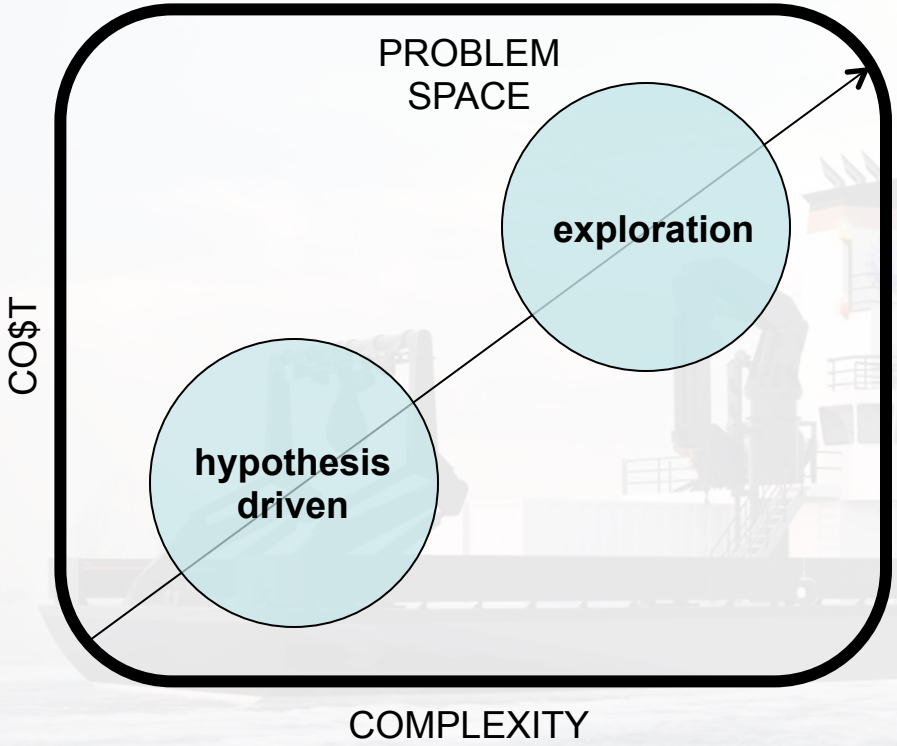
Continuous Observation Platforms.
Common Data Products.
QA/QC.

MAINTAIN a common sensor suite across class.

OPERATE resident sensors to run continuously.

PERFORM near real-time QC to promote QA

The datapresence problem space – where do we fit?



High Complexity / Unique:
Problem
Too many techs not enough shipboard science
Solution
connect shoreside science with A/V tech

Lower Complexity / More Common:
Traditional seagoing technician/scientist ratio –
science outnumbers tech support
Hidden Problem-
Awash in data, logistics, etc.
Solution –
Turn data to information off the ship

The Datapresence Problem Statement: In Other Words, Why?

By nature seagoing research is resource limited:

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

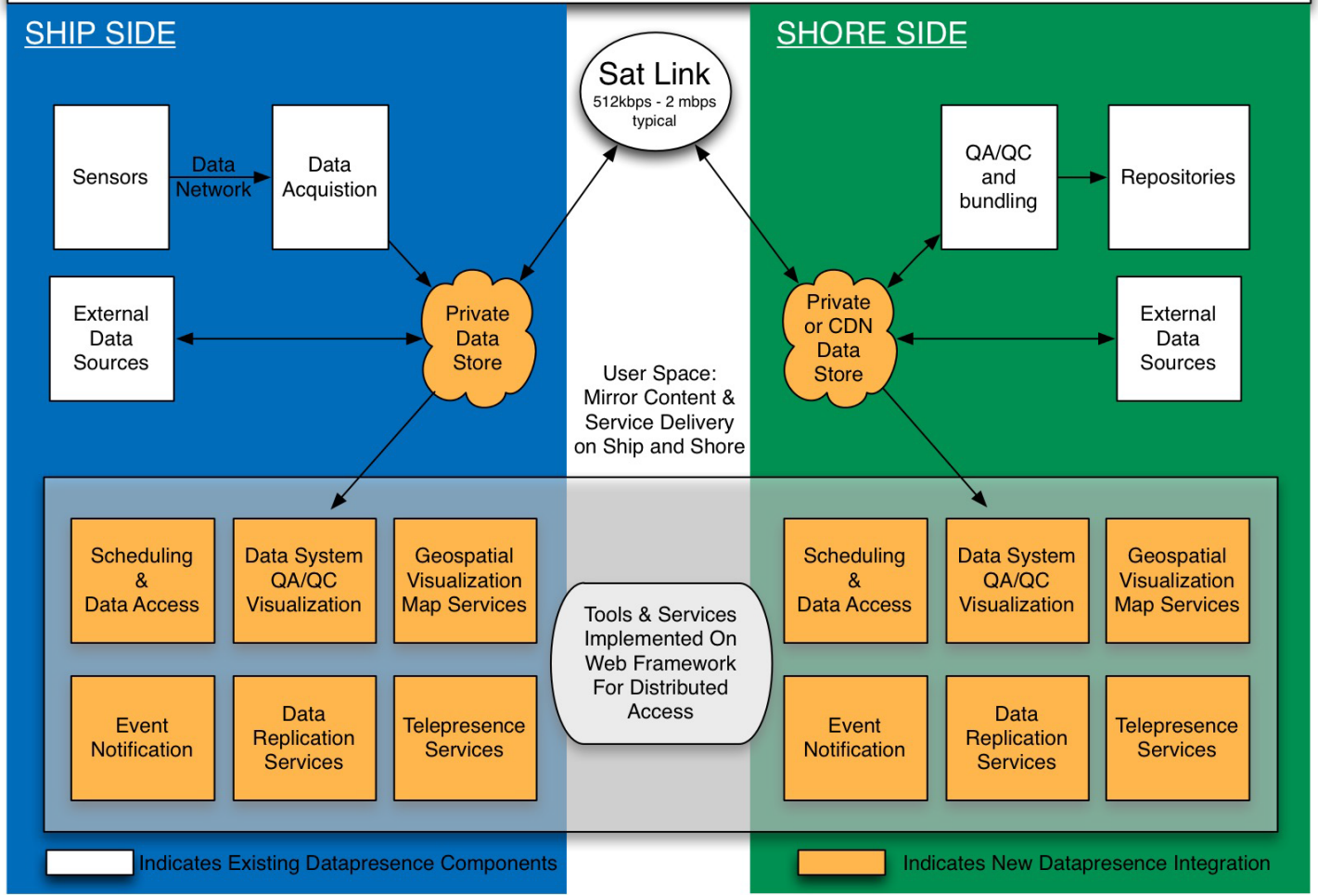
Potential Impacts:

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

Needs Assessment:

AUDIENCE - Who are we targeting?	YES.
DEMAND – What do they need?	YES..
PRODUCT – What are we offering?	YES...
SERVICE – How are we providing it?	YES....

RCRV Datapresence Functional Diagram



Service Requirements

- **Data Discovery** – UI has “portal like” capabilities
- **Data Access** – Erddap and other data services (map services, file shares..)
- **Chart/Plot Data Visualization** – UI time series visualizations
- **Map Data Visualization** – Sikuliaq like mapserver implementation 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

Advanced Datapresence For a New Generation of Research Vessels

Datapresence System Architecture

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College of Earth, Ocean, and Atmospheric Sciences, Oregon State University, Corvallis, Oregon, USA

Component Layers	Data Acquisition Workflow	Datapresence Workflow (Shares sensor, sensor-network interface, and data network with acquisition workflow)
CLIENT LAYER	**SUDS CLIENTS** Shipboard Scientific Party R2R & SAMOS rvdata.us	**DATAPRESENCE CLIENTS** Shipboard Scientific Party Shoreside Scientific Party & other shoreside actors Leaflet, MATLAB, R, tableau, ArcGIS Pro, esri, GIS > Applications
SERVICE INTERFACE	**FILES:** SMB/CIFS, NFS, FTP	**FILES:** SMB/CIFS, NFS; **DATA:** ERDDAP, REST; **MAPS:** ESRI MAP, WMS, WFS; **PUB/SUB:** Websockets
SERVICE LAYER L1: Annotated Data L2: Calibrated Data L3: Binned Data L4: Derived Products	**LOCAL DATA ACCESS** Hourly files distributed via web accesible folders and network attached storage	File Server; Data Server; Map & GIS Server; Notification Server Calibration; Processing; Quality Assessment SHIPSIDE DATASTORE; SHORESIDE DATASTORE **STACK:** Django (w/channles) PostgreSQL PostGIS EDB Replication Server Single Master Replication Multi Master Replication MongoDB Cassandra
NETWORK-DATA STORE INTERFACE	**AGGREGATORS & UTILITIES** *Input:* Standardized UDP data packets *Output:* Files *Processes:* Parse XML, Write CSV Files	**AGGREGATORS** *Input:* Standardized UDP data packets *Output:* Database objects *Processes:* Parse XML, Write to DB **UTILITIES** Merge Sensors Georeference Derived Measures **2016-2017 Prototype Efforts:** ☑ Aggregator & Utilities ☑ Single master replication ☐ Multi master replication ☑ Map and Data Services ☐ Web Client development and testing **STACK:** Python Django
TRANSPORT LAYER L1: Annotated Data (L0 Data encapsulated for transport)	**DATA NETWORK** Physically isolated (air-gapped) data distribution network	**DATA NETWORK** Physically Isolated (air-gapped) 10G OM4 Fiber & CAT7 Backbone
SENSOR-NETWORK INTERFACE	**SUDS DAS BOARD** *Input:* Analog & Serial Observations *Output:* UDP packets with Standardized XML payload XML	**2015-2016 Prototype Efforts:** Developed RPi Sensor-Network Interface Software RCRV RPi's broadcast SUDS Version 2 SML: ☑ serial ☐ analog **RCRV DAS BOARD (Raspberry Pi 3)** *Input:* Serial Observations *Output:* UDP packets with Standardized XML payload
SENSOR LAYER L0: Raw Data	*Example Sensors:* Singlebeam echosounder, Temperature, Pressure, and Humidity sensors, Pyrometer, Ocean Surface Radiometer, Anemometer, Rain gauges, and others.	Atmosphere Ocean Sensors Observations

Regional Class Research Vessel UNOLS

OSU Oregon State University
College of Earth, Ocean, and Atmospheric Sciences

Synchronizing the data store

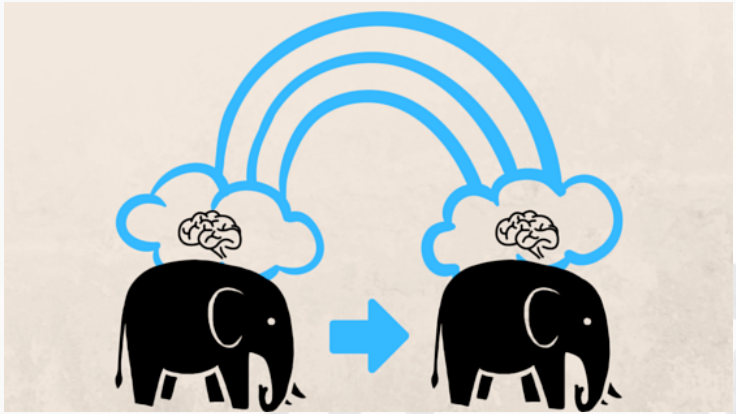
Target Requirements:

- Synchronize all “simple” vector time series data at full resolution
- Synchronize continuously instead of episodically
- Use COTS solution if possible, don’t roll-your-own
- Use a reliable or consistent method

Options:

- File Transfer (rsync) - simple (but you need to roll your own mgmt. logic), episodic
- **Shared Database –** pub/sub model, asynchronous (store and forward changes)
- Messaging – many models, some do guarantee reliable delivery, message-oriented-middleware (MOM), again some considerable assembly required.

Database Replication



Currently Testing EDB PostgreSQL's xDB Replication Server

- Write Ahead Logs are used to protect against data loss
- You can ship the logs to remote db and play them forward

- Performance is great in a local area network
  - Can push logs as frequently as once per second

- Out of the box performance isn't so great over high latency (RTT = 850ms) and high packet loss networks.

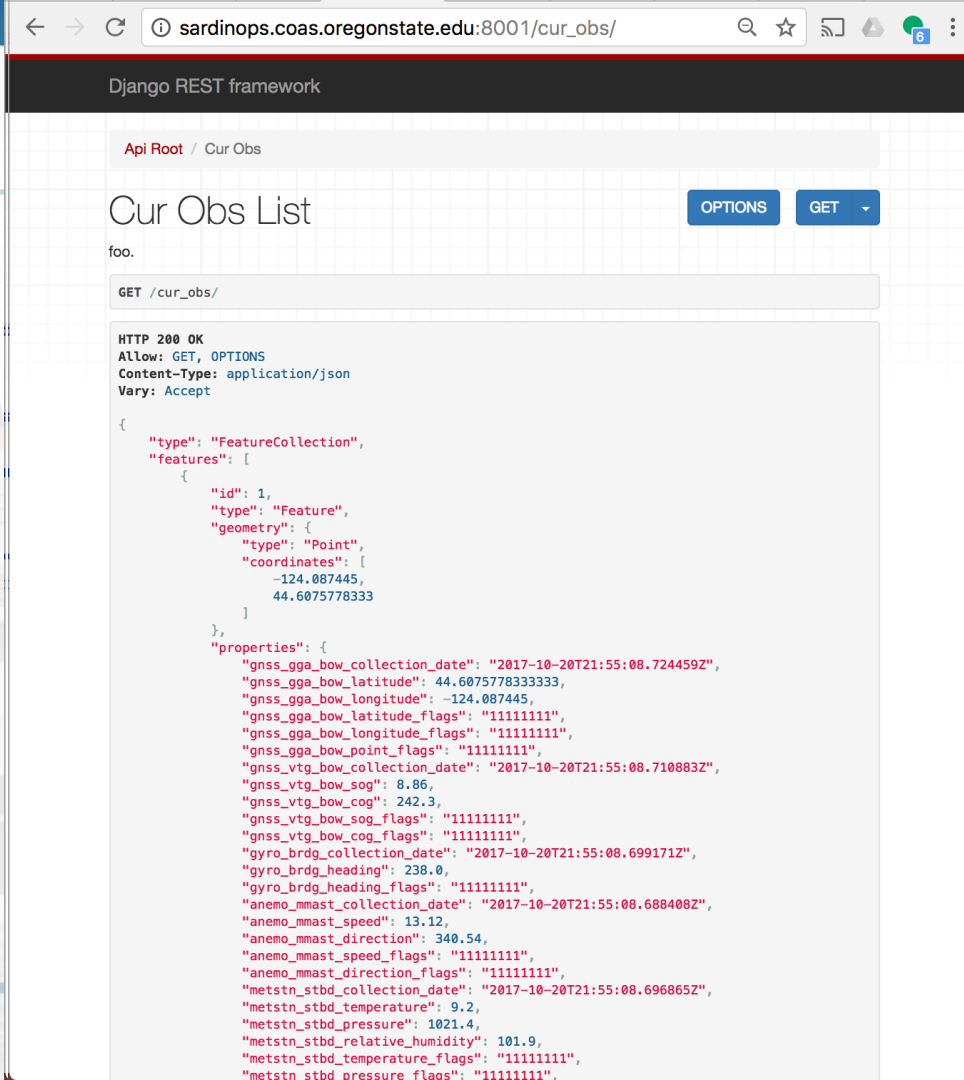
OPTIMIZATION

- Change TCP send and receive window size, disable slow start, selective acks, etc.
- During tests on *Endeavor* (April 2017) we replicated 12 sensors collecting at 2 Hz
  - Utilization - Ship to Shore **~59 kbps (175 kbps spikes)**
  - Gracefully handles outages: 20 minute outage (over 28,000 transaction backlog)

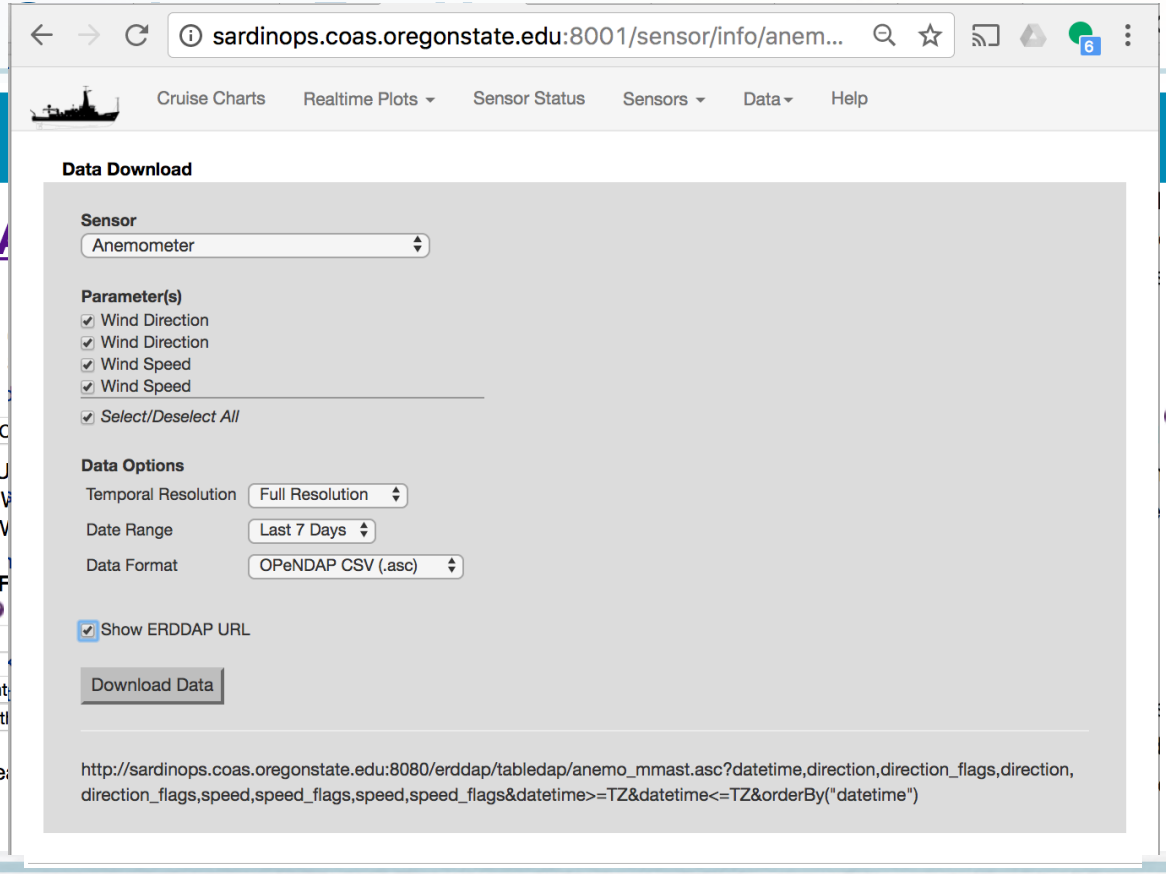
Data Services:

User Interface components built on the Django Rest Framework.

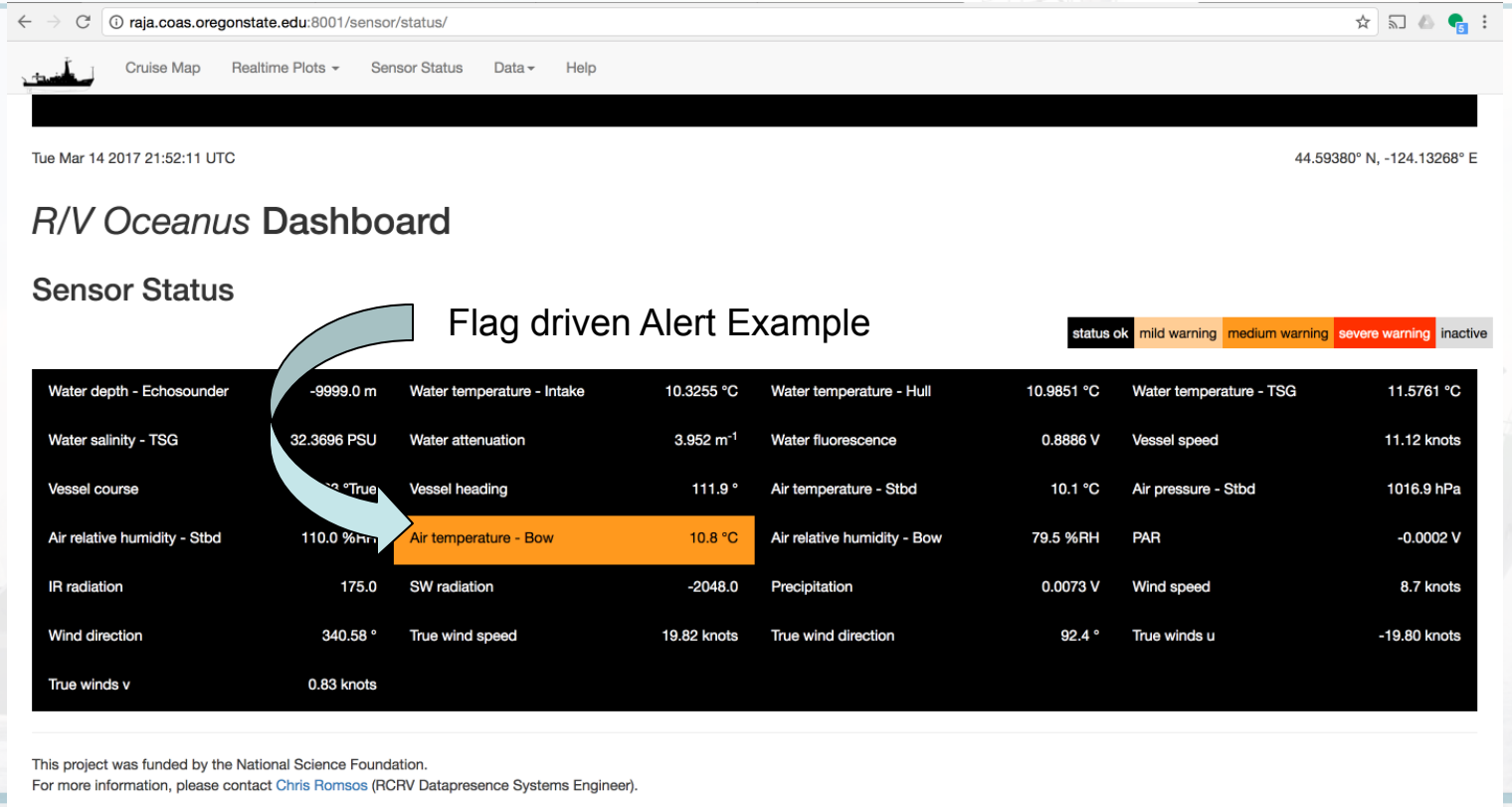
- Data is serialized as JSON & geoJSON
- Integrates easily into javascript plotting libraries like Highcharts, D3, etc.
- Modify URL with query parameters to:
  Window/Filter/Order/etc.



Data


sardinops.coas.oregonstate.edu:8001/sensor/info/anem...
Cruise Charts
Realtime Plots
Sensor Status
Sensors
Data
Help
Data Download
Sensor
Anemometer
Parameter(s)
Wind Direction
Wind Direction
Wind Speed
Wind Speed
Select/Deselect All
Data Options
Temporal Resolution
Full Resolution
Date Range
Last 7 Days
Data Format
OPeNDAP CSV (.asc)
Show ERDDAP URL
Download Data
http://sardinops.coas.oregonstate.edu:8080/erddap/tabledap/anemo_mmast.asc?datetime,direction,direction_flags,direction,
direction_flags,speed,speed_flags,speed,speed_flags&datetime>=TZ&datetime<=TZ&orderBy("datetime")

Web User Interface: Sensor Status



Web User Interface: Sensor Specific Time Series Plots

Pyrometer

10.5.1.202:8001/sensor/info/pyro001/

67%

Search

Cruise Charts | Sensor Plots | Sensor Status | Sensors | Data | Help

Heading greater than 113 degrees

- Anemometer - Forward
- Anemometer - Main Mast
- Echosounder
- Flowmeter - Science Seawater
- Flowmeter - pCO2
- GNSS
- Gravimeter
- Gyrocompass - Primary
- Gyrocompass - Secondary
- Inertial Navigation System
- Met Station
- Multi-sensor Fluorescence and Turbidity
- OOI mooring
- PAR sensor
- Pyrometer
- Rain Gauge
- Speedlog
- Thermometer - Forward Intake
- Thermosalinograph
- True Winds - Forward Mast
- True Winds - Main Mast
- True Winds - Main Mast - RCRV
- pCO2 sensor

R/V Sikuliaq Datapresence

Mon Oct 16 2017 01:24:11 UTC
44.65089° N, -124.20131° E

Pyrometer

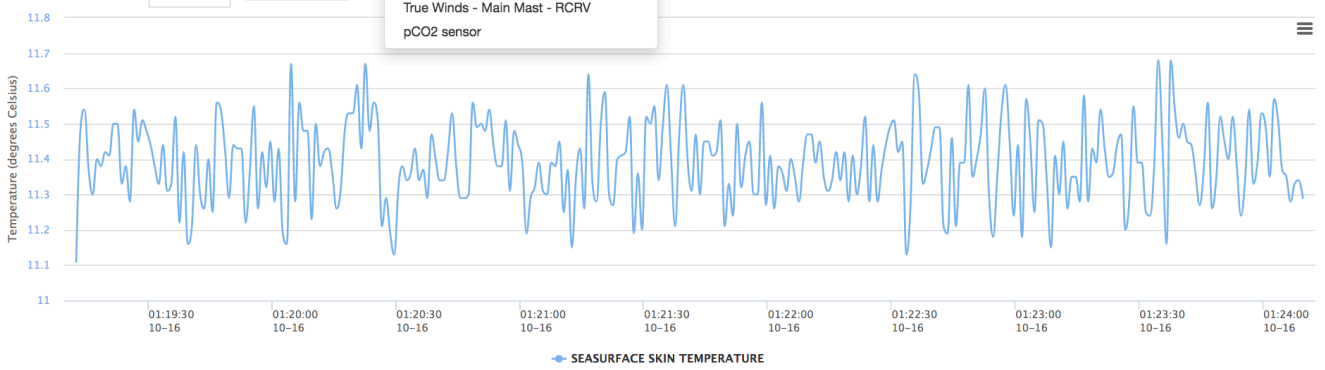
HEITRONICS Infrarot Messt
CT15.10
S/N 10975
Location - Science Control R
Condition - unknown
Enabled - True
Configuration - unknown
Sample Rate - 1 Hz

General Description
Infrared radiation pyrometer.

Parameters
Seasurface Skin Temperature: foo

Seasurface Skin Temperature: 11.40 degrees Celsius

Time Interval (minutes): 5 Update Chart



10.5.1.202:8001/sensor/info/gyro002/

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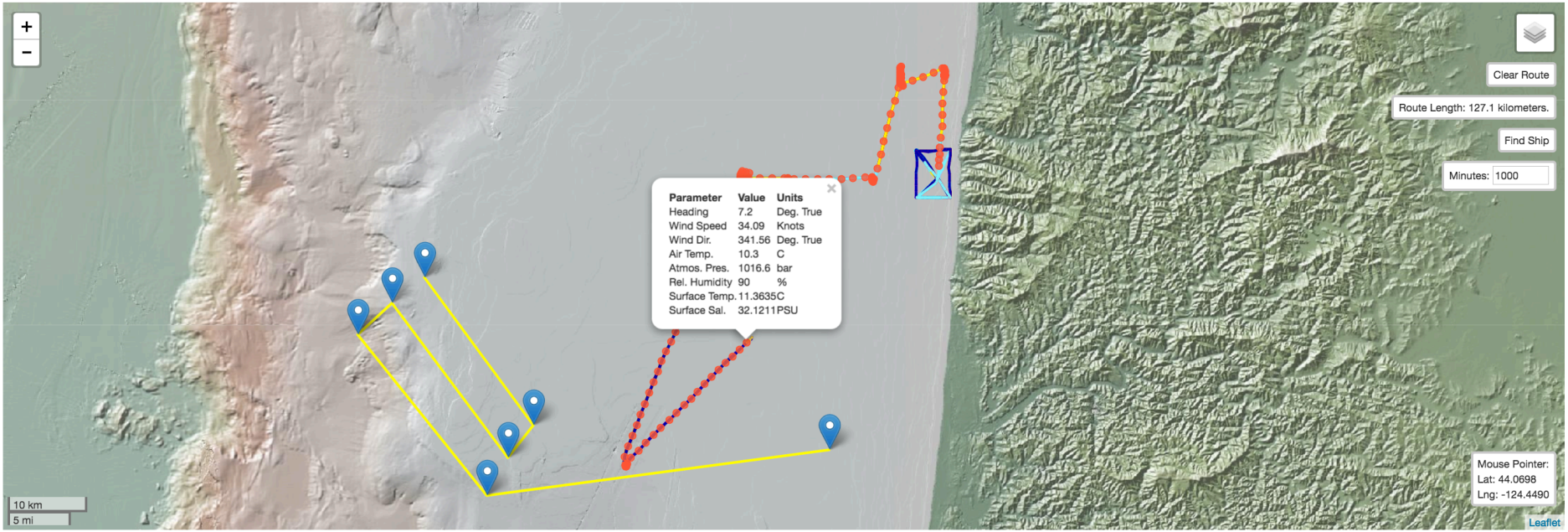
Datapresence Dashboard

Thu Oct 26 2017 02:41:39 UTC
44.07423° N, -124.43955° E

Cruise Map



Next Steps:

1. Collaborate:
   - I used to hear things like “you can’t do that” and “good luck”
   - Now I’m hearing “I want to do that also”
2. Fork:
   - Fork off branches to develop alternate methods for:
     - Synchronizing the data store (file or message models)
     - Data delivery to clients (web sockets)
3. Human engineering:
   - Noting beats demonstrated success and performance

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R2R & SAMOS

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