Water Resources Research Center Annual Technical Report FY 2017

Introduction

This report covers the period March 1, 2017 to February 28, 2018, the 52nd year of the Massachusetts Water Resources Research Center (WRRC). The Center was under the direction of Dr. Paula Rees, who held joint appointments as Director of the WRRC and Director of Diversity Programs for the College of Engineering at the University of Massachusetts Amherst (UMass) until September 1, 2017, when she resigned her position and was replaced by Marie-Françoise Hatte as Interim Director.

The goals of the Massachusetts Water Resources Research Center are to address water resource needs of the Commonwealth and New England through research, creative partnerships, and information transfer. Through the USGS 104B program, WRRC aims to encourage new faculty as well as students to study water resources issues.

In fiscal year 2017, three new research projects were supported through the USGS 104B Program, and 2 information transfer projects were selected for funding.

Progress results for each project are summarized for the reporting year in the following sections.

Research Program Introduction

In fiscal year 2017, three new research projects were supported through the USGS 104B Program:

• "The Massachusetts Isoscape Project: A tool for understanding hydrologic processes and water resource sustainability" was led by Dr. David Boutt of UMass Amherst. Boutt's research project built on a regional-scale monthly record of the stable isotopic composition of surface and ground water in Massachusetts with the goal of assessing constraints on the seasonality of recharge, ground water residence times, sources of water to streams, and understanding the sensitivity of stream baseflow to seasonal hydrologic variability. • "Addressing water supply issues through the modeling, analysis and optimization of renewable hybrid systems for water and electricity production" was headed by Dr. Jon McGowan at UMass Amherst. McGowans's project developed a conceptual model for a solar hybrid energy-desalination system capable of producing fresh water and electricity. • Dr. Baoshan Xing at UMass Amherst worked on the "Development of an in-field method for detecting engineered nanoparticles and their transformations in aquatic environments using surface-enhanced Raman spectroscopy." Xing's project received a no-cost extension to develop a new field method to detect low levels of nanoparticles and track their transformations in the aquatic environment.

The stable isotopic composition of shallow and deep ground waters in Massachusetts

Basic Information

Title:	The stable isotopic composition of shallow and deep ground waters in Massachusetts
Project Number:	2016MA452B
Start Date:	5/1/2016
End Date:	4/30/2017
Funding Source:	104B
Congressional District:	MA-002
Research Category:	Ground-water Flow and Transport
Focus Categories:	Groundwater, Geochemical Processes, Hydrogeochemistry
Descriptors:	None
Principal Investigators:	David Boutt

Publications

1. Boutt, D.F. The Massachusetts Water Isotope Mapping Project: An Integrated Precipitation, Surface Water, and Ground Water IsoScape for Improved Understanding of Hydrologic Processes, Abstract PP24B-07, presented at 2016 Fall Meeting, AGU, San Francisco, Calif., 12-16 Dec.
2. Boutt, D.F. The Massachusetts Water Isotope Mapping Project: An Integrated Precipitation, Surface Water, and Ground Water IsoScape for Improved Understanding of Hydrologic Processes, Abstract PP24B-07, presented at 2016 Fall Meeting, AGU, San Francisco, Calif., 12-16 Dec.

Problem and Research Objectives:

Surface and ground water in the Northeast US are heavily impacted by intense land-use changes, urbanization (Weiskel et al., 2007), and climatic changes (Hodgkins et al., 2002; Hodgkins et al., 2003, Hunntington et al., 2004; Hayhoe et al., 2007). More emphasis is being placed on water suppliers, stakeholders, and environmental managers to assess water quantity and water quality with increasing confidence intervals for sustainable management (e.g. minimum streamflow regulations). However, an over-reliance on physical measures of hydrologic behavior (such as streamflow and water table elevation) that do not uniquely assess the connectedness, residence time, and age distribution of surface and ground waters (McDonnell et al., 2010) cloud decision-making and introduce significant uncertainty. Recently, advances in theory and instrumentation have allowed the use of geochemical tracers (such as H_2O, D and ^{18}O) in combination with physical data to resolve discrepancies in measurements and reduce uncertainty in system conceptualization (IAEA, 2000). These tools and techniques are not yet been widely available to water suppliers.

The interpretation of stable isotope data in isotope hydrology relies on accurate, high-precision measurements of H and O isotopes of water samples (Brand et al 2009; Wassenaar et al 2012). With the advent of low-cost and high-throughput liquid water isotope analyzers based on cavity ring-down spectroscopy (CRDS, Berden et al 2000), hydrologic scientists can fully utilize these tools for assessment and management decisions with greater certainty. The applicability of stable isotopic tracers rely on robust understanding of the seasonal behavior of precipitation and the characterization of the isotopic behavior of surface and ground water isotopes.

Methodology, Principal Findings, and Significance:

<u>*Database and sample Collection:*</u> With support through the 104B program we have designed and built our isotope database. The current database consists of 1500 precipitation measurements across 15 stations, 2500 surface water measurements across 150 sites, and 2000 groundwater samples from 200 wells screened in overburden and bedrock wells. During the summer of 2016 alone we collected 800 new samples of surface water and groundwater. A map of new sample locations is presented in Figure 2. Significant effort was put into developing a network of collaborators at local watershed organizations. Through meetings

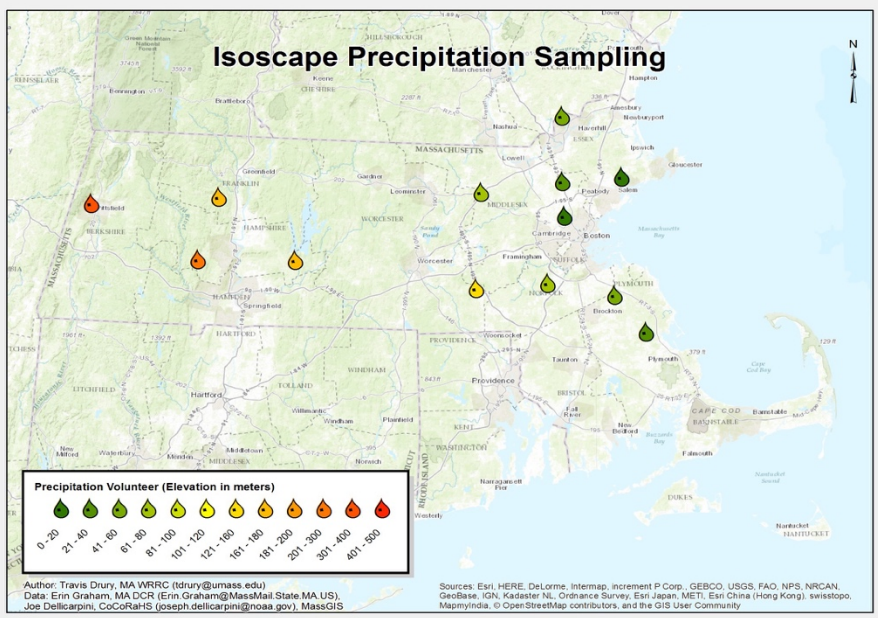

Figure 1: Precipitation sampling localities across the state of Massachusetts. Precipitation samples are composited bi-weekly at 14 proposed locations

with state entities –such as MA DCR – we are now having samples sent to us monthly from DCR and other cooperative water monitoring programs.

Results:

Isotopic composition of the region varies significantly as a function of topography and season. Because of the coastal orientation of the region, there is a large variability in the mean ^{18}O-H_2O composition of precipitation due to locally dominant precipitation sources. Deuterium excess of precipitation in the range of 10 – 14 ‰ are typical. Five years of surface water samples across the region show a strong seasonal trend ranging from -10 to -3 ‰ $\delta^{18}O$-H_2O. Surface waters depict seasonal evaporative enrichment in the heavy isotopes and demonstrate a similar magnitude of deuterium excess compared to the precipitation. During the winters of 2014 and 2015 typical seasonal trends are interrupted by distinctly depleted stream waters of the order of -12 to -11 ‰ $\delta^{18}O$-H_2O. These excursions are consistent with a source of water vapor to the region from more northerly (colder) regions. Mean stream water $\delta^{18}O$- H_2O isotopic compositions show a strong relationship to upgradient drainage area. Groundwater compositions range from -12 to -5 ‰ $\delta^{18}O$-H_2O across all the sites. A correlation between groundwater well elevation and $\delta^{18}O$-H_2O is observed with higher elevation sites depleted in heavy isotopes with variations of 2-3 ‰ $\delta^{18}O$-H_2O at any given elevation. Groundwater isotopic composition is distinct between overburden aquifer types (till, glacial fluvial) and bedrock suggesting that these aquifers are experiencing unique mixtures of recharge water. The development of this database and the resulting science will enable local and regional water stakeholders to manage protect water resources while allowing hydrologists explore regional and globally relevant scientific questions.

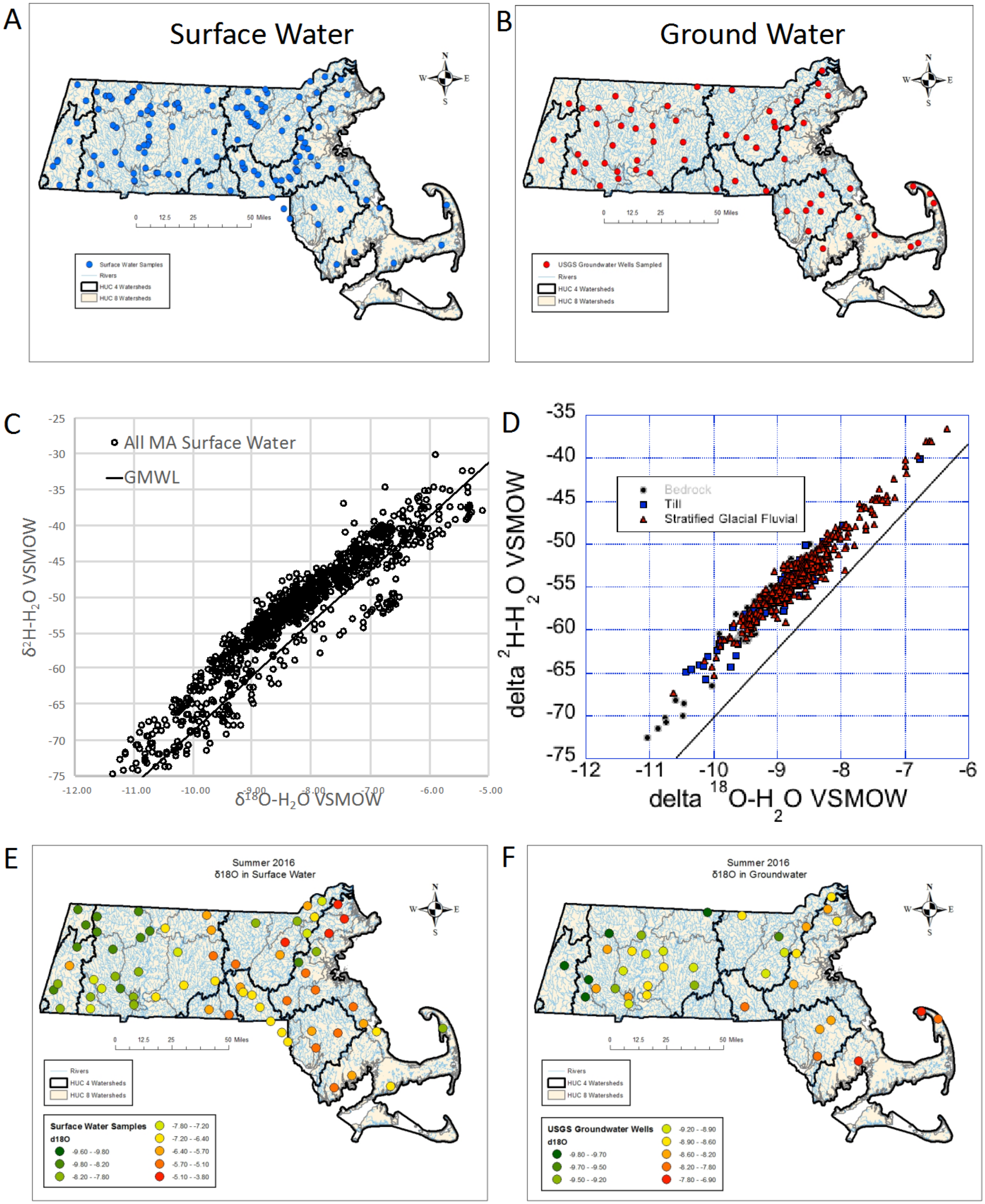

Figure 2: (A) Spatial distribution of where surface water samples were taken across Massachusetts B)

Spatial distribution of where surface water samples were taken across Massachusetts C) Relation of O18 and H2 values for all MA surface waters, plotted against the GMWL D) Relation of O18 and H2 values for bedrock type found in MA, plotted against the GMWL E) Spatial distribution of d18O values of surface water across Massachusetts F) Spatial distribution of d18O values of groundwater across Massachusetts

__The Database in Action__

Through our partnership with MA DCR Quabbin watershed environmental quality team, we prototyped isotopic baseflow separation using data collected from the network during a precipitation event in June of 2016. Figure 3 summarizes the data collected during this event that plots total stream discharge (blue) and isotopic composition of the stream water during the event. A gray bar shows a composite analysis of the precipitation that fell during the storm (~ -4. $\delta^{18}O\text{-}H_2O$ ‰). Before the storm, streamflow isotopic composition was about -9 $\delta^{18}O\text{-}H_2O$ ‰. The isotopic composition of the stream water gradually increases to – 7.2 $\delta^{18}O\text{-}H_2O$ ‰ and then falls back towards the pre-event composition. Using a two end-member mixing model based on the isotopic composition of precipitation and that of the pre-event stream water we estimate that proportion of new water in the stream (the precipitation) is the red line on the hydrograph. Summing up the area of the curve it turns out that about 75% of the discharge during the event was old water stored in the catchment and hydraulically pushed out of the ground by infiltrating new water. This type of information is important to consider when interpreting run-off events from a water quality perspective.

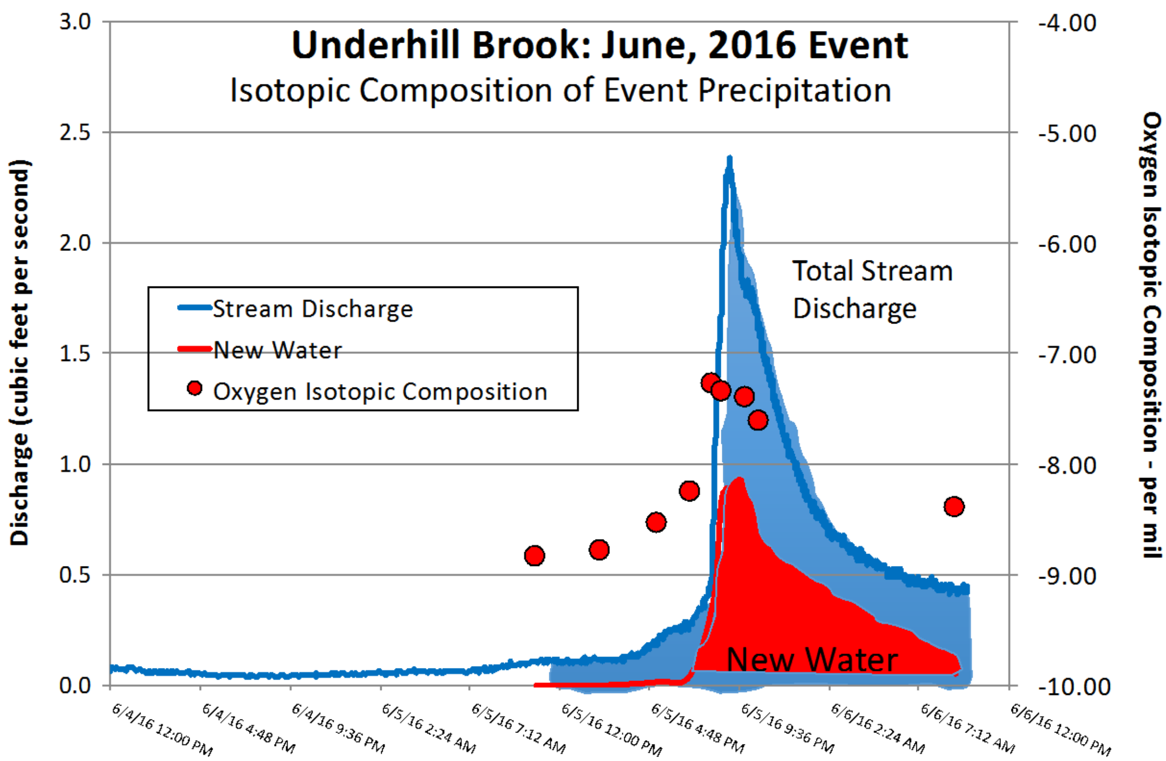

Figure 3: The isotopic composition of Underhill Brook vs the composition of the precipitation indicates that after the storm event the discharge composition was not dominated by new water.

Development of an in-field method for detecting engineered nanoparticles and their transformations in aquatic environments using surface-enhanced Raman spectroscopy

Basic Information

Title:	Development of an in-field method for detecting engineered nanoparticles and their transformations in aquatic environments using surface-enhanced Raman spectroscopy
Project Number:	2017MA462B
Start Date:	3/1/2017
End Date:	12/31/2019
Funding Source:	104B
Congressional District:	MA-002
Research Category:	Water Quality
Focus Categories:	Toxic Substances, Methods, Water Quality
Descriptors:	None
Principal Investigators:	Baoshan Xing

Publications

There are no publications.

Problem and Research Objectives: Silver nanoparticles (AgNPs) are released to and/or naturally formed in the environment due to their widespread use. Thus, it is urgent to develop reliable and rapid analytical methods which can be used in the field to detect AgNPs. We are developing a procedure which couples a rapid filtration with a portable Raman spectrometer to achieve on-site detection of AgNPs for aqueous samples. This method will enable simple volume adjustment and consistent AgNP distribution on the membrane. It will be the first field-deployable SERS method for sensitive measurements of trace levels of AgNPs in environmental waters.

Principal Findings and Significance:

As the award arrived in late summer 2017 and the majority of the budget is for the graduate student summer salary, we could not use the funding this funding cycle. We were granted a no-cost extension and will use the fund for the student summer salary of 2018 to do the proposed research.

Addressing water supply issues through the modeling, analysis and optimization of renewable hybrid systems for water and electricity production

Basic Information

Title:	Addressing water supply issues through the modeling, analysis and optimization of renewable hybrid systems for water and electricity production
Project Number:	2017MA463B
Start Date:	3/1/2017
End Date:	2/28/2018
Funding Source:	104B
Congressional District:	MA-002
Research Category:	Engineering
Focus Categories:	Water Supply, Water Quantity, Models
Descriptors:	None
Principal Investigators:	Jon McGowan, Matthew Arenson Lackner

Publications

1. Mohammadi,Kasra; Jon G. McGowan, 2018, Thermodynamic analysis of hybrid cycles based on a regenerative steam Rankine cycle for cogeneration and trigeneration, Energy Conversion and Management, 158, 460–475.
2. Mohammadi,Kasra; Jon G. McGowan, Under Review, A thermo-economic analysis of a combined cooling system for air conditioning and low to medium temperature refrigeration, Journal of Cleaner Production, Elsevier.
3. Mohammadi,Kasra; Jon G. McGowan, Under Review, An efficient integrated trigeneration system for productions of dual temperature cooling and fresh water: thermoeconomic analysis and optimization, Applied Thermal Engineering, Elsevier.
4. Mohammadi, Kasra, 2018, Thermo-economic and optimization of several hybrid multigeneration systems driven by concentrated solar tower plants, PhD Dissertation, Mechanical Engineering Deparmtent, University of Massachusetts Amherst, Amherst, Massachusetts, pp. TBA

Problem and Research Objectives:

In recent decades, growth in the world population, economic and living standards have been responsible for substantial increases in global energy consumption. Moreover, exploitation of fossil fuels to supply energy demands has led to global climate change, which is expected to have far-reaching and long-lasting consequences on the planet. These factors have motivated the importance and necessity of developing more efficient ways for energy conservation and generation that avoid the production of greenhouse gases that contribute to climate change. One method to address these issues is to develop combined production such as cogeneration, trigeneration, and multigeneration for simultaneous production of electricity, cooling, heating, fresh water, etc. using renewable energy sources such as solar. By using hybrid systems with multiple output products, the overall efficiency of the system can be increased over a single output system, and by using renewable sources, carbon and other harmful emissions are avoided.

The overall objective of this project is to propose, model, simulate, and optimize several integrated systems that can efficiently, renewably, sustainably, and economically address different demands including power, fresh water, cooling, and heating for both residential and industrial applications. Concentrated solar tower is used as a prime or supplementary mover for all proposed configurations and cycles, enabling a high temperature thermal heat source to generate electricity and provide thermal requirements of other systems.

Concentrated solar tower technology has attracted more interest in recent years due to its capability to provide high temperature thermal energy leading to a higher thermodynamic efficiency. Several solar tower technologies have been proposed that employ different design receivers and utilize different heat transfer fluids including molten salt, air, water/steam, CO_2, liquid metals and solid particles. In this project, however, the main focus is on utilizing air and CO_2 as working fluid in the solar receiver.

A main common aspect of all solar tower technologies is the utilization of several mirrors (heliostats) to reflect and concentrate direct normal irradiation (DNI) to a receiver mounted on the top of a tower. The heliostat field performance is described based on the optical efficiency, which is the ratio of the net energy reflected by heliostat field and absorbed by the receiver to the incident energy on the heliostat field.

A significant part of the required investment cost for developing solar tower technologies is attributed to heliostat field. Therefore, optimal design of heliostat field is of high significance to improve the optical efficiency of the field and overall performance of the system and reduce the investment cost.

This project differs from previous investigations and brings new contributions to the research community in several different key aspects. The novelty of this research mainly lies in the development of several novel utility scales cogeneration, trigeneration and multigeneration configurations using the above sub-systems that satisfy the most important demands in both the residential sector as well as industrial sector such as food, textile, chemical, oil, etc. Also, an efficient multi-objective optimization approach will be employed to introduce the most suitable configurations for each sector to reach higher profitability of the plant, higher efficiency, reliability and sustainability of the system as well as lower environmental impacts. Furthermore, another novel aspect of the project is the development of control schemes and strategies that can meet all the operational, reliability and safety requirements of the hybrid system operating autonomously throughout the year. This makes the developed hybrid system and mathematical model realistic and applicable for both sectors for year-round utilization. Finally, a number of case studies in the United States and worldwide will be developed and the optimization process and control scheme will be developed based on the possible electricity, fresh water, cooling and heating demands of each case study.

One of the important aspects to integrate power cycles with other cycles such as cooling, heating, and desalination for trigeneration and multigeneration purposes, is that integration should be accomplished in such a way that it minimizes the impact on the power production. This consideration is relevant for all configurations and systems in this project.

The objectives of this project include:

Specific objective 1: Create several computational codes that can simulate different integrated system based on the concentrated solar tower as a prime mover for the purpose of multigeneration of electricity, fresh water, cooling and heating. The integration of concentrated solar tower to the high-temperature, high-efficiency power cycles such as a Rankine or Brayton combined cycle is modeled. By using a combined cycle, a system is modeled that can reach higher operating temperatures and produce more electricity than the case of the Rankine cycle.

Specific objective 2: Propose and evaluate different thermodynamic configurations using the above mentioned sub-systems that can be applied to the residential and industrial sectors. For this aim, the developed computational codes simulate utility scale multigeneration systems at different scales. Then the plant economic performance is assessed by performing a detailed economic evaluation in terms of cost analysis, payback period and other important economic factors. In economic evaluation, the variation of cost is investigated due to modifications in the plant configuration, especially high temperature cycles, desalination units and refrigeration systems.

Specific objective 3: Via sensitivity analyses, determine and introduce the most important design parameters that influence the performance and economic of each proposed integrated configuration.

Specific objective 4: Apply an efficient multi-objective optimization approach to optimize each proposed configuration and introduce the most suitable configurations. The optimization approach enables a trade-off between higher performance, lower capital investment as well as the cost of generation of electricity, fresh water, cooling and heating, environmental concerns and sustainability.

Specific objective 5: Compare the performance of optimized hybrid systems with separate plants that do not implement a hybrid approach, cogeneration plants (producing two useful outputs) and trigeneration plants (producing three useful outputs).

Specific objective 6: Consider several case studies in the United States, as well as other parts of the world, with different energy, fresh water, cooling and heating demands in both residential and industrial sectors as well as different climate conditions and solar energy features. Site-specific direct normal irradiation (DNI) data and other required climate data are collected and used in simulations.

The results generated from this project will provide substantial insight regarding the technical, economic and environmental aspects of utility scale hybrid multigeneration systems using concentrated solar tower as a primary or supplementary energy source. The proposed configurations have the potential to make a significant impact on supplying all products. This project will provide guidelines for constructors, investors, decision makers and plant operators with a large number of decisions including choosing the optimal configurations based on existing demands of a location as well as operating and controlling the sub-systems.

Methodology:

To fulfill the objectives, several computational codes are developed using engineering equation solver (EES) software. EES is an equation-solving program that enables the solution of thousands of non-linear equations numerically. One of the main features of EES that significantly assists this research is its high accuracy thermodynamic and transport property databases for hundreds of substances, enabling it to simulate thermodynamic cycles that use different fluids [24]. The computational codes to simulate hybrid systems in this project include any of the following advanced systems:

- Concentrated solar tower systems as a primary or supplementary mover
- Back-up energy using natural gas
- High efficiency steam and transcritical CO_2 Rankine power cycles
- High efficiency Brayton and combined power cycles
- High efficiency supercritical CO_2 Brayton power cycles
- Organic Rankine cycle (ORC) power cycles
- A thermally driven MED or TVC-MED water desalination system
- Thermally driven LiBr-H2O absorption cooling cycles
- Thermally driven NH3-H2O absorption refrigeration cycles
- An electrically driven vapor compression or cascade refrigeration cycle

For all above-mentioned advanced cycles, proper thermodynamic models were developed and implemented in EES. The thermodynamic mathematical modeling of all cycles was carried out under steady state and steady flow (SSSF) conditions by assuming negligible kinetic, potential and chemical energies.

For an economic evaluation of the proposed integrated systems, economic models were developed to calculate different economic indicators such as total annual cost (TAC), annual capital cost (ACC), annual operating cost (AOC), levelized cost of energy (LCOE), levelized cost of cooling (LCOC), levelized cost of water (LCOW), net present value (NPV) and payback period (PBP).

As noted, due to the significant capital cost of heliostat field (mirrors), optimal design of heliostat field is of high significance to improve the optical efficiency of the field and overall performance of the system and reduce the investment cost. For this purpose, a detailed mathematical modeling is developed using Matlab to simulate the performance of different sizes heliostat field and provide an optimal filed configuration to achieve a higher flied efficiency and a lower capital cost.

Principal Findings and Significance:

The developed computational tools can simulate the operation of proposed integrated systems at various operating conditions and at different geographical locations. They enable parametric studies to identify the influence of several design parameters on the overall performance of systems. The developed computational codes for all considered cycles allow evaluation of several feasible configurations for different residential and industrial applications. Using the developed computational codes, it is also possible to conduct component and system configuration optimization to achieve optimal production of electricity, fresh water, heating and cooling.

The important contribution of this research is the proposal of different new integrated systems. The proposed systems can be developed and implemented for practical applications to supply the demands efficiently and economically in both residential and industrial sectors. Techno-economic analysis of the proposed hybrid systems for efficient energy utilization is a creative contribution to the body of knowledge.

The results of this research demonstrate that proposed multigeneration systems can supply multiple demands including electricity, fresh water and cooling at a higher thermodynamic efficiency and lower capital and operating costs than single production of these multiple useful products.

The Massachusetts Isoscape Project: A tool for understanding hydrologic processes and water resource sustainability

Basic Information

Title:	The Massachusetts Isoscape Project: A tool for understanding hydrologic processes and water resource sustainability
Project Number:	2017MA465B
Start Date:	3/1/2017
End Date:	2/28/2018
Funding Source:	104B
Congressional District:	MA-002
Research Category:	Climate and Hydrologic Processes
Focus Categories:	Hydrology, Drought, Groundwater
Descriptors:	None
Principal Investigators:	David Boutt

Publications

1. Belaval, Marcel; Boutt, David; Schroeder, Timothy; Ryan, Peter; J. Kim, Jonathan, 2018, Characterizing the groundwater-surface water system in a PFOA-contaminated fractured rock aquifer using radon and stable isotopes, 53rd Annual GSA Northeastern Section Meeting - 2018, DOI: 10.1130/abs/2018NE-310939.
2. Cole, A.; Boutt, D., 2017, Spatial and Temporal Mapping of Distributed Surface and Groundwater Stable Isotopes Enables New insights into Hydrologic Processes Operating at the Catchment Scale, American Geophysical Union, Fall Meeting 2017, abstract #H13G-1483

Problem and Research Objectives:

Surface and ground water in the Northeast US are heavily impacted by intense land-use changes, urbanization (Weiskel et al., 2007), and climatic changes (Hodgkins et al., 2002; Hodgkins et al., 2003, Hunntington et al., 2004; Hayhoe et al., 2007). More emphasis is being placed on water suppliers, stakeholders, and environmental managers to assess water quantity and water quality with increasing confidence intervals for sustainable management (e.g. minimum streamflow regulations). However, an over-reliance on physical measures of hydrologic behavior (such as streamflow and water table elevation) that do not uniquely assess the connectedness, residence time, and age distribution of surface and ground waters (McDonnell et al., 2010) cloud decision-making and introduce significant uncertainty. Recently, advances in theory and instrumentation have allowed the use of geochemical tracers (such as H_2O, D and ^{18}O) in combination with physical data to resolve discrepancies in measurements and reduce uncertainty in system conceptualization (IAEA, 2000). These tools and techniques are not yet been widely available to water suppliers.

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Methodology, Principal Findings, and Significance:

Database and sample Collection: With support through the 104B program we have designed and built our isotope database. The current database consists of 1500 precipitation measurements across 15 stations, 2500 surface water measurements across 150 sites, and 2000 groundwater samples from 200 wells screened in overburden and bedrock wells. During the summer of 2016 alone we collected 800 new samples of surface water and groundwater. A map of new sample locations is presented in Figure 2. Significant effort was put into developing a network of collaborators at local watershed organizations. Through meetings

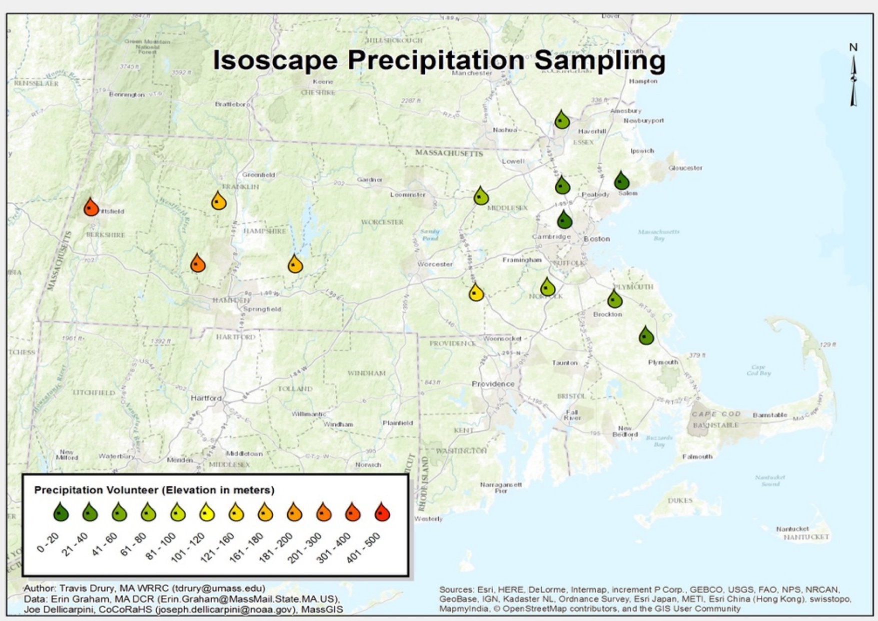

Figure 1: Precipitation sampling localities across the state of Massachusetts. Precipitation samples are composited bi-weekly at 14 proposed locations

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Results:
Isotopic composition of the region varies significantly as a function of topography and season. Because of the coastal orientation of the region, there is a large variability in the mean ^{18}O-H_2O composition of precipitation due to locally dominant precipitation sources. Deuterium excess of precipitation in the range of 10 – 14 ‰ are typical. Five years of surface water samples across the region show a strong seasonal trend ranging from -10 to -3 ‰ $\delta^{18}O$-H_2O. Surface waters depict seasonal evaporative enrichment in the heavy isotopes and demonstrate a similar magnitude of deuterium excess compared to the precipitation. During the winters of 2014 and 2015 typical seasonal trends are interrupted by distinctly depleted stream waters of the order of -12 to -11 ‰ $\delta^{18}O$-H_2O. These excursions are consistent with a source of water vapor to the region from more northerly (colder) regions. Mean stream water $\delta^{18}O$- H_2O isotopic compositions show a strong relationship to upgradient drainage area. Groundwater compositions range from -12 to -5 ‰ $\delta^{18}O$-H_2O across all the sites. A correlation between groundwater well elevation and $\delta^{18}O$-H_2O is observed with higher elevation sites depleted in heavy isotopes with variations of 2-3 ‰ $\delta^{18}O$-H_2O at any given elevation. Groundwater isotopic composition is distinct between overburden aquifer types (till, glacial fluvial) and bedrock suggesting that these aquifers are experiencing unique mixtures of recharge water. The development of this database and the resulting science will enable local and regional water stakeholders to manage protect water resources while allowing hydrologists explore regional and globally relevant scientific questions.

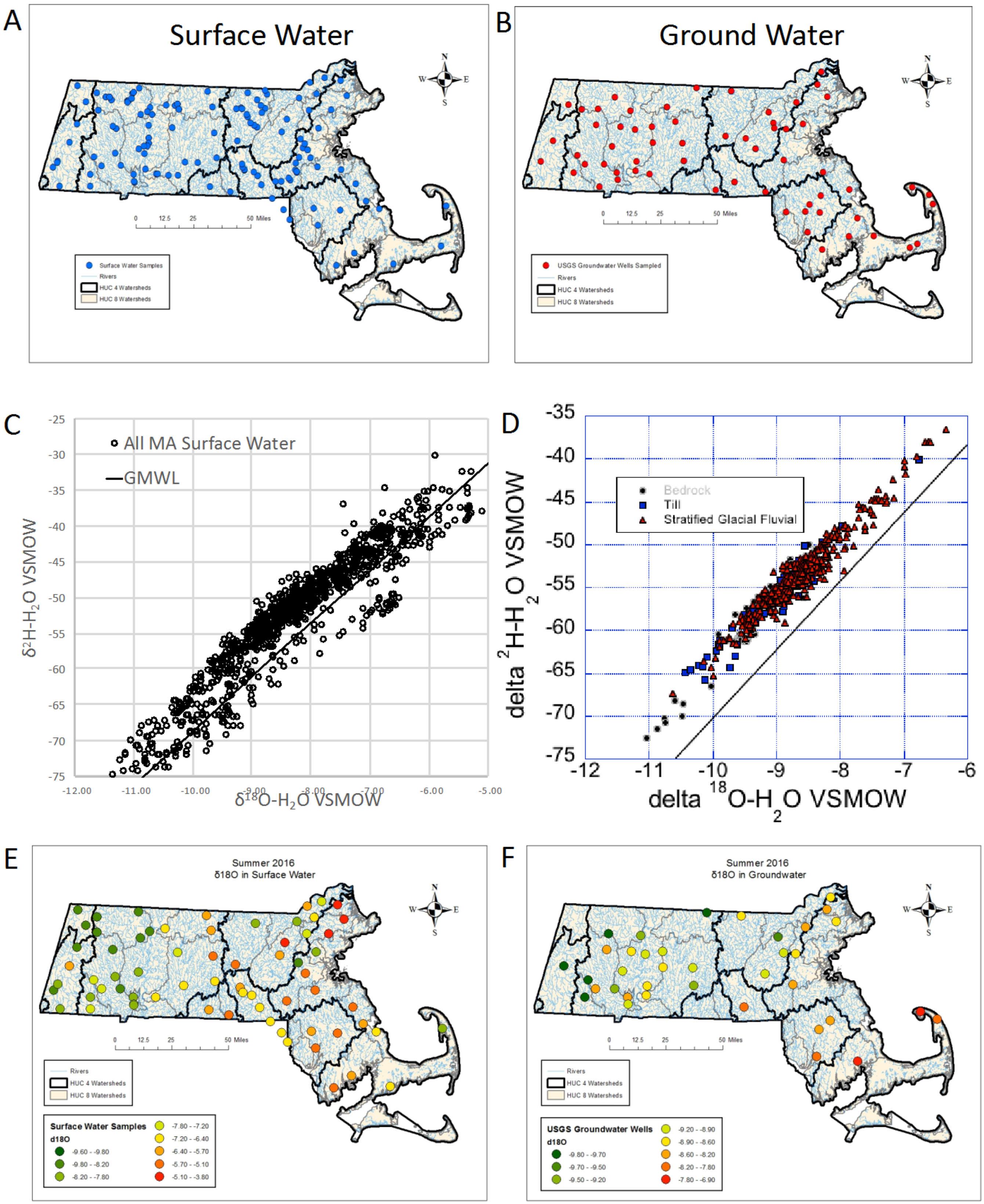

Figure 2: (A) Spatial distribution of where surface water samples were taken across Massachusetts B)

Spatial distribution of where surface water samples were taken across Massachusetts C) Relation of O18 and H2 values for all MA surface waters, plotted against the GMWL D) Relation of O18 and H2 values for bedrock type found in MA, plotted against the GMWL E) Spatial distribution of d18O values of surface water across Massachusetts F) Spatial distribution of d18O values of groundwater across Massachusetts

The Database in Action

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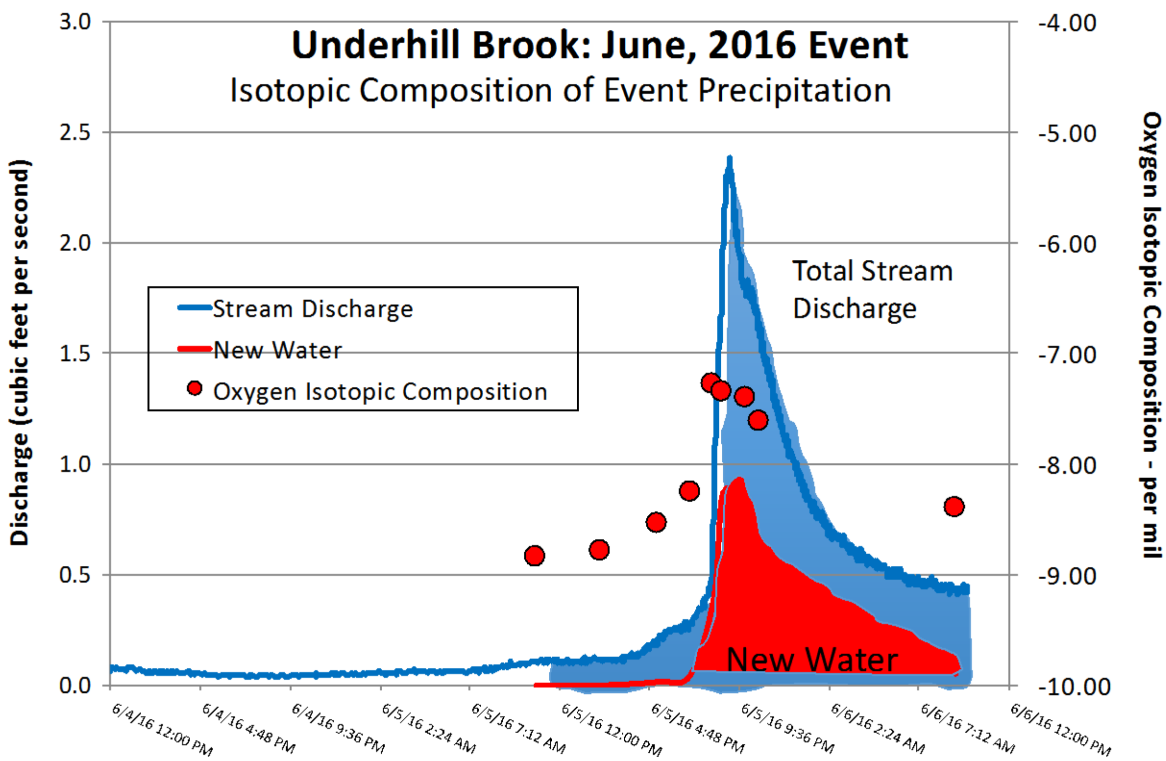

Figure 3: The isotopic composition of Underhill Brook vs the composition of the precipitation indicates that after the storm event the discharge composition was not dominated by new water.

Information Transfer Program Introduction

One of the Massachusetts Water Resources Research Center's goals is the transfer of information on water resources. In FY2017 we proposed to hold two educational symposia: a water conference symposium focused on water supply challenges and the water-energy nexus, and the New England Graduate Student Water Symposium.

Progress results for each project are summarized for the reporting year in the following sections.

WRRC Workshops

Basic Information

Title:	WRRC Workshops
Project Number:	2017MA466B
Start Date:	3/1/2017
End Date:	2/28/2018
Funding Source:	104B
Congressional District:	MA-02
Research Category:	Not Applicable
Focus Categories:	Drought, Water Quality, Water Supply
Descriptors:	None
Principal Investigators:	Paula Sturdevant Rees

Publications

There are no publications.

Water Symposium

Our plans to organize a symposium on the UMass Amherst Campus in January 2018 to follow up on previous workshops and investigate new topics was postponed to 2019 due to a Principal Investigator's major health issue. A no-cost extension was requested and granted and the symposium will take place in the next fiscal year.

North East Graduate Student Water Symposium 2017

National conferences provide valuable presentation experience and networking opportunities. Unfortunately, the cost of travel, lodging, and registration presents substantial obstacles for most graduate students. To address this problem, the New England Graduate Student Water Symposium (NEGSWS) was created in 2014 and ran for its fourth consecutive year in 2017. Also in 2017, the conference maintained the NEGSWS acronym, but the full name was changed to "North East Graduate Student Water Symposium" to more accurately reflect the expanding geographic representation of the attendees.

The conference was organized by a team of University of Massachusetts graduate students with help from the Massachusetts Water Resources Research Center and University of Massachusetts College of Engineering Professor Dr. David Reckhow. Thanks to the support of conference sponsors, registration was free for students and two nights of hotel accommodations were provided to presenters and student coauthors for a small $45 fee. Due to the unique draw of a student-only conference and low costs, approximately 157 people attended the conference from 34 institutions and organization from the North East region of North America (Table 1). Attendees came to the NEGSWS conference from nine U.S. states—Connecticut, Maine, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, Pennsylvania, and Rhode Island—and two Canadian provinces—Nova Scotia and Quebec.

Table 1: Institutions and organizations represented at the symposium

CDM Smith	Salem State University
Clarkson University	Smith College
Columbia University	Syracuse University
Cornell University	The State University of New York at Buffalo
Dalhousie University	Thermo Fisher Scientific
ENSA Agadir	Tighe & Bond
Harvard University	Tufts University
Lafayette College	University at Buffalo SUNY
Lehigh University	University of Connecticut
LuminUltra Technologies Ltd.	University of Maine
Manhattan College	University of Massachusetts Amherst
Massachusetts Institute of Technology	University of Massachusetts Boston
McGill University	University of Massachusetts Lowell
Montclair State University	University of Minnesota
Northeastern University	University of New Hampshire
Rensselaer Polytechnic Institute	University of Rhode Island
Roger Williams University	Wright-Pierce

The conference opened Friday, September 8, 2017 with an informal dinner which allowed attendees to check in at registration and network with faculty, sponsors, and other students (Figure 1). Technical presentations began the next morning and continued through Sunday. All presentations were given by undergraduate and graduate students, but post docs, alumni, faculty, and industry representatives were invited to attend. Presentations were grouped into the following topics: flood risk, hydrology, and water resources management; environmental monitoring: technologies and techniques; wastewater treatment; drinking water treatment; surface water modelling and monitoring; groundwater: assessment and remediation; and environmental systems management.

Figure 1: Friday evening NEGSWS dinner

Saturday's events also included a poster session (Figure 2), a career fair with presentations from industry sponsors, and an entrepreneurship panel which informed students on the basics of turning their research into entrepreneurship opportunities.

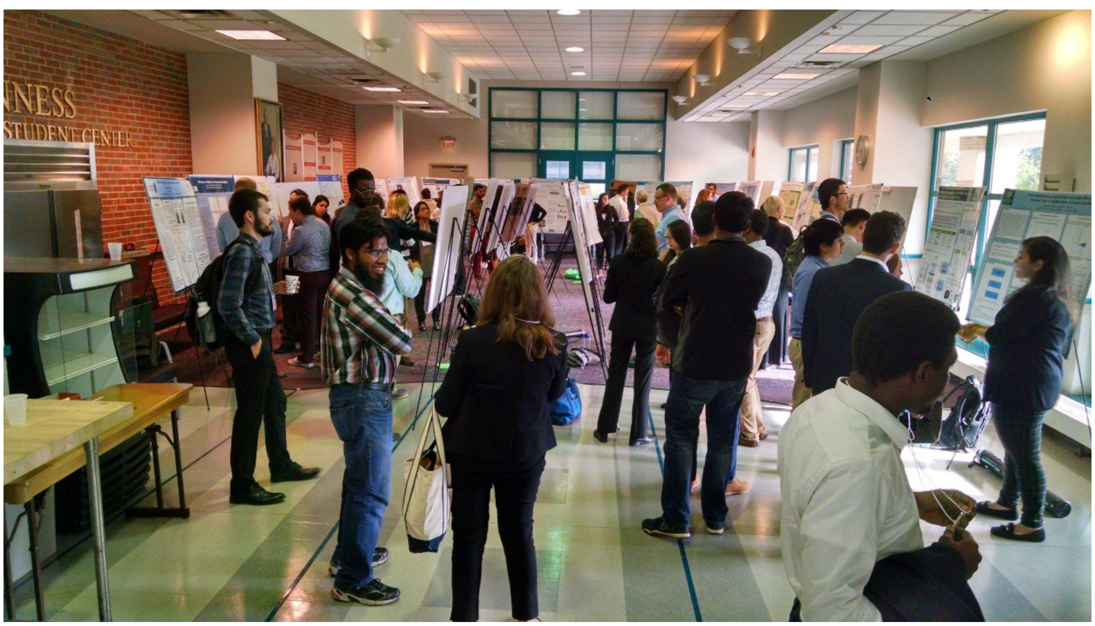

Figure 2: Poster presentations

On Sunday, one more session of technical presentations was held before the keynote speaker, former U.S. EPA Administrator Gina McCarthy, wrapped up the conference. Overall, there were 55 technical presentations and 37 posters presented by undergraduate and graduate students.

Figure 3: Students interacting with industry sponsors

Figure 4: Group Photo of NEGSWS 2017 Attendees

NEGSWS

North East Graduate Student Water Symposium

Friday, September 8th

5:30pm – 6:00pm	**Registration** –*Engineering Quad*
6:00pm – 9:00pm	**Dinner** – *Engineering Quad*

Saturday, September 9th

8:00am – 9:00am	**Registration** – *Marcus Lobby*
9:00am – 10:30am	**Technical Session 1**
10:30am – 10:45am	**Break** – *Marcus Lobby*
10:45am – 12:15 pm	**Technical Session 2**
12:15pm – 1:30pm	**Lunch** – *UMass Dining Commons*
1:30pm – 3:00pm	**Technical Session 3**
3:00pm – 3:30pm	**Break** – *Marcus Lobby*
3:30pm – 4:15pm	**Career Fair and Industry presentations-** *Marcus Auditorium Room 131*
4:15pm – 5:00pm	**Entrepreneurship Panel-** *Marcus Auditorium Room 131*
5:00pm – 6:30pm	**Poster Session**- *Student Gunness Center*
7:00pm – 9:30pm	**Dinner** –*Holiday Inn Express, Hadley*

Sunday, September 10th

8:30am – 9:00am	**Registration** – *Marcus Lobby*
9:00am – 10:30am	**Technical Session 4**
10:30am – 10:45am	**Break** – *Marcus Lobby*
11:00am – 12:15pm	**Keynote Lecture- Gina McCarthy-** *Elab 2 Auditorium*
12:15pm – 1:00pm	**Small Reception, Group photo and Closing**

Figure 4: NEGSWS 2017 schedule

USGS Summer Intern Program

None.

Student Support					
Category	**Section 104 Base Grant**	**Section 104 NCGP Award**	**NIWR-USGS Internship**	**Supplemental Awards**	**Total**
Undergraduate	4	0	0	0	4
Masters	0	0	0	0	0
Ph.D.	1	0	0	0	1
Post-Doc.	0	0	0	0	0
Total	5	0	0	0	5

Notable Awards and Achievements