

Integrating Data Literacy into Undergraduate Coursework at Saint Mary's College of California

Nekesha Williams, Ph.D.
Associate Professor
Environmental and Earth Sciences

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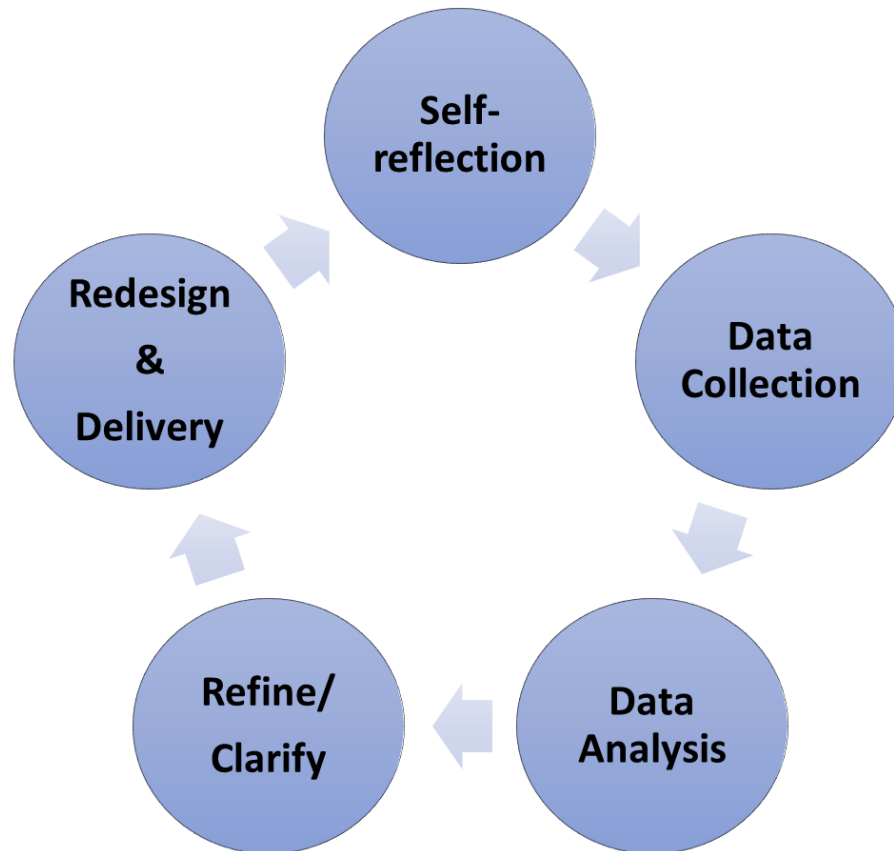
Introduction

- Employers and graduate programs desire/require undergraduate students to possess critical data competencies.
- Proficiency with **technology** and **critical thinking** are career readiness competencies that were identified by **NACE**.
- Pre-professionals (students) be data literate, and analytically-minded.
- **Challenge:** Balancing the need for disciplinary knowledge and building data literacy skills.

Reflective Teaching: The Process

“Reflective teaching is examining one’s belief about teaching and learning and determining the alignment of those belief’s with what happens within your courses”

(Reflective Teaching, 2021)



Reflective Questions: Teaching Practice

1. What data competencies have I been promoting and cultivating in the courses I teach?
2. How explicit am I in integrating data competencies throughout my courses?
3. What activities/exercises and tools have I used to build and enhance students' data competencies within courses?

I. What data competencies have I been promoting and cultivating in the courses I teach?

Courses → Skills ↓	EES 310: Hydrology	EES 410: Intro. GIS	EES 430: Coastal Systems	EES 450: Wetlands
Data Collection & Management		X		X
Data Evaluation		X	X	
Data Visualization	X	X	X	X
Critical Thinking	X	X	X	X
Numeracy/Statistics	X		X	X
Spatial Analysis - Geography		X	X	X
Discipline-specific Expertise	X	X	X	X
Communication-Information literacy	X	X	X	X

2. How explicit am I in integrating data competencies throughout my courses?

Course Number and Title	Course Learning Objectives (Data competency related)
EES 310: Hydrology	<ul style="list-style-type: none">Students will locate and synthesize hydrological data in support of monitoring efforts and decision-making.
EES 410: Intro. GIS	<ul style="list-style-type: none">Students will create, execute and collect data in support of a basic GIS project within ESRI ARCGIS System.
EES 430: Coastal Systems	<ul style="list-style-type: none">Students will use basic geospatial technologies in coastal systems assessments.Students will graph, analyze and interpret quantitative data.
EES 450: Wetlands	<ul style="list-style-type: none">Students will analyze and interpret data sets to obtain important information related to wetlands.Students will create informative wetlands profiles for scientific and educational purposes.

3. What activities/exercises and tools have I used to build and enhance students' data competencies within courses?

Case 1: EES 430 Coastal Systems

- ✓ **Lecture 60 min or 95 min**
- ✓ **Four (4) Credit Units**
- ✓ **Three (3) hour lab period**

Case 2: EES 450 Wetlands

- ✓ **Lecture 60 min or 95 min**
- ✓ **Four (4) Credit Units**
- ✓ **Three (3) hour lab period**



Case I: Coastal Systems - Laboratory

Course Learning Objectives: Describe the basic abiotic and biotic processes influencing coastal and marine environments.

Teaching Unit: Sea level Changes and Tidal Cycles

Activity: Identify tidal patterns present at select location in the United States.

Data Sources: National Oceanic and Atmospheric Administration. NOAA Tides & Currents, <https://tidesandcurrents.noaa.gov/>. Last accessed (March, 18, 2025).

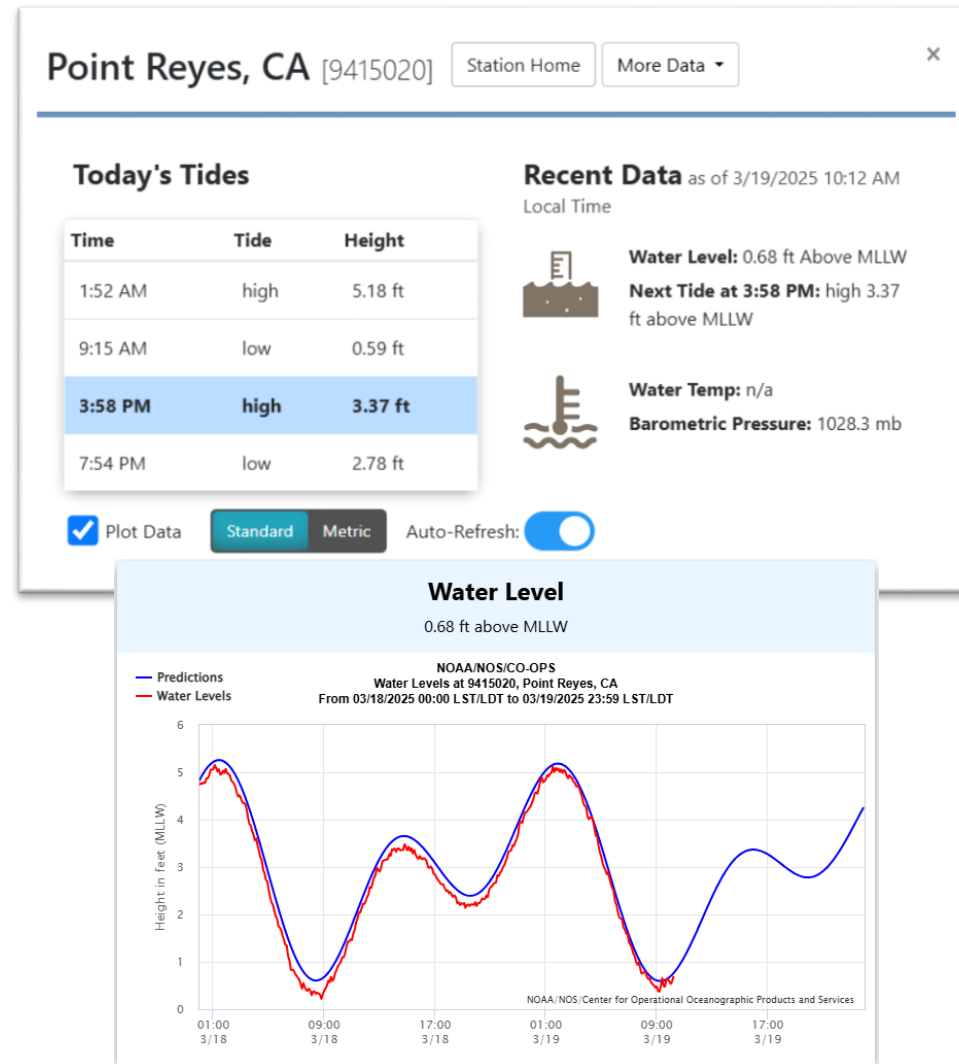
Coastal Systems – Laboratory Exercise

Navigate to “Point Reyes, CA”

a. What is the tidal pattern at this location? (0.5pt)

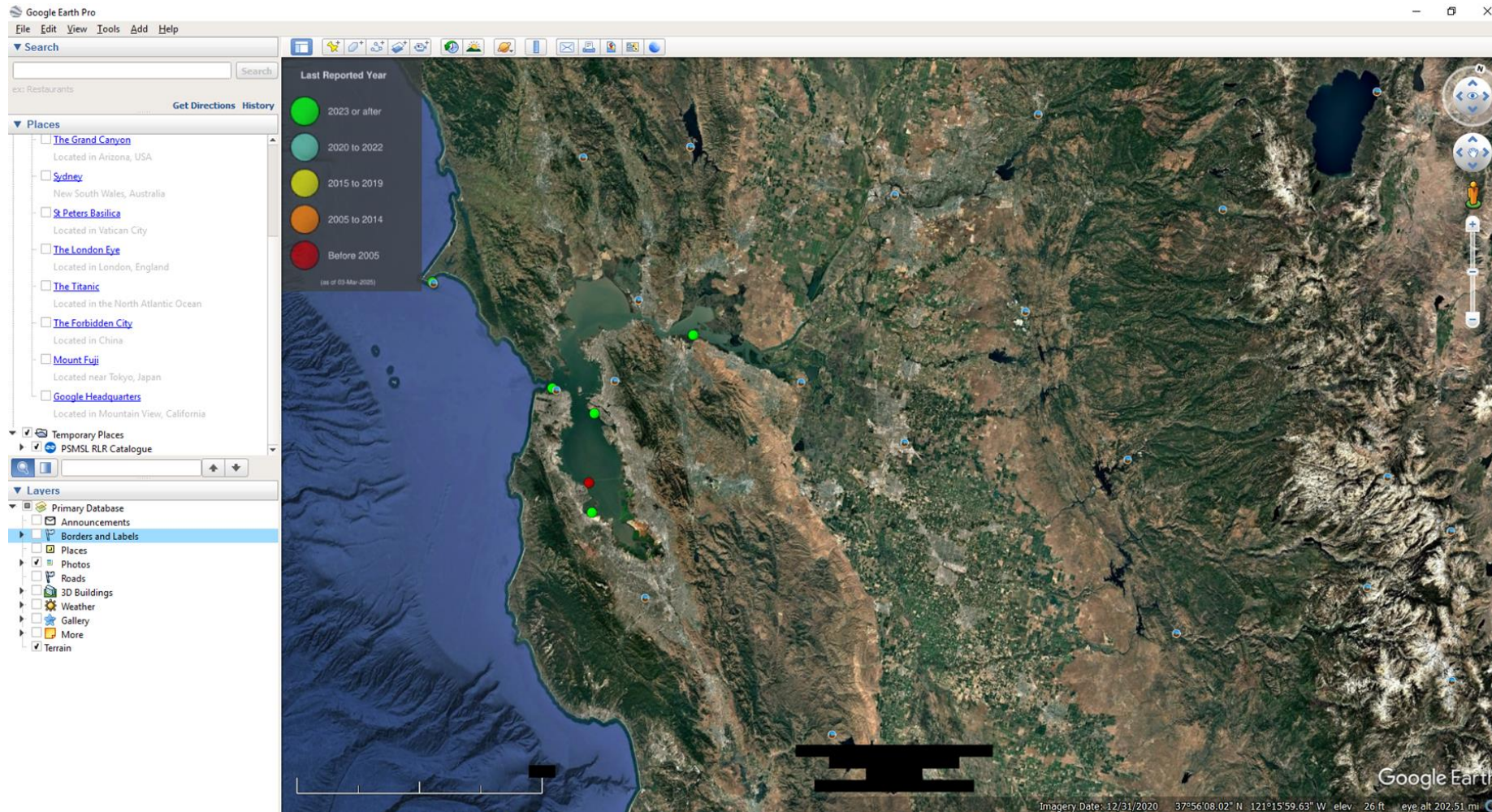
b. What is the relative sea level at this site? (0.5pt)

c. What may be the reason for any similarities or differences visible between Arena Cove and Point Reyes, California? (1pt)



Google Earth Pro: Sea Level Trends - Local

Competencies: Spatial literacy and Data locating

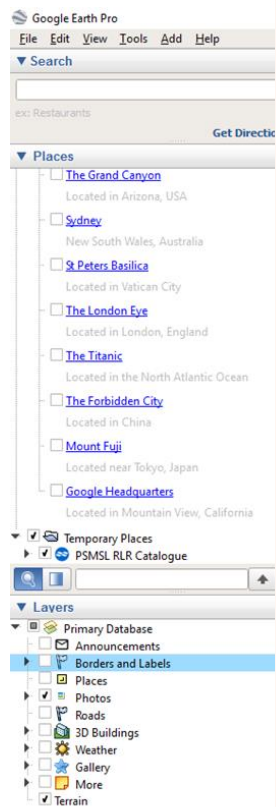


Permanent Service for Mean Sea Level (PSMSL)

(Holgate et al., 2013; PSMSL, 2025)

Google Earth Pro: Sea Level Trends - Local

Competencies: Spatial literacy and Data locating



National Oceanography Centre Permanent Service for Mean Sea Level

About Us Data Products GLOSS Training Links

You are here: [home](#) > [data](#) > [obtaining](#) > [stations](#) >

Data

- Obtaining
- Supplying
- High-Frequency
- Bottom Pressure Records
- Other Long Records
- GLOSS/ODINAFRICA Calibration Data

Donate
Donate to PSMSL

Data Notes

- Individual Station Data and Plot Notes
- Referencing the Data Set
- PSMSL Help File
- 2010 Changes to the PSMSL Data Files

Extracted from Database
03 Mar 2025

SAN FRANCISCO

Station Information

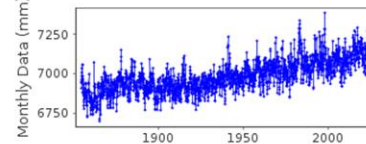
Station ID:	10
Latitude:	37.806667
Longitude:	-122.465
GLOSS ID:	158
Coastline code:	823
Station code:	31
Country:	UNITED STATES
Time span of data:	1854 – 2024
Completeness (%):	99
Date of last update:	23 Jan 2025

Green Arrow: Current Station
Yellow Marker: Neighbouring RLR Station
Red Marker: Neighbouring Metric Station

Please note: In many cases, the station position in our database is accurate to only one minute. Thus, the tide gauge may not appear to be on the coast.

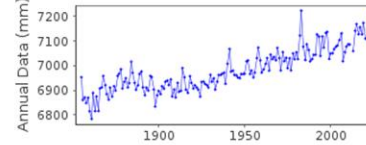
Tide Gauge Data

Monthly Data (mm)



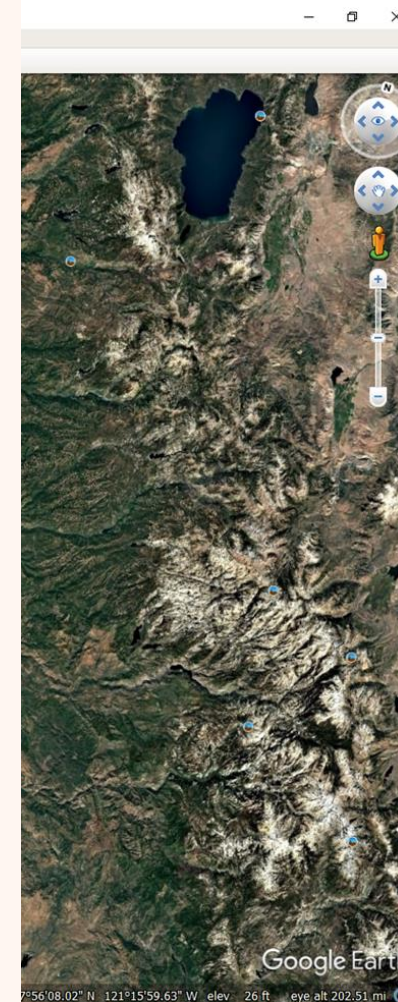
[Link to larger image of monthly data plot.](#)
[Download monthly mean sea level data.](#)

Annual Data (mm)



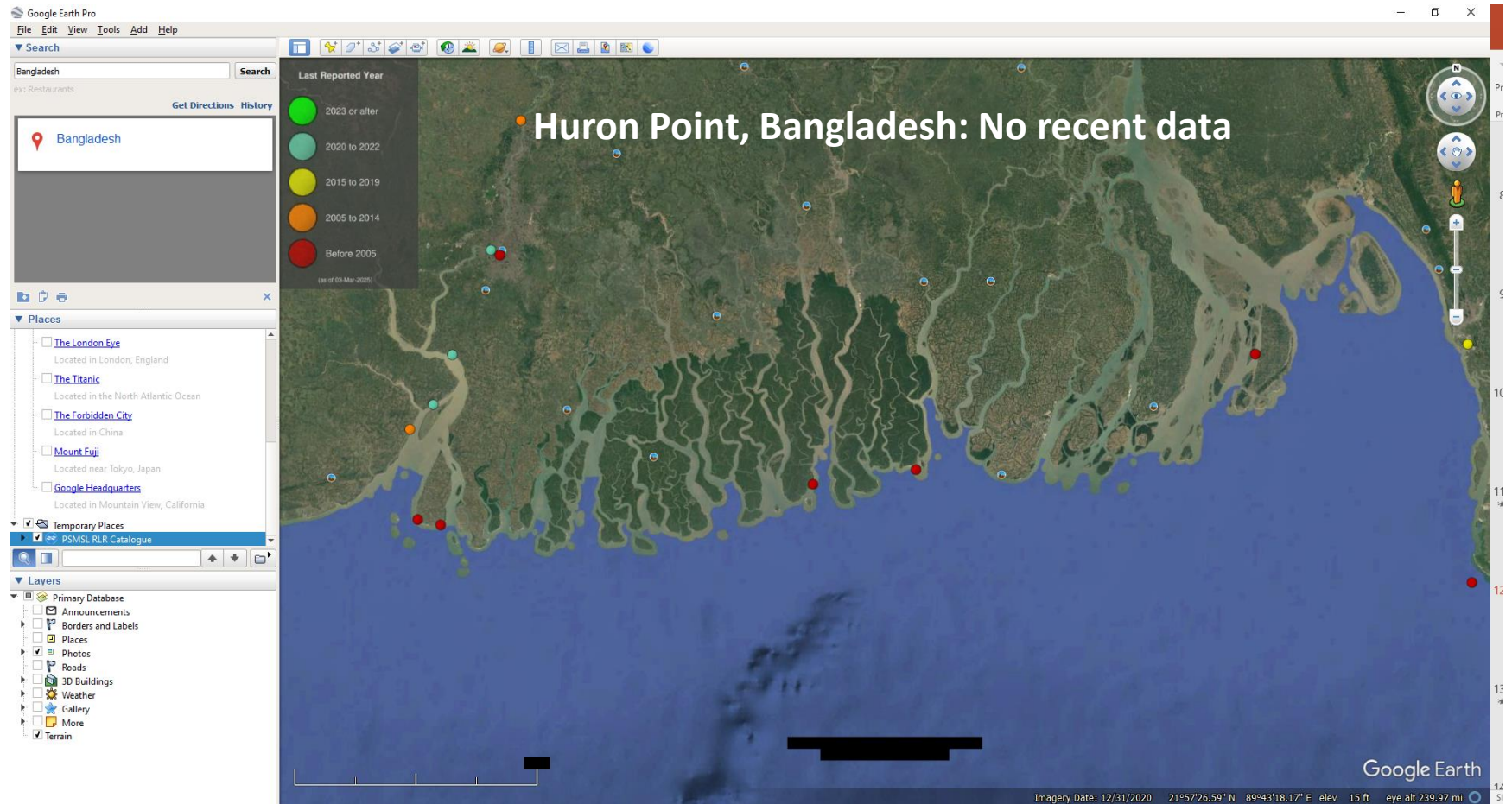
[Link to larger image of annual data plot.](#)
[Download annual mean sea level data.](#)

[Download metric sea level data. Use only with extreme caution.](#)



Sea Level Trends: Global

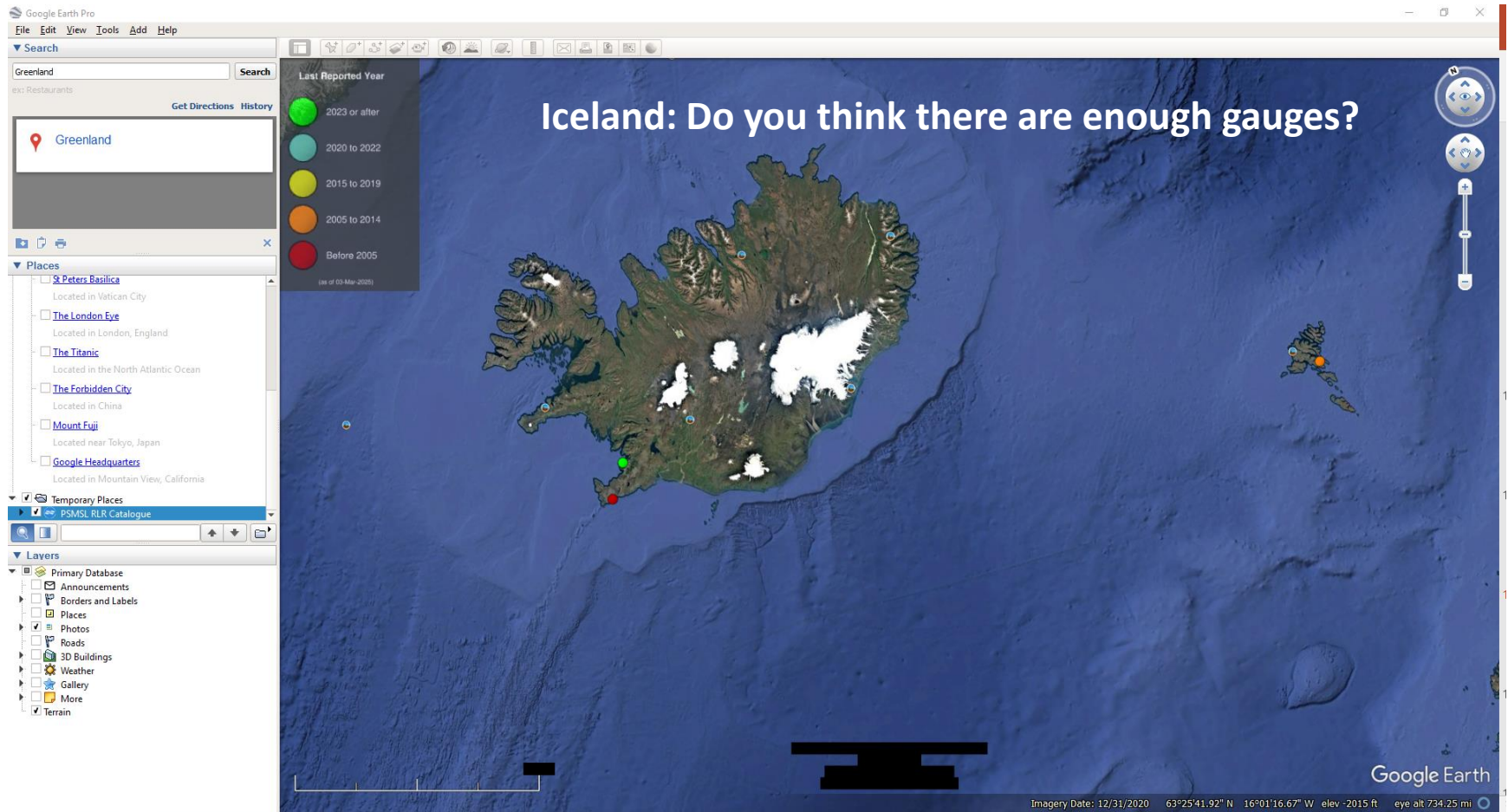
Competencies: Data evaluation and interpretation



(Holgate et al., 2013; PSMSL, 2025)

Sea Level Trends: Global

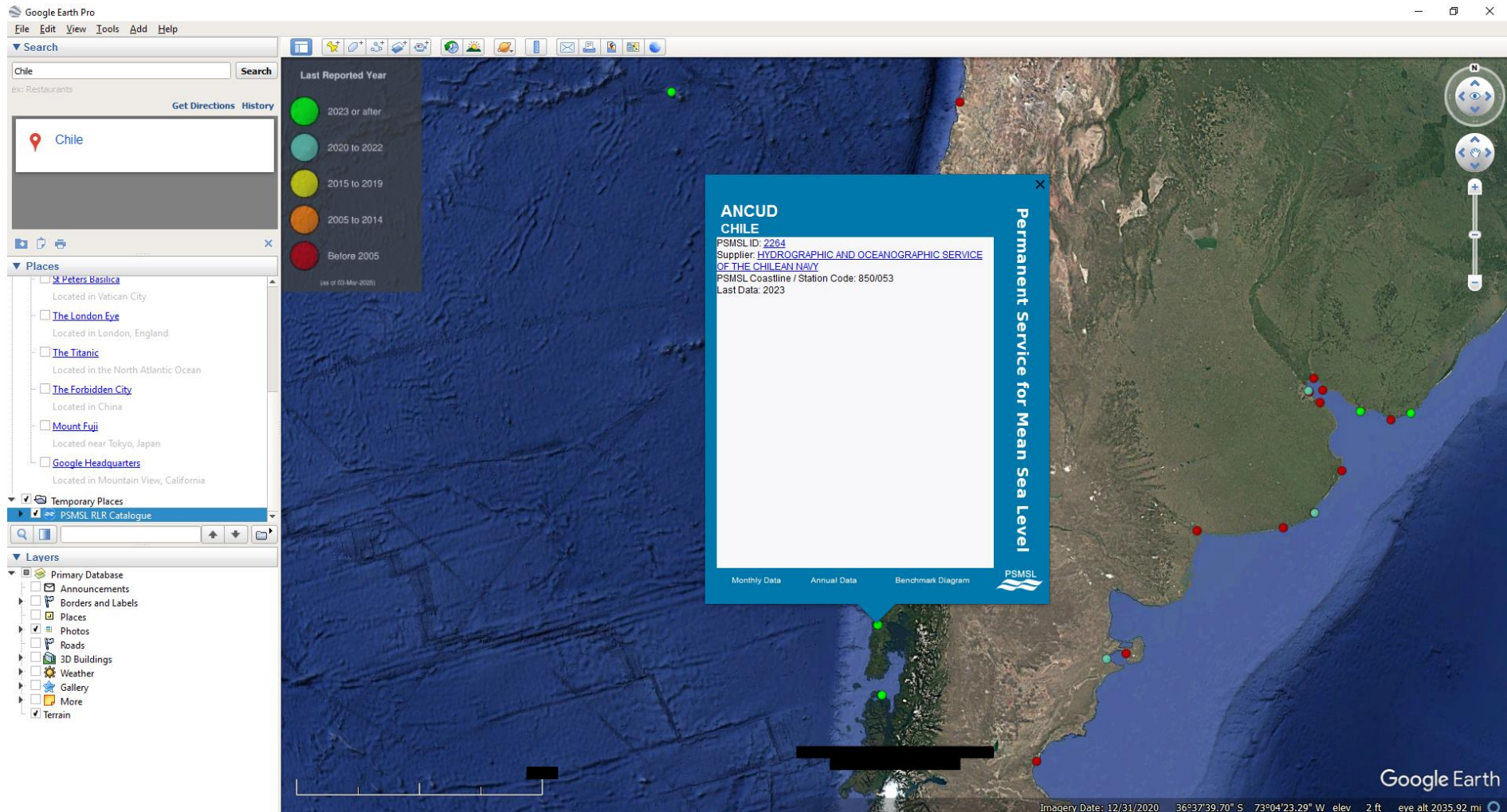
Competencies: Data evaluation and interpretation



(Holgate et al., 2013; PSMSL, 2025)

Sea Level Trends: Global

Competencies: Data evaluation and interpretation



(Holgate et al., 2013; PSMSL, 2025)

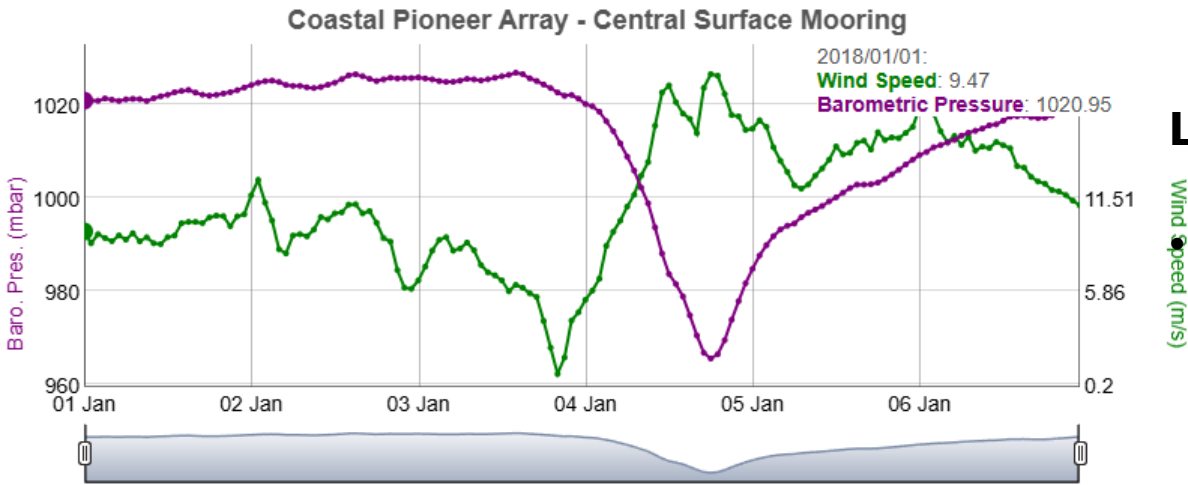
Sea Level Trends: Global

Competencies: Data evaluation and interpretation

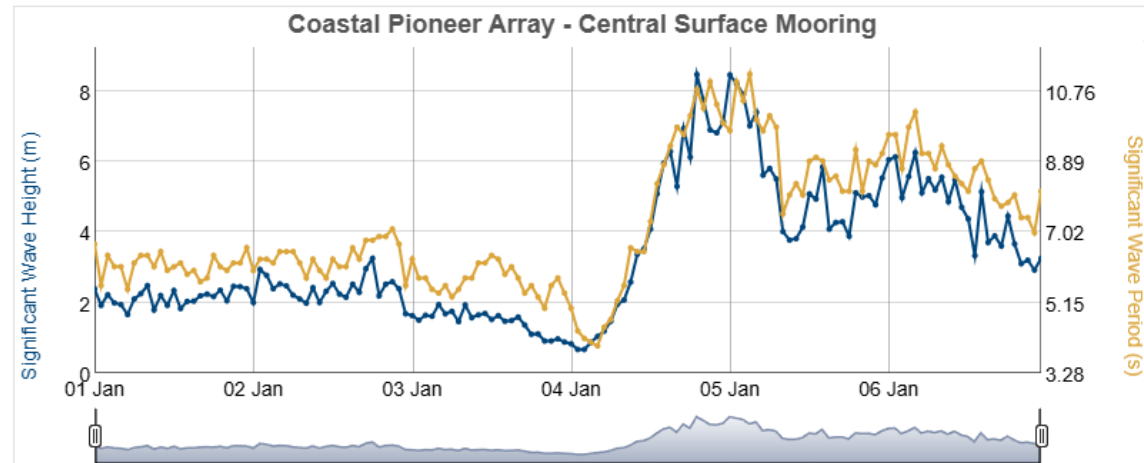


(Holgate et al., 2013; PSMSL, 2025)

Coastal Systems: Analyzing real-world wave data



Wave Height and Wave Period



© 2020 Rutgers University Ocean Data Labs Project

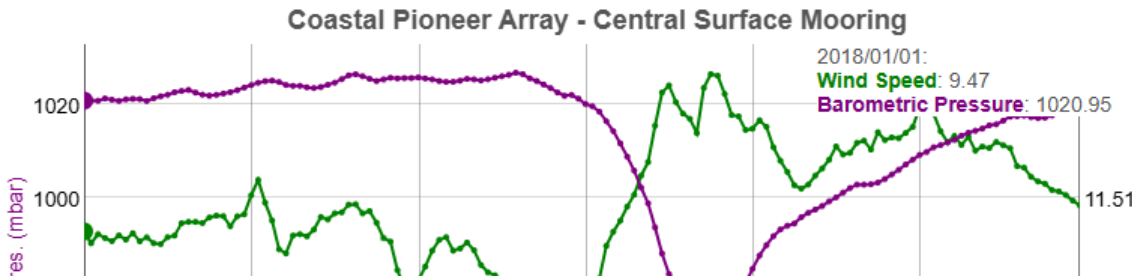
Laboratory questions:

Which of the sampling locations in the wetland system may have the highest energy relative to other sites in this study area? (1pt)

- **What conditions can lead to a change in sediment distribution?** For example, what can cause an increase in sand and/or coarser grained particles to be deposited into this environment? (1pt)
- **How might wave energy differ between a beach and a coastal wetlands such as a salt marsh?** (1pt)

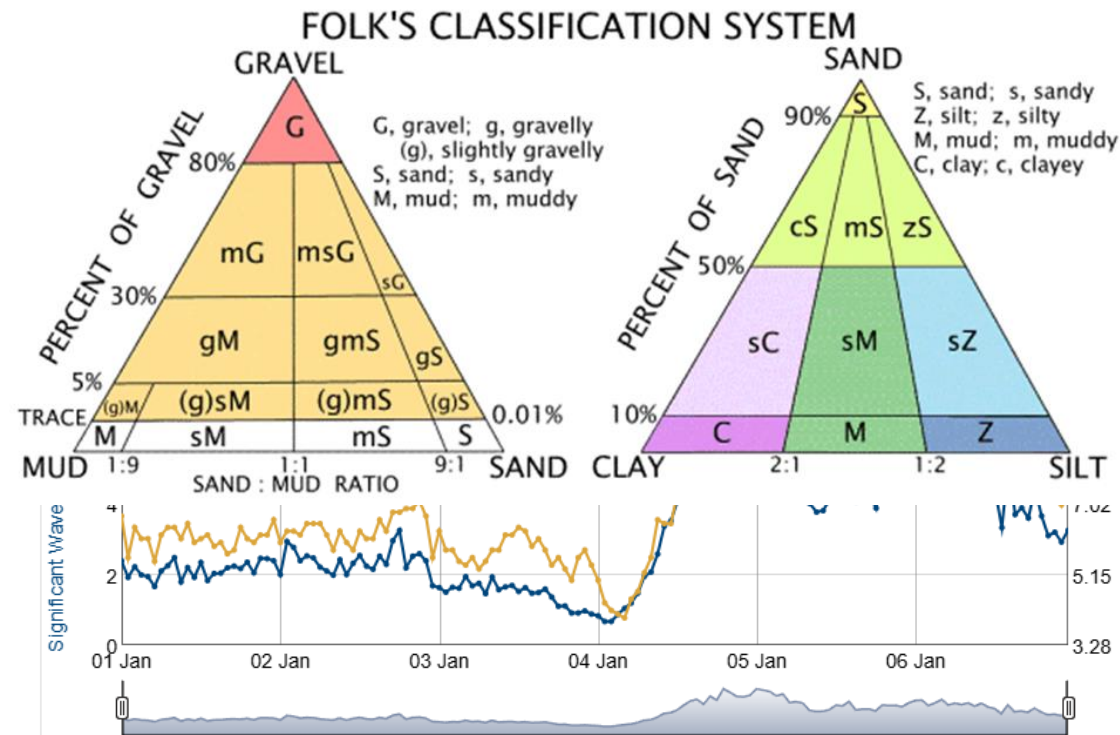
(Long, Dixon and Lichtenwalner, 2021)

Coastal Systems: Analyzing real-world wave data



Laboratory questions:

Which of the sampling locations in the wetland system may have the highest energy relative to other sites in this study area? (1pt)



- What conditions can lead to a change in sediment distribution? For example, what can cause an increase in sand and/or coarser grained particles to be deposited into this environment? (1pt)
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Case 2: EES 450-Wetlands

Learning Objective: Students will examine data sets to extract key insights regarding wetland systems.

Teaching Unit: Wetland Hydrology

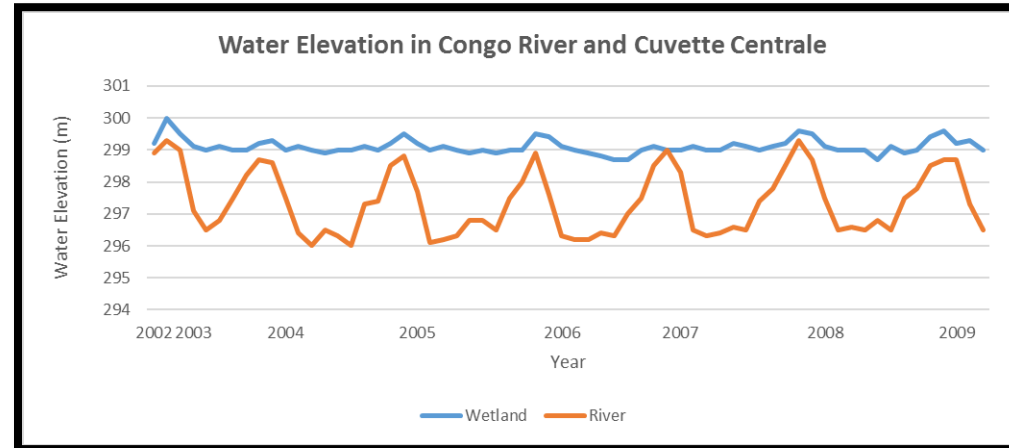
Activity: Graph water elevation for the Congo River and adjacent Cuvette Centrale wetland system, DRC.

Data Source: Alsdorf, D., E. Beighley, A. Laraque, H. Lee, R. Tshimanga, F. O'Loughlin, G. Mahé, B. Dinga, G. Moukandi, and R. G. M. Spencer (2016), Opportunities for hydrologic research in the Congo Basin, *Rev. Geophys.*, 54, 378–409, doi:[10.1002/2016RG0000517](https://doi.org/10.1002/2016RG0000517).

Wetland Hydrology

Year	Water Elevation (m)	
	Wetland	River
2002	299.2	298.9
	300	299.3
	299.5	299
2003	299.1	297.1
	299	296.5
	299.1	296.8
	299	297.5
	299	298.2
	299.2	298.7
	299.3	298.6
2004	299	297.5
	299.1	296.4
	299	296
	298.9	296.5
	299	296.3
	299	296
	299.1	297.3
	299	297.4
	299.2	298.5
	299.5	298.8
2005	299.2	297.7
	299	296.1
	299.1	296.2
	299	296.3
	298.9	296.8
	299	296.8
	298.9	296.5
	299	297.5
	299	298
	299.5	298.9
2006	299.4	297.6
	299.1	296.3
	299	296.2
	298.9	296.2
	298.8	296.4
	298.7	296.3
	298.7	297
	299	297.5
	299.1	298.5
	299	299

1. **Graph** both the river water elevation and wetland water levels in Excel (one graph).



2. What pattern is/are visible on the graph?

3. How would you characterize the wetland hydroperiod?

4. **Perform** a regression on the data set to examine the relationship between water elevations in the river and wetland. Report your r^2 .



5. Does the river have a major influence on wetland hydrology? Explain your answer. What additional information/questions would you like to know to support your response?

Field Notes: Metadata

EES 450: Wetland Science
Lab 5: Lafayette Reservoir

Fall 2024

Due Date: October 16th, 2024 by 11:59pm.

Aim: The purpose of this lab is to observe a local wetland site and generate field notes with photographs. We will spend about and 1-1.5 hrs. evaluating soils, hydrology and ecology.

Learning Outcomes:

As environmental scientists and professionals, one of the most important skillset that you will need to develop is collating good field notes for a site. These field notes are crucial for learning and articulating the quality and function of a system. Specifically, students will learn to:

- Practice detailed environmental observations.
- Produce photographic documentation accompanied by detailed description.
- Conduct a transect walk and identify differences in species and habitat.
- Write an accurate and honest report.

Guidelines:

- Record date, time, place of observation and weather conditions.
- Make observations on hydrology, soils, vegetation and ecology.
- Take pictures when possible to add visuals to your note taking.

Student deliverables:

- Write a 1-2 page single spaced report on your field observations with 1-inch margins
- Include your photo documentations with detailed descriptions after each.

Grading Rubric

Criteria	Possible Points	Points Awarded
Identifies location and environmental conditions at time observations.	1	
Provides detailed observations on hydrology, soils, vegetation and ecology.	5	
Report is: <ul style="list-style-type: none">• Well-written• Uses scientific language appropriately• Organized• No grammatical or punctuation errors	5	
Produced quality photographic documentation	2	
Overall quality of report	2	

ESRI ArcGIS Survey 123

ArcGIS Survey123

My surveys

Organization

?

Nekesha

Untitled survey_1

Overview

Design

Collaborate

Analyze

Data

Settings

Survey title not set

Description content for the survey

Please drag from or press on the right panel to add your first question.

Submit

Powered by ArcGIS Survey123

Add

Edit

Appearance

Options

Text, number, date, and time

Singleline text

Multiline text

Number

Slider

Date

Time

Date and time

Email

Website

Barcode

Choice

Single select

Multiple select

Single select grid

Dropdown

Likert scale

Rating

Ranking

Location

Map

Address

Saved

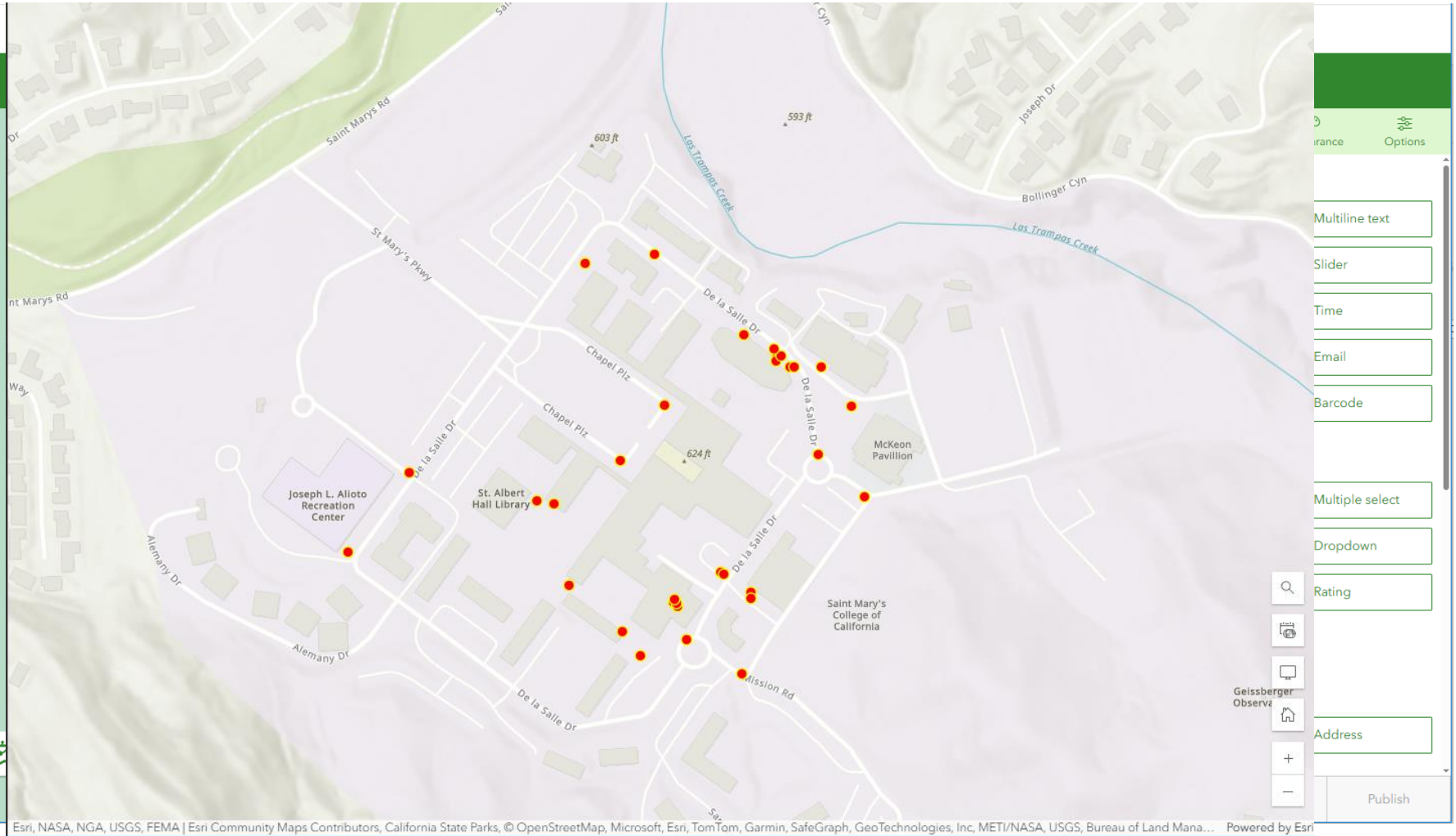
Preview

Publish

Survey123 assistant

BETA

ESRI ArcGIS Survey 123



Sewers

NA

Surveyor Name

Data and Time

MM/DD/YYYY

hh:mm

Location (in road or parking lot)

ID

Cracks or damage?

Yes

No

Geissberger Observations

Search

Home

+

-

Multiline text

Slider

Time

Email

Barcode

Multiple select

Dropdown

Rating

Address

Publish

Esri, NASA, NGA, USGS, FEMA | Esri Community Maps

s, Inc, METI/NASA, USGS, Bureau of Land Management... Powered by Esri

Summary

- **Data literacy** can be defined as the possession of skills that enables one to read, understand, **create** and communicate data effectively.
- **Communicate data competencies** to students in the context of discipline-specific activities.
- **Need for creativity**- Developing activities with real-world, real-time data. (Authentic case studies)
- Integrate other literacies, but also **become more intentional about incorporating ethics and justice components to exercises and case studies.**

References:


Long, J.W., Dixon, R.W., and Lichtenwalner, S. (2021). Ocean Physics- Waves Generated by Large Storms. In Bristol, D.L. and Pfeiffer-Herbert, A. (Eds.), *Ocean Data Labs: Exploring the Ocean with OOI Data – Online Laboratory Manual*. 2nd edition. Rutgers, The State University of New Jersey. Accessed [March, 19, 2025] <https://datalab.marine.rutgers.edu/ooi-lab-exercises/>

National Oceanic and Atmospheric Administration (NOAA)-Tides and Currents. Accessed [March 25, 2025] <https://tidesandcurrents.noaa.gov/>

Permanent Service for Mean Sea Level (PSMSL). (2025). "Tide Gauge Data", Retrieved 03 March 2025 from <http://www.psmsl.org/data/obtaining/>.

“Reflective Teaching”. (2021). Feedback on Teaching. Yale, Poorvu Center for Teaching and Learning. Accessed. [March 25, 2025] <https://tidesandcurrents.noaa.gov/>

Simon J. Holgate, Andrew Matthews, Philip L. Woodworth, Lesley J. Rickards, Mark E. Tamisiea, Elizabeth Bradshaw, Peter R. Foden, Kathleen M. Gordon, Svetlana Jevrejeva, and Jeff Pugh (2013). New Data Systems and Products at the Permanent Service for Mean Sea Level. *Journal of Coastal Research*: Volume 29, Issue 3: pp. 493 – 504.
doi:10.2112/JCOASTRES-D-12-00175.1.

A group of diverse students are sitting on stone steps outdoors, focused on their studies. They are holding notebooks, pens, and pencils. The background is softly blurred, showing more students in a similar setting. A semi-transparent grey box is centered over the image, containing the text 'THANK YOU !!!'.

THANK YOU !!!



SAINT MARY'S
COLLEGE OF CALIFORNIA