

KING TIDES PROJECT: Mobile GIS for Collecting and Mapping Photos

*"Snap the shore,
see the future"*

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Photo: Andre P. Seale



<http://PacifcIslandsKingTides.org>



- ▶ What are king tides?
- ▶ Project aims and evolution
- ▶ Mobile GIS: collecting geotagged photos
- ▶ Online mapping of photo database
- ▶ Dataset access



Nāwiliwili Small Boat Harbor, Kaua'i



Sands of Kahana, Maui



Māpunapuna, O'ahu



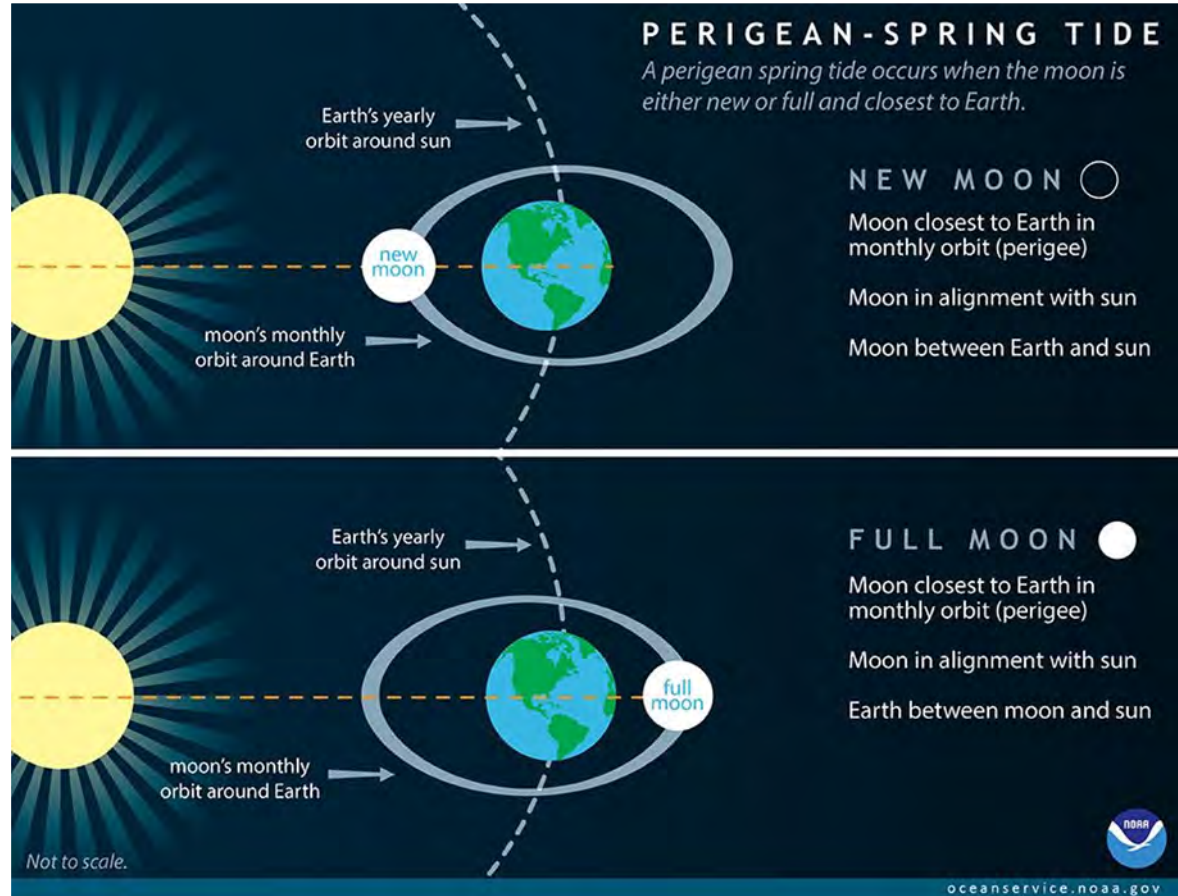
Richardson's Beach Park, Hawai'i

WHAT ARE KING TIDES?



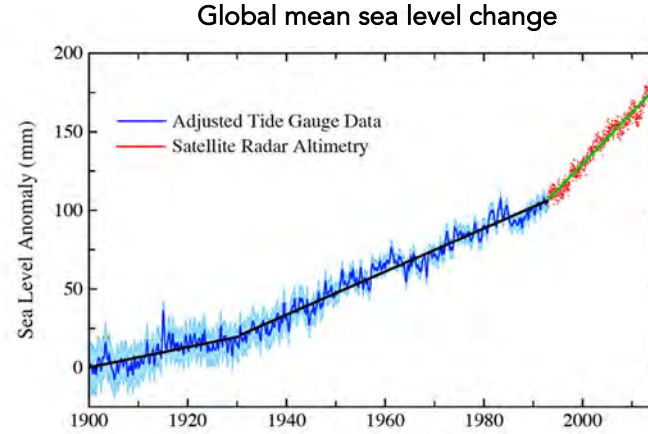
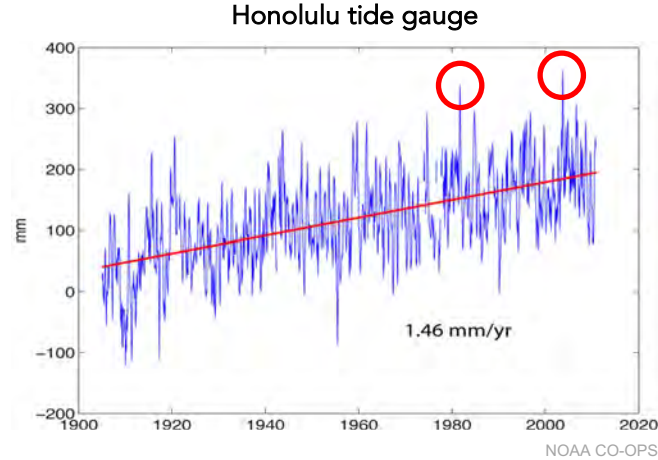
Herb Kawainui Kāne, "Wa'a Kaulua of Hawai'i"

King Tides = the HIGHEST high tides of the year.



WHY STUDY KING TIDES?

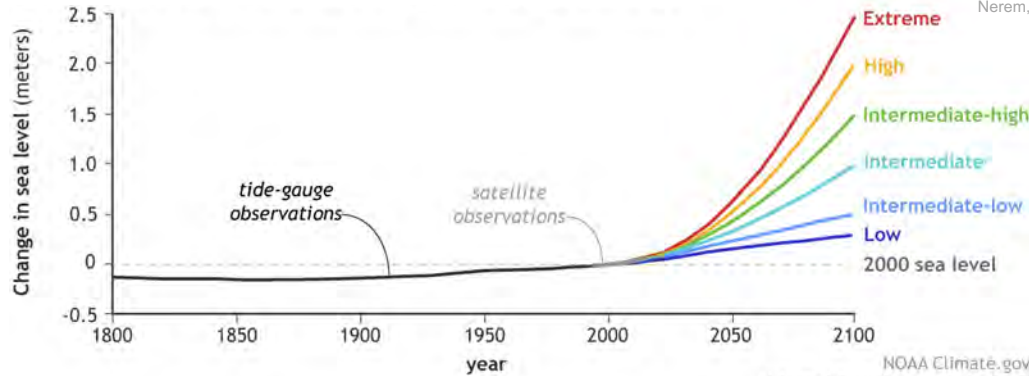
Sea Level Rise: Today's King Tides are tomorrow's average sea levels.



Adapted from Church and White 2011, Nerem et al. 2010, Yi et al. 2015, Hay et al. 2015, Hansen et al. 2016, Watson et al. 2015, Fasullo, Nerem, and Hamlington 2016.



Possible future sea levels for different greenhouse gas pathways



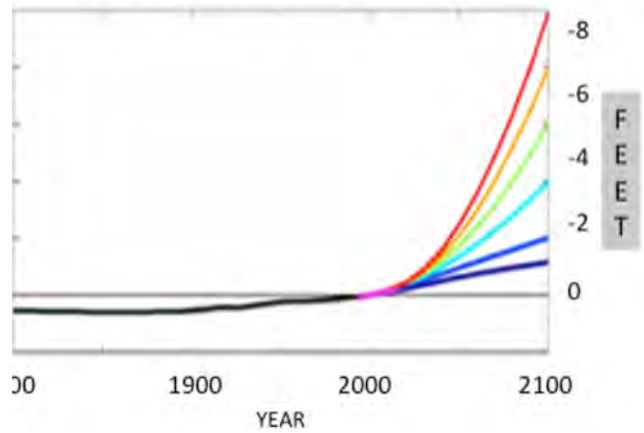
NOAA Climate.gov
Adapted from Sweet et al., 2017

HawaiiSeaLevelRiseViewer.org



Seeing is believing: Bring climate science projections to the here and now.

Six Projections for Rising Sea Level
2017 NOAA Technical Paper 083

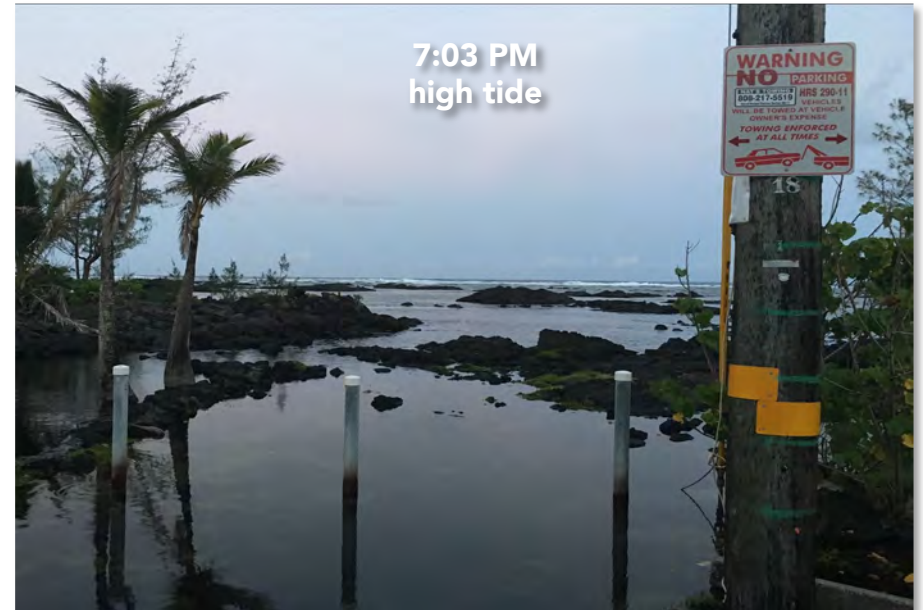


- ▶ abstract
- ▶ technical
- ▶ distant future
- ▶ vast geography

- ▶ place-based
- ▶ community-generated
- ▶ personal
- ▶ immediate time scales



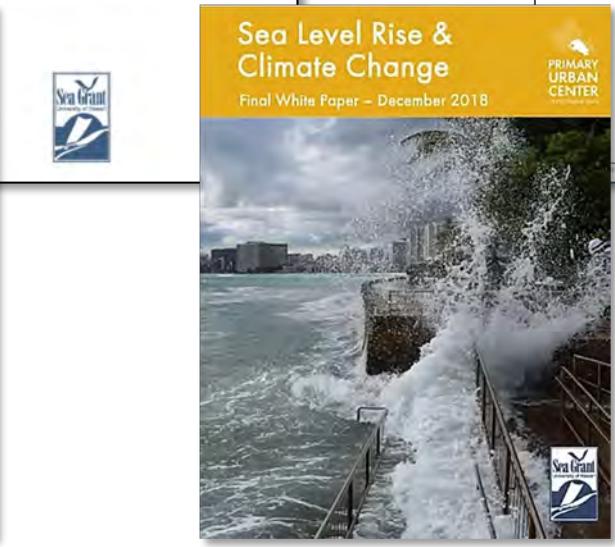
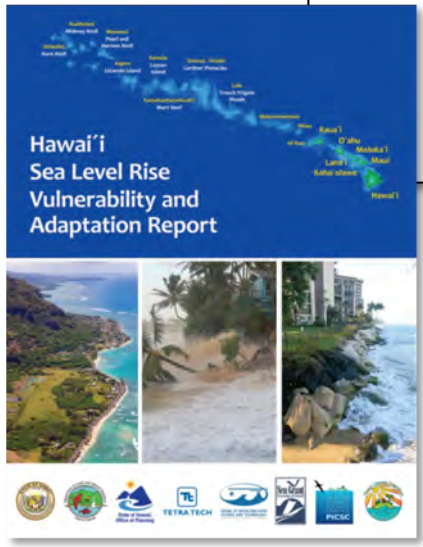
I ka nana, no a 'ike: By observing, we learn.
Document water levels during King Tides.



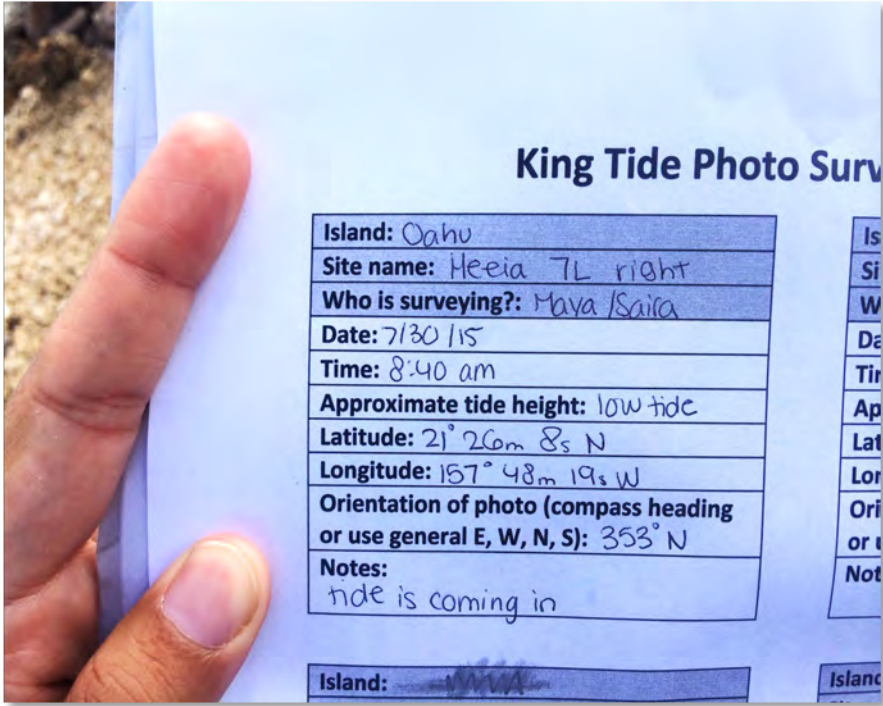
Kapoho tide pools, Hawai'i Island
May 29, 2017

Photos: Kristin Rajala

Kōkua: inform and support research, policy, and climate adaptation.



2015



Paper data sheets

Fill out Blue columns before survey

Island	Site name	Who is surveying?
Kauai	Kapaa Beach Park Pono Kai	Les Milnes and Jackie Marti
Kauai	Kapaa Beach Park Pono Kai	Les Milnes and Jackie Marti
Kauai	Kikiaola Harbor near west side breakwater, Waimea	
Kauai	Mamo Road, Waimea	donna lee
Kauai	Nawiliwili Harbor seawall	Ruby Pap
Kauai	Nawiliwili Harbor seawall	Ruby Pap
Kauai	Niumalu Beach Park	Carl Berg
Kauai	Niumalu Beach Park	Carl Berg
Kauai	Nawiliwili CG ramp	Carl Berg
Kauai	Nawiliwili CG ramp	Carl Berg
Kauai	Kaiola Canoe Club	Carl Berg
Kauai	Kaiola Canoe Club	Carl Berg

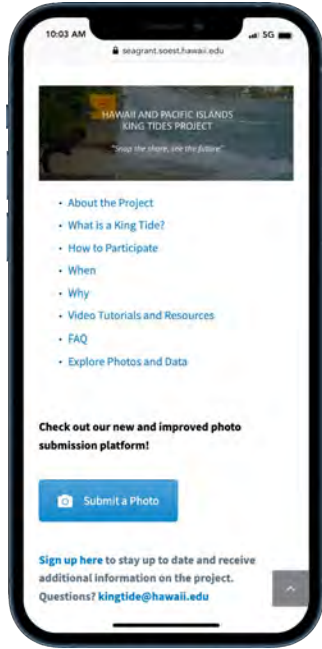
Google Sheets sign-up

2018

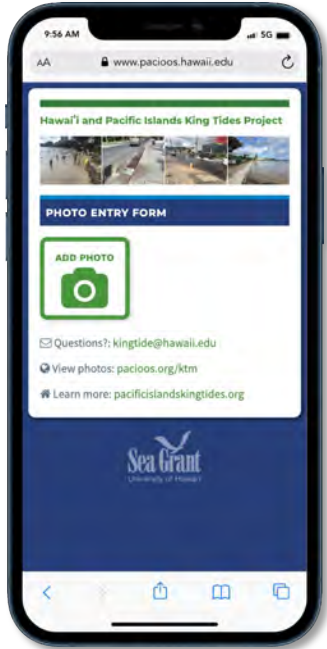
PacificIslandsKingTides.org

pacioos.org/kt

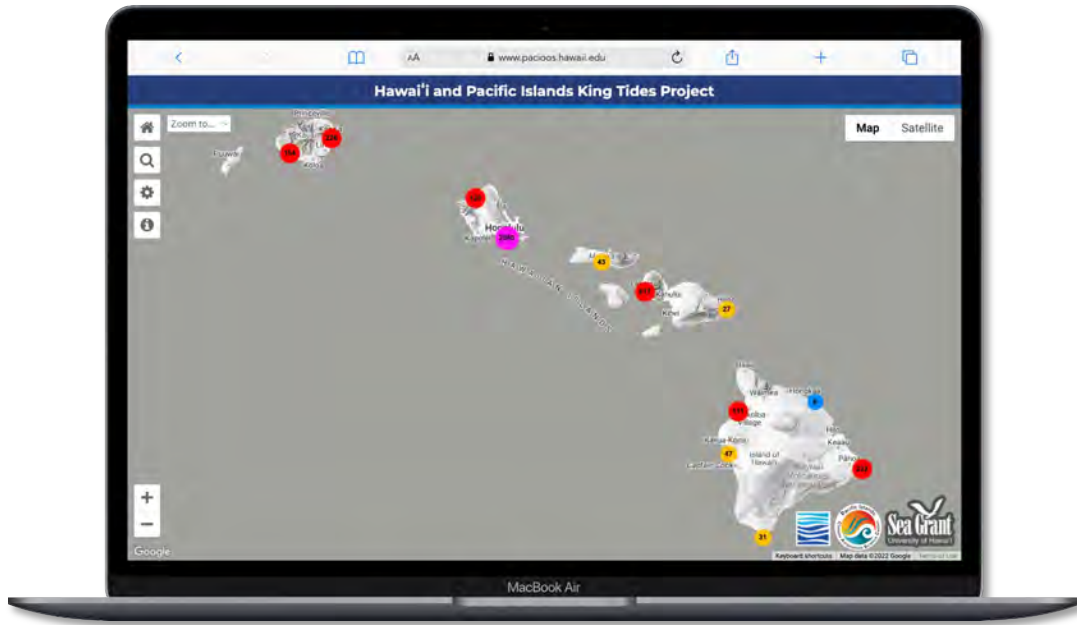
pacioos.org/ktm



website:
info and links



mobile GIS:
photo submission



online mapping:
find, view, and access photos

2022

as of August 1st

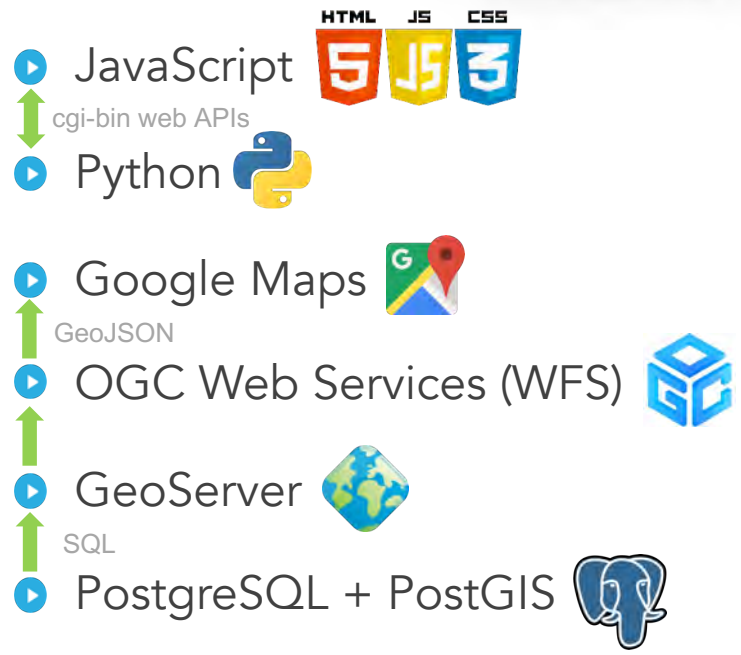
- ▶ **3,815** photos
- ▶ **469** unique contributors
- ▶ Spans **7 years**: 2015-2022
- ▶ **Hawaii**: 3,703 photos (97%)
American Samoa: 100 photos
RMI: 7 photos
Guam: 5 photos
- ▶ **3.6 GB**

Mahukona Harbor, Hawai'i Island
August 2, 2019



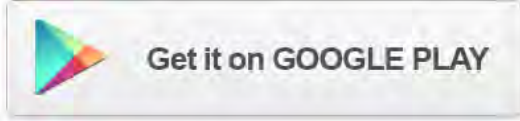


Technology stack:



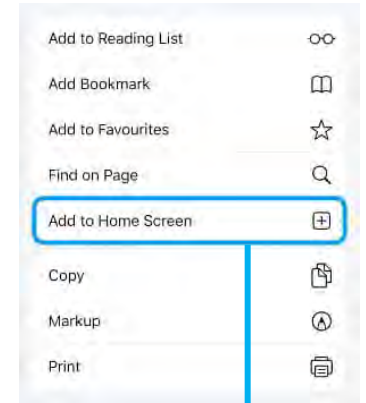


Native App



vs.

Web App



- ▶ works across **all** device types
- ▶ works on mobile **and** desktop
- ▶ **one** code base
- ▶ **familiar** development environment
- ▶ **real-time** deployment & updates



📍 Location

Latitude 20 deg 47' 25.31" N
 Longitude 156 deg 30' 40.31" W



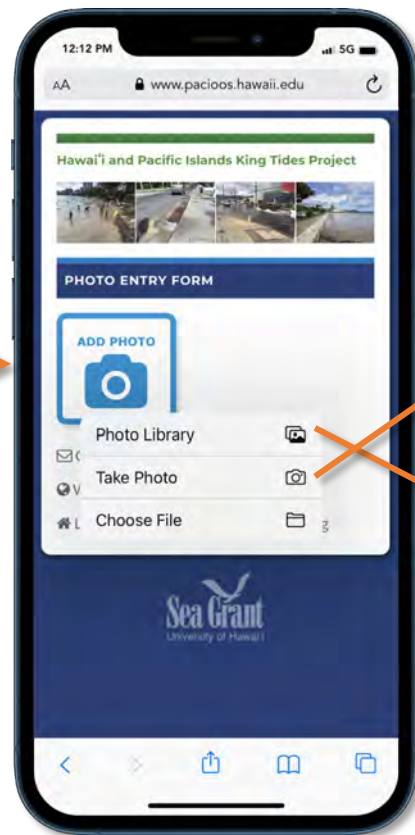
Image Metadata	
FileName	kingtides_202207291626__8ks9x2q.jpg
PixelXDimension	4032
PixelYDimension	3024
Orientation	1
Artist	Hawaii Sea Grant King Tides Project; Photographer, John Fitzpatrick
ImageDescription	Region: Maui, Hawaii. Location: Maalaea breakwall. Observations: High tide on a new moon king tide.
DateTime	2022:07:29 16:28:00 ← <i>no time zone</i>
GPSLatitude	20, 47, 25.31
GPSLatitudeRef	N
GPSLongitude	156, 30, 40.31
GPSLongitudeRef	W
Copyright	Copyright, Hawaii Sea Grant King Tides Project, 2022. Some rights reserved. Licensed under the Creative Commons Attribution 4.0 International License ("CC BY 4.0"). To view a copy of this license, visit https://creativecommons.org/licenses/by/4.0/

⋮ etc.



MOBILE GIS ▶ Photo Selection

Kamalo Wharf, Moloka'i, July 12, 2022 Photo: Barbara Bostwick





Got lat/Ing?
Photos with **EXIF GPS** coordinates get mapped automatically.



Need lat/Ing?
Otherwise, the user can navigate a **Google Map** to pin-point the location.



Locate Me
Allow **HTML5 Geolocate API** to find your position.
Requires HTTPS.



Search Map
Uses **Google Maps Geocoding Service** to find a location name.

1:19 PM www.pacioos.hawaii.edu

* Location Description (e.g., Waimea Bay):
Kamalo Wharf

* Tell us something about your photo:
Wharf parking area is partially inundated during the King Tide. Base of surrounding trees and vegetation are submerged.
122/254 char

Impact:
Flooding

* E-mail:
jane.doe@address.com

First Name:
Jane

Last Name:
Doe

* Indicates required field

By uploading an image you irrevocably consent that it may be used for educational, research, outreach and promotional purposes, in any medium, in perpetuity.

12:12 PM www.pacioos.hawaii.edu

AA * Location Description (e.g., Waimea Bay):
Kamalo Wharf

* Tell us something about your photo:
Wharf parking lot is partially submerged during the King Tide. Base of surrounding trees and vegetation are submerged.
118/254 char

Coastal Erosion

Wave Run-Up

Flooding

Storm Drainage

No Impact

I Don't Know

Other



<http://pacioos.org/king-tides/photos/>

Region	Island	Year	Month	File	
<ul style="list-style-type: none">00README.txtguam/hawaii/nwhi/other/rmi/samoa/	<ul style="list-style-type: none">hawaii/kauai/maui/molokai/oahu/	<ul style="list-style-type: none">2015/2016/2017/2018/2019/2020/2021/2022/	<ul style="list-style-type: none">06/07/	<ul style="list-style-type: none">kingtides_202207121417_vkzntsmv.jpgkingtides_202207121418_h57gqz6.jpgkingtides_202207121446_u421uzqd.jpgkingtides_202207121533_s5vgikpw.jpgkingtides_202207121539_vyyledqu.jpgkingtides_202207121545_n2s0dsi6.jpgkingtides_202207121545_plwlr9_9.jpgkingtides_202207121545_revcj56n.jpgkingtides_202207121547_awanubeb.jpgkingtides_202207121553_wi2tiv7a.jpgkingtides_202207121556_04lp1pne.jpgkingtides_202207121558_zuxbyoiv.jpgkingtides_202207131015_juixaj5i.jpgkingtides_202207131015_qx273ixc.jpgkingtides_202207131021_7un974_5.jpg	

Fort DeRussy Groin, O'ahu, July 12, 2022, 2:17 PM
Photo: Eric Teeplees

http://pacioos.org/king-tides/photos/hawaii/oahu/2022/07/kingtides_202207121417_vkzntsmv.jpg

PostGIS: Spatial Database

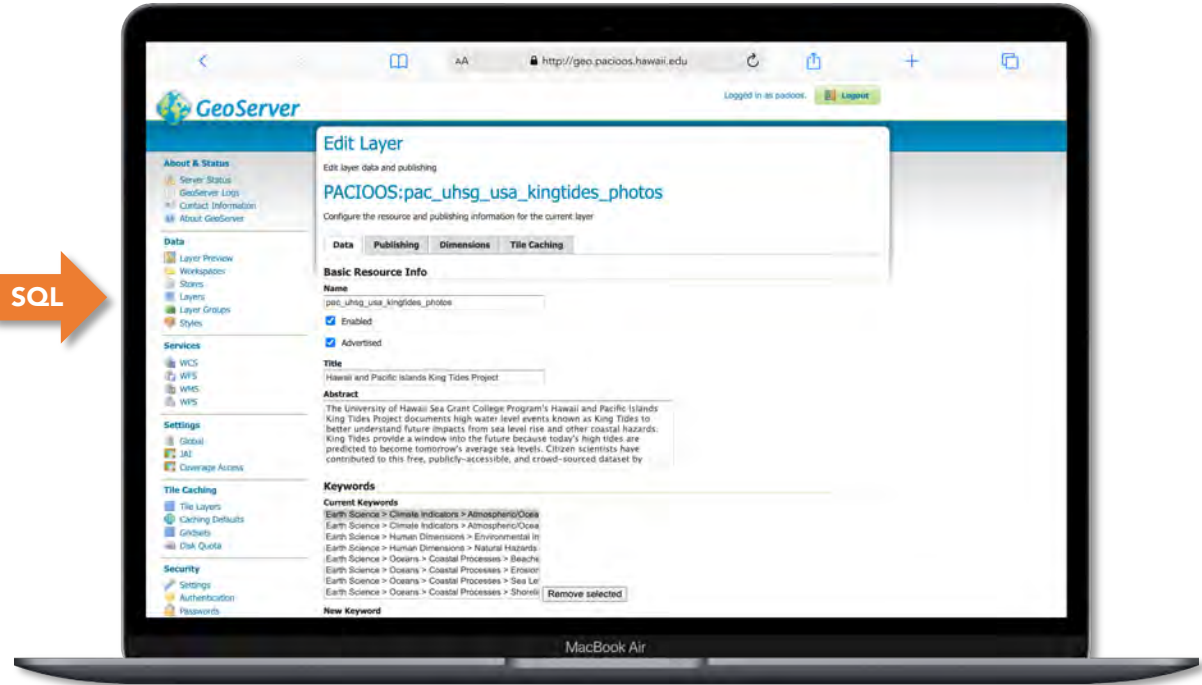
```

INSERT INTO "PAC_DAT".pac_uhsg_usa_kingtides_photos (
  photo_id,
  date,
  first_name,
  last_name,
  region,
  location,
  impact,
  comment,
  photo_url,
  submit_lat,
  submit_lon,
  size_bytes,
  md5,
  geom
)
VALUES (
  3807,
  '2022/07/14 09:31',
  'Kelley',
  'Anderson Tagarino',
  'American Samoa',
  'Nuuuli, Coconut Point',
  'flooding',
  'King tides plus strong winds have pushed water into
the back of the coconut point lagoon causing coastal
flooding',
  'http://pacioos.org/king-tides/photos/nwhi/2016
/12/kingtides_201612161238_RuTjpy.jpg',
  -14.317487,
  -170.701752,
  1397514,
  '6aeb9a30a13785d79cc059406a16eed9',
  ST_GeomFromText('POINT( -170.701752 -14.317487 )',
4326)
);

```



GeoServer: Online GIS



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



[king-tides] new photo: maui: John Fitzpatrick
1 message

PacIOOS <info@pacioos.org> Fri, Jul 29, 2022 at 4:29 PM
Reply-To: John Maurer <jmaurer@hawaii.edu>
To: John Maurer <jmaurer@hawaii.edu>

The following photo was submitted to the King Tides photo database:



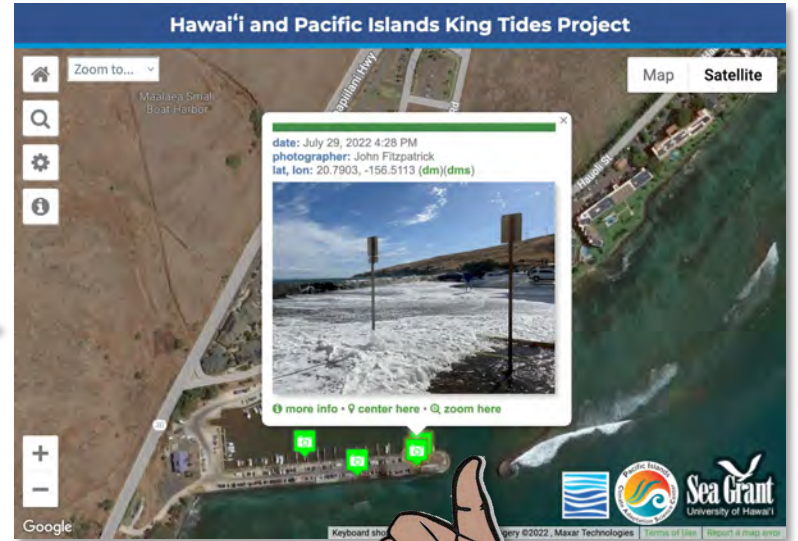
http://www.pacioos.hawaii.edu/king-tides/photos/hawaii/maui/2022/07/kingtides_202207291628_0yy1ixgr.jpg
<http://www.pacioos.hawaii.edu/king-tides/map.html?id=3828>

Record #: 3828
Name: John Fitzpatrick
Date: Fri Jul 29, 2022 04:28 PM
Impact: Wave Run-Up
Island(s): Maui
Latitude, Longitude: 20.790291°, -156.511252°
Location Description: Maalaea breakwall
Comment:
High tide on a new moon king tide.

Size: 1.8 MB
MD5: b435b7804c92c408d0b3fc346fa62cd7
User-Agent: Mozilla/5.0 (iPhone; CPU iPhone OS 15_5 like Mac OS X) AppleWebKit/605.1.15 (KHTML, like Gecko) Version/15.5 Mobile/15E148 Safari/604.1
Browser: Safari 15.5
Device: iPhone 15.5

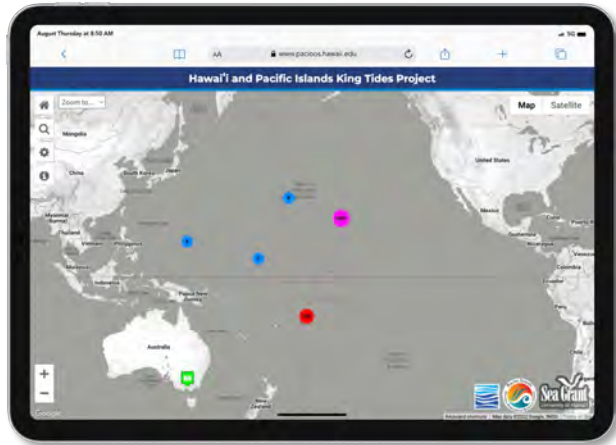


King Tides online map

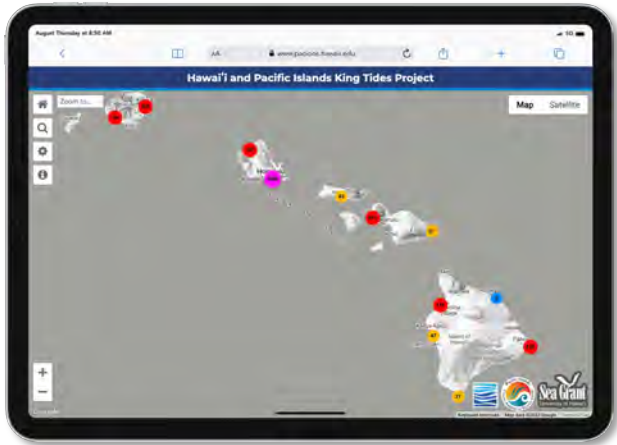


<http://pacioos.org/ktm>

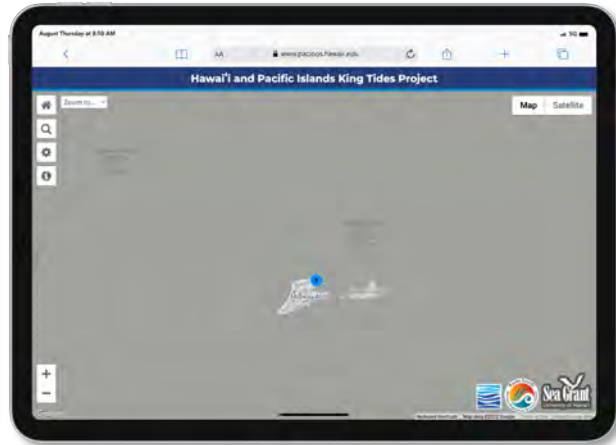
Pacific



Main Hawaiian Islands



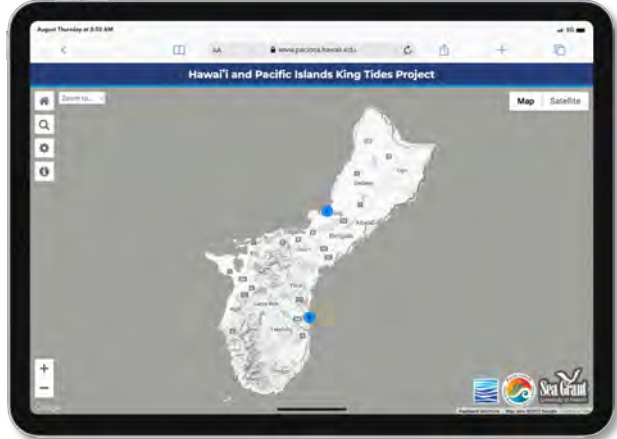
Northwestern Hawaiian Islands



American Samoa



Guam



Republic of the Marshall Islands



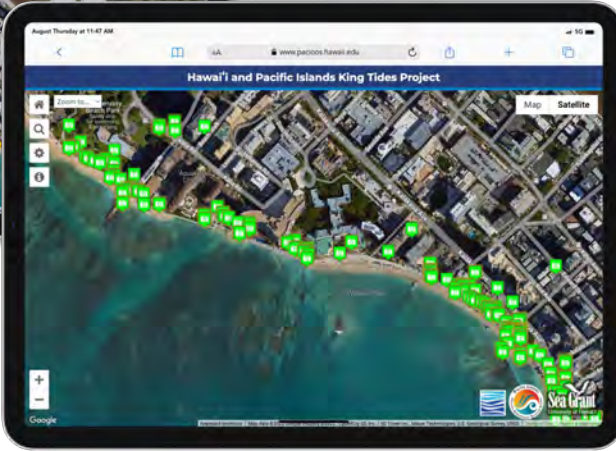
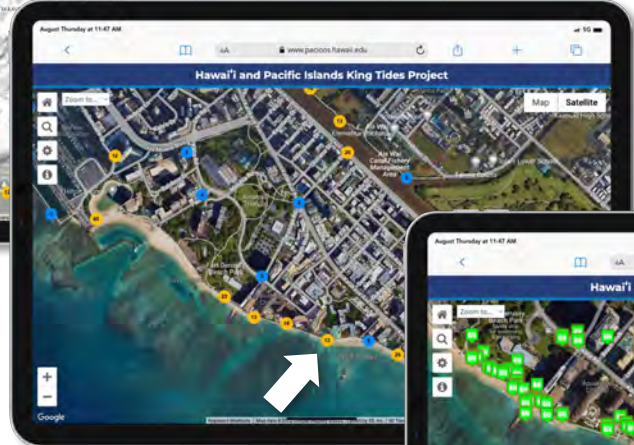
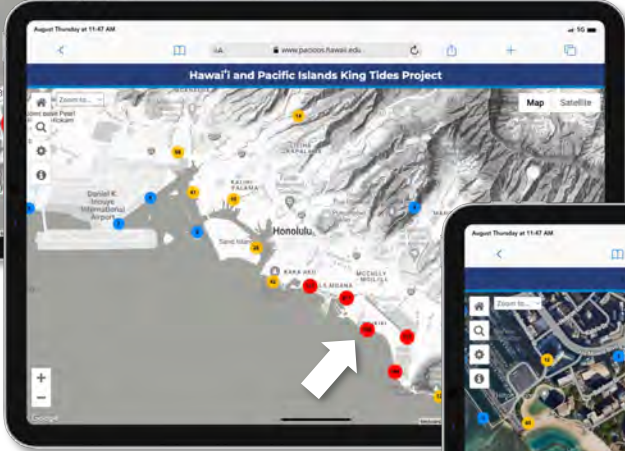
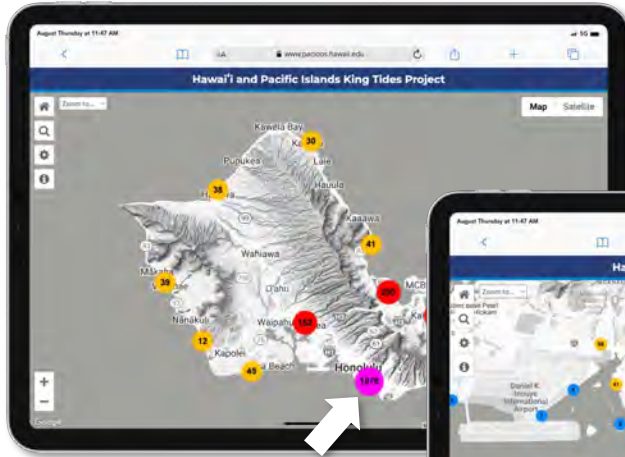


Photo Icon



Visible after zoomed in or low enough density.

Marker Clustering



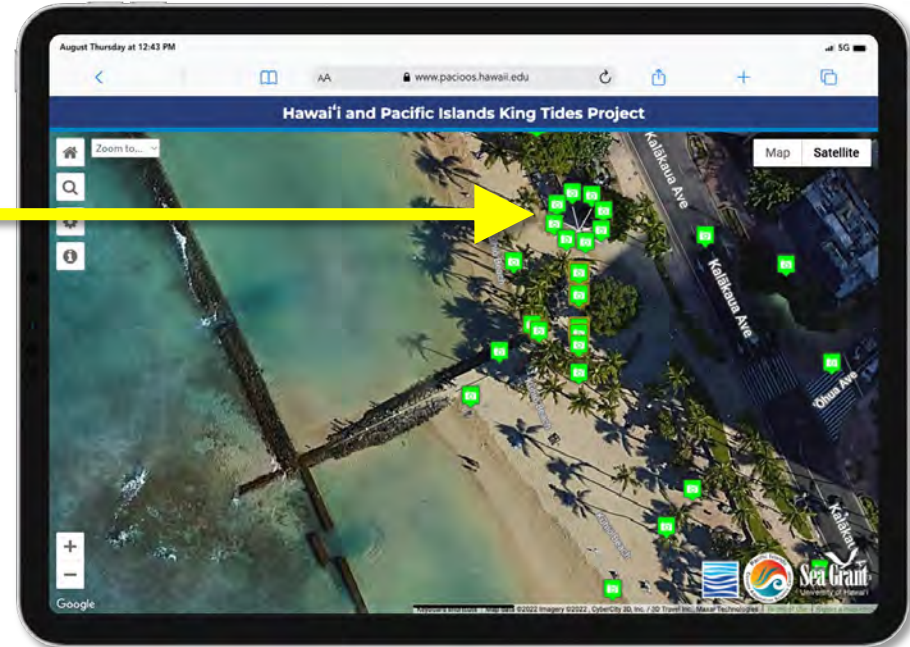
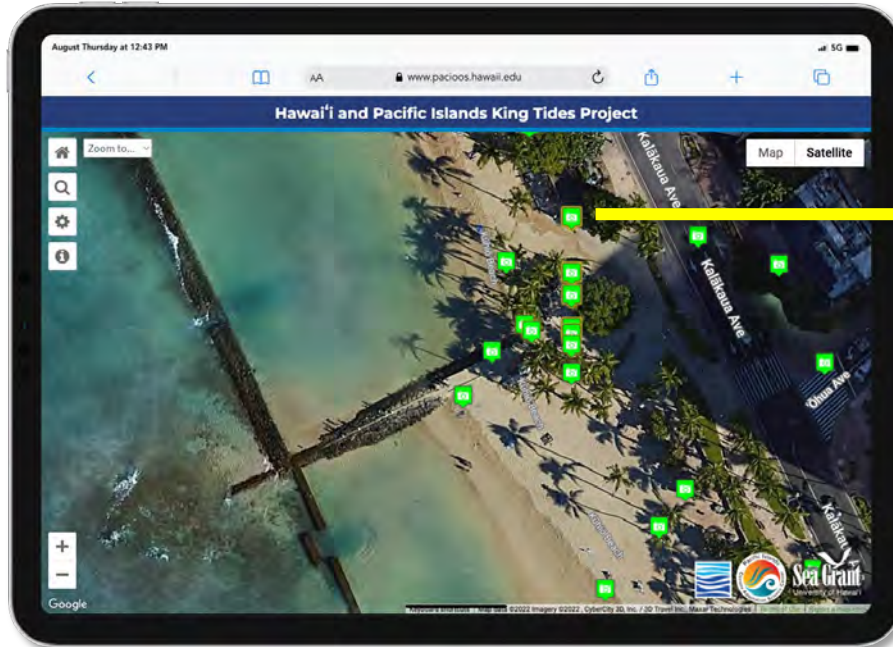
density of photos

via **MarkerClusterer**
Google Maps plug-in

Marker Spiderfy

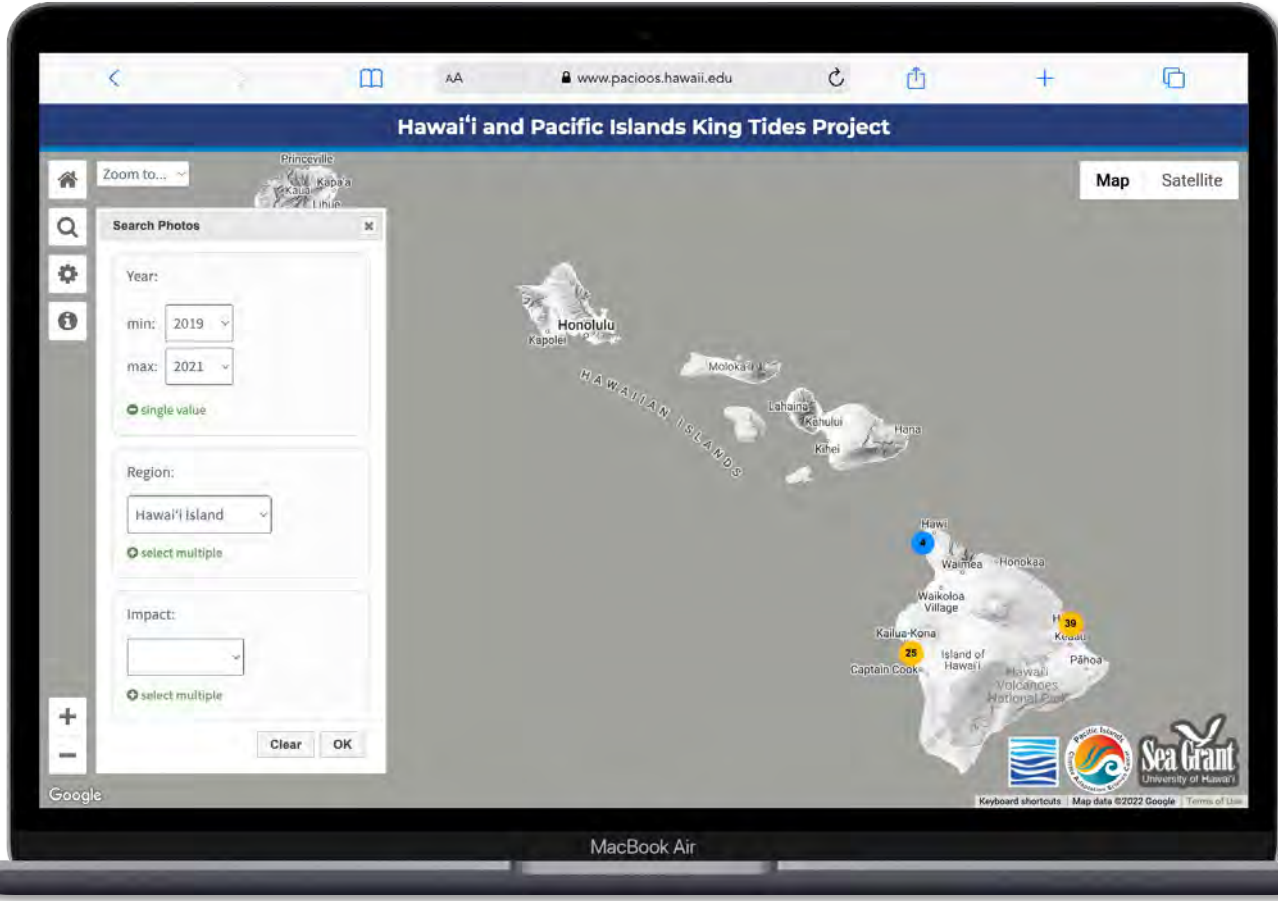


Highlighted marker icons indicate multiple photos.
Click to fan-out individual photo icons at that location.



via **OverlappingMarkerSpiderfier**
Google Maps plug-in

<https://github.com/jawj/OverlappingMarkerSpiderfier>





OGC Web Feature Service (WFS)

GetFeature request

with Geography Markup Language (**GML**) filter

https://geo.pacioos.hawaii.edu/geoserver/PACIOOS/pac_uhsg_usa_kingtides_photos/ows?service=WFS&version=2.0.0&srsName=CRS:84&request=GetFeature&typeName=pac_uhsg_usa_kingtides_photos&outputFormat=application/json&filter=

<Filter

xmlns:gml="http://www.opengis.net/gml">

<And>

<PropertyIsGreaterThanOrEqualTo>

<PropertyName>date</PropertyName>

<Literal>2019/01/01</Literal>

</PropertyIsGreaterThanOrEqualTo>

<PropertyIsLessThanOrEqualTo>

<PropertyName>date</PropertyName>

<Literal>2021/12/31</Literal>

</PropertyIsLessThanOrEqualTo>

<PropertyIsEqualTo>

<PropertyName>region</PropertyName>

<Literal>Hawaii</Literal>

</PropertyIsEqualTo>

</And>

</Filter>



```
{
  "type": "FeatureCollection",
  "totalFeatures": 68,
  "features": [
    {
      "type": "Feature",
      "id": "pac_uhsg_usa_kingtides_photos.2816",
      "geometry": {
        "type": "Point",
        "coordinates": [
          -155.967082,
          19.579006
        ]
      },
      "geometry_name": "geom",
      "properties": {
        "photo_id": 2795,
        "date": "2019/07/02 14:55",
        "first_name": "Cindi",
        "last_name": "Punihaole Kennedy",
        "region": "Hawaii",
        "location": "Kahalu'u Beach Park and Bay",
        "impact": "runup",
        "comment": "Tide completely covered rocky areas of coastline.",
        "photo_url": "http://www.pacioos.hawaii.edu/king-tides/photos/hawaii/hawaii/2019/07/kingtides_201907021455_sedo8gi3.jpg",
        "submit_lat": 19.579006,
        "submit_lon": -155.967082,
        "size_bytes": 2942966,
        "md5": "a71056f9252e5e22b13c214a8e830948"
      }
    }
  ],
  "crs": {
    "type": "EPSG",
    "properties": {
      "code": "4326"
    }
  }
}
```

.....▶ +67 others...



GeoJSON
FeatureCollection returned

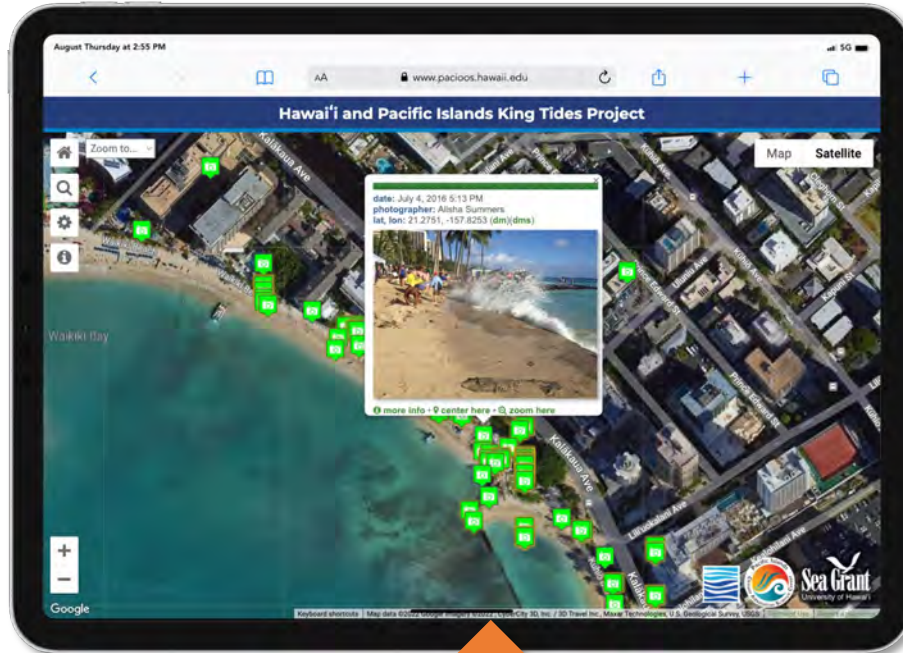
Marker Info Window

Preview image.
Who, when, where.



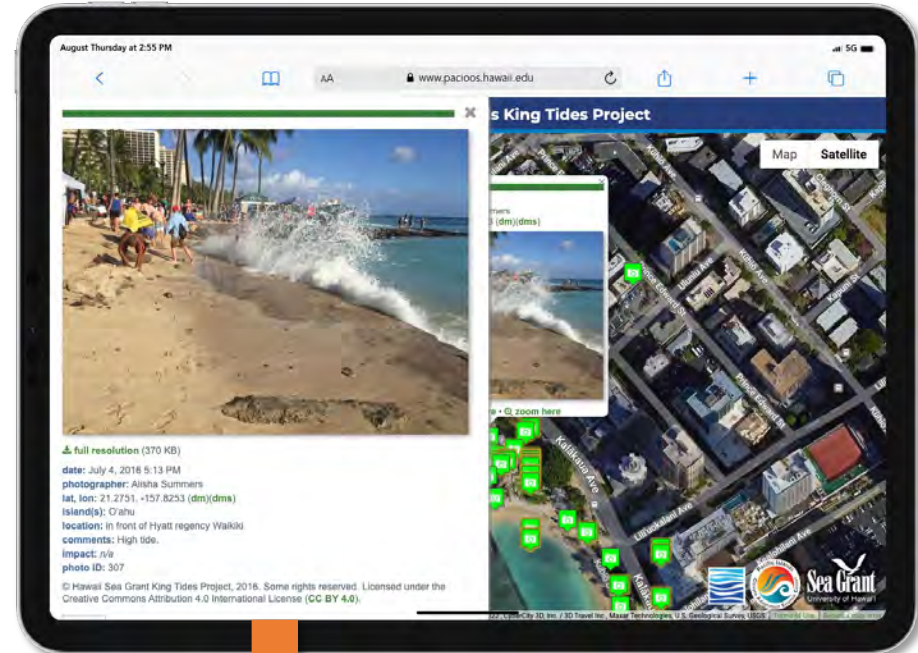
Photo Details Panel

Larger preview image.
More data attributes.



GeoJSON

Use data response from
GeoServer WFS GetFeature.



Download Image

Click **full resolution** above.
Right-click and **Save Image As**.

pacioos.org or pacioos.org/data/search/

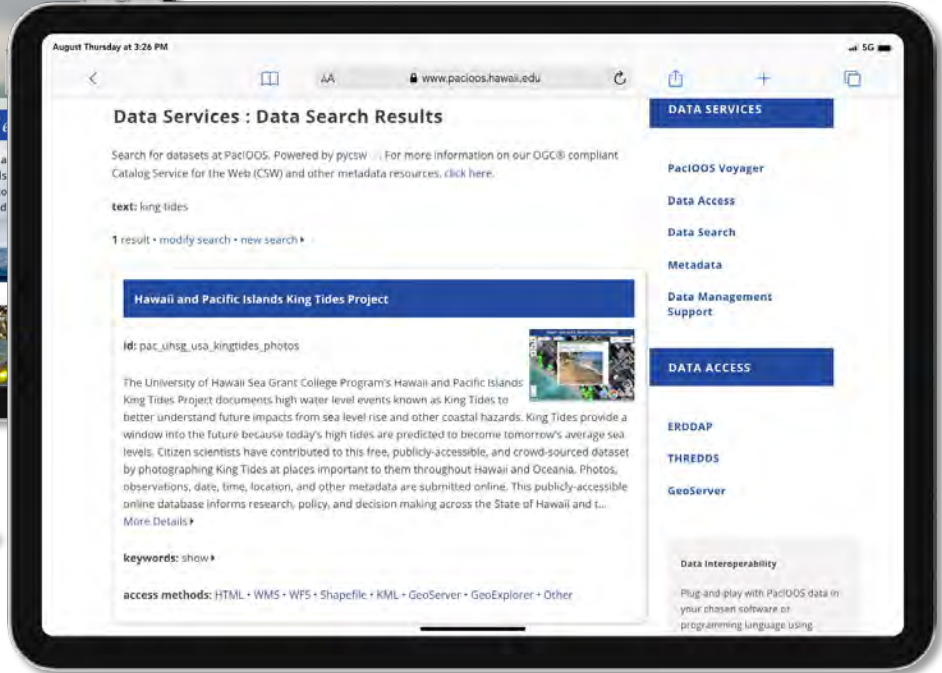
PacIOOS Data Catalog
OGC Catalog Service for the Web (CSW)
Powered by **pycsw**.



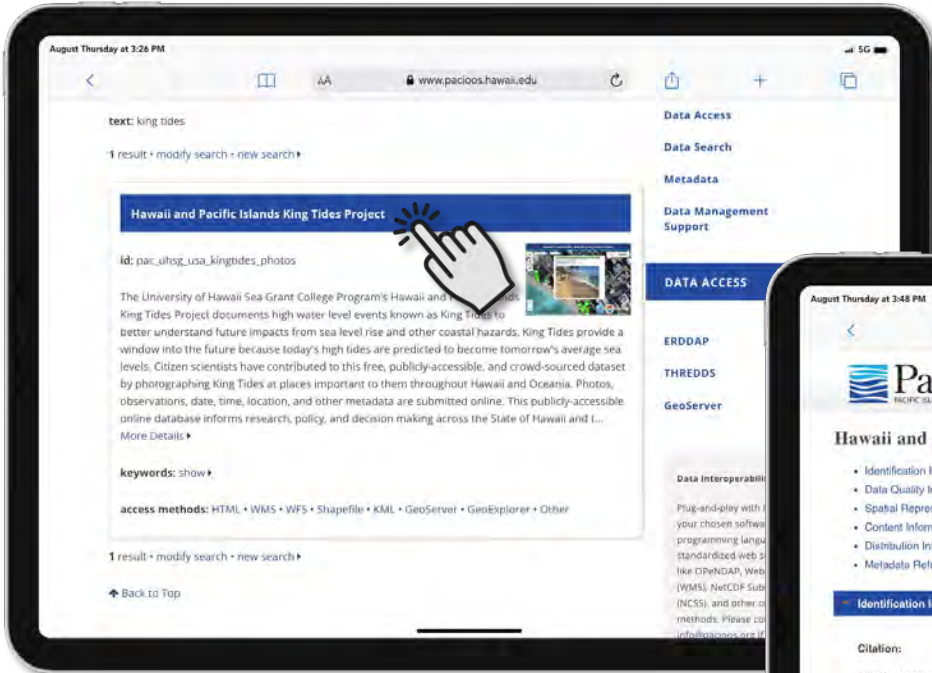
Dataset Search
Click magnifying glass.
Search for "king tides".



Dataset Summary
Click dataset title for metadata.
Click an access method for data.

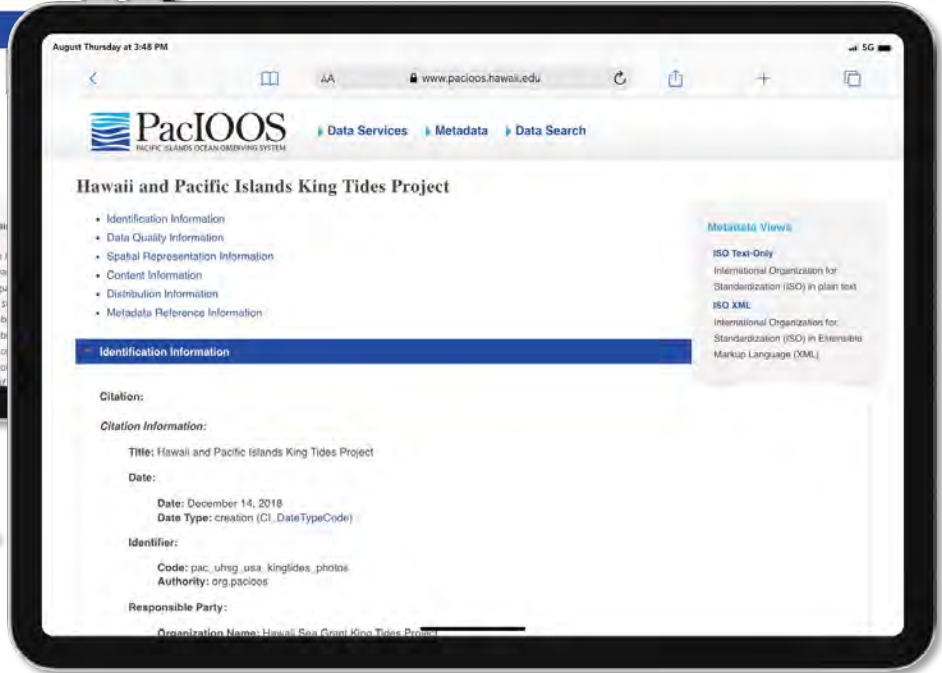


id: pac_uhsg_usa_kingtides_photos



Dataset Title
Click on title in catalog.

ISO-19115 Metadata
View full metadata record
in HTML, plain text, or XML.



Direct Links

Click on a data format below...



- ▶ [Shapefile](#)
- ▶ [CSV](#)
- ▶ [GeoJSON](#)
- ▶ [KML](#)
- ▶ [WFS](#)
- ▶ [WMS](#)

Next King Tides!
Aug 10-11, 2022



Mahalo!
Any questions?

STAY CONNECTED



kingtide@hawaii.edu
info@pacioos.org



facebook.com/uhseagrants
facebook.com/pacioos



@HawaiiSeaGrant
@PacIOOS

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



Sea Grant
University of Hawaii

