

OOI Data Flow and Data Access

Michael F Vardaro, M. Crowley, L. Belabbassi,
M. Smith, L. Garzio, F. Knuth, J. Kerfoot, S. Glenn,
O. Schofield, S. Lichtenwalner

Rutgers University, Dept. of Marine & Coastal
Sciences, New Brunswick, NJ



1. OOI & Data Team Intro

2. OOI Data Flow

3. OOI Data Access



OOI By the Numbers



7 Arrays

57 Stable Platforms
Moorings, Profilers, Nodes

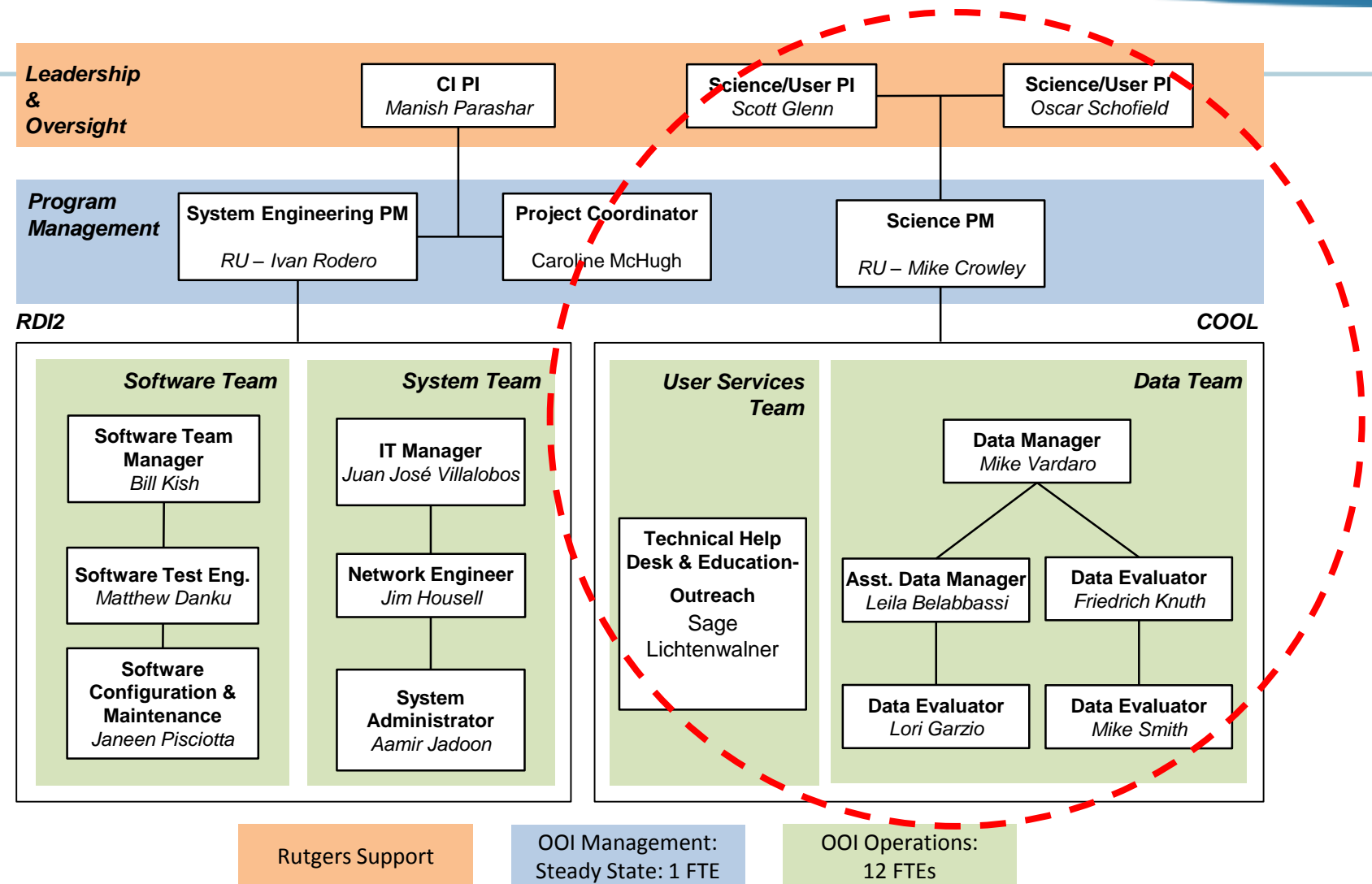
32 Mobile Assets
Gliders, AUVs

>850 Instruments

>2500 Science Data Products

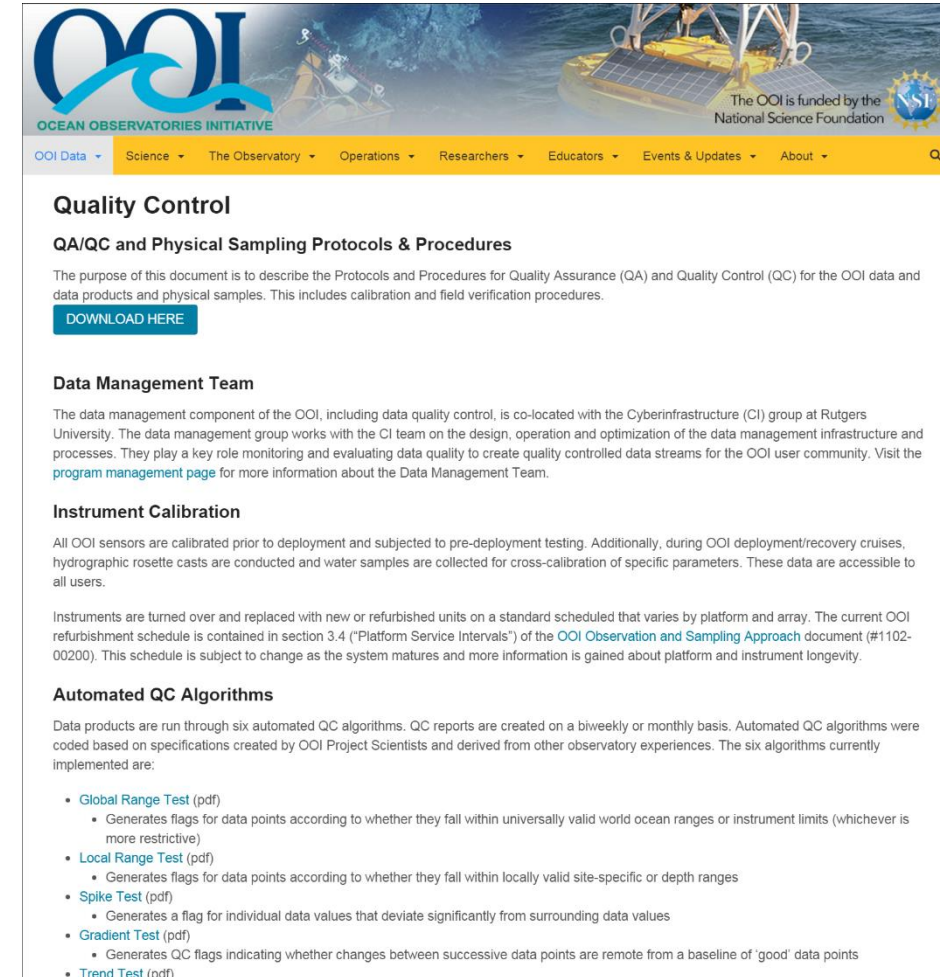
>100K Science/Engineering Data Products

Data Team



Data Evaluation Procedures & Tools

- Data QA/QC and Sampling Plan:
 - 1102-00300_QAQC_Cal_Physical_Samples_OOI
- Sampling Strategy Document:
 - 1102-00200_Observation_and_Sampling_Approach_OOI
- Data Product Specifications:
 - 1341-000xx (DPS) and 1342-000xx (Data Flow)
- Calibration Information
 - github.com/ooi-integration/asset-management
- Data Product and QC Algorithms:
 - github.com/ooici/ion-functions/tree/master/ion_functions
- Quality Control Lookup tables:
 - github.com/ooi-integration/qc-lookup
- Data Team download and plotting tools:
 - github.com/ooi-data-review

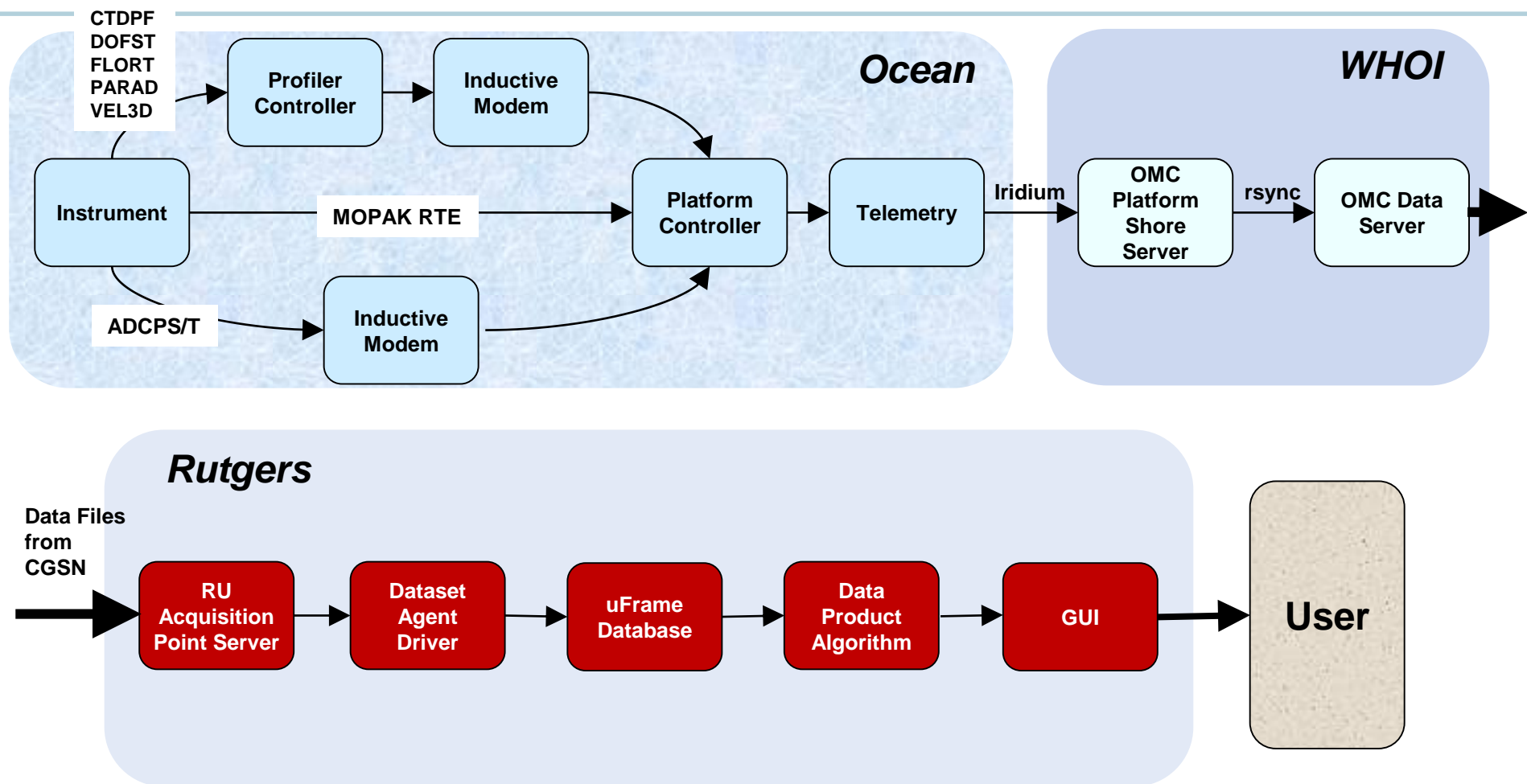


The screenshot shows the OOI website's 'Quality Control' page. The header includes the OOI logo and navigation links: OOI Data, Science, The Observatory, Operations, Researchers, Educators, Events & Updates, and About. The main content area is titled 'Quality Control' and 'QA/QC and Physical Sampling Protocols & Procedures'. It states the purpose of the document is to describe the Protocols and Procedures for Quality Assurance (QA) and Quality Control (QC) for the OOI data and data products and physical samples. A 'DOWNLOAD HERE' button is visible. Below this, the 'Data Management Team' section describes the team's role in data quality control. The 'Instrument Calibration' section explains the calibration process for OOI sensors. The 'Automated QC Algorithms' section lists six algorithms: Global Range Test, Local Range Test, Spike Test, Gradient Test, and Trend Test, each with a brief description of its function.

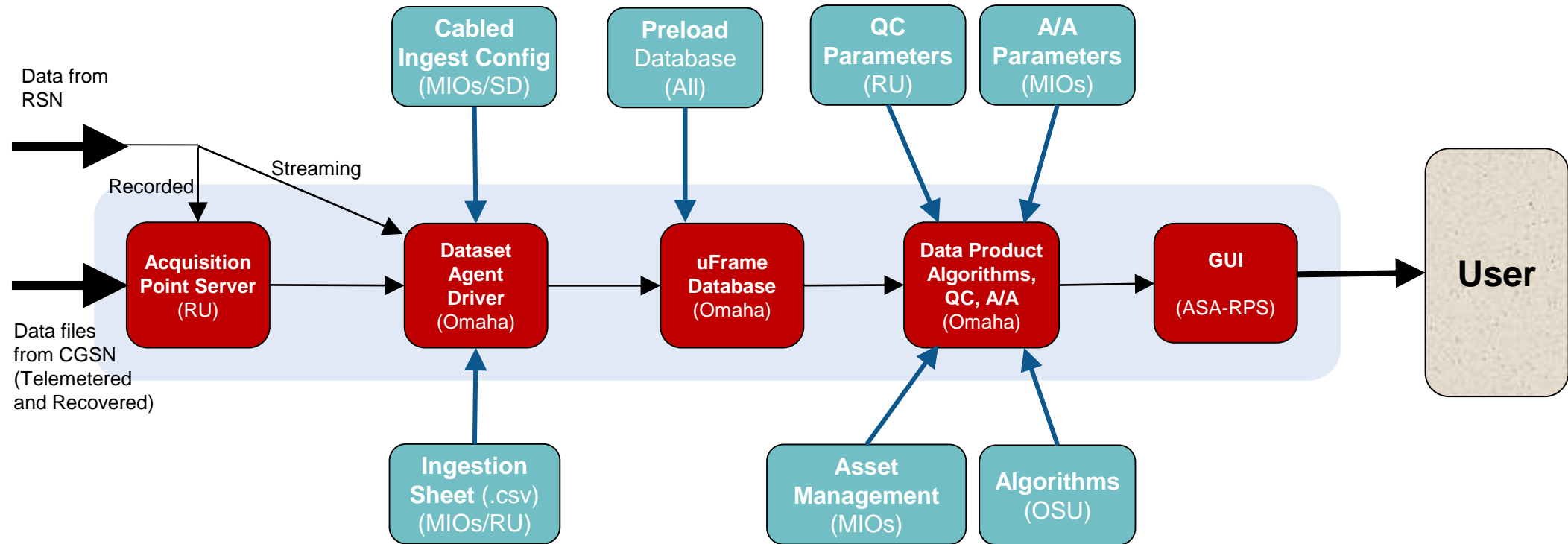
OOI Data Flow



Data Flow Example: Pioneer Profiler



Data Processing Flow



OOI Data Product Levels

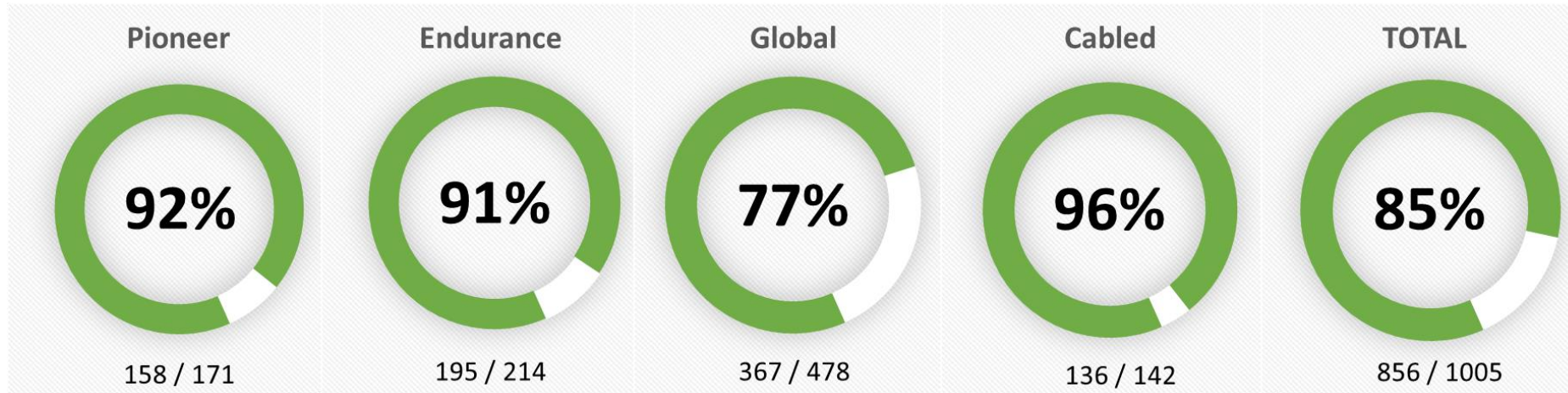
- **Raw data:** The datasets as they are received from the instrument
 - May contain multiple L0, L1, or L2 parameters, data for multiple sensors, and be in native sensor units
 - Always persisted and archived by the OOI
 - Example: format 0 binary file from an SBE-37IM on a Global Flanking Mooring.
- **Level 0 (L0):** Unprocessed, parsed data parameter that is in instrument/sensor units and resolution
 - Sensor by sensor (unpacked and/or de-interleaved) and available in OOI supported formats (e.g., NetCDF)
 - Always persisted and archived by the OOI
 - Example: SBE-37IM Temperature portion of the hex string
- **Level 1 (L1):** Data parameter that has been calibrated and is in scientific units
 - QC may be applied at this level, utilizing simple automated techniques or human inspection
 - Actions to transform Level 0 to Level 1 data are captured and presented in the metadata of the Level 1 data
 - Example: SBE-37IM Temperature converted from hex to binary and scaled to produce degrees C
- **Level 2 (L2):** Derived data parameter created via an algorithm that draws on multiple L1 data products
 - Products may come from the same or from separate instruments
 - Example: SBE-37IM Density and Salinity

Streams vs. Parameters

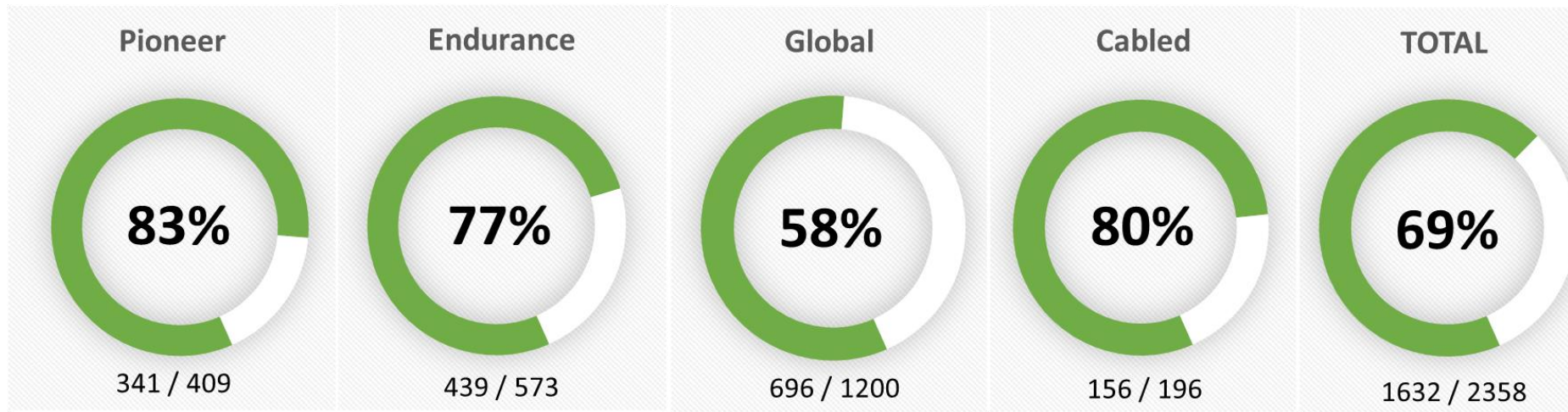
- Raw data are parsed by system code into data streams (science, engineering, metadata, etc.)
- Each stream is a “package” containing multiple parameters
- A single instrument can produce multiple data streams with many different parameter types within them
- Science parameters are processed (and combined) via additional algorithm code to produce L1 and L2 data products
- If an algorithm uses data streams from multiple instruments to produce L2 products, data from all relevant instruments will be provided during download



Data on Production System



Instruments



Data Streams

OOI Data Access

Data Access Points

- Data Portal (GUI)
 - Updated with new landing page, navigation, and plotting functionality (including streaming plots)
- ERDDAP (in beta form; Winter 2016)
- M2M Interface (Fall 2016)
- Shipboard Data
 - Available via Alfresco; currently being updated
- Raw data files
 - Mirror of OOI data repository; data files as they are delivered from instruments
- Direct Pass to community organizations
 - IRIS
 - IOOS portals; NANOOS, MARACOOS (soon)
 - OceanSITES (soon)

OOI Data

OOI Data Availability

OOI provides free access to a wide range of data collected from around the world's oceans. We are offering these data in phases. We will offer you greater functionality and more data sets in the coming months based on your [feedback](#). All data are safely archived, and our goal is to get them to scientists and educators as quickly as possible using various delivery mechanism as appropriate.

[Learn more about the availability of individual data tools...](#)

Increasing the availability of evaluated data and the diversity of delivery modes will continually evolve based on community feedback in the coming months. You can subscribe to a [mailing list](#) to receive updates and notification as additional data and functionality becomes available. We also look forward to your feedback as well as suggestions on the tools that would increase the efficiency of synthesizing the diverse data collected by the program.

Over 200 unique data products are measured or derived from the over 800 instruments deployed from the air-sea interface to the seafloor amongst the seven OOI arrays.

The OOI CI provides a common operating infrastructure, the OOI system software (OOI Net), to connect and enable the coordination of operations of the OOI marine components (Global, Coastal, and Cabled Arrays) with the scientific and educational pursuits of oceanographic research communities. OOI Net permits 24/7 connectivity to bring sustained ocean observing data to a user any time, any place. Anyone with an internet connection can create a login on OOI Net and access OOI data.



DATA PORTAL

The primary source for all OOI datasets and metadata



EXPLORE OOI DATA PRODUCTS

Browse the list of all major data products sampled by the OOI



OOI CRUISE DATA

Access data from all OOI Cruises

Preliminary Data

- [Cabled Array Preliminary Data on IRIS](#)
- [Cabled Array tilt meter and co-located temperature plots](#) courtesy of Dr. Bill Chadwick

THREDDS SERVER

Selected pre-calculated streams are available through through OPENDAP and the NetCDF Subset Service on our THREDDS data server

Coming Soon

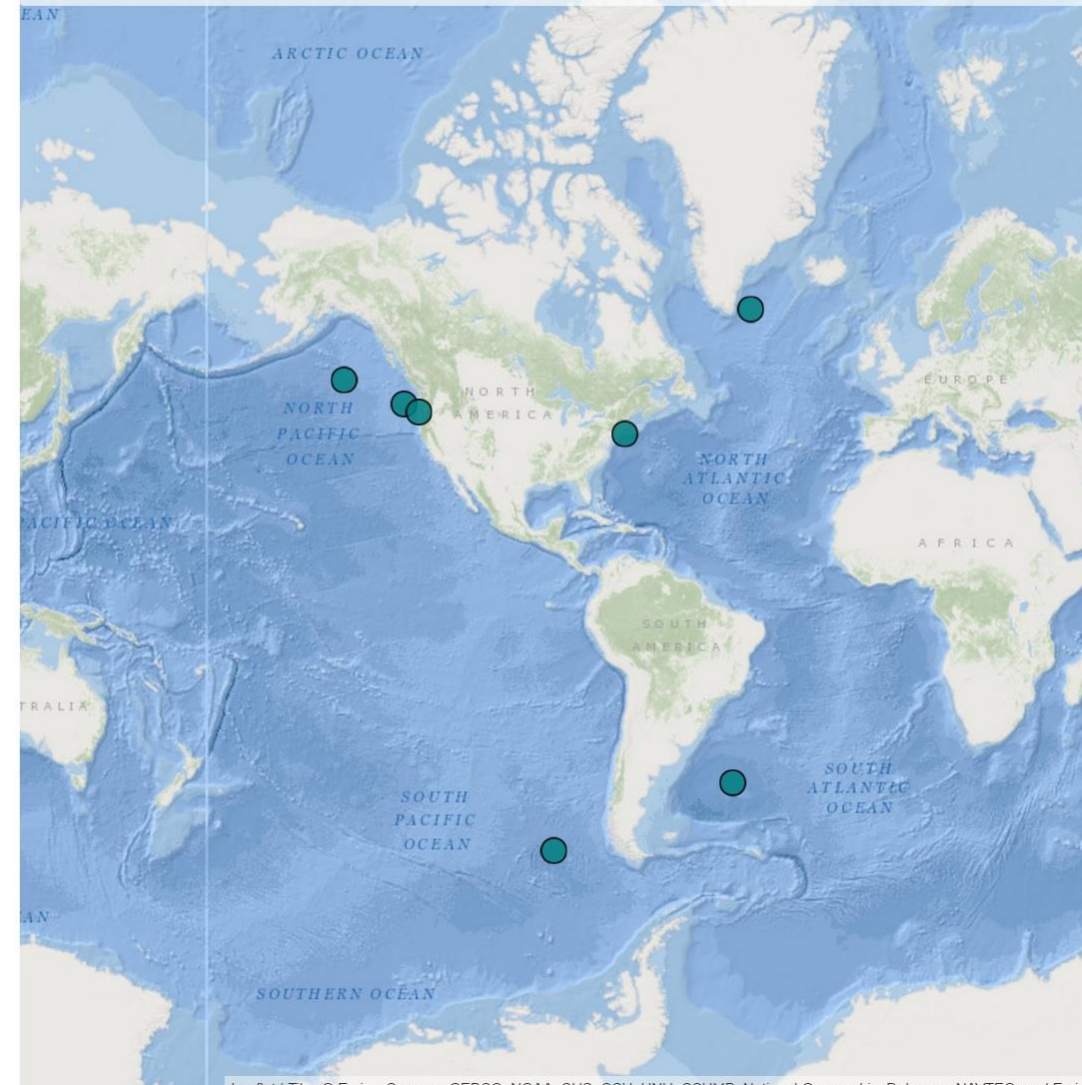
The following additional data access methods are currently in development and should be available in 2016.

- Raw Datafile Access

Research Arrays

Select an array on the map or choose from the list.

- Endurance
- Station Papa
- Pioneer
- Argentine Basin
- Irminger Sea
- Southern Ocean
- Cabled Array



OOI Prioritized Datasets

1. All Arrays, all platforms:

- a. CTD data products (Temperature, Conductivity, Pressure, Density, Salinity)
- b. Dissolved Oxygen
- c. ADCP (all series)
- d. Bulk Meteorology (all products)
- e. Surface Wave Spectra – significant wave height
- f. Fluorometric Products (CDOM/Chlorophyll/Backscatter)
- g. Nitrate
- h. Seawater pH
- i. In-Water and Air/Sea pCO₂

2. Cabled Array EOVs (these instruments are only on the Cabled Array):

- a. HD Camera Products
- b. Bottom Pressure/Tilt Products
- c. Seafloor Pressure
- d. Low-Frequency Hydrophone Products
- e. Vent Fluid and Particulate DNA Sampler – D1000 Temperature Products

ERDDAP Data

- <http://ooi-data.marine.rutgers.edu/erddap/tabledap/>
- Draft form – data are still being loaded to test the system
- Latest 6 months of data available for download, from the available platforms (Endurance, Station Papa, and Cabled)
- Production-level public-facing server hosted at Rutgers CI (Winter 2016)
 - Designed to serve (at least) the latest 6 months of data from all platforms

ERDDAP
Easier access to scientific data

ERDDAP > tabledap

Tabledap lets you use the OPeNDAP constraint/selection protocol to request data subsets, graphs, and maps from tabular datasets (for example, buoy data).
For details, see ERDDAP's [tabledap Documentation](#).

List of tabledap Datasets

76 matching datasets, listed in alphabetical order.

Grid DAP Data	Sub-set	Table DAP Data	Make A Graph	W M S	Source Data Files	Title	Summary	FOQC, ISO, Metadata	Background Info	RSS	E mail	Institution	Dataset ID
						* The List of All Active Datasets in this ERDDAP *						Rutgers Univers ...	allDatasets
						CE04OSPS-PC018-4A-CTDPPA109-streamed-ctdp_gptode_sample		F I M	background	3.45x		Ocean Observato ...	CE04OSPS-PC018-4A-CTDPPA109-streamed-ctdp_gptode_sample
						CE04OSPS-PC018-4C-PCO2WA105-streamed-pco2w_a_sam_data_record		F I M	background	3.45x		Ocean Observato ...	CE04OSPS-PC018-4C-PCO2WA105-streamed-pco2w_a_sam_data_record
						CE04OSPS-SF018-2A-CTDPPA107-streamed-ctdp_sbe43_sample		F I M	background	3.45x		Ocean Observato ...	CE04OSPS-SF018-2A-CTDPPA107-streamed-ctdp_sbe43_sample
						CE04OSPS-SF018-2B-PHSENA108-streamed-phsen_data_record		F I M	background	3.45x		Ocean Observato ...	CE04OSPS-SF018-2B-PHSENA108-streamed-phsen_data_record
						CE04OSPS-SF018-3A-FLORTD104-streamed-fort_d_data_record		F I M	background	3.45x		Ocean Observato ...	CE04OSPS-SF018-3A-FLORTD104-streamed-fort_d_data_record
						CE04OSPS-SF018-4A-NUTRA102-streamed-nutr_a_sample		F I M	background	3.45x		Ocean Observato ...	CE04OSPS-SF018-4A-NUTRA102-streamed-nutr_a_sample
						CE04OSPS-SF018-4F-PCO2WA102-streamed-pco2w_a_sam_data_record		F I M	background	3.45x		Ocean Observato ...	CE04OSPS-SF018-4F-PCO2WA102-streamed-pco2w_a_sam_data_record
						CE04OSSM-RID26-04-VELPTA000-telemetered-velpt_ab_dcl_instrument		F I M	background	3.45x		Ocean Observato ...	CE04OSSM-RID26-04-VELPTA000-telemetered-velpt_ab_dcl_instrument
						CE04OSSM-RID26-06-PHSEND000-telemetered-phsen_abcdcl_dcl_instrument		F I M	background	3.45x		Ocean Observato ...	CE04OSSM-RID26-06-PHSEND000-telemetered-phsen_abcdcl_dcl_instrument
						CE04OSSM-RID26-07-NUTNRB000-telemetered-nutr_b_dcl_instrument		F I M	background	3.45x		Ocean Observato ...	CE04OSSM-RID26-07-NUTNRB000-telemetered-nutr_b_dcl_instrument
						CE04OSSM-RID27-02-FLORTD000-telemetered-fort_dcl_instrument		F I M	background	3.45x		Ocean Observato ...	CE04OSSM-RID27-02-FLORTD000-telemetered-fort_dcl_instrument
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						CE04OSSM-SBD11-04-VELPTA000-telemetered-velpt_ab_dcl_instrument		F I M	background	3.45x		Ocean Observato ...	CE04OSSM-SBD11-04-VELPTA000-telemetered-velpt_ab_dcl_instrument
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						CE04OSSM-SBD12-04-PCO2AA000-telemetered-pco2a_a_dcl_instrument		F I M	background	3.45x		Ocean Observato ...	CE04OSSM-SBD12-04-PCO2AA000-telemetered-pco2a_a_dcl_instrument
						CE04OSSM-SBD12-04-PCO2AA000-telemetered-pco2a_a_dcl_instrument_water		F I M	background	3.45x		Ocean Observato ...	CE04OSSM-SBD12-04-PCO2AA000-telemetered-pco2a_a_dcl_instrument_water
						CE05MOAS-GL381-01-PARADIM000-telemetered-parad_m_glider_instrument		F I M	background	3.45x		Ocean Observato ...	CE05MOAS-GL381-01-PARADIM000-telemetered-parad_m_glider_instrument
						CE05MOAS-GL381-02-FLORTM000-telemetered-fort_m_glider_instrument		F I M	background	3.45x		Ocean Observato ...	CE05MOAS-GL381-02-FLORTM000-telemetered-fort_m_glider_instrument
						CE05MOAS-GL381-04-DOSTAM000-telemetered-dosta_abcdm_glider_instrument		F I M	background	3.45x		Ocean Observato ...	CE05MOAS-GL381-04-DOSTAM000-telemetered-dosta_abcdm_glider_instrument
						CE05MOAS-GL381-05-CTDGM000-telemetered-ctdgm_m_glider_instrument		F I M	background	3.45x		Ocean Observato ...	CE05MOAS-GL381-05-CTDGM000-telemetered-ctdgm_m_glider_instrument
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						CE07SHSM-MF035-05-PCO2WB000-telemetered-pco2w_abcd_dcl_instrument		F I M	background	3.45x		Ocean Observato ...	CE07SHSM-MF035-05-PCO2WB000-telemetered-pco2w_abcd_dcl_instrument
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						CE07SHSM-MF035-05-PCO2WB000-telemetered-pco2w_abcd_power		F I M	background	3.45x		Ocean Observato ...	CE07SHSM-MF035-05-PCO2WB000-telemetered-pco2w_abcd_power
						CE07SHSM-MF035-06-PHSEND000-telemetered-phsen_abcdcl_dcl_instrument		F I M	background	3.45x		Ocean Observato ...	CE07SHSM-MF035-06-PHSEND000-telemetered-phsen_abcdcl_dcl_instrument
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						CE07SHSM-RID27-03-CTDBPC000-telemetered-ctdbp_cdef_dcl_instrument		F I M	background	3.45x		Ocean Observato ...	CE07SHSM-RID27-03-CTDBPC000-telemetered-ctdbp_cdef_dcl_instrument
						CE07SHSM-RID27-04-DOSTAD000-telemetered-dosta_abcdm_dcl_instrument		F I M	background	3.45x		Ocean Observato ...	CE07SHSM-RID27-04-DOSTAD000-telemetered-dosta_abcdm_dcl_instrument
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						CE07SHSM-SBD11-04-VELPTA000-telemetered-velpt_ab_dcl_diagnostics		F I M	background	3.45x		Ocean Observato ...	CE07SHSM-SBD11-04-VELPTA000-telemetered-velpt_ab_dcl_diagnostics
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						CE07SHSM-SBD12-04-PCO2AA000-telemetered-pco2a_a_dcl_instrument		F I M	background	3.45x		Ocean Observato ...	CE07SHSM-SBD12-04-PCO2AA000-telemetered-pco2a_a_dcl_instrument
						CE07SHSM-SBD12-04-PCO2AA000-telemetered-pco2a_a_dcl_instrument_water		F I M	background	3.45x		Ocean Observato ...	CE07SHSM-SBD12-04-PCO2AA000-telemetered-pco2a_a_dcl_instrument_water
						CE07SHSM-SBD12-05-WAVSA000-telemetered-wavsa_a_dcl_fourier		F I M	background	3.45x		Ocean Observato ...	CE07SHSM-SBD12-05-WAVSA000-telemetered-wavsa_a_dcl_fourier
						CE07SHSM-SBD12-05-WAVSA000-telemetered-wavsa_a_dcl_mean_directional		F I M	background	3.45x		Ocean Observato ...	CE07SHSM-SBD12-05-WAVSA000-telemetered-wavsa_a_dcl_mean_directional
						CE07SHSM-SBD12-05-WAVSA000-telemetered-wavsa_a_dcl_motion		F I M	background	3.45x		Ocean Observato ...	CE07SHSM-SBD12-05-WAVSA000-telemetered-wavsa_a_dcl_motion

M2M Interface

- Machine to Machine, script-based data download
- Use Python script to send properly formatted request to the system (using API username and token), data file is returned
- User requests consist of the rest of the URL and parameters that normally form a uFrame data request
- Data returns are not aggregated, so small, recurring requests are better (this may change)
- Still in testing/feedback phase

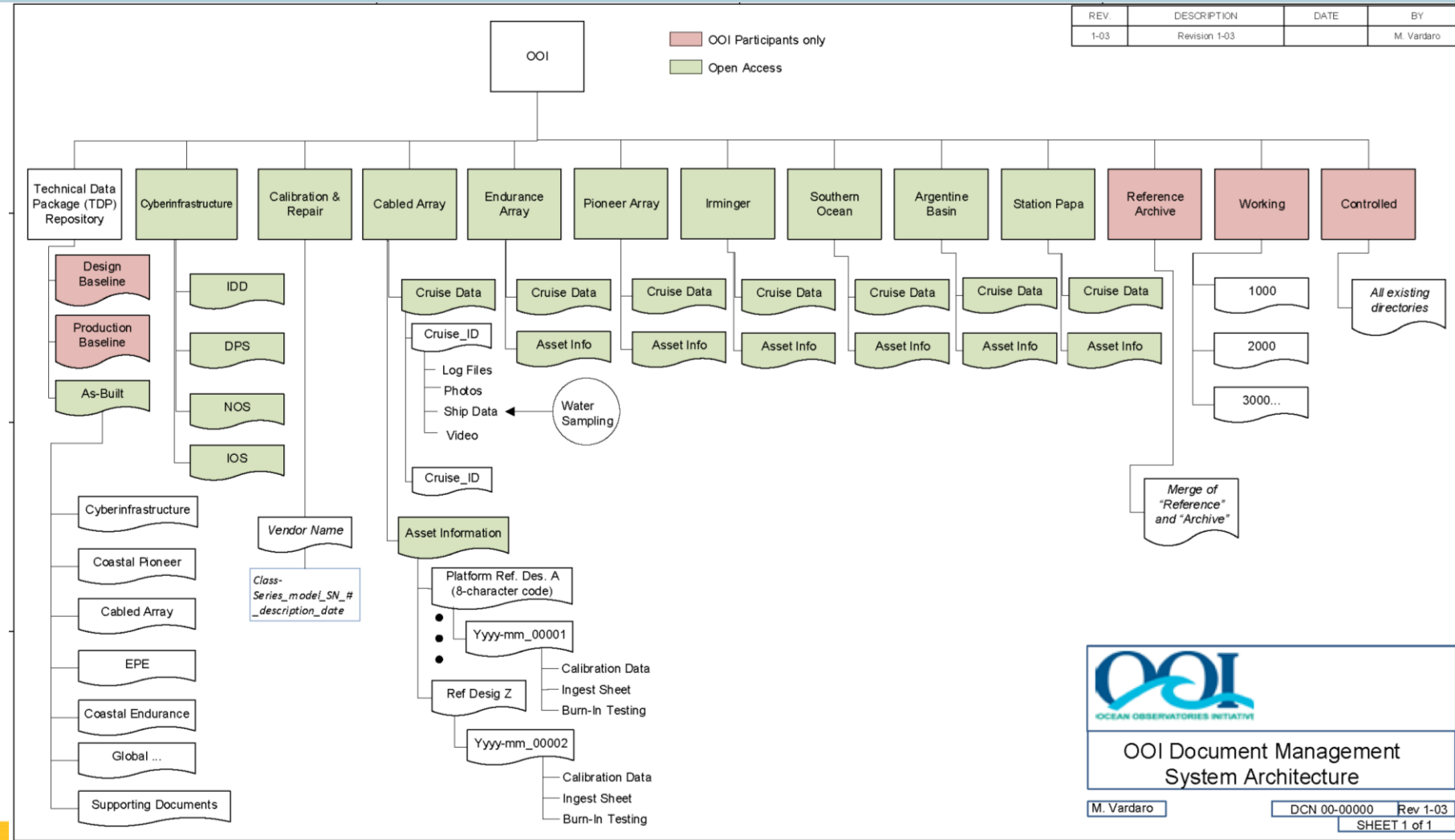


The screenshot shows the 'User Profile' page of the M2M interface. At the top, there is a navigation bar with a map of the United States, the title 'User Profile', and links for 'Data Catalog Search' and 'Glossary'. Below the navigation bar, the page is titled 'Profile'. The form contains the following fields:

- Email:** admin@ooi.rutgers.edu
- Account Enabled:** ☒
- First Name:** Default
- Last Name:** Admin
- Primary Phone:** 8001234567
- Secondary Phone:** (empty)
- Email Opt-In:** ☒
- Organization:** (empty)
- Vocation:** (empty)
- Country:** (empty)
- State:** (empty)
- API Username:** OOI-API-ADMIN
- API Token:** 3MY8XNZUHP847E14O6R1LNXW29

A green button labeled 'Refresh API Token' is located at the bottom right of the form.

Alfresco Document Management

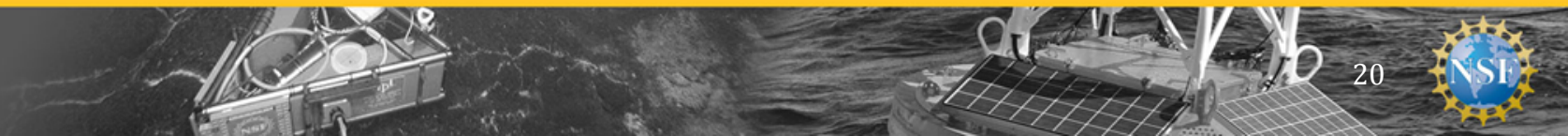


Shipboard Data Types

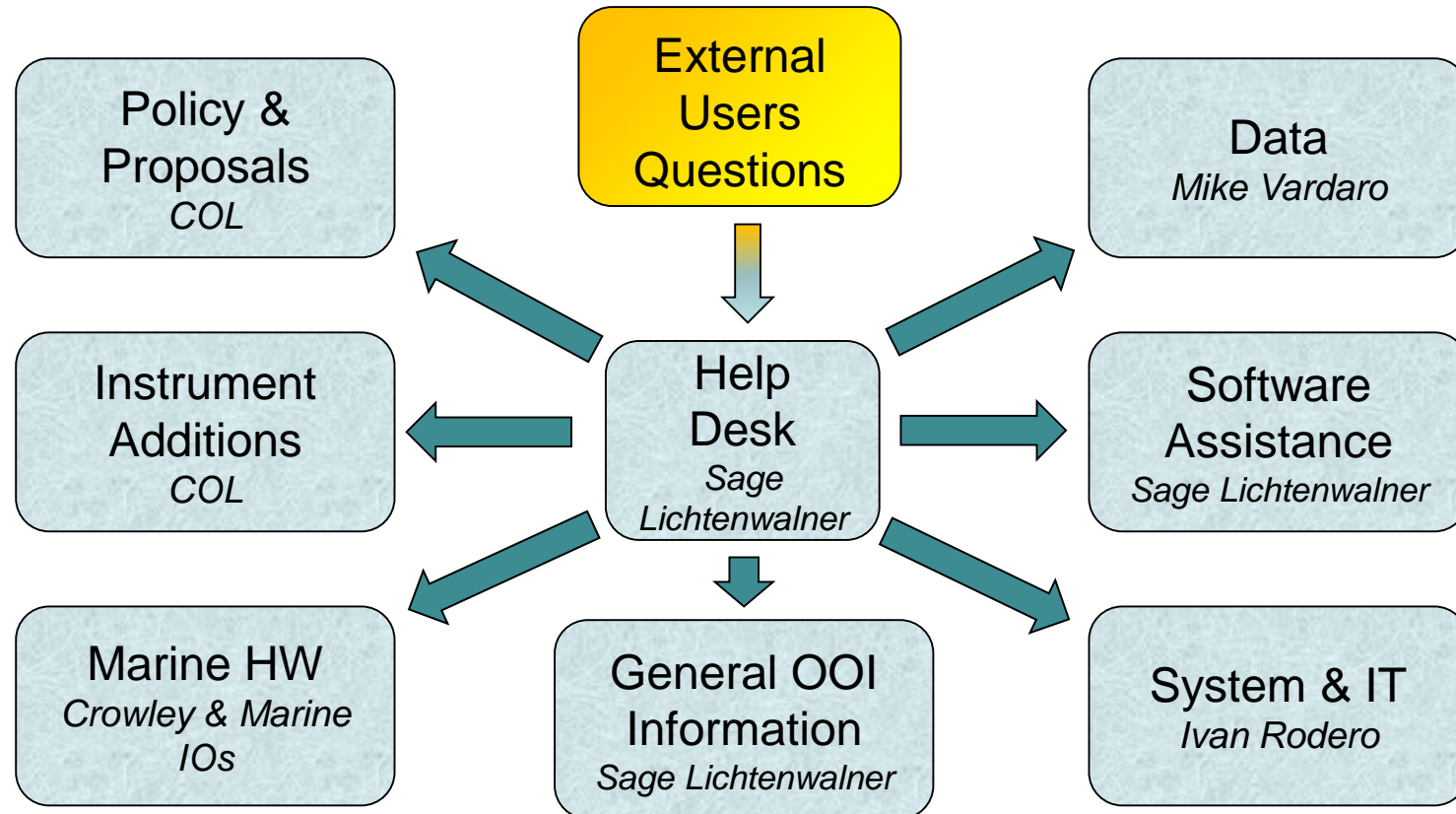
Data Type	Examples	Source/Format	Purpose	User-Needed Functions
UNOLS Shipboard Instrumentation	Navigation Track	R2R – or – .pdf, csv file, spreadsheet, native file format (ship tech and scientist upload) ~100 Gb/cruise	Field Verification Support/enable Science Users	Access/Download Plotting in OOI Net (?)
	Multibeam Data			
	Underway Meteorologic Data (e.g. SST, air temp, humidity, wind speed)			
	ADCP			
	CTD Cast Data (Raw Files)			
	CTD Cast Data (Processed Files)			
	Sailing Orders, Staffing Logs In-line (underway) Cytometer			
Cruise Report	Text	.pdf for report - and - raw spreadsheets, csv files, high-res figures (scientist upload) ~100 Mb/cruise max	Support/Enable Science Users	Access/Download
	Figures			
	Maps			
	E-log			
	ROV dive tracks, ROV Log Instrument Layouts			
Water Samples from CTD Rosette	Salinity (shore-based)	spreadsheets, csv files, native file format (scientist upload) <100 Mb/cruise max	Calibration Field Verification Support/Enable Science Users	Access/Download Plotting in OOI Net (?)
	Dissolved oxygen (ship- or shore-based)			
	Chl-a fluorescence (ship- or shore-based)			
	Pigment distribution (shore-based)			
	Nitrate + nitrite (shore-based analyses)			
	Full nutrient suite: PO4, NO3, NO2, SiOH4, NH4 (shore-based analyses)			
	Total DIC, total alkalinity (shore-based) pH, spectrophotometric (shore-based)			
Physical Samples from Seafloor (Water, Gas, Other)	Methane	spreadsheets, csv files, high-res figures, native file format (scientist upload)	Calibration Field Verification Support/Enable Science Users	Access/Download Plotting in OOI Net (?)
	Ethane			
	Hydrogen sulfide			
	Carbon dioxide			
	pH Sediment Cores			

Raw Data Access

- Apache server mirroring Rutgers data archive
- HD Video
- Still images
- Seismic Data
- Low-Frequency Hydrophones
- Broadband Hydrophones
- Bioacoustic Sonar



Help Desk Process



- help@oceanobservatories.org
- Redmine used to track trouble tickets.
- Help desk will be covered by DM and PM in Help Desk absence.

Questions?

- OOI Main Web site: <http://oceanobservatories.org>
- Data Portal: <http://ooinet.oceanobservatories.org>



Mike Vardaro, Data Manager, OOI CI Data Team
vardaro@marine.rutgers.edu



Acknowledgements: NSF, COL, Rutgers University, University of Washington, WHOI, Oregon State University, RPS-ASA, Raytheon, UCSD/SIO

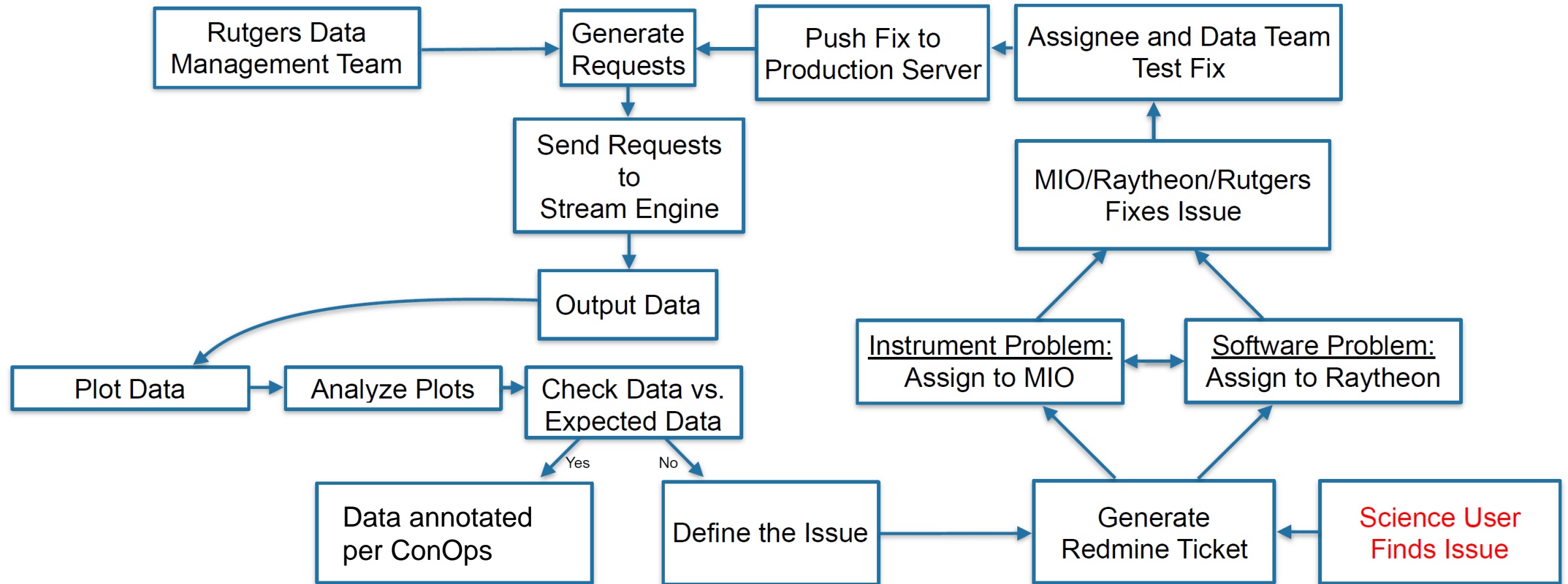
Additional Material



QC Procedures and Tools



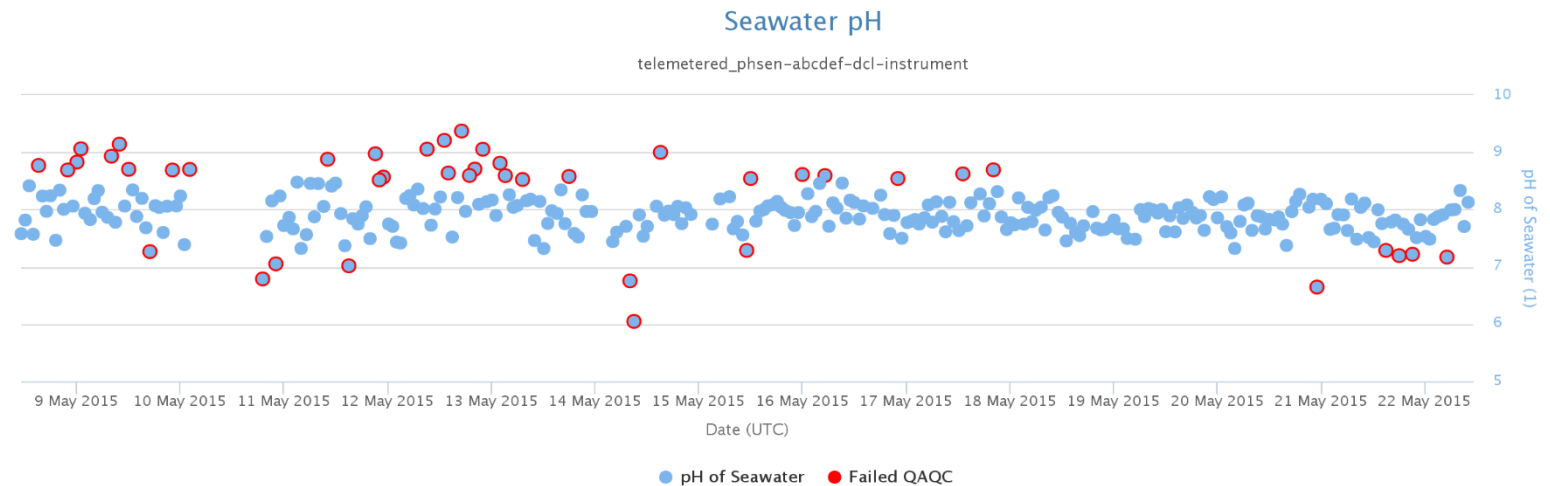
Data Evaluation Team QA/QC Testing



OOI Automated QC Procedures

- 7 automated QC algorithms can produce 8 flags (including logical “or” which combines flags) which are plottable and are included in downloaded files
- Coded based on specifications written by OOI Project Scientists, derived from QARTOD manuals and other observatory experiences
- Algorithms refer to “lookup tables” assembled by OOI Project Scientists with input from subject matter experts: <https://github.com/ooi-integration/qc-lookup>

1. Global Range Test
2. Local Range Test
3. Spike Test
4. Stuck Value Test
5. Trend Test
6. Temporal Gradient Test
7. Spatial Gradient Test (Profile)



QC Challenges

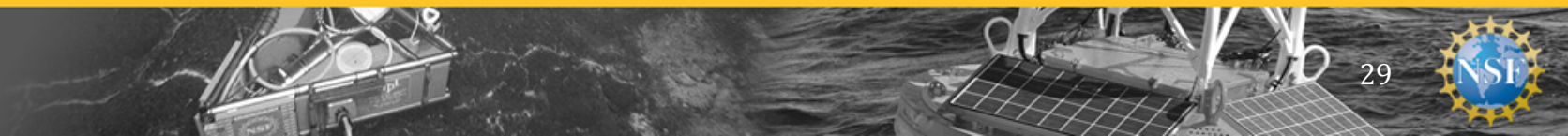
- Local range values will require ongoing gathering of environmental data for each platform
- Spike test is currently very simple, and needs tweaking to avoid false positives/negatives (especially in biological data) and to work with certain data types
- Trend test may not work as designed, because it requires the system to compare data prior to the user request date
- Gradient test is complicated to apply, requires 2D dataset
- Not all QC algorithms apply to all data products – ongoing review with Project Scientists
- The QC algorithms do NOT trigger alerts in the system
 - Alerts/alarms only trigger when new data is telemetered/streamed
 - Can set alerts on L1/L2 data streams based on Global/Local range values

Progress Since January

- New GUI (faster responses, no terms pop up, more array info, better plotting, better data catalog, asset management improvements)
- Majority of data loaded on production system, downloadable
- Streaming data plotting available
- Raw data access since April
- ERDDAP demo
- M2M nearly ready for release (still needs testing)
- Full database of platforms, instruments, data streams, and parameters created by data team

Work to Go

- GUI upgrades needed (better maps, status info, glider page, plotting updates)
- Aggregation of downloaded data files
- Full data ingestion and delivery
- Full Asset Management
- Health and Status information page, Operator Logs, Data Forum
- Implement full QC plan
- Secondary calibration



Lessons Learned

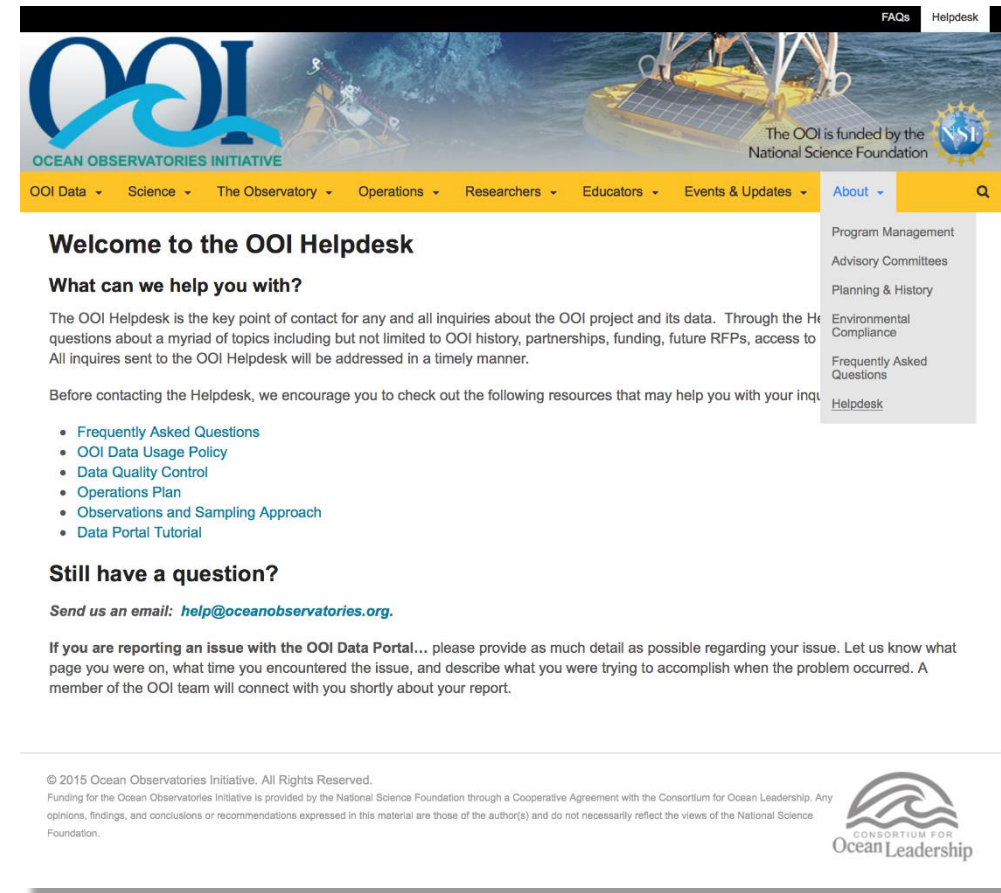


Metadata standards

- Process of defining, collecting, and determining presentation of metadata has been ongoing for longer than anticipated
- Software developers interpreted metadata standards differently than intended by the science requirements
- Climate and Forecast (CF-1.6) standards adopted
- Presentation in NetCDF header is incomplete but being improved
- Provenance delivered in a separate .json file
- More formatting work needs to be done

Communication

- The main method of communication from the data team to users is via annotation (requires enhancement)
- Main method of communication from users to data team is through help desk requests (via website)
- Also needed to standardize and improve communication between data team and Marine Implementing Organization personnel



The screenshot shows the OOI Helpdesk website. The header features the OOI logo and navigation links: OOI Data, Science, The Observatory, Operations, Researchers, Educators, Events & Updates, About, and a search icon. A sidebar on the right lists: Program Management, Advisory Committees, Planning & History, Environmental Compliance, Frequently Asked Questions, and Helpdesk. The main content area is titled "Welcome to the OOI Helpdesk" and includes a section "What can we help you with?" followed by a paragraph about the Helpdesk's role. Below this is a list of resources: Frequently Asked Questions, OOI Data Usage Policy, Data Quality Control, Operations Plan, Observations and Sampling Approach, and Data Portal Tutorial. A section "Still have a question?" provides an email address: help@oceanobservatories.org. The footer contains copyright information and the Consortium for Ocean Leadership logo.

QA vs. QC

- Quality Control is a product check to identify flaws or defects
- Quality Assurance is a defined process used to diagnose why a product is flawed or being produced incorrectly
- The data team has had to become increasingly familiar with the end-to-end production of data products
- Wider teamwork required to track (sometimes mysterious) issues back to a specific cause
 - Software error or missing data vs...
 - Instrument miscalibration by vendor vs...
 - Instrument settings changed during deployment vs...
 - Mooring run over by ship



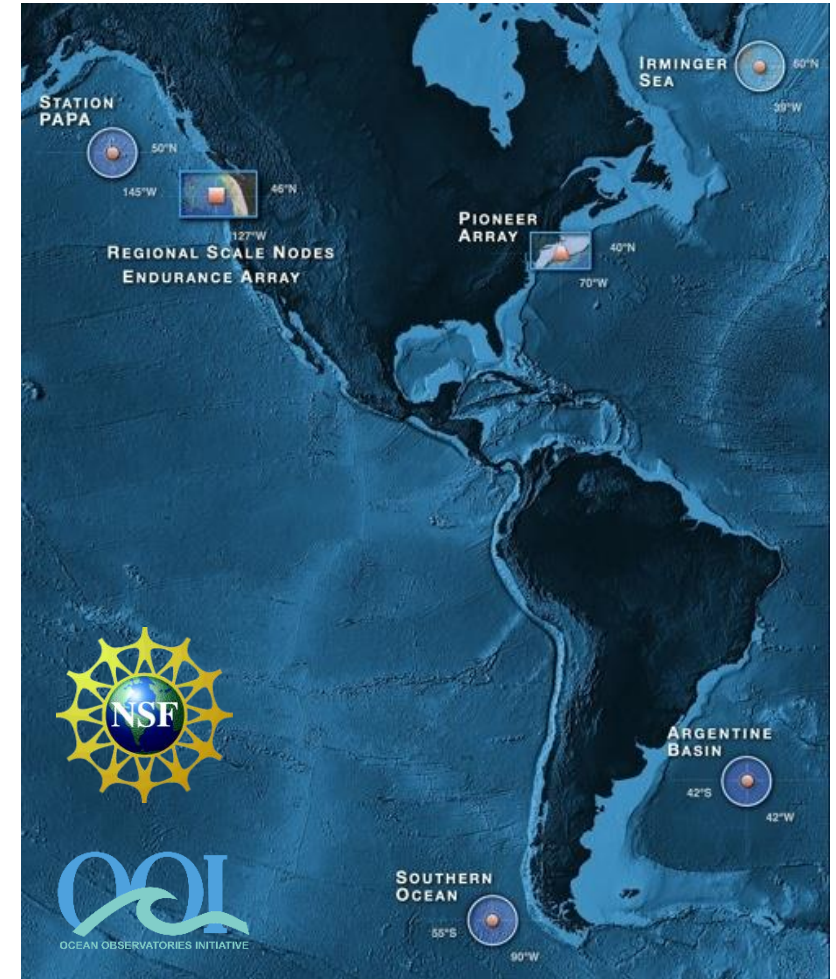
Near-Term Priorities

- Deliver high quality data to the community, enabled and accelerated via feedback and community “eyes” on the products
 - Requires transparency in software releases, QC procedures, and documentation
- Hybrid data delivery approaches to augment asynchronous data delivery via GUI, using THREDDS, ERDDAP, etc.
- Organize a cross-project team to define and develop a method for post-recovery secondary calibration. This group will rely on external community input.
- Several high value and high interest OOI datasets (e.g. bioacoustics, covariance flux measurements, vent fluid chemistry) will require entraining the external community in data quality and delivery discussions
- Addition of a data forum and additional communications to external scientists
 - OOI is more than a collection of sensors: an ongoing distributed community discussion

Education and Public Engagement

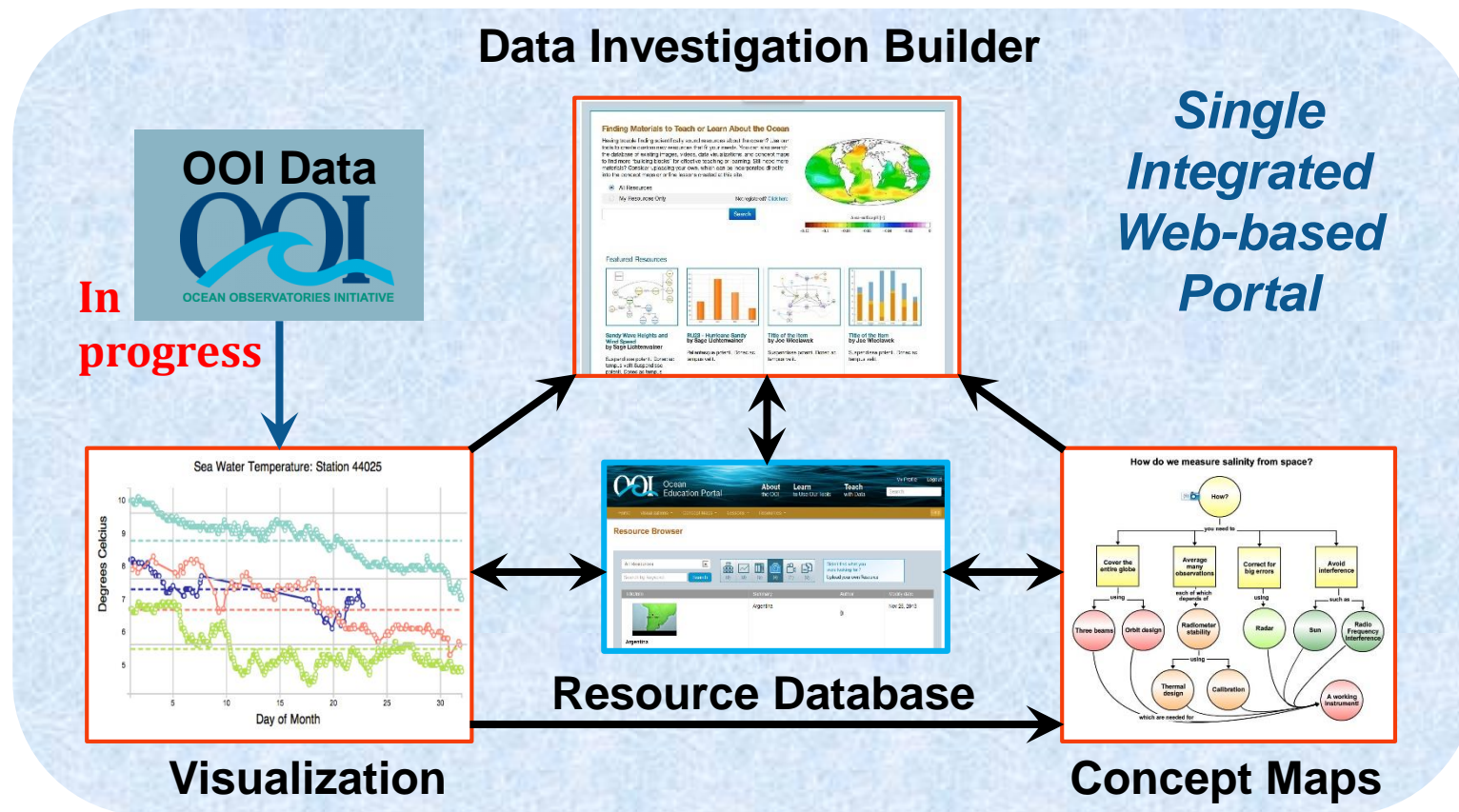


Enabling the Use of Real-Time OOI Data in the Undergraduate Classroom



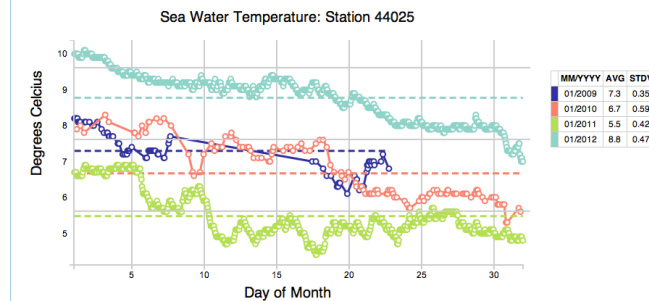
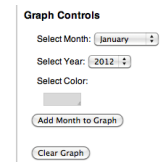
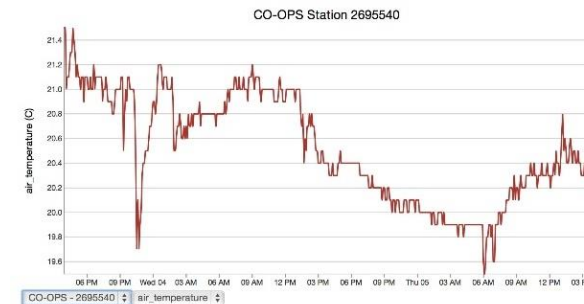
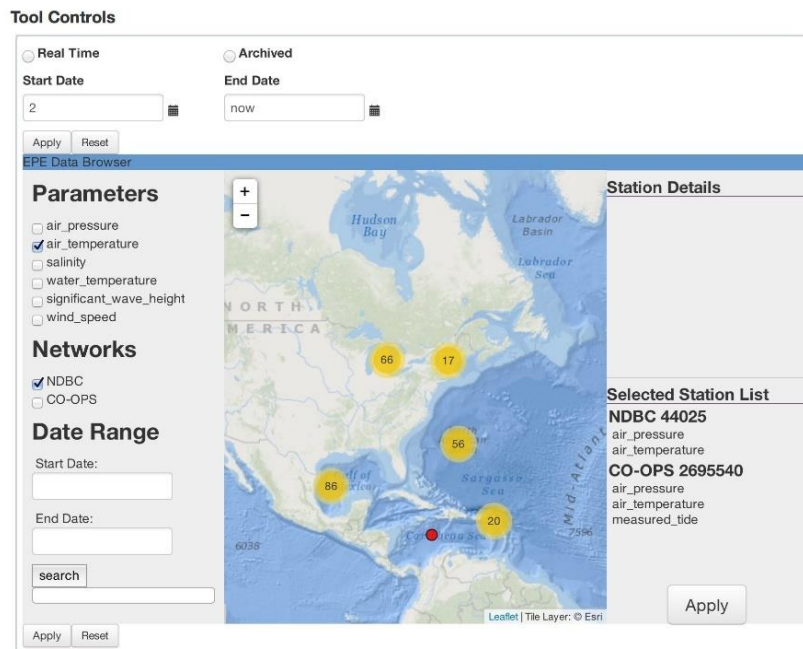
EPE System Architecture

Three primary tools, accessible through a single website, and sharable through a resource database:



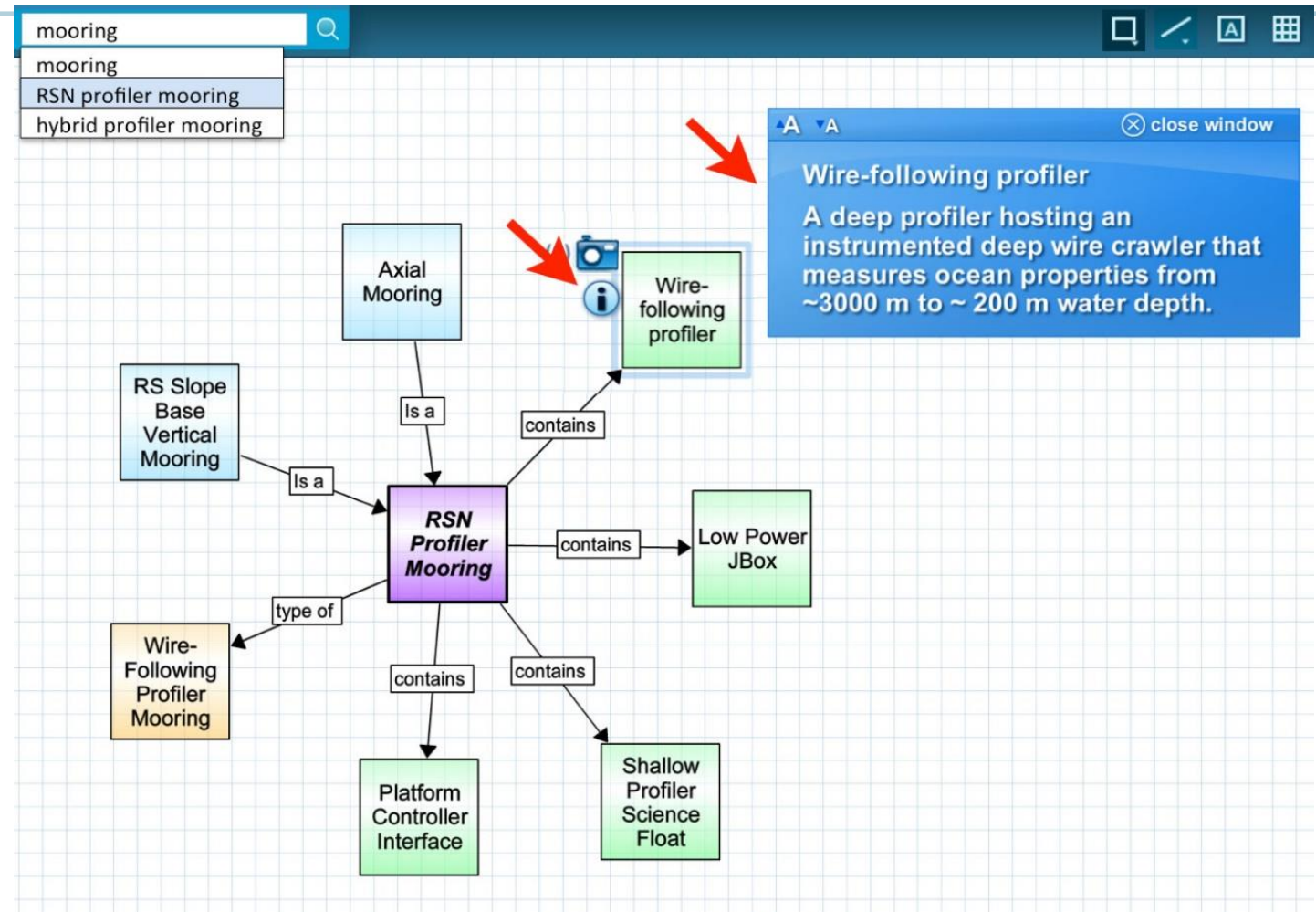
Educational Visualization Service

- Building flexible and customizable visualization tools
- Focused on various time series
- Goal is to balance capability and usefulness
- Multiple entry points (teacher, student, developer)



Concept Mapper

- Concept Map Builder (create & edit) and Viewer
- Concept & linking phrase suggestions (ontologies)
- Embedded content resources such as descriptions, data visualizations, photos & videos from OOI & outside resources



Data Investigation Builder

- Community library of investigations
- Online lesson template
- Investigation Builder Wizard (step by step design process)
- EPE resource integration



Welcome to the Investigation Builder

This tool will help you create an online homework assignment, lecture demonstration, or laboratory using archived or real time data from the Ocean Observing Initiative (OOI).

The OOI is a long-term, NSF funded program to provide 25-30 years of sustained ocean measurements to study climate variability, ocean circulation and ecosystem dynamics, air-sea exchange, seafloor processes, and plate-scale geodynamics. The OOI will enable powerful new scientific approaches for exploring the complexities of Earth-ocean-atmosphere interactions, thereby accelerating progress toward the goal of understanding, predicting, and managing our ocean environment.

Use this tool to help your undergraduate students learn how interpret scientific data and draw conclusions. We have made this software "smarter" in attempts to help you apply the latest and best information from the learning sciences to help you improve your students' ability to learn science content. The activities created with this tool are ideal for introductory undergraduate classes or as engagement activities for senior level classes.

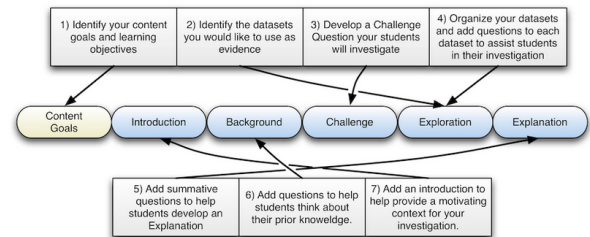
Definitions

Homework Assignment

Ideally these would be videos of professors describing these categories of use. We can use folks from the usability testing- record them and publish to the tool interface

Lecture Demonstration

Laboratory Exercise



Establish your Content Goals

Let's get started. Before we delve into creating your investigation, take a moment to think about the science concepts you would like your students to investigate in this activity.

Come up with between 1 to 3 science content goals that address what ideas or processes would you like the students to learn about and how those ideas relate to larger ideas.

Establishing science content goals on their own help you focus on any developing your activity. The datasets you include and the questions you ask students to think about should support the goals you identified. If you find that you have additional content you wish students to review that go beyond these goals, you might consider creating a separate activity to keep the investigations focused.

Don't worry about perfecting this right away; you can always come back and adjust them later.

If you have any specific learning objectives you wish to cover, you can enter them here for your reference.

- Examples**
- how changes in CO_2 emissions affect ocean pH and how those changes impact calcifying organisms in the ocean. Carbon is the backbone to life on earth and it plays an important role in our atmosphere as well as our oceans.
 - the relationship between temperature and dissolved oxygen. Understanding the properties of water is critical for understanding ocean ecosystems.
 - how temperature and salinity vary over the course of a year at several locations. Understanding the spatial and temporal variability of these parameters will help students identify different habitat zones.

Next >

Design Process

Content Type

Package

In this step we will walk through how to create a lesson that takes into account your students' prior knowledge. This step will give you a chance to think about the data that will allow you to help them make sense of new information, and establish relevance and connections to their existing knowledge.

The user is undergoing learning there is that people construct new knowledge and understanding based on what they already know and believe. New knowledge must be constructed from existing knowledge. Therefore, the student is asked to bring their existing knowledge to the task. The student is asked to bring their existing knowledge to the task. The student is asked to bring their existing knowledge to the task.

Later the text you would like to appear on this page.

Slideshow (or single image?)

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Questions

Design Process

Content Type

Package

Also, help provide some context about the lesson or what is to be completed. This could consist of one of the following:

- General information on a study area
- An introduction to an experiment or data collection process
- An overview of a research project or expedition
- Background on how a scientific process works
- Why the process or experiment students are about to investigate matters

Enter the text you would like to appear on this page.

Slideshow

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Questions

Design Process

Content Type

Package

The first step of your investigation is the Preparation step, in which students view each of the datasets you have selected and consider the questions you have proposed.

Then, for each dataset, add a description and one or more investigation questions.

These datasets will be the evidence students will use to answer the research challenge question while making their investigation using data provided. This step is to help students understand the process and nature of evidence by building their context while making and interpreting data, constructing explanations and building models.

To help guide students as they investigate the datasets, you should provide some additional information or questions to consider.

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Create Lab Lesson Builder

Instructions | **Content Goals** | Introduction | Background | Challenge | Exploration | Explanation

Design Process

Content Type

Package

How that you have identified the science concepts and datasets you wish to use, we are ready to begin accompanying your activity.

The first step is to identify the research challenges you wish your students to answer. This may or may not be the scientific problem or research question you want for your students to investigate, depending on whether you want to let them to identify a research question or relationship themselves.

- Develop a research question or relationship
- Analyze data from a dataset
- Analyze data from a dataset
- Analyze data from a dataset

The challenge you put to your students should connect your science concept goals with applied skills you have them to develop.

In this activity you will investigate the following challenge:

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Questions

Design Process

Content Type

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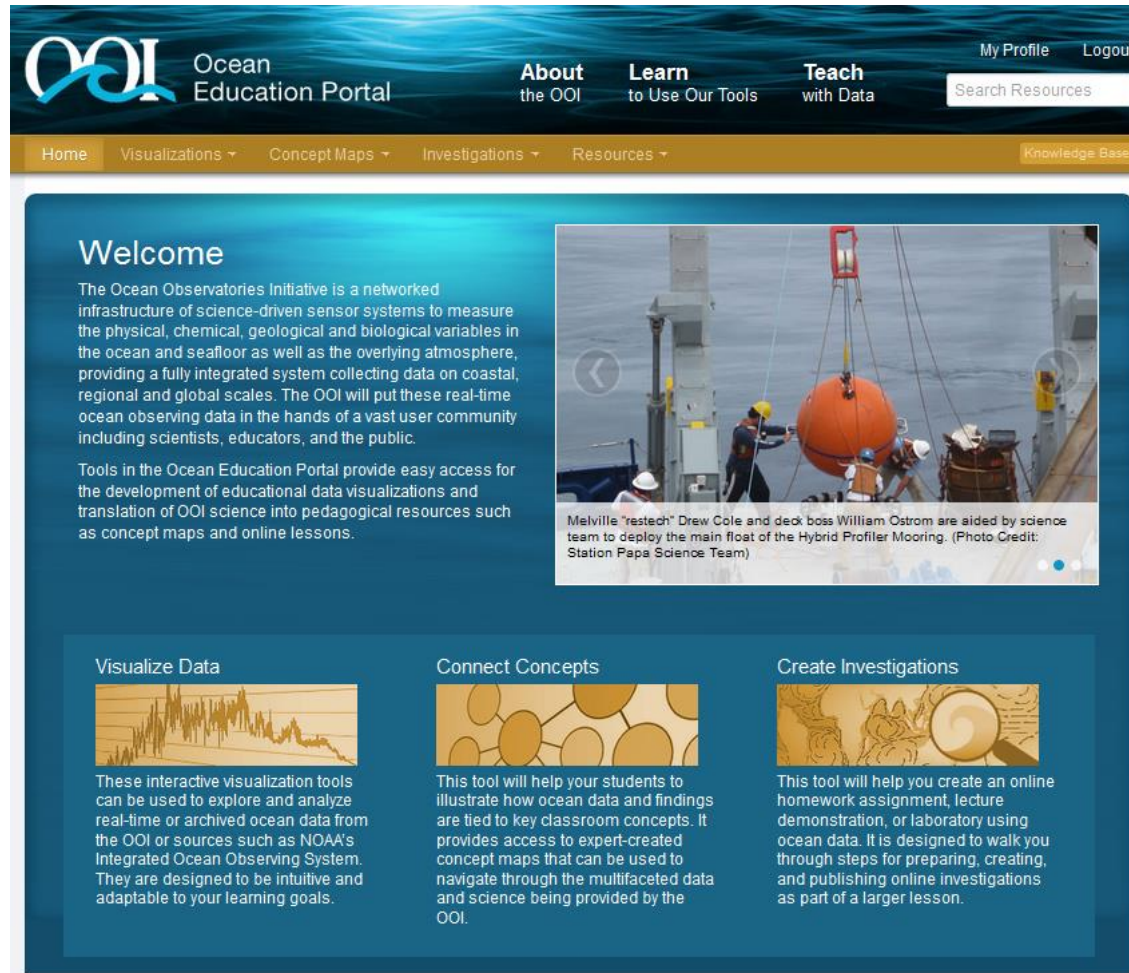
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EPE Website: <http://education.oceanobservatories.org>



The screenshot shows the Ocean Education Portal website. The header includes the OOI logo, the text "Ocean Education Portal", and navigation links for "About the OOI", "Learn to Use Our Tools", and "Teach with Data". There are also links for "My Profile" and "Logout", and a search bar labeled "Search Resources". Below the header is a navigation bar with links for "Home", "Visualizations", "Concept Maps", "Investigations", "Resources", and "Knowledge Base". The main content area features a "Welcome" section with a description of the Ocean Observatories Initiative and a photo of a ship's deck. Below this are three columns: "Visualize Data", "Connect Concepts", and "Create Investigations", each with a brief description and a representative image.

Welcome

The Ocean Observatories Initiative is a networked infrastructure of science-driven sensor systems to measure the physical, chemical, geological and biological variables in the ocean and seafloor as well as the overlying atmosphere, providing a fully integrated system collecting data on coastal, regional and global scales. The OOI will put these real-time ocean observing data in the hands of a vast user community including scientists, educators, and the public.

Tools in the Ocean Education Portal provide easy access for the development of educational data visualizations and translation of OOI science into pedagogical resources such as concept maps and online lessons.

Visualize Data

These interactive visualization tools can be used to explore and analyze real-time or archived ocean data from the OOI or sources such as NOAA's Integrated Ocean Observing System. They are designed to be intuitive and adaptable to your learning goals.

Connect Concepts

This tool will help your students to illustrate how ocean data and findings are tied to key classroom concepts. It provides access to expert-created concept maps that can be used to navigate through the multifaceted data and science being provided by the OOI.

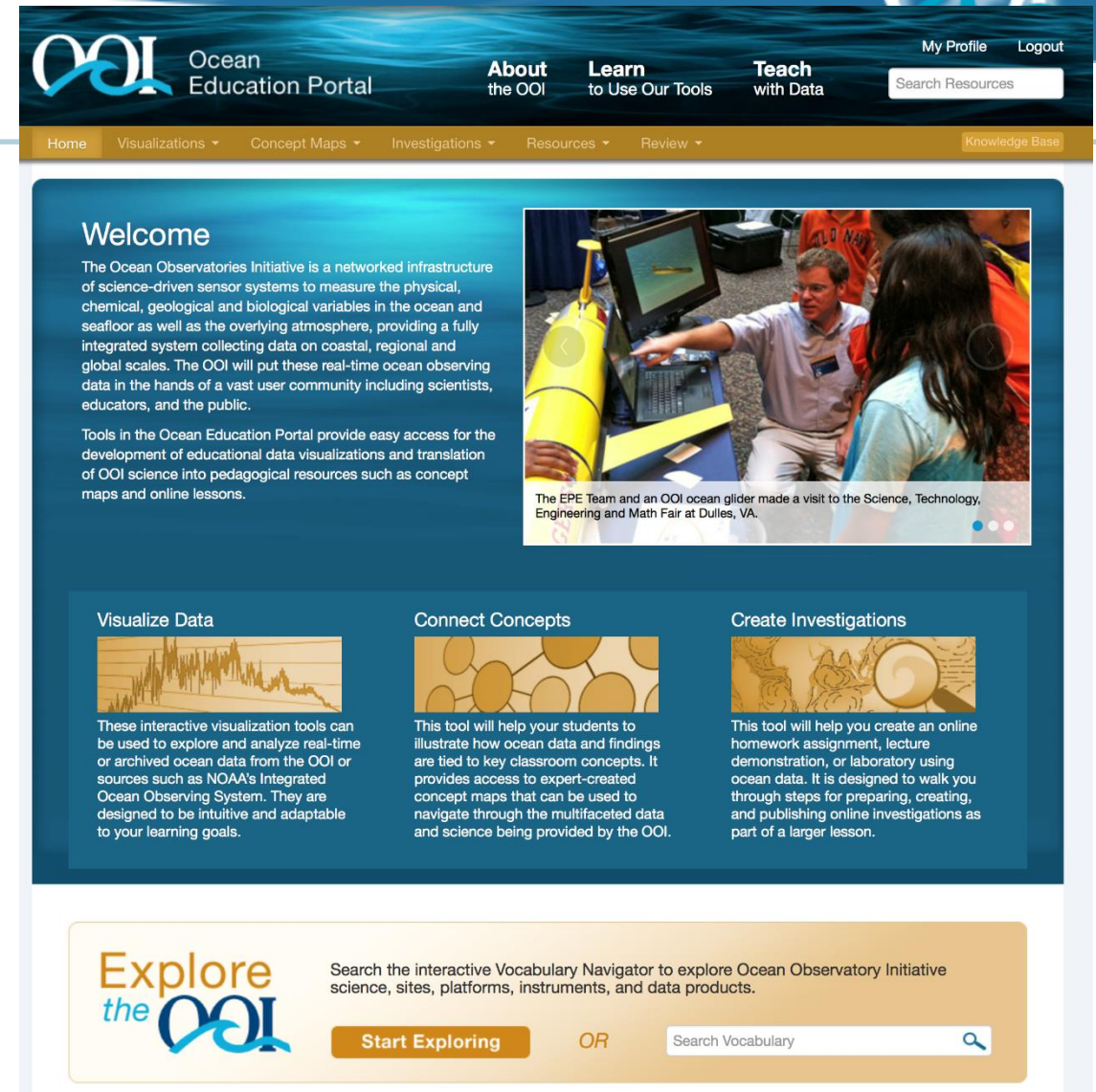
Create Investigations

This tool will help you create an online homework assignment, lecture demonstration, or laboratory using ocean data. It is designed to walk you through steps for preparing, creating, and publishing online investigations as part of a larger lesson.

Ocean Education Portal

Education Tools

- Concept Map Builder
- Investigation Builder
- Visualization Tools
- Vocabulary Navigator
- Resource Database



The screenshot displays the Ocean Education Portal website. At the top, the OOI logo is on the left, and navigation links for 'About the OOI', 'Learn to Use Our Tools', and 'Teach with Data' are on the right. A search bar is also present. Below the header is a horizontal menu with links: Home, Visualizations, Concept Maps, Investigations, Resources, Review, and Knowledge Base. The main content area features a 'Welcome' section with a paragraph about the OOI's networked infrastructure and a photo of the EPE Team. Below this are three columns: 'Visualize Data' with a line graph icon, 'Connect Concepts' with a bubble icon, and 'Create Investigations' with a magnifying glass icon. At the bottom, there is a section titled 'Explore the OOI' with a search bar and a 'Start Exploring' button.

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The EPE Team and an OOI ocean glider made a visit to the Science, Technology, Engineering and Math Fair at Dulles, VA.

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Explore the OOI

Search the interactive Vocabulary Navigator to explore Ocean Observatory Initiative science, sites, platforms, instruments, and data products.

[Start Exploring](#) OR