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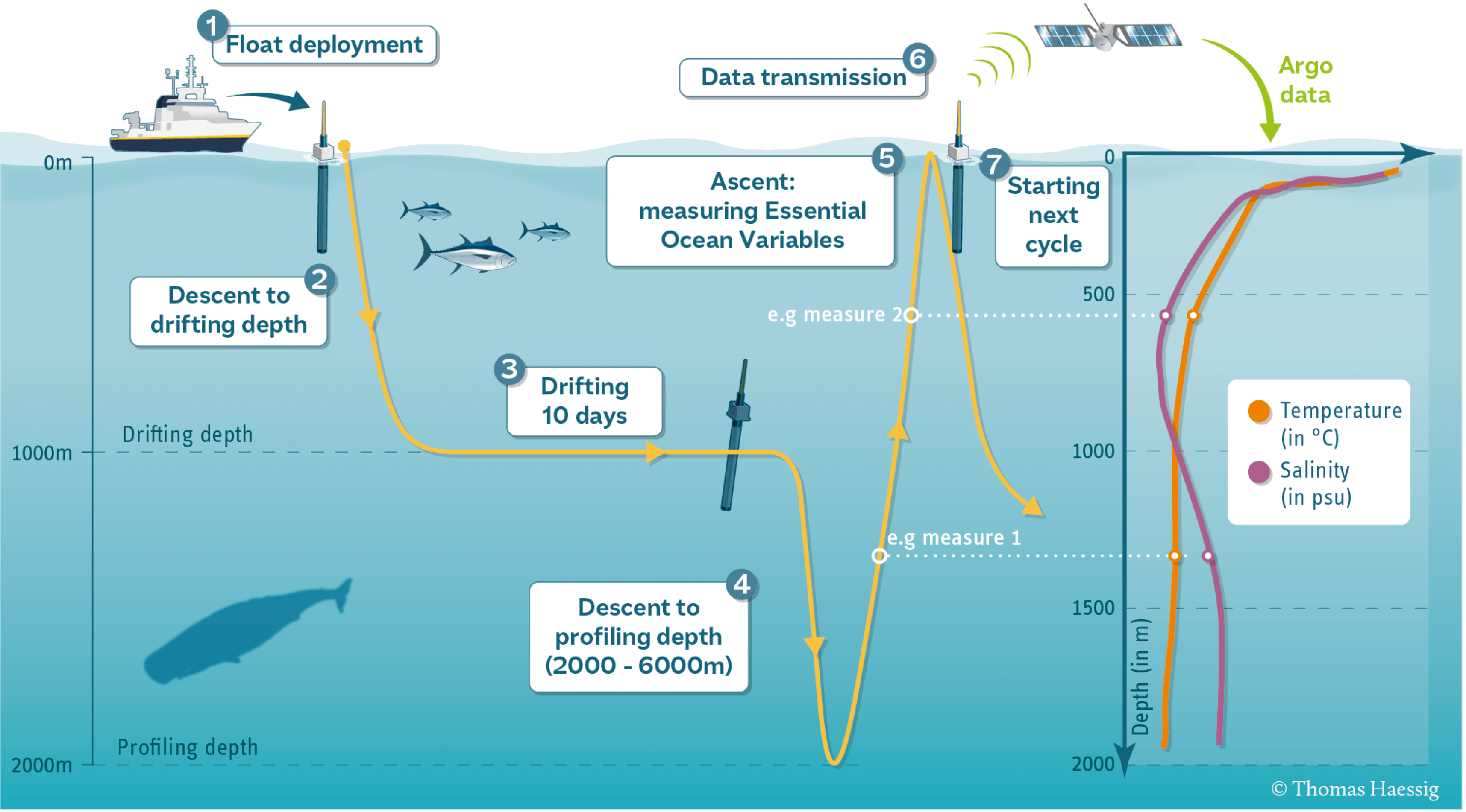
- **Problem Statement ID –** SIH25040
- **Organization Name** : Ministry of Earth Sciences (MoES)
- **Problem Statement Title:** **ARGO ocean data is vast but locked behind complexity, leaving non-experts without an easy way to explore and gain insights.**
- **Team Name :** Epic Innovators
- **Team Leader Name :** KIRIT P S
- **PS Category :** Software
- **Team Name :** Epic Innovators
- **Theme Name :** AI-Powered Software for Ocean Data Discovery



1 Float deployment
6 Data transmission
Argo data
0m
5 Ascent: measuring Essential Ocean Variables
7 Starting next cycle
2 Descent to drifting depth
3 Drifting 10 days
Drifting depth
1000m
e.g measure 2
e.g measure 1
4 Descent to profiling depth (2000 - 6000m)
Profiling depth
2000m
0
500
1000
1500
2000
Depth (in m)
Temperature (in °C)
Salinity (in psu)
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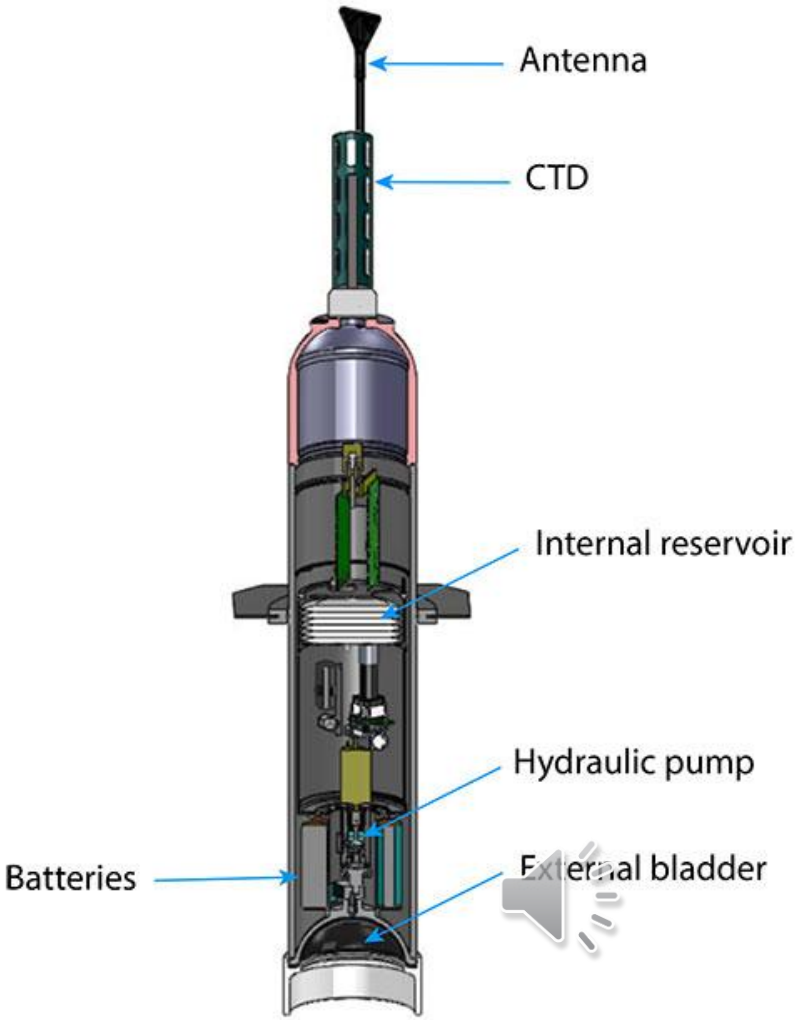

Antenna
CTD
Internal reservoir
Hydraulic pump
Batteries
External bladder

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Jal VaaniAI

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Proposed Solution:

1. Data Pipeline:

Ingest ARGO NetCDF files and convert them into MongoDB, storing Vector DB and summaries for efficient querying.

2. AI Backend:

Use RAG pipelines with multimodal LLMs to translate natural language queries into database queries, supporting multilingual input and output.

3. Visualization:

Interactive dashboards with maps, depth-time plots, and profile comparisons; enable exporting summaries to ASCII or NetCDF.

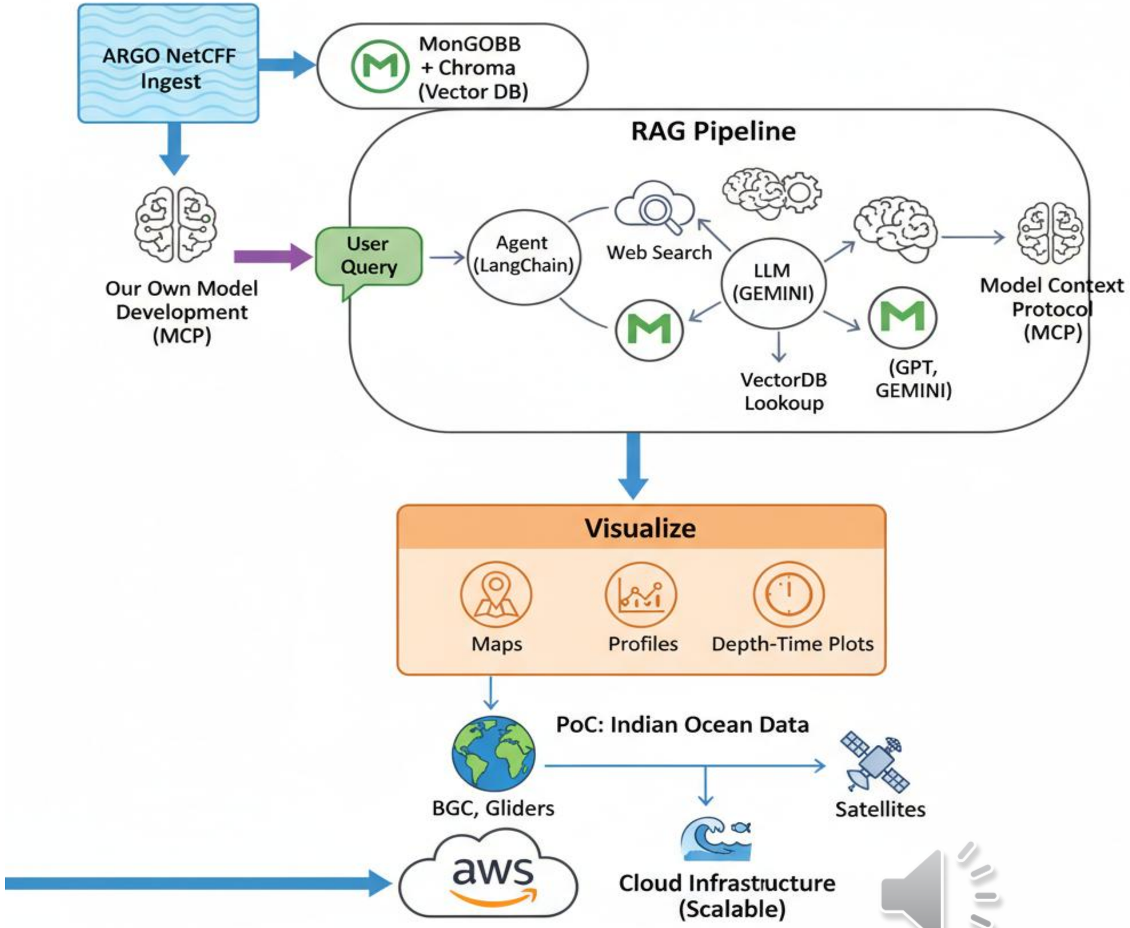
4. Chat Interface:

Conversational AI allows users to query floats, salinity, or BGC parameters, guiding discovery in multiple languages.

5. PoC Scope:

Demonstrate Indian Ocean ARGO dataset functionality, scalable to BGC floats, gliders, satellites, and future datasets.

Link : https://drive.google.com/file/d/1LQ0DB-JRFfgnwdxrhIncKqCjyC5Qii1e/view?usp=sharing



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TECHNICAL APPROACH

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Technologies:

- **Programming & Databases:** Python, MongoDB
- **Vector Search & RAG:** Chroma, LangChain
- **Frontend & Visualization:** Flask, Dash, Plotly, React
- **AI & Cloud:** GPT, GEMINI, Custom LLM(**Developing Model**), AWS
- **Integration Protocol:** MCP (Model Context Protocol

Methodology:)

- **Data Ingestion:** ARGO NetCDF → MongoDB + Vector Database for structured storage.
- **AI Query Engine:** RAG pipeline converts user queries → LLM → Vector DB + Web Search for precise insights.
- **Interactive Visualization:** Maps, profiles, depth-time plots for intuitive exploration.
- **PoC & Scalability:** Indian Ocean ARGO datasets demonstrated; easily extendable to BGC floats, gliders, and satellite data.

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FEASIBILITY AND VIABILITY

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Feasibility & Scalability:

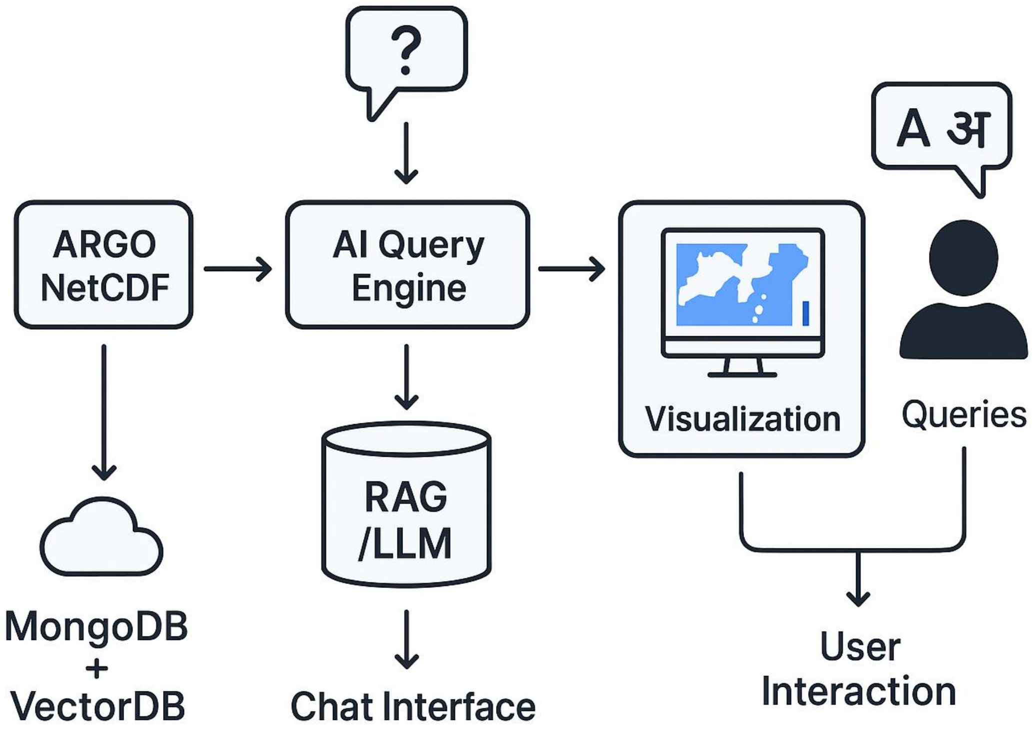
- Fully feasible using **Python, SQL, LLMs, interactive dashboards, and cloud infrastructure**.
- **Hybrid scalable databases** (MongoDB + VectorDB) enable efficient handling of large ARGO datasets.

Challenges & Risks:

- Managing **massive data volumes**, ensuring **real-time updates**, and driving **user adoption**.
- Risks include **misinterpretation of scientific queries** and **high infrastructure costs**.

Strategies & User Support:

- Optimize storage, deploy **domain-tuned LLMs**, and leverage **cloud GPU scaling**.
- Provide a **simple, multilingual UI with guided workflows** for effortless use by non-experts.



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IMPACT AND BENEFITS

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Easy Insights: Data-driven tools for Researchers & Policymakers.

Economic Growth: Boosts Fisheries, Shipping & Renewable Energy.

Environmental Health: Enhances Climate & Marine Ecosystem Monitoring.

Social Equity: Democratizes Access, Boosts Awareness & Education.

Scientific Breakthroughs: Accelerates Oceanographic Research & Innovation.

Global Resilience: Strengthens Climate Resilience & Sustainable Development.

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RESEARCH AND REFERENCES

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