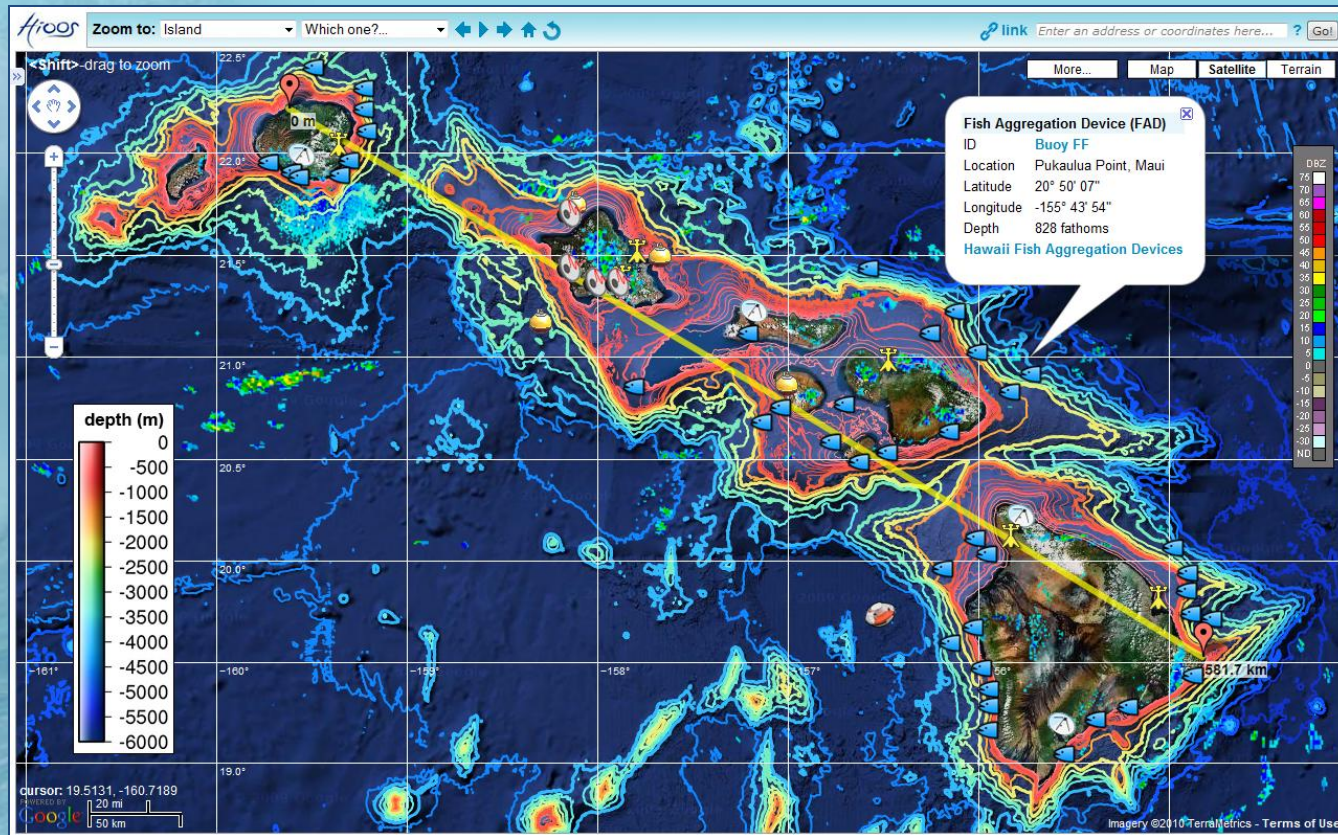


# PacIOOS Data Management and Communications (DMAC)



**John Maurer**

Data System Administrator

Pacific Islands Ocean Observing System ([PacIOOS.org](http://PacIOOS.org))

School of Ocean and Earth Science and Technology (SOEST)

University of Hawai'i at Mānoa

May 2012

Pacific Islands Ocean Observing System

PacIOOS

[john.maurer@hawaii.edu](mailto:john.maurer@hawaii.edu)

**data**

**servers**

**metadata**

**services**

**viewers**



**Pacific Islands Ocean Observing System**

**PacIOOS**

[john.maurer@hawaii.edu](mailto:john.maurer@hawaii.edu)

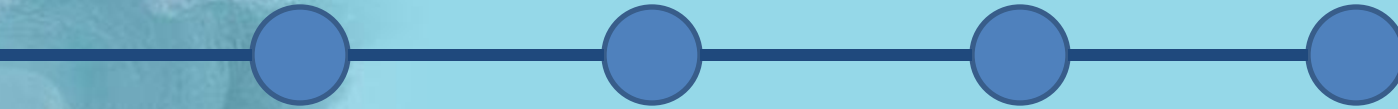
**data**

**servers**

**metadata**

**services**

**viewers**



**data**

**servers**

**metadata**

**services**

**viewers**



**NetCDF: Network Common Data Form**



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data

servers

metadata

services

viewers



# NetCDF: Network Common Data Form

time series:



nearshore sensors

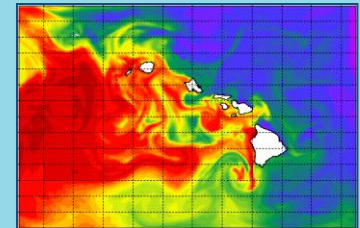
water quality buoys

tide gauges

gliders

high frequency radios

forecast models



## Pacific Islands Ocean Observing System



data

servers

metadata

services

viewers



**NetCDF: Network Common Data Form**

time series:



nearshore sensors

water quality buoys

tide gauges

gliders

high frequency radios

forecast models

ocean circulation

ocean waves

tides

atmosphere

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data

servers

metadata

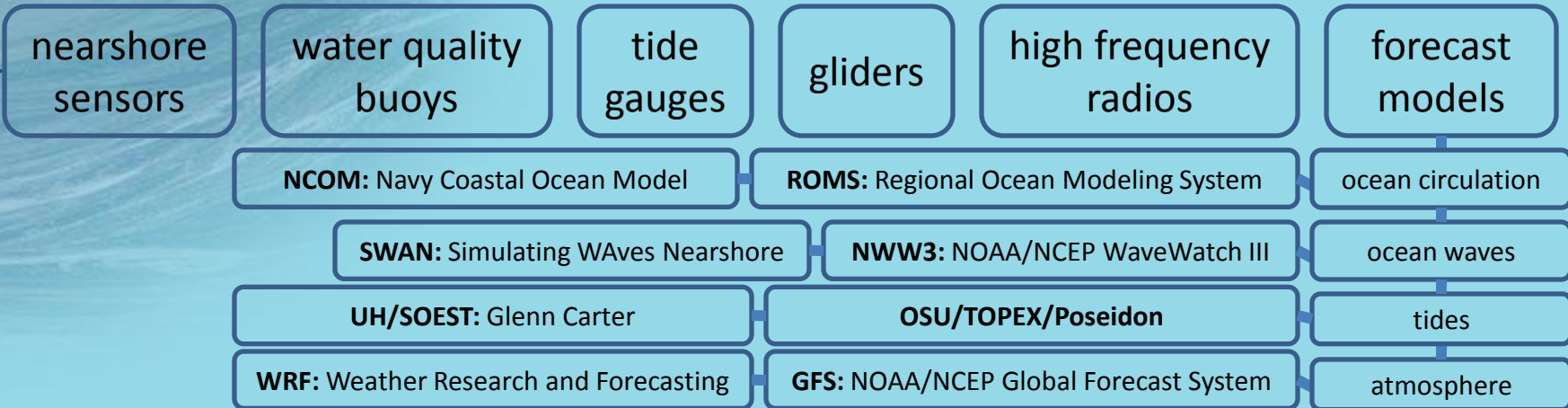
services

viewers



**NetCDF: Network Common Data Form**

time series:



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data

servers

metadata

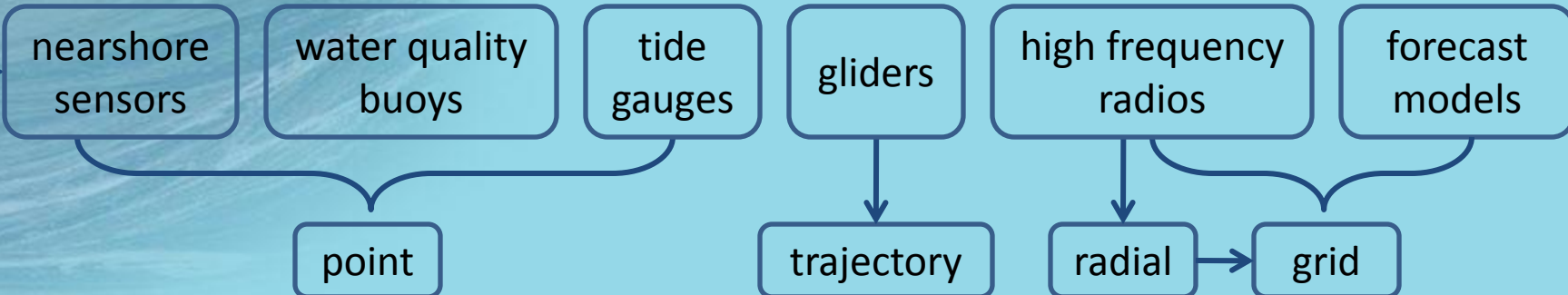
services

viewers



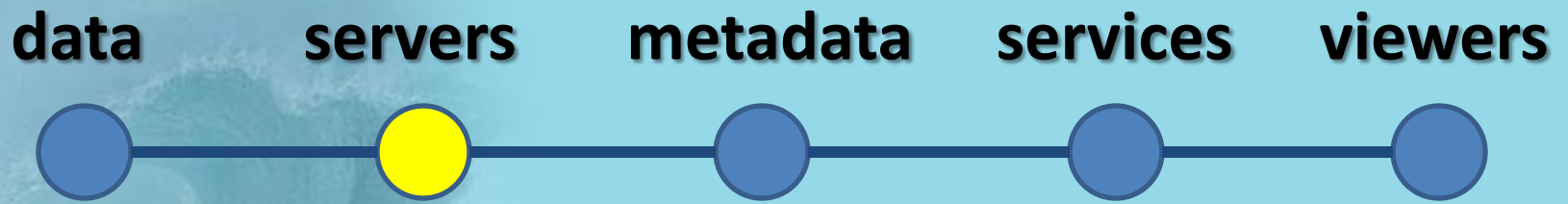
**NetCDF: Network Common Data Form**

time series:



Pacific Islands Ocean Observing System





# Pacific Islands Ocean Observing System



data servers metadata services viewers



**TDS: THREDDS Data Server**



**Thematic Realtime Environmental Distributed Data Services**

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data servers metadata services viewers



**TDS: THREDDS Data Server**



**Thematic Realtime Environmental Distributed Data Services**

- data catalog: organize and present your NetCDF data in one place
- virtual aggregations: more than a simple file server
- modifications to data/metadata via NetCDF Markup Language ([NcML](#))

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## TDS: THREDDS Data Server



### Thematic Realtime Environmental Distributed Data Services

- data catalog: organize and present your NetCDF data in one place
- virtual aggregations: more than a simple file server
- modifications to data/metadata via NetCDF Markup Language ([NcML](#))

## Dapper



- used for DChart and ERDDAP viewers
- specifically for NetCDF point data

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# ERDDAP: Environmental Research Division's Data Access Program



- NetCDF gridded data from TDS
- NetCDF point data from Dapper

data servers metadata services viewers



## TDS: THREDDS Data Server



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- specifically for NetCDF point data

Pacific Islands Ocean Observing System



## ERDDAP: Environmental Research Division's Data Access Program

- NetCDF gridded data from TDS
- NetCDF point data from Dapper



## LAS: Live Access Server

- specifically for NetCDF gridded data



**data servers metadata services viewers**



## TDS: THREDDS Data Server



### Thematic Realtime Environmental Distributed Data Services

- data catalog: organize and present your NetCDF data in one place
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# ERDDAP: Environmental Research Division's Data Access Program

- NetCDF gridded data from TDS
- NetCDF point data from Dapper



# LAS: Live Access Server

- specifically for NetCDF gridded data



data servers metadata services viewers



# TDS: THREDDS Data Server



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# Dapper



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- specifically for NetCDF point data

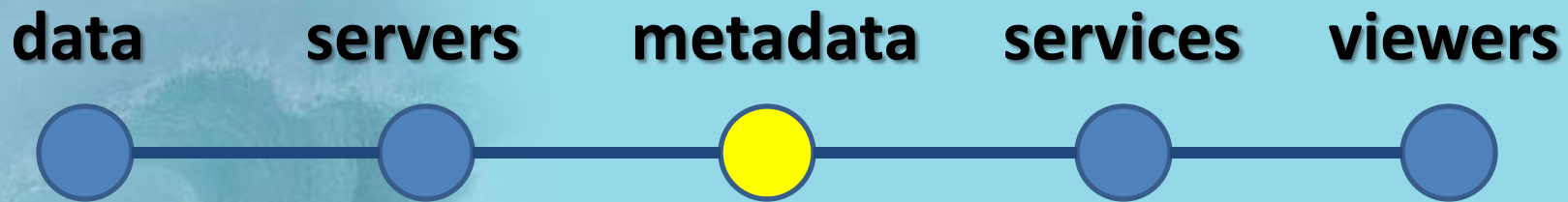
# OOS Tethys

Ocean Observing System + (Greek sea goddess)

- Sensor Observation Service ([SOS](#))
- specifically for NetCDF point data

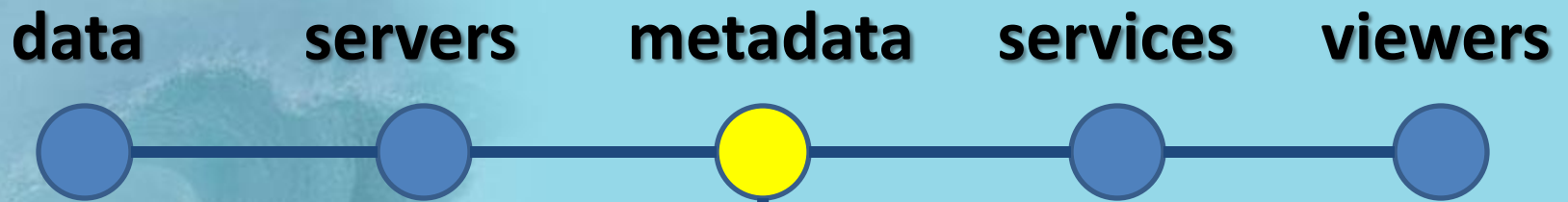
## Pacific Islands Ocean Observing System





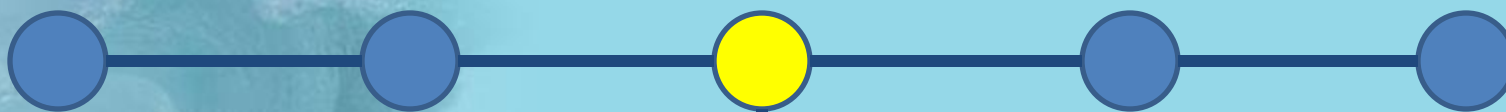
# Pacific Islands Ocean Observing System





- descriptive information: who, what, when, where, why, how
- standardized vocabularies
- machine-readable format (XML)
- enable community-wide search and discovery

data servers metadata services viewers



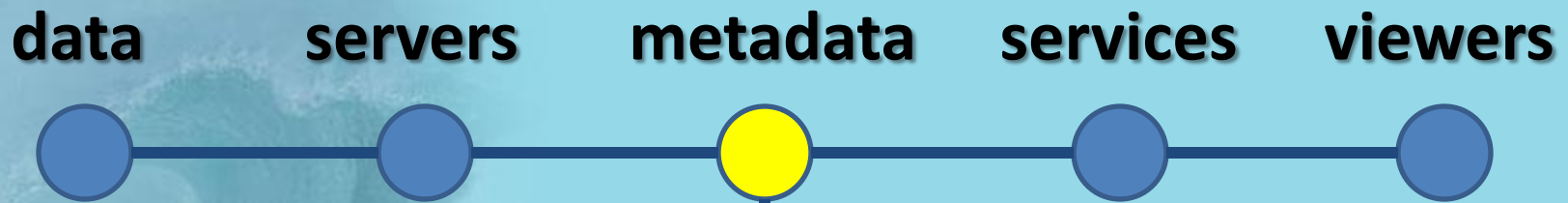
## THREDDS Dataset Inventory Catalog Specification

- presents metadata on TDS catalog page

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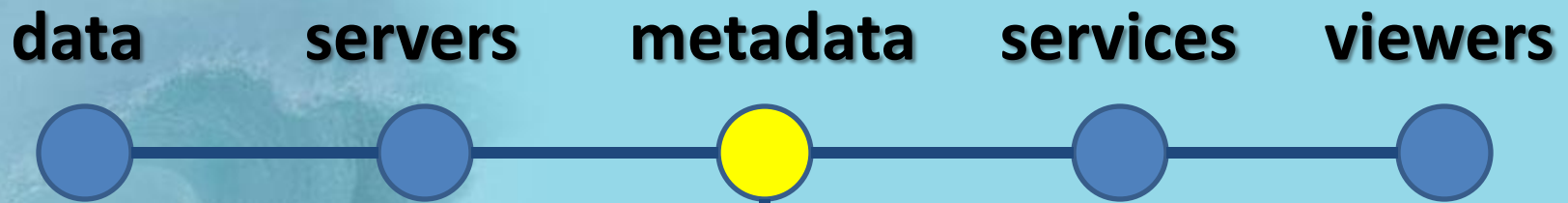


## THREDDS Dataset Inventory Catalog Specification

- presents metadata on TDS catalog page

## CF: NetCDF Climate and Forecast Metadata Convention

- global attributes + [standard variable names](#) + standard data organization + etc.



▶ **THREDDS Dataset Inventory Catalog Specification**

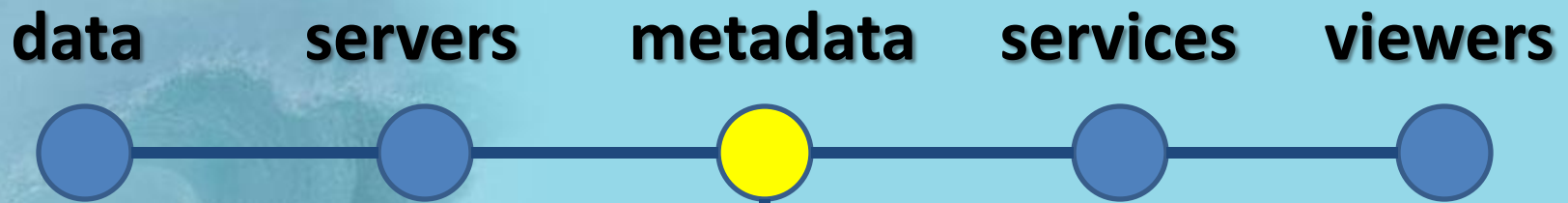
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▶ **CF: NetCDF Climate and Forecast Metadata Convention**

- global attributes + [standard variable names](#) + standard data organization + etc.

▶ **NetCDF Attribute Convention for Dataset Discovery**

- global attribute fields



▶ **THREDDS Dataset Inventory Catalog Specification**

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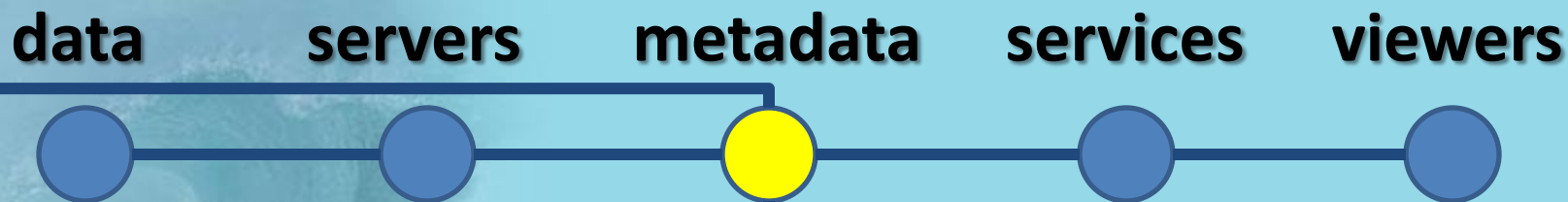
▶ **ISO 19115-2: Geographic Information – Metadata**

- international standard; will be auto-generated from the above standards

# FGDC: Federal Geographic Data Committee

## CSGDM: Content Standard for Digital Geospatial Metadata

- U.S. standard; we can auto-translate from ISO



### THREDDS Dataset Inventory Catalog Specification

- presents metadata on TDS catalog page

### CF: NetCDF Climate and Forecast Metadata Convention

- global attributes + [standard variable names](#) + standard data organization + etc.

### NetCDF Attribute Convention for Dataset Discovery

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Pacific Islands Ocean Observing System



**data**

**servers**

**metadata**

**services**

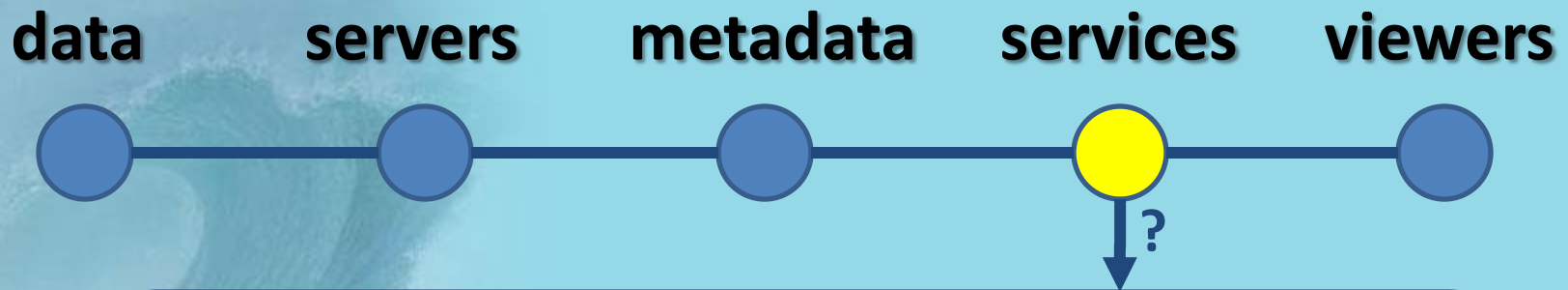
**viewers**



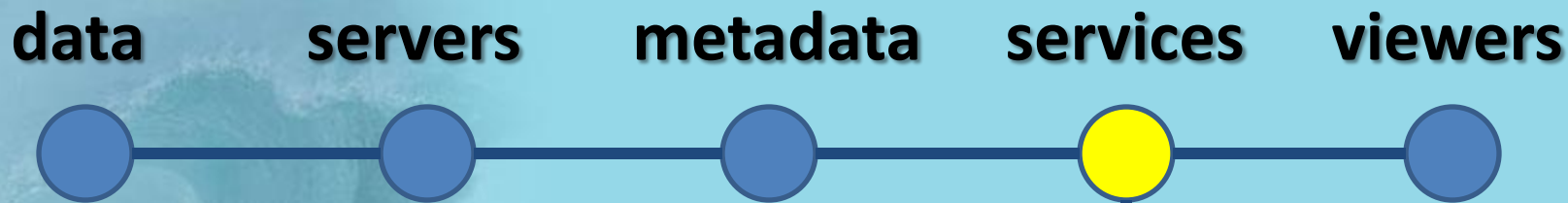
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- standard protocols for accessing data over HTTP
- data accessed via URL; customize result via parameter values:  
REST = Representational State Transfer
- import data directly into user's software client (Matlab, ArcGIS, etc.)
- enable community-wide data interoperability



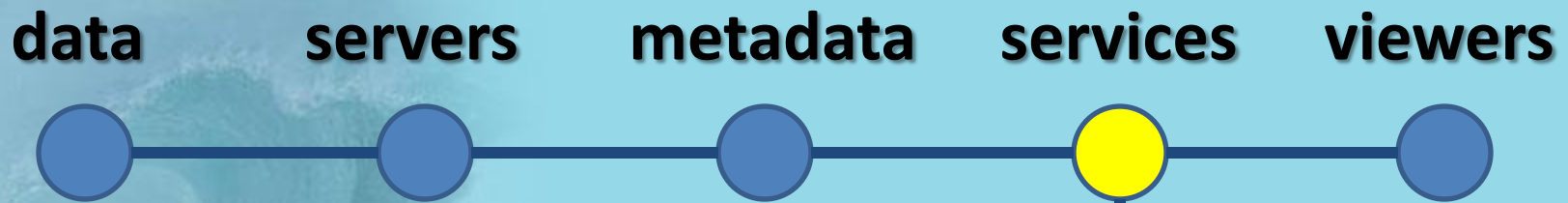
## **OPeNDAP: Open-source Project for a Network Data Access Protocol**

- subset data via index ranges (e.g. [start:stride:stop], [0:5:50]); get ASCII or binary

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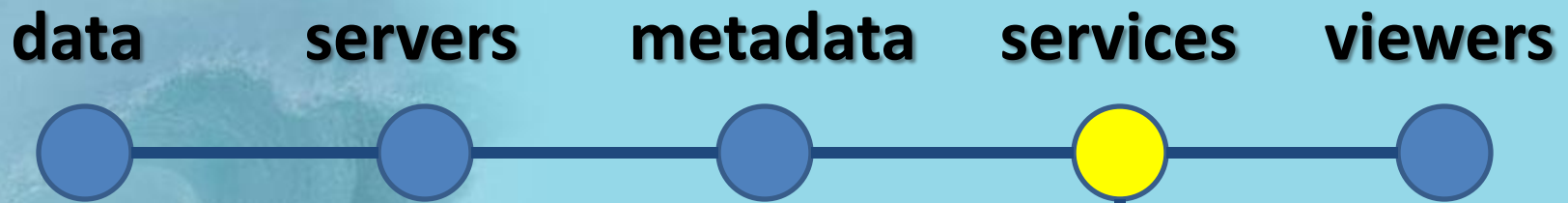


▶ **OPeNDAP: Open-source Project for a Network Data Access Protocol**

- subset data via index ranges (e.g. [start:stride:stop], [0:5:50]); get ASCII or binary

▶ **NetCDF Subset Service**

- subset gridded data via lat/lon, time, and/or depth; get ASCII, XML, or NetCDF



▶ **OPeNDAP: Open-source Project for a Network Data Access Protocol**

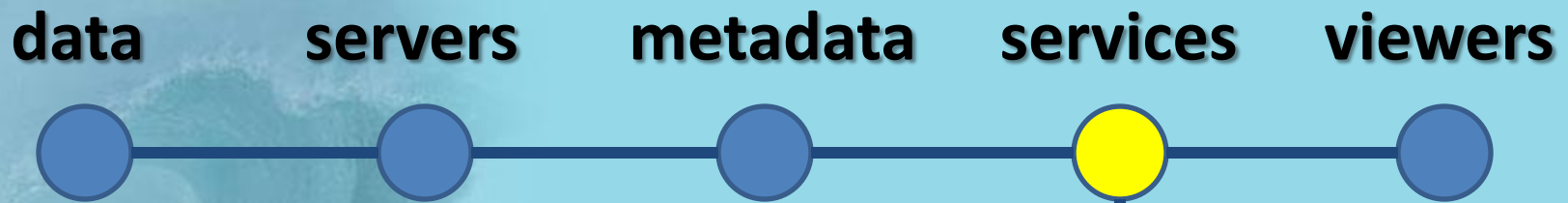
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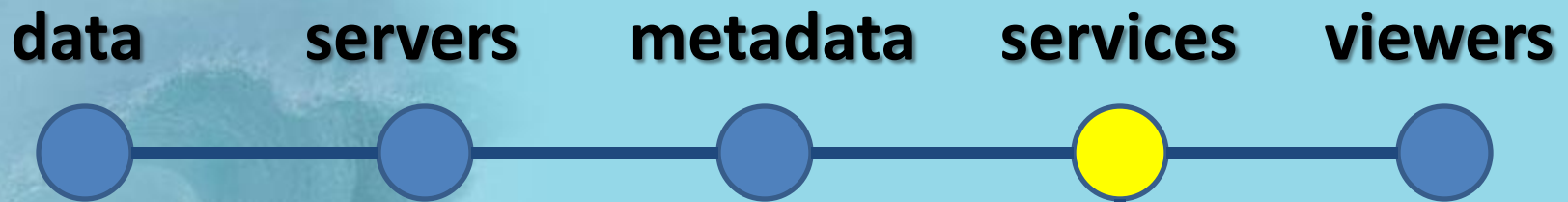
- subset gridded data via lat/lon, time, and/or depth; get ASCII, XML, or NetCDF

▶ **WMS: Web Map Service**

- for gridded data, get image (JPG, PNG, GIF, KMZ); specify projection, space, time, etc.

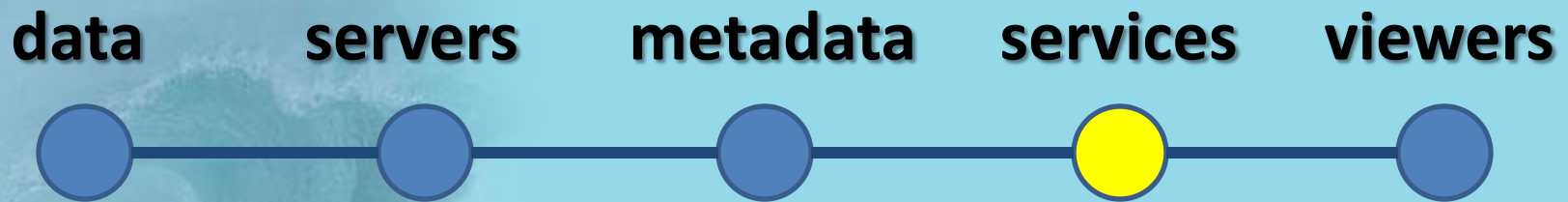


- ▶ **OPeNDAP: Open-source Project for a Network Data Access Protocol**
  - subset data via index ranges (e.g. [start:stride:stop], [0:5:50]); get ASCII or binary
- ▶ **NetCDF Subset Service**
  - subset gridded data via lat/lon, time, and/or depth; get ASCII, XML, or NetCDF
- ▶ **WMS: Web Map Service**
  - for gridded data, get image (JPG, PNG, GIF, KMZ); specify projection, space, time, etc.
- ▶ **WCS: Web Coverage Service**
  - for gridded data, get GeoTIFF; specify projection, space, time, resolution, etc.



- ▶ **OPeNDAP: Open-source Project for a Network Data Access Protocol**
  - subset data via index ranges (e.g. [start:stride:stop], [0:5:50]); get ASCII or binary
- ▶ **NetCDF Subset Service**
  - subset gridded data via lat/lon, time, and/or depth; get ASCII, XML, or NetCDF
- ▶ **WMS: Web Map Service**
  - for gridded data, get image (JPG, PNG, GIF, KMZ); specify projection, space, time, etc.
- ▶ **WCS: Web Coverage Service**
  - for gridded data, get GeoTIFF; specify projection, space, time, resolution, etc.
- ▶ **SOS: Sensor Observation Service**
  - for point data, get XML ([O&M](#)); specify space, time, etc.

Pacific Islands Ocean Observing System



**OPeNDAP: Open-source Project for a Network Data Access Protocol**  
**NetCDF Subset Service**



**WMS: Web Map Service**

**WCS: Web Coverage Service**

**SOS: Sensor Observation Service**



Pacific Islands Ocean Observing System



**data**

**servers**

**metadata**

**services**

**viewers**



**Pacific Islands Ocean Observing System**



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# ncWMS Godiva2



- standalone or TDS built-in: view gridded data: produce maps and plots; animate

**data servers metadata services viewers**



Pacific Islands Ocean Observing System



Auto-zoom on select

PaclOOS TDS

Regional Ocean Modeling System (ROMS):

Main Hawaiian Islands: Regridded

- ..... sea\_surface\_height
- ..... eastward\_sea\_water\_velocity
- ..... northward\_sea\_water\_velocity
- ..... sea\_water\_potential\_temperature
- ..... sea\_water\_salinity
- ..... sea\_water\_velocity

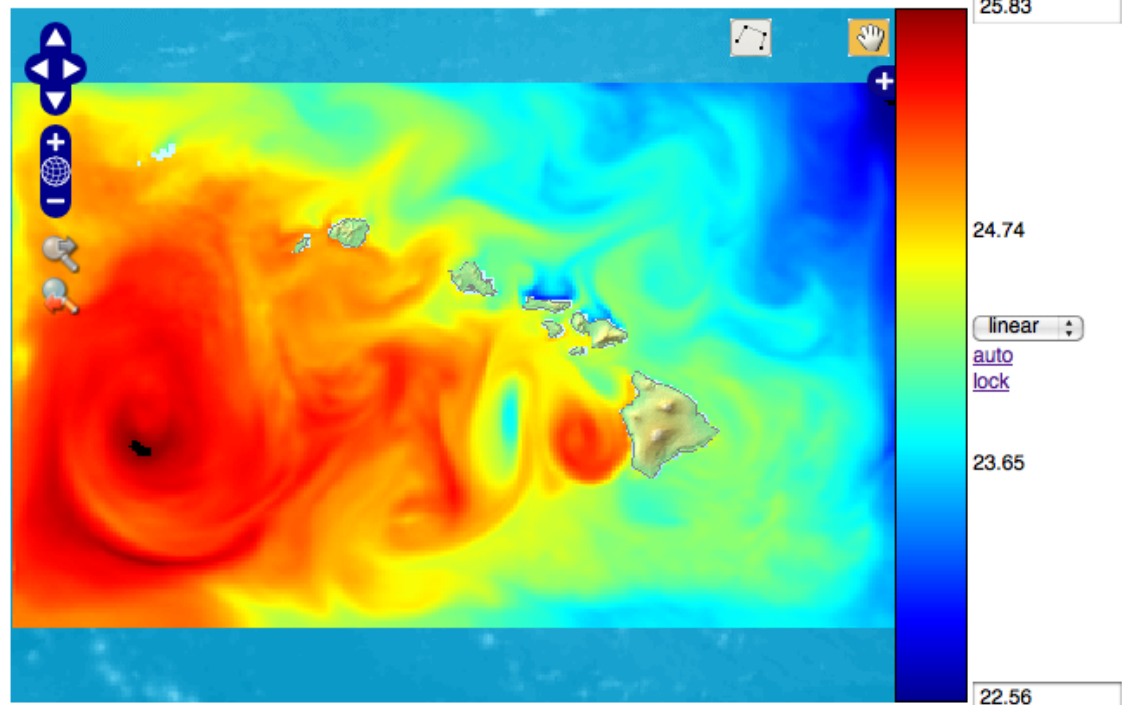
**Layer:** PaclOOS TDS > Regional Ocean Modeling System (ROMS):  
Main Hawaiian Islands: Regridded > sea\_water\_potential\_temperature  
**Units:** Celsius

**Elevation (meters):** -5

**Date/time:** 08 May 2012 00:00:00 UTC [first frame](#) [last frame](#)

? May, 2012						
« < Today > »						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		
Select date						

[Fit layer to window](#)



[User guide](#)



[test image](#)

Overlay opacity: 100%

Powered by [OpenLayers](#) and [OGC](#) standards

[Permalink](#) | [email](#)

## ncWMS Godiva2



- standalone or TDS built-in: view gridded data: produce maps and plots; animate

**data servers metadata services viewers**



## LAS: Live Access Server



- view gridded data: produce maps and plots; animate, compare, Google Earth, download

Pacific Islands Ocean Observing System

PacIOOS

# Hawaii Ocean Observing System (HiOOS)

[Link to this page](#)

Choose dataset

Update Plot

Set plot options

Animate

Compare

Google Earth

Show Values

Export to Desktop Application

Save As ...

Print

HI-ROMS Hawaii Regional Ocean Model (4km) potential temperature



23.98 N  
163.83 W 152.52 W  
17.02 N

**MAPS**  
 Latitude-Longitude

**LINE PLOTS**

- Time series
- Depth
- Longitude
- Latitude

**VERTICAL SECTION PLOTS**

- Longitude-depth
- Latitude-depth

**HOFMULLER PLOTS**

- Longitude-time
- Latitude-time
- Depth-time

Date Jun 01 2010 00:00

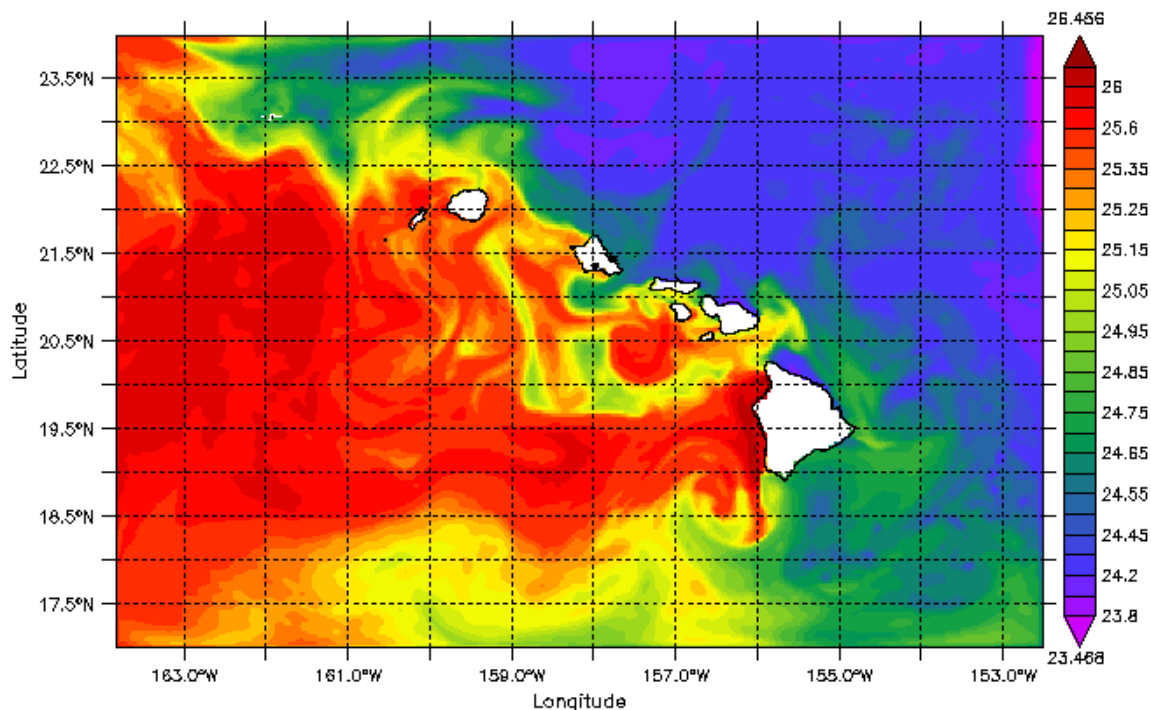
Depth (sigma coordinate) :

-0.0167

LAS 7.+/Ferret 6.62 NOAA/PMEL

Z : -0.01667  
TIME : 01-JUN-2010 00:00

DATA SET: HI-ROMS Hawaii Regional Ocean Model (4km)



potential temperature (Celsius) Native Curvilinear Plot

Select Axis to Vary in Panels

+ Difference Mode

Z (sigma coordinate): -0.0167

Start date/Time: 2010 Jun 01 00:00


Auto Set Color Fill Levels for Gallery

Image zoom: Auto

Gallery Settings

Apply

Data Set Plot Options



23.98 N

163.83 W ★ 152.52 W

17.02 N

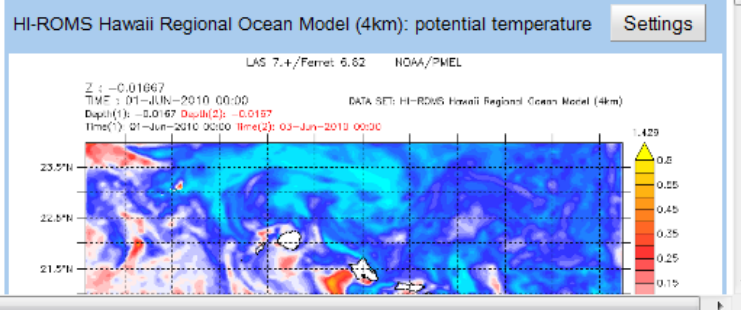
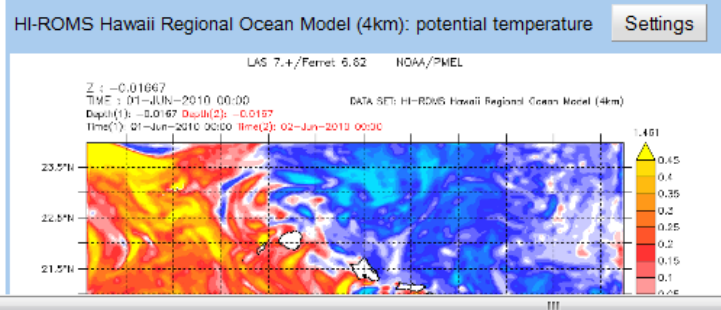
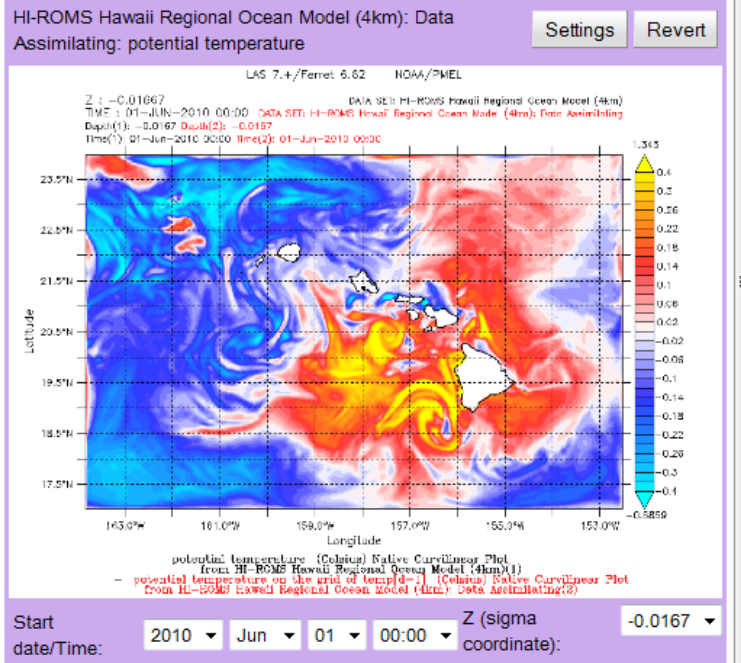
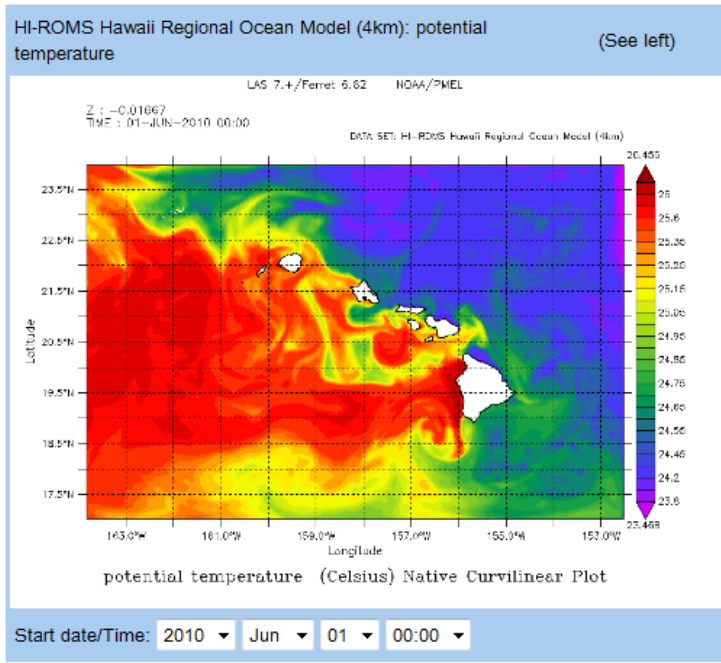
Maps

Latitude-Longitude

Line Plots

Vertical Section Plots

Hofmuller Plots



## ncWMS Godiva2



- standalone or TDS built-in: view gridded data: produce maps and plots; animate

**data servers metadata services viewers**



## LAS: Live Access Server



- view gridded data: produce maps and plots; animate, compare, Google Earth, download

## DChart: Dapper Chart



- view point or gridded data: dynamic plots or maps; download; Google Maps/Earth

Pacific Islands Ocean Observing System

PacIOOS

# HiOOS DChart

Data discovery for the Hawaii Ocean Observing System (HiOOS)

Center map at location:

[Click to select one station or drag to select multiple stations](#) [Help](#) [Hide map](#)



Server request timed out

Plot Selected

[Link to this page](#)

## Datasets

Category	Dataset
ARGO	<a href="#">Argo profiling floats</a>
Nearshore Sensors	<a href="#">Aggregate</a>
Nearshore Sensors	<b>NS01</b>
Nearshore Sensors	<a href="#">NS02</a>
Nearshore Sensors	<a href="#">NS03</a>
Nearshore Sensors	<a href="#">NS04</a>
Tide Gauges	daily data
Tide Gauges	hourly data
Tide Gauges	monthly data
Water Quality Buoy	WQB AW

## Variables

chlorophyll  
conductivity  
salinity  
**temperature**  
turbidity

## Plot type

### Time series plot

- Time series bar plot
- Property/Property plot
- Export data
- Export to Google Earth
- Export to Google Maps

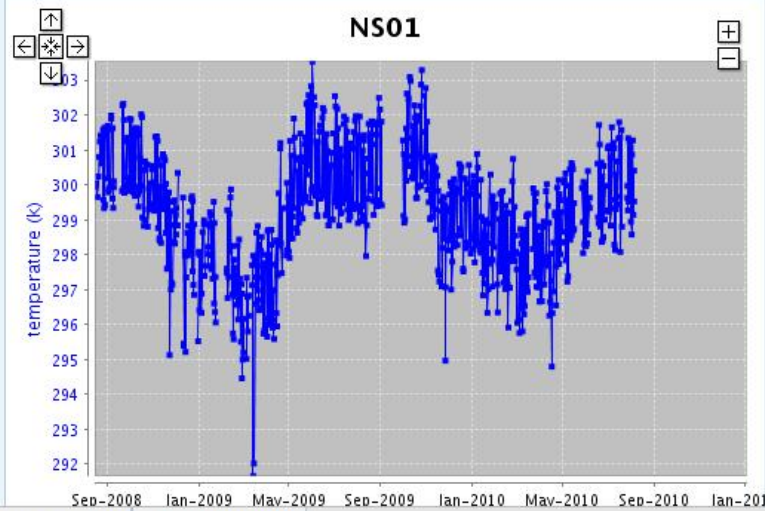
## Station filter

Lon

Lat

Z

Time



Plot selected [Link to this page](#)

## ncWMS Godiva2



- standalone or TDS built-in: view gridded data: produce maps and plots; animate

**data servers metadata services viewers**



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- view point or gridded data: dynamic plots or maps; download; Google Maps/Earth

## ERDDAP: Environmental Research Division's Data Access Program



- view/download gridded data or download point data; get table; embed elsewhere

Pacific Islands Ocean Observing System

PacOOS

## ERDDAP > [griddap](#) > Make a Graph

Dataset Title: **Simulating WAVes Nearshore (SWAN) Regional Wave Model: Oahu**  
Dataset ID: SWAN\_Oahu\_Best [RSS](#) [Email](#)  
Institution: University of Hawaii  
Information: [Summary](#) | [Variables](#) | [Background](#) | [Data Access Form](#)

Graph Type: surface  
X Axis: longitude  
Y Axis: latitude  
Color: mdir

**Dimension Ranges**

time (UTC) specify just 1 value → Start: 2010-08-10T09:00:00Z Stop:

altitude (m) specify just 1 value →

latitude (degrees\_north)  +

longitude (degrees\_east)  +

### Graph Settings

Color Bar:  Continuity:  Scale:

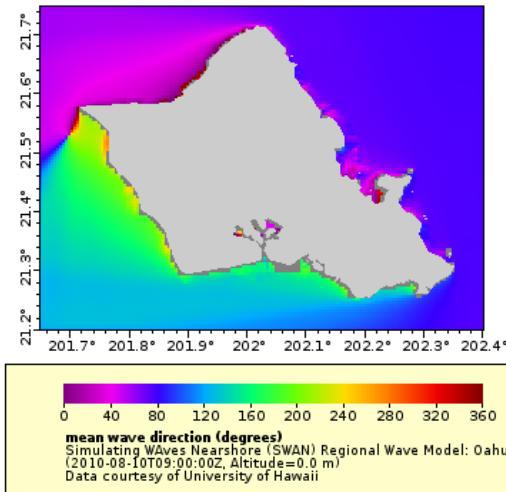
Min:  Max:  N Sections:

Draw the land mask:

**Redraw the Graph**

Then set the File Type:  and

or view the URL: [http://oos.soest.hawaii.edu/erddap/griddap/SWAN\\_Oahu\\_E](http://oos.soest.hawaii.edu/erddap/griddap/SWAN_Oahu_E)



## Things You Can Do With Your Graphs

- Web page authors can [embed a graph of the latest data in a web page](#) using HTML `<img>` tags.
- Anyone can use [Slide Sorter](#) to build a personal web page that displays graphs of the latest data, each in its own, draggable slide.
- Anyone can use or make [Google Gadgets](#) to display images with the latest data on their iGoogle home page.

The Dataset Attribute Structure (.dap) for this Dataset

## ncWMS Godiva2



- standalone or TDS built-in: view gridded data: produce maps and plots; animate

**data servers metadata services viewers**



## LAS: Live Access Server



- view gridded data: produce maps and plots; animate, compare, Google Earth, download

## DChart: Dapper Chart



- view point or gridded data: dynamic plots or maps; download; Google Maps/Earth

## ERDDAP: Environmental Research Division's Data Access Program



- view/download gridded data or download point data; get table; embed elsewhere

## Google Maps API and Google Earth



- HiOOS Data Viewer: one application for viewing all our data, plus others (in progress)

Pacific Islands Ocean Observing System

PacOOS

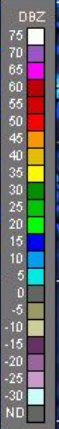
Shift+drag to zoom



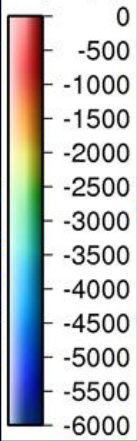
More... Map Satellite Terrain

Fish Aggregation Device (FAD)

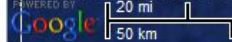
ID Buoy FF  
 Location Pukaulua Point, Maui  
 Latitude 20° 50' 07"  
 Longitude -155° 43' 54"  
 Depth 828 fathoms  
[Hawaii Fish Aggregation Devices](#)



depth (m)



cursor: 19.5131, -160.7189



POWERED BY Google

# future directions



- integrate remaining station data (time series) into viewer
- fish and wildlife: distribution maps
- time zone support in viewer: HST, UTC, Local
- CF 1.6, ncSOS
- get away from KML
- gliders and Argo floats into viewer
- search box in viewer
- Google Maps API Version 3
- mobile devices?



**? or !**

**John Maurer**

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University of Hawai'i at Mānoa



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