American Carbon Registry "Tier 3" Methodology for N_2O Emission Reductions through Changes in Fertilizer Management

EPRI GHG Emissions Offset Workshop #11
Washington, DC
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WINROCK INTERNATIONAL

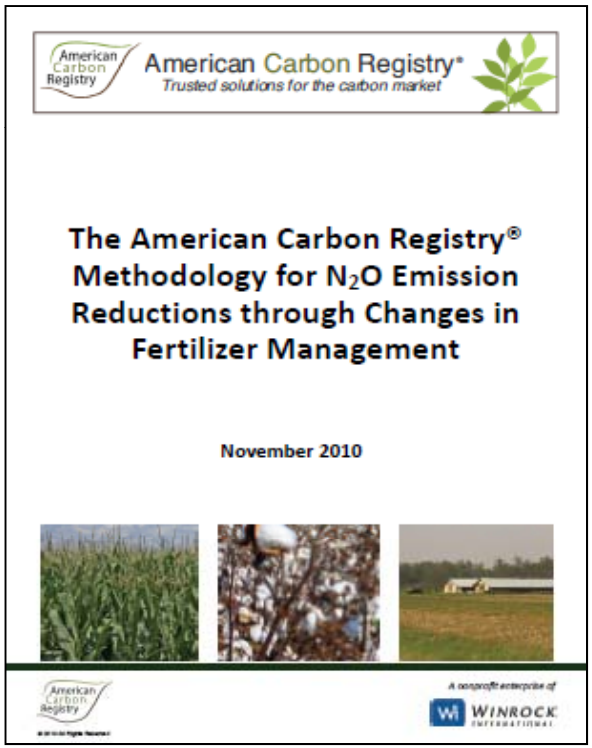
American Carbon Registry

Winrock International - American Carbon Registry

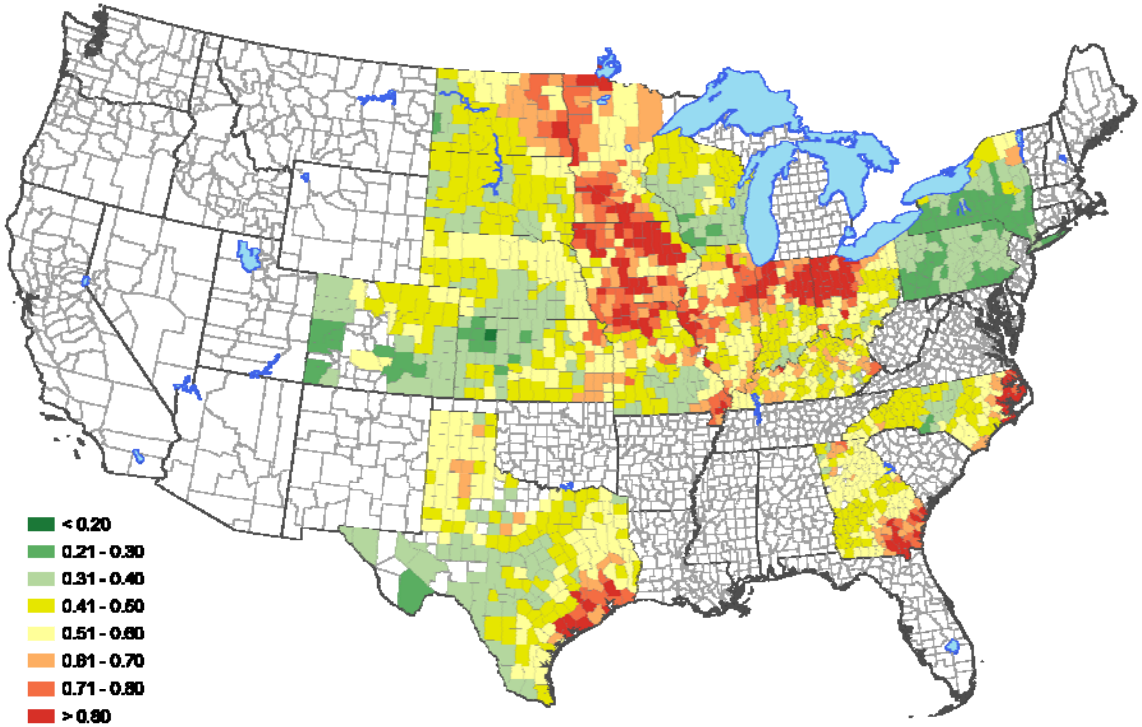
- Founded 1996 by Environmental Resources Trust
- 30 million tons issued to date
- Develop and approve protocols, oversee validation & verification, review and register projects, provide transparent tracking of transactions and retirements
- Part of Winrock International Institute for Agricultural Development
- In-house expertise in forest carbon, REDD+, agriculture and rangelands, international renewable energy, biofuels

N_2O reductions through changes in fertilizer management

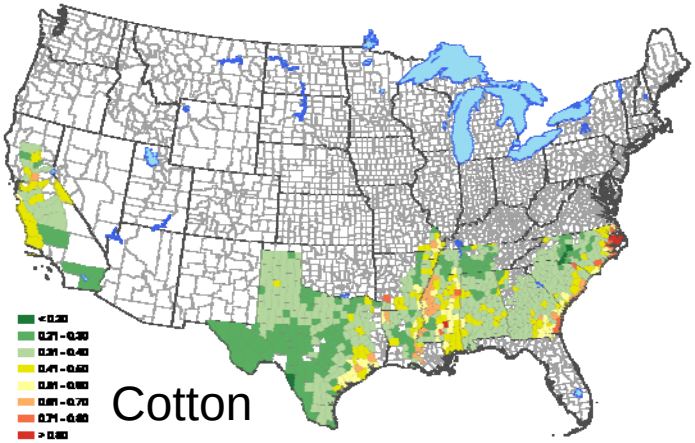
- Applicable to any modified fertilizer practice
  - Change fertilizer type, timing, placement, rate, use timed-release fertilizers, nitrification inhibitors, other advanced technologies, cover crops, etc.
- No geographic or crop constraints
- Uses DNDC to calculate direct N_2O emissions, and IPCC defaults for indirect N_2O from leaching and volatilization, for baseline and project



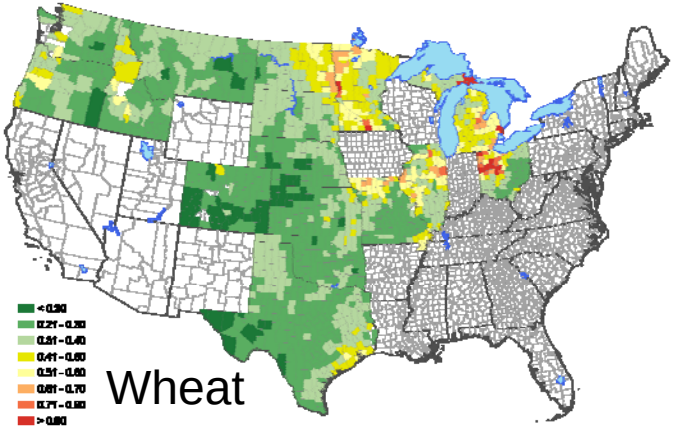
Spatial analysis of fertilizer emissions (3 crops and 3 main fertilizer types)



Corn



Cotton



Wheat

Emissions from anhydrous ammonia (tCO_2e/acre-yr)

Objectives

- Target significant, scalable, no reversal risk emission reduction opportunity
  - Environmental co-benefits, made in America flavor
- Scientific rigor for compliance markets
  - Process model to capture the site-specific and seasonal factors affecting N_2O emissions
  - Conservative approach; understand and mitigate uncertainty
- Wide applicability and flexibility for farmers
  - Practice neutral; can implement multiple changes
  - Enhance competitiveness -- revenue and cost, maintain yield, (reduce GHG emissions)
- "Stackable" with water and air quality benefits

Project boundary

- Physical: all participating fields
  - Aggregation likely
- Temporal: one year or longer
- GHG boundary:

Sources	Gas	Included / Excluded	Justification / Explanation of choice
Direct and Indirect Nitrous Oxide Emissions Resulting from Fertilizer Application	CO_2	Excluded	Not applicable
	CH_4	Excluded	Not applicable
	N_2O	Included	GHG emitted from fertilizer application
Emissions resulting from Fossil Fuel Combustion	CO_2	Included	GHG emitted from fossil fuel combustion
	CH_4	Included	GHG emitted from fossil fuel combustion
	N_2O	Included	GHG emitted from fossil fuel combustion
Emissions from fertilizer production	CO_2	Included	GHG emitted from production of urea and synthetic fertilizer

Baseline scenario and additionality

- Identify realistic and credible land use scenarios on project lands in absence of project
  - Continuation of pre-project fertilizer management (previous 5 years)
  - Project activity without registration as ACR activity
- Demonstrate additionality of project scenario via ACR three-prong test
  - Project activity surplus to regulations, not common practice, faces at least one barrier

DNDC model cal / val

- Plant growth impacts soil water, C and N regimes, which determine biogeochemical reactions affecting N_2O emissions
- Calibration parameters:
  - Maximum crop biomass (kg C/ha), Biomass fractions (grain, leaves + stems, roots), Biomass C/N ratio (grain, leaves + stems, roots), Total N demand to reach maximum production (kg N/ha), Thermal degree days (^oC), Water demand (g water/g dry matter)
- Use existing research, default values in DNDC crop library, or do own calibration
- Validation: comparison against measured fluxes

Which crops already calibrated and/or validated?

- 22 crops already calibrated and validated in DNDC
  - Corn, winter wheat, spring wheat, soybean, sugarcane, barley, oats, alfalfa, sorghum, cotton, rye, papaya, potato, beets, paddy rice, upland rice, peanut, rapeseed, tobacco, millet, sunflower, beans
- 19 vegetable, 3 fruit, and 4 other crops calibrated for specific cultivars
- Calibration/validation studies underway in California for:
  - Corn, wheat, cotton, tomatoes, rice, alfalfa, lettuce, almonds, grapes, broccoli
  - ARB using DNDC for agricultural GHG inventory and calibrating for 6 vegetable, 8 fruit/nut, and 6 field/seed crops
- Several crops calibrated by Agriculture Canada

California research on N_2O from agricultural soils

Project #	1	2	3	4	5	6	7
State Agency	ARB	ARB	ARB	CEC	CEC	CDFA	CalRecycle
Funding	$300,000	$82,000	$249,688	$500,000	$750,000	$150,000	$450,000
Title	Assessment of baseline nitrous oxide emissions in cropping systems	Assessment of baseline nitrous oxide emissions in 's dairy farms	Calibrating, validating, and implementing process models for CA agriculture greenhouse gas emission estimation	Nitrous oxide emissions from the application of fertilizers in agricultural soils	The potential of biochar soil amendments as a carbon sequestration method in agriculture	Measuring and modeling nitrous oxide emissions from CA cotton, and corn cropping systems	Evaluate nitrous oxide emissions from waste compost
Period	2009-2012	2010-2012	2011-2013	2009-2012	2010-2013	2009-2012	2010-2013
Investigator	Will Horwath	Will Horwath	Changsheng Li	Johan Six	Johan Six	Dave Goorahoo	Will Horwath
Affiliation	UC Davis	UC Davis		UC Davis	UC Davis	CSU	UC Davis
Crop	tomatoes, wheat, alfalfa, lettuce, rice	corn	N/A	wheat, tomatoes, alfalfa, vineyard, almonds	vineyard, almonds, tomatoes, corn	corn, cotton	tomatoes, almonds
Region	SV, SJV,	SJV	SV, SJV,	(SV)	SV, (SJV)	SJV	SV
N source	synthetic	synthetic, organic	synthetic, organic	synthetic	Synthetic	synthetic, organic	organic
Approach	field monitoring	field monitoring	modeling (DNDC, DAYCENT)	field monitoring, modeling	lab incubation, field monitoring	field monitoring, modeling	lab incubation, field monitoring
Sampling techniques	chamber/GC	chamber/GC	N/A	chamber/GC; Eddy covariance	mobile auto sampler	chamber/photo-acoustic gas monitor	chamber/GC; Eddy covariance
Sampling frequency*	event daily + nonevent weekly/biweekly	intensive events + nonevent biweekly	N/A	event 4/day + nonevent 10/season	intensive events	event daily + nonevent weekly	intensive events
Status	18-month data	sampling beginning spring, 2011	in planning	18-month data	on-going	sampling beginning May, 2011	preliminary data

Calculations (baseline and project)

- Direct N_2O from applied fertilizer + nitrate leaching loss + ammonia volatilization
  - 4,096 Monte Carlo runs
- Run *ex post* based on actual weather, precipitation, dates of management events
  - Baseline and project runs identical except for modified fertilizer practice
- Also include fossil fuel and fertilizer production emissions
- Formulas to calculate model structural uncertainty
  - Minimum of 10 fields reduces model uncertainty
  - More measurements (vs. default inputs) reduces uncertainty
  - Uncertainty deduction if total uncertainty > 10% of net ERs
- No leakage or buffer deduction

Testing in 3 CIG grants

- Delta Institute
  - Real-world testing of two fertilizer protocols in IL, MI and OK
  - Efficient aggregation, data management, V/V, registration
- Chesapeake Bay Foundation
  - Region-specific, user-friendly version of DNDC
  - Test N_2O benefits of soil testing/adaptive management, manure injection, and variable rate technology
- The Fertilizer Institute
  - Evaluate 4R nutrient stewardship for GHG offsets
  - Smart Nitrogen Application Program and Nitrogen Desktop
  - Test ACR, MSU, and Alberta protocols on corn/soy in IA and IL
- Additional work in New England and California

Fertilizer offsets for California market

- ARB voted to approve cap-and-trade regulation; offset supply short
- Strong interest in agricultural offset protocols
  - Potential supply… 0.5 MMT/y California, 20 MMT/y U.S.?
  - State has funded $2.5 million in research on N_2O from agricultural soils
- ACR fertilizer (and EDF rice) identified in ARB August 24 announcement as protocols under review for adoption in 2012
  - Early action / compliance offset protocol
  - Increases interest from investors/developers and potential revenues to farmers

Preliminary thoughts one year on…

- Science (field data and model cal/val) and protocols are strong and continue to expand
  - More cal/val expands scope and increases confidence
- Standardization possible but comes at a price
  - Performance standards for additionality
  - Run DNDC do derive EFs for different regions, crops, practices
  - Do cal/val up front and prescribe uncertainty adjustment
- User interface tools are needed
- On-the-ground demonstrations needed
  - Costs, benefits, risks, protocol usability, regulatory risk
  - Protocols evolve with producer feedback; regulators become more confident with real-world results

Further information

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