2021 Summer Undergraduate Internship Descriptions*

Team: Integrated Assessment Model

Topic Area: Spatial analysis of water quality in Vermont watersheds

Physical Location: UVM

Number of Positions Available: 1

Faculty: Donna Rizzo and Scott Hamshaw

Mentor: Scott Hamshaw

Research Description: Interns will participate in research in understanding the spatial variability of water quality dynamics in the Lake Champlain Basin of Vermont. Watershed function can be highly varied spatially and can be observed using remote and in situ sensing. Recently, a wide variety of remote sensing and spatial data sets (e.g., high-resolution land cover, lidar topography, satellite soil moisture data) have become available offering new opportunities to identify watershed areas associated with hot spots and moments of transport of sediment and nutrients. Characterizing this spatial variability is essential to help inform ongoing watershed management efforts and inform the future in situ sensing and monitoring programs.

Interns will be responsible for designing and testing a GIS mapping method (spatial model) to identify unique areas of watershed function using spatial data sets. Interns will work with faculty and mentors in designing this method and in relating results to BREE project research on water quality dynamics.

Specific Skills/Experiences Desired: Coursework or experience with GIS. Previous experience with water quality sampling or basic programming (Matlab, Python, or R) beneficial.

Structure: Intern will interact with the mentor on an almost daily basis, with tasks given to the intern on days when face-to-face interaction is not possible. This position is primarily lab/computer based but may have select opportunities for field days performing aerial (UAV) surveys or other watershed monitoring efforts. The intern will participate in weekly research group meetings with faculty mentors and also have the chance to collaborate and interact with other undergraduate summer interns.

Contingencies around COVID: In the case of inability to meet in person, faculty and mentors will work with intern over Microsoft Teams. All data sets and software is available for students to use remotely.

Team: Climate

Project Title: Climate Statistics

Physical Location: University of Vermont

Number of Positions Available: 1

Faculty: Brian Beckage and Patrick Clemins

Mentor: Maike Holthuijzen

Research Description: The main goal of the climate team is to assess the frequency, intensity, and spatial patterns of historical and future extreme precipitation events over the Lake Champlain Basin. The intern will 1) conduct exploratory analyses to assess the ability of simulated climate data to capture extreme distributions, 2) apply techniques of extreme value theory to climate data generated by a regional climate model, and 3) conduct trend analyses to determine if extreme events are projected to change over time. The intern will be responsible for writing clean, commented code to conduct analyses and manipulate datasets, constructing effective, publication-quality graphics, and carrying out analyses using the statistical software R. Other tasks will include using a Linux server, creating a poster presentation, and writing a final report.

Software skills and knowledge: competence in R is preferred. The intern must have taken at least one course beyond introductory statistics and one course in R programming.

Structure: The intern will meet weekly with the mentor virtually to assess progress and additionally as needed to plan his or her current tasks. The intern will attend weekly virtual BREE Climate Team Meetings led by faculty members. The intern must have access to a computer and internet, as work will consist largely of data analysis and visualization using R. This internship will provide the intern an opportunity to improve his or her skillsets in data visualization, programming, effectively communicating scientific results in writing, and the basics of extreme value theory. Interns will be required to participate in additional CWDD virtual activities.

Team: Ecological team

Topic Area: Lake biogeochemistry

Physical Location: UVM

Number of Positions Available: 2

Faculty: Andrew Schroth

Mentor: Graduate student Wilton Burns and research technician Saul Blocher

Research Description: The lake biogeochemistry group is working to understand processes that affect the timing and intensity of summer cyanobacteria blooms in Lake Champlain. The BREE grant has an emphasis on the role of extreme weather events on the nutrient dynamics that lead to these harmful blooms. Interns will help deploy a sensor network in Lake Champlain and assist in weekly water sampling and laboratory prep work. Independent research projects will be carried out using water quality data from the sensors. Interns will interpret nutrient concentration data to determine seasonal nutrient dynamics and impacts of extreme events. We are looking for undergraduate students to join our team that are interested in working with big data, participating in a demanding but rewarding summer field season, and taking a hands-on approach to learning about the biogeochemistry of Lake Champlain. Manual labor in sensor deployment is required and interns should be prepared for weekly field sampling in a variety of weather conditions.

Specific Skills/Experiences Desired: Interest in nutrient cycling and lake biogeochemistry, experience with computer programming a plus but not required, ability to swim, comfortable on small research vessels

Structure: These positions will involve a mix of laboratory and field work out on Lake Champlain. Primary mentor will interact with interns on an almost daily basis, with tasks given to the intern on days when face-to-face interaction is not possible. There will be biweekly Ecology group meetings that will have a primary mentor (grad student/post doc) and/or one of the faculty advisors give a ~20 minute research talk that also illustrates how their research fits into the larger context of BREE. This will be followed by intern group updates on how they have spent the previous two weeks in their respective labs.

Team: Social

Topic Area: Climate Change Resilience through Town Planning and Water Quality Governance

Number of Positions Available: 1

Faculty: Dr. Richard Kujawa and Dr. Clare Ginger

Mentor: Dr. Richard Kujawa and Dr. Clare Ginger

Research Description: The purpose of this Summer 2021 internship will be to examine efforts in Vermont to increase resilience to climate change driven extreme events and to increase water quality by exploring policy development and implementation. This examination will have a primary focus on the municipal level although interactions with regional and state policies will be considered. The internship includes the following tasks:

- Assess the status town ordinances and bylaws that relate to river corridors and flood hazards.
- Assess municipal development plans to characterize policy intentions to mitigate flood hazards, especially related to land use restrictions, natural resource protection, stormwater management, and water quality.
- Characterize the status of town-level efforts to meet requirements to reduce stormwater discharge and improve water quality through the state program addressing municipal roads.
- Review municipal planning documents to identify sources of external support identified by towns as important to taking action to implement plans.
- Contribute to social sciences team efforts underway during summer 2021, as assigned

Activities will include web-based research on regional and local governance; continued development and analysis of existing data (using collaborative tools in the Google Suite and Microsoft Excel); analysis of individual and group interviews; and archival/media research. Training and support for spreadsheet database management and content analysis will be provided.

Specific Skills/Experiences Desired:

- A course or prior experience in environmental, land use or water quality policy, law, planning, or management
- Introductory knowledge about climate change, extreme events, and implications for human settlements
- Curiosity about social dimensions of environment and natural resource management
- Computer skills for using the internet and spreadsheets to gather, organize, and enter data
- Interest in learning and applying data analysis skills
- Interpersonal skills and interest in interacting with local and regional planners and managers

Software Skills and Knowledge:

- Microsoft Office Suite (Word and Excel)
- Google Sheets
- Training in qualitative data coding software will be provided as needed

Structure:

- Interns' daily work occurs in places as specified by the Center for Workforce Development and Diversity (CWDD) associated with the grant program. This internship can be completed from a remote location should circumstances require it. Some field experience may be part of the internship if it is allowed by circumstances of the Covid-19 pandemic.
- Faculty mentors work closely with the intern in weekly meetings to set goals and report on progress. These meetings will be conducted either in-person or remotely as circumstances dictate.

- Mentors and interns interact via email on a regular basis.
- Team wide/IAM intern meetings may also be held at the request of the team leads for Social Systems and IAM. These meetings include brief reports and discussion of team-wide projects, and tasks that are broader than this Kujawa/Ginger internship.
- Interns will engage in activities provided by CWDD.

Team: Integrated Assessment Model

Topic Area: Understanding Future Water Quality in a Changing Landscape and Climate

Number of Positions Available: 1

Faculty: Dr. Elizabeth Doran & Dr. Asim Zia

Mentor: Dr. Elizabeth Doran

Research Description:

In its final year, the BREE project is looking to analyze the results from a series of land use change and management scenarios centered around the Adaptive Land Use and Land Cover Agent Based Model (ALL ABM) and prepare findings for publication. The land use and land cover model is incorporated into an integrated modeling framework to understand nutrient dynamics and downstream water quality impacts within the Lake Champlain Basin system under different scenarios of extreme weather events and policy assumptions. The focus of the planned work will be on the adoption of specific nutrient management practices by diverse stakeholders in the target watershed. The intern will work to support this effort by helping to perform analysis of IAM model output under different scenarios and assist in tasks related to the preparation of results for publication. The intern will be expected to support this effort through the following activities:

- Perform analysis and prepare visuals of IAM ensemble model output in the R programming environment to assess land cover change and agent behavior impacts on downstream water quality;
- Assist in narrative development for management and land use change scenario outputs; and,
- Perform literature review and generate summary text in support of manuscript development.

Specific Skills/Experiences Desired: Environmental science, environmental engineering or ecology background preferred; modeling experience or interest in modeling is required; GIS experience is preferred; programming proficiency required, preferably in R.

Structure: Prospective intern should plan to interact with their primary mentor multiple times per week in addition to periodic meetings with their faculty advisor. Additional open work sessions and overall program meetings and activities will also have mandatory attendance. Work will primarily occur in an office setting, however opportunities to join other teams for field work are possible.

Contingencies around COVID: Due to possible restrictions resulting from the ongoing pandemic, internship activities may be hybrid or fully remote.

Team: Social

Topic Area: General Equilibrium Model

Number of Positions Available: 1

Faculty: Bill Gibson

Mentor: Graduate student to be determined

Research Description:

The summer intern will assist in the development of a computable general equilibrium (CGE) model to be applied to the BREE project. This is a regional model based on data from social accounting matrices from IMPLAN for Vermont and New York. The intern will be responsible for writing and running programs to prepare data for the modeling effort, such as sectoral aggregation and bi-proportional adjustment (RAS). The model is then solved in the general algebraic modeling system (GAMS) and simulation results are linked to the agent-based model developed for the BREE project. No previous GAMS experience is required but the ideal candidate must be willing to learn how to prepare and run simulations in a data intensive environment. Strong Excel skills are expected and writing in LaTeX/Overleaf is important.

Interns will be supervised daily by the graduate student mentor with approximately weekly interactions with the faculty advisor.

Team: IAM

Topic Area: Hydrological Droughts and Harmful Algal Blooms

Number of Positions Available: 1

Faculty: Prof. Asim Zia

Mentor: Dr. Panagiotis (Takis) D. Oikonomou, Postdoctoral Associate

Research Description: Natural stresses and anthropogenic activities are affecting water quality of inland water bodies. Major concern in many places around the world, including the US, are the increasing patterns of harmful algal blooms (HABs) in lake systems. Projected changes in future extreme events due to climate change will further affect water resources systems. Understanding the response to such events in an integrated manner is central for environmental management and protection efforts.

The integrated Assessment Model at Vermont EPSCoR contains a chain of models that simulate physical processes (e.g. climate, hydrology, nutrients) and anthropogenic activities (e.g. land use change, governance, and macroeconomic model). Thus, the IAM has the capacity to simulate the coupled natural and human systems and explore their combined effects on water quality. The selected intern will utilize datasets from the IAM in order to investigate relationships between drought phenomena and the development of HABs. While there are many drought manifestations, the focus of this project is on hydrological drought.

Main Duties:

- Analyze lake water quality output data
- Prepare and analyze climate input data
- Assist with literature review

Specific Skills/Experiences Desired: This internship is targeted to applicants enrolled in majors such as Civil & Environmental Engineering, Data Science, Statistics, and have interests and skills in data analysis, water resources, extreme events, and/or environmental science. Proficiency in MS Excel is required along with some knowledge of statistical analysis. Basic R programming knowledge is required, with familiarity on Geographic Information Systems (GIS) being a plus. In the application package, please describe any relevant information about prior research experience and related courses taken in the fields of programming, statistics, environment/water engineering and GIS.

Structure: The selected intern will be based in a University of Vermont office setting with other Social Systems, Ecology and Climate interns. The interaction with the primary mentor will be on a daily basis with formal meetings taking place once a week to set weekly/short term goals (in person or remotely). In addition, the intern will meet with other members of the project, including the faculty mentor. Although the envisioned work does not require any data collection, there are occasional opportunities to join other teams for fieldwork if that is of interest. Interns will be required to participate in all CWDD activities (e.g., potential outings to stakeholder groups, and professional development opportunities).

Contingencies around COVID: The proposed work does not include any fieldwork or data collection. All tools needed to complete the internship are open source, meaning that the intern could work from his personal computer. Thus, there will be minimal implications if a hybrid or a remote internship mode is required due to COVID.

Team: Climate

Topic Area: Hydroclimatology

Number of Positions Available: 1

Faculty: Drs. Lesley-Ann Dupigny-Giroux and Arne Bomblies

Mentor: Caitlin Crossett

Research Description: The goals of the hydroclimatology team are to determine how heavy precipitation and drought events arise within the Northeast US. The hydroclimatology intern will perform analysis on past heavy precipitation events or droughts within the Northeast US to determine how their frequency, intensity, and drivers have changed over time. The intern in this position will utilize the ERA5 climate reanalysis dataset and other observational datasets to examine atmospheric and land-surface characteristics. By understanding how these events have emerged in the past, one can make better predictions of how they may look from a climatological perspective in the future

Specific Skills/Experiences Desired: Competence in MATLAB, Python or a similar computer programming language preferred. Must have taken at least one class in weather or climate.

Structure: The intern will informally meet with their mentor daily and have weekly formal meetings to set weekly goals. The intern will have bi-weekly meetings with faculty advisors, and weekly meetings with the other interns working from the EPSCoR office. The intern will work from the EPSCoR office and no fieldwork is associated with this project. Interns will be required to participate in all CWDD activities (e.g. potential outings to stakeholder groups, and professional development opportunities).

Contingencies around COVID: If the internship is a hybrid or remote style the intern will meet with their mentor daily either in person (if hybrid on the days they are in the office), or on zoom, Microsoft Teams etc. (if hybrid and not in the office or if full remote). Screen sharing capabilities will be used in both the hybrid and remote style internship to help the intern progress in their research. Meeting schedules will stay the same for faculty and EPSCoR office interns/their mentors, but these will be done using zoom, Microsoft Teams etc.

Team: Social

Topic Area: Modeling Social Systems in the Lake Champlain Basin

Physical Location: 23 Mansfield Ave, University of Vermont, Burlington, Vermont

Number of Positions Available: 1

Faculty: Asim Zia

Mentor: Kevin Andrew

Research Description:

The Lake Champlain Basin is a complex system containing many interacting decisionmaking individuals and organizations. The Deep Agent-Based Model (Deep ABM) is a model using deep machine learning to investigate potential behavioral trends within this system in response to changing economical and ecological situations. Findings from the Deep ABM will be used for characterization of human agents in the BREE Integrated Assessment Model. The intern will assist in the validation and statistical analysis of social systems and environmental feedback model results for the region.

Work will include the following:

- Statistical analysis of model behavior and accuracy over runs
- Processing of large-scale model datasets for validation and analysis

Specific Skills and Experience Desired:

A background in mathematics or data science is preferred, but not mandatory; some knowledge of statistical analysis would be useful; experience or interest in computer programming is preferred, but not necessary.

Structure:

The intern will have regular meetings with their mentor multiple times a week and meetings with their faculty advisor weekly, and additionally as needed. Additional large-group and working meetings will occur throughout the course of the program.

Team: Ecological Team

Topic Area: Watershed and Soil Biogeochemistry

Physical Location: UVM

Number of Positions Available: 1

Faculty: Andrew Schroth, Carol Adair

Mentor: Dustin Kincaid

Research Description: The student will participate in ongoing research that seeks to understand the influence of watershed processes on water quality. Projects will be designed around the student's interests but will broadly focus on one of the following: 1) understanding how watersheds influence storm-driven solute transport in streams, or 2) investigating the influence of soil biogeochemical processes in riparian wetlands on greenhouse gas production or stream water quality. The students will collect and analyze data from the field, which may include water or greenhouse gas chemistry in combination with high-frequency sensor data from streams and/or riparian wetlands.

In-person/hybrid experience

The student will collect samples from multiple sources in the watershed (soils, groundwater, or streams) and analyze them for carbon, nitrogen, phosphorus, and other key elemental concentrations. They will also learn to maintain and gather data from a network of cutting-edge stream and soil sensors. The student on this project will be able to utilize past data to get a head start on their project, while also continuing data collection over the course of the summer internship. The individual chosen for this project will assist with field sampling, sensor maintenance, laboratory analyses, data analysis, and presentation of results.

Specific Skills/Experiences Required: The most important qualification is a desire to learn new skills and an interest in working in diverse settings (field, lab, office). The student will be required at times to spend long days outside and should be comfortable in or near water and also be able to engage in physical labor (e.g., carrying heavy backpacks, digging holes in soil). Other preferred skills include proficiency with Microsoft Excel or R and experience working in field or laboratory settings.

Remote/virtual experience

Similar to the in-person/hybrid experience, except the student will work with existing datasets.

Specific Skills/Experiences Required: The most important qualification is a desire to learn new coding and statistical modelling skills. The student will benefit from having experience working with R.

Structure: The student will interact with their mentor on an almost daily basis. When daily interactions with are not possible, clearly defined tasks will be given to the student ahead of time.

The student will participate in bi-weekly meetings with the entire Ecology group, where they will report on their research as well as hear from other interns and postdocs/faculty about other aspects of BREE research. These meetings will also be an opportunity for the student to interact with their faculty advisers.

* Project availability and location may change due to the COVID pandemic and available funding.