Research and Educational Benefits of Institutional Real-Time Weather Modeling

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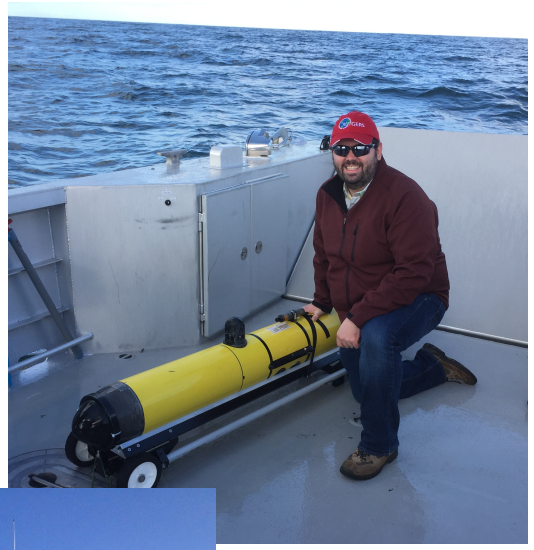
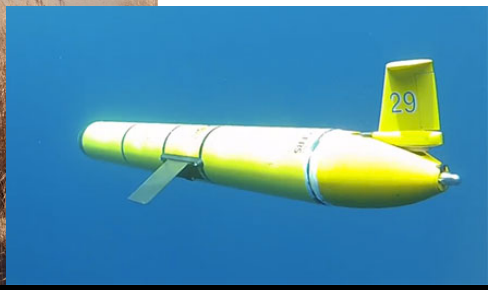
Center for Ocean Observing Leadership
Department of Marine and Coastal Sciences
School of Environmental and Biological Sciences

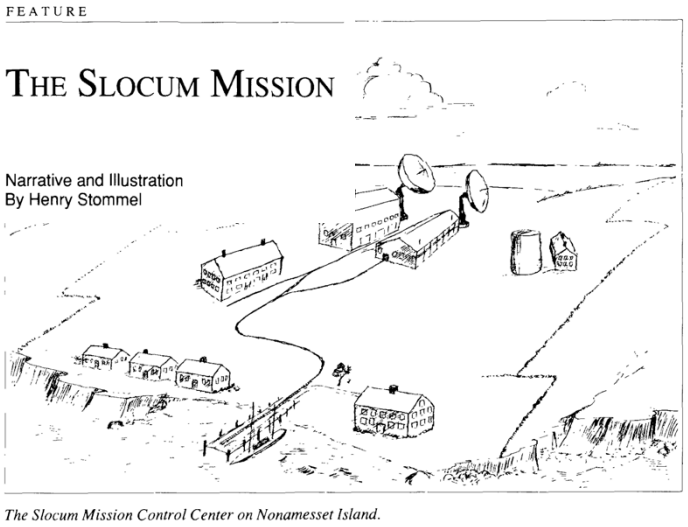
RU-COOL Overview

- 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


FEATURE

THE SLOCUM MISSION

Narrative and Illustration
By Henry Stommel

Each Slocum reports into Mission Control via satellite about six times a day.

The Slocum Mission Control Center on Nonamesset Island.

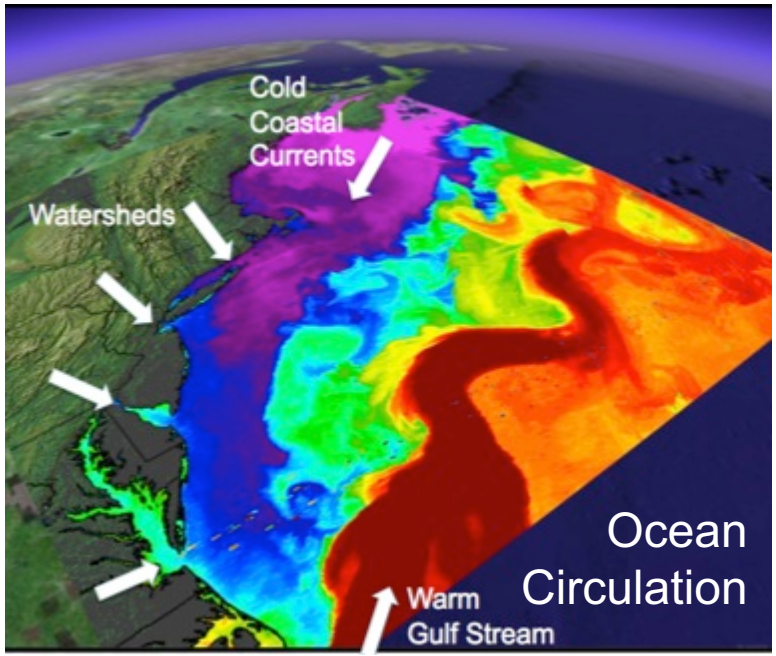
1989
Science Fiction Article

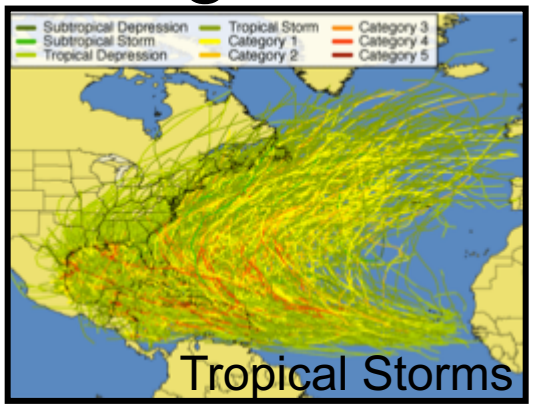
1999
First Slocum deployed at Sea

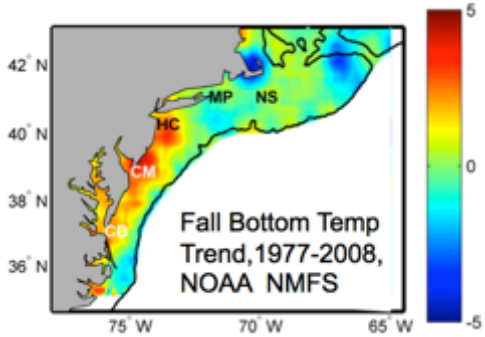
TELEDYNE MARINE
Everywhereyoulook™

2009
First Glider crosses an Ocean Basin

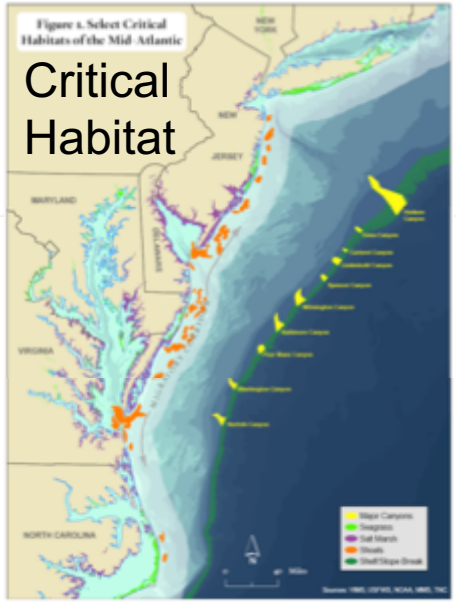
Mid-Atlantic Regional Drivers

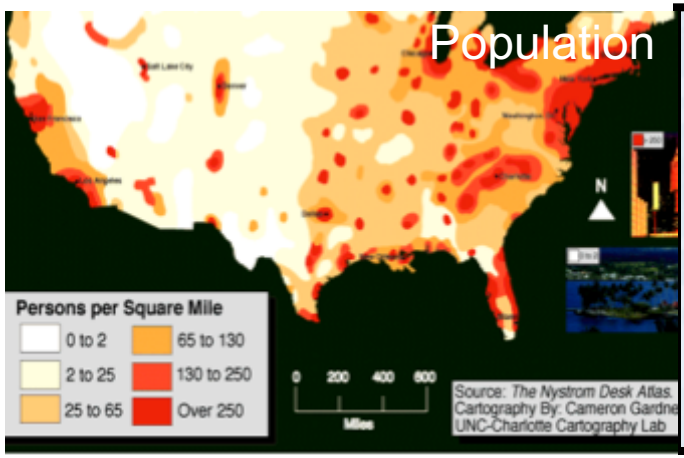






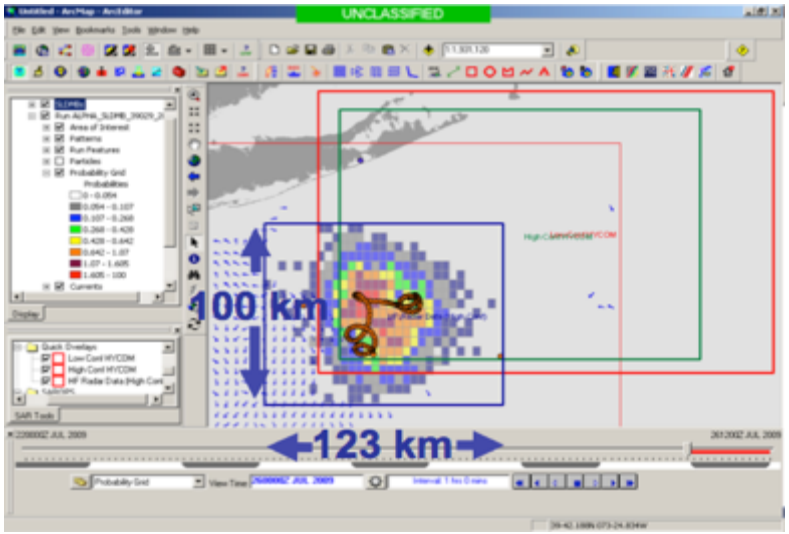
Climate Change



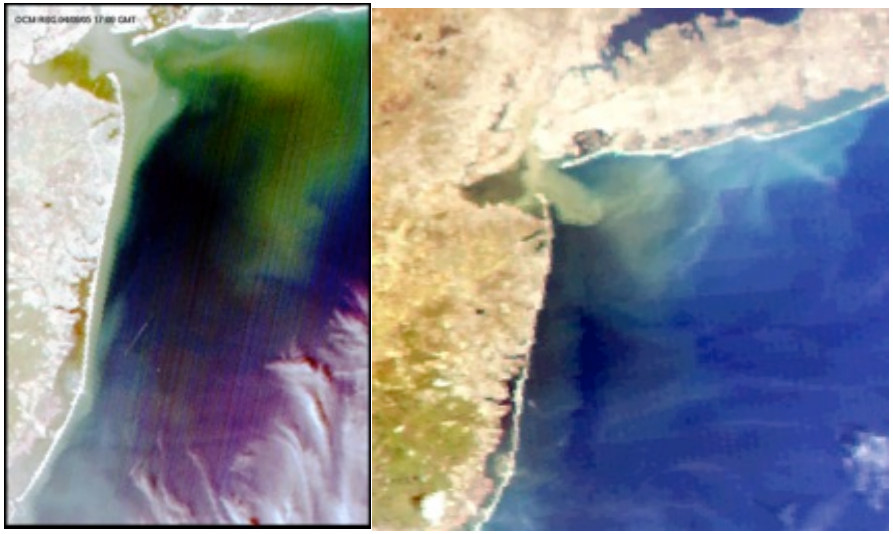


MARACOOS Regional Themes

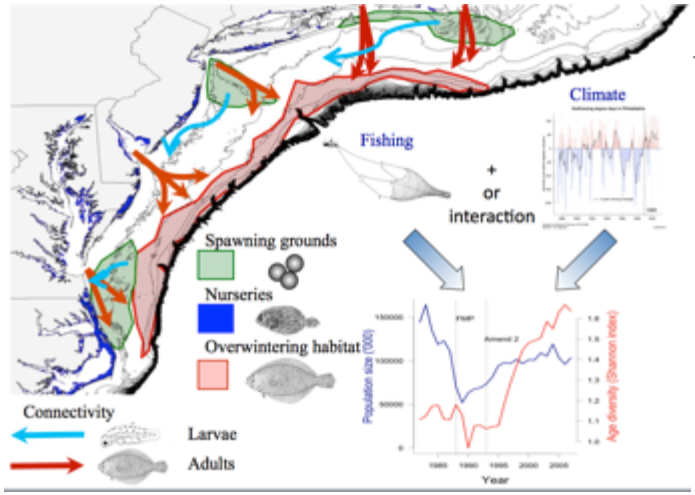
1) Maritime Operations – Safety at Sea



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

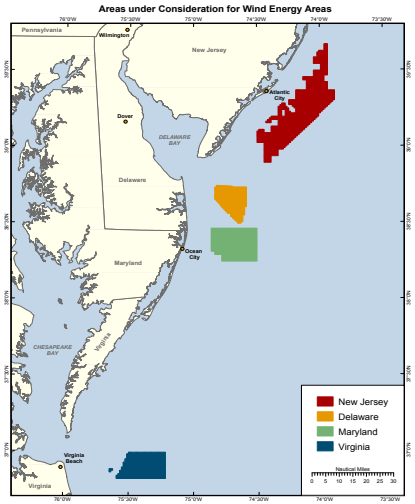


2) Ecosystem Decision Support - Fisheries



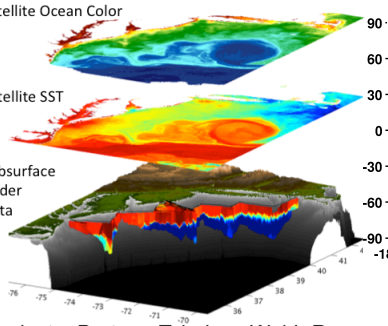
4) Coastal Inundation - Flooding

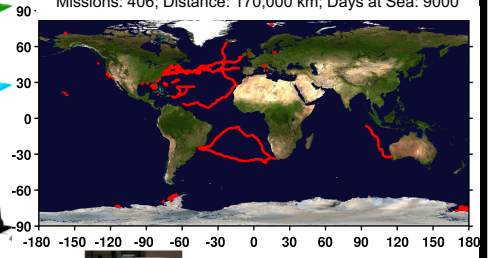
5) Energy – Offshore Wind

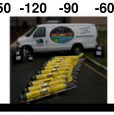


Mid-Atlantic Regional-Scale Observation Network

Mid-Atlantic Bight Glider Network



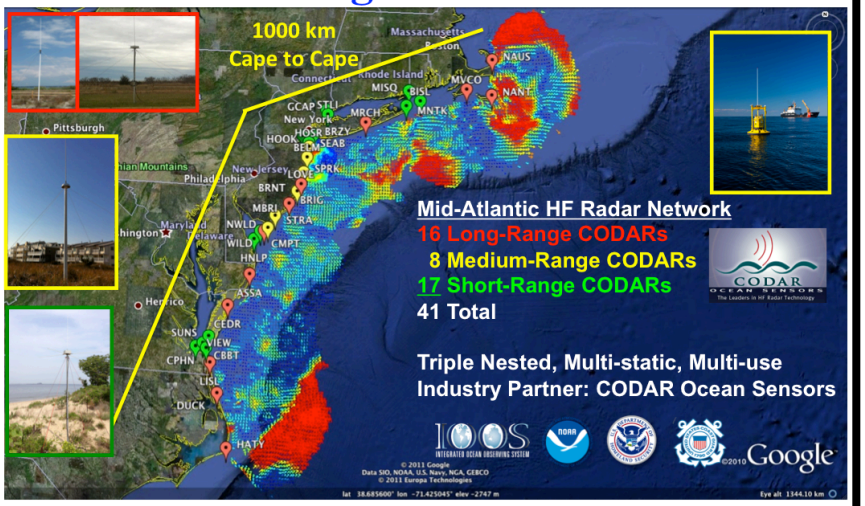




TELEDYNE WEBB RESEARCH
Everywhereyoulook™

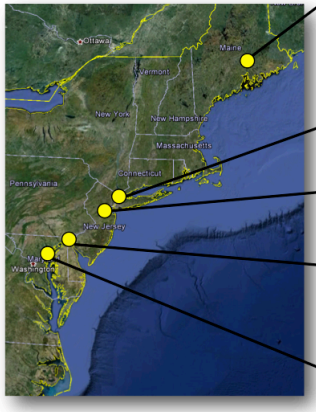
Industry Partner: Teledyne Webb Research

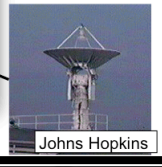
Mid-Atlantic Bight HF Radar Network



Northeast U.S. Real-Time Satellite Ground Stations

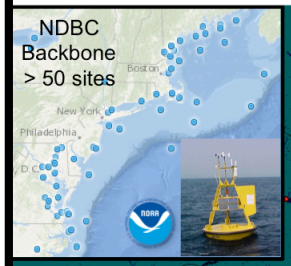
Satellites: NOAA Polar Orbiters, NPP, Terra, Aqua, Metop & GOES





Industry Partner: SeaSpace

Mid Atlantic Bight Weather Network



Regional Industry Enhancement
> 100 sites

WeatherFlow Station
Hurricane Network Station

WeatherFlow
Better Data. Better Decisions.

Coastal Met-Ocean Monitoring Station

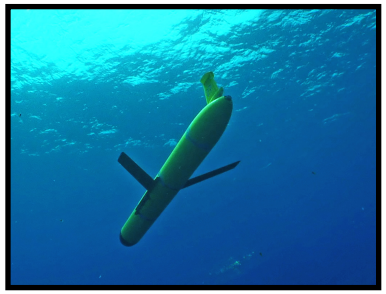
- Located at the RU Marine Field Station in Tuckerton, NJ
- 12 m meteorological tower
- Triton SODAR
- Lockheed WindTracer scanning lidar (coming soon)

Rutgers University - Coastal Ocean Observation Lab

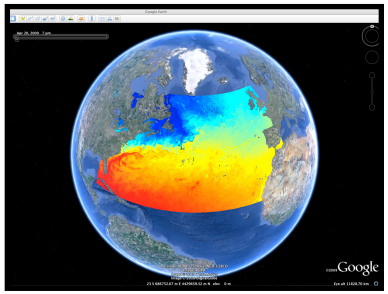
Observatory Operations, Data Fusion & Training Center

L-Band & X-Band Satellite Receivers

CODAR Network



Glider Fleet

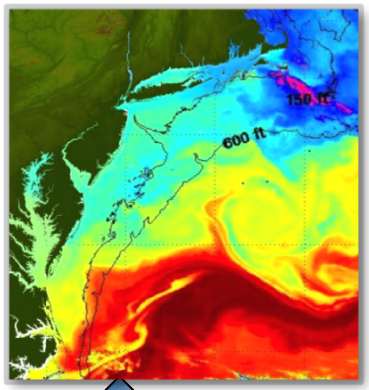


3-D Nowcasts & Forecasts

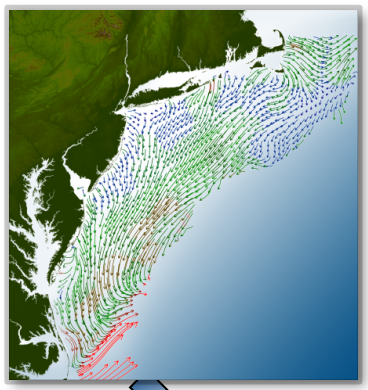
IOOS INTEGRATED OCEAN OBSERVING SYSTEM · NSF · NOAA · U.S. DEPARTMENT OF HOMELAND SECURITY · DEPARTMENT OF DEFENSE · NASA · DEPARTMENT OF THE NAVY ONR Science & Technology · BPU · NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION · DODGE FOUNDATION · NJOPP · GORDON AND BETTY MOORE FOUNDATION

Regional Ocean Data Products

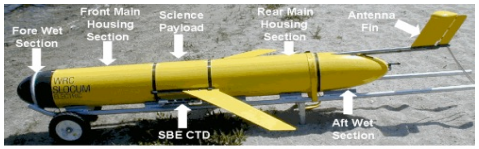
Satellites

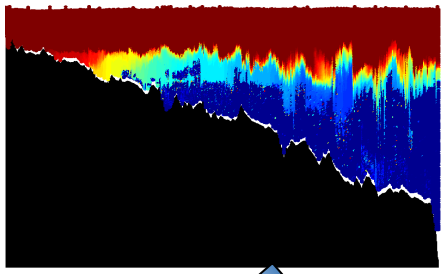


HF radar

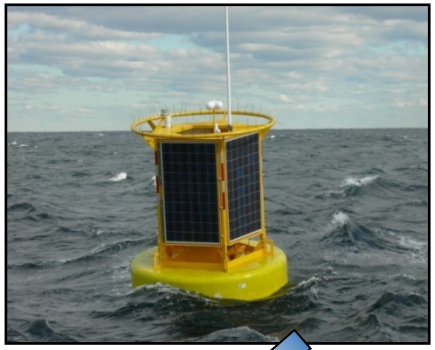


Gliders

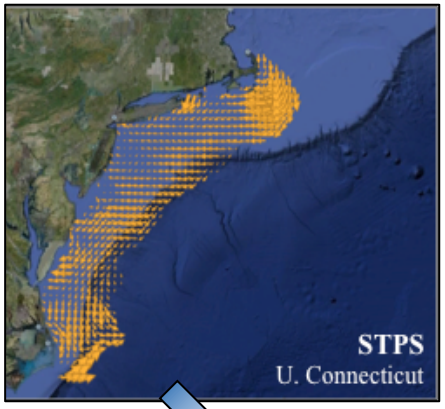


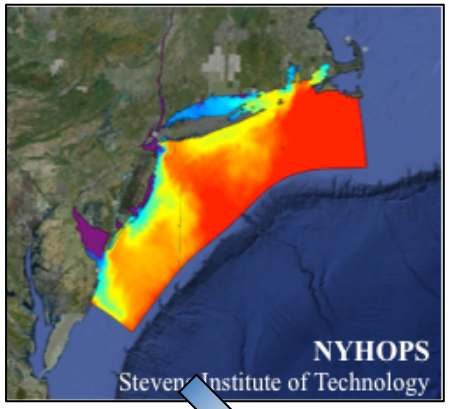


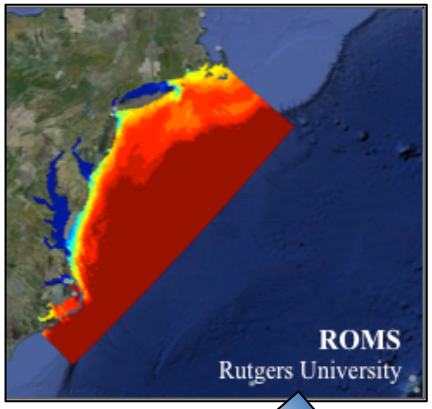
Fixed Platforms

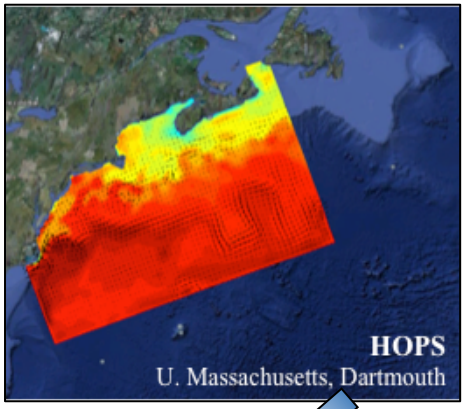


Assimilated by an Ensemble of Ocean Models





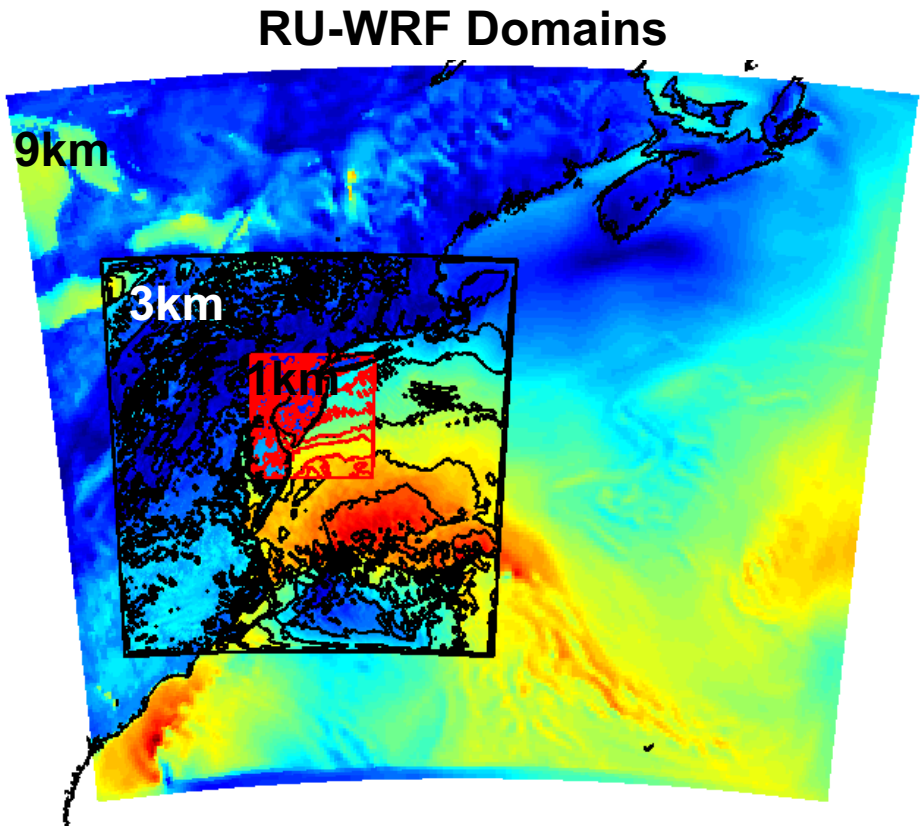




Connections to the Atmosphere

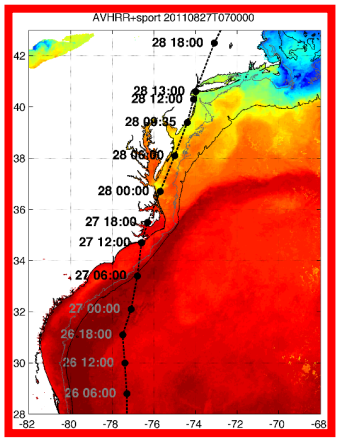
Real-Time Weather Modeling

- 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



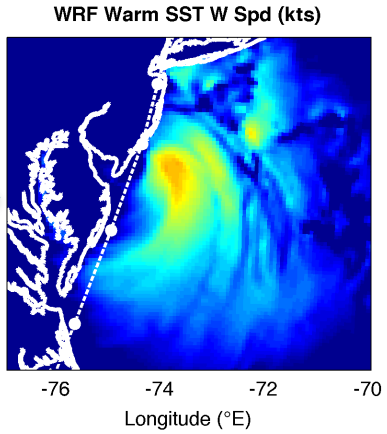
RU-WRF Research

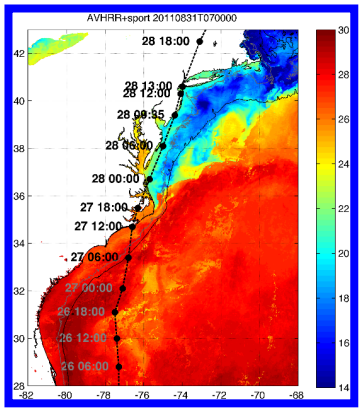
Hurricanes



Warm Ocean

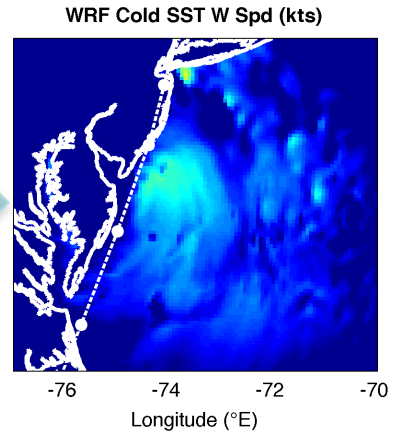
Cat I Hurr





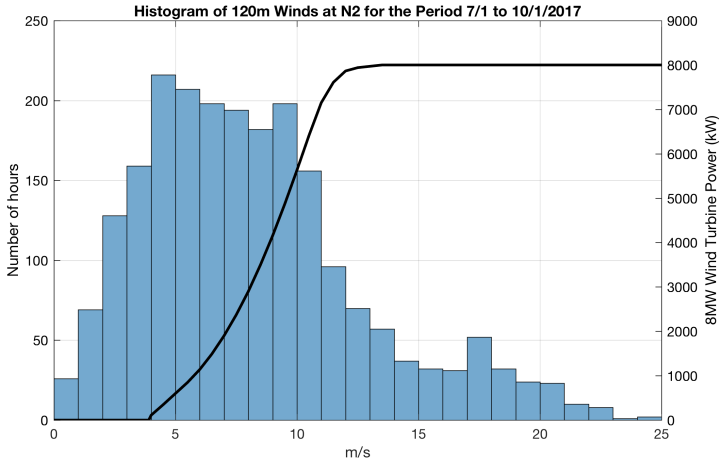
Cold Ocean

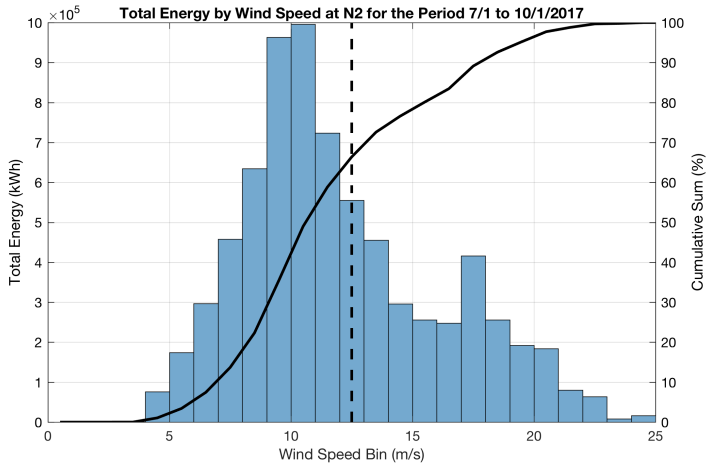
Trop Storm



Irene: Aug 2011

Wind Energy





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 decisions 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

- Email me: jbrodie@marine.rutgers.edu
- Visit us at **http://rucool.marine.rutgers.edu**

Questions?