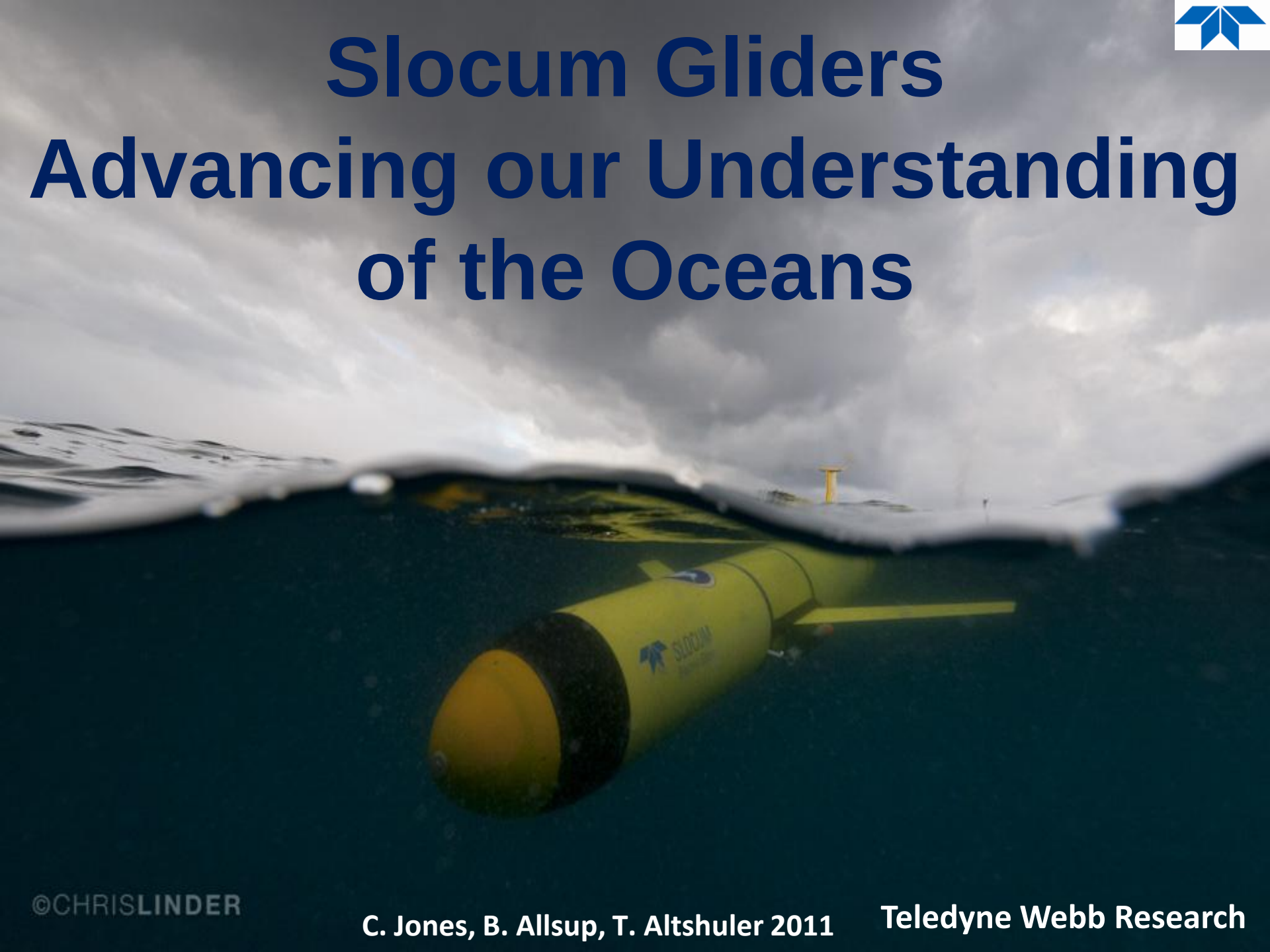
Slocum Gliders
Advancing our Understanding of the Oceans



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Teledyne Webb Research

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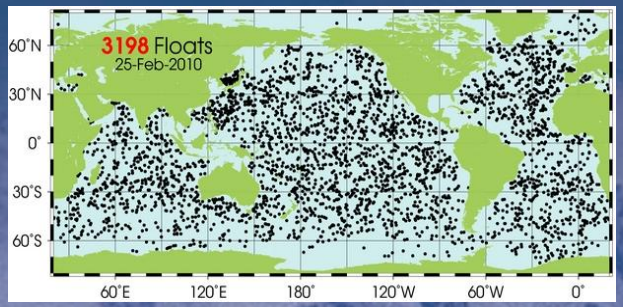
Moored
Sound Sources

- RAFOS for acoustic tracking of drifters
- Swept Frequency for acoustic tomography

Floats
APEX

- Drift with ocean currents while profiling down to 1500M depth



Gliders
Slocum Glider

- Autonomous Underwater Vehicles (AUVs) which “fly” through the ocean using buoyancy changes and wings

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Teledyne Marine Platforms

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Buoyancy Driven Gliders
Buoyancy Driven Floats
Hybrid Gliders

TELEDYNE BENTHOS
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Remotely Operated Vehicles
Deep Tow Survey Vehicles

TELEDYNE GAVIA
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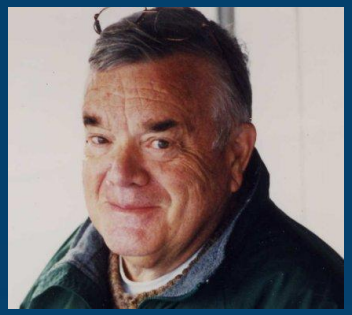
Gavia Defense AUV
Gavia Offshore AUV
Gavia Scientific AUV

Slocum Mission

"We have found, over the years, that the payoff in increase of knowledge often is greatest the more unconventional the idea, especially when it conflicts with collective wisdom."



Doug Webb

Henry Stommel

Henry Stommel, The SLOCUM Mission, 1989

Hybrid Glider Development

MEMORIAL UNIVERSITY

Hybrid glider tests Holyrood, Newfoundland, Canada
February 2011

Hybrid glider test configuration
February 2011

Additional sensors installed:

- Microstrain IMU
- Roll, pitch, yaw @10Hz
- Coulomb counter

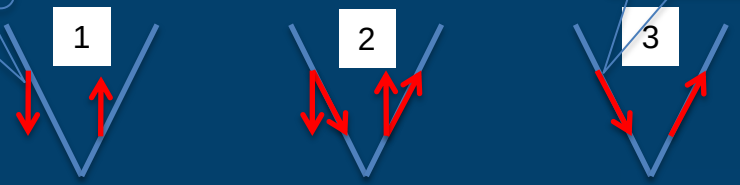
Thruster Integration

MEMORIAL UNIVERSITY

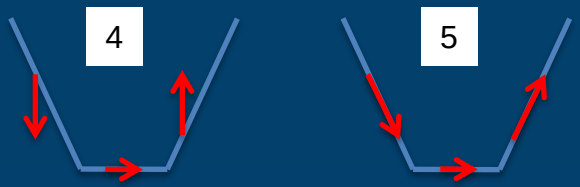
Buoyancy driven

Thruster driven

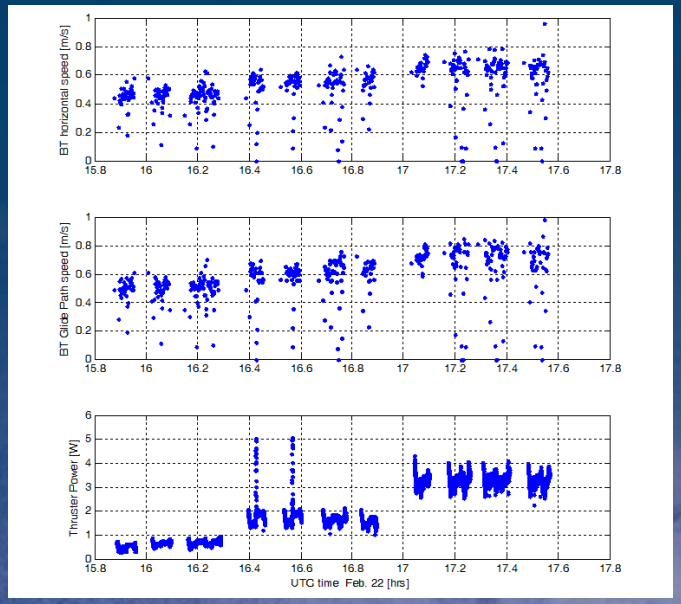
Saw-tooth profiles



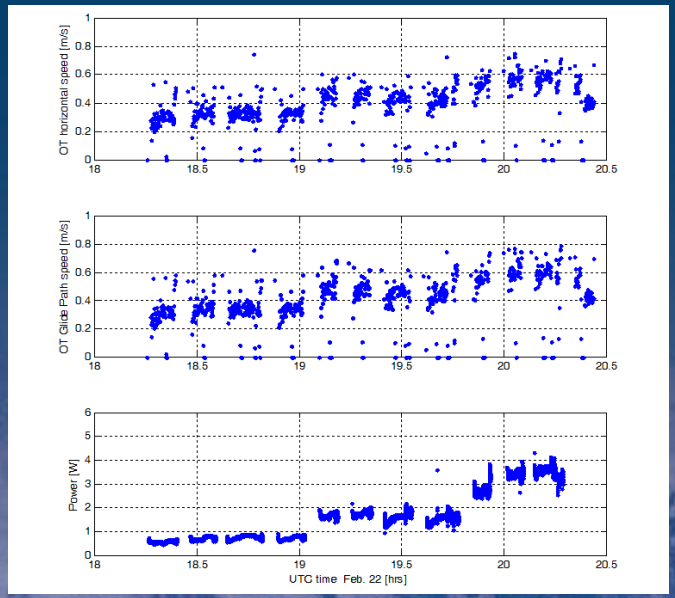
Bathtub profiles



Preliminary results for profile 2



Preliminary results for profile 3



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Hybrid Glider Development

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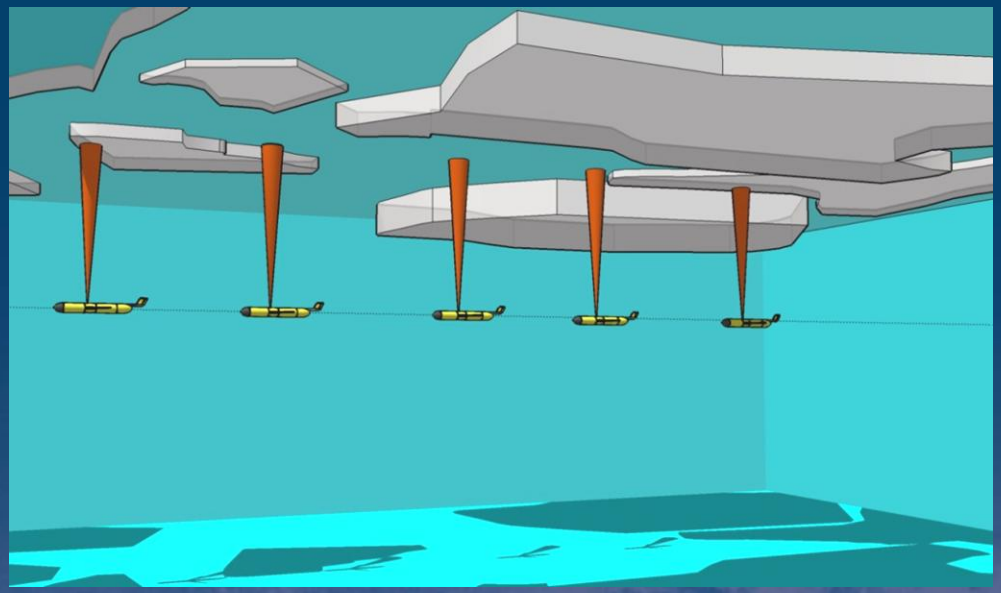
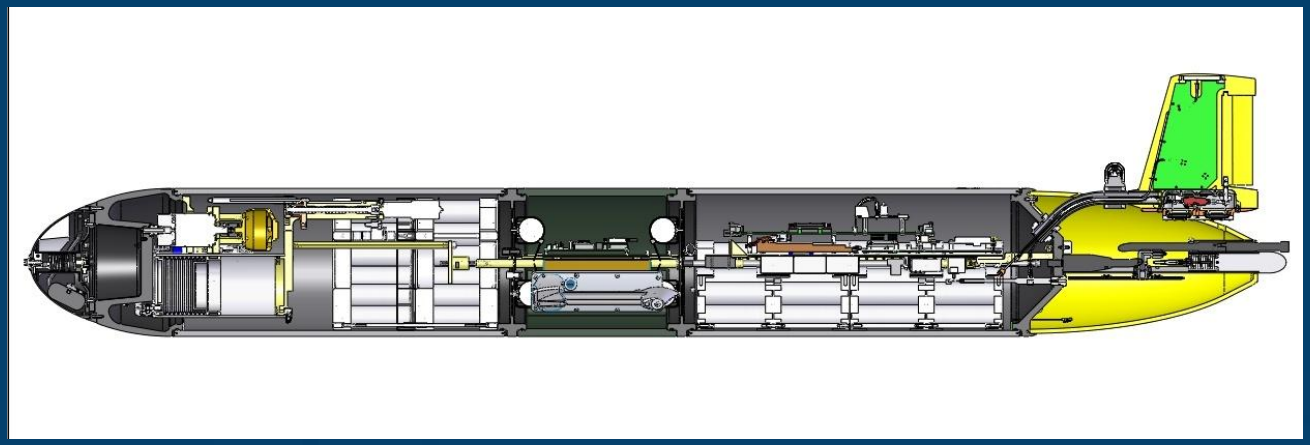
- Why put another propulsion device onto a Glider?
  - Horizontal flight
  - Higher speeds
  - Underwater docking



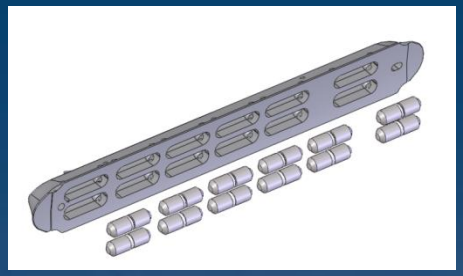
Hybrid Glider flying potential ice profiling mission. [RB]

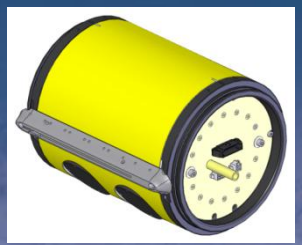
Reference: Brian Claus, Ralf Bachmayer, Christopher D. Williams, Memorial University, Newfoundland and Labrador, Canada, **AUV 2010**, Monterey, CA

Slocum G2 – A Vehicle for Science

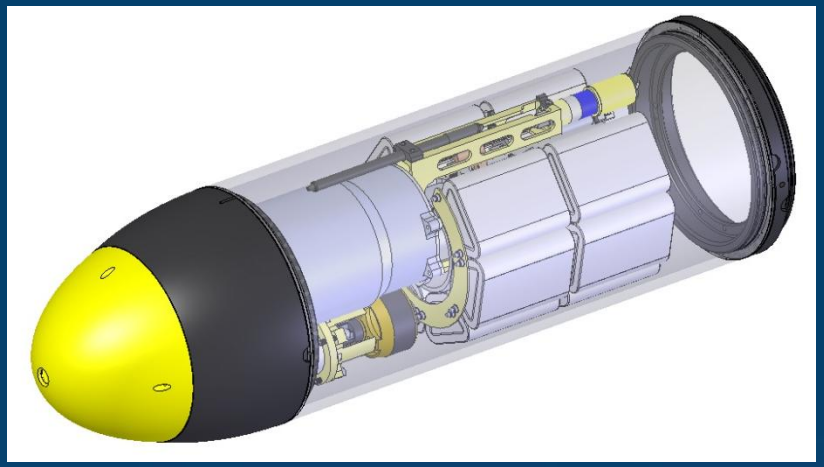


- 1000m Rated
- Modular Architecture
- Multiple Energy Types
- Robust Design





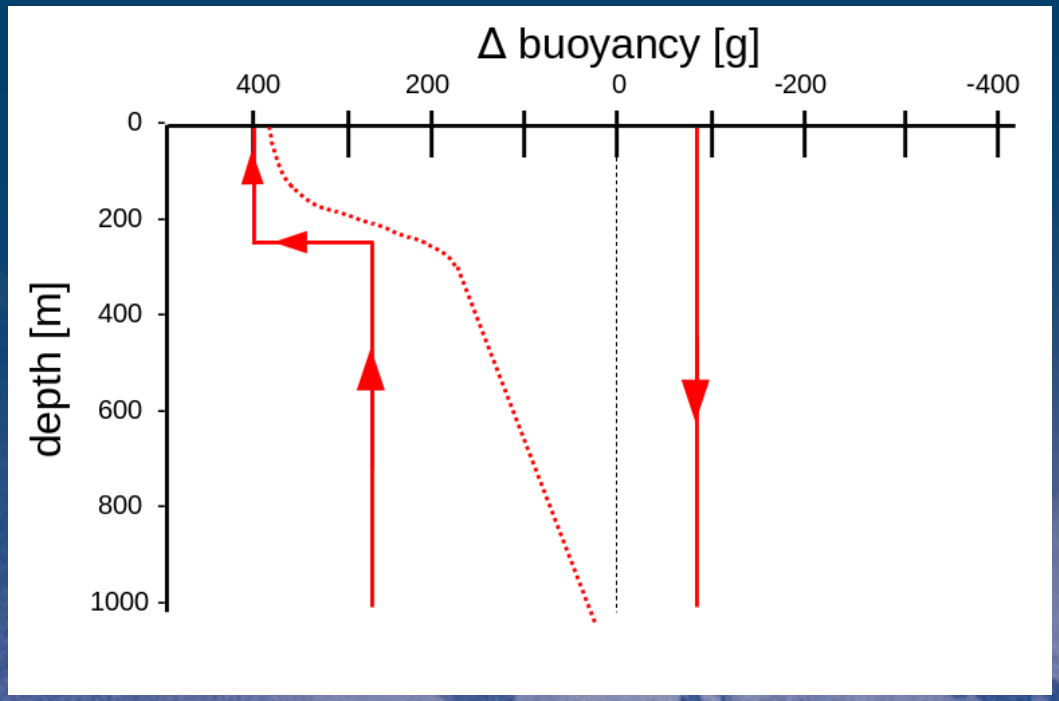
Unified Pump



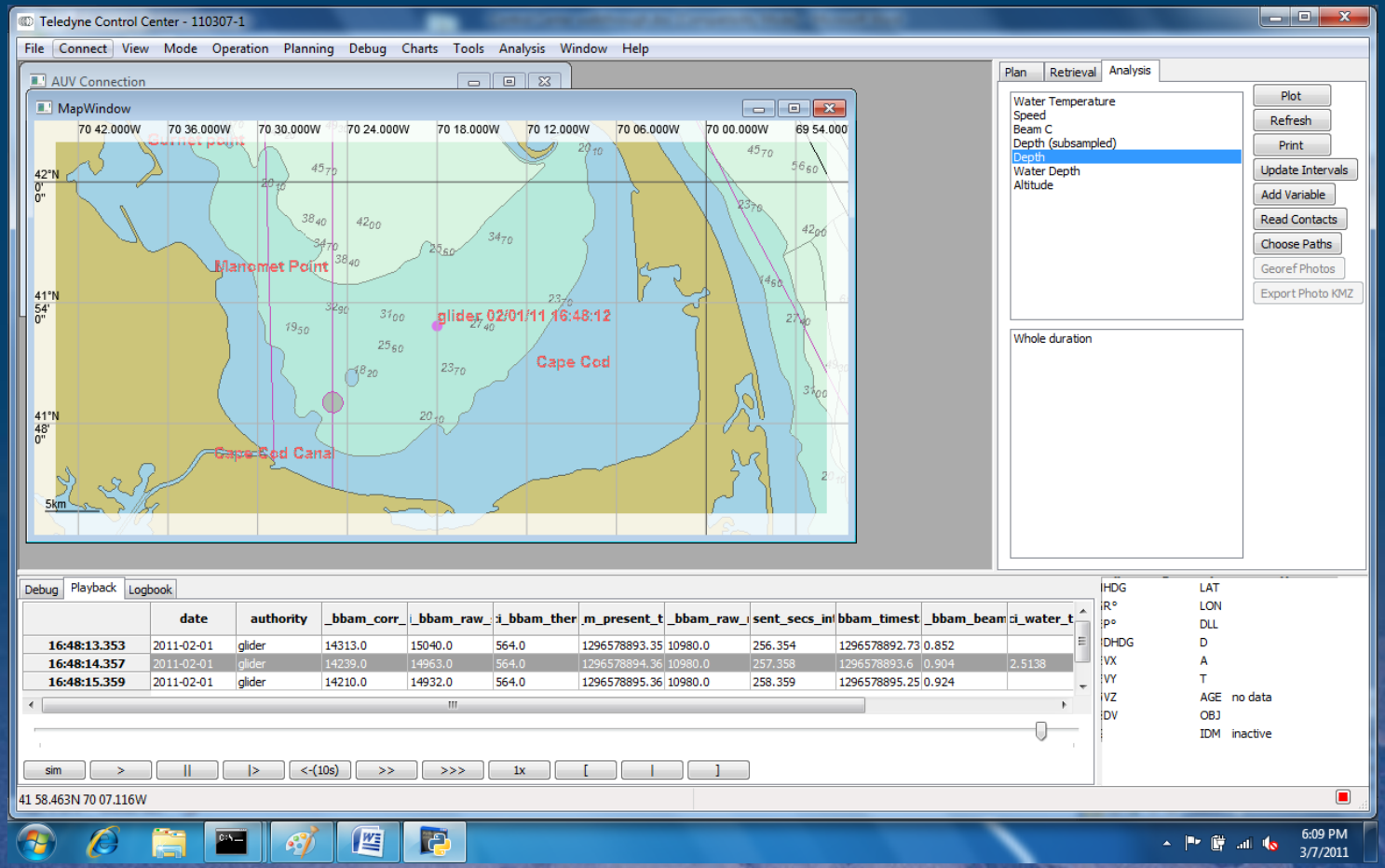
- Greater Displacement
- Reduced Maintenance Interval
- Self De-Gassing
- Reduced Hydraulic Paths
- Adaptable Pump Efficiency
- High Range Valve Flow Control

Auto-ballast and Speed Control

- Maintain a minimum vehicle speed
- Controlled ascent through low density/low buoyancy thermocline



Mission Planning Tools



Sensor Packages

Acoustic Modem
ADCP
Altimeter
Bathyphotometer (bioluminescence)
Beam Attenuation Meter
Optical Backscatter
Optical Attenuation
Oxygen
Conductivity, Temperature, Depth
Fish Tracking
Fluorometer
Hydrophones
PAR sensor
Radiometer
Scattering Attenuation Meter
Spectrophotometer (red tide detection)
Turbulence

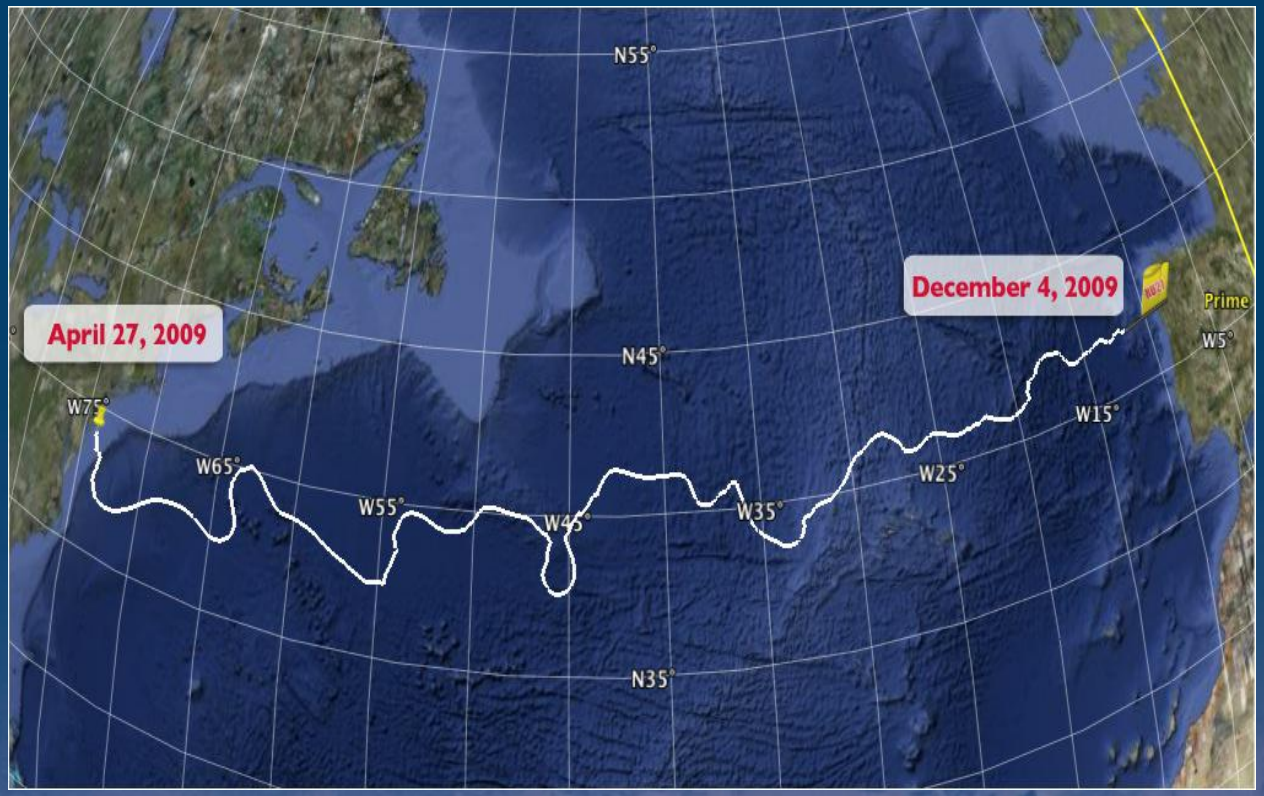
Modular 6 L Payload Bay
Nominally 3 – 6 kg air weight
Customized for a variety of acoustic, optic and chemical sensors

Science Bays can be stacked or stretched.

Sensor Suites

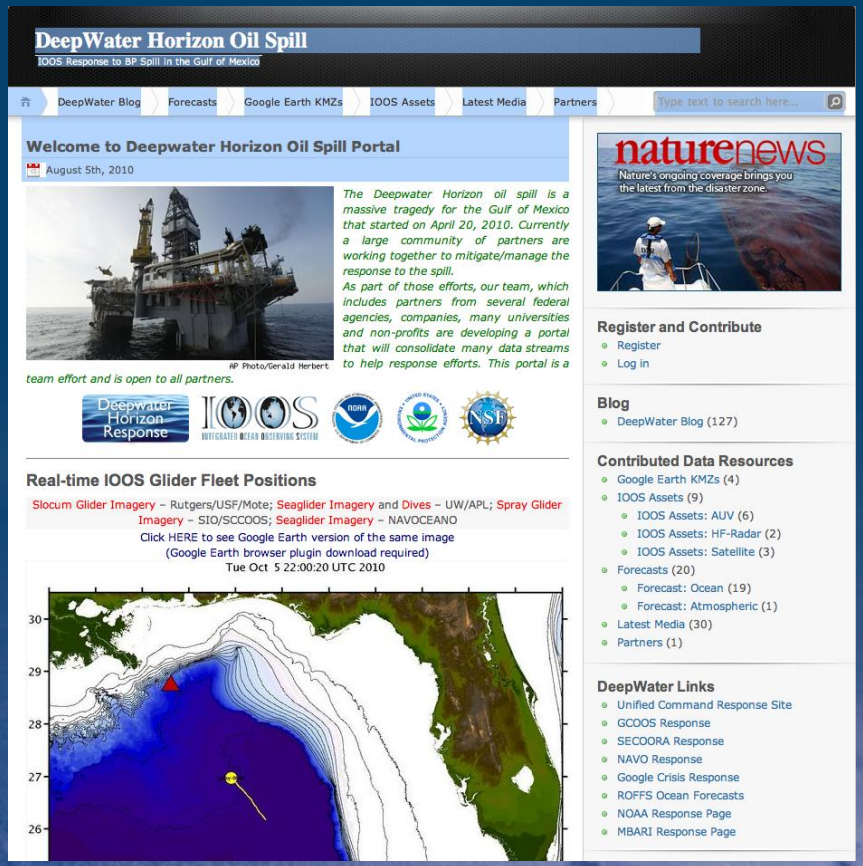
RU27 NJ – Spain April – December 2009

221 Days
7,409 km



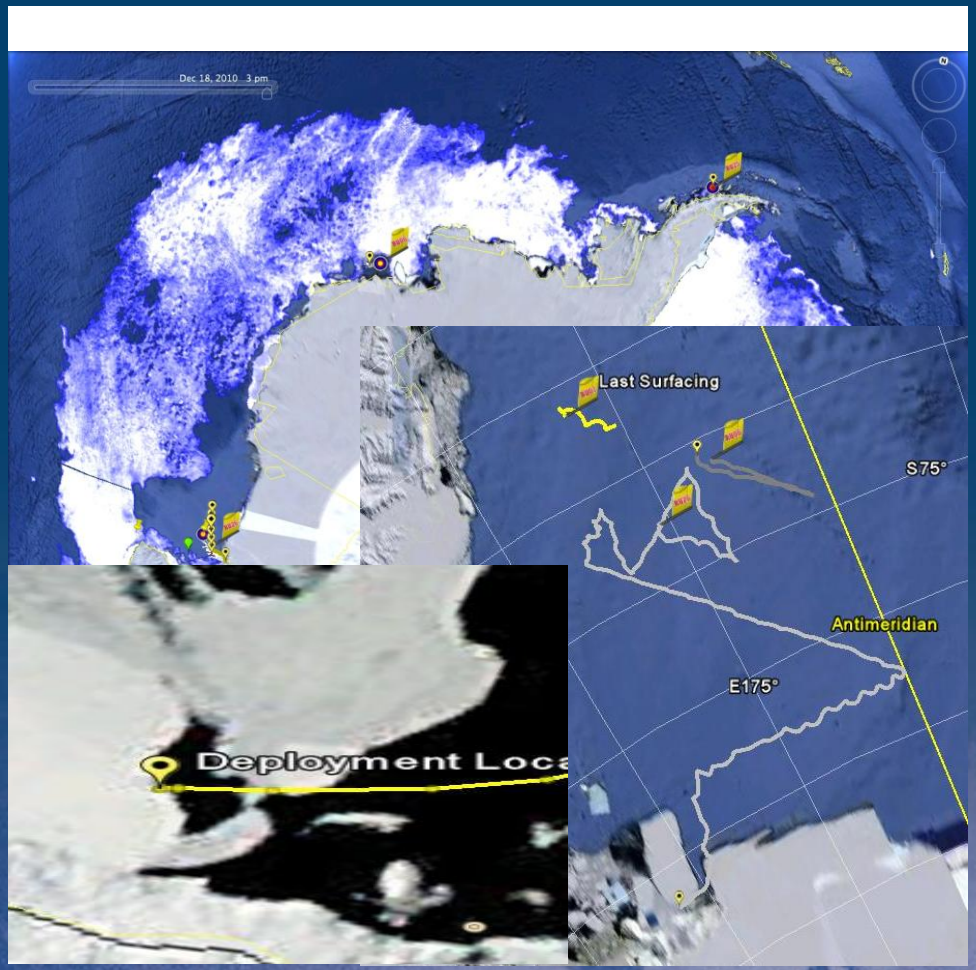
Smithsonian Ocean Hall

Deepwater Horizon Oil Spill

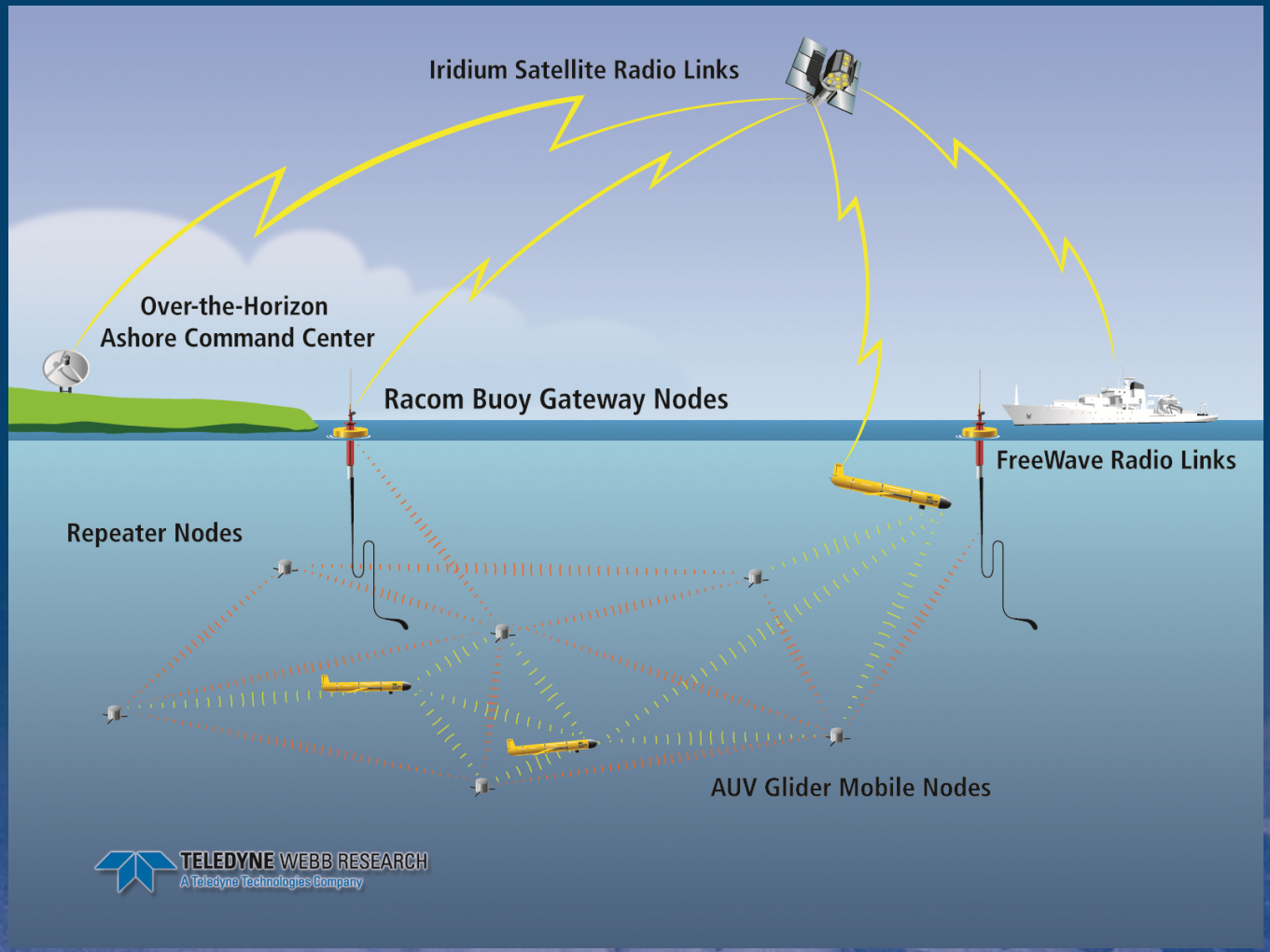


Glider	# Deployed	Tot Days	Tot Dist (km)
RU21	1	35	607
RU23	5	87	1582
UD 134	3	51	1111.5
Bass	3	31	552
Waldo	4	74	1476
Sam	2	39	677
TOTALS:	**18**	**317**	**6005.5**

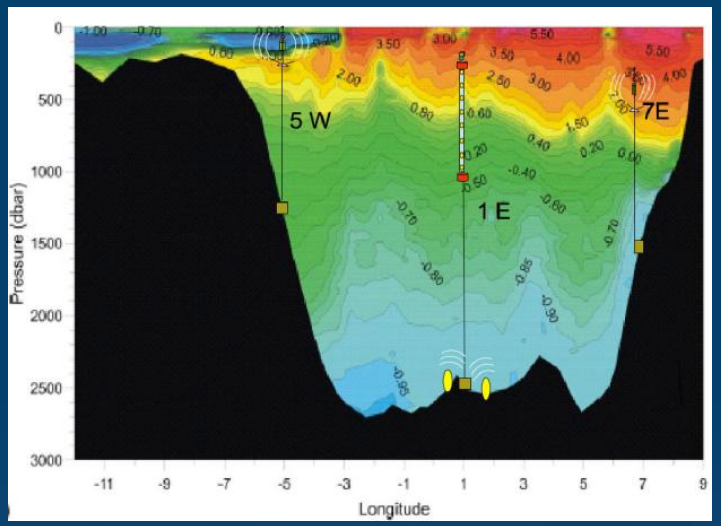
Antarctic Deployments



Gateway Gliders

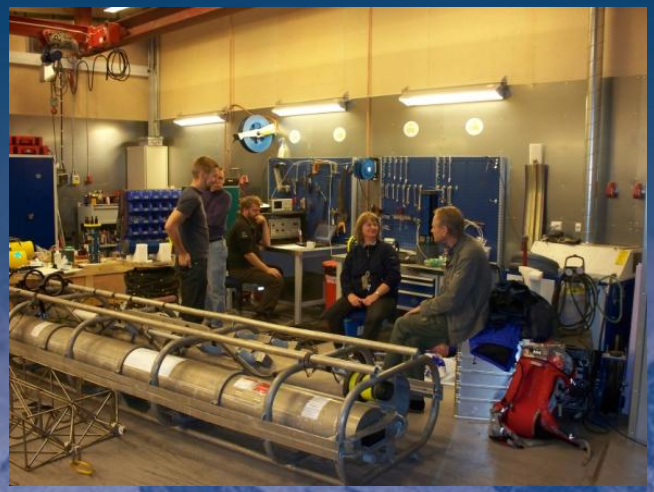


Under Ice Acoustics

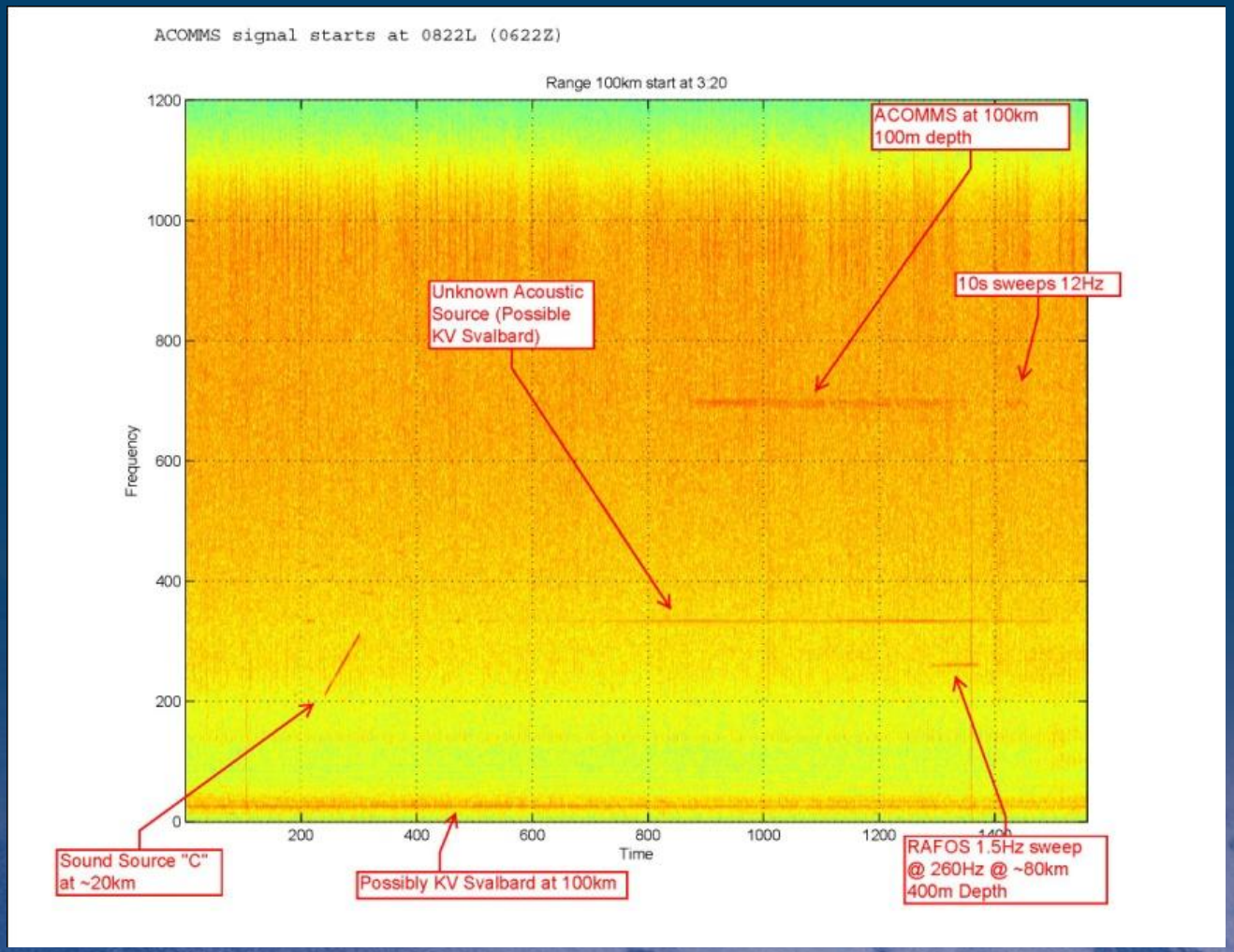


- **Long-Range Navigation**

Duda T.F., Morozov A.K., Howe B.M., Brown M.G., Speer K., Lazarevich P., Worcester P.F., Cornuelle B.D. Evaluation of a Long-Range Joint Acoustic Navigation / Thermometry System, *Proceedings of Oceans 2006.*



Under Ice Navigation & Communication



- Glider Navigation and Long-Range Communications
  - 6 bpd
  - 694Hz

Reference:: L.Freitag and M.Stojanovic, "Basin-Scale Acoustic Communication: A Feasibility Study Using Tomography M-Sequences," in Proc. IEEE Oceans'01 Conference, Honolulu, HI, November 2001.

Slocum Thermal Glider

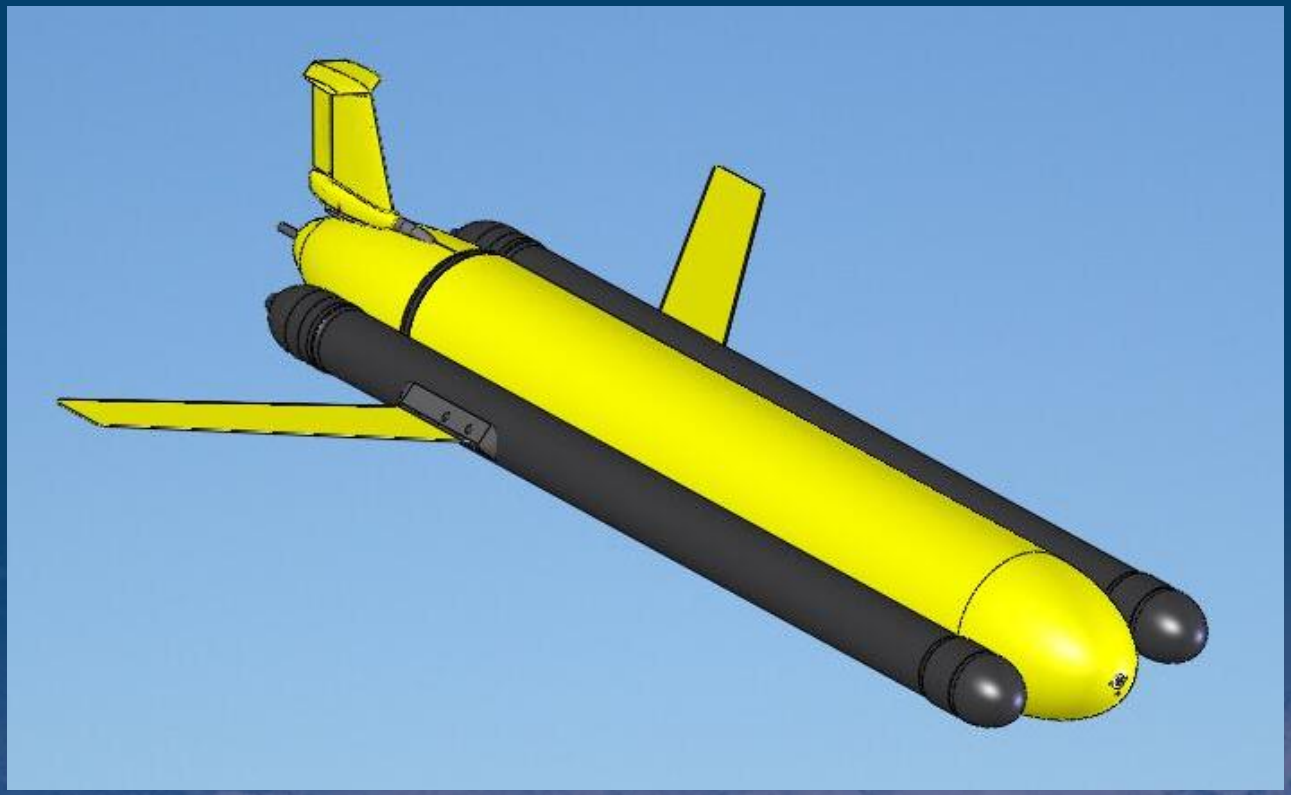
Long range and high endurance

- Propulsion energy source: Environmental (Thermal)
- Projected Endurance: 3 - 5 years
- Max. depth: 1200 m
- 56 Kg
- Operable in approximately 65% of the world's oceans

Cook (Unit 151)

- Traveled 2650 km in 106 days
- Cook: 25 km/day
- Used 60 amp/hr out of 750 available

Electrical Generation – Endurance to ?



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