Photo by Kayla Spangelo

SOIL, ENERGY, and AGRICULTURE for Resilient Ecosystems

NCSS
National Cooperative Soil Survey

National Conference Program & Schedule

July 9 to 13, 2023

Bismarck State College
National Energy Center of Excellence

Bismarck, North Dakota

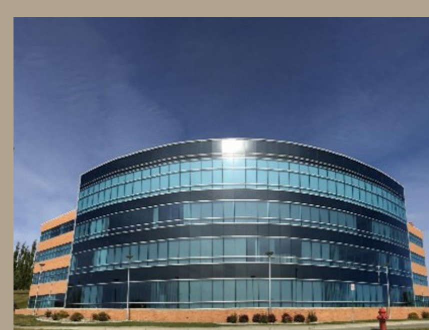
Agenda

Bavendick State Room

Collaborate with NCSS cooperators on innovative solutions for soil survey.

Posters

Engage during the poster session and social at North Dakota's Gateway to Science.



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Major North Dakota NCSS Cooperators

NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

NDSU NORTH DAKOTA STATE UNIVERSITY

Thank you to our NCSS Conference sponsors!

NDSU School of Natural Resources

Western Plains Consulting

Professional Soil Classifiers Association of North Dakota

and

Board of Registration for Professional Soil Classifiers of North Dakota

The North Dakota Coat of Arms

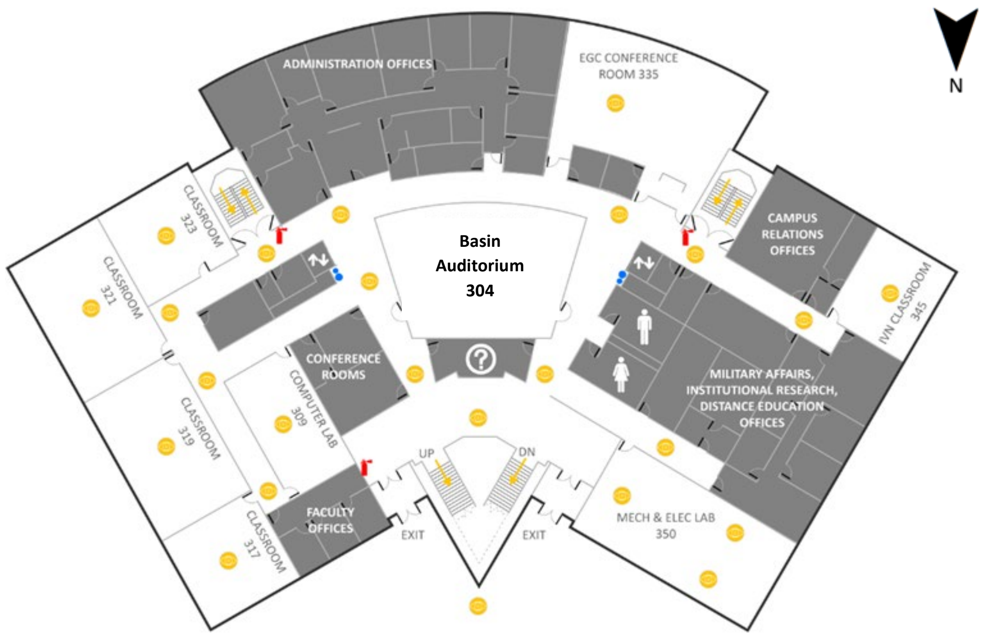

Keelboat Park and Riverside
North Dakota's Gateway to Science
BSC National Energy Center of Excellence
Hampton Inn & Suites Bismarck Northwest
Stadium Sports Bar and Grill
Dan's Supermarket
Farmer's Union Oil CENEX
City Brew Coffee
N
Bismarck State College
MDU Resources Community Bowl
Missouri River High Bridge
Google Earth
Imagery Date: 9/1/2022

BISMARCK STATE COLLEGE | North Dakota's Polytechnic Institution

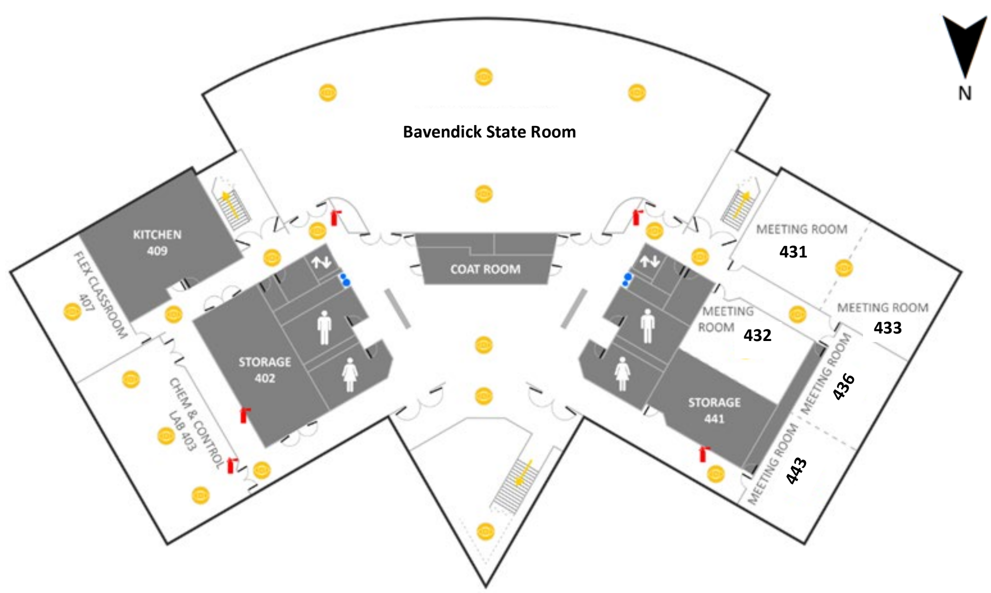
1200 Schafer Street, Bismarck, North Dakota

National Energy Center of Excellence Floor Plan

BSC National Energy Center of Excellence 3rd Floor

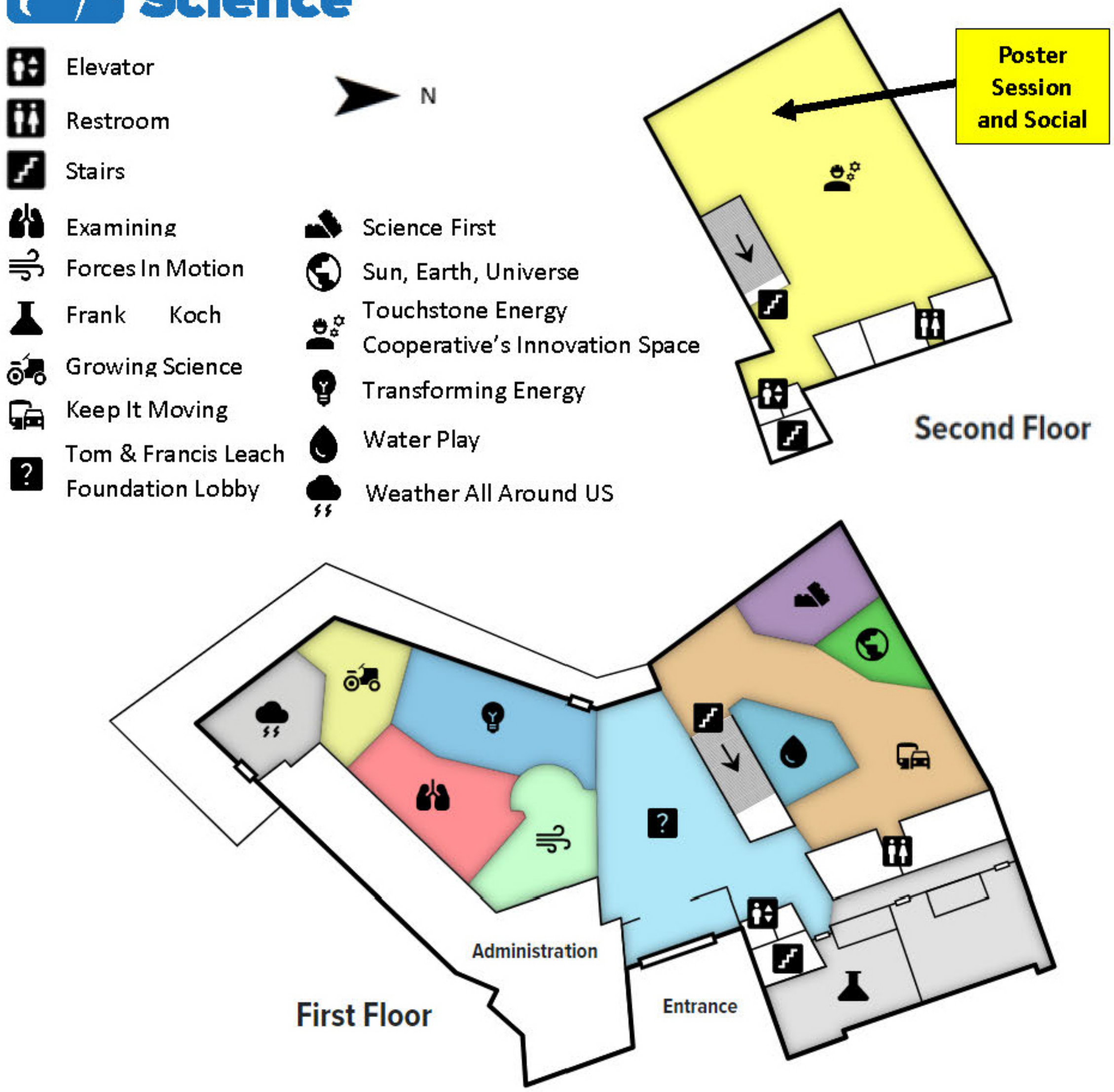


BSC National Energy Center of Excellence 4th Floor



North Dakota’s Gateway to Science Floor Plan

1810 Schafer Street
Bismarck, North Dakota



The poster session and social will be held on the second floor.

Be sure to experience the USDA collaborative projects in the “Growing Science” and “Weather All Around Us” exhibits. Extensive technical assistance and data were provided for the following projects.

- Virtual Farm
- Soil Columns
- Trees Against the Wind

Our sincerest THANK YOU to Bismarck State College and North Dakota's Gateway to Science for their GREAT hospitality.

Program Schedule

Saturday, July 8, 2023

1:00 to 7:00 p.m.	**Registration** – Hampton Inn & Suites Bismarck Northwest **DINNER** (on your own)

Sunday, July 9, 2023

6:45 a.m.	Assemble and load buses in the north parking lot of the Bismarck State College National Energy Center of Excellence **(NECE)** **Buses will leave promptly at 7:00 a.m.**
7:00 a.m. to 6:00 p.m.	**FIELD TOUR** (lunch included) Sedimentary Plains Tour: Belfield and Medora, North Dakota Explore and enjoy the history, geology, and soils of Western North Dakota including sodium-affected soil pits near Belfield. Then we'll continue west for lunch at Medora, and into the heart of the North Dakota Badlands and Theodore Roosevelt National Park as *Dr. Bernhardt Saini-Eidukat*, North Dakota State University presents on this **Truly Legendary Landscape!**
12:00 to 6:30 p.m.	**Registration** – Hampton Inn & Suites Bismarck Northwest **DINNER** (on your own)

Monday, July 10, 2023

7:00 a.m.	**Registration** – 4th Floor, Bismarck State College NECE (coffee/continental breakfast included) *Registration will remain open until 5:00 p.m.*
   8:00 a.m.	**PLENARY SESSION** – Bavendick State Room Moderator: *Wade Bott,* USDA NRCS, North Dakota **Welcome Remarks** *Dr. Doug Jensen*, President, Bismarck State College
8:10 a.m.	*Dan Hovland,* State Conservationist, USDA NRCS, North Dakota
8:20 a.m.	**Welcome to North Dakota — a state of remarkable soils and a unique soil survey legacy!** *Dr. David Hopkins*, North Dakota State University
8:40 a.m.	**Remarks from Soil Science Society of America** *Dr. Carrie Laboski,* President, Soil Science Society of America

Monday, July 10, 2023 (continued)

9:00 a.m.	**Remarks from USDA NRCS Leadership** *Dr. Luis Tupas*, Deputy Chief, SSRA, USDA NRCS, Washington D.C.
9:15 a.m.	**Remarks from Soil and Plant Science Division Leadership** *Dr. David Lindbo*, Director, SPSD, USDA NRCS, Washington D.C.
9:30 a.m.	**BREAK**
10:00 a.m.	**Farming, Hunting, and Mining among North Dakota's First People** *Dr. Andrew Clark*, State Historical Society of North Dakota
10:15 a.m.	**Traditional Gardening Practices of the Mandan, Hidatsa, and Arikara People: Historic and Contemporary Glimpses in Time** *Dr. Ruth Plenty Sweetgrass-She Kills*, Nueta Hidatsa Sahnish College
11:00 a.m.	**National Cooperative Soil Survey Activities at the Northern Great Plains Field Station, 1949-1956** *Dr. Mark Liebig*, USDA ARS, Mandan, North Dakota
	COMMITTEE BREAKOUT SESSIONS – Bismarck State College NECE
11:15 a.m.	**Committee Meetings** (4 concurrent) • Bylaws – Meeting Room 436/443 • Interpretations – Meeting Room 431/433 • Taxonomy – Bavendick State Room • Technology – Basin Auditorium 304
12:00 p.m.	**LUNCH** (provided)
1:00 p.m.	**Committee Meetings** (4 concurrent) • Hydric/SAS – Meeting Room 436/443 • Research – Bavendick State Room • Soil and Ecosystem Dynamics – Basin Auditorium 304 • Standards – Meeting Room 431/433
1:45 p.m.	**BREAK**
2:00 p.m.	**Committee Meetings (4 concurrent)** • Bylaws – Meeting Room 436/443 • Interpretations – Meeting Room 431/433 • Taxonomy – Bavendick State Room • Technology – Basin Auditorium 304
2:45 p.m.	**BREAK**

Monday, July 10, 2023 (continued)

3:00 p.m.	**Committee Meetings** (4 concurrent) • Hydric/SAS – Meeting Room 436/443 • Research – Bavendick State Room • Soil and Ecosystem Dynamics – Basin Auditorium 304 • Standards – Meeting Room 431/433
3:45 p.m.	**BREAK**
4:00 p.m.	Cooperator/Partner Business Meetings – Bavendick State Room, Meeting Room 431/433, or Meeting Room 436/443 State Soil Scientist Business Meeting – Basin Auditorium 304
5:00 p.m.	**DINNER** (on your own)

Tuesday, July 11, 2023

7:00 a.m.	Morning Networking Session – 4th Floor, Bismarck State College NECE (coffee/continental breakfast included)
	PLENARY SESSION – Bavendick State Room Moderator: *Dr. David Hopkins*, North Dakota State University
8:00 a.m.	**Transformation of Agriculture in North Dakota for Ill and for Good** *Dr. David Franzen*, North Dakota State University
8:30 a.m.	**Measuring Soil Carbon: Unique Considerations for Climate Mitigation** (VIRTUAL) *Dr. Jonathan Sanderman*, Woodwell Climate Research Center
8:50 a.m.	**Overview of the USDA Climate Hubs and Soil-Related Tools and Resources** *Dr. Dannele Peck*, USDA ARS, Fort Collins, Colorado
9:10 a.m.	**Climate Regulation Services from Northern Plains Agroecosystems** *Dr. Mark Liebig,* USDA ARS, Mandan, North Dakota
9:30 a.m.	**BREAK**
10:00 a.m.	**The National Coordinated Soil Moisture Monitoring Network: What it is, and why soils characterization is an integral component of our success (VIRTUAL)** *Marina Skumanich,* NOAA-NIDIS, Boulder, Colorado
10:20 a.m.	**DSP4SH: Using Cooperative Research to Define Dynamic Soil Property and Soil Health Reference Conditions for Soil Survey** *Dr. Skye Wills*, SPSD-NSSC, USDA NRCS, Nebraska

Tuesday, July 11, 2023 (continued)

10:40 a.m.	**Trends in Soil Properties Across the Minneapolis-St. Paul Metropolitan Area - Implications for Ecosystem Services** (VIRTUAL) *Dr. Nic Jelinski*, University of Minnesota, Twin Cities
11:00 a.m.	**The Changing Demands on Soil Survey – What the Future May Hold** *Dr. David Lobb*, University of Manitoba, Winnipeg, Manitoba, Canada
11:20 a.m.	**Species Composition Trends and Impacts on Native Ecological Sites States** *Dr. Kevin Sedivec*, North Dakota State University
11:40 a.m.	**Building Rangeland Resilience to Adapt to Climate Change** *Dr. David Toledo*, USDA-ARS, Mandan, North Dakota
12:00 p.m.	**LUNCH** (provided) with **The Geology of North Dakota** *Ed Murphy*, North Dakota Geological Survey
1:00 p.m.	**ORAL POSTER PRESENTATIONS** – Bavendick State Room **Sensor-informed soil water, nitrate, and greenhouse gas monitoring and management for climate-smart agriculture** *Dr. Jingyi Huang*, University of Wisconsin, Madison
1:15 p.m.	**Impacts of wildfire on the ecologic, hydrologic, and geomorphic resiliency of forest soils in the Southwestern U.S.** *Dr. Craig Rasmussen*, University of Arizona
1:30 p.m.	**State-and-transition models in a time of change: toolsets for integrated carbon management** *Dr. James Thompson*, West Virginia University
1:45 p.m.	**Legacy data rescue for retrospective soil survey and change detection in topsoil organic carbon stocks of the Corn belt, USA** *Dr. Meyer Bohn*, University of Iowa
2:00 p.m.	**Visualizing Soil Landscapes by Mining Soil Survey Taxonomic Data** *Dr. Darrell Schulze*, Purdue University
2:15 p.m.	**Soil landscapes of the United States (SOLUS): A 21st century raster soil survey inventory** *Suzann Kienast-Brown*, SPSD-NSSC, USDA NRCS, Montana
2:30 p.m.	**BREAK –** Move to North Dakota' Gateway to Science at 1600 Canary Avenue, Bismarck, North Dakota

Tuesday, July 11, 2023 (continued)

3:00 p.m.	**Poster Session with "Stump Talks"** – North Dakota's Gateway to Science gallery viewing
5:00 p.m.	Poster Social and North Dakota's Gateway to Science Gallery Viewing (Heavy hors d'oeuvres and cash bar)
7:00 p.m.	**DINNER** (on your own)

Wednesday, July 12, 2023

6:45 a.m.	Assemble and load buses in the north parking lot of the Bismarck State College NECE **Buses will leave promptly at 7:00 a.m.**
7:00 a.m. to 9:00 p.m.	**FIELD TOUR** (lunch & dinner included) Missouri Corridor Tour: Underwood, Mandan, & McKenzie, North Dakota An event filled day! Discuss soil pits on reclaimed coal mine land and restored wetlands; then compare them to the unmined soils and landscape. Experience the Garrison Dam and Lake Sakakawea, learn the history of the development, energy contributions, and flood control use of the 3rd largest reservoir in the Unites States. Tour the USDA ARS Northern Great Plains Research Laboratory in Mandan where you will learn of the history, research, and collaborations of the 111-year-old station. End the day with dinner during the NCSS Awards Banquet hosted by the Black Leg Ranch, owned and operated by the Doan Family since 1882. This ranch, heavily involved in conservation and regenerative agriculture has won numerous state and national Environmental Stewardship Awards including the Inaugural Aldo Leopold Conservation Award for the state of North Dakota.

Thursday, July 13, 2023

7:00 a.m.	Morning Networking Session – 4th Floor, Bismarck State College NECE (coffee/continental breakfast included)
8:00 a.m.	**PLENARY SESSION** – Bavendick State Room Moderator: *Lance Duey*, USDA NRCS, North Dakota **Walking Back – Looking Forward** *Jay Fuhrer*, Burleigh County SCD Menoken Soil Health Farm
8:30 a.m.	**UPDATES FROM FEDERAL PARTNERS** **Updates from USDA Agricultural Research Service** (VIRTUAL) *Sarah Beebout*, USDA ARS, Maryland

Thursday, July 13, 2023 (continued)

8:45 a.m.	**What's the BLM been up to?** (VIRTUAL) *Ron McCormick*, USDI BLM, Washington D.C.
9:00 a.m.	**Updates from USDA Forest Service** (VIRTUAL) *Robert Colter*, USDA FS, Washington, D.C.
9:15 a.m.	**With a lot of help from our friends: Soils data, information, and partnerships in the National Park Service Washington Office** *Jason Kenworthy*, USDI NPS, Colorado
9:30 a.m.	**The Dynamic Role of Depressional Wetlands in Agroecosystems in North Dakota and Beyond** *Owen McKenna*, USDI GS, North Dakota
9:45 a.m.	**BREAK**
10:00 a.m.	**Bylaws** CHAIR: *Jenn Mason*, SPSD, USDA NRCS, Tennessee
10:15 a.m.	**Interpretations** CHAIR: *Bob Dobos*, SPSD-NSSC, USDA NRCS, Nebraska
10:30 a.m.	**Taxonomy** CHAIR: *Andrew Brown*, SPSD, USDA NRCS, California
10:45 a.m.	**Technology** CHAIR: *Aaron Friend*, USDA NRCS, Tennessee
11:00 a.m.	**Subaqueous Soils Ad Hoc** CHAIR: Greg Taylor, SPSD, USDA NRCS, North Carolina
11:15 a.m.	**Research Priorities** CHAIR: *Dr. Skye Wills*, SPSD-NSSC, USDA NRCS, Nebraska
11:30 a.m.	**Soil and Ecosystem Dynamics** CHAIR: *Curtis Talbot*, SPSD, USDA NRCS, New Mexico
11:45 a.m.	**Standards** CHAIR: *Deb Surabian*, SPSD, USDA NRCS, Connecticut
12:00 p.m.	**Hydric Ad Hoc** CHAIR: *Lenore Vasilas*, SPSD, USDA NRCS, Maryland
12:15 p.m.	**LUNCH** (provided)

Thursday, July 13, 2023 (continued)

	TOWN HALL DISCUSSION Moderator: *Dr. Meyer Bohn*, Iowa State University
1:15 p.m.	**Recruitment and Retention**
2:15 p.m.	**NCSS Business Meeting and NCSS Next Host** *Dr. David Lindbo*, Director, SPSD, USDA NRCS, Washington D.C.
2:45 p.m.	**Closing Remarks**

Friday, July 14, 2023

7:30 a.m.	Travel to Menoken, North Dakota
8:00 to 10:30 a.m.	**Burleigh County SCD, Menoken Soil Health Farm Tour** Witness soil health cropping systems, cover crops, composting system, high tunnel, vermiculture, and the no-till garden.

Guest Speakers — Biographies and Abstracts

Sunday, July 9, 2023

Saline and Sodic Soils of Western North Dakota

Dr. Tom DeSutter, North Dakota State University

Dr. DeSutter received his B.S. and M.S. degrees from South Dakota State University (Brookings, South Dakota) in 1994 and 1998, respectively, and his Ph.D. in 2004 from Kansas State University (Manhattan, Kansas). After completing a Post-Doc with the USDA ARS (Ames, Iowa), he was hired in 2006 as an Environmental Soil Scientist by the Department of Soil Science at North Dakota State University (Fargo, North Dakota). His primary research interests are saline and sodic soils, reclamation of energy-extraction impacted soils, and instrumentation for measuring soil physical and biological parameters. DeSutter teaches Soil and Land Use and Environmental Field Instrumentation and Sampling.

Geology of the North Dakota Badlands

Dr. Bernhardt Saini-Eidukat, North Dakota State University

Bernhardt Saini-Eidukat is a geologist who uses a geochemical perspective to work on earth materials. He has expertise in X-ray diffraction, electron microscopy, and related analytical tools. Bernhardt earned B.S degrees in geology and geophysics, and a Ph.D. in geology from the University of Minnesota on the potential for platinum group element deposits in the Duluth Complex. After post-doctoral work in Austria studying ore deposit potential in Finland and Russia, he joined North Dakota State University where he is currently a professor. He teaches a wide variety of courses, including many domestic and international field courses.

Welcome to North Dakota — A State of Remarkable Soils and a Unique Soil Survey Legacy

Dr. David Hopkins, North Dakota State University

David Hopkins earned a B.S. in Agricultural Science-Soils from Montana State University in 1979; and worked for the Soil Conservation Service in eastern Montana on the Carter and Fallon County soil surveys. In 1981, Hopkins began working on intensive soil surveys for the North Dakota Agricultural Experiment Station. His M.S. degree on sodic soils was followed by a Ph.D., due an interest in teaching. Hopkins taught Intro Soils Science for 14 years, Soil Genesis since 2005, and a one-week intensive Field Soils Interpretation course has been offered since 2013. Since 2015, Hopkins has focused on soil micromorphology as a proxy for soil health on the benchmark Barnes soil.

Abstract

Welcome to North Dakota, land of “exemplar” chernozems (Mollisols), ranked as the top national producer of 12 commodity crops, and boasting the third greatest cropland acreage of the fifty states. The soils of this state were also “home” to, or investigated by, some of the most influential pedologists America has yet produced. The immense 1908 soil survey of western North Dakota led by the “party leader” Macy H. Lapham, included George Coffey and Thomas Rice among others. Charles Kellogg was a soils professor at North Dakota Agricultural College (NDAC), who, in a brief time academically (1930-34), transformed soil survey and educated some of the brightest minds in American pedology. This introduction is inspired by three trains that traversed North Dakota from the days of the homesteaders to the time of the modern tractor. The “locomotives” offer a figuratively unique way to highlight North Dakota soil and North Dakotan soil scientists.

Remarks from Soil Science Society of America

Dr. Carrie Laboski, President, Soil Science Society of America

Dr. Carrie Laboski is a Soil Scientist and Research Leader at the Pasture Systems and Watershed Management Research Unit in University Park, Pennsylvania. Her research is focused on improving sustainability and resilience of agroecosystems through improved soil fertility and nutrient management practices. Her research interests include improving nutrient use efficiency of nitrogen, phosphorus, and potassium from fertilizer and animal manure; soil fertility issues related to lime, secondary, and micronutrients; and evaluation of soil and plant diagnostic tests. Previously, Dr. Laboski was a Professor and Extension Specialist at the University of Wisconsin-Madison where she developed educational materials, programs, curricula, and decision-making tools for farmers, crop advisors, and regulatory agencies. Dr. Laboski is President of the Soil Science Society of America. Her expertise has been sought after to serve on state and national committees related to nutrient management policy.

Remarks from USDA NRCS Leadership

Dr. Luis Tupas, Deputy Chief, SSRA, USDA NRCS, Washington D.C.

Dr. Louie Tupas is the Deputy Chief for Soil Science and Resource Assessment at the U.S. Department of Agriculture's Natural Resources Conservation Service. Dr. Tupas provides leadership for addressing the scientific basis for conservation and sustainable agriculture through research, national surveys of soil, snow, water, and other natural resources, inventories of U.S. natural resources and their ecological transitions, and analyzing the impact of conservation practices, including soil, water, and climate studies. He also provides national leadership to address global change and climate impacts on agriculture, forestry, and other landscapes, develop and expand climate mitigation and adaptation strategies, and enhance the sustainable utilization of agricultural working lands and waters. He also develops and implements strategies for sustainable natural resources utilization and environmental systems management and promotes domestic and international partnerships and engagement through collaborative research, education, and outreach programs.

Louie served as a faculty member at the University of Hawaii at Manoa from 1991-2002. His research and teaching career were in the fields of biogeochemistry, microbial ecology, aquaculture, and biological oceanography. He began his federal government career in 2002 as a Program Director at the U.S. National Science Foundation. In 2004, he joined USDA Cooperative State Research, Education, and Extension Service, now known as the National Institute of Food and Agriculture (NIFA). He served at NIFA as a National Program Leader, Division Director and Deputy Director for Bioenergy, Climate and Environment. He joined NRCS in 2020. His responsibilities include being the NRCS Research and Scientific Integrity Officer, and co-Executive Leader of the USDA Climate Hubs.

Remarks from Soil and Plant Science Division Leadership

Dr. David Lindbo, Director, SPSD, USDA NRCS, Washington D.C.

Dr. David Lindbo, PhD, NCLSS, CPSS
Director, Soil and Plant Science Division, USDA NRCS (2015 to present)
Professor Emeritus Soil Science Department, North Carolina State University (1995-2015)
Former President of the Soil Science Society of America (2012-14)
Fellow Soil Science Society of America (2009)

Education

Ph.D. from University of Massachusetts, Plant and Soil Science Dept.
M.S. from University of Massachusetts, Geology Dept.,
M.S. from University of New Hampshire, Forest Resources Dept.,
B.S. from University of New Hampshire, Institute of Natural and Environmental Resources.

Dr. Lindbo directs the soil and ecological site survey, research, and interpretation programs for the USDA Natural Resources Conservation Service. He has spent his career working on land use soils relations including soil interpretations, hydric soils, wastewater, and related issues. He has worked extensively with K12 students and teachers regarding soils and land education. He has authored/co-authored numerous research and extension publications including practitioner training materials related to decentralized wastewater, low impact development issues, hydric soils and hydropedology as well as a general interest soil book for young children "Soil! Get the Inside Scoop" and an advanced book "Know Soil, Know Life." He has over 130 publications (not including abstracts), has given over 200 invited presentations, and taught well over 10,000 professionals in his array of extension courses.

Farming, Hunting, and Mining among North Dakota's First People

Dr. Andrew Clark, State Historical Society of North Dakota

Andrew Clark is the Director of Archaeology and Historic Preservation and Deputy SHPO for the State Historical Society of North Dakota. Clark's research interests include the archaeology of conflict and peace, public archaeology, and technological applications to cultural resource management including remote sensing and analyzing drone-acquired aerial photos. Working for the South Dakota State Historical Society, U.S. Army Corps of Engineers, and private consulting companies, he has spent most of his career working in the northern Plains but has also conducted archaeological investigations in 15 states and two countries. Andrew holds a bachelor's degree from the University of South Dakota, a master's from the University of Memphis, and a doctorate from the University at Albany.

Abstract

The northern Great Plains' first inhabitants shared many of the same traits as modern-day North Dakotans. They were hard-working and self-sufficient but simultaneously deeply connected and integral to those living in other regions. Through ethnographic and archaeological information, this presentation will show that North Dakota's first people were at the heart of the world. From the Knife River Flint trade, North Dakota's first mineral export, to cultural centers such as the village of Yellow Earth (now known as Double Ditch State Historic Site), North Dakota's first people were cultural and economic drivers of North America before the arrival of the first immigrants from Europe.

Traditional Gardening Practices of the Mandan, Hidatsa, and Arikara People: Historic and Contemporary Glimpses in Time

Dr. Ruth Plenty Sweetgrass-She Kills, Nueta Hidatsa Sahnish College

Dr. Ruth Plenty Sweetgrass-She Kills is an enrolled member of the Three Affiliated Tribes of the Fort Berthold Indian Reservation. She is also descended from the Fort Peck Sioux and Assiniboine. She has gardened and gathered traditional foods and medicines with her family her entire life. Currently, she serves as the Food Sovereignty Director at Nueta Hidatsa Sahnish College and is senior researcher personnel for the University of Montana. Other projects she also works on include a project to digitize her tribal college's special collections, as well as develop the traditional seed cache and a project focused on developing a consortium of Indigenous led research along the Missouri River Watershed.

Abstract

The food systems of Mandan, Hidatsa, and Arikara people include a long history of gardening and working with the land. They grew and continue to grow corn, beans, squash, sunflowers, melons, and tobacco. Traditionally, their gardens were along the floodplain of the Missouri River, which was very fertile. They were able to grow enough produce to sustain themselves and have a surplus for trade. This contributed to the region becoming a trade center. Many factors, including a series of federal policies impacted these practices and access to the land with whom they had centuries-long relationships. Presently, the Mandan, Hidatsa, and Arikara continue to garden and seek to reunite with their seed relatives through the process of seed rematriation. This talk will provide a history and description of the gardening practices, as well as the current revitalization of our traditional food systems.

National Cooperative Soil Survey Activities at the Northern Great Plains Field Station, 1949-1956

Dr. Mark Liebig, USDA ARS, Northern Great Plains Research Laboratory, North Dakota

Mark Liebig is a Research Soil Scientist with the USDA ARS Northern Great Plains Research Laboratory near Mandan, North Dakota. For the past 23 years, Mark has contributed to research seeking to develop soil, crop, and animal management practices for the Great Plains to overcome limitations to productivity while enhancing environmental quality. As a team member, Mark leads research to quantify management effects on soil properties and greenhouse gas emissions. As a supplement to core responsibilities, Mark develops decision aides and evaluation tools for producers, conservationists, and scientists, and regularly contributes to research networks within and outside USDA ARS.

Abstract

Previous soil survey activities in North Dakota have provided a wealth of information to understand, manage, and sustain the state’s abundant soil resources. While an active field component has been the backbone of soil survey activities for over 75 years, a lesser-known laboratory component supplied critical information at a time when agriculture was rapidly evolving throughout the state. In 1949, the Missouri Basin Soil Survey Laboratory was established at the Northern Great Plains Field Station, Mandan, North Dakota. Initial activities of the laboratory focused on generating data for the proper classification of soils under irrigated agriculture. Subsequent laboratory activities were expanded to include studies on soil chemical changes under dryland cropping throughout the Great Plains. The laboratory was moved to Lincoln, Nebraska, in July 1956. This presentation will document the history of the laboratory, while reflecting on soil research activities that preceded and followed its seven-year tenure.

Transformation of Agriculture in North Dakota for Ill and for Good

Dr. David Franzen, North Dakota State University

Dave Franzen was born outside of Chicago, Illinois, and received his B.S. (75), M.S. (76), Ph.D. (93) from the University of Illinois with a B.S. in Forest Soils, M.S. in soil fertility and a Ph.D. in soil chemistry. He worked as an agronomist and manager for a chain of fertilizer retail locations in Illinois for about 18 years before coming to NDSU in his present position as Extension Soil Specialist. He is now a Professor of Soil Science in the School of Natural Resource Sciences at NDSU. His research has focused on soil sampling and the use of active-optical sensors for site-specific nutrient management, field research leading up to the revision of all fertilizer recommendations in the state, and examination of non-conventional products for their use by farmers. His work is highly tied to no-till management and the prevention of soil erosion from wind, with North Dakota as the only state with an N credit for long-term no-till management. He is a Fellow of the American Society of Agronomy, and he has received many awards for his work during his 29 years at NDSU.

Abstract

North Dakota farming prior to European/Asian settlement was by Native Americans alongside the Missouri River who farmed much as the ancient Egyptians, but at a much smaller scale and without supplemental irrigation networks. Plowing the prairie soils covering much of the state exposed the soil to persistent strong winds, resulting in the eventual loss of feet of topsoil from most fields and destruction of some soils for future crop farming use. As karma would have it, industrial agriculture began to help farmers address the soil degradation problem with tools and means to establish successful no-till and modified no-till management. The use of no-till management has reversed the trend of degradation on many farms to one of improvement. Though the transformation of degraded soils will take generations to attain, the use of industrial technologies makes soil improvement possible.

Measuring Soil Carbon: Unique Considerations for Climate Mitigation (VIRTUAL)

Dr. Jonathan Sanderman, Woodwell Climate Research Center

Dr. Jonathan Sanderman's work focuses on the role that soils can play in climate mitigation and sustainable food production. He strives to understand the processes that add, remove, and transform carbon in soils, ranging from coastal marshes to tropical forests and working farmlands. Throughout his career, he has uncovered under-recognized complexity in soil carbon reservoirs. Dr. Sanderman's research encompasses both place-based, experimental work and large-scale computer modeling. Currently, much of Dr. Sanderman's attention is focused on developing high-quality, cost-effective methods for measuring soil carbon to support carbon markets in the agricultural sector. He works with a diverse group of partners and collaborators in industry, academia, and environmental advocacy.

Abstract
How soil carbon is measured will vary greatly depending on your goal, be it, a regional mapping study, detecting treatment effects in a field trial, or monitoring the success of a climate-smart agricultural program. Focusing on the latter, the main goal is to be able to measure incremental changes in a large and variable carbon stock relative to what would have happened on that field in the absence of a climate-smart management intervention. Additionally, this monitoring needs to be accomplished while only costing a few dollars per acre. In this presentation, I will discuss this challenge and present what I think are some promising solutions.

Overview of the USDA Climate Hubs and Soil-Related Tools and Resources

Dr. Dannele Peck, USDA ARS, Northern Plains Climate Hub, Colorado

Dr. Dannele Peck is Director of the Northern Plains Climate Hub within the USDA Agricultural Research Service, based out of Fort Collins, Colorado. Trained as an agricultural economist, Dr. Peck focuses on farm-level decision-making under risk and is a coauthor on the Fourth and Fifth National Climate Assessments. Raised on a dairy farm in upstate New

York, Dannele was the first person in her family to earn a college degree, but happily not the last! For the past 20 years, she has called Laramie, Wyoming, home.

Abstract

The USDA Climate Hubs are a unique collaboration among the U.S. Department of Agriculture's numerous agencies, partners, and working-land managers who have a shared interest in enabling climate-informed decision-making. The Director of the Northern Plains Climate Hub will give an overview of the Climate Hub network and share practical examples of how they work with agricultural and forest land-managers, in collaboration with trusted advisors and service providers, to enable climate adaptation and mitigation by co-developing science-based, region-specific information, technologies, and knowledge exchanges. Examples will include tools and resources co-developed with soil science professionals, practitioners, and working-land managers.

Climate Regulation Services from Northern Plains Agroecosystems

Dr. Mark Liebig, USDA ARS, Northern Great Plains Research Laboratory, North Dakota

Mark Liebig is a Research Soil Scientist with the USDA ARS Northern Great Plains Research Laboratory near Mandan, North Dakota. For the past 23 years, Mark has contributed to research seeking to develop soil, crop, and animal management practices for the Great Plains to overcome limitations to productivity while enhancing environmental quality. As a team member, Mark leads research to quantify management effects on soil properties and greenhouse gas emissions. As a supplement to core responsibilities, Mark develops decision aides and evaluation tools for producers, conservationists, and scientists, and regularly contributes to research networks within and outside USDA ARS.

Abstract

Most agricultural soils in the northern Plains have the capacity to store more carbon. Increasing soil carbon can provide climate regulation benefits, and in doing so, may offer supplemental income for farmers and ranchers through ecosystem service markets. However, there is

considerable uncertainty regarding the efficacy of agroecosystems to achieve lasting climate regulation benefits, particularly in the northern Plains. This presentation will review research findings from the USDA-ARS Northern Great Plains Research Laboratory, where soil inventory and micrometeorological methods have been used to document management effects on soil carbon and greenhouse gas emissions in rainfed cropping, integrated, and pasture-based production systems. Broadly, findings suggest achieving climate regulation benefits is difficult under conventional management. Agricultural practices that preserve carbon already stored in soil while extending periods of photosynthesis are effective responses to climate change, both in mitigating its causes and adapting to its impacts.

The National Coordinated Soil Moisture Monitoring Network: What it is, and Why Soils Characterization is an Integral Component of our Success (VIRTUAL)

Marina Skumanich, NOAA-NIDIS, Boulder, Colorado

Marina Skumanich is a Program Specialist with the National Integrated Drought Information System (NIDIS), and coordinator of the National Coordinated Soil Moisture Monitoring Network (NCSMMN), a multi-agency, multi-institutional initiative to integrate soil moisture data from around the country and to capitalize on its transformative potential for a wide range of natural resource applications, including drought, flooding, wildfire risk, and agricultural and ecosystem management. Marina has focused her career on using scientific and technical information to create effective public policy. Prior to NIDIS, Marina served as Principal of Skumanich Consulting, which provided environmental program management and assessment services in both the government and nonprofit sectors. Before that, Marina was a Senior Research Scientist at the Battelle Seattle Research Center's Environmental Policy and Management Program. Marina has an MS in Environmental Science and Technology Policy from MIT, and a BS in Chemistry.

Abstract

The National Coordinated Soil Moisture Monitoring Network (NCSMMN) is a multi-agency, multi-institutional initiative to integrate soil moisture data from around the country and to capitalize on its transformative potential for a wide range of applications across sectors of the economy. This talk will provide an overview of NCSMMN objectives and current activities and highlight the role of soils analysis in ensuring the effort's success.

DSP4SH: Using Cooperative Research to Define Dynamic Soil Property and Soil Health Reference Conditions for Soil Survey

Dr. Skye Wills, SPSD-NSSC, USDA NRCS, Nebraska

Skye Wills is the National Leader for Soil Research at the Soil and Plant Science Division’s (SPSD) National Soil Survey Center. The SPSD provides national leadership to NRCS' soils program and the National Cooperative Soil Survey (NCSS) Program. The research branch is working to develop new techniques in dynamic soil survey including soil health, soil moisture, and other properties and interpretations that change over time. Skye’s previous work includes the Rapid Carbon Assessment project (a national soil carbon inventory) and the Dynamic Soil Properties for Soil Health project (cooperators using soil survey and ecological sites to organize soil health measurements). She’s a proponent of reproducibility and open science to maximize the impact and accessibility of soil data. Skye has degrees from Kansas State University in Agronomy and Iowa State University in Soil Morphology and Genesis and has worked in agronomy, semi-arid rangelands, and tidal marshes across the country.

Abstract

National cooperative soil survey (NCSS) products are often used in land management planning to provide information related to inherent soil properties. The use of dynamic soil properties (DSPs) and soil health indicators for soil survey requires that reference and benchmark values be established for various soil types. To address this need, the Soil and Plant Science Division (SPSD) coordinated a series of projects known collectively as Dynamic Soil Properties for Soil Health (#DSP4SH). The goals of these projects focus on establishing consistent data collection, aggregation, and

presentation protocols for DSPs and soil health metrics that can be used as a part of soil survey. These projects combine concepts from ecological sites and state and transition models to establish reference values that can be expanded and extrapolated. General agronomic concepts are also applied to business as usual and soil health management systems so that typical and aspirational values can be established by project, management system, and soil series through DSP4SH projects. The data from these projects are publicly available for use by researchers and practitioners. Examples from initial pilot projects and Soil Health Assessment Protocol and Evaluation (SHAPE) scores will be presented.

Trends in Soil Properties Across the Minneapolis-St. Paul Metropolitan Area - Implications for Ecosystem Services (VIRTUAL)

Dr. Nic Jelinski, University of Minnesota, Twin Cities

Dr. Nic Jelinski is an Assistant Professor of soil science in the Department of Soil, Water and Climate. His teaching responsibilities include Basic Soil Science, Field Study of Soils and Soil Judging. His research interests are centered around urban soils and permafrost-affected soils, enhancing access to soil information, and improving teaching and outreach for soil science in higher education and to the public. He has lived and worked around the world in land management for state (Wisconsin Department of Natural Resources) and federal agencies (Department of Defense, National Park Service) as well as the private sector (Alliant Energy). He received his B.S. and M.S. from the University of Wisconsin-Madison and his Ph.D. from the University of Minnesota.

Abstract

Management of urban soils impacts their properties and subsequently the ecosystem services these soils can provide. At 397 locations across Minneapolis-St. Paul in residential, community garden and urban farm and parks and green spaces, we sampled soils to 1m depth in 6 increments (0-10cm, 10-20cm, 20-40cm, 40-60cm, 60-80cm, 80-100cm). Individual depth increment samples were analyzed for organic carbon (SOC, dry combustion), pH, available phosphorus, and total lead (Pb, by portable X-Ray Fluorescence). Cultural practices in food-producing urban sites typically involve significant inputs of compost and other soil

amendments, which may alter soil properties in relation to non-food producing areas. Understanding these changes is important for informing data-driven policies related to food production in cities as well as soil-centered outreach, education, and initiatives that sustain urban soils.

The Changing Demands on Soil Survey — What the Future May Hold

Dr. David Lobb, University of Manitoba, Winnipeg, Manitoba, Canada

David Lobb is a Professor of Landscape Ecology in the Department of Soil Science at the University of Manitoba in Winnipeg, Canada. He studies soil erosion and sedimentation processes, and how they impact our soil and water resources. He is internationally recognized for his research in tillage translocation and tillage erosion, particularly for his advances in experimental methods and modeling. David is active in several national and international organizations focused on soils.

Abstract

Although I teach pedology and soil classification, I don't consider myself a soil surveyor. However, I am a heavy user of soil survey data. Over the past 35 years of assessing soil erosion and sedimentation within agricultural landscapes and watersheds, I have developed a keen appreciation of the strengths and weaknesses of current soil survey data, and I have formulated some ideas on how this data could be enhanced to meet future demands. This presentation lays out these ideas for discussion.

As we move towards more continental scale and global scale applications of soil data, there is a growing need for improved communication, including standardization and correlation.

Soil survey data is rarely used in isolation anymore; for environmental modelling applications and there is a great need for the integration of soil data with weather and climate data and land use and land management data.

There is a new understanding of processes operating in landscapes that affect soils as they are evolving: recognition of tillage erosion as the

dominant erosion process and its interactions with wind and water erosion.

There is potential for much more sophisticated characterization and use of topographic data associated with soil data, including landform classification and quantification, as well as field form classification and quantification.

Species Composition Trends and Impacts on Native Ecological Sites States

Dr. Kevin Sedivec, North Dakota State University
North Dakota State University Extension Rangeland Management Specialist, School of Natural Resource Sciences Professor, and Central Grasslands Research Extension Center Director

Kevin received his B.S. in Zoology in 1987, M.Sc. in Animal and Range Sciences in 1989, and PhD in 1994 in Animal and Range Sciences from North Dakota State University. He started his career at North Dakota State University as the State Extension Rangeland Specialist in 1989 and Central Grasslands Research Extension Center Director in 2016.

His current research and extension programming focuses on adaptive grazing management strategies to improve livestock production while enhancing ecosystem services for pollinators and wildlife and studying disturbance ecology to increase biodiversity across the landscape – both above and below ground. He has also been involved with land reclamation related to energy development and has been the North Dakota leader for youth programs related to range judging and range youth camps since 1990.

He has authored or co-authored 87 peer-reviewed journal articles, 66 Extension circulars, 216 popular press articles, and over 1,000 professional talks.

Abstract
Invasive grass species are encroaching rangelands in the U.S. and altering community composition and plant diversity. In the Northern Plains, exotic cool-season perennial grasses such as Kentucky bluegrass (Poa pratensis), crested wheatgrass (Agropyron cristatum), and smooth brome (Bromus inermis) have invaded with their ecological impacts alarming, both in

terms of ecosystem services and agricultural losses. Studies have shown these cool-season grasses impact the landscape, both locally and regionally, by impacting species richness and diversity, soil biology, and land resiliency. The Northern Plains rangelands invaded by one or more of these exotic grasses decreased site richness and maximum potential for richness, and site plant diversity, especially native forb diversity. Clayey and loamy ecological sites had a shift in plant community composition when invaded with Kentucky bluegrass and smooth brome. Clayey, loamy and limy residual ecological sites were more likely to be invaded by these grasses; while very shallow, shallow loamy, and thin loamy sites least likely to be invaded by these grasses.

Building Rangeland Resilience to Adapt to Climate Change

Dr. David Toledo, USDA ARS, Northern Great Plains Research Laboratory, North Dakota

David Toledo is a Rangeland Scientist with the USDA ARS in Mandan, North Dakota. His research focuses on ecosystem health evaluation, the human dimensions of rangeland management, and finding ways of optimizing land management practices under changing climate and land-use scenarios. David's work has resulted in improvements to rangeland sampling techniques used in the USDA NRCS National Resources Inventories; in the integration of pastureland and rangeland monitoring and assessment methods; and in determining the socio-ecological factors affecting the use of prescribed fire in Texas and North Dakota. Today, David will discuss long-term research efforts at the USDA ARS Northern Great Plains Research Lab aimed at developing management practices that enhance ecosystem function and resilience under projected climate change scenarios.

Abstract

The continued invasion of non-native cool season grasses in the northern Great Plains is making these landscapes less diverse and more susceptible to loss of function during extreme weather events. Current weather predictions suggest variable climates and more climate extremes. Increasing the diversity of native plant species and plant functional groups offer the potential for improving the resilience of these ecosystems. Fire

and grazing are part of the natural disturbance regime of this region. Management practices using prescribed fire and high-intensity grazing have shown promise as a way to reduce cool season invasives and in some cases increase native species composition. We have compared the effects of prescribed fire, mob grazing, multi-species grazing, season-long grazing, and a combination of grazing and fire on grassland productivity and ecosystem services. We report on 4 years of results and tradeoffs associated with applying these different practices.

The Geology of North Dakota

Ed Murphy, North Dakota Geological Survey

Ed Murphy has a B.S. in Geology and a M.S. in Geology from the University of North Dakota. He began working for the North Dakota Geological Survey in 1977 as a summer temporary employee and went full-time in 1980. He has served as North Dakota State Geologist for the last 19 years. He has published hundreds of Geological Survey maps and reports on various aspects of Williston Basin geology including surface geology, geohazards, hydrology, coal stratigraphy, and, most recently, critical minerals.

Abstract

The Williston Basin covers the western two-thirds of North Dakota and contains up to 16,000 feet of sedimentary rocks, primarily carbonates and shales with lesser amounts of sandstones and layers of salt. The basin contains 19 rock formations that have produced oil and/or gas including the prolific Bakken and Three Forks Formations. Recently, attention has been focused on the shallow salt layers and their potential to store hydrocarbons as well as the ability of the sandstones to store carbon dioxide. Although the terrain of North Dakota is primarily gently rolling hills, the North Dakota Geological Survey recently completed mapping 63,777 landslides across the state. The U.S. Department of Energy set the potential economic threshold for rare earth elements in coal at 300 ppm. The Paleocene rocks in North Dakota contain two horizons that are approximately 1,000 feet apart stratigraphically that contain elevated concentrations of critical minerals. In a recently completed critical minerals project, the North Dakota Geological Survey reported that 42 of

107 (39%) lignite and carbonaceous mudstone samples taken from one of those stratigraphic horizons in west-central North Dakota contained rare earth element concentrations in excess of 300 ppm. Nine of those samples contained concentrations between 900 – 1,800 ppm and three were between 1,880 - 2,570 ppm. These are, to the author's knowledge, the highest spot concentrations yet reported from a North American coal.

Oral Poster Presenters

Sensor-informed soil water, nitrate, and greenhouse gas monitoring and management for climate-smart agriculture

Dr. Jingyi Huang, University of Wisconsin, Madison

Dr. Jingyi Huang is an Assistant Professor of Soil Physics at the Department of Soil Science, University of Wisconsin-Madison. Dr. Huang's research interests focus on integrating proximal and remote sensing data and models to improve the understanding of soil water, carbon, nutrient, and energy cycles across scales for sustainable natural resources management. Dr. Huang currently leads several projects on high-resolution mapping and modeling of dynamic soil properties such as soil moisture and carbon stocks and soil greenhouse gas emissions for Climate-Smart Agriculture and Forestry.

Abstract

Information on dynamic soil properties such as water, nitrate, and greenhouse gas fluxes is essential for increasing agricultural productivity and reducing its environmental footprints under a changing climate. There is an urgent need to develop affordable, reliable, and field-level sensing platforms to monitor soil water, nitrate, and greenhouse gas (GHG) fluxes and evaluate best management practices for climate-smart agriculture. This study presents in situ and remote sensing platforms recently developed by researchers at the University of Wisconsin-Madison and collaborators and demonstrates three case studies on the use of these sensing tools for evaluating water resources management at the catchment scale, monitoring nitrate leaching at a long-term agricultural research station, and monitoring field-level soil GHG emission. Preliminary results indicate that sensor-informed high-resolution soil

moisture, nitrate, and CO2 fluxes maps are able to characterize the spatial and temporal variability of these key dynamic soil properties due to natural variations and sustainable management and have the potential to be integrated with other USDA cyberinfrastructure to provide useful information to assist decision-making toward a net-zero future.

Impacts of wildfire on the ecologic, hydrologic, and geomorphic resiliency of forest soils in the Southwestern US

Dr. Craig Rasmussen, University of Arizona

Dr. Rasmussen is a Professor of Soil Science in the Department of Environmental Science with over 20 years of experience working in ecosystems ranging from Southwestern deserts to alpine forest and grasslands. He has performed extensive research on soil formation, soil organic carbon cycling and sequestration, mineral weathering, and predictive soil mapping.

Abstract

Wildfire acts as a catalyst for change in ecologic, hydrologic, and soil geomorphic systems that can substantially modify water availability, water quality, soil nutrient and carbon cycling, and the likelihood of hazards such as floods, rill and sheet erosion, and debris flows. The objective of this project is to quantify changes in dynamic soil properties (hydrologic, physical, chemical) and plant communities within areas that were recently burned and reburned in forested systems of the Southwestern US. The study leverages existing research infrastructure and baseline data for forest ecosystems in Arizona and New Mexico, including ecological sites in the Santa Catalina, Pinaleño, and Rincon Mountains, and Gila National Forest that span a range of burn severity, ecological resource units, and time since wildfire. We employed standard techniques to quantify temporal changes in near-surface soil bulk density, water repellency, saturated hydraulic conductivity, sorptivity, and ground cover, as well as particle size distribution, organic C and N, available P and N, exchangeable cations and pH. Results to date indicate significant variation in available P and N and soil hydraulic properties across a gradient of burn severity and ecological resource units.

State and transition models in a time of change: toolsets for integrated carbon management

Dr. James Thompson, West Virginia University

Jim Thompson is a Professor of Soil Science in the Division of Plant and Soil Sciences at West Virginia University. He received a B.S. in Agronomy from Penn State University in 1990, an M.A. in Geography from Ohio State University in 1992, and a Ph.D. in Soil Science with a minor in Water Resources from the University of Minnesota in 1996. Following faculty appointments at the University of Kentucky and North Carolina State University, he moved to West Virginia University in 2004. The emphasis of his research, education, and outreach efforts is to improve our understanding and representation of soil geography and to investigate how differences in soils affect land use decision-making and environmental quality. At WVU, he teaches courses on soil judging, wetland environments, soil survey and land use, soil genesis and classification, and forest soils. His current research incorporates mapping, modeling, and monitoring techniques to inventory ecological sites and assess dynamic soil properties. Within the National Cooperative Soil Survey, in addition to working closely with partners in the NRCS and the Forest Service, he is a co-lead of the Digital Soil Mapping Team, a member of the Communications and Outreach Team, co-chair of the Soil and Ecosystem Dynamics Committee, and a member of the International Committee on Subaqueous and Aquic Soils.

Abstract

State and transition models (STMs) are used to document ecological dynamics in a user-friendly way for land managers. For a given type of land with similar soils, climate, and geomorphology, an STM can help predict responses to drivers of change (e.g., drought, fire, grazing, treatments). Although STMs have historically been primarily focused on vegetation dynamics, many other ecosystem parameters influence and respond to ecological state changes. Fluctuations in primary productivity of drylands and associated net carbon flux have been shown to dominate interannual carbon cycle variability, while wind and water erosion in these systems also have profound impacts on the carbon cycle. Fire in the boreal forest has been shown to mobilize large soil carbon stocks,

particularly from organic horizons. This talk will explore examples of STMs that have characterized these important processes with a focus on carbon, show how these processes relate to vegetation dynamics already characterized in STMs, and discuss the need for expanded use of STMs for understanding and predicting how our changing climate and land uses impact carbon stocks.

Legacy data rescue for retrospective soil survey and change detection in topsoil organic carbon stocks of the Corn belt, USA

Dr. Meyer Bohn, University of Iowa

Meyer Bohn is postdoctoral researcher with the Geospatial Laboratory for Soil Informatics headed by Bradley Miller at Iowa State University. Meyer specializes in digital soil mapping, pedology, geomorphology, and environmental process modelling. He also coaches the ISU soil judging team. A native of Bismarck, North Dakota, Meyer received his B.S. in environmental science from Dickinson State University and his M.S. in soil science from North Dakota State University. He completed his Ph.D. in soil morphology and genesis at Iowa State University in August 2022. In his free time, Meyer enjoys hunting, fishing, and pickin' on his six-string.

Abstract

This study aims to rescue soil legacy data, which has been archived in various forms, to create a retrospective soil survey to detect temporal changes in topsoil organic carbon stocks for the Corn belt of the USA. Legacy data can be used to train machine learning models to create retrospective spatial predictions of soil properties. In the first year of this project, we use Iowa and surrounding area as a testing ground to develop legacy data retrieval protocols and soil organic carbon stock modelling and mapping methods. We first outline the protocols for retrieval of legacy soil data and its conversion into georeferenced digital form for harmonization with the National Soil Information System (NASIS) database. Secondly, we investigate the optimization methods for temporally divided model training datasets for decadal estimates of topsoil organic carbon stocks. Lastly, we explore the influence of retrospective model predictions on detecting change in topsoil organic carbon stocks over time.

Visualizing Soil Landscapes by Mining Soil Survey Taxonomic Data

Dr. Darrell Schulze, Purdue University

Darrell Schulze is a professor of soil science in the Agronomy Department at Purdue University where his research and teaching focuses primarily on soil mineralogy, chemistry, and pedology. In addition to his work in the U.S., he has conducted research in Germany, Brazil, Kenya, and Peru. He currently teaches a dual level (graduate/undergraduate) course titled Soils and Landscapes that combines the traditional approach of studying pedons with a soil geomorphology approach in which students use detailed maps of soil properties on iPads in the field to learn how soil properties vary across landscapes. He developed and maintains the SoilExplorer.net website and mobile apps as part of his current interest in soil landscape visualization.

Abstract

Although we usually think of soil properties in the context of where they occur within a soil profile, soil properties vary spatially across landscapes as well. The SSURGO database provides a rich source of data that can be used to map soil properties across landscapes for the SoilExplorer.net website and apps. On the surface, the process appears simple. Select a property of interest, for example, the presence of an argillic horizon or swelling properties. For each component, use the family classification to determine if the component contains the property. Calculate the percentage of the property in each map unit. Assign each map unit to one or more map classes and prepare the resulting map. In practice, the process is more complicated. Graphs of cumulative area versus the percentage of a property in the map unit usually have no clear 'natural' breaks between 10 - 90% to guide setting thresholds for map classes. Taxclname contains classifications from virtually all versions of the Keys to Soil Taxonomy, greatly complicating extraction of some soil properties. Soil Taxonomy often defines formative elements like "hum-" differently for different soil orders. Properties such as a dark-colored surface horizon, which define Mollisols and mollic subgroups, are not reflected at all in the classification of many swelling soils. Working around these and other quirks of SSURGO and Soil Taxonomy are challenging. Nevertheless,

the resulting maps often provide new insights into the distribution of soil properties and on the possibilities and limitations of using taxonomic classes for mapping soil properties.

Soil landscapes of the United States (SOLUS): A 21st century raster soil survey inventory

Suzann Kienast-Brown, SPSD-NSSC, USDA NRCS, Montana

Suzann Kienast-Brown is the Soil Scientist/National GIS Specialist at the National Soil Survey Center for the USDA NRCS Soil and Plant Science Division. She began her career with NRCS in 1997 as a student intern while finishing her bachelor's degree in Soil and Water Science from Utah State University. She went on to earn a master's degree in Pedology at Utah State University under Dr. Janis Boettinger, applying digital soil mapping techniques to production soil survey in the desert of Utah. During her career as an NRCS soil scientist, Suzann has focused on exploring, developing, testing, implementing, and integrating GIS, remote sensing, and digital soil mapping techniques into local, state, national, and global soil survey activities. She is currently the lead for the national Digital Soil Mapping Focus Team and oversees digital soil mapping activities in the Soil and Plant Science Division. She is also a co-lead for the Dynamic Soil Survey Focus Team.

Abstract

Soils are a critical component of natural systems. Soil knowledge is required to explore and address questions regarding ecological function, climate change, conservation, and land management at any scale. A variety of soil information products are needed to meet the demand and diversity of current environmental challenges. The National Cooperative Soil Survey (NCSS) is striving to address that need by creating and publishing a range of relevant products. The NCSS Digital Soil Mapping Focus Team has developed a continental-scale 30-m covariate dataset offering users over 200 different terrain and spectral derivatives by watershed and continental mosaic for use in modeling and analysis. The next phase of continental-scale 10-m covariates is underway. The Team has also produced SOLUS100, a set of 100-m resolution key soil property maps for the continental US, and work has begun on a 30-m maps

(SOLUS30). These NCSS datasets will be publicly available via Google Earth Engine's Data Library. The vision is to incorporate dynamic soil properties with the current set of static soil properties and develop interpretations for use and management from these products. Fundamental pedology and communication of soil knowledge will be the primary focus of this effort, yielding a framework for delivery of seamless raster-based soils data for all areas of the US on annual cycles. This framework will foster an environment of continuous improvement and support a complete, consistent, correct, comprehensive, and current inventory of the soil resources of the U.S.

Thursday, July 13, 2023

Walking Back – Looking Forward

Jay Fuhrer, Burleigh County SCD Menoken Soil Health Farm

As a long-time conservationist growing up in the Dakotas on a small grain and livestock farm, Jay Fuhrer built a career taking care of the soil.

Working at the USDA Natural Resources Conservation Service from 1980 to 2020 in Bismarck, North Dakota, Jay particularly enjoyed working from the pickup end gate on the field edge with a spade and the client. Conservation planning one field at a time.

Currently, Jay spends his time supporting soil health efforts through the Menoken Farm. The Menoken Farm is a conservation demonstration farm and Jay's favorite place to work. Here, the five soil health principles can be applied while monitoring plants, animals, and soils.

Abstract

Landscape simplification has been ongoing for generations fueled by loss of perennials and animal impacts, combined with soil disturbance, residue removal, and low diversity crop production without cover crop integration. Symptoms are evident and include reduced soil organic matter, wind erosion, water erosion, salinity, water quality impacts, poor infiltration, and high fossil fuel inputs. Rebuilding and maintaining life in the soil begins with the implementation of the Soil Health Principles in a systems approach; along with understanding the carbon cycle as it relates to cropping systems, grazing systems, and gardens. Green plants and the

soil food web provide a means for carbon to enter the soil and provide us with nutrient rich food. Walking Back – Looking Forward is a brief review of agriculture in the Northern Plains.

Updates from Federal Partners

Updates from USDA Agricultural Research Service (VIRTUAL)

Dr. Sarah Beebout, USDA ARS, Maryland

Dr. Sarah Beebout is National Program Leader for Sustainable Intensification with the U.S. Department of Agriculture's Agricultural Research Service (USDA ARS), based in Beltsville, Maryland. Her passion is improving the environmental, social, and economic sustainability of food and agriculture systems, including crops, livestock, and people. She has been with ARS since 2019, following 15 years in sustainable cropping systems research at the International Rice Research Institute in the Philippines. She grew up in Iowa, received her B.S. in chemistry from Wheaton College (IL), her M.S. in soil chemistry from Texas A&M University (TX), and her Ph.D. in soil science from Cornell University (NY). She has in-depth experience working in multiple cultures within the U.S. and during her time in Asia.

What's the BLM been up to? (VIRTUAL)

Dr. Ron McCormick, USDI-BLM, Washington D.C.

Dr. McCormick is a classically trained field naturalist who came to embrace the ecology of complex systems in his late thirties and has never looked back. With an educational background in soil science, forestry, hydrology, and botany, Ron's early work experiences ranged from the woods of Michigan's Upper Peninsula to the hills of southeastern Oklahoma to nearly all of Florida. It was in Florida where he first referred to himself as an ecologist and formed a deep and lasting land ethic.

After graduating from Oklahoma State University, Ron vowed to never again enroll in any college, anywhere. Yet, his experiences in Florida had shown him there were still things to learn about ecology. In 1994, he moved to Madison to start on a 'piled higher and deeper' degree. One year later, he was deeply disillusioned with the dark side of academia and considering a return to consulting in Florida. But his office mate suggested he sit down with Dr. Timothy F.H. Allen, the godfather of hierarchy theory – perhaps the most underrated yet important contribution to systems science and ecology alike. Seeing no downside, he walked into Tim's office. Thirty minutes later he was officially one of Tim's new graduate students, and the rest, as they say, is history. His decades of thinking about and applying systems theory to social-ecological problems has led him to the Real Green New Deal – what society desperately needs at this critical juncture. His day job is as an ecologist for the Bureau of Land Management Headquarters office.

Updates from USDA Forest Service (VIRTUAL)
Dr. Robert Colter, USDA-FS, Washington, D.C.

Robert Colter is the new national soils program leader for the USDA Forest Service for the National Forest System. He started his Forest Service career in 2002 in the Shawnee National Forest (R9) as a GS-9 term soil scientist. Afterward, he moved to the Inyo and Eldorado National Forests (R5) as a permanent GS-11 soil scientist. While there, Colter was introduced to BAER and treatment effectiveness, along with range, forest, and OHV management. In 2005, he accepted a GS-12 forest soil scientist/ecologist position in the White Mountain National Forest (R9). In this position, Colter continued his education in forest and recreation management, along with an introduction to forest soil nutrient depletion due to acid deposition. Also, he served as watershed program manager and climate change coordinator while in this position.

Colter has participated in multiple opportunities to broaden his forest management outlook along with a better understanding of the Forest Service, which included line officer duties for seven months and acting Forest Management Group Leader with Northeastern Area State and Private overseeing the Forest Stewardship, Urban and Community Forestry, Tree Improvement and Watershed Management and Resource Conservation programs across the 7-state field office area.

Colter has a broad educational background consisting of a B.S. in general agriculture, an M.S. in plant and soil science, and a Ph.D. in forest ecology.

His interests are in forest management, emphasizing doing what's right on the ground based on what the soils and ecology tell us, developing partnerships to build capacity, achieving common goals, and incorporating new technologies to maximize time on the ground.

With a lot of help from our friends: Soils data, information, and partnerships in the National Park Service Washington Office

Jason Kenworthy, USDI-NPS, Colorado

Jason Kenworthy is a geologist with the National Park Service Geologic Resources Division in Lakewood, Colorado. He has been with the division since 2005. Since 2018 he has served as the Geologic Resources Inventories coordinator overseeing a team charged with providing nearly 300 parks baseline geologic and soils map data, information, and resource management focused reports. However, he is not a total stranger to soil and agriculture. Jason started his federal career with USDA Agricultural Research Service in the Soybean Genomics and Improvement Laboratory and worked with the University of Maryland soybean breeding program.

The Dynamic Role of Depressional Wetlands in Agroecosystems in North Dakota and Beyond

Dr. Owen McKenna, USDI-GS, Northern Prairie Wildlife Research Center, North Dakota

Owen McKenna is a Research Ecologist with the USGS Northern Prairie Wildlife Research Center in Jamestown, North Dakota. Dr. McKenna's research is focused on applying a mechanistic understanding of how wetland ecosystems respond to changes in climate and land use in support of both migratory-bird habitat management and water quality and water quantity issues in agricultural and grassland landscapes of the Northern Great Plains, Midwestern United States, and Southcentral Canada.

Abstract

Nutrient inputs to agricultural land support high crop yields and food production. However, excess nutrients from croplands may move into downstream waters and negatively impact water quality. Depressional wetlands embedded in croplands and grasslands provide migratory bird

breeding habitat and the potential for enhancing downstream water quality in the Northern Great Plains. The Integrated Landscape Modeling (ILM) partnership is an effort by the U.S. Geological Survey (USGS) and U.S. Department of Agriculture (USDA) to identify, evaluate, and develop models to quantify services derived from ecosystems, with a focus on wetland ecosystems and conservation effects. Through monitoring, modeling, and mapping wetland processes the ILM is providing Natural Resource Managers with science to inform how to invest agricultural conservation practices most effectively in North Dakota and beyond.

Town Hall Discussion

Recruitment and Retention

Moderator: ***Dr. Meyer Bohn***, Iowa State University

Meyer Bohn is postdoctoral researcher with the Geospatial Laboratory for Soil Informatics headed by Bradley Miller at Iowa State University. Meyer specializes in digital soil mapping, pedology, geomorphology, and environmental process modelling. He also coaches the ISU soil judging team. A native of Bismarck, North Dakota, Meyer received his B.S. in environmental science from Dickinson State University and his M.S. in soil science from North Dakota State University. He completed his Ph.D. in soil morphology and genesis at Iowa State University in August 2022. In his free time, Meyer enjoys hunting, fishing, and pickin' on his six-string.

2023 National Cooperative Soil Survey Award Winners

Scientist of the Year

Donald Parizek
Soil and Plant Science Division
USDA NRCS, Connecticut

Work Experience:

- 30 plus years of soil survey project work in Alaska, Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Puerto Rico, Rhode Island, and Vermont.
- 3 years consulting soil scientist, conducting wetland delineations and soil test pit evaluations.

Awards, certifications, affiliations etc.

- Million Acre Mapper Award
- Certified Professional Soil Scientist, (ARCPACS # 24825)
- Society of Soil Scientists of Southern New England, Board of Directors
- New England Hydric Soils Technical Committee, member
- Coastal Zone Soil Survey Focus Team, member

Hello, my name is Donald C. Parizek. I am a soil scientist with the USDA NRCS soil survey office in Tolland, CT. I am currently on detail to the Special Projects Office as the Survey Project Leader for the Long Island Sound Coastal Zone Soil Survey (LIS-CZSS). I began my soil science career as a private consultant in Connecticut conducting wetland delineations after graduating from the University of Connecticut (UCONN 1988) with a B.S. degree in Agriculture and Natural Resources with an emphasis in soil science and geology.

My career path is based on my desire to work outdoors and to learn as much as possible about the natural environment. Soil Science piqued my interest, after taking a required soil science class with an exceptionally enthusiastic professor at UCONN, the late Harvey D. Luce. In 1992 I began work with the USDA Soil Conservation Service (SCS) working on the statewide soil survey update project in Connecticut. This where I learned to map soils at the landform level in complex glaciated landscapes, utilizing my soils and geology skills, along with the now outdated stereo scope. I took advantage of all the great training SCS/NRCS had to offer to advance my skill set. In the early days, soil scientists worked by themselves with very little interaction day in and day out during field season, a level of independence and self-reliance not as prevalent these days.

Over the course of my 30-plus-year career, I have worked on soil survey projects in Alaska, Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Puerto Rico, Rhode Island, and Vermont. I have mapped soils in some of the most remote areas of the Alaskan wilderness, densely populated urban soils in New York City, and most recently subaqueous soils in coastal areas. The beauty of soils, they are almost everywhere. I have earned the Million Acre Mapper Award for my work on initial soil surveys in Alaska and Maine, an award resulting from numerous arduous and enjoyable field days. Like most soil scientists, I want to know what lies beneath the surface, over the next hill, the other side of the mountain, or across the estuary. I love to dig holes; every soil profile has a story to tell if you are willing to observe and learn. Sharing our knowledge with others who have never bothered to look is an important part of what we do. Some of my most rewarding days in the field are from sharing my knowledge of soils with students in New York City around a soil pit; for many it is the first time they have observed real soil in an outdoor setting, it is eye-opening.

I am a longstanding board member of the Society of Soil Scientists of Southern New England (SSSSNE). I joined the society fresh out of school, taking the advice of the SCS state soil scientist, "It will be good for you your career." SSSSNE has provided great opportunities to connect with other soil scientists and share knowledge. A successful field workshop will recharge the batteries of both the participants and instructors alike.

I am a member of the New England Hydric Soils Technical Committee. We are constantly evaluating and testing hydric soil indicators for use in the glaciated northeast. Our work is done in collaboration with NRCS, academia, private consultants, state, and federal agencies. This work has led to an increased knowledge of hydric soils morphology, problematic hydric soils, and our understanding of hydropedology and wetland identification. The value of this work cannot be underestimated given all the regulations and interest associated with wetlands.

I am a certified professional soil scientist through the Soil Science Society of America Soils Certification Board, a great way to maintain professional growth, credentials, and communicate the importance of soil science as a profession.

I am currently a member of the Coastal Zone Soil Survey Focus Team, advancing soil science in this critical ecosystem, where terrestrial norms give way to subaqueous environs. As the climate changes and sea level rises, soil scientists are present, and providing exceptional soil resource information in this unique environment. The Coastal Zone Soil Survey Focus Team is very active moving soil science and soil survey forward in the 21st century. We all know soil forming processes do not stop at the water's edge.

In 2022 I was detailed to the special projects office to lead the congressionally funded LIS-CZSS, by far the most challenging and rewarding project I have ever had the opportunity to work on. I have very much realized the value of true teamwork, and a golden opportunity to pass on knowledge to the next generation of scientists. The future looks bright for soil science and soil scientists from my vantage point. NRCS has an amazing workforce willing to step up to the challenges we all face in our environment. Soil scientists have the best job in the agency by far. Soil science is essentially the building block for all other forms of resource management and will remain so into the foreseeable future.

Scientist of the Year

Matt Cole
Soil and Plant Science Division
USDA NRCS, Nevada

I began my career with NRCS as a student trainee (SCEP program) in 2006 while attending college at the University of Nevada, Reno. After graduation, I started my first assignment at the Ely, NV MLRA office. This was a tremendous opportunity to gain soil survey experience with several initial surveys in eastern Nevada. After the initial soil surveys in eastern Nevada were finished, I was transferred briefly to the Reno NRCS office, and then to the Minden, NV MLRA office in 2011. My work became much more varied including update projects, SDJR projects, TSS assistance, initial soil survey details, soil climate data collection, snow survey, and assisting with wetland determinations among many other tasks. In 2014, I started working in the White Mountains in eastern California as part of the collaboration between NRCS and the University of California to collect soil climate data. I have been conducting yearly visits to collect data there since. In 2019, I became the project leader of the NV764 soil survey project north of Elko, NV. I joined this survey after the first project leader moved on to a new position. This was a great chance to lead an initial soil survey through the remaining field work, final correlation, and to publication in 2021.

2022 was a busy year for me as I started the CA806 soil survey in eastern California as the project leader, returned to the Nevada wetland cadre, and coordinated the installation of 8 soil climate stations in the White Mountains. I feel very honored and grateful to receive the NCSS Scientist of the Year Award. But I know I am just one member of the exceptional team of professionals in NRCS who are working hard every day, crossing all those items off our to-do lists.

I live in Minden, Nevada, with my wife Joyce (a former NRCS soil scientist), our daughters Juliet and Phoebe, and our dog, Bodie. We enjoy getting outside and into the mountains and lakes as much as we can.

Career Achievement Award

Ronald Collman
USDA NRCS, Illinois

Ron studied at the University of Illinois-Urbana-Champaign, graduating with a B.S. in Agriculture-Agronomy\Soils in 1989.

He began with initial soil survey as a Missouri Department of Natural Resources soil scientist (SS) in Madison County in 1990. Ron familiarized himself with several software tools and databases including the Pedon input codes, Pedon Description Glossary, Basic, DOS, and R-Base. We had one DOS based computer with Word and Lotus 1,2,3. We printed to a dot matrix printer and mailed hardcopies.

In 1993, Ron trimmed his mullet and began working for the Soil Conservation Service (SCS) in a satellite field office attached to the Springfield, Illinois Major Land Resource Area (MLRA) working on the Adams County Update.

Ron worked during the “Great Flood of 1993” to identify geologic materials and locate the base of road slides and mapped sediment and wetlands. Ron bought a top of the line “Pentium” computer and started updating Unix based tools to Microsoft 3.1 OS and MS-Works. Ron worked to develop a transect database with collection forms using Microsoft Access and a field ruggedized 386 tablet computer. Hundreds of transects and descriptions to support the update were completed. Ron expanded his computer knowledge to include UNIX, Windows, Excel, and Access. Illinois adopted an MLRA update concept and established 5 MLRA offices across the state each with a Project leader, additional soil scientists, and a GIS specialist. We saw SCS become NRCS, SSD become NASIS, Imagery become Ortho-rectified, Internet was via modem, and Windows 95 and Netscape were top of the line.

In 1997, Ron transferred to the Charleston, Illinois MLRA. He helped finish up the hand compilation of the Adams County Update and then moved on to work on the Champaign, McLean, and Crawford County Updates and compilation. Ron became project leader for the Douglas, Clark, and Macon County Updates and main author of the manuscripts. He developed Excel spreadsheets that incorporated NASIS data and provided a method of checking the data against OSD ranges, lab data, and similar map units and parent materials. This pre-dated many of the checks, validations, and calculations we have now in NASIS. Initially, these spreadsheets were just used for a single MLRA subset but use soon expanded to check statewide data and make join tables for interpretation maps.

His efforts led to promotion to Asst. State Soil Scientist in 2007. During this time, Ron participated in field reviews and correlations, assisted with EM and GPR studies, rapid carbon assessment, reviewed and edited many manuscripts, administered the Illinois NASIS data, developed more Excel tools to produce correlation documents, and made statewide property and interpretive maps for soils and ecological sites, assisted with training, supported sampling efforts and special studies using KSSL protocols, backhoe operations, became quite good at NASIS input, interpretations, queries, and data review; and navigated the National Soil Survey Handbook, Soil Survey Manual, Field Book for Describing and Sampling Soils, and Taxonomy.

After a detail to New Mexico as acting State Soil Scientist, Ron Became State Soil Scientist for Illinois in 2012.

Through CESU and other Agreements and Contracts, the Illinois NRCS Soils and GIS team has been able to acquire, process, and create LiDAR derivatives; archive LiDAR, imagery, and soils data; use supercomputing to analyze LiDAR data, complete FSA compliance slide scanning and soils document scanning with university students; develop sampling plans for dynamic soil properties and analysis, establish outdoor soil classroom pits at the U of I, and design and purchase probe trucks and other remote sensing and sampling equipment.

Ron continues to support soil judging, sampling for soil health and dynamic soil properties, sampling at climate stations, reviewing ESDs and data, soil interpretations including Illinois linked productivity, delivering educational outreach and recruitment, work with Illinois Soil Classifiers Association, participate with Soil Business Area Analysis Group, and provide basic soil, soil health, and hydric soils training. He maintains section 2 of the Illinois eFOTG and the Illinois NRCS Soils website, is state climate liaison, and administers Natural Resources Inventory (NRI), and the Farmland Protection Policy Act (FPPA).

Ron has 31 years as a soil scientist. In that time, he has participated in initial, update, and order one mapping, collected monoliths for the Smithsonian and helped set up the soils display at the St. Louis Science Center, correlated state and MLRA legends, and aided numerous cooperators and Universities. Ron has been Acting Asst. State Conservationist (ASTC) for Field operations and ASTC for Compliance and Appeals. He has had the pleasure of working with many exceptional individuals and teams in the SSD\SPSD and NCSS.

Ron's goals before he retires are to update the "Keys to Illinois Soils," produce a digital archive of documents and imagery, convert some of the in-person soils training to online versions, and continue to assist partners of the NCSS. Ron is also working towards his M.S. Degree.

Ron's family includes Sara, his wife of 22 years, Nicholas, recent high school graduate; Zach, stationed at Mountain Home Air Force Base, Idaho, his wife Kinzie and two grandkids; and Matt, stationed at Hill Air Force Base, Utah, his wife Kassie and three grandkids.

Ron attributes his successes to family, those who came before, have supervised, trained, and worked with him; being able to adjust to change, and his stubbornness.

Career Achievement Award

Luis Hernandez

Soil and Plant Science Division

USDA NRCS, Massachusetts

Luis Hernandez grew up and completed his primary education in the mountainous region of Puerto Rico in the little town of Morovis. He spent many years playing competitive basketball for his town and helped the team achieve many championships. He was inspired by his dad to pursue a degree in soils. His Dad farmed the land with coffee, sugarcane, tobacco, bananas, plantains, and other tropical crops. He initiated his college years at the University of Puerto Rico – Mayaguez Campus. He transferred to Kansas State University (KSU) and completed a bachelor's degree in Agricultural Sciences with emphasis in soils. After completing school at KSU, he returned to the University of Puerto Rico – Mayaguez Campus to pursue a graduate school degree and completed a master's degree in Soil Science with emphasis in soil microbiology.

Luis began his public service career at the U.S. Forest Service International Institute of Tropical Forestry in San Juan, Puerto Rico. Then he was transferred to the USDA Natural Resources Conservation Service (NRCS). With NRCS he has served in technical, administrative, and leadership roles such as: Soil Scientist (Pennsylvania and West Virginia), New York City Soil Survey Program Director, State Soil Scientist (Nebraska and Arkansas), Soil Survey Program Regional Director (Arkansas-based South Central Region), Acting Director of the Soil and Plant Science Division (SPSD) (Washington, D.C.), Outreach Coordinators of the Soil & Water Resource

Conservation Act (Washington D.C.), USDA NRCS Caribbean Area Watershed Protection Program Coordinator during hurricane Maria/Irma recovery efforts, and Acting Director of the NRCS International Programs Division (Washington, D.C.). He's currently serving as the SPSD Northeast Soil Survey Regional Director in Amherst, MA.

Luis has also served in other NRCS administrative positions such as California Deputy State Conservationist (acting), Arkansas Assistant State Conservationist for State Operations (acting), Arkansas Assistant State Conservationist for Field Operations (acting), and Arkansas State Public Affairs Specialist (acting). He has also co-chaired the SPSD Training Focus Team, and the Leadership, Diversity and Recruitment Focus Team. Currently he's serving as SPSD Liaison to the Northeast National Cooperative Soil Survey Region, SPSD Leadership Team, and on the NRCS-NHQ Civil Rights-EEO Committee.

Luis has held leadership positions outside of government: President of the National Organization of Hispanic Professional Employees of NRCS, President of the Nebraska Association of Professional Soil Scientists, and President of the Honorary Fraternity of the Caribbean Alpha Zeta. With the Soil Science Society of America, he has served as Chair of the Training and Continuing Education for Soil Scientists Committee, Chair-Elect of the Training & Continuing Education for Soil Scientists Committee, Member of the Urban Soils Committee, and Member of the Training and Continuing Education for Soil Scientists Committee.

Internationally, he served as USDA NRCS technical advisor for Hurricane Mitch recovery efforts in Central America, invited professor of the International Seminar of Soil Classification (Mexico City), and soil classification professor of the Nicolás Aguilera International Edaphology Course sponsored by the National Autonomous University of Mexico (UNAM). He has also taught soil classification and soil quality short courses in Spain and Latin America. He served as technical advisor to the Soil Survey of Catalonia (Spain), the Soil Organic Carbon Map of Mexico, and the Soil Organic Carbon Manual of the FAO Global Soil Partnership. He led an international team responsible for translating the Keys to Soil Taxonomy (10th and 11th edition) from English to Spanish language. He has completed near 50 foreign assignments in Latin America and Europe. Most recently, in 2021, he collaborated with international soil survey cooperators from Argentina and organized the First International Workshop of Soil Taxonomy.

Luis has published more than 30 papers, articles, soil survey books, and book chapters. He's author and co-author of the Berkeley County (WV) Soil Survey Manuscript, South LaTourette Soil Survey Manuscript (New York City), Gateway National Recreation Area Soil Survey Manuscript (New York City and New Jersey), New York City Reconnaissance Soil Survey Manuscript, and Soils of Arkansas Booklet, among others. He was a major contributor for the development of national soil survey standards for the mapping, classification, description, and interpretation of urban soils. He wrote a book chapter to highlight urban soil survey efforts of the USA National Cooperative Soil Survey in the book titled Urban Soils. He was instrumental with the completion of the SPSD SSURGO Initiative, the Rapid Carbon Assessment Initiative (RaCA), and the implementation of the Major Land Resource Area (MLRA) national structure for administration of the USA soil survey program.

Luis is a graduate of the NRCS National Leadership Program and the USDA Senior Executive Candidate Development Program. He's certified by OPM for the Senior Executive Service. He's also certified as Professional Soil Scientist and Professional Soil Classifier by the Soil Science Society of America Soils Certification Board.

Luis is recipient of the following national awards: NRCS Chief's Civil Rights Award, USDA Secretary's Honor Award, USDA Under Secretary for Farm Production and Conservation Honor Award, NRCS Chief's Workforce Diversity Civil Rights Award, NRCS Chief's Team/Group Civil Rights Award, NRCS Hispanic Emphasis Program Manager of the Year, and the National Organization of Professional Hispanic NRCS Employees (NOPHNRCSE) Award of Excellence in Natural Resources Conservation.

He is the father of three children (Luis Gabriel, Abraham Xavier, and Luis Antonio) and currently lives in Massachusetts with his wife Salome and youngest child Luis Antonio. He enjoys gardening, hiking, kayaking, camping, and watching Luis Antonio playing soccer and music (trumpet, piano, and accordion).

Committee Charges and Proposals

Purpose:

- Report actions on prior conference recommendations and solicit new recommendations.
- Report to the conference business meeting the progress made on all recommendations.
- Each committee establishes an action item register.
- The standing committee reflect both the National and Regional Conferences.
- The National and Regional Conferences can have ad hoc committees as needed.

National and Regional Standing Committees

Bylaws Committee

Charges: This committee proposes, solicits, and reviews changes to the bylaws. This committee meets as needed based on proposals brought forward by NCSS members.

Chair: Jenn Mason, SPSD, USDA NRCS, Tennessee

Vice-Chair: Deb Surabian, SPSD, USDA NRCS, Connecticut

Interpretations Committee

Charges: This committee reviews, identifies, and prioritizes interpretation needs and delivery methods for soils and ecological site information.

Chair: Bob Dobos, SPSD-NSSC, USDA NRCS, Nebraska

Vice-Chair: Colby Mooreberg, Kansas State University

Research Priorities Committee

Charges: This committee reviews, identifies, and prioritizes research needs that meet the NCSS objectives.

Chair: Dr. Skye Wills, SPSD-NSSC, USDA NRCS, Nebraska

Vice-Chair: Dr. Karen Vaughn, University of Wyoming

Soil and Ecosystem Dynamics Committee

Charges: This committee reviews, identifies, and prioritizes data needs, data collection, data storage, standards, and dissemination methods related to ecological site descriptions and dynamic soil properties.

Chair: Curtis Talbot, SPSD, USDA NRCS, New Mexico

Vice-Chair: Charles Stemmans, SPSD, USDA NRCS, Louisiana

Vice-Chair: Dr. Jim Thompson, West Virginia University

Standards Committee

Charges: The Standards committee solicits and reviews proposed changes to existing handbooks, manuals, and soil database elements. The committee proposes new standards with input from the NCSS.

Chair: Deb Surabian, SPSD, USDA NRCS, Connecticut

Vice-Chair: Robert Colter, USDA FS, Washington D.C.

Taxonomy Committee

Charges: This committee proposes, solicits, and reviews taxonomy updates. It provides a forum to discuss proposed changes and distributes discussion notes.

Chair: Andrew Brown, SPSD, USDA NRCS, California

Vice-Chair: Janis Boettinger, Utah State University

Vice-Chair: Mark Stolt, University of Rhode Island

Technology Committee

Charges: This committee reviews, identifies, and prioritizes technological advances that promote the objectives of all partners.

Chair: Aaron Friend, USDA NRCS, Tennessee

Vice-Chair: Dr. Lee Burras, Iowa State University

National Ad Hoc Committees

Hydric Soils Committee

Charges: This committee reviews proposals brought forth by the National Technical Committee for Hydric Soils and from the ad hoc national committee members.

Chair: Lenore Vasilas, SPSD, USDA NRCS, Maryland

Vice-Chair: Manuel Matos, USDA NRCS, Puerto Rico

Vice-Chair: Jacob Berkowitz, United States Army

Subaqueous Soils Committee

Charges: This committee reviews, identifies, and prioritizes methodologies, protocols, and characterization methods for subaqueous soils; and documents progress of subaqueous soils research in soil survey and applications to interpretations.

Chair: Greg Taylor, SPSD, USDA NRCS, North Carolina

Vice-chair: Jim Turenne, USDA NRCS, Rhode Island

Proposals and Recommendations

Bylaws Committee Recommendations

Decisions will be executed by majority vote during the NCSS Business Meeting.

National Soil Survey Handbook, Part 602 – Conferences of the National Cooperative Soil Survey

Article V – Executive Services

- Use of GovDelivery for maintaining email

Article VI – National Conference Steering Committee

- Ensuring charges and objectives for ad hoc committees are defined on the NCSS web page.

Article VII – Conferences

- Conference Hosts and Years were updated.

Article VIII – Standing and Ad hoc Committees

- Section 4.0
    - Added Hydric as a Standing Committee
    - Added Subaqueous as a Standing Committee
    - Added Urban as a Standing Committee
- Section 5.0 – Permanent Standing Committee Chairs of the national conference as follows:
    a. Standards – National Leader for Standards
    b. Bylaws – National Leader for Standards
    c. Taxonomy – National Leader for Taxonomy
    d. Research Priorities – National Leader for Soil Science Research
    e. Technology – National Leader for Soil Business Systems
    f. Soils and Ecosystem Dynamics – National Leader for Ecological Sites
    g. Interpretations – Leader for Interpretations
    h. Urban – Senior Soil Scientist for Special Projects, Urban Areas
    i. Subaqueous – Senior Soil Scientist for Special Projects, Subaqueous Soils

Article IX - NCSS Awards

- This section uses the terminology that is distributed for each conference.

Article IX - Amendments

- Section 1.0 The bylaws may be amended with a majority vote of the NCSS members. Fifty percent of the bylaws committee constitutes a quorum for the transaction of business.

  An active member is someone who has participated in at least two or more quarterly meetings that year. The committee chair does not vote except in the case of a tie vote.
- Section 2.0 Approved amendments to the bylaws will be posted for 30 days using GovDelivery. After the 30-day comment period the amendment is, unless otherwise provided therein, effective immediately upon adoption and remains in effect until changed. Amendments to these bylaws will be published in the National Soil Survey Handbook within 6 months of approval by the members.

602.15 Conducting NCSS Conferences

- Timeline of Activities further define the time at which work should begin and finish.
- Communication and File storage was defined. Recommendations made to use Box as the official file storage and GovDelivery as official means for communication.
- New roles added for the SPSD National Leader for Standards were added and defined.

Taxonomy Committee Proposals

The complete proposals can be found at the following URL:
https://nrcs.app.box.com/s/ofulfsvr556u937n40uiwbfizcxh4sw5/folder/191159321682

- ***Artesols Soil Order***
  Proposal to recognize significantly thick human-altered or human-transported (HAHT) soils in a new soil order because of their unique physical and chemical properties and singular dominant soil forming factor (human activity).

- ***Simplifying the Mollic Epipedon***
  Proposal is to reformat and streamline the definition and requirements of the mollic epipedon to make it much easier to read, apply, and understand.

- ***Aquasol Soil Order***
  Proposal is to create a wet soil order that explicitly recognizes the values and functions of these soils and their role in soil interpretations.

- ***Eliminate Pyrophosphate Criteria***
  Proposal is to eliminate requiring pyrophosphate color for determining decomposition class in the classification of Histosols and many hydric soil indicators.

Subaqueous Soils Committee

- ***Refer to the Bylaws Committee Recommendations***
  Proposal is to formally separate the Hydric Soils Committee from the Subaqueous Soils Committee and to establish the Subaqueous Soils Committee as a standing committee.

Urban Soils Committee

- ***Refer to the Bylaws Committee Recommendations***
  Proposal is to establish a standing Urban Soils Committee

Poster Abstracts

Poster #1:

Using Digital Soil Mapping Techniques to Reach the 2026 Initiative in Pine County, Minnesota: A Rationale for Support of the Process

Presenting Author: Brianna Wegner, MLRA Soil Survey Office, Fargo, ND

Digital Soil Mapping (DSM) is still evolving in the soil survey program. While it may have lost its novelty with NRCS Soil Scientists, it may still be an enigma to universities and other partners. DSM techniques include using a conditioned Latin Hypercube Sampling (cLHS) method to generate sampling points, data collection and refinement, sub-model building for select soil properties, and accuracy assessment. Unlike traditional soil survey, a percent accuracy can be assigned to the newly created raster product which may be integrated more effectively with precision agriculture technology as well as other interpretations. Producing a raster product also takes less time than producing a vector product or by using other traditional methods.

Poster #2:

Soil Survey 360^0

Presenting Author: Bernie Skipper, USDA NRCS, SPSD-NSSC

Soil Survey 360^0 demonstrates how to view the soil survey in 3D. The ortho-mosaic of the atlas sheets from the published soil survey is draped over the Lidar-derived, high-resolution Digital Elevation Models (DEMs). The virtual camera in the ArcGIS Pro software is used to render objects in 3D. Waypoints are customized for the flyover animation, including the height above the surface of the virtual camera and the angle of the camera to the surface.

Image-to-image ortho-rectification (IIR) is the science behind Soil Survey 360^0. The OrthoMapper software was used during the SSURGO (Soil Survey Geographic Database) Initiative to automatically recompile soil surveys. The ERDAS procedure we use to rectify the atlas sheets is based on the procedure that the National Resources Inventory (NRI) staff uses to rectify aerial photographs. The rectified atlas sheets are assembled into one image, the ortho-mosaic of the atlas sheets.

USDA has increased the CRP acreage limit to 27 million acres this year. The Conservation Reserve Program (CRP) is offering higher payment rates and new incentives to promote climate-smart agriculture. CRP requires HEL (Highly Erodible Land) determinations. The Digitizing Unit is currently digitizing the first version of the modern soil survey for the states to be used for HEL determinations. After we create the mosaic of the atlas sheets, we extract the soil lines from the mosaic. We use the ArcGIS software to build the polygons that the states use for HEL determinations.

Poster #3:

Soils2026: Digital Soil Mapping for Class 5 Products

Presenting Author: Suzann Kienast-Brown, USDA NRCS

Co-Authors: Tiffany Allen, Dave White, Stephen Roecker, Jessica Philippe, Alex Stum, Jay Skovlin, USDA NRCS

The Soils2026 Initiative references achieving full coverage of the authoritative soil inventory layer across all lands. The initiative was conceived with the National Cooperative Soil Survey (NCSS) Federal Lands partnership, as most remaining acreage missing inventory is under Federal management. This will mark a principal achievement in the 120-year history of the NCSS and will be foundational to the future of the program. In early 2023, the Digital Soils Mapping (DSM) team from the National Soil Survey Center – Soil Business Systems staff was engaged to support the Northwest and Southwest Soil Survey Regions in completion of their Class 5 Soils2026 projects. These projects are NOTCOM areas with minimal use and management concerns and extremely remote or restricted access with limited or no available field documentation and all occur on federal lands in the Northwest and Southwest Soil Survey Regions. The DSM team is developing and testing innovative approaches to developing Raster Soil Survey products to provide mapping in these areas including STATSGO disaggregation, unsupervised classification, and modeling diagnostic features for classification. The resulting Raster Soil Survey products will be converted to a SSURGO product for publication in Web Soil Survey to meet the requirements of the Soils2026 Initiative. The DSM team will collaborate with Soil Survey Office staff and federal partners to support publication of the intended products. In addition to products derived from the Class 5 projects, this process will present opportunities for training, developing DSM job aids, and updating standards.

Poster #4:

South Central Region – View of Past, Present, and Future Vision

Presenting Author: J. Josiah Parsley, USDA NRCS, SPSD-South Central Region

The South Central Region of the Soil and Plant Science Division (SPSD) works on soil survey inventory projects for dynamic soil properties (DSP), major land resource area (MLRA) updates, initial soil survey, ecological sites, long-term monitoring, and dynamic soil survey (DSS). Projects involve gathering soil climate variables and ecology, soil carbon, and support of climate monitoring in collaboration with tribal lands. The Region provides technical soil services (TSS), works with National Cooperative Soil Survey (NCSS) partners, and supports diversity in project staffing, genesis, concentration, and locations. The South Central Region provides soil survey and ecological site coverage for lands primarily in Texas, Oklahoma, New Mexico, Kansas, Arkansas, and Louisiana. A view of the past fiscal year 2022, current fiscal year 2023, and future vision for the region will be presented.

Poster #5:

WRB and Soil Taxonomy—Recent Updates, Similarities, and Differences

Presenting Author: Curtis Monger, Department of Plant and Environmental Sciences, New Mexico State University

The World Reference Base (WRB) is a widely used international soil classification system. Like Soil Taxonomy (ST), WRB released an updated version within the past year. Also, like ST, WRB was designed to classify all soils worldwide. Both WRB and ST are based on quantitatively defined diagnostic properties and both require the user to go through a key systematically to classify a soil. Unlike ST, however, WRB is not hierarchical, but rather is based on 32 Reference Soil Groups, such as Cryosols, Kastanozems, and Cambisols, to which a set of principal and supplementary qualifiers are added (i.e., Eutric Stagnic Leptic Cambisol (Loamic, Humic)). Also, unlike Soil Taxonomy, WRB does not apply soil moisture and temperature regimes in the classification of soils, stating that the classification is therefore not subordinated to the availability of climate data and the name of a certain soil will not become obsolete due to global or local climate change. Soil Taxonomy, on the other hand, considers soil climate to be an important property that can be measured or estimated based on vegetation. As global or local climate change occurs, the ST system can reflect that change, such as the migration of the boundary between the Ustolls and Udolls. Rather than being a liability, having a classification that reflects soil property changes is an asset for understanding soils as a dynamic component of the landscape.

Poster #6:

Numerical Classification of Soil Profiles

Presenting Author: Dylan Beaudette, USDA NRCS Soil and Plant Science Division

Co-Authors: Shawn Salley, Jon Maynard, USDA NRCS Soil and Plant Science Division

Nearly every aspect of Soil Survey depends on a form of comparison between soil profiles, as conditioned by similar comparisons within and across collections: i.e., "how different is A as compared to B, relative to C?". Soil profile data are complex, usually including an ordered sequence of horizon-level soil morphologic descriptions, possibly laboratory or proximally sensed data, along with a description of the above ground conditions (ecological and geomorphic context). In the more general case, "soil profiles" can include map unit components and soil series concepts. The application of Soil Taxonomy (or other soil classification systems) relies on multiple evaluations (usually binary comparisons) against reference conditions and thresholds. Unfortunately, there is no single set of soil properties, depth intervals, or thresholds related to soil function that can universally partition soil profile data into groups or allocate to a soil classification system.

In this presentation we discuss highlights in the development of a "numerical classification of soil profiles" (NCSP) algorithm, as implemented in the aqp package for R, and ways in which it can be applied to routine Soil Survey operations. The NCSP algorithm performs pair-wise comparisons between soil profile data using suites of properties (nominal, ordinal, and ratio scale data), accounting for variability in soil depth and the presence of missing data. Examples focus on the selection and weighting of soil properties and morphologic features for specific tasks such as "similar/dissimilar" comparisons, selection of modal profiles, soil correlation, and functional classification below the family level of Soil Taxonomy. R code, soil profile data, and additional worked examples related to this talk will be available as a vignette included with the aqp package.

Poster #7:

Mapping soils from terrain features – the case of Nech SAR National Park of Ethiopia

Presenting Author: Shetie, Gatew M[1,2]
Co-Authors: Dondeyne, Stefaan[3]; Nyssen, Jan[3]; Vancampenhout, Karen[2,4]; Deckers, Jozef [2]
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Current soil maps of Ethiopia do not represent accurately the soils of Nech Sar National Park. In the framework of studies on the ecology of the park, we prepared a new soil map based on field observations and a digital terrain model derived from SRTM data with a 30-m resolution. The landscape comprises volcanic cones, lava and basalt outflows, undulating plains, horsts, alluvial plains and river deltas. SOTER-like terrain mapping units were identified. First, the DTM was classified into 128 terrain classes defined by slope gradient (4 classes), relief intensity (4 classes), potential drainage density (2 classes), and hypsometry (4 classes). A soil-landscape relation between the terrain mapping units and WRB soil units was established based on 34 soil profile pits. Based on this relation, the terrain mapping units were either merged or split to represent comprehensive soil and terrain map. The new soil map indicates that Leptosols (30 %), Cambisols (26%), Andosols (21%), Fluvisols (12 %), and Vertisols (9%) are the most widespread Reference Soil Groups of the park. In contrast, the harmonized soil map of Africa derived from the FAO soil map of the world indicates that Luvisols (70%), Vertisols (14%) and Fluvisols (16%) would be the most common Reference Soil Groups. However, these latter mapping units are not consistent with the topography. This case study shows that with the now freely available SRTM data, it is possible to improve current soil information layers with relatively limited resources, even in a complex terrain like Nech Sar National Park.

Poster #8:

Mark Twain National Forest: Soil Survey Built on Collaboration

Presenting Author: John Hammerly, USDA NRCS

Co-Authors: Suzann Kienast-Brown, USDA NRCS; Tiffany Allen, USDA NRCS; Kyle Steele, USDA USFS; Gene Campbell, USDA NRCS; Dennis Meinert, USDA-USFS contractor

A steadfast effort of the National Cooperative Soil Survey (NCSS) involving the USDA Natural Resources Conservation Service (NRCS) and the USDA Forest Service (USFS) has fostered a digital soil mapping (DSM) project of the Eleven Point Ranger District of the Mark Twain National Forest. The district, located within the Ozark Highland Major Land Resource Area (MLRA 116A) in southern Missouri, spans portions of four counties. The original and most current soil survey, completed between 1967 and 1970, is one of the older surveys in the region and is no longer meeting the needs of USFS. In addition to updating the soil mapping, this project also includes updates to the USFS Terrestrial Ecological Unit Inventory and NRCS Ecological Site Descriptions.

The project design targets three distinct geomorphic areas, the Roubidoux Upland, River Hills, and Jefferson City Upland, which will be modeled and completed successively until the entire area is incorporated into the final Raster Soil Survey map. Current project work is focused on the Roubidoux Upland. Collection of field documentation is scheduled for completion during quarter 2 and 3 of fiscal year (FY) 2023, and model development during quarter 3 and 4, with all 3 geomorphic areas complete by end of FY 2025. The continued cooperation on this project between USDA agencies demonstrates the strength of NCSS and its ability to create positive meaningful outcomes.

Poster #9:

Soil Survey Activities in the Northeast Soil Survey Region

Presenting Author: Luis A. Hernandez; NRCS SPSD, Northeast Soil Survey Region

Co-Authors: Wendy Noll, Joxelle Velazquez, and the NE Soil Survey Region Staff, SPSD

The Soil and Plant Science Division (SPSD) Northeast Soil Survey Region utilizes the Project Management Process described in the National Soil Survey Handbook to identify, propose, and prioritize soil survey activities in the region. This poster presentation presents information about the distribution of approved projects for Fiscal Year 2023. The great majority of projects are in the soil survey update category that includes Evaluations, MLRA Update, Tabular Edits, and Spatial Edits. Other approved activities include Initial Soil Survey, Ecological Site Inventory, and Dynamic Soil Properties. This poster also includes information about the regional standard operations procedures in a flow chart format to make project management process easier to be understood by soil survey staff, cooperators, and others.

Poster #10:

Origin and Distribution of Silty Deposits in the Southern Part of the Western Lowlands of Arkansas

Presenting Author: Edgar Mersiovsky, USDA NRCS, SPSD

Co-Authors: L.T. West, USDA NRCS (retired), L.B. Ward USDA NRCS (Retired), D.A. Wysocki, USDA NRCS (Retired), and E.M. Rutledge (University of Arkansas, Fayetteville, deceased)

The Western Lowlands of Arkansas, between Crowley's Ridge and the Ozark Plateau, is comprised of five braided stream terraces formed by an ancestor of the Mississippi River. The terraces are noted as Pve5 to Pve1, oldest to youngest. Evaluations of loess distribution in the northern part of the Lowlands found that Crowley's Ridge and Pve3 were capped by two or more loess deposits, the most recent, Peoria and Roxana, were deposited from the Lowlands east of Crowley's Ridge. Silty deposits on Pve2, however, were interpreted as being alluvial. To evaluate silty parent material and loess distribution in the southern part of the Lowlands, 23 pedons were described and sampled along a transect that traversed Pve2, Pve3, and Pve4. Total sand, total clay, and clay-free silt fraction distribution with depth identified two silty deposits on Pve3 and Pve4 with the lower deposit having a moderately-developed paleosol. Relationships between silt-size and distance from the lowlands east Crowley's Ridge as well as the relationship between thickness and distance confirmed that these two deposits were loess with an eastern source. Although no properties are definitive of a particular loess, the loesses on Pve3 and Pve4 were assumed to correlate with the loesses to the north and identified as Peoria Loess and Roxana Silt. Lack of systematic distance relationships for the single silty deposit on terrace Pve2 suggested an alluvial origin for this deposit. Distance relationships for the loesses on Pve3 and Pve4 suggest that neither would be identifiable east of the terrace segments evaluated.

Poster #11:

Exploring the Influences of Soil Survey Attributes on the Occurrence of Landslides in Puerto Rico Using a Multivariate Approach

Presenting Author: Edwin O. Irizarry Brugman, USDA Natural Resources Conservation Service, 3-HAM – Soil Survey Office, Northeast Region, Soil and Plant Science Division
Co-Authors: Stephen Hughes[1] and Manuel Matos[2]
University of Puerto Rico at Mayagüez, Department of Geology[1], USDA Natural Resources Conservation Service Caribbean Area[2]

The Natural Resource Conservation Service (NRCS) developed a soil mass movement risk interpretation, using primarily soil attributes to determine landslide susceptible areas. This interpretation can be utilized anywhere in the United States that contains the necessary soil data, including Puerto Rico. Discrepancies were observed after comparisons were completed between the interpretation map and a Hurricane Maria landslide inventory susceptibility map of the island. This study aimed to refine our understanding of how specific soil attributes relate to mass wasting vulnerability on the island using a multivariate approach.

Principal Component Analysis (PCA) was used to explore quantitative soil attributes that are common in soil map units known to be prone to rainfall-induced landslides. Soil attributes of the 700+ soil map units on the island were evaluated in the analysis, obtained from the NRCS SSURGO database. The objective of the PCA method was to establish clusters of landslide prone soil map units and determine which soil attributes influenced the clustering.

The analysis demonstrates no unique or uniform combination of soil attributes that correlates with mass wasting vulnerable soils in Puerto Rico, but slight trends influenced by clay content at 0-60 cm depth are notable. While inconclusive, these trends suggest that concentrations of clays at key soil depths could be important for shallow landsliding on the island. The overall lack of correlation supports the conclusion that diverse soils and soil attributes combined with other highly variable site-specific factors can yield variations of soil mantle material that is susceptible to shallow mass wasting.

Poster #12:

Analysis of Dynamic Soil Properties of Terrace Soils in the South Canadian River Valley

Presenting Author: Tyson Morley USDA NRCS, South Central Region, Soil and Plant Science Division

Co-Author: Tyler Kemph, USDA NRCS

The South Canadian River Valley Dynamic Soil Property study was conducted in Dewey County, Oklahoma and compared different management systems. The management systems that were studied included three dry land no-till, three dry land conventional till, two irrigated no-till, and one irrigated conventional till. The two irrigated no-till sites were chosen because they were long term no-till sites that have adapted the regenerative agriculture management system. The focus of this project was to specifically target aggregate stability, bulk density, pH, salinity, and other soil health properties across the different management practices. Bulk density and pH showed only slight differences between management systems. Elevated EC is assumed due to irrigation. Visible salt accumulations were described in the soil pedon descriptions for all three irrigated sites. Aggregate stability measurements illustrated the most difference between management systems investigated with the irrigated no-till regenerative agriculture site showing the highest stability of the investigated management systems.

Poster #13:

Digital Soil Mapping to Complete the Pine County, Minnesota Initial Soil Survey and Reconcile Surrounding Soil Survey Areas

Presenting Author: Betsy M. Schug, USDA NRCS, SPSD

This initial survey is a multi-year digital soil mapping (DSM) project that began in 2017 and spans several geomorphic surfaces with no digital soil information and includes updating those geomorphic surfaces as they cross political boundaries with differing soil survey correlation dates. This project is being completed using a blend of digital soil mapping, traditional soil mapping, field investigations, and progressive correlation to produce a 10m Raster Soil Survey (RSS) layer. In addition to the Raster Soil Survey layer, an updated Soil Survey Geographic Database (SSURGO) product to aid in land use planning, management, and conservation efforts will be produced. Data integrity issues within the individual geomorphic areas will be resolved using quantitative analysis of data collected over the course of the project, as well as available data from NRCS Cooperators. This project will produce a seamless and consistent SSURGO product in addition to a 10m raster product with data populated to meet the most current and highest development National Cooperative Soil Survey (NCSS) standards.

Poster #14:

Updating Soil Surveys on Surface-Mined Landscapes

Presenting Author: Daniel J. Benyei; USDA NRCS SPSD; Marietta, OH

Co-Authors: Jeffery R. Thomas, Wendy J. Noll; USDA NRCS SPSD

A total of approximately 1.4 million acres within the Marietta, Ohio, soil survey office area of responsibility, spanning 54 counties of Kentucky, Ohio, Pennsylvania, and West Virginia, have been surface mined for coal. The mining processes alter the soil properties and qualities to the extent that they no longer reflect the data in Web Soil Survey (WSS), the NRCS public-facing soil survey publication. Interpretations based on this outdated information may be unreliable. In response to requests from internal and external customers of the NRCS for current soils information, the Marietta, Ohio, soil survey office conducted update soil survey projects in selected areas that have been surface mined since the original soil mapping was completed. Soil scientists remapped the selected areas and analyzed the new soil properties and qualities data. In WSS, the updated soils information is now available for these selected areas, including characteristics such as the dominant texture of the surface horizon, slope gradient class, and surface rock fragments, and the interpretations for reclamation of mined soils.

Poster #15:

Reaction Classes in Mine Soils in MLRA 127

Presenting Author: Joel Gebhard, USDA NRCS, Soil and Plant Science Division, Morgantown, WV Soil Survey Office

Co-Authors: Andrew Brown, USDA NRCS, Soil Survey Office, Soil and Plant Science Division, Sonora, CA; Ann Tan, USDA NRCS, Soil and Plant Science Division Morgantown, WV Soil Survey Office

In the Allegheny Plateau and Mountains, mine soil series are differentiated based on parent material and reaction classes. These soils were created in pairs, based on their parent material. Sewell and Fiveblock have sandstone parent material. Cedarcreek and Kaymine are mixed dominant rock type, but with more sandstone. Bethesda and Fairpoint are also mixed dominant rock types, but the particle size control section has greater than 18% clay and more silt. In these pairs of mine soils, one has a reaction class of “acid”, and the other has a reaction class of “nonacid”.

While mapping in northern Pennsylvania, it was determined that the map units were most likely to be complexes, as the pH of the soil would change within short distances of one another. In order to confirm we were not missing an important geographic element, we decided to do an analysis on how past soil surveys mapped the two reaction classes. In R, we compared the location of consociations of nonacid mine soil series with consociations of acid mine soil series, looking at aspect, precipitation, temperature, landform position, and slope. We found no significant differences in the comparison.

One of the reasons we are not finding any differences could be a result of the dynamic properties of mined soils. As time passes, the pH of these soils has changed over the years. Many have settled to a pH of 5.5, which is the cutoff of the acid/ nonacid reaction class.

Poster #16:

Mine Soil Mapping in MLRA 127 Eastern Allegheny Plateau and Mountains

Presenting Author: Ann Tan, USDA NRCS

Co-Authors: Joel Gebhard, Megan Thomas, USDA NRCS

The Eastern Allegheny Plateau and Mountains, MLRA 127, has a history of mining. Geologically it consists of alternating bed of sandstone, limestone, coal, and shale. This MLRA was also the site of the first well drilled specifically for oil in the United States. While some soil survey areas have soil series on mined area, others are represented by miscellaneous area, and most are out of date with the current extent of mining. Because whether an area is mined or not affects soil interpretations, it is important that the extent is captured correctly. State supplied permit maps, topographic maps, and GoogleEarth historic images were used to premap minesoils. Then field work was used to verify the extent and the soils. As dynamic as minesoils are, some conventions are needed to consistently describe minesoil throughout the region. Post Surface Mining Control and Reclamation Act of 1977 (SMCRA), soil material is needed to replace the upper topsoil that was scrapped away. If a state didn't have an exemption to this law, this replaced topsoil can develop rather quickly. The OSD for Bethesda, for example, was established in 1978. It, and most minesoil series in the region, are classified as Udorthents, and will be classified as Anthroportic Udorthents with the update in Keys to Soil Taxonomy, 13th Edition. In the 40 years since, that soil has developed a cambic horizon.   This poster will discuss the various conventions involved in minesoil mapping, such as taxonomy, field descriptions, and phase names, especially as it deals with the types of reclamation.

Poster #17:

Marcellus Formation and Needmore Shale, undivided Characterization Sampling

Presenting Author: Chris Seitz, USDA NRCS

Co-Authors: Jared Beard, Brian Nestor, Abigail Clark, USDA NRCS

The Marcellus Formation and Needmore Shale, undivided (Dmn) Characterization Sampling embodied the notion of identifying a potential project area through preliminary investigations to determine the potential value and extent of future soil survey work. The (Dmn) Characterization sampling was conceived and reinforced based on the following ideas: 1) identification of soils in the field that did not represent the mapped acid loamy-skeletal Berks and Weikert components, as they were fine-loamy to fine, fewer rocks, higher pH, consistently redder, observation of limestone and limy shale (reaction with HCl); 2) black walnut (Juglans nigra) trees commonly occurred in low management and forested areas; 3) limy Edom soils mapped intricately among Berks and Weikert; 4) land use activity commonly more intense than mapped soils perceived to be suited; 5) considering characteristics that constitute the end of soil. Field work and sampling were completed in Fall 2022, samples were sent for analyses to the Kellogg Soil Survey Laboratory (KSSL). The results of the sampling include: 1) identification of extent of soils suited to more intensive agriculture; 2) confirm specific soil properties and interpretations such as coarse fragments, water holding capacity, pH and % Base Saturation, K and T effects, and important farmland classification; 3) differences in soil productivity and capability compared to prior mapping.

Poster #18:

Mineralogical Trends from a Milaca Pedon in Thin Section: An Analysis of Superior Lobe Till

Presenting Author: Emily Jackson, North Dakota State University

Co-Author: Dr. David Hopkins, North Dakota State University

The state of Minnesota has about 26 million acres of agricultural land and more than 1,000 recognized soil series. However, only 11 of those series have thin sections and associated characterization data available from the Kellogg Soil Survey Laboratory database. The Milaca Series is one of the many soil series lacking data regarding its mineralogical composition and geologic provenance. Of the 14 available KSSL reports correlated to the Milaca Series, only two contain mineralogy data and only for the fine sand and clay fractions. The Milaca Series is unique in that it formed in noncalcareous, Superior lobe till; and by analyzing the mineralogy of the Milaca, interpretations of weathering processes can be made. The Milaca pedon was sampled in cropland about 2 miles south of Pierz in Morrison Country, Minnesota, and contained jasper clasts characteristic of Superior Lobe till throughout its profile. Preliminary investigations reveal abundant calcic and potassic feldspars, quartz, hematite, pyroxene and hornblende, as well as evidence of clay alteration of the aforementioned minerals' edges to kaolinite and chlorite. A complete analysis of the mineralogy throughout this pedon could provide additional information on genetic processes within the Milaca Series and provide useful data for drawing comparisons to soils derived from the till of other glacial lobes.

Poster #19:

Distributions and Mineralogy of Manganese Oxides in Soils of the Mid-Atlantic Region, USA

Presenting Author: Jocelyn L. Wardrup[1], University of Maryland, College Park, Maryland, USA,
Co-Authors: Martin C. Rabenhorst[1], Dylan E. Beaudette[2], Jeffrey E. Post[3]
[1]University of Maryland, College Park, Maryland, USA; [2]USDA NRCS, Soil and Plant Science Division, Sonora, California, USA; [3]Department of Mineral Sciences, National Museum of Natural History, Smithsonian Institution, Washington, DC, USA.

Manganese (Mn) redoximorphic features occur as distinct black features indicating periodic, moderately reducing conditions in soils. Research gaps exist in understanding the distribution of Mn redoximorphic features in U.S. soils. Furthermore, gaps exist in relating the distribution of extractable Mn within pedons to the type of redoximorphic feature (nodules/concretions, coatings, masses) and quantities observed. Lastly, since Mn is poorly crystalline and present in small quantities, the mineralogy of the Mn minerals in soils have not been well documented. To investigate these gaps further, we synthesized publicly available geographic (spatial) data for Mn features and have described and sampled soil pedons. For the geographic component of this work, we assessed distributions, morphology and quantities of various Mn redoximorphic features by harmonizing a spatial dataset of mapped soil series (with extents greater than 10,000 acres) that contain Mn features documented in official soil series descriptions (OSDs). To investigate and document Mn redoximorphic features in soils, we sampled over thirty pedons in the mid-Atlantic region, representing a variety of ecosystems, landscape positions and parent materials. Through these efforts, we have examined the occurrence and distributions of the three main morphological forms of Mn features encountered in soils (nodules/concretions, coatings, masses) both via data synthesis and field/lab-based methods. Dithionite (DCB) extractable iron (Fe) and Mn were measured using atomic adsorption spectroscopy. Mn mineralogy of selected features was obtained using Raman spectroscopy. A synthesis of the observations, data and trends will be reported.

Poster #20:

Clay Plaster

Presenting Author: Meghan Krueger, USDA NRCS, Soil and Plant Sciences Division, Soil Services Information Branch

How suitable is soil as a wall covering? A synthesis of studies described in peer reviewed journal articles indicate clay plaster to be suitable as a wall covering. Clay plaster as a wall covering is relatively fire retardant, buffers moisture and acts as a passive thermal regulator. Suitability for soils to be used as a wall covering is dependent on the ideal ratios of clay, silt, sand, and fiber contents. A challenge with using clay plaster as a wall covering is experts in clay plaster and application are hard to find. A suitability interpretation for clay plaster for soil survey users could raise awareness and provide education on the suitability of soils for clay plaster.

Poster #21:

Heavy metals contamination in urban playgrounds and the risk related to children exposure in Lafayette, LA

Presenting Author: Holly L. Heafner, Delta Urban Soils Laboratory, School of Geosciences, University of Louisiana at Lafayette
Co-Author: Anna A. Paltseva, Environmental Science, School of Geosciences, University of Louisiana at Lafayette

Exposure to heavy metal contamination in urban playgrounds can lead to multiple significant human health issues, especially in children. Children are generally more vulnerable to heavy metal exposure due to prolonged outdoor time and incomplete physical development. Lead poisoning is common in children, with direct ingestion of soil particles being the leading route of exposure. Heavy metal contamination is typically elevated in older areas, historically poor communities, and communities of color. This study will be the first to address the connection between heavy metal concentrations in local playgrounds, risks to children's health, and the socioeconomic situation in Lafayette, LA. Soil samples will be collected from multiple public playgrounds in Lafayette, metal concentrations will be measured with XRF and mapped using GIS. This survey will help understand a disproportionate pattern of contamination in disadvantaged communities that can be correlated to diminished neurological development in children. This study aims to determine soil heavy metal concentrations in playgrounds and determine corresponding risks to children's mental and physical development, highlighting environmental injustice in Lafayette, LA's communities.

Poster #22:

Assessing soil change across contrasting spatio-temporal scales representing Ohio physiographic regions using DRIFTS

Presenting Author: Thomas Doohan, Ohio State University

Co-Authors: Leonadro Deiss, OSU; Shameema Oottikka, OSC; Karen Tomko, OSC; Steve Culman, WSU; M. Scott Demyan, OSU

Variation in biologically relevant soil properties (BRSP) has significant impact on environmental quality, C sequestration, and agronomic productivity. However, it is not clear how these properties change across spatial and temporal scales, and how they are impacted by land use change. Sampling and direct measurement of these properties can yield insight into their variability, but soil sampling and laboratory analyses can be laborious and time consuming. Diffuse reflectance infrared Fourier transform spectroscopy (DRIFTS), which can predict various soil properties after calibration with measured reference soil data, is one possible method for rapidly predicting these important soil properties and improving our understanding of their temporal and spatial variability.

The objective of this research is to develop multivariate predictive models for DRIFTS to rapidly predict dynamic BRSP representing the four major physiographic regions of Ohio and to use these models to assess change over different temporal and spatial scales. We resampled historic National Cooperative Soil Survey points and special soil samples across contrasting land uses in Ohio, providing a repeated sampling >70 years. Basic characterization, soil health data, and soil organic C (SOC) fractions including Particulate Organic Matter, Sand and Stable Aggregates, Silt and Clay, and Resistant SOC were measured and this data used to develop multivariate models to predict data for unknown historic soil samples. The accurate prediction of these properties will allow us to assess changes in BRSP and parameterize and initialize process-based SOC models to accurately estimate unknown samples with only the infrared spectra.

Poster #23:

Morphological Soil Variability at the Trial Scale in Eastern South Dakota

Presenting Author: Kristopher Osterloh, South Dakota State University

Co-Author: Shaina Westhoff, SDSU

Soils are naturally variable across landscapes and at all scales. Soil series and soil survey map units allow for an acceptable amount of variation and deviation from the Official Series Description (OSD). When conducting field trials, such as fertilizer response trials, researchers may take surface samples of soil but entirely ignore the deeper. Large studies with multiple reps and blocks may extend across entire map units and encompass map unit complexes with inherently different soil properties. This study looks at the variability in full depth soil morphology (150+ cm) between field trial plots across benchmark soils of Eastern South Dakota. With this study we quantified the variability within a single map unit as well as how close the soils represent their map units. This study is in conjunction with a potassium fertilizer study, and we predict that deep soil variability will account for some of the variation in above responses within singular soil map units.

Poster #24:

Examining Patterns in Soil Form and Function Across Scales using Soil Color

Presenting Author: Dylan Beaudette[1]

Co-Authors: Jon Bathgate[1], Samuel Indorante[2], John Kabrick[3], Ron Collman[1], Jorge Lugo-Camacho[1], Eric Brevik[4]

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Soil can be defined as the unconsolidated material or organic matter on the surface of the earth that has been subjected to and shows effects of genetic and environmental factors of climate, macro and microorganisms, conditioned by relief, acting on parent material, over a period of time. The effects of the genetic and environmental factors are reflected in the observed morphology and measured properties of the soil profile. Soil color is an important indicator of soil genesis and environmental factors; conveniently integrating information related to drainage, accumulation of organic matter, development of secondary clay minerals, accumulation of carbonates, etc. into a single sensory input. The objective of this poster is to demonstrate pedologic interpretation of soil color maps at several cartographic scales to better communicate the main ideas supporting soil survey: parent material provenance, modifications by water and ice, and geomorphic relationships to name a few. We examined soil color maps at scales representing continental to watershed-level features, and across several soil depth slices (10, 25, 50, 75, and 125 cm). These maps were generated by NRCS SPSD staff, at 30m resolution, from a multitude of sources: gNATSGO, MLRAs, Official Series Descriptions, and morphologic descriptions linked to SSURGO components. The soil color maps of the continental US are created on an annual refresh cycle, coinciding with the release of gNATSGO each October. Data are available for download on the NRCS website [1] or as interactive maps and web coverage service (WCS) through SoilWeb [2].

[1] https://www.nrcs.usda.gov/resources/education-and-teaching-materials/soil-colors-of-the-united-states

[2] https://casoilresource.lawr.ucdavis.edu/soil-properties/?prop=soil_color_025

Poster #25:

Dynamic Soil Properties in National Forests of the Great Lakes Region

Presenting Author: Dan Wing, USDA Natural Resources Conservation Service – SPSD, North Central Region

Co-Authors: David Morley, USDA Forest Service – Superior National Forest, Duluth, MN; Randy Kolka, USDA Forest Service – Northern Research Station, Grand Rapids, MN

The Forest Service and Natural Resource Conservation Service are collaborating in the Great Lakes Region to establish a standardized protocol for assessing the effects of forest management activities on dynamic soil properties that is quantitative and repeatable across a gradient of soil textures, soil disturbance, timber harvest methods, season of harvest, and time since harvest. The primary goal of the project is to compare reference with post-harvest conditions over time and space to determine if changes to soil properties are negatively affecting soil productivity or ecology, and if so, how long it takes soils to recover to reference conditions. The 5-year agreement between the Forest Service and Natural Resource Conservation Service, now in its second year, includes forest floor and mineral soil sample collection at multiple depths down to 40 cm, laboratory analyses of soil physical and chemical properties, and soil pedon and vegetation descriptions. Results will help to establish a consistent method of assessing forest soil health and inform future forest management practices.

Poster #26:

Mapping infiltration in an urbanizing mixed-land-use Appalachian watershed

Presenting Author: Jim Thompson, Division of Plant and Soil Sciences, West Virginia University

Co-Author: Sarah Higgins, Division of Plant and Soil Sciences, West Virginia University

The spatial and temporal variability of dynamic soil properties is critical to the development of a dynamic soil survey that is applicable to a variety of scales and land uses. Digital soil mapping historically uses static environmental covariates, such as those derived from digital elevation models, for predicting soil properties. Advancements in satellite imagery and statistical modeling offer opportunities to improve the accuracy of digital soil maps by incorporating multi-temporal data that can capture landscape-scale change over relatively short periods of time. The addition of these dynamic environmental covariates may be especially useful for spatial prediction of dynamic soil properties, like infiltration rate, that are strongly affected by land use and change rapidly as a result of human activity. Infiltration strongly impacts soil health and hydrologic characteristics in a watershed. Understanding infiltration for sustainable land management is vital in urbanizing environments like the West Run watershed in

Morgantown, WV. We hypothesize that infiltration can be predicted at a higher accuracy and a finer spatiotemporal scale using digital soil mapping techniques than is currently provided by the soil survey. Spatial predictions of infiltration rate are being produced of the West Run watershed using both static and dynamic environmental covariates. Training and validation data on saturated hydraulic conductivity were collected using automated dual head infiltrometers at locations selected using a conditioned Latin hypercube sampling scheme. The results of this study will benefit the development of a dynamic soil survey and will improve hydrologic models in this and potentially other mixed-land-use watersheds.

Poster #27:

Topographic Wetness Index as a Proxy for Soil Moisture In Soil Survey Applications

Presenting Author: H. Edwin Winzeler, USDA ARS, Booneville, AR

Co-Authors: Phillip Owens, Zamir Libohova, USDA ARS, Dale Bumpers Small Farms Research Center, Booneville, AR; Amanda Ashworth, USDA ARS, Poultry Production and Product Safety Research Unit, Fayetteville, AR

Topographic wetness index (TWI) is used as a proxy for soil moisture where direct measurements of soil moisture are scarce. How well it performs across varying timescales and methods of calculation is not well understood. We examined spatial correlations between TWI and in situ soil volumetry water content for five years in a hillslope catena. We also explored visual patterns of soil darkening, presumably from moisture and organic matter variance, in Sentinel reflectance data in bare-soil images to determine strength of relationship. Results show that in certain conditions, TWI can be a useful proxy for soil moisture patterns when topography influences soil moisture variability, but that the relationship is not perfect and needs to be calibrated to site-specific considerations.

Poster #28:

Floating bog soils have limited acreage but great diversity across the globe

Presenting Author: Barret M. Wessel, Department of Plant, Soil and Microbial Sciences, Michigan State University, East Lansing, MI

Co-Authors: Chelsea E. Duball, Department of Biology, Grand Valley State University, Allendale, MI; Alexander L. Kholodov, Geophysical Institute Permafrost Laboratory, University of Alaska Fairbanks, Fairbanks, AK

Floating bogs, organic soil horizons over water that sometimes occur as detached floating islands, are frequent objects of public fascination and occasional concern. They can serve as habitat for rare plant and insect species, or they can despoil beaches and block waterways if a floating island moves into an unfortunate position, requiring costly removal. They may be hotspots of methanogenesis, in contrast to their value as archives of organic carbon. Floating bog soils seem to form via several different mechanisms that have been reported in different regions. In permafrost regions where thermokarst is forming, the thaw and physical collapse of underlying mineral soils allows the overlying peat to detach and float as it traps gas bubbles produced via decomposition. Other floating bogs form as peaty lake sediments accumulate gas and float, sometimes seasonally or intermittently. Some floating bogs may form as vegetation mats simply grow out from the shoreline under the right circumstances. Floating bogs have been reported in Alaska, Florida, Australia, India, Fiji, and elsewhere. In the US, three soil series have been established for floating bog soils—Kantishna, Carlin, and Uskabwanka. We summarize floating bog genesis and fate, soil properties, potential hazards, and research needs.

Poster #29:

Idaho Problematic Hydric Soils Study

Presenting Author: Shanna Bernal-Fields, USDA NRCS

Recognizing and delineating wetlands is important for compliance with several federal laws that relate to NRCS conservation planning. In the arid west, with abundant salts in the environment, there are sites where the hydrology and plants are indicative of a wetland, yet the soil does not show classic redox features to meet the definition of a hydric soil. These soils are known as "problematic" as an indicator does not yet exist to account for them. The soil chemical properties including alkalinity and salinity paired with minimal vegetation create an environment of nutrient deficits that limit plant growth and microbial production. The salt tolerant plants that commonly do grow in these soils provide little carbon or nitrogen to microbes, this limits microbial activity and reduction potential when saturated.

This study launched in May 2021 aims to gather water table data to characterize saturated conditions in the upper part of the soil during the growing season, utilizing remote water table monitoring stations in the field as well as tubes and strips that function as indicators of reduction in soils (IRIS). Redoximorphic features will often appear in the upper part of the profile but fail to meet color contrast requirements. This may be the result of alkaline pH values (8.4 to 9.6 found at study sites) reducing microbial activity and the reduction of iron. If the monitoring data proves the water table is present at depth per the technical standard the next step will be to develop and propose a new indicator.

Poster #30:

Coastal Zone Soil Survey of Long Island Sound

Presenting Author: Donald Parizek, USDA NRCS, SPSD, Tolland, CT

On March 11, 2022, President Biden signed the 2022 budget into law, funding a Coastal Zone Soil Survey (CZSS) for Long Island Sound, a project submitted by United States Senator Christopher Murphy of Connecticut. The congressionally directed spending provides the Natural Resources Conservation Service (NRCS) with funding to work with National Cooperative Soil Survey (NCSS) partners to conduct and publish a CZSS for the shallow water areas, tidal marshes, and nearshore upland areas of the Long Island Sound estuary system in Connecticut and New York. Long Island Sound is home to the newly designated (2022) home to the nation's 30th National Estuarine Research Reserve.

In the spring of 2022 NRCS SPSD soil scientists began work on a coastal zone soil survey for Long Island Sound. The project is being conducted by the SPSD Special Projects Office (SPO). NOAA is providing topo-bathymetric LIDAR data, the University of Connecticut and University of Rhode Island are providing lab analysis for the project. Over 300 data points have been collected, by over 40 soil scientists, ES staff, NRCS staff, students, and volunteers. SPO has been instrumental in providing boats, equipment, knowledge, quality assurance, and staff to accomplish the work in a timely manner. The project will be published on Web soil survey when it is completed and will aid coastal communities, local, state, and federal agencies with dredging projects, tidal marsh restoration, endangered species conservation, aquaculture, shellfish and eel grass restoration, blue carbon assessment, and coastal resiliency projects.

Poster #31:

Utilizing Mn and Fe-coated IRIS Films in Restored Wetlands

Presenting Author: Grace M. Bodine, Univ. of Maryland, College Park, MD, USA*

Co-Authors: Martin C. Rabenhorst, Kristen Rigney†*

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Providing evidence of reducing soil conditions and identifying hydric soils are critical in wetland sciences and mitigation efforts. While Indicator of Reduction in Soil (IRIS) devices have been used to detect reducing soil conditions for the last two decades, there is limited research on the utilization of IRIS in wetland restoration sites. Previous work has shown the functionality of IRIS devices is dependent on soil temperature and saturation. In natural wetlands, Mn-coated IRIS films were found to be more sensitive in cool (5-11 ºC), early growing season conditions when

Fe reduction is limited (Rabenhorst et al. 2021). In order to evaluate and compare the effects of soil temperature and saturation on IRIS performance in restored wetland ecosystems, Fe-coated and Mn-coated IRIS films were deployed at 11 restored wetland sites with seasonal hydrology across three physiographic regions in Maryland from the early to mid-growing season (February to May). Six batches of five Fe-coated and five Mn-coated IRIS films were deployed at each site for one month every two weeks. Additionally, groundwater table depth, soil temperature, and porewater alpha-alpha dipyridyl reaction were recorded throughout the IRIS deployment period. This study aims to provide more insight into the environmental drivers on the reduction of IRIS oxide coatings to better understand IRIS applications in wetland restoration efforts.

Citation: Rabenhorst, Martin C., Patrick J. Drohan, John M. Galbraith, Colby Moorberg, Lesley Spokas, Mark H. Stolt, James A. Thompson, Judith Turk, Bruce L. Vasilas, and Karen L. Vaughan. 2021. "Manganese-Coated IRIS to Document Reducing Soil Conditions." Soil Science Society of America Journal 85 (6): 2201–9. https://doi.org/10.1002/saj2.20301

Poster #32:

The Dynamic Soil Properties for Soil Health phase 1 and 2 dataset

Presenting Author: Ekundayo Adeleke, USDA NRCS SPSD, National Soil Survey Center
Co-Authors: Skye Wills, Tiffany Carter, USDA NRCS SPSD, National Soil Survey Center

Soil health, the qualitative capacity of soil to continue to deliver ecosystem services and function that supports plants, animals, and human health, is receiving increased attention among agricultural stakeholders, and the governments. Therefore, the growing popularity has created a need for scientific studies that will assess the soil health and role of management systems that contribute to changes in its status using collections of soil health indicators. The dynamic soil properties for soil health project (DSP4SH) is a science of soil health initiative that was designed to collect, process, and publicize scientifically rigorous data to meet the need for scientifically sound indicators, consistent, replicable, associated data, and interpretations. The soil and plant science division of NRCS and university cooperators collected a suite of standardized soil health metrics across eight states (Oregon, Washington, Kansas, Minnesota, Illinois, Connecticut, North Carolina, and Texas) of five soil survey regions (Northwest, North Central, Northeast, Southeast, and South Central). Each cooperator collected field description of representative pedons and conducted laboratory analyses for samples collected per layer or genetic horizon. Each group submitted data for up to 52 variables for laboratory measurements, 58 variables for layer/horizon descriptions, 38 variables for laboratory analysis conducted at the Kellogg Soil Survey laboratory, 19 variables for the management systems.

Additional 20 variables were developed as metadata for location or site description. To prepare the table for dynamic soil property assessment, all tables (except for dataset from Kellogg Soil Survey Laboratory) were stratified with management system or ecological state. These categories were mainly business as usual (BAU), the reference condition (Ref) and the soil health management (SHM). By the publication of the DSP4SH phase 1 and 2 dataset, we aim to promote increased accessibility, further analyses and understanding the benefits of surveying dynamic soil properties for soil health.

Poster #33:

Standardizing and expanding soil enzyme assay methodology as a Dynamic Soil Property for soil health assessment

Presenting Author: Chammi Attanayake, Department of Crop Sciences, University of Illinois Urbana-Champaign, IL

Co-Author: Andrew J. Margenot, Department of Crop Sciences, University of Illinois Urbana-Champaign, IL

USDA NRCS has identified soil enzyme activity as one of the Dynamic Soil Properties (DSP) for soil health assessments. Enzyme activities catalyze C, N, P, and S depolymerization and mineralization, and are therefore useful as measures of soil metabolism and nutrient cycling. However, the full potential of enzyme activity in soil health assessment is restricted in part by the lack of standardization of enzyme assay methodology and understanding of enzyme activity relationships to other DSP and soil management practices. This study aims to describe enzyme activity trends and data among benchmark soils, test potential relationships of enzyme activities with additional DSP, and systematically evaluate assay parameters to optimize activity measurements. We will collect soils from representative series of the US Midwest under contrasting, replicated management practices at experimental field sites in Illinois, Indiana, and Missouri. Activities of β-glucosidase, N-acetyl-β-glycosaminidase, acid phosphatase, alkaline phosphatase, and arylsulfatase will be measured. Assay parameters of temperature, substrate concentration, and matrix type will be evaluated to test variance in activities among methods and to test the potential to compare activity values, including legacy data, across assay conditions. Additionally, activities of N-cycling enzymes – protease and aminopeptidases – will be evaluated as potential indicators sensitive to management practices that impact soil N availability. Activities of all enzymes will be related to field- and lab-based DSP. The relationships between enzyme activities and other soil properties will be assessed through regression and multivariate statistics. This study will improve the use of soil enzyme activities to monitor soil health.

Poster #34:

Nitrogen-cycling enzymes for soil health monitoring

Presenting Author: Andrew J. Margenot, University of Illinois Urbana-Champaign
Co-Authors: Rachel C. Daughtridge, University of Illinois Urbana-Champaign; Chammi Attanayake, University of Illinois Urbana-Champaign; Ekundayo Adeleke, USDA NRCS NCSS

Mineralization of nitrogen (N) in soils is catalyzed by extracellular enzymes that hydrolyze polymeric forms of organic N into monomeric organic N, and ultimately NH4+-N. The majority of soil organic N is amino-based in the form of proteins and amino acids and amino sugars such as chitin and glucosamine. As depolymerization of amino-containing compounds is thought to be rate-limiting for available N supply, measuring the activities of enzymes that catalyze this depolymerization process can provide soil health indicators sensitive to N provisioning, a key soil function. Here, we present an overview of N-hydrolytic enzymes that could serve as soil health indicators tuned to N cycling functions of soils. Additionally, we present results from mesocosm and field studies to evaluate the sensitivity of N-hydrolytic enzyme activities to management practices that directly and indirectly impact N cycling. Finally, parameterization of these oft-looked enzymes is presented. Results will be used to inform additional assay parameterization in a new NRCS cooperative agreement project on soil enzyme activities for dynamic soil property benchmarking and monitoring.

Poster #35:

Landscape-scale modeling of soil organic carbon dynamics (1984-2018) in a coastal agricultural region in British Columbia, Canada

Presenting Author: Siddhartho S. Paul, Department of Agronomy, Purdue University, West Lafayette, IN, USA
Co-Authors: Jordan H. Kersey, Sean M. Smukler, Soil Science, Faculty of Land and Food Systems, University of British Columbia, Unceded xwməθkwəy̓əm (Musqueam) Territory, Vancouver, BC, Canada

Understanding soil organic carbon (SOC) dynamics is critical for developing sustainable agricultural production. Additionally, sequestering SOC has recently gained wide attention as an effective strategy for drawing down atmospheric carbon. Geospatial analysis using time-series remote sensing data and digital soil mapping tools is becoming increasingly powerful for tracking SOC dynamics. This study applied geospatial analysis to model SOC changes (1984-2018) across a coastal agricultural region – Lower Fraser Valley in British Columbia, Canada. Time-series Landsat satellite images, topographic indices, and down-scaled climate data were utilized in machine learning models to predict SOC changes and understand the spatiotemporal

interactions between SOC, land use changes, and climatic variability. Our model resulted in R2 of 0.67 and concordance correlation coefficient (CCC) of 0.76 for 2018 prediction and R2 of 0.46 and CCC of 0.58 for 1984 prediction. SOC losses were detected in 61% of the landscape while the majority of these losses were observed in the areas that were consistently in the same type of agricultural production. Historical information on regenerative practices was available for a part of the region where we investigated the fields with winter cover crops, grassland set-aside rotations, and hedgerows for their impacts on SOC dynamics. SOC concentration was found to be 86% greater in the fields with both winter cover crop and grassland set-aside rotations compared to the fields without any known history of regenerative practices. However, climate variability was not a strong regulator of SOC changes in our analysis. These results illustrate the need for widespread adoption of regenerative practices to ensure agroecosystem sustainability in the region.

Poster #36:

Using a Soil Survey Approach to Quantify and Understand the Fate of Blue Carbon: A Case Study of the Albemarle-Pamlico Estuary, North Carolina

Presenting Author: A. Reuben Wilson, USDA NRCS SPSD, Raleigh, NC

Co-Authors: Matthew C. Ricker, NC State University; Ben K. Odhiambo, University of Mary Washington

A national cooperative effort is underway to map coastal zone areas due to their importance in carbon storage. The Albemarle-Pamlico Estuary (APE) is the second largest estuarine system in the United States and covers approximately 809,000 hectares of North Carolina and Virginia. We examined twelve wetland sites in the APE peninsula consisting of the three major ecosystems in the region: tidal forested (average salinity, 0.16 – 1.64 ppt); degraded oligohaline tidal forests (4.32 – 8.32 ppt); and established mesohaline tidal marshes (12.0 – 15.5 ppt). Three subaqueous soil cores were taken from each study site (n = 24) to a depth of at least 200 centimeters or vibracore refusal. A nearshore-offshore sampling design was implemented. The design encompassed historical subaerial soils being lost to submergence (nearshore) and subaqueous soils older than the 1980s soil survey map boundaries (offshore). At each site, data was gathered on subaqueous and subaerial peat depth and morphology to understand the fate of peat upon submergence. When nearshore, subaqueous total carbon (C) pools (Mg C/ ha) were compared to subaerial ecosystem equivalents, using LiDAR to correct for elevation, tidal freshwater forests lost (730 ± 343), ghost forests lost (564 ± 315), and marshes lost (471 ± 206) of their respective C pools upon submersion; none of the three types of ecosystems were found to be significantly different ($p = 0.2252$). These data will be used to direct land management decisions and better understand the effects of sea-level rise induced submersion and erosion on soil C stocks.

Poster #37:

Identifying and evaluating sources of uncertainty for Soil Organic Carbon stock estimates

Presenting Author: Zamir Libohova, USDA ARS, Dale Bumpers Small Farms Research Center, Bonneville, Arkansas

Co-Authors: Dylan Beaudette, Skye Wills, USDA NRCS SPSD, National Soil Survey Center, Lincoln, Nebraska

Soil scientists have long asserted that soil carbon sequestration offers a potentially significant mechanism for GHG mitigation. Assessing soil organic carbon (SOC) stocks at any scale requires defensibly representative sampling frames and the capacity to accurately measure bulk density and carbon contents. Few studies have systematically focused on multiple sources of the uncertainty that include the compositional variability in a given target area, laboratory conditions (LC), methods of measurements (MM), coarse fragments (Cf), spatial aggregation (Measured vs Estimated - MvE), short range variability (SRV), the adequacy of any sampling designs. Data collected by USDA NRCS, Soil and Plant Science Division allows evaluation of errors from some of these sources. The mean error for all identifiable sources of uncertainty combined was 26.8 Mg ha-1 with a fair relative root mean square error (RRMSE) of 0.29. The RRMSE varied from 0.03 (excellent) for LC to 1.48 for MvE (poor). Translated to SOC stock basis the uncertainty varied from 3.1 Mg ha-1 to 196 Mg ha-1 or expressed in $ ha-1 from 93 to 5,902. Identifying and ranking the sources of uncertainty provides valuable information should help reduce the uncertainty of SOC stock estimates.

Poster #38:

Major Pedo-geomorphic Factors Affecting Blue Carbon Storage in Tidal Marsh Systems

Presenting Author: Marissa A. Dellinger, Dept. of Crop and Soil Science, North Carolina State University

Co-Author: Matthew C. Ricker, Dept. of Crop and Soil Science, North Carolina State University

Tidal marsh systems dominate the North Carolina coastline but exist in many different geomorphic locations. Back barrier and tidal creek marshes are high-energy environments that form mineral soils characterized by the polyhaline (18-30 ppt) salinity range. Low-energy sound marshes, or areas classified as protected estuaries, encourage the accumulation of thick organic materials creating Histosols or mineral soils with histic epipedons and typically have a mesohaline (5-18 ppt) salinity range. All tidal marsh systems have the potential to store

significant amounts of soil organic carbon. However, limited data has been collected to determine what pedo-geomorphologic factors contribute to their development and what that could mean for blue carbon storage. To strengthen our understanding of coastal soil organic carbon (SOC) storage, this study identified four distinct marsh types and sampled pedons along transects within each type location. In total, 51 pedons were sampled for laboratory analysis, and 98 soil descriptions were made.

Total SOC pools were highly dependent on the thickness of organic materials and the textural class of mineral marsh soils. High-energy back barrier marsh soils had significantly ($p < 0.001$) smaller SOC pools to 200 cm (11.5 kg/m_2) compared to SOC storage in marsh Histosols (66.5 kg/m_2). In addition, SOC concentrations and bulk density differed significantly ($p < 0.001$) depending on horizon type ($n = 284$). Results from this study suggest that tidal marshes vary significantly in their potential to store SOC and that defined geomorphic settings can be used to refine regional blue carbon accounting efforts.

Poster #39:

An Introduction to USDA Climate Hubs and Opportunities for Collaboration

Presenting Author: Cory Christine Owens, USDA NRCS, Oregon
Co-Author: Michael Robotham, USDA NRCS, Soil Science and Resource Assessment (SSRA)

The USDA Climate Hubs are a ten-region strong network of collaborators from across the department's agencies. Hubs are led and hosted by the Agricultural Research Service and Forest Service, and each includes an NRCS Co-Lead on its team. This session will introduce the mission and vision of the USDA's Climate Hubs, introduce the wealth of tools, data, and resources that each Hub maintains, demonstrate how NRCS co-leads and Hub staff are working to help USDA agencies meet their climate adaption planning goals, help attendees get connected to their regional hubs, and highlight opportunities for collaboration between NCSS partners with Hubs. Participants will leave the session with a better understanding of the Hub network, how Hubs fit into the USDA, and how Hubs are working across USDA to support robust and healthy agricultural production and natural resources under increasing climate variability and climate change.

Poster #40:

The Climatic Microsite of Madera Canyon and Sustained Sky Island Biodiversity of the Coronado National Forest

Presenting Author: Jalene Weatherholt, USFS TEUI, Region 3

The Madrean Sky Island Archipelago in southeastern Arizona offers the environmental and climatic stage for a biodiversity hotspot within a relatively small area from the influence of the surrounding Sierra Madre Occidental, Rocky Mountains, Sonoran Desert, and Chihuahuan Desert. In this zone, the Coronado National Forest (CNF) contains species from saguaro to corkbark fir supported by a climatic gradient within a 1,350-10,700 ft elevation range. Ongoing Terrestrial Ecological Unit Inventory (TEUI) of the CNF maps across complex ecological types by classifying zones, termed life zones, with similar climate conditions and adapted vegetation communities. While the CNF currently supports six life zones, modeled climate change impacts show that elevations of habitable area for vegetation communities are migrating up and away from their current distribution. In the Santa Rita Mountains of the CNF, Madera Canyon supports madrean encinal woodlands, ponderosa pine-evergreen oak forests, and mixed conifer forests with extended, isolated spatial ranges at relatively low elevations documented by TEUI that are contradictory to general climate predictions. With this we ask, what climatic and landscape features support extended life zone ranges in Madera Canyon? As climatic shifts alter vegetation community elevational extent, woodland and forested microsites such as cold-air drainages may be key candidates for conservation efforts as they support vital, intact vegetation communities that are easily accessible and frequented by wildlife and recreationalists. Identification, description, and analysis of the ecological attributes important to the occurrence of these niche ecosystems in this given landscape setting are essential for sustaining Sky Island biodiversity.

Poster #41:

Land Resource Inventory (LRI) is Key indicator for Climate- Drought Resilience in Watershed using Farm scale Soil Mapping approach - A success story by Sujala III World Bank project

Presenting Author: R. Srinivasan, ICAR- National Bureau of Soil Survey & Land Use Planning
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Agricultural watersheds are ideal for assessing climate variability due to headwater alteration and loss of ecosystem services to buffer runoff and temperature changes. Nutrients and organic carbon concentrations increase and soil and crop quality changes with runoff. The proper management of watersheds could be achieved by understanding the soil variability and water availability for the adoption of site-specific management which helps to crop suggestion, soil and water conservation, nutrients, and crop management. The present study was performed in different watersheds of Karnataka but the case study was attempted 1:7829 scale for soil mapping in a Bhagyanagar sub-watershed with a geographical area of 6033 ha of Koppal district in Karnataka, India. The land parcels are grouped into management units based on similarity in soil and site characteristics. Farm scale soil survey outcome with 24 soil series and 75 mapping units. Bhagyanagar sub-watershed soil varies from very shallow to very deep, loam to very fine clay and calcareous to non-calcareous apart from wide variations in site characteristics like slope, erosion, etc. This is critical in selecting the best-suited crop and type of conservation structures needed at the field level based on the variability, similar areas are separated as one management unit. Soil and water are the two key resources assessment need to be conserved and managed scientifically for sustainable yield and profit at a watershed level for mitigating drought and adopting climate resilience.

Poster #42:

Using NASA Earth Observations to Identify Spatial and Seasonal Trends of Harmful Algal Events in Lake Champlain

Presenting Author: Zachary Warning, Soil Scientist, USDA NRCS, Belmont, NY
Co-Authors: Brianne Kendall, Laramie Plott, Ian Turner, Aaron Carr, NASA-DEVELOP Program

Lake Champlain provides clean drinking water for 35% of the surrounding watershed and offers recreational opportunities to millions of tourists. However, current levels of cyanobacteria and phosphorus created breeding grounds for harmful algal blooms (HABs). The excess of phosphorus runoff into Lake Champlain over the past decade encouraged toxic cyanobacterial formations, thereby increasing the severity of HABs and their impact on local economy and ecology. In partnership with the Natural Resources Conservation Service (NRCS) Northeast Region, this project utilized Earth observations to identify risk factors associated with toxic algal blooms. The team detected historic algal bloom trends with Sentinel-2 MultiSpectral Instrument (MSI), Sentinel-3 Ocean and Land Color Instrument (OLCI), Landsat 8 Operational

Land Imager (OLI), and Landsat 9 OLI-2. The team also used Sentinel-3 OLCI and the German Aerospace Center's Earth Sensing Imagery Spectrometer (DESIS) to visualize algal bloom patterns and Landsat 8 OLI, Landsat 9 OLI-2, and the Shuttle Radar Topography Mission (SRTM) to identify phosphorus sources within the watershed. The team's analyses indicated an increase in cyanobacteria blooms during summer months from 2016–2022, with Missisquoi and St. Albans Bay exhibiting the greatest concentrations of toxic events. Furthermore, 16% of the watershed was identified as posing an immediate threat to the lake's hydrology. The area of greatest concern was the Missisquoi Bay sub-watershed, with 229,044 acres of land prone to excessive phosphorus runoff. Providing this information to the NRCS Northeast Region enabled the organization to quantify risk factors associated with algal blooms and modify mitigation efforts to better target future bloom events.

Poster #43:

Seventy-One Years of Soil Change in the U.S. Great Plains: Insights from the Haas Soil Archive

Presenting Author: Mark A. Liebig, USDA ARS, Mandan, ND

Co-Authors: Lisa M. Durso, USDA ARS Agroecosystem Management Research Unit; Francisco J. Calderon, Oregon State University; Andrea K. Clemensen, USDA ARS Northern Great Plains Research Laboratory; Jed O. Eberly, Montana State University; Jonathan J. Halvorson, USDA ARS Northern Great Plains Research Laboratory; Syed Hashsham, Michigan State University; Virginia L. Jin, USDA ARS Agroecosystem Management Research Unit; Andrew J. Margenot, University of Illinois at Urbana-Champaign; Xun Qian, Michigan State University; Catherine E. Stewart, USDA ARS Soil Management and Sugarbeet Research Unit; Jim Tiedje, Michigan State University; Ezgi Telli, Michigan State University; Nihat Telli, Michigan State University; Scott Van Pelt, USDA ARS Wind Erosion and Water Conservation Unit

In the U.S. Great Plains, climatic and edaphic factors frequently relegate detection of soil change to decadal timescales, requiring long-term evaluation sites and associated soil archives for insight into trends in soil condition that manifest at scales relevant to sustainability. However, few multi-decadal investigations into soil change have been conducted in the region. Here, we document effects of rainfed agricultural practices on a suite of soil properties using matched historic (1947) and contemporary (2018) soil samples from the Haas Soil Archive, collected at the same locations in the northern (Moccasin, MT), central (Akron, CO), and southern (Big Spring, TX) Great Plains. Historic samples were initially analyzed by the Missouri Basin Survey Laboratory (Mandan, ND; 1949-1956) in support of activities carried out by the National Cooperative Soil Survey. Shared results will leverage knowledge and experience of a diverse investigative team using current analytical methods, with emphasis on elemental composition, soil carbon, labile organic matter, particle-size distribution, and molecular markers of antibiotic resistance.

Poster #44:

An Evaluation of Select Dynamic Soil Properties in a Semi-arid Region in North Dakota

Presenting Author: Samson-Liebig, S.E., USDA NRCS-ND

Co-Authors: W. Bott, USDA NRCS-ND; R. Luciano, USDA NRCS-FL; K. Thomson, USDA NRCS-SPSD, J. Heilig, USDA NRCS-SPSD; P. Sullivan, USDA NRCS-SPSD; J. Kempenich, USDA NRCS-ND;, R. Anderson, WV (Former USDA NRCS-ND); J. Enger, USDA NRCS-SPSD ;B. Wegner, USDA NRCS-SPSD; H. Weiser, USDA NRCS-ND (Retired); S. Boltz, USDA NRCS-SHD; and M.A Liebig, USDA ARS, Mandan, ND

Assessing dynamic soil properties (DSP) across various land uses on a single soil type provides valuable insights into soil change through the quantification of soil physical, chemical, and biological properties. In 2020, a DSP study was initiated at the USDA-ARS Northern Great Plains Research Laboratory (NGPRL) near Mandan, North Dakota, USA as a collaborative effort between the Dickinson and Bismarck MLRA Soil Survey Offices, North Dakota State Soils Staff, and researchers at the USDA-ARS-NGPRL. Three contrasting field sites were studied: long-term no-till small grain-fallow, no-till aspirational cropping systems, and a long-term pasture with prescribed grazing. Sampling points were determined using digital soil mapping techniques to ensure similarity in soil type and landscape position across study sites. A suite of measurements was used to evaluate land use effects on select soil chemical and biological properties. A summary of salient outcomes will be shared in this presentation. This study serves as a baseline for future monitoring and assessments to understand the impact of land management on dynamic soil properties and soil health in a semi-arid region of North Dakota.

Poster #45:

NRCS SPSD soil sampling for MESONETS in Upper Missouri River Basin (UMRB)

Presenting Author: John Warner, NRCS SPSD-NCR

This poster will focus the Upper Missouri River Basin UMRB project. This project is working with the U.S. Army Corps of Engineers, National Oceanic and Atmospheric Administration, University of Montana, University of Nebraska, North Dakota State University, South Dakota State University, and University of Wyoming. The SPSD is managing the characterization sampling of all MESONET climate stations being installed in the UMRB. Sites are being installed every 500 sq miles in the UMRB. The SPSD is providing the characterization sampling and laboratory analysis.

The information provided by the SPSD is an integral part of modeling for the UMRB flood prediction.

Poster #46:

A holistic understanding of Andisol soil organic matter across an environmental gradient and its role in volcanic island resilience

Presenting Author: Tanner B. Beckstrom, Department of Natural Resources and Environmental Management, University of Hawaiʻi at Mānoa, Honolulu, HI

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A sound understanding of soil organic matter (SOM) persistence is critical to maximize soil ecosystem services and carbon sequestration. Soil health, a soil's capacity to sustain biological productivity and maintain environmental quality, connects management practices to SOM functions and landscape resilience. Andisols (volcanic ash-derived soils) contain poorly and non-crystalline minerals that can store relatively high SOM concentrations. However, SOM quantity and distribution vary greatly across natural and working lands. In this study, we measured the effects of precipitation and current land use on SOM pools and soil health in Andisols. We collected soil samples across two moisture regimes (Udands and Ustands) and three land uses (cropland, pasture, forest) on Hawaiʻi Island. Then, we quantified the carbon (C) concentration of four operationally defined SOM components and integrated ten dynamic soil properties into a soil health score. We found that Udands contained greater mineral-associated organic matter C (MAOM-C) than Ustands ($p<0.001$). However, the effect of land use depended upon moisture regime ($p<0.01$), with greatest MAOM-C concentrations in Udand forests (mean 82 ± se 7 mg C kg soil^{-1}). When soil health scores were adjusted for intensive land use history, they ranged from 0.04 to 1.00 across sites. The healthiest systems included Udand forests, Udand pastures, and Ustand pastures. Combining SOM dynamics with soil health metrics provides a holistic framework to understand edaphic complexities. This integrated approach should be applied across diverse soil types and land uses to support resilient landscapes in (sub)tropical and volcanic islands.

Poster #47:

Selling Carbon by the Horizon

Presenting Author: Greg Taylor, USDA NRCS SPSD

Attend any coastal, urban, or climate-based conference or meeting and you're bound to hear carbon mentioned. As one of the primary drivers and concerns related to climate change, carbon is on everyone's mind. How much is stored in the soil of urban environment? How much carbon can a marsh or sound sequester? How much carbon does soil health and other conservation practices actually add to the soil? These are all common questions associated with carbon and soils. Then the topic often shifts to how best to quantify carbon stocks or loss within the soil. From there issues arise such as inconsistent sampling standards, insufficient data storage and sharing capabilities, and issues associated with mapping land. The NCSS has the solution to all these issues and is best equipped to lead in mapping carbon within the soil. However, we must be united and consistent in promoting our NCSS expertise. This presentation will offer suggestions and arguments that support selling carbon by soil survey inventory methods by soil series on a soil horizon basis.

Poster #48:

Carbon Storage in Mid-Atlantic Tidal Marshes

Presenting Author: Martin Rabenhorst, Univ. of Maryland, Dept. Environmental Sci. and Technology

Co-Author: Jordan Kim, Univ. of Maryland, Dept. Environmental Sci. and Technology

Relative to their aerial extent, soils of tidal marshes are known to store disproportionately large quantities of C. Given the implications for the global C cycle and climate change, there is a heightened interest in obtaining good estimations of blue C in coastal settings, especially since work in marshes is challenging and historically these areas have been understudied. In this project, our goal was to more accurately estimate the C stocks in tidal marshes of the Mid-Atlantic region. In consultation with NRCS collaborators, Mid-Atlantic marshes were grouped into five distinct units based upon geomorphology and associated pedological processes. Soils were examined along 28 transects at more than 100 locations. We observed that C storage differed significantly among marshes in different pedogeomorphic units (PGUs), and this was reflected in the soil morphology. We also demonstrated that the mean C densities of particular soil material types can be used in conjunction with soil morphological descriptions to reliably estimate the C stocks in the absence of laboratory data. Based on the morphological and laboratory data collected, existing concepts of tidal marshes in the region were augmented by incorporating newly gained understandings of the spatial changes in morphology and C stocks across marshes within specific pedogeomorphic settings.

Poster #49:

Understanding the Spatial Distribution of Tidal Marsh Soils for Carbon Accounting

Presenting Author: Mark H. Stolt, Department of Natural Resources Science, University of Rhode Island

Co-Author: Joseph Manetta, Department of Natural Resources, University of Rhode Island

Although coastal salt marshes have an incredible ability to sequester carbon, accurate maps and models of their carbon stocks are difficult to create. This is due to the challenging nature of sampling and modeling these complex ecosystems; the poor understanding of plant-soil interactions; that coastal tidal marshes typically have little elevation change across a landscape that can extend hundreds to thousands of meters; and that these marshes can be difficult to access and traverse. In this study, we identified five major pedo-geomorphic units: coves, tidal rivers, tidal creeks, back barriers, and open water marshes. Representative soil samples from 40 marshes were collected and analyzed from each pedo-geomorphic unit for carbon accounting and classification purposes. Our objective was to understand the pedo-geomorphologic parameters that contribute to the spatial distribution of blue carbon in tidal marshes occurring along the northeastern Atlantic Coast.

Poster #50:

Installing and Maintaining Soil Moisture and Temperature Sensors in the Fernow Experimental Forest

Presenting Author: Ann Tan, USDA NRCS

Co-Author: Joel Gebhard, USDA NRCS

The Fernow Experimental Forest is one of three US Forest Service experimental sites SPSD has partnered with for a Dynamic Soil Survey value-added product. This project compares soil moisture and temperature between two watersheds in the Fernow: Watershed 4 and 5. Watershed 4 is the control watershed and was likely cut between 1903-1911. It has been following natural regeneration since. Watershed 5 is managed by single tree selection harvest, performed nearly every 10 years (1958, 1968, 1978, 1983, 1987, 1998, 2007, 2013). Each watershed is approximately 100 acres and dominated by Calvin channery silt loams. In September 2022, a team installed TEROS 12 sensors (soil moisture, temperature, and EC) and TEROS 21 sensors (matric potential) at 15 sites across the two watersheds. Each site has a full pedon description, and samples were taken for bulk density, organic matter content, and particle size distribution analysis at each depth the sensors were installed. This poster will walk through the planning process, the installation, and the upkeep of the sensors.

Poster #51:

Land Use Influence on Soil Water Dynamics in a Semi-arid North Dakota Soil

Presenting Author: Luciano, R., USDA NRCS-FL

Co-Authors: S.E. Samson-Liebig, USDA NRCS-ND, W.D. Bott, USDA NRCS-ND, and M.A. Liebig, USDA ARS, Northern Great Plains Research Laboratory, Mandan, ND

Soil water movement and agricultural land use are inextricably linked. While soil-plant root contact points are important for enhanced water and nutrient uptake, excessive compaction can reduce rates of water and air fluxes, restrict root growth, and impede nutrient and water uptake, thereby reducing crop yields and increasing negative environmental impacts. Soil water movement is an important process in soil because it controls the amount of water available to plants, how much water can be stored in the soil, and whether the root zone has excess water. A summary of findings will be shared in this presentation. Briefly, low aggregate stability caused by a no-till small grain-fallow system increased bulk density, reduced macro-porosity, and reduced infiltration and soil saturated hydraulic conductivity (Ksat). When a no-till aspirational cropping system replaced a no-till small grain-fallow system, the soil reconsolidated. Over time, on the transitional no-till system, connective pores were re-established, soil structure was strengthened or re-established, and infiltration increased. The Ksat data collected in a dynamic soil properties (DSP) sampling is very useful information for the prediction of long-term dynamics of soil water with land use. Practices that improve ecosystem services are critical for the management of soil water in semi-arid areas.

Poster #52:

The Influence of Tillage and Cover Crop Management Practices on the Spatiotemporal Patterns of Soil Micrometeorological Factors

Presenting Author: Jean Bertrand Contina, The Rodale Institute, Midwest Organic Center, Marion, IA

Co-Author: Reza Keshavarz Afshar, The Rodale Institute, Midwest Organic Center, Marion, IA

Soil moisture and temperature represent key factors in determining the rates and directions of soil physicochemical processes such as evaporation, aeration, and nutrient mineralization. Additionally, they strongly influence biological processes such as seedling emergence, root development, and microbial activity. However, their spatial distribution is poorly understood owing to the spatial heterogeneity of the agricultural landscape, seasonal variations, and the differences in soil management practices. The objectives of this study were to: (i) assess the spatiotemporal distribution of soil moisture and temperature under till and no-till practices; (ii) develop data-driven models for evaluating the spatial dependence of soil micrometeorological factors to different soil management practices; and (iii) determine the effect of soil micrometeorological factors on cover and cash crops growth and development. Cereal rye was used as a winter cover crop and was planted in September of the previous year and later in Spring, dry beans were planted on rolled-down rye. Data on soil moisture and temperature were taken in Spring and Summer at regular intervals using a portable Acclima® Sensor Reader. Results showed significant spatiotemporal variations of soil moisture between the till and no-till systems, while soil temperature was significantly influenced by seasonal variations. Kriging and Akima spatial interpolation models were used to create rasterized maps of soil moisture and temperature. Modeling the spatiotemporal patterns of soil micrometeorological factors will enhance our understanding of the physicochemical and biological processes occurring across the agricultural landscape and management practices.

Poster #53:

A climate smart index using productivity, adaptability and mitigation indicators for rice based cropping systems

Presenting Author: Kiran Kumar Mohapatra[1,2]
Co-Authors: A K Nayak[1], R K Patra[2], Rahul Tripathi[1], Chinmaya Kumar Swain[1]*
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Prioritization of appropriate interventions of different climate smart index (CSI) indicators was developed and will be used in agricultural practices to cope with future challenges related to climate change and food security requires more investment in research, specifically action research on climate-smart crop production system. These cropping opportunities can help the farmers to sustaining in changing productivity, profitability and lowering the greenhouse gas emissions. A CSI was developed taking different indicators such as productivity, energy productivity, water productivity, nutrient use efficacy, global warming potential and benefit cost ratio to access different rice based cropping system (Rice-Rice, Sunflower-Rice, Maize-Rice, Green Gram-Rice and Black Gram-Rice) in eastern India. The CSI was recorded highest in S-R cropping system followed by GG/BG-R, M-R and least in R-R. Intensification of rice crop with sunflower, black gram and green gram provided addition systemic yield of 2.24-2.95 Mg ha^{-1}, enhance mean benefit cost ratio of 9.5 -12.3%, reduced system input energy consumption by 38.8 to 45.9%, mitigate GHG emission by 44.3 to 50.2% over R-R system. Therefore, intensification of oil seed and pluses in rice based cropping systems is not only productive and profitable but environmentally cleaner sustainable too.

Poster #54:

A framework for assessing soil properties and function under varying hydroclimatic conditions and agricultural management practices

Presenting Author: Amanda Pennino, USDA NRCS, SPSD NSSC

Co-Authors: Ekundayo Adeleke, Dylan Beaudette, Tiffany Carter, Jonathan Maynard, Travis Nauman, and Skye Wills, National Soil Survey Center, Lincoln, NE

It is well recognized that agricultural production activities modify soil properties which can affect soil function and whole-catchment processes (e.g., runoff quality, nutrient cycling, plant communities). What is less known, is a comprehensive understanding of the interplay between soil properties and the mediation of site conditions (management, climatic, catchment characteristics). To explore some of these linkages, an edge-of-field study located in Salina, KS will assess impacts of common management regimes. Four small, well defined agricultural catchments, relatively homogenous at baseline, will undergo five years of varying management practices while soil moisture, runoff chemistry, and weather are monitored via climate instrumentation. The presented framework will propose a sampling collection scheme, soil analyses, and modeling methodology for better quantifying temporal and management effects on soil function. Because Crete soils are representative of a much larger area and comparable management practices are used extensively across this region, research results from this project could have broad applicability for soil health and water quality under changing hydroclimatic conditions.

Poster #55:

Northwest Soil Survey Region – Review of Region Activities in Soil and Ecological Sciences

Presenting Author: Eva Muller, USDA NRCS, SPSD-Northwest Region

The Soil and Plant Science Division (SPSD) provides a unique source of comprehensive, quality, up-to-date data and information concerning all aspects of soils and ecological sites. Seven soil survey regional offices provide leadership in the production and quality assurance of soil survey and ecological site information based on Major Land Resource Areas (MLRA). Soil Survey office staff in MLRA Offices develop and update soil survey maps and ecological site data throughout their assigned area to meet the changing needs of users. The Northwest Region Soil Survey area has 20 MLRA Soil Survey Offices who create and maintain high quality soil survey and ecological site data across 360 million acres. In collaboration with National Cooperative Soil Survey partners and NRCS State Conservationists, the Soil and Plant Science Division has developed priority activities including a plan to accelerate the soil inventory of the remaining Tribal, private, and Federal lands to complete the foundational soil inventory by 2026. Other high priority activities include soil services and information delivery, and strengthening the National Cooperative Soil Survey. The high-quality soil and ecological site data produced and maintained by scientists in the Northwest region is critical to ensure the productive and sustainable use of our land regardless of ownership, to deliver high-quality science and technology for voluntary conservation on private lands, and to strengthen the stewardship of all lands.

Poster #56:

Using Inherent Soil and Climate Properties to Rate Reclamation Suitability of North Dakota Soils

Presenting Author: Bott, W.D.[1]

Co-Authors: M.A. Meehan[2] and T.M. DeSutter [3]

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[3]Department of Soil Science, North Dakota State University, Fargo, North Dakota, USA

Successful reclamation of lands following disturbances associated with temporary changes in land use or installation of infrastructure such as pipelines, well pads, access roads, evaporation ponds, or pits is not guaranteed. Preparation and planning are essential to increase reclamation success. The National Soil Information System (NASIS) database, which utilizes approximate reasoning, was used to develop interpretive rules that evaluate soils suitability for reclamation based on their resilience and ability to maintain or resume function after being drastically disturbed. The soil features considered are slope, slope aspect, seasonal high-water table, ponding, flooding, surface fragments, mean annual precipitation minus potential evapotranspiration, available water capacity, organic matter, rooting depth, clay content, coarse fragment content, electrical conductivity, sodium adsorption ratio, pH, and calcium carbonate equivalent. This set of interpretive rules is intended to identify those soils that are least suited for reclamation activities so that their disturbance may be avoided, or appropriate management practices can be implemented in the planning process to increase reclamation success. This poster discusses criteria and displays the interpretive ratings for North Dakota soils.

Poster #57:

The Barnes series of North Dakota; micromorphologic contrasts between cropped and reference state pedons

Presenting Author: David Hopkins, Department of Soil Science, School of Natural Resource Sciences, NDSU, Fargo, ND

Co-Authors: Matt Morin, NDSU; Shahid Iqbal, NDSU; Meyer Bohn, Iowa State University; and Annika Cristensen, NDSU

The benchmark Barnes soil series (Fine-loamy, mixed, superactive, frigid Calcic Hapludolls) occupies 2.15 M ha of land in central and eastern North Dakota. The series, vital to the state's agricultural economy, has suffered extensive productivity loss as a result of natural and tillage erosion. Striking evidence of erosional losses were presented in the 1985 Fragile Lands slideshow created by the NRCS State Agronomist. A National Soils Handbook exhibit from MLRA 55A demonstrated that eroded Barnes delineations might fail to meet diagnostic criteria for mollic and cambic horizons. Micromorphologic evidence can highlight changes to cropped Barnes soils in contrast to native, "reference state" conditions. Soil thin sections were produced from eight cropped Barnes delineations in eastern North Dakota in an NRCS funded study in 2016-2018. The eight sites have excellent morphologic descriptions, photography, and limited chemical analyses including SOC and $CaCO_3$ content. More recently, three Barnes reference pedons were sampled for micromorphologic analysis. These sites span the range of the Barnes series from the South Dakota border to near the Turtle Mountains. Evidence of horizon mixing and loss of the cambic horizon is clearly apparent in cropped site thin sections. Voids in cropped sites have limited biotic activity, but reference site A horizons show stunning levels of biotic activity and aggregation. Even reference pedon Bk horizon thin sections show more biologic activity than cropped topsoils. Porosity estimates, biotic activity, and matrix proportions are being quantified using image analysis software and will be demonstrated in this poster.

Poster #58:

Carbon Dynamics in Three Land Management Systems in The Northern Great Plains

Maria Batool, North Dakota State University, Department of Soil Science, Fargo, ND, USA

Co-Authors: Larry J. Cihacek and Rashad Alghamdi, North Dakota State University, Department of Soil Science, Fargo, ND, USA

The largest terrestrial carbon reservoir in the global carbon cycle is the soil but there are still gaps in our knowledge of identifying changes in carbon stocks in multi-use land systems. A study was conducted in north central South Dakota to determine differences in the soil organic and inorganic stocks in. adjacent native grassland (NG), cropped field (CF), and 20-year-old

Conservation Reserve Program (CRP) sites on similar soil types. Three replicate cores were collected from a transect from a wetland border to an interfluve position for each land management. The soils were sampled to a depth of 1 meter where possible at a five to ten-meter spacing within each transect for a total of 576 samples (192 from each land management). Soil total carbon (STC), soil organic carbon (SOC), and soil inorganic carbon (SIC) were measured using a carbon analyzer. We found that SIC comprised up to 2 times more of the stored subsurface soil C than SOC in the NG and CF. The mean SIC for NG, CF, and CRP land systems is 13.1 kg/m^2, 9.7 kg/m^2, and 6.68 kg/m^2 respectively as compared to SOC which is 7.0 kg/m^2, 7.44 kg/m^2, and 8.36 kg/m^2 respectively. The lower SIC in the CRP is likely due to the changes in the water movement and leaching it below the 60 cm depth. When comparing NG, CF, and CRP management systems at depth of 60 cm, the STC levels in the NG are abundant and more (20.3 kg/m^2) followed by the CF (17.2 kg/m^2) and least in CRP (15.05 kg/m^2). Very low soil moisture levels in the CRP limited the ability to sample below the 60 cm depth in several of the sampling points along the CRP transect. The differences in the amount of SIC accumulation illustrate the differences in soil-water relationships between the three management systems. The three transects were on similar landscape slopes surrounding a common wetland marsh so that position relative to the wetland should not play a major role in the carbon fluctuation at differing depths. We will discuss the implications and importance of SIC's role in evaluating the C sequestration in lower rainfall areas of the northern Great Plains.

Poster #59:

Soil color and organic carbon relationships in Nebraska

Presenting Author: Judith Turk, School of Natural Resources, University of Nebraska-Lincoln, Co-Author: Aldi Airori, University of Nebraska-Lincoln

Soil color is an easy-to-measure property that can be used as an indirect proxy for soil organic carbon (SOC). This study was conducted to evaluate relationships between soil color and SOC in for the state of Nebraska. Relationships were evaluated using NASIS pedon descriptions and characterization data from NRCS, as well as selected samples from the Kellogg Soil Survey Laboratory archive. Color was evaluated using the Munsell Color Charts (MCCs) and a portable color sensor (PCS). Both methods show regional variability in soil color and SOC relationships, with R^2 ranging from 0.23 to 0.69 for the MCC and 0.47 to 0.81 for the PCS. Further studies will aim to evaluate PCS-based prediction models and a prototype color chart for SOC estimation based on regionally-specific data.

Poster #60:

Red spruce *(Picea rubens)* ecological sites, ecological states, and restoration pathways quantified through soil organic carbon

Presenting Author: Jim Leonard, USDA NRCS Soil and Plant Science Division
Co-Author: J.A. Thompson, West Virginia University

Ecological site descriptions (ESD) are a restoration tool that provides targeted management prescriptions for distinct ecological communities. ESD use state and transition models (STM) as the framework through which restoration occurs. STM are generally concerned with aboveground ecological changes but can also be used to guide dynamic soil properties (DSP) changes. Here, soil organic carbon (SOC) stock differences among ecological states of two red spruce ecological sites (ES) are examined to assess the utility of STM to quantify SOC sequestration potential. Mean SOC stock differences as well as the relationship between percent conifer canopy cover and SOC stocks were compared among five SOC stock pools. Analyses showed differences between ES total SOC stock ($p < 0.0001$), O horizon SOC stock ($p < 0.0001$), non-spodic mineral horizon SOC stock ($p = 0.0005$), and spodic horizon SOC stock ($p = 0.001$), while O horizon SOC ($p = 0.001$) stocks were also different at the ecological state level. Regression analysis showed significant effect of conifer percent cover on total SOC ($p < 0.0001$) and O horizon SOC ($p < 0.0001$) stocks. Further analysis demonstrated a significant effect of relative conifer percent cover on O horizon SOC when adjusted for ES and ecological state within ES ($p = 0.008$). While STM and ESD are useful for understanding potential changes in vegetation, our findings suggest that they can also be applied to balancing the effects of management-driven changes in ecological states on SOC and other DSP for the purposes of more integrated landscape management.

Poster #61:

Ecological Sites of Glacier National Park – A Story Map

Presenting Author: Stephanie Shoemaker, USDA NRCS
Co-Author: Jay Skovlin, USDA NRCS

This poster introduces the Story Map created for the Ecological Sites of Glacier N.P. in Montana. The Story Map has a format that allows for a broad audience that is immersive, interactive, and informative. The format includes subject tabs that allow users to jump to each section. Tabs included are Introduction, Map Tour, Products, MLRAs/Lifezones, 43A Alpine Ecological Sites (ES), 43A Subalpine ES, 43A Montane ES, and 43B Eastside ES. The Map Tour of Ecological Sites is an interactive map with brief non-technical narratives and photos attached to each point on the tour. The Story Map also includes an overview of NRCS Soil Survey products including polygon and raster maps, soil survey and ecological site concepts on separate tabs. In-depth technical narrative pages for each Ecological Site which address the important site, soil, and vegetation concepts. Ecological sites are grouped by life zone for ease of use. Embedded within narrative pages are button hotlinks to Web Soil Survey, EDIT, OSD web page and MLRA land classification handbooks.

Poster #62:

Soils of Upland Wooded Green Ash Draw Ecological Sites in MLRA 58C

Presenting Author: Krista Bryan, USDA NRCS SPSD-Dickinson, ND
Co-Authors: Jeanne Heilig, USDA NRCS SPSD-Dickinson, ND; John Kempenich, USDA NRCS ND; Ruth Anderson, WV

This project characterized representative soils for three newly established ecological sites (Flat-Bottomed Wooded Draw, Loamy overflow, Steep Sided Wooded Draw) in MLRA 58C, Northern Rolling High Plains, Northeastern Part. It is one of the last steps in a multi-year project between Natural Resources Conservation Service, United States Forest Service, Bureau of Land Management, and National Park Service to identify, characterize, and publish ecological sites to represent these wooded areas in MLRA 58C. These areas are unique in this MLRA, as it is typically characterized by short grass prairie intermingled with sparsely vegetated, steeply sloping dissected badlands along the Little Missouri River and its tributaries. These wooded areas exist on the north and east aspects where a cool, moist microclimate is present. They are important areas to consider for wildlife habitat, ecosystem services, and land use management. It was determined that the representative soil for the Loamy Overflow site is Straw-a pachic soil that was previously not mapped in the MLRA. Representative soil for the Flat-Bottomed Draw is Patent-like, a soil that also has a non-wooded component. The soil for the Steep-Sided Draw site is Arikara-like, a soil that was previously mapped via canopy cover and not by soil properties. Lab data has been completed on the Loamy overflow site and Flat-Bottomed Draw site. After data is returned for the Steep-Sided site; identifying and updating the tabular and spatial data for these soils and map units will commence.

Poster #63:

Forest Productivity Data in NASIS and Web Soil Survey: Is There Room for Improvement?

Presenting Author: Nicholas Butler, USDA NRCS Maine

The Web Soil Survey (WSS) is arguably the primary source for forest productivity attribution for land users in the United States. For WSS users, is our data that comes from NASIS as accurate and usable as it can be? Much of the Site Index and Culmination of Mean Annual Increment

(CMAI) data in NASIS is based off minimal observations collected many years ago. Is CMAI still relevant as a means of measuring production or should it be replaced with a more user-friendly attribute? There are opportunities to utilize more current and accurate productivity data via the Forest Inventory and Analysis (FIA) program, many regional and statewide entities, and other efforts that capture such data. Here we relate what forest productivity data/format our customers seek, and our efforts to pair our soils data with their vegetative analysis and express it in the most useful form. We propose to look at ways to update NASIS productivity data, thus providing the most accurate and useful soil and vegetative relationship data to our customers via Web Soil Survey, and additionally, take our Ecological Site Descriptions to the next level.

Poster #64:

Utility of canopy height models to show variability of site index within stands.

Presenting Author: Greg J. Schmidt, USDA NRCS SPSD, Grand Rapids, MI
Co-Author: Trevor Hobbs, Huron-Manistee National Forests

A canopy height model using Digital Aerial Photogrammetry (DAP) was combined with stand age and site index data from the Huron-Manistee National Forests to determine how forest growth varies by landscape position within the same stand. Tree growth curves were fit for broad forest groups and stratified by slope position, aspect, and soil attributes. In general, forest productivity as determined by the maximum annual height growth rate and maximum canopy height, is highest at lower slope positions, and lowest at upper slope positions, within the same soil group. Similarly, maximum canopy height also varies by aspect, with canopy heights being highest on northern aspect, with greater topographic shading, while the lowest canopy heights are found on southern aspects receiving greater solar radiation. The results show that existing soil map units or stand boundaries do not adequately resolve important differences in site productivity as measured by canopy height.

Poster #65:

Integrating Ecological Sites and the Conservation Assessment Ranking Tool for Improved Land Management and Soil Health

Presenting Author: Shawn W. Salley, USDA NRCS SPSD, NCSS, NM
Co-Authors: Shawn Salley[1], Joel Brown[1], Jarred Kneisel[2], Laura Morton[1], Travis Nauman[1], Daria Scala[2], Curtis Talbot[1], Skye Wills[1]
[1]NRCS-SPSD-National Soil Survey Center; [2]NRCS-ESD-Conservation Planning Branch

The use of robust ecological site data and state-and-transition models (STMs) is critical for effective management of land resources and preserving soil health. STMs offer a comprehensive approach for informed decision-making and setting conservation targets based on land capability, current ecological condition, and potential improvement paths. Scientists across multiple business areas in NRCS are collaborating to evaluate the current and future use of STMs in conservation planning applications. Our goal is to develop a data model that can be tested and iteratively improved for use in the Conservation Assessment Ranking Tool (CART) and other land management decision-support tools. The data strategy will harness ecological site STMs, dynamic data collection opportunities, geospatial data integration, and the practicality of the CART tool. Developing a data-driven approach and an iterative improvement process will improve existing ecological site data management and the state and transition model usability.

Poster #66:

How fungicide and parasiticide affect soil health properties under diverse native grasses

Presenting Author: Shiva Torabian, South Dakota State University, Department of Natural Resource management, Brookings, SD

Co-Authors: A. Joshua Leffler, Lora Perkins, South Dakota State University, Department of Natural Resource Management

Anthropogenic chemicals are commonly used to control pests in agriculture, but these chemicals can negatively affect essential functions in soil health like nutrient cycling. The effects of chemicals on soil health can be different in the plant community with different species richness. We hypothesize that high richness plant community can maintain resistance and resilience of soil system greater than plant communities with low species richness or monocultures. We tested this hypothesis in a greenhouse experiment. We planted 600 pots with three different numbers of grass species but the same density, including pots with no plants, pots with monocultures (one species), three species (low species richness), or six species (high richness). After the plants were established, we treated pots with three concentrations of chemicals (low, medium, and high) commonly used in agriculture (Captan [fungicide] and Ivermectin [parasiticide]) and sampled the pots 0, 3, and 60 days after the application of chemicals. Ammonification and nitrification changed dramatically three days after application in all pots for both chemicals in high and medium concentrations. Sixty days following treatment, ammonification recovered to pre-treatment levels for both Ivermectin and Captan in high richness pots better than low richness, monoculture, and soil-only pots. Nitrification, however, only recovered in monoculture pots treated with low concentration of Ivermectin and low richness pots treated with high and medium concentrations of Captan after 60 days. Our results suggest that high richness communities can provide resilience for some functions of soil system, but that richness cannot completely ameliorate the influences of anthropogenic chemicals on all ecosystem processes.

Poster #67:

Developing quantitative cropland state-and-transition models using Bayesian network analysis

Presenting Author: Jonathan Maynard, USDA NRCS National Soil Survey Center
Co-Authors: Shawn Salley, Travis Nauman, Jamin Johanson, Ekundayo Adeleke, and Skye Wills, USDA NRCS

Ecological sites (ESs) and state-and-transition models (STMs) are part of a resilience-based management framework used to classify land with similar ecological potential based on its biophysical properties (e.g., soil, climate, and potential vegetation), land condition, and its response to disturbance. While originally developed for rangelands, ESs and STMs are being developed for croplands to increase ecosystem services, support conservation planning, and maximize land health. ESs and STMs are conceptual models, developed by technical experts, that describe the patterns and drivers of ecosystem dynamics in landscapes with similar capability. These conceptual models largely exist in narrative form, with qualitative descriptions and ranges of ecosystem attributes relating to potential ecological states and state transitions. Leveraging recent work on dynamic soil properties and soil health indicators in different cropland management systems, this project will explore the development of quantitative cropland state-and-transition models using a Bayesian network modeling framework. To accomplish this, we developed quantitative soil and ecosystem property distributions for an ecological site and its corresponding states within an agricultural dominated landscape using a range of soil (e.g., SSURGO, EDIT, NASIS, KSSL, DSP4SH) and environmental (e.g., climate, terrain, remote sensing) datasets. Our presentation will discuss how quantitative STMs can improve our understanding of the effects of agricultural management on land health and ecosystem function.

Poster #68:

Evaluation of Double Eagle Wonder Black (Organic Fertilizer) on performance of wheat and cauliflower

Presenting Author: Sabina Devkota, Nepal Agricultural Research Council, National Soil Science Research Centre, Khumaltar, Lalitpur
Co-Author: Kamana Rayamajhi, Nepal Agricultural Research Council, National Soil Science Research Centre, Khumaltar, Lalitpur

The Productivity or fertility of the soil is determined by the amount of organic matter content in soil as it controls most of the soil physical, chemical, and biological properties. There are several organic fertilizers available in the market, but the quality of the products is not assured. The study was conducted from November to March 2019 and in 2020 in RCBD with 8 treatments each to study the response of different composition of organic fertilizer (Double Eagle Wonder Black) on yield attributes and soil parameters of cauliflower and wheat based cropping system. In wheat, the significant thousand grain weight was obtained from FYM 10 t/ha which is similar with the application of 600 kg wonder black per ha. Application of 50% recommended dose of chemical fertilizer and farmyard manure also produce equal effect that of wonder black application and full dose of NPK, FYM and control. In cauliflower, the average curd diameter, the average curd depth of cauliflower was significantly influenced by the application 30 t FYM/ha which is similar/at par with the 50% wonder black and 50% FYM and 50% RDF. The yield and biomass were significantly influenced by the application of full dose of RDF which is similar/at par with 50% wonder black and 50% FYM. In cauliflower, soil parameters like soil pH and soil potassium content were obtained significantly higher from the application 30 t FYM/ha which is similar with the application of 50% wonder black and 50% FYM whereas in wheat, soil parameters like soil pH, organic matter, nitrogen, phosphorous and potassium were not significantly influenced by the application of NPK, FYM and wonder black organic fertilizer. However, there is no serious decline in soil pH after the application of wonder black. In this way wonder black together with FYM and RDF produce better result rather than sole application of wonder black organic fertilizer and it is also helpful to enrich soil organic matter and nitrogen content though the results were non-significant.

Poster #69:

From science to applications: Microbiome as a bioindicator for management practices: Global demonstration of microbiome properties as a bioindicator linked to differential management practices

Presenting Author: Alberto Acedo

Co-Authors: Rüdiger Ortiz-Álvarez, Héctor Ortega-Arranz, Vicente J. Ontiveros, Miguel de Celis, Charles Ravarani, Alberto Acedo, Ignacio Belda Msystems

Agroecosystems are human-managed ecosystems adhering to generalized ecological rules. Understanding the ecology behind the assembly and dynamics of soil fungal communities is a fruitful way to improve management practices and plant productivity, particularly, mechanization with ecological computing to analyze the soil microbial networks. Monitoring soil health would benefit from using metrics that arise from ecological explanations that can also guide agricultural management.

Beyond traditional biodiversity descriptors, community-level properties can inform about specific ecological situations. Our observations using traditional approaches show results concurring with previous literature: influence of geographic and climatic factors on sample distributions or different operational taxonomic unit (OTU) compositions depending on agricultural management. Furthermore, using network properties, we observe that fungal communities range from dense arrangements of associations to a sparser structure of associations, indicating differential levels of niche specialization. We detect fungal arrangements capable of thriving in wider or smaller ranges of temperature, revealing that niche specialization may be a critical soil process impacting soil health. Low-intervention practices (organic and biodynamic management) promoted densely clustered networks, describing an equilibrium state based on mixed collaborative communities. Thus, we hypothesize network properties at the community level may uncover how human intervention (land use) can affect community structure and ecological processes in agroecosystems impacting food quality production.

Poster #70:

Developing an automated, web-based soil property estimation tool using mid-infrared (MIR) spectroscopy and machine learning

Presenting Author: Yakun Zhang, University of Wisconsin-Madison, Department of Soil Science, Madison, WI

Co-Authors: Alfred E. Hartemink, Malithi Weerasekara, University of Wisconsin-Madison, Department of Soil Science, Madison, WI

Mid-infrared (MIR) spectroscopy measures soil absorbance or reflectance spectra at 2500 to 25000 nm (4000-400 cm^{-1}) in the electromagnetic spectrum. It contains absorption features related to organic groups, clay minerals, quartz, and carbonates, which are important for assessing soil health indicators. The USDA NRCS-SPSD has developed a high-quality MIR spectral library and deployed MIR technologies to 15 field offices for collecting soil MIR spectra of soils across the US. Our project aims to build a user-friendly, web-based portal that would automate the modeling process and estimate soil properties and soil health indicators from MIR spectra across the 15 field offices. Here, we will present our recent updates on this project, including a literature review, data collection and pre-processing. The soil property data and MIR spectra (n = 37,426) used in this project are collected by NRCS KSSL, which covers the entire U.S., including Alaska, Hawaii, and Puerto Rico, and spans twelve soil orders. It presents diverse landscapes, climatic regions, and land use types of the U.S. Our preliminary modeling results showed that most soil properties (C, texture, carbonate, POM-C) were well predicted from MIR spectra. We will continue our modeling and collaborate with field offices to evaluate and develop a web-based portal.

Poster #71:

Determining dynamic soil position spatial variability using digital soil mapping

Presenting Author: Sage Reuter, South Dakota State University
Co-Authors: Dr. Kristopher Osterloh, South Dakota State University

The ability of soils to provide natural capital and ecosystem services is dependent on their current conditions. Long term monitoring of Dynamic Soil Properties (DSPs) is crucial for maintaining these soil services. DSP studies may last many years, but will stay spatially static to maintain consistent data from year to year. This project uses a combination of traditional and rapid proximal soil sensing techniques (VisNIR, MIR, and SLAKES app) to assess the landscape variability of these DSPs and how that variability is affected by land use intensity. Better understanding of the landscape relationships with soil properties (soil organic carbon, aggregate stability, and bulk density) will provide higher confidence in the extrapolation of long-term DSP studies across larger scales. Using digital soil mapping, we will create additional landscape features inputs to provide a better insights and quantification of these DSP-landscape feature relationships. This project will aide both NRCS and research soil scientists with the implementation of DSP studies as well as the confidence in extrapolating of their results.

Poster #72:

Digital Soil Model Creation for Closed Depressions in North Dakota

Presenting Author: Mackenzie Ries, USDA NRCS SPSD, MLRA 53B SSO, Bismarck, ND.
Co-Authors: Kyle Thomson, USDA NRCS SPSD; Perry Sullivan, USDA NRCS SPSD

Spatial data is vital and unfortunately overtime it can be subject to change. In the Missouri Coteau prolonged wet-dry cycles have caused significant changes in prairie wetlands, small lakes, rivers, and ponds over the decades from when they were initially mapped in the 1980s. This has resulted in many inaccuracies for already established spatial data as areas that were once relatively dry are now fully submerged for a large portion of the year or longer. The main priority for the initiation and completion of this soil survey project was to resolve soil series correlation issues by updating soil property data, update spatial and tabular information, and to develop a raster soil survey product through the creation of a spatial model to more accurately represent the current landscape and the relations between modern day soil series boundaries. Terrain and spectral data were factored to generate data points for the training, which would be used in creation of the model. Soil features of interest, such as depth to aquic conditions, thickness of mollic epipedon, and depth to secondary carbonates were used for the actual development of the model. This project encompasses 1.9 million acres of wetland soils within MLRA 53B stretching from the US-Canadian Border to Faulk County, South Dakota.

Poster #73:

Deep-Learning Framework for Optimal Selection of Soil Sampling Sites

Presenting Author: Sravanthi Bachina, South Dakota State University, Brookings, SD
Co-Authors: Dr. Kristopher Osterloh, South Dakota State University; Praneel Acharya, South Dakota State University; Dr. Kim-Doang Nguyen, Florida Institute of Technology

Soil sampling is one of the most fundamental processes in agriculture. Soil analysis is a key practice to increase the efficiency of nutrient management and agriculture productivity. Among the 4R's concept (i.e., choosing the right fertilizer to apply at the right rate, right time and in the right place) three of them depend on knowing the soil nutrient availability which in turn relies on proper soil sampling techniques. Farmers currently gather the samples on their own and send them to a laboratory for analysis but are not sure of which parts of their fields each sample represents. This creates a problem as the collected soil samples may not accurately represent the actual soil properties, resulting in unreliable analysis results. It requires a good understanding of soil science and how soil properties are distributed in a field. Landscape position\landscape attributes like slope, aspect, flow accumulation and flow drainage are strongly related to spatial variability of soil dynamic properties like soil carbon, water holding capacity. When collecting soil samples for analysis, farmers encounter two major difficulties: deciding where to take the samples and the cost of analyzing each sample. So, by dividing soil samples based on the location of the land, farmers can gain more precise information about the distribution of soil properties, which can help with precision agriculture. To fulfill this need, this project will develop a deep learning framework which is capable of refining landscape data and extracting the optimal locations for soil sampling in a given field. This framework can then be used to accurately interpolate soil properties from the collected samples which will be more precise and cost-effective soil data for precision agriculture systems.

Poster #74:

Survey123 as a tool for rapid, location specific, and relatable ecological site data collection and management

Presenting Author: Grover, Henry S.[1]
Co-Authors: Kristen Meier[2], Jalene Weatherholt[1], Maureen Yonovitz[1], Thomas Giambra1, Eric Robertson[1]
U.S. Forest Service Region 3 TEUI[1], U.S. Forest Service Apache-Sitgreaves National Forest[2]

The complexity of ecological site description data has created many hurdles for data entry and database management. These issues are compounded when attempting to make data standardized and accessible across multiple ecological site survey groups and ecosystem types. Currently robust databases exist to house finalized data and Survey123 could be a valuable bridge between data collection in the field and these databases. Our group created two surveys to standardize data collection between our two working areas in Arizona and New Mexico. These surveys share common data tables and column headers but have different choices in each column to allow for survey relevant specific choices of soil, plant, and geomorphology data. This workflow has greatly reduced time spent collecting and entering data, allowing for more acres to be surveyed per field season. Additionally, Survey123 has allowed for seamless integration with ArcGIS Pro making visualizing data in our mapping area and editing draft data more straightforward.

Poster #75:

The National Geospatial Data Act and its Implications for the SPSD and NCSS

Presenter: Stephen Roecker, USDA NRCS
Co-Authors: Laura Morton, USDA NRCS; Debbie Surabian, USDA NRCS; Chad Ferguson, USDA NRCS

The Geospatial Data Act (or GDA) of 2018, is a 'new' law that clarifies the role and requirements of Federal Agencies who maintain or collect geospatial data. The Natural Resource Conservation Service Soil & Plant Sciences Division (SPSD) is, perhaps not surprisingly, the Lead Agency for the Soils Theme. This designation carries with it numerous responsibilities and limitations! Not only is the SPSD responsible for publishing metadata on GeoPlatform, it's also responsible to developing and maintaining "standards," providing leadership, and coordinating with partners. This is all familiar territory for the SPSD, which is overflowing with standards and partners, but as usual there is more. For starters, the SPSD needs to document its compliance annually for Congress and biannually for the USDA Office of Inspector General (OIG). Two limitations mentioned in the GDA are particularly noteworthy. The first, states that agencies may not use Federal funds for geospatial data that does not comply with applicable standards, unless one of several exemptions apply. Second, agencies may not use funds to collect data unless a search of all sources (including Federal, State, local or private) has determined none exist that already meets their needs. These are both sensible limitations. At present the issue/challenge is that none of these limitations and several other GDA requirements, are not already codified in the National Soil Survey Handbook (NSSH). To streamline compliance, the OIG suggests that the SPSD develop additional guidelines that address the requirements and limitations outlined in the GDA, in addition to creating a paper trail of SPSD activities. It is clear that the GDA will have an impact on SPSD operations. However, this law also impacts National Cooperative Soil Survey (NCSS) cooperators, as it applies to the data they collect that is funded by Federal research grants. Also, it cements the existing role the NCSS plays in contributing to the development of Standards. Therefore, this presentation will give a broad overview of the GDA and will provide additional details on how it will impact the SPSD and NCSS.

Poster #76:

We're Listening: NCSS Communications and Outreach – What's New and Where do we go From Here?

Presenting Author: Paul Reich, USDA NRCS
Co-Authors: Heather Emmons, Jennifer Mason, and Kristie Wiley, USDA NRCS

As the lead agency for the National Cooperative Soil Survey, the NRCS Soil and Plant Science Division (SPSD) is looking for ways to improve communications and outreach within the partnership. Current online information and resources for NCSS will be reviewed and opportunities for better collaboration will be highlighted. The recent update of the NRCS website changed how NCSS online content is organized. SPSD publishes the quarterly NCSS Newsletter, and we are in the process of redesigning and modernizing it so that it meets the needs of the partnership and our customers. Our goal is to reinvigorate how the NCSS partners communicate internally and externally to better inform the public about our soil science resources.

Poster #77:

Putting the "C" in NCSS: Leveraging Interagency Partnerships for Multi-Purpose Data Generation

Presenting Author: Sharon Perrone, USDA NRCS
Co-Author: Jason Kenworthy, Geologist, DOI-NPS

The National Cooperative Soil Survey (NCSS) is a collaborative effort across Federal agencies, universities, and other institutions to generate new soil survey products and enhance our collective knowledge about soils. In January 2023, Presidential Management Fellow Sharon Perrone (Natural Resources Conservation Service – Soil and Plant Science Division) joined the Geologic Resources Division of the National Park Service (NPS) under the supervision of Jason Kenworthy for a 4-month rotation. The Geologic Resources Division and other NPS national offices currently lack capacity to better understand and integrate soils data and information into inventories projects, planning, resource management goals, and outreach at a service-wide level. The goal of this partnership was to determine how best to address those needs with increased cooperation between NRCS and NPS by: supporting development of the soils and surficial geology inventories, collaborate with NPS areas to develop example products derived from NRCS data (including, but not limited to, dynamic soil properties, soil interpretations), develop new or utilize existing soil interpretations to provide data and information to NPS areas; develop outreach products for NPS staff or general public regarding soils information, utility, and access; collaborate with NPS or NPS/NRCS partners to develop or implement outreach products; and provide guidance for responding to soils-related technical assistance requests. Project results will be showcased in poster presentation as they become available with focus on NPS connections to ecology and agronomy, soil science, soil health, and urban soils.

Poster #78:

Can a visualization-based soil description form improve student recall of important soil properties and interpretations? Preliminary results.

Presenting Author: Jaclyn C. Fiola[1]
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[1]Delaware Valley University; Doylestown, PA
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Soil descriptions are an integral part of learning soil science, but description forms require knowledge not only of soil properties but of jargon and abbreviations that will fit within specific boxes. Our goal was to design a soil description form that better connects students, especially introductory-level students, with soil morphology, genesis, and land-use. Thus, the integrated soil description form has a large space for sketching the soil profile and surface vegetation, with horizon morphology directly adjacent to the soil sketch. The back of the form has circle-able diagrams for landform and landscape position as well as short descriptions of possible hydric soil indicators & options for soil classification. We compared student learning using traditional soil description forms versus an integrative description form in two separate soil science classes. Half of the class used a traditional soil-judging style description form while the other half used the integrated form to describe a soil profile. At the next profile, they used the other form type. Then, they completed a short quiz about soil properties (e.g., water table depth, rock content, etc.) of both profiles and we compared their grades. We found that, on average, using the integrated description form improved student recall of soil features. Most students new to soil descriptions preferred the integrated form. Such description forms may be useful for introducing soil profile descriptions and emphasizing key soil properties and interpretations.

Poster #79:

Training with the NRCS Soil and Plant Science Division

Presenting Author: Meredith Albers, USDA NRCS SPSD
Co-Author: Jennifer Mason, USDA NRCS SPSD

The Natural Resources Conservation Service (NRCS) Soil and Plant Science Division (SPSD) supports a national training program for the development and delivery of soil survey products and services. The SPSD Training Team will present on the status of the training program including recommended curriculum, course descriptions, and current offerings. They will discuss challenges and adaptations because of staff turnover, COVID-19, and compliance with Section 508 of the Rehabilitation Act. Metrics of course delivery and projected needs will be presented. Resources and opportunities for NRCS employees, partner agencies, and academia will be discussed.

Poster #80:

NRCS SPSD Safety Focus Team: Ensuring a Safe and Comfortable Working Environment for All

Presenting Author: Wendy Noll, USDA NRCS SPSD Safety Focus Team
Co-Author: USDA SPSD

The NRCS SPSD Safety Focus Team is a group of individuals passionate about safety made up of subject matter experts from the Soil and Plant Science Division, Regional Safety Coordinators, Kellogg Soil Survey Laboratory Safety Representatives, and National Cooperative Soil Survey partners with an interest in collaboration on safety. It is the responsibility of the Safety Team to develop, review, and maintain safety policies for the Soil and Plant Science Division, make recommendations on safety protocols and improvements, and to collaborate and liaise with other Focus Teams where safety centric items should be incorporated. The core mission for the Safety Team is to establish and promote a safe and comfortable working environment for all and to assist in mitigating on the job hazards and injuries with consistent and focused Division wide, relevant guidance and resources.

Poster #81:

“These are the skills we need in our major”: bringing digital soil mapping skills to non-soils undergraduate environmental science students through urban soil and ecosystem restoration

Presenting Author: Margaret Borders, The Ohio State University

Co-Authors: Dr. Brian Slater, The Ohio State University; Dr. Nick Basta, The Ohio State University

The ecosystem restoration professionals of tomorrow are the students of today. Even as interest in soil science as a major declines, courses on restoration of ecosystems in urban environments can introduce students to important soils skillsets, including digital soil mapping. Ohio State environmental science students with a focus in ecosystem restoration are required to take the course “Urban Soils and Ecosystem Services: Assessment and Restoration.” Over the course of a semester, students work with a local client on a real-world restoration project in Columbus, Ohio. Students are required to read and interpret soil maps, design sampling plans and perform soil sampling, conduct morphology assessments of soil cores, map results of lab-analyzed soil properties, and interpret their maps to provide guidance to their client. As a result, students gain competency in GIS, soil morphology, soil sampling, soil health assessment, mapping, and technical writing. By the end of the semester, students produce full-scale, technical reports which include maps of all analyzed soil properties as well as a remediation plan of their own design, tailored to their client’s objectives. After the course, students indicated feeling more confident in their abilities to create and interpret soil maps, use GIS, and communicate the results of their analyses, all of which are critical DSM skills. In addition, by working with a local client who is interested in applying their recommendations, students are able to immediately see the value in their skillset, and they end the semester feeling more well-rounded and better prepared for their profession.

Poster #82:

Converting USFS TEUI mapping to NRCS SSURGO mapping

Presenting Author: Mike Rokus, USDA NRCS, Duluth, MN

The United States Forest Service and Natural Resources Conservation Service have partnered in an InterAgency Agreement to create a modern soil survey of the unmapped portion of Lake and Cook Counties, Minnesota within the Superior National Forest. At the onset of the project in 2020 there were approximately 645,000 acres to complete in 12 Land Type Associations (LTAs). Currently 257,000 acres in 5 LTAs have mapping completed.

Land managers currently use a short one-page description of the soils derived from the existing Terrestrial Ecological Unit Inventory (TEUI) data. Their goal is to have detailed soils data and interpretations to guide and improve their land management decisions with a publish Web Soil Survey dataset. Primary land uses within the Superior National Forest are Forestry Management, Wildlife Habitat management, and rural recreation land development.

Spatial data editing of the existing TUEI data is completed to improve existing line placement for accuracy, to recognize additional mapping concepts, and enhance mapping detail. Soil Scientists collect pedon data during the field season through hand dug soil pits and backhoe excavations to verify mapping concepts. Ecologists and botanists collect vegetative data on a subset of pedon data locations. This collaboration is also developing crosswalks between ecological site descriptions, soil components, and TEUI concepts.

Poster #83:

The use of ground penetrating radar in technical soil services and soil survey updates
Presenting Author: Alan Moore, USDA NRCS SPSD, Huntington, WV

Ground penetrating radar (GPR) is being used in technical soils services to assist conservation planners and cooperators implement conservation activities in an efficient manner. GPR is used to determine the placement of covered feeding pad structures on the landscape. Many times, in bedrock-controlled areas of MLRA's 124, 125, and 126, GPR is used to identify bedrock restrictions or boulders that may limit the placement of the structures support poles. GPR has also been used to successfully locate old tile drainage system outlets in areas where no tile survey can be found, and manual identification proved unsuccessful. GPR has also been used to support cultural resource efforts by identifying areas of older unmarked graves so as not to disturb the cultural resources when NRCS is planning to implement ground disturbing conservation practices. In the soil survey updating process GPR has successfully been used to identify the depth to bedrock restrictions over a large landscape. The data gained from using GPR shows the variability over a large area and helps soil scientists more accurately populate the NASIS database with low, representative, and high depth to bedrock entries.

Poster #84:

Following the Concept of the Most Important Line to Aggregate Digital Soil Maps to Scale-Dependent Vector Maps
Presenting Author: Kyle Thomson, USDA NRCS SPSD, Bismarck, ND
Co-Authors: Joseph Brennen, USDA NRCS, St. Paul, MN; Betsy Schug, USDA NRCS SPSD, St. Paul, MN

Digital soil maps in raster format typically render higher spatial detail than conventional scale-dependent soil surveys. In raster maps with localized complexity, aggregation up to delineations that resemble conventional maps can be challenging without employing logic and tacit knowledge of the mapper. Chapter 4 of the Soil Survey Manual describes the logic of the mapper through the concept of the most important line, beginning with significant geomorphic processes and continuing with emphasis on breaks of significance for use and management while also combining concepts of similar performance. The most important line as applied in traditional soil maps may vary among mappers and soil survey areas. Using digital soil maps and spatial tools, automating the logic of the most important line is practical for consistent map development. Logic is structured into a dichotomous key to identify the sequence of features to map at various scale considerations. Results are aggregated with similar features combined prior to dissimilar features. Resulting delineations are then analyzed for heterogeneity and distilled into map units across project areas of any extent.

Poster #85:

Toward a National Assessment of Soil Biodiversity: A framework for biological data collection

Presenting Author: Tiffany Carter, USDA NRCS, SPSD

Co-Authors: Skye Wills, David Hoover, and David Lindbo, USDA NRCS, Soil and Plant Science Division

Soil microorganisms play a key role in global nutrient cycling and provide various ecosystem services. While biodiversity is known to vary with ecosystem and soil type, it has not been captured by most soil and ecosystem hierarchies. Soil survey traditionally collects data related to soil physical and chemical properties. There is growing interest in soil biology and biodiversity as a part of conservation planning for soil health. Thus, there is a need to build NRCS capacity to measure and interpret soil biological data. The USDA NRCS soil survey has expanded past traditional properties and interpretations to include ecological site information and dynamic soil property data. To meet the increasing demand for soil biological data there is a clear need for the development of efficient and cost-effective methodology that can be used by the National Cooperative Soil Survey (NCSS) to better understand the spatial and depth distribution of biological activity and diversity. This presentation aims to provide a framework for the collection of soil microbiological data across the conterminous US. Various soil types and land management practices uses will initially be targeted. Potential products and insights from this work will be discussed.

Poster #86:

Partnerships, Projects, and Progress

Presenting Author: Patty Burns, USDA NRCS SPSD, MN

Soil Scientists from the USDA NRCS Bemidji MLRA soil survey and the USFS Chippewa National Forest have partnered on two 5-year Interagency Agreements. Through this partnership Bemidji MLRA Soil survey office has evaluated and updated over 1.7 million acres of which approximately 420,000 acres were located on the Chippewa National Forest. This partnership was born out of the need to update the SSURGO soils layer within the national forest and to aid the USFS with their Terrestrial Ecological Unit Inventory (TEUI). The Forest service targeted Land Type Associations (LTA's) within the forest that needed TEUI mapping. NRCS staff then evaluated the major soil types present within the targeted LTA's and developed MLRA wide update projects across the entire extent of the soil series. Soil, vegetation, and site data was collected at preselected points throughout the project extent. All documentation collected within the national forest was shared with the Chippewa National Forest to be utilized in the TEUI mapping. Six update projects have been completed with a seventh currently in progress. Digital Soil Modeling (DSM) techniques have been utilized on four of the projects resulting in a raster soil survey product on just over 1 million acres and updated SSURGO data on approximately 1.7 million acres.

Poster #87:

Use of Image Analysis to Update Urban Soil Survey in Kokomo, Indiana

Presenting Author: Sarah Smith, USDA NRCS, IN

Co-Author: Alena Stephens, USDA NRCS, IN

Kokomo is a small, but growing, city located in the central part of Indiana. Between 2010 and 2020, the city grew by almost 30 percent, from 45,468 to 59,604 people (United States Census Bureau). This growth has impacts on many environmental and social issues, including water quality, farmland loss, and availability of goods and services. Local planners can use the information of where, and how, the city is growing to plan the continued growth efficiently and effectively, and to limit its impacts on the surrounding community. One of the best ways to track these changes is through image analysis within a GIS. For this investigation, data from the National Land Cover Dataset from 2001 and 2019 was evaluated for changes over time, specifically for increase in urban cover. The aerial imagery, LiDAR and its derivatives, and soil survey data were then collected for the areas of urban growth. From there, future soil survey projects can be developed to expand the application of urban land map units. An update to the soil survey data then provides accurate information on current land use capabilities to the public. Finally, with the development of this process, urban growth can be detected, and soil surveys subsequently updated in other metropolitan areas in Indiana, and other states across the country.

Poster #88:

Review of the accuracy and precision of pXRF analyzers in relation to heavy metal contamination in heterogeneous urban soil

Presenting Author: Eriell Jenkins, Delta Urban Soils Laboratory, Lafayette, LA
Co-Author: Dr. Anna Paltseva

As the number of people living in cities rapidly increases, the use of urban agricultural practices grows as well. Unfortunately, urban soil is often contaminated with heavy metals that are hazardous to human health when ingested. Portable XRF (x-ray fluorescence) analyzers are a quick way to measure the concentrations of these contaminants in the lab as well as on-site during field testing. Based on existing literature, this preliminary study aims to determine the accuracy and precision of pXRF analyzers with implication for urban agriculture. The focus was directed toward the XRF's limitations, accuracy, and precision and the methods used to analyze heavy metal(loid)s in heterogeneous urban soil. Ultimately, the research will help optimize sampling to reduce lab costs and time for site assessments, delineate priority metals, and identify metal contamination hot spots. This information will be beneficial to identify gaps in existing studies on XRF methodology to provide recommendations for future research to advance soil survey and conservation planning.

Poster #89:

Portable X-ray Fluorescence Spectrometer Application for Assessing Salinity and Sodicity in Glacial Northern Great Plains Soils

Presenting Author: Adam Devlin, South Dakota State University
Co-Authors: Kristopher Osterloh, South Dakota State University

Saline/sodic soils are increasing in area across the Northern Great Plains (NGP) due to climate change and management factors bringing geologically derived salts closer to the surface. Traditional laboratory assessments such as exchangeable sodium percentage (ESP) and electrical conductivity (EC) can be time consumptive and expensive. Importantly, they do not give us information on the type of salts causing salinity or dispersion. This has led to the desire for more rapid, accurate alternatives. Portable X-ray fluorescence spectrometry (PXRF) may be a viable alternative, as it is able to provide accurate elemental data in minutes under field or laboratory conditions and can directly quantify major salinity contributing elements like Ca, Mg, K, and Cl. PXRF paired with predictive models has proven to be useful for a diverse range of soil applications such as prediction of taxa, parent material, horizonation, texture, cation exchange capacity, fertility, presence of contaminants, and salinity. This study will assess the capability of PXRF for quantifying salinity and sodicity factors in-situ and under lab conditions through analysis of glacial till and glaciolacustrine soils found in the northern James River Valley of South Dakota.

Poster #90:

Mid-infrared Spectroscopy for Estimating Hydrological Soil Properties in Mississippi and Texas

Presenting Author: Yasas Gamagedara[1]

Co-Author: Nuwan K. Wijewardane[1]

[1]Department of Agricultural & Biological Engineering, Mississippi State University, Starkville, MS

Mid-infrared (MIR) spectroscopy has developed as a rapid and low-cost measurement technique capable of supplementing, if not replacing, laboratory analysis of soil properties. MIR spectroscopy has been successfully used to estimate dynamic soil properties (DSP) including moisture, organic carbon, cation exchange capacity, electrical conductivity, and pH. However, studies on hydrological soil properties (HSP) such as infiltration, soil hydraulic conductivity, and water retention are scarce. This 3-year USDA NRCS funded project's goal is to enable NRCS field offices in Mississippi and Texas to use MIR spectroscopy to derive DSPs and HSPs in-office rather than conducting time-consuming and costly conventional field or laboratory measurements. To achieve this goal, two objectives are devised: (i) investigate the impacts of global-to-local and spectrometer-to-spectrometer variations on MIR spectroscopic models to determine the best methodology for using the Kellogg Soil Survey Laboratory (KSSL) MIR spectral library for Mississippi and Texas soils, (ii) study the strategies to use MIR spectroscopy to derive HSPs. Soil sampling (35 soil series) and analysis of Mississippi soils has been completed, and sampling in Texas is planned for year 2023. The current analysis on model transfer has shown that the models calibrated on fine-ground KSSL MIR spectral library can be transferred to local non-fine-ground spectra using calibration transfer techniques. The additional sampling and analysis in upcoming years will enable forming rigid conclusions on this and to achieve the project objectives.

Poster #91:

Climate-Smart Agriculture: Sensor-Based Irrigation Technology for Sustainable Hemp Cultivation

Presenting Author: J.Q. McComb Southern University Ag Center, Baton Rouge,
Co-Authors: L.A. Hodges, C. V. Rogers, Southern University Ag Center, Baton Rouge, LA

Water and fertilizer requirements may prove challenging due to insufficient research and agronomical knowledge about adequately fertilizing and watering hemp. Climate-smart agriculture (CSA) technology can enable farmers to contend with the enormous challenge of water shortages while meeting the increasing consumer demands. Consequently, prospective producers/farmers are introduced to transformational ideas and theories to help meet hemp water requirements. The adoption of Internet of Things (IoT) technology in agriculture is changing to improve conventional techniques in croplands and farmlands. The benefits span from boosted crop yield, and saving on inputs such as water, fertilizers, energy, and labor accessed by farmers. Precisely, CropX®, an innovative ag analytics company, offers a cloud-based farm management platform, leading farmers around the globe into the era of connected soil. The software integrates additional data such as location, crop variety, weather, and satellite imaging. The cloud system developed by CropX® allows farmers to determine how much water goes where via recommendations from the sensor. These sensors provide the soil intelligence farmers need to dramatically increase crop yield and reduce water, fertilization, and energy costs. The affordable, easy-to-use soil sensors integrate with intelligence platforms and top irrigation systems to inform farmers when specific field parts need to be watered and how much water they need in real-time from any mobile device. Thus, stakeholders can manage the water much more accurately below the soil surface.

Poster #92:

Impact of Viticulture Production Upon USDA-MRLA 131A Southern Mississippi River Alluvial Soil

Presenting Author: L.A. Hodges, Southern University Ag Center, Baton Rouge, LA
Co-Authors: U. Johnson, Southern University A&M College, Department of Chemistry, Baton Rouge, LA; J. McComb, Southern University Ag Center, Baton Rouge, LA; C. V. Rogers, Southern University Ag Center, Baton Rouge, LA; Devaiah Kambiranda, Southern University Ag Center, Baton Rouge, LA

Louisiana makes up 23% of the Southern Mississippi River Alluvial Soil USDA NRCS MRLA 131 Region. This region resides on the Mississippi River's Western banks below its Ohio River junction. Region soils (70%) are prime farmland for producing soybeans and corn. These soils also have the potential for regional viticulture production. The Southern University Ag Center established viticulture research on the regional soil type of Oprairie Silt (0-1% slope). Despite showing production potential, no scientific-based information on the impact of viticulture on Oprairie Silt is available. Therefore, the project objective is to compare the soil properties of fallow Oprairie Silt to viticulture production Opraire Silt. Soil analysis will determine physicochemical parameters (pH, C:N ratio, textural analysis), nutrient content (P, K,), and trace elements (Ca, Mg, Na, S, Cu, Zn). Project results produce baseline information for stakeholder viticulture producers in the Southern Mississippi River Alluvial Soils in the USDA NRCS MRLA 131 Region.

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National Cooperative Soil Survey

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Leadership and Coordination

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