Transitioning Cereal Systems to Adapt to Climate Change

November 13-14, 2015

Funded through Award #2011-68002-30191 from USDA National Institute of Food and Agriculture

A sustainable approach to climate-adapted agricultural production

Ann Bartuska
USDA Deputy Undersecretary for Research
Education and Economics

United States Department of Agriculture
Research, Education, and Economics

Achieving Sustainable Agriculture Globally: Connecting the Pieces of a Complex System

Dr. Ann Bartuska

United States Department of Agriculture
Deputy Under Secretary for Research, Education, and Economics

Transitioning Cereal Systems to Adapt to Climate Change Conference
Minneapolis, MN
November 13, 2015

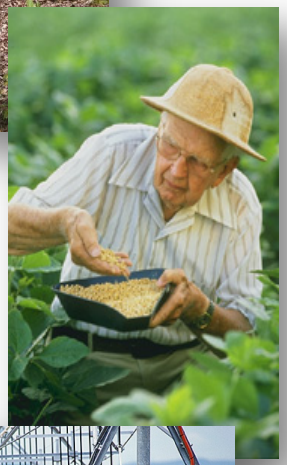
USDA
United States Department of Agriculture
Research, Education, and Economics

The Context

- 9 billion people by 2050
- 25% of all land “highly degraded”
- 60-75% of disease outbreaks from animals to humans
- By 2025, 1.8 billion potentially living with absolute water scarcity
- Uncertainty brought by climate change

United States Department of Agriculture
Research, Education, and Economics

Climate Change – Global and Regional

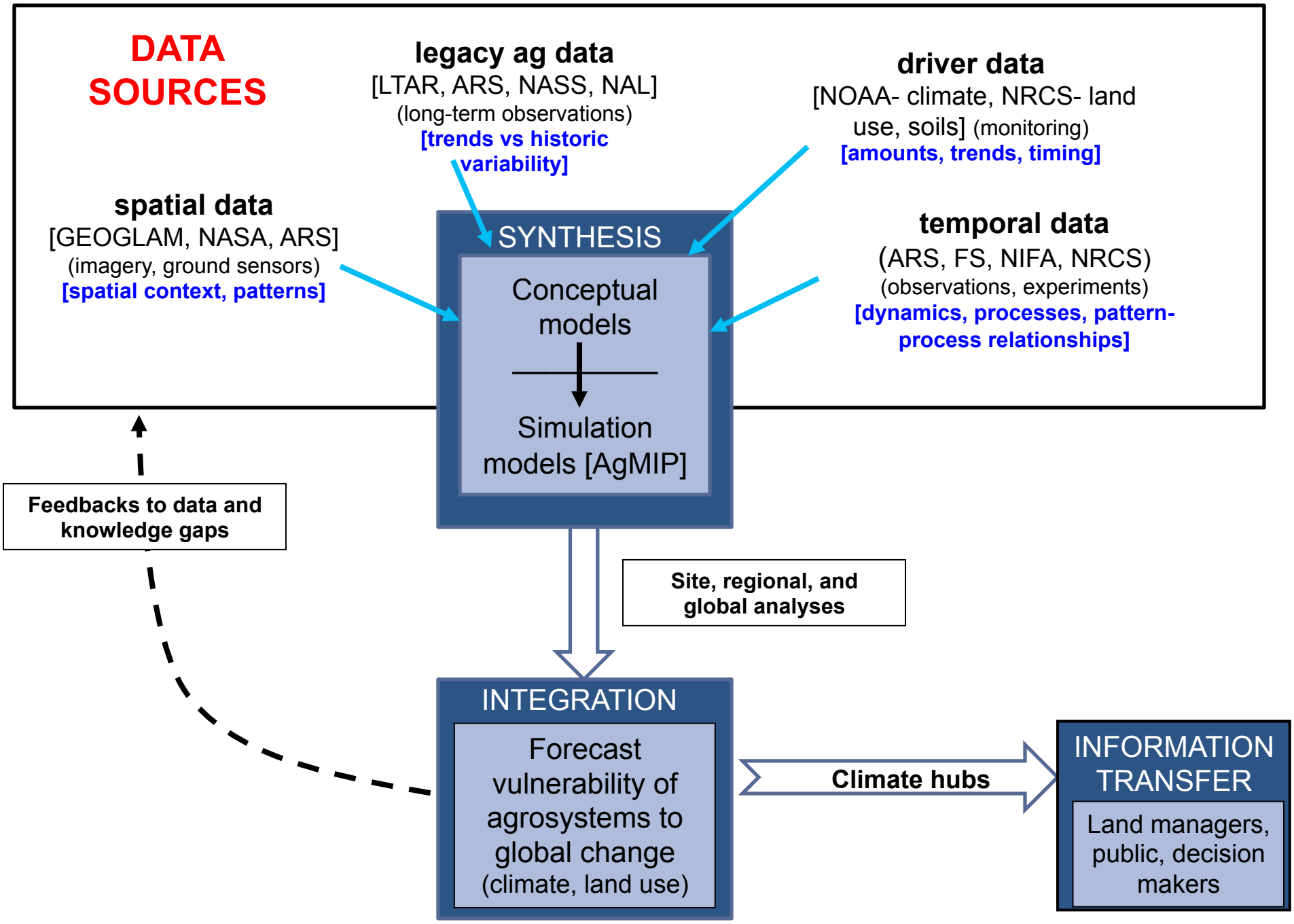


- Seasonal changes in precipitation - drought
- Increased variation in temperature and precipitation among and within years
- Changes in weather patterns in season
- Increase the temperature and precipitation extremes

USDA United States Department of Agriculture
Research, Education, and Economics

Climate Smart Agriculture and Big Data

- Crop and livestock genomic databases (GRIN Global, iPlant, iAnimal)
- Long Term Agro-ecosystem Research (LTAR)
- Greenhouse Gas Reduction through Agricultural Carbon Enhancement network (GRACEnet)
- Agricultural Model Intercomparison and Improvement Project (AgMIP)
- Global Research Alliance on Agricultural Greenhouse Gases (GRA) – 46 countries
- USDA Regional Climate Hubs


DATA SOURCES
legacy ag data
[LTAR, ARS, NASS, NAL]
(long-term observations)
[trends vs historic variability]
driver data
[NOAA- climate, NRCS- land use, soils] (monitoring)
[amounts, trends, timing]
spatial data
[GEOGLAM, NASA, ARS]
(imagery, ground sensors)
[spatial context, patterns]
temporal data
(ARS, FS, NIFA, NRCS)
(observations, experiments)
[dynamics, processes, pattern-process relationships]
SYNTHESIS
Conceptual models
Simulation models [AgMIP]
Feedbacks to data and knowledge gaps
Site, regional, and global analyses
INTEGRATION
Forecast vulnerability of agrosystems to global change
(climate, land use)
Climate hubs
INFORMATION TRANSFER
Land managers, public, decision makers

Crop and range production (area, yield by type, land use, location)

imagery
NASA, ARS

GEOGLAM

legacy data
LTAR, ARS, NASS, ERS, NRCS

Short-term data
FSA, ARS, NASS, NIFA, GRA

observations, experiments, land use, management strategies

Driver data

[NOAA- climate, weather; NRCS- land use, soils; ARS- invasives, APHIS- pests, pathogens]

Site-level synthesis

Conceptual models

Statistical models (AgMIP, others)

Simulation models (AgMIP, others)

Feedbacks to data and knowledge gaps

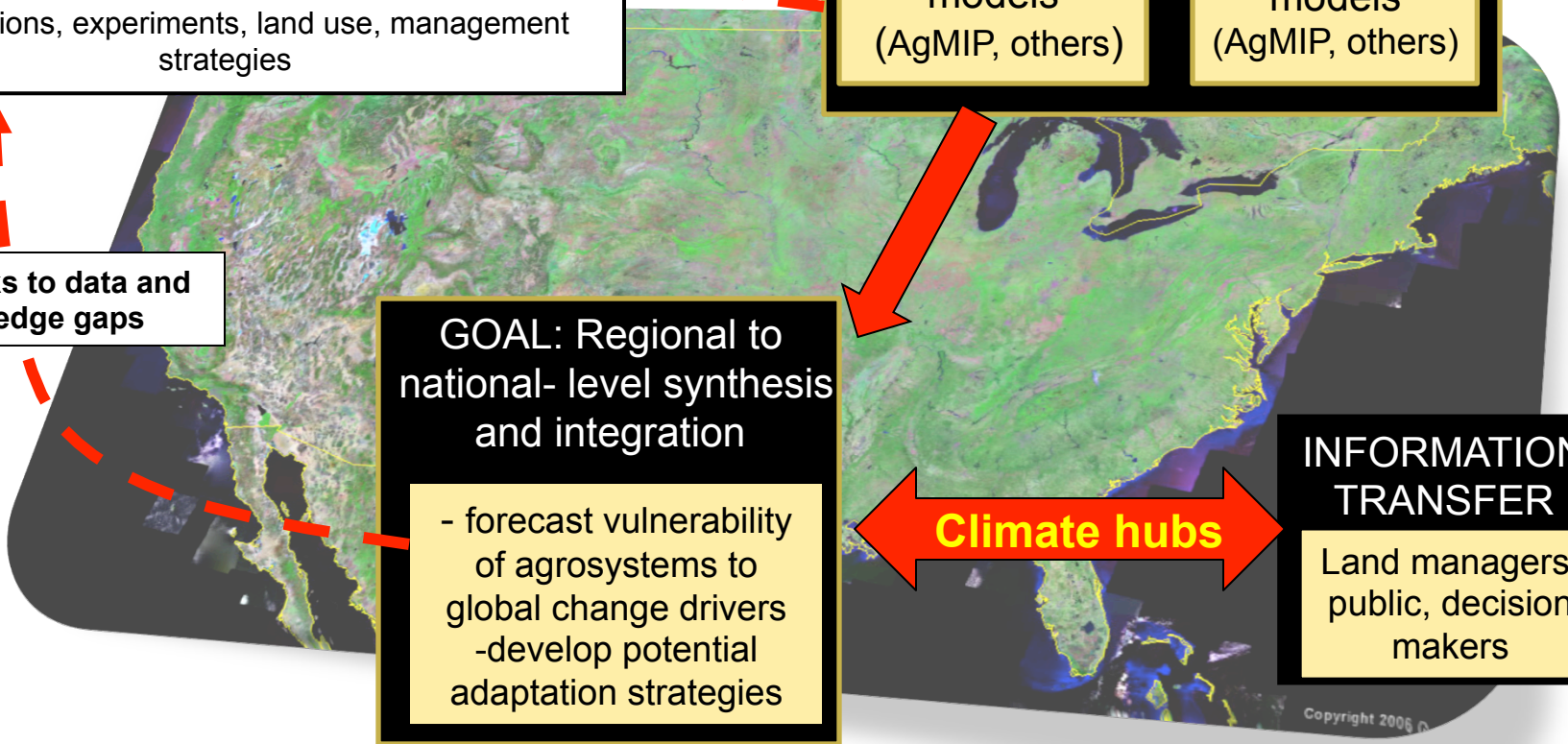
GOAL: Regional to national- level synthesis and integration

- forecast vulnerability of agrosystems to global change drivers -develop potential adaptation strategies

Climate hubs

INFORMATION TRANSFER

Land managers, public, decision makers



Crop and Livestock Genomic Databases

USDA's Role in Genomics Research:

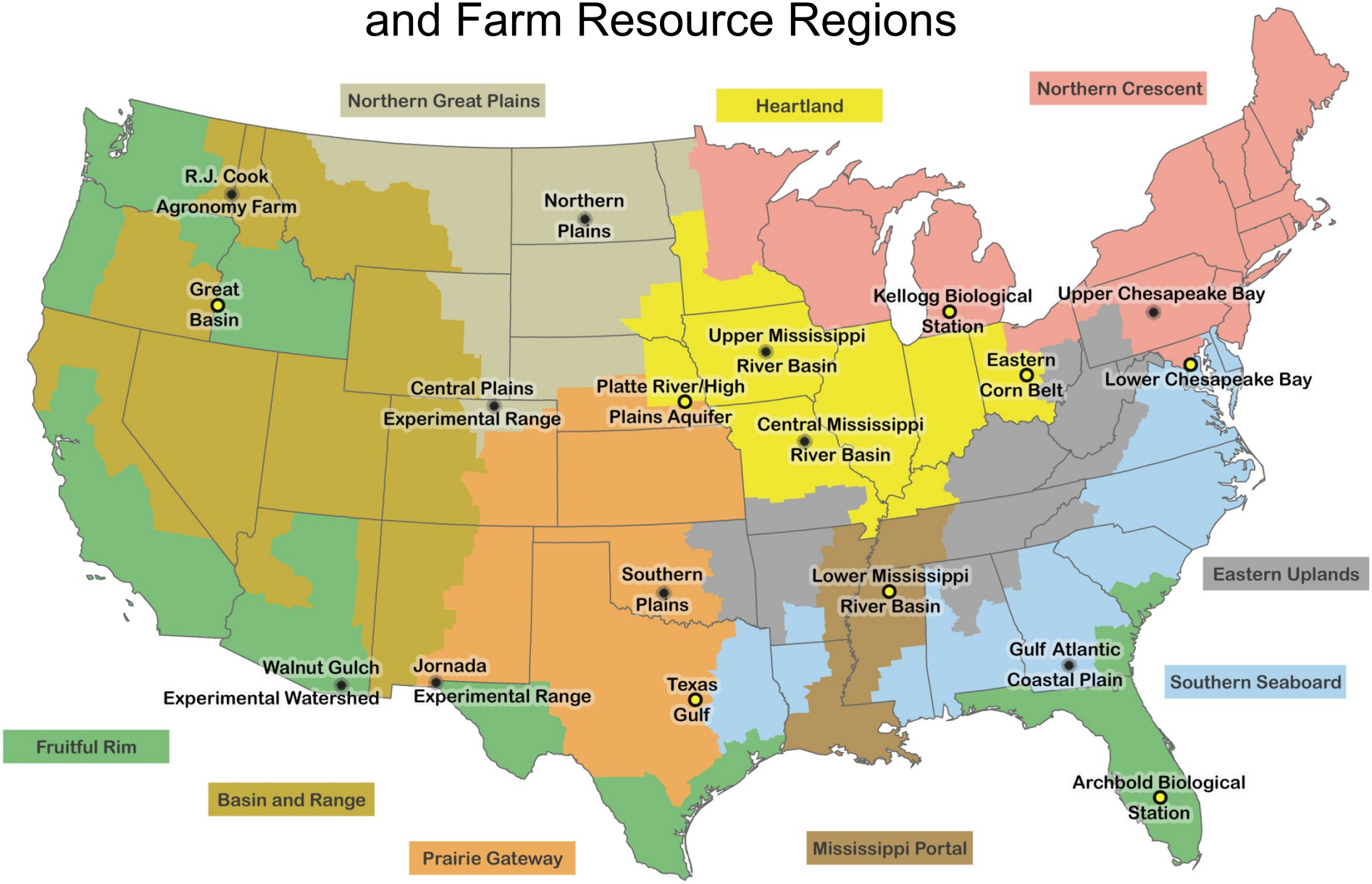
- Lead development of new genome sequence, databases, and analytical tools
- Facilitate collaborations and partnerships to deliver practical applications that address the needs of multiple stakeholders
- Leverage foundational resources
  - National Plant Germplasm System with its Germplasm Resources Information Network (GRIN), National Center for Genetic Resources Preservation, National Animal Germplasm Program (NAGP)

Crop and Livestock Genomic Databases

Vision and expected outcomes

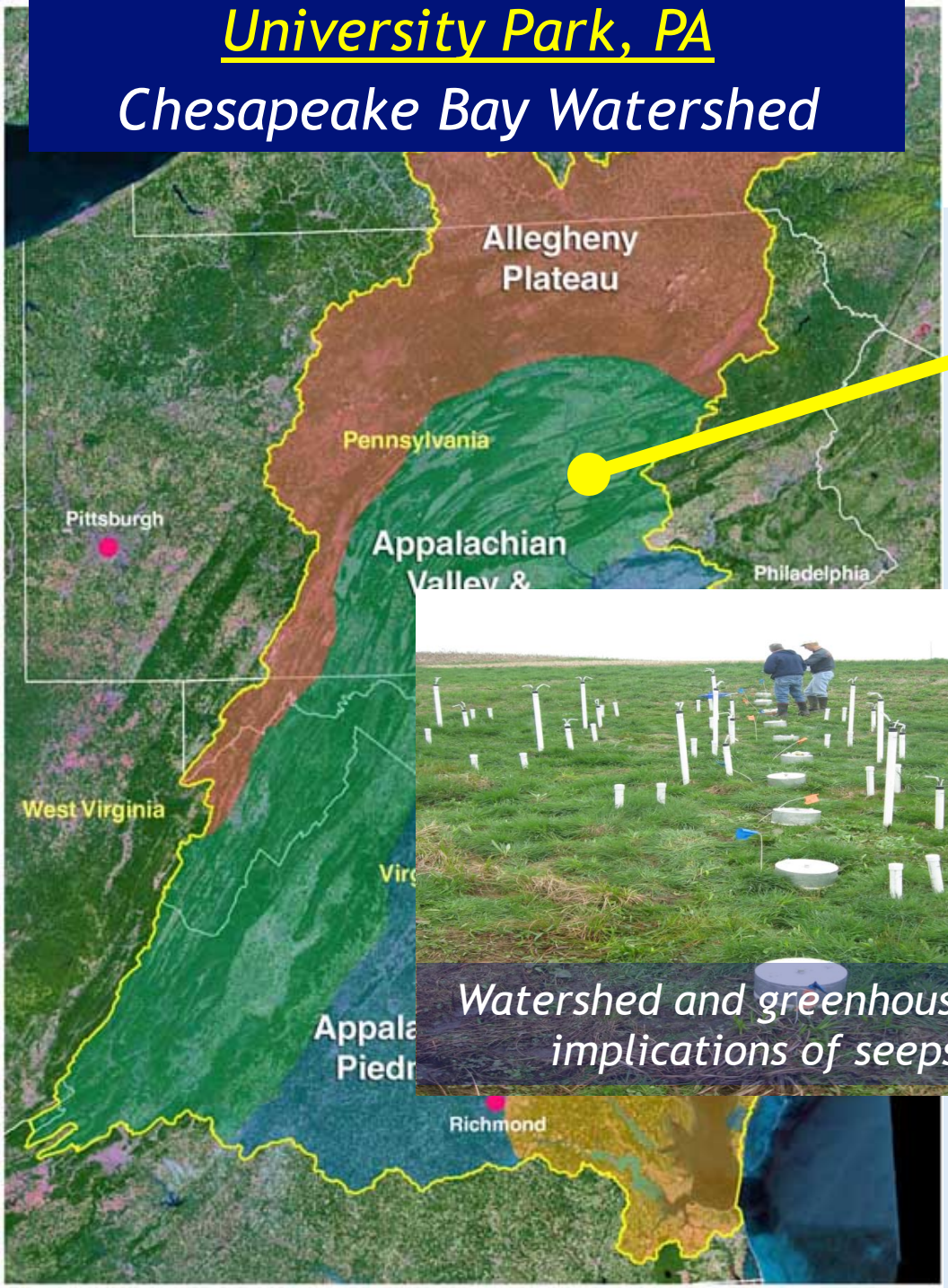
- Integrate genomics with systems approaches across the agricultural sciences
- Deliver new plant varieties and livestock breeds with multiple improved traits (adaptation to climate change, disease resistance, improved quality, and yield)
- Faster, more efficient use of resources

Long Term Agro-ecosystem Research (LTAR) Sites and Farm Resource Regions

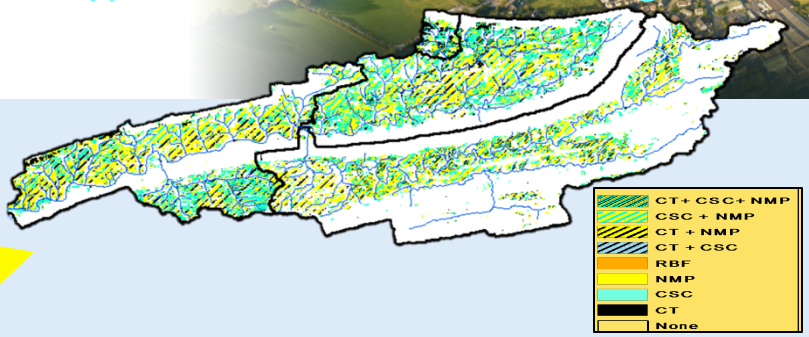


University Park, PA

Chesapeake Bay Watershed

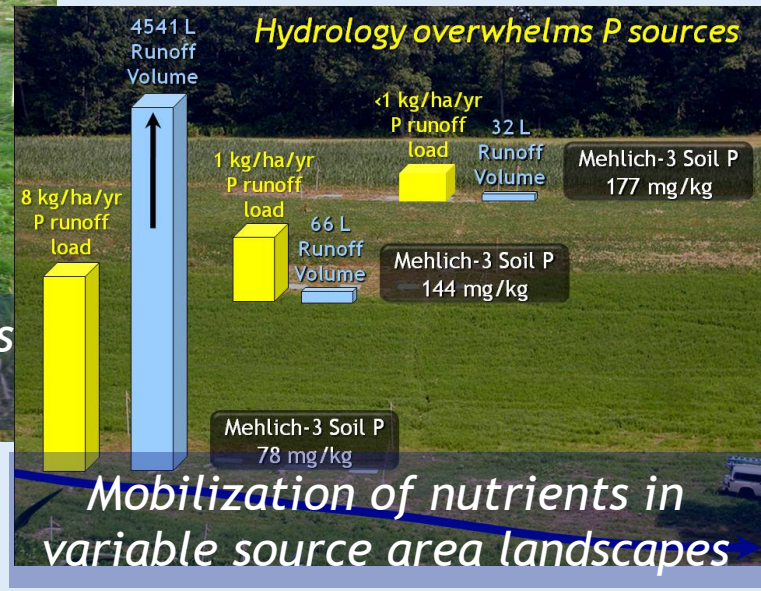


Optimized BMP placement for cost efficient watershed strategies



Research to improve identification and management of critical sources and flow pathways

Watershed and greenhouse gas implications of seeps



Mobilization of nutrients in variable source area landscapes

United States Department of Agriculture
Research, Education, and Economics

Agricultural Model Intercomparison and Improvement Project (AgMIP)

Climate, crop, and economic models + Cutting-edge IT = Improved crop and economic models, better climate impact projections for agriculture

Crop and range production (area, yield by type, land use, location)

imagery
NASA, ARS

GEOGLAM

legacy data
LTAR, ARS, NASS, ERS, NRCS

Short-term data
FSA, ARS, NASS, NIFA, GRA

observations, experiments, land use, management strategies

Driver data

[NOAA- climate, weather; NRCS- land use, soils; ARS- invasives, APHIS- pests, pathogens]

Site-level synthesis

Conceptual models

Statistical models (AgMIP, others)

Simulation models (AgMIP, others)

Feedbacks to data and knowledge gaps

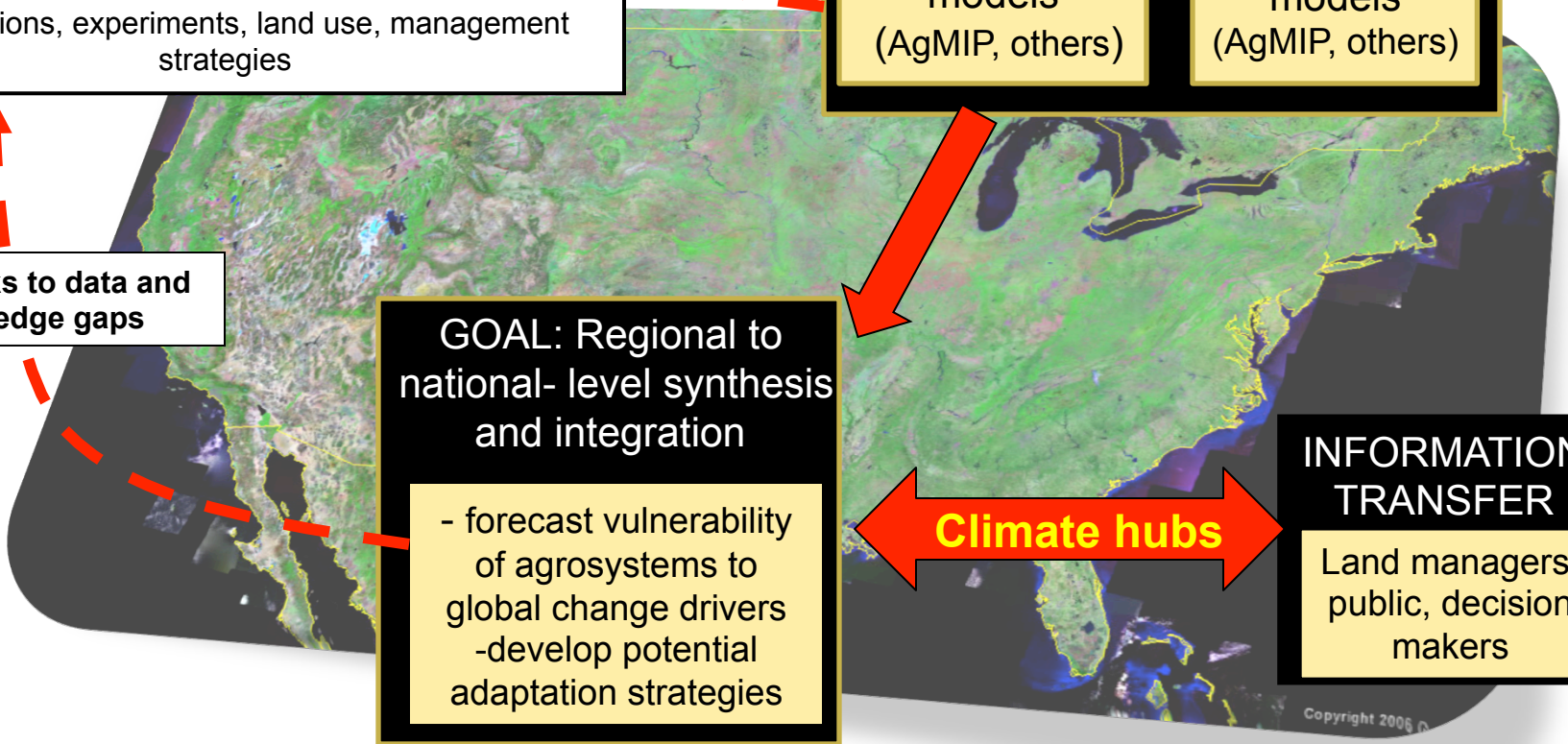
GOAL: Regional to national- level synthesis and integration

- forecast vulnerability of agrosystems to global change drivers -develop potential adaptation strategies

Climate hubs

INFORMATION TRANSFER

Land managers, public, decision makers



Current GEOGLAM partners

Future GEOGLAM partners

Long Term Ag Research (ARS)

Site-based Research (ARS, NIFA, NASS, ERS)

Imagery of patterns in production (NASA)

Country-level data on crop type, yield, location (Foreign Ag Service)

Ground-based data (experiments, sensors, observations)

Develop new technologies (ARS, NIFA)

Forecasts and scenarios (AgMIP simulation models of climate, crops, economics)

Global crop production maps/assessments by country, crop type (Center for Global Agricultural Monitoring Research, University of Maryland)

Future upscaling

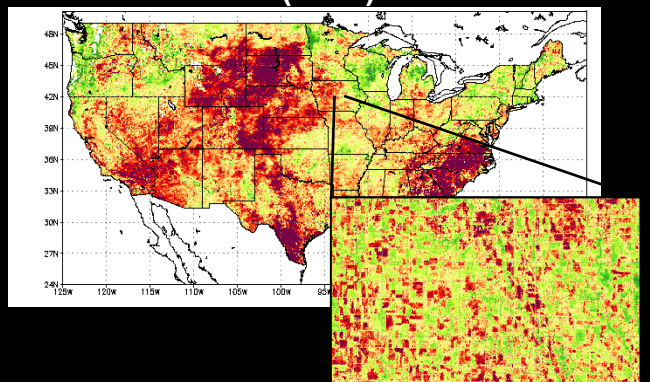
Crop production assessments and projections by field

Other Products

Market analyses, disaster reports (Ag Market Information System G20 Initiative)

Policy, action

***Example of field-based production using new multi-scale technology (ARS)**



***Thermal imagery can identify potential drought locations, and fine-scale imagery (< 100-m) provides individual field assessments.**

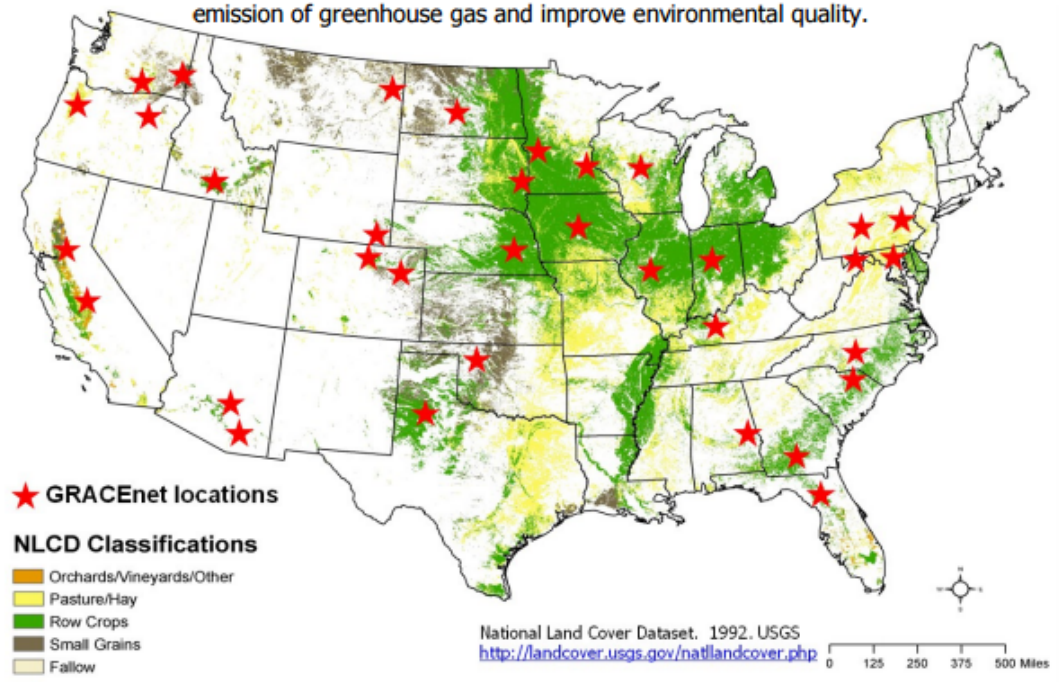
United States Department of Agriculture
Research, Education, and Economics

GRACEnet

(Greenhouse Gas Reduction through the Agricultural Carbon Enhancement network)

GOAL

Identify and develop agricultural strategies to enhance soil carbon sequestration and reduce greenhouse gas emission and to provide a scientific basis for carbon credit programs, to reduce net emission of greenhouse gas and improve environmental quality.



An assessment network of soil carbon sequestration and greenhouse gas mitigation through agricultural management

United States Department of Agriculture
Research, Education, and Economics

Global Research Alliance on Agricultural Greenhouse Gases (GRA)

- Launched in 2009, now has 38 member countries
- Focused on work that will help deliver ways to grow more food without growing greenhouse gas emissions
- USDA supports the participation of Alliance member developing countries through the Global Research Alliance Fellowships.
  - Hosted by USDA/ARS and/or U.S. universities active in the targeted research areas.
  - U.S. scientists who serve as mentors to the fellows will travel to the fellows' country for up to 10 days to continue their collaboration on climate change mitigation research.

USDA Building Blocks for Climate Smart Agriculture

- U.S. Commitment – 26-28% reduction in GHG emissions below 2005 levels by 2025
- USDA is well-positioned to contribute
  - One of the only departments that can both reduce GHG emissions and store carbon
  - Goal dovetails with much of the work that agencies are already doing (e.g., Soil Health Initiative, forest restoration, climate change adaptation)
- Secretary's announcement – April 23 at Michigan State
  - Outlined the building blocks
  - Established a goal of reducing emissions by 120 MMTCO_2e per year by 2025
  - Announced early actions by industry and nonprofit partners

United States Department of Agriculture
Research, Education, and Economics

Principles of the USDA Building Blocks

- **Voluntary and incentive-based** – Building on existing legislation and our history of “cooperative conservation.”
- **Focused on multiple economic and environmental benefits** – Through efficiency improvements, improved yields, or reduced risks.
- **Meet the needs of producers** – By focusing on working farms, ranches, forests, and production systems.
- **Assess progress and measure success** – Through quantitative goals and objectives.
- **Cooperative and focused on building partnerships** – With industry, farm groups, and conservation organizations.

USDA

United States Department of Agriculture
Research, Education, and Economics

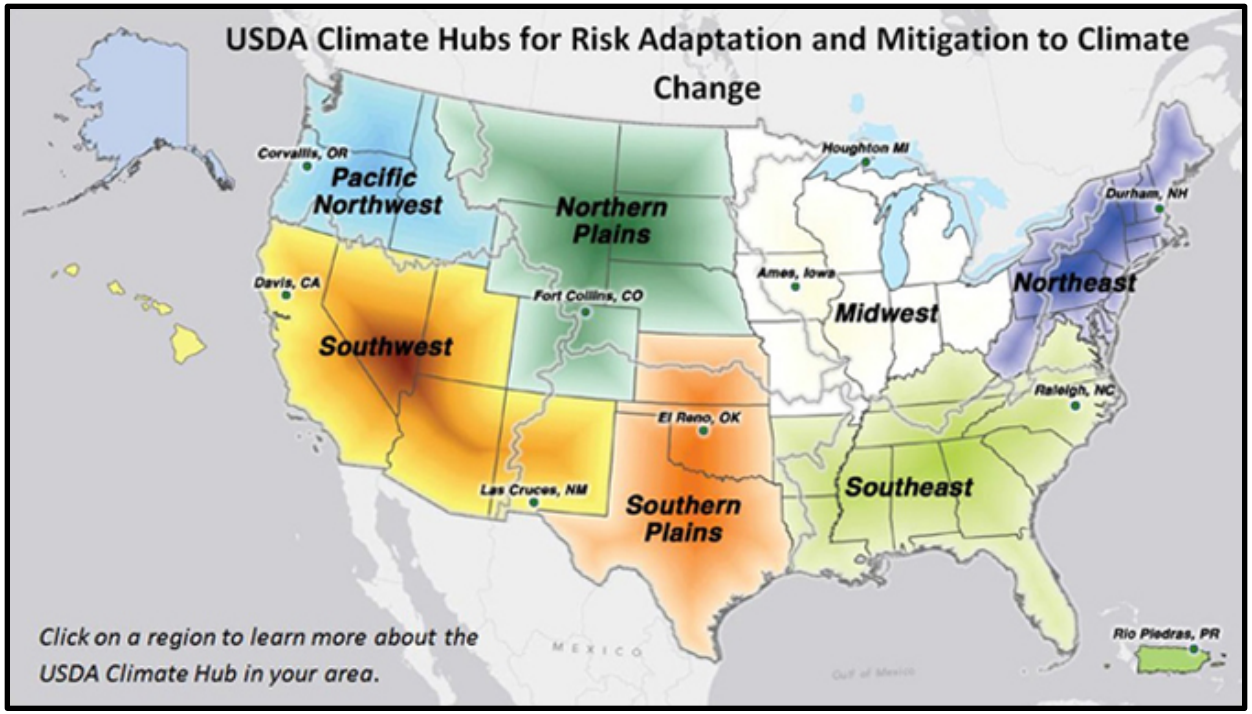
Building Block	Goals
Soil Health	Increase no-till from 67 M acres to 100-200 M acres
Nitrogen Stewardship	Through 4 “R’s” reduce nitrous oxide emissions by 10%
Livestock Partnerships	Install 500 anaerobic digesters; install impermeable covers on 10% of dairy cattle and swine operations
Conservation of Sensitive Lands	Enroll 400,000 acres of CRP with high GHG benefits; protect 40,000 acres through easements; transfer expiring CRP acres to permanent easements
Grazing and Pasture Lands	Establish grazing management plans on an additional 4 M acres, for a total of 20 M acres
Private Forest Growth and Retention	Through FLP and CFP, protect almost 1 M acres of working landscapes. Through FSP, establish management plans on 2.1 M acres of forest annually.
Stewardship of Federal Forests	Reforest 5,000 additional acres (above baseline)
Promotion of Wood Products	Increase the number of building projects supported through technical assistance from 280 in 2014 to 2,000 in 2025
Urban Forests	Plant 90,000 additional trees in urban areas
Energy Generation and Efficiency	Promote renewable energy technologies and improve energy efficiency through EECLP, REAP, and NOFEI (EQIP)

United States Department of Agriculture
Research, Education, and Economics

USDA Regional Climate Hubs

Diverse Production:
- Major crops
- Specialty crops
- Ranching
- Forestry

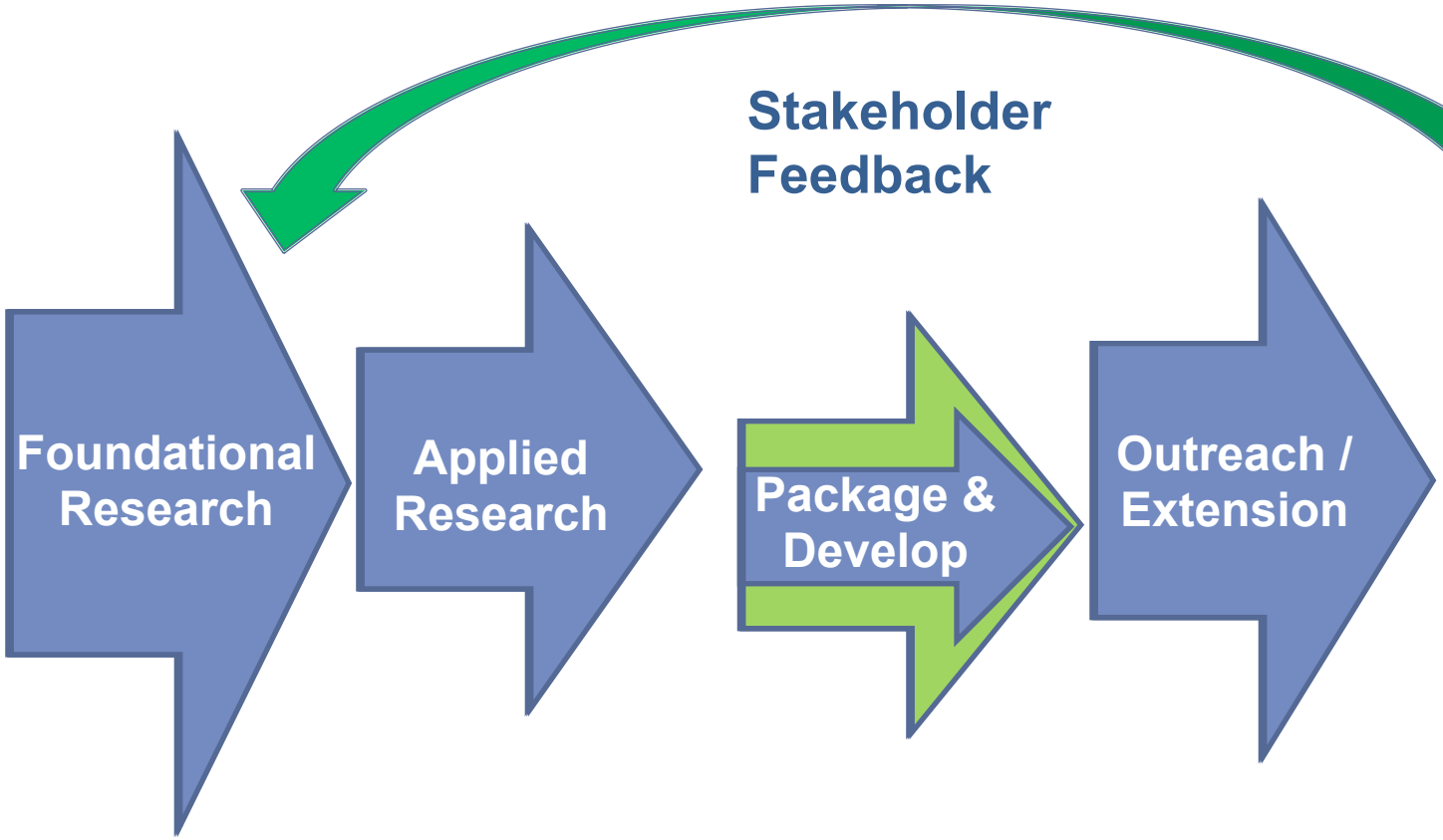
Diverse Challenges:
- Drought
- Heat stress
- Flooding
- Pests
- Fires



A regionally-focused approach to delivering climate and weather adaptation and mitigation tools and data to U.S. farmers, ranchers and foresters.

United States Department of Agriculture
Research, Education, and Economics

The Hubs improve the information flow to AND *from* stakeholders to provide feedback to research agencies



Stakeholders

- USDA Service Agencies
- Cooperative Extension
- Land Grant Universities
- Farmers
- Ranchers
- Forest land owners

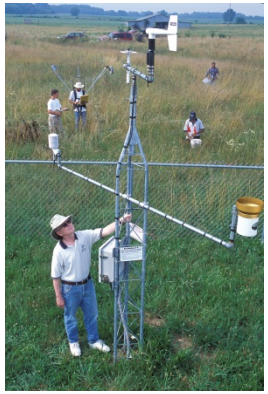
Looking Ahead

- **Integrating diverse, big data sets to predict and enhance crop and livestock performance**
- **Improving sustainability of farming practices, adaptation to climate change**

United States Department of Agriculture
Research, Education, and Economics

Farming and the Internet of Things

- Precision agriculture – GPS enabled technologies
  - Planting and fertilizer application
  - Harvesting
- Examples of new technologies
  - Drip irrigation
  - Sensors to monitor soil moisture
  - Geospatial (drones & satellites)



Looking Ahead

- Integrating diverse, big data sets to predict and enhance crop and livestock performance
- Improving sustainability of farming practices, adaptation to climate change
- Addressing the issue of food loss *(developing)* and food waste *(developed)*
- Developing an *environmental marketplace*

Looking Ahead

- Integrating diverse, big data sets to predict and enhance crop and livestock performance
- Improving sustainability of farming practices, adaptation to climate change
- Addressing the issue of food loss *(developing)* and food waste *(developed)*
- Developing an *environmental marketplace*
- ***Urban Agriculture….<u>but that's another story!</u>***

United States Department of Agriculture
Research, Education, and Economics

Thank you!

Transitioning Cereal Systems to Adapt to Climate Change

REACCH
Regional Approaches to Climate Change –
PACIFIC NORTHWEST AGRICULTURE

Thank you!

University of Idaho

Washington State University

USDA NIFA

United States Department of Agriculture
National Institute of Food and Agriculture

Oregon State University OSU

Pacific Northwest Farmers Cooperative

CHS

Monsanto