

New Proposal:

From Inventory to Mitigation with DNDC

“Improving DNDC Modeling Capability to Quantify Mitigation Potential of Nitrous Oxide from California Agricultural Soils”

Jianguo Qi and William Salas, Center for Global Change and Earth
Observation, Michigan State University

Changsheng Li, University of New Hampshire

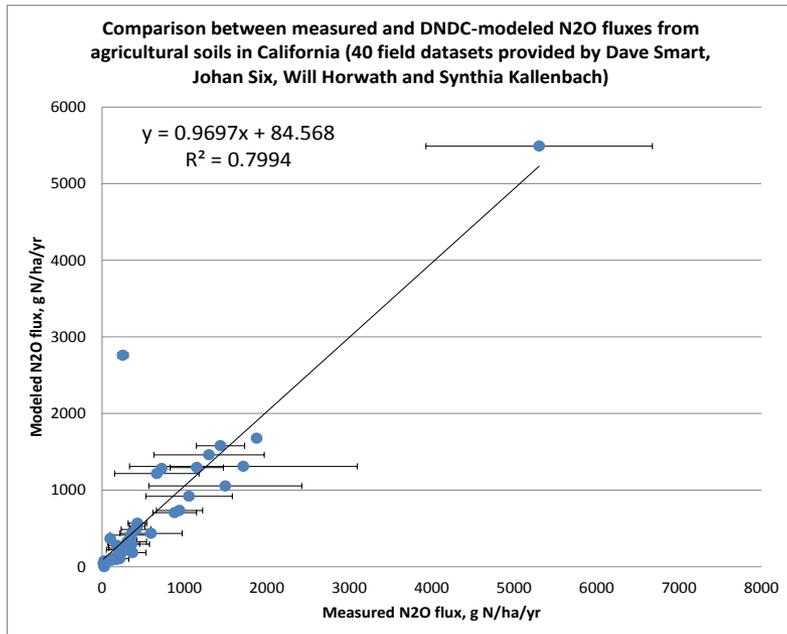
Rob Braswell, Applied Geosolutions, LLC

N₂O Stakeholders Meeting, January 29, 2014

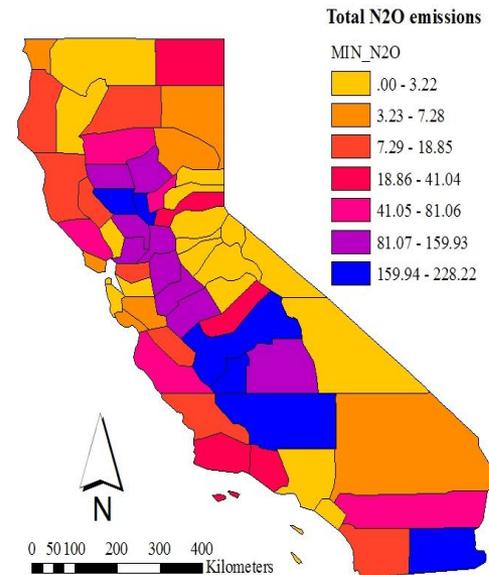
Background 1

During 2011-2013, sponsored by CA ARB, a process-based model, DNDC, was calibrated and validated against N₂O datasets measured by several groups of CA researchers (e.g., Horwath, Six, Amart, Kallenbach). The results indicated that DNDC is applicable for all the tested cropping systems across the state.

Comparison between measured and DNDC-modeled annual/seasonal N₂O emissions from CA crop fields



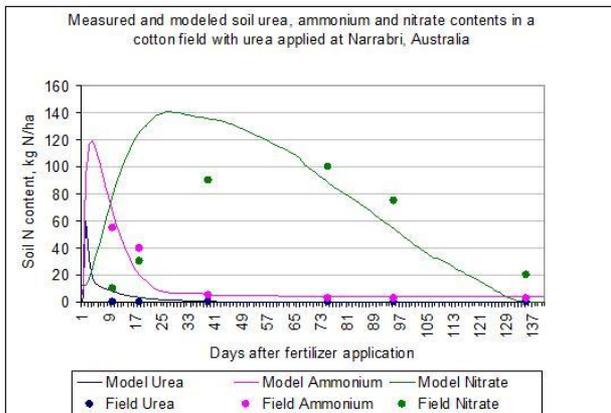
DNDC-modeled county-level N₂O emissions



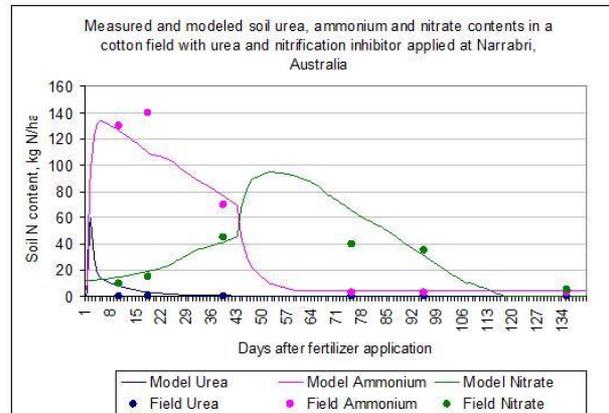
Background 2

Several alternative management practices (e.g., nitrification inhibitor, slow-release fertilizer, sprinkler and drip irrigation, fertigation) have been parameterized in DNDC and tested against field data reported by researchers in New Zealand, Australia and China with encouraging results.

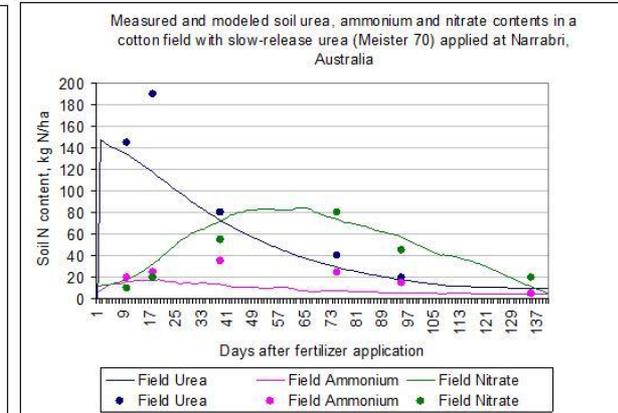
Normal urea



Normal urea with nitrification inhibitor



Slow-release urea



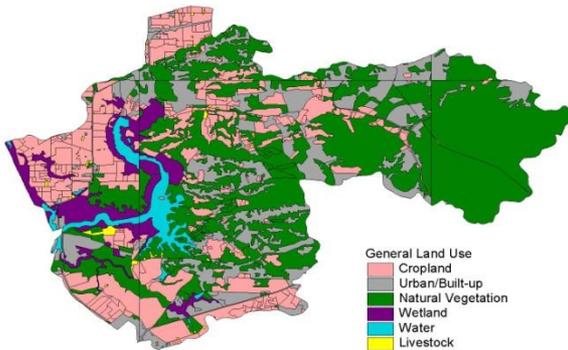
Soil ammonium and nitrate dynamics under different fertilizer management conditions in a cotton field in Narrabro, Australia (Li et al., 2014, in preparation)

Background 3

DNDC-database fused mitigation tools have been built up for small watersheds (e.g., Elkhorn Slough in CA, Old Woman Greek in OH etc.) during past years for testing their applicability. The protocol of interface can be referred for building large-scale tools.

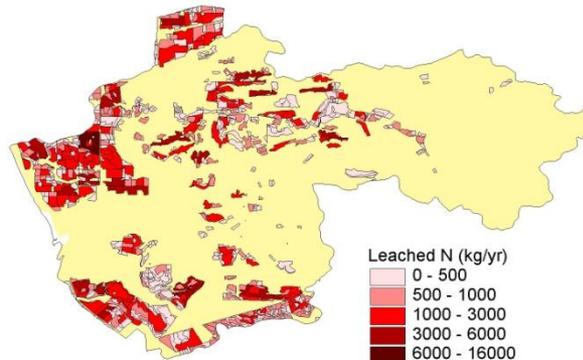
Land use database of Elkhorn watershed

General Land Uses in Elkhorn Slough watershed (Source: Calif. DWR)



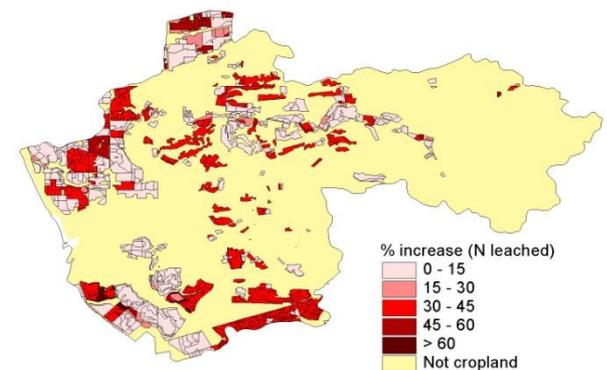
DNDC-modeled baseline N leaching loads

ES-DNDC Regional Mode Application -
Leached N (kg/yr) - baseline fertilizer application



DNDC-modeled increase in N leaching loads with doubled fertilizer rates

ES-DNDC Regional Mode Application -
% Increase of N leached (baseline vs. double fert. application)



Overall Tasks

Task 1: Refine DNDC by incorporating newly emerged field data and scientific findings of N₂O mechanisms (e.g., Zhu et al., 2013 in PNAS).

Task 2: Calibrate and validate of DNDC with targeted mitigation options such as nitrification inhibitor, slow-release fertilizer, fertigation with drip irrigation, etc.

Task 3: Enhance CA database by including detailed manure application, crop rotation, sub-county SSURGO data, etc.

Task 4: Develop CA-specific mitigation calculation interface with hard-coded linkage between DNDC and database for easy input access and post-simulation analysis.

Task 5: Run the mitigation model tool to quantify statewide mitigation potential with sensitivity and statistical analysis for uncertainty.

Task 6: Deliver the tool and train ARB staff for using the new mitigation model tool.

Project Outcome

- A DNDC based modeling system capable of quantifying N₂O emission reductions opportunities under a variety of crop specific management practices.
- Statistical quantification of DNDC model structural and database uncertainty for quantifying N₂O emission reductions.
- Modeling system will bolster the State's ability to address greenhouse gas mitigation strategies that are essential for meeting long-term climate change goals set forth by AB 32.
- ***Project timeline: October 2014 – September 2016***