

Unmanned Semi-Submersible (USS) Project

Chad A. Steed
Naval Research Laboratory

Pete Alleman
C & C Technologies, Inc.
Lafayette, Louisiana

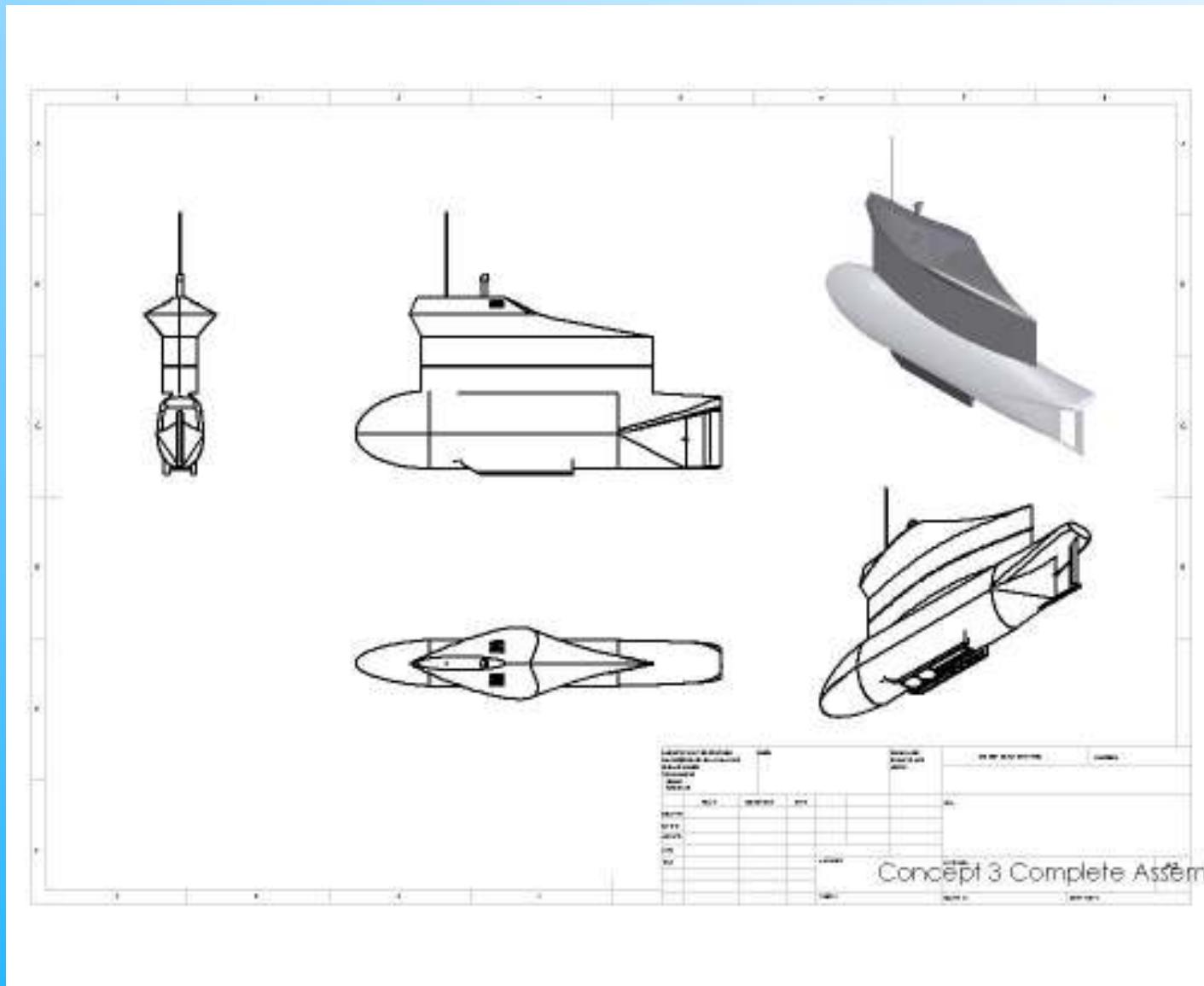
Unmanned Semi-Submersible Project

- The Challenge – Make a better survey launch
 - Better sea keeping
 - Less weather downtime
 - Longer duration
 - Low maintenance
 - Less risk to personnel
- Originally funded through a NOAA contract
 - Now transitioned to an NRL contract

Concept Vehicles

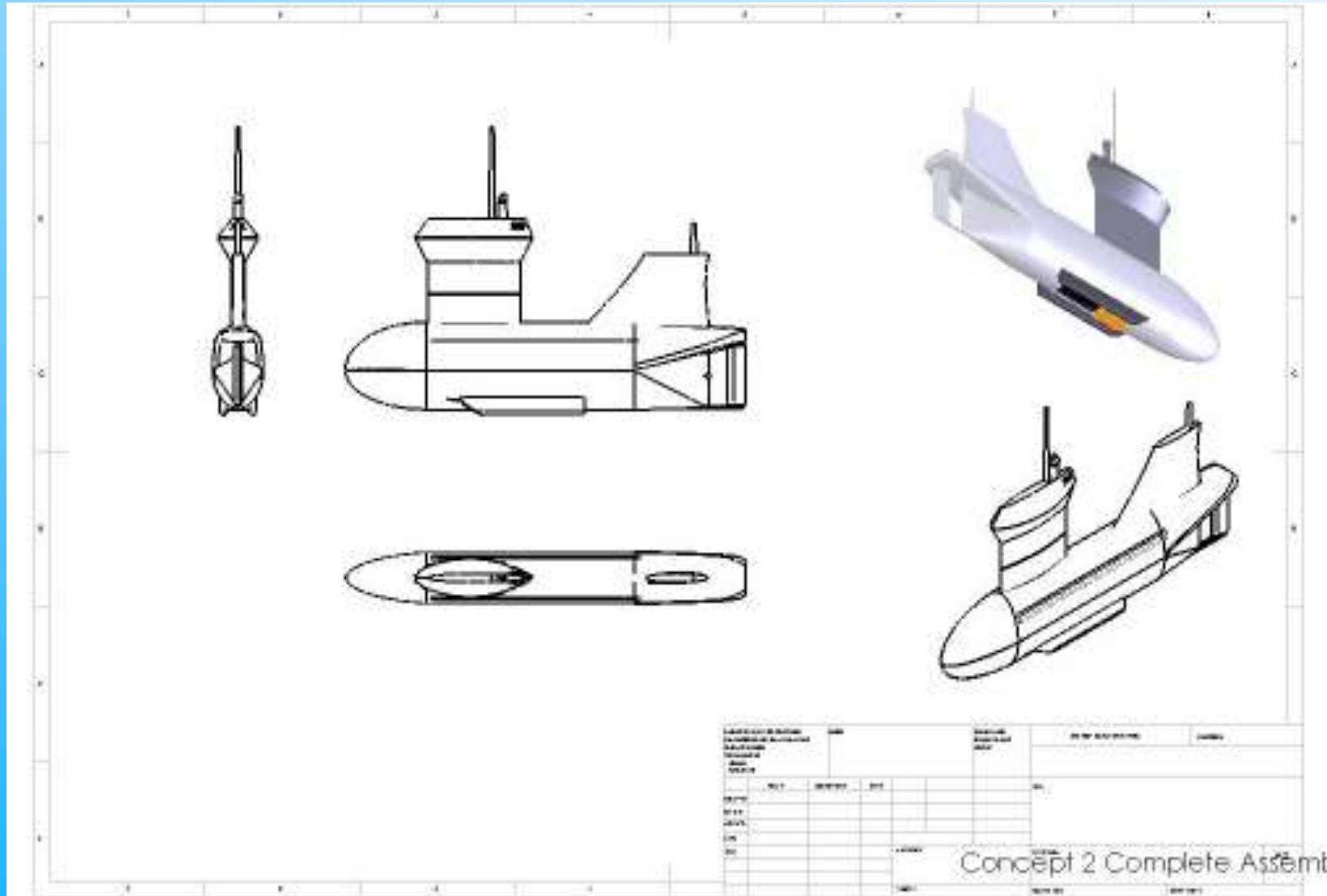
- Floaters and semi-floaters
 - Main hull has surface expression
 - Still affected by rough seas
- Semi-submersible
 - Main hull below sea surface
 - More tolerant of rough seas

Semi-Floater Hull Designs

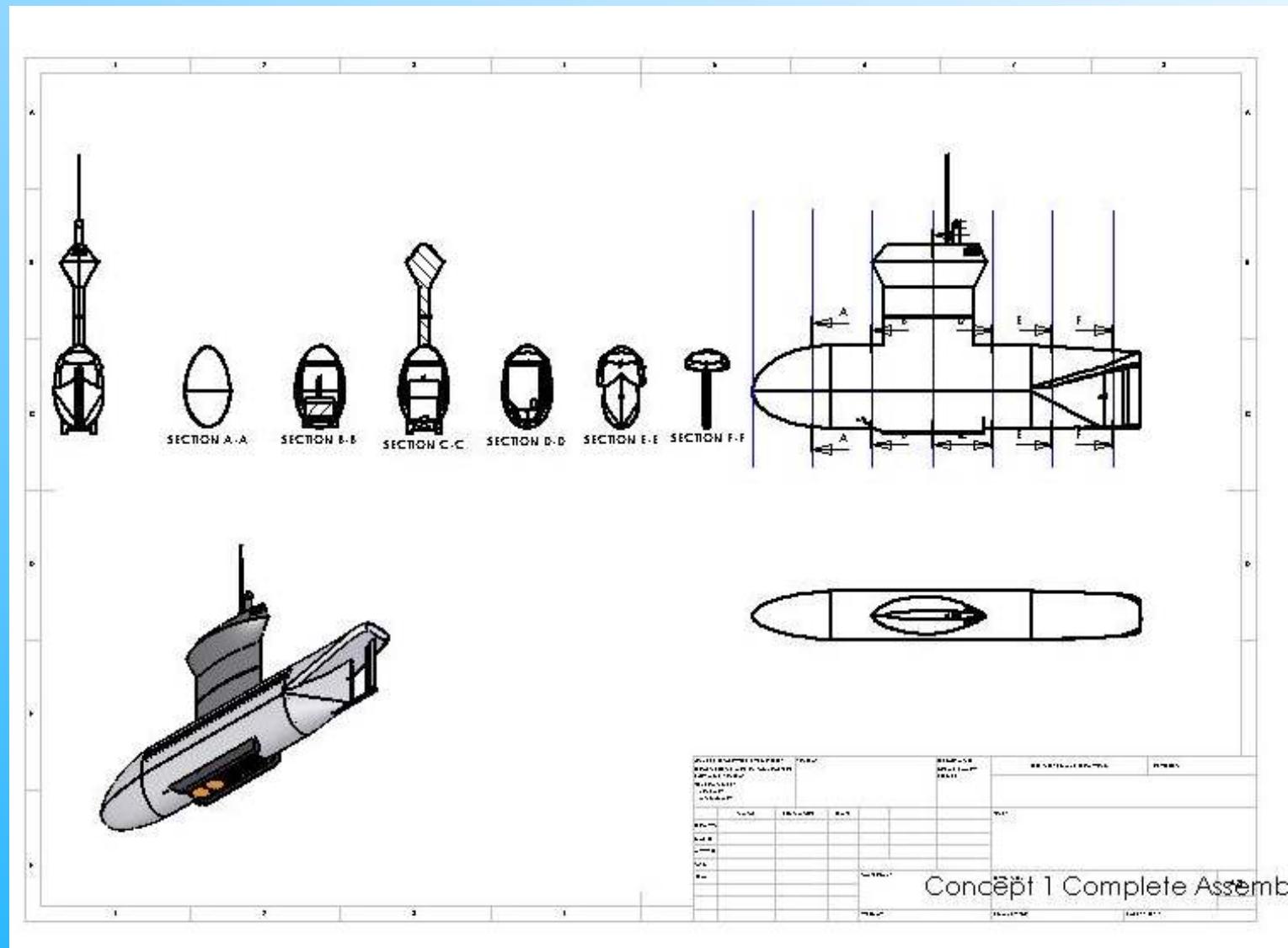


Semi-Submersible hull designs

Twin Strut



Semi-Submersible Hull Designs



ORCA Project Lessons Learned

Pressure hull

Heavy

Seals are challenging

Positively Buoyant

Fore and Aft control Planes

Good active control

Limits useful operational speeds

Increased drag

Difficult to launch and retrieve

Requires heavier keel

Deep Keel

Limits shallow water

Difficult to launch and Retrieve

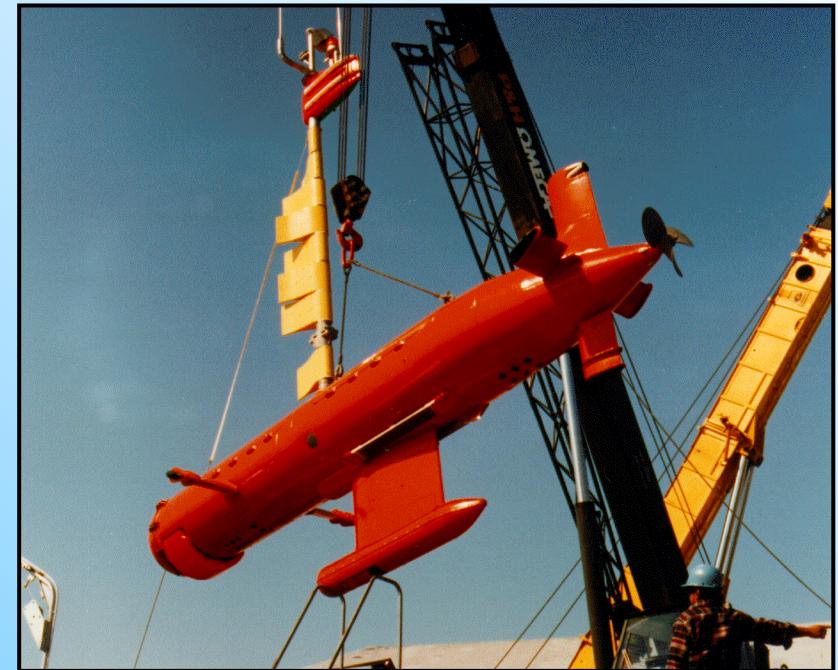
Exhaust underwater

Problems when engine is off

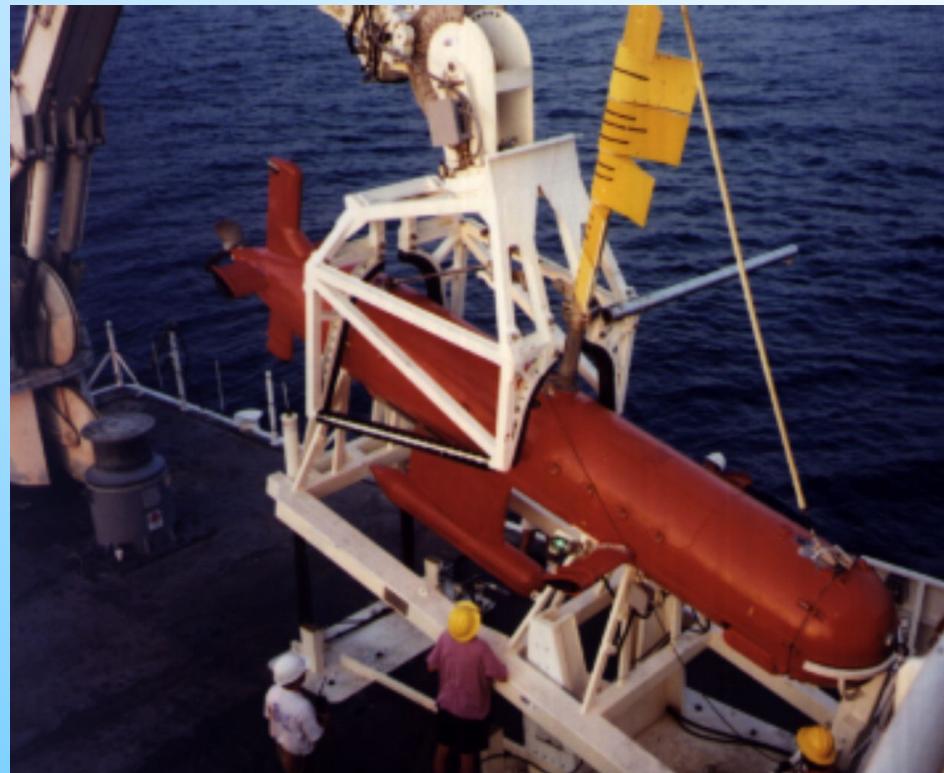
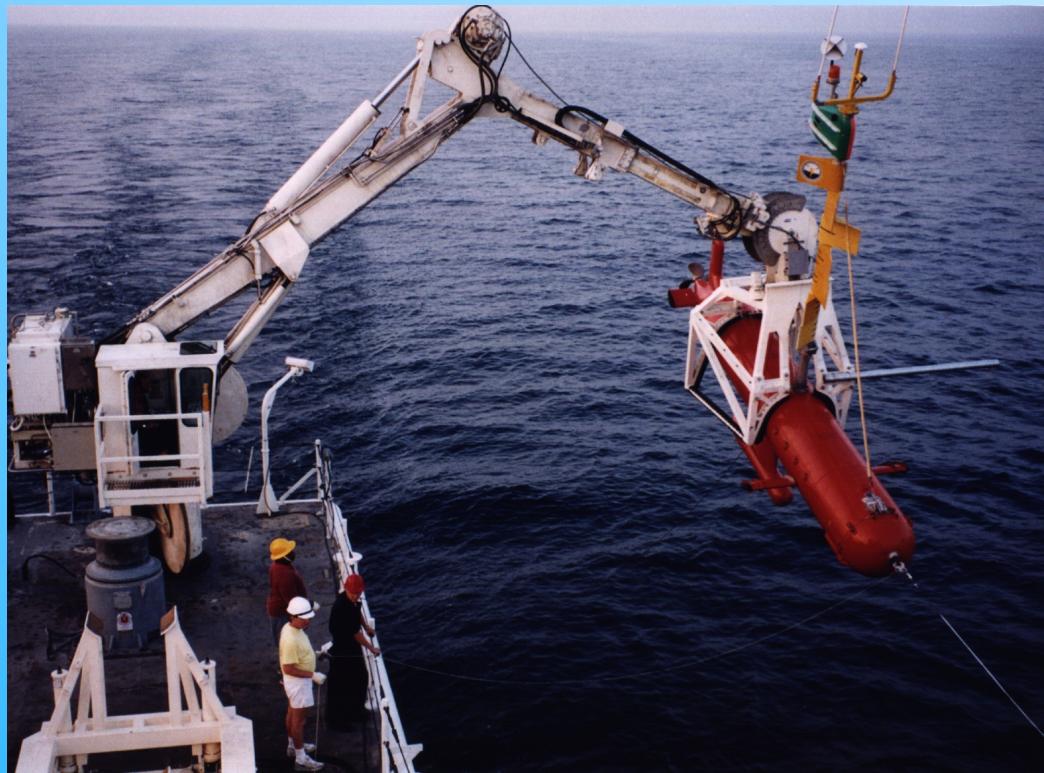
Specialized components

Expensive

Difficult to obtain



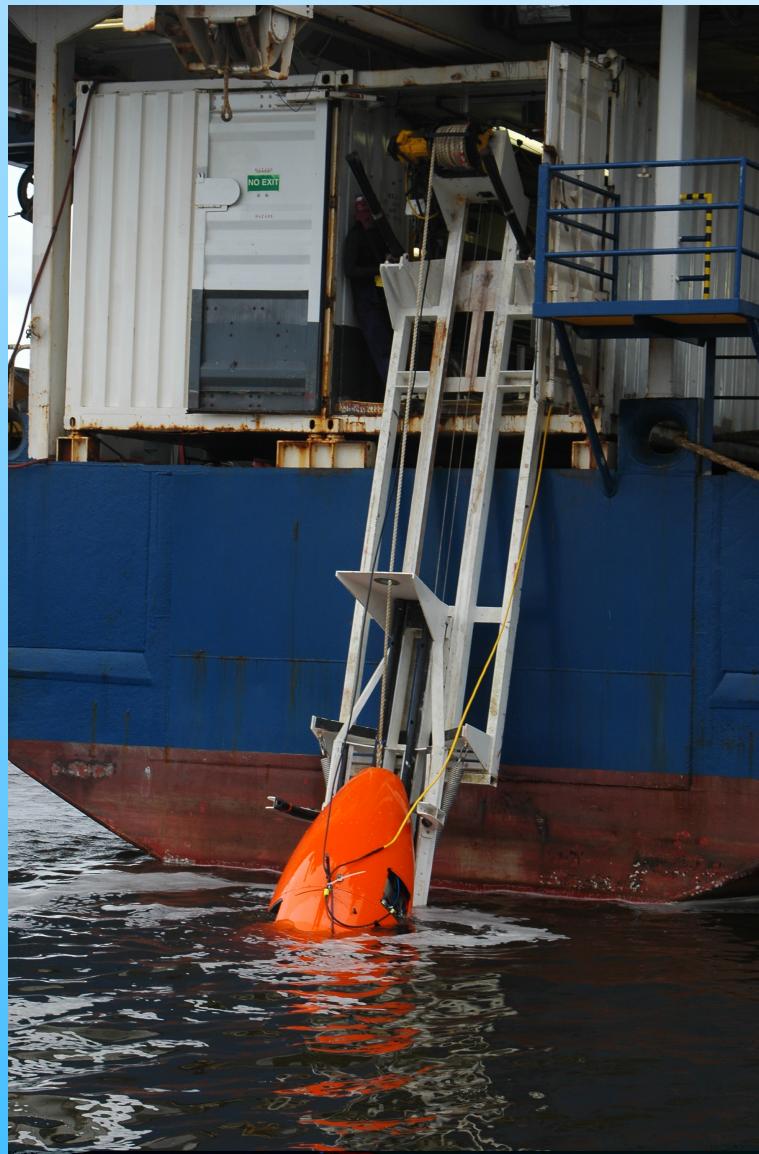
ORCA Launch & Retrieval System



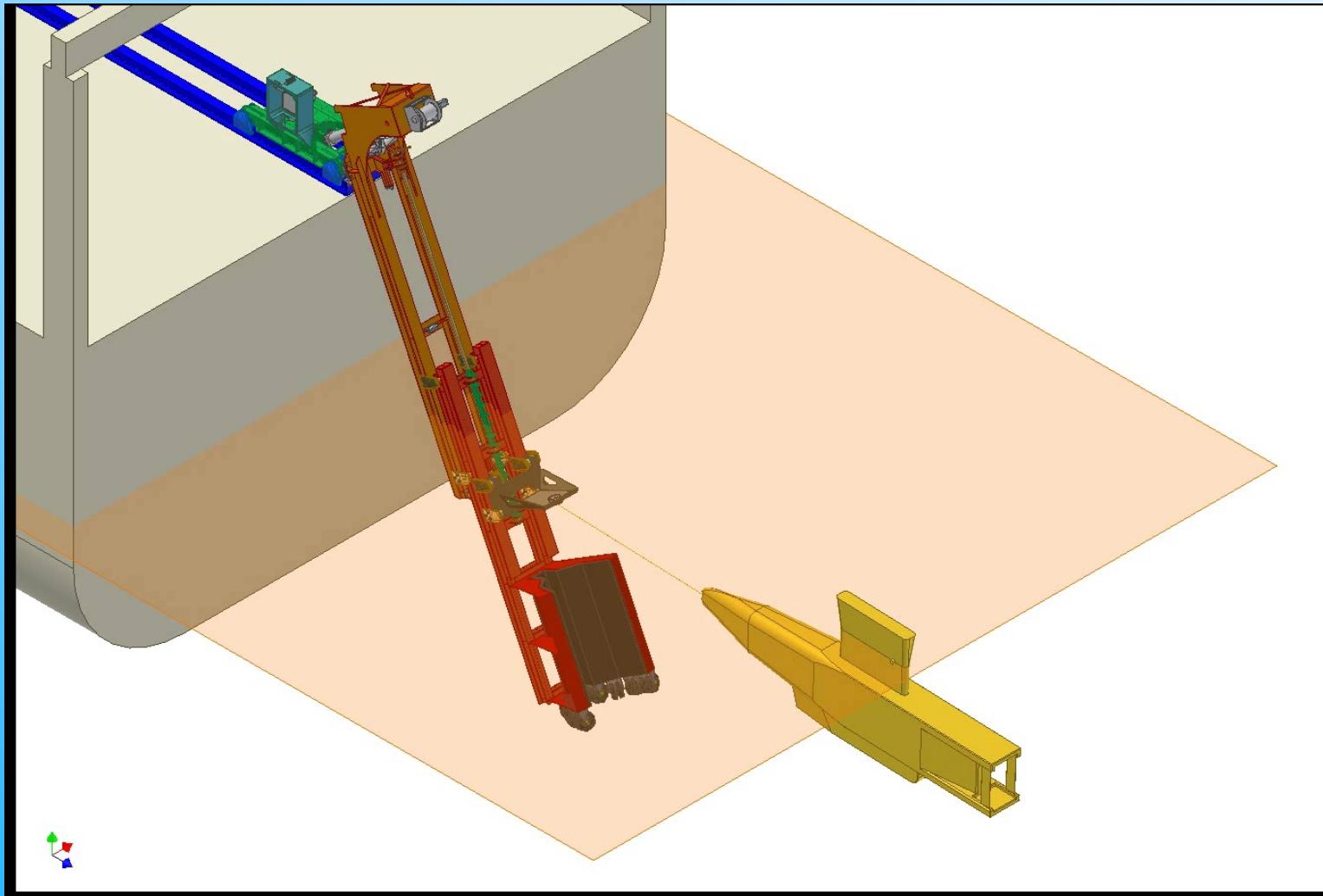
TAMU² Towfish and L&R system



C-Surveyor Launch and Recovery



USS Handling Concept

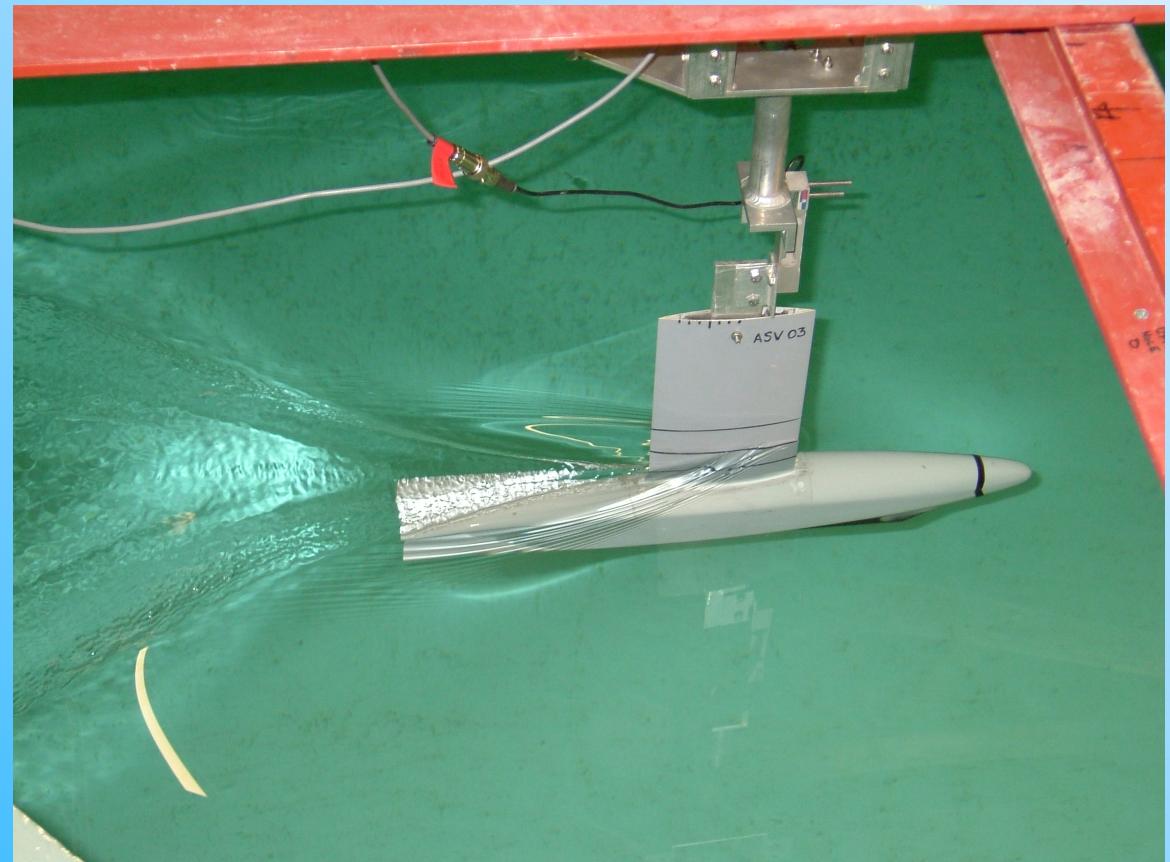


ASV's SASS Semi-submersible



Tow Tank Tests

- Chose the most promising concepts
- Built scale models of the hulls
- Tested in a tow tank



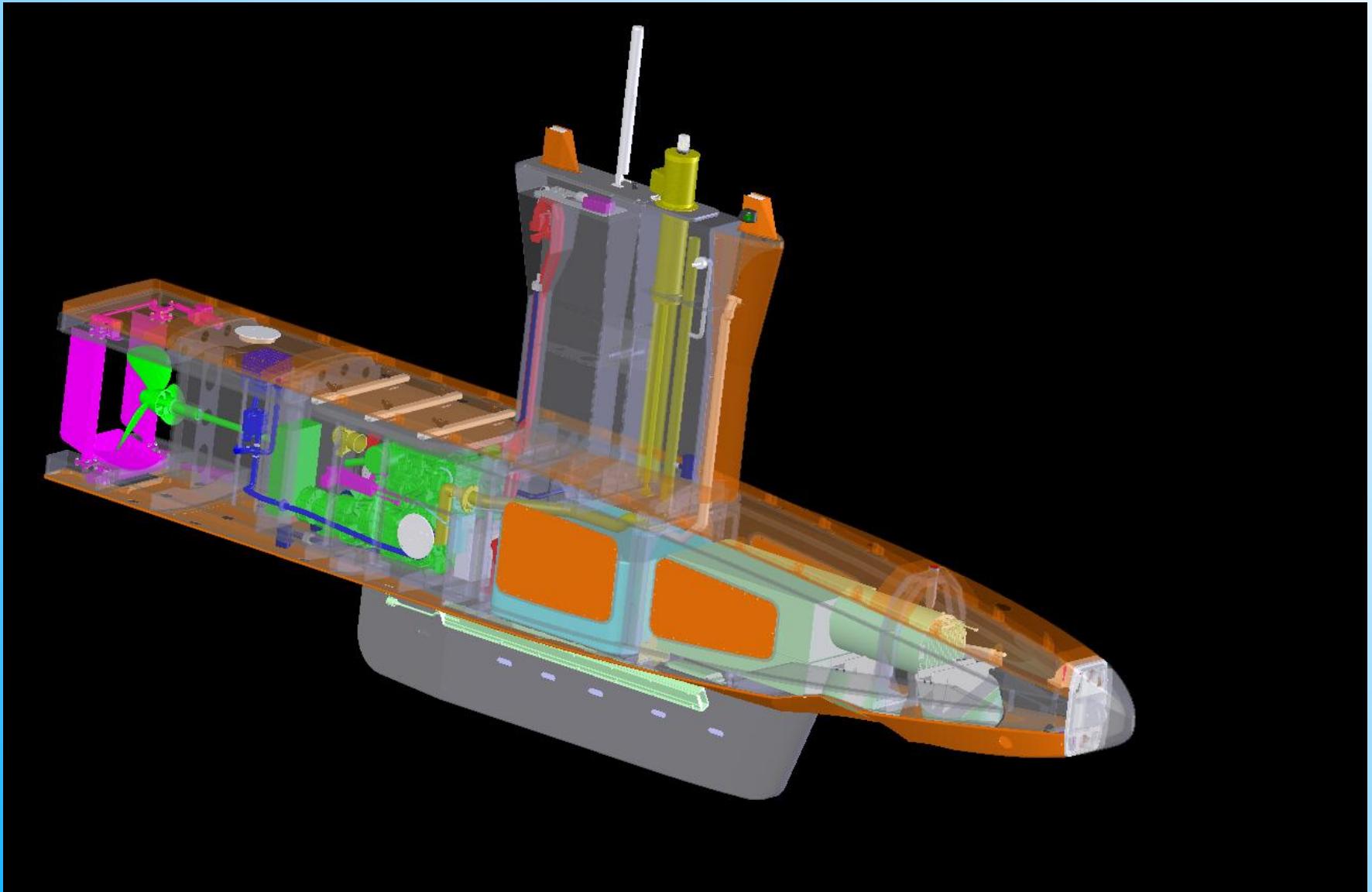
Wave Tank Test – USS vs Launch



USS Design Goals

- Small as possible
 - Designed to fit initial payload sensors
 - Designed for launch and retrieval
 - Minimize protrusions
- Minimize keel size
- Minimum of 2 day duration
- At least 6 knots survey speed
- Off-the-shelf components
 - Standard engine
 - Standard control electronics

USS Design



Design Change

- Suspended project for 1 year due to funding
- Time to review and reconsider design decisions
- Initial 5.5 meter design vehicle too small
 - Could not fit other sonars under consideration
 - Not flexible enough
- Extended vehicle to 6.3 meters
 - Judged to be a small change that would not seriously affect hydrodynamics
 - Added more payload space

Fabrication Team

- Joint Team
 - C & C hardware and software development team
 - ASV engineering and fabrication team
 - Subcontractors
- Fabricated at ASV's facility in England



Initial Tests

- Test as much as possible on the shop floor
- Check ballast in water
- Verify shutdowns and failsafes
- Simple maneuvering exercises
- Check for leaks
 - Water intrusion in engine cylinder
 - Solenoid valve installed



Acceptance Test

- Verify controls
- Verify failsafes
- Exercise propulsion and maneuvering
- Speed vs RPM measurements
- Evaluate Dynamic Stability
 - Pitch stability issues discovered
- Turning radius measurements



Acceptance Test



Vehicle Processor Sea Trial

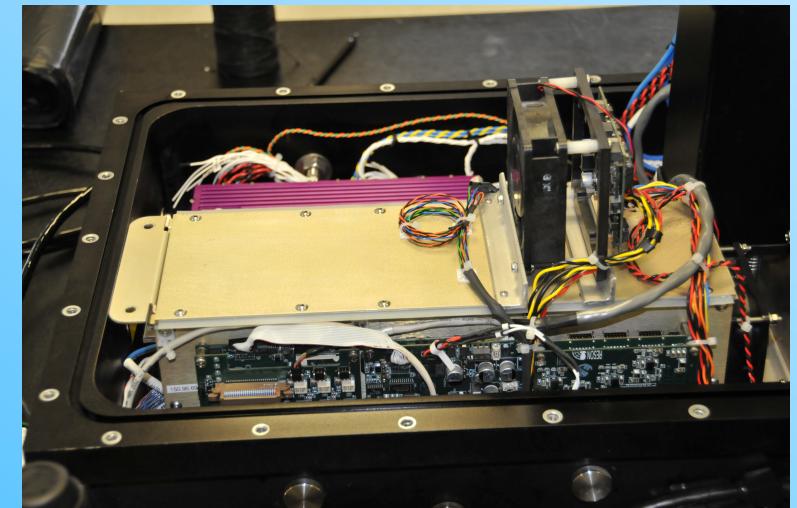
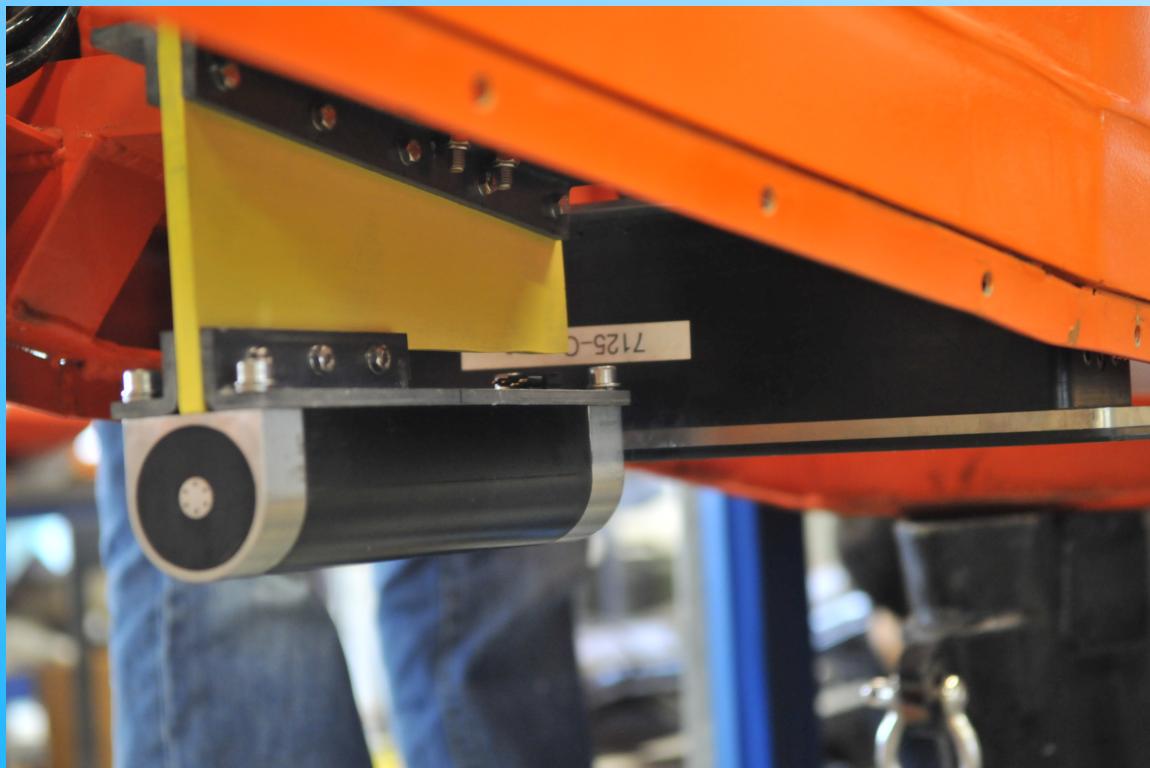
- Vehicle Control Processor (VP) was installed
- Thoroughly tested in the shop
- Sea trial
 - Verify real-time sensors
 - Verify real-time VP control
 - Test heading control system



Sensor Integration

- Initial target tasks – Hydrographic Surveying, Obstruction Detection, and Port Clearance
 - Multibeam Sonar
 - Reson 7125
 - AUV Version
 - 400 kHz transducers
 - Sidescan Sonar
 - Edgetech 2200-MP
 - 300/600 kHz
 - Hull mounted transducers
 - Upward Looking Altimeter
 - Tritech

Reson Installation



Edgetech Installation

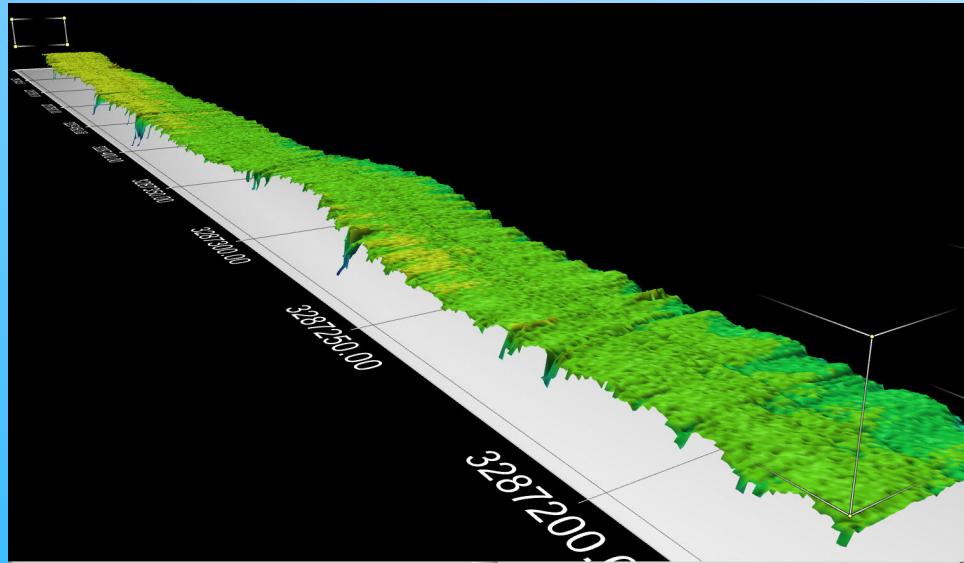


USS Sea Trial

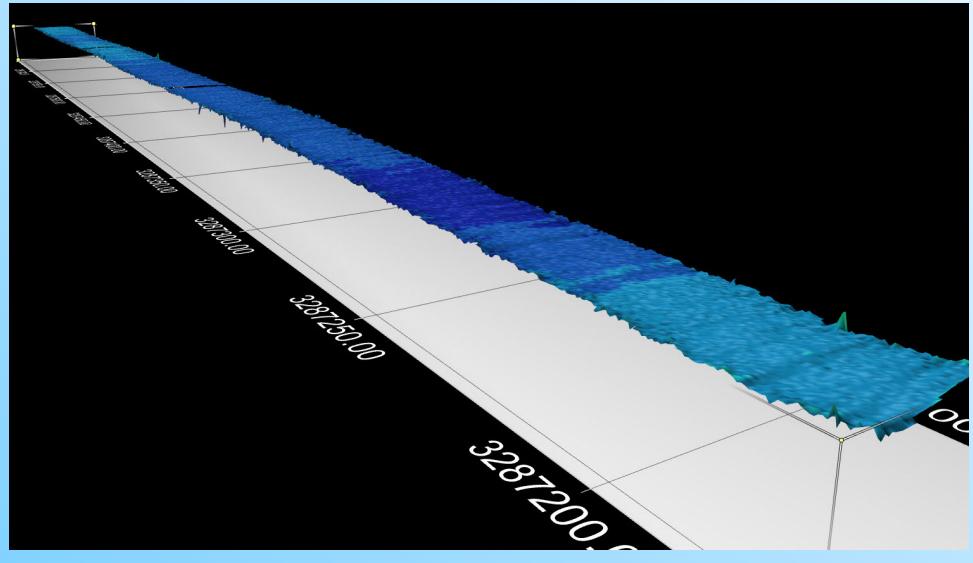
Comparison to Survey Launch



Multibeam Data Comparison

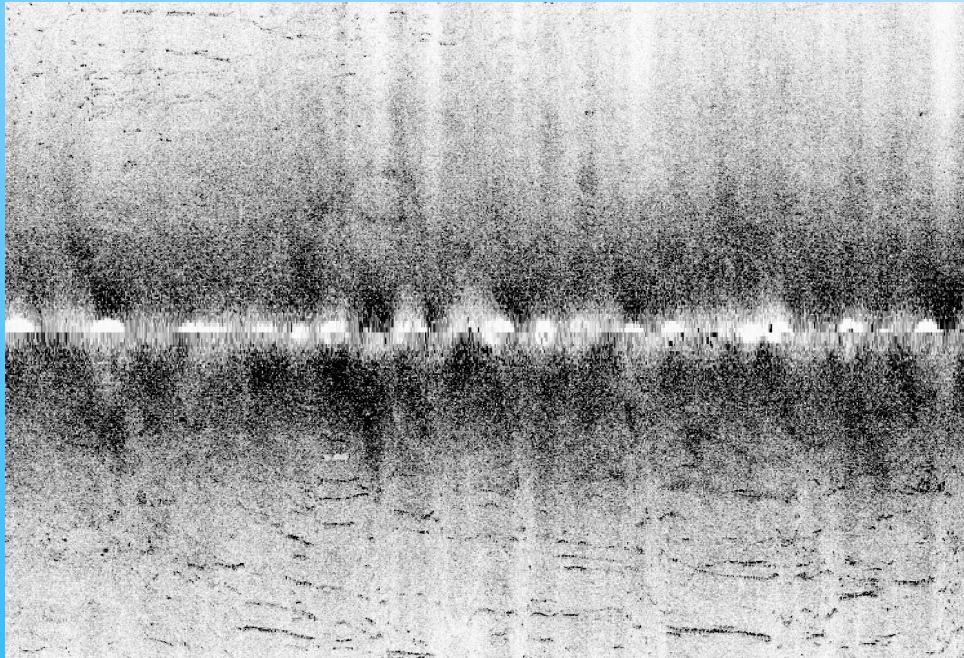


Survey Launch

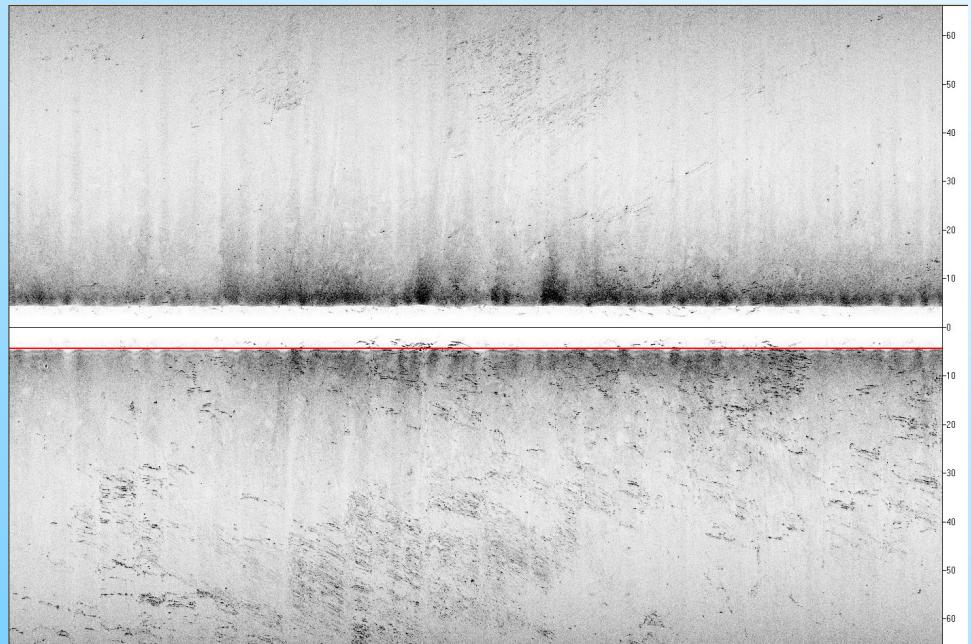


USS

Sidescan Data Comparison



Survey Launch



USS

Current Status

- Base vehicle is operational
 - Engine and propulsion system working well
 - Electrical power systems operational
 - Control systems verified
 - Vehicle Processor tested
- Pitch stability issue
 - New scale models have been tested
 - Designing hull modifications
- Payload installed and tested
 - Computers
 - Multibeam Sonar
 - Sidescan Sonar



Future

- Camera to be installed
- Demonstration in Pensacola
 - Hydrographic survey capability
 - Emergency response capability
 - Visual reconnaissance capability

