Research and Universities

Implementations and Uses Cases for the Wave Glider

www.liquidr.com

Areas Wave Gliders Have Been Used in the North American Scientific Community

- Oceanography
- Satellite Validation
- Ocean Acidification
- Hurricane Monitoring
- Mothership/Gateway
- Acoustic Ship Monitoring
- Seismic
- Fish Tracking
- Marine Mammal Acoustics
- Shark Tracking
- Fish Finding
- Survey

Devices Integrated Onto Wave Gliders

- Airmar WX200 Weather*
- Seabird GPCTD*
- Teledyne RDI Workhorse Monitor ADCP – 300/600kHz*
- Turner C3*
- Datawell Wave Height*
- VEMCO Vr2C*
- LI-COR LI-820 CO2
- MAPCO2
- Honeywell Durafet II pH
- Wet Labs Eco Puck
- SeaFET pH
- WHOI Micromodem*
- Benthos Transducer*
- Sonardyne 6G*
- Inertial Navigation Unit
- MBARI Comms Hot Spot
- WHOI DMON
- SCRIPPS HARP
- Inmarsat
- NDBC DART
- PME Thermistor
- MacArtney Winch

*LRI Supported Products

Ocean Surface Measurements

SIO – Luc Lenain & Kendall Melville

- Operated near R/V FLIP
- Provided broader spatial coverage of sub-surface measurements
- Comparison with airborne remote sensing data
- CTD, ADCP, Thermistor Chain

http://www.unols.org/sites/default/files/201406sco_ap12.pdf

Winch

SIO – Luca Centurioni

- MacArtney Winch – 100m depth
- CTD Profiles
- Real time data and power
- Testing in San Diego
- SV2

http://www.onr.navy.mil/reports/FY12/pocentu1.pdf

Tsunami Warning and Weather Station

NDBC – Helmut Portmann

- Weather Station
- Deep-Ocean Assessment and Reporting of Tsunami (DART)
- Gulf of Mexico

http://www.ndbc.noaa.gov/glider_launch.shtml

Satellite Comparison

WHOI – SPURS – David Fratantoni

- Salinity Processes in the Upper Ocean Regional Study (SPURS)
- CTD (float and sub) and Weather Station
- Comparison to satellite, buoyancy gliders and AUVs
- Mid Atlantic Ocean, multiple years, 6+ month deployments

http://cosee.umaine.edu/coseeos/spurs/how_resources4.htm

Satellite Calibration

NASA – John Moisan, Stan Hooker

- Profiling Optical Sensor
- PACE ocean color calibration field studies
- Biospherical Instruments
- In development
- SV3

https://www.fbo.gov/index?s=opportunity&mode=form&id=e6b6eceeb9ac9fc483eb62f70a8bf1f4&tab=core&_cview=1

Ocean Acidification

MBARI – Francisco Chavez

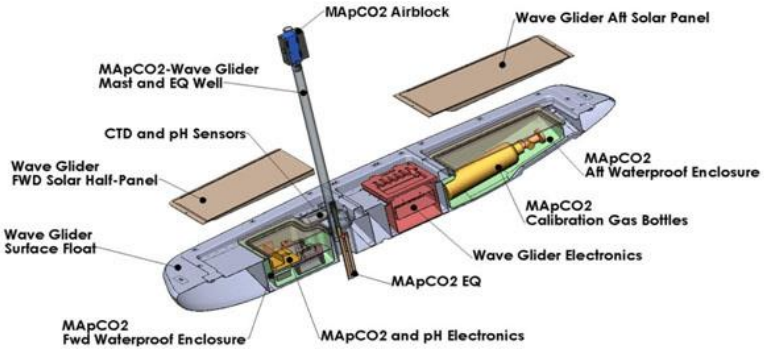
- SV2 and SV3
- Monterey Bay, CA
- pCO2, pH, Oxygen, Salinity, Temperature
- Near production

http://www.mbari.org/education/internship/11interns/papers/Tougher.pdf

Ocean Acidification

NOAA – Christopher Sabine and Chris Meinig

- MAPCO2 system, SeaFET pH sensor and SeaBird CTD
- Pacific Northwest and South Atlantic Sea
- SV2



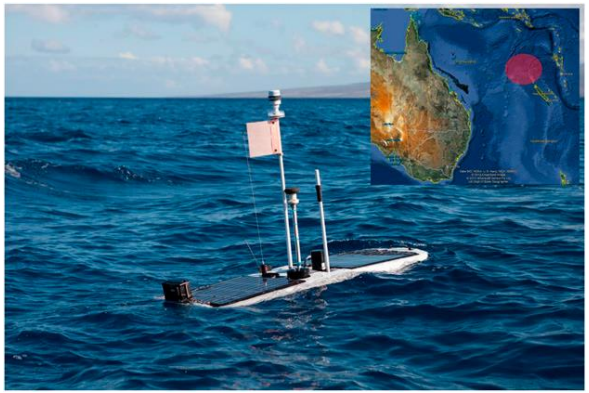
http://www.pmel.noaa.gov/co2/story/Carbon+Wave+Glider

Pacific Marine Environmental Laboratory

Tropical Cyclone Surface Measurements

SIO – Luc Lenain & Kendall Melville

- Pacific Crossing Challenge (PacX)
- Conducted by LRI
- Open dataset
- CTD+DO, Weather, Waves, Fluorometer
- Paper discusses improved methods of measuring surface ocean-lower atmosphere (SOLA) processes in tropical cyclones.

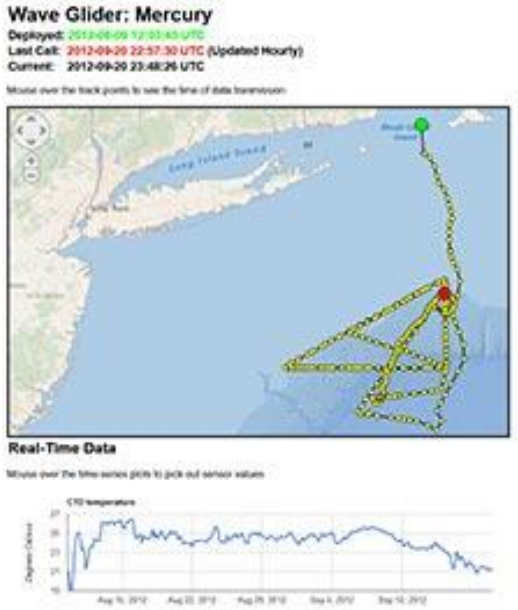


http://journals.ametsoc.org/doi/pdf/10.1175/JTECH-D-14-00012.1

Fetch/Tsunami Node

Rutgers, MARACOOS, Sonar

- Sonardyne 6G
- North American Atlantic Coastal
- Hurricane Sandy
- Fetch Nodes
- Early Warning System

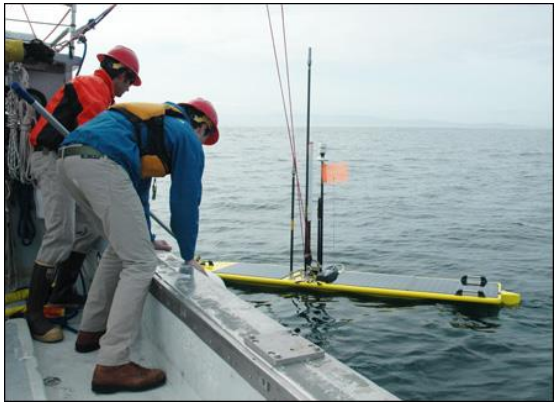


http://maracoos.org/content/fetchtsunami-node-wave-glider-ocean-observing-demonstration-project

Mothership

MBARI - Mark Chaffey, Tom O'Reilly

- High-bandwidth communications relay from the long-range AUV via Wave Glider acoustic communications to shore
- Able to reposition/retask AUVs and follow along on surface to maintain contact

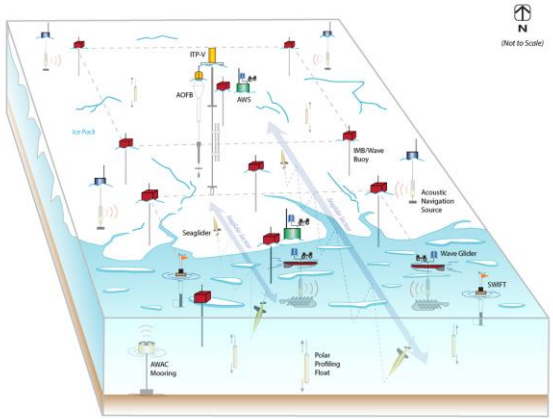


http://www.mbari.org/news/behind-the-scenes/behind-the-scenes.html

AUV Navigation Beacons

WHOI – Lee Freitag

- Arctic Ice Sheet movement
- Benthos/WHOI modem on sub
- Provides location information to AUVs below ice sheet
- SV3 and SV2

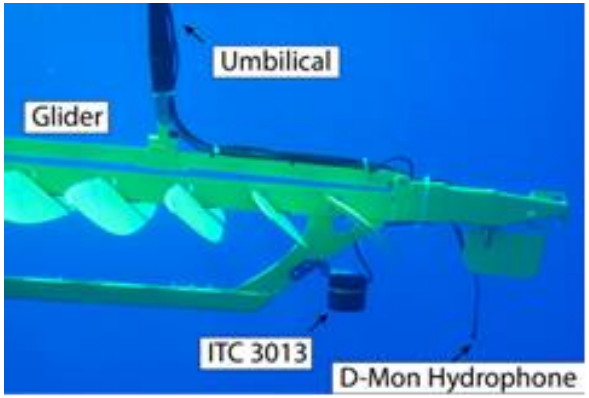


http://www.onr.navy.mil/reports/FY13/agfreit.pdf

Passive Acoustic Monitoring/Gateway

University of Hawaii – Brian Bingham & Bruce Howe

- WHOI Micro-modem
- WHOI DMON Hydrophone
- Hawaii Operations

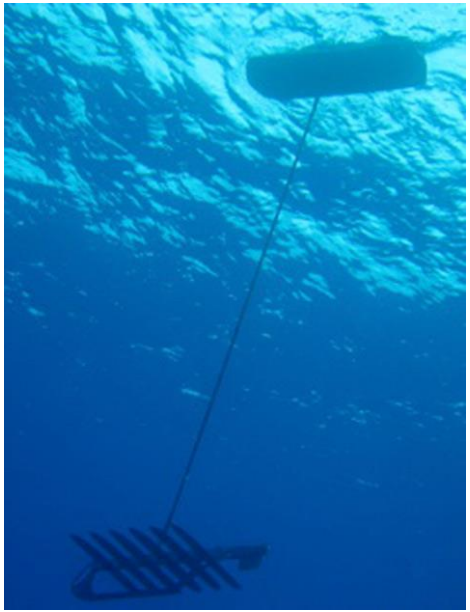


ftp://soest.hawaii.edu/bhowe/outgoing/20130623_UAC_Corfu/UAC2013_Howe_Paper_20130424q.doc

Acoustic Ship Detection

CIMES – Margo Edwards

- Live Ship Detection
- Acoustic Hydrophone
- SV3
- Low Visibility Wave Glider
- MPA Protection

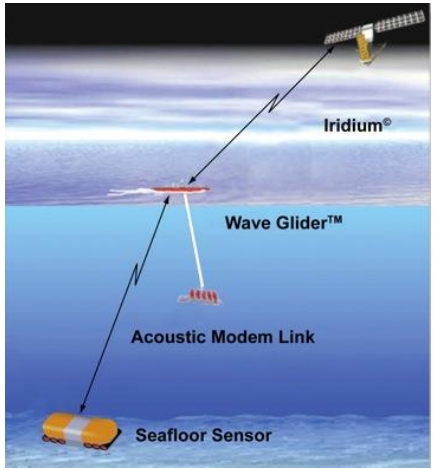


ftp://soest.hawaii.edu/margo/Jan30_Demo_Agenda.pdf

Tectonic Plate Movement

SIO – Jonathan Berger and John Orcutt

- ADDOSS – Autonomously Deployed Deep-Ocean Seismic System
- WHOI Micromodem w/Benthos Transducer
- SV2
- Hawaii and California Coast

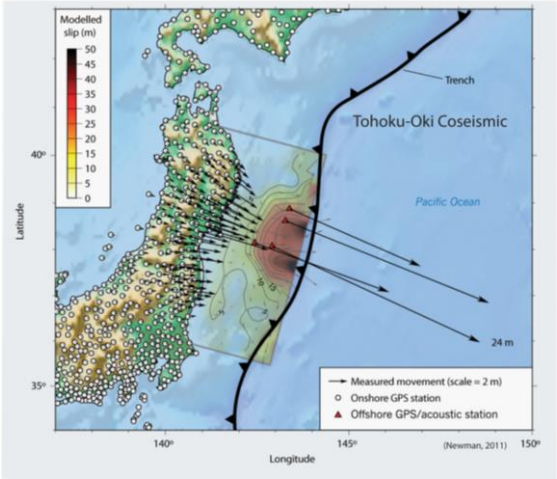


http://www.obsip.org/documents/ADDOSS-Oct2013-2.pdf

Tectonic Plate Movement

SIO – David Chadwell

- Acoustic Seafloor Geodessy
- Dual frequency GPS receiver embedded in an Inertial Navigation Unit, a second GPS antenna/receiver to align the INU, and a high precision acoustic ranging system
- Earth Observatory of Singapore deploying similar system

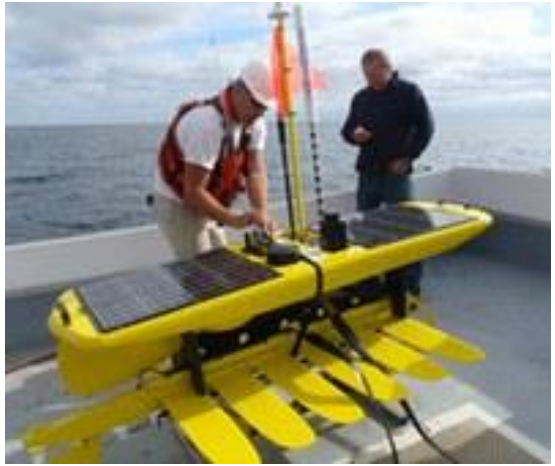


•http://adsabs.harvard.edu/abs/2013AGUFM.G14A..01C

Fish Tracking

Ocean Tracking Network – Fred Whoriskey

- VEMCO Acoustic Receiver and modem
- Real-time detections
- Node Data Retrieval
- Offshore Halifax, Gulf of St. Lawrence
- SV2
- Salmon, crab, eel, others



http://green.blogs.nytimes.com/2012/07/10/a-new-way-to-track-fish/?_r=0

Fish Tracking

ECU – Roger Rulifson, Joseph J. Luczkovich

- Towed Decimus PAM
- CTD
- VEMCO Vr2C
- Fluorometer
- ADCP
- SV2
- North Carolina Coast
- In development

http://www.ecu.edu/cs-cas/articles/wave-glider.cfm

Live Whale Audio

Jupiter Research Foundation

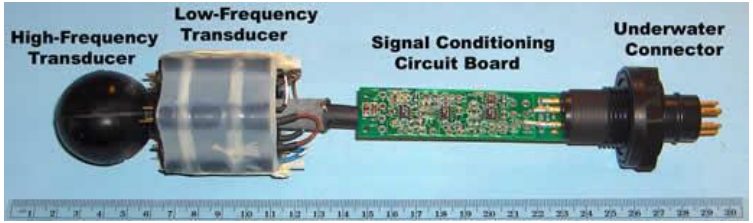
- Hydrophones
- Digitally Compressed mp3s
- Transferred via cellular networks
- SV2
- Inmarsat

http://jupiterfoundation.org/#projects

Passive Acoustic Monitoring

SIO – John Hildebrand, Sean Wiggins

- High-frequency Acoustic Recording Packages (HARPs)
- Gulf of Mexico
- SV2
- Recorded acoustic marine mammal



http://roch.sdsu.edu/waveglider/

Shark Tracking

Hopkins Marine Station/GTOPP – Barbara Block

- VEMCO Acoustic Receiver
- Real Time Detections
- California Coast
- SV2
- Shark Net phone app

http://www.gtopp.org/

Global Tagging of Pelagic Predators

Biosonics Echosounder

NWSFC – Hufnagle and Chu, Cornell – Chuck Greene

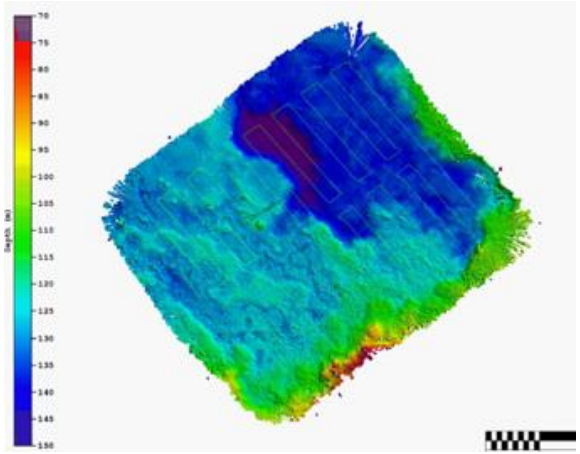
- Biosonics DT-X Towed Echosounder
- Hawaii, Great Lakes, Oregon coast
- Finds different aggregations of fish
- Samples sent back real-time

http://www.nwfsc.noaa.gov/news/features/wave_glider/index.cfm

Multibeam Echosounder

Teledyne Odom & CARIS

- Survey
- Automated Post Processing
- Teledyne ODOM MB-1 Multi-beam Sonar
- CARIS HIPS signal processing and visualization software
- SV3



http://www.iho.int/mtg_docs/rhc/MACHC/MACHC14/Stakeholders-7-Hydrone-LRI.pdf