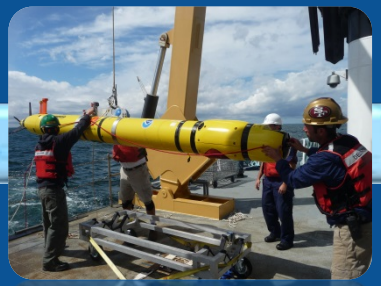



NOAA's Use of AUVs for Hydrographic Surveys

Rob Downs

NOAA Office of Coast Survey

International Marine Technician Symposium (INMARTECH 2014)
November 18-21
Corvalis, OR

Coast Survey AUV Project Timeline

- 2004 — T&E AUV (REMUS-100)
- 2005 — Navigation System Upgrades
- 2006 — Safe Seas Demo
- 2007 — Vieques UXO Survey; Vieques UXO Survey
- 2008 — Florida Keys Survey
- 2009 — First Hurricane Response; REMUS-600 AUV Delivered; Maritime Homeland Defense Survey & Loss
- 2010 — CTD AUV Testing
- 2011 — Emergency Response AUV Team Established
- 2012
- 2013 — Multibeam AUV Delivered
- 2014 — First HASSLER Deployment; Florida Keys Survey

Office of Coast Survey AUV Projects

Objective:

- Develop technical expertise, define functional and technical requirements, and develop standard operating procedures to transition AUV technology into NOAA's operational hydrographic survey fleet.

Operational Concepts:

- Emergency Response
  - Man-portable Side Scan Sonar AUVs for detection of hazards to navigation in post-storm surveys.
  - Transitioned to operations in 2011.

- Bathymetric Mapping
  - Medium-sized Multibeam Sonar AUVs for bathymetric surveys in support of nautical charting.
  - Development & Testing began in 2012.

Emergency Response

Personnel

- Pool of 8 qualified operators in OCS
- Operational team – 2 minimum

Equipment

- Hydroid REMUS-100 AUV with 600/1200 KHz Marine Sonic SSS
- VCT HarborScan AUV with 455/900 KHz Klein SSS

Functional Requirements

- Operating Platforms – Shore, small boats, and vessels of opportunity
- Operating Environment – Ports and harbors
- Operating Mode – Fully Autonomous & Attended
- Unique Requirements – Highly portable, self-contained systems

Advantages

- Improved flexibility
- Host vessel can conduct other critical missions

Bathymetric Mapping AUV Project

Operational Concept

- Force multiplier
  - Multiple Bathymetric Mapping AUVs deployed from NOAA hydrographic survey vessels to increase data acquisition capabilities

Functional Requirements

- Operating Platforms – NOAA Hydrographic Survey Vessels (HASSLER)
- Operating Environment – Ports, harbors, and coastal areas
- Operating Mode – Fully Autonomous or monitored

Data Requirements

- Data must conform to NOAA standards.
- Data must be compatible with the data processing pipeline.

Operational Requirements

- Shipboard infrastructure and personnel must be able to safely and effectively support AUV operations.
- The AUV must demonstrate a worthwhile benefit to efficient survey ops.
- Support agreement must be in place between OCS, OMAO, and FH prior to transition.

REMUS-600 Specs

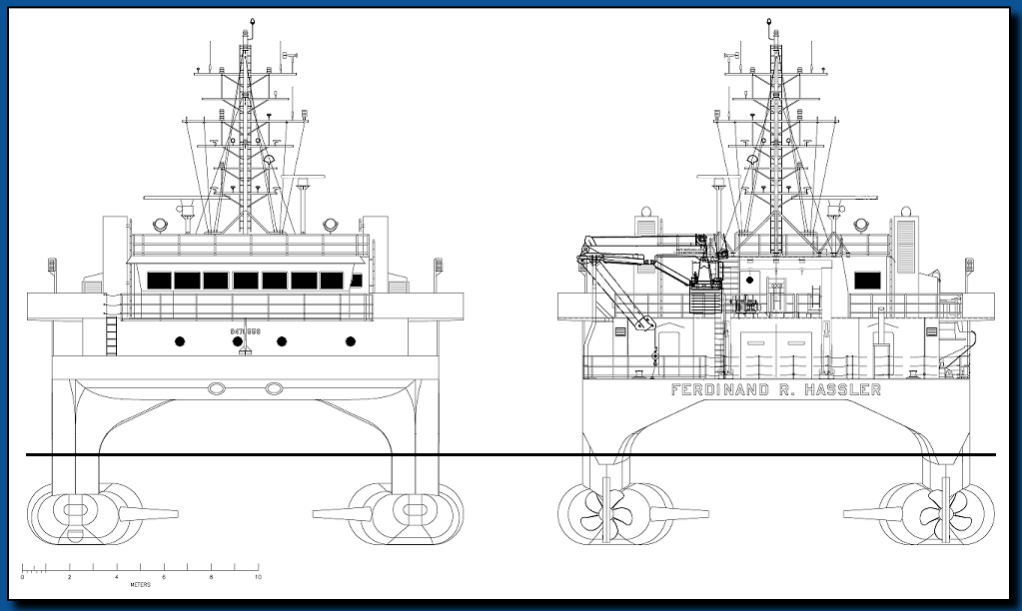
REMUS-600 AUV

- LOA – 140 in
- Diameter – 12.75 in
- Weight in Air – 668 lbs
- Max Depth – 300M (Limited by sonar transducers)
- Endurance – >20 hours @ 4 knots
- Navigation –
  - Honeywell HG9900 IMU
  - RDI 600KHz DVL
  - L1/L2 GPS
  - NavP Software
- Communications
  - WHOI Acoustic Micro-Modem
  - Iridium
  - Wireless and Wired Ethernet
- Sensors
  - Kongsberg EM3002 Multibeam Sonar (300KHz)
  - Neil Brown CT Sensor
  - Obstacle Avoidance Sonar (675 KHz)
  - Paroscientific Depth Sensor

NOAA Ship Ferdinand R. Hassler

Ship Specifications

- SWATH Design
- Length – 122 feet
- Breadth – 54 feet
- Displacement – 740 Metric Tons
- General Purpose Winch – 5060 lbs pull
- A-Frame – 4000 lbs load
- Knuckle Boom Crane – 8000 lbs load
- Crew and Berthing - 14



NOAA Ship Ferdinand R. Hassler Operations

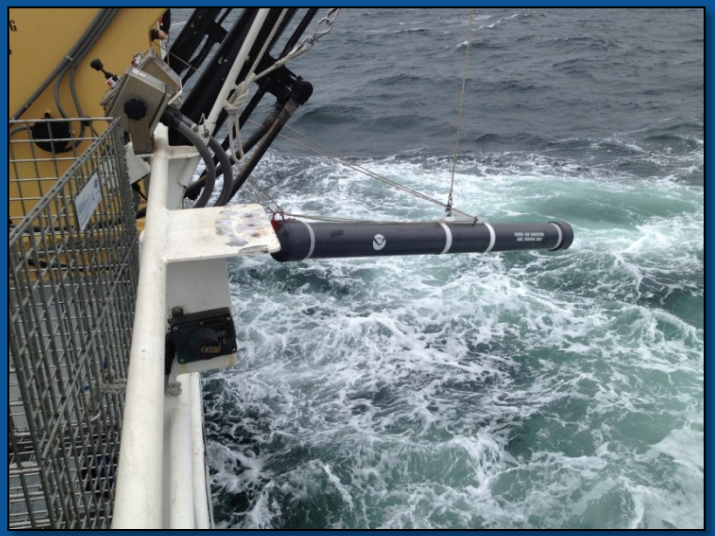
Pier-Side Mock-Up Drills (Dec 2012)

Underway Testing (2013)

- Developed safe launch and recovery procedures
- Evaluated Hassler's suitability for hosting the AUV
- Evaluated AUV operational concepts, communications, and monitoring requirements over missions of increasing endurance (2-16 hours)

Underway Testing (2014)

- Integrated AUV operations into routine shipboard survey operations
- Assessed man-power requirements
- Evaluated data acquisition efficiency gain and additional operational concepts



NOAA Ship Ferdinand R. Hassler Lessons Learned

Launch & Recovery

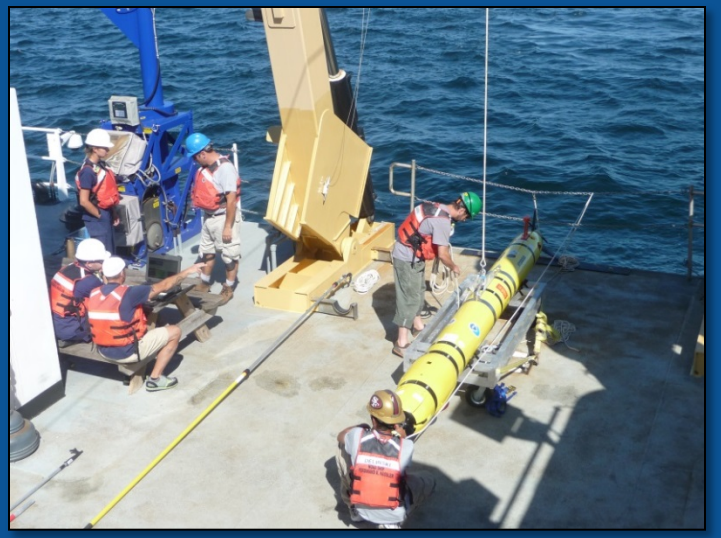
- Simplified rigging
- Sea State limits same as small boat (Tested up to 4')
- LARS desirable for safety & efficiency

Communications

- WiFi
  - Up to 1000M (500M typical)
  - Limited during recovery
- ACCOMS observed to 1600M
- Iridium proved robust

Endurance

- Average Battery consumption 4% per hour
- Charging time approximately 6 hours



NOAA Ship Ferdinand R. Hassler Lessons Learned

Shipboard Suitability

- Adequate for test and evaluation

- Recommended improvements for continued operations:
  - Fantail tie-downs (Baxter Bolts)
  - AUV “Dog House”
  - Hull-mounted acoustic communications
  - LARS

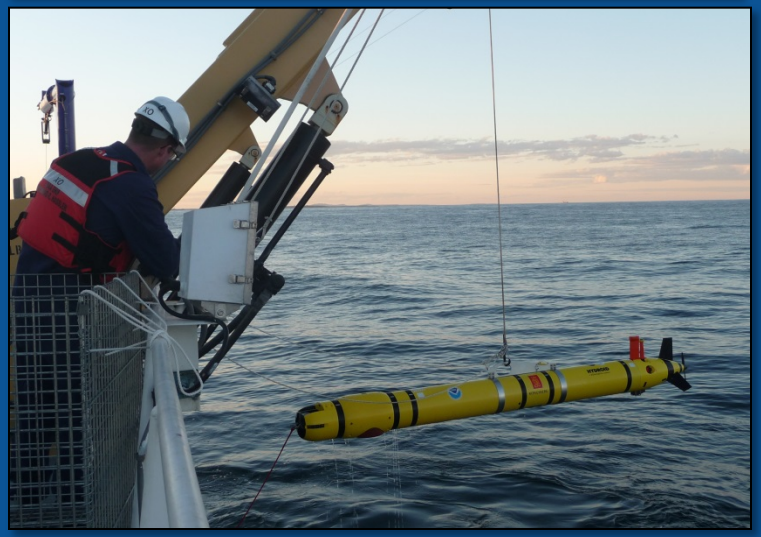
NOAA Ship Ferdinand R. Hassler Overnight Operations

Benefits

- Maximize AUV time on mission
- Minimize interruption to ship ops (One launch and recovery per day)
- Launch & Recovery during daylight
- Mission Prep and PMA during normal workday
- Less vessel traffic overnight
- AUV much more visible on surface (Strobe visible over 1NM away)

Limitations

- Mission Prep and PMA must be performed by watch standers.
- Significant faults would require nighttime recovery.



NOAA Ship Ferdinand R. Hassler Man-Hour Assessment

Daily Man-Hours

	Sep 3	Sep 4	Sep 5	Sep 6	Sep 7	Sep 8	Sep 9	Sep 10	Sep 11
Pre-Mission Tasks	2.75	1.75	1.5	1.75	1.75	0	4.75	.5	0
Post-Mission Tasks	0	1.5	1.5	1	1	1.5	.75	0	1.5
Daily Total	2.75	3.25	3.00	2.75	2.75	1.5	5.50	.5	1.5

Man-Hours per Mission

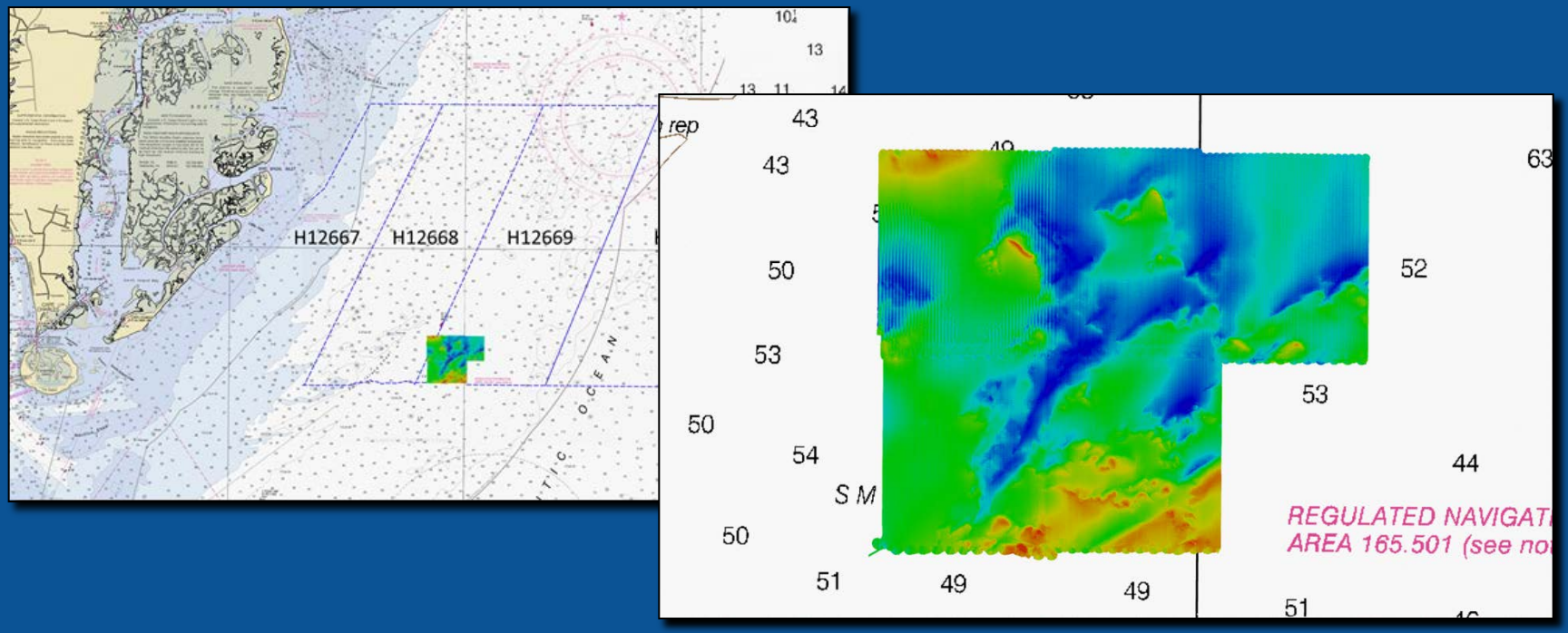
	Mission 1	Mission 2	Mission 3	Mission 4	Mission 5	Mission 6
Man-Hours	4.25	3.25	2.50	2.75	3.25	6.75

Average for Standard Mission – 3.2 man-hours

NOAA Ship Ferdinand R. Hassler Survey Efficiency

Concept of Operation – Mainscheme Survey

- AUV covered 200 lnm and 9.2 sqkm in five missions.
- *Hassler* covered 630 lnm and 35 sqkm during the same period.
- 25% increase with one shipboard system (15-20% expected with two)
- 16-hour Missions = 12-14 hours on survey



Overarching Challenges

Risk Management

Staffing & Training

Operations & Maintenance Requirements and Life Cycle Cost

Contact Information

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