

Graduate Studies

Environmental Fluid Mechanics and Water Resources Engineering

ENVIRONMENTAL FLUID MECHANICS & WATER RESOURCES (EFMWR) at the Georgia Institute of Technology focuses on water, atmosphere, and land systems, with emphasis on the science and engineering applications of hydroclimatology, environmental transport processes and integrated resource management. The program mission is to educate scientists and engineers through well integrated and stimulating courses; create new knowledge through innovative experimental, computational, and modeling research; and develop new technologies and tools that benefit engineering practice in fluid mechanics, hydraulics, hydrology, hydroclimatology, and water resources.

RESEARCH AREAS

Research is concentrated in three distinct areas and is supported by federal, state, and international agencies including the National Science Foundation, Georgia Department of Transportation, United States Agency of International Development, National Oceanic and Atmospheric Administration, Environmental Protection Agency, United States Geological Survey, Office of Naval Research, and World Bank.

Hydroclimatology and Water Resources research focuses on terrestrial and atmospheric water/energy processes and fluxes; vegetation dynamics and decision support systems promoting holistic, equitable, and sustainable use of water resources. Projects include:

- Remote sensing of hydrologic variables
- Coupling of atmospheric, surface, and subsurface models
- Flood/drought forecasting and management
- Decision support systems for water resources assessment, planning, and operation
- Climate change research and impact assessments

Environmental Fluid Mechanics and Hydraulic Engineering research focuses on turbulent entrainment, transport, and mixing processes in natural and engineered environments. Projects include:

- Sediment transport and bridge scour
- Wastewater dispersion in coastal waters
- Cohesive sediment resuspension
- Flood hydraulics and river restoration
- Biological and ecological flows
- Hyporheic exchange in streams
- Hydrodynamics in UV and ozone reactors

Coastal Engineering research is primarily conducted through the Georgia Tech Regional Engineering Program (GTREP) in Savannah, Georgia. Projects include:

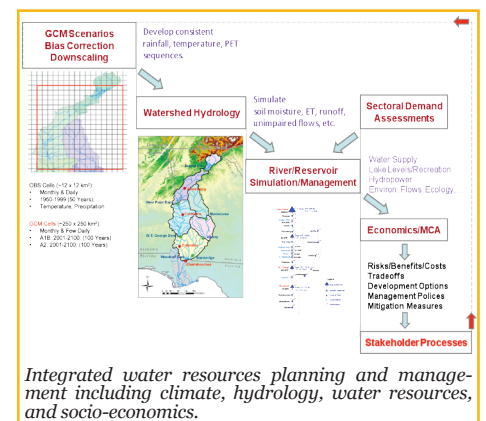
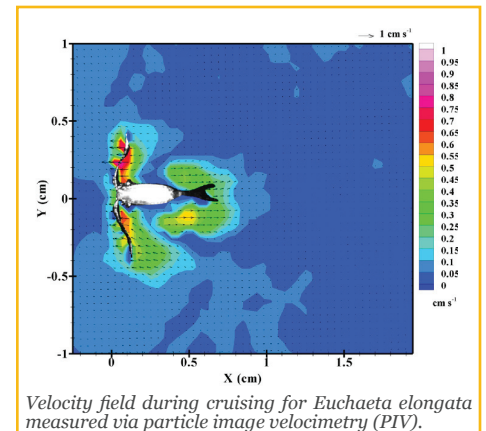
- Water waves generated by winds, landslide, avalanche, or earthquake
- Dredging for navigation or sand supply
- Circulation and transport in estuaries, rivers, and lakes
- Coastal current modeling
- Beach erosion

FACILITIES

Research and teaching are supported by state of the art experimental, computational, and data acquisition facilities. The Environmental Fluid Mechanics Laboratory includes a large constant-head tank, a 4.3-m wide sediment scour flume, a 24-m long tilting flume, a recirculating flume for cohesive sediment resuspension, a recirculating saltwater flume, a density-stratified towing tank, and a 24-m long wave tank. Each of the flumes is also equipped with cutting-edge instrumentation.

GRADUATE COURSES

- Physical Hydrology
- Probability and Statistics for Civil & Environmental Engineers
- Water Resources Management
- Intermediate Fluid Mechanics
- Advanced Fluid Mechanics
- Environmental Fluid Mechanics
- Advanced Environmental Fluid Mechanics
- Fluid Mechanics of Organisms
- Open Channel Hydraulics
- Sediment Transport
- Computational Fluid Mechanics
- Hydrodynamic Stability and Turbulence
- Linear Wave Theory
- Coastal Geology and Sediment Transport
- Introduction to Coastal Engineering
- Coastal Engineering Measurements
- Coastal Structures
- Coastal Hydrodynamics
- Nonlinear Wave Theory
- Convective Transport
- Hydroclimatology
- Flow through Porous Material



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FACULTY

Aris Georgakakos, Ph.D.
**Professor, EFMWR Group Leader
and Director of GWRI**

Remote sensing of hydrologic variables; flood and drought management; hydrothermal scheduling; agricultural planning; decision support systems for river basin planning, management, and climate change impact assessments.

**Rafael Bras, Sc.D., K. Harrison Brown Chair
Professor, Provost and Executive Vice President
for Academic Affairs**

Biophysical processes (radiation, heat fluxes, and evapotranspiration); hydrological processes; biochemical processes and vegetation dynamics; as well as complex and self-organizing systems.

**Francesco Fedele, Ph.D.,
Assistant Professor**

Nonlinear water waves; rogue waves; oceanic turbulence; probability & statistics of nonlinear random wave fields; image processing for coastal and ocean engineering; compressive sensing via active surfaces.

**Hermann Fritz, Ph.D.,
Associate Professor**

Coastal hazards; tsunamis and hurricane storm surges; subaerial and submarine landslides; hydropower and marine renewable energy; hydraulic and coastal structures; laser measurement techniques; numerical simulation of multiphase flows; natural hazard mitigation and risk analysis.

Kevin Haas, Ph.D., Associate Professor

Coastal engineering; numerical modeling of nearshore circulation; sediment transport in coastal regions; hydrodynamics of rip current systems; morphodynamic evolution; sediment and contaminant transport in tidal marshes; extracting energy from waves and currents.

Jian Luo, Ph.D., Assistant Professor

Groundwater contamination and remediation; reactive transport in porous and fractured media, water resources management and policy; stochastic hydrogeology; geostatistics; linear and nonlinear systems; inverse modeling.

Phil Roberts, Ph.D., P.E., Professor

Environmental fluid mechanics, mixing and dynamics of rivers, lakes, coastal waters, and estuaries; outfalls for wastewater discharge; mathematical models of wastewater fate and transport; oceanographic field programs and data interpretation.

**Thorsten Stoesser, Ph.D.,
Assistant Professor**

Computational fluid dynamics; turbulence modeling; environmental turbulence; flood protection; river restoration; hydraulic structures; hydrodynamics in water treatment and storage; and hydropower.

Terry Sturm, Ph.D., P.E., Professor

Hydraulic engineering; open channel flow resistance; compound channel hydraulics; sediment transport; scour around bridge abutments; cohesive sediment re-suspension.

**Jinfeng Wang, Sc.D.,
Principal Research Scientist**

Evapotranspiration; remote sensing of hydroclimatic variables; stochastic processes in hydroclimatology.

Donald Webster, Ph.D., P.E., Professor

Fluid mechanics; turbulence; turbulent and chaotic mixing; biological, ecological, and environmental flow applications; experimental methods.

**Paul Work, Ph.D., P.E.,
Associate Professor**

Coastal engineering; water waves, sediment and contaminant transport; beach nourishment; ports and harbors; coastal and riverine flooding; and various other applications of environmental fluid mechanics. Projects often combine field observations and numerical modeling tools.

**Huaming Yao, Ph.D.,
Principal Research Engineer**

Hydropower and river basin management; information and decision support systems for water resources; and dynamic optimization methods.



Green and purple dye released in a feeder channel, converging and moving offshore in a rip current. This research was part of a field campaign to measure the pressure-gradient force and the resulting flows within a rip current system off of Moreton Island, Australia.

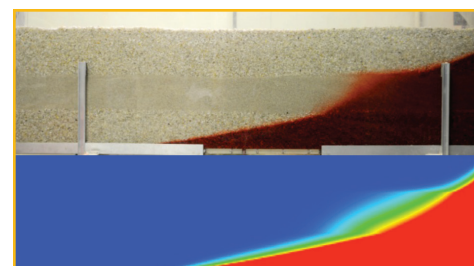
CONTINUING EDUCATION CLASSES

Offered through the Georgia Water Resources Institute (GWRI) at: <http://www.gtri.org>.

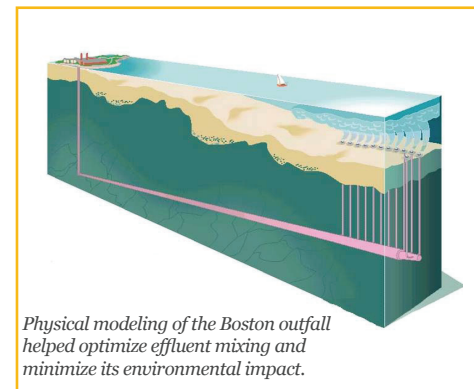
- Hydrologic Engineering for Dam Design
- River Hydraulics and Bridge Scour using HEC-RAS
- Decision Support for River Basin Planning and Management
- Water Quality Models for Lakes and Rivers
- Culvert Hydraulics
- GIS and Database Development for Environmental Applications

INTERNATIONAL EDUCATION INITIATIVES

The Georgia Water Resources Institute (GWRI) and the EFM&WR program at Georgia Tech have recently partnered with the University of Pretoria Water Institute in South Africa to offer a new joint Master's program on integrated water resources planning and management. This comprehensive program is conducted at the University of Pretoria (UP) campus and includes graduate courses jointly taught by GT and UP faculty and the completion of a Master's thesis. Contact Dr. Aris Georgakakos (aris.georgakakos@ce.gatech.edu) for additional information about this program.



Experimental and numerical modeling of freshwater seawater interface in a multi-layered aquifer.



Physical modeling of the Boston outfall helped optimize effluent mixing and minimize its environmental impact.