Data from: Nitrous oxide (N2O) emissions from subsurface soils of agricultural ecosystems

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Date Published: April 3, 2019

DOI: https://doi.org/10.5061/dryad.c6c4bt8

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Funding	National Science Foundation (United States), grant number 1027253; 1637653
Pageviews	19
Keywords	greenhouse gas emissions, agriculture, subsurface N2O production, N2O concentration profile, N2O diffusion, soil subsurface
Scientific Names	Medicago sativa, Zea mays, Populus sp.
Spatial Coverage	midwest US, southwest Michigan, Kellogg Biological Station (KBS), KBS Long-term Ecological Research, KBS LTER Main Cropping System Experiment, KBS LTER Resource Gradient Experiment

Abstract

Nitrous oxide (N2O) is a major greenhouse gas and cultivated soils are the most important anthropogenic source. N2O production and consumption are known to occur at depths below the A or Ap horizon but their magnitude in situ is largely unknown. At a site in SW Michigan USA we measured N2O concentrations at different soil depths and used diffusivity models to examine the importance of depth-specific production and consumption. We also tested the influence of crop and management practices on subsurface N2O production in 1) till vs. no-till, 2) a nitrogen fertilizer gradient, and 3) perennial crops including successional vegetation. N2O concentrations below 20 cm exceeded atmospheric concentrations by up to 900 times, and profile concentrations increased markedly with depth except immediately after fertilization when production was intense in the surface horizon, and in winter, when surface emissions were blocked by ice. Diffusivity analysis showed that N2O production at depth was especially important in annual crops, accounting for over 50% of total N2O production when crops were fertilized at recommended rates. At nitrogen fertilizer rates exceeding crop need, subsurface N2O production contributed 25-35% of total surface emissions. Dry conditions deepened the maximum depth of N2O production. Tillage did not. In systems with perennial vegetation, subsurface N2O production contributed <20% to total surface emissions. Results suggest that the fraction of total N2O produced in subsurface horizons can be substantial in annual crops, is low under perennial vegetation, appears to be largely controlled by subsurface nitrogen and moisture, and is insensitive to tillage.

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