

Supplementary information (Table S1)

Effects of nitrogen deposition on growing-season soil methane sink across global forest biomes

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Table S1. Information on location, climate, forest type, and design of manipulated N addition experiments in forest ecosystems.

ID	Lon	Lat	MAT (°C)	MAP (mm)	GSMT (°C)	GSMP (mm mon ⁻¹)	Forest type	N forms	N additions (kg N ha ⁻¹ yr ⁻¹)	Reference
1	-148.30	64.75	-2.8	284	14.0	51	BF	NH ₄ NO ₃	0, 171	Gulledge and Schimel,2000
2	-148.30	64.75	-2.8	284	14.0	51	BF	NH ₄ NO ₃	0, 143	Gulledge and Schimel,2000
3	25.62	61.32	-3.3	680	15.3	69	BF	NH ₄ NO ₃	0, 200	Maljanen et al., 2006
4	121.51	50.83	-5.4	580	14.3	104	BF	NH ₄ NO ₃	0,10,20,40	Xu et al., 2014
5	121.88	50.42	-5.4	500	13.5	111	BF	NH ₄ Cl/KNO ₃	0,10,40	Gao et al., 2013
6	128.89	47.18	-0.3	676	15.9	109	TF	NH ₄ NO ₃	0,20,40, 80	Song et al., 2017
7	141.33	43.10	9.5	995	17.9	95	TF	NH ₄ NO ₃	0,50	Kim et al., 2012
8	-72.19	42.52	3.5	1120	16.3	99	TF	NH ₄ NO ₃	0,37,120	Stuedler et al., 1989
9	-72.19	42.52	3.5	1120	16.3	99	TF	NH ₄ NO ₃	0,37,120	Stuedler et al., 1989
10	127.78	42.52	2.7	872	15.5	116	TF	NH ₄ NO ₃	0,50	Chen et al., 2017
11	127.78	42.52	2.7	872	15.5	116	TF	NH ₄ NO ₃	0,50	Chen et al., 2017
12	-85.40	42.40	9.7	890	18.9	91	TF	NH ₄ NO ₃	0, 10, 30	Ambus and Robertson,2006
13	-85.40	42.40	9.7	890	18.9	91	TF	NH ₄ NO ₃	0,10,30	Ambus and Robertson,2006
14	-85.40	42.40	9.7	890	18.9	91	TF	NH ₄ NO ₃	0,100	Suwanwaree and Robertson,2005
15	128.10	42.40	4.1	855	15.4	111	TF	NH ₄ Cl/KNO ₃	0,45	Xu et al., 2011
16	-80.03	41.60	9.8	1125	17.3	107	TF	NH ₄ NO ₃	0,100	Chan et al., 2005
17	-74.58	39.92	12.3	1143	20.4	100	TF	NH ₄ NO ₃	0,50,67	Aronson et al., 2012
18	116.08	40.06	11.6	630	19.2	95	TF	NH ₄ NO ₃	0,50,100,150	Wang, 2012
19	115.06	26.74	17.9	1505	17.9	125	SF	NH ₄ Cl/NaNO ₃	0,40,120	Li et al., 2015
20	118.70	32.18	15.5	1020	15.5	85	SF	NH ₄ NO ₃	0,50,100,150	Hu et al., 2011
21	110.45	31.60	10.6	1650	10.6	138	SF	NH ₄ NO ₃	0,50	Pan, 2013
22	112.17	23.17	21	1927	21	161	SF	NH ₄ NO ₃	0,50,100,150	Zhang et al., 2008; Zheng et al., 2016
23	112.17	23.17	21	1927	21	161	SF	NH ₄ NO ₃	0,50,100,150	Zhang et al., 2008; Zheng et al., 2016
24	112.17	23.17	21	1927	21	161	SF	NH ₄ NO ₃	0,50,100,150	Zhang et al., 2008; Zheng et al., 2016
25	112.83	22.57	22.5	1534	22.5	128	SF	NH ₄ NO ₃	0,50,100	Zhang et al., 2012

Note: MAT, MAP, GSMT and GSMP indicate mean annual temperature, mean annual precipitation, growing-season mean temperature, and growing-season mean monthly precipitation, respectively. BF, TF, and SF indicate boreal forest, temperate forest, and subtropical forest, respectively.

Reference

- Ambus, P., Robertson, G.P. 2006. The effect of increased N deposition on nitrous oxide, methane and carbon dioxide fluxes from unmanaged forest and grassland communities in Michigan. *Biogeochemistry*, 79(3), 315-337.
- Aronson, E.L., Vann, D.R., Helliher, B.R. 2012. Methane flux response to nitrogen amendment in an upland pine forest soil and riparian zone. *Journal of Geophysical Research: Biogeosciences*, 117, G03012.
- Chan, A.S., Steudler, P.A., Bowden, R.D., Gullede, J., Cavanaugh, C.M. 2005. Consequences of nitrogen fertilization on soil methane consumption in a productive temperate deciduous forest. *Biology and fertility of soils*, 41(3), 182-189.
- Chen, Z., Setälä H., Geng, S., et al. 2017. Nitrogen addition impacts on the emissions of greenhouse gases depending on the forest type: a case study in Changbai Mountain, Northeast China. *Journal of Soils and Sediments*, 17(1), 23-34.
- Gao, W.L., Cheng, S.L., Fang, H.J., et al. 2013. Early responses of soil CH₄ uptake to increased atmospheric nitrogen deposition in a cold-temperate coniferous forest. *Acta Ecologica Sinica*, 2013, 3(23), 7505-7515.
- Gullede, J., Schimel, J.P. 2000. Controls on soil carbon dioxide and methane fluxes in a variety of taiga forest stands in interior Alaska. *Ecosystems*, 3, 269-282.
- Hu, Z.H., Zhang, H., Chen, S.T., Li, Q., Li, M.H., Shen, S.H. 2011. Effects of simulated nitrogen deposition on N₂O and CH₄ fluxes of soil in forest belt. *China Environmental Science*, 31(6), 892-897.
- Kim, Y. S., Imori, M., Watanabe, M., Hatano, R., Yi, M. J., Koike, T. 2012. Simulated nitrogen inputs influence methane and nitrous oxide fluxes from a young larch plantation in northern Japan. *Atmospheric Environment*, 46, 36-44.
- Li, X., Cheng, S., Fang, H., et al. 2015. The contrasting effects of deposited NH₄⁺ and NO₃⁻ on soil CO₂, CH₄ and N₂O fluxes in a subtropical plantation, southern China. *Ecological Engineering*, 85, 317-327.
- Maljanen, M., Jokinen H., Saari, A., Strommer, R., Martikainen, P.J. 2006. Methane and nitrous oxide fluxes, and carbon dioxide production in boreal forest soil fertilized with wood ash and nitrogen. *Soil Use and Management*, 22, 151-157.
- Pan, D.R. 2013. Study on greenhouse gas emission for grassland soil below different forest soils under precipitation reduction and Nitrogen deposition in Shennongjia mountain. Gansu Agricultural University, Master's thesis.

- Song, L., Tian, P., Zhang, J., Jin, G. 2017. Effects of three years of simulated nitrogen deposition on soil nitrogen dynamics and greenhouse gas emissions in a Korean pine plantation of northeast China. *Science of the Total Environment*, 609, 1303-1311.
- Stuedler, P.A., Bowden, R.D., Melillo, J.M., Aber, J.D. 1989. Influence of nitrogen fertilization on methane uptake in temperate forest soils. *Nature*, 341(6240), 314-316.
- Suwanwaree, P., Robertson, G.P. 2005. Methane oxidation in forest, successional, and no-till agricultural ecosystems. *Soil Science Society of America Journal*, 69(6), 1722-1729.
- Wang, R.N. 2012. Effects of simulated atmospheric nitrogen deposition on the exchange fluxes of greenhouse gases in the temperate forest soil. Beijing Forestry University, Master's thesis.
- Xu, X., Han, L., Luo, X., Han, S. 2011. Synergistic effects of nitrogen amendments and ethylene on atmospheric methane uptake under a temperate old-growth forest. *Advances in Atmospheric Sciences*, 28(4), 843-854.
- Xu, M., Cheng, S., Fang, H., et al. 2014. Low-level nitrogen addition promotes net methane uptake in a boreal forest across the Great Xing'an mountain region, China. *Forest Science*, 60(5), 973-981.
- Zhang, W., Mo, J., Zhou, G., et al. 2008. Methane uptake responses to nitrogen deposition in three tropical forests in southern China. *Journal of Geophysical Research: Atmospheres*, 113, D11116.
- Zhang, W., Zhu, X., Liu, L., et al. 2012. Large difference of inhibitive effect of nitrogen deposition on soil methane oxidation between plantations with N-fixing tree species and non-N-fixing tree species. *Journal of Geophysical Research: Biogeosciences*, 117, G00N16.
- Zheng, M., Zhang, T., Liu, L., Zhang, W., Lu, X., Mo, J. 2016. Effects of nitrogen and phosphorus additions on soil methane uptake in disturbed forests. *Journal of Geophysical Research: Biogeosciences*, 121(12), 3089-3100.