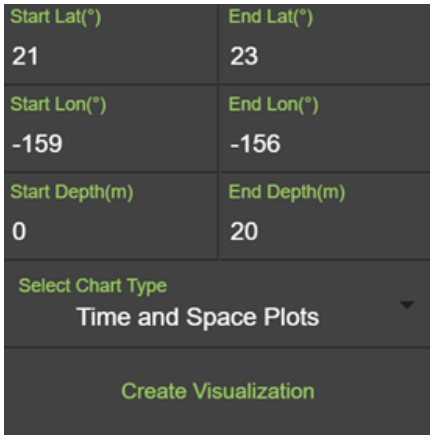
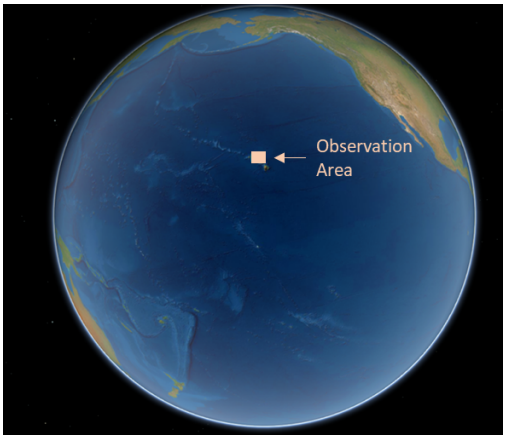
Overview: In today's lab, you will be exploring the Simons CMAP (Collaborative Marine Atlas Project) data portal. Simons CMAP compiles and visualizes marine datasets from a variety of different instruments we have talked about in this class. This is a data lab that will enable you to use this portal to compare/contrast what different sensing methods can tell us about environmental changes on various temporal scales, and how integrating observations from the multiple methods can create a more complete picture of environmental processes.

Simons CMAP Instructions: You will need a computer to access the Simons CMAP portal (https://simonscmap.com/). To find the datasets you will need below, click the **Visualization** tab at the top of the page and select **Charts and Plots**. From there you can select the desired dataset followed by the environmental variable. There is an enormous amount of data housed in this database so generating plots can take up to a minute to compile. For extra help navigating the data portal, click the **Help** button in the top right corner and select **Watch Video** for a video tutorial or the **Quick Tour** for a brief webpage tour.

Part 1: Exploring sea surface temperatures around Hawaii (40 pts)

In this part, you will be working with sea surface temperature data collected from three different methods (ships, autonomous vehicles, and satellites) in the same region around Hawaii. Once you find the dataset you want to plot (see sections 1.1 - 1.3 below) you will use the following location information (latitude/longitude) to restrict the data that is plotted to the region around Hawaii (highlighted on the globe). We are interested in surface water data so we will limit our search to data between 0-20m.





1. For each of the datasets you plot, record the (1) range of temperatures recorded (including units), (2) the time scale of the dataset (with start and end times), (3) any patterns you notice in the data, and (4) the cause of those patterns. Record those observations in the table below so that you can easily compare the datasets.

Hawaii Observations (30pts)

Observing method	What is the **temperature range** observed? Include units. (2pts each)	What is the **time scale** for this dataset (start and end times)? (2pts each)	What **patterns** or trends do you see in the data? (3pts each)	What do you think is the **cause of these pattern(s) or trend(s)**? (3pts each)
Ship (2018 SCOPE Falkor Cruise)				
Autonomous vehicle (Global Drifter Program)				
Satellite				

1.1 Ship-based data

On the CMAP visualization page, find the **2018 SCOPE Falkor Cruise** and select **CTD Temperature** data from the drop down menu. Do not edit the start/end dates. Use the location, depth and chart type parameters above and click **Create Visualization**. Select the **Time** tab once the visualization generates to navigate to the time series plot. Using the graph you generated, fill out the four questions in the table above in the ***Ship*** observations row.

1.2 Autonomous Vehicle Data

On the CMAP visualization page find the **Global Drifter Program** and select **Sea Surface Temperature** from the drop down menu. Do not edit the start/end dates. Use the location, depth and chart type parameters above and click **Create Visualization**. Select the **Time** tab once the visualization generates to navigate to the time series plot. Using the graph you generated, fill out the four questions in the table above in the ***Autonomous vehicles*** observations row.

1.3 Satellite Data

On the CMAP visualization page find the **Sea Surface Temperature (Near Real Time)** and select **Sea Surface Temperature** from the drop down menu. Do not edit the start/end dates. Use the location, depth, and chart type parameters above and click **Create Visualization**. This plot may take a minute to create because it is compiling A LOT of data! Select the **Time** tab once the visualization generates to navigate to the time series plot. Using the graph you generated, fill out the four questions in the table above in the ***Satellite*** observations row.

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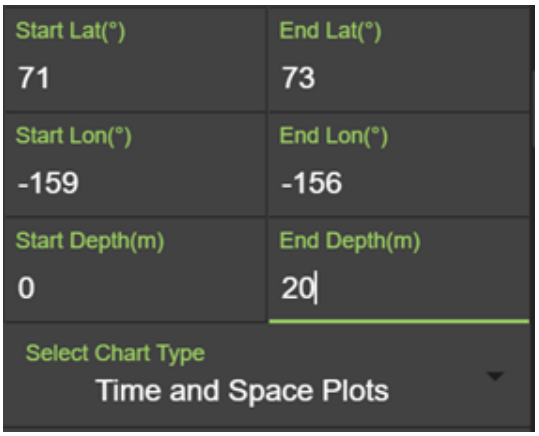
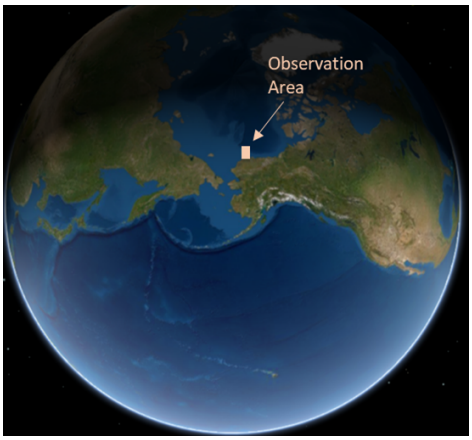
2. How does the cruise data, autonomous vehicle data, and satellite data compare or differ from each other? Be sure to compare time scales and temperature ranges. (10pts)

Part 2: Exploring surface ocean temperatures in the Arctic (40pts)

Now, we will compare surface temperature measurements taken using similar methods in the Arctic. Once you find the dataset you want to plot (see sections 2.1 - 2.3 below) you will use the following location information (latitude/longitude) to isolate data in the region off the coast of Alaska (highlighted on the globe). To explore conditions in the Arctic, we will use the same longitude range we used for Hawaii but shifted north by 50 degrees latitude. We are still interested in surface water data so we will limit our search to data between 0-20m.





1. For each of the datasets you plot, record the (1) range of temperatures recorded (including units), (2) the time scale of the dataset (with start and end times), (3) any patterns you notice in the data, and (4) the cause of those patterns. Record those observations in the table below so that you can easily compare the datasets.

Arctic Observations (30pts)

Observing method	What is the **temperature range** observed? Include units. (2pts each)	What is the **time scale** for this dataset (start and end times)? (2pts each)	What **patterns** or trends do you see in the data? (3pts each)	What do you think is the **cause of these pattern(s) or trend(s)**? (3pts each)
Ship (Tara Oceans Expedition)				
Autonomous vehicle (Argo Float Program)				
Satellite				

2.1 Ship-based data

On the CMAP visualization page, find the **Tara Oceans Expedition** and select **Temperature** data from the drop down menu. Do not edit the start/end dates. Use the location, depth, and chart type parameters above and click **Create Visualization**. Select the **Time** tab once the visualization generates to navigate to the time series plot. Using the graph you generated, fill out the four questions in the table above in the ***Ship*** observations row.

2.2 Autonomous Vehicle Data (Argo Float Program)

On the CMAP visualization page, find the **Argo Float Core Profiles** and select **Sea Water Temperature** data from the drop down menu. Do not edit the start/end dates. Use the location, depth, and chart type parameters above and click **Create Visualization**. Select the **Time** tab once the visualization generates to navigate to the time series plot. Using the graph you generated, fill out the four questions in the table above in the ***Autonomous vehicles*** observations row.

2.3 Satellite Data

On the CMAP visualization page find the **Sea Surface Temperature (Near Real Time)** and select **Sea Surface Temperature** from the drop down menu. Do not edit the start/end dates. Use the location, depth, and chart type parameters above and click **Create Visualization**. This plot may take a minute to create because it is compiling A LOT of data! Select the **Time** tab once the visualization generates to navigate to the time series plot. Using the graph you generated, fill out the four questions in the table above in the ***Satellite*** observations row.

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2. How does the cruise data, autonomous vehicle data, and satellite data compare or differ from each other? Be sure to compare time scales and temperature ranges. (10pts)

Part 3: Reflection questions (18pts)

1. How do the surface temperatures in the Arctic compare to those in Hawaii? Why? (3pts)

2. What are the short-term (less than a year) temperature changes captured by integrating these different methods in Hawaii vs. Alaska? Are there similarities or differences? (4pts)

3. What are the long-term (more than a year) temperature changes captured by integrating these different methods in Hawaii vs. Alaska? Are there similarities or differences? (4pts)

4. What are the benefits and limitations of each method in Hawaii? In Alaska? (4pts)

5. What additional information or data (with what sensing systems) would you like to better understand environmental changes in both locations? (3pts)

Feedback: What did you think of this lab? What did you learn from it? Did you enjoy it? What can be improved? (2 pts)