Geophysical Research Abstracts
Vol. 16, EGU2014-3172, 2014
EGU General Assembly 2014

Simulating N2O emissions from irrigated cotton wheat rotations in Australia using DAYCENT: Mitigation options by optimized fertilizer and irrigation management

Clemens Scheer (1), Stephen DelGrosso (2), William Parton (3), David Rowlings (), and Peter Grace ()

(1) Institute for Future Environments, Queensland University of Technology, Brisbane, QLD, Australia, (2) USDA-Agricultural Research Service, Natural Resources Research Center, Fort Collins, CO, USA , (3) Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, CO, USA

Irrigation and fertilization do not only stimulate plant growth, but also accelerate microbial C- and N-turnover in the soil and thus can lead to enhanced emissions of nitrous oxide (N_2O) from soils. In Australia there are more than 2 million hectares of agricultural land under irrigation and research has now focused on a combination of nitrogen fertilizer and irrigation management to maintain crop yields, maximize nitrogen use efficiency and reduce N_2O emissions. Process-based models are now being used to estimate N_2O emissions and assess mitigation options of N_2O fluxes by improving management at field, regional and national scales. To insure that model predictions are reliable it is important to rigorously test the model so that uncertainty bounds for N_2O emissions can be reduced and the impacts of different management practices on emissions can be better quantified.

We used high temporal frequency dataset of N_2O emissions to validate the performance of the agroecosystem model DayCent to simulate daily N_2O emissions from sub-tropical vertisols under different irrigation intensities. Furthermore, we evaluated potential N_2O mitigation strategies in irrigated cotton-wheat rotations in Australia by simulating different fertilizer and irrigation management scenarios over a climatically variable 25 year time span.

DayCent accurately predicted soil moisture dynamics and the timing and magnitude of high fluxes associated with fertilizer additions and irrigation events. At the daily scale we found a good correlation of predicted vs. measured N_2O fluxes (r^2 = 0.52), confirming that DayCent can be used to test agricultural practices for mitigating N_2O emission from irrigated cropping systems. The simulations of different fertilization and irrigation practices in cotton-wheat rotations over a 25 year time frame clearly showed that there is scope for reducing N_2O emissions by modified fertilizer and irrigation management. For wheat and for cotton the model predicted that a reduced fertilizer rate can sustain high yields but substantially reduce N_2O losses. These results emphasize the need for site and crop specific N management practices with increased N use efficiency to minimise N_2O emissions and maximise the economic benefits at the same time. Irrigation intensity had only a minor effect on N_2O fluxes, but a significant effect on yield with highest yields under the optimized irrigation scenario, which was in good accordance with the field data. Our simulations clearly show that the N_2O intensity (N_2O emitted per ton of yield) can be significantly reduced while maintaining high yields by an optimized irrigation and fertilization strategy. Regular irrigation when the available water content is depleted will help to optimize yield, while avoiding excessive applications of N fertilizer will significantly reduce N_2O losses.