Importance of Technology and the Ocean

Thomas B. Curtin, Ph.D.

28 June 2005
Technology is the stepping stone to the true state of the ocean.

Perceived Ocean

True Ocean

Fidelity

Time

1800 1900 2000

Nansen bottle

SOFAR float

Bathythermograph

Mooring

Satellite

Autonomous Vehicle

Technology is the stepping stone to the true state of the ocean.
Depiction of the world by Ptolemy.
Nansen water bottles before (I), during (II), and after (III) reversing. (From Dietrich et al. 1980)
Oxygen (µM/kg) for A23_A16 25W
Temperature Pictures
Speed of Sound

- Speed of Sound (m/s)
- Increase
- Mixed Layer
- Thermocline
- Deep Water
- Sonar
- Echo
- Noise
- Shadow Zone (No echo here)
- Machinery noise
Early chart showing the Gulf Stream
Temperature Charts
Temperature measured by Ship Profiles, AOSNII experiment
AOSN-II Glider Tracks (August 2003)

(> 11,000 profiles)
<table>
<thead>
<tr>
<th></th>
<th>Slocum Glider</th>
<th>Seaglider</th>
<th>Spray Glider</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Webb Research Corporation</td>
<td>University of Washington Applied Physics Laboratory</td>
<td>Scripps Institution of Oceanography Instrument Development Group</td>
</tr>
<tr>
<td>Electric</td>
<td>Electric</td>
<td>Electric</td>
<td>Electric</td>
</tr>
<tr>
<td>Thermal</td>
<td>Thermal</td>
<td>Thermal</td>
<td>Thermal</td>
</tr>
<tr>
<td>Weight</td>
<td>123 lb</td>
<td>132 lb</td>
<td>110 lb</td>
</tr>
<tr>
<td>Diameter</td>
<td>21 cm</td>
<td>21 cm</td>
<td>30 cm</td>
</tr>
<tr>
<td>Length</td>
<td>1.5 m</td>
<td>1.5 m</td>
<td>2.8 m</td>
</tr>
<tr>
<td>Horiz. Speed</td>
<td>0.6 knots</td>
<td>0.6 knots</td>
<td>0.6 knots</td>
</tr>
<tr>
<td>Max Depth</td>
<td>200 m</td>
<td>2000 m</td>
<td>1000 m</td>
</tr>
<tr>
<td>Endurance</td>
<td>15-30 days</td>
<td>5 years</td>
<td>6 months</td>
</tr>
<tr>
<td>Range</td>
<td>600-1500 km</td>
<td>40,000 km</td>
<td>4000 km</td>
</tr>
<tr>
<td>Energy</td>
<td>Battery</td>
<td>Environment</td>
<td>Battery</td>
</tr>
<tr>
<td>Comms</td>
<td>Iridium</td>
<td>Iridium</td>
<td>Iridium</td>
</tr>
</tbody>
</table>
Glider Movement Diagram

- GPS and Iridium antenna at tail
- Change buoyancy to dive or ascend
- Wings for forward propulsion
- Move batteries fore and aft to change pitch
- Nose down orientation at surface provides robust communications
- No propeller, or other external moving parts. Can be carried by two people.
Temperature measured by 5 SIO Gliders, AOSNII experiment
Advantages

What advantage does adapting to the environment provide to PD, PFA?

How to obtain the best field estimates given sparse sampling?

What advantage does a clustered, adaptive architecture provide to predictive skill?

What advantage does targeted observation give to predictive skill?

What advantage does a nested, adaptive aperture antenna provide to PD, PFA?

Feature tracking

Target glimpse

What gain advantage do mobile, vector arrays provide?
Example Coverage Analysis for All Gliders in AOSN-II

σ varies 2 km (at shore) to 10 km (at 4000m depth), \( \tau = 24 \) hours,
Outside black contour, locations not sampled for 48 hours.
New Tools for Ocean Exploration

- Seaglider
- Slocum
- Spray
- Liberdade
Labrador Sea: 5 month deployment

Communication Summary
Total number of dives: 423
Dives requiring 1 call: 238 (56%)
Dives requiring 2 calls: 89 (21%)
Dives requiring 3 calls: 28 (6%)
Dives requiring 4 calls: 20 (4%)
Dives requiring 5 calls: 11 (2%)
Dives requiring 6 calls: 4 (0%)
Dives requiring 7 calls: 4 (0%)
Dives requiring 8 calls: 15 (3%)

Communication Summary
Total number of dives: 347
Dives requiring 1 call: 122 (35%)
Dives requiring 2 calls: 55 (15%)
Dives requiring 3 calls: 18 (5%)
Dives requiring 4 calls: 11 (3%)
Dives requiring 5 calls: 89 (25%)
Dives requiring 7 calls: 1 (0%)
Dives requiring 8 calls: 22 (6%)

Note: Up to 10 meter wave heights reported

http://seaglider.ocean.washington.edu/gina
Technology is the stepping stone to the true state of the ocean.