Measuring and Modeling Nitrous Oxide Emissions from California Cotton, Corn and Vegetable Cropping Systems

Project Leaders

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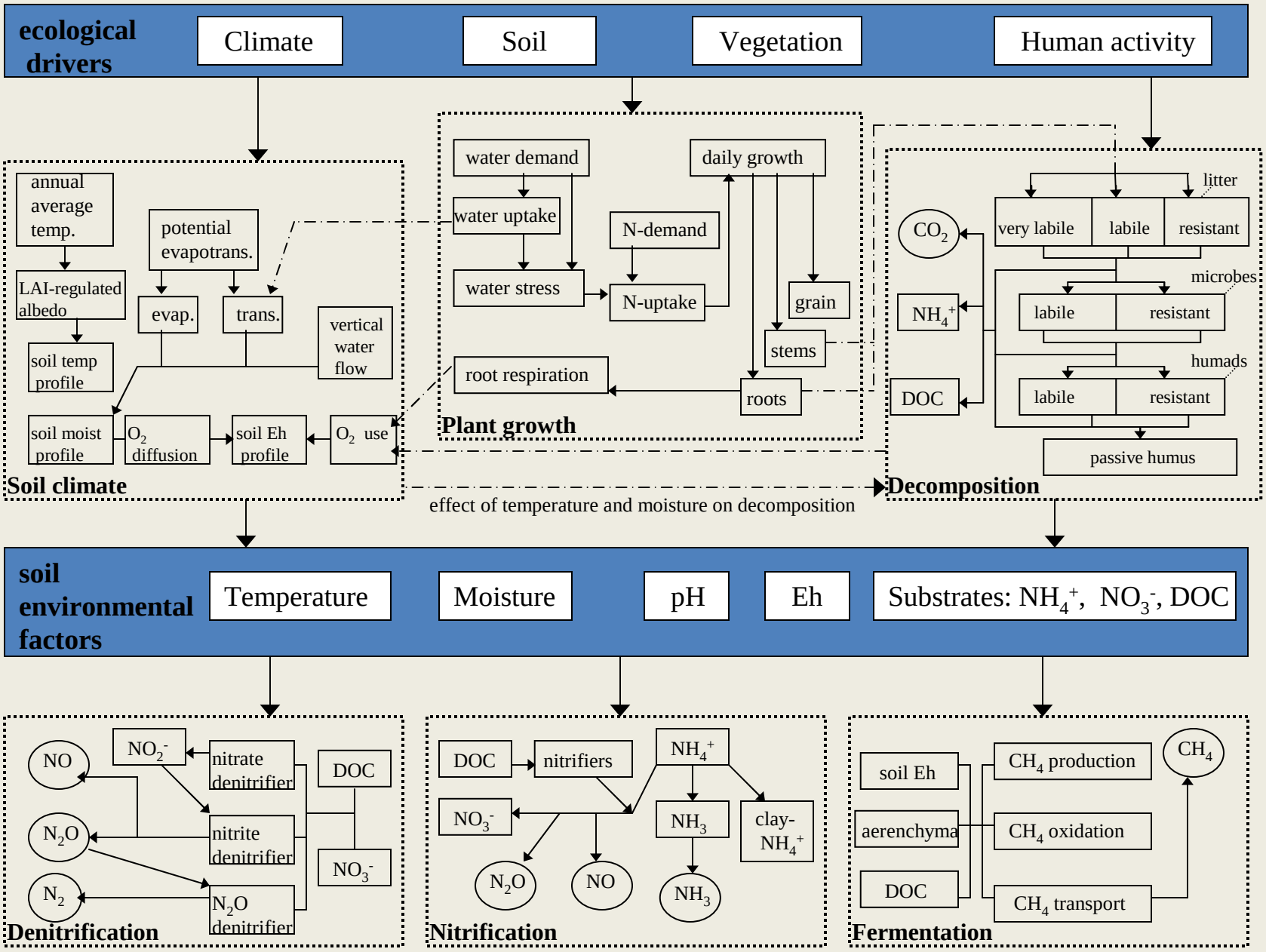
Complementary Project Proposals

- *"N2O Emissions from the Application of Fertilizers in Agricultural Soils"*; PI is Dr. Johan Six, 3-year project for $400,000) has been selected for funding by CEC PIER program
- "*Establish Baseline N_2O Emissions from Nitrogen Fertilizer use Based on Field-Derived California Specific N_2O Emission Factors*"; PI is Dr. Will Horwath, project for $300,000) has been submitted to ARB
- California State University - Agricultural Research Initiative. Matching funds will be requested from the ARI program. Funds will be used for expanding field measurements and model validation efforts.

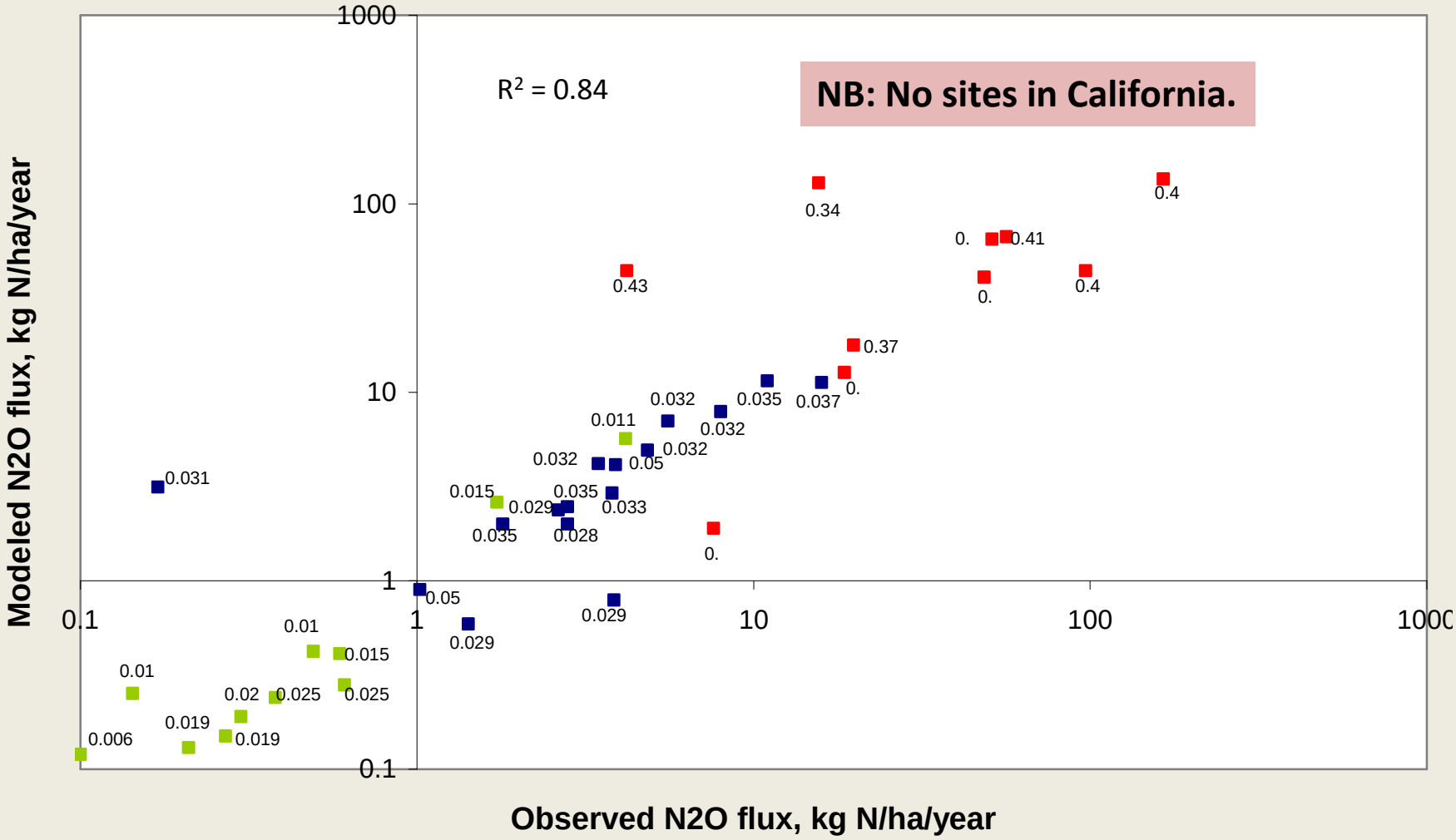
Project Objectives

- ✓ (1) determine detailed time series of N2O fluxes and underlying factors at crucial management events (irrigation, fertilization, etc.) in representative agroecosystems in Central Valley of California; and
- ✓ (2) use the intensive data on N2O fluxes to calibrate and validate processed based biogeochemical model (DNDC).

The DNDC Model



The DNDC model has been utilized for predicting N_2O emissions in the U.S., Canada, EU nations, Australia, New Zealand, Russia, China, Japan and India



Crop systems selected for N2O monitoring

	statewide acreage	Fertilizer range kg N/ac	Region	Project
corn	520,000	0-140	SJV	**FREP**
wheat	520,000	0-90	SV	CEC, ARB
cotton	560,000	30-120	SJV	**FREP**
tomatoes	280,000	50-120	SV	CEC, ARB
rice	526,000	0-200	SV	ARB
alfalfa	1,050,000	0 or 25	SV	CEC, ARB
Lettuce	210,000	50-150	Coastal	ARB
grapes	790,000	0-50	SJV, SV	CEC
almonds	585,000	20-160	SJV, SV	CEC

Final selection of cropping systems for monitoring will be done in collaboration With the CEC and ARB projects. There will likely still be gaps in data collection for Some important cropping systems in California. Additional resources will be Sought to fill in these gaps.

Approach

- FREP proposal uses the same set of field methods as the CEC and ARB proposed projects with the goal of covering major cropping systems and regions in a systematic and consistent fashion. While the three projects are designed in aggregate as one large joint project, each project is designed to succeed individually.

Proposed Tasks

1. *Select cropping systems for N2O field measurements.*
   - ✓ Convene an oversight committee for a meeting to discuss the selection of crops, define industry standard cultivation practices for each crop and design of our field trials.
   - ✓ Perform preliminary model simulations as part of the site selection process

Proposed Task cont.

2. Measure and calculate N2O emissions
   - ✓ Two replicate plots of each treatment will be sampled in each of the two growing seasons in corn and cotton.
   - ✓ N_2O flux will be measured daily in each microplot following fertilizer applications and irrigation or rainfall events.
   - ✓ measurements will be taken less frequently (weekly) when elevated N_2O flux has subsided and soils are relatively dry. We will collect at a minimum weekly emission data during periods without fertilizer applications.
   - ✓ Flux chambers will be used with fixed PVC rings.
   - ✓ Chamber headspace gas samples will be sampled and analyzed by a Photoacoustic Field Gas-Monitor 1412 (INNOVA AirTech Instruments)

Proposed Task cont.

2. Ancillary measurements.
   - ✓ Soil temperature will be measured during each gas sampling, and air temperature will be recorded at the local weather station.
   - ✓ Average soil moisture to a depth of 12 cm will be measured by time domain reflectometry.
   - ✓ Periodically (every three weeks) inorganic N to a depth of 15 cm will be determined in soil extracts, and pH will be measured in soil slurries.
   - ✓ Crop yields will be measured in each microplot. The amount of N needed to achieve maximum yield, i.e. the economic N yield, will be inferred from the N application rates and yield data.

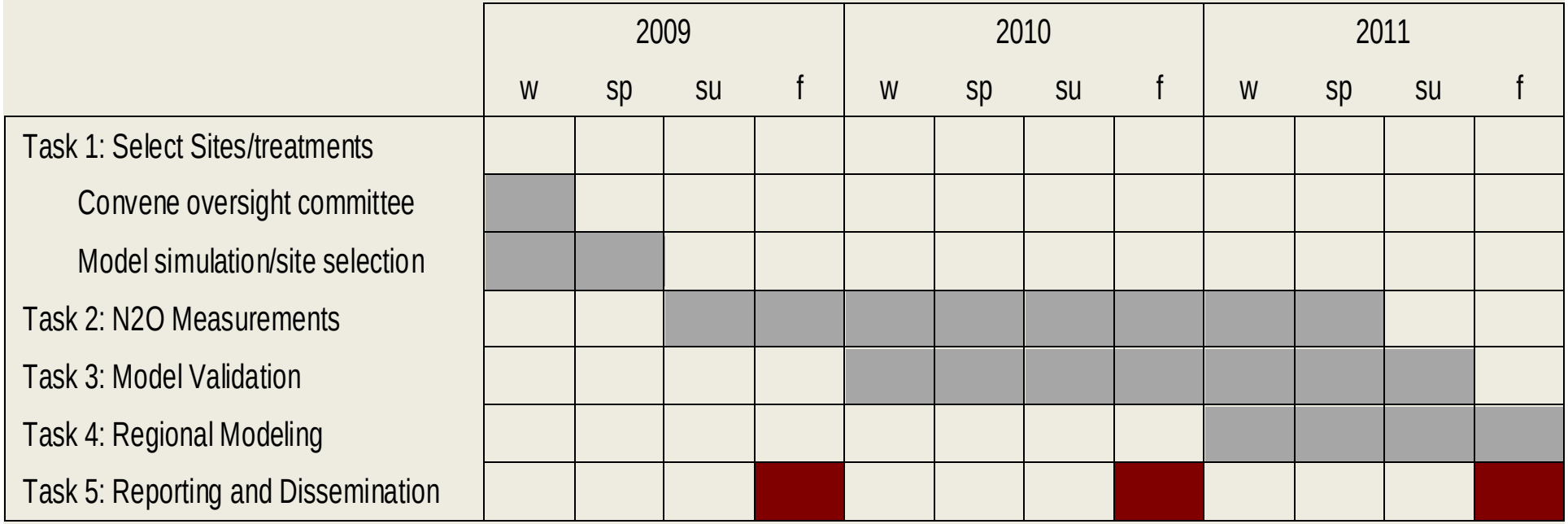
Proposed Task cont.

3. Validate DNDC model in three stages:
   - ✓ 1) test the model with no calibration (i.e., no new data collected in this project is used to calibrate the model),
   - ✓ 2) test the model with moderate calibration (i.e., 50% of the new data is used for calibration and the other 50% is left for validation) and
   - ✓ 3) test the model with extensive calibration (i.e., 75% of the new data is used for calibration and the other 25% is left for validation).

Proposed Task cont.

4. Run DNDC across range of corn and cotton systems in SJV.
   - ✓ GIS data (NRCS) on soils will be used to capture range of soil conditions
   - ✓ CIMIS data will be used for daily climate
   - ✓ DWR land use maps
5. Reporting and dissemination of results

Task Timeline and Milestones



……and Thanks.