Rice Cultivation Project Protocol Workgroup Meeting #1

CLIMATE ACTION RESERVE

February 7th, 2011

Agenda

- Welcome and Introductions
- Workgroup Process
- Protocol Specific Discussion
- Overview of Environmental Defense Fund and California Rice Commission Project and DNDC Model
- Q and A
- Next Steps

Welcome and Introductions

Reserve Staff

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Workgroup

CLIMATE ACTION RESERVE

California Rice Commission

Carbon Solutions America

Deloitte Consulting

Environmental Defense Fund

ibLaunch Energy, Inc.

National Wildlife Federation

NRG Energy

Terra Global Capital

Trinity Carbon Management, LLC

University of California Cooperative Extension

U.S. Environmental Protection Agency

U.S. Department of Agriculture – Natural Resources Conservation Service

Open Development Process

- Transparency is an important principle
- Significant interest in agriculture workgroup involvement
- We are striving for completely open development process:
  - Each agriculture protocol has a website with meeting logistics
  - Background papers , slides, agendas, and other materials will be posted
  - Workgroup meetings will be open to the public in real time (listen-only)
  - After the meetings a video recording of webinars will be posted (if technically feasible)

Workgroup Goal and Objectives

- Develop a standardized approach for quantifying, monitoring and verifying GHG offsets from management practice changes that reduce methane emissions from rice cultivation in the U.S.
- Maintain consistency with or improve upon existing methodologies
- Ensure accuracy and practicality of projects

Workgroup Responsibilities

- Participate in all 4 workgroup meetings
  - 3 Conference calls planned, possibly 1 additional call (as needed)
  - 1 In-Person All-Day meeting in Los Angeles (Late April or Early May)
  - Possibly additional sub-group conference calls (as needed)
- Provide written comments on draft protocol and revised protocol
- Serve as a resource to Reserve staff throughout process

Staff Responsibilities

- Ensure protocol meets Reserve's standards and is aligned with Reserve's principles
- Lead and facilitate workgroup discussions
- Direct research of contractor to maximize support for protocol development
- Maintain transparent development process with workgroup and other stakeholders
- Draft protocol, including verification guidance
- Respond in writing to written public comments on protocol
- Integrate new protocol into Reserve program
- Support implementation and feedback processes

Protocol Decision-Making

- Strive for workgroup consensus during protocol development
- Workgroup focuses on eligibility and additionality test development, quantification, monitoring, verifiability and practicality
- Climate Action Reserve has pre-defined program rules for certain protocol elements
  - Detailed in the Reserve Program & Verification Manuals
    - http://www.climateactionreserve.org/how/program/program-manual/

Protocol Development Timeline

Key Milestones/Meetings	Date
Kick-off Workgroup Meeting	February 7, 2011
PS Analysis and Recommendations Summary	Early March 2011
Workgroup Meeting #2 *To Discuss Scope, Performance Standard, and Eligibility Options*	Week of March 21, 2011
DNDC Uncertainty Analysis and Modeling Guidelines Summary	Early April 2011
1st Draft of Protocol to WG	April 27, 2011
Workgroup Meeting #3 (in person) *To review draft protocol*	Week of May 2, 2011
Work Group 1st Draft Comments Due	May 27, 2011
Workgroup Meeting #4 *To Discuss Public Draft*	Week of June 20, 2011
Public Comment Draft	July 1, 2011
30-day Public Comment Period	July – August 2011
Workgroup Meeting #5 (depending on need)	August 2011
Responses to Public Comment	August-September, 2011
Board Consideration of Final Draft	September 28, 2011

Concurrent Protocol Development

	Rice Cultivation	Cropland Management	Nutrient Management
WG kickoff meeting	February 7	February 9	April 2011
First Draft Protocol to WG	April 29, 2011	June 6, 2011	August 2011
Start of Public Comment Period	July 1, 2011	January 9, 2012	January 9, 2012
Consideration by Board	September 28, 2011	March 2012	March 2012

Standard Protocol Outline

Define the GHG reduction project	Section 2
Determine eligibility	Section 3
Establish the GHG assessment boundary	Section 4
Calculate GHG reductions – Baseline emissions – Project emissions	Section 5
Monitoring requirements	Section 6
Reporting requirements	Section 7
Verification guidance	Section 8

Geographic Scope

- At a minimum, the goal is to have a protocol for California, with a framework that will enable easy expansion into other rice growing regions

- California (Sacramento Valley):
  - –Unique cultivation practices due to climate
    - No ratoon crops, minimal rice straw burning, water/pest management techniques
  - –Data available for Performance Standard Analysis and determining baseline practices
  - –Successful DNDC modeling runs

- Other Regions (Gulf, Grand Prairie, Mississippi River Delta)
  - –Wetter/warmer climate results with different cultivation practices
    - Ratoon crops, water/pest management techniques
  - –Unknown data availability for P.S. analysis / baseline modeling
  - –No DNDC model validation

Potential Project Activities

- Methane reduction may occur due to changes in:
  - Water management
    - Drill (dry) seeding
    - Mid-season drainage
    - Minimizing or discontinuing practice of winter flooding
  - Residue management
    - Rice Straw Baling
    - Rice Straw Incorporation
  - Changes to rice variety
    - Rice varieties that require shorter flood periods
- Project activities may differ by region due to variations in common practices

Reserve Eligibility Criteria

I:	Location	→	California, with potential to expand to other U.S. Regions
II:	Project Start Date*	→	Project must submit no more than 6 months after project becomes operational *
III:	Additionality	→	Meet performance standard
		→	Exceed Legal Requirements
IV:	Regulatory Compliance	→	Compliance with all applicable laws
Crediting Period		→	10 years, renewable one time

*See Reserve's Program Manual for more detail on project start date policy:

Common Practices and Additionality

- Need to understand common practices in order to:
  - Develop performance standard(s) for additionality
    - Water and residue management
  - Model baseline emissions
    - Soil types, fertilizer application, water management, residue management, other cultivation practices

- Common practices vary regionally based on variety of rice, climate, and other factors

Additionality Test Development

- Examine regional trends, current practices, adoption rates, current and pending regulations, etc.

Key questions:

- What is common practice for each rice growing region:
  - Seeding, water management, residue management
- To what extent are lower methane management practices already utilized, and why?
- What data are necessary to determine common practices?
- Do existing or pending regulations require implementation of any potential project activities?

Quantification Challenges

- GHG emissions affected by:
  - Soil properties
  - Regional Climate
  - Water management
  - Residue management
  - Fertilizer use

- Complex interactions present challenges to GHG accounting

Quantification Options

- Emission Factors
  - Low accuracy
  - Do not capture site specific parameters or management conditions

- Monitoring/Measurement
  - Flux measurement:
    - Very costly on project-level basis

- Process Models (Deemed most viable option)
  - Provide ‘system’ based approach to quantification
  - Incorporates interactions between numerous parameters
  - Requires complex model validation and parameterization to produce accurate results

Key Questions - Quantification

- How does protocol address model uncertainty
- How can we minimize complexity for end-users
- Is data available to parameterize and validate model?
  - California: Yes
  - Other U.S. Rice Growing Regions: ?
- Can aggregation improve uncertainty and alleviate complexity and burden

Other Key Issues

- Leakage
  - What is the risk that activities will negatively impact crop yields (shifting production outside the project boundary)
  - Protocol will include measures to minimize risk and methodology to account for leakage
- Unintended impacts
  - Migratory bird habitats
  - Water quality/air quality
  - Weeds/pests
- Protocol ‘Usability’ and ‘Verifiability’

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EDF / CalRice Project Update

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- Belinda Morris –EDF
- Paul Buttner – CalRice
- Dr. William Salas – Applied Geosolutions
- Dr. Steven De Gryze – Terra Global Capital

Assessing GHG Emissions from CA Rice Agro-ecosystems using the DNDC Model

Presentation to CAR Rice Working Group

February 7, 2011

Dr. William Salas

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DNDC Model

DNDC stands for **D**e**n**itrification and **D**e**c**omposition, two processes dominating losses of N and C from soil into the atmosphere, respectively.

What are Process-based Models?

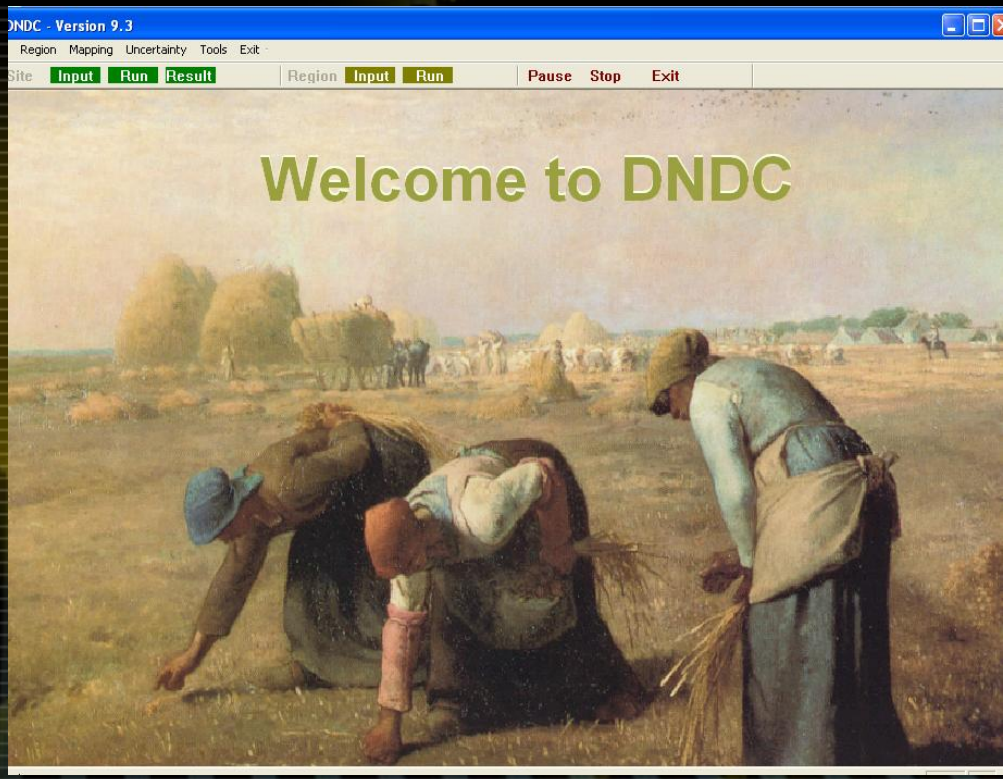
- Process-based modeling refers to biochemical and geochemical reactions or processes
- **Biogeochemical processes**… like decomposition, hydrolysis, nitrification, denitrification, etc…
- True process-based models **do not rely on constant emission factors**.
- They simulate and track the impact on emissions of varying conditions within soil and crop environment

Advantage of Process-based Models

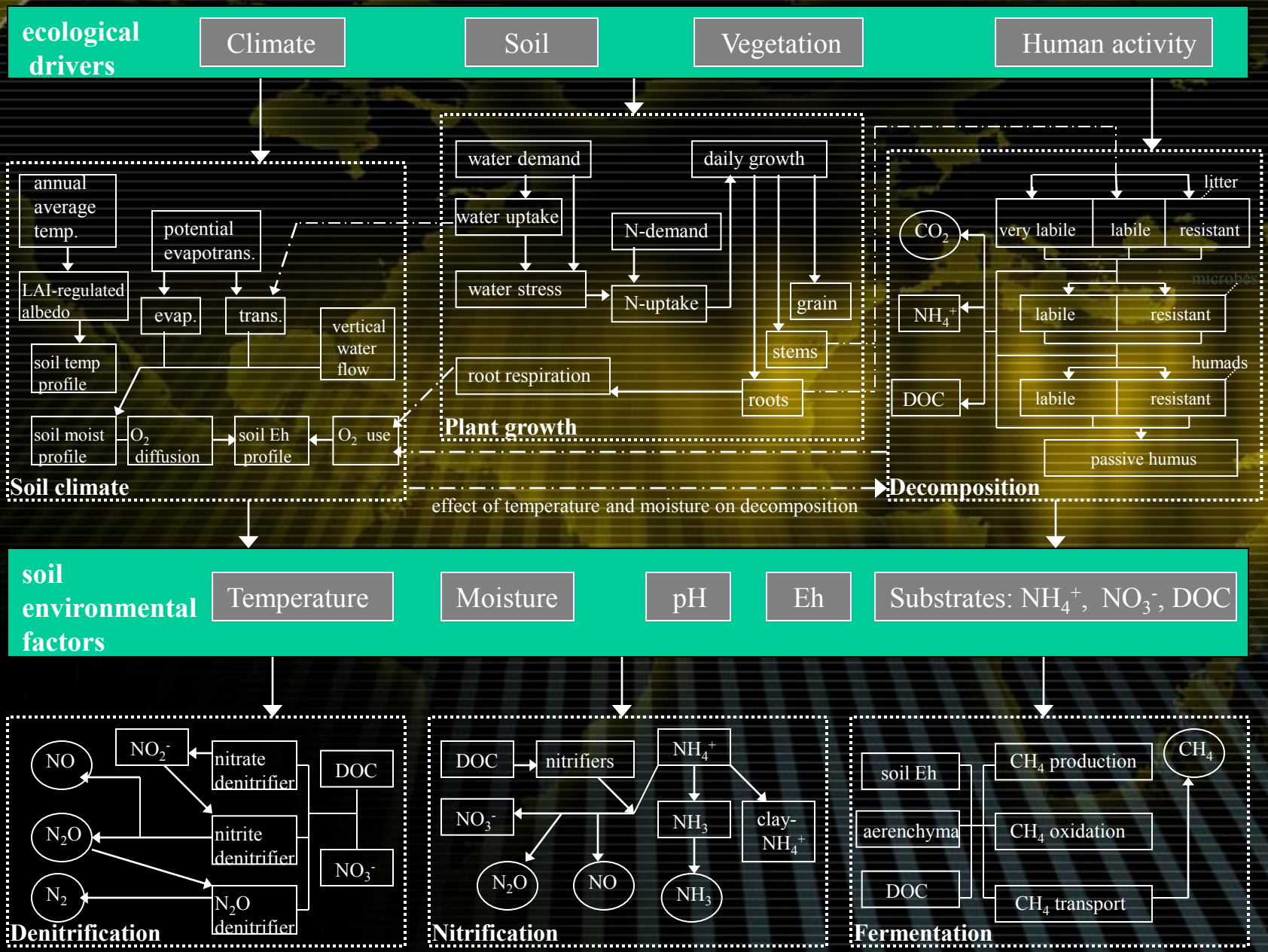
- Capture impact of soils on C and N cycling and GHG emissions
- Capture variability of weather/climate on C and N cycling
- Can be used to simultaneously assess impact of management practices on crop yields and GHG emissions
- Can be used to assess a wide range of ecosystems services (climate, food/fiber, air quality, water quality)

DNDC Biogeochemical Model Suite:

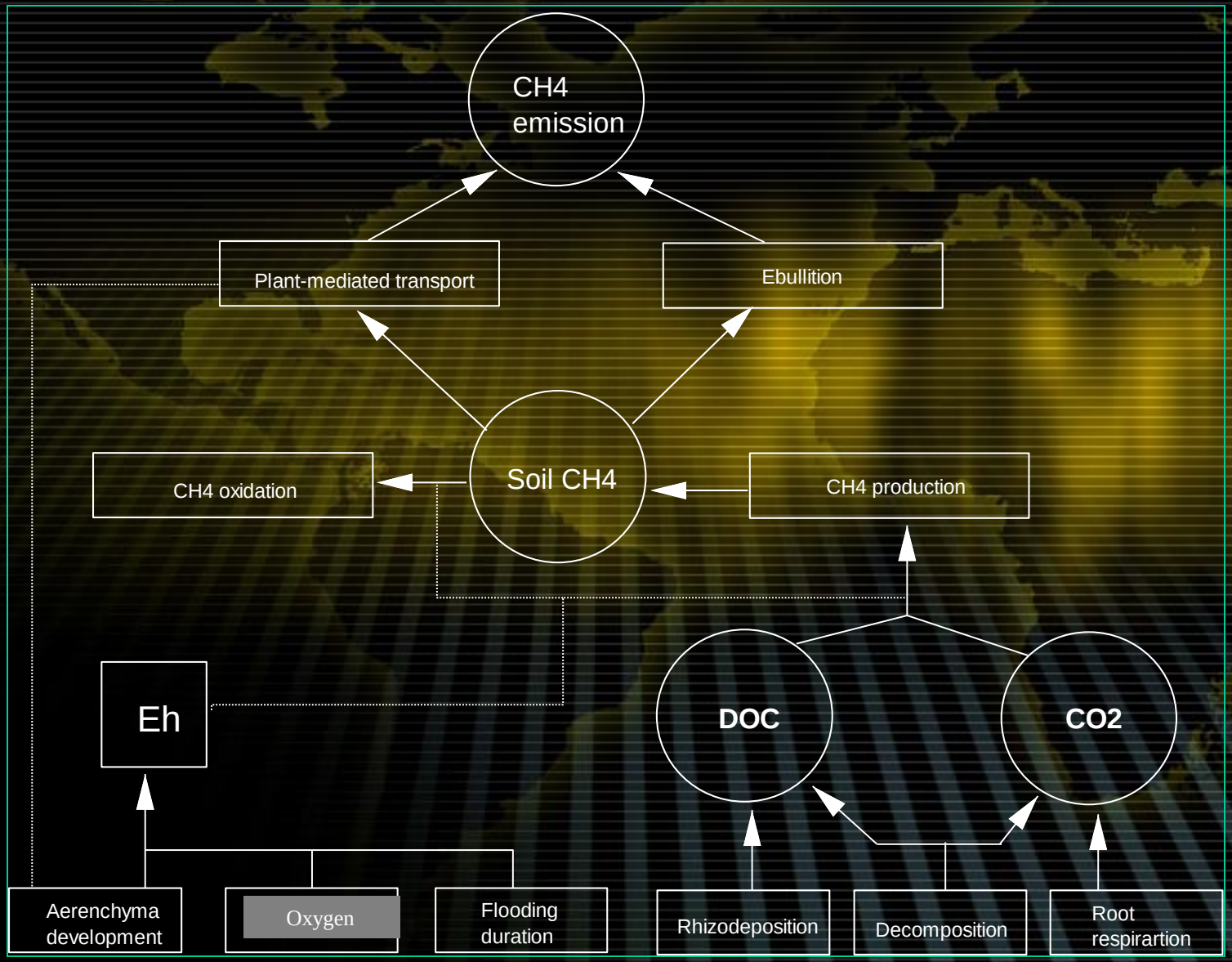
- DNDC
  - ✓ First model, development started in 1990
  - ✓ Initial focus on N2O
  - ✓ Focus on crop lands (>20 types of crops)
  - ✓ Models CO2, CH4, N2O, and crop growth/yields



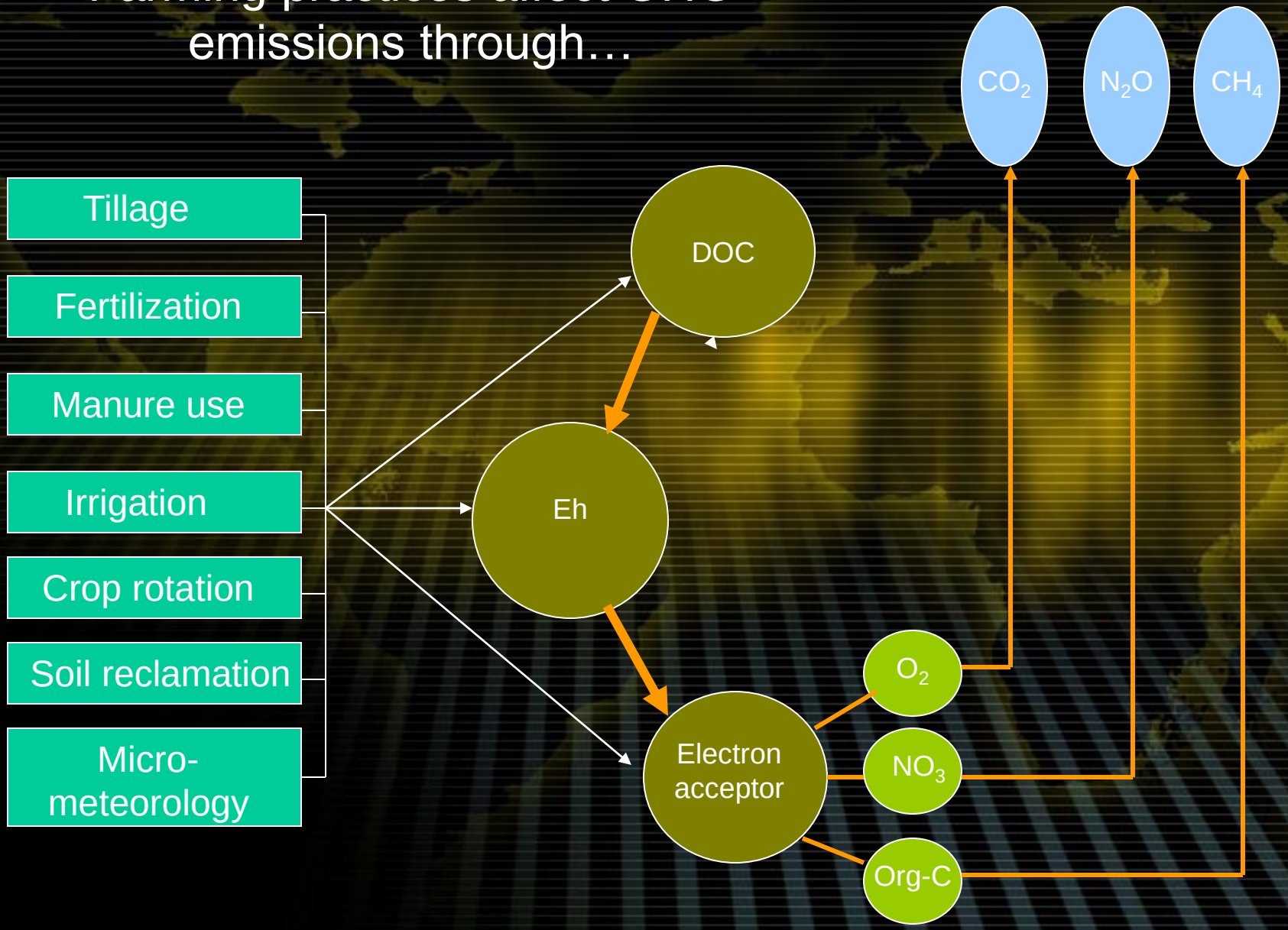
The DNDC Model



DNDC Modeling CH4 Emission from Rice paddies



Farming practices affect GHG emissions through…

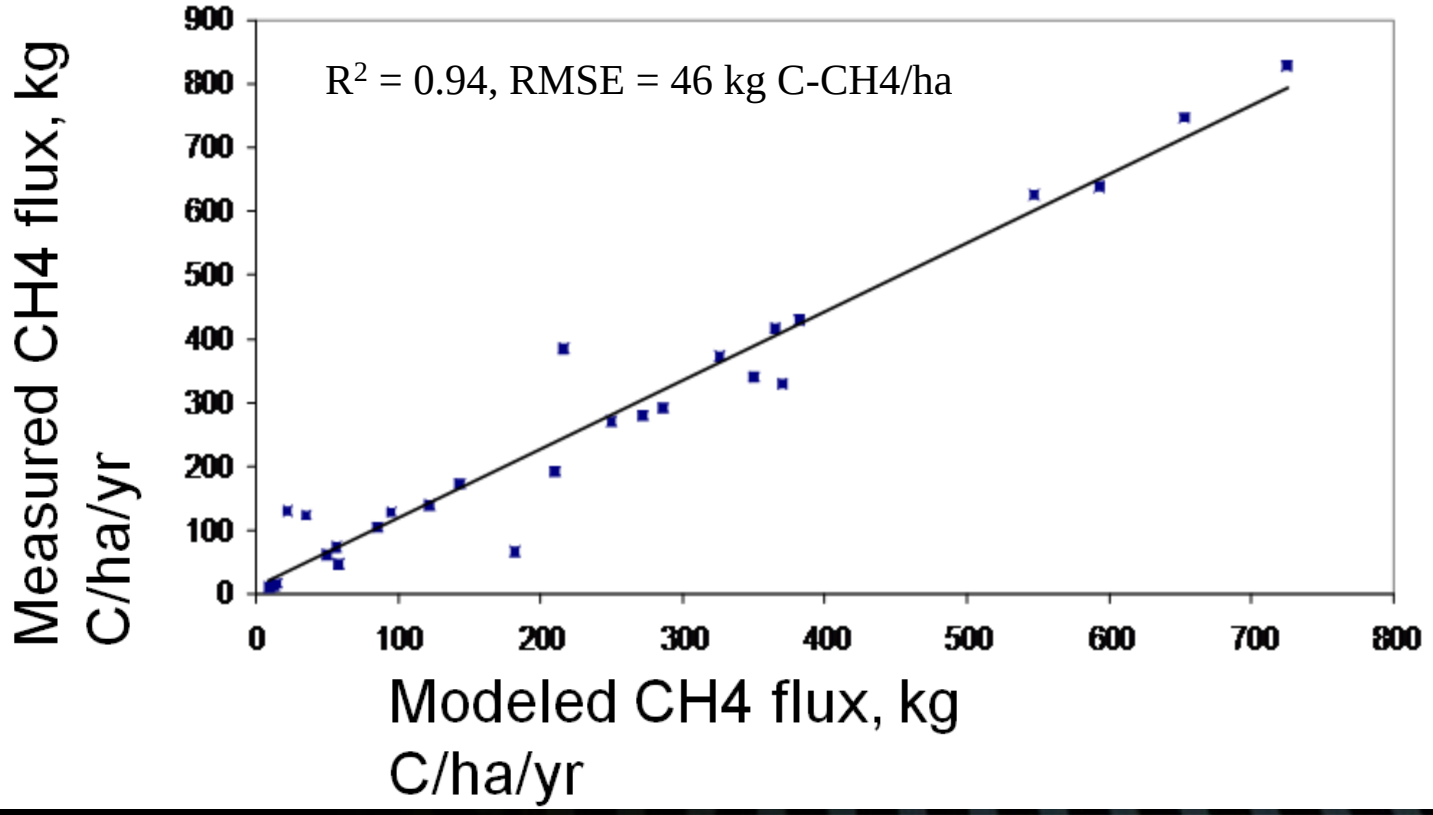


Model Validation…

- Rigorous model validation is key for acceptance (scientific and market)
- Lack of appropriate field data for process-model validation
- DNDC has been validated extensively for agroecosystems worldwide (over 100 peer review papers)
- Additional validation efforts underway for California cropping systems

CH4 Model Validation: Rice

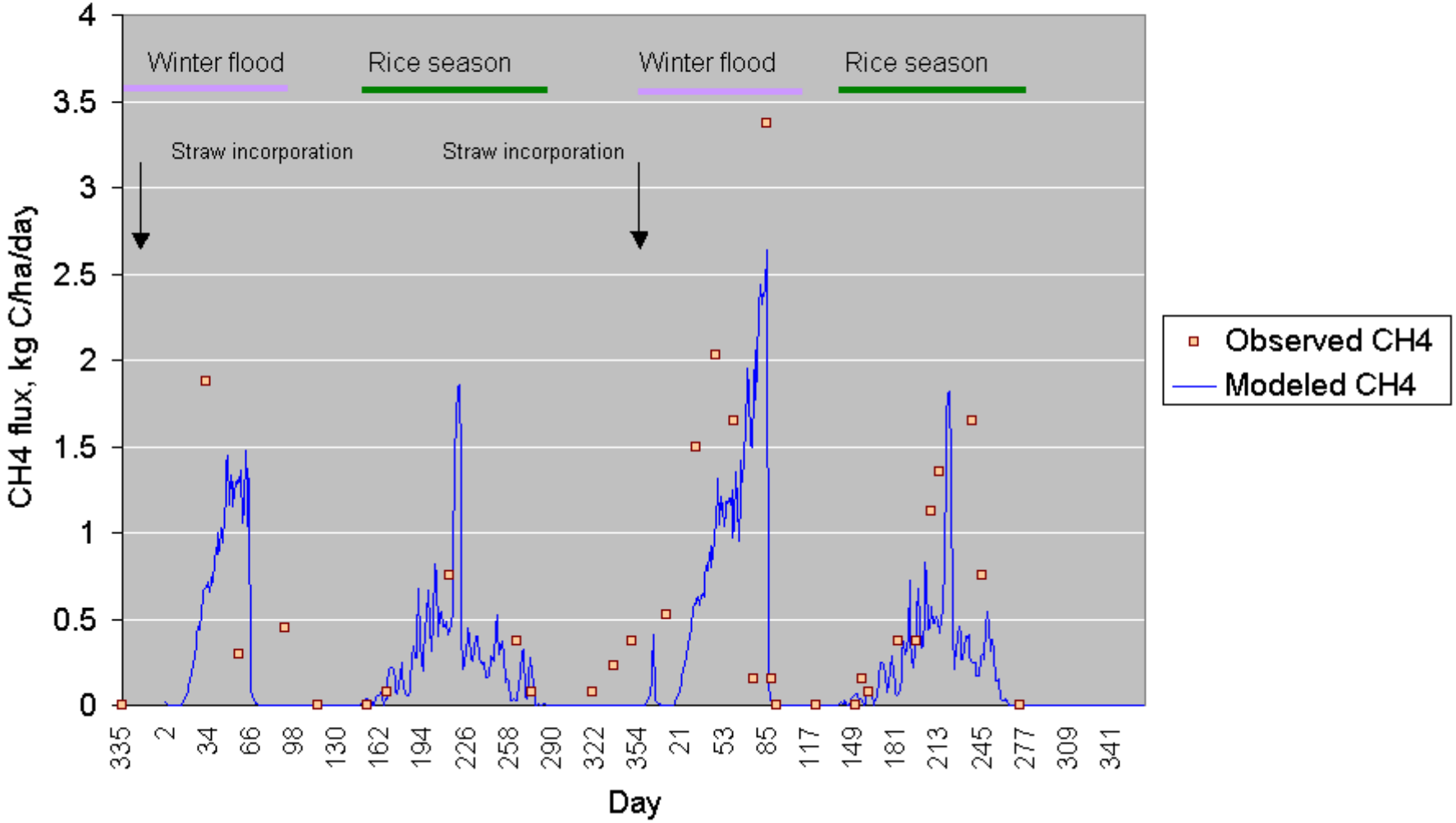
Observed and DNDC-modeled CH4 fluxes from rice paddies in China, Thailand, Japan, Italy and the U.S.



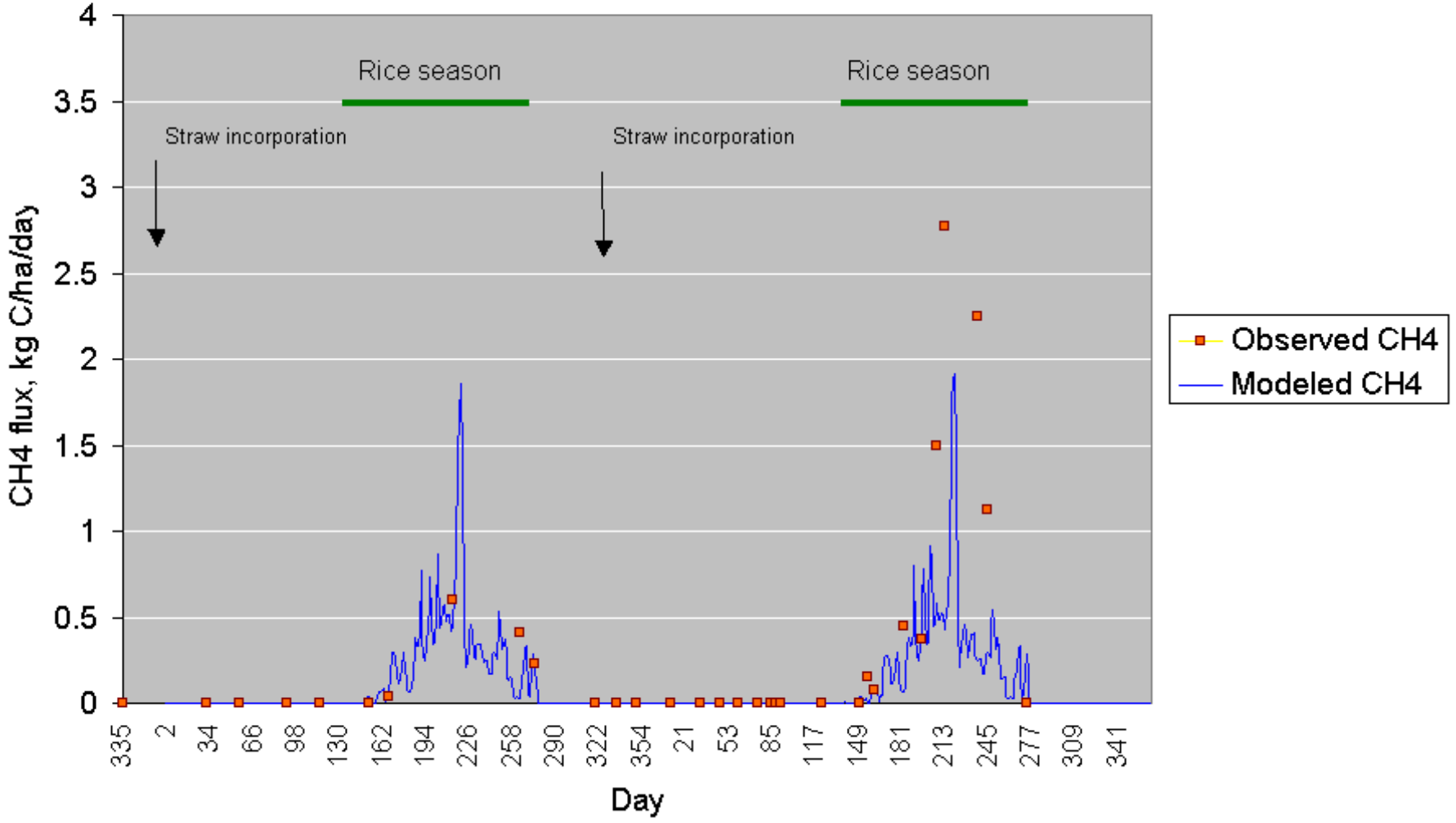
Model Testing: Maxwell & RES

- Tested DNDC against published data from a water management and residue management study at Maxwell, California.
- New data collected by Assa and Horwath at RES
- Validation data: CH4 emissions
  - Baseline management: straw incorporation with winter flooding for decomposition
  - Removal (burning) of straw residue with winter flooding
  - Incorporation of straw without winter flooding
  - Drill seeding

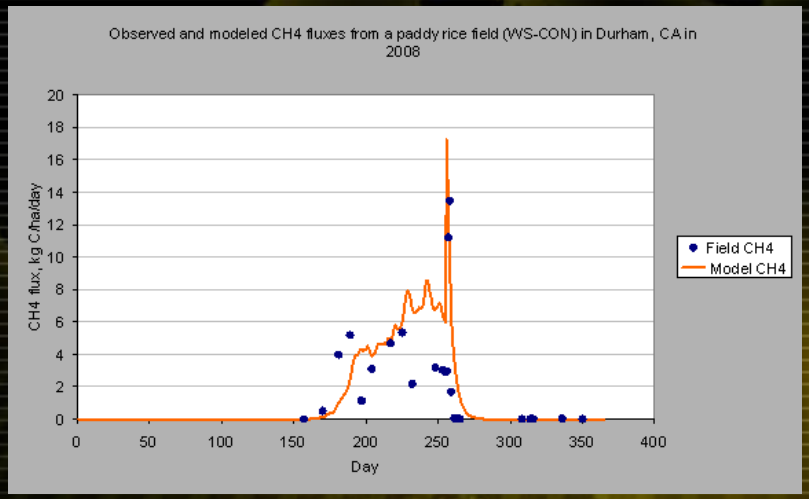
Observed and DNDC-modeled methane fluxes from a paddy rice field with winter flood and straw incorporation in Maxwell, California 1994-1996

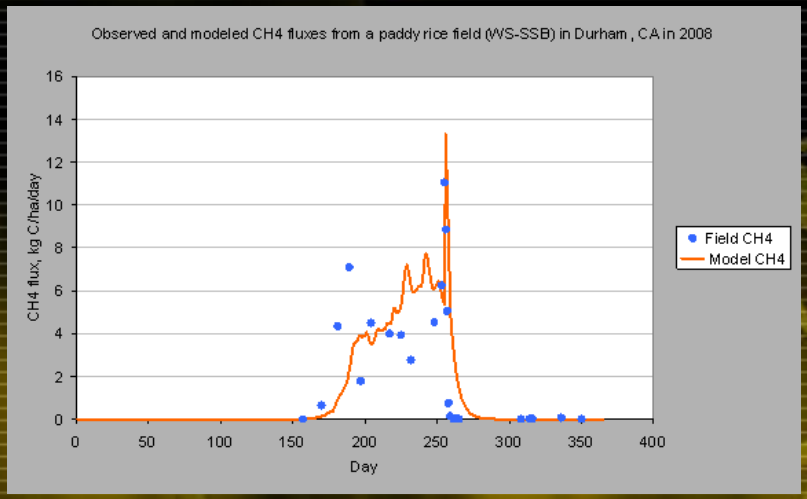


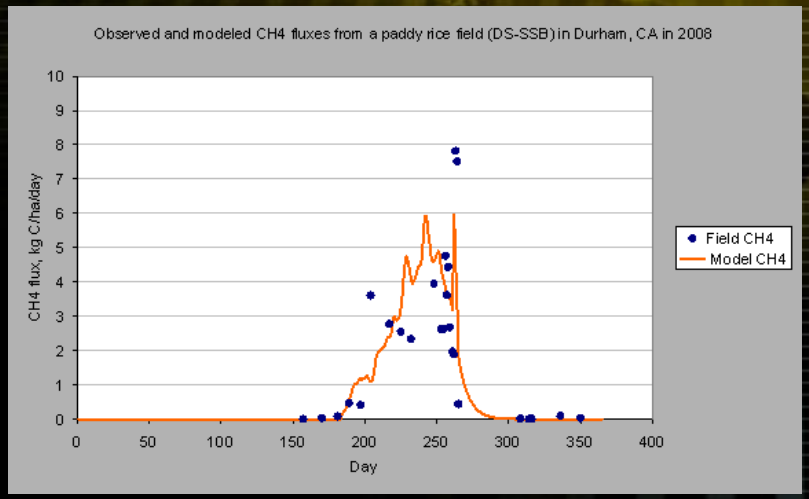
Observed and DNDC-modeled methane fluxes from a paddy rice field with straw incorporation but no winter flood in Maxwell, California 1994-1996

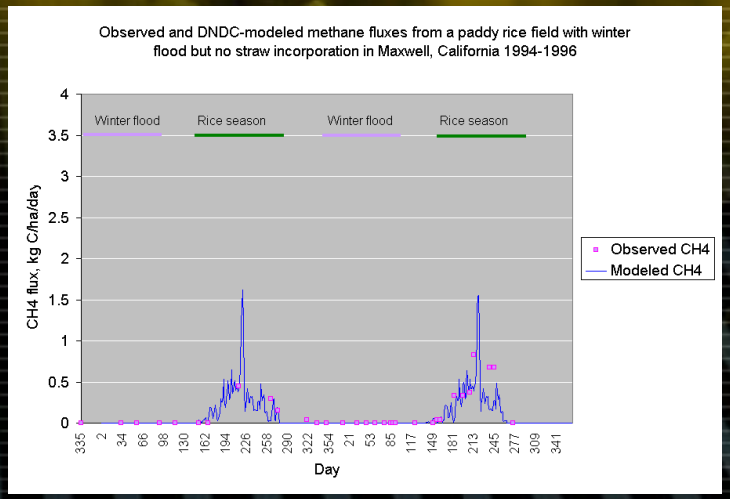


Additional Rice Methane validation data for California





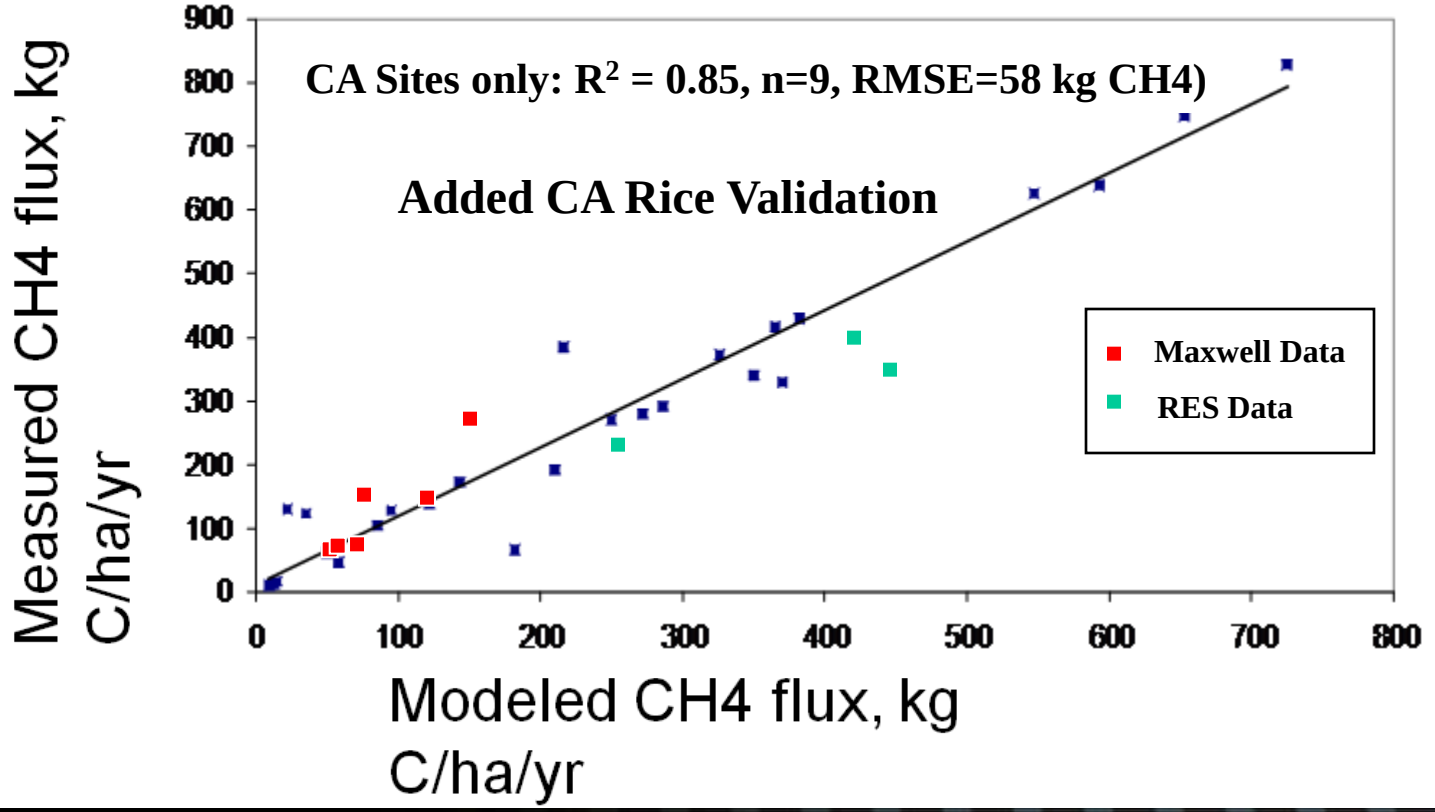




RES data: source Assa and Horwath, unpublished

CH4 Model Validation: With CA Sites

Observed and DNDC-modeled CH4 fluxes from rice paddies in China, Thailand, Japan, Italy and the U.S.



Highlights from current rice methodology

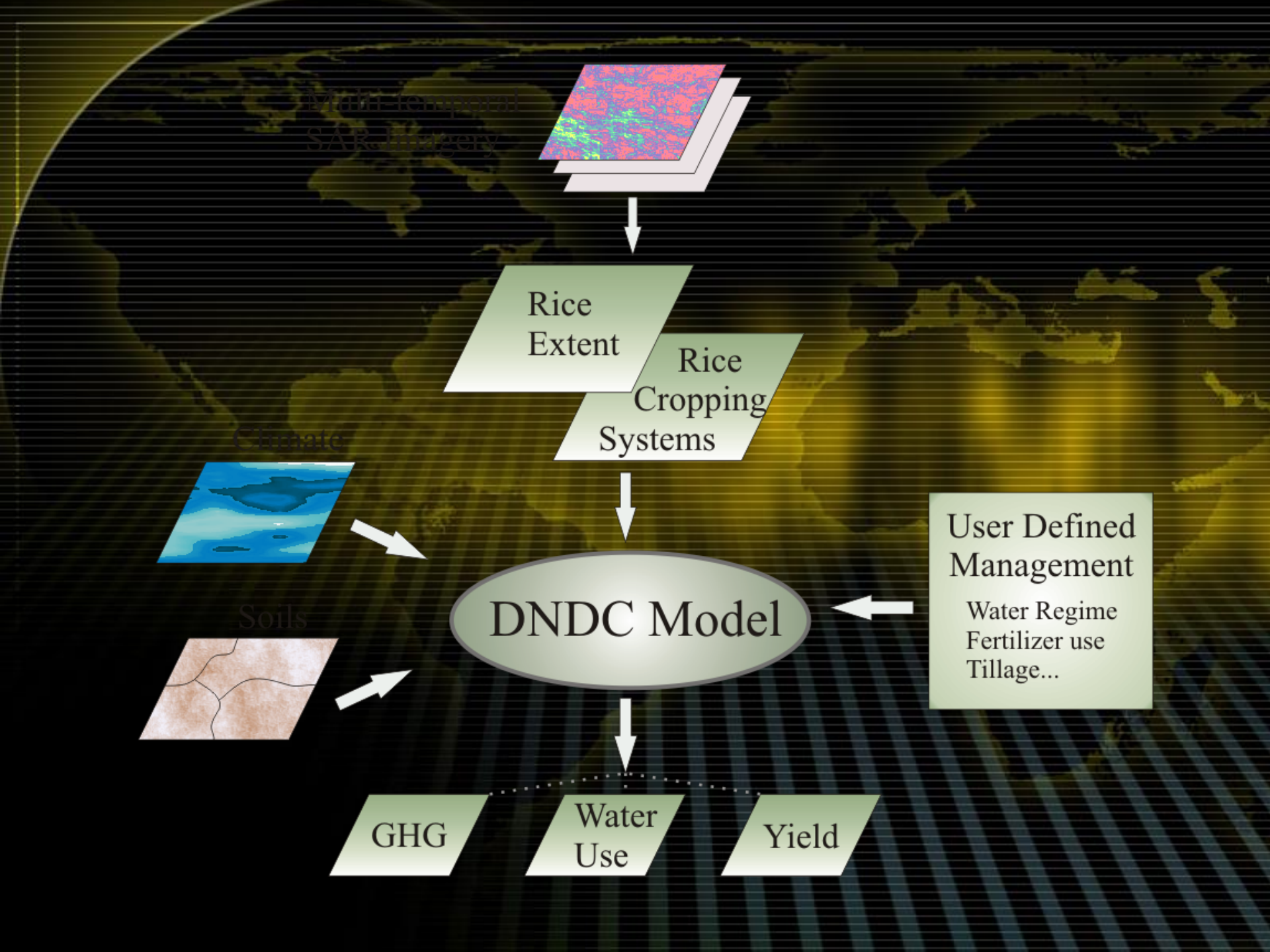
Steven De Gryze
Paul Buttner
Belinda Morris
Bill Salas

Introduction and Larger Context

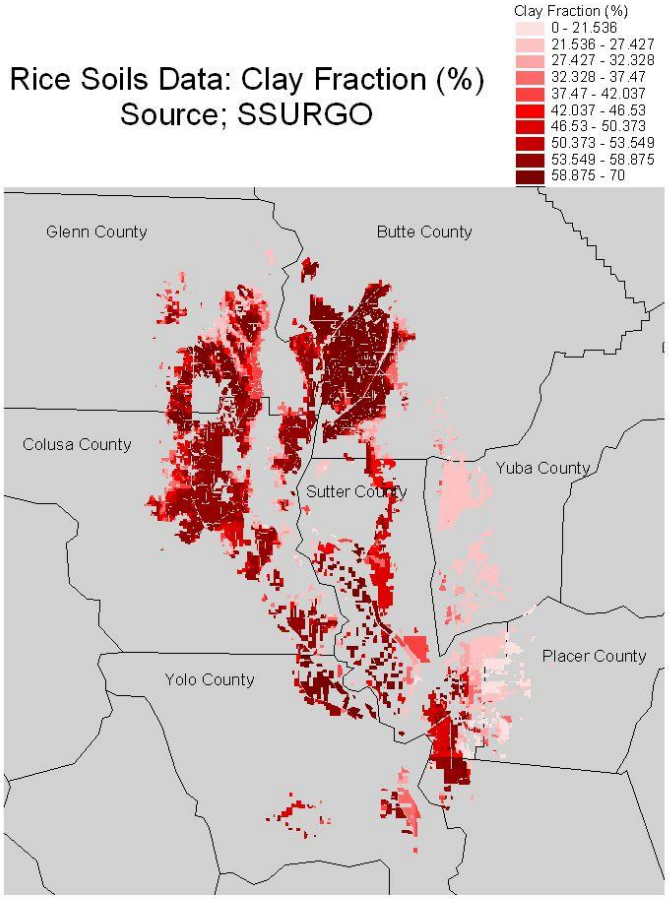
- EDF & CRC implemented 3-year project (CIG funds) to understand:
  - ✓Economically viable management practices that reduce GHG emissions (California rice growers)
  - ✓How to quantify those reductions cost-effectively (DNDC)
  - ✓How to create opportunities for growers to benefits from carbon markets (methodology)

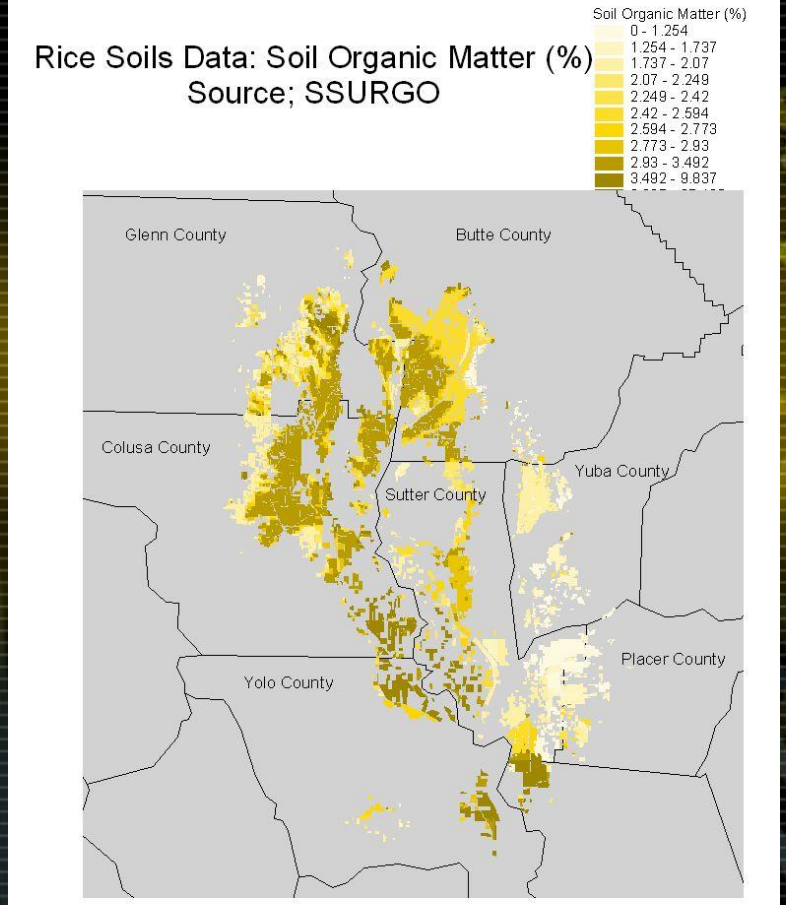
CIG Project's Activities

- Literature & expert consultation
- Modeling
- Determination of GHG mitigating activities
- Field trial & determination of feasibility
- Economic analysis
- Analysis of co-benefits and environmental tradeoffs


Multi-temporal
SAR Imagery
Rice
Extent
Rice
Cropping
Systems
Climate
Soils
DNDC Model
User Defined
Management
Water Regime
Fertilizer use
Tillage...
GHG
Water
Use
Yield

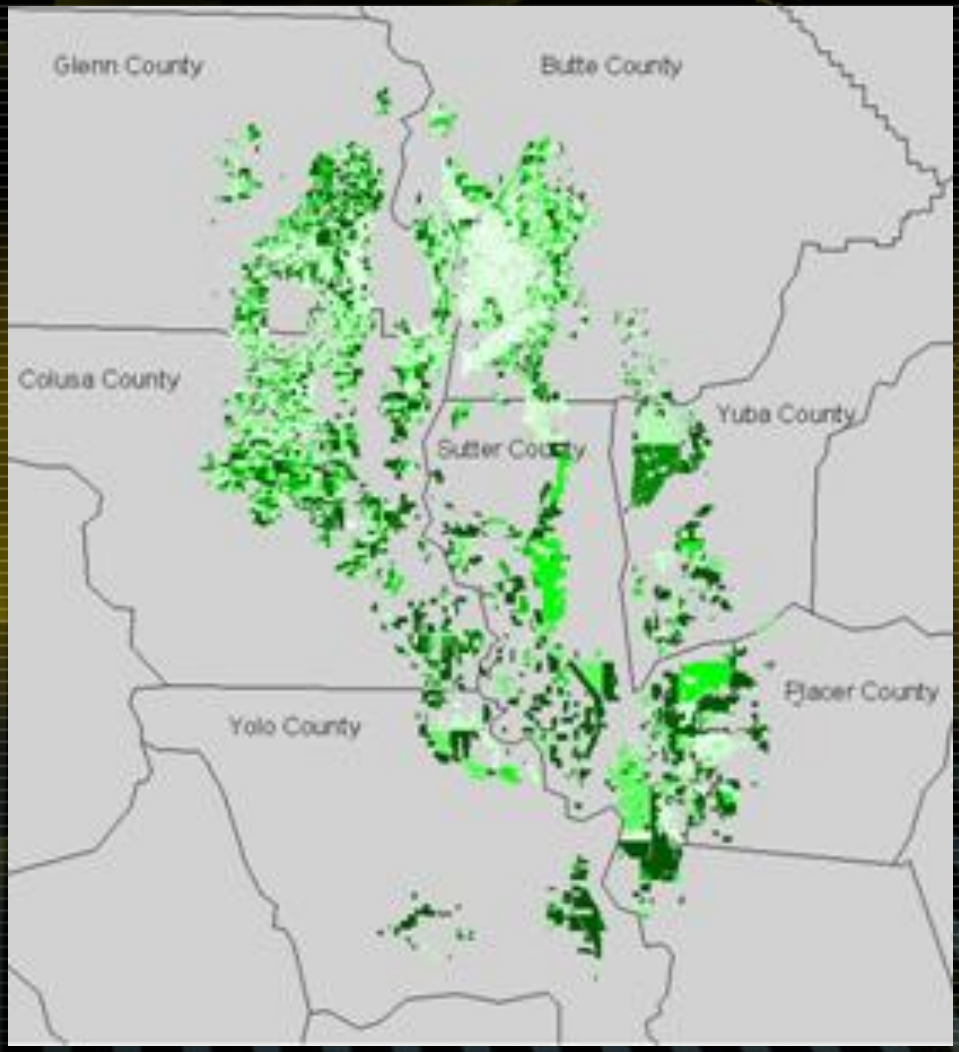
GIS Soils Databases





Model Results

- Ran model for over 6000 individual fields
- Ran 12 management scenarios for each field.
  - ✓ Winter flooding
  - ✓ Rice straw
  - ✓ Drill Seeding
  - ✓ Mid-season drainage
- Have field level and regional estimates of mitigation potential



Costs, yields, profits and average emissions for baseline & 7 scenarios

Scenario	Total costs (1)	Model yield (2)	Model revenues minus costs (3)	Average GHG emissions per acre without fossil fuel emissions (4)	Average GHG emissions per cwt without fossil fuel emissions (5)	Avg. total GHG emissions per acre (6)	Avg. total GHG emissions per cwt (7)
	($/acre)	(cwt/acre)	($/cwt)	(tCO2eq/acre)	(tCO2eq/cwt)	(tCO_2eq/acre)	(tCO_2eq/cwt)
Scenario 0: Baseline	1572	87.79	2.43	3.13	0.036	3.45	0.039
Scenario 1: RI-WF	1570	87.71	2.44	3.31	0.038	3.62	0.041
Scenario 2: RI-NWF	1575	87.90	2.42	2.86	0.033	3.19	0.036
Scenario 3: Straw Removal-NWF	1616	87.88	1.95	2.73	0.031	3.00	0.034
Scenario 4: Straw Removal-WF	1622	87.88	1.88	3.07	0.035	3.34	0.038
Scenario 5: Drill-seeding; RI-WF	1542	84.44	2.08	2.88	0.034	3.20	0.038
Scenario 6: Mid-season drainage 30-42 DAP; A	1563	64.47	-3.91	2.14	0.033	2.44	0.038
Scenario 7: Mid-season drainage 40-54 DAP; B	1563	71.93	-1.39	2.14	0.030	2.44	0.034

Status and Timeline

- Methodology is in internal review
- To be submitted in 4-6 weeks
- VCS requires two rounds of validations by independent auditors
- Most likely, SCS will be first verifier
- Total validation process takes 6-8 months
- ACR – peer review process likely to take 4-6 months

Main Characteristics

- Based on process-based biogeochemical model
- Model uncertainty is handled through deduction system
- Explicit quantification of uncertainty using measured data is required
  - ✓ Only specific practices and geographic regions are included
- Incentivizes “aggregation” of fields within one project
  - ✓ Fields managed by different growers are combined within one project through an third party: “aggregating entity”
  - ✓ More fields => Smaller uncertainty => More credits

Methodology is modular

- Universe of practices to reduce methane emissions from rice cultivation
  - ✓ Reducing the duration of flooding during the growing season (e.g., mid-season drainage, faster growing cultivars, drill seeding)
  - ✓ Reducing the duration of flooding outside of the growing season
  - ✓ Removing crop residues after harvest and before flooding
  - ✓ Switching from conventional to low-methane rice cultivars
  - ✓ Laser-leveling fields before planting
- Only a subset of the universe is included
  - ✓ minimizing the duration of winter flooding
  - ✓ removal of rice straw from the field after harvest
  - ✓ drill seeding instead of water seeding
- Expansion of the protocol when sufficient ground-based field measurements become available

Types of Data Needed As Model Input

- Soil data
  - ✓texture
- Daily weather data
- Management data
  - ✓Yields
  - ✓planting and harvesting dates
  - ✓fertilization dates and amounts
  - ✓Flooding dates

Sources of Data Used in Scenarios ($t < 5$ yr)

- Baseline emissions cannot be fixed ex-ante since weather influences emissions significantly
- Ex-ante calculations
  - ✓ Baseline: 5-yr historical records of actual management
  - ✓ Project: changing key management data according to best-guess (e.g., dates of straw removal after harvest)
- Ex-post calculations
  - ✓ Baseline: actual data for all non-key management interventions (e.g., actual weather must be used), and historical data for key management practices
  - ✓ Project: actual data

Sources of Data Used in Scenarios (t > 5 yr)

- Common practice may gradually change over time
  - ✓E.g., use of different cultivars, winter flooding
- Therefore, five years after project start, baseline calculations must be based on an analysis of common practice in area
  - ✓Data source: surveys, extension service, etc.

Applicability Conditions

1. DNDC model has been successfully calibrated for the proposed project activities and geographic area
2. Rice fields have been under continuous rice for 5 years (one fallow season is allowed)
3. Project area consists of at least five rice fields or 1000 acres to reduce structural uncertainty around model results
4. 5-yr management records are available for each field
5. Project activities do not impact rice yield (avoid leakage)
6. The project area does not contain any soils with carbon content greater than 3%
7. Baseline adoption rate of the management practices can be determined

Q&A

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Next Steps

- Review background information and Reserve programmatic policies
- Respond to request (doodle poll) for next WG call and LA meeting availability
- Expect follow up calls/emails from staff

Thank you!

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