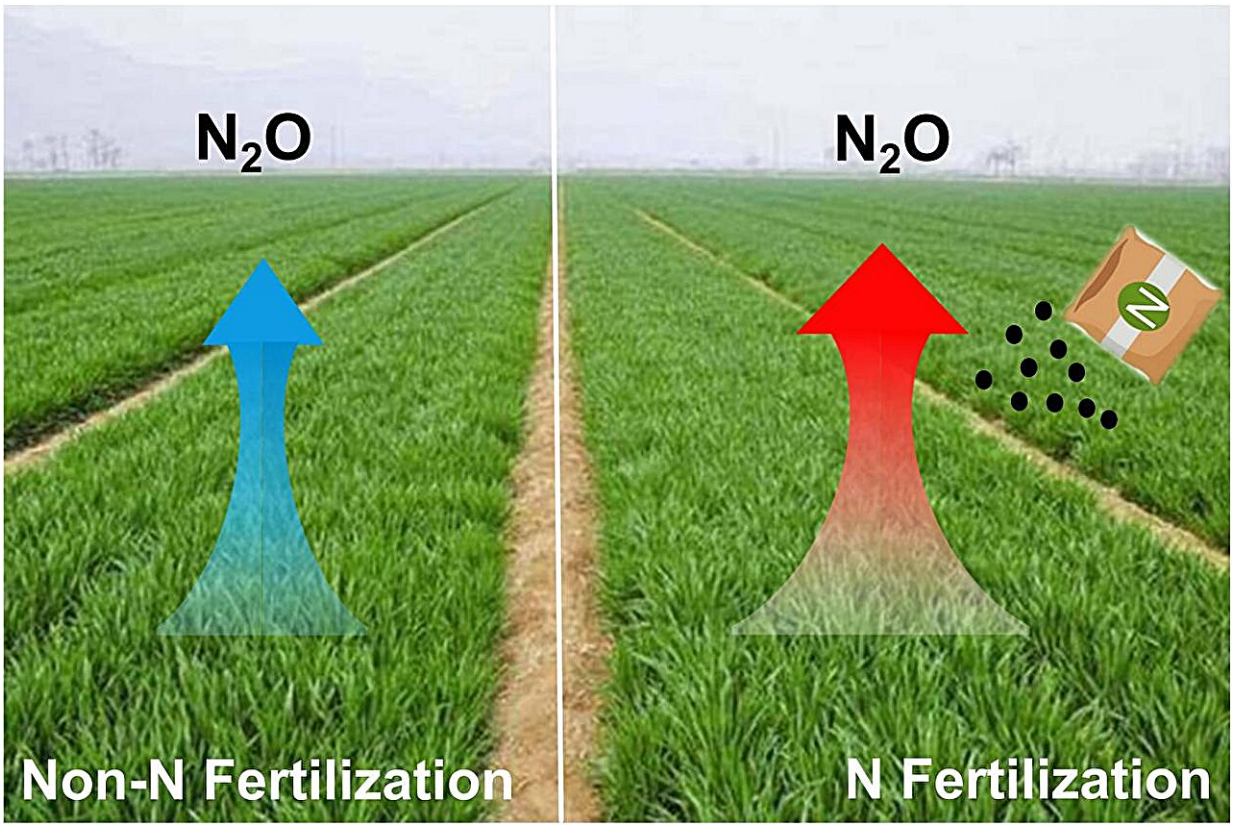
Study refines understanding of factors influencing global N_2O emissions from agricultural soils

August 2 2024



N fertilizer stimulated N_2O emission from agricultural soils, whose key influence factors vary under different climate conditions. Credit: Li Siqi

Global atmospheric N_2O concentration has surged by more than 23%

since the pre-industrial era, rising from 270 parts per billion (ppb) in 1750 to 336 ppb in 2022. Approximately two-thirds of these emissions come from nitrogen fertilizer-applied soils and natural soils. Key factors influencing N_2O emissions include climate, soil properties, and agricultural practices.

A team of researchers from various institutions in China and Germany has refined the hierarchical structure of these factors at a global scale. Their findings, published in *Advances in Atmospheric Sciences*, provide new insights into the main drivers of N_2O emissions from agricultural soils.

The team conducted correlation and structural equation modeling analyses on a global N_2O emission dataset to explore the influence of climate, soil properties, and agricultural practices on N_2O emissions from both non-fertilized and fertilized upland farming systems. Additionally, they performed variance partitioning analysis to identify the primary controlling factors in different climatic zones.

The study concluded that climatic factors, such as mean annual precipitation (MAP) and mean annual air temperature (MAT), are the principal influences on N_2O emissions from non-fertilized upland soils.

"In contrast, agricultural practices are the most influential factors for fertilized upland soils on a global scale," said Dr. Li Siqi, one of the corresponding authors and a researcher from the Institute of Atmospheric Physics (IAP) at the Chinese Academy of Sciences, "However, the key factors affecting N_2O emission intensity vary under different climate conditions."

For non-fertilized treatments, soil physical properties contributed most to N_2O emission intensity in the subtropical monsoon zone (23%), while climate factors (MAP and MAT) were dominant in the temperate

continental (22%) and monsoon (23%) zones.

For fertilized treatments, soil physical properties had the greatest impact in the subtropical monsoon (26%) and temperate continental (28%) zones, whereas agricultural practices were most significant in the temperate monsoon zone (17%).

"Our study also suggests that proper agricultural management practices, such as reducing nitrogen fertilizer rates combined with the addition of nitrification and urease inhibitors, can potentially mitigate N_2O emissions by more than 60% in upland farming systems," said Dr. Li Yong, also a corresponding author of the study.

More information: Wenqian Jiang et al, Refining the Factors Affecting N_2O Emissions from Upland Soils with and without Nitrogen Fertilizer Application at a Global Scale, *Advances in Atmospheric Sciences* (2024). DOI: 10.1007/s00376-024-3234-7

Provided by Chinese Academy of Sciences