Argo Float Explorer – User Documentation

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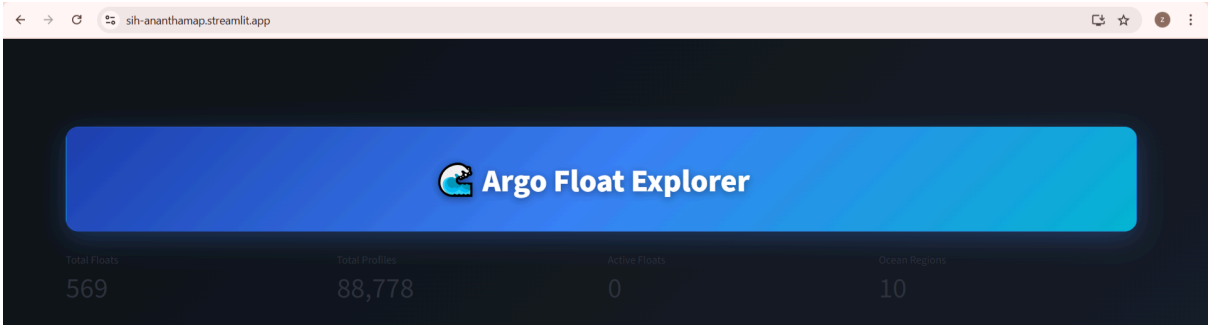
Live Application: https://sih-ananthamap.streamlit.app/

1. Application Overview

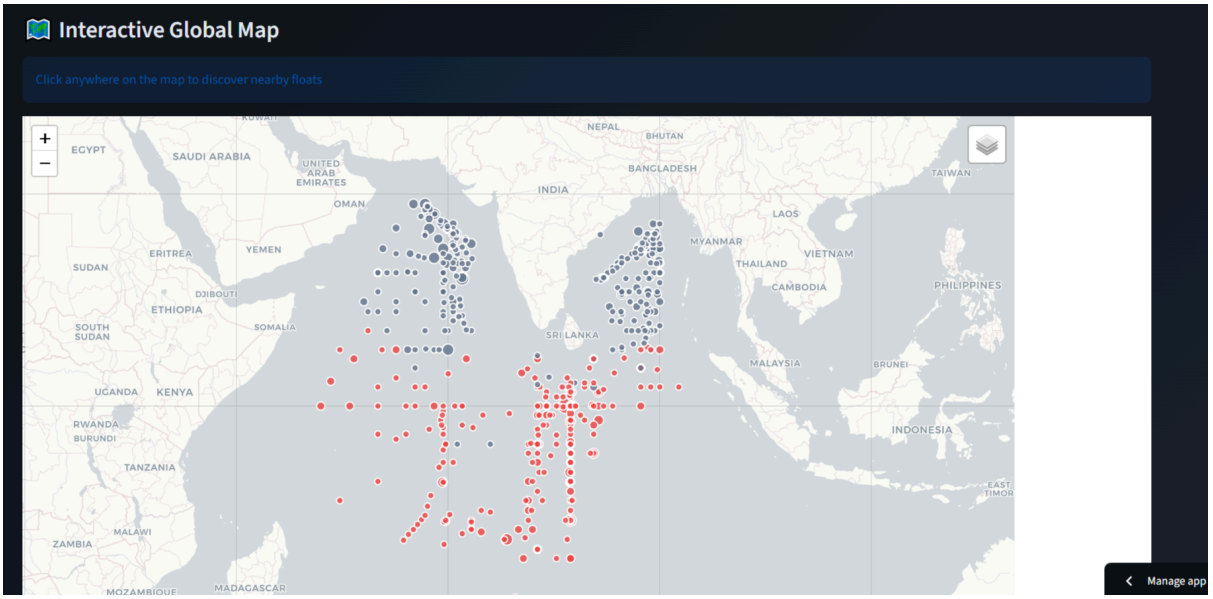
Argo Float Explorer is a web-based platform designed to provide users with the ability to analyze global ocean data collected by Argo floats. These floats are autonomous instruments deployed in oceans worldwide to measure temperature, salinity, and pressure across varying depths. The application offers an interactive and user-friendly interface that allows researchers, students, and enthusiasts to discover, select, and analyze oceanographic data from thousands of floats operating in different regions of the world's oceans.



For the purpose of this project, particular emphasis has been placed on the Indian Ocean. More than 20 million measurements from floats deployed across this region have been included, creating a rich and detailed dataset that reflects India's contribution to global oceanographic studies. By combining this large dataset with advanced visualization and AI-driven analysis features, the application enables users to gain a deeper understanding of ocean systems, trends, and regional variations.

2. Getting Started – Interactive Map

The core of the Argo Float Explorer experience begins with the interactive global map. By default, the map opens centered on the Indian Ocean, although it provides coverage of the entire globe. Thousands of floats are represented as colored markers on this map, and each marker reflects the real-world position of a float. Users can freely zoom, pan, and explore the map to identify float deployments across different regions. This visual interface makes it easier to understand the spatial distribution of floats and highlights the global reach of the Argo program.

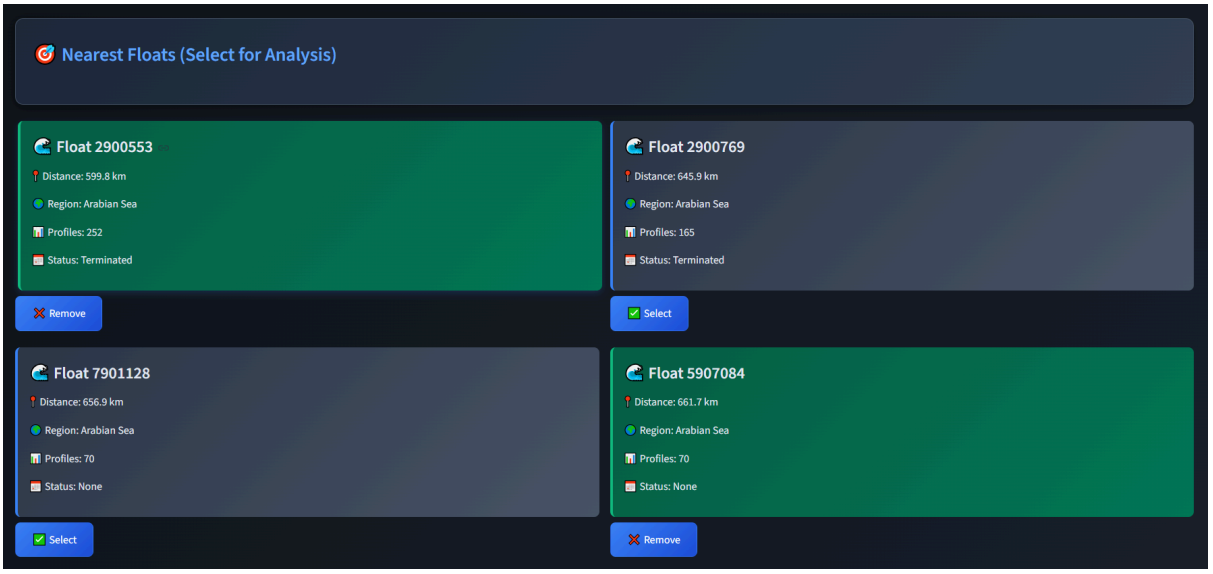


To begin exploring, a user simply clicks on any location within the ocean regions of the map. The application then processes the input and automatically identifies the ten nearest floats to the selected point. Once identified, information cards appear below the map, summarizing key details of each float. From this stage, users can move forward into the analysis phase, where the selected floats can be compared, visualized, and examined in greater depth through various tools provided in the platform.

3. Float Selection Process

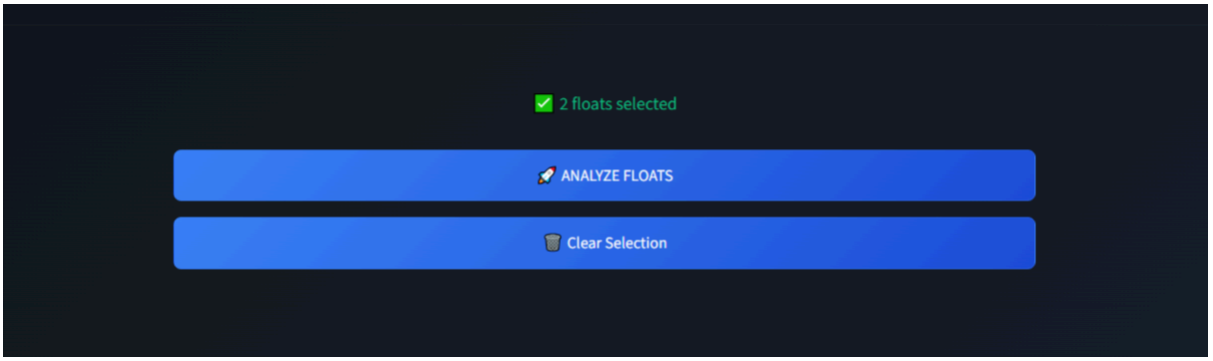
After clicking on the map, the nearest floats are presented as information cards, each containing essential metadata. These cards display the float's unique identification number, the distance of the float from the selected location, the corresponding ocean region such as the Indian, Pacific, or Atlantic Ocean, and the number of profiles or measurements recorded by that float. The mission status of the float, whether active or inactive, is also clearly indicated.

The selection process is straightforward. Users can add a float to their analysis queue by clicking the "Select" option on its card, while floats already chosen can be removed at any time. Once selected, floats are visually highlighted, making it easier to track them. Importantly, the system allows the selection of multiple floats, enabling comparative analysis across different locations, regions, or deployment histories. Once satisfied with their choices, users can proceed to the next stage by pressing the "Analyze Floats" button, which opens up the detailed analysis dashboard.



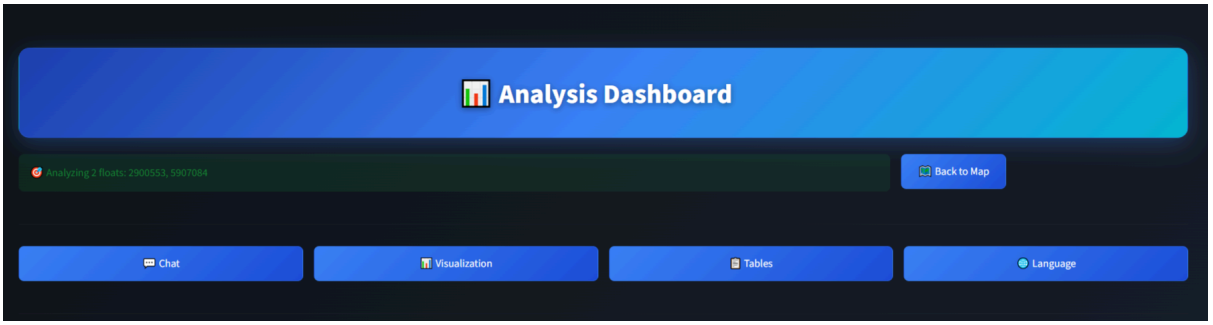
Start Analysis

Once you've selected floats, click the **"ANALYZE FLOATS"** button to proceed to the analysis dashboard.



4. Analysis Dashboard

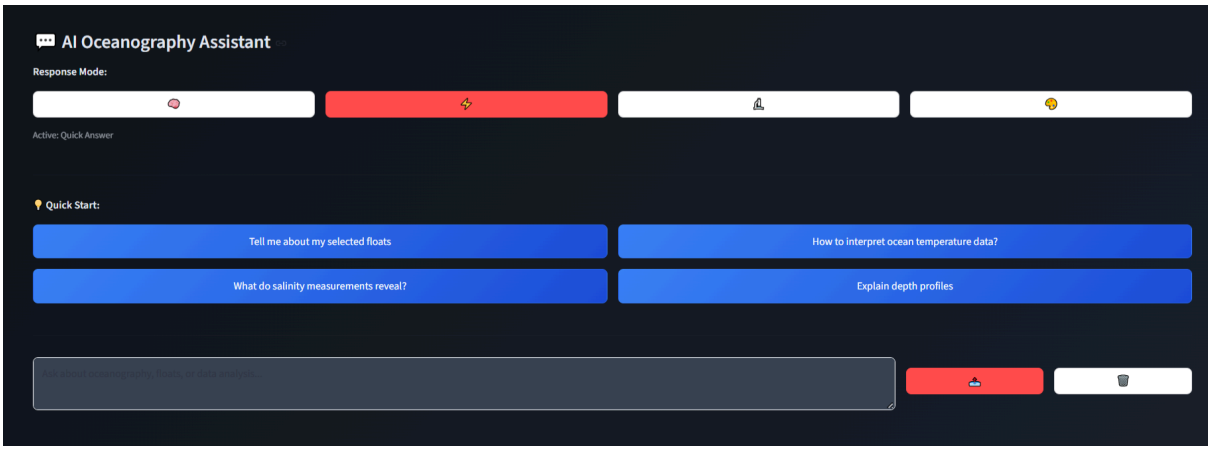
The analysis dashboard forms the central hub for exploring and interpreting float data. It is divided into four key sections, each designed for a different type of interaction. The Chat section provides AI-powered assistance for interpreting data, asking scientific questions, and receiving explanations. The Visualization section offers multiple ways to graphically represent the data through interactive charts and plots. The Tables section provides access to raw measurement data in a structured and sortable format. Finally, the Language section supports multi-language capabilities, ensuring that users from different linguistic backgrounds can comfortably interact with the platform.



5. AI Chat Assistant

The AI chat assistant serves as a powerful tool for guiding users through the complexities of oceanographic analysis. It is capable of responding in different modes depending on the user's needs.

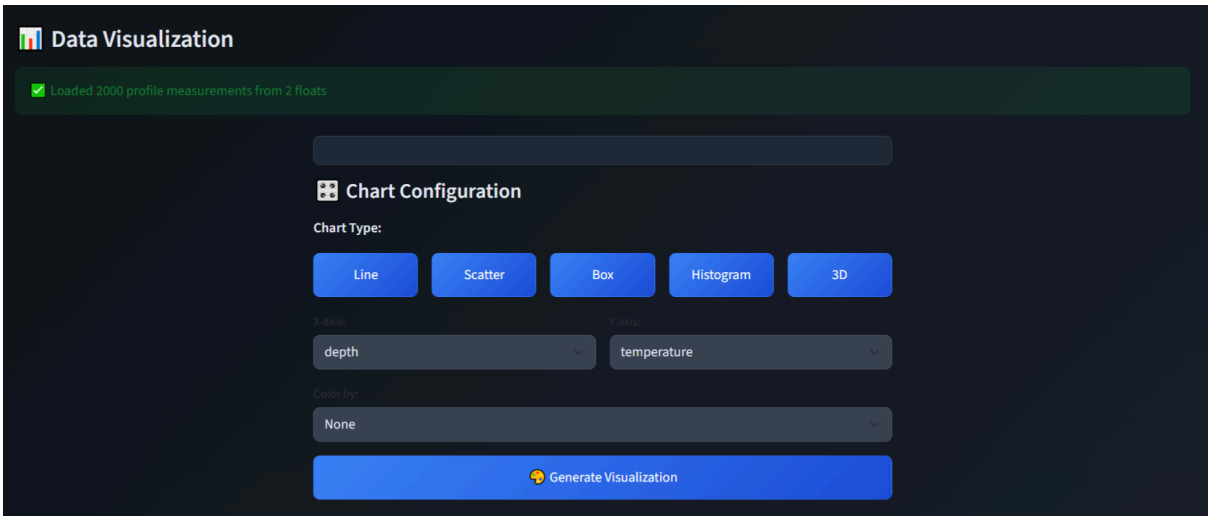
- **Think Deeper:** Generates detailed and comprehensive analyses.
- **Quick Answer:** Provides fast and concise summaries.
- **Research Mode:** Offers academically oriented responses with references and citations.
- **Creative:** Allows for exploratory and open-ended perspectives on the data.



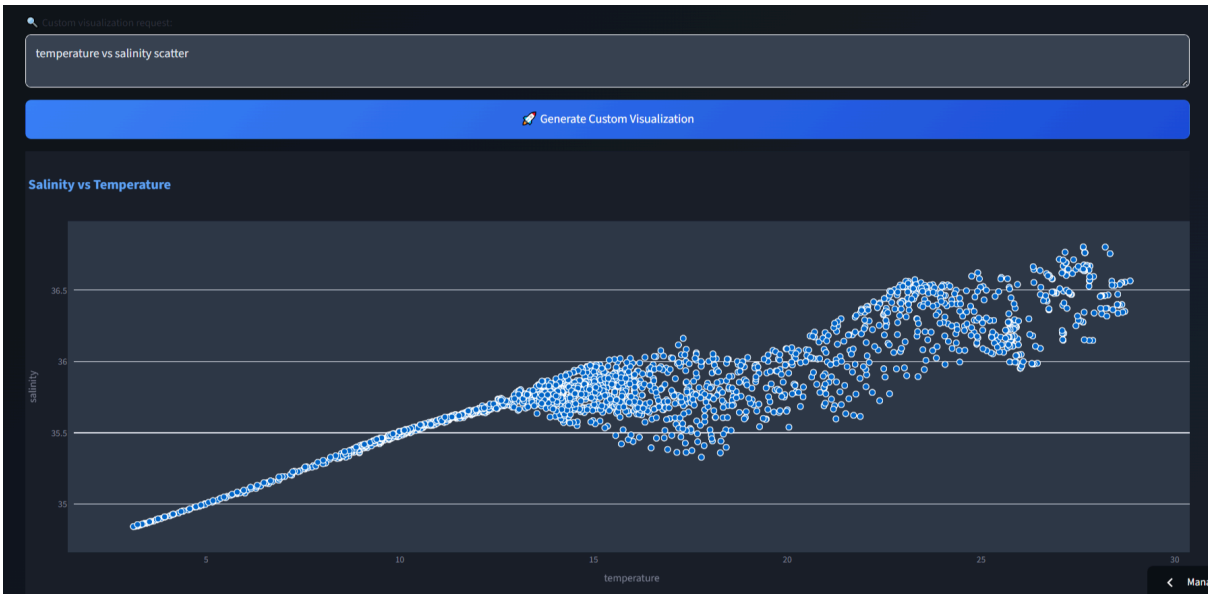
Users can interact with the assistant by typing questions directly related to their selected floats or broader oceanographic concepts. For instance, a user may ask about the temperature profiles of a specific float, request an analysis of salinity trends, or compare float data across multiple regions. The assistant also suggests starter questions, making the tool approachable even for first-time users. This feature transforms the platform into more than just a data viewer—it becomes an intelligent guide for ocean learning and research.

6. Data Visualization

One of the strongest features of the Argo Float Explorer is its visualization capability. Users are provided with multiple chart types, including scatter plots, line charts, histograms, box plots, and even three-dimensional scatter plots for advanced analysis. These visualizations allow users to identify patterns such as correlations between salinity and temperature, observe vertical profiles over depth, or study time series trends.



The visualization process is highly interactive. Users begin by selecting a chart type from the dropdown menu, then define which variables to plot along the X and Y axes. Filters and grouping options are available to refine the analysis, after which the chart can be generated instantly. The system also provides advanced features such as interactive zooming, color coding based on float ID or depth, and exporting charts for external use in reports or presentations. This ensures that both basic and advanced users can adapt the tool to their analytical needs.



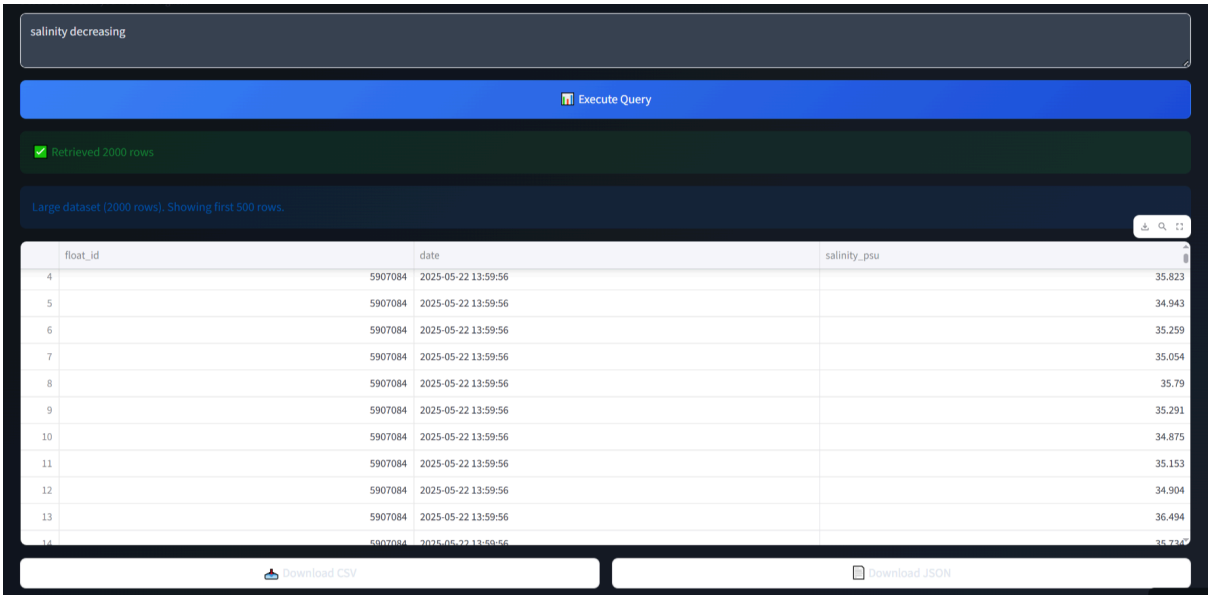
In addition, the platform offers a custom visualization feature designed for users who want quick, specific insights without navigating through multiple settings. Users can simply specify the variables

they are interested in, such as temperature versus salinity, and the system will automatically generate a focused chart tailored to their request. This approach streamlines the visualization process for casual users or those seeking immediate analysis, making it easy to explore specific relationships within the oceanographic data.

7. Data Tables

For those who wish to work directly with raw measurements, the Tables section of the dashboard offers a detailed tabular view. Each row corresponds to a float measurement, while the columns capture details such as float ID, date, latitude, longitude, depth, temperature, and salinity.

This feature is especially important because accessing the same data externally can be slow and cumbersome, with no straightforward way to download it efficiently. Within the platform, users can instantly retrieve structured datasets with just a simple selection or prompt, providing a fast, reliable, and user-friendly method to obtain the information needed for further research or analysis.

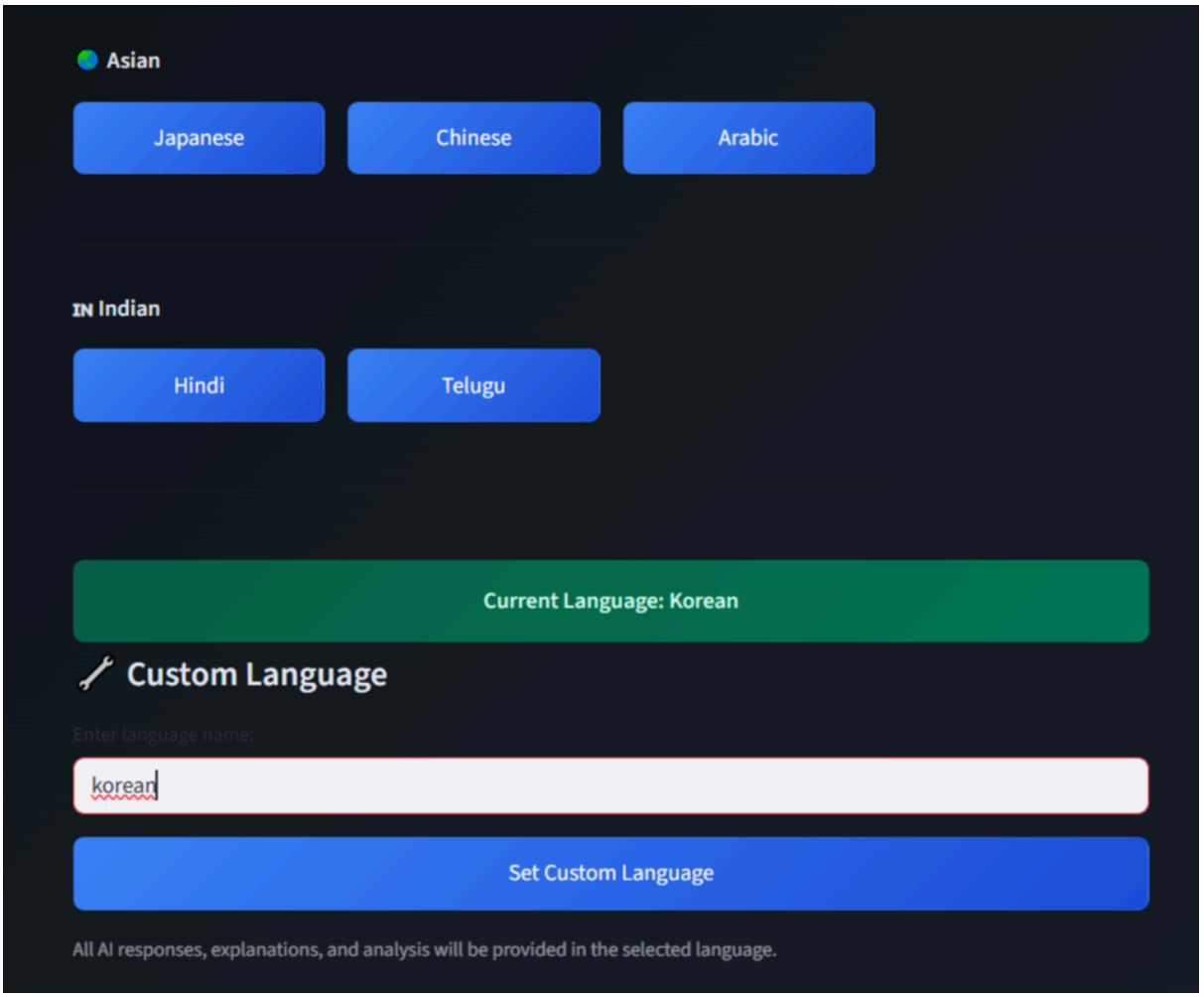


The table is fully interactive, with sortable columns and a built-in search function to filter data by specific criteria. Large datasets are easily navigated through pagination, and export options allow users to download the data as CSV or Excel files for offline use. This makes the platform not only a visualization and AI tool but also a reliable source of structured data for detailed study.

8. Multi-Language Support

Accessibility is enhanced by the platform's multi-language feature, which supports most of the world's popular languages such as English, Spanish, French, German, Italian, Portuguese, Russian, Japanese, Chinese, Hindi, Arabic, and Telugu. Users can also easily add additional languages, like Korean, through a simple prompt. While the main interface elements remain

in English, AI responses are generated in the selected language, and scientific terminology is adapted with native language explanations where possible. The system also includes error handling for invalid inputs—if a user types random letters or an unsupported language, the platform will provide a clear error message, ensuring smooth and reliable operation.



9. Technical Features

Argo Float Explorer is powered by a live PostgreSQL database that continuously updates to reflect the latest float positions and measurements. This real-time connection ensures that users are always working with the most current data available. A statistics dashboard within the application provides users with a quick overview of the total number of floats and profiles available.

To improve efficiency, the system only retrieves data from the floats selected by the user, rather than loading the entire dataset of over 20 million measurements. This approach drastically reduces processing time, often limiting queries to just tens of thousands of rows, which saves a significant amount of time and resources while still providing all the relevant data for analysis. Performance has also been optimized through cached data loading and efficient query structures, with query timeouts set at thirty seconds to prevent lags. The

responsive design ensures smooth usability across devices, whether accessed on desktops, tablets, or mobile phones, making the tool flexible for a variety of contexts.

10. Use Cases and Applications

The Argo Float Explorer can be applied across multiple domains. In academic research, it serves as a resource for studying temperature and salinity variations, identifying trends, and analyzing global or regional patterns. For climate-related studies, it helps track ocean changes over time, which are critical for understanding climate variability and long-term change. The platform is also suitable for educational settings, offering students a practical tool to learn about ocean measurement techniques, data interpretation, and visualization methods.

To maximize the value of the tool, users are encouraged to begin by exploring different ocean regions, selecting floats for comparison, and engaging with the AI assistant to interpret findings. Visualizations can then be used to identify hidden patterns or confirm hypotheses, and finally, data and charts can be exported for reports, publications, or extended offline analysis.

11. Troubleshooting and Support

Like any online application, occasional issues may arise. If the map does not load, refreshing the browser often resolves the problem. Database connection errors are typically temporary and can be solved by waiting a few moments before retrying. In cases of slow response times, reducing the number of selected floats helps speed up performance.

For additional support, users are encouraged to experiment with different visualization methods, try selecting floats from multiple regions, and make use of the AI chat assistant, which is capable of answering not just data-related queries but also conceptual questions about oceanography. The platform is designed to be self-guiding and exploratory, ensuring users can adapt it to their needs with minimal external support.

Contact and Additional Information

Application URL: https://sih-ananthamap.streamlit.app/

This documentation outlines the main features and functions of the Argo Float Explorer. By combining live oceanographic data, advanced visualizations, and AI-driven guidance, the platform makes complex ocean data both accessible and understandable. It is a valuable tool for researchers, educators, and anyone interested in exploring and learning about the world’s oceans.