**Data to Discovery Program**
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California Institute of Technology
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# DeepSee

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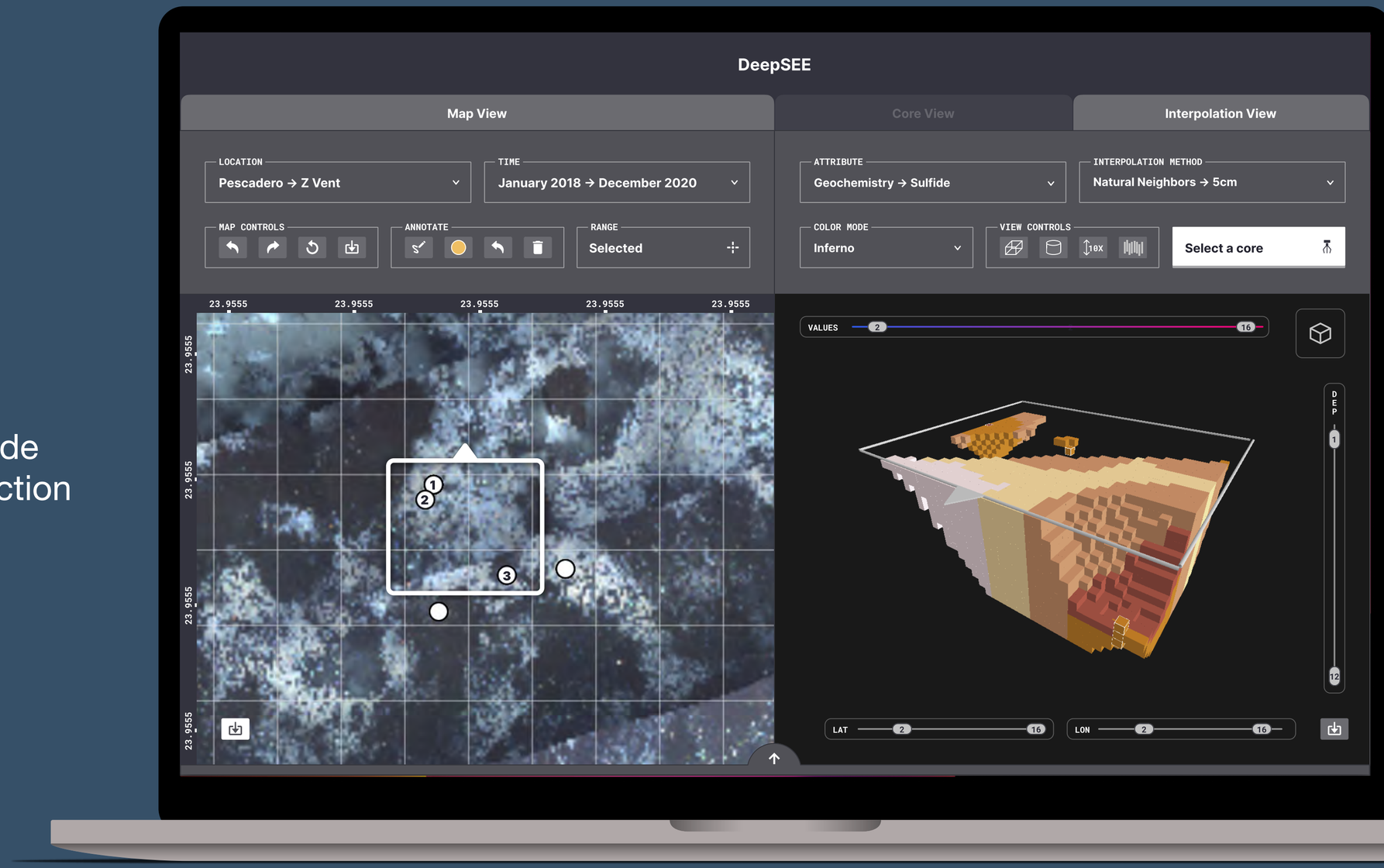
# DeepSee

Interpolating sparse data to guide deep sea core sample site selection



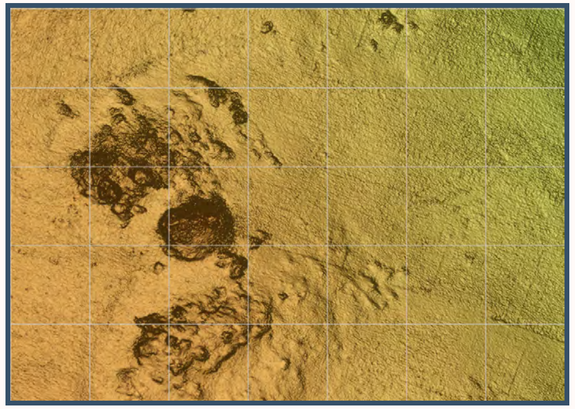
**Scientists at Caltech's Orphan Lab are actively studying microbial communities that live around methane seeps at the bottom of the ocean.**

These microbes consume huge amounts of methane, preventing it from reaching the atmosphere and contributing to climate change.

To study these microbes, scientists survey the ocean floor and draw core samples using underwater robots.

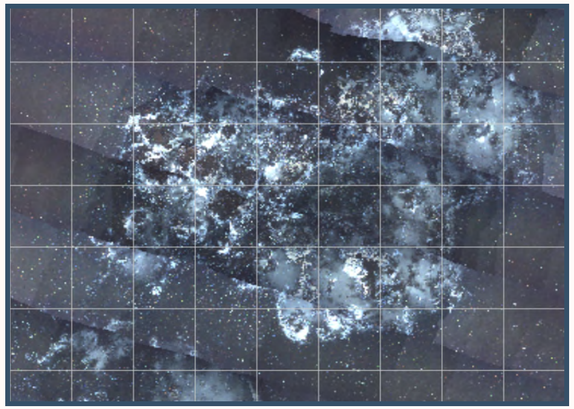
This process is expensive and time consuming, and so only a very limited number of samples can be taken.


## Pre-Dive Mapping Data

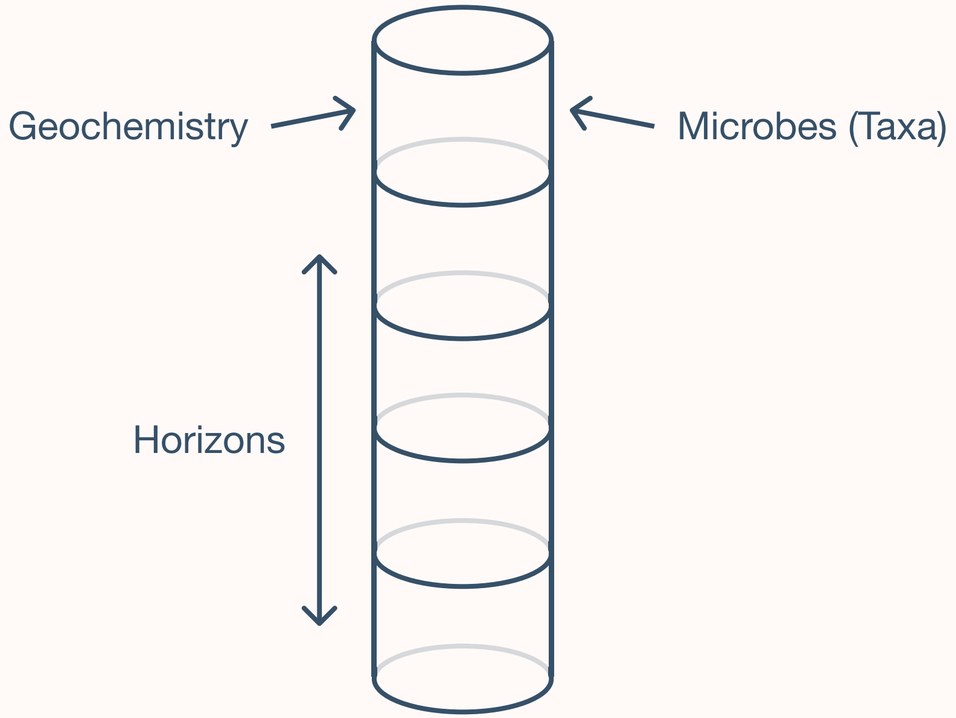


Bathymetry

Photomosaic

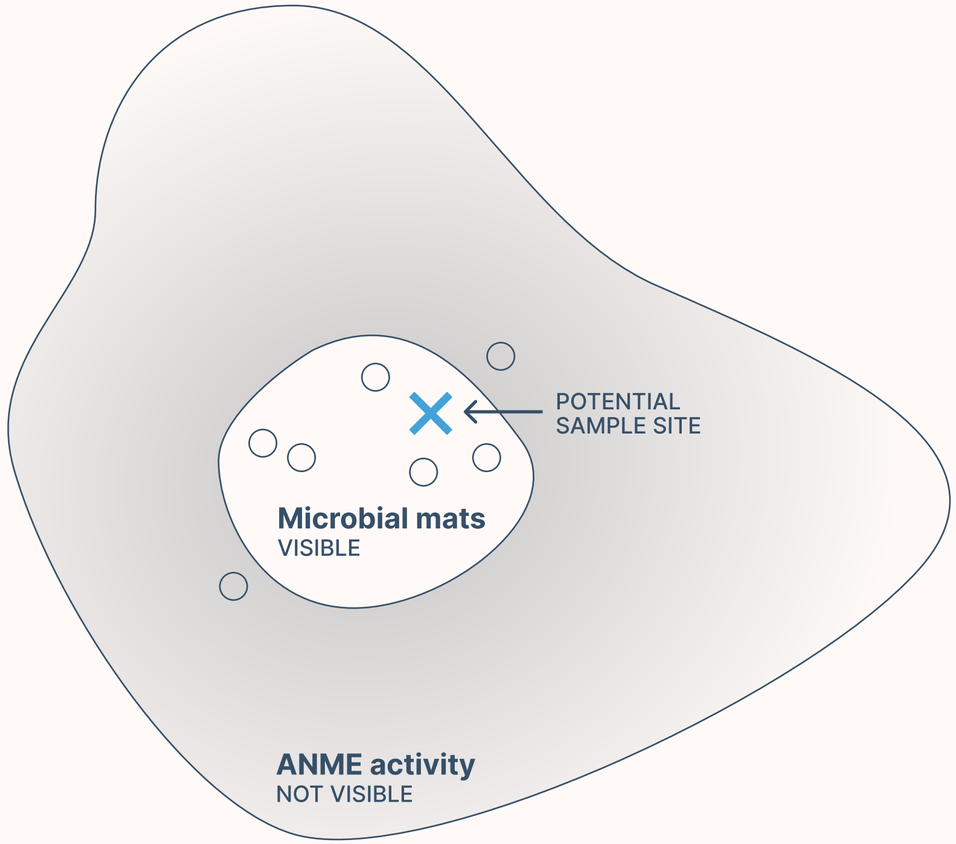


## Core Sample Data

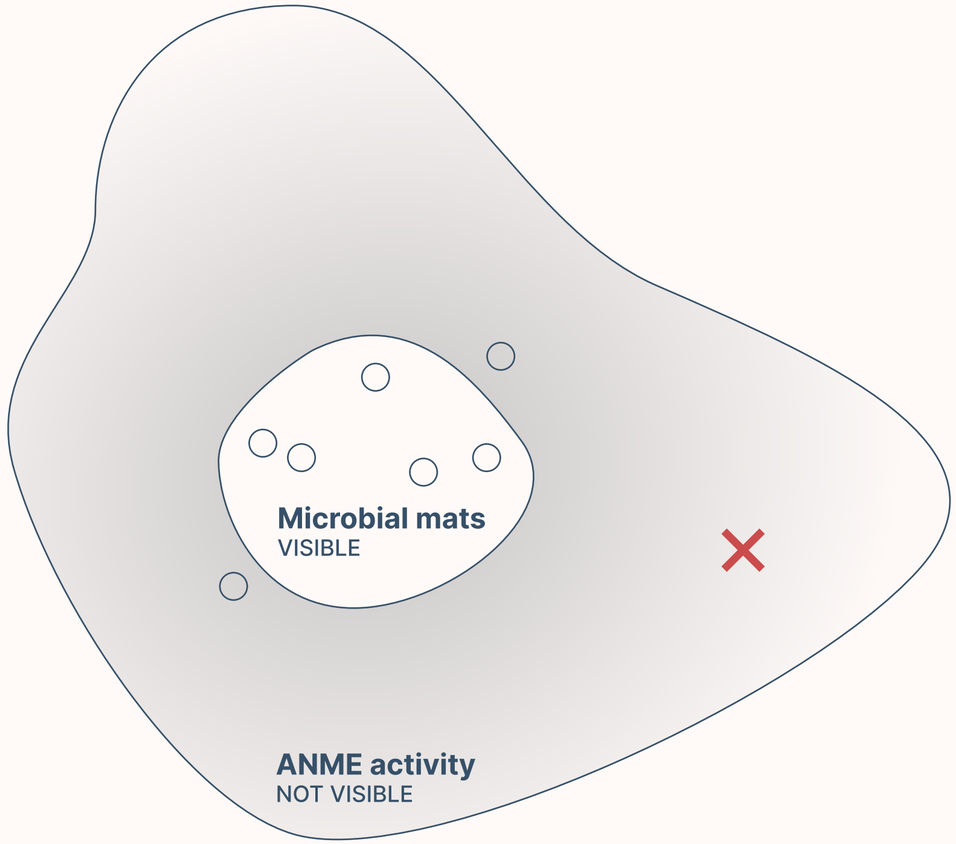


# The cost associated with taking samples creates strong incentives to pick “obvious spots” where there is visible surface expression of microbial communities.

Samples that are taken outside surface expression are less likely to have scientific value.



However, this approach limits scientists’ ability to understand the true bounds of where these important microbes live and how this changes over time.



Our Task

Help scientists make **more informed sample site selections** in non-obvious locations to illuminate the “edges” of microbial activity around methane seeps.

Our Process

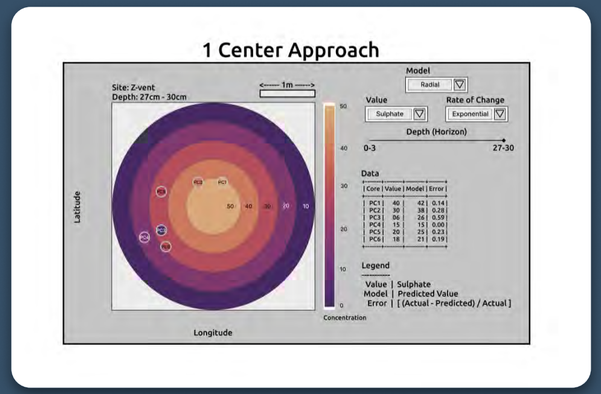
**Contextual Inquiry**

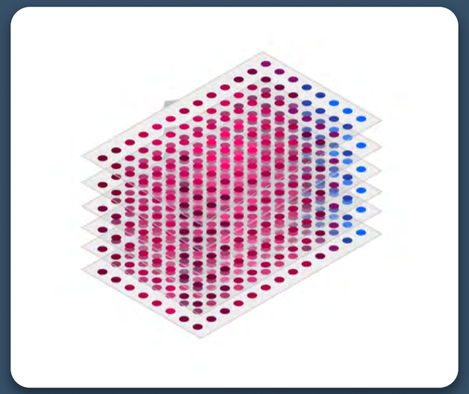
**Design & Data Exploration**

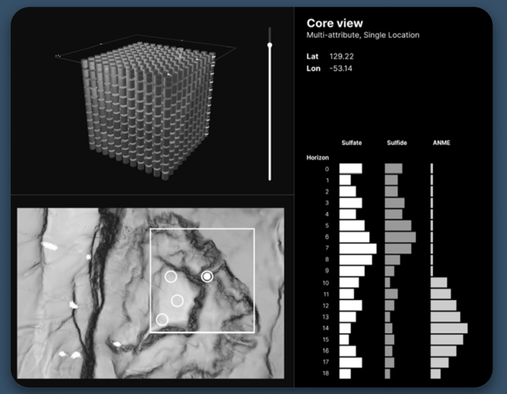
**Today's Prototype!**

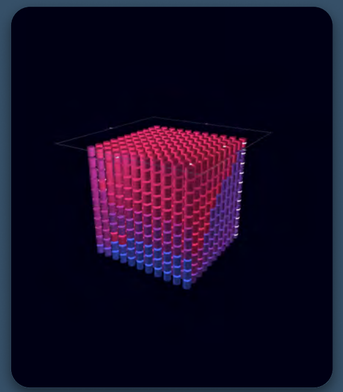

**User Testing & Refinement**

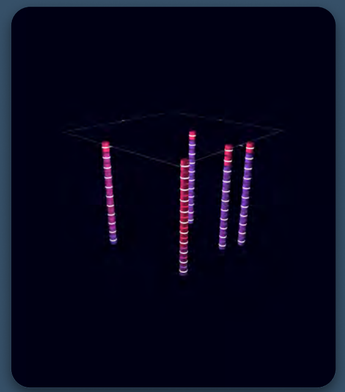
# Alternative Explorations

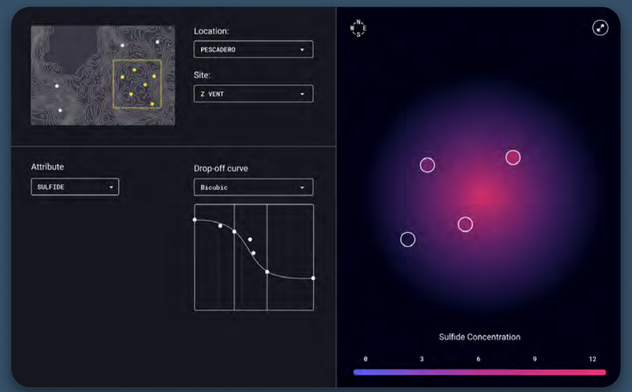


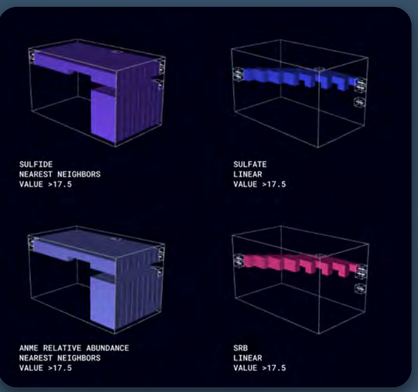



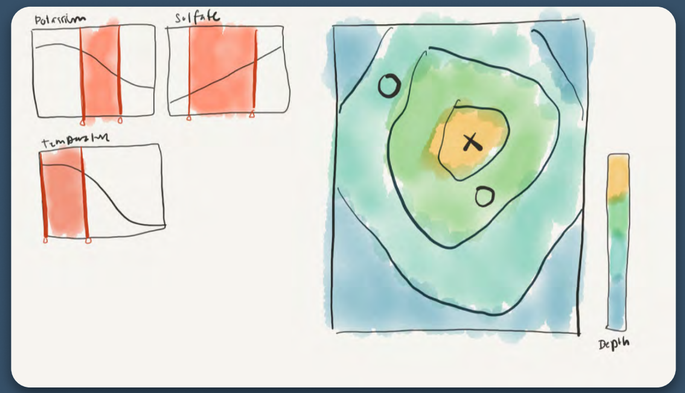


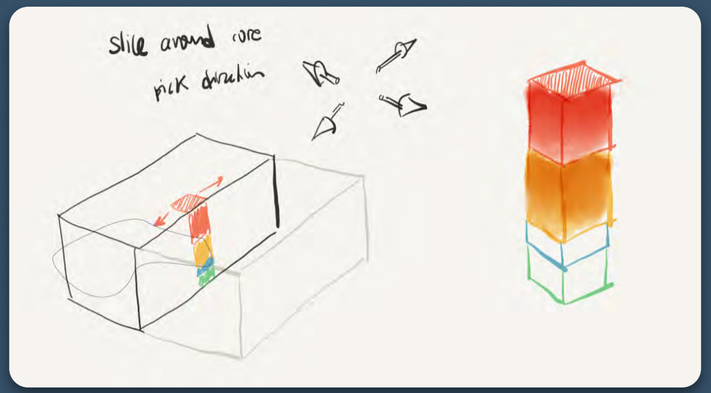







Our Solution

**DeepSee** provides a platform to generate and visually explore 3D interpolations between sparse core data to guide future sample site selection.

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*Interpolating between known samples to fill in gaps in data and identify previously invisible hotspots of activity.*

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*Allow scientists to visually explore interpolated data in 3 dimensions, building spacial intuition about distributions.*

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DeepSee provides a platform to generate and visually explore 3D interpolations between sparse core data to guide future sample site selection.

*Provide all the necessary contextual information to inform site selection, including bathymetry and photomosaic maps.*

1

## Pre-cruise planning

Identify promising sample sites in advance of an upcoming research cruise

2

## On-site refinement

Interpolate on the fly with data collected before a dive occurs (i.e. temperature)

# Demo

## 1 Backend server

*Python*

A Python Flask web app is running in the background, receiving the CSV data from the frontend and creating datasets of XYZ data to be plotted by Three.js in the frontend.

## 2 Frontend interface

*Vue.js*
*+ Vuetify*
*+ Electron*

Vue.js serves static assets (PNG, CSV, JSON) and provides UI interactions styled with the Vuetify Material Design Framework, all wrapped into a standalone Electron desktop app.

## 3 Visualization

*D3.js*
*+ Three.js*

D3.js plots previously sampled cores on top of PNG images scaled by latitude and longitude. Three.js creates a traditional 3D render scene with lighting effects to show the distribution of interpolated values.

# Avenues for Future Work

## 1 Integration with existing ecosystem of tools

Allow users to seamlessly analyze known cores in addition to interpolations.

## 2 Robust comparisons and annotations

Allow users to save maps, interpolations, annotations, and entire files in addition to cores.

## 3 Improved interpolation methods

Provide new ways to generate data, ranging from machine learning to nutrient flux modeling.

## 4 Inform autonomous space sampling missions

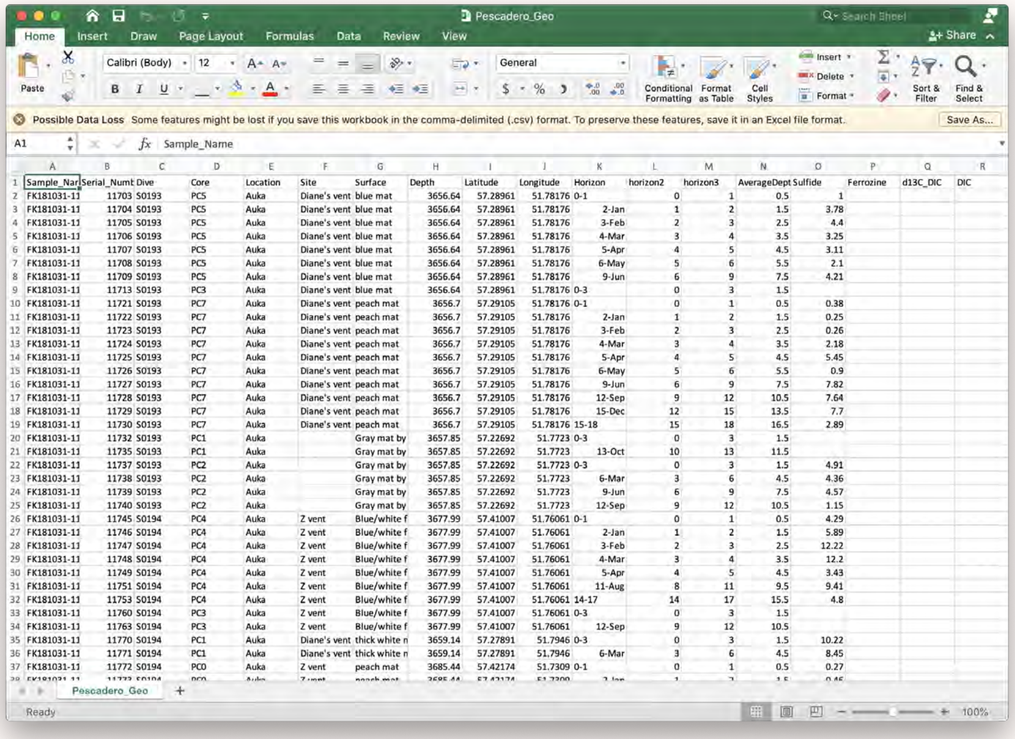
Leveraging the information humans use in selecting sample sites to help train autonomous sampling systems on other planets.

Next Steps

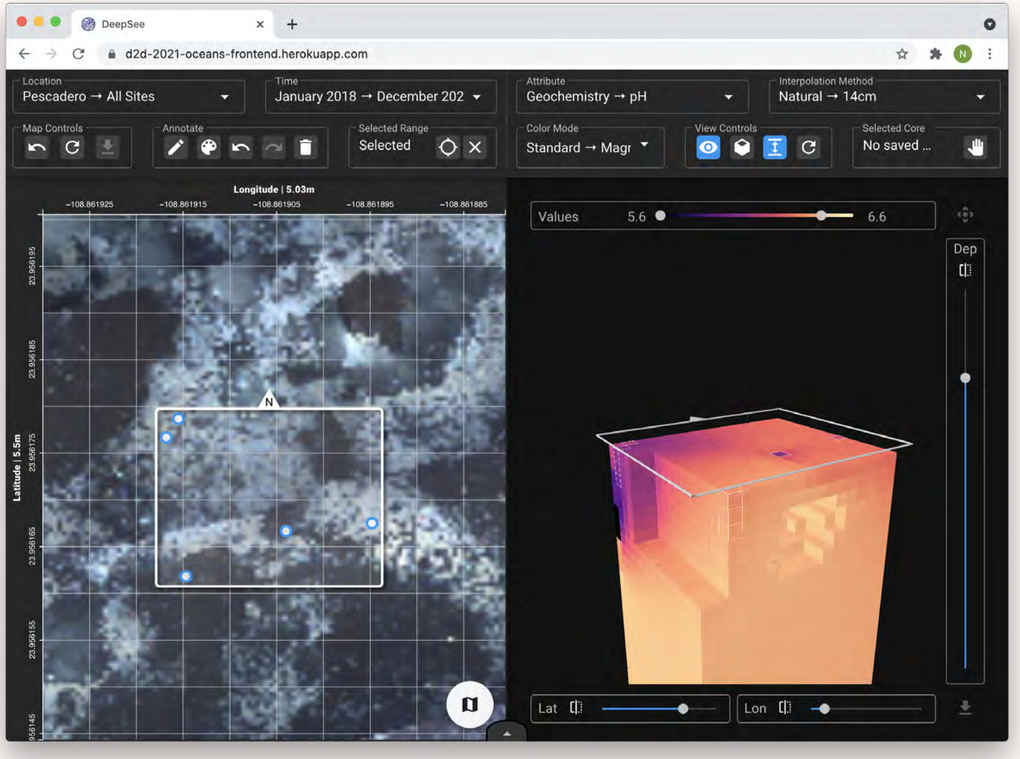

# Test DeepSee on an upcoming research cruise!

# Summary of Contributions

## Before




## After



Acknowledgments

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Thank you to our mentors **Hillary**, **Santiago**, **Maggie,** and **Scott** for their guidance and support throughout!

Thank you!

# Questions?

# Data to Discovery

NASA JPL

Caltech

ArtCenter


**Jet Propulsion Laboratory**
California Institute of Technology

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