Efficient Geospatial Data Access with NASA's AppEEARS

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NASA LP DAAC Science Coordination Lead

KBR, Contractor to USGS EROS Center

Work performed under USGS contract 140G0121D0001
for NASA contract NNG14HH33I

U.S. Department of the Interior
U.S. Geological Survey

About the LP DAAC

- Land Processes (LP) Distributed Active Archive Center (DAAC)
- NASA's Land Discipline Archive (one of several DAACS)
- A NASA-USGS Partnership since 1990
- Sponsored by the NASA Earth Observing System Data and Information System (EOSDIS)
- Located and Managed at USGS EROS, Sioux Falls, SD
- All data and resources available at no cost

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Application for Extracting and Exploring Analysis Ready Samples

- ❑ Discover, mine, and visualize
- ❑ At-archive data reduction
- ❑ Increased usability, interoperability, and interpretability
- ❑ Traceability and reproducibility

National Aeronautics and Space Administration

Land Processes Distributed Active Archive Center

National Snow and Ice Data Center Distributed Active Archive Center

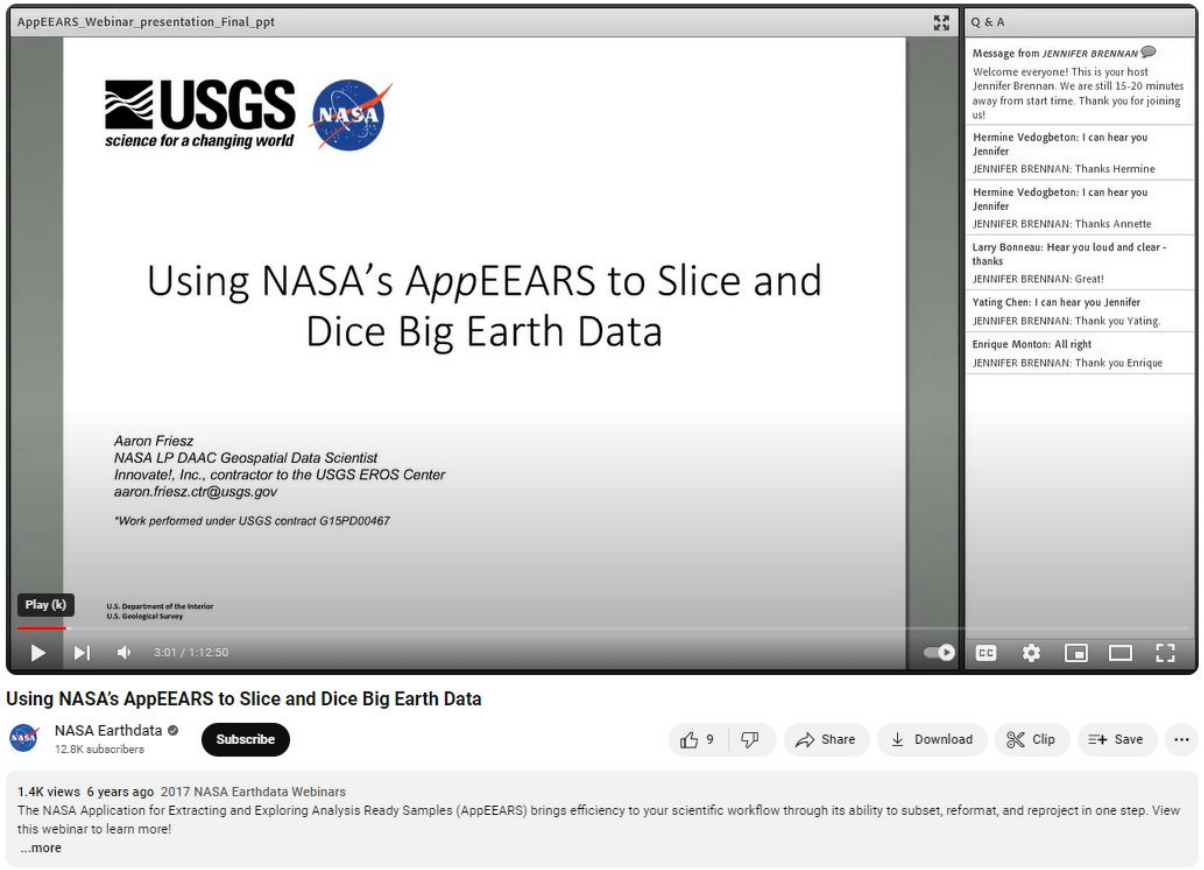
Socioeconomic Data and Applications Center

Oak Ridge National Laboratory Distributed Active Archive Center

United States Geological Survey

Not the first time here

- First appearance: October 2017
- Since then:
  - Release AppEEARS API
  - Added ~80 additional data products
  - Moved AppEEARS to Earthdata Cloud
    - Download & Direct S3 access
  - Considerable increase in users and requests
    - 6-month average
      - Users – 161 vs 1301
      - Requests – 744 vs 47818



“Efficient Geospatial Data Access”

Dataset nuances

- File names
- Metadata references (e.g., shortname, concept id, etc.)
- Tiles, grids, scenes, projections
- Dates & time

Workflow

- Search & discovery
- Access
- Exploratory data analysis
- Preprocessing
  - Mosaic, clipping, reprojections
- Quality Associations

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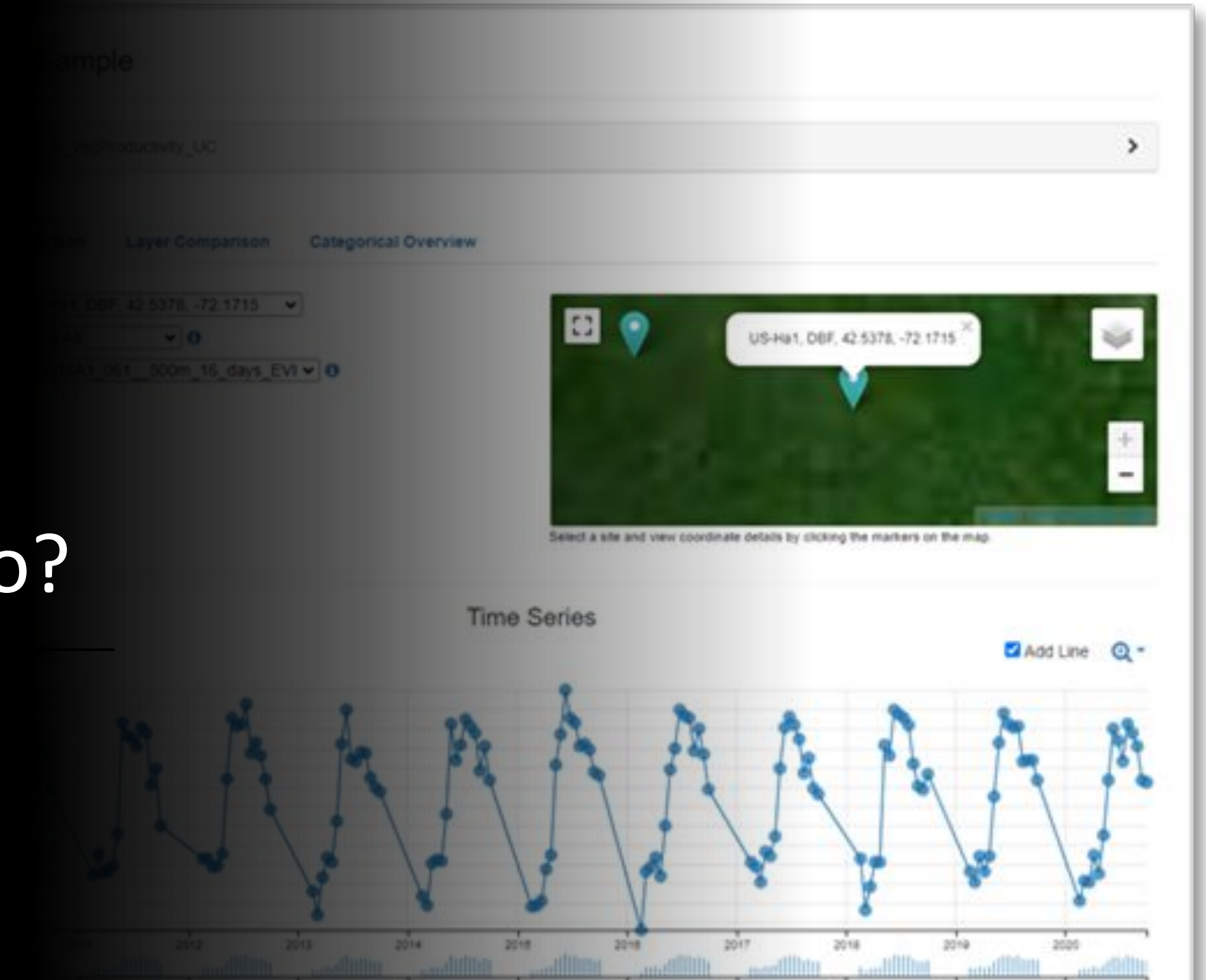
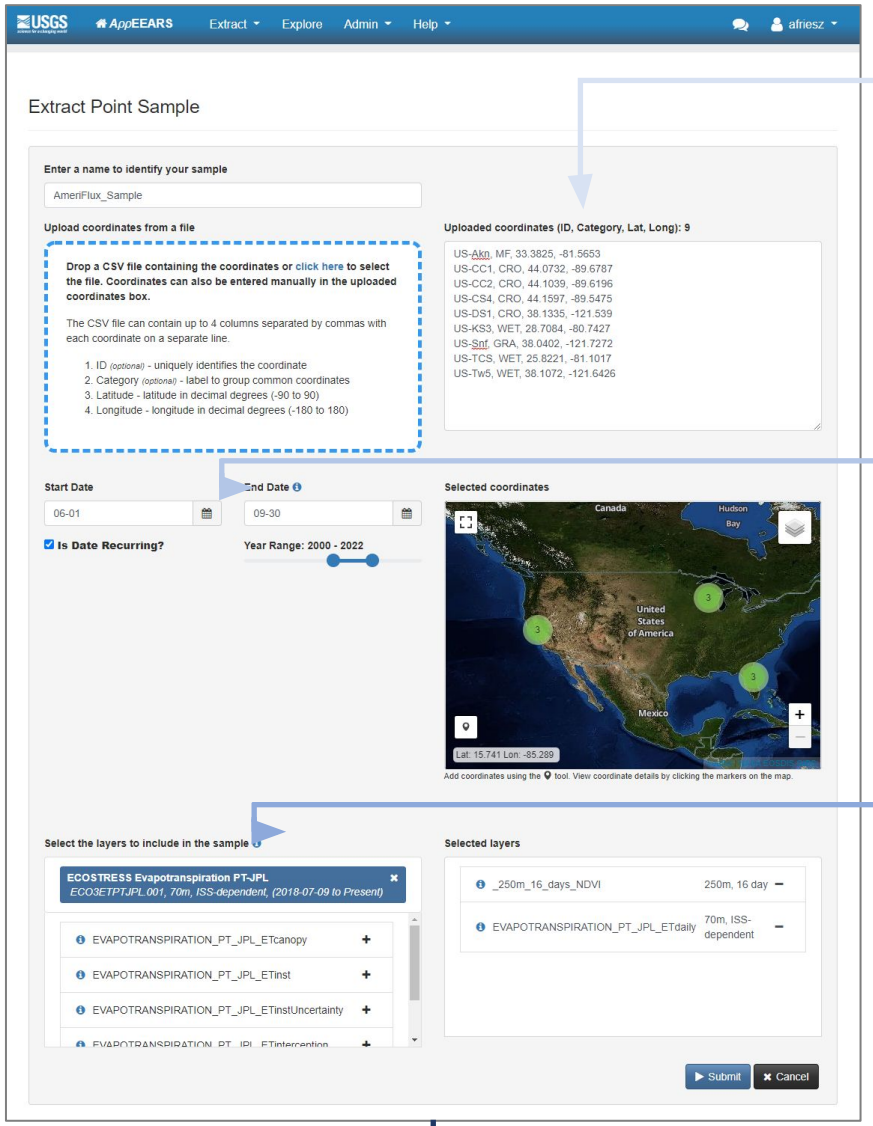
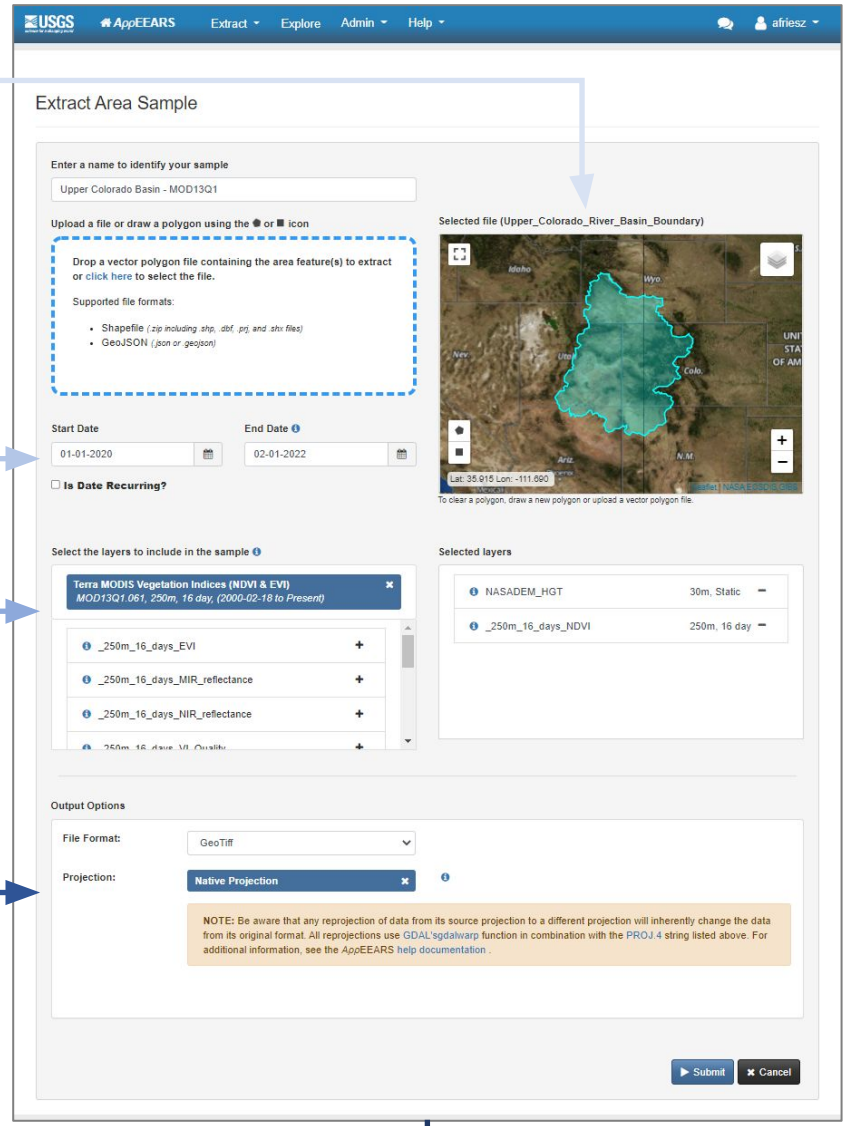
What can AppEEARS do?



Point Sample



Area Sample



Point locations or area of interests

Date range or recurring date range

Select variables of interest (access to multiple federal archives)

Select output format and output CRS/Proj

Analysis ready / reproducible outputs

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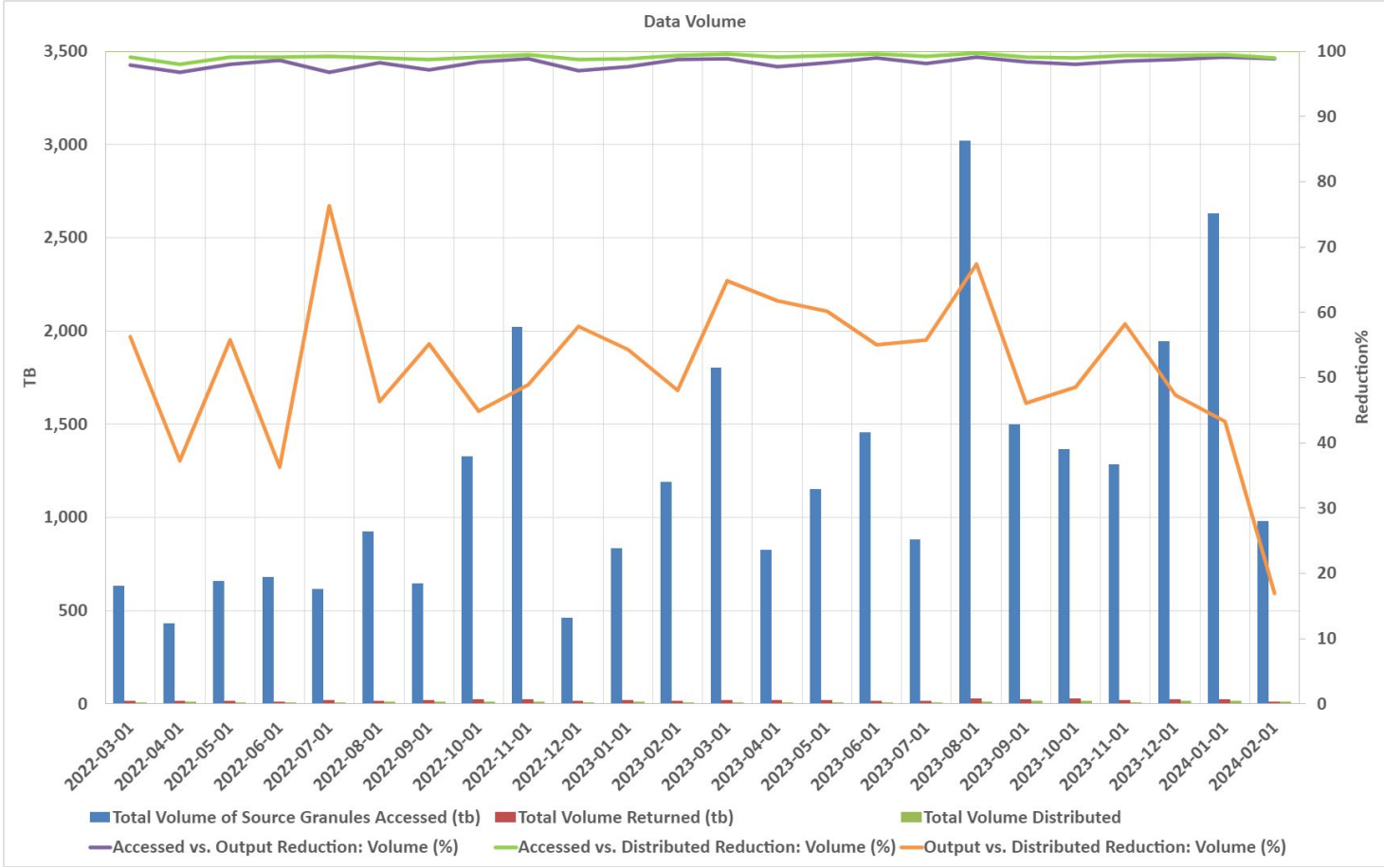
Data Reduction Machine!



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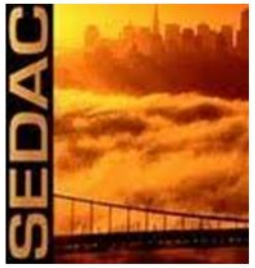
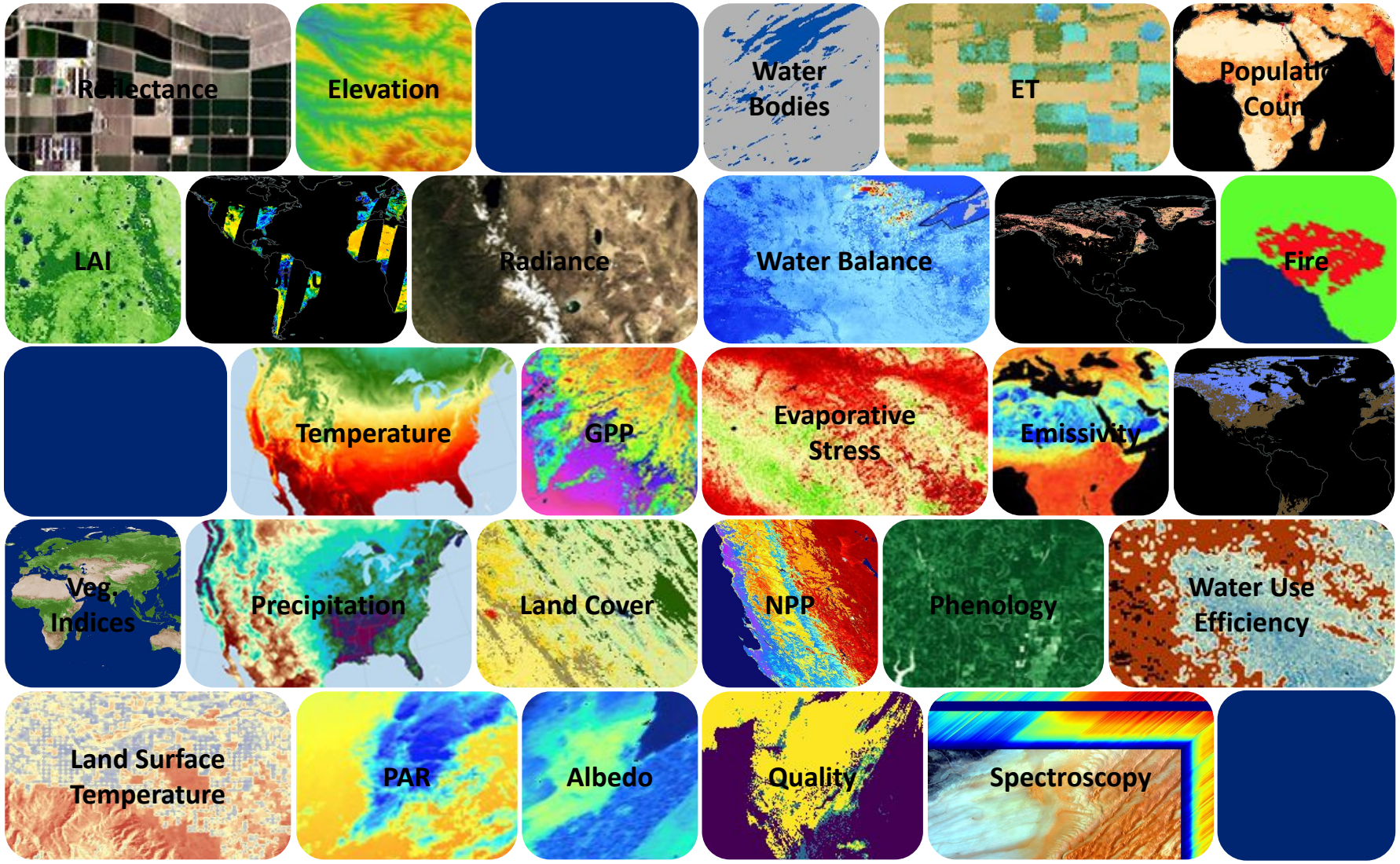
What data is available from AppEEARS?





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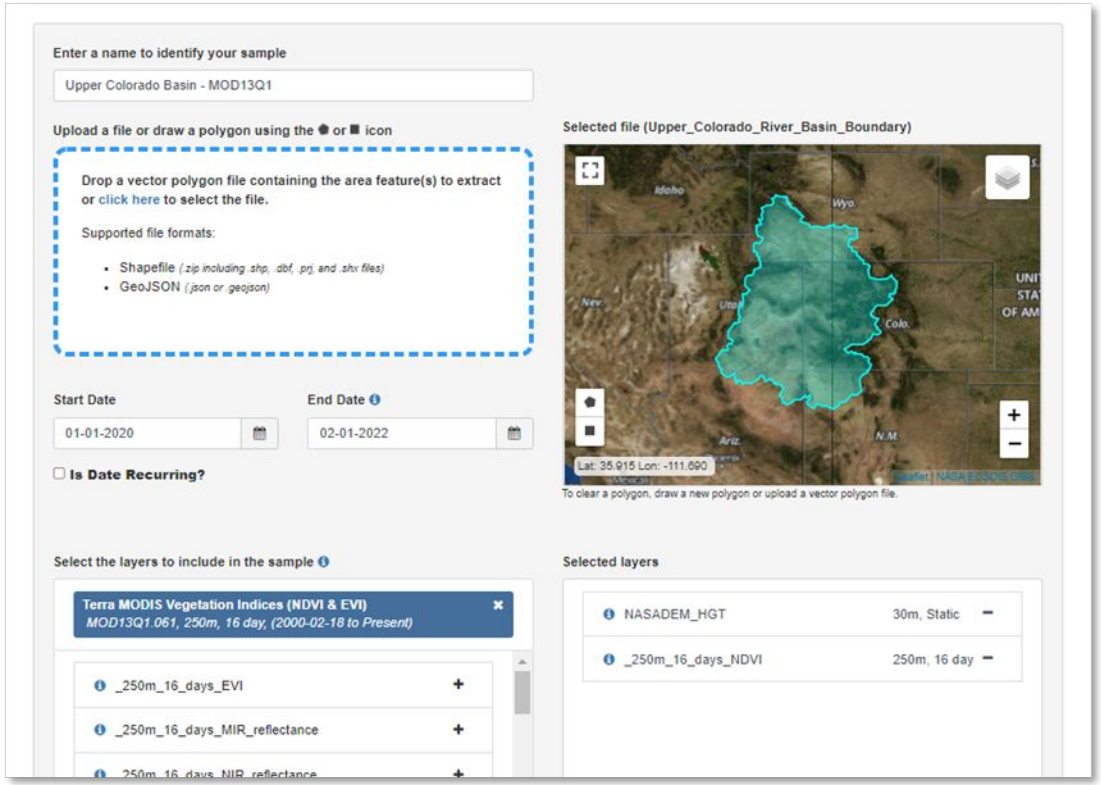
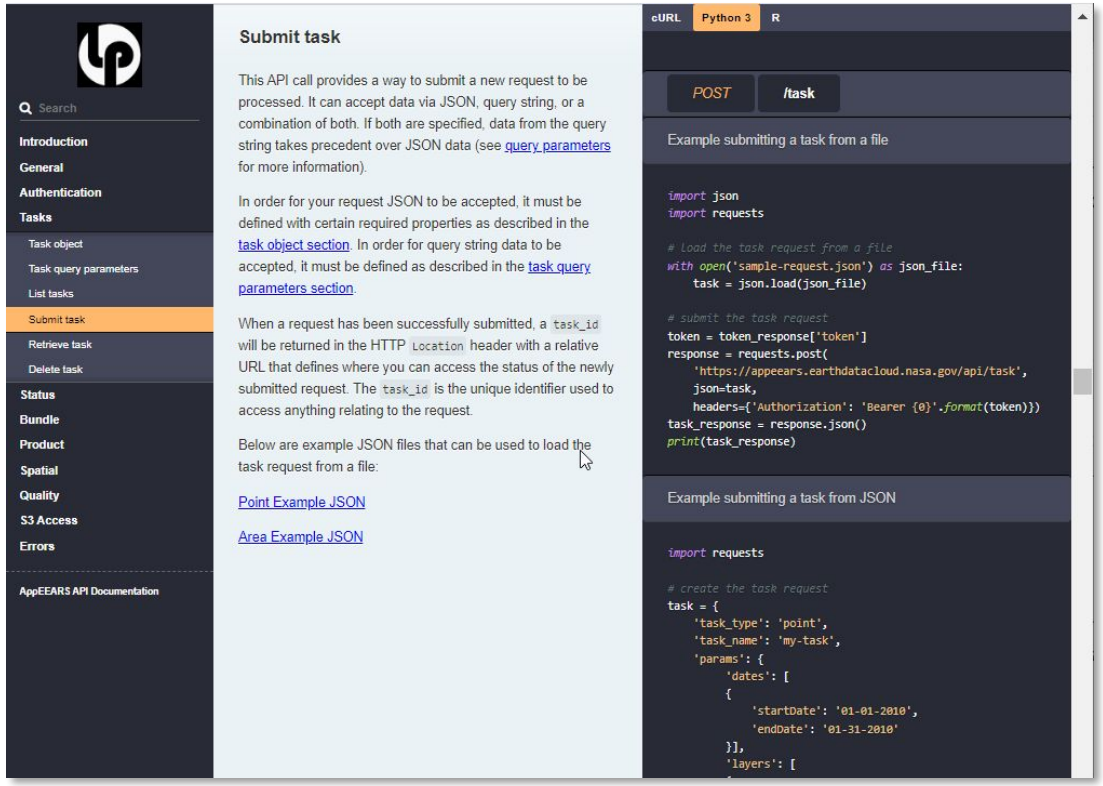
Demos

User interface walk-through



AppEEARS API in AWS



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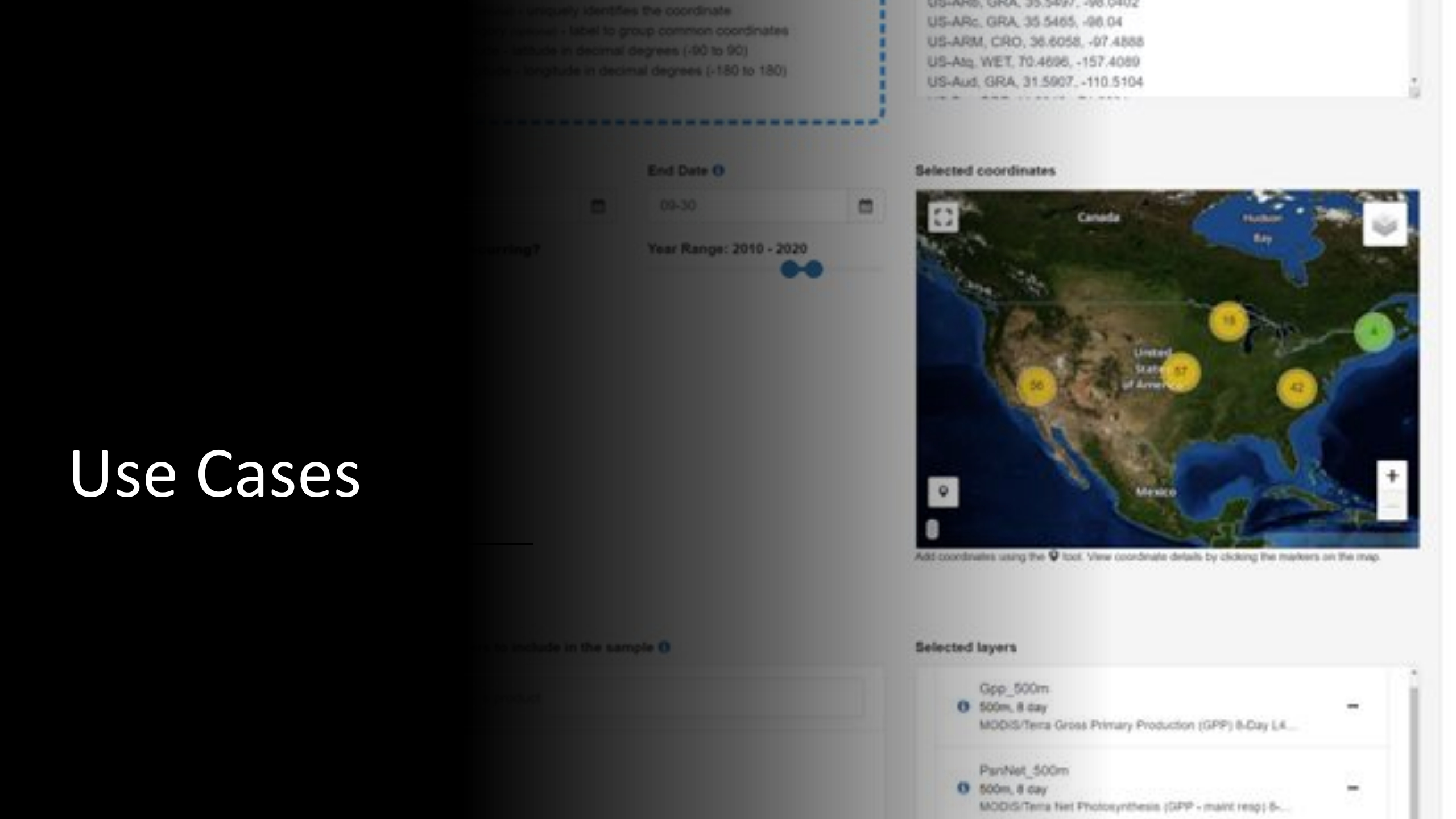
Use Cases


US-ARc, GRA, 35.5465, -98.04
US-ARM, CRO, 36.6058, -97.4888
US-Atq, WET, 70.4696, -157.4089
US-Aud, GRA, 31.5907, -110.5104
End Date
09-30
Year Range: 2010 - 2020
Selected coordinates
Canada
Hudson Bay
United States of America
Mexico
Add coordinates using the tool. View coordinate details by clicking the markers on the map.
Selected layers
Gpp_500m
500m, 8 day
MODIS/Terra Gross Primary Production (GPP) 8-Day L4...
PsnNet_500m
500m, 8 day
MODIS/Terra Net Photosynthesis (GPP - maint resp) 8-...

- ❑ EMIT L1B At-Sensor Calibrated Radiance and Geolocation Data
- ❑ EMIT L2A Estimated Surface Reflectance and Uncertainty and Masks

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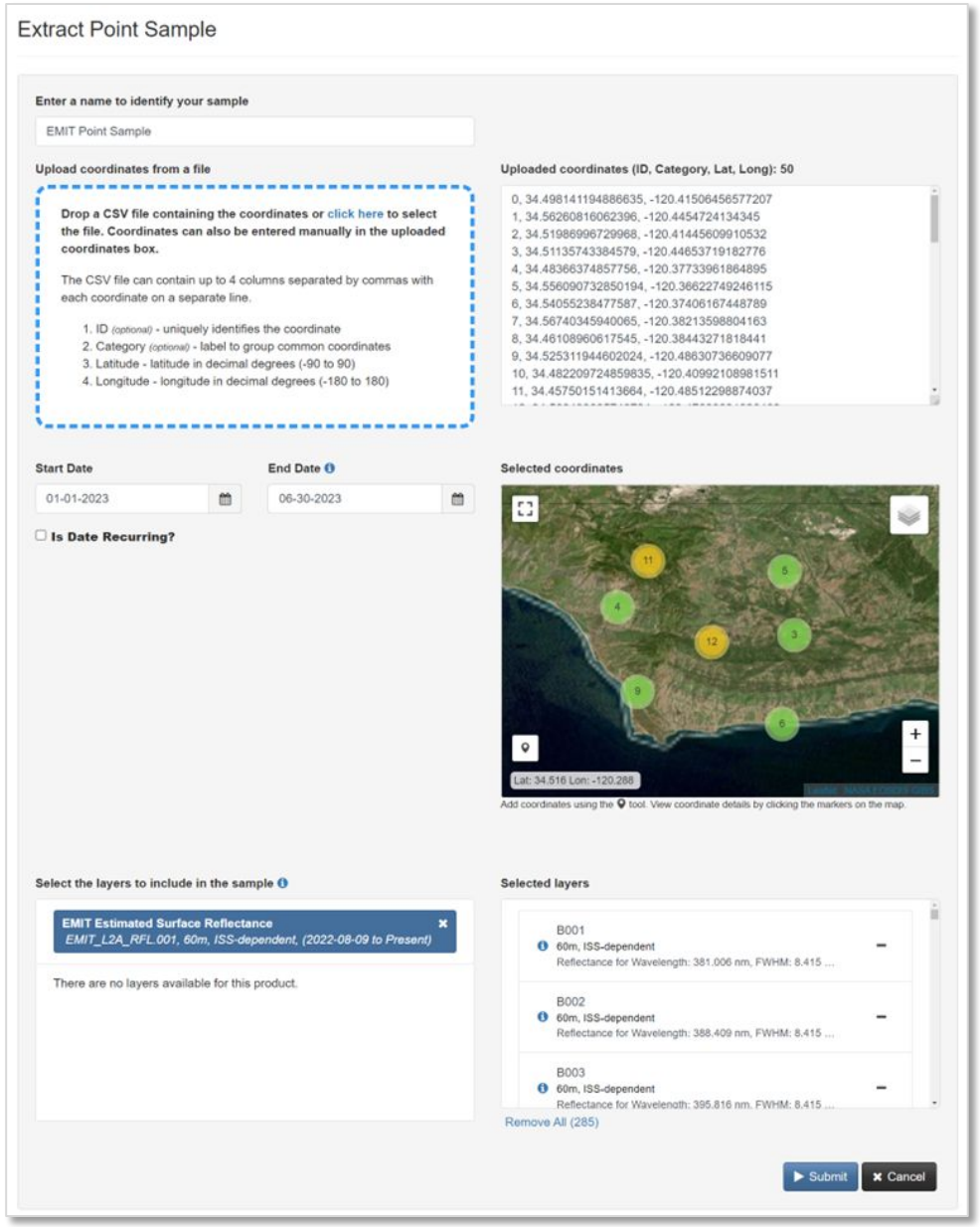
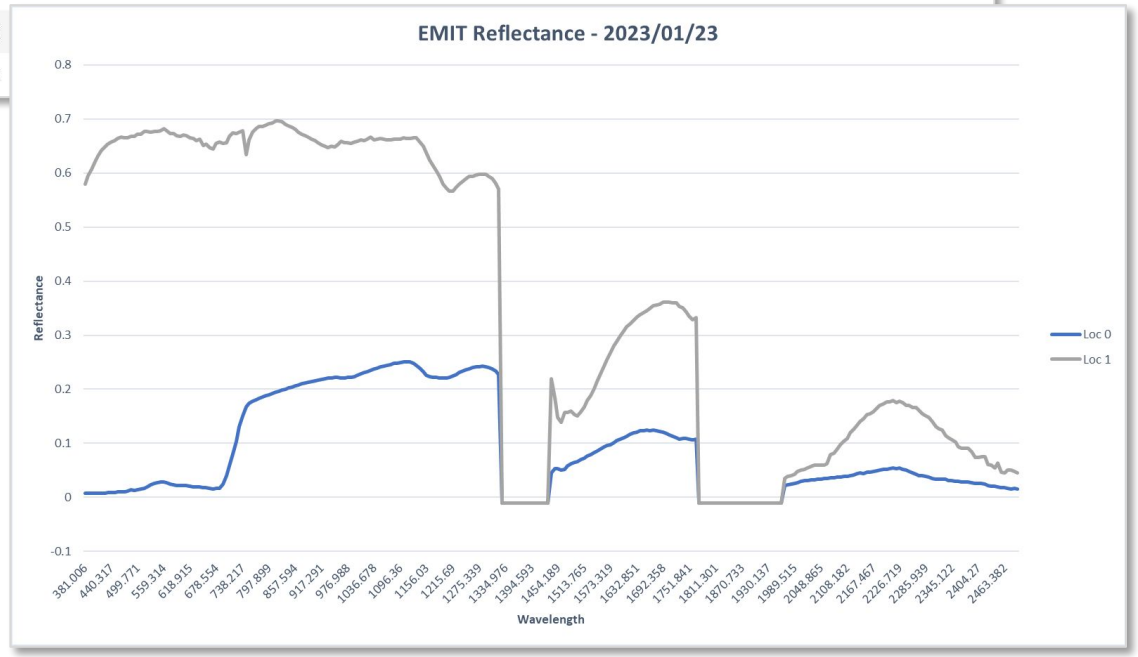


	ID	Latitude	Longitude	Date	Band	wavelength	fwhm	reflectance	good_wavelengths	elev
0	0	34.498141	-120.415065	2023-01-29 21:13:08 UTC	B001	381.006	8.415	0.008307	1.0	291.464554
1	0	34.498141	-120.415065	2023-01-29 21:13:08 UTC	B002	388.409	8.415	0.008064	1.0	291.464554
2	0	34.498141	-120.415065	2023-01-29 21:13:08 UTC	B003	395.816	8.415	0.007821	1.0	291.464554
3	0	34.498141	-120.415065	2023-01-29 21:13:08 UTC	B004	403.225	8.415	0.007582	1.0	291.464554
4	0	34.498141	-120.415065	2023-01-29 21:13:08 UTC	B005	410.638	8.417	0.007499	1.0	291.464554
...	...	...	...	...	...	...	...	...	...	...
117700	9	34.525312	-120.486307	2023-06-29 17:04:49 UTC	B281	2463.382	8.803	0.080405	1.0	76.241964
117701	9	34.525312	-120.486307	2023-06-29 17:04:49 UTC	B282	2470.768	8.804	0.076033	1.0	76.241964
117702	9	34.525312	-120.486307	2023-06-29 17:04:49 UTC	B283	2478.153	8.806	0.076020	1.0	76.241964
117703	9	34.525312								
117704	9	34.525312								



EMIT Data Volume: 27.49 GB

AppEEARS Output Volume: 12.3 MB

Data Reduction: >99%

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Ameriflux Point Sample

Researcher: Gil

Objective: Intercompare and evaluate vegetation productivity using satellite remote sensing observations and measurements taken from Ameriflux sites

What this highlights

- Point sample extraction
- Data from multiple collections
- Spatial and re-occurring temporal subsetting
- User interface exploration

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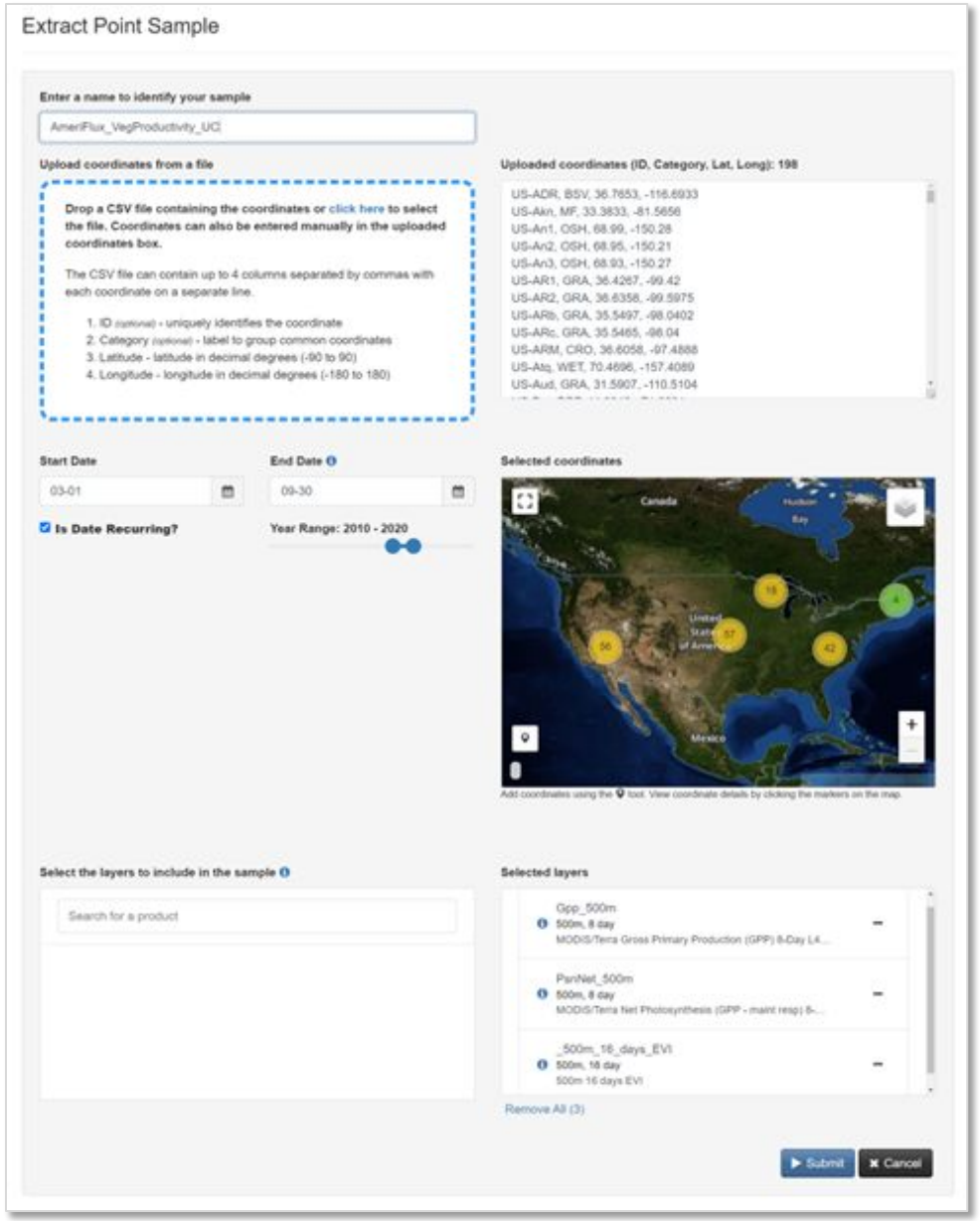

- ❑ 198 Point Locations
- ❑ Touches 7568 files
- ❑ Extracts and decode QA
- ❑ ~ 2 hrs to complete

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View Point Sample

Request: AmeriFlux_VegProductivity_UC

Temporal Comparison | Layer Comparison | Categorical Overview

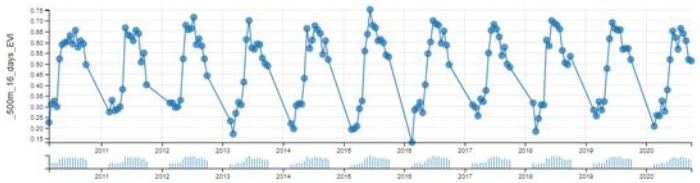
Site: US-Ha1, DBF, 42.5378, -72.1715
Quality: Show All
Layer: MOD13A1_061__500m_16_days_EVI

Select a site and view coordinate details by clicking the markers on the map.

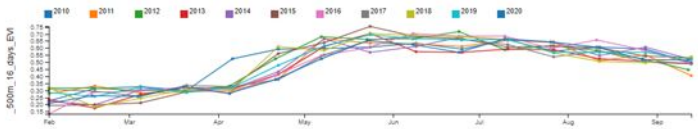
Time Series

Dates Selected: **All**

Add Line



Stacked Time Series



Date	MOD13A1_061__500m_16_days_EVI	Quality	Quality Description
09-29-2020	0.5129	0	VI produced with good quality
09-13-2020	0.5192	0	VI produced with good quality
08-28-2020	0.6082	0	VI produced with good quality
08-12-2020	0.6408	0	VI produced with good quality
07-27-2020	0.664	0	VI produced with good quality
07-11-2020	0.5681	0	VI produced with good quality
06-25-2020	0.6225	0	VI produced with good quality
06-09-2020	0.653	0	VI produced with good quality
05-24-2020	0.5213	0	VI produced with good quality
05-08-2020	0.3773	0	VI produced with good quality
04-22-2020	0.2783	0	VI produced with good quality
04-06-2020	0.3262	0	VI produced with good quality
03-21-2020	0.2557	0	VI produced with good quality
03-05-2020	0.2616	0	VI produced with good quality
02-18-2020	0.2081	2	Pixel produced, but most probably cloudy
09-30-2019	0.5203	0	VI produced with good quality
09-14-2019	0.5708	0	VI produced with good quality
08-29-2019	0.5702	0	VI produced with good quality
08-13-2019	0.5694	0	VI produced with good quality
07-28-2019	0.6601	0	VI produced with good quality

1 to 20 displayed, 165 in total

View Point Sample

Request: AmeriFlux_VegProductivity_UC

Temporal Comparison | Layer Comparison | Categorical Overview

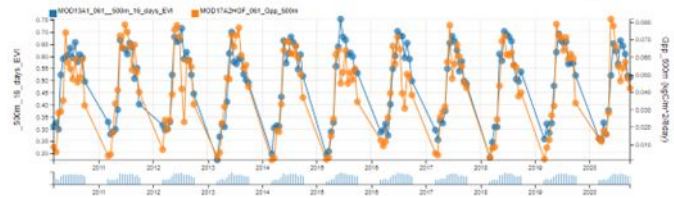
Site: US-Ha1, DBF, 42.5378, -72.1715
Quality: Show All
Layer 1: MOD13A1_061__500m_16_days_EVI
Layer 2: MOD17A2HGF_061_Gpp_500m

Select a site and view coordinate details by clicking the markers on the map.

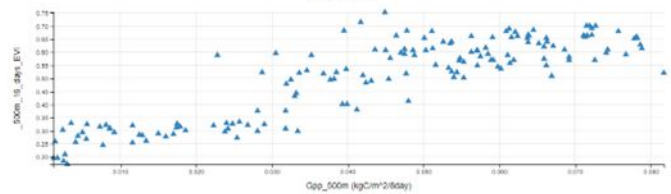
Time Series

Dates Selected: **All**

Add Lines



Scatter Plot



Date	MOD13A1_061__500m_16_days_EVI	MOD13A1_061__500m_16_days_EVI Quality	MOD13A1_061__500m_16_days_EVI Quality Description
09-29-2020	0.5129	0	VI produced with good quality
09-13-2020	0.5192	0	VI produced with good quality
08-28-2020	0.6082	0	VI produced with good quality
08-12-2020	0.6408	0	VI produced with good quality
07-27-2020	0.664	0	VI produced with good quality
07-11-2020	0.5681	0	VI produced with good quality
06-25-2020	0.6225	0	VI produced with good quality
06-09-2020	0.653	0	VI produced with good quality
05-24-2020	0.5213	0	VI produced with good quality
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04-22-2020	0.2783	0	VI produced with good quality
04-06-2020	0.3262	0	VI produced with good quality
03-21-2020	0.2557	0	VI produced with good quality
03-05-2020	0.2616	0	VI produced with good quality
09-30-2019	0.5203	0	VI produced with good quality
09-14-2019	0.5708	0	VI produced with good quality
08-29-2019	0.5702	0	VI produced with good quality
08-13-2019	0.5694	0	VI produced with good quality
07-28-2019	0.6601	0	VI produced with good quality
07-12-2019	0.6551	0	VI produced with good quality

1 to 20 displayed, 154 in total

View Point Sample

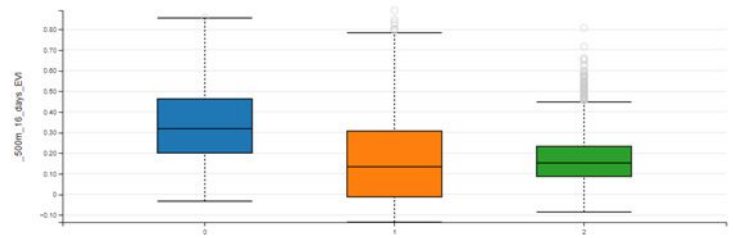
Request: AmeriFlux_VegProductivity_UC

Temporal Comparison | Layer Comparison | Categorical Overview

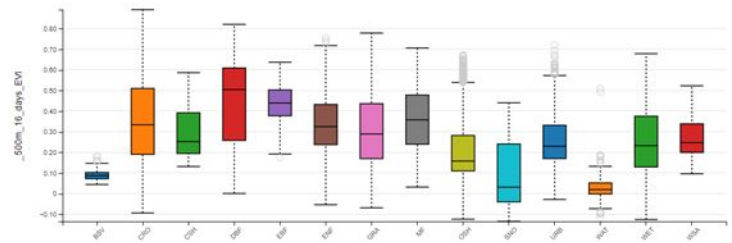
Layer: MOD13A1_061__500m_16_days_EVI

Data Selected: **All**

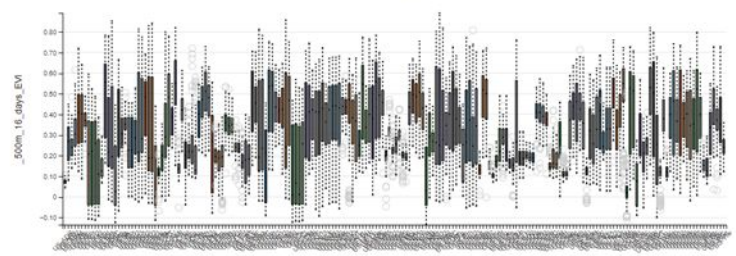
Quality

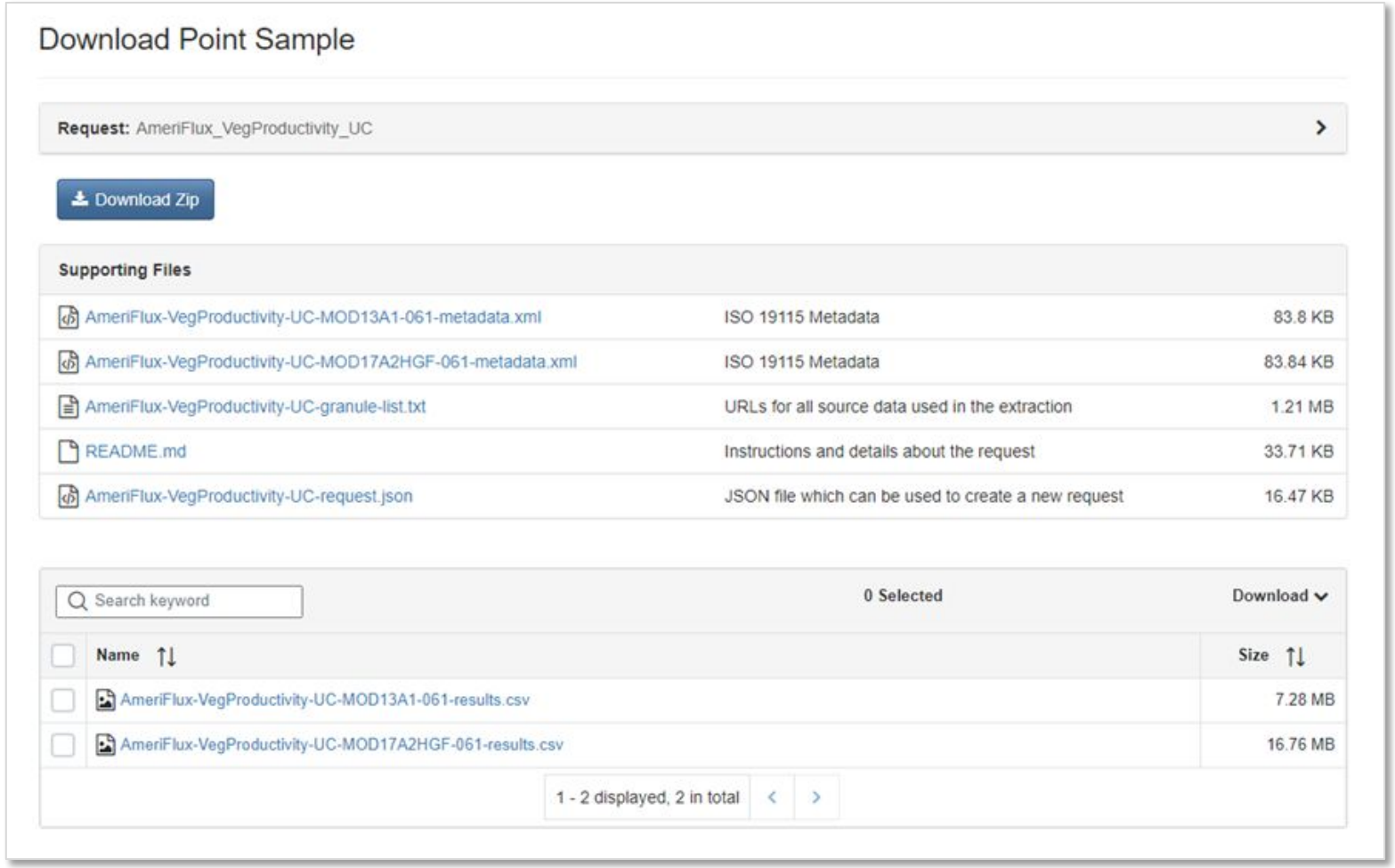


Categories



Sites





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Crop Monitoring – User Drawn Feature

Researcher: Ed

Objective: Create snow zone maps for the western United States and evaluate how meteorological and topographic variables impact snow zone extent and persistence.

What this highlights

- User drawn feature extraction
- Swath to grid transformation of ECOSTRESS
- Temporal and Spatial Subsetting
- Reprojection

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Extract Area Sample

Enter a name to identify your sample

Crop_Monitoring_UC

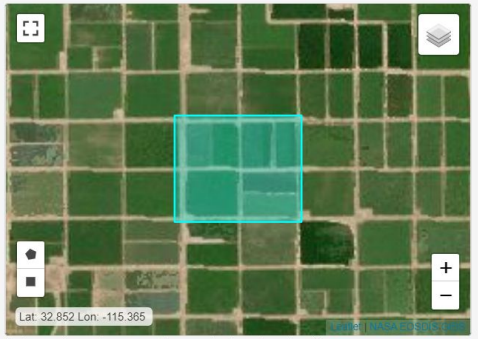
Upload a file or draw a polygon using the ⬟ or ■ icon

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)*

Selected file (User-Drawn-Polygon)



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

Start Date 04-01

End Date 09-30

Is Date Recurring?

Year Range: 2021 - 2023

Select the layers to include in the sample

Search for a product

Selected layers

- 30m, Daily
- B8A — 30m, Daily
- EVAPOTRANSPIRATION_PT_JPL_ETdaily — 70m, ISS-dependent
- SDS_LST — 70m, ISS-dependent

Remove All (6)

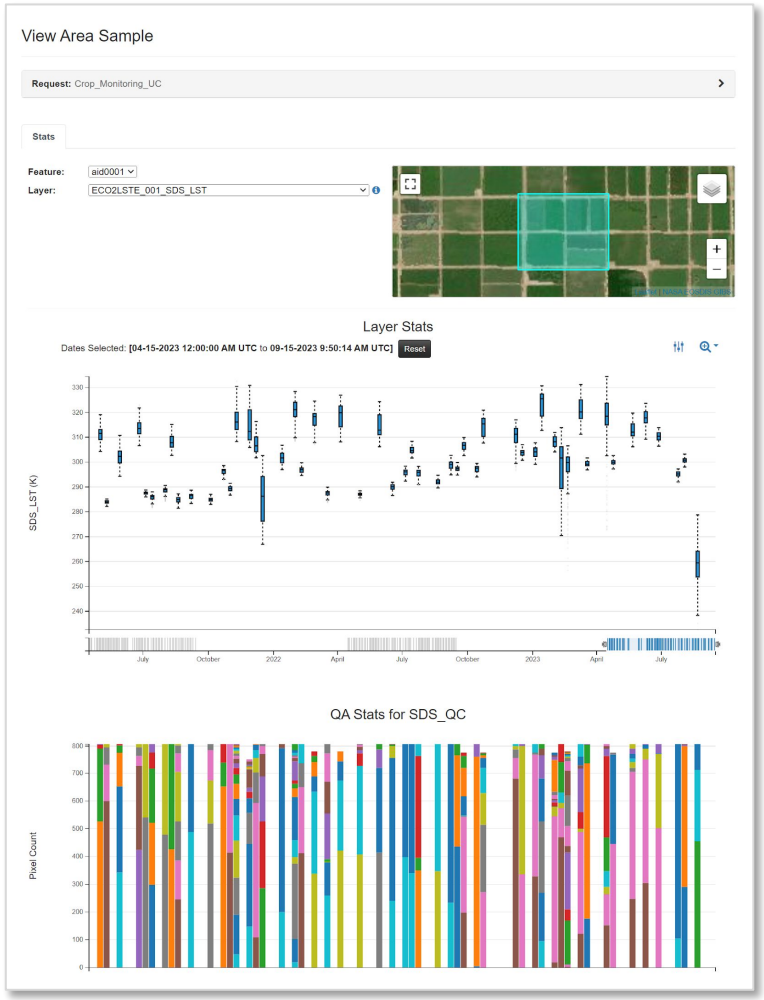
Output Options

File Format: GeoTiff

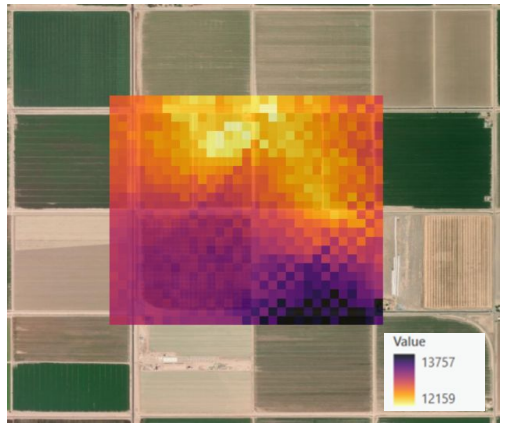
Projection: Geographic
Datum: *WGS84*
EPSG: *4326*
PROJ.4: *+proj=longlat +datum=WGS84 +no_defs=True*

NOTE: Be aware that any reprojection of data from its source projection to a different projection will inherently change the data from its original format. All reprojections use GDAL's gdalwarp function in combination with the PROJ string listed above. For additional information, see the *App*EEARS help documentation .

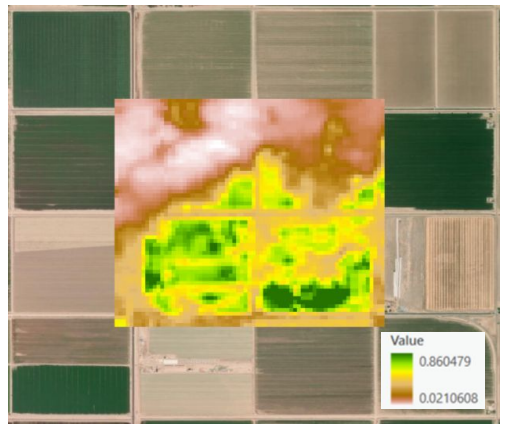
▶ Submit ✖ Cancel



ECOSTRESS LST



HLS Derived NDVI



W/out AppEEARS

- 1647 Files
- 603 GB

With AppEEARS

- 1254 Files
- 5.72 MB

Snow Zones

Researcher: Lindsey

Objective: Create snow zone maps for the western United States and evaluate how meteorological and topographic variables impact snow zone extent and persistence.

What this highlights

- Large area extraction
- Data from multiple providers
- Temporal and Spatial Subsetting
- Reprojection

Moore C, Kampf S, Stone B, Richer E. 2015. A GIS-based method for defining snow zones: application to the Western United States. *Geocarto Int.* 3(1): 62–81, doi: 10.1080/10106049.2014.885089.

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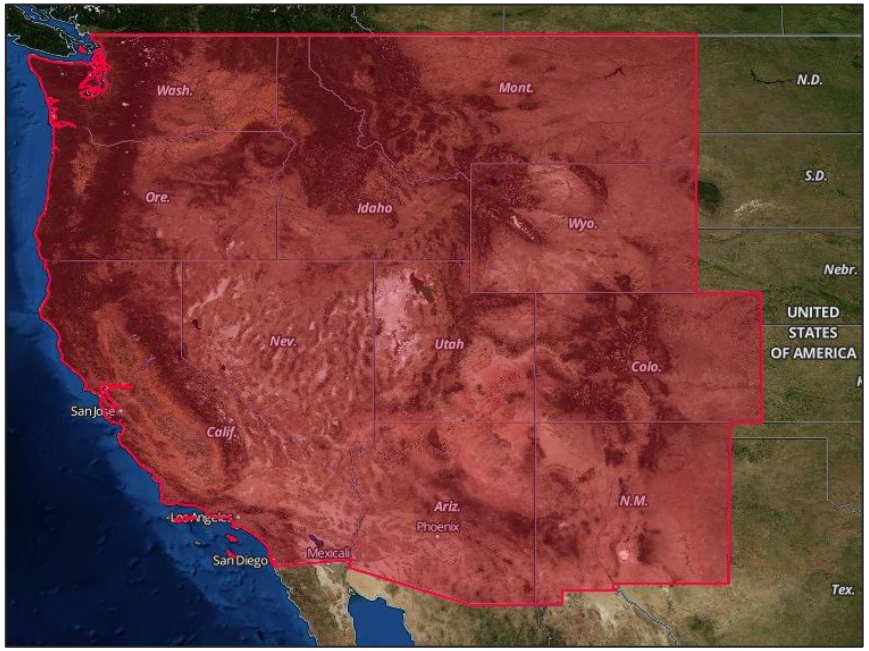


Study Area

- Western United States
  - 11 States
- Single feature shapefile

Time Span

- 2000 – 2010
- January 1st – Jul 1st

Format

- GeoTIFF

Datasets

- MODIS 8d/500 m Snow
  - Snow Cover
  - Snow Extent
- MODIS 8d/1,000 m LST
  - LST
- NASA SRTM 3 arc second
  - Elevation

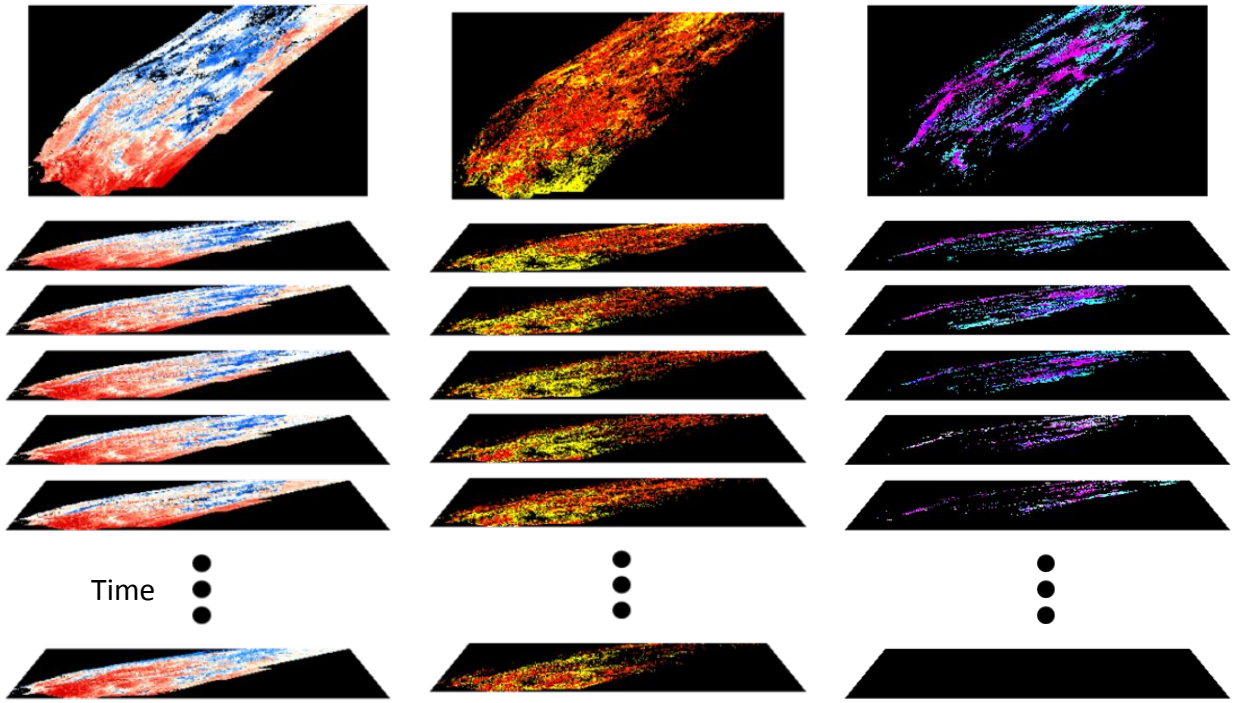
Projection

- Sinusoidal

MOD11A2.061
LST_Day_1km

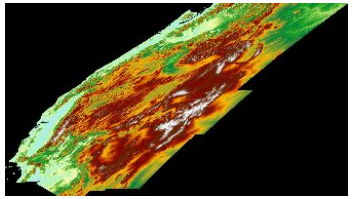
MOD11A2.061
QC_Day

MOD10A2.061
8_Day_Snow_Cover



Without AppEEARS	*With AppEEARS*
• 3,074 files	• 386 files
• 7+ GB	• 1.85 GB

SRTMGL3
Elevation



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Thank You!

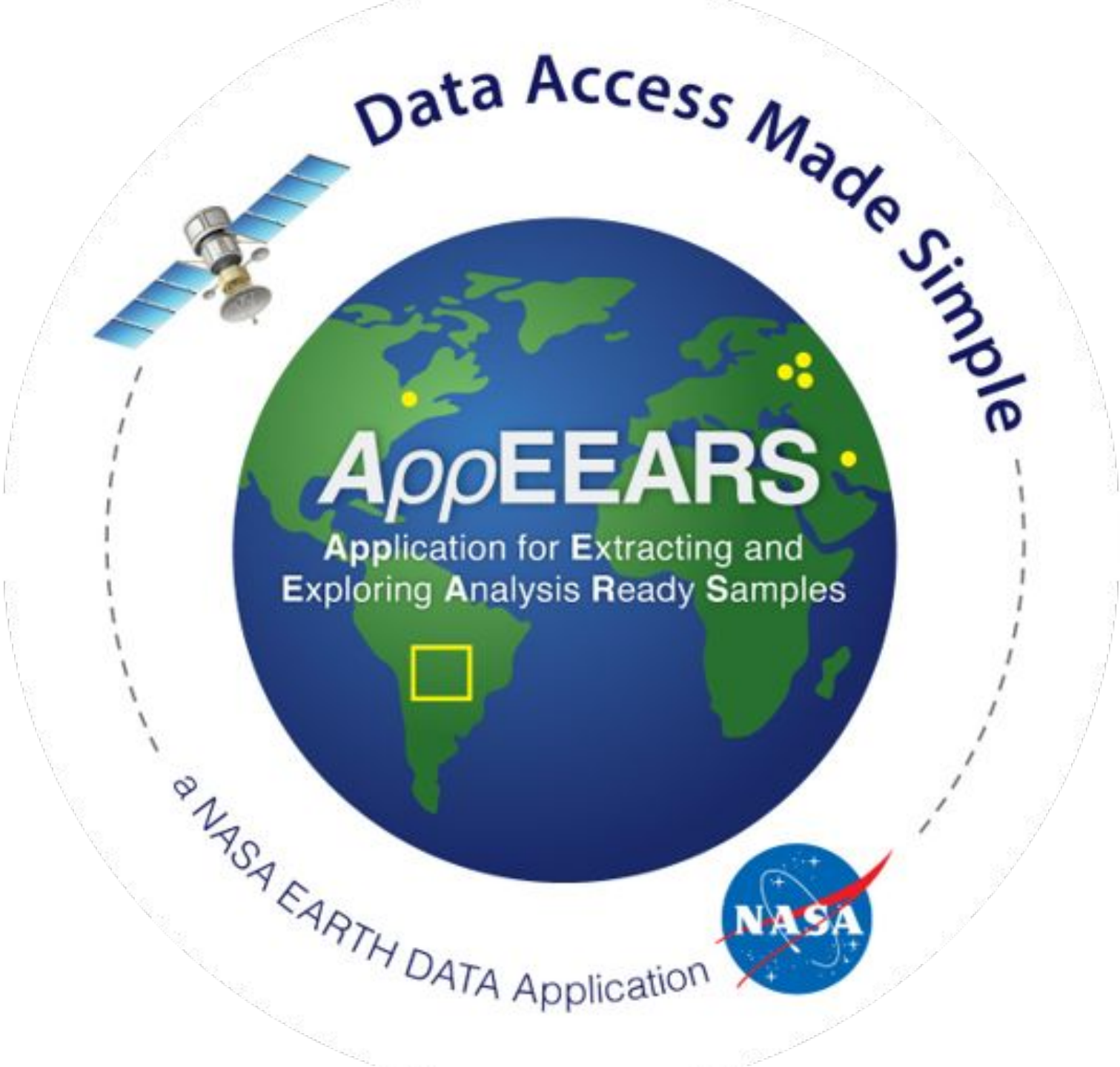
Contact Us

E-mail:

LPDAAC@usgs.gov

Earthdata Forum:

https://forum.earthdata.nasa.gov/

Subscribe to the LP DAAC Listserv:

Send a blank email to lpdaac-join@lists.nasa.gov