AtmosInsight: Visualizing the Earth, Listening to the Climate

Omnicron Animate – NASA Space Apps Challenge 2025

1. A Story Born from Space

For more than half a century, NASA has observed our planet as never before: from space, with thousands of technological eyes orbiting and recording every change in its atmosphere, soil, vegetation, and oceans. However, although satellites capture terabytes of information daily, much of this data remains hidden behind technical portals, complex formats, and scientific vocabularies difficult for the general public to interpret.  
  
This is where AtmosInsight is born: a tool that translates satellite science into human stories, combining interactive visualization with accessible narration. We want anyone, regardless of technical background, to understand what satellites see and to listen to what Earth is trying to tell us.

2. The Challenge

The challenge that inspired this project was clear:  
  
“How can we make Earth observation data understandable, engaging, and useful for everyone?”  
  
Most scientific portals present raw data: maps, indices, coordinates, graphs. But behind each pixel lies a story: a spreading drought, a forest that breathes less, a column of sulfur dioxide revealing an active volcano.  
  
AtmosInsight proposes a new way to tell environmental science — with an experience that unites spatial visualization, digital narration, and artificial intelligence.

3. Our Solution

Interactive visualization + sound narration.  
  
AtmosInsight is a web application that connects directly to NASA's open APIs — especially GIBS (Global Imagery Browse Services) — to bring real-time satellite imagery and reconstruct the evolution of atmospheric and terrestrial phenomena.  
  
Users can:  
- Choose a date or historical event (for example, a hurricane or pollution peak).  
- Select a satellite layer such as NDVI (vegetation), SMAP (soil moisture), SO₂ (volcanic emissions), OPERA (surface water), or MODIS Terra (temperature and visible images).  
- Visualize information on the map and observe temporal changes.  
- Listen to an AI-generated narration explaining the phenomenon in clear, educational, and accessible language.  
  
Thus, the experience not only shows data — it tells stories about how Earth breathes, changes, and adapts.

4. Architecture and Technical Flow

Layer 1 – NASA Satellite Data  
Data is consumed directly from the GIBS (WMTS) service:  
https://gibs.earthdata.nasa.gov/wmts/epsg3857/best/{LAYER}/default/{DATE}/GoogleMapsCompatible\_Level9/{z}/{y}/{x}.png  
  
These layers are 100% NASA or partner data (NOAA, ESA, JPL), ensuring eligibility for the Space Apps Challenge.  
  
Layer 2 – Visualization  
Frontend: React + Leaflet + TailwindCSS + Framer Motion  
Interactive map centered on the user’s region (e.g., Latin America)  
Controls for date, layer, and zoom  
Information panel with source, agency, data type, and date  
  
Layer 3 – Narrative  
Text-to-Speech (TTS) module using OpenAI TTS or Notebook LM.  
Short narrations that translate technical information into educational language.  
Ability to generate audio clips for social media or environmental education.  
  
Layer 4 – Hosting / Integration  
Deployment on GitHub Pages or Vercel.  
Open-source (MIT license).  
Public link for NASA evaluation.

5. NASA Data Used

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| --- | --- | --- | --- | --- |
| Dataset | Description | Agency | Type | Frequency |
| MODIS Terra True Color | Daily RGB visible image of Earth’s surface. | NASA EOSDIS | Optical | Daily |
| VIIRS NOAA-20 NDVI (8-day) | Normalized Difference Vegetation Index. | NASA/NOAA | Biophysical | 8 days |
| SMAP Soil Moisture L3 | Surface soil moisture (36 km). | NASA JPL | Microwave | Daily |
| OPERA Surface Water Extent (HLS) | Dynamic surface water extent. | NASA JPL | Radar | Daily |
| TROPOMI SO₂ Column | Total vertical sulfur dioxide. | ESA/Copernicus (NASA EOSDIS) | Chemical | Daily |
| MERRA-2 Air Temperature | Atmospheric temperature at 2 m. | NASA GMAO | Reanalysis | Monthly |

6. Methodology

Approach: Exploratory-applied, emphasizing accessibility and scientific dissemination.  
Design: Functional web prototype based on real data, integrating automated narration.  
Method:  
- Descriptive: visual and narrative interpretation of environmental trends.  
- Analytical: temporal comparison of layers and anomaly detection.  
- Educational: scientific translation through AI for educational audio.

7. Impact

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| Dimension | Contribution |
| Scientific | Spreads environmental knowledge based on real satellite data. |
| Educational | Creates understandable content for schools, communities, and media. |
| Social | Democratizes access to science and fosters climate awareness. |
| Technological | Demonstrates a reproducible cloud architecture using open APIs. |