Underwater Gliders: Novel Payloads for Monitoring Anthropogenic Inputs and Impacts

Daniel Hayes, Ehsan Abdi, and many more

Cyprus Subsea Consulting and Services C.S.C.S. Ltd

EOOS Tech Forum
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CYPRUSSUBSEA
Consulting and Services C.S.C.S. Limited

Who Are We?

- Based in Nicosia, Cyprus

- Founded 2012

- 6 employees + contractors
  - Oceanography
  - Ocean Engineering
  - Maritime Security

- Research Focus

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Overview of activities

Research in Marine Science and Technology to advance observational capacity

Sales, rental, support, and operations through a global network of suppliers and experts

Real time data collection: from surface to full ocean depth

Research Projects
Gliders and advanced observing methods

H2020

- **GROOM2 (Gliders for Research, Ocean Observation and Management II)**
- **TechOceanS (Technologies for Ocean Sensing)**
- EU Marine Robots Transnational Access Grant, "Ecosystem profiling with ocean gliders"
- BRIDGES (Bringing together Research and Industry for the Development of Glider Environmental Services

NSF

- **Development of a Carbon Dioxide Seaglider (University of Alaska Fairbanks)**

RIF Cyprus

- OS Aqua (Open Sea Aquaculture in the Eastern Mediterranean)
- STEAM (Sea Traffic Management in the EAstern Mediterranean)
- SMART CABLES (Smart Standardized Marine Sensor Cable Interface)

Martera ERANET-cofund

- PIMEO-AI (Pollution Identification, Mapping, and Ecosystem Observation with AI-powered water quality USV)
- **BioGlider: Autonomous Exploration and Monitoring of Marine Ecosystems**

Areas of Expertise
Operations, maintenance, support, development, analysis

- **Autonomous Vehicles:** for ocean conditions, acoustic monitoring.

- **Fixed Buoys:** for ocean conditions and acoustic monitoring.

- **HF Radar (over the horizon):** for ship tracking, currents, waves.

- **Drifting and/or profiling buoys:** for search and rescue, currents.

- **Operational Oceanography:** for search and rescue, current prediction for pollution. Monitoring and forecasting of ocean in real time.

- **Ocean acoustics:** for quantifying noise levels, marine mammal presence and identification, ship detection, fish and bubble detection.

- **Remotely-Operated Vehicle (ROV):** for inspection, search and recovery.

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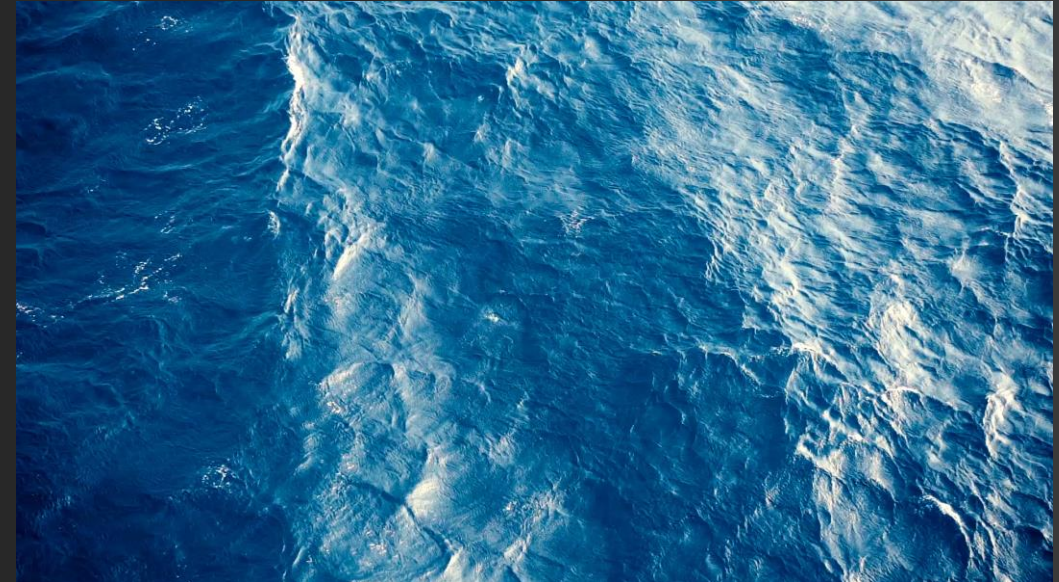
Cyprus Subsea's SIRMA^{TM}

- Smart Interoperable Real-time Maritime Assembly
- Variety of interchangeable modules
  - Processing modules
  - Protocol modules (RS-323, 485, 422, Ethernet, USB, CAN-bus)
  - Power modules (step-up, step-down, protection circuit)
  - Miscellaneous modules (ADC, memory, Real-time clock, etc.)
- Pressure tolerant
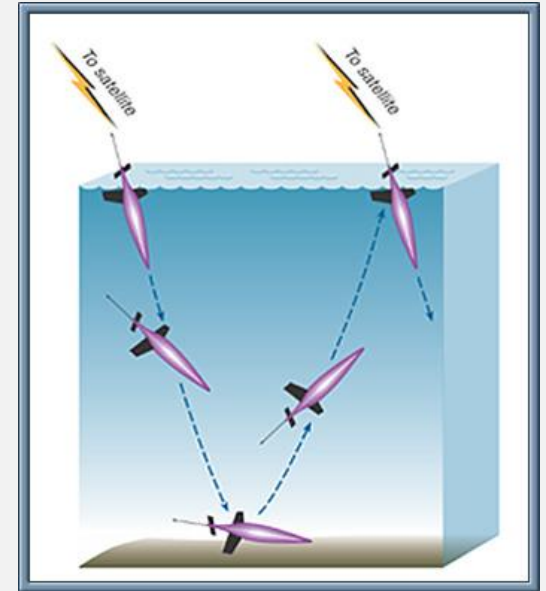- Customizable connector/pin-out
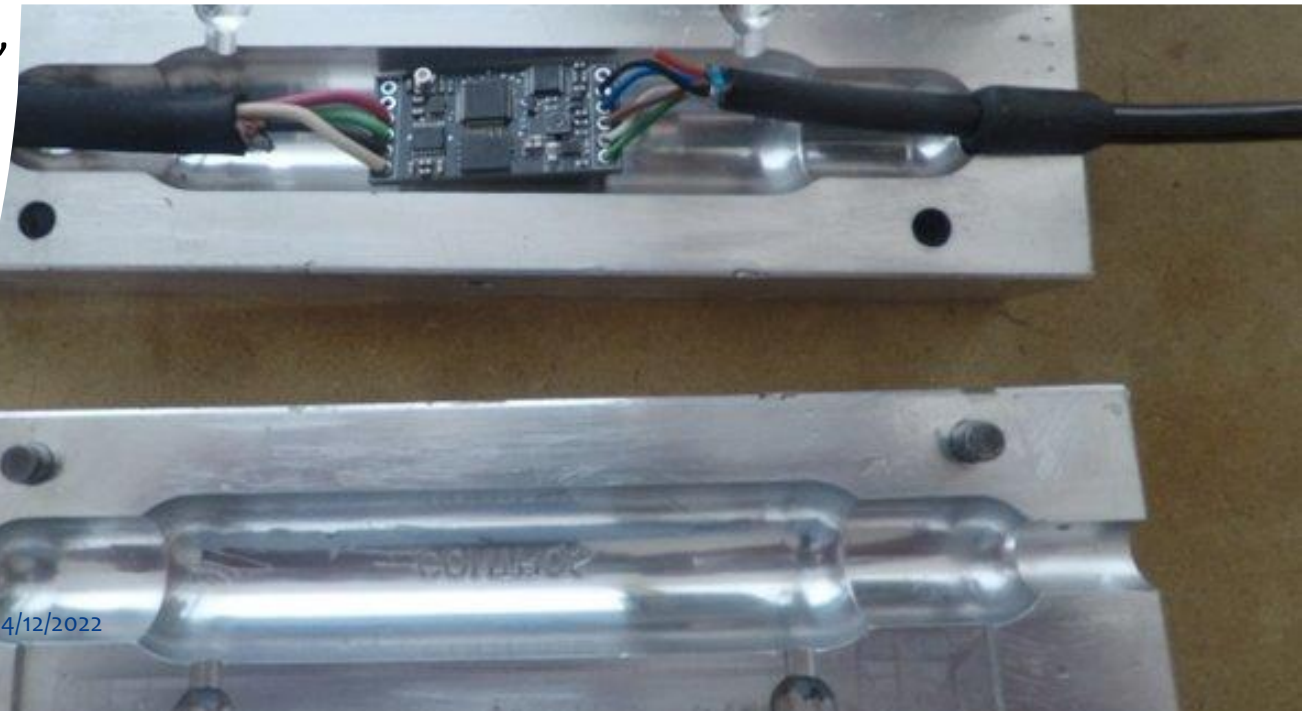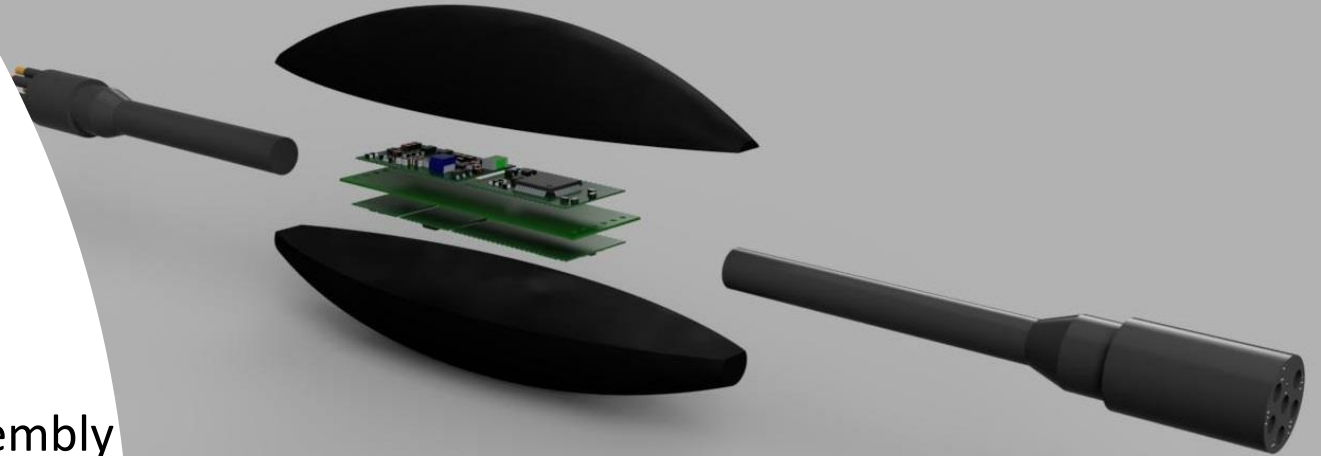
Cyprus Subsea's Glider Fleet

- FOUR Seagliders
- 1000 m rated
- CTD, DO, Fluorometers
- Rent as a service, with customizable payloads

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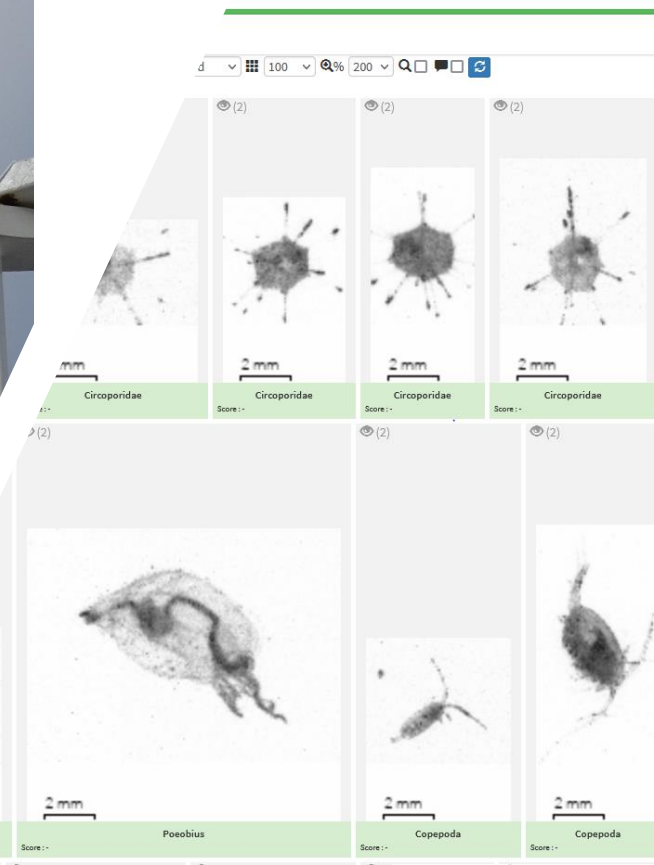
Example 1: pCO2 (CH4 next)

- 4H-Jena (Contros) HydroC
- Seaglider with SIRMA
- Technical trials completed 11/21 (CY)
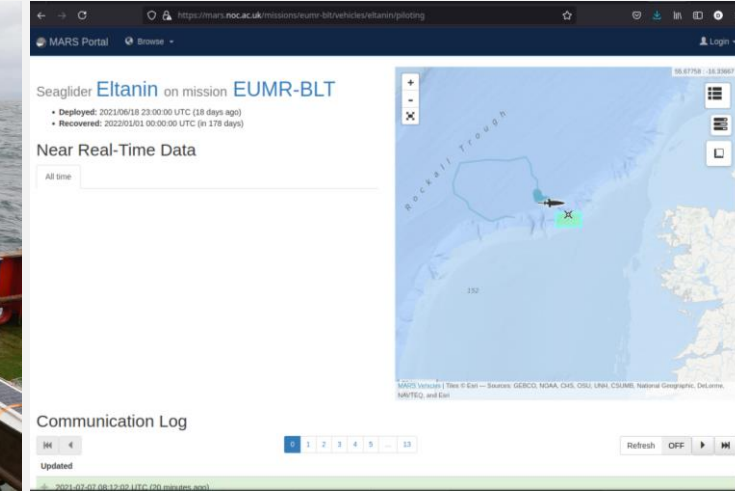- Scientific trials 4/22 (AL)

Example 2: UVP6

- Akvaplan-Niva (Lional Camus) and CNRS-SU LOV (Marc Picheral)

- Seaglider with SIRMA cable

- Hydroptic UVP6

- Norwegian and Arctic technical trials 5/21, scientific trials 5/22

TechOceanS
TECHNOLOGIES FOR OCEAN SENSING

HYDROPTIC

Example 3: Passive and Active Acoustics

- **gListen:** hydrophone system designed for glider for passive acoustic monitoring

- Seaglider with SIRMA

- Technical and Scientific trials completed 6/21 (UK)

- **DeepEcho**: scientific echosounder designed for glider for detection of fish, plankton, bubbles

- Seaglider with SIRMA

- Technical trials completed 12/22 (CY)

- Scientific trials 5/22 (Polar Front)
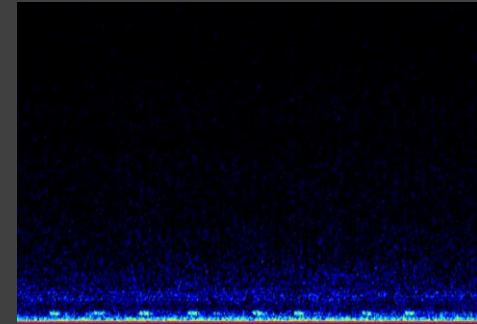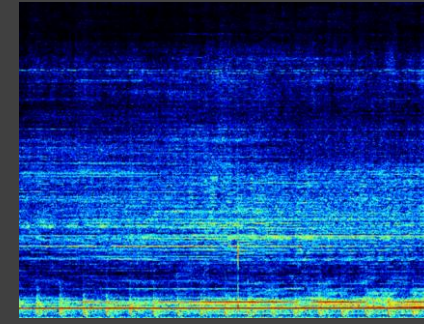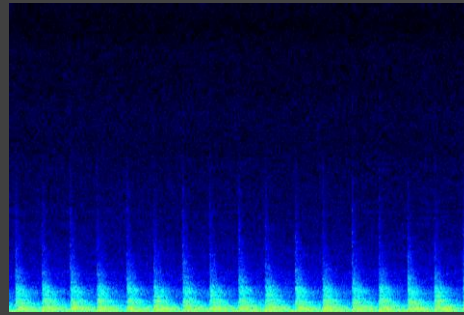
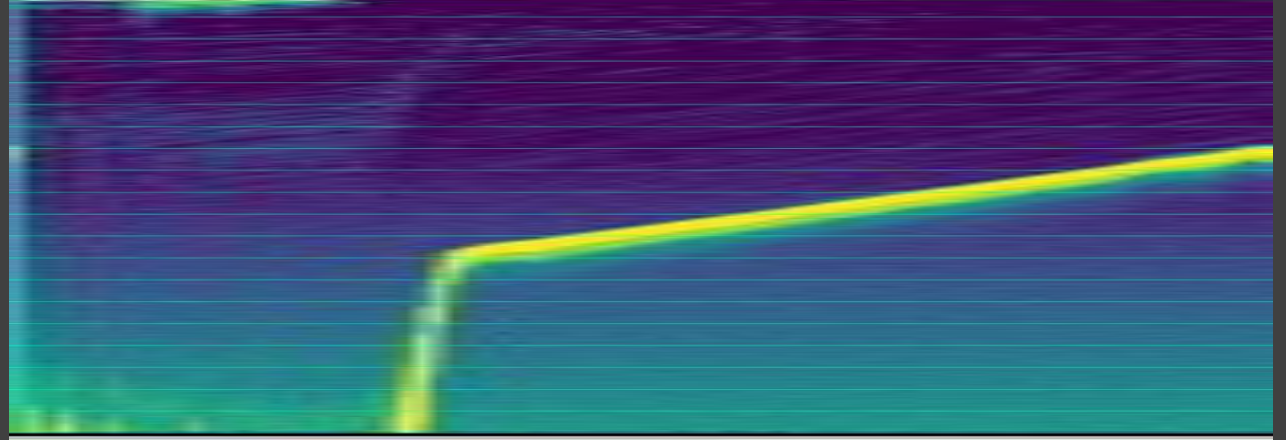National Oceanography Centre | Huntington Ingalls Industries — Hard Stuff Done Right™ | OCEAN SONICS | KONGSBERG | Akvaplan niva | GLIDER — Unmanned Ocean Exploration

Passive Acoustics



- Seaglider with SIRMA inside glider
- Ocean Sonics icListen (Kayak next)
- Analyzes, transmits acoustic spectra
- Near-real-time event detection

OCEAN SONICS

Huntington Ingalls Industries
Hard Stuff Done Right™

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Active Acoustics

- Kongsberg Simrad WBAT mini-ek80

- First scientific wide-band echosounder on glider

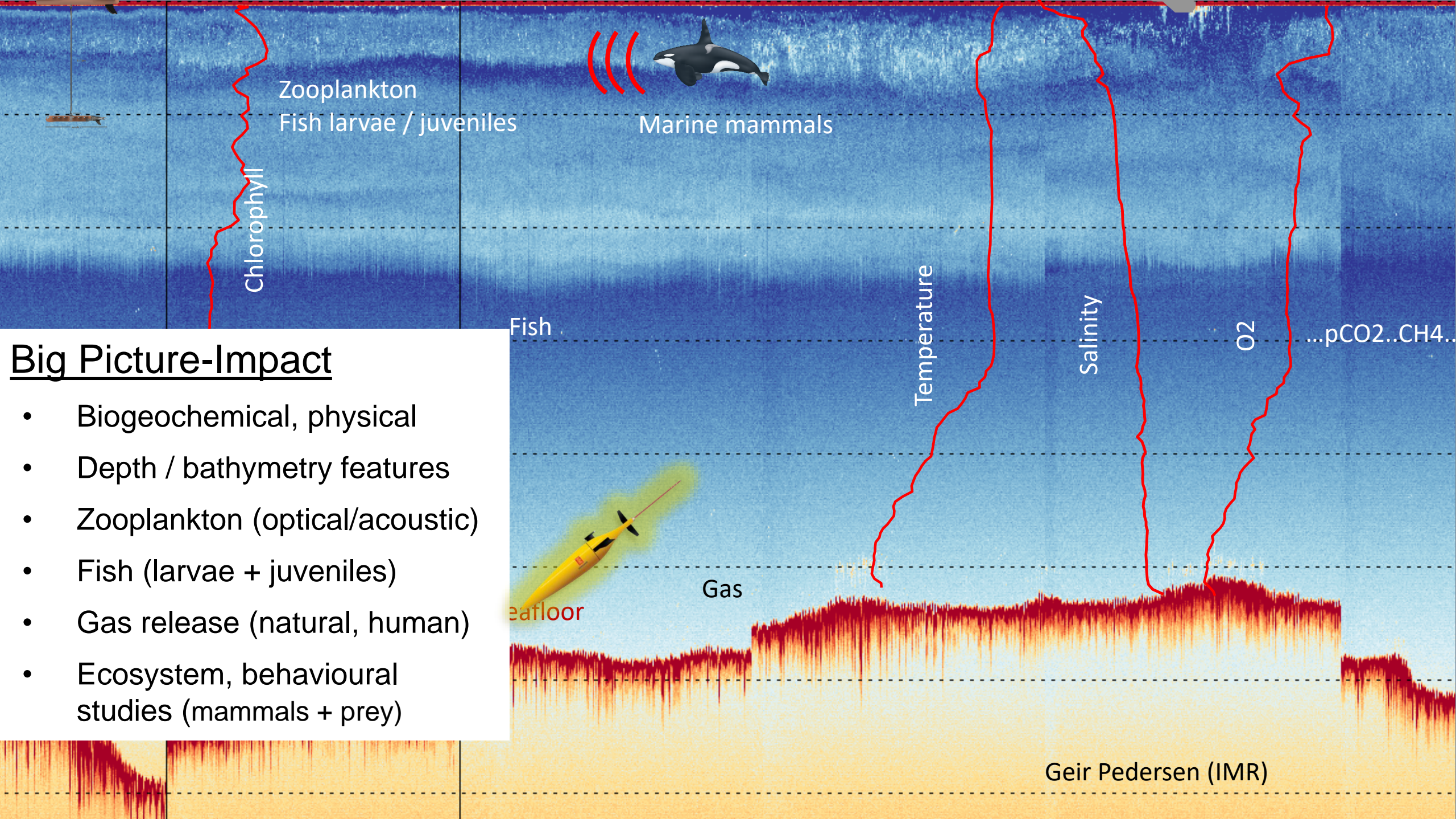- Modified electronic boards to fit a pressure housing
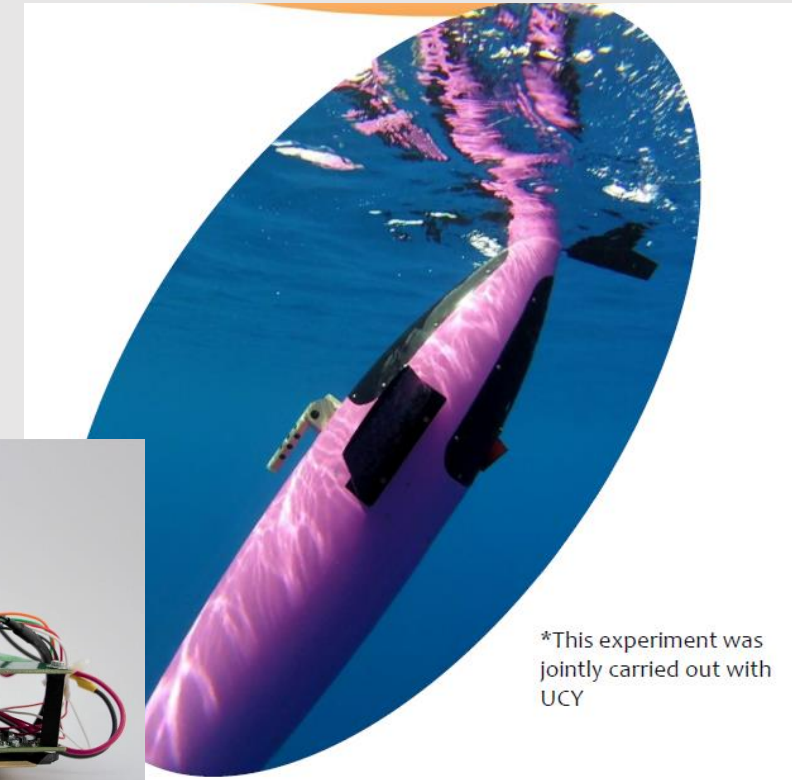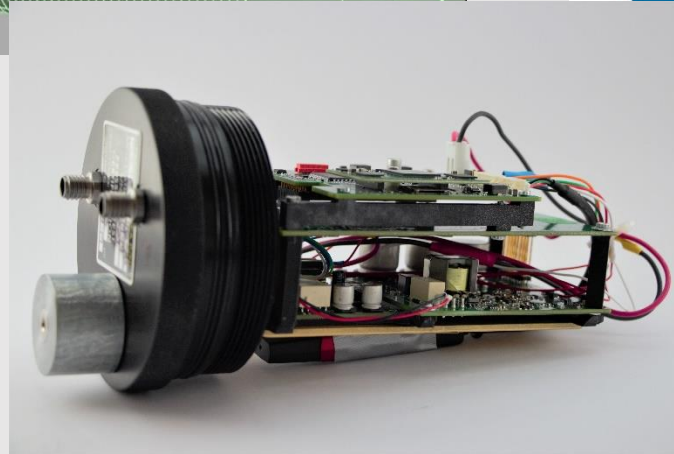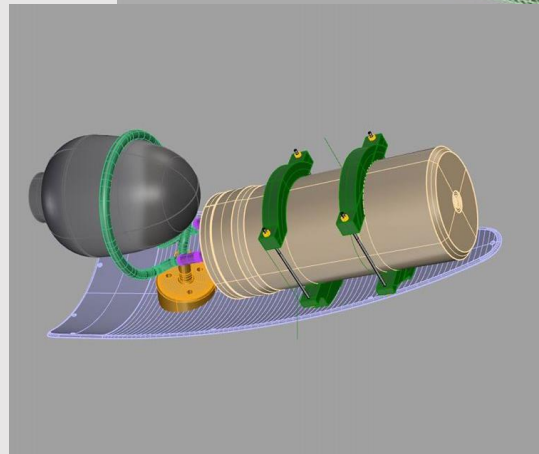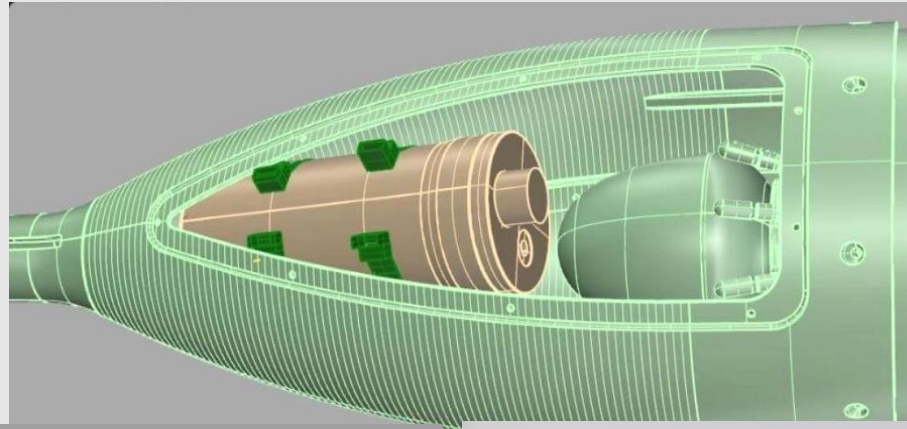
*This experiment was jointly carried out with UCY

Big Picture-Impact

- Biogeochemical, physical

- Depth / bathymetry features

- Zooplankton (optical/acoustic)

- Fish (larvae + juveniles)

- Gas release (natural, human)

- Ecosystem, behavioural studies (mammals + prey)

Zooplankton
Fish larvae / juveniles

Marine mammals

Chlorophyll

Temperature

Salinity

O2

...pCO2..CH4...

Fish

Gas

eafloor

Geir Pedersen (IMR)

Conclusions

- Ocean gliders complement ocean monitoring of pollution inputs and impacts
  - High persistence, high resolution, quiet acoustically
  - Taking the sensors away from surface, down to 1000 m

- pCO2
  - Coastal carbon processes can be observed in 3-D over long periods. [input]

- UVP6
  - Ecosystem characteristics merged with biogeochemical [impact]

- Passive Acoustics
  - Impacts on marine mammals from noise and other pollution [input and impact]

- Active Acoustics
  - Characterize plankton communities and biomass [impact]
  - Characterize gas seeps [input]

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Thank you

- Daniel Hayes, Managing Director, hayesdan@cyprus-subsea.com
- And the whole team!