The use case for Datapresence: Remote participation in at sea research.

Chris Romsos • Datapresence Systems Engineer • Regional Class Research Vessel Program • Oregon State University
Co-authors: Jasmine Nahorniak, Katie Watkins-Brandt, Demian Bailey, Clare Reimers, and Daryl Swensen

NSF

Regional Class Research Vessel
UNOLS

University of Rhode Island
HOPE
1892

1868
Oregon State University

The Datapresence Team

Chris Romsos
Datapresence Systems Engineer

Jasmine Nahorniak
Assistant Datapresence Systems Engineer

Katie Watkins-Brandt
Sensor Systems Engineer

R/V Taani will transition to operations in 2021 with Oregon State University as the first operator of a Regional Class Research Vessel with advanced Datapresence capabilities. University of Rhode Island, our East coast partner will lead the second ship operations in conjunction with the East Coast Oceanographic Consortium.

Demian Bailey • Project Manager
Clare Reimers • Project Scientist

For more information regarding the Regional Class Research Vessel Project, visit:
http://ceoas.oregonstate.edu/ships/rcrv/


Da•ta•pres•ence
noun
New technologies developed for research vessels to enable virtual participation, situational awareness and adaptive sampling at sea; the ability to integrate data from a broad suite of ocean and meteorological sensors and facilitate quality real-time data collection and data visualization to inform the science mission, enable shore side participation, and encourage education and community outreach
Sat, Oct 23, 1:52 PM
The C-STAR is not transmitting data to shore. Please check.
K
Network cable was unplugged. Data should be streaming now.
Got it! Thx.
Sat, Oct 23, 4:19 PM
Satellite image shows eddy at 24.6N,126.0W. Should we change next CTD cast location?
Yes. Please do a deep cast.
Cast looks great! Interesting scattering feature at 25 m.
Planning a second cast. Will request water from 25 m.
Thx.

USE CASE: Description of Goal & Actors

The goal of remote participation in at sea-research is to leverage existing under- or non-utilized shoreside resources to the benefit of shipboard science. Remote participation acknowledges and mitigates resource scarcity inherent in seagoing research activities.

Actors

Group 1: Shipboard Scientific Party & Technical Support Staff

Group 2: Shoreside Scientific Party & Technical Support Staff

USE CASE: Understanding the Problem and Actors

Confluence Spaces People Create ··· Search

DatapresenceDev

Pages
Blog

SPACE SHORTCUTS

Here you can add shortcut links to the most important content for your team or project. Configure sidebar.

PAGE TREE

- 1 - Datapresence Survey
  - 1.1 - Datapresence Survey docs
- 2 - Datapresence Presentations
- 3 - Datapresence Meetings
- 4 - Datapresence Hardware
- 5 - Datapresence System Admin
- 6 - Datapresence Prototype
- 7 - Datapresence Cruises
- 8 - Datapresence Training
- 9 - Datapresence SOPs & TSDs
- 10 - Datapresence RCRV Spec. Files
- 11 - RCRV CMO Satellite & Network Testbed

Space tools

Dashboard / DatapresenceDev Home

Edit Save for later Watching Share ···

1 - Datapresence Survey

Created by Christopher Romsos, last modified on Dec 22, 2016

Before tackling the task of designing and building a datapresence system for the RCRV we undertook a series of site visits and ship visits. We also conducted numerous interviews with key personnel around the country, people who had previous experience with telepresence, shipboard support, end-users, etc. We named this activity the "Datapresence Survey" and documented the process and results through visit and interview write-ups as well as a final report with findings.

Like Be the first to like this

No labels

Write a comment...

USE CASE: Understanding the Problem and Actors

Stakeholders

- Vessel Operators
- Marine Technicians
- Shipboard Science
- Shoreside Science
- Data Assembly Centers
- Federated Archives
- Educators & Students
- General (Interested) Public

Requirements

- Better situational awareness
  - Shipboard
  - Shoreside
- Improved data quality
- Increased operational efficiency
- Ability to act adaptively

USE CASE: The Datapresence Problem Statement

By nature seagoing research is resource limited:

- Time at sea – you've got the time you've been allotted
- Active participants – you've only got so many bunks to fill
- Technology on hand – can't easily scale up and out
- Connectivity – information, social, other..

Potential Impacts:

- Reduced situational awareness
- Reduced data quantity & quality
- Unrealistic expectations & workload
- Impaired ability to act adaptively
- Reduced access to traditional support networks

Functional & Usability Requirements

Shipboard & Shoreside Web Graphical User Interface – No Kiosk

Wiki Documentation!

Data Discovery – Web GUI has "portal like" capabilities

Data Access – ERDDAP & other data services (map services, file shares, code examples)

Chart/Plot Data Visualization – UI time series visualizations

Map Data Visualization – Sikuliaq like "map server" with GMRT base layers

Data Replication – mirror full resolution content to shore

Event Notification – Users can create custom notifications

Shipboard QA/QC – Flagging and notification

Shoreside QA/QC – FTE for sensor technician oversight

USE CASE: Preconditions

Existing Cyber Infrastructure:

- RELAIBLE Satellite or Wireless connectivity (Currently no SLA)

New Cyber Infrastructure:

- Shipboard datapresence system
  - Underway Data Database w/Metadata
    - Underway data relay to shore
    - Underway metadata synchronization with shore
  - Web User Interface
  - ERDDAP & JSON REST API's
- Shoreside datapresence system (Same components as above)

Datapresence Preconditions: Existing CI

Bandwidth is low.

Ku-band (HSN)	256-512 kbps up, 512 kbps 1 Mbps down
Ka-band (Inmarsat Gx)	1Mbps up, 2 Mbps down
L-band (Inmarsat FBB500)	256 kbps CIR

Link Utilization is high.

- HSN reports show high utilization.
- With high utilization comes collisions, packet loss, and retransmissions

Contention is real.

- Connection to subscriber ratio
  - Ku-band (1:1 in Pacific right now)
  - Ka-band (1:4 up to 1:16..)

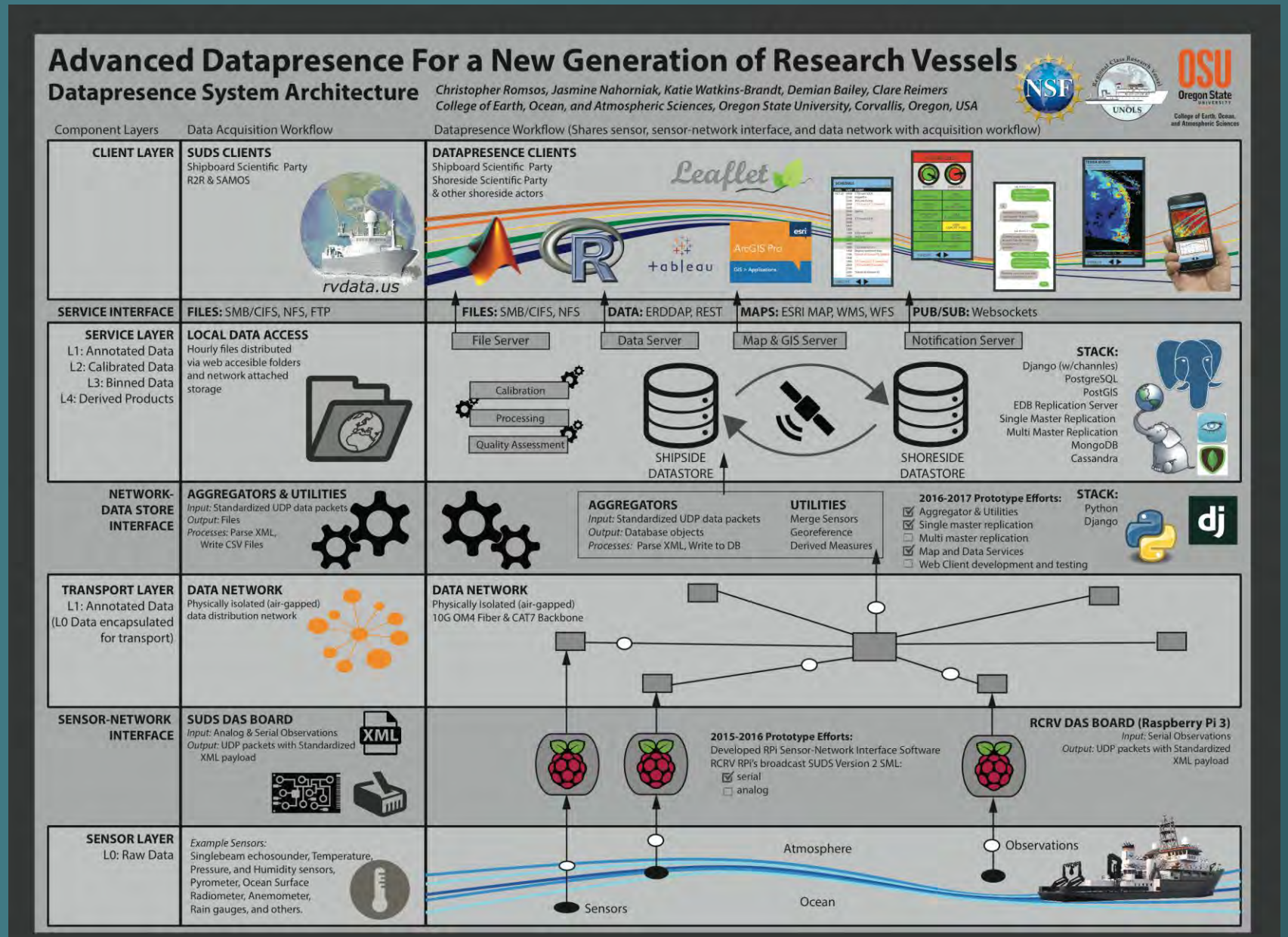
Reliability varies with conditions.

- Dual antennas (mitigate mast blockage)
- Out-of-Band backchannel

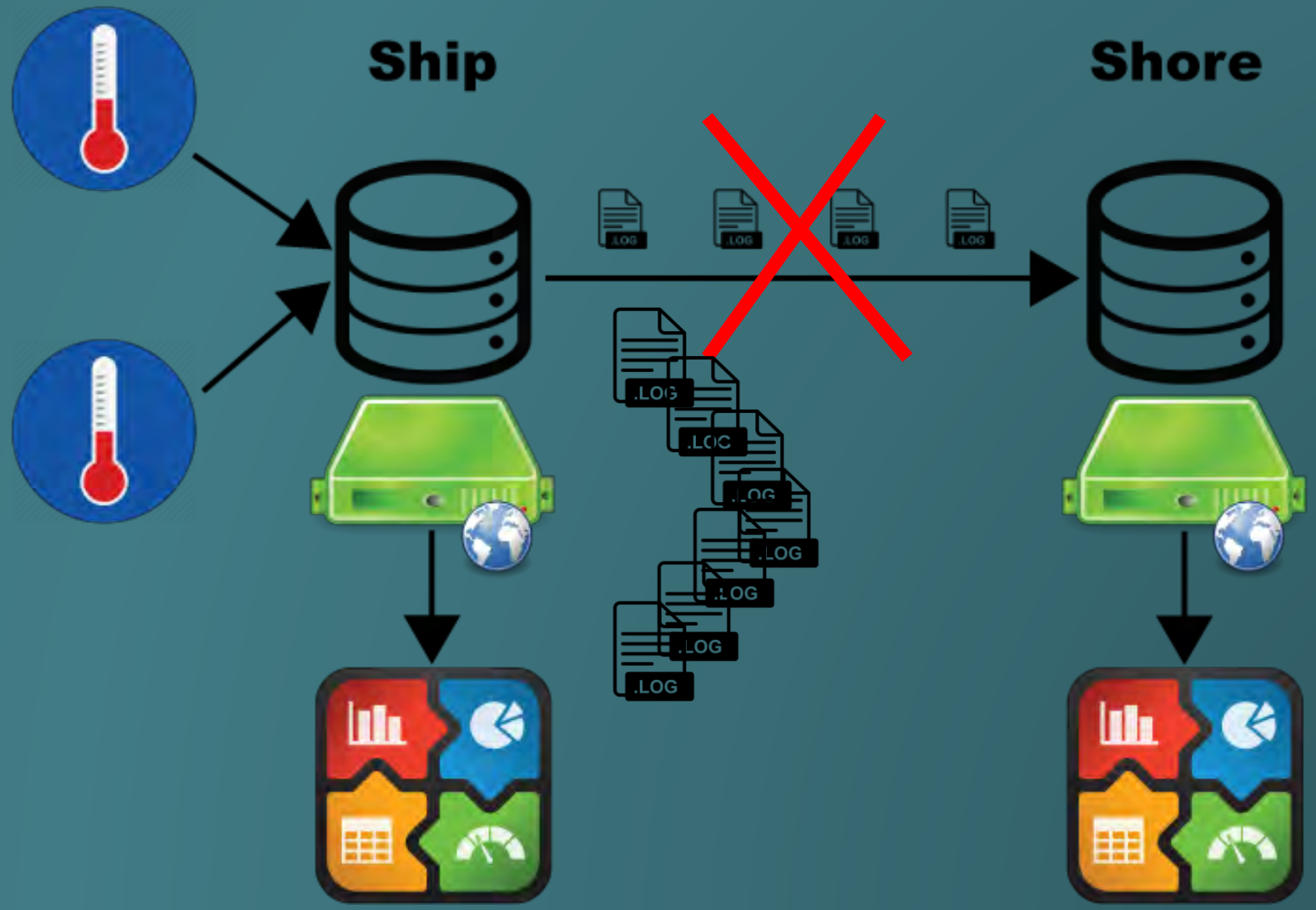
Summary:

- While telepresence is bandwidth expansion territory **datapresence isn't.**
- Vessels shall be configured to prioritize datapresence among other services.

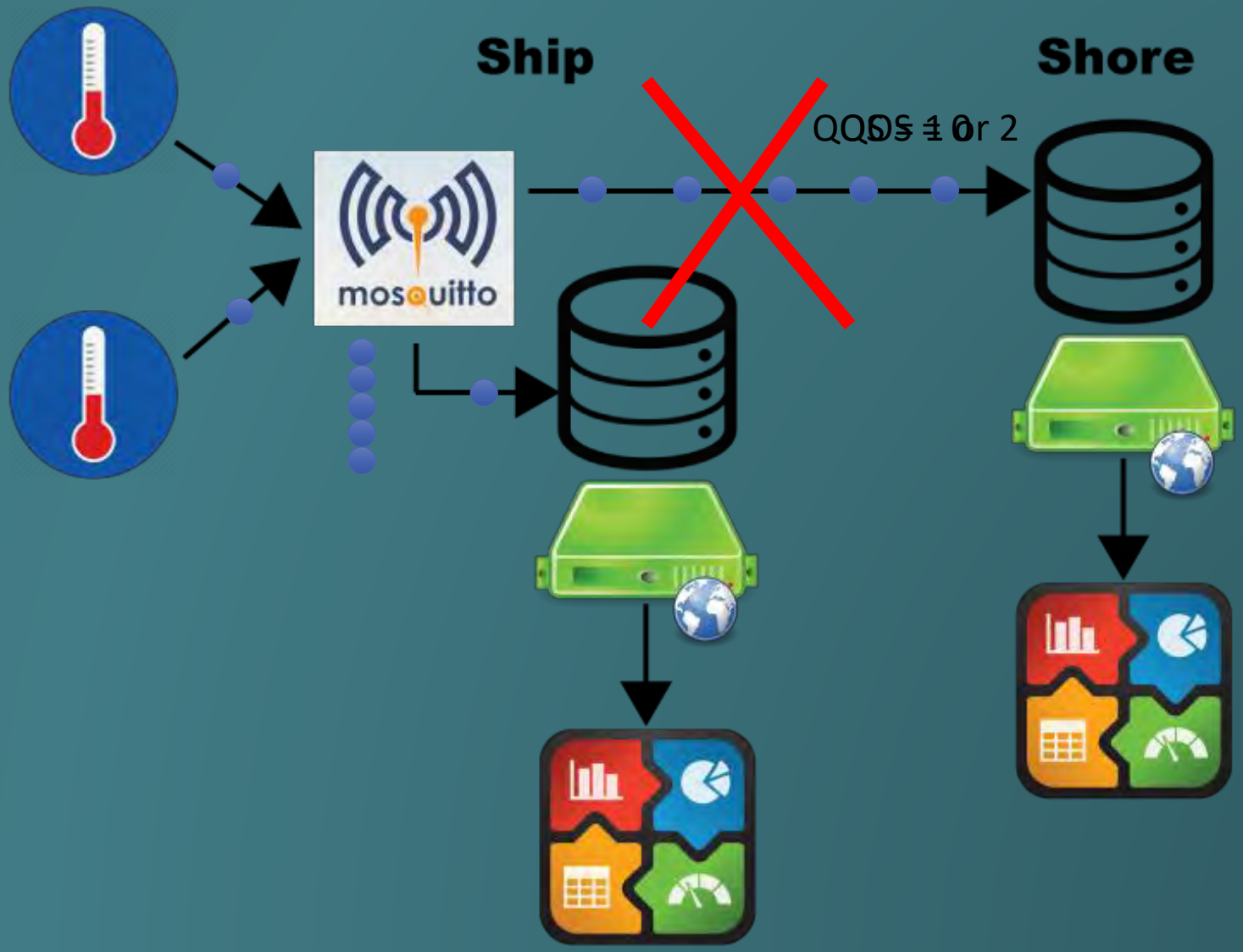
USE CASE: New CI, System Architecture – More Detail



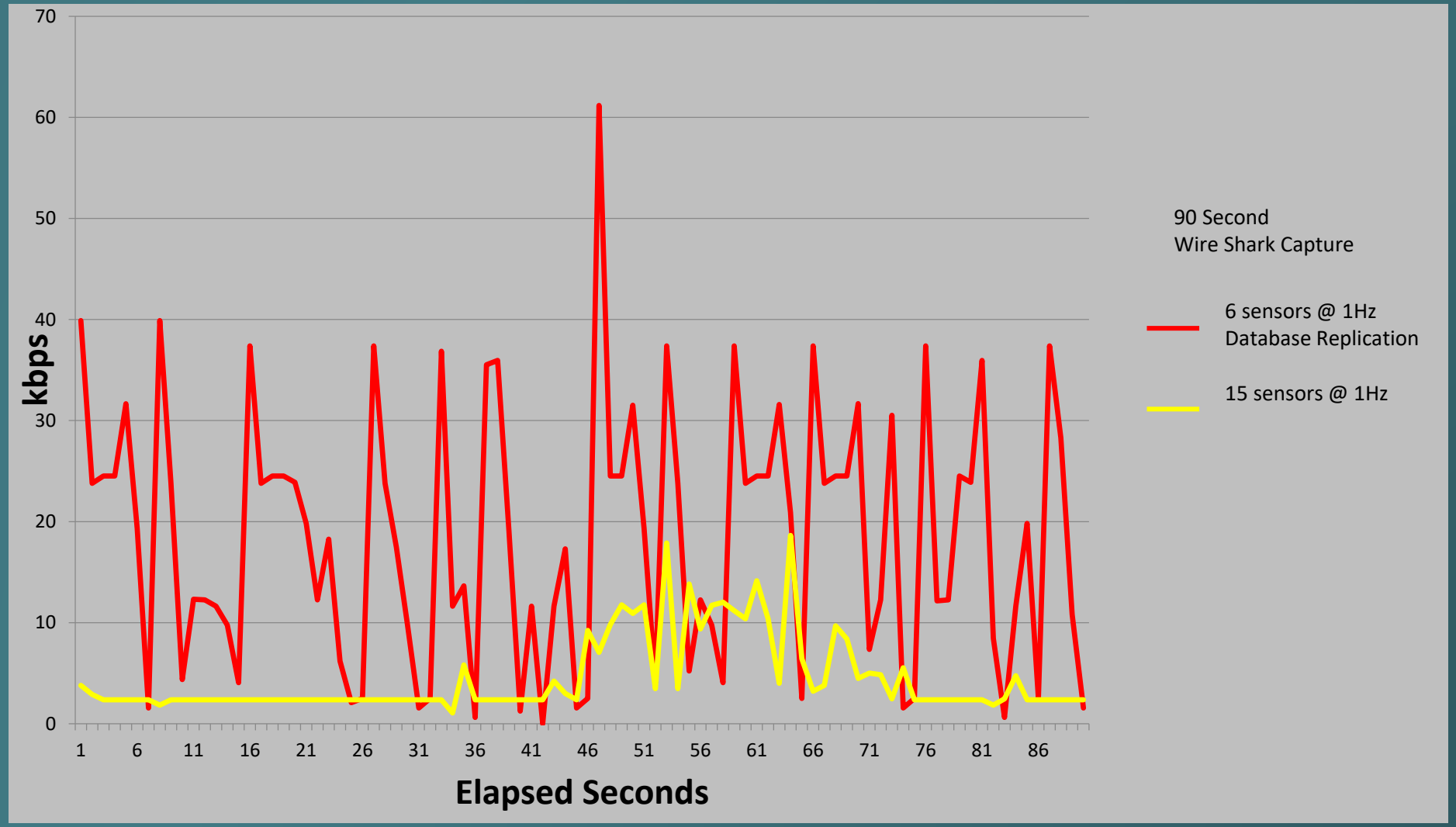
Replicating Data To Shore: Option 1 – Database Replication



Replicating Data To Shore: Option 2 – Message Queue



Performance DB Replication vs MQTT over satellite



Ship to Shore Data Transfer: Two Options Tested

Option 1 – Database Replication

Protocol: Transaction log shipping
Model: Publication/Subscription
Publisher: Primary Database on ship
Subscriber: Replicate Database on shore

- Pros
  - Out-of-the-box
  - Easy to set up
  - Little to manage
- Cons
  - Verbose & Chatty
  - Serial dependencies
  - Subscription fees
  - ACID Compliance

Option 2 – Message Queue

Protocol: Message Queue Telemetry Transport (MQTT)
Model: Publication/Subscription
Publisher: MQTT Client on the ship
Subscriber: MQTT Client on shore (can be one to many)

- Pros
  - Lightweight on wire
  - Guaranteed Delivery (QOS)
  - Choice to buffer or not
  - Persistent Sessions
  - Supports eventual consistency
- Cons
  - Some assembly required
  - Relaxed QOS options means you must manage expectations

USE CASE: Flows

Basic Flow:

- Shoreside remote participant monitors shoreside hosted website to stay abreast of shipboard activities.
- Near real-time sensor timeseries data viewed in plots and map formats.
- Shoreside participants aid in the reduction of data and feedback actionable information to shipboard science party.

Alternate Flow

- Shoreside remote participant utilizes shoreside hosted data service (ERDDAP) to access underway data.
- Data is processed shoreside to an informational product and returned shipside.
- Results are incorporated into programs and processes otherwise outside the scope of the underway activity.

NSF

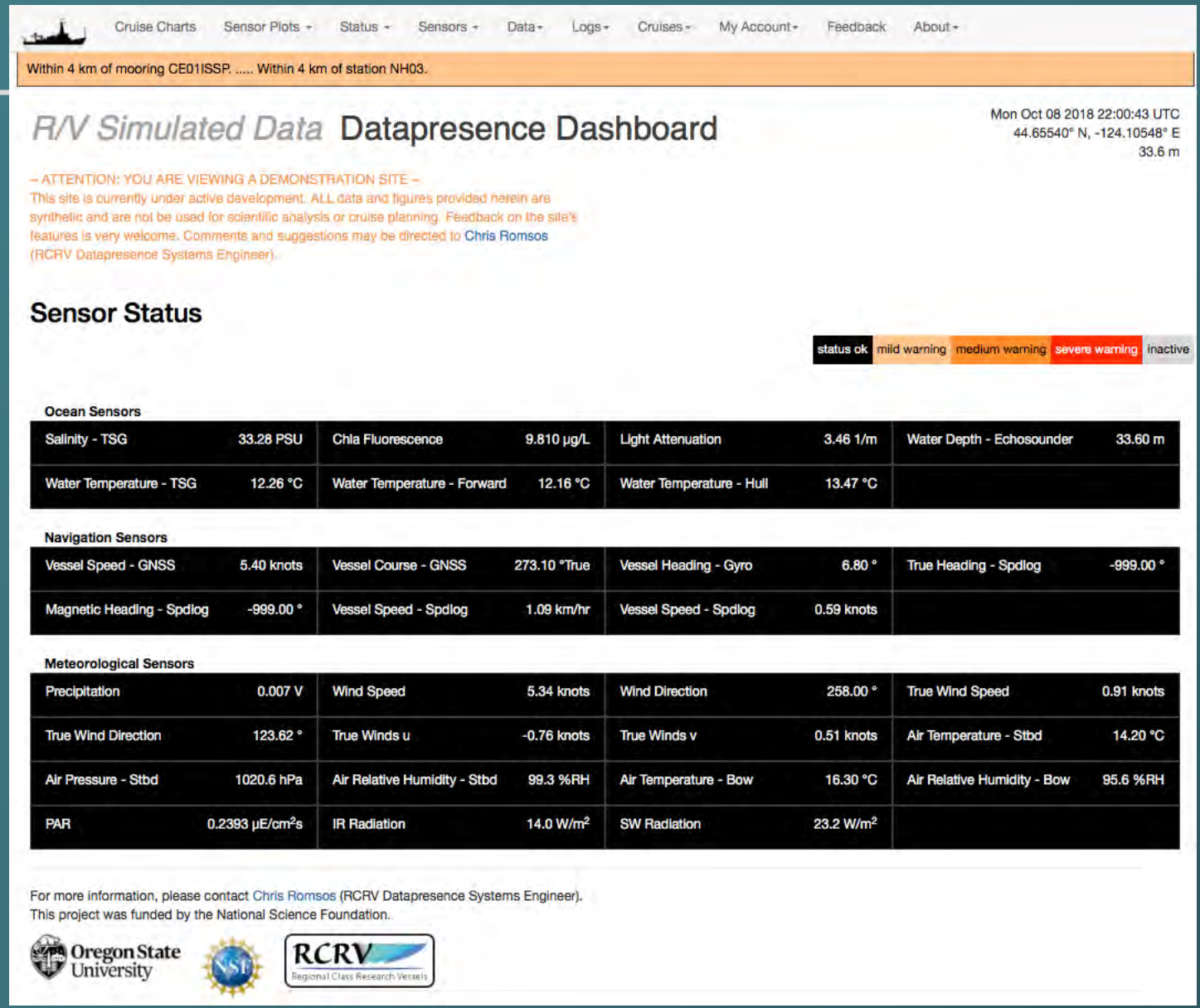
Regional Class Research Vessel
UNOLS

Oregon State University

University of Rhode Island
HOPE
1892

User Interface:

- Near real-time access to and display of data from all resident sensors
- Real-time health and status information of all datapresence components
- Intuitive, user-friendly interface
- Shore-side access to the same data and interface as ship-side



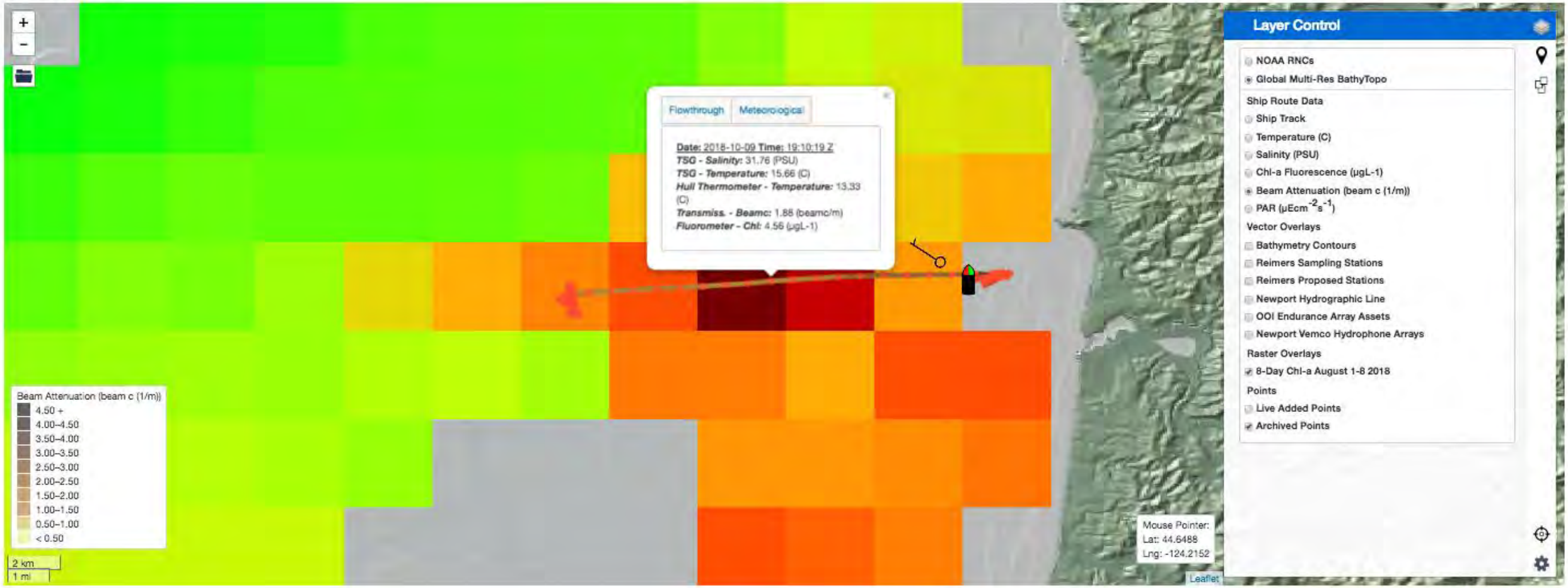
http://datapresence.coas.oregonstate.edu:8101/status/

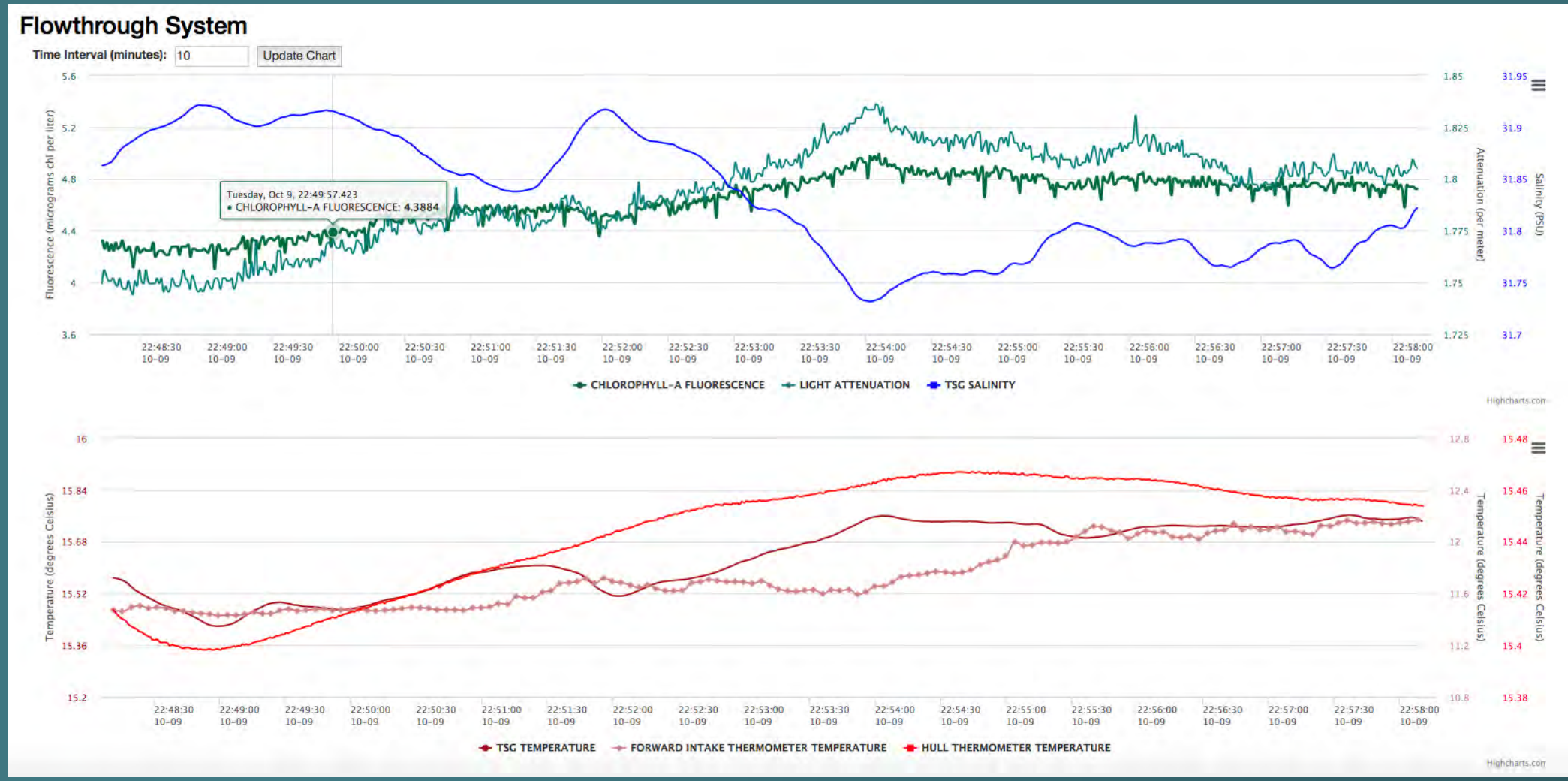
R/V Simulated Data Datapresence Dashboard

Tue Oct 09 2018 21:21:07 UTC
44.64854° N, -124.12258° E
46.2 m

– ATTENTION: YOU ARE VIEWING A DEMONSTRATION SITE –
This site is currently under active development. ALL data and figures provided herein are synthetic and are not be used for scientific analysis or cruise planning. Feedback on the site's features is very welcome. Comments and suggestions may be directed to Chris Romsos (RCRV Datapresence Systems Engineer).

Cruise Chart





Real-time plots, updated once per second, of all flowthrough system parameters.
A similar page displays data from the meteorological sensors.

Fluorometer

Plots | Data Download | Data Spreadsheet | Sensor Log | Measurement Specs | Maintenance | Calibrations | Parameters | Quality Flags | References | Support

Sea-Bird Scientific (WET Labs)
WETStar- WSCHL
S/N WSCHL-1490
Location - Flowthrough
Condition - excellent
Enabled - True
Configuration - default
Sample Rate - 1 Hz
UDP Port - 30300

General Description
Underway measurement of chlorophyll fluorescence using an excitation of 460nm and an emission of 695nm, raw voltage is converted into µg Chl/L using the scale factor derived during factory calibration.

Parameters
Chlorophyll-a Fluorescence (volts): Raw underway chlorophyll fluorescence in volts.

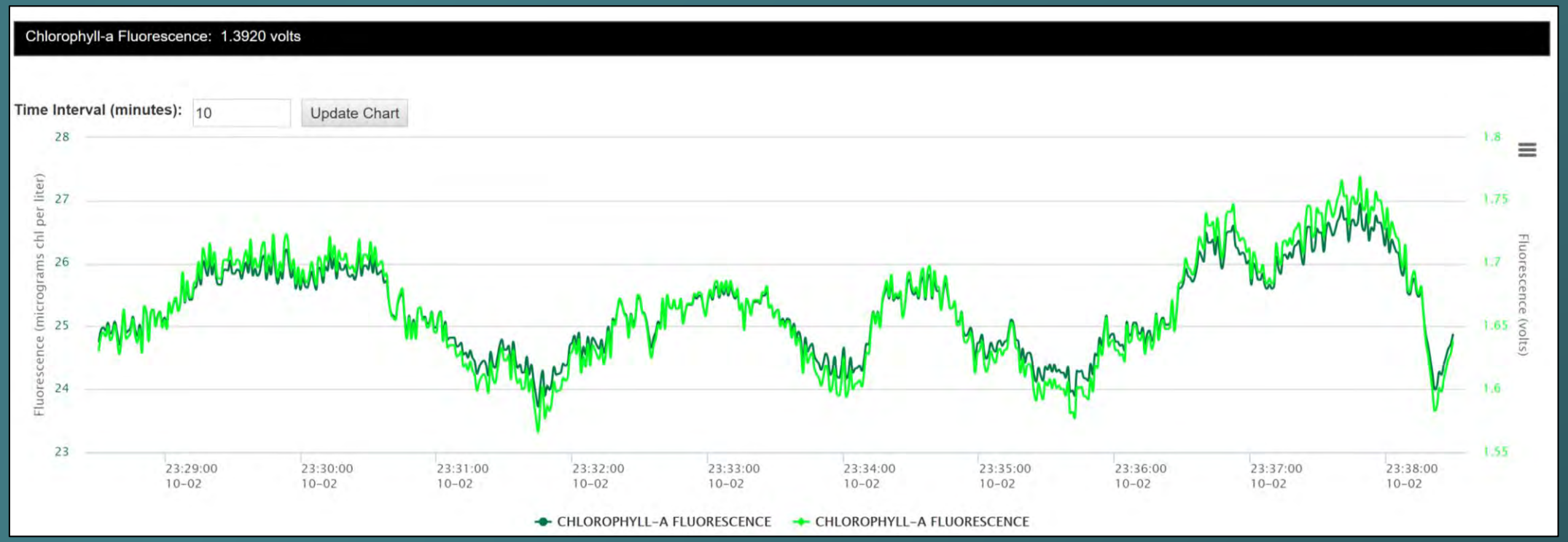
Chlorophyll-a Fluorescence (micrograms chl per liter): Derived underway chlorophyll fluorescence in µg Chl/L.

Each sensor information page includes detailed information about the instrument,
the data it collects, its history and current status, and links to references.
Each physical sensor will have a QR code sticker attached to it that takes you to its sensor information page.

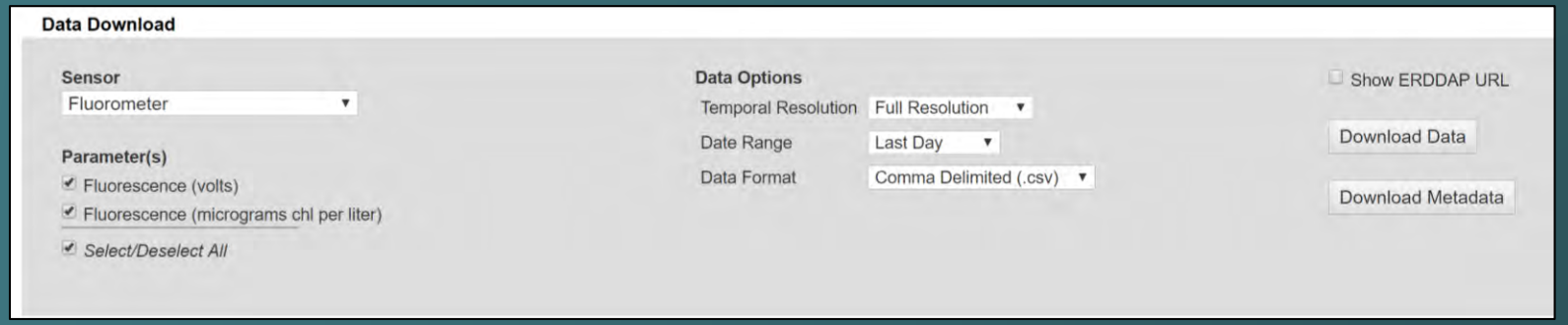
Cruise Charts | Sensor Plots | Status | Sensors | Data | Logs | Cruises | My Account | Feedback | About

Fluorometer

Plots | Data Download | Data Spreadsheet | Sensor Log | Measurement Specs | Maintenance | Calibrations | Parameters | Quality Flags | References | Support



Data will be available for download at various processing levels
(raw, calibrated, merged, binned, ...)



Cruise Charts | Sensor Plots | Status | Sensors | Data | Logs | Cruises | My Account | Feedback | About

Within 4 km of mooring CE01ISSP. ..... Within 4 km of station NH03.

R/V Simulated Data Datapresence Dashboard

Tue Oct 09 2018 21:23:22 UTC
44.64824° N, -124.12654° E
47.3 m

~ ATTENTION: YOU ARE VIEWING A DEMONSTRATION SITE ~
This site is currently under active development. ALL data and figures provided herein are synthetic and are not be used for scientific analysis or cruise planning. Feedback on the site's features is very welcome. Comments and suggestions may be directed to Chris Romsos (RCRV Datapresence Systems Engineer).

Event Log

Download Event Log

Add New Entry

> >

Cruise ID	Event	Details
OOXXIV	Event 2	ctd - deployment/recovery - completed
	Notes	Interesting underway feature, stop to do a profile here.
	Participants	Katie Watkins-Brandt, Chris Romsos, Jasmine Nahorniak
	Entered By	KWB
	Add Note	Initials Submit

#	Subevent	Date & Time (UTC)	Latitude	Longitude	Water Depth	Subevent Depth	Sea State	Cloud %	Notes
1	in_water	2018-09-26 19:51:55	44.65499	-124.10066	28.7		3_slight	10	Allowing pumps to flush.
2	start_descent	2018-09-26 20:02:01	44.65507	-124.10071	28.5		3_slight	10	Pumps have flushed, beginning descent.
3	at_max_depth	2018-09-26 20:15:29	44.65519	-124.10087	28.8	20.0	3_slight	10	Max depth of 20m reached.
4	start_ascent	2018-09-26 20:16:21	44.65521	-124.10103	28.8		3_slight	10	Begin triggering bottles on the ascent.
5	at_surface	2018-09-26 20:35:19	44.65429	-124.10077	28.8		3_slight	10	All bottles triggered.
6	end_event	2018-09-26 20:40:57	44.65481	-124.10079	28.8		3_slight	10	Package on deck, here come the vultures.
7	comment	2018-09-26 20:02:47							Edit this to include event depth was actually 25.6m. --- KWB

Cruise ID	Event	Details
OOXXIV	Event 1	ctd - deployment/recovery - completed
	Notes	Equipment test deployment and recovery
	Participants	Katie Watkins-Brandt, Chris Romsos, Jasmine Nahorniak
	Entered By	KWB
	Add Note	Initials Submit

Cruise Charts | Sensor Plots | Status | Sensors | Data | Logs | Cruises | My Account | Feedback | About

Not Secure | sardinops.coas.oregonstate.edu:8080/erddap/info/index.html?page=1&itemsPerPage=1000

ERDDAP
Easier access to scientific data

Brought to you by NOAA NMFS SWFSC ERD

ERDDAP > List of All Datasets

23 matching datasets, listed in alphabetical order.

Grid DAP Data	Sub-set	Table DAP Data	Make A Graph	WMS	Source Data Files	Title	Sum-mary	FGDC, ISO, Metadata	Back-ground Info	RSS	E mail	Institution	Dataset ID
	set	data	graph			* The List of All Active Datasets in this ERDDAP *		M	background			Oregon State Univ...	allDatasets
		data	graph			ANEMO_MMAST		M	background	RSS		Oregon State Univ...	anemo_mmast
data			graph	M		Chlorophyll-a, Aqua MODIS, NPP, 0.0125°, West US, EXPERIMENTAL, 2002-present (8 Day Composite), Lon+/-180		F I M	background	RSS		NOAA NMFS SWFSC ERD	MODIS_Chl_8day
		data	graph			CUR_OBS		M	background	RSS		Oregon State Univ...	cur_obs
		data	graph			ECHO_WELL		M	background	RSS		Oregon State Univ...	echo_well
		data	graph			FLUOR_FLTH		M	background	RSS		Oregon State Univ...	fluor_flth
data			graph	M		Fluorescence, Aqua MODIS, NPP, 0.0125°, West US, 2002-present (8 Day Composite), Lon+/-180		F I M	background	RSS		NOAA NMFS SWFSC ERD	MODIS_Chl_Fluorescense_8day
		data	graph			GNSS_GGA_BOW		F I M	background	RSS		Oregon State Univ...	gnss_gga_bow
		data	graph			GNSS_VTG_BOW		M	background	RSS		Oregon State Univ...	gnss_vtg_bow
		data	graph			GYRO_BRDG		M	background	RSS		Oregon State Univ...	gyro_brdg
		data	graph			METSTN_BOW		M	background	RSS		Oregon State Univ...	metstn_bow
		data	graph			METSTN_STBD		M	background	RSS		Oregon State Univ...	metstn_stbd
data			graph	M		MODISA L3 SMI,		F I M	background	RSS		NASA/GSFC OBPG	Modis_8_day_SST
		data	graph			PAR_MMAST		M	background	RSS		Oregon State Univ...	par_mmast
		data	graph			RAD_MMAST		M	background	RSS		Oregon State Univ...	rad_mmast
		data	graph			RAIN_MMAST		M	background	RSS		Oregon State Univ...	rain_mmast
		data	graph			SPEEDLOG_WELL		M	background	RSS		Oregon State Univ...	speedlog_well
data			graph	M		SST, Aqua MODIS, NPP, 0.0125°, West US, Day time (11 microns), 2002-present (8 Day Composite), Lon+/-180		F I M	background	RSS		NOAA NMFS SWFSC ERD	MODIS_SST_Daytime_8day
		data	graph			THERM_FWD		M	background	RSS		Oregon State Univ...	therm_fwd
		data	graph			THERM_HULL		M	background	RSS		Oregon State Univ...	therm_hull
		data	graph			TRANSMISS_FLTH		M	background	RSS		Oregon State Univ...	transmiss_flth
		data	graph			TRUE_WINDS		M	background	RSS		Oregon State Univ...	true_winds
		data	graph			TSG_FLTH		M	background	RSS		Oregon State Univ...	tsg_flth

The information in the table above is also available in other file formats (.csv, .htmlTable, .itx, .json, .jsonlCSV, .jsonlKVP, .mat, .nc, .nccsv, .tsv, .xhtml) via a RESTful web service.

ERDDAP, Version 1.82

www.noaa.gov

Cruise Charts | Sensor Plots | Status | Sensors | Data | Logs | Cruises | My Account | Feedback | About

Not Secure | datapresence.coas.oregonstate.edu:8001/api/

Django REST framework

Api Root

Api Root

OPTIONS GET

The default basic root view for DefaultRouter

```
GET /api/
```

```
HTTP 200 OK
Allow: GET, HEAD, OPTIONS
Content-Type: application/json
Vary: Accept
```


```
{
    "cur_obs": "http://datapresence.coas.oregonstate.edu:8001/api/cur_obs/",
    "cur_obs_archive": "http://datapresence.coas.oregonstate.edu:8001/api/cur_obs_archive/",
    "gnss_gga_bow": "http://datapresence.coas.oregonstate.edu:8001/api/gnss_gga_bow/",
    "gnss_vtg_bow": "http://datapresence.coas.oregonstate.edu:8001/api/gnss_vtg_bow/",
    "gyro_brdg": "http://datapresence.coas.oregonstate.edu:8001/api/gyro_brdg/",
    "anemo_mmast": "http://datapresence.coas.oregonstate.edu:8001/api/anemo_mmast/",
    "metstn_stbd": "http://datapresence.coas.oregonstate.edu:8001/api/metstn_stbd/",
    "metstn_bow": "http://datapresence.coas.oregonstate.edu:8001/api/metstn_bow/",
    "tsg_flth": "http://datapresence.coas.oregonstate.edu:8001/api/tsg_flth/",
    "transmiss_flth": "http://datapresence.coas.oregonstate.edu:8001/api/transmiss_flth/",
    "therm_hull": "http://datapresence.coas.oregonstate.edu:8001/api/therm_hull/",
    "echo_well": "http://datapresence.coas.oregonstate.edu:8001/api/echo_well/",
    "fluor_flth": "http://datapresence.coas.oregonstate.edu:8001/api/fluor_flth/",
    "therm_fwd": "http://datapresence.coas.oregonstate.edu:8001/api/therm_fwd/",
    "par_mmast": "http://datapresence.coas.oregonstate.edu:8001/api/par_mmast/",
    "rad_mmast": "http://datapresence.coas.oregonstate.edu:8001/api/rad_mmast/",
    "rain_mmast": "http://datapresence.coas.oregonstate.edu:8001/api/rain_mmast/",
    "speedlog_well": "http://datapresence.coas.oregonstate.edu:8001/api/speedlog_well/",
    "true_winds": "http://datapresence.coas.oregonstate.edu:8001/api/true_winds/",
    "sensor_float_1": "http://datapresence.coas.oregonstate.edu:8001/api/sensor_float_1/",
    "sensor_float_2": "http://datapresence.coas.oregonstate.edu:8001/api/sensor_float_2/",
    "sensor_float_3": "http://datapresence.coas.oregonstate.edu:8001/api/sensor_float_3/",
    "sensor_float_4": "http://datapresence.coas.oregonstate.edu:8001/api/sensor_float_4/",
    "sensor_float_5": "http://datapresence.coas.oregonstate.edu:8001/api/sensor_float_5/",
    "sensor_float_6": "http://datapresence.coas.oregonstate.edu:8001/api/sensor_float_6/",
    "sensor_float_7": "http://datapresence.coas.oregonstate.edu:8001/api/sensor_float_7/",
    "sensor_integer_1": "http://datapresence.coas.oregonstate.edu:8001/api/sensor_integer_1/",
    "sensor_point_1": "http://datapresence.coas.oregonstate.edu:8001/api/sensor_point_1/",
    "sensor_mixed_1": "http://datapresence.coas.oregonstate.edu:8001/api/sensor_mixed_1/",
    "sensor_mixed_2": "http://datapresence.coas.oregonstate.edu:8001/api/sensor_mixed_2/",
    "sensor_mixed_3": "http://datapresence.coas.oregonstate.edu:8001/api/sensor_mixed_3/",
    "custom_sensor_1": "http://datapresence.coas.oregonstate.edu:8001/api/custom_sensor_1/",
    "custom_sensor_2": "http://datapresence.coas.oregonstate.edu:8001/api/custom_sensor_2/",
    "custom_sensor_3": "http://datapresence.coas.oregonstate.edu:8001/api/custom_sensor_3/"
```

USE CASE: Postconditions

- Shipboard scientific party DIRECTLY benefits by leveraging shoreside resources to assist with activities such as data processing, quality assurance, and planning.

- Data services provide INDIRECT benefit by robust near real-time access to high quality shipboard data for larger observational efforts (e.g. weather forecasting, remote sensing validation, or other).

Questions/Comments

Chris Romsos Datapresence Systems Engineer
cromsos@coas.oregonstate.edu

Jasmine Nahorniak Assistant Datapresence Systems Engineer
jasmine@ceoas.oregonstate.edu

Katie Watkins-Brandt Sensor Systems Engineer
kwatkins@ceoas.oregonstate.edu

Thank you for your time and feedback!

Demian Bailey • Project Manager
Clare Reimers • Project Scientist

For more information regarding the Regional Class Research Vessel Project, visit:
http://ceoas.oregonstate.edu/ships/rcrv/