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Supplement of

Complex controls on nitrous oxide flux across a large-elevation gradient in the tropical Peruvian Andes

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1 Supplementary Online Materials

2 Table S1

A. Analysis of Variance: Effect of Habitat, Season, and Topography on N₂O Flux

Whole Model				
Source	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Model	10	22.27	2.23	3.28
Error	297	201.73	0.68	P > F
Corrected Total	307	224.00		< 0.0005
Effects Test				
Source	Degrees of Freedom	Sum of Squares	F Ratio	P > F
Habitat	3	9.68	4.75	0.0003
Season	1	2.29	3.38	0.0671
Habitat x Season	3	2.17	1.07	0.3633
Topography	3	3.11	1.52	0.2082

B. Analysis of Variance: Effect of Habitat, Season, and Topography on Soil Water-Filled Pore Space

Whole Model				
Source	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Model	10	239699.58	23970.00	637.97
Error	294	11046.32	37.60	P > F
Corrected Total	304	250745.90		< 0.0001
Effects Test				
Source	Degrees of Freedom	Sum of Squares	F Ratio	P > F
Habitat	3	195753.01	1736.67	0.0001
Season	1	1429.96	38.06	0.0001
Habitat x Season	3	1423.71	12.63	0.0001
Topography	3	1018.58	9.04	0.0001

C. Analysis of Variance: Effect of Habitat, Season, and Topography on Soil Oxygen Content

Whole Model				
Source	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Model	10	1757.45	175.75	27.70
Error	232	1471.88	6.34	P > F
Corrected Total	242	3229.33		< 0.0001
Effects Test				
Source	Degrees of Freedom	Sum of Squares	F Ratio	P > F
Habitat	3	758.23	39.84	0.0001
Season	1	22.88	3.61	0.0588
Habitat x Season	3	112.28	5.90	0.0001
Topography	3	271.56	14.27	0.0001

D. Analysis of Variance: Effect of Habitat, Season, and Topography on Soil Temperature

Whole Model				
Source	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Model	10	5580.34	558.03	790.74
Error	282	199.01	0.71	P > F
Corrected Total	292	5779.35		< 0.0001
Effects Test				
Source	Degrees of Freedom	Sum of Squares	F Ratio	P > F
Habitat	3	4938.98	2332.88	0.0001
Season	1	81.83	115.95	0.0001
Habitat x Season	3	26.06	12.31	0.0001
Topography	3	19.58	9.25	0.0001

E. Analysis of Variance: Effect of Habitat, Season, and Topography on Air Temperature

Whole Model				
Source	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Model	10	4420.24	442.02	103.17
Error	282	1208.26	4.29	P > F
Corrected Total	292	5628.50		< 0.0001
Effects Test				
Source	Degrees of Freedom	Sum of Squares	F Ratio	P > F
Habitat	3	3703.60	288.13	0.0001
Season	1	7.39	1.72	0.1903
Habitat x Season	3	27.01	2.10	0.1002
Topography	3	33.42	2.60	0.0524

F. Analysis of Variance: Effect of Habitat, Season, and Topography on Resin-Extractable Ammonium Flux

Whole Model				
Source	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Model	10	888.48	88.85	1.28
Error	154	10659.41	69.22	P > F
Corrected Total	164	11547.90		0.2442
Effects Test				
Source	Degrees of Freedom	Sum of Squares	F Ratio	P > F
Habitat	3	385.18	1.86	0.1396
Season	1	393.24	5.68	0.0184
Habitat x Season	3	109.77	0.53	0.6633
Topography	3	24.70	0.12	0.9489

G. Analysis of Variance: Effect of Habitat, Season, and Topography on Resin-Extractable Nitrate Flux

Whole Model				
Source	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Model	10	3300.74	330.07	38.99
Error	154	1303.65	8.47	P > F
Corrected Total	164	4604.39		0.0001
Effects Test				
Source	Degrees of Freedom	Sum of Squares	F Ratio	P > F
Habitat	3	2833.28	111.56	0.0001
Season	1	11.33	1.34	0.2491
Habitat x Season	3	89.39	3.52	0.0166
Topography	3	217.43	8.56	0.0001

4 **Table S2**

A. Analysis of Variance: Effect of Habitat, Moisture Treatment, and Incubation Phase on ¹⁵N-N₂O Flux				
Whole Model				
Source	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Model	31	168536.12	5436.65	3.06
Error	290	516782.46	1782.01	P > F
Corrected Total	321	685318.58		< 0.0001
Effects Test				
Source	Degrees of Freedom	Sum of Squares	F Ratio	P > F
Habitat	3	2899.26	0.54	0.6537
Moisture Treatment	3	38272.10	7.16	0.0001
Habitat x Moisture Treatment	9	18653.09	1.16	0.3186
Incubation Phase	1	395.69	0.22	0.6378
Habitat x Incubation Phase	3	49485.77	9.26	0.0001
Moisture Treatment x Incubation Phase	3	10833.25	2.03	0.1103
Habitat x Moisture Treatment x Incubation Phase	9	48227.69	3.01	0.0019

B. Analysis of Variance: Effect of Habitat, Moisture Treatment, and Incubation Phase on ¹⁵N-N₂ Flux				
Whole Model				
Source	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Model	31	5830626.80	188085.00	14.20
Error	286	3788108.30	13245.00	P > F
Corrected Total	317	9618735.10		< 0.0001
Effects Test				
Source	Degrees of Freedom	Sum of Squares	F Ratio	P > F
Habitat	3	1419473.80	35.72	0.0001
Moisture Treatment	3	311519.50	7.84	0.0001
Habitat x Moisture Treatment	9	1105825.90	9.28	0.0001
Incubation Phase	1	114763.10	8.66	0.0035
Habitat x Incubation Phase	3	136383.20	3.43	0.0175
Moisture Treatment x Incubation Phase	3	694924.10	17.49	0.0001
Habitat x Moisture Treatment x Incubation Phase	9	2046045.50	17.16	0.0001

C. Analysis of Variance: Effect of Habitat, Moisture Treatment, and Incubation Phase on N₂O Yield				
Whole Model				
Source	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Model	31	26.02	0.84	9.85
Error	282	24.04	0.09	P > F
Corrected Total	313	50.07		< 0.0001
Effects Test				
Source	Degrees of Freedom	Sum of Squares	F Ratio	P > F
Habitat	3	4.98	19.45	0.0001
Moisture Treatment	3	0.69	2.68	0.0471
Habitat x Moisture Treatment	9	6.17	8.04	0.0001
Incubation Phase	1	0.27	3.12	0.0784
Habitat x Incubation Phase	3	1.50	5.86	0.0007
Moisture Treatment x Incubation Phase	3	2.77	10.84	0.0001
Habitat x Moisture Treatment x Incubation Phase	9	9.44	12.30	0.0001

6 **Table S3**

A. Analysis of Variance: Effect of Habitat, Nitrogen Treatment, and Incubation Phase on ¹⁵N-N₂O Flux				
Whole Model				
Source	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Model	29	99197.38	3420.60	5.67
Error	120	72439.14	603.66	P > F
Corrected Total	149	171636.52		< 0.0001
Effects Test				
Source	Degrees of Freedom	Sum of Squares	F Ratio	P > F
Habitat	4	78227.06	32.40	0.0001
Nitrogen Treatment	2	2603.41	2.16	0.1202
Habitat x Nitrogen Treatment	8	1859.37	0.39	0.9268
Incubation Phase	1	4577.86	7.58	0.0068
Habitat x Incubation Phase	4	9865.06	4.09	0.0039
Nitrogen Treatment x Incubation Phase	2	615.19	0.51	0.6021
Habitat x Nitrogen Treatment x Incubation Phase	8	1449.44	0.30	0.9646

B. Analysis of Variance: Effect of Habitat, Nitrogen Treatment, and Incubation Phase on ¹⁵N-N₂ Flux				
Whole Model				
Source	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Model	29	665505.20	22948.50	1.66
Error	120	1663313.50	13860.90	P > F
Corrected Total	149	2328818.70		< 0.0314
Effects Test				
Source	Degrees of Freedom	Sum of Squares	F Ratio	P > F
Habitat	4	411489.03	7.42	0.0001
Nitrogen Treatment	2	6529.08	0.24	0.7905
Habitat x Nitrogen Treatment	8	63172.83	5697.00	0.801
Incubation Phase	1	33.45	0.00	0.9609
Habitat x Incubation Phase	4	65174.72	1.18	0.3251
Nitrogen Treatment x Incubation Phase	2	3177.92	0.11	0.8918
Habitat x Nitrogen Treatment x Incubation Phase	8	115928.19	1.05	0.4062

C. Analysis of Variance: Effect of Habitat, Nitrogen Treatment, and Incubation Phase on N₂O Yield				
Whole Model				
Source	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Model	29	4.74	0.16	0.75
Error	120	26.29	0.22	P > F
Corrected Total	149	31.03		< 0.8177
Effects Test				
Source	Degrees of Freedom	Sum of Squares	F Ratio	P > F
Habitat	4	1.82	2.08	0.0874
Nitrogen Treatment	2	0.22	0.49	0.612
Habitat x Nitrogen Treatment	8	0.85	0.49	0.8645
Incubation Phase	1	0.02	0.08	0.7819
Habitat x Incubation Phase	4	0.84	0.96	0.4307
Nitrogen Treatment x Incubation Phase	2	0.01	0.03	0.9673
Habitat x Nitrogen Treatment x Incubation Phase	8	0.97	0.56	0.8118

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8 **Figure S1.** ^{15}N - N_2O flux from nitrate reduction (mid-grey bars) or nitrate reduction +
 9 nitrification (white bars) during the (a) early (0-24 hours) and (b) late (24-48 hours) incubation
 10 phases of the of the water-filled pore space experiment. The bar charts show means and
 11 standard errors.

