California State Agencies Collaborative Research Project

Measuring and Modeling Nitrous Oxide Emissions from California Agricultural Lands

Agencies involved and their roles: The Air Resources Board, the California Department of Food and Agriculture, the California Energy Commission, and the California Department of Resources, Recycling, and Recovery (CalRecycle) collaborate on this project. The Air Resources Board, California Energy Commission, and California Department of Food and Agriculture projects aim to set a baseline for nitrous oxide (N_2O) emissions from soils for a variety of typical cropping systems, and to provide a scientific basis for N_2O modeling efforts. The CalRecycle portion of the project will investigate greenhouse gas emissions from the composting process and from the application of finished compost on agricultural land; both alone and in tandem with synthetic fertilizers.

Funding:

Air Resources Board:	$465,500
Department of Food and Agriculture:	$150,000
California Energy Commission:	$500,000
CalRecycle:	$450,000
Total:	$1.56 million

Background Information: N_2O has a global warming potential 296 times higher than carbon dioxide over a 100-year period. In 2005, a California Energy Commission Public Interest Energy Research program roadmap of research on greenhouse gases inventory methods identified N_2O emission from soils as a priority. Previous research on N_2O emissions from soils funded by the California Energy Commission Public Interest Energy Research program highlighted a need for sufficient field data for validation of modeled greenhouse gas emissions from soil due to the sporadic nature of the N_2O emissions. Improved and validated models are needed to estimate N_2O emissions from agricultural soils in order to improve the statewide inventory maintained by the Air Resources Board. In October, 2007 the Air Resources Board adopted an expanded list of early action measures to curb greenhouse gases that calls for collaborative research to understand how to reduce emissions of N_2O from agricultural lands. To carry out the measure, the Air Resources Board, California Energy Commission, the Department of Food and Agriculture, and CalRecycle are conducting extensive N_2O research.

Project description: The research goal is to ascertain baseline N_2O emissions from a variety of soil types, crops, and farming techniques used throughout California. The California Energy Commission project will take detailed, event-related (irrigation, fertilizer use) N_2O flux measurements at different spatial and temporal scales and integrate them with predictions of daily and seasonal N_2O emissions by biogeochemical models at wheat, tomato, alfalfa, grape and almond field sites in the Sacramento Valley. The Department of Food and Agriculture project will measure and model N_2O emissions from cotton, corn and vegetable cropping

systems in the San Joaquin Valley. The Air Resources Board project is assessing the baseline N_2O emissions of tomato, wheat, alfalfa, lettuce and rice in the Central Valley and the coastal area. The Air Resources Board is also funding two additional research projects looking at N_2O emissions in California's dairy farms, and NO_x emissions from California agricultural soils to improve ozone modeling. CalRecycle's research will attempt to determine what, if any, improvements over baseline conditions may be attained through application of compost to agricultural soils, and to quantify N_2O and methane emissions from the composting process itself in multiple soil types and crop systems. The impacts of compost use on N_2O and methane emissions from agricultural soils will be measured by using compost alone and in conjunction with the application of synthetic nitrogen fertilizers.

Research coordination: The combined research projects will investigate the complex relationships between soil, fertilizer, irrigation and N_2O emissions. The expected deliverables from these projects are a comparable, comprehensive, and robust set of field measurement datasets that will enable us to improve the greenhouse gas emissions inventory for California and to calibrate and validate emission process models for a wide variety of crops and sites. As indicated before, the different projects address different crops and/or research issues and complement each other. In addition to coordinating research activities among the state agencies, all of the agencies involved have worked hard to make the development of these research projects a transparent and open process. To this end, we have coordinated with the San Joaquin Valley Agricultural Technical Committee. This committee consists of growers, researchers, fertilizer industry representatives, and federal, state, and local government agencies. Quarterly stakeholder meetings have been held to address research priorities and technical issues, and discuss project updates.

Benefits to the state: N_2O emissions from the use of fertilizer in agricultural soils dominate the N_2O emissions from the agricultural sector but there is a high level of uncertainty in the emissions estimations. This uncertainty, which prevents growers from significantly capitalizing on reduction potentials, is mostly related to the scarcity of accurate N_2O flux estimates in agriculture. In California, for some of the most economically important cropping systems (e.g., alfalfa hay, tomato, vegetables, orchards, and vineyards), virtually no data is available for the calibration and validation of models used to predict N_2O fluxes. Therefore, there is a need to quantify annual N_2O emissions and their associated uncertainty at multiple spatial and temporal scales to determine actual emissions and to more realistically estimate the opportunities available to reduce N_2O emissions.

These projects will assist the State of California in compliance with AB 32 and will position the state and its important agricultural industry to participate in future state, national and international initiatives to reduce emissions of climate warming gases. In addition, the potential impact of compost use on N_2O emissions from agriculture has never been quantified. According to the Air Resources Board inventory, emissions of N_2O from California agricultural soil management resulted in roughly 8 million tons of CO_2 equivalent emissions in 2006, about 53 percent of all N_2O emissions in the State.