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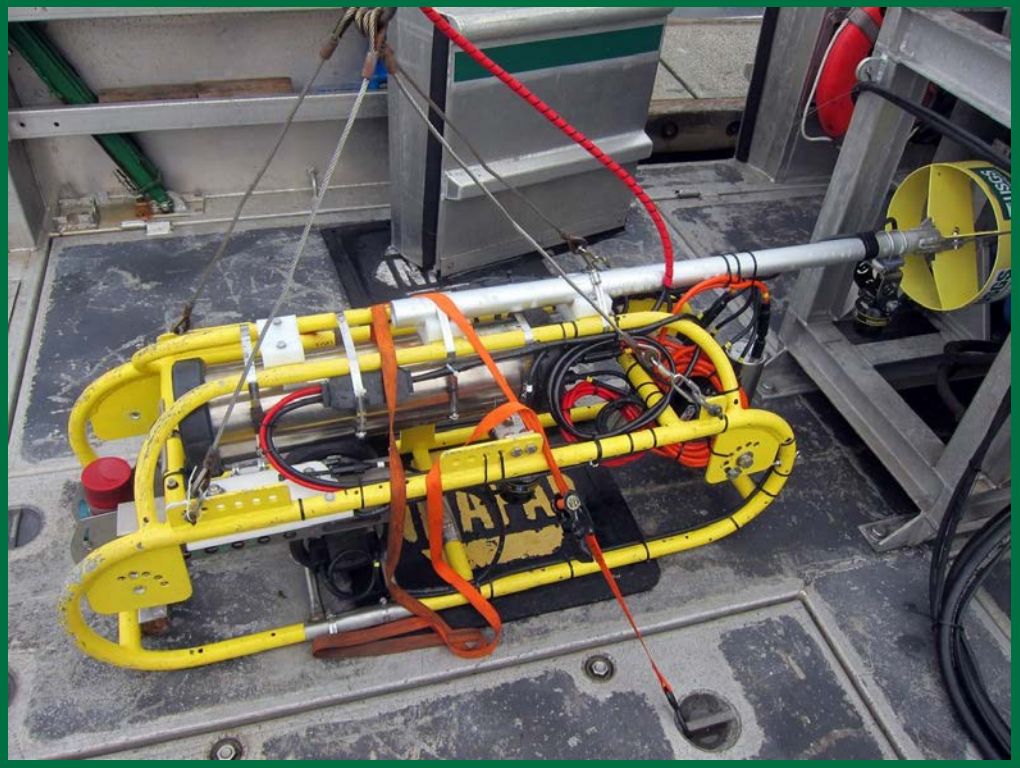
The New USGS Benthic OBservation Sled (BOB Sled) High Definition Seafloor Video Camera System



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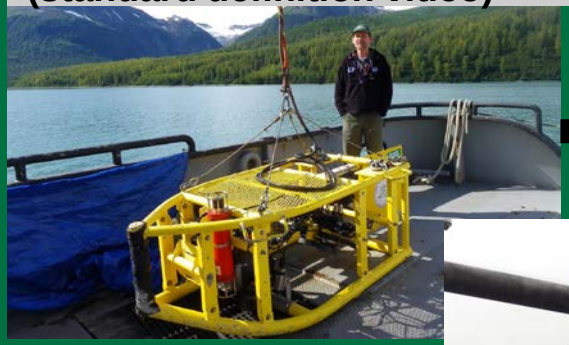
What It Is:

- A complete redesign and upgrade of our old large vessel deep water standard definition camera system to modern high definition video for deployment from our 34’ research vessel “R/V Parke Snavely”

- Underwater camera systems have been used since the 1970s at the Pacific Coastal and Marine Science center for purposes such as habitat mapping and to “ground truth” seafloor sonar data bottom type estimates.

Old Camera System for “Big Boats” (standard definition video)



New System for the 34’ Parke Snavely. Smaller, Same Depth + HD Video!

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Total Budget ~$80,000:

- Sea-cable alone cost ~$15,000
- Re-use of existing equipment or re-purpose of obsolete equipment when ever possible was required.
  - Camera housings are redesigned Canon flash housings
  - Control system housing is from deep water battery case
  - Tail fin is from obsolete sonar tow fish
  - Step down transformer housing from compass housing
  - Lasers and altimeter scavenged from the previous camera sled
  - Frame is from obsolete camera system
- For the rest try and use “low cost” off the shelf equipment as much as possible.

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Starting Hurdles:

- Settling on a cable specification that would meet our requirements & fit on our existing winch drum and work with our diamond bar level wind (0.45”)

- Slip Ring Problem
  - oMore than one fiber pass gets Expensive!
  - oMore than one fiber pass gets big

- Subsurface Termination - Strength, Fiber & Electrical
  - -> Esmet extruded jacket Syn. rope strength termination
  - -> potted Y electrical/fiber split
  - -> MacArtney OptoLink for Fibers
  - -> Standard Subconn connector for electrical

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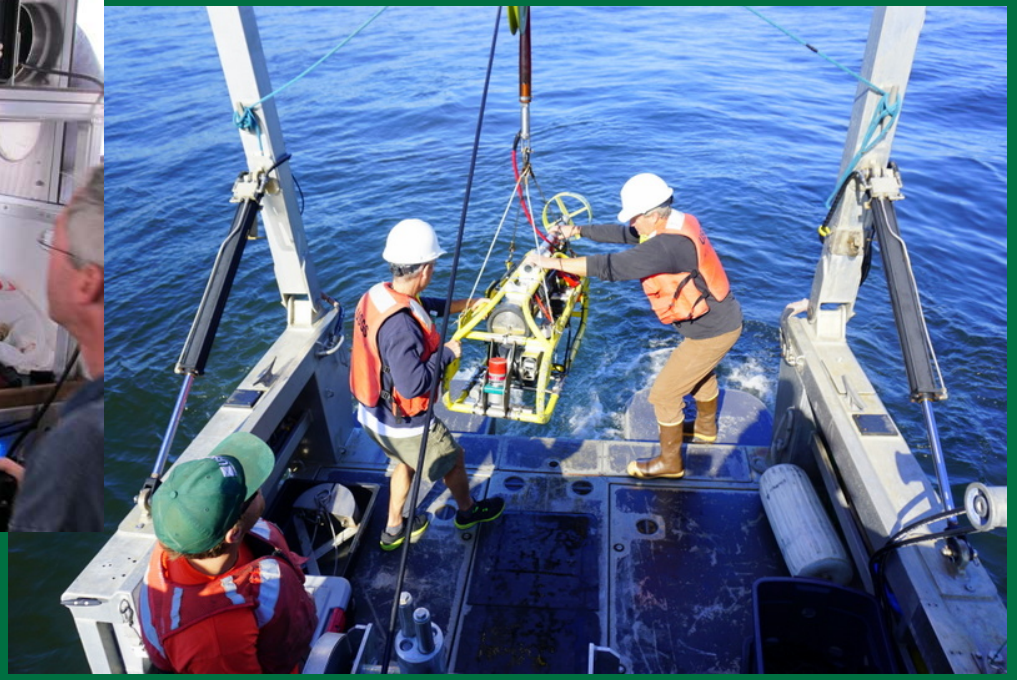
What it Does:

- Very low compression (~100Mbps) video recorded on the surface in real-time to compact flash (1Gb every minute – can be less if space is an issue)
- Video time code is precisely synchronized with GPS time on both HD channels along with the ancillary data (navigation and water properties)
- Navigation (GPS NMEA) is encoded on left audio tracks.
- Provides a power and data interface to other “instruments of opportunity”



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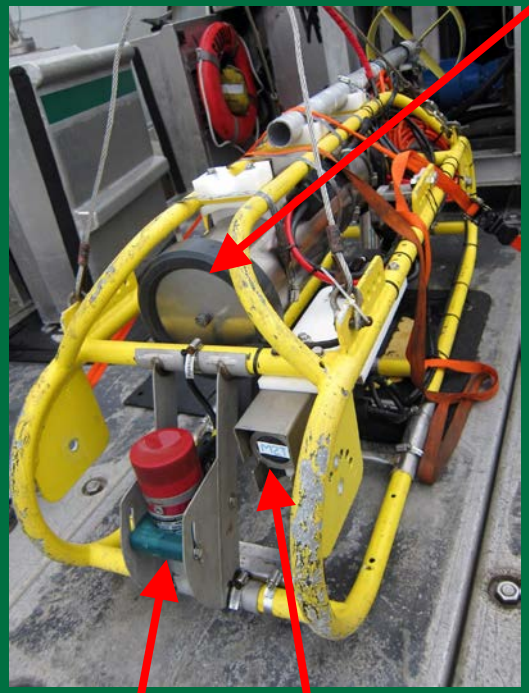
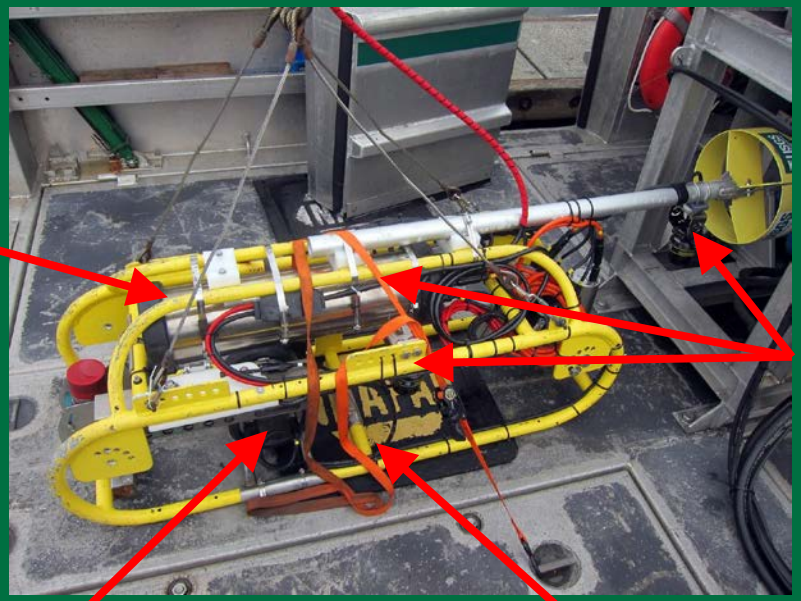
Components:

Control & Communication Electronics
Tilt, Roll & Heading Sensor





Three 150W
“SeaLite
Sphere”
LED Lights

Still Camera

Pressure and Altitude Sensors

Conductivity &
Temperature Sensor

Forward looking scanning sonar
for collision avoidance

Two Sony FCB-H11 block cameras
and HD-SDI interface boards.
One camera looking slightly forward.
The other looking straight down.

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Two pair of
DeepSea Power &
Light red lasers

Components Cont.:

Compact Flash Recording
Linear Time Code synchronized to UTC
NMEA GPS encoded on audio track

Real-time display and Human Machine Interface

To simplify and reduce the cost of the Slip-ring some electronics were housed Inside of the winch drum.

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How it Does it:

- 480VAC sent from Surface, stepped down to 120 VAC at sled and AC to DC converters provide 24VDC, 12VDC, 5VDC (~600 Watts total at sled).
- Ethernet over fiber for all data communications between surface and sled. Converted to Ethernet over coax inside the winch drum for slip ring.
- MODBUS over TCP/IP for primary system control.
- Instrument control via serial data multiplexed over Ethernet. Scanning Sonar, Attitude Sensor, and Seabird conductivity temperature also send data via the serial multiplexer.
- Two channels of HD-SDI are multiplexed over a single fiber & separated into two channels of HD-SDI over coax at winch drum.

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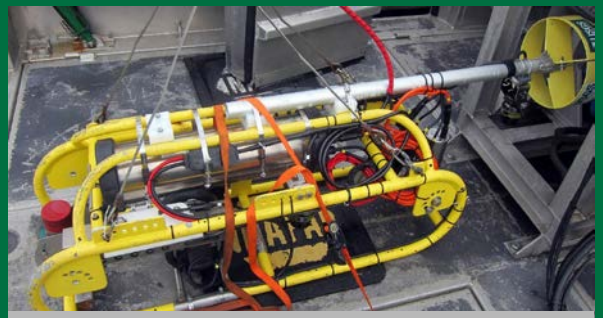
What We Have Done With It (so far):

- During development a hand deployable version was created with a single HD camera, two LED lights, and a single pair of lasers.
  - oUsed in Puget Sound to look at the effect of sediment being delivered to the sound from the removal of the Elwha Dam.
  - oUsed in Hawaii in conjunction with swath sonar to characterize coral reef health and species diversity.
  - oUsed in American Samoa also to characterize coral reef health and species diversity.

Mini BOBSled 75m hand-deployed



BOBSled 700m Capable

- The Deepwater (700 meter) two camera system with all the capabilities described was used successfully offshore of Coos Bay, OR in September 2014 to depths as great as 650 meters. It's purpose was part of the "ground truthing" of freshly collected sonar data.

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Opportunities For Development:

- Add a USBL tracking system for better position.
- Add a second channel of fiber through fiber optic rotational joint out of the other side of winch drum axis.
- Very High Resolution Still Camera.
- Generic instrument connector for adding instruments of opportunity without having to open control can.
- Structure from motion surfaces from overlapping video frames.
- Embed all system data directly into HD-SDI data stream.

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Sample Video clips (very reduced quality)

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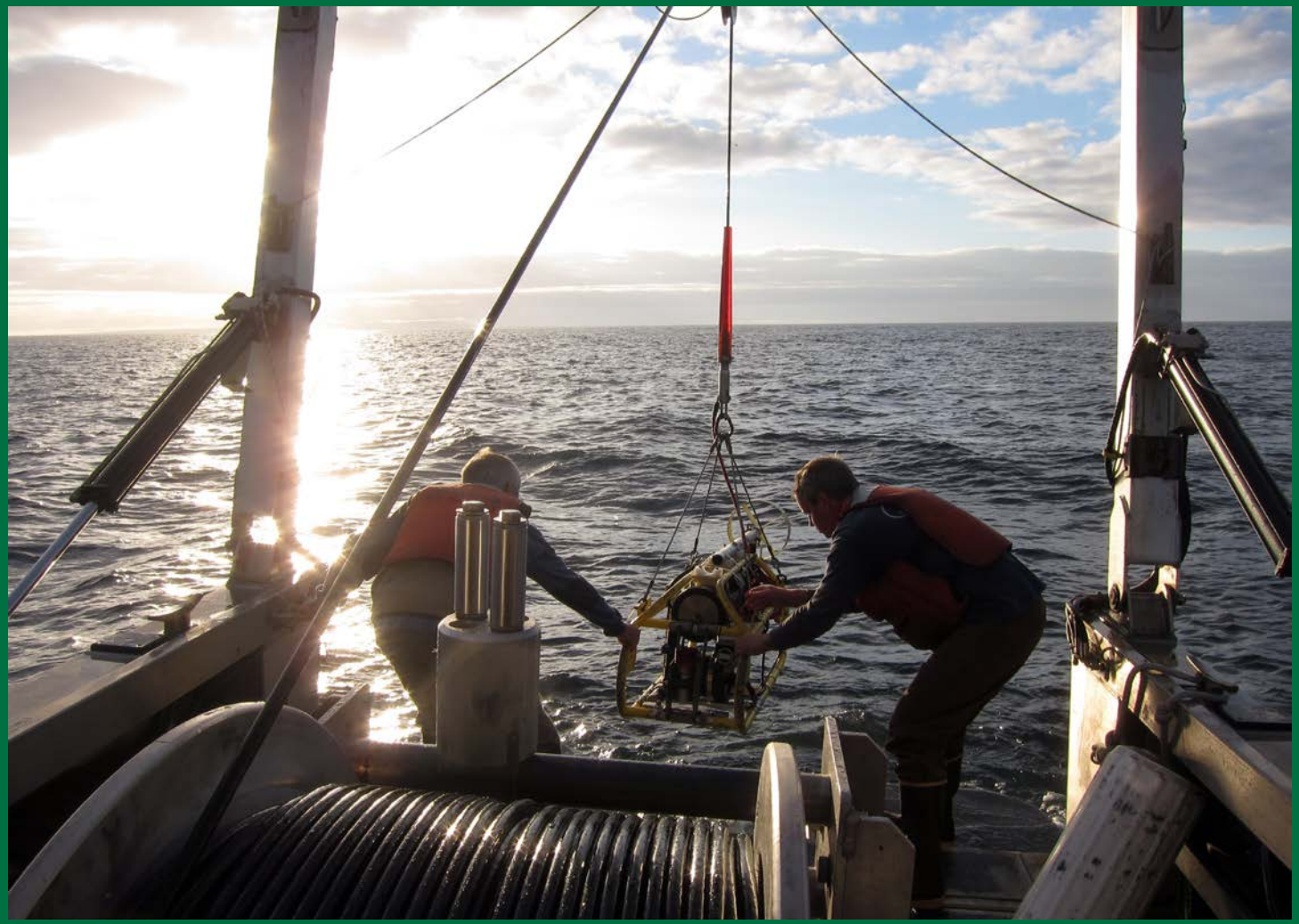
Questions?



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