

A new method for measuring N_2 emissions from denitrification in soils

Wendy Yang

Whendee Silver Lab
Dept. of Environmental Science, Policy, and Management
University of California, Berkeley

DOE GCEP End-of-Summer Workshop
August 14, 2007

N_2 is produced from nitrous oxide, a greenhouse gas and catalyst for stratospheric ozone depletion.

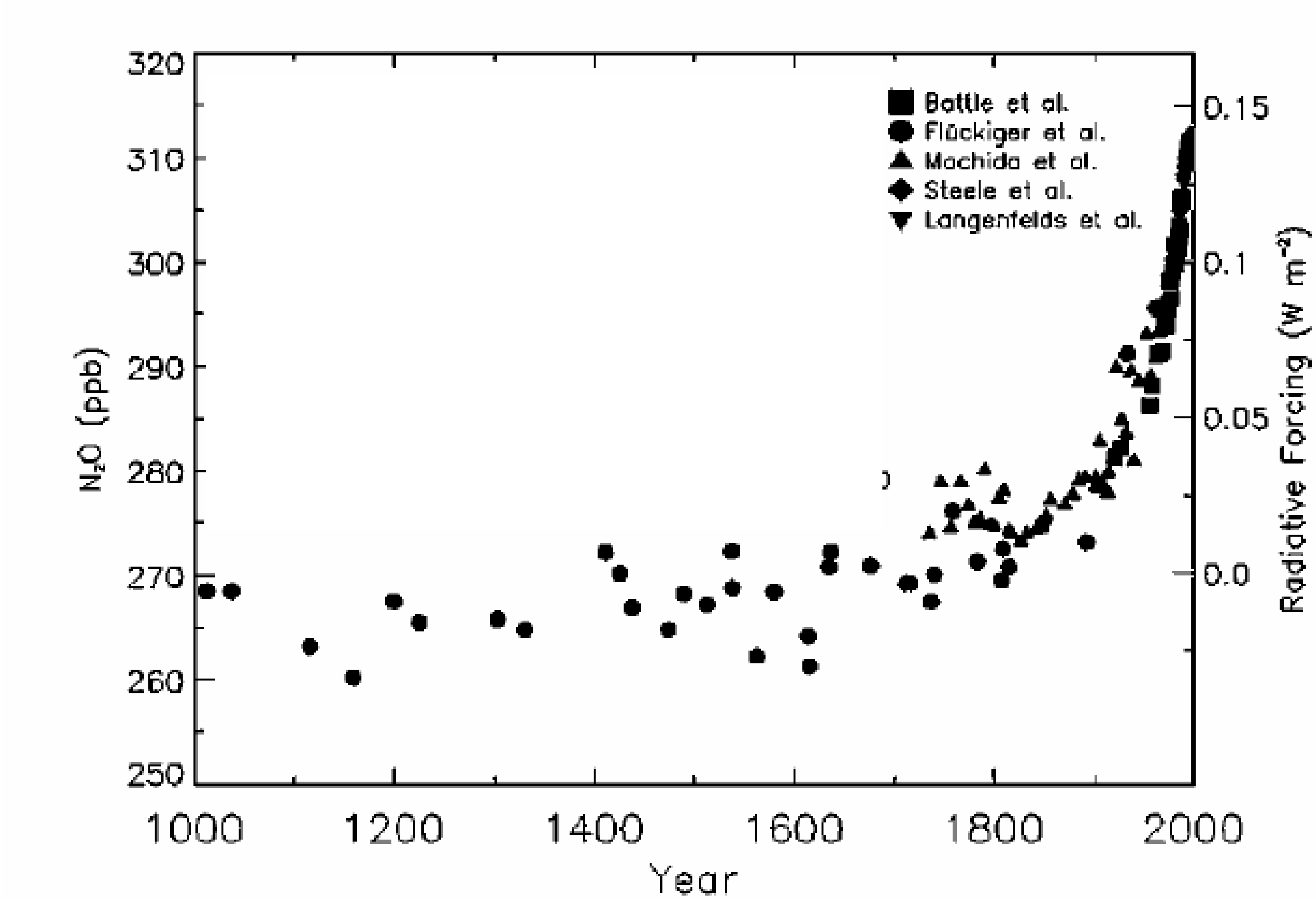
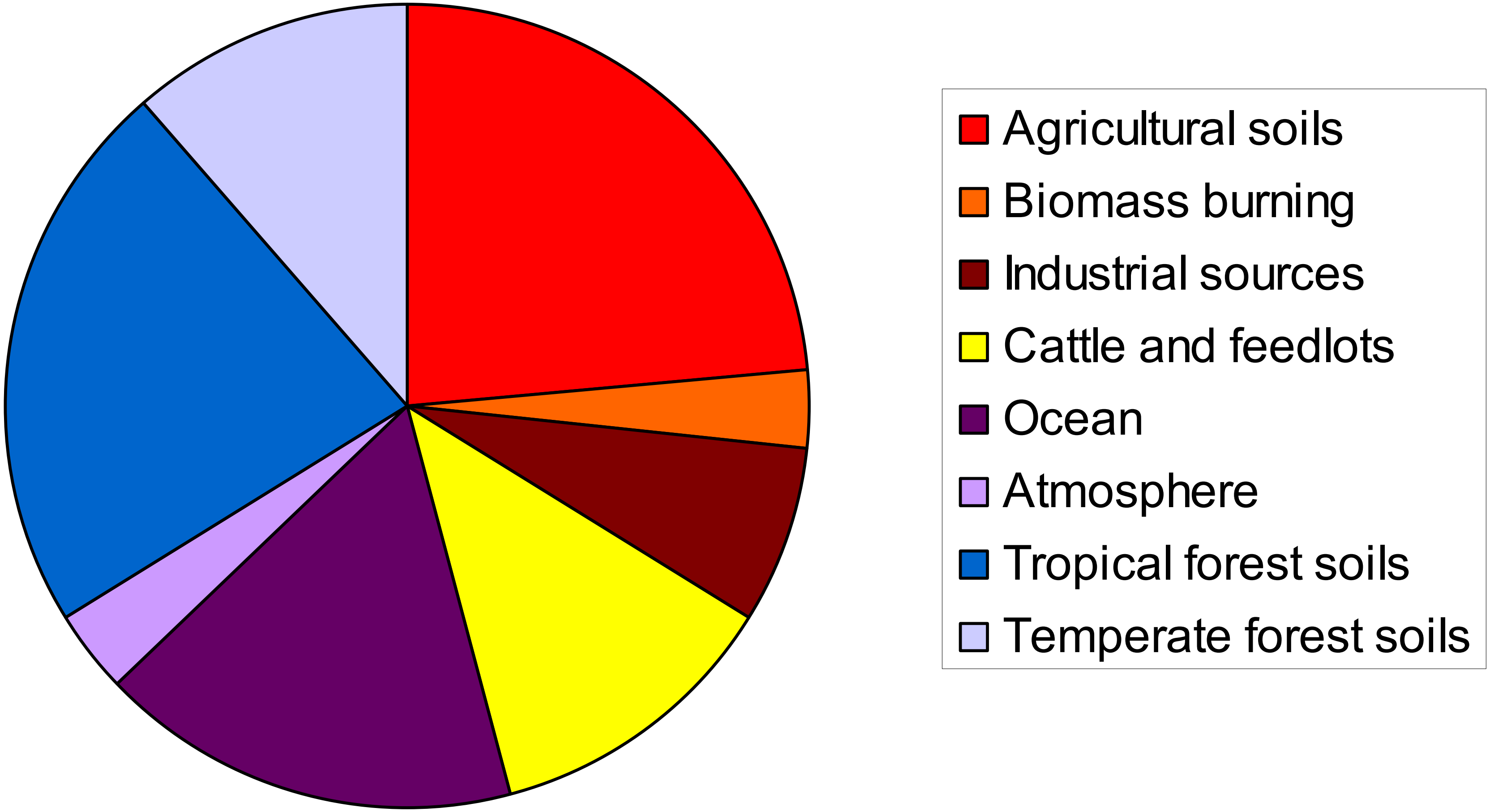


Figure from Stein and Yung 2003

Human activity accounts for over half of global nitrous oxide emissions.



Adapted from Stein and Yung 2003

Nitrogen deposition rates are projected to increase dramatically in the tropics.


Existing methods for measuring N_2 emissions from soils are flawed.

(1) ^{15}N tracer

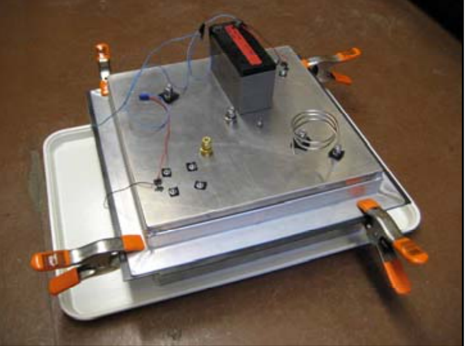
- high detection limit

(2) Acetylene inhibition

- underestimates N_2 production rates

(3) Incubation in N_2 free headspace

- difficult to keep out atmospheric N_2



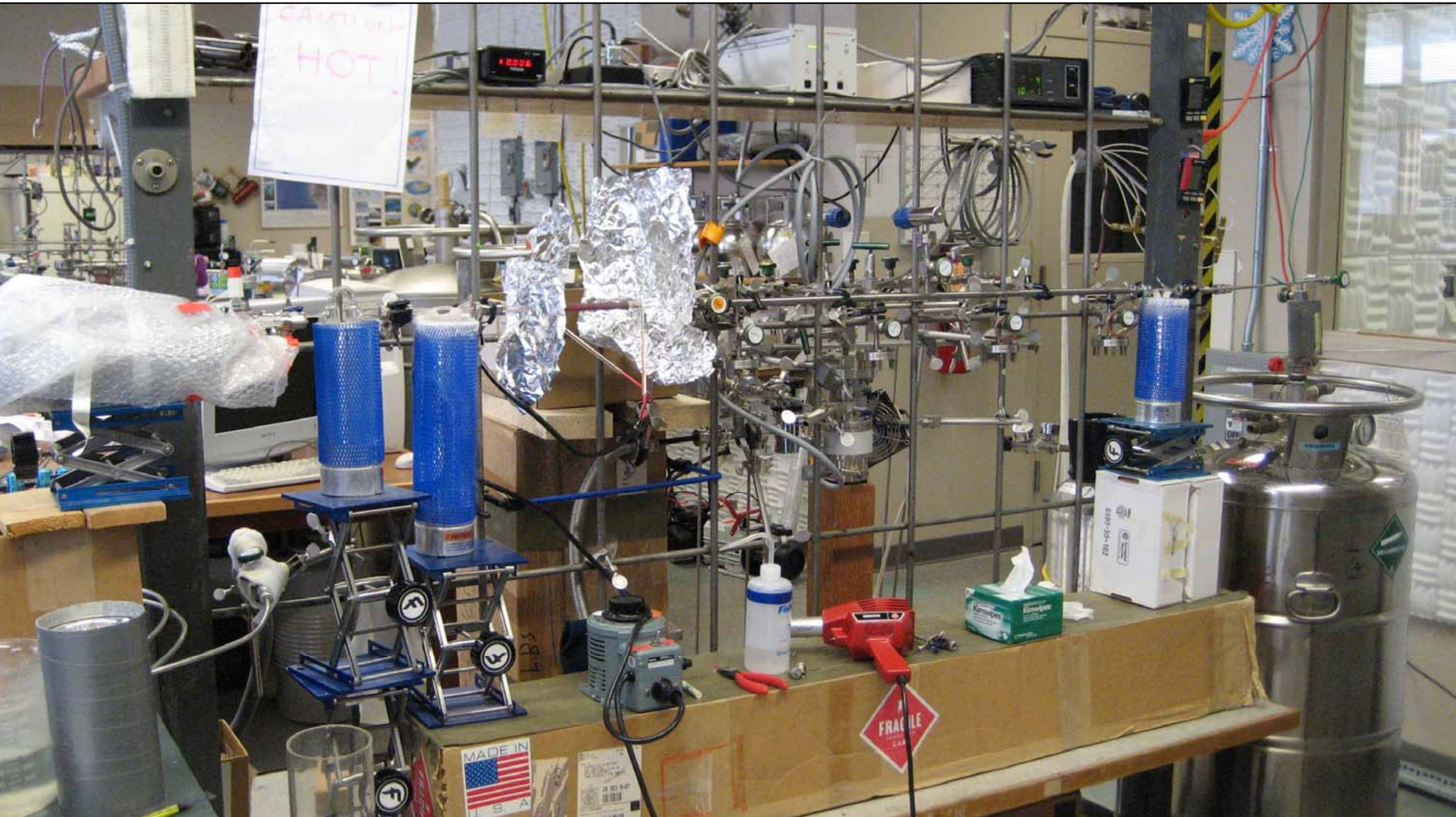
N_2/Ar requires high precision to detect N_2 fluxes from upland soils.

$$\delta N_2/Ar =$$

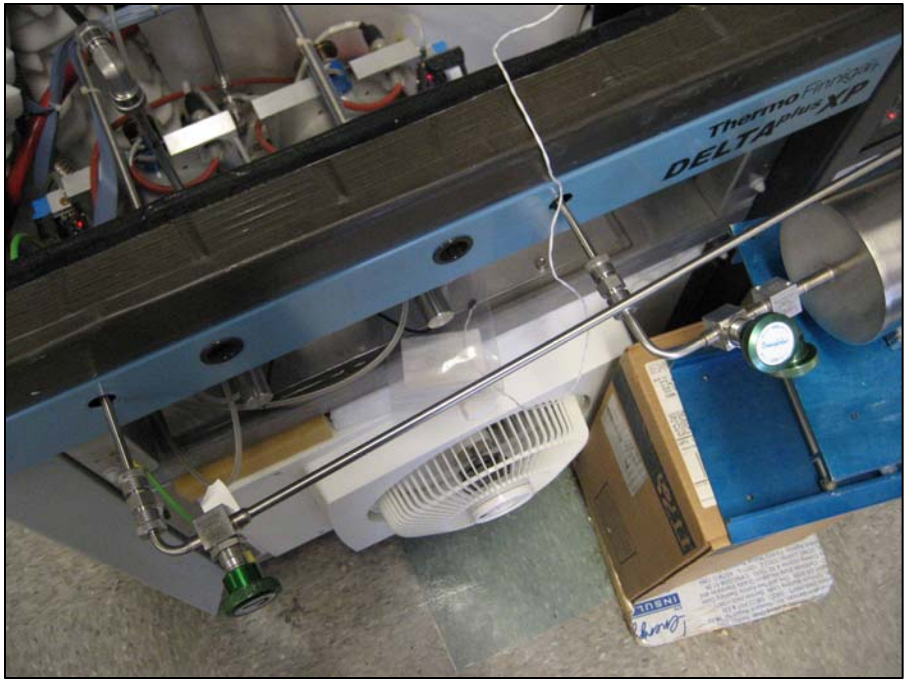
$$[(N_2/Ar_{sample}) / (N_2/Ar_{ref}) - 1] * 10^6$$

20 per meg change in $\delta N_2/Ar$ =
10-20 ng-N/cm^2/h or 2-4 ng-N/gdw/h

Liquid helium is used to quantitatively transfer gas samples.

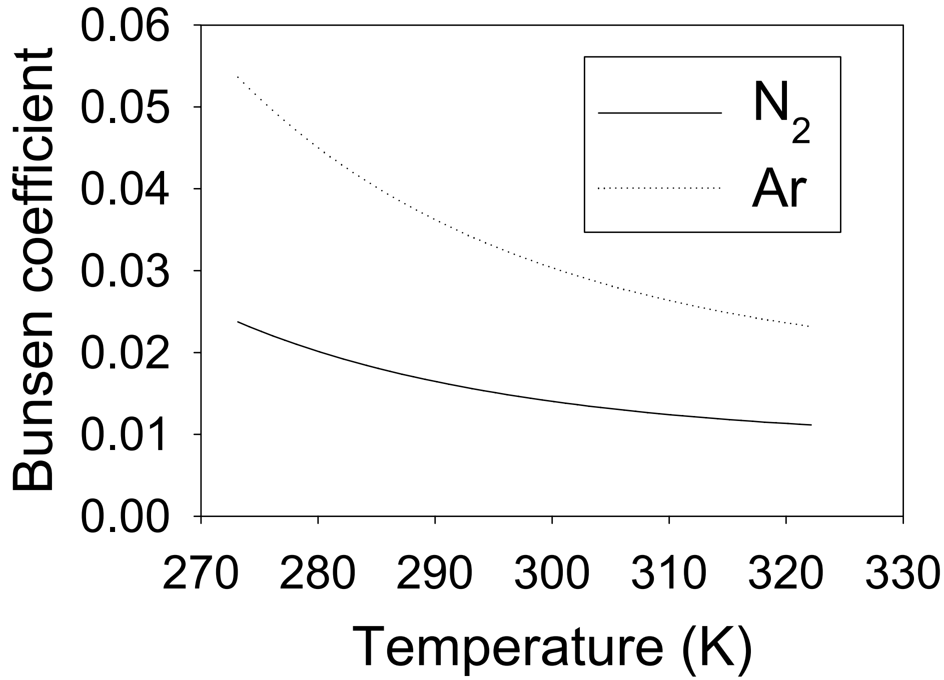


Gas handling causes most of the variability in repeated measurements.



Biological N_2 flux must be separated from physical effects on N_2/Ar.

- Water vapor flux fractionation
- Thermal diffusion



$\delta^{40}Ar$ could constrain mass dependent fractionation effects on $\delta N_2/Ar$.

Thermal diffusion may not be a large factor influencing $\delta N_2/Ar$.

Temperature increase	% water-filled pore space	Change in $\delta N_2/Ar$ (per meg)	
		0-20 cm	0-50 cm
0.5°C	30	38	61
	50	75	131
	70	123	242
0.1°C	30	8	12
	50	15	27
	70	25	49

Conclusion:
Perseverance will be rewarded.

Acknowledgements

<u>Collaborators</u>

Mark Conrad (LBNL)

Mary Firestone (UCB, LBNL)

Ralph Keeling (UC-San Diego)

Jeff Severinghaus (UC-San Diego)

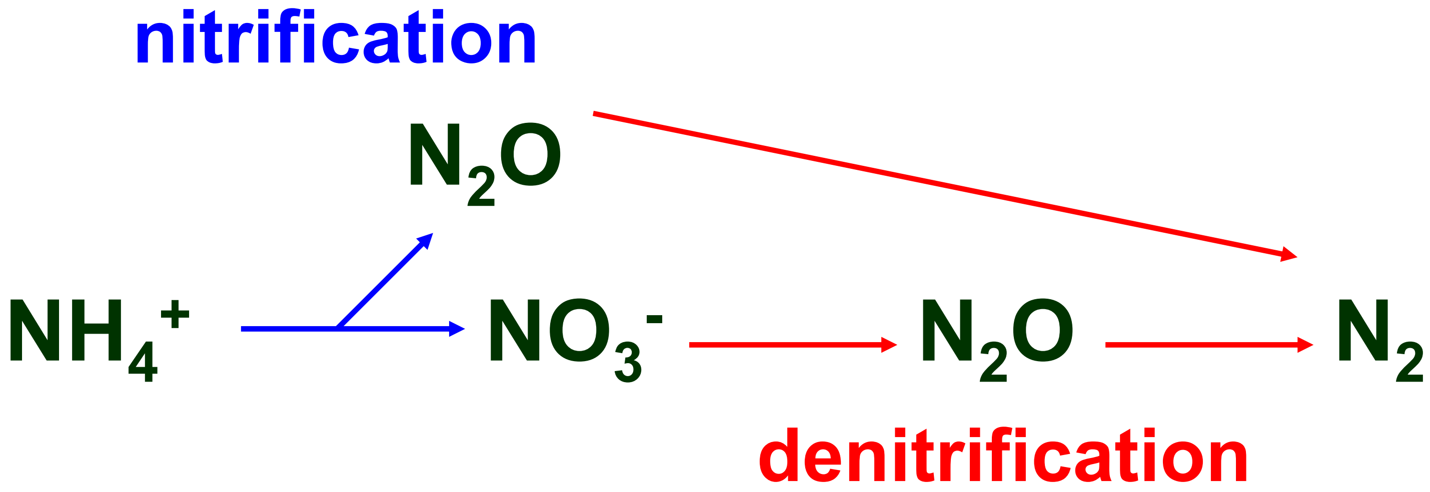
<u>Funding</u>

DOE GCEP GREF

NSF Graduate Research Fellowship

Berkeley Atmospheric Sciences Center Graduate Fellowship

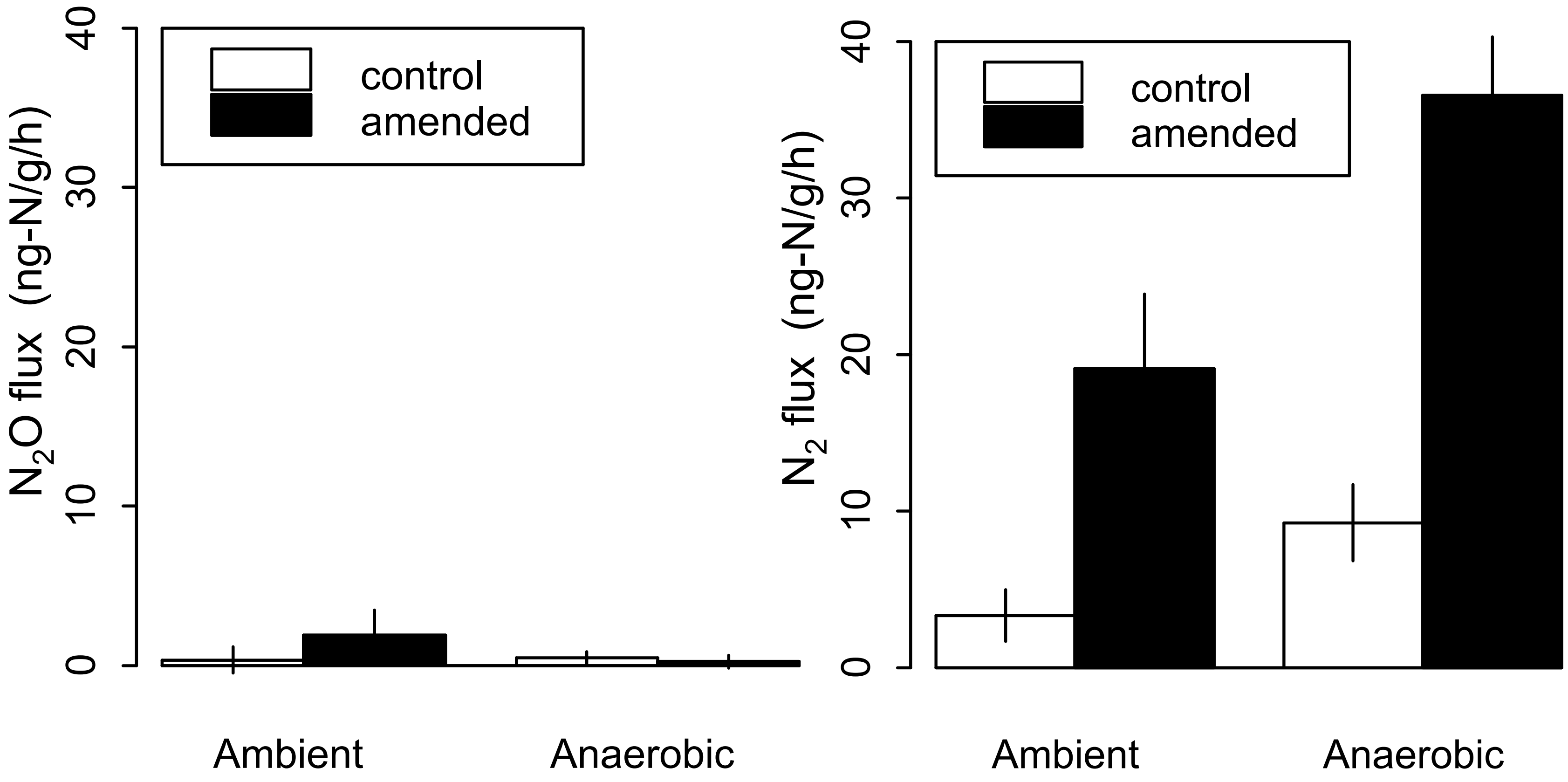
Low nitrate availability drives nitrous oxide reduction to N_2.



aerobic microbial process

anaerobic microbial process

N_2 could be an important fate of anthropogenic nitrogen inputs.



Yang et al., in prep.