

Nitrous oxide, a greenhouse gas, is on the rise: study

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Most of us know nitrous oxide as "laughing gas," used for its anaesthetic effects. But nitrous oxide (N_2O) is actually the third most important long-lived greenhouse gas, after carbon dioxide (CO_2) and methane. Nitrous oxide is also one of the main stratospheric ozone depleting substances—and we are releasing more of it into the atmosphere than previously

thought, according to a new study published this week in *Nature Climate Change*.

"We see that the N₂O emissions have increased considerably during the past two decades, but especially from 2009 onwards," said lead scientist Rona L. Thompson from NILU-Norwegian Institute for Air Research. "Our estimates show that the emission of N₂O has increased faster over the last decade than estimated by the Intergovernmental Panel on Climate Change (IPCC) emission factor approach."

Increasing use of nitrogen fertilizers is leading to higher N₂O levels in the atmosphere

In the study, Thompson and scientists including Eric Davidson of the University of the Maryland Center for Environmental Science found that nitrous oxide in the atmosphere has risen steadily since the mid-20th century. This rise is strongly linked to an increase in nitrogen substrates released to the environment. Since the mid-20th century, the production of nitrogen fertilizers, widespread cultivation of nitrogen-fixing crops (such as clover, soybeans, alfalfa, lupins, and peanuts), and the combustion of fossil and biofuels has increased enormously the availability of nitrogen substrates in the environment.

"The increased nitrogen availability has made it possible to produce a lot more food," Thompson said. "The downside is of course the environmental problems associated with it, such as rising N₂O levels in the atmosphere."

Rate of increase has been underestimated

The study authors found that N₂O emissions increased globally to approximately 10% of the global total between 2000-2005 and 2010-2015. This is about twice the amount reported to the United

Nations Framework Convention on Climate Change based on the amount of nitrogen fertilizer and manure used and the default emission factor specified by the IPCC. The researchers argue that this discrepancy is due to an increase in the emission factor (that is, the amount of N₂O emitted relative to the amount of N-fertilizer used) associated with a growing nitrogen surplus. This suggests that the IPCC method, which assumes a constant emission factor, may underestimate emissions when the rate of nitrogen input and the nitrogen surplus are high.

From scientific methods to practical measures

"This new publication demonstrates both how we can solve a problem of growing greenhouse gas emissions and how current efforts are falling short in some regions of the world," said co-author Eric Davidson of the University of Maryland Center for Environmental Science. "These emissions come primarily from using fertilizers to grow food and increasing livestock herds, but we've learned how to produce more food with less nitrous oxide emission."

"In Europe and North America, we have succeeded in decreasing growth in nitrous oxide emissions, an important contributor to climate change and stratospheric ozone depletion," he added. "Unfortunately, the same can't be said for Asia and South America, where fertilizer use, intensification of livestock production, and the resulting nitrous oxide emissions are growing rapidly.

"The good news is that this problem can be solved, but the less good news is that it will take a global effort, and we are far from there yet," he said.

"Acceleration of global N₂O emissions seen from two decades of atmospheric inversion" was published in *Nature Climate Change*.

More information: Thompson, R.L., Lassaletta, L., Patra, P.K. et al. Acceleration of global N₂O emissions seen from two decades of atmospheric inversion. *Nat. Clim. Chang.* (2019) [DOI: 10.1038/s41558-019-0613-7](https://doi.org/10.1038/s41558-019-0613-7)

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