# Table of Contents

## Master’s Students

- Ysabel Banon, CCNY/CUNY ............................................................... 3
- Harold Gamarro, CCNY/CUNY ....................................................... 4
- Matthew Hilding, UTEP ................................................................. 5
- Damien Hudson, CCNY/CUNY ....................................................... 6
- Carlos Iturrino, University of Puerto Rico, Mayaguez .................. 8
- Nicolas Maxfield, CCNY/CUNY .................................................... 9
- Jessica Montes, SDSU ................................................................. 10
- Corrie Monteverde, SDSU ........................................................... 11
- Christiana Sasser, UMBC ............................................................. 12
- Anna Vaculik, CCNY/CUNY ....................................................... 13
- Jean Pierre Valle, University of Puerto Rico, Mayaguez ............. 14

## Ph.D. Students

- Steven Buckner, Hampton University ......................................... 16
- Equisha Glenn, CCNY/CUNY ...................................................... 17
- Rose Jiménez, Graduate Center/CUNY ................................. 18
- Veeshan Narinesingh, CCNY/CUNY ........................................... 19
- Alana Menendez, CCNY/CUNY ................................................. 20
Master’s Students
Research Synopsis

*Thermal Stress and Bleaching in Coral Reef Communities During The 2014-2016 Caribbean Bleaching Event*

The goal of this research is to analyze the extent to which satellite-based measurement of heat stress conditions in coral systems relate to in-situ coral bleaching observations. It employs data sets produced from NOAA Coral Reef Watch CRW Degree Heat Week (DHW) and compares them with in-situ bleaching observations in the Caribbean coral reefs for the so-called Third Global Bleaching event for 2014, 2015 and 2016. The DHW is derived from the remote sensing data of sea surface temperature (SST), and provides an indicator of the thermal stress for the coral reefs.

Two analyses are necessary. The first analysis involves developing regional groupings of DHW observations by the Virtual Stations. The second analysis consists of a pixel-based assessment of grouped observations each by 0.05-degree pixel (5Km by 5Km). Significant coral bleaching is expected to occur one to three weeks after reefs begin to experience DHW values over 4°C weeks. Mass bleaching and mortality are expected after 8°C weeks.

Multi-year datasets are analyzed in more detail for the Florida Keys, where the most complete coral bleaching observations are available, to see how thermal stress varies with bleaching observations for each year across multiple years. This time series analysis includes linear regression and K-means cluster analyses. Preliminary analyses for the K-means showed the distribution of the DHW was noticeable around 5 °Celsius and 67% bleaching. For observations where DHW values > 4°C-weeks, bleaching was expected and confirmed by in-situ bleaching observations.
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CESSRST Research Theme: Atmospheric Hazards

Research Synopsis
Underground Infrastructure Thermal Storage in Dense Urban Environments
The research will develop a parametrization of the under-ground infrastructure in dense urban environments using physical models and thermal remote sensing (GOES-16) data for representation of the surface energy balance in cities. The physical parameterization will be imported in urbanized weather models as an added capability to better represent urban climate and weather physics.
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CESSRST Research Theme: Atmospheric Hazards

Research Synopsis

*Temperature Estimation from Land Surface Temperature to Assess Heat Island Effects in Richmond, VA*

Comparison of in-situ air temperature data with satellite derived land surface temperature (LST). Regression model performed to estimate the air temperature from LST.
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CESSRST Research Theme: Atmospheric Hazards

Research Synopsis

An Analysis of the Standardized Precipitation Evapotranspiration Index (SPEI) On Drought Based On Economic Impacts in The Northeast (US)

In order to examine causes of economic and/or environmental distress, it is important to understand drought. Drought is a byproduct of long periods without precipitation, but it is extremely difficult to quantify. Therefore, an index known as the Standardized Precipitation Index (SPI) has been used in previous studies to analyze droughts that are considered as months-years of below normal precipitation. This type of drought is known as meteorological drought. Absence of rainfall could be used as a tool to measure drought, but it does not consider evaporation; hotter and drier air can extract water from soil and plants. Thus, additional models can incorporate groundwater details or particular characteristics of plants.

There are other types of droughts called Agricultural and Non-Agricultural. Agricultural drought is the reduction of plant growth and crop production due to below normal precipitation, less frequent rainfall and/or above normal evaporation which result in dry soil. Non-Agricultural drought on the other hand affects businesses, tourism etc. instead of crops. Using the SPI to evaluate/analyze these two types of drought would not be effective because this index is solely based on precipitation. For this reason, the Standardized Precipitation Evapotranspiration Index (SPEI) was created. This index was created to measure agricultural droughts, but it also takes into consideration, the meteorological droughts as well as crop evapotranspiration.

In the Northeast (United States), many studies suggest that there are signs of drought occurrences. Therefore, in this study, we want to understand how “good” of a predictor the SPEI is by looking at the northeast to find trends between dryness indication of the SPEI and drought economic impacts. First, the SPEI was formatted to look at trends in drought-intensity-duration-frequency. Second, economic impact data is looked at to find out where there are trends in low production in both crops and business output.
Objectives
Given the SPEI, the user will be able to ensure that the frequency of extreme events will be consistent on any time scale due to its standardization. The SPI is calculated by fitting probability density function to the frequency distribution of the precipitation that is summed over the timescale chosen. To define meteorological drought, the SPI is a valuable tool for the estimation of drought intensity, frequency and duration. In terms of intensity, frequency and duration of drought, the SPI method is able to return fundamental parameters in the analysis of drought.

Given the SPEI data, drought will be defined by precipitation and temperature. For instance, a SPEI value of 2 or more can be considered as extremely wet and a SPEI or -2 or less can be considered as extreme drought as seen in table 1. To measure the duration and intensity of droughts, we will use the SPEI to quantify the duration. For instance, we will try to make a correlation between the extreme droughts and duration. It may be the case that where there are extreme droughts, their durations are shorter and vice versa.
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**CESSRST Research Theme:** Atmospheric Hazards

**Research Synopsis**

*Acquiring Multispectral Images Using a Commercial Camera for Ocean Color Products*

This project focuses on the development of a lens system to capture the spatial as well as the spectral information of an image plane. Reconstruction algorithms are tested for the creation of a multispectral data cube and compared with spectral instruments.
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**CESSRST Research Theme:** Water Prediction & Ecosystem Services

**Research Synopsis**

*Hydrological Drought Trends in the U.S. Using Low-flow Observations*

The project focuses on the behavior of streamflow gages in relation to meteorological drought indicators. As research progresses, we hope to gain a better understanding of meteorological drought and its temporal and spatial relationship with socio-economic drought. The research shall provide a methodology for studying and analyzing drought and its impacts on different areas of society.
Assessing Soil CO2 Effluxes in Semiarid Chaparral Shrublands

Soil respiration (Rsoil) is the second largest carbon dioxide (CO2) flux in terrestrial ecosystems and it is important in estimating future effects of climate change. Considering semiarid shrublands are significant sinks of CO2, we will study the effects of vegetation microsites, soil temperature, and rainfall events on Rsoil in a chaparral ecosystem in Southern California.
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CESSRST Research Theme: Water Prediction & Ecosystem Services

Research Synopsis

Climate Change Impacts on Winegrowing Regions in Southern California: From the Perspective of a Regional Climate Model

This project will use high-resolution regional climate modeling and observational data analysis to estimate wine grape crop suitability changes for Southern California in the near future and the potential effects of global warming on crop yield. Wine grape represents an economically valuable perennial crop and is very sensitive to changes in temperature. Therefore, determining how climate change can impact crop suitability and potential yield is key.
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CESSRST Research Theme: Atmospheric Hazards

Research Synopsis
Analyzing The Effect of Varying Boundary Conditions On a Wind Farm
Using LIDAR data and meteorological data to determine varying boundary and stability conditions and how the wind profiles are affected, ultimately affecting wind turbine power production
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Major: Geology

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CESSRST Research Theme: Atmospheric Hazards

Research Synopsis
Downscaling of Satellite Land Surface Temperature Over Urban Environments
The purpose of this study is to estimate high temporal and high spatial resolution land surface temperature (LST) over different surface types in urban regions. The goal is to estimate high resolution LST by combining Landsat 8 and the Geostationary Operational Environmental Satellite-R Series (GOES-R) infrared-based LST. Landsat 8 provides higher spatial resolution (30 m) estimates of skin temperature every 16 days. However, GOES-R which has lower spatial resolution (2 km) has much higher temporal resolution (5 min). The research project aims to match the dates that both GOES-R and Landsat LSTs to find their spatial relationship to develop the downscaling of GOES-R LST. The downscaling approach will account for systematic biases between Landsat and GOES-R LST products.
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CESSRST Research Theme: Water Prediction & Ecosystem Services

Research Synopsis

Flood Risk Assessment Using In-Situ and Remote Sensing Products: Development of Flash Flood Forecasting System for Puerto Rico

Weather-related disasters have seen an increase in their frequency since 1980. For Puerto Rico, a territory of the United States in the Caribbean, the past decades have been plagued with constant floods, whose impact range from limited to catastrophic. This can be attributed to the topographic features and weather patterns of a tropical climate, where constant high temperatures lead to high intensity convective rainfall. Even though any rainfall event can lead to a flood, they are more likely to occur during the hurricane/rain season. Currently, the method used by the National Weather Service for flash flood analysis in Puerto Rico is the Flash Flood Guidance. For the island, the Flash Flood Guidance divides the territory in multiple regions and provides a single value for each one of them. For Puerto Rico, whose topography and weather patterns experience drastic changes in short distances, this guidance value may not be an accurate representation for all the area contained within each of the subdivisions.
Ph.D. Students
Research Synopsis

*Developing and Testing New A-Priori Inputs for NUCAPS Ozone Profiles Using OMPS Limb Profiler Ozone Data*

The NOAA Unique Combined Atmosphere Processing System (NUCAPS) creates high resolution profile products of different atmospheric constituents and properties. The NUCAPS ozone product is made using a combination of Cross-track Infrared Sounder (CrIS) data for the lower atmosphere along with an a-priori of a tropopause-based climatology derived from ozone sondes for the upper atmosphere. It is thought that incorporating data from the Ozone Mapping and Profiler Suite Limb Profiler (OMPS-LP) instrument, which is on the Suomi NPP satellite along with CrIS, as a stratospheric a-priori could help to improve the ozone product. An improved ozone product could be used by the National Weather Service in their forecasting efforts. This project focuses on creating the new a-priori and validating the results against other ozone measuring instruments and techniques, including data from SAGE III-ISS and MLS.
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**CESSRST Research Theme:** Atmospheric Hazards

**Research Synopsis**

*Caribbean Climate Impacts on Water Resources in Surrounding Regions*

Caribbean climate has impacts that extend to surrounding regions, especially the U.S. One such impact includes availability of moisture. Moisture availability has many implications for environmental hazards which include, but are not limited to, hurricanes, floods and droughts. These hazards are linked to water security and this research aims to model these events in order to create water management strategies as the region faces these extreme climate changes in the near future.
Human Health and Safety Geographies of NYC Sewer Overflows

Water released from combined sewer outfalls (CSO) contains raw sewage, litter and large debris, organic material, nutrient loads, particulate matter, lipids/petrochemicals, and even pharmaceuticals. Storms increase stress on the NYC sewer system, contributing to increased CSO discharge into open water.

Exploratory research on CSO overflow volume changes from 2006 to 2016 will be used as an empirical framework to promote planning for adaptability to storms, and climate and weather stressors, including creating public warning and public education strategies for before, during, and after inclement weather. Preliminary research was conducted to analyze the trends of CSO discharge in Brooklyn and Queens following city initiatives to reduce CSO volume. Goals of the NOAA-CESSRST initiative to integrate social sciences into research and education training include “defining and measuring the impact of NOAA and CESSRST research products on society, [as] well as how the research supports societal decision making” with regard to Decision Science, Risk Assessment, and Risk Communication. For these elements, a critical human health geography desk study is being undertaken.

Issues that may affect health, safety, and quality of life and require public warning are: safety during rain events, safe recreation strategies in precarious waters, avoiding physical dangers of CSO discharge safe consumption of fishes caught from bodies of water surrounding New York City and/or affected by CSO overflow. This includes recreational and subsistence and requests for volunteer maintenance, i.e., clearing clogged sewer grates

These public warning strategies can be extrapolated to other necessary warnings, including, but not limited to, increasing understanding of weather forecasts, preparation for extreme weather events, and community emergency preparedness. Safe interaction with water bodies may increase quality of life in New York City.
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**CESSRST Research Theme:** Atmospheric Hazards

**Research Synopsis**

*Atmospheric Block Maintenance in a Hierarchy of Models*

This project involves the study of atmospheric blocking in reanalysis and various idealized models provided by GFDL. Idealized models vary in topography and diabatic heating.

Specifically, block properties such as strength, duration, and area are compared. Block maintenance is also studied using wave activity flux and potential vorticity flux convergence.
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CESSRST Academic Advisor: Maria Tzortziou

CESSRST Research Theme: Coastal Resilience

Research Synopsis

Colored Dissolved Organic Matter Dynamics in the Long Island Sound

This project is examining colored dissolved organic matter concentration and quality in the Long Island Sound estuary- trying to decipher anthropogenic versus natural inputs into the system. The project is also examining spatial heterogeneity across the Sound and from river-to-estuary transects. We are developing new satellite remote sensing algorithms based on datasets being collected and analyzed.