AGROCLIMATOLOGY One Pagers - 2016 PD Meeting

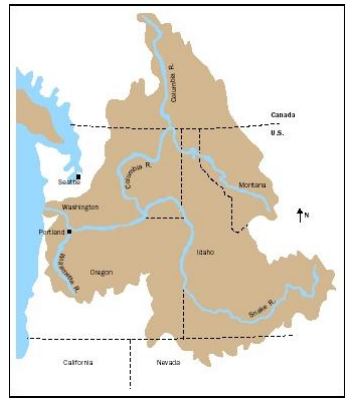
Page	PD First Name	PD Last Name	Titie
1	Jennifer	Adam	BioEarth project
2	Raymond	Arritt	Collaborative Project: Attribution of changes in precipitation intensity over the central United States
3	Philip	Bachand	Economic evaluation of agricultural adaptation to climate change and water resources constrain California
4	Peter	Bottomley	The Impact of Archaeal and Bacterial Nitrifiers on the Fate of Ammonical N Applied to Soils
5	Mary Ann	Bruns	Greenhouse gas trade-offs and N cycling in low-disturbance soils with long term manure additions
6	Alex	Mahalov	Earth System Models-3: Physics-Based Predictive Modeling for Integrated Agricultural and Urban Applications
7	Carolyn	Copenheaver	Increased sensitivity of sugar maple to precipitation to Precipitation
8	Courtney	Creamer	Microbe-mineral interactions and the fate of soil carbon along soil climo-chronosequences
9	Daniel	Devlin	Resilience and vulnerability of beef cattle production in the Southern Great Plains under changing climate, land use and markets
10	Sharon	Doty	The Use Of Diazotrophic Endophytes as a Means for Climate Change Mitigation and Adaptation In Agroecosystems
11	Stefan	Gerber	Climate Sensitivity of Microbial Processes and their Implication for Carbon Sequestration and Greenhouse Gas Fluxes in Subtropical Pastures
12	David	Hennessy	Adaptation of agroecosystems to climate change at the edge of the U.S. Cornbelt—assessing different drivers in a spatially explicit network of infrastructure
13	Menas	Kafatos	Using a Multi-Model Regional Simulation of Climate Change Impacts on Agriculture in the Southwestern United States and Its Application to a Research Framework in the Korean Peninsula
14	Armen	Kemanian	Strengthening farm operators' capacity for climate change adaptation
15	Beverley	Law	CarboN cycle dynamics in Oregon and Western US Part 1
16	Beverley	Law	CarboN cycle dynamics in Oregon and Western US Part 2
17	David	Lawrence	Collaborative Research (EaSM3, NSF/NIFA): Land Use Change and Land-Atmosphere Feedback Processes as Regulators of Regional Climate Change
18	Johannes	Lehmann	Soil Organic Carbon Interactions with Organic Matter Additions: Mechanisms and Models
19	Yonqiang	Liu	Detecting and Parameterizing Wildfire Induced Land-surface Changes for Earth System Models
20	Vikram	Mehta	Predictability of Impacts of Decadal Climate Variability on Water and Crop Yields in the Missouri River Basin, and Its Use in Agricultural Adaptation
21	Maureen	McCarthy	Water for the Seasons: Water Sustainability and Climate Resiliency in Snow-Fed Arid Lands
22	Maureen	McCarthy	Ehancing Climate Resiliency of Tribal Farming and Ranching in Southwest
23	Richard	McNider	Migration of Agricultural Production Back to the Southeast as a Climate Change Adaptation Strategy
24	William	Parton	Impact of Sea Surface Temperatures, Climate and management on Plant Production and GHG fluxes in Asia and the Great Plains
25	Linda	Prokopy	Useful to Usable (U2U): Transforming Climate Variability and Change Information for Cereal Crop Producers
26	Linda	Prokopy	Lessons Learned from Five Years of Investment by USDA NIFA into Climate Change and Agroecosystems
27	Matthew	Ruark	Climate Change Mitigation and Adaptation in Dairy Production Systems of the Great Lakes Region
28	Kathleen	Savage	Integrated Belowground Greenhouse Gas Flux Measurements and Modeling
29	Carl	Schmidt	Adapting Chicken Production to Climate Change through Breeding
30	Sanford	Eigenbrode	Climate Adaptation and Mitigation for Wheat Production Systems of the Inland Pacific Northwest
31	John	Stark	Microbial Carbon-use Efficiency in Agroecosystems: The Effect of Drought and N Availability on Soil Microbial Production and Respiration

32	Quinn	Thomas	Decadal prediction of sustainable agricultural and forest management - Earth system prediction differs from climate prediction
33	Rodrigo	Vargas	Coupling Solid-Aqueous-Gas Phases Of Carbon And Nitrogen Across Topographic Gradients And Extreme Weather Events
34	Mark	Walker	Forging A Working Partnership In The Southwestern United States For Locally Relevant, Action-Oriented Climate Change Education
35	Brian	Wilsey	Carbon cycling in native vs. non-native dominated systems
36	Randy	Wisser	Analysis Of Clinal Variation In Maize: Implementation Of An Experimental Framework For Studying Crop Adaptation
37	Xiangming	Xiao	Multi-scale analysis of microbe-climate interactions in greenhouse gas emissions from grasslands and croplands

BioEarth

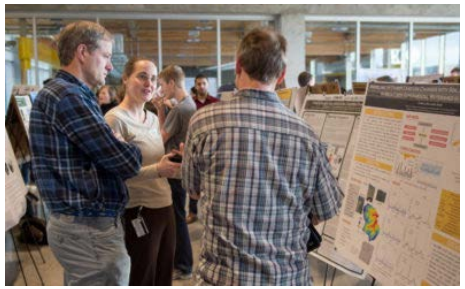
Biosphere-relevant earth system model

Project Director: Jennifer Adam, Washington State University



Objective: To improve understanding of the interactions between coupled C:N:H_20 dynamics and human actions at regional and decadal scales under global change to

- better understand the role that resource management activities have in impacting earth systems dynamics, and
- inform sustainable resource management decisions.



Approach: Development and application of a modular integration framework that

- incorporates atmospheric, terrestrial, and aquatic processes,
- explicitly includes human processes with a focus on agricultural resource (crops, forests, range) decision making and interactions with water and air resources.

Impact:

- Assessment of optimal climate resilient strategies by producers,
- Identification of unintended consequences and ancillary benefits of agricultural management actions, and
- Improved understanding of information gaps of PNW agricultural and natural resource managers.

Washington State University

Donald Bren School of Environmental Science & Management, University of California, Santa Barbara

NCAR

Oregon State University OSU

Pacific Northwest National Laboratory

The University of Vermont

USDA

NIFA Award #2011-67003-30346

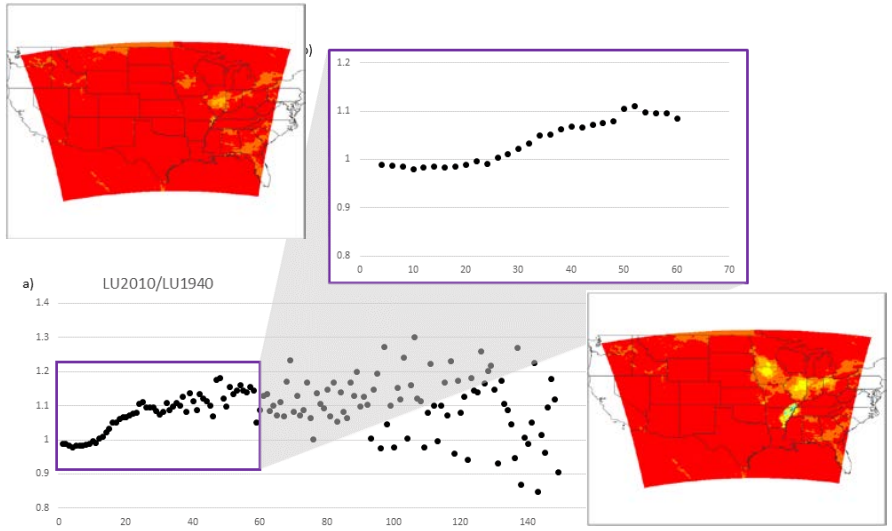
Project Director: Raymond Arritt, Iowa State University

Collaborative Project: Attribution of changes in precipitation intensity over the central United States

United States Department of Agriculture
National Institute of Food and Agriculture

Objectives

- Assess the effect of changing crop type on the observed trend of more intense precipitation over the central U.S.
- Quantify historical trends in land devoted to specific crops over the central U.S.



Approach

- Analyze county level data to assess decadal trends in crop type over the central U.S. from 1940-2010.
- Compare regional atmospheric model results using historical versus modern crop coverage as the lower boundary condition.

Impact

- Showed that technology-driven changes in crop type contributed to increases in extreme rainfall.
- Developed historical land use data base for use in other studies.

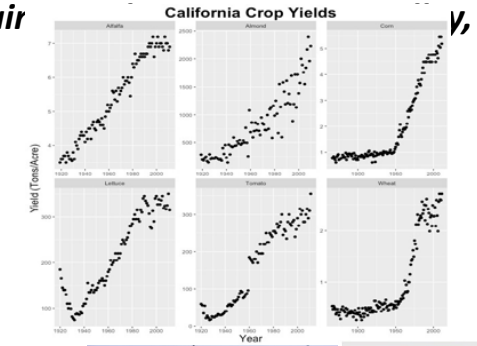
NIFA Award # 2013-67003-20642

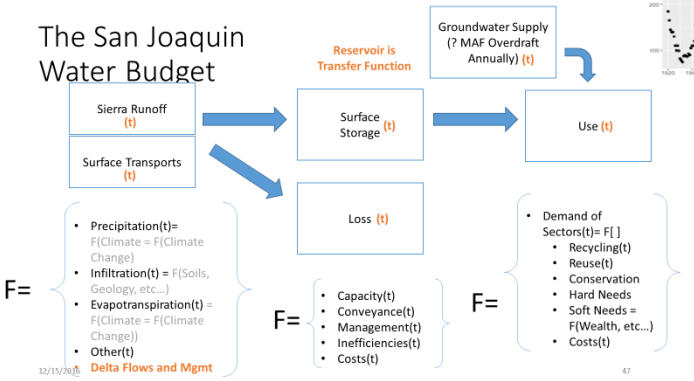
Project Directors: William Horwath, UC Davis and Philip Bachand, Bachand & Associates

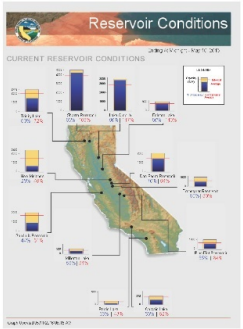
Economic evaluation of agricultural adaptation to climate change and water resources constrair y, California

Objectives:

- Integrate **water, agricultural and economic** into a modeling **framework** (**WAEF**) to examine scenarios that represent adaptation themes to water, agricultural and climate pressures standardized against Business-As-Usual.
  - Use available water and economic models, and agricultural datasets
- Test opportunities to improve water management under climate change:
  - Reservoir re-operation scenarios
  - Groundwater management and improved integration into California water portfolio
  - SGMA considerations and constraints
  - Water Transfers
- Test agricultural strategies (e.g. changes in cropping strategies, practices and fallowing)
- Use economics as foundation for producer and water managers decisions
- Consider in the context of climate change and California regulatory climate, particularly the 2014 Sustainable Groundwater Management Act (SGMA)







Approach:

- Five organizations: UC Davis, UC Merced, Tetra Tech, Inc., Bachand & Associates, Systech
- Collaboration and discussion with California agencies (e.g., DWR, SWRCB, CDFA), local water agencies and irrigation districts, and farming organizations (e.g. farm bureaus, resource conservation districts, UC Cooperative Extension).
- Parallel analyses of strategies using water, economic and agricultural modeling and analyses tools under a framework of tested scenarios.
- Research:Extension:Education: 75:12:13

UCDAVIS UNIVERSITY OF CALIFORNIA

THE UNIVERSITY OF CALIFORNIA MERCED

Impact

- Improve California water resources modeling tools to consider climate change impacts on Sierra runoff, reservoir reoperation strategies, and improved surface and ground- water integration.
- Inform California stakeholders and agencies on promising strategies for water and agricultural adaptation in the San Joaquin Valley to accommodate climate change and upcoming regulations.
- Provide an analytical framework that can be integrated into future water and agricultural sustainability analyses.
- Provide useful data and information as State and local agencies begin implementation of SGMA.

BACHAND & ASSOCIATES

TETRA TECH

SYSTECH WATER RESOURCES

The Impact of Archaeal and Bacterial Nitrifiers on the Fate of Ammonical N Applied to Soils

Project Directors: P. J. Bottomley, A.E. Taylor, D.D. Myrold, Oregon State University

Objectives

To determine how soil factors influence the relative contributions of AOA and AOB to nitrification in soils supplied with digester ammonical N.

To determine how field conditions and plant growth stage affect the relative contributions of AOA and AOB to nitrification and the fate of the N.

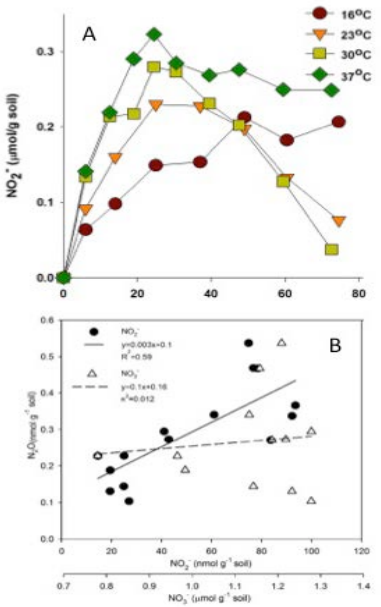
To determine the influence of soil temperature on nitrifier-dependent NO_2^- accumulation, and its impact on N_2O production.

Approach

Involves a combination of soil microbiologists and dairy specialists who have designed a combination of field and laboratory based studies using a variety of microbiological, molecular, and isotopic techniques to address project objectives.

Regional based field and laboratory studies involving PIs and graduate students, OSU Extension Service, and stakeholders including dairy farmers and digester operators.

Results



NO_2^- and N_2O accumulation in a pasture soil.
A) NO_2^- accumulation in response to NH_4^+ at 16, 23, 30 and 37°C.
B) The relationship between N_2O production and NO_2^- (solid line) or NO_3^- (dotted line) accumulation at 25°C.

Impact

We will gain a better understanding of the critical soil conditions and microbial factors that uncouple or couple nitrification from the other NH_4^+ consuming sinks. This will enable us to refine nitrogen models and field based management strategies that prevent excessive and/or untimely losses of soil and fertilizer N. This will reduce economic losses to farmers and reduce the potential for off-site damage to environmental quality.

NIFA Award No. 2016-67003-24964

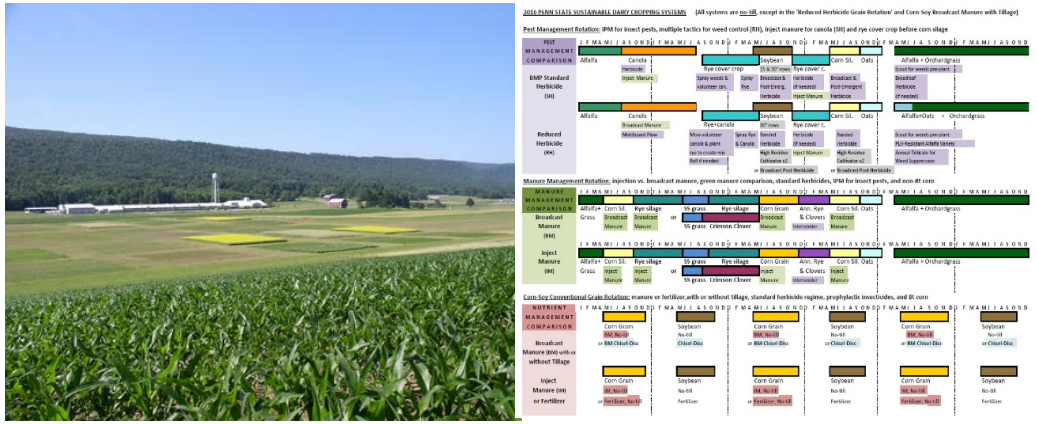
Greenhouse gas trade-offs and N cycling in low-disturbance soils with long term manure additions

PD: Mary Ann Bruns, Pennsylvania State University

Rationale: Manures contain nitrate-ammonifying (NA) bacteria, and soils can be managed to promote NA activity to reduce nitrous oxide production by denitrifiers.

Objectives

- Assess types and densities of NA bacteria in diverse manures and manured soils
- Identify physico-chemical conditions that favor NA activity in soil and reduce N_2O emissions
- Evaluate the impact of climate adaptive management practices (C addition, low disturbance) on GHG tradeoffs



Approach

- Use *nrfA* (NA functional gene) as a molecular marker
- Design mesocosm experiments under varied conditions (different substrates, labile C:NO_3^- ratios, Eh, pH) affecting NA activity
- Evaluate net global warming potentials of NA-conducive soil management and manure handling practices

Impact

- Provide data for improved modeling of GHG emissions from dairy cropping systems
- Extend information from laboratory studies and farm-level analysis to growers
- Contribute to watershed database for Upper Chesapeake Bay network (USDA-LTAR site)

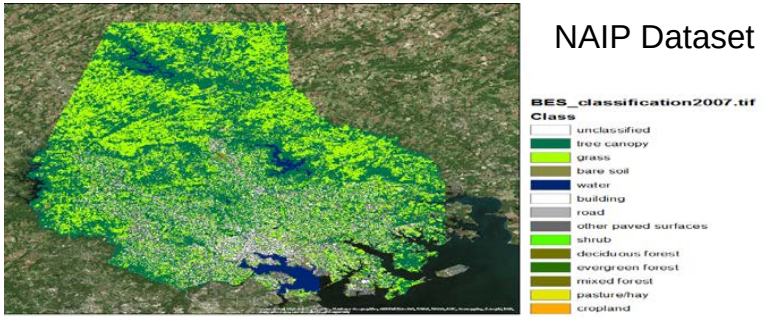
NIFA award #: 2016-67003-24966

Project Directors: Alex Mahalov, Arizona State University and Fei Chen, NCAR

Earth System Models-3: Physics-Based Predictive Modeling for Integrated Agricultural and Urban Applications

Objectives

- Develop an integrated agricultural and urban modeling system
- Characterize decadal and regional impacts associated with agriculture/urban expansion for selected regions in the continental US
- Examine socio-economic impacts associated with agri-urban development including urban farms/community gardens
- Educate next generation of interdisciplinary scientists



Approach

- Physics based predictive modeling and data development supporting agricultural management strategies and policy decisions at multiple scales
- Advanced modeling system includes crop modeling capabilities embedded in a land surface Noah-MP/biogeochemistry/hydrology model with tiling for accommodating a mixture of crop/urban landscapes
- High resolution USDA National Agriculture and Imagery Program (NAIP) datasets are integrated in data development

Impact

- Developed a new paradigm for studies of linked regional agricultural and urban systems on decadal time scales
- Assessment of agri-urban development pathways
- Created advanced physical and cyberinfrastructure to support continued integration across disciplines
- The integrated agricultural and urban modeling system will be released for community use

USDA-NIFA awards # 2015-67003-23508 and 2015-67003-23460; NSF # 1419593

Increased Sensitivity of Sugar Maple to Precipitation

Project Director: Carolyn A. Copenheaver, Virginia Tech

Co-Directors:
Glenn Juday (UAF)
Saskia van de Gevel (ASU)
Ketia Shumaker (UWA)
Steve Chhin (MSU)
Margaret Evens (UA)

Grant title: Forest Resilience to climate change: A dendroclimatic assessment of trees with commercial and conservation value

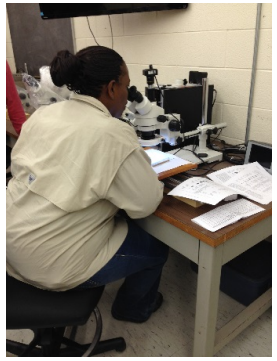
Overall Objective:
Predict the resilience of black spruce, Douglas-fir, eastern hemlock, Alaska birch, pinyon pine, ponderosa pine, sugar maple, quaking aspen, white bark pine and white oak to climate change.

Approach:
Establish historical relationship between tree-ring growth and climate. Use predictive models to anticipate growth response of each tree to climate change scenarios .

First-year findings: # of months tree growth significantly correlated to precipitation

Sites	Pre-1950	Post-1950
Pennsylvania	0	4
New York	1	4
Ontario	2	4
Minnesota	2	4

Sampling sugar maple → Organizing samples → Preparing samples → Matching growth to climate → Communicating results



NIFA Award #: 2015-08461

Microbe-mineral interactions and the fate of carbon along soil climo-chronosequences

Project Director: Mark Waldrop
Courtney Creamer, Andrea Foster, Corey Lawrence, Jack McFarland, Marjorie Schulz
USGS Menlo Park, CA

2014-67003-22043

Objectives

- Understand and model the new paradigm of soil carbon (C) stabilization at the C-microbe-mineral interface with varying:
  - Carbon input chemistry
  - Microbial community composition, and
  - Soil mineralogy
- Integrate findings across spatial (molecular to landscape) and temporal scales using:
  - Gradients of soil age (~40 to 250 ka), and climate (~300 to 1200 mm yr^{-1})
- Incorporate improved mechanistic understanding of C stabilization/destabilization into new reactive transport models

Impacts

- Developed new analytical and technical tools:
  - Raman spectroscopy to non-destructively quantify and track added C substrates through microbes on onto mineral surfaces through time
- Improved mechanistic understanding of our new paradigm of soil C research (for example):
  - Importance of C chemistry in the extent of microbial stabilization of C
  - Necessity of C processing by live microbes for stabilization of C, particularly on non-sorptive minerals
- Improved representation of C cycling in reactive transport models

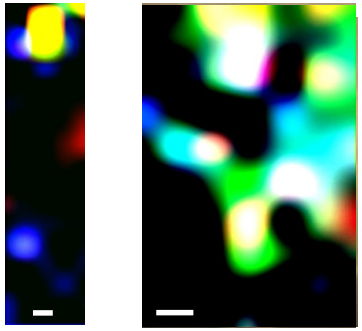
Approach

The experiment occurs in 4 phases in relies on isotopic, spectroscopic and microbial techniques to address our new paradigm that C stabilization occurs through association of C with mineral surfaces:

1. Incubations to quantify and test small scale mechanisms and develop Raman spectroscopy
2. Mesocosms to quantify the destabilization of microbial C by plant C in controlled soil environments
3. Field and lab incubation studies to test conceptual understanding across our age and climate gradients
4. Reactive transport modeling to project C storage over time with improved mechanisms and parameterization

Graphics and Pictures

Design for in-field quantification of stabilized C with varying chemistry (glucose, oxalate) and depth (1.6 m).



Spatial distribution of lipids (blue), carbohydrates (red), and proteins (green) on feldspar (left) and aluminum hydroxide (right) using Raman. Scale is 5 µm.

RESILIENCE AND VULNERABILITY OF BEEF CATTLE PRODUCTION IN THE SOUTHERN GREAT PLAINS UNDER CHANGING CLIMATE, LAND USE AND MARKETS

Project Director: Dan Devlin, Kansas State University; Project Co-Director: Jean Steiner, USDA-ARS
Project No. 2012-02355 and 2013-69002-23146

OBJECTIVES

- **Institutional** – Build capacity among regional institutions to move research and extension to a higher level of integration
- **Scientific** – Better understand beef-grazing system dynamics, quantify instability and adaptability, safeguard the sustainability of production and ecosystem services
- **Educational** – Provide information and technology to enable producers to employ risk-based information in decision making
- **Extension** – Train the next generation of producers and researchers to collectively address rising challenges

IMPACTS

- Improved grazing management, increased water efficiency and drought planning, more diversified forage sources
- Better understanding of vulnerability and enhanced resilience of beef-grazing systems
- Safeguarded and strengthened production and ecosystem services lessening the severity of greenhouse gas emissions in the Southern Great Plains

APPROACH

- Interdisciplinary and participatory development of extension activities to increase producer and consumer knowledge
- Integrate Extension and stakeholder participation and evaluate the social, economic, and environmental acceptability of cropping systems.
- Experimental and observational research targeted to fill knowledge gaps in environmental and economic impact models

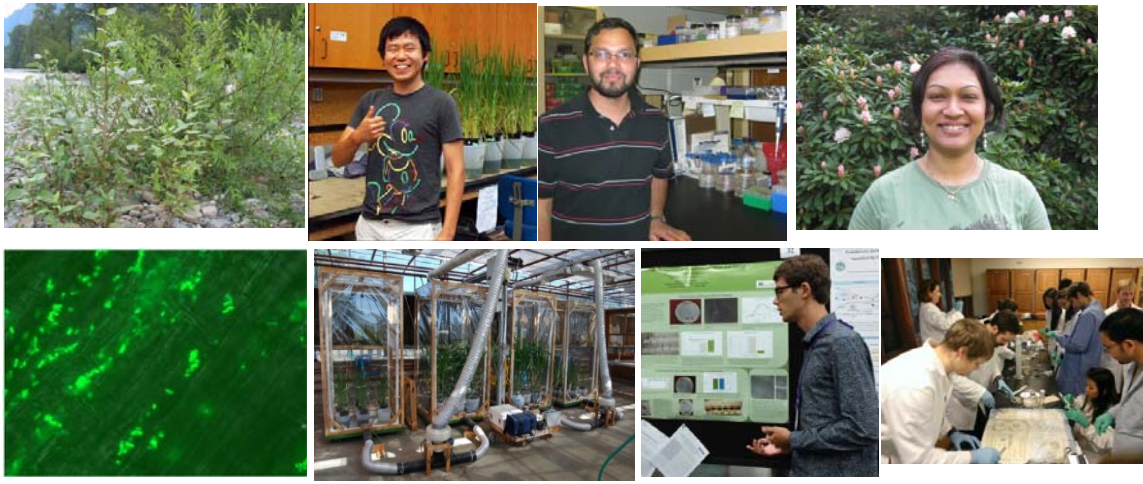
School of Environmental and Forest Sciences
UNIVERSITY of WASHINGTON
College of the Environment

Project Director: Professor Sharon L. Doty
Co-Director: Assoc. Prof. Soo-Hyung Kim
University of Washington, Seattle

The Use of Diazotrophic Endophytes as a Means for Climate Change Mitigation and Adaptation In Agroecosystems

Objectives:

1) To develop the most effective N-fixing endophyte inoculum for improved growth with minimal need for chemical fertilizers
2) To screen for endophytes that impart stress tolerance and increased water use efficiency
3) To assess the significance of endophytic symbiosis in mitigating the impacts of climate change
4) To develop outreach programs and educational opportunities to insure that the knowledge gained in this research is widely disseminated.



Approach:

1) Characterize microbial endophytes from wild plants naturally subjected to abiotic stresses in their native environments
2) Test on maize, rice, and Douglas-fir
3) Evaluate the physiological benefits of the endophytic symbionts under current and elevated CO_2 conditions
4) Develop a plant microbiology lab course; discuss the research at agronomic conferences; partner with companies and license the endophyte strains for use in agriculture and forestry

Impact:

* Utilize microbial plant symbionts ("plant probiotics") to:
  * **increase water use efficiency**
  * **provide essential nutrients**
  * **improve plant growth**
  * **increase plant stress tolerance**

The overall goal of this project is to develop tangible options to mitigate and adapt to climate change impacts on agriculture and forestry more quickly than could be reached by relying solely on crop improvement approaches via breeding or transgenics

NIFA Award # 2012-68002-19824

Climate Sensitivity of Microbial Processes and their Implication for Carbon Sequestration and Greenhouse Gas Fluxes in Subtropical Pastures

Objectives

Characterize the soil microbial community across different management practices and measure the corresponding greenhouse gas fluxes.

Determine the adaptation and acclimation of the soil microbial community climate change.

Improve a soil greenhouse gas emission model to predict greenhouse gas emissions under global change scenarios.

Approach

Determine functional gene composition in soils to laboratory manipulations and natural variability of soil climate.

Assess greenhouse gas flux response of soils to laboratory treatments of warming and precipitation variability

Incorporate microbial functional and structural response to climate into existing process-based soil model to evaluate response to global change factors.

Impact

Understand the resilience of a grazing land soils to a future climate scenario.

Improve predictions of GHG emissions under global change for different management practices in Southeastern grazing lands.

Decision making tool to estimate effects of management practices on greenhouse gas emissions under global change.

Project Director: Stefan Gerber, University of Florida

Award Number # 2016-67003-24962

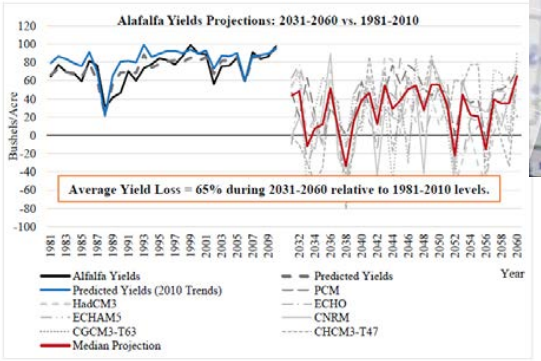
Adaptation of agroecosystems to climate change at the edge of the U.S. Cornbelt—assessing different drivers in a spatially explicit network of infrastructure

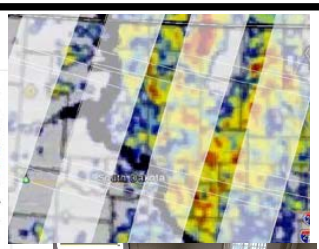
PD: Peter Wolter, ISU; CO-PDs: H. Feng and D.A. Hennessy, MSU; X. Du, UW-Madison; L. Janssen and M. Wimberly, SDSU; A. Akyüz, NDSU. (Grant No. 2014-67003-21772)

Objectives

- Discern location shifts for different agricultural production systems
- Set up spatially explicit modeling framework to assess climate and other driving factors behind adoption of different production systems
- Project evolution of production systems under alternative climate scenarios and assess outcomes from alternative adaptation strategies

Graphics and Pictures





Approaches

- Extract landscape use, weather, infrastructure, and related data for cropping fringe areas of the Dakotas
- Survey landowners at cropping fringe on land use intentions, motivations and adaptation strategies
- Project evolution of production systems under climate scenarios and assess outcomes from adaptation strategies

Impacts

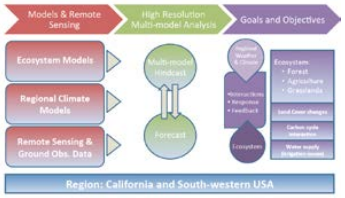
- Identify comparative importance of change drivers
- Use of novel data and information technology capabilities in integrated multidisciplinary team
- Policies to support low-cost adaptation strategies and sustainable production systems
- Provide evidence of cropping and grazing system agglomeration effects

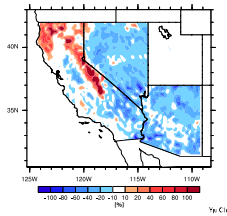
Project Director: Menas Kafatos, Chapman University

Using a Multi-Model Regional Simulation of Climate Change Impacts on Agriculture in the Southwestern United States and Its Application to a Research Framework in the Korean Peninsula

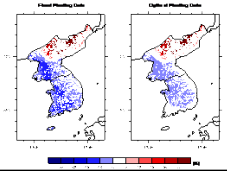
Objective

- To assess the potential impacts of climate variability and change on ecosystems and agriculture in semi-arid regions, specifically the Southwestern US (SW US).
- To apply the research framework outside of the US (Korean Peninsula) with international collaborators.





Agricultural system in North and South Korea



Approach

- Utilize accurate regional modeling, and capture climate impacts at regional ecosystem scales.
- Inter-compare multi-crop model simulations driven by regional climate models and create an ensemble to reduce uncertainties in forecasting crop yields.
- Examine the relationship between daily temperatures in SW US and various climate modes.

Impacts

- A better understanding of the relationship between climate variability and ecosystems and agriculture in the SW US.
- Applying and transferring the research framework outside of the U.S.
- The connection between climate modes and early warm season temperature variability over the SW US.
- Simulating future yield and adaptation strategies for use by growers and decision makers.

CHAPMAN UNIVERSITY
SCHMID COLLEGE OF SCIENCE AND TECHNOLOGY
Center of Excellence in Earth Systems Modeling & Observations

UCLA

UNIVERSITY OF MIAMI

PRINCETON UNIVERSITY

KOREA UNIVERSITY 고려대학교

(NIFA Award: 2011- 67004-30224)

Strengthening farm operators' capacity for climate change adaptation

Robert Weaver, Armen Kemanian, Charlie White, Chris Duffy and John Tooker

Framework

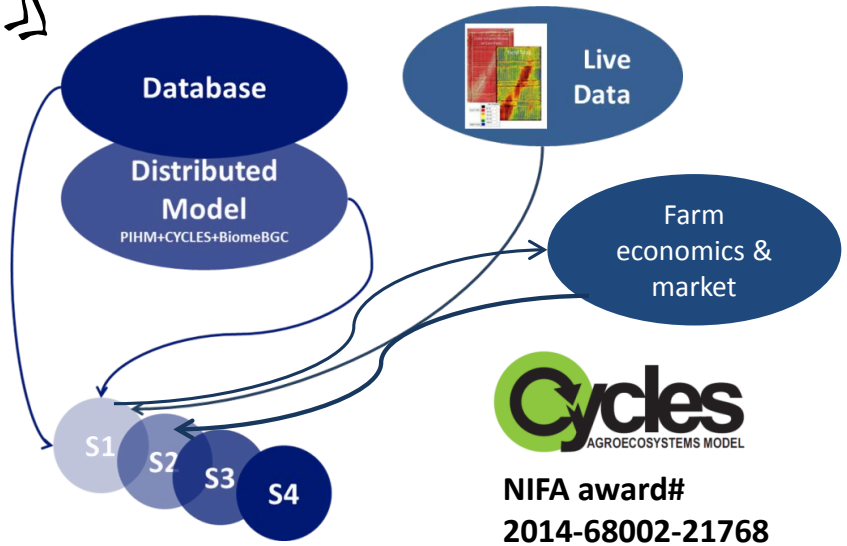
Farm operators make strategic and tactic decisions based on dynamic climate and market processes. However, they do not access and use all the information enabled by powerful information technologies.

Objectives

Assemble a model-based tool for Strategic Adaptive Management Support System (SAMSS). The tool connects market condition assessments with the agroecosystems model Cycles.

Impact

- **Decision support tool to evaluate alternative farm-level strategies.**
- **Climate and market scenario-based analytics to enhance operators' adaptive capacity.**



NIFA award# 2014-68002-21768

Carbon cycle dynamics within Oregon's urban-suburban-forested-agricultural landscapes:
Part 1 - Current Land-Use/Land-Cover

PI: B.E. Law, CoIs: C. Still, T. Hilker, A. Schmidt Oregon State University

Objectives

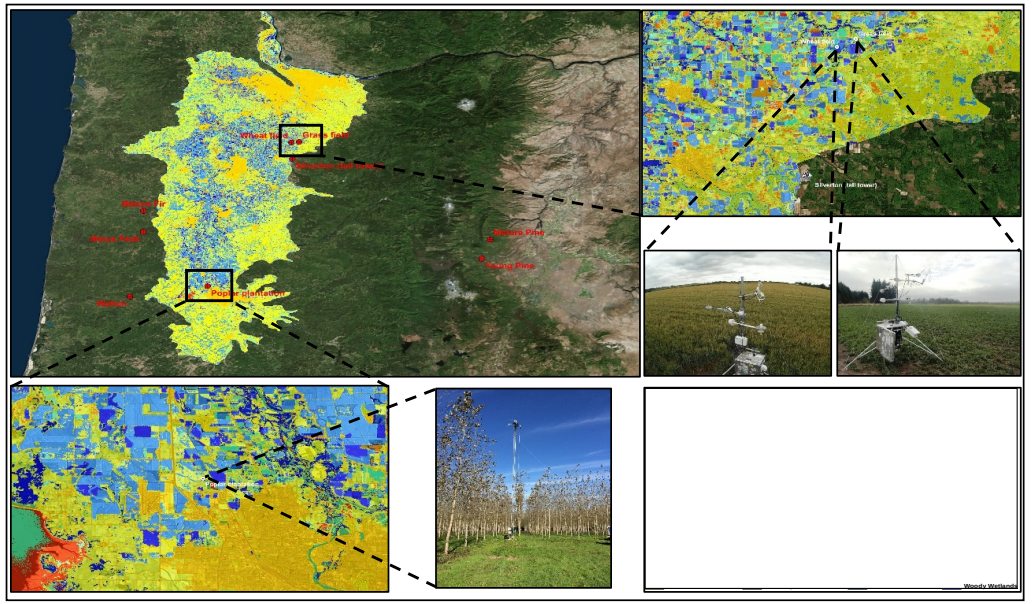
- Compare effects of climate and land use on fluxes within the same climate zone and among the mesic and semi-arid regions
- Combine multi-scale observations (satellite, flux sites, inventories, tall towers) in neural networks to determine how *current* climate, land-use and land cover influence processes

Approach

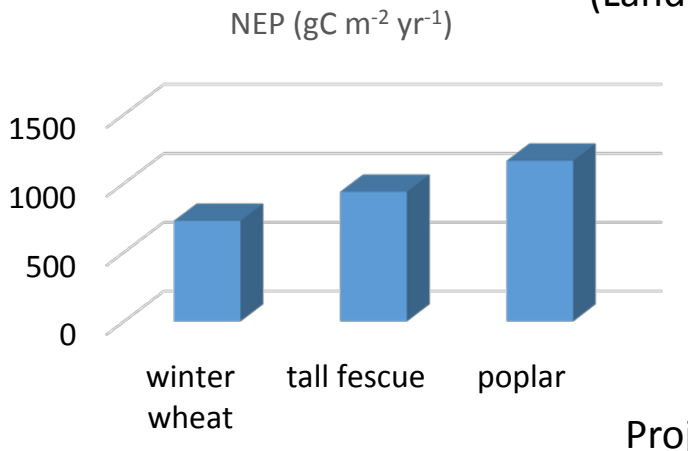
- Establish flux sites in major crops (wheat, grass seed) and poplar
- Compare seasonal and annual fluxes among cover types
- Assess effects of current land cover and land use on ecosystem processes

Impacts

- Enhanced carbon uptake by afforestation of major non-food, non-forage crops
- Information for reducing GHG emissions



(Land cover by T. Hilker)



Project # OREZFES-867

Carbon cycle dynamics within Oregon's urban-suburban-forested-agricultural landscapes:
Part 2 – Future Climate and Land-Use/Land-Cover

PI: B.E. Law, CoIs: C. Still, T. Hilker, A. Schmidt (Oregon State University), Collaborator: T. Hudiburg (UI)

Objectives

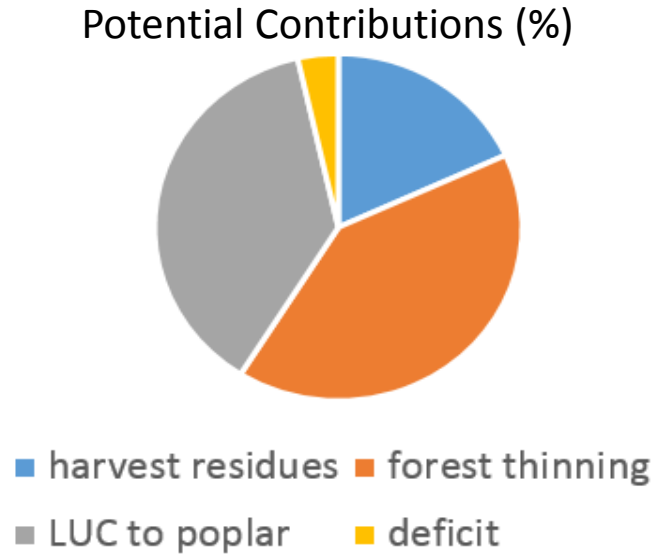
- Modify CLM to reduce uncertainties in simulated effects of land use and land cover on biogeochemical and biophysical processes (crops, poplar)
- Investigate future climate variability, and effects of changes in land use and land cover on terrestrial processes

Approach

- Assess uncertainty in CLM using flux site data and tall tower CO_2 data
- Determine effects of land-use change from non-food grass seed crop to poplar for bioenergy
- Simulate thinning of vulnerable forests and LUC of crop to poplar to supply bioenergy facility
- Determine sustainability of supply while minimizing impacts on forests

Impacts

- Information for land-use effects on the land carbon sink and atmosphere
- Information for reducing GHG emissions



Thinning dry vulnerable forests reduced C stock, not sustainable
LUC from grass seed to poplar increased C stock (belowground)

Project # OREZFES-868

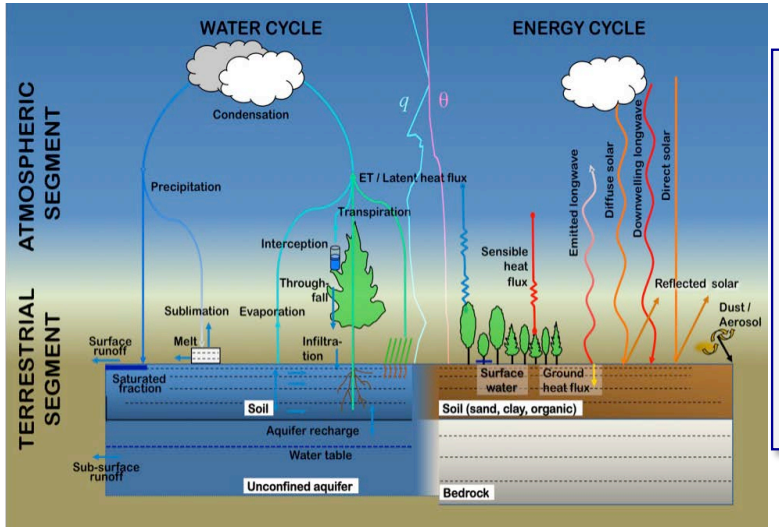
Collaborative Research (EaSM3, NSF/NIFA): Land Use Change and Land-Atmosphere Feedback Processes as Regulators of Regional Climate Change

PIs Paul Dirmeyer, George Mason University; Dave Lawrence, NCAR

Objective

Understand and quantify the nature of land-atmosphere interactions

- as they exist today
- as they may be modulated by the radiatively-driven component of climate change
- as they may evolve with changing land use



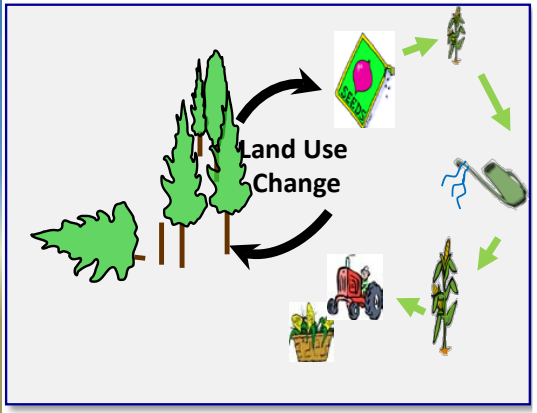


Figure 1. The hydrologic and energetic components of the land-atmosphere system.

Approach

Build upon recent advances in process-based understanding of land-atmosphere coupling to more thoroughly explore how anthropogenic land use can modify the physical and biospheric pathways through which land-atmosphere interactions are initiated and maintained

NIFA Award # 2015-67003-23489

Impact

- Improved understanding of impacts and interactions of climate and land-use change provides a benefit to society by allowing for more informed policymaking, especially as land-use change impacts on climate may amplify in the future
- Contribute to the design of Land Use Model Intercomparison Project (LUMIP) of CMIP6
- Define metrics for assessment of land-use change and land-atmosphere interactions for LUMIP

Soil Organic Carbon Interactions with Organic Matter Additions: Mechanisms and Models

PD: Johannes Lehmann (Cornell University) (award 2014-67003-22069)
Collaborators: Natalie Mahowald, Dominic Woolf (Cornell University), Nancy Hess (EMSL), Thea Whitman (University of Wisconsin)

Cornell University EMSL THE UNIVERSITY of WISCONSIN MADISON

Objective

*Objective 1***.** Quantify priming effects of organic substrates of varying quality (litter, PyOM, root) on SOC
Objective 2. Determine mechanisms dominating SOC priming interactions
Objective 3. Include effect of priming in two key soil carbon cycle models (CENTURY and CLM-CN)

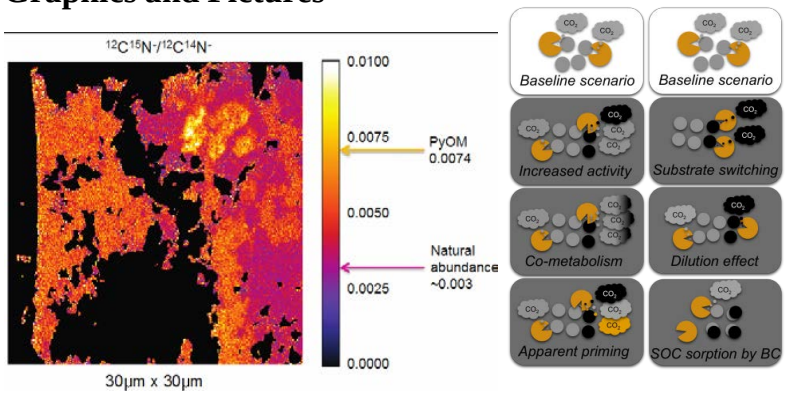
Impacts

- Improved mechanistic understanding of priming reactions to advance next-generation, integrated models of the human-Earth system
- Improved prediction of soil carbon feedback to soil management in a changing climate

Approach

- Production of ^{13}C-labeled biomass
- Pyrolysis at different temperatures
- Incubations studies (use of different soils, amounts of easily mineralizable carbon, additions of nutrients and lime) to measure $^{13/12}CO_2$ and surface interactions (NanoSIMS, laser ablation AMS)
- Greenhouse studies with plants
- Use of three-part partitioning with two isotopes
- Modification of soil organic carbon models

Graphics and Pictures

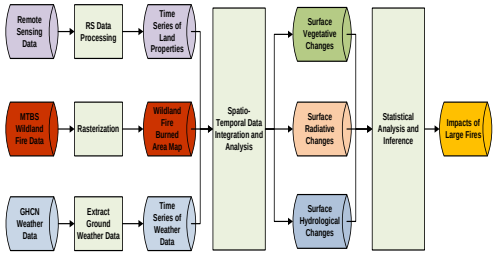


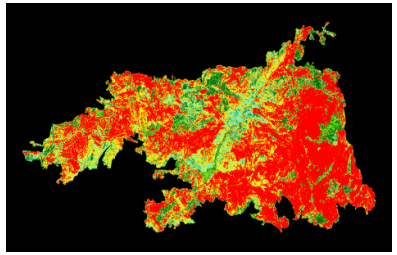
Project Director: Yongqiang Liu, USDA Forest Service (yliu@fs.fed.us)

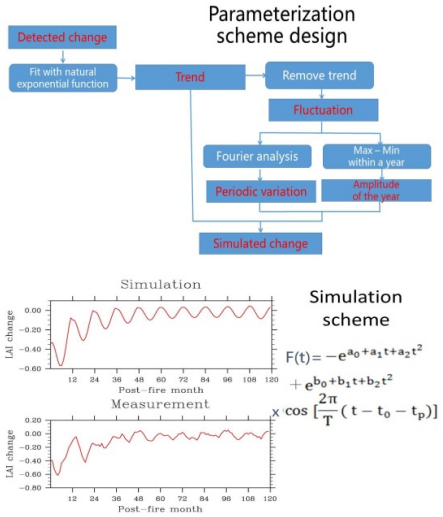
Detecting and Parameterizing Wildfire Induced Land-surface Changes for Earth System Models

Objectives

- Develop an approach to identify the land-surface changes due to wildfires
- Detect land-surface property changes for multiple mega-fires in the U.S.
- Develop a scheme to parameterize the changes







Approach

- Examine more than a dozen of mage-fires obtained from the Monitoring Trends in Burning Severity (MTBS) (USGS and USFS) .
- Obtain changes in NDVI, LAI, albedo, and temperature from MODIS products.
- Develop a parameterization scheme through analyzing and fitting the post-fire changes in land-surface properties.

Impact

- Thresholds to identify the fires capable of generating significant land-surface property changes.
- Knowledge of patterns, magnitude, and differences in the fire-induced changes with different properties.
- Parameterization scheme to provide a tool that adds the CESM capacity in simulating regional climate effects of wildfires through land-air interactions.

NIFA award #: 2013-35100-20516

Predictability of Impacts of Decadal Climate Variability on Water and Crop Yields in the Missouri River Basin, and Its Use in Agricultural Adaptation

Project Director: Vikram Mehta, Center for Research on the Changing Earth System

USDA – NIFA Grant 2011-67003-30213 in the EaSM Program.

Background

❖The Missouri River Basin (MRB), largest river basin in the US, 46% wheat, 22% grain corn, 34% cattle produced in the Basin; Over 2000 urban water systems

❖Natural decadal climate variability (DCV) phenomena – Pacific Decadal Oscillation (PDO) and tropical Atlantic SST variability - make major impacts on the MRB

Objectives

☞ Develop decadal climate, water, and agricultural impacts prediction system

☞ Develop adaptive water and agriculture management system

☞ Assess value of decadal climate and impacts information to MRB agriculture

Approach

⦿ Decadal climate prediction by four global Earth System Models

⦿ Hydro-meteorological predictions and idealized scenarios as inputs to the Soil and Water Assessment Tool (SWAT), a land use-hydrology-crop model calibrated for the entire MRB at 12 km x 12 km scale

⦿ Use of SWAT outputs in the water and crop choices model RIVERSIM to assess economic impacts

⦿ Observed climate, hydro-meteorological, stream flow, and crop data from 1961 to 2010.

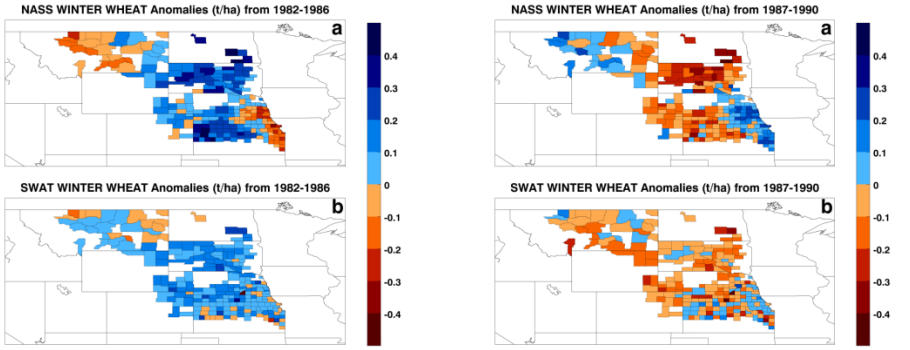
Outcomes: Development of models and methodologies for prediction of

DCV impacts on water and crop yields; Development of crop adaptation options for farmers; Assessment of value of DCV information to MRB agriculture; webinars and workshops with 25 stakeholders; 5 PhD thesis; 16 undergraduate students trained to use SWAT; 6 peer-reviewed papers and 10 conf. presentations

SWAT verification of NASS winter wheat yields in wet and dry epochs

Wet; PDO index positive

Dry; PDO index negative

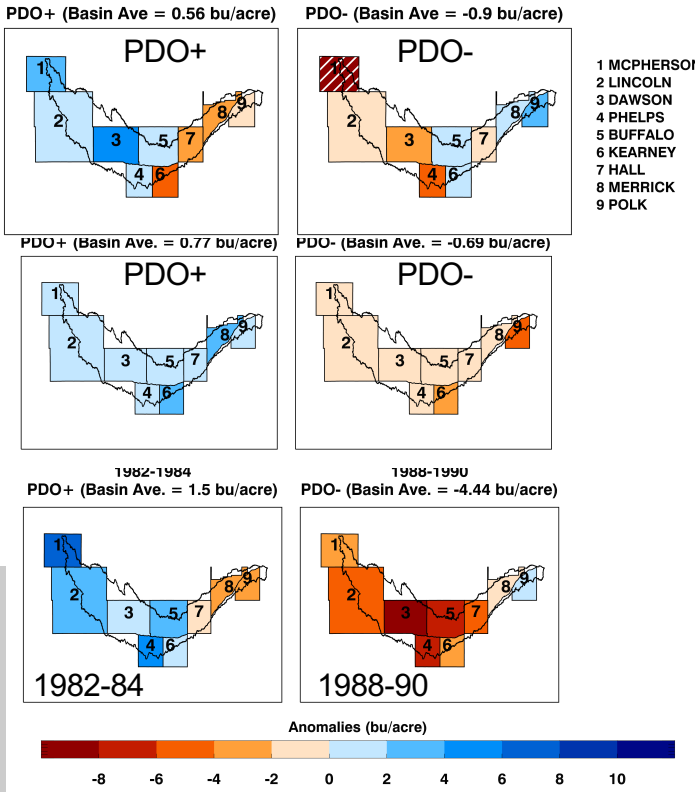


Decadal climate prediction started in Jan. 1981 predicts positive PDO phase in 1982-84 and negative PDO phase in 1988-90; this info. used for multiyear winter wheat yield prediction.

Winter wheat yield anomaly prediction with 50-year NASS data statistics

Winter wheat yield anomaly prediction with SWAT

Actual yield anomalies

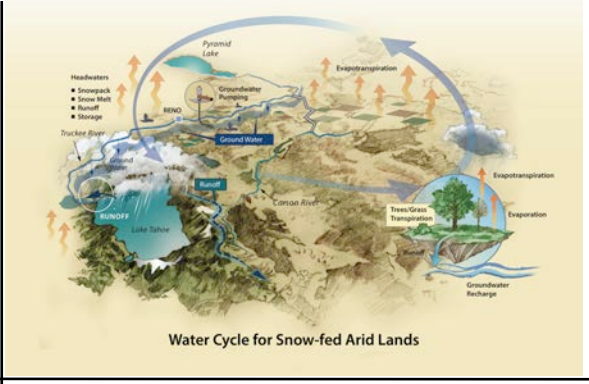


Project Director: Maureen I. McCarthy (University of Nevada, Reno)

Water for the Seasons: Water Sustainability and Climate Resiliency in Snow-Fed Arid Lands

Objectives

- Develop stakeholder-informed climate scenarios
- Model water supply/demand outcomes resulting from the climate scenarios
- Integrate human decision-making with hydroclimatic models to understand water sustainability and climate resiliency
- Assess the transferability of this approach



Water Cycle for Snow-fed Arid Lands

Snow-Fed Arid Land Water Cycle

Pilot Area – Truckee-Carson River System (TCRS)

Approaches

- Integrated team – hydrologists, climate scientists, environmental policy experts, resource economists, artists, environmental journalists
- Participatory modeling used to engage diverse stakeholder groups from TCRS headwaters to terminus
- Partnership with researchers, extension faculty, federal scientists (USGS) and Stakeholder Affiliate Group
- Producing multimedia outreach and education materials

Impacts

- Tested water sustainability and using suite of stakeholder-informed climate scenarios
- Stimulated system-wide interactive discussions among stakeholders about adaptation trade-offs using new integrated surface and groundwater models
- Models used to develop 30 year drought contingency plan for Truckee Meadows Water Authority

Partners

University of Nevada, Reno; Desert Research Institute; USGS science for a changing world; Ohio University

Sponsors

NSF; USDA

NSF/USDA WSC Project: 130505/130506

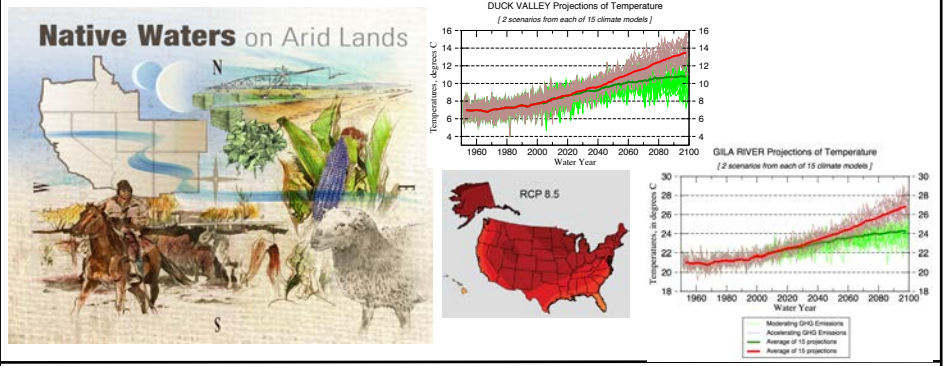
Native Waters on Arid Lands

Project Director: Maureen I. McCarthy (University of Nevada, Reno)

Enhancing Climate Resiliency of Tribal Farming and Ranching in Southwest

Objectives

- Analyze projected climate impacts to water resources
- Identify opportunities and barriers to sustaining tribal agriculture for trade and sustenance
- Enhance understanding of agricultural practices from traditional knowledge and ecology
- Build research capacity for students and faculty in partnership with Tribal Colleges and Universities (TCU



Approaches

- Integrated research and extension team of climate scientists, hydrologists, resource economists, ecologists, artists, journalists
- Research partnership with FALCON and TCU network
- Host Tribal Summit annually with tribal leaders, resource managers, farmers, ranchers
- Nevada and Arizona Federally Recognized Tribal Extension program facilitating collaboration with tribes

Impacts

- Created forum for researchers and tribal members to share knowledge and build trust
- Established faculty-faculty partnership to support TCU student research internship
- Building knowledge portal to share secondary data among researchers, tribal partners, and TCU faculty
- Provided tribes in research area with reservation-based climate projections to inform climate adaptation plans

SPONSORED BY USDA NIFA United States Department of Agriculture National Institute of Food and Agriculture

PARTNERS University of Nevada, Reno; DRI Desert Research Institute; USGS science for a changing world; Ohio University Voinovich School of Leadership and Public Affairs; FALCON; UtahStateUniversity; The University of Arizona

USDA/NIFA Grant: 2015-69007-23190

Migration of Agricultural Production Back to the Southeast as a Climate Change Adaptation Strategy

Richard McNider [1], Gerrit Hoogenboom[2], Richard Marcus [3], Grover Ward[4], Amelia Ward[4], Lee Ellenburg[1], John Christy [1], Jeff Mullen[5], James Cruise [1], Cameron Handyside [1]

The Problem

•The droughts of 2012 and the current California drought are illustrative of the problems our USDA-EaSM proposal foresaw in 2010. Our EaSM proposal was based on the concerns about the migration of agriculture in the 20th century which concentrated grain production in a small area in the upper Midwest and concentrated vegetable, potato, cotton and other crops in the arid West. While this migration produced extraordinary food and grain production is it a sustainable geography?

•With nearly 90% of the Nation's corn production now concentrated in a small region we have made corn for food, feed and energy vulnerable to small regional droughts which we know from historical data will occur and may be exacerbated by climate change.

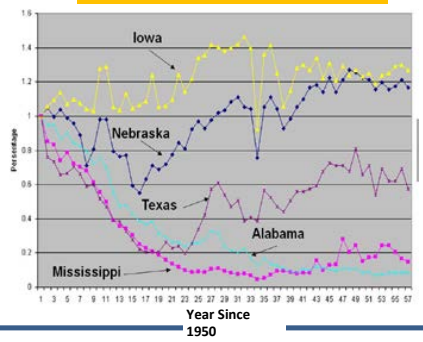
•Loss of agriculture devastated rural economies especially in the South.

•This migration has left the U.S. vulnerable to the concentration of agriculture in the arid West where existing water resource scarcity may be exacerbated by climate change.

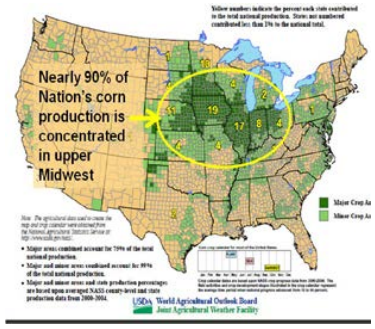
•The migration and concentration of grain production leaves the U.S . And the world vulnerable to regional droughts in the upper Midwest.

•Concentration of grain production in upper Mississippi Valley adds to nutrient loading and hypoxia in Gulf of Mexico. Substantial energy consumption is tied to transporting agricultural products to consumers.

Corn Acres Planted as Fraction of 1950



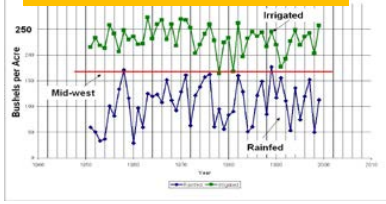
Distribution of U.S. Corn Production



Potential Solution

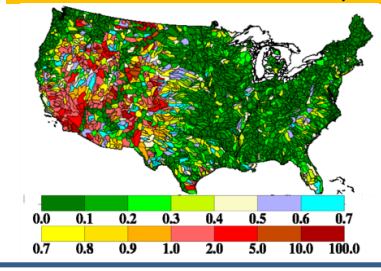
•Agricultural production in the East appears to be economically competitive under an irrigation . A more distributed production system may more sustainable.

Corn Yield Estimated by DSSAT Crop Model for Coastal Plain Soils in South Alabama



•The water resources in the Southeast appear able to support sustainable expanded irrigation using a smaller fraction than the West. Average water availability in the SE is much greater than the West but there are infrequent periods of drought when rivers can be stressed. This argues for intermittent withdrawal restrictions.

Ratio of Water Consumed to Water Availability



Objectives of Project

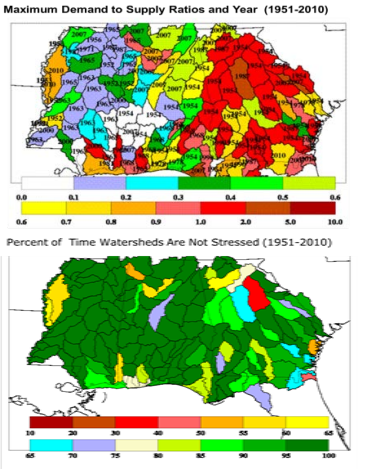
•Couple climate, crop, hydrologic, economic ,ecosystem and social models to determine full economic and environmental costs of expanded irrigation in the Southeast.

•Assess the impact on regional water resources. While average resources are plentiful water sheds can sometimes be impacted by drought.

•Assess nonlinear impact on flood plains of water withdrawal.

•Assess social and political barriers to expanded irrigation .

Monthly Stress Index - Fraction of Water Consumed (by all uses) to Water Availability



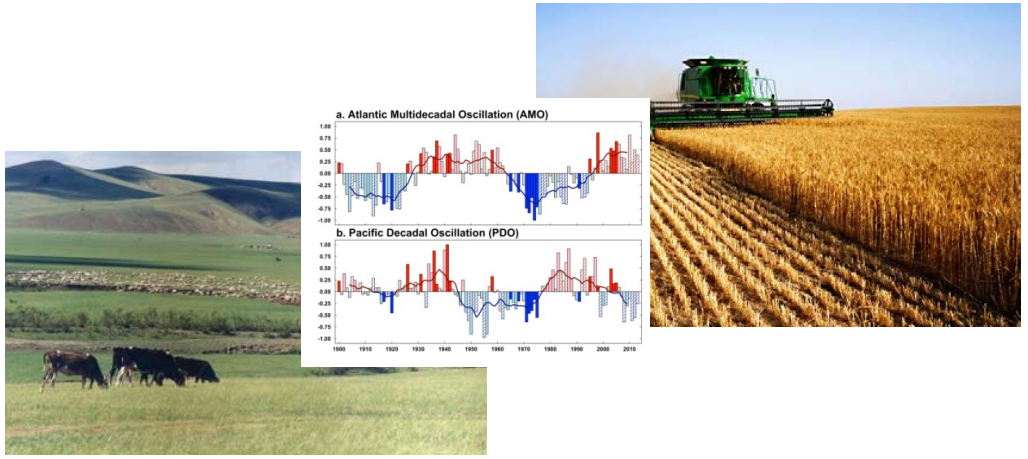
University of Alabama in Huntsville[1], University of Florida[2], California State University Long Beach[3], University of Alabama[4], University of Georgia[5]

Project Director: William Parton, Natural Resource Ecology Laboratory, Colorado State University

Impact of Sea Surface Temperatures, Climate and management on Plant Production and GHG fluxes in Asia and the Great Plains

Objectives

- Link the DayCent/Century model to the UCLA Land Surface model
- Determine the impact of agriculture practice in the U.S. and Asia on soil nutrient cycling, greenhouse gas fluxes, and global carbon cycling
- Evaluate the impact of AMO, PDO, and ENSO sea surface temperature on grassland plant production in the U.S. Great Plains



Approach

- Link the DayCent soil carbon and nutrient cycling models into the UCLA Land Surface model
- Use the DayCent model to simulate the impact of current land use practice in Asia on greenhouse gas and carbon fluxes
- Use remote sensing NDVI, AMO, PDO, ENSO sea surface temperature patterns, and DayCent to simulate water fluxes to predict grassland plant production in the U.S. Great Plains

Impact

- Provide seasonal forecast of grassland plant production based on remotely sensed NDVI and sea surface temperature patterns in the spring
- Provide modeling tools which will allow farmers and ranchers in the U.S. and Asia to determine the impact of their land use practices on crop yields and nutrient dynamics on soil carbon and greenhouse gas fluxes
- Predict the impact of current and future land use practices on net greenhouse gas fluxes (C, N_2O, CH_4) in Asia

NIFA Award #2015-67003-23456

Useful to Usable (U2U): Transforming Climate Variability and Change Information for Cereal Crop Producers

Project Director: Linda S. Prokopy, Purdue University

AFRI Grant No. 2011-68002-30220

United States Department of Agriculture
National Institute of Food and Agriculture

Objectives

1. Use **existing data and models** to better understand weather impacts on crop variability and implications for future management options.
2. Understand the **use and value of climate information** for agricultural decision making.
3. Develop **tools and resources** that lead to more effective decision making and adoption of climate-resilient practices.
4. **Evaluate the effectiveness** of decision resources and implementation approaches in four pilot states.
5. Broadly **disseminate validated decision tools and Extension programs** across the Corn Belt.

Impacts

U2U By The Numbers

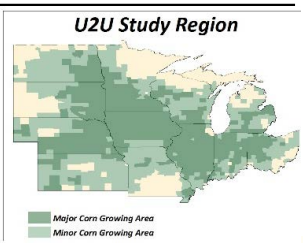
- 50 Peer-Reviewed Publications
- 37,000+ Web Users
- 5 Decision Support Tools
- 150+ Outreach Events
  - 1 Scientific
  - 4 Conference
  - 5 Presentations
- 150 Trade & Popular Press Articles
- 2015 College of Ag TEAM Award
- 2015 USDA-NIFA Partnership Award
- TEN Students Graduated

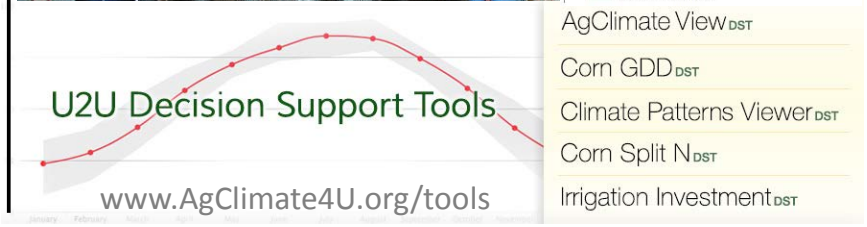
Approach

The U2U project uniquely integrates biophysical and social science research to develop usable climate tools for farmers and ag advisors. Our interdisciplinary team includes experts in natural resource social science, climatology, ag economics, crop modeling, Extension, and IT.

Stakeholder engagement is at the core of this project and highly critical to its success. Agricultural producers and advisor groups, including University Extension, play an important role in the co-production of science.

Evaluation in an ongoing task to ensure tool development, outreach, and dissemination efforts are effective and stakeholder needs are met. Evaluation also enables consistent tracking of project outcomes & impacts.





Lessons Learned from Five Years of Investment by USDA NIFA into Climate Change and Agroecosystems

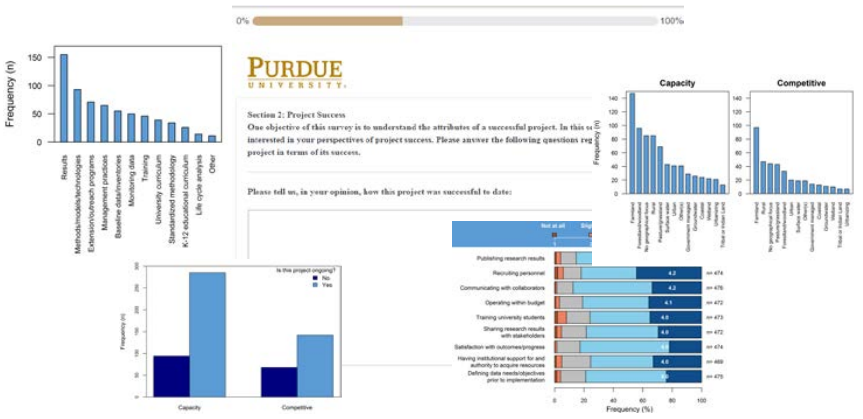
Linda Prokopy, Purdue University, Co-Principal Investigator
Jerry Hatfield, USDA ARS, Co-Principal Investigator

PURDUE UNIVERSITY

USDA ARS
United States Department of Agriculture
Agricultural Research Service

Objective

Develop a synthesis of USDA NIFA's investments in the climate change and agroecosystems 2010-2015 portfolio.



Approach

- Multi-method study (surveys, focus groups, case studies, mapping, data mining, interviews)
- Analyze the impact of research, education, and extension
- Evaluate success of projects and how to create a successful project

Impact

- Robust picture of the outcomes, knowledge, educational curriculum, outreach, and tools that were developed with USDA NIFA support
- Determine gaps in research, education, and extension not addressed by USDA NIFA programs

Award number: 2016-67003-24895

Climate Change Mitigation and Adaptation in Dairy Production Systems of the Great Lakes Region

Award No. 2013-68002-20525

USDA United States Department of Agriculture | National Institute of Food and Agriculture

SUSTAINABLE DAIRY

SCIENCE FOR SUSTAINABLE PRODUCTION

PD: Matt Ruark Co-PD: Molly Jahn
Carolyn Betz, Project Manager
University of Wisconsin-Madison

WISCONSIN UNIVERSITY OF WISCONSIN–MADISON

sustainabledairy.org

Objectives:

- Conduct experiments at a network of monitoring sites to measure greenhouse gases and water and energy fluxes across each phase of dairy production systems: cow and barn; manure handling and processing; soil and feed
- Make experimental results available in a publicly-accessible data library
- Develop decision support tools for management practices that mitigate and adapt at the farm level without compromising profit
- Analyze and integrate process models across scales
- Conduct life cycle analyses of dairy production systems
- Conduct Extension and outreach at farm and regional level
- Conduct education activities at high school, undergraduate and graduate levels, including summer internship opportunities

Approach:

- Conduct research in Wisconsin, Pennsylvania and New York; present and publish findings
- Harmonize five process models coordinated across six institutions; present and publish findings and share with the Life Cycle Assessment team
- Conduct Life Cycle Assessment and Life Cycle Inventories to identify beneficial management practices
- Share findings using national eXtension, a Virtual Farm and other outreach programming through one-on-one education and regional conferences
- Engage students in opportunities to learn about greenhouse gas fluxes through first hand experiences, field and laboratory experiments and curricula related to agricultural production systems

Impacts

- Farmers, product manufacturers, policy makers, teachers, students and the general public will be better informed about sustainable management practices for dairy.
- Greenhouse gas emissions from all components of the dairy production cycle (cow, manure, and soil management) will be reduced.
- Beneficial management practices will be adopted in dairy production systems to increase resilience to climate change.

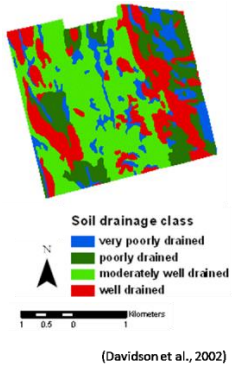
University of Washington | INNOVATION CENTER FOR U.S. DAIRY | UNIVERSITY OF MARYLAND | UNIVERSITY OF MICHIGAN | Cornell University | PENNSTATE | North Carolina Agricultural and Technical State University | UNIVERSITY OF ARKANSAS

Project Director: Eric Davidson, University of Maryland Center for Environmental Science
David Hollinger, Andrew Richardson, Kathleen Savage, Julie Shoemaker, Debjani Sihi

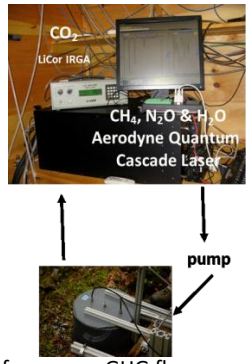
Integrated Belowground Greenhouse Gas Flux Measurements and Modeling

Objectives

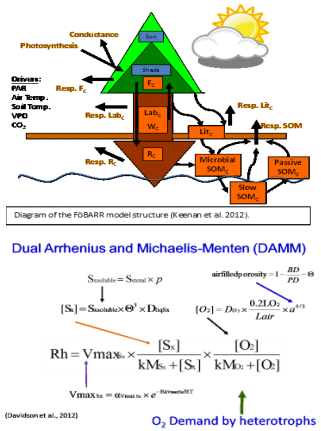
- Novel integration of measurement and modeling of upland and wetland soils at the Howland Forest AmeriFlux site in central Maine.
- Improve understanding of interactions of belowground temperature, moisture, and substrate supply as controllers of net soil emissions of CO_2, CH_4, and N_2O (GHG).
- Merge the Dual Arrhenius and Michaelis-Menten (DAMM) soil enzymatic kinetics model and the Forest Biomass, Assimilation, Allocation and Respiration (FöBAAR) ecosystem flux model.
- The parsimonious structures of these models are designed to be applicable to both site-level analysis and Earth system models.



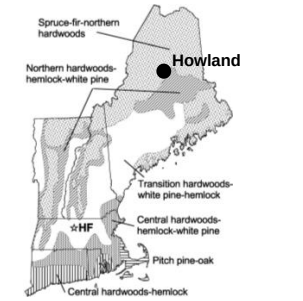
Mosaic of soil drainage classes at the Howland Forest.



High frequency GHG flux measurements using newly available fast response, highly accurate laser based instruments.



Merging the DAMM and FöBAAR model-DAMM heterotrophic respiration model shown.



Approach

- High temporal frequency measurements of soil and ecosystem fluxes of multiple GHGs.
- Develop and test DAMM model for CO_2, CH_4 and N_2O fluxes along a soil drainage gradient.
- Develop and validate the merged DAMM- FöBAAR model, providing a new approach to simulation of climate-dependent responses of terrestrial ecosystems at both short (hourly to seasonal) and long (annual to centennial) time scales.

Impact

- Simulations of CO_2, CH_2, and N_2O fluxes from belowground processes using DAMM will be internally consistent with respect to the biophysical processes of gaseous production and transport within the soil.
- Linking GHG's belowground, through DAMM, to aboveground processes of carbon supply through FöBAAR to the soil, has the potential to provide greater confidence that the most important mechanisms are appropriately simulated.
- Due to its parsimonious and modular structure of DAMM- FöBAAR, this modeling approach will inform effective ways of improving representation of these important GHG flux processes in earth system models.

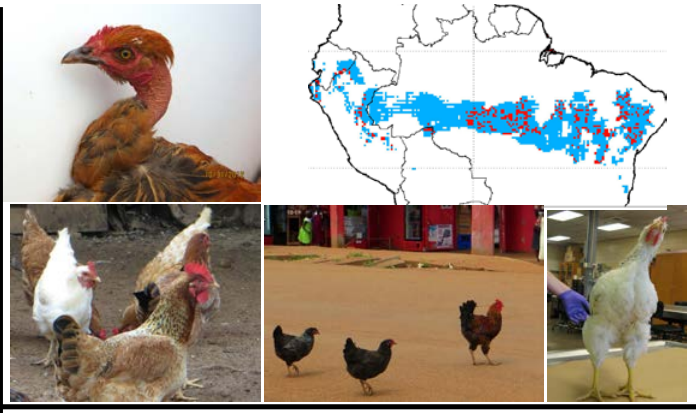
USDA award # 2014-67003-22073

Project Director: Carl J. Schmidt, University of Delaware

Adapting Chicken Production to Climate Change through Breeding

Objectives:

- Identify alleles that adapt chickens to the stress of a changing environment.
- Identify alleles that improve nutrient utilization in production lines of chickens.
- Identify novel alleles in African chickens where birds have been naturally selected to be more tolerant of climate variation.



Approach:

- Molecular genomic methods were employed to identify multiple genes and genomic regions responsive to climate change and regulating feed efficiency in chickens.
- Encompassed scientists from 4 U. S. and 3 African institutions.
- Multiple U.S. lines were sampled along with chickens from Uganda, Egypt and Rwanda.

Impact:

- Genome wide association studies mapped 120 genomic loci controlling response to heat stress or impacting nutrient use.
- In the African chickens, multiple genomic regions were identified suggesting the birds were under selection for improved resistance to oxidative stress.
- Transcriptome studies in multiple chicken lines identified over 1000 genes responsive to heat stress.

NIFA Award 2011-67003-30228

University of Delaware | Iowa State University | USDA United States Department of Agriculture National Institute of Food and Agriculture | Virginia Tech | NC State University

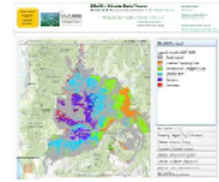
REACCH
Regional Approaches to Climate Change – Pacific Northwest Agriculture

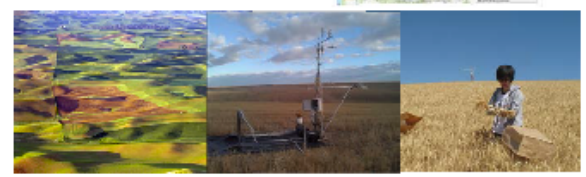
Project Director: Sanford Eigenbrode, University of Idaho

Climate Adaptation and Mitigation for Wheat Production Systems of the Inland Pacific Northwest

Objectives

- Identify and implement management approaches and technology that
  - impart resilience to climate change
  - reduce GHG emissions
- Extend project information to producers and others
- Educate next generations: K-20





Approach

- Integrated effort involving biologists, agronomists, climate modelers, economists, entomologists, sociologists, educators, extension educators
- Regional, with 3 universities, ARS, >200 participants (PIs, students, others)
- Stakeholder input from inception
- 75:12:13, Research:Education:Extension

Impact

- Prepared farmers and stakeholders capable of managing climate/agriculture issues
- Climate resilient, sustainable wheat production in the PNW
- Physical and cyberinfrastructure to support continued integration across disciplines and institutions in the PNW

OSU Oregon State University | Washington State University | University of Idaho | USDA ARS

NIFA award #: 2011-68002-30191

Utah State University ECOLOGY CENTER

Project Director: John M. Stark, Utah State University

Microbial Carbon-use Efficiency in Agroecosystems: The Effect of Drought and N Availability on Soil Microbial Production and Respiration

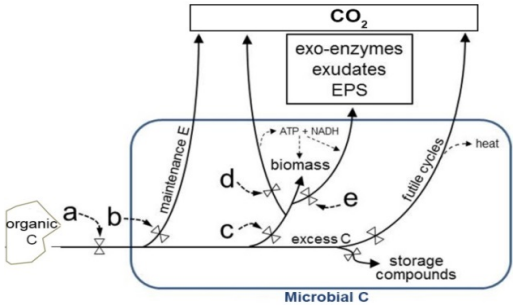
USDA United States Department of Agriculture National Institute of Food and Agriculture

NIFA Award 2016-67004-24920

Objectives:

- Determine how soil moisture and nutrients regulate microbial C-use efficiency (CUE)
- Develop mathematical functions that can be incorporated into earth system models
- Improve our ability to predict the impact of climate change on soil C-sequestration in agricultural systems

Microbial partitioning of carbon



Approach:

- Utilize novel isotopic techniques involving gas-phase ^{13}C and ^{15}N to measure microbial CUE in both dry and moist soil
- Measure how CUE changes in lab and intact field soils under different environmental conditions
- Model interactive effects of nutrient availability, soil water content, and soil water potential on microbial CUE

Progress During First Year:

- Demonstrated proof of concept for gas-phase ^{13}C and ^{15}N measurements of microbial CUE
- Refined isotopic techniques for use in agricultural soils
- Completed preliminary experiments showing water potential and water content effects on microbial CUE

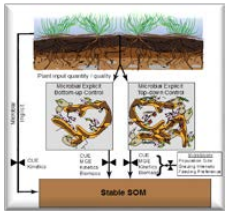
Decadal prediction of sustainable agricultural and forest management - Earth system prediction differs from climate prediction

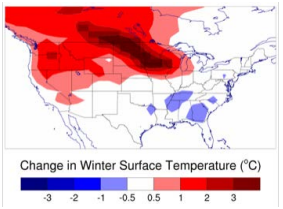
PD: Quinn Thomas, Virginia Tech

Funded through interagency Decadal and Regional Climate Prediction Using Earth System Models (EaSM) Program

Objectives

- Explore how crop and forest management influences decadal scale climate predictions
- Improve the representation of managed ecosystems in Earth system models
  - Specific focus on institutional strengths: soil carbon dynamics, pine plantation forestry, plant physiology under warming temperatures, forest nitrogen cycling
- Evaluate and reduce uncertainty associated with ecological processes in climate predictions





Approach

- Integrated effort involving climate modelers, ecosystem scientists, plant physiologists, soil scientists, and foresters.
- New field measurements and synthesis of existing datasets for parameterization and evaluation of an Earth system model
- Development and application of the Community Earth System Model

Impacts

- Crop and forest management strategies that maximize climate benefits
- Earth system modeling tool available to the community to predict crop and timber production in a changing environment
- Capacity building through connecting and training scientists to work at the interface of managed ecosystems and climate sciences

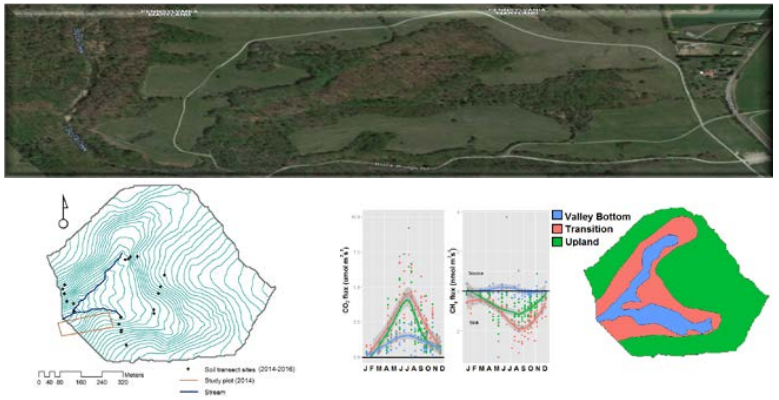
USDA-NIFA Project 2015-67003-23485

Project director: Rodrigo Vargas, University of Delaware

Coupling Solid-Aqueous-Gas Phases of Carbon and Nitrogen across Topographic Gradients and Extreme Weather Events

Objectives

To understand how weather variability (including extreme weather events) influences the key ecosystem processes of nutrient and soil GHG fluxes in ex-urban forests



Approach

- *In situ* field measurements across topographic gradients
- Experiment of extreme water pulses on soils
- Automated measurements of multiple soil GHG
- Up-scaling information using digital soil mapping techniques

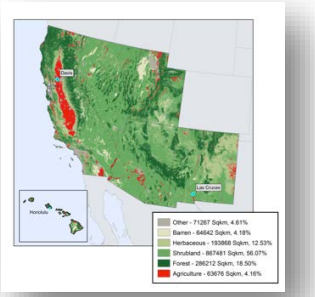
Impact

- Training next generation of environmental professionals capable to address climate/ecological challenges
- Discovery of new ecosystem processes and responses to weather variability
- Development of novel techniques to measure soil greenhouse gases and upscale measurements using digital soil mapping.

NIFA Award #: 2013-02758

Project Director: Mark Walker, University of Nevada

Forging A Working Partnership In The Southwestern United States For Locally Relevant, Action-Oriented Climate Change Education



Objectives

- Develop a working intellectual foundation to support development of local adaptation and mitigation strategies
- Identify stakeholder and extension staff needs and concerns.
- "Mainstream" Climate Literacy in Extension's educational programs and materials.
- Develop a strong working partnership between Extension and research groups (such as the Hub and Sub Hub efforts, and state climate offices)
- Share resources and approaches to programs and teaching about climate
- Develop approaches to program evaluation

Regional Climate Related Issues

Left to Right: 1. Wildfire (U.S. National Park Service, Hawaii), 2. Drought (Nevada Governor's Office), 3. Tree die-off in California's Sierra Nevada (Shauna Potocky), 4. Habitat loss for threatened species (Friends of Black Rock, High Rock), 5. Flooding in New Mexico (NOAA), 6. Predicted sea level rise, Guam (Pacific RISA), 7. Reduced snow pack in Utah (KUER), 8. Water supply for the central Arizona Project, (azwater.gov).

Approach

- Hold a regional workshop to:
  - Advance the partnership between Cooperative Extension, our partners and the Southwestern regional Climate Hub (Las Cruces, NM) and Subsidiary Hub (Sub Hub)(Davis, CA)
  - Take participants from education to action about climate change.
  - Build on the experiences and evaluations from the 2013 National Extension Climate Science Initiative workshop, organized by the Association of Natural Resources Extension Professionals (ANREP) and other national
  - create regional working teams that harness our collective resources of our states to develop locally relevant, programs

Impact

- Partnerships
- Shared resources
- Efficiencies in program development and delivery
- Climate science as a regional, cross-disciplinary theme
- Supports Western Governors' and Western Land Grant University agenda for program emphases

Partners

Center for Climate Adaptation Science and Solutions · The University of Arizona College of Agriculture & Life Sciences Cooperative Extension · USDA United States Department of Agriculture Southwest Climate Hub · University of Nevada, Reno · University of California Agriculture and Natural Resources · NMSU Extension · Utah State University · College of Tropical Agriculture and Human Resources Cooperative Extension · University of Guam

Carbon cycling in native vs. non-native dominated systems 2014-67003-22067

PD: Brian Wilsey, Iowa State University
Co-PD: Kirsten Hofmockel, Iowa State University
Collaborator: H. Wayne Polley, USDA-ARS Temple, TX

IOWA STATE UNIVERSITY USDA ARS Agricultural Research Service

Objective

We are addressing a fundamental information gap on how belowground C-cycling is impacted by the replacement of native rangelands with non-native communities. Our specific objective is to determine if C cycling processes are altered by conversion of native to exotic-dominated grasslands using ongoing experiments and comparative studies.

Impacts

So far, we have found that carbon cycling is significantly different between native and non-native dominated systems, summarized in the following publications: Polley et al. 2016 (*Ecosystems*), Martin and Wilsey 2015 (*Ecology*), Craven et al. 2016 (*Phil. Trans.*), Isbell et al. (*Nature*), Xu et al. 2015 (*Ecology Evol*), Wilsey et al. 2014 (*Ecology Letters*), Xu et al. (*Ecosphere*).

Approach

Our objectives are being addressed by comparing in our exotic and native species mixtures: 1) belowground and aboveground net primary productivity, 2) soil C and root biomass in 10-cm depth increments to a 100 cm depth, 3) rate of infection by mycorrhizae and total fungal biomass, 4) N availability, 5) microbial community structure and enzyme activities, and 6) decomposition of root and shoot litter from plots in mesh bags.

Graphics and Pictures

Experimental plots in central Texas.

Nutrient mineralization probes. N mineralization was higher in native than non-native plots ($P < 0.01$)

Analysis Of Clinal Variation In Maize: Implementation Of An Experimental Framework For Studying Crop Adaptation

http://www.maizeatlas.org

2011-67003-30342

PD: **Randy Wisser**; PIs: **Natalia de Leon**, **Sherry Flint-Garcia**, **James Holland**, **Nick Lauter**, **Seth Murray**, **Wenwei Xu**

Objective

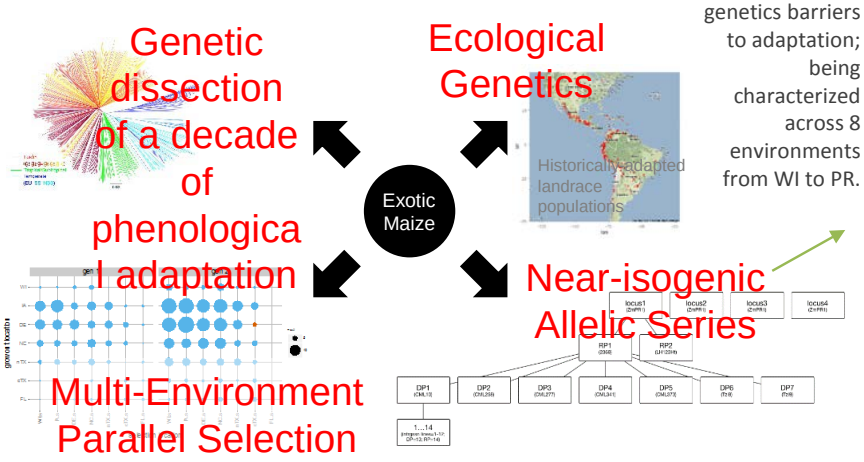
Create knowledge, approaches and resources for adapting crops to new environments

Approach

Develop an integrated experimental framework to study barriers to adaptation

Elucidate the genetic basis of selection response for environmental adaptation

Produce new genetic and genomic resources and analytical methods for plant breeding



Introgression lines developed for studying genetics barriers to adaptation; being characterized across 8 environments from WI to PR.

Impact

Enhance the ability to harness untapped gene diversity for the development of climate-resilient germplasm

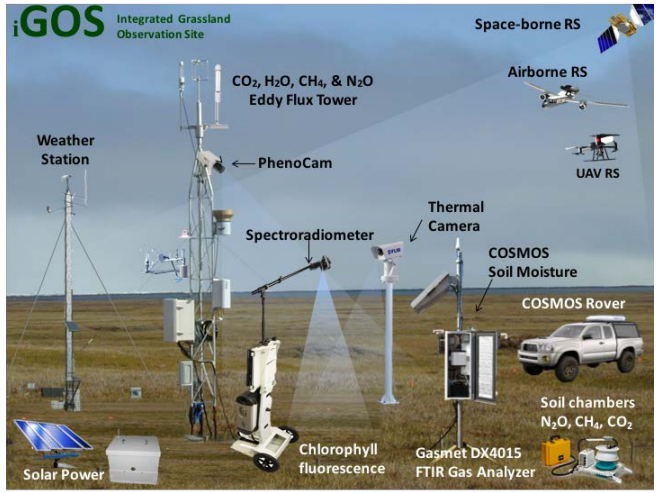
Project Director: Xiangming Xiao, University of Oklahoma

NIFA Award #: 2016-68002-24967

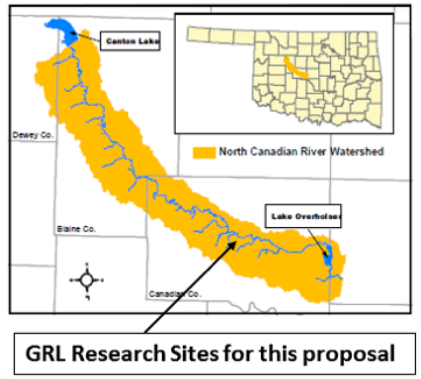
Multi-scale analysis of microbe-climate interactions in greenhouse gas emissions from grasslands and croplands

Objectives

- Understand, model and predict greenhouse gases emissions from grasslands and winter wheat croplands under changing microbes, climate, livestock and manure use across the scales of field, farm and watershed
- Broaden STEM education for K-12 and college students and teachers, and engage farmers, ranchers, decision makers, and citizen scientists to participate in *in-situ* data collection and analyses



Study sites at USDA ARS GRL, OU KAEFS,



Approaches

- Integrated and multi-scale observations and models for microbes, soils, plants, atmosphere, livestock grazing and cropland management practices
- Integrated research and education team for translation of research results to education activities
- Crowdsourcing and citizen science toolkits (e.g., Field Photo smartphone app) and training for broader participation
- Research and education components: 2/3 and 1/3

Impacts

- Improved knowledge of microbe-climate interactions and advanced models for greenhouse gases emissions from grasslands and winter wheat croplands
- Informed farmers, ranchers and decision makers on critical issues relevant to agricultural GHG emissions under various livestock and land management practices
- Improved agriculture-relevant STEM education for K-12 and college students and teachers

Project Partners: University of Oklahoma, University of New Hampshire, USDA ARS GRL, The BlueSTEM Agro-Learning Center