Pervasive control of soil pH on $\text{N}_2\text{O}$ and $\text{N}_2$ emissions under anaerobic conditions from upland agricultural soils across China

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Background

- Soil $\text{N}_2$ emission is an important pathway of $\text{N}$ losses, which is difficult to quantify in terms of both the magnitude and the contributions of the processes involved, yielding uncertainty in closing the $\text{N}$ budget for agricultural systems;
- Soil pH might be the most important factor influencing both denitrification and $\text{N}_2\text{O}$ production, but it remains largely unclear if soil pH regulate the $\text{N}_2\text{O}/(\text{N}_2\text{O} + \text{N}_2)$ ratio in natural soil pH gradients over relatively large regional scales;
- We know rather little on the contributions of denitrification, co-denitrification to $\text{N}_2\text{O}$ production, and denitrification, co-denitrification plus anaerobic ammonium oxidation (anammox) to $\text{N}_2$ productions.

Objectives

- We investigate the influence of environmental factors, especially pH on $\text{N}_2\text{O}$ and $\text{N}_2$ production, as well as on the $\text{N}_2\text{O}/(\text{N}_2\text{O} + \text{N}_2)$ ratios in eight areas from three representative agricultural regions across China (northeast, central and southern China);
- We also partitioned the sources of $\text{N}_2$ to denitrification or co-denitrification plus anammox based on the different $^{15}\text{N}$ isotope pairing between these processes;
- The overall objective was to improve our understanding of potential $\text{N}$ gas losses ($\text{N}_2\text{O} + \text{N}_2$, except NO and $\text{NH}_3$), $\text{N}_2\text{O}/(\text{N}_2\text{O} + \text{N}_2)$ ratios, controlling factors, and responsible processes (denitrification vs. co-denitrification plus anammox) from major Chinese upland agricultural soils.

Experimental routes

- $\text{N}_2$ was the dominant end product of denitrification under anaerobic conditions;
- $\text{N}_2$ productions were high at soils with high pH;
- $\text{N}_2$: $\text{N}_2\text{O}$ ratios ranged from 4 to 372.

Contributions of denitrification and co-denitrification to $\text{N}_2\text{O}$ and $\text{N}_2$ productions

- Denitrification was the dominant process producing both $\text{N}_2\text{O}$ and $\text{N}_2$;
- Denitrification contributed to 85~99% of $\text{N}_2\text{O}$, and 65~100% of $\text{N}_2$ productions, as compared with co-denitrification (plus anammox for $\text{N}_2$).