National Cooperative Soil Survey Newsletter

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## 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 Regional Conferences

The 2016 North Central Regional Cooperative Soil Survey Conference will be held in Sycamore, Illinois, from July 12-15, and hosted by Northern Illinois University. This year's theme is "Soil Survey Interpretations—Bringing Soil Survey Users and Producers Together." Program topics will be soil survey interpretations, soil health and dynamic soil properties, and digital soil mapping. The field trip on Wednesday (July 13) will look at soil-geomorphic relationships on ice-walled lake plains and relict periglacial features, soil variability, hydric soils, septic loading rates, and dynamic soil properties and bison at Nachusa Grasslands. More information is available at: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/partnership/ncss/?cid=nrcseprd959208.

The 2016 Northeast Cooperative Soil Survey Workshop will be held in Lake Placid, New York, from June 20-23. It will include a visit to Whiteface Mountain to examine some of the spodic, bordering on andic, properties of soils in the High Peaks. More information is available at: http://www.cvent.com/events/2016-northeast-regional-cooperative-soil-survey-workshop/event-summary-c77c592b222f44ba9fbc66a85bf65c27.aspx.

The 2016 Southern Regional National Cooperative Soil Survey Conference will be held in Rincón, Puerto Rico, from June 20-23 and hosted by Recinto Universitario de Mayagüez, Universidad de Puerto Rico. This year's theme is "A Healthy Soil: The Key For A Healthy Environment." The field trip on Wednesday (June 22) will visit the Puerto Rican Parrot Recovery Project and provisional ecological sites as part of the Maricao State Forest. The tour will continue to the Guanica Dry Forest

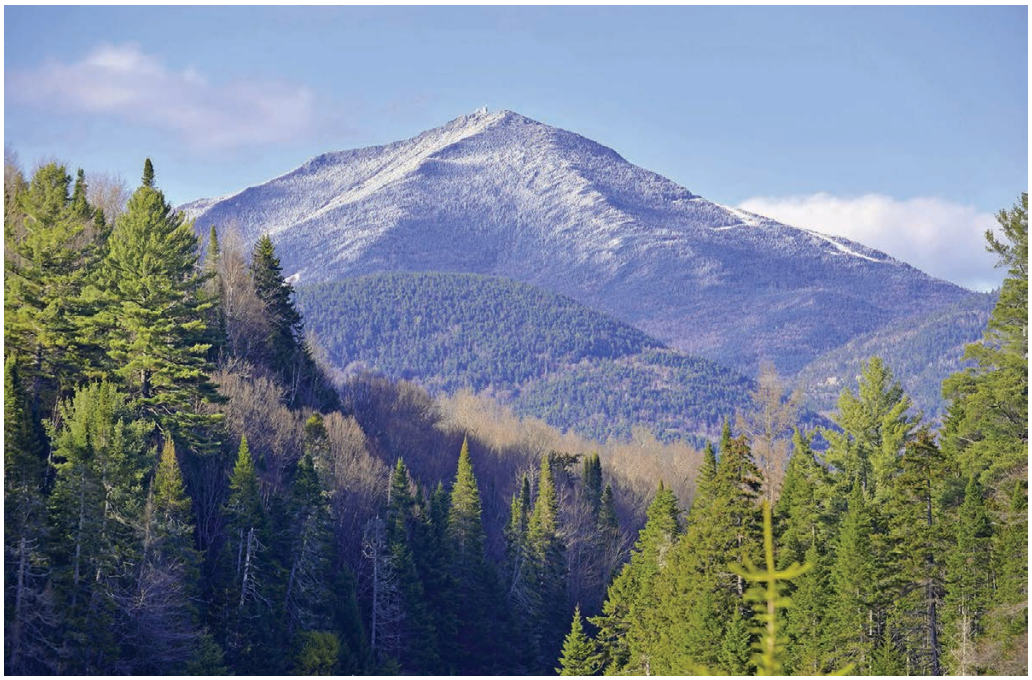
and the NEON Project and end with a visit to the Cabo Rojo Salt Flats, the Costal Restoration Initiative, and the Historic Cabo Rojo Light House. More information is available at: http://www.uprm.edu/p/srcs/home.

The 2016 Western Regional Cooperative Soil Survey Workshop will be held in Fairbanks, Alaska, from July 25-28 and hosted by the University of Alaska. This year's theme is "Importance of Soil and Ecological Inventory in a Changing Climate." Discussions will include permafrost and climate effects on the North Slope, initial soil survey in the western States, Native Alaskan corporation needs for future soil survey information, and digital and classification standards for continuing inventories. The field tour on Wednesday (July 27) will explore soil catenas in the boreal forest and tussock tundra environments near Fairbanks, including examples of patterned ground features, cryostructures, and thermokarst. Groups will also tour the CRREL Permafrost Tunnel and visit the Trans-Alaska Pipeline. More information is available at: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/partnership/ncss/?cid=nrcseprd908408. ■

## 2016 Northeast Regional Cooperative Soil Survey Workshop

By Richard Shaw, NRCS, New York State Soil Scientist.

The workshop will be held Monday, June 20, through Thursday, June 23, at Lake Placid, in New York's Adirondack Region. New York NRCS staff are working with Cornell University to host the event at the High Peaks Resort, located in the heart of the village best known as the two-time site of the Olympic Winter Games. The location is within walking distance to the town's activities and amenities and offers easy access to the region's natural beauty.



**Whiteface Mountain, one of the 46 High Peaks (above 4,000 feet) of the Adirondacks, is noted for its extensive vertical drop and 360-degree view.**

The workshop will provide updates on NCSS activities, notably the Coastal Zone Soil Survey, collaborative ecological site description (ESD) efforts (with U.S. Fish and Wildlife Service, NatureServe) in the Northern Forest, and the Provisional ESD Initiative. Three soil survey regions will report. Other items of interest will include the Soil Taxonomy Task Force and information on research projects from our long-time top-notch university partners in the region as well as from newcomer Brooklyn College. Northeast committees include Subaqueous and Hydric Soils, Soil and Ecosystem Dynamics, Taxonomy, Research Needs, New Technology, and Bylaws.

There will be a technical field tour of Whiteface Mountain to examine some of the spodic, bordering on andic, properties of soils at higher elevations. In addition, the traditional (since 1984) NECSS Silver Spade Award will be presented.

Although a theme was not selected for the event, much of the workshop will focus on future directions for Soil Survey. A guest speaker will discuss the history of Soil Survey in New York State. A town hall meeting with the new Director of the Soil Science Division will discuss challenges facing the NCSS and strategic planning for the future. In the words of Marlin Cline, who spent a productive 35-year academic career at Cornell, “Soil scientists can’t wait to see what is on the other side of the hill.” ■

## National Cooperative Soil Survey Strategic Planning Meeting 2016

The soil science discipline has experienced significant changes and substantial turnover over the past 30 years. Priorities have shifted from the hard copy maps of a generation ago to online and mobile information delivery and interpretation. The NRCS Soil Survey Program, universities, the United States Forest Service, and other cooperative agencies have experienced a loss of personnel. The National Cooperative Soil Survey (NCSS) needs to adapt to current rapid changes and prepare for the future. For the NCSS to remain viable, it needs to reinforce partnerships and renew collaborations. In order to move forward, the NCSS needs a strategic plan to form a pathway to the future.

The effort to assess these challenges and opportunities began in the fall of 2014, and an initial assessment was presented at the 2015 NCSS Conference in Duluth, Minnesota. In May of 2016, cooperators from across the nation met in Lincoln, Nebraska, to develop a strategic plan. The group agreed upon vision and mission statements and four overall goals for this strategic plan. The completed draft of the plan will be available for review in mid-June and formally presented and discussed at the 2016 regional NCSS conferences. Comments and feedback will be accepted through September 1, 2016, and the plan will be finalized by the strategic planning team by early October 2016. This proposed strategic plan is intended for a 10-year period.

### NCSS Strategic Plan Statements and Goals

*Vision:* A society that values soil as an ecological resource

*Mission:* To provide knowledge about soils and ecosystems for resource management

*Goals:*

- Increase the knowledge base of soils and ecosystems
- Ensure a critical mass of well-qualified scientists and technical specialists
- Strengthen and expand collaboration
- Communicate the importance of soils to society

To keep informed of progress on the NCSS strategic plan, you can sign up for updates through GovDelivery on the NCSS webpage, which is hosted by the NRCS Soil Science Division.

Go to http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/survey/partnership/ncss/, and click Sign up for E-mail updates on the National Cooperative Soil Survey.

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|---|---|---|
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# 2016 Professional Soil Scientists Association of California Annual Meeting

By Phil Smith, Soil Science Division, Region 2, Hanford MLRA Soil Survey Office.

The Professional Soil Scientists Association of California held their annual meeting and field tour April 7-9 in Fresno and Kings Counties, California. The focus was on the hydrology, geomorphology, soils, and archaeology of the Tulare Lake Basin, once the largest body of fresh water west of the Great Lakes. Soil scientists from private industry, academia, and government service sectors convened at Harris Ranch Resort, near the town of Coalinga. On Friday, April 8, the group attended informative presentations about the geological and archaeological history of the area as well as the impact of agricultural development in the era of post-European settlement. Expert speakers informed meeting participants on topics including the geologic evolution of the California Trough with an emphasis on the Tulare Lake Basin, the significance of clay mineralogy in sediment stratigraphy as an indicator of past periods of climate change, and the flora and fauna of the region (past and present). Also discussed were Native American settlements around the lake, historic floods and droughts, processes responsible for aquifer collapse, and the alarming rate of land subsidence due to ground-water withdrawals.

Assistance provided by the Hanford MLRA Soil Survey Office, Soil Science Division-Region 2, was critical to the success of the conference and field tour. Retired Soil Scientist and Earth Team Volunteer Kerry Arroues arranged for the presentations of expert speakers while MLRA Soil Survey Leader Phil Smith organized and co-led the field tour with Arroues. Soil Scientist Rafael Ortiz helped with field tour preparations and logistics.

Field tour topics and points of interest included basin soils, archaeology, hydrology, landform and soil formation processes, and agriculture. At the first stop, Smith and Ortiz showed the group a soil profile of the Houser Series, and Geo-Archaeologist Jack Meyer discussed Clovis Native American settlements along the southwestern edge of the lakebed. The next stop along the tour's 139-mile route was Sand Ridge, where California State University-Bakersfield Professor Dr. Robert Negrini and Meyer discussed theories related to the geological processes that formed the Sand Ridge

**PSSAC tour participants along the Tule River at El Rico Ranch and 10th Avenue. Photo courtesy of Irfan Ainuddin.**

and the significance of the landform in terms of influencing landscape hydrology as well as its importance to early human settlements. The tour then proceeded to the third stop, the J.G. Boswell Company's El Rico Ranch, where the Tule River enters the Tulare Lakebed and feeds an impressive system of irrigation canals that provide water to the lakebed's immense acreage of cropland. At El Rico Ranch, Agronomist David McEuen spoke to the group about the company's agricultural operations in the area, in particular crop rotations of Pima cotton, safflower, and tomatoes. The fourth tour stop was a site located along a canal, near the lake's high stand elevation, where evidence of prehistoric people at the lake dating to at least 8,000 years before present was shown by Meyer in ditch bank stratigraphy. Rounding out the afternoon, the group made their final tour stop atop a large levee that protects the California Aqueduct from the floodwaters of the Arroyo Pasajero. At this stop, Arroues discussed the fatal 1995 flood which destroyed a bridge over Interstate 5 and claimed the lives of seven people.

This meeting brought a diverse group of people together with the common goal of studying the past geological, hydrological, soil, and human history of the southern San Joaquin Valley in California. Meetings with an agenda this wide usually gain their impetus through the encouragement of others, and this meeting was no exception. Roy Shlemon, consultant in Newport Beach, California, was instrumental through his encouragement and technical advice that assisted both Arroues and Smith in their preparation for this conference. Arroues credits instructors at the 2008 Soil Geomorphology Institute, held at New Mexico State University, who provided much of the impetus for further investigations and compilations covering a large geographical area, such as the Tulare Lake Basin. ■

## MLRA 72 Provisional ESDs: Accelerating Ecological Site Descriptions

By Chris Tecklenburg, NRCS ecological site inventory specialist.

A workshop for the technical team of Soil Survey Region 5, MLRA–72, was held April 26–27, 2016, at Wray, Colorado. The workshop was in support of the development of provisional ecological site descriptions (PESDs). Seventeen individuals from three states (Colorado, Nebraska, and Kansas) assembled to finalize and field-verify the MLRA–72 ecological site key, to approve the Limy Tableland (now Limy Slopes) ecological site description, to review quality control procedures, and to discuss future direction and work.

Accelerating the ecological site description (ESD) process requires a solid, foundational ecological site key for an MLRA. These keys are developed, refined,

**Figure 1.—Workshop participants Tom Cochran (KS), Dan Shurtliff (NE), Tom Nadgwick (CO), Kristin Dickinson (NE), Jeff Nichols (NE), Chuck Markley (NE), Josh Saunders (CO), Kristi Gay (CO), Clark Harshbarger (NE), Michelle Busch (KS), Kimberly Diller (CO), David Kraft (KS), Julie Elliot (CO), Roger Tacha (KS), and Ted Houser (KS). Also present but not pictured were Chris Tecklenburg (KS) and Mike Moore (CO).**

and improved by the MLRA technical team. An ecological site key is an important tool for accurate identification of an ecological site (ES) and for differentiating one ES from another. The key is developed along with the site concepts to assist in ES classification.

**Figure 2.—A breaks landscape. The Shallow Limy ecological site overlooks the Limy Slopes ecological site.**

**Figure 3.—The group verifying the short, steep, hummocky, Choppy Sands ecological site north of Wray, Colorado.**

This workshop allowed the technical team to use the MLRA–72 ecological site key as a means to effectively communicate which ecological sites were to be designated as PESDs this fiscal year. Changes to ecological site names were examined to reflect abiotic and biotic factors. The workshop also gave the group the opportunity to collectively comment on one approved ESD and five draft PESDs.

On the first day, the meeting was held indoors. Participants discussed provisional and approved ESDs, quality control responsibilities, the ecological-site land resource hierarchy, plant-species production tables, MLRA–72 boundaries in 1978 and 2006, spatial maps of ecological sites, photograph use for state-and-transition models, EDIT and ESIS, the Limy Tableland (now Limy Slopes) ESD, and the MLRA–72 ES key.

The second day of the workshop was aimed at field verification of the MLRA–72 ecological site key. At each field-visit location, the participants verified the ecological site using the ecological site key. At a minimum, verification requires an understanding of landscape position. In most cases, it also requires digging a hole to verify some of the inherent soil properties.

**Figure 4.—The Rolling Sands ecological site (background and foreground), which is characterized by large, subtly rolling topography. The Subirrigated ecological site is along the stream.**

Refer all comments or questions related to this article to Chris Tecklenburg at chris.tecklenburg@ks.usda.gov or (620) 921–3551. ■

## A Day in the Woods

By Charles A. Lagoueyte, NRCS soil scientist, Richmond Hill MLRA Office.

The personnel at the Richmond Hill MLRA Soil Survey Office were recently invited to attend the 2nd annual "A Day in the Woods" community event. The invitation was proffered by District Conservationist Stan Moore of the Nashville, Georgia, NRCS Field Office. The event was held on April 23 at the Gaskins Forest Education Center. Heather Brasell and Karla Gaskins from the Center organized the event with the assistance of volunteers and co-organizers. The event was supported by the National Wild Turkey Federation and the Coastal Plain chapter of the Native Plant Society. The aim of the event was to provide non-commercial, all-day outdoor activities involving craftsmanship and knowledge of local traditions, including those of the town of Alapaha and extended communities in rural southeast Georgia. Special emphasis was

**Figure 1.—Gaskins Forest Education Center.**

placed on the family. The diverse activities included portable sawmill demonstrations, fire behavior demonstrations, night sky astronomy, wild game cookouts, and many displays of wildlife, pollinator native bee's nests, and native plants.

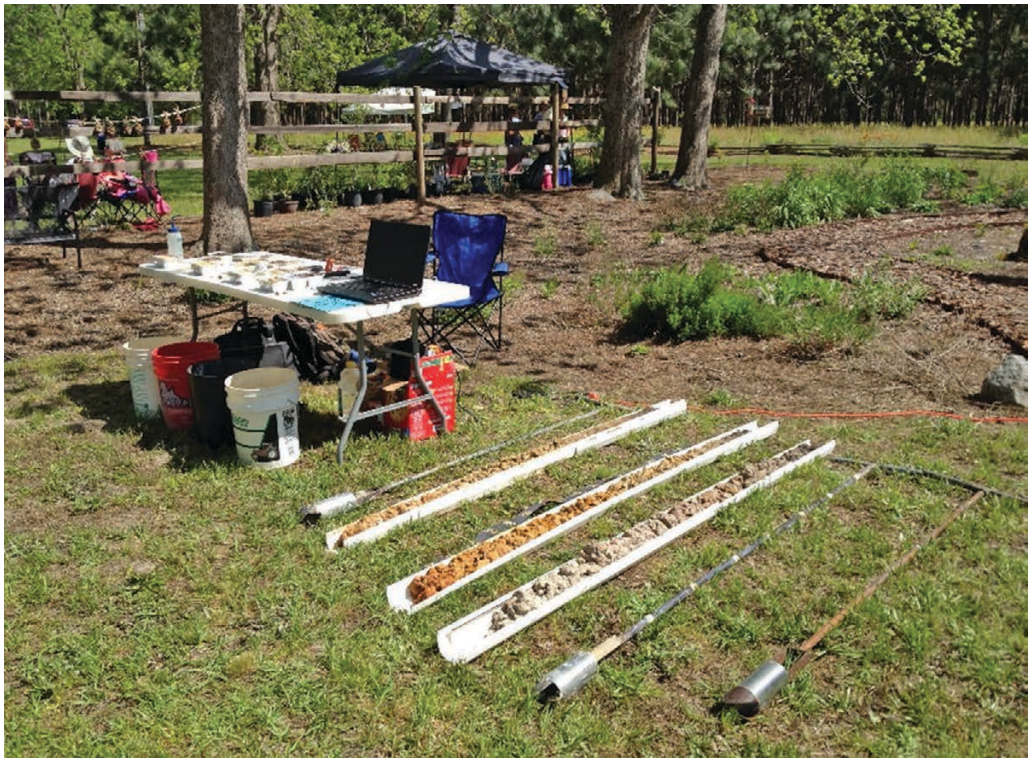

**Figure 2.—Soils display by the Richmond Hill MLRA Office.**

Approximately 300 visitors attended the event. The Richmond Hill MLRA Office used the opportunity to showcase soil profiles extracted from areas near the education center. Using the Soil Survey of Berrien and Lanier Counties and knowledge of landform positions, the soil scientists collected three distinct soil profiles. The profiles came from positions ranging from the top of a rise down to a wetland and were dug to a depth of 2 meters using a hand auger. The profiles included Fuquay soils (loamy, kaolinitic, thermic Arenic Plinthic Kandiudults), Stilson soils (loamy, siliceous, subactive, thermic Oxyaquic Paleudults), and Grady soils (fine, kaolinitic, thermic Typic Paleaquults). Most importantly, the attendees conversed about issues as diverse as farming, soils, NRCS conservation programs, and the rich geologic history of the area.

Participants were also encouraged to examine the different textures of soils from Ware County, Georgia. The soils included an organic sample, sandy clay loam, sandy loam, and sand. All of the samples were sieved to particles less than 2 mm. The gravel, mainly ironstone, was displayed separately. Also displayed were soils of varying organic matter content, which were discussed for soil health considerations. Included in the display were soil survey tools, such as augers, a compass, a GPS unit, and a Munsell color book. A laptop displayed pictures that looped from digital elevation models to soil maps.

The Richmond Hill MLRA Office hopes to make this an annual outreach event. Talks are already being conducted to work in conjunction with the NRCS field office in Nashville and the MLRA office in Tifton, Georgia. ■

## Establishing a Soil Judging Program at Fresno State University: Renewing a Tradition at One of California's Leading Hispanic Serving Agricultural Universities

By Phil Smith, Soil Science Division—Region 2, Hanford MLRA Soil Survey Office.

During the week of April 2-9, the American Society of Agronomy's 55th National Collegiate Soil Judging Contest was hosted by Kansas State University. Twenty-three colleges and universities from around the nation competed, including Fresno State University, which had not fielded a soil judging team in more than 30 years. Fresno State's re-emergence in this important soils educational activity is very significant, and not only for hopefully indicating a renewed interest in soil judging in the western part of the country. Fresno State was the only Hispanic Serving Institution participating in this year's contest. A Hispanic Serving Institution is defined by the U.S. Department of Education as an institution of higher education that has an enrollment of undergraduate full-time equivalent students that is at least 25 percent Hispanic. Located in California's San Joaquin Valley, Fresno State University is one of the State's most diverse educational institutions as well as a leading university in the agricultural sciences.

The effort to establish a collegiate soil judging team at Fresno State began in May of 2014 with discussions between Fresno State University Professor Dr. Bruce Roberts and Hanford MLRA Soil Survey Leader Phil Smith. Getting students involved in activities such as collegiate soil judging had always been an important part of Roberts' educational philosophy, while Smith, having participated on Dr. Larry West's soil judging teams at the University of Georgia in the mid-1990s, recognized the valuable experience that the unique hands-on field activity provides undergraduate students. With strong backing from Dr. John Bushoven, Department Head of the

Fresno State Plant Science Department, and Dr. Cynthia Stiles, Regional Director of the USDA-NRCS Pacific Regional Soil Survey Office, Roberts and Smith conducted meetings to discuss how to make soil judging a reality at Fresno State. Many issues were discussed, including how to fund the team, who would coach the team, how the team could prepare for the contest, and, most importantly, whether the students would be interested. Over the course of the next few months all these questions would be answered.

The question of who would coach the soil judging team would be answered first. In October of 2014, Michael Sowers, a Certified Professional Soil Scientist (CPSS) and a consultant with 20 years of experience, relocated with his family from eastern Pennsylvania to California's San Joaquin Valley to accept a position with Cascade Earth Sciences (CES), a division of Valmont Industries. At CES, Sowers is the Senior Soil Scientist for the company's field office in Visalia, CA, where he is responsible for projects that encompass soil mapping and interpretations for land use, wetland determinations, onsite wastewater application, nutrient recycling, and nutrient loading. While Michael enjoys his work at CES and keeps busy with an array of consulting projects, what Michael truly loves is teaching young people about soils.

For Fresno State, the timing of Michael's relocation to California could not have been better. Before moving across the country, Michael had not only worked in the soil consulting industry, he also had worked part-time at his alma mater, Delaware Valley University, where he was an adjunct instructor of soil science and the university's soil judging coach from 2008 until 2014. Only 4 months after moving to the Golden State, Michael began searching for an opportunity to share soil science with college students once again. While attending the World Ag Expo in February of 2015, Michael met some faculty members of Fresno State and asked them about working with the university to sponsor a soil judging team. The faculty referred Sowers to Dr. Sharon Benes, a soil science professor at Fresno State and coordinator of the university's FFA land judging competitions. Benes, aware of the efforts underway by Roberts and Smith, suggested Sowers visit with Smith during the FFA land judging finals later in the spring.

Sowers and Smith met at Fresno State's high school FFA land judging contest in April of 2015. The two men talked for hours about their enthusiasm for soil judging and how it is a great way to teach soil science, via a hands-on field activity. Both realized what a great opportunity lay before them as Fresno State's path to sponsoring a soil judging team became clearer than ever. Sowers and Smith later met with Dr. Roberts, and the development of a soil judging program at Fresno State proceeded from there. As a USDA-NRCS Earth Team Volunteer, Michael Sowers would be the soil judging coach; Phil Smith and the Hanford MLRA Soil Survey Office would assist with technical support, practice pits, and logistics as needed; and Dr. Roberts, as the official advisor to the team, would work with the university and acquire the funds to make it all happen. Funding for the team's activities would be provided with matching contributions by Dr. Sandra Witte and Dr. Dennis Nef (Dean, Jordan College of Agricultural Sciences & Technology, and Vice Provost, respectively) and generous donations from industry and growers.

Even though Fresno State does not offer degrees in soil science and does not teach courses in many of the fundamental soil sciences, such as pedology, soil chemistry, soil physics, etc., students from various majors such as plant health, agricultural education, viticulture, and animal science appreciate soils as the basis of agricultural production and life on Earth. Many of the students in Fresno State's agricultural programs were also FFA members in high school and participated in FFA land judging, a popular activity among FFA chapters in California's San Joaquin Valley. The answer to the question of student interest was never in doubt.

In November of 2015, Dr. Roberts announced to students in the Plant Science Department the formation of a soil judging team that would compete in the national

**The Fresno State University soil judging team with Hanford MLRA Soil Survey Office staff in Santa Margarita, CA. Shown, left to right, are Soil Scientist Rafael Ortiz, Faculty Advisor Dr. Bruce Roberts, Nancy Valdez, Coach Michael Sowers, Mark Castanon, Georgina Reyes Solorio, Aldo Garcia, and Soil Survey Leader Phil Smith.**

contest at Kansas State. For the initial meeting, six students came forth eager to learn. Sowers and Smith met with the group on November 10, and a new era of soil judging at Fresno State began. Coach Sowers introduced the concepts and purpose of soil judging to the group, discussing what they would learn, what they would do, where they would go, and how much fun they would have. Subsequent training sessions began the following semester in late January. The soil judging team met for 2 to 3 hours on several Friday evenings during the run up to the national contest the first week of April. At times, up to 15 students would sit in on the classroom instruction as Coach Sowers taught soil properties and characteristics, landforms and landscapes, soil profile descriptions, soil taxonomy, and soil interpretations. In addition to the classroom instruction, the team practiced soil texturing with samples of known particle-size distribution provided by the USDA-NRCS Kellogg Soil Survey Laboratory in Lincoln, Nebraska.

The Hanford MLRA Soil Survey Office, working with a local high school FFA chapter and two community colleges, set up practice pits for the Fresno State team in February and March. Phil Smith made arrangements for the team to judge pits in nearby Woodlake, California, where Woodlake FFA Advisor Jason Ferreira, a Fresno State alum, offered the use of the school farm for practice pits. The Fresno State team was also able to judge practice pits at West Hills Community College and Merced College, where Smith, along with MLRA Soil Scientists Rafael Ortiz and Genevieve Landucci, and Soil Conservationist Jennifer Foster, evaluated pits for the respective colleges' high school FFA land judging competitions.

On February 20, the team participated in a regional contest with Cal Poly – San Luis Obispo on a private ranch near Santa Margarita. The contest was organized by NRCS Area Resource Soil Scientist Ken Oster with assistance from MLRA Soil Survey Leader Beverly Harben and Genevieve Landucci from the nearby Templeton Soil Survey Office. Phil Smith and Rafael Ortiz assisted Oster on the day of the

contest as pit monitors and scorecard graders. With only two teams participating from a soil judging region that serves universities from six western States, the contest was low key, but served well as a means for the students to gauge their proficiencies and get a sense of the pressures they would face at the national contest in Kansas. This small regional contest also gave the NRCS soil scientists who helped organize and administer the contest a good sense of how to set up and run a contest for the following year.

After more than 2 months of learning and training for the national contest, four students travelled with Coach Sowers to Kansas on April 2. The team spent the first 4 days, from dawn to dusk, judging soils at the practice pits provided by Kansas State University. At Kansas State, the team learned even more and got to experience the unique opportunity of seeing the soils and landscapes of the Great Plains and America's Heartland. The team did well in the individual contest on April 7 as well as the group judging contest on April 8. Coach Sowers was proud of the team and noted that the experience gained in this year's contest laid the groundwork for an even better prepared team next year.

The 2016 Fresno State soil judging team is truly a success story, demonstrating how a group of students can come together and work as a team to accomplish a goal and proudly represent their school. The students were all eager to learn about soils. Even without the benefit of a core pedology course, they studied their materials and learned an incredible amount of information about soil properties, soil classification, interpretations, landforms, and landscapes. Dr. Bruce Roberts and the Fresno State Plant Science Department faculty are proud of the team's success. What also makes the Fresno State soil judging team inspiring is that the team was the only Hispanic Serving Institution participating in this year's National Collegiate Soil Judging Contest. The team's representation at the national contest increased the diversity of the students participating overall.

The formation of the Fresno State soil judging team is also a success story because individuals and groups from various organizations worked together to make it happen. The process showed how faculty from a university, a private-sector consulting firm, a high school FFA chapter, two community colleges, a ranch owner, the Kellogg Soil Survey Lab, and a few NRCS soil scientists can team up for the benefit of soils education and help students succeed. The groundwork was laid for next year's Fresno State team, and all involved gained experience that will make the future of soil judging in California more successful. Next year also brings the possibility of a larger regional competition. Dr. Cynthia Stiles strongly supports soil judging as an outreach activity and has asked her staff to help coordinate a regional competition next year in California. Other universities are interested in participating, and Chico State is likely to sponsor a soil judging team for the first time ever. The future of soil judging in Soil Survey Region 2 is looking very bright indeed! ■

**Team members (left to right) Nancy Valdez, Mark Castanon, Georgina Reyes Solorio, and Aldo Garcia evaluate a pedon of the Mayberry series during the group judging contest in Pottawatomie County, Kansas.**

# Soil Science Division Training

By Shawn McVey, SSD training coordinator.

Everyone has primary responsibility for their own training. Regional directors and state soil scientists, however, must also provide leadership and coordination on soils training for their staff, for all other disciplines in NRCS, and for other users of soil survey information. State and sister agencies are using soil information in many of their programs, and they need to have a basic level of understanding about the information. External groups, such as realtors, sanitarians, appraisers, and town planners, have questions about our soil data, and they also need training. These groups need to be aware of the training that NRCS and the Soil Science Division (SSD) have to offer.

### SSD Training

The SSD manages 21 official courses through the National Employee Development Center (NEDC). It also offers 20 to 24 sessions annually based on a Training Needs Inventory (TNI). SSD training sessions are open—tuition free—to partners in the National Cooperative Soil Survey. NRCS employees, however, commonly have first priority for open seats. Over 50 Subject Matter Experts (SMEs) participate as instructors. The SMEs are from both within and without NRCS and the SSD. They deliver the training and make recommendations for updates to the training. Some courses, such as “Soil Correlation,” are offered every other year. Courses that are managed outside of the SSD (e.g., “Managing for Excellence”) may also be needed to round out an employee’s experience and work competency.

Some of the training provided by the SSD should be taken early in the career of nearly every soil scientist and of the majority of ecological site specialists. This training includes “Basic Soil Survey Field and Laboratory,” “Introduction to Digital Remote Sensing,” “Soil Geomorphology Institute,” “Remote Sensing for Soil Survey Applications,” “Digital Soil Survey Data Editing,” “Digital Soil Survey Data Management,” and “Introduction to Image Interpretation.”

Many SSD training courses are grouped for GIS, Interpretations, or Technical Soil Services, and a track can be chosen depending on an employee’s goals. The GIS track includes “Spatial Analysis Workshop,” “Statistics for Soil Survey,” and “Digital Soil Mapping with ArcSIE.” The Interpretations track includes “NASIS: Understanding Soil Interpretations,” “Science of Interpretations,” and “NASIS: Designing and Developing Soil Interpretations.” The Technical Soil Services track includes “Soil Technology-Application of Soil Data Viewer and ArcGIS in Technical Soil Services,” “Advanced Hydric Soils for Soil Scientists,” and “Technical Soil Services.”

Some employees repeat training to improve workplace performance. In some cases, they retrain because it has been 5 to 10 years since they performed a particular task. In other cases, an employee wants a refresher on how a process works with the current version of software. Taking a training course again is not a problem administratively. There is no agency policy that states an employee can only take training one time.

### Competency Profiles

NRCS has invested in competency profiles to improve its workforce. A competency profile is a set of skills, know-how, proficiency levels, and associated behaviors that link directly to the work of a certain job series. Everyone in NRCS has required, foundational competencies (e.g., Integrity and Honesty or Ability to Influence and Negotiate). Occupational competencies for soil scientists include such topics as soil examination, classification, geomorphology, and hydrology. Those at higher grade levels may have leadership and management competencies, such as “political savvy.”

Competency surveys are assigned in AgLearn. Target levels are set for an employee's grade level. Employees take a self-evaluation survey to rate their skills, know-how, proficiency level, and so on. The employee's supervisor also rates the employee on these same competencies to temper the ratings. In some cases, a supervisor may think the employee is rating himself or herself lower or higher than their actual level. In other cases, the supervisor needs the employee to be performing at a level different from the one the employee is currently trained for. The difference between the survey ratings and the target level is considered a gap. The most critical gaps should be addressed with training to improve workplace performance. Training should address an immediate or eminent need of the employee and agency. Training should not be assigned "just for the fun of it."

### Training Needs Inventory

NEDC annually solicits input about needs for training to close competency gaps. The Training Needs Inventory (TNI), which is announced each year, is essentially a head count of how many NRCS employees need a particular training course. Which of the SSD-managed NEDC courses are offered and how many sessions are offered depend on this head count.

### Individual Development Plans

Ideally, the TNI is based on employee Individual Development Plans (IDP). The IDP is simply a tool to assist in career and personal development. The intent of the IDP is to help employees reach short- and long-term goals and to improve current job performance (i.e., close the competency gaps).

Not all of the activities on an IDP need to be a NEDC course. External activities can also be included using form SF–182 (which is available in AgLearn). The form documents external training and is added to the employee's AgLearn learning history. Participating in a topically relevant webinar is an example of an external activity. The SSD typically hosts 10 to 15 webinars each year on a wide variety of topics. Additionally, the National Soil Survey Center (NSSC) maintains a list of nearly 100 training videos and webinars on YouTube. The ENTSC (East National Technology Support Center) Training Library is also an excellent source of external training activities with topics related to climate and conservation. Other external training opportunities include an NRCS-funded subscription to ESRI's Virtual Campus for self-paced GIS training, over 200 OJT (on-the-job) training modules, dozens of job aids to help employees with new tasks, and university courses and workshops.
An online example of how to fill out an SF–182 for external training is on the SSD OJT Training Modules page: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054326.

### Training Schedules and Course Descriptions

Training schedules and course descriptions can be found on the NSSC Education pages, by browsing course listings in AgLearn, and via the NEDC Course Catalog. Do a Google search if you are unfamiliar with these sources. The descriptions contain course prerequisites and objectives for both online and classroom training. Training locations and dates are posted once the classes are scheduled. The scheduling process starts each year in August.

### What's New in Training

- Over 300 pictures of soil profiles and landscapes have been added to the NRCS Photo Gallery. Look under the "soil survey" heading on this site to find quality pictures for use in presentations.
- The "Guide to Pronouncing Taxonomic Terms" contains over 170 terms that are used in Soil Taxonomy along with other terms used to describe soils. This

resource includes the audio pronunciation (both the preferred pronunciation and acceptable alternatives) as well as phonetic spellings.

- The “Illustrated Guide to Soil Taxonomy, v2.0” is intended to help multiple disciplines and novice classifiers understand and use Soil Taxonomy. The guide is not intended to replace the full version of the "Keys to Soil Taxonomy." Some of the more technical and complicated criteria have either been omitted or referenced in notes to make the user aware that there are exceptions.
- The National Ecological Site Training Team has been working to determine what ecology training is needed for conservation planning. It proposed seven new training courses for ecological site specialists and others involved in soil survey. These courses are “Ecological Site Fundamentals,” “Ecological Site Projects,” “Working with Ecological Data,” “Effective Ecological Collaborations,” “Technical Writing for ESDs,” “Ecohydrology,” and “Spatial Analysis for Ecological Applications.” There are also more than 30 OJT training modules on ecological site inventory.
- This year the SSD piloted “Statistics for Soil Survey,” a fairly comprehensive course on statistics geared toward soil survey applications. The course is built around the R environment. The training is designed to help advance SSD inventories to the next level.
- The SSD also released three soil-property modules as part of a larger series for AgLearn. These first three modules deal with soil color, salinity and sodicity, and restrictive features. In all, there will be 21 soil property modules, which can be taken individually or in a series.
- Earlier this year, the SSD opened access to its subscription for National Seminars Webinars. Many of these on-demand webinars correct gaps related to foundational competency and leadership and management competency.
- Lastly, the SSD wants to make everyone aware that it will be advertising for a university to host the 2017 Soil Science Institute. This 3-week institute will be attended by 20 to 30 soil scientists. It is being designed to provide updates on the latest technical information and technology developments in soil science and related disciplines and to refresh educational backgrounds in soil science.

### Summary

Many training resources are available to increase technical capabilities, close competency gaps, and improve workplace performance. Employees need to know the timetables for IDP and TNI development. They also need to know where to find training information and resources. Supervisors need to make sure all non-scientist employees and others using soil information are well trained. Supervisors, take charge of your and your staff’s competency development – it’s your career and theirs at stake! ■

## Preparing Digital Elevation Models for Use in Soil Survey Applications

By Tom D’Avello, GIS specialist/soil scientist, NRCS, National Soil Survey Center, Geospatial Research Unit, Morgantown, West Virginia, and Jon Bathgate, resource analyst, NRCS, Marion, Illinois.

### Background

We are living in a time of abundant data resources, especially with regard to digital elevation data. There was a time in the 1980s and 1990s when soil scientists could accurately proclaim that the maps they created did a better job of

representing terrain than the digital elevation models (DEMs) of the day. In this age of high-resolution DEMs, however, the data have improved immensely, claims have tempered, and information needs have inverted.

When DEM resolutions were 30-meter or coarser, the desire was for finer resolutions to capture smaller, subtler landscape features and to generate more accurate terrain derivatives, such as slope gradient. The 30-meter DEMs were not suitable for soil survey work in much of the country. Now, however, DEMs of 1- to 5-meter resolution are readily available in many parts of the country. Local and State agencies commonly have sub-meter resolution data available by special agreement. The challenge for DEM users has switched from having too little resolution to handling and interpreting 100 to 900 times more data points. The good news is that higher resolution data provides more options to the user. This article provides a few examples for dealing (without resorting to brutish methods) with a product that is often viewed as providing too much information.

### Preprocessing Checklist

A quick workflow for any DEM should include:

(1) Verifying the projection parameters,
(2) Verifying the horizontal units,
(3) Verifying the vertical units,
(4) Verifying the resolution,
(5) Verifying the extent in terms of rows and columns, and
(6) Performing a qualitative check using a hillshade.

These checks can be used to determine if it is necessary to project to a common projection with common units. Although ArcGIS provides dynamic projection capabilities, the best practice is to use one common projection for all of the raster data used in the GIS analyses. For DEMs that require re-projection, a Job Aid is available that provides details related to that operation. If the raster data will also be utilized in statistics applications (such as R), it is imperative that all layers share common projections, resolutions, and extents.

Matching the horizontal and vertical units is preferred. This makes for assumption-free derivation of slope gradient, slope curvature, and related terrain derivatives. Data provided in a geographic coordinate system, e.g., decimal degrees, must be converted to a projected coordinate system. Many users have been frustrated by trying to interpret a slope-gradient layer generated from mismatched units. It is not uncommon for input data to have horizontal units in degrees or vertical units in centimeters or feet while the output horizontal units are in meters. There are situations in which users should maintain DEMs that have different units for vertical and horizontal, but these are rare and best left to another discussion.

The last step in this review is the easiest. Create a hillshade or painted relief using a reasonable vertical exaggeration. You can then perform a qualitative review, checking for anything that does not look correct. There is a tool to create painted reliefs in xTerrain Toolbox. The choice of vertical exaggeration factor is a personal preference, but a general guide is 1x for mountainous terrain (> 150 meters of relief), 2x for rolling terrain (30-150 meters of relief), and 5x for low relief (< 30 meters of relief).

### Noisy DEMs

One of the definitions of noise (from Merriam-Webster) is “irrelevant or meaningless data or output occurring along with desired information.” High-resolution DEMs derived from LiDAR are often noisy, providing elevation values for such micro-features as cultivation furrows, seedbeds, seedlings in conifer plantations, and sporadic dense, shrubby vegetation. This excess detail often remains undetected until terrain

derivatives are developed and evaluated. It is important to smooth the DEM before performing terrain analysis.

The following example is from an area that is in the midwestern United States and has 1-meter LiDAR data. Plowing ahead, as many of us are apt to do, I use ArcGIS to produce a slope-gradient layer. It is apparent that the output is quite noisy, as this is slope on the micro-topographic scale (fig. 1). Slopes range from 0 to 108 percent, data which would be practical and useful only from the perspective of a toad or millipede.

A quick look at the hillshade would have saved the step of producing this unusable slope-gradient layer. Figure 2 shows the hillshade with 5x vertical exaggeration for

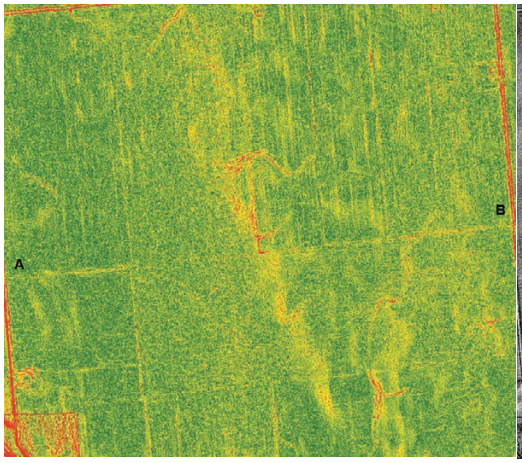


**Figure 1.—Slope gradient from ArcGIS, original DEM.**

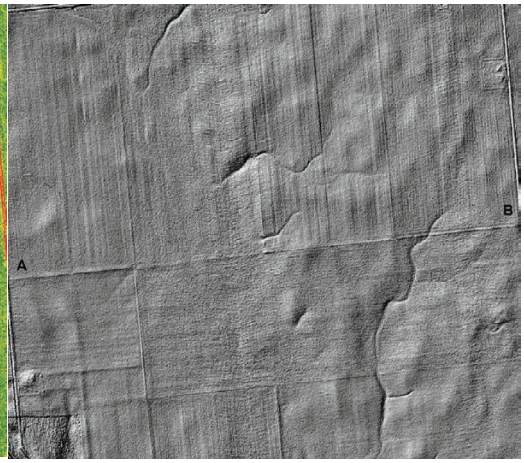


**Figure 2.—Hillshade of area shown in figure 1.**

the area. A qualitative view of the hillshade reveals the type of excess noise known as “corn rows.” This area has roughly 3 meters of relief over a horizontal distance of 1,625 meters (10 feet/mile).

Figure 3 is a landscape photo of the area, looking from point A to point B shown in figure 2. The slight rise on the left side of the photo is just outside of the upper right

**Figure 3.—Midwestern landscape.**

corner of figure 2. “Flat, grading to very gently sloping” would be a good description of the terrain for this part of the world.

This qualitative review indicates that a modest filtering operation could be performed to smooth the data before producing terrain derivatives. The filtering process reduces micro-topographic features to render a surface more representative of the broad elevation trends that are useful at the scales of soil survey. The filtering operation assigns a value to the center cell of the neighborhood based on a user-defined statistical parameter of the neighborhood, typically the mean. Two tools, Gaussian Smoothing and Iterative Focal Smoothing, are available in the xTerrain

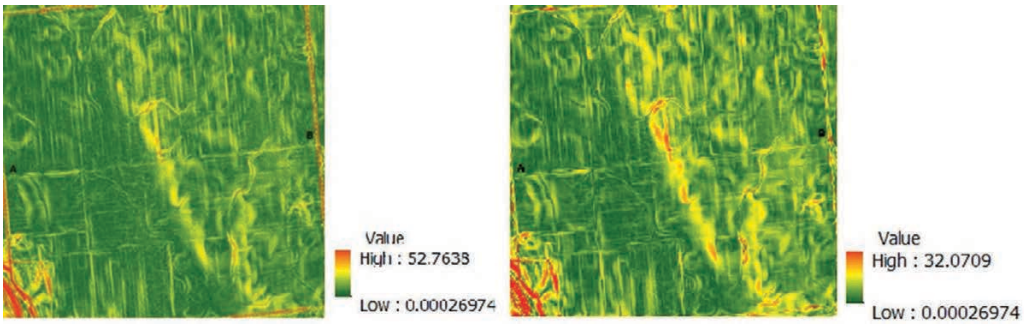


**Figure 4.—Slope gradients from ArcGIS. The left image is a Gaussian-filtered DEM, and the right is a focal-smoothed DEM. Each operation was performed five times. The focal-smoothed DEM was based on a 3-cell radius neighborhood.**

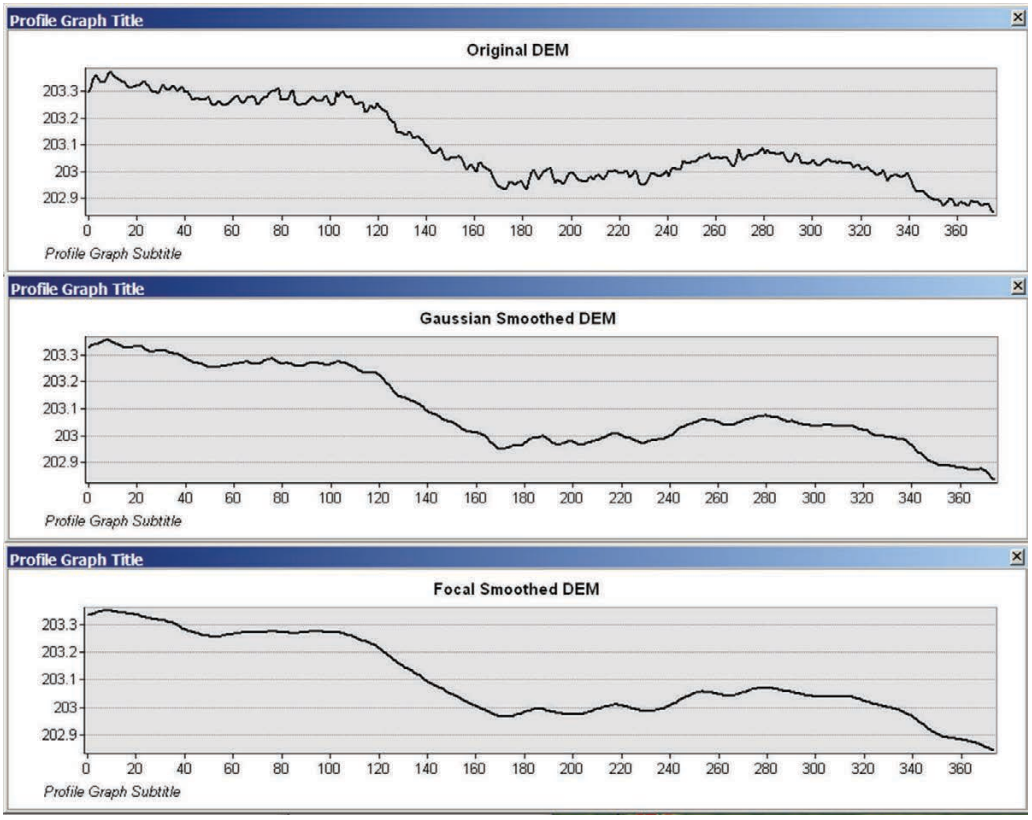


**Figure 5.—Cross-sections showing, from top to bottom, the elevations of the original, Gaussian-filtered, and focal-smoothed DEMs.**

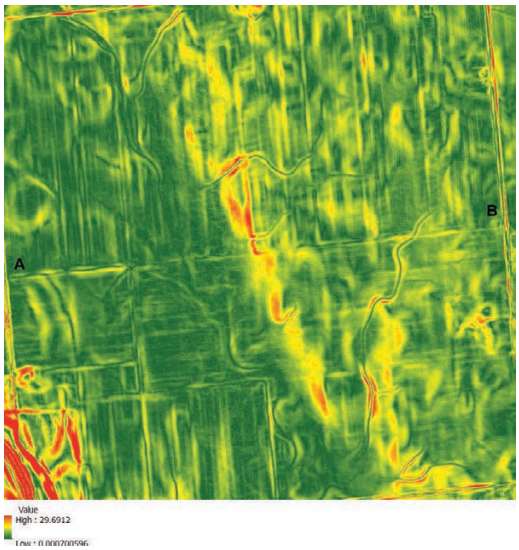


**Figure 6.—Slope gradient produced using the ArcSIE extension with a 15-meter, circular neighborhood.**

Toolbox to automate this process. The slope gradient layers produced from the smoothed DEMs are shown in figure 4. Either layer from figure 4 would be more usable than the one produced from the unfiltered DEM. A final look at the cross-sections of each DEM in figure 5 reveals the general trend of elevation changes that soil scientists need to capture and represent.

The last slope-gradient production example shown is the most streamlined and useful. The ArcSIE extension has a feature that allows selection of neighborhood size and shape as parameters to the derivation of terrain derivatives, such as slope gradient, slope curvature, and slope aspect. Figure 6 shows the slope gradient results using the original, unfiltered DEM

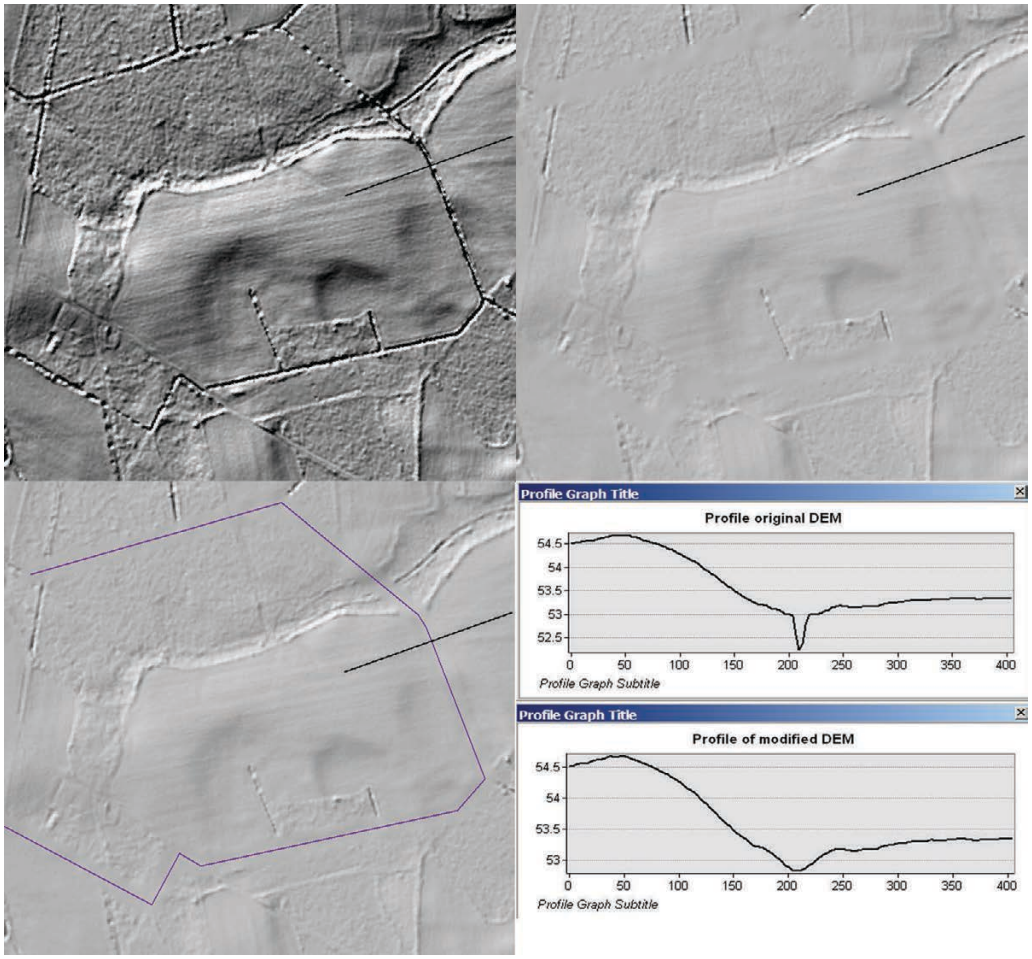


**Figure 7.—The upper left panel shows the original 5x hillshade. The upper right panel is the hillshade after linear artifacts were "removed." The lower left shows the linear artifacts applied to the "removal." The lower right shows the cross-sections for each DEM.**

and a 15-meter, circular neighborhood. This method automates what a user learns to do intuitively, ignore the short-term variation of corn rows, stubble, furrows, or old fence rows and estimate slope gradient.

These examples have shown a remedy for DEMs that are primarily noisy due to row crop agriculture. Similar procedures may be used for DEMs exhibiting noise due to vegetation or the rectilinear artifacts that are occasionally introduced from the tiling schemes used for processing and managing LiDAR data and DEMs that are extracted from large, mosaiced datasets.

**Minimizing Anthropogenic Features**

High-resolution DEMs typically show most manmade features with awesome detail. Examples include road beds, road ditches, railroad beds, drainage ditches, and brush piles. Application of a global filter, as described above, is not a suitable approach for treating localized features. One method for “blending” away this excessive detail uses the Remove Linear Artifacts tool in ArcSIE.

The following example is based on a 3-meter resolution DEM in the southeastern United States. The images in figure 7 are based on a hillshade with a 5x vertical exaggeration.

The Remove Linear Artifacts tool requires a vector layer representing the linear artifacts. In this example, the ditches are represented in panel C. Cross-sections are shown in panel D with the upper section from the original DEM and the lower section from the DEM with linear artifacts removed. It is apparent that the sharp features of the ditch have been blended away by viewing the profile in the vicinity of the 200-meter station. Using this tool to process large areas requires existing vector data that matches the corresponding feature on the DEM. More specific information related to this tool in particular and to ArcSIE in general is available in the ArcSIE User Guide. ■

## Keys to Soil Taxonomy (2.0) in Spanish

The 12th edition of the “Keys to Soil Taxonomy” was recently translated into Spanish. After working with soil scientists from around the world, NRCS decided the translation was needed to increase awareness and expand knowledge of the value of soil and its impact on all aspects of life. Many soil scientists and other professionals from Latin America, the United States, and other countries will benefit from this translation for years to come. According to NRCS leadership, the translation expands the application of U.S. Soil Taxonomy by allowing professionals in all parts of the world to understand and use the system in a more uniform and consistent way. Although soils differ globally, the goal of a universally understood and accepted system of classification is shared by many soil scientists. As the world struggles with global warming and other environmental challenges, a universally accepted method for addressing soil problems will contribute to successful outcomes.

The Keys were translated by Carlos Alberto Ortiz-Solorio, Ma del Carmen Gutierrez Castorena, and Edgar V. Gutierrez-Castorena of Area de Genesis, Morfologia y Clasificacion de Suelos, Programa de Edafologia, Campus Montecillo, Colegio de Postgraduados en Clencias Agricolas.

Following the translation, a technical review was performed by Soil Classification Specialist Ken Scheffe and editorial support was provided by Jenny Sutherland, both of the USDA National Soil Survey Center. Currently, the Spanish edition of the Keys is available only in PDF. It can be downloaded at: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051546.pdf. ■

# Advanced Digital Soil Mapping Workshops in Central America

By Zamir Libohova, research soil scientist, USDA-NRCS National Soil Survey Center.

This spring, the Global Water Initiative (GWI) held an Advanced Digital Soil Mapping (DSM) workshop in El Salvador (March 7–18), Honduras (April 11–15), and Nicaragua (April 18–22). The goal of GWI, which is sponsored by the Howard G. Buffett Foundation, is to improve food security in Central America. The workshop was organized by Purdue University in cooperation with Catholic Relief Services (CRS) as part of the ProSuelos Project (fig. 1).

**Figure 1.—Central American countries that are part of the ProSuelos Soil Map Project.**

The GWI aims at improving food security in Central America by influencing policies, programs, and practices. It especially focuses on rain-fed agriculture, which produces 65 percent of the food and comprises 71 percent of the land used for agriculture (per GWI, 2015). Of particular focus is the "Dry Corridor," which extends through all four countries and is heavily impacted by a recent persistent drought.

A detailed soil map is vital for implementing conservation practices and sustaining food production and other soil functions. The main goal of the ProSuelos Project is to develop a platform to map major soil properties by combining legacy data, local tacit knowledge, and new DSM techniques. The properties of interest are related to physical and chemical characteristics and soil fertility at a scale where decisions are being made by local farmers. Such a map is not currently available.

The GWI also aims at building a capacity for generating and delivering soil information. In addition to detailed soil maps, the project will generate interpretative maps based on soil properties and functions, including water-holding capacity, erosion potential, crop suitability, yield potential, nutrient availability, infrastructure development, and land use planning. The soil information will be provided at a resolution suitable for planning across different management scales, including national, regional, and farm field.

**Figure 2.—Workshop participants in front of the Honduras Coffee Institute. The Honduras Coffee Institute has over 20,000 georeferenced soil samples collected from coffee growers throughout the country. It is making the samples available to the ProSuelos Project.**

In El Salvador, approximately 12 local soil scientists and experts from the Ministry of Agriculture and Environment as well as and graduate

Figure 3.—Participants in the workshop in Nicaragua.

students participated in the workshop. The workshop in Honduras had 13 participants, including graduate students, local soil scientists, and experts from the University of Honduras in Tegucigalpa, Catholic Relief Services, Honduras Coffee Institute (fig. 2), and government agencies. The workshop in Nicaragua had 14 participants, including soil scientists and experts from the University of Nicaragua in Managua, Catholic Relief Services, Ministry of Agriculture, and Ministry of Environment (fig. 3).

The workshops started with a series of short presentations on DSM methodology and techniques by Dr. Owens' team from Purdue University. The participants then discussed: (1) short-, medium-, and long-term goals and objectives of soil mapping; (2) DSM resource development, such as acquisition of data and information from field observations, laboratory data, and soil legacy data; (3) action plans; and (4) a timeline for expected deliverables. The lecture series and discussions were followed by intensive training on DSM techniques focused on a pilot area (fig. 4).

One of the unique features of this project is that all lectures and training materials are delivered in Spanish. Major contributions were made by Minerva Dorantes, who is a soil scientist and a PhD student at Purdue University. The first-draft soil map guided the 2 days of fieldwork, which consisted of soil descriptions, soil-landscape modeling, and soil sampling. During the fieldwork, the participants explored soil-landscape relationships and models developed based on DSM and expert knowledge. They refined the models based on field observations and soil descriptions (fig. 5).

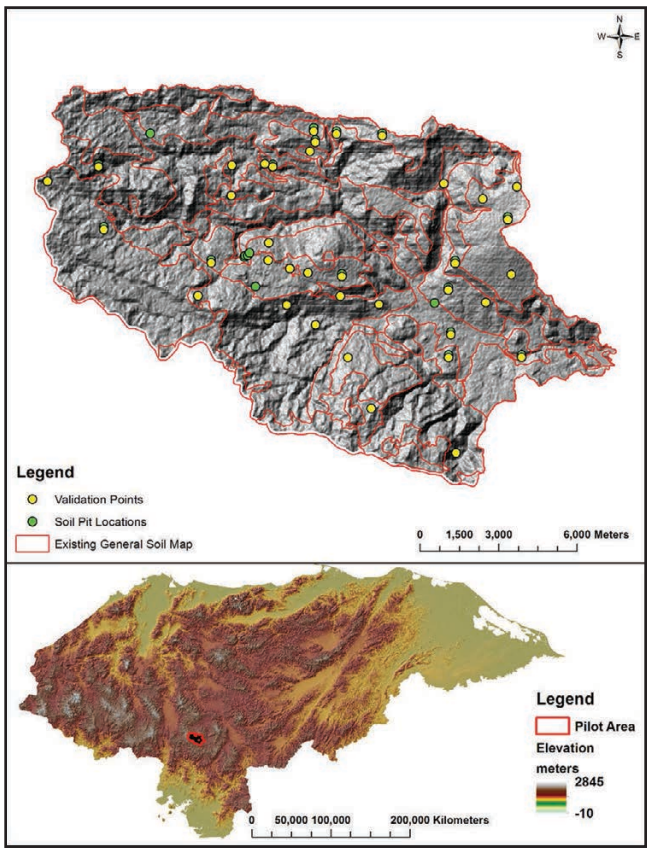


Figure 4.—Elevation of Honduras (bottom) and pilot area (top). The map of the pilot area shows the existing soil map and the locations of soil pits and validation points. The pilot area is located in the dry region of Honduras that has been recently impacted by climate fluctuations.

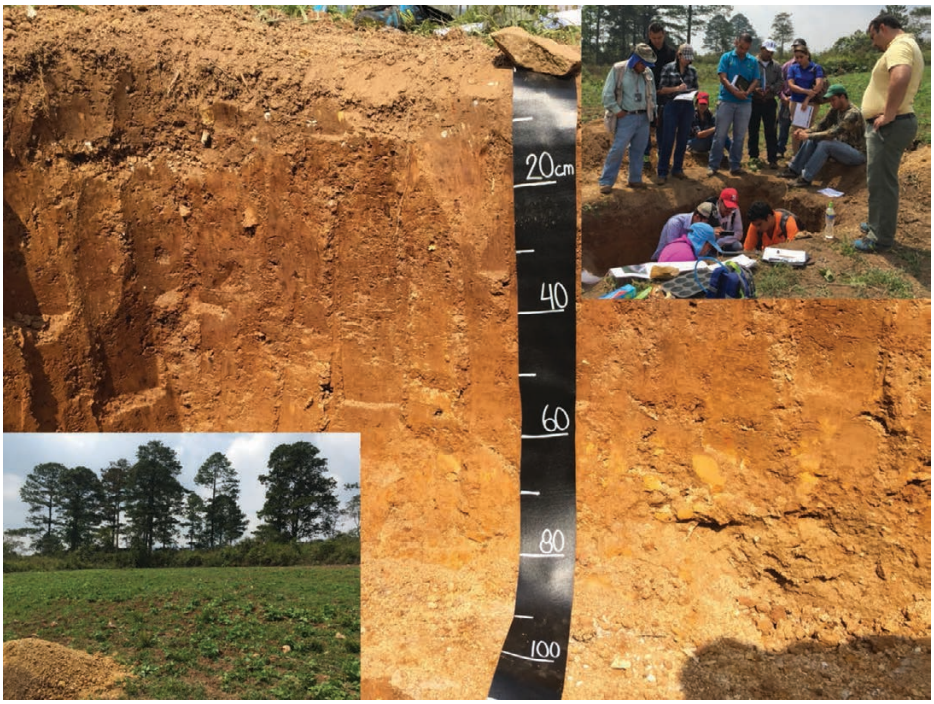


**Figure 5.—A pit (in Honduras) showing a soil developed on "tuff" (*in-situ*, weathered soft rocks developed from ash deposits). The soils in the pilot area are highly variable because of differences in parent material. The pilot area is characterized by soils that formed on ash caps and that are protected by vegetation. Older and clayey soils formed from underlying basalt.**

**Figure 6.—A soil profile (in Nicaragua) from the lower part of a steep backslope. The soil is characterized by a mixture of colluvium deposits and *in-situ* weathering of parent materials of volcanic origin. The soil-landscape relationships were recorded in a modified form-232.**

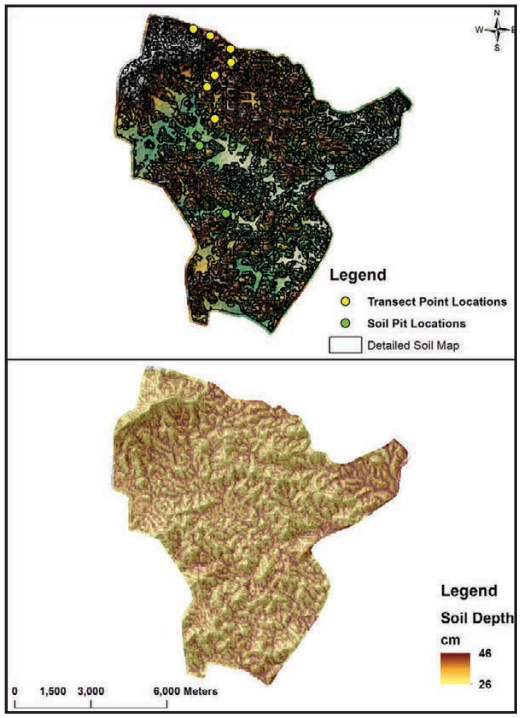


**Figure 7.—Detailed soil-class map of the pilot area in Nicaragua (top). This map shows more variability than the existing soil map. Soil-depth map (bottom) based on the new detailed soil-class map.**

During the fieldwork, the soil scientists were trained on describing soil pits (fig. 6). More importantly, however, they were also trained on how to relate pit observations to slope position and landscape to improve soil maps and predictions of soil properties. The participants were introduced to soil geomorphology concepts and soil landscape models and were trained to make related observations. This training approach is similar to the approach used at the Soil Geomorphology Institute (SGI), which is conducted by the USDA National Soil Survey Center.

Soil samples were collected by horizon for further analysis at the University of El Salvador in San Salvador and the University of Honduras in Tegucigalpa. Upon completion of the fieldwork, the team of soil scientists focused on generating a refined, detailed soil-class map and a soil-depth map (fig. 7). The soil maps generated from the DSM techniques were furthered refined and validated in the field. There was high agreement between the initial soil maps generated from a combination of DSM tools and the expert knowledge of local soil scientists. A soil-depth map was generated from the field measurements and existing coarse-scale maps (1:50,000). The soil-depth maps were more detailed than the existing soil maps and conformed to the soil-landscape model (fig. 8).

The pilot area projects can serve as a model in expanding and upscaling work to the national level. Currently, the countries involved with the ProSuelos Project are identifying teams to work at the national level and manage soil data collection, soil map production, and soil databases. The ultimate goal is to produce functional soil maps that will help decision makers for resource management and preservation. ■

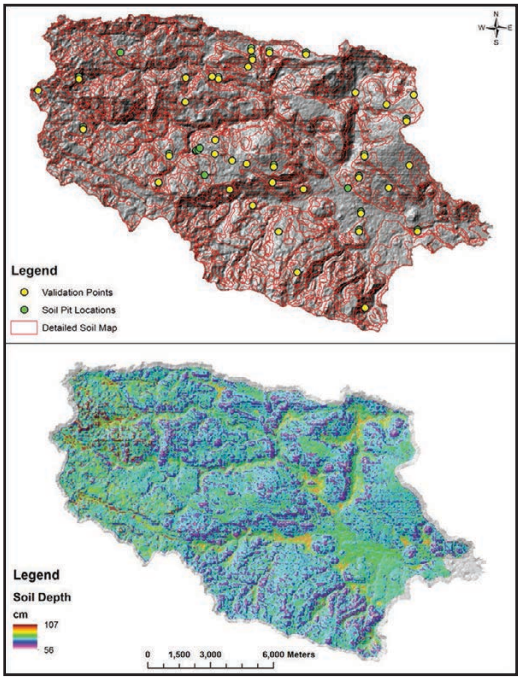


**Figure 8.—Detailed soil-class map of the pilot area in Honduras (top). This map shows more variability than the existing soil map. Soil-depth map (bottom) based on the new detailed soil-class map.**

## Celebrating Soils Across the National Park Service

Congratulations to Susan Southard, soil scientist with the NRCS National Soil Survey Center, and Gregory Eckert, soil ecologist with the National Park Service. Susan and Gregory co-wrote "Celebrating Soils across the National Park Service," which was featured on the cover of the latest edition of "Park Science." Susan has served as a liaison from NRCS to the National Park Service since 2007. She has been involved with soil mapping conducted as part of the NRCS-NPS Soil Resources Inventory. Greg works for the Biological Resources Division of the NPS Natural Resource Science and Stewardship Directorate. The article is available at http://www.nature.nps.gov/parkscience/. ■

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