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Cloud Cover

Researchers improve predictions of cloud formation for better global climate modeling.

Atmospheric scientists have developed simple, physics-based equations that address some of the limitations of current methods for representing cloud formation in global climate models — important because of increased aerosol pollution that gives clouds more cooling power and affects precipitation.

These researchers have also developed a new instrument for measuring the conditions and time needed for a particle to become a cloud droplet. This will help scientists determine how various types of emissions affect cloud formation. The research is funded by the National Science Foundation, NASA and the National Oceanic and Atmospheric Administration.

Clouds play a critical role in climate, explains Athanasios Nenes, an assistant professor in the Georgia Institute of Technology School of Earth and Atmospheric Sciences and the School of Chemical and Biomolecular Engineering. Low, thick clouds cool the earth by reflecting solar radiation, whereas high, thin clouds have warming properties by trapping infrared radiation emitted by the earth.

Scientists have learned that human activities influence cloud formation. Airborne particles released by smokestacks, charcoal grills and car exhaust restrict the growth of cloud droplets, causing condensing water to spread out among a larger number of smaller droplets. Known as the "indirect aerosol effect," this gives clouds more surface area and reflectivity, which translates into greater cooling power. The clouds may also have less chance of forming rain, which allows cloud droplets to remain longer for cooling.

"Of all the components of climate change, the aerosol indirect effect has the greatest potential cooling effect, yet quantitative estimates are highly uncertain," Nenes says.

Current computer climate models can't accurately predict cloud formation, which, in turn, hinders their ability to forecast climate change from human activities, Nenes explains. To address both a lack of enough computer power and shortcomings of existing empirical techniques, Nenes and his colleagues developed simple, physics-based equations that link aerosol particles and cloud droplets. These offline equations can be scaled up to a global level, providing accurate predictions thousands of times faster than more detailed models. This modeling method has proven successful in two field tests.

Understanding how aerosols' chemistry affects cloud formation is another key challenge in predicting

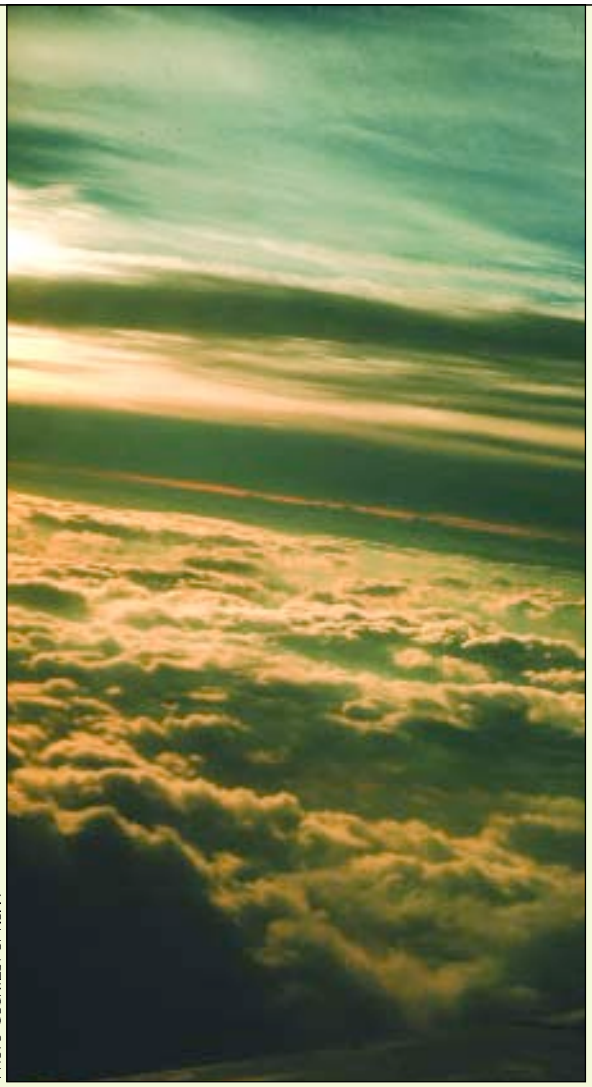
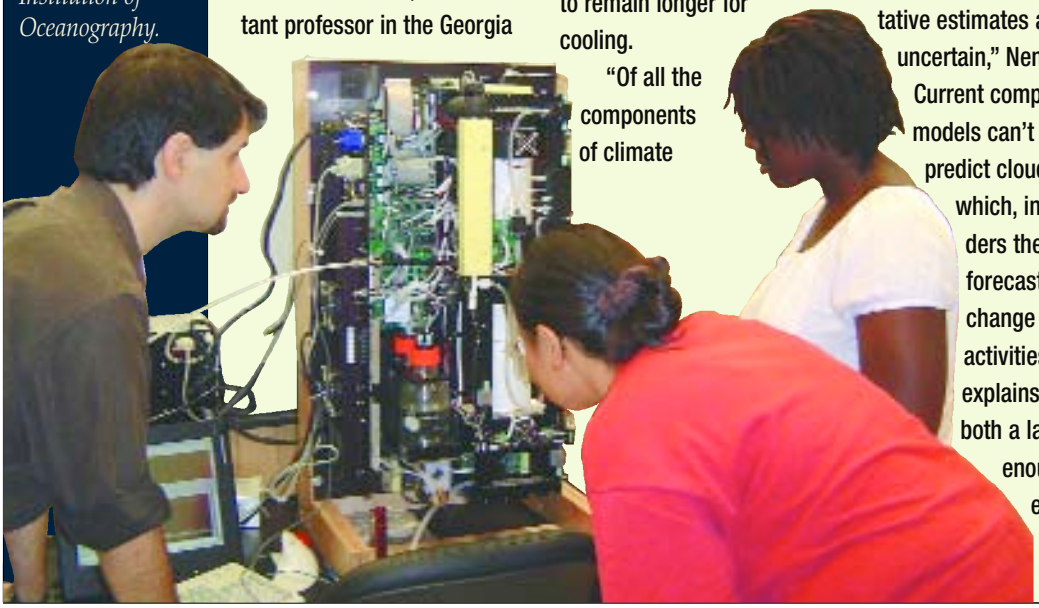


PHOTO COURTESY OF NOAA

National Oceanic and Atmospheric Administration (NOAA) researchers observe clouds from the air. Here, the photographer captured multiple layers of clouds above stratocumulus clouds.



BELOW: *Assistant Professor Athanasios Nenes, left, and students Jeessy Medina, center, and Akua Asa-Awuku study the cloud condensation nuclei counter that Nenes designed with Gregory Roberts at the Scripps Institution of Oceanography.*

climate change. Particles vary in their potential for forming cloud droplets, and they mix and change quickly. But models often don't consider this chemical aging of aerosols, Nenes says.

Working with Gregory Roberts at the Scripps Institution of Oceanography, Nenes developed a new type of cloud condensation nuclei counter that delivers fast, reliable measurements.

"It gives us a much needed link for determining how different types of emissions will affect cloud formation," Nenes explains.

—T.J. Becker

@ Contact: Athanasios Nenes at 404-894-9225 or nenes@eas.gatech.edu. Read more at: **gtresearchnews.gatech.edu/newsrelease/cloudcover.htm**

IMAGE COURTESY OF NOAA

Clouds form in a super-cell storm over the plains of Texas. These clouds are often associated with violent weather.

Converting Quantum Bits

A team of physicists at the Georgia Institute of Technology has taken a significant step toward the development of quantum communications systems by successfully transferring quantum information from two different groups of atoms onto a single photon.

The work, recently reported in the journal *Science*, represents a "building block" that could lead to development of large-scale quantum networks. Sponsored by the Research Corporation and NASA, the work is believed to be the first to demonstrate transfer of quantum information from matter to light.

The researchers, Assistant Professor Alex Kuzmich and graduate student Dzmitry Matsukevich, from Georgia Tech's School of Physics, report transferring atomic state information from two different clouds of rubidium atoms to a single photon. In the photon, information about the spatial states of the atom clouds was represented as vertical or horizontal optical polarization.

"This is the first step, one building block," Kuzmich says. "What we have done is create a quantum network node, and now the next step is to create a second quantum network node and connect them."

Qubits, or quantum bits, differ from conventional computing bits, which exist in either a 0 or 1 state. Qubits can simultaneously exist in both states and interact with other qubits. These odd properties mean quantum computers could provide dramatic advantages over conventional systems in certain types of computation.

The approach taken by Kuzmich and Matsukevich begins with two clouds of rubidium atoms, each cloud with a different state, forming a matter qubit. By passing a split beam of light separately through each cloud (also known as an ensemble) and then recombining it, they were able to create a qubit that was entangled with a single photon.

Practical applications are still at least 7 to 10 years away, Kuzmich estimates.

— John Toon

@ Contact: Alex Kuzmich at 404-385-4507 or alex.kuzmich@physics.gatech.edu. Read more at: **gtresearchnews.gatech.edu/newsrelease/quantumtrans.htm**

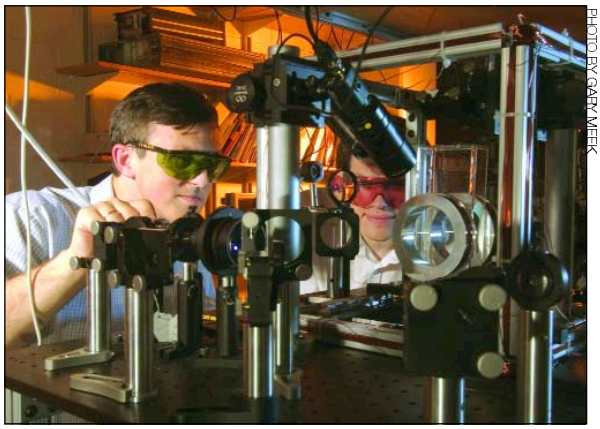


PHOTO BY GARY MEEK

Georgia Tech physicists Alex Kuzmich, left, and Dzmitry Matsukevich operate optical equipment used to transfer information from two different groups of atoms onto a single photon.

Under the Sea

A new study has revealed a mechanism that counters established thinking on how the rate at which tectonic plates separate along mid-ocean ridges controls processes such as heat transfer in geologic materials, energy circulation and even biological production.

The study also pioneered a new seismic technique — simultaneously shooting an array of 20 airguns to generate sound — for studying the Earth's mantle. The research, funded by the National Science Foundation (NSF), was reported in the Dec. 9, 2004 issue of the journal *Nature*.

PHOTO COURTESY NOAA

"Mid ocean ridges produce most of the volcanism on the Earth, releasing a lot of heat – in some places enough to support large biological communities on the seafloor," says Daniel Lizarralde, lead author of the

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paper and an assistant professor in the Georgia Institute of Technology School of Earth and Atmospheric Sciences. "There are large variations in the amount of ridge volcanism worldwide that are probably controlled by processes deep in the mantle," he explains. "Those processes leave behind an imprint in the crust and mantle that have moved away from ridge. In this study… we went well away from ridge where things have cooled down and looked at those imprints."

Slow rates of plate separation, or spreading, correlate to dramatic changes in processes occurring at mid-ocean ridges. But researchers have not had a thorough understanding of this phenomenon. So Lizarralde and his colleagues studied an extreme case that occurred over a 35-million-year period southwest of Bermuda.

They found that as the spreading rate changes, the ability of molten rock, or melt, to get out of the mantle is hindered. This finding differs from the established idea that a slow spreading rate at a mid-ocean ridge cools geologic materials and doesn't produce much melt.

"… The mechanisms we propose can explain variations in the chemistry of rocks that come out at mid-ocean ridges worldwide," Lizarralde says.

—Jane M. Sanders

@ Contact: Daniel Lizarralde, Georgia Tech, at 404-894-3976 or danl@eas.gatech.edu. Read more at: **gtresearchnews.gatech.edu/newsrelease/tectonic.htm**

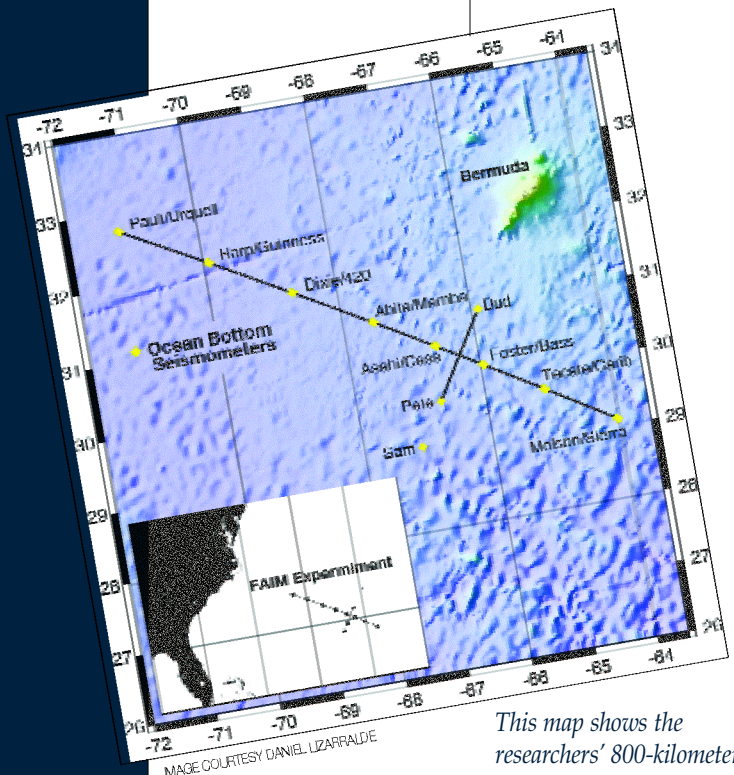
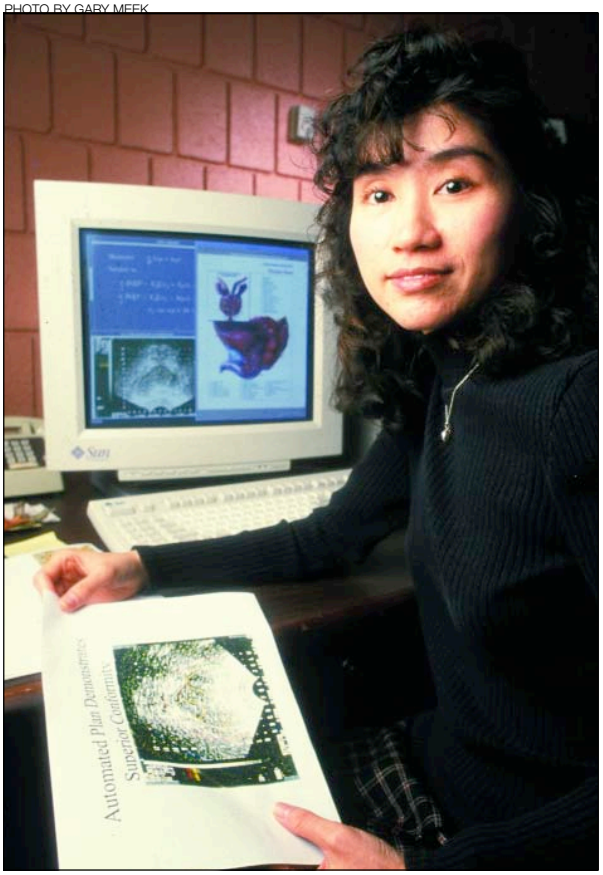


IMAGE COURTESY DANIEL LIZARRALDE

This map shows the researchers' 800-kilometer study area near a mid-ocean ridge southwest of Bermuda in the Atlantic Ocean.

PHOTO BY GARY MEEK



Associate Professor Eva Lee displays an ultrasound image of a prostate. She is working with researchers at Memorial Sloan-Kettering Cancer Center to bridge the gap between advanced diagnostic technologies and treatment planning and delivery systems.

Biological Optimization Software

As diagnostic imaging and radiation treatment technologies both become more capable and precise, physicians using them face an increasingly difficult task — how to transfer information from the diagnostic systems to the treatment planning systems.

Researchers at the Georgia Institute of Technology and Memorial Sloan-Kettering Cancer Center are solving that problem with an image translation system designed to bridge the gap between advanced diagnostic techniques such as magnetic resonance spectroscopy (MRS) and the latest techniques for delivering precise doses of radiation to tumors. The system can also compensate for how tumors change between diagnosis and treatment, during treatment, between treatments – and even as patients breathe.

Based on advanced computer modeling, the image translation technique would facilitate a biological optimization planning system that uses information about the location and density of cancer cells to deliver escalated doses of radiation to tumors.

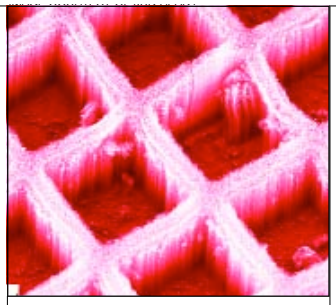
"The benefit to the patient would be in improved local tumor control," says Eva K. Lee, an associate professor in the Georgia Tech School of Industrial and Systems Engineering and the Emory University Winship Cancer Institute. "That means the rate of recurrence should be lower, and there will be fewer complications affecting the normal tissue. Patients should also experience fewer side effects from the treatment."

Sponsored by the Whitaker Foundation and the National Science Foundation, the work is part of Lee's collaboration with Marco Zaider, professor of physics in radiology at Cornell University Medical College, and head of brachytherapy physics at Memorial Sloan-Kettering.

Lee has been working on radiation treatment planning optimization for prostate and other forms of cancer. She used the new system for developing radiation therapy plans for patients undergoing MRS imaging at Memorial Sloan-Kettering. The results are promising, though controlled clinical studies must be done to compare the results with standard techniques that treat tumors as homogenous masses.

—John Toon

@ Contact: Eva Lee at 404-894-4962 or eva.lee@isye.gatech.edu. Read more at: **gtresearchnews.gatech.ed/newsrelease/morphing.htm**



Nano Manhattan

When residents of New York's Manhattan Island ran out of real estate for new construction, they expanded vertically – using multi-story buildings to get more living space on their compact island.

Georgia Tech Research Institute (GTRI) engineers hope to follow their example, but on a nanometer scale – building carbon nanotube "towers" atop photovoltaic (PV) cells to extract more power from the sun.

The nanometer-scale towers, which would be coated by special p/n junction materials used to generate electrical current in PV cells, would increase the surface area available to generate electricity. Reflections off the towers would provide more opportunity for each photon of sunlight to interact with the cell. That would increase the power output from PV cells of a given size, or allow cells to be made smaller while producing the same amount of power.

Especially in desert areas that receive lots of sunlight, these "solar tube" cells could provide an alternative power source for the growing number of electronic devices soldiers use. Without the need for trucking in fuel, compact PV cells could directly power certain applications or be used to recharge batteries in soldiers' equipment.

"You will generally get low voltages from the sun, but it generates a steady state — like a fuel cell — but without the need for a consumable fuel," explains Jud Ready, a GTRI research engineer. "It would certainly be viable for recharging and for supplying power to a base where people are stationed long-term. This could have significant benefits from a supply logistics standpoint."

— John Toon

@ Contact Jud Ready at 404-385-4497 or jud.ready@gtri.gatech.edu. Read more at: **gtresearchnews.gatech.edu/newsrelease/solartubes.htm**

Unified Environmental Improvement

Bartow County, Ga., government agencies, local industry and the Cartersville-Bartow County Chamber of Commerce have launched a first-of-its-kind unified effort aimed at reducing the countywide environmental impact of both government and industry operations.

Representatives of the participating organizations recently signed a mission statement that will be the basis for the development and implementation of a comprehensive countywide environmental management system (EMS). The Bartow County EMS could become the first in the nation to be developed jointly by the public and private sectors. Bartow County is about 45 miles northwest of Atlanta.

Development of the EMS is being led by Georgia Tech's Economic Development Institute, with assistance from the U.S. Environmental Protection Agency's Region IV office in Atlanta.

Goals include improving the county's quality of life and business climate by reducing air emissions, minimizing production of solid waste and hazardous waste, and improving management of solid waste and water resources. Beyond environmental considerations, the EMS should bring cost reductions and efficiency improvements.

Nationally, there have been pilot projects in which public entities have made environmental improvements, and similar projects have been done by private industry. The Bartow EMS is believed to be the first initiative in which a county government and city government have worked together with private industry to bring about countywide environmental improvements.

— John Toon

@ Contact: Deann Desai at 706-542-8902 or deann.desai@edi.gatech.edu. Read more at: **gtresearchnews.gatech.edu/newsrelease/ems.htm**

LEFT: Using proven techniques, Georgia Tech Research Institute researchers are growing carbon nanotube bundles in their lab for testing.

IMAGE COURTESY GEORGIA DEPT. OF ECONOMIC DEVELOPMENT

Bartow County, Ga., will soon develop and implement a comprehensive countywide environmental management system, possibly the first in the nation to be developed jointly by the public and private sectors.

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Bridging Educational Gaps

School-to-work consortium helps prepare students for high-tech careers.

Education and economic development are closely linked. A skilled labor force is critical to attract companies with high-paying jobs to locate in a community.

"Yet if educators don't understand what skills and educational background employers are looking for, their students may be unaware of emerging career opportunities — or unprepared for them," says Claudia Huff, director of Georgia Tech's Foundations for the Future (F3).

A collaboration of researchers at the Georgia Tech Research Institute (GTRI), F3's mission is to accelerate technology use in K-12 classrooms throughout Georgia. One of its recent projects, a school-to-work consortium in southeastern Georgia, has focused on closing educational gaps that might hinder economic development.

The catalyst was a new technology park in Fitzgerald, Ga., being developed next to East Central Technical College (ECTC). To support the park, ECTC has been building a new telecommunications learning facility and developing new curriculum to provide employers with a steady supply of well-trained graduates. Yet another piece of that strategy was to ensure the success of incoming students, and ECTC approached GTRI to help align its curriculum with five surrounding high school systems.

In addition to providing technical expertise, F3 developed the necessary infrastructure for the consortium, which was funded by the Georgia Department of Technical and Adult Education. Participants were recruited from ECTC and South Georgia College faculty along with teachers and curriculum specialists from high schools in Ben Hill, Irwin, Atkinson, Coffee and Wilcox counties.

"The idea was to bring the faculty together to discuss their experiences and address disconnects that occur between high school, college and the work world," Huff explains.

During the past two years, Bostelman and other consortium members compared 76 courses at ECTC with 30 high school courses. Numerous modifications were recommended to existing courses in mathematics, science, social science, English and technology, such as:

- Requiring more technical writing.
- Asking students to use Microsoft Word software when writing science lab reports and Excel to present data in a spreadsheet format.
- Requiring students to learn the binary number system, which is the backbone of computer processing.
- Learning more computer terminology and maintenance.

What's more, a new high school course, Telecom Technology Overview, has been proposed to prepare students for ECTC's new broadband and telecommunications offerings.

Demonstrations of technical equipment are especially effective in engaging students, says Jeff Evans, F3's associate director. For example, measuring signal reception on cellular systems illustrates why they need to know logarithmic concepts used in signal-testing equipment.

"Students learn best when they understand why they're learning what they're learning," Evans says. "And if you tie concepts into a unique technology that captures their attention, it can motivate students to embrace a particular career path."

The consortium's work also will help teachers better prepare students in lower grades.

IMAGE COURTESY ECTC

East Central Technical College students celebrate their graduation.

Researchers from the Georgia Tech Research Institute's Foundations for the Future project provided technical expertise and helped establish a consortium to improve the success of students at East Central Technical College in southeastern Georgia.

"The idea of seamlessness in K-12 education is not so new or revolutionary," Huff says. "But the actual practice is sufficiently scarce that it remains more of a goal for most educators — a goal toward which we constantly strive. Curriculum alignment helps teachers become better teachers and students become better learners."

Van Waters, executive vice president at ECTC, views curriculum alignment as an economic-development tool. "It shows technology companies that we understand what it takes to be successful," he says.

And attracting high-tech companies to Fitzgerald is key to battling brain drain. "Being able to offer good, high-paying jobs to our best and brightest students helps keep them at home instead of losing them to larger cities," Waters explains.

The consortium's work should have far-reaching results, Waters adds: "Even though the consortium focused on technology education, the framework that Georgia Tech developed could be replicated in other areas, such as medical fields."

— T.J. Becker

@ Contact: Claudia Huff at 404-894-3941 or claudia.huff@gtri.gatech.edu. Read more at: **gtresearchnews.gatech.edu/rh-w05/f3.html** *and* **www.f3program.org**

Creative Wherewithal

The Georgia Institute of Technology and two European institutions are joining forces to study what fosters creativity among researchers.

The project, known as Creative Capabilities in Science and Technology (CREA), includes participants from Georgia Tech's Technology Policy and Assessment Center, the Fraunhofer Institute for Systems and Innovation Research in Germany and the Science and Technology Policy Research unit at the University of Sussex in the United Kingdom.

The partners will use expert panels and bibliometrics (quantitative analysis and statistical research methods that describe patterns within a particular field or body of literature) to identify about 60 researchers responsible for recent breakthroughs in genetics and nanoscience. Then CREA will study how these researchers were able to work so effectively.

"Past research, especially in psychology, has looked at individual creativity," explains Philip Shapira, a public policy professor at Georgia Tech who is leading the school's team. "That's obviously important, but we want to understand the environmental and institutional circumstances that lead to highly innovative discoveries. Some of our existing hypotheses relate to organizational flexibility, interdisciplinary activity, strategic vision and environments that tolerate some failures and allow people to recover from them."

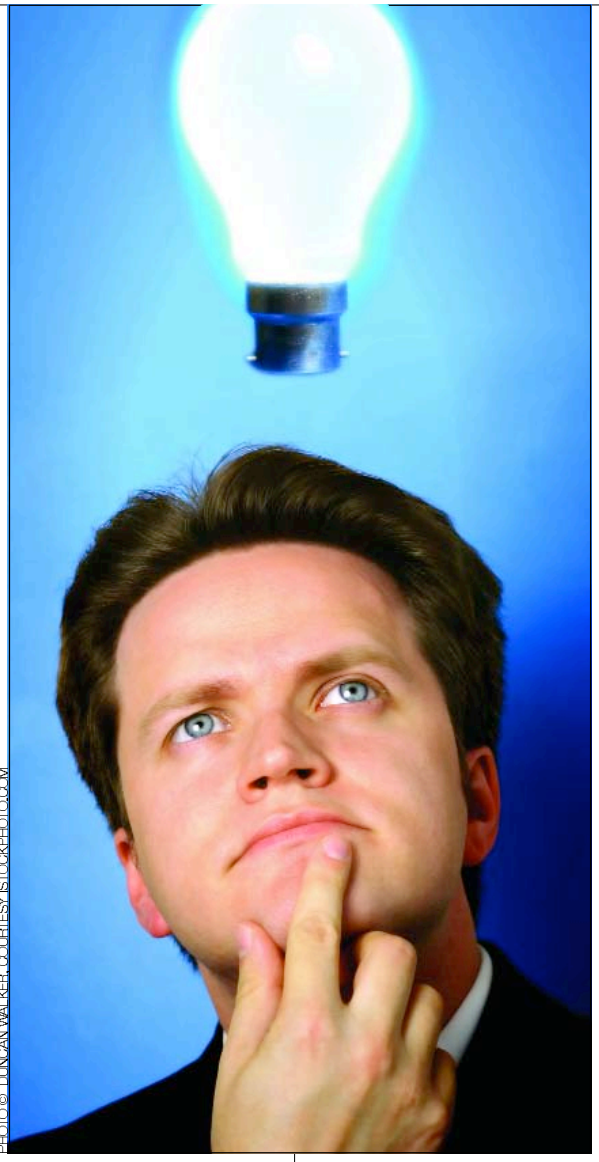

PHOTO © DUNCAN WALKER, COURTESY ISTOCKPHOTO.COM

Georgia Tech scientists are collaborating with European academics to study what fosters creativity among researchers.

Joining Shapira from Georgia Tech will be Juan Rogers, Diana Hicks and Cheryl Leggon, professors of public policy in the Ivan Allen College.

CREA is expected to shed light on:

- How to balance support between individuals and groups.
- When and where multidisciplinary research is most appropriate.
- The best ways to stimulate and reward creativity.

Findings will be used to make recommendations about science policy to support innovative research and how research institutions should be organized and managed. The study is sponsored by the European Union's program in Newly Emerging Science and Technologies.

—T.J. Becker

@ Contact: Philip Shapira at 404-894-7735 or ps25@prism.gatech.edu.

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Fiscally Healthy

These days it seems everyone is interested in staying healthy, and local governments are no exception. So when the city of Alpharetta, Ga., needed to know how proposed zoning changes would affect its fiscal health, officials contacted Georgia Tech's Economic Development Institute (EDI) to use a software planning tool known as WebFIT™.

The tool relies on analysis of how changes in population and residential, commercial and industrial property values affect government revenues and expenditures. For instance, research into the cost of serving residential and non-residential properties has consistently shown that, on average, households don't generate enough revenue to pay for the services they require. For commercial and industrial properties, the situation is usually reversed.

WebFIT was originally designed to analyze county-wide impacts and has been used by suburban Gwinnett County, with earlier versions used by Paulding and Fayette counties. By modifying the program, EDI researchers were able to help Alpharetta officials get the information they needed to evaluate the proposed land-use changes. The work could pave the way for other cities to tap WebFIT for the information they need to stay fiscally healthy.

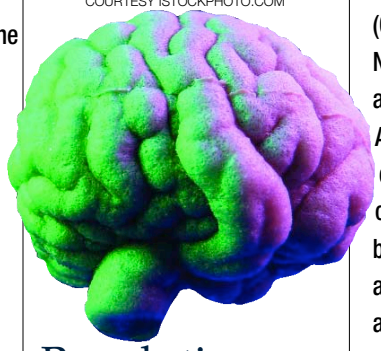
— Jack Lynch

@ Contact: Robert Lann at 404-894-3475 or robert.lann@edi.gatech.edu. Read more at: **gtresearchnews.gatech.edu/newsrelease/webfit.htm**

PHOTO BY GARY MEEK

Georgia Tech's Economic Development Institute used its WebFIT tool to help the city of Alpharetta assess the fiscal impact of proposed land-use changes. Shown examining a map of the city are (left to right) Robert Lann, manager of research services at EDI, Alpharetta Mayor Arthur Letchas and Diana Wheeler, director of community development for the city.

PHOTO © DAN BRANDENBURG, COURTESY ISTOCKPHOTO.COM



Revolutionary Neuroscience

A disembodied living brain that can be re-embodied may seem the realm of science fiction. But a group of Georgia Institute of Technology researchers, including Steve DeWeerth and Robert Butera, of the School of Electrical and Computer Engineering, and Steve Potter, of the Department of Biomedical Engineering, are building devices that can sustain and interact with networks of animal brain tissue living outside the body.

The technology, computerized multi-electrode arrays, connects neural cells — such as cultured rat brain tissue — to robotic and electronically simulated bodies. The system allows the brain tissue to direct movements in its artificial body and adapt to virtual environments by developing new neural connections.

Such real-time neural interfaces are among several tools for brain study that are under development by the Georgia Tech scientists and 90 others affiliated with the Innovative Technology Initiative of the Atlanta Center for Behavioral Neuroscience (CBN). Supported by the National Science Foundation and the Georgia Research Alliance, CBN scientists conduct research on the neurobiology of complex social behaviors associated with affiliation, aggression, fear and reproduction.

Specifically, CBN scientists are developing better technology to study how neurons and synapses dynamically alter their structures and functions in response to social interactions. With the multi-electrode arrays, scientists can create closed circuits between networks of neurons and a variety of components.

"Conventional electrophysiology techniques for studying neural tissue focus on small groups of cells contained in brain slices," Potter says. "But that approach to studying the brain is like trying to figure out the current state of the economy by asking a single person what they bought at a grocery store. With multi-electrode array technology, we can study entire living neuronal networks as they change and respond to the environment and other stimuli over time."

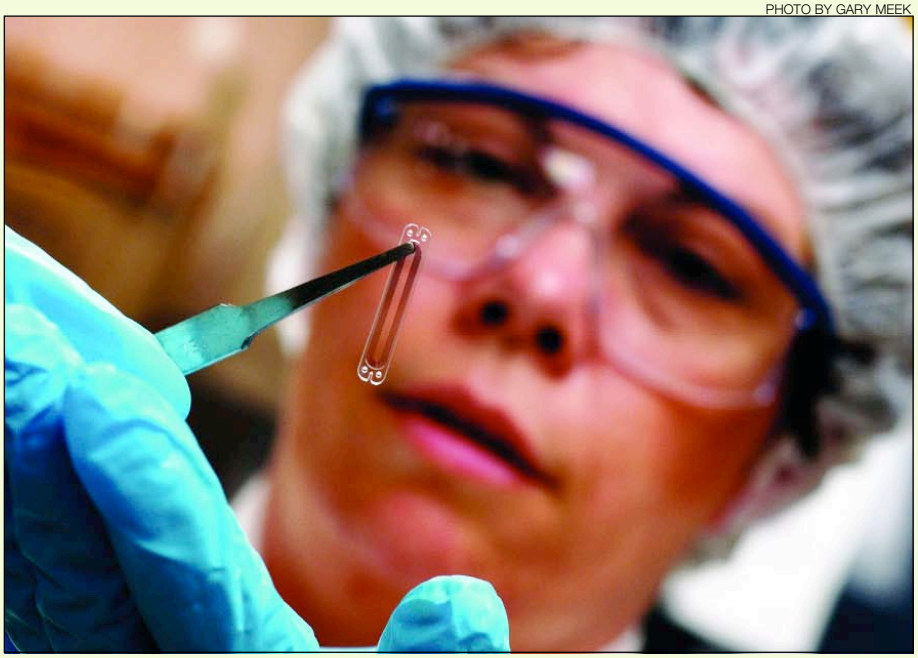
— Poul E. Olson

@ Contact: Steve Potter at 404-385-2989 or steve.potter@bme.gatech.edu. Read more at: **gtresearchnews.gatech.edu/reshor/rh-w05/brain.html**

Heart Healthy

Company moves closer to commercializing its innovative sensors for heart patients.

PHOTO BY GARY MEEK



Deborah McGee of CardioMEMS examines an EndoSensor in the company's clean room facility in the ATDC Biosciences Center located at Georgia Tech's Environmental Science and Technology Building. The sensor is implanted to measure pres - sure in an aneurism being treated by a stent graft.

CardioMEMS, a start-up company based at the Georgia Institute of Technology's Advanced Technology Development Center (ATDC) is pioneering a new breed of testing devices to monitor heart patients.

The sensor — based on research conducted at Georgia Tech and the Cleveland Clinic — combines wireless communications technology with microelectro-mechanical systems (MEMS) fabrication and will provide doctors with more information while making testing less invasive for patients.

In June 2004, the U.S. Food & Drug Administration (FDA) allowed CardioMEMS to begin clinical trials for its EndoSensor™. The device measures blood pressure in people who have an abdominal aortic aneurysm, a weakening in the lower aorta. If the aneurysm ruptures, a person can bleed to death within minutes. Doctors can treat the aneurysm with a stent graft, a slender fabric tube placed inside the bulging artery to brace it and relieve pressure by creating a channel for blood flow. Still, the stent can fail, so lifetime monitoring is required.

Until now, doctors have relied on CT scans for monitoring, but they have limitations.

"One problem is that CT scans only show the size of the aneurysm," explains David Stern, CardioMEMS' chief executive. "Yet pressure, which is what our device monitors, is the most important measurement."

CardioMEMS' biocompatible sensor, which is implanted along with the stent, monitors the stent more effectively than CT scans. It's also cheaper and more convenient. During checkups, patients don't even need to remove their clothes. The physician merely waves an electronic wand in front of the patient's chest. Radio-frequency waves activate the EndoSensor, which takes pressure measurements and then relays the information to an external receiver and monitor.

Doctors began implanting CardioMEMS EndoSensors in patients at the Cleveland Clinic in July 2004. By the end of December, about 100 patients had received the devices.

"Our trials show the EndoSensor is safe and producing good data," Stern reports. "Doctors are enthusiastic because the sensor is very easy to use even though it's complex technology."

Stern hopes the FDA will allow CardioMEMS to begin selling the EndoSensor by mid-2005.

CardioMEMS is also advancing its HeartSensor, a wireless device that measures intracardiac pressure in patients with congestive heart failure. The HeartSensor would be inserted through a catheter in a non-surgical procedure. Patients would then use monitoring electronics to check pressure daily from home. That data would be transferred over a phone line to their physician.

CardioMEMS began initial animal studies last fall, and this year Stern hopes to begin human trials both in and outside of the United States.

Launched in 2001, CardioMEMS was co-founded by cardiologist Jay Yadav, director of the Cleveland Clinic Foundation, and Mark Allen, a professor in Georgia Tech's School of Electrical and Computer Engineering and director of the school's MEMS research group. Yadav was interested in Allen's use of MEMS technology for microsensors that could measure pressure in turbine engines. Although Allen had designed the sensors specifically for military drone aircraft, he and Yadav believed that they could adapt the technology to monitor heart and blood pressure in humans.

— T.J. Becker

@ Contact: David Stern at 404-920-6700 or dstern@cardiomems.com. Read more at: **gtresearchnews.gatech.edu/newsrelease/cardiomems.htm**

BELOW: *A batch of CardioMEMS' pressure sensors is prepared for a final cleaning step.*

PHOTO BY GARY MEEK

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Scientific Circle

Coming full circle has new meaning for researchers who demonstrated a promising new approach integrating scientific experimentation and mathematical modeling to study a key signaling pathway that helps cells decide whether to grow or die.

With implications for disease characterization, biotechnology and drug design, the approach tested by researchers at the Medical University of South Carolina (MUSC) and the Georgia Institute of Technology offers an efficient way of gaining useful knowledge from the massive amounts of complex biological information generated with today's advanced analysis technology.

The work represents another step toward modeling complex biological systems accurately enough to make useful predictions.

"Our research went beyond describing a one-way street," says Professor Eberhard Voit of the Georgia Tech/Emory University Wallace H. Coulter Department of Biomedical Engineering. "Experimenters generate data, modelers design a mathematical model that fits the data, and often that's the end of the story. But, in this research, the experimenters actually tested hypotheses generated by the model, thus closing the circle."

Voit — also a Georgia Research Alliance Eminent Scholar with expertise in mathematical and computational modeling — reported this research with his MUSC colleagues in the Jan. 27, 2005 issue of the journal *Nature*. The researchers demonstrated their scientific approach within the context of sphingolipid metabolism in yeast. Sphingolipids are signaling molecules that assist cells in deciding whether to grow or die. Research has shown these molecules have implications in preventing several types of cancer in animal models.

"We amassed an incredible amount of data from the literature and the lab on this particular metabolic pathway and integrated it all into one functioning entity — the mathematical model," Voit explains. "This model now allows us to test 'what-if' scenarios and make predictions on experiments that have not been performed or that are very difficult, or impossible, to perform."

The *Nature* paper represents a very early stage in the necessary process of developing more sophisticated models, Voit says. Though the paper focused on modeling sphingolipid metabolism in yeast, it represents a good starting point for modeling this pathway in humans because of similarities in the process, he adds. He plans to collaborate on developing such a model with Georgia Tech Professor of Biology Alfred Merrill, whose research focuses on human sphingolipids.

In the current study, Voit and his co-authors tested their model to determine the degree to which its predictions were accurate.

"Qualitatively, all of our predictions were correct," Voit says. "If we predicted an increase in something, the experiments showed a similar increase. Quantitatively, our predictions need to be refined further. If we had a human model of the current quality, we would still not be able, for instance, to predict with sufficient reliability the drug dosage needed for treating a specific disease process."

The researchers plan to refine their model with additional mathematical methods and then create new hypotheses for experimenters to test.

"We'll be able to compute mathematically the points in the system that are most crucial to test because they are most sensitive to change," Voit explains. "Eventually, we'll have a metabolic model of the yeast cell. Then, for example, we might be able to apply it in biotechnology to yeast strains that are better producers of industrial alcohol or methanol as fuel for cars."

The research was funded by the National Institutes of Health. Voit's co-authors on the *Nature* paper included Yusuf Hannun, professor and chair of the MUSC Department of Biochemistry and Molecular Biology.

— Jane M. Sanders

@ Contact: Eberhard Voit at 404-385-5057 or eberhard.voit@bme.gatech.edu.

Read more at:
gtresearchnews.gatech.edu/newsrelease/pathways.htm

PHOTO BY HOLLY SASNETT, COURTESY OF GEORGIA RESEARCH ALLIANCE

Professor Eberhard Voit and colleagues from the Medical University of South Carolina reported on a new approach for gaining useful information from complex biological data.

MapRelief

Experts provide high-tech mapping software to help with tsunami recovery.

Sending money to help southeast Asia's tsunami-stricken region wasn't enough for a Georgia Tech Research Institute scientist and his colleague. They decided to send themselves — paying with their own funds — to lend their high-tech mapping expertise to recovery and rebuilding efforts.

Their volunteer mission began in early January 2005 with providing advanced geographic information system (GIS) mapping capability to aid agencies and other officials working in the region, which was devastated by a Dec. 26, 2004 tsunami that killed more than 169,000 people. GIS combines layers of information, such as terrain and vegetation data, for comprehensive analysis of a particular area.

"We decided we should go sooner rather than later," says Nick Faust, a semi-retired principal research scientist at the Georgia Tech Research Institute (GTRI). "…. We saw the news reports, the accounts of all the deaths – one-third of them children. We wanted to do something, and we had the contacts and the expertise."

Faust and Tim Foresman, president of the non-profit International Center for Remote Sensing Education (ICRSE), of which Faust is vice-president, installed advanced image processing and GIS software for their colleagues at the Asian Institute of Technology (AIT) in Bangkok, Thailand. Their mission was part of ICRSE's "MapRelief" effort to provide quick mapping capabilities to places in need.

IMAGE COURTESY INTERNATIONAL CENTER FOR REMOTE SENSING EDUCATION

"When we got there, we found what we expected," Faust says. "A lot of the aid agencies were having to send people out in the field with no maps…. The U.N. has GIS mapping capabilities on a global scale, but what they needed were maps on a local scale because the tsunami damage only extended from the coast to a few miles inland."

Commercial satellite imagery companies provided the needed imagery, but AIT researchers needed advanced technology to incorporate it into a GIS system. So Faust installed the ERDAS Imagine software, which was donated to the cause by Leica-Geosystems, a Swiss company.

"GIS maps will be able to help with cleanup and rebuilding as officials try to determine higher areas were people can build," Faust explains. Accurate mapping, along with a tsunami warning network similar to those in Japan and the central Pacific, will help save lives in case of another tsunami, he adds.

With the software upgrade, AIT will be able to use its conference facilities to host training sessions in GIS and global positioning system technology for AIT graduates — many of whom work for aid agencies throughout southeast Asia — and others.

In the coming months, Faust and Foresman — under the auspices of ICRSE — hope to obtain government or private foundation grants to fund additional collaboration with AIT to assist in relocation plans for tsunami victims and develop a long-term regional planning response to the disaster. The researchers hope to recruit some of their GIS colleagues around the world as volunteers in the effort and to coordinate their participation with other professional volunteer groups.

@ Read more at: **gtresearchnews.gatech.edu/reshor/rh-w05/tsunami-map.html**

BY JANE M. SANDERS

CONTACTS

Nick Faust at 404-894-0021 or nick.faust@gtri.gatech.edu

Tim Foresman at 410-796-1980 or foresman@direcway.com.

ABOVE: *Before-and-after satellite images show the devastation (note increase in greenish area in bottom image) from the tsunami along the Thai coast in Phuket.*

LEFT: *Georgia Tech researcher Nick Faust observes damage on the Thai peninsula in early January.*

BACKGROUND: *A satellite image of Khao Lak, Thailand, reveals coastal damage (brownish areas) caused by the tsunami, while higher elevations (areas of green vegetation) were left untouched.*