

Welcome to NASA Applied Remote Sensing Training (ARSET) Program

- We will begin shortly
- Please ensure you have created your [Earthdata](#) and [OpenET](#) accounts
- The wifi password is:
- Be sure to completed the workshop registration to access training materials
- (insert QR code for registration here)





National Aeronautics and
Space Administration

National Association of Conservation Districts Workshop Series One

NASA Satellite Earth Observation Resources and Tools to Support Conservation Districts

Kait Lemon

Applied Remote Sensing Training (ARSET)

Kaitlyn.I.lemon@nasa.gov



Credit: [NASA](#)

Today's Agenda

Introduction

1. NASA's Legacy in Agriculture & Introduction to Remote Sensing
2. NASA Earth Observations for Agriculture Data Access, Visualization, and Application

Break

3. Introduction to NASA Earth Observations for Vegetation and Rangeland Monitoring
4. Introduction to Data Products for Water Quality and Quantity Monitoring for Agriculture Applications

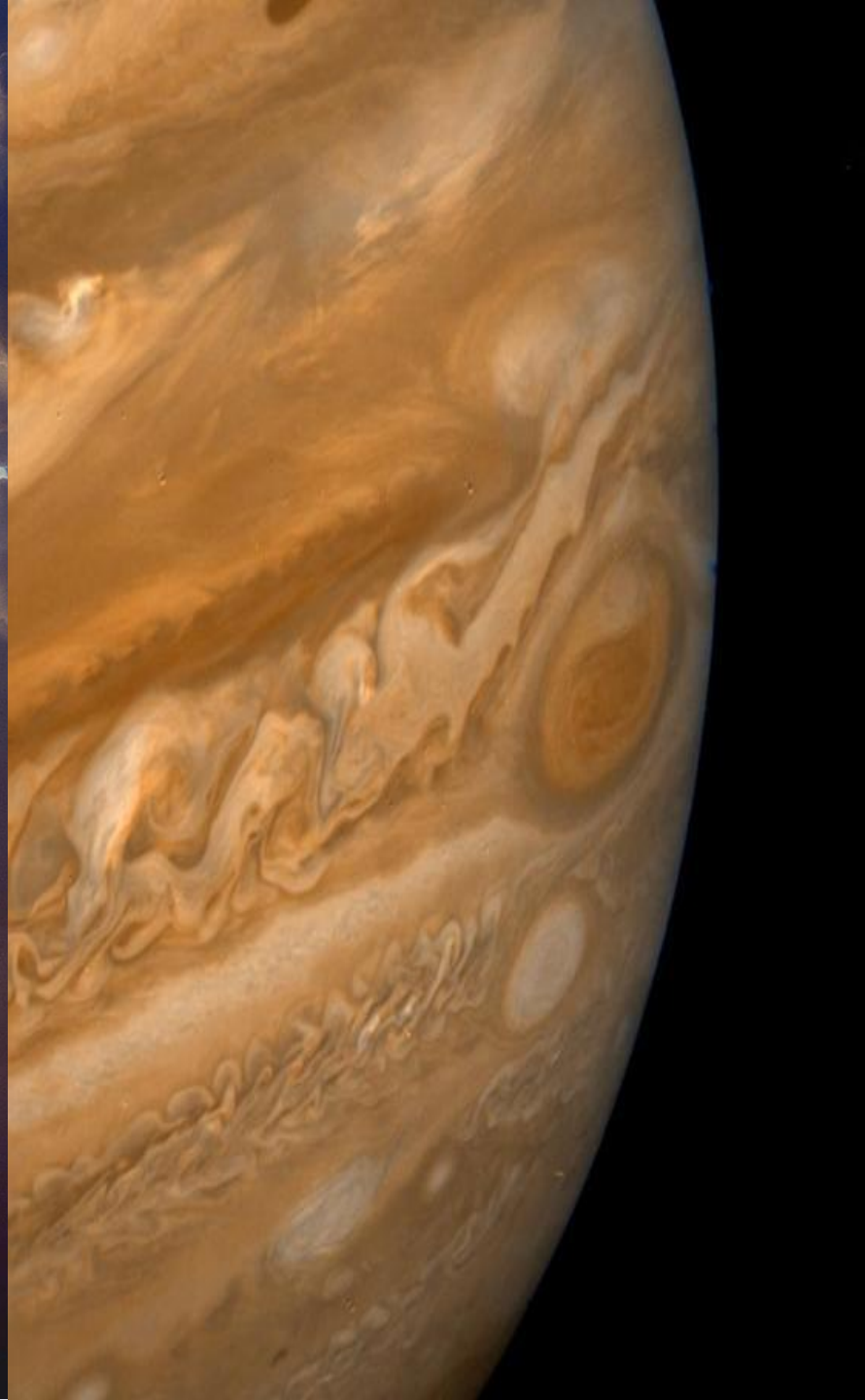
Conclusion

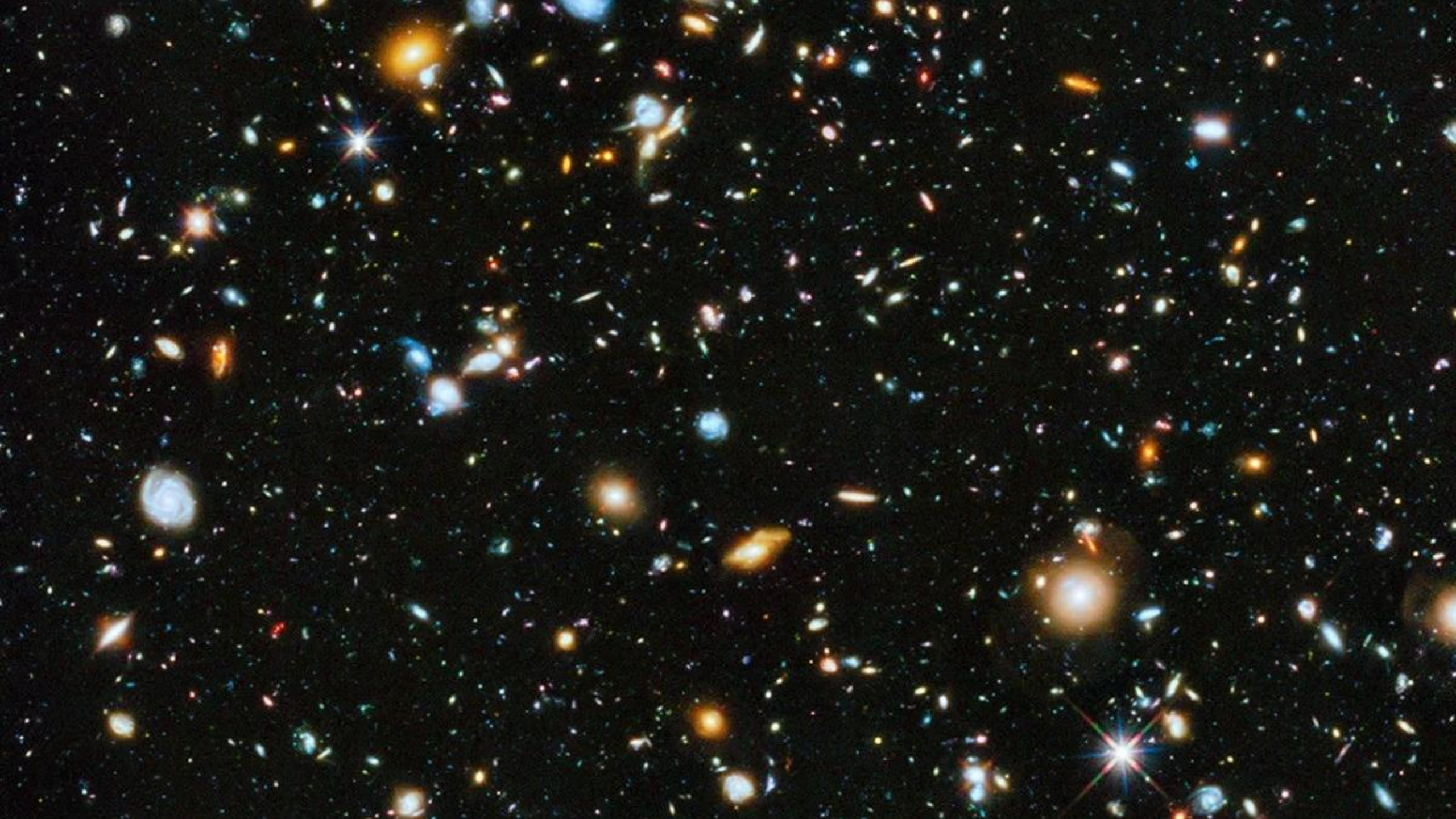


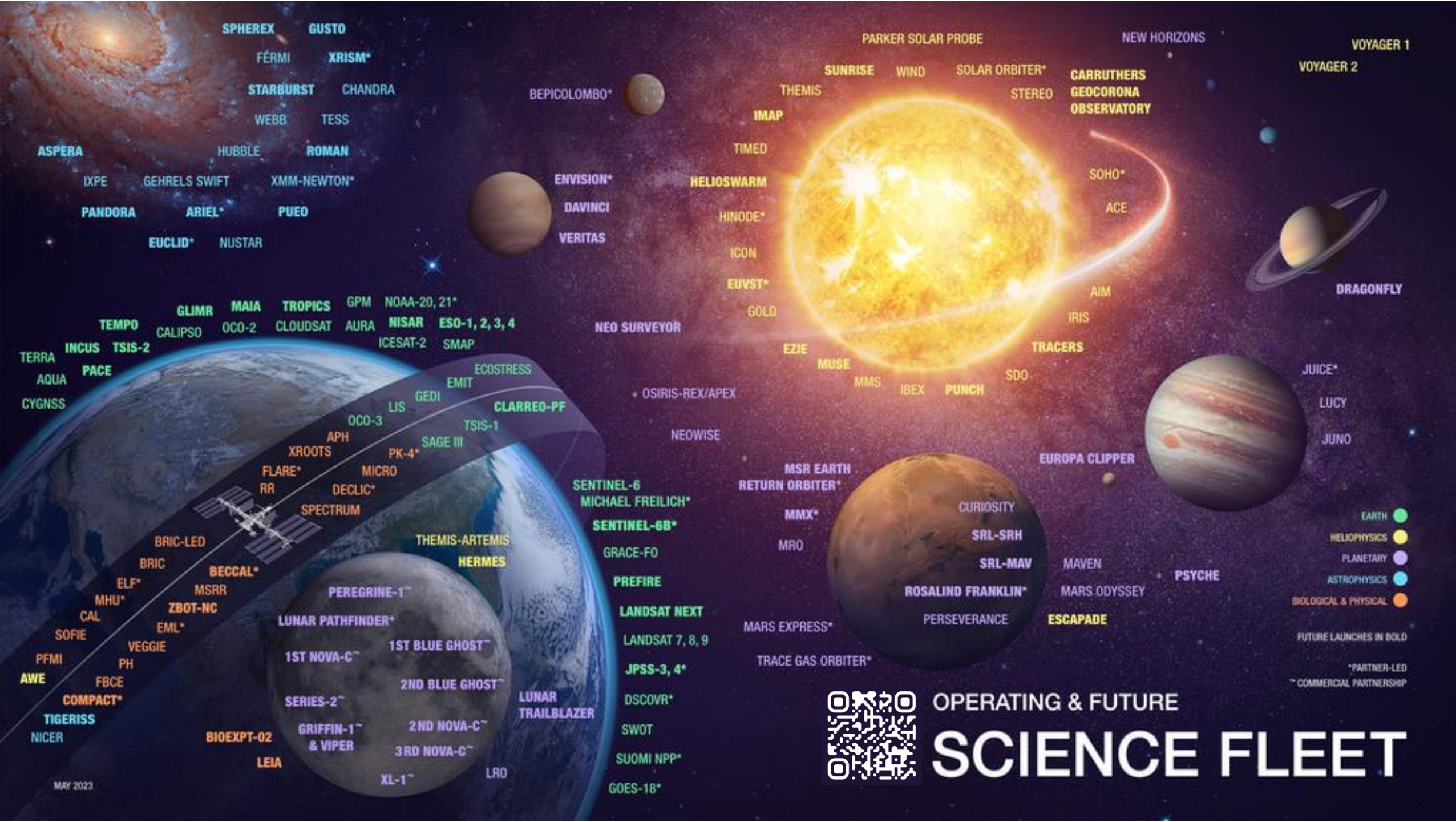
Learning Objectives

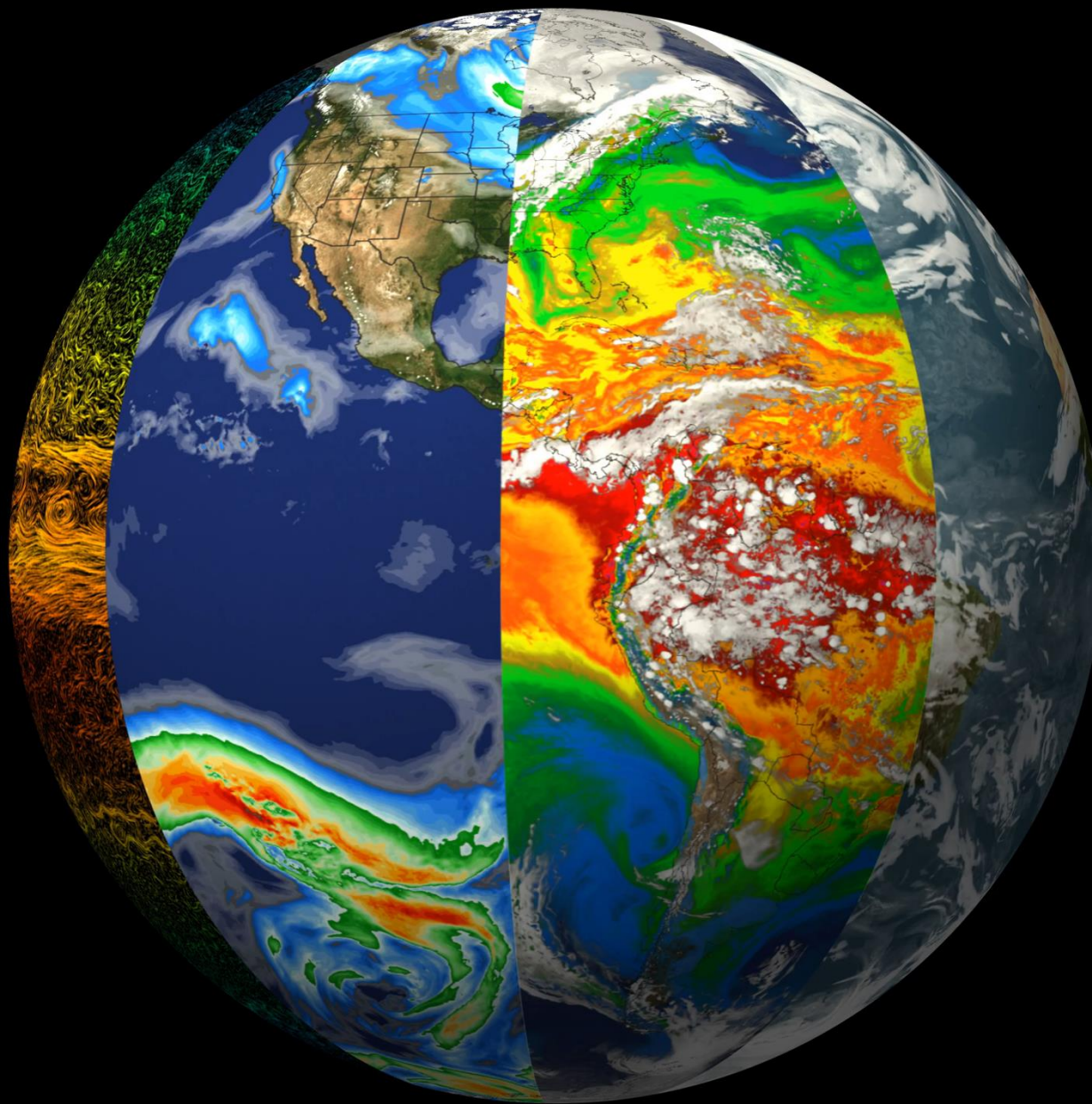
- Recognize how data from NASA satellites and sensors are used for different agricultural applications
- Select appropriate NASA data products and web tools for a variety of issues within conservation districts, such as vegetation health to water quality, and evapotranspiration to rangeland management
- Access NASA Earth observation data products through Worldview, and explore data layers relevant for conservation district issues

**What do you think about when
you think about NASA?**

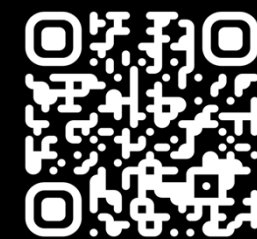








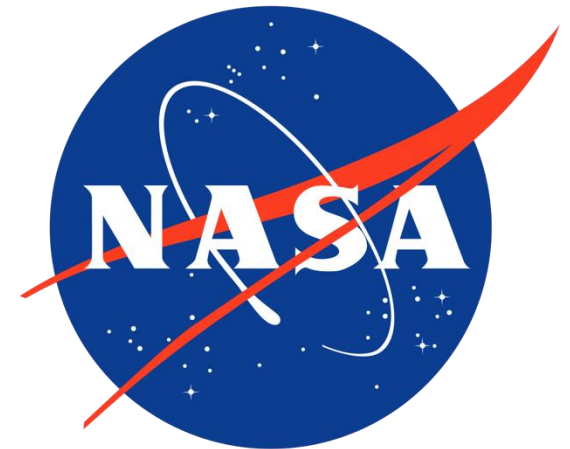
Animation by NASA Science Visualization Studio (SVS)



Earth: A System
of Systems

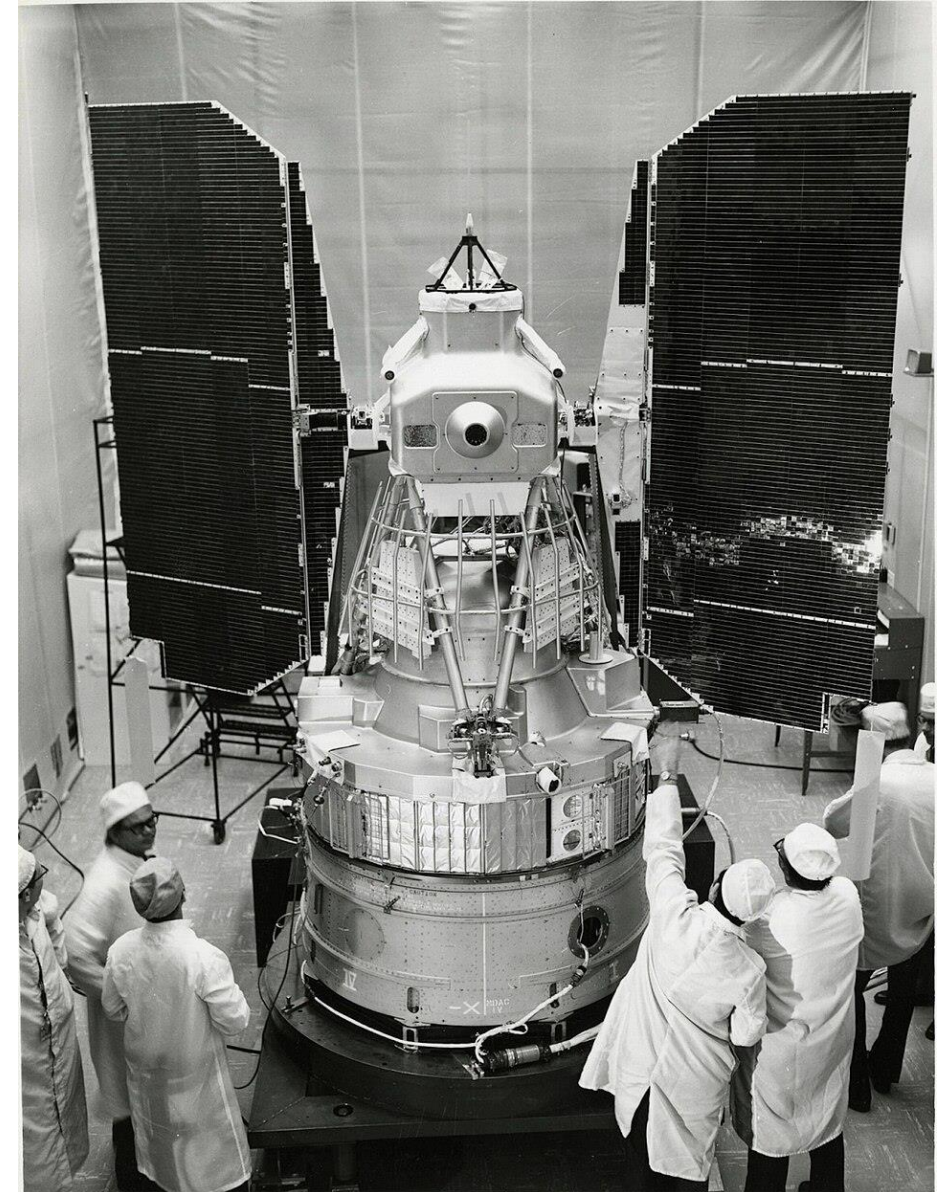
History – USDA & NASA

- 1965 Statement of Agreement between the U.S. Department of Agriculture (USDA) – Agricultural Research Service (ARS) and NASA
- Aimed to characterize reflectance and emission signatures of different land covers
- Goal was to enable their identification using aircraft and satellite sensors
- Led to the design of the first sensors carried on Landsat 1 (originally named Earth Resources Technology Satellite)



Landsat 1

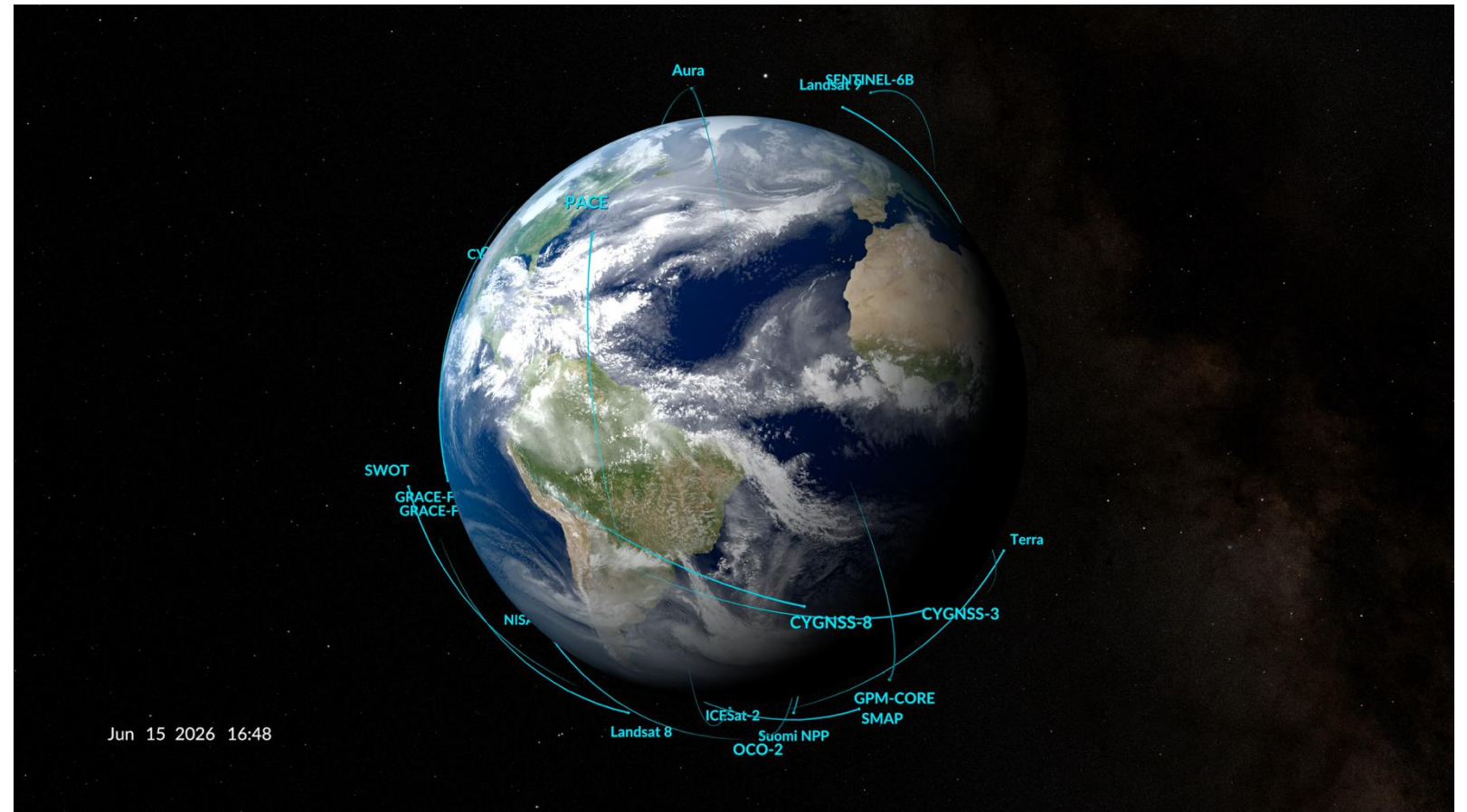
- Launched on July 23, 1972
- First satellite designed specifically to study and monitor land surfaces
- First satellite to carry a multispectral scanner
- First study of the normalized difference vegetation index (NDVI) over rangeland in the Great Plains (Rouse et al., 1974. TAMU)
- Beginning of a global satellite agricultural monitoring system that continues to this day



Credit: [NASA](#)

Featured NASA Science Products

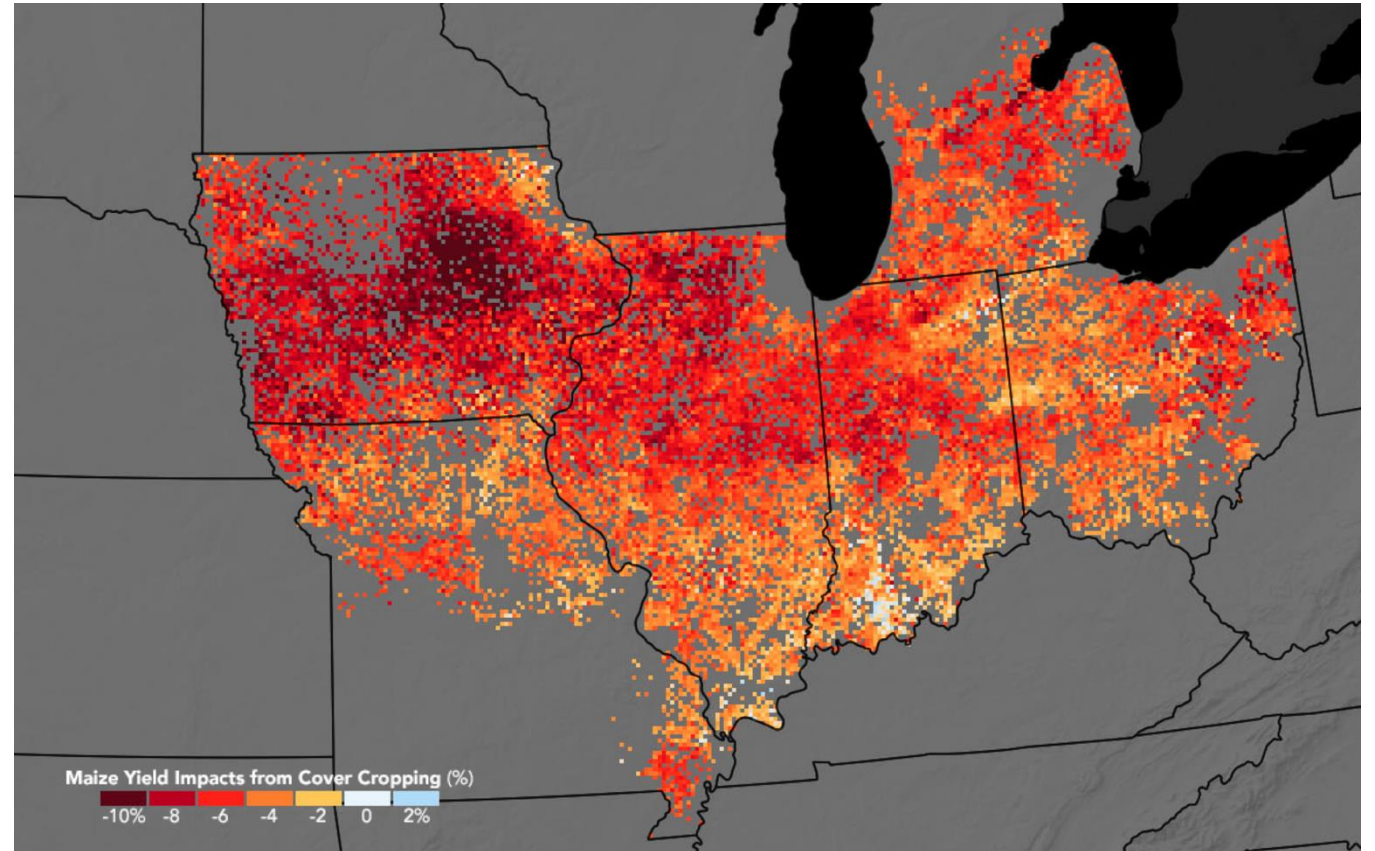
- Precipitation
- Soil moisture
- Evapotranspiration
- Surface water
- Surface reflectance
- Vegetation greenness



Credit: <https://svs.gsfc.nasa.gov/5067/>

Satellite Applications for Agriculture

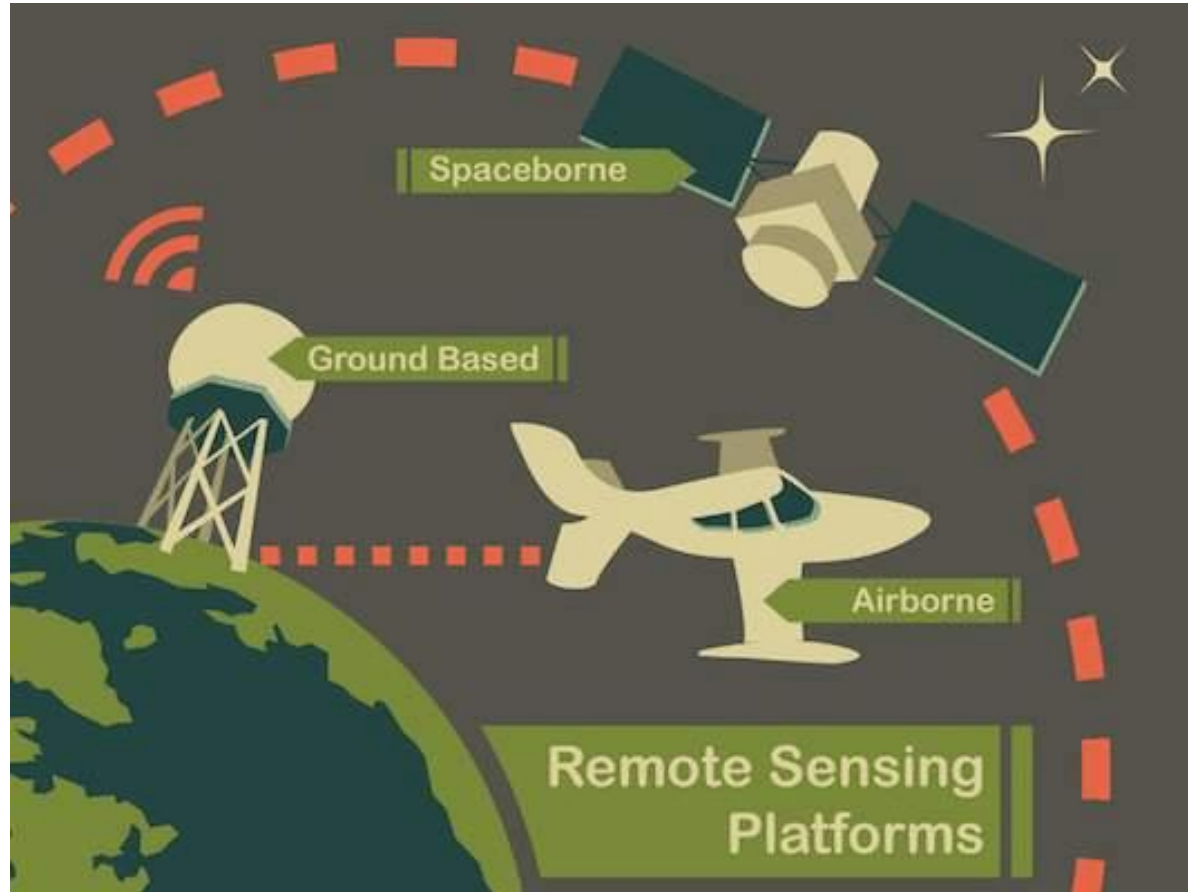
- Assess soil moisture and irrigation
- Identify soil and crop health characteristics
- Monitor plant growth and estimate crop and rangeland productivity
- Validate incentive programs
- Quantify and visualized damage from extreme weather events



Midwest Farmers Using Cover Crops Take Small Yield Hit

Credit: [NASA SVS | Midwest Farmers Using Cover Crops Take Small Yield Hit](#)

What is Remote Sensing?

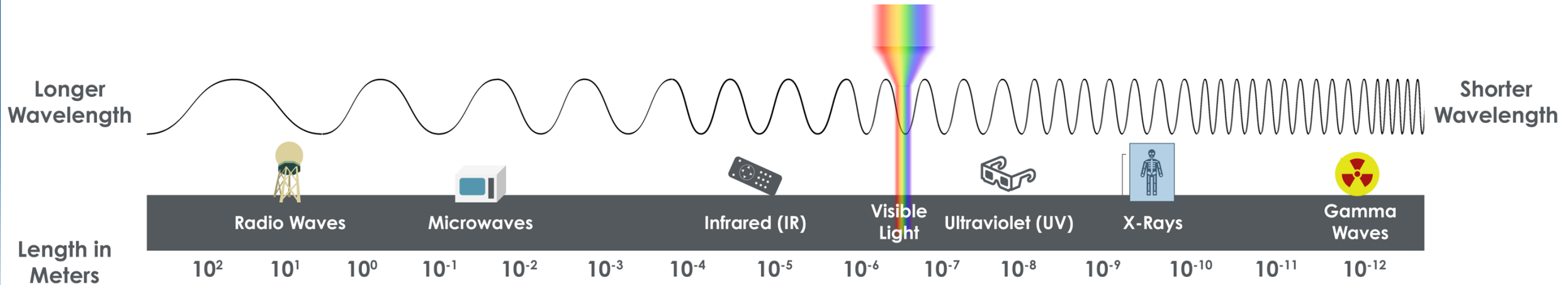


- Remote sensing is obtaining information about an object from a distance
- Photography is a very common form of remote sensing
- There are different ways to collect data, and different sensors are used depending on the application
- Some methods collect ground-based data, others airborne or **spaceborne**

Satellite Characteristic Questions

- What parts of the Earth can the sensor see?
- Can the sensor make observations at night?
Can it see through clouds?
- What features will I be able to see? How often are observations made over my location of interest?
- Is the data product I want available from this sensor?

The Electromagnetic Spectrum



Remote Sensing Resolutions

Spectral Resolution

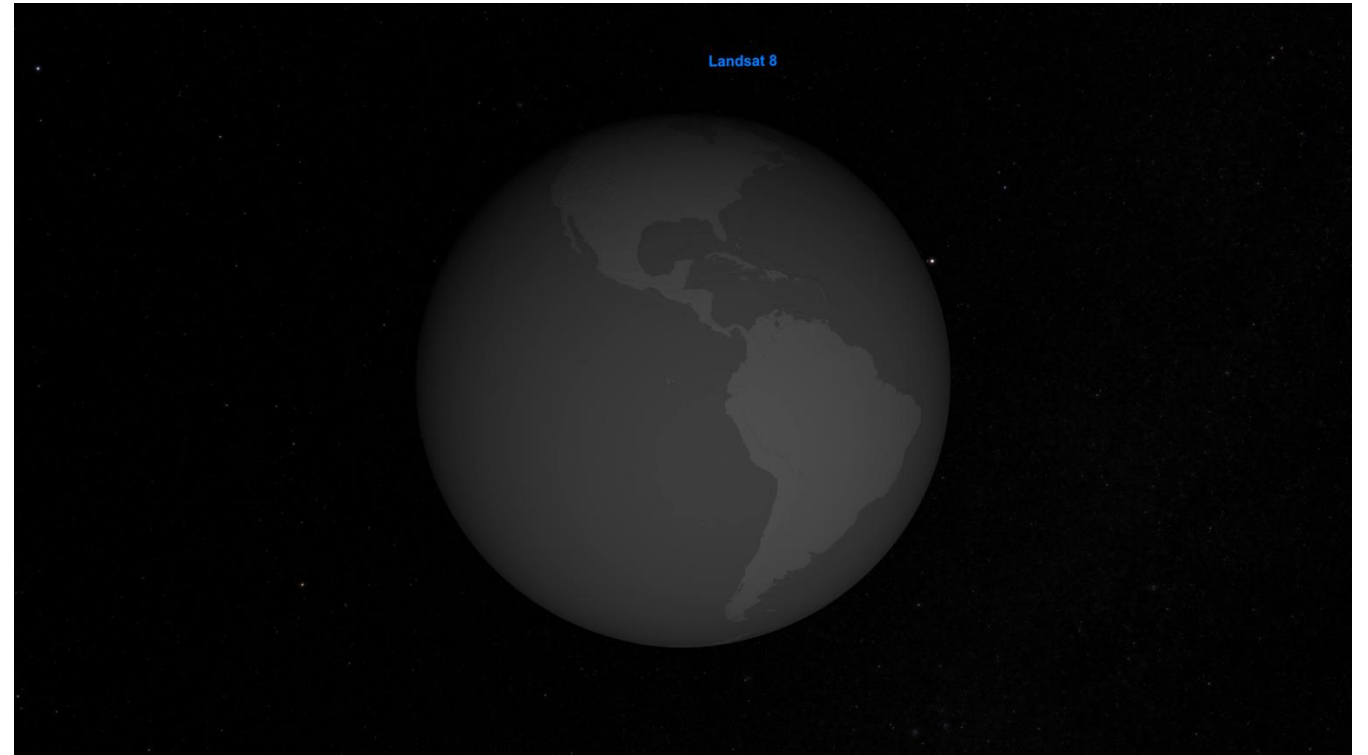
- Number of independent channels (or bands)

Temporal Resolution

- Frequency of measurement

Spatial Resolution

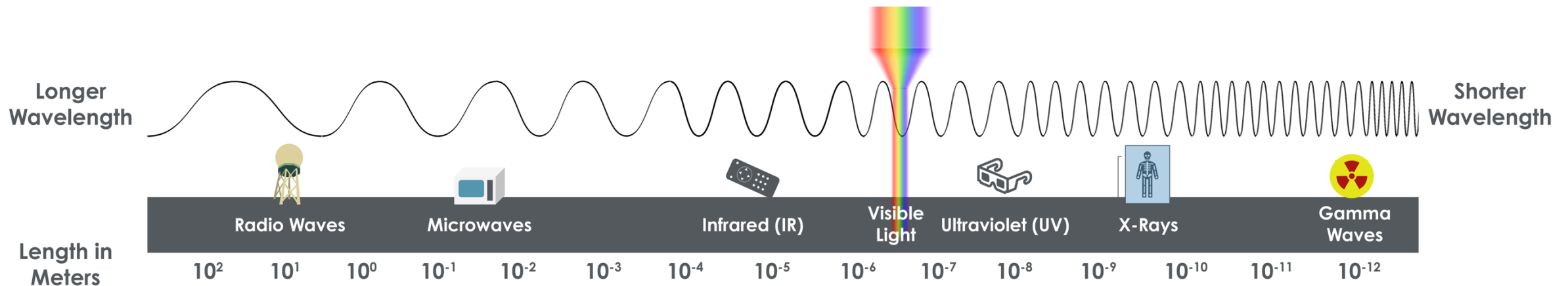
- Smallest spatial measurement



Each resolution depends on the satellite orbit configuration
and sensor design -
Resolutions are different for different sensors

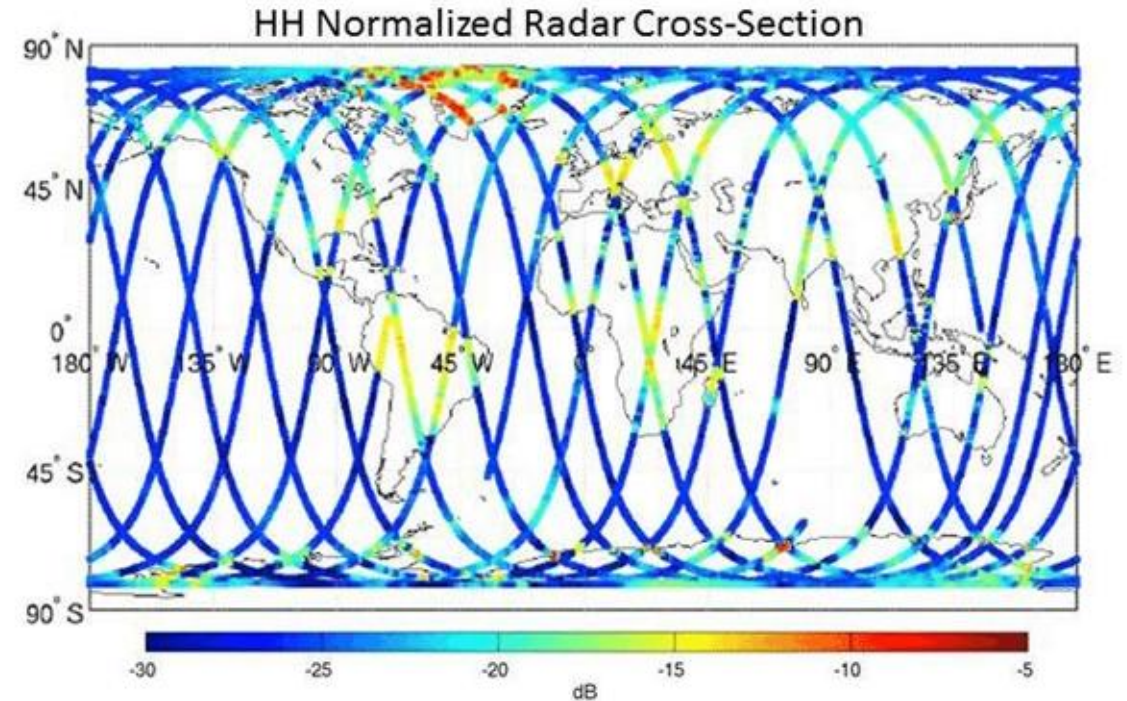
Spectral Resolution

- A sensor's spectral resolution depends upon satellite **orbit configuration** and **sensor design**
- Signifies the number and width of spectral bands of the sensor. **The higher the spectral resolution, the narrower the wavelength range** for a given channel or band
- More and finer spectral channels enable remote sensing of different parts of the Earth's surface
- Typically, **multispectral imagery refers to 3 to 10 bands**, while hyperspectral imagery consists of hundreds or thousands of (narrower) bands (i.e., higher spectral resolution)



Temporal Resolution

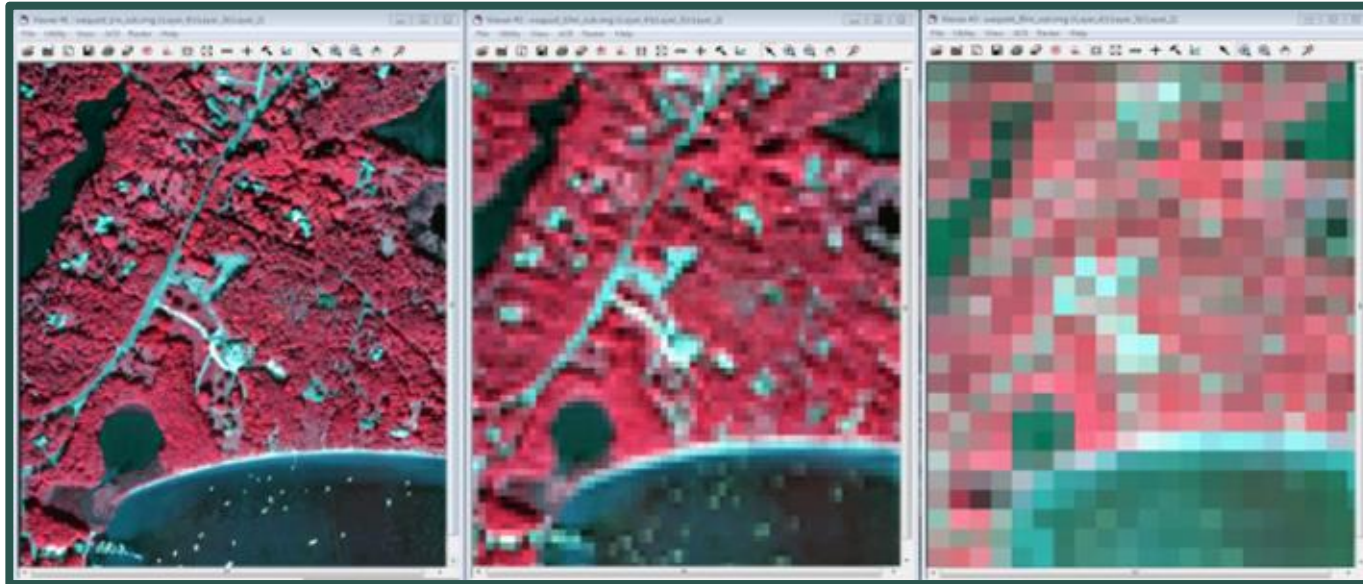
- The time it takes for a satellite to complete one orbit cycle—**also called “revisit time”**
- Depends on satellite/sensor capabilities, swath overlap, and latitude
- Some satellites have greater temporal resolution because:
 - They can maneuver their sensors
 - They have increasing overlap at higher latitudes



Sensor	Revisit time
Landsat	16-days
MODIS	2-days
Commercial (OrbView)	1-2 days

Spatial Resolution

- Resolution depends upon satellite orbit configuration and sensor design
- Different sensors have different resolutions
- Signifies the ground surface area that forms one pixel in the image
- It is usually presented as a single value representing the length of one side of a square
- The **higher the spatial resolution, the less area is covered** by a single pixel



Spatial Resolution

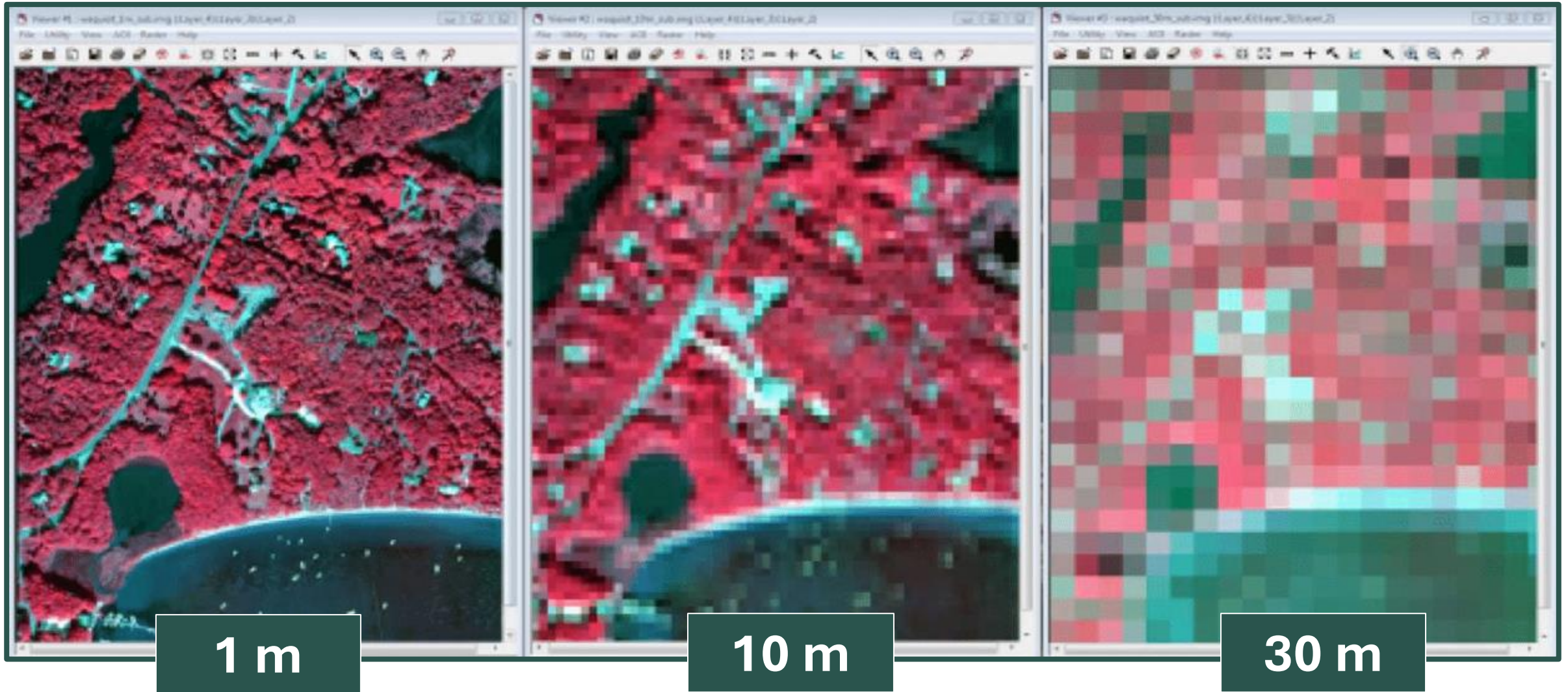
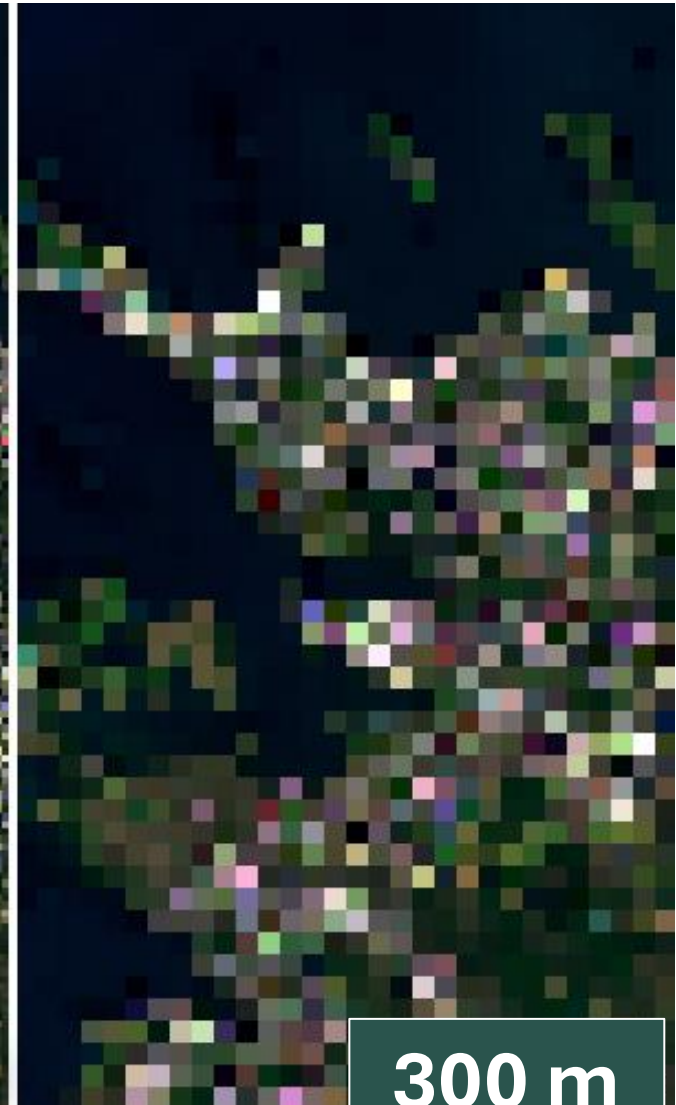
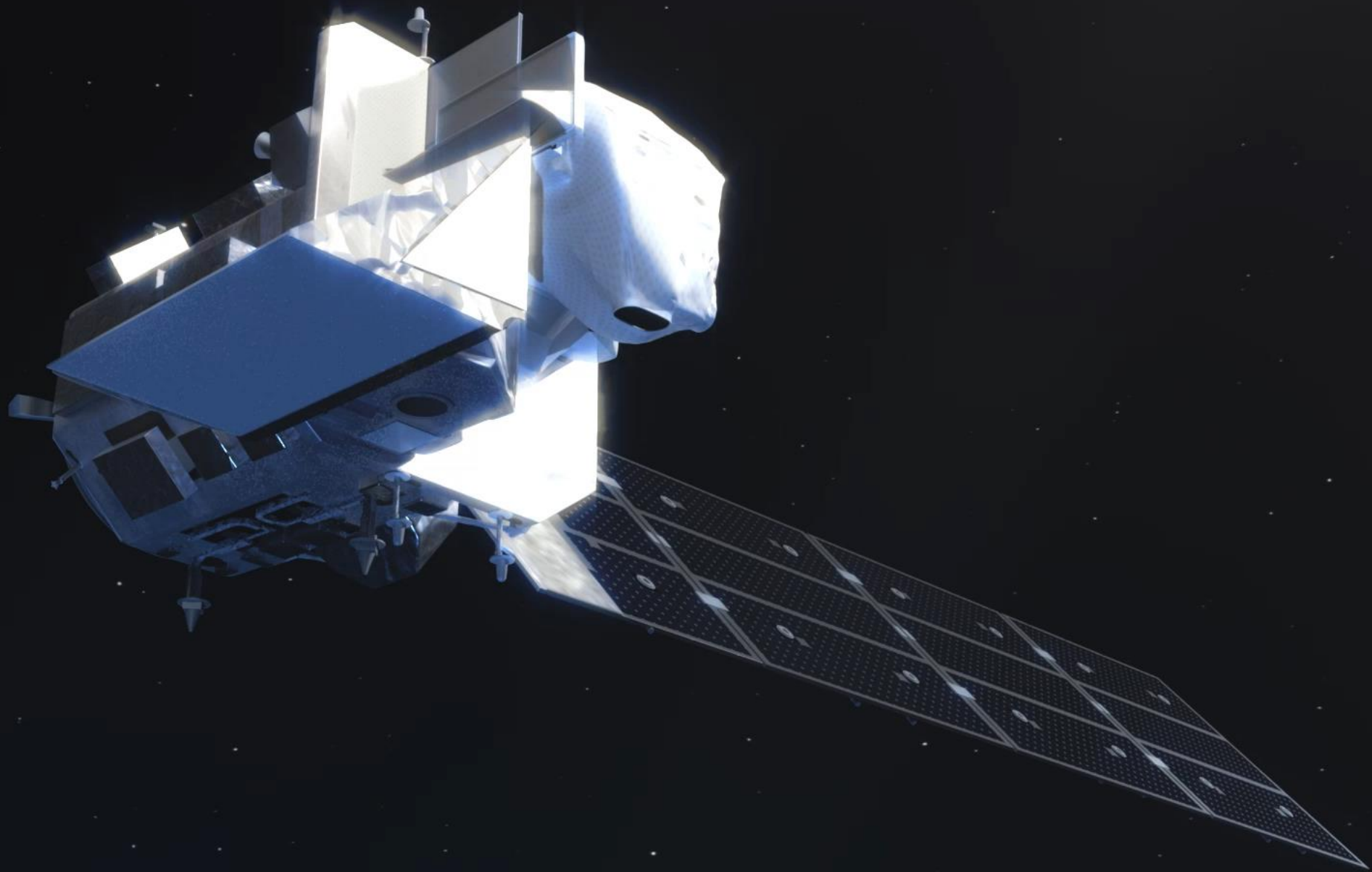
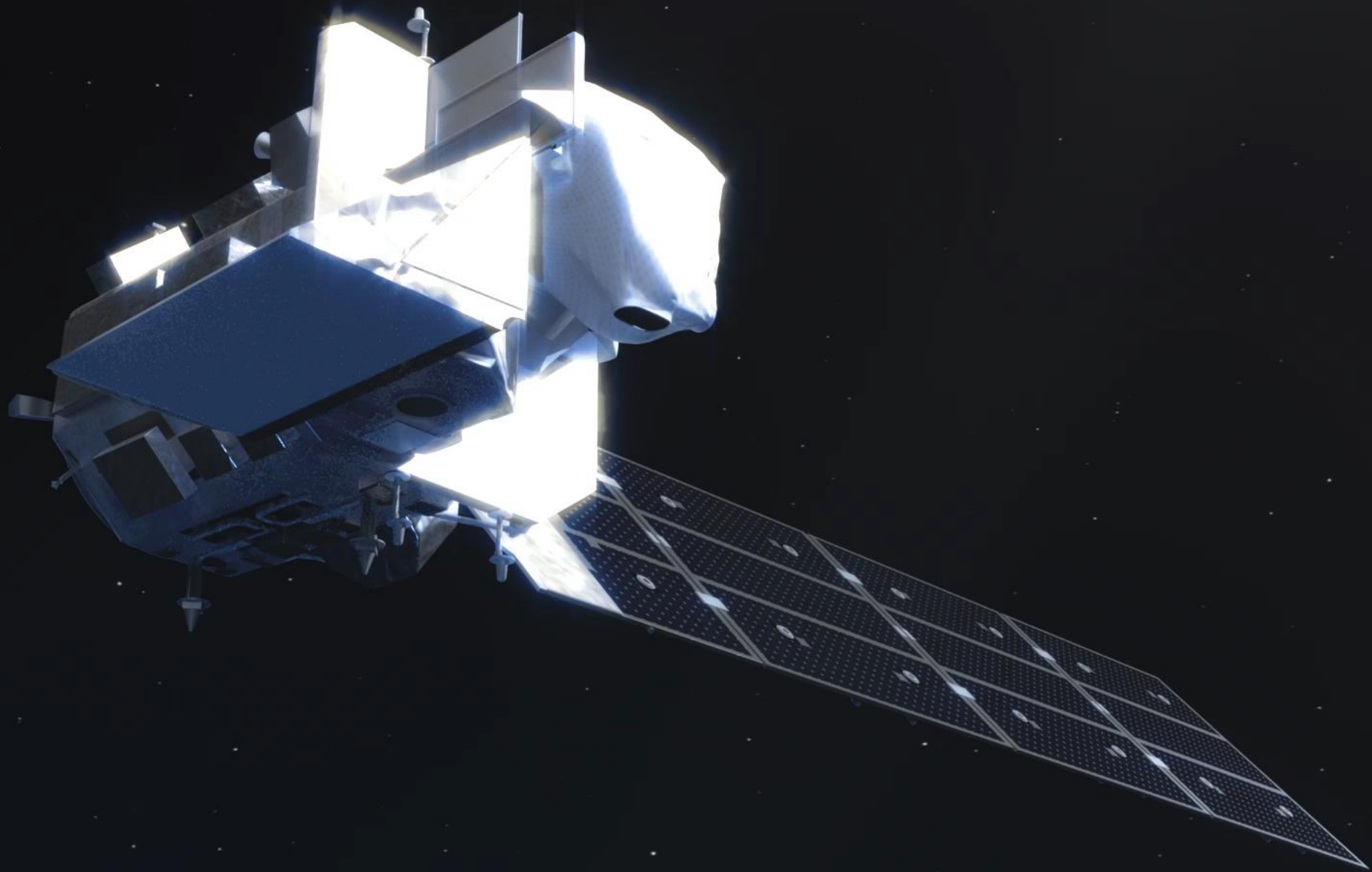


Image Credit: csc.noaa.gov

Spatial Resolution



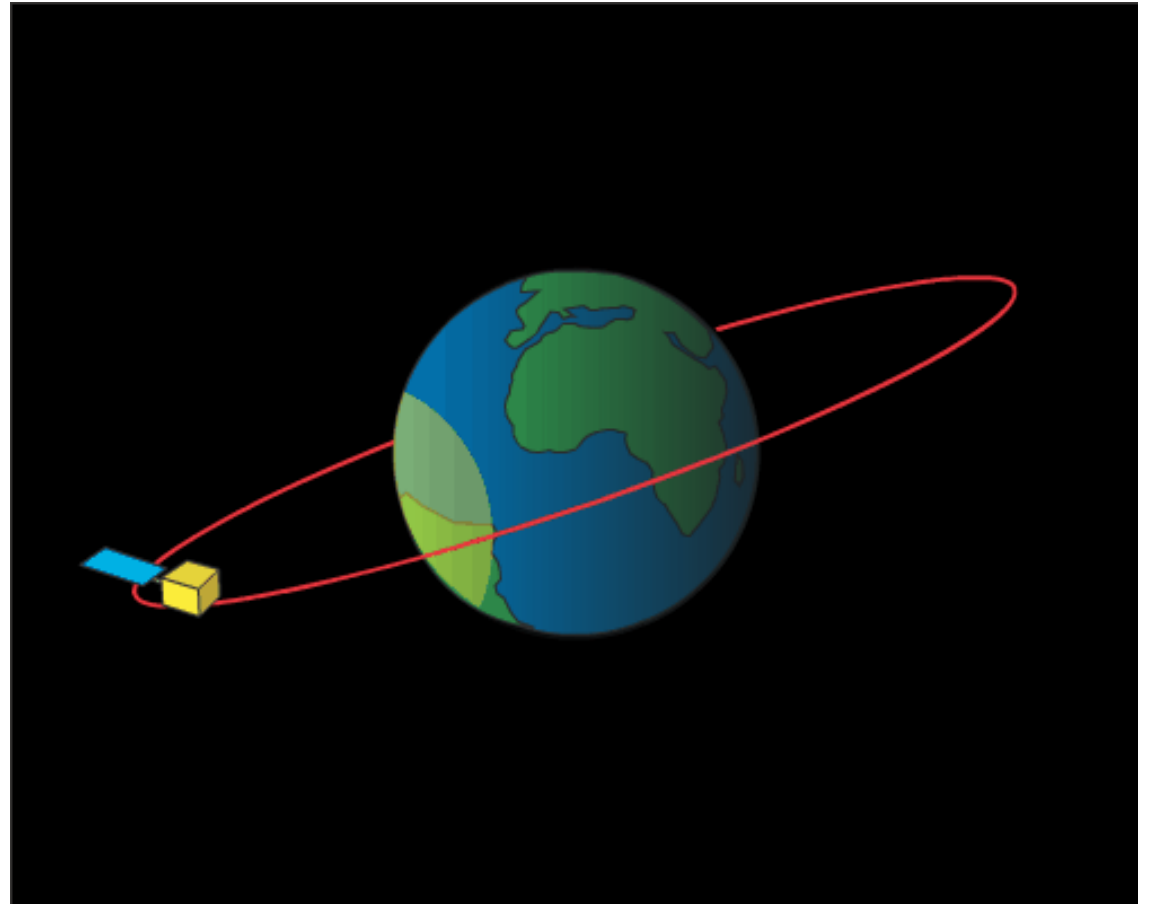
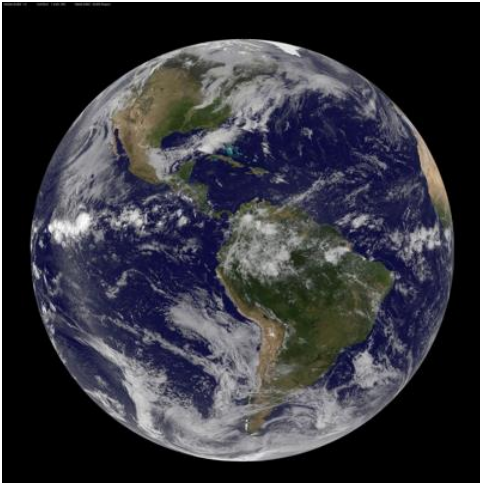




Satellite Orbit Types

Geostationary Orbit (GEO)

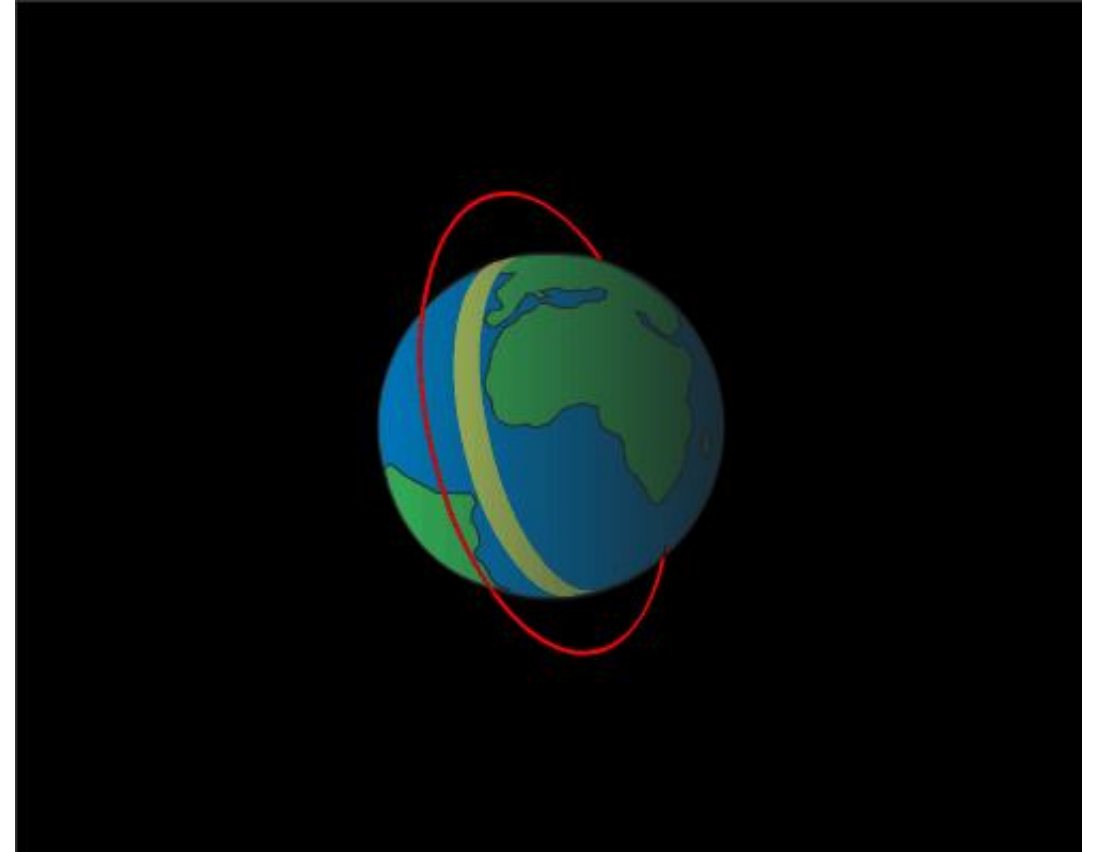
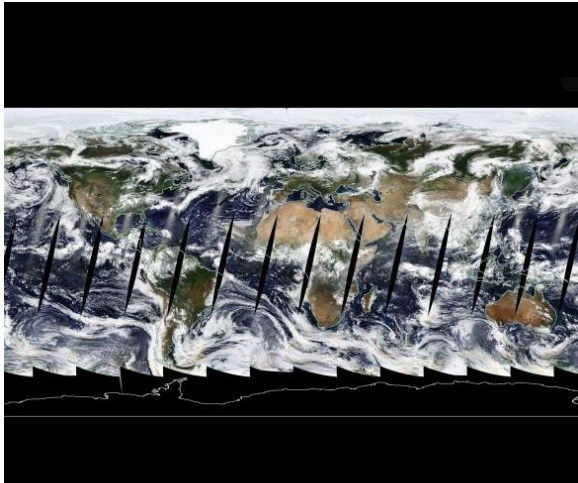
- Has the same rotational period as Earth
- Appears 'fixed' above Earth
- On the same plane as the equator
- Orbits ~36,000 km above the equator



Satellite Orbit Types

Low Earth Orbit (LEO)

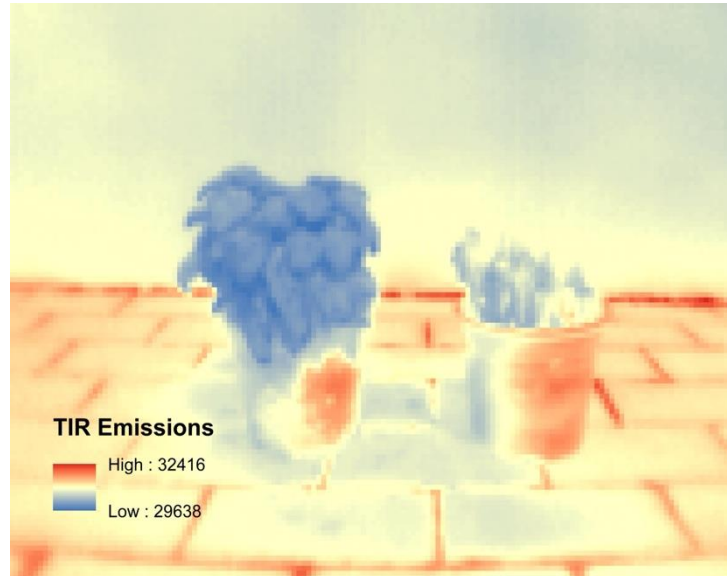
- Fixed, circular orbit above Earth
- Commonly used due to numerous orbital tracks
- Pole to pole can acquire data for the entire globe
- Non-polar cover a partial range of latitudes



What The Satellite 'Sees'



“True color”
(red, green, blue)

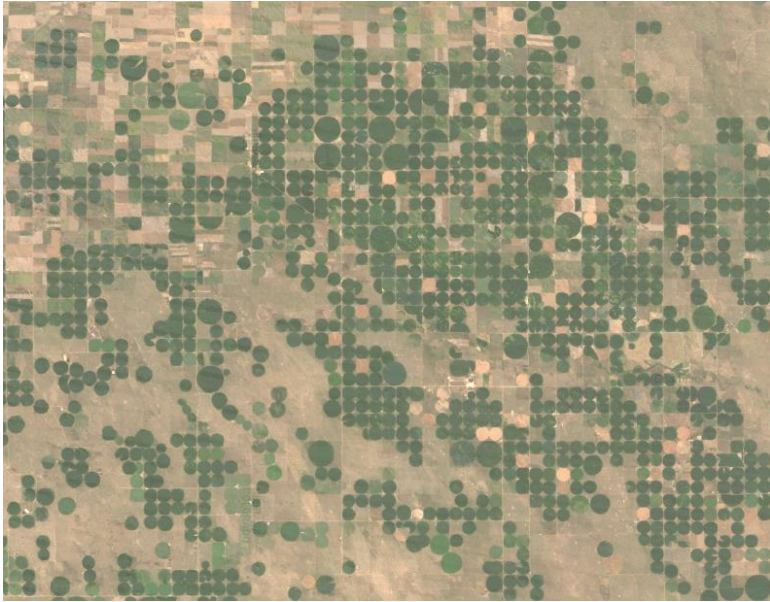


Thermal infrared
emissions

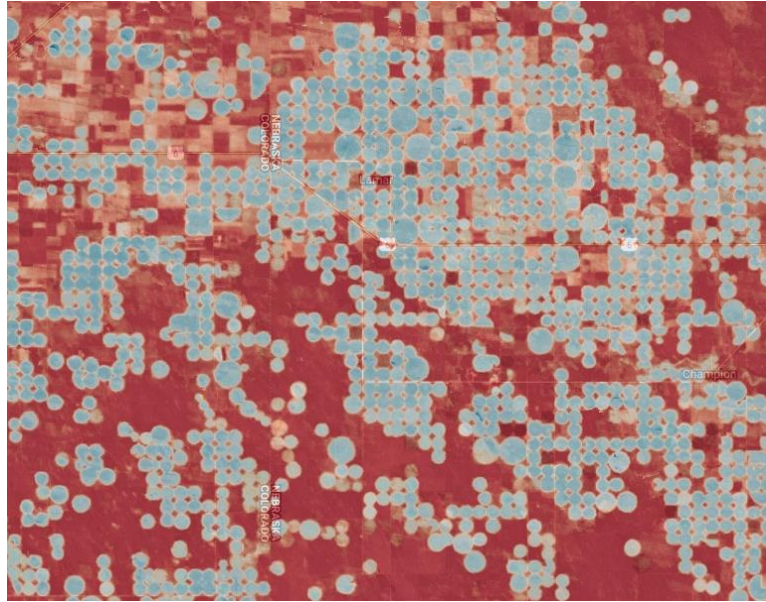


NDVI
(Normalized Difference
Vegetation Index)

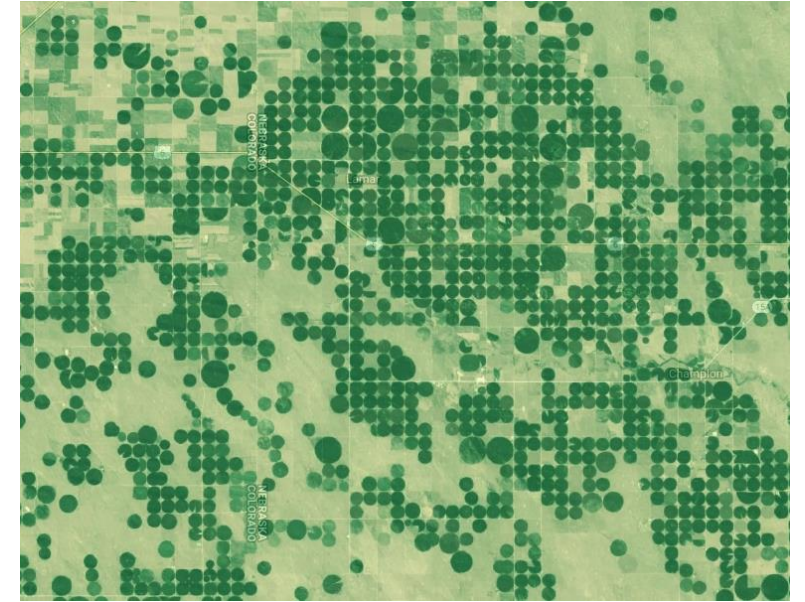
What The Satellite 'Sees'



“True color”
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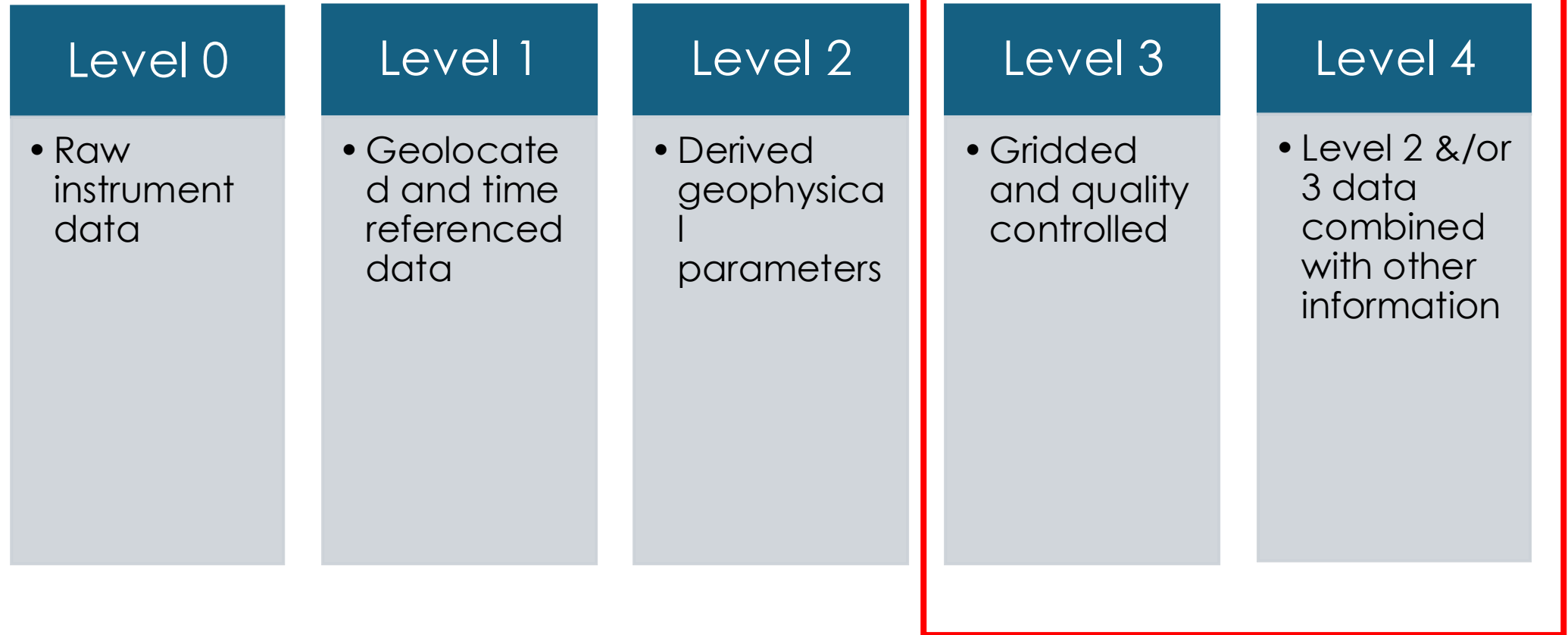


Thermal infrared
emissions



NDVI
(Normalized Difference
Vegetation Index)

NASA Data Processing Levels



Satellites and Sensors: Optical Sensors

Satellites Orbits	Sensors	Spectral Measurements	Temporal Coverage, Observation Time, and Resolution	Spatial Coverage and Resolution
Landsat 8 Landsat 9 polar	TIRS, OLI TIRS-2, OLI-2	Visible, Near IR, Middle IR, Thermal IR	2/2013 – Present 11/2021– Present 10:30 am/pm local time 16 Day	Global Swath: 136 km 30 m
Terra Aqua Polar	MODIS	Visible, Near IR, Middle IR, Thermal IR	12/1999 – Present (10:30 am/pm) 4/2002 – Present (13:30 am/pm) 1-2 Days	Global Swath: 2330 km 250 m to 1 km
SNPP JPSS polar	VIIRS	Visible, Near IR, Middle IR, Thermal IR	10/28 2011– Present 11/18 2017 – Present 11/10 2022 – Present 1:30 am/pm local time 12 Hours	Global Swath: 3040 km 375 m, 750 m
Sentinel 2A Sentinel 2B & 2C Polar	MSI	Visible, Near IR	6/23/2025 – Present 3/7/2017– Present 10:30 am/pm 5 Day	Global Swath: 290 km 10 m, 20 m, 30 m
PACE Polar	OCI	Visible, Near IR, Shortwave IR	2/8/2024 –Present 1 AM/PM 1 to 2 Days	Global Swath: ~2500 km 1 km

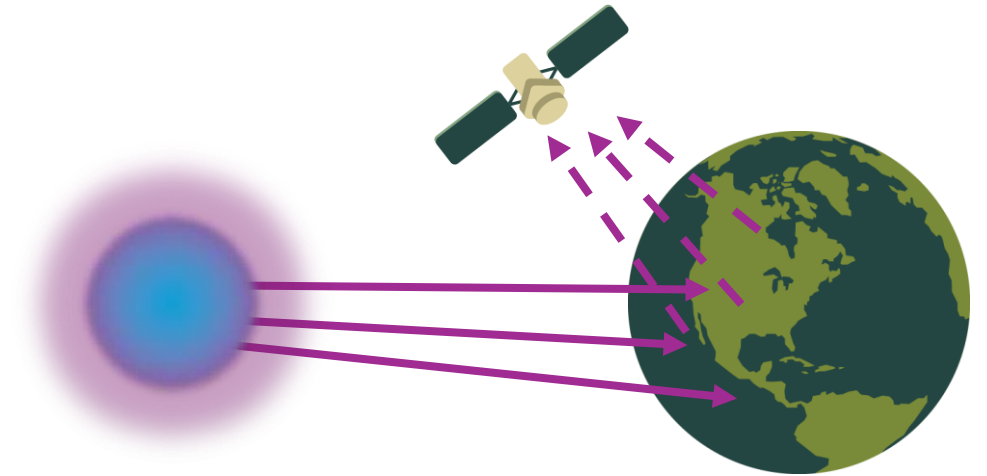
Satellites and Sensors: Microwave Sensors

Satellite/Orbit	Sensors	Spectral Measurements	Temporal Coverage, Observation Time, and Resolution	Spatial Coverage and Resolution
TRMM GPM Low inclination/ Non-polar Orbit	Microwave Radiometer and RADAR TMI, PR GMI, DPR	TMI: 10–85 GHz GMI: 10–183 GHz PR (Ku) and DPR (Ku and Ka)	11/27/1997 – 4/15/2015 2/27/2014 – Present Diurnally Varying ~90 minutes	35° S – 35° N 65° S – 65° N Swaths: 760 – 878 km 885 – 931 km 5 – 72 km 5 – 42 km
SMAP Polar Orbit	Microwave Radiometer	L-Band	1/31/2015 – Present 6:00 am/pm 2–3 days	Near-Global Swath: 1000 km 38 km, 9 km
NISAR Polar Orbit	Microwave Synthetic Aperture Radar	L-Band S-Band	7/30/2025 - Present 6:00 am/pm 12 Day	Global Swath: 242 km 2 – 8 m (band dependent)
SWOT -Near polar Orbit Non-sun synchronous	- Microwave Radar Interferometer & Radar Altimeter - Microwave Radiometer	KaRIN: Ka band (35.75 Ghz) Poseidon-3C Ku Band (13.6 Ghz) & C Band (5.3 Ghz) 18.7, 23.8, 34 GHz	12/2022-Present 21 day revisit time Varying local time of observations	Global Swaths: 120 km Oceans: 14-15 km Coastal Zones: 10 km Land ~100 m

Remote Sensing Recap

- What are some ways remote sensing is applicable for conservation district management?
- What is a situation where temporal resolution (return time) would be more important than spatial resolution?
- What are the main differences between active vs. passive sensors?
- At 30-meter Landsat resolution, can the government see you in your back yard?

What Type of Sensor is This?



NASA Earth Observations for Agriculture: Data Access, Visualization, and Application



Precipitation

- Global Precipitation Measurement (GPM)
- Integrated Multi-satellitE Retrievals for Global Precipitation Measurement (IMERG) product
- IMERG: 1998 – present
- Spatial resolution: $0.1^\circ \times 0.1^\circ$ grid ($\sim 10 \text{ km}^2$)
- Temporal resolution: half-hourly, daily, monthly
- NASA & JAXA joint mission
- Access: Earthdata Search & Worldview

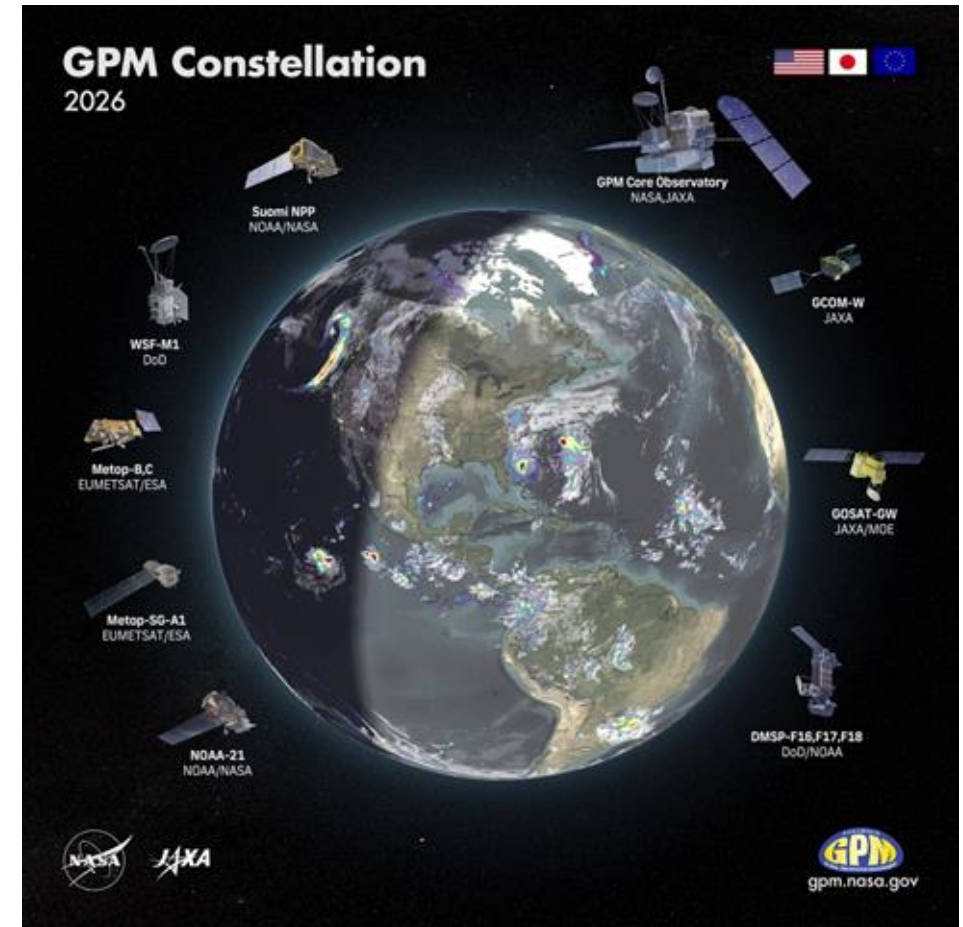
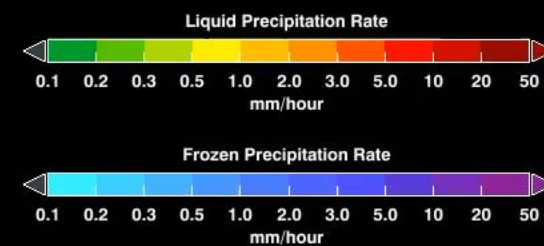


Diagram of the GPM satellite constellation (2026)
Image Credit: [NASA GSFC](https://www.nasa.gov/gpm/)

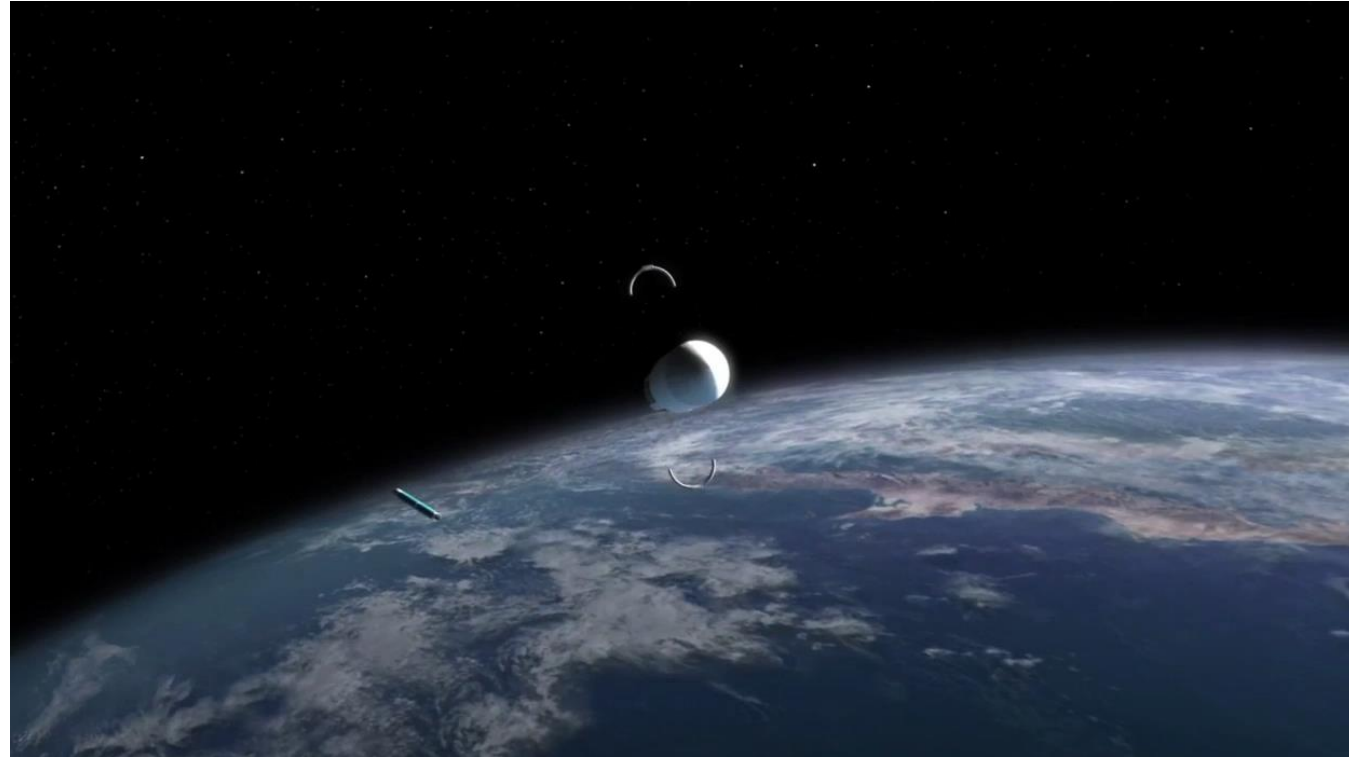


7/25/2014 00:55



Soil Moisture – SMAP

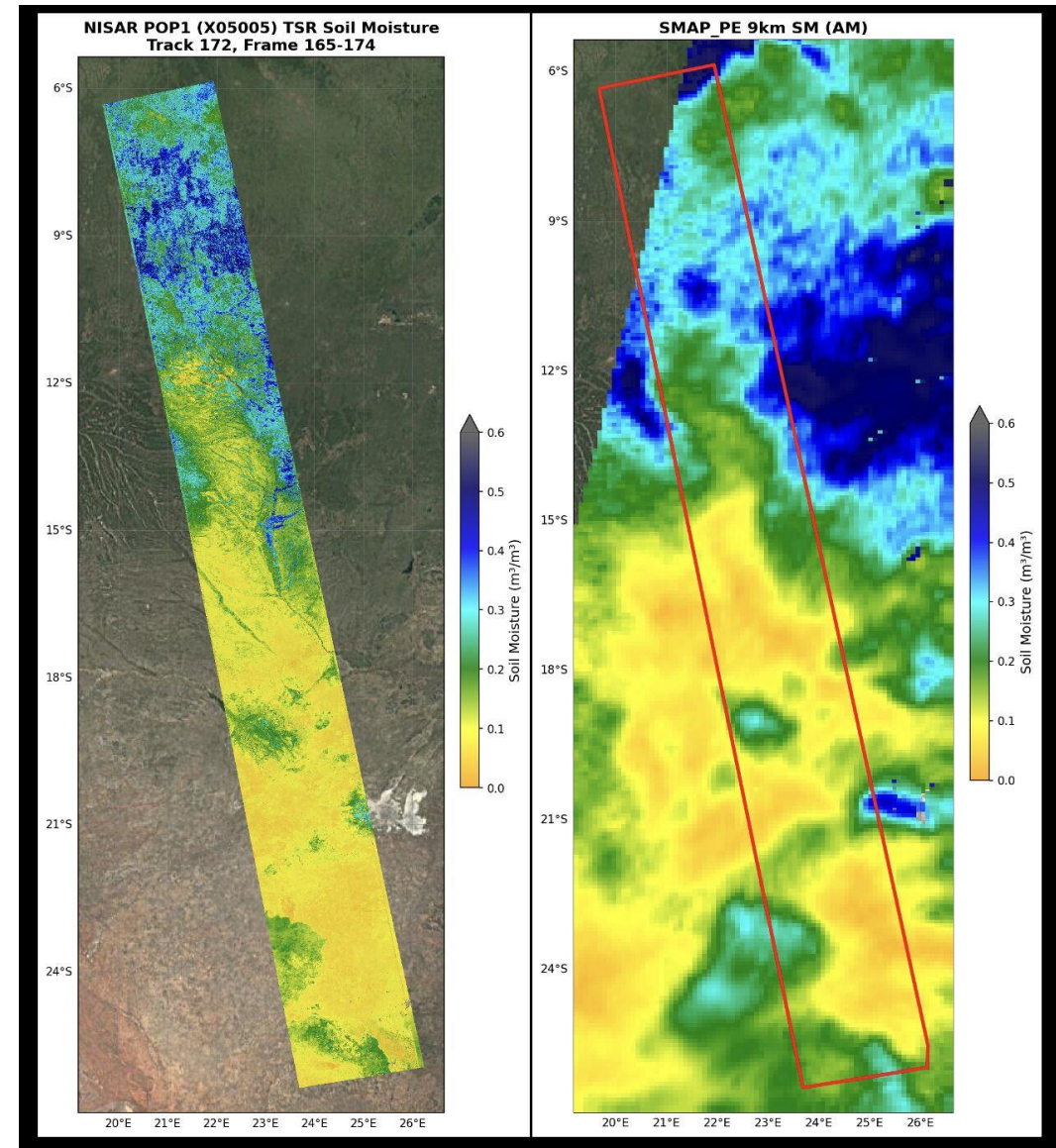
- Soil Moisture Active Passive (SMAP)
- 2015 – present
- Spatial Resolution: 9 km
- Temporal Resolution: Every 3 days, daily, 3-hourly
- L-band passive radiometer (microwave energy at 1.41 GHz)
- Baseline science mission provides estimates of soil moisture in the top 5 cm of the soil
- Access: [Earthdata Search](#) & [Worldview](#)



Animation of SMAP launching and collecting data.
Credit: [NASA/JPL](#)

Soil Moisture – NISAR

- NASA/Indian Space Research Organization (ISRO) Synthetic Aperture Radar (NISAR)
- Spatial Resolution: 200 m
- Temporal Resolution: 6–12 days
- L-band SAR (24 cm wavelength) and S-band SAR (9.4 cm wavelength)
- Level-3 science products will enable farm field-scale soil moisture monitoring when released in 2026
- Access: coming soon through the Alaska Satellite Facility



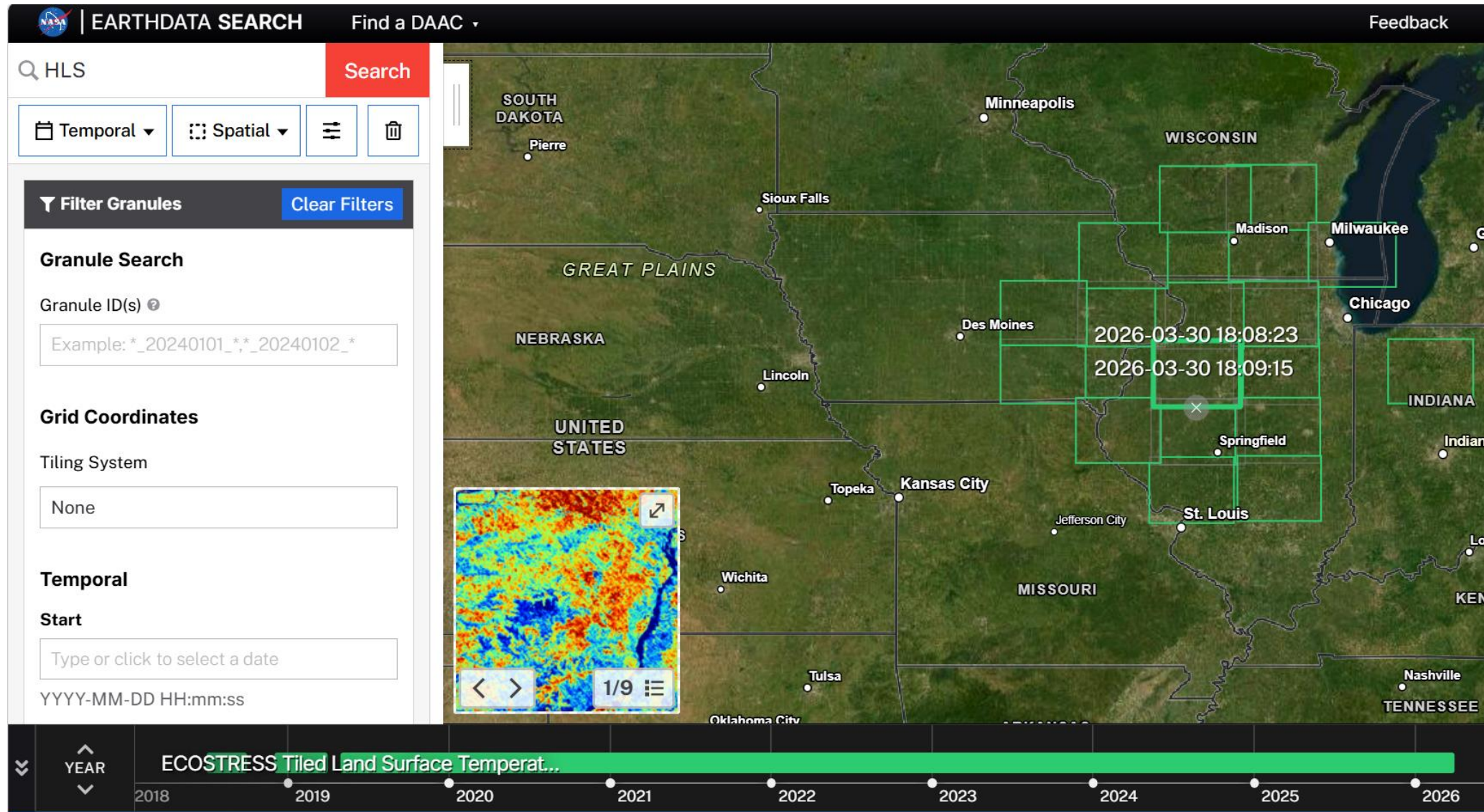
(left) NISAR soil moisture at 200m, November 11, 2025; (right) SMAP soil moisture at 9km. Soil Moisture overlaid on google earth. Credit [NASA](#)

Data Access

- [Earthdata Search](#)
- [AppEEARS](#)
- [Worldview](#)
- Free registration and access through Earthdata login
- Allows for variation in data needs
 - Visualization vs. download



Earthdata Search



AppEEARS!

 EARTHDATA

Other DAACs ▾

 AppEEARS

Extract ▾

Explore

Help ▾

Sign In

Welcome to AppEEARS!

Application for Extracting and Exploring Analysis Ready Samples (AppEEARS)

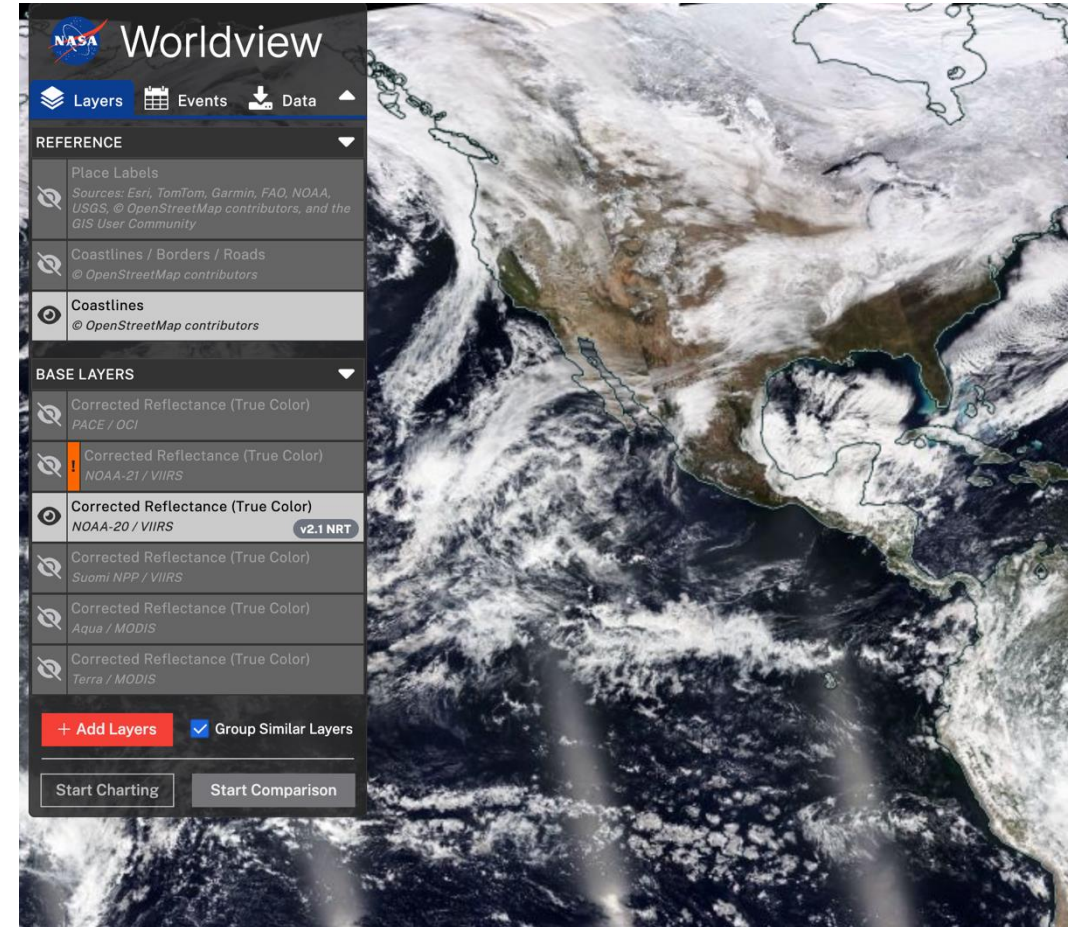
The Application for Extracting and Exploring Analysis Ready Samples (**AppEEARS**) offers a simple and efficient way to access and transform geospatial data from a variety of federal data archives. AppEEARS enables users to subset **geospatial datasets** using spatial, temporal, and band/layer parameters. Two types of sample requests are available: **point samples** for geographic coordinates and **area samples** for spatial areas via vector polygons. Sample requests submitted to AppEEARS provide users not only with data values, but also associated quality data values. Interactive visualizations with summary statistics are provided for each sample within the application, which allow users to preview and interact with their samples before downloading their data. Get started with a sample request using the Extract option above, or visit the [Help page](#) to learn more.

Worldview

<https://worldview.earthdata.nasa.gov/>

Access satellite data easily:

- 1000+ global, full-resolution satellite imagery layers
- Some imagery available in near real time
- Choose date or date range
- Browse, search, save, share & download imagery layers



Worldview Controls

Mobile Browser



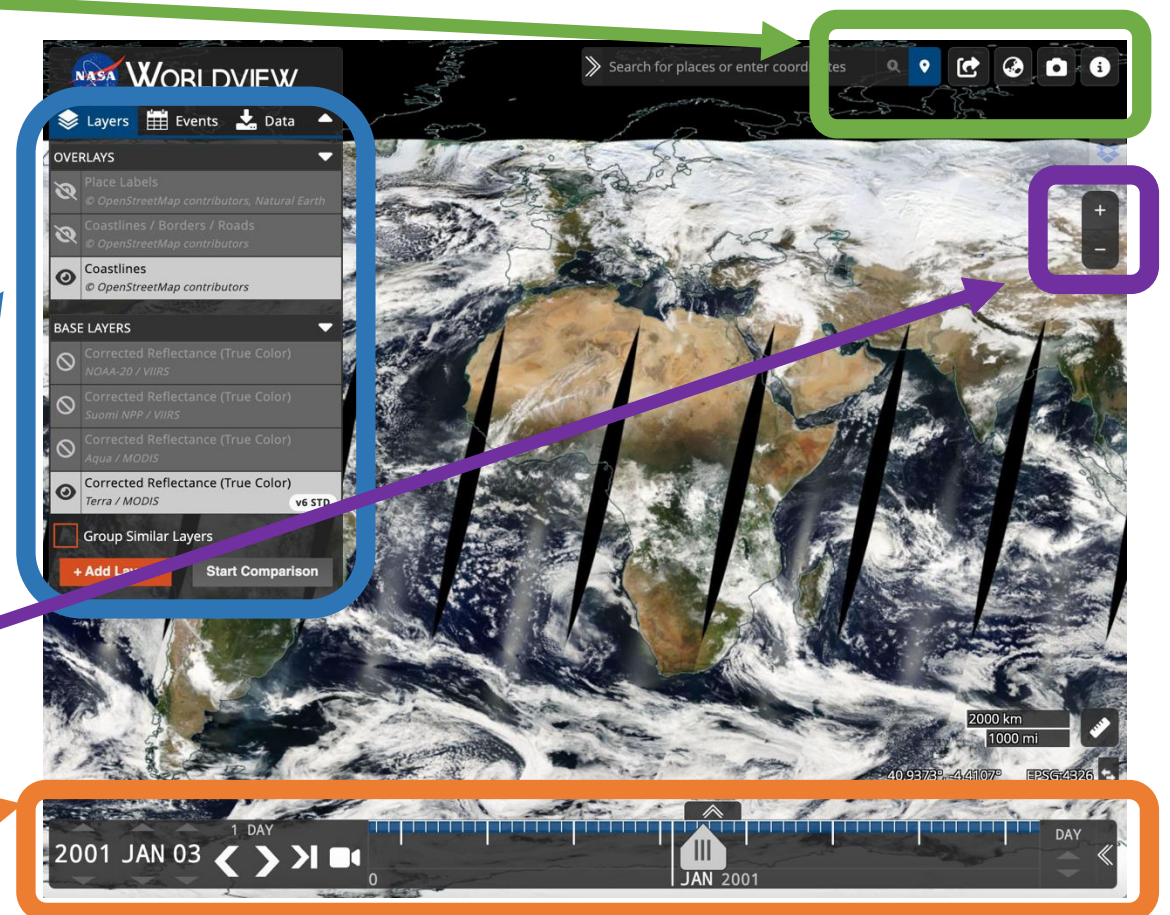
- Search by location
- Share image
- Change projection
- Help/info

- View layers, events
- Add image layers
- Download data

- Zoom via buttons or mobile device pinch

- Choose date & time
- Create an animation

Desktop Browser



- Search by location
- Share image
- Change projection
- Help/info

- View layers, events
- Add image layers
- Download data

- Zoom via buttons or mobile device pinch

- Choose date & time
- Create an animation

Explore Imagery Layers

Organized by application area and science discipline

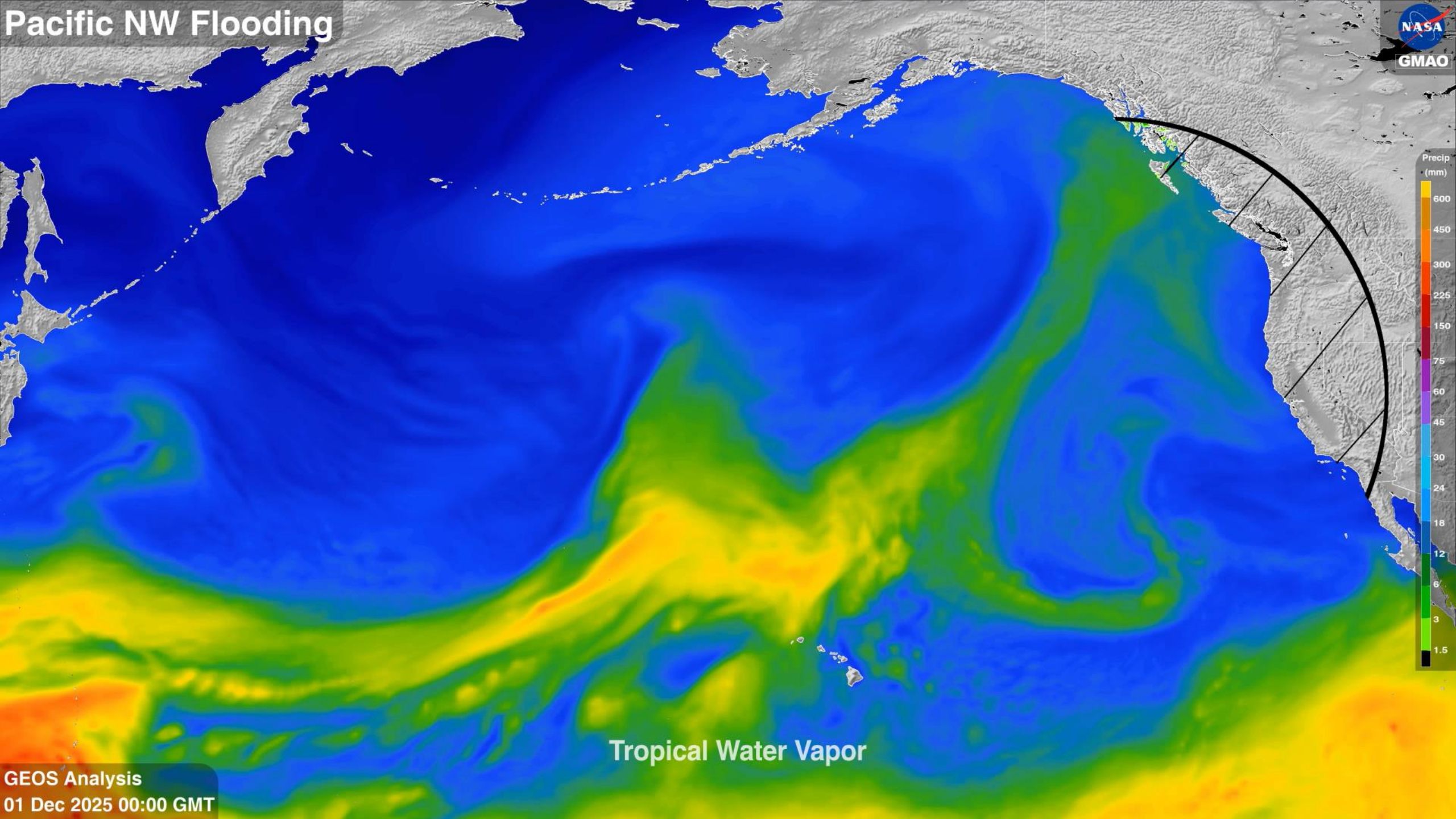
The screenshot displays the NASA WorldView web application interface. The top navigation bar includes the NASA logo, the text "WORLDVIEW", and tabs for "Layers", "Events", and "Data". Below this, a search bar is present. The main content area is organized into a grid of categories, each with a representative image and a list of available layers:

- Hazards And Disasters**: Includes layers like Aboveground Biomass, Absolute Dynamic Topography, Aerosol Index, Aerosol Optical Depth, Aerosol Albedo, and Aerosol Type.
- Air Quality**: Includes layers like Aerosol Index, Aerosol Optical Depth, Aerosol Type, Carbon Monoxide, Corrected Reflectance, and Dust.
- Ash Plumes**: Includes layers like Aerosol Index, Aerosol Optical Depth, Corrected Reflectance, Fires and Thermal Anomalies, Human Built-up And Settlement Extent, and Land Surface Reflectance.
- Drought**: Includes layers like Corrected Reflectance, Dams, Drought Hazard, Human Built-up And Settlement Extent, Land Surface Reflectance, and Land Surface Temperature.
- Dust Storms**: Includes layers like Aerosol Index, Aerosol Optical Depth, Aerosol Type, Dust, Corrected Reflectance, Human Built-up And Settlement Extent, and Land Surface Temperature.
- Fires**: Includes layers like Aerosol Index, Aerosol Optical Depth, Aerosol Type, Fires and Thermal Anomalies, Carbon Monoxide, Corrected Reflectance, and Land Surface Temperature.
- Floods**: Includes the layer Flood.
- Severe Storms**: Includes the layer Corrected Reflectance.
- Shipping**: Includes the layer Corrected Reflectance.

On the left side, there are sections for "OVERLAYS" (Place Labels, Coastlines / Borders / Roads, Coastlines) and "BASE LAYERS" (Corrected Reflectance (True Color) from NOAA-20 / VIIRS, Suomi NPP / VIIRS, Aqua / MODIS, and Terra / MODIS). There are also buttons for "Group Similar Layers", "+ Add Layers", and "Start Comparison".

The bottom of the interface features a timeline for the month of March 2024, with a "1 DAY" view selected. The timeline shows the dates from 2024 MAR 01 to 2024 MAR 24, with a "DAY" button on the right.

Pacific NW Flooding



Tropical Water Vapor

GEOS Analysis
01 Dec 2025 00:00 GMT

Demo – Worldview



Demo Case Study – Arkansas Flooding

- April 2025
- >12 inches of rain triggered catastrophic flooding
- \$99 million in crop damages
- Submerged ~ 31% of the state's 840,000 planted acres
- Impacted commodity crops such as corn, soy, and rice



[Credit: Arkansas Farmers Face Lingering Floodwaters - NASA Science](#)

Hands on Exercise Time

Ask a trainer for assistance!

We will reconvene at 1:25pm



Hands on Practice – Small Groups

Step 1. Navigate to Worldview: <https://worldview.earthdata.nasa.gov/>

Step 2. Choose a flooding event location from the provided list and locate it in Worldview

1. Upper Midwest (Southern Minnesota to Northwest Iowa) June 16th-23rd, 2024
2. Fort Lauderdale Flash Flood April 12th-13th, 2023
3. Hill Country Texas (Kerr County) July 4th, 2025
4. Pacific Northwest Atmospheric River (Whatcom County) Dec 2nd, 2025

Suggested Tools to Explore

Step 3 Explore the data

- Variables to explore:
 - True Color Base Layers and Reference Layers
 - GPM IMERG
 - SMAP Soil Moisture
 - Land Surface Reflectance: Terra MODIS (Bands 1-2-1)250m or Landsat 8 & 9/ OLI (Vegetation Analysis False Color, Bands 6-5-4)30m
- Tools to explore:
 - Temporal comparison tool
 - Charting tool
 - Generating an animation
 - Snapshot tool

Hands on Exercise Discussion

- Q & A
- Reflection questions:
 - What event did you choose to explore?
 - Which tool(s) did you use and why?
 - Did you find any difficulties with the tools or data?
 - Did you see anything interesting or confusing?
 - How might this apply to your work/how might you use these resources in the future?

Flooding Events

1. Upper Midwest (Southern Minnesota to Northwest Iowa) June 16th-23rd, 2024
<https://science.nasa.gov/earth/earth-observatory/record-rainfall-floods-midwest-152982/>
2. Fort Lauderdale Flash Flood April 12th-13th, 2023
(<https://storymaps.arcgis.com/stories/55cf948a0bfe40509fb261203a160427>)
3. Hill Country Texas (Kerr County) July 4th, 2025
(<https://www.earthdata.nasa.gov/dashboard/stories/tx-flood>)
4. Pacific Northwest Atmospheric River (Whatcom County) Dec 2nd, 2025
<https://appliedsciences.nasa.gov/what-we-do/disasters/disasters-activations/washington-atmospheric-rivers-2025>

10 Minute Break – back at 1:45pm

