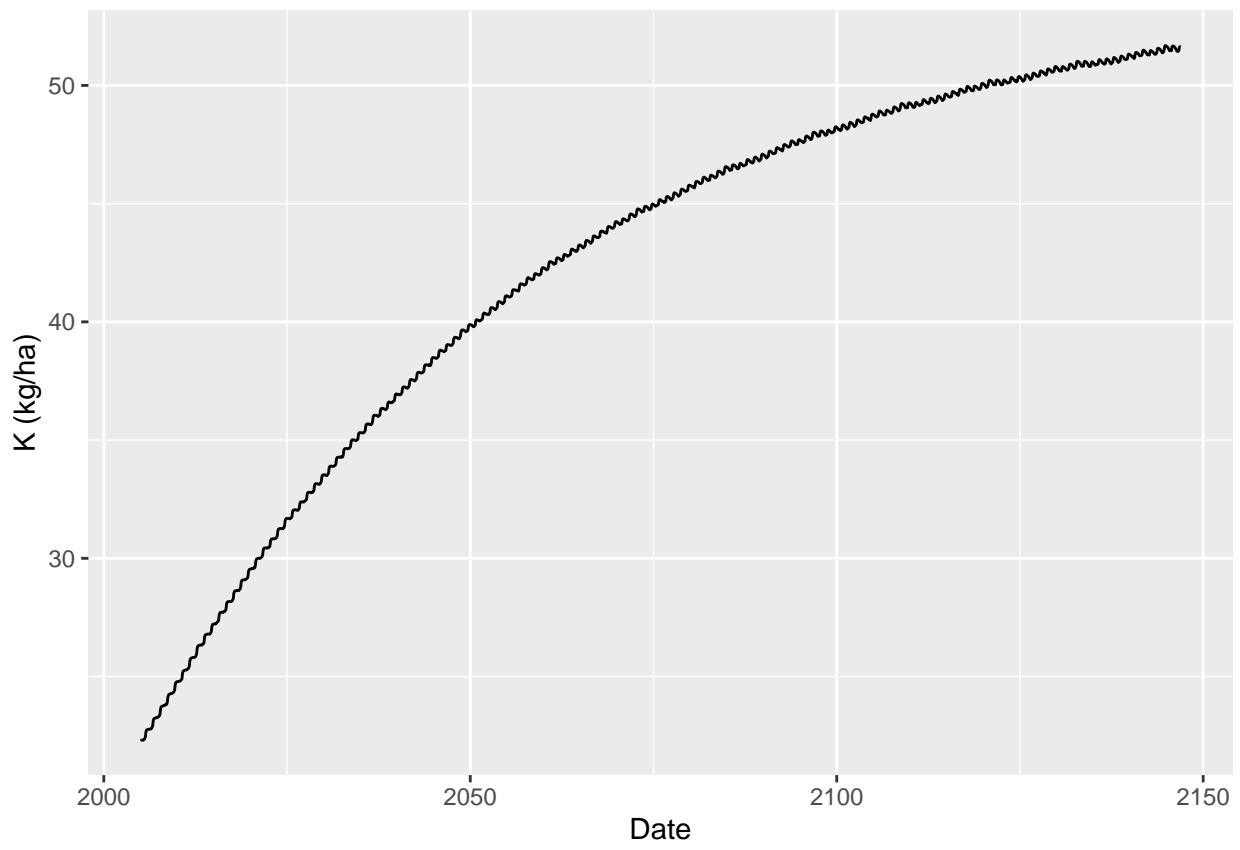
Figure 21: Litter Pool Nutrient Content Over Simulation Period

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.

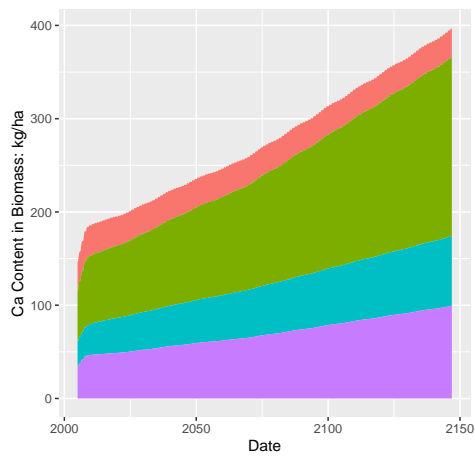
As of now, forest floor carbon content and carbon sequestration over time is in line with published literature (if we use certain sites as a kind of rough chronosequence; I will describe more of this in a later update). Furthermore, fine and coarse litter pools seem to be approaching steady state, which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

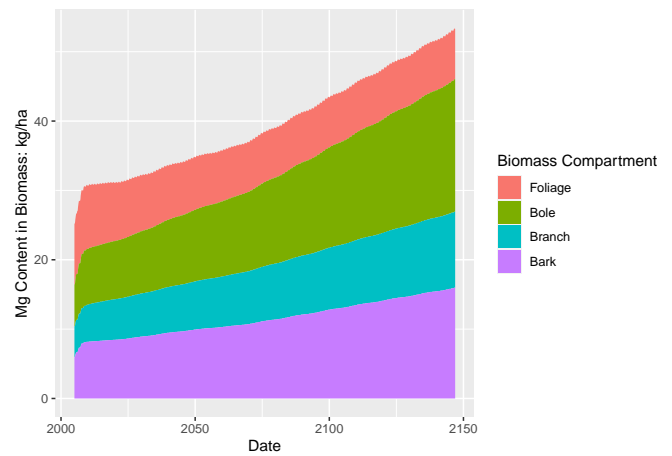




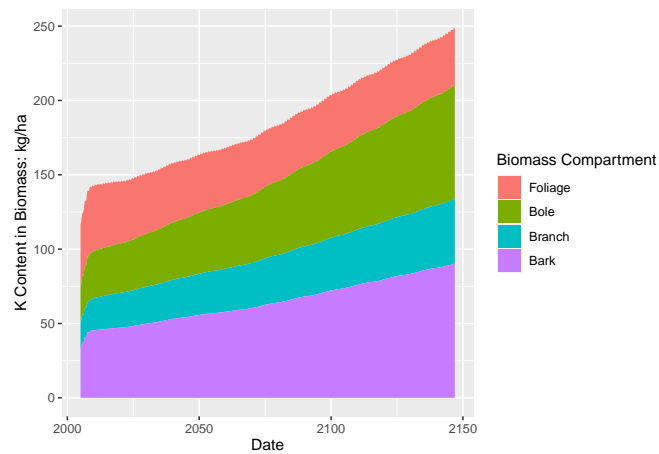
Tree Nutrient Content



(a) Calcium content in each biomass compartment

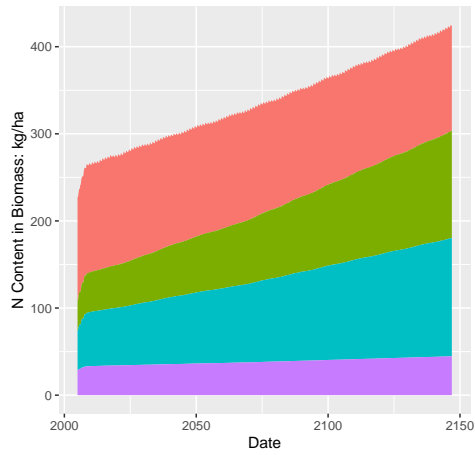


(b) Magnesium content in each biomass compartment

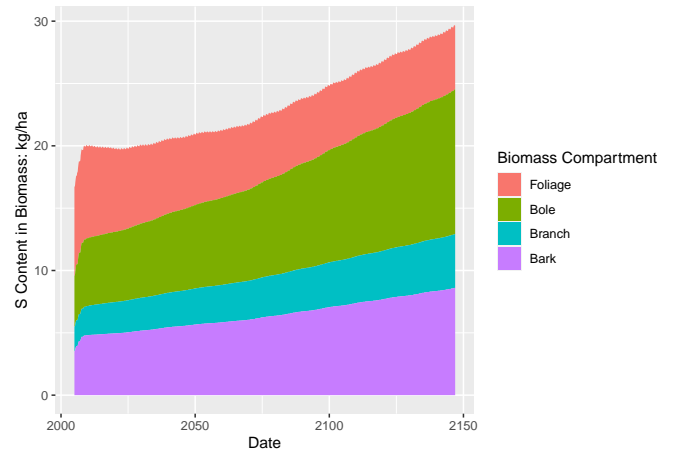


(c) Potassium content in each biomass compartment

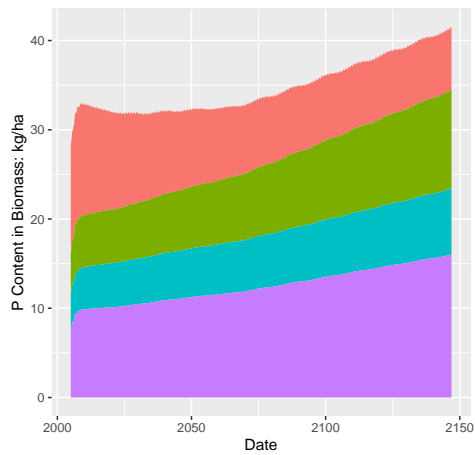
Figure 22: Base Cation Nutrient Content in Simulated Forest



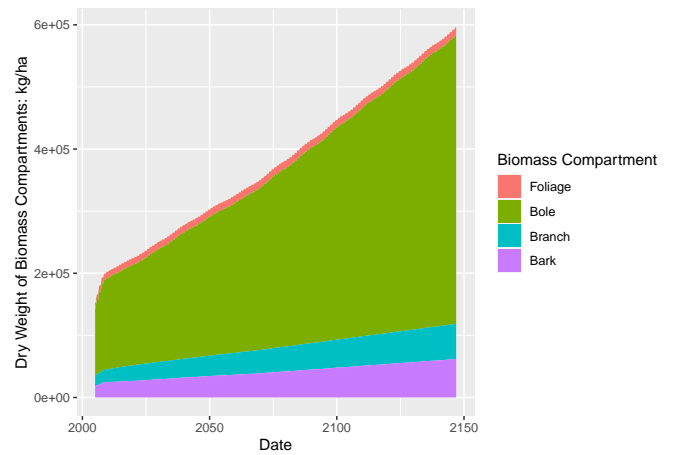
(a) Nitrogen content in each biomass compartment



(b) Sulfur content in each biomass compartment



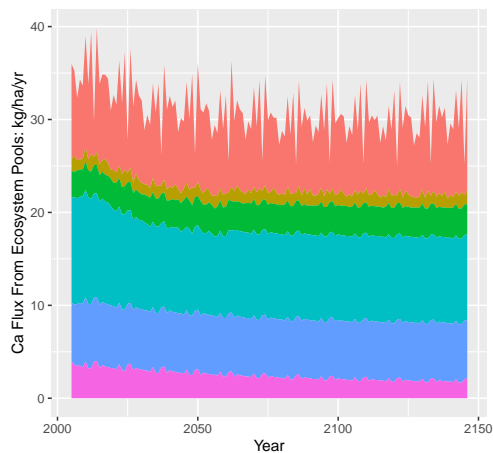
(c) Phosphorous content in each biomass compartment



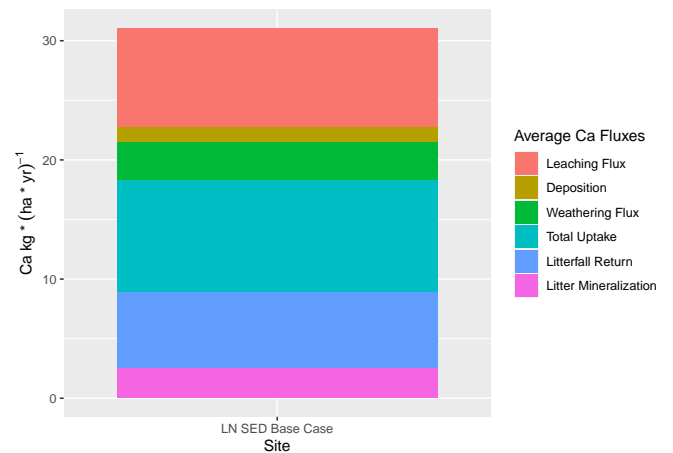
(d) Biomass of each compartment

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

Analysis 1: Stack Flux Data

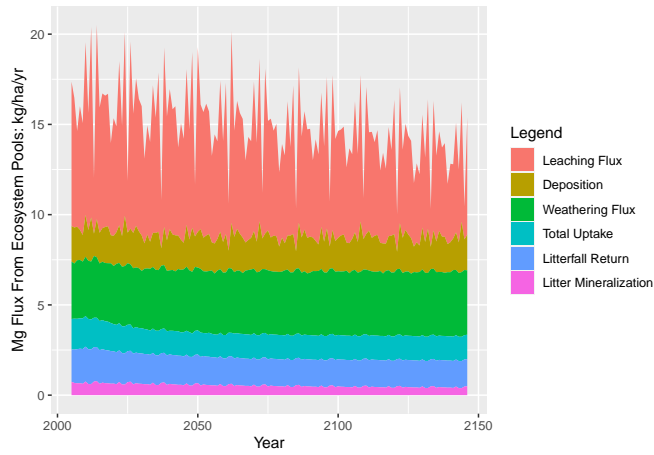


(a) Ca input and output fluxes over time

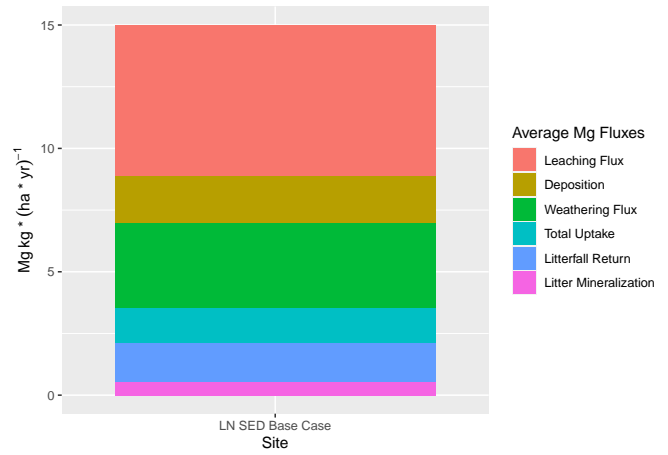


(b) Total Average Ca input and output fluxes

Figure 24: Calcium input and output comparison graphs

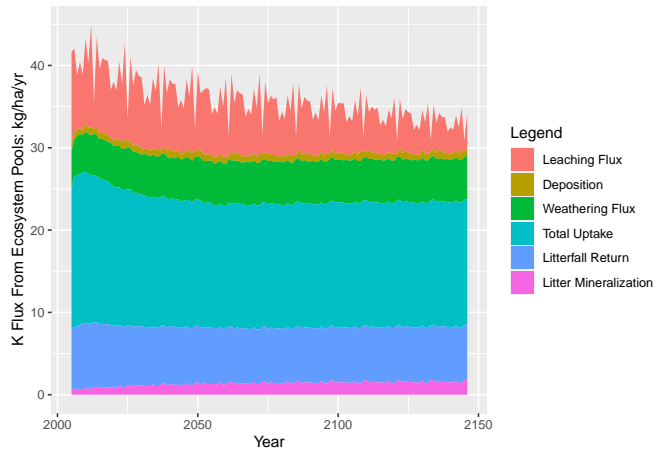


(a) Mg input and output fluxes over time

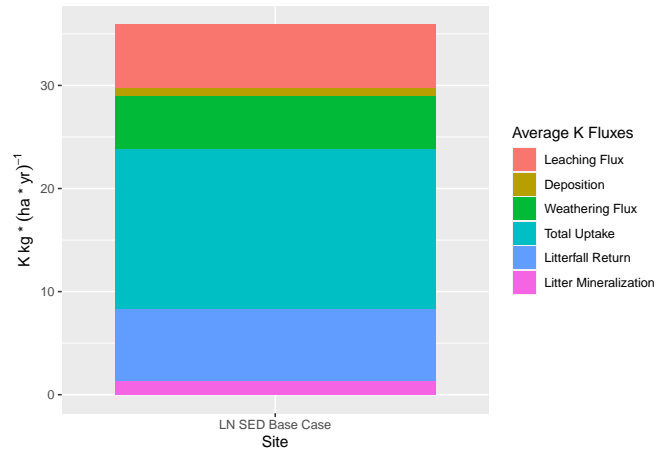


(b) Total Average Mg input and output fluxes

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

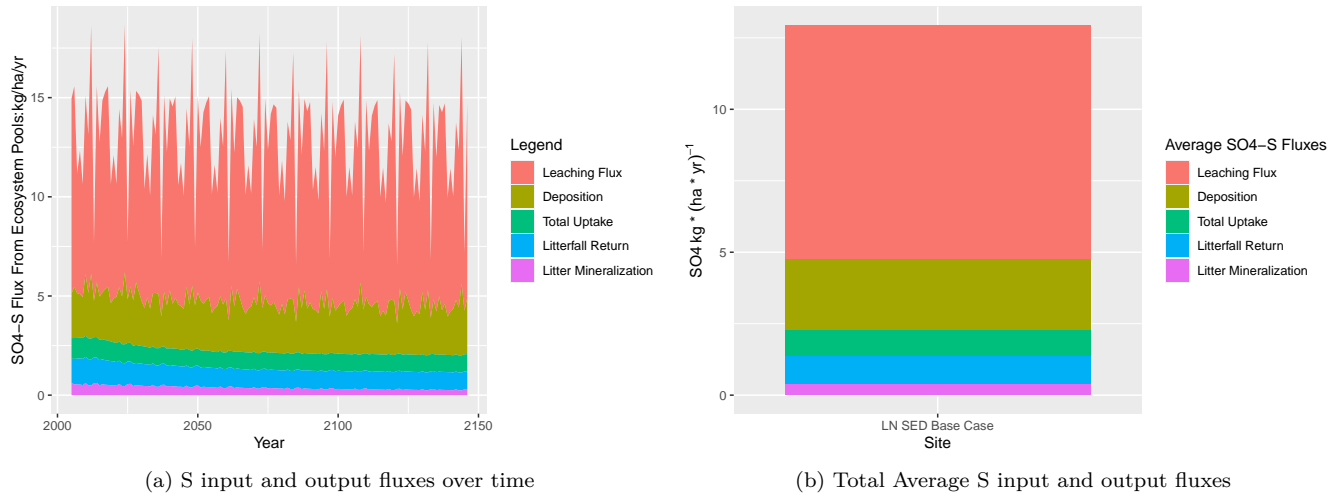


Figure 27: Sulfur input and output comparison graphs

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.

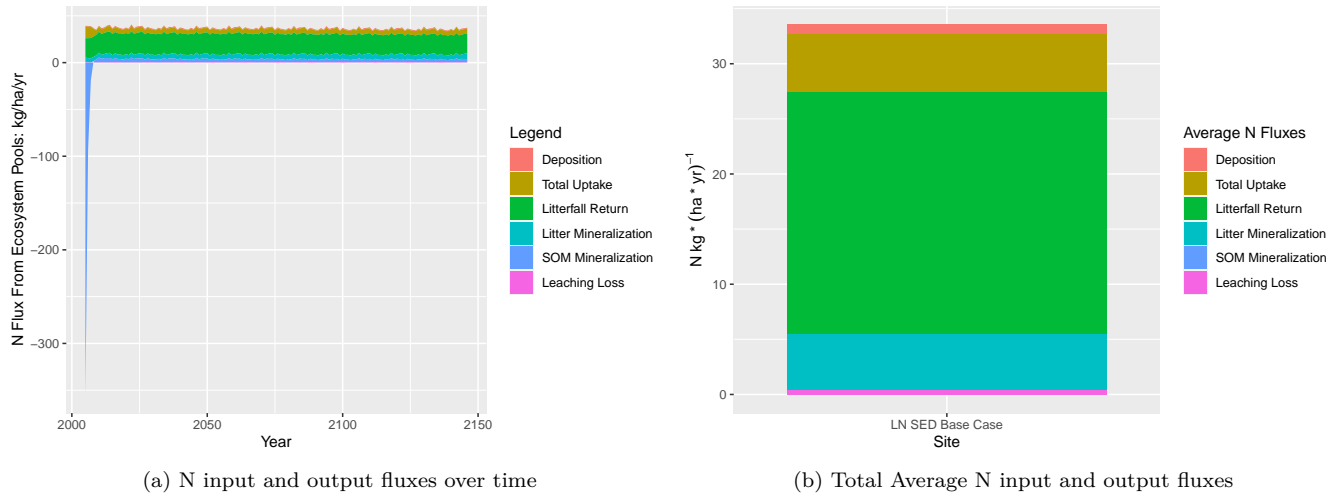


Figure 28: Nitrogen input and output comparison graphs

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

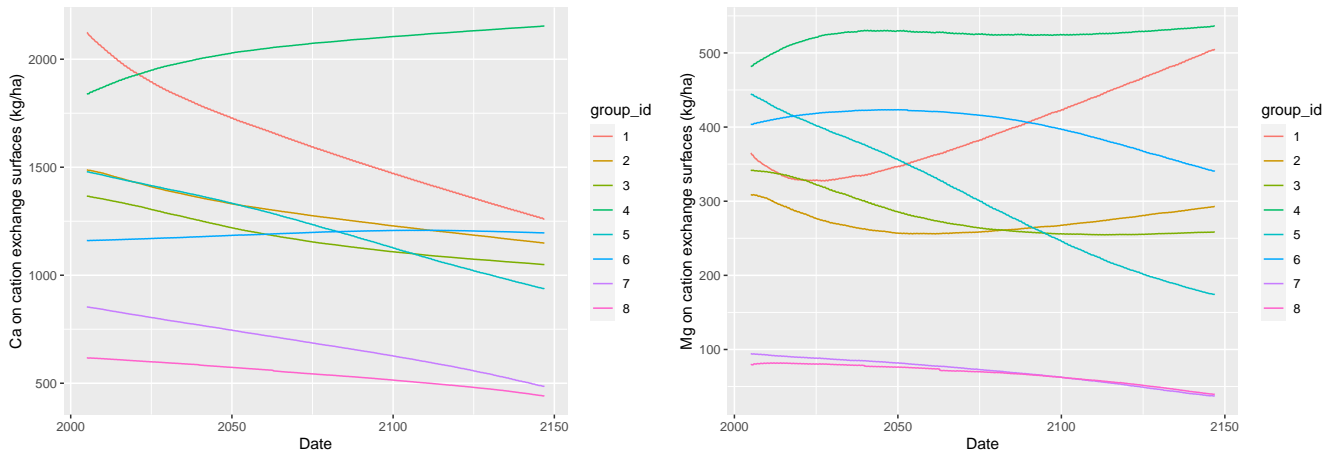


Figure 29: Calcium and Magnesium CEC adsorption over time

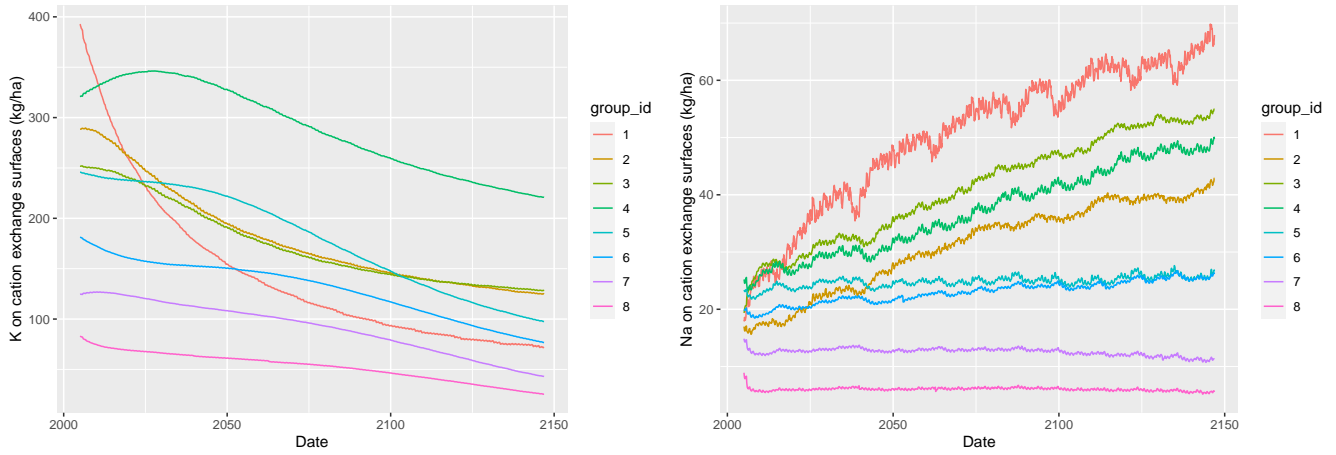


Figure 30: Potassium and Sodium CEC adsorption over time

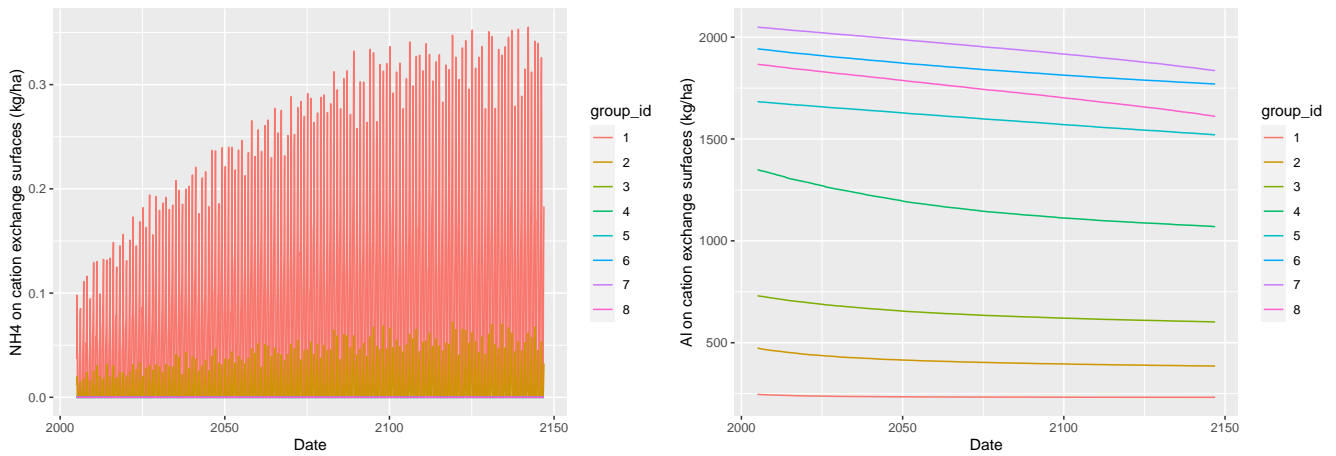
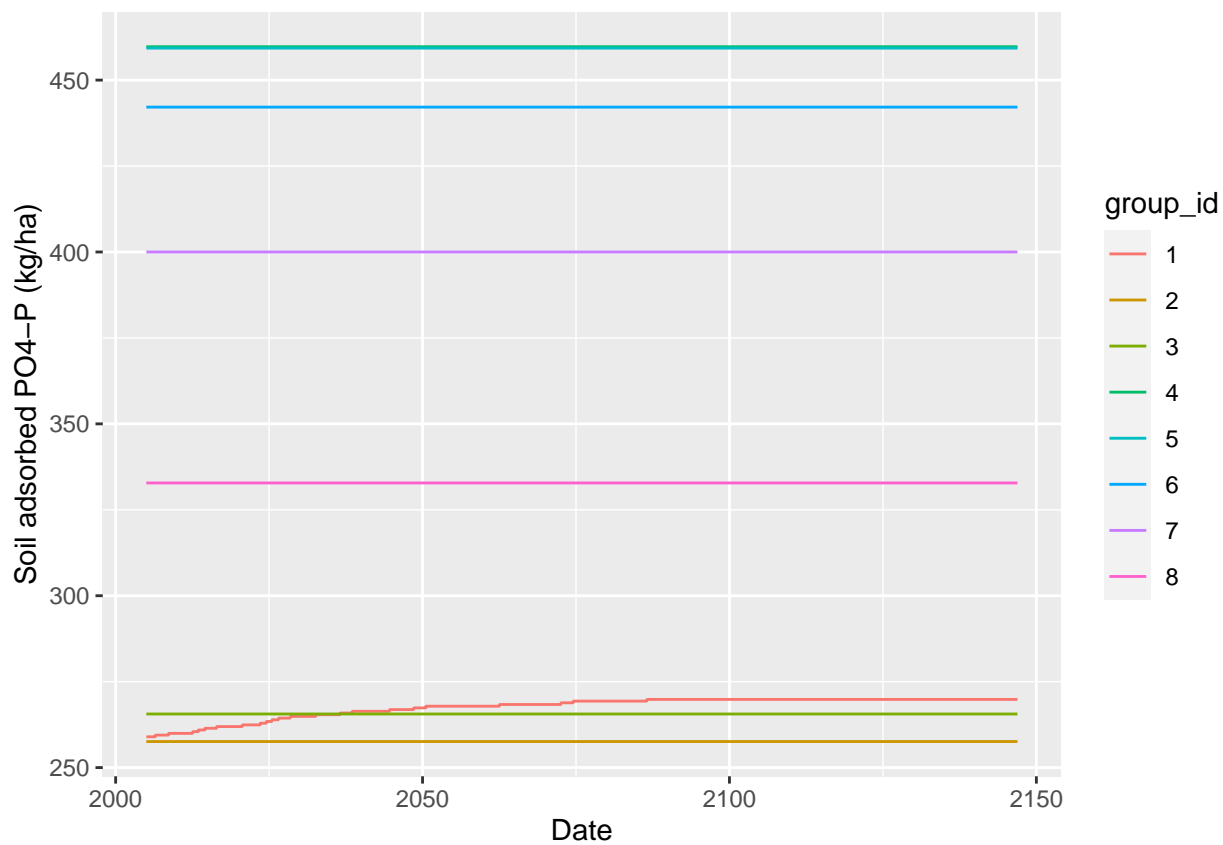
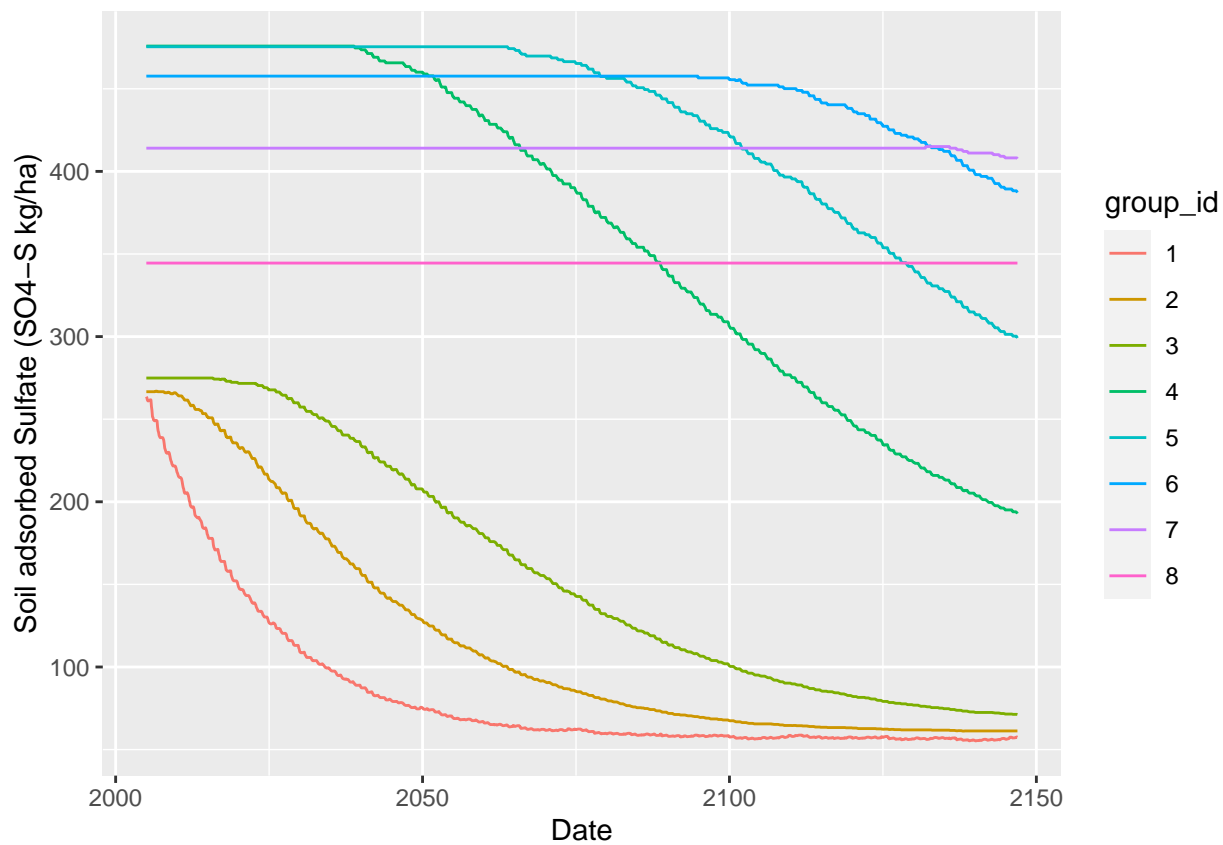
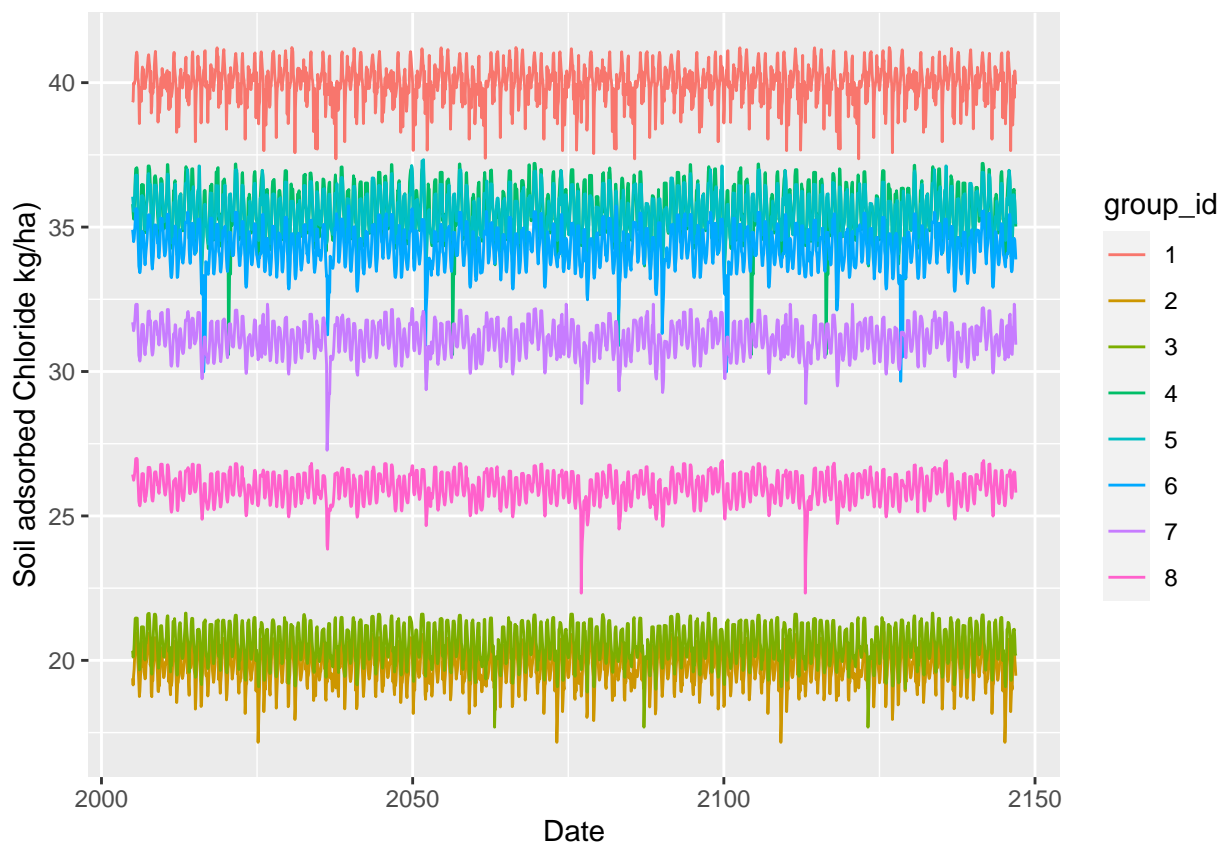


Figure 31: Ammonium and Aluminum CEC adsorption over time

Anion Exchange Capacity





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

