Modeling Nitrous Oxide Emissions from California Cropping Systems:
I. Methodology Development and Preliminary Results

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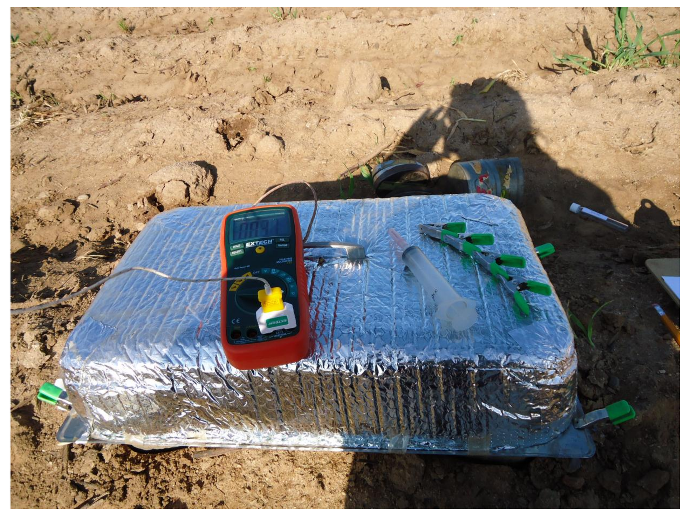
Introduction

•The effects of the anthropogenic increase in atmospheric greenhouse gases (GHGs) concentration on climate change are being widely debated
• Of the three biogenic GHGs (i.e., carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O)), N_2O is considered to be the most potent.
• The100 year global warming potential of N_2O is about 320 times as strong as that of CO_2.
•More importantly, N_2O concentration is increasing in the atmosphere at the rate of 0.6-0.9 ppbv per year.
•It has been estimated that in California, agricultural soils accounts for 64% of the total N_2O emissions.
•California's San Joaquin Valley (SJV) is among the major producers of cotton, forage and vegetables in the U.S.

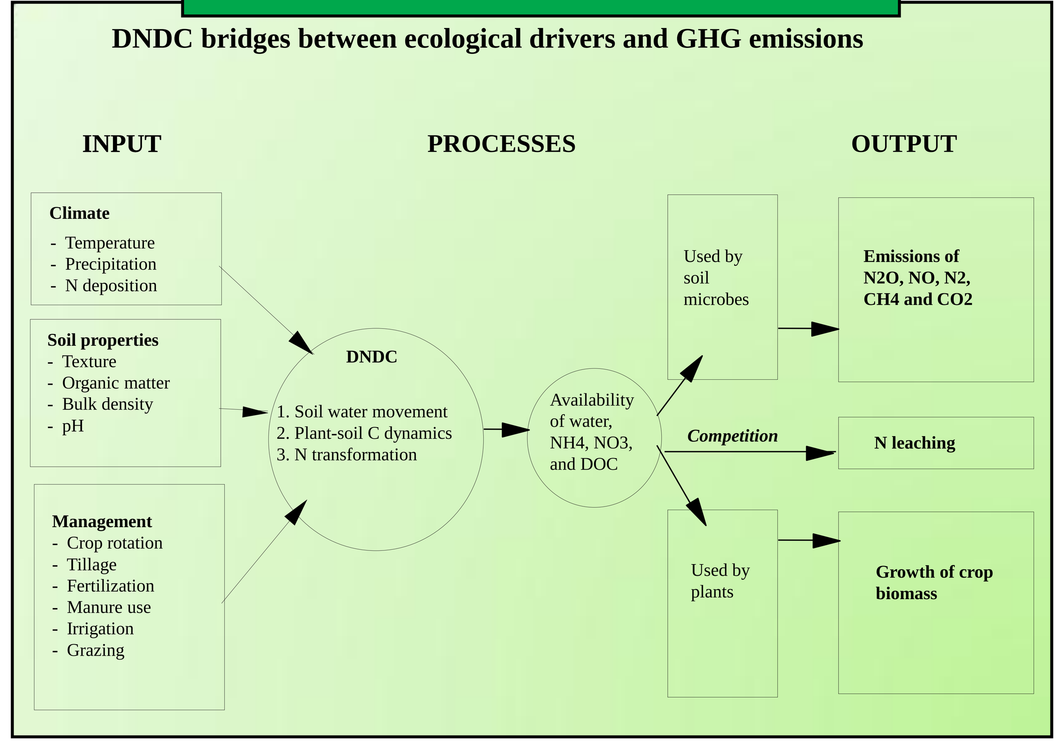
Objectives

This phase: To determine detailed time series of N_2O fluxes and underlying factors at crucial management events (irrigation, fertilization, etc.) in representative agroecosystems in Central Valley of California, using flux chambers.
Long term:
•Measure and determine parameters for calibration of the Denitrification-Decomposition (DNDC) model.
•To evaluate the potential of the (DNDC) model to predict N_2O emissions from California corn, cotton and tomato cropping systems.

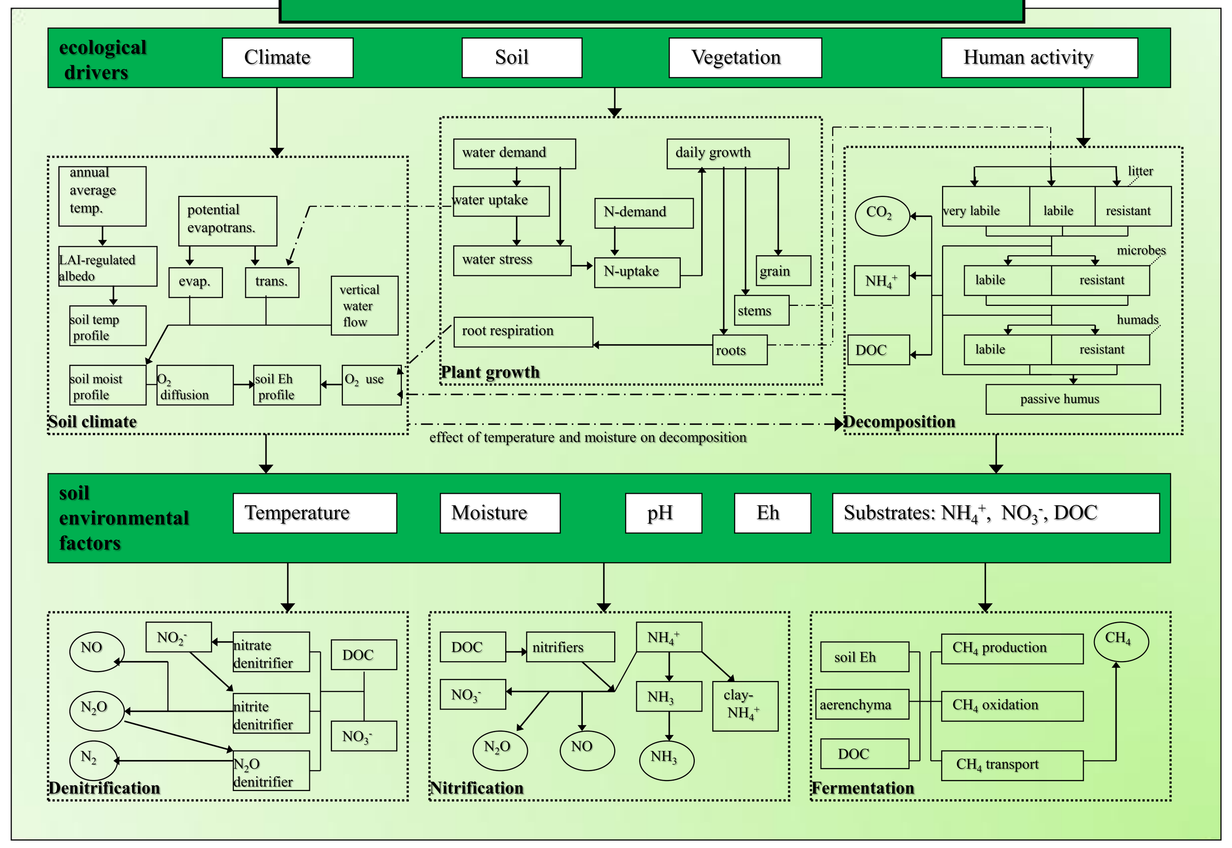


Photos of EPA approved flux chambers techniques being used in the field and the Gas Chromatograph (GC) used for nitrous oxide determinations in the laboratory.

Approach



The DNDC Model



Sampling Techniques

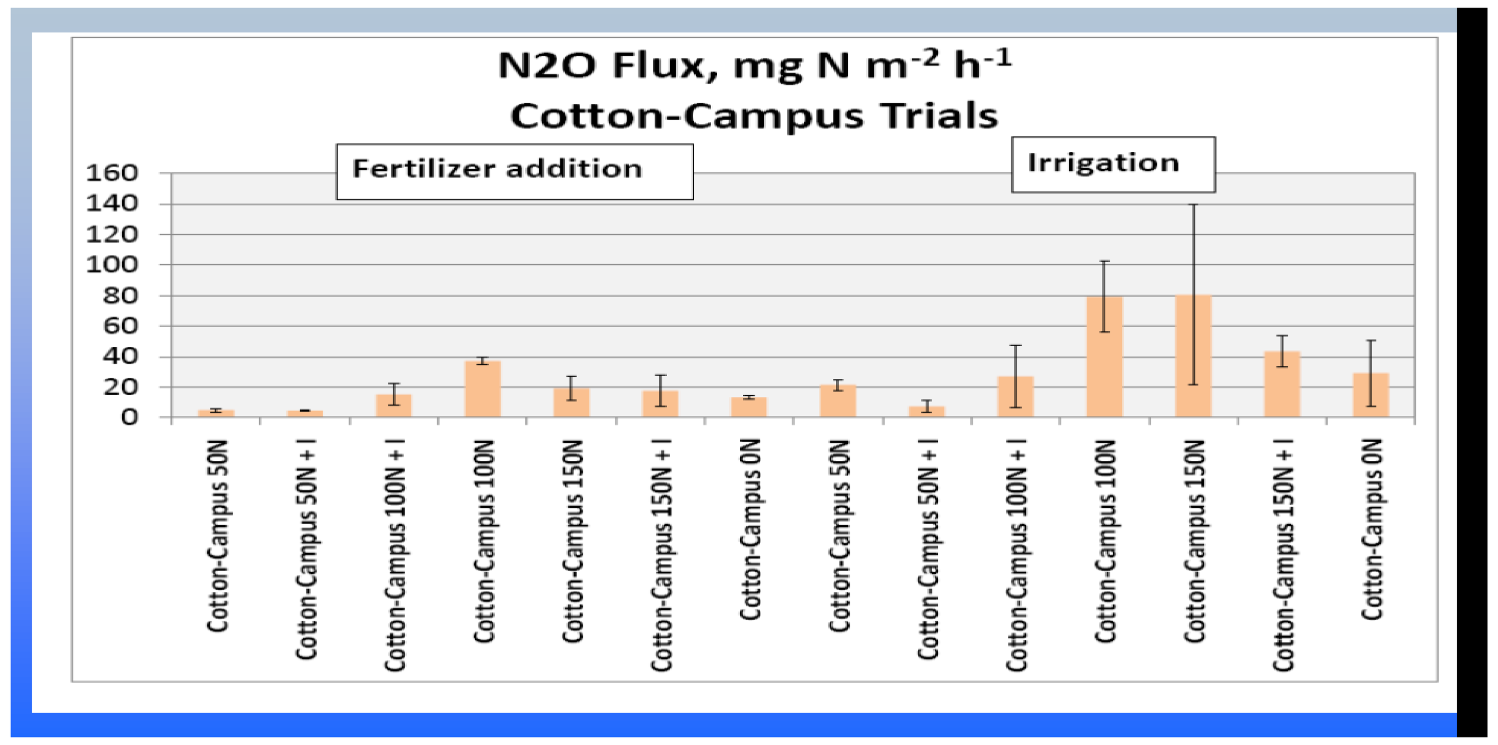
•Rectangular stainless steel chamber bases (50x30x8 cm) and tops (50x30x10 cm) covered with reflective insulating material.
•Chamber gas samples collected at 0, 20 & 30 min. and one ambient gas sample.
•20 mL gas sample with needle of a polypropylene syringe through sampling port and injected into evacuated 12 mL glass vials
•Soil moisture in addition to air temperature inside and outside the chamber during each gas sampling Gas samples analyzed (ppm data) using a Gas Chromatograph

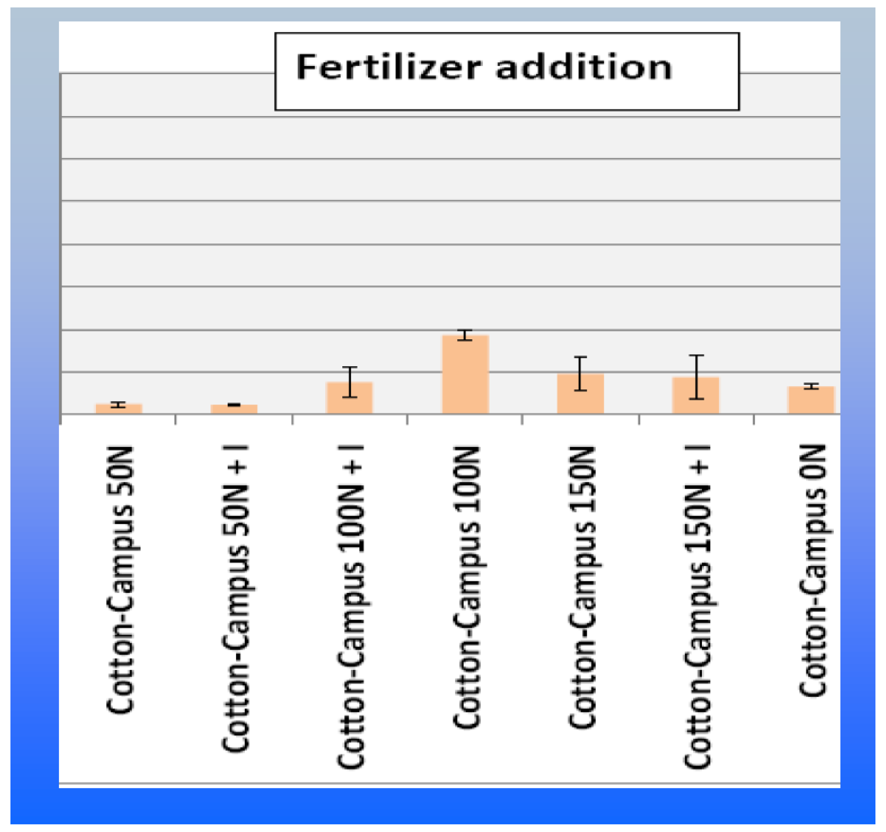
Sampling Events

•Tillage
•Fertilizer application
•Irrigation
•Rainfall

Preliminary Results

Refer to Figure 1:
•In a cotton field fertilized with UAN 32, N_2O fluxes ranged from less than 10 to 40 ug N/m²/h for plots receiving 50 to 100lbs N/acre, respectively.
• After an irrigation event, these fluxes increased to 20 to 80 ug N/m²/h.
•Nitrification inhibitor significantly reduced N_2O fluxes from 100 lbs N/acre treatment before and after irrigation event.
•Significant effect of nitrification inhibitor for 50 lbs N/acre after irrigation.





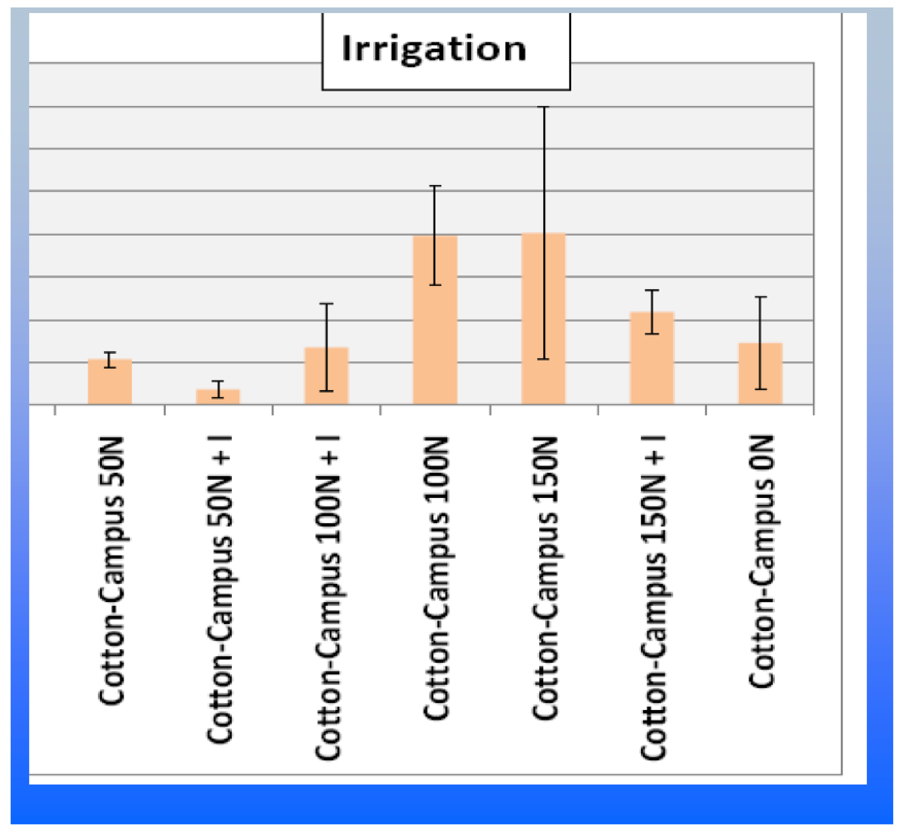


Figure 1:N_2O flux measurements obtained from cotton with various fertilizer treatments following irrigation events.

Future Work

• Calibration of the DNDC model
• Compare predicted and measured fluxes under varying fertilizer and irrigation regimes

Acknowledgments

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References

• Giltrap et al. (2010). "DNDC: A process-based model of greenhouse gas fluxes from agricultural soils." Agriculture, Ecosystems & Environment **136**(3-4): 292-300
• www.dndc.sr.unh.edu
• Babu, et al., 2006. Field validation of DNDC model for methane and nitrous oxide emissions from rice-based production systems of India. Nutrient Cycling in Agroecosystems 74, 157–174

Further Information

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