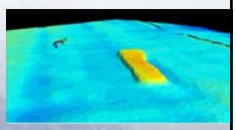
Hydro 2010
Rostock, Germany
November 2-4, 2010

The Right Technology at the Right Place

Presentation by: Francois P. Leroy

Teledyne Marine



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Overview

- Introduction
- Shallow Water Platforms
- Deep Water Platforms
- Positioning and Mapping
- Summary

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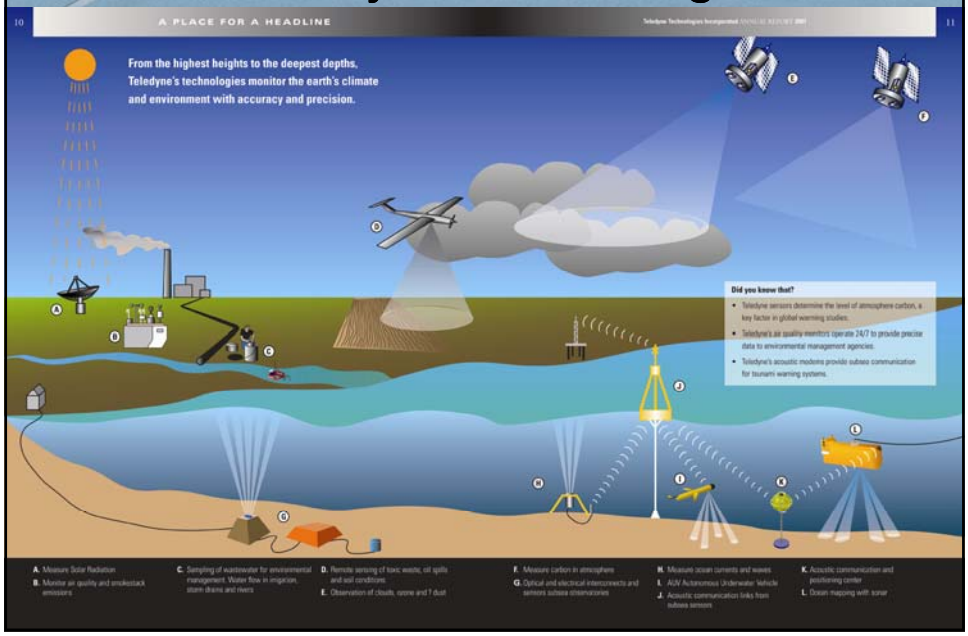

Shallow Water Survey

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Shallow Water Survey

- Challenges
  - Get the right vessel to location
  - Survey efficiencies
  - Data relevance and accuracy
- Solutions
  - Specialized craft or mountings
  - Different sounding solutions
  - Measuring efficiencies and productivity

Shallow Water Survey

- Challenges
  - Accessibility, draft, clearance
  - Stability, equipment load, weather proofing
  - Productivity, performance

Shallow Water Survey - Platforms

What works

Pole mount, Small Craft

Towable Surface platforms

Unmanned Surface Vehicles

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Shallow Water Survey - Platforms

What doesn't work

Underwater Tow Vehicles

Autonomous Underwater Vehicles (very shallow)

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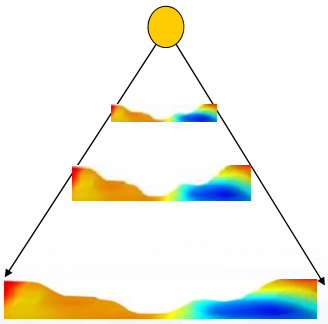
Shallow Water Survey - Sensors

- Choice of sensor

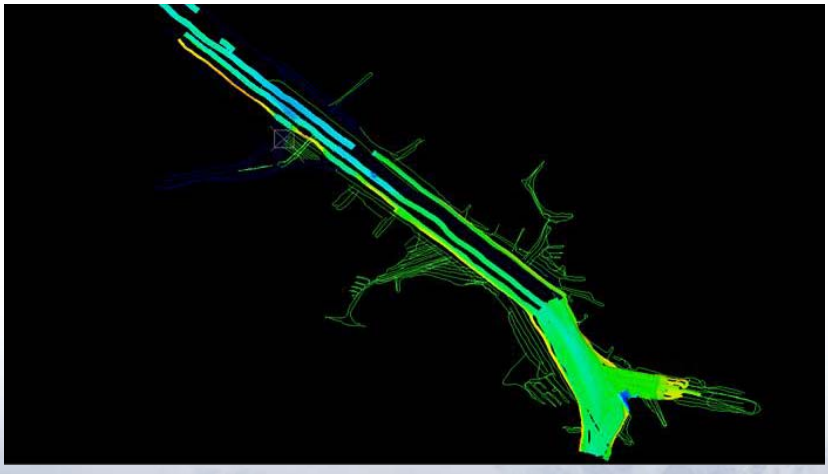
  - Fixed Angle Sensors (multibeam)

    - Greater Vertical Accuracy
    - Range dependant on altitude
    - Poor productivity in shallow water

  - Multibeam is a better choice for main harbor channels and coastal areas

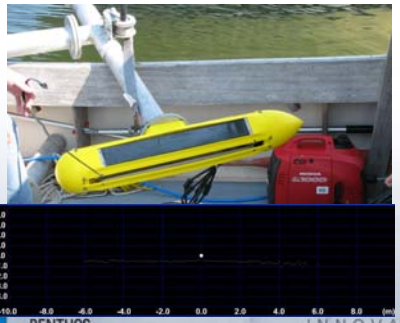


Shallow Water Survey - Sensors



Shallow Water Survey - Sensors

- Platform Choices
  - For Shallow inlets and inland waters
  - Swath Bathymetry (wide side looking beams)
  - Sweep beam system (multiple single beams)



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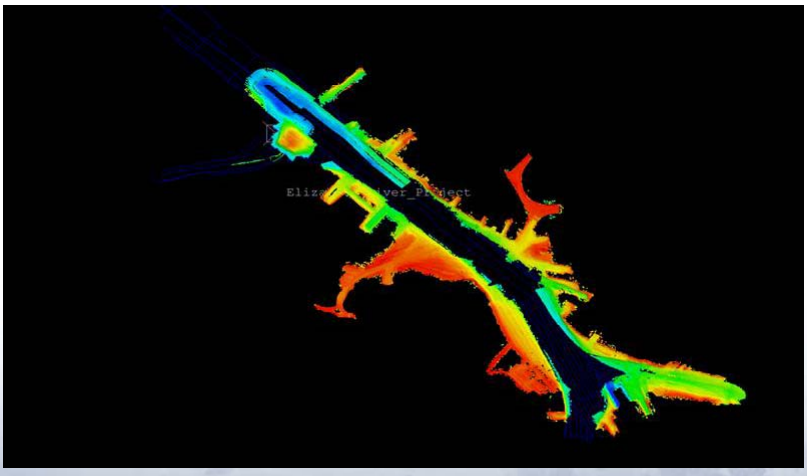
Shallow Water Survey - Sensors



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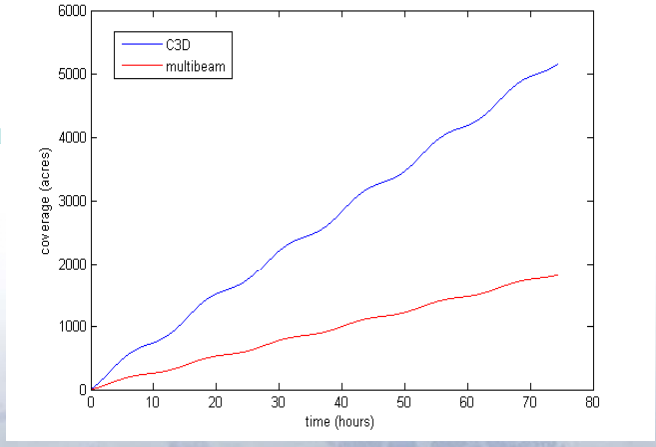
Shallow Water Survey - Efficiencies

- Measuring Efficiencies and Productivity – **Time based**

- **Assumptions**
- **10 times depth below transducer for C3D and 3.5 times water depth for multibeam**
  - **2m water depth**
  - **1m tidal variation**
  - **6 tidal cycles**



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Shallow Water Survey - Efficiencies

- Measuring Efficiencies and Productivity – **Cash based**

Operational Considerations	
Sonar Capital Expenditure	**Variable**
Ancillary Equipment Capital Exp.	**Fixed**
Vessel Day Rate	**Fixed**
Personnel	**Fixed**
Sonar Efficiency	**Variable**
Survey Day Sell Rate	**Fixed**
Survey Days per Year	**Variable**

Financial Considerations	
Working Capital Rate	10%
Discount Rate	5%
Depreciation life (years)	3
Sales growth	5%
Tax	40%
Overhead	7%
Selling expenses	10%
G&A Expenses	8%

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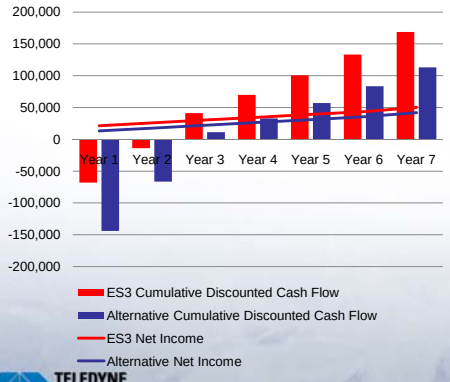
Shallow Water Survey - Efficiencies

- Measuring Efficiencies and Productivity – **Cash based**

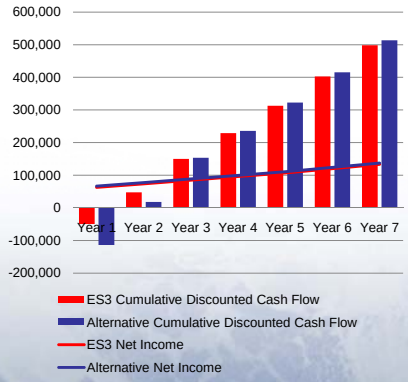
Assumptions – 50 days/yr survey

ES3 and Alternative system Income and Cash Flow



Assumptions – 100 days/yr survey

ES3 and Alternative system Income and Cash Flow



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Deep Water Survey

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Deep Water Seafloor Exploration

- Low Resolution Requirements
  - Study of Shelf and Plate movement
  - Basin level thermography and climate study
  - Fisheries Habitat mapping

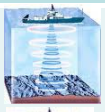
- High Resolution Requirements
  - Search and Recovery
  - Pipe line and Cable routes
  - Engineering Infrastructure Survey
  - Deep Sea Underwater Mining

Deep Water Seafloor Exploration

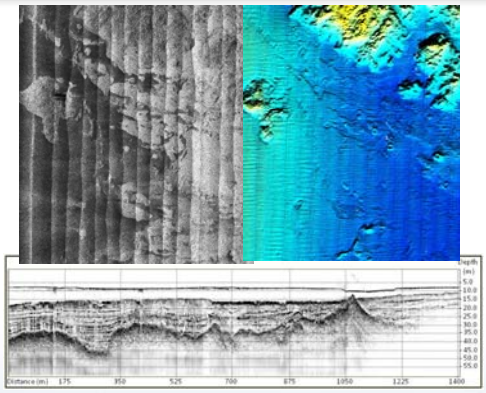
- Methods
  - From Surface Ships with Singlebeam
    - Spars coverage, likely to miss large features
  - From Surface Ships with Multibeam
    - Good positioning/Low resolution – 100m grid

- Deep Sea Survey Tools
  - Deep Tow Platforms
    - Endurance/Integration/High Res. – 1m grid
  - Autonomous Underwater Vehicles (AUV)
    - Closer to Bottom/Less demanding Surface Support

Deep Water Seafloor Exploration

Low Resolution Requirements	High Resolution Requirements
 Adequate Spars covers Efficient data processing ✓	 Inadequate Spars coverage Missing large features
 Efficient Good coverage Good positioning ✓	 Inadequate Large grid size No imagery
 Inadequate Poor positioning Small area coverage	 Efficient Combined sensors Endurance ✓
 Inefficient Poor positioning Short missions	 Adequate Combined Sensors Short missions ✓

Deep Water Sensor Consideration



Combined Sensors for Survey Efficiencies

Deep Water Sensor Consideration

- Mode of Operation (Deep Tow or AUV platforms)
  - Multibeam, Side Scan, Sub-bottom Profiler
    - Multibeam – Higher off the seafloor
    - Side Scan – Closer to the seafloor
    - Sub-bottom Profiler – Closer to the seafloor

  → Compromise data or duplicate survey

  - Swath Bathymetry, Side Scan, Sub-bottom Profiler
    - Swath Bathymetry – Closer to the seafloor
    - Side Scan – Closer to the seafloor
    - Sub-bottom Profiler – Closer to the seafloor

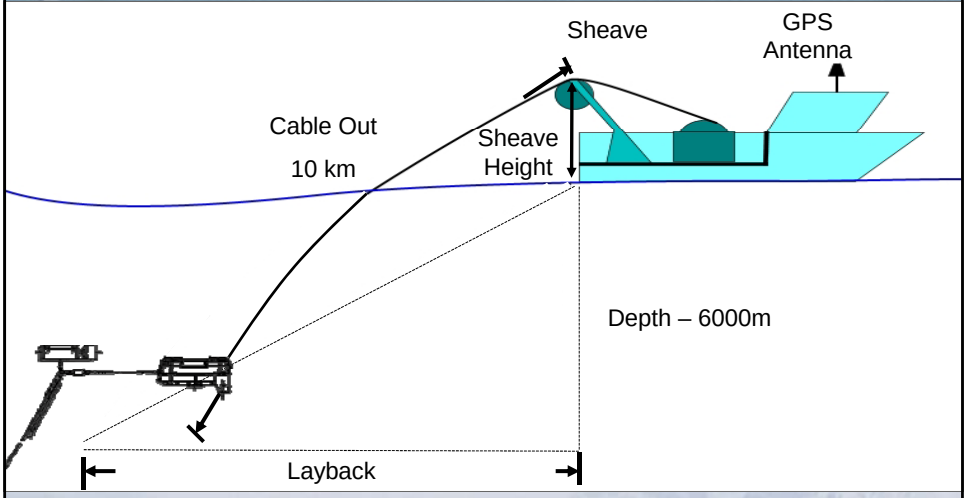
  → No Compromise and Survey Efficiency

Positioning and Mapping

Positioning and Mapping

- Importance of proper positioning – Mapping/Relocation
- Challenges of positioning – Depth/Distance
- Solutions for Positioning
  - Combination of Acoustics/DVL/INS – no deployment
  - USLB or LBL – extensive or limited deployment
  - Subsea and Surface cross reference – no deployment

Distance and Depth

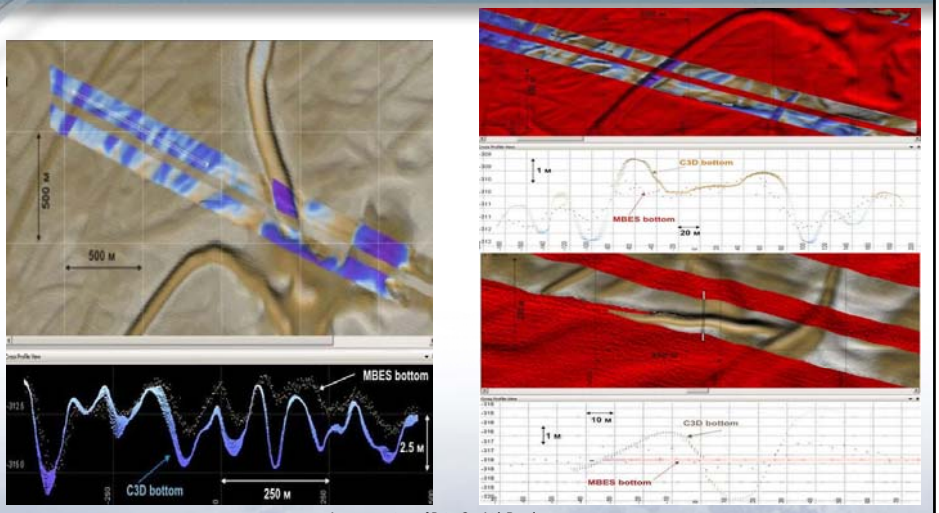


Layback = f(Cable Out, Depth of Depressor, and Tow Speed)

+ g(Cable Length from Depressor and Altitude of Tow-Body above Depressor)

C3D Positioning with Multibeam Dataset

The pictures were presented at the fourth International Conference "Oil and Gas of the Arctic Shelf", Murmansk, Russia, November 12-14, 2008: Modern Technologies of the Geophysical Investigations on the Shelf for the Purposes of Geohazards Detection. A. Fyodorov, S. Mironyuk, S. Kleshchin (Peter Gaz Ltd., Russia)



Images courtesy of Peter Gaz Ltd, Russia

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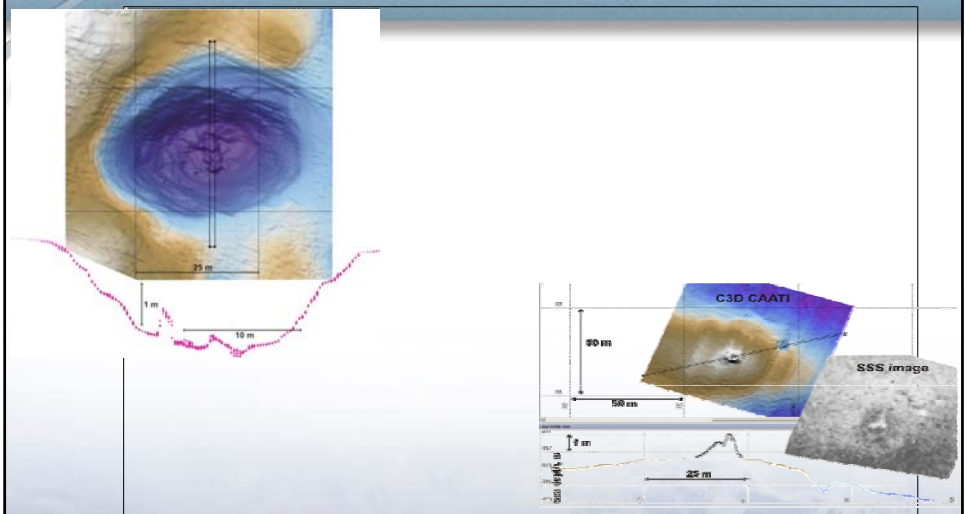
Undetected Information



C3D-SBP samples courtesy to PeterGaz, Russia

Modern Technologies of the Geophysical Investigations on the Shelf for the Purposes of Geohazards Detection.
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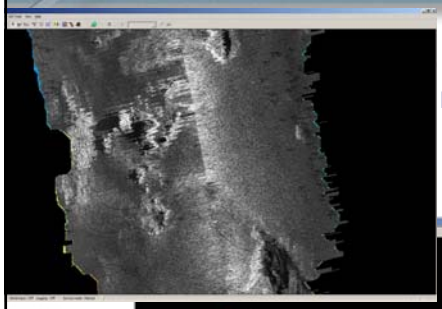
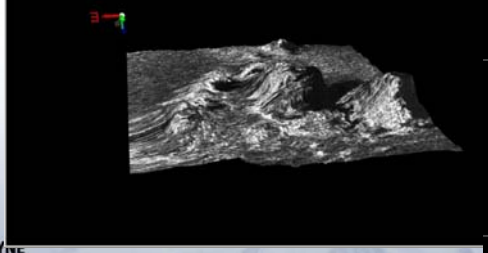
Higher Resolution Data

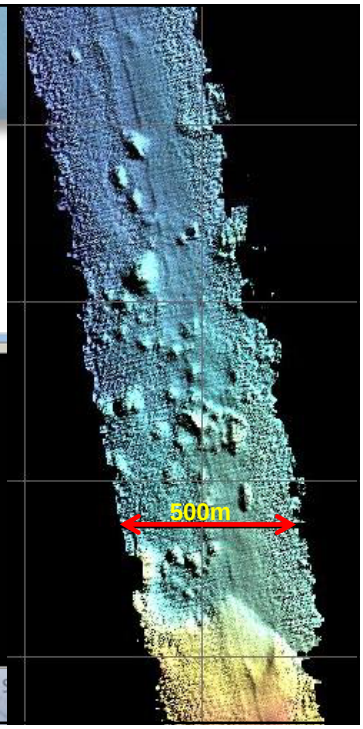


Data relevance and accuracy @ 1500m



3D View

Sub Meter Resolution



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Summary

- Many different tools are available to the Surveyor

- Make application based Instrument selection, rather than solely performance based decisions

- Set and measure goals and performance related to type of operations

- Personnel considerations are important and often tied to the Instrument selection

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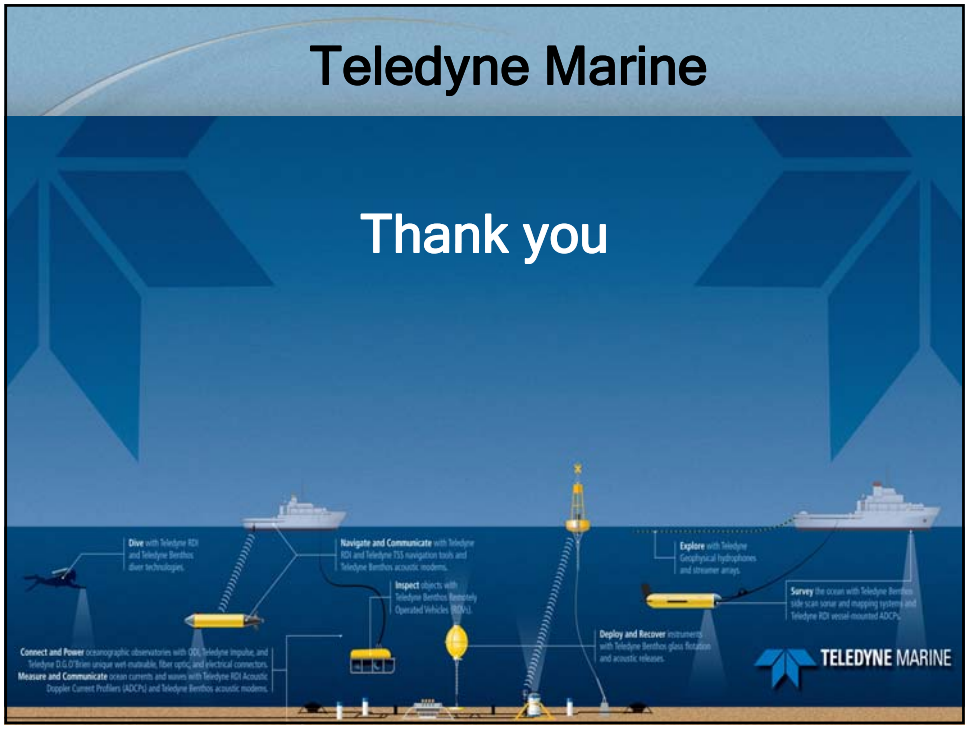
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Navigate and Communicate with Teledyne RDI and Teledyne TSS navigation tools and Teledyne Benthos acoustic modems.
Inspect objects with Teledyne Benthos Remotely Operated Vehicles (ROVs).
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