

What does it mean to be resilient? (it's a tricky question)

Ecological

- "... the capacity of a system to experience shocks while **retaining** essentially the **same function**, structure, feedbacks, and therefore identity"

Social-ecological

- "...the ability of a system to **cope** with a disturbance, **responding**, or **reorganizing** to anticipated or past events..."

Disaster

- "... the measure of a system's, or part of a system's, capacity to **absorb** and **recover** from the occurrence of a hazardous event"

Urban

- "... the ability of a city or urban system to **withstand** a wide array of shocks and stresses, and return to normal..."

Community

- "... the existence, development and engagement of community resources by community members to thrive in an environment characterized by change, **uncertainty**, unpredictability and **surprise**"

Davidson, J., C. Jacobson, A. Lyth, A. Dedekorkut-Howes, C. Baldwin, J. Ellison, N. Holbrook, M. Howes, S. Serrao-Peterson, and T. Smith. 2016. Interrogating resilience: toward a typology to improve its operationalization. *Ecology and Society*.

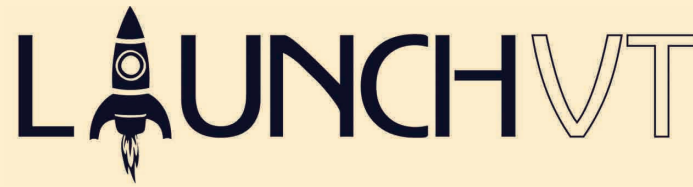
Patrick Bitterman, Postdoctoral Associate, Social Systems,
at Fall 2017 Policy and Technical Advisory Committee (PTAC) Meeting

Vermont Established Program to Stimulate Competitive Research

Our New and Continuing Partnerships



Celebrates and promotes women entrepreneurs and ventures that impact and empower the lives of women and families.



Vermont's statewide business pitch competition.



Working to enhance understanding of science by helping train the next generation of scientists and health professionals to communicate more effectively with the public, public officials, the media, and others outside their own discipline. University of Vermont became an Alda Center Affiliate in 2015.



A NSF funded project focusing on extreme events and resilience; building transdisciplinary research and integrated modeling capacity.



Works in partnership with government agencies from New York, Vermont, and Québec, private organizations, local communities, and individuals to coordinate and fund efforts that benefit the Lake Champlain Basin's water quality, fisheries, wetlands, wildlife, recreation, and cultural resources.



Promoting the sustainable use of Vermont's natural resources, protecting and improving the health of Vermont's peoples and ecosystems, and promoting sustainable outdoor recreation.



The Ana G. Méndez University System (AGMUS) and Universidad Metropolitana
Providing undergraduate summer research internships and an opportunity to present VT EPSCoR research at the annual "Research Symposium for Minority Students" in San Juan, Puerto Rico.



Vermont Public Broadcast Station educates, informs, entertains and inspires Vermonters to be lifelong learners and engaged in their community.



The University of Vermont

Home of Vermont EPSCoR and center of RACC interdisciplinary research aligning with its mission to be among the nation's premier small research universities for faculty, post-doctoral associates, graduate students, undergraduates.



Facilitating the VT EPSCoR Water Quality Research laboratory and undergraduate and high school research opportunities.



University of Puerto Rico at Rio Piedras and the Luquillo Long Term Ecological Research (LTER)
Integrating high school teams into Vermont EPSCoR RACC research to learn about climate change and water quality.



Balancing liberal arts and nationally recognized professional programs that integrate theory with hands-on experiences to prepare individuals for success.



Home to the VT EPSCoR Center for Workforce Development and Diversity (CWDD), water quality analysis laboratory for total suspended solids and summer internship opportunities for undergraduates and high school students.



Offering researchers valuable insights into Lake Champlain processes enhanced by data from the research vessel, David Folger.



VSSMF (Vermont State Science and Math Fair) and Norwich University
Vermont 5th-12th grade students' state-wide science fair competition inspires students and provides opportunities to further their interests in STEM.



The National Science Foundation
Where discoveries begin



Providing motivated adults the opportunity to participate in authentic research opportunities leading to continued STEM education or career opportunities.



A leader in creating successful learning strategies for students who learn differently and strengthening the STEM workforce.



Vermont Technology Council
A catalyst for the creation of science-and-technology-based business in Vermont.



Putting the SOCIAL in Social Ecological Systems

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One of the long standing and unique features of Vermont EPSCoR's ongoing work in water quality and extreme events is the effort of the social systems team to collect data and model human and institutional behavior. The underlying assumption guiding this work is that human beings and the institutions and organizations they create are as much features and products of ecosystems as soils, rivers and vegetation. The BREE social scientists like to joke that unlike some of the natural systems agents, social agents have something call "free will." They can change their mind, make irrational decisions, and possess a range of knowledge, skills and attitudes that are hard to account for. In the parlance of complexity science, social systems are "stochastic." In essence, people and the institutions they create are not only shaped by their



environments, but also consciously reshaped their environments- thereby creating their own conditions for new possibilities. Stochastic social systems thus, appear on the surface to be random or unpredictable. This reality has led some to assert that social systems are, ultimately, more complex than physical and biological

cal systems (see Beckage, B., Kauffman, S. Zia, A., Koliba, C., Gross, L.J. 2013. **More Complex Complexity: Exploring the Nature of Computational Irreducibility Across Physical, Biological, and Human Social Systems.** Zenil, H. editor. Irreducibility and Computational Equivalence. Berlin: Springer-Verlag. 79-88).

This is the backdrop for the work of the BREE Social Systems team who are charged with modeling the land use, governance and economic dynamics of Lake Champlain's social ecological system. Three distinct, but interrelated "agent based models" (ABMs) are being constructed. In each model, agents take different forms: farmers, households, or for-



esters; municipalities, state agencies, regional or regional planners; buyers and sellers. In each model agents are programmed to have their own "decision heuristics," or decision making criteria. Data drawn from many sources are used to create and validate these heuristics. The end results are a set of models that attempt to capture the behaviors of humans and institutions, and anticipate how they adapt to changing climatological, meteorological, economic and policy dynamics.

Not only is the BREE project modeling human and institutional behaviors inside of its models, but also interfacing with stakeholders who live and work in the Lake Champlain Basin. The "adaptive management" goals of the project seeks to use the results of the models to inform

practices and shape public policy. In other words, the BREE project is interested in having the models, scenarios and results used to ensure better water quality for our region.

To accomplish this goal we have convened a standing committee of policy and technical advisors,



deemed the "Policy and Technical Advisory Committee" or PTAC. The PTAC meets twice a year for full day workshops during which time BREE researchers and invited speakers share data and results, pose questions and seek advice from some of our region's leading experts in water quality. PTAC members are drawn from the Environmental Protection Agency, United States Department of Agriculture, representatives from the Vermont Agencies of Natural Resources, Food, Agriculture & Markets, and Transportation, regional and municipal planners, the Lake Champlain Basin Program, as well as representatives from Quebec and the International Joint Commission.

PTAC meetings have evolved to become lively spaces where water quality science and policy meet, where the relevance of findings are debated, where paper and policy brief conclusions are framed, and where new directions for model and scenario development are advanced. The presentations from PTAC meetings are routinely posted on the Resilient Waters website. <http://resilientwaters.org/> and the VT EPSCoR website at www.uvm.edu/EPSCoR

BREE Policy and Technical Advisory Committee (PTAC) Fall Meeting

The Policy and Technical Advisory Committee (PTAC) Fall Meeting was held on November 28, 2017. This served as the second meeting in 2017 for the committee, offering a chance for stakeholders from around the state and region to participate in interactive sessions and discuss the state of the Lake Champlain Basin.

Fifty stakeholders participated in the November meeting. Each of the following organizations saw representation during the day:

- Agency of Natural Resources
- City of South Burlington
- City of St. Albans
- Environmental Protection Agency
- Friends of Northern Lake Champlain
- International Joint Commission of Canada and US
- Lake Champlain Basin Program
- Ministère du Développement durable, Environnement et Lutte contre les Changements Climatiques
- Northwest Regional Planning Commission
- Organisme Bassin Versant Baie Mississquoi
- The Nature Conservatory
- US Geological Survey
- United States Department of Agriculture Natural Resources Conservation Service
- University of Vermont Extension
- Vermont Agency of Agriculture, Food, and Markets
- Vermont Agency of Transportation
- Vermont Department of Environmental Conservation
- Vermont EPSCoR
- Vermont Law School

The day-long meeting offered stakeholders a chance to share their work and concerns with the rest of the group. The morning session also provided attendees with a chance to break into small groups to discuss potential solutions with representatives from multiple organizations.

The next PTAC Meeting will be held in the Spring of 2018.



University Communications

By
Jeffrey R. Wakefield
University
Communications

Water Is Focus of UVM's Fifth Legislative Summit

There was no golden dome on the top of the Davis Center, but the fourth floor of the UVM's student center bore more than a passing resemblance to the Vermont State House on Monday morning.

various aspects of water and legislators from Montpelier, who have to make policy about these very issues," said Richard Galbraith, UVM's vice president for research, who was on hand for the event.

The nature of Vermont's citizen legislature makes this kind of exchange important, said Chris Bray ('77, G'91), chair of the Senate Committee on Natural Resources and Energy and a former member of the UVM Board of Trustees.

"One of the glories of Vermont is the citizen legislature," he said. "I love the legislature, but I also realize that we don't have the expertise for a lot of very complicated things that come our way. I'm always up for opportunities to help us educate ourselves, and I think that's where an event like the summit can really help," he said.

This year's event was organized as a "slam." Faculty presenters in each of the topic areas had four minutes to give a quick overview of their research, then repaired to one of several round tables. Legislators could then have a more extended Q&A with the faculty member of their choice.

"Instead of having long presentations and a relatively small amount of discussion, we changed it to short presentations with a large amount of discussion to increase the interaction between the two groups," Galbraith said.

Faculty participating in the Legislative Summit included George Pinder, Eric Roy and Raju Badir eddy (groundwater contamination); Breck Bowden, Chuck Ross and Chris Koliba (causes and consequences of algal bloom); and Ellen Marsden, Mindy Morales-W illiams, and Andrew Schroth (Lake Champlain as sentinel).

"The goal of this year's Legislative Summit is to maximize the exchange of information between scientists at the University of Vermont who study

Raju Badireddy (right), assistant professor of Civil and Environmental Engineering and director of the Water Treatment & Environmental Nanotechnology Lab at the University of Vermont, discusses groundwater contamination with legislators at UVM's fifth Legislative Summit. This year's event took the form of a presentation. Faculty took questions from legislators for an extended period in a roundtable format. (Photo: Sally McCay)

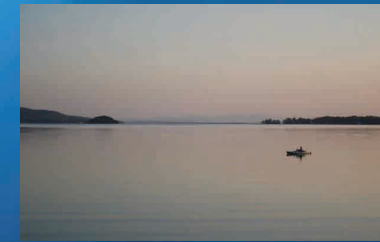
Nearly 50 state legislators took up residence there from 9 a.m. to 12:30 p.m., on hand for UVM's fifth annual Legislative Summit.

After addressing education, climate change, the Vermont economy and healthcare policy in past years, the summit's topic this year was "Water: How Will We Ensure That It Is Clean and Plentiful." The summit was divided into three sub-areas: groundwater contamination, causes and consequences of algal bloom and Lake Champlain as sentinel.

UVM faculty in disciplines ranging from natural resources, geology and public administration to agriculture and civil and environmental engineering shared with legislators the key takeaways from their research programs, with the idea that the information would help them do their jobs.

St. Albans Bay Buoy Deployment

By Andrew Schroth, Ph.D., Ecological Systems Co-Lead, Research Assoc. Prof. of Geology, UVM
Wilton Burns, Graduate Research Associate, Ecological Systems



In early May of 2017 the UVM EPSCoR lake Ecological team deployed two high-frequency water quality monitoring platforms (buoys) in St. Albans Bay. First, moorings were put in place using the R/V Melosira then boat captain Steve Cluett, PI Andrew Schroth, research technician Saul Blocher, YSI engineer Stephen, and PhD student Wilton Burns deployed the platforms and set up high-frequency data collection systems. EXO sondes with sensors that measure a host of water quality parameters (water

temperature, dissolved oxygen concentration, pH, and relative amounts of chlorophyll and cyanobacteria) were attached to the platforms. The water quality monitoring systems were then programmed to make a vertical profile of the water column every hour, collecting information on the parameters listed above from the surface to the bottom of the lake at that site. The data are automatically stored and then sent back remotely to their computers at UVM. These water quality platforms allow for real-time high-frequency monitoring of St. Albans Bay to better understand the drivers of nutrient dynamics and cyanobacteria blooms. A team from Middlebury College led by Tom and Pat Manley deployed an array of physical sensors that will be used to study the movement of water and sediment in the St. Albans Bay system. Sensors are dispersed around the Bay to capture baywide water circulation and sediment transport. Ultimately, data from the ecological, biogeochemical and physical monitoring arrays will be used in concert to develop a comprehensive physical, chemical and ecological model of the Bay that can be incorporated into the BREE Integrated Assesment Model to study impacts of extreme events on lake water quality.



Boat captain Steve Cluett, principle investigator Dr. Andrew Schroth, research technician Saul Blocher, and YSI engineer Stephen walk to the boat launch at Kamp Kill Kare State Park.



Undergraduate interns Bridger and Toby help hook-up the internal electronics for the water quality monitoring platform.



Undergraduate interns Toby and Bridger and research technician Saul Blocher pose by the water quality monitoring platform in Missisquoi Bay on the last day of field work for the interns in August.



PhD student Wilton Burns, research technician Saul Blocher, and PI Dr. Andrew Schroth hold up an EXO sonde before hooking it up to the water quality monitoring platform in St. Albans Bay.



Moorings and buoys for the 3 profiling systems in Lake Champlain being driven out to the three sites on the R/V Melosira.



Andrew Schroth at the St. Albans Area Watershed Association meeting held at St. Albans Bay Park on August 30th.



PhD student Wilton Burns hooks up the EXO sonde to the water quality monitoring platform. The sensors are attached via an orange cable and operated by a winch to make vertical profiles of the water column every hour.



Tom Manley, Assist. Prof. Geology, Middlebury College, instructs BREE undergraduate interns on the R/V David Folger.



Picture of cyanobacteria bloom (or blue-green algae) at St. Albans Town Park.

Agricultural Site Installation

Dr. Carol Adair, BREE Ecological Systems Co-Leader, directed the installation of a new cutting-edge sensor network in the Hungerford Brook watershed in June 2017. The team installed the sensors in several different riparian areas to study what makes those areas effective water filters. Learning this information will enable researchers to maintain the processes when and where the riparian areas fail to filter water after an extreme event or in a riparian area that fails to remove pollution.

Photos by Carol Adair



BREE researchers put up solar panels in the AG wetland site.



Undergraduate intern Colleen Yancey bails out a soil pit to install lysimeters and sensors.



A flooded soil pit, which indicates a wetland. Shallow groundwater table.



Undergraduate intern Sara Mecca saws a PVC pipe for the sensor installation. Sensors go in the pipes.



Undergraduate intern Kunal Palawat poses by a soil pit. A hardpan silt/clay layer made the pit difficult to dig.



Undergraduate intern Colleen Yancey installs lysimeters.



Undergraduate interns Kunal Palawat and Ernesto Vazquez put up solar panels.



Undergraduate interns Amanda Jackson-Mojica and Ricardo Feliciano work to make the sensors talk to the data logger.



Undergraduate intern Kunal Palawat, tired out after a hard day's work.

BREE CLIMATE TEAM VISITS COLLEAGUES AT DARTMOUTH COLLEGE

Interns and mentors from Vermont EPSCoR's BREE Climate Team visited Dartmouth College in July 2017 to share their findings with colleagues.

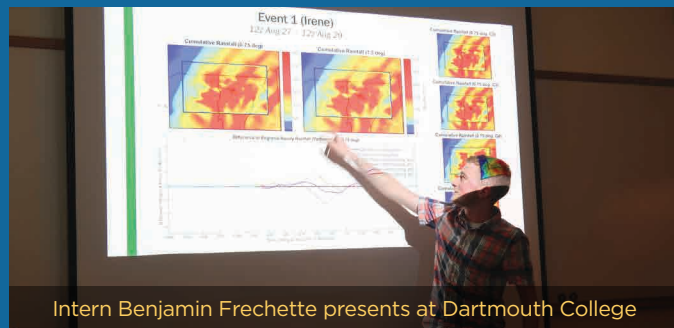


From left to right: Jonathan Winter, Huanping Huang, Janel Hanrahan, Tania Bacchus, Kevin Ziegler, Harris Eidelman, Benjamin Frechette, Celia Fisher, Ilan Nieves, Jory Hecht

Vermont EPSCoR members included Jonathan Winter (Assistant Professor of Earth Science, Dartmouth College), Huanping Huang (Graduate Research Associate, Dartmouth College), Janel Hanrahan (Assistant Professor of Atmospheric Sciences, Lyndon State College), Tania Bacchus (Professor of Environmental & Health Sciences, Johnson State College), and Jory Hecht (Post-doctoral Associate).

Summer Undergraduate Interns included Kevin Ziegler, Harris Eidelman, Benjamin Frechette, Celia Fisher, and Ilan Nieves. Each student intern participated in a summer internship located at the University of Vermont, Johnson State College, or Lyndon State College. Their home universities included the University of Alabama, Clark University, Lyndon State College, and the Universidad de Puerto Rico.

The visit gave the interns the opportunity to present research from their summer experience with team members located at Dartmouth College.



Intern Benjamin Frechette presents at Dartmouth College



Intern Benjamin Frechette presents at Dartmouth College

SAVING OUR WATERS

VERMONT PBS

Saving Our Waters, is comprised of three thought-provoking short documentaries covering steps toward keeping our waterways clean; the impacts of phosphorus and other contaminants; and using the science behind the issues to derive solutions that have positive impact on our communities. Featuring interviews with scientists, citizens, farmers, business owners, and dozens of other stakeholders, the series creates a comprehensive look at the health of the entire watershed of the lake, which encompasses approximately 40% of the state. **Saving Our Waters** aims to examine the state of the Lake Champlain Basin today with an eye toward practical solutions to keeping Vermont's waterways clean in an age of extreme weather events.

Vermont PBS hosted multiple town hall meetings in three of the communities most affected by watershed issues. Over 200 community members attended the Town Meetings in Burlington, St. Albans and Rutland. The videos of these in-depth conversations may be seen on PBS and by visiting the website below.

Saving Our Waters was produced by VT PBS with major funding by VT EPSCoR, NSF OIA 1556770.

Watch now on:
<https://www.vermontpbs.org/water/>

THINKING LIKE A WATERSHED

A conversation about water quality science, policies, and advocacy in the Lake Champlain watershed, with community members and an expert panel. Recorded Nov. 1, 2017 at ECHO Leahy Center for Lake Champlain, Burlington.

Seated Left to Right:

Host: **Fran Stoddard** • **Asim Zia, Ph.D.**, Vermont EPSCoR, Basin Resilience to Extreme Events (BREE) Integrated Assessment Co-Leader UVM, Associate Professor, Community Development and Applied Economics Dept. • **Julie Moore**, Secretary of the Vermont Agency of Natural Resources (ANR), Former Water Resources Group Leader at Stone Environmental, Montpelier VT • **Jon Groveman, Esq.**, Policy and Water Program Director, Vermont Natural Resources Council (VNRC) Former Chair of the Vermont Natural Resources Board (NRB).



RESILIENCE IN A TIME OF EXTREME EVENTS

A conversation focusing on efforts to address water quality in local waterways and the science information best practices, with community members and an expert panel. Recorded Nov. 8, 2017 at Paramount Theatre, Rutland.

Seated Left to Right:

Host: **Fran Stoddard** • **Alan Betts, Ph.D.**, Independent climate scientist at Alan Betts Atmospheric Research, Pittsford VT. Known as Vermont's leading climate scientist. • **Kari Dolan**, Program Manager, Vermont Clean Water Initiative Program Vermont Agency of Natural Resources, Dept. of Environmental Conservation (DEC). • **Chris Koliba, Ph.D.**, Vermont EPSCoR, Basin Resilience to Extreme Events (BREE) Social Systems Leader, UVM, Professor, Community Development and Applied Economics Dept.



OUR LAKES MATTER

A conversation focusing on cyanobacteria blooms, water quality science, what can be done, and changing policies, with community members and an expert panel. Recorded Nov. 15, 2017 at 14th Star Brewing Company, St. Albans.

Seated Left to Right:

Host: **Fran Stoddard** • **Chuck Ross**, Director, UVM Extension Former Secretary of the Vermont Agency of Agriculture, Food and Markets • **Lori Fisher**, Executive Director, Lake Champlain Committee • **Andrew Schroth, Ph.D.**, Vermont EPSCoR Lake Watershed Team Leader, UVM, Associate Research Professor of Geology.



Net Gain

By
Jeffrey R. Wakefield
University
Communications

Vermonters Benefit from Statewide Fiber Optic Network

"It's really hard to mimic the feeling of an in-person writing workshop" online, says Doug DeMaio, support and instruction coordinator for the Young Writers Project. "But having that instantaneous connection, and even setting up your chairs and tables in a way that it looks and feels

width to research universities and government agencies, and, second, to link institutions around the state, like the Vermont State Libraries, to the high performance information artery – creating a de facto state network that is benefitting Vermonters in many ways today.

\$2 MILLION UPGRADE

In 2009 flagship universities in Vermont, New Hampshire, Maine, Rhode Island and Delaware decided that the time had come to give their faculty a major internet upgrade, enabling them to easily exchange massive data sets with their colleagues at other institutions – a hallmark of the age of big data – by connecting to Internet2, which was attracting more universities every year.

The group banded together as the Northeast Cyberinfrastructure Consortium and secured funding from the National Science Foundation and the National Institutes of Health to link to the Internet2 network.

UVM received \$2 million of the total and, with the help of a contractor who dug trenches and strung fiber on poles, built fiber optic pathways to an Internet2 node in Albany to the west and Hanover, New Hampshire, connected to a node in Boston, to the east.

Larner College of Medicine cancer researcher Julie Dragon is one of a many UVM faculty and staff benefitting from UVM's Internet2 connection. She and her colleagues supplement the relatively small number of cancer samples available in Vermont with large down-

loads of publicly available genomic data – up to eight terabytes a week are possible – from the Cancer Genome Atlas at the National Institutes of Health; download times would be impossibly long using the commercial internet.

THE LAND GRANT NETWORK

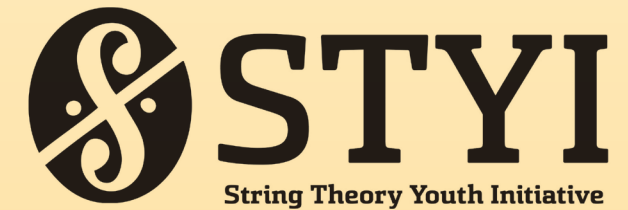
Vermont EPSCoR played an integral role in winning both Internet2 grants.

When a new National Science Foundation grant program was announced in 2011 to enable Internet2 universities EPSCoR applied for and won a \$1 million grant from NSF and hired Clemens to broadly expand UVM's Internet2 connectivity to other institutions in the state.

"My role was to start that conversation rolling, and then perpetuate the follow-up," he says.

Clemens became an Internet2 evangelist, meeting with Vermont colleges and universities, school districts, state government agencies and commercial Internet Service Providers, and handing off to Randy Spooner, director of UVM's Office of Telecommunications and Networking Services, and his team of network engineers to plot out the technical details of where and how connections could be made.

When all was said and done, all five campuses of the Vermont State College system, St. Michael's College, Norwich University and Vermont state government, including the state libraries, were brought into the Internet2 fold. So were ISP's like Burlington Telecom, Sovernet and First-Light, who extended the reach of Internet 2 to their education and research-oriented customers, including Champlain College, Middlebury College and nearly 80 public schools in eight supervisory unions.



INTERNET2 ENABLES LOLA MUSIC CONNECTION BETWEEN TENNESSEE AND VERMONT.

Members of Lee University, in Cleveland, Tennessee, the String Theory Youth Initiative (STYI), along with violinist Robyn Bollinger, connected with young musicians in Burlington, Vermont, using LoLa (Low Latency Audio Visual Streaming). STYI musicians performed with students from the Vermont Youth Orchestra. This event, which took place at the Chattanooga Public Library with a performance featuring cellist Emily Taubl along with Ms. Bollinger. This event is in collaboration with the Lake Champlain Chamber Music Festival.

The LoLa technology referred to ONLY runs over Internet2 – technology supported by VT EPSCoR and the University of Vermont.

Burlington, through the Fletcher Free Library and Big Heavy World, is one of a dozen hotspots of LoLa activity in the entire world.

STYI is a program for select high school students and aims to cultivate the next generation of arts leaders and advocates through project-based learning. The students plan the entire week of outreach and learn about operations, marketing, advocacy, outreach, and more.



(from left):
Michael Voity, network engineer in UVM's Telecommunications and Network Services office;
Patrick Clemens, cyber specialist at Vermont EPSCoR; and **Randy Spooner**, director of Telecommunications and Network Services.
The lowest cable on the pole behind them, located in South Burlington, connects to an Internet2 node in Albany.

like you're all sitting around one table, it's really powerful," a night-and-day improvement over the sessions YWP tried to run using conventional internet service. The new setup, says DeMaio, brings an experience to rural teens, like those who participated from the Rockingham Free Public Library, that is usually reserved for their counterparts in Vermont's bigger cities, where in-person writing workshops are typically held.

The virtual writing workshop was just the kind of outcome a team of University of Vermont faculty and staff envisioned seven years ago when they took steps, first, to connect UVM to a broadband superhighway called Internet2, a national initiative providing warp speed and massive band-

VT EPSCoR Center for Workforce Development and Diversity (CWDD)

The VT EPSCoR Center for Workforce Development and Diversity (CWDD) is off to a busy start with the beginning of the new academic year and the new Basin Resilience to Extreme Events (BREE) research program. The CWDD Team hit the ground running! Visits included local Vermont elementary, middle, and high schools, a college, and a visit to partner Puerto Rico Universities to help cultivate new connections for undergraduate summer internship opportunities.

Here are just a few highlights of their outreach efforts so far this year:

Shelburne Farms



Vermont EPSCoR Graduate Research Associates Caitlin Crossett and Maike Holthuijzen together with Livia Donicova and Janel Roberge from the Center for Workforce Development and Diversity (CWDD), traveled to Shelburne Farms in Shelburne Vermont to demonstrate scientific methods to elementary students from area schools during Watershed Day on October 5, 2017.

Students learned “picking” protocol and observed macroinvertebrate samples under microscopes.



They tallied their samples and as a group discussed their results, including why it is important, and what it means for water quality.

Livia explained “we did this activity four times throughout the day with four separate classes of 20-25 students in each class. It was extremely fun and rewarding!”

Watershed Day is a partnership between the Community Sailing Center, the Lake Champlain Basin Program, the ECHO Lake Aquarium and Science Center, Vermont EPSCoR, and the University of Vermont.

Macroinvertebrate Workshop



Declan McCabe, PhD, Professor of Biology at Saint Michael's College and BREE member, led a macroinvertebrate workshop for educators on July 19, 2017. The hands on workshop offered middle and high school instructors tools with which they could incorporate the study of aquatic ecosystems into their curricula.

Teachers from the Barnet School, Benson Village School, the Bonnyvale Environmental Education Center, the Community Sailing Center, and the Lund Family Center completed the workshop.

Teachers learned how to identify various macroinvertebrates using microscopes and received an introduction to the Vermont EPSCoR macroinvertebrate mobile app that has an extensive identification database.

Dr. McCabe holds annual macroinvertebrate workshops every summer and winter. The next workshop is scheduled to take place in December 2017. For more information, please contact the CWDD at (802) 654-3270 or cwdd@smcvt.edu.

High School Students from Puerto Rico

High School students from Puerto Rico, Andrea Salellas and Gabriela Handall, along with their teachermentor Marcel Torres, were selected as a VT EPSCoR High School Team to take an intensive training in management and water quality at Saint Michael's College in Vermont. The students "decided to focus on the area of environmental chem-

istry by performing water quality testing and the detecting heavy metals in two rivers in the San Juan area. On these rivers, the students and their teacher-mentor will perform tests to determine levels of phosphorus, nitrate, and total suspended solids. They will also perform a habitat assessment and a collection of macroinvertebrates."



After Hurricane Maria – VT EPSCoR High School Team in Puerto Rico

Marcel Torres (center) and his students set up for water quality and macroinvertebrate sampling at a stream in San Juan, Puerto Rico.



The CWDD is supporting the research of students from Robinson School in Puerto Rico. Their research is sampling two streams to assess water quality in the wake of Hurricane Maria. Marcel Torres (science teacher), Gabriela Handall and Andrea Salellas make up the Robison team participating in the 2017-2018 BREE High School program. They were joined by four other Senior stu-

dents from the school that wanted to do research. While doing routine sampling of their project sites after the Hurricane, they noted that residents had improvised access to the stream to gather water for their daily needs. This motivated the students to assess the water quality and potential health risks and communicate those to the community.



Robinson School students Andrea Salellas and Gabriela Handall take notes during their field sampling.



Robison School students sampling for macroinvertebrates.



Robison School students doing water velocity measurements at a stream in San Juan, Puerto Rico.

Vermont Students Awarded a total of \$55,000 in Scholarships for STEM



The awards were conveyed in a ceremony at the Vermont State House hosted by Ted Brady, Deputy Secretary of Commerce and Community Development. Deputy Secretary Brady emphasized the many career opportunities in the STEM fields that Vermont offers. He encouraged the students to consider Vermont as they begin their careers and improve and strengthen our STEM workforce.

The scholarships are offered annually by the CWDD which works to cultivate and prepare a diverse science, technology, engineering and math workforce in Vermont by inspiring students to enter STEM careers.

Scholarships are awarded on the basis of academic standing, letters of recommendation, and an essay detailing career goals. Applications are now being accepted for 2018. The deadline is April 1, 2018. For more information, or to apply for a scholarship, please visit: <http://epscor.w3.uvm.edu/2/node/134>

2017 Scholarship Awardees

NATIVE AMERICAN SCHOLARSHIP RECIPIENTS:

Kohle Feeley of Swanton is a graduate of Missisquoi Valley Union High School and will be attending Champlain College in the fall to study computer networking and cybersecurity. Kohle is passionate about learning and is driven to pursue a career in computer and digital forensics. He participated in the Governor's Institute of Vermont on Informational Technology and Digital Media. His long-term goal is to become a senior security director of a company's computer networking infrastructure. He is the son of Heather Bellrose and Michael Feeley.

Erikka Sherman of Highgate is a rising senior at St. Michael's College where she studies math and elementary education. Her eagerness to learn and her intellectual curiosity have made her a role model to her peers at St. Michael's. She anticipates graduating in the spring of 2018 after which she plans to stay in Vermont to teach at an elementary school. She is the daughter of Holly and Anson Sherman.

FIRST GENERATION SCHOLARSHIP RECIPIENTS:

Umesh Acharya of Shelburne is a rising senior at the University of Vermont where he studies neuroscience with a minor in chemistry. He anticipates graduating in the spring of 2018. Umesh originally came to Vermont from a refugee camp in Nepal. Since arriving in the United States, he has become a national activist for refugees and those who

are not able to represent themselves. He wants to attend medical school and work with economically disadvantaged populations and make the care they need affordable. He is the son of Uma Acharya.

Urmila Chhetri of Burlington is a graduate of Burlington High School and will be attending the University of Vermont in the fall to study biology. Urmila has wanted to be a doctor since she was very young. Since arriving in the United States from a refugee camp in Nepal she has embraced every opportunity available to her so she can strive for her goal of improving health care for the refugee community, including participation in the Burlington High School "Medical and Sports Sciences" program. She is the daughter of Laxman and Indra Chhetri.

Emily Dunn of Lyndonville is a graduate of Lyndon Institute and will be attending the University of Vermont to study microbiology. Emily says she discovered that science truly excited her while taking a biology class at a local college in her senior year. She demonstrates a fierce commitment to her academics and a natural inclination to help others. Emily has completed multiple programs and internships to further her science education including Medquest, Governor's Institute of Vermont, and an internship at Northeastern Vermont Regional Hospital. She dreams of working for the Center for Disease Control. She is the daughter of Kelley and Daniel Dunn.

Fardowsa Ibrahim of Burlington is a student at the University of Vermont where she majors in Medical Laboratory Sciences in the College of Nursing and Health Sciences. Fardowsa first came to the United States from a refugee camp in Kenya where the acute lack of medical care inspired her to pursue a career in health services. She became a mother two weeks before her first semester of college and yet she has managed to do excellent academically each and every semester. She anticipates graduating in the spring of 2018, and entering a physician's assistant program. Fardowsa is married to Murjan-amir and they have a son Hanza Kassim.

Alexander LaSante of Chittenden is a graduate of Rutland High School and will be attending Vermont Technical College to study mechanical engineering. He has been an integral part of the Rutland Area Robotics Team and a role model for younger teammates. He was the lead fabricator for the 2016 team that qualified for the FIRST World Championships, an annual four day robotics competition. He hopes to continue designing and building machinery. He is the son of Richard and Lisa LaSante.

Noorto Mohamed of Burlington is a graduate of Burlington High School and will be attending the University of Vermont in the fall to study biology. She came to the United States from a refugee camp in Kenya. She wants to become an OB GYN doctor. Noorto has been part of the Sports and Medical Sciences Program at Burlington Technical Center, and has participated in MedQuest, Med Mentors, Skills USA, Upward Bound, the Dream Program, and the Brain Bee Competition. She is the daughter of Fatuma and Hussein Haydar Mohamed.

Megan Roberts of Windsor is a graduate of Windsor High School where she was the valedictorian. She will be attending Johnson State College to study secondary education and mathematics. She has received the United States Air Force Certificate of Achievement, the Wesley Book Award, the American Psychological Association Award, a gold medal at the Vermont State Science Fair, and the University of Vermont Green and Gold Scholars Award. Megan says she, "knew by the age of six that I belonged in front of the classroom, writing math problems on a whiteboard" and she plans to become a math teacher. She is the daughter of Robin and Matthew Roberts.

Duane (DJ) Snide Jr. of Cambridgeport is a graduate of Bellows Falls Union High School and will be attending the University of Vermont to study mathematics. In addition to excelling academically, DJ has been a three-sport athlete and an active member of student government. He looks forward to applying mathematics to either business, economics, or engineering after college. He is the son of Duane Snide Sr. and Tammy Pratt.

Tricia Wright of Enosburgh Falls enrolled in the Early College program at Johnson State College where she completed her senior year of high school and her freshman year of college at the same time. She will attend the University of Vermont to study exercise and movement sciences. She anticipates graduating in the spring of 2020. She wants to become a physical therapist and help children that have been injured or born with disabilities. She is the daughter of Jennifer and Aaron Wright.



Applications for 2018 scholarships are currently being accepted. The deadline for applications is **April 1, 2018**. For more information, please contact:

The Vermont EPSCoR Center for Workforce Development and Diversity (CWDD)
One Winooski Park, Box 137
Saint Michael's College
Colchester, Vermont 05439
802-654-3270 • cwdd@smcv.edu

"This scholarship has been incredibly helpful to my pursuits. Without it, I would not have been able to attend my top choice school (St. Michael's College) and receive such a great education that I will cherish and utilize forever."

- Erikka Sherman, 2017 Scholarship Recipient



If You Need to Make a Change

by Katie Powers
NOW News
Community College
of Vermont

The first time she walked through the doors of CCV-Winooski, Sara Mecca felt uncertain. “I’d never gone to college before. I didn’t take my SATs. I was a little bit nervous about the Accuplacer [assessment].” At the same time, she was determined. “I felt like I just had jobs my whole life and I never had a career.” She’d worked in kitchens, tended bar, been a landscaper, worked construction. “...all these different things that just never seemed to lead anywhere...and they don’t pay well.” She was thinking to herself, “I’d just like to be doing something that I enjoy, and feel like I’m contributing.”

And so at 35 she started working on a degree in multimedia communications. She dreamed of becoming an investigative reporter; in her native Hawaii, she’d freelanced for the local paper and hosted a radio show.

While Mecca was busy narrowing in on her field of study, two other programs were helping her gain momentum.

Her stepdaughter (who happens to also be studying at CCV) told her about the TRIO program. Mecca knew she stood to benefit from the specialized support the federal program offers: intensive advising and assistance with financial aid; leadership development and private tutoring opportunities; and access to grants and scholarships.

Mecca also took advantage of a highly competitive opportunity with VT EPSCoR (Established Program to Stimulate Competitive Research). Mecca was one of just 36 students from across the U.S. and Puerto Rico to spend the summer working with Vermont’s Basin Resilience to Extreme Events (BREE) project, from the National Science Foundation to conduct research on the effects of climate change on the Lake Champlain Basin.

Mecca had applied for the internship once before and been turned down—but she is nothing if not resilient herself. “I applied before this because it sounded so interesting...the fact that it was field work, and

that it was paid field work, and research—like teaching the best methods in how to research—which I’d been learning in other classes but not to this extent. It’s real science, you know, which is so exciting.” She says she thought of the internship as “a long shot” that first time she applied, but Garrett-Ostermiller and others encouraged her to try again.

Yet at the start, the internship brought up a familiar misgiving. “I was the only one my age. It made me a little self-conscious at first...I felt a little bit kind of isolated at first, especially in the big group,” she recalled. “But everybody was super friendly, and part of the EPSCoR [program] is trying to get a diverse group of people into science, and age is part of that diversity.”

Mecca will complete her last semester at CCV this fall, and then transfer to the University of Vermont’s Rubenstein School of Environment and Natural Resources. “I want to get my bachelor of science in natural resources.” After that, she has her sights set on graduate school.”

“I think that EPSCoR definitely makes me feel more prepared to go to UVM, not just because of the demographics, but because of everything I learned.”

Of the resources she’s tapped into and the experiences she’s had as a result, “I would say apply, apply, apply! It’s such an amazing opportunity,” she said of EPSCoR. “I couldn’t believe I was there half of the time; you know, National Science Foundation leaders in the room, and getting to see everybody present their research...just to know exactly what’s going on in this state, what they’re doing here to mitigate the effects of climate change.”



BREE UNDERGRADUATE SUMMER INTERNS

The first cohort of 30 undergraduate summer interns began their research on Lake Champlain Basin Resilience to Extreme Events (BREE) on Tuesday May 30th. Their internship began with a



four-day orientation. The first day started with of an overview of the BREE project and an introduction to the different components: climate modeling, integrated assessment modeling, social sciences, ecology, and workforce develop-

ment. After that, interns hiked Mt. Philo for their first introduction to the watershed. The second day of the orientation consisted of an overview of watershed geomorphology with a streams table and a low ropes course team building exercise. The third day included a workshop on climate change and a tour of the St. Albans Bay watershed, one of the focal locations for BREE research. During the tour interns heard about some of the social implications of cyanobacterial blooms in the bay, how development affects streams, how farming practices and stormwater runoff affect phosphorus loading, and what steps are being taken to manage loading. Following a library session and final lunch on Friday, the interns headed to the campuses where they began conducting their focused summer research.

ACCOLADES

JOHN EVANS

Evans Receives Highest Award from Greater Burlington Industrial Corporation



The Greater Burlington Industrial Corporation (GBIC) has given its highest recognition award to John Evans, special advisor to the University of Vermont president, president of the Vermont Technology Council and former dean of UVM's Larner College of Medicine.

GBIC presented Evans with the 2017 C. Harry Behney Lifetime Economic Development Achievement Award. The award was made at GBIC's 63rd annual meeting on June 21 at the Echo Leahy Center on the Burlington waterfront. Approximately 300 members of the northwest Vermont community attended.

Given each year since 1995 in honor of past GBIC president C. Harry Behney, the Behney Award recognizes Vermont leaders for their significant contributions to advancing the state's economic wellbeing and promoting a climate that enhances the economic vitality of the state of Vermont.

GBIC honored Evans for advancing innovation, entrepreneurship and dynamic economic development in the region and the state. He is one of the founding members of the Vermont Technology Council and is the founder and creator of VCET, the Vermont Center for Emerging Technologies, where he continues to serve on the VCET Board of Directors. Evans is also a member of the GBIC Board of Directors and is a professor emeritus at the Larner College of Medicine.

"GBIC recognizes Dr. Evans for his incredible leadership in research, innovation and entrepreneurship in our region and in Vermont," said GBIC president Frank Cioffi. "As the founder of VCET, Dr. Evans blazed the trail to advancing innovation & technology based economic development in our state. We honor and thank Dr. Evans as one of Vermont's most outstanding leaders in advancing economic development. His contributions have been so transformational to Vermont and Vermonters."



TAYNA BACCHUS

Naturalization ceremony on March 2nd at the US District Court in Burlington. "This was a very special day for me (30 years in the making) and which was spent with a few of my very dear friends including Liz Dolci."

Naturalization Ceremony Speech excerpt:

"I would like to take a few minutes to congratulate those of you who are about to become U.S. citizens... in particular I welcome you to Vermont...I share with you today the sentiments of the President of the United States who comes from Vermont, President Calvin Coolidge, who said:

I love Vermont because of her hills and valleys, her scenery and invigorating climate, but most of all, I love her because of her indomitable people."

Dr. Tania S. Bacchus

Professor of Environmental Science
Department of Environmental
and Health Sciences
Johnson State College

OPEN CALLS for PROPOSALS

Feb 7th, 2018

SBIR/STTR Phase (0)

<http://epscor.w3.uvm.edu/2/node/45>

Feb 21st, 2018

Pilot Awards

<http://epscor.w3.uvm.edu/2/node/104>



Where Are They Now?

IN BRIEF FROM RECENT VT EPSCOR GRADUATE STUDENTS AND POSTDOCTORAL ASSOCIATES



Justin Guilbert, Ph.D. completed his PhD dissertation "The Impacts of Climate Change on Precipitation and Hydrology in the Northeastern United States" on August 25, 2016 and is currently a technical analyst with Vermont Environmental Research Associates, Inc.



Scott Hamshaw, Ph.D. completed his PhD dissertation "Fluvial Processes in Motion: Measuring Bank Erosion and Suspended Sediment Flux Using Advanced Geomatics and Machine Learning" on September 12, 2017. He currently serves as a Post-doctoral Associate researcher in BREE.



DongJoo Joung, Ph.D. served as a post-doctoral research associate with the University of Southern Mississippi Division of Marine Science until 2017, at which point he joined the Department of Earth and Environmental Science at the University of Rochester as a research scientist.



Bonnie Reese, MBA is currently enrolled in the National Science Foundation's Interdisciplinary Graduate Education and Research Traineeship (IGERT) program. In addition to research on institutional entrepreneurship and its role in energy system transition at UVM, Bonnie also works as the Director of Business Development for GameTheory.

Climate Change Indicators Are Not Enough

By
Alan K. Betts
EOS, Earth & Space
Science News



Extreme events capture the public's attention, but gradual climate shifts will more profoundly affect civilization and life on Earth. Scientists must get better at conveying this to the public.

Dealing with climate change will require transforming both science and society in the coming decades. Society is struggling to accept the idea that Earth's climate will change radically this century unless we double or triple energy efficiency and rapidly shift from burning fossil fuels to renewable energy sources. Scientists, who were trained to think of climate as 30-year averages, are struggling to understand a complex physical, ecological, and social system that is changing every decade. We are all faced with an uncertain future and mounting risks that could overwhelm our societies unless we change direction very soon [Oreskes and Conway, 2014].

Ironically, political and scientific interests alike can use our limited understanding of the complexity of the Earth system to rationalize waiting either for greater certainty or for more data.

A SHIFTING BASELINE

Science deals with measurable quantities: We search for the clearest indicators of climate change that we can present to the public so that they can understand what is happening, face reality, and adapt. Clear examples are the shrinking of the Arctic ice cap in summer, the shortened duration of the Northern Hemisphere's cold season, and the rising sea level caused by warming oceans and the melting of grounded ice sheets.

But for society, slow changes can be ignored, especially if the interannual variability is large. In contrast, extremes of precipitation and flooding, strong hurricanes and storm surges, heat waves and severe drought cannot be ignored, although they can be dealt with as one-time events that are unlikely to recur.

Some belief systems may attribute these events to factors that are beyond our control. For science, extremes are challenging because they are statistically rare, and our statistics of extremes must necessarily use scarce data from the past.

A still greater challenge is that because the climate has changed, the weather statistics from the past are no longer valid [Milly et al., 2008]. So the public is confused when it hears that a disaster was a "100-year flood" when it knows there have been several similar floods in recent decades. Those who would rather stall for time and argue that it is wise to wait for greater certainty will find instead that the climate system is moving into new unexpected regimes.

UNDERSTANDING INTERCONNECTED SYSTEMS

Science is important in providing new understanding of the changing climate, especially in the face of false information provided by many vested interests. For example, it's critical for local communities in northern latitudes to understand that the rapid melting of the Arctic sea ice in summer in the past 30 years is driven by the same chain of processes that decrease snow cover and produce the warmer winters that they are experiencing.

THE CHALLENGE OF EXTREMES

The public may simply accept these decadal climate changes coupled with large interannual variability. However, society reacts to extreme events. A large earthquake can lead to new building codes, even though such disasters are rare and generally unpredictable. A major flood from Tropical Storm Irene galvanized Vermont to rethink its river buffers and flood plain management.

CHOOSING A PATH FORWARD

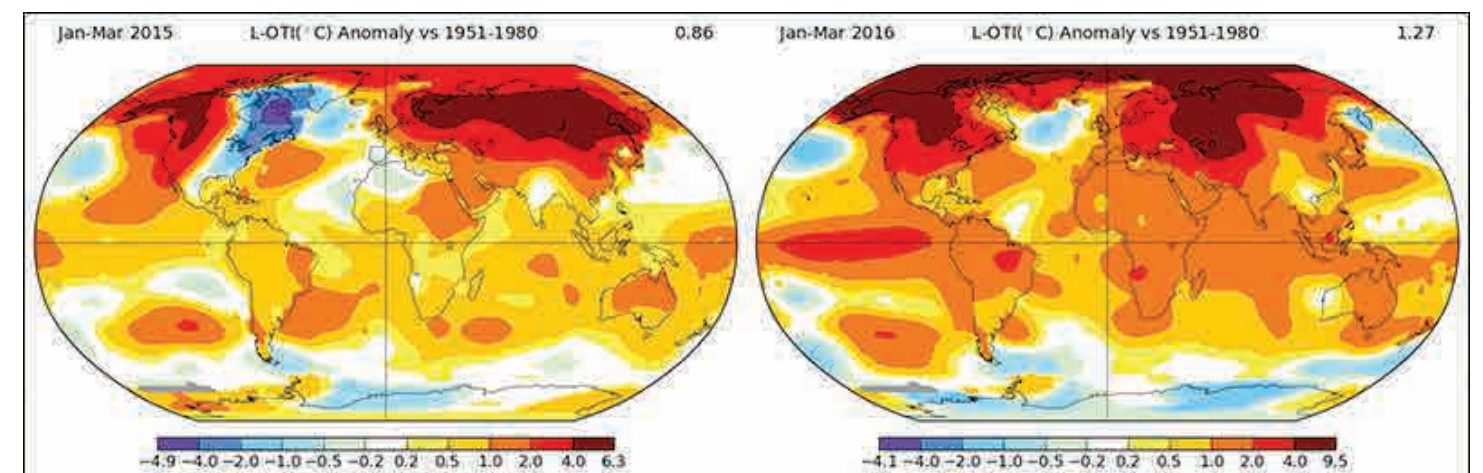
The shift from the arrogance of our own power to a frame where we understand and cooperate with the living Earth system will not be easy.

For scientists, this change will require a new willingness to engage strongly with society, from the local to the national and international levels.

Climate change indicators are powerful tools, but they are not enough.

ACKNOWLEDGMENT

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Excerpted article. For full article visit: <https://doi.org/10.1029/2017EO077689>. Citation: Betts, A. K. (2017), Climate change indicators are not enough, *Eos*, 98. Published on 14 July 2017.



BREE Graduate Research and Postdoctoral Associates

Dr. Judith Van Houten, VT State EPSCoR Director, met with the new cohort of BREE Graduate Research Associates (GRA) and Postdoctoral Associates (Postdoc) in January 2018 to discuss individual development plans and progress on the research areas they are working on with the BREE teams. The group met in the VT EPSCoR Interdisciplinary Research Space at 23 Mansfield on the UVM campus where they share office space and are able to interact across the disciplines and hold seminars on topics of interest.

Pictured above left to right are:

Front:

Brittany Lancellotti **GRA**
Caitlin Crossett **GRA**
Maike Holthuijzen **GRA**
Elizabeth Doran **Postdoc**

Back:

Judith Van Houten,
VT State EPSCoR Director
Wilton Burns **GRA**
Doug Denu **GRA**
Scott Hamshaw **Postdoc**
Erin Seybold **Postdoc**
Daniel Demers **GRA**
Jory Hecht **Postdoc**
Kevin Andrew **GRA**
Patrick Bitterman **Postdoc**



From the Director

We are happy to share with you the latest news from Vermont EPSCoR in this winter issue of our magazine.

Please watch us on Saving Our Waters, produced in partnership with VT PBS - a three-part documentary on the health and resiliency of the Lake Champlain basin. It includes interviews with scientists, community members, policy makers, farmers, business owners and stakeholders, and creates a comprehensive look at the Lake Champlain watershed, which covers approximately 40% of Vermont.

All programs and descriptions at www.vermontpbs.org/water

Please check in with often and follow us on Twitter, Facebook, LinkedIn and our website at www.uvm.edu/EPSCoR

Please check in with us often and follow us on twitter, Facebook and our awesome web page.

Best wishes!

Judith Van Houten, Ph.D.
University Distinguished Professor
State Director, VT EPSCoR



DOUBLE YOUR IMPACT!

Please join me in making a gift to the newly created **Merit Award Fund** for special recognition of graduate students and postdocs who embody the multi-disciplinary commitment to research and mentoring excellence that the VT EPSCoR program has built upon since its inception in Vermont in 1985. I will match up to the first \$2,500 in gifts to help kick off this important fund.

To learn more and to make a donation, please visit:
www.uvm.edu/EPSCoR/meritfund



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