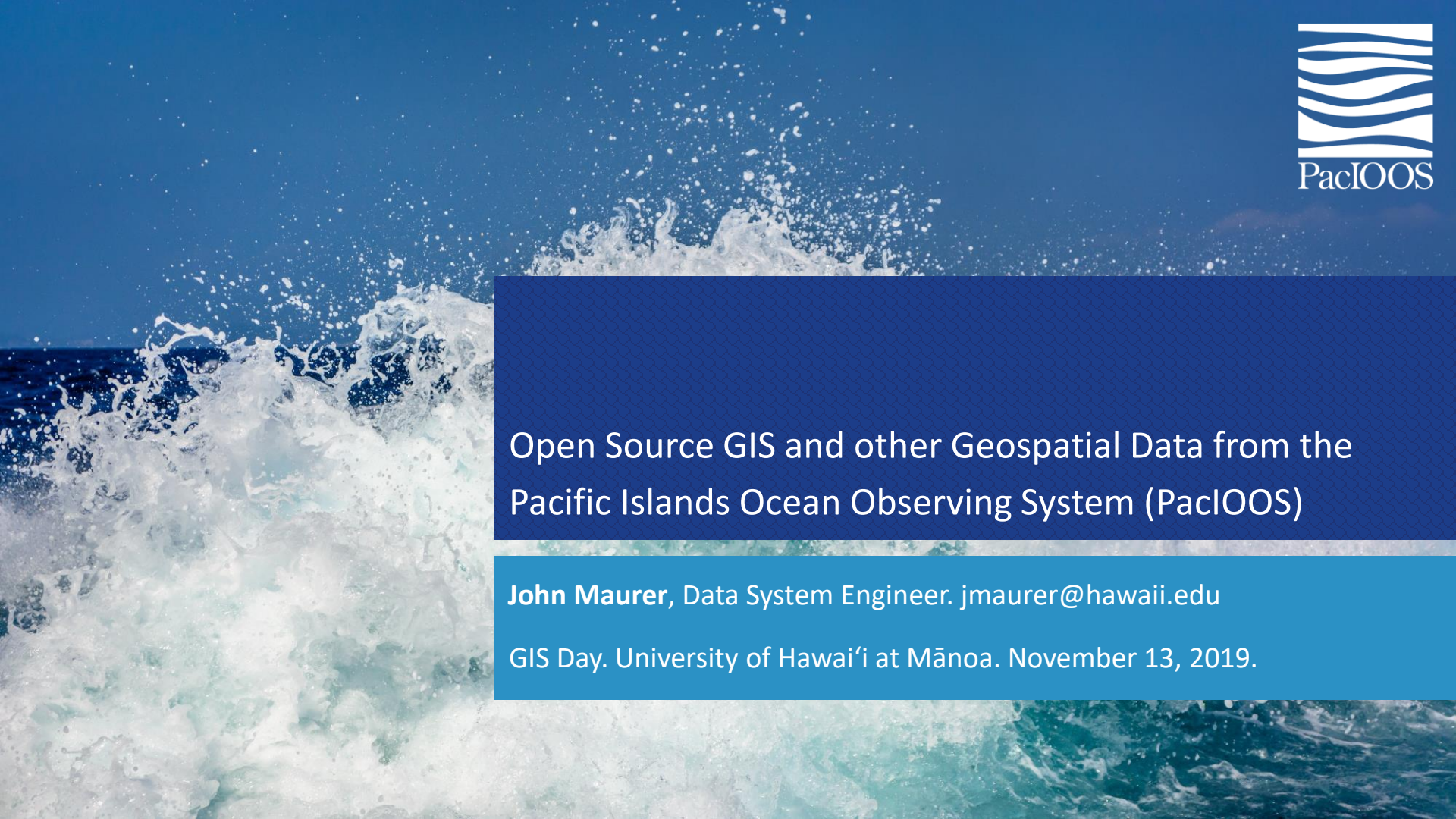


Open Source GIS and other Geospatial Data from the Pacific Islands Ocean Observing System (PacIOOS)

John Maurer, Data System Engineer. jmaurer@hawaii.edu

GIS Day. University of Hawai‘i at Mānoa. November 13, 2019.

OPEN SOURCE GIS

PacIOOS
PACIFIC ISLANDS OCEAN OBSERVING SYSTEM

QGIS

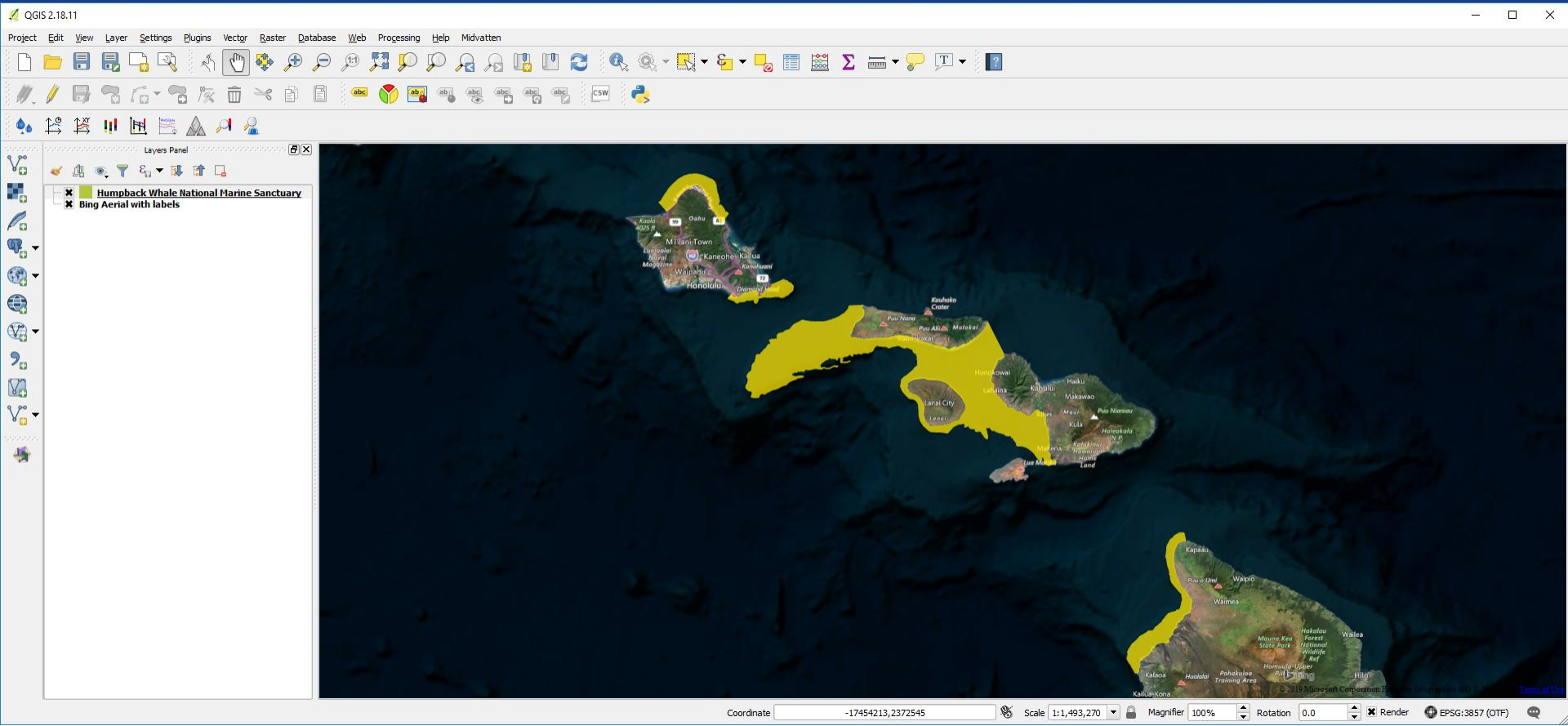
http://qgis.org

OPEN SOURCE GIS

PacIOOS
PACIFIC ISLANDS OCEAN OBSERVING SYSTEM

QGIS

http://qgis.org



OPEN SOURCE GIS

PacIOOS
PACIFIC ISLANDS OCEAN OBSERVING SYSTEM

GeoServer

http://geoserver.org

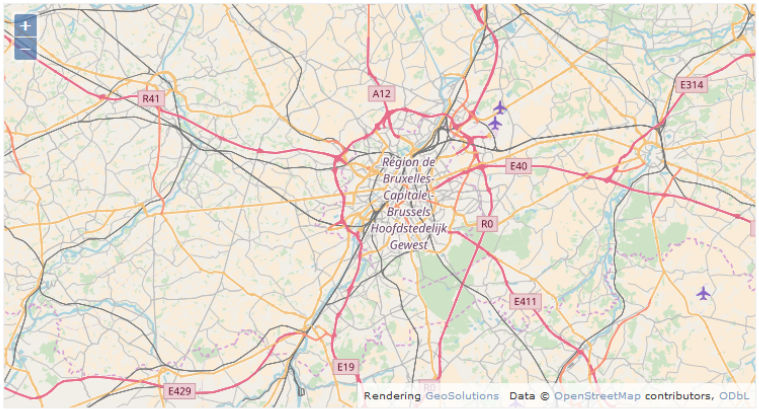
GeoServer

About | Blog | Download | Documentation | Community

Fork me on GitHub

GeoServer is an open source server for sharing geospatial data.

Designed for interoperability, it publishes data from any major spatial data source using open standards.



Download

Stable	Maintenance	Development
2.16.0	2.15.3	Master
Nightly	Nightly	

News

GeoServer 2.15.3 released

We are pleased to announce the release of GeoServer 2.15.3 with downloads (zip|war), documentation (html) and extensions. This is a maintenance release recommended for production. This release is made in conjunction with GeoTools 21.3 and GeoWebCache 1.15.3. Thanks to everyone who contributed to this release. For more information see the GeoServer 2.15.3 release notes. Improvements and Fixes This release [...]

GeoServer 2.16.0 released

We are happy to announce the release of GeoServer 2.16.0. Downloads are available (zip and war) along with docs and extensions. This is a GeoServer release candidate made in conjunction with GeoTools 22.0. Faster map rendering of complex styles If you have very complex styles, with lots of rules and complex filtering conditions you'll be pleased to hear [...]

Join Me in Funding an Important GeoServer Initiative

TLTR GeoServer Project has been at the forefront of the standards-based geospatial web since 2001. Meanwhile, it's been some years since GeoServer has been formally certified OGC-compliant. There is an opportunity to permanently improve how this is done by boosting a crucial component of the GeoServer software build infrastructure. OSGeo has put forth an initiative and [...]

OGC Implementation

GeoServer implements industry standard OGC protocols such as Web Feature Service (WFS), Web Map Service (WMS), and Web Coverage Service (WCS). Additional formats and publication options are available as extensions including Web Processing Service (WPS), and Web Map Tile Service (WMTS).

GeoServer is working with the OSGeo Foundation to be certified as compliant and we need your help. We ask for your sponsorship or donation to integrate OGC testing into our nightly build. See blog post for details.

Part of a Vibrant Open Source Community

GeoServer is developed, tested, and supported as community-driven project by a diverse group of individuals and organizations around the world. We are proud to be a recognized Open Source Geospatial Foundation project.

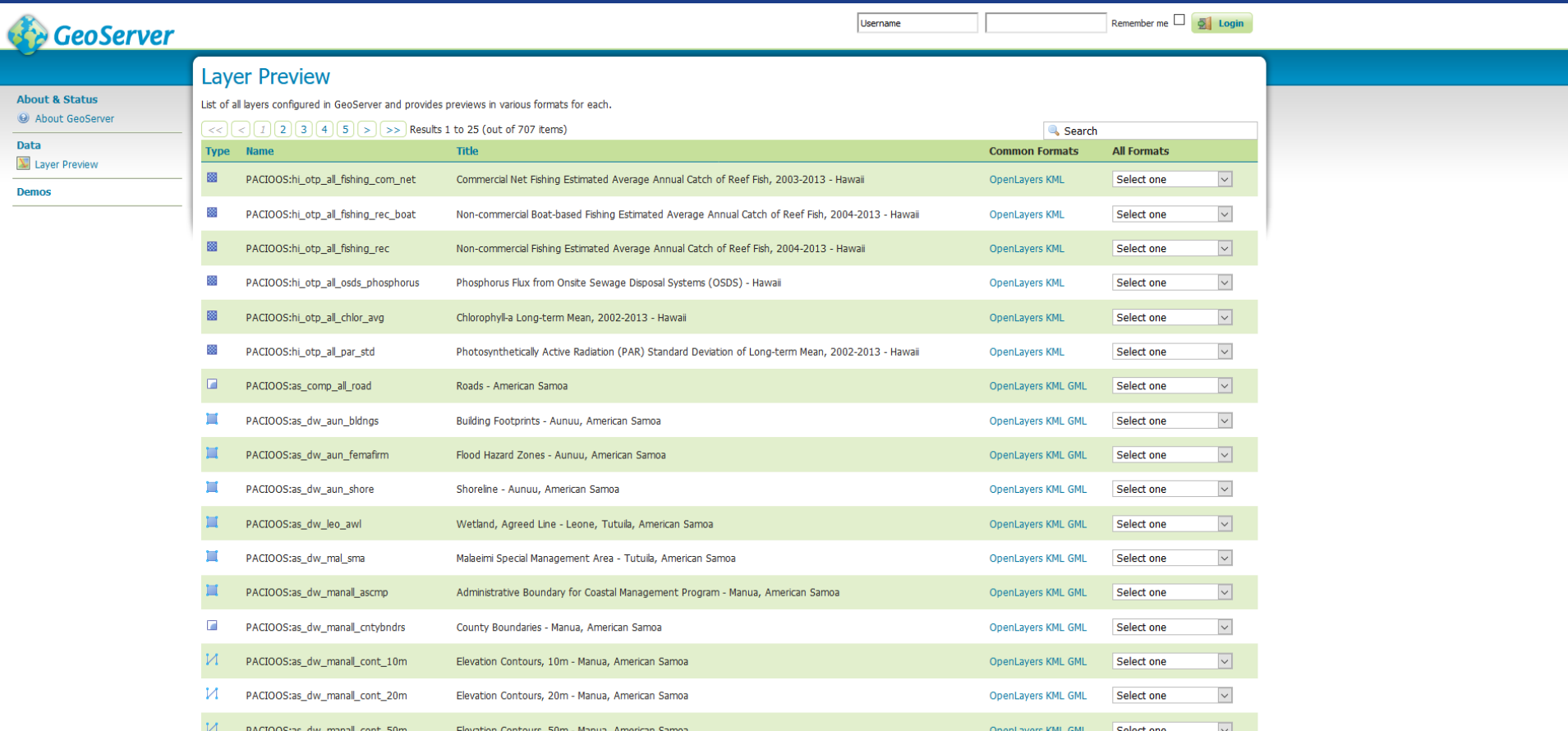
GeoServer participates in the annual Free and Open Source Software for Geospatial conference, join us in Bucharest for FOSS4G 2019!

OPEN SOURCE GIS

PacIOOS
PACIFIC ISLANDS OCEAN OBSERVING SYSTEM

GeoServer

http://pacioos.org/geoserver/



OPEN SOURCE GIS

PacIOOS
PACIFIC ISLANDS OCEAN OBSERVING SYSTEM

Web Mapping APIs

http://leafletjs.com

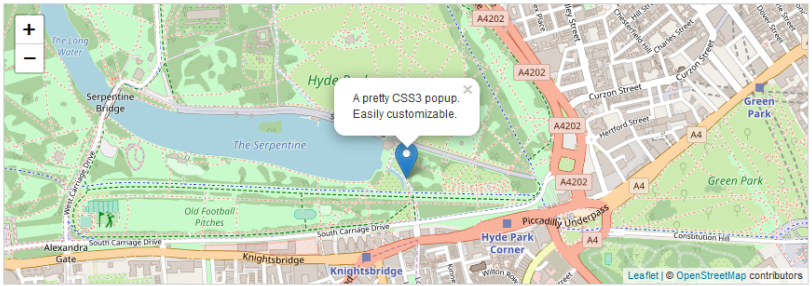
https://cloud.google.com/maps-platform/

Leaflet

an open-source JavaScript library
for mobile-friendly interactive maps

Leaflet is the leading open-source JavaScript library for mobile-friendly interactive maps. Weighing just about 38 KB of JS, it has all the mapping features most developers ever need.

Leaflet is designed with *simplicity*, *performance* and *usability* in mind. It works efficiently across all major desktop and mobile platforms, can be extended with lots of plugins, has a beautiful, easy to use and well-documented API and a simple, readable source code that is a joy to contribute to.



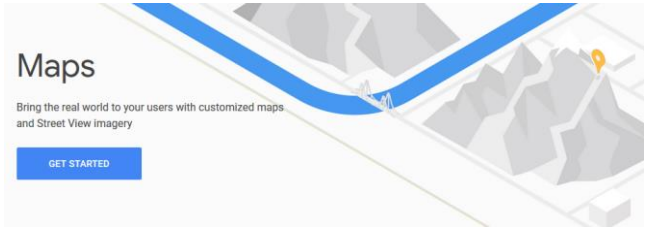
Here we create a map in the `'map'` div, add tiles of our choice, and then add a marker with some text in a popup:

```
var map = L.map('map').setView([51.505, -0.09], 13);

L.tileLayer('https://{s}.tile.openstreetmap.org/{z}/{x}/{y}.png', {
    attribution: '&copy; <a href="https://www.openstreetmap.org/copyright">OpenStreetMap</a> contributors'
}).addTo(map);

L.marker([51.5, -0.09]).addTo(map)
    .bindPopup('A pretty CSS3 popup.<br> Easily customizable.')
    .openPopup();
```

Google Maps Platform



ADD A MARKER TO A MAP | ADD A MAP IN ANDROID | ADD A MAP IN IOS | APPLY CUSTOM STYLING


```
        https://developers.google.com
/maps/documentation/javascript/tutorial
    -->
    <link rel="stylesheet" href="/maps/documentation
/javascript/cgc/demos.css">
  </head>
  <body>
    <div id="map"></div>
    <script>
      function initMap() {
        var myLatLng = {lat: -25.363, lng: 131.044};

        // Create a map object and specify the DOM
element
        // for display.
        var map = new
google.maps.Map(document.getElementById('map'), {
          center: myLatLng,
          zoom: 4
        });

        // Create a marker and set its position.
        var marker = new google.maps.Marker({
          map: map,
          position: myLatLng,
          title: 'Hello World!'
        });
      }

    </script>
    <script src="https://maps.googleapis.com/maps/api
/js?key=YOUR_API_KEY&callback=initMap"
        async defer></script>
  </body>
</html>
```

OPEN SOURCE GIS

Open Geospatial Consortium (OGC)

http://www.opengeospatial.org

- Web Map Service (WMS)
- Web Feature Service (WFS)
- Web Coverage Service (WCS)
- Catalog Service for the Web (CSW)

U.S. INTEGRATED OCEAN OBSERVING SYSTEM

PacIOOS
PACIFIC ISLANDS OCEAN OBSERVING SYSTEM

Regional Associations

- IOOS is part of NOAA (National Ocean Service)
- 11 Regional Associations
- IOOS feeds into GOOS (Global Ocean Observing System)

PacIOOS REGION

PacIOOS
PACIFIC ISLANDS OCEAN OBSERVING SYSTEM

IOOS
Integrated Ocean Observing System

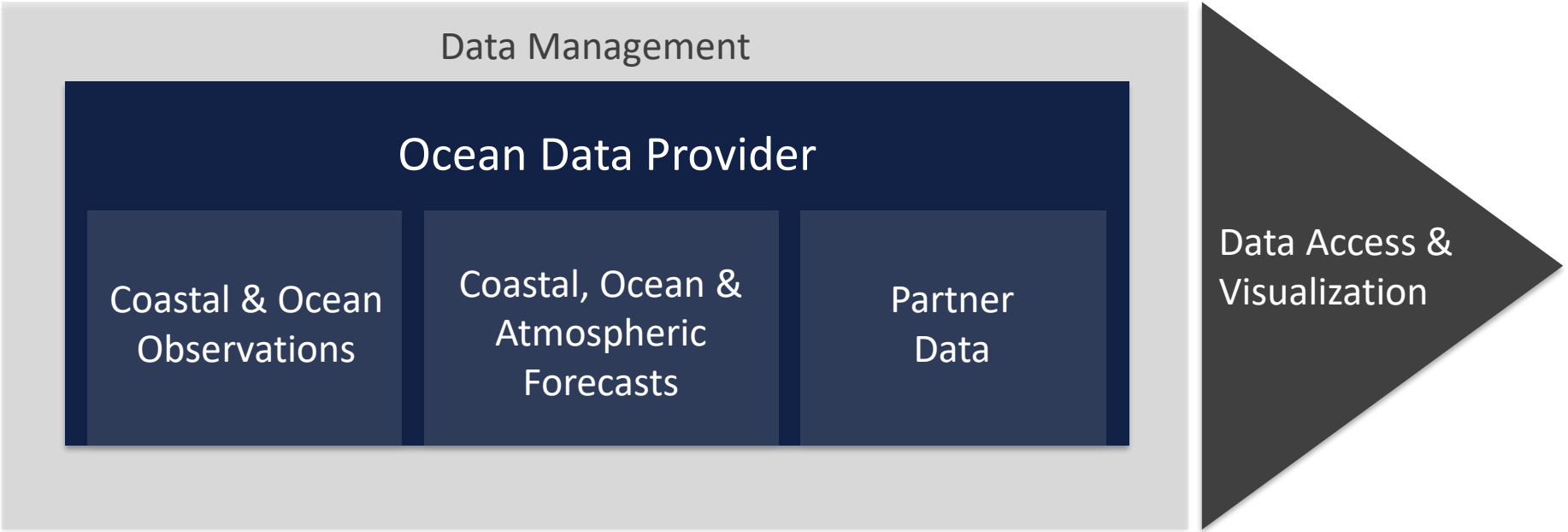
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY
UNIVERSITY OF HAWAI'I AT MĀNOA

UNIVERSITY OF HAWAI'I
UA MAU KE EA O KA 'ĀINA I KA PONO
1907

PACIFIC ISLANDS OCEAN OBSERVING SYSTEM (PacIOOS)

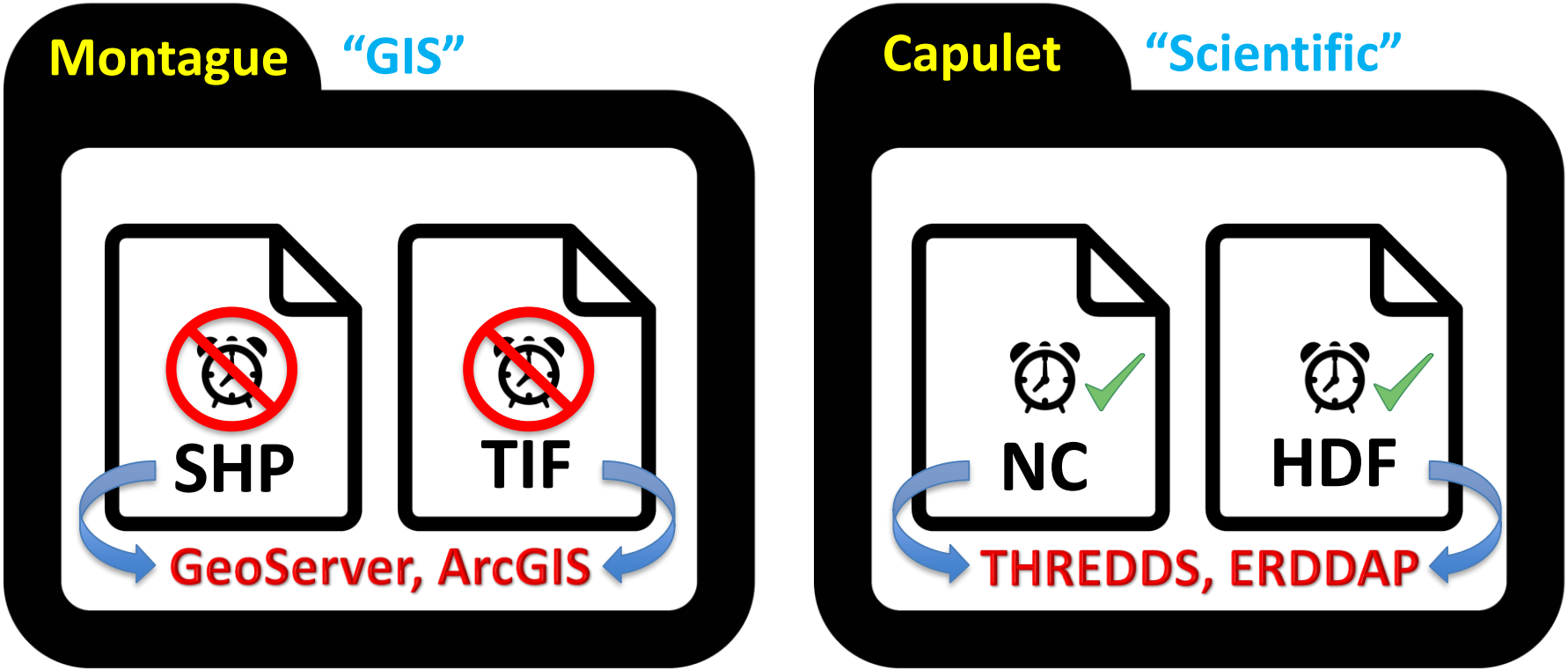
What is PacIOOS?



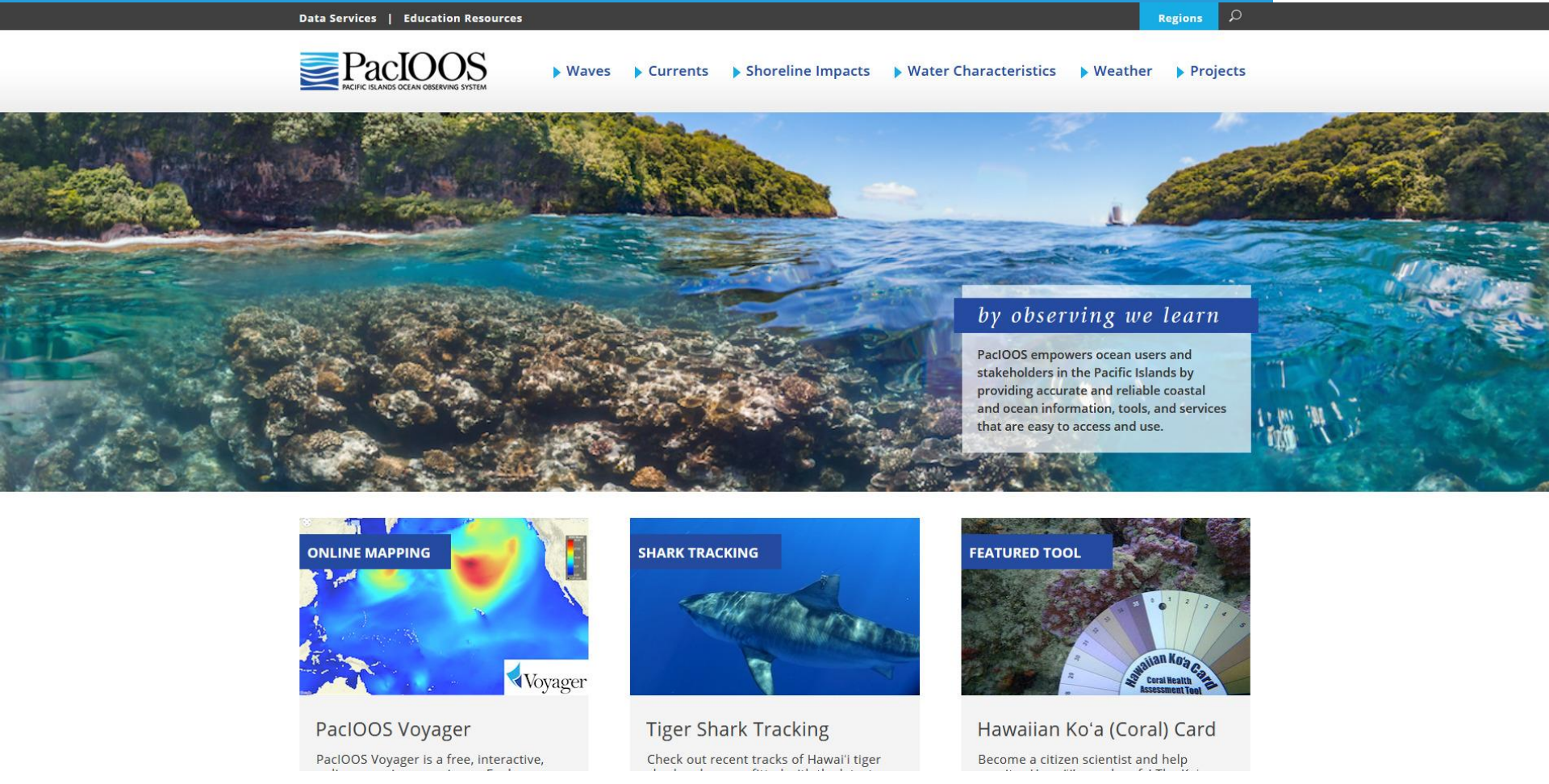
MISSION *- PacIOOS empowers ocean users and stakeholders throughout the Pacific Islands by providing accurate and reliable coastal and ocean information, tools, and services that are easy to access and use.*

STATIC vs. DYNAMIC GEODATA

A House Divided



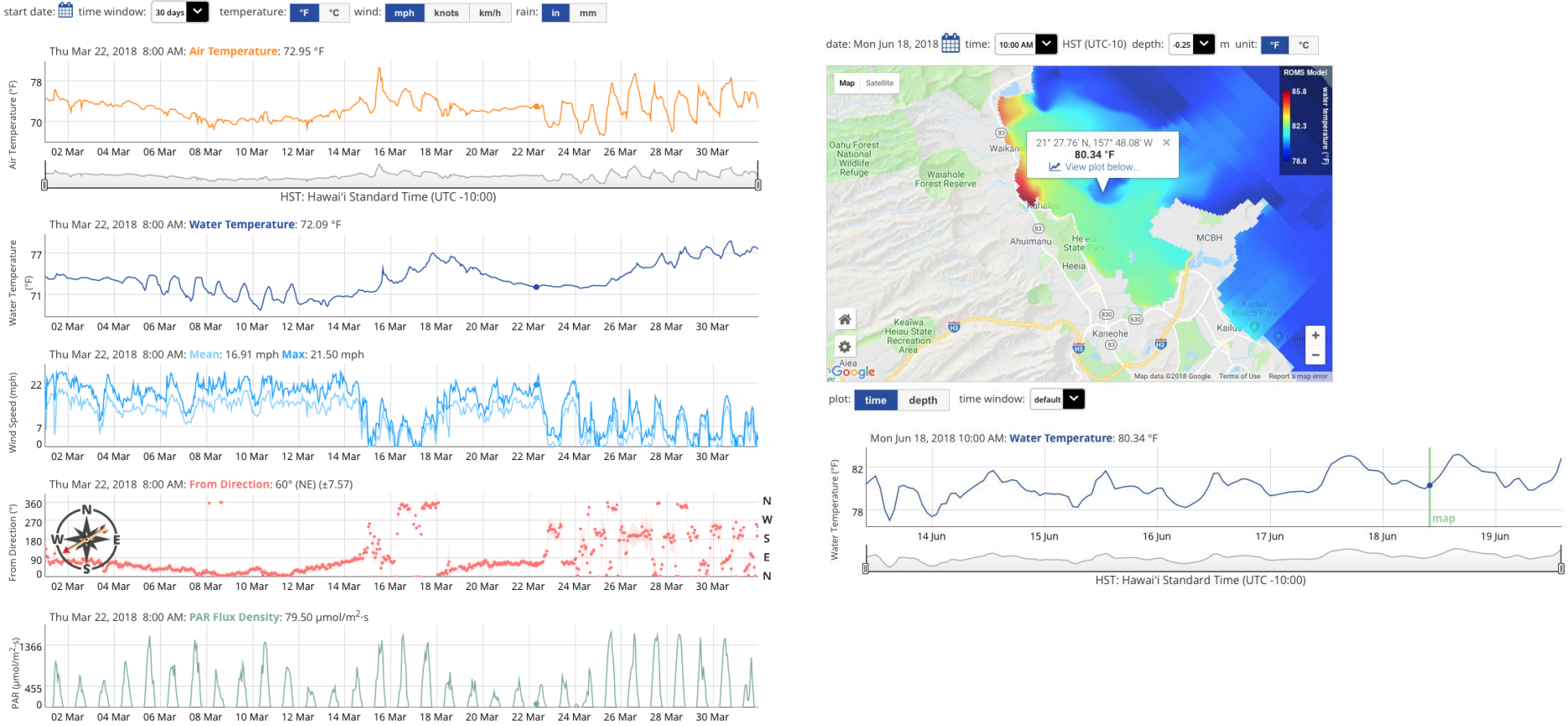
PacIOOS website: http://pacioos.org



DYNAMIC DATA: TIME SERIES

PacIOOS
PACIFIC ISLANDS OCEAN OBSERVING SYSTEM

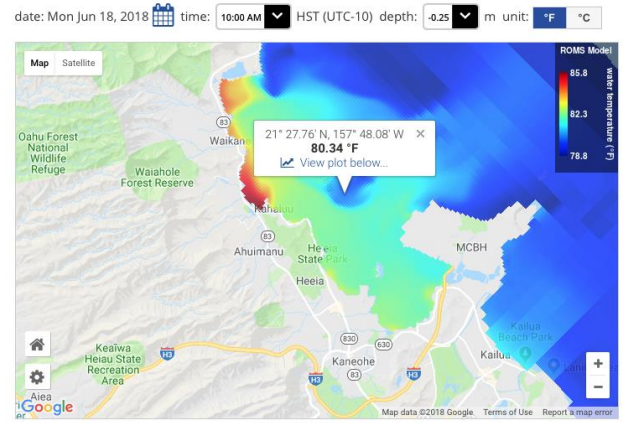
Observations (*left*) and Forecasts (*right*)

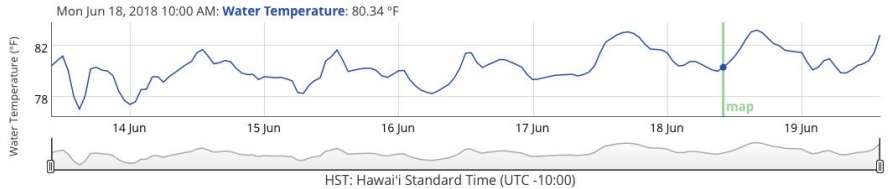


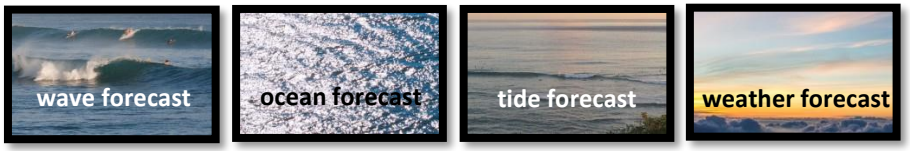
DYNAMIC DATA: TIME SERIES

PacIOOS
PACIFIC ISLANDS OCEAN OBSERVING SYSTEM

Observations (*left*) and Forecasts (*right*)







DYNAMIC DATA: DATA SERVERS

ERDDAP

http://pacioos.org/erddap/

PacIOOS ERDDAP
Easier access to scientific data

ERDDAP > tabledap > Make A Graph

Dataset Title: **PacIOOS Water Quality Buoy 04 (WQB-04): Hilo Bay, Big Island, Hawaii**
Institution: Pacific Islands Ocean Observing System (PacIOOS) (Dataset ID: WQB-04)
Range: longitude = -155.082 to -155.082°E, latitude = 19.7341 to 19.7341°N, depth = 1.0 to 1.0m, time = 2010-10-23T10:00:00Z to 2019-11-12T19:00:00Z
Information: Summary | License | FGDC | ISO 19115 | Metadata | Background | Subset | Data Access Form

Graph Type: lines
X Axis: time
Y Axis: temperature

Constraints	Optional Constraint #1	Optional Constraint #2
time	>= 2019-10-01T00:00:00Z	<= 2019-11-01T00:00:00Z
	>=	<=
	>=	<=
	>=	<=
	>=	<=

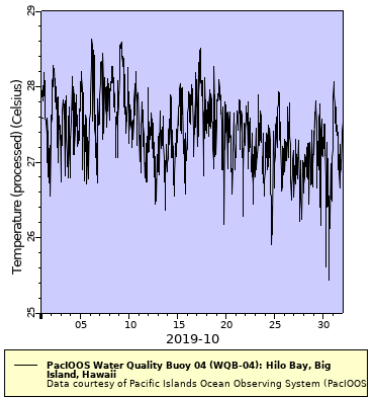
Server-side Functions
distinct()

Graph Settings
Color:
Y Axis Minimum: Maximum: Ascending

Redraw the Graph (Please be patient. It may take a while to get the data.)

Optional:
Then set the File Type: .htmlTable (File Type information)
and Download the Data or an Image
or view the URL: https://pae-paha.pacioos.hawaii.edu/erddap/tabledap/WQB-04.htr
(Documentation / Bypass this form)

Time range: 1 month(s)



Things You Can Do With Your Graphs

Well, you can do anything you want with your graphs, of course. But some things you might not

DYNAMIC DATA: DATA SERVERS

THREDDS Data Server (TDS)

http://pacioos.org/thredds/

PacIOOS TDS

THREDDS Data Server

Catalog http://oos.soest.hawaii.edu/thredds/catalog/hioos/roms_forec/hiig/catalog.html

Dataset: ROMS Hawaii Regional Ocean Model/Best Time Series

- *Data format:* netCDF
- *Data type:* GRID
- *Naming Authority:* org.pacioos
- *ID:* hioos/roms_forec/hiig/ROMS_Hawaii_Regional_Ocean_Model_best.ncd

Documentation:

- **summary:** Best time series, taking the data from the most recent run available.
- **summary:** Regional Ocean Modeling System (ROMS) 7-day, 3-hourly forecast for the region surrounding the main Hawaiian Islands at approximately 4-km resolution. Boundary conditions provided by the global, 1/12-degree (~9-km) HYbrid Coordinate Ocean Model (HYCOM). Atmospheric forcing generated by the Weather Research and Forecasting (WRF) model for the region surrounding the main Hawaiian Islands (WRF_HI) at approximately 6-km resolution. Tide forcing uses the Oregon State University (OSU) Tidal Prediction Software (OTPS) TOPEX/Poseidon global inverse solution (TPXO) to derive barotropic tidal elevation and velocity. Data are assimilated over the previous 3 days using all available observations to improve the model estimate of current ocean state (its "nowcast") before forecasts are run. Assimilated observations may include satellite-based sea surface temperatures from MODIS, AVHRR, or OSTIA; satellite-based sea surface height from AVISO; surface currents from PacIOOS high-frequency radios (HFR); and in-situ water temperature and salinity profiles from ARGO floats and ocean glider autonomous underwater vehicles (AUV). While considerable effort has been made to implement all model components in a thorough, correct, and accurate manner, numerous sources of error are possible. As such, please use these data with the caution appropriate for any ocean related activity.
- **rights:** These model data were generated as part of an academic research project, and the principal investigator, Brian Powell (powellb@hawaii.edu), asks to be informed of intent for scientific use and appropriate acknowledgment given in any publications arising therefrom. The data are provided free of charge, without warranty of any kind.
- **funding:** The Pacific Islands Ocean Observing System (PacIOOS), funded through the National Oceanic and Atmospheric Administration (NOAA), is a Regional Association within the U.S. Integrated Ocean Observing System (IOOS). PacIOOS is coordinated by the University of Hawaii School of Ocean and Earth Science and Technology (SOEST).
- PacIOOS ROMS Hawaii
- Regional Ocean Modeling System (ROMS)
- Pacific Islands Ocean Observing System (PacIOOS)

Access:

1. **OPENDAP:** /thredds/dodsC/hioos/roms_forec/hiig/ROMS_Hawaii_Regional_Ocean_Model_best.ncd
2. **NetcdfSubset:** /thredds/ncss/hioos/roms_forec/hiig/ROMS_Hawaii_Regional_Ocean_Model_best.ncd
3. **WMS:** /thredds/wms/hioos/roms_forec/hiig/ROMS_Hawaii_Regional_Ocean_Model_best.ncd
4. **WCS:** /thredds/wcs/hioos/roms_forec/hiig/ROMS_Hawaii_Regional_Ocean_Model_best.ncd
5. **ISO:** /thredds/iso/hioos/roms_forec/hiig/ROMS_Hawaii_Regional_Ocean_Model_best.ncd
6. **NCML:** /thredds/ncml/hioos/roms_forec/hiig/ROMS_Hawaii_Regional_Ocean_Model_best.ncd

Contributors:

- Dr. Brian Powell **(Principal Investigator)**
- Dr. Jim Potemra **(Data Manager)**

Keywords:

- Earth Science Services > Models > Ocean General Circulation Models (OGCM)/Regional Ocean Models **(GCMD Science Keywords)**
- Earth Science Services > Models > Weather Research/Forecast Models **(GCMD Science Keywords)**
- Earth Science > Oceans > Ocean Temperature > Potential Temperature **(GCMD Science Keywords)**
- Earth Science > Oceans > Salinity/Density > Salinity **(GCMD Science Keywords)**
- Earth Science > Oceans > Sea Surface Topography > Sea Surface Height **(GCMD Science Keywords)**

PARTNER DATA: GIS

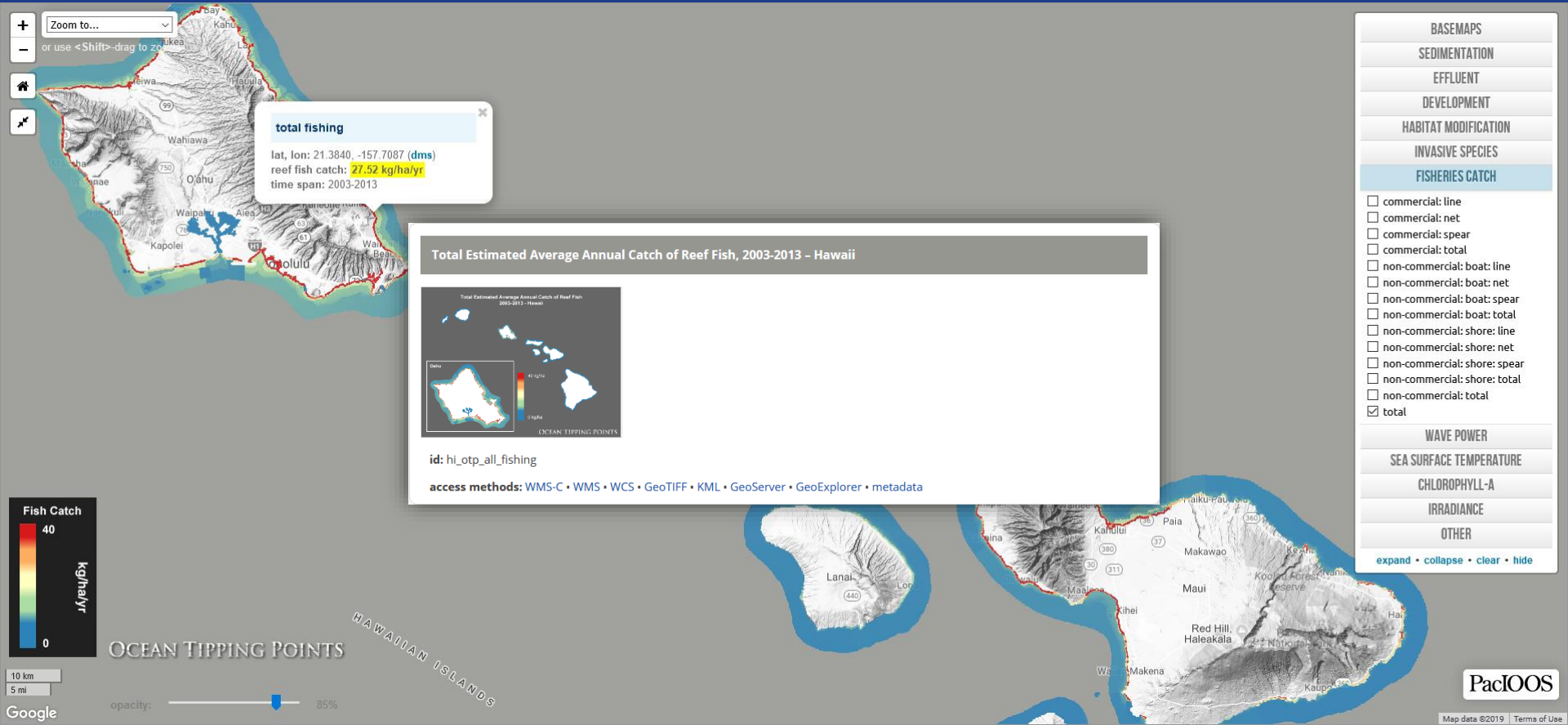
Ocean Tipping Points

http://pacioos.org/projects/otp/

PARTNER DATA: GIS

Ocean Tipping Points

http://pacioos.org/projects/otp/



PARTNER DATA: GIS

Estimated Coral Cover in Hawai'i

http://pacioos.org/projects/coral/

PARTNER DATA: GIS

PacIOOS
PACIFIC ISLANDS OCEAN OBSERVING SYSTEM

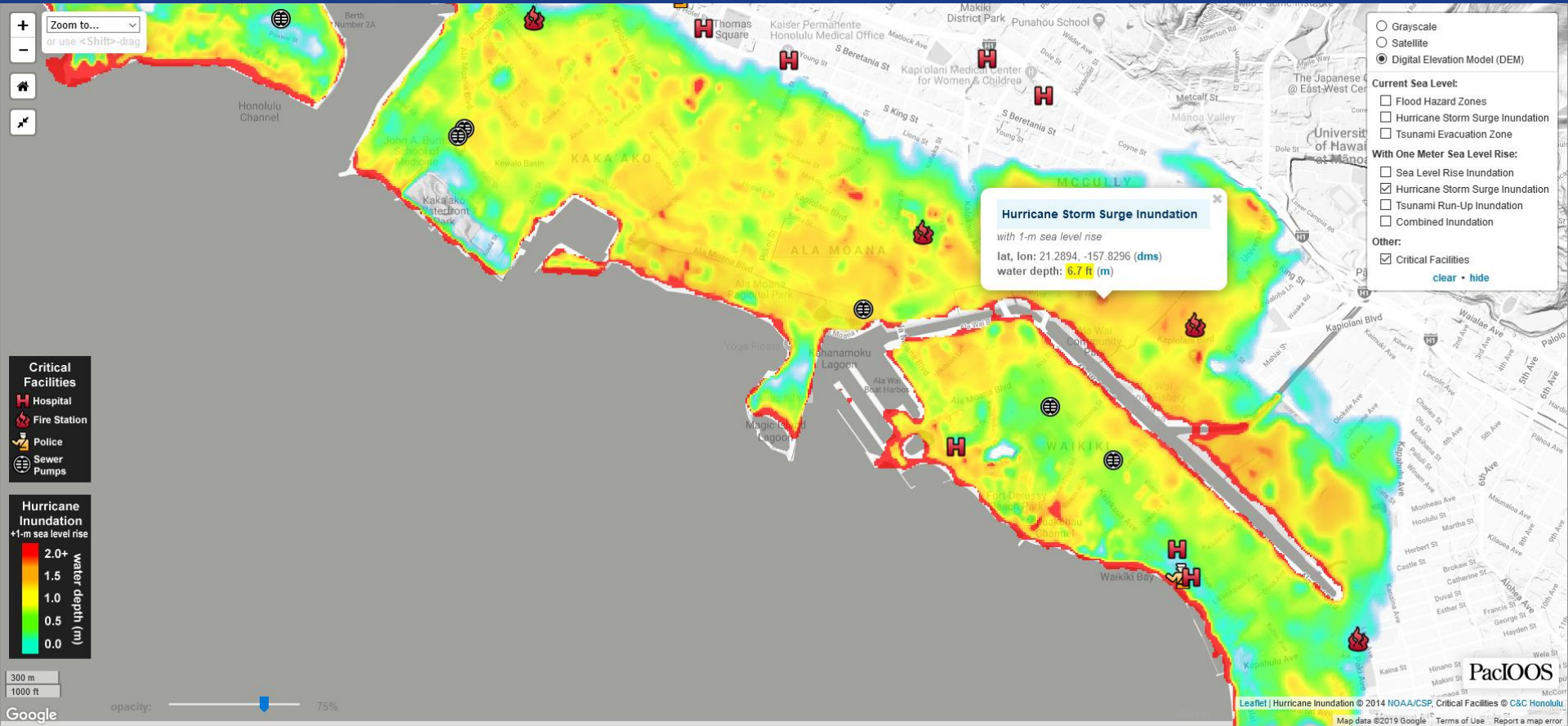
Hawai'i Sea Level Rise Viewer

http://pacioos.org/shoreline/slr-hawaii/

PARTNER DATA: GIS

Honolulu Sea Level Rise Inundation Risk

http://pacioos.org/shoreline/slr-honolulu/



PARTNER DATA: GIS

PacIOOS
PACIFIC ISLANDS OCEAN OBSERVING SYSTEM

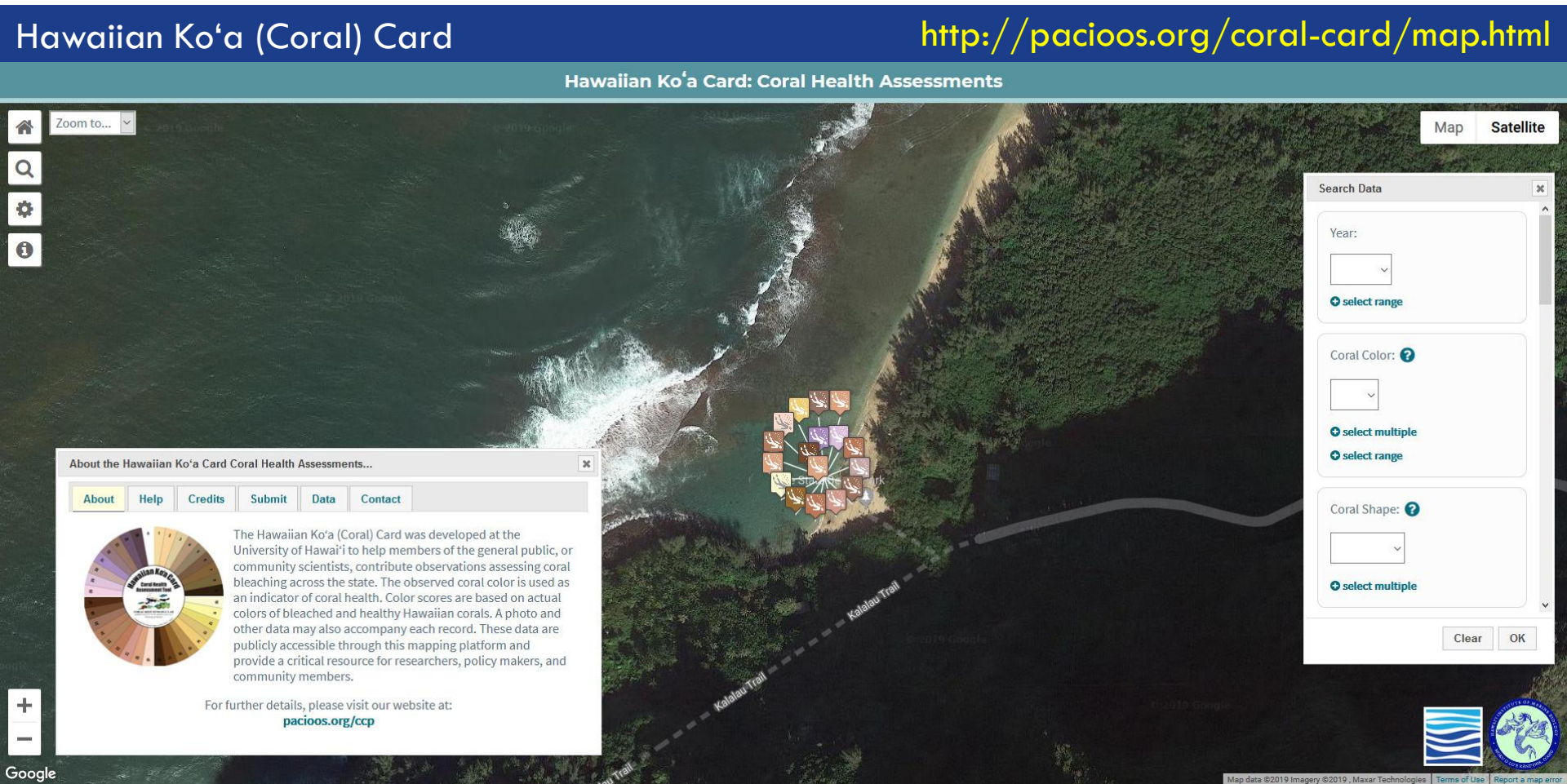
King Tides Project

http://pacioos.org/king-tides/map.html

PARTNER DATA: GIS

Hawaiian Koʻa (Coral) Card

http://pacioos.org/coral-card/map.html

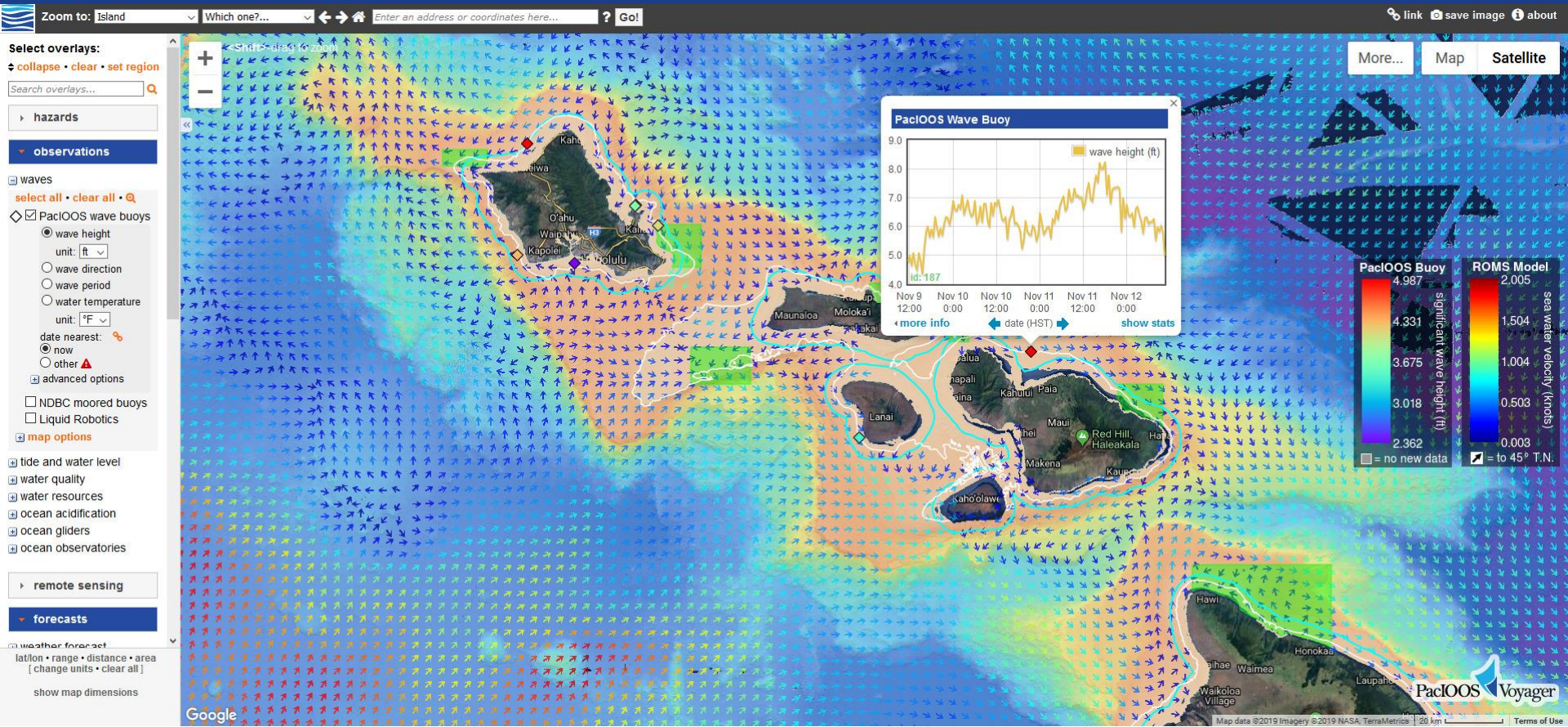


DATA PORTAL

PacIOOS
PACIFIC ISLANDS OCEAN OBSERVING SYSTEM

PacIOOS Voyager

http://pacioos.org/voyager/



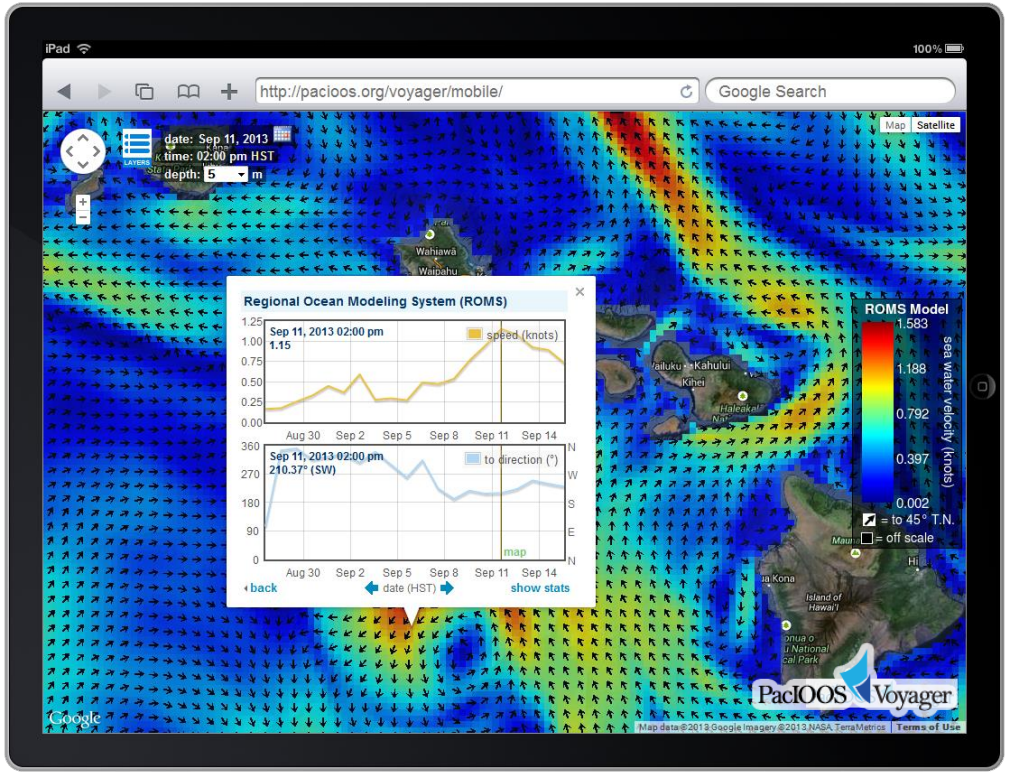
DATA PORTAL

PacIOOS

PacIOOS Voyager Mobile

http://pacioos.org/voyager/mobile/

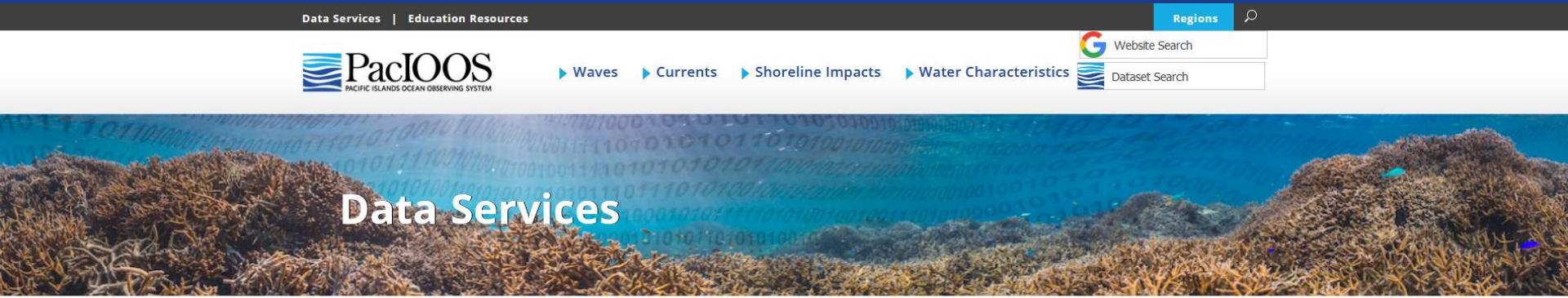
Voyager



DATA SEARCH

Catalog Service for the Web (CSW)

http://pacioos.org/data/search/



Home / Data Services / Data Search

SHARE

Data Services : Data Search

Search for datasets at PacIOOS. For more information on our OGC®-compliant Catalog Service for the Web (CSW) and other metadata resources, click here. To search all U.S. IOOS® datasets, click here.

Basic

Search datasets... Or click a keyword below...

Aquatic Assemblages Atmosphere Bathymetry Biological Biology Biosphere Boundaries Census Cetaceans Chemistry Chlorophyll Circulation Classification Coastal Conductivity Coral Currents Direction Doppler Ecology Ecosystems Environmental Fish Fisheries Forecast Global Guam Habitat Hawaii Height Hilo Honolulu Human Humidity Kauai Lanai Landforms Longwave Mammals Mariana Marshall Maui Micronesia Models Molokai Monitoring Oahu Oceans OGCM Oxygen Pago Palau Period

DATA SERVICES

- PacIOOS Voyager
- Data Access
- Data Search
- Metadata
- Data Management Support

DATA ACCESS

THREDDS

DATA SEARCH

PacIOOS
PACIFIC ISLANDS OCEAN OBSERVING SYSTEM

Catalog Service for the Web (CSW)

http://pacioos.org/data/search/

Data Services : Data Search Results

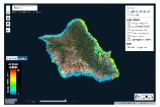
Search for datasets at PacIOOS. Powered by pycsw. For more information on our OGC® compliant Catalog Service for the Web (CSW) and other metadata resources, click here.

text: coral, **S:** 18.5941° **W:** -160.4498° **N:** 22.4364° **E:** -154.5996°, **exclude global:** true

Showing **20** of **87** results • modify search • new search

Page **4** of **5**

Predicted Coral Cover in the Hawaiian Islands



id: hi_ef_all_coralreefs

Output from a model to predict the total benthic cover of six coral species (Montipora capitata, Montipora flabellata, Montipora patulla, Porites lobata, Porites compressa, Porites meandrina) in the Hawaiian Islands as a proportion (0-1.0). Coral cover was modeled with boosted regression trees (BRT) in R software using data from coral cover surveys and environmental covariates derived from models and/or observations including wave height, benthic geomorphology, and downwelled irradiance. The best performing BRT model was used to predict coral cover for the entire geographic study domain. Data and model output represent conditions for shallow coral reefs in the Hawaiian Islands from 0 m to -30 m depth over the time period 2000-2009. Further ... More Details

keywords: show

access methods: HTML • WMS-C • WMS • WCS • GeoTIFF • KML • GeoServer • GeoExplorer

DATA SERVICES

PacIOOS Voyager

Data Access

Data Search

Metadata

Data Management Support

DATA ACCESS

THREDDS

ERDDAP

LAS

GeoServer

Data Interoperability

Plug-and-play with PacIOOS data in your chosen software or programming language using standardized web services protocols like OPeNDAP, Web Map Service

METADATA

PacIOOS
PACIFIC ISLANDS OCEAN OBSERVING SYSTEM

ISO-19115 and FGDC

http://pacioos.org/data/metadata/

PacIOOS
PACIFIC ISLANDS OCEAN OBSERVING SYSTEM

Data Services | Metadata | Data Search

Predicted Coral Cover in the Hawaiian Islands

- Identification Information
- Data Quality Information
- Spatial Representation Information
- Distribution Information
- Metadata Reference Information

Metadata Views

ISO Text-Only
International Organization for Standardization (ISO) in plain text

ISO XML
International Organization for Standardization (ISO) in Extensible Markup Language (XML)

FGDC HTML
U.S. Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM)

Identification Information

Citation:

Citation Information:

Title: Predicted Coral Cover in the Hawaiian Islands

Date:

Date: January 25, 2016
Date Type: creation (CI_DateTypeCode)

Identifier:

Code: hi_ef_all_coralreefs
Authority: org.pacioos

Responsible Party:

Organization Name: Erik Franklin
Contact:

Online Resource:

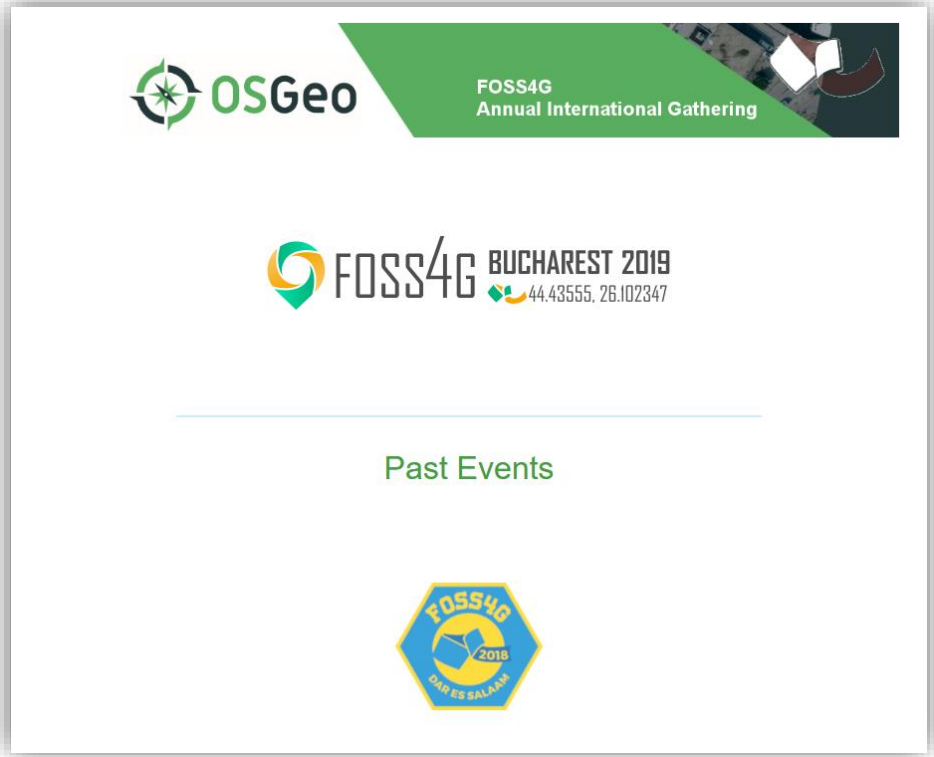
Linkage: https://sites.google.com/a/hawaii.edu/franklinlab/
Protocol: http
Function: information (CI_OnLineFunctionCode)

OPEN SOURCE GIS

PacIOOS
PACIFIC ISLANDS OCEAN OBSERVING SYSTEM

Free and Open Source Software for Geospatial (FOSS4G)

http://foss4g.org



Thank you!

Any questions?

STAY CONNECTED

info@pacioos.org

facebook.com/pacioos

@PacIOOS

http://pacioos.org