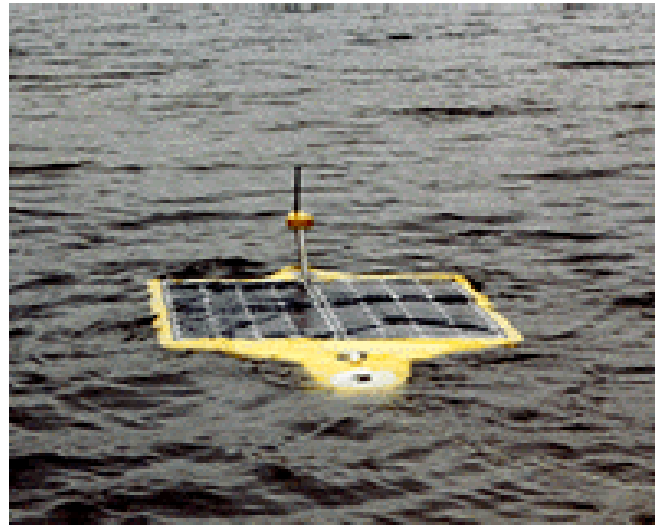
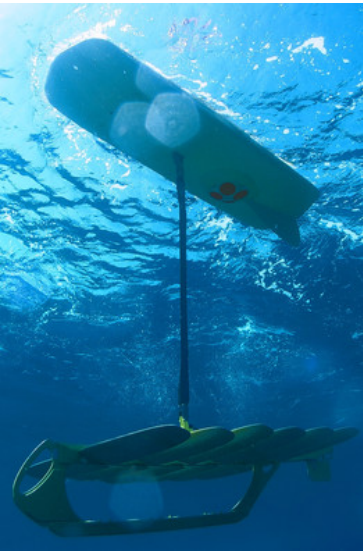




# Unmanned Systems

Richard Crout, PhD and Walt McCall  
NOAA National Data Buoy Center



# Definitions

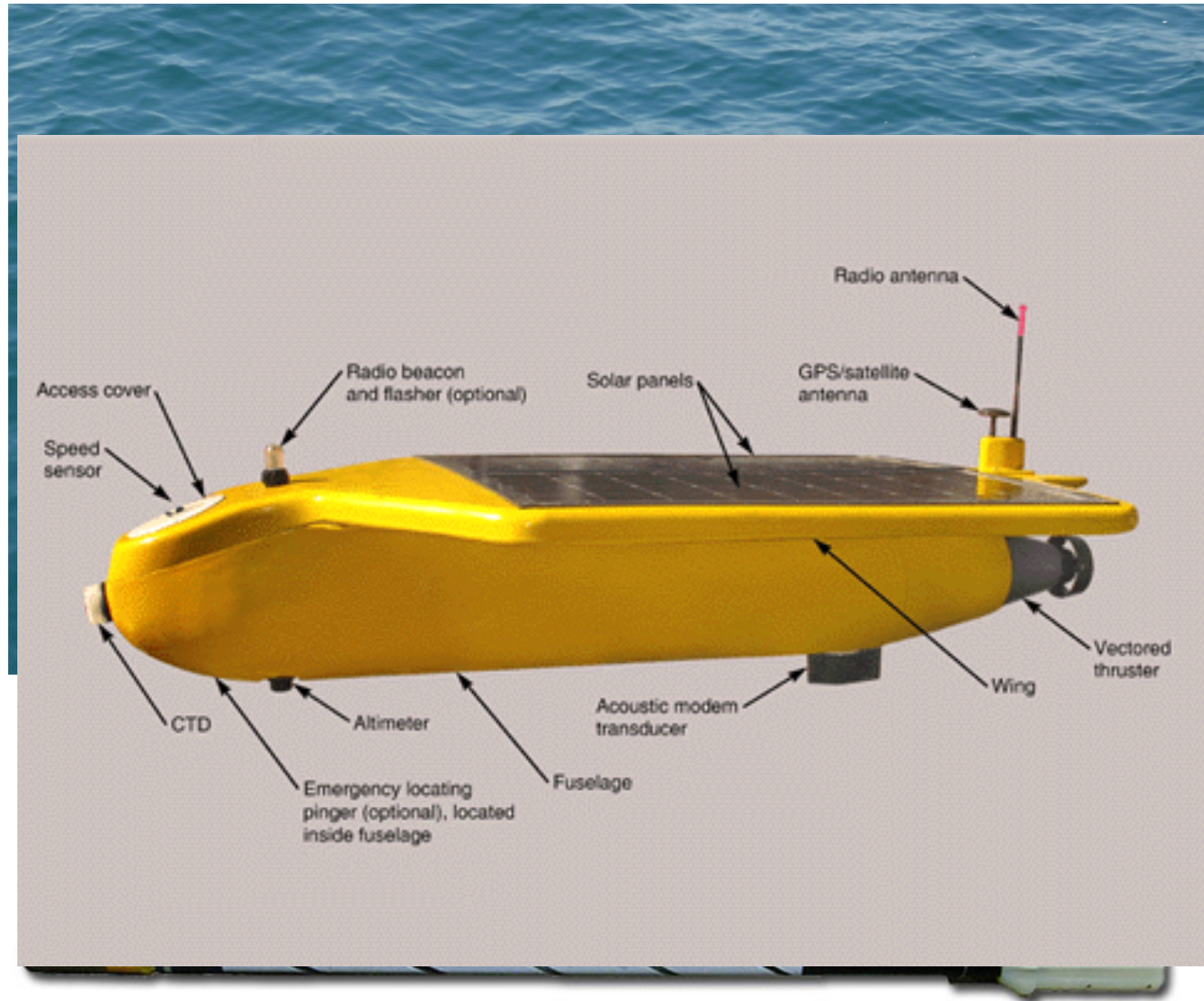
- Unmanned System is an Autonomous System capable of Operating in the Ocean for deployments longer than 2 weeks
- Glider is an ocean platform with control surfaces that allow guidance
- Profiling glider dives and resurfaces to transmit profile data (aka, benthic glider and porpoising glider)
- AUV is an Autonomous Underwater Vehicle
- ASV is an Autonomous Surface Vehicle
- USV is an Unmanned Surface Vehicle

# Background History

- Consider subset of unmanned systems that are of interest for Operational Ocean Observations
- Profiling gliders developed for U.S. Navy
- 4-6 months, 2 man carry, depths 1000 meters
- University of Washington, SCRIPPS, Webb
- Seaglider, SPRAY, Slocum
- 0.5 kt speed over ground

# Current AUV Systems

- Slocum
- SPRAY
- Seaglider
- Exocetus
- Solar AUV



# Slocum Glider Alkaline

- Depth: 4-200 Meters
- Length: 1.5 Meters
- Weight: 54kgs
- Duration: 15-40days
- Speed thru Water: .35m/s
- \Mass Shifter



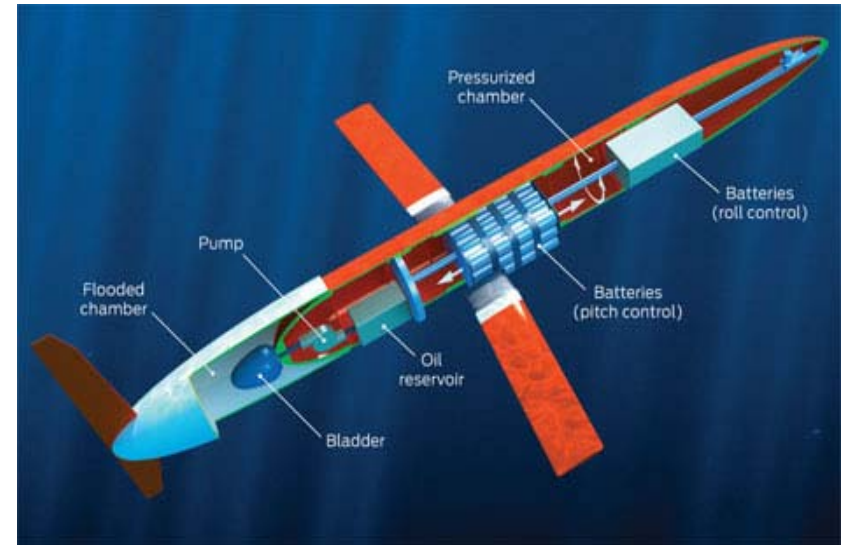
# Slocum Lithium (Deep)

- Depth: 40-1000 Meters
- Length: 1.5 Meters
- Weight: 54kgs
- Duration: 100-200days
- Speed thru Water: .1-.35m/s
- Buoyancy Engine



# SPRAY Glider

- Depth: 40-1500 Meters
- Length: 2.1 Meters
- Weight: 52kgs
- Duration: 120-160days
- Speed thru Water: .19-.35m/s
- Buoyancy Engine



# Seaglider

- Depth: 40-1500 Meters
- Length: 2.8 Meters (1.8 w/o antenna)
- Weight: 52kgs
- Duration: 120-240days
- Speed thru Water: .1-.35m/s
- Buoyancy Engine





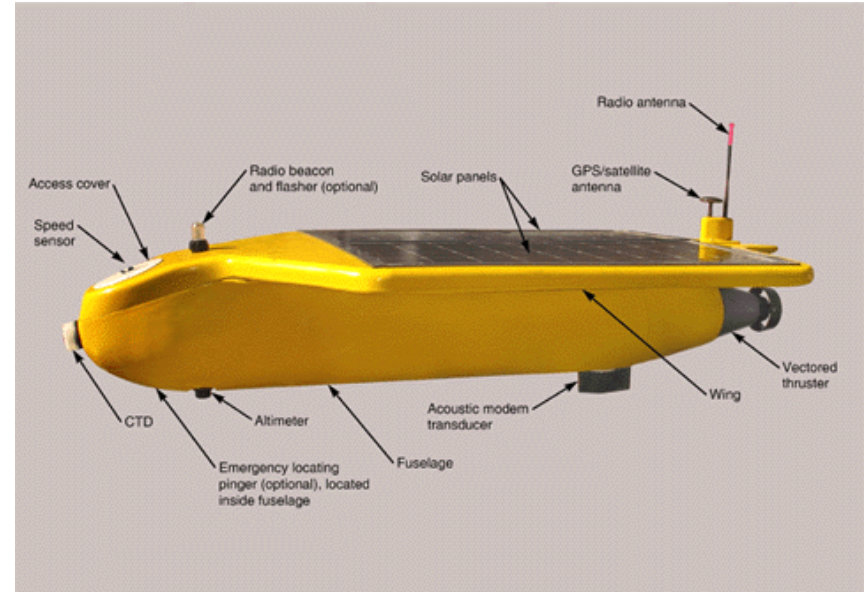
# Exocetus

- Depth: 10-200 Meters
- Length: 3 Meters (2 w/o antenna)
- Weight: 120kgs
- Duration: 15days
- Speed thru Water: .5-1m/s
- Buoyancy Engine
- Alkaline Only



# Solar AUV

- Depth: 1-500 Meters
- Length: 2.3 Meters
- Weight: 200kgs
- Duration: 25-35days
- Speed thru Water: .5-1m/s
- Propeller



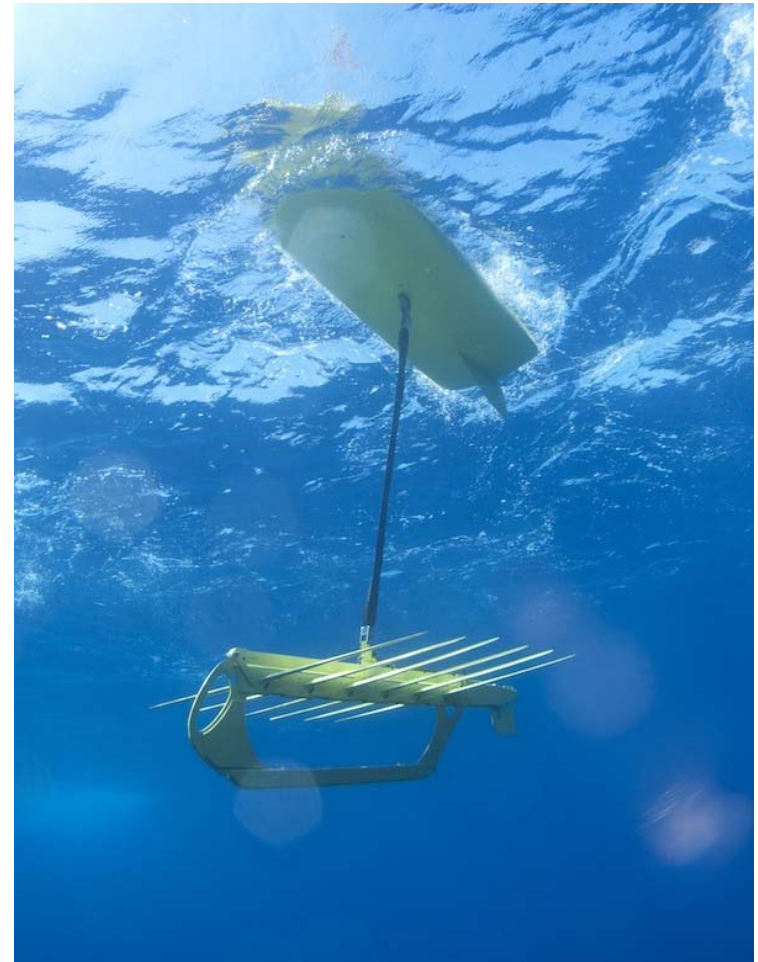
# Current ASV Systems

- Waveglider
- Robo-Kayak



# Waveglider

- Length: 2 Meters
- Weight: 90kgs
- Duration: 60-180days
- Speed thru Water: .1-.8m/s
- Mechanical Wave Energy



Sailboat

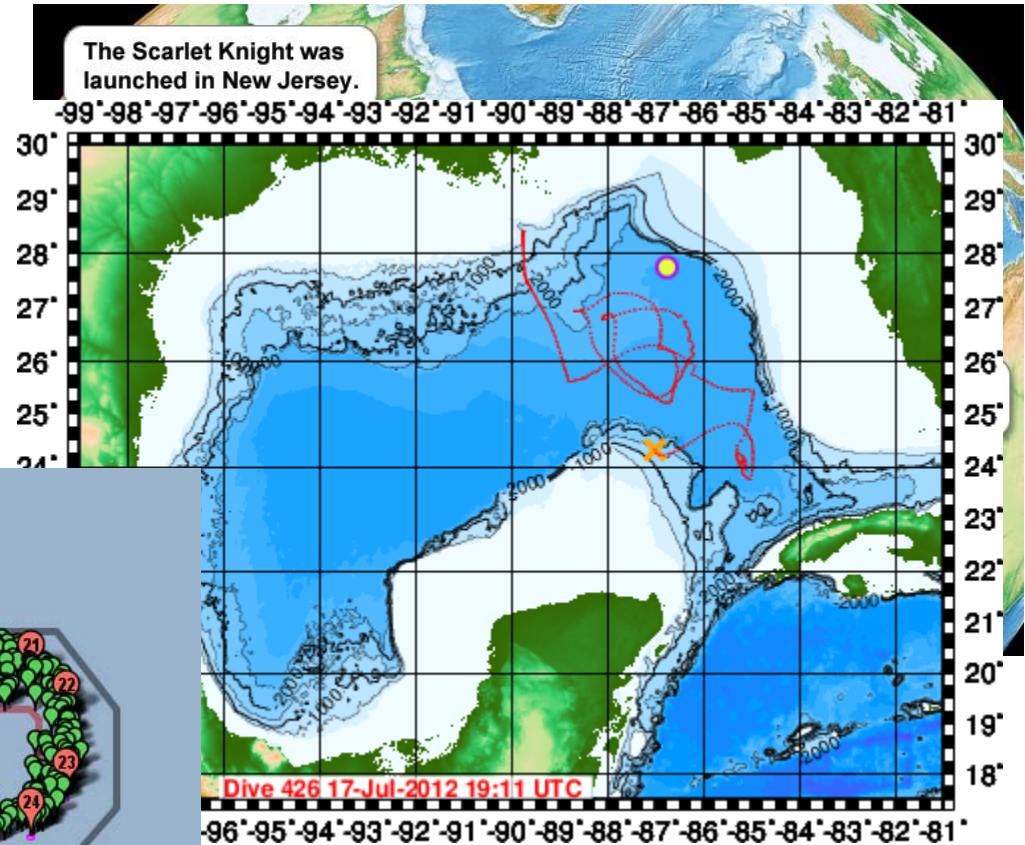
# Robo-Kayak

- Length: 3 Meters
- Weight: 91kgs
- Duration: 3-20days
- Speed thru Water: 1-3m/s
- Propeller



# Glider Mission Types

- Ship Transit Paths
- Section Surveys
- Station Keeping



# Piloting/Mission Planning

- Primitive piloting tools. No operational minded GUI.
- Vessel traffic and vandalism
- Navigation hazards
- Strong currents and High wind/waves
- Deployment and recovery locations
- Escape locations
- Etc.



# Operation/Maintenance

- Recalibrate compass
- Re-ballast profilers
- Re-battery
- Deployment hoist
- Recovery tools
- Refurbish modems, antennas, and parts

# Ancillary Information

- ARGO profiling floats are already transmitting data in a BUFR format; could be used for gliders
- Most glider operators currently provide data in netCDF (many in US operated by Universities) and would be a preferred method for sending the data over future transmission systems (WIGOS)
- NOAA NDBC received and transmits data from US Integrated Ocean Observing System gliders
- Future possibility of “gliders” augmenting, complementing, gap-filling, or replacing surface and/or subsurface systems to combat vandalism and reduce maintenance costs

# Conclusions

- Gliders will be a part of many marine observing systems in the future
- Some gliders may complement buoy operations
- Need to control the calibration, guidelines for use, and transmission of the data (JCOMM DBCP should set the Standards)
- netCDF should be considered as a format for future WIGOS transmission
- A glider concept of operations should be a JCOMM DBCP document

# Lagniappe

- 2<sup>nd</sup> Generation Profilers
  - Faster Speeds (2kts STW)
  - Longer Mission Endurance (1+years)
  
- 2<sup>nd</sup> Generation USVs
  - Improved Endurance (1yr reliability)
  - Increased Speed (2-3kts STW)