BRC Science Highlight
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Nitrous Oxide Fluxes Over Establishing Biofuel Crops: Characterization of Temporal Variability Using the Cross-Wavelet Analysis

Background/objective

Nitrous oxide (N_2O) emissions over agricultural lands are a major source of greenhouse gas (GHG) emissions. Precise N_2O accounting is essential to understanding GHG budgets and the spatiotemporal relationships between emissions and environmental variables. In this work, researchers use cross-wavelet analysis to probe the temporal relationship between N_2O flux and a suite of environmental variables over four different bioenergy cropping systems in the Midwestern United States.

Approach

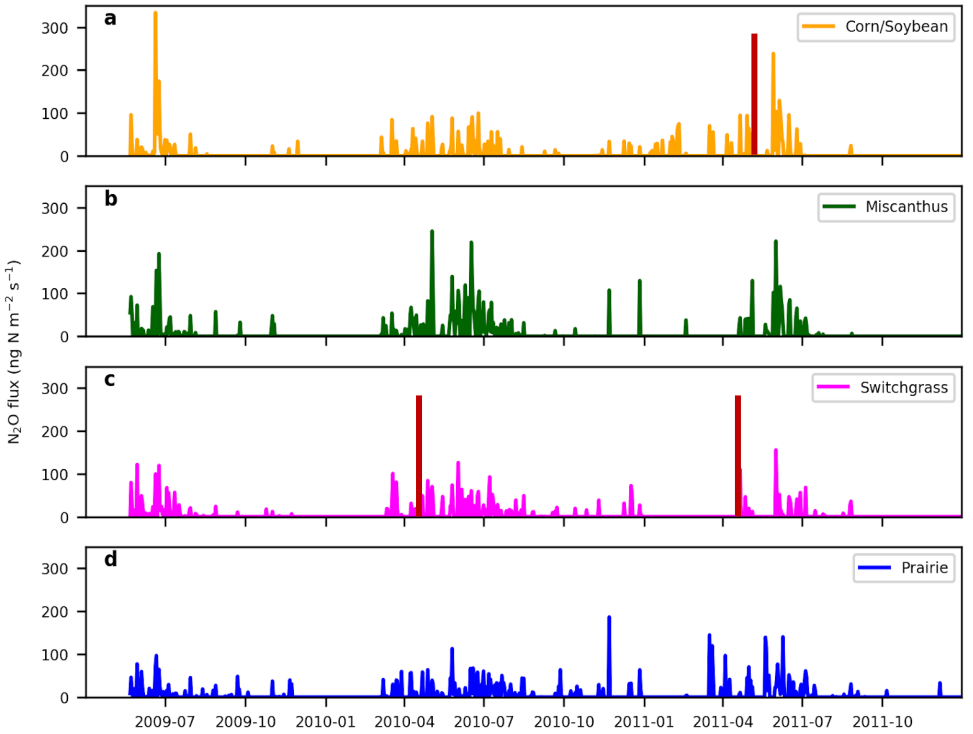
- N_2O fluxes were measured over four biofuel cropping systems in Central Illinois during their establishment phase between 2009 and 2011: maize-soybean rotation, miscanthus, switchgrass, and mixed native prairie plants.
- Cross-wavelet analysis was used to elucidate the relationship of N_2O flux with soil moisture and soil and air temperature.

Results

- Cumulative N_2O fluxes averaged 1.5 kg N ha^{-1} yr^{-1} and were associated with peaks in soil moisture and soil and air temperature, especially during spring and winter thaws.
- N_2O fluxes had significant temporal variance on a 4- to 32-day time scale, with delays of up to 8 days in the relationships between N_2O flux and environmental variables.
- Cross-wavelet patterns were similar between N_2O fluxes and all three environmental variables.

Significance

The temporal patterns of fluxes and environmental variables support emissions modeling and highlight the importance of considering timing of fluxes in relation to environmental variables. This increases understanding of the factors driving N_2O fluxes from biofuel crop fields and will inform management practices to reduce agriculture-associated GHG emissions.



Mean daily N_2O fluxes (ng N m^{-2} s^{-1}), for the plots of (a) maize/soybean rotation, (b) miscanthus, (c) switchgrass, and (d) prairie. Fertilization treatments marked with the red vertical bars. Measurements taken at the Energy Farm at the University of Illinois at Urbana-Champaign.

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