The Denitrification paradox

Jonathan Barnes

School of Marine Science and Technology
University of Newcastle upon Tyne
NE1 7RU, United Kingdom
Jonathan.barnes@ncl.ac.uk
Atmospheric growth varies, reflecting changing source-sink strengths
This complicates climate prediction and planning
What are the sources and sinks and how important are they?
THIS CONFIRMS GLOBAL WARMING’S REAL! NOW YOU HAVE TO DO SOMETHING ABOUT IT!

TODAY I’M BANNING GLOBAL WARMING STUDIES...
Where is the atmospheric $\text{N}_2\text{O}$ coming from?
Recent IPCC evaluation

- Natural Soils 34%
- Cattle & Feedlots 12%
- Industrial 7%
- Biomass Burning 3%
- Agricultural Soils 34%
- Oceans 17%
- Atmospheric $\text{NH}_3$ 3%
Where is the atmospheric $N_2O$ coming from?

Recent IPCC evaluation

- **Natural Soils**: 34% (19-60)
- **Agricultural Soils**: 34% (3-85)
- **Biomass Burning**: 3% (1.2-6)
- **Cattle & Feedlots**: 12% (3-18)
- **Industrial**: 7% (4-10)
- **Atmospheric $NH_3$**: 3% (2-6)
- **Oceans**: 17% (6-28)

School of Marine Science & Technology
Solving experimental uncertainty in soil/sediment N$_2$O production. Oxygen plays the key role!
Traditional thinking implies high N$_2$O production in anoxic conditions with significant N loading.
Data from the polluted Adyar estuary, India show this may be flawed. Lower $N_2O$ concentrations are consistently observed in the lowest oxygen zone of the estuary, where highest $N$ loading occurs.
$N_2O$ measurements in tank headspace without oxygen manipulation (typical of traditional incubations)

- Sudden peak in $N_2O$ production at 4% oxygen
Summary Remarks

Oxygen plays the pivotal role in the production of atmospheric \( \text{N}_2\text{O} \) from global soils and sediments.

Sub-oxic environments are potentially the largest source of \( \text{N}_2\text{O} \) because of increased yield from nitrification at low oxygen tensions and or increased coupled nitrification-denitrification.

Anoxic environments, even those with heavy nitrogen and carbon loads are not always sources of \( \text{N}_2\text{O} \) because in isolation denitrification may act as a sink for \( \text{N}_2\text{O} \).

Future studies:
Identify oxygen tensions which maximise \( \text{N}_2\text{O} \) yield from sediments.
Acknowledgements

For providing funds: the U.K. Leverhulme Trust for financial support

And Finally, thank you for listening.