

National Aeronautics and
Space Administration

EARTHDATA

Exploring Earth's Surface Through Remote Sensing

Earth Educators' Rendezvous
Monday, July 15, 2024, 1:30pm-4:00pm ET

Elizabeth R. Joyner, Earth Science Data Systems, Community
Coordinator

Mike P. Taylor, NASA Landsat Communications and Public
Engagement, Earth Outreach Scientist



Today's Schedule

1:30 - 2PM	Introductions, Goals, Housekeeping, IceBreaker
2-2:20PM	Introduction to Remote Sensing
2:20-3PM	STELLA
3-3:40PM	AppEEARS
3:40 - 4PM	Wrap Up & Share Out
4PM	Adjourn



Welcome, Introductions, Housekeeping

Elizabeth & Mike

9 - 9:20 AM

Elizabeth Joyner

From SC



Marine Geologist



Government & NGO:
NOAA, NASA, AGI



Elizabeth Joyner
Community
Coordinator
AKA
Data Evangelist

Hello
my pronouns are
SHE/HER/HERS

Proud Wife and
Mom of Two



Former Teacher
& Researcher



EARTHDATA

Mike Taylor

From Maryland



Landsat Outreach
Scientist



Husband,
Father of two,
GIS major



STELLA
Team Lead



EARTHDATA

EARTHDATA

Enabling Earth Science Data to Serve Society

Earth Science to Action Strategy

Public Understanding & Exchange

- Put more scientific understanding into public sphere
- Deliver applied science to users
- Participate in multi-way info exchange
- Use input to inform subsequent work

Solutions & Societal Value

- Offer models, scientific findings and info through Open-Source Science principles
- Support climate services
- Provide science applications and tools to inform decisions

Earth System Science & Applied Research

- Grow scientific understanding of Earth's systems
- Develop predictive modeling for science applications and tools to mitigate, adapt and respond to climate change

Foundational Knowledge, Technology, Missions, & Data

- Technology innovation
- Earth observations missions
- Data collected from space, air and ground

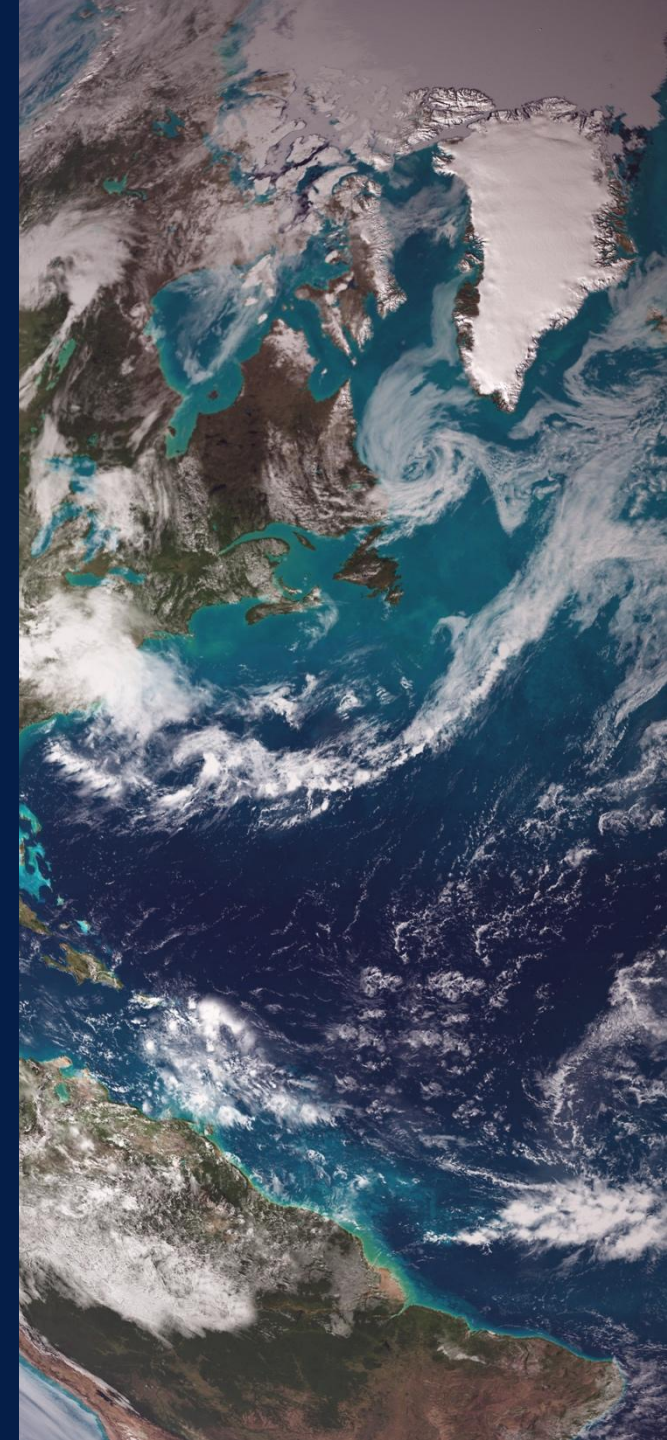
EARTHDATA

Credit: NASA

Outcomes

3.5 hours

1. *Describe* the basics of how remote sensing works and how this technology benefits humanity
2. *Collect surface reflectance data using STELLA* to evaluate how plants change over time and space
3. *Explore* the AppEEARS tool for accessing Landsat (and other) NASA data



Resource Guide:

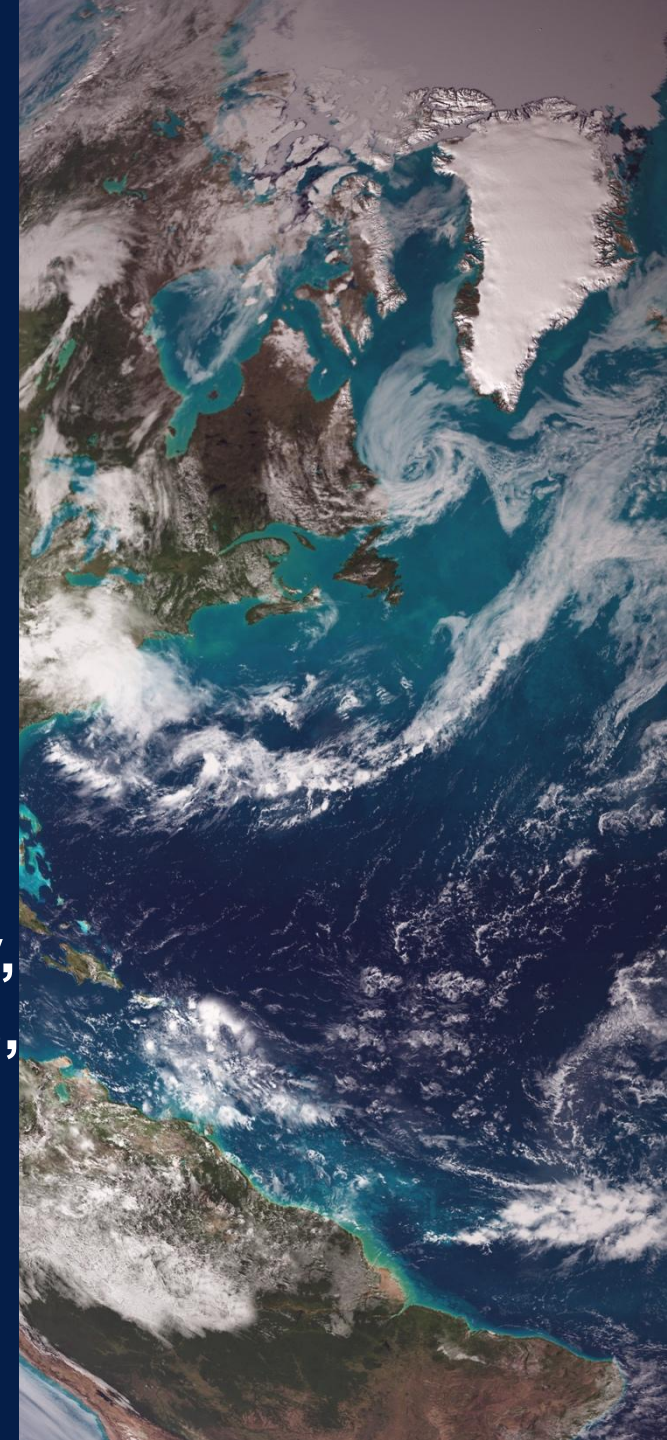
zenodo



Navigate
to the
most
updated
version.

Includes
Agenda, Survey,
Activities, Links,
and more!

<https://zenodo.org/records/12609217>



Guidelines & Code of Conduct

- **Be respectful:** actively listen, stay in the present, be kind
- **Be inclusive:** create physical and social space for others to participate, welcome all, be aware of yourself, practice an open mindset
- **Be collaborative:** acknowledge that everyone brings something different, make assumptions explicit, be accountable of your own actions, respect intellectual property and data sovereignty
- **Be safe:** Avoid harmful behaviors and let us know if any occur
- **Be vocal:** Speak Up! If you want support or have a suggestion, please message Elizabeth at 757-771-2019. Anyone experiencing or witnessing behavior that constitutes an immediate or serious threat to public safety is advised to contact 911 or your local emergency number.



If you believe you are being or have witnessed harassment at this workshop:

- document the incident fully
- tell someone you trust
- report the incident to Elizabeth

Getting Help with Tools during hands-on sessions:

I'm with you.



Let's go.

Slow down.



I need help.

Instructor

Co-Instructor and Helpers



Credit: The Carpentries

Sticky notes

Positive Polarities: Ice Breaker

Instructions

- Silently stand up
- Listen/watch for prompts from the facilitator
- Move to where you think you are along the “positive polarity”

There's no right or wrong answer. This is your perception of yourself.

- Goal 1: Meet other people at the workshop
- Goal 2: Acknowledge and welcome the positive (differences) polarities at the workshop

Long distance<---> Short Distance

Left side of the room <--->Right side of the room

Prompt:

I traveled from a long distance or short distance

Internal <---> External

Left side of the room <--->Right side of the room

Prompt:

I am an Internal processor (organize your thoughts inside your head) or external processor (organize your thoughts outside your head)

Little Movement <---> Lots of Movement

Left side of the room <--->Right side of the room

Prompt:

**I use little or lots of hand and body movements
(also called gestures) when I am talking**

Comfortable <---> Uncomfortable

Left side of the room <---> Right side of the room

Prompt:

I am comfortable or uncomfortable with silence

High <---> Low

Left side of the room <--->Right side of the room

Prompt:
I prefer high or low eye contact

Adult <---> K-12

Left side of the room <--->Right side of the room

Prompt:

I primarily teach adult learners or those in k12 environments

Long <---> Short

Left side of the room <--->Right side of the room

Prompt:
I prefer long or short emails

Soft <---> Loud

Left side of the room <--->Right side of the room

Prompt:
I am soft or loud when I talk

Reflection

Pair up with someone whom YOU DO NOT KNOW and take turns answering the prompts below.

Prompts:

1. What did you notice about yourself during the exercise?
2. What did you observe about others during the exercise?
3. How might these differences impact group communication and success?
4. Identify someone from your group to introduce yourselves and explain your answers to the questions above.



Introduction to Remote Sensing

Mike Taylor

2-2:20PM



What is Remote Sensing?

- Remote sensing is the technique of obtaining information from a distance.
- The most common remote sensing in our daily life – photography.
- In Earth science context, we often refer to satellite, airborne platforms, drones.

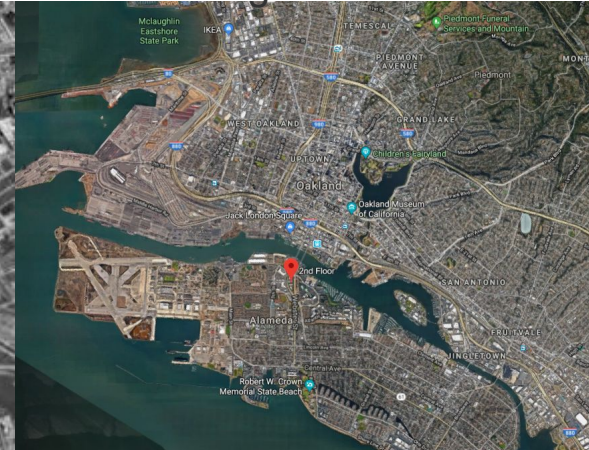
Creative Commons



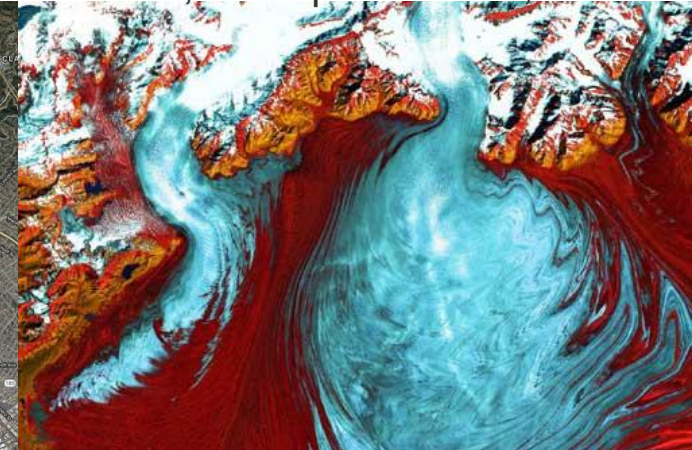
Army Corps Engineers



Google Earth



Landsat, Malaspina Glacier, Alaska

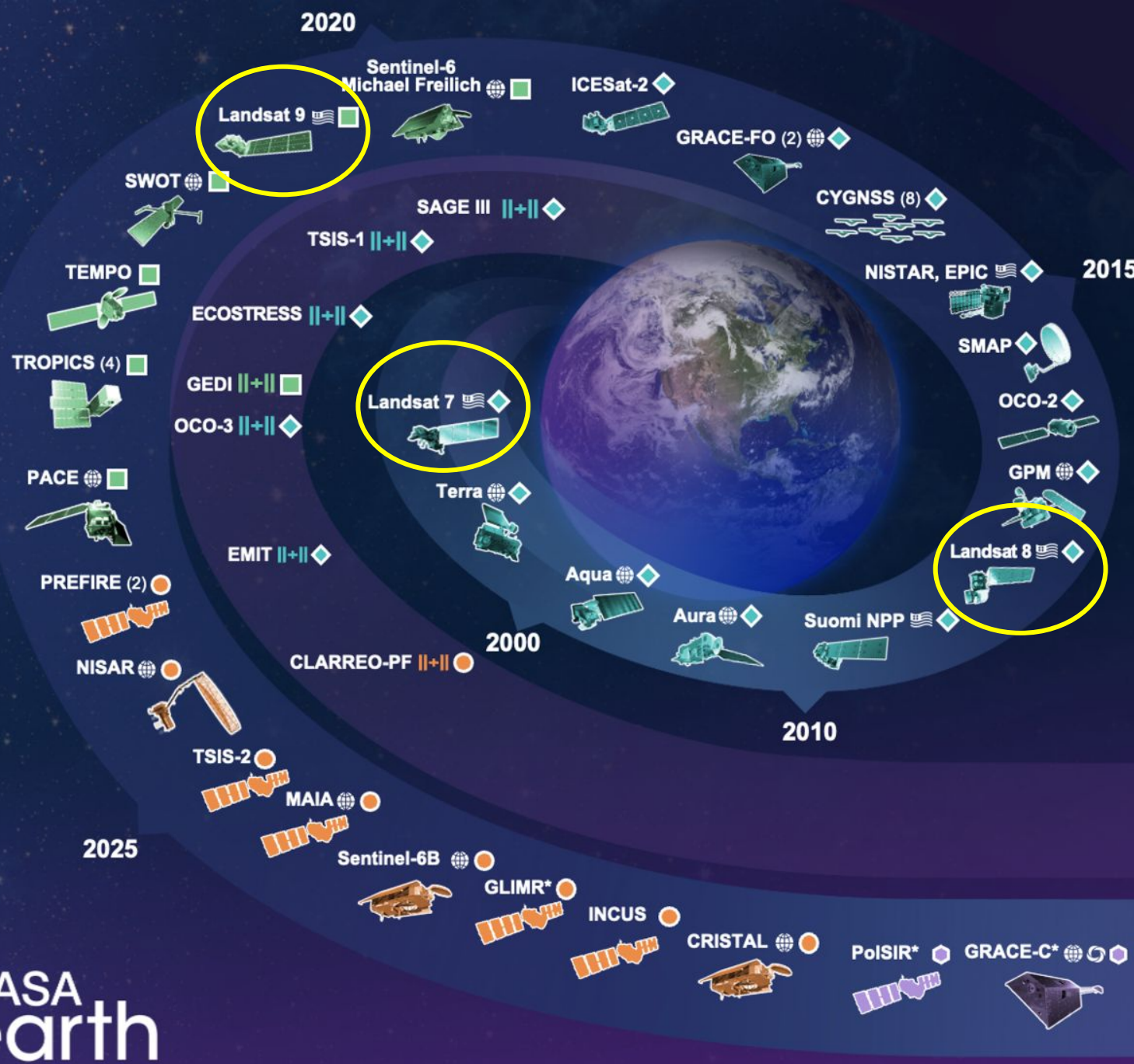




Nov 19 2009 21:29



EARTH FLEET



Key

- International Partners
- U.S. Partner
- ISS Instrument
- JPSS Instrument
- Cubesat
- Launch Date TBD
- Earth System Observatory Mission (Pre) Formulation
- Implementation
- Operating
- Extended

Invest/CubeSats

- NACHOS 2022
- CTIM 2022
- NACHOS-2 2022
- MURI-FD 2023
- SNOOPi* 2024
- HYTi* 2024
- ARGOS* 2024

JPSS Instruments

- OMPS-LIMB 2022
- LIBERA 2027
- OMPS-LIMB 2027
- OMPS-LIMB 2032

ISS INSTRUMENTS

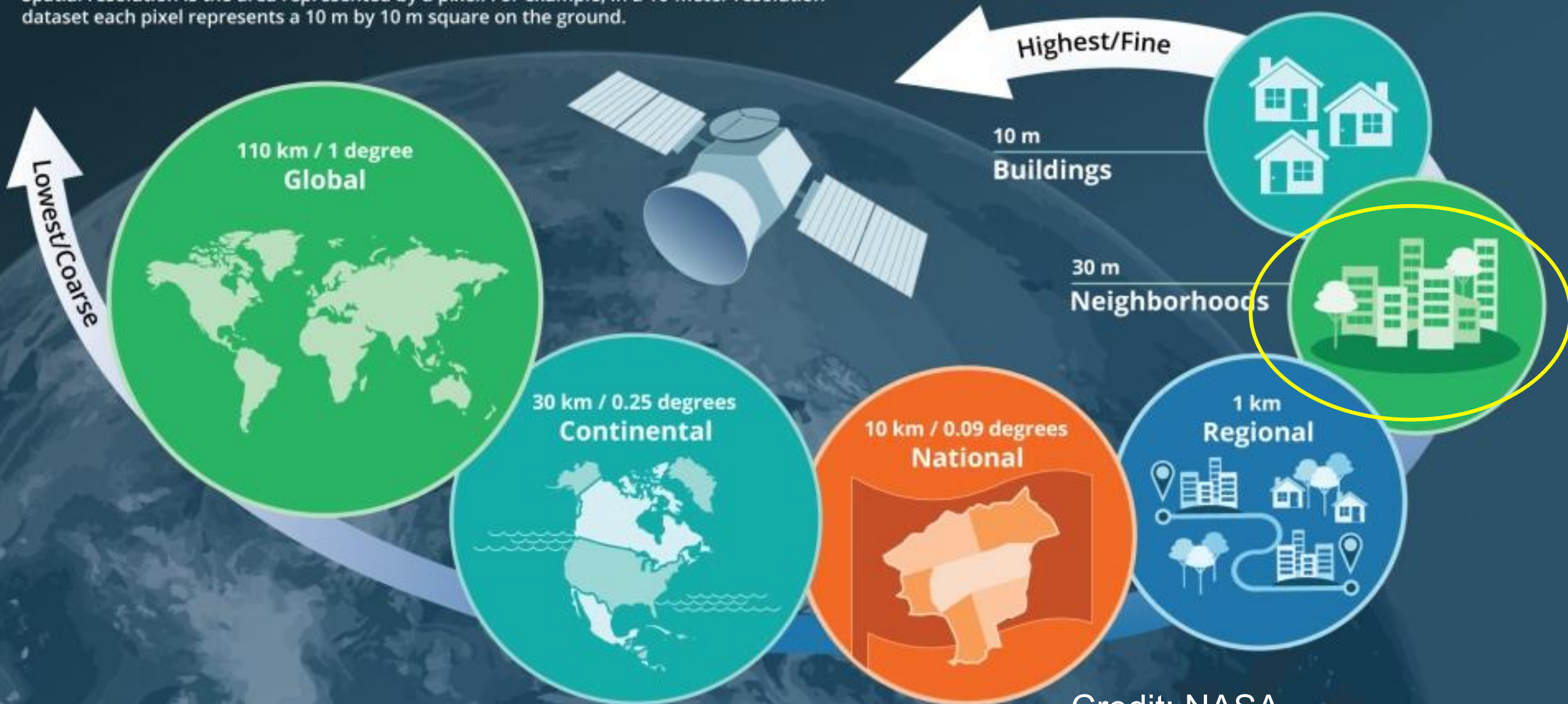
- PoISIR*
- GRACE-C*
- PMM*
- SBG*
- AOS Sky*
- Landsat Next*

MISSIONS

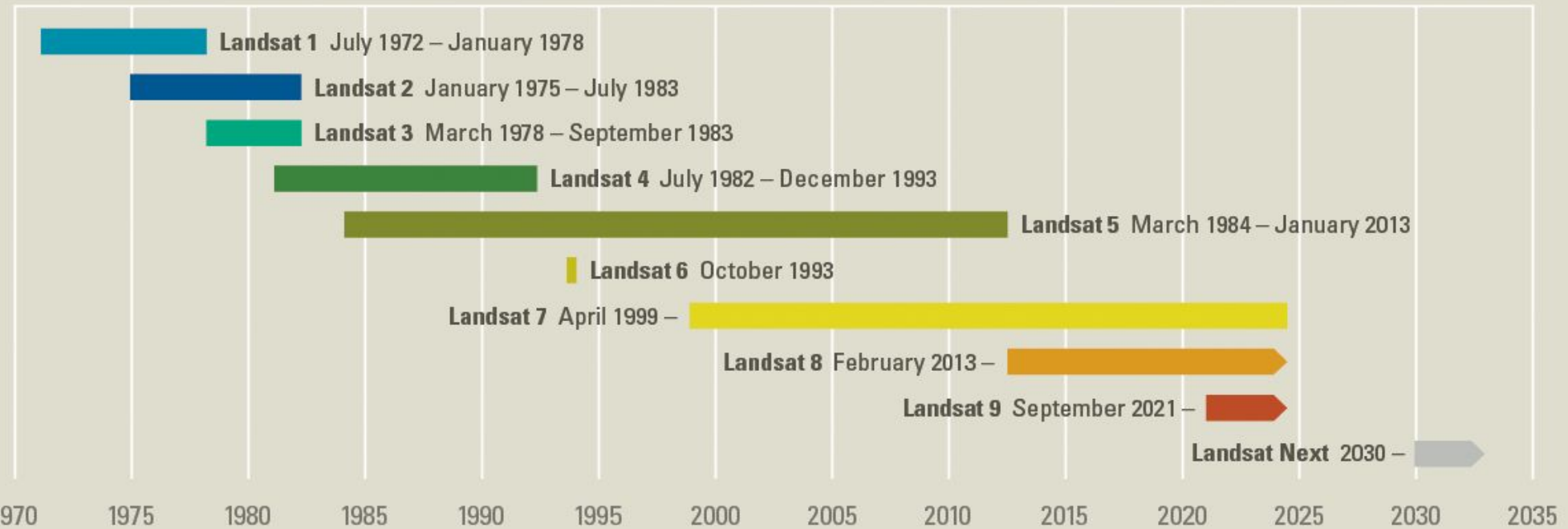
What Spatial Resolution Do I Need?

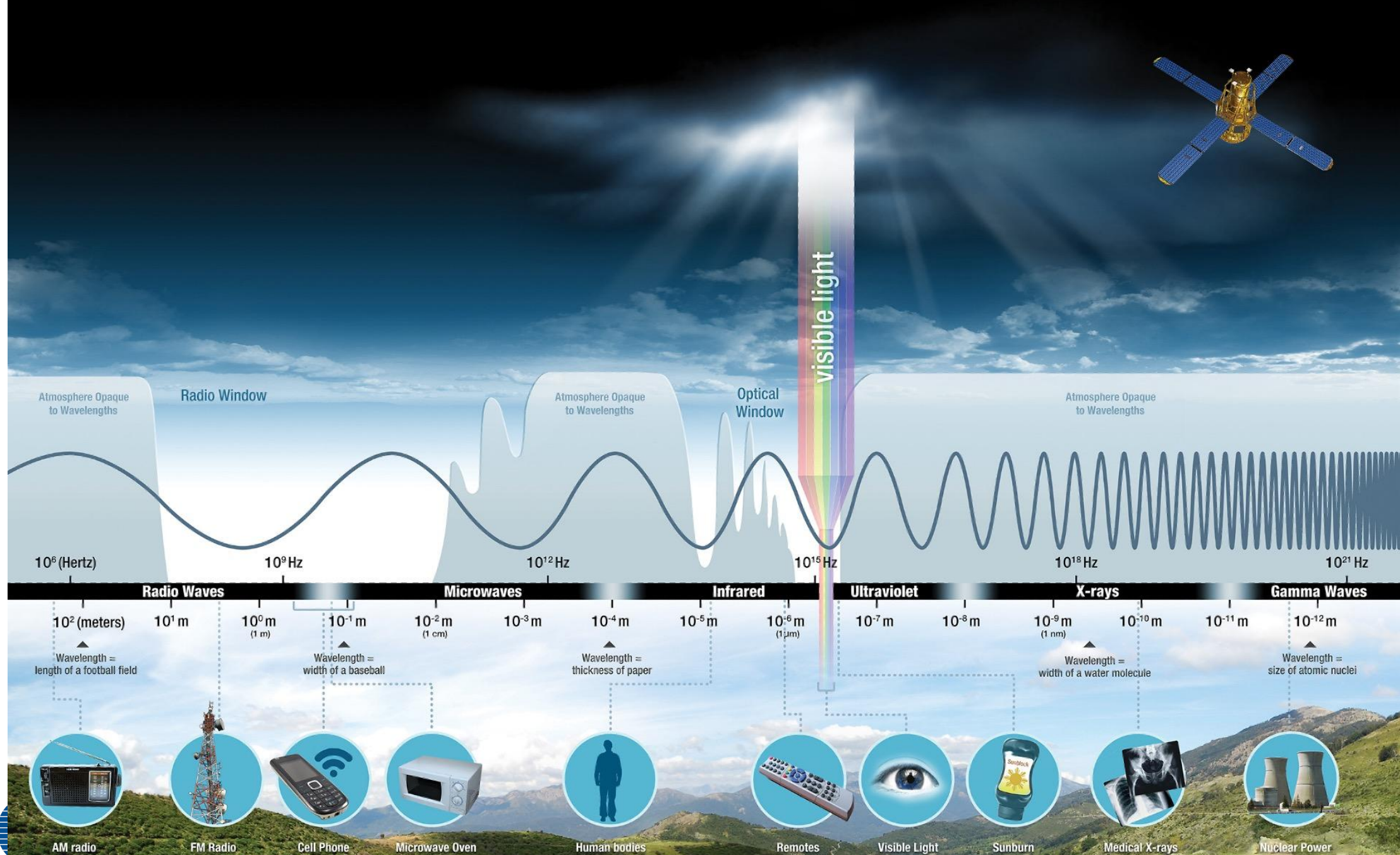


Spatial resolution is the area represented by a pixel. For example, in a 10-meter resolution dataset each pixel represents a 10 m by 10 m square on the ground.



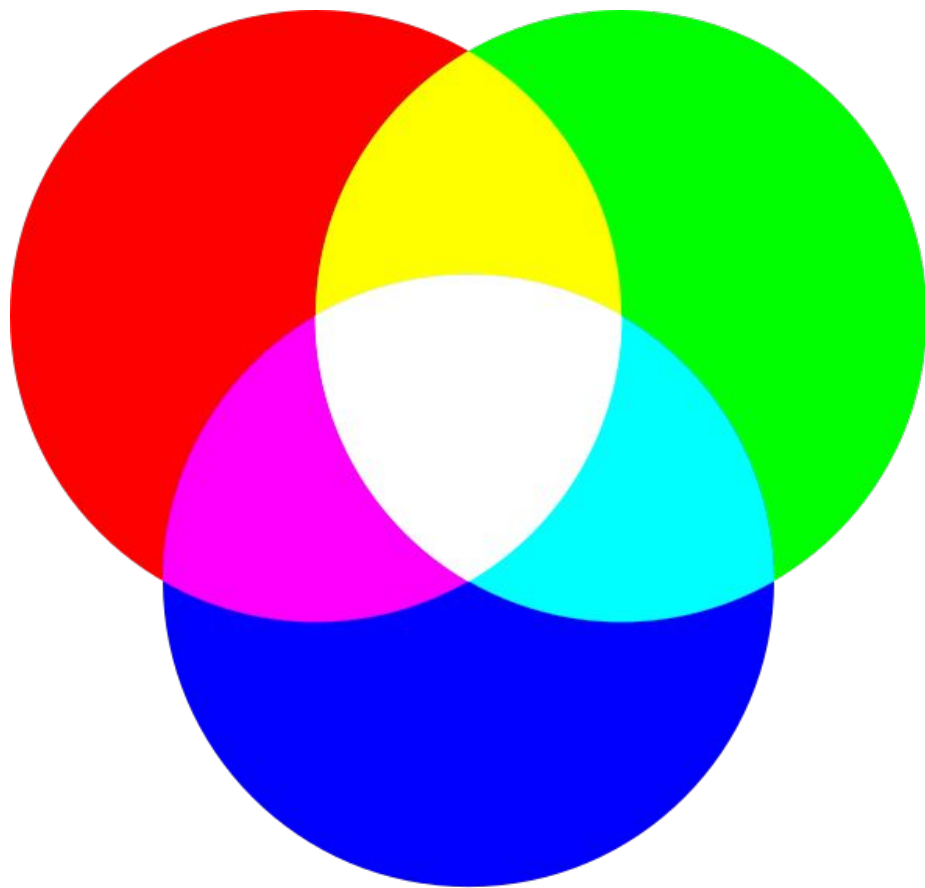
Landsat Missions: Imaging the Earth Since 1972





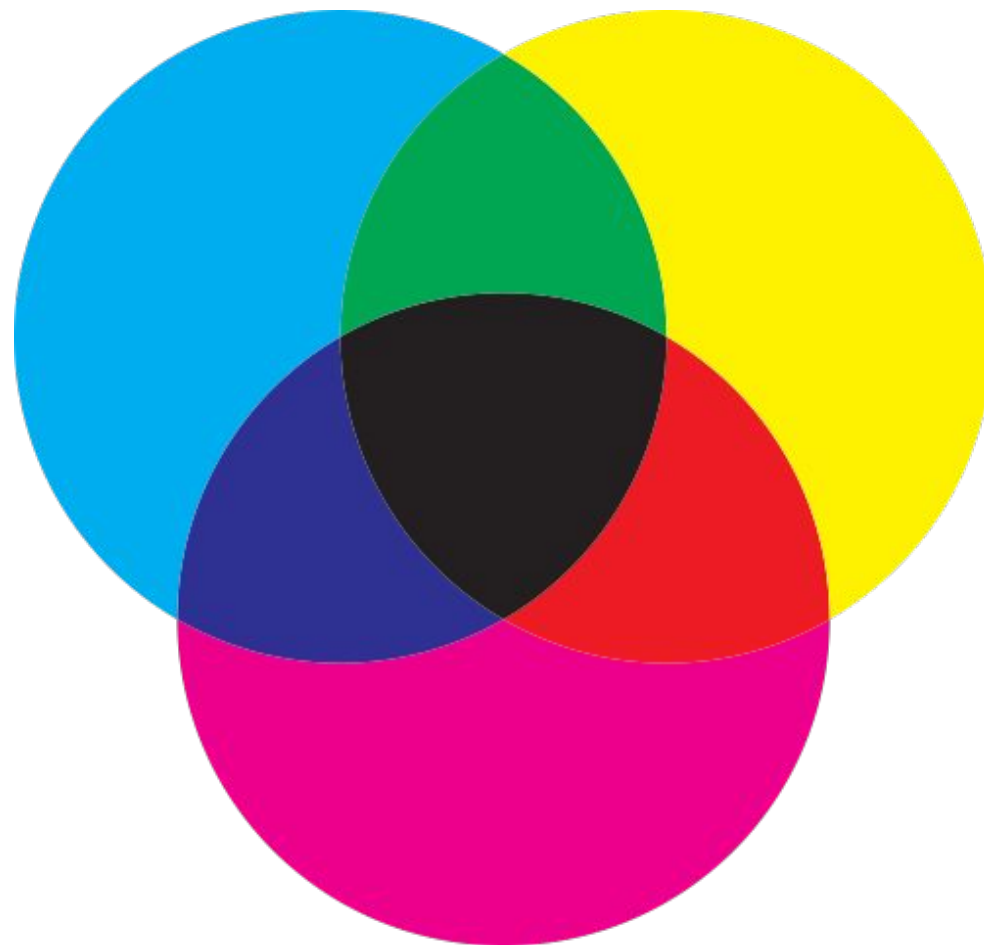
Credit: NASA

Light



Additive Color Mixing

Paint

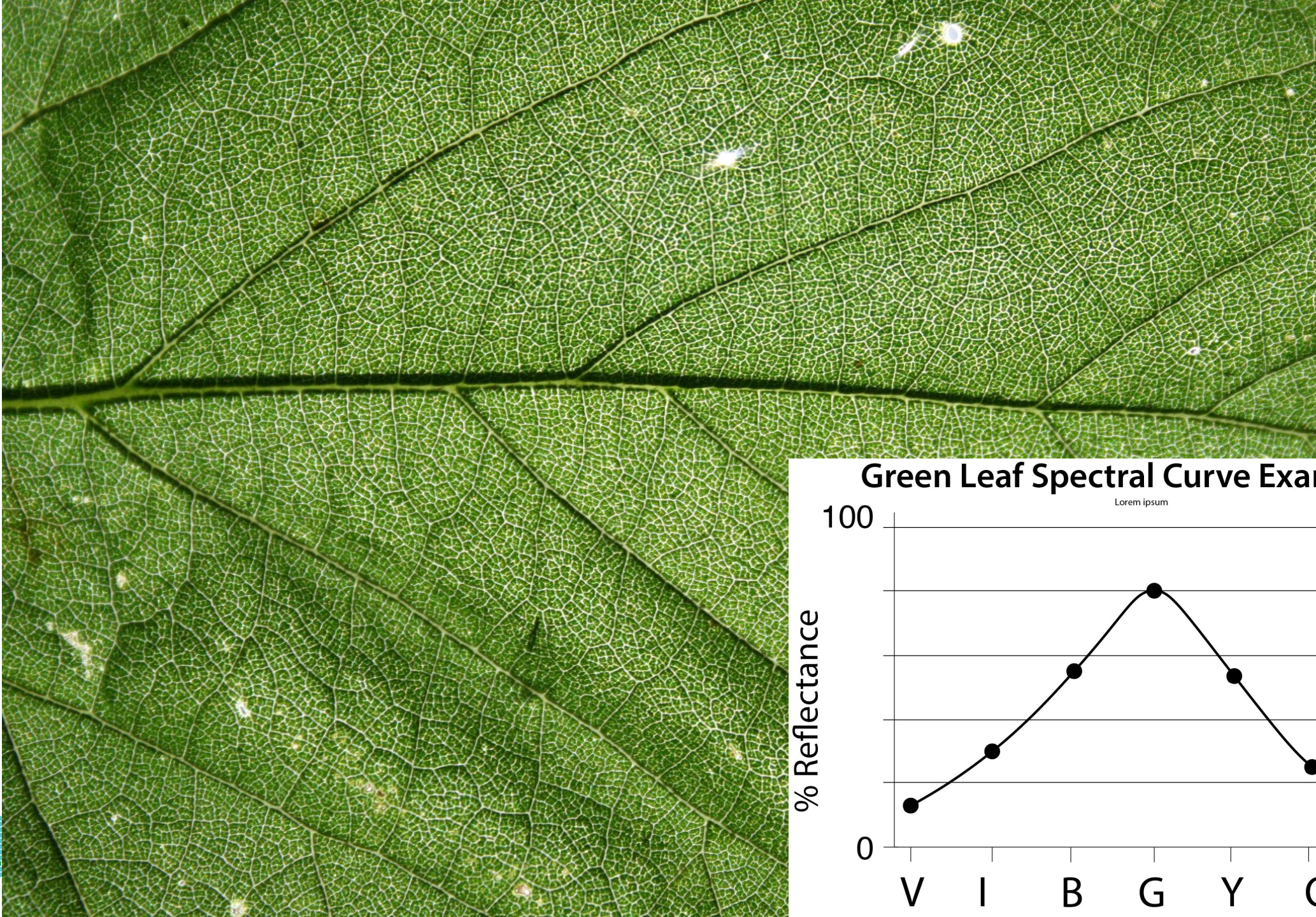


Subtractive Color Mixing



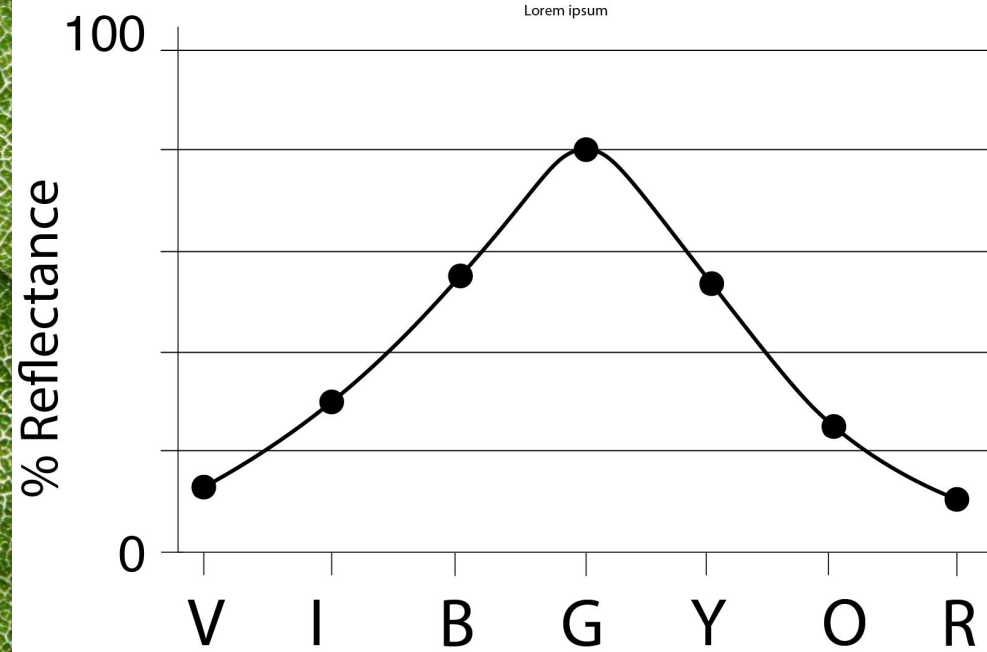
EARTHDATA

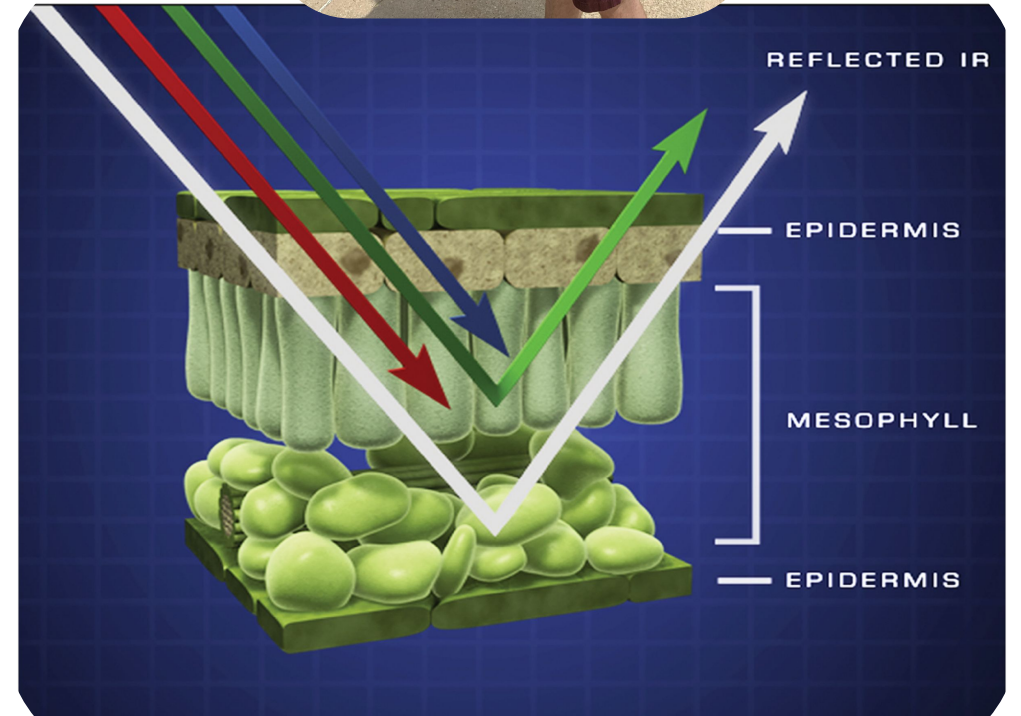
Credit: Wikimedia Commons



Green Leaf Spectral Curve Example

Lorem ipsum

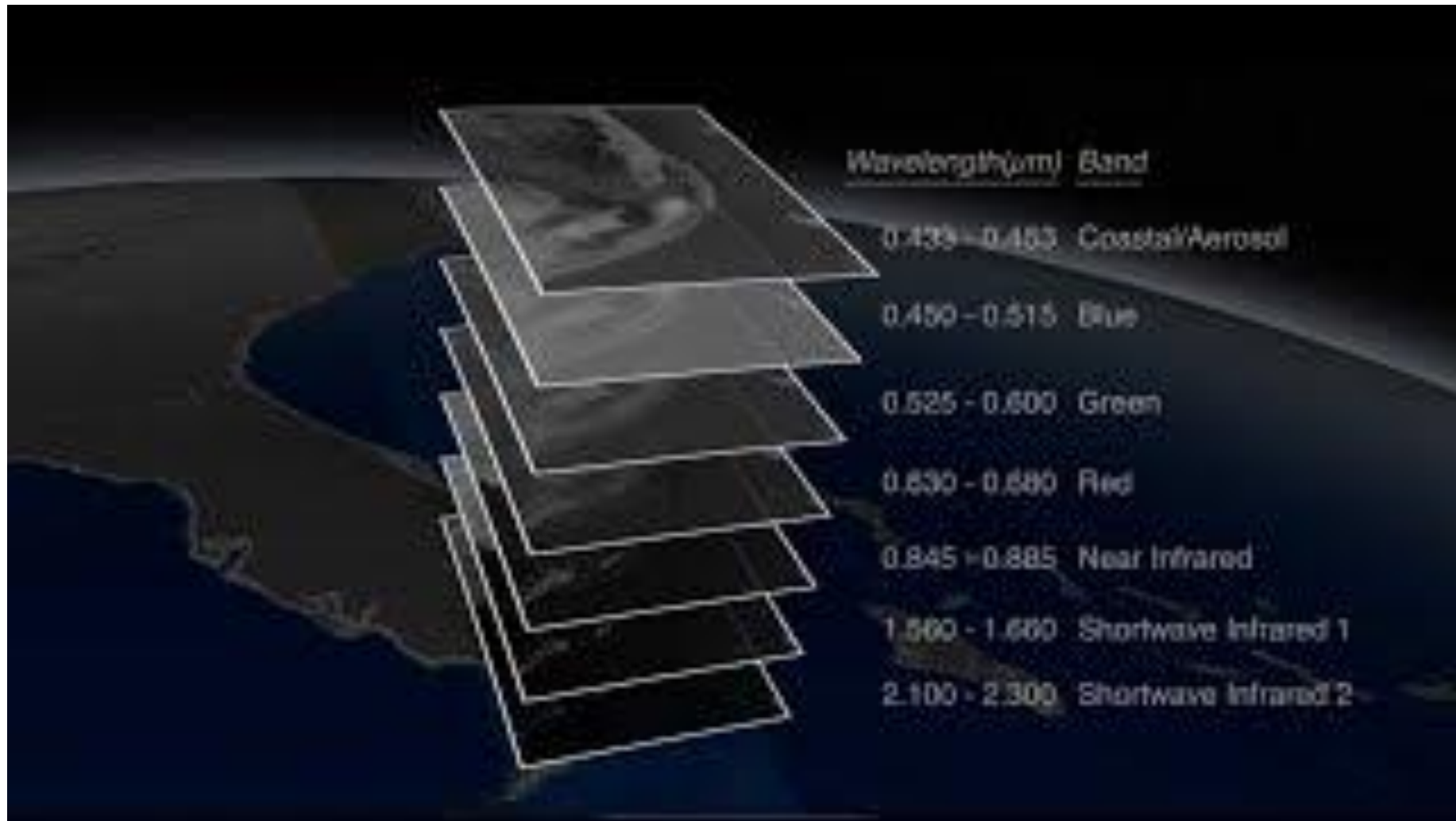




Credit: NASA



Landsat Onion Skin



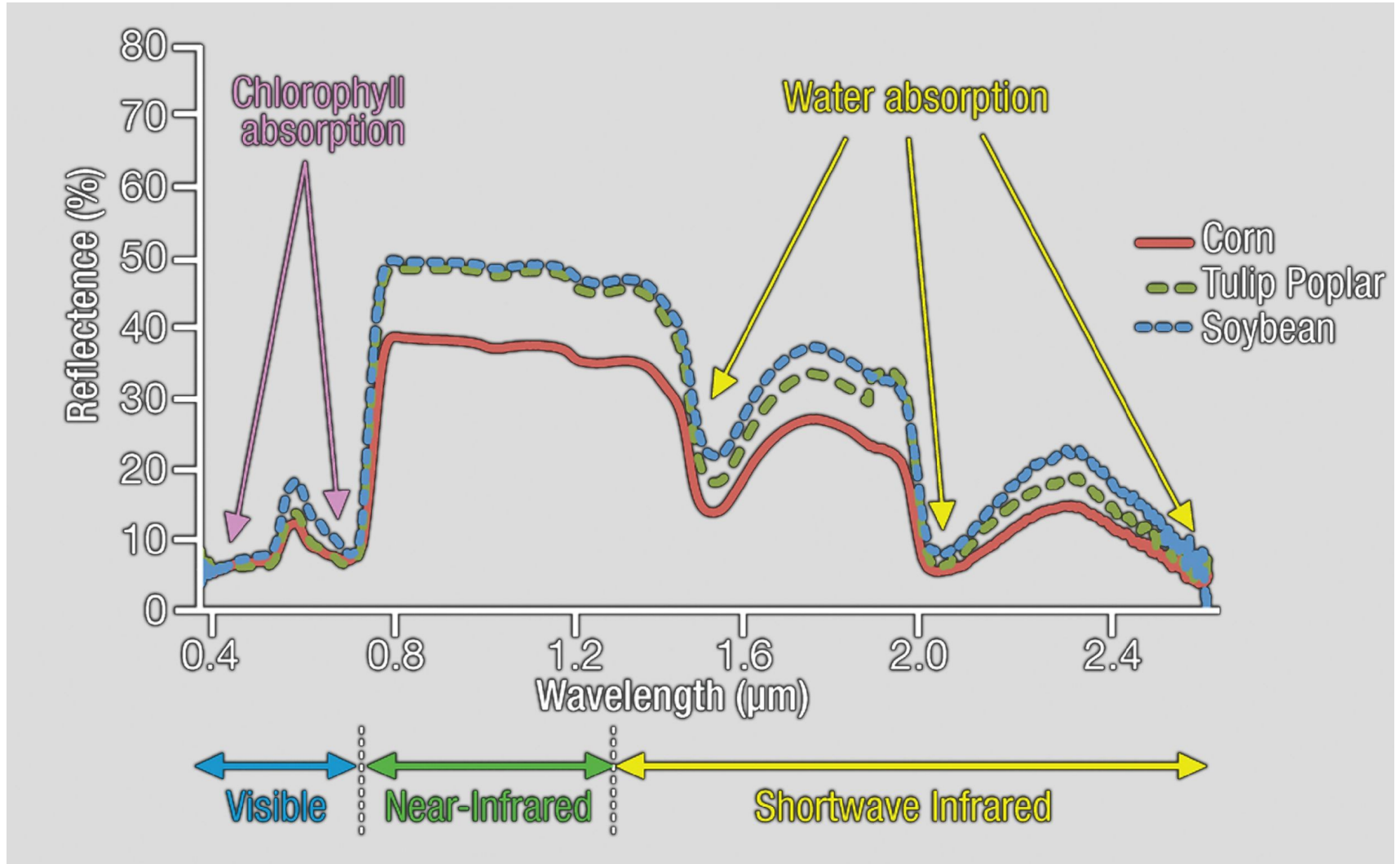
EARTHDATA

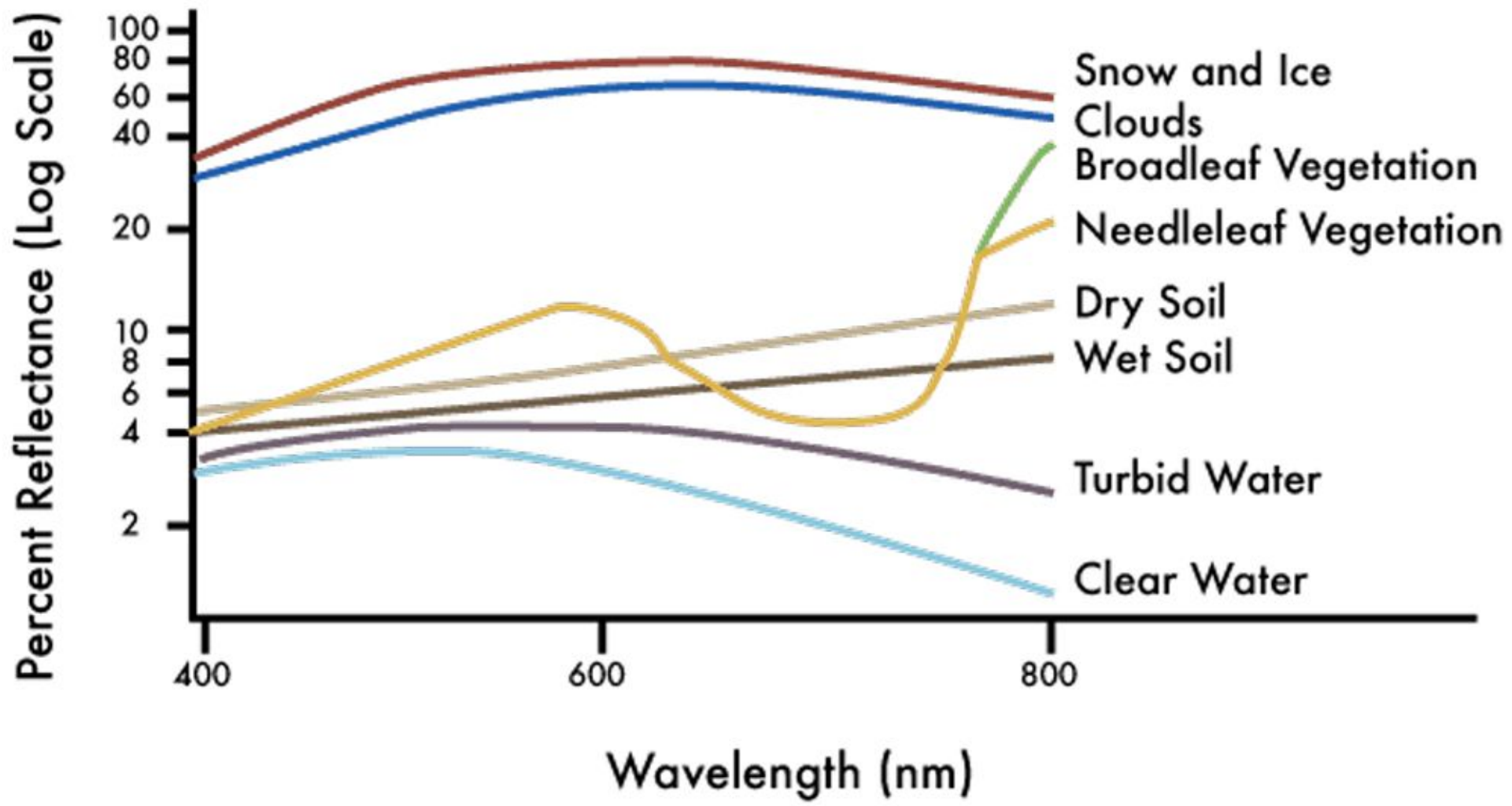
Las Vegas Timelapse

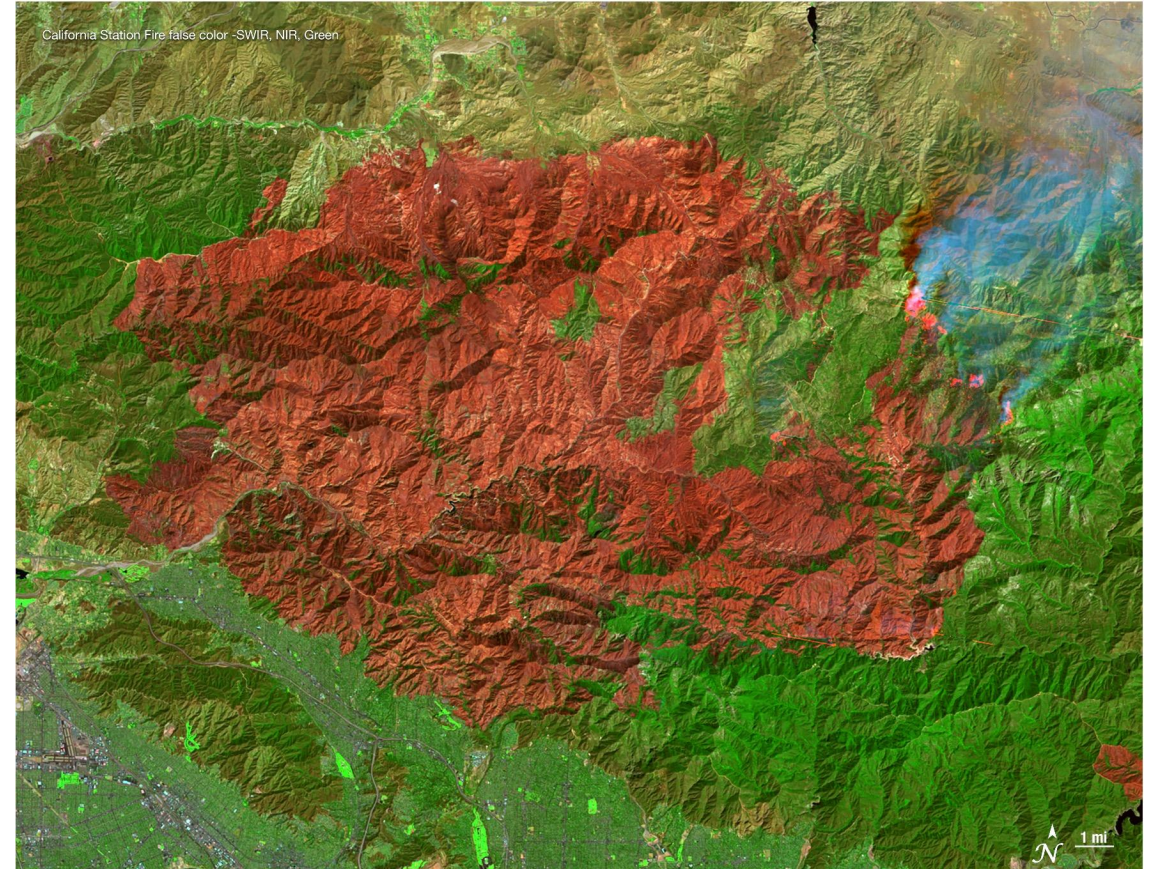








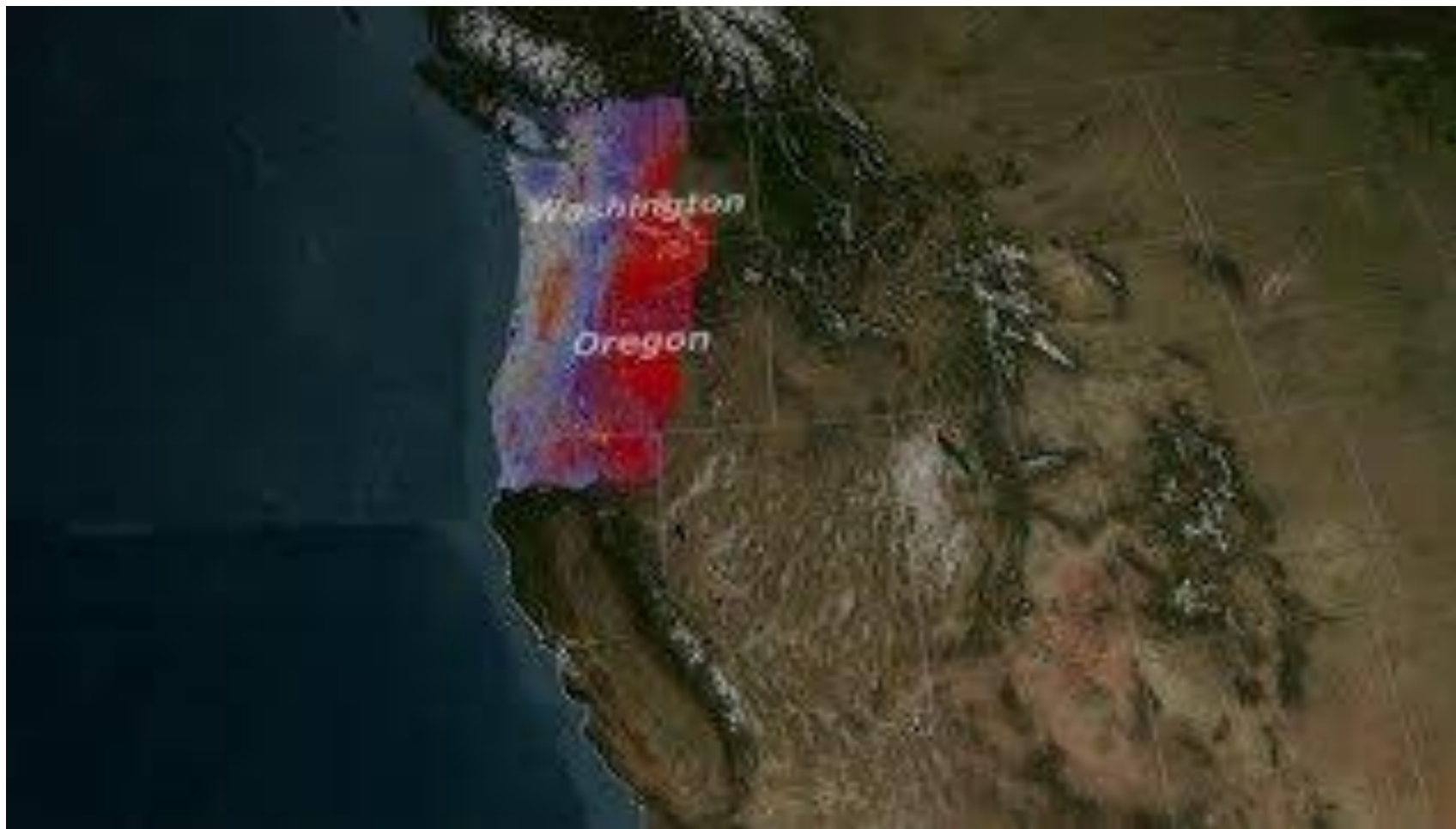




Yellowstone Recovery from Fire



Data in Numbers



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Harmonized Landsat and Sentinel-2 data

- Landsat 8 and Sentinel-2 satellites have spectral and spatial similarities that make using their data together possible.
- When the data are used together observations can be more timely and accurate.
- HLS project is an effort to "harmonize" the data of the two satellite programs so that they can be more easily used in unison
- 2-3 day global surface reflectance coverage at 30 meters that removes residual differences between the sensors due to spectral bandpass and view geometry

<https://hls.gsfc.nasa.gov/>



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DATA IN HARMONY

NASA'S HARMONIZED LANDSAT AND SENTINEL-2 PROJECT



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Introduction to STELLA

Mike Taylor
2:20-3PM





Landsat CPE Presents:

STELLA

Science and Technology Education
for Land / Life Assessment

An instrument
for education, outreach, and engagement

What is STELLA?

Low-cost education and outreach DIY instruments inspired by Landsat

How did STELLA come about?

STELLA was derived from an activity using a spectrometer to introduce remote sensing concepts and Landsat

What is Landsat?

Landsat is joint program between NASA and the USGS that has been performing Earth observations operating since 1972. Currently there are two satellites deriving another complete observation of the Earth's surface every 8 days, Landsat 8 and 9.

Landsat Website:
landsat.gsfc.nasa.gov



Landsat 8

Credit: NASA



STELLA in the classroom



VT put together
5 STELLA's



**GEOTed Drone
Workshop 2023**
Highschool & Community
College Educators

**Forest
Photogrammetry
Course in Spring
2023**

Remote Sensing for Juniors
and Seniors

STELLA on Drones



Mounted on a DJI Air 2s

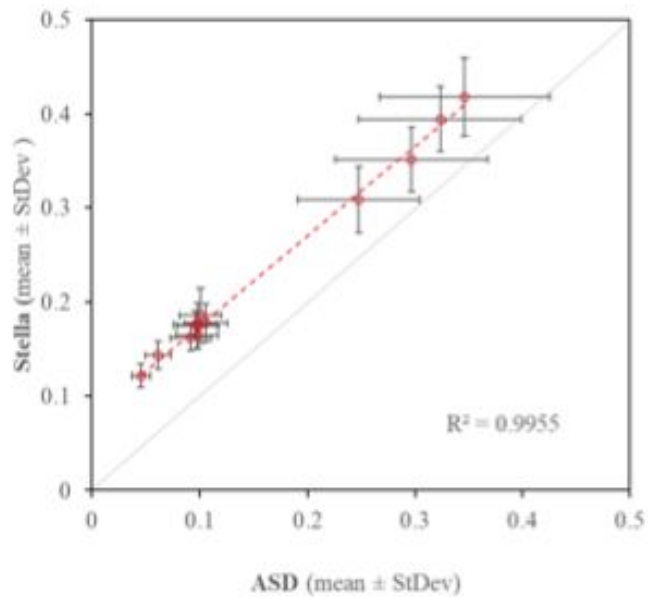


STELLA in the Field

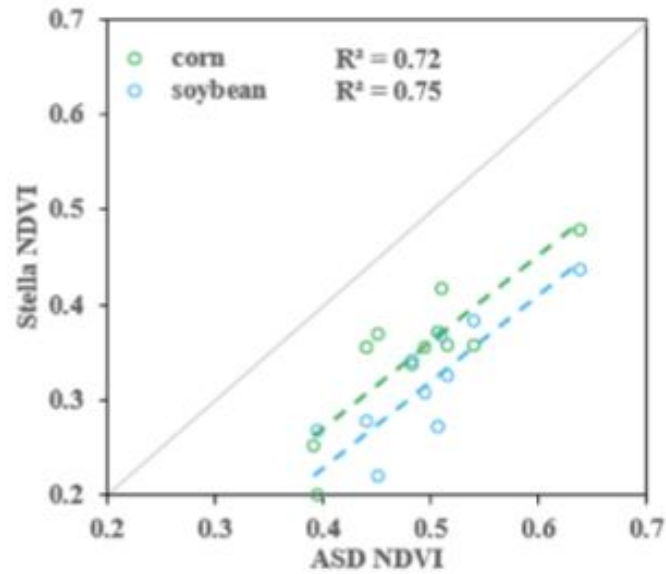


GOALS:

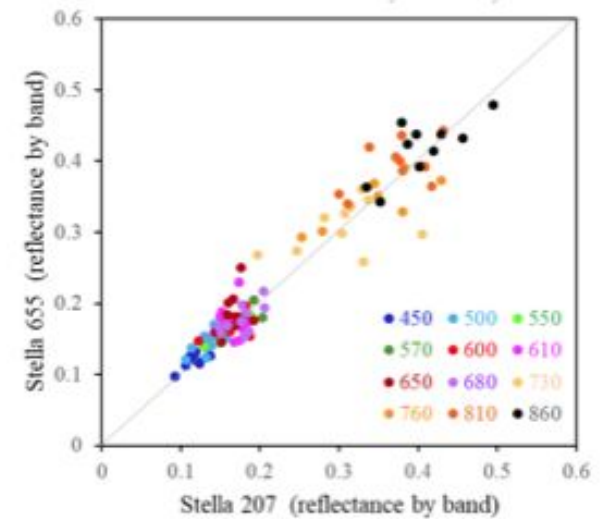
- Evaluate how STELLA measurements compare to a field spectrometer
- Establish field protocols to measure with STELLA different canopies



- Comparing Stella and ASD for crops, the results were strongly correlated



- Comparing NDVI between ASD and STELLA the results for soybean were slightly better (higher R^2)



- Comparing two Stella instruments (207 and 655) we obtained comparable measurements for grass





CHALLENGES:

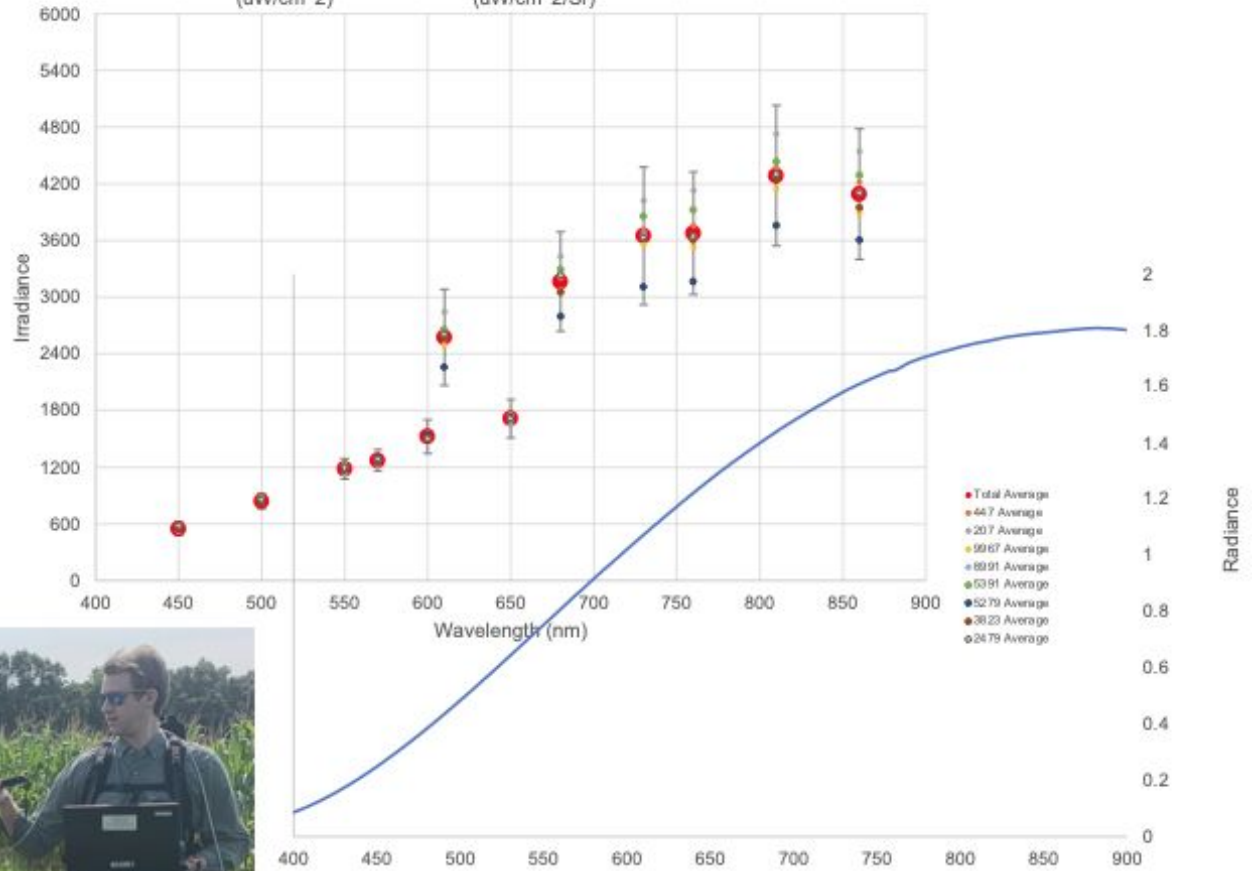
- Measuring diverse canopies
- Comparing data from instruments with a very different field of view
- Canopy diversity and movement
 - Others?
 - Additional experiments using diverse targets are needed



STELLA Calibration



Stella Irradiance Vs ASD Radiance
($\mu\text{W}/\text{cm}^2$) ($\mu\text{W}/\text{cm}^2/\text{Sr}$)



STELLA-AQ

(Science and Technology Education for Land / Life Assessment – Air Quality Edition)

Introducing the STELLA A(ir) Q(uality) instrument!

STELLA-AQ senses and records:

- Humidity, temperature, barometric pressure -- BME280
- CO2 concentration -- SCD-40
- Air Quality / Particulate Matter (PM) -- PMSA003I

STELLA-AQ is **modular** aka the instrument will function even if any of the three sensors are not present, allowing builders to reduce the cost by excluding individual sensors.

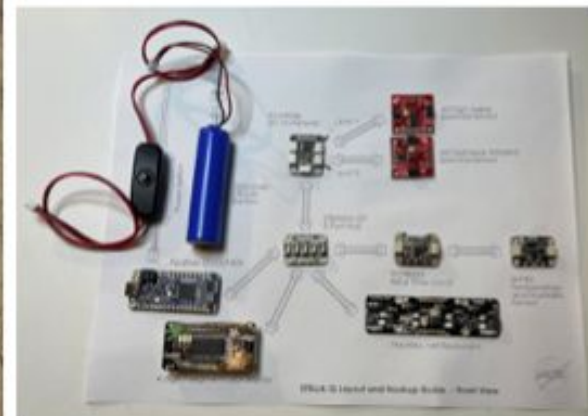
\$204 parts cost, with all three sensors.



E Landsat satellite data has been useful in estimating air quality, particularly in measuring particulate matter (PM) concentrations like PM10 and PM2.5 across various urban areas globally.



Open-source [build instructions](#), [material lists](#), and [code](#) available, including diagrams and a [Github forum](#) for additional user support.



STELLA Dataviewer

#batch

0

1

Graphs

RAW

NDVI

REFLECTANCE

distance (cm) +

1

calibration #batch

0

1

03/06/2023

time: 4:03:01 PM

21.1°C air_temp

20.9°C surface_temp

37% relative_humidity

3.84 V battery_voltage

The #batch section of the sidebar allows you to select which batch you are currently viewing.

Visible (filtered) Infrared (filtered)

UID: 9631

μW/cm²

Wavelength (nm)

Record

5/8

Help

Graphs and Indices -

+ 'RAW'

+ 'NDVI'

- 'SR'

'SR' ('Simple Ratio')

$SR = R860/R650$

Vegetation indices are commonly used as

Reflectance

Wavelength (nm)

• Tutorial Sequence

• Improved Help Section

• Updated UI

STELLA Instruments

STELLA-1.1



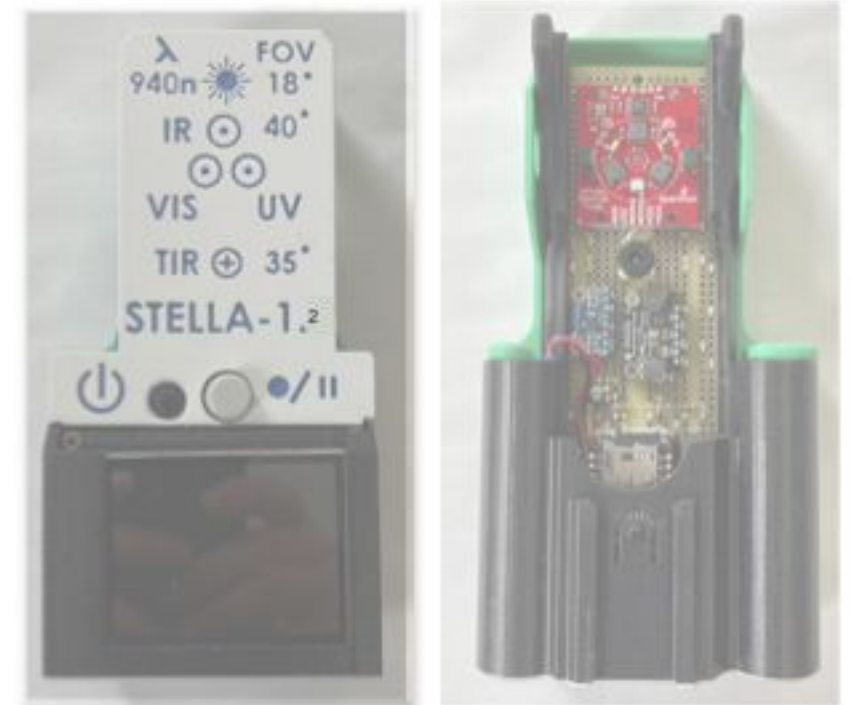
- 12 channels: 6 visible, 6 near infrared
- Infrared remote surface temperature
- Air temperature, humidity, pressure
- LiDAR and cuvette holder accessories
- Touchscreen display

STELLA-2.0



- 12 channels: 6 visible, 6 near infrared
- Infrared remote surface temperature
- Air temperature, humidity, pressure
- Bluetooth connects to smart phone
- 68 g bare mass, 112 g with housing

STELLA-1.2 — in development

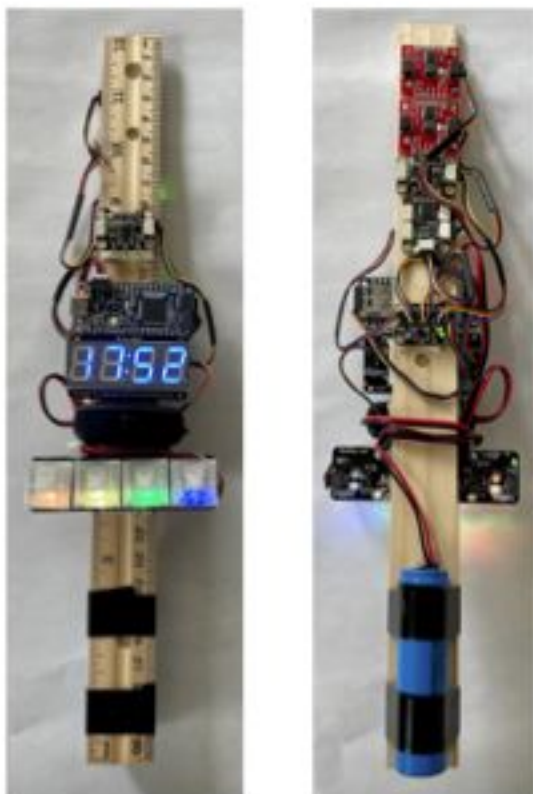


- 18 channels: UV, visible, near infrared
- Infrared remote surface temperature
- Air temperature, humidity, pressure
- LiDAR and cuvette holder accessories
- Touchscreen display
- And much more

STELLA Instruments — Quick Connect Series

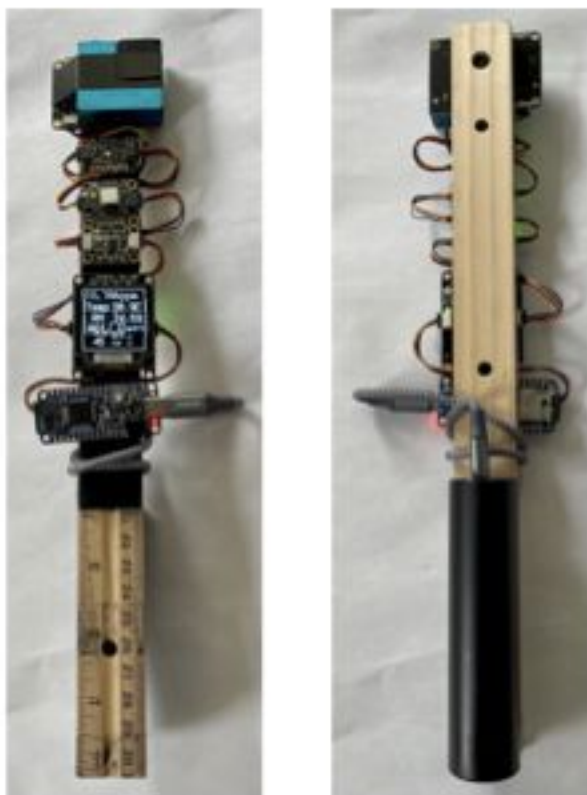
Plug-in connectors only, no soldering required

STELLA-Q1



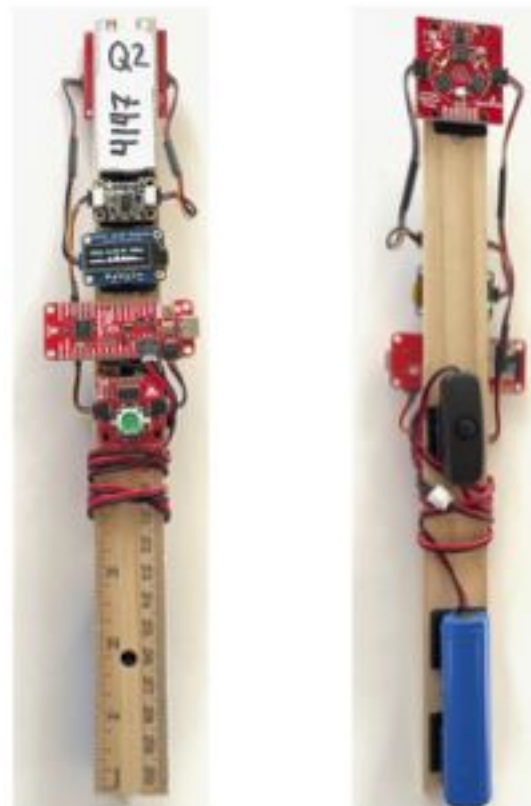
- 12 channels: 6 visible, 6 near infrared
- Air temperature, humidity, pressure

STELLA-AQ



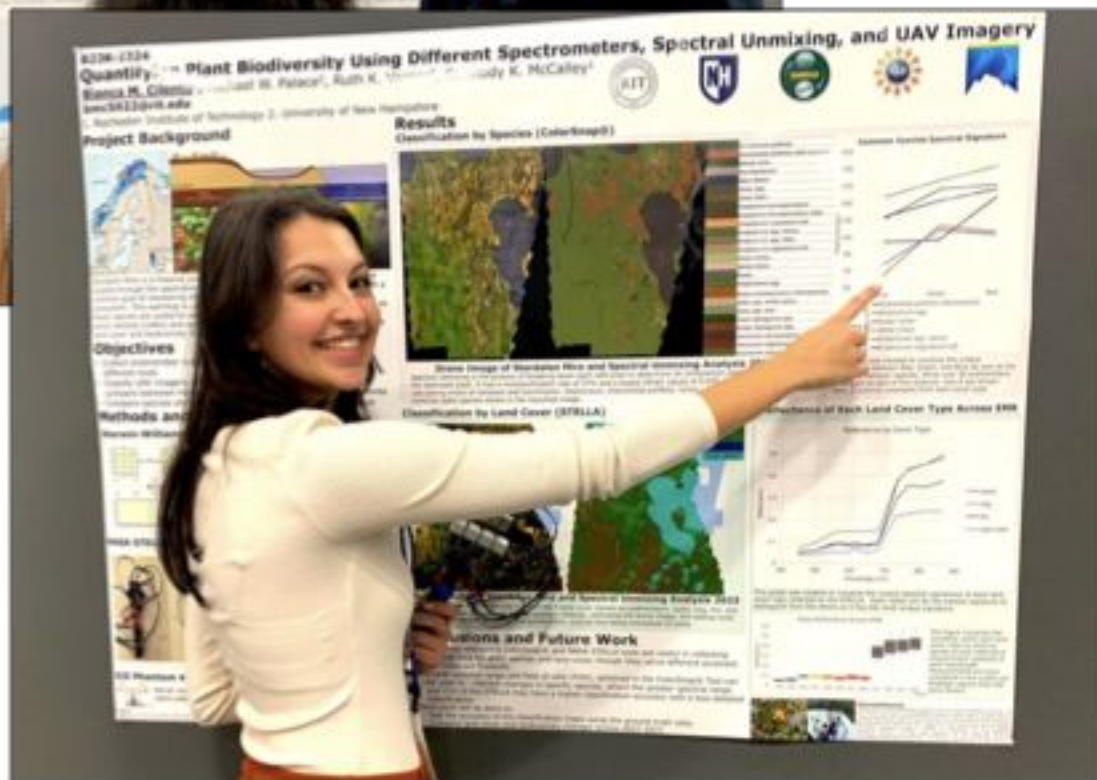
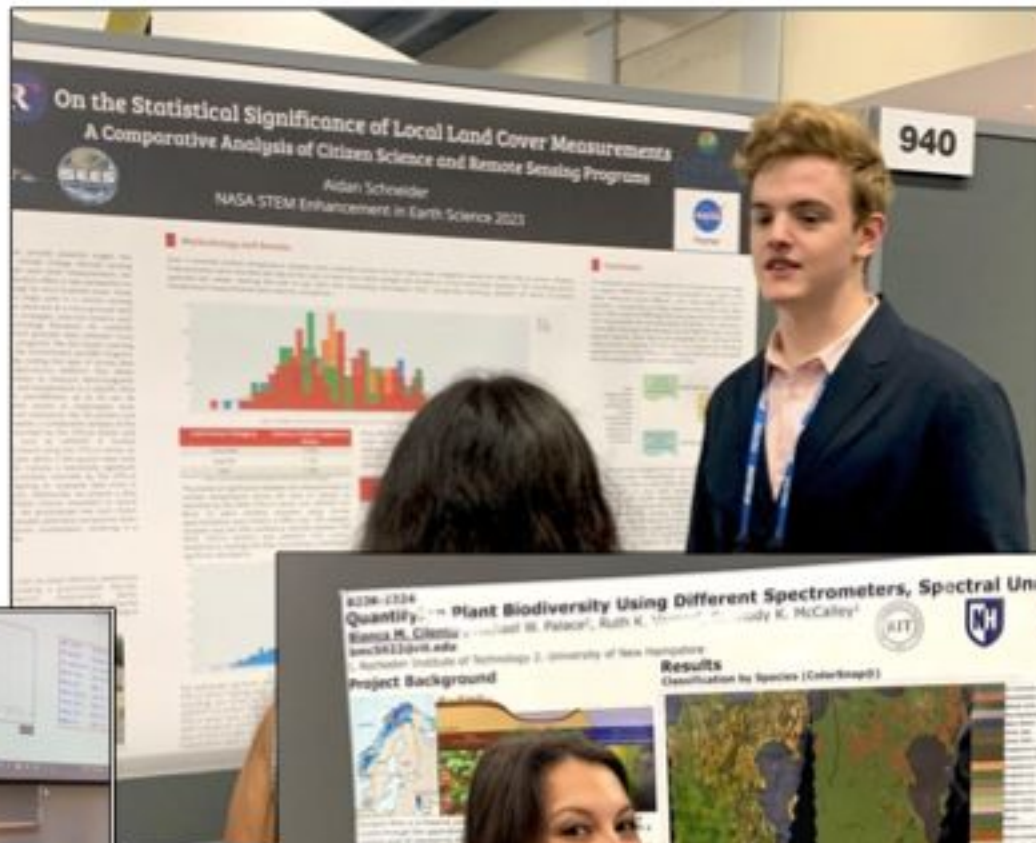
- CO₂ 400 to 2000 ppm
- Particulate counter: PM1, PM2.5, PM10
- AQI_p, Air Quality Index for particulates
- Air temperature, humidity, pressure

STELLA-Q2



- 18 channels: visible, near infrared
- Live graphical display
- 410nm to 940nm
- Very low cost

A Few Uses





STELLA Website:

<https://landsat.gsfc.nasa.gov/stella/>

STELLA Forum:

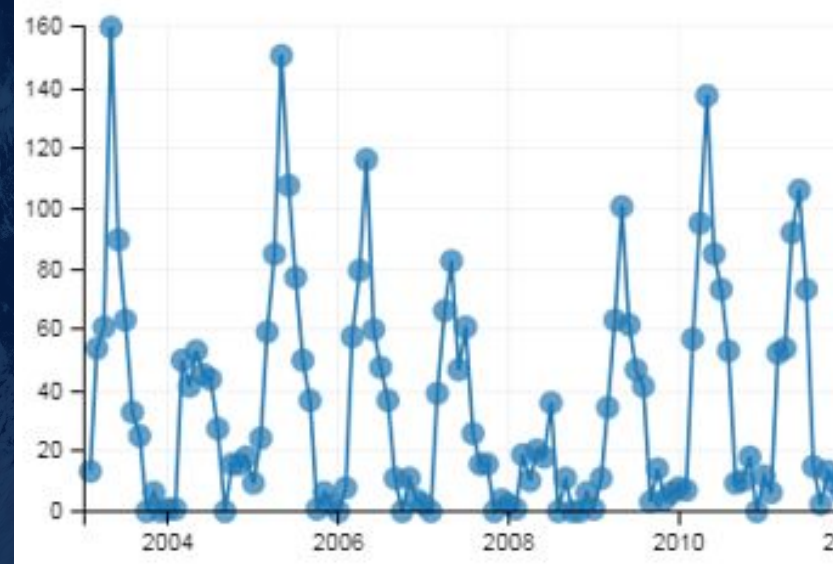
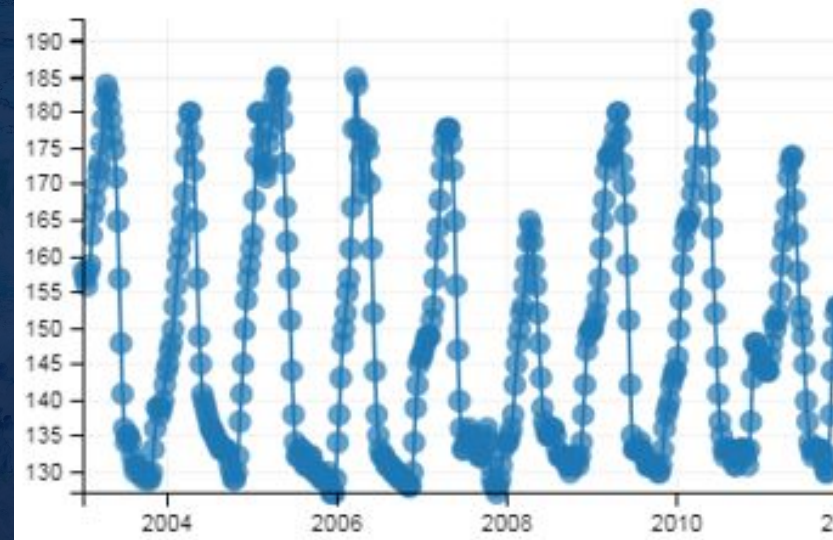
<https://github.com/STELLA-Landsat/STELLA/discussions>



Introduction to AppEEARS

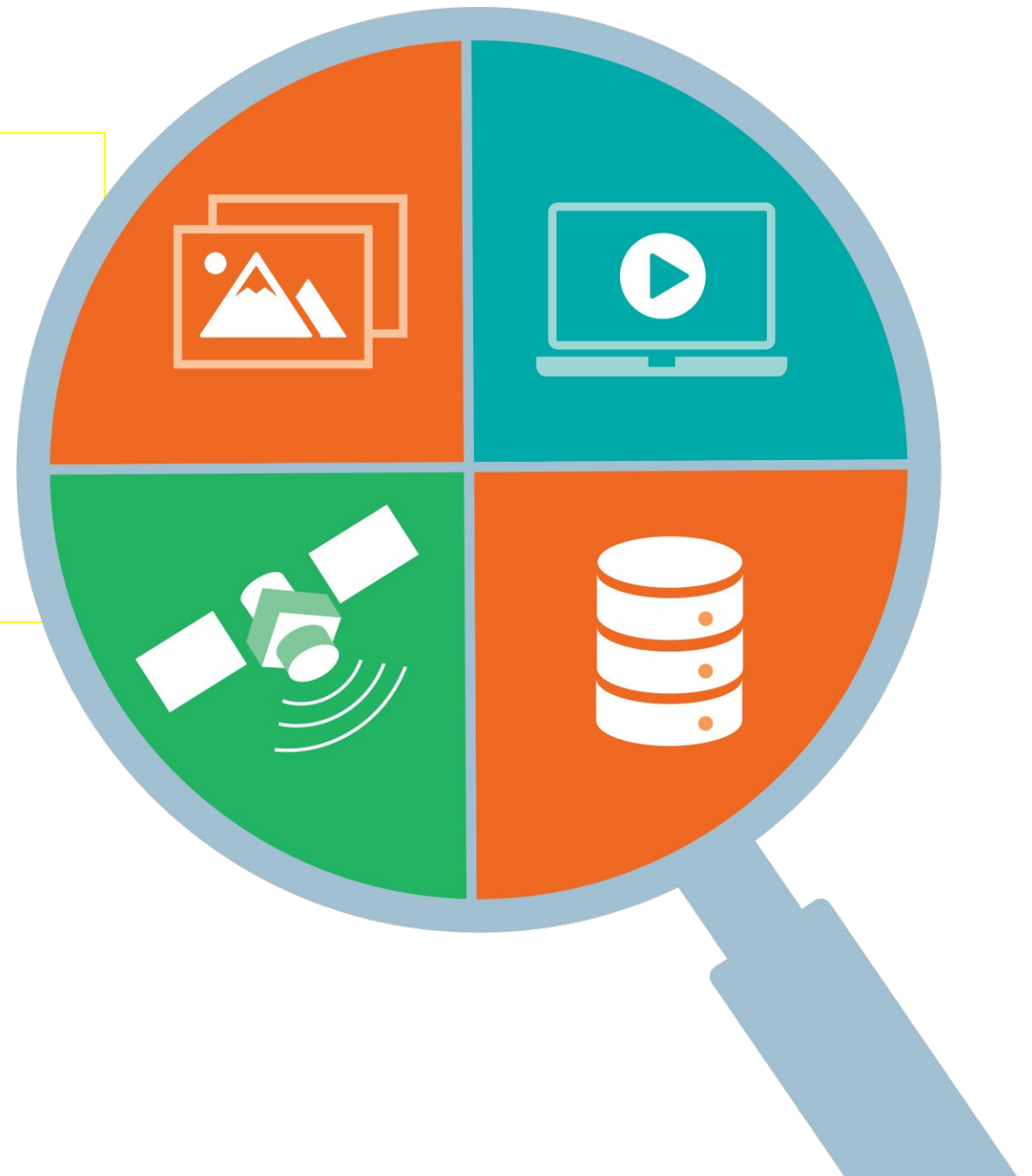
Elizabeth Joyner
3-3:40PM

Credit: NASA/USGS



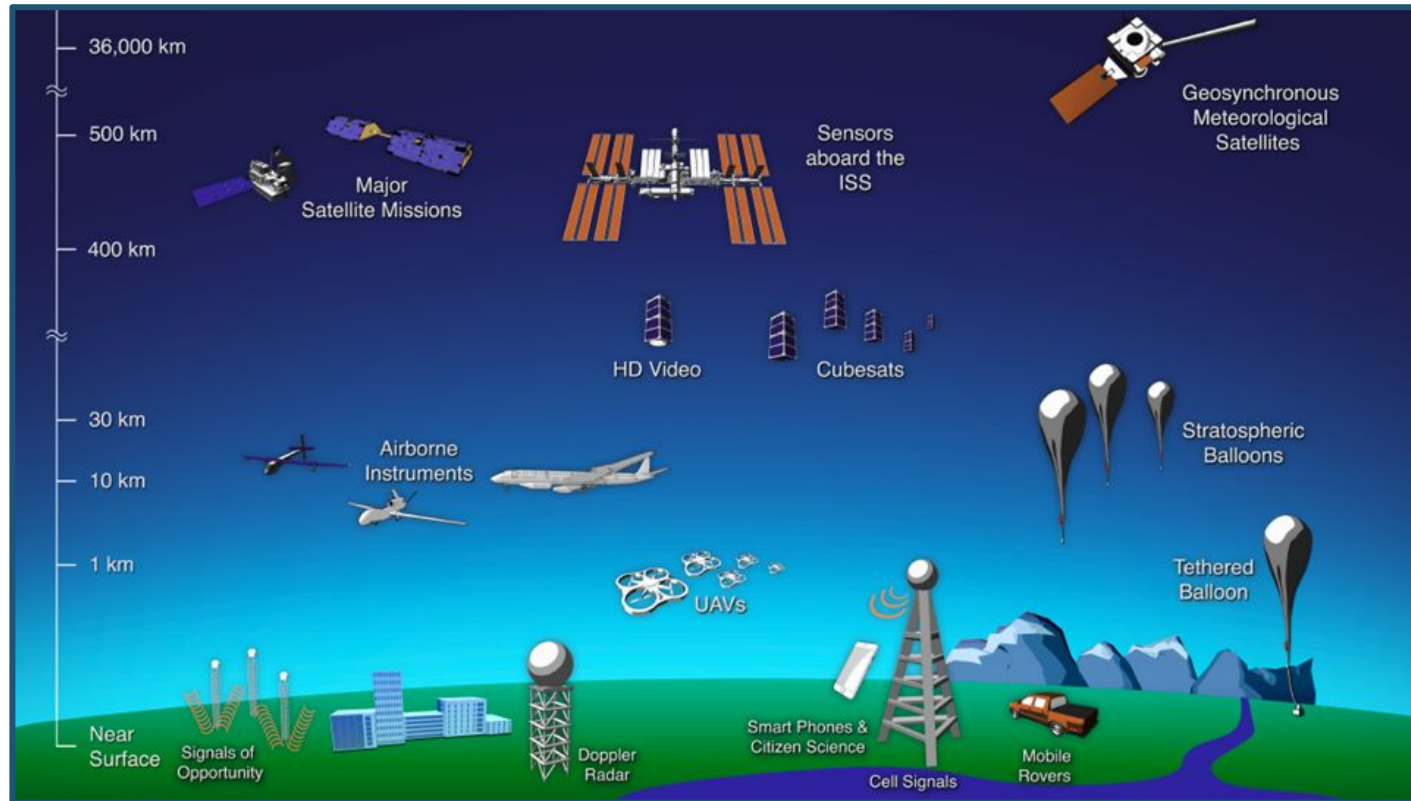
FINDABLE

- Where do you get data?
 - **AppEEARS**
 - Worldview
 - Giovanni
 - Earthdata Search
 - Science Discovery Engine



EARTHDATA

Remote & In-Situ Earth Observations



How does NASA make science observations?

→ From Space, right...?

yes...

but *also* from:

Aircraft, UAS

Ships, R/Vs

Balloons

Vehicles

Ground networks

Ocean platforms

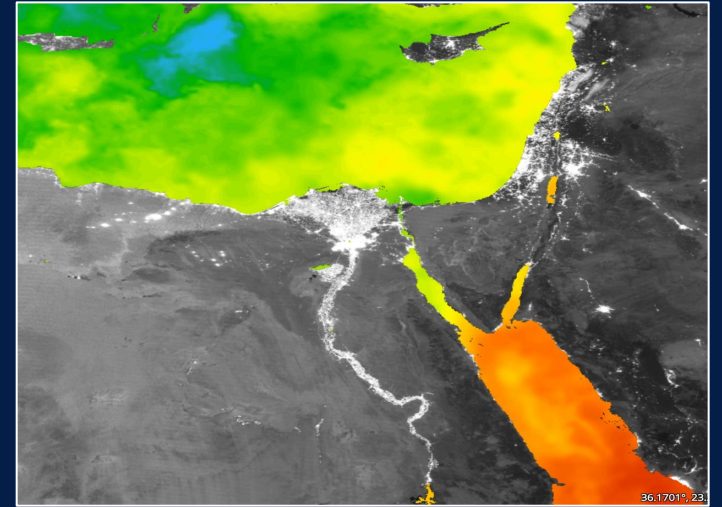
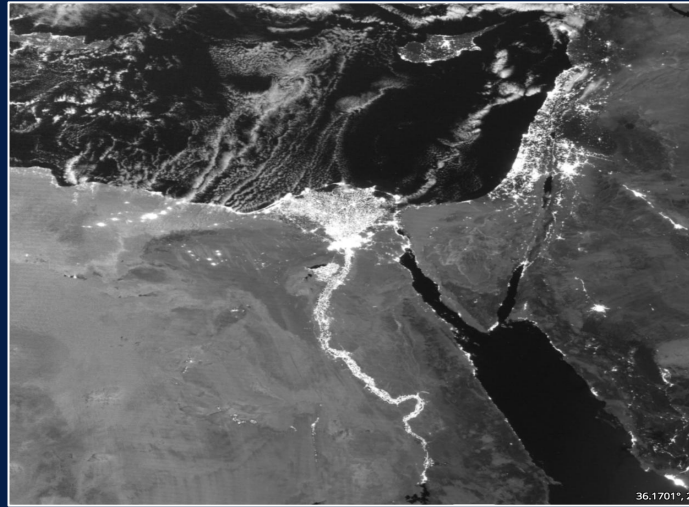
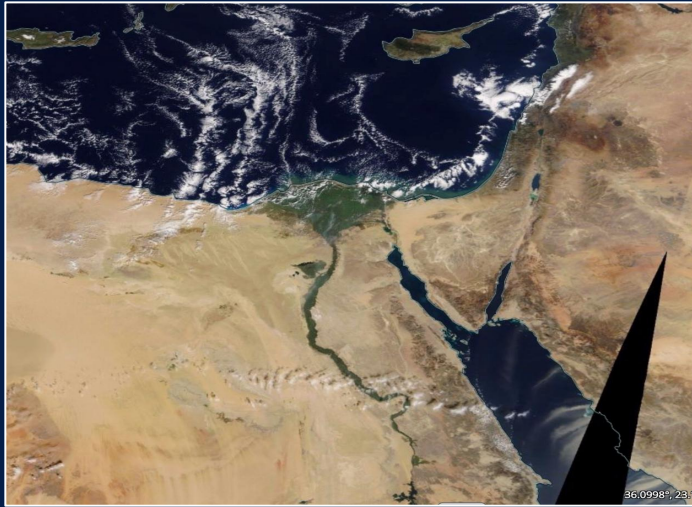
Credit: NASA



- North America
- South America
- Europe
- Africa

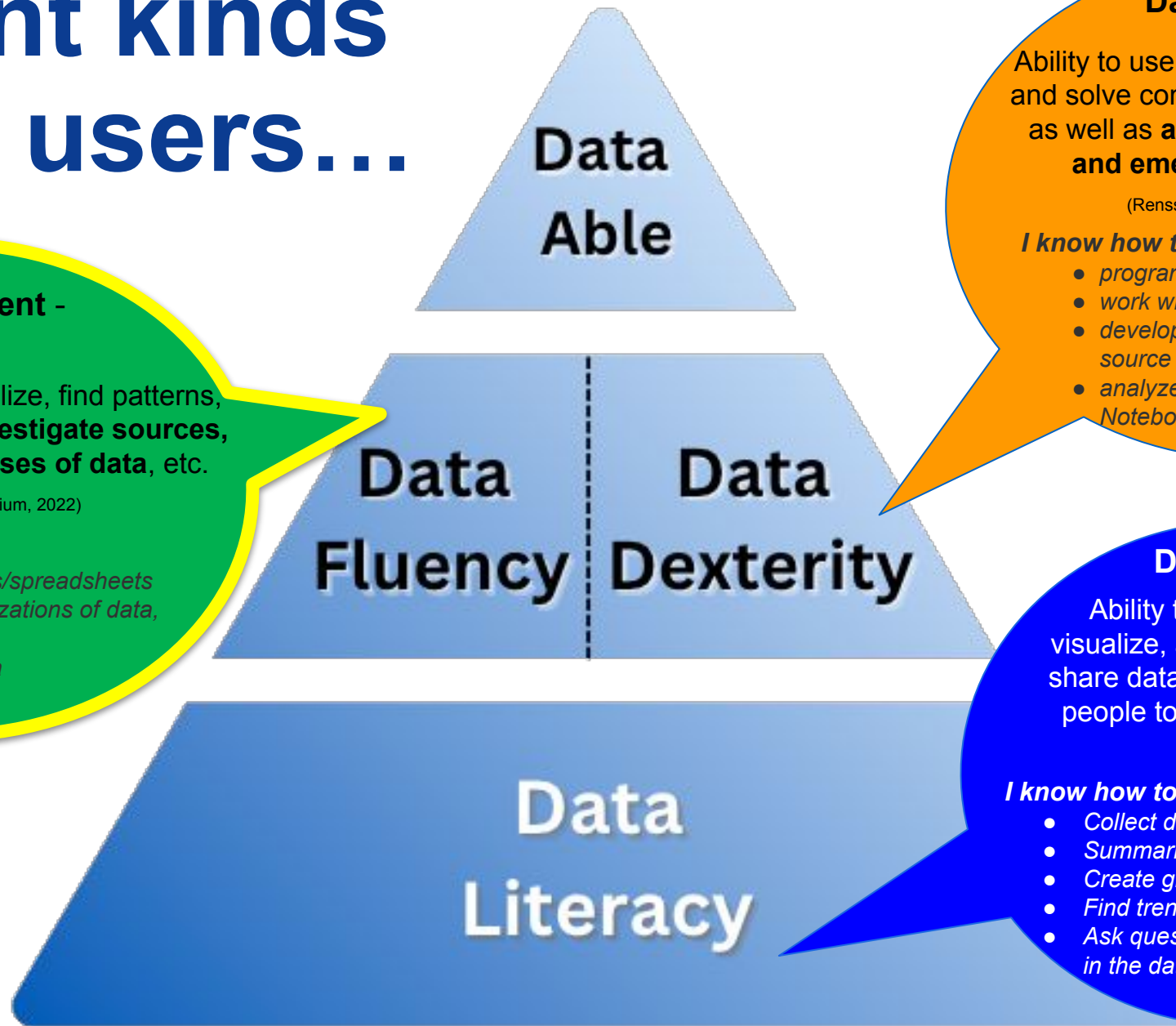
- Asia
- Australia

23:06:30



NASA's Earthdata is the single largest repository of Earth science data in the world.

Different kinds of data users...



Data Fluent -

Ability to explore, visualize, find patterns, identify problems, investigate sources, think about ethical uses of data, etc.

(Concord Consortium, 2022)

I know how to:

- Work with databases/spreadsheets
- Create maps, visualizations of data, dashboards, etc.
- Evaluate bias in data

Data Dextrous

Ability to use diverse datasets to define and solve complex real-world problems, as well as **adapt and adopt existing and emerging technologies**.

(Rensselaer Polytechnic Inst, 2022)

I know how to:

- program/code regularly
- work with data in the cloud
- develop technologies using open source resources
- analyze data in Jupyter Notebook or Google Colab

Data Literate

Ability to collect, organize, visualize, analyze, interpret, and share data for yourself and other people to use and understand.

(Dataspire, 2021)

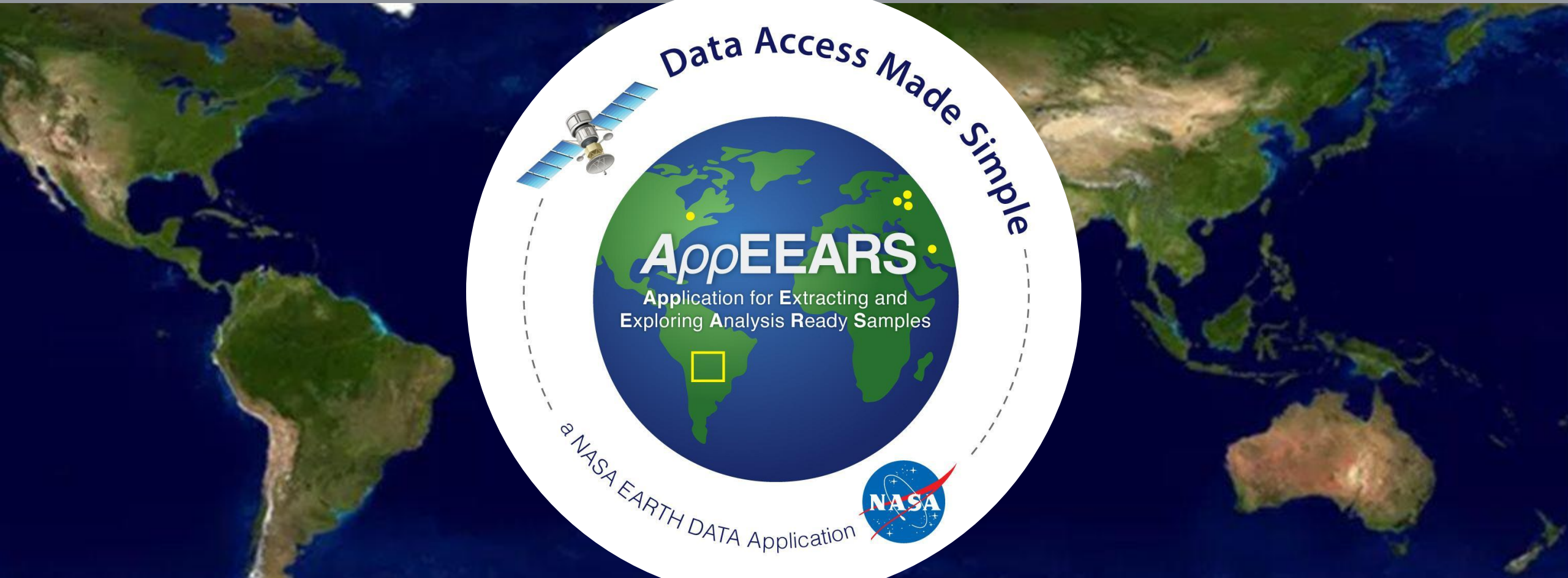
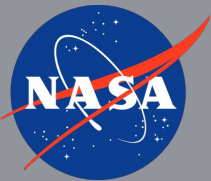
I know how to:

- Collect data
- Summarize data
- Create graphs/charts of data
- Find trends and identify outliers
- Ask questions and identify insights in the data

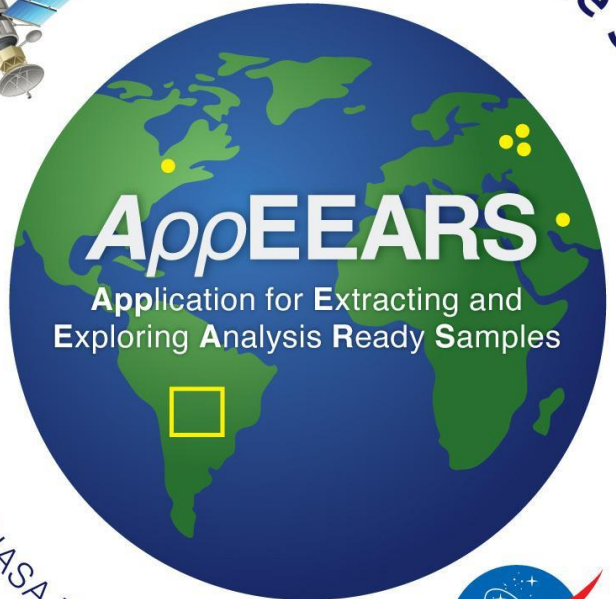


Common NASA Tools & Their Characteristics

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Freedom/Choice for Working with Data</p> <p>Worldview</p> <ul style="list-style-type: none"> • Data Exploration Tool • Easy, Intuitive Learning Curve • Highly Visual User Interface • Parameters span a variety of Earth science disciplines • Cannot Download data directly • Imagery Only 	<p>Giovanni</p> <ul style="list-style-type: none"> • Easy-Moderate learning curve • Designed for basic analysis (20+ types) No error bars, limited statistics, coarser resolution • Parameters span a variety of Earth science disciplines • Limited to GES DISC Holdings <i>Mostly</i> • Download data in a variety of formats (CSV, GEOTIFF, NetCDF) • Level 3 & 4 • Can be slow 	<p style="text-align: center;">AppEARS</p> <ul style="list-style-type: none"> • Easy-Moderate learning curve • Provides information on data quality • Limited to only some of the NASA data centers • Download data in a variety of formats (CSV, GEOTIFF, NetCDF) • Can be slow to receive information • Parameters are mostly limited to land processes 	<p>GIS</p> <ul style="list-style-type: none"> • GIS Image service and OGC service-WMS/WCS • Access to a large amount of data without the user needing to store and process the data • Ability to view, subset and analyze the data using ArcGIS, QGIS • Build GIS applications, webmaps, story maps • Available for Level 3 & 4 (as of now) • Available for high value datasets 	<p>Earthdata Search</p> <ul style="list-style-type: none"> • Intermediate-Advanced learning curve • Provides comprehensive access to NASA's Earth science data holdings • Search tool only, no analytics • Provides the data for the user to analyze as needed for science • Offers data from all of NASA's DAACs & partners • Variety of data formats • Provides all levels of NASA data (1-4) • Parameters span the Earth science disciplines
<p>Advanced Data Skills/Knowledge Required</p>				



Data Access Made Simple



AppEEARS

Application for Extracting and Exploring Analysis Ready Samples

a NASA EARTH DATA Application



EARTHDATA

Land Processes Distributed Active Archive Center

Access remote sensing data through point and or area samples of your choice

 EARTHDATA LOGIN



AppEEARS
Application for Extracting and Exploring Analysis Ready Samples

Access remote sensing data through point and or area samples of your choice

Spectral Reflectance	Temperature	Water Bodies
Snow Cover	Snow Water Equivalent	Evaporative Stress
Evapotranspiration	Fire	Freeze Thaw Date
Precipitation	Emissivity	Water Balance
Vegetation Phenology	Vegetation Indices	Water Use Efficiency
Landcover	Human Population	Soil Moisture
Albedo	Vapor Pressure	Elevation



Access remote sensing data through point and area samples of your choice while avoiding challenging dataset nuances

No file naming conventions, Grids, Tiles, or Julian dates

Spectral Reflectance	Temperature	Water Bodies
Snow Cover	Snow Water Equivalent	Evaporative Stress
Evapotranspiration	Fire	Freeze Thaw Date
Precipitation	Emissivity	Water Balance
Vegetation Phenology	Vegetation Indices	Water Use Efficiency
Landcover	Human Population	Soil Moisture
Albedo	Vapor Pressure	Elevation

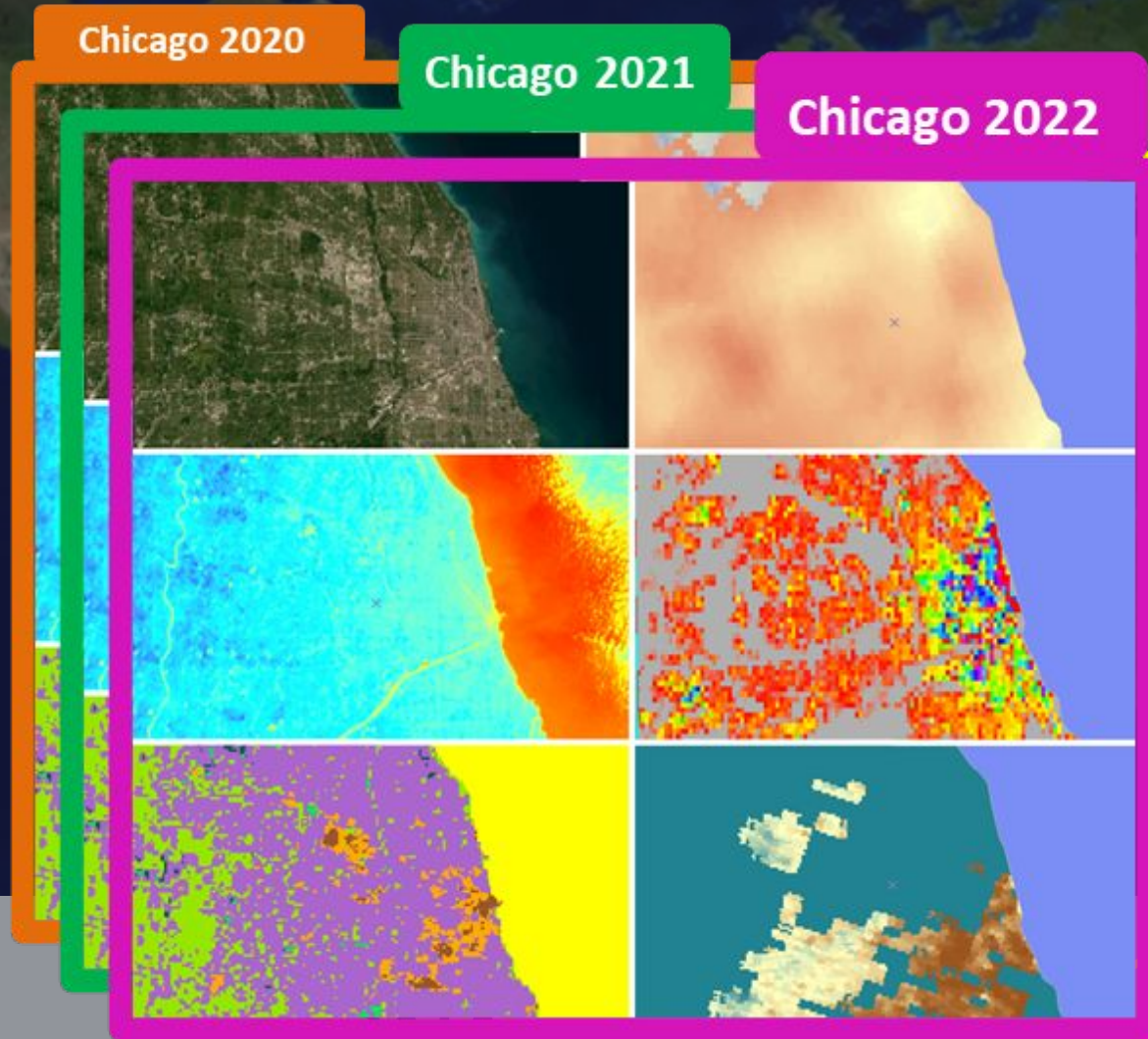


Subset multiple datasets simultaneously



EARTHDATA

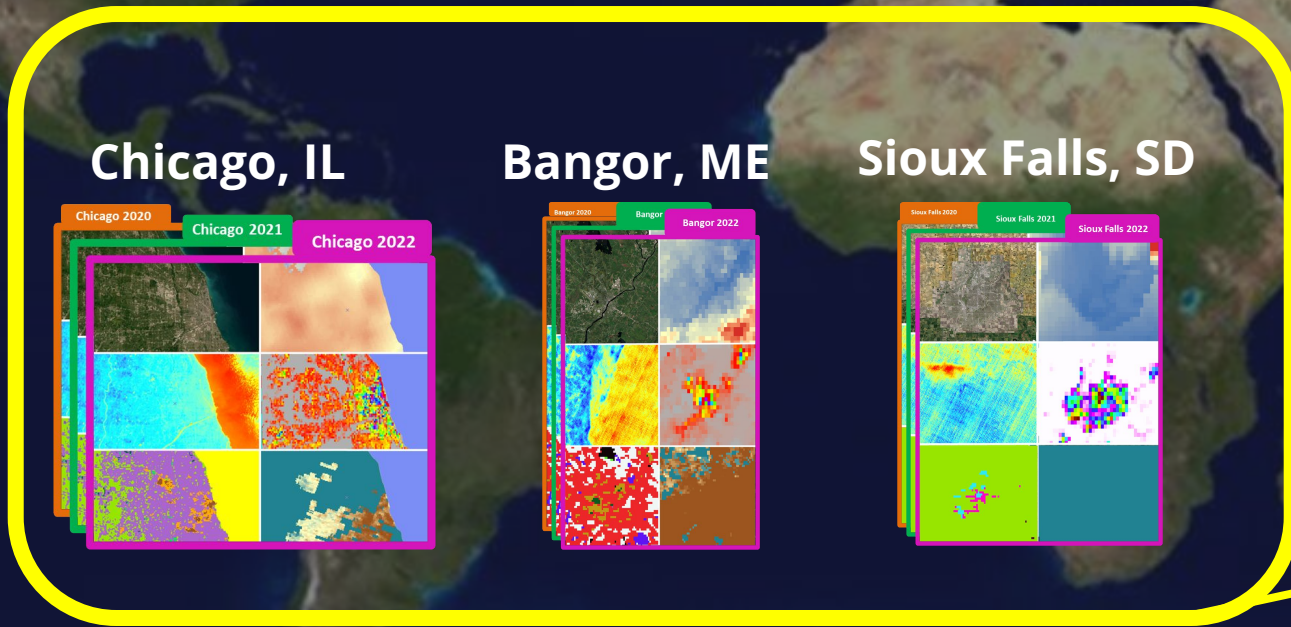
Subset multiple datasets and years simultaneously



Subset multiple datasets, years, and locations simultaneously



Choose a projection and file type that works for you!



Keep track of and revisit your requests (for years)

Explore Requests Please see [Sample Request Retention](#) for details on expired requests.

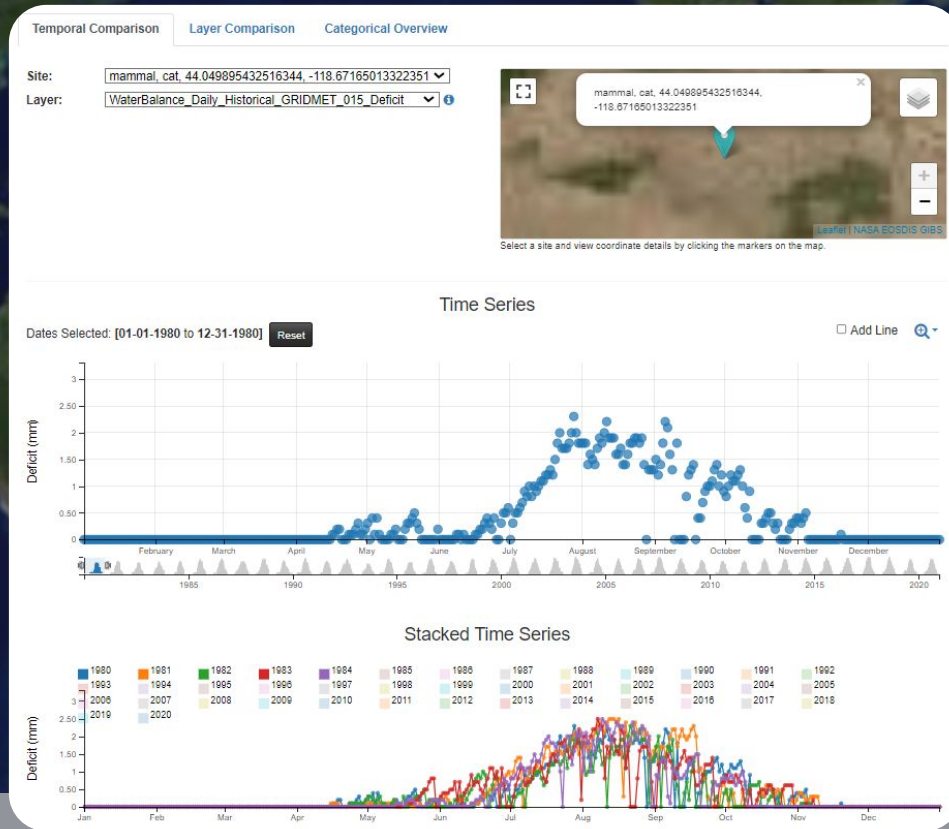
Showing requests 1 - 32 of 32

« Prev 1 Next »

Request	Type	Status	Details	Date Submitted	Date Completed	
bangor_land2	Area Sample	Done	i	11-14-2022 9:44:13 PM CST	11-14-2022 9:47:10 PM CST	
SF_landc2	Area Sample	Done	i	11-14-2022 9:37:47 PM CST	11-14-2022 9:39:02 PM CST	
SiouxFalls_Landcover	Area Sample	Done	i	11-14-2022 9:31:36 PM CST	11-14-2022 9:31:52 PM CST	
SiouxFalls_daymet	Area Sample	Done	i	11-14-2022 9:30:46 PM CST	11-14-2022 9:31:48 PM CST	
Bangor_landcover	Area Sample	Done	i	11-14-2022 9:29:39 PM CST	11-14-2022 9:31:06 PM CST	
Bangor_All2	Area Sample	Done	i	11-14-2022 9:28:09 PM CST	11-14-2022 9:30:47 PM CST	
Bangor_all	Area Sample	Done	i	11-14-2022 9:21:15 PM CST	11-14-2022 9:23:36 PM CST	
SiouxFalls_all	Area Sample	Done	i	11-14-2022 9:19:14 PM CST	11-14-2022 9:21:30 PM CST	
Chicago_landcover	Area Sample	Done	i	11-14-2022 7:28:44 PM CST	11-14-2022 7:30:50 PM CST	
Chicago2	Area Sample	Done	i	11-14-2022 7:11:43 PM CST	11-14-2022 7:15:25 PM CST	
Chicago_All	Area Sample	Done	i	11-14-2022 11:42:14 AM CST	11-14-2022 11:48:55 AM CST	
Anchorage_temp2	Area Sample	Done	i	11-14-2022 11:29:00 AM CST	11-14-2022 11:32:16 AM CST	



Explore your data prior to download



Share your requests with friends and colleagues

Request: acadia

Download Zip

Supporting Files

acadia-WaterBalance-Monthly-Historical-GRIDMET-015-metadata.xml	ISO 19115 Metadata	16.09 KB
acadia-granule-list.txt	URLs for all source data used in the extraction	5.1 KB
README.md	Instructions and details about the request	21.12 KB
acadia-request.json	JSON file which can be used to create a new request	1.19 KB

Upload a request file

Drop a JSON file containing the request to copy or click here to select the file.

JSON request files (*.request.json) are included in the download bundle available from any AppEEARS requests.



Missions supported

SMAP SOIL MOISTURE
ACTIVE PASSIVE

ASTGTM v003

ASTER Global Digital Elevation Model 1 arc second

LANDSAT

Harmonized Landsat Sentinel-2

MODIS

MODERATE RESOLUTION IMAGING SPECTRORADIOMETER

Visible Infrared Imaging Radiometer Suite (VIIRS)

SOCIOECONOMIC DATA AND APPLICATIONS CENTER (SEDAC)

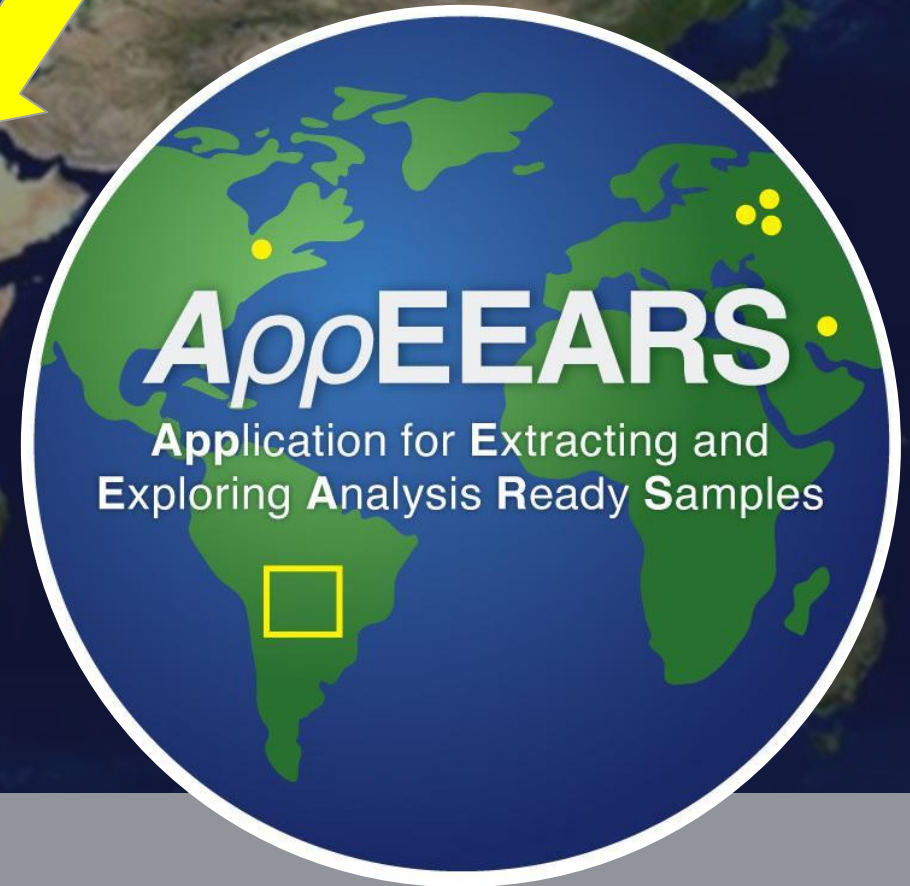
Gridded Population of the World (GPW), v4

Daily Historical Water Balance Products for the CONUS

DAYMET
DAILY SURFACE WEATHER AND
CLIMATOLOGICAL SUMMARIES
ORNL DAAC

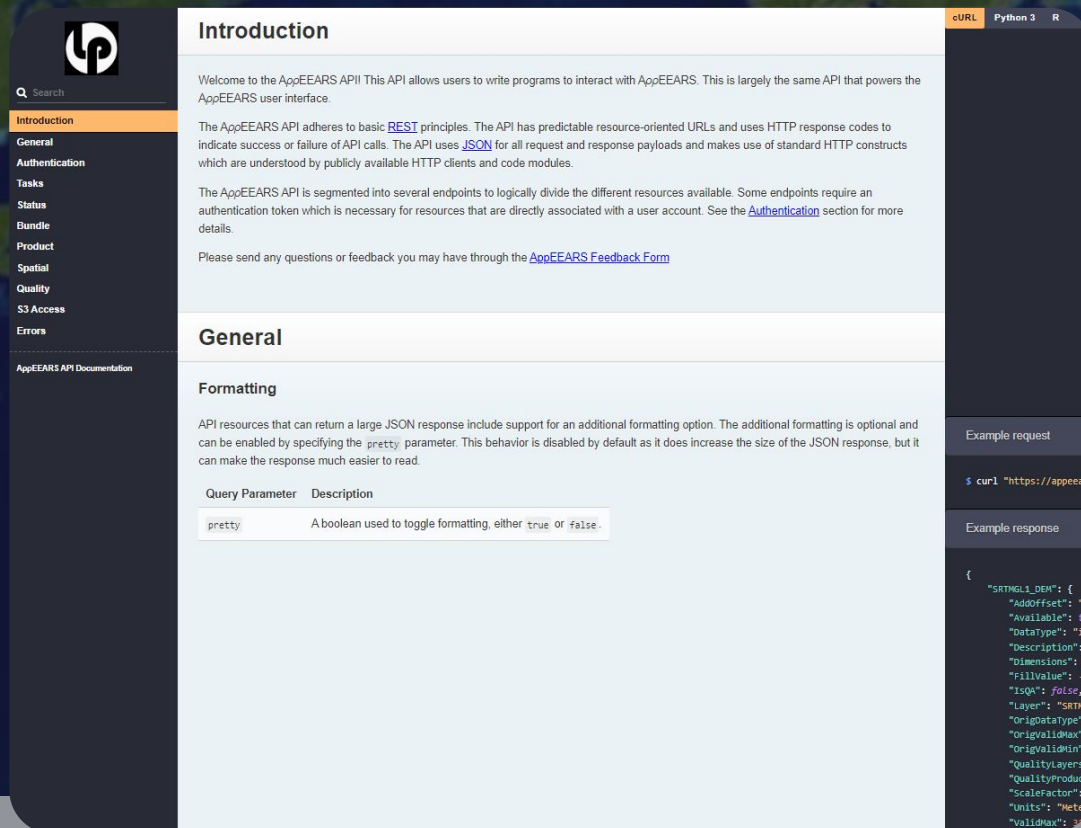
ECOSTRESS

**Shuttle Radar
Topography Mission**
The Mission to Map the World



EARTHDATA

Use the **API** for programmatic access



Introduction

Welcome to the AppEEARS API! This API allows users to write programs to interact with AppEEARS. This is largely the same API that powers the AppEEARS user interface.

The AppEEARS API adheres to basic [REST](#) principles. The API has predictable resource-oriented URLs and uses HTTP response codes to indicate success or failure of API calls. The API uses [JSON](#) for all request and response payloads and makes use of standard HTTP constructs which are understood by publicly available HTTP clients and code modules.

The AppEEARS API is segmented into several endpoints to logically divide the different resources available. Some endpoints require an authentication token which is necessary for resources that are directly associated with a user account. See the [Authentication](#) section for more details.

Please send any questions or feedback you may have through the [AppEEARS Feedback Form](#).

General

Formatting

API resources that can return a large JSON response include support for an additional formatting option. The additional formatting is optional and can be enabled by specifying the `pretty` parameter. This behavior is disabled by default as it does increase the size of the JSON response, but it can make the response much easier to read.

Query Parameter	Description
<code>pretty</code>	A boolean used to toggle formatting, either <code>true</code> or <code>false</code> .

Example request

```
$ curl "https://appeears" -H "Content-Type: application/json" -d '{"pretty": true}'
```

Example response

```
{
  "SRTMGL1_DEM": {
    "AddOffset": "",
    "Available": true,
    "DataType": "int",
    "Description": "SRTMGL1 DEM",
    "Dimensions": [
      "FillValue": -99,
      "ISQA": false,
      "Layer": "SRTMGL1",
      "OrigDataType": "int",
      "OrigValidMax": 99,
      "OrigValidMin": -99,
      "QualityLayers": "SRTMGL1",
      "QualityProduct": "SRTMGL1",
      "ScaleFactor": 1,
      "Units": "Meter",
      "ValidMax": 99,
      "ValidMin": -99
    ]
  }
}
```



Use and co-develop R and Python resources for the AppEEARS **API**



nasa / AppEEARS-Data-Resources



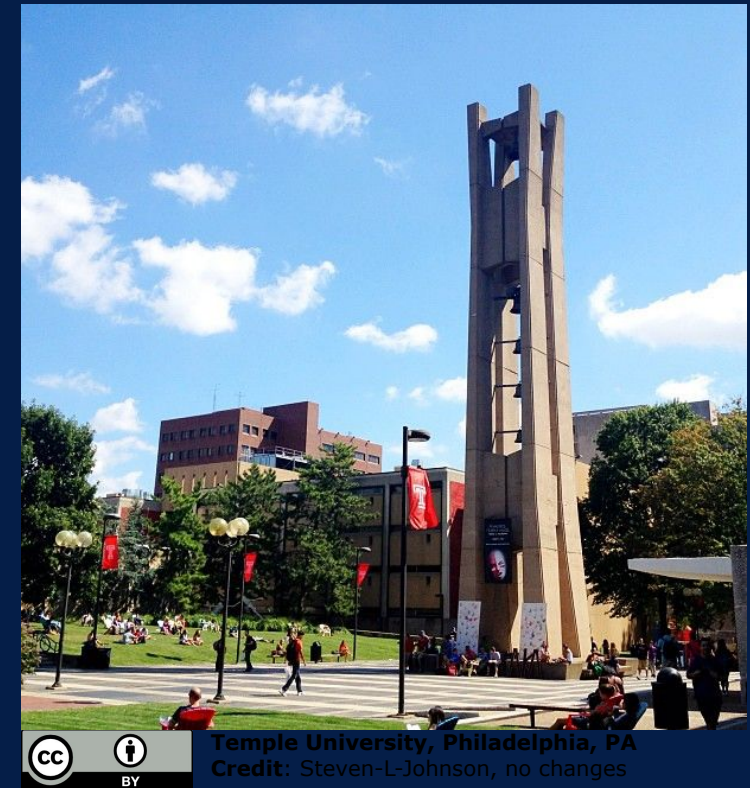
EARTHDATA

USE CASE

Arnie, natural resource planner for Temple University, Philadelphia, PA



Arnie was tasked to evaluate the green spaces around the campus to reveal changes and infer long-term trends of vegetation. Arnie must develop a proposal that includes a projection for campus beautification projects. Arnie heard of AppEEARS as a way to access NASA and USGS data for quick download and decided to use the AppEEARS tool.



Temple University, Philadelphia, PA
Credit: Steven-L-Johnson, no changes



EARTHDATA

Hands On Activity

Location: Temple University

Instrument: Landsat 8

Data: Surface reflectance data band combination 5, 4, 3

Visualization:

- Area extraction (Temple University footprint)
- Point extraction for greenspaces of interest
- Temporal and Spatial Subsetting
- Optional: Data from multiple datasets and missions (e.g., weather-related data)

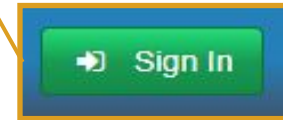
Get Started

AppEEARS Extract Explore Help

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.



EARTHDATA LOGIN

Username ?

Password

Stay signed in (this is a private workstation)

[I don't remember my username](#)
[I don't remember my password](#)
[Help](#)


Explore AppEEARS



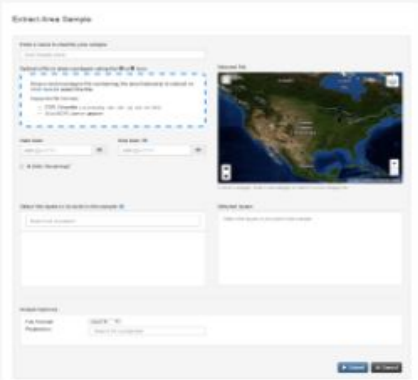
Create an Area Request

Extract Area Sample


a



Start a new request




b



Copy a previous request

You don't have any previous requests to copy.

c



Upload a request file



Drop a JSON file containing the request to copy or [click here](#) to select the file.

JSON request files (*.request.json) are included in the download bundle available from any AppEEARS requests.

Create an Area Request

Extract Area Sample

Enter a name to identify your sample


Upload a file or draw a polygon using the  or  icon

Drop a vector polygon file containing the area feature(s) to extract or [click here](#) to select the file.


Supported file formats:

- Shapefile (.zip including .shp, .dbf, .prj, and .shx files)
- GeoJSON (.json or .geojson)

Start Date

End Date 

Selected file





The map displays North America with a blue-shaded area in Hudson Bay. The map includes labels for 'Canada', 'United States of America', and 'Hudson Bay'. There are navigation controls: a square icon in the top-left, a stack of layers icon in the top-right, a diamond icon in the bottom-left, and a plus sign in the bottom-right.

Create an Area Request

Extract Area Sample

Enter a name to identify your sample


Upload a file or draw a polygon using the  or  icon



Drop a vector polygon file containing the area feature(s) to extract or [click here](#) to select the file.

Supported file formats:


- Shapefile (.zip including .shp, .dbf, .prj, and .shx files)
- GeoJSON (.json or .geojson)

d


Start Date 

End Date  

Is Date Recurring?

Select the layers to include in the sample 

Selected file



e

To clear a polygon, draw a new polygon or upload a vector polygon file.

Selected layers



Create an Area Request

Selected file

Canada

Hudson Bay

United States of America

Mexico

Lat: 26.007 Lon: -133.664

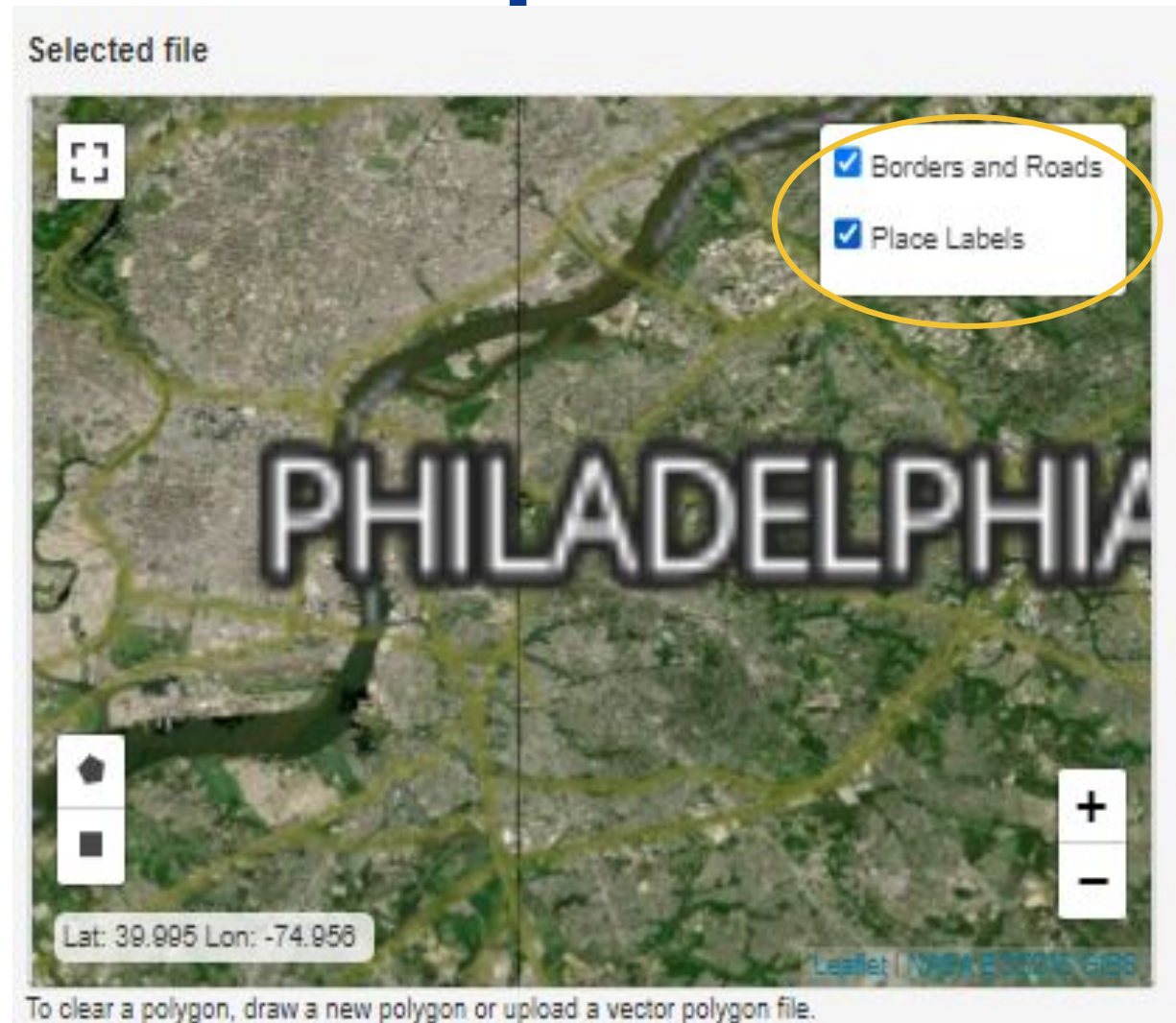
To clear a polygon, draw a new polygon or upload a vector polygon file.

Selected file (User-Drawn-Polygon)

Lat: 39.993 Lon: -75.156



To clear a polygon, draw a new polygon or upload a vector polygon file.

Create an Area Request



Setting Requirements

Date Requirements

Start Date	End Date ⓘ
<input type="text" value="07-01-2023"/> 	<input type="text" value="07-31-2023"/> 
<input type="checkbox"/> Is Date Recurring?	

Setting Requirements

Dataset Requirements

Select the layers to include in the sample ⓘ

Search for a product

Selected layers

Select the layers to include in the sample

Select the layers to include in the sample ⓘ

Search for a product

 AppEEARS Extract ▾ Explore Help ▾

Help ▾

- AppEEARS Documentation
- API Documentation
- Changelog
- Available Products
- Contact User Services

Available Products

Select a dataset below to list the products that are currently available in AppEEARS .

Aqua MODIS ▾


Product	Version	Source	Layer	
MYD09A1	061	LP DAAC	sur_refl_b01 Surface Reflectance Band 1	Available
			sur_refl_b02 Surface Reflectance Band 2	Available
			sur_refl_b03 Surface Reflectance Band 3	Available
			sur_refl_b04 Surface Reflectance Band 4	Available
			sur_refl_b05 Surface Reflectance Band 5	Available



Select *Landsat ARD*
Landsat Collection 2
ARD Surface
Reflectance - Landsat
8 L08.002, 30m, 16
Day, (2013-03-18 to
Present).

Landsat 8 Band Characteristics & Uses

Band	Wavelength (μm)	Description	Common Uses of this Band	Spatial Resolution
Green (3)*	0.53 - 0.59	Green Light	Vegetation health, land cover classification, plant vigor	30 m
Red (4)*	0.64 - 0.67	Red Light	Vegetation, vegetative slopes, natural color composites	30 m
Near-Infrared NIR (5)	0.85 - 0.88	Reflected Near-Infrared	Plant health assessment, biomass estimation, shorelines	30 m

Band Combination	Name	Common Applications of this Band Combination Application	Sample Display
5-4-3	Color Infrared (CIR)/ NIR False Color	Vegetation/Forest/Wetland health (highlight healthy vegetation (appears bright red); commonly used for measuring disturbed ground	



Setting Requirements

Dataset Requirements

- A. SR_B5 (L08.002)
- B. SR_B4 (L08.002)
- C. SR_B3 (L08.002)

The screenshot shows a web interface for selecting layers in a sample. The interface is divided into two main sections: "Select the layers to include in the sample" and "Selected layers".

Select the layers to include in the sample

- Landsat ARD Landsat Collection 2 ARD Surface Reflectance - Landsat 8**
L08.002, 30m, 16 day, (2013-03-18 to Present)
- 30m, 16 day
Band 2 Surface Reflectance
- SR_B6
30m, 16 day
Band 6 Surface Reflectance
- SR_B7
30m, 16 day

Selected layers

- SR_B3
30m, 16 day
Band 3 Surface Reflectance
- SR_B4
30m, 16 day
Band 4 Surface Reflectance
- SR_B5
30m, 16 day
Band 5 Surface Reflectance

Remove All (3)

Select All (8)

Setting Requirements

Dataset Requirements

Select GeoTIFF for File Format.

Select Geographic for Projection.

Output Options

File Format:

Projection:

Geographic ✕
Datum: WGS84
EPSG: 4326
PROJ.4: +proj=longlat +datum=WGS84
+no_defs=True


Setting Requirements

Explore Requests





Please see [Sample Request Retention](#) for details on expired requests.

Showing requests 1 - 2 of 2

« Prev 1 Next »

Request	Type	Status	Details	Date Submitted	Date Completed	
Temple University Demo	Area Sample	Queued		05-23-2024 5:43:25 PM EDT	05-23-2024 5:43:26 PM EDT	  

Manage, Explore, and Download the Results

1. **You will get an email when the request is complete.** At this time, access the **Explore Request** page to review, interact with, and explore the data.
2. Once the status of your request displays **Done**, users will have a variety of options available:
 - i. Click the **View** icon  to view and interact with your results.
3. Click on the **Request** dropdown option at the top of the page to view the sample extraction details (e.g., Date Range, Product/Layers, Input Shapefile, Output File Format/Projection and Request ID).
 - Users have visualizations to explore data: (Note: visualizations are not publication-quality visualizations but are available for quick insights before downloading data.)
 - **Layer Stats Tab**
 - The Download Icon  to download the results (.zip).
 - There are a couple of ways to download the data
 - Visit the Explore Screen, select the dropdown for the Request. Click the **Download** button 
 - Or visit the Explore navigation and select **Explore Requests**, and select the download  icon.
 - The Download Area Sample page contains two sections:
 - Supporting Files
 - The sample request output **GeoTIFF** or NetCDF-4 files

Create a Point Request



Extract Point Sample

Enter a name to identify your sample

Point Sample name

Upload coordinates from a file

Drop a CSV file containing the coordinates or click here to select the file. Coordinates can also be entered manually in the uploaded coordinates box.

The CSV file can contain up to 4 columns separated by commas with each coordinate on a separate line.

1. ID (optional) - uniquely identifies the coordinate
2. Category (optional) - label to group common coordinates
3. Latitude - latitude in decimal degrees (-90 to 90)
4. Longitude - longitude in decimal degrees (-180 to 180)

Uploaded coordinates (ID, Category, Lat, Long): 0

Upload or enter the coordinates to include in the sample (e.g. US-Ha1, DBF, 42.5378, -72.1715)

Setting Requirements

Date Requirements: 07/01/2013 to 07/01/2023

Start Date	End Date ⓘ
<input type="text" value="07-01-2013"/> 	<input type="text" value="07-01-2023"/> 
<input type="checkbox"/> Is Date Recurring?	

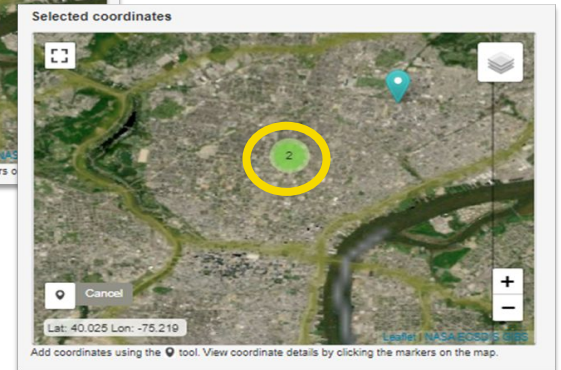
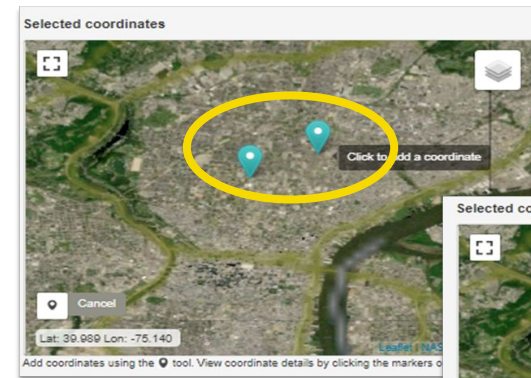
Setting Requirements

Spatial Requirements:

1. Insert the coordinates of your AOI in one of the following methods:

- a. Upload or drop a CSV file containing lat/long coordinates.*
- b. Manually enter the coordinates of your AOI in the right hand box under "Uploaded Coordinates". Inputs must be entered so that each row represents a single site and each column is separated by a comma.*
If you do not know the coordinates of green spaces for Temple University, consider using the following:

Zoom to your AOI on the map box (bottom right), select the **Point icon Map** point draw icon and then click on a location. (Note: You may not be able to zoom to your AOI at the resolution necessary).



Name of Green Space	Coordinates
Beury Beach	39.981588, -75.154273
1828 N Park Ave	39.980904, -75.156423
1801 N Broad St	39.981212, -75.154050
2001-59 N 13th St	39.983620, -75.153837

Setting Requirements

Dataset Requirements

Select the layers to include in the sample ⓘ

Search for a product

Selected layers

Select the layers to include in the sample

Select the layers to include in the sample ⓘ

Search for a product

 AppEEARS Extract ▾ Explore Help ▾

Help ▾

- AppEEARS Documentation
- API Documentation
- Changelog
- Available Products
- Contact User Services

Available Products

Select a dataset below to list the products that are currently available in AppEEARS .

Aqua MODIS ▾

Product	Version	Source	Layer	
MYD09A1	061	LP DAAC	sur_refl_b01 Surface Reflectance Band 1	Available
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			sur_refl_b03 Surface Reflectance Band 3	Available
			sur_refl_b04 Surface Reflectance Band 4	Available
			sur_refl_b05 Surface Reflectance Band 5	Available



Select *Landsat ARD*
Landsat Collection 2
ARD Surface
Reflectance - Landsat
8 L08.002, 30m, 16
Day, (2013-03-18 to
Present).

Setting Requirements

Dataset Requirements

- A. SR_B5 (L08.002)
- B. SR_B4 (L08.002)
- C. SR_B3 (L08.002)

Select the layers to include in the sample ⓘ

Landsat ARD Landsat Collection 2 ARD Surface Reflectance - Landsat 8 ✕
L08.002, 30m, 16 day, (2013-03-18 to Present)

30m, 16 day Band 2 Surface Reflectance	+
SR_B6 30m, 16 day Band 6 Surface Reflectance	+
SR_B7 30m, 16 day	+

Select All (8)

Selected layers

SR_B3 30m, 16 day Band 3 Surface Reflectance	-
SR_B4 30m, 16 day Band 4 Surface Reflectance	-
SR_B5 30m, 16 day Band 5 Surface Reflectance	-

Remove All (3)




Setting Requirements

Explore Requests





Please see [Sample Request Retention](#) for details on expired requests.

Showing requests 1 - 2 of 2

« Prev 1 Next »

Request	Type	Status	Details	Date Submitted	Date Completed	
Temple University Demo	Area Sample	Queued		05-23-2024 5:43:25 PM EDT	05-23-2024 5:43:26 PM EDT	  

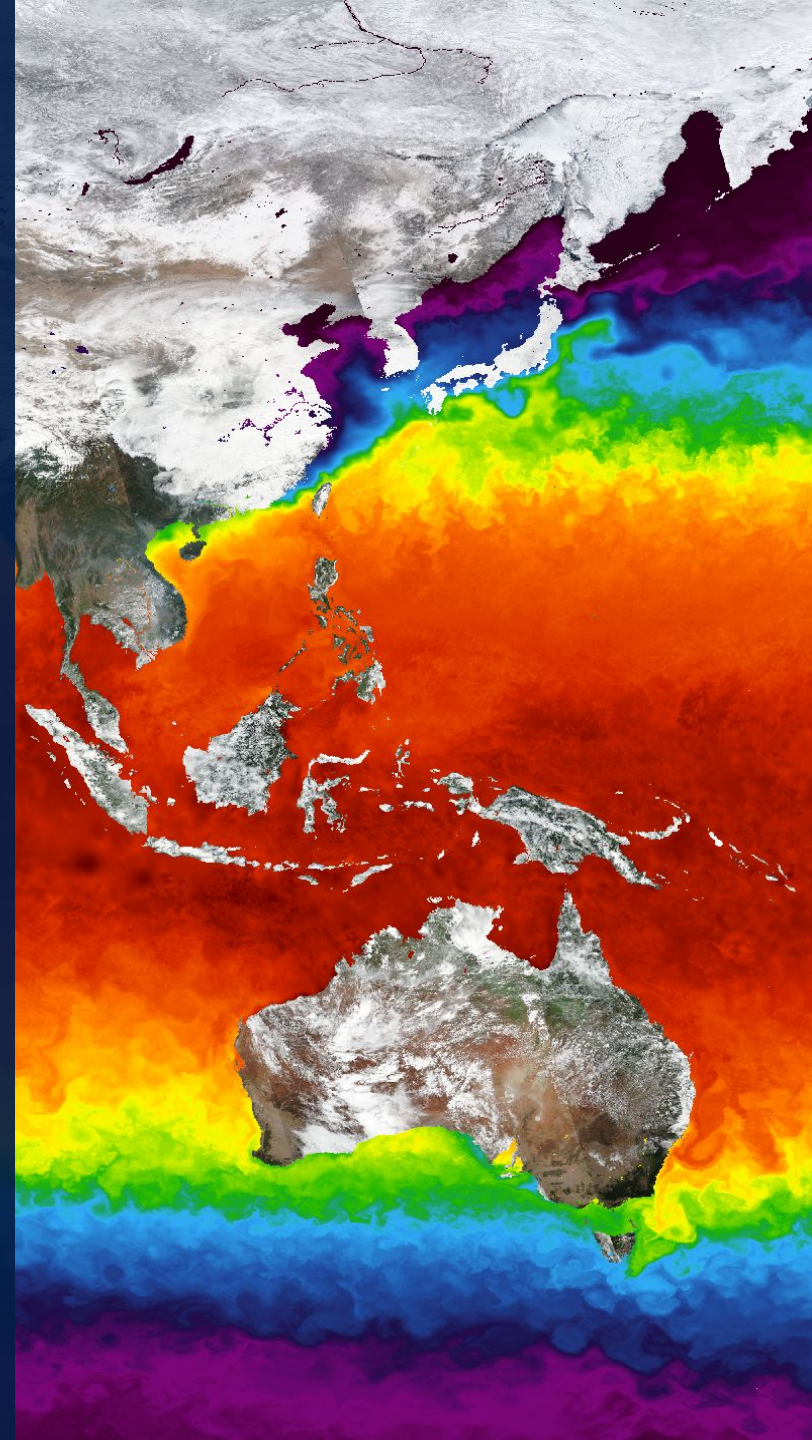
Manage, Explore, and Download the Results

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2. Once the status of your request displays **Done**, users will have a variety of options available:
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3. Click on the **Request** dropdown option at the top of the page to view the sample extraction details (e.g., Date Range, Product/Layers, Input Shapefile, Output File Format/Projection and Request ID).
 - Users have visualizations to explore data: (Note: visualizations are not publication-quality visualizations but are available for quick insights before downloading data.)
 - **Temporal Comparison Tab**
 - **Time Series Plot**
 - **Stacked Time Series Plot**
 - The Download Icon  to download the results (.zip).
 - There are a couple of ways to download the data
 - Visit the Explore Screen, select the dropdown for the Request. Click the **Download** button 
 - Or visit the Explore navigation and select **Explore Requests**, and select the download  icon.
 - The Download Point Sample page contains 3 sections:
 - Bundle zip file
 - Supporting Files
 - The sample request output **CSV files**

Wrap Up

Elizabeth Joyner
3:40 - 4PM

Credit: NASA/USGS



Returning Home

Want More Training? Connections?

- [ARSET](#)
- Earthdata Newsletter and Social Media
- Earthdata Webinars



Take-Home Points

- NASA has the largest repository of the Earth and environmental data in the world including Landsat
- NASA has a variety of data and resources to help inform decision makers about vegetation and other environmental conditions.
- STELLA provides students with connection real-world remote sensing tools and data to make the learning personal
- NASA's data web apps and tools are not all created the same and are designed with different kinds of features and users in mind.
 - NASA Earthdata provides users access to the entire NASA repository.
- Users have support when they return home.

EARTHDATA

earthdata.nasa.gov

Thank you!