North Dakota Space Grant Consortium 2022 Student Symposium and Affiliates Meeting
April 8, 2022

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NASA Goddard Space Flight Center
Computer Scientist
CISTO Data Science Group
OSTEM Space Grant/EPSCoR Specialist

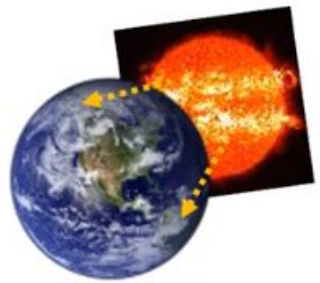
NASA GSFC One World-Class Organization

What makes Goddard one-of-a-kind?

*NASA's **leading science center**, with **cross-disciplinary, end-to-end** capabilities*

Goddard
SPACE FLIGHT CENTER

Executing NASA's **most complex missions**



*World leader in **understanding the Sun's impact on Earth***

***Communications backbone** – 98% of NASA's data is transmitted via Goddard infrastructure*

***1 of 2 US routes for ISS cargo;** 1 of 4 US orbital launch facilities*

*Independent Verification and Validation Facility **assures NASA's most complex software functions as planned***

Goddard's Investments in Technology

Technology investments support strategic goals

- Enabling NASA to take on diverse missions, enhance technological capabilities, and facilitating climate change characterization and response.
- Significantly reduce mission risk, cost, and uncertainty.
- Increase scientific return and infusing cutting edge technologies into the commercial sector.
- Provide a unique, differentiating technology capability for science or exploration.

Core Lines of Business

Astrophysics
Evolution of the Universe
Exoplanet characterization
Multimessenger Astrophysics

Earth Sciences
Sustained focus on climate change
Surface Topography & Vegetation
Planetary Boundary Layer

Heliophysics
Leadership in Space Weather
Develop and Mature long lead tech
Unlocking the mysteries of Heliophysics

Planetary
Habitability, life evidence, ocean worlds
Mars, Lunar, sample return science
Focus on Artemis and CLPS

Enabling

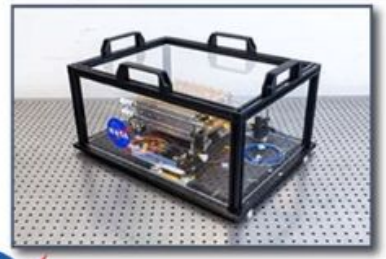
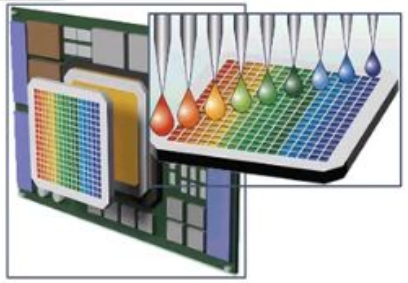
Cross-cutting
Radical Innovation Initiative
Distributed System Missions
Quantum sensing
Constellations
3D mapping LIDARs
Microelectronics, low SWAP, PICs

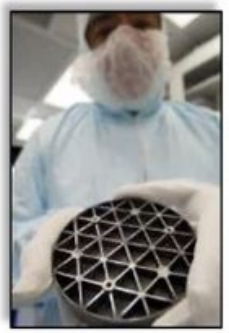
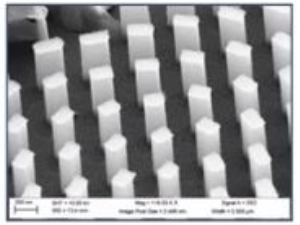
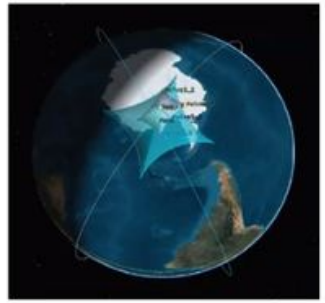
Enabling

Comm & Nav
SCaN and related infrastructure
Optical communication
Quantum comm/networking
High performance link services

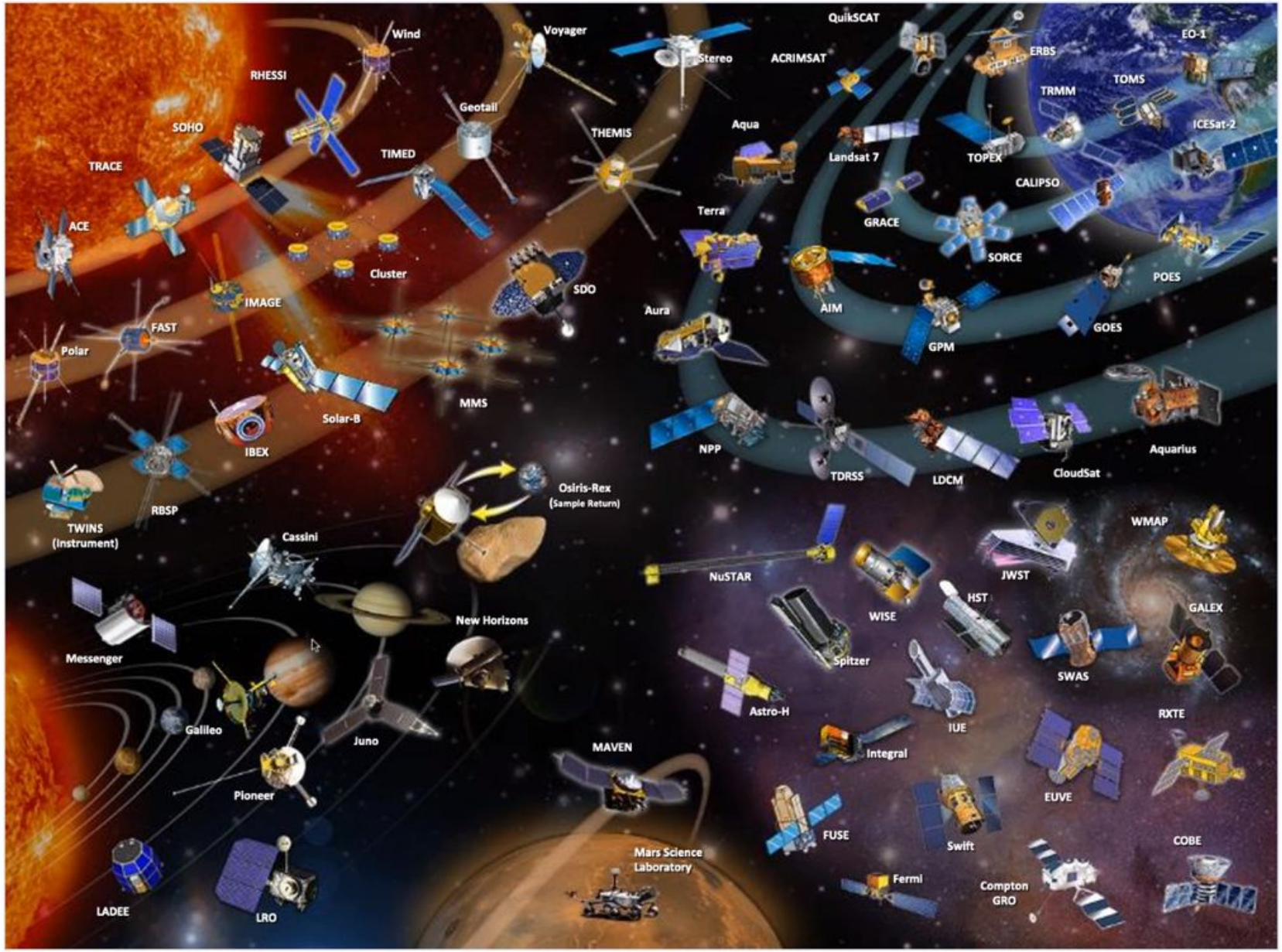
Enabling

Suborbital/SmallSat Platforms and Range Services
CubeSat/SmallSat capabilities
Airborne sciences, balloons, unmanned aircrafts
Commercial launch capabilities

GSFC: A Diverse Mission Portfolio



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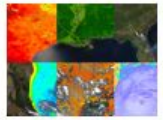
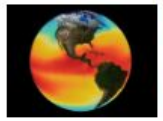
Groups

606.1 -The **Networks and Information Technology (IT) Security Group** provides strategic network planning, services, and capabilities to meet the research and mission requirements of the Sciences and Exploration Directorate (SED) now and in the future.

606.2 -The **High-Performance Computing Group** manages and operates the NASA Center for Climate Simulation (NCCS), one of the world's most powerful supercomputer and data storage centers.



606.3 -The **Information Science and Technology Research Group** performs strategic planning to prioritize information technology advances needed to enable science investigations and missions.



606.4 - The **Scientific Visualization Studio** facilitates scientific inquiry and outreach within NASA programs through visualization, such as videos and animation. The SVS collaborates with scientists to create visualization products, systems, and processes to promote a greater understanding of Earth and Space Science research activities at Goddard.

Overview

The Computational and Information Sciences and Technology Office (CISTO) provides Information Technology (IT) and computational services, as well as applied information system research and services, to support the research programs of the Science and Exploration Directorate (SED). The office provides high performance computing and networking, mass storage and information systems technologies, computational science expertise, software engineering and performance optimization services, information technology (IT) security services, scientific visualization services, research in information science and technology, and educational and outreach programs. CISTO is SED's interface with Goddard's Chief Information Officer and IT organizations in Code 700 regarding IT security policy, implementation, and services, Enterprise Architecture development and compliance, strategic IT investment planning and management, and implementing NASA and Goddard IT policies and initiatives to ensure compliance. CISTO also develops strategies to optimize cost-effective use of information technologies in support of the Directorate's mission.

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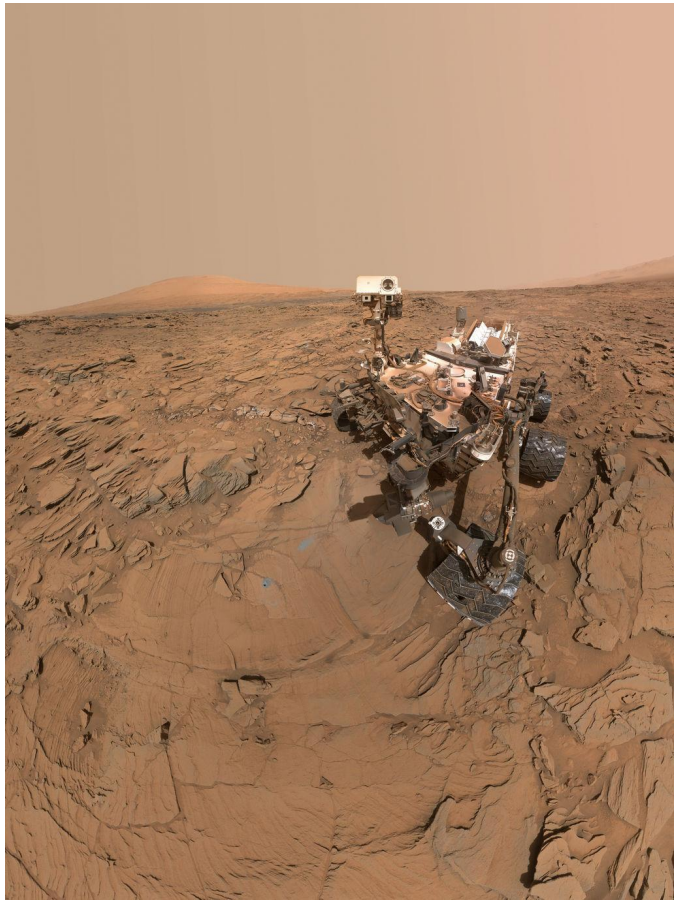
General inquiries about the scientific programs at NASA's Goddard Space Flight Center may be directed to the Center Public Affairs office at 1.301.286.8955.

Why Data Science Literacy?

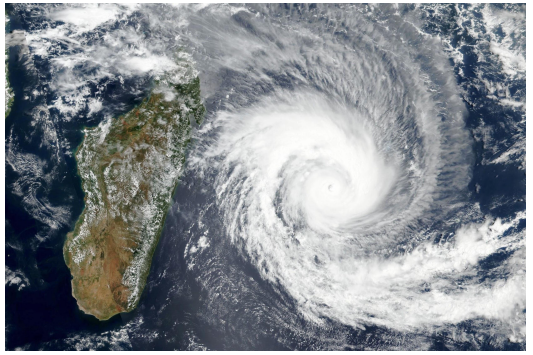
Data science is becoming central to the modern world. Data science has experienced 650% job growth since 2012 and recent job reports show that 7 out of the 10 fastest growing careers are data centric. Whether they are entering newer roles such as data scientist and machine learning engineer or working in newly data-transformed roles in sales development, software development, and customer success manager, today's workers need data skills to compete and succeed. Engaging students in using data to address scientific questions has long been an integral aspect of science education the key factor to manage NASA Mission research. Today's information technology provides many new mechanisms for collecting, manipulating and aggregating data, in addition to the large on-line data repositories, that provide the opportunity for new kinds of student experiences.



Data literacy is also necessary for everyday life, as Americans work to successfully consume information and advocate within their communities. From evaluating data used to justify claims in news reports to weighing the risks and benefits of personal choices, interpreting and working with data is now central to even the most commonplace activities. Engaging students in using data to address scientific questions has long been an integral aspect of science education the key factor to manage NASA Mission research. Today's Information technology provides many new mechanisms for collecting, manipulating and aggregating data, in addition to the large on-line data repositories, that provide the opportunity for new kinds of student experiences.

(2) *SMD Strategy for Data Management and Computing for Groundbreaking Science*

Why Data Science Literacy?



Planning Strategies:

Focus on *SMD Strategy for Data Management and Computing for Groundbreaking Science*

Goal 3: Harness the Community and Strategic Partnerships for Innovation.

Strategy 3.1: Cultivate a strong community of practice across SMD, the science archives, and the broader research community. As sections of the community come together, there is a growing realization that collaboration is the best way to tackle extremely large and interesting science questions. To enable increased collaboration, such a community of practice provides a forum to share best practices, discuss common strategies or concerns, and identify training needs.

Strategy 3.2: Partner with academic, commercial, governmental and international organizations to augment SMD's in-house capabilities. External sectors have expertise that is well-suited to managing, analyzing, and assimilating very large data sets and has expressed interest in working with NASA. These organizations often have unique expertise and complementary data that can support groundbreaking science.

Strategy 3.3: Promote opportunities for continuous learning through collaboration with academia, industry and other government agencies. Data analytics, computing, software development and data management are changing rapidly and accelerating the rate of scientific discovery beyond what any one individual can synthesize. Breakthrough science is now being done at the intersection of data science and traditional physical sciences. Finding 5 The ways students are being trained in the sciences are not necessarily up-to-date given the evolution of data science.(2)

- **Recommendation 11:** SMD should make investments to incentivize and educate the community on how to use AI/ML to approach science in new ways. Hands-on training can be achieved through expansion of hackathons, competitions, and grant programs. Science results and lessons learned about the use of AI/ML will be shared at community meetings to increase awareness of the potential of these techniques. (2)
- Excerpt from Harvard Business Review publication Data & Digital Transformation: "Contrary to popular belief, digital transformation is less about technology and more about people. You can pretty much buy any technology, but your ability to adapt to an even more digital future depends on developing the next generation of skills, closing the gap between talent supply and demand, and future-proofing your own and others' potential."

A NASA OPEN SOURCE SCIENCE INITIATIVE:
TOPS: TRANSFORM TO OPEN SCIENCE

Why transform now?

Current challenges:

- Climate change
- Protecting our interconnected world from extreme space weather events
- Identifying threats from interplanetary space
- Searching for life beyond Earth
- Unlocking the secrets of the Universe

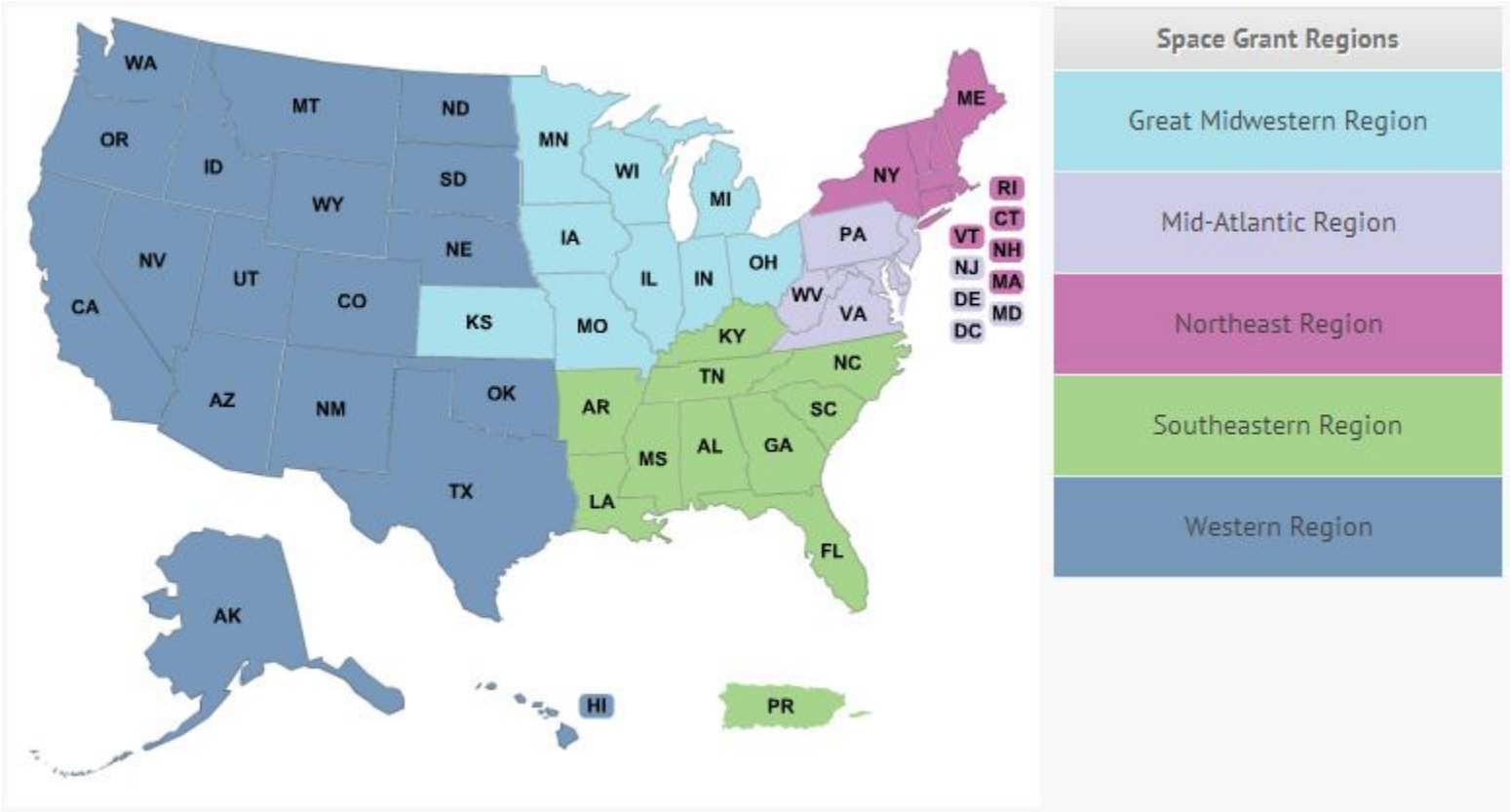
What are we going to do about it?

- Recognize the transformative potential of open science to reduce inequalities AND advance science

Image credit: NOAA

Space Grant/EPSCoR Regional DS/ML/AI Working Groups

DS/ML/AI Working Groups seeks to develop a highly capable research arm for the Agency's goal to increase science and technology innovations for spaceflight missions and increasing science returns from Big Data while fulfilling the Agency's goals to promote a culture that aligns with the Agency's Diversity and Inclusion and Equal Employment Opportunity goals.



Space Grant Regional DS/ML/AI Working Group Goals

The primary strategy involves establishing regional working groups to facilitate:

Education and Training - skill development in the form of tutorials as well as informal and peer learning is often a component. Furthermore, lateral knowledge transfer through collaboration provides an opportunity to learn skills that are not described in papers and software implementations.

Tool Development - opportunity for scientific software developers to meaningfully engage with users and critically evaluate applications to particular scientific issues.

Community Building - opportunity to catalyze community development through a shared interest in solving computational challenges with open source software. Allow computationally minded researchers to break from the isolation of their institutions and spark new collaborations.

Interdisciplinary Research - Promote Intensive, time-bounded collaborative events as an opportunity to experiment with concepts, questions, and methods that span boundaries within and across disciplines. Despite the fact that interdisciplinary experiments are impactful, they are often discouraged in traditional academic environments.

Recruitment and Networking - A melting pot of participants from academia, government, and industry and provide numerous opportunities for networking. Close collaboration in diverse groups exposes skills that might be suitable for careers outside of a narrow domain.

Fault Diagnosis for Safety-Critical Autonomous Spacecraft Systems - 1st Meeting of the Mid-Atlantic Space Grant Data Science Consortium

Summer 2022
West Virginia University
Morgantown, West Virginia

Introductory Webinar – November 2021
Register Online by October 15th, 2021
Website coming soon!

For more information, contact
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Evana Gizzi (evana.gizzi@nasa.gov) or
Piyush Mehta (piyush.mehta@mail.wvu.edu)

NASA EPSCoR

NASA

West Virginia University

NASA West Virginia Space Grant Consortium
WVSPACEGRANT.ORG

NASA EPSCOR PRESENTS

Virtual Research Discussion with the Goddard Space Flight Center Science and Exploration Directorate Information Science and Technology Research, Science Mission Directorate

WEDNESDAY, 12/1/2021 @ 4 PM EST

NASA EPSCoR presents a virtual research discussion with the Goddard Space Flight Center Science and Exploration Directorate Information Science and Technology Research, Science Mission Directorate. The event will feature brief presentations from the NASA researchers listed below, followed by a moderated Q&A session.

James Harrington is a computer scientist with the Computer Information Science and Technology Office (CISTO) Research Group at NASA's Goddard Space Flight Center in Greenbelt, Maryland. He also supports Goddard's Office of STEM Engagement. His primary responsibilities include data science/ machine learning research outreach, as well as systemic STEM reform for professional learning and student achievement in STEM

Dr. Elizabeth MacDonald is the heliophysics lead for Citizen Science at NASA Headquarters in Washington, D.C., on a part-time detail from Goddard. She has spent the past 25 years studying how the dynamic aurora are born and evolve. At Goddard, MacDonald leads Aurorasaurus, an interdisciplinary project offering a mobile platform for citizen scientists to report aurora. She is actively involved in educational outreach efforts aimed at increasing diversity in STEM fields and communicating the beauty of science.

Brian Thomas is a Data Scientist and Research Scientist at NASA in Heliophysics Science Division.
He has more than 25 years of experience supporting or leading scientific research, data analysis, building data environments for research and scientific programming. He has worked in a variety of environments including National Optical Astronomy Observatory, NASA's Goddard Space Flight Center, and the University of Maryland. He is an expert in science data engineering and archives.

PROGRAM AGENDA

- **4:00 pm EST**
  – NASA Researcher Intros & Priority Overview
- **4:30 pm EST**
  – Moderated Q & A
- **5:15 pm EST**
  – Wrap up & Next Steps

ZOOM INFO

Meeting Link
Meeting ID: 926 7273 0030
Password: 913467

2022 EPSCoR R3 Appendix F

F.1.0 NASA SMD Computational and Information Sciences and Technology Office (CISTO)

POCs: James Harrington, james.l.harrington@nasa.gov 301-286-4063
Elizabeth A. Macdonald, elizabeth.a.macdonald@nasa.gov, 301-286-6690

F.1.1. Program Computational and Information Sciences and Technology Office (CISTO) Computational and Technological Advances for Scientific Discovery via AI/ML Modeling and Development implementing an open science approach.

NASA open science promotes the availability of original source code and data to be available on the public domain to be repurposed for easier collaborations to be born among different groups or teams to work towards solving scientific problems that can benefit society.
NASA SMD communicates a VISION via the SMD Big Data Working Group (SBDWG) to enable transformational open science through continuous evolution of science data and computing systems for NASA's Science Mission Directorate. SMD requests that NASA EPSCoR include research opportunities for data analysis that provide tools and training to diverse communities to be better able to collaborate with all types of computational and computer scientists that enables the funding of successful collaborations, including Artificial Intelligence and Machine Learning (AI/ML).

The SBDWG report states that "SMD and the individual science divisions do not operate in isolation and therefore should recognize there is tremendous value in engaging with multiple stakeholder groups to identify opportunities to increase collaboration and use of advanced tools and techniques to drive scientific discovery. The decisions on when and how to collaborate should be made in such a way that SMD sets policies and facilitates sharing best practices, while providing the science divisions with responsibility and flexibility to manage their systems to meet the needs of their communities.

One such strategy to support this VISION is promoting a robust Citizen Science program recommended by the SMD Science Management Council approved by the SMD Associate Administrator. SMD citizen science projects shall be held to the same rigorous standards as any SMD science program. Documented project goals must include advances in science, the merit of which shall be determined by peer review.

Additionally, the SBDWG report communicates a goal to: Continuously Evolve Data and Computational Systems - SMD must therefore continuously evolve data and computational systems to realize the potential of innovative techniques to more efficiently manage data and computing resources and establish policies optimized to support investments in technology development and adoption. This will require investments in data systems, computational

F.1.2: Supporting Heliophysics Citizen Science Goals through Data Partnerships

POC: Elizabeth MacDonald, elizabeth.a.macdonald@nasa.gov, 505-920-7602

1) Program: Artificial Intelligence and Machine Learning Capability
2) Research Title: Supporting Heliophysics Citizen Science Goals through Data Partnerships

3) **Research Overview:**
The Science Mission Directorate Heliophysics Division studies the nature of the Sun, and how it influences the very nature of space — and, in turn, the atmospheres of planets and the technology that exists there. Space is not, as is often believed, completely empty; instead, we live in the extended atmosphere of an active star. Studying this system not only helps us understand fundamental information about how the universe works, but also helps protect our technology and astronauts in space. NASA seeks knowledge of near-Earth space, because -- when extreme -- space weather can interfere with our communications, satellites and power grids. The study of the Sun and space can also teach us more about how stars contribute to the habitability of planets throughout the universe.

Citizen science in Heliophysics has a balanced strategy and implementation plan that maximizes natural opportunities over the next five years. Our Vision is to leverage public participation in Heliophysics to help drive innovation and diversity in science, society, and education and our Mission is to build a robust, dynamic, and engaging Heliophysics citizen science portfolio that fuses natural phenomena, mission opportunities, and the power of people's diverse viewpoints to fuel collective innovation. To achieve our Mission, a number of inter-related Objectives build momentum towards our goals to Grow, Execute, Innovate, Communicate, Optimize, and Partner. There is an opportunity to achieve this vector of opportunities in our strategic plan to its fullest implementation and we look forward to pursuing this here. We are looking to advance this Vision by building new partnerships and capacity between existing citizen science projects, achieving our vision and the data science interest of this call. More about our strategy can be found here: https://science.nasa.gov/heliophysics/programs/citizen-science.