Enhancing Agricultural Productivity and Environmental Quality through Soil Health

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President and CEO

SOIL HEALTH
INSTITUTE

SOIL HEALTH:

The capacity of a soil to function as a vital, living ecosystem that sustains plants, animals, and humans.

The Imperatives

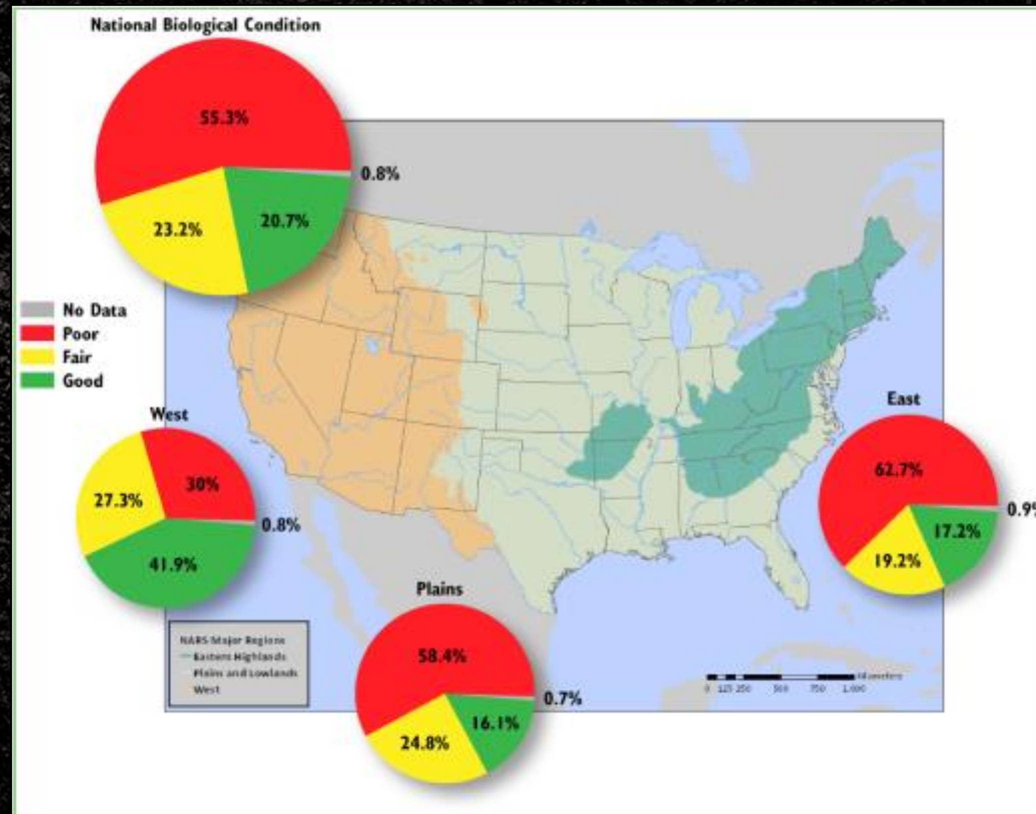
National Rivers & Streams Assessment

Biological condition:

- •Poor - 55.3%
- •Fair – 23.3%
- •Good – 20.7%
- •Unknown – 0.8%

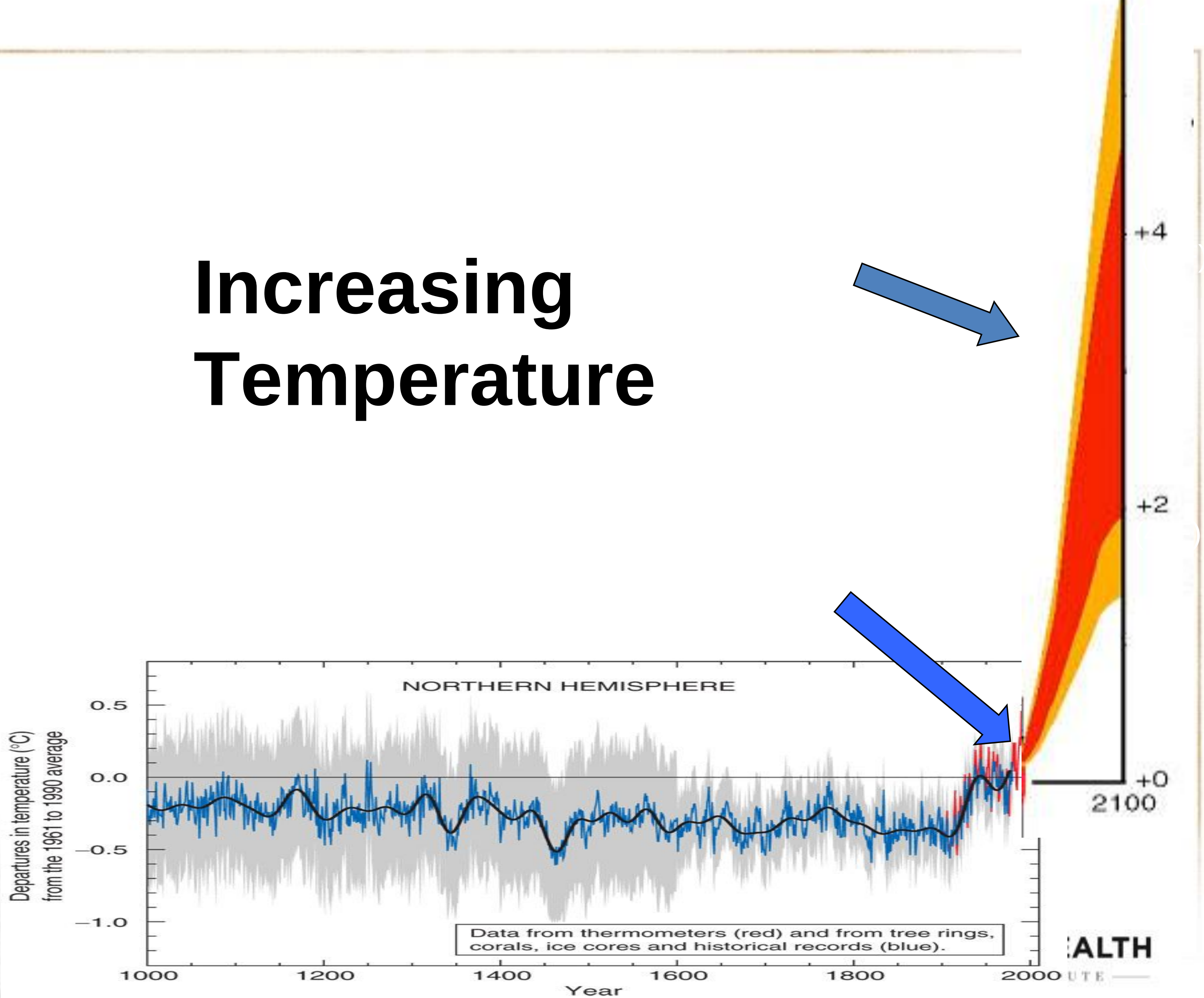
Greatest stressors:

- •Phosphorous
- •Nitrogen
- •Riparian cover and disturbance
- •Streambed sediment
- •Enterococci



Source: USEPA (2016)

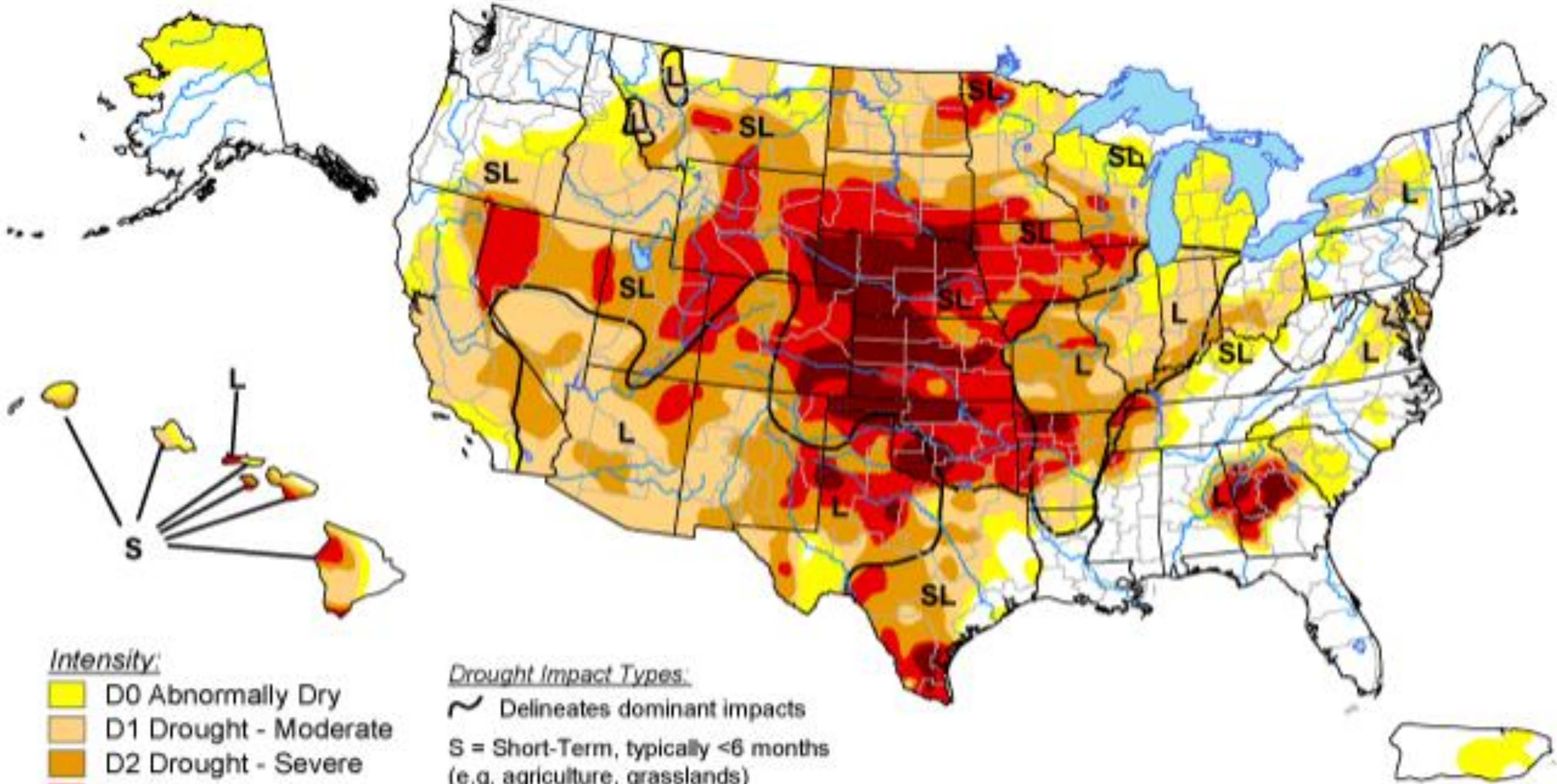
Increasing Temperature



Adapted from Hayhoe 2011

U.S. Drought Monitor

September 25, 2012
Valid 7 a.m. EDT



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:

~ Delineates dominant impacts

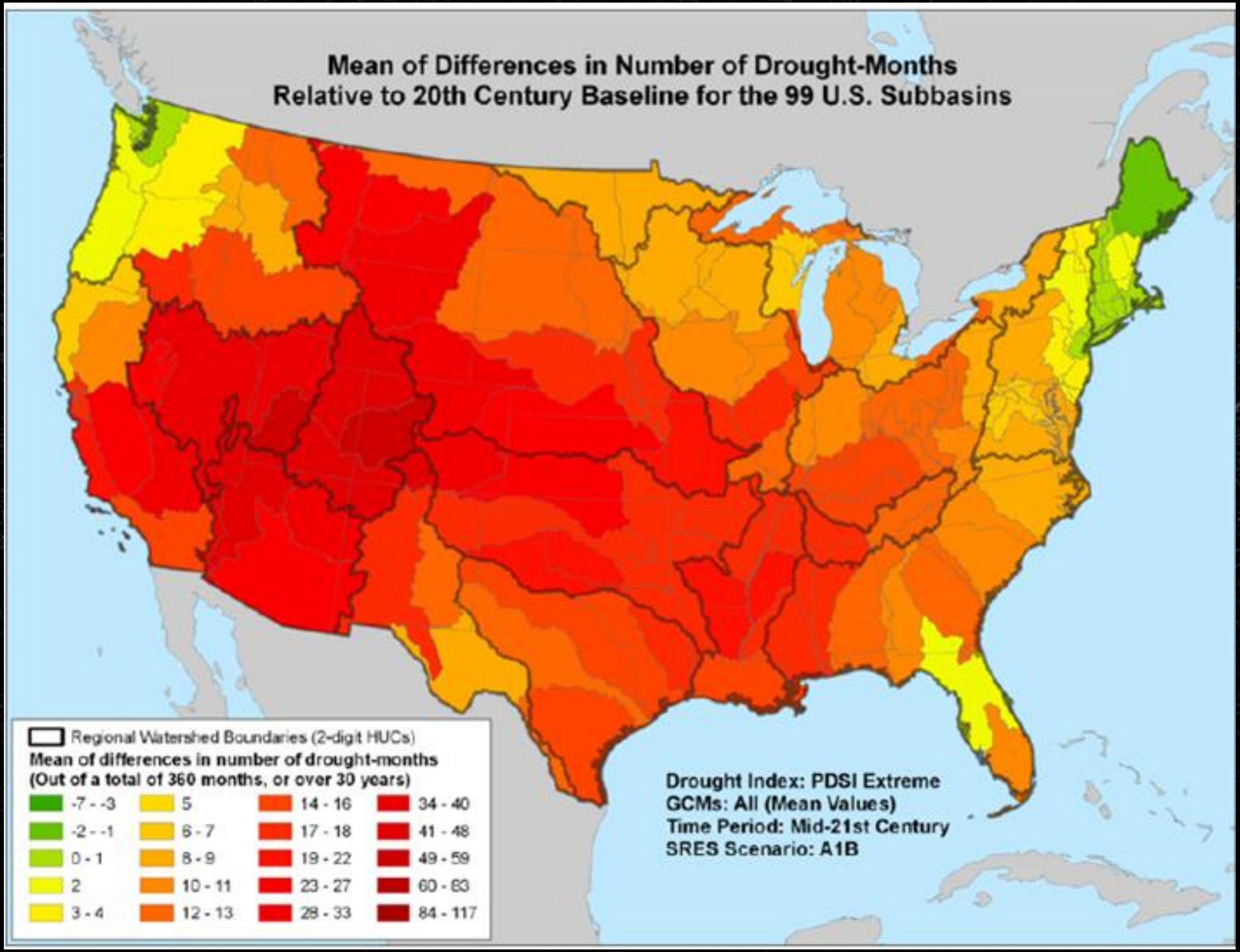
S = Short-Term, typically <6 months (e.g. agriculture, grasslands)

L = Long-Term, typically >6 months (e.g. hydrology, ecology)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu/

Released Thursday, September 27, 2012
Author: Anthony Artusa, NOAA/NWS/NCEP/CPC



Strzepek et al., 2010

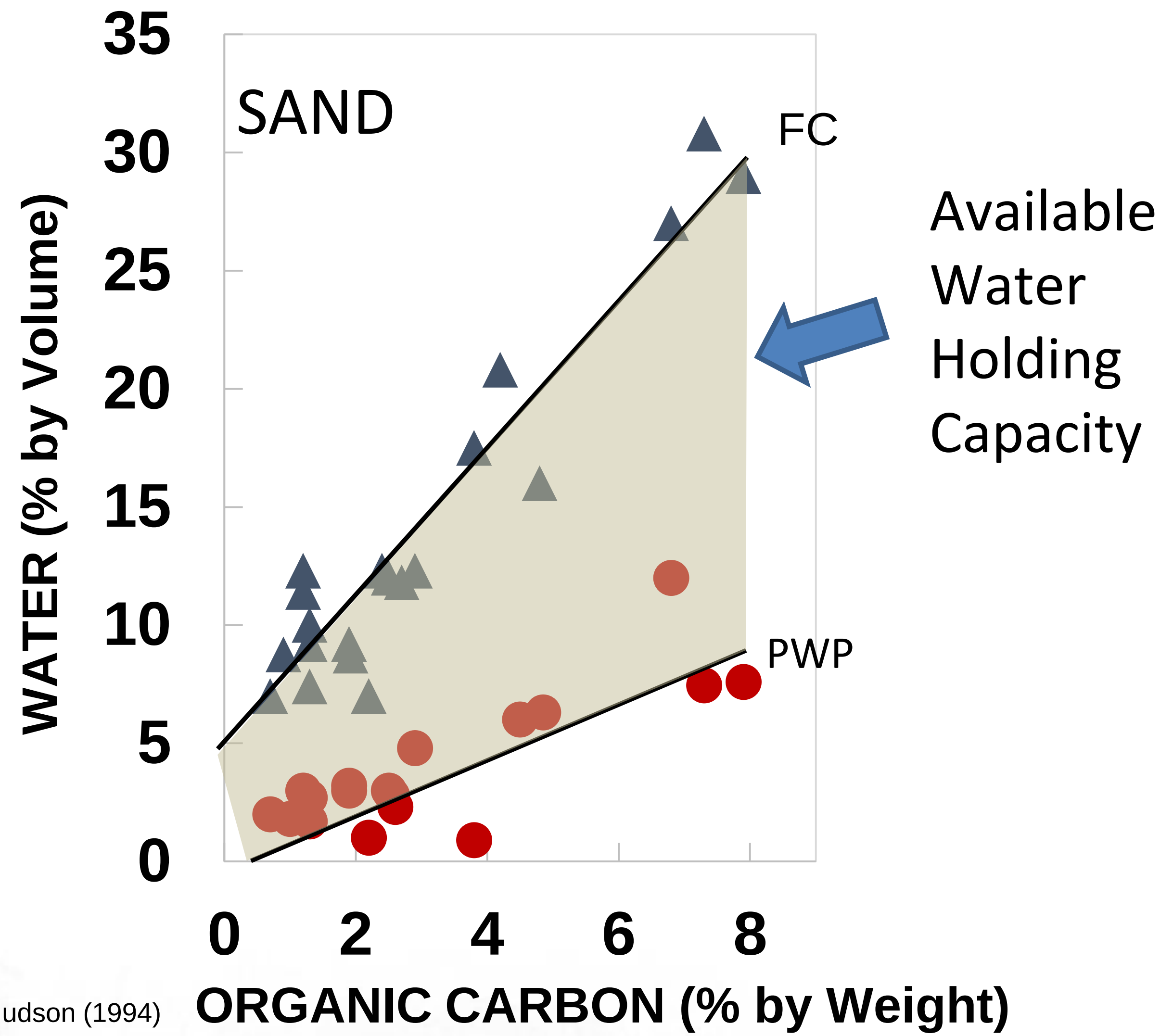
The Opportunities


Resources for Farmers


Key Soil Health Practice: No-Till

Soil Organic C (Mg/ha)

State	Years	Conventional Tillage	No Tillage
IA	15	60.3	71.1
IL	6	45.4	51.3
IN	11	60.0	73.0
KY	5	45.9	52.8



Adapted from Hudson (1994)

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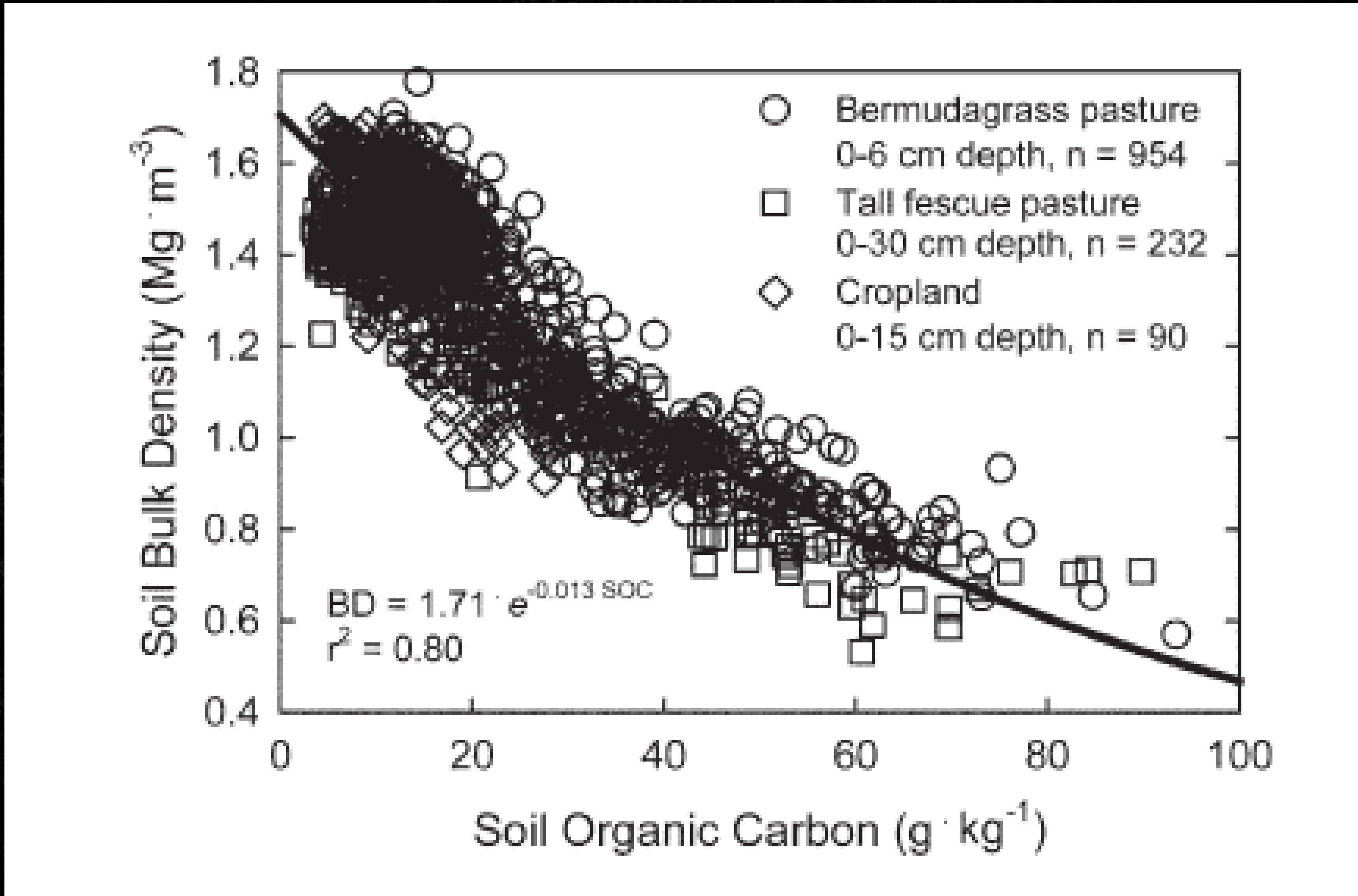
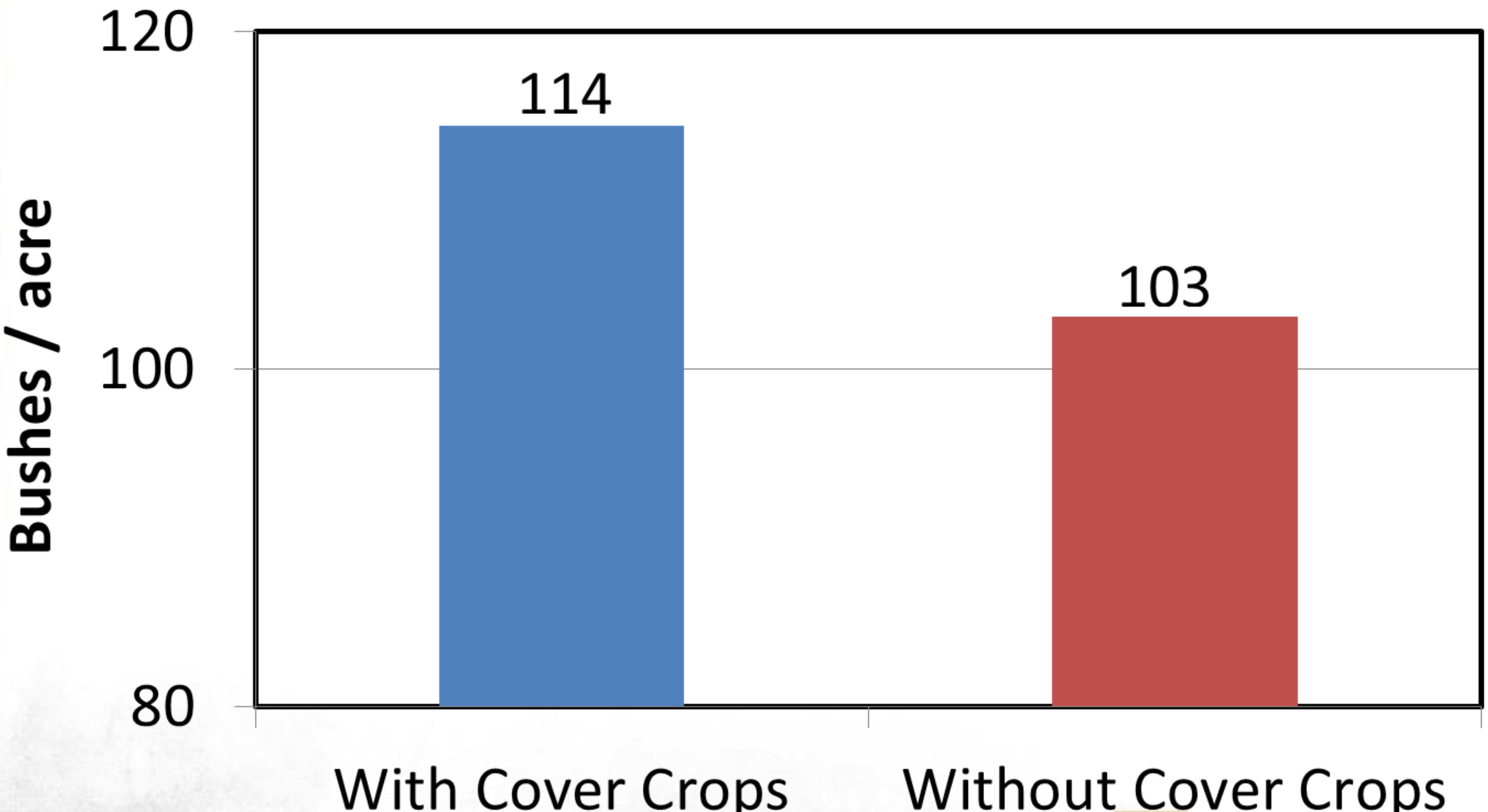


Georgia studies – Typic Kanhapludults.
Franzluebbers (2010) SSSAJ 74:347–357

Key Soil Health Practice: Cover Crops

USDA-SARE, CTIC Survey

2012 Corn Yield Drought States



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Tillage & Cover Crop Impacts On Water Infiltration Rate

Location	Years	Tillage & Crop	Impact on Infiltration Rate	Reference
KS	15	NT Winter Wheat-Sorghum	182% Increase with Cover Crop	Blanco-Canqui et al. (2011)
MD	11	NT Corn	164-462% Increase with Cover Crop (different sites & years)	Steele et al. (2012)
KS	11	NT Wheat-Sorghum-Fallow	132-194% Increase with No-Till	Stone and Schlegel (2010)
Malawi	3	NT Corn	165% Increase in No-Till	TerAvest et al. (2015)

Infiltration – Brookings County, SD

Cover Crop Impacts on Nitrate Leaching

Location	Cover Crop	Reduction in Nitrate Leaching (%)	Reference
CA	Rye	65-70	Wyland et al. (1996)
DE	Rye	30	Ritter et al. (1998)
France	Ryegrass	63	Martinez and Guirard (1990)
IN	Winter Wheat (and reduced fertilizer)	61	Kladivko et al. (2004)
IA	Rye	61	Kaspar et al. (2007)
KY	Rye	94	McCracken et al. (1994)
KY	Hairy Vetch	48	McCracken et al. (1994)
MD	Rye	77	Staver and Brinsfield (1990)
MD	Rye	80	Staver and Brinsfield (1998)
MI	Rye	28-68	Rasse et al. (2000)
MN	Rye	13	Strock et al. (2004)

Initiated in 2013, **Farm Foundation, NFP** and the **Noble Foundation** initiated the Soil Renaissance to advance soil health and make soil health the cornerstone of land use management decisions.

RESEARCH

Convene the research community to advance soil health.

MEASUREMENT

Incorporate soil health measures into standardized soil testing that is readily available, affordable, and commercially viable.

ECONOMICS

Quantify the effects of soil health on economic risks and returns.

EDUCATION

Reawaken the public to the importance of soil health.

Mission

Safeguard and enhance the vitality and productivity of the soil through science-based research and advancement

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Guiding Principles

- Integrated Science Approach
- Science-based
- Partnership Driven
- Inclusive and representative
- Transparent and open sourced
- Communications at all levels
- Purposeful outcomes with measurable impacts
- Continuing evaluation and improvement

Note: These guiding principles were developed by the Soil Renaissance strategic development committee and adopted by all working groups.

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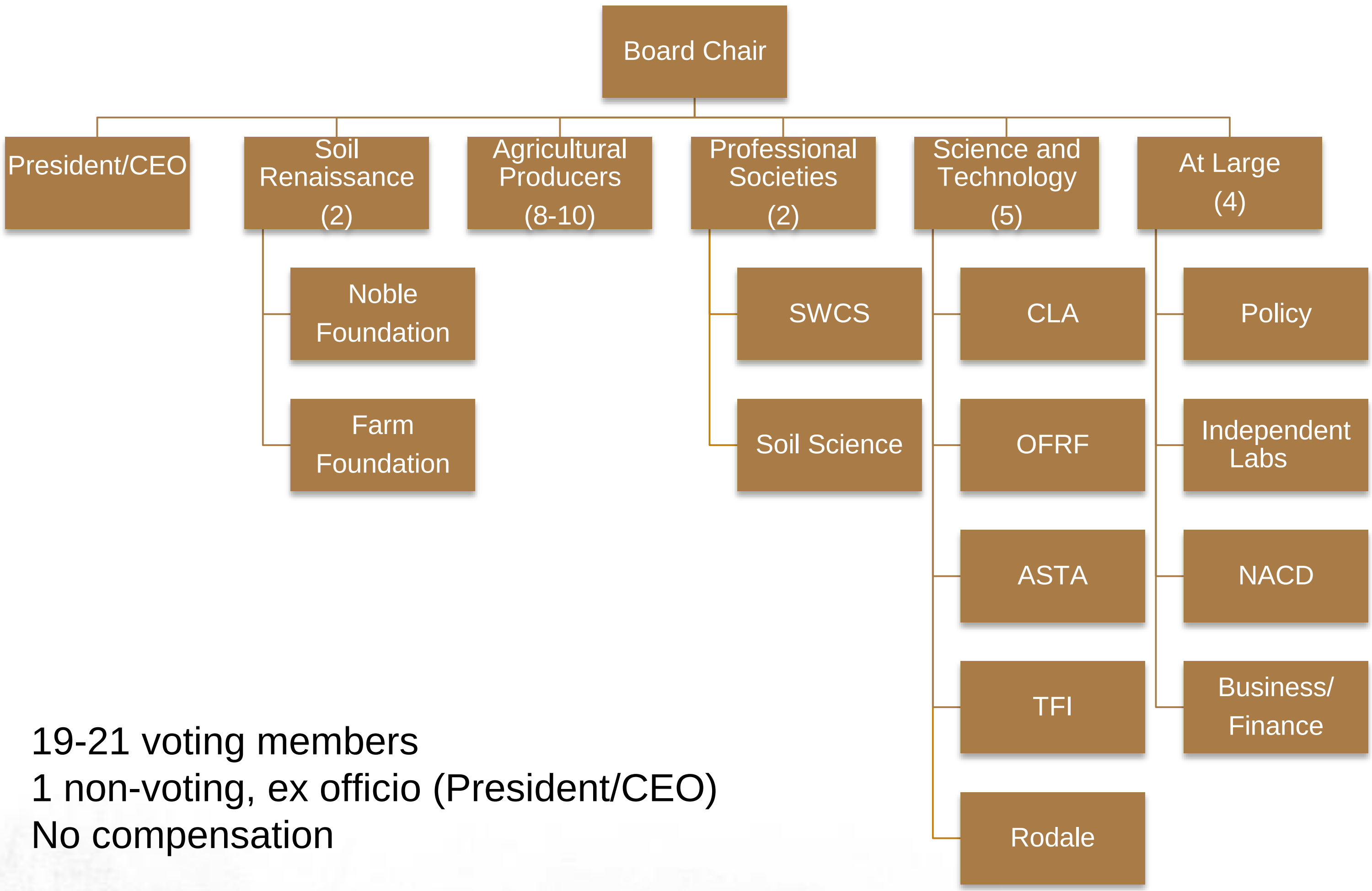
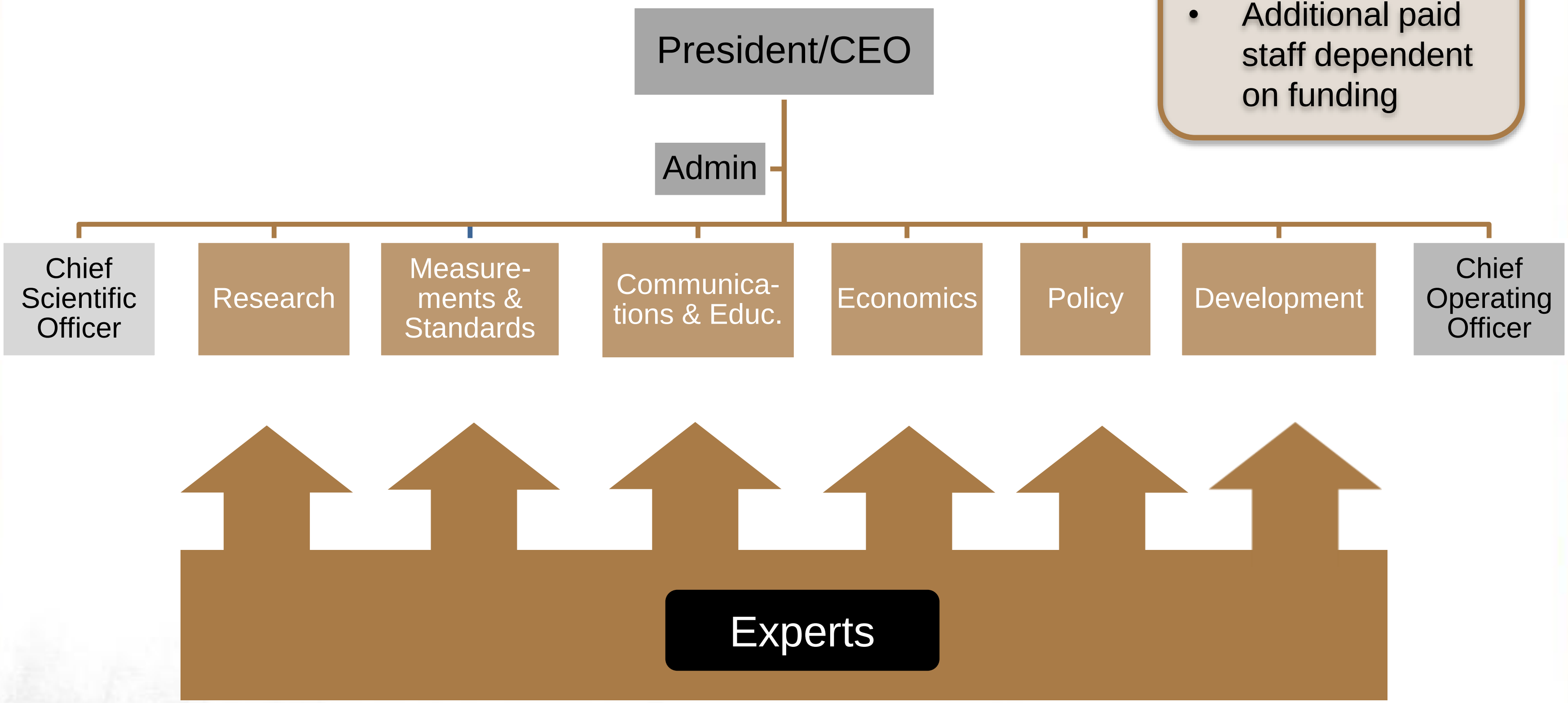
Governing Board



- 19-21 voting members
- 1 non-voting, ex officio (President/CEO)
- No compensation

Operational Structure

- Location: RTP
- Additional paid staff dependent on funding



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Soil Health Institute Approach

Knowledge Generation

1. Enhance Productivity
2. Enhance Resilience
3. Quantify Environmental Impacts
4. Biological Processes & Indicators

Measurements & Stds.

Economics

Commun. & Education

Policy

Development

Knowledge Adoption

1. Assess Current State
2. Assess Potential Impacts (to target)
3. Partner to Enhance Adoption & Quantify Impacts

Achieving Vision

Safeguard & Enhance Vitality & Productivity of Soils

Knowledge Generation (Research)

Enhance Productivity	• Establish Potential Targeted Levels of Key SH Properties Across U.S. • Determine Land Mgmt. (e.g. C Input) Required to Achieve Targets
Enhance Resilience	• Quantify Rate of Change in Available Water Holding Capacity as a Function of Soil Properties, Management, Climate, C Input Properties
Quantify Environmental Impacts	• Predict Potential Reductions in Soil & Nutrient Loss, GHG Emissions, etc. Given Various Adoption Levels of SHMS • Validate Predictions (e.g. EOF Studies Across Climates, Soils, Systems)
Biological Processes & Indicators	• Develop Fundamental Knowledge of Key Biological Processes, their Interactions, and Corresponding Indicators • Integrate Knowledge of Microbiome / Phytobiome to Design, Explore, & Evaluate New Soil Health Management Systems

Soil Health Institute Approach

Measurements & Standards
- Identify Best Available Indicators
- Coordinate Design & Conduct of National Soil Health Assessment

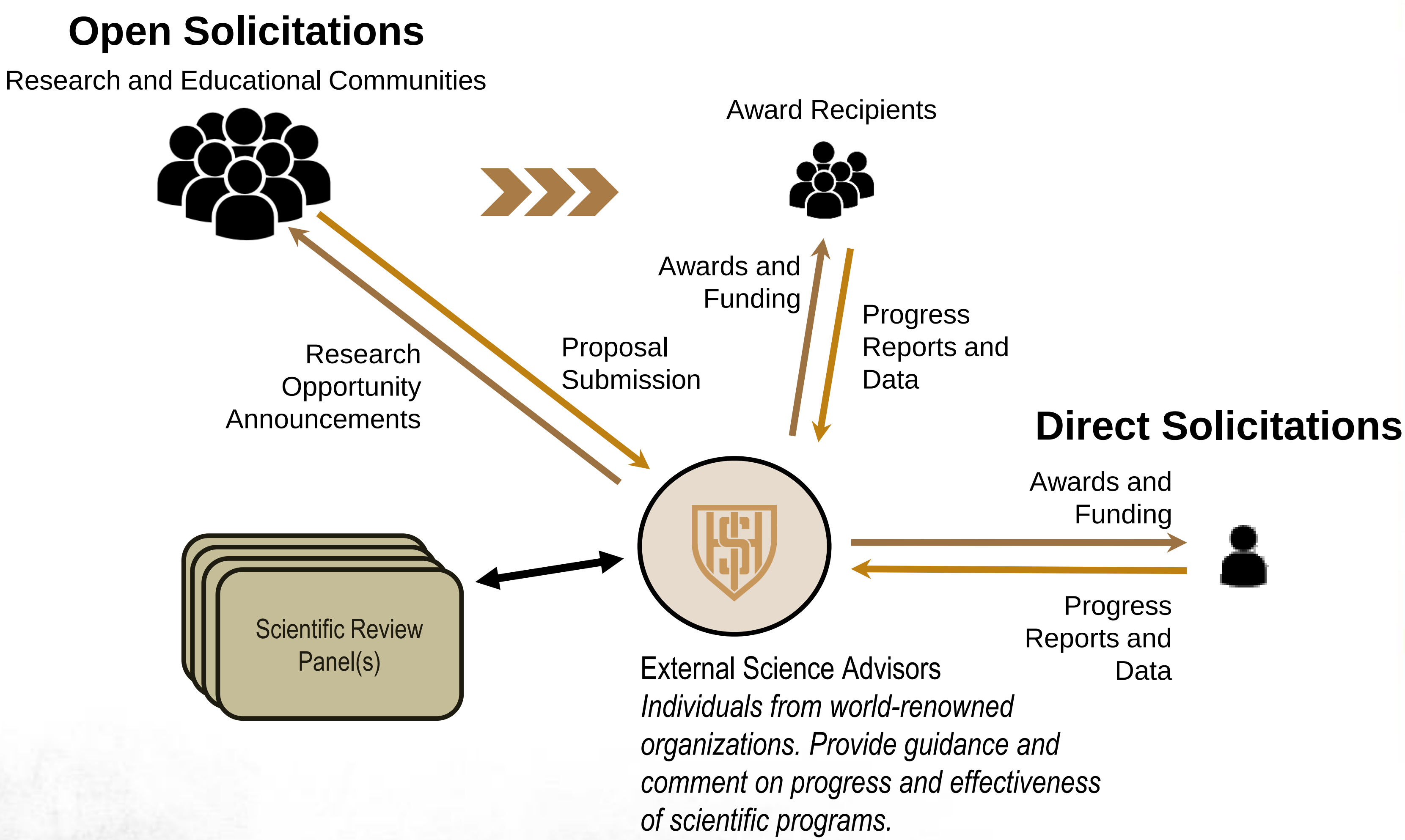
Economics
- Quantify Impact on Profitability and Risk (Representative Systems, Climates, Inputs)
- Decision Support System

Communication & Education
- Transfer Technology to Farmers & Ranchers
- Serve as Central Hub for Research & Info (Research Landscape Tool)
- Expand SH Knowledge to Key Target Audiences

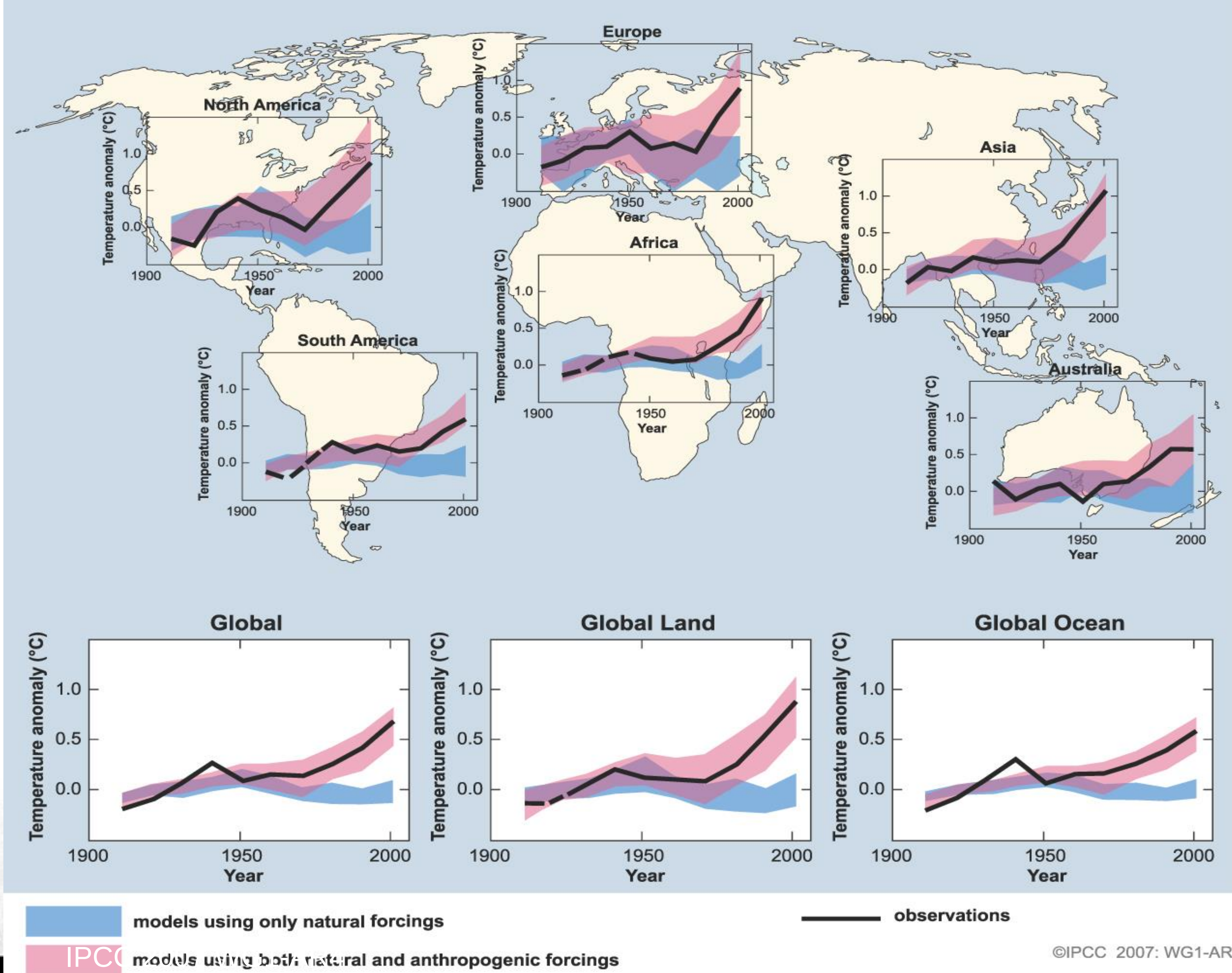
Policy
- Identify Policies Negatively Impacting SH and Changes Needed
- Identify Policies Positively Impacting SH and Changes to Enhance Benefits
- Provide Information

Development
- Identify and Secure Funding to Assist in Achieving Institute Mission

Soil Health Research Awards

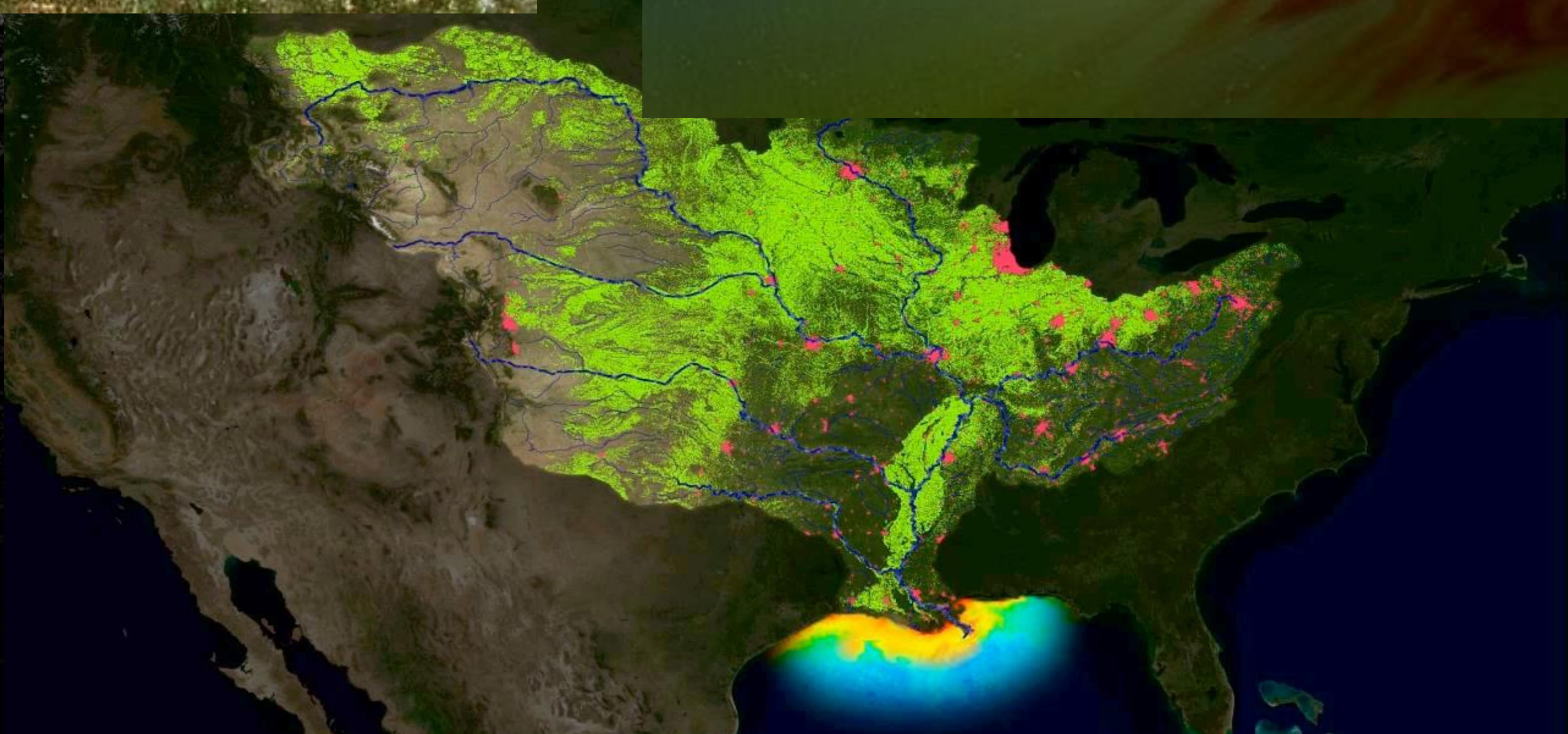


Thank you



North America
Europe
Asia
Africa
South America
Australia
Global
Global Land
Global Ocean
Temperature anomaly (°C)
1.0
0.5
0.0
1900
1950
2000
Year
models using only natural forcings
models using both natural and anthropogenic forcings
observations
©IPCC 2007: WG1-AR4





Research

- Identify gaps in soil health research
  - Priorities/solicitations determined by CSO (in consultation with the CEO) with External Science Advisors.
- Construct research road maps
  - Current research is not consolidated nor in useful user form.
  - Soil health roadmap is a jigsaw puzzle of many pieces.
- Rigorous protocol related to submission of proposals and assessment of outcomes
  - Research opportunities defined by continued Soil Renaissance convening hosted by the Soil Health Institute.

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Soil Health Institute Approach

1. Increase Adoption of SH Mgmt. Systems
   - Quantify impacts on profitability and economic risk.
   - Quantify SOC vs. AWHC relationships across soils, climates, cropping systems. Develop Decision Support System for producers.
   - Partner with boots on the ground organizations (NACD, LGU, NRCS, Agri-business, SH Partnership,…) for workshops, demonstration sites, field days, webinars,…

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2. Target Adoption of SH Mgmt. Systems (Example: Water Quality)
   - Determine potential water quality improvements for given levels of SH mgmt. system adoption (modeling).
   - Ground-truth predictions with Edge-of-Field monitoring (Discovery Farms, LTARs,…)
   - From above, identify priority sub-watersheds

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3. Quantify Adoption and Impact

- Assess current status of soil health in U.S.
- Assess current status of soil health practice adoption in U.S.
- Use above for establishing baseline for measuring future progress