

National Aeronautics and
Space Administration



SPRING 2016 **DEVELOP**er NEWSLETTER

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LAUNCHING EOX



Participants at Goddard Space Flight Center

Over the past year, DEVELOP has published 1 peer reviewed article, “Multi-Temporal Independent Component Analysis and Landsat 8 for Delineating Maximum Extent of the 2013 Colorado Front Range Flood”, along with 9 other non-peer-reviewed articles. Seeing this as a valuable asset to the future of the program, DEVELOP’s National Program Office decided it would be beneficial to collaborate with sources of scientific publication. While attending a conference in 2014, Dr. Kenton Ross met a representative from Elsevier and began discussions about creating a microarticle journal to which motivated DEVELOP participants could submit a short article on their project. The rationale was that all the impressive hard work and research that goes into each project could have an outlet to reach the much broader science community.

In 2015, this idea evolved into the Earth-Observations-X, or EOX, microarticle journal. Each year, eight to ten DEVELOP projects that best embody the quality and innovation for which the program has become known will be selected to submit to EOX and be showcased to the broader scientific community. Selected projects will provide a four page article which includes multiple pieces of interactive content ranging from audio slides to interactive data viewers. Approved articles will be peer reviewed and receive a Digital Object Identifier (DOI), which allows further citation in future DEVELOP projects. Additionally, the publication’s open access policy provides the capability to attract a multitude of individuals over a broad interest range which may not have been concerned otherwise. The future is bright for EOX, which could prove to be a powerful tool in the promotion of not only the DEVELOP program, but the talented individuals who put so much effort into their work. Currently, EOX is set to launch in summer 2016.

GEOINFORMATICS HIGHLIGHTS



DEVELOP's Geoinformatics team was especially busy during the spring term with both of its members attending separate Esri conferences.

Kimberly Berry was invited to Esri's FedGIS Conference and the 2016 Esri Developer Summit in Washington, DC. While there, she helped staff the DEVELOP table in the vendor hall and was able to connect with many former DEVELOPers who were excited to share their memories of the DEVELOP Program. Away from the vendor hall, Kimberly attended three days of presentations and workshops learning the new functionality of ArcGIS Desktop 10.4, ArcGIS Pro, and exciting new GIS applications. Kimberly's personal highlights were the workshops she attended that showed near real-time GIS applications, geodatabase tools and setup in Python, and innovations in Drone technology integrating into GIS.

Brittany Zajic explored Esri's newest GIS development innovations at the 2016 Esri Developer Summit in Palm Springs, CA. She attended 4 days of workshops learning the new functionality of ArcGIS Desktop 10.4 and ArcGIS Pro, as well as many demonstrations. Brittany's favorite workshop topics included real-time GIS in ArcGIS Online, developing geoprocessing tools in Python, and scientific programming with SciPy. Time in between workshops was spent in the Esri Showcase room networking with geodevelopers and learning how best to bring back and apply this new knowledge to the DEVELOP program. >>>





PROGRAM HIGHLIGHTS



108 Participants



26 Projects



12 Locations



The 2015 Pacific Water Resources Team was awarded the NOAA National Centers for Environmental Information 2015 Employees' Choice Award for Innovative Product of the Year.

The MSFC East Africa Disasters project published an article about their work in *The Earth Observer*. The project was completed during the summer 2015 term.

The Navajo Nation team (ARC) and the Southeast Idaho Disasters team (ID) conducted in-person workshops to demonstrate the tools created for their respective partners.

Congratulations to the MSFC Lake Victoria Water Resources team for winning the spring VPS contest! The video can be seen [here](#) and the team can be seen in the image on the left.



NASA Langley Research Center (LaRC)

Rebekke Muench, Emily Adams, and Jamie Favors represented DEVELOP at Virginia Aerospace Days in Richmond, VA. They met with legislators to discuss the program and the collaborative activities that benefit the decision making occurring in the Commonwealth.

The State of NASA is strong! Charles Bolden visited Langley Research Center to give the State of NASA address, after which participants were able to meet him.

Participants attended numerous tours on center, including the 8-ft supersonic wind tunnel, the hangar, and the inflatable habitat.

Nancy Searby, Dan Irwin, and Ana Prados visited the DEVELOP offices on March 29th. Participants welcomed them with a potluck lunch and presented their final results.

Anoop Mehta, president of SSAI, and other scientists from the Science Directorate at Langley attended the final presentations on March 31st. DEVELOPers were then invited to present their posters at the CEOS Working Group for Capacity and Data Democracy meeting in Hampton.



University of Georgia (UGA)

The Atlanta Water Resources Team was invited to the Cities Retreat in Atlanta, Georgia to present their project contributing to the development of a conservation program for the metropolitan Atlanta area. Several environmental organizations, non-profit groups, and stakeholders were in attendance.

UGA's Georgia Water Resources project was featured in an Earthzine article on Groundwater Storage Change and Contamination Risks in southwest Georgia. <http://earthzine.org/2016/02/22/georgia-water-resources-groundwater-storage-change-and-contamination-risks/>

UGA's Lead Science advisor, Dr. Marguerite Madden, and Center Lead, Caren Remillard, have been invited to present about the NASA DEVELOP National Program at the International Society for Photogrammetry and Remote Sensing Congress in Prague, Czech Republic this coming July.

LaRC

UGA

JPL

NCEI

GSFC

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ARC

MCHD

ID

MSFC

WC

IRI





NASA Jet Propulsion Lab (JPL)

Center Lead Nick Rousseau, Fellow Mark Barker, and former participant Gregory Halverson joined the Planetary Society tour with Bill Nye the Science guy.

The entire DEVELOP JPL crew, including mentor Ben Holt, joined the Bolsa Chica Ecological Forecasting team in a tour of the wetlands of Bolsa Chica to meet project partners from the Amigos de Bolsa Chica.

JPL DEVELOPerS took a tour of the JPL site and visited the Flight Project Operations Center, LDSD Lab, Mars Yard, and Von Karmen Museum.

Los Angeles Oceans II Team Lead, Rebecca Trinh, presented the data and results about the Hyperion sewage treatment plant at the Oceans Conference in Louisiana.



NOAA National Centers for Environmental Information (NCEI)

NOAA NCEI teams broke ground as both completed invaluable work for their partners. The Levant Climate I team worked closely with the 14th Weather Squadron on their project which laid the foundation for drought prediction, especially in countries devastated by war. The Cascade Water Resources team was able to take various precipitation datasets for their region and compare them across space and time. The team delivered supporting evidence for both in situ as well as remotely-sensed data, which is being used by their partners at the National Weather Service and the Western Regional Climate Center.

Emma Baghel and Jessica Sutton have been working with NOAA NCEI employees to develop a NCEI DEVELOP website, NCEI DEVELOP Portfolio, NCEI DEVELOP icon, and partner and participant pre-term and post-term surveys about data access/analysis.

Following the 2015 summer term, the Pacific Water Resources team worked with their advisors to publish two journal articles from their summer project. One article has been accepted and is available for early online release at <http://journals.ametsoc.org/doi/pdf/10.1175/BAMS-D-15-00219.1>. The other article has been accepted with minor revisions to EOS Transactions.

In February 2016, the 2015 Summer Pacific Water Resources team was awarded the NOAA National Centers for Environmental Information 2015 Employees' Choice Award for Innovative Product of the Year.

Participants from Wise and NCEI joined the UGA teams to present their projects during the 2016 spring term closeout at UGA in Athens, Georgia.

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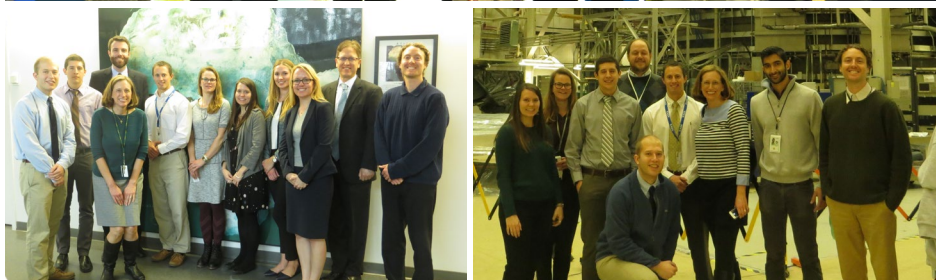
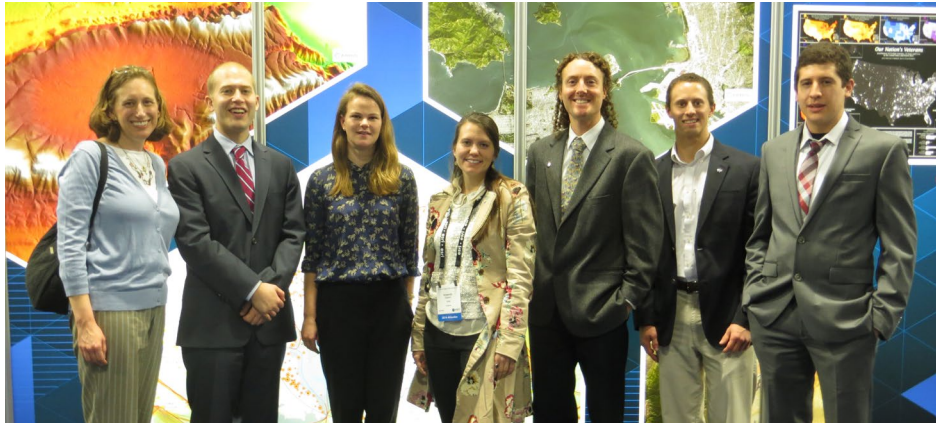
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NASA Goddard Space Flight Center (GSFC)

The Indonesia Agriculture team created geospatial products identifying current palm oil plantations and a risk map delineating areas of natural forests at risk of conversion from palm oil development for their project partner, the World Wildlife Fund (WWF). At the request of the partner, the team created a webinar for WWF field offices explaining their methodology.

Amanda Clayton and Sean McCartney presented two projects pertaining to Ecological Forecasting at the Society for Conservation GIS chapter meeting on March 22, 2015.

Throughout the term, participants toured the Thermal Vacuum Chamber, Acoustic Test Chamber, High Bay Clean Room (currently housing the James Webb Space Telescope), and Mission Control for several Earth observing missions based at GSFC.

During the 2016 spring closeout at Goddard Space Flight Center (GSFC), participants from the International Research Institute for Climate and Society (IRI) joined the GSFC team for a joint final presentation in Greenbelt, MD.



USGS at Colordao State University (FC)

The Gunnison Agriculture team developed a novel methodology for creating reference data that could otherwise only be collected through more time consuming and costly fieldwork. Team members utilized high resolution NAIP imagery to classify percent spruce mortality within forested areas equivalent in size and location to Landsat pixels, and then modeled mortality across the landscape using Landsat 8 OLI derived indices.

Maps produced by the Gunnison Agriculture team portray the location and severity of trees killed by the spruce beetle in mixed spruce-fir forests throughout Colorado. These maps are an improvement on current spatial datasets available to our partners at the USFS because they provide percent mortality as opposed to a simple presence and absence metric.

The Laramie Mountains Ecological Forecasting team worked closely with the Wyoming Game and Fish Department and USDA Forest Service, Laramie Ranger District, to analyze fire history in Southeastern Wyoming. Previous research was severely limited due to the lack of roads and steep terrain throughout the study area.

Within the Laramie Mountains Ecological Forecasting study area, locations at risk for future fires were identified using a variety of statistical models. These data will prove instrumental in the following term when DEVELOpers will research aspen growth in relation to previously burned areas. Project partners will use the cumulative research to aid aspen regeneration throughout Southeastern Wyoming.

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NASA Ames Research Center (ARC)

On February 10th, the team attended the annual Earth Science Poster Session at the NASA Ames Research Center. During this event, DEVELOP participants presented two DEVELOP posters from the Fall 2015 term (Puerto Rico Health & Air Quality and Lake Tahoe Water Resources) to an audience of scientists, researchers, and policy-makers from the Ames Earth Science Division, USGS, and other local environmental organizations.

On April 1st and 2nd, the Puerto Rico Health & Air Quality and Caribbean Oceans teams presented their findings at the American Association of Geographers (AAG) Annual Meeting in San Francisco. The summer 2015 Navajo Nation and fall 2015 Lake Tahoe projects also gave oral presentations at this event.

During the first week of April, the Navajo Nation Climate project presented the end-products from the spring and summer 2015 terms at the Intertribal Timber Conference in San Carlos, AZ. This event culminated over a year's work on the Drought Severity Assessment – Decision Support Tool (DSA-DST), and included a hands-on workshop with their project partners from the Navajo Nation that demonstrated the uses and capabilities of this tool for drought monitoring within the reservation.



Mobile County Health Department (MCHD)

The Mobile team visited their study area on a field trip to local marshes and wetlands around Mobile Bay. While visiting, the team took photos of marshes and met with local community members to gain insight into the significance of marshes to the community. This insight provided the team with new perspectives into the importance of studying the marsh ecosystems.

The team presented to their partners at the Alabama Coastal Foundation office at the end of the term. They engaged with members of the foundation, local environmental organizations, and community members during the event to provide more information about the team's research and the DEVELOP program.

The Mobile Bay Ecological Forecasting team worked with NDVI maps derived from MODIS data to identify marsh phenology trends in different regions of the study area. The trends were then compared to natural and anthropogenic stressors to gain knowledge of the effect these disturbances have on the marshes. These results helped the partner identify areas to focus future restoration efforts in Mobile Bay.

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BLM at Idaho State University GIS TReC (ID)

Center Lead Jenna Williams attended the NASA Applied Sciences Program Wildfire Program annual review meeting in Boise, Idaho. During this meeting she visited the National Interagency Fire Center, toured the Smoke Jumper's facilities, listened to presentations on multiple wildfire research projects, and met Lawrence Friedl, the director of NASA's Applied Sciences Program Leadership.

The Southeast Idaho Disasters II team worked closely with their project partners at the Bureau of Land Management's Pocatello Field Office to produce predictive juniper encroachment maps. This process involved learning how to use the LandTrendr modeler, a tool that is new to the BLM.

The team conducted a technical hand off with their project partners. Members from the Bureau of Land Management and Idaho Fish and Game came to the GIS Training and Research Center and learned how to use a juniper phase model produced during this two-term project.



NASA Marshall Space Flight Center (MSFC)

The Alabama Ecological Forecasting team visited their study area in Bankhead National Forest where the team learned about past Southern Pine Beetle infestations and current mitigation efforts. The team also met their project partner Dave Casey from the USDA Forest Service and had the opportunity to interview him.

MSFC DEVELOPers visited the United States Space and Rocket Center where they were able to see a replica of the International Space Station, as well as learn about the current projects on the International Space Station.

In late February, Daryl Ann Winstead attended the Esri FedGIS Conference in Washington, D.C. where she learned new ways to apply Esri products to future DEVELOP projects.

The Lake Victoria Water Resources II team presented to the NASA SERVIR Coordination Office, including Dan Irwin, NASA SERVIR Program Manager, and project partner Africa Flores, about the progress of the project.

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Wise County Clerk of Court's Office (WC)

The Wise Disasters team worked diligently with the Coupled Routing and Excess Storage (CREST) model throughout the term to build a flood model for Wise County, Virginia. Results from this model were used to create flood maps to aid the Wise County Board of Supervisors in planning for future flood events.

The Wise Disasters team was led on a tour of Clinchport, Virginia, which was destroyed by a flood in 1977. Data from this flood were used to calibrate the CREST model for 100 year floods. The team came away with a greater understanding of the devastating effect that floods of this magnitude have on the people of Southwest Virginia.

The African Great Lakes II team spent the majority of the term processing Modern-Era Retrospective Analysis for Research and Applications (MERRA) weather data to gain a more thorough understanding of factors that drive storm development over Africa's Lake Victoria. The findings were inconclusive; however, the team paved the way continued research for the African Great Lakes III Team, which will be conducted during the Summer 2016 Term.

Participants from the Wise County node gave a talk to an assembly of 4th through 7th graders at Norton Middle School in Norton, Virginia. These students had previously participated in the "Hour of Code," an entry level coding competition. DEVELOP participants spoke about their coding experience and how they use coding in their work at NASA DEVELOP.



International Research Institute for Climate and Society (IRI)

The Uruguay Agriculture III team at the IRI created a drought severity index (DSI) tool based on NASA Earth observations within the IRI data library. This DSI had previously been used by the project partners to assess drought severity on a country-wide level. During this term, the team created an interactive map of the DSI for end users to see the primary drivers of the drought on a more local scale by viewing the individual components of the DSI at the time of the drought.

The team learned new coding skills to facilitate the creation of the interactive map within the IRI data library. These new coding skills will be useful in future projects by making the connection between Earth observations and the general public more attainable and accessible.

The IRI team traveled down to Greenbelt, MD to participate in a dual Goddard-IRI closeout at the end of the term. During this closeout, the IRI team had the opportunity to present their work to the scientists at NASA Goddard, after which they were able to tour the facility and see control rooms for a variety of NASA Earth observations.



RYAN UMBERGER

SPRING 2016 DEVELOPer OF THE TERM

Ryan Umberger walked in the Wise County node unannounced during orientation on Day 1 of the term, having been sent to the node by a UVA-Wise astronomy professor just a few minutes earlier. Starting that day he was an excellent volunteer participant in the DEVELOP office. He came into the program with little working knowledge of GIS or remote sensing, and little in the way of an Earth science background. Ryan enthusiastically dug into the literature, GIS programs, and coding necessary for the project. He was a tremendous asset to the African Great Lakes Weather II team, the node, and DEVELOP as a whole. Ryan was instrumental in the drafting of all deliverables, including the production of a very polished VPS video. During the ups and downs of the term, he always maintained a positive attitude and was always willing to help and learn from his team. Ryan's dedication, initiative, self-motivation, and professionalism set an example for all the participants at the node, an example which makes even more of a mark considering his volunteer status.

Ryan graduated from the United States Air Force Academy in May of 2013 with a bachelor's degree in Aeronautical Engineering and a minor in Spanish. Though his career as an Air Force pilot was curtailed for medical reasons, his commitment to serve his country remains steadfast. Before moving to Wise, VA for a six-month period to follow his wife's medical residency, he worked for Lockheed Martin on the F-35 project as a Flight Test Engineer. Ryan's future career goals are focused on continuing to serve his country in the national defense and security sectors.



DEVELOPer OF THE TERM NOMINATIONS



Amanda Clayton
NASA Goddard Space Flight Center

Amanda Clayton was an incredible asset to the DEVELOP program at GSFC during the spring 2016 term. Amanda demonstrated incredible leadership, passion, and resolve through her work as both Team Lead and Assistant Center Lead. She led the Gulf of Mexico Health and Air Quality team consisting of only two participants, having requested the project because it was outside the realm of her previous research, demonstrating her desire to challenge herself intellectually and professionally. The scale of the project would be enough to test the limits of larger teams, but her dedication led to successfully completing the project and providing her project partner, the Bureau of Ocean Energy Management (BOEM), the monthly, seasonal, and annual maps of aerosols and pollutants as a time series throughout the Gulf of Mexico, as well as a methodology workflow to analyze concentration profiles of pollutants. Having overcome many obstacles throughout the course of the term, Amanda led by example, maintaining a positive outlook and setting an example for her teammate and other participants to follow.

Amanda received her BS in Biodiversity and Conservation Biology from Cedar Crest College in Allentown, PA. She went on to receive her MS in Environmental Science and a GIS graduate certificate from the University of Illinois at Springfield. Her research interests include all things conservation, small mammal ecology, and GIS. She is also an excellent cook and baker, testimony of which is provided by participants at GSFC, whom she regularly treat to her home cooking!



Andrew Kruczkiewicz
International Research Institute for
Climate and Society

Andrew's passion for the nexus between science and society drives his work to reach the next level. With a graduate degree from Columbia University in Climate and Society, Andrew understands the importance of research that has societal implications. This past term, Andrew had the chance to work on the Uruguay Agriculture III team where he helped create code for the DSI which allows endusers to view local scale drought drivers in their region of interest. His dedication always produces outstanding work and his collaborative nature makes him an excellent team player. Andrew has been an integral team member for DEVELOP at the IRI since 2013.



Tyler Rhodes
NASA Langley Research Center

Tyler has been an incredible asset to the DEVELOP program for the past 3 terms. During this past term he was a strong Team Lead and positive role model for the Southern Rockies Ecological Forecasting II project. Despite the project having many setbacks, Tyler was always ready to keep charging forward. His optimism, and passion are infectious. He is readily available to provide support to not only his own team members but to the node as a whole.





Wenjing Xu
University of Georgia

Wenjing participated in the NASA DEVELOP Program during the summer 2015, fall 2015 term, and spring 2016 terms. She has served as a team member and team lead. She has continually demonstrated her commitment to environmental research and value to the DEVELOP program through her hard work and diverse skill set. Wenjing has been an effective leader and devoted team member. All of the participants respect Wenjing for her professionalism, communication skills, and passion for environmental issues.



Martha Sayre
NASA Ames Research Center

Martha is a recent graduate of the University of California—Davis with a Bachelor's of Science in Environmental Science and Management, focused in Watershed Science. Martha was drawn to environmental science at an early age. Growing up on the banks of the Russian River, she witnessed the river cycle through periods of degradation, counteracted by restoration efforts put forth by community voices. Remote sensing became an interest of Martha's while she was studying at UC Davis, where she realized the limitless potential to incorporate these data and techniques into applied environmental research. Her passions for Earth science are broad, and she was excited to acquire skills in public health, disease prevention, and remote sensing through her experience on the Puerto Rico Health project. Throughout the project's two terms, Martha ran a Maximum Entropy Species Distribution model in order to better understand the distribution of dengue-infected *Aedes aegypti* mosquitoes across the island of Puerto Rico. This proved to be a rewarding experience in not only forging relationships with the project partners, but also in building confidence as an environmental scientist.



Kelsey Herndon
NASA Marshall Space Flight Center
at NSSTC

Kelsey has taken initiative in various tasks in the Alabama Ecological Forecasting project, as well as in learning everything she can about GIS, remote sensing, and the applications of NASA Earth observations. She has embodied the DEVELOP core values by bringing a positive and eager attitude to the office, encouraging her fellow DEVELOPers and being passionate about bridging the gap between real-world environmental issues and NASA Earth observations. Kelsey has proven to be a problem solver by finding solutions to problems as they arise and by collaborating with her fellow team members.



Darin Schulte
USGS at Colorado State University

Darin Schulte, a 3-term DEVELOPer that will be leaving the program this spring, was a natural choice for the Fort Collins node DEVELOPer of the Term nominee. As a current University of Denver PhD candidate, Darin entered the program hoping to hone his skills in R programming and remote sensing. Just three terms later, Darin has mastered these skills, while concurrently spreading the word about the NASA DEVELOP National Program throughout northern Colorado. Darin put in long hours, sometimes up to 15 hours in a single day, not just to get the work done, but to ensure that he will leave the program with the skills and experience required to apply NASA Earth observations and remote sensing to his own, long-term research goals. Beyond his technical ability, Darin has been a dynamic team-player, often taking time to teach new DEVELOPers programming skills and tools and tricks to expedite remote sensing processing. We'll be sad to see Darin leave this term, but wish him the best in his future endeavors. Way to go Darin!



Alec Courtright
NOAA National Centers for
Environmental Information

Alec is a returning participant from the 2015 fall term at NCEI. Over the past two terms, Alec has grown, developed, and enhanced his skills. Last term he was a team member on a team with four participants. This term, he is the team lead of a very difficult and unique project, the Levant and Central American Climate I team, with only three participants. He has shown his ability to move into a leadership position and tackle a difficult project. His team has been working with the 14th Weather Squadron over the term, which has proven to be an amazing, but different type of experience than many participants have over a term. Alec has risen to the occasion and has done a terrific job at communicating with his team and partners. While Alec is a “born leader”, he knows how to delegate tasks and supports his other team members to focus on certain aspects of their project. He helps to foster his teammates’ growth and development as much as his own. Additionally, he has shown great personal growth by leading a team that is limited in their data analysis skills. Alec is an inspiring, passionate, and funny team lead. He has done a great job at keeping his team in high spirits and thinking of the bigger picture. Having Alec around the office livens the atmosphere and makes you want to smile because of his open and engaging communication skills.



Courtney Kirkham
Mobile County Health Department

Courtney is a student at the University of Southern Mississippi – Long Beach studying computer science. Courtney embodied the true meaning of a DEVELOPer. Throughout the term Courtney displayed her willingness to not only work together with others to accomplish tasks but also learn from them while doing these tasks. Her passion and enthusiasm were a driving force, helping to move the project forward during the term as well as encouraging those around her. She consistently searched for new ways to improve the efficiency of tasks and create a productive work environment. Due to her willingness to collaborate with others, the passion she brought to the team, and the innovative ideas she provided, Courtney makes an excellent candidate for DEVELOPer of the term.



Emily Beck
NASA Jet Propulsion Laboratory

Meet Emily Beck, the NASA Jet Propulsion Laboratory’s DEVELOPer of the term! Emily just finished her second term with DEVELOP as a participant. She has been a reliable asset to the Louisiana Ecological Forecasting team. She is a pleasant person to work with and shows considerable dedication to her work no matter how difficult the day is. Emily graduated from California State University, Monterey Bay in May 2014 with a Master’s Degree in Coastal Watershed Science and Policy. Prior to obtaining her Master’s, she received a Bachelor’s in Applied Ecology from University of California, Irvine and worked as a Restoration Ecologist with a focus in coastal habitats in southern California. The CSUMB graduate program had a strong focus on applied science and technology, including GIS, remote sensing and modeling coursework, and Emily became passionate about using these methods to inform her work in restoration and natural resource management. She has enjoyed her time at DEVELOP, where she has combined her love of wetlands and interest in applied science and technology to create a hydrological model of land building in the Wax Lake Delta.



Ryan Howerton
BLM at Idaho State University GIS TRec

Ryan is a volunteer for the BLM at ISU Pocatello node and has proven to be an invaluable member of the team. Ryan has been working with Keith Weber, our science advisor, on the NASA RECOVER project. He has a BA in Anthropology and is working on a Master’s in GIS. Ryan has provided assistance in a multitude of ways during the term, from but the most notable has been creating many scripts to aid in pre-processing of data and working on an object based classification model that will help our endusers in identifying different phases of juniper encroachment. On top of his assistance in the technical realm of DEVELOP, Ryan is always in a positive mood and ready to help, making him a joy to work with and a great member of our team.

Monitoring Drought in the NAVAJO NATION

By Vickie Ly

Using NASA Earth Observations data in the development of the Drought Severity Assessment Tool (DSAT)

Amidst the buttes and red rock canyons, water management is undeniably a key part of the landscape of the Navajo Nation. Located at the corners of Arizona, Colorado, New Mexico, and Utah, The Navajo Nation, is the largest Native territory in the country in both area and population. The combination of water rights history, infrastructure, and drought management has put drought monitoring on the forefront of issues for the Navajo Nation.

Defining and characterizing drought can be a difficult task due to numerous existing definitions of this phenomenon. The Navajo Nation Department of Water Resources (NNDWR) currently characterizes drought using an internationally-used index, the Standardized Precipitation Index (SPI). The SPI is a calculation that characterizes drought from 'extremely dry' to 'extremely wet', based on comparing a normal distribution of monthly accumulated rainfall to historical precipitation trends in the same region and time of year. The Navajo Nation uses SPI values calculated by the Western Regional Climate Center (WRCC). However, the WRCC calculates SPIs for areas of the U.S. Climate Divisional Dataset, a state-based divisional system that does not take the Navajo Nation's political boundaries into account. As a result, the majority of the Reservation falls into one climate division, and therefore receives only one SPI.

The WRCC-provided values do not provide for the spatial and climatic intricacies of the Nation.

The NNDWR uses SPI values to write monthly drought reports, which then go to Navajo Nation leadership and policymakers who decide how to allocate financial resources. In order to provide the leadership with accurate information, it is key that the SPI values provide the spatial specificity needed to properly allocate drought mitigation dollars.

"We want to make sure that the drought mitigation dollars or emergency dollars that are meant for that drought emergency goes to the chapters that need it the most," said Robert Kirk, principal hydrologist of the NNDWR. "The way it is right now, is that every time we have a drought emergency the amount gets equally distributed to all 110 chapters and then that doesn't really negate the emergency."

To address this, the Navajo Nation Climate team at the Ames Research Center in Mountain View, California collaborated with the NNDWR to create the Drought Severity Assessment Tool (DSAT) over the spring and summer terms of 2015. The team sought to design and create a tool that would allow water managers to calculate and visualize drought severity and integrate NASA Earth observation data in monitoring



drought within the Navajo Nation. The goal was to provide a way for water managers to calculate SPI rasters specifically for the Navajo Nation, and to calculate their own average SPI values for boundaries of their choice.



Vickie Ly presents the Drought Severity Assessment Tool (DSAT) to NNDWR staff in Window Rock, AZ.

In April 2016, Ames Assistant Center Lead and team member Vickie Ly traveled to the Navajo Nation to deliver the tool. Vickie met with the NNDWR staff at the Navajo Nation Museum in Window Rock, AZ, where they spent the day conducting a workshop. Vickie helped the staff install, run, and test the tool on their laptops. By providing step-by-step instructions and on-site troubleshooting, Vickie was able to effectively hand-off the tool to the partners and collectively make plans with the partners on how they would like to move forward. The project partners were very pleased to have an opportunity to work and meet in-person after over a year of working together.

The NNDWR partners are very excited to continue taking the next steps to incorporating the tool into their decision-making process. The NNDWR plans to test the tool and compare the SPI values calculated with DSAT against their collected stream gauge data for validation. For the NNDWR, using NASA Earth observing data could provide a method for continual monitoring, improved spatial coverage, and serve as a supplement to their in-situ rain gauge data in understanding drought regimes. The NNDWR has long term goals to use DSAT to help

produce monthly drought reports to identify areas within the Nation that are experiencing higher degrees of drought and assign more attention and financial resources towards those areas.

This project was just as much about the partnership as it was about a tool. The team steadily worked to build a partnership with the NNDWR for over a year, through telecons, emails, and phone calls. Moreover, the DEVELOP framework provided the team with opportunities to build their working relationship. Particularly, the Virtual Poster Session (VPS) provided a way to break out of the formality of work. The team interviewed Teresa Showa and Robert Kirk, Principal Hydrologists from the NNDWR, and began to hear first-hand about the issues they were facing. In interviewing



The Navajo Nation Climate project was built over a year of collaboration. Pictured left to right: Cindy Schmidt (previous ARC advisor), Carl McClellan (NNDWR), Michelle Begay (NNDWR), Ryan Barton (NNDWR), Vickie Ly (ARC DEVELOP), and Jesse Hillis (NNDWR).

“We want to make sure that the drought mitigation dollars or emergency dollars that are meant for that drought emergency goes to the chapters that need it the most.”

- Robert Kirk, principal hydrologist of the NNDWR

the partners, the team was able to step out of an “office” meeting and create space for dialogue, for the team to ask questions and, most importantly, to listen.

While the two-term project has come to a close, there are many ways that DSAT can be expanded and built upon.

DSAT will be publically available on NASA DEVELOP’s Github page (github.com/NASA-DEVELOP/DSAT) for users to test and customize to their region of interest. The team looks forward to continuing collaboration with their project partners to see the application of the tool.



Monitoring precipitation and understanding drought regimes is key to water resource management in the Navajo Nation.



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The DEVELOP gear webstore is now available online. Order individually, or as a node @ <http://tinyurl.com/gs6oq8h>

This online gear site will allow participants, alumni and family members flexibility to order at their leisure. Orders will be processed on the last day of every month, and sent directly to the shipping address provided.

UPCOMING EVENTS

May 23-July 1 Fall 2016 Term Application Window

June 6 Summer 2016 Term Begins

June 15-17 Great Lakes & St. Lawrence Cities Initiative Annual Meeting -- Niagara Falls, NY

June 22-25 2016 SCGIS Annual Conference -- Monterey, CA

August 10 DEVELOP Annual Earth Science Applications Showcase -- NASA HQ

August 11 Summer 2016 Earthzine Virtual Poster Session Launch

August 12 Summer 2016 Term Ends

**September 12-
November 18** Fall 2016 Term

