Is Multibeam Water Column Data Really Worth the Disk Space?

Lindsay Gee and Maurice Doucet - QPS, Inc.
David Parker – UK Hydrographic Office
Tom Weber and Jonathan Beaudoin – CCOM-JHC UNH
Acknowledgements

• Chris Hancock
• Tom Reis
• Jens Steenstrup
Data fusion of current modalities is mature...

...but what is happening in the water column?
Background:
Multibeam Sonars and the Water Column

- 1997: Simrad SM2000
- 2002: 3D Visualization
Background:
MBES WC – Beyond Fisheries

- 2003: Imaging bubble populations (Weber et al.)
- 2003: Suspended particulate density (Jones)
- 2003: Military mid-water targets (Gallaudet and deMoustier)
- 2006: Hydrographic survey applications, least depth detection (Hughes Clarke)
- 2011: Oil detection (Weber et al.)
Looking at the Water Column
Multibeam Volumetric Imaging Examples: Atlantic Herring

Raw Data

Layered, transparent isosurfaces of constant amplitude
Water Column Tool: Background

- **GOAL:** Provide easy to use tool to actually USE water column data, across MANY applications

- 2008: IVS 3D supported CCOM to develop and commercialize software for working with water column data

- 2010: FMMidwater beta being used during Deep Water Horizon and on other research projects

- 2010: IVS 3D releases FMMidwater as part of the Fledermaus Suite
CCOM Water-Column Project

Challenges:

- Huge data volumes – bathy to backscatter to water-column
- Most of the time there isn’t much to see
- Proliferation of sonar formats
- Geospatial and temporal data
- Variety of applications and requirements
Water Column Tool: FM Midwater

Requirements included:

- Simple/fast mid-water feature extraction
- Unification of a mid-water format - GWC
- Ability to manage/view files in non-linear time
- Multiple metaphor - 4D visualization
- Application specific analysis tools - plugin
FMMidwater

Range Solution (Bottom Detect)

NOT the Range Solution
FMMidwater

Fan

Curtain

ASCII Refracted Points

ASCII Points

ASCII
Applications

Hard Targets

• Hydrographic

Soft Targets

• Fisheries
• Oceanography
• Geophysics/Geology
• Engineering

System Performance
UK Civil Hydrography Programme Trial

Compare least depth over wrecks from:
- Wire Sweep
- MBES conventional bottom detect
- Side Scan Sonar
- MBES Water Column Data

MBES:
- Kongsberg EM 3002D
- Kongsberg EM 710
- Reson SeaBat 7125
UK CHP Trial
## UK CHP Trial Results

<table>
<thead>
<tr>
<th>No.</th>
<th>Wreck-Name</th>
<th>General depth [m]</th>
<th>MBES least depth [m]</th>
<th>WCD least depth [m]</th>
<th>SSS least depth [m]</th>
<th>Wire sweep cleared depth [m]</th>
<th>Difference from Next Shoalest [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hloposes Boiler</td>
<td>34.00</td>
<td>28.6</td>
<td>28.6</td>
<td>28.6</td>
<td>-</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>T-FG-009</td>
<td>37.30</td>
<td>36.0</td>
<td>35.9</td>
<td>36.0</td>
<td>-</td>
<td>0.1</td>
</tr>
<tr>
<td>3</td>
<td>T-FG-014</td>
<td>34.20</td>
<td>30.3</td>
<td>30.1</td>
<td>30.3</td>
<td>-</td>
<td>0.2</td>
</tr>
<tr>
<td>4</td>
<td>T-FG-016</td>
<td>37.00</td>
<td>29.6</td>
<td>29.6</td>
<td>29.6</td>
<td>-</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>T-HB-018</td>
<td>43.00</td>
<td>38.2</td>
<td>38.0</td>
<td>38.2</td>
<td>-</td>
<td>0.2</td>
</tr>
<tr>
<td>6</td>
<td>T-VH-003</td>
<td>41.00</td>
<td>35.6</td>
<td>35.6</td>
<td>35.3</td>
<td>-</td>
<td>0.3</td>
</tr>
<tr>
<td>7</td>
<td>W-16309</td>
<td>40.00</td>
<td>31.6</td>
<td>31.8</td>
<td>31.8</td>
<td>-</td>
<td>0.2</td>
</tr>
<tr>
<td>10</td>
<td>W-16400</td>
<td>28.90</td>
<td>20.3</td>
<td>20.4</td>
<td>20.8</td>
<td>-</td>
<td>0.1</td>
</tr>
<tr>
<td>11</td>
<td>W-16445</td>
<td>40.00</td>
<td>34.3</td>
<td>32.6</td>
<td>34.3</td>
<td>-</td>
<td>1.7</td>
</tr>
<tr>
<td>12</td>
<td>W-16515</td>
<td>39.00</td>
<td>32.3</td>
<td>32.2</td>
<td>32.3</td>
<td>-</td>
<td>0.2</td>
</tr>
<tr>
<td>14</td>
<td>W-17789</td>
<td>33.00</td>
<td>27.4</td>
<td>24.8</td>
<td>27.3</td>
<td>-</td>
<td>2.6</td>
</tr>
<tr>
<td>16</td>
<td>W-16439</td>
<td>35.00</td>
<td>30.2</td>
<td>30.2</td>
<td>30.2</td>
<td>-</td>
<td>0.0</td>
</tr>
<tr>
<td>17</td>
<td>Hloposes N</td>
<td>33.60</td>
<td>27.1</td>
<td>27.8</td>
<td>26.6</td>
<td>27.3</td>
<td>0.5</td>
</tr>
<tr>
<td>18</td>
<td>Hloposes S</td>
<td>34.00</td>
<td>30.0</td>
<td>30.0</td>
<td>30.0</td>
<td>29.5</td>
<td>0.5</td>
</tr>
<tr>
<td>19</td>
<td>W-73522</td>
<td>42.40</td>
<td>35.4</td>
<td>35.7</td>
<td>35.9</td>
<td>34.9</td>
<td>0.5</td>
</tr>
<tr>
<td>20</td>
<td>W-73523</td>
<td>39.00</td>
<td>35.9</td>
<td>35.8</td>
<td>36.0</td>
<td>35.4</td>
<td>0.1</td>
</tr>
<tr>
<td>21</td>
<td>EM710-Frame</td>
<td>18.80</td>
<td>18.8*</td>
<td>15.2</td>
<td>-</td>
<td>15.6</td>
<td>0.3</td>
</tr>
</tbody>
</table>
UK CHP Conclusions

- MBES bottom detect not necessarily the shallowest depth within the beam.
- SSS can give valuable extra information about protruding parts of wrecks, but this requires a towfish in the water.
- Wire sweeping is difficult and time consuming, and can be unreliable.
- MBES WCD appears to provide reliable information about protruding parts of wrecks which the MBES alone may miss.
- WCD resolution is normally comparable to a good SSS, but has the advantage of being quicker and easier to gather.
Shallow Survey 2012

- Extraction of additional data to append the bottom detect data (least depth on wreck, confirmation of features)
Gulf of Mexico – Clearance Survey
Gulf of Mexico – Clearance Survey
Gulf of Mexico – Clearance Survey
Gulf of Mexico – Clearance Survey
Shallow Survey 2012
NW Rota-1 Volcano
(US Naval Oceanographic Office)
Acoustic Observations in Support of the Response to the Deepwater Horizon Oil Spill

Tom Weber
CCOM/JHC
University of New Hampshire

CCOM Seminar Series
12 November 2010
Applications for Water Column Data

- Detection and mapping of gas seeps

MBES Acoustic Observations

Ship Track

1350 m

5000 m

Multibeam Sonar Fan

Acoustic backscatter from gas seep
Engineering Inspection - Diffusers
Summary

• Integrated acquisition, processing and analysis.
• Water column data can enhance survey.
• Demonstrated use in additional detection of hard targets – protruding parts of wrecks.
• New applications and understanding — exploration, fisheries, engineering and research.
Thank You – Questions?

Email: gee@qps-us.com