Environmental Engineering Program Director Search

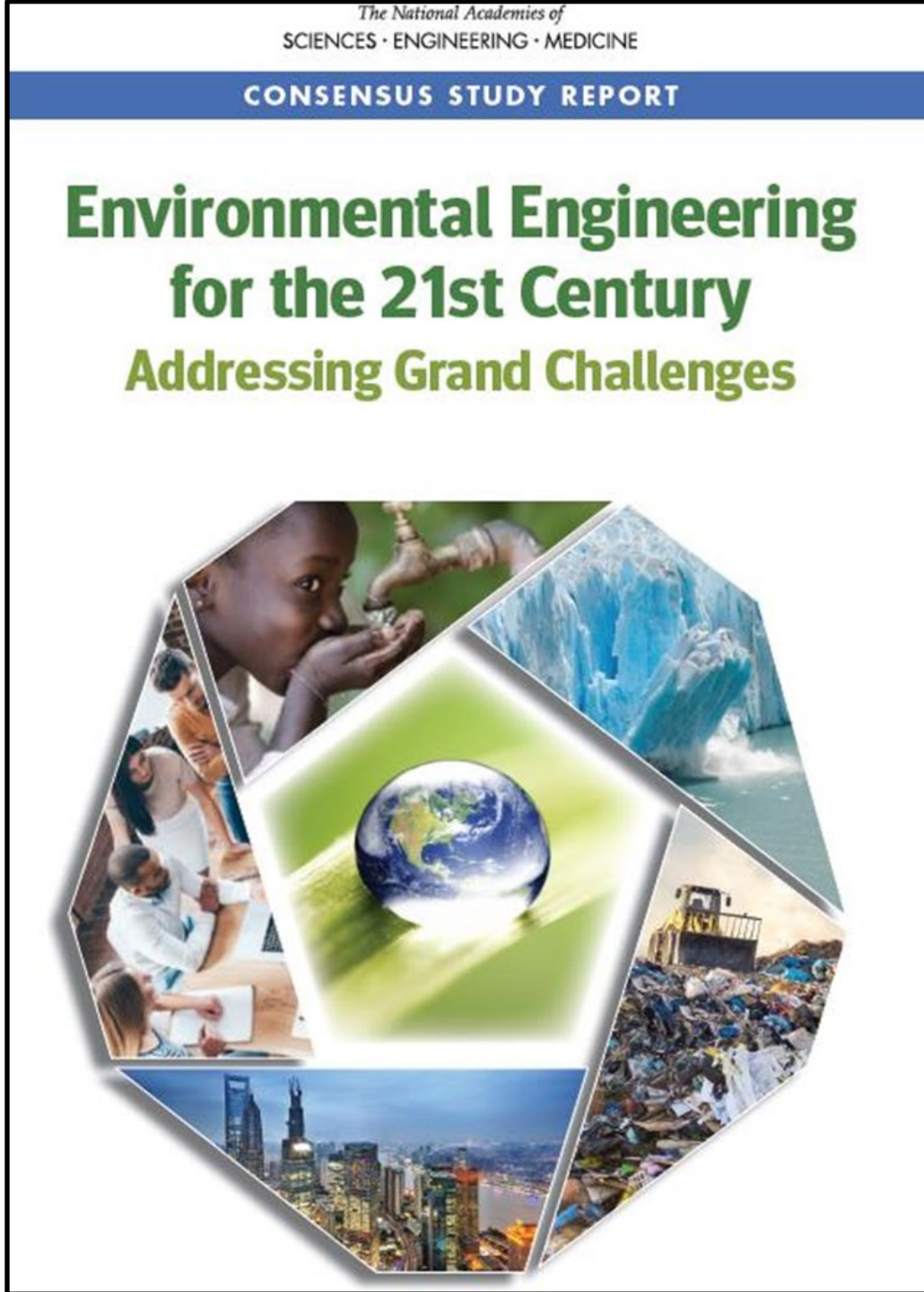
Should you or your colleagues be interested in this position, or wish to nominate suitable candidates, please email a current CV accompanied by a cover letter that highlights:

- Background that specifically relates to the program objectives;
- availability time frame and reasons for interest in an IPA position at NSF, and;
- prior experience working in a multi-disciplinary team environment.

Position Description: https://beta.nsf.gov/careers/openings/eng/cbet/cbet-2022-33337

NSF Program 1440:
https://beta.nsf.gov/funding/opportunities/environmental-engineering-1

Vacancy Contact: Mamadou Diallo
National Science Foundation
Alexandria, VA 22314
Phone: (703) 292-4257
Email: mdiallo@nsf.gov

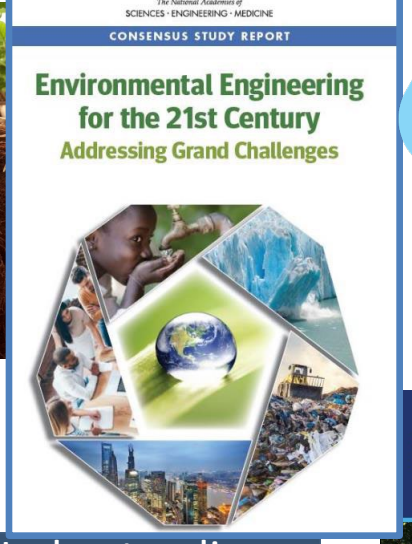


The Recent Evolution of Sustainability Research at NSF in Relation to Soil Science and Engineering

Brandi Schottel
National Science Foundation

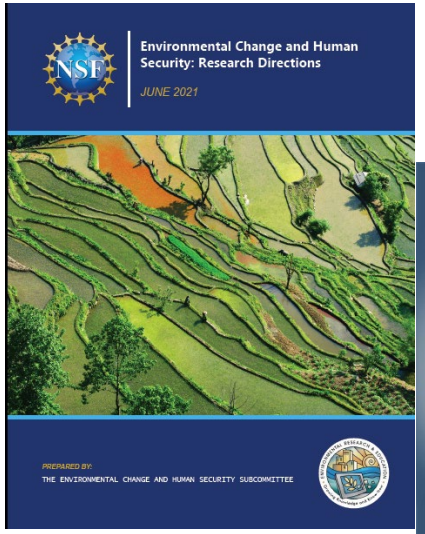
March 24, 2022

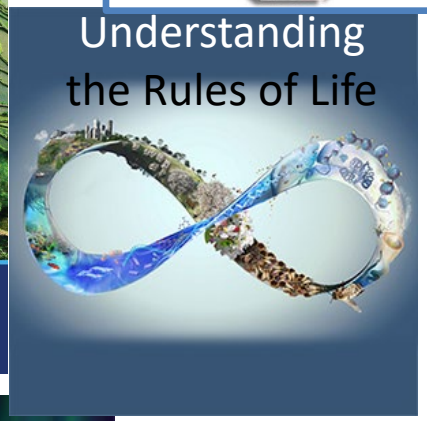
Credit: Rob Margetta/NSF – Rainbow https://nsf.gov/news/mmg/mmg_disp.jsp?med_id=132291&from=

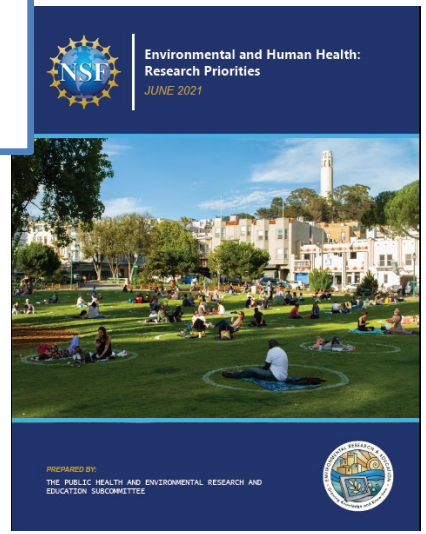


STEPS: Science and Technologies for Phosphorus Sustainability
https://steps-center.org/

CIVIC INNOVATION CHALLENGE
POWERING SMART & CONNECTED COMMUNITIES

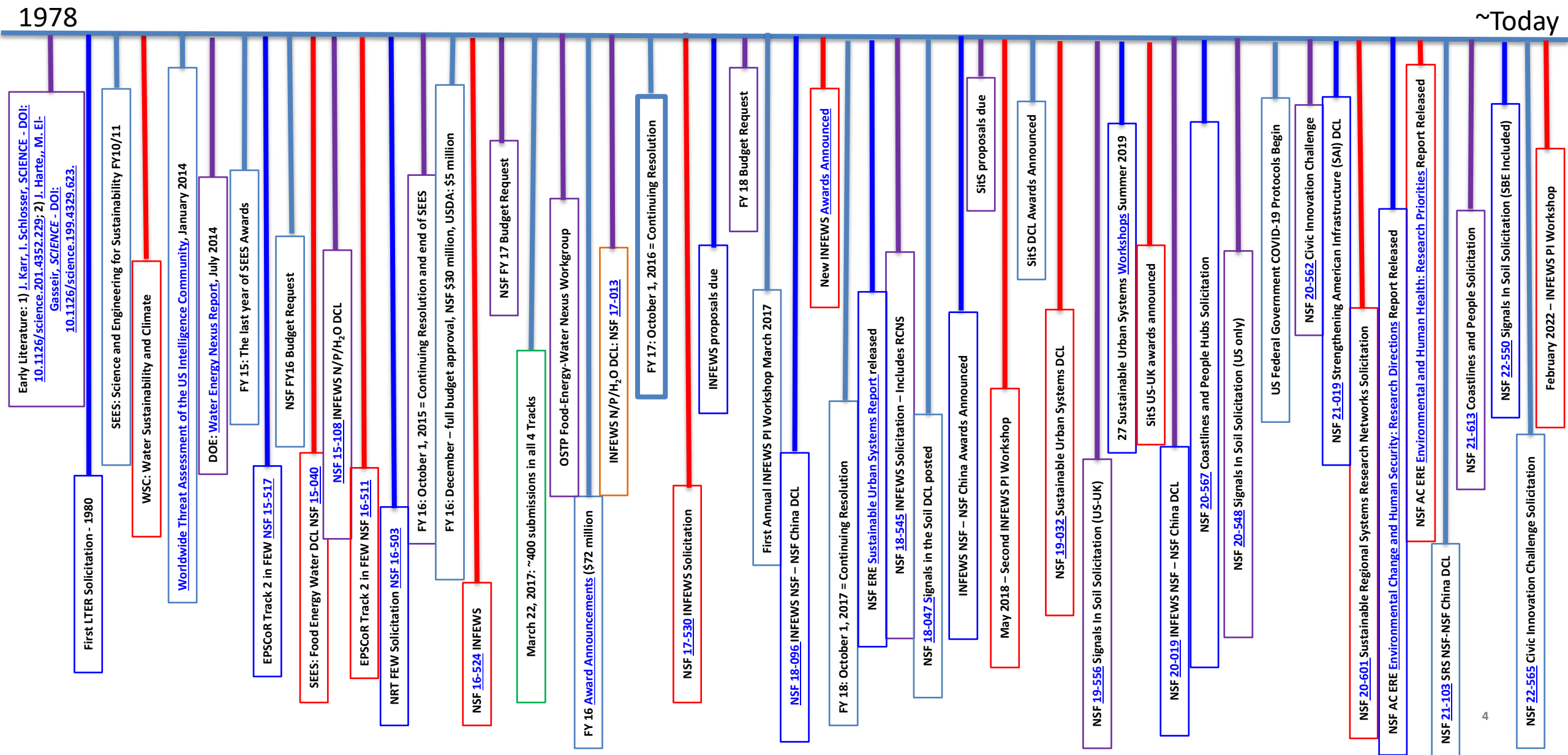






IoT4Ag
The Internet of Things for Precision Agriculture
an NSF Engineering Research Center
https://iot4ag.us/

Sustainability: Incomplete (and ongoing) History



Long-Term Ecological Research (LTER)

NATIONAL SCIENCE FOUNDATION
LTER NETWORK
LONG TERM ECOLOGICAL RESEARCH

- Started in 1980
- 28 sites
- Annual budgets per site: ~ $1.1 million
- Supported by BIO, GEO & SBE directorates
- Managed by the LTER Working Group
- Sites submit renewal proposals every 6 years
  - Proposals are rigorously reviewed
  - Sites with weak proposals are put on probation
    - 2 years of support
    - Submit a new proposal
- Entire program externally reviewed every 10 years
- Renewal Competition for current sites is underway (NSF 22-543)

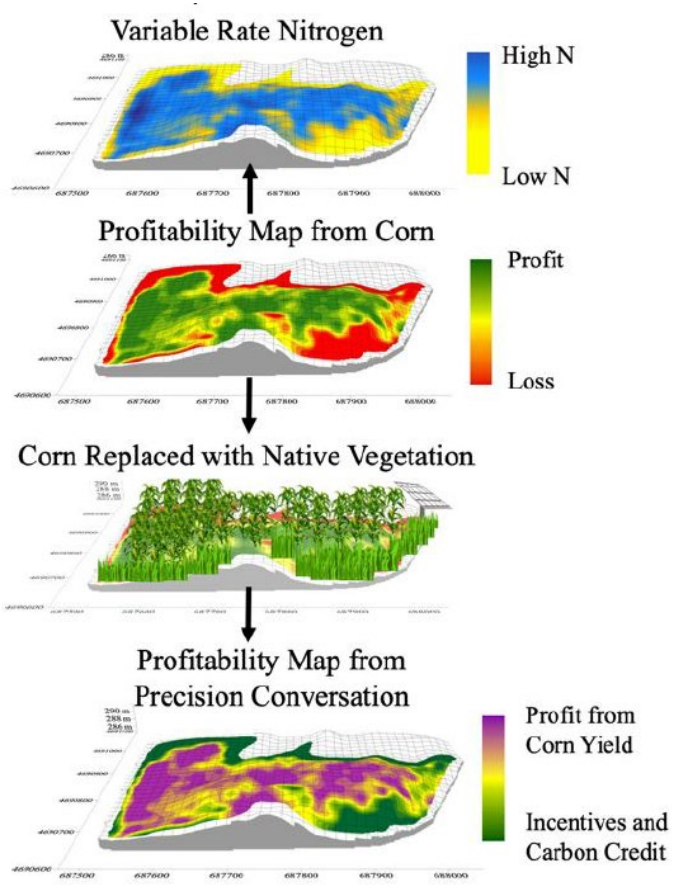
Long-Term Ecological Research

NATIONAL SCIENCE FOUNDATION
LTER NETWORK
LONG TERM ECOLOGICAL RESEARCH

- Question-driven research (unlike NEON) that requires long-term data
- 5 “core” areas (primary production, population dynamics, organic matter, nutrient cycles, impacts of disturbance) → Conceptual framework
- Network office
  - Coordinates activities across sites
  - Facilitates synthesis activities
  - Organizes meetings
- Data archived in a centralized hub

Biotechnology/Bioeconomy

LTER: Kellogg Biological Station



B. Bruno. (used with permission)

Ecology & Economics of Agricultural Landscapes

- how microbes make nutrients available to crops
- how pest populations are kept in check & pollination facilitated
- how plant diversity contributes to agricultural productivity
- how to re-think the economy of agricultural landscapes
  - Production for food vs. fuel (1)
  - Adding complexity & biodiversity back into agriculture

Why is this leading edge? Because ecological and economic incentives can be reinforcing if typical agricultural practices are re-envisioned.

Beyond DEB: PBI, SitS, DISES, HEGS, SRS RNs, USDA/LTAR

(1) Schulte, et al. Nat Sustain (2021). https://doi.org/10.1038/s41893-021-00827-y

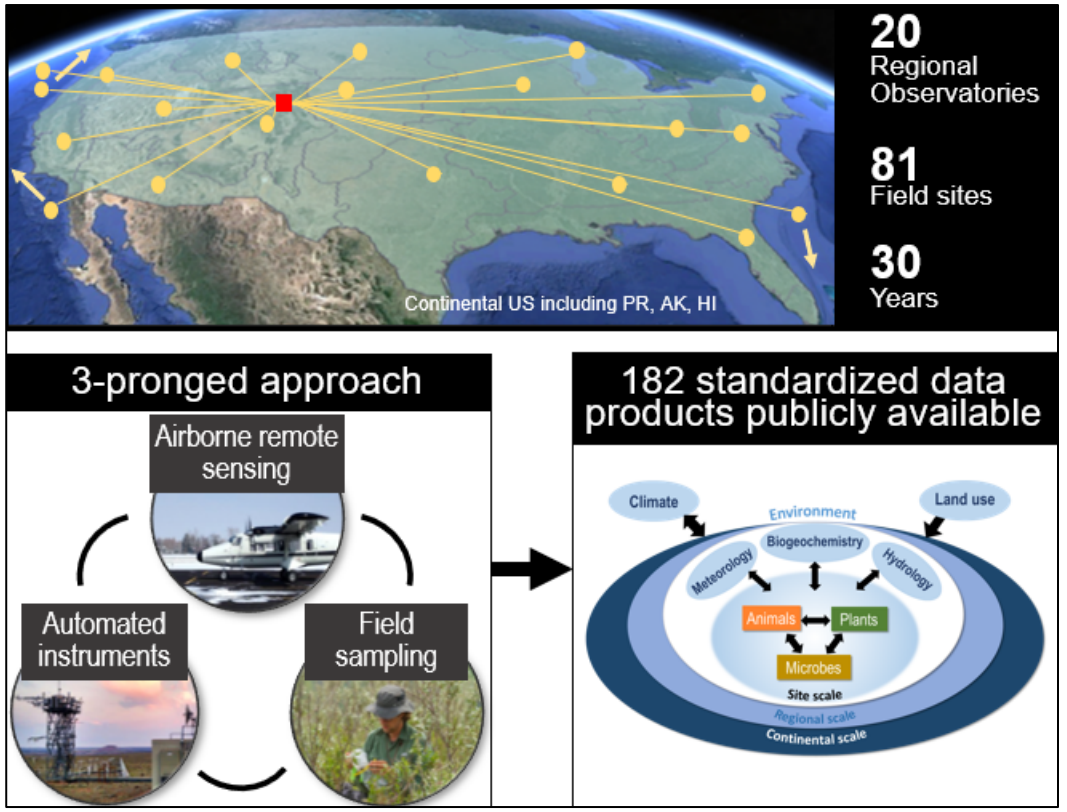
NEON Intent and Design

Intent

- Enable regional to continental scale research
- Enable individual and team science
- Democratize and standardize ecological research

Design

- Geographically distributed field and lab infrastructure
- Fully networked research platform
- Internet accessible, data, computational, analytical, and modeling capabilities



NEON Soil Measurements and Data Products

Provide estimates of key physical, chemical, and biological soil properties

SOIL MEASUREMENTS

Terrestrial Instrumentation Measurements

- Soil temperature (0.1Hz)
- Soil moisture (0.1Hz)
- Soil CO2 concentrations (0.1Hz)
- Soil heat flux (0.1Hz)
- *Throughfall near soil surface*
- *Skin temperature above soil surface*
- *Net shortwave and longwave radiation & PAR above soil (1Hz)*

Terrestrial Observational Sampling *within the airshed of the instrumented towers*

- Up to three collection bouts of soil cores (yearly)
  - Soil moisture, temperature, pH, microbial biomass, community composition
- Soil biogeochemical measurements (every five years)
  - *In-situ* net nitrogen transformation rates
  - Total organic carbon, nitrogen, and C &N isotopes
  - Root biomass
- Initial soil Megapits
  - Texture, bulk density, carbon, nutrients, cation exchange capacity, metals, etc.

SOIL RELATED DATA PRODUCTS

Instrumentation related data products

- Soil CO2 concentration
- Soil water content and water salinity
- Soil heat flux plate
- Soil temperature

Observation related data products

- Soil physical and chemical properties
- Soil stable isotopes
- Root biomass and chemistry
- Root stable isotopes
- Soil inorganic nitrogen pools and transformations
- Soil microbial biomass
- Soil microbe group abundances
- Soil microbe community composition
- Soil microbe metagenome
- Soil microbe marker gene sequences

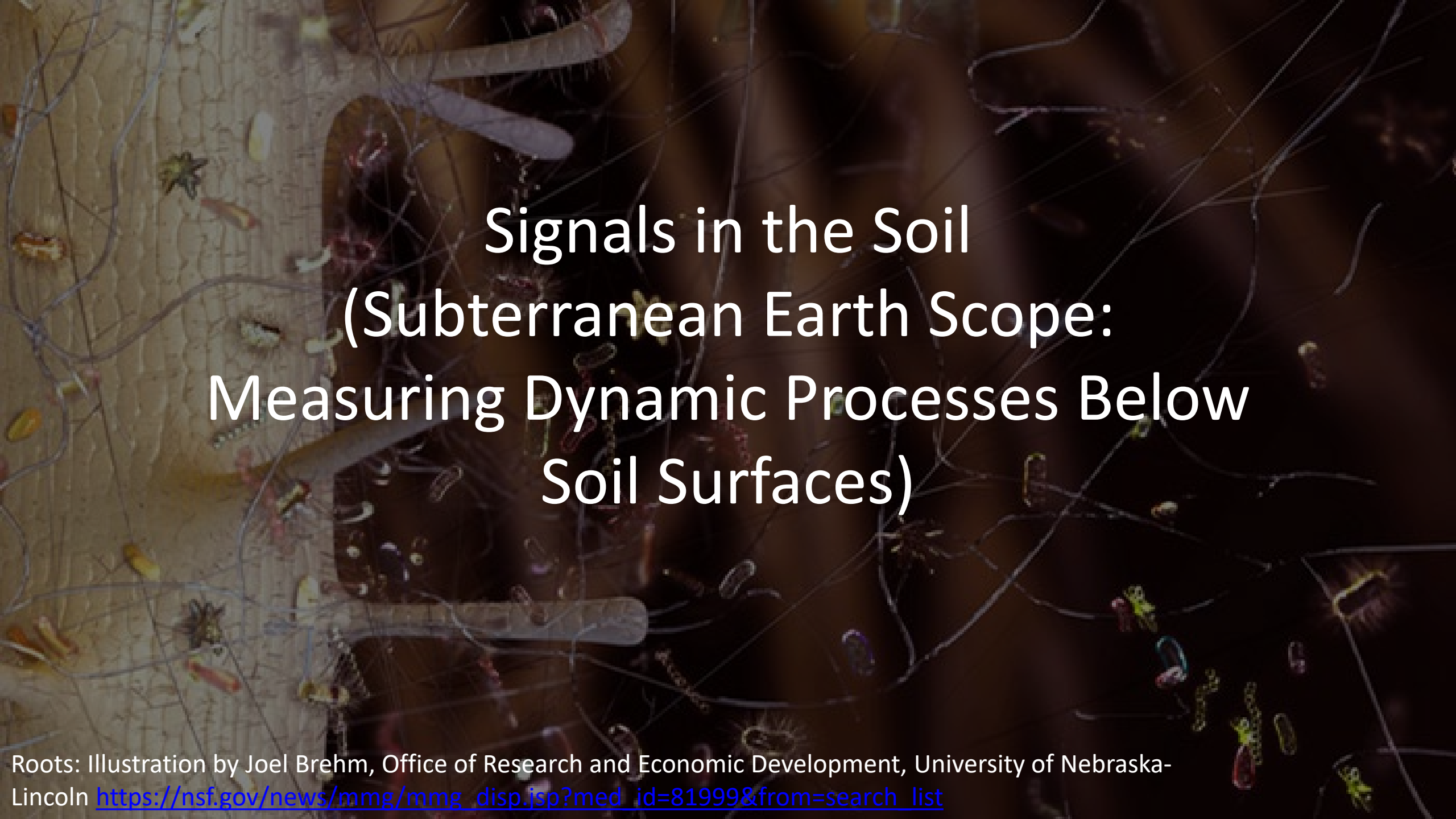
Archival Samples

Innovations at the Nexus of Food, Energy, and Water Systems

USDA NIFA

- Significantly advance our understanding of the food-energy-water system through quantitative and computational modeling, including support for relevant cyberinfrastructure;
- Develop real-time, cyber-enabled interfaces that improve understanding of the behavior of FEW systems and increase decision support capability;
- **Enable research that will lead to innovative system and technological solutions to critical FEW problems**
- Grow the scientific workforce capable of studying and managing the FEW system, through education and other professional development opportunities.

Amy Landis studies the feasibility of restoring soils degraded by industrial wastes and other pollutants for growing bioenergy crops. *Credit: Jessica Hochreiter/Arizona State University*



Signals in the Soil (Subterranean Earth Scope: Measuring Dynamic Processes Below Soil Surfaces)

Roots: Illustration by Joel Brehm, Office of Research and Economic Development, University of Nebraska-Lincoln https://nsf.gov/news/mmg/mmg_disp.jsp?med_id=81999&from=search_list

Signals in the Soil (SitS)

NSF 1745824: Subterranean Macroscope Workshop - University of Chicago

- **2018** – NSF 18-047: Dear Colleague Letter: Signals in the Soil (SitS) - NSF (ENG, BIO, CISE, GEO) - Awards
- **2018/2019** - NSF 18-097: Dear Colleague Letter: Planning for New SitS-Themed NSF Industry/University Cooperative Research Centers (IUCRCs) – NSF (ENG, CISE, GEO) - Awards
- **2019** – NSF 19-556: Signals in the Soil - NSF (ENG, BIO, CISE, GEO), USDA NIFA, and UKRI (NERC, BBSRC, EPSRC, STFC) - NSF Awards
- **2020** – NSF 20-548: Signals in the Soil – NSF (ENG, BIO, CISE, GEO, MPS) and USDA NIFA – NSF Awards
- **2022** – NSF 22-550: Signals in the Soil – NSF (ENG, BIO, CISE, GEO, MPS, SBE) and USDA NIFA

Six Themes:

- **Novel Sensors:** Sensing soil biological/metagenomics, chemical, or physical characteristics; inexpensive, buried for long time periods.
- **Wireless Systems:** Advances in wireless communications to collect and transmit data from sensors buried in soils.
- **Advanced Cyber Systems & Data Analytics:** For data fusion & analytics of sensor outputs (visualization, reporting tools, etc.).
- **Understanding Biological Entities/Soil/Organism Interactions:** Advances in knowledge of signaling and interactions between species and soil.
- **Modeling Soil Ecosystems**: Next-generation dynamic models of soil bio, chem, and/or physical components, describing interactions among processes at different temporal and spatial scales.
- **Socializing Soil:** Better understand complex people-soil dynamics through partnerships between soil scientists and social scientist

Biotechnology and Biological Sciences Research Council

Engineering and Physical Sciences Research Council

Natural Environment Research Council

Science and Technology Facilities Council

NSF's current headquarters: 2415 Eisenhower Avenue, Alexandria, VA, 22314
Credit: *National Science Foundation* (*www.nsf.gov*)

Questions?

Brandi Schottel: bschotte@nsf.gov