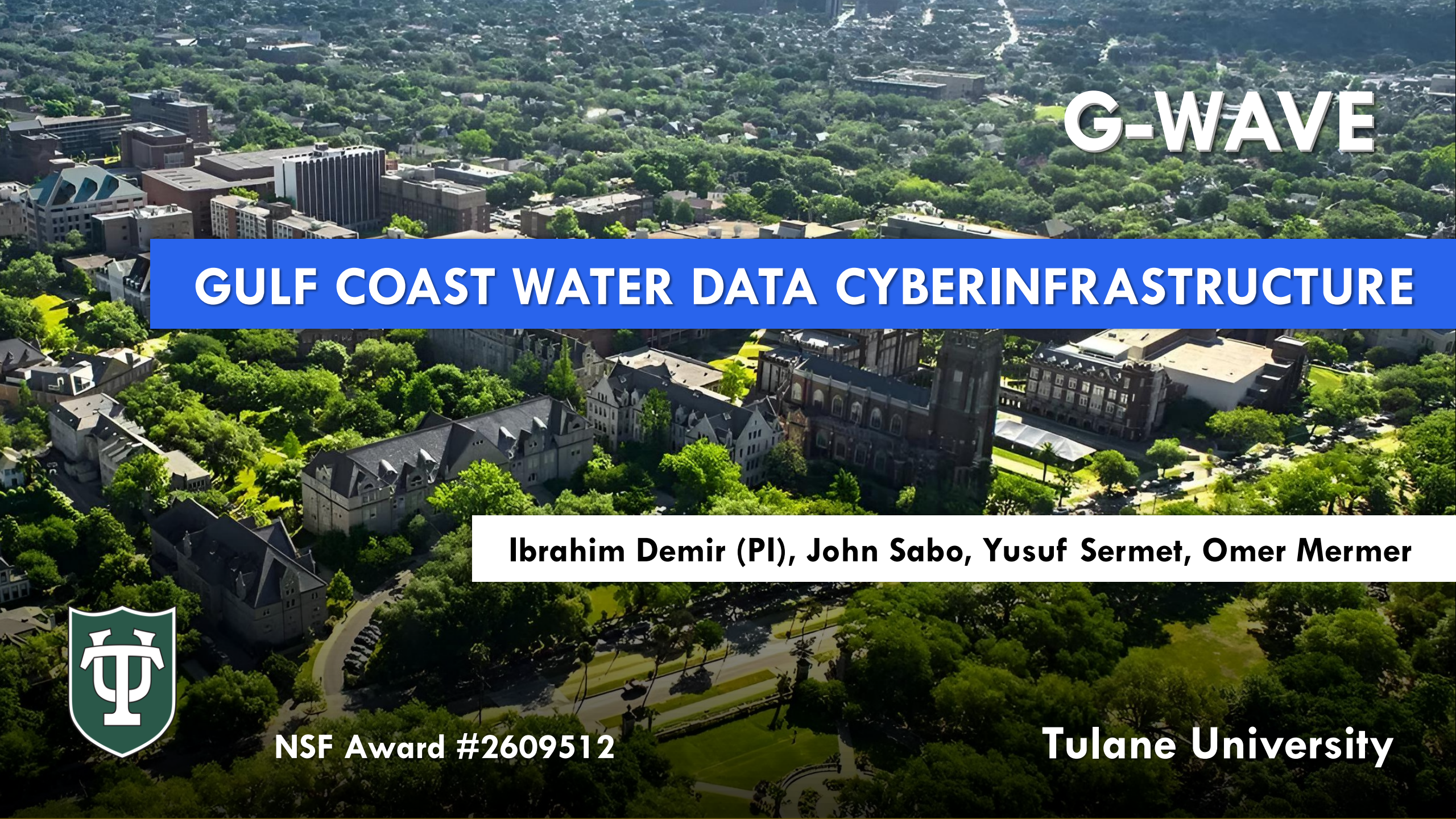


G-WAVE

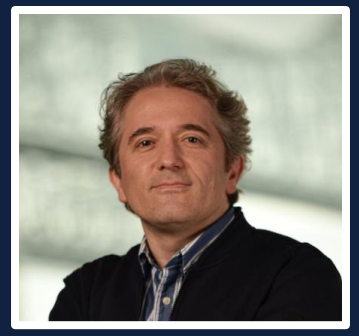
GULF COAST WATER DATA CYBERINFRASTRUCTURE

Ibrahim Demir (PI), John Sabo, Yusuf Sermet, Omer Mermer

NSF Award #2609512

Tulane University

Project Team



PI: Demir

Cyberinfrastructure, AI, and Hydroinformatics

Co-PI: Sabo

Hydrology & Coastal Engineering

Co-PI: Sermet

AI & Data Science, Cyberinfrastructure

Co-PI: Mermer

Data Engineering & Machine Learning

The Gulf Coast Challenge

Compounding Hazards

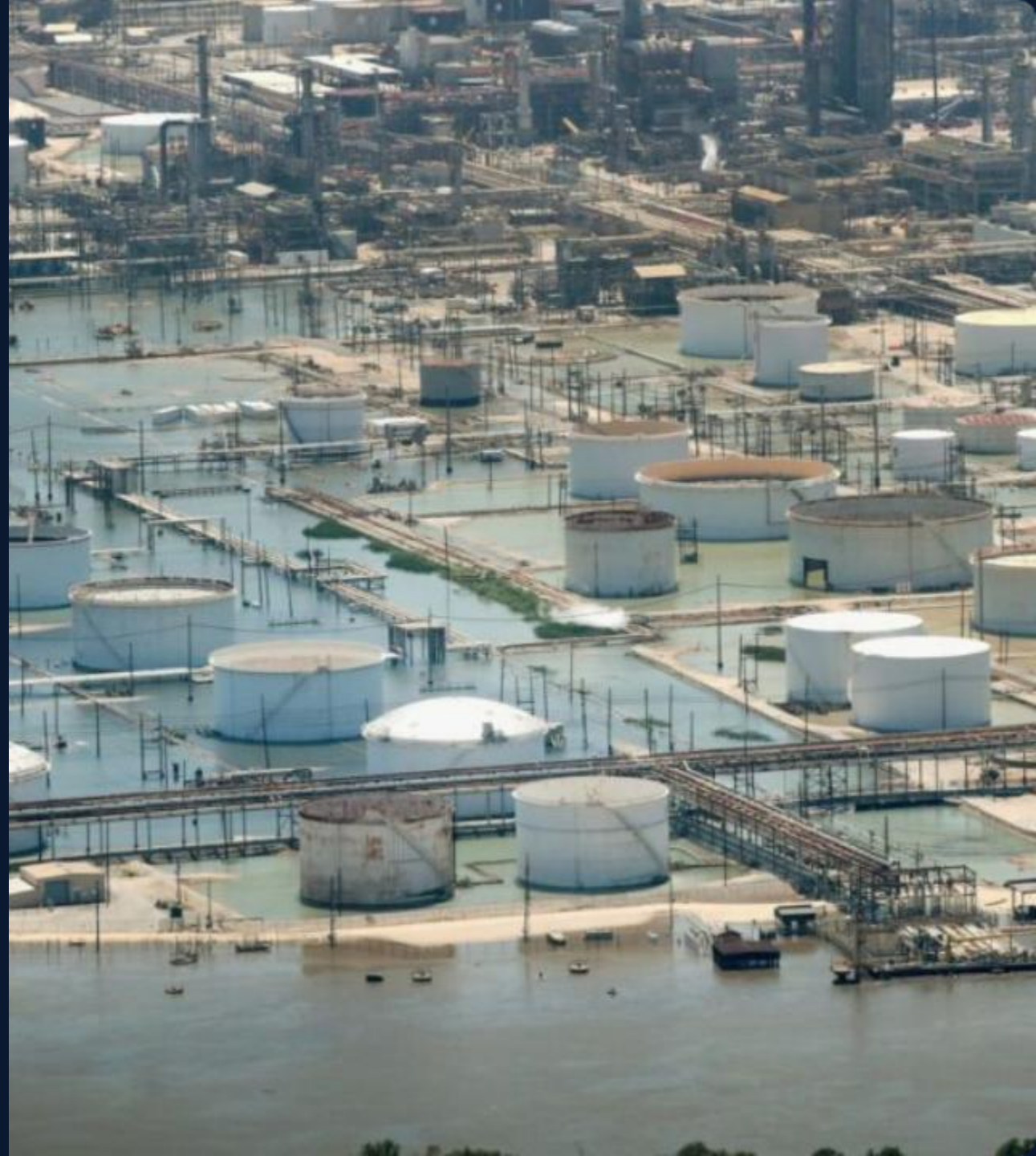
The U.S. Gulf Coast faces recurrent hurricanes, intense rainfall, storm surge, and sea-level rise.

Cascading Impacts

These hazards trigger cross-sector disruptions across energy supply chains, transportation systems, and healthcare networks.

Fragmented Data

Critical data remains siloed across federal, state, and local agencies without an interoperable, AI-ready cyberinfrastructure.



G-WAVE Vision

Current Limitations

Data environments supporting hazard monitoring and forecasting rely heavily on ad-hoc pipelines.

Heterogeneous radar, sensor, and model data lack interoperability, making it exceedingly difficult to scale, reproduce, or transfer analytical workflows.

This restricts systematic scenario exploration across interdependent systems.

Integrated Future State

A transdisciplinary, AI-enabled water data cyberinfrastructure tailored for the Gulf Coast testbed.

Provides a unified backbone supporting the entire scientific data lifecycle, empowering complex "what-if" analyses.

Fuses high-performance computing, predictive modeling, and intelligent agents into an operational framework.

G-WAVE Core Technological Pillars

Gulf Digital Twin

A dynamic, shared virtual environment syncing real-time data and physical models for continuous, interactive scenario testing and decision-support.

AI Agents

Operational intelligence driven by large language models, serving as the primary user interface to execute complex, natural-language cross-sector queries.

Predictive AI

Leveraging physics-informed neural networks and hybrid ML surrogates to drastically accelerate complex hydrodynamic and environmental modeling.

Planning Objectives

- **Elicit Cross-Sector Requirements:** Engage researchers, agencies, and community leaders across five states to identify critical workflows and data gaps.
- **Assess Data Landscapes:** Evaluate the maturity of existing regional platforms and identify scalable components for a production-quality environment.
- **Design Technical Architecture:** Formulate integration patterns for the three core AI pillars through focused, transdisciplinary design sprints.
- **Develop Governance Framework:** Establish charters, tiered access models, and sustainable funding strategies to support long-term operations.
- **Roadmap to Category II:** Synthesize findings into a competitive, actionable implementation plan for a state and regional-scale IDSS facility.

Stakeholders in LA

Public & Private Universities

- Tulane University
- Louisiana State University (LSU)
- University of New Orleans (UNO)
- University of Louisiana at Lafayette
- Southern University and A&M College
- Xavier University of Louisiana
- Dillard University
- Nicholls State University
- McNeese State University
- Louisiana Tech University
- University of Louisiana at Monroe

NGO, Foundations & Research Institutes

- The Water Institute
- Coalition to Restore Coastal Louisiana (CRCL)
- Pontchartrain Conservancy
- Center for Planning Excellence (CPEX)
- Foundation for Louisiana
- Greater New Orleans, Inc. (GNO, Inc.)
- Gulf of Mexico Alliance (GOMA)
- Restore the Mississippi River Delta Coalition

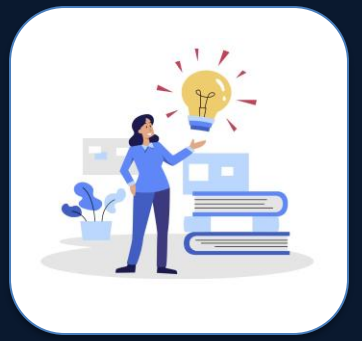
State Agencies & Regional Authorities

- Coastal Protection and Restoration Authority (CPRA)
- Department of Energy and Natural Resources (DENR)
- Louisiana Watershed Initiative (LWI) / Office of Community Development (OCD)
- Department of Transportation and Development (DOTD)
- Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP)
- Department of Environmental Quality (LDEQ)
- Department of Health – Office of Public Health (LDH)
- Department of Wildlife and Fisheries (LDWF)
- Department of Agriculture and Forestry (LDAF)
- Office of the Chief Resilience Officer (Office of the Governor)
- Southeast Louisiana Flood Protection Authority–East & West (SLFPA-E / SLFPA-W)
- Pontchartrain Levee District
- Lafourche Basin Levee District
- Terrebonne Levee and Conservation District

Private Companies & Critical Infrastructure Operators

- Entergy Louisiana / Entergy New Orleans
- Greater Lafourche Port Commission (Port Fourchon)
- Greater Baton Rouge Port Commission
- Royal Engineers & Consultants
- Port of New Orleans (Port NOLA)
- Port of South Louisiana
- Port of Lake Charles
- Cleco Power
- ExxonMobil
- Chevron
- Shell US
- Cheniere Energy
- Arcadis
- Stantec
- Moffatt & Nichol
- HDR Engineering
- Fenstermaker
- GIS Engineering
- DXC Technology
- IBM Services

Activities: Discovery



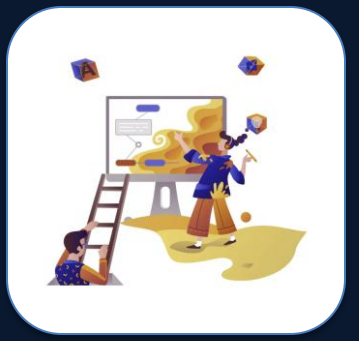
WP1: Stakeholder Requirements

Execute comprehensive stakeholder mapping and conduct interactive, scenario-based regional workshops to formalize cross-sector use cases.

WP2: Data Landscape Assessment

Compile a standardized registry of datasets and tools, evaluating interoperability and integration readiness of existing Gulf pilots.

Activities: Design



WP3: Technical Architecture

Run rigorous design sprints to develop conceptual blueprints covering data ingestion, analytics, and interaction layers.

Define end-to-end reference workflows that integrate physics-informed AI and agentic tools with existing NSF compute resources.

WP4: Governance & Access

Establish a formalized governance charter defining institutional roles, scientific advisory structures, and change management.

Outline sustainable operations through diversified partnerships, fee-for-service models, and tiered data security protocols.

G-WAVE Timeline

Q1 - Q2

Requirements Elicitation & Landscape Assessment via Gulf-wide workshops.

Q3 - Q4

Architecture Design Sprints and definition of core reference workflows.

Q5 - Q6

Development of Governance, Tiered Access, and Sustainability blueprints.

Q7 - Q8

Roadmap Synthesis, external validation, and Category II proposal generation.

Broader Impacts

Disaster Resilience

Addresses critical vulnerabilities in the Gulf Coast by mitigating cascading disaster risks across interdependent infrastructure chains.

Democratized Access

Lowers barriers to complex hydrological data through natural-language AI interfaces, empowering emergency managers and local leaders.

Workforce Development

Trains the next generation of STEM professionals in transdisciplinary fields merging AI, data science, and environmental engineering.

Questions

IBRAHIM DEMIR

idemir@tulane.edu

Hydroinformatics Lab

https://hydroinformatics.tulane.edu

ByWater Institute
TULANE UNIVERSITY