Spatial distribution of nitrogen inputs drive short- and long-term variability in global N_2O emissions

E. Harris[1,2], L. Yu[3,13] , Y. Wang[4], J. Mohn[3], S. Henne[3], E. Bai[5], M. Barthel[6], M. Bauters[7], P. Boeckx[7], C. Dorich[8], M. Farrell[9], P. Krummel[4], Z. Loh[4], M. Reichstein[10], J. Six[6], M. Steinbacher[3], N. Wells[11], C. Zellweger[3], M. Bahn[2], P. Rayner[12]

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[12]Department of Earth Sciences, University of Melbourne, Australia
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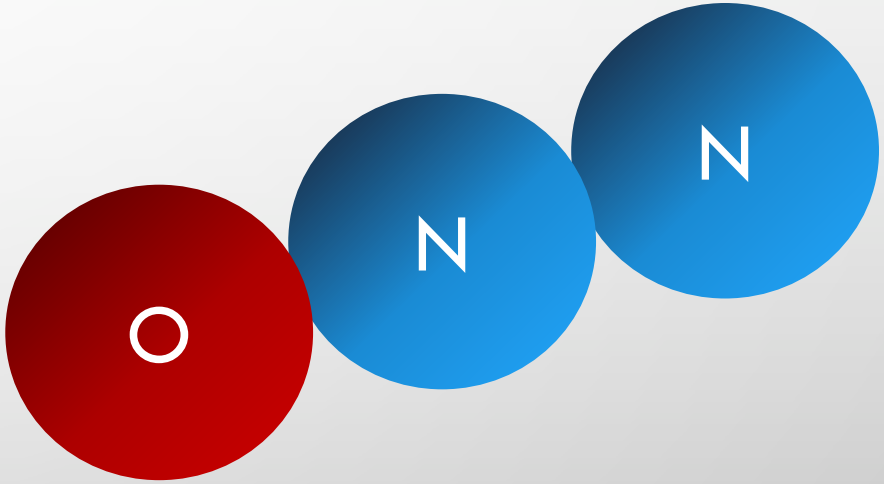
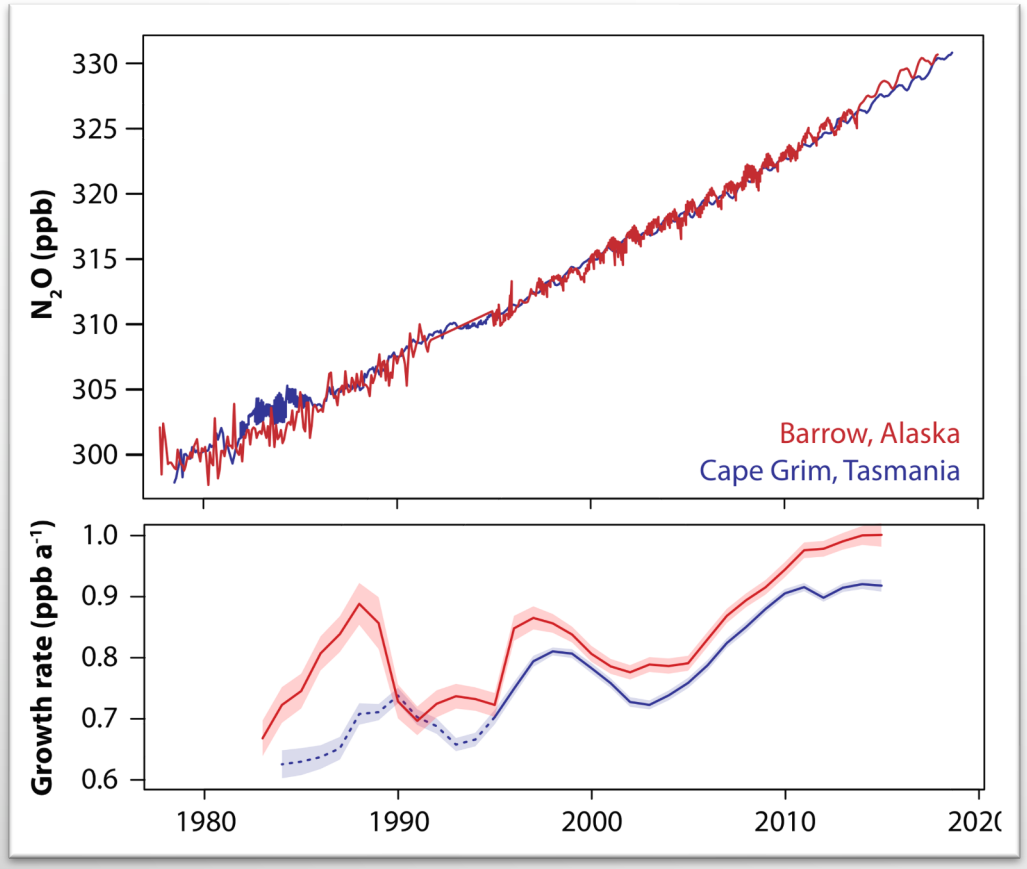


N_2O: Rising globally, impacting climate



Data: AGAGE – Cape Grim data; NOAA – Barrow data.

- N_2O mole fraction is rapidly increasing around the world

- N_2O is primarily produced by microbes:

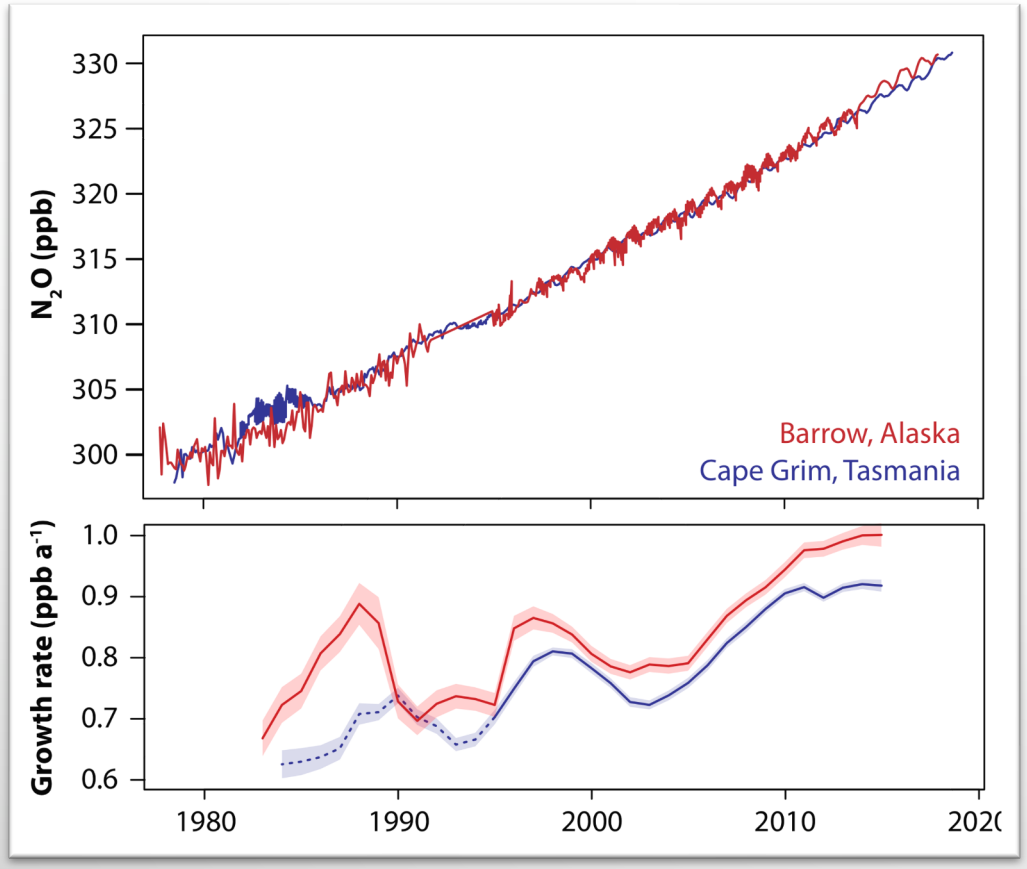
Denitrification: **anoxic**

$$NO_3^- \rightarrow NO_2^- \rightarrow NO \rightarrow \mathbf{N_2O} \rightarrow N_2$$

Nitrification: **oxic**

$$NH_4^+ \rightarrow NH_2OH \rightarrow NO_2^- \rightarrow NO_3^-$$
$$\hookrightarrow \mathbf{N_2O}$$

N_2O: Rising globally, impacting climate



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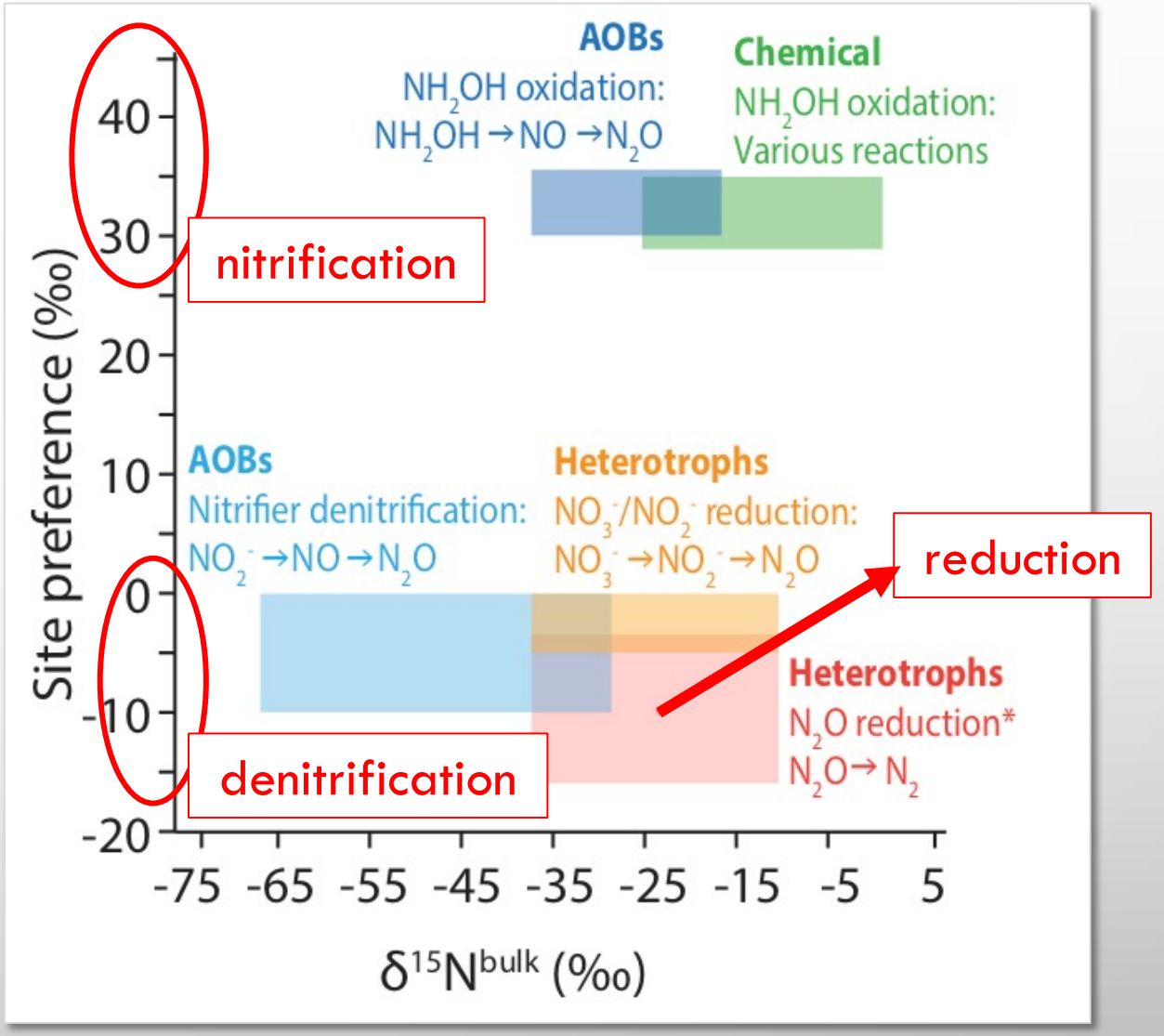
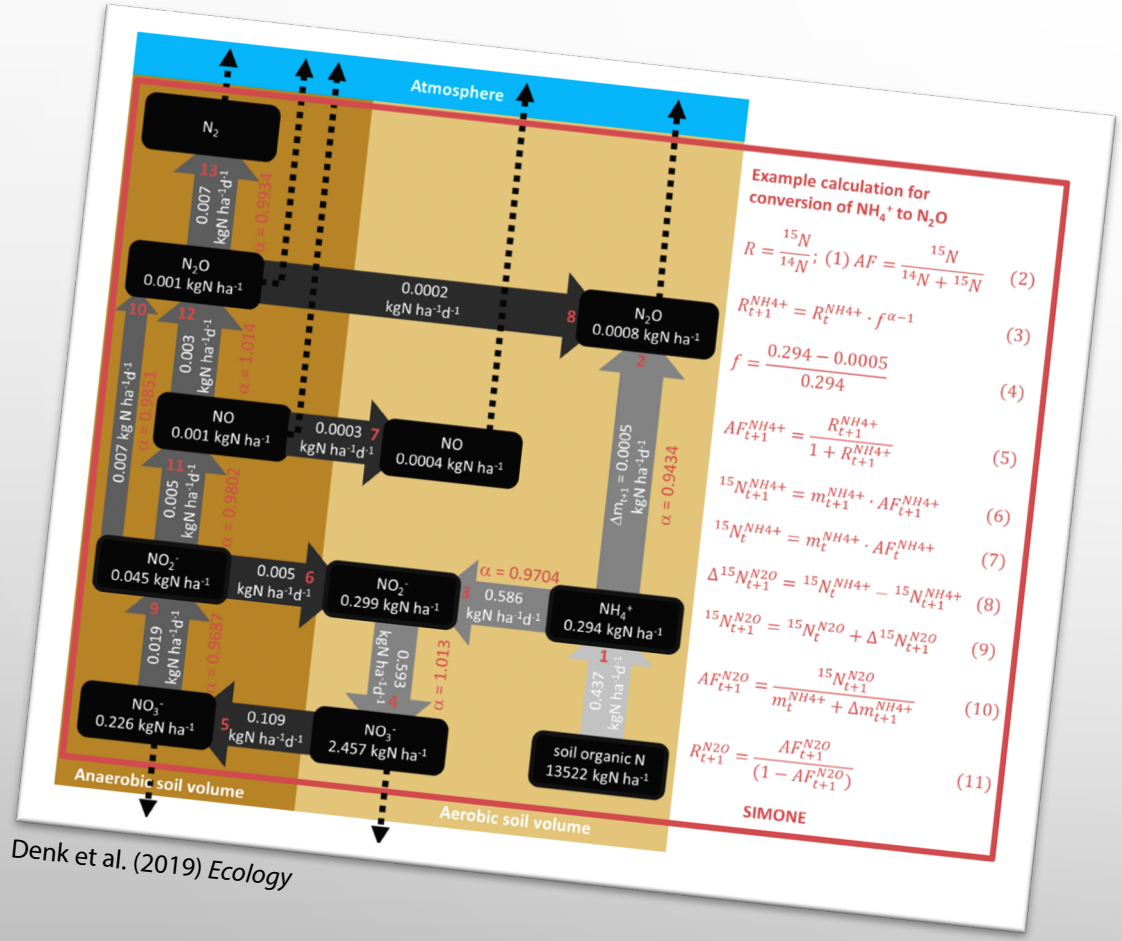
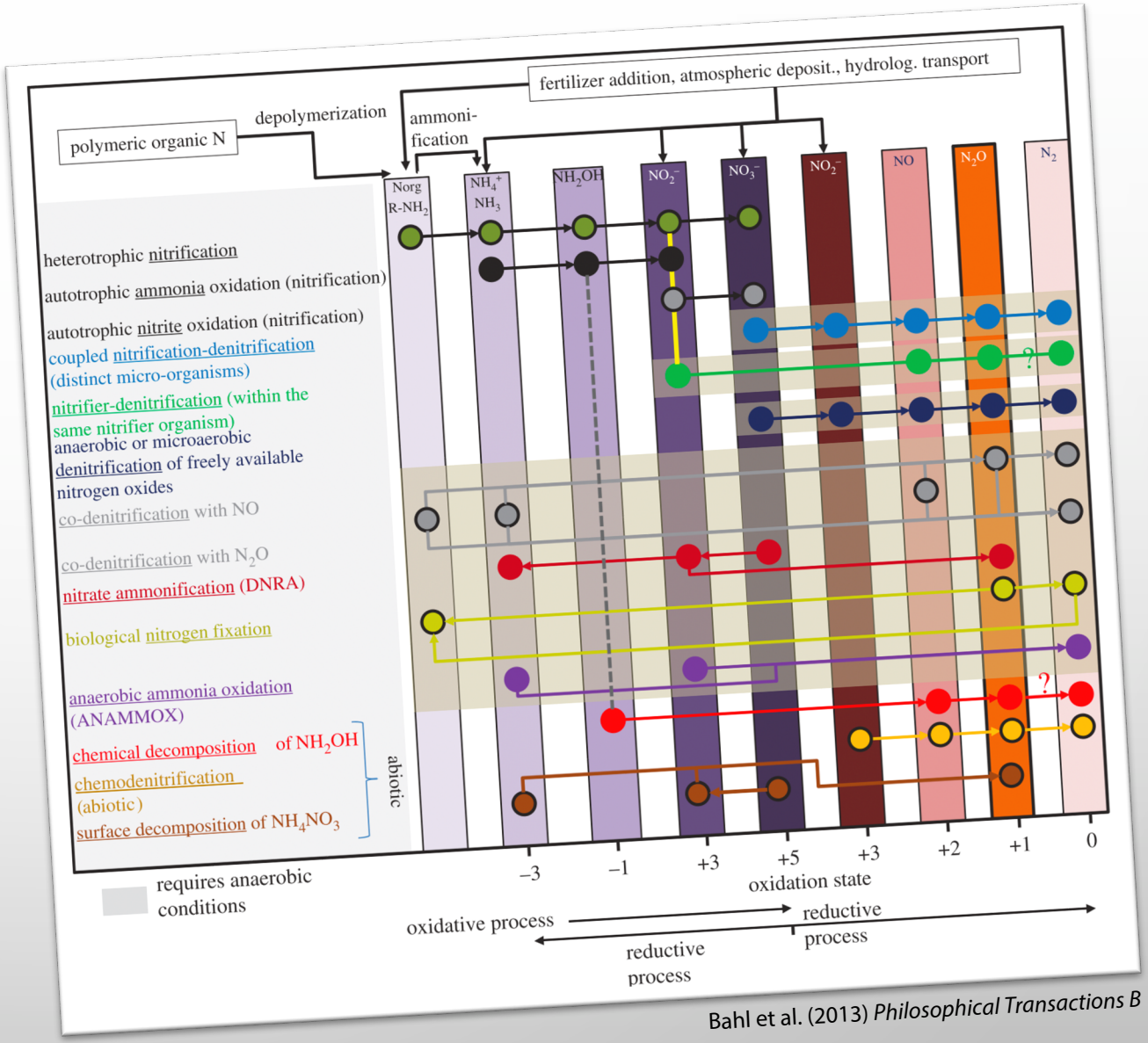


Modelling N_2O emissions and the N cycle

- Process-based modelling of the N cycle is complicated...



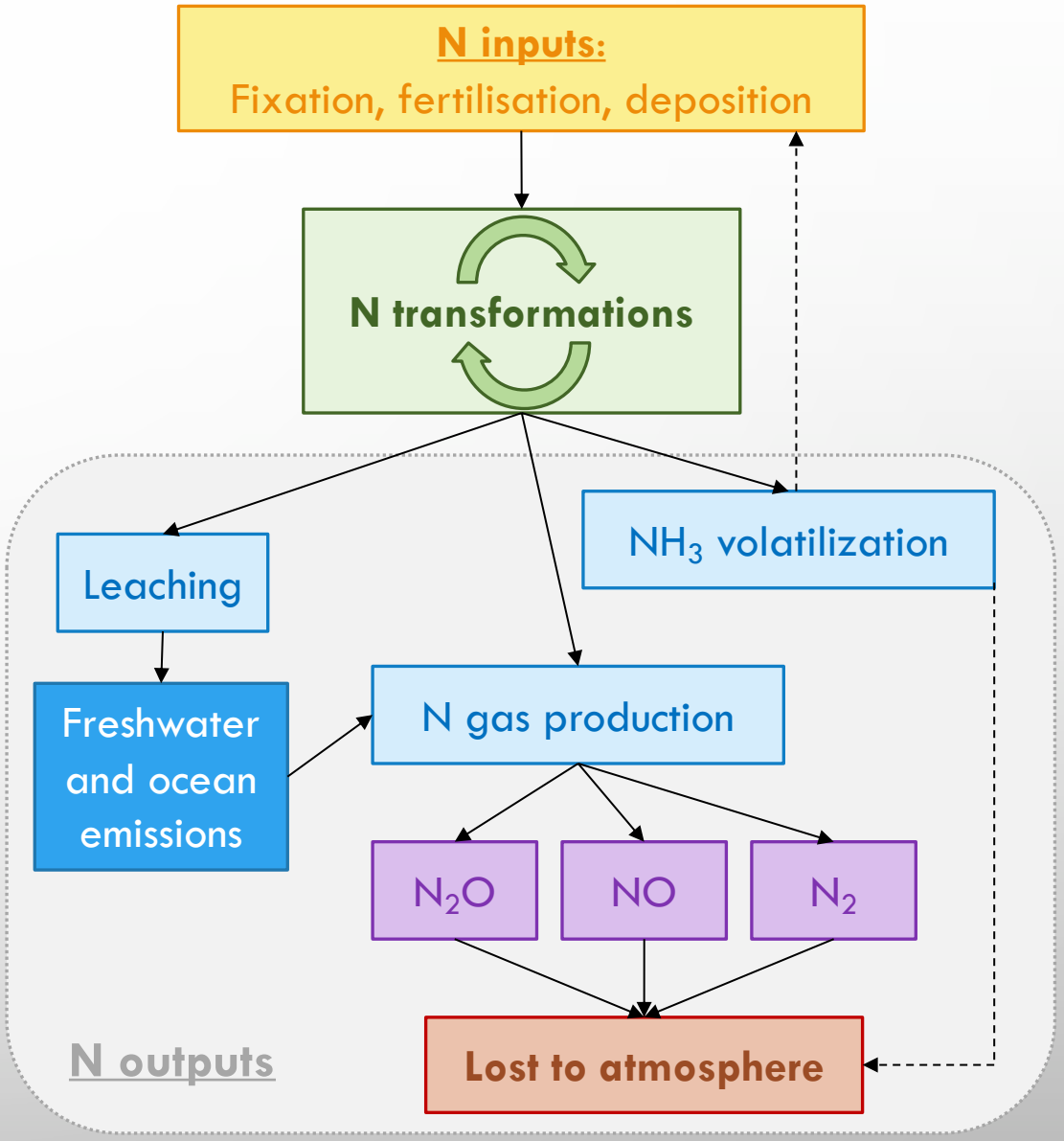
Denk et al. (2019) *Ecology*

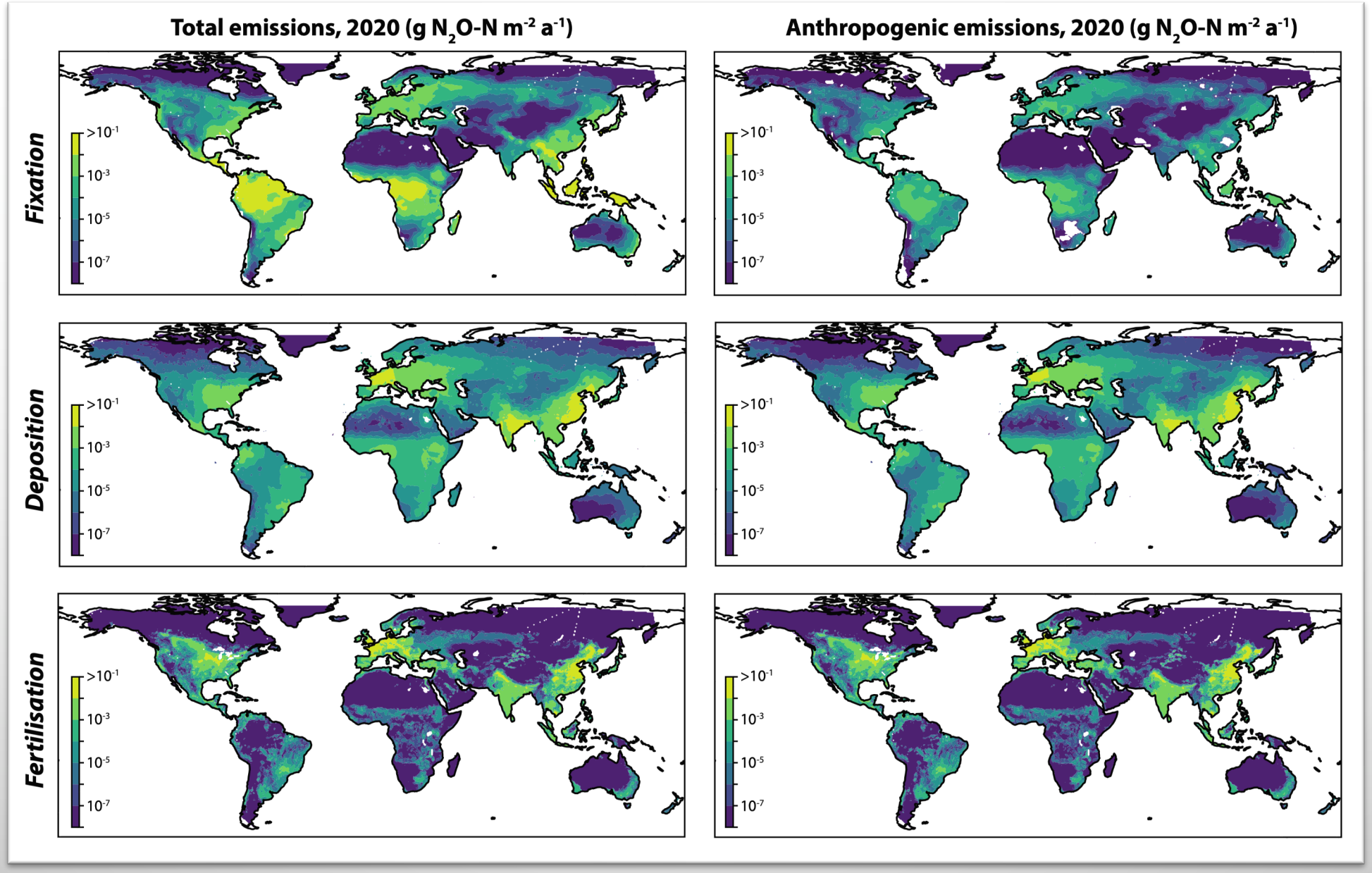


Bahl et al. (2013) *Philosophical Transactions B*

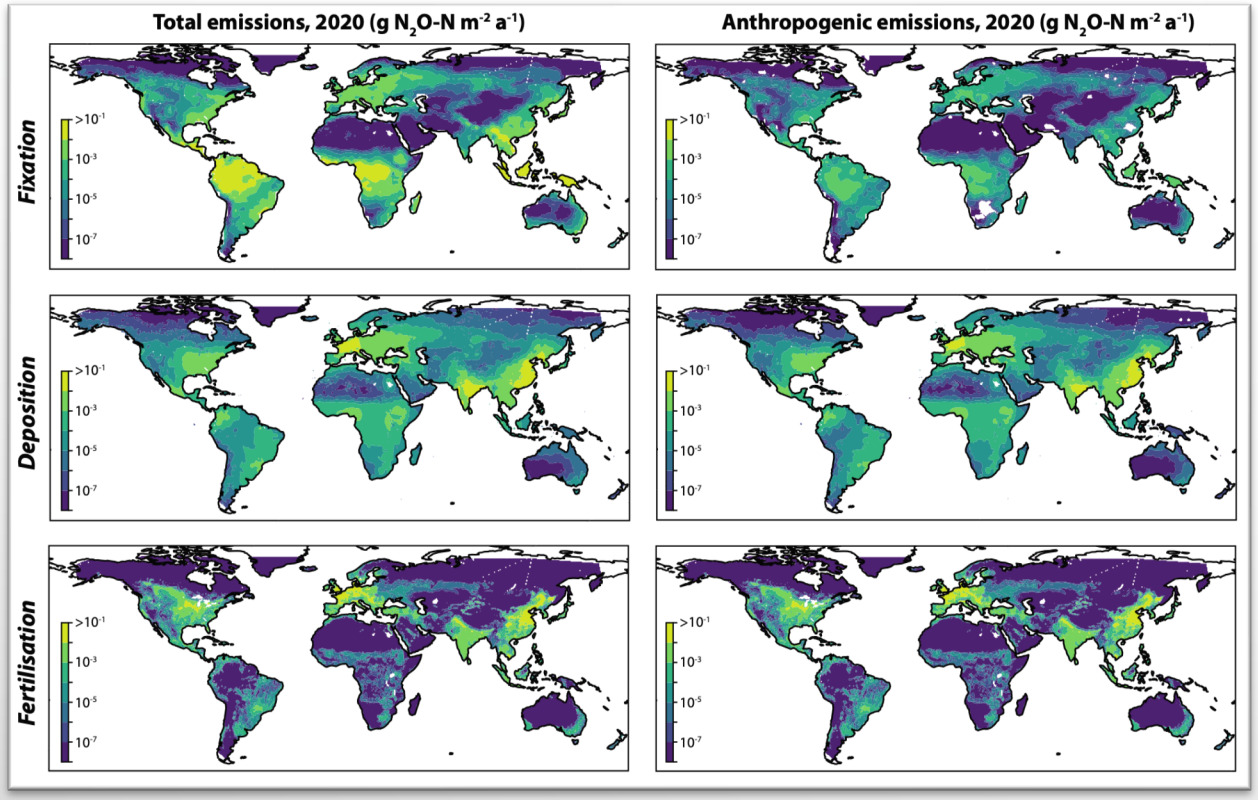
Modelling N_2O emissions and the N cycle

- Process-based modelling of the N cycle is complicated...
- Isotopes can act as an 'integrated' signature of numerous processes
- At steady state:
  - N inputs = N outputs
  - ^{15}N inputs = ^{15}N outputs
- **Can we use N isotopes as a simple constraint for the global N_2O budget?**





However, there is very little representative emission data to test the model…



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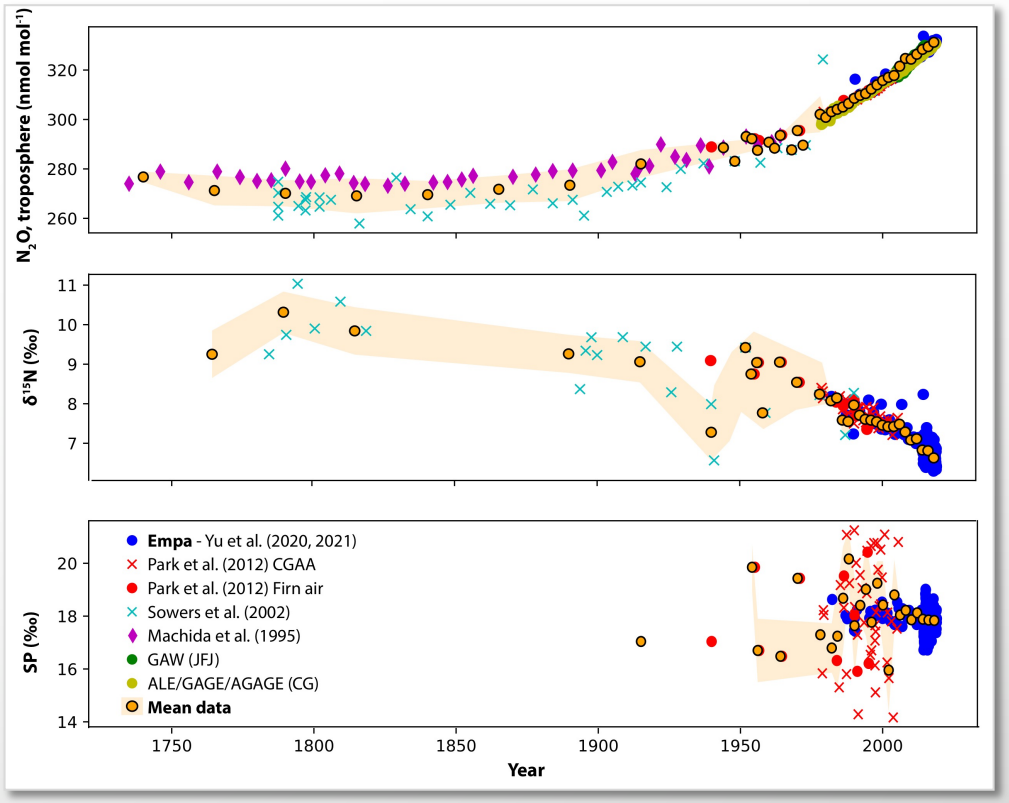
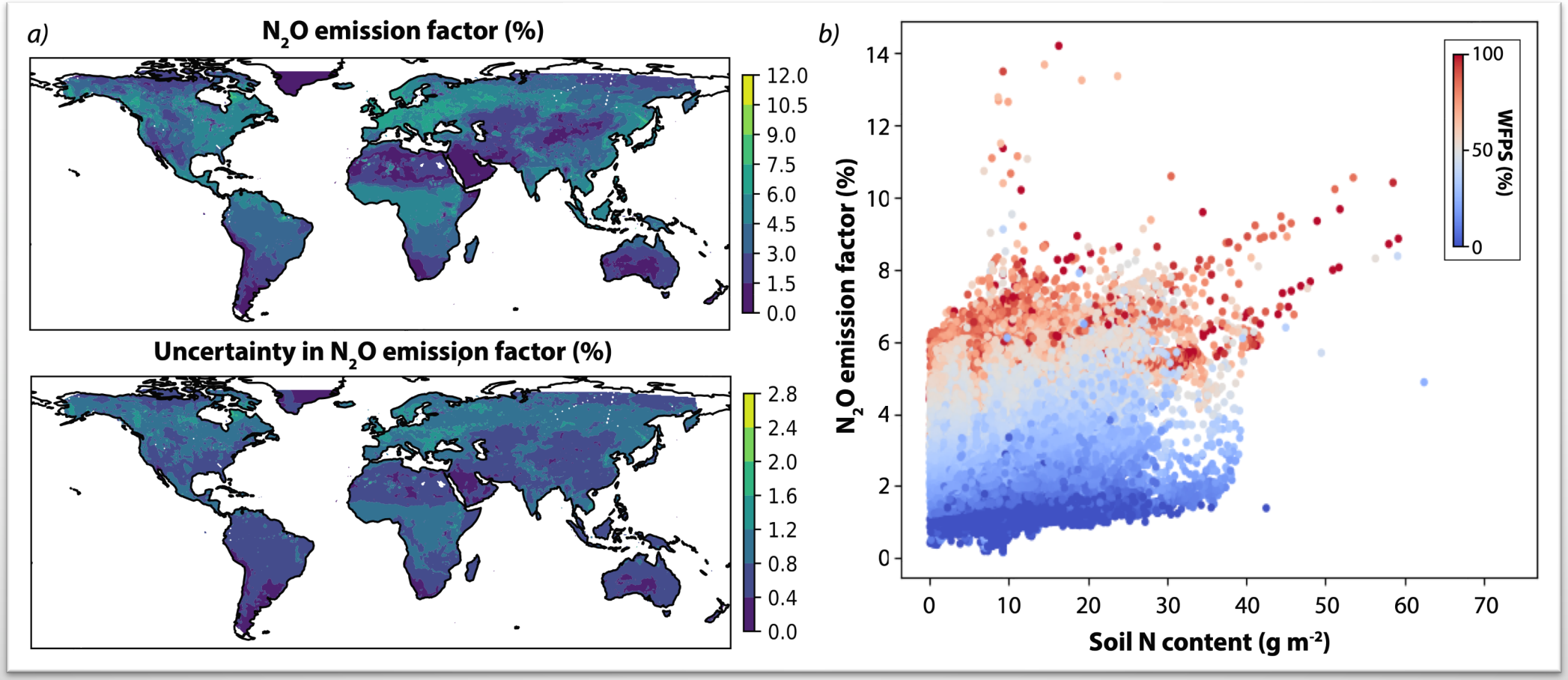


= The IsoTONE model framework

Results: N_2O emission factor



- Area-weighted global mean EF is 1.0%, however N-input-weighted global EF is 4.3%
- Using $\delta^{15}N$ as a proxy would allow annual EF to be estimated at many more sites

- *Acknowledgements of funding sources:*
- The Tirolean Wissenschaftsförderung, the Austrian Science Foundation (FWF; P31132), and the FFG (LTER-CWN) for financing field experiments
- The OECD Cooperative Research Program for Sustainable Agriculture, the University of Innsbruck's Digital Innovation program, and the Austrian Science Foundation (FWF; P31132) for funding work on modelling and data analysis

Thanks for listening to this presentation!