Supplementary Materials

Table S1. Elemental information of sampling sites.

Vegetation pattern	Climate	Altitude (m)	Slope	Sampling sites
Mixed evergreen and deciduous broad-leaved forest	subtropical monsoon climate	851	NBYE 38°	2
		1183	NBYE 22°	
Broadleaved deciduous forest	temperate monsoon climate	1309	DUE NORTH	5
		1506	NBYW 21°	
		1581	NBYW 38°	
		1668	NBYW 17°	
		1761	NBYE 27°	
Mixed broadleaf -conifer forest	frigid temperate monsoon climate	1908	NBYW 19°	7
		2032	NBYW 24°	
		2115	NBYW 35°	
		2213	NBYW 41°	
		2303	NBYW 24°	
		2431	NBYE 35°	
		2517	NBYE 33°	
Coniferous forest		2605	NBYE 22°	3
		2733	NBYW 30°	
		2817	NBYW 18°	
Mountain shrub meadow		2918	NBYW 40°	1

Table S2. Statistical results of TOC, TN, and TP contents in litterfall, humus, and soil (0–20 and 20–40 cm) among three sampling time.

Items	Sampling time	Layers	Mean	Min	Max	SD	CV (%)
TOC (mg/g)	May	Litterfall	463.92	321.30	513.80	46.39	0.10
		Humus	293.72	139.30	463.70	102.62	0.35
		Soil (0–20 cm)	40.09	17.47	67.95	14.28	0.36
		Soil (20–40 cm)	23.26	6.33	46.68	10.75	0.46
	August	Litterfall	467.59	401.70	506.50	31.04	0.07
		Humus	301.80	175.30	425.10	80.61	0.27
		Soil (0–20 cm)	42.09	11.44	74.26	17.28	0.41
		Soil (20–40 cm)	25.24	7.76	49.98	11.78	0.47
	September	Litterfall	468.49	425.10	501.30	23.88	0.05
		Humus	250.02	105.90	412.00	84.32	0.34
		Soil (0–20 cm)	44.77	17.71	114.58	25.05	0.56
		Soil (20–40 cm)	23.51	10.77	47.30	10.64	0.45
TN (mg/g)	May	Litterfall	16.67	8.70	24.60	4.14	0.25
		Humus	14.60	7.70	21.00	4.02	0.28
		Soil (0–20 cm)	1.49	0.72	2.23	0.41	0.27
		Soil (20–40 cm)	1.12	0.42	1.63	0.39	0.35
	August	Litterfall	18.33	11.70	26.60	3.65	0.20

		Humus	15.46	8.50	20.90	3.42	0.22
		Soil (0–20 cm)	1.43	0.64	2.24	0.44	0.31
		Soil (20–40 cm)	1.17	0.41	2.00	0.49	0.42
	September	Litterfall	14.53	9.10	20.30	3.53	0.24
		Humus	12.88	6.40	18.80	3.69	0.29
		Soil (0–20 cm)	1.41	0.76	2.12	0.42	0.30
		Soil (20–40 cm)	1.22	0.53	2.15	0.48	0.39
TP (mg/g)	May	Litterfall	10.26	4.81	15.21	3.02	0.29
		Humus	10.46	5.38	15.30	2.44	0.23
		Soil (0–20 cm)	0.62	0.21	1.15	0.27	0.43
		Soil (20–40 cm)	0.55	0.14	1.15	0.29	0.52
	August	Litterfall	9.78	2.01	19.04	4.33	0.44
		Humus	10.14	6.40	14.26	2.65	0.26
		Soil (0–20 cm)	0.61	0.16	1.24	0.31	0.50
		Soil (20–40 cm)	0.65	0.21	1.19	0.28	0.43
	September	Litterfall	8.93	4.09	13.11	2.77	0.31
		Humus	9.13	3.73	14.25	2.99	0.33
		Soil (0–20 cm)	0.65	0.18	1.28	0.30	0.46
		Soil (20–40 cm)	0.57	0.18	1.02	0.25	0.44

Note: TOC: total organic carton; TN: total nitrogen; TP: total phosphorus; SD: standard deviation; CV: coefficient of variation.

Table S3. Statistical results of C:N, C:P, and N:P in litterfall, humus, and soil (0–20 and 20–40 cm) among three sampling time.

Items	Sampling time	Layers	Mean	Min	Max	SD	CV (%)
C:N	May	Litterfall	29.72	15.97	57.06	9.23	0.31
		Humus	19.83	14.47	24.90	3.13	0.16
		Soil (0–20 cm)	26.67	17.46	34.72	4.86	0.18
		Soil (20–40 cm)	20.23	15.17	34.37	4.50	0.22
	August	Litterfall	26.54	18.15	42.62	6.16	0.23
		Humus	19.51	15.11	28.34	3.20	0.16
		Soil (0–20 cm)	28.49	16.79	39.63	6.04	0.21
		Soil (20–40 cm)	21.25	14.47	26.11	3.02	0.14
	September	Litterfall	34.19	22.31	51.96	8.70	0.25
		Humus	19.30	14.22	24.61	3.08	0.16
		Soil (0–20 cm)	31.14	18.79	80.80	14.19	0.46
		Soil (20–40 cm)	19.36	13.70	25.99	3.61	0.19
C:P	May	Litterfall	50.37	26.85	103.11	20.36	0.40
		Humus	28.72	14.31	43.52	9.60	0.33
		Soil (0–20 cm)	72.09	40.25	152.20	30.37	0.42
		Soil (20–40 cm)	48.21	21.68	135.88	25.79	0.53
	August	Litterfall	61.72	25.35	206.98	41.85	0.68
		Humus	31.64	15.22	61.20	11.93	0.38
		Soil (0–20 cm)	75.60	47.01	134.59	26.51	0.35
		Soil (20–40 cm)	43.70	9.57	78.67	20.19	0.46

	September	Litterfall	59.33	34.79	116.22	24.60	0.41
		Humus	31.44	10.86	110.59	21.67	0.69
		Soil (0–20 cm)	71.64	35.48	135.53	24.66	0.34
		Soil (20–40 cm)	44.65	25.45	86.11	17.84	0.40
N:P	May	Litterfall	1.68	1.21	2.51	0.33	0.20
		Humus	1.43	0.93	2.42	0.39	0.27
		Soil (0–20 cm)	2.69	1.85	5.09	0.97	0.36
		Soil (20–40 cm)	2.36	1.30	6.10	1.08	0.46
	August	Litterfall	2.42	1.11	9.22	1.88	0.78
		Humus	1.59	1.00	2.23	0.42	0.26
		Soil (0–20 cm)	2.70	1.80	4.47	0.89	0.33
		Soil (20–40 cm)	2.03	0.46	3.55	0.88	0.43
	September	Litterfall	1.72	1.12	2.81	0.42	0.25
		Humus	1.59	0.66	4.91	0.93	0.58
		Soil (0–20 cm)	2.46	1.11	4.15	0.82	0.33
		Soil (20–40 cm)	2.25	1.58	3.38	0.52	0.23

Note: SD: standard deviation; CV: coefficient of variation.

Table S4. Statistical results of DOC, AN, and AP contents in soil (0–20 and 20–40 cm) among sampling time.

Items	Sampling time	Layers	Mean	Min	Max	SD	CV (%)
DOC (mg/g)	May	Soil (0–20 cm)	0.21	0.10	0.31	0.06	0.27
		Soil (20–40 cm)	0.11	0.04	0.17	0.04	0.33
	August	Soil (0–20 cm)	0.12	0.04	0.22	0.05	0.43
		Soil (20–40 cm)	0.05	0.02	0.11	0.02	0.48
	September	Soil (0–20 cm)	0.37	0.15	1.03	0.21	0.55
		Soil (20–40 cm)	0.18	0.08	0.37	0.10	0.53
AN (mg/g)	May	Soil (0–20 cm)	0.30	0.12	0.52	0.11	0.37
		Soil (20–40 cm)	0.19	0.04	0.41	0.11	0.57
	August	Soil (0–20 cm)	0.29	0.12	0.59	0.13	0.47
		Soil (20–40 cm)	0.20	0.06	0.45	0.11	0.53
	September	Soil (0–20 cm)	0.29	0.10	0.81	0.17	0.59
		Soil (20–40 cm)	0.20	0.07	0.45	0.10	0.52
AP (mg/g)	May	Soil (0–20 cm)	0.04	0.03	0.07	0.01	0.28
		Soil (20–40 cm)	0.03	0.02	0.06	0.01	0.28
	August	Soil (0–20 cm)	0.04	0.02	0.05	0.01	0.24
		Soil (20–40 cm)	0.03	0.02	0.05	0.01	0.31
	September	Soil (0–20 cm)	0.04	0.02	0.06	0.01	0.28
		Soil (20–40 cm)	0.03	0.02	0.05	0.01	0.33

Note: DOC: dissolved organic carton; AN: available nitrogen; AP: available phosphorus; SD: standard deviation; CV: coefficient of variation.

Table S5. BRT model settings (learning rate, number of trees) and performance diagnostics (CV deviance, CV deviance SE, CV correction, CV corerelation SE) in the BRT model.

Layers	Items	CV deviance	CV deviance SE	Learning rate	Number trees	CV correlation	CV correlation SE
Litterfall	TOC	22.115	3.54	0.001	1950	0.26	0.164
	TN	1.422	0.149	0.001	7300	0.871	0.028
	TP	0.973	0.15	0.001	8850	0.949	0.01
	C:N	3.071	0.725	0.001	6450	0.935	0.016
	C:P	10.141	3.423	0.001	10000	0.896	0.038
	N:P	0.343	0.139	0.001	10000	0.892	0.022
Humus	TOC	20.853	2.222	0.001	9650	0.958	0.011
	TN	1.337	0.157	0.001	8900	0.894	0.034
	TP	1.11	0.137	0.001	10000	0.806	0.07
	C:N	1.857	0.22	0.001	10000	0.722	0.062
	C:P	4.702	1.325	0.001	10000	0.882	0.042
	N:P	0.321	0.118	0.001	10000	0.871	0.04
Soil (0-20 cm)	TOC	5.812	0.978	0.001	9950	0.929	0.025
	TN	0.155	0.01	0.001	8500	0.876	0.042
	TP	0.079	0.01	0.001	9550	0.951	0.017
	C:N	3.61	0.81	0.001	10000	0.815	0.054
	C:P	11.492	1.174	0.001	10000	0.858	0.025
	N:P	0.416	0.053	0.001	8550	0.786	0.052
Soil (0-20 cm)	TOC	3.113	0.459	0.001	10000	0.915	0.038
	TN	0.125	0.011	0.001	10000	0.941	0.015
	TP	0.095	0.016	0.001	7850	0.907	0.039
	C:N	2.111	0.179	0.001	10000	0.57	0.135
	C:P	7.259	1.21	0.001	9900	0.926	0.018
	N:P	0.348	0.065	0.001	9800	0.672	0.154

Note: CV: cross-validation; SE: standard error.

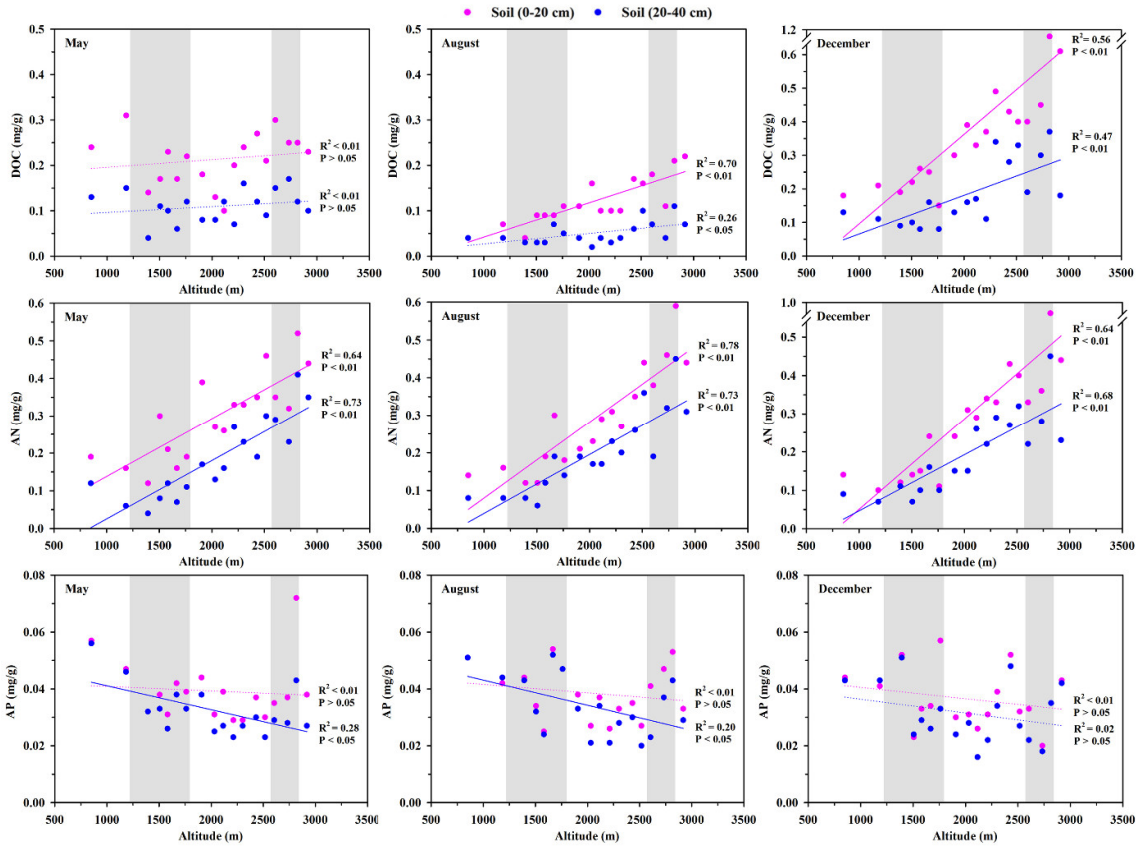


Figure S1. Linear correlations between altitude and DOC, AN, and AP concentrations in soil (0–20 and 20–40 cm) for different sampling times (May, August, and December). The solid line represents a significant correlation and the dotted line represents a non-significant correlation. Background of white and gray represent different vegetations of mixed evergreen and deciduous broad-leaved forest, broadleaved deciduous forest, mixed broadleaf-conifer forest, coniferous forest and mountain shrub meadow zone from left to right.

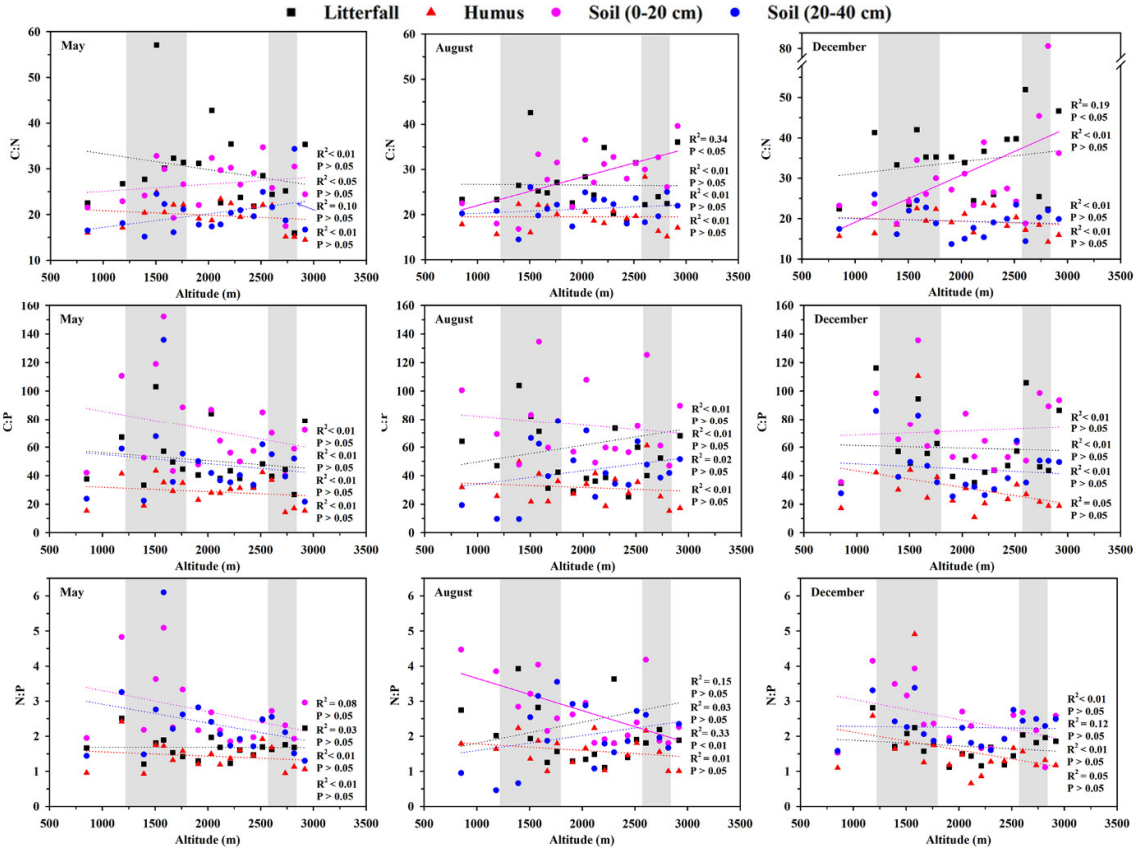


Figure S2. Linear correlations between altitude and C:N, C:P, and N:P ratios in different layers (litterfall, humus, and soil (0–20 and 20–40 cm)) for different sampling times (May, August, and December). The solid line represents a significant correlation and the dotted line represents a non-significant correlation. Background of white and gray represent different vegetations of mixed evergreen and deciduous broad-leaved forest, broadleaved deciduous forest, mixed broadleaf-conifer forest, coniferous forest and mountain shrub meadow zone from left to right.

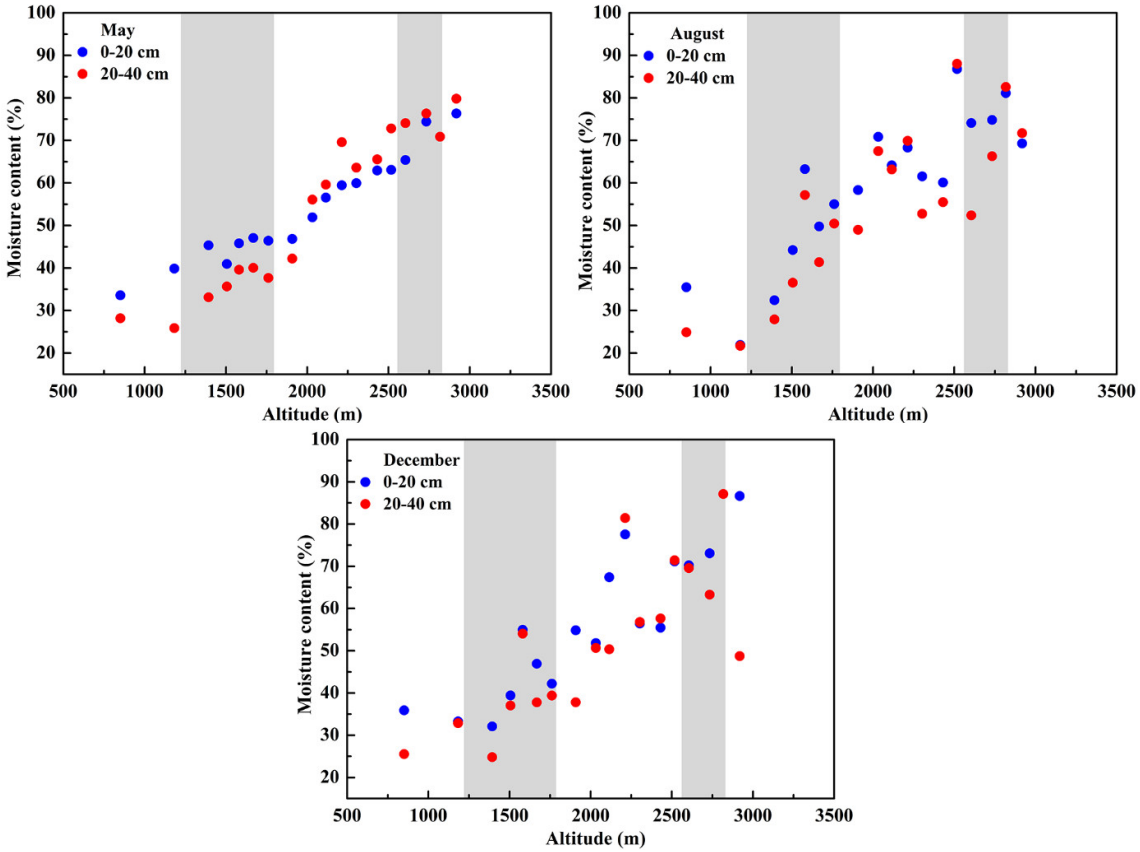


Figure S3. Distribution of moisture content of soil with altitude in May, August, and December. Background of white and gray represent different vegetations of mixed evergreen and deciduous broad-leaved forest, broadleaved deciduous forest, mixed broadleaf-conifer forest, coniferous forest and mountain shrub meadow zone from left to right.

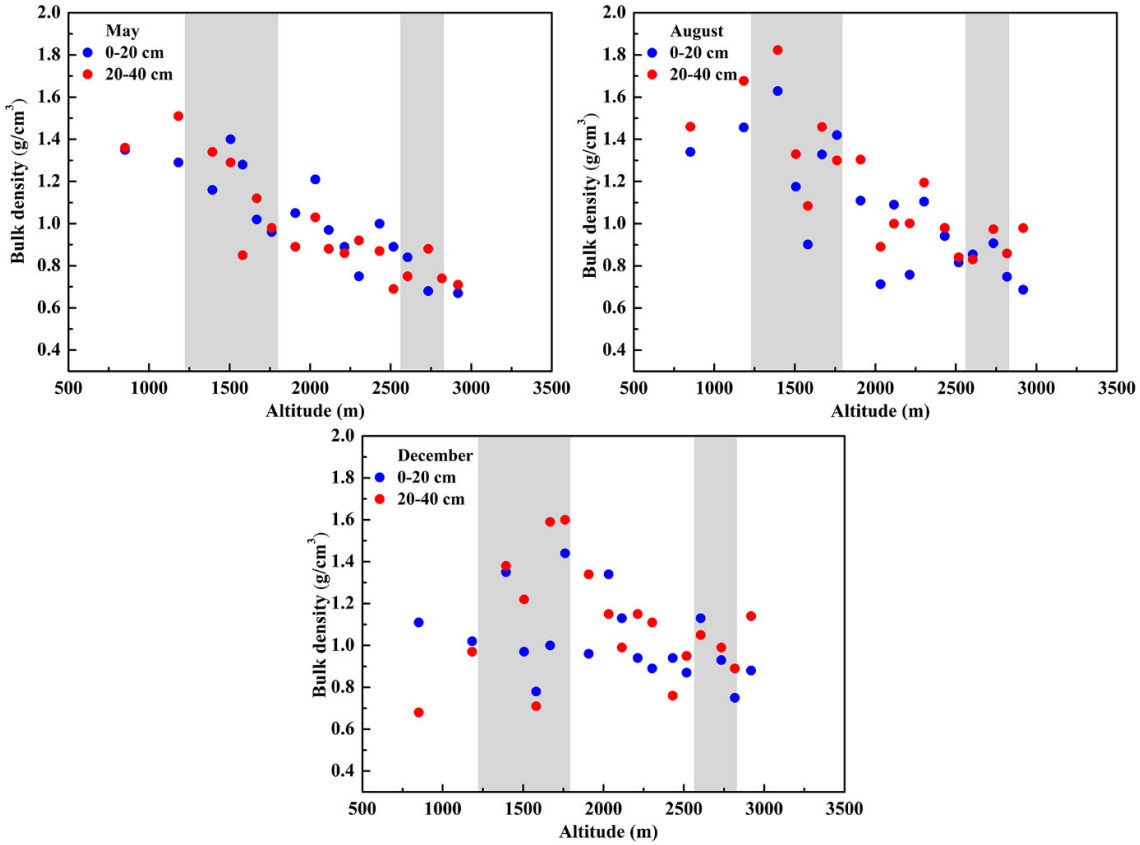


Figure S4. Distribution of bulk density of soil with altitude in May, August, and December. Background of white and gray represent different vegetations of mixed evergreen and deciduous broad-leaved forest, broadleaved deciduous forest, mixed broadleaf-conifer forest, coniferous forest and mountain shrub meadow zone from left to right.

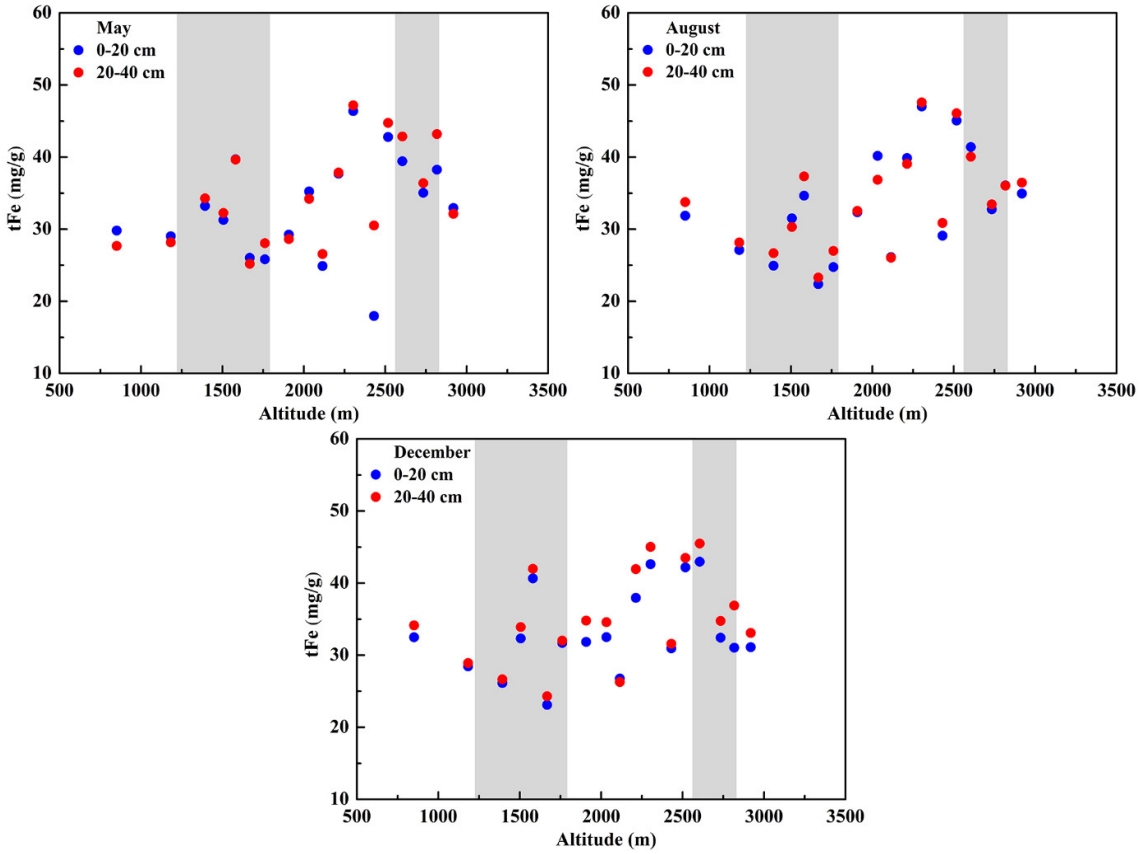


Figure S5. Distribution of tFe of soil with altitude in May, August, and December. Background of white and gray represent different vegetations of mixed evergreen and deciduous broad-leaved forest, broadleaved deciduous forest, mixed broadleaf-conifer forest, coniferous forest and mountain shrub meadow zone from left to right.

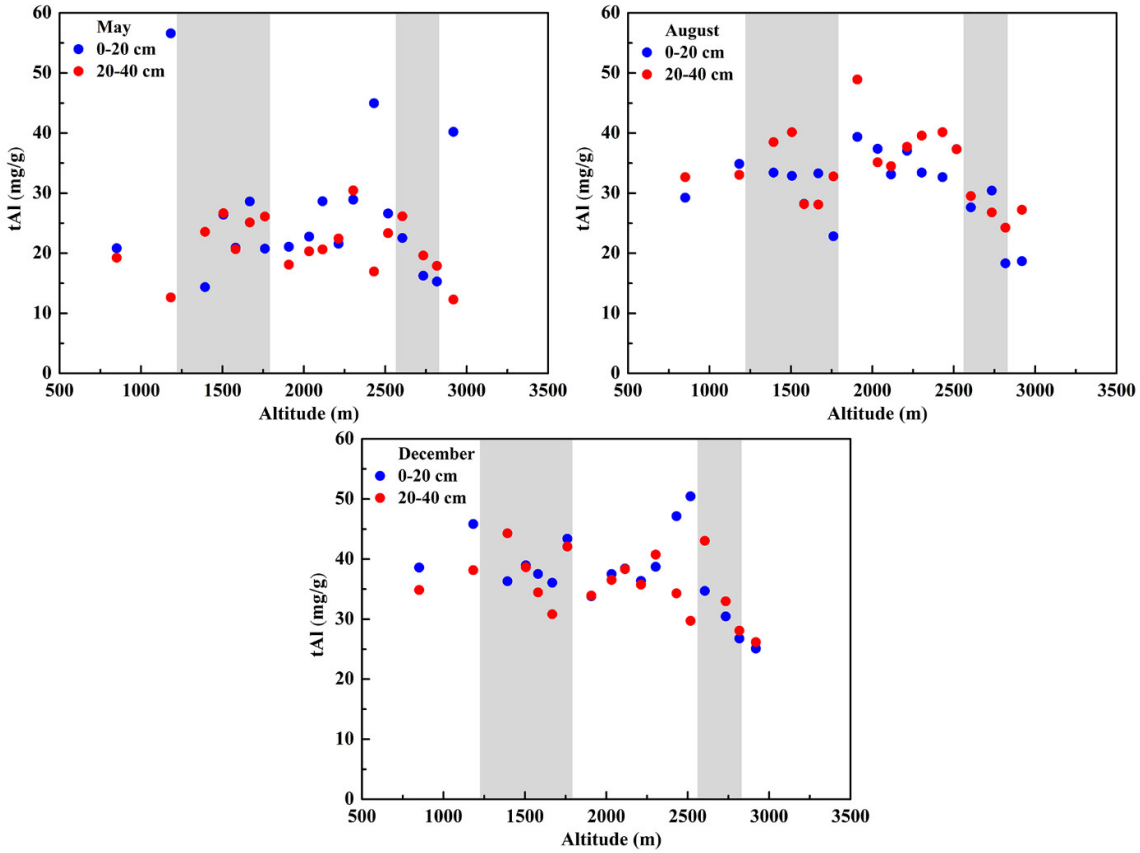


Figure S6. Distribution of tAl of soil with altitude in May, August, and December. Background of white and gray represent different vegetations of mixed evergreen and deciduous broad-leaved forest, broadleaved deciduous forest, mixed broadleaf-conifer forest, coniferous forest and mountain shrub meadow zone from left to right.

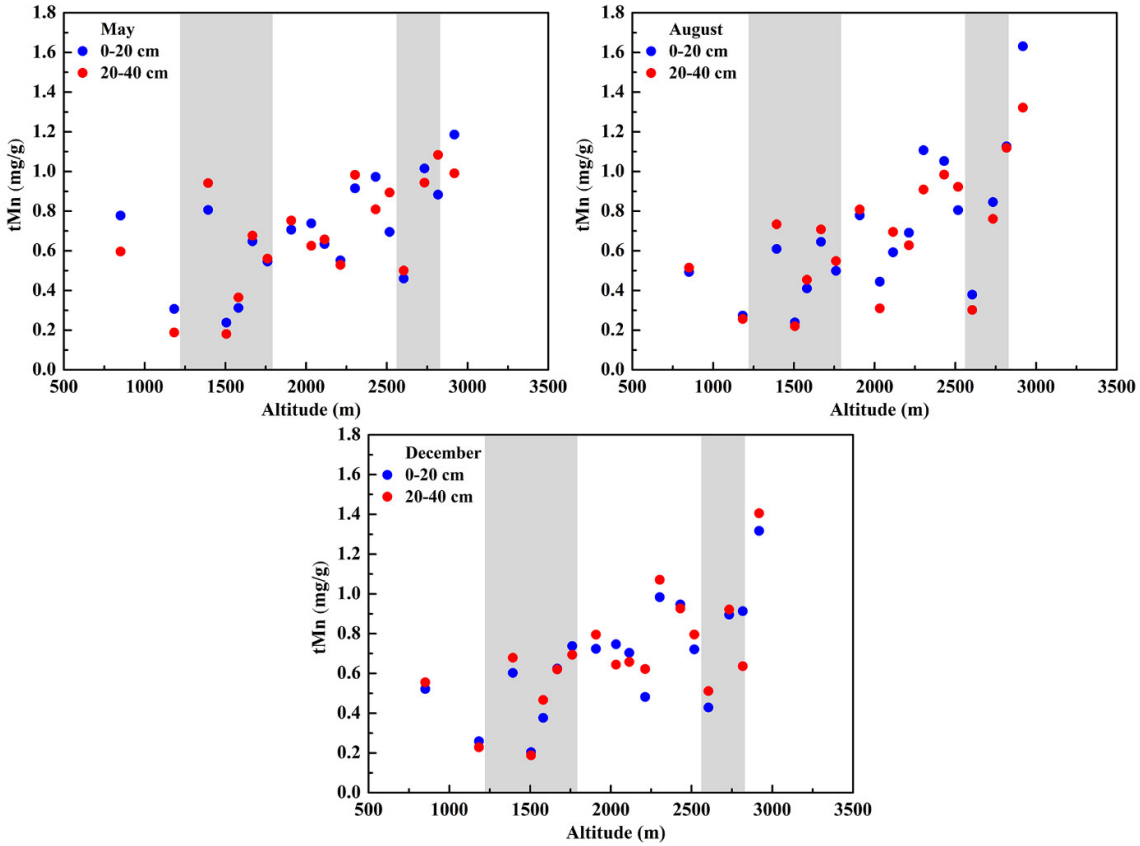


Figure S7. Distribution of tMn of soil with altitude in May, August, and December. Background of white and gray represent different vegetations of mixed evergreen and deciduous broad-leaved forest, broadleaved deciduous forest, mixed broadleaf-conifer forest, coniferous forest and mountain shrub meadow zone from left to right.