



Slocum Gliders

Expanding the Capabilities

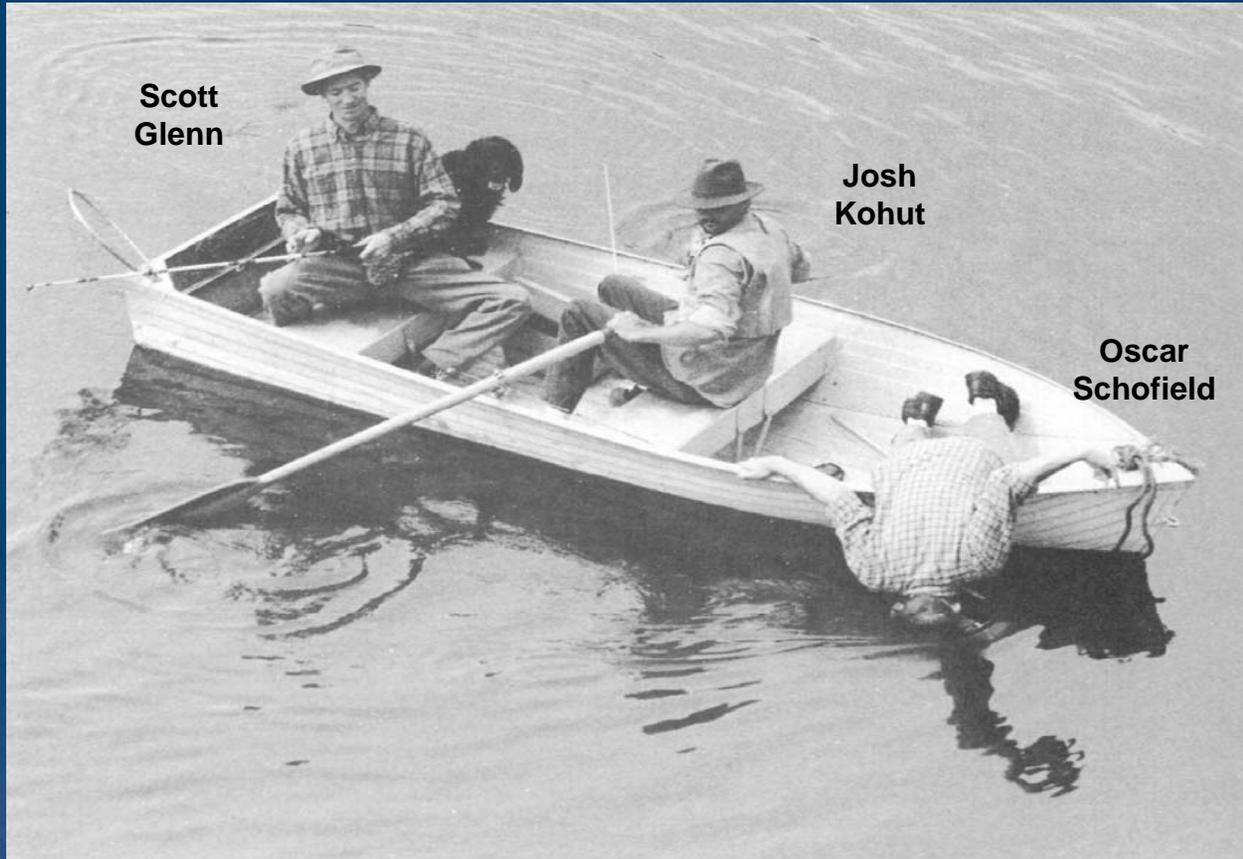


C. Jones, B. Allsup, T. Altshuler 2010

Teledyne Webb Research

Image by Dan Crowell

Oceanographic Observation Methods



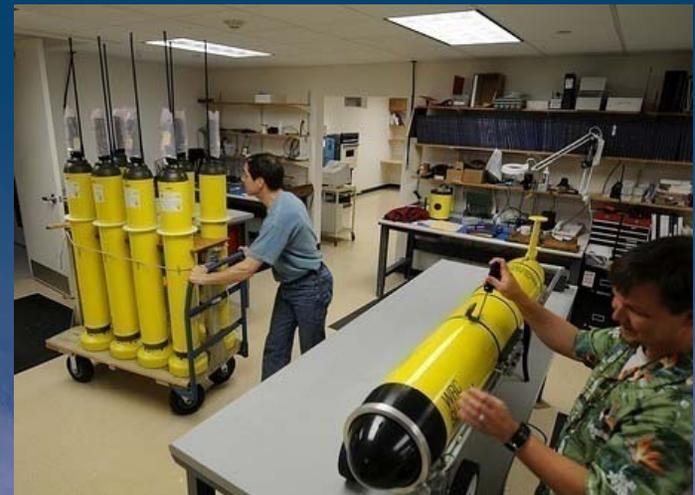
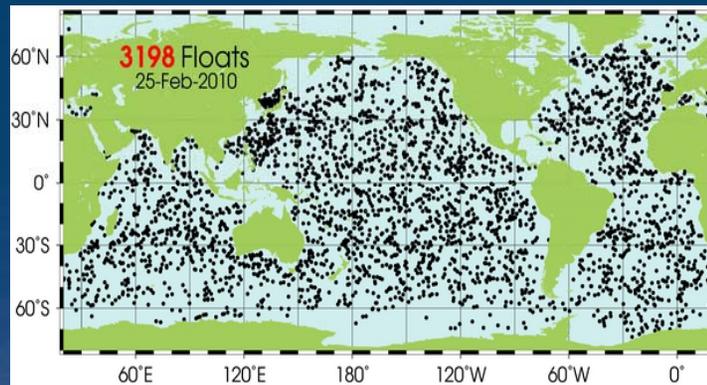
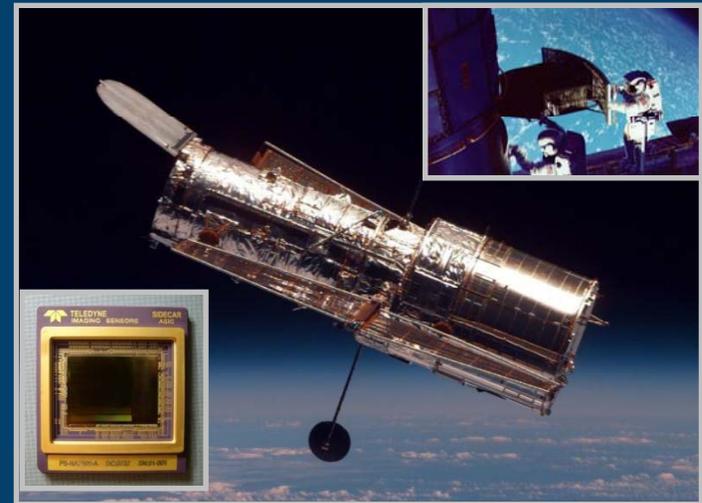
Despite heroic efforts, the ocean is chronically under-sampled.



Teledyne

Provides platforms and tools to enable the world to better understand the universe.

Deep Space to Deep Ocean



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Slocum Mission and Gliders

“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.”

Henry Stommel, The SLOCUM Mission, 1989



Doug Webb



Henry Stommel

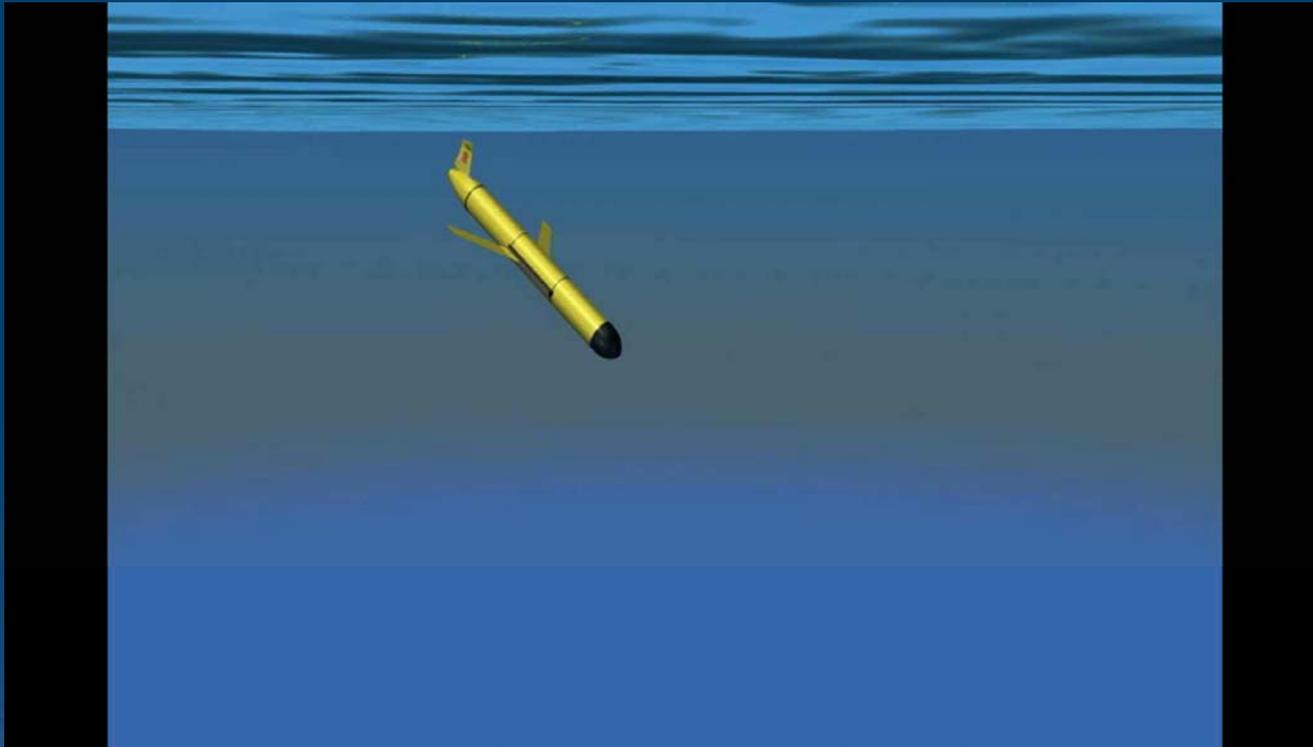


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Glider "Flight"



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Slocum Glider Family:

- Littoral Electric 30m, 100m, 200m
- Deep Electric 1000m
- Slocum G2 with modular pumps
- Thermal 1200m



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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

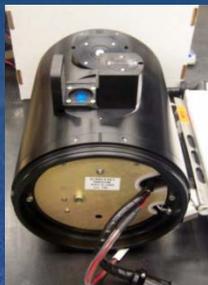
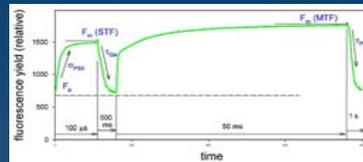
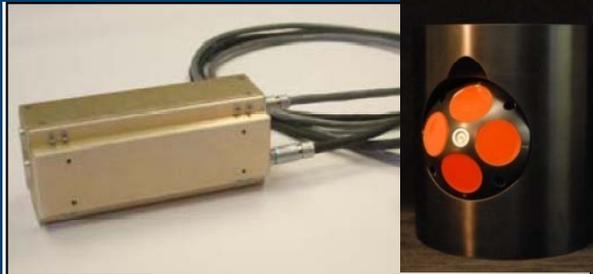


Modular 6 L Payload Bay
Nominally 3 – 6 kg air weight
Customized for a variety of acoustic,
optic and chemical sensors

Science Bays can be stacked or
stretched.



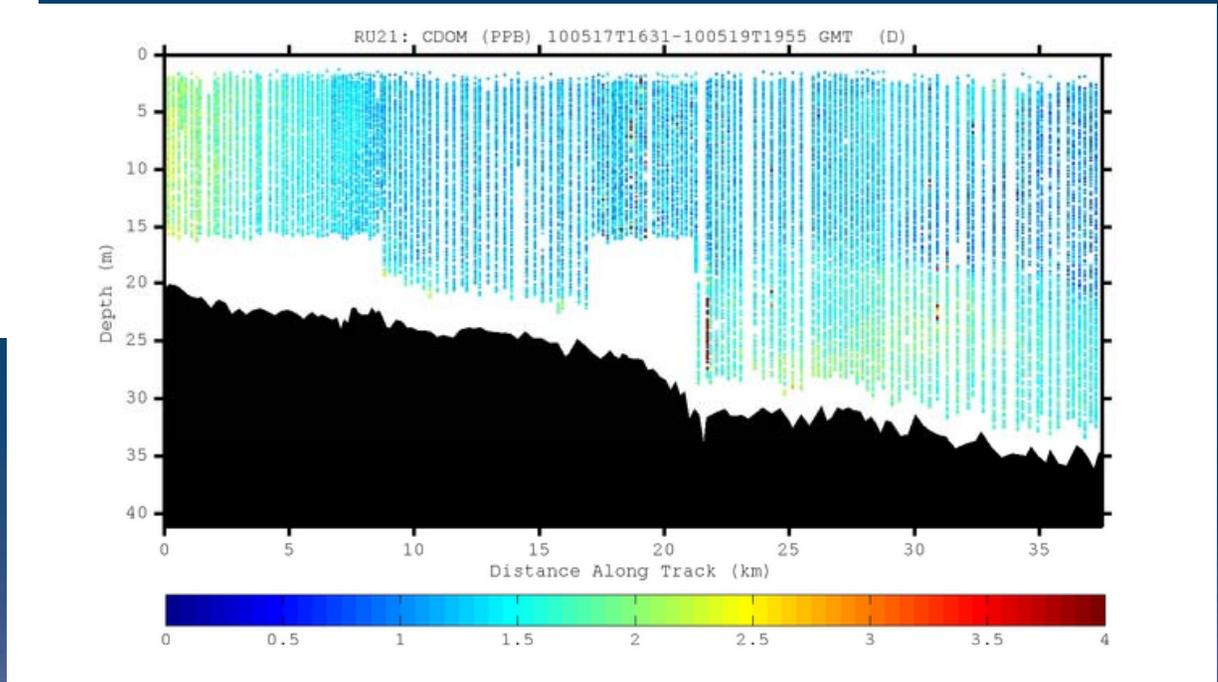
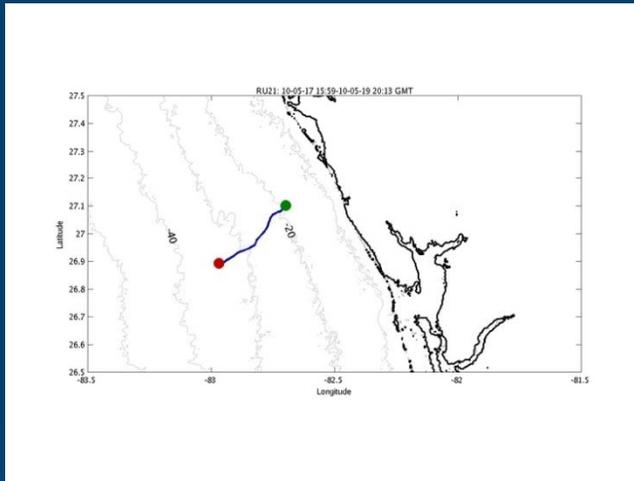
Sensor Suites



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Gulf of Mexico – Oil Spill



Physical Current Models & CDOM

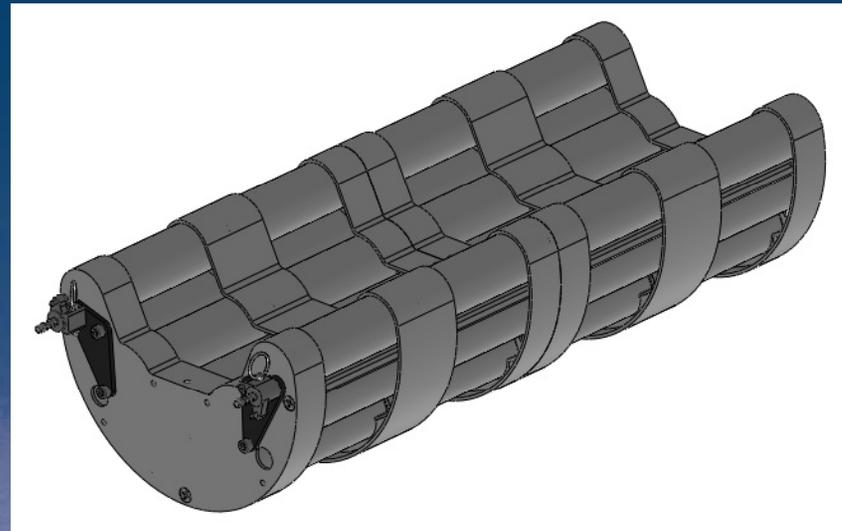
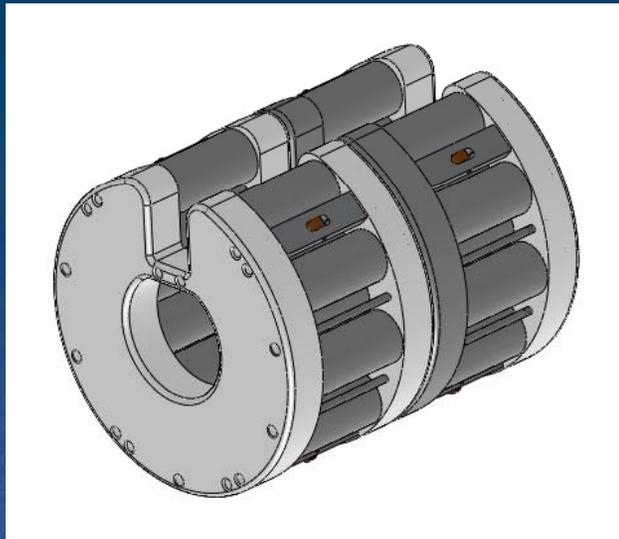


Batteries

Alkaline: 260 C cells.

Lithium-ion: 24 packs of 12 each 18650-22 cells.

Lithium: SAFT 26500 220 & 340 C cells.
Electrochem CSC93 435 C cells.
Electrochem CSC93 78 DD cells.



Additional Payload/Energy Capacity

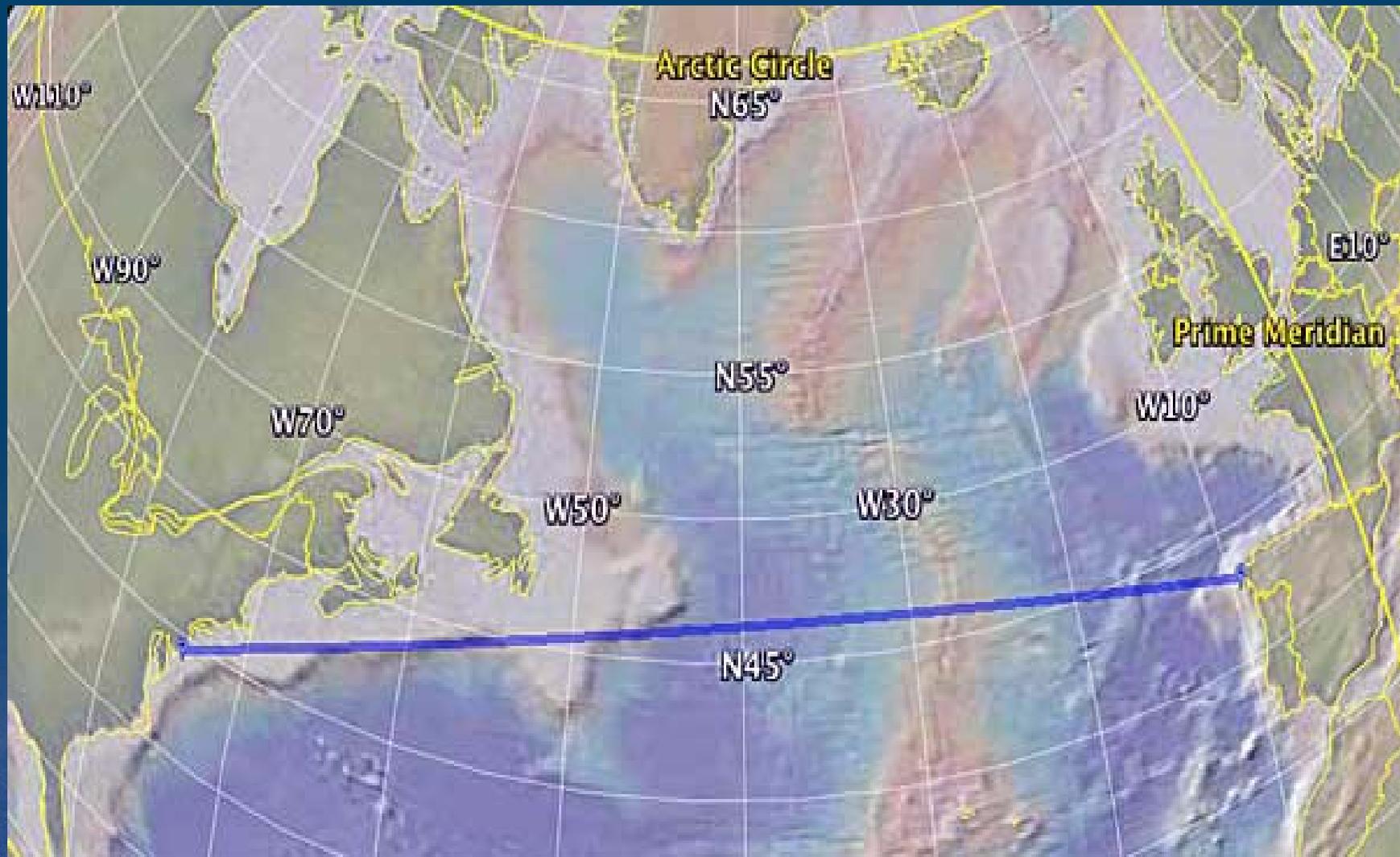


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The Challenge



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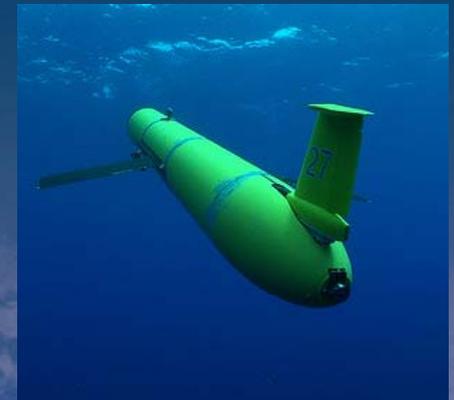
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RU17 NJ – Azores

5,700 km 160 day Flight
May – October, 2008



RU27 NJ – Azores

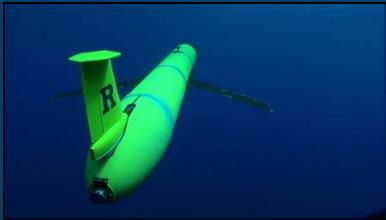


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RU27 NJ – Spain April – December 2009



221 Days
7,409 km
11,000 Dives
11,000 Climbs

*Energy Equivalent of 8 minutes
power for lights on the
Rockefeller Center Tree.*



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Recovery



Photo by Dan Crowell



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Baiona, Spain

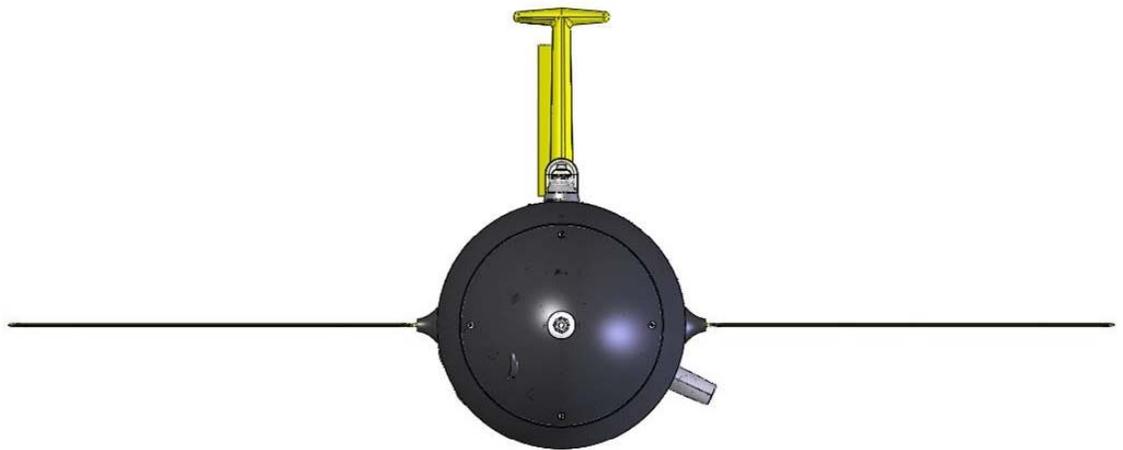
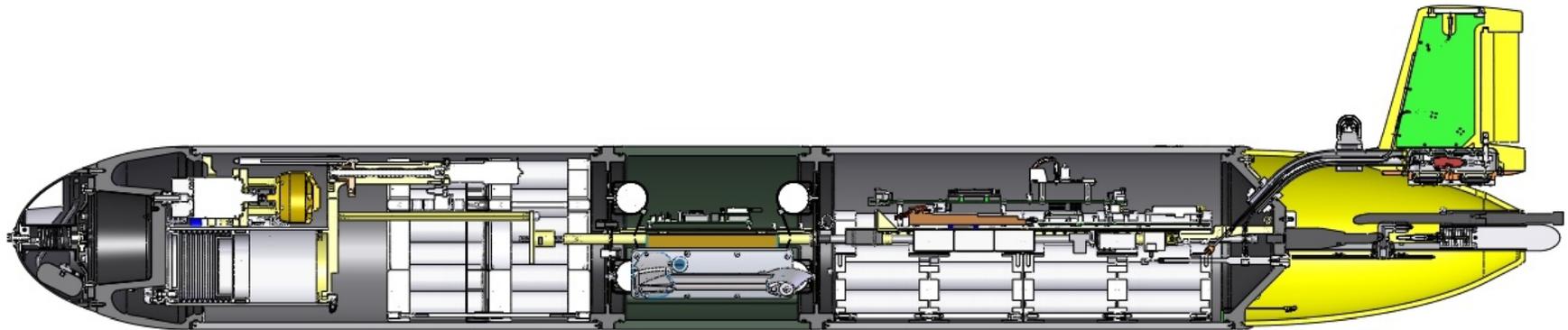


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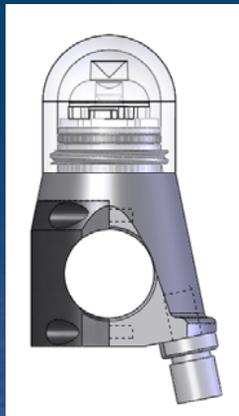
Slocum G2 & LBS-G



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Recovery Aids



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Slocum Command & Control (C2)

The screenshot displays the Slocum C2 software interface. The main window is titled "Slocum C2" and features a Google Earth map of the Atlantic Ocean. The map shows several glider tracks (drake, RU05, RU21, RU23, RU27, UD134) and various overlays (Fleet Updater, MARCOOS, Spanish Coast cc, STATUS, Spanish Coast Po). The map includes a compass, zoom controls, and a "Google" logo. The bottom of the map shows coordinates: 34°55'06.22" N, 60°33'19.55" W, elev -16124 ft, and an eye alt of 7604.46 mi.

Below the map is the "Mission Parameters" section, which includes tabs for "Waypoints", "Yo", "Surface", "Sampling", "Glider Output", and "Log". The "Yo" tab is active, showing a graph of Dive Depth (400 m) and Dive Angle (26 deg) over time. The graph also displays Climb Depth (100 m) and Climb Angle (26 deg). A text box on the right contains the following mission parameters:

```
behavior_name=yo
# yo10.ma
# climb 3m dive 12m alt 9m pitch 26 deg
# Hand Written
# 18-Feb-02 tc@DinkumSoftware.com Initial
# 13-Mar-02 tc@DinkumSoftware.com Bug fix,
end_action from quit(0) to resume(2)
# 09-Apr-03 kniewiad@webbresearch.com Adjusted
for Ashmet

<start_b_arg>
b_arg: start_when(enum) 2 # pitch idle (see
doco below)
b_arg: num_half_cycles_to_do(nodim) -1 #
```

The Windows taskbar at the bottom shows the Start button, several application icons, and the system tray with the time 9:38 PM.



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

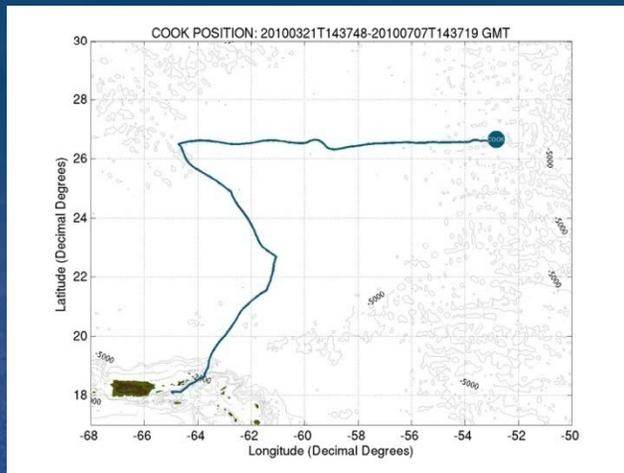


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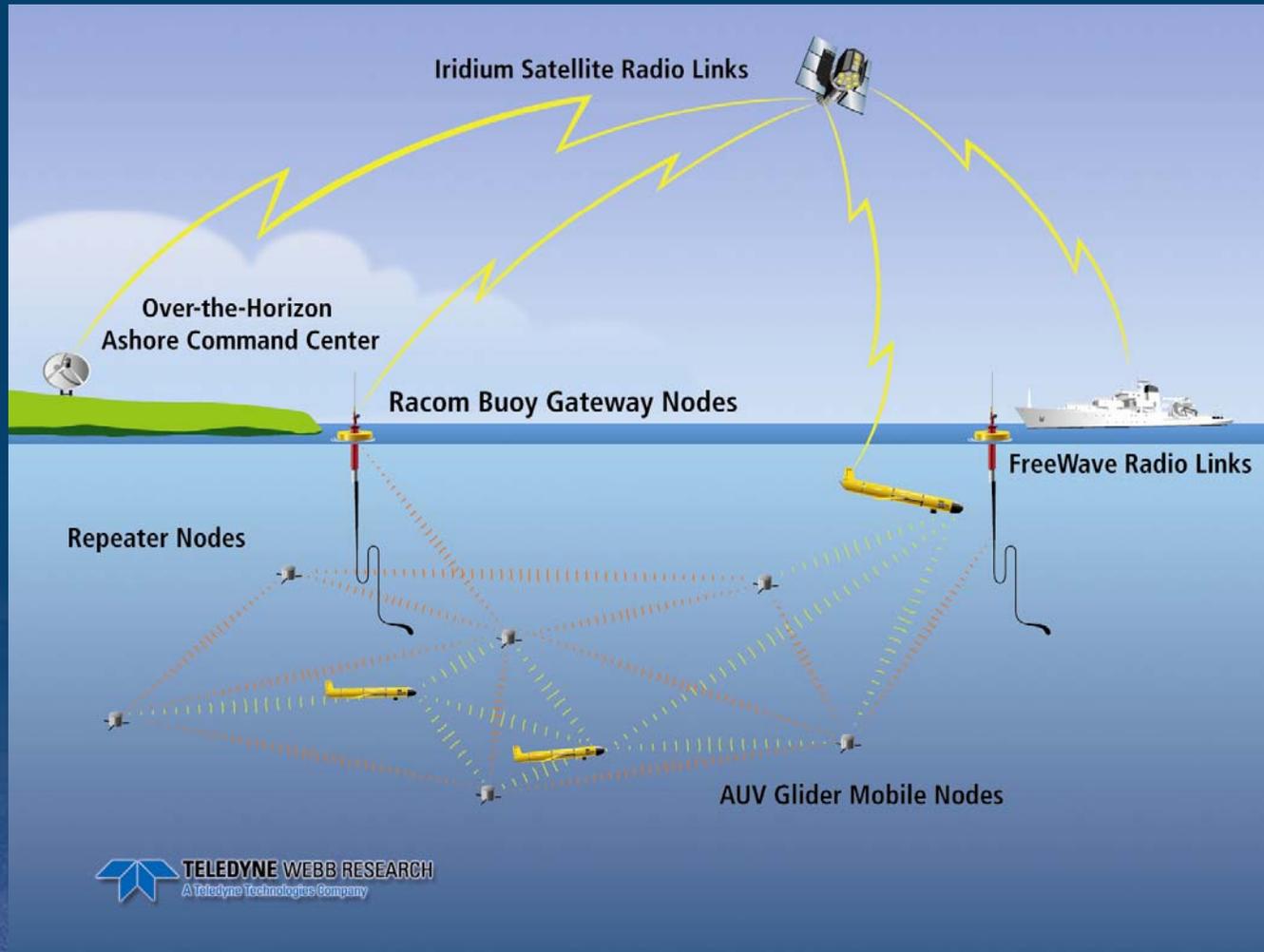


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James Cook - launch March 21, 2010



Gateway Gliders

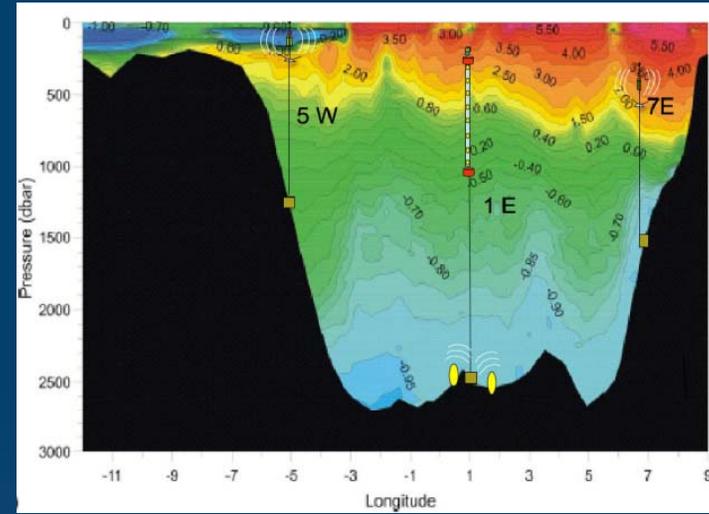


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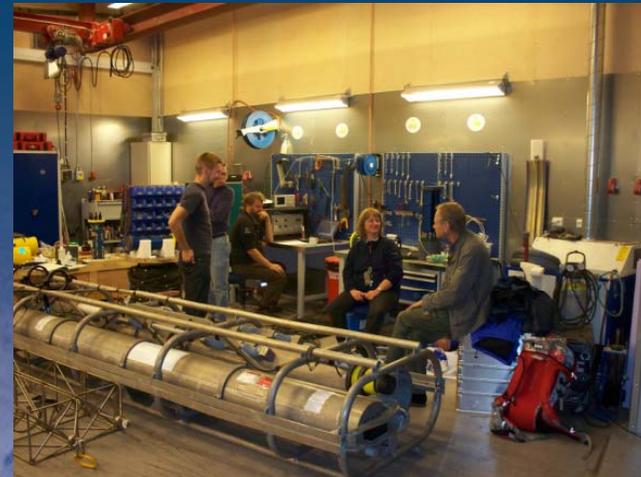
Under Ice Acoustics

The Arctic Acoustic Tomography

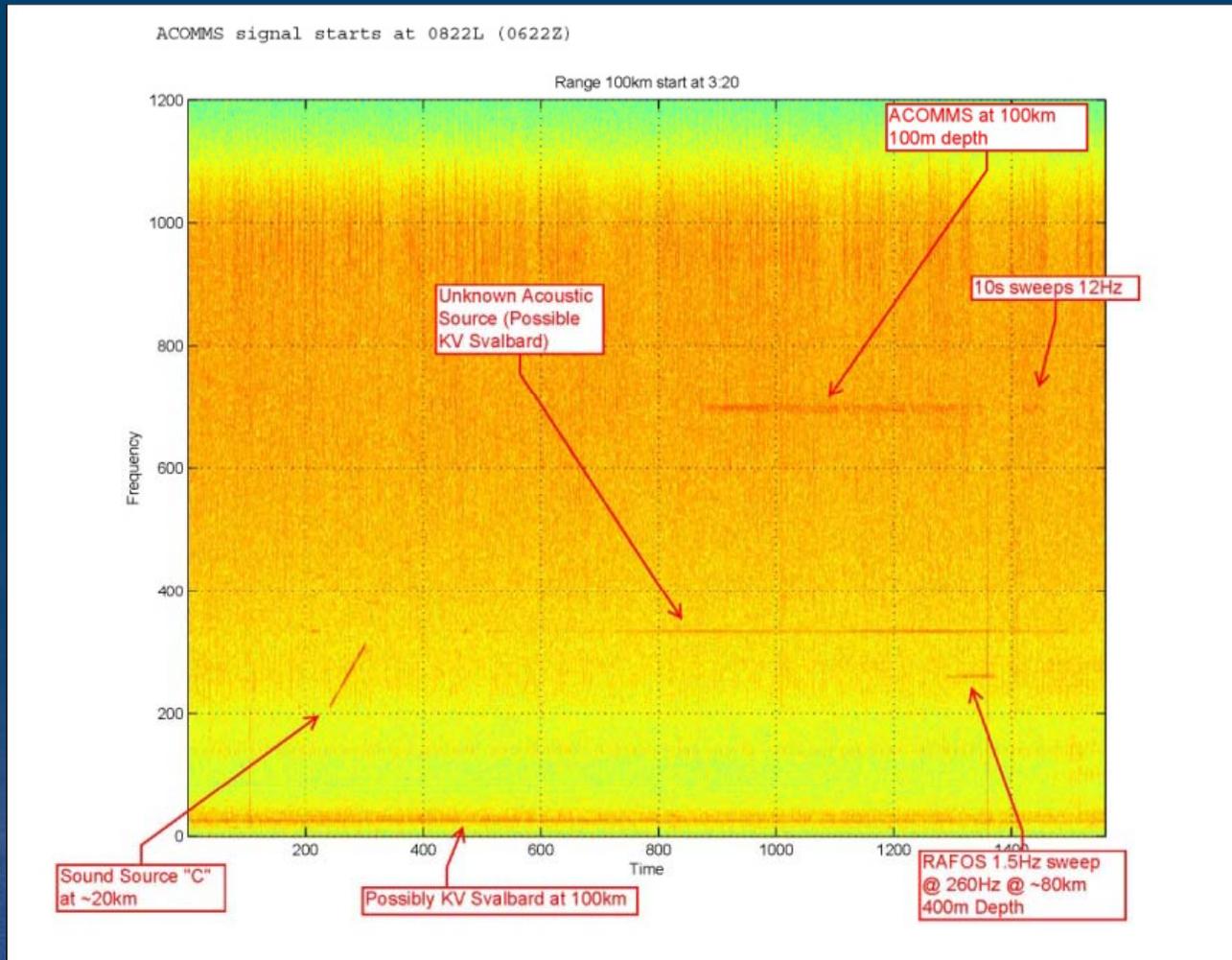


- Long-Range Navigation

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



The Future

- The vehicle versatility will continue to improve
- Endurance will increase
- Sensors choices will expand

We are just starting to explore the oceans!



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