Suspended particle characteristics from a glider integrated LISST sensor

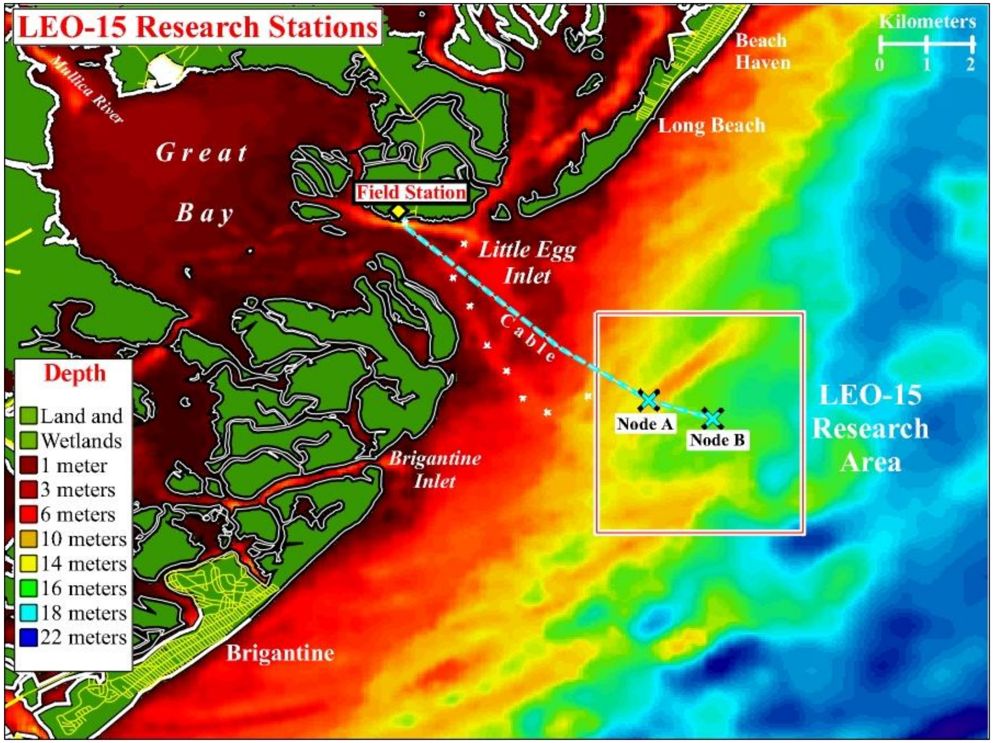
Travis Miles[1], Wayne Slade[2], Josh Kohut[1], and Donglai Gong[3]

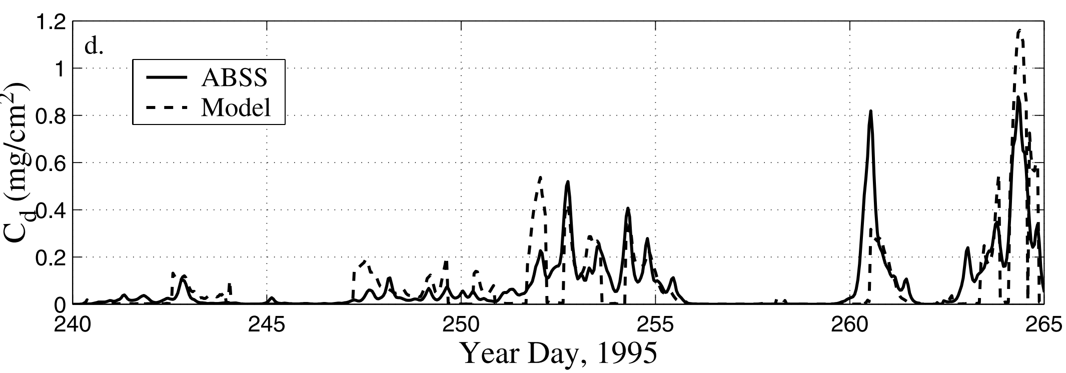
[1]Rutgers University, [2]Sequoia Scientific, Inc., [3]Virginia Institute of Marine Sciences

EGO-8/UG2
New Brunswick, NJ
May 21-23, 2019

Thank You from the RUCOOL Family

Sediment Transport Studies at LEO Site –1990's

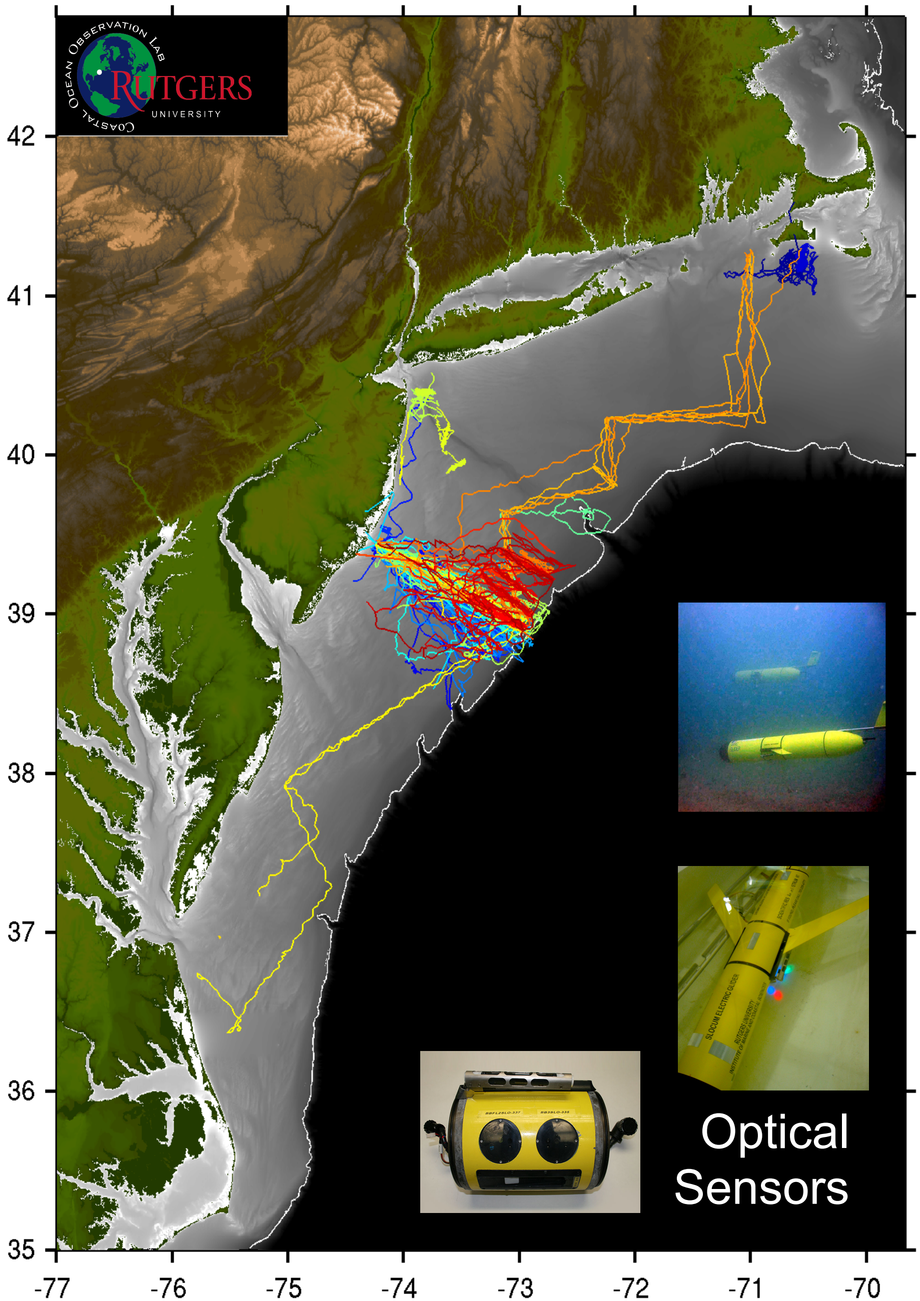


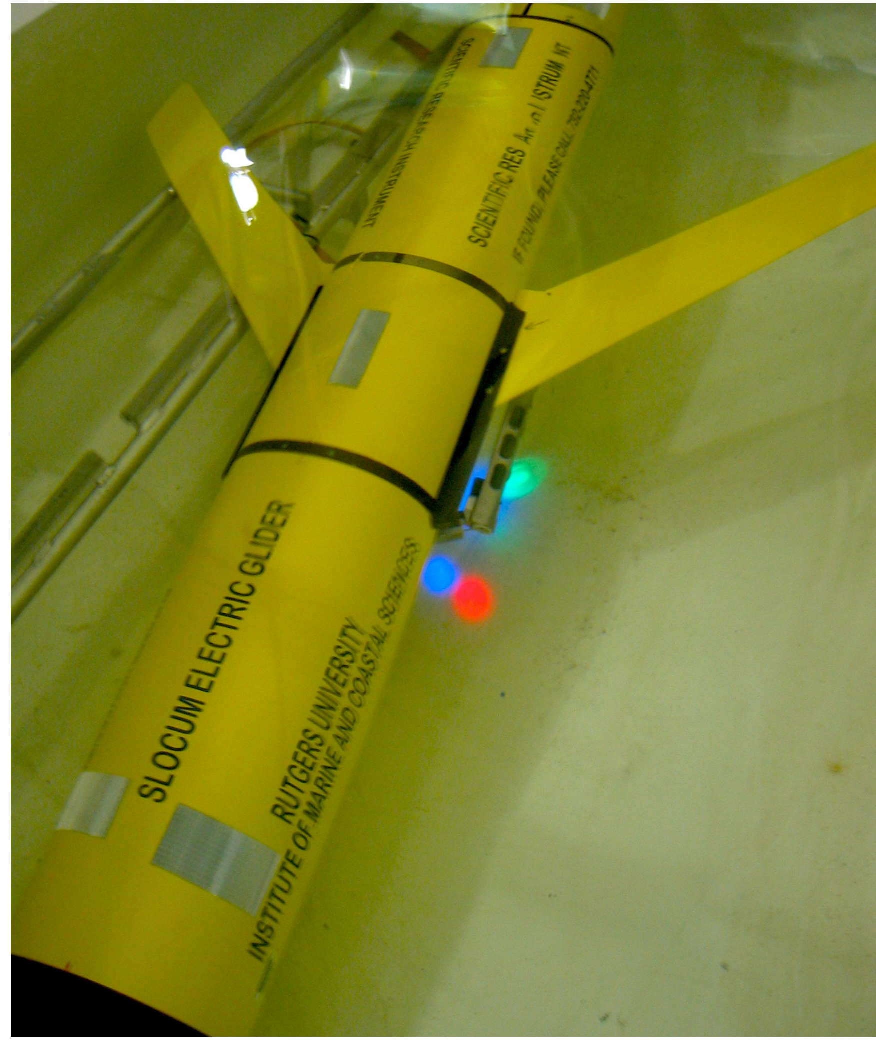


Benthic Acoustic Stress Sensor (BASS) Tripod

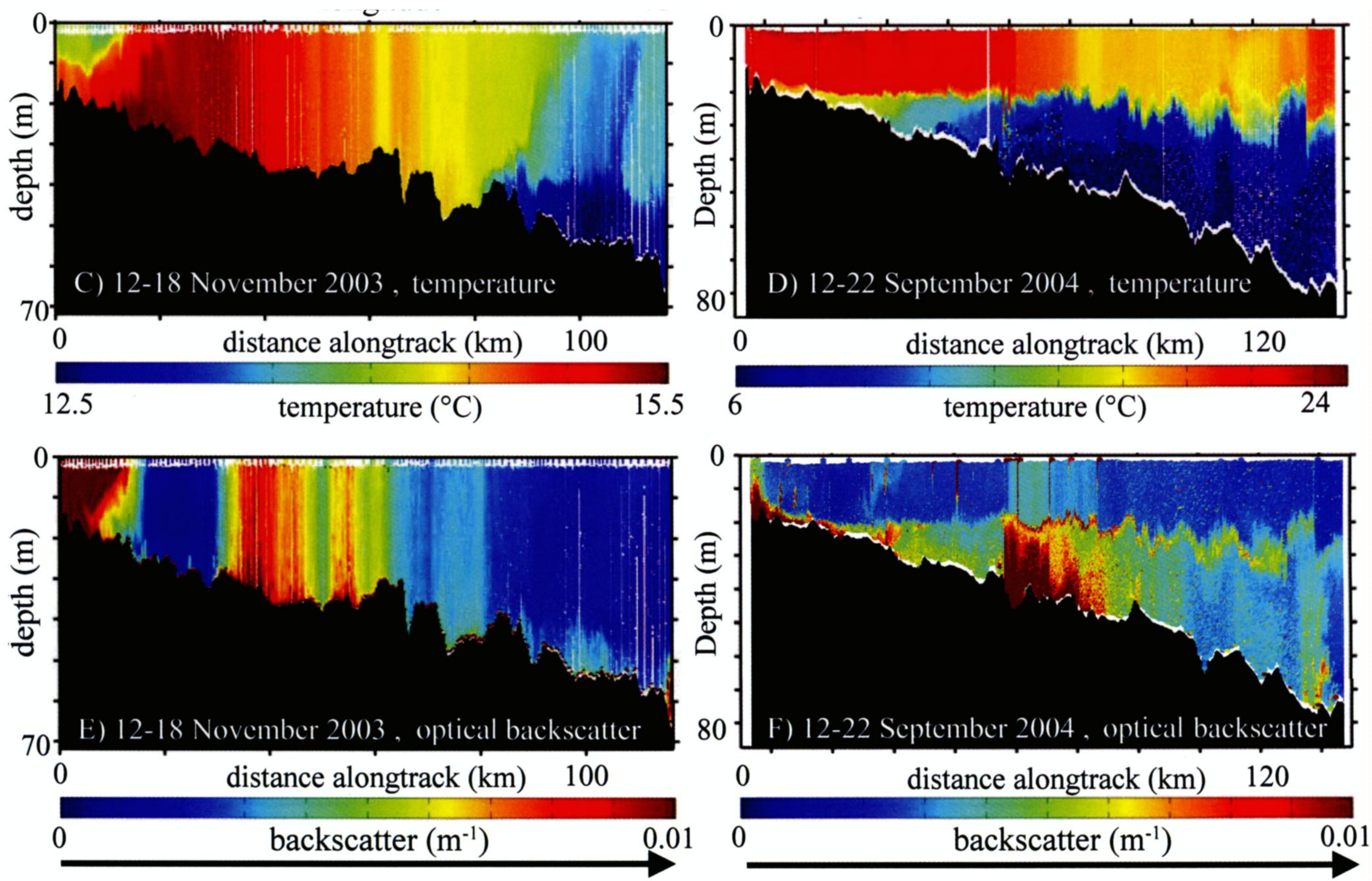
RUTGERS

Glider Observations of Sediment Resuspension in a Middle Atlantic Bight Fall Transition Storm (Glenn et al., 2008)





RUTGERS

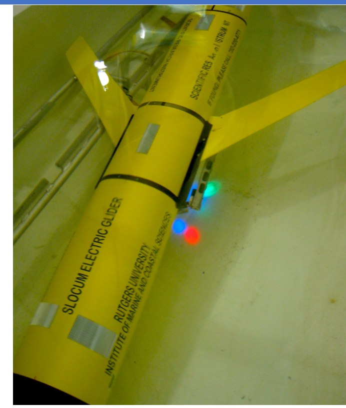


C) 12-18 November 2003 , temperature
depth (m)
0
70
0
distance alongtrack (km)
100
12.5
temperature (°C)
15.5
D) 12-22 September 2004 , temperature
Depth (m)
0
80
0
distance alongtrack (km)
120
6
temperature (°C)
24
E) 12-18 November 2003 , optical backscatter
depth (m)
0
70
0
distance alongtrack (km)
100
0
backscatter (m-1)
0.01
F) 12-22 September 2004 , optical backscatter
Depth (m)
0
80
0
distance alongtrack (km)
120
0
backscatter (m-1)
0.01

RUTGERS

Storm Glider Development

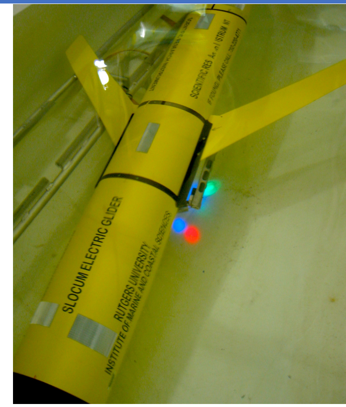
<u>Storm Glider (v1)</u>
Un-pumped Seabird Conductivity Temperature Depth (CTD), Wetlabs ECOpuck (CDOM, Chlorophyll, Backscatter),



Optical Backscatter is sensitive to smaller particles

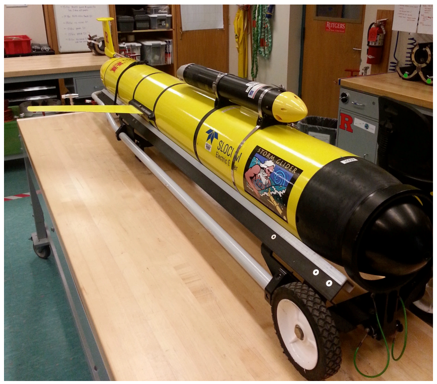
RUTGERS

Storm Glider Development



<u>Storm Glider (v1)</u>

Un-pumped Seabird Conductivity Temperature Depth (CTD), Wetlabs ECOpuck (CDOM, Chlorophyll, Backscatter), Aandera Optode (Oxygen) – Small Particles



<u>Storm Glider (v2)</u>

Pumped CTD, Externally mounted Nortek Aquadopp Current Profiler, accelerometer test for waves, extended battery bay – Larger Particles

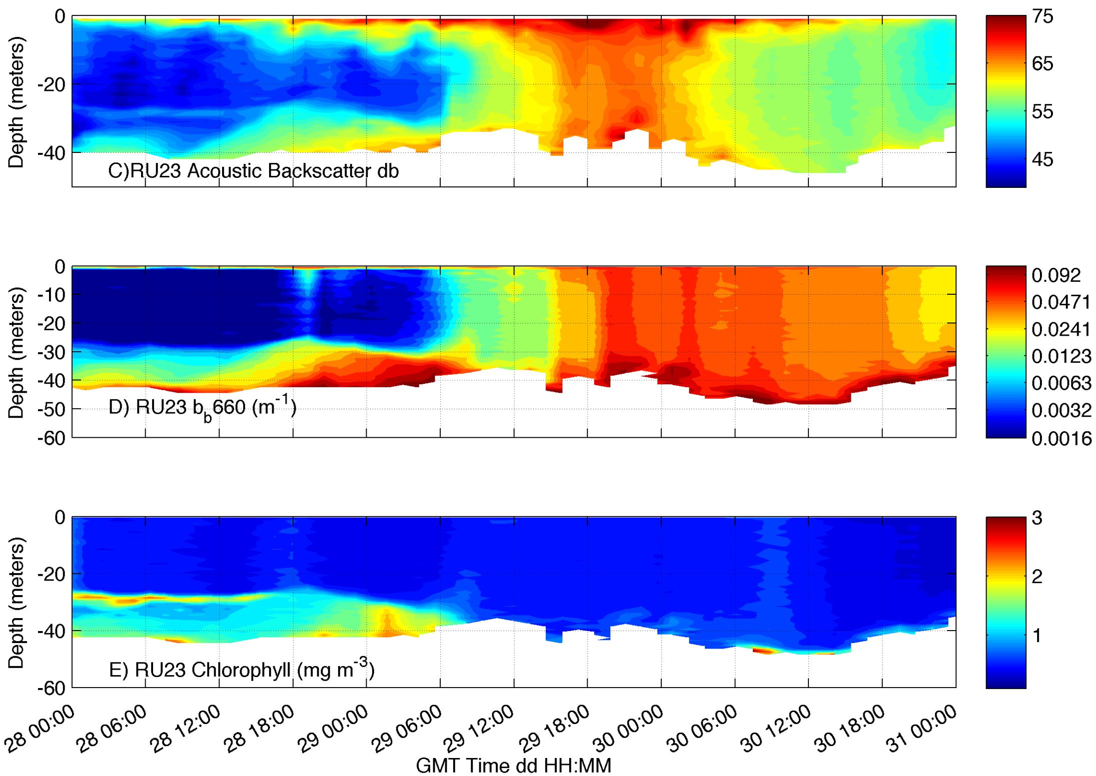
Acoustic Backscatter is sensitive to larger particles

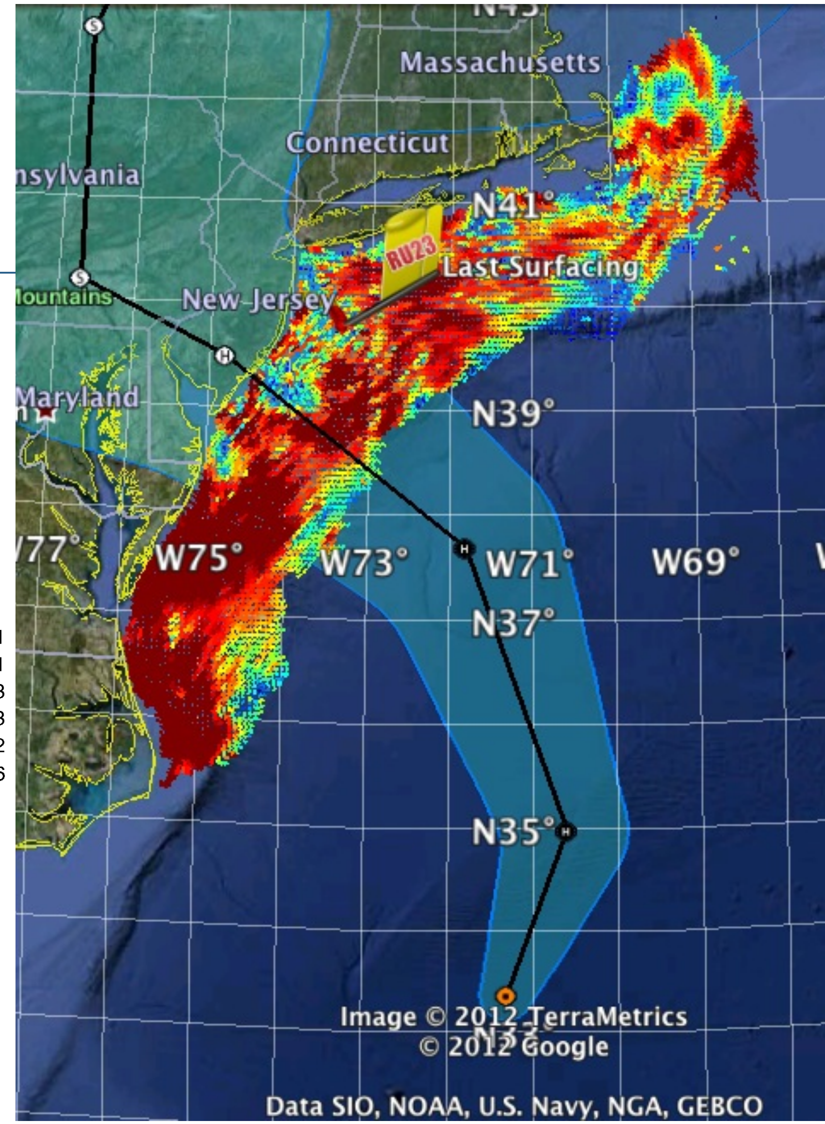
RUTGERS

Glider observations and modeling of sediment transport in Hurricane Sandy

Travis Miles[1], Greg Seroka[1], Josh Kohut[1], Oscar Schofield[1], and Scott Glenn[1]

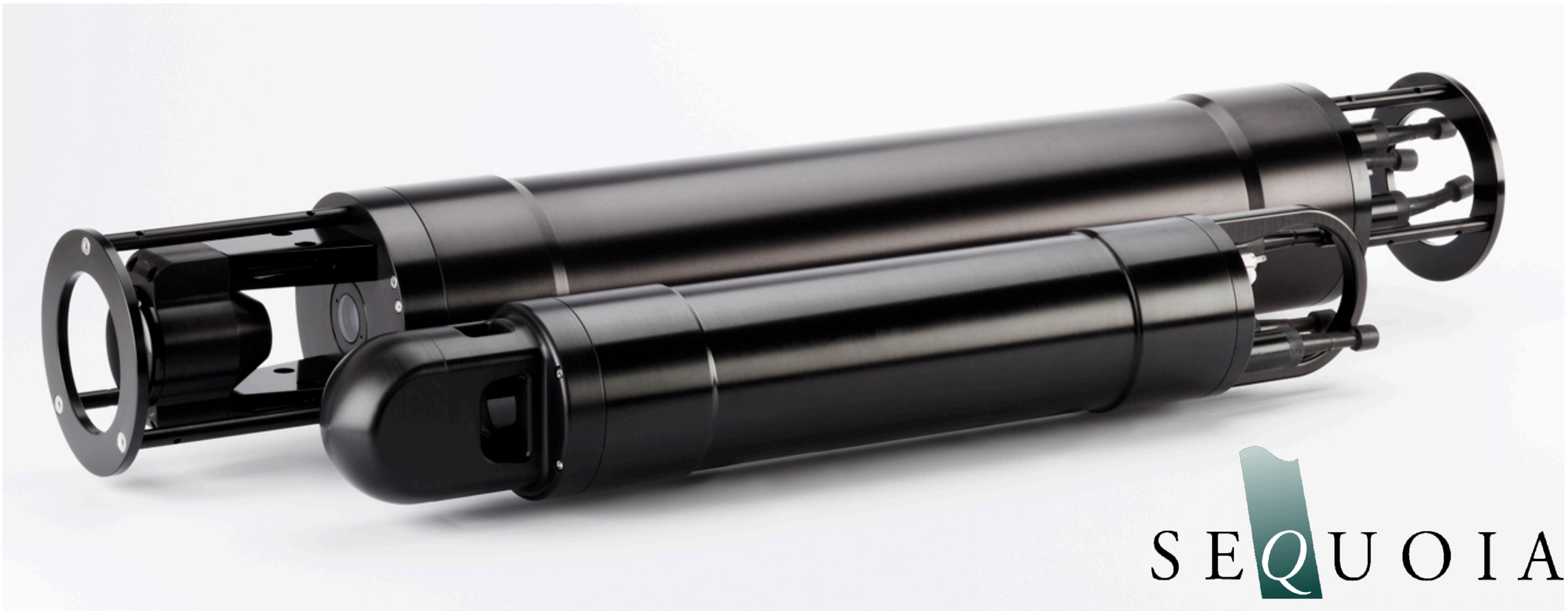
[1]Center for Ocean Observing Leadership, Department of Marine and Coastal Sciences, School of Environmental and Biological Sciences, Rutgers University, New Brunswick, New Jersey, USA





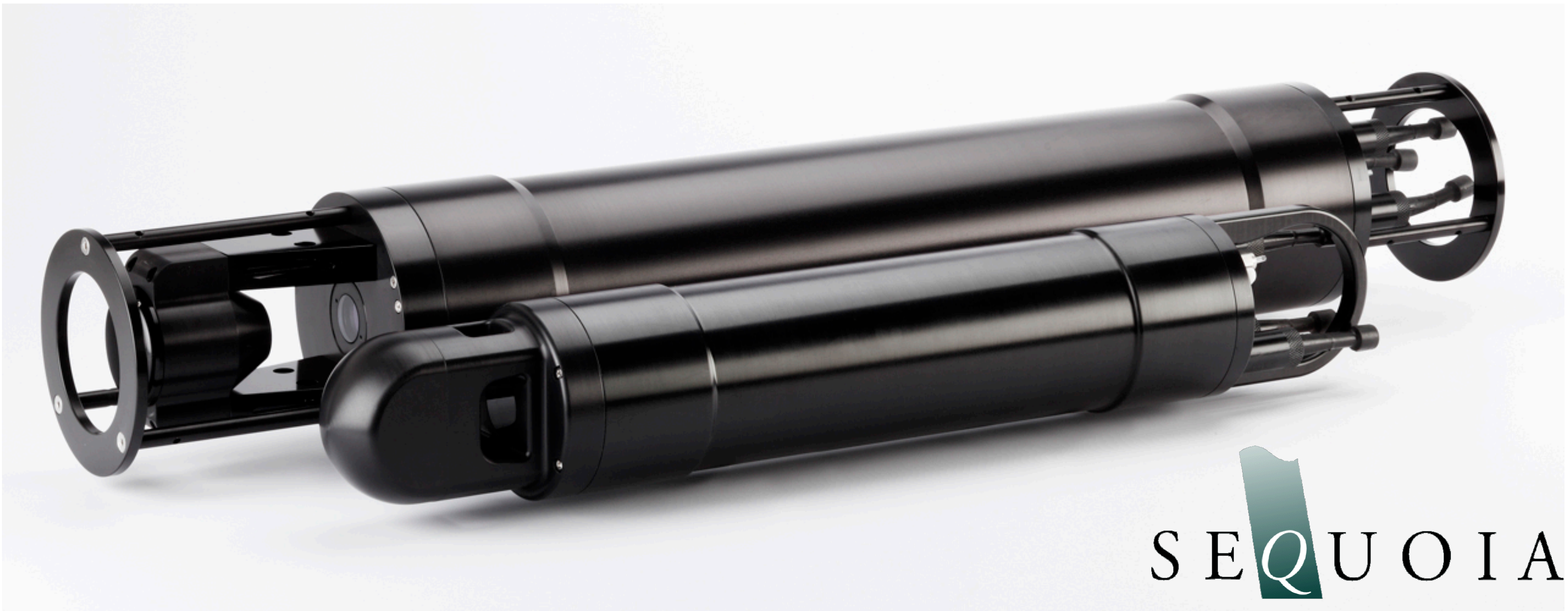
RUTGERS

Laser In-Situ Scattering and Transmissometry (LISST) sensor



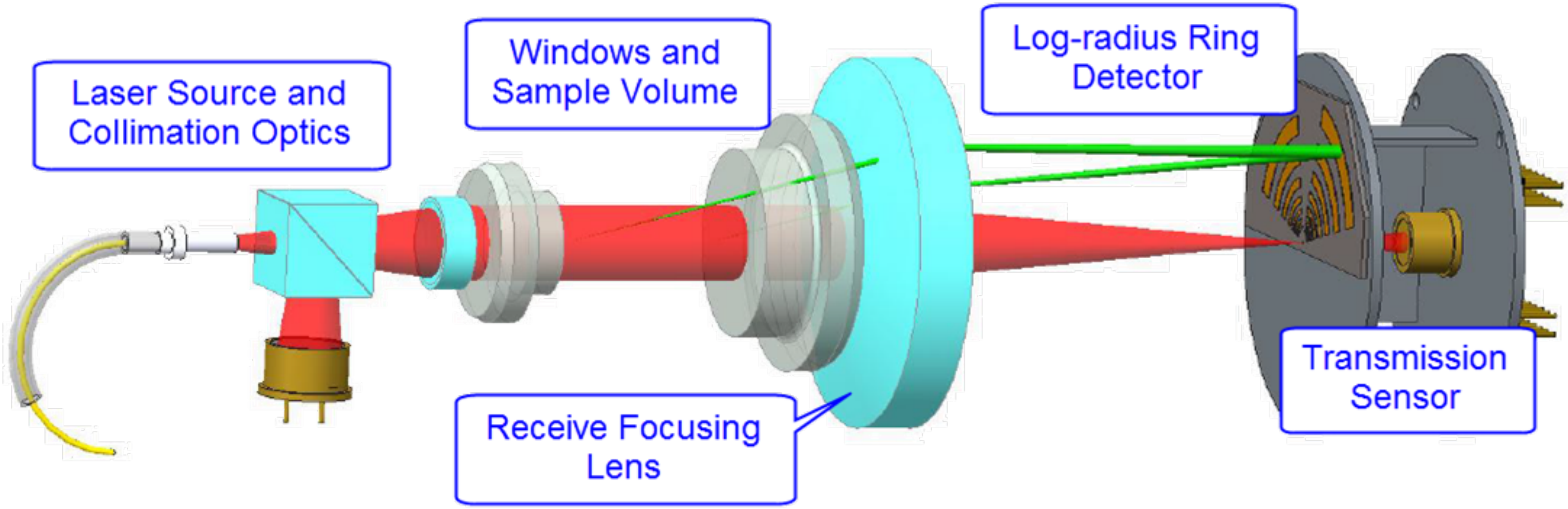
Agrawal, Y. C., and H. C. Pottsmith (2000), Instruments for particle size and settling velocity observations in sediment transport, *Mar. Geol.*, *168*(1–4), 89–114, doi:10.1016/s0025-3227(00)00044-x.

Laser In-Situ Scattering and Transmissometry (LISST) sensor



Agrawal, Y. C., and H. C. Pottsmith (2000), Instruments for particle size and settling velocity observations in sediment transport, *Mar. Geol.*, *168*(1–4), 89–114, doi:10.1016/s0025-3227(00)00044-x.

How laser diffraction works

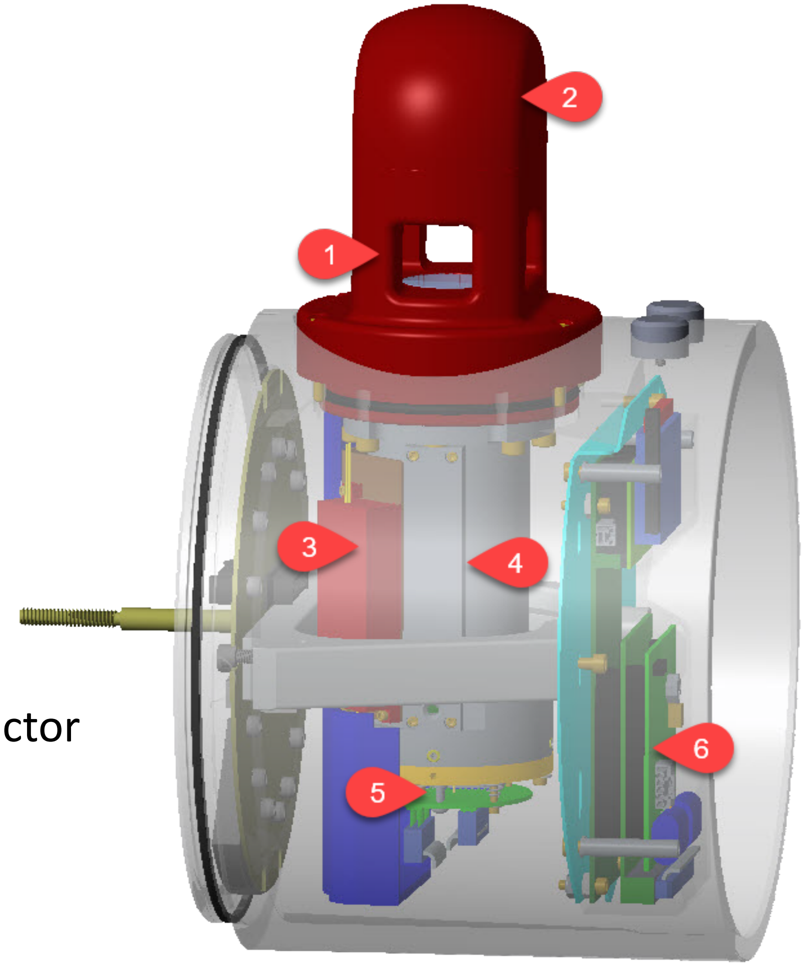


- Volume illuminated by laser light, which is scattered by particles in sample volume
- Large particles scatter most of their light at small angles and small particles scatter at larger angles
- Sum of scattering by all particles is measured as function of angle using specialized detector array
- Scattering by particles of different sizes can be modeled using Mie Theory --> Inversion technique can be used to determine amount of each size needed to produce the measured scattering vs. angle
- Inversion result is the equivalent spherical size distribution by volume

RUTGERS

SEQUOIA

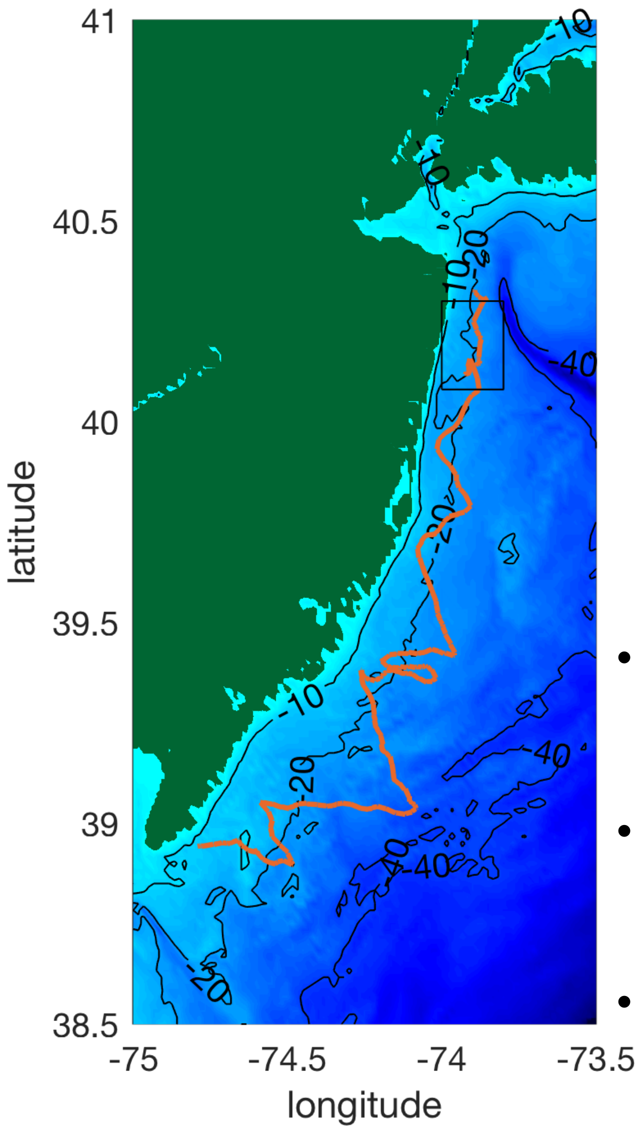
LISST particle sizer glider integration and test deployment



1) Scattering volume
2) Beam collimation optics and reference detector
3) Fiber coupled diode laser module
4) Scattered light received through lens tube
5) Ring detectors and transmission sensor
6) Electronics section

RUTGERS TELEDYNE WEBB RESEARCH Everywhereyoulook SEQUOIA Office of Naval Research ONR Science & Technology

LISST – Glider test deployment April 2017

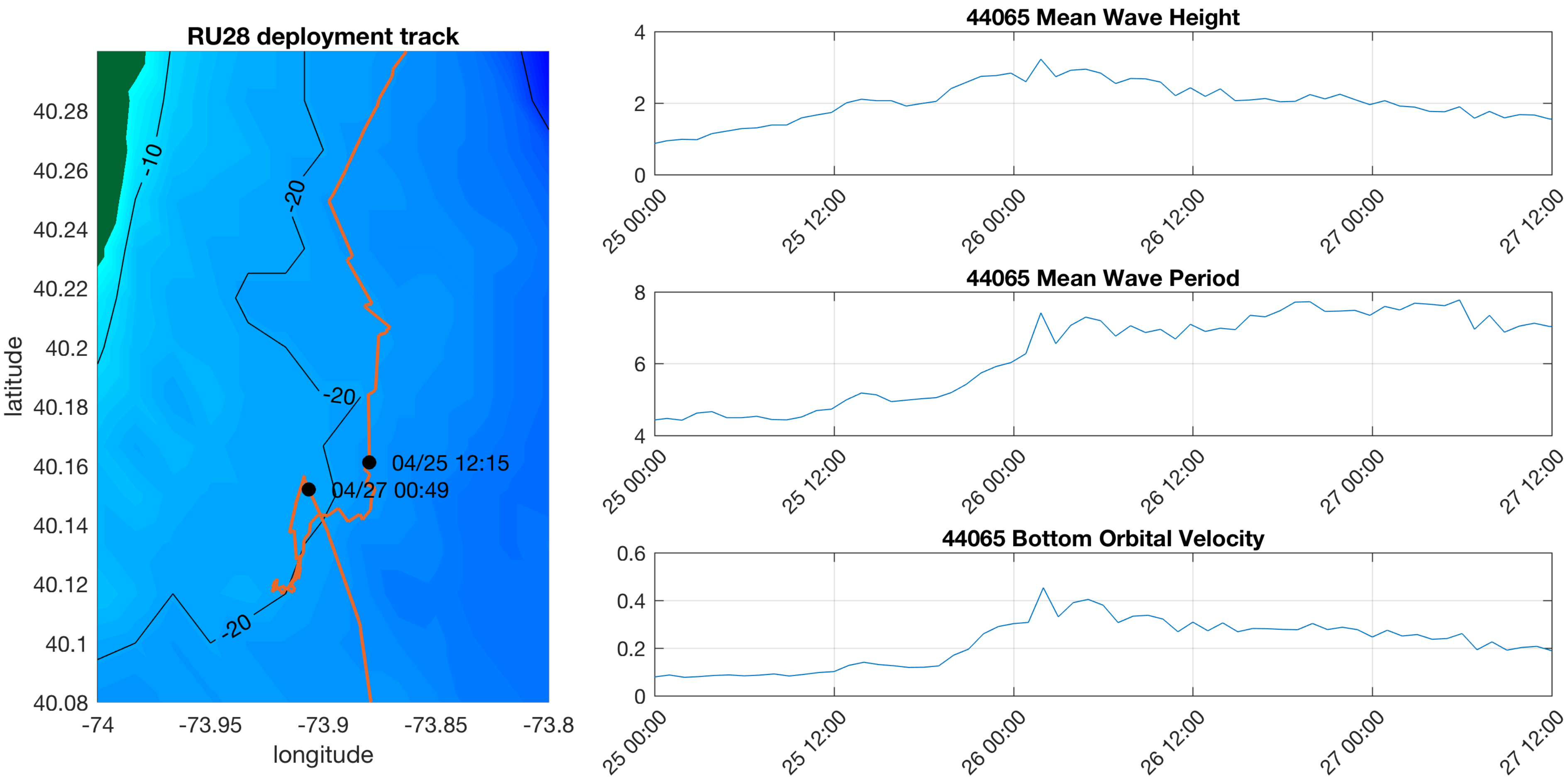


- Deployed for a 1 month mission along the New Jersey Coast in April of 2017.
- NJ Department of Environmental Protection mission mapping low oxygen
- Large supporter of new sensor testing and storm research.

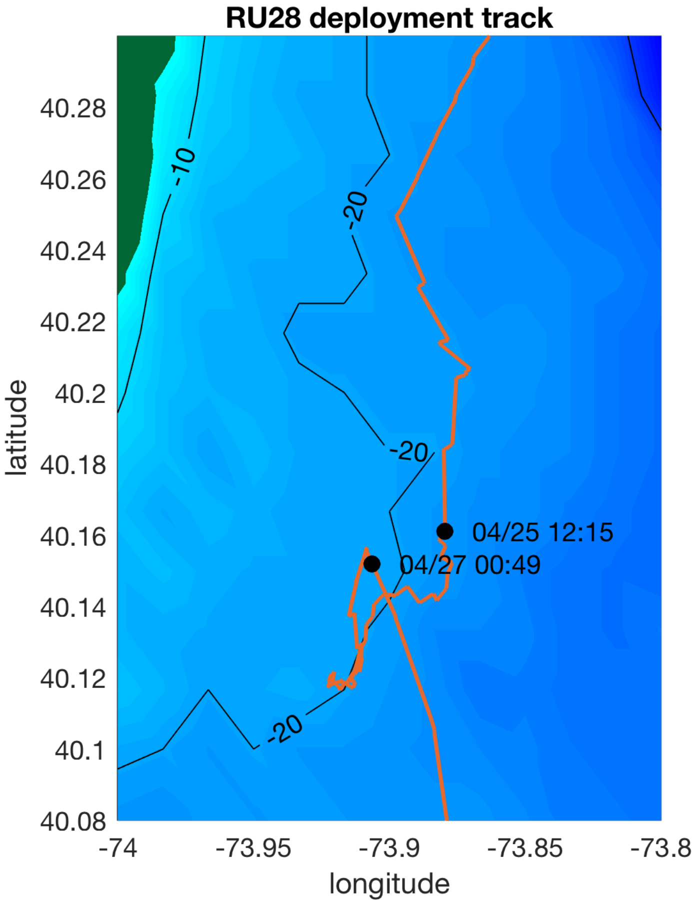
RUTGERS

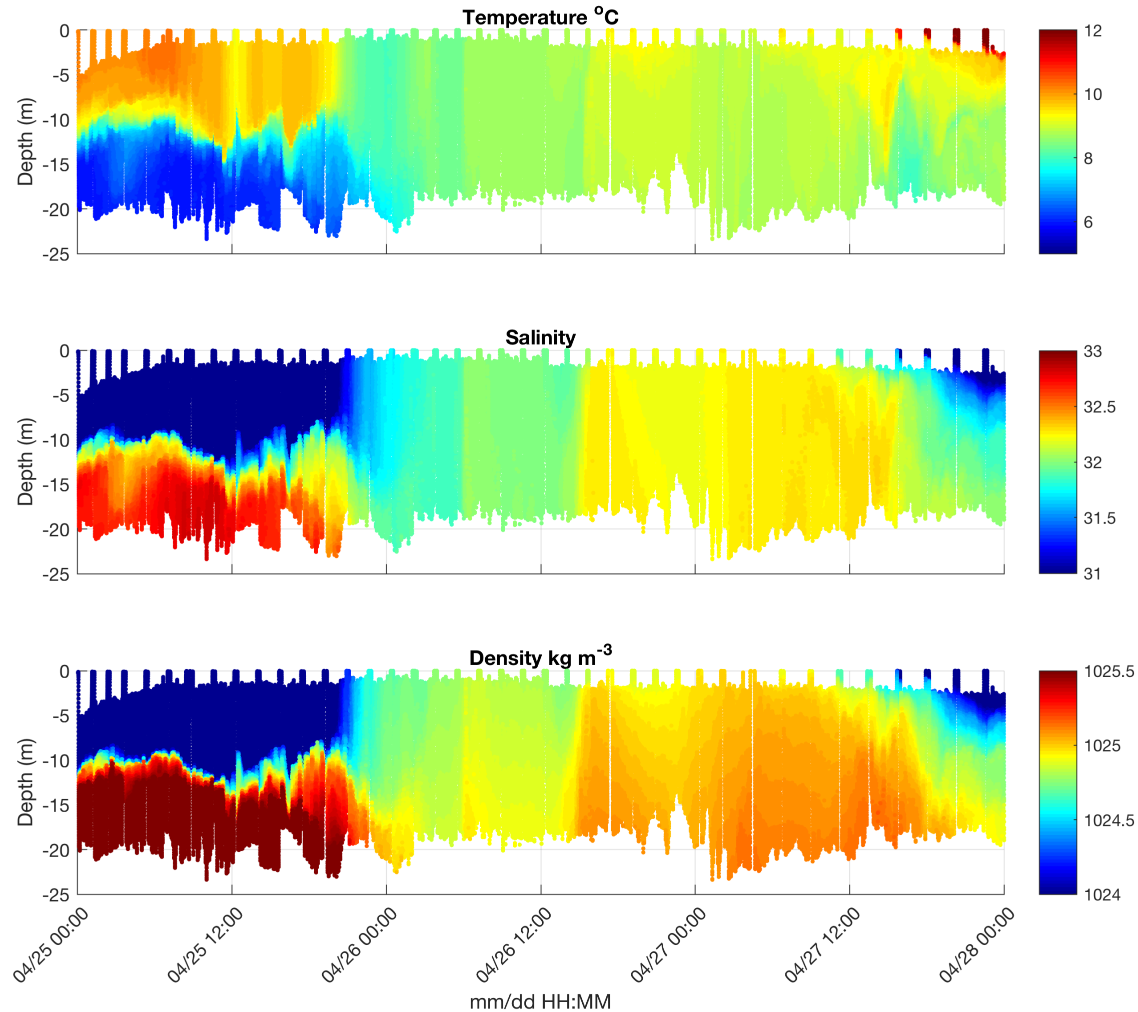
State of New Jersey
Department of Environmental Protection

LISST – Glider test deployment April 2017



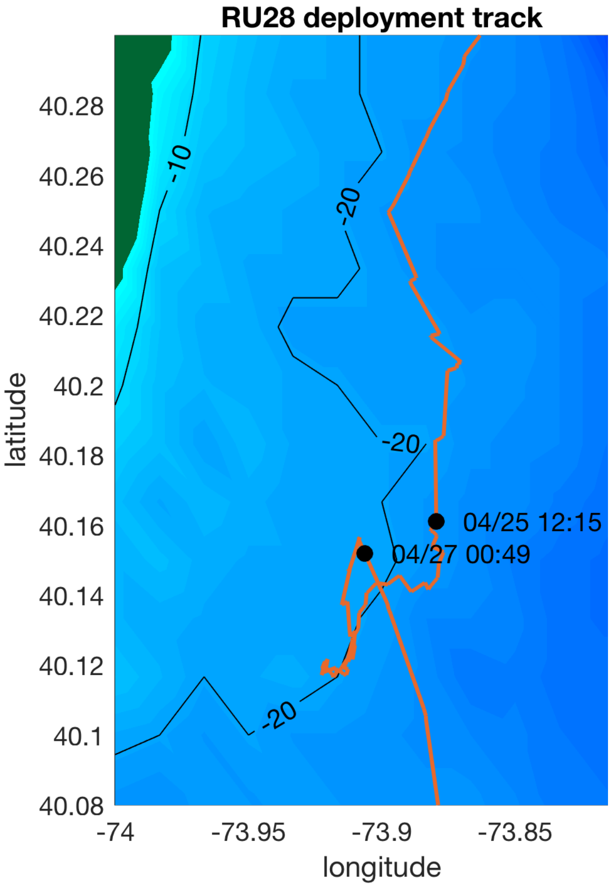
LISST – Glider test deployment April 2017

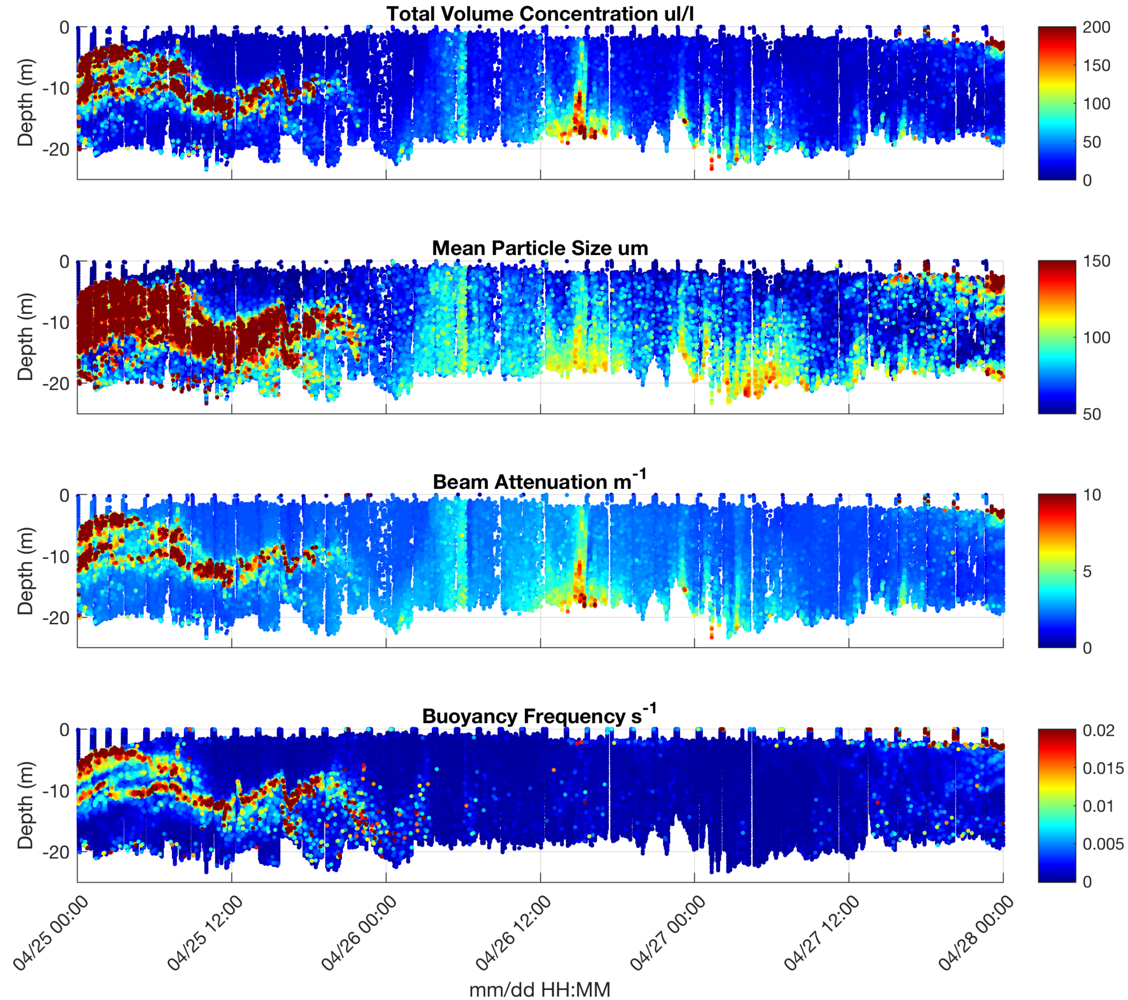




RUTGERS

LISST – Glider test deployment April 2017





Real time data delivered in regular glider data stream:
Estimated using the weighted sum of net scattered light.
Agrawal and Mikkelsen (2009)

RUTGERS

LISST – Glider test deployment April 2017

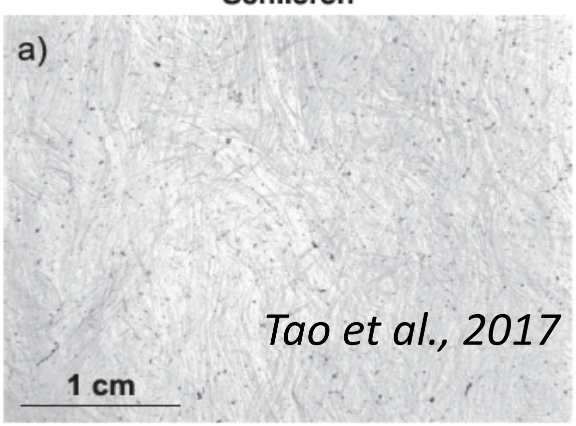
Schlieren is visible in images when the buoyancy frequency exceeds ~0.12 s-1.

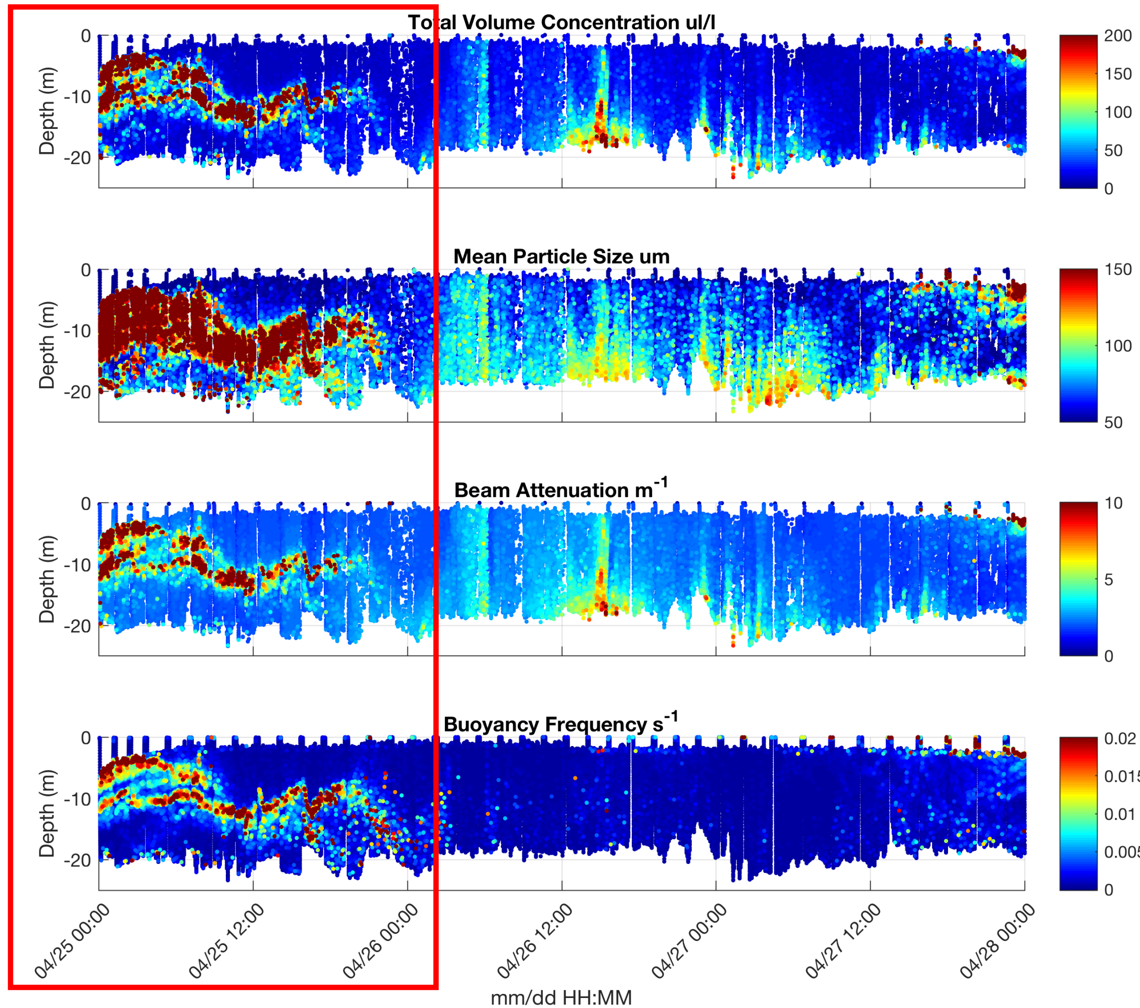
Buoyancy frequencies above 0.025 s^{-1} may increases beam attenuation due to scattering from density gradients.

Measured as particles in larger size bins, >100 um

Mikkelson et al., 2008

Schlieren





Real time data delivered in regular glider data stream:
Estimated using the weighted sum of net scattered light.
Agrawal and Mikkelsen (2009)

RUTGERS

LISST – Glider test deployment April 2017

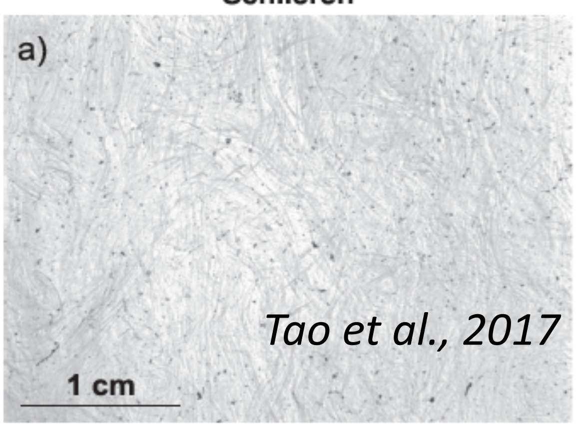
Schlieren is visible in images when the buoyancy frequency exceeds ~$0.12\ s^{-1}$.

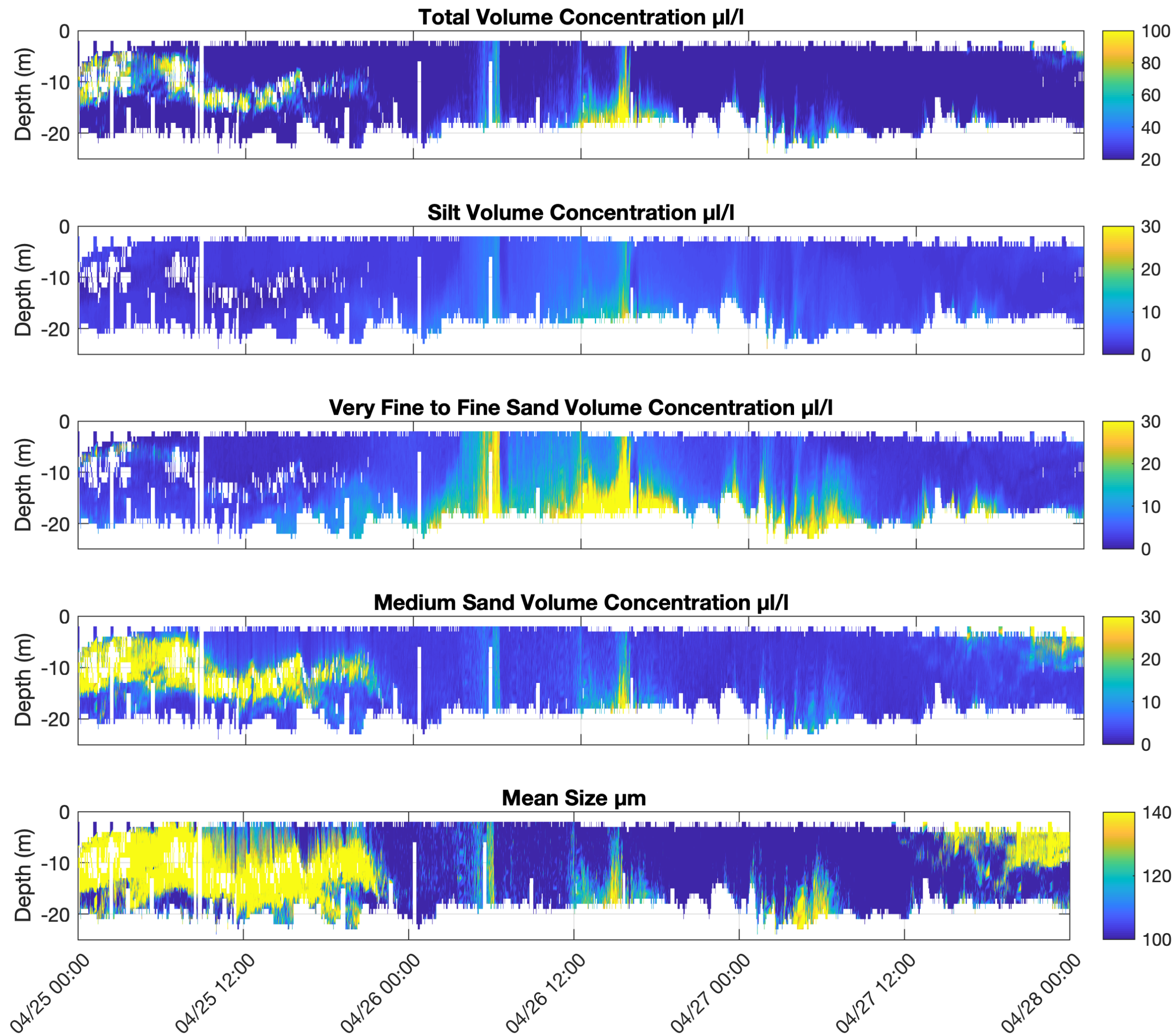
Buoyancy frequencies above 0.025 s^{-1} may increases beam attenuation due to scattering from density gradients.

Measured as particles in larger size bins, >100 um

Mikkelson et al., 2008

Schlieren

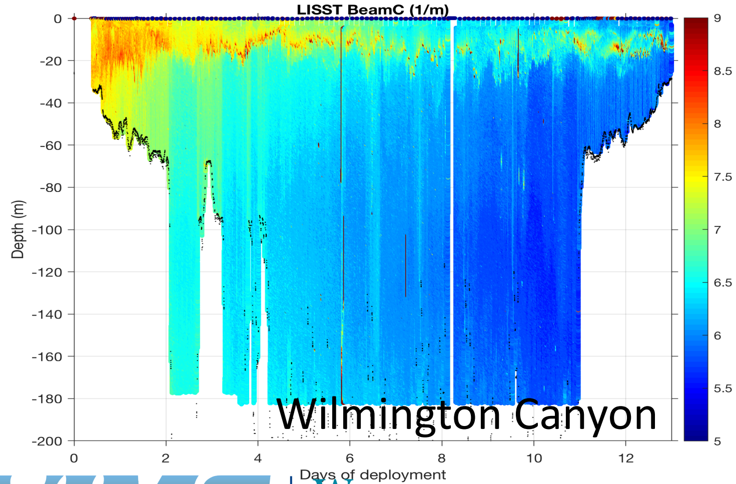




RUTGERS

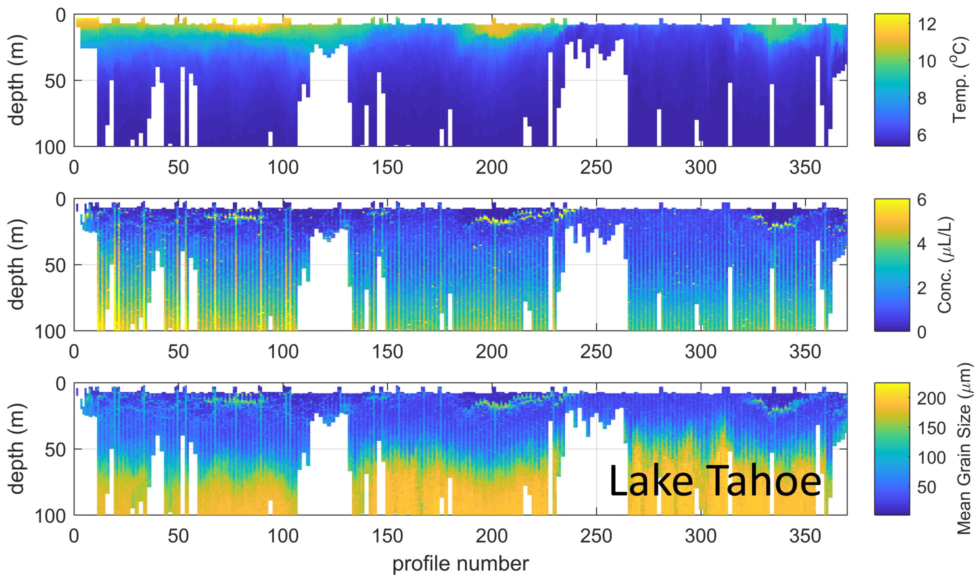
Post processing shore side: Standard processing codes for LISST 200-X *Agrawal et al., 2008*

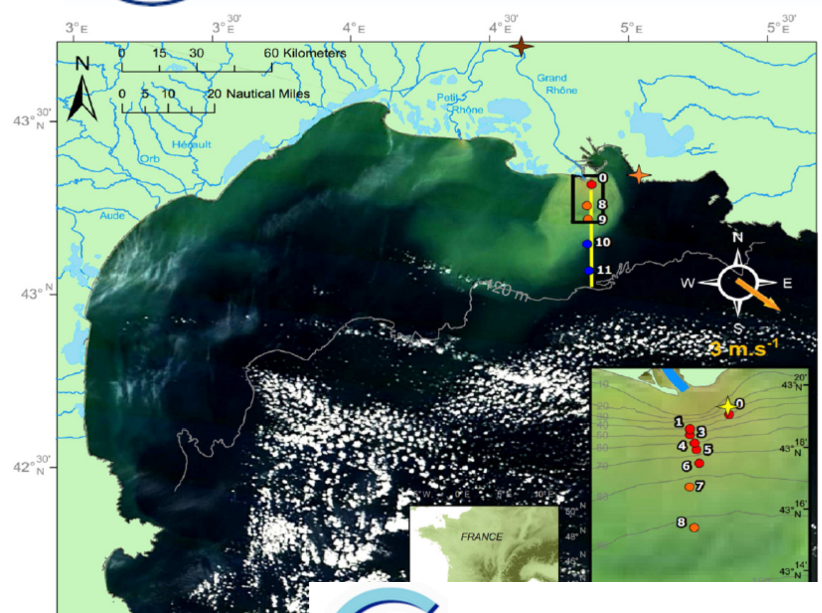
Current and future field tests – Anyone else?



VIMS | William & Mary
Virginia Institute of Marine Science

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL





UCDAVIS
UNIVERSITY OF CALIFORNIA

CEFREM
Centre de formation et de recherche
sur les environnements méditerranéens