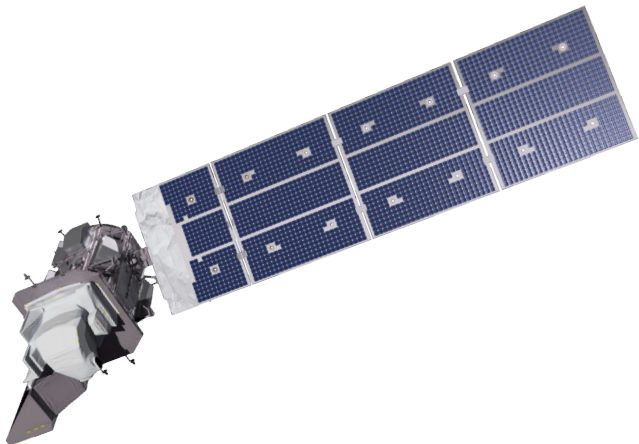


# U.S. Geological Survey Land and Agriculture User Needs Supported by the GeoXO Mission



**USGS National Land Imaging Program  
Ellen Wengert (KBR contract support)**

**20 May 2025**

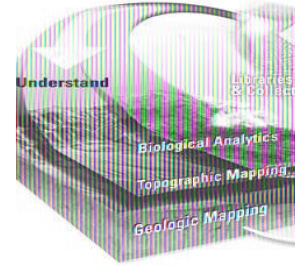


# U.S. Geological Survey Focus Areas



## Energy & Mineral Resources

Provides impartial scientific information on geologic energy and mineral resources and their supply chains. Delivering actionable science that informs crucial resource management impacting the Nation.



## Core Science Systems

Provides topographic and geologic mapping for Federal and State requirements, national geospatial coordination, satellite operations and remote sensing.



## Water Resources

Monitors, assesses, and conducts targeted research to deliver information on a wide range of water resources and conditions including streamflow, groundwater, water quality, and water use and availability.



## Natural Hazards

Monitor a wide range of natural hazards so stakeholders have the understanding they need to enhance preparedness, response, and resilience.



## Ecosystems

Provides science that directly benefits the health, safety, and prosperity of the American people by providing trusted and timely information to help address the Nation's toughest management and conservation issues.

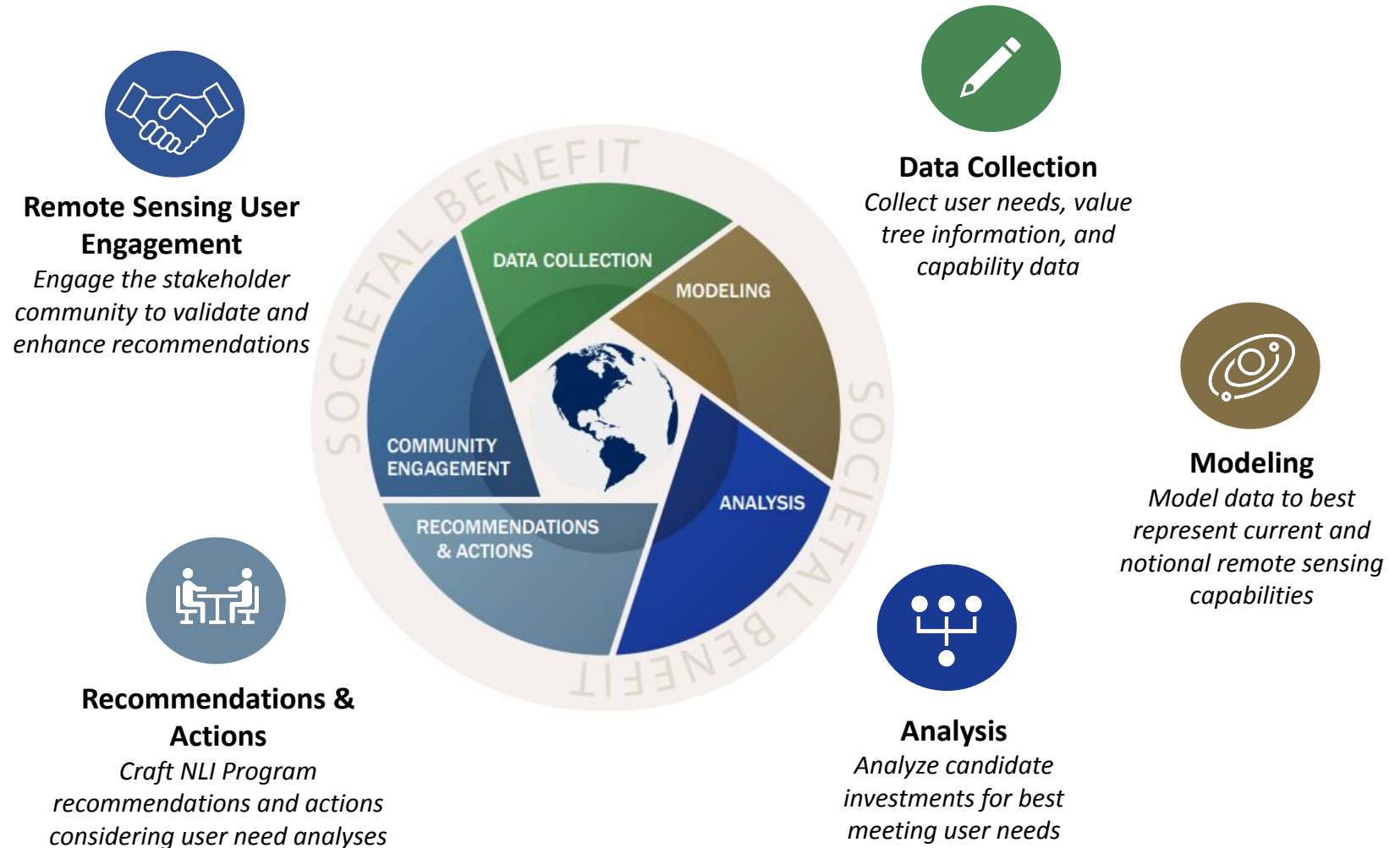
Land cover and agricultural applications cross-cut almost all of the USGS mandated science areas

# What is RCA-EO?

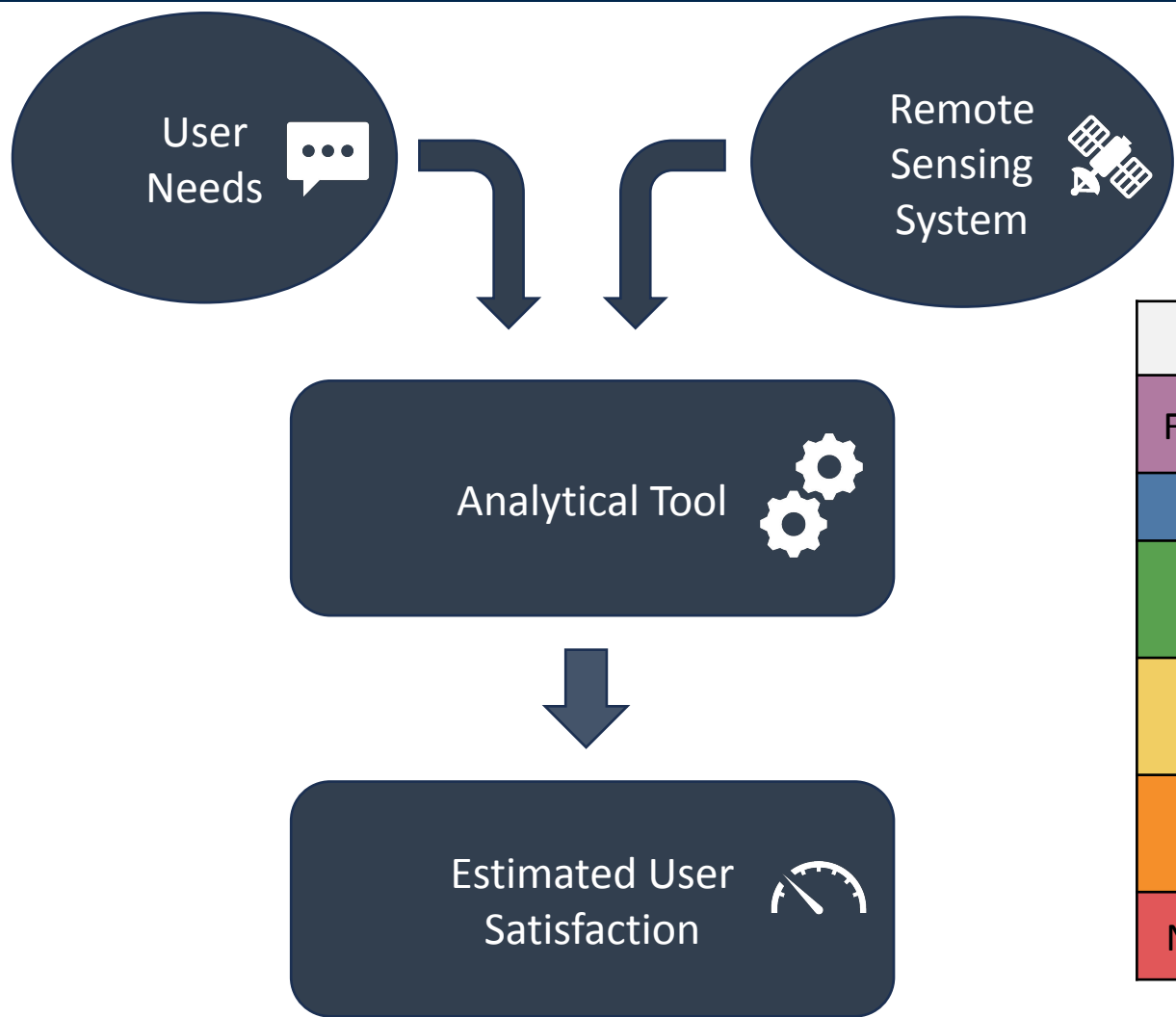
Requirements, Capabilities and Analysis for Earth Observation: *USGS National Land Imaging Program charge to collect and analyze user needs for land imaging mission engagements*



We collect and analyze land imaging user needs across the Federal Earth observation enterprise to inform strategic investments and partnerships – including with NOAA!!



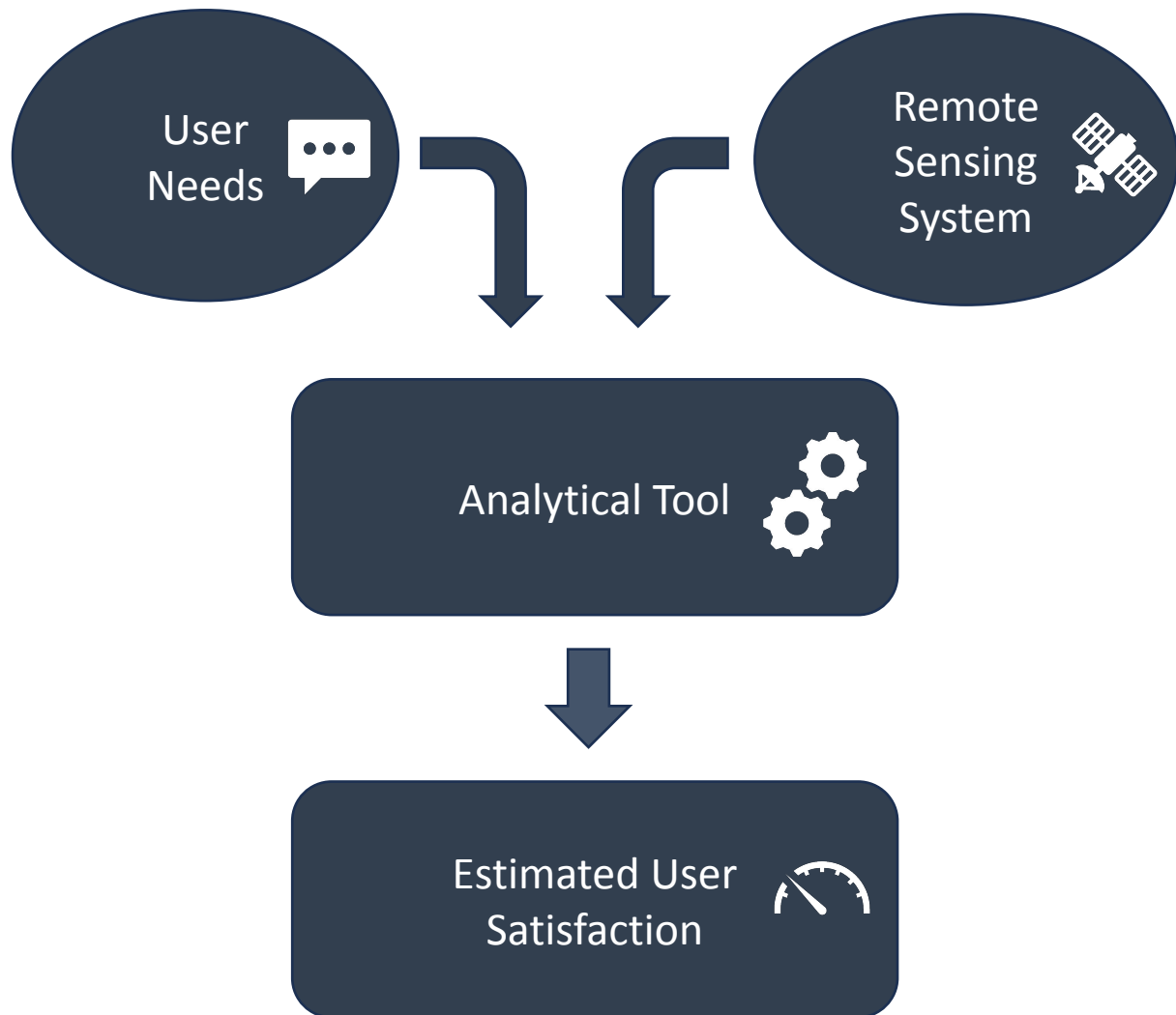
# Analytical Tools to Estimate Performance



**Analytical tool output is an estimate of each user’s satisfaction with the system:**

Estimated Performance	
Fully Satisfied	Meets all requirements
Good	Meets all requirements with minor limitations
Fair	Meets most major requirements, with significant limitations
Poor	Fails to meet many major requirements, but provides some value
Very Poor	Fails to meet most major requirements, but provides minor value
No Capability	Provides no value

# Analysis of GeoXO for USGS Land Applications



**User Needs:** Evaluated a subset of 315 USGS user needs

- Most of the user needs we collect are mod or high resolution, so many were not applicable for this evaluation
- In addition, many are coastal or littoral-zone focused (out of scope for agriculture/land applications)

**Remote Sensing System:** Evaluated GeoXO GXI

- Other GeoXO sensors were eliminated from the analysis due to 1) a lack of relevance to land imaging [e.g., ACX] or 2) lack of coverage over CONUS [e.g., OCX]

# User Needs Supported by GeoXO Imager



**Using this process, we identified 5 example USGS project areas where the estimated user satisfaction was “Fully Satisfied”, “Good”, or “Fair” for the GeoXO Imager:**

- 1) Regional Identification and Evaluation of Refugia from Drought
- 2) Vegetation Drought Response Index (VegDRI)
- 3) Global Food Security Analysis Data
- 4) Post-Fire Shrub Recovery
- 5) Water Use Estimates from Irrigated Lands

Estimated Performance	
Fully Satisfied	Meets all requirements
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# 1. Regional Identification and Evaluation of Refugia from Drought



*USGS – Core Science Systems Mission Area*

**Project Description:** This project systematically maps and **evaluates refugia from drought and environmental change** in the northwest US. The objectives are to (1) identify and map macro-scale and micro-scale refugia from regional changes in temperature and hydrologic conditions (i.e. drought) using a diverse set of existing data, and (2) explore spatial and ecological overlaps and differences between various kinds of refugia.

**End Users:** Natural resources managers

**Variable:** Vegetation Index (*Red and NIR bands*)

**Geographic Area of Interest:** Northwest US States

Data Attribute	Minimum Useable	Desired
Spatial Resolution	1.25km	1km
Cloud-free Observation Frequency	2 months	1 month



<https://www.usgs.gov/news/featured-story/slow-steady-improvement-25-years-monitoring-reveals-impacts-northwest-forest>

# 2. Vegetation Drought Response Index (VegDRI)



*USGS – Core Science Systems Mission Area*

**Description:** VegDRI is a weekly national drought tool in operation since May 2009. VegDRI maps **portray vegetation conditions as plants respond to solar energy, soil moisture, and other limiting factors**. The VegDRI data and models that underpin the relatively-detailed VegDRI maps indicate levels of drought stress on vegetation across the conterminous U.S. at a 1 km spatia

**End Users:** National Drought Mitigation Center, drought science and climate users, other federal agencies, academia

**Variable:** Vegetation Index (*Red and NIR bands*)

**Geographic Area of Interest:** Conterminous US (CONUS)

Data Attribute	Minimum Useable	Desired
Spatial Resolution	1.25km	250m
Cloud-free Observation Frequency	2 weeks	1 week



<https://www.usgs.gov/special-topics/monitoring-vegetation-drought-stress/science/vegdiri>



# 3. Global Food Security Analysis Data (GFSAD)



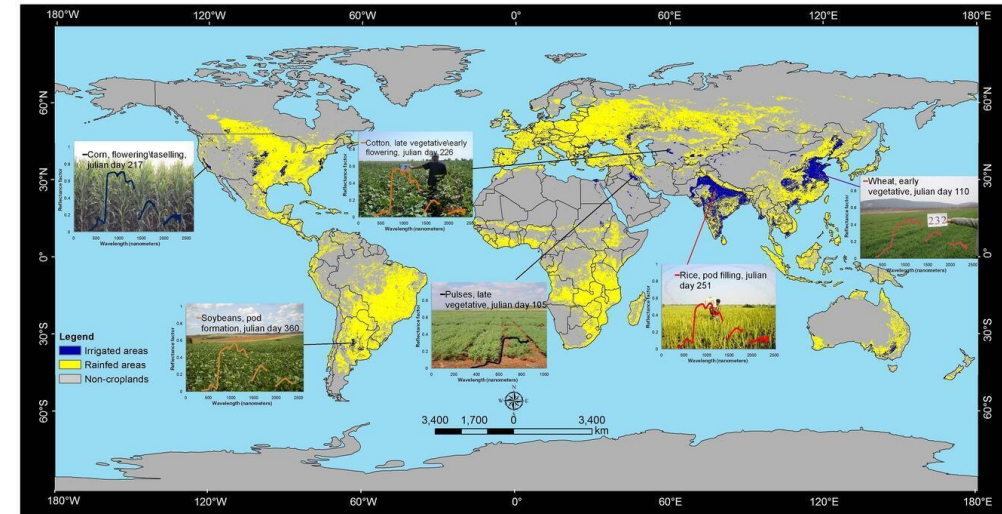
USGS – Core Science Systems Mission Area

**Description:** The GFSAD provides highest-resolution **global cropland data and water use** that contributes **towards global food-and-water security** in the twenty-first century. Products are derived through multi-sensor remote sensing data and field-plot data and to document cropland dynamics from 2000 to 2030. Monitoring global croplands is imperative for ensuring sustainable water and food security to the people of the world in the twenty-first century.

**End Users:** Federal agencies, national institutes, universities, etc

**Variable:** Vegetation Index (*Red and NIR bands*)

**Geographic Area of Interest:** Global Land



<https://www.usgs.gov/centers/western-geographic-science-center/science/global-food-and-water-security-support-analysis>

Data Attribute	Minimum Useable	Desired
Spatial Resolution	1km	30m
Cloud-free Observation Frequency	1 month	1 week

# 4. Post-Fire Shrub Recovery

USGS – Ecosystems Mission Area

**Description:** Understand vegetation type, height, and percent cover in areas that are recovering from fire; post-implementation of recovery efforts, determine fraction green to understand the success of vegetation regrowth; understand soil type and health to inform restoration efforts; understand past fire events to include perimeters and burn severity; understand weather, temperature and precipitation environment to predict how precipitation and winds can affect soil erosion post-fire events; understand past fire risk and effects in order to predict future risk.

**End Users:** Academia, researchers

**Variable:** Vegetation Fraction – Green (*Visible Bands*)

**Geographic Area of Interest:** CONUS



Data Attribute	Minimum Useable	Desired
Spatial Resolution	1km	30m
Cloud-free Observation Frequency	1 month	2 weeks

<https://link.springer.com/article/10.1007/s10980-023-01621-1>

# 5. Water Use Estimates from Irrigated Lands

## USGS – Water Resources Mission Area

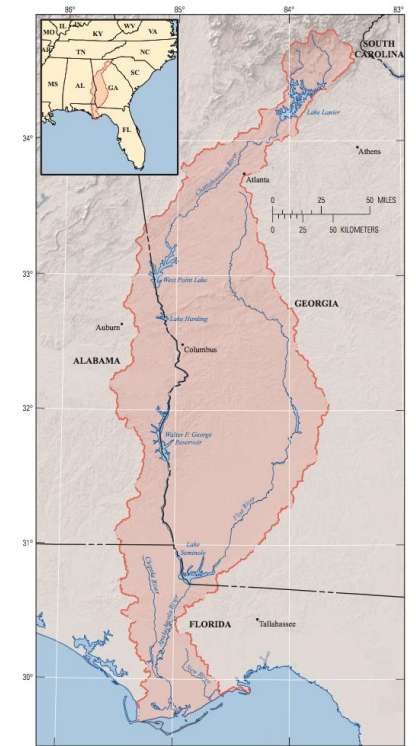
**Description:** This research project supported the water use component of the ACF River Basin focus area study of the USGS National Water Census. Goals of the study include developing a site-specific database of water use for the ACF Basin, **developing improved methods for estimating agricultural withdrawals, and compiling available water use projections.** Calculations of net water use will be improved by obtaining information on inter-basin transfers, determining irrigation and septic tank return flows, and estimating consumptive use by thermoelectric power plants.

**End Users:** Water managers

**Variable:** Crop Type (*Visible bands*)

**Geographic Area of Interest:** Southeast US

Data Attribute	Minimum Useable	Desired
Spatial Resolution	1.25km	100m
Cloud-free Observation Frequency	2 days	1 day



[https://www.usgs.gov/mission-areas/water-resources/science/apalachicola-chattahoochee-flint-river-basin-focus-area-study?qt-science\\_center\\_objects=0#qt-science\\_center\\_objects](https://www.usgs.gov/mission-areas/water-resources/science/apalachicola-chattahoochee-flint-river-basin-focus-area-study?qt-science_center_objects=0#qt-science_center_objects)



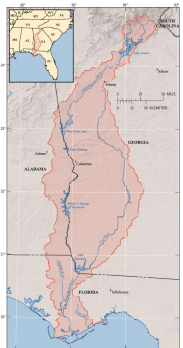
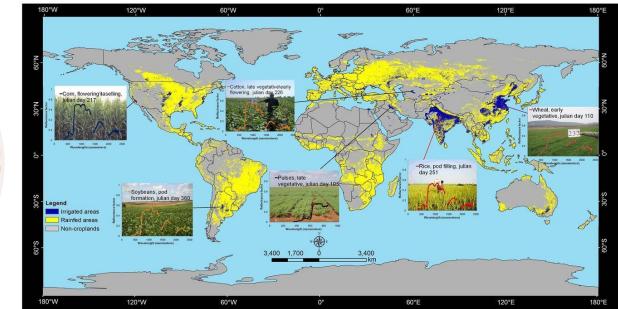
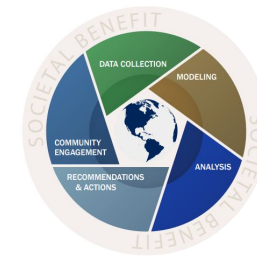
# GeoXO USGS Example Use Case Summary



**We discussed five USGS example land and agriculture user needs that could potentially benefit from GeoXO GXI data**

- Applications included drought monitoring, food security assessment, ecosystem monitoring, post-fire evaluation and irrigation water use
- Key variables measured by GeoXO include vegetation index, vegetation fraction: green, and crop type
- Uses span research and operational activities

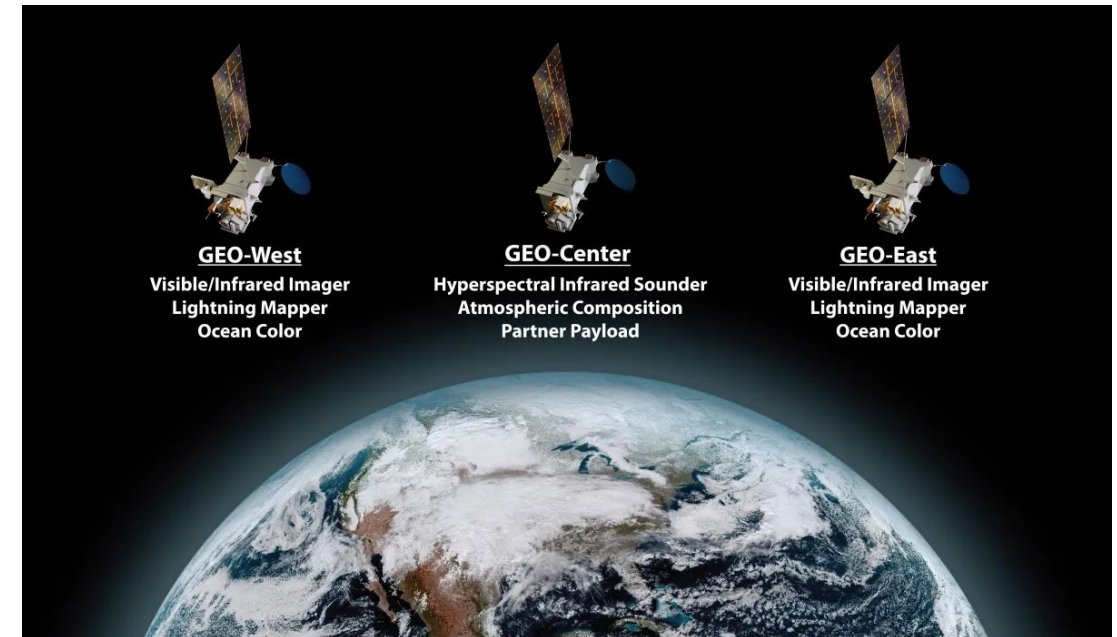
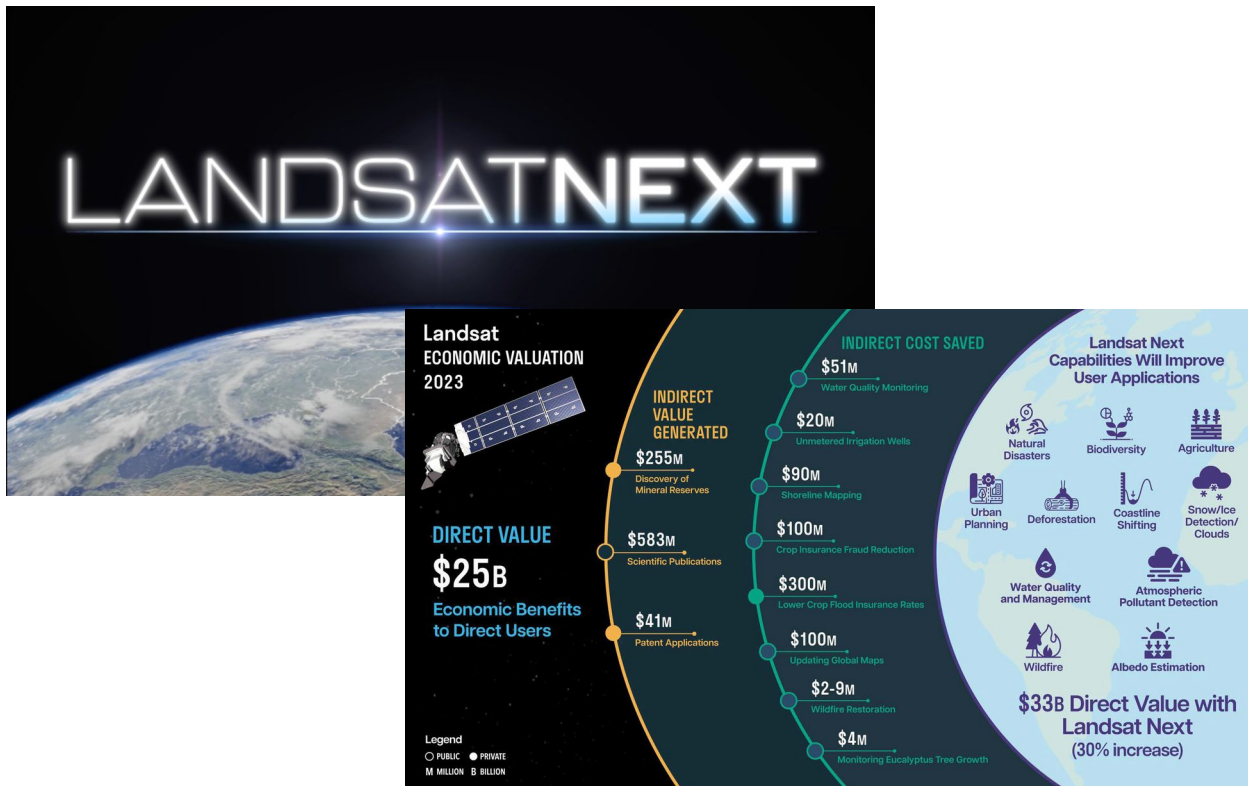
***GeoXO GXI's coarse resolution, high temporal revisit VSWIR data provides important contributions to these applications***



# The future of land imaging: Landsat Next and GeoXO GXI Synergies



**GeoXO GXI and Landsat Next will offer complementary ground sample distance, spectral bands, US geographic coverage, and revisit to continue to satisfy many land and agricultural users' needs into the 2030s**





# Thank you!



**For additional information on USGS user needs, USGS RCA-EO, or to contribute to our process please contact:**

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Ellen Wengert ([ewengert@contractor.usgs.gov](mailto:ewengert@contractor.usgs.gov))



USGS RCA-EO website:

