Center for Coastal Solutions at the University of Florida

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visit us: http://ccs.eng.ufl.edu
Coastal hazards are on the rise

South Florida Sun Sentinel, 4/4/21

Lake O discharges meeting ocean waters near the Sanibel Causeway

Source: [https://calusawaterkeeper.org/](https://calusawaterkeeper.org/) on Nov. 20, 2020
These biological events & other water quality hazards are unpredictable & increasing in frequency due to climate change and population growth.
Consequences of Coastal Water Quality Hazards:
Environmental, Health & Economic Degradation
Statewide, coastal dunes, oyster reefs, coral reefs, seagrass meadows, marshes, mangrove & maritime forests are in decline.
Health & Quality of Life

Gastrointestinal and respiratory illnesses from hazards are widespread. Longer-term effects on mental and physical health require further research.
A Weakened Economy

Negative impacts from: direct clean-up efforts, tourism revenue loss, damaged fisheries, rental income loss, real estate devaluation

RED TIDE
Empty beach over Labor Day weekend due to Red Tide in Sarasota 2018. (Getty)
Lots of data is being collected

Satellites: NOAA CoastWatch, others

Monitoring: FDEP, FWC, NERRs, local entities

Mote, USF, others operating gliders; FWC FWRI leading water sampling

Sanibel-Captiva Conservation Foundation’s RECON system
Major Investments in Database Development

**GCOOS**

- Total Number of Data Partners: 53
- Total Number of Regional Stations: 259
- Total Number of Federal Stations: 159
- Total Number of Sensors: 1613

**SECOORA**

- Centralized access to Southeast U.S. coastal and ocean data

**FDEP WIN, STORET, SEACAR**

- Statewide Ecosystem Assessment of Coastal and Aquatic Resources (SEACAR)

**FWC FWRI HAB & Wildlife Databases**

- FWC FWRI HAB & Wildlife Databases
Root Causes & Potential Solutions Remain Obscured

1. Coastal waterways are complex; interconnectivity affects conditions
2. Watershed/ocean data/models not sufficiently coupled to identify interactions
3. Data from different sensors not sufficiently integrated to resolve complexity
Can we ‘turn the tide’ and build a more proactive coastal hazard response paradigm?
Yes!

Stakeholders & databases are ready.

Transformational technologies are here.
Center for Coastal Solutions at University of Florida
Provide the State of Florida real-time intelligence critical to preventing and mitigating coastal water hazards
What will ‘real-time intelligence’ look like?
Our 5 to 10-year Vision

A Comprehensive Coastal Observing Network that generates 3 key products to support decision making:
(1) Real-Time, High Resolution 3-D Maps
(2) Accurate, Local Water Quality Forecasts
(3) Coastal Response Simulator
Real-time, High Resolution 3-D Maps

of hazards affecting waterways across the state.

Maps created by using Artificial Intelligence to integrate data from different sensors to optimize resolution of coastal water conditions

Allowing users to reliably visualize hazards everywhere in coastal waterways, all the time.
Accurate & Local Water Quality Forecasts

Reliable, local projections of where hazards will form and how they will change over time. Created by integrating watershed and ocean forces and validating with historic data.

Forecasts will support proactive decision making and coordinated disaster response.
Coastal Response Simulator

That allows users to explore the scale, location, timing, and sequence of different management actions, supporting data-driven decisions and measurable improvements in water quality.

Potential interventions:
- Nutrient load reductions
- Septic conversions
- Modify river discharge
- Oyster reef construction

Interventions “optimized” to achieve high returns on investment in improvement in water quality, economic activity, public health, etc.
Accelerating Solution Development by Harnessing the Ingenuity of Partners
Comprehensive Coastal Observing Network - Pilot

Blue-Green Algae
Red Tide (K. brevis)
Macroalgae Blooms
Hypoxia
Climate change

2021 building backbone of:
3-D Maps
Forecast
Support from: UF HWCOE & Private Donation
3-D Maps of Coastal Waters: Integrating satellite + in water sensors

Caloosahatchee River Plume Tracker:
Using AI to “Fuse” Data from Different Sources
Leaders: Paul Gader, Allen, Ron Fick, with the National Geospatial Agency SCCS
Summary: We are linking in-the-water and satellite sensors to monitor the location and movement of the river plume.

Identifying When & Where Hazards Form: Non-linear Time Series Analyses
Leaders: Miles Medina, Christine Angelini, Charlotte Harbor Aquatic Preserves, Coastal Heartland National Estuary Partnership, City of Cape Coral
Summary: Time series analyses to identify underlying drivers of water quality impairments in Charlotte Harbor sub-watersheds

Supporting the identification of nutrient loads that, if reduced, would achieve the greatest reductions in HAB incidence
Coastal Water Quality Forecasts

Stakeholder desire to have **local, beach-scale** predictions of red tide and other hazards
And, for a modeling system that **integrates nutrients and other drivers** into predictions

ROMS Ocean Grid for Caloosahatchee River Estuary

Maitane Olabarrieta  
Luming Shi
Coastal Water Quality Forecasts

ROMS Modeled Surface Water Density Anomaly (2021-01-18 – 2021-01-25)
We are working towards incorporating nutrients and phytoplankton (including *Karenia brevis*) into CompCON forecasting system, and aim for these forecasts to:

- Support clear, consistent communication among HAB-response stakeholders
- Create new insights about drivers of HABs in Charlotte Harbor, including land-ocean connections
Fate & Transport of Aerosolized Brevetoxins

Dr. Myoseon Jang, Karen Sem, Zechen Yu, Dr. H. Dail Laughinghouse

Key Findings:
- Night & morning Btx half-life: 1-1.5 hr
- Ave. wind speed in Tampa = 8.25mph
- Residents living within 8.25 miles from red tide sources exposed to at least 50% Btx levels.
- Next step: HAAR model

Team is working on proposals to quantify Btx affects on human respiratory health.
Applying CompCON Science to Policy

Coastal Policy Analyst:
Starting June ‘21 to work on policy supported by CompCON science to reduce incidence of coastal hazards. Will work in coordination with Florida Sea Grant Extension agents.

Coastal Policy Lab:
Course involving teams of science, engineering and law students to tackle a coastal hazards from a range of perspectives. Looking for opportunities to partner with local stakeholders on key topics.

Support for the development of science-based policies to prevent and mitigate HABs and their rippling impacts.
Red Tide Socio-Economic Impacts

Economic Impact Analysis Program:
Dr. Christa Court and her team conduct regional economic analyses for funded research projects, industry organizations, and government agencies.

Focus on Harmful Algal Blooms:
Several projects aimed at comprehensively quantifying and qualifying the socioeconomic impacts of the 2017-2019 *Karenia brevis* event in Florida. Preliminary results suggest significant and measurable impacts for:
- Peer-to-peer accommodations (e.g. Airbnb)
- For-hire/charter fishing and diving
- Marine recreation support

The project team is also investigating impacts on commercial fishing, recreational fishing activity, tourism, and property values.

Multi-institutional Team

Christa Court, UF/IFAS

Funding Sources
Why UF?

Uniquely positioned to leverage the brightest minds & most advanced technologies to improve Florida’s economic, human and environmental health.
Why UF?

Institutional Support
- > $1M invested in CCS, 4 new hires

Infrastructure
- $70M UF-NVIDIA AI Superpod & K-Grey training

World-Class Leadership & Expertise
- >50 Affiliate Faculty from Engineering, Medicine, Public Health, Law, Biology, Agricultural & Life Sciences

Public-Private Partnerships
Statewide Ed, Outreach & Workforce Training

POWERING THE NEW ENGINEER TO TRANSFORM THE FUTURE
Action Now, Positive Impacts Tomorrow

**Today**

REACTIONARY

- Coastal events arrive
  - No warning
  - Impact is unpredictable
- Economic Disruption
- Mitigation difficult, slow, costly
- Harmful to residents and tourism

**Tomorrow**

PREDICTIVE

- Early hazard prediction from data
- Impact/disruption is manageable
- Defined mitigation strategies deployed

**Future**

PROACTIVE

- Data and forecasts identify events early
- Coastal impacts proactively addressed
- Agencies, industry & academia are empowered and well-coordinated
- Florida’s ecology, economy and public health protected
Learn more about how to become a part of the solution: ccs.eng.ufl.edu