Made for this film: a fictional practice proposal, never submitted.

Project Summary

Overview

This Faculty Early Career Development (CAREER) project will determine how the depth, duration and sequence of field drainage in irrigated rice set the soil redox conditions that control methane and nitrous oxide emissions, and will turn that knowledge into a reflooding rule that growers can use. Alternate wetting and drying saves irrigation water and cuts methane, but it can raise nitrous oxide by amounts that vary more than tenfold between studies. The project measures soil redox potential, methane and nitrous oxide fluxes, and the expression of microbial functional genes together, at sub-daily resolution, through repeated drain and reflood cycles in a sixteen-plot field experiment, tests a redox-based reflooding rule at the research farm and on a commercial farm, and builds an education program around the low-cost chamber node the laboratory developed: a course module in which engineering students build and calibrate the node, a summer institute for rural science teachers, and a paid research pathway for undergraduates.

Intellectual Merit

The project tests whether the nitrous oxide cost of drainage depends mainly on how long the surface soil stays oxidized rather than on how deep the water falls, whether repeated wet–dry cycles shift denitrifying communities toward incomplete denitrification, and whether a rule based on measured redox time can keep most of the methane benefit of drainage while avoiding most of the nitrous oxide cost. It will produce the first data set in which redox, fluxes and gene expression are measured together through repeated drains in a working rice system, and the measured redox trajectories that process models of rice systems now lack.

Broader Impacts

The project will give growers, crop consultants and incentive programs a field-tested reflooding rule and an inexpensive, openly released instrument for applying it. About two hundred engineering students will build and calibrate the node in their course, thirty-two teachers from rural districts will bring local, real data on the carbon and nitrogen cycles to their classrooms, and ten undergraduates, many of them the first in their families to attend college, will be trained in field and molecular research. One doctoral student will be trained in research, teaching and outreach.