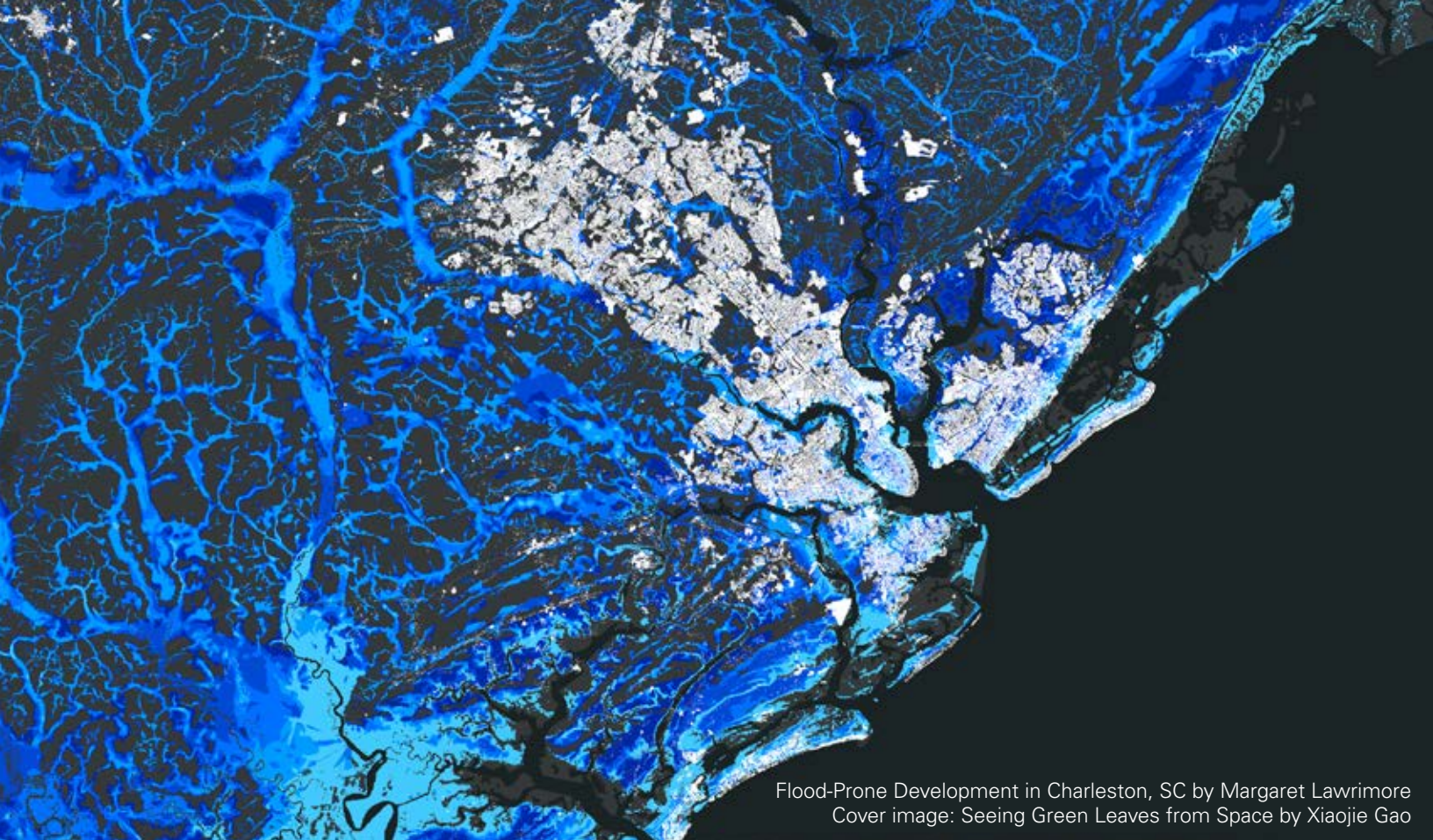


NC STATE
UNIVERSITY

Center for
Geospatial Analytics

Annual Report 2022–2023





Flood-Prone Development in Charleston, SC by Margaret Lawrimore
Cover image: Seeing Green Leaves from Space by Xiaojie Gao

MESSAGE FROM THE CENTER DIRECTOR



A new five-year strategic plan is an opportunity for renewed energy and growth at a university center like ours, and this year, the Center for Geospatial Analytics

successfully completed the first phase of its new 2022–2027 Strategic Plan. I am pleased to share with you in this annual report our progress towards our strategic goals and other highlights of our work, as we strive to build a forward-thinking, inclusive future rooted in data justice and service.

I am particularly proud of several developments at the Center this year: Thanks to the efforts of hardworking staff, researchers and faculty, we raised the minimum stipend for Ph.D. students to enhance the competitiveness of our Geospatial Analytics doctoral program and address rising inflation; we secured a \$1.5 million award from the

National Science Foundation to advance open source geospatial modeling; and we built a new research collaboration with industry partner Tetra Tech, Inc. to address climate challenges.

Our Center is dedicated to student success and cultivating innovative partnerships that advance research with real-world impact. I hope you will find that dedication reflected in these pages.

The coming years will see new initiatives that aim to enhance community and expand our impact. We welcome your feedback on these initiatives.

As always, thank you for your support.

Dr. Ross Meentemeyer
Director of the Center for Geospatial Analytics
Goodnight Distinguished Professor of Geospatial Analytics

Annual Report 2022–2023

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About the Center

At the Center for Geospatial Analytics, we push the boundaries of spatial data science to advance discovery and inform real-world decision-making.

Our world-renowned researchers collaborate across disciplines to answer pressing questions about the world and address challenges.

Our signature academic programs train new generations of geospatial data scientists and GIS professionals to tackle emerging issues and leverage new technologies.

Through research, teaching and consulting, our community of experts work closely with industry, government, nonprofit and other community partners to produce data-driven solutions to real problems.

Connect with Us

Website: geospatial.ncsu.edu

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Center for Geospatial Analytics



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STRATEGIC PLAN 2022–27: Year One Updates



In July 2022, the Center for Geospatial Analytics launched its ambitious new five-year Strategic Plan. We are proud to share with you now the outcomes of its first year in action.

Goal 1: Ensure preeminence in interdisciplinary research, scholarship, innovation and collaboration, elevating the national and global reputation and visibility of the Center.

Consulting and engineering firm **Tetra Tech, Inc. selected the Center to support a five-year, \$100 million contract** awarded to the company by the US Environmental Protection Agency (EPA) Office of Research and Development (ORD). The partnership will assess the impacts of global climate change on ecosystems and human health and include modeling risks from future fire, sea level rise, flooding, urbanization and habitat loss. Our Center is the only academic partner on the contract and one of only two geospatial partners.

The Center's **grant funding increased by over \$15.9 million.** Funding agencies included:

- > Intelligence Advanced Research Projects Activity (IARPA)
- > National Aeronautics and Space Administration (NASA)
- > National Oceanic and Atmospheric Administration (NOAA)
- > National Science Foundation (NSF)
- > North Carolina Department of Justice
- > US Department of Agriculture (USDA)
- > US Environmental Protection Agency (EPA)
- > US Geological Survey (USGS)
- > US National Park Service (NPS)
- > United States Golf Association

Goal 2: Lead in developing sustainable, open and just research, education, engagement and operations.

The National Science Foundation awarded a \$1.5 million grant to expand access to and support for the freely available geospatial software platform GRASS GIS. GRASS GIS allows researchers around the world to find new solutions to pressing problems, and build on each other's work, by creating and modifying geospatial workflows for a wide range of analyses. The newly funded project will modernize software infrastructure and strategically grow the GRASS community to achieve a technologically and socially sustainable open-source ecosystem. The project team is led by Associate Director Helena Mitsova and Geospatial Research Software Engineers Vaclav Petras and Anna Petrasova, all members of the GRASS Project Steering Committee.

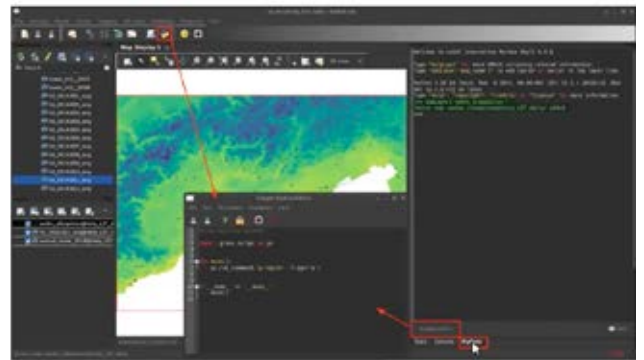


Vaclav Petras, Helena Mitsova and Anna Petrasova have collaborated on open source software development for many years at the Center for Geospatial Analytics. The new grant they are leading, funded by the National Science Foundation, will expand GRASS GIS's accessibility and sustainability, expanding the community of developers and users.



In spring 2023, the Center hosted Verónica Andreo as a Visiting Scholar. Andreo is chair of the GRASS Project Steering Committee, a researcher with Argentina's National Council for Scientific and Technical Research (CONICET) and a lecturer for the National Commission for Space Activities' (CONAE) and National University of Córdoba's Gulich Institute. During her visit, Andreo met with students, faculty and staff, and she delivered two Geospatial Forum presentations, including an interactive three-hour studio that taught participants how to use GRASS GIS and R for species distribution modeling with satellite data.

Geospatial Research Software Engineer Vaclav Petras and Postdoctoral Scholar Corey White began developing a course entitled Open Source Geospatial Software Development, to be offered in Fall 2024 at the 700-level. Students will learn how to professionally engage in the collaborative development of geospatial open source software. The course will be aimed at students in the Geospatial Analytics Ph.D. program but will also be appropriate for students in the master's degree in Geospatial Information Science and Technology (MGIST), as well as graduate students from other majors at NC State.



The recording of Verónica Andreo's popular Geospatial Studio has garnered over 100 YouTube views.

Goal 3: Empower students for a lifetime of success and impact.

The Geospatial Graduate Student Organization (GGSO) successfully advocated to **raise the minimum stipend for Ph.D. students**, and the Center committed to a base stipend of \$30,000 per year effective Fall 2023.

The Center also **increased the stipend for professional master's students serving as teaching assistants (TAs)** from \$2,000 to \$2,500, with a plan to increase to \$3,000 in the future.

The Center's Education Committee **formalized and launched a Teaching Assistant (TA) program for Ph.D. students** who are funded by the

Center. These students are matched to an appropriate course to serve as a TA for 10 hours per week. Ph.D. students are now serving as TAs in courses at all levels (undergraduate, master's and Ph.D. core courses).

The **Geospatial Analytics Ph.D. program successfully completed its first program assessment** for the Graduate School and will be required to complete assessments each spring going forward. The assessment will be completed on a three-year cycle; for 2023, the program assessed its goals related to interdisciplinarity.

Goal 4: Expand and advance our engagement with and service to North Carolina and beyond, exemplifying the standard for a 21st-century land-grant university, with emphasis on involving stakeholders in decision-making.

The Center for Geospatial Analytics and Interior Region 1 of the US National Park Service (NPS) **participate in a collaborative effort to develop a program of GIS research and development**. Much of the research effort is performed by supervised graduate students who participate in both the research process and the publication of results, provided directly to the NPS, supporting extension services within North Carolina and the Southeast United States.

The Center **hosted two Visiting Scholars** this year, advancing our engagement beyond the borders of North Carolina. Verónica Andreo (see page 5) visited from Argentina in Spring 2023, and Dan Andersson visited from Sweden in Fall 2022. Andersson, a doctoral candidate in Sports Science at the Swedish School of Sports and Health Sciences, worked with Aaron Hipp, our Associate Director of Social and Behavioral Science Applications. Their research focused on understanding how different environmental factors, such as greenery, traffic and topography are perceived by pedestrians.



Goal 5: Champion a culture of equity, diversity, inclusion, belonging and well-being in all we do.

Center Ph.D. students and Faculty Fellows **published five articles in peer-reviewed journals relating to equity and inclusion:**

- > Evaluating the use of semi-structured crowdsourced data to quantify inequitable access to urban biodiversity: A case study with eBird (*PLoS ONE*)
- > Call for environmental justice amplification among ecology scholars and practitioners: A Black Ecology perspective (*The Bulletin of the Ecological Society of America*)
- > Mapping for whom? Communities of color and the citizen science gap (*ACME: An International Journal for Critical Geographies*)
- > An antiracist, anticolonial agenda for urban greening and conservation (*Conservation Letters*)
- > Equity in FEMA hazard mitigation assistance programs: The role of state hazard mitigation officers (*Environmental Science & Policy*)

Center Ph.D. students and Faculty Fellows **presented at symposia dedicated to social justice**, including the NC State Oppressive Infrastructures Colloquium, NC State Equity Research Symposium and NC State Black Research Symposium.

Faculty Fellows and Center researchers **worked on five active grants relating to equity and inclusion:**

- > Justwater: Policy Leadership and Environmental Justice During Disaster Recovery
- > Promoting Sustainable State Park Management in North Carolina through the Identification of Equitable Pricing Strategies
- > Mapping Playspace Inequity in Three Locally-Focused Colorado Communities
- > Play Potential and Retention Value of Park and Playspace Attributes
- > Connecting Campuses to Communities with Micromobility Infrastructure

Two Geospatial Forum events focused on topics related to diversity, equity and inclusion:

- > Oppressive Infrastructures: Mapping Racism in the Built Environment (presented by Sara Queen and Tania Allen, NC State)
- > (Spatial) Scales of Justice: Equity, Inclusion and Accessibility in Participatory Sciences (presented by Caren Cooper, NC State)

The Center **implemented higher stipends for international Ph.D. students** to facilitate pay equity, compensating for a higher tax burden on these students.

Executive Assistant Lois Utt **completed the Inclusive Excellence Certificate Program**. Science Communicator Megan Skrip **completed Green Zone (military student) training**.

A significant **leap in gender equity** has been made by the Center's master's degree in Geospatial Information Science and Technology (MGIST) program, with the percentage of female students enrolled in the program rising from 32% in the 2020–21 academic year to 45% in 2022–23.

The Geospatial Graduate Student Organization (GGSO) **advanced advocacy on behalf of students and increased awareness of graduate student needs**. The GGSO created and administered a Student Financial Stability survey, which revealed alarming financial burdens on graduate students and sparked action across the university. In addition to raising Ph.D. stipends, the Center created a grazing station to combat food insecurity and instituted a new policy allowing students to add external funding from grants, scholarships and fellowships to their base stipend. The topic of how to find personal funding or grants has been incorporated into the GGSO regular Lunch & Learn sessions.

View the entire 2022–2027 Strategic Plan at geospatial.ncsu.edu/about/strategic-plan.

Invasive Insect That Kills Grapes Could Reach CA Wine Region by 2027

Last year, published research led by Research Scholar **Chris Jones** gained national media attention, highlighting the risk posed by spotted lanternfly to California's multi-billion-dollar grape industry. This year, the research was highlighted by *USA Today*, and Jones was further quoted in spotted lanternfly coverage by WRAL, NBC Lx, MSN, KRON, Patch and Food & Wine.



Study: U.S. Flood Damage Risk Is Underestimated

Research from our Center about flooding was also widely reported last year, pointing out that flood maps from the Federal Emergency Management Agency (FEMA) do not capture the full extent of flood risk in the continental United States. This year, Research Scholar **Georgina Sanchez** was quoted or interviewed for her flood risk expertise by CNN, Newsy's "The Why," Insurance Journal, CableFreeTV, *South Florida Sun Sentinel* and *The Maine Monitor*.



Scientists Use Satellites To Track Earth 'Greening' Amid Climate Change

In March, research led by Geospatial Analytics Ph.D. student **Xiaojie Gao** and co-authored by Faculty Fellow **Josh Gray** found that changes in global "greening," or the amount of leaves plants are able to produce, will play a significant role in how much carbon dioxide plants capture and store. The work was covered by Tech Explorist, CTV News, PiPa News and Nature World News.



Learn more about the latest Center research at geospatial.ncsu.edu/news/category/new-research.

THE YEAR IN NUMBERS



49+

publications



12+

publications with a student first author



37

new and continued affiliated grants



\$19+M

new and continued affiliated funding

Diversity of Our Graduate Programs

| | Female Students (%) | | | Underrepresented Minority Students (% of Domestic) | | |
|-----------------------|---------------------|-----------|-----------|--|-----------|-----------|
| | 2020 – 21 | 2021 – 22 | 2022 – 23 | 2020 – 21 | 2021 – 22 | 2022 – 23 |
| Doctoral Degree | 45 | 49 | 62 | 12 | 16 | 19 |
| Professional Master's | 32 | 39 | 45 | 14 | 13 | 15 |
| Graduate Certificate | 51 | 57 | 58 | 14 | 13 | 17 |



15

Geospatial Forum speakers



41

capstone community partners



34

at organizations

RESEARCH SPOTLIGHT



Graduation to Vocation: Geospatial Analytics Ph.D. Alum Corey White is Democratizing Geospatial Data

After earning his doctorate from the Center for Geospatial Analytics in May 2023, Corey White launched OpenPlains Inc. in Durham.

As founder and CEO of OpenPlains Inc. (openplains.com), White hopes to provide communities in North Carolina and beyond with a scenario-based engagement platform that allows them to make data-driven decisions that contribute to climate resilience and promote environmental justice.

“By offering this platform, OpenPlains aims to make geospatial modeling and simulation more accessible, engaging and effective, thereby helping communities to better understand complex issues and create more equitable and sustainable outcomes,” White said.

We asked White how his time at NC State University prepared him for a career in geospatial analytics.

Check out the Q&A:



How did your degree prepare you for your future?

The Center for Geospatial Analytics has prepared me in many ways for my future in both technical and soft professional skill sets. Technically, the Center has provided me with the skills necessary to perform and develop complex geospatial modeling and analysis using open-source software such as GRASS GIS. Additionally, the Center’s culture of collaboration and focus on science communication has provided me with leadership and communication skills to help me as a researcher and entrepreneur.

What’s your favorite memory or class from your time at NC State?

I had a fun debate with a fellow member of my Ph.D. cohort for our Grand Challenges in Geospatial Analytics seminar course regarding open-source software and open science. We were both assigned a side to defend, and I luckily was given the position of defending open-source and open science. During the debate, we argued about the commercialization potential of open-source projects. I argued that code does not make a company and that there are many examples of profitable open-source companies, with one of the most significant existing in Raleigh — Red Hat. My opinion did not falter throughout my time as a graduate student, and I am still committed to open-source software and open science.

What is unique about you or your work?

My work focuses on flipping the traditional role of the researcher on its head because the researcher/modeler is there to facilitate the modeling efforts, but the community is driving the research.

What motivated you to pursue your work?

We are facing an existential climate crisis that will impact all of us in some way. It is the challenge of my generation to figure out how to combat and plan for a very uncertain future. I view science as a creative pursuit to design and develop novel approaches to better understand the world around us in order to improve how we interact within it. My motivation to pursue my work stems from my desire to unite people to co-design more sustainable and resilient solutions to address these issues through geospatial analytics.

What advice would you give students entering your major or field?

You are entering into geospatial analytics at a fantastic time where recent advancements in the amount of data and computing power available give you so many opportunities to be creative to solve real-world problems. However, to make the most impact, you must learn to be comfortable with code, listen, and communicate your work clearly and compellingly.



SERVICE CENTER SPOTLIGHT

Through our Service Center, government agencies, private companies and other clients gain payment-based access to resources and expertise at the Center for Geospatial Analytics. We welcome both campus and external partners to use our Service Center, to solve problems both large and small.

For example, we...



> build 2-D and 3-D web mapping applications with cutting-edge technology



> create custom geospatial databases to house tabular and spatial data



> offer flexible and robust spatial data hosting for web mapping applications



> provide various remote sensing services, including land use classification



> create high-quality maps (both physical and electronic), tailored to meet client specifications and cartographic standards

We can also help you...



> perform your big-data analyses faster through batch automation



> process your geospatial imagery, including scanning and georeferencing hard copy imagery



> install and run your own tangible user interface for geospatial analysis

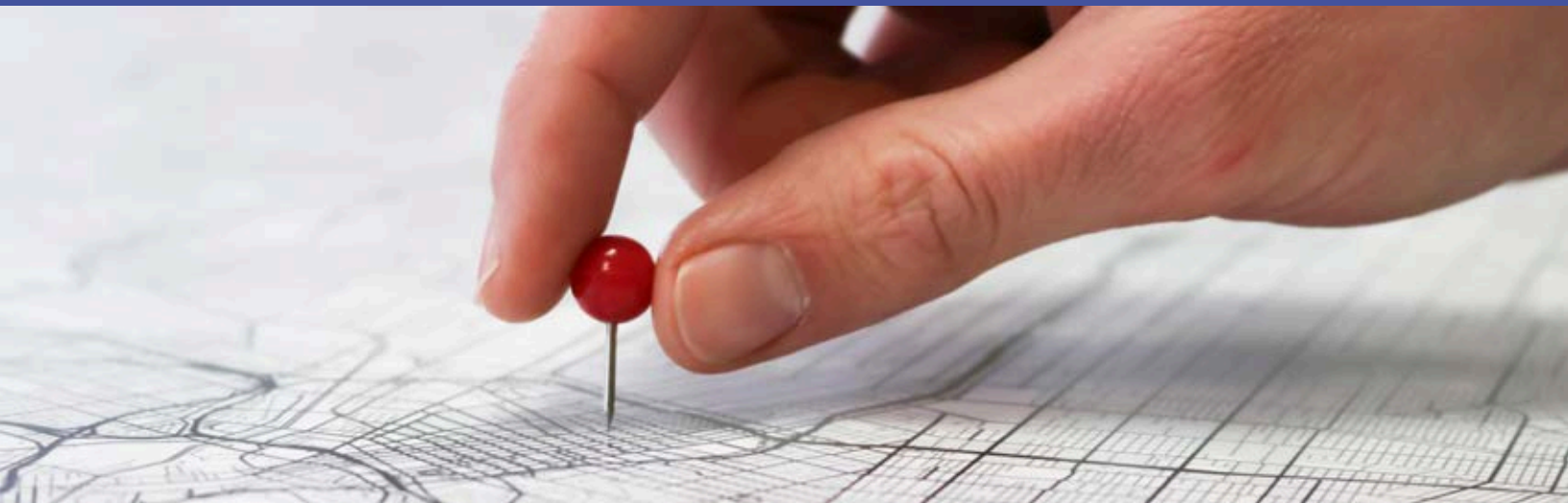


> launch your drone research with mission planning, imagery processing and analytics



> build the skill set of your own team through personalized training

To learn more and get started, visit geospatial.ncsu.edu/engage/service-center.



GIS Tops NC State University's Graduate Certificate Programs

In recent years, more students have earned the Center for Geospatial Analytics' Graduate Certificate in GIS than any other graduate certificate at NC State University.

Given how useful spatial analysis is to a range of fields, and the growing demand for a professional workforce with GIS skills, the popularity of the certificate is perhaps no surprise.

"The Graduate Certificate in GIS has become the university's best example of a stackable credential," says Eric Money, director of graduate programs for both the Certificate and NC State's professional master's degree in Geospatial Information Science and Technology (MGIST). Money is also the Center for Geospatial Analytics' associate director of educational innovation.

NC State graduates earning the Graduate Certificate in GIS have recently represented 24 majors, ranging from international studies and civil engineering to landscape architecture and biology. These students earned degrees from the Colleges of Agriculture and Life Sciences, Design, Engineering, Humanities and Social Sciences, Natural Resources, Sciences and Veterinary Medicine.

"The Certificate was initially designed to serve students who did not want to commit to a full

graduate program in GIS," Money says, "so it can be completed all on its own. At least 60% of our students do that. After completing the Certificate, though, many students discover that they wish to dive deeper into GIS study, and probably at least half of these students decide to continue on and complete our master's degree. This is in addition to those students already enrolled in a full-time graduate program at NC State who want to pair the Certificate with their degree, so they can apply GIS skills to their own work."

An average of 100 students are enrolled in the Graduate Certificate in GIS program in any given year, and the number graduating each year is increasing.

"Geospatial jobs continue to be in high demand," Money explains. "The number of jobs requiring geospatial skills are expected to grow 3–36% above average over the next decade, according to the US Bureau of Labor Statistics."

Launched in 2002, the Graduate Certificate in GIS helps students establish themselves in GIS practice and build essential skills. To serve both full-time students and working professionals, it can be completed entirely online. The deadline for Fall admission is April 15 and for Spring admission is October 15.

RESEARCH SPOTLIGHT



Residential flooding in Reidsville, Georgia. Photo by Jackie Jones.

Finding Floods from Space to Support Community Action

By Megan Skrip, Center Science Communicator

Across the United States, flood risk is underestimated, and many people experience frequent flooding despite living outside of the 100-year floodplain designated by the Federal Emergency Management Agency. To make matters worse, 21 states lack flood disclosure laws, which require home sellers to notify prospective buyers about past flood damage.

In Reidsville, Georgia, one of the nondisclosure states, homeowner Jackie Jones learned only after purchasing her house that heavy rainfall meant substantial and costly flooding—and not only of her property but many others' nearby. Yet, when she brought her concerns to the local city council, her observations were dismissed.

To secure the extra evidence she needed to prompt flood control action in her community, Jones turned to the American Geophysical Union's Thriving Earth Exchange, which finds scientists to partner with community groups. Over the past year, she worked with a research team led by Faculty Fellow Mirela Tulbure at the Center for Geospatial Analytics, to corroborate Reidsville residents' observations using remote sensing.

"Ms. Jackie had already collected data on whose properties flooded and the days that there was rain," explains Geospatial Analytics Ph.D. candidate Mollie

Gaines, one of Tulbure's advisees. "As the team of remote sensing scientists for this project, our goal was to determine how we could best use satellite imagery to validate the lived experiences of rainy day flooding reported by the residents of Reidsville and Collins, Georgia."

Spotting a Flood From Space Is Not As Straightforward As It May Seem

"When you're using satellite imagery to find flooding in the backyards and front yards of people's homes, resolution is a problem," explains Geospatial Analytics Ph.D. student Varun Tiwari, also a member of Tulbure's lab. "Even three-meter resolution isn't enough to capture flooding in someone's yard."

"Shadows from clouds, trees and buildings can also look like water in satellite imagery," adds Gaines, making flood delineation with visual imagery tricky.

So, the research team tested different methods that could reveal changes in the proportion of water before and after reported flood events, based on the kind and amount of light reflected or absorbed in individual pixels.

"There are different spectral bands that you can

get from the satellite data,” Tiwari explains, “like RGB—red, green, blue, which we can see—and NIR, near-infrared, which we cannot see.” Vegetation, urban development and water are characterized by distinct spectral signatures, and “you can have different spectral signatures in different proportions in a pixel.”

With the spectral signature for water as their focus, the research team compared satellite imagery before and after the dates of floods reported by the Reidsville community, and found that after reported flood events, the contribution of water to particular pixels increased considerably.

“We can’t say there was a flood for sure, just from the satellite data,” says Tulbure, because image resolution and shadows make flooding hard to actually see, “but we can tell there was more water in the satellite data after the reported flood event, and more rainfall from rainfall data. Corroborating these pieces of information, we can safely conclude that those were flood events.”

At monthly meetings with Jones, Tulbure’s team shared their progress and findings, with a main goal of being as useful as possible. “It was important to learn how our work would be most beneficial,” Tulbure says, “asking ‘What do you need at the end? What would be helpful?’”

Research That Makes a Difference

Ultimately, the team’s final products included a brief technical report, which can be included in community proposals for infrastructure projects, and a publicly accessible, interactive StoryMap that details the project’s findings and can be easily shared by Jones and her collaborators.

“Ms. Jackie is an invaluable resource for describing the flooding problem and the community needs,” Gaines says, underscoring “just how much effort she has put into the community science projects and how much she continues to put in.” Jones has been working with a number of groups, including the Army Corps of Engineers, National Fish and Wildlife Foundation and the Anthropocene Alliance, to advance green flood-control projects. Although her work for justice continues, Center researchers are gratified to have played a part.

“This was a good experience for me, but it was great to have the students involved,” Tulbure says, “to have them see, ‘our work is impactful, it’s important, it has an immediate use.’ Students are excited about the impact—not just publishing papers, but seeing how

their work will be used, really helping a community get the resources that they need.”

Before coming to NC State, Tiwari worked for five years as a remote sensing and geoinformation analyst with the International Centre for Integrated Mountain Development, an intergovernmental organization based in Nepal. In this role, he collaborated closely with the Afghanistan Ministry of Agriculture, gaining first-hand experience with stakeholders and communities. “When you work on a real-world problem, it makes a lot of sense, as data often represent meaningful and physical characteristics that we aim to mathematically model,” he says, “and you have end-users who are going to use that research. You’re making a contribution, to make a change.”

“This was my first experience being one of the expert scientists on a community project,” Gaines says. “It was really cool, getting to apply our science, getting on-the-ground input, getting out of the ivory tower, and doing work that can actually benefit people. This kind of experience is exactly why I came to NC State. I’m not interested in an academic career. I’m interested in applying science to real issues, whether in government or in industry. And that is what this [Geospatial Analytics Ph.D.] program is geared toward. It is really satisfying to do this kind of work as a student.”

Additional members of Tulbure’s lab who assisted with the project were doctoral student Vini Perin, who graduated in December 2022, and undergraduate researcher Brooke Cox, who helped with the storymap. The researchers also thank Thriving Earth Exchange partners Cathy Liebowitz, Jackie Jones and Jonathan A. Sullivan.



Current members of Mirela Tulbure’s Geospatial Analysis for Environmental Change Lab, from left to right: Varun Tiwari, Rebecca Composto, Júlio Caineta, Brooke Cox, Mirela Tulbure, Mollie Gaines.

EDUCATION SPOTLIGHT



Students in ENV 101 present their findings after analyzing geospatial data they collected themselves in a historically Black neighborhood in Raleigh that experiences frequent flooding. Photo by Stacy Nelson.

First-Year Students Learn Value of GIS for Environmental Justice

By Megan Skrip, Center Science Communicator

Location matters for addressing practically any environmental challenge: Wildlife depend on suitable habitat in specific places to thrive; pollution carried by rain from city streets flows into rivers downstream; and discriminatory policies have shaped the structures of neighborhoods and the circumstances of the people who live there.

For over five years, the Environmental First Year Program at North Carolina State University has taught students the importance of location to addressing environmental issues, as part of the foundational course ENV 101: Exploring the Environment.

“It takes a lot of creative and critical thinking to solve grand challenges,” said Megan Lupek, director of the Environmental First Year Program and course instructor. “Otherwise, they’d already be solved.” By partnering with experts from the Center for Geospatial Analytics, Lupek gives students the chance to think critically through a place-based lens. Over a two-week case study, students use GIS to collect and analyze their own data, exposing the impacts of institutional racism on environmental inequities in their own city.

Neighborhood as Classroom

Less than ten minutes’ drive from NC State’s Central Campus in western Raleigh lies the neighborhood of Rochester Heights, developed in the 1950s within the floodplain of Walnut Creek. The neighborhood is predominantly Black for historical reasons: In the early 20th century, the city demolished prosperous downtown Black neighborhoods, displacing 165 families, to construct new highways. Due to racially segregated housing policies and practices, homes were built in the Walnut Creek floodplain specifically for African Americans.

At the time, “it was illegal for Black people to live north of Edenton Street in Raleigh,” explained Stacy Nelson, a faculty fellow in the Center for Geospatial Analytics, professor in the Department of Forestry and Environmental Resources, and interim associate dean for diversity and inclusion of the College of Natural Resources (CNR). “Nobody wanted that land anyway, at the bottom of the watershed,” he said, because it frequently floods, and so families with limited options were the ones who moved in.

Every fall, students in ENV 101 visit Rochester Heights to learn about, and witness, the impacts of racist practices on environmental inequity.

In the hall of St. Ambrose Episcopal Church, where a local environmental justice advocacy group was founded in the 1990s, NC State alum Father Jemonde Taylor explains the history of Rochester Heights and how development elsewhere in Raleigh and Cary exacerbates local flooding. Students also learn about environmental justice more broadly from former CNR associate professor Louie Rivers III, now senior social science advisor at the US Environmental Protection Agency.

After talking with the guest speakers, students then walk the streets of Rochester Heights and nearby Biltmore Hills, two of the oldest historically Black neighborhoods in Raleigh, to collect “Quality of Life” data. Using the ArcGIS Collector app on their smartphones, each student records the locations

Meaning-Making with Spatial Analysis

Back in their classroom at NC State, students then analyze the data they’ve collected to find spatial patterns and interpret what they mean.

Nelson gives students a primer on GIS so that they can work together in ArcGIS Online and share their findings with the entire class. Center for Geospatial Analytics research associate Bill Slocumb creates the databases students need to visualize environmental information about southeast Raleigh and run analyses with the data they collected. “Bill works tirelessly behind the scenes to make it work for us,” Nelson said. “There is really a tremendous amount of effort that goes into building these databases, sometimes 100 hours or more on the back end, to make it relatively easy for students to develop the necessary expertise in one sitting. Folks like Bill contribute their time and energy simply because we know how critical it is for our next generation to



In their NC State classroom, ENV 101 students learn about GIS and flood insurance coverage gaps from CNR Interim Associate Dean Stacy Nelson. Photo by Lauren Pharr.

of features related to an assigned metric, such as schools, community amenities like playgrounds, and goods and services like grocery stores and pharmacies.

Quite often, students don’t find what they’ve been assigned to look for. “No data or low data is important data too,” Lupek said she reminds them. “It’s telling.”

The area students walk represents “an older, Black neighborhood with limited voice and power to protect their property and investments” from flooding, explained Nelson. “That also affects goods and services and their connectedness to the rest of the community.”

have the most advanced tools at their disposal to tackle our greatest natural and societal challenges. Getting things ready for the students is a lot of work each year, but worth it in the end.”

Working in ArcGIS Online is “really an opportunity for students to learn basic GIS skills but also to figure out, ‘how does my data actually relate to the environmental features of the landscape,’” Nelson explained. “We do a crash course in GIS, but the idea is that the maps they create communicate ideas, and they use those ideas to communicate about solutions.”

By visualizing which homes, schools and businesses lie within the Walnut Creek floodplain, and calculating walking distances and walking times between these destinations, students discover that flooding poses a risk to many buildings in the Rochester Heights and Biltmore Hills neighborhoods, and that many people live in “food deserts” without convenient access to grocery stores. Flood zones also make the availability of other stores and services unreliable.

“When the students analyze the data, they look through a lens of what they imagine an idealized neighborhood to be, based on their own experience or just basic human decency,” Nelson said. “They really get to ask themselves how the community relates to the data they collected, and think about the people who live in the neighborhoods they’ve mapped. How does a community go about their daily lives, get kids to school, when there’s flooding?”

“These students are the ones to make substantive change. We want to instill in them that they have that power. They can fix things.”

With GIS, it quickly becomes clear to students that Raleigh’s history of discriminatory socio-economic policies and systemic racism have created real disadvantages and vulnerabilities still present in neighborhoods today. “Systemic racism has put people in the places where they are,” Nelson explained.

“Students are sitting in a place of privilege because they are at NC State,” Lupek added. “By far, the environmental justice case study comes up among the top for students, as the one they learned the most from and found most interesting.” In their final reflection papers, ENV 101 students often report having their eyes opened to the reality that environmental injustices exist not only in faraway places but also in the city where they attend college.

“It’s so cool to see the passion and energy that the students put into working together,” Nelson added. “We want them to think out of the box, a little broader, about how can you address these issues. These students are the ones to make substantive change. We want to instill in them that they have that power. They can fix things.”

Continued Nelson, “Not only does this experience get the First Year students engaged in collecting data, and applying geospatial tools to make informed decisions about addressing these issues, but these students also gain an understanding of how to become better stewards of the environment and develop equitable solutions for all.”

Continuing the GIS Journey

ENV 101 introduces NC State freshmen to GIS because many environmental grand challenges require geospatial thinking. “Times have changed,” Nelson said. “If you’re dealing with natural resources, you have to have GIS skills. They are as important as any other skills. Over the last ten or twelve years, I can’t remember seeing any natural resources position that didn’t ask for GIS-related skills.”

“There are four ‘big things’ in geospatial science,” Slocumb added. “GIS, GPS, spatial databases and remote sensing. In this course, students are exposed to three of them.”

NC State currently offers three geospatial science courses specifically for undergraduates: GIS 205 (Spatial Thinking with GIS), GIS 280 (Introduction to GIS) and FOR 353 (GIS and Remote Sensing for Environmental Analysis and Assessment).

Since Fall 2017, 799 students have taken ENV 101; as of Fall 2022, 182 had gone on to take at least one geospatial science course (either GIS 205, GIS 280 or FOR 353), 20 had taken two geospatial courses, and one student had taken all three.

“The more we offer these courses, the more demand there is for more undergrad expansion in GIS,” Nelson said.

GEOSPATIAL GRADUATE STUDENT ORGANIZATION

This past year, the Geospatial Graduate Student Organization (GGSO) planned and coordinated even more varied and ambitious programs than last year, surpassing the success of their first annual GIS Week celebration in 2021!

GIS Week at NC State 2022 in November featured:

- > 274 registrations by 103 unique people
- > A kickoff networking event in the newly renovated Natural Resources Library with 69 attendees, including members of the public
- > Four workshops open to the broader public, with students from other institutions and employees of private companies in attendance: UAS, Intro to ArcGIS Pro, Intro to QGIS, Unleashing the Power of GRASS GIS with Jupyter Notebooks
- > Three research roundtables featuring 12 faculty fellows

GGSO also hosted **nine Lunch & Learn workshops** as part of their "Getting Data, Big and Small" series, all but one of which were led or co-led by Geospatial Analytics Ph.D. students:

- > Get to know your NC State University Libraries — data & viz, research services, spaces and more! (September 2022)
- > Show Me the Money: Be your own boss with grants and fellowships (October 2022)
- > Vector Data Bingo: Play to find useful and interesting datasets from the public and private sector! (October 2022)
- > Raster Chef: Stirring the geospatial soup with APIs and cloud computing (November 2022)
- > Grad Student Informal Q&A (November 2022)
- > Newsworthy Research: Getting media coverage for your work (January 2023)
- > Don't Fear Data Entry: Building tools for quick and painless drudgery (February 2023)
- > Command line magic: Productivity tools for data management (March 2023)
- > Hands-on workshop: Make your own spiffy personal website (April 2023).

Social events hosted by GGSO also brought together members of the Center community, including a Welcome Picnic at Raleigh Brewing Company in August 2022, regular post-Geospatial Forum socials, and group outings to 21+ Nights at Marbles Children's Museum, the NC Museum of Natural Sciences, NC State Fair and sports events.



GIS Week at NC State in November 2022 featured networking opportunities and workshops at which learners from NC State and beyond could make connections and gain new skills.

MAKING CONNECTIONS

Geospatial Forum Series

The Geospatial Forum returned to in-person presentations in Fall 2022! We hosted eleven speakers from academia and industry, and four Geospatial Analytics Ph.D. students presented their research during a special doctoral student edition. The Forum series also included a popular studio presented by Visiting Scholar Verónica Andreo.

Recordings are available to watch anytime: www.youtube.com/ncstatecenterforgeospatialanalytics

Fall 2022



Dr. Eric Edwards – NC State

Long-Term Outcomes of Recognizing Indigenous Property Rights to Water



Profs. Sara Queen and Tania Allen – NC State

Oppressive Infrastructures: Mapping Systemic Racism in the Built Environment



Austin Stone and Corbin Kling – Planet

Introduction to Planet's Science Programs, Constellations and Applications



Dr. Rachel Levy – NC State

Introduction to the NC State University Data Science Academy



Dr. Bruno Sánchez-Andrade Nuño – Microsoft

GIS Week: Scaling Planetary Insights with Geospatial Data

Spring 2023



Dr. Donal O'Leary – Finite Carbon

Including Family-Owned Forests in the Fight Against Climate Change



Dr. Xun Shi – Dartmouth

Applying Geospatial Analysis to Studies of Infectious/Communicable Diseases



Doctoral Student Forum

Lightning talks by Martine Mathieu, Ian McGregor, Annie Paulukonis and Felipe Sanchez



Dr. Caren Cooper – NC State

(Spatial) Scales of Justice: Equity, Inclusion and Accessibility in Participatory Sciences



Dr. Veronica Andreo – CONICET and the Gulich Institute, Argentina; Chair of the GRASS GIS project steering committee

Lecture | Environmental Drivers of Vector-Borne and Zoonotic Diseases: Leveraging Remote Sensing in Public Health

Studio | Using Satellite Data for Species Distribution Modeling with GRASS GIS and R



Day of Giving 2023

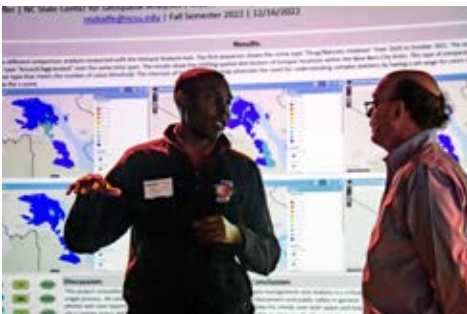
The Center's Development Committee and the Geospatial Graduate Student Association (GGSO) raised 11 gifts totaling \$760 during the March 2023 Day of Giving; these funds will go toward establishing a scholarship for military MGIST students. Thank you to our donors!

- > Sarah Corica
- > Gary Allred
- > John Vogler
- > Brandy and John Polo
- > Carmen W.
- > Six anonymous donors

MGIST Capstone Experiential-Learning Partners

Each year, our professional master's degree in Geospatial Information Science and Technology (MGIST) students provide client-focused solutions through their capstone projects. Thank you to our 2022–2023 partners!

- > Army Geospatial Center
- > BSA LifeStructures
- > Buncombe County Election Services
- > Cabarrus County Schools
- > City of New Bern Police Dept.
- > City of Montevallo, AL
- > City of Oxford, NC
- > City of Raleigh, NC
- > City of Winston-Salem, NC
- > Crown Castle
- > Duke University School of Medicine
- > Durham County Stormwater
- > Durham Public Schools
- > Hickory Fire Department
- > JC Raulston Arboretum
- > Manulife
- > National Park Service
- > National Tropical Botanical Garden
- > NC State Climate Office
- > NC Department of Transportation, Rail Division
- > NC Emergency Management
- > NC State Historic Preservation Office
- > NC State University Center for Geospatial Analytics
- > NC State University Dept. of Biological and Agricultural Engineering
- > NC State University Dept. of Parks, Recreation and Tourism Management
- > NC State University Facilities
- > NC State University Real Estate and Development
- > RTI International
- > Town of Matthews, NC
- > University of North Carolina Charlotte
- > USDA Agricultural Research Service
- > US Geological Survey
- > VHB
- > Western Carolina University Archaeology GIS Laboratory



Students present their capstone projects at the MGIST Digital Symposium in Fall 2022.

CELEBRATING OUR COMMUNITY



Students, faculty and staff at the Center's fourth Awards Ceremony at the NC Museum of Natural Sciences.

Annual CGA Awards

On January 31, we celebrated achievements by our exceptional students, faculty and staff at our fourth Awards Ceremony. Learn more, view the event program and browse the photo gallery at go.ncsu.edu/CGA-awards-2023.

Advocate Award

- > Student: Shannon McAvoy
- > Staff: Lois Utt

Beacon Award

- > Student: Katie McQuillan
- > Faculty: Katie Martin

Collaboration & Innovation Award

- > Team: Geospatial Analysis for Environmental Change Lab, led by Mirela Tulbure, with Rebecca Composto, Mollie Gaines, Varun Tiwari and Vini Perin

Creativity in Teaching Award

- > Student: Myleigh Neill
- > Faculty: Stacy Supak

Interdisciplinary Advancement Award

- > Awardee: Andrea Saravitz

Gladys West Award

- > Student: Izzi Hinks
- > Staff: John Vogler



Esri Innovation Program Student of the Year

Geospatial Analytics Ph.D. candidate Alexander Yoshizumi was NC State's 2023 Esri Innovation Program Student of the Year!

Yoshizumi's collaborative work with the US National Park Service, Veteran Fire Crews and NC State researchers resulted in a powerful StoryMap sharing the stories of veterans in fire management. His work demonstrates the power of StoryMaps to cohesively tell a story through text, maps and other visualizations, and the product he created will continue to lead to further collaboration and storytelling.

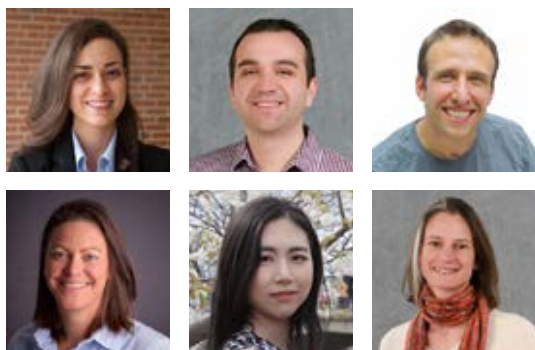
NEW FACES AT THE CENTER

Faculty Fellows

Our faculty fellows are pillars of the Center for Geospatial Analytics, making significant contributions to scholarly research and education and reflecting our commitment to excellence.

This academic year, we welcomed six new fellows:

- > Eleni Barkada, Civil, Construction and Environmental Engineering
- > Fernando Garcia Menendez, Civil, Construction and Environmental Engineering
- > Chris Jones, Center for Geospatial Analytics
- > Georgina Sanchez, Center for Geospatial Analytics
- > Zhen Qu, Marine, Earth and Atmospheric Science
- > Elsa Youngsteadt, Applied Ecology



Geospatial Analytics Ph.D. Students

The Geospatial Analytics Ph.D. is an on-campus, experiential degree program that brings together departments from across the university to train a new generation of interdisciplinary data scientists.

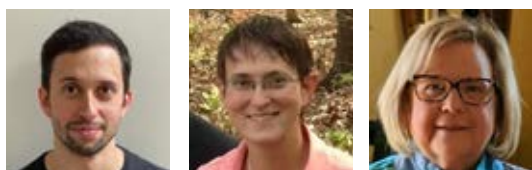
This year, we welcomed our fifth student cohort:

- > Emma Butzler
- > Grace Choi
- > Rebecca Composto
- > Mark Feinberg
- > Truffaut Harper
- > Eli Horner
- > Jamie Huerta
- > Christina Perella



Center Staff

Our dedicated staff keep the Center for Geospatial Analytics running smoothly. This year we welcomed a new software engineer, and two staff members moved into permanent positions:



- > Christopher Johnson, WebOPS Research Software Engineer
- > Juliana Quist, Geospatial Instructional Coordinator
- > Lois Utt, Executive Assistant

OUR GRADUATES

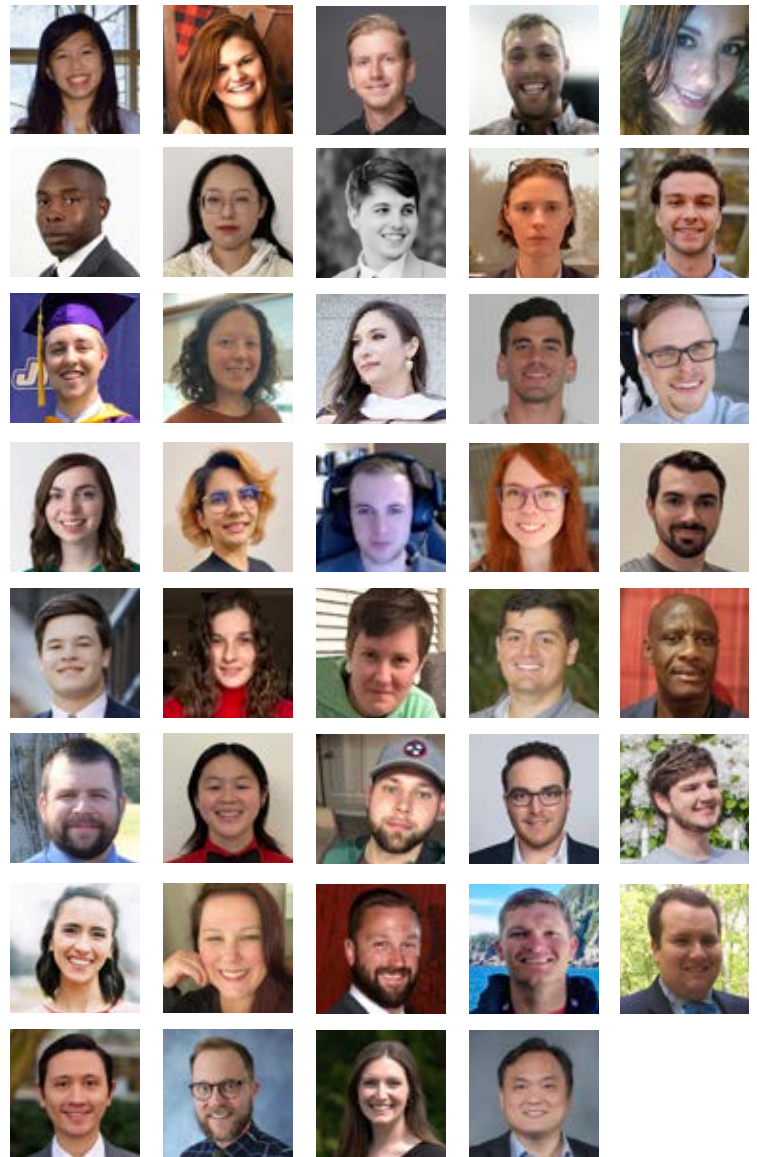
Professional Master's of Geospatial Information Science and Technology

Fall 2022

- > Deirdre (Dee) An
- > Ashley Belwolff
- > Jeremy Davis
- > Ryan Held
- > Mary Hughes
- > Randy Johnson
- > Yajie Liu
- > Michael Mirolli
- > Jill Robson
- > Ryan Shaffer
- > Brendan Simms
- > Hannah Swartz
- > Lexi Thomas
- > Zach Tunstall
- > Patrick Williams
- > Paige T. Yelen

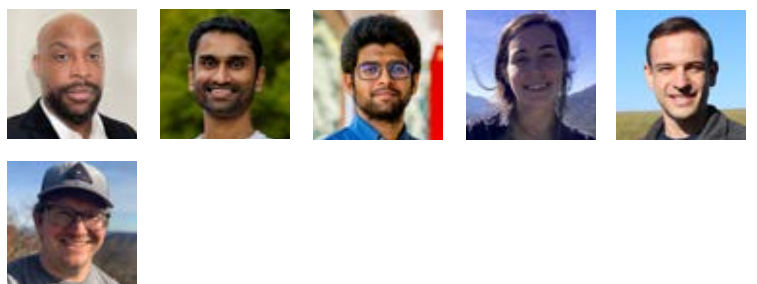
Spring 2022

- > Purdeep Dhanoa
- > Scott Ellis
- > Summer Faircloth
- > Roderick Flannery
- > Andrew Freeland
- > Jessica Hackman
- > Dallas Hoffman
- > David Kist
- > Yale Kodwo-Nyameazea
- > Robert Lawson
- > Natalie Luftman
- > Alexander Mann
- > Ben Masters
- > Kyle Noel
- > Macy Sawtelle
- > Greyson Smith
- > Derek Stanley
- > Colby Traynor
- > William Turner
- > James Webber
- > Devin M. Whitney
- > Caroline Wood
- > Hubert Yun



Geospatial Analytics Ph.D.

- > Byron Ifediora
- > Vishnu Mahesh Vivek Nanda
- > Rohith Matli
- > Katie McQuillan
- > Vini Perin
- > Corey White



Publications (Not an exhaustive list)

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Awards and Honors

(Not an exhaustive list)

Students

Jenna Abrahamson received a National Science Foundation Graduate Research Fellowship.

Emma Butzler received a University Graduate Fellowship.

Rebecca Composto received a University Graduate Fellowship.

Raja Das received a Graduate Student Research Grant from the Geological Society of America; the 2023 J. Hoover Mackin Award for best Ph.D. research proposal to the Quaternary Geology and Geomorphology Division of the Geological Society of America; a North Carolina ArcGIS User Group (NC AUG) Graduate Student Scholarship; and Roy J. Shlemon Scholarship Grant from the Environmental and Engineering Geology Division of the Geological Society of America.

Jeremy Davis was NC State's graduate student winner of the G. Herbert Stout Award for Innovative Student Papers, representing the university at the NC GIS Conference in March 2023.

Christopher Dunstan received a travel award to attend the 2023 Spatial Social Network Workshop.

Mollie Gaines was named a NASA SCoPE AGU Affiliate. She was also on the team that won the Center's Collaboration & Innovation Award.

Izzi Hinks won the Center's Gladys West Award.

Dallas Hoffman won the Center's MGIST capstone poster competition in Spring 2023.

Jamie Huerta was accepted into the 2022–23 Rachel Carson Campus Fellows program.

Margaret Lawrimore received an Honorable Mention in the Graphics & Data Visualization category of the NC State 2022 Envisioning Research Contest.

Martine Mathieu received a Student Meeting Attendance Grant from SETAC and an internship with the Department of Biostatistics and Bioinformatics at Emory University.

Shannon McAvoy was named an AGU Thriving Earth Exchange Community Science Fellow. She also won the Center's Advocate Award.

Katie McQuillan won the Center's Beacon Award.

Myleigh Neill won the Center's Creativity in Teaching Award.

Sanchez, G.M., Eaton, M.J., Garcia, A.M., Keisman, J., Ullman, K., Blackwell, K., **Meentemeyer, R.K.** (2022). Integrating principles and tools of decision science into value-driven watershed planning for compensatory mitigation. *Ecological Applications*: e2766. <https://doi.org/10.1002/eap.2766>

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Uchenna Osia received a Travel Grant from ACM SIGSPATIAL and was accepted into the Yale Environmental Fellows program.

Christina Perella was named a Global Change Graduate Fellow through the Southeast Climate Adaptation Science Center and received an IALE-NA Travel Award. She also received a University Graduate Fellowship.

Vini Perin was on the team that won the Center's Collaboration & Innovation Award.

Ariel Saffer received an honorable mention for a National Science Foundation Graduate Research Fellowship.

Felipe Sanchez received a conference travel award from the Comparative Medicine Institute.

Hannah Swartz won the Center's MGIST capstone poster competition in Fall 2022.

Varun Tiwari was on the team that won the Center's Collaboration & Innovation Award.

Corey White was accepted to summer 2023 cohort of the RIoT Accelerator Program for startups.

Alex Yoshizumi won the poster competition in the "Management & Policies" category (for Ph.D. students) at the CNR Graduate Research Symposium with his poster "A Tool for Assessing Electric Vehicle Infrastructure Across Emergency Evacuation Scenarios." He was also named NC State's 2023 Esri Innovation Program (EIP) Student of the Year.

Faculty and Staff

Faculty Fellow **Caren Cooper** was promoted to professor.

Faculty Fellow **Bethany Cutts** won an Outstanding Extension and Engagement Award from NC State and named to the Academy of Outstanding Faculty in Extension and Engagement.

Faculty Fellow **Aaron Hipp** was promoted to professor.

Faculty Fellow **Anders Huseth** was named a University Faculty Scholar.

Faculty Fellow **Daniela Jones** received an Honorable Mention in the Faculty & Staff Photography category of the NC State 2022 Envisioning Research Contest.

Faculty Fellow **Katie Martin** won the Center's Beacon Award

Faculty Fellow **Rob Scheller** won an Outstanding Research Award from NC State.

Associate Teaching Professor **Stacy Supak** won the Center's Creativity in Teaching Award.

An audio documentary co-created by Faculty Fellow **Mirela Tulbure** was honored with a science communication award from the Alexander von Humboldt Foundation and the International Journalists' Programmes. Tulbure also led the team that won the Center's Collaboration & Innovation Award.

Executive Assistant **Lois Utt** won the Center's Advocate Award.

Research Scholar **John Vogler** won the Center's Gladys West Award.

Faculty Fellow **Jelena Vukomanovic** was promoted to associate professor with tenure.

Faculty Fellow **Karl Wegmann** won an Outstanding Teaching Award from NC State.

New Grants (Not an exhaustive list)

PIs: **Christopher Jones, Chelsey Walden-Schreiner, Ross K. Meentemeyer**

Coupling Pest and Pathogen Spread and SAFARIS
Phenological Forecast with Tangible Landscape Visualization
US Dept. of Agriculture – Animal and Plant Health Inspection
Service (USDA APHIS)
\$137,446 (8-1-2022 to 7-31-2023)

PIs: **Chris Jones, Ross K. Meentemeyer, Chelsey Walden-Schreiner**, Yu Takeuchi

Adding Economic Optimization Modules to the Eradication
Analysis & Decision Support Tool
US Dept. of Agriculture – Animal and Plant Health Inspection
Service (USDA APHIS)
\$125,866 (8-1-2022 to 7-31-2023)

PIs: **Ross K. Meentemeyer, Christopher Jones, Chelsey Walden-Schreiner**, Yu Takeuchi

Automated Host Mapping Tool for Spread Modeling and Field
Operations Planning
US Dept. of Agriculture – Animal and Plant Health Inspection
Service (USDA APHIS)
\$115,954 (8-1-2022 to 7-31-2023)

PIs: Jean Ristaino, Ignazio Carbone, **Peter Ojiambo, Chris Jones**, Kelly Zering, **Laura Tateosian**, Qingshan Wei, **Raju Vatsavai, Ross K. Meentemeyer**, Jason Delborne

PIPP Phase I: Real-time Analytics to Monitor and Predict
Emerging Plant Disease
National Science Foundation (NSF)
\$1,000,000 (8-1-2022 to 1-31-2024)

PIs: Jean Ristaino, Qingshan Wei, **Christopher Jones**
A Data Driven and Sensor Integrated Platform for Monitoring
Emerging Phytophthora Diseases with VOC and MN Patch
Sensors
US Dept. of Agriculture – Animal and Plant Health Inspection
Service (USDA APHIS)
\$308,523 (8-1-2022 to 7-31-2023)

PIs: Yu Takeuchi, **Brian Reich, Christopher Jones**
Trade Route Analytic Computing and Evaluation (TRACE)
US Dept. of Agriculture – Animal and Plant Health Inspection
Service (USDA APHIS)
\$224,150 (8-1-2022 to 7-31-2023)

PIs: **Chris Jones, Peter Ojiambo, Ross K. Meentemeyer**
US-UK Collab: Long-Distance Dispersal and Disease Spread
Under Increased Ecological Complexity
US Dept. of Agriculture – National Institute of Food and
Agriculture (USDA NIFA)
\$248,162 (9-1-2022 to 8-31-2023)

PI: **Jelena Vukomanovic**
CESU: Enhancing Fire Management and Engagement through
Fire Ecology Science
US National Park Service
\$76,000 (9-16-2022 to 9-30-2025)

PIs: **Aaron Hipp, Jing Huang**
Play Potential and Retention Value of Park and Playspace
Attributes
KOMPAN, Inc.
\$89,763 (10-1-2022 to 12-1-2023)

PI: **Natalie Nelson**
Future of Aquatic Flows: Exploring Changes in the Freshwater/
Saltwater Interface and its Impacts to Aquatic Species
US Geological Survey (USGS)
\$128,028 (10-1-2022 to 9-30-2023)

PIs: **Aaron Hipp**, Kyle Bunds
Longitudinal Analysis of US Golf Course Value
United States Golf Association
\$85,611 (1-5-2023 to 1-5-2024)

PIs: Yu Takeuchi, **Chris Jones**, Sheila Saia
SAFARIS Technical Agreement
US Dept. of Agriculture – Animal and Plant Health Inspection
Service (USDA APHIS)
\$350,210 (2-1-2023 to 1-31-2024)

PIs: **Laura Belica, Jennifer Richmond-Bryant**
Beginner-Intermediate Data Management and GIS Training for
OAQPS Staff North Carolina State University
US Environmental Protection Agency (EPA)
\$18,000 (4-1-2023 to 12-31-2023)

PIs: **Elsa Youngsteadt, Justyna Jeziorska**, Nathan Hostetter
Connectivity for a Complex Life Cycle: Conserving the Crystal
Skipper Butterfly in a Coastal Urban Environment
National Science Foundation (NSF)
\$429,687 (5-1-2023 to 4-30-2026)

MGIST Capstones

Fall 2022

Deirdre (Dee) An

Identifying Areas Within the City of Raleigh That Could Have Been Burdened by Past Transportation Planning
City of Raleigh

Ashley Belwolff

Developing a Tree Inventory Database and Web Application for Data Collection and Management
NC State University Facilities

Jeremy Davis

Town of Matthews, NC: Tree Canopy Analysis Tool
Town of Matthews

Ryan Held

Creating an Effective Primary Care Network for Bassett Health
BSA LifeStructures

Mary Hughes

Open-Source GIS Solutions: National Tropical Botanical Gardens
National Tropical Botanical Garden

Randy Johnson

Durham Public Schools: Socioeconomic Disadvantage Index
Durham Public Schools

Yajie Liu

Identify Different Density Targets Derived for Elevation-Derived Hydrography by Watershed
US Geological Survey

Michael Mirolli

Geospatial Technology Remote Sensing Vegetation Identification and Classification Analysis for Critical Infrastructure Management
City of Winston-Salem

Jill Robson

Hickory Fire Department Risk Assessment
Hickory Fire Department

Ryan Shaffer

Crime Hotspot Analysis Application for the New Bern Police Department
City of New Bern Police Dept.

Brendan Simms

Petersburg National Battlefield: Picket Line Assault
National Park Service - Petersburg National Battlefield

Hannah Swartz

North Carolina Emergency Management: LiDAR Story
North Carolina Emergency Management

Lexi Thomas

Update and Revision: Disc Golf Course at NCSU
NC State Real Estate and Development

Zach Tunstall

Citrus Tree Resilience Tracking
USDA Agricultural Research Service

Patrick Williams

Site Suitability Analysis For EV Charging Stations
NC State University Facilities

Paige T. Yelen

Identifying Suitable Areas for Trail of Tears Routes in Monroe County, Tennessee
Western Carolina University Archaeology GIS Laboratory

Spring 2023

Purdeep Dhanoa

North Carolina Historic Image Web Application
NC State Historic Preservation Office

Scott Ellis

Analysis of a Soil-Derived Crop Yield Index in the California Central Valley
RTI International

Summer Faircloth

Tracking Short Line Railroad Infrastructure Improvements Funded by Grant Programs
NCDOT Rail Division

Roderick Flannery

Trails to Trends: Visualizing Rocky Mountain National Park (ROMO) Trail Use Data
National Park Service

Andrew Freeland

Updating Impervious Surfaces for Durham County's Stormwater Utility Fee
Durham County Stormwater

Jessica Hackman

Assessing Quality of Life and Mapping Community Assets in Montevallo, AL
City of Montevallo, AL

Dallas Hoffman

Yield Monitor Data Analysis for Soybean Producers
NC State Climate Office & Dept. of Bio. and Ag. Engineering

David Kist

Implementing Risk-Based Prioritization of Utilities in Oxford,
North Carolina
City of Oxford, NC

Yale Kodwo-Nyameazea

Environmental Justice Communities and Gentrification Risk in
North Carolina
UNC Charlotte

Robert Lawson

Hickory Fire Department Fire Accreditation Analysis
Hickory Fire Department

Natalie Luftman

NC Trail Compilation: Calculating Trail Density by County
NC State Univ. Dept. of Parks, Recreation and Tourism
Management

Alexander Mann

Zebra Crosswalk Detection Using ArcGIS Deep Learning
VHB

Ben Masters

Server, Database, and Workflow Migration for the JC Raulston
Arboretum
JC Raulson Arboretum

Kyle Noel

Site Suitability Analysis for the Construction of Two Bridges to
Complete Lake Raleigh Trail Loop
NC State University Real Estate

Macy Sawtelle

Data Processing and Automation for Seedling Survival Audits
Manulife

Greyson Smith

Drones: Site Selection and Flyability
Crown Castle

Derek Stanley

Streamlining OpenStreetMaps in the United States Army
Army Geospatial Center

Colby Traynor

Cabarrus County Schools Infrastructure and Facility
Management
Cabarrus County Schools

William Turner

Field of Analysis of Fort Stedman at Petersburg National
Battlefield
National Park Service

James Webber

The Distribution of Child Opportunity Index in North Carolina
Duke University School of Medicine

Devin M. Whitney

Consolidated Precinct Analysis for Buncombe County, NC
Buncombe County Election Services

Caroline Wood

Honey, I'm Home: Creating and Sustaining Pollinator Gardens
at NCSU
NC State University Facilities Division

Hubert Yun

MGIST Capstone Partnership
NC State University Center for Geospatial Analytics

NC STATE
UNIVERSITY

Center for
Geospatial Analytics