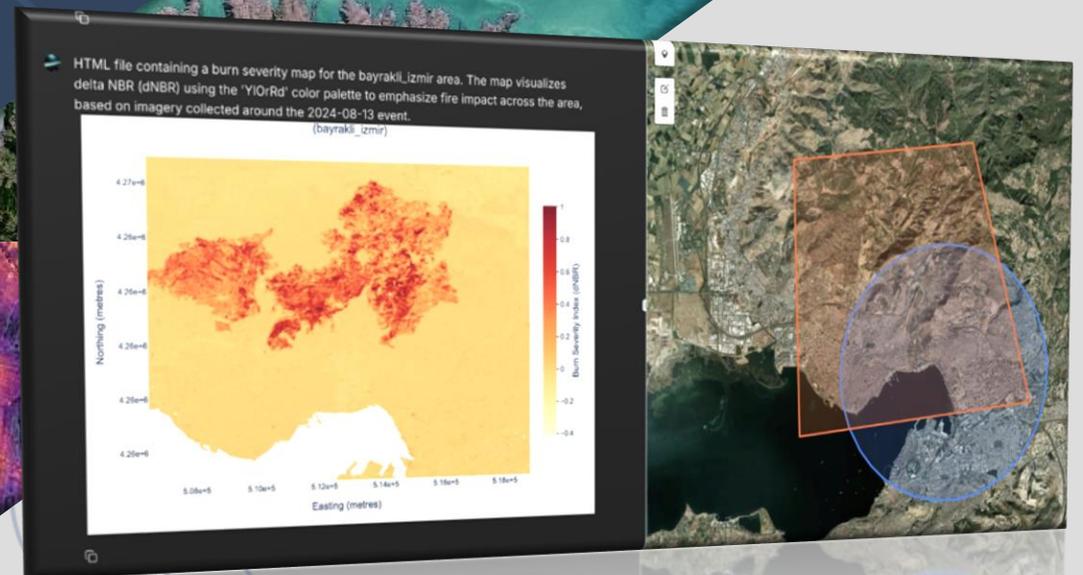
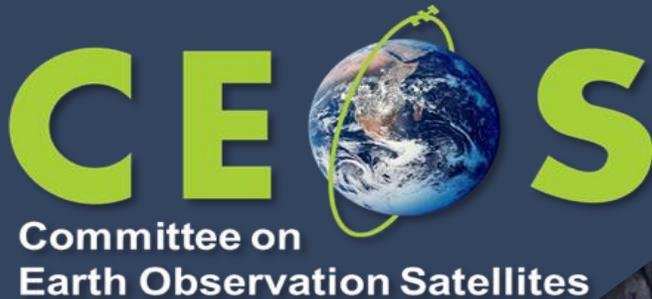


EO-GPT: An Open-Source, Open-Science Framework for Geospatial AI

Dave Borges, CEOS SEO

Technical team: Otto Wagner, Emir Korukluoglu, Brian Terry, Oguz Yetkin, Tommy Thomas, Sanjay Gowda

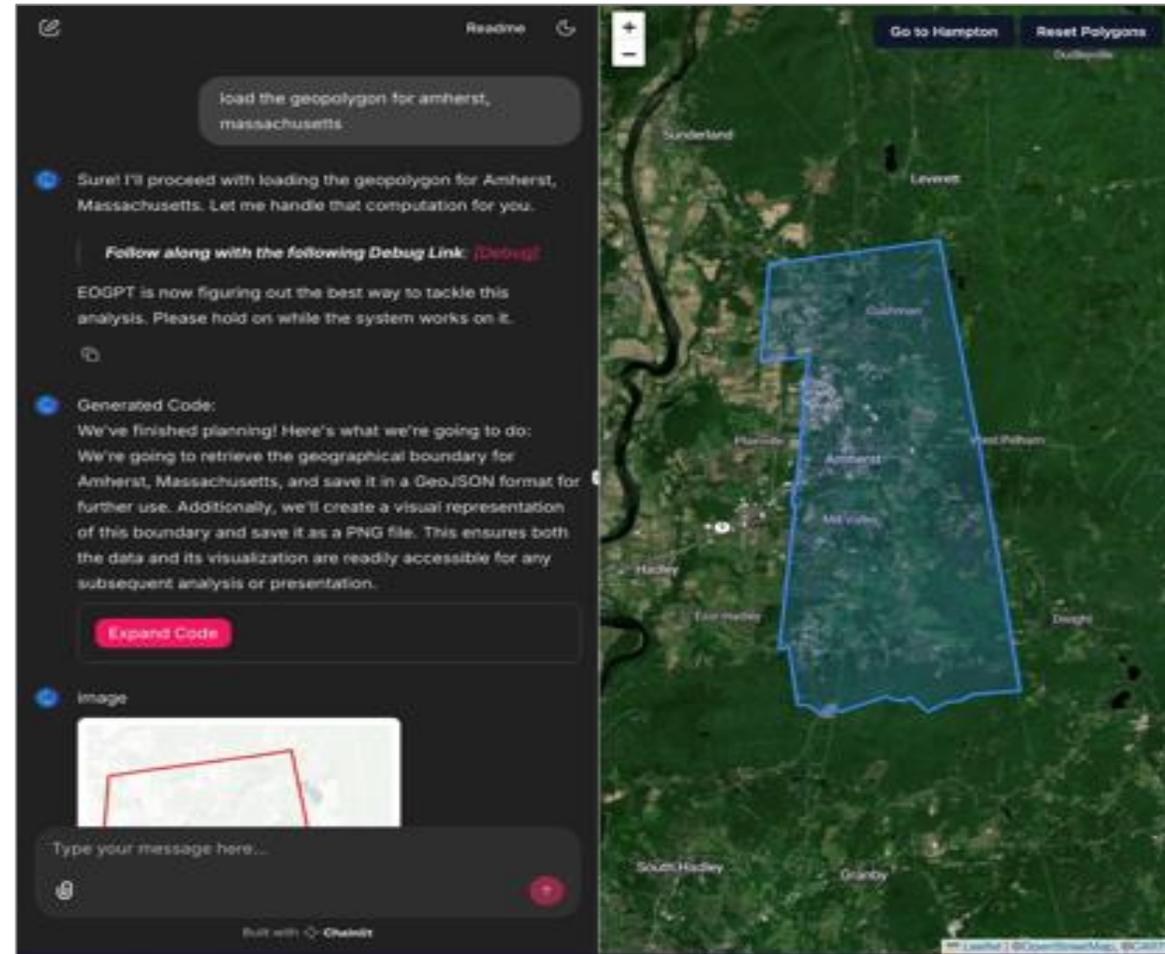
March 12th, 2026



EO-GPT Vision & Approach



- **Vision:** Enable more flexible and accessible EO analysis through a modular, LLM-enabled architecture
- **EO-GPT provides an AI-powered operational interface for Earth Observation**, enabling users to discover, analyze, and visualize geospatial information through a unified conversational environment that integrates visual intelligence with automated analytical workflows.
- **EO-GPT is targeted for open-source release in 2026** to promote broader community collaboration and innovation. It has been in development since 2024.
- **Builds on community toolsets** such as the Open Data Cube to help address important challenges, including resiliency.
- **Brings together multiple sources of data, information, and analytical capability, including:**
 - Module repositories with community code and natural-language annotations (*used in Process Orchestration*)
 - Research publications and technical outputs
 - News and related external sources
 - STAC data and metadata resources
- **Enables generation of reusable code modules** for deeper analysis, with a strong **focus on user interface and user experience.**



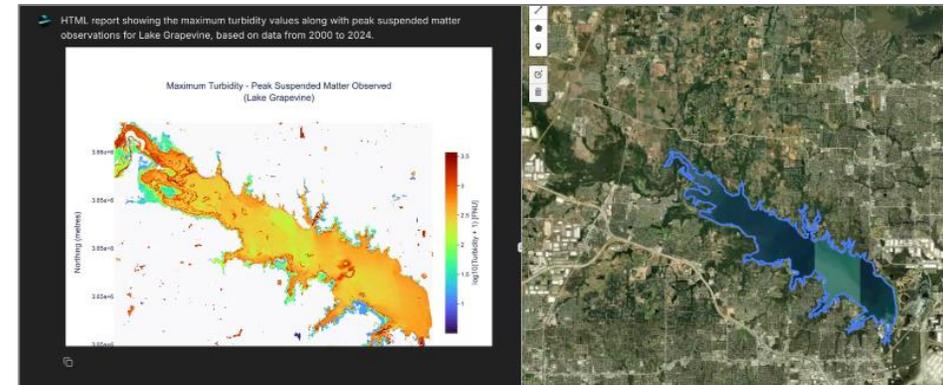
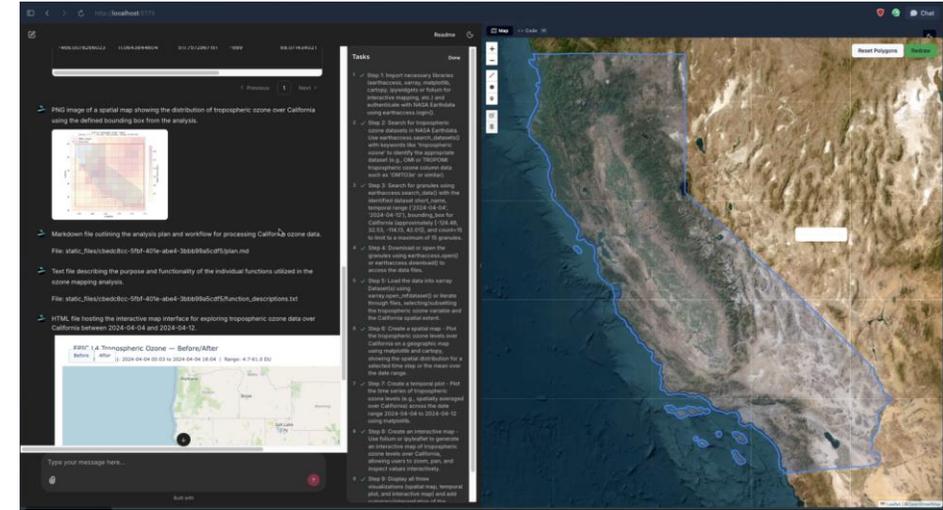
Natural Language Interface
(Intuitive for all users)

Map Interface
(Intuitive for geospatial users)

Core Capabilities



- 1. Conversational User Interface** - Enables users to interact with Earth Observation systems using natural language while maintaining conversational context and translating requests into system actions.
- 2. Geospatial Visualization & Map Control** - Supports interactive spatial exploration through dynamic map control, including adjusting views, adding layers, and visualizing geospatial assets.
- 3. Global EO Data Access** - Provides seamless access to satellite imagery and geospatial datasets, enabling efficient discovery and retrieval of EO data and metadata.
- 4. Process Orchestration** - Executes backend analysis and processing on Earth observation data
- 5. Automated Code Generation & Repair** - Generates and executes scripts for EO analysis while automatically detecting and correcting errors to ensure reliable workflows.
- 6. Computer Vision Enhanced AI Analysis** - EO-GPT can analyze imagery, identify spatial patterns, and integrate visual insights directly into the conversation and analytical workflows.
- 7. External Knowledge Integration** - Enhances EO insights by incorporating contextual information from external sources (e.g., web search, current events).



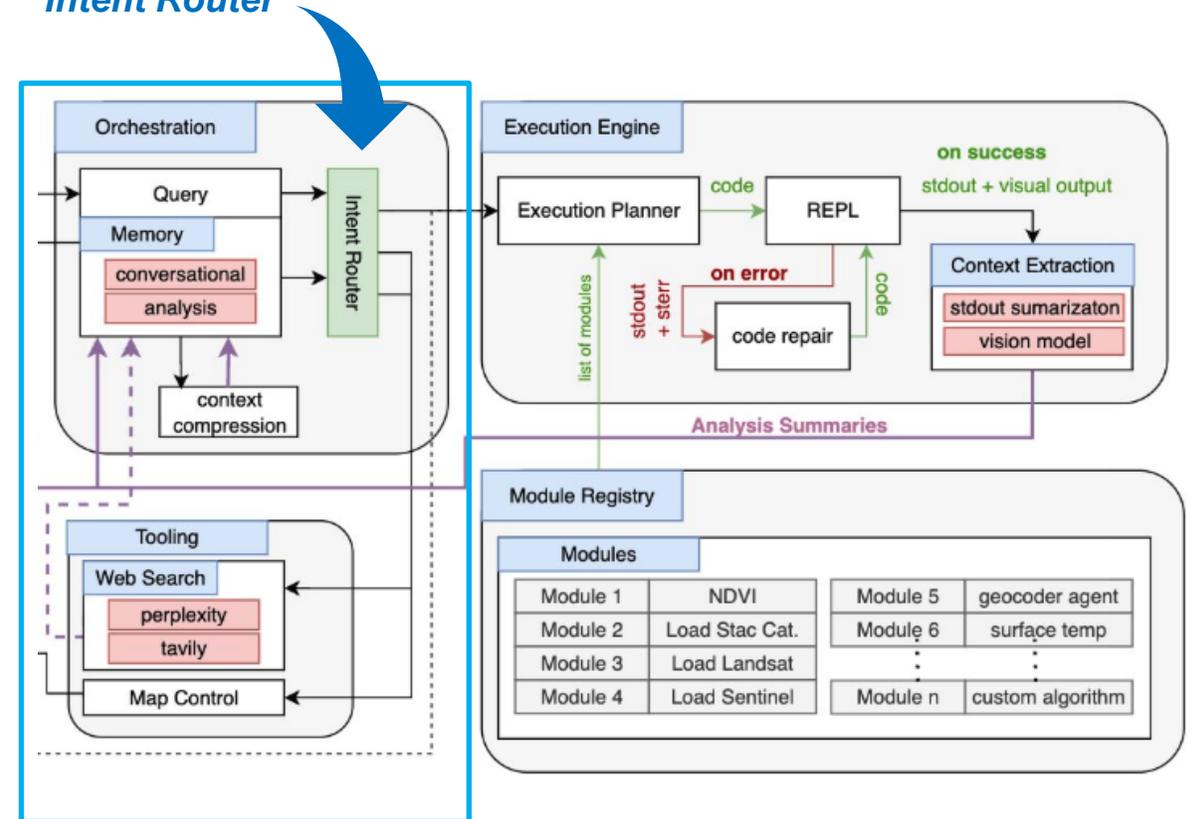
EO-GPT Interactions are categorized as “Intents”



Categorization of interactions into “Intents”

1. **Search Intent** - This intent handles information retrieval from external sources such as web search or news. The system interprets user questions, gathers relevant contextual information, and produces informative responses that combine EO knowledge with broader situational context.
2. **Computational Intent** - Executes analytical operations on the EO-GPT backend. This includes retrieving satellite imagery and geospatial datasets, running data processing workflows, and integrating the results of computations directly into the conversation.
3. **Map Control Intent** - Manages interactions with the geospatial interface. Through this intent, EO-GPT can control map views, adjust zoom levels, add spatial assets or layers, and enable interactive exploration of geographic data.
4. **Conversational & Analysis Intent** - Manages direct conversation with the user while also supporting interpretation and discussion of analytical results within the current session. It enables dialogue about existing outputs such as datasets, satellite imagery, derived products, or map layers that are already loaded in the workspace. This allows EO-GPT to function as an interactive analytical assistant, helping users understand and explore results without needing to restart or re-run workflows.

Intent Router



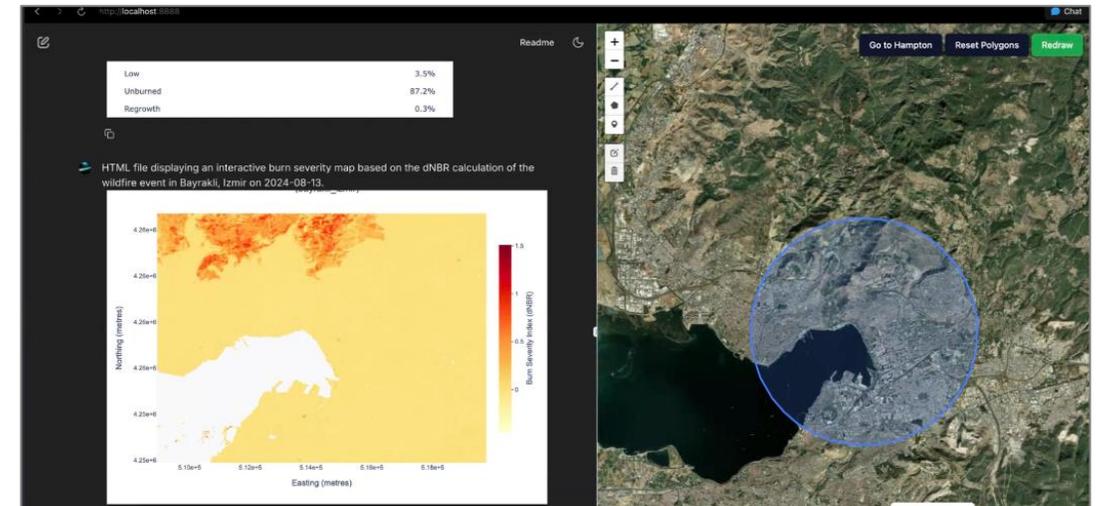
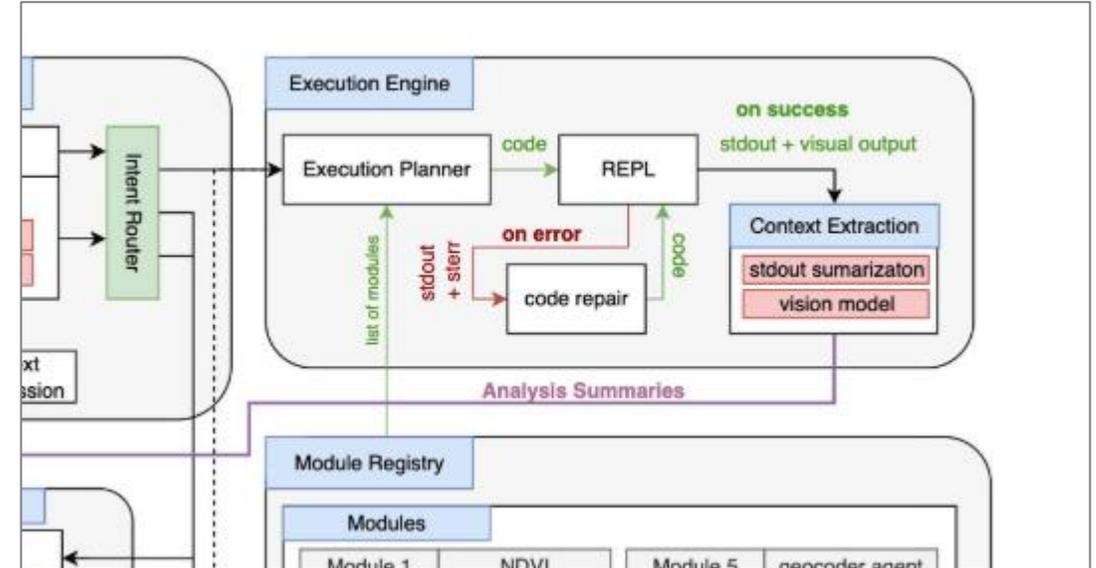
Together, these intents form the core orchestration layer of EO-GPT, allowing the system to translate natural language requests into conversational responses, data retrieval, geospatial interaction, analytical processing, and automated workflow correction.

At the foundation of EO-GPT is process orchestration



Decomposable Analysis:

- Modules are created and stored in a Module Registry (EO-GPT Algorithm Hub)
- GPT model generates code using existing modules and other knowledge in its training corpus
- Execution engine executes code, debugs errors, and displays results
- Tools exist for specific analyses for specific conditions like wildfires, droughts, algae, etc.
- Larger analyses form pipelines made up of modular algorithms and techniques



DEMONSTRATION - EO-GPT Intents



EO-GPT “Intents” Demonstration

News Search Intent

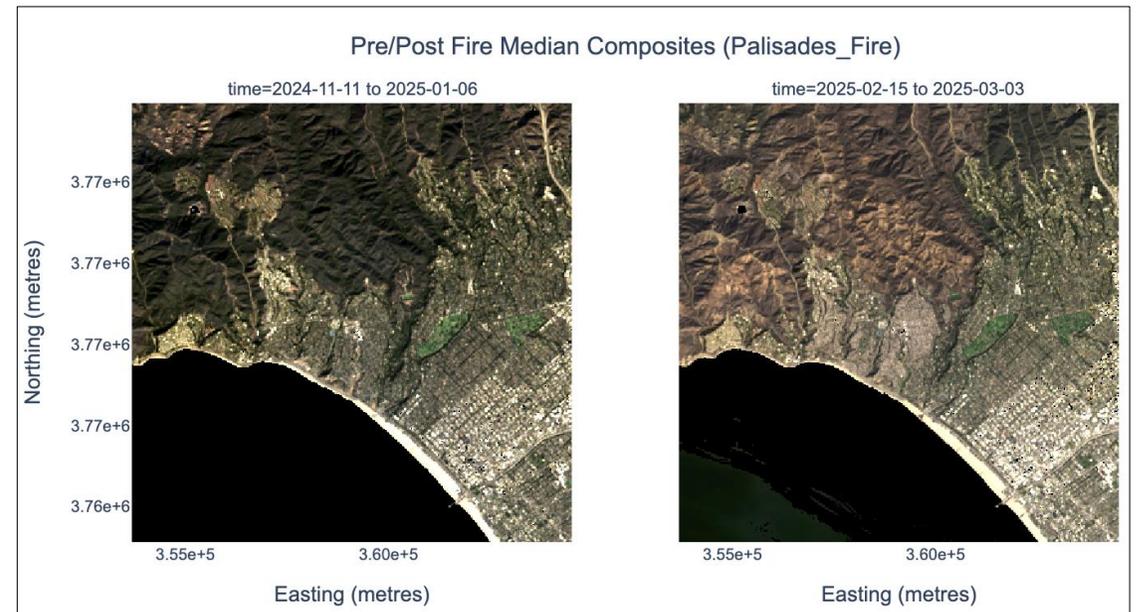
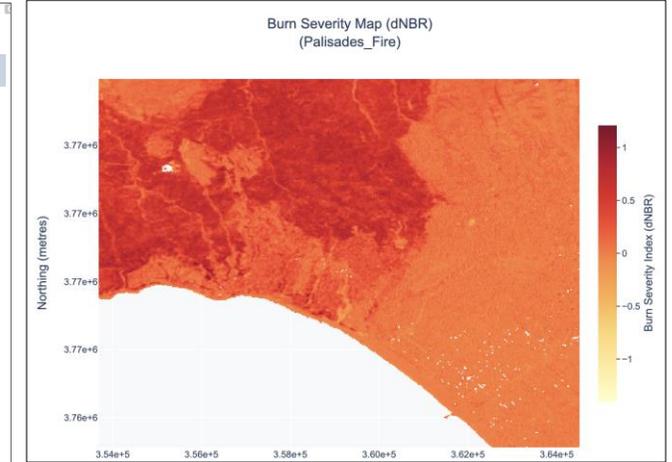
EO-GPT >> “Briefly list the dates of the Palisades fire”

Computational Intent

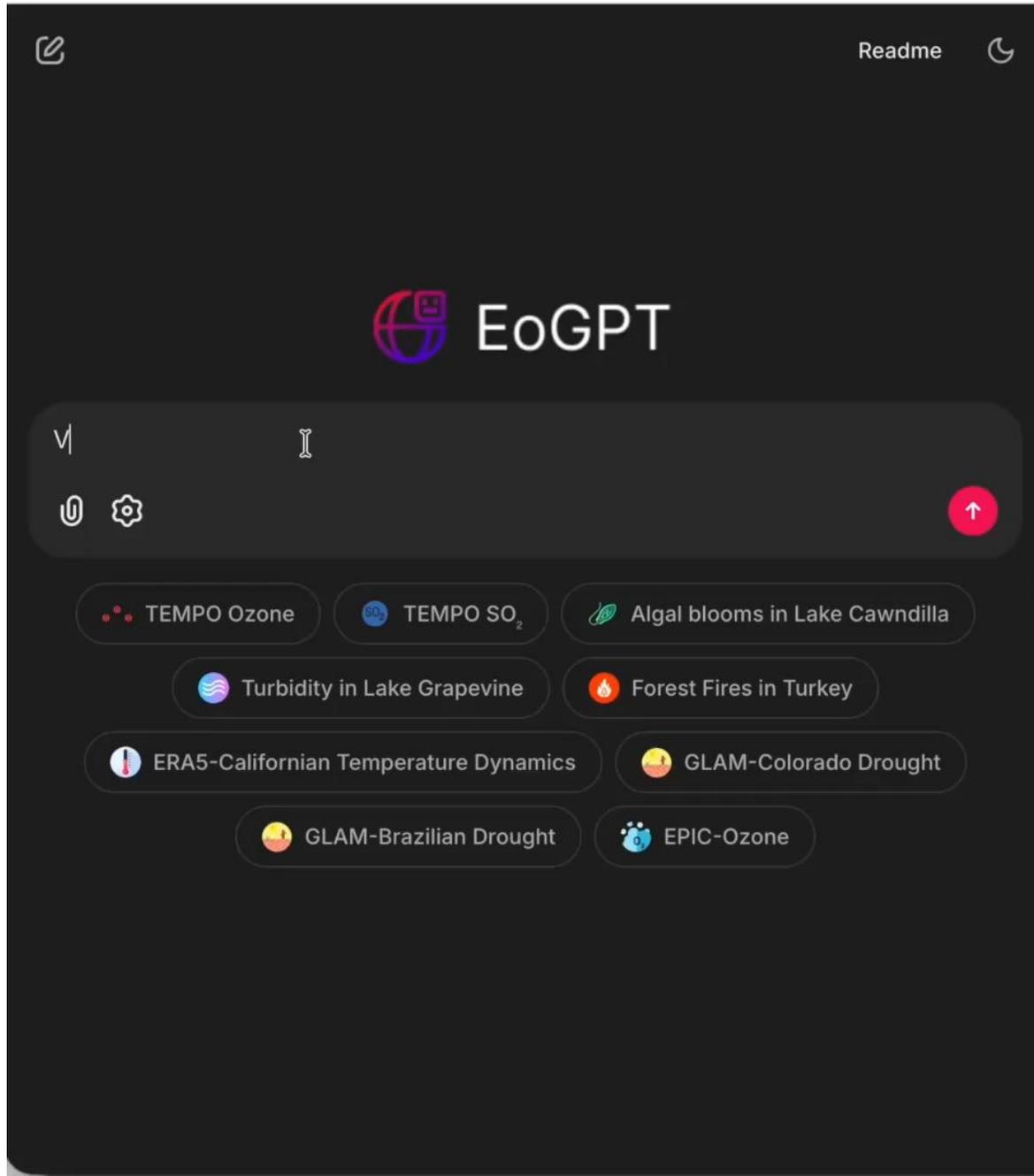
EO-GPT >> “Analyze this fire”

- EO-GPT classifies user input into various intents such as:
 - “Conversational”
 - “Tool Running”
 - “News Search”
- This capability allows a non-expert to “zoom in” on an event such as a fire or a flood without knowing too much about it
- The module creates a statistical summary as well as maps
- The NBR (Normalized Burn Ratio) module utilizes the EO-GPT change detection module which creates geomedians from multiple “before” and “after” images. We would like to curate more sophisticated modules like this one from the community

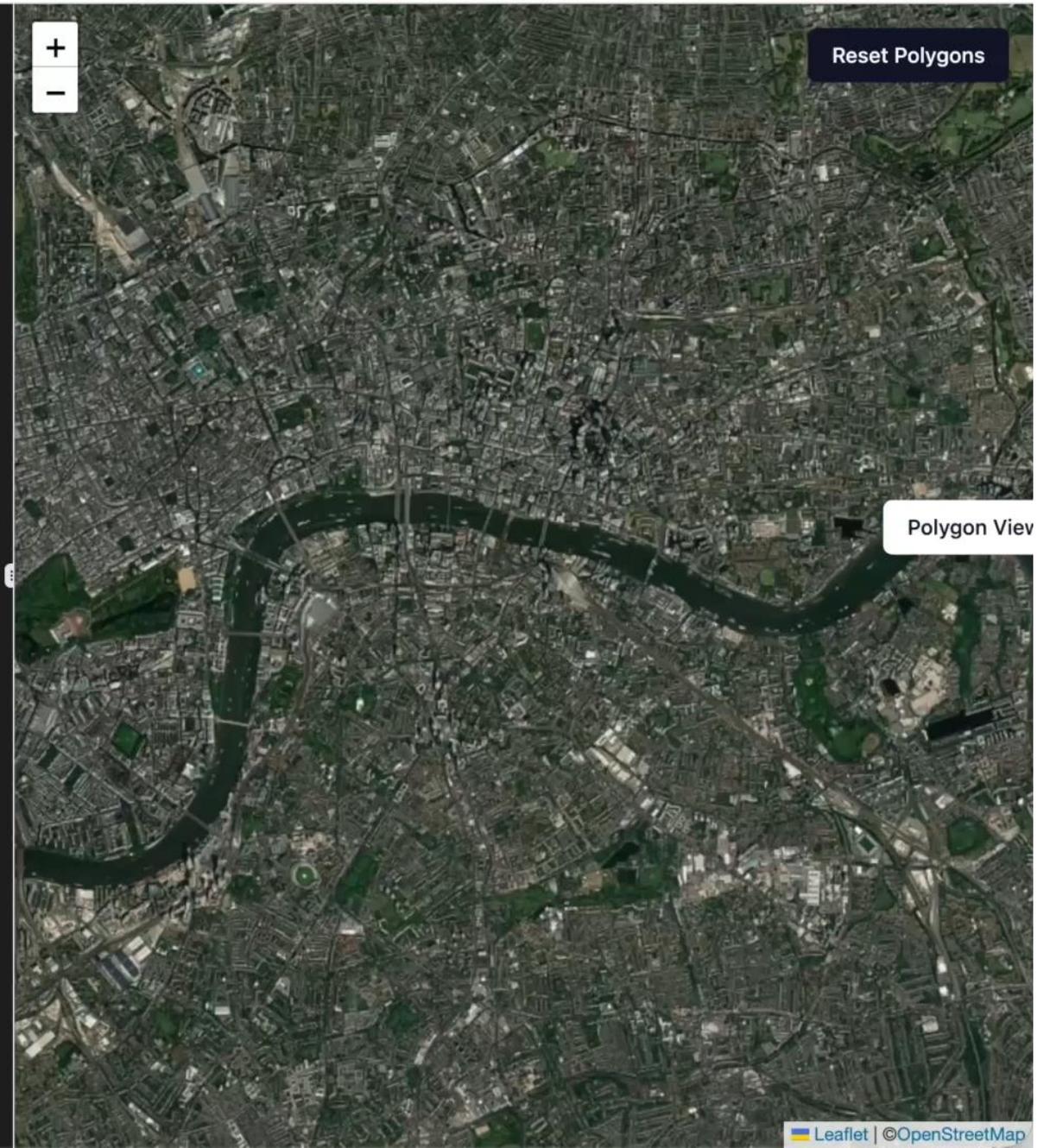
Burn Severity Statistical Summary	
Metric	Value
Fire Location Details	
Location	Palisades_Fire
Fire Date	2025-01-07
Pre/Post-fire Data Summary	
Aggregation Method	MEDIAN
Pre-fire Period	2024-11-11 to 2025-01-06
Pre-fire Acquisitions	3
Post-fire Period	2025-02-15 to 2025-03-03
Post-fire Acquisitions	3
Fire Coverage Metrics	
Valid Pixels	96,969
Valid Percentage	74.4%
Burn Impact Metrics	
Total Area (km ²)	87.27



EO-GPT "Intents" Demonstration



The screenshot shows the EoGPT web application interface. At the top left is a share icon, and at the top right are links for "Readme" and a moon icon. The main header features the EoGPT logo, which consists of a stylized globe icon and the text "EoGPT". Below the header is a search bar containing the text "V" and a cursor. To the left of the search bar are icons for a link and settings, and to the right is a red button with an upward arrow. Below the search bar is a grid of ten interactive buttons, each with a unique icon and text: "TEMPO Ozone" (red dots), "TEMPO SO₂" (blue SO₂ molecule), "Algal blooms in Lake Cawndilla" (green leaf), "Turbidity in Lake Grapevine" (blue waves), "Forest Fires in Turkey" (orange flame), "ERA5-Californian Temperature Dynamics" (red thermometer), "GLAM-Colorado Drought" (yellow sun), "GLAM-Brazilian Drought" (yellow sun with rain), and "EPIC-Ozone" (blue globe with dots).



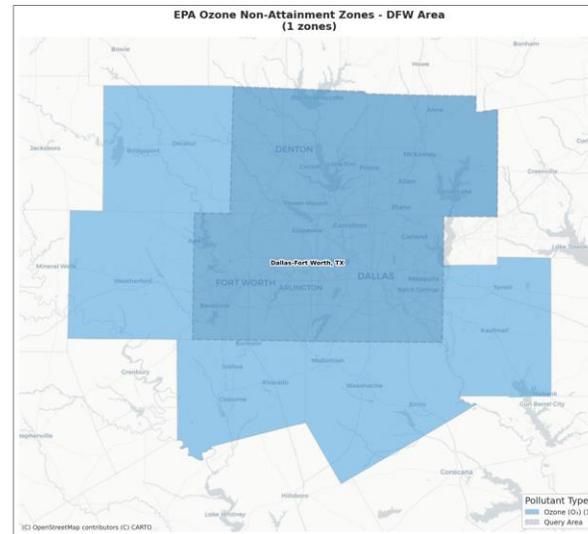
DEMONSTRATION - ASDC DAAC Use Case



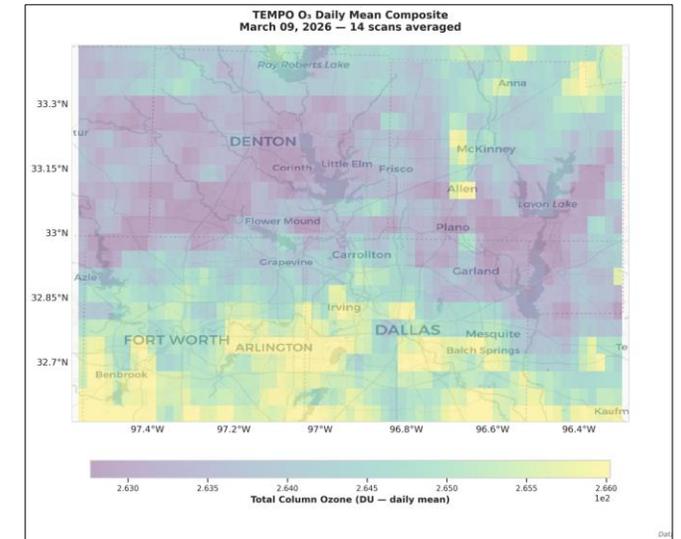
NASA LaRC's Atmospheric Science Data Center (ASDC)

EO-GPT >> "Analyze today's ozone across the DFW ozone non-attainment area (Dallas, Tarrant, Collin, Denton counties in Texas). Query the EPA ozone non-attainment zones, then compute the TEMPO daily ozone product over the full region and visualize."

- Collaboration with the NASA Atmospheric Sciences Data Center
- **TEMPO Mission:** Ability to retrieve pollutants such as O_3 , SO_2 , NO_2 , etc.
- **EPIC Mission:** Ability to retrieve various pollutants
- **EPA Non-attainment Zone Database:** Areas in the United States which have fallen short of EPA goals.



EPA Non-Attainment Zones near Dallas, TX



O_3 Concentration for March 10 2026 for the DFW Area

EO-GPT ASDC Demonstration



Readme



Type your message here...

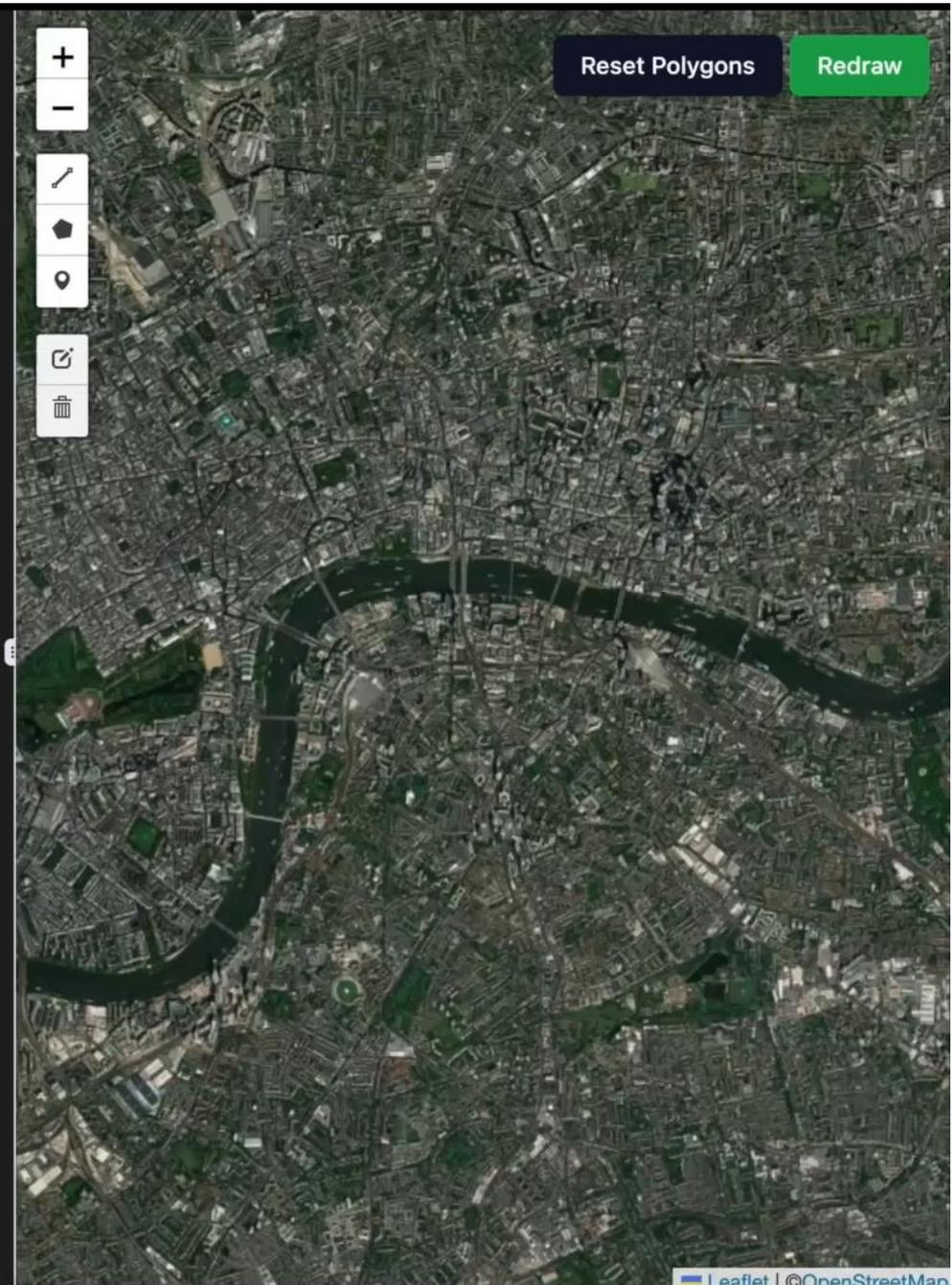


- TEMPO Ozone
- TEMPO SO₂
- Algal blooms in Lake Cawndilla
- Turbidity in Lake Grapevine
- Forest Fires in Turkey
- ERA5-Californian Temperature Dynamics
- GLAM-Colorado Drought
- GLAM-Brazilian Drought
- EPIC-Ozone



Reset Polygons

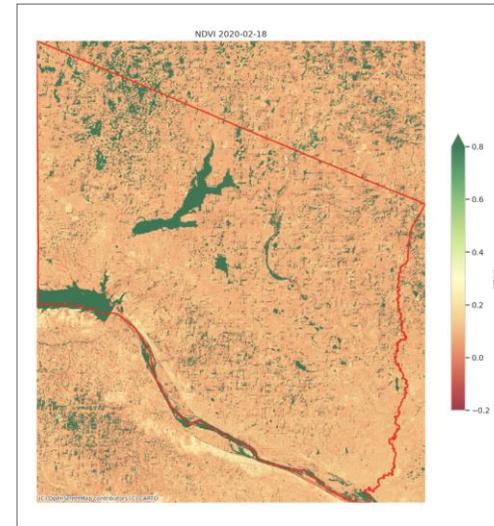
Redraw



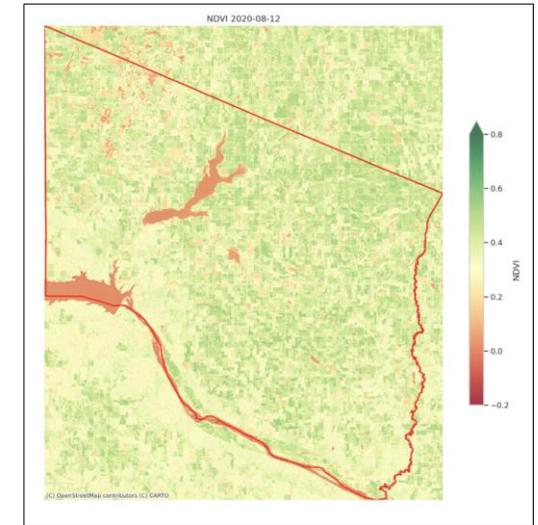
GEO – GLAM Use Case

EO-GPT >> “Please analyze the NDVI using GLAM for Yankton reservation in South Dakota between January 1 2020 and August 31 2020”

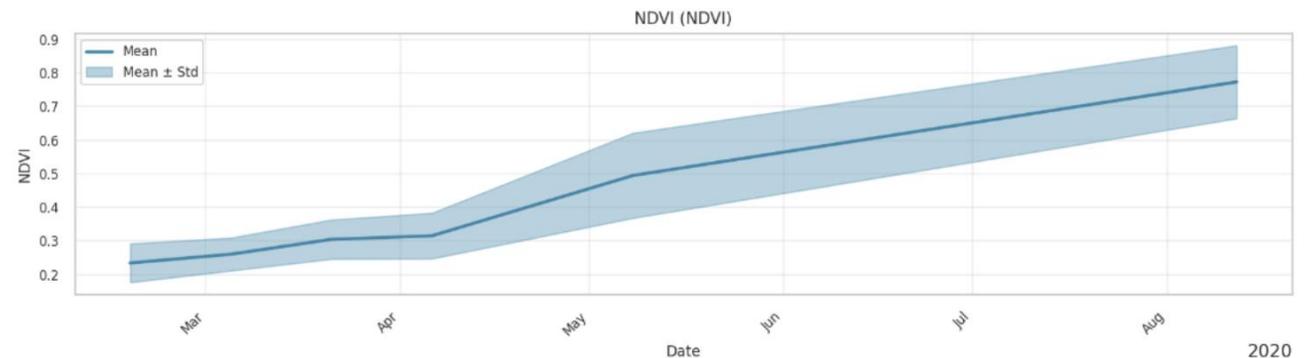
- This use case is a collaboration between the CEOS SEO and GEO
- GLAM Library module implemented
- Ability to retrieve NDVI, SWI and other parameters from specified geographic areas using the provided API
- The module can also augment provided data by providing its own before/after NDVI images for the time range



NDVI January 2020



NDVI August 2020



GEO – GLAM Demonstration

The screenshot displays the EoGPT web application interface. On the left, a dark sidebar contains the EoGPT logo, a search bar with the placeholder text "Type your message here...", and a list of data visualization options. The main area shows a satellite map of a city with a river. A vertical toolbar on the left side of the map includes zoom in (+), zoom out (-), pan, polygon drawing, location, share, and delete icons. In the top right corner of the map area, there are "Reset Polygons" and "Redraw" buttons. A "Polygon View" tooltip is visible on the right side of the map. The bottom right corner of the map shows the Leaflet and OpenStreetMap logos.

Readme

EoGPT

Type your message here...

TEMPO Ozone

TEMPO SO₂

Algal blooms in Lake Cawndilla

Turbidity in Lake Grapevine

Forest Fires in Turkey

ERA5-Californian Temperature Dynamics

GLAM-Colorado Drought

GLAM-Brazilian Drought

EPIC-Ozone

Reset Polygons

Redraw

Polygon View

Leaflet | OpenStreetMap

EO-GPT Future Work & Publications



Future Work:

- Continued **Validation and Verification** of toolset - All modules are created and/or curated by experts
- Improved integration of **Visual Intelligence** to summarize the results – E.g., We want EO-GPT to be able to intelligently interpret the graphs and maps it creates
- Increased focus on **Use Cases and applications**
- **Analysis Explorer** – Slice and dice your analysis data
- **Open Source** slated for mid-2026

Publications:

"A generative artificial intelligence framework for earth observation analysis." Wagner, Otto, Jeffrey Gordon, Aya Mousa, Brian Terry, Joshua Baptist, Oguz Yetkin, David Borges, and Sanjay Gowda. In IGARSS 2024-2024 IEEE International Geoscience and Remote Sensing Symposium, pp. 6986-6990. IEEE, 2024.

"Improving EO-GPT: An LLM Orchestration Framework for Earth Observation Analysis." Terry, Brian, Otto Wagner, Oguz Yetkin, Jeffrey Gordon, Joshua Baptist, David Borges, and Sanjay Gowda. In Proceedings of the IEEE International Geoscience and Remote Sensing Symposium (IGARSS) 2025.

Submitted to IGARSS 2026 (Washington D.C.)

"EO-GPT: An Open Source AI Framework for Earth Observation Analysis" Terry, Brian, Otto Wagner, Emir Korukluoglu, Oguz Yetkin, Aya Mousa, David Borges, Sanjay Gowda. In Proceedings of the IEEE International Geoscience and Remote Sensing Symposium (IGARSS) 2026

