Research and Educational Benefits of Institutional Real-Time Weather Modeling


Center for Ocean Observing Leadership
Department of Marine and Coastal Sciences
School of Environmental and Biological Sciences
RU-COOL Overview

• Founded as the Coastal Ocean Observation Lab in 1992 by Scott Glenn & Oscar Schofield
• 4 tenure-track faculty (including the founders)
• 2 research/extension faculty
• 2 PhD-level research directors
• 1 post-doc, 7 graduate students
• 18 FT research and operations staff
• Numerous undergraduate students (10+ presently)
Robotic Underwater Gliders have Evolved Rapidly

1989
Science Fiction Article

1999
First Slocum deployed at Sea

2009
First Glider crosses an Ocean Basin
Mid-Atlantic Regional Drivers

Ocean Circulation

Tropical Storms

Climate Change

Critical Habitat

Population

Nor'easters

Ports

Rutgers Center for Ocean Observing Leadership
MARACOOS Regional Themes

1) Maritime Operations – Safety at Sea

2) Ecosystem Decision Support - Fisheries

3) Water Quality – a) Floatables, b) Hypoxia, c) Nutrients

4) Coastal Inundation - Flooding

5) Energy – Offshore Wind
Mid-Atlantic Regional-Scale Observation Network

Mid-Atlantic Bight Glider Network
- Missions: 406
- Distance: 170,000 km
- Days at Sea: 9000
- RU01, RU15, RU29
- Satellite Ocean Color
- Satellite SST
- Subsurface Glider Data
- Industry Partner: Teledyne Webb Research

Mid-Atlantic Bight HF Radar Network
- 16 Long-Range CODARs
- 8 Medium-Range CODARs
- 17 Short-Range CODARs
- 41 Total
- Triple Nested, Multi-static, Multi-use
- Industry Partner: CODAR Ocean Sensors

Northeast U.S. Real-Time Satellite Ground Stations
- Satellites: NOAA Polar Orbiters, NPP, Terra, Aqua, Metop & GOES
- U. Maine
- City College of N.Y.
- Rutgers
- Johns Hopkins
- U. Delaware
- Industry Partner: SeaSpace

Mid-Atlantic Bight Weather Network
- NDBC Backbone
- > 50 sites
- Regional Industry Enhancement
- > 100 sites
- WeatherFlow Station
- Hurricane Network Station
- Tuckerton, NJ

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Coastal Met-Ocean Monitoring Station

- Located at the RU Marine Field Station in Tuckerton, NJ
- 12 m meteorological tower
- Triton SODAR
- Lockheed WindTracer scanning lidar (coming soon)
Regional Ocean Data Products

Satellites

HF radar

Gliders

Fixed Platforms

Assimilated by an Ensemble of Ocean Models

STPS
U. Connecticut

NYHOPS
Steves Institute of Technology

ROMS
Rutgers University

HOPS
U. Massachusetts, Dartmouth

Connections to the Atmosphere

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Real-Time Weather Modeling

- Run Continuously 2011 – Present
- Triple nested: 9km-3km-1km
  - 9km: 0, 6, 12, 18Z cycles
  - 3km: 0, 12Z cycles
  - 1km: 0Z cycle (Research Mode)
- Hourly forecast:
  - 9km: out 5 days
  - 3km: out 2 days
  - 1km: out 1 days
- Lateral Boundary Conditions:
  - 9km: 0.25 degree Global Forecast System
  - 3km: RU-WRF 9km
  - 1km: RU-WRF 3km
- Vertical Levels:
  - 40 levels more tightly packed near the surface.
- Surface Boundary Condition:
  - RU Coldest Pixel Composite
RU-WRF Research

Hurricanes

Warm Ocean
Cat I Hurr

Cold Ocean
Trop Storm

Irene: Aug 2011

Wind Energy

Histogram of 120m Winds at N2 for the Period 7/1 to 10/1/2017

Total Energy by Wind Speed at N2 for the Period 7/1 to 10/1/2017
Ocean Observatories Research Course -
Team-Based Research Projects

**Course Mechanics:**
1) Marine Science Major requires 6 credits of Research.
2) Ocean Observatories course is 1.5 credits – one 80-minute class period per week.
3) Students can sign up multiple times.

**What we (the teachers) do:**
1) Mentorship Model – Cognitive Apprenticeship – Experiential
   Watch One -> Do One -> Teach One
   (Observer -> Worker -> Mentor)
2) Grand Challenges can only be achieved through sustained teamwork – research now bridges semesters and summers.
3) We do not fear failure – Undergraduate Education is a time for exploration and risk-taking.

**What the students do:**
1) Divide into research teams led by a mentor (teach one), and consisting of a few workers (do one) and a few observers (watch one).
2) Propose and conduct a team research project based on ocean observatory data.
3) Communicate results through blogs and presentations.
Expanding Modeling Experience

• Working to bridge the gap between ocean and atmosphere
• Understanding of how operational models are run and processed can help with better understanding of operational oceanography
• Bringing in students in Rutgers’ meteorology program for internships and other hands-on experience
Masters in Operational Oceanography

Training a workforce – Based on lessons learned:
• Residency in an operational ocean observatory – build community through grand challenges
• Work together as a team to operate new observing technologies in frontier areas
• Curate the data flow from collection to use in forecasts that inform decision makers
• Senior students mentor junior students

Masters Program (Lecture and Research Credits)
• Introductory Classes, Physical Oceanography and Biological Oceanography (from Undergrad)
• Software Bootcamp (Analysis Tools, Common File Formats, and QA/QC)
• Integrated Ocean Observing (Platforms and Sensors)
• Ocean Observing Field Lab (hands-on opportunities within an operating ocean observatory)
• Ocean Observing Cyber Lab (data analysis techniques, model operation and validation)
• Thesis – (conference presentation/paper, mentor new students, contribute to shared software)
Contact Us

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Questions?