EVALUATION OF A MICROBIAL DENITRIFICATION MODEL IN THE ENVIRONMENTAL POLICY INTEGRATED CLIMATE MODEL

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BACKGROUND & OBJECTIVE

- Nitrous oxide (N₂O) is a potent greenhouse gas (GHG)
- Agriculture is the main contributor of global N₂O emissions
- Nitrous oxide emissions are strongly influenced by management including fertilization, tillage, and crop rotation
- Land management has a strong effect on N₂O fluxes
- The Environmental Policy Integrated Climate (EPIC) model is a terrestrial ecosystem model that models interactions between crop, soil, climate and management for assessing productivity and environmental impacts (Williams, 1995; Izaurralde et al., 2006)
- A microbial denitrification model was added to EPIC to model N₂O fluxes and their relationship with production system dynamics (Izaurralde et al. 2012)
- There is a need to evaluate the model against field measured data to assess its utility and provide feedback for model improvement

MODEL EVALUATION

- Evaluated EPIC against measurements from the Main Cropping System Experiment at the Kellogg Biological Station Long-Term Ecological Research Site in Southwestern Michigan (42°24'N, 85°24'W)
- Managed as a no-till corn-soybean-wheat rotation
- Replicated as six 1 ha plots
- Established in 1989
- Measurements included
  - Crop yield (annual)
  - Soil inorganic nitrogen in top 25 cm (1X or 2X monthly until ground is frozen)
  - Surface N₂O flux (1X or 2X monthly until ground is frozen)
  - Volumetric water content in top 25 cm (VWC; measured with soil nitrogen and N₂O flux samplings)
- Implemented a Particle Swarm Optimization algorithm (Zambrano-Bigiarini & Rojas, 2013) to optimize model parameters related to
  - Soil water balance
  - C/N cycling
  - Crop growth
  - Competitive inhibition by N oxides for electron acceptance

SUMMARY

- Dataset provides flux and ancillary measurements to assess core model components in a common crop rotation over a long time period
- Key components of soil water, soil nitrogen and yield are modeled adequately
- Modeling of N₂O follows seasonal trends and peaks, but does not show proper responsiveness to fertilization and wetting/drying trends
- Improvements will consider the impact of O₂ consumption during nitrification and nitrifier denitrification

RESULTS

<table>
<thead>
<tr>
<th>Date</th>
<th>Soil organic matter decomposition (%)</th>
<th>Denitrification (daily)</th>
<th>Nitrous oxide (g N ha⁻¹ d⁻¹)</th>
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RECENT WORKS

- Evaluation of the model against measured data to assess its utility and provide feedback for model improvement.

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REFERENCES


