

**MICHIGAN STATE**  

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**UNIVERSITY**

# Beta Presentation

## Ocean Carbon Pollution Cleanup

### The Capstone Experience

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*From Students...  
...to Professionals*

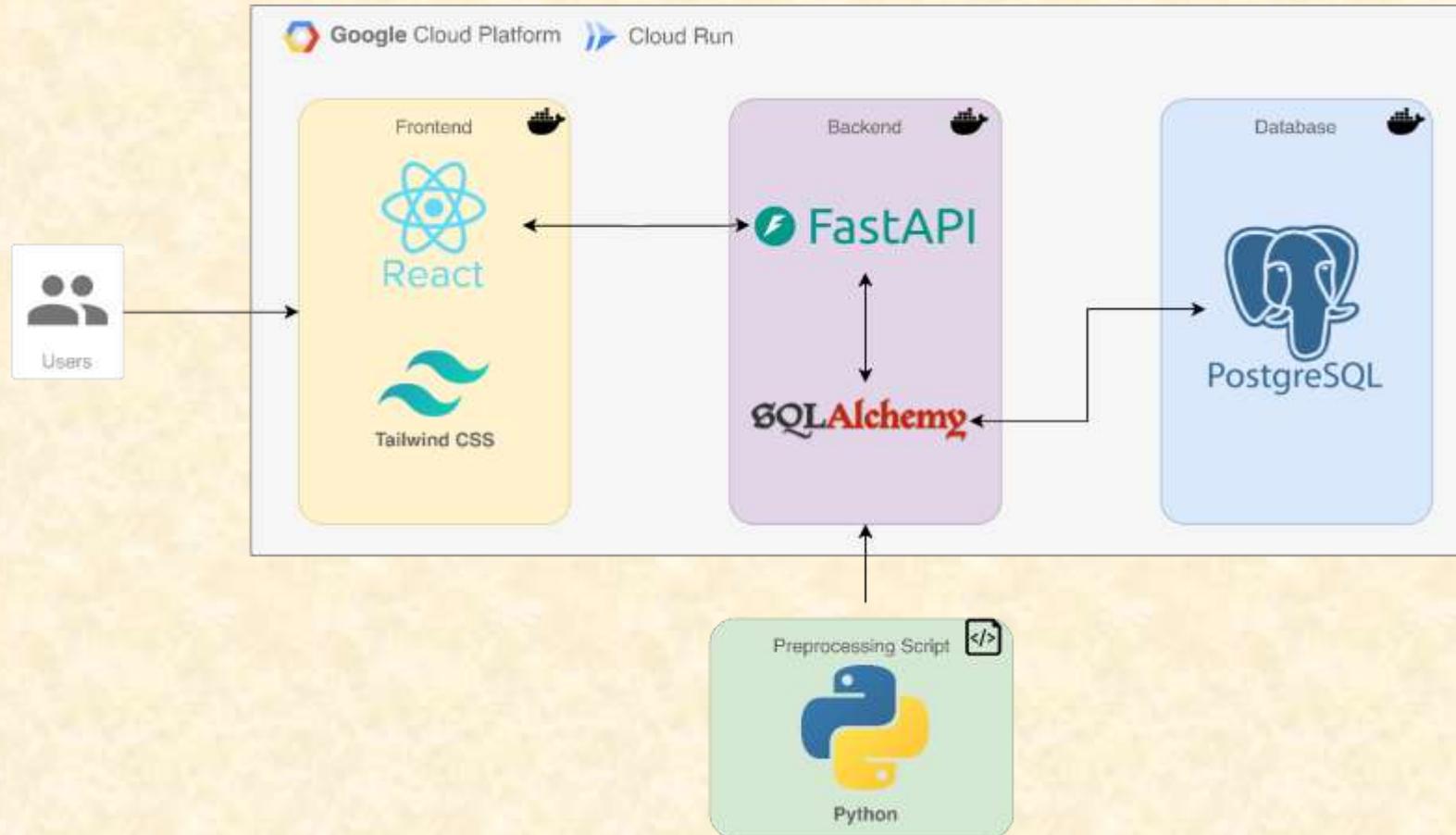
# Project Overview

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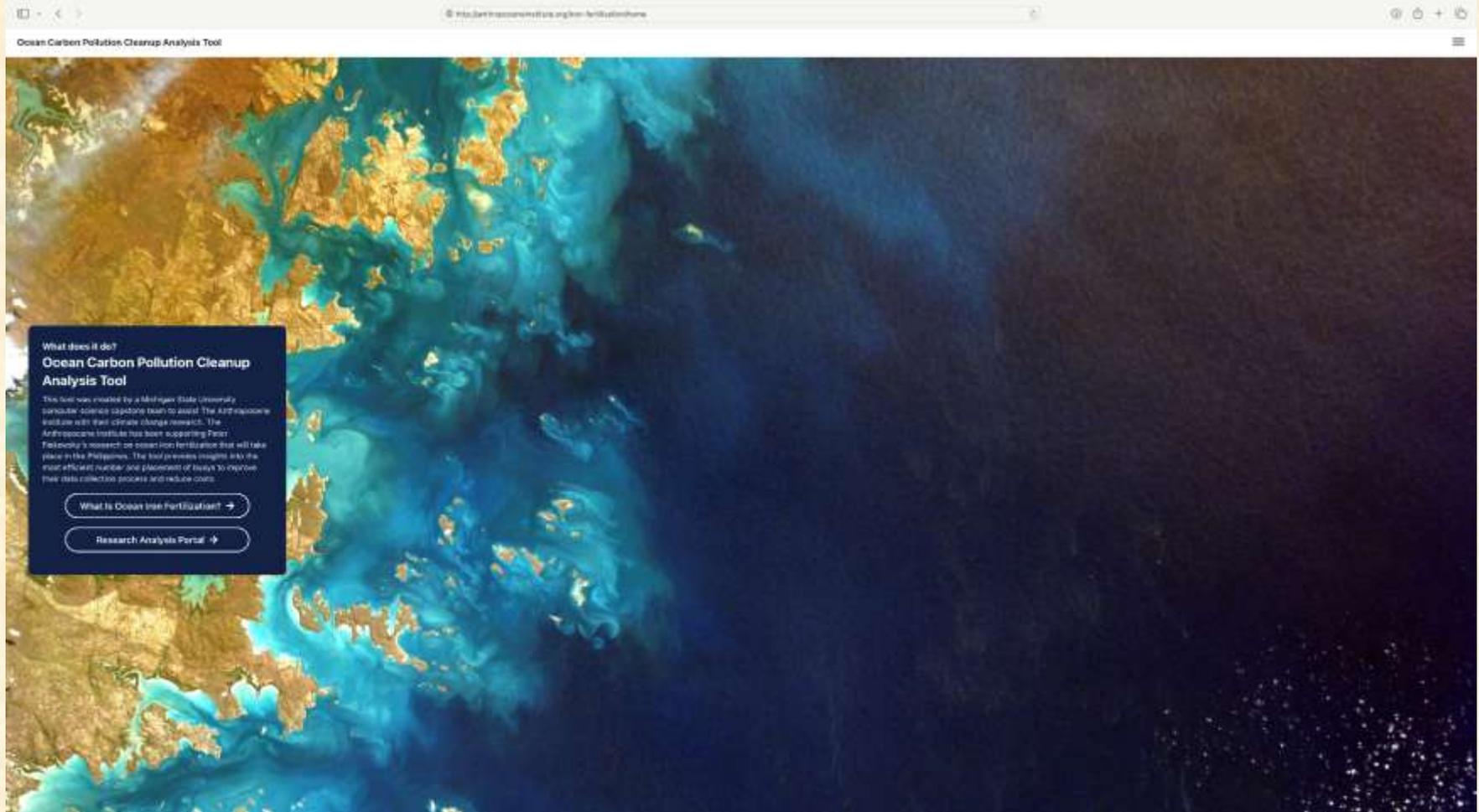
- Analyze ocean sensor network configurations for an iron fertilization experiment
- By modeling various proposed buoy layouts and comparing how effective data collection will be
- Create visualizations and graphs of the prospective outcomes to convey potential experimental results



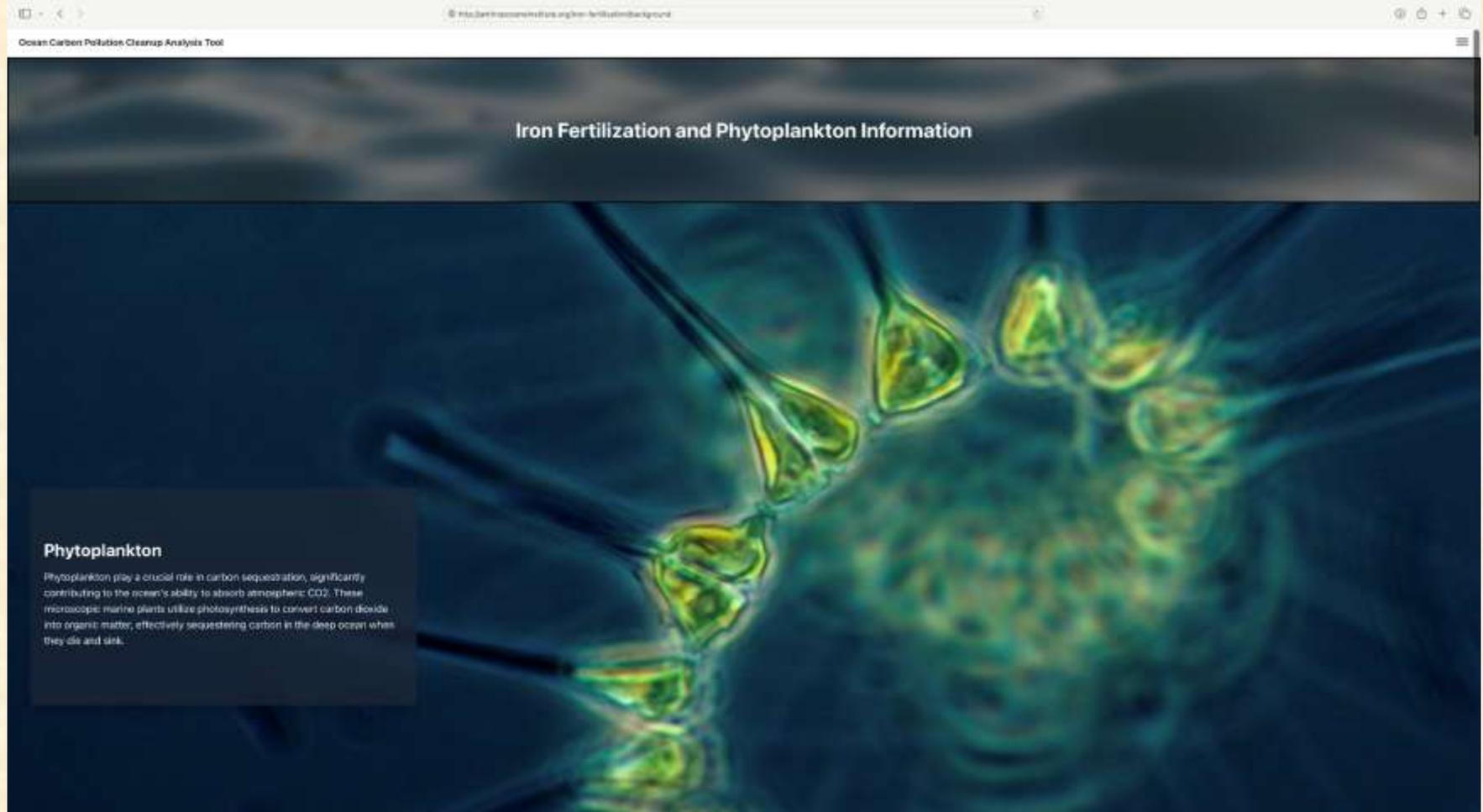
# System Architecture



# Home



# Background



The screenshot shows a web browser window with the address bar containing the URL <https://beta.anthropoceneinstitute.org/iron-fertilization/background>. The page title is "Ocean Carbon Pollution Cleanup Analysis Tool". The main heading is "Iron Fertilization and Phytoplankton Information". Below the heading is a large microscopic image of phytoplankton, showing several green, teardrop-shaped cells with long, thin flagella. In the bottom left corner of the image area, there is a text box with the following content:

**Phytoplankton**

Phytoplankton play a crucial role in carbon sequestration, significantly contributing to the ocean's ability to absorb atmospheric CO<sub>2</sub>. These microscopic marine plants utilize photosynthesis to convert carbon dioxide into organic matter, effectively sequestering carbon in the deep ocean when they die and sink.



# Collecting Data

**Ocean Carbon Pollution Cleanup Analysis Tool**

**Timeline 1**

Hour: 12

**Measurements Taken by 1995 and 1996**

**Measurements Taken by 1995 and 1996**

**Measurements Taken by 1995 and 1996**

Clear buoys will play an important role in this experiment. These buoys have sensors on them that monitor various environmental conditions throughout the duration of the experiment. While these buoys measure can be tailored to meet the needs of the given experiment but some common factors include temperature, carbon dioxide, atmospheric concentration, salinity, and more.

However, these buoys can't be operated by us, so it is critical that enough are deployed to accurately monitor the experiment, without causing undue monetary resources.

To better understand ocean buoys and how they collect information, the data from multiple NOAA buoys that were running at the same time in 2016 was combined, plotted, and analyzed. This particular dataset was chosen due to being located in the Pacific Ocean at similar latitudes to the planned location for the experiment. Over the course time these buoys were running they got very far apart from each other. Since the first deployment experiment will take place within a 300km x 300km area, for time frames when all four buoys were close to each other were selected to display and analyze.

This data was used to design potential sensor configurations for the experiment. These are located on the 'Reports' page of this website.

July 1000 was used to compare the other buoy's measurements. These graphs plot the difference in dissolved CO2 between another buoy and 1000 without flow since the buoy was at 1000 when the experiment was taken.

**TIP:** To better see individual lines on the graph you can click on labels in the key to toggle the lines on and off.



# Experiment Model



# Experiment Model 2

The screenshot displays the 'Ocean Carbon Pollution Cleanup Analysis Tool' interface. At the top, there is a browser address bar and navigation icons. Below the browser bar is a timeline labeled 'Day' with markers from 1 to 25. Three buttons are visible: 'Customize', 'Clear', and 'Save'. The main content area is titled 'Graphical Algae Model' and includes the text 'Updates Every 5 Days'. Two maps are shown: 'Algae Bloom 1' on the left and 'Carbon Network' on the right. Both maps feature a grid with a central colored area (green and red) representing an algae bloom. Below the maps is a 'Day: 5' slider. At the bottom left, a section titled 'Comparing Algae Blooms' contains five bullet points. At the bottom right, there is a small inset window showing a simplified version of the maps. The footer contains copyright information for the Anthropocene Institute and data sourcing from the National Oceanic and Atmospheric Administration.

Ocean Carbon Pollution Cleanup Analysis Tool

Day

Customize Clear Save

### Graphical Algae Model

Updates Every 5 Days

Algae Bloom 1

Carbon Network

Day: 5

#### Comparing Algae Blooms

- On average, map 1 has 0 buoys measuring a potentially harmful algae bloom
- On average, map 1 has 1 buoy measuring enhanced algae growth
- On average, map 1 has 34 buoys measuring normal algae amounts
- On average, map 2 has 0 buoys measuring a potentially harmful algae bloom
- On average, map 2 has 0 buoys measuring enhanced algae growth
- On average, map 2 has 4 buoys measuring normal algae amounts

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Data sourced from the National Oceanic and Atmospheric Administration.



# About

**NOAA**  
The National Oceanic and Atmospheric Administration (NOAA) conducts important work, from monitoring the climate and fisheries to forecasting the weather and northern lights. Many of the datasets our system uses are from a multi-organizational effort, partially funded by NOAA, to rethink the way the tropical Pacific is observed and monitored.

**Data Extrapolation**  
Our primary data model is based off of a series of measurements from a single buoy traveling in a straight line. We used advanced statistical methods, including the equations shown above, to extrapolate any two points from this straight line of data into a larger set of data points throughout the entire experimental area.

**Buoy Variance**  
The buoy variance is a measure of how consistent the data collected across the buoy network is. We used statistical analysis to find this number, of which a value closer to 0 shows a greater consistency in the network while values further from 0 show that there are inconsistencies within the data collected.

**Algae Growth**  
Modeling algae growth under ideal conditions involves simulating how algae populations expand when provided with optimal light, nutrients, and temperature. The exponential growth equation used is extrapolated and fit with basic wave patterns from a paper titled "Modeling and Optimization of Algae Growth".

**Anthropocene Institute**  
The Anthropocene Institute has the ultimate goal of making Earth abundant and sustainable for all generations to come. They are working to achieve this goal by connecting experts with government organizations, providing funding to upcoming technologies, and promoting education about the climate.

**Capstone**  
Colleges like Michigan State University collaborate with companies like the Anthropocene Institute, providing students with funds on experience while helping businesses access fresh talent and prototypes for various business needs.

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# What's left to do?

- Features
- Stretch Goals
  - Daily Algae Graphical Updates
- Other Tasks
  - Citation Linking
  - Client Textual Updates on Background Page
  - Tooltip Bug Fix
  - Buoy Cost Change
  - Experimental Model Page Context
  - Dark Mode Bug Fix
  - Web Deployment



# Questions?

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