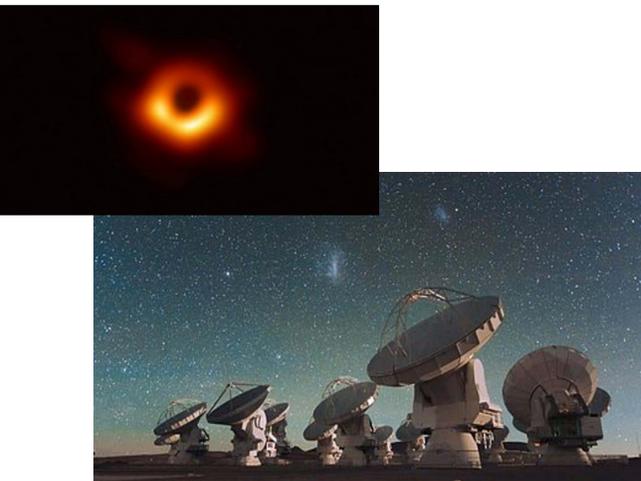


Why NEREID and why now?

We are in the Age of Big Data.

- Globally we now create 2.5 exabytes of data daily, and 90% of all existing data have been created within the last two years, (Bernard Marr, Forbes Magazine, May 21, 2018).
- Earth and space science data represent a significant and important source of these accumulating data. Remote sensing alone accounts for nearly 22 petabytes of earth science data gathered between 2000-2017.
- The Large Synoptic Survey Telescope and the Square Kilometre Array will produce 7.3 petabytes and 1 exabyte of data per year, respectively.



Recently, astronomers captured the first direct visual evidence of a black hole. Five petabytes (a million gigabytes) of data were needed to make this image. The Atacama Large Millimeter/submillimeter Array (ALMA) in Chile was instrumental in making this observation possible (ESA-Event Horizon Telescope). ALMA is managed by AUI.

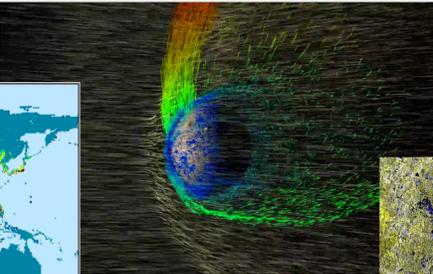
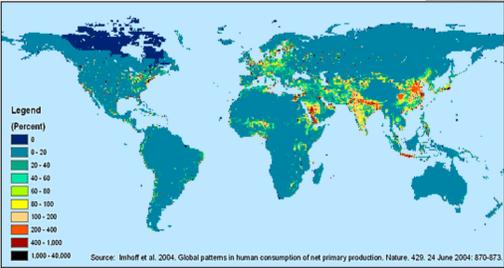
The rapid pace of this revolution in big data has resulted in a widening gap between learning and the demands of the science and engineering workplace.

- While industry is feeling an ever-increasing need for competent data scientists and data analysts, the academic pipeline for producing a qualified and educated workforce to fill these positions is only now emerging, and there is a lack of a concerted and coherent message and exposure to data science that would attract students to these disciplines.
- Concerted efforts to address this issue are much needed, as they will ensure successful career paths for both current and future students.

Network for Earth-space Research Education and Innovation with Data: NEREID

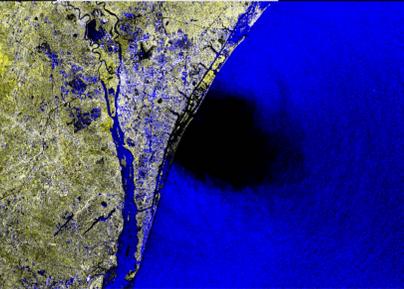
Catherine Cramer¹ and Stephen Miles Uzzo²
¹ Associated Universities, Inc. (AUI) / ² New York Hall of Science/AUI

Human appropriated net primary productivity as a percentage of local net primary productivity (Columbia U.-SEDAC)



Impact of Hurricane Florence on coastal communities from cloud-penetrating SAR imagery (ESA-Earth Big Data)

Effect of solar wind on Mars' atmosphere (NASA-MAVEN)



Trajectory of near-Earth asteroid Apophis in 2029 (NASA-JPL)

Images showing just a few of the wide variety of applications at the intersection of social, earth and space science.

NEREID is a catalyst to bring the earth and space data science communities together with learning scientists, policymakers, and tool developers to circumscribe these needs, both now and in the future, and to create scalable infrastructure to accelerate discovery and innovation at the frontiers of human knowledge.

- NEREID works with academia, industry and research to identify, leverage, amplify and scale efforts to conduct research, develop tools, and engage communities of learners and policymakers in earth and space science.
- NEREID recognizes the importance of interdisciplinarity, equity, and the dynamic relationship among data, modeling, and individual perspective.
- NEREID stimulates and facilitates addressing the most important real-world problems through earth and space data by developing and disseminating accessible and democratized tools and methods and working with the systems of education and learning.
- NEREID accomplishes this through the development of a community of practice: a network of practitioners who are aligned in their goals and work mutualistically toward a common purpose.

Mission: *NEREID ('nirē'id) advances research and innovation through education and engagement with big data in earth-space sciences.*

Goals:

- Explore the challenges of big data in earth-space science, and implement solutions across learning.
- Build an interdisciplinary community of practice in earth-space data science learning.
- Develop and disseminate research-based best practices and curricular resources in teaching and learning with earth-space data.
- Bring together industry, academia, and policy makers to build and grow a data literate workforce and society.

Joining NEREID offers opportunities for collaboration and networking to amplify earth-space data resources; to scale these resources and discoveries to effectively address real world problems and big scientific questions; and to thereby develop a generation of citizens well-versed in earth-space data and equipped to use this knowledge to create a better society for all. For more information on joining NEREID, please contact nereid@au.edu

Why earth and space data?

We have also entered the Age of Complexity.

- Bringing widely disparate data sources together has become a routine interdisciplinary tool for exploring and solving a wide gamut of challenges.
- Everything from land management, navigation, and ecosystems ecology, to disaster preparedness, socioeconomic, political, defense and security applications are conducive to data-driven earth and space science solutions.
- Big data in earth-space science are used to give advance notice of earthquakes and hurricanes, track near-earth asteroids, discover new planets around distant stars and unlock the secrets of dark matter.

Bringing together a wide variety of data from earth and space that relate to human activities provides a pathway to address humanity's most difficult and persistent problems, such as climate change, poverty, access to clean water and food, and eradication of disease.

NEREID Workshop

Funded through NSF's Convergence Accelerator initiative, a kick-off workshop was held at the Green Bank Observatory in Green Bank, West Virginia on November 20 - 22, 2019. The workshop brought together 28 leading experts in Earth and space data science and education. Some key findings from the workshop:

- K-14 and community education programs are valuable resources for testing the acceleration of Earth-space sciences convergence, as the data used in each individual program often spans multiple disparate scientific domains.
- Data science can be a catalyst for convergence in our understanding of Earth and space sciences, but communities of users need significant support to use existing tools and develop new ones.
- Resources commonly available to researchers and educators in the space sciences (e.g., planetarium capabilities for modeling) offer a potentially wide-reaching set of resources for the Earth sciences.
- Mature data architectures from the Earth and atmospheric sciences open up significant open-source data sharing capabilities across the space science educational infrastructures.
- Diversity, equity, and inclusion are essential characteristics of a convergence accelerator.
- Educating both the current and next generation to embrace complexity and use a variety of data tools, including sophisticated AI-driven data tools, will be essential for accelerating convergence of Earth-space science.

The workshop participants continue to work together on next steps, and a full report on the workshop will be published and available online at <https://sites.google.com/view/nereid2019/home>

This effort is supported by the National Science Foundation Award Number 1939471 to Associated Universities Incorporated. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation. NEREID is an initiative of Associated Universities Incorporated (AUI), a non-profit scientific research and education corporation that brings people together to collaborate across organizations, cultures, and borders, and engages people with shared interests in promoting the advancement of science and empowerment of the public through scientific literacy.

