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

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SAINT MARY'S COLLEGE OF CALIFORNIA

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**.

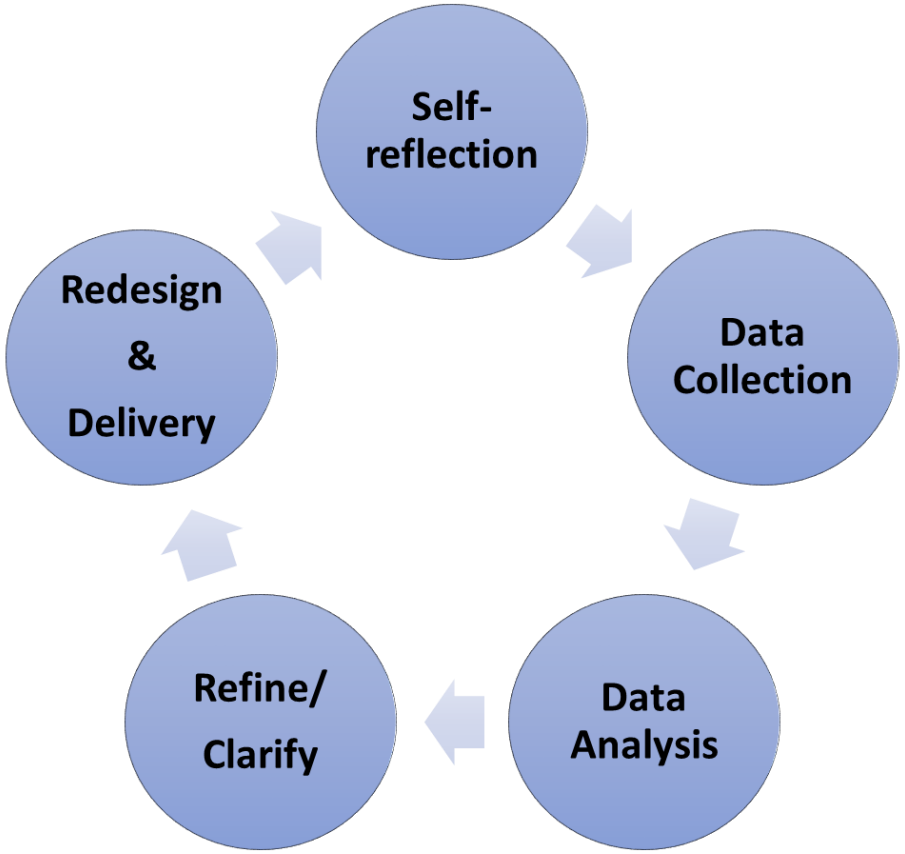
- Pre-professionals (students) be data literate, and analytically-minded.

- **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?

1. 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	• Students **will locate** and **synthesize hydrological data** in support of monitoring efforts and decision-making.
EES 410: Intro. GIS	• Students **will create, execute and collect data** in support of a basic GIS project within ESRI ARCGIS System.
EES 430: Coastal Systems	• Students will **use basic geospatial technologies** in coastal systems assessments. • Students **will graph, analyze and interpret quantitative data.**
EES 450: Wetlands	• 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 1: 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).

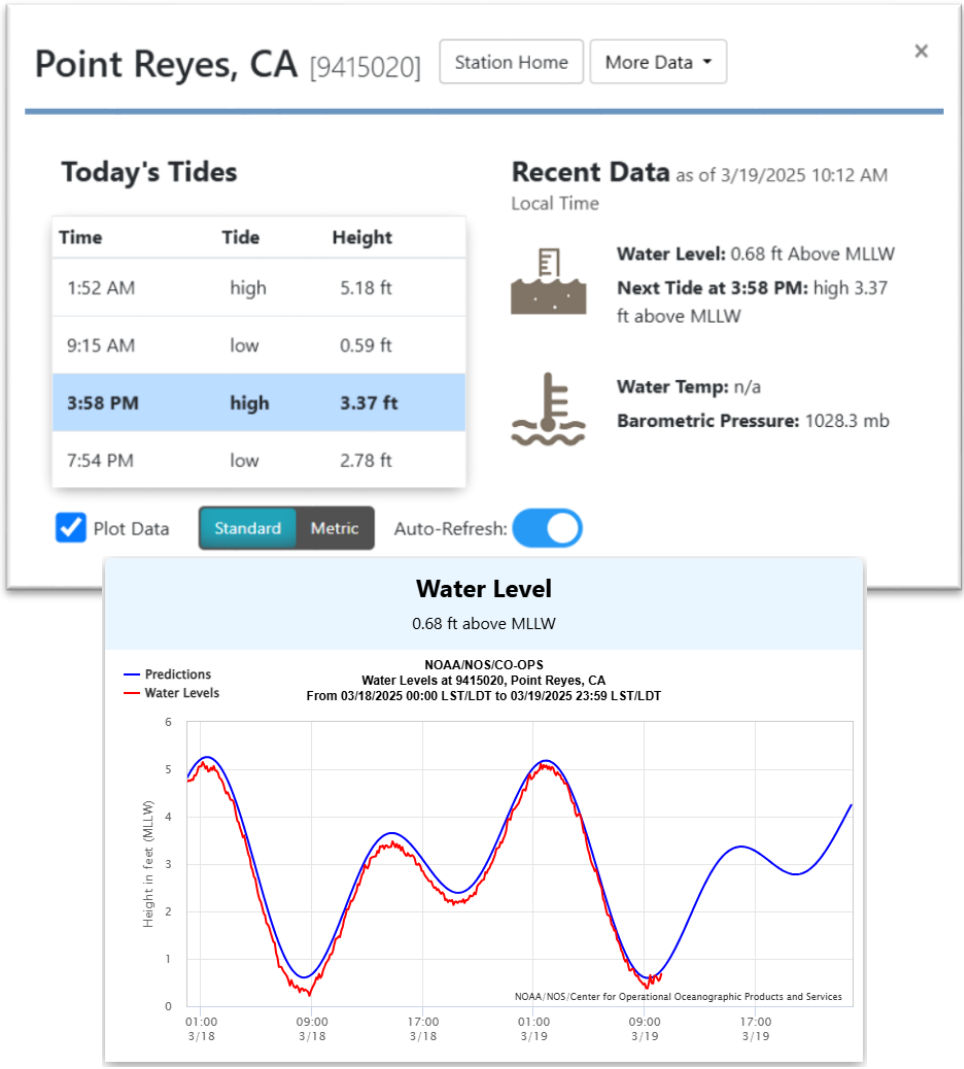
Coastal Systems – Laboratory Exercise

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)

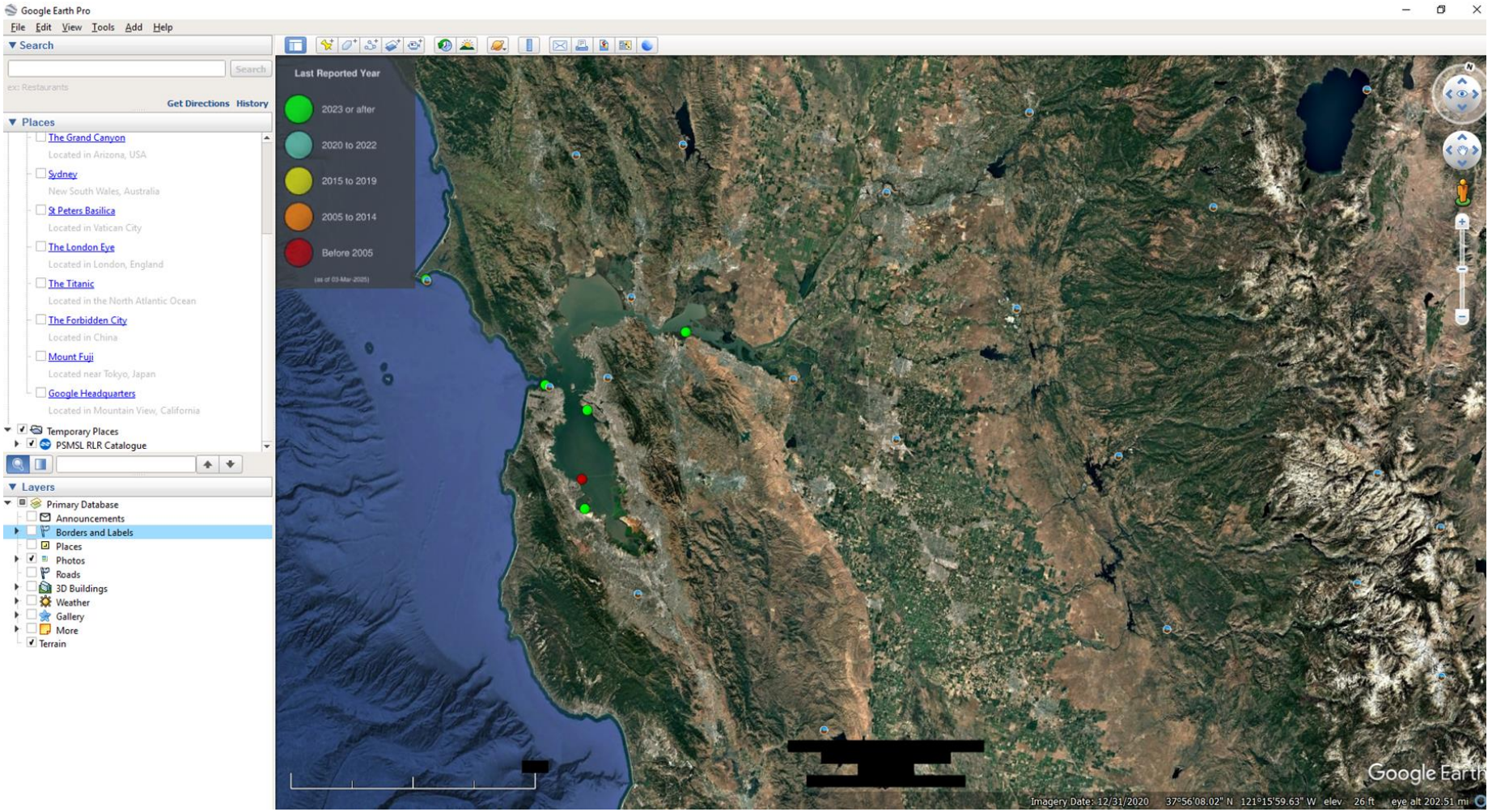
c. **What may be the reason for any similarities or differences visible between Arena Cove and Point Reyes, California?** (1pt)



Source: https://tidesandcurrents.noaa.gov/

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)

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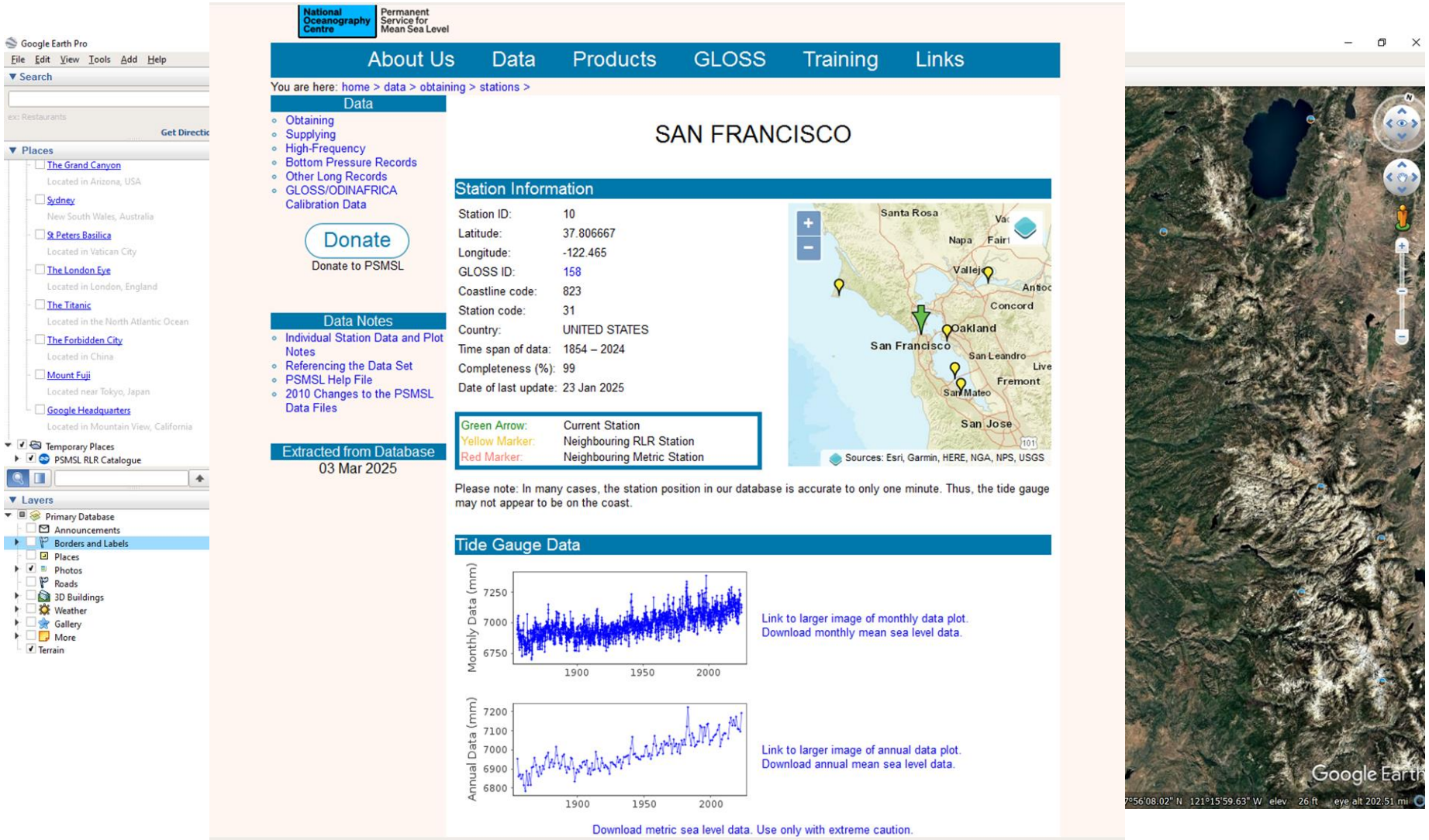

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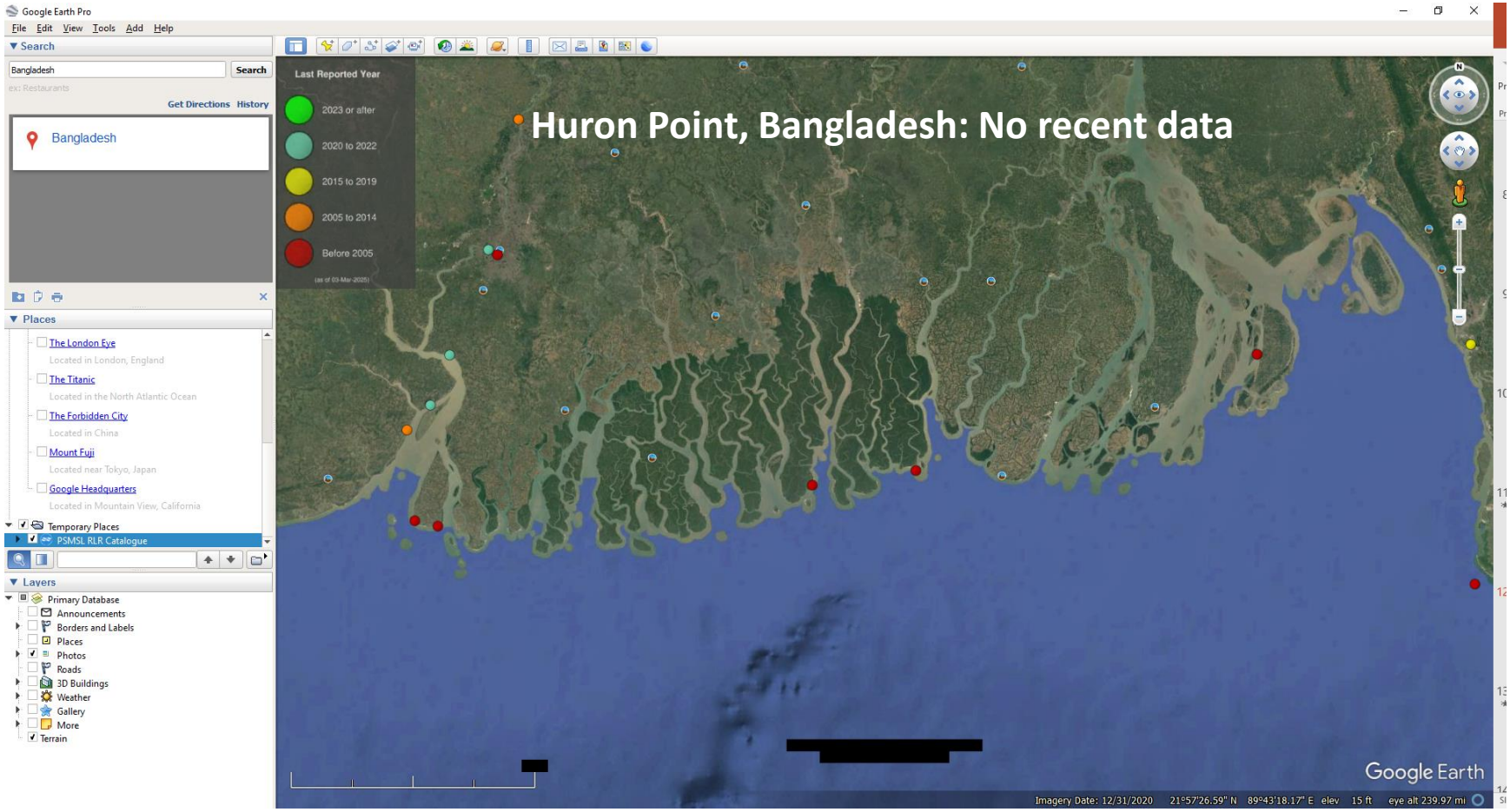
Sea Level Trends: Global

Competencies: Data evaluation and interpretation



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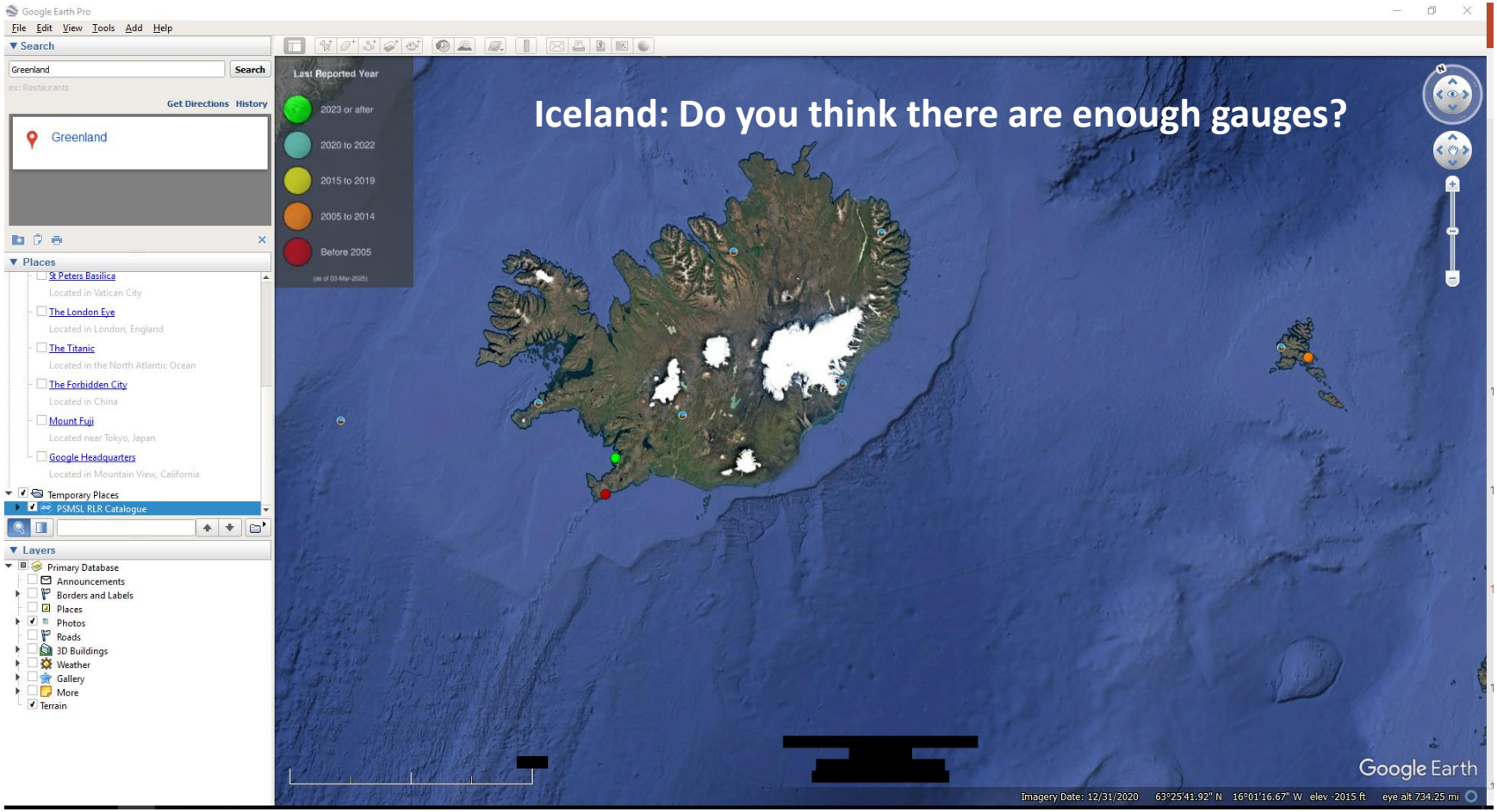

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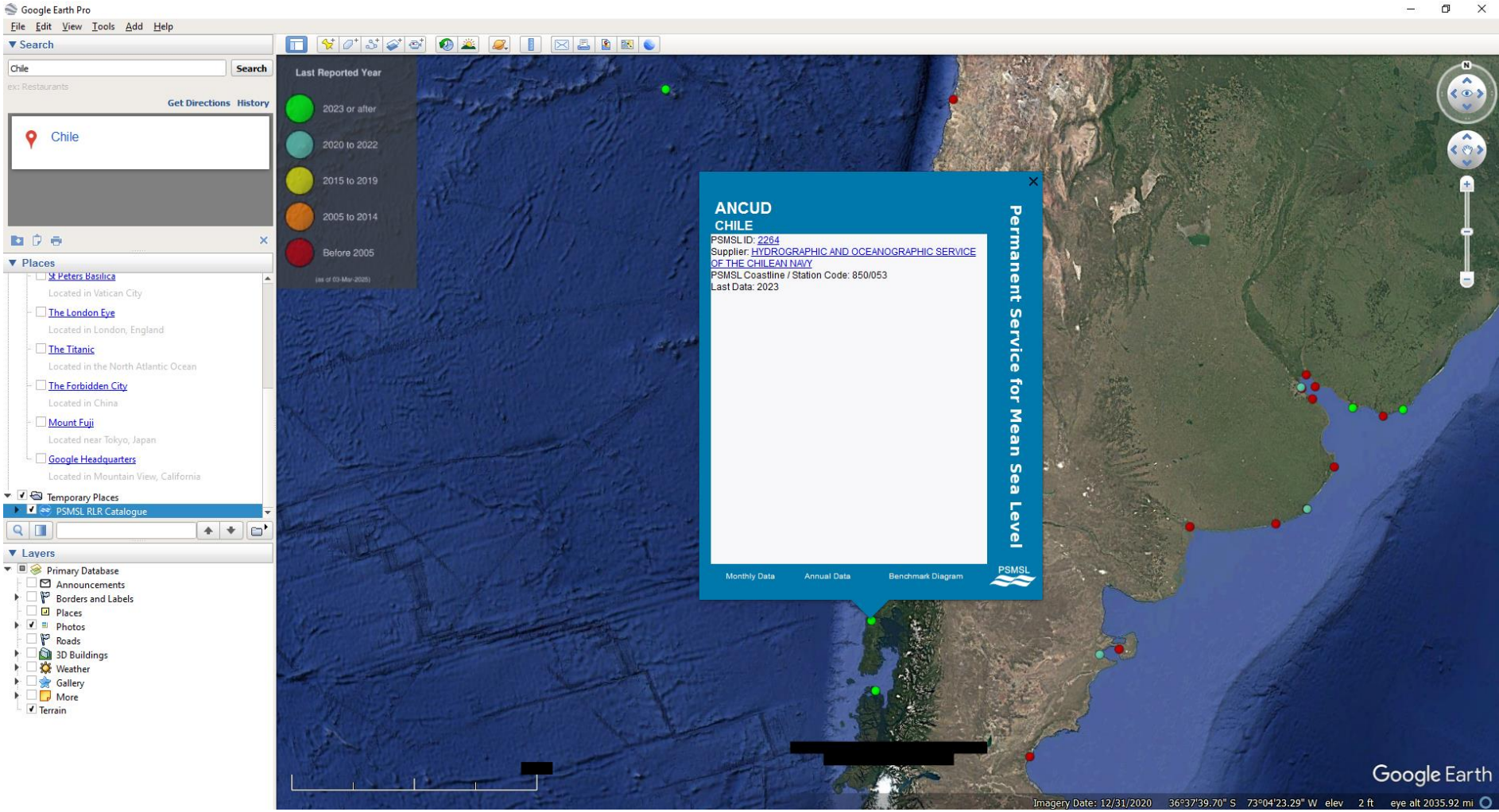

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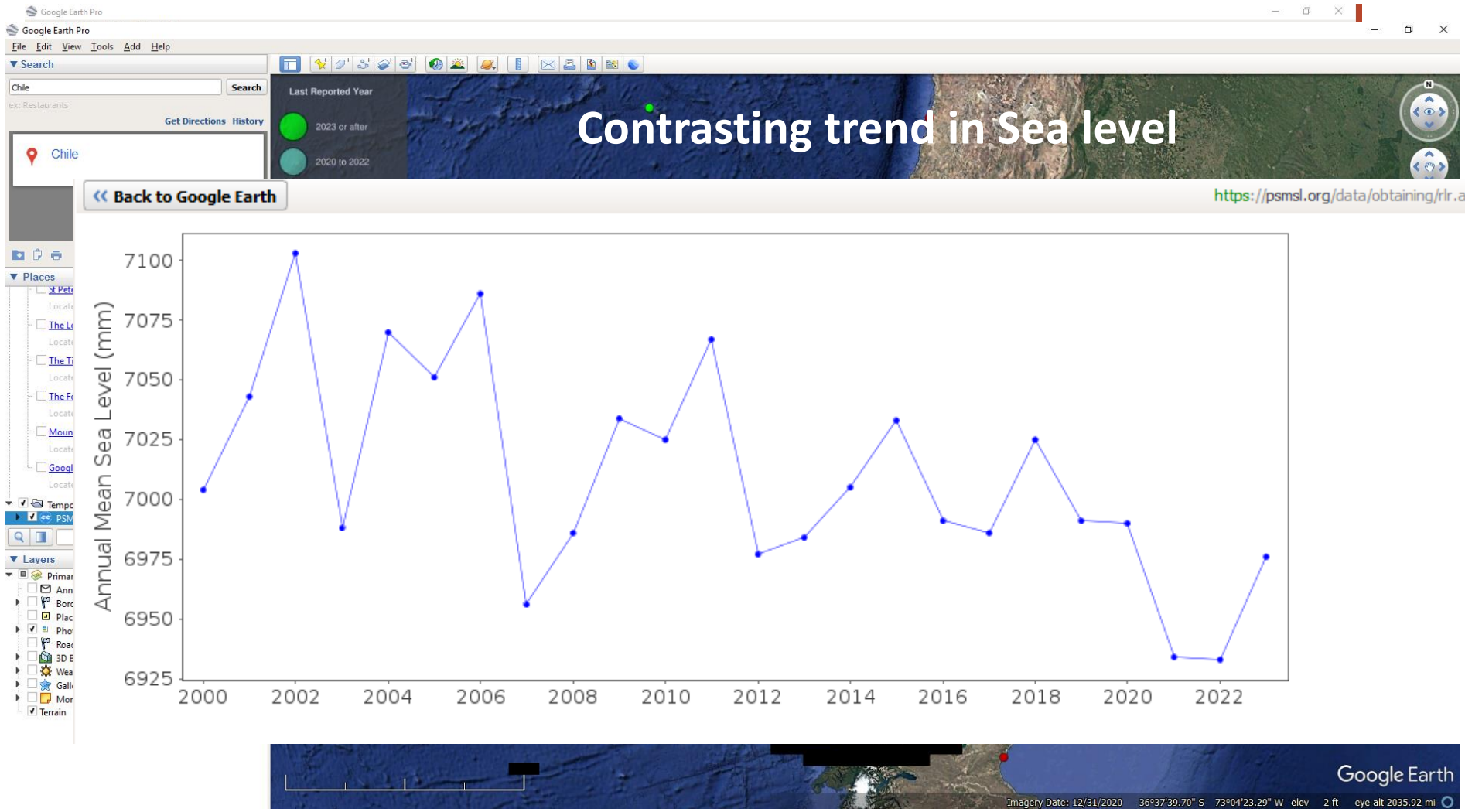

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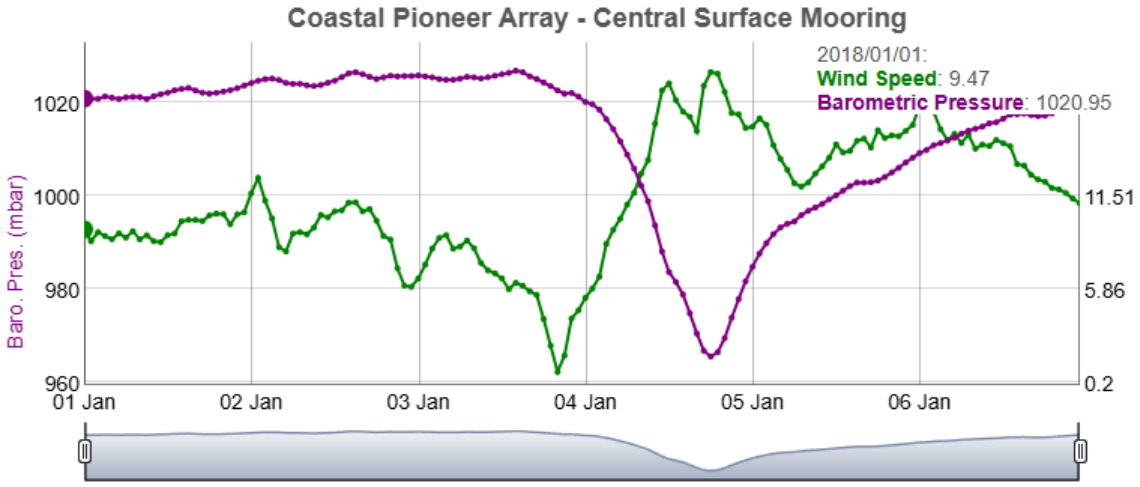
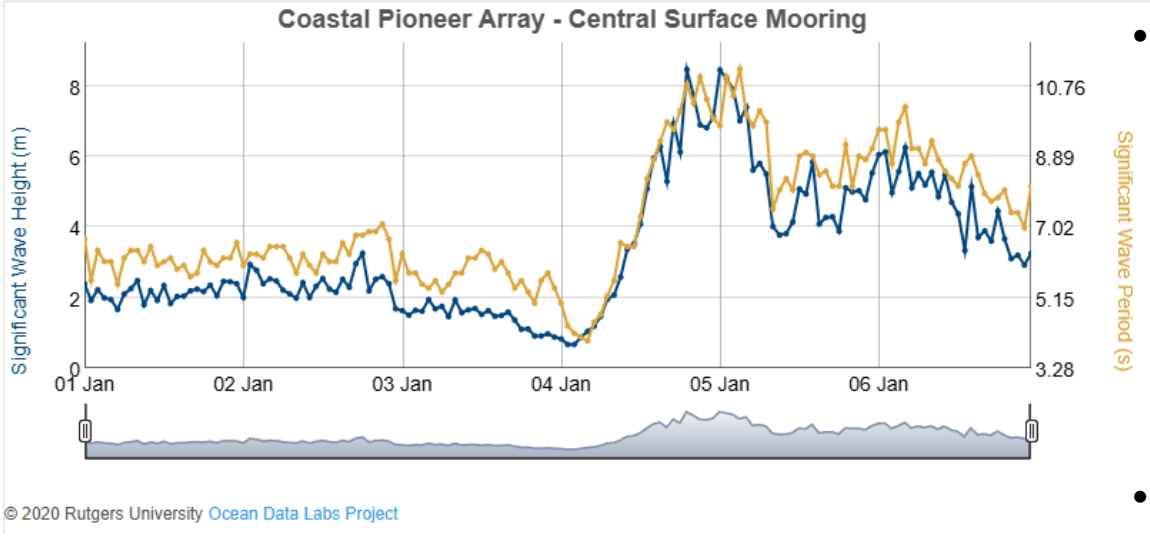
Coastal Systems: Analyzing real-world wave data



Wave Height and Wave Period



Laboratory questions:

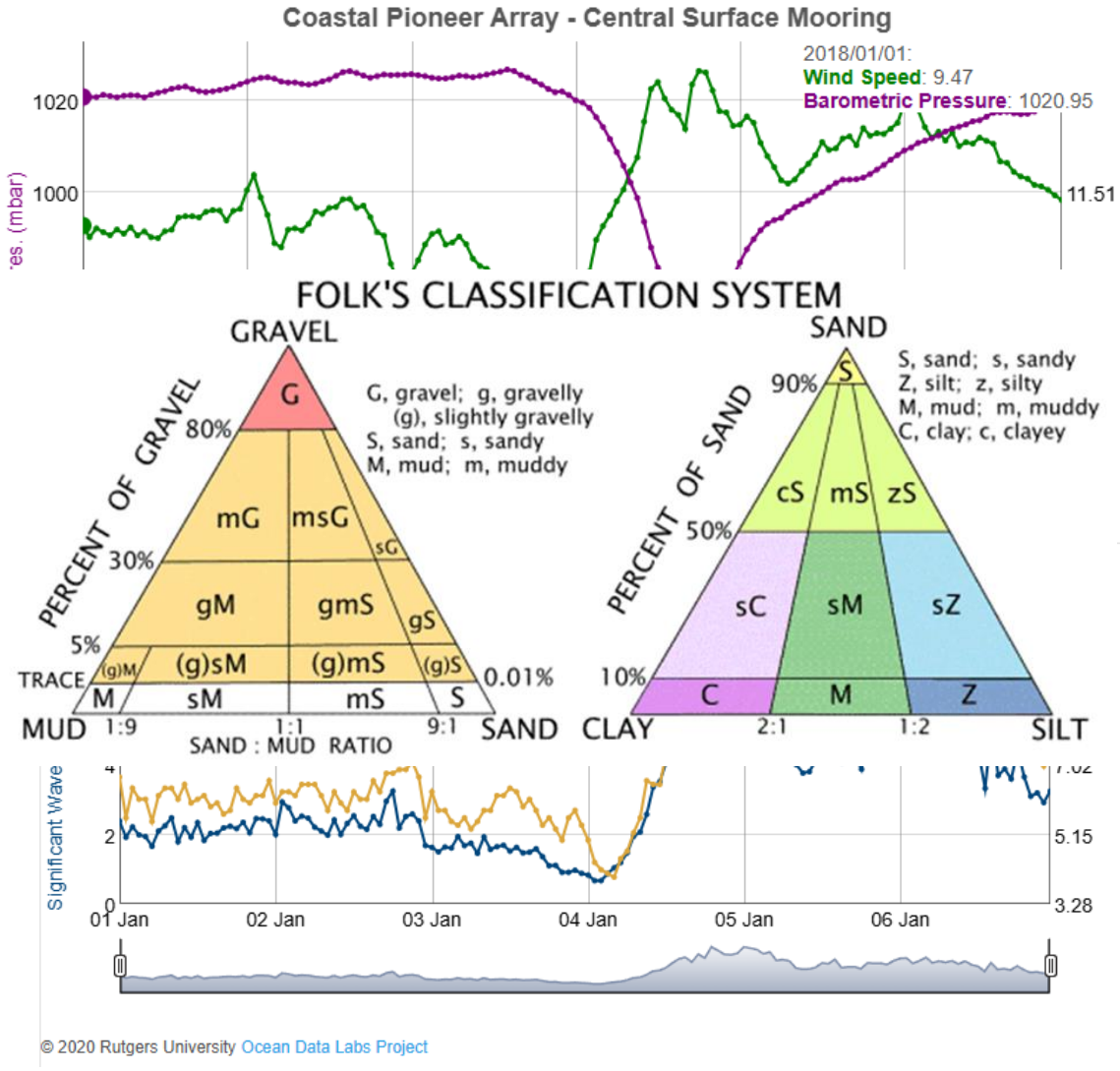
- **Which of the sampling locations in the wetland system may have the highest energy relative to other sites in this study area?** (1pt)

- **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



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(Long, Dixon and Lichtenwalner, 2021)

Case 2: EES 450-Wetlands

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

Teaching Unit: Wetland Hydrology

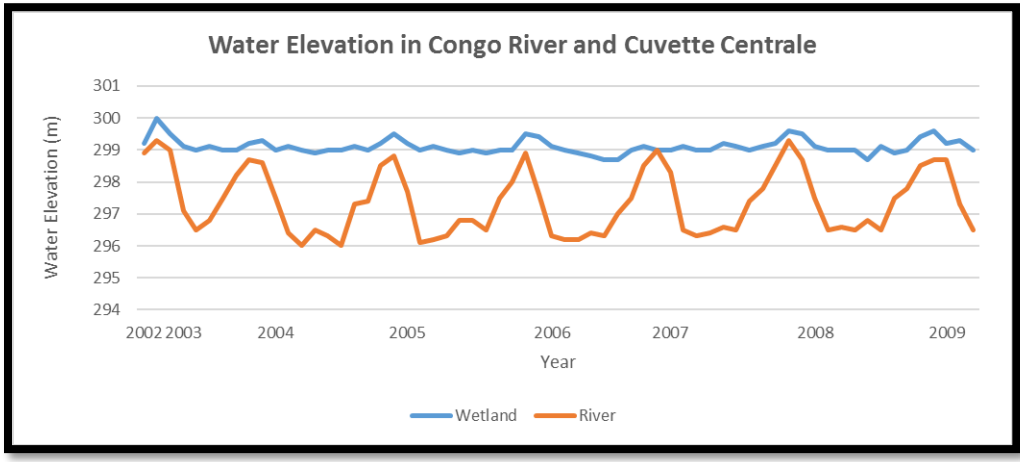
Activity: Graph water elevation for the Congo River and adjacent Cuvette Centrale wetland system, DRC.

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:10.1002/2016RG000517.

Wetland Hydrology

	Water Elevation (m)	
Year	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
	299.4	297.6
2006	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 **Fall 2024**
Lab 5: Lafayette Reservoir

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.

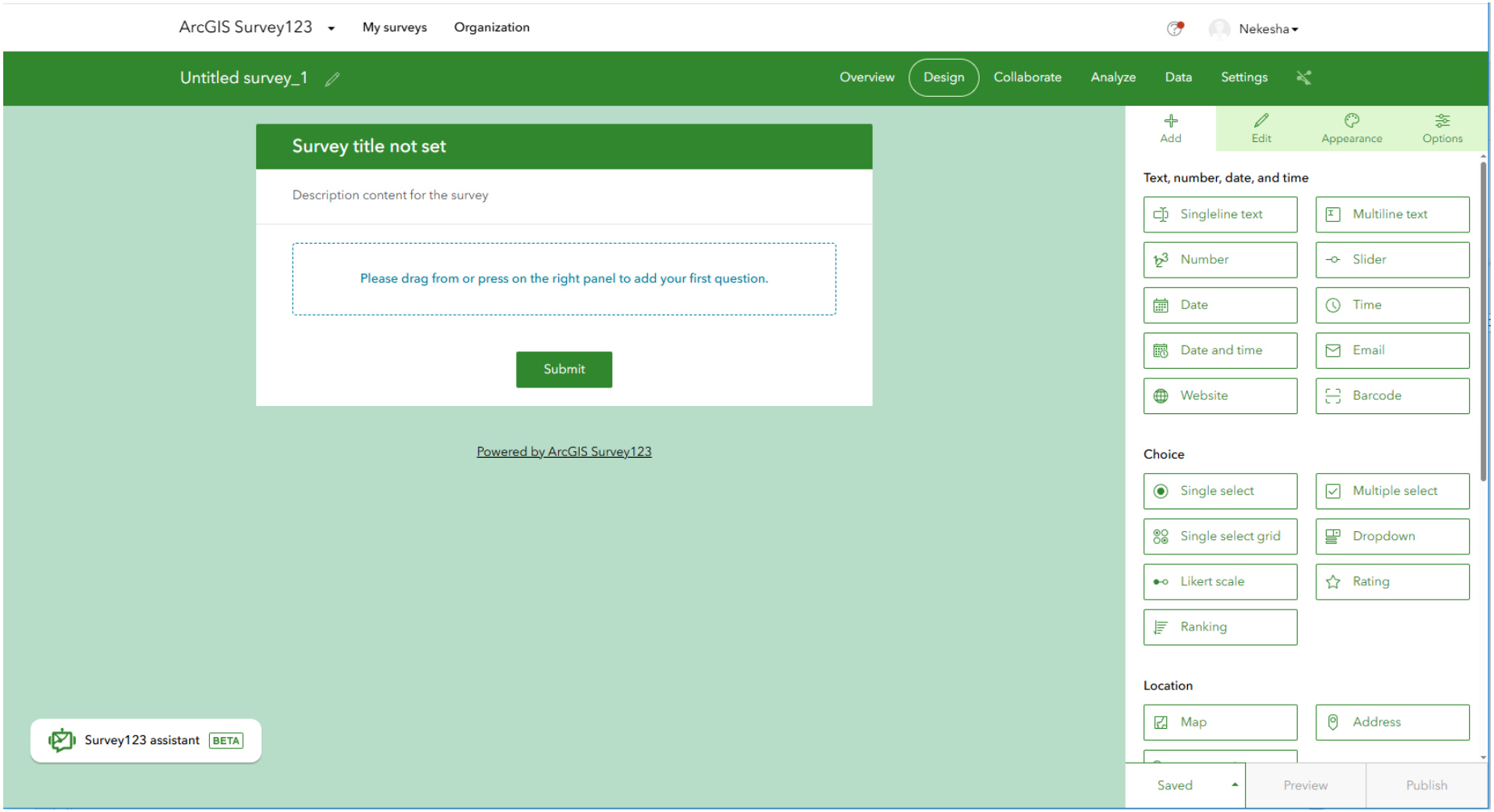
Student deliverables:

- 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: • 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



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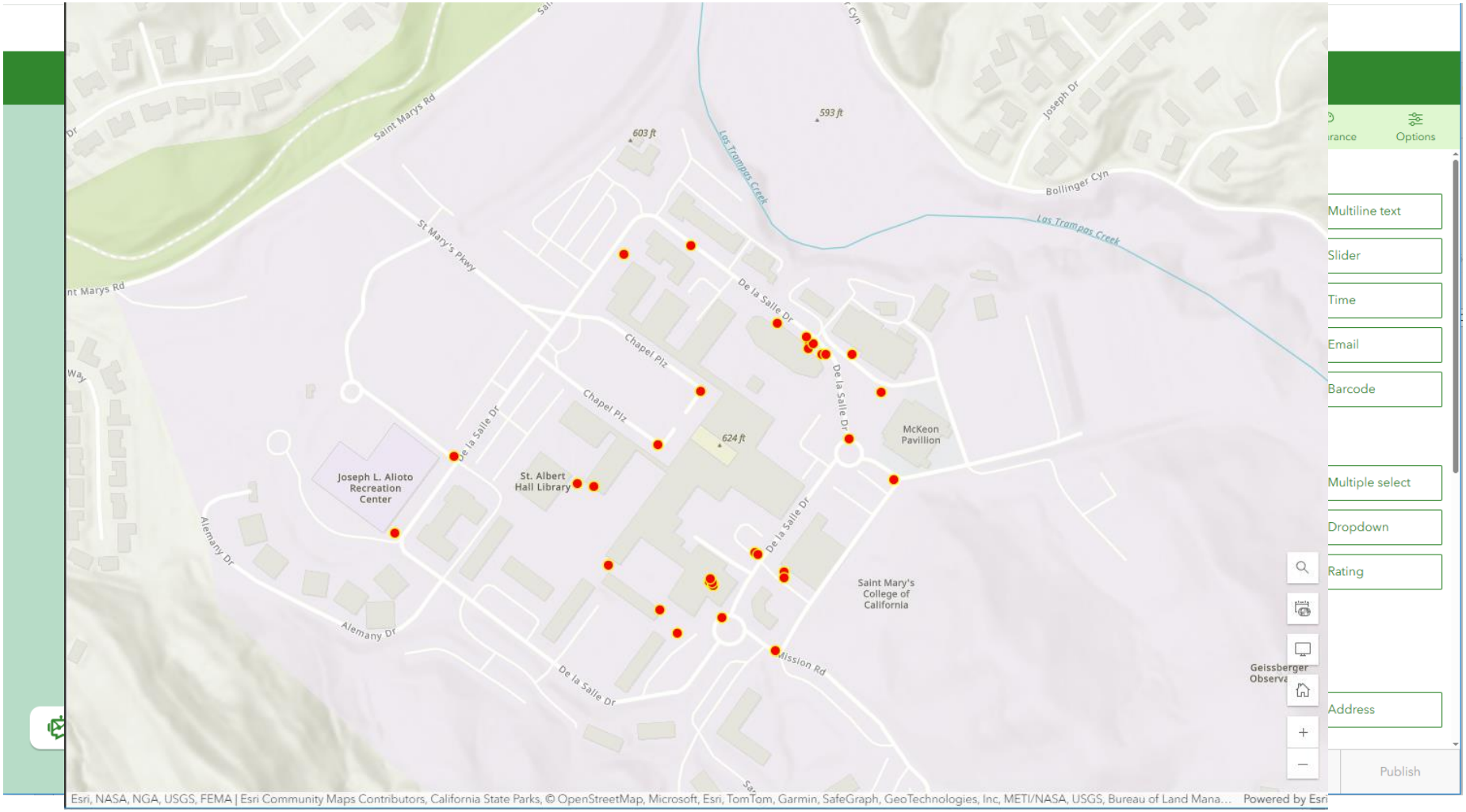

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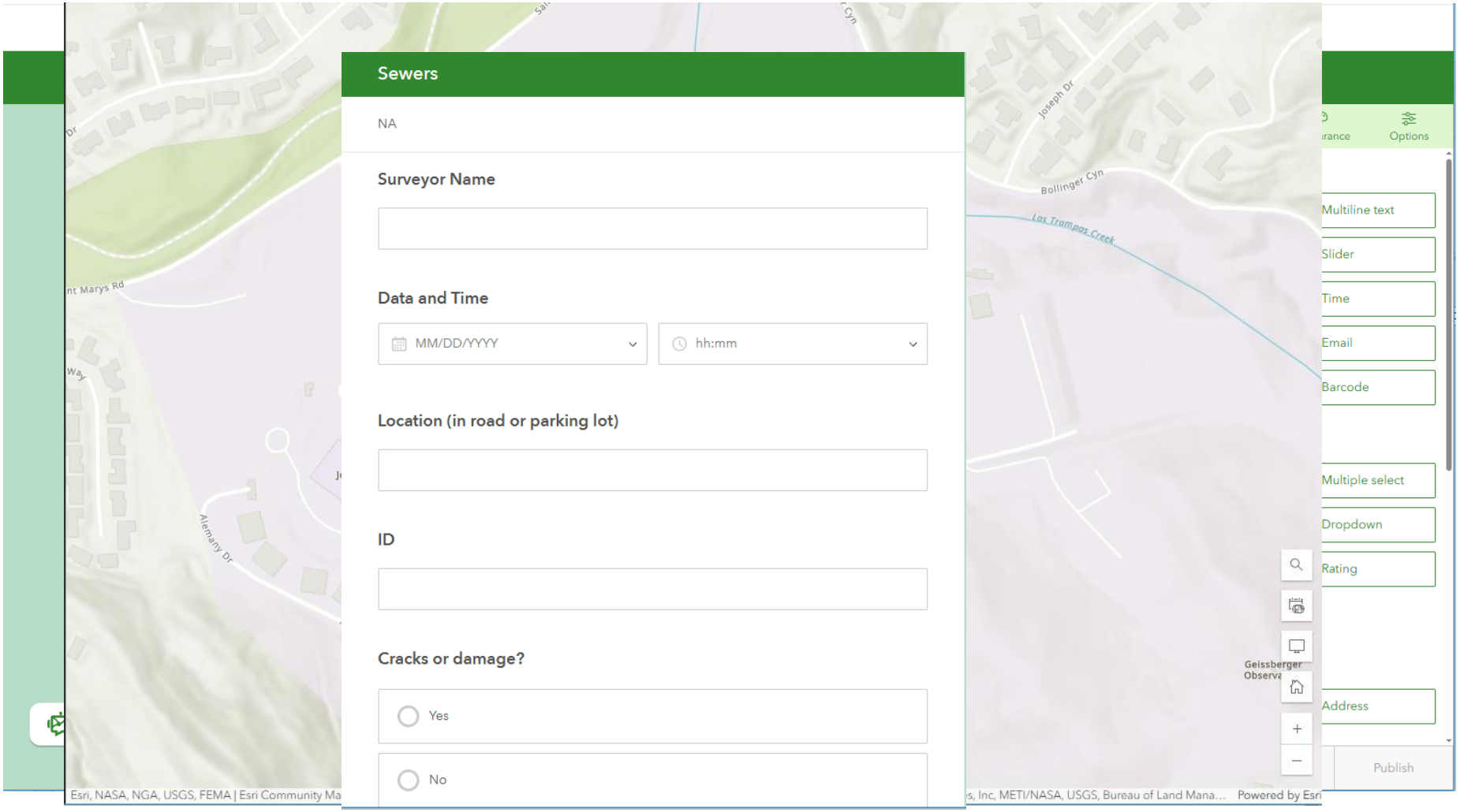

Summary

- **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/

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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.


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