

Autonomous Vehicles for the Real-Time Mapping of Water Quality and Bathymetry

TIM FINEGAN

REAL-TIME WATER MONITORING WORKSHOP - NOVEMBER 7, 2023



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Tim Finegan

Systems Engineer West Coast and Canada, YSI

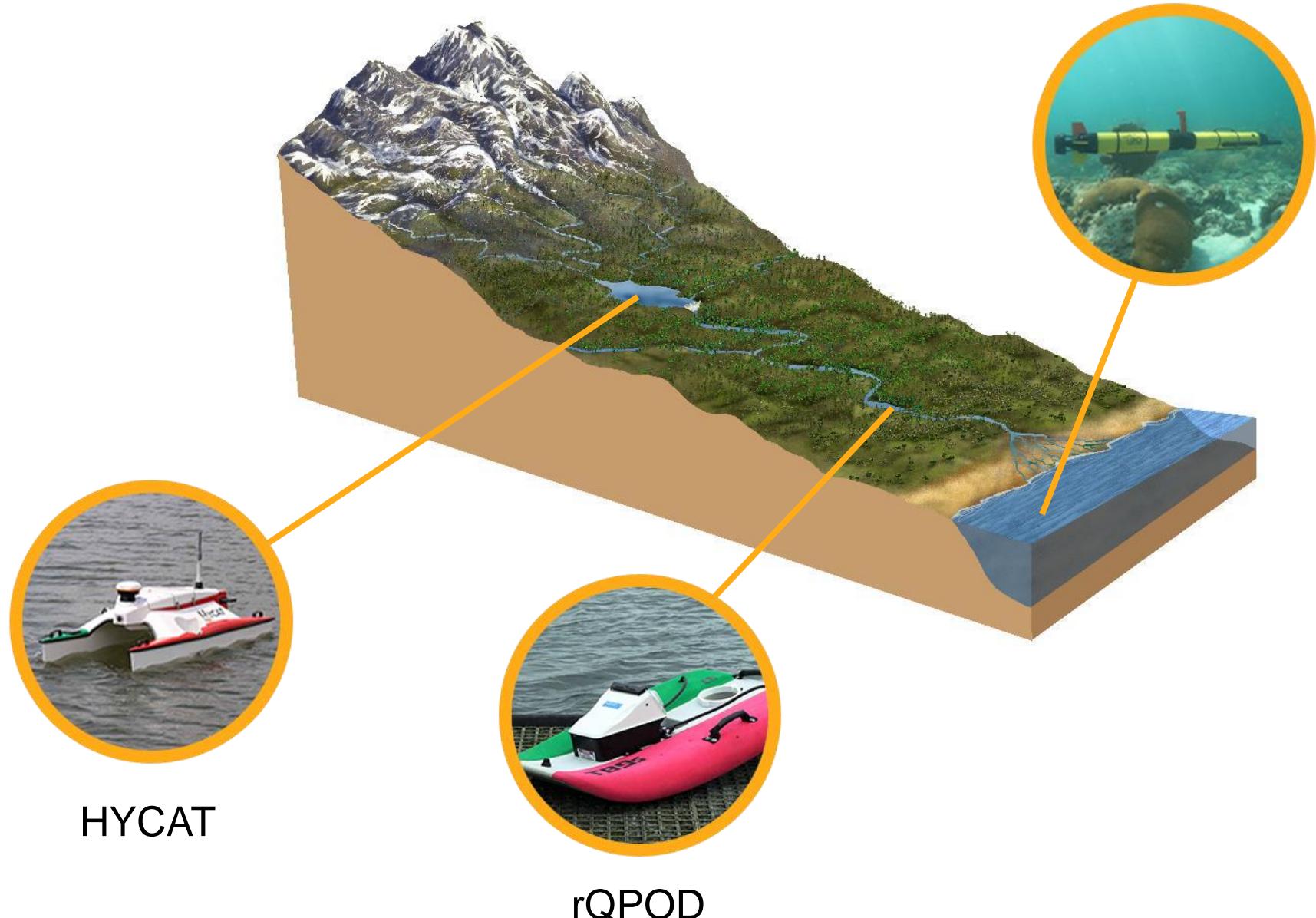
- Tim has worked for YSI (Xylem) for 18 years in different roles.
- YSI/Sontek/Xylem offer water quality and water quantity monitoring instrumentation. Our integrated systems division designs complete water monitoring stations and vehicles for the autonomous water monitoring



Agenda

- Vehicle Platforms
 - rQPOD
 - HYCAT
 - i3XO EcoMapper

i3XO EcoMapper



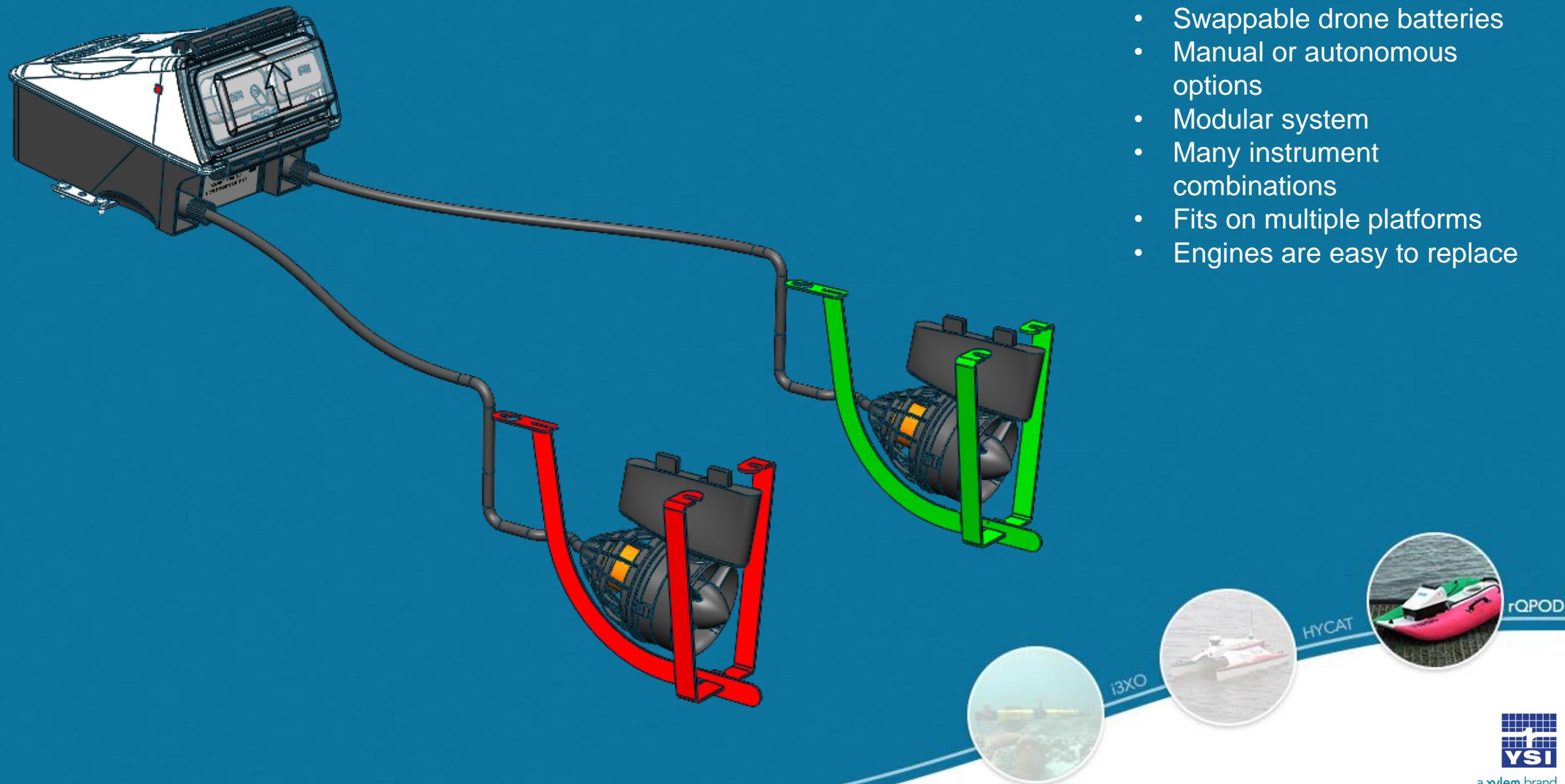
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rQPOD

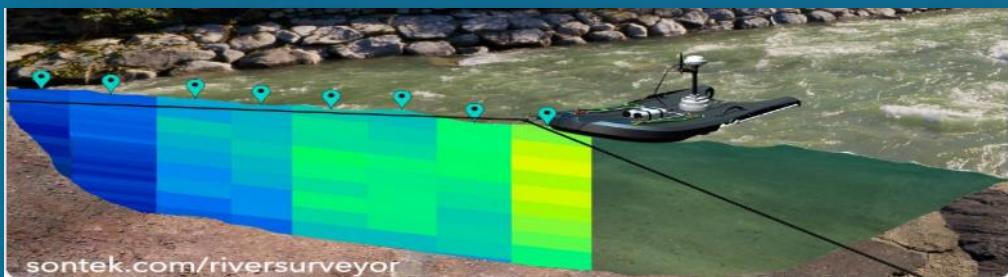


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What is the rQPOD?



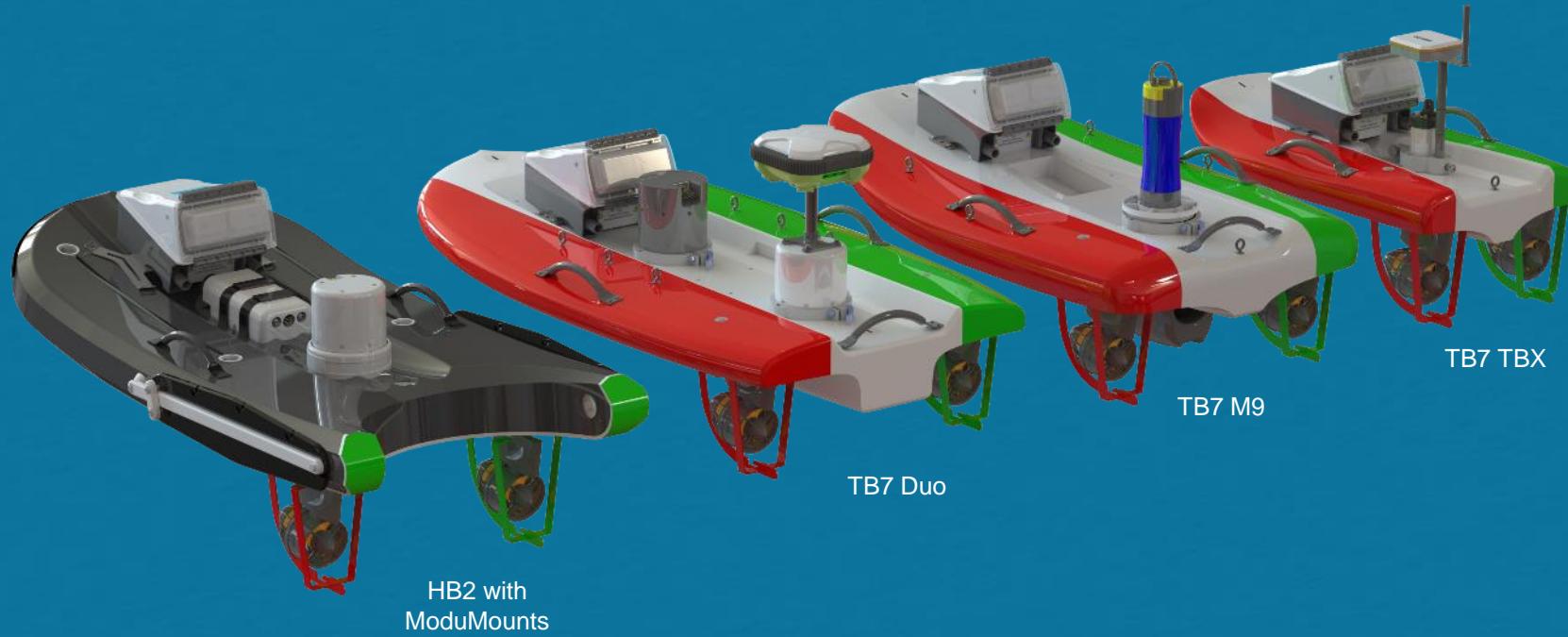
Virtual Anchor – needs autonomous upgrade



*Just flick the switch no
programing required,
only gps signal.*



rQPOD Platforms

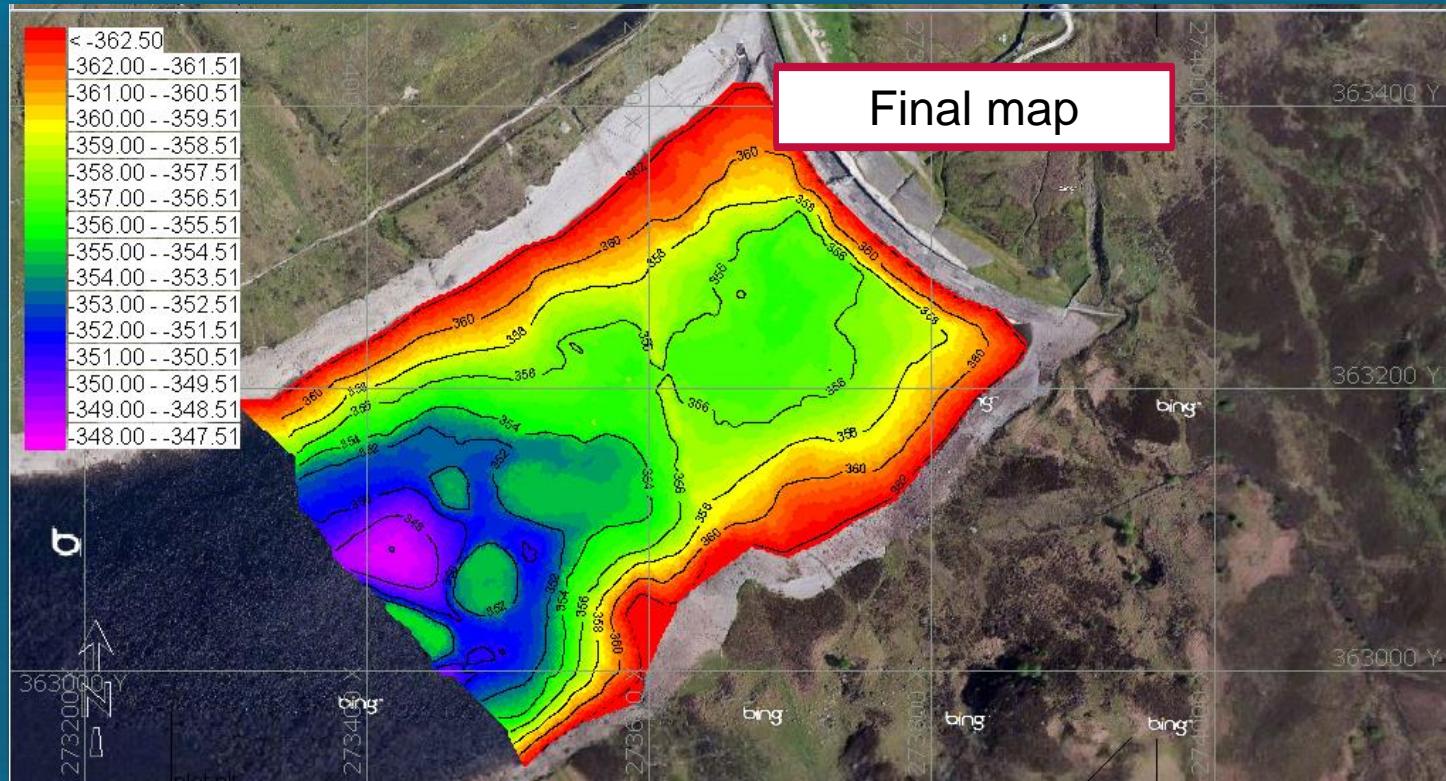


rQPOD Case Studies



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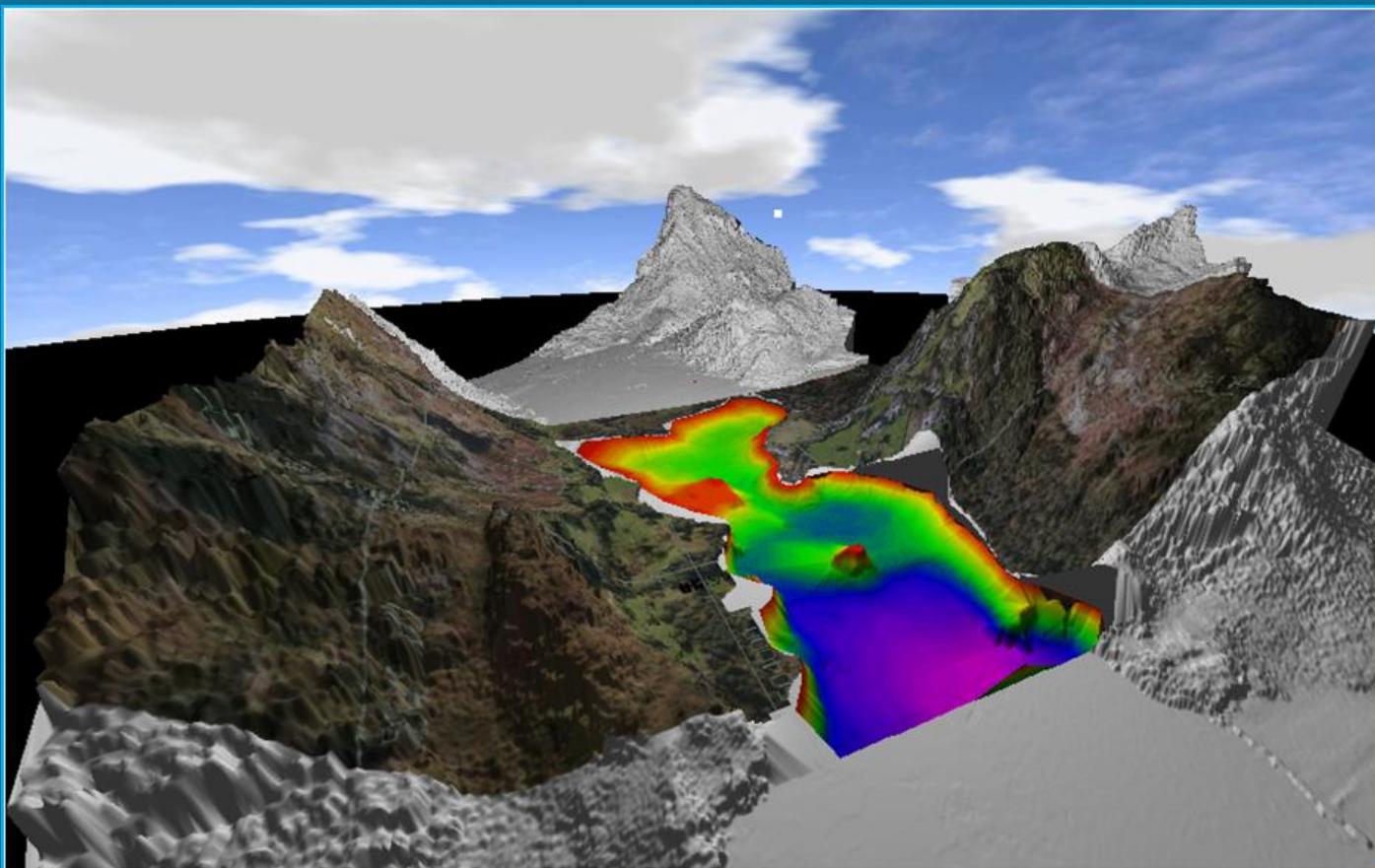
Bathymetry Case Study



- Mission or line plan created in Hypack
- Uploaded to ArQPOD via USB
- Started/stopped using RC handheld
- Range is 6 to 9km (2 to 3 hours)
- Survey speed is 1.5knots
- Steers and follows line using GPS and compass
- Hold position at end waypoint

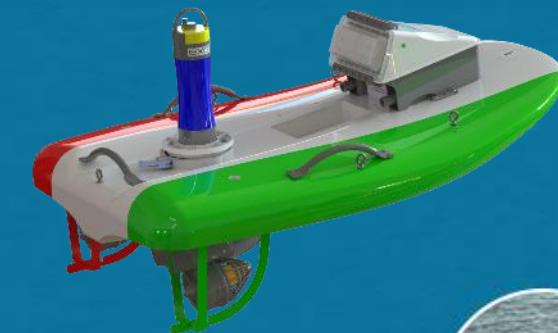
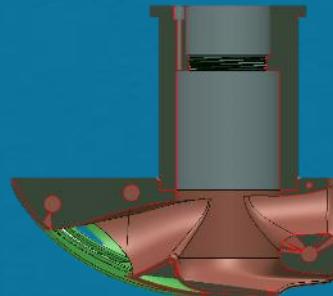
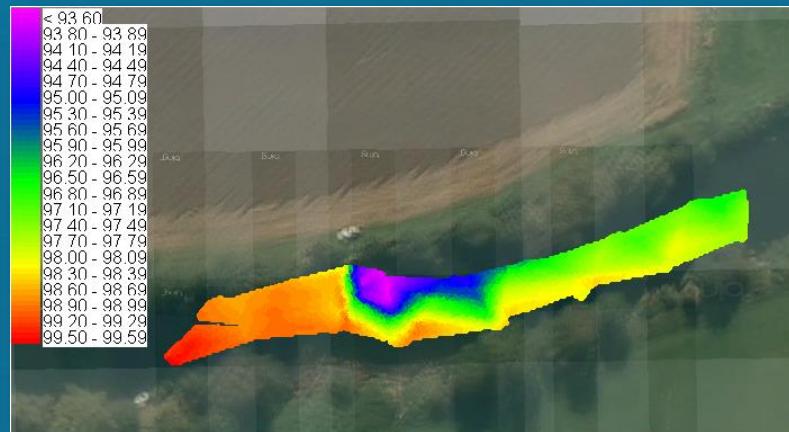


Bathymetry Case Study



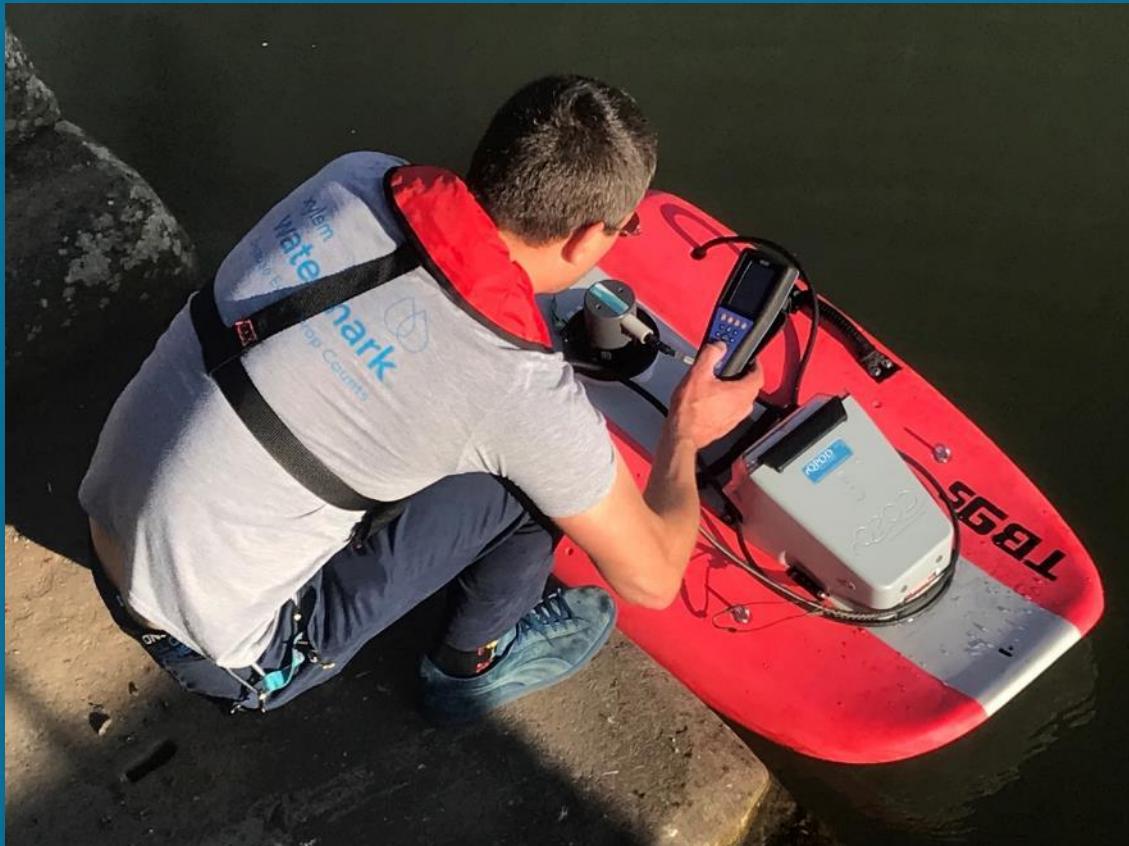
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EXOWhale Mount For Water Quality Surveys



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EXOWhale - Using the handset



Advantages

- Cheapest way
- GPS tagged using the handheld
- Good for long missions

Disadvantages

- Have to download and post process the data in Hypack
- Can't see live data



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Location

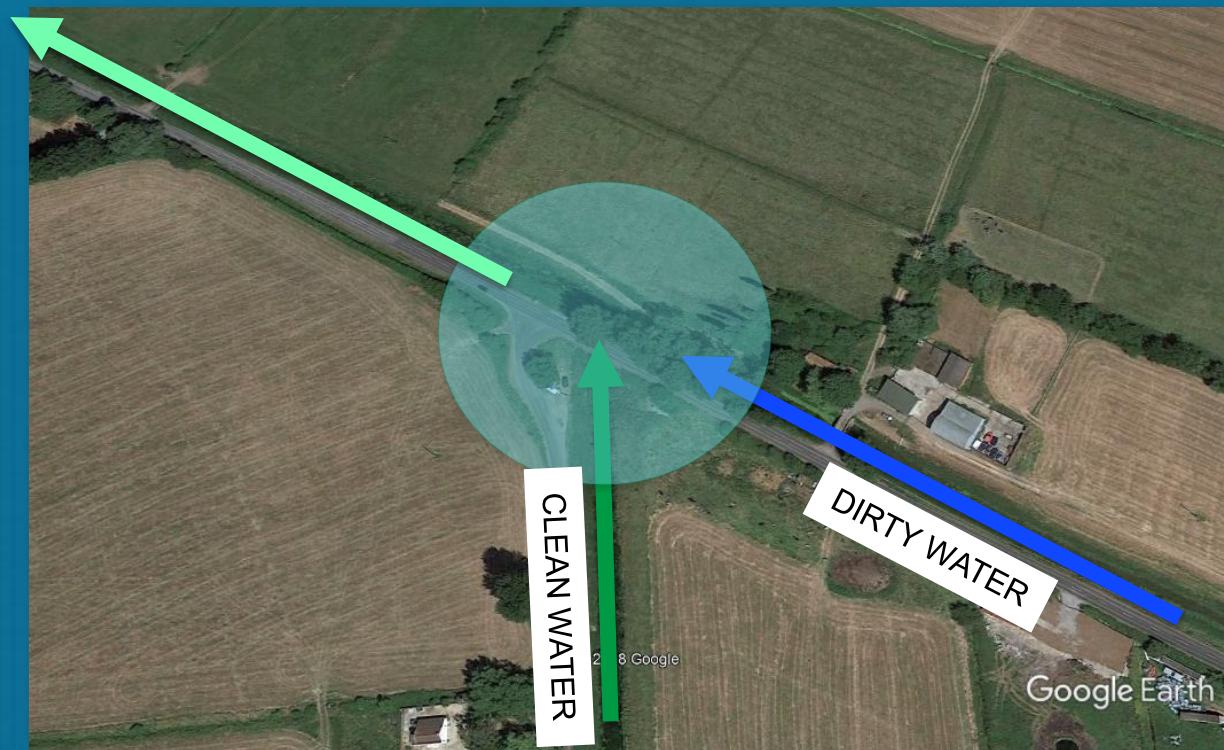


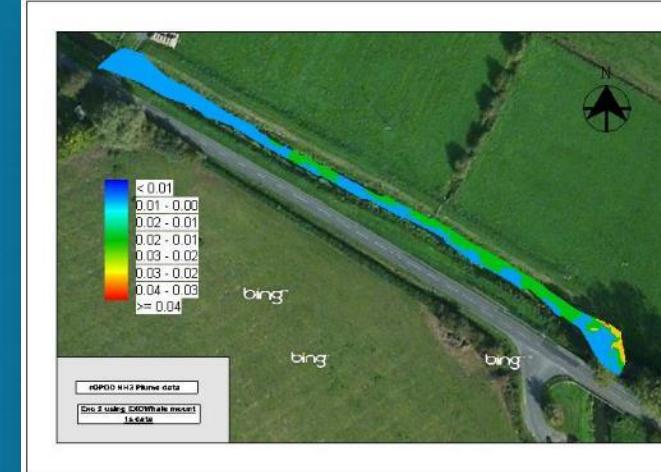
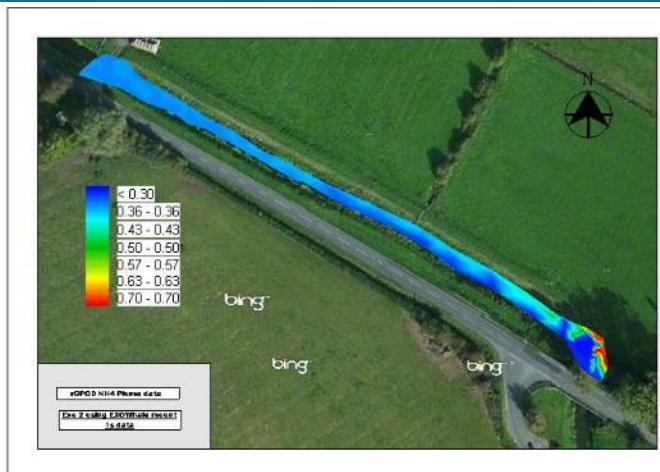
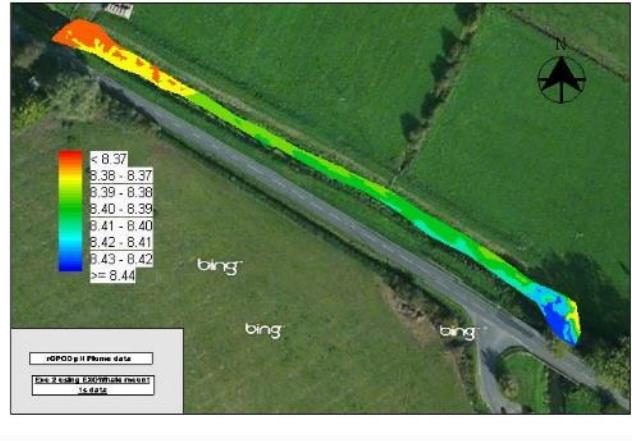
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Sampling Point



3kms from works





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2

HYCAT



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HYCAT Specifications

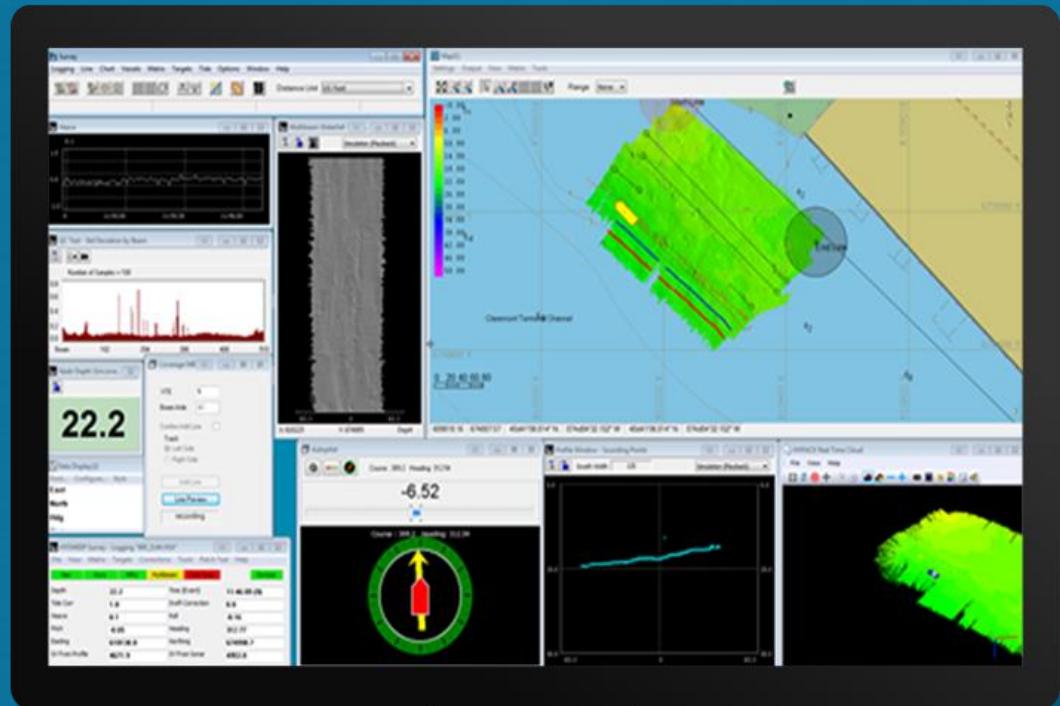
- 1.8 M Long X 0.86 M Wide
- Weight: 53kg
 - 2 person deployable
- Top Speed: 7.8 Knots
- Endurance: 2.7 – 8 hours (speed depending)
 - Survey Speed ~ 3 knots = 6 hours
 - Steering: Differential thrust
- Operational State: Beaufort Wind Scale 4



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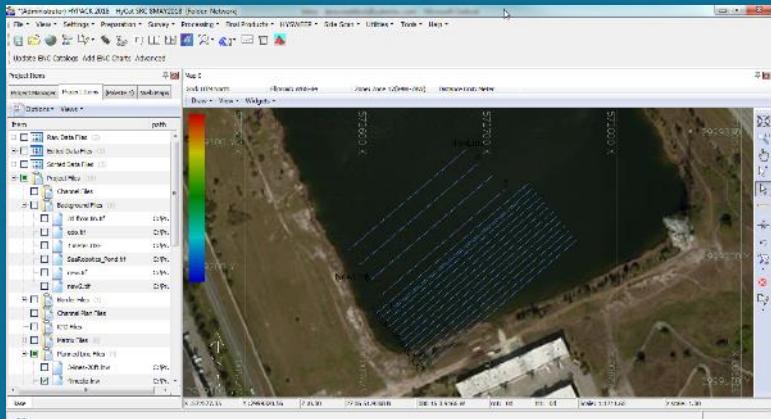
HYCAT HYPACK Driver

- Xylem HYPACK developed operating system
 - One software package to run EVERYTHING
- Mission Planning, Surveying, and post processing
 - Data collection with base station connected to ASV
- Real-Time data, Real-Time decision making
 - Change mission while underway
 - All data collected and stored in one location

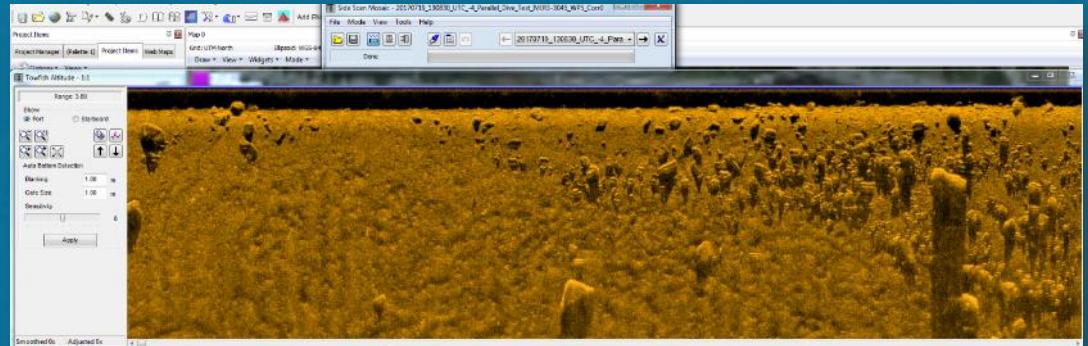


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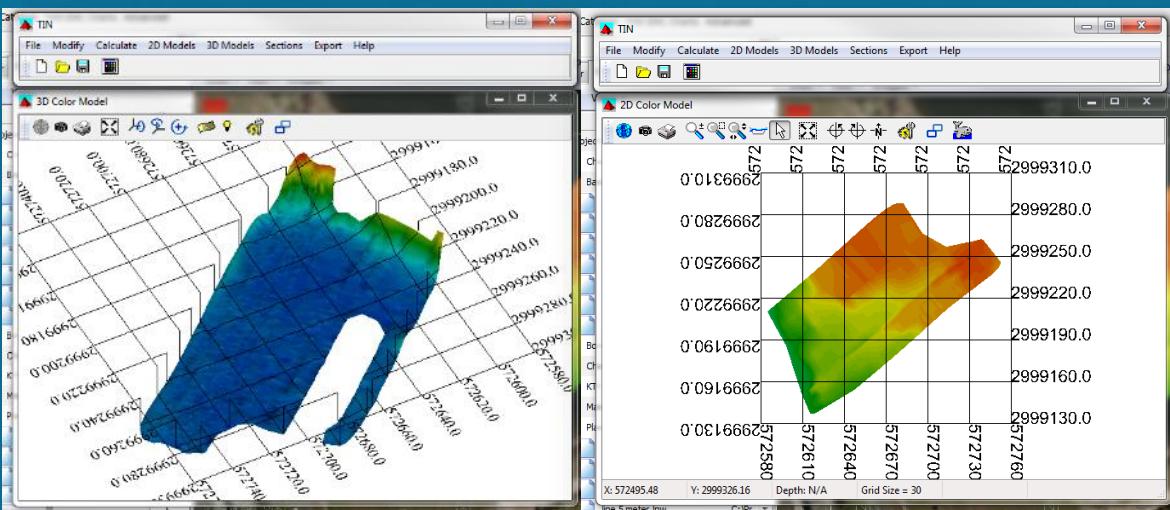
Line Editor



Side Scan Targeting & Mosaicking



Bathymetry Tin Models



On-Board Sensor Interface and Visualization

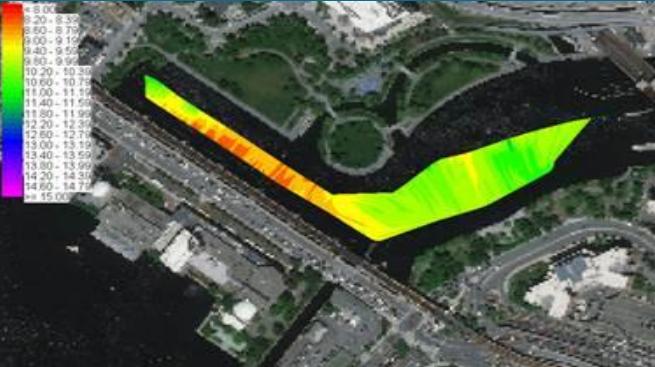


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HYCAT Applications

- North Point Park, Boston, MA
 - Water Quality Survey of urban park to determine the health of water for swimming & recreation
 - Survey Time – 30 minutes
 - Speed – 3 knots
 - Crew – 2 personnel
 - Time on Site – 1 hours
 - Outcome: Collection of multiple WQ parameters enabling decision making

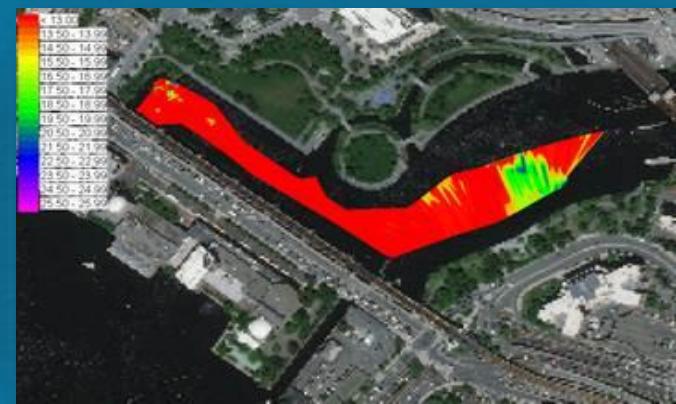
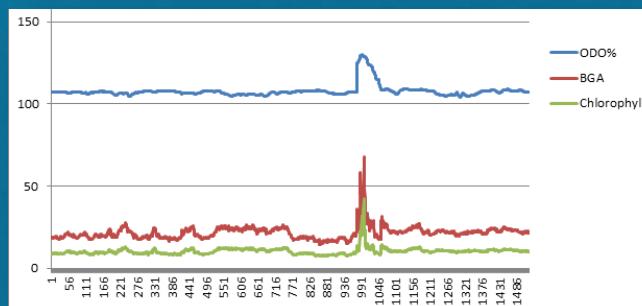
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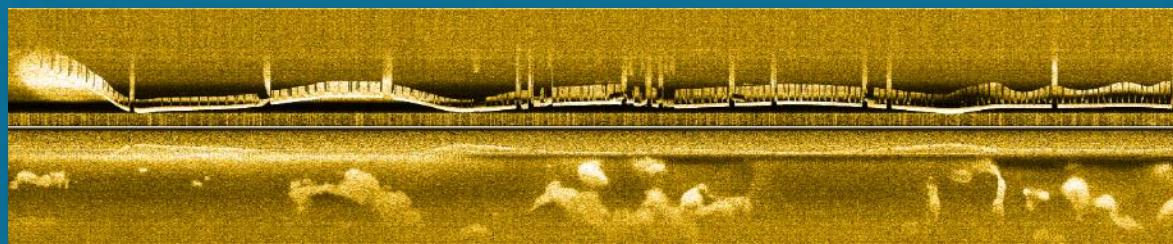
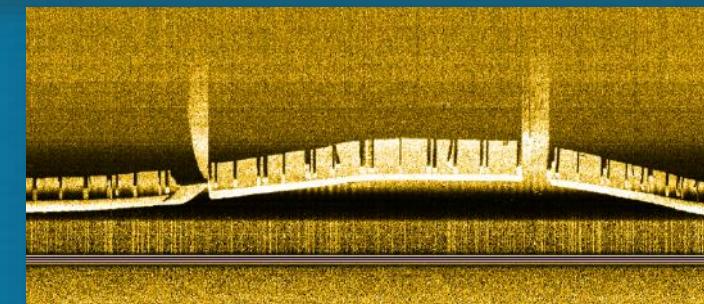
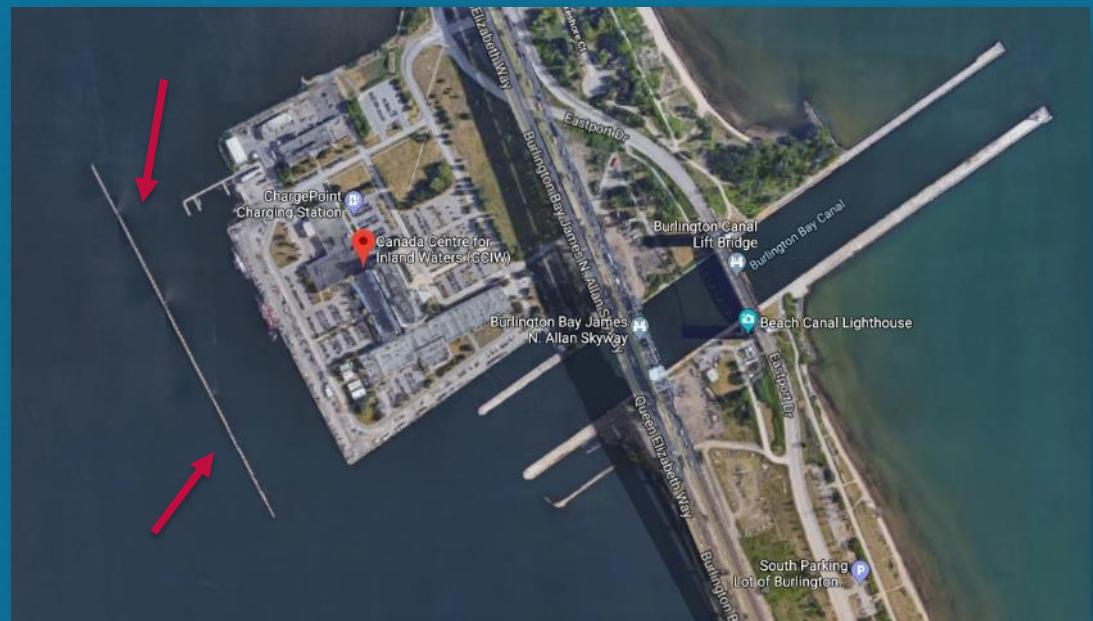


BGA



HYCAT Applications

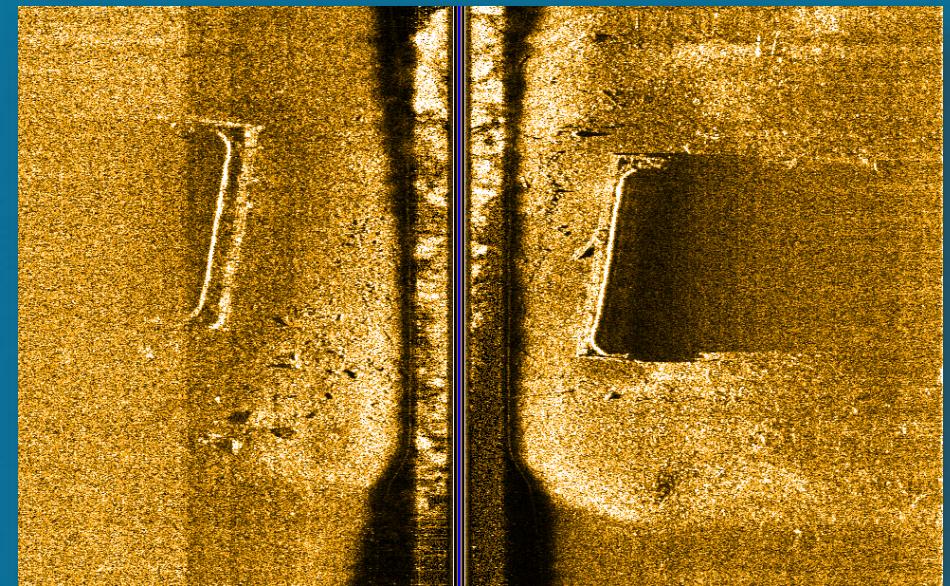
- Inspection of a Breakwater
 - SideScanSonar imaging of breakwater looking for missing or damaged barriers
 - Survey Time - 15 minutes
 - Speed – 2 knots
 - Crew – 2 personnel
 - Time on Site – 30 minutes
 - Outcome: Identification, in Real-Time, of missing sections.



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HYCAT Applications

- Bridge Scour/Inspection
 - Scour measurements around footings and main channel, looking for debris and sediment buildup. Terrestrial inspection of underside of bridge.
 - Survey time – 15 minutes
 - Speed – 3 knots
 - Crew – 2 personnel
 - Time on site – 45 minutes
 - Outcome: Minimal debris detected

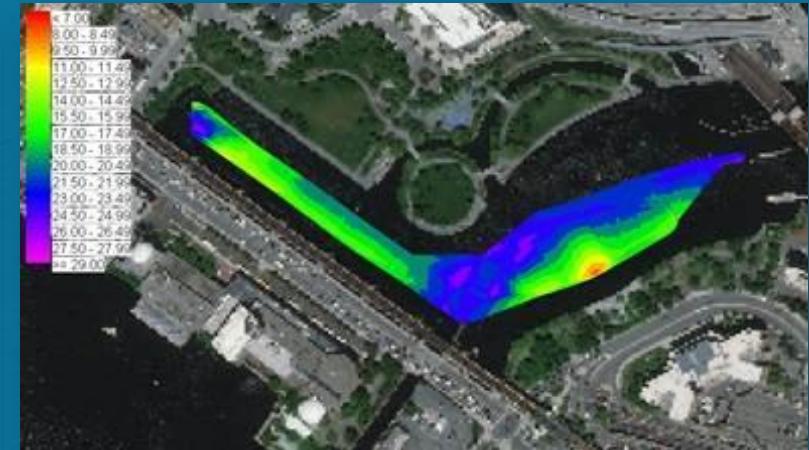
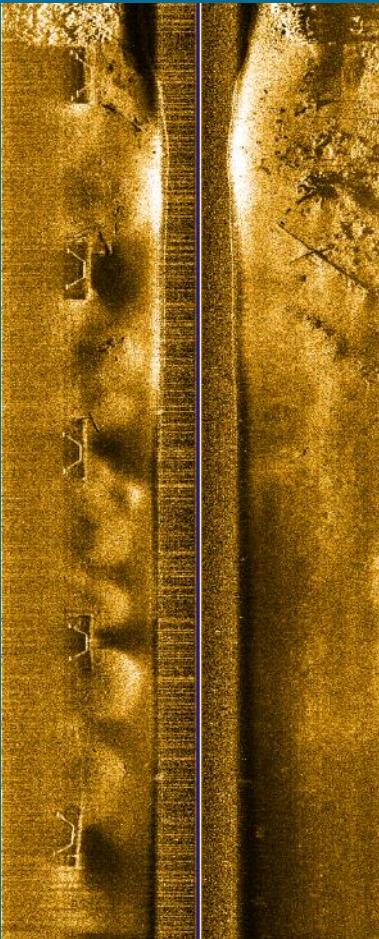


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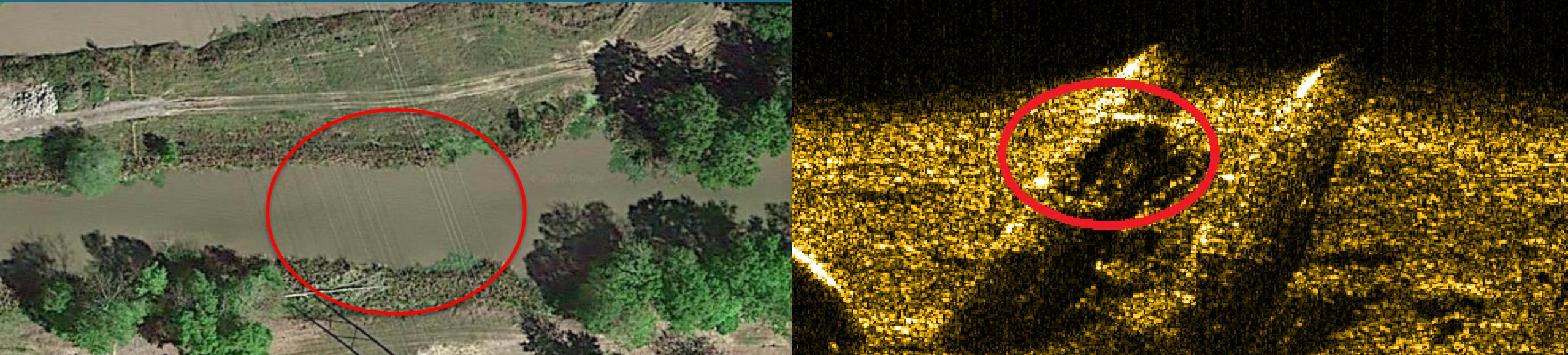
HYCAT Applications

- Hydrographic Survey

- Multibeam survey of proposed swimming area
- Survey time – 15 minutes
- Speed – 3 knots
- Crew – 2 personnel
- Time on site – 45 minutes
- Outcome: water depth determined to be 15 ' – 20 ', minimum debris and scouring from inlets on edge



HYCAT Applications



- Pipeline Survey
- SideScanSonar imaging of damaged pipeline
- Outcome: Imaging shows impact damage to one of two drainage pipes

- Survey time – 15 minutes
- Speed – 2.5 knots
- Crew – 2 personnel
- Time on site – 1 hour



3

i3XO EcoMapper



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i3XO EcoMapper Specifications

- Length: 1.5-2 Meters long (configuration depending)
- Weight: 27-45 kg (configuration depending)
- Depth Rating: 100 Meters
- Speed: 1-4 Knots
- Endurance: 6-10 Hours (speed and configuration depending)
- Integrated EXO1 OEM with 3 additional water quality sensor ports (C/T sensor required)
- Bottom Tracking: up to 81 Meters



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i3XO EcoMapper Advantages

- Underwater missions up to 100 Meters depth
- Different mission types depending on requirements:
 - Height from Bottom
 - Depth from Surface
 - Undulation
- Capable of running in high boat traffic areas
 - With INS, vehicle has error of less than 0.3% of distance traveled
- Record water quality, side scan, bathymetry, and photogrammetry in one mission



i3XO EcoMapper Applications

- Most Suitable Applications
 - Lakes
 - Estuaries
 - Reservoirs
 - Near-Coastal
 - Slow moving rivers



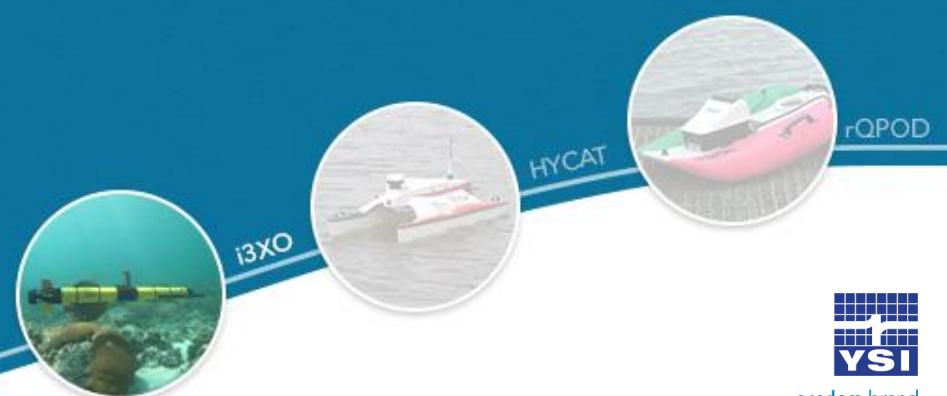
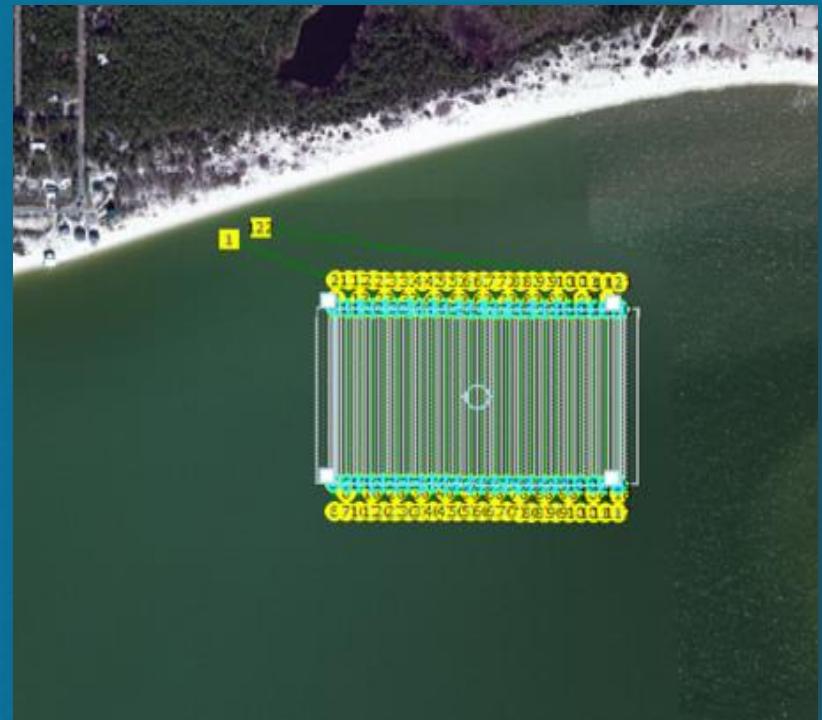
- What is not?
 - High-Flow River Applications
 - Deep Ocean Studies
 - Fast Current Environments



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VectorMap Software

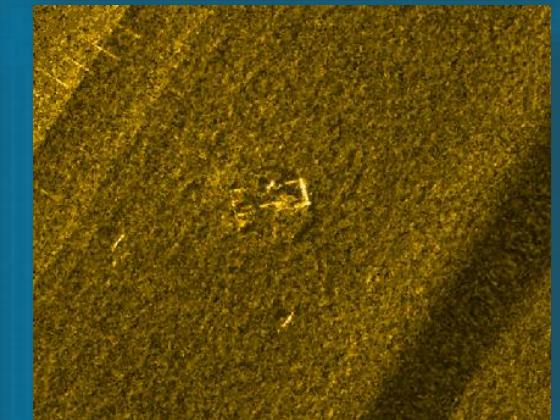
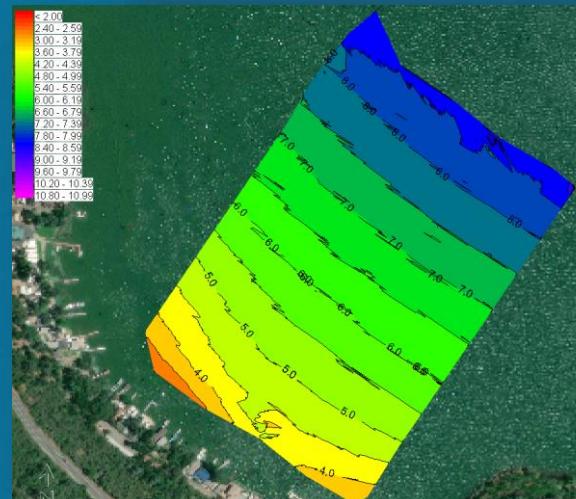
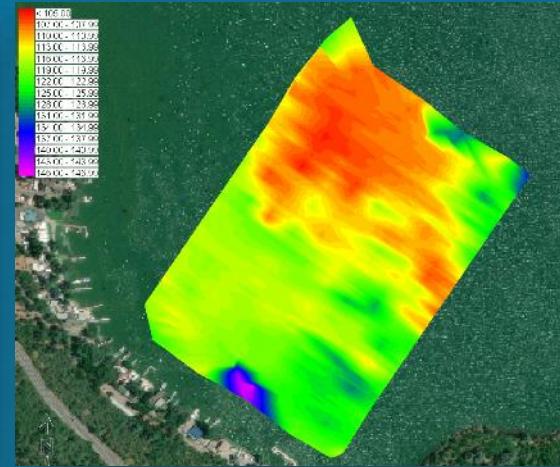
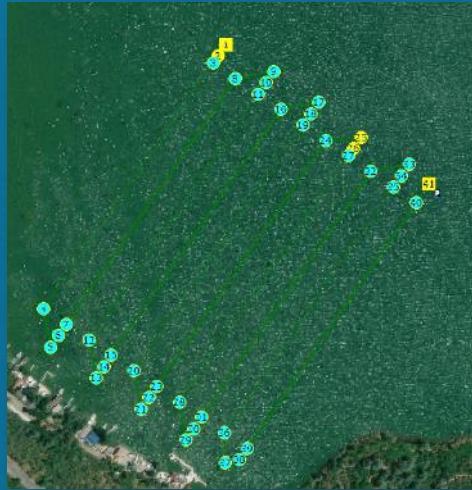
- VectorMap software allows quick and easy mission planning
- Accepts a variety of geo-referenced maps
- Missions drawn directly on geo-referenced maps through point and click method
- Easily create full coverage mission plans using the lawnmower feature
- Quickly and easily modify missions on the fly
- VectorMaps can also be used to quickly process data from missions to allow adjustments for next mission



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i3XO EcoMapper Applications

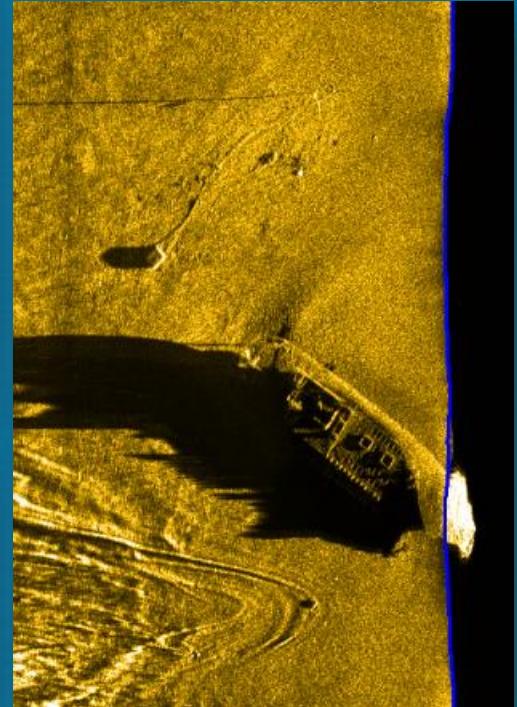
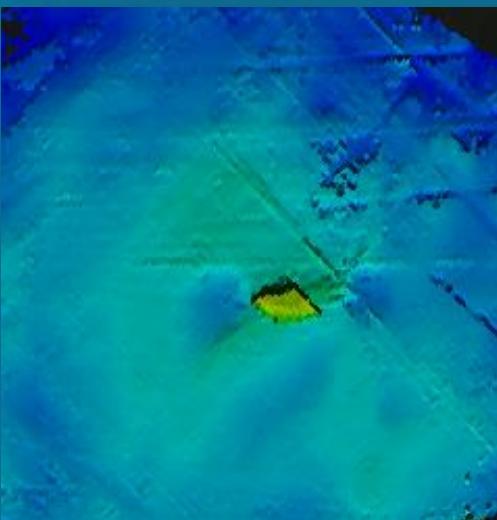
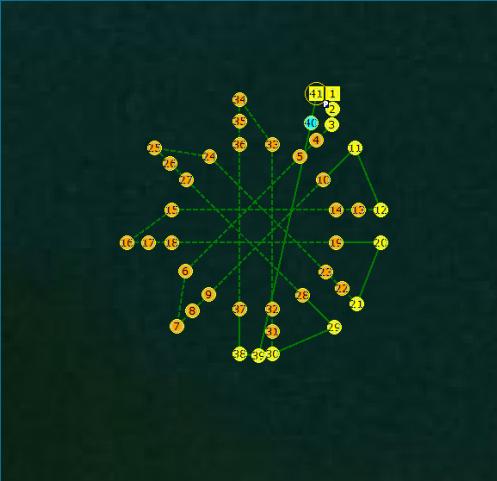
- California
 - Water quality, bathymetry, and side scan sonar survey of a harbor, all in one mission.
 - Survey Time – 1 hour 27 minutes
 - Speed – 2 Knots
 - Mission Length – 6650 Meters



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i3XO EcoMapper Applications

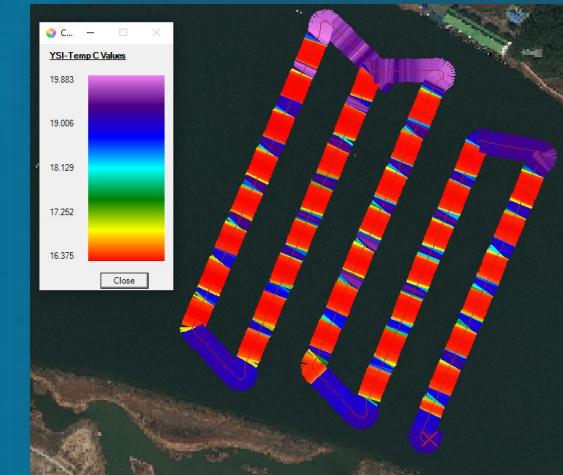
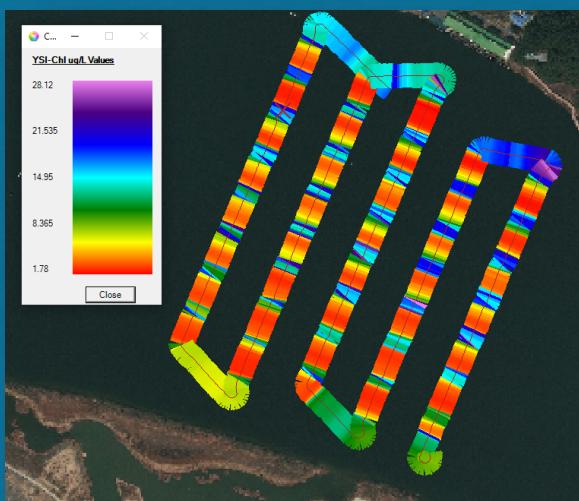
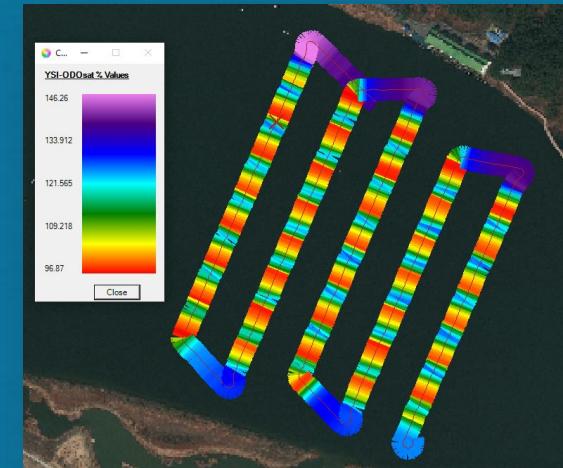
- Narragansett Bay, Rhode Island
 - Bathymetric and Side Scan survey of boat wreckage
 - Survey Time – 33 minutes
 - Speed – 2 Knots
 - Mission Length – 2532 Meters
 - Mission Type – 8 Meters HFB



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i3XO EcoMapper Applications

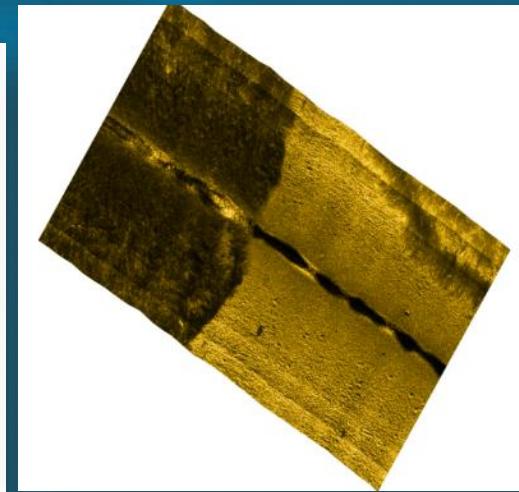
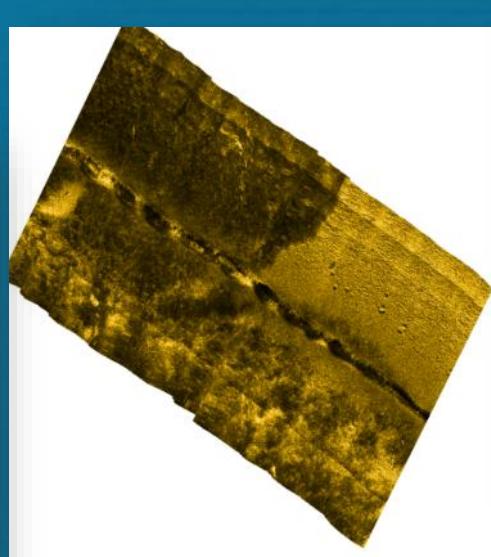
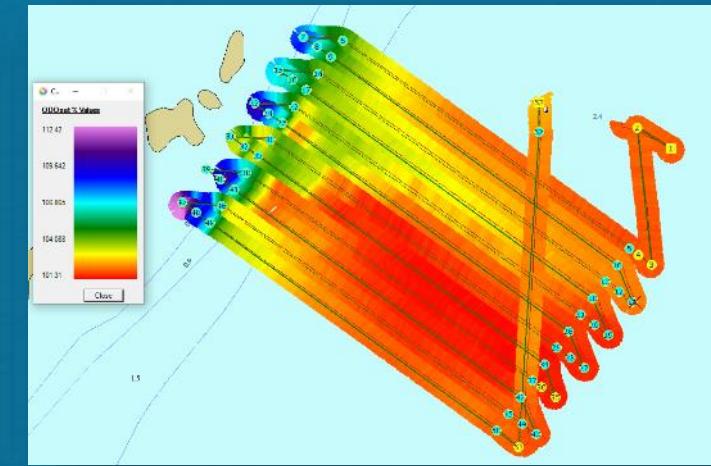
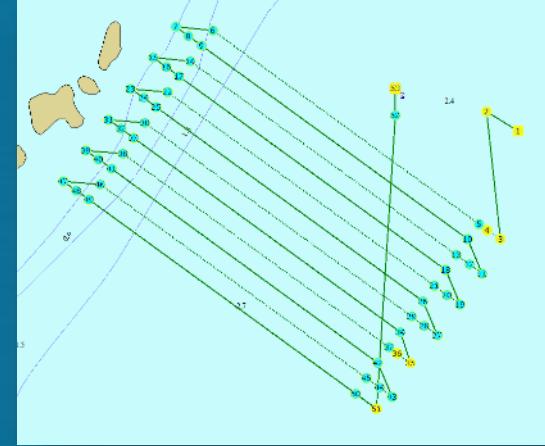
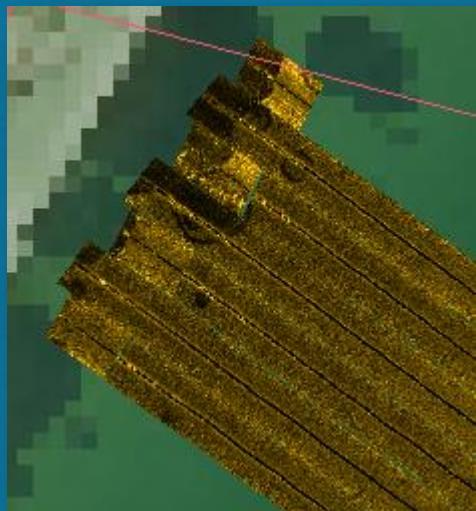
- Daegu City, South Korea
 - Water quality survey near water treatment plant
 - Survey Time – 33 minutes
 - Speed – 2 Knots
 - Mission Length – 2532 Meters
 - Mission Type – Undulation from surface to 2 Meters HFB



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i3XO EcoMapper Applications

- Tampa Bay, Florida
 - Side Scan Survey to detect eel grass
 - Survey Time – 1 hour 50 minutes
 - Speed – 2 Knots
 - Mission Length – 8330 Meters
 - Mission Type – 1 Meter DFS



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Questions?



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