**EVERSOURCE ENERGY CENTER**

**Undergraduate Research Fellowships (URF): The Science of Energy Resilience in a Changing Environment**

***RESEARCH TOPICS***

**1. Using weather data to assess predictive outage uncertainty and accelerate storm restoration (Astitha/Wanik)**

 **Overview:** The prediction of storm-based outages is critical for improving disaster preparedness, response and mitigation strategies by utilities. In this research topic we will focus on two key aspects of storm outage prediction and mitigation: evaluating uncertainty of weather data in outage modeling and development of advanced predictive analytics and modeling techniques for estimating the spatial variability of expected outages based on weather input. The expected outcomes are: 1) familiarity with the concepts of prediction models (numerical and machine learning); 2) understanding connections between weather and outage prediction; 3) training on the usage and analysis of weather and outage data; 4) comprehensive and thorough understanding of statistical analysis techniques and data interpretation.

1. **Effects of roadside forest management treatments on tree and forest ecosystem structure and functioning (Fahey/Morzillo)**

**Overview:** Many power failures in northeastern US are related to trees falling on power lines. In many cases, the trees that are interacting with the power lines are not necessarily the closest to the road, but rather trees within a 100 foot distance from the road that may not be structurally resistant to wind events. The Stormwise initiative (http://stormwise.uconn.edu/) and related management trials and biomechanical monitoring are designed to test methods to increase the resilience of trees and forests to wind and ice events in the short and medium term. The program also has an interest in the long-term regeneration response of trees, associated co-benefits and costs of treatments, human reactions to treatments, and cost recovery and benefits to local economies.

**3.** **Assessing infrastructure and vegetation change using LiDAR (Parent)**

**Overview:** Eversource Energy maintains 27,000 km of utility lines in Connecticut alone. Light Detection and Ranging (LiDAR) and other remote sensing technologies can greatly enhance the utility’s ability to monitor changes to its utility network. This research topic focuses on using air- and ground-based LiDAR to quantify vegetation growth rates around utility lines after different tree trimming treatments are applied. Understanding vegetation growth after tree trimming will help determine appropriate trim cycles as well as the LiDAR acquisition intervals needed to effectively monitor vegetation change.

1. **Evaluation of Substations Vulnerability of Flooding in Current and Climate Change Scenarios (Shen/Nikolopoulos)**

**Overview:** Many utilities have critical infrastructure located within floodplain areas that are vulnerable to extreme events. Early warning systems have the potential to predict flooding impacts and allow for better emergency response and mitigation efforts. This research topic focuses on estimating flood frequency using long-term hydrological simulations forced by reanalysis meteorological data. The estimated extreme flood events are then ingested into a hydraulic model to: 1) estimate the risk of failure (ROF) of hydraulic structures near substations; 2) evaluate the inundation risk over substation areas during flood events and 3) design management strategies that reduce the ROF of hydraulic structures and inundation risk of substations.

1. **Grid Resilience Assessment Using the GoldSim Model (Bagtzoglou/W. Zhang)**

**Overview:** System performance for the power grid and asset management during extreme weather and security events can be formulated as a modular system, known as a total system/performance assessment model. Complex system dynamics as well as discrete event simulation can be used to track and understand the complex system behavior and associated uncertainty propagation. The objective of this research project is to identify the correlations between environmental data and power outages using a total system/performance assessment model that builds upon the GoldSim software. GoldSim is a dynamic, probabilistic simulation software combining an extension of system dynamics with some aspects of discrete event simulation. GoldSim allows for treatment of uncertainty propagation by executing models in Monte Carlo mode, while recording alternative model outputs to compute statistics on the performance metric and confidence intervals. The undergraduate research intern will assist in data analysis and simulations for the resilience of the power grid using this software.