NASA Climate Change Research Initiative (CCRI)

Application Period: 8/29/22 - 9/23/22

The NASA Climate Change Research Initiative (CCRI) is a 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 in New York City, NY or the NASA Goddard Space Flight Center in Greenbelt, MD.

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 and STEM education experts who integrate NASA education resources 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 guiding the research team to complete all program deliverables. Educators develop an Applied Research STEM Curriculum Portfolio that integrates components of their research into a comprehensive 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.

Team Research Projects:

- Volcanic Emission Impacts on Climate Systems, Agriculture and Society (GISS)
- Climate Change in the Hudson Estuary — Past, Present, and Future (GISS)
- Characterizing the Urban Land Surface Temperature via an Innovative, Multi-Platformed Suite of Satellite and Ground-Based Remote Sensing Technologies (GISS)
- Monitoring and Studying Lakes from Space in a Changing Climate (GISS)
- Connecting the Local Urban Fabric to Global Climate Change (GSFC)
- *****New Project in Development - Coming Soon.*** GSFC**

Education Award Stipend:

Team Member	Stipend	Contact Hours
Teachers / Associate Researcher	$7,650	340

Graduate Student Research Assistants	$11,700	520
Undergraduate Intern	$5,840	320
High School Intern	$2,400	240

Program Dates: 10/17/22 - 8/11/23

- **Fall:** 10/17/22 -12/23/22: (part time: 10 weeks)
- Intersession Period: 12/24-1/29
- **Spring:** 01/30/23 – 04/07/23: (part time: 10 weeks)
- Intersession Period: 4/8-6/18
- **Summer:** 06/19/23 - 08/11/23: (full time: 6-8 weeks)

Team Primary Deliverables:

- Publishable Scientific Research Paper
- Scientific Poster
- PowerPoint presentation
- Applied Research STEM Curriculum Portfolio

How to Apply:

CCRI applicants must be **US citizens**. Housing, relocation and travel expenses are not provided. Teachers, graduate students and interns who's locality is regional to the NASA Goddard Institute for Space Studies in New York City, NY and NASA's Goddard Space Flight Center in Greenbelt, MD are encouraged to apply. Hybrid and remote options are available. Applications are considered upon receipt.

- The application deadline for educators and graduate students to apply for the CCRI 2022-2023 program is **September 23, 2022**.

- The application deadline for Summer 2023 CCRI high school and undergraduate internship opportunities is March 1st**, 2023**.

CCRI Teacher and Graduate Student Research Assistant Application Submission Link
https://nasagov.app.box.com/f/02131190ee294a38b49ffcd1d6ffab40

Application Requirements:

Upon submission of your application please e-mail matthew.d.pearce@nasa.gov to confirm receipt of your application.

- **Teachers:** Teachers applying for CCRI should submit a cover letter, resume, unofficial transcripts and letter of support from their administration as a single document. The cover letter should also include:

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

- **Research Assistants:** Graduate Student Research Assistants applying for CCRI should submit a cover letter, resume, unofficial transcripts and letter of support from their graduate school advisor or other program official as a single document. The cover letter should also include:

- A description of how participating in CCRI aligns with your current degree program. 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.

- **High School and Undergraduate Student Interns:**

  - Submit application to individual projects posted within NASA's Internship Program portal at intern.nasa.gov between October 1st 2022 and March 1st 2023.

Upon submission of application please contact Matthew Pearce at matthew.d.pearce@nasa.gov to confirm receipt of application.

Project Descriptions:

Volcanic Emission Impacts on Climate Systems, Agriculture and Society (GISS):

Prior to the prolific generation of human greenhouse gases over the last 150 years, volcanic events were THE largest short-term perturbation to the climate system throughout human history. Bizarre cool summer temperatures, wide-spread droughts, famines, are coincident with large, tropical strato-volcanic eruptions for the last two millennia.

The intern project will use an ensemble suite of GISS climate model simulations of volcanic events to assess the impact on our climate system. These simulations will apply a special version of the GISS model designed to emulate the ocean carbon cycle. The interns will work with NASA GISS partnered with an international consortium of researchers (climate scientists, ecologists, historians and more) investigating how agricultural and marine productivity was impacted by volcanic activity, and how these impacts projected onto the historical development of human societies.

Applicants should have analytical skills (R, Python, java, ArcGIS, C, FORTRAN, julialang, etc.) to visualize and assess the impact of volcanic events on a NASA GISS computer model simulated carbon cycle. Further, these simulations will be fed through fishery-ecological models to ascertain impacts on marine life."

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

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.

New Project in Development coming soon.

For any questions related to the Climate Change Research Initiative program, please contact Matthew Pearce at the information provided below.

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