



# CoRP Symposium, July 2023

**Hugo Berbery**

Deputy Director of CISESS



EARTH SYSTEM SCIENCE  
INTERDISCIPLINARY CENTER



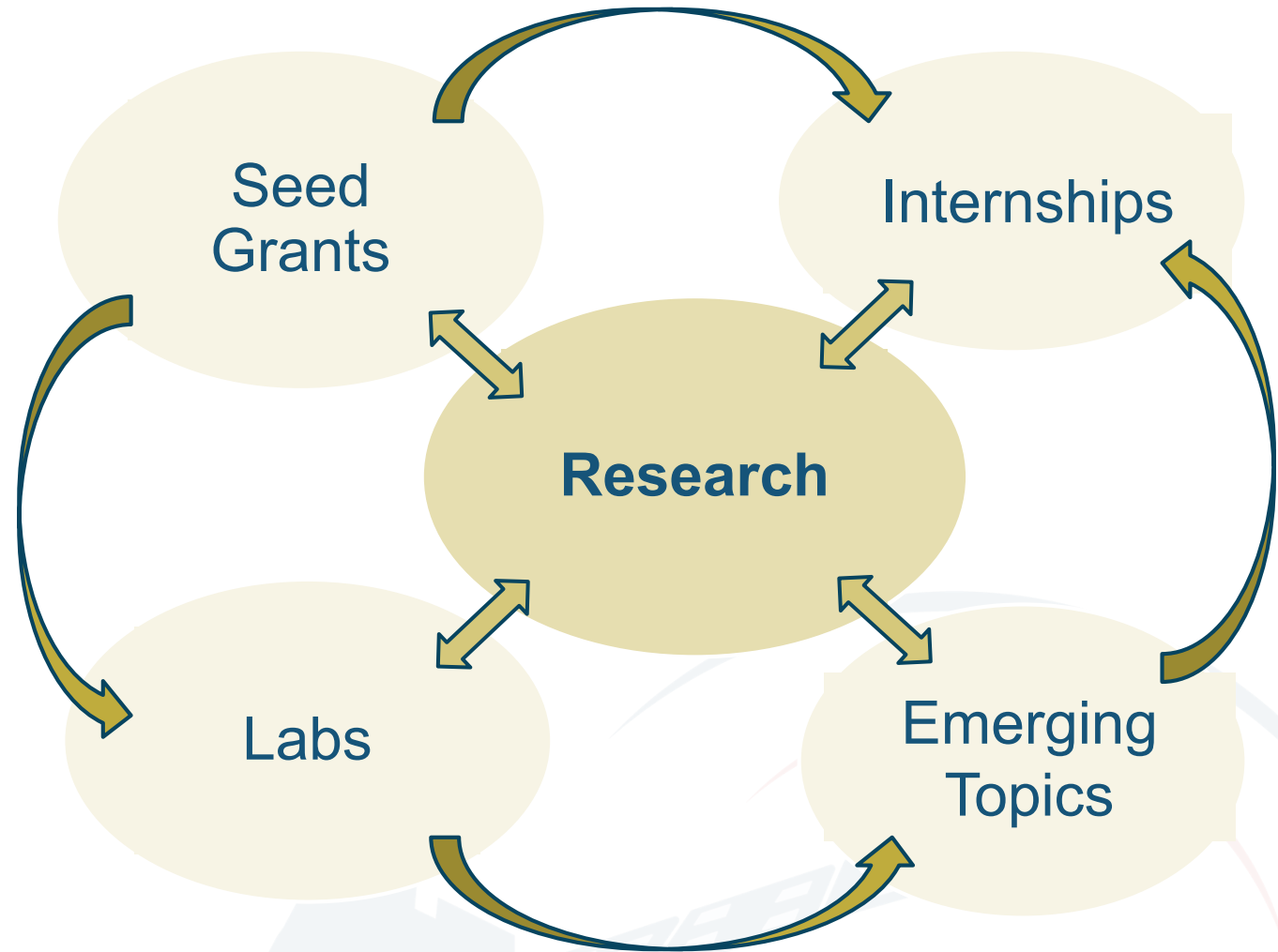
**NC STATE UNIVERSITY**



# Science Components

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- I. Research Themes
- II. Seed Grants Program
- III. Internship Program
- IV. Laboratories
- V. Emerging Topics



# CISESS Topics by Themes

## Theme 1: Satellite Services

- Satellite Observing Systems
- Sensor Cal/Val
- Algorithm & New product development
- Data fusion and blended prods.

## Theme 2: Earth System Observations and Services

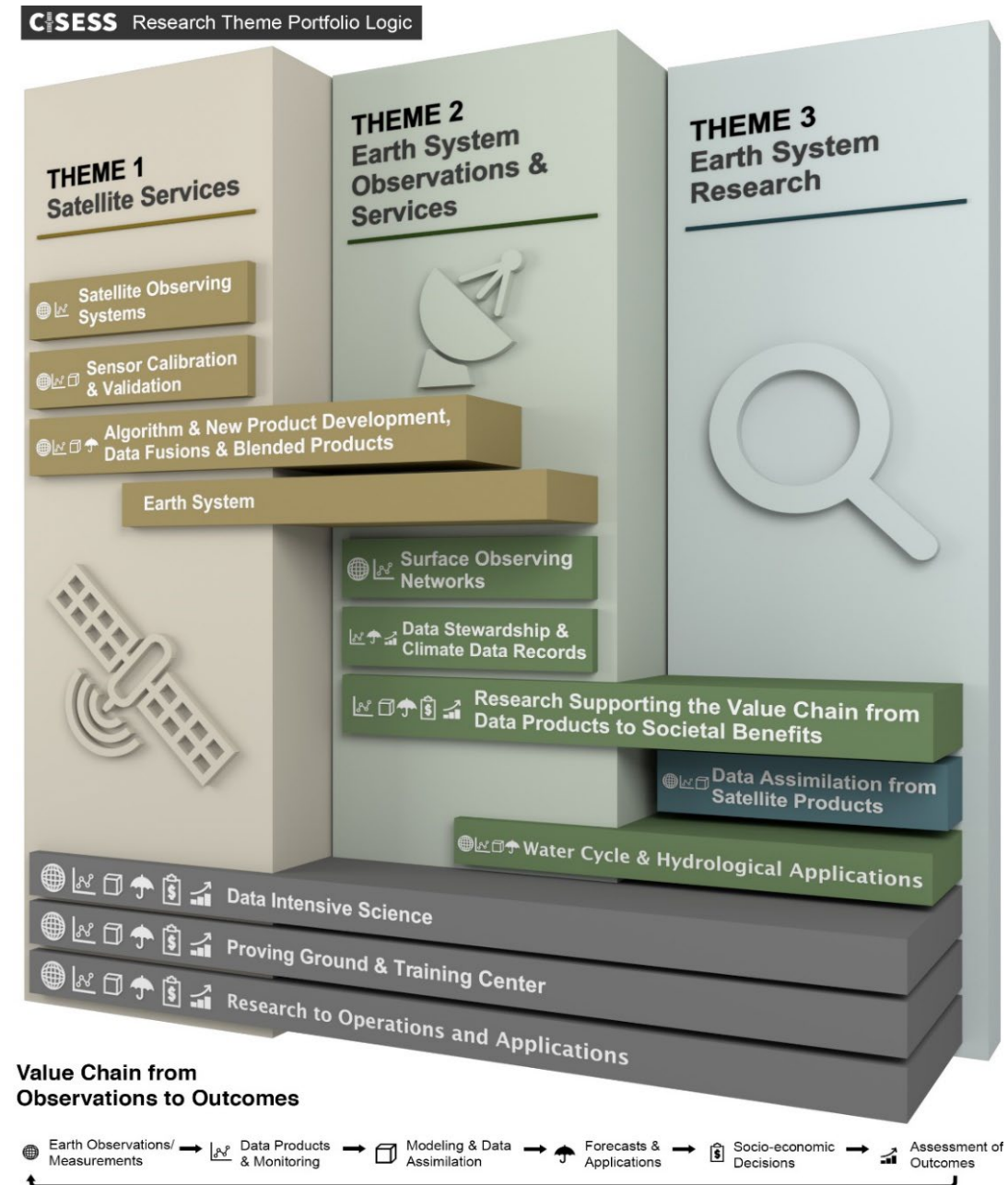
- Surface Observing Networks
- Data stewardship and CDRs

## Theme 3: Earth System Research

- Data assimilation of satellite products
- Water Cycle & Hydrological Applications
- Research supporting the value chain from data products to societal benefits

## Crosscuts:

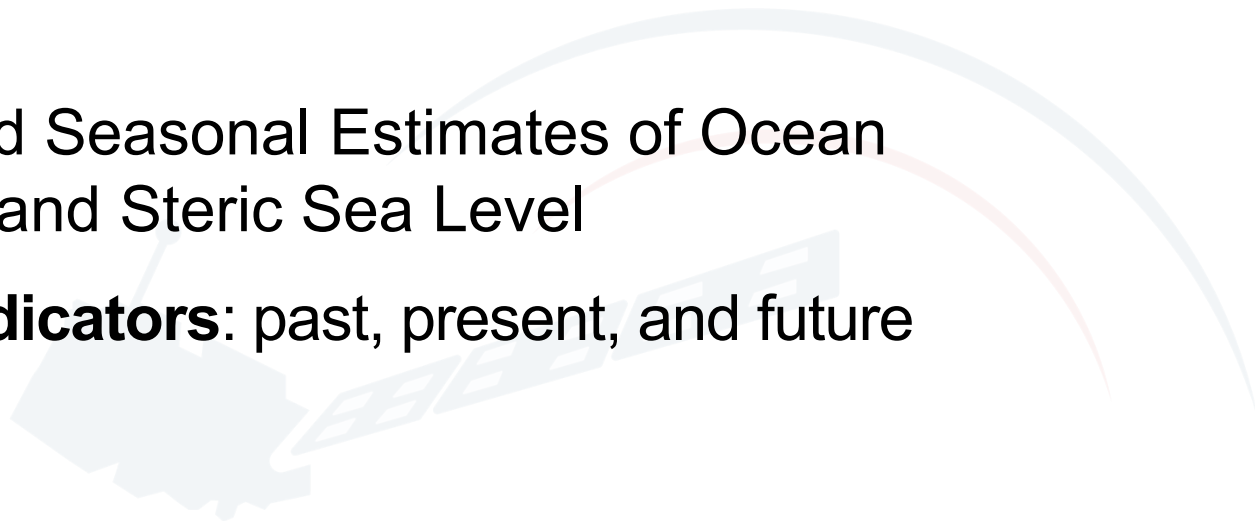
- Earth System
- Data Intensive Science
- Proving Ground & Training Center
- Research to operations and applications



- Planning and design of **future satellite missions**
- Pre-launch and Post-launch **calibration** both for geostationary and polar-orbiting satellites
- **New and blended products:** *Precipitation, soil moisture, evapotranspiration, snowfall, land and ocean surface temperature, albedo, vegetation properties, lightning statistics, and more.*
- **(North Carolina) Extending satellite records** (Climate Data Records) based on older NOAA polar orbiting satellite constellation instruments

## Theme 2: Earth System Observations and Services

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- Scientific Research on Air Pollution and Atmospheric Dispersion: Observations for improved understanding of **greenhouse gases**, and short-lived **air pollutants**.
  - Generation of a high-resolution data set on pollutants in Baltimore and Washington to guide numerical simulations and address **environmental justice** issues.
  - **World Ocean Database** Updates and Seasonal Estimates of Ocean Temperature, Salinity, Heat Content, and Steric Sea Level
  - Global surface **ocean acidification indicators**: past, present, and future
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# Theme 2: Earth System Observations and Services (North Carolina)

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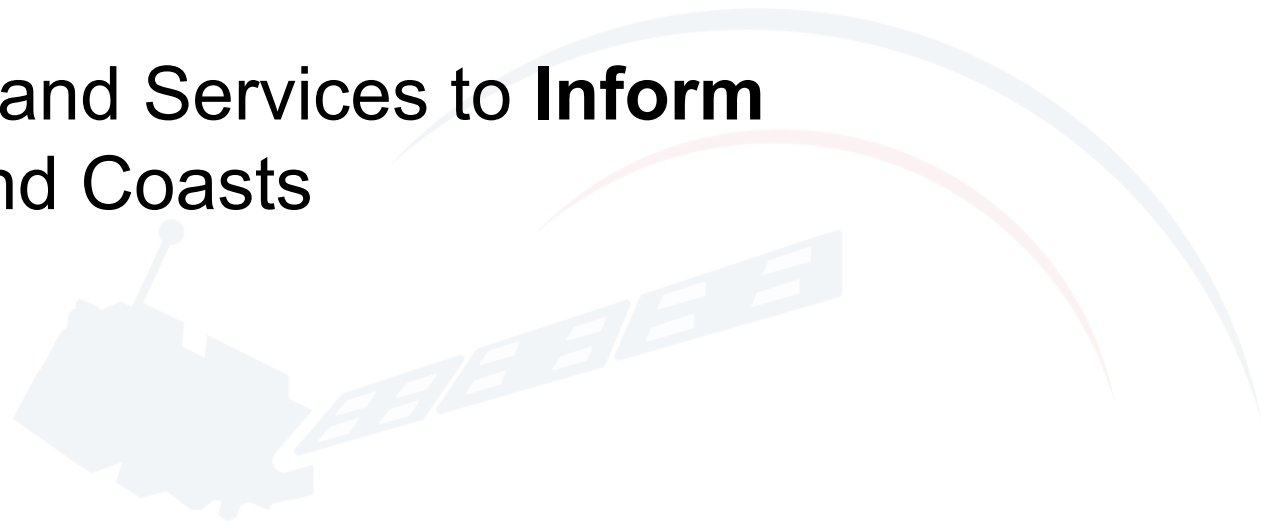
- **Climate assessments and information** – The multidisciplinary Technical Support Unit supports the National Climate Assessment (NCA) process, produced NOAA’s State Climate Summaries, and led the development of the North Carolina Climate Science Report.
- **National Center for Artificial Intelligence** – CISESS NC supported the development of the NCAI. Current work focuses on developing standards and guidance for “AI Ready Data.”
- **Data access and research in the cloud** – CISESS NC serves as the data broker and engagement lead for the NOAA Open Data Dissemination program, which provides cloud access to NOAA data via Google Cloud, Microsoft Azure, and Amazon Web Services.

# Theme 3: Earth System Research

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STAR

- Developing Coastal and Ocean Remote Sensing Monitoring Systems and Products and Coordinating Activities on a Global Scale
- Oceanographic Satellite Data Applications, **User Engagement and Education** for Improved Coastal Decision-Making on the U.S. East Coast
- Satellite Products, Applications and Services to **Inform Decision-Making** for Oceans and Coasts



# Theme 3: Earth System Research

NCEI

## (North Carolina)

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- **Climate change and extreme events** – As part of a new, multi-institution rapid-attribution team, CISESS scientists are improving our understanding of how climate change influences heatwaves and heavy precipitation events. This joint effort is with NCEI, GFDL, CPC, and PSL.
- **Societal benefits from blending physical, biological, and social sciences**  
Multiple efforts focus on addressing human impacts through multidisciplinary research. Our scientists are helping NOAA and CDC develop real-time drought indicators and an early-warning system for harmful algal blooms.





# I. Seed Grants Program

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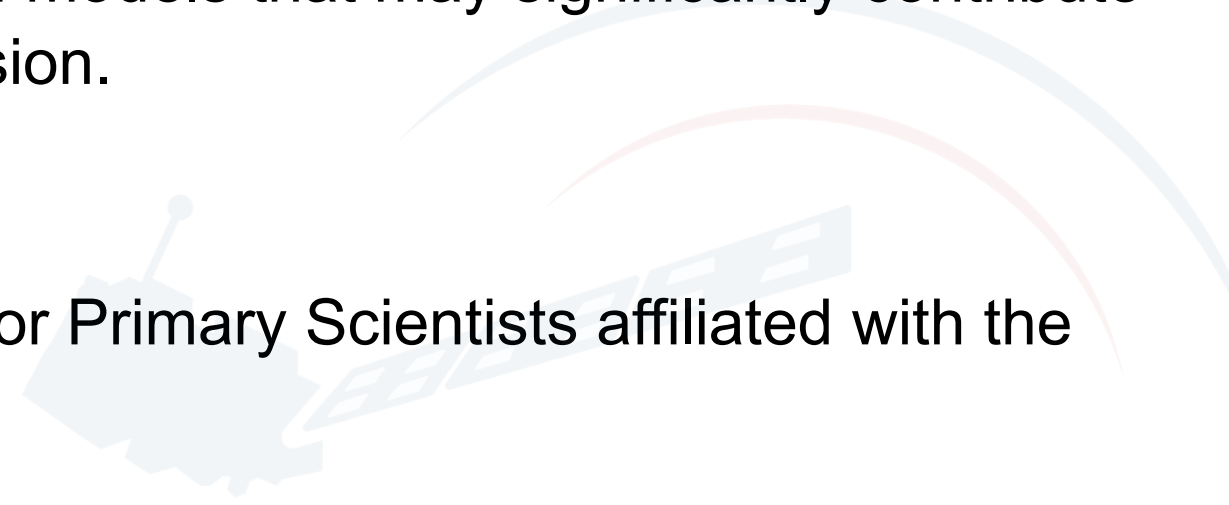
**One-year grants, with the option to a second year.**

Amount: \$30,000 (+\$15,000 if extended to a 2<sup>nd</sup> year)

**Focus:** To encourage new techniques and approaches to use satellite products, instruments, and models that may significantly contribute to advancing NOAA's mission.

**Priorities:** Updated every year.

**Eligibility:** All CISESS Task Leaders or Primary Scientists affiliated with the University of Maryland.

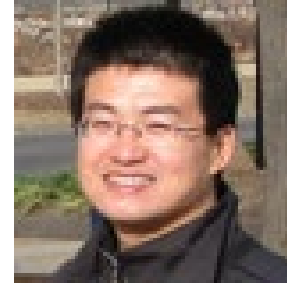


# I. Seed Grants

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Building and Deploying Tools to Better Observe Lightning in the Washington D.C. Region and Beyond (**Daile Zhang**)



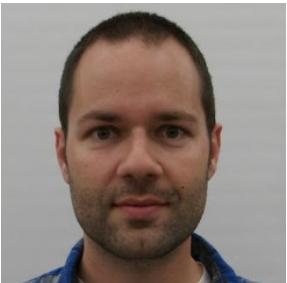
Developing Low-cost Microwave Radiometers for Student Training and Supporting JPSS programs (**Hu Yang**) **LAB**



Real-Time NOAA Weather and Climate Product Analysis in Virtual Reality (**Guangyang Fang**) **LAB**



3D-VISSYS: Three-dimensional Weather Visualization System For Maryland-DC Region (**Malarvizhi Arulraja**)



Use of Machine Learning for Emulating Satellite Passive Microwave Brightness Temperature from the GOES Advanced Baseline Imager (**Veljko Petkovic**)

# II. Summer Intern Program

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- Aimed at **Undergraduates and High School Seniors**.
- **Student support:** CISESS covers hourly wages for twelve weeks, at 20 hs per week. Hourly wage is variable depending on experience. (Approximate range \$18-\$25.)
- Each student is **paired with a mentor** according to common interests. Mentors have the responsibility of training the student.
- At the end of the season, **interns write reports and present their results** at a students' workshop.

# II. Summer Intern Program

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- **Summer 2021:** 22 interns.
- **Summer 2022:** 25 interns.
- **Summer 2023:** 35 interns.
- Each year, several continue through other periods with support from the mentors' tasks.

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UGs come from different Departments, including Computer Sciences and Atmospheric and Oceanic Science. HS students are from local schools.

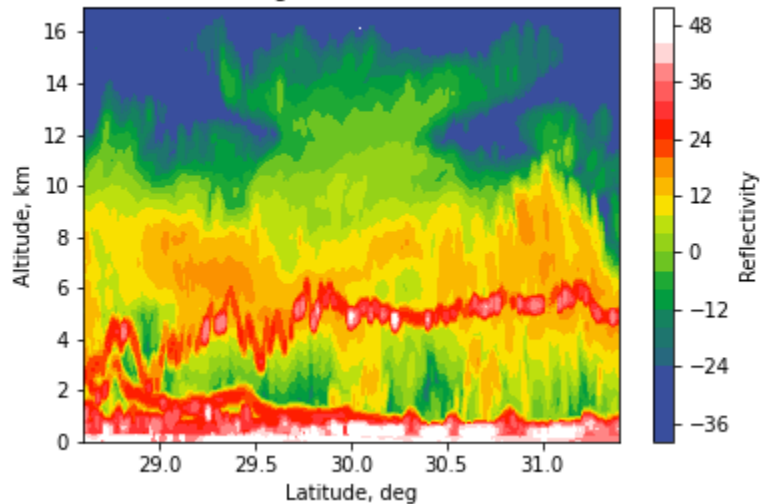
# II. Summer Intern Program



## Examples of topics:

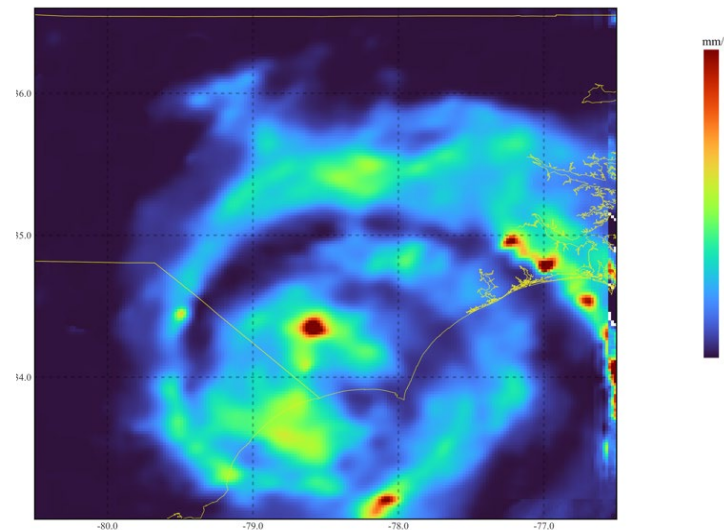
- Python Code Development
- Development of user-interactive websites
- Machine learning approaches
- Use of satellite data

Figure 7 Bottom

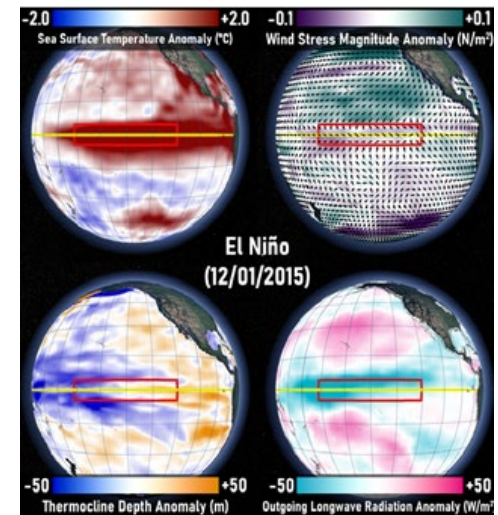


Developing Python tools for the visualization of spaceborne radar measurements

GPROF Precipitation Rate\_2018091418



Developing Machine Learning Models for ABI and Passive Microwave Observations



Creative ways to use virtual reality to analyze and visualize 3D weather and climate datasets

# III. Laboratories

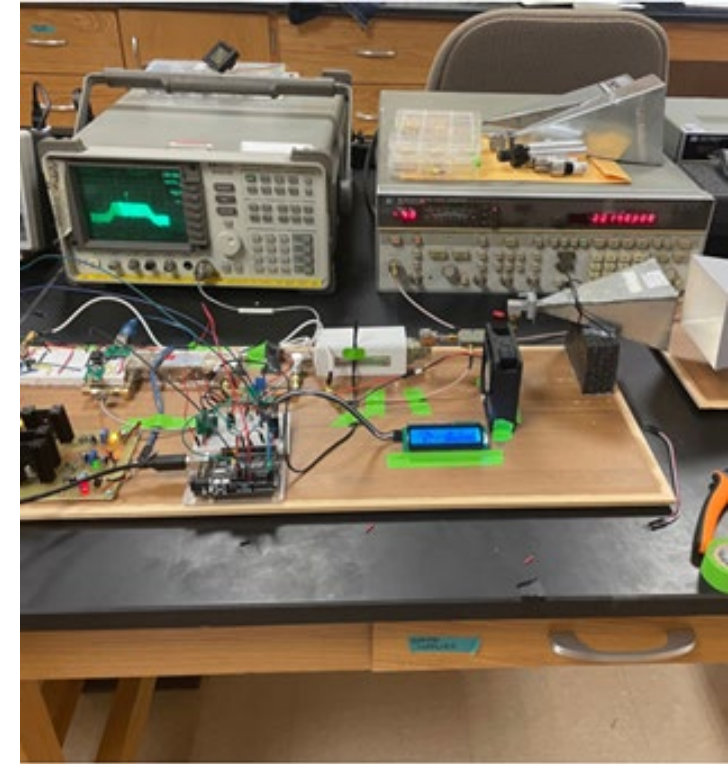
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## Remote Sensing Lab

Developing Low-cost Microwave Radiometer for Student Training and Supporting JPSS programs

Robotic Ground-based Cal/Val System Design and Integration

Demonstration of field campaigns to support VIIRS and ABI Cal/Val



## Visualization Lab (Proving Ground and Training Center)

Real-Time NOAA Weather and Climate Product Analysis in Virtual Reality

Testing of gridded products visualization in AWIPS



# IV. Emerging Topics

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- a) **Artificial Intelligence:** AI/ML is becoming an indispensable tool in many of the tasks carried out at CISESS. CISESS recognizes the need to increase collaborations with NOAA and other relevant partners to ensure the optimal use of these new tools;
- b) **Cloud computing:** We believe that as an institute that provides support to NOAA's mission, CISESS needs to be involved in the process of transitioning datasets and processes to cloud systems;
- c) **Support for nanosatellite technology and commercial satellite data:** A paradigm change is imperative for exploring and accelerating the use of small satellites (SmallSat) data in NWP;
- d) **Support for future satellites science (Future NOAA Low Earth Orbit Constellation and Geostationary Extended Observations (GEOXO):** CISESS scientists have played a critical role in pre-launch and post-launch activities for LEO (e.g., JPSS) and GEO (e.g., GOES-R) constellations with expertise in algorithm development, data fusion, calibration and validation of satellite sensors;
- e) **Development and implementation of social science approaches** to improve the utility of NOAA research and products.



**Thank you**

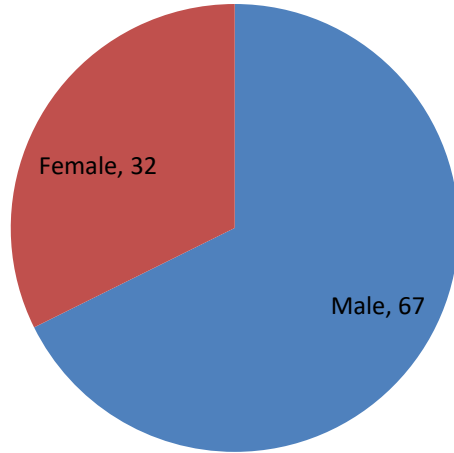




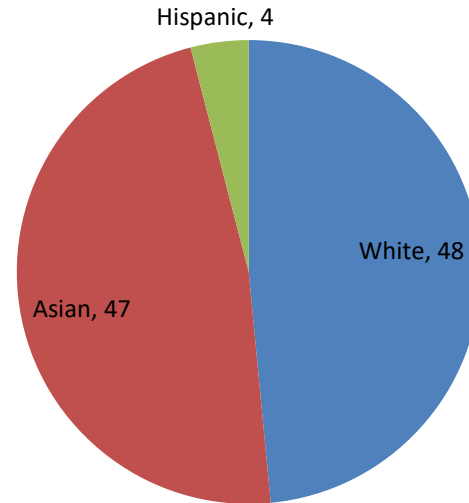




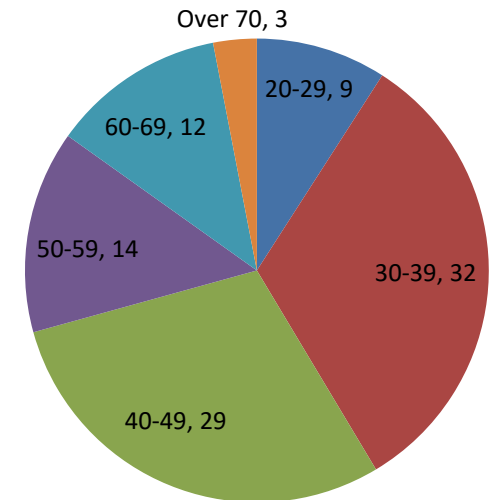
### ESSIC/NOAA by gender



### ESSIC/NOAA by ethnicity



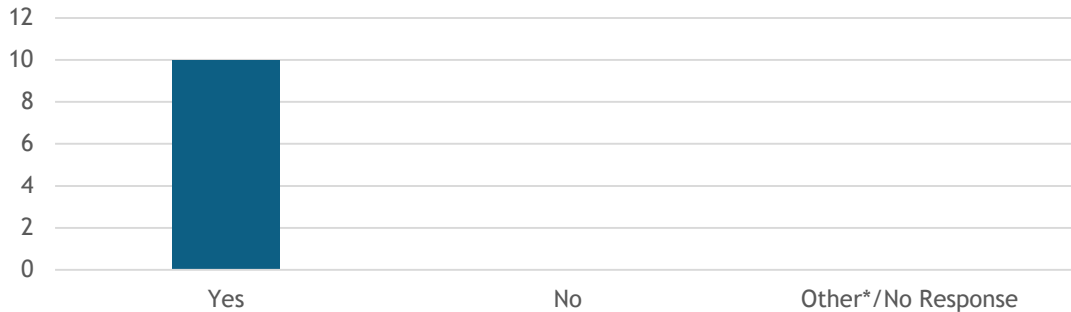
### ESSIC/NOAA by age



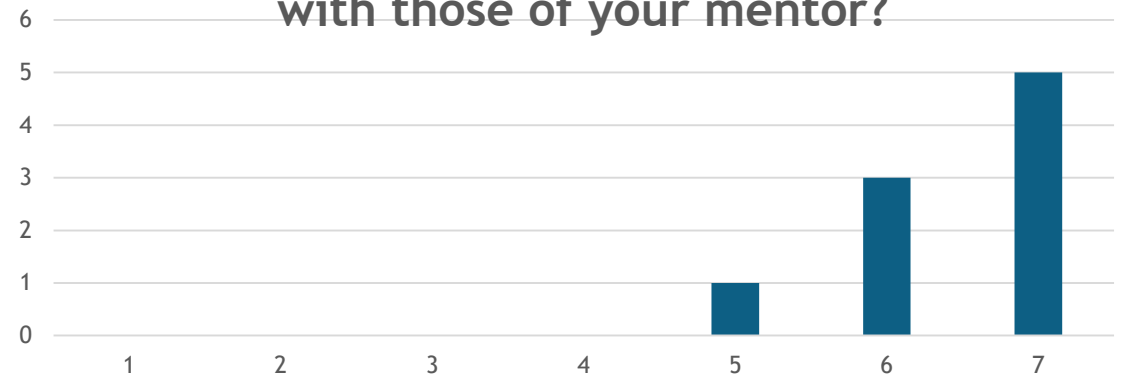
# Survey: The Interns' View 2022



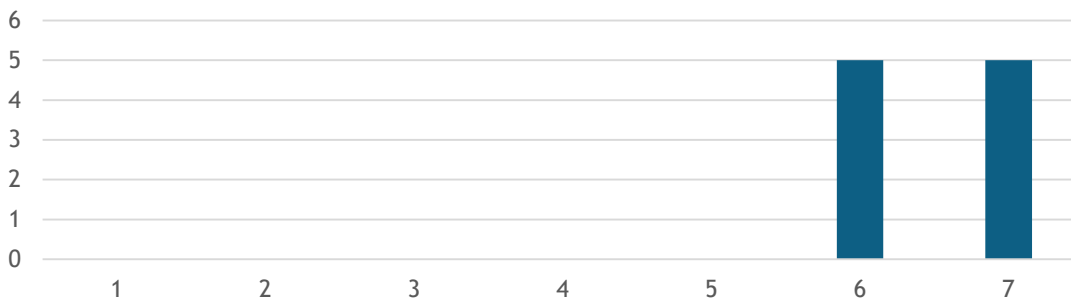
Were you able to maintain effective communication with your mentor?



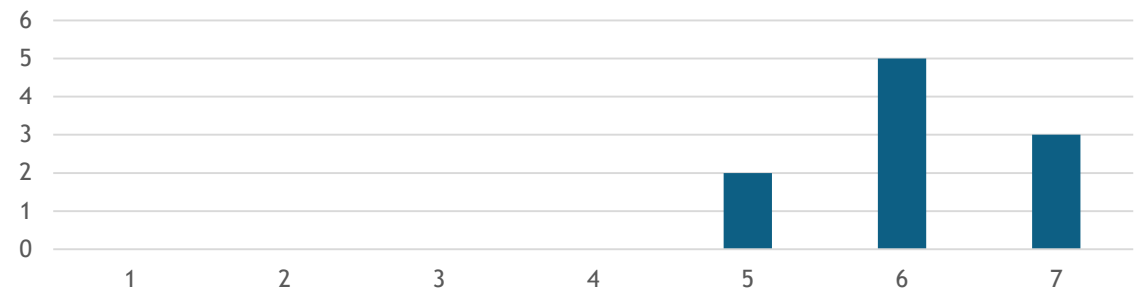
How aligned were your expectations with those of your mentor?



Do you feel this program promoted your professional development?



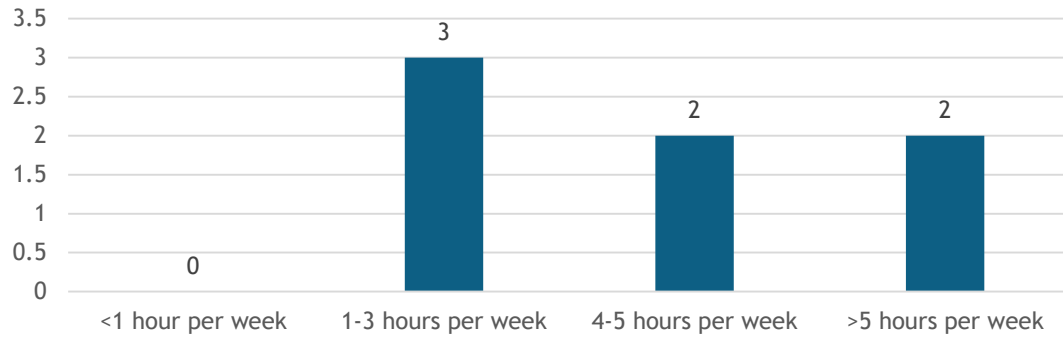
How would you rate your overall experience with the internship program?



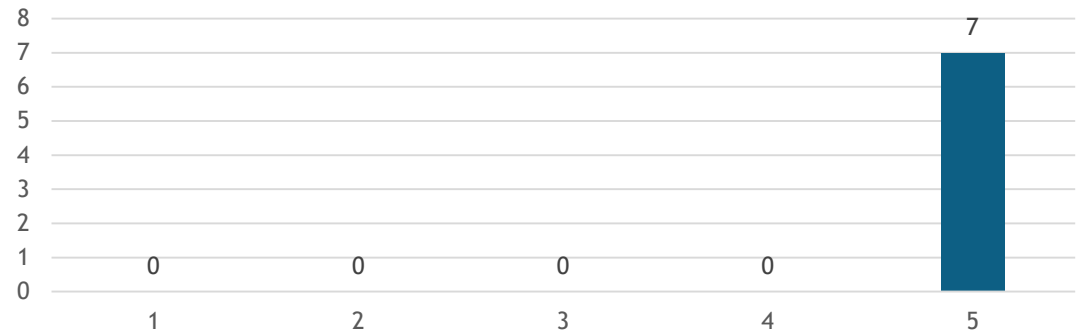
# Survey: The Mentors' View 2022



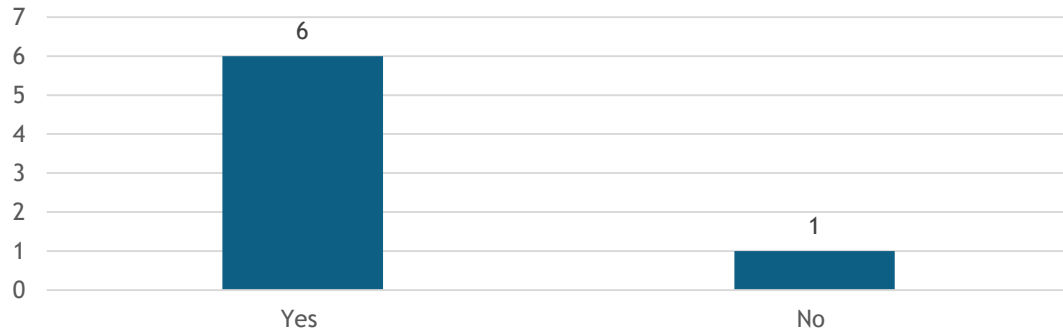
How much time did you generally commit to your intern per week?



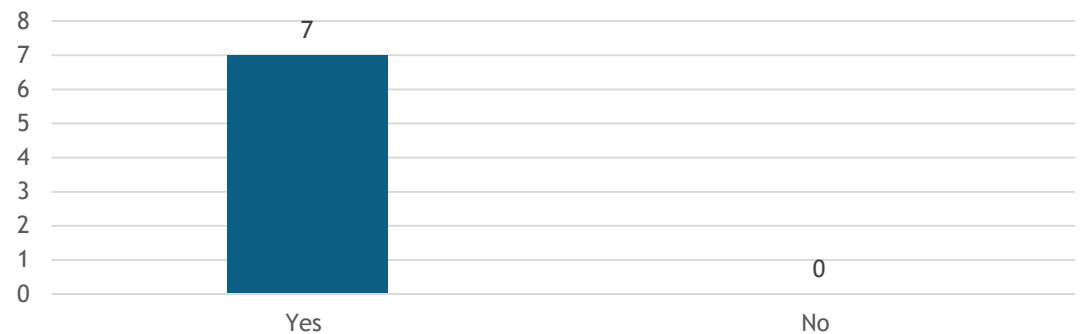
How would you rate your experience with the Internship program?



Did the additional funding for interns affect your participation?



Was the work that your intern did valuable to your research?



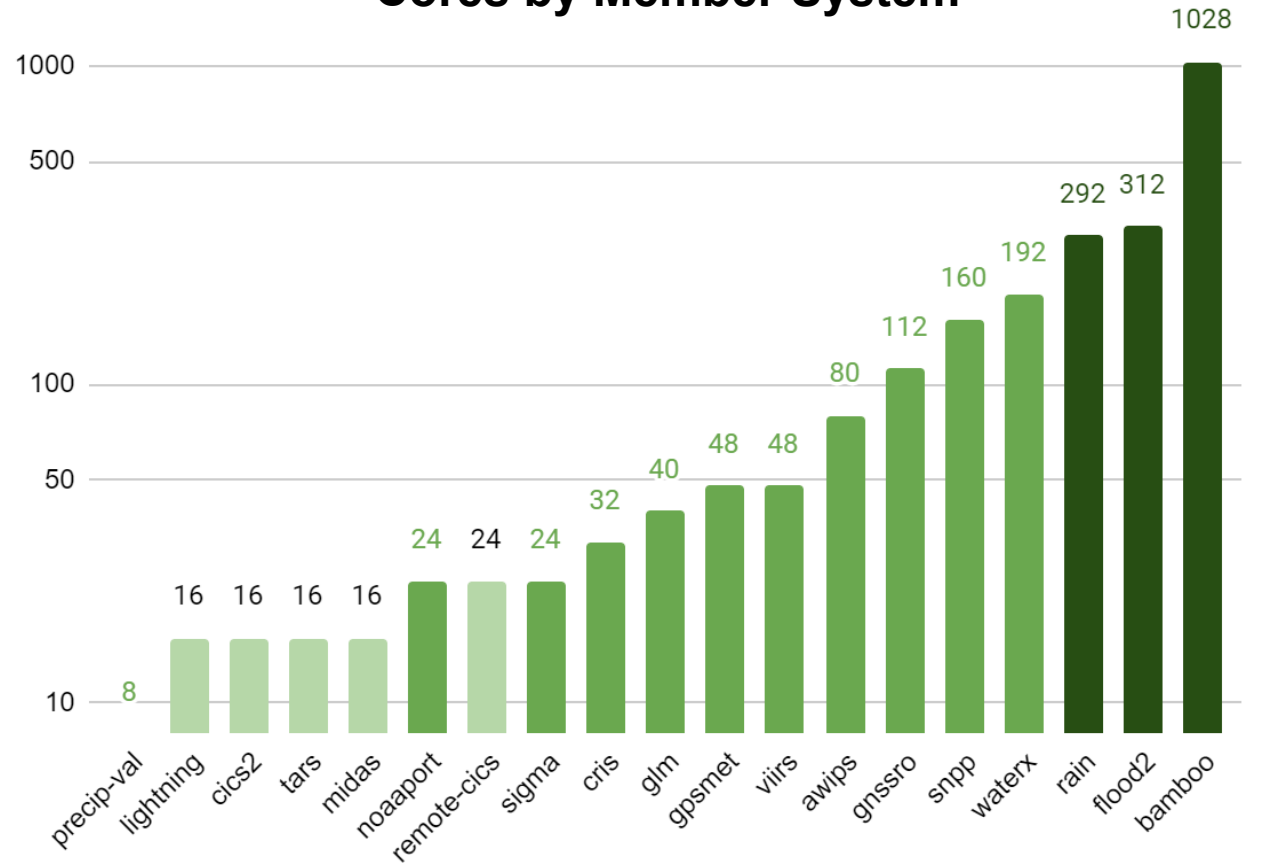
# CISESS Computational Facilities



Many aspects of the Institute's overarching science mission are facilitated through task-sponsored computing. A significant assemblage of these resources are hosted, maintained and managed on-premise at the CISESS Earth Science Computational Data Center (ESCDC).

Featured ESCDC systems include the Center's 3 high-performance (HPC) clusters (rain, bamboo & flood2), numerous task-dedicated physical and virtual servers and a vast storage pool for both data archival and serving.

## Cores by Member System



# II. 2022 Students' Workshop



## Students' Workshop

At the end of the internship, students

- (1) prepare a report and
- (2) present their studies at a students' open workshop.  
(Open to mentors, NOAA partners, other researchers.)

Summaries of all the presentations are available at:

<https://cisess.umd.edu/outreach/students-page/>

