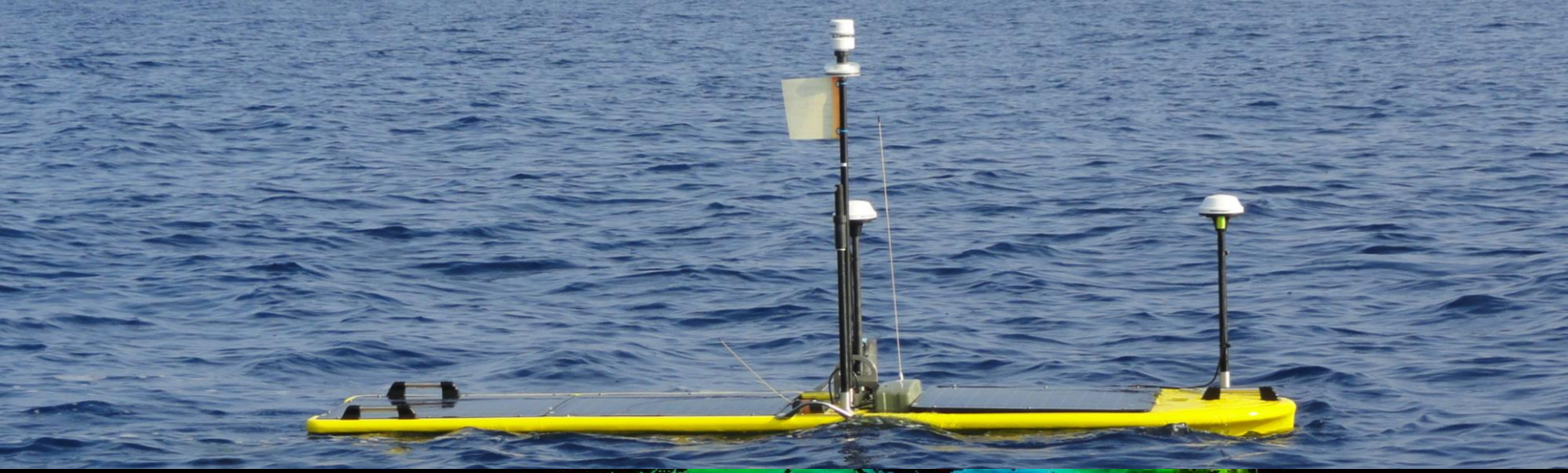
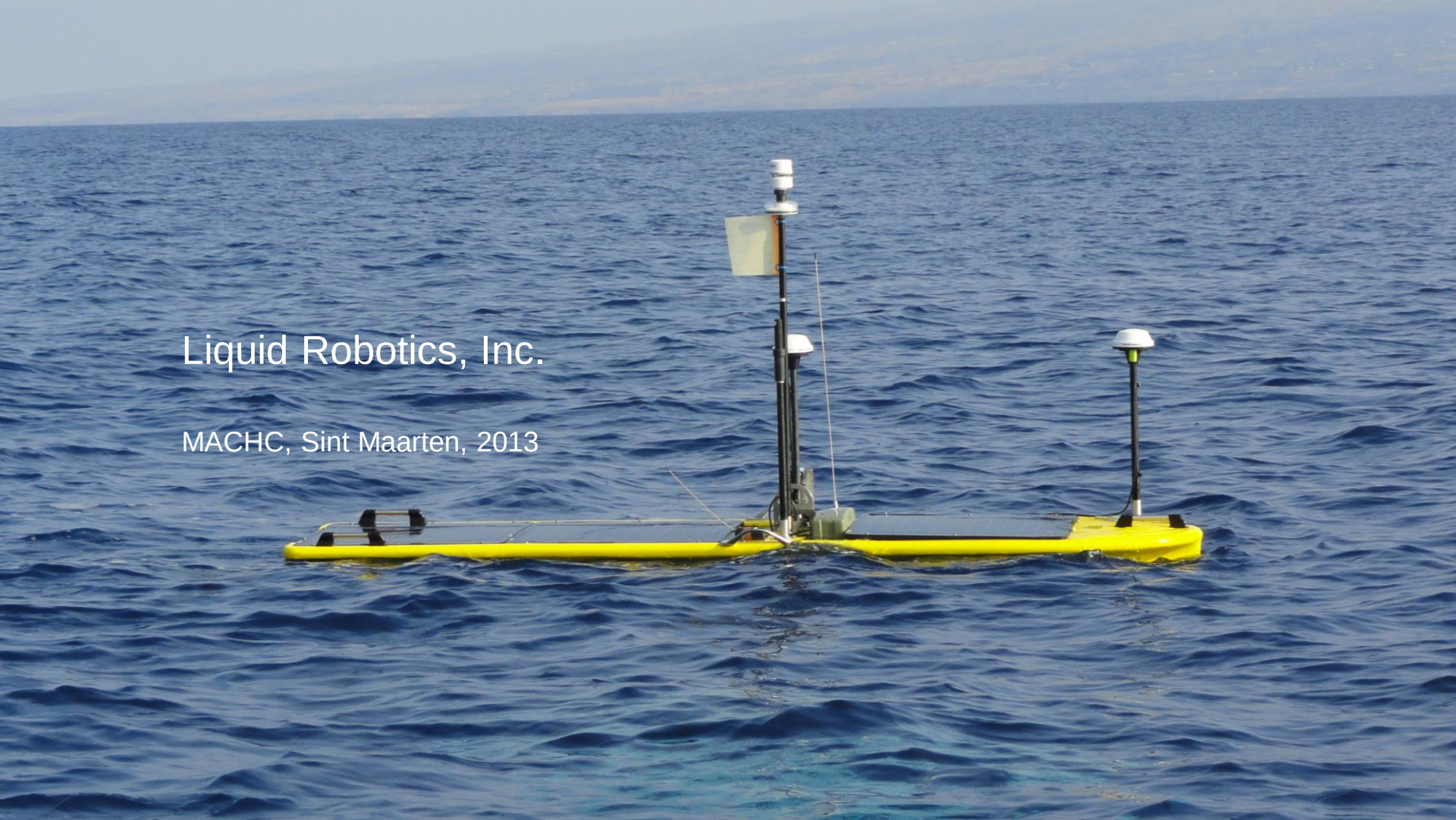


Liquid Robotics Inc. / Teledyne / CARIS

Hydrone Autonomous Multibeam Survey with Black Widow including Automated Post Processing

14th MACHC Meeting, St. Maarten

Presented by: Paul Cooper, David Walker, Doug Lockhart, and Karen Hart

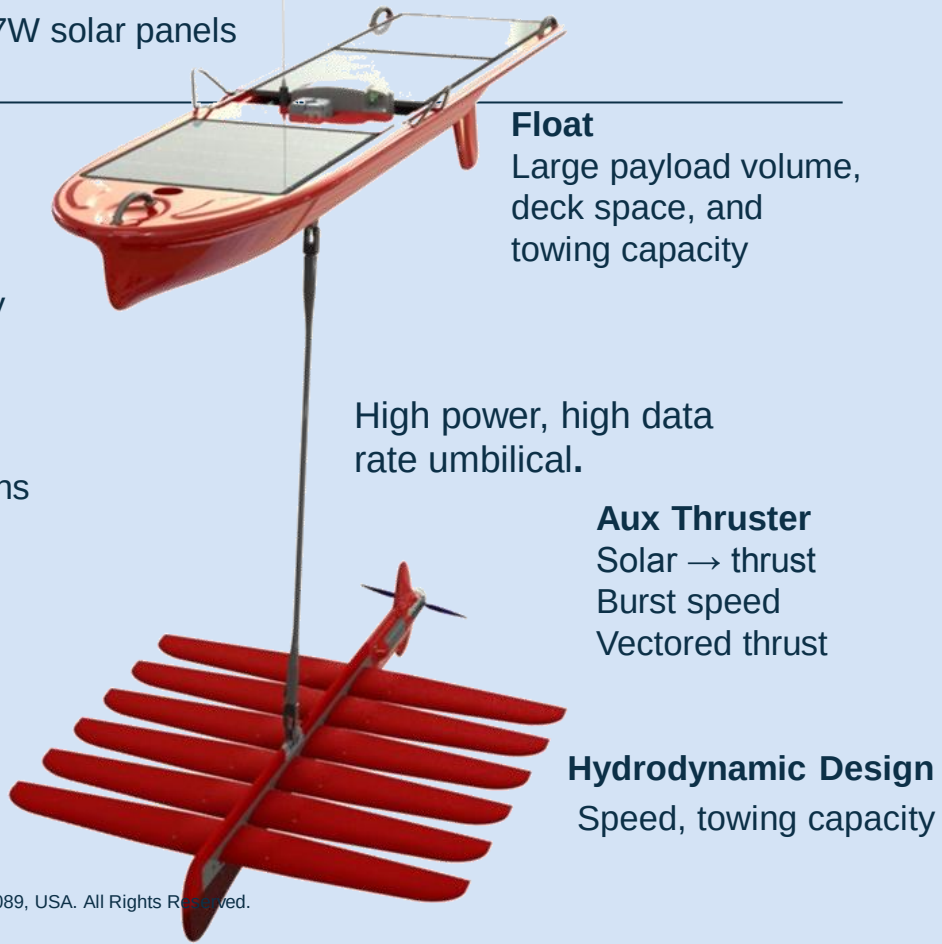

Liquid Robotics, Inc.
MACHC, Sint Maarten, 2013

Outline

- Introduction to Wave Glider
  - SV3
  - How it works
- MB1 Integration with the Wave Glider

Wave Glider SV3
design highlights

Solar Power
3x 57W solar panels



Float
Large payload volume, deck space, and towing capacity

AMPS (Adaptable Modular Power System)
- Up to 7.8kWh rechargeable battery capacity
- Expandable and configurable

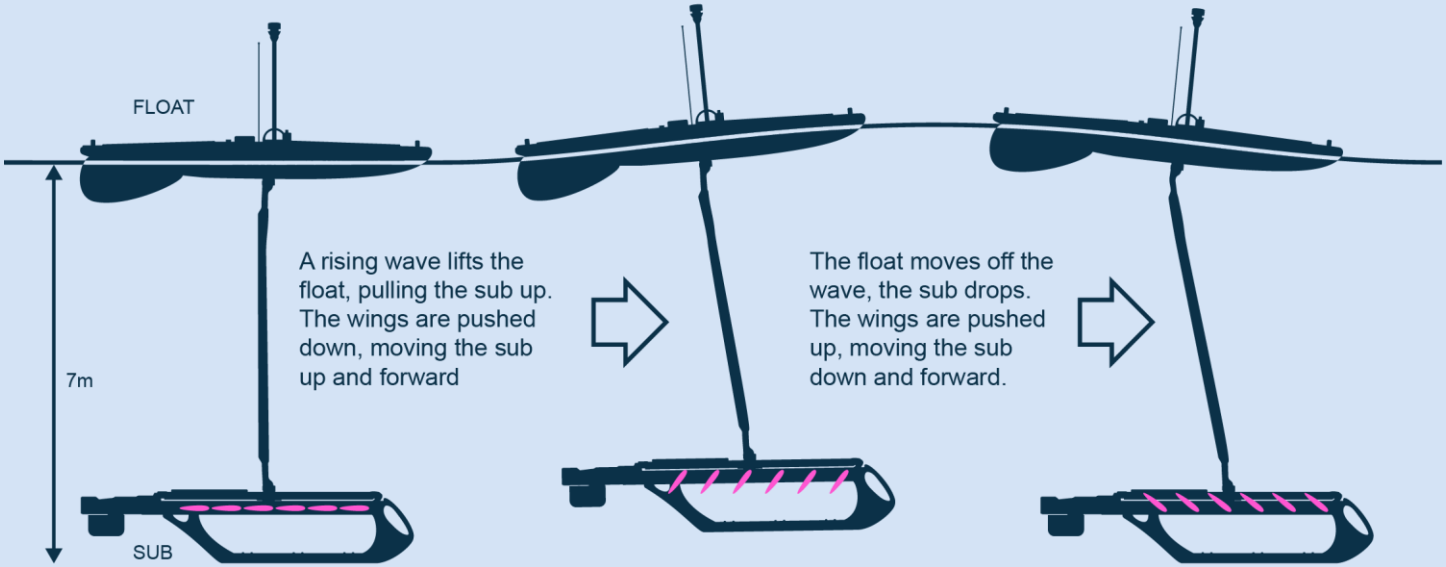
Regulus Linux / Java control system
- Support autonomy and advanced applications
- High availability
- Threaded, multi-client support
- Encrypted data and communications

High power, high data rate umbilical**.**

Aux Thruster
Solar → thrust
Burst speed
Vectored thrust

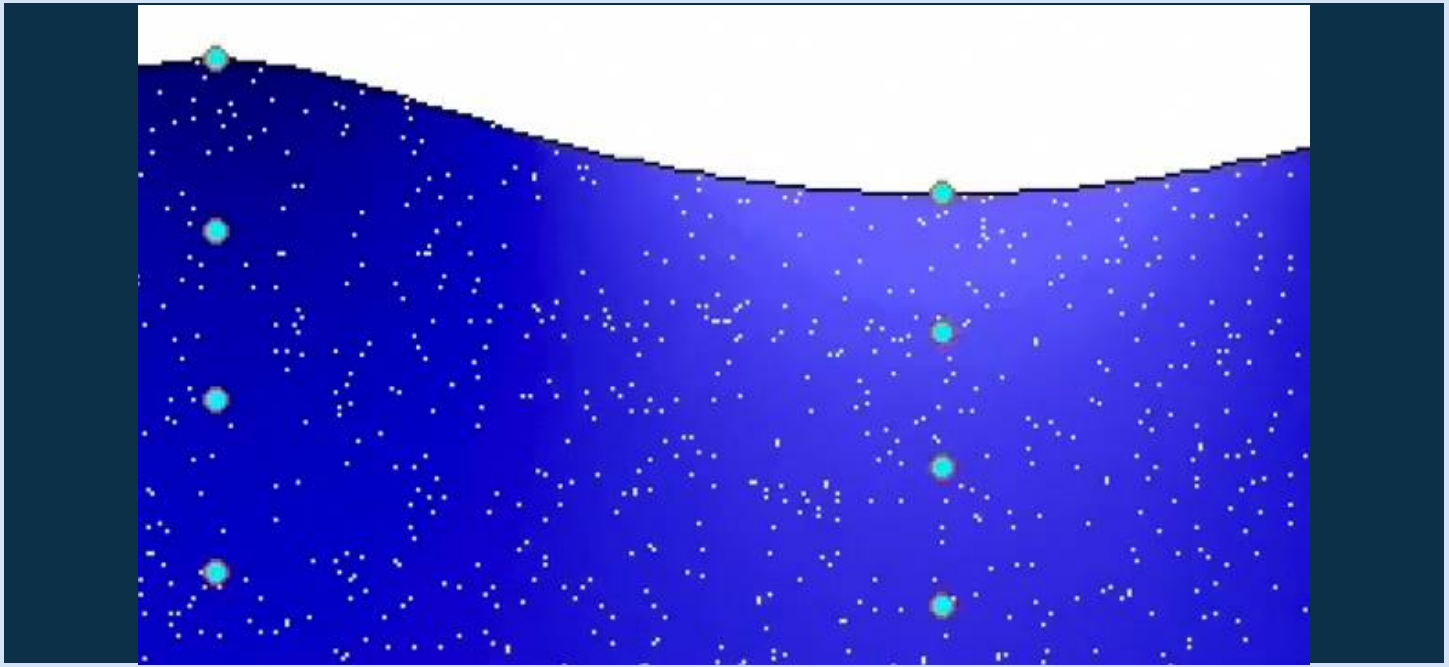
Hydrodynamic Design
Speed, towing capacity

How It Works



3 U.S. and 9 foreign patents issued. 20 U.S. Provisional applications, 42 foreign applications.

How It Works



Data Gathering Platforms

Satellites

+ Large Coverage
- “Best Guess” from 250 Miles Up
- Weather Limited
- $7-11B Lifetime

Ships

+ Large Coverage
+ Direct Tasking
- Human Risk to Deploy and Maintain
- Weather Limited
- $20-155K Per Day

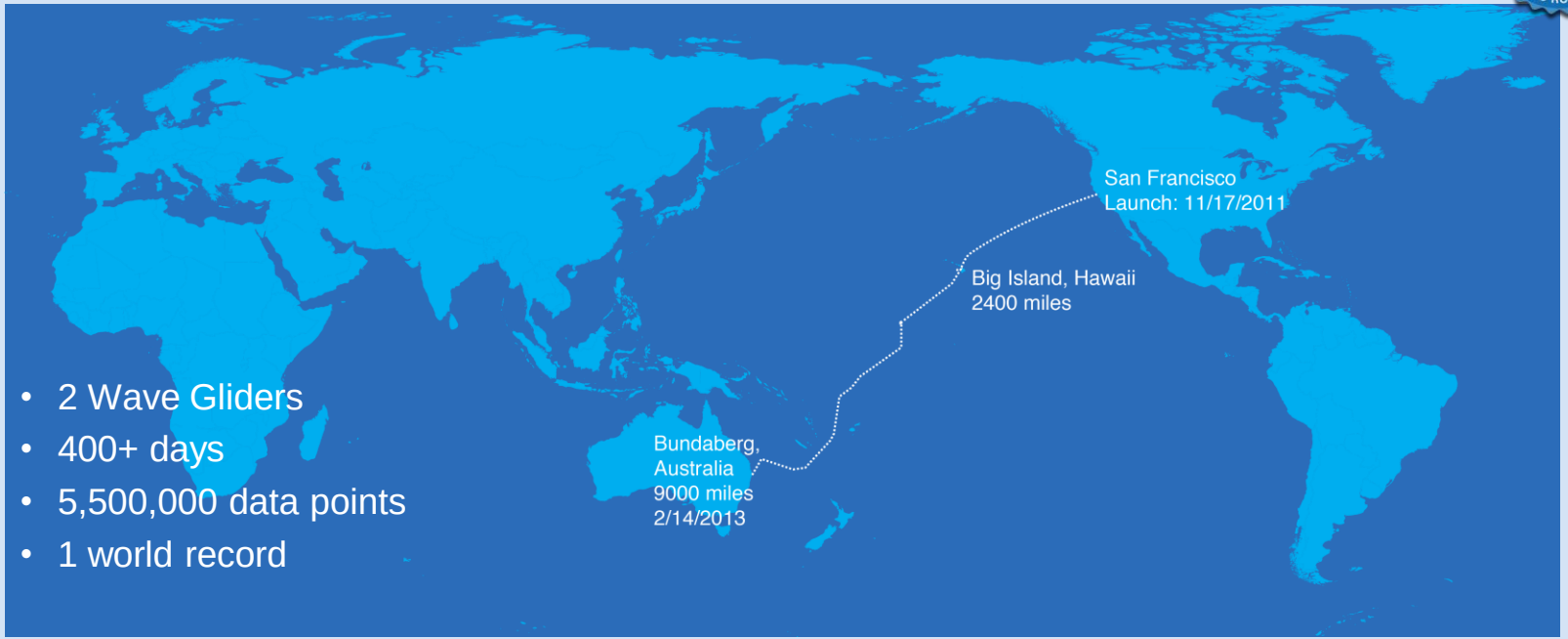
Buoys

+ Direct Measurement
- Single Point
- Human Risk to Deploy and Maintain
- $0.5-3M to Set (in deep ocean)
- Up to $1M/Year to Maintain

Wave Gliders

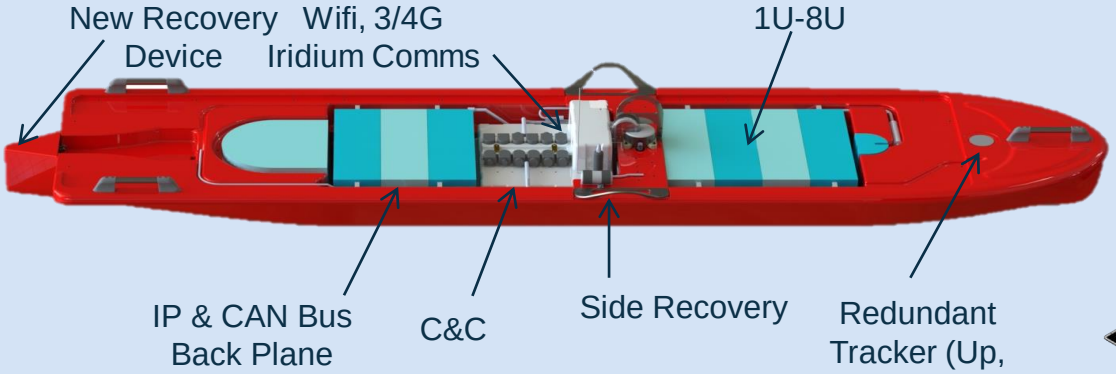
+ Large Coverage
+ Direct Measurement
+ Direct Tasking
+ $1-3K Per Day

PacX Challenge

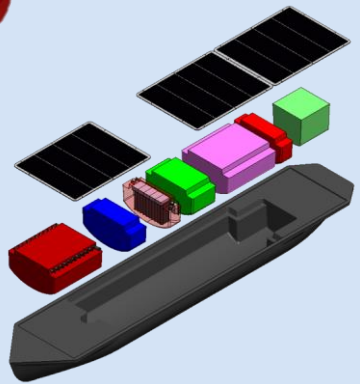


- 2 Wave Gliders
- 400+ days
- 5,500,000 data points
- 1 world record

Float



- Modular Design
- High-Power payloads
- Ethernet connectivity
- Cellular Network connectivity

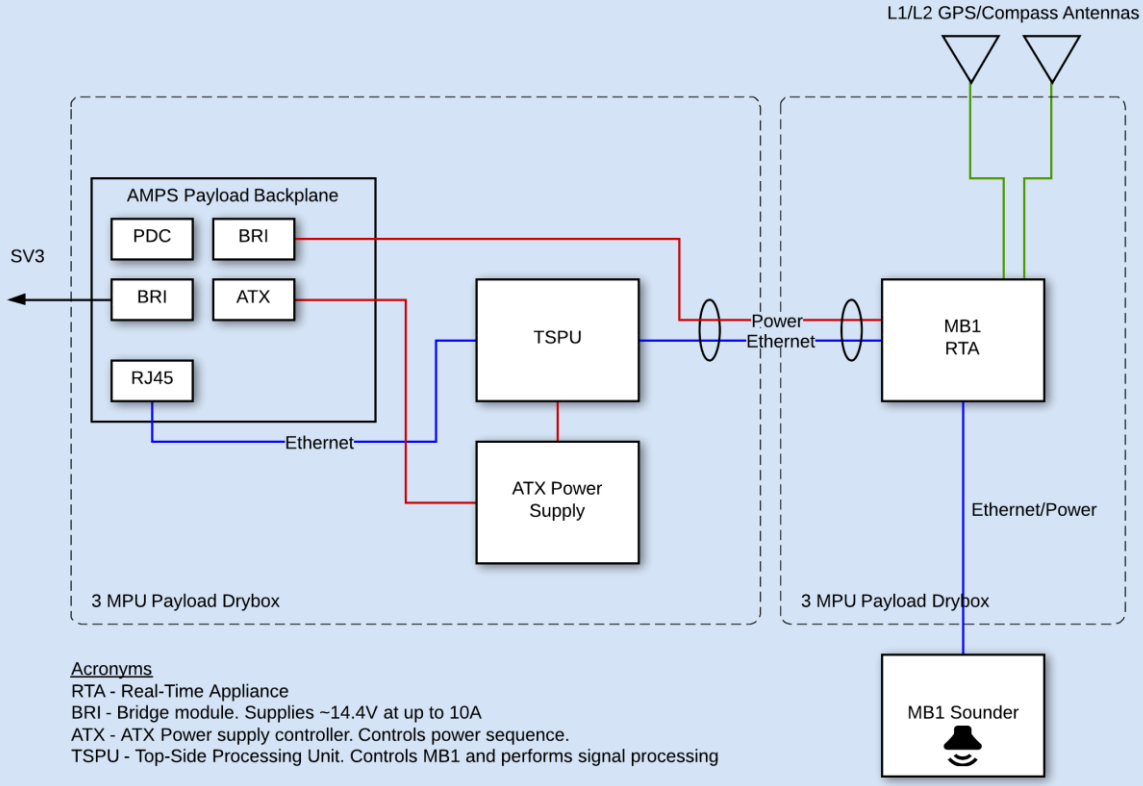


Variable sized, modular “float units”

CARIS/Teledyne Odom/LRI Project Goals

- Demonstrate near real-time acquisition of Hydrographic survey data combining:
  - Wave Glider platform
  - Teledyne ODOM MB-1 Multi-beam Sonar
  - CARIS HIPS signal processing and visualization software
- Present live demonstration at IHO Meso American Caribbean Hydrographic Commission Meeting in St Maarten, Dec 9-12, 2013
- Live data will be provided by a system deployed near LRI's Hawaii facility (Kawaihae, HI)

System Block Diagram

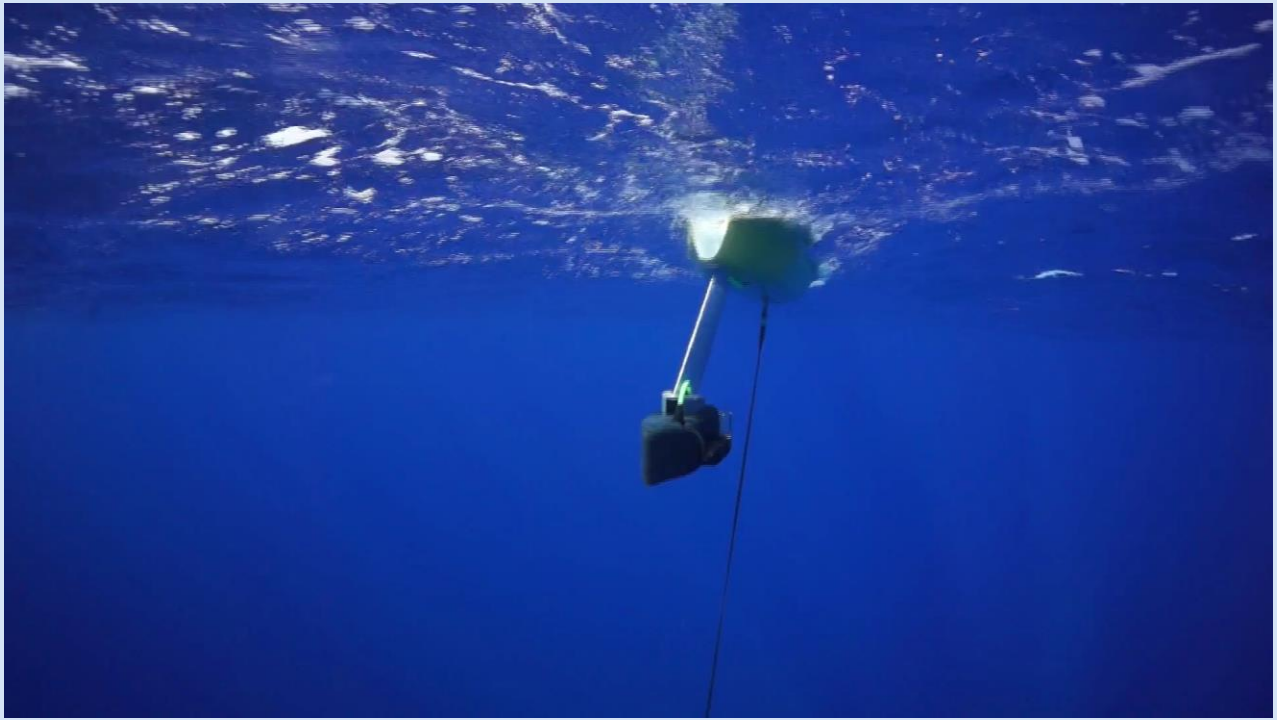


Acronyms
RTA - Real-Time Appliance
BRI - Bridge module. Supplies ~14.4V at up to 10A
ATX - ATX Power supply controller. Controls power sequence.
TSPU - Top-Side Processing Unit. Controls MB1 and performs signal processing

Sonar Mounting

- Skeg used on the Wave Glider to stabilize the float
- Mounted on alternative skeg made from aluminum sailboat spar material
- Streamlined skeg with faring
- Sensor submerged ~1m
- Less interference between sonar and glider (Glider typically leads float)

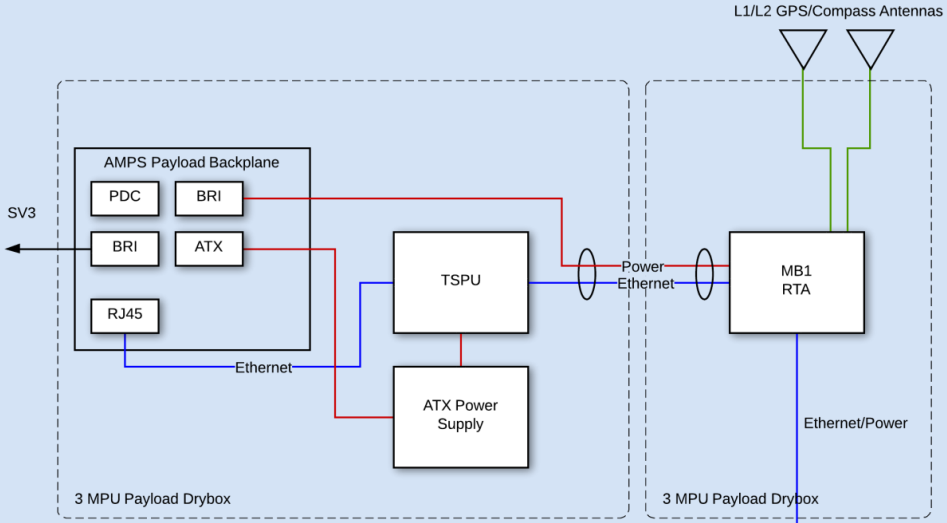
Sounder Mounting



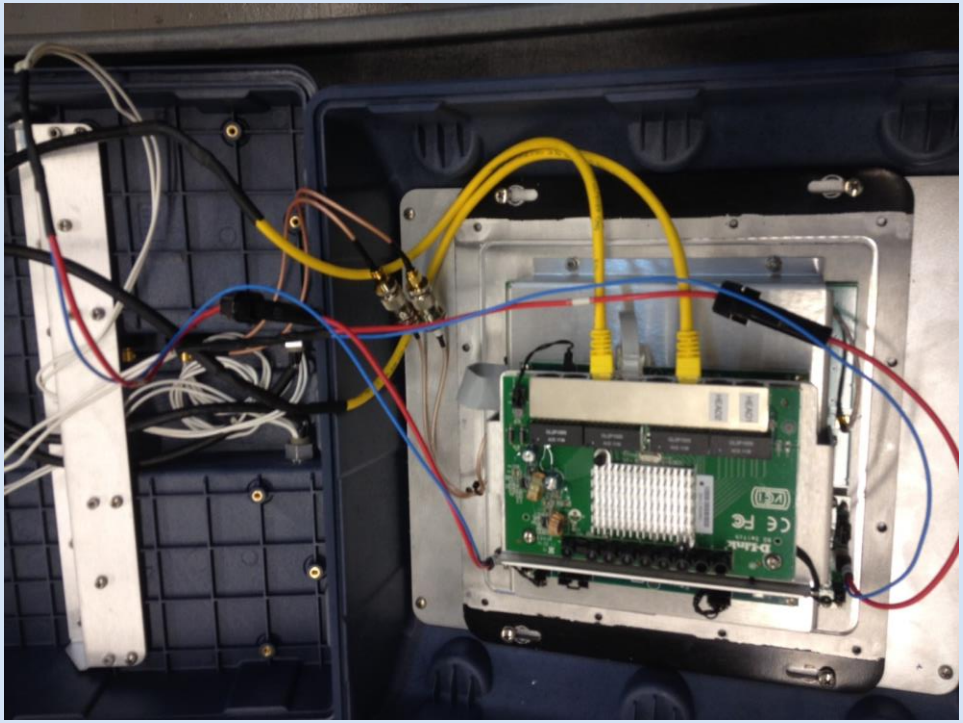
Electronics Packaging

- Two separate boxes to house the RTA and TSPU
  - Improved power dissipation
  - Ease of integration
- TSPU
  - ADL Embedded Solutions ADLQM67PC-2715QE
    - Intel Quad Core i7 2.1-3GHz
    - 8GB DDR3-1333 RAM
    - Dual Ethernet
      - Core system/cell modem
      - RTA
    - Designed for heat-sink fan less installations
    - 128Gb SLC Solid-state hard drive
- RTA
  - Unit from Teledyne Odom installed with little modification (only the cover removed)

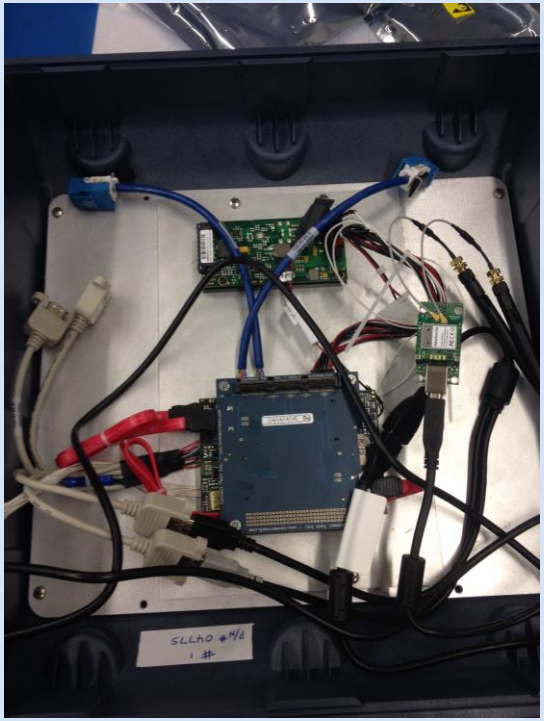
Electronics Packaging

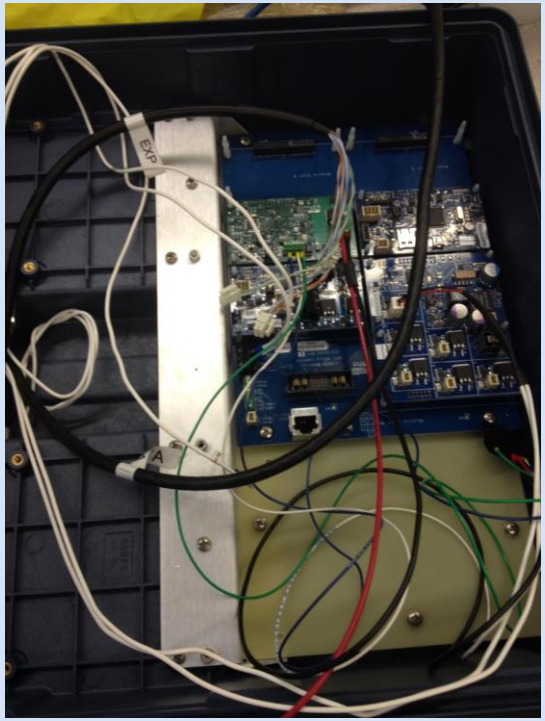


Electronics Packaging - RTA



Electronics Packaging - TSPU

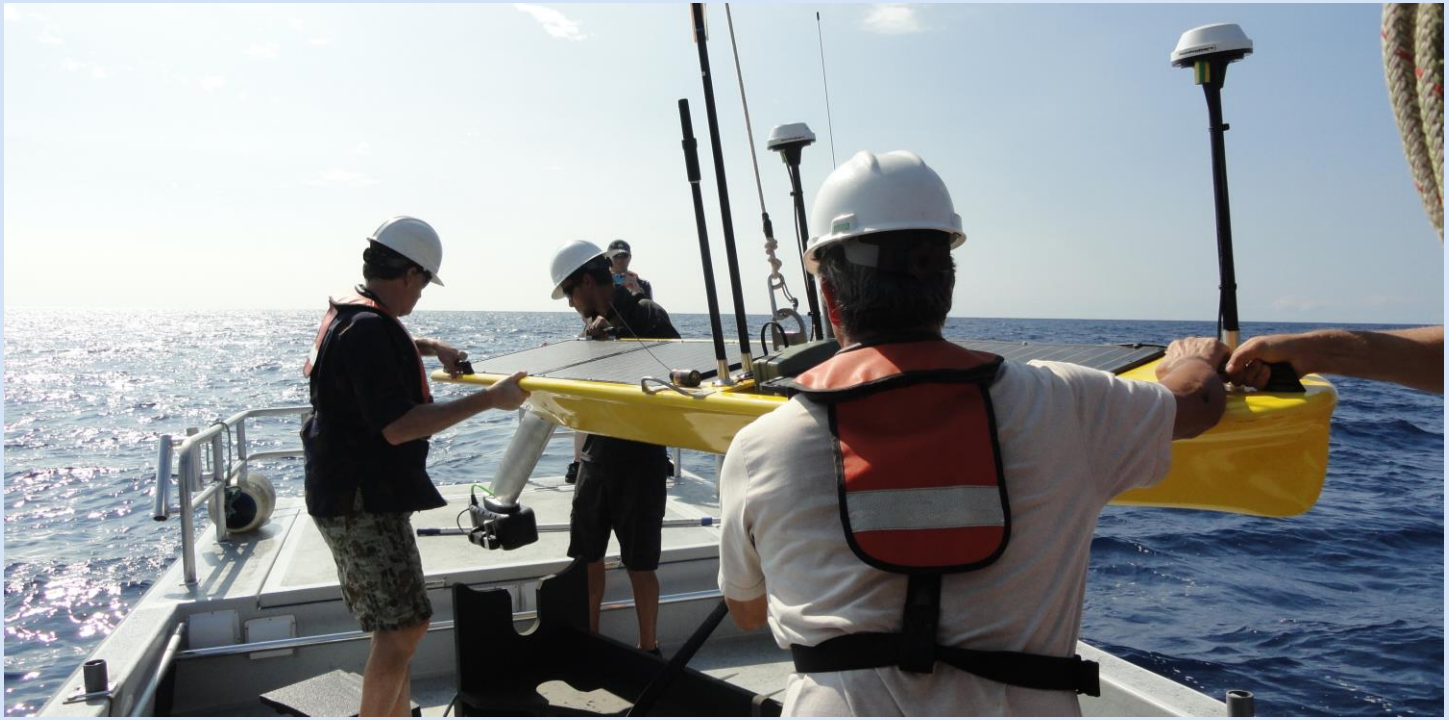




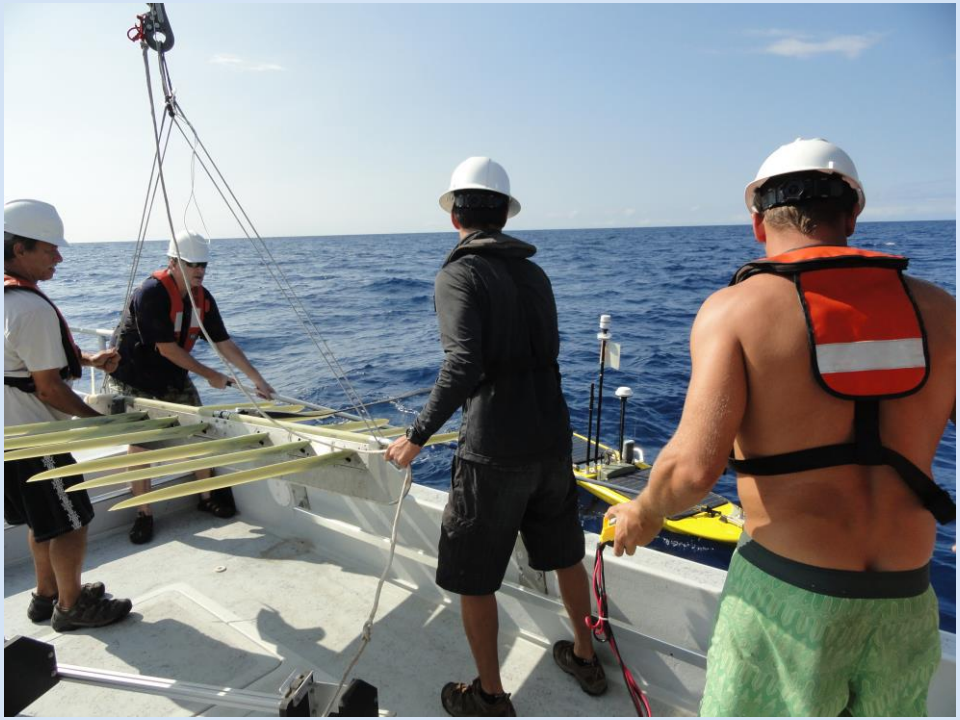
Software Integration

- TSPU Communicates to shore over Cell Modem
- Desktop connection using TightVNC
  - Can use existing Teledyne Odom and CARIS software

Deployment

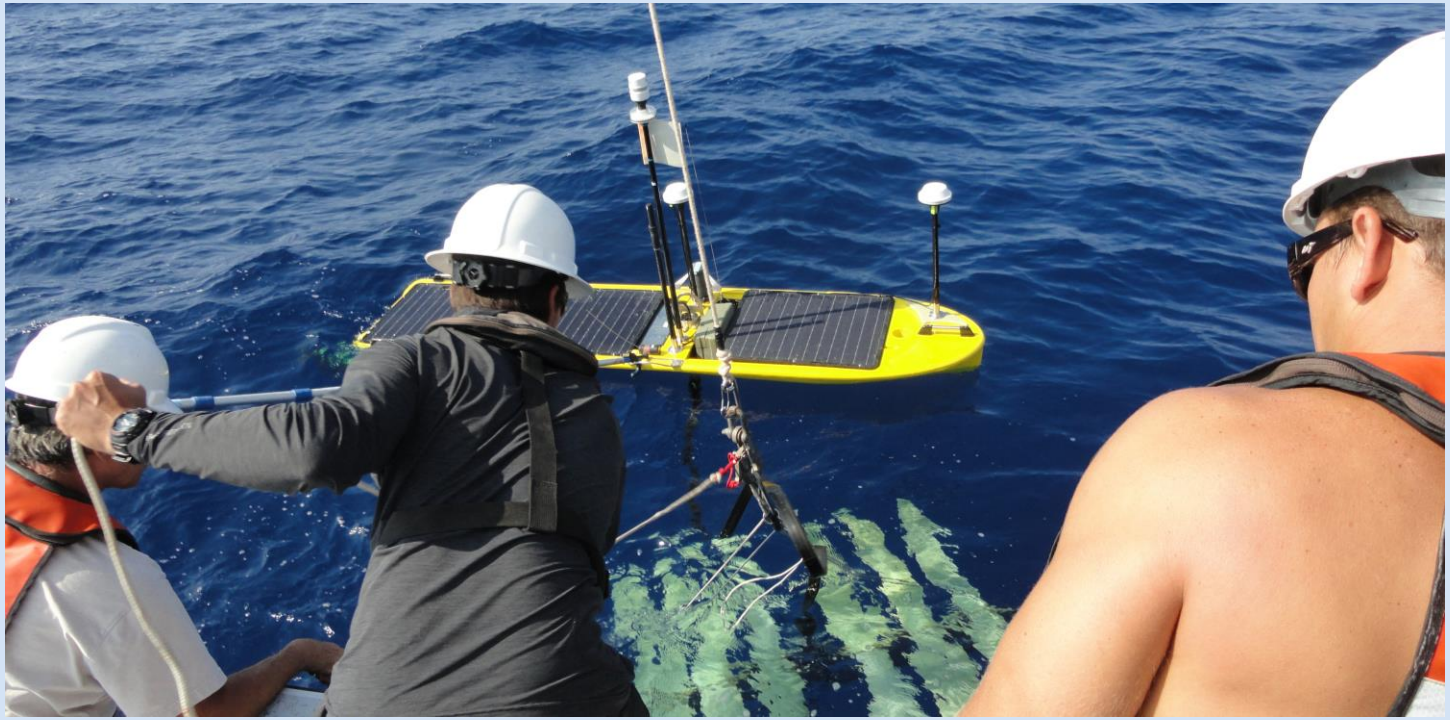


Deployment

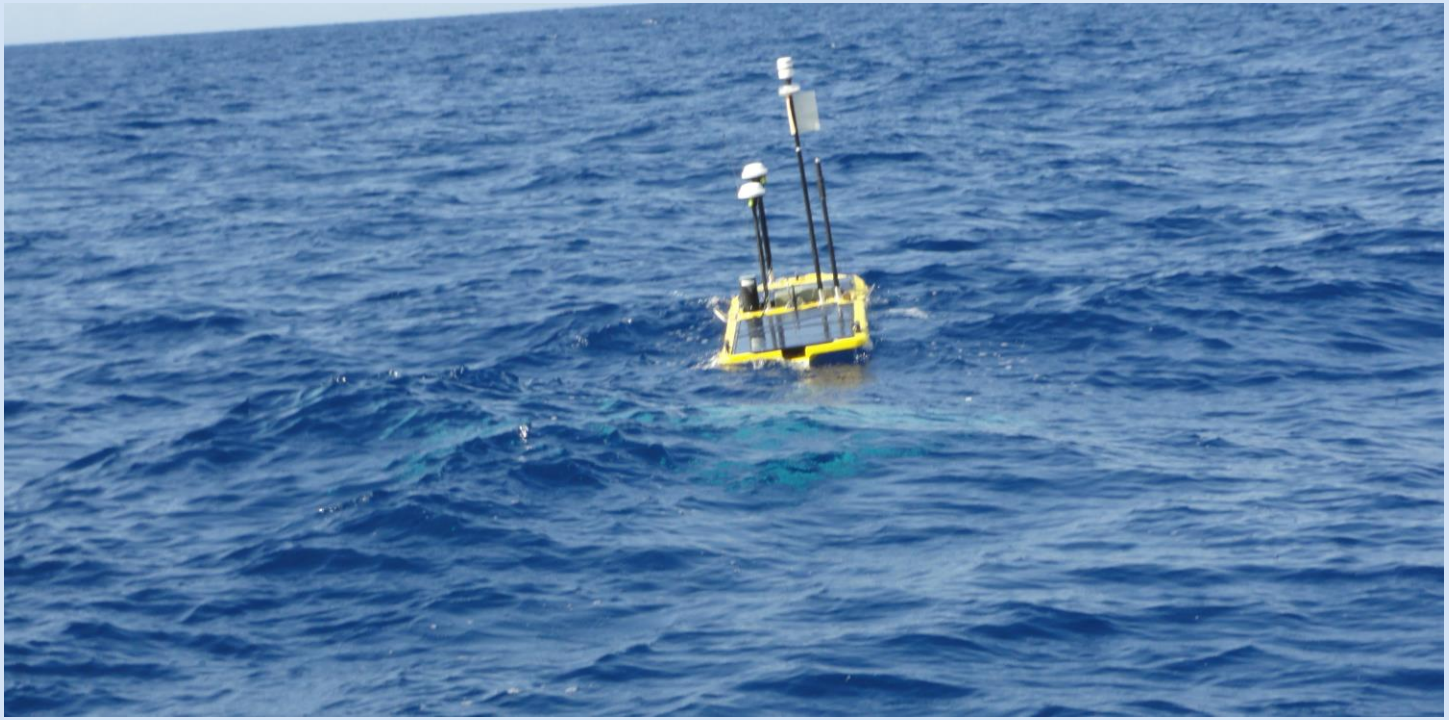


Deployment

Deployment



Deployment



System Operating Power

Required Core Components

Subsystem	Power (W)
Iridium	0.22
GPS	0.18
VMC	2.29
Rudder	0.55
Total	3.24

Optional Core Components

Subsystem	Power (W)
Weather	1.81
Water	1.28
Cell Modem	2.52
Ethernet SW	2.78
AIS	1.34
Total	9.73

Plus thruster power

Payload Component

Subsystem	Power (W)
RTA	47.24
TSPU	43.98
Total	91.22

Solar collection ~540W·hr/day