National Cooperative Soil Survey Newsletter

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In This Issue—

Editor's Note

Issues of this newsletter are available at http://soils.usda.gov/. Under the Soil Survey tab, click on Partnerships, then on NCSS Newsletters, and then on the desired issue number.

You are invited to submit articles for this newsletter to Jenny Sutherland, National Soil Survey Center, Lincoln, Nebraska. Phone—(402) 437–5326; email—jenny.sutherland@lin.usda.gov. ■

NCSS Soil Scientists in Rincón, Puerto Rico

The 2016 Southern Regional National Cooperative Soil Survey Conference was hosted at Rincón, Puerto Rico, by the Caribbean Area NRCS and the University of Puerto Rico-Mayagüez (UPRM), Soil Science Department. National Cooperative Soil Survey collaborators convened June 20–24 to discuss regional issues, increase the knowledge base for tropical soils and ecosystems, present new initiatives, and expand collaboration to seek new ways to improve the dissemination of soils information. Over 80 experts, representing Federal, regional, State, and local government agencies; universities; and the private sector gathered to celebrate "A Healthy Soil—The Key for a Healthy Environment." Conference planners were honored to host collaborators from 10 different universities as well as from Haiti and Japan.

The week-long conference featured over 30 scientific presentations, a day-long field trip, NCSS committee meetings, panel discussions, a poster session, and a formal banquet recognizing outstanding NCSS soil scientists. Presentations were also shared on climate change, soil health, soil science research, ecological sites, international activities, and collaborative efforts to develop interpretations.

The highlight of the conference was a field trip through southwestern Puerto Rico. The group explored a wide range of landscapes and climates, visited three State forests and agriculture reserves, traversed three different major land resource areas (MLRAs), and witnessed the diversity of Puerto Rico's soils and ecosystems. The trip included reports on the U.S. Fish & Wildlife Service's Puerto Rican Parrot recovery project; provisional

Samuel Rios (red shirt), Mayagüez MLRA soil scientist, discussing the Cerro Gordo Series (fine-loamy, mixed, isothermic Typic Haploperox) at Maricao State Forest. Cerro Gordo soils are well drained and formed in iron-rich residuum that weathered from serpentinite bedrock.

ecological sites; the NEON project in Puerto Rico; soil health management systems for tropical crops; pineapple production in southern Puerto Rico; collaborative efforts for coastal restoration; and soil genesis, morphology, and classification of an Oxisol (formed from serpentinite), an Ultisol (formed from colluvium over residuum), and a Vertisol (formed from alluvium over clayey marine sediments).

During the poster symposium, conference collaborators and more than 15 students showcased their research findings with more than 21 posters. Topics included soil surveys, soil interpretations, ecological sites, soil heath management systems,

Jose Zamora, fruit specialist, Agricultural Extension Service, UPRM, provides a presentation on pineapple production and varieties that are common in the Caribbean.

hydrology, and soil genesis, morphology, and classification. The session was a perfect venue for NCSS partners to interact with and recruit future soil scientists.

Later that day, NCSS partners conducted their business meetings. The committees shared their reviews, discussions, and recommendations.

The conference closed with a formal banquet recognizing three outstanding NCSS soil scientists.

- Wes Tuttle, soil scientist at the National Soil Survey Center, received the Soil Scientist Achievement Award.
- Carmen Santiago, former state soil scientist for NRCS Caribbean Area, received recognition for her outstanding contributions to the NCSS.
- Dr. Friedrich Beinroth, received the NCSS Lifetime Achievement Award for over 40 years of contributions to the NCSS and international collaboration on tropical soils research. Dr. Beinroth's wife, Rosie, and daughter, Katryn, humbly received the award on his behalf.

Many people contributed their time and talents to make this conference a success. The organizing committee included Manuel Matos, USDA–NRCS, Soil Science Division, Puerto Rico; Samuel Rios, USDA–NRCS Soil Science Division, Puerto Rico; Michael Robotham, National Leader for Technical Soil Services; Debbie Anderson, USDA–NRCS, Soil Science Division, North Carolina; Carmen L. Santiago, retired state soil scientist, Puerto Rico; Miguel A. Munoz, professor, UPRM; Wanda I. Lugo, associate professor, UPRM; Rebecca TiradoCorbala, assistant professor, UPRM; Lynette Feliciano, administrative official, Agricultural Experiment Station, UPRM; Madelyn Rios, administrative official, Agricultural Extension Service, UPRM; Edwin Mas, plant material specialist, USDA–NRCS, Caribbean Area; and Julie Wright, public affairs specialist, Caribbean Area.

Other partner agencies and organizations included the U.S. Fish and Wildlife Service, Puerto Rico Department of Natural Resources, USDA Forest Service, Puerto Rican Society of Agricultural Sciences, Sea Grant, NEON Puerto Rico, Federacion de Asociaciones Pecuarias, Industria Lechera de Puerto Rico, and Caribbean Fruit Farm Incorporated. ■

Dr. Bryan Brunner, UPRM, leading a presentation on soil health management systems in the Caribbean area at the Lajas Agricultural Experiment Station.

GlobalSoilMap Consortium Meeting

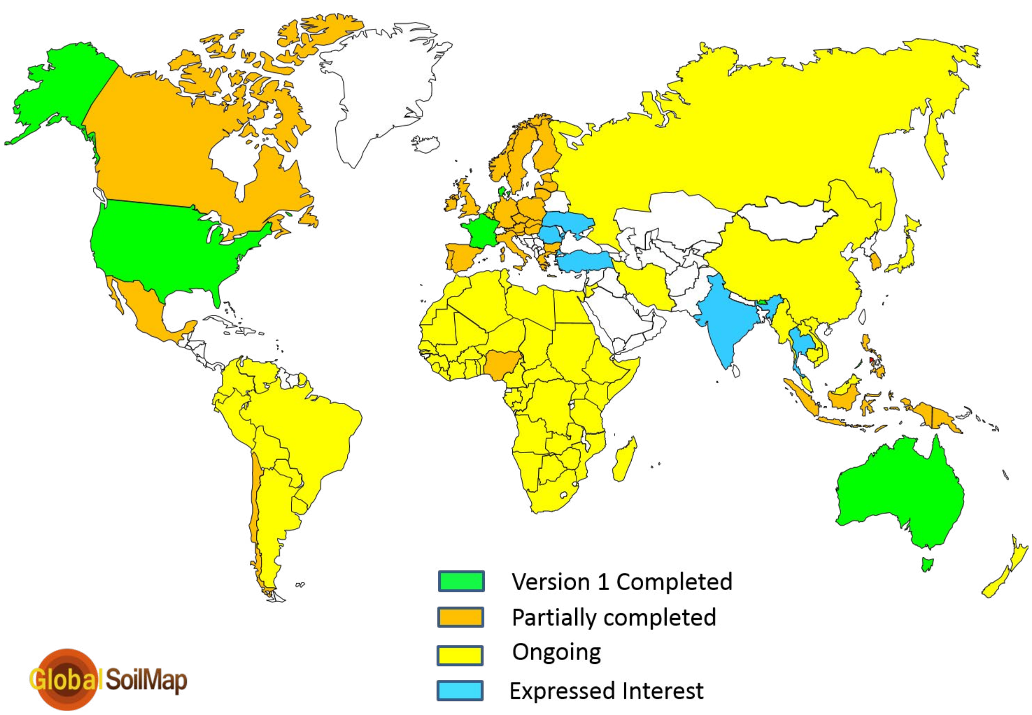
A meeting of the GlobalSoilMap (GSM) consortium was held June 26–27, 2016, in Aarhus, Denmark. It was hosted by Mogensh Greve, Aarhus University. Participants came from Australia, France, United States, China, and Denmark.

The purpose of the meeting was to: (1) review GSM progress; (2) evaluate the GSM administration; (3) review the new consortium agreement (rules of membership, responsibilities, etc.); (4) discuss the status of the International Union of Soil Scientists (IUSS) GSM Working Group application; (5) consider related scientific topics; and (6) plan for the future.

The NRCS Soil Science Division and the National Cooperative Soil Survey are active members of the GSM consortium. Working with West Virginia University—Morgantown, they developed the first generation of soil property maps that meet the standards for one of the GSM tier specifications. Zamir Libohova represented the NRCS National Soil Survey Center at the meeting.

Discussions at the meeting focused on the new agreement for the GSM consortium. The agreement calls for expanding the membership to other countries and institutions, for developing a bottom-up approach to generating the first global coverage of main soil property maps, and for a 100m x 100m grid resolution.

Another topic was the placement of a “time stamp,” especially for properties that change within a short period (i.e., dynamic soil properties). The main issue of concern is how to bring soil properties with different time stamps, such as soil pH and organic matter, to a common time denominator. The participants agreed that it would be important to first determine what properties should be considered dynamic. The GSM could provide specifications and guidance, and the producers could provide the conversion to a common time denominator. The Rapid Carbon Assessment project was considered one venue that could be used to develop transfer functions for converting data with different time stamps to a common time denominator, especially for soil organic matter. The next GSM consortium meeting is scheduled for July 4–7, 2017, in Moscow, Russia. ■



Updated progress on GlobalSoilMap (modified from Arrouays, 2016).

International Union of Soil Sciences Awards Medal

Professor Emeritus Delvin S. Fanning was awarded the 1st Pons Medal at the 8th International Acid Sulfate Soils Conference.

Professor Leigh Sullivan from Federation University in Australia is the Chair of the Acid Sulfate Soils Working Group of the International Union of Soil Sciences. On July 21, 2016, he announced that Professor Emeritus Delvin S. Fanning of the University of Maryland (UMD) had been selected to be the recipient of the 1st Pons Medal. Professor Sullivan awarded the medal to Professor Fanning during a mid-day ceremony at the conference.

This new medal was recently approved by the International Union of Soil Sciences (IUSS) to be awarded at the meeting of the Acid Sulfate Soils Working Group/ Commission (approximately every 4 years). The medal goes to a distinguished scientist recognized for contributions to the application of acid sulfate soil science through publication, innovative research, leadership, education, and service. The medal is named after the late Leen Pons, who was Professor of Regional Soil Science at Wageningen University in The Netherlands. Professor Pons has been credited with helping to bring acid sulfate soils and related phenomena to the center stage of environmental science. Professor Fanning spent the last 20 years of his career (as well as the 17 years following his "retirement" in 1999) in the study of acid sulfate soils and in advocacy for solutions to environmental problems associated with acid sulfate phenomena.

Professor Leigh Sullivan (Federation University, Australia), Chair of the Acid Sulfate Soils Working Group of the International Union of Soil Sciences, congratulates Professor Emeritus Delvin S. Fanning and awards him the 1st Pons Medal.

The 8th International Acid Sulfate Soils Conference was held at College Park, Maryland, from July 17–23, 2016. The conference was hosted by the UMD Department of Environmental Science and Technology. Other sponsors included the Acid Sulfate Soils Working Group of the International Union of Soil Sciences, UMD College of Agriculture and Natural Resources, USDA–NRCS, Soil Science Society of America, Mid-Atlantic Association of Professional Soil Scientists, Virginia Association of Professional Soil Scientists, Smithsonian Environmental Research Center, and American Society of Mining and Reclamation. Over 70 delegates from 13 countries participated in the conference, which had technical sessions on July 18, 19, and 21. Three field tours were held in conjunction with the conference: (1) a pre-conference tour on July 17 visited the Hart-Miller Island dredge deposition site; (2) a mid-conference tour on July 20 visited the UMD Research and Education facility in Upper Marlboro and the Smithsonian Environmental Research Center (SERC) in Edgewater; and (3) a post-conference tour on July 22–23 visited southern Maryland and the Richmond and Fredericksburg, Virginia, areas.

Previous Acid Sulfate Soils Conferences have been held in Wageningen, The Netherlands (1972); Bangkok, Thailand (1981); Dakar, Senegal (1986); Ho Chi Minh City, Vietnam (1992); Tweed Heads, Australia (2002); Guangzhou, China (2008); and Vaasa, Finland (2012). The next conference is tentatively scheduled to be held in Thailand in 2020. ■

New Job Aids for Digital Soil Mapping

By Tom D'Avello, NRCS, National Soil Survey Center, Geospatial Research Unit, Morgantown, West Virginia.

Two new job aids are available in the Digital Soil Mapping and Raster Processing section of the NRCS Soils Job Aids webpage. The first, "Best Practices for Processing Raster Data in Soil Survey Applications" (http://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1224008&ext=pdf), presents guidelines that can help minimize problems during the application stages of projects. The second, "Modifying Digital Elevation Models to Develop More Realistic Wetness Index Layers for Soil Survey Applications" (http://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1257808&ext=pdf), describes a procedure that can help minimize the effect of anthropogenic features on the wetness index.

The first job aid addresses the wealth of raster data available for developing covariates to use in soil survey related activities. Because of the large spatial extent of many soil survey projects, planning is of paramount importance for data development. The objectives of the job aid are to: (1) reduce data processing errors due to improper planning, and (2) standardize data among layers to facilitate analyses and interpretation. The job aid also helps to prevent matching problems (fig. 1) by understanding the basis of how covariates are derived.

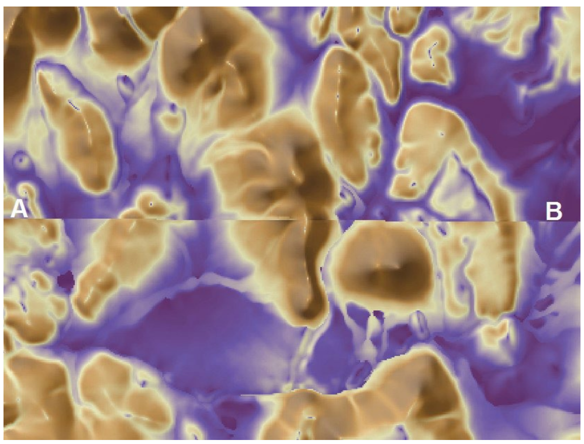


Figure 1.—Poor match of wetness index (along A-B line) because watershed extents were not considered.

The second job aid addresses the effect of manmade features on wetness index values. Manmade features, such as roads, railroads, and gravel pits, often confound the usefulness of terrain derivatives by functioning as ridges or pits, creating micro-topographic noise. Soil scientists ignore these features when creating polygon-based soil survey maps. However, when raster data is used for the mapping inputs and is the desired output format, these features can produce undesired results. Figure 2 shows the difference in wetness index values along the juncture of a transportation right-of-way. ■

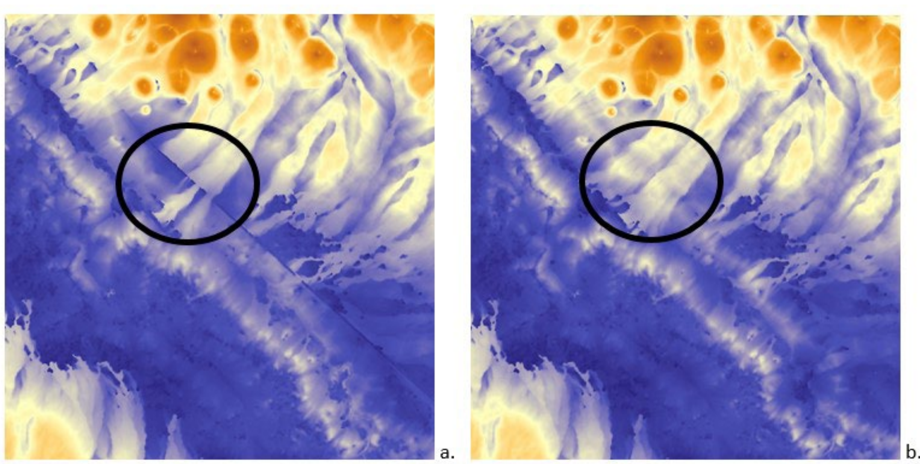


Figure 2.—Wetness index from the original DEM (a) and modified DEM (b).

A Survey to Better Understand the Use of the Terms "Colluvium" and "Alluvium"

By Bradley Miller, assistant professor, Department of Agronomy, Iowa State University, Ames, Iowa, and Jérôme Juilleret, engineer in Soil Science and Hydrology, Department of Environmental Research and Innovation (ERIN), Luxembourg Institute of Science and Technology, Belvaux, Grand-Duchy of Luxembourg.

We need your help to fully understand how scientists from different backgrounds define the terms "colluvium" and "alluvium." We ask that you contribute your perspective by taking the survey at http://goo.gl/forms/fV8RBWKjis. The closing deadline is October 31, 2016. The feedback so far has been positive, and many participants have described the experience as fun. Many commented on how the survey challenged their thinking about these sediments, causing them to more carefully consider potential gaps in their definitions for the terms and their strategies for identifying the materials. Others have expressed great interest in the results because they too have sometimes struggled with how to best use these terms. The following background describes why we are pursuing the question of how scientists are using the terms colluvium and alluvium.

People classify things for two primary reasons: (1) to help make sense of a complex world, and (2) to improve communication. We are focusing on the latter. Communication problems occur if two people have different concepts when they are using the same word. The United States is fortunate to have national entities, such

Figure 1.—Sediments in different locations of this landscape have been transported by different processes that also vary in magnitude. Part of the challenge in applying definitions of colluvium and alluvium is the gradient between the two, but how a sediment is classified can be very different based on the type of diagnostic criteria and associated processes emphasized by the scientist. For example, diagnostic criteria that we have found by reviewing the literature and reaching out to the Earth science community via social media include landscape position, degree of sorting, connection to stream, and distance traveled.

as NRCS, which produce official definitions that U.S. scientists can reference for communicating with one another. When we work internationally, however, it becomes apparent that some terms (especially colluvium) can have a very different meaning from the common U.S. meaning.

As we've investigated the issue further, we've been surprised by the variety of perspectives. The differences have not been just between countries or disciplines, but also within those demographics, including within the United States. The differences also go beyond simply recognizing that the American term "colluvium" is not equivalent to the German term "kolluvium" (Kleber, 2006). These differences are the reason we initiated this survey to collect data on how Earth scientists are actually using the terms.

The terms colluvium and alluvium have had an interesting historical progression. The word parts "luvium" and "luvial" come from the Latin "luo" or "luere," which means to wash (Glare, 2010). Although this suggests an association with process, early uses of these terms had more of a connection to time periods of deposition. In the oldest literature, alluvium generally described all recent deposits formed in the Holocene. Alluvium contrasted with "diluvium," which described deposits from the last glacial period. Note that diluvium has a shared Latin etymology with deluge, reflecting the theory at that time that linked till with the biblical great flood.

It is not clear when colluvium came into use, but the Latin etymology of "co" suggests that it was intended to describe material that was with or mixed with something else. Along those lines, Foucault et al. (2014) included the etymology of colluvium as "with alluvium," but went on to define colluvium as a footslope deposit that has undergone less transportation than alluvium. The old French-Latin dictionary provides some different clues. The definition of "Colluvi-es" includes "mixing, confusion," "dirty water mixture," and "mud," whereas "Alluvi-o" includes "soil made by a river," "violent flood," and "river water or rainwater" as well as "floods the fields and completely disrupts them" (De Wailly, 1861). Despite being intriguing, the origins of these terms do not have a strong bearing on how they are applied today.

Definitions of colluvium and alluvium in modern literature tend to rely on location or process. Although the past and modern definitions can be seen to be compatible in some ways, the longer a definition is, the more likely it is to mark out exceptions to its originally stated principle and conflict with other definitions. For example, many definitions of colluvium identify it as being located at the base of hillslopes but vary in the defining process. Examples include gravitational forces (Whittow, 1984); under the influence of gravity, assisted by water (Schaetzl and Thompson, 2015); and unconcentrated surface runoff or sheet erosion (definition (b) from Neuendorf et al., 2005). Some definitions of colluvium specify that it is heterogeneous or usually unsorted (Whittow, 1984; Owen and Shaw, 2007; Schaetzl and Thompson, 2015), but definitions that include sheet flow, rainwash, or local wash are not completely compatible with that diagnostic criteria. Adding another dimension, Leopold (2003) defined the German word kolluvium as sediments deposited due to anthropogenic-induced soil erosion caused by settling, clearing, mining, grazing, and/or farming. Examining the differences between definitions highlights the variety of perspectives on what to emphasize when distinguishing these parent materials. In practice, many more perspectives may be in use as scientists adapt to the landscape in which they work. It is time to make note of all of these perspectives and look for ways to synthesize an approach that facilitates global understanding and communication.

Although we recognize that the results of this survey process will not authoritatively provide definitions for colluvium and alluvium, we believe it will make progress on two objectives. First, it will allow us to "map" how the terms are being used across countries, landscapes, and disciplines. This mapping will provide a guide for recognizing and translating meanings among people with different perspectives. Second, we hope the data will shed light on why the use of these terms varies and thereby identify some potential strategies for better describing these sediments. After this first round of the survey, we plan to provide all of the survey participants with the results and then present to them a series of potential options for addressing issues and unifying perspectives based on the data. It is our hope that the final results will lay the groundwork for reducing confusion, facilitating better communication, and improving the description of these sediments. We look forward to your input!

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Mapping the Potential Impact of Sea-Level Rise

By Allison Leapard, graduate student at the University of Florida and USDA–NRCS soil conservationist, Chesapeake, Virginia.

The following briefly summarizes “Mapping the Potential Impact of Sea-Level Rise and Increased Salinity on Agricultural Land in Virginia Beach, Virginia.” The full version, including references and data sources, is available from allison.leapard@va.usda.gov. The study examines how sea-level rise may impact the unprotected agricultural lands of southern Virginia Beach by the year 2100.

The Hampton Roads region of southeastern Virginia is experiencing the highest rates of sea-level rise of any area along the east coast of the United States. While global average sea level has been rising at a rate of about 1.8 mm/year, sea level at the Sewells Point tidal station in Norfolk, Virginia, has been rising at an average of 4.4 mm/year (Zervas, 2009).

Hampton Roads is at the mouth of the Chesapeake Bay (fig. 1). The region is currently the second largest population center at risk from sea-level rise in the country, second only to New Orleans (Connolly, 2015). The City of Virginia Beach, the largest city in Hampton Roads and the most populous city in Virginia, is in the southeastern most corner of the State. It is bordered by the Atlantic Ocean to the east and Chesapeake Bay to the north.

The northern sector of Virginia Beach is intensely developed. The southern

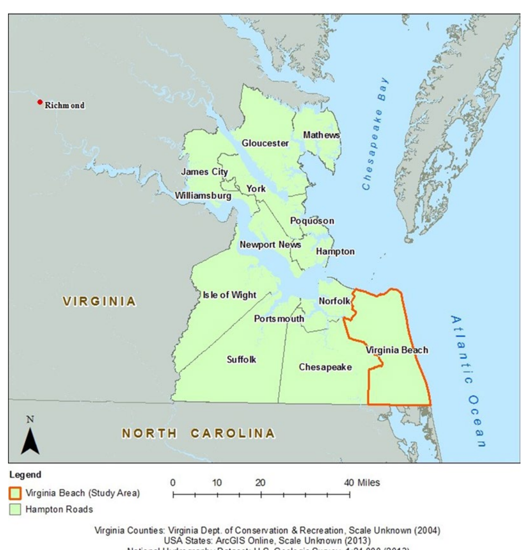

Figure 1.—The Hampton Roads area of Virginia.

sector is largely rural, with agriculture being the primary land use. In 1979, the City of Virginia Beach established an urban-growth boundary, known as the green line, to concentrate development to the north and protect its agricultural heritage to the south. City policies strictly limit development south of the green line.

City planners intend to protect the intensely developed northern portion of the city from rising seas. Based on current city planning, however, the southern portion will likely remain unprotected (Titus et al., 2009). Much of the agricultural land is alongside waterbodies, such as the North Landing River and Back Bay.

Projections for sea-level rise and Geographic Information Systems (GIS) were used to predict the potential impact of rising seas on the agricultural land of southern Virginia Beach. The percentage of the land that is currently agricultural and that could be impacted by sea-level rise by the year 2100 was predicted, and the local soil series that would be most affected were determined.

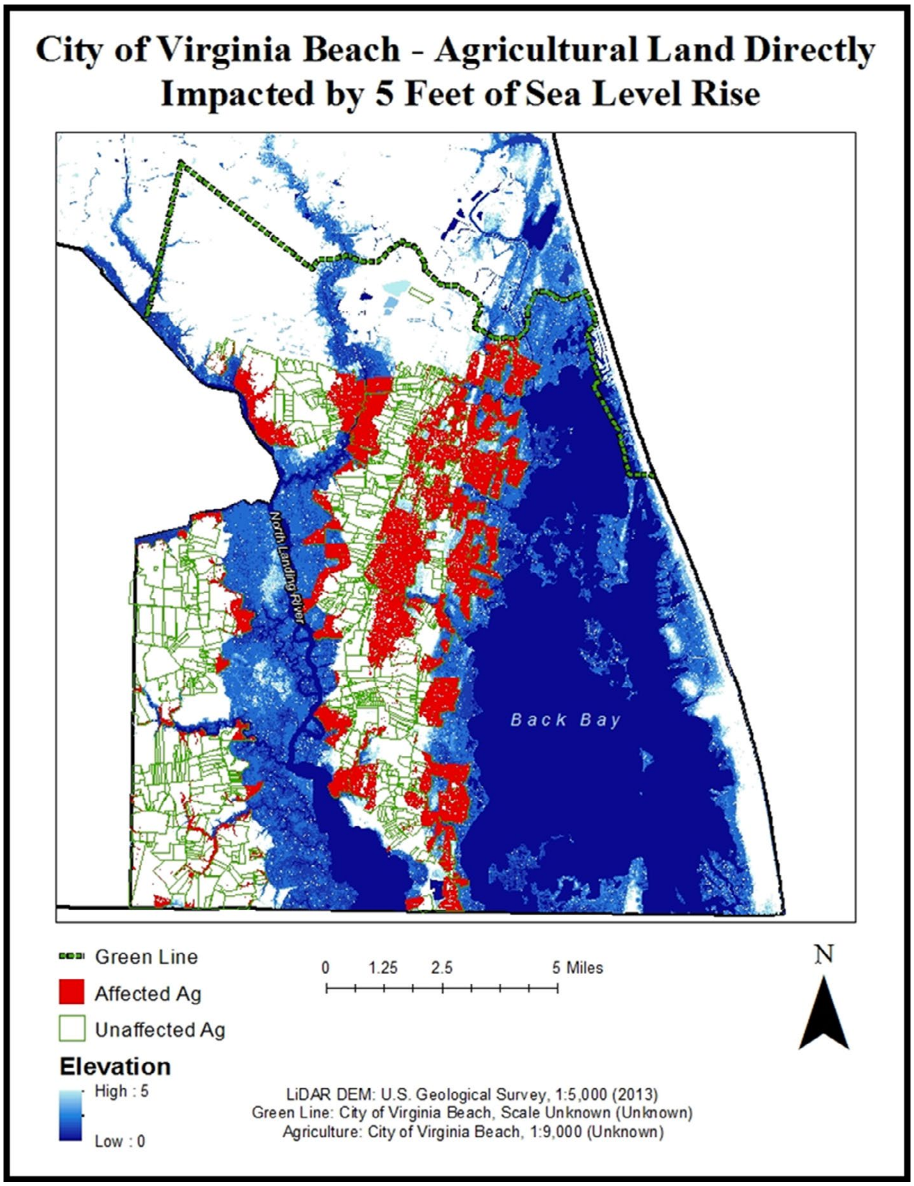

Figure 2.—Map depicting 5 feet of sea-level rise in Virginia Beach and the affected and unaffected agricultural land units.

Projections for sea-level rise vary based on climatic variables and models. This study used a 5-foot sea-level rise. The U.S. Army Corps of Engineers Sea Level Change Curve Calculator (USACE SLCCC) v2015.46 produces sea-level rise projections. This study used the tide gauge and high tide projections at Sewells Point and estimates from NOAA and USACE for low to high ranges of sea-level rise. Lewis (2015) and Scherer (2012) reported that many scientific communities, including NASA and IPCC (Intergovernmental Panel on Climate Change), have been underestimating the current and projected rates of sea-level rise. This study therefore used a projection of 5 feet, which is between the NOAA intermediate-high projections and the USACE high projections.

ArcMap 10.0 was used to analyze data and create maps predicting the impact of sea-level rise. A LiDAR DEM, which is a high-resolution digital elevation model, was used. A *projected sea-level rise* raster, an *Affected Ag* feature, and an *Affected Soils* layer were generated. The *Affected Soils* layer was then quantified to indicate which soil types would be most affected by sea-level rise.

Figure 2 displays the projected impact of 5 feet of sea-level rise on southern Virginia Beach. About 72 percent of the agricultural land units in Virginia Beach would be affected. Out of 44 soil map units in Virginia Beach, 23 are within the *Agriculture* layer and 22 are within the *Affected Ag* layer. The five predominant affected soil series are shown in table 1. Because the majority of the affected agricultural soils are poorly drained and hydric, they will be further subjected to the detrimental impacts of sea-level rise and salt-water transgression.

Table 1.—Predominant Affected Soil Series

[Predominant soil series affected by 5 feet of sea-level rise in agricultural land in Virginia Beach and their drainage classes as defined by the Soil Survey of the City of Virginia Beach, VA]

Soil Series Name	% of Affected Soil	Drainage Class
Nimmo loam (hydric)	22%	Poorly drained
Tomotley loam (hydric)	19%	Poorly drained
Dorovan mucky peat (hydric)	13%	Very poorly drained
Acredale silt loam (hydric)	11%	Poorly drained
Dragston fine sandy loam (non-hydric)	6%	Somewhat poorly drained

The study methodology gives a generalization of the impact of 5 feet of sea-level rise. It does not account for loss of wetland buffers or for increased storm surges or increased tidal ranges, which should also be considered in land management planning.

Overall, it is clear that sea-level rise has the potential to pose a great threat to the agricultural lands. This risk should be a topic of discussion among city planners and those working in, or affected by, the local agricultural industry. Further studies are needed to indicate which agricultural parcels are at the greatest risk and how soon they may be affected. Such studies would allow for prioritization of resources and adequate planning time. ■

Kellogg Soil Survey Laboratory Reaches New Milestone for Number of Samples Logged

In 2001, the Kellogg Soil Survey Laboratory (KSSL) brought online a laboratory information management system (LIMS). Just recently, KSSL Senior Analyst Michelle Etmund applied LIMS label number 250,000 to a soil sample, providing an opportunity to highlight KSSL achievements.

LIMS is a custom-made software system designed for the unique and changing needs of the KSSL and its customers. After samples are logged-in, LIMS manages the information as samples move through the analytical process, including recording results, performing calculations, and organizing and reporting data. Each sample represents a horizon in a soil profile. Typically, all horizons to a depth of 2 meters are sampled. At the KSSL, about 15 analytical methods are applied to each sample. Some methods produce multiple results. For example, the trace element procedure yields results for 22 elements. LIMS demonstrates its immense value by managing such information in support of more than 25 KSSL analysts and scientists who routinely use LIMS to record data, perform calculations, and retrieve and report soil information. Analytical data from LIMS is reported directly to those submitting samples and is made available through a publicly accessible website at http://ncsslabdatamart.sc.egov.usda.gov/.

Since 2001, the LIMS database has accommodated:

- About 15,000 samples per year
- More than 2,300 projects
- More than 30,000 pedons
- More than 129,000 layers
- More than 3,500,000 individual measurements, including over 50 chemical, physical, biological, and mineralogical properties used to classify soils, to make interpretations, and to assess soil quality.

The KSSL LIMS is estimated to do the work of at least three full-time employees while also reducing errors and facilitating quality control. In short, LIMS is an extremely valuable “hidden player” in the process of efficiently producing quality data. ■

Michelle Etmund managing one of the many thousands of samples received by the KSSL.

Soil Science in Southeastern Montana

The staff at the NRCS soil survey office at Miles City in Southeastern Montana has taken many opportunities this year to share the importance of soils. Brian Kloster is a soil scientist who has been with the soils program for many years in many areas of the State. Raven Chavez is a first-year soil scientist.

Brian and Raven have been mapping previously Denied Access areas. Due to a change in generations of ranch owners, NRCS is now allowed to map an additional 4,000 acres in Garfield County. These acres provided an excellent training opportunity for Raven, who has been working in Dickinson, North Dakota. Initial mapping opportunities are rare. They are needed so new soil scientists can learn from the ground up how soil information is obtained, studied, and keyed to a taxonomic classification. Because of this shortage of opportunities, the Denied Access mapping has become a critical training component early in Raven's career.

Brian worked diligently with Raven, teaching her how to use the five soil-forming factors to read a landscape and make predictions about it. He has also taught her different techniques for soil mapping, classification of soil samples, and how to use several field tools. This experience exposed Raven to the world of soil mapping and equipped her with knowledge she can use in both the field and office.

After learning different techniques, using several tools, and mastering texturing challenges, Raven now knows what goes into mapping an area for its soil resources.

Brian is able to teach soils to people of all ages and interests. He has standing invitations to participate at field days at several schools in southeastern Montana. One of the schools recently held worm races. The races—in addition to being entertaining—helped the children to learn about the importance of soil health.

The Terry Badlands in Southeastern Montana.

This year and other years, Brian assisted Montana State University students who were working on the National Resource Inventory (NRI) for Montana. He taught them about soils and about navigating the vast, open prairies during storms and unforgiving heat. Brian also spent time with a Pathways student in Broadus, Montana, where he demonstrated how a soils map is produced.

Brian plans to work with the newly appointed soil scientist for the Bureau of Land Management (BLM) in Miles City. The BLM manages approximately 434,000 acres of public lands in eight counties in south-central Montana and in Big Horn County, Wyoming. This cooperation will help ensure that the Federal agencies have a clear communication line while helping people help the land. ■

Post Guy Smith Interviews: Dr. Larry Wilding

The Soil Survey Standards staff at the National Soil Survey Center is conducting a series of interviews to capture the knowledge of distinguished pedologists. The goal is to collect the stories behind the evolution of the Soil Survey Program and the advances in soil science and soil classification. These interviews are a follow-up to the *Guy Smith Interviews: Rationale for Concepts in Soil Taxonomy*, published in 1986. The following is from the interview of Professor Emeritus Dr. Larry P. Wilding, Texas A&M University, conducted by Ken Scheffe, NRCS National Soil Survey Center, on February 5, 2016. Dr. Wilding has a long and distinguished career in soil survey as a professor, researcher, and cooperator in the NCSS.

With respect to the National Cooperative Soil Survey, did you observe a significant change in the involvement of land-grant universities during your career?

> "I would say a significant change occurred with regard to the land-grant university involvement in the National Cooperative Soil Survey Program (NCSSP) during my career. During most of the years of the Dr. Charles E. Kellogg administration and shortly thereafter, the State/Federal relationships among the land-grant institutions and the Soil Conservation Service (SCS) were quite formal, structured, and strained. This was especially true for some States conducting their own soil survey programs, either in concert with or independent of the SCS. Disharmony often diluted the spirit of cooperation among NCSSP constituencies. It was often a philosophy of 'they' versus 'us' with true cooperative initiatives limited. However, during early phases of *7th Approximation* development (and earlier *Approximations*) which served as the forerunner to *Soil Taxonomy*, enhanced harmony and enrichment among NCSSP partners began to bear fruit. A number of State representatives to the NCSSP and international scientists became active and productive contributors to the NCSSP. While it is always dangerous to single out individuals, early contributions were made by Drs. Marlin G. Cline (Cornell University), Frank F. Riecken (Iowa State University), and Frederick C. Westin (South Dakota State University), among others. Likewise, Dr. R. Tavernier (University of Ghent, Belgium) was an early pioneer in development of *Soil Taxonomy* and scientific contributions to NCSSP. As a side light, when I was a graduate student at South Dakota State University in the late 50's under Dr. Frederick C. Westin, he was quite involved in

the development of the *4th* and *5th Approximations*, well before the *7th Approximation* and *Soil Taxonomy* were completed. His sabbatical leave to Venezuela working with Dr. Juan Comerma certainly augmented those efforts. In summary, I would say there were isolated cases of engagement of academic faculty involvement early in the NCSSP, but it certainly was not universal. More recently following the Dr. Guy D. Smith's Interviews, and progressive State and Federal leaders in the USDA–NRCS, the NCSSP has been molded into a dynamic partnership which is the envy of many countries."

Do you think that the international committees, such as ICOMID, were effective in their effort to improve *Soil Taxonomy*? What would be your thoughts on continuing this?

"Well, I thought the Soil Management Support Services (SMSS) program was an ingenious concept to foster international scientific interactions and collaborations among leading pedologists domestically and abroad. It did three or four things to enhance these relationships. For example, it provided an opportunity for land-grant professors/academicians to more closely interact with field soil scientists. As such, it fostered working partnerships and recognition of mutual contributions to the NCSSP. There were multiple SMSS projects spanning diverse environments and ecosystems from the tropics to the artic and from deserts to humid regions. I probably was involved in four or five of these and always found them well organized, efficient, productive, informative, creative, and motivating. This speaks volumes for the quality of participants and leaders engaged in the SMSS, and especially for Drs. John Kimble and Hari Eswaran's efforts to lead most of these ventures. In addition to strengthening the interaction between academia and field soil scientists, it enhanced the international protocol of a mostly nationalistic NCSSP before SMSS. At that time (the 60's, 70's, and 80's,) we were looking for a way of testing *Soil Taxonomy*, including the *1st* to *7th Approximations* in an international arena. And in many cases, the only way we could do this effectively was to go to other countries to see for ourselves the management history, soil/landscape patterns, diagnostic horizons, presumed pedogenesis, environmental interactions, and develop a rapport with their scientists, to develop the protocol that enhanced the transformation of the *Soil Taxonomy* into a more international product. The third thing it did, it served as a teaching tool for those of us in academic institutions. Knowledge gained from SMSS paper presentations, field trips, and subsequent SMSS publications were incorporated into our student lectures and educational materials. Further, such information helped focus future research efforts of the NCSSP.

"Finally, in some ways the SMSS program served as the forerunner to help develop the World Reference Base (WRB). For example, through *Soil Taxonomy* and SMSS, important diagnostic horizons and properties were identified and quantified. These were used as *Soil Taxonomy* differentiae, and many of these diagnostic features have subsequently been used in WRB as an international correlation tool. So while it is in the best interests of international community to continue the development of these two systems collaboratively, we need to vigilantly preserve caretaker rights of *Soil Taxonomy*.

"Yes, the SMSS projects (like ICOMID) were a truly valuable part of the NCSSP. They brought a nice combination of pedologists 'to the table' to help enhance our knowledge of *Soil Taxonomy* as an international taxonomic system. They provided seed monies to help augment pedological research that coupled personnel with field and the laboratory expertise. I would strongly encourage the leadership within the NCSSP to explore possible ways to undertake a similar program as SMSS in the future. It is an excellent model to enhance the knowledge base of geoscientists nationally and internationally."

Do you feel that geostatistics should play a larger role in Soil Taxonomy?

"As a latecomer to geostatistics, I have relatively little expertise to evaluate its possible role as a soil survey or soil taxonomy tool. I've done quite a bit of soil variability work, and most of it was done within the context of polygonal mapping units, of which I'm still a very strong proponent. Part of the reason I'm a strong proponent is because I'm a believer in landscape models of soil patterns. Soil variability in these systems is often (at least partially) systematic and not random. Classic statistics assumes that observations are random and this goes against our best pedological knowledge. But I know geostatistics has some powerful applications. It can help in sampling strategies. It can help in determining where and what kind of separation distances are needed before observations are more or less independent of one another. It can help us determine how many samples need to be taken in a certain locale. And It can help in distinguishing how much of the variability is random and how much is systematic. While I am reluctant to say too much more about geostatistics and its soil survey applications, I feel that it has an important future role in soil survey applications. Geostatistics is much better equipped to help quantify soil variability in landscape models than classical statistics because it has the capability to capture systematic soil variability that may well be lost in random sampling schemes. "

Is there more work that should be done with soil carbonates, especially with respect to carbon sequestration?

"There are probably more questions than answers in understanding carbonate synthesis and its role in carbon sequestration. I have enjoyed the opportunity to work with other geoscientists on synthesis of pedogenic carbonates in humid, semi-arid, and arid systems, and certainly the processes have similarities and differences. Pedologists have done extensive work on pedogenic carbonate synthesis and conclude that precipitation is triggered by biogenic (organic), chemical (inorganic), or mixed process mechanisms. The question remains as to which process or processes take precedence and under what environmental conditions. Personally, I would vote that in most soil systems both inorganic and biogenic processes are active, but the extent to which they function and under what conditions are still a mystery. Some geoscientists investigating ancient limestone systems in Texas claim that all of the carbonates in these bedrock systems are biogenic. This may be true, but I am a bit a skeptic. In humid climates where pedogenic carbonates occur, we commonly believe they have chemically precipitated closer to the surface by evaporative pumping, although we know this process is also active in some arid and semi-arid systems too with shallow ground waters. But, we are not sure of how much influence biogenic processes may impact this model. Chemical precipitation of pedogenic carbonates in semi-arid and arid regions is often believed associated with downward-moving water fronts, but that model too may need to be modified with biogenic synthesis of carbonates. How to put together inorganic and biogenic models of formation of pedogenic carbonates is still a challenge.

"Likewise, carbon sequestration associated with pedogenic carbonate synthesis is also a question. Judged from equilibria chemistry, half of the carbon in chemical precipitation of carbonates would be from the atmosphere and half from lithogenic sources. However, in most soil systems, kinetics control reaction rates rather than chemical equilibria. As I understand it from geochemists, this favors the more energetic light carbon isotope which is enriched in atmospheric gases to participate preferentially in the chemical reaction compared to the heavier less energetic lithogenic carbon isotope. If this is true, then chemical equilibria models would underestimate the amount of atmospheric carbon sequestered by chemical precipitation. In other words, more than half of the carbon sequestered within the pedogenic carbonates would be of atmospheric source. Further, how might isotope geochemistry dynamics influence sequestration of carbon by biogenic processes? And what about soluble organics? How do they influence carbonate precipitation and sequestration of atmospheric carbon? Finally, what controls the limits of pedogenic carbonate synthesis in base-rich environments? Is it the source of soluble bases or some other limiting factor?

"Clearly our understanding of carbonate synthesis and carbon sequestration is in early stages of gestation. This is rather interesting given the fact that carbonate precipitation chemically would seem to be a straight forward pedogenic process. But it is further complicated by biogenic carbonate synthesis and isotope geochemistry. This nicely illustrates that soils are very complex biogeochemical systems with few unmitigated answers to pedogenesis and functionality." ■

HACU Intern at MLRA Soil Survey Office

By Phil Smith, MLRA soil survey leader, Region 2, Hanford, California. Photos by Kerry Arroues, Earth Team volunteer.

During June, July, and August, the National Internship Program of the Hispanic Association of Colleges and Universities (HACU) provided an opportunity for Nelson A. Velázquez to work at the Hanford MLRA soil survey office in California's San Joaquin Valley. Velázquez, who recently completed his undergraduate degree in geology, will be entering graduate school at the University of Puerto Rico at Mayagüez to pursue his master's degree in soil science. The HACU internship was a great opportunity for him to gain experience in soil survey work before beginning graduate studies. HACU internships are proven as an effective way for the Soil Science Division to conduct outreach and recruitment for a diverse workforce. Velázquez'

Intern Nelson Velázquez in the streambed of Wallace Creek, directly atop the San Andreas Fault. At this location (119°49'39.037"W 35°16'17.479"N), the Wallace Creek streambed has moved 420 feet over the course of 3,800 years as the Pacific Plate on the west side (left in photo) moved north. The North American Plate is on the east (right) side.

internship was the second time in as many years that the Hanford MLRA Soil Survey Office has hosted an HACU intern.

Velázquez arrived at Fresno-Yosemite International Airport on Sunday, June 19, after making a cross-country flight from Washington, D.C., where he had participated in HACU's 2-day orientation session. At the airport in Fresno, he was greeted by his supervisor, MLRA Soil Survey Leader Phil Smith. Smith and Velázquez drove the scenic route back to Hanford through Sequoia-Kings Canyon National Park. During the quick tour of the park, Velázquez learned about the area's geology, soils, and world famous Giant Sequoia trees. Having just arrived from the Nation's capital, Velázquez was able to see the Giant Sequoia forest only hours after seeing the Capitol Building and the White House. For Velázquez, it was truly an amazing day for seeing national historic landmarks and natural wonders.

During Velázquez' first week at the Hanford MLRA Soil Survey Office, he worked with Soil Scientist Rafael Ortiz, a former HACU intern himself. Ortiz assisted Velázquez with learning the National Soils Information System (NASIS) and the steps for entering pedon and site data. Nelson's first assignment was to enter taxonomic unit descriptions into NASIS. He entered data for MLRA–16 and MLRA–17 soils of San Joaquin County. The data entering process included the use of ArcGIS for determining the geographic coordinates of each site as well as climate and elevation data. Later, Velázquez assisted Smith with building future projects in NASIS. They followed a protocol for populating Project Mapunit tables, used the NASIS-SSURGO tool in ArcMap to create shapefiles, populated acreage values in the Project Land

Category Breakdown tables, and made high-quality maps of soil map unit extent. Velázquez also gathered map unit descriptions and taxonomic unit descriptions from soil survey manuscripts and archived them in folders for future projects.

The internship provided Velázquez experience with two special projects that developed his field skills for describing and sampling soils. In the first project, he assisted with the characterization sampling of two pedons in the California Delta (MLRA–16) near Sacramento. The purpose of the sampling was to assist with quality assurance for the EPA's National Wetland Condition Assessment. During this project, Velázquez learned how to describe a soil profile using the standards outlined in the "Field Book for Describing and Sampling Soils, version 3.0."

The second special project involved soil descriptions for the National Ecological Observatory Network (NEON) in the nearby Sierra Nevada Mountains. In early August, construction began on towers and infrastructure at two of the three NEON sites for which the Hanford Office is responsible for soils work. Velázquez assisted his supervisor and co-worker with the soil descriptions at both sites.

Other highlights of Velázquez' internship included assisting Earth Team Volunteer Kerry Arroues and NRCS Rangeland Management Specialist Dennis Dudley with an annual forage productivity study. During this activity, Velázquez learned how soil scientists and rangeland specialists sample dry plant matter in order to correlate annual forage productivity to various soil types. While working with Arroues, Velázquez was also given an overview of the geology, geomorphology, and soils of the southwestern San Joaquin Valley (MLRA–17) and the adjacent hills of MLRA–15 in western Fresno and eastern San Luis Obispo Counties. Possibly the most exciting event while working with Arroues was viewing and standing directly atop the San Andreas Fault!

Velázquez' professional goals in the next few years are to finish his master's degree and pursue a career as a USDA–NRCS soil scientist. ■

Intern Nelson Velázquez sampling forage biomass on Exclose soils in the Ciervo Hills of western Fresno County.

Frogsboro

By James W. Lewis, NRCS Soil Scientist, Greensboro, North Carolina.

I recently had the opportunity to talk with a landowner in Caswell County about soils, land use, and soil maps. He was interested in acquiring a several-hundred-acre farm to expand his cattle production (fig. 1). He was also curious about limitations associated with the soils on the farm. He asked to meet onsite and walk over parts of the farm to discuss soils information. After reviewing the soil map, I learned that the farmer would be dealing primarily with just one soil. Interestingly, the soil was in a proposed new series we will be correlating this year. The series, called Frogsboro, is basically a wet Iredell soil. It is very deep to bedrock and has smectitic mineralogy, very high shrink-swell potential, and very slow permeability. The new series is named after a community in eastern Caswell County that has a mafic (gabbro and diorite) and ultramafic (pyroxene and amphibole) geology. This soil is prominent in the entire area. Roger Leab, retired NRCS soil scientist, and I discovered this soil while out mapping and decided to set up the series. The late Steve Evans mapped the area where this farm is located. I remember how he returned from the field many days, always amazed at the extent of this soil series in the area and at how bad and wet this soil was.

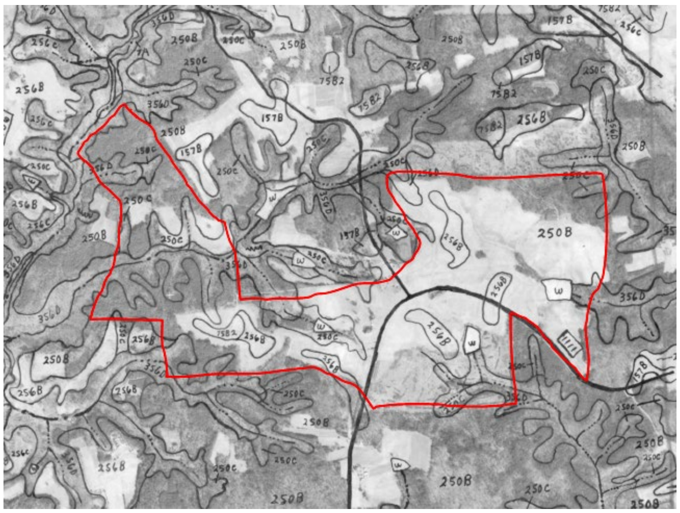

Figure 1.—A red outline showing the property under consideration for cattle production. Frogsboro soil was mapped 250B, C, and D in this area; Enon soil was mapped 256B, C, and D; and Tirzah soil was mapped 75B2, C2, D2, and E2.

Figure 2.—An area of Frogsboro soil in Caswell County, North Carolina. Photo courtesy of Mitch Thompson, Caswell County District Technician.

I met with the prospective buyer of the farm onsite. Upon arriving at the farm, I was struck by how flat and wet-natured the landscape of the entire farm was (fig. 2). We had conversations at four different areas on the farm about the limitations of having this soil under the majority of the farm. The soil was moist from the precipitation over the fall and winter. The Ap horizon was dark yellowish brown (10YR 4/4) or brown (10YR 4/3) loam and averaged about 8 to 12 inches in thickness. Typically, an argillic layer of clay was directly below the surface. It ranged from 65 to 73 percent clay in the particle-size control section.

One of the auger holes had water running in the hole at a depth of about 25 inches. The farmer wanted to keep the sample from the third auger boring to show his family what the soil was like on this farm. After the fourth auger boring, the farmer was convinced that the soil could present management issues when either wet or dry. I had to literally beat the auger head to retrieve the soil core at each location.

I brought the fourth auger boring to the office to try an experiment on the amount of water it would absorb. I collected the sample intact and in the shape of the auger bucket. I left the intact soil sample in the back of the truck most of the day while I collected transect data and visited sites around the county. The temperature was around 75 degrees. Arriving at the office around 4:30 p.m., I went straight to our workspace. I retrieved an aluminum casserole pan (12” x 8” x 2.5”) that we usually use for drying soil samples for particle-size analysis. I thoroughly inspected the pan to ensure that there were no pin holes where water could leak out. I filled the pan about half full with water, placed the soil core in the pan at about 4:35 p.m., and left it overnight.

I came to work the next morning and checked the sample around 8:30 a.m. To my surprise, 90 to 95 percent of the water had absorbed into the soil core!

Figure 3.—The sample after being left in a pan half full of water overnight.

Remember, I had retrieved this soil core from a field that was moist from recent precipitation and had left it in the back of the truck for about 5 or 6 hours prior to placing it in the pan of water. I had to literally beat the auger head to loosen the soil core enough to retrieve it from the auger. About 80 to 85 percent of the core was saturated. The top 15 percent was somewhat hard or hard to the touch because either not enough moisture reached the top or not enough time had passed to allow the moisture to reach and saturate the top.

Needless to say, I think the farmer is seriously weighing his limited options on the use of this farm. ■

National Soil Survey Center Hosts New Zealand Scientist

The National Soil Survey Center hosted Dr. Bryan Stevenson for 2 days during the week of July 11. Dr. Stevenson is Senior Research Scientist and Capability Team Leader for Landcare Research at Manaaki Whenua, New Zealand. He is in charge of the New Zealand Soil Quality monitoring project. His discussions with NSSC staff focused on managing, assessing, and monitoring soil quality and soil health. Dr. Stevenson spent time in the field with NSSC Agronomist Mike Kucera and University of Nebraska Extension Engineer Paul Jasa. They observed cover crops, long-term no-till/conventional tillage plots, ARS research plots, equipment, and soil health practices at the University of Nebraska Rogers Memorial Farm near Lincoln, Nebraska. Dr. Stevenson also toured the Kellogg Soil Survey Laboratory, where he was especially interested in the lab's nascent mid-infrared (MIR) spectroscopy program. Dr. Stevenson and his colleagues are very interested in continuing discussions with NRCS to exchange information and to explore possible future collaborative activities. ■

Dr. Bryan Stevenson examines no-till soybeans at the Rogers Experimental Farm (photo by Mike Kucera, NRCS).

8th International Acid Sulfate Soils Conference

The 8th International Acid Sulfate Soils Conference was held July 17–23, 2016, in College Park, Maryland. The conference provided a forum for an exchange of ideas regarding the origins, properties, management, classification, and reclamation of acid sulfate soils. It was hosted by the International Union of Soil Scientists Working Group and Commission for Acid Sulfate Soils and the National Cooperative Soil Survey. The NCSS hosts were University of Maryland, USDA–NRCS, and Virginia Tech University, Blacksburg, Virginia. The organizing committee members were Dr. Martin Rabenhorst (UMD), Dr. Delvin Fanning (UMD emeritus), Dr. Brian Needleman (UMD), Maxine Levin (USDA–NRCS), Thomas Reinsch (USDA–NRCS, retired), and Lee Daniels (Virginia Tech). Technical support was provided by the Maryland Association of Professional Soil Scientists; USDA–NRCS Kellogg Soil Survey Laboratory; Virginia Association of Professional Soil Scientists; Maryland NRCS State Soils Staff; Paul Reich, USDA–NRCS; and Susan Demas, USDA–NRCS, Hammonton, New Jersey. In attendance in an official capacity for USDA–NRCS were Debbie Surabian, Jim Turenne, Edwin Muniz, Greg Taylor, Robert Tunstead, Leslie Glover, Manuel Matos, Dean Cowherd, Jim Brewer, Phillip King, Susan Southard, and Maxine Levin.

NRCS had a booth and distributed “Keys to Soil Taxonomy, 12th Edition,” “Field Book for Describing and Sampling Soils, Version 3” (which has the new criteria for sulfur-bearing and acid-producing materials), “Field Indicators of Hydric Soils in the United States,” and “Understanding Soil Risks and Hazards.” NRCS presentations and posters covered a variety of subjects, including interpretations and guidelines for

Profile of an active acid sulfate soil at Stafford Airport, Virginia.

subaqueous soils and the Coastal Initiative. The conference had over 75 registered participants representing 14 countries. NCSS cooperators in attendance included private consultants and representatives of universities, State governments (MD, NJ, PA, VA, and WV), local governments, USGS, NASA, EPA, ACOE (Army Corps of Engineers), and USDA.

Acid sulfate soils cover extensive areas, particularly along the tropical coasts in Southeast Asia, the Caribbean, and Western Africa. They are also widespread on the coasts of Australia and around the Baltic Sea. When acid sulfate soils are drained, metal sulfides that had accumulated in the subsoil are gradually oxidized. This oxidation gives rise to the acidification of soil and drainage waters, often with detrimental ecological consequences.

In places in the tropics, these soils are reclaimed for agriculture. In such areas, they are commonly used for growing rice. In temperate areas, they are commonly drained more intensively. Deeper draining exposes sulfides in the deeper horizons to oxidation. Acid sulfate soils are impacted by changes in sea level and by climatic events.

The program for the conference covered the chemistry and physics of sulfurization (oxidation), sulfidization (biotic and abiotic reduction), and maintenance and reclamation of acid soils. The information on sulfidization included NASA soil research for Mars! The conference also covered U.S. policy and worldwide recommendations for guidelines, regulation, and policy.

The conference included three field tours, which illustrated major issues and influences of acid soils in the mid-Atlantic and opportunities for collaboration and research. Highlights were Hart-Miller Island dredge soil and reclamation in the Baltimore Harbor of Chesapeake Bay; active, potential, and post-active acid soils in the inner and outer coastal plain of Maryland; Smithsonian Ecological Research Center (SERC) and marshlands; Fredericksburg housing developments; Stafford Airport, Virginia; and the Shirley Plantation, Virginia, farmland and active research site for dredge soil and gravel mining reclamation. ■

Acid sulfate soil pit at the University of Maryland Agricultural Experiment Station.

Finding Ecological Site Information Using SSURGO

By Lucas Wiseley, geographic information specialist, NRCS Soil Survey Regional Office 5.

The guide "Using SSURGO to Find Ecological Site Information" explains how to use the SSURGO geodatabase to find ecological site information based on the user's location and how to show where specific sites are mapped in the spatial data. Users are able to use the Identify tool in ArcMap to select a polygon and navigate through the related tables down to the Component Table. The user can then access the child tables under the Component Table. Alternatively, a user can start at the Ecological Classification Table, select a specific site or sites, and navigate up the hierarchy to the Component Table and the Mapunit Table. From the Mapunit Table, the user can identify the polygons where the selected ecological sites are mapped. The guide is available at: http://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1203408&ext=pdf. ■

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