NASA's Application for Extracting and Exploring Analysis Ready Samples (AppEEARS) as a geospatial data access and processing tool

Dr. Monika Anna Tomaszewska

Center for Global Change & Earth Observations

Michigan State University

https://appeears.earthdatacloud.nasa.gov

MICHIGAN STATE UNIVERSITY

- Land Processes Distributed Active Archive Center (LP DAAC) is one of several discipline-specific data centers within the NASA Earth Observing System Data and Information System (EOSDIS).
- The LP DAAC is located at the USGS Earth Resources Observation and Science (EROS) Center in Sioux Falls, South Dakota.
- The LP DAAC processes, archives, and distributes land data products to users in the earth science community free of charge through NASA Earthdata Search and download clients.
- The LP DAAC supports tools and services, like the AppEEARS, which allows users to transform and visualize data before download while offering enhanced subsetting and reprojecting capabilities.

Available Products

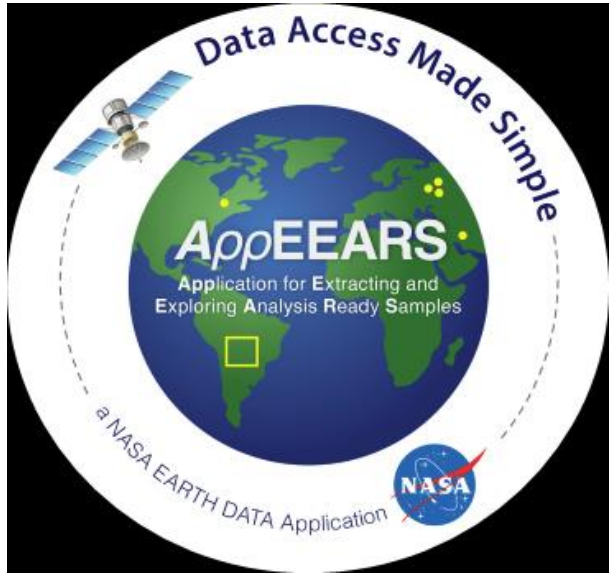
MICHIGAN STATE UNIVERSITY

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

Aqua MODIS

- Aqua MODIS
- ASTER GDEM
- Combined MODIS
- DAYMET
- ECOSTRESS
- EMIT
- Global WELD
- GPW
- Harmonized Landsat and Sentinel-2
- Landsat ARD
- MEaSUREs LSTE
- NASADEM
- NOAA-20 VIIRS
- NPS Historical Water Balance, Daily
- NPS Historical Water Balance, Monthly
- SMAP
- SRTM
- Suomi NPP VIIRS
- Terra MODIS

ion	Source	Layer	Availability
	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
		sur_refl_b06 Surface Reflectance Band 6	Available
		sur_refl_b07 Surface Reflectance Band 7	Available
		sur_refl_day_of_year Day of the year for the pixel	Available
		sur_refl_qc_500m Surface reflectance 500m band quality control flags	Available
		sur_refl_raz MODIS relative azimuth angle	Available
		sur_refl_state_500m Surface eflectance 500m state flags	Available
		sur_refl_szen MODIS solar zenith angle	Available
		sur_refl_vzen MODIS view zenith angle	Available
	LP DAAC	gflags_1 Geolocation flags	Available
		granule_pnt_1 Granule Pointer	Available
		iobs_res_1 Observation number	Available
		num_observations_1km Number of observations per 1K pixel	Available
		num_observations_500m Number of observations per 500m pixel	Not Available
		obscov_500m_1 Observation coverage	Available
		orbit_pnt_1 Orbit pointer	Available
		q_scan_1 250m scan value information	Not Available
		QC_500m_1 Surface Reflectance 500m Quality Assurance	Available
		Range_1 Distance to sensor	Available
		SensorAzimuth_1 Azimuth angle to sensor	Available
		SensorZenith_1 Zenith angle to sensor	Available
		SolarAzimuth_1 Solar azimuth	Available
		SolarZenith_1 Zenith angle to sun	Available
		state_1km_1 1km Reflectance Data State QA	Available
		sur_refl_b01_1 Surface Reflectance Band 1	Available
		sur_refl_b02_1 Surface Reflectance Band 2	Available
		sur_refl_b03_1 Surface Reflectance Band 3	Available
		sur_refl_b04_1 Surface Reflectance Band 4	Available
		sur_refl_b05_1 Surface Reflectance Band 5	Available
		sur_refl_b06_1 Surface Reflectance Band 6	Available
		sur_refl_b07_1 Surface Reflectance Band 7	Available



Extract Point Sample

Enter a name to identify your sample

Gap_Fire_DEMO

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): 6

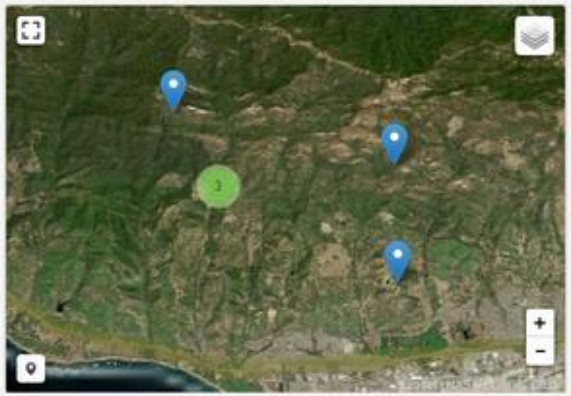
0, Non-fire, 34.4544983, -119.8659973
1, Non-fire, 34.4714012, -119.9179993
2, Non-fire, 34.4856987, -119.9169998
17, Fire, 34.4805984, -119.9000015
18, Fire, 34.4976006, -119.9229965
19, Fire, 34.4842987, -119.8669968

Start Date: 01-01-2000

End Date: 11-25-2016

Is Date Recurring?

Selected coordinates



Add coordinates using the tool. View coordinate details by clicking the markers on the map.

Select the layers to include in the sample

Terra MODIS Vegetation Indices
MOD13Q1.006, 250m, 16 day, (February 2000 - Present)

- _250m_16_days_MIR_reflectance
- _250m_16_days_NIR_reflectance
- _250m_16_days_VI_Quality
- _250m_16_days_blue_reflectance

Selected layers

_250m_16_days_EVI	250m, 16 day
_250m_16_days_NDVI	250m, 16 day

▶ Submit ✖ Cancel

Extract Area Sample

Enter a name to identify your sample

Gap_Fire_Area_Analysis

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:

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

Selected file (Gap_Fire_AGU_Demo)

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

Start Date: 01-01-2006

End Date: 12-31-2010

Is Date Recurring?

Select the layers to include in the sample

Search for a product

Selected layers

Lai_500m	500m, 8 day
NDVI_TOA	30m, Monthly
FireMask	1000m, 8 day
Maximum_Snow_Extent	500m, 8 day
population-density	1000m, Quinquennial
Band1	30m, Static

Output Options

File Format: GeoTiff

Projection: Search for a projection

▶ Submit ✖ Cancel

Data Visualization

Request: Gap_Fire_DEMO

Temporal Comparison | Layer Comparison | Categorical Overview

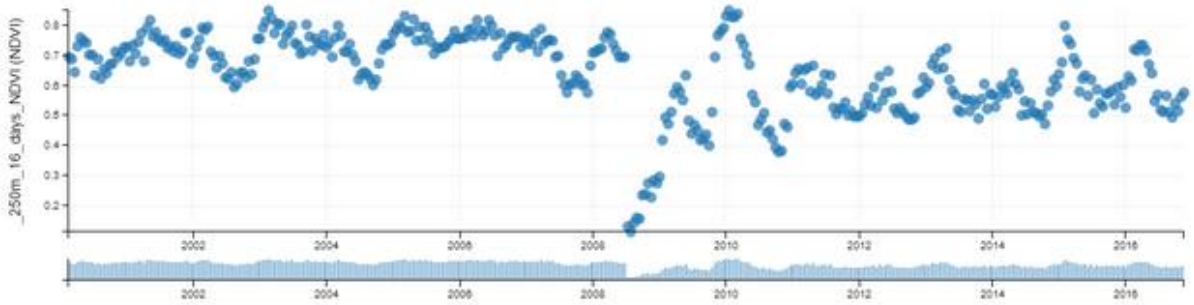
Site: 18, Fire, 34.4976006, -119.9229965
Quality: Show All
Layer: MOD13Q1_006__250m_16_days_NDVI

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

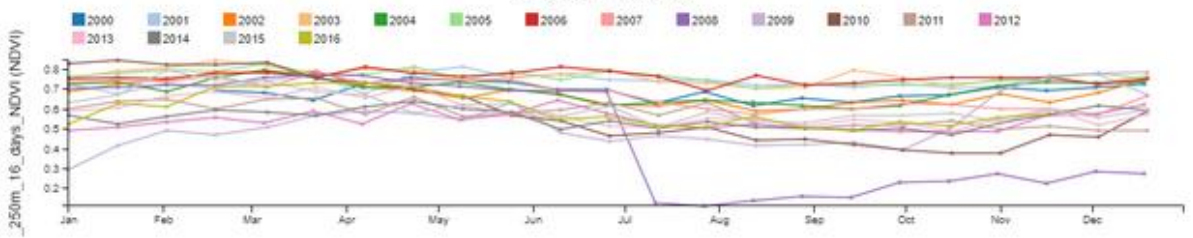
Time Series

Dates Selected: All

Add Line



Stacked Time Series



Date	006__250m_16_days_NDVI	Quality	Quality Description
11-16-2016	0.577399969100952	0	VI produced with good quality
10-31-2016	0.562900006771088	0	VI produced with good quality
10-15-2016	0.514899969100952	0	VI produced with good quality

Data Comparison

Temporal Comparison | Layer Comparison | Categorical Overview

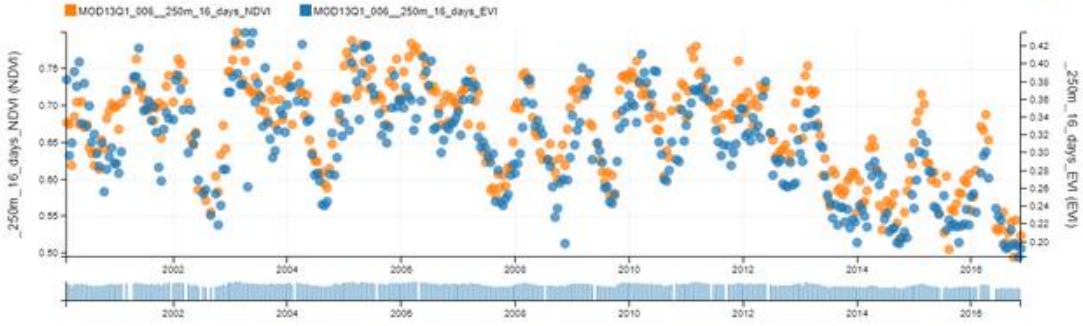
Site: 2, Non-fire, 34.4856987, -119.9169998
Quality: Show Good Quality
Layer 1: MOD13Q1_006__250m_16_days_NDVI
Layer 2: MOD13Q1_006__250m_16_days_EVI

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

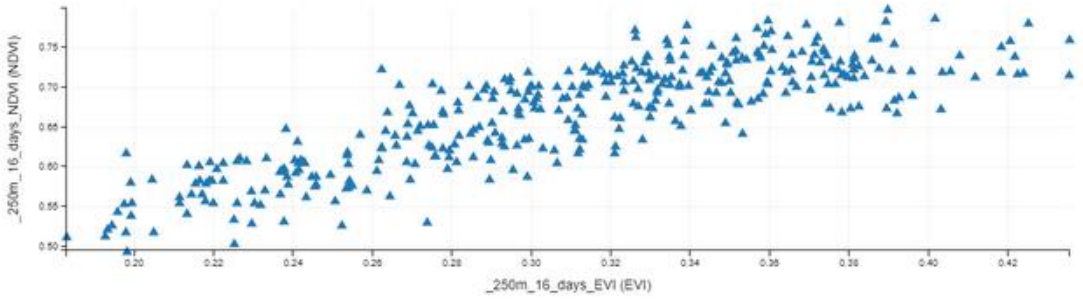
Time Series

Dates Selected: All

Add Lines

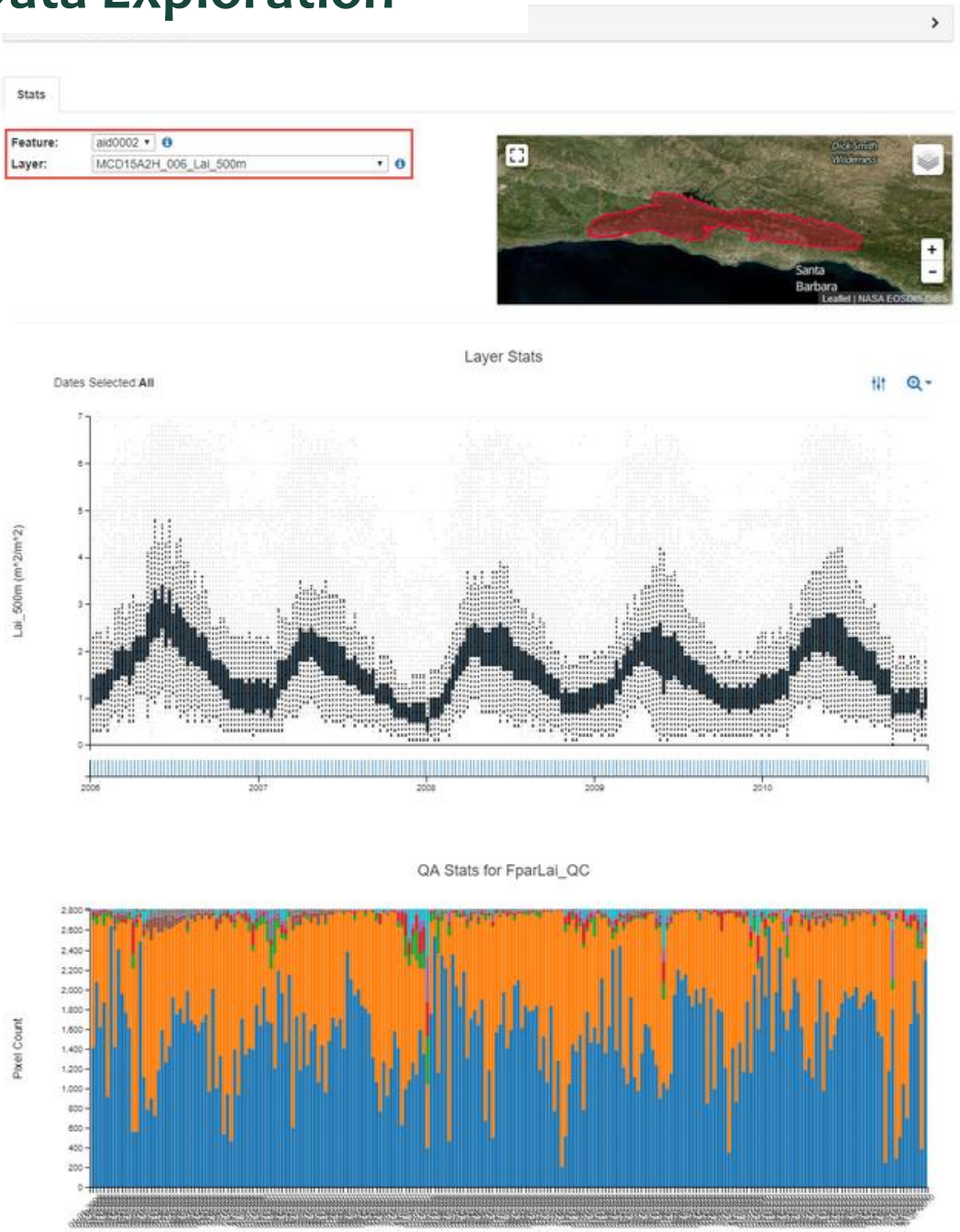


Scatter Plot

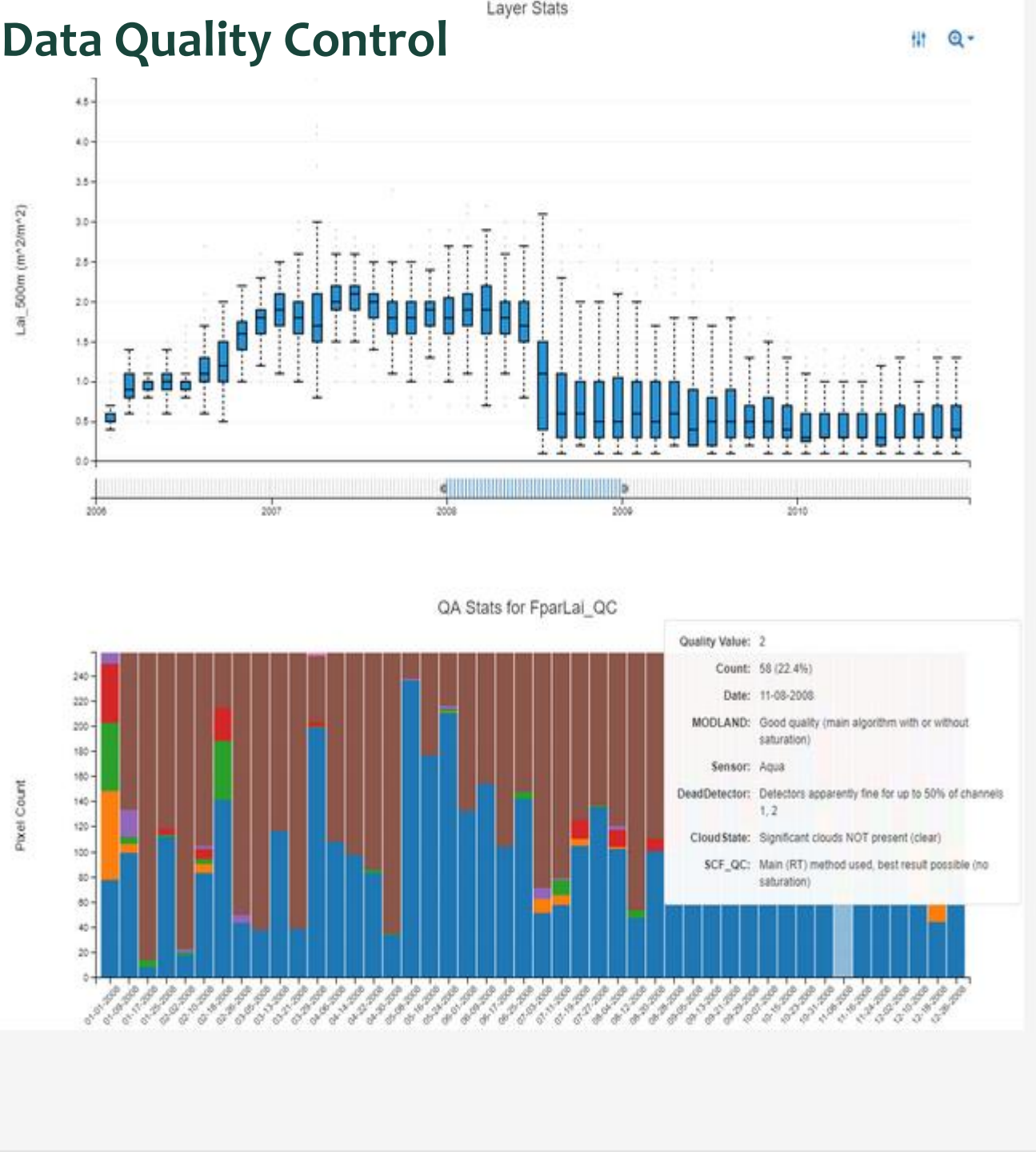


Date	006__250m_16_days_NDVI	006__250m_16_days_NDVI Quality	006__250m_16_days_NDVI Quality Description	006__250m_16_days_EVI	006__250m_16_days_EVI Quality	006__250m_16_days_EVI Quality Description
11-16-2016	0.523499965667725	0	VI produced with good quality	0.193299993872643	0	VI produced with good quality
10-31-2016	0.513499975204468	0	VI produced with good quality	0.18299999833107	0	VI produced with good quality
10-15-2016	0.544699966907501	0	VI produced with good quality	0.195799991488457	0	VI produced with good quality

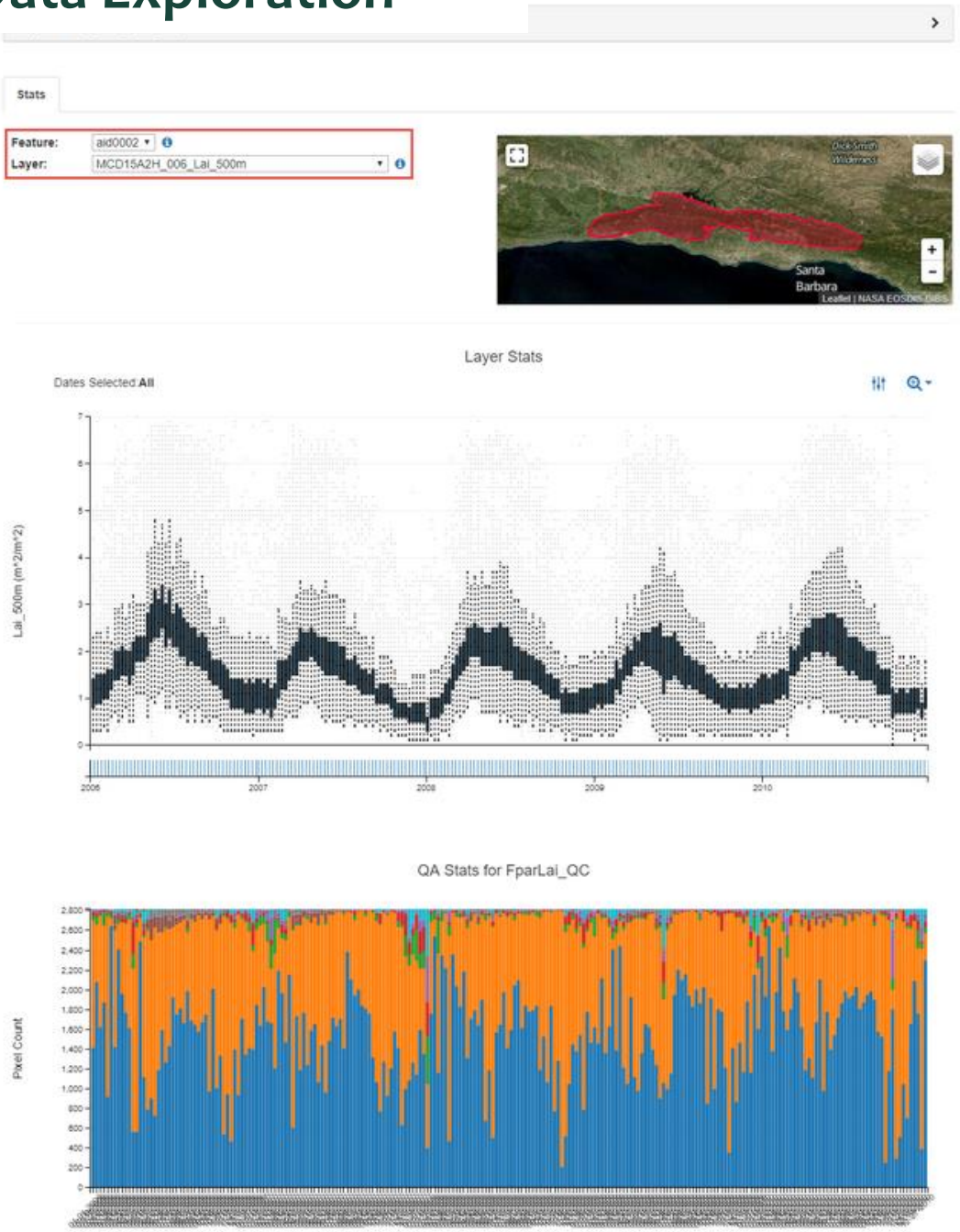
Data Exploration



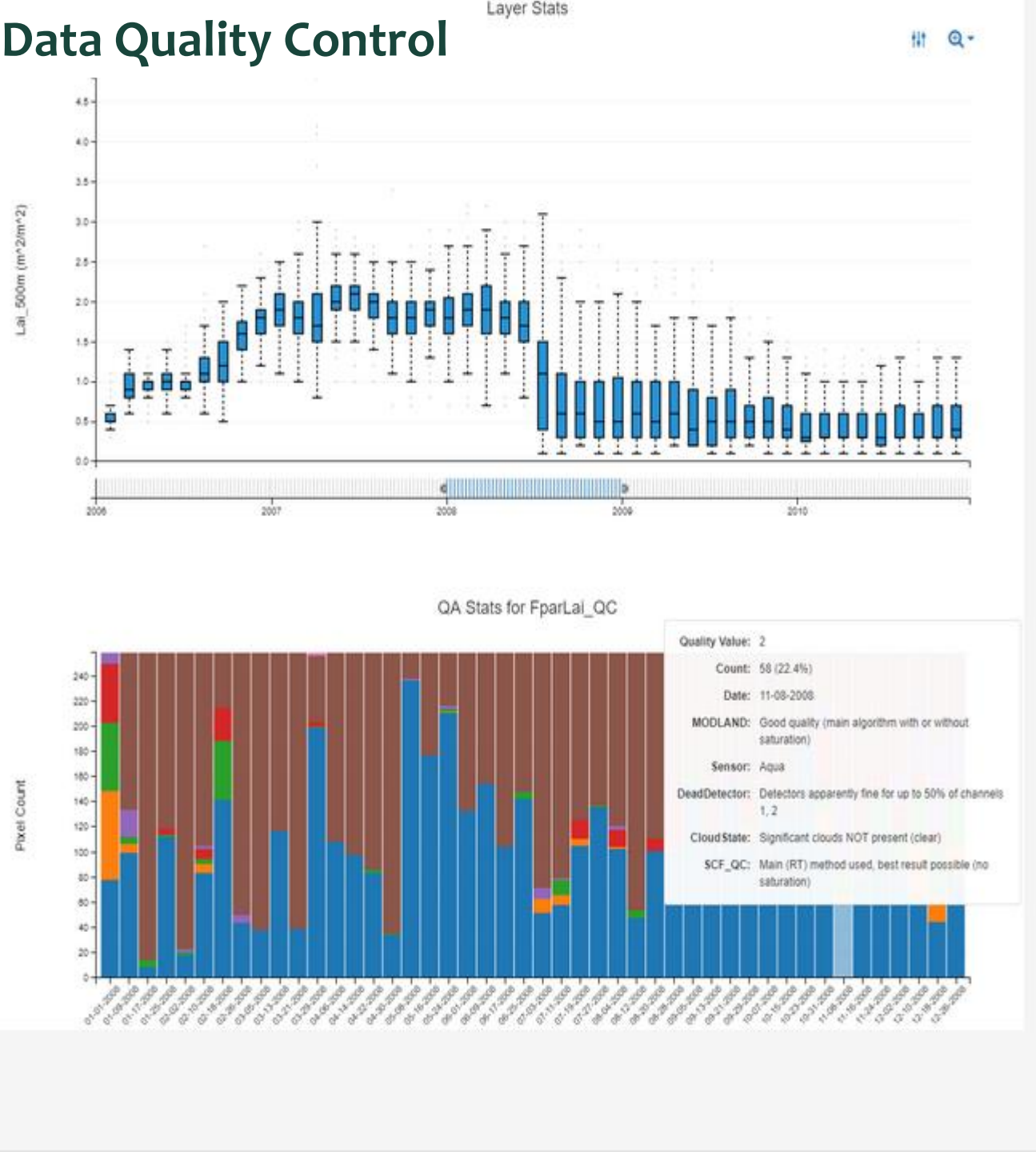
Data Quality Control



Data Exploration



Data Quality Control



Extract Area Sample

Enter a name to identify your sample

RO S30 2017

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

01-01-2017

End Date

12-31-2017

Is Date Recurring?

Select the layers to include in the sample

Search for a product

Selected layers

B04
30m, Daily
B04 - Red (0.64 – 0.67 µm)

B11
30m, Daily
B11 - SWIR1 (1.57 – 1.65 µm)

B8A
30m, Daily
B8A - NIR Narrow (0.85 – 0.88 µm)

Remove All (4)

Output Options

File Format: GeoTiff

Projection: Native Projection

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

```r
get_data <- function(iterator){
  library(getPass)
  library(httr)
  library(jsonlite)
  library(tidyverse)
  API_URL = 'https://appeears.earthdatacloud.nasa.gov/api/'
  user <- "USERNAME"        # Enter NASA Earthdata Login Username
  password <- "PASSWORD"    # Enter NASA Earthdata Login Password
  secret <- jsonlite::base64_enc(paste(user, password, sep = ":"))
  response <- httr::POST(paste0(API_URL,"login"),
                         add_headers("Authorization" = paste("Basic",
                         gsub("\n", "", secret)),
            "Content-Type" ="application/x-www-form-urlencoded;charset=UTF-8"),
            body = "grant_type=client_credentials")

  response_content <- content(response)
  token_response <- toJSON(response_content, auto_unbox = TRUE)
  remove(user, password, secret, response)
  prettify(token_response)
  token <- paste("Bearer", fromJSON(token_response)$token)

  hls <- substr(iterator, 5, 7)
  yr <- substr(iterator, 1, 4)
  task_id <- substr(iterator, 8, nchar(iterator))
  outDir <- file.path(paste0("N:/RO_CAP_LCLUC/LSP_South/HLS/Data_in/",yr,"/",hls))
  response <- GET(paste0(API_URL, "bundle/", task_id), add_headers(Authorization = token))
  bundle_response <- prettify(toJSON(content(response), auto_unbox = TRUE))

  bundle <- fromJSON(bundle_response)$files
  count = 0
  for (id in bundle$file_id){
      # retrieve the filename from the file_id
      filename <- bundle[bundle$file_id == id,]$file_name
      filename2 <- basename(filename)
      # create a destination directory to store the file in
      filepath <- paste(outDir,filename2, sep = "/")
      if (file.exists(filepath)){next}
      suppressWarnings(dir.create(dirname(filepath)))
      # write the file to disk using the destination directory and file name
      response <- GET(paste0(API_URL, "bundle/", task_id, "/", id),
                      write_disk(filepath, overwrite = TRUE), progress(),
                      add_headers(Authorization = token))
      count = count+1
  }
}
library(parallel)
cluster   <- makeCluster(4)
parLapply(cluster, iterators, get_data)
stopCluster(cluster)
```

Recent webinar

- @NASA Earthdata YouTube channel: Efficient Geospatial Data Access with NASA's AppEEARS https://www.youtube.com/watch?v=0nK2DFlltJA & https://www.earthdata.nasa.gov/learn/webinars-and-tutorials

For users looking for programmatic (API) access

- AppEEARS API : https://appeears.earthdatacloud.nasa.gov/api/
- Github repository for users looking for programmatic (API) access: https://github.com/nasa/AppEEARS-Data-Resources
- Repository contains a couple of word documents that provide step-by-step instructions for walking through point and area extraction examples (they are from a workshop given in 2020 so the products listed may have newer versions): https://git.earthdata.nasa.gov/projects/LPDUR/repos/naccb/browse
- LP DAAC e-learning website: https://lpdaac.usgs.gov/resources/e-learning/

Feedback to monikat@msu.edu:

What products and/or features would you like to see added to AppEEARS?

THANKS!