NASA Science Mission Directorate's Climate Change Research Initiative (CCRI) program is an interdisciplinary, collaborative, year-long STEM engagement, and experiential learning opportunity for educators and graduate students to work directly with NASA scientists and lead research teams in a NASA research project hosted at either the NASA Goddard Institute for Space Studies ,CUNY City College of Technology in New York City, NY, or the NASA Goddard Space Flight Center in Greenbelt, MD. The summer component of each CCRI project also includes undergraduate and high school interns.

During the fall and spring terms of CCRI, the research team will consist of NASA Principal Investigators who lead in-service high school STEM educators and graduate student research assistants to become immersed in a NASA science research area related to climate change.

Educators participating in this opportunity become associate researchers, CCRI education ambassadors and STEM education experts who integrate NASA education resources, platforms, data and content into their classrooms while improving STEM education within their communities.

Participating high school STEM educators contribute to the research project, assist in the development of a research question and assist in guiding the research team to complete all program deliverables. Educators also develop an Applied Research STEM Curriculum portfolio and unit plan that utilizes NASA education resources aligning NASA Science and STEM curricula to the Next Generation Science Standards. The teachers will then incorporate the STEM curriculum into their classrooms and also provide community STEM engagement events related to their NASA research study. The fall and spring term will not conflict with the educators' primary schedule, roles or responsibilities at their school sites.

For graduate student research assistants, this opportunity will not conflict with class schedules during the fall and spring. It is considered to be a part-time position that supports the graduate student's major area of study.

During the summer session, the primary research team will add an undergraduate intern and high school intern to the CCRI research team. The entire team will work collaboratively on a full-time basis to complete the research project, deliver presentations, create a scientific poster and a publishable research paper that will be presented at the NASA Goddard Institute for Space Studies, and other science conferences and symposiums. The final symposium may have participants from other government agencies, such as the National Science Foundation (NSF), National Oceanic and Atmospheric Administration (NOAA), the United States Department of Education (USDE) and the United States Department of Defense (DoD) and many others.

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CCRI Autumn - Summer

Research opportunities for educators, grad student assistants, and interns during Autumn through Summer include the following projects:

- Deciphering Changing Probabilities of Extreme Climate Events in Climate Models and measurements. (GISS)
- Climate Change in the Hudson Estuary — Past, Present, and Future (GISS/LDEO)
- Monitoring and Studying Lakes from Space in a Changing Climate (GISS/CUNY)
- Characterizing the Urban Land Surface Temperature via an Innovative, Multi-Platformed Suite of Satellite and Ground-Based Remote Sensing Technologies (GISS/CUNY)
- Land Surface Temperature via Satellite and Remote Sensing Technologies (GSFC)
- SnowEx and Understanding the Role of Snow and Measurements (GSFC)

Detailed descriptions of the these projections are available here.

Education Award Stipend

Team Member	Stipend
Teachers/Assoc. Researcher	$7,650
Graduate Student Research Asst.	$11,700
Undergraduate Intern	$5,840
High School Intern	$2,400

Contact Hours:

- Fall: 10/16/23-12/22/23: (~5-10 hr. per week for 10 weeks)
- Spring: 01/29/24–04/26/24: (~5-10 hr. per week for 10 weeks)
- Summer: 06/17/24-08/9/24: (~40 hr. per week for: 6-8 weeks)

How to Apply:

CCRI applicants must be **US citizens**. Housing, relocation and travel expenses are not provided. Teachers, graduate students and interns whose locality is regional to the NASA Goddard Institute for Space Studies in New York City, NY, or NASA's Goddard Space Flight Center in Greenbelt, MD, are encouraged to apply. Virtual / hybrid candidates are also eligible to apply. Applications are considered upon receipt.

The deadline for educators and graduate students to apply for the CCRI 2023-2024 year-long program is **August 25th, 2023**

The application deadline for Summer CCRI high school and undergraduate internship opportunities is **October 20, 2023** at intern.nasa.gov

Additional Requirements

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Upon submission of your application please update Matthew Pearce to confirm receipt of your application.

Educators:
Teachers applying for CCRI should submit a cover letter, resume, and unofficial transcripts. Teachers are also encouraged but not required to submit any additional portfolio exemplars. The cover letter should also include:

- A description of how participating in CCRI will benefit your students, school and community.
- Description of IT and programing skills indicating a self-proficiency ranking.
- Rank in order of preference the CCRI projects that the teacher candidate would like to apply to and be considered for.

- The selected candidate will be requested to provide a letter of support from their school administration for participation and collaboration in the program.

Graduate Students:
Graduate Student Research Assistants applying for CCRI should submit a cover letter, resume and unofficial transcripts. The cover letter should also include:

- A description of how participating in CCRI aligns with your current degree program, career goals and anticipated graduation date.
- Description of IT and program skills indicating a self-proficiency ranking.
- Rank in order of preference the projects that the graduate student would like to apply to and be considered for.

- The selected candidate will be requested to provide a letter of support from their graduate school advisor for participation and collaboration in the program.

Teachers should submit their cover letter and application materials to our Box Account: https://nasagov.app.box.com/f/02131190ee294a38b49ffcd1d6ffab40

Please visit NASA Education Program Fosters Climate of Discovery for additional program information and direct any questions regarding the Climate Change Research Initiative to:

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Climate Change Research Initiative Project Descriptions

Deciphering Changing Probabilities of Extreme Climate Events in Climate Models and Measurements. (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.

Climate Change in the Hudson Estuary — Past, Present, and Future (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.

Characterizing the Urban Land Surface Temperature via an Innovative, Multi-Platformed Suite of Satellite and Ground-Based Remote Sensing Technologies (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.

Monitoring and Studying Lakes from Space in a Changing Climate (GISS)
Duty location also at CUNY New York City College of Technology, Downtown Brooklyn

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 in-land 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 “lake-response” 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.

Connecting the Local Urban Fabric to Global Climate Change (GSFC)

Urban areas are principal agents of change across our home planet. In an increasingly urbanizing biosphere, scientific understanding, and societal adaptation each require tools to accurately measure and monitor the dynamics and environmental consequences of the urban ecosystem. With over half of the world's population living in urban areas today—projected to grow to 68% by 2050—these tools, data, and scientific understanding will make significant contributions to national and international policies to ensure the sustainability of cities and settlements in the face of a changing climate. While urban areas still represent today a small proportion of Earth's land surface, urbanization can have significant impacts on hydrological cycles and microclimates of local and surrounding areas up to regional and even continental scales.

New, more detailed, and more accurate remotely-sensed data on urban areas and associated built-up surfaces can provide a foundation for a better understanding of the impacts of cities on their environment and potential improvements in the modeling of the impacts of urbanization on the energy/water/carbon cycles. The unprecedented level of spatial detail in these new data sets allows for a much improved and accurate characterization of the urban fabric (e.g., roads, buildings, open space), and their change, at a spatial scale that is directly relevant to cities and settlements and their inhabitants. This project will leverage existing and future NASA remote sensing assets to study in detail the direct connections between changes in the urban fabric and

environmental changes in the Baltimore/Washington DC study area and the Chesapeake Bay Watershed. The aim is to develop, test and assess data and methodologies regionally but with potential applicability to other areas of the world. Successful applicants will work closely with the mentor and associated scientists at NASA Goddard Space Flight Center to perform work in the following suggested areas:

- Assess quality and accuracy of the harmonized Landsat and Sentinel 2 data set for urban change monitoring in the Baltimore/Washington DC area (see https://hls.gsfc.nasa.gov/).
- Develop methods and assess useability of NASA Lidar remote sensing (e.g., satellite/airborne) for urban vertical structure.
- Assess useability of Landsat and ECOSTRESS satellite data for monitoring the urban heat island effect.
- Use Very High Resolution commercial satellite archive at NASA for urban change detection and vertical change.
- Perform field studies using field measurements and the GLOBE Observer mobile phone app (see https://observer.globe.gov/) to assess accuracy of data sets above. This work will involve local schools and high school students.
- Develop maps or other cartographic products using NASA satellite data over the Baltimore/Washington DC region.
- Work with local stakeholders to communicate science and to build capacity to use new data sets for local/regional applications.
- Communicate findings with science community via presentations and written work.
- Participate in NASA research proposals and publications as appropriate.

SnowEx and Understanding the Role of Snow and Measurements (GSFC)

Snow 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. The candidates should have some experience with data analysis and scripting. Experience working in snow research is highly desired. The candidates will also help in preparing metadata, charts, and presentation material to introduce the data to the larger snow community.

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