

Life at the edge: Science and application needs at the coastal interface

Rashmi Shah, Kyra Adams, Angelica Rodriguez, Michael Denbina, Benjamin Hamlington, Cedric David, Severine Fournier, Anthony Bloom, Christine Lee, Marc Simard, Ryan Pavlick, Nicholas Parazoo, Dimitris Menemenlis, Sidharth Misra, and Andreas Colliander

Coastal Issues in the News

USDA Climate Hubs U.S. DEPARTMENT OF AGRICULTURE ABOUT US CONTACT US NEWSLETTER

HUBS PRIORITIES TOPICS ACTIONS & RESOURCES

Northeast Climate Hub About Topics Climate Impacts Actions & Resources Newsletter

Saltwater Intrusion: A Growing Threat to Coastal Agriculture

Home > Welcome to the USDA Northeast Climate Hub

Leer en español: Intrusión de agua salada: Una amenaza creciente para la agricultura costera

As sea levels rise along the coasts, saltwater can move onto the land. Known as saltwater intrusion, this occurs when storm surges or high tides overtop areas low in elevation. It also occurs when saltwater infiltrates freshwater aquifers and raises the groundwater table below the soil surface.


MAGAZINE ARTICLES

The Vanishing Forest

Purple sea urchins are devouring California's kelp forests, but scientists are working to put the ecosystem in balance.

Behind Toledo's Water Crisis, a Long-Troubled Lake Erie

Share full article



Algae-infested water from Lake Erie on Monday washed up onshore at Maumee Bay State Park in Oregon, Ohio, near Toledo. Joshua Lott for The New York Times

nature climate c

Explore content About

Article | Open access | Published: 01 March 2024

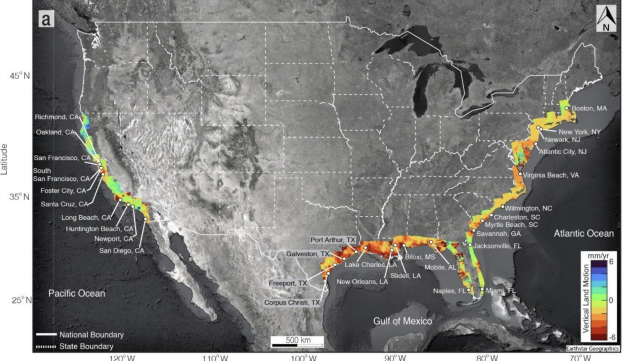
Climate threats to coastal infrastructure and sustainable development outcomes

Daniel Adshead, Amelie Paszkowski, Sarah S. Gall, Alison M. Peard, Mohammed Sarfaraz Gani

RESEARCH

Study: Sinking land increases risk for thousands of coastal residents by 2050

By Travis Williams 6 MAR 2024 5 minute read



Map showing coastal areas at risk of sinking land by 2050. The map covers the United States and the Gulf of Mexico, with a color scale indicating the level of risk. Key cities labeled include Richmond, CA; Oakland, CA; San Francisco, CA; San Jose, CA; Foster City, CA; Berkeley, CA; San Diego, CA; Corpus Christi, TX; Houston, TX; New Orleans, LA; Jacksonville, FL; Miami, FL; Naples, FL; Savannah, GA; Myrtle Beach, SC; Charleston, SC; Wilmington, NC; Virginia Beach, VA; Washington, DC; New York, NY; Philadelphia, PA; Boston, MA.

Climate change's impact on coastal flooding to increase five times over this century

According to new data on the Human Climate Horizons platform, a collaboration between the Climate Impact Lab and UNDP, increased coastal flooding this century will put over 70 million people in the path of expanding floodplains. Latin America and the Caribbean, East Asia and the Pacific, and Small Island Developing States (SIDS) are at the forefront, projected to lose significant land and critical infrastructure to permanent inundation.

POSTED NOVEMBER 28, 2023

GLOBAL HUMAN CLIMATE HORIZONS WHAT IS HCH EXPLORE CLIMATE

AAMCNEWS

In coastal communities, the health risks of climate change accelerate

Contaminated water, polluted lakes, and growing mold pose lasting threats to populations that lack resources to overcome the damage and get access to care. Universities and hospitals are exploring solutions.

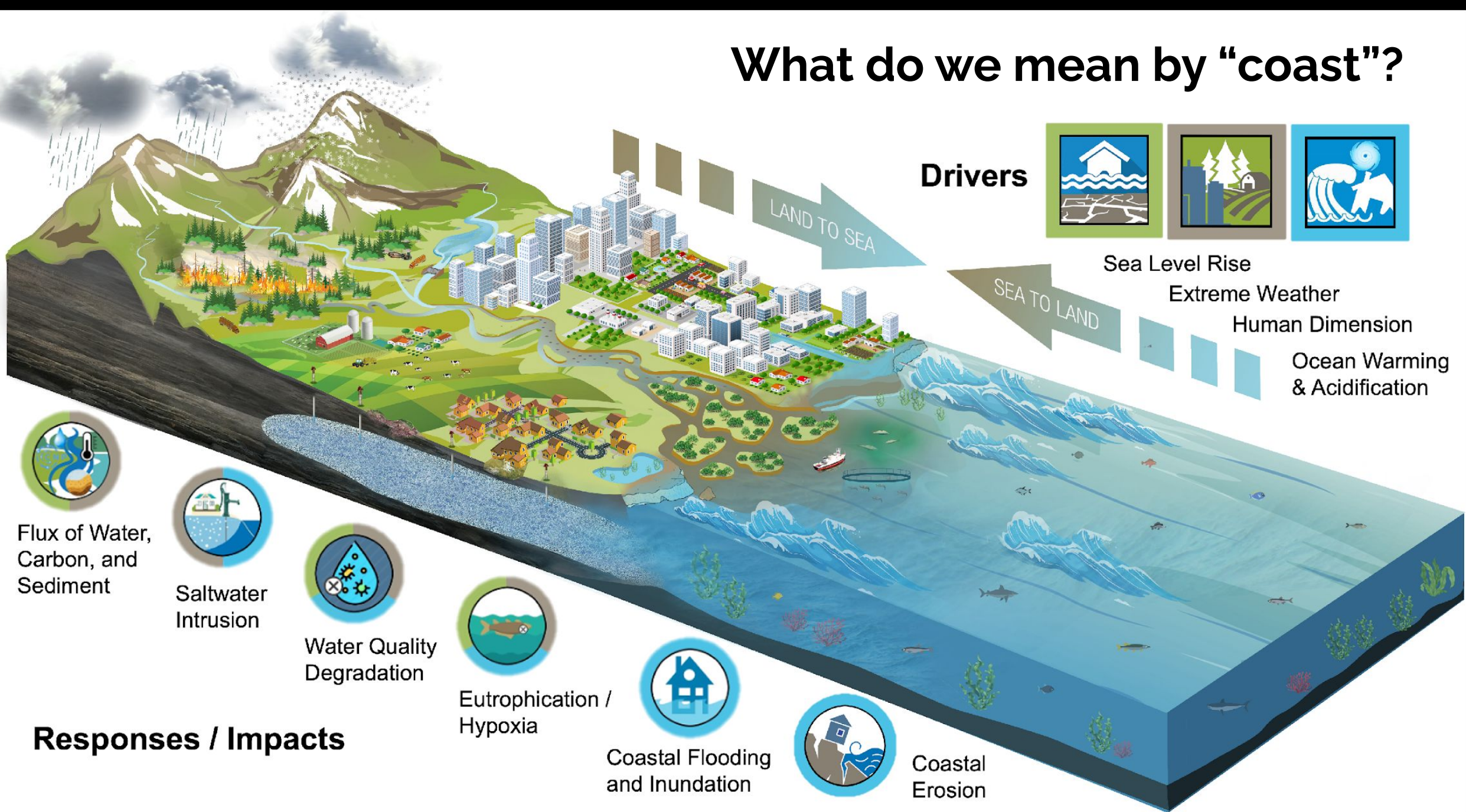


Sargassum is choking the Caribbean's white sand beaches, fueling an economic and public health crisis

Published: June 4, 2024 8:45am EDT

Sargassum washes ashore in large, smelly mats. Clearing it away isn't easy. Lhote/Andia/Universal Images Group via Getty Images

What do we mean by "coast"?



Drivers



Sea Level Rise

Extreme Weather

Human Dimension

Ocean Warming & Acidification

LAND TO SEA

SEA TO LAND

Flux of Water, Carbon, and Sediment

Saltwater Intrusion

Water Quality Degradation

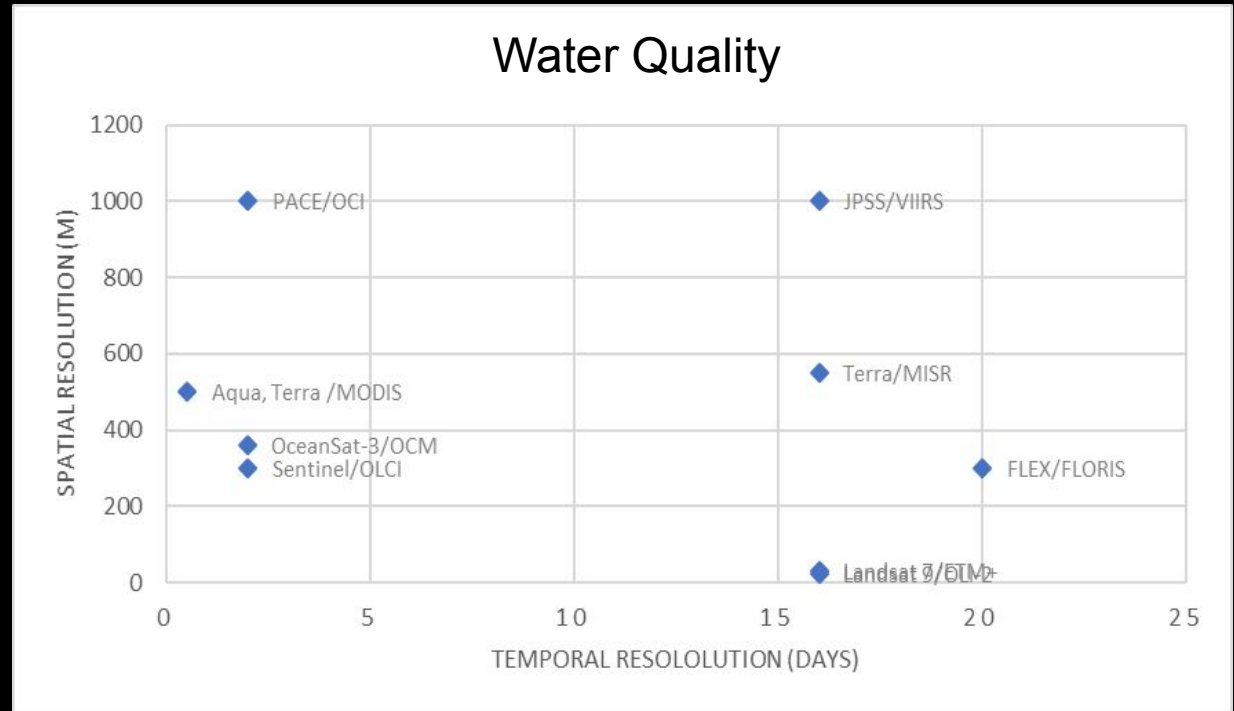
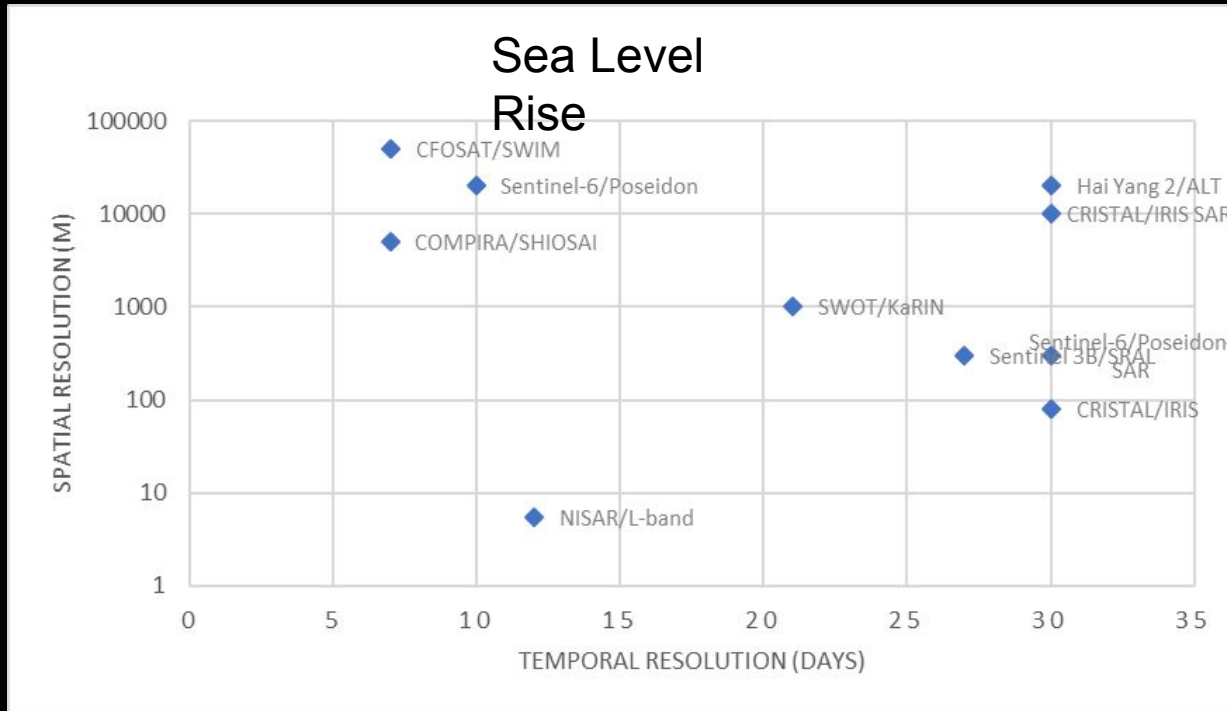
Eutrophication / Hypoxia

Responses / Impacts

Coastal Flooding and Inundation

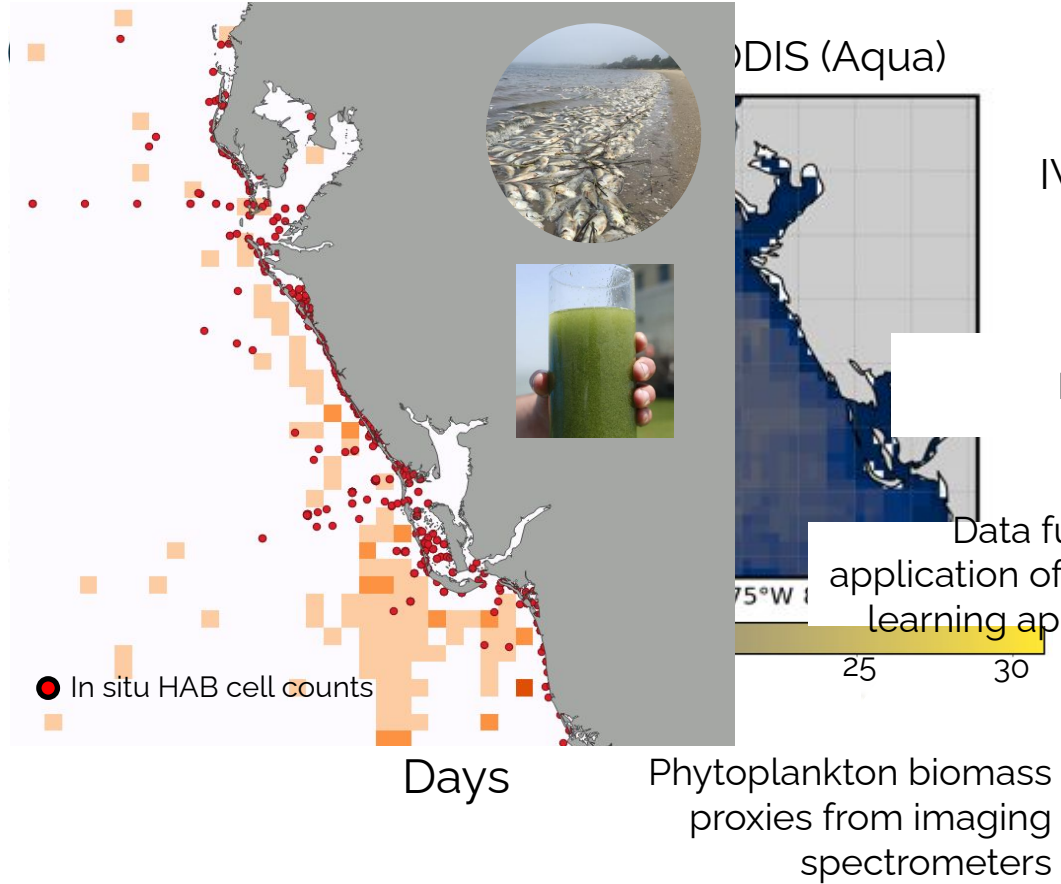
Coastal Erosion

The existing spaceborne Program of Record may be insufficient at the spatial and temporal resolutions needed for science and applications at the coast



Earth Science to Action: Supporting Harmful Algal Bloom (HAB) Management

August 2018

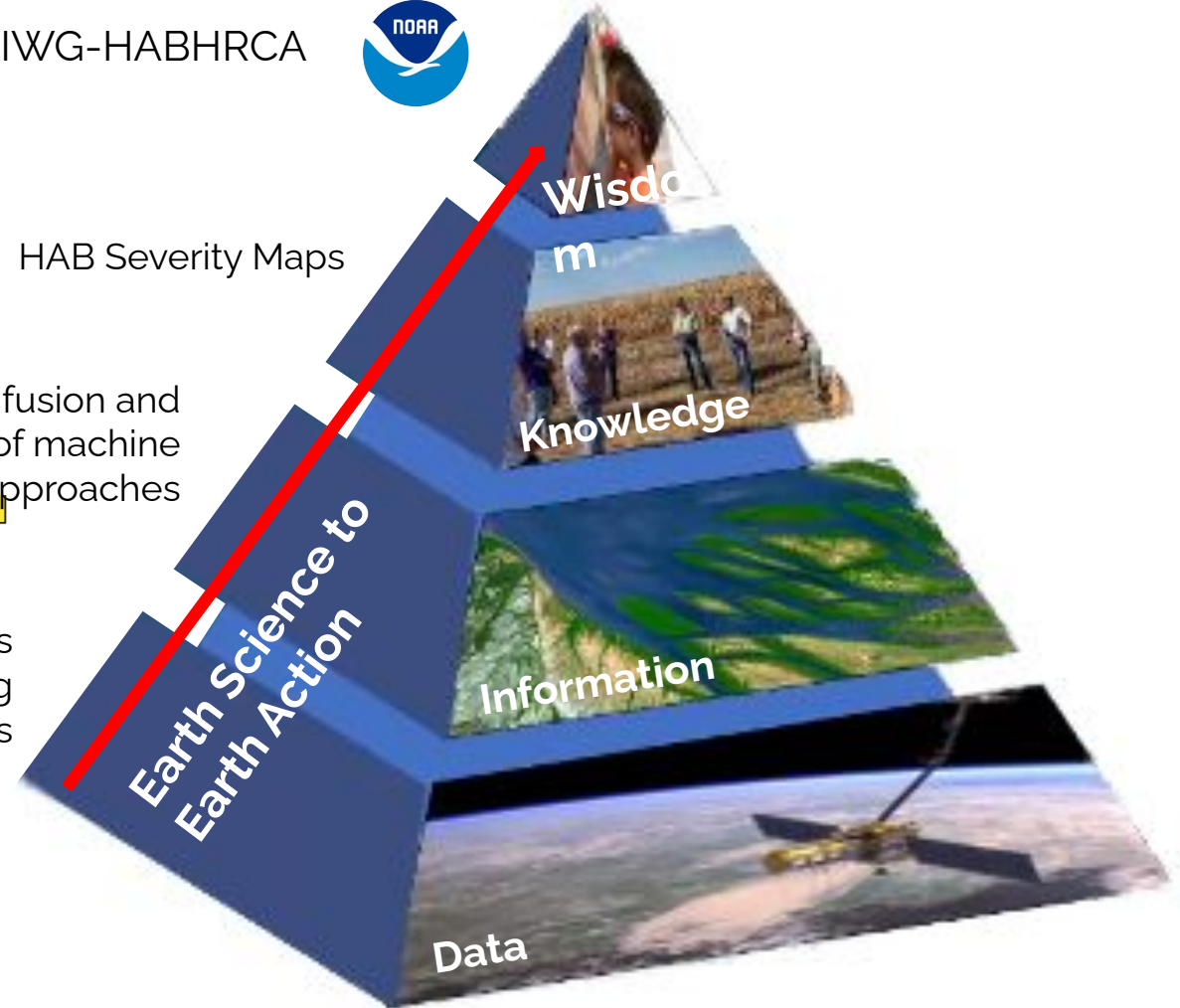


IWG-HABHRCA

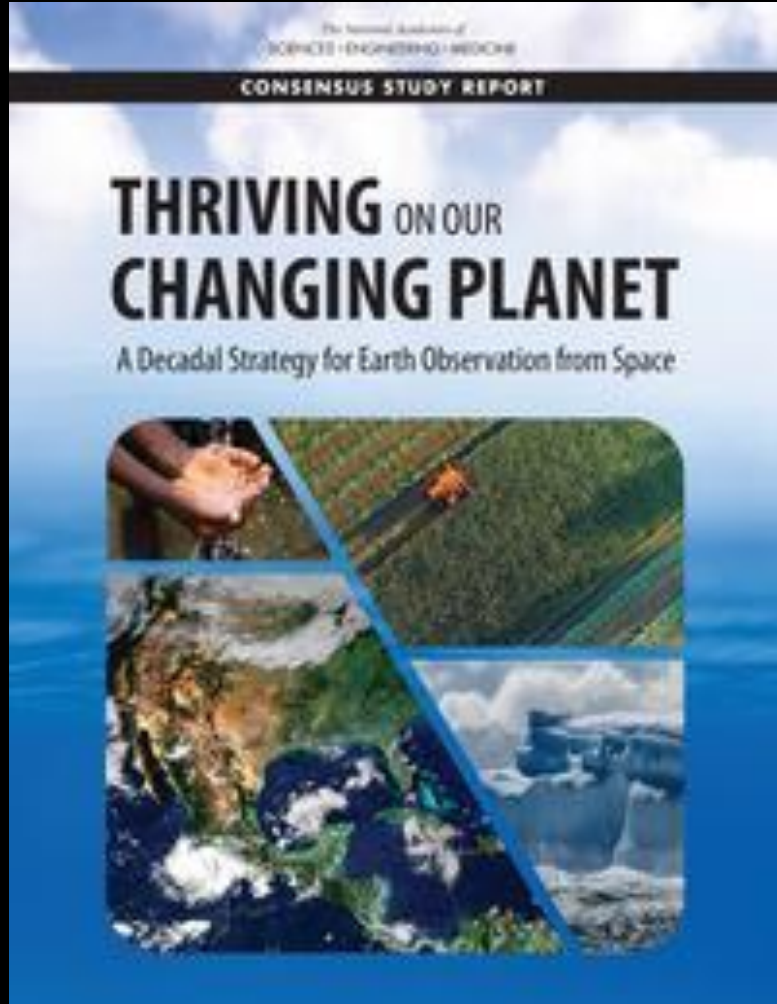


HAB Severity Maps

Data fusion and application of machine learning approaches



Preparation for the 2027 Earth Decadal Survey



- What observation system and observables are needed in 2040-2050?
- What are the key coastal challenges expected at this time to aid with informed decision making and management?

What is the habitability of coasts today, and how habitable might they be in the future in the face of climate change, specifically sea level rise, weather extremes, ocean warming and their compound?

1. Impacts to infrastructure and human migration / relocation (UN SDG* 9, 11)

- Changes in flooding extent and frequency along the coastlines
 - Surface landscape change along coastlines

Observables:

water elevation; water extent; land elevation / shallow water bathymetry; vertical land motion; geomorphology; land surface deformation

Requirements: hours – years ; 10-100m

Earth Science to
Earth Action

Data

What is the habitability of coasts today, and how habitable might they be in the future in the face of climate change, specifically sea level rise, weather extremes, ocean warming and their compound?

2. Availability of, and accessibility to, clean water and sanitation (UN SDG* 6)

- Distribution and transport of terrestrial freshwater and water properties from inland to the coast
 - Lateral movement of the freshwater/saltwater gradient at the coastal interface
 - Coastal water quality (e.g., temperature, salinity, optical properties)
 - Coastal water pollutants (e.g., plastics, contaminants)

Observables:

Water elevation; water extent; shallow water bathymetry; temperature; salinity; aquatic biogeochemistry; contaminants; plastics; land cover; elevation; subsidence; groundwater storage

Requirements: days-years; 10-100m

Data

Earth Science to
Earth Action

What is the habitability of coasts today, and how habitable might they be in the future in the face of climate change, specifically sea level rise, weather extremes, ocean warming and their compound?

3. Diversity of ecosystems, or biodiversity (UN SDG* 14-15)

- Extent, composition, and/or physiology of:
 - Coastal vegetated ecosystems (e.g., mangroves)
- Coastal shallow, submerged benthic communities (e.g., kelp, seagrass)
 - Coastal phytoplankton blooms

Observables:

Vegetation type; vegetation traits; SIF;
biomass & structure; soil carbon; pigments;
community composition; Chl:C ratio;
benthic fractional cover; temperature

Requirements: daily-years; 10-100m

Earth Science to
Earth Action

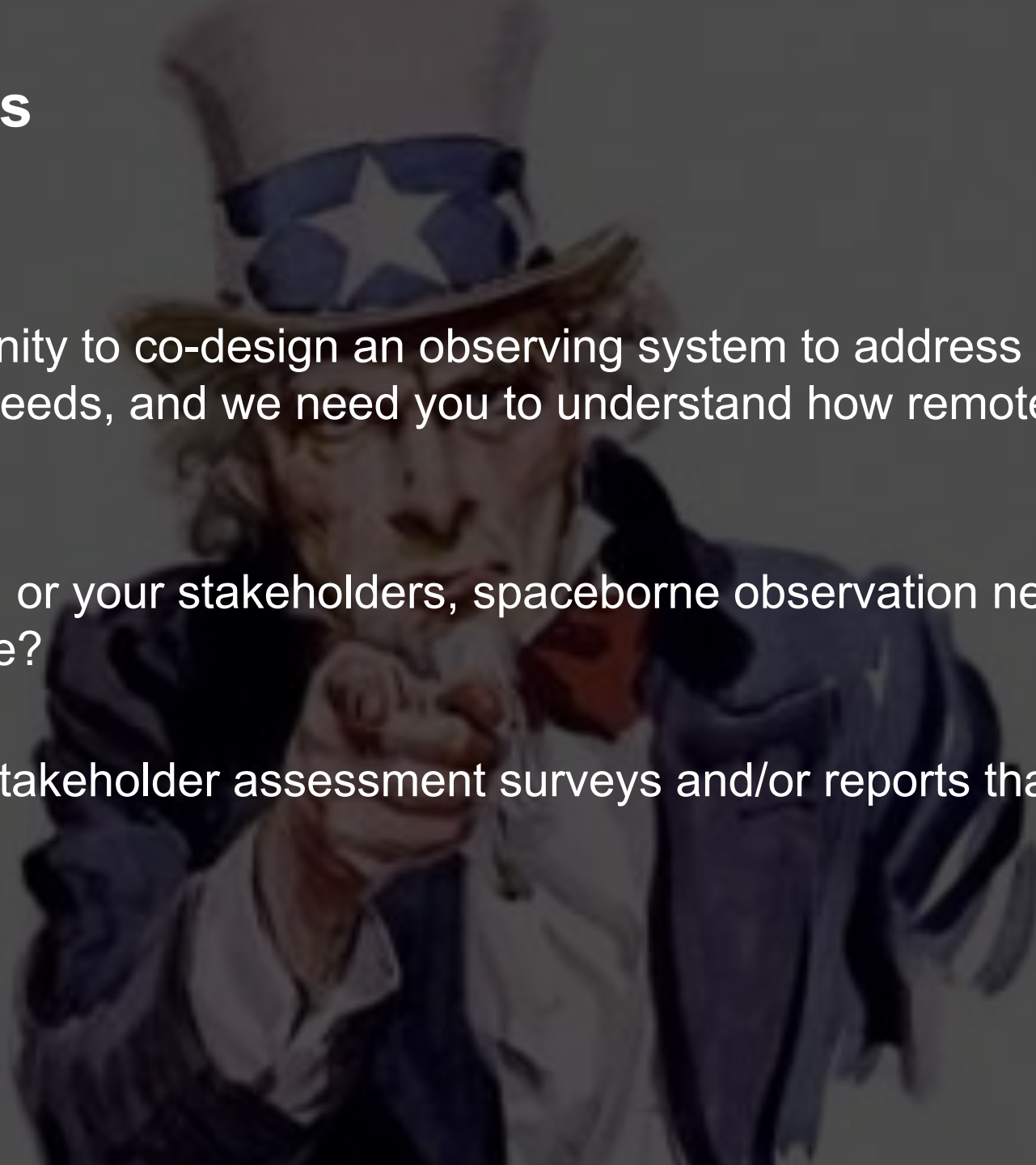
Data

Key Takeaways

- We need to consider land-to-sea and sea-to-land drivers and their impacts at the coast
- The existing spaceborne Program of Record may be insufficient to address coastal observations
- Satellite continuity is not a given!
 - Satellites should be part of an envisioned coastal observing system, helping to fill in spatial and temporal gaps
 - We can lean on the existing Program of Record to define next generation observing systems at the coast (e.g., SWOT and PACE)
- In a cost constrained environment, we need to prioritize observations of significant societal relevance / stakeholder needs now and in the future

Closing Remarks

- This is an opportunity to co-design an observing system to address coastal science and applications needs, and we need you to understand how remote sensing fits into this!
- What are your, or your stakeholders, spaceborne observation needs at the coast in space and time?
- Do you have stakeholder assessment surveys and/or reports that could be of benefit?

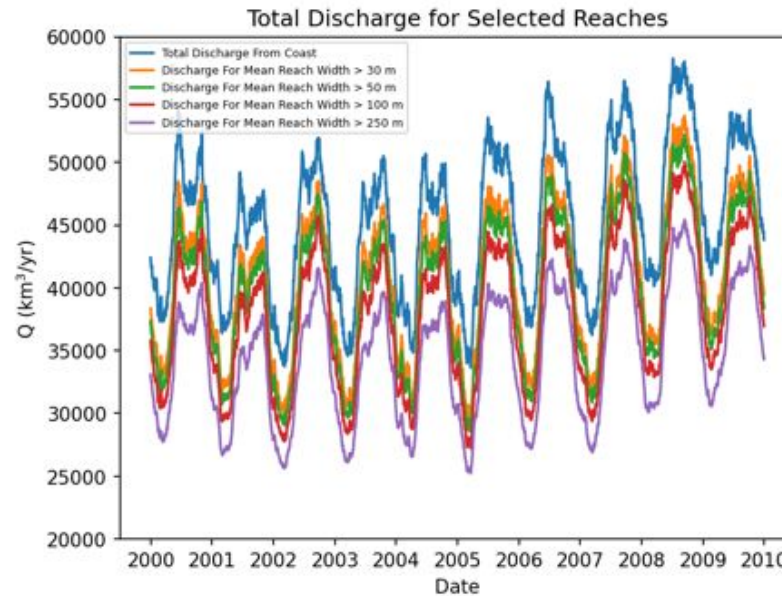
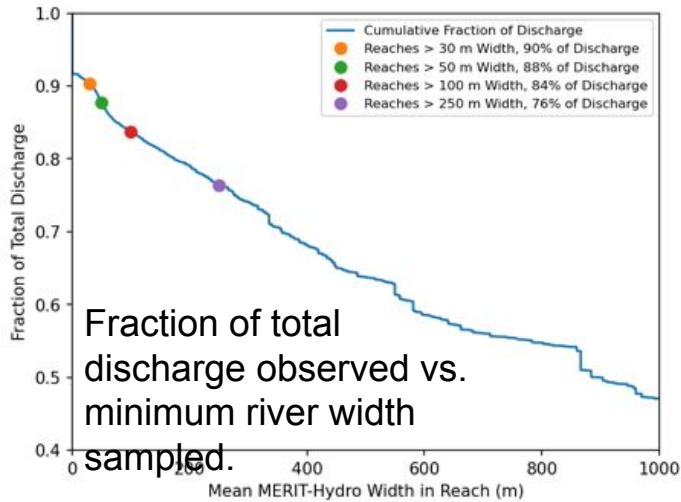
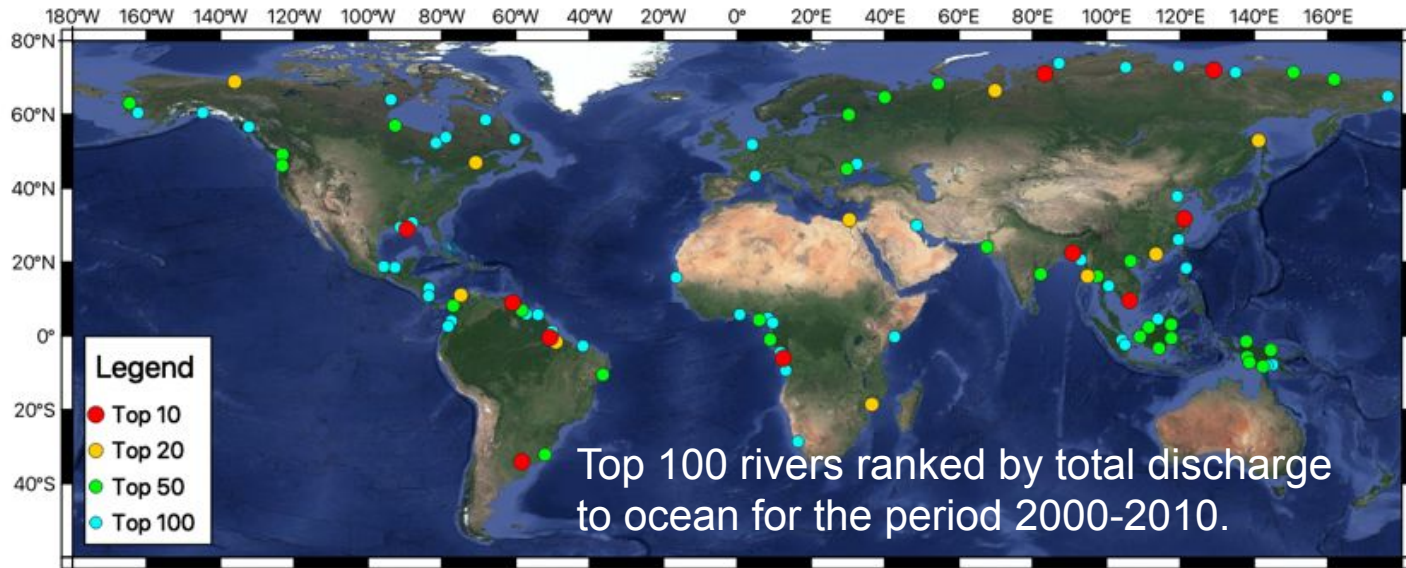




Jet Propulsion Laboratory
California Institute of Technology

jpl.nasa.gov

Global Coastal Discharge: Spatio-Temporal Sampling Needs



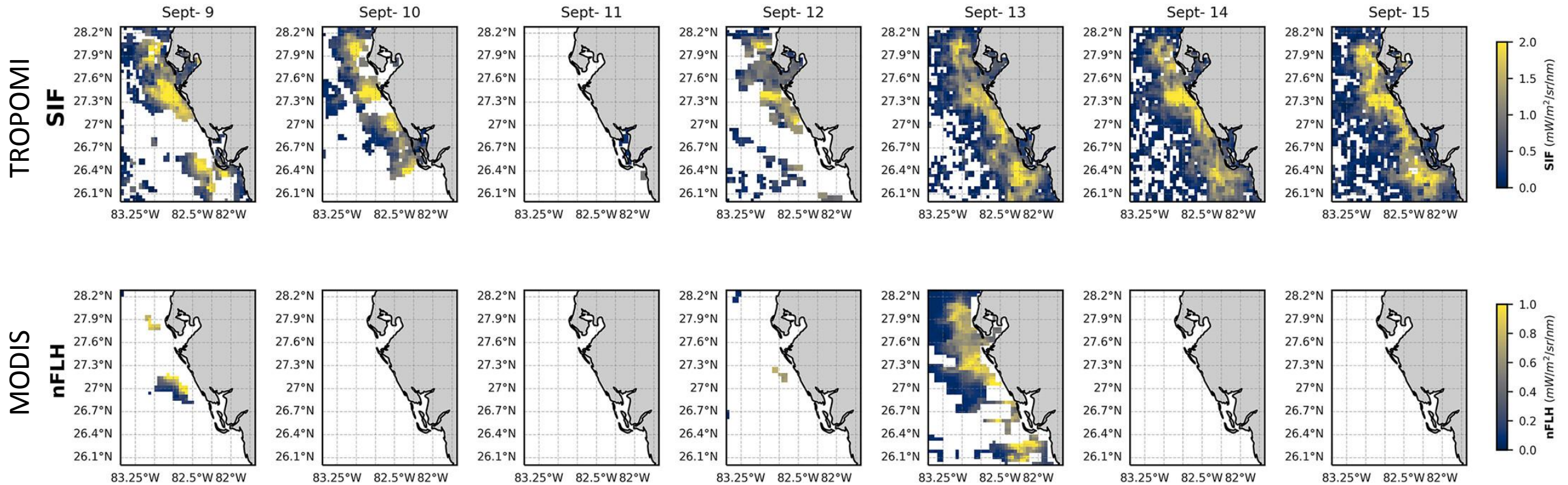
Key Takeaways:

- For measuring total discharge from coast to ocean, impact of temporal sampling is negligible. Spatial resolution and coverage are more important.
- For monitoring **high flow periods** (e.g., potential flooding) and other dynamic events, **temporal sampling increases in importance.**

Total discharge (in blue) vs. time, compared to discharge sampled for different river widths.

Harmful Algal Blooms – West Florida Shelf

Exploration and exploitation of various spaceborne instruments for HAB monitoring

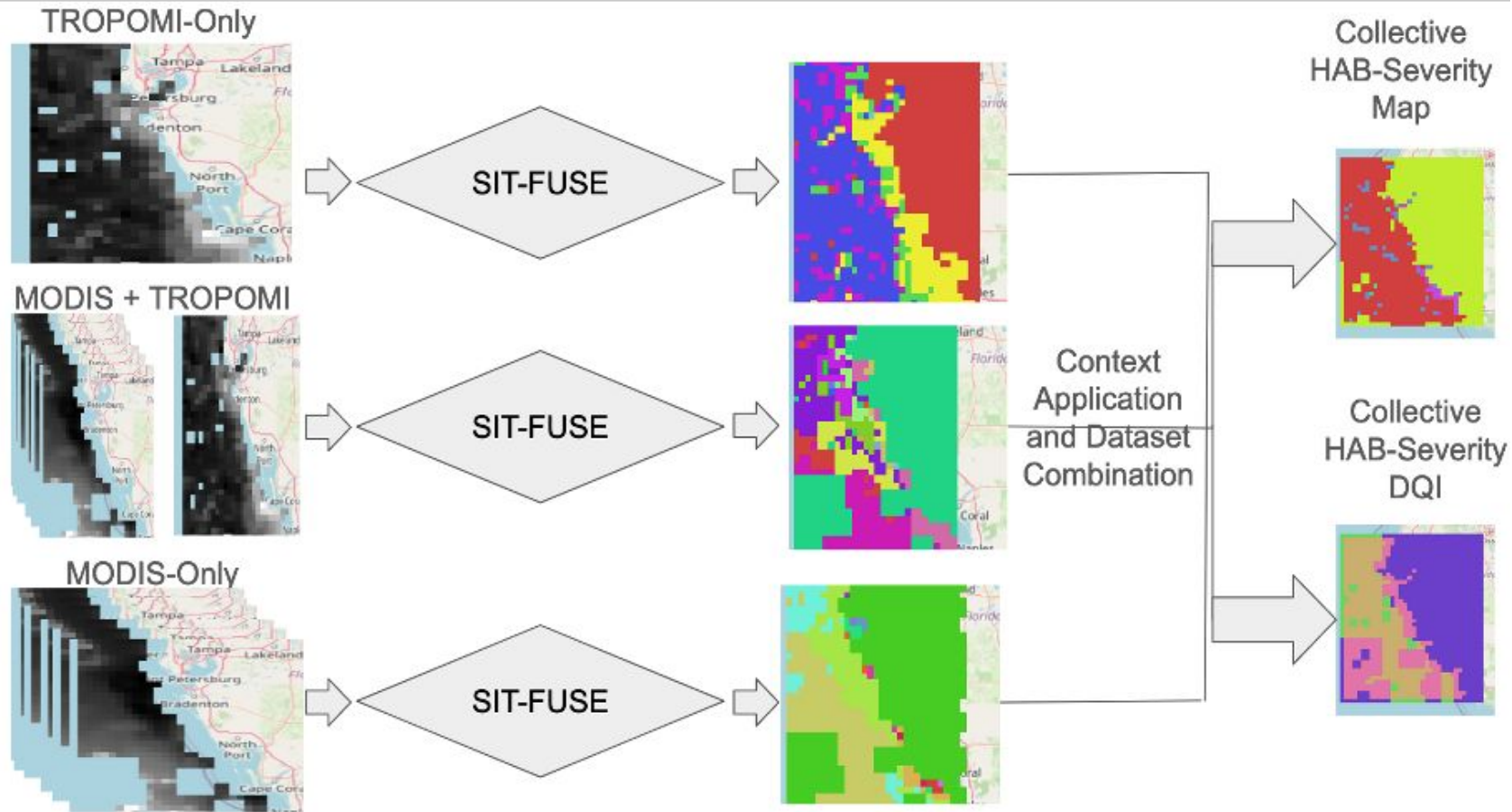


Red solar-induced fluorescence (SIF) can provide nearly double the amount of HAB information as conventional remote sensing methods for HAB monitoring

Luis et al. 2023

Harmful Algal Blooms – West Florida Shelf

Prototype ML Framework for HAB Severity Mapping



Adapted JPL's Segmentation, Instance Tracking, and data FUSion Using multi-SEnsor data (SIT-FUSE) software system to generate HAB severity maps for U.S. coastlines.

Gierach, Luis, LaHaye, et al