Cloud Interactive Visualization for Near Real-Time Ocean Sonar Data

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INTRODUCTION

- Ocean exploration requires methodical planning of ship routes, precise sonar timing, extensive data storage, and effective visualization techniques
- The National Oceanic and Atmospheric Administration (NOAA) leads in using sonar technology to investigate marine ecosystems
- Data volume has increased dramatically over the past decade, but processing and utilization capabilities have not kept pace
- A locally accessible mapping application has been proposed to efficiently present geospatial sonar data in a user-friendly format

OBJECTIVES

- Upgrade the **open-source Echoshader package** to enhance echogram analysis and offer improved customization for users
- Build a **web-based map application** integrating NOAA ship sonar data with visualization of ship tracks, sonar readings, and dynamic echogram displays
- Provide interactive controls to support customizable sonar data visualizations within the map application
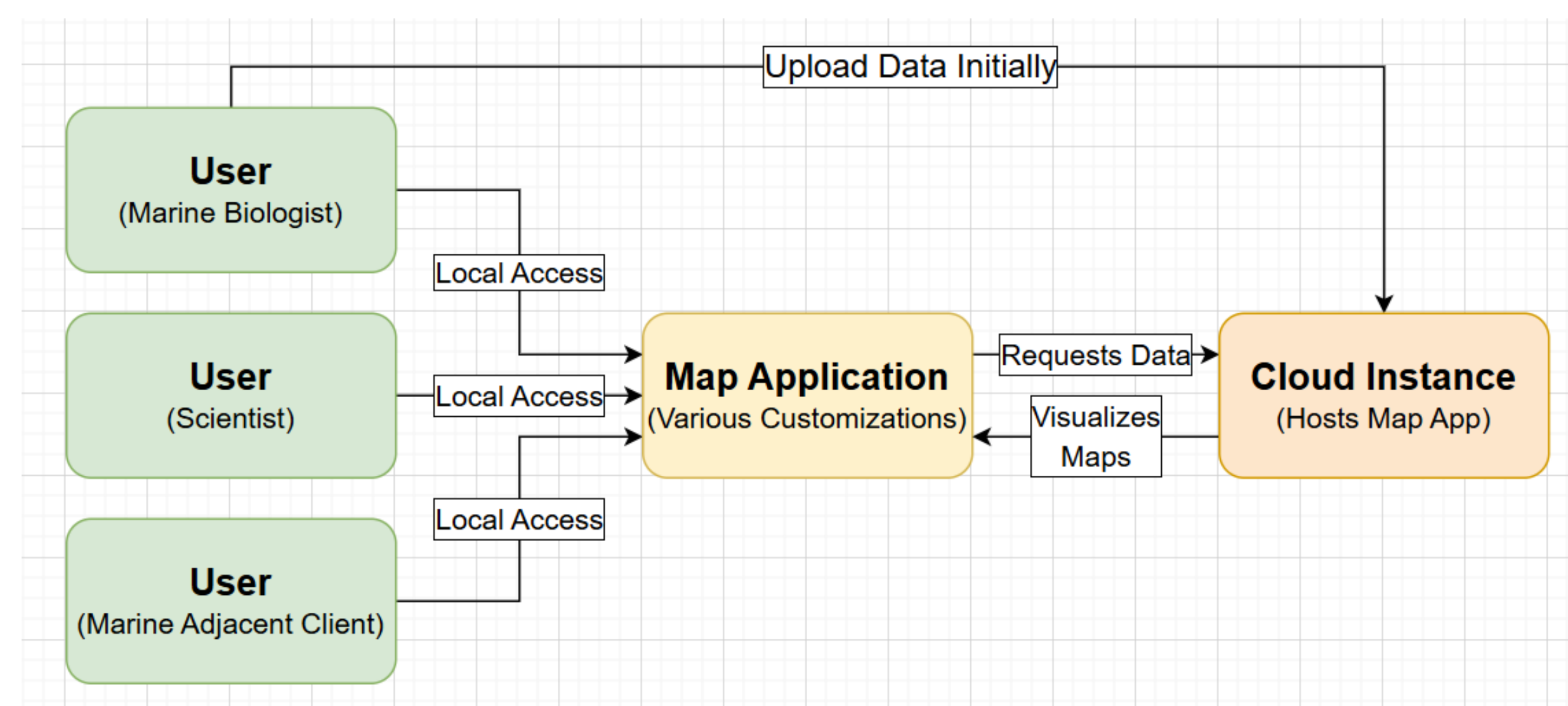

WEB MAP APPLICATION

Backend server

- Loads sonar data from cloud storage, performs resampling and coordinate transformations
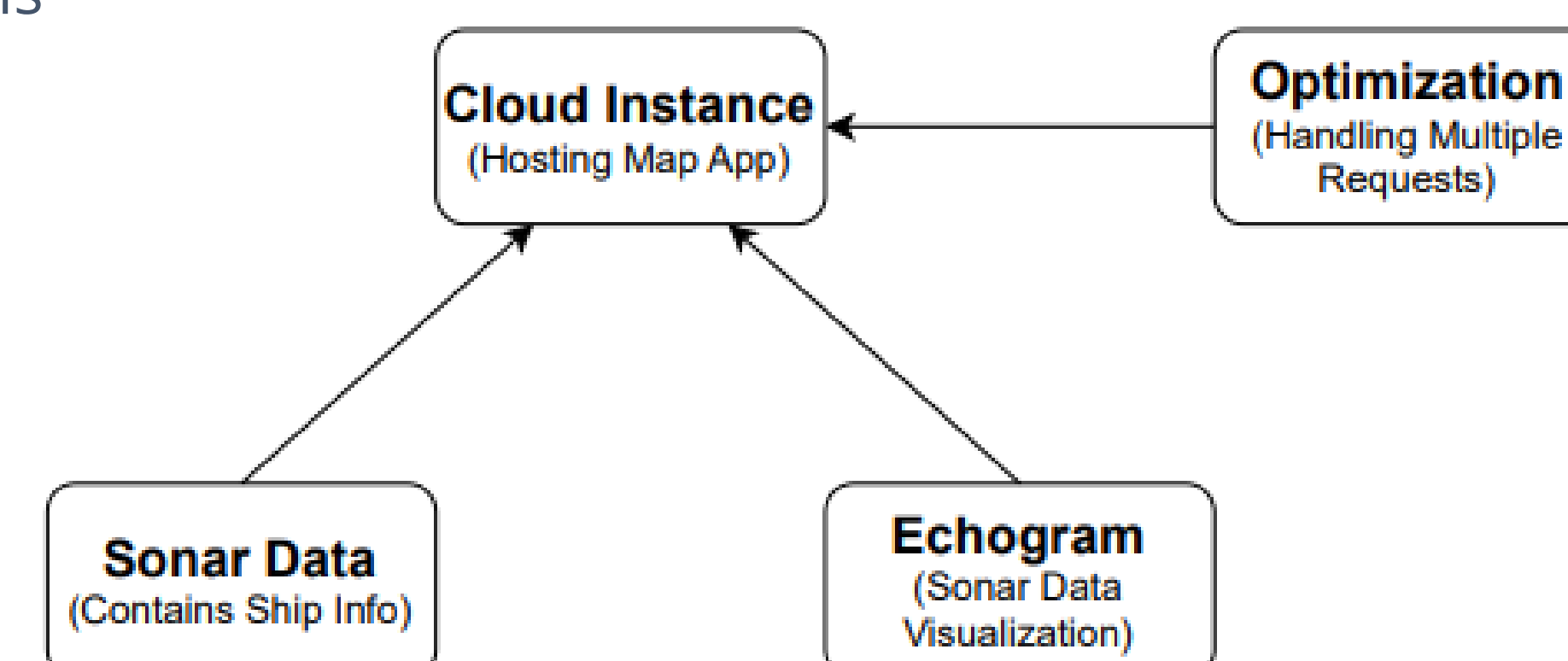
Frontend server

- Supports integration of multiple sonar datasets from NOAA
- Generates sonar data visualizations (echograms) within the interface
- Customizable widgets to select ships, time ranges, and adjust echogram parameters (e.g., SV range, channel)
- Visualizes real-time ship tracks alongside corresponding sonar data for intuitive spatial exploration
- Intuitive interface designed for marine scientists to explore large-scale ocean sonar data easily
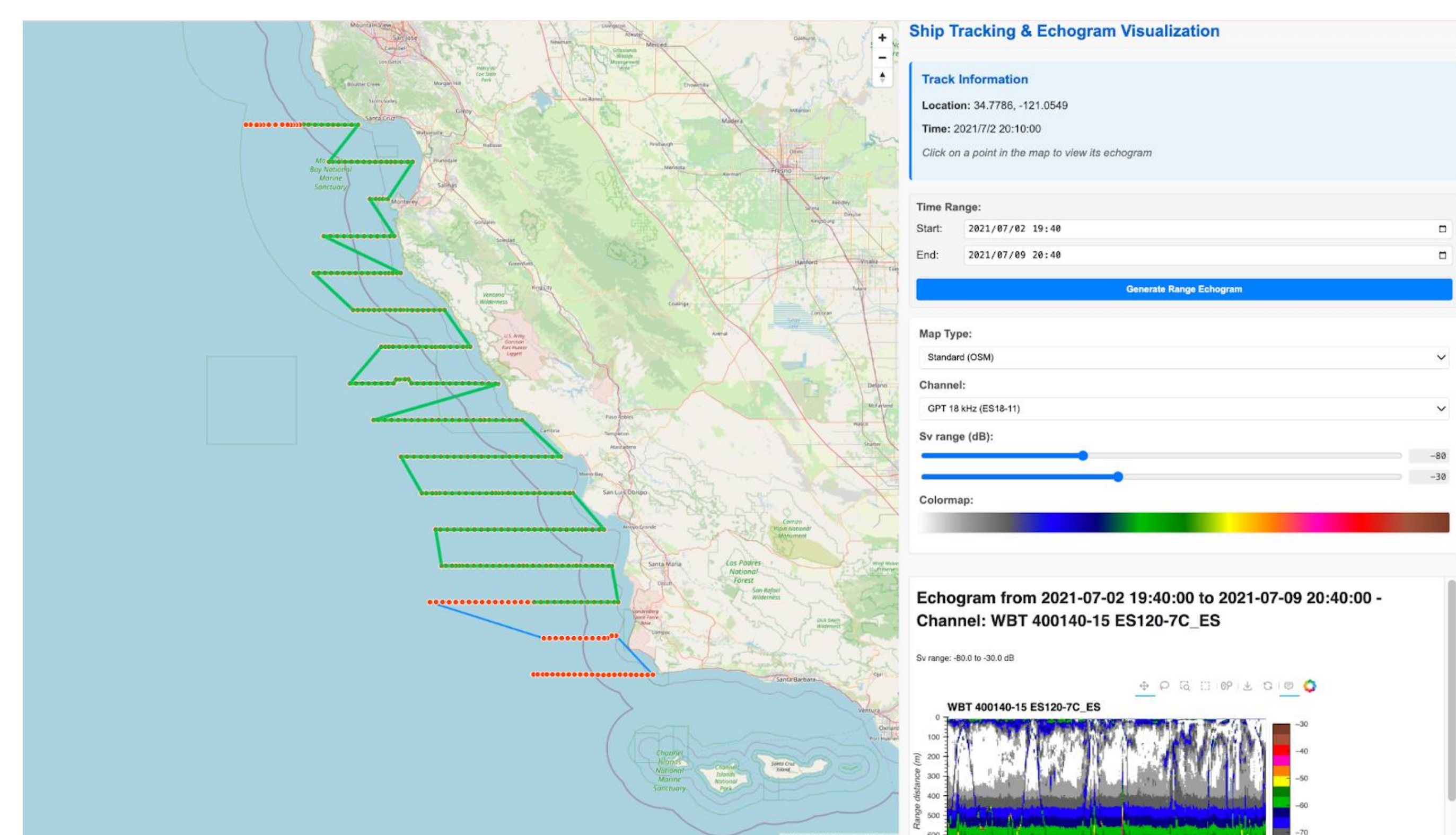
ECHOSHADER PACKAGE

- Prototyped upgraded 3D curtain plotting using Plotly, enhancing image detail and reducing rendering time, with plans for future integration into the Echoshader package
- Improved unit tests and resolved several compatibility issues
- Developed a prototype region browser in Jupyter notebooks, enabling users to interact with polygonal regions on echograms to support intuitive data exploration in upcoming Echoshader updates
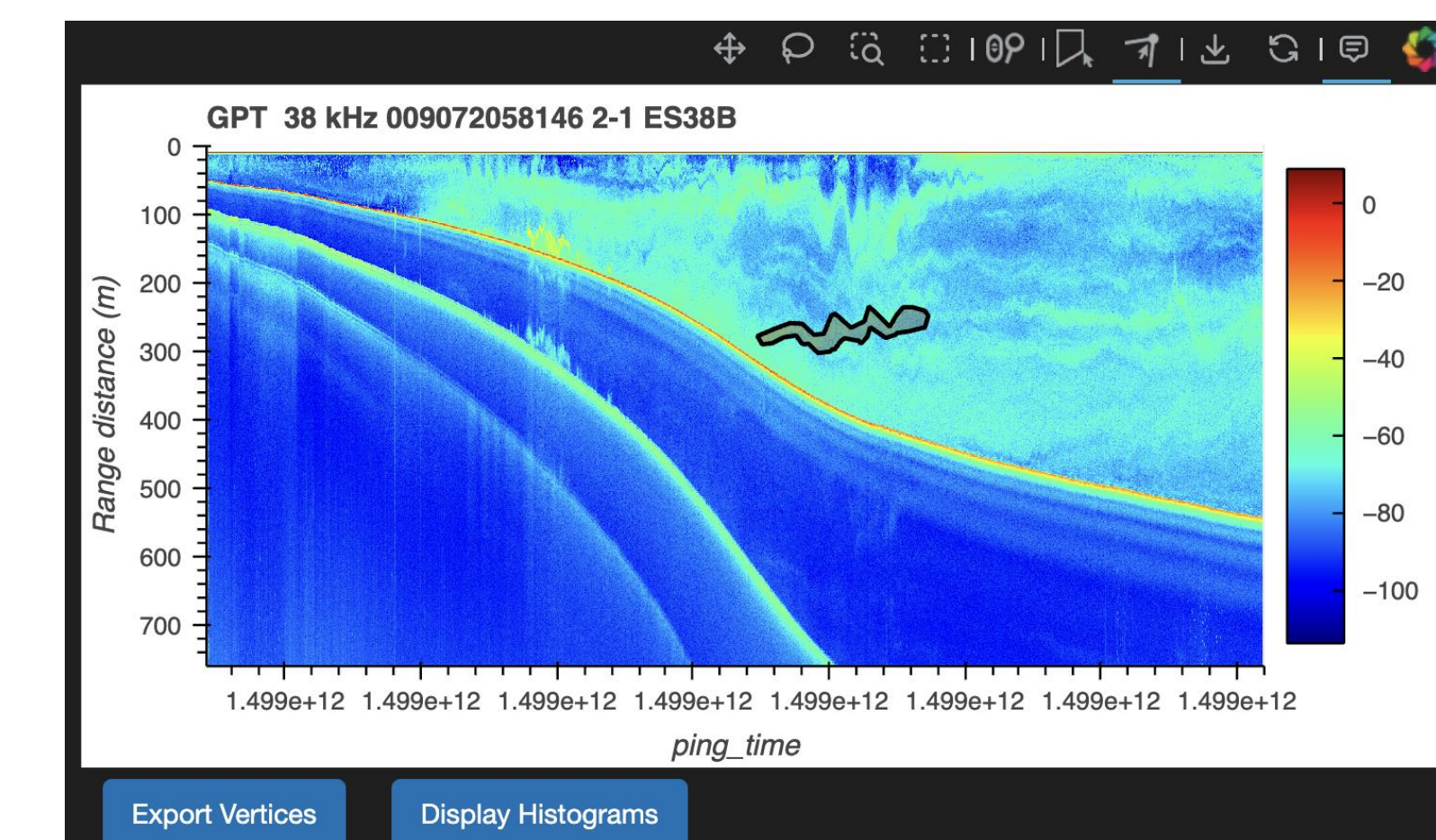
CONCLUSION

- Enhanced the open-source Echoshader package by fixing bugs and improving performance
- Prototyped additional functionalities in the Echoshader package, including upgraded 3D curtain plotting and a region browser
- Developed a cloud-hosted web application that integrates NOAA sonar data with ship track visualizations and customizable echogram displays
- Built the app using interactive web technologies and open-source Python libraries to support flexible data exploration

FUTURE WORK

- Further optimize data loading and visualization performance
- Stress test the map application later this summer using newly collected sonar data
- Continue development on the Echoshader project, which is part of a broader ecosystem of tools—such as the Echopype package—dedicated to ocean data exploration