New study quantifies temperature sensitivity of soil gaseous nitrogen loss in forest ecosystems

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Researchers from the Institute of Applied Ecology and the Institute of Geographical Sciences and Natural Resources Research of the Chinese

Academy of Sciences have investigated the critical role of gaseous nitrogen loss (N_2O and N_2) in nitrogen limitation and its implications for carbon sink function in terrestrial ecosystems, particularly in the context of climate warming.

The researchers developed a novel ^{15}N tracer technique to quantify the production rates of N_2O and N_2 derived from denitrification in forest soils at 18 sites in China, covering a wide range of climatic gradients.

The results showed an exponential increase in denitrification N_2O and N_2 production rates with increasing temperature, exhibiting a geographical pattern.

Importantly, they found a consistent temperature sensitivity for N_2O and N_2 release across different climatic zones, with Q_{10} values of 2.1 ± 0.5 and 2.6 ± 0.6, respectively.

The temperature sensitivities obtained in this study are comparable to those reported for denitrification in aquatic ecosystems, suggesting a consistent response across soil and marine sediment environments. This consistency facilitates future model simulations and predictions of denitrification response under global warming.

In particular, the researchers highlighted that N_2O, a potent greenhouse gas, would be further enhanced by warming, creating a positive feedback loop on climate change. Additionally, a warmer climate was found to promote more complete denitrification, leading to increased losses of soil gaseous nitrogen as N_2.

They emphasized that the loss of gaseous nitrogen and the resulting nitrogen limitation due to climate warming would likely further limit the primary productivity and carbon sink function of terrestrial ecosystems, as most forests are nitrogen-limited.

To assess the impact of global warming on forest soil gaseous nitrogen losses, the researchers used the ecosystem process model DyN-LPJ to simulate future global forest soil denitrification gaseous nitrogen release under different warming scenarios (SSP2-4.5 and SSP5-8.5). The model predicted an increase in N_2O and N_2 release rates by 2,100 under these scenarios.

In conclusion, this study provides important insights into the temperature sensitivity of N_2O and N_2 release from denitrification in forest soils and contributes valuable data to model simulations.

The results improve our understanding of the complex carbon and nitrogen coupling processes in forest ecosystems and their feedback mechanisms in the face of future warming.

More information: Haoming Yu et al, Universal temperature sensitivity of denitrification nitrogen losses in forest soils, *Nature Climate Change* (2023). DOI: 10.1038/s41558-023-01708-2

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