*i*COAST: A 21ˢᵗ Century Coastal Monitoring Network and Forecasting System

David Kaplan, Christine Angelini, Thomas Bianchi, John Bowden, Alberto Canestrelli, Nancy Denslow, Peter Ifju, Hugh Fan, Jeffrey Johnson, James Liao, Elise Morrison, Maitane Olabarrieta, Todd Osborne, Nikki Dix Pangle

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#ufwater2020

The Big Picture – Coastal Hazards + Vulnerability

- ~40% of world's population lives within 100 km of the coast (**vulnerability**)

- **Coastal human and environmental health <u>hazards</u>**: surge, sea level rise, saltwater intrusion, contaminants, pathogens, microplastics, invasive species...even aging infrastructure

- Vulnerability + Hazard → tremendous and rapidly growing **risk to coastal communities**
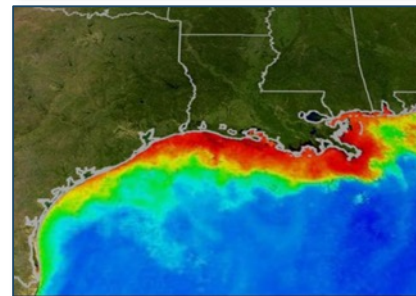
Florida *is* the Coast

- 8,436 miles of coastline; sub-tropical to temperate climates; urban to rural; rich to poor...

- 14.5 million Floridians live on coast

- Coastal population growth and land-use change: 3 to 30 times US average

- Florida's coastal economy ~$200 billion annually (tourism, ports, boating, fishing)

70% of Floridians live on/near the coast

90 million visitors/yr

Boating: $12 billion/yr

Saltwater fishing: $7.6 billion/yr

"Ground Zero" for Coastal Change

- Water quality & quantity challenges (nutrients, pathogens, saltwater intrusion)
- Sea-level rise, intensifying storms, drought
- Invasive species, overharvesting, habitat loss
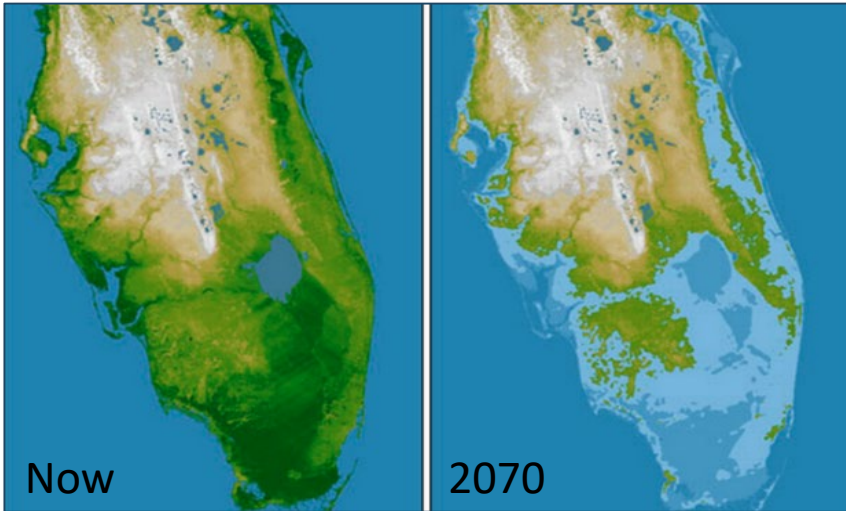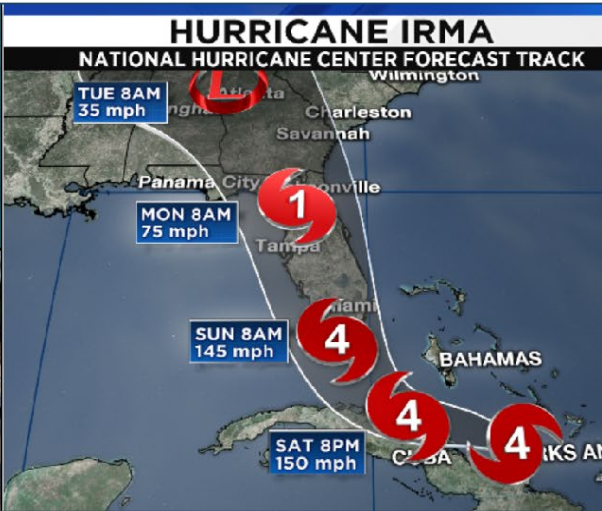
Economic and Public Health Consequences

- Economic/public health costs rapidly rising

- Red-tide occurring ~20-times more often, costing SW FL **$131.6M in 2018 alone**

- Fecal bacteria regularly closes beaches and shellfish harvest, causing illness

- Human/environmental exposure is high due to reactionary management of crises

How can we sustain public health, economic activity, and ecological quality in Florida?

UF Moonshot Initiatives

Fall 2018: UF Office of the Provost and Office of Research funded a competitive "moonshot" RFP for *multi-disciplinary* approaches to solving big problems

January 2019: UF *iCoast* moonshot launched ← pun intended

*i*COAST Team – Five UF Colleges/Units
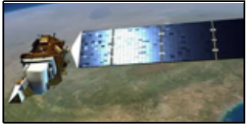
*i*COAST Mission

- Design a 21st century, multi-scale, multi-platform *sensing system* to rapidly detect and track coastal (water quality) hazards

- Develop advanced *forecasting system* to predict and mitigate coastal environments threats
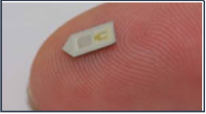
- Testbed: Matanzas River Estuary
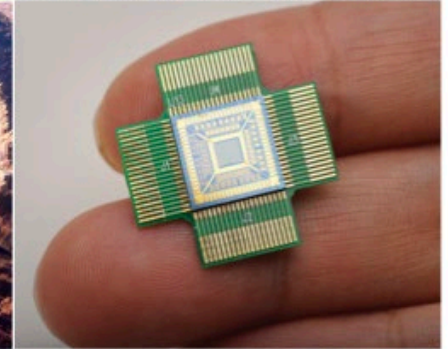
*i*COAST Vision

(1) Multi-scale sensing systems detect hazards
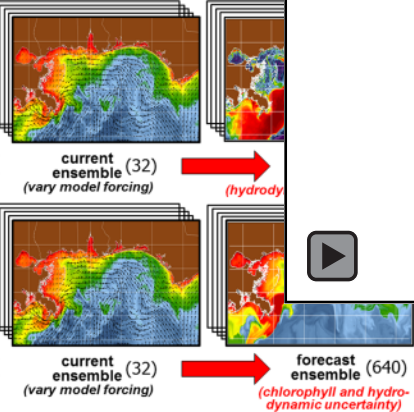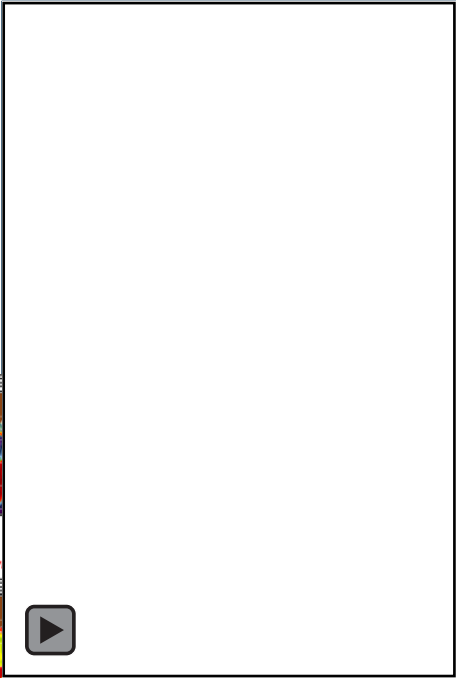
Intelligent sensing systems detect hazards, communicate via early warning systems
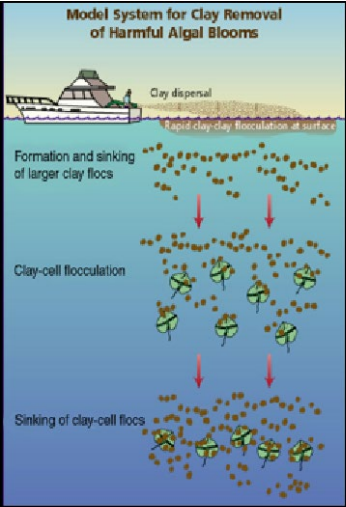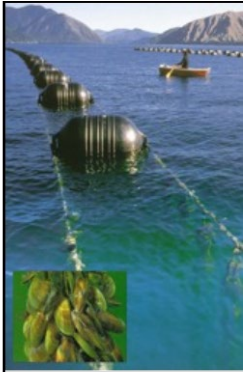
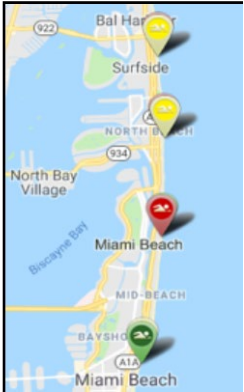## (2) "Cyber-physical" models forecast hazard

Forecast ensembles

High-resolution models forecast how hazards move through environment

(3) Activate Hazard Mitigation Strategies

Active intervention and communication with stakeholders

*i*COAST Testbed: Matanzas River Estuary

- **UF Whitney Lab for Marine Bioscience:** ideal platform for UF coastal research: dynamic coastline and diversity of land-water environments

- Fastest-growing county in FL; many opportunities to study and solve water quality changes

- St. Augustine heavily invested in climate-resilience

- Well-connected with city and state officials, natural resource managers and business leaders

THE WHITNEY LABORATORY
for MARINE BIOSCIENCE
UNIVERSITY OF FLORIDA

*i*COAST Testbed: Matanzas River Estuary

- **Guana-Tolomato-Matanzas Research Reserve** (GTM NERR): 1 of 29 NERRs around the country
- Collaboration between NOAA and FDEP
- Research, education sector, and stewardship sectors
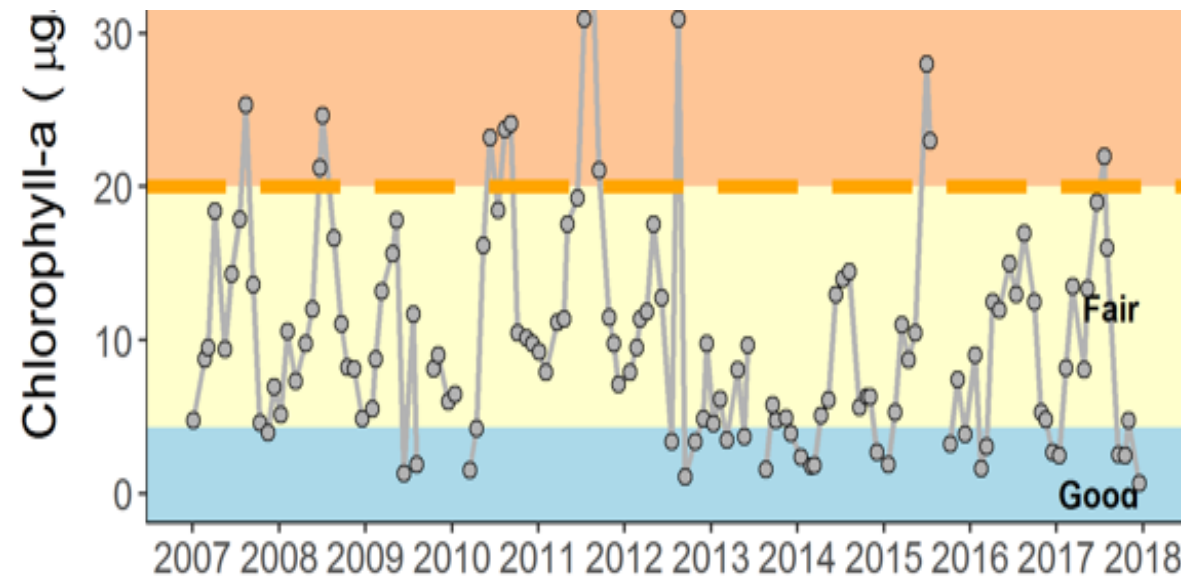
Goals: *i*Coast Sensing and Detection

What's is in the water?

1. Define **novel indicators** of human, environmental, and industrial contamination

2. Develop **microfluidic sensors** for rapid detection of waterborne diseases and pathogens

3. Engineer **new aerial platforms** for rapid, reliable, adaptive water sampling

4. Integrate **diverse data streams** (e.g., video-based) & analyses into monitoring systems

Faculty: *Christine Angelini, Thomas Bianchi, John Bowden, Nancy Denslow, Hugh Fan, Peter Ifju, Elise Morrison, Todd Osborne*

Snapshot: *i*Coast Sensing and Detection
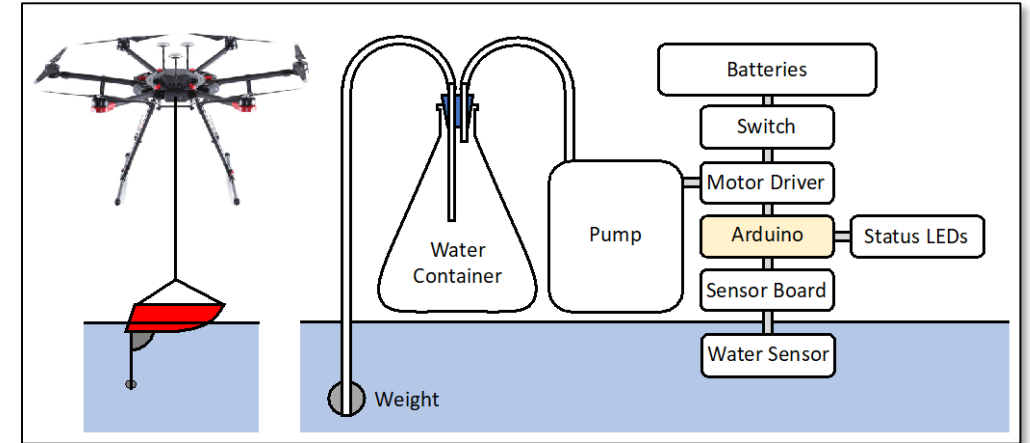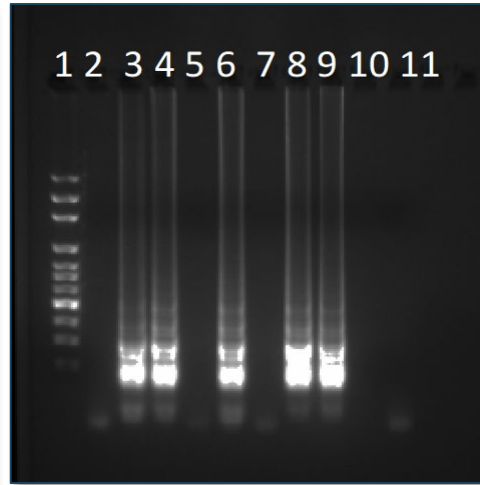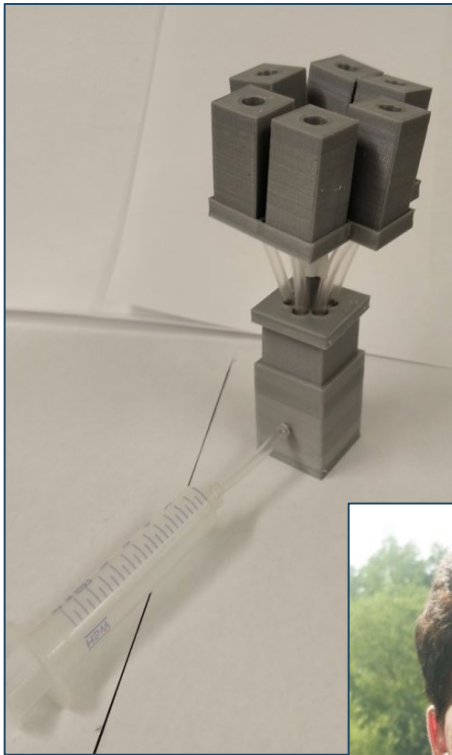
*i*Coast Video-Monitoring System

Lauren Brisley, Meg Palmsten, Joe Calantoni, Alex Sheremet, Christine Angelini

Snapshot: *i*Coast Sensing and Detection

*i*Coast E. coli Chip and Drone Prototypes

Hugh Fan, Carlos Manzanas, Peter Ifju+

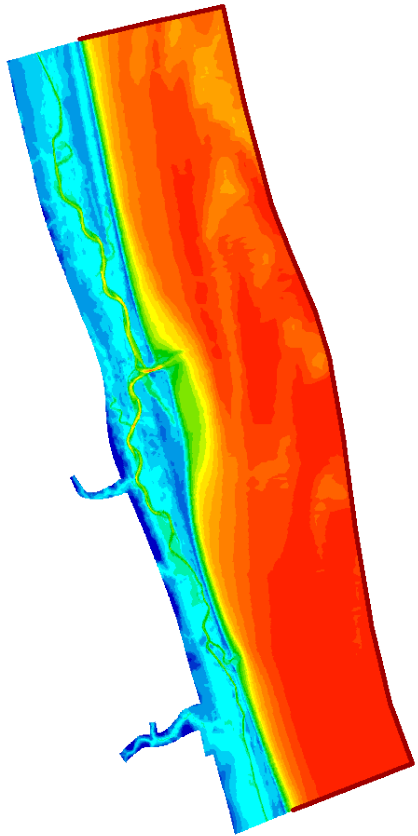# Goals: *i*Coast Forecasting System

Where are pollutants going?

1. Build **hydrodynamic models** to simulate tides, surge, salinity, oxygen, and pathogen transport in the St. Augustine-Marineland estuary

2. Design **forecasting system** that integrates multiple data streams: weather, hydrodynamics and water quality data, and climate

3. Future: **replicate forecasting system** across Florida and other coasts

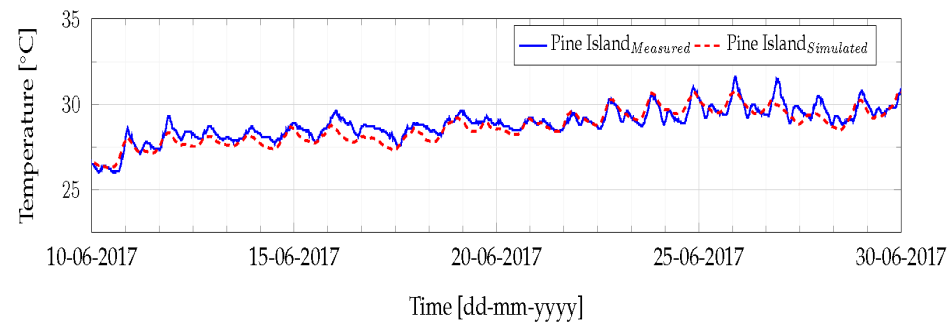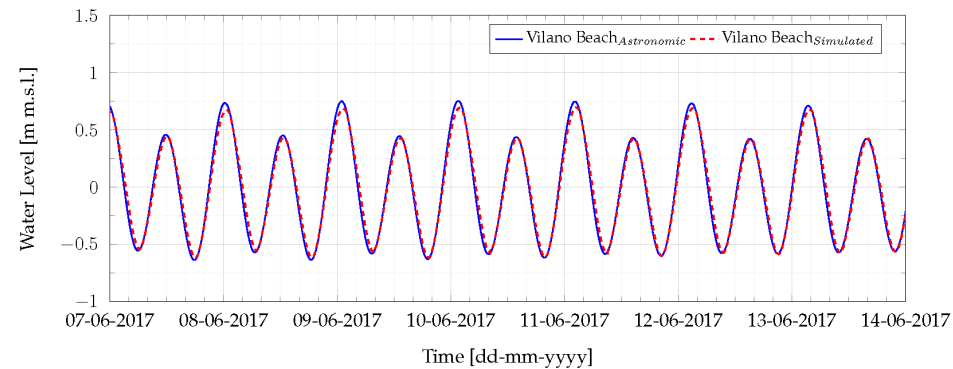**Faculty**: *Alberto Canestrelli, David Kaplan, Maitane Olabarrieta*

Snapshot: *i*Coast Forecasting

Numerical Modeling

Hydrodynamic and Water Quality Calibration

Leveraging *i*COAST Momentum
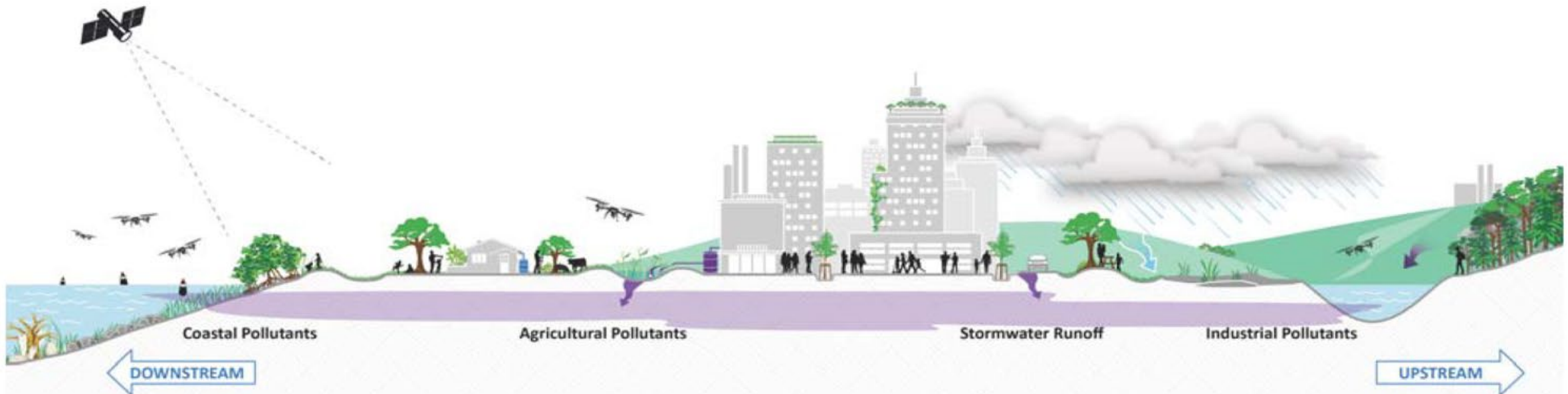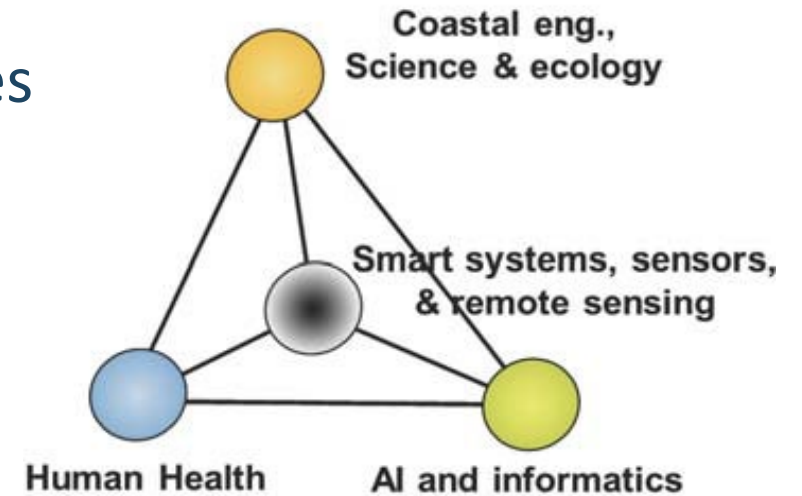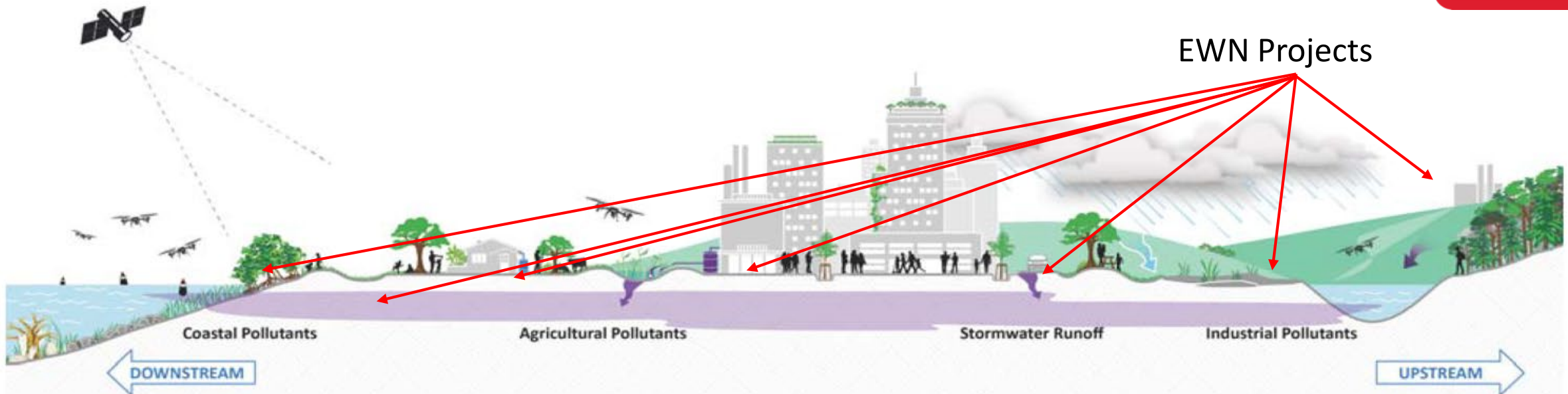
Leveraging *i*Coast: NSF ERC Proposal

- **Goal**: reduce water quality risk to coastal communities
- Developing university, industry and Federal lab partnerships to enhance research capacity
- Expanding workforce training capacity

Leveraging *i*Coast: Natural Infrastructure Research Lab

- Arrays of **"Engineering with Nature" (EWN)** projects spanning from headwaters to the coast
- **Transdisciplinary, cross-agency research**, public education, workforce development, and technology transfer

EWN Projects

Coastal Pollutants

Agricultural Pollutants

Stormwater Runoff

Industrial Pollutants

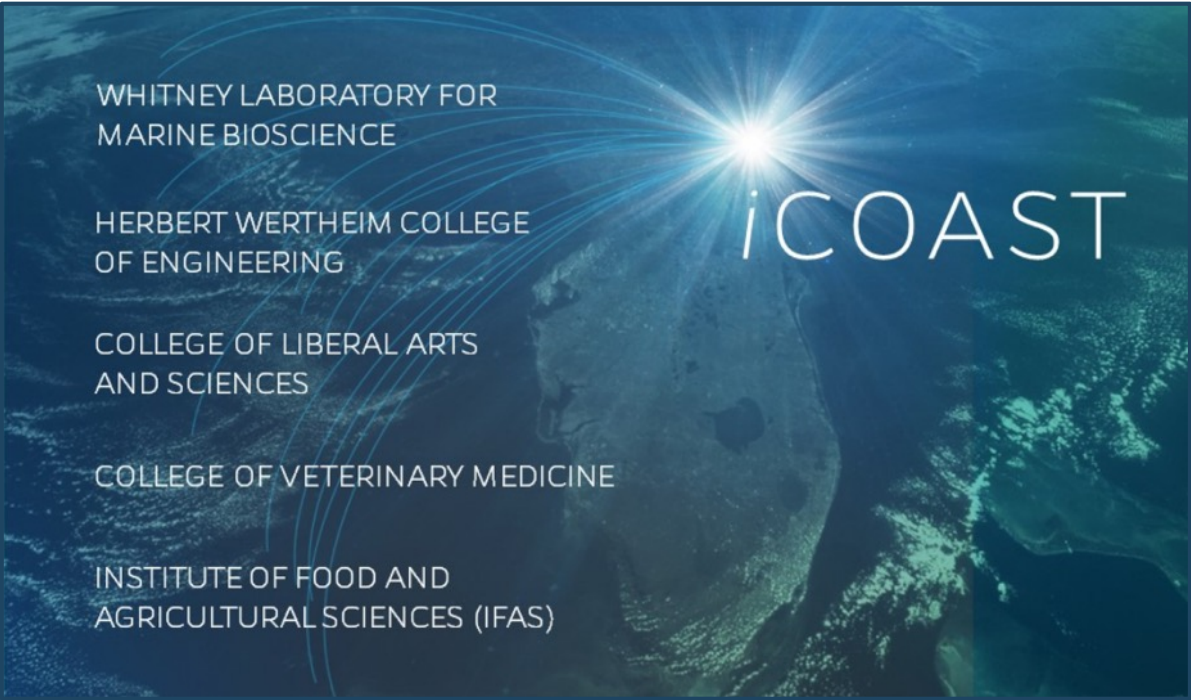DOWNSTREAM

UPSTREAM

Leveraging *i*Coast: External Funding

- **Federal**: $133K secured; $4.6M pending…
- **State**: $40K secured; $240K pending
- **Private**: $330K secured, $6.2M pending
- <u>**Total:**</u>   **$503K secured; $11M pending**

The Magic Ingredient…

Thank you! Questions?

https://icoast.program.ufl.edu
David Kaplan (dkaplan@ufl.edu)
Engineering School of Sustainable Infrastructure and Environment