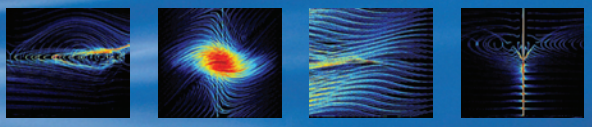
Vermont EPSCoR
Experimental Program to Stimulate Competitive Research



February 2008 Newsletter

Complex Systems Modeling

FOR ENVIRONMENTAL PROBLEM SOLVING

Running Deep

VT EPSCoR Wins $6.7M Award from NSF to fund new approach to Lake Champlain study

by Joshua Brown
UVM Senior Science Writer

A watch is complicated, but a watershed is complex. Remove one gear from the hundreds in the watch and it, predictably, stops working. Pollute one river with excess phosphorous and the whole watershed is likely to change in hundreds of ways, but nobody can be quite sure if or when or where a beach-closing toxic algae bloom will appear in Lake Champlain.

"Complex and complicated mean two very different things," says Judith Van Houten, professor of biology and lead researcher on a new project, Complex Systems Modeling for Environmental Problem Solving, funded by a $6.7 million National Science Foundation grant to the EPSCoR program at the University of Vermont.

"A complex system is far more than the sum of its parts," she says, "the whole always has surprises that could not have been predicted by studying individual pieces." Cardiac cells yield a beating heart. Leaderless ants build bridges with their bodies. Chaotic hurricanes retain their fierce form across the ocean.

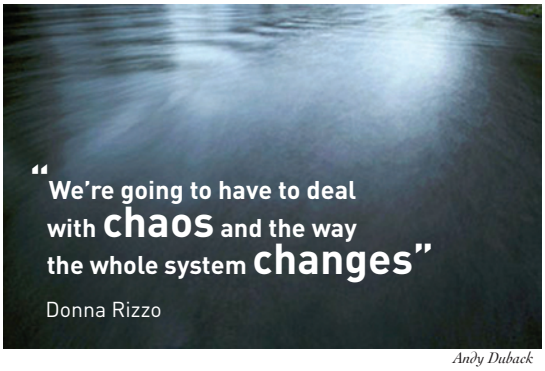
Or think of the Lake Champlain watershed. It doesn't sit there like a paper-maché model. Instead, the whole emerges from the interplay of tiny parts, and evolves in reaction to itself. It's 8,234 square miles, constantly remade by molecules of water, grains of shifting sediment, and the scuttling of microscopic insects—but also by large forces like land development, regional weather, and the globe's climate. Traditional studies of one scale or stream or species are not able to produce a very illuminating guide to what makes the whole watershed tick.

Which may explain why, though pollution has been attacked by researchers and citizens for decades—and phosphorous in a concerted way since 1991—many problems in the lake remain and are poorly understood.

"We know that areas that have higher phosphorous concentration are more likely to have blue-green algae blooms," says lake ecologist Mary Watzin, one of more than a dozen UVM scientists working with Van Houten. "But if you look at the south lake and you look at Missisquoi Bay they actually have about the same concentrations of phosphorous and yet the north lake is plagued with algae blooms and the south lake is not. Why is that? We don't understand."

The new project promises a way forward for unraveling this mystery and many other as-yet-undiscovered principles governing the lake's watershed. But Van Houten's team will not take the conventional approach of trooping out to the field to collect additional information.

Instead, drawing together ecologists, computer scientists, and engineers from across UVM, they'll compile the many rich data sets already collected over the last two decades by Watzin and other researchers, the State of Vermont, and the Lake Champlain Basin Program. These tally nitrogen and phosphorous levels, streambank erosion, forest cover, phytoplankton abundance, farm field locations, insect species richness, fish and bird populations, new pavement, weather conditions, soil types, and many other variables in and around the lake.



Andy Duback

Then it all goes in the blender. Using powerful mathematical modeling tools, the scientists will examine numerous layers of this disparate data at the same time. High-speed computers at UVM's Advanced Computing Center, running self-learning programs—including "artificial neural networks" that evolve as they work, echoing the complex systems they study—should fish out patterns hidden within the brew of interactions between water, organisms, pollution, and land use changes.

"I'm interested in developing the tools that will enable you to model these kinds of systems," says assistant professor of engineering Donna Rizzo, one of the project's partners, "but what's most exciting is getting together those of us on the computational side with the people who have been observing what's been happening in the watershed," like Watzin and UVM geologist Paul Bierman.

"If we can truly understand their data sets, we can help," Rizzo says. "They've been picking up patterns. Picking up patterns is what is so exciting."

The new computational approaches that Rizzo and her colleagues are developing "to draw these patterns to the surface" do more than calculate quickly. They take into account the "nonlinear" or chaotic properties that can make a small change create a huge effect and the ways in which simple interactions give rise to complex emergent properties.

"We cannot model the whole lake with traditional deterministic models," Rizzo says, derived from averages and that assume the system is a static backdrop. "We're not going to be able to answer management problems that way. We're going to have to deal with chaos and the way the whole system changes."

And from this darkness, "the hope is that these modeling tools can tease out what is associated with global climate change," Watzin says, "and determine what most powerfully shapes water quality in the lake. Can we see points where the system suddenly starts to deteriorate more rapidly, 'a so-called threshold response.'"

The UVM researchers think complex systems-based computer models will give answers to this kind of question—and a better sense of what various policies are likely to yield.

"If we know what the most powerful forces are and where those thresholds are, then we can develop management plans that focus where it matters and work aggressively to not cross those thresholds," says Watzin. "We know it's more complicated than just phosphorous." It's complex. ■

Lake Champlain is a Complex System

by Dr. Mary Watzin
Complex Systems Science Leader
Professor, UVM Rubenstein School of Environment and Natural Resources

The ecology of Lake Champlain is an enigma, even to those who study it. As a complex system responding to many influences, it is extremely difficult to tease apart which combination of influences are driving the patterns of water quality and biodiversity we see. Indeed we are learning that we need a fundamentally different approach to understanding complex systems because the lake's behavior emerges from the interactions between influences, and the old way of separating out the parts does not predict the condition of the whole.

Lake Champlain is closely connected to its surrounding watershed. The condition of the lake reflects that connection and the last twelve thousand years of history since the last glacier uncovered Vermont. The glacier shaped the lake's shorelines, separated its deep waters and shallow bays, and influenced the assemblage of species that invaded. In the last several centuries, European settlers have dramatically altered the landscape of the basin and fundamentally altered the connections between land and water. Although the legacy of the glaciers is still there, people have modified those initial influences and changed the water quality and biodiversity of the lake and its streams and rivers.

Today, phosphorus pollution from growing urban areas, sewage treatment plant discharges, and the region's many farms is thought to be the single greatest threat to the health of Lake Champlain. Phosphorus is an essential nutrient that all plants need to grow, but too much phosphorus may be stimulating nuisance algae blooms in the lake, some of which can be toxic to people and pets. In addition to adding phosphorus, human activities also greatly change river channels and their habitats, and generate a variety of other pollutants, including nitrogen (another essential nutrient for plant growth), sediments, and a myriad of other substances. In recent decades, warmer summers, milder winters, and a different pattern of intense storms have changed how water is delivered to the lake – and what it carries with it. These changes in water delivery and water quality have enormous implications for the biota of the Lake Champlain basin. But there is even more. The legacy of overharvesting tasty fish like trout and salmon is still apparent in the watershed's biodiversity, as is a history of changing river connections through dams, canals, and even culverts. The lake and its rivers and streams have a dramatically different complement of species as a result of these activities.

Mary Watzin

The ecological integrity of Lake Champlain and its watershed today is the cumulative result of many natural factors, interacting with human activities, both positive and negative, through the last few centuries. The lake's condition has emerged from a unique and chaotic combination of stressors over time and space. That makes sorting out causes of problems enormously difficult. Just as we cannot say that any single factor controls human health, we likewise cannot find any single factor that defines the health – or impairment – of the Lake Champlain ecosystem.

Why are toxic algae blooms common is some parts of the lake and not in others? Why do the blooms vary so much from year to year? Why are some streams in the Lake Champlain Basin home to many different species of fish and invertebrates while others, which from the surface look quite similar, are home to only a subset of those species? Are there ways we can predict how the Lake Champlain watershed will respond to climate changes and the growing human population in its basin? These are some of the fundamental questions the Complex Systems Science Team is trying to address.

By bringing together natural scientists, engineers, and modelers, we hope to combine the observations and measurements collected by those working in the field with new mathematical techniques to explore how one pattern is dependent on another.

Complex systems modelers talk about "emergent properties," or characteristics that arise from the interactions, feedbacks, and context of a system, including unpredictable (and never exactly repeated) prior events like severe storms. These emergent properties create the condition of the lake we see today. The key to understanding these emergent properties lies in finding patterns, and we find patterns by focusing on the interactions within the system, not by tracking one component or stress individually over time. In discovering the patterns, we can also understand why natural systems change in "fits and starts" not gradually, and indentify the thresholds or tipping points that exceed the capacity of the system to adapt.

Mary Watzin

Over the long term, we hope we can use the understanding we gain to help resource managers and policy makers find those interventions that work with natural processes and offer the greatest potential for restoration and management of a sustainable Lake Champlain ecosystems in the future. ■

Complex Systems Group Faculty

Science Leaders

Paul Bierman (Geology)
Breck Bowden (RSENR)
Nicholas Gotelli (BIO)
Cully Hession (C&EE)
Mary Watzin (RSENR)

Core Members

Joshua Bongard (CS)
Maggie Eppstein (CS)
Charles Goodnight (BIO)
Donna Rizzo (C&EE)
Lori Stevens (BIO)

EPSCoR Complex Systems IT Professional

Scott Duckworth

From the Director

Judith Van Houten, Ph.D.

In August 2007 we were happy to learn that the Vermont EPSCoR program was awarded $6.7M for research on *"Complex Systems Modeling for Environmental Problem Solving"* for the next three years. A great deal lot of progress has been made since August and even more is underway as we round the corner on the first year of funding. In this issue, we invite you to catch a glimpse of the good work that has been initiated and learn of the future directions of the program.

What is Complex Systems Modeling anyway?

We were fortunate to generate a good deal of press coverage for the award and I invite you to read the article that appeared in the Burlington Free Press and the transcript of an interview from Vermont Public Radio reprinted with their permission in this newsletter for an overview of the project. Visit the NOVA website on "emergence" for an excellent description: http://www.pbs.org/wgbh/nova/sciencenow/3410/03.html.

UVM has an excellent group of complex systems modelers and watershed experts (listed in the box) who will break new ground as a group and tackle existing problems of the Lake Champlain watershed in new ways. Their multidisciplinary approach is innovative and necessary as we look forward to growing this initiative and competing on the national scene.

Outreach – Streams Project

We are also pleased to announce a new outreach effort called the "Streams Project". KathiJo Jankowski Giefer, MS, is the coordinator of the project and will work closely with Drs. Charles Goodnight (UVM), Declan McCabe (St. Michael's College) and Sallie Sheldon (Middlebury) and Mary Watzin (UVM) to train undergraduates from baccalaureate colleges across Vermont and the University of Vermont to take stream samples over the next three years. The data they collect will be analyzed and modeled for future study. The existing high school outreach program has been folded into this project so that high school students and teachers will join in the collection and analysis of this relevant data. Look for more information on Page 7.

Private Sector – Phase (0), IF and Use of Facilities Awards

VT EPSCoR is committed to provide funding opportunities for entrepreneurs to help stimulate economic growth in Vermont; especially in science, engineering and technology sectors. The long established SBIR Phase (0) program joins a new program called "Innovation awards" or, "IF" awards and offers up to $10,000 for each successful proposal. A second new funding opportunity called the "Use of Facilities Award" also provides funds for entrepreneurs to use facilities and off set costs at UVM laboratories for their research. This year's awardees are listed in this issue.

The Phase (0) program continues to provide the seed money needed for an entrepreneur to work through identified research or development barriers before competing at the Federal Phase I or II levels. The IF awards are designed for truly innovative and transformative ideas that are less likely to be funded through traditional funding mechanisms. These awards are expected to be truly transformational and risky ideas that could potentially change an area of industry if successful. A second call for each of these proposals will be available shortly. The funding term for the Phase (0) awards has been extended to nine months instead of six. **The due date for submissions is expected to be late August 2008.**

Vermont Public Television and Podcasts

Look for the new VT EPSCoR "Emerging Science" series to air on Vermont Public Television beginning April 30, 2008. This three year, twelve part series will showcase faculty researchers, entrepreneurs and scientific areas that VT EPSCoR has supported throughout the state. In addition, **podcasts** showcasing vignettes of each episode will be available beginning on March 5, 2008. I invite you to subscribe to the podcasts and tune in to the program – you may see some very familiar faces and even learn a few things that you didn't know were happening in Vermont!

I hope you find the progress to date as exciting as we do. ■

UVM Researchers to Analyze Lake Data

by Ross Sneyd, as reported on Vermont Public Radio October 3, 2007

University of Vermont researchers hope they can learn some new lessons about Lake Champlain from some old work.

As VPR's Ross Sneyd reports, the scientists think high-speed computers can analyze previous data to solve the lake's problems.

(Sneyd) Many rivers and streams feed the lake. Water drains into it from farms and from the forest. Add the runoff from homes and businesses and you have a watershed. The watershed can interact in mysterious ways, causing pollution or affecting plant and fish life in the lake.

Over the years, many different studies have looked at problems from one part of the watershed – think farms and phosphorous.

Now, scientists like Josh Bongard want to pull out that earlier work, merge the disparate data and find out what it tells them.

(Bongard) "If we can do that, if we can model the watershed, then we can start to make predictions about outcomes in the watershed. For example, we can ask questions about policy: What would happen if we implemented this particular land-use policy? What would be the effect on the health of the lake next year, 10 years down the line and so forth."

(Sneyd) Bongard teaches computer science at the University of Vermont. He and other university researchers recently won a $6.7 million grant from the National Science Foundation.

One of the things they'll develop is a "complex systems computation" program. Research director Judith van Houten says the program will involve computers that can actually think ... artificial intelligence.

The program will take individual threads from different research projects and weave them into a more complete explanation of how the watershed works.

(Van Houten) "What we're really looking for are the rules of the watershed. We're not doing just one more lake study or watershed study, collecting data. But we're looking for the underlying rules of this very complex system. If we understand the rules then we'll know much better where to invest, how to do interventions. Right now we don't understand the rules."

(Sneyd) Van Houten says that once the scientists create the computational tools, they believe they'll be better able to analyze other complex systems.

(Van Houten) "This is very generalizable. As the state has other projects, other issues that need looking at – for example climate change or transportation and urban sprawl and all kinds of other things that are complex, as opposed to complicated – this is what we want to build for the state is a resource in computation."

(Sneyd) She says that means that, in the future, policy makers could plug a proposed solution to a problem into the program and understand whether it might work and how. ■

UVM Tries to Grasp Lake's Complexity

by Tim Johnson, Burlington Free Press

This much can certainly be said about the University of Vermont's celebrated new multi-disciplinary research project: It's not rocket science.

Actually, it's more complex than that.

With a little fanfare, UVM staged a news conference Friday to announce a $6.7 million grant from the National Science Foundation. Sen. Patrick Leahy, D-Vt., was there, befitting his longstanding support for scientific and technical research at UVM. President Dan Fogel spoke of the exciting new three-year research project that dovetails with the university's environmental agenda. About a dozen UVM faculty in various disciplines will participate in this study, and many of them were there, too.

The grant has three parts, one of which will engage students and teachers from around the area in a study of streams, and another that will promote private-sector innovation among small businesses. The main part – the scientific centerpiece – will be a study of something that has already been heavily studied: the Lake Champlain watershed.

Tons of data exist on the lake and its watershed – levels of phosphorus and aquatic life, hydrologic statistics, etc. – gathered over many years. All of that will be primary fodder for the new study.

What makes this study different is its ambition to understand the workings of the watershed in ways no one has been able to before.

The watershed, said Judith van Houten, lead investigator and biology professor, is an example of a complex system. Such a system is really "bigger than the sum of its parts," she said, and it behaves in ways no one can predict. Properties emerge unexpectedly.

She distinguished between systems that are "complex" and merely "complicated." A watch is complicated; so is a rocket. If you remove a part, you can predict what the whole thing will do.

"However, self-organizing things like social groups of people or neural networks or watersheds, are complex," she said. "You cannot predict the outcomes from the sum of the parts."

Members of the CSYS group attend the press announcement. Front row - Drs. Mary Watzin, Donna Rizzo, (Judith Van Houten), Charles Goodnight. Back row - Drs. (Fran Carr), Breck Bowden, Lori Stevens, Josh Bonngard. Not pictured: Maggie Eppstein, Paul Bierman, Nicholas Gotelli.

Flocking among birds is another example. A complex-systems approach to flocking has in fact deciphered implicit rules that birds follow as they veer about in groups, said Josh Bongard, a UVM computer scientist who will participate in the watershed study. A complex-systems approach looks at the totality and tries to infer rules by studying interactions of the components. Other everyday examples of complex systems include an ant colony, or a slime mold, or a hurricane.

Armed with the reams of existing Lake Champlain data, van Houten said, "We're going to listen to the watershed. We're going to let the watershed tell us what its rules are." Facilitating this will be self-modifying programs that run the data through the Advanced Computing Center.

Beyond the watershed study, complex systems are a hot topic at UVM these days. They're the primary research focus at the College of Engineering and Mathematical Sciences. Fogel envisions complex systems research as something of a niche for UVM, with prospective opportunities across departments throughout the campus.

Developing the tools "for understanding complexity is very, very appropriate for us," he said.

From left to right: VT EPSCoR Director Judith Van Hotuen, U.S. Senator Patrick Leahy, UVM Vice President for Research & Graduate Studies Dr. Fran Carr, VT Technology Council Member, Fred Hackett, UVM President Daniel M. Fogel at the press announcement.

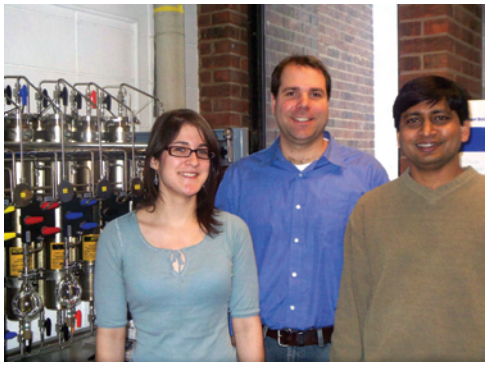
Vermont EPSCoR Notables

Dr. Matthias Brewer and Dr. Frederic Sansoz awarded NSF Career Grants

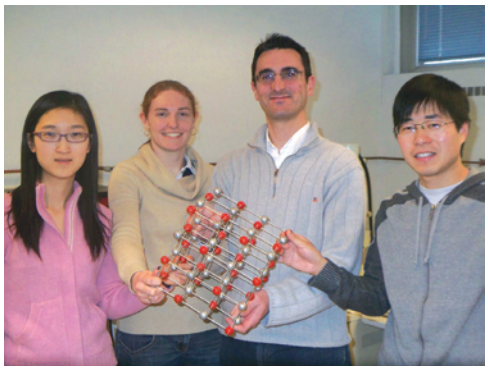
Dr. Matthias Brewer, UVM Department of Chemistry, was recently awarded a **5 year, $500,000 NSF Career Award** for his research entitled: Synthetic methodology for the preparation of polycyclic nitrogen or oxygen containing heterocycles.

NSF Career Awards support untenured faculty's career-development in both research and education. Dr. Brewer is "thrilled to have received this support. I look forward to developing both the research and the educational aspects of my proposed work. Being a faculty member at UVM it is no surprise that I am interested in green chemistry. Green chemistry concepts and practices have become increasingly important in the field of chemistry as a whole and I plan to incorporate these concepts and experiments into the undergraduate organic curriculum to strengthen our students' education. This will lay the groundwork for the next generation of chemists to develop more efficient and environmentally friendly processes throughout their careers."

VT EPSCoR funding in the form of an Equipment Acquisition Grant and an EPSCoR Mini-Grant for use of UVM Facilities have been instrumental in this project's success. Dr. Brewer's research is based on discoveries made by graduate student Muhammad Irfan Javed while he was supported by a Vermont Genetics Network Graduate Student Assistantship. Irfan is working towards his Ph.D. and is now in his fifth year of graduate studies. He will continue to develop this science for his Ph.D. thesis. Jodi Wyman, a second year graduate student also working toward her Ph.D., is tackling a different aspect of this project with the help of Adam Burgess, a second year undergraduate student. Stephanie Jochum, (UVM undergraduate, Class of 2007) helped to gather preliminary data for this work with research support in the form of a mini-grant from the Hughes Endeavor for Life Science Excellence (HELiX).



From left to right: Jodi Wyman, Dr. Matthias Brewer, and Muhammad Irfan Javed.



From left to right: Ph.D. candidates Jessie Gu, Virginie Dupont, Dr. Frederic Sansoz and Ph.D. candidate Chuang Deng.

Dr. Frederic Sansoz, Assistant Professor in the Department of Mechanical Engineering, UVM School of Engineering, was recently awarded a **$400,000 NSF CAREER grant** for his work on Microstructure and Size Effects on Metal Plasticity at Limited Length Scale. This five year grant will provide funding to further his research and "will also broadly advance the understanding in the field while promoting educational training of undergraduate and graduate students involved in the research project. In particular, this award is expected to enhance the education of students in the area of high performance and parallel computing, and high-resolution imaging."

The Faculty Early Career Development (CAREER) Program is a Foundation-wide activity that offers the National Science Foundation's most prestigious awards in support of the early career-development activities of those teacher-scholars who most effectively integrate research and education within the context of the mission of their organization. Such activities should build a firm foundation for a lifetime of integrated contributions to research and education.

Dr. Sansoz explained the significance of the research by saying, "The nanoscale is unique because it is the size scale where the familiar day-to-day properties of materials like hardness and strength meet the more exotic properties of the atomic and molecular world. For example, nanoscale wires of gold, which is naturally a very soft metal, are ultra-strong materials with strengths up to 100 times that of bulk metals. The proposed research is to gain fundamental understanding of the size-effects associated with microstructural features and sample dimension on the strength of such metallic "nanowires". To accomplish this, we will use a combined experimental/modeling research approach harnessing the power of both atomistic simulation and atomic force microscopy. This combination of methodologies will be very successful in bridging the gap between experiment and modeling in the mechanical characterization of nanomaterials. This research is also expected to show new ways to fabricate nanorods and nanowires with specific defects that make them stronger; thereby providing a roadmap for others to make improved materials. For me, the support from Vermont EPSCoR over the past four years was crucial to obtain this grant. In particular, VT-EPSCoR provided me with start-up funding and several mini-grants for equipment acquisition, which have been used to buy key laboratory instruments such as high-resolution microscopes specifically-designed for nanomechanical analysis. Also, the simulation component of this project will be conducted via massively-parallel molecular dynamics simulations performed using UVM's newly-established Vermont Advanced Computing Center."

Dr. Sansoz said of the award, "It is a great honor to receive this award and be placed amongst some of the top American researchers in my field. With this opportunity, I will be able to conduct some fundamental research in the area of metallic nanomaterials, which can dramatically improve the existing state of knowledge in the experimental and computational mechanics community. The educational component of this 5-year grant will also broadly revitalize the interest for materials science and engineering at UVM, help recruit engineering students from underrepresented groups, and stimulate international student exchanges with several European engineering-specific programs at undergraduate level via the existing International Student Exchange Program. I sincerely want to thank Vermont EPSCoR and my colleagues from the mechanical engineering program, the materials science program, and the College of Engineering and Mathematical Sciences for their continuous encouragement through the preparation of this award."

Further information about the award from NSF website at:

http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=0747658

Nora Joyal joins VT EPSCoR Administrative Team

Nora joins the office as the new Administrative Assistant.

She can be reached at Nora.Joyal@uvm.edu or by phone at 656-7931.

Award Results

Graduate Assistantship Awards

Nilanjan Lodh
Donna Rizzo (CEE)
Geomorphology and Biodiversity

Karim J. Chichakly
Robert Costanza/Breck Bowden (RSENR)
Methods for Parameterization and Parameter Estimation of a Complex Systems Model of the Winooski Watershed

Zhenyu Lu
Joshua Bongard (CS)
Automated Symbolic Modeling of Spatial Datasets

Mohammed Al-Kateb
Byung Lee (CS)
Energy-Efficient Data Storage and Retrieval in a Large-Scale Wireless Sensor Network

Kerensa M. Alley
Jane Molofsky (Plant Biology)
Using Spatially Explicit Models to Investigate Mechanisms Maintaining species and agenetic diversity

Joel Nipper
Breck Bowden (RSENR)
Storm Drain Pollutant Loads: Extrapoluting small scale site data and parameterizations to the Watershed Scale

Bree Mathon
Jane Hill (School of Engineering)
Scaling-up Bacterial Transport: The Development of Tools to Model Pathogen Migration at Multiple Scales

William Hackett
Paul Bierman (Geology)
ANN modeling of climate change impacts on Winooski River flow

Biyu Liang
Jeffrey Frolik (EE & CS)
Building Dynamic, Complex and Resilient Sensor Networks with Simple Autonomous Agents

Sreedhar Manchu
Yves Dubief (ME)
Self-Assembling and Mechanical Properties of Lipid Bilayers

Joshua L.Payne
Maggie Eppstein (CS)
Interaction Topologies and the Flow of Information in Complex Adaptive Systems

Ganesh K. Oka
George Pinder (CE&E, Math)
A Complex Systems Based Simulation of the Interrelationship between Biomass Growth and Changes in Hydraulic Conductivity of Soil

Innovation Fund (IF) Awards

Dylan Burns
MEMS Gyros for the use in Controlling the Orientation of Small Satellites

Anju Dahiya
Algae growing design for oil production guided by evolutionay forces

Vladimir Gouli
Utilization of A Significant Waste Product for Mass Production of Specialized Insect-killing Fungi for IPM

Dryver Huston
Self Sealing Hydrogen Fuel Storage Tanks and Piping

Byung Lee
GPS Data Processing with a Multifaceted Spatiotemporal Hierarchy

Kimbery Wallin
Expanding our understanding of insect host location behaviors by investigating the role and heritability of specific wavelength reflectance of host trees

Tian Xia
Frequency Agile Multistandard Wireless Radio System

UVM Pilot Awards

Brian Beckage
Investigating the dynamic of savanna communities through computer simulation

Christopher Danforth
Complex Systems Modeling of Climate Regime Change in Chaotic Convection

Peter Dodds
Investigations of Complex Social Phenomena through Large-Scale Online Experiments: Explorations of Collective Creativity and Problem Solving

Byung Lee
Energy-Efficient Data Storage and Retrieval in a Large-Scale Wireless Sensor Network

Beverly Wemple
Developing capacity in the application of complex systems modeling for watershed science and management: a case test

SBIR Phase (0) Awards

Susanne Conklin
Conklin Engineering Services, P.C.
Developing a modified geotextile for road surface to increase tire traction and eliminate winter application of road salts and sands.

Michael Cross
MW NanoTek
RuO2 Nanorods For The Production of Hydrogen

Aleksandra Drizo
Phosphoreduc University of Vermont
Steel slag filter technology for phosphorus and suspended solids reduction from non point pollution sources

Jacob Glaser
Microbrightfield, Inc.
Automated tracking and analysis of freely behaving C. elegans populations

John Hartin
Automated Resaoner Technologies for Wind Turbines and Green Energy

Kevin Holm-Hansen
Nathaniel Group, Inc.
Fiber Optic Communications for Endoscopic Video

Ben Machin
Redstart Forestry and Consulting, Inc.
Developing Tools to Forecast and Aggregate Gree-Certified Wood Supply from a Diverse Base of Private Forested Parcels

Peter Zvara
TeleMedTest, LLC
SonoUroFlowmetry-Home-Based Method for Urinary Flow Measurement

NASA EPSCoR SBIR Phase (0)
Jie Yang
Environment Friendly Microdevices, Inc.
Developments of Capillary Technologies to use Intensified CCD Camera and Microscopic Imaging for Online Laser Light Scattering

Use of Facilities (UVM)

Jeff Padgett
Engineered Solutions, Inc.
Sampling of Constructed Gravel Wetlands for Stormwater Treatment in Cold, Mountainous Environments

The Streams Project

KathiJo Jankowski
Streams Coordinator

Faculty Leaders
Declan McCabe
St. Michael's College
Sallie Sheldon
Middlebury College
Charles Goodnight
UVM
Mary Watzin
UVM

Vermont EPSCoR and the HELiX program are pleased to announce the new Streams Project, a collaborative effort by high school students and teachers, undergraduate students, and faculty members from colleges around the state to investigate and monitor streams of the Lake Champlain Basin. We are combining our successful, but previously independent, high school and college outreach programs into one large program that focuses on a single theme, the health of our waterways.

Lake Champlain is of great importance to the state of Vermont; our economy, culture and ecology depend on the clean freshwater it provides. However, the lake faces many threats from the activities that take place within its watershed; runoff from the basin carries large loads of phosphorus, sediment and bacteria that lead to blooms of toxic algae, bacteria, and invasive plant species, making parts of the lake inhospitable for recreation and wildlife. The Streams Project team will focus on small streams and rivers within the watershed, which can act as conduits for pollution entering the lake. Understanding the status of water quality in these streams will aid our state's ability to pinpoint the major sources of pollution to the lake and manage them effectively.

Under the direction of faculty from various Vermont colleges, teams of high school students, teachers and undergraduate students will collect and analyze phosphorus, bacteria and macroinvertebrate data year-round in streams identified as priorities for the state. These data will be uploaded to the web (www.uvm.edu/~streams), shared among participants in the Streams Project, and available to other interested state and local groups, including the Complex Systems modeling group. These efforts will culminate in a "Streams Symposium" every spring, during which all participants can meet one another and share their findings.

To accomplish this great task, we need the help of teachers and students from around the state. There are many ways to become involved in the Streams Project, but it's important to act soon!

There are several upcoming application deadlines:

March 5th	**Faculty research proposals**
March 14th	**High school team applications**
April 21st	**High school teachers applications, to do 5 weeks of research at UVM in the summer**

We are looking forward to getting out in the field and working as a statewide team to learn more about our largest watershed!

The Streams Project is being coordinated by **KathiJo Jankowski**, who comes to us with a background in freshwater ecology. She has a Masters degree in Aquatic Ecology and has done research on the effects of invasive species, nutrient pollution, and stormwater on streams, wetlands and lakes. She most recently completed a study of stormwater pollution on a local farm, which led to farm members taking action to improve water quality. She has also worked with the state as an assistant to the Vermont Legislature, doing policy research and public relations work for the Fish, Wildlife & Water Resources and Natural Resources & Energy committees. She is very excited to be part of the Streams Project—it's a wonderful combination of ecology and community involvement that has the potential to make a real positive impact in the Lake Champlain basin and Vermont as a whole.

Vermont EPSCoR
Experimental Program to Stimulate Competitive Research

Front cover images (upper right)
These images represent four models of a mechanical pendulum, generated by an algorithm that automatically synthesizes models of complex systems. Provided by Dr. Joshua Bongard.

Upcoming Events

VERMONT PUBLIC TELEVISION Be more PBS

NEW Funding Cycle	**SBIR Phase (0) and Innovation Fund (IF) Awards** Calls for proposals will be out soon. Proposals will be due in late August. Funding period will be for **9 months** from October 1, 2008 - June 30, 2009
March 5, 2008	**Baccalaureate Faculty Research Applications Due** **Podcasts begin – Vermont Public Television**
March 18, 2008	**Pilot Awards for UVM Faculty Research in Complex Systems Modeling Applications Due**
March 14, 2008	**Streams Project (High School Outreach) Applications Due**
April 2, 2008	**HELiX Summer Internship Applications Due**
April 21, 2008	**Streams Summer of Science Applications Due**
April 29, 2008	**Screening Party – Vermont Public Television** New "Emerging Science" series funded by VT EPSCoR premieres April 30, 2008 on VPT
June 2-6, 2008	**Streams Project Interns Orientation**
June 6, 2008	**NSF Research Day** A panel of NSF Program Officers visit UVM campus for a day-long workshop. Upates at ww.uvm.edu/EPSCoR
June 23-27, 2008	**Streams Project High School Outreach Week**
July 7 - August 8, 2008	**Streams Summer of Science (HS teachers)**
Fall 2008	**Water Conference** Date to be determined

Always visit us on the web at www.uvm.edu/EPSCoR for more information!!

Vermont EPSCoR
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