

## Data Streams at PacIOOS: From Acquisition to End Products

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Hawai'i Surveying & Mapping Conference | March 21, 2019

## Regional Associations



- ▶ U.S. IOOS is part of NOAA
- ▶ 11 Regional Associations
- ▶ Stakeholder Driven

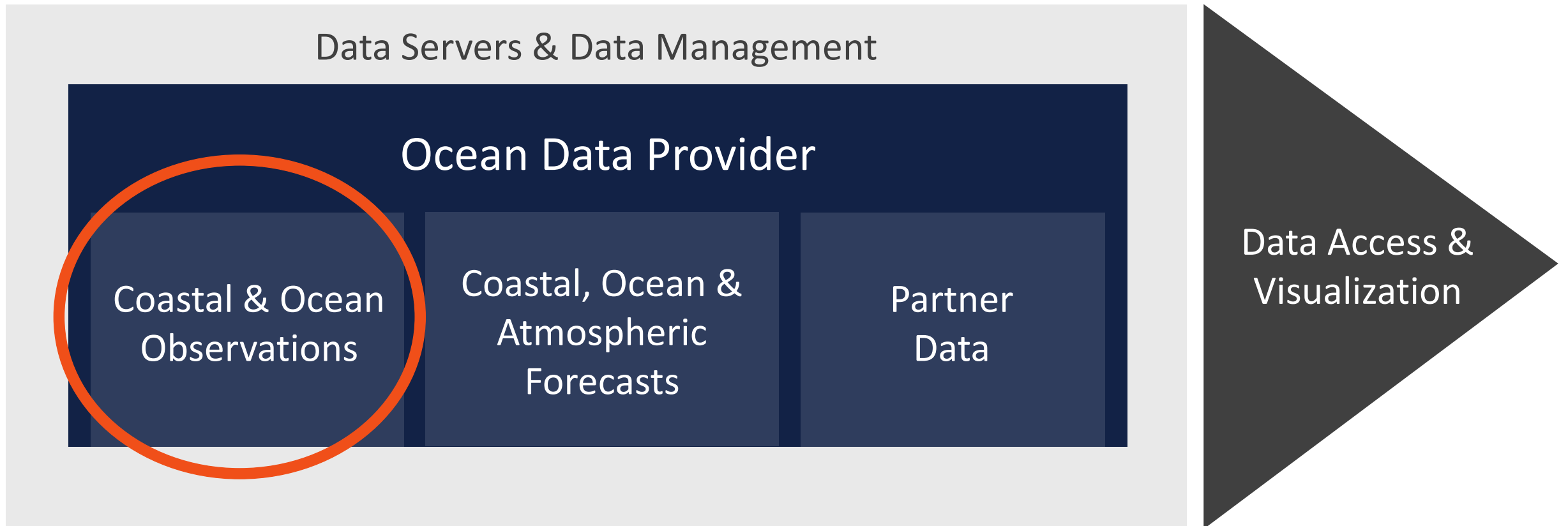


SCHOOL OF OCEAN AND EARTH  
SCIENCE AND TECHNOLOGY  
UNIVERSITY OF HAWAII AT MĀNOA



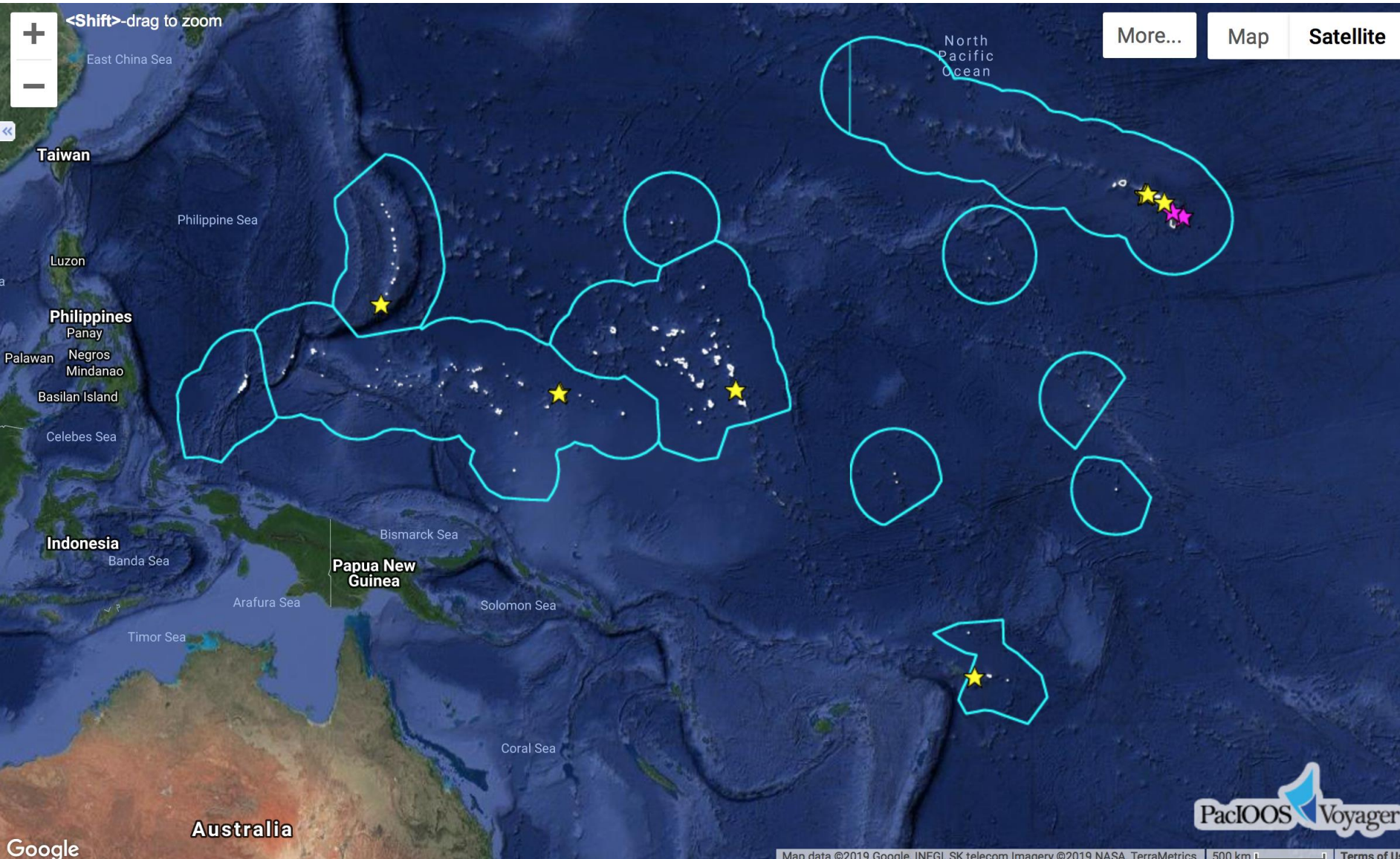
## What is PacIOOS?

**MISSION** - PacIOOS empowers ocean users and stakeholders throughout the Pacific Islands by providing accurate and reliable coastal and ocean information, tools, and services that are easy to access and use.





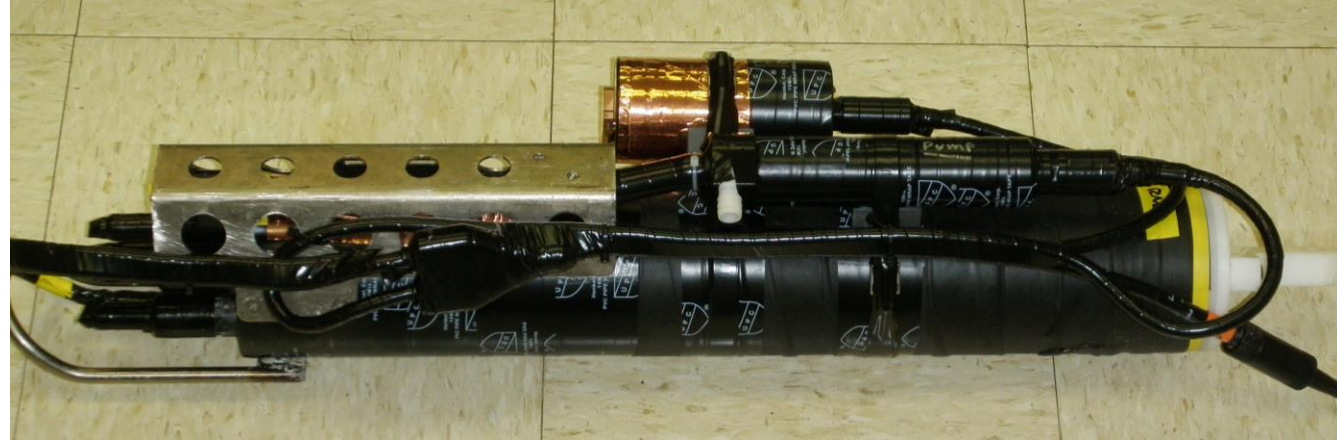
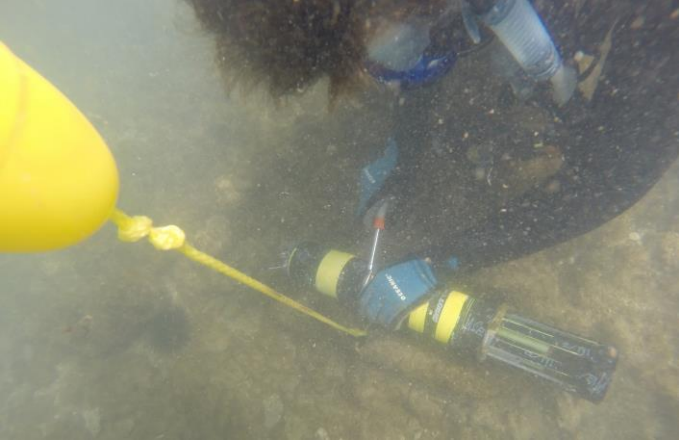
## Water Quality Monitoring: Nearshore Sensors and Buoys



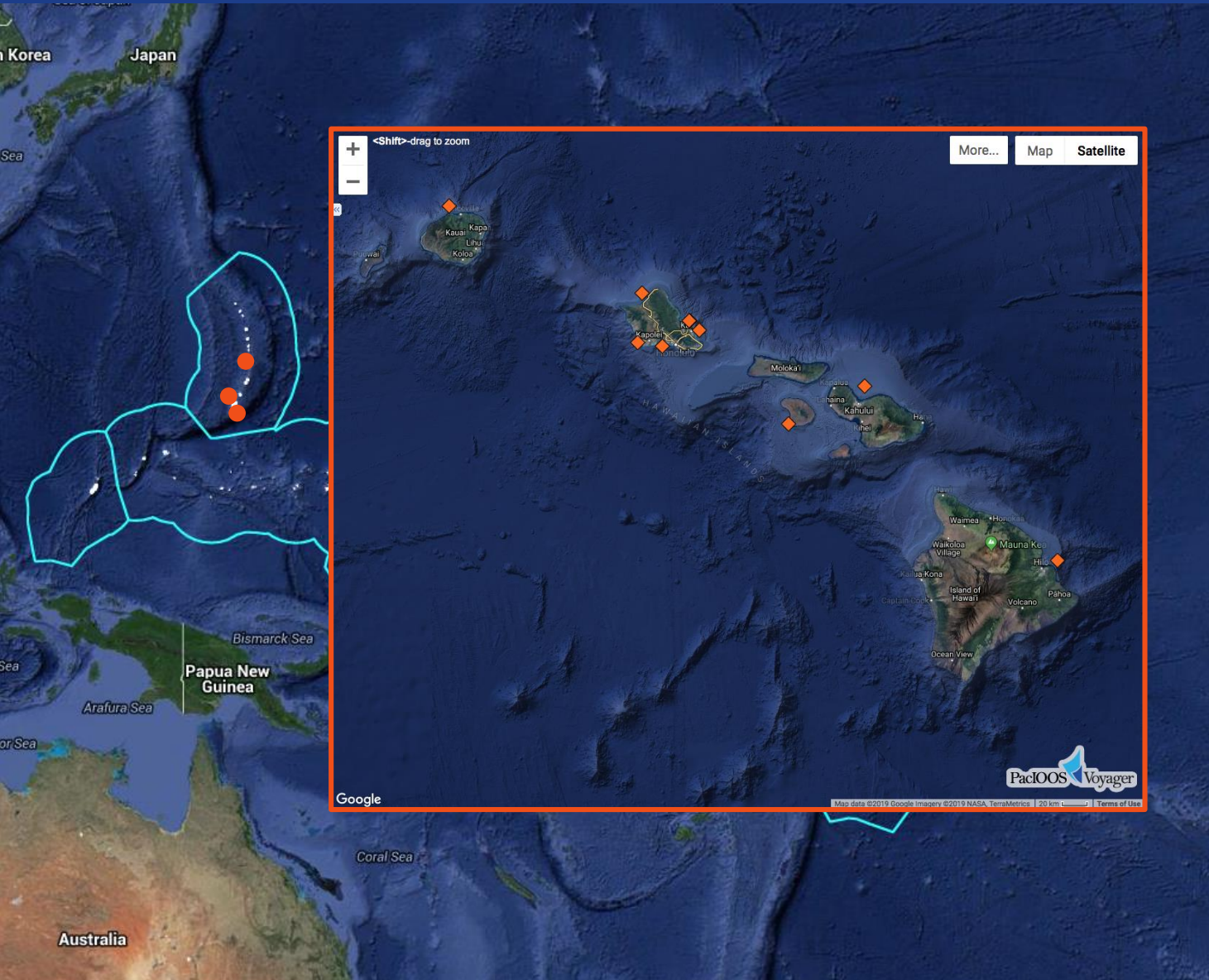
- ✧ Temperature
- ✧ Salinity
- ✧ Depth
- ✧ Chlorophyll
- ✧ Turbidity
- ✧ Dissolved Oxygen
- ✧ pH



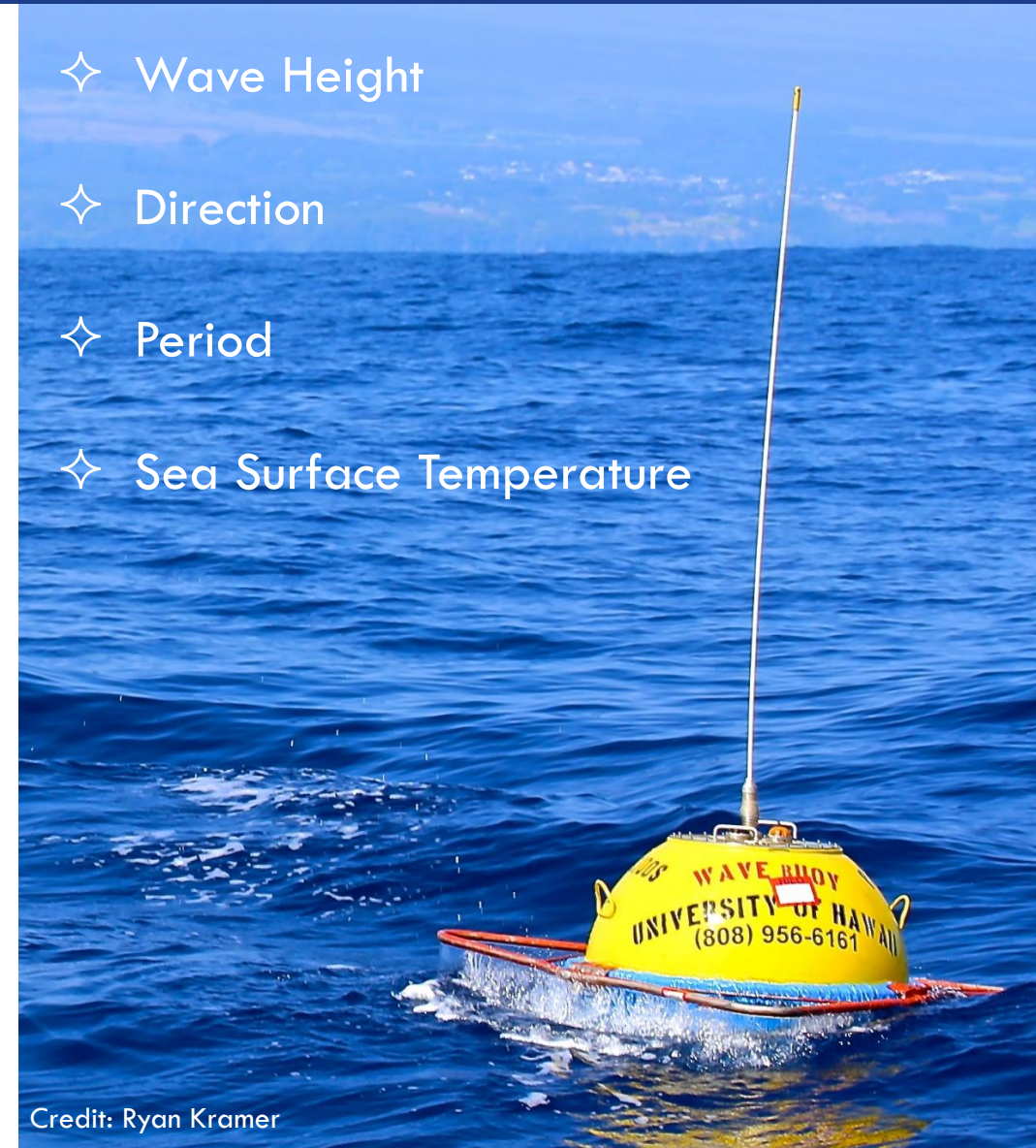
## Water Quality Monitoring: Nearshore Sensors and Buoys Set-up and Users



## Wave Buoys



- ✧ Wave Height
- ✧ Direction
- ✧ Period
- ✧ Sea Surface Temperature



Credit: Ryan Kramer

## Wave Buoy Data Users



## Weather Station



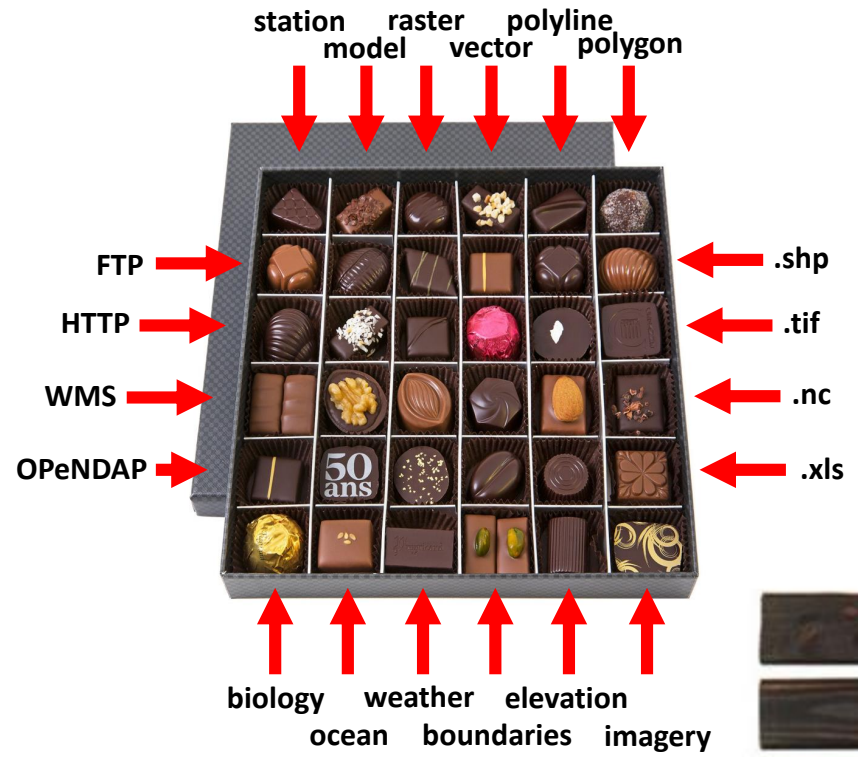
- ✧ Air Temperature
- ✧ Water Temperature
- ✧ Wind Speed
- ✧ Wind Direction
- ✧ Total Rainfall
- ✧ PAR Flux Density
- ✧ Shortwave Radiation
- ✧ Ultraviolet Radiation

Credit: Joshua Levy, HIMB

## Box Of Chocolates



## Box Of Chocolates



## Box Of Chocolates



## Box Of Chocolates



PacIOOS Metadata Viewer

### PacIOOS Nearshore Sensor 02 (NS02): Hawaii Yacht Club, Oahu, Hawaii

- Identification Information
- Data Quality Information
- Geospatial Representation Information
- Content Information
- Distribution Information
- Metadata Reference Information

**Identification Information**

Citation:  
Title: PacIOOS Nearshore Sensor 02 (NS02) Here  
Date: July 29, 2008  
Date Type: creation (CI\_DateTypeCode)  
Identifier:

### PacIOOS Nearshore Sensor 02 (NS02): Hawaii Yacht Club, Oahu, Hawaii

id: NS02agg

The nearshore sensors are part of the Pacific Islands Ocean Observing System (PacIOOS) and are designed to measure a variety of ocean parameters at fixed point locations along the south shore of Oahu. NS02 is located at a floating dock off the Hawaii Yacht Club. The instrument is a Sea-Bird Electronics model coupled with a WET Labs ECO-FLNTx combination sensor. The package is fixed to a below the ocean surface.

begin date: July 29, 2008 end date: March 18, 2019

keywords: show

access methods: HTML • Voyager • THREDDS • ERDDAP • OPeNDAP



ERDDAP > tabledap > Make A Graph

Dataset Title: PacIOOS Nearshore Sensor 02 (NS02): Hawaii Yacht Club, Oahu, Hawaii (50) (50)

Location: University of Hawaii (Dataset ID: NS02-008)  
Longitude: -157.8428 to -157.8428  
Latitude: 21.28641 to 21.28641  
Depth: 0 to 0 to 0.5m, time = 2008-07-29T00:00:00Z

Graph Type: Line  
Y Axis: Temperature  
Constraints: Optimal Constraint #1: NS02-008, Optimal Constraint #2: NS02-008

Server-side Functions: NS02-008

Scan Settings: Color, Line, Background

Redraw the Graph: (Please be patient, it may take a while to get the data)



## Got Telemetry?

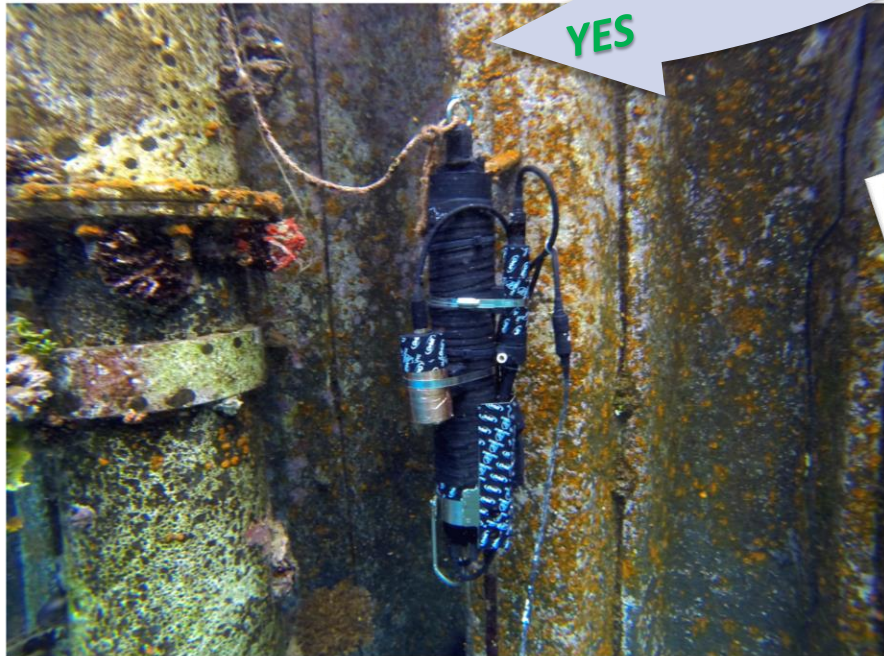
# got telemetry?



 Near Real-Time (NRT)

Delayed Mode 

YES



NO



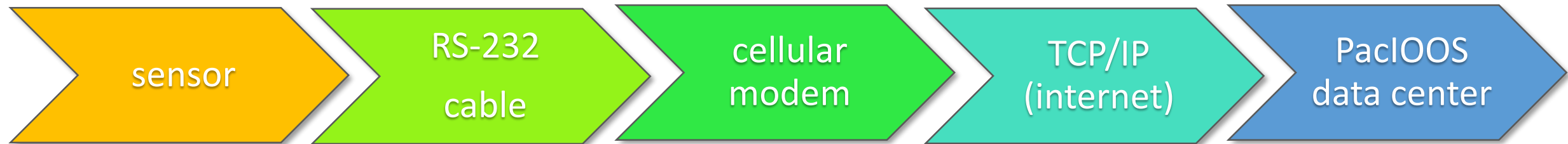
## Near Real-Time (NRT)



0 1 0 1  
1 0 1  
0 1 1 0



## Telemetry



sensor

RS-232  
cable

cellular  
modem

TCP/IP  
(internet)

PacIOOS  
data center

underwater

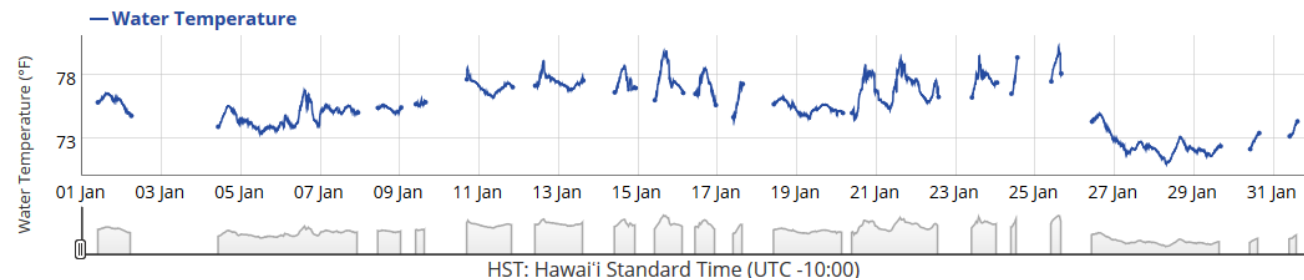
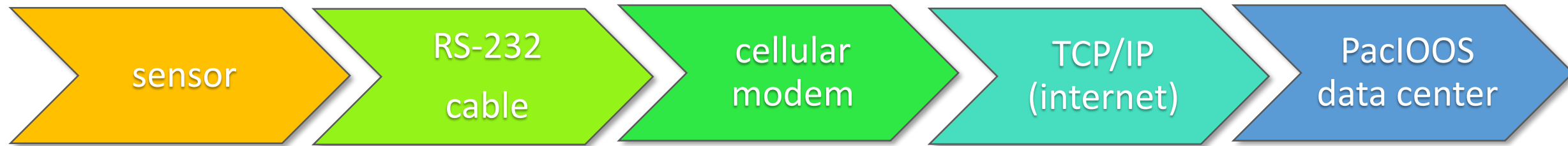
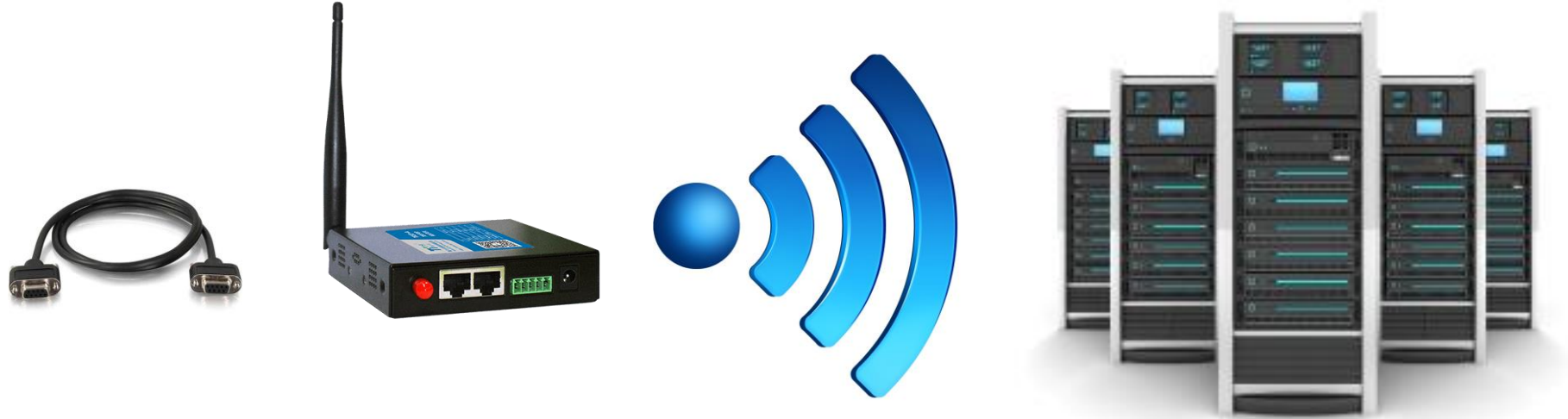
connect to serial port

on-site cellular modem  
(or a single-board computer and  
someone's WiFi; usually solar-  
powered and on a nearby beach)

on-site script "listens"  
to RS-232 port and  
transmits data to Univ.

Data Turbine

## Telemetry



## Data Turbine

<http://dataturbine.org>

### OPEN SOURCE DATA TURBINE INITIATIVE

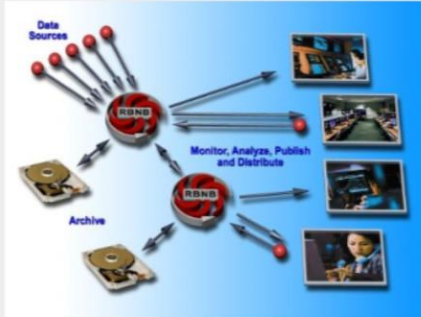
Empowering the Scientific Community with Streaming Data Middleware

#### DataTurbine

In a Nutshell

**DataTurbine** is a robust real-time streaming data engine that lets you quickly stream live data from experiments, labs, web cams and even Java enabled cell phones. It acts as a "black box" to which applications and devices send and receive data. Think of it as express delivery for your data, be it numbers, video, sound or text.

**DataTurbine** is a buffered middleware, not simply a publish/subscribe system. It can receive data from various sources (experiments, web cams, etc) and send data to various sinks (visualization interfaces, analysis tools, databases, etc). It has "TIVO" like functionality that lets applications pause and rewind live streaming data.



**Why Use It?**

- **Extendable:** It is a free Open Source project with an extensive well documented API.
- **Scalable:** It uses a hierarchical design that allows a network structure that grows with the requirements of your application
- **Portable:** DataTurbine runs on devices ranging from phones & buoys to multicore servers.
- **Dependable:** Using a Ring Buffered Network Bus, it provides tunable persistent storage at key network nodes to facilitate reliable data transport

**What's Next?**

**DataTurbine** has a long history of enabling scientists and engineers to record and distribute streaming data. Code (source and binary) is available for download at <https://github.com/cycronix/dataturbine>. At this point it is frozen except for possible custom updates and fixes. Legacy dataturbine.org website content available upon request.

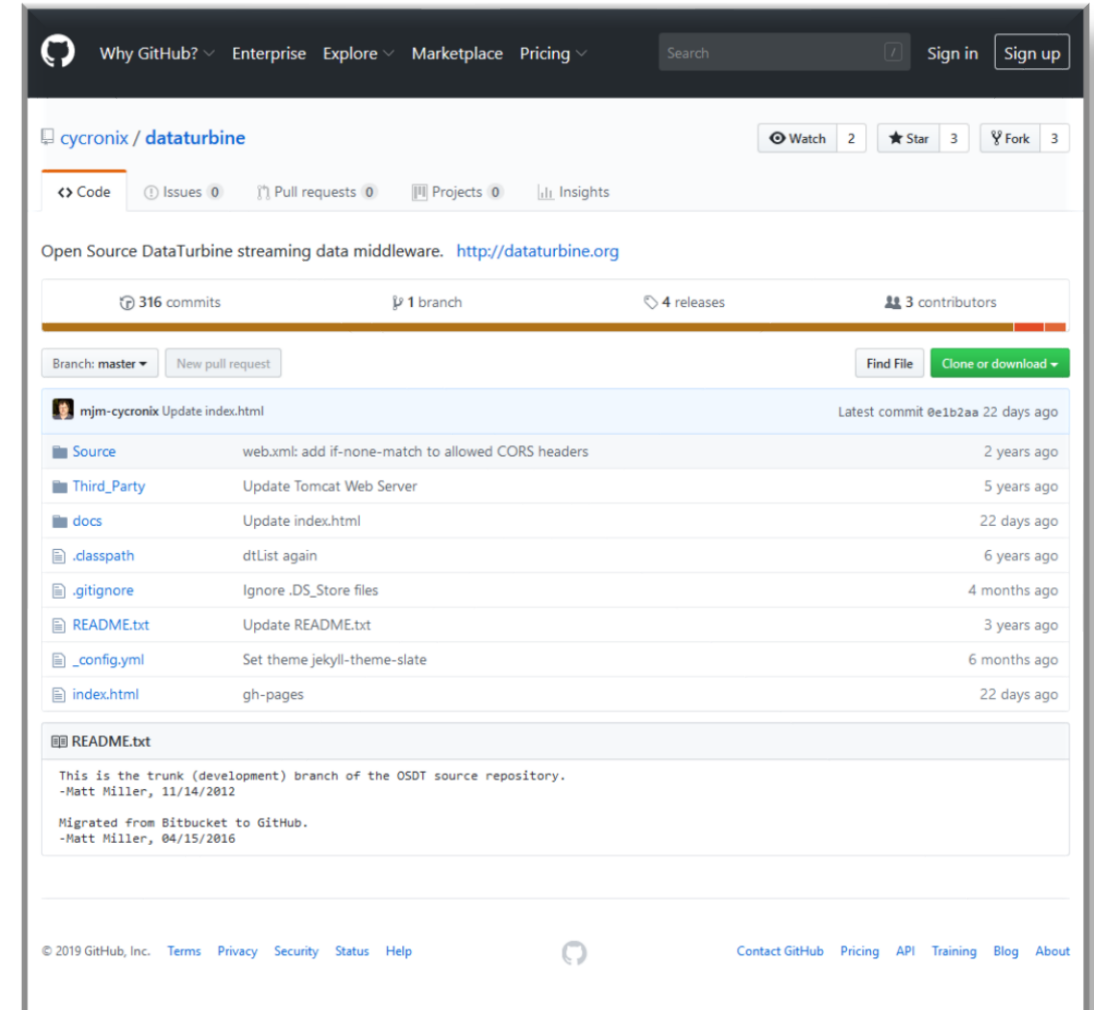
For related next-generation technology, check out **CloudTurbine** at <http://cloudturbine.com>.

**More Info**

**DataTurbine** software and website maintained by its inventor. For more info please contact: [info@cycronix.com](mailto:info@cycronix.com)

[info@cycronix.com](mailto:info@cycronix.com)

<http://github.com/cycronix/dataturbine>



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cycronix / dataturbine Watch 2 Star 3 Fork 3

Code Issues 0 Pull requests 0 Projects 0 Insights

Open Source DataTurbine streaming data middleware. <http://dataturbine.org>

316 commits 1 branch 4 releases 3 contributors

Branch: master New pull request Find File Clone or download

mjm-cycronix Update index.html Latest commit 0e1b2aa 22 days ago

Source	web.xml: add if-none-match to allowed CORS headers	2 years ago
Third_Party	Update Tomcat Web Server	5 years ago
docs	Update index.html	22 days ago
.classpath	dtList again	6 years ago
.gitignore	Ignore .DS_Store files	4 months ago
README.txt	Update README.txt	3 years ago
_config.yml	Set theme jekyll-theme-slate	6 months ago
index.html	gh-pages	22 days ago

README.txt

This is the trunk (development) branch of the OSDT source repository.  
-Matt Miller, 11/14/2012




Migrated from Bitbucket to GitHub.  
-Matt Miller, 04/15/2016

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## Data Turbine

[http://bbl.ancl.hawaii.edu/kilonalu-data/alawai/AW02XX\\_001CTDXXXXR00/DecimalASCIISampleData/](http://bbl.ancl.hawaii.edu/kilonalu-data/alawai/AW02XX_001CTDXXXXR00/DecimalASCIISampleData/)

### Index of /kilonalu-data/alawai/AW02XX\_001CTDXXXXR00/DecimalASCIISampleData

<u>Name</u>	<u>Last modified</u>	<u>Size</u>	<u>Description</u>
 <a href="#">Parent Directory</a>		-	
 <a href="#">2013/</a>	30-Nov-2013 14:59	-	
 <a href="#">2014/</a>	30-Nov-2014 14:59	-	
 <a href="#">2015/</a>	30-Nov-2015 14:59	-	
 <a href="#">2016/</a>	30-Nov-2016 14:59	-	
 <a href="#">2017/</a>	30-Nov-2017 14:59	-	
 <a href="#">2018/</a>	30-Nov-2018 14:59	-	
 <a href="#">2019/</a>	28-Feb-2019 14:59	-	

## Data Turbine

[http://bbl.ancl.hawaii.edu/kilonalu-data/alawai/AW02XX\\_001CTDXXXXR00/DecimalASCIISampleData/](http://bbl.ancl.hawaii.edu/kilonalu-data/alawai/AW02XX_001CTDXXXXR00/DecimalASCIISampleData/)

### Index of /kilonalu-data/alawai/AW02XX\_001CTDXXXXR00/DecimalASCIISampleData

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<a href="#">2013/</a>	30-Nov-2013		
<a href="#">2014/</a>	30-Nov-2014		
<a href="#">2015/</a>	30-Nov-2015		
<a href="#">2016/</a>	30-Nov-2016		
<a href="#">2017/</a>	30-Nov-2017		
<a href="#">2018/</a>	30-Nov-2018		
<a href="#">2019/</a>	28-Feb-2019		

### Index of /kilonalu-data/alawai/AW02XX\_001CTDXXXXR00/DecimalASCIISampleData/2019/03/20









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<a href="#">AW02XX_001CTDXXXXR00_20190320100256.10.1.dat</a>	20-Mar-2019 00:59	69	

## Data Turbine

[http://bbl.ancl.hawaii.edu/kilonalu-data/alawai/AW02XX\\_001CTDXXXXR00/DecimalASCIISampleData/](http://bbl.ancl.hawaii.edu/kilonalu-data/alawai/AW02XX_001CTDXXXXR00/DecimalASCIISampleData/)


### Index of /kilonalu-data/alawai/AW02XX\_001CTDXXXXR00/DecimalASCIISampleData

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 <a href="#">2015/</a>	30-Nov-2015		
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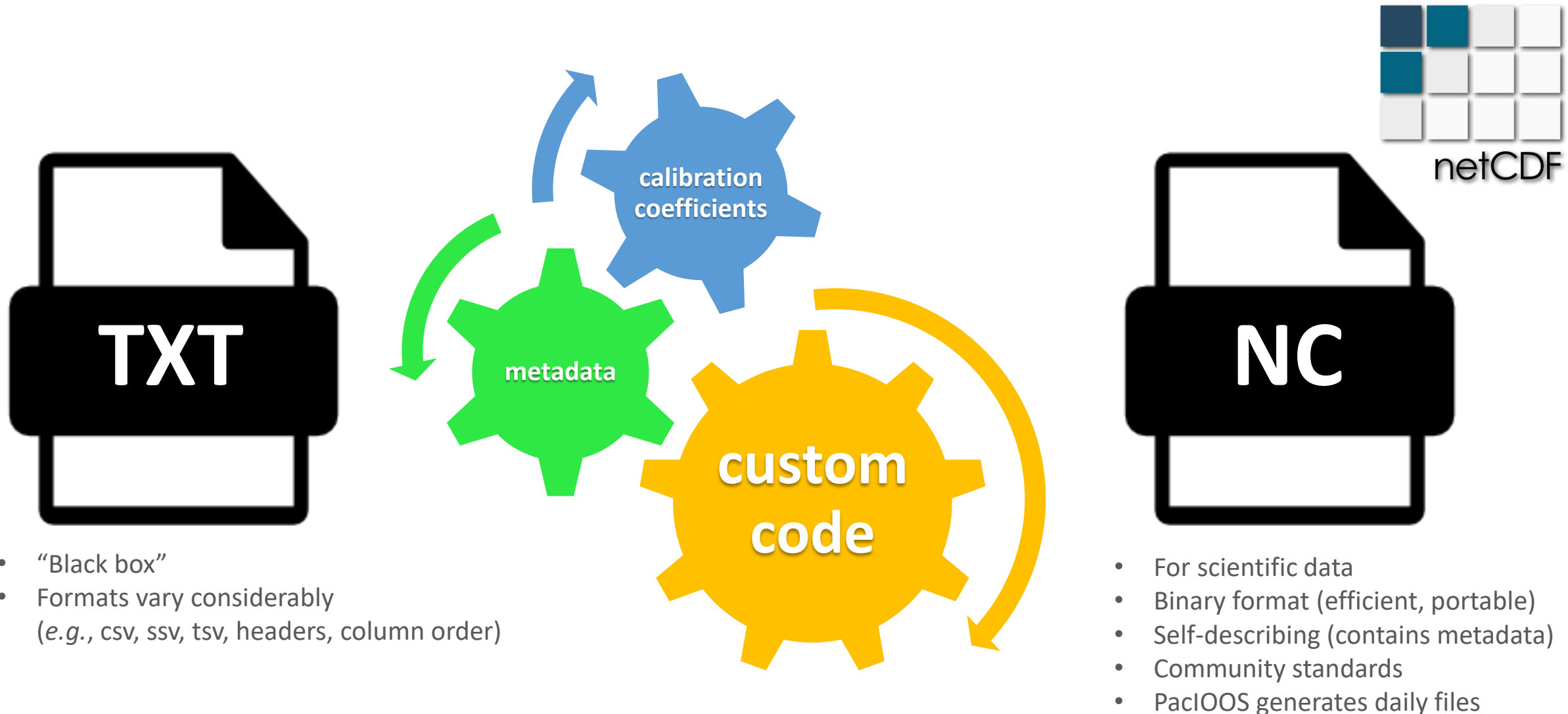
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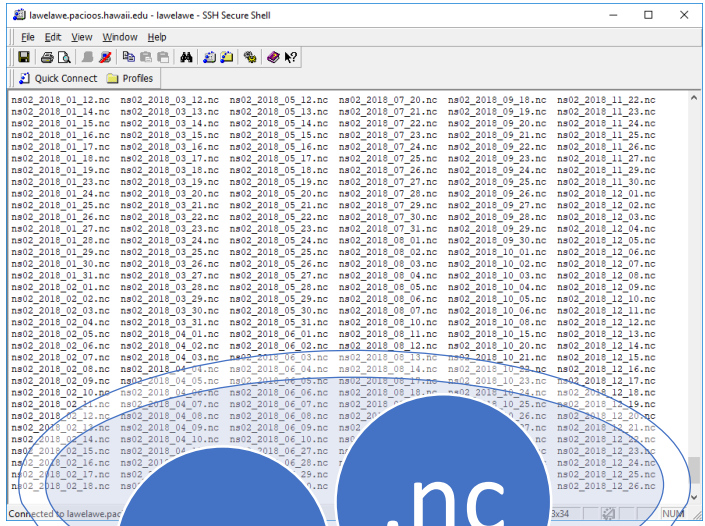
Name
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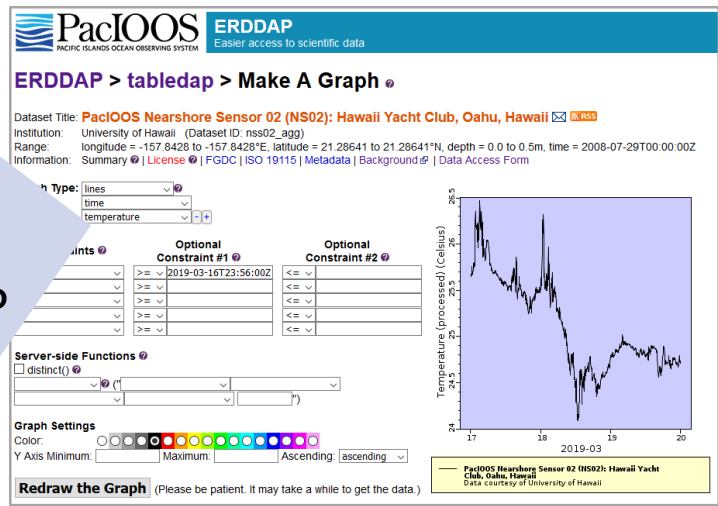
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#	24.8812,	5.03279,	0.1868,	0.1127,	33.0609,	19	Mar	2019	23:15:08
#	24.8846,	5.03315,	0.1806,	0.1137,	33.0610,	19	Mar	2019	23:19:08
#	24.8822,	5.02975,	0.1892,	0.1152,	33.0377,	19	Mar	2019	23:23:08
#	24.8829,	5.02958,	0.1928,	0.1140,	33.0360,	19	Mar	2019	23:27:08
#	24.8748,	5.03016,	0.1915,	0.1164,	33.0461,	19	Mar	2019	23:31:08
#	24.8695,	5.02971,	0.1866,	0.1166,	33.0467,	19	Mar	2019	23:35:08
#	24.8760,	5.03106,	0.1855,	0.1161,	33.0519,	19	Mar	2019	23:39:08
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#	24.8406,	5.03840,	0.1856,	0.1136,	33.1320,	19	Mar	2019	23:47:08
#	24.8377,	5.03928,	0.1854,	0.1137,	33.1406,	19	Mar	2019	23:51:08
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## NetCDF: Network Common Data Form

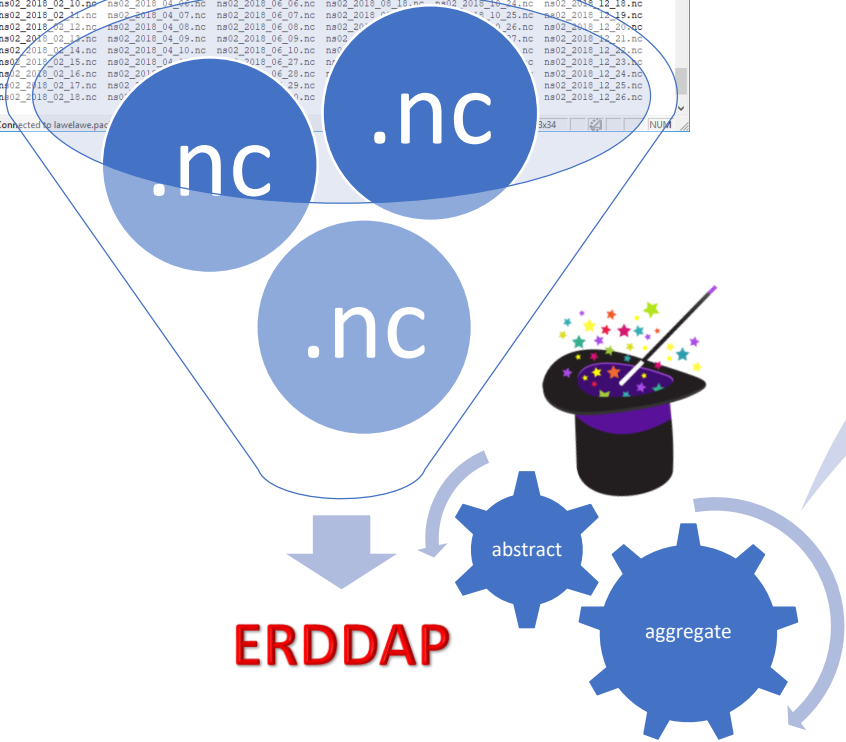




<http://pacioos.org/erddap/>



### Web Services



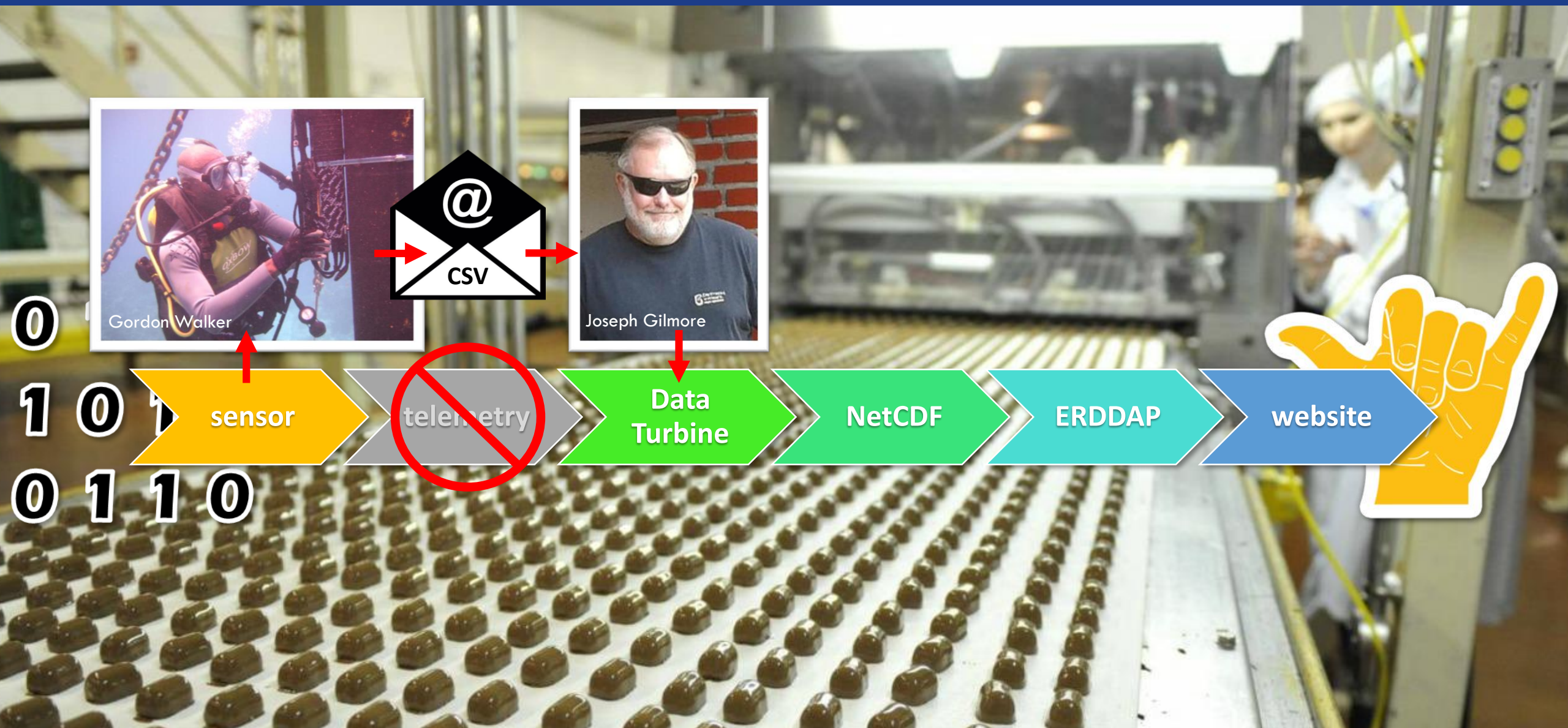
- subset
- format
- OPeNDAP

**REST** = Representational State Transfer  
**API** = Application Programming Interface

<http://some.address.org/directory/filename.nc>

<http://some.address.org/give-me?dataset&vars&time&format>

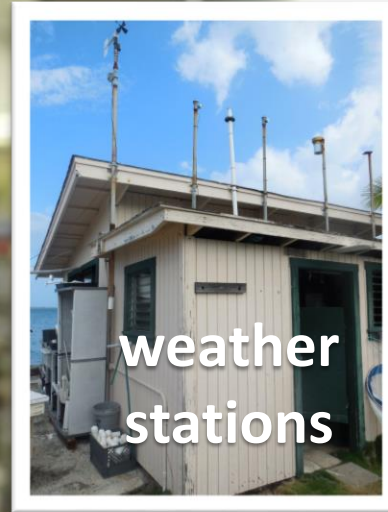
## Delayed Mode



0  
1 0 1  
0 1 1 0



Same Same?

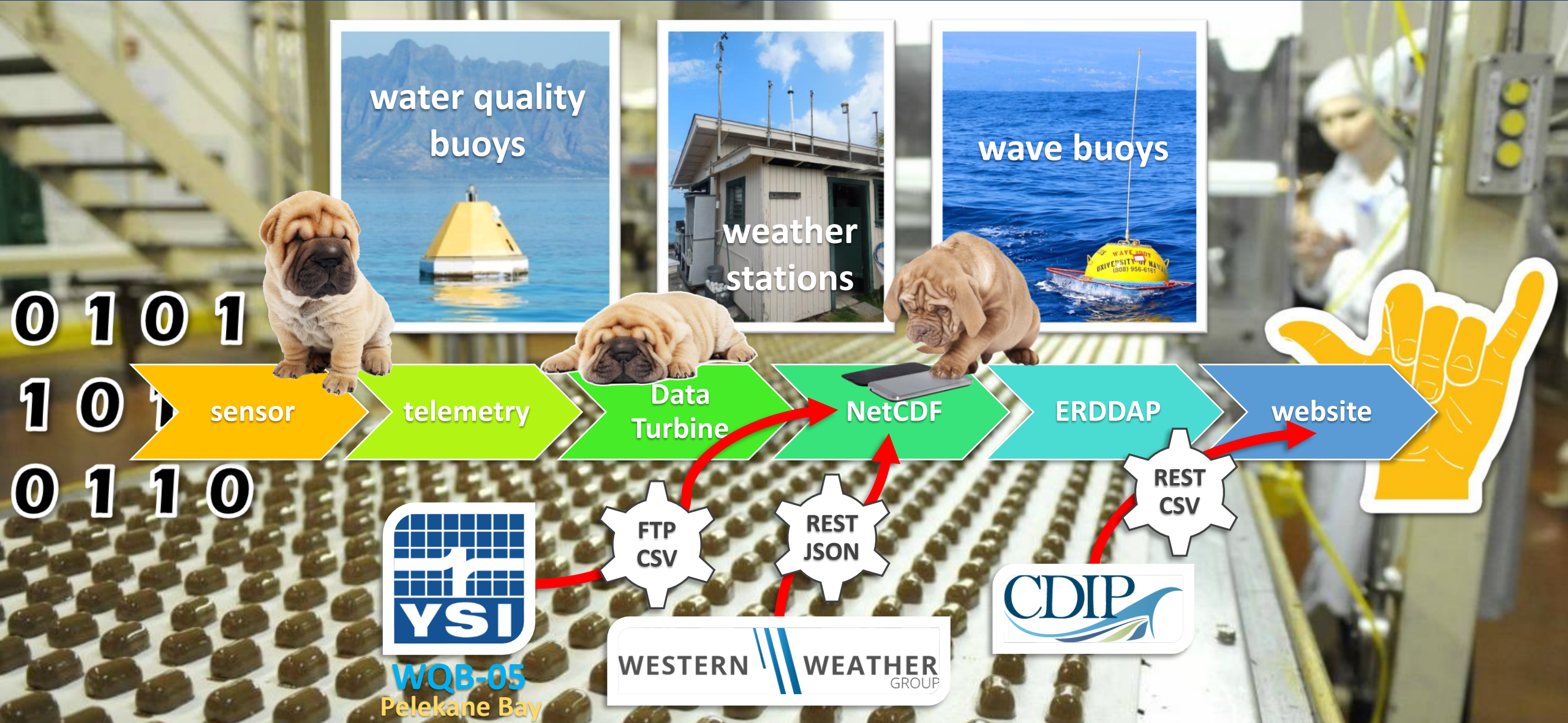


0 1 0 1  
1 0 1  
0 1 1 0



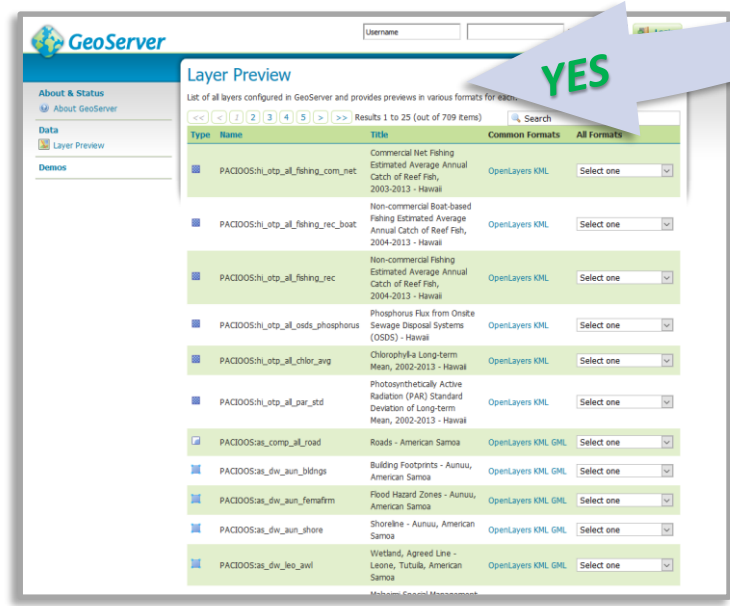
# OTHER STATION ASSETS

Always Wrinkles



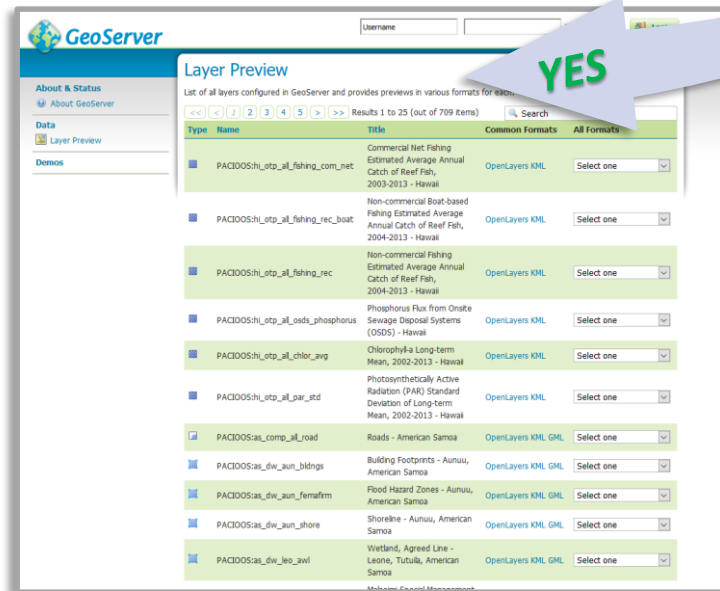
# got GIS?

<http://pacioos.org/geoserver/>



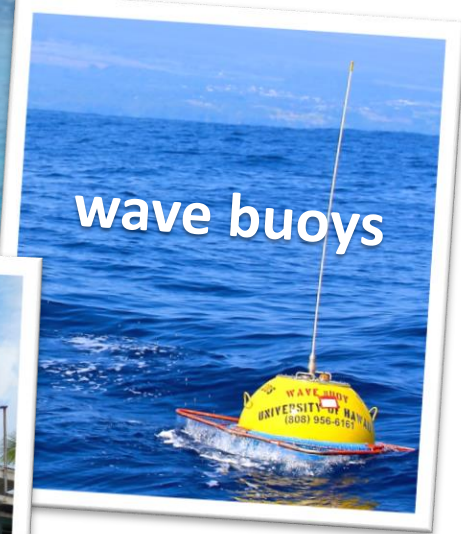
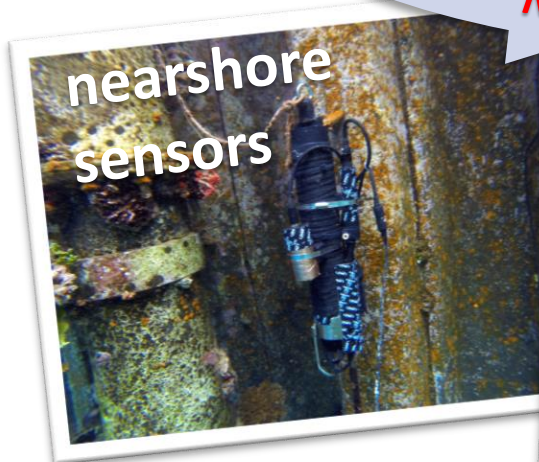
# got GIStatic?

<http://pacioos.org/geoserver/>



YES

NO



- NS02: Atlantis dock:
- 5 variables
- 4 minute interval
- 11 years of data
- 7 million observations!

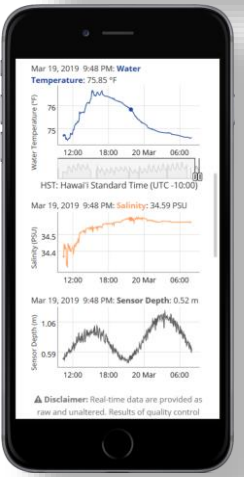
<http://pacioos.org/erddap/>

# got GIStatic?

**NO**



- NS02: Atlantis dock:
- 5 variables
- 4 minute interval
- 11 years of data
- 7 million observations!



<http://pacioos.org>

<http://pacioos.org/voyager/>



STAY CONNECTED



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[@PacIOOS](https://twitter.com/PacIOOS)

<http://pacioos.org>