Project Descriptions

Extreme Climate Events in Climate Models and Measurements – NASA GISS

Extremes in precipitation and temperature are the realization of climate change most familiar to us in our daily lives. Will the "100-year storm" now arrive every other year? In this project, CCRI participants will look at simulations from the GISS climate model and constrain them against satellite retrievals in the present day. How many years does it take for the probability of extreme weather to become noticeable? The students will then look at simulations of the future and the past and apply the same analyses to see how the incidence of 'extremes' changes through time.
Location: Goddard Institute for Space Studies, New York City

Climate Change in the Hudson Estuary – NASA GISS

The Hudson Estuary is comprised of key tidal marshes, which serve to provide many ecosystem services to the large population of this important coastal region, including NYC. These services include fish nurseries, coastal protection, water purification, paleoclimatic archives, and carbon sequestration repositories. We seek to understand the records of past droughts, cold intervals, floods, and vegetation shifts along with the past shifts in carbon storage. From this information, we can better understand our present snapshot of climate/carbon and predict future accumulation rates as climate warms and sea level rises.
Location: Goddard Institute for Space Studies, New York City

Characterizing the Urban Land Surface Temperature – NASA GISS

In light of climate change, urban micro-climates, the urban heat island effect and other urban geophysical phenomena and processes, there is a new urgency to better study, understand, and characterize urban environments. Revolutionary and innovative ideas are being considered to transform the study of the urban landscape. Fundamental changes are taking place in geophysics and in engineering to aid in the adaptation and mitigation of the environmental challenges to which cities must respond.

For this project, students will perform a local, intensive, and comprehensive surface energy balance data collection and processing initiative that will help to characterize the urban heat island, the heat index, and more particularly the land surface temperature over various local community built and natural environments. The project aims to produce high temporal and spatial resolution land surface temperatures for the local community and for New York City using the combination of satellite remote sensing observations and ground-based measurements. Students will obtain remote sensing data from multiple polar orbiting and geostationary satellites. Additionally, students will use infrared cameras and flux tower instruments to understand how urban surfaces react to solar radiation and its consequent heat. Students will be able to monitor the incoming and outgoing radiation and heat energy components using the cameras. The differences between traditional rooftop materials and new green or white roofs will be explored. Moreover, hand held temperature measuring devices, Unmanned Aerial Systems

(UAS), and observations from satellite infrared observations will be collected. Using statistical approaches and data processing, the gaps in temporal and spatial coverage appropriate for the development of a heat index (effect of air temperature + humidity) will be filled. The volume of data used in this project is expected to in the range on 5TB. The added-value of this initiative is that cross-pollination between students and the local community and the transfer of knowledge between the two groups will be created and sustained long after the project ends.

Project Activities Include:

- Monitoring thermal characteristics of urban surfaces such as concrete, asphalt, rooftop, and vegetated surfaces at different seasons and times of the day by collecting data
- Coordinating with community partners to receive skin temperature measurements from various surfaces in the local community.
- Obtaining and analyzing satellite land surface temperature observations from geostationary and polar orbit satellites such as from the Geostationary Operational Environmental Satellite-R Series (GOES-R), LandSat, Ecostress, Sentinel 2A, the Moderate Resolution Imaging Spectroradiometer (MODIS), etc.
- Analyzing the collected data to define and to develop a high spatial resolution (10 m) and high temporal resolution (every 5 min) skin temperature over the local- community and over New York City using several statistical approaches by fusing satellite based and ground observations.
- Developing an online interactive server platform to disseminate the data to the local community and to scientists. Data visualization and queries will be among important features of the proposed platform.
- Working closely with the local community on the use of the collected data to interpret and predict the strength and extent of heat wave events.

Location: CUNY City College of Technology, New York City

Monitoring and Studying Lakes from Space in a Changing Climate – NASA GISS/CUNY

Climate change has impacted all components of the environment, and the impacts on global lakes have been quite noticeable. There are over 100 million lakes on Earth (excluding those that are covered with glaciers), covering roughly 4% of the total land surface. Natural lakes and man-made reservoirs are essential sources of freshwater, and they provide inarguably important services to society. They are used for fresh drinking water, municipalities, recreational activities, and fisheries. Moreover, lakes play a major role in carbon sequestration and thereby are critically important for our planet. Many lakes have been desiccated by the adverse impacts of climate change, and their ensuing degraded water quality has led to major losses in economic and ecological value as they have now become significant societal and health risks. In addition to climate change desiccation, lakes are dying and degrading due to human mismanagement, point and non-point source pollution, and general loss. The extent and rate of global “lake-loss” is not fully understood. Therefore, many aspects of in-land water bodies require robust, comprehensive study and monitoring in order to achieve sustainable environments, habitats, economies, and agriculture. Spaceborne remote sensing observations with their unique spatial and temporal coverage have considerable capabilities for supporting investigations of the Earth system

including inland water bodies. This project, therefore, focuses on the application of satellite remote sensing and geographic information system techniques complimented by ground observations to study lakes and to provide insights about “lake-health” and about “lakeresponse” to the adverse impacts of climate change. Interns will obtain and analyze satellite data from geostationary and polar orbiting satellites such as the Geostationary- Operational Environmental Satellite-R Series (GOES-R), LandSat, ECOSTRESS, Sentinel 2A, the Moderate Resolution Imaging Spectroradiometer (MODIS), etc.

Successful applicants will work closely with their mentors in related lakes research areas to:

- Analyze surface temperature and land cover change trends of major global lakes using daily infrared-based satellite sensors;
- Perform validations of satellite-based products such as surface water temperature estimates (among others) using ground observations;
- Develop regional algorithms to predict Chlorophyll-a (Chl-a) and Harmful Algal Blooms (HAB) concentrations using high resolution satellites such as LandSat and Sentinel 2A;
- Predict and study regional and global ice phenology in lakes and thereby define the impacts of climate change on ice-in and ice-out timing.

Location: CUNY City College of Technology, New York City

SnowEx and Understanding the Role of Snow and Measurements – NASA GSFC

now is an important part of Earth’s climate system, helping to regulate Earth’s surface temperature, as well as providing a freshwater source. More than one-sixth of the world’s population (1.2 billion people) relies on seasonal snowpack and glaciers for, water supply, agriculture, hydropower, and recreation. Snow cools the planet and supports many ecosystems. Snow melt can contribute to widespread and damaging floods.

We need accurate snow information to respond to altering climate and water availability and predict future snow resources.
There are four features that need to be measured:

1. The areal extent and location of the snow
2. How long the snow lingers
3. The depth and water equivalent of the snow
4. How the snow is changing

Snow varies in space, making it difficult to validate on the ground what is observed from above. Landscape and vegetation characteristics can mask or impact remote sensing capabilities. Snow also varies is time. Changing snow characteristics, such as depth, grain size, density, and liquid water content, influence the signals observing snow.

SnowEx is a multi-year field experiment, which includes extensive surface-based observations to evaluate how to best combine different remote sensing technologies to accurately observe snow throughout the season in various landscapes.

The team members will contribute to the development of the SnowEx meteorological data archive. This includes evaluating data collected during the 2017-2020 snow seasons for errors and assisting in formatting and analysis to prepare the data for archival.
Location: Goddard Space Flight Center, Greenbelt, MD

Soil Moisture Missions Validation and Assessment – NASA GSFC

The Teacher and Graduate Student Research Assistant will contribute to the development and analysis of the soil moisture data archive and experimental plan. This includes evaluating data collected during the previous years' field campaign and current available satellite data for errors and assisting in formatting and analysis to prepare the data for archival. The candidate should have some experience with data analysis and scripting. Interest in working in soil moisture research is highly desired. Any experience working in soil moisture would be beneficial. The candidate will also help in preparing metadata, charts and presentation material to introduce the data to the larger snow community.

This project would combine the traditional methods of estimating soil moisture and applying machine learning techniques to develop new models. We will access previous and current NASA mission data (SMAP) as well as upcoming missions to test the newly developed models. The project will also have application across hydrological disciplines with the upcoming NISAR mission with soil moisture and snow. Soil moisture is a significant forcing of the hydrologic cycle, and it impacts almost every other variable. The amount of soil moisture can have significantly different implications depending on location, season, soil type, and depth. For example, the same absolute value of soil moisture can indicate a serious drought in the Southeast, while it represents normal soil in the Southwest.
Location: Goddard Space Flight Center, Greenbelt, MD