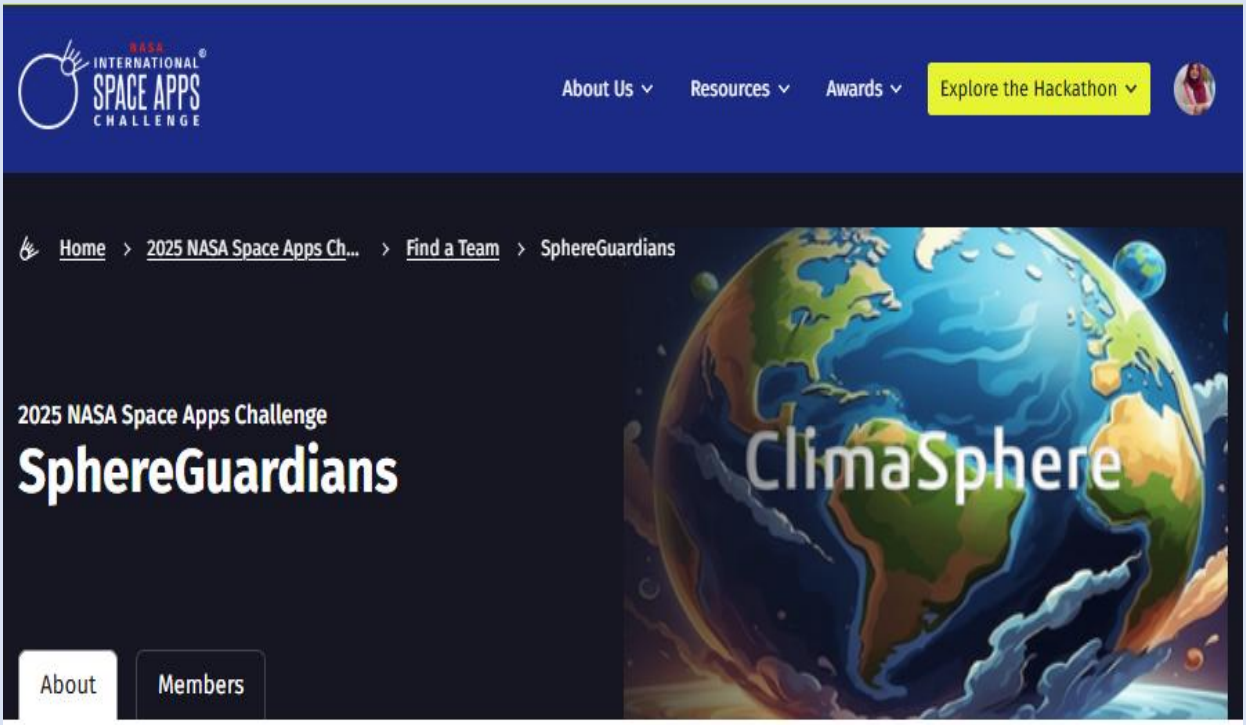
Project “ClimaSphere” by Team SphereGuardians



ABOUT THE TEAM

SphereGuardians develops an AI-powered weather app using NASA and NOAA data to deliver timely forecasts and alerts. Our mission is to empower communities with real-time updates, flood prediction, cyclone tracking, and drought monitoring. We aim to raise awareness of NASA's role in disaster resilience while providing educational insights that enhance preparedness and reduce climate-related risks.

ABOUT THE CHALLENGE

If you're planning an outdoor event—like a vacation, a hike on a trail, or fishing on a lake—it would be good to know the chances of adverse weather for the time and location you are considering. There are many types of Earth observation data that can provide information on weather conditions for a particular location and day of the year. Your challenge is to construct an app with a personalized interface that enables users to conduct a customized query to tell them the likelihood of "very hot," "very cold," "very windy," "very wet," or "very uncomfortable" conditions for the location and time they specify. (Earth Science Division)

You are a team member.

× Leave Team

Team Information

Local Event
Dhaka, Bangladesh

Challenge
Will It Rain On My Parade?

Contents

Project "ClimaSphere"

1. High level Summary:

The *"**ClimaSphere**"* project is developed by team ***SphereGuardians*** is a web-based platform that predicts climate risks and raises awareness with an interactive, user-friendly interface. Unlike static datasets, our project ClimaSphere connects directly to live NASA and partner APIs. This ensures that users get the latest information for monitoring hazards and supporting early warnings. The ***NASA Power API*** and ***OpenWeather API*** provide real-time atmospheric conditions including data on temperature, humidity, wind and solar radiation. For forecasts, ClimaSphere uses the ***NASA GEOS-S2S API*** and provides predictions ***up to 45 days*** in advance. It also incorporates the ***GPM IMERG API*** for high resolution rainfall estimates, the ***MERRA-2 API*** for adjusted atmospheric variables and the ***MODIS NDVI*** for vegetation dryness. These data sources support three main hazard modules. **Cyclone prediction** combines weather data with ***ENSO*** and ***IOD*** indices to deliver risk assessments at the state level. ***Flood prediction*** pulls in rainfall, soil moisture proxies and hydrological warnings to create short and medium-term outlooks. ***Bushfire prediction*** analyzes weather variables, vegetation dryness and fire hotspot detections to issue alerts and generate risk maps. The platform's backend built on ***FastAPI*** processes API data into structured outputs. The frontend designed with ***React*** and ***TailwindCSS*** uses ***leaflet*** and ***Mapbox*** to provide responsive dashboards, charts and maps.

240 seconds video: https://youtu.be/nq8SpQRpMU4

2. Project Demo: 30 seconds video: https://youtu.be/E9QBX-4fVdc

3. Final project:

3.1. https://clima-sphere-rosy.vercel.app/ (due to File upload storage limitation, we only successfully deploy frontend part)

3.2. GitHub: https://github.com/FariaSara/ClimaSphere

4. Project Details:

4.1. The Why, the What, the How

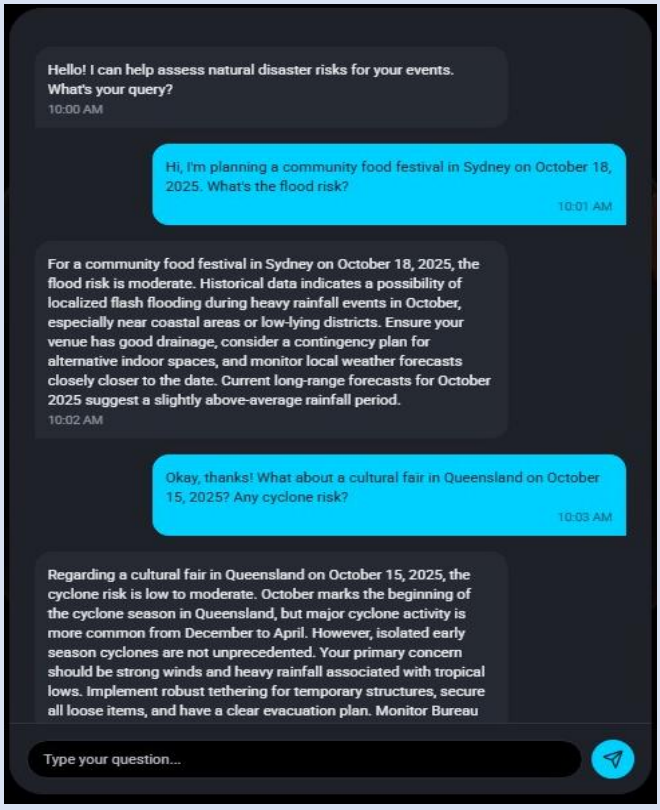
4.1.1. Why We Developed:

Extreme weather events such as floods, cyclones and bushfire are becoming more frequent and severe due to climate change. Communities

often lack access to real-time, reliable data to prepare for such disasters. Our project aims to make NASA's open data accessible in a user-friendly web-based platform so that people can learn, prepare and act faster.

4.1.2. What Our Project Is: Our ClimaSphere is a web-based climate risk prediction platform that consolidates NASA's real-time and forecast API into one interactive system. It provides insight on weather, floods, cyclones and bushfires not only showing ***current conditions*** but also ***predicting early or upcoming risks*** through graphs, values. The platform transforms complex satellite data into clear, accessible information, helping communities, students, and decision-makers monitor hazards, learn and prepare more effectively.

4.1.3. How We Addressed the Challenge: The challenge was to make complex NASA climate data accessible to communities in a clear, practical way. Instead of working with raw datasets, we addressed this by building a web-based platform that connects directly to live NASA APIs. The system processes data into simple risk levels, guidance so that users can monitor hazards without technical barriers.

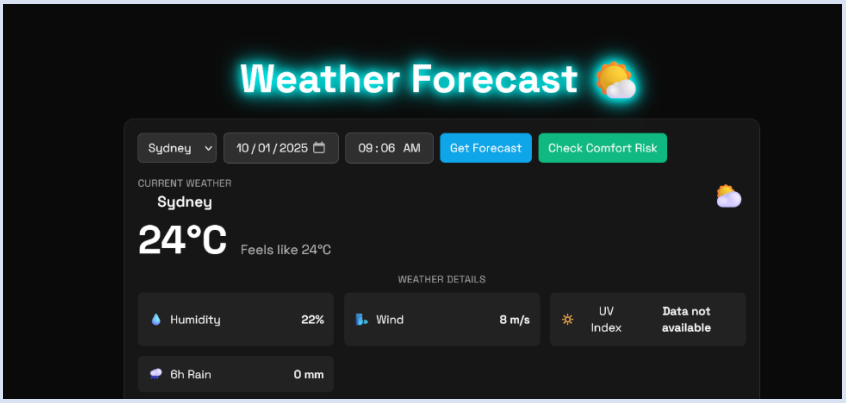


4.1.4. How We Develop the Project:

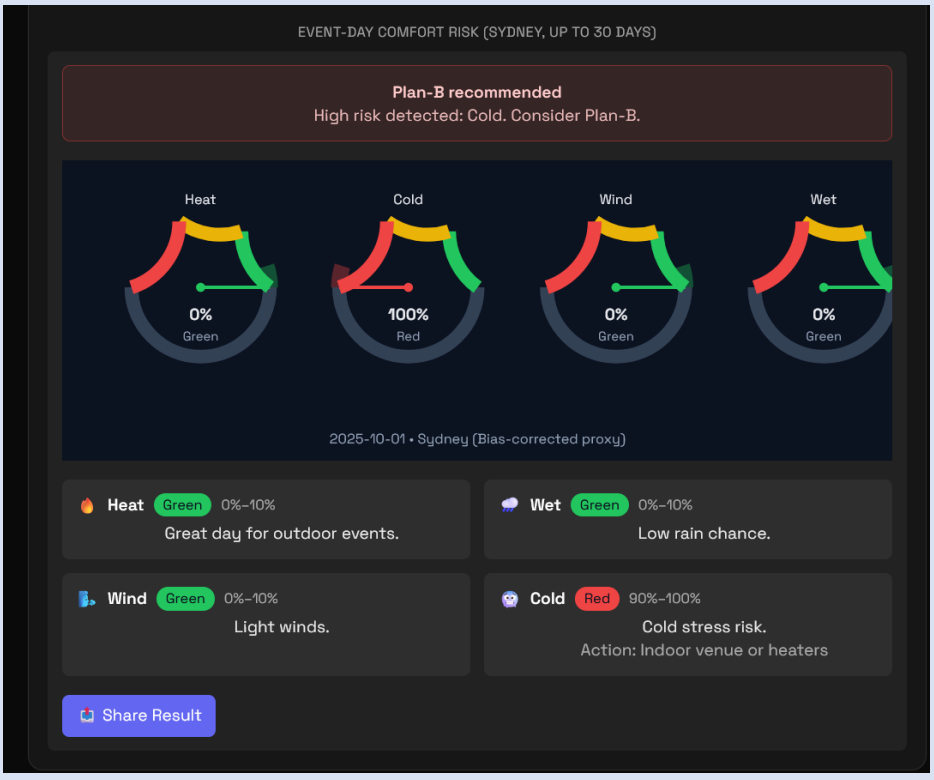
- For Real-time using NASA POWER API, NASA OpenWeather API, NASA GEOS-S2S.
    - For Future Forecast using NASA GEOS-S2S, GPM IMERG, MERRA-2, NASA POWER API Climatology.
- Flood prediction using NASA POWER API, GPM IMERG, MERRA-2, NOAA CPC IOD.
- Cyclone prediction using NASA POWER API, GPM IMERG, GEOS-S2S with NOAA CPC IOD & ENSO (ONI) indices.
- Bushfire monitoring using NASA POWER, MODIS NDVI, IOD, NOAA CPC ENSO, GPM / MERRA-2.
- The backend is built in FastAPI to serve structured JSON outputs and the frontend in React, TailwindCSS, Leaflet, Mapbox for interactive dashboards.

Home Page:

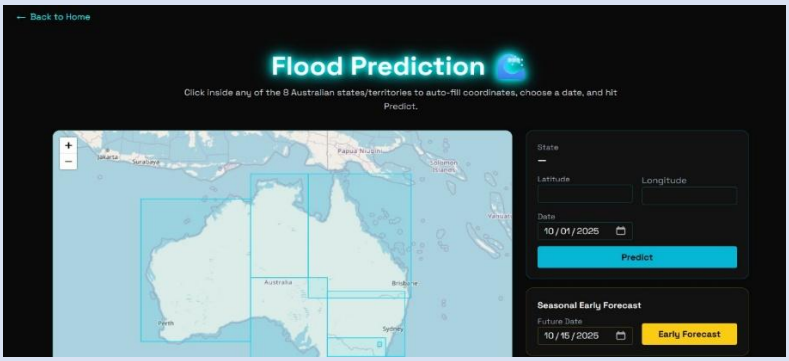
Weather Forecast:



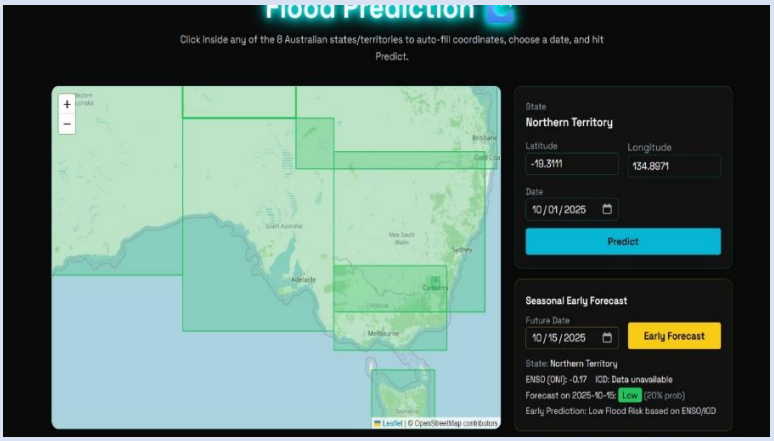
"In the Weather Forecast tab, users see live temperature, rainfall, humidity, and wind from NASA POWER and other real-time feeds, as well as an hourly forecast. Based on that, Users get smart notifications — for example: High UV index, Apply Sunscreen. However, we go further: GEOS-S2S delivers forecasts up to 30 days ahead. GPM IMERG adds high-resolution rainfall. MERRA-2 and POWER climatology provide a historical context for bias correction. Not only that, the User can also share the link, send it to their friends and family.



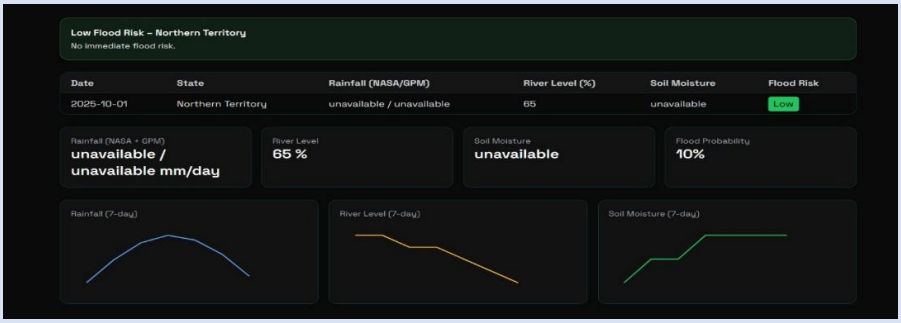
Flood Prediction:



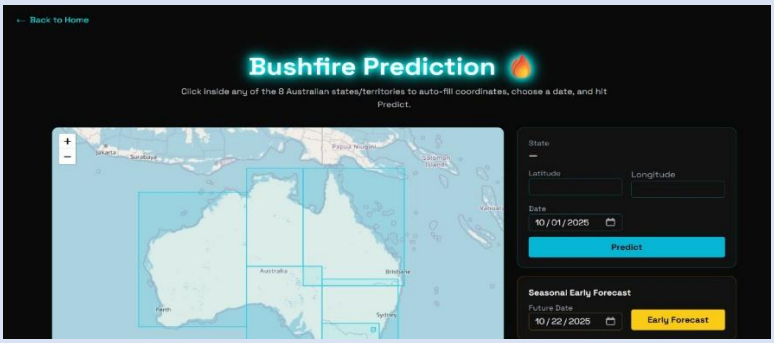
"In Flood Prediction, users simply click anywhere on the map of Australia, and latitude and longitude are auto-generated.



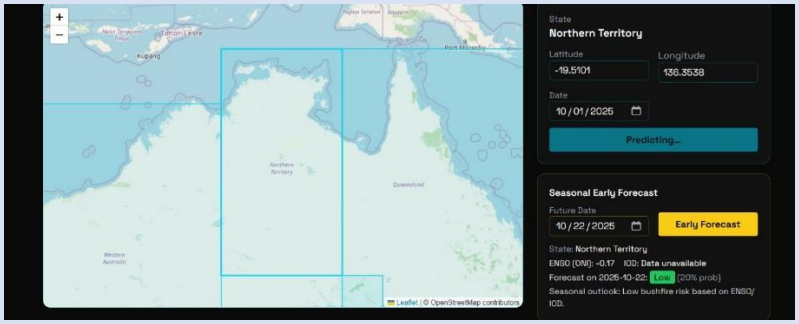
The system combines POWER data, IMERG rainfall, MERRA-2 soil moisture, and NOAA's ONI index, validated against local flood alerts.
It shows 7-day trends for rainfall, river level, and soil moisture with probabilistic flood risk. For seasonal outlooks, ONI and IOD extend forecasts up to 45 days.



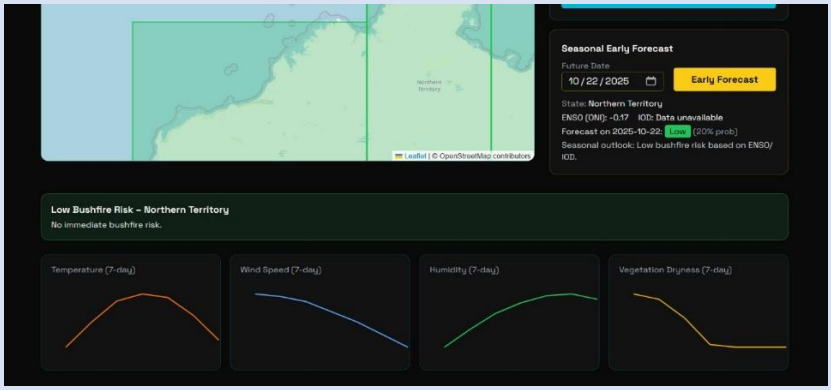
Bushfire Prediction:



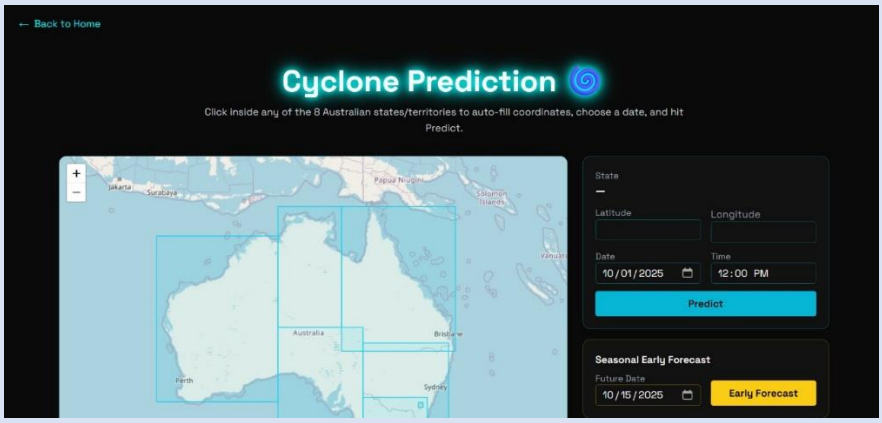
"*In Bushfire Prediction, we combine NASA POWER data, MODIS vegetation dryness, NDVI, and MERRA-2 soil moisture.*



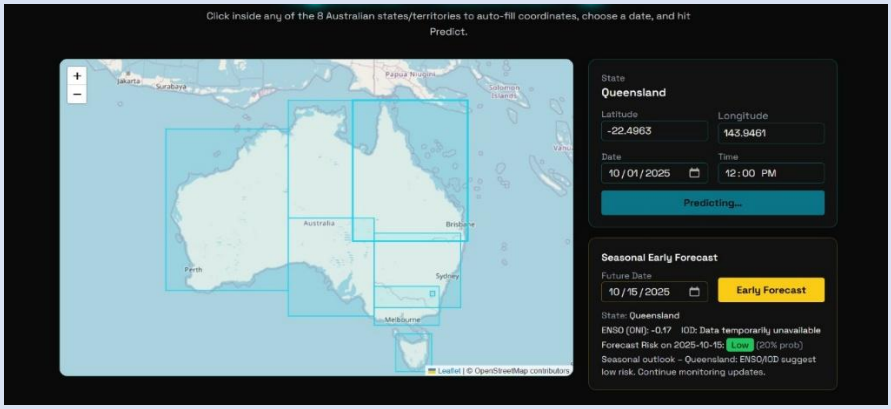
ENSO and IOD help identify seasonal drought risk. Output includes probability maps, 7-day trends for temperature, humidity, and vegetation dryness — turning complex climate data into practical, localized awareness."



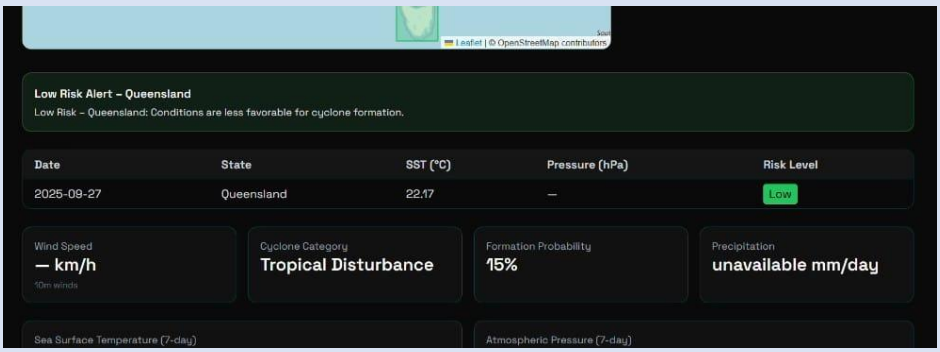
Cyclone Prediction



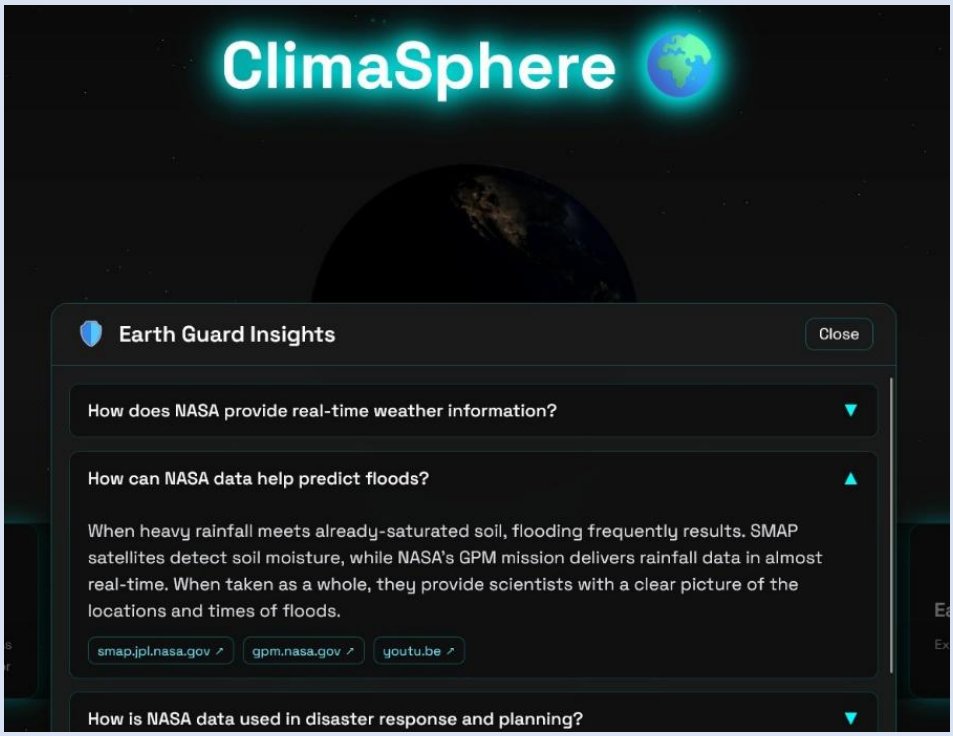
"The Cyclone Prediction tab integrates sea surface temperature, atmospheric pressure, rainfall, and wind patterns.



Users see real-time conditions, 7-day trends for SST and pressure, and a risk level that accounts for ENSO and IOD signals — giving a medium-term view of cyclone potential."



Earth Guard Insights:



It connects users with resources, guides, and direct access to NASA datasets—like MERRA-2, Getting Familiar with MODIS satellites, alongside educational videos on how NASA predicts floods, cyclones, and climate impacts. From carrying an umbrella, to preparing for floods, cyclones, and Bushfire NASA's open data, empowers communities worldwide.

Software Model: We apply **Incremental Model** with **Agile** practices.

- **Incremental Phase:** We developed features in steps starting with real-time weather, then flood prediction, cyclone prediction, bushfire prediction and finally earth guard insights. Each API integration was tested and added independently.
- **Agile Practices:** Team members worked in short sprints, integrating feedback quickly and focusing on working increments rather than a big bang build.

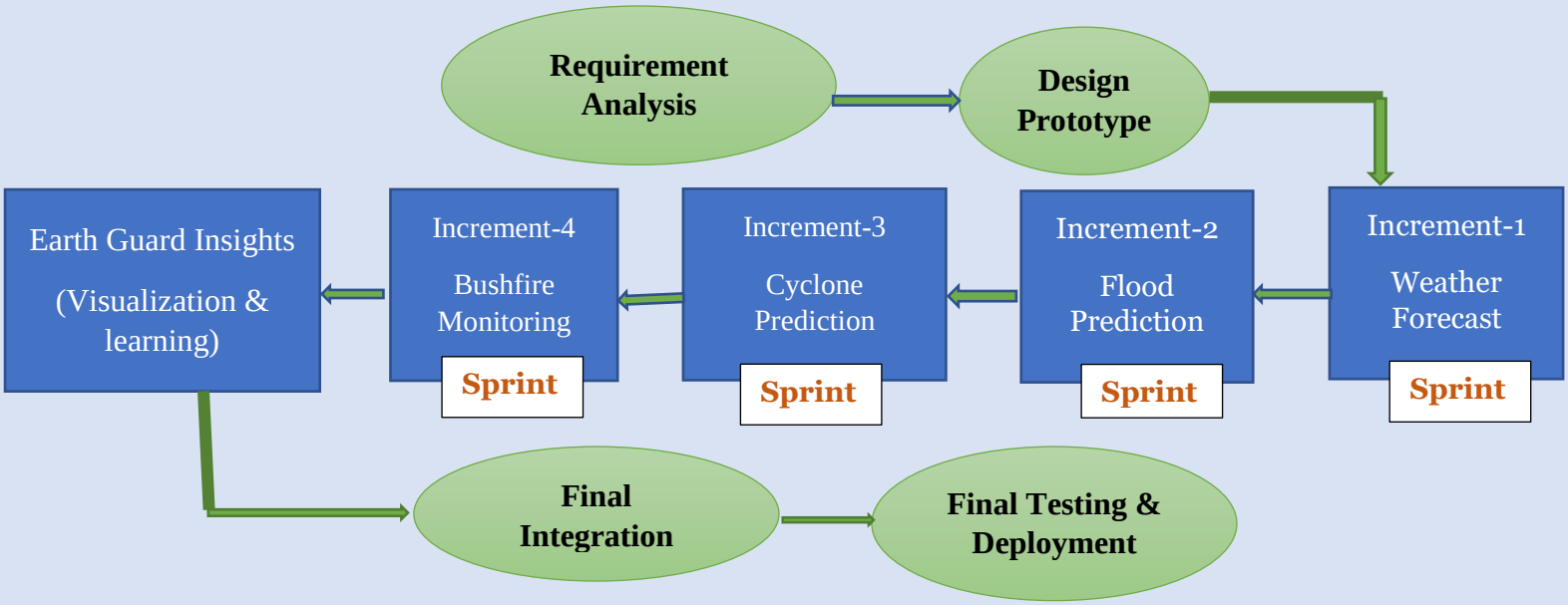


Fig-: Incremental Model with Agile Practices

It ensures rapid development, continuous testing of NASA APIs, reduced risks from API failures and allowed modular growth.

4.2. The Community Involvement

4.2.1. Hope to Achieve: We aim to empower citizens, students and communities with real-time knowledge of weather and hazard risks. By simplifying NASA APIs into user-friendly insights, we hope to improve awareness, preparedness and resilience against climate-driven disasters.

4.2.2. Important Note: As our project is not an official disaster alert system, users must always rely on local government authorities for emergency response. Mainly our ClimaSphere is an educational and awareness tool powered by open NASA data.

4.2.3. Highlighted Features:

- Real-time weather conditions like hot, windy, cloudy, wet.
- Flood risk projection with rainfall and soil moisture data.
- Cyclone risk categorization using NASA, ENSO-IOD indices.
- Bushfire detection via fire hotspots and vegetation dryness.
- Earth Guard insights via Q&A with references to NASA sources.

4.2.4. Benefits:

- **Citizens:** Quick access to disaster risk awareness.
- **Students:** Learn interactively about NASA Earth data.
- **NGOs or Communities:** Build preparedness and resilience strategies.
- **Researchers:** gateway to explore open NASA APIs for extend studies.
- **Decision-makers:** Gain timely science-backed insights to guide disaster preparedness and resource planning.
- **Event Organizers:** Check upcoming weather and hazard risks in advance to ensure safer event scheduling and management.

4.3. The Tools, Technologies & Languages Used:

- **APIs:**
  - NASA GEOS-S2S (primary long-range forecast for temperature, humidity, wind, prediction up to 45 days or 1.5 months)
  - GPM IMERG (precipitation estimates, rainfall using earth data token)
  - MERRA-2(temperature & wind for historical bias correction, soil moisture)
  - NASA Open Weather data (Climatology)
  - NASA POWER API (weather variables)
  - IOD index(disaster warnings)
  - NOAA CPC (ONI[ENSO])
  - MODIS NDVI (vegetation dryness)
- **Languages:** Python, Javascript, React, Node js.
- **Frontend:** React, TailwindCSS, Leaflet.js, Mapbox, HTML, CSS.
- **Backend:** FastAPI, Node js , Uvicorn, Python Libraries (xarry, netCDF4, requests).
- **Dataset Authentication:** Earthdata token.
- **Videography:** Adobe Aftereffects, Adobe Photoshop, Adobe Premiere Pro.
- **Design:** Figma & Canva.
- **Collaboration & Version Control:** GitHub.
- **Deployment:** Vercel.

4.4. Use of Artificial Intelligence:

- **Cursor.ai:** Used as an AI-powered IDE to speed up coding and debugging.
- **Windsurf.ai:** Assisted in prototyping user flows and brainstorming desing ideas.
- **ChatGPT:** Writing, refining project documentation and structuring reports.
- **GrokAI:** Brainstorming, validating technical decisions.

5. Space Agency Data:

- NASA POWER
- GPM IMERGE
- GEOS-S2S
- MERRA-2
- IOD SST index
- NOAA CPC ONI
- MODIS NDVI
- OpenWeather API
- NASA POWER Climatology API

6. References:

- NASA Earthdata
- NASA Applied Sciences - Disasters
- Cursor.ai
- Windsurf

------Thank You-----