

NRT: Education Model Program on Water-Energy Research (EMPOWER) at Syracuse University

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Syracuse University

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agency specific instructions)

Charles T Driscoll

Accomplishments

What are the major goals of the project?

For the EMPOWER (Education Model Program on Water-Energy Research) NRT program at Syracuse University, we have developed a new, interdisciplinary approach to graduate education at the water-energy nexus. Our overarching goal for EMPOWER is to develop a graduate program that combines rich regional and international research opportunities with comprehensive professional training in skills needed for the diverse careers available to students broadly trained in water and energy. We have developed a comprehensive graduate research training program that equips students with the content knowledge and professional skills necessary to pursue academic and non-academic careers at the water-energy nexus.

The “water-energy nexus,” which describes the interrelationships between human needs for water and energy, is a priority research area nationally. A goal for EMPOWER has been to empower cohorts of graduate students to conduct research spanning the complete hydrocarbon energy cycle: from deposition and origin of hydrocarbons; to hydrocarbon production from shale; to use and effects of hydrocarbons in energy, industry and transportation; and how these phases of the energy cycle interface with the hydrologic cycle, in terms of both water quality and quantity. The water-energy research theme produces STEM graduates who pursue non-academic career paths. But, there are few graduate programs that bridge interdisciplinary research at the water-energy interface with the professional development needed for careers in business, government, and non-profits.

New models are needed for graduate education in STEM that address the changing trajectory of postgraduate careers that are increasingly non-academic. Graduate programs that provide students with professional development, mentoring opportunities, and a broad exposure to non-academic career paths serve the needs of all students. Our goal is to produce STEM graduates with not only in-depth content knowledge, but also strong oral and written communication skills, a multidisciplinary perspective, entrepreneurial and project management skills, a sense of professionalism, and an understanding of how knowledge in one area can be applied across broad context.

Our NRT program is built on a review of the most promising academic and non-academic careers for advanced degree holders with research expertise at the interface of water and energy cycles. Graduates of EMPOWER are pursuing careers in four sectors: business, government, not-for-profits, and academia, each requiring particular specialized professional skills. To this end, we have designed a “T-shaped” educational program that combines broad training across management, policy, communication, and law with in-depth training in a self-designed focus area most applicable to the trainee’s career objectives. We also adopt a T-shaped approach to research, with students obtaining training in the three research themes, while pursuing a focused dissertation research topic.

The training elements of our program include:

1. The Water-Energy Seminar: a 1-cr seminar featuring current issues at the water-energy nexus research training and professional development, which are integrated with a visiting lecture series.



2. The Professional Development Specialization Area (PDSA): coursework that provides focused training in professional skills tailored to students’ self-identified career trajectory. Ph.D. students are required to take 12 credits and MS students are required to take 6 credits in the PDSA.
3. Science Communication training: a 3-cr course designed to improve skills among trainees in public communication of science.
4. A Career Pathway Experience: an experience to give NRT trainees an opportunity to develop research activities that integrates professional development in support of their career goals.
5. Summer Domestic and International Field Experiences: NRT trainees learn to conduct research with faculty under challenging conditions as a unifying capstone experience, which is especially useful preparation for careers requiring intensive collaboration. We have developed a two-course integrated field program in the northeastern U.S. and Rwanda that weaves together the three EMPOWER research themes.
6. Seed Grant Program: trainees are eligible to apply for small grants to support specific lines of emerging research or professional development activities not supported by traditional research grants or assistantships.

What was accomplished under these goals?

Research on Spatiotemporal Variations in Upper Crustal Extensions:

Preexisting crustal heterogeneities are shown to influence rift process at a variety of scales, but how these crustal inheritance rift-scale spatiotemporal kinematics operate in a magma-poor rift environment is poorly understood. EMPOWER trainee Lachlan Wright and faculty member Christopher Scholz examined the influence of crustal inheritance on active rifting by balancing and restoring a series of regional cross sections across the Lake Tanganyika Rift in the Western Branch of the East African Rift System. Their results demonstrate how crustal inheritance exerts a fundamental control on the evolution of extension localization, ultimately impacting the geometry and structural architecture of rift basins.

Research on Beaver Mimicry Restoration Structures: Stream restoration structures are used around the world to shape hydrological functioning of impacted or altered streams. The latest iteration of stream restoration structures – the beaver dam analogue – is a semi-porous structure designed to mimic the effects of beaver dams. While these structures are being deployed throughout the western US, research has lagged implementation. Julianne Sweeney (EMPOWER NRT Trainee), Laura Lautz (former EMPOWER faculty), and Christa Kelleher (EMPOWER faculty) have used several innovative techniques to analyze the hydrologic and geomorphic impacts of these restoration structures. By combining high resolution imagery and three-dimensional models from unoccupied aerial vehicles with on-the-ground surveying and hydrological observations, they show that these restoration structures strongly influence and alter patterns of erosion and deposition, groundwater-surface water interactions, and nutrient cycling in western streams. However, they are some of the first researchers to demonstrate that the benefits of these structures may be limited in spatial extent, and do not always match restoration goals.

Research on Mercury Emissions, Atmospheric Concentrations, and Wet Deposition across the Conterminous United States: Research by Connor Olson (EMPOWER NRT trainee) working with Charles Driscoll (EMPOWER PI) show that mercury concentrations in air and precipitation and wet deposition have decreased across the United States over the last twenty years, coincident with decreases in stationary mercury emissions. Their findings highlight the success of air management policies in the United States and are especially timely, as the United States Environmental Protection Agency is currently considering a roll-back of the Mercury Air Toxics and Standards rule.

Education and Training Activities:

Water-Energy Seminar: This interdisciplinary 1-cr seminar features current research at the water-energy nexus and professional development. Students discuss papers, have professional development opportunities, and host visiting lecturers. In Fall 2019, professional development training first focused on how to manage student-adviser expectations. The class also conducted a mock proposal review panel to better understand the process of peer review and research funding. We hosted noted guests Kathy Fallon-Lambert, Senior Advisor Harvard C-CHANGE and Josh Henkin of STEM Career Services, who led an intensive set of workshops over the course of two days, half of which were open to all STEM graduate students at the university. Visiting lecturers included author Leo Trasande and Auden Schendler, VP of Sustainability at Aspen Skiing Company. In Spring 2020 we hosted a second Alan Alda Science Communication Workshop as well as a “Finding Your Strengths” workshop led by EMPOWER PI Driscoll and the Director of the Graduate Careers Office, Dan Olson-Bang. Guest lecturers for the semester included Diane McKnight (UC Boulder) and Kristin Doughty (University of Rochester).

Domestic Field Course: A domestic summer field course was offered for the second time in August of 2019. The two-week field class covered concepts at the water-energy nexus through demonstrations and hands-on exercises at various regional field sites. Learning goals included examining processes that control the cycling of organic matter in the water column of lakes;

investigating the fate of atmospheric deposition in forested catchments; and regional controls on groundwater quality in shale gas basins. Field sites included Green Lakes State Park (Fayetteville, New York), the Hubbard Brook Long-Term Ecological Research (LTER) site (New Hampshire), and the Marcellus Shale region (in New York). Field studies included an immersive 7-day stay at the Hubbard Brook Experimental Forest, as well as several day trips in Central New York. Field methods included: lake water column chemistry and analysis; in-stream tracer addition tests; and water sampling and analysis. Field experiments were augmented with demonstrations at the various field sites and geochemical work in analytical laboratories. Twelve NRT trainees completed the course in summer 2019.

Science Communication Skills Training: Developing science communication skills is a foundational component of EMPOWER. Trainees are required to complete a graduate level science communication class, but science communication training is also woven throughout all program elements. In Water Seminar, students honed their communication skills by leading class discussions about research pertaining to upcoming visiting lecturers but also practiced visual communication and storytelling with Dr. Christa Kelleher (EMPOWER faculty). A half day workshop and networking lunch with Kathy Fallon Lambert had the trainees giving an elevator pitch, preparing a plain language summary or a lightning presentation of their research. All students routinely receive feedback on what they present in class to their peers and to the faculty. We hosted a full day Alan Alda Science Communicating Science workshop (our second) which uses improv techniques to teach scientists the importance of first connecting to an audience to better convey their message. Josh Henkin from STEM Career Services led a two day workshop focused on career planning which included seminars covering in-person networking techniques, developing an elevator pitch, interviewing techniques and building effective (and appropriate) social networking profiles.



Evaluation Methods/Activities:

EMPOWER's external evaluator, Higher Ed Insight, continued to assess program activities during the reporting period. In Fall 2019, evaluators administered a pre-questionnaire to EMPOWER trainees in Earth Science and Civil and Environmental Engineering to understand their perceptions of their career awareness, professional and technical skillsets, and research and scholarly engagements. This questionnaire was also administered to non-participants in these same departments, comprising a comparison group. A post-questionnaire will be administered at the end of Spring 2020 and will be used to measure potential changes in student outcomes. Further, student focus groups will be conducted in May 2020 aimed at gaining more in-depth understandings of student experiences as a result of participating in the EMPOWER program. Additionally, faculty interviews will be conducted in May and June 2020 to capture insights relating to core and affiliated faculty's perceptions of the EMPOWER program; its progress toward realizing student and institutional outcomes; and contributions EMPOWER has made to the larger STEM community. Finally, document review will continue to be on-going, with artifacts shared as they became available. Examination of program documents will be performed to assess the fidelity of program implementation.

Specific Objectives:

The training elements of EMPOWER are designed to achieve the following outcomes:

Student Outcomes (desired attributes of EMPOWER NRT trainees):

1. Trainees will be familiar with the techniques, languages, cultures, and range of careers available in the three research themes of EMPOWER;
2. Trainees will develop technical and professional skills relevant to both research and research-related careers;
3. Trainees will understand the relevance and potential broader impacts of their research in areas related to business, law, public policy and communications, and be able to identify the potential benefits of their research to a range of stakeholders;
4. Trainees will develop a professional network that will foster the establishment of mentoring relationships with professionals in academic and nonacademic careers;
5. Trainees will develop oral and written communication skills desired by employers in academic and non-academic careers that enable them to synthesize and translate the impacts of their research to a range of stakeholders; and
6. Trainees will be productive researchers, publishing their work in high quality peer-reviewed scientific publications and presenting at regional, national, and international conferences.

Institutional Outcomes (Cultural change at the University):

1. Faculty and administrators will recognize the value of professional development training for STEM graduate students and incorporate elements of our training paradigm into other STEM graduate programs at the University and elsewhere;
2. The university will provide long-term, institutionalized support for the elements of our training model that are most successful for developing professional skills of stem graduate students; and

3. New collaborations will be developed among faculty, staff, and students to advance interdisciplinary, cutting-edge research at the water-energy interface.

Specific objectives of individual training elements:

1. Familiarize trainees with the three EMPOWER research thematic areas;
2. Develop trainee's understanding of the relevance and potential impacts of their research in areas related to business, law, policy and communications;
3. Promote student-centered integration of technical and professional training
4. Build networking opportunities that foster mentoring relationships between students and professionals;
5. Provide mentoring from professionals external to the institution; and
6. Foster the development of transferrable professional skills (e.g., project management, leadership, communication, entrepreneurship, conflict resolution);
7. Provide training in technical and professional skills that prepare students for multiple career paths;
8. Develop trainee's communication skills to translate and communicate the potential benefits of their research to a range of stakeholders;
9. Develop oral and written communications skills desired by employers in academic and non-academic careers;
10. Foster a sense of community among EMPOWER participants;
11. Develop professionalism.

Significant Results:

Example Results Related to Major Research Efforts:

1. Findings on Spatiotemporal Variations in Upper Crustal Extensions:

Trainee Lachlan Wright and faculty leadership member Christopher Scholz published a paper in the journal *Tectonics* detailing their results on the way in which crustal inheritance exerts a fundamental control on the evolution of extension localization, ultimately impacting the geometry and structural architecture of rift basins. In addition to publishing this work, trainee Lachlan Wright presented his work at the American Geophysical Union Fall Meeting, San Francisco, 2019.

2. Findings on Hydrogeomorphic Impacts of Beaver Mimicry Structures:

Trainee Julianne Sweeney recently won two prestigious awards from the American Geophysical Union for her presentation of hydrogeomorphic impacts of beaver dam analogues in the western US. Julianne's visual storytelling earned her a Runner-Up award in the AGU Data Visualization Competition. Her poster presentation of novel findings was awarded a prestigious Outstanding Student Presentation Award, typically given to a very small percentage of students presenting in the Hydrologic Sciences Section.

3. Findings on Mercury Emissions, Atmospheric Concentrations, and Wet Deposition across the Conterminous United States:

Trainee Connor Olson developed a paper

“Mercury Emissions, Atmospheric Concentrations, and Wet Deposition across the Conterminous United States: Changes over 20 Years of Monitoring” which is accepted for publication in the journal *Environmental Science and Technology Letters*. In addition, Olson gave presentations of this work at the annual meeting of the Society of Environmental Toxicology and Chemistry, North America, in Toronto Canada, 4 November 2019 and at the 14th International Conference on Mercury as a Global Pollutant in Krakow Poland, 12 September 2019.

Results related to Major Education and Training Efforts:

1. Student Placement in Career Pathway Experiences: During 2019-2020 we have had continued success placing students in career pathway experiences. We had 5 trainees complete their internships during this reporting period. Those experiences are detailed elsewhere in the report (opportunities for training and professional development section).

2. Student Degree Completion and Career Placement: We enrolled our final, largest and most diverse cohort in Fall 2019. Our final 11 students are matriculated in Earth Sciences, Engineering and Biology departments. We continue to see our students successfully complete their training and move on to placement in a variety of STEM careers, both within and outside academia. We have had 10 trainees graduate since our last report, 6 with Ph.D. and 4 with MS degrees. All have gained employment in industry (3), government (2), environmental consulting (4) or academia (1).

3. Student Achievement in Science Communications: There is a strong emphasis on student development of science communication skills in EMPOWER. Several trainees have received recognition for their superior writing or presentations. Lucie Worthen was selected for an NSF Graduate Research Fellowship Program Honorable Mention, May 2019. Julianne (Sweeney) Davis’s visual storytelling earned her a 2nd place award in the American Geophysical Union (AGU) annual meeting Data Visualization Competition and her poster presentation of her novel findings was awarded a prestigious Outstanding Student Presentation Award also at AGU in December 2019. Geoffrey Millard was given an All-University Dissertation Award in April 2020. EMPOWER trainees Geoffrey Millard, Caitlin Eger and former EMPOWER trainee Jacqueline Gerson led a data analysis and visualization workshop at the 14th International Conference on Mercury as a Global Pollutant in Krakow Poland, September 2019.

Evaluation Findings:

Higher Ed Insight, the external evaluator of the EMPOWER program, administered a perceptions questionnaire to NRT trainees as well as non-participants who served as reference students. A review of program activities is on-going.

The evaluation findings demonstrate:

1. Research engagement is highly valued within EMPOWER, with numerous mechanisms supporting student participation in scholarly activities.
2. Numerous activities support and provide an opportunity for science communication training, which has positively impacted EMPOWER students’ experience and confidence.



3. EMPOWER affords students the opportunity to collaborate with professionals at internships, field sites, national research labs, not-for-profit agencies, and other universities—career experiences that increase trainees’ awareness of the wealth of opportunities that exist.
4. Students are provided opportunities to participate in domestic and international field courses, cultivating their technical and professional skillsets as they partake in authentic, interdisciplinary, group-based, hands-on research experiences across field sites.
5. Students describe feeling more connected as a result of interactions and opportunities for mentorship between established and newly enrolled trainees.
6. EMPOWER continues to be well managed, organized, and implemented.

Other findings include:

1. When comparing EMPOWER students’ understandings of and preparation for educational, research, and other professional endeavors to their non-participant peers, EMPOWER students’ self-percepts within these domains are observed to be higher.
2. EMPOWER students have a greater understanding of the relevance of their research; the potential for their research to influence business, law, policy, and communication; and the potential of impacts resulting from their research engagement when compared to non-participants.
3. EMPOWER students have greater awareness of career opportunities available within their disciplines of study.
4. Trainees are highly assured in their critical capacities, namely problem solving, thinking critically, and adapting to new situations. They also have high confidence in their interpersonal skills, such as listening to others’ views, leading teams, and working within teams.
5. EMPOWER students engage in scholarly activities at a higher rate than their peers. These engagements are supported by embedded program structures like the Seed Grant opportunities.
6. EMPOWER students’ exposure to numerous career pathway experiences positively contribute to their desires to explore diverse market sectors, as evident by their intention to pursue a wider array of industry sectors as compared to their counterparts.

Examination of questionnaire responses reveal that EMPOWER students are highly motivated to pursue careers related to the water-energy nexus, with many enrolling in their programs of study to be involved in work and careers that positively impact the environment. Further, trainees feel strongly that not only is the water-energy nexus a critical national issue, but also one in which they want to actively participate. Trainees have heightened career awareness and enhanced conceptualization of the implications of their research. Outcomes that can be attributed to the NRT program are core to activities regularly engaged by students through targeted offerings. Nearly 30% of EMPOWER students have had research published, with students on average reporting two publications and as many as five products. Two-thirds of trainees have presented their scholarship at professional conferences. While research and dissemination efforts clearly occur by students outside of program participation, EMPOWER has greatly catalyzed trainees' access to and engagement with these professional opportunities. As an illustration, Seed Grants have supported student engagement in research and scholarly endeavors, including travel to science labs to conduct laboratory analyses and purchase of laboratory supplies to support scientific data collection. In addition, the scholarship of EMPOWER participants has been influenced by professional mentorship, with more than 80% reporting having mentors. Overall, NRT trainees feel well supported and highly encouraged.

Interdisciplinary research achievements:

1. Trainees Ruta Basijokaite and Shiru Wang are part of an interdisciplinary team working to disentangle the complex relationships among human behavior, hydrological processes, and chemicals of emerging concern. Working collaboratively with EMPOWER faculty members Christa Kelleher and Teng Zeng as well as Sociology faculty Rebecca Schewe, they are developing several manuscripts that describe the occurrence of synthetic organic chemicals with diverse uses in waters across central NY. This work has afforded these trainees the opportunity to advance their interdisciplinary experience by broadening their research through collaboration with elements of social science.
2. Trainee Qasim Mehdi, working with Dr. Peter Wilcoxon, a faculty member in the Public Administration program of the Maxwell School at Syracuse University has leveraged research and training support provided through EMPOWER to develop an interdisciplinary component to his dissertation research. In the

early 2017, air quality data were published for the first time in Pakistan showing air pollution levels amongst the highest in the world. This poor air quality results from the burning of agricultural waste across northern India and Pakistan and the release of acute levels of fine particulate matter. This project is being executed in partnership with the in-house survey team of Institute of Development and Economic Alternatives (IDEAS). IDEAS is a non-partisan policy institution focused on improving decision making in Pakistan. Through an SU IRB approved survey administered to farmers in lower-middle income strata, this project aims to explore the income-barriers leading to crop-burning.

3. NRT trainee Geoffrey Millard, working with Charles Driscoll of the Department of Civil and Environmental Engineering developed a proposal in collaboration with the Department of Energy laboratories at Oak Ridge, TN and the Pacific Northwest at Richland WA. This work involved utilization of analytical facilities at the Pacific Northwest Laboratory including Fourier transform ion cyclotron resonance mass spectroscopy and proton nuclear magnetic resonance. Millard worked with DOE colleagues to characterize the chemical interactions of mercury with naturally occurring organic matter in soil and water at Honnedaga Lake watershed in the Adirondack region of NY. The analytical characterization and data analysis have been completed and were included as part of Millard's dissertation. Millard is working on a manuscript describing this work.

Demonstration of exceptional added value to trainee educational experiences:

In August 2019, EMPOWER completed a domestic field class involving 12 trainees. Trainees worked in teams to conduct hands-on measurements and experiments and data analysis and presentation of results. Activities included tours of field research facilities and experiments. A highlight was the group dinners prepared by teams of trainees.

Seed Grant Program:

The seed grant program provides considerable added value to graduate student experience by supporting emerging research ideas, professional network development, and other professional development training opportunities. Seed grants funded since the prior annual report include:

- Purchase of laboratory supplies and materials to conduct data-collection for micro-plastics research project entitled, "Investigation the influence of UV and temperature on the leaching of estrogenic compounds from polyethylene terephthalate (PET) plastic water bottles using bioanalytical and chemical analyses." Laura Markley. Type: Emerging Interdisciplinary Research Seed Grant. Status: Ongoing.
- Travel and lodging to Pasco, Wa. to utilize analytical facilities at the DOE's ESML/PNNL. March 2019. Geoff Millard. Type: Emerging Interdisciplinary Research Seed Grant. Status: Complete. Trainee report submitted.
- Travel and lodging to attend the East Africa Petroleum Conference and Exhibition 2019. May 2019. Shaidu Nuru Shaban. Type: Professional Development Training Mini-Grant. Status: Complete. Trainee report submitted.



- Exam registration and study materials for the preliminary Professional Geologist certification to be undertaken on October 4th, 2019. Micah Wiesner, Julianne Sweeney, Julio Bertran. Type: Professional Development Training Mini-Grant. Status: In progress. Grant awarded, trainees taking the examination in Spring 2020. More material to learn than expected.
- 40-Hour OSHA HAZWOPER Training Course Amanda Klaben, Type: Professional Development Training Mini-Grant. Status: Completed September 2019. No report required.
- Travel and lodging to attend and present research results at: 15th Annual Workshop on LC/MS/MS Applications in Environmental Analysis and Food Safety in Miami May 2019 and American Chemical Society (ACS) Fall 2019 National Meeting in San Diego. Shiru Wang. Type: Professional Training Mini-Grant. Status: Completed. Trainee report submitted.
- USGS Southwest Biological Science Center research internship. June 16 - July 16, 2019. Micah Wiesner. Type: Emerging Interdisciplinary Research Seed Grant. Status: Complete. Trainee report submitted.
- Travel expenses to present and participate in a panel at the Annual Conference on South Asia at the University of Wisconsin-Madison October 17-20, 2019. Nimisha Thakur. Type: Professional Network Development Grant. Status: Completed. Trainee report submitted.
- Trainee initiated and organized invited speaker event, Leo Trasande, MD. October 8th 2019. Laura Markley. Type: Professional Network Development Grant. Status: Completed. No report required.
- Travel to Krakow, Poland to attend and deliver a workshop at the International Conference on Mercury as a Global Pollutant (ICMGP2019). Workshop entitled: "Achieving data management, visualization, and analysis." The workshop was a collaboration between EMPOWER Trainees Geoffrey Millard and Caitlin Eger, and former EMPOWER trainee Jacqueline Gerson (now at Duke University). Type: Emerging Interdisciplinary Research Seed Grant. Status: Completed. Trainees report submitted.
- Travel to Krakow, Poland to attend the International Conference on Mercury as a Global Pollutant (ICMGP2019). September 2019. Connor Olson. Type: Professional Development Training Mini-Grant. Status: Complete. Trainee report submitted.
- Funds for a Light Detection and Ranging (LiDAR) Survey to Aid in Investigation of the Effectiveness of Beaver Dam Analogues in Stream Restoration project. Fall 2019. Julianne Davis (Sweeney). Type: Emerging Interdisciplinary Research Seed Grant. Status: In progress.
- 40-Hour OSHA HAZWOPER Training Course Micah Wiesner, Type: Professional Development Training Mini-Grant. Status: Completed November 2019. No report required.
- Funds for quantifying nitrate uptake in an urban stream using a labelled 15N tracer. Fall 2019. Julio Bertran. Type: Emerging Interdisciplinary Research Seed Grant. Status: Complete. Trainee report submitted.
- Travel to Toronto, Canada to attend and present at SETAC (Society for Environmental Toxicology and Chemistry) November 2019. Connor Olson, Shiru Wang, Laura Markley. Type: Professional Training Mini-Grant. Status: Complete. Trainees report submitted.
- Travel and Registration for CUAHSI Snow School. January 2020 Training on variety of different field and remote snow measurement techniques. Student networked with many professionals working on snow research. JR Slosson. Type: Professional Development Training Mini-Grant. Status: Completed. Trainee report submitted.

What opportunities for training and professional development has the project provided?

Components of the adopted traineeship model that have been developed and implemented for transferrable professional skill development:

Water-Energy Seminar (ongoing): This seminar is offered every semester. The seminar is open to all Syracuse University and SUNY College of Environmental Science and Forestry graduate students. A total of 21 students enrolled in Fall 2019 and 22 enrolled in Spring 2020. The seminar was co-taught by the EMPOWER PI (Driscoll) and two of the co-PIs (Kelleher, Johnson). The course expectations are the same for MS and Ph.D. students enrolled in any given semester, but Ph.D. students are required to take the seminar 4 different semesters and MS students are required to take the seminar for 2 different semesters. The entire course content is determined from student input and approximately half of the sessions are student-led. Proficiency and progress in communication skills are regularly assessed in the Water-Energy seminar.

Seed Grant Program (ongoing): The seed grant program continues to be implemented during this reporting period.

Professional Development Specialization Area (PDSA) Courses (ongoing): EMPOWER trainees continue to enroll in coursework designed to provide professional development training in areas of communication, policy, business, education, and law. The coursework



provides focused training in professional skills tailored to students' self-identified career trajectory. Trainees have been taking approved classes since Fall 2016 and this component of the program is ongoing.

Career Pathway Experience: The career pathway experience gives NRT trainees an opportunity to focus on a particular aspect of their studies that integrates professional development in support of their career goals. Five NRT trainees completed their career pathways experience since our previous report:

- **Lachlan Wright:** Lachlan spent 14 weeks in Houston, Texas as an Earth Scientist with the Integrated Exploration Strategic Research Division at Chevron Corporation. Over the course of the summer his team crafted a suite of deliverables that was tailored to the needs of professionals actively working on exploration in the field.
- **Micah Wiesner:** Micah spent a month at the USGS in Moab, Utah collaborating with research ecologist Sasha Reed. They designed a project to explore alkalinity titration techniques in desert soils.
- **Geoffrey Millard:** Geoffrey spent two weeks at the Pacific Northwest National Laboratory in an immersive research experience. While on-site he conducted solid phase extractions on soil and water samples and advanced laboratory analysis (Fourier Transform Ion cyclotron Resonance Mass Spectroscopy). This research formed a chapter in his Ph.D. dissertation (now completed).
- **Amanda Klaben:** Amanda completed a semester-long internship at O'Brien and Gere Ramboll Engineering in Syracuse, NY prior to being hired full-time as an Engineer I immediately following completion of her graduate training in December 2019.
- **Julianne Sweeney:** Julianne completed phase 2 of her experience, a second summer internship with The Nature Conservancy in Lander, Wyoming. While there, she participated in workshops and lunch webinars with TNC staff and organized field work with members of the Lander TNC office as well as the Wyoming Game and Fish Department. She is also coordinating with the Director of Communications at TNC to produce a fact sheet about the beaver dam analogue research being conducted on Red Canyon Ranch. The fact sheet is for a landowner audience to explain the construction, maintenance and possible outcomes of beaver dam analogue stream restoration projects.

Domestic Summer Field Course: Our domestic summer field course was offered for the second time in August of 2019. The two-week field class covered concepts at the Water-Energy Nexus through demonstrations and hands-on exercises at various regional field sites. Learning goals included examining processes that control cycling of organic matter in the water column; investigating the fate of atmospheric deposition in forested catchments; and regional controls on groundwater quality in shale gas basins. Field sites included Green Lakes State Park (Fayetteville, New York), the Hubbard Brook Experimental Forest (a NSF Long-Term Ecological Research site in New Hampshire), and the Marcellus Shale region (in New York). Field studies included an immersive 7-day stay at the HBEF, as well as several day trips in Central New York. Field methods included: lake water column chemistry and analysis; stream gauging techniques; in-stream tracer addition tests; and water sampling and analysis. Field experiments were augmented with demonstrations and tours at the various field sites and biogeochemical work in analytical laboratories. Twelve NRT trainees completed the course in summer 2019.

Examples of one-time professional development programs not described earlier in the report:

- **EMPOWER Orientation:** The EMPOWER Fall 2019 orientation program included an overview of the training elements by Charles Driscoll (PI), as well as trainee-led panel discussions on science communication training, professional development specialization area coursework, and career pathway experiences. On-going trainees were paired with new trainees to encourage mentorship and foster an immediate connection to the program.
- **Review Panel:** To learn more about the processes of peer review and research funding, students engaged in a mock proposal review panel. In preparation for and during the first class, all students reviewed two proposals, provided and summarized written comments, and made decisions about proposal rankings. In the second class meeting, all students participated in summarizing proposals and their rankings for the entire "panel" (consisting of all class members), culminating in a panel-wide decision of which two proposals the class would fund.
- During a visit from SU's Graduate Career Services, students listened to a short presentation and discussed the writing process with English Ph.D. and Career Center Head **Dr. Dan Olson-Bang**. Discussion focused on how to approach the writing process and overcome obstacles and set-backs in the process of writing a thesis or dissertation.
- **Kathy Fallon Lambert:** A three-hour workshop focused on science communication from Kathy Fallon Lambert, Senior Advisor with The Center for Climate, Health, and the Global Environment at the Harvard T.H. Chan School of Public Health (Harvard C-CHANGE). All students performed readings and watched instructional videos about scientific communication prior to class, and participated in giving either an elevator pitch, preparing a plain language summary of their work, or making a lightning presentation. The workshop ended with a discussion of challenges associated with presenting controversial issues.
- **Project Management:** A student led discussion focused on explaining elements of project management. After discussing and asking students to identify themselves as one of four leadership styles, the students were split into smaller groups based on these leadership styles, and asked to engage in an activity to plan a two-week field course. Each group developed a budget, plan for course



activities, and risk management plans, and presented these to the group.

- **Alan Alda Science Communication Workshop:** This full-day workshop was conducted focused on successful communication of science topics. The workshop covered strategies for optimizing physical and emotional presence, concise delivery, resetting after mistakes and connecting to an audience.
- **Finding your Strengths Workshop with CliftonStrengths:** Students completed a comprehensive strengths assessment which revealed their five “top” strengths. Workshop focused on leadership styles and how to leverage a student’s inherent abilities and to develop highly productive teams.

How have the results been disseminated to communities of interest?

Conference Oral and Poster Presentations:

EMPOWER’s program coordinator, students and faculty presented program results and training outcomes through poster presentations at Northwestern University during the annual NSF NRT meeting, September 2019. EMPOWER program coordinator Annie Pennella was chosen by peers to present program best practice findings to conference attendees including NSF leadership on the final day of the conference.

22 separate NRT trainees gave oral presentations and posters and led a workshop at the following conferences during the reporting period, including: East Africa Petroleum Conference and Exhibition, May 2019; 15th Annual Workshop on LC/MS/MS Application in Environmental Analysis and Food Safety, Miami FL, May 2019; American Chemical Society National Meeting, San Diego CA, September 2019; Annual Conference on South Asia, Madison WI, October 2019; International Conference on Mercury as a Global Pollutant, Krakow Poland, September 2019 (2 current and one former trainee invited to lead workshop); Society for Environmental Toxicology and Chemistry International Conference, Toronto Canada, November 2019; annual American Geophysical Union Conference, December 2019.

EMPOWER Newsletter:

We disseminate information about program activities twice a year in a program newsletter. The newsletter features articles about training and research opportunities provided by EMPOWER. The newsletter also includes student and faculty spotlights, which highlight achievements in research and professional development by project participants. The newsletter is distributed to project participants (faculty, students, and staff), administrators, external advisors, and other individuals with interest in EMPOWER.

EMPOWER Website:

The EMPOWER website (empower.syr.edu) is a primary tool used to disseminate program activities and results to interested parties. Program results are featured in news pieces published on the website, many of which are authored by EMPOWER trainees and describe program training elements and activities.



EMPOWER Twitter Feed:

We maintain an active Twitter feed for the EMPOWER program (@SU_EMPOWER). The twitter feed disseminates information about program events, professional development training, accomplishments of faculty and students in the program, as well as other news items related to the EMPOWER NRT training program.

What do you plan to do during the next reporting period to accomplish the goals?

For the next reporting period, we plan to:

- Offer the International Field Course: If circumstances allow, we plan to offer the international field course for the second time. The 3-credit field course will cover concepts at the water-energy nexus through hands-on exercises, student mini projects and demonstrations at various field sites on and near Lake Kivu, Rwanda. This will be a collaborative activity involving students and faculty from the University of Rwanda and Syracuse University.
- Continue efforts to institutionalize elements of the traineeship model: As the award approaches closure, we are working on strategies for institutionalizing the most effective elements of our training model, such as the interdisciplinary graduate seminar, the professional development coursework (similar to a certificate program), and the career path experience.
- Formative evaluation results provided by Higher Ed Insight identified the following action items for the next reporting period:
 1. Expanding Career-Oriented Support Structures
While faculty and staff provide a wealth of career-oriented guidance and support that are well connected in particular sectors, students have expressed concern with difficulty finding internships or job opportunities outside of traditional academic pathways and with direct faculty connections. Trainees suggest that it may be helpful to compile a resource of companies and institutions across sectors that might offer experiential opportuni-

ties. Leveraging the cumulative knowledge and connections that exist among faculty and current and former trainee networks could inform this process. It would be developed as an illustrative catalog rather than an exhaustive list, serving as another structure of student support.

2. Continued Cultivation of Scholarly Development

Continue to cultivate students' professional development. Students have benefitted from events held by the program. These activities include mock review panels and paper reviews, CV development and experience and advice in interviewing, science communication and data visualization workshops. In addition, numerous opportunities for meaningful interaction with a variety of visiting professionals have equipped students with a unique knowledge- and skill-set—opportunities that will undoubtedly prepare them for a range of professional and scholarly engagements.

3. Maintaining a Strong Sense of Community

Students feel disconnected from EMPOWER when they or colleagues are no longer enrolled in the Water-Energy seminar. Students also feel that once a student has completed the Water-Energy seminar requirement they have attained considerable experience, so they are positioned to offer helpful insights to less experienced program participants. Following this transition, mentorship as well as informal exchanges of knowledge and ideas between more experienced and less experienced trainees become diffuse. A potential strategy for mitigating this challenge could be extending seminar enrollment across students' programs of study (e.g., 1st and 3rd semesters for Master's students) rather than targeting participation during their first few semesters. Another suggestion is finding more deliberate ways to include senior trainees into EMPOWER activities outside of passive invitations to participate. The sense of community is strong among active Water-Energy Seminar participants. Helping to maintain these relationships will both preserve comradery that was initially established and support greater inclusivity across cohorts, thus strengthening the entire EMPOWER network.

4. Balance within the Water Energy Seminar

Some students feel in Water-Energy seminar issues in water have been heavily emphasized, with inadequate coverage relating to energy. This emphasis may shift by semester with the interest of participating faculty, but it would be helpful to achieve a balance between materials covered pertaining to these foci.

5. Sustaining Program Efforts Institution-Wide

EMPOWER has been well received by participating stakeholders—all of whom cite the range of positive outcomes that have resulted from effective programming. With the grant nearing its final year, program leadership has given thought to how efforts might be sustained past the funding period. It was hoped that the EMPOWER model might be more widely adopted across the University, as such integration could support model sustainability. It would seem that EMPOWER would be a compelling model for Syracuse University. Syracuse is a medium sized R1 university with strong professional schools (management, public policy, law, communications, informatics) that are well positioned to support broad-based STEM graduate training. As EMPOWER has demonstrated, such a program is a persuasive option for a community of high achieving students interested in career-oriented graduate training. Unfortunately, despite efforts

to promote the program university-wide, EMPOWER has not been embraced by the university administration. There have, however, been recent shifts in administrative personnel in relevant schools and colleges. We hope to utilize the remaining time for the program to demonstrate the depth of impact achieved by EMPOWER at both the student and institutional levels. Further, we will try to extend outreach and dissemination regarding EMPOWER beyond faculty, staff, and University stakeholders already involved within the program to broaden recognition of the success and impact of this STEM graduate training program. Identifying resources external to the university to supplement program funding beyond March 2021 would certainly be useful. But most ideal would be formal adoption of the EMPOWER model at some level within the University, demonstrating its commitment to the program and acknowledging the promise of this framework system-wide. Integration of this interdisciplinary graduate training model at an institutional level provides the best opportunity to contribute to a shift in University culture in the delivery of quality, well-rounded STEM graduate education—a condition implemented albeit preliminarily by EMPOWER faculty, staff and students.

Products

Journals or Juried Conference Papers

BP Baldigo; SD George; TJ Sullivan; CT Driscoll; DA Burns; S Shao; GB Lawrence. (2019). Probabilistic relations between acid-base chemistry and fish assemblages in streams of the western Adirondack Mountains, New York, USA. *Canadian Journal of Fisheries and Aquatic Sciences*. 76 (11). DOI: 10.1139/cjfas-2018-0260.

CI Olson; GB Beaubieu; JL Sims; RR Otter (2019). Mercury Accumulation in Millipedes (*Narceus* spp.) Living Adjacent to a Southern Appalachian Mountain Stream (USA). *Bulletin of Environmental Contamination and Toxicology*. 103. 528. DOI: 10.1007/s00128-019-02664-4

C Zheng; MA Eldeeb; D Coombs; B Akih-Kumgeh. (2019). Comparative Analysis of Detailed and Reduced Chemical Models of N-Dodecane. *Proceedings of the ASME Turbo Expo 2019: Turbomachinery Technical Conference and Exposition*. DOI: 10.1115/GT2019-91385

EA Baker; LK Lautz; JM McKenzie; C Aubrey-Wake. 2019. Improving the accuracy of time-lapse thermal infrared imaging for hydrologic applications. *Journal of Hydrology*, 571:60-70. DOI: 10.1016/j.jhydrol.2019.01.053

GB Beaubien; CI Olson; RR Otter (2019). The Role of Sexual Dimorphism and Tissue Selection in Ecotoxicological Studies Using the Riparian Spider *Tetragnatha elongata*. *Bulletin of Environmental Contamination and Toxicology*. 103. 225. DOI: 10.1007/s00128-019-02632-y

GD Millard; CT Driscoll; MR Montesdeoca; Y Yang; S Boucher; A Shaw; W Richter; E Paul; C Parker; K Yokota. (2020). Patterns and trends of fish mercury in New York State. *Ecotoxicology*. DOI: 10.1007/s10646-020-02163-x

H Shen; Y Chen; Y Li; AG Russell; Y Hu; LRF Henneman; MT Odman; JS Shih; D Burtraw; S Shao; H Yu; M Qin; Z Chen; AS Lawal; GK Pavur; MA Brown; CT Driscoll. (2019). Relaxing energy policies on top of climate change will significantly undermine states' efforts to attain U.S. ozone standards. *One Earth*. 1 (2), 229. DOI: 10.1016/j.oneear.2019.09.006.

JD Muirhead; LJM Wright; CA Scholz (2019). Rift evolution in regions of low magma input in East Africa. *Earth and Planetary Science Letters*. 506 332. DOI: 10.1016/j.epsl.2018.11.004

JS Denkenberger; H. Fakhraei; C.T. Driscoll. (2020). Watershed influences on mercury in tributaries to Lake Ontario. *Ecotoxicology*. DOI: 10.1007/s10646-019-02157-4

JN Weitzman; PM Groffman; JL Campbell; CT Driscoll; RT Fahey; TJ Fahey; PG Schaber; LE Rustad. (2019). Ecosystem nitrogen response to a simulated ice storm in a northern hardwood forest. *Ecosystems*. DOI: 10.1007/s10021-019-00463-w

LJM Wright; JD Muirhead; CA Scholz. (2020). Spatiotemporal variations in upper crustal extension across the different basement terranes of the Lake Tanganyika Rift, East Africa. *Tectonics*. 39. DOI: 10.1029/2019TC006019

LM Demott; CA Scholz; CK Junium (2019). 8200-year growth history of a Lahontan-age lacustrine tufa deposit. *Sedimentology*. 66 2169. DOI: 10.1111/sed.12579

LM DeMott; SA Napieralski; CK Junium; M Teece; CA Scholz (2019). Microbially influenced lacustrine carbonates: A comparison of late Quaternary Lahontan tufa and modern thrombolite from Fayetteville Green Lake, NY. *Geobiology*. 00. DOI: 10.1111/gbi.12367

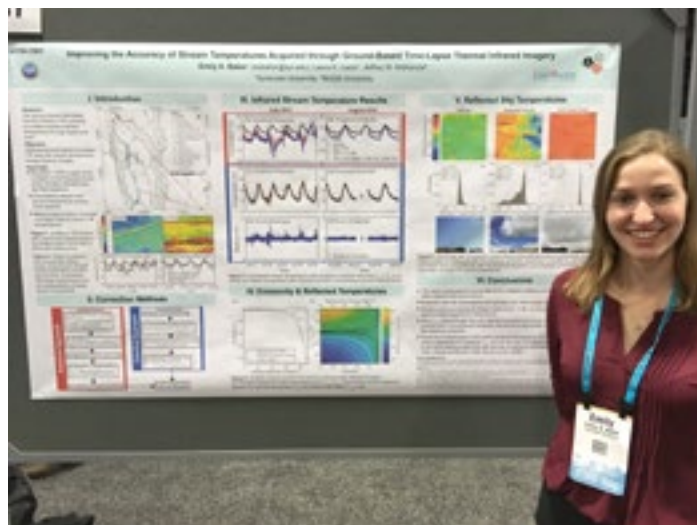
M Fahnstock; J Bryce; C McCalley; MR Montesdeoca; S Bai; Y Li; CT Driscoll; P Crill; V Rich; R Varner. (2019). Mercury reallocation in thawing subarctic peatlands. *Geochemical Perspectives Letters*. 11 33. DOI: 10.7185/geochemlet.1922

NJ Zaremba; CA Scholz (2019). High-resolution seismic stratigraphy of Late Pleistocene Glacial Lake Iroquois and its Holocene successor: Oneida Lake, New York. *Palaeogeography, Palaeoclimatology, Palaeoecology*. 534 . DOI: 10.1016/j.palaeo.2019.109286

RL Glas; LK Lautz; JM McKenzie; R Moucha; D Chavez; B Mark; J Lane. 2019. Hydrogeology of an alpine talus aquifer: Cordillera Blanca, Peru. *Hydrogeology Journal*, 27(6):2137-2154. doi:10.1007/s10040-019-01982-5

RL Glas; D Burns; LK Lautz. 2019. Historical changes in New York State streamflow: attribution of temporal shifts and spatial patterns from 1961-2016. *Journal of Hydrology*, 574:308-323. doi: 10.1016/j.jhydrol.2019.04.060

RP Mulligan; DJ Mallinson; GJ Clunies; A Rey; SJ Culver; N Zaremba; E Leorri; S Mitra (2019). Estuarine responses to long-term changes in inlets, morphology and sea-level rise. *Journal of Geophysical Research: Oceans*. 124. DOI: 10.1029/2018JC014732



RT Fahey; JW Atkins; JL Campbell; LE Rustad; M Duffy; CT Driscoll; TJ Fahey; PG Schaber. (2020). Effects of an experimental ice storm on forest canopy structure. *Canadian Journal of Forest Research*. 50 (2), 136. DOI: 10.1139/cjfr-2019-0276

S Belyazid; J Phelan; C.T. Driscoll. (2019). Assessing the effects of climate change and air pollution on soil properties and plant diversity Northeastern U.S. hardwood forests: model setup and evaluation. *Water Air and Soil Pollution*. 230 (5). DOI: 10.1007/s11270-019-4145-6.

SH Caldwell; C Kelleher, EA Baker, LK Lautz. 2019. Relative information from thermal infrared imagery via unoccupied aerial vehicle informs simulations and spatially-distributed assessments of stream temperature, *Science of the Total Environment*, 661:364-374. DOI: 10.1016/j.scitotenv.2018.12.457

SJ Dugdale, CA Kelleher, IA Malcolm, S Caldwell, DM Hannah. (2019). Assessing the potential of drone-based thermal infrared imagery for quantifying river temperature heterogeneity *Hydrological processes*. 33 (7), 1152-1163. DOI: 10.1002/hyp.13395

S Shao; CT Driscoll; TJ Sullivan; DA Burns; BP Baldigo; GB Lawrence; TC McDonnell. (2020). The response of stream ecosystems in the Adirondack region of New York to historical and future changes in atmospheric deposition of sulfur and nitrogen. *Science of Total Environment*. 716. DOI: 10.1016/j.scitotenv.2020.137113

Y Yang; L Meng; RD Yanai; M Montesdeoca; PH Templer; H Asbjornsen; LE Rustad; CT Driscoll. (2019). Climate change may alter mercury fluxes in northern hardwood forests. *Biogeochemistry*. 146 (1). DOI: 10.1007/s10533-019-00605-1

Z Dong; CT Driscoll; SL Johnson; JL Campbell; A Pourmokhtarian; AMK Stoner; K Hayhoe. (2019). Projections of water, carbon, and nitrogen dynamics under future climate change in an old-growth Douglas-fir forest in the western Cascade Range using a biogeochemical model. *Science of the Total Environment*. 656 608. DOI: 10.1016/j.scitotenv.2018.11.377

Z Ye; H Mao; CT Driscoll. (2019). Impacts of anthropogenic emissions and meteorology on mercury deposition over lake vs land surface in Upstate New York. *Ecotoxicology*. DOI: 10.1007/s10646-019-02113-2

J Davis (2019). Assessing the Impacts of Beaver Dam Analogues (BDAs) on Channel Morphology using High-Resolution Images from Unoccupied Aerial Vehicles (UAVs). *SUNY Geneseo Student Research Symposium*. Geneseo, New York.

Other Conference Presentations / Papers

AE Campbell and LK Lautz. (2019). Methane emissions from groundwater production over the Marcellus play, Geological Society of America, Annual Meeting (poster). *American Geophysical Union, Fall Meeting (lightning oral and digital poster)*. San Francisco, California.

AE Campbell. (2019). Invited talk. Methane emissions from groundwater production over the Marcellus play. *Geological Society of America, Annual Meeting (poster) American Geophysical Union, Fall Meeting (lightning oral and digital poster)*. San Francisco, California.

C Pu; T Zeng (2019). Formation of N-nitrosamines upon chlorination and chloramination of cyanobacterial strains. *Gordon Research Conference on Water Disinfection, Byproducts and Health*. South Hadley, MA.

C Pu; and T Zeng. Formation of total and specific nitrosamines from amine-containing micropollutants in wastewater. *ACS Spring 2019 National Meeting & Exposition*, Orlando, FL, Mar 31, 2019.

C Zheng. (2019). Real Gas Model Parameters for High-Density Combustion from Chemical Kinetic Model Data. *11th National Combustion Meeting*. Caltech. Pasadena, California.

J Beltran; LK Lautz; JR Slosson. (2019). The impact of stream-groundwater exchange on seasonal nitrate uptake dynamics in an urban stream. *American Geophysical Union Annual Meeting*. San Francisco, California.

J Davis (2019). Assessing the Impacts of Beaver Dam Analogues on Channel Morphology in Western Rangelands. *Central New York Association of Professional Geologists*. Syracuse New York.

J Davis (2019). Eager as a Beaver: Imitating Nature's Ecosystem Engineers" 2019 Ignite@AGU storytelling event, San Francisco, CA. *American Geophysical Union Fall Meeting*. San Francisco, California.

JR Slosson; LK Lautz; J Beltran. (2019). Groundwater Storage of Seasonally-Applied Road Salt in an Urban Watershed. *American Geophysical Union*. San Francisco, California.

LM DeMott; CA Scholz. (2019). Paleohydrologic control on lacustrine carbonate tufa distribution in the Winnemucca Basin, NV, USA. *American Geophysical Union Fall Meeting*. San Francisco, CA.

LJM Wright; DJ Shillington; CA Scholz. (2019). Fault Linkage and Slip History of Basement-Involved Faults in the Lake Malawi (Nyasa) Rift, East Africa. *American Geophysical Union Fall Meeting*. San Francisco, CA.

LA Markley and CT Driscoll. (2019). To Drink or Not to Drink? Estrogenic Activity of PET Bottled Water Under Various Storage Conditions. *SETAC North America*. Toronto, Canada.

LK Lautz. Invited Commentary: "Predicting natural methane occurrence in domestic groundwater wells in the Marcellus Shale region: A case for empirical modelling approaches" *Hydrological Processes*. (2019) 33:1022-1028).

M Tan, C Zhang, LJM Wright, and CA Scholz. (2020). How climate-rift interactions drive the stratigraphic record: Model results and subsurface observations from the Lake Malawi (Nyasa) Rift, East Africa. *SEPM International Sedimentary Geosciences Congress*. Flagstaff, Arizona.

M Wiesner, S. Reed. (2019). Calibrating Paleotemperature Proxies in a Modern Lacustrine Setting. *USGS Moab, June, 2019. USGS Research Roundup Conference*. Moab, Utah.

NJ Zaremba; CA Scholz. (2019). Late-Pleistocene Stratigraphy of Proglacial Lake Iroquois revealed through high-resolution seismic data and sediment cores; Oneida Lake, New York Glacial Lake Iroquois and its Holocene successor. *American Geophysical Union Fall Meeting*. San Francisco, CA.

SN Shaban; CA Scholz. (2019). Lacustrine Deltaic Deposits of Southern Lake Tanganyika, East Africa, and Implications for Paleo-environmental Reconstructions. *East African Petroleum Conference and Exhibition*. Mombasa, Kenya.

S Wang; MG Perkins; G Matthews; T Zeng. (2020). Organic micropollutants in New York lakes: A citizen science-based occurrence study. *Finger Lakes Research Conference*. Geneva, New York.



S Wang; M. Perkins; C. Kelleher; R. Schewe, T. Zeng. Assessing organic micropollutants in lakes and creeks in Upstate New York. *15th Annual LC-MS/MS Workshop on Environmental and Food Safety*, Miami Beach, FL, May 30, 2019.

S Wang. Micro-pollutant research in the Finger Lakes. *2020 Bob Brower Scientific Symposium in "Plain English."* Auburn NY, Mar 7, 2020.

S Wang. Organic micropollutants in lakes in Upstate New York: Citizen-science based monitoring. *SETAC North America 40th Annual Meeting*. Toronto, ON, CA, Nov 7, 2019.

Thesis/Dissertations (completed during reporting year)

Emily Baker, "Surface Water - Groundwater Interactions in a Proglacial Alpine Catchment: Applications of Heat Tracing, Modeling, and Remote Sensing Methods."

Julio Bertran, "Effects of urbanization on stream nitrate loads and cycling."

Crystal Burgess, "Hydro-thermal characterization of urban green spaces: Determining the productivity of vegetated vacant lots."

Laura DeMott, "Depositional constraints on lacustrine carbonates from the Winnemucca Dry Lake basin, NV, USA."

Geoff Millard, "Status and remediation of mercury in fish and aquatic ecosystems."

Riley Sessanna, "Capturing and analyzing multispectral UAV imagery to delineate submerged aquatic vegetation on a small urban stream."

Alexa Stathis, "Photolysis Kinetics of Aromatic Pollutants in Liquid and Solid Environmental Condensed Phases."

Lucie Worthen, "Doing a Lot with a Little: A Diagnostic Analysis of SWMM to Simulate Hydrologic Behavior within LID Systems."

Yige Yang, "Evaluating the Hydrologic and Thermal Performance of a Green Roof in Syracuse: Measurements and Modeling of a Full-Scale System."

Chenwei Zheng, "Modeling and Simulation of High-Density Spray Combustion."

Websites

<https://empower.syr.edu/> (Website)

@SU_EMPOWER (Twitter)

Participants/Organizations

What individuals have worked on the project?

Name	Most Senior Project Role
Charles Driscoll,	PD/PI
Christa Kelleher	Co PD/PI
Christopher Scholz	Co PD/PI
Chris Johnson	Co-Investigator
Christopher Junium	Co-Investigator
Peter Wilcoxon	Co-Investigator
Teng Zeng	Co-Investigator
Ben Akih-Kumgeh	Faculty
David Chandler	Faculty
Laura Condon	Faculty
Cliff Davidson	Faculty
Greg Hoke	Faculty
Zunli Lu	Faculty
Katie Becklin	Faculty
Tripti Bhattacharya	Faculty
Heather Coleman	Faculty
Svletoslava Todorova	Faculty
Susan Wadley	Faculty
Annie Pennella	Program Coordinator

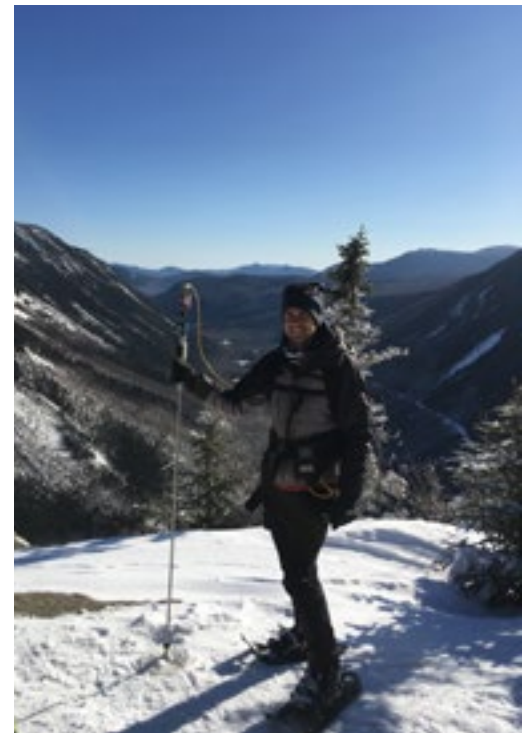
What other organizations have been involved as partners?

Name	Type of Partner Organization
University of Rwanda	Academic Institution



What trainees and advisors have worked on the project this reporting period?

Trainee	Degree Program	Academic Discipline	Advisor
Sarah Araldi-Brondolo	Ph.D.	Biology	Becklin
Ruta Basijukaite	Ph.D.	Geosciences	Kelleher
Julio Beltran	MS	Geosciences	Lautz
McKenzie Brannon	MS	Geosciences - Hydrologic Sciences	Scholz
Peter Brennan	MS	Geosciences - Hydrologic Sciences	Bhattacharya
Amanda Campbell	Ph.D.	Geosciences - Hydrologic Sciences	Lautz
Laura DeMott	Ph.D.	Geosciences - Geology	Scholz
Eric Deutsch	MS	Geosciences - Hydrologic Sciences	Chipman
Caitlin Eger	Ph.D.	Engineering - Environmental	Driscoll
Courtney Gammon	MS	Engineering - Environmental	Davidson
Alaina Hickey	MS	Geosciences - Geochemistry	Junium
Eliza Hurst	MS	Geosciences - Hydrologic Sciences	Kelleher
Amanda Klaben	MS	Engineering - Environmental	Driscoll
Alexander Johnson	Ph.D.	Engineering - Environmental	Davidson
Gaired Jordan	MS	Engineering - Environmental	Chandler
Nicholas LoRusso	Ph.D.	Engineering-Environmental	Driscoll
Yngrid Marques	MS	Engineering- Environmental	Kelleher
Laura Markley	Ph.D.	Engineering- Environmental	Driscoll
Qasim Mehdi	Ph.D.	Public Administration	Wilcoxon
Geoffrey Millard	Ph.D.	Chemistry - Environmental	Driscoll
Connor Olson	Ph.D.	Chemistry - Environmental	Driscoll
Changcheng Pu	Ph.D.	Engineering - Environmental	Zeng
Shaidu Nuru Shaban	Ph.D.	Geosciences	Scholz
John Slosson	Ph.D.	Geosciences - Geomorphology	Lautz
Laura Streib	Ph.D.	Geosciences - Geology	Scholz
Julianne Sweeney	MS	Geosciences-Hydrologic Sciences	Lautz
Nimisha Thakur	Ph.D.	Anthropology	Wadley
Jeff Wade	MS	Geosciences - Hydrologic Sciences	Kelleher
Dan Wang	Ph.D.	Biology	Coleman
Shiru Wang	Ph.D.	Engineering - Environmental	Zeng
Joseph Wasswa	Ph.D.	Engineering - Environmental	Zeng
Micah Wiesner	MS	Geosciences	Hoke
Lachlan Wright	Ph.D.	Geosciences - Geology	Scholz
Yige Yang	Ph.D.	Engineering - Environmental	Davidson
Nick Zaremba	Ph.D.	Geosciences - Geology	Scholz
Mengyi Zhang	MS	Engineering- Environmental	Todorova
Chenwei Zheng	Ph.D.	Engineering - Mechanical	Kumgeh



Full details of organizations that have been involved as partners:

University of Rwanda

Organization Type: Academic Institution

Organization Location: Rwanda

Partner’s Contribution to the Project:

In-Kind Support

Facilities

Collaborative Research

Personnel Exchanges

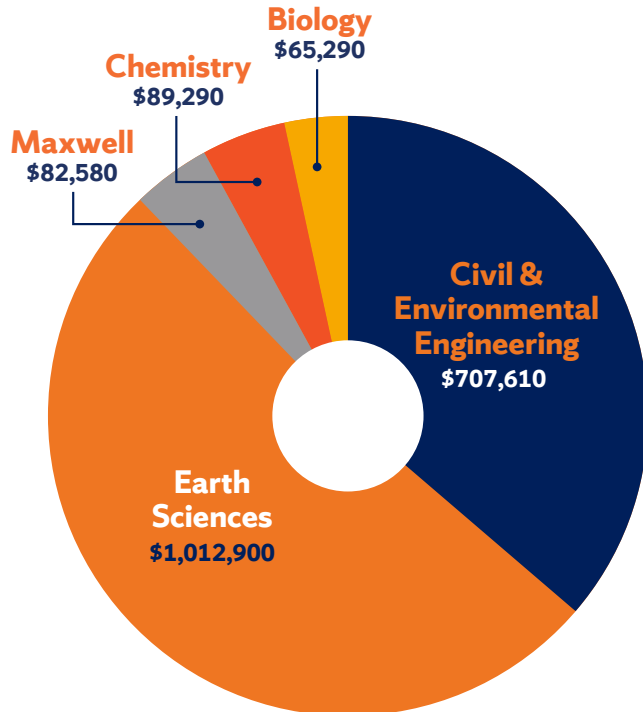
More Detail on Partner and Contribution: The international field course in Rwanda was offered collaboratively with faculty and students from the University of Rwanda. The University of Rwanda made materials, facilities, and staff available for support of the field experience.

What is the impact on the development of human resources in the reporting period?

Total number of NRT trainees currently in EMPOWER:	37
Trainees supported by NRT stipends:	14
Trainees support by other sources:	21
Number of Trainees Enrolled in:	
Earth Sciences:	17
Civil & Environmental Engineering:	16
Biology:	2
Anthropology:	1
Public Administration:	1
Ph.D. program:	23
MS program:	14
Total Number of Graduate Students Institution-wide Benefitting from the Program:	142

Impacts

NRT & Water Initiative Fellowships Awarded by Department Since Program Inception



What is the impact on physical resources that form infrastructure?

Over 2,500 sq. ft. of office and meeting space was created at Syracuse University to support the EMPOWER program. The 333 Heroy Suite was completely gutted and renovated to create two conference rooms, small meeting spaces, a quiet study area, and 5 new faculty and staff offices. The extensive renovation was made possible by a generous commitment of financial support from the Provost & Vice Chancellor’s Office. The conference rooms are regularly used for EMPOWER professional development events, and the weekly water-energy seminar class. The study area is also frequently used as a gathering place for students from different degree programs to come together for social and professional interactions.

What is the impact on society beyond science and technology?

Most of the scientific and technological innovations that benefit society originate within the curious mind of a student innovator. Often, it’s simple barriers that can prevent a prospective innovator from achieving their full potential: an inability to communicate effectively, an unfamiliarity with engaging experts outside their field or not having adequate understanding of how other disciplines intersect with their own.

The EMPOWER NRT program has provided professional development training for graduate students, both within and outside of the program. The program has presented and published findings on best practices for developing STEM graduate programs that prepare students for careers within and outside of the academy. These findings have been presented at national conferences and published in national journals.



