

Measuring and Modeling Gaseous Losses of Nitrogen from Irrigated Crops in Central Washington

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Introduction and Relevance

- Irrigated crops like potatoes and corn receive high inputs of fertilizers (> 300 kg N ha⁻¹) in the Columbia Basin of Washington State (ca. ½ million ha).
- Coupled with the input of water, these N inputs set the stage for gaseous N losses from the soil (NH₃, N₂O, NO) and crop (NH₃).
- Information on the timing and quantity of these gaseous losses is lacking, and is relevant due to the role of both NH₃ and NO in photochemical ozone and aerosol production at a regional level, the role of N₂O as greenhouse, and because volatilization and denitrification imply a net loss of N from the soil-crop system.

Objectives

Measure and model the emission of gaseous losses of NH₃, N₂O, and NO from a high-input irrigated agroecosystem.

Methods

N₂O: Disjunct Eddy Accumulation and Static Chambers

NH₃ and NO: ultraviolet optical absorption spectroscopy (wavelength range 200 to 240 nm)



Figure 1. Disjunct eddy accumulation system for measuring N₂O flux and the UV differential optical absorption spectroscopy for NH₃ and NO measurements.

Preliminary Field Results

Concentration of NH₃ greater than background level in potatoes and corn fields (Fig. 2); flux not estimated yet;

Concentration of nitric oxide below detection level;

Flux of nitrous oxide was extremely low.

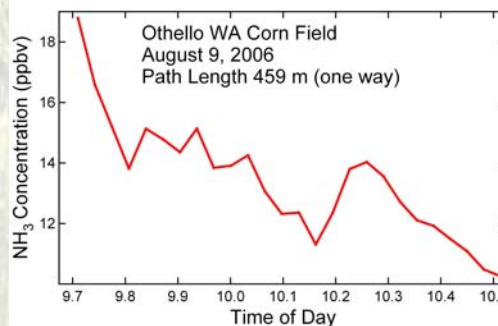
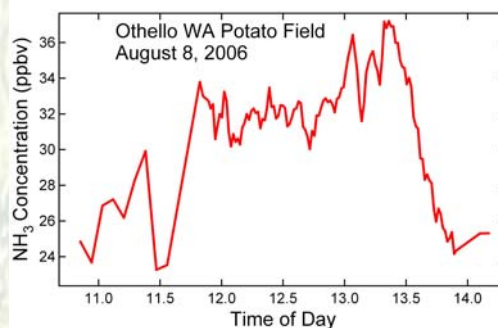


Figure 2. Ammonia concentration downwind of potatoes and corn fields 1 week after fertigation. Compare with background concentrations of < 5 ppbv.

Modeling

A crop/soil/atmosphere model was developed to evaluate soil and canopy emissions at a sub-hourly time-step. Main features are: (1) partitioning the canopy in sunlit and shaded fractions, (2) calculation of radiation interception by sunlit and shaded leaves, (3) computation of average sunlit and shaded leaves stomatal conductance (iteration), transpiration, and CO₂ exchange.

Currently working on estimating NH₃ compensation point (graduate student) to estimate NH₃ fluxes.

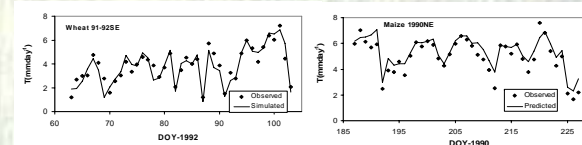


Figure 3. Validation of the canopy emissions model, simulation of transpiration for wheat and corn. Measured values were obtained with a lysimeter in Bushland, TX.

Current and Future Activities

- Include static chambers to verify N₂O low fluxes;
- Compute NH₃ fluxes based on the tracer method;
- Link modeled NH₃ compensation point and that obtained by inverting measured flux.

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