Parce, ¿Va a llover? A NASA Earth Weather Data Observation Application

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I. Introduction

In recent years, the frequency and intensity of extreme weather events have grown significantly, affecting millions of people around the globe. Floods, landslides, poor air quality, and severe weather conditions not only threaten lives but also disrupt economies, damage infrastructure, and challenge the resilience of entire communities. Access to reliable and timely information is no longer a luxury—it is a necessity for informed decision-making and risk mitigation in daily life.

At the same time, the increasing availability of open scientific data has created unprecedented opportunities to transform raw environmental information into actionable knowledge. NASA Earth observation data, in particular, provides high-quality insights into atmospheric, hydrological, and environmental conditions worldwide. However, the full potential of this information often remains untapped for the general public, who need tools that are both accessible and tailored to their specific contexts.

This project proposes the development of an interactive application that bridges this gap by offering a personalized dashboard for weather forecasting and hazard assessment. By integrating NASA Earth observation data, the platform enables users to obtain forecasts of key variables—such as temperature, precipitation, wind speed, and air quality—while also evaluating the likelihood of flood and landslide risks at a user-defined location and date. Unlike conventional weather applications, this tool is designed not only to inform but also to anticipate, providing early warnings that can help individuals and communities prepare for potential hazards.

The importance of this application extends beyond convenience. For individuals, it means greater confidence in daily planning and safety. For communities, it provides a tool that enhances resilience and supports emergency preparedness. And for society at large, it demonstrates how open scientific data can be transformed into meaningful, life-protecting solutions. Through an intuitive, interactive dashboard, this application empowers users with information that is both relevant and reliable, contributing to a safer and more informed world.

II. Justification

As climate change fuels more extreme weather, access to reliable, location-specific information on natural hazards is critical. Communities worldwide face growing risks from floods, landslides, and poor air quality, which threaten public safety, infrastructure, and economic stability. However, most weather apps offer only general forecasts, lacking the tailored, multi-variable early-warning systems needed for precise risk assessment. This information gap leaves individuals and decision-makers without the tools they need to anticipate hazards and respond effectively.

NASA's open-access Earth observation data offers a powerful solution. By leveraging these high-resolution datasets, we can build an application that moves beyond standard forecasts. Our tool will translate complex environmental data—including temperature, precipitation, wind speed, and air quality—into actionable warnings for potential hazards like floods and landslides. Unlike traditional services, this application focuses not just on reporting conditions, but on empowering users with insights that support proactive risk management.

The application will function as a personalized risk dashboard. Users can input their location and desired time frame to receive targeted forecasts and alerts, enhancing both everyday preparedness and long-term planning. With its interactive interface, the platform ensures accessibility even for non-technical users, while also providing detailed outputs that can be valuable to urban planners, local governments, and emergency management agencies. In this way, the dashboard bridges the gap between scientific data and practical decision-making, making advanced environmental intelligence available to everyone.

Beyond its immediate utility, the project also contributes to a larger vision of resilience and sustainability. By democratizing access to satellite-based hazard assessment, it equips vulnerable populations with the knowledge to protect themselves, supports infrastructure planning in rapidly growing cities, and aids policymakers in developing adaptive strategies for climate resilience. The integration of predictive weather modeling with hazard assessment in a single, user-friendly platform represents an innovative step forward in how society can harness scientific data for public good.

Ultimately, the development and deployment of this tool demonstrate the practical value of open scientific resources while championing transparency, accessibility, and societal benefit. In a world where climate-driven risks are accelerating, this application is more than a forecasting tool—it is a pathway toward safer, more informed, and more resilient communities.

III. Objectives

A. Main Objective

To develop an application that uses NASA Earth observation data to create a personalized dashboard, enabling users to obtain information about the likelihood of specified weather conditions (temperature, wind speed, precipitation, air quality) and to assess and receive early warnings for flood and landslide risks at a user-defined location and day.

B. secondary Objectives

1) To collect, preprocess, and model NASA Earth observation data, integrating weather, hydrological, and environmental indicators required for forecasting weather conditions and assessing flood and landslide risks.
2) To design and implement a user-friendly application that allows individuals to specify their location and date, and receive personalized insights through an interactive dashboard.
3) To validate the application's predictive accuracy and system performance through test datasets and user scenarios, ensuring reliability of early warnings and usability of the dashboard.
4) To deploy the application in a stable environment and publish it for end users, including documentation, user guides, and outreach to potential stakeholders.

IV. Methodology

General Approach

The project development followed an approach based on meteorological data analysis and the implementation of a user-oriented interactive interface. Data processing techniques, dynamic visualization, and frontend development were combined to build an informative and accessible tool.

Data Acquisition and Processing

- **Data Source:** Meteorological datasets from the NASA POWER API were used, containing daily records of climate variables such as air temperature at 2 m (T2M), corrected precipitation (PRECTOTCORR), and wind speed at 10 m (WS10M).
- **Period and Location:** Data were obtained for a specific time range and selected locations (e.g., Bogotá, Colombia).
- **Data Processing:** The records were processed to calculate representative statistics such as:
  - Average precipitation (mm/day)
  - Average temperature (°C)
  - Average wind speed (m/s)

  These values were integrated into the system in JSON format for use within the frontend.

System Design and Implementation

- **Framework:** React.js was used as the frontend base due to its efficiency in creating reusable components and its integration with animation libraries.
- **Complementary Libraries:**
  - *Framer Motion:* For smooth transitions and animations in the chart carousel.
  - *Lucide React:* For lightweight and consistent icons.
  - *Recharts:* For generating bar and donut charts.
- **Component Architecture:** Modular components were organized, including:
  - *ProbabilityChartCarousel:* Interactive carousel displaying animated statistical charts.
  - *ChartBar* and *ChartDonut:* Components responsible for data visualizations.
  - *WeatherStatistics:* View presenting average indicators and explanations of each climate variable.

Interface and User Experience

An intuitive and visually clean interface was prioritized, following modern design principles:

- Soft color palette associated with meteorological variables (blues, yellows, greens).
- Readable typography with a clear visual hierarchy.
- Automatic animations with pause on hover, improving interaction without distracting the user.

Validation and Testing

- Verified correct rendering of components and data synchronization across different browsers.
- Performed responsiveness testing to ensure compatibility with mobile devices.
- Statistical values were cross-checked with the original dataset results to validate accuracy.

Repository and Data Sources

The complete source code and implementation details of the project are available in the public GitHub repository:

- **Project Repository:** https://github.com/JuanBeltran09/NasaSapaceApp.git

The meteorological data used in this application were obtained from NASA's official open-access resource through the POWER Data Access Viewer developed by Giovanni:

- **Data Source:** NASA POWER Data via *Giovanni – The NASA Goddard Interactive Online Visualization and Analysis Infrastructure:* https://giovanni.gsfc.nasa.gov/

Methodological Conclusion

The methodology integrated data analysis, interface design, and modular programming to create an application capable of communicating complex climate information in a visual, accurate, and engaging manner.

V. Results

This section presents the functional prototype of the Weather Probability App, demonstrating its key features and user interface design. The application successfully integrates NASA POWER API data to provide statistical climate analysis through an intuitive web interface.

A. Main Interface

Figure 1 shows the landing page of the application, featuring a clean and modern design. The interface includes interactive components for location selection (map-based) and date input, allowing users to query historical weather patterns for any geographic coordinates and future dates.

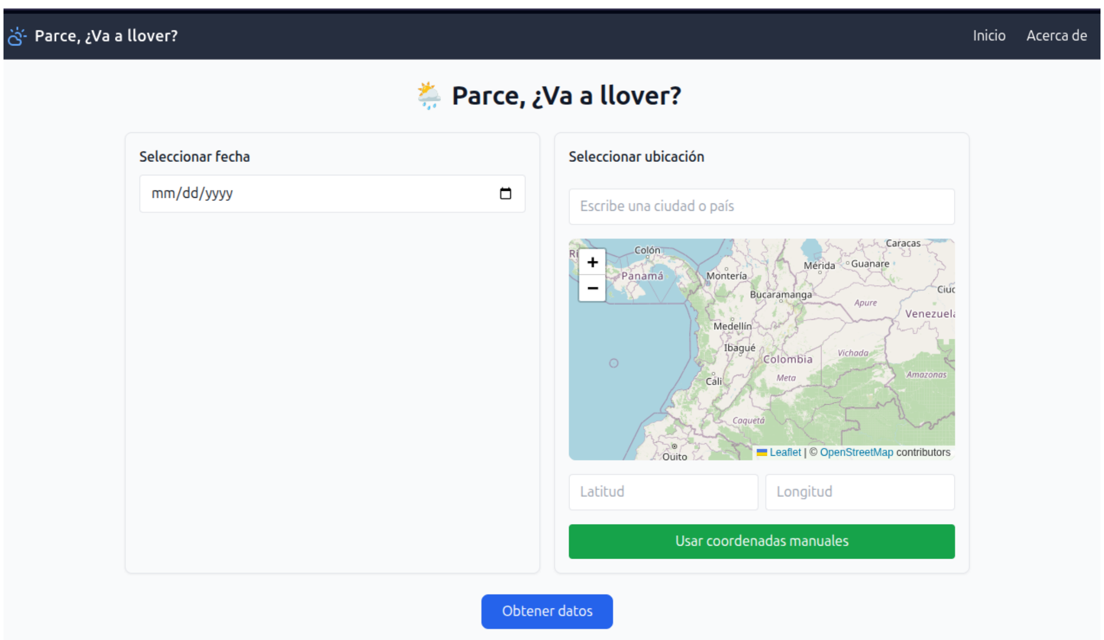

Figure 1. Main page interface showing location selector, date picker, and search functionality. The gradient background and card-based layout provide an intuitive user experience.

B. Data Visualization and Statistical Analysis

Once the user submits a query, the application processes historical NASA data and displays comprehensive weather probability analysis. Figure 2 illustrates the results dashboard, which includes:

- **Probability distribution**: Percentage breakdown of different weather categories (sunny, cloudy, rainy, windy, extreme conditions)
- **Historical statistics**: Average temperature, precipitation, and wind speed metrics
- **Visual explanations**: Clear descriptions of the variables used in the analysis

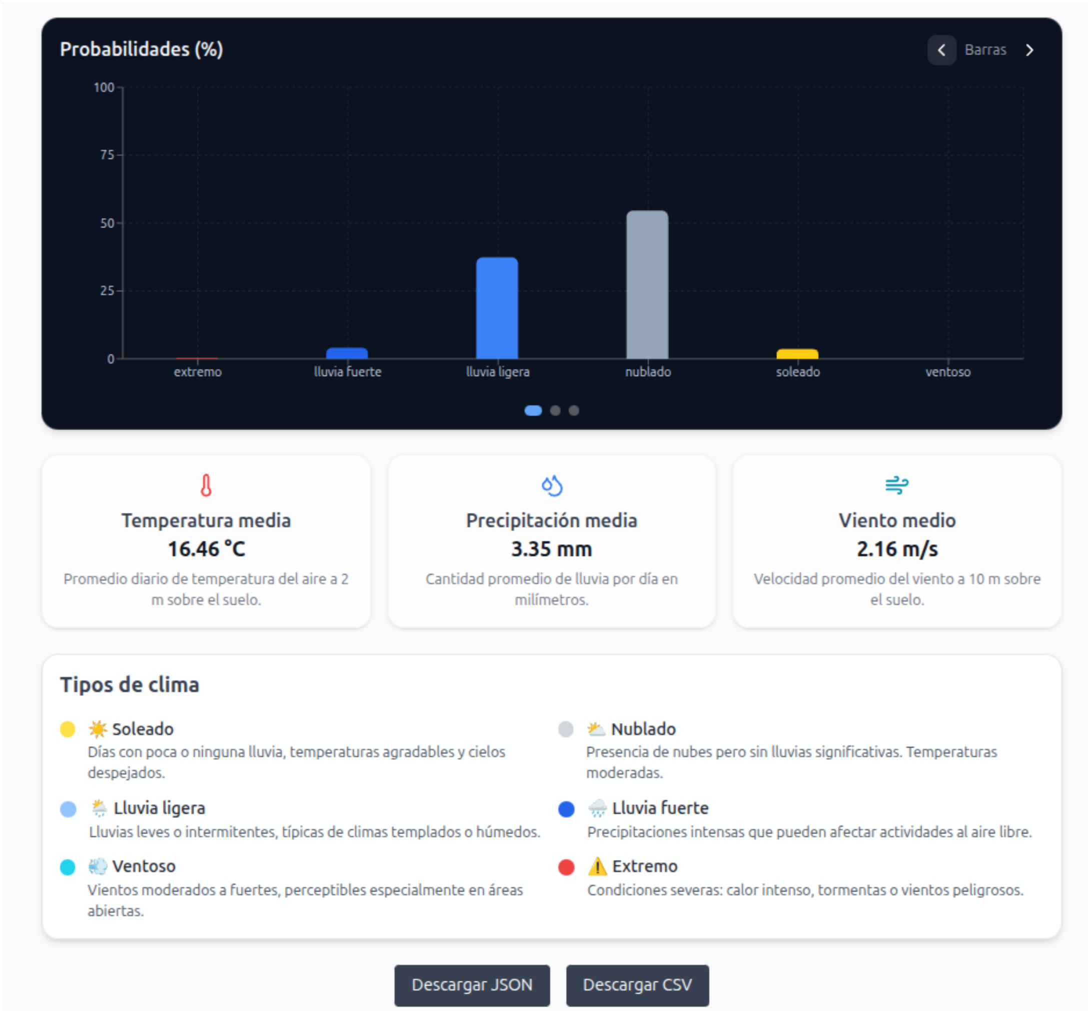

Figure 2. Data visualization dashboard displaying weather probabilities, statistical metrics, and explanatory text for user interpretation.

C. Chart Components and Data Representation

The application provides multiple visualization formats to enhance data comprehension. Figure 3 demonstrates the different chart types available:

- **Bar charts**: Show percentage distribution of weather categories
- **Statistical cards**: Display key metrics (temperature, precipitation, wind) with iconography
- **Interactive tooltips**: Provide detailed information on hover

All visualizations are built using Recharts library, ensuring responsive design and smooth interactions across devices.

Figure 3. Types of diagrams used in the application: bar charts for probability distribution and card-based layouts for statistical summaries.

D. Technical Performance

The prototype demonstrates successful integration between:

- **Backend**: Flask API processing NASA POWER data with NumPy-based statistical analysis
- **Frontend**: React application with Tailwind CSS styling and Recharts visualizations

- **Data flow**: Real-time API requests returning JSON-formatted probability distributions and statistics

Response times average between 2-4 seconds depending on the historical data range requested (typically 20-30 years of daily records).