THE HUNTSVILLE
R&D
REPORT
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Charting a New Course

HUNTSVILLE FLEXES ITS GEOSPATIAL MUSCLE

ON THE MAP
GEO Huntsville unites the city's geospatial high-fliers

AN APP FOR THAT
Mapping tech aids first responders in disaster zones and on battlefields

FROM MAYANS TO SMARTPHONES
UAH finds myriad new uses for GIS

The only journal focused on North Alabama's engineering, space and genetics community, anchored by Cummings Research Park

In a lab at UAH's Earth Systems Science building, Dr. Rob Griffin, right, discusses a wall-size GIS map with research engineer Cameron Handyside.

Endless applications

From ancient Mayans to next-gen smartphone apps, UAH utilizes GIS across variety of disciplines

Story by Kimberly Ballard
Photography by Sarah Cole

Space archaeology. Smartphone apps. Hydrology models. It's all possible through the field of Geographic Information Systems (GIS) and it's happening at the University of Alabama in Huntsville.

Scientists are often accused of working in isolation, conducting research in their own vertical "silos" instead of collaborating with other scientists and organizations to drive scientific discovery. UAH researchers blend academics and research across a variety of scientific disciplines related to GIS to find that the real excitement lies between the silos.

Using this integrated approach, Huntsville's National Space Science and Technology Center (NSSTC) at UAH – along with the academic arm of the UAH Department of Atmospheric Sciences, and its research arm, the Earth Systems Science Center (ESSC) – is tackling some of Earth's most intriguing climate, cultural and planetary problems.

"We all wear several hats," says Dr. Sundar Christopher, chair of the Department of Atmospheric Sciences and ESSC associate director. "With remote sensing, geographic information systems (GIS), and geospatial technology at the heart of our work, we say to our students and faculty, 'Come out of

your silo.' Together we can better solve interdisciplinary problems."

"Geospatial technology is not a single sensor on a satellite or a piece of software," says Cameron Handyside, research engineer for the ESSC. "It is a bringing together of several different data sets and analytical tools so that depending on what type of satellite data you are pulling down, you can see different things on the ground."

For instance, pulling Landsat satellite data sets allows observation of almost anything environmental: land use change, deforestation rates, population growth. LiDaR (Laser radar) uses active lasers to penetrate through a tree canopy approximately 2 centimeters into the ground surface. Microwave remote sensing measures soil moisture.

Although UAH's geospatial technology initiatives are painted with broad strokes and deep colors, Christopher's department can be couched in three thematic areas: land, water (hydrology) and air (atmosphere).

SPACE ARCHAEOLOGY EXAMINES LAND USE AMONG ANCIENT MAYANS

Environmental archaeologist Dr. Robert Griffin, assistant professor of atmospheric sciences (AS) with the ESSC, received a Graduate Student Researchers Project fellowship, sponsored by NASA, to travel throughout Central America studying the 1,500-year-old Mayan civilization. Using GIS, remote sensing technology, geospatial analyses and satellite imagery, Griffin seeks to understand the positive benefits and detrimental aspects of the Mayans' interaction with their environment. His results show the Mayans squandered their land resources, which puts into context the importance of using our own resources wisely.

Space archeology – using geospatial mapping and satellite imagery –

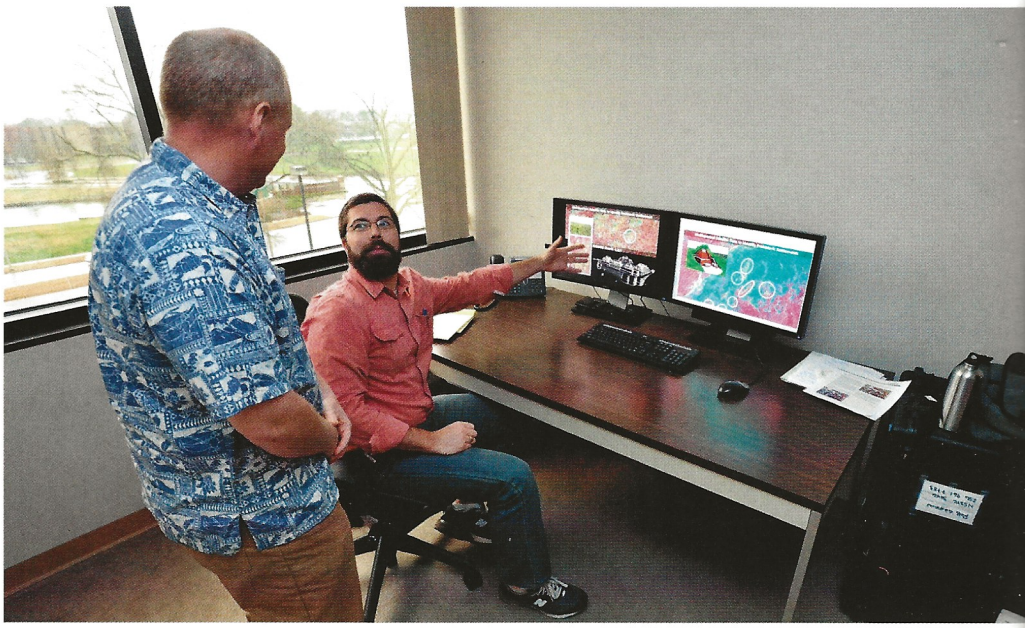
allows scientists to see through the tree canopy to locate pyramids (sometimes buried) that signify a former Mayan settlement.

"Satellite data gives us a population estimate, and by studying bone isotopes to measure the amount of carbon and nitrogen in their bones, we know they ate 60 percent of their diet in corn," Griffin explains. "The Mayans were a 'slash and burn' society. They cut down their forests to plant corn, but they did not replant trees. As the population grew, they cut down more of their rainforests to plant more corn."

AS researchers and scientists are working to quantify how the effects of deforestation on a massive level affected local climate patterns and reduced rainfall.

"We run similar models to determine how much land they used up with this farming method. These results show similar implications for our current civilization."

"Dr. Griffin's findings underscore the important role our department plays in integrating technologies and research," says Christopher. "Atmospheric issues integrated with archeology and ancient agricultural methods help us prevent the same things happening today."



Cameron Handyside, left, and Dr. Rob Griffin discuss detailed GIS maps at UAH's Earth Systems Science building.

HYDROLOGY TECH HELPS ALABAMA FARMERS COMPETE

Handyside, ESSC research engineer, uses geospatial crop modeling coupled with a new geospatial hydrology model to create tools that help Alabama's rain-fed or dry land farmers make farming more productive and profitable.

Profitability graphs for Alabama farmers show an up and down pattern, with crops flourishing during years of heavy rains but drying up in drought years. "We've not found a way to control the weather," says Handyside, "but geospatial technology helps us mitigate it and adapt."

He shares a story about a colleague's conversation with a man from California. The Californian said the wealthiest people he knew were farmers. The Alabama colleague said the poorest people he knew were farmers. What is the difference?

"It all boils down to water," says Handyside. "California's Central Valley is primarily desert, but they have plenty of water for farming because they irrigate, using 100 percent of the water they bring in. In Alabama, we have plenty of water – if we added up all the water in the state – but we use only 2.5 percent of it. We are the only state in the union without a water policy. During periods of intense summer drought like the past 10 years, Alabama farmers who fall on the wrong side of the nationally drawn drought lines suffer for it."

Every week, the Nation Drought Mitigation Center (NDMC) in Lincoln, Neb. compiles data from 87 mapping services to categorize and draw drought lines known as the U.S. Drought Monitor. It matters on which side of the line a farmer falls: one side of the line qualifies for disaster relief assistance, while the other side does not.

Handyside says the NDMC does a good job in general, but the monitor takes into account several long- and short-term factors that skew the lines: "A component of our geospatial model uses tools to create a unique map we can contribute to the NDMC every week."

The maps would consider what lakes/rivers are running dry. If a farmer is growing corn and falls short of the drought line because soybean and cotton farmers don't have the same water requirements, that data would be fairly reflected in the Monitor's data.

"More prosperous farmers build small reservoirs on the farm, and harvesting water during the winter to reuse during the dry season has been successful for some," he says. "But many parts of Alabama only have access to upland streams that dry up when they are needed most."

Handyside says there is more his geospatial research can do.

"We need to push for more irrigation in Alabama," he says. "During periods of drought, environmentalists worry we will deplete the water, but using interactive real time maps, we know that we can never naturally stress the Tennessee River. In fact, the Tennessee can irrigate one million acres of water and not notice it. The problem is water management."

To locate Alabama's water resources, the ESSC built geospatial hydrology models on top of geospatial crop models. Researchers want to know how the water is flowing, and how much water we have at any given time, at any given location. If your farm is on the Tennessee River, there is no problem. Twenty miles north of Huntsville, farmers' only water access points are the Flint River and Limestone Creek, which are highly stressed during drought.

"When you put that data on a map and color all the creeks and waterways showing stress in red, a light goes off. We showed the Alabama Office of Water Resources and the Governor's office how a water pipeline would help," Handyside explains. "They know it makes sense. Now we need a water policy to move it. We are hoping that by turning this data over to the State of Alabama in Montgomery, they will start working on one."

Last summer Governor Robert Bentley signed the Irrigation Incentives Bill, initiated by the Alabama University Irrigation Initiative (AUII), which used geospatial technology to create "what if" scenarios based on agricultural research.

"If we expand the amount of irrigated acres in this state, we will become more profitable," explains Dr. Richard McNider, UAH professor and AUII chair said. "Our studies show that if we irrigate, we can compete with Midwestern farmers."

For his efforts, McNider won the prestigious 2013 American Meteorological Society award for Outstanding Contribution to the Advance of Applied Meteorology.

"Farming is still the number one industry in the state – primarily poultry farming, but for years, Alabama farmers have been just on the verge of making money," Handyside says. "Last summer, after six weeks of intense drought, Alabama corn farmers lost their corn crop."

Importing corn from the Midwest at market price to feed chickens cuts into profits. Mississippi had the same

problem, but they have a water moving policy for irrigation so they chose to grow their own and become corn independent."

After an intense 10-year drought, Georgia put a moratorium on new wells; yet across the Chattahoochee River, an Alabama farmer received a tax credit to dig a well from the same aquifer. Handyside's department is working on a map that shows Alabama and Georgia's agricultural areas in black and white.

"Compared to South Alabama, the map will explode like light and day when you see the water mapping in Georgia," he says. "Yet there is no difference between the two areas."

GIS is powering information to the farmer. Georgia and Mississippi have 1 million acres of irrigation. Florida has more than that. Alabama has only 100,000 acres of irrigation and that includes golf courses and sod farms.

"We want to offer incentives so the farmer can take advantage of the natural resources available, but do it on a sustainable level. We are building ground water maps that tell us where the ground water is and whether there are too many wells."

SMARTPHONE APP IDENTIFIES AIR POLLUTION

GIS work at UAH also has a broader reach into the general public.

"Our Atmospheric Science department has broken another vertical silo by working in collaboration with the computer scientists at the Information Technology Center at UAH to create an iPhone app with predictive capabilities for air pollution," says Christopher. Using geospatial technology combined with satellite remote sensing and GIS models, the end-user app has caught the interest of the Environmental Protection Agency (EPA).

"We have coupled geospatial technology with weather forecasting apps to create a tool that has a practical use," says Christopher. "If you suffer from a respiratory illness, you can refer to the app and determine that over the next couple of hours, the particulate matter will be high, so you should probably avoid going out."

He explains the technology behind the app with an example of a major air pollution event.

"Let's say there is a forest fire," Christopher explains. "The app uses numerical models based on weather information like temperature and wind to predict where the smoke will move. Furthermore, it pulls down satellite information to keep it up to date."

Those models, he says, can look six, 12, even 24 hours out, but every hour that it updates, the information becomes progressively more accurate.

UAH offers a Master's degree program in Earth Systems Science with a heavy focus on GIS. The program teaches students how to apply GIS and remote sensing technologies to create meaningful and relevant applications in space archeology, land use and land cover, air pollution, or hydrology and water resources.

This integrated approach at the NSSTC's Department of Atmospheric Sciences and ESSC has produced one of the country's most prolific scientific think tanks. With geospatial technology capable of providing a comprehensive toolbox of interdisciplinary tools, the NSSTC has become the poster child for how to solve many of today's conundrums about climate, culture, history, and economics. ●

AEgis TECHNOLOGIES

AEGIS TECHNOLOGIES REORGANIZES, NAMES NEW BUSINESS UNIT HEADS

The AEgis Technologies Group has reorganized into two business units, Defense Services and Technology Solutions, to better support its customers and execute the company's strategic plan for growth.

"We expect the realignment to accelerate our diversification of solutions within aerospace, defense, training, simulation, nanotechnology and additional commercial markets," says Steve Hill, president and CEO of AEgis Technologies, in a press release.

Effective immediately, Lance Cooper will lead the Defense Services business unit as executive vice-president and David King will lead the Technology Solutions business unit, also as executive vice-president. Cooper, a 25-year veteran of the aerospace/defense industry, has contributed to the growth of the company over his nine years with AEgis. King brings 25 years of experience in modeling and simulation, and has led the fastest growing group over the last seven years as the AEgis vice-president of simulation development.

"This organizational change allows us to expedite the development of the systems and processes unique to services and products businesses, and capitalize on the rare talent and strengths of the people in these groups," says Hill.

Additional promotions have been made to support the expansion of the Technology Solutions Business Unit. Del Beilstein, a former Army aviation officer and business development director, has been promoted to vice president for business development. Additionally, Mark McDaniel, a 30+ year aerospace/defense operations