**Sensor-Independent LAI/FPAR CDR Description**

**Department of Earth and Environment**

**Boston University**

**Cliveg Research Group**

**June 27, 2023**

README FILE AND SCRIPTS

**1. DATA DESCRIPTION**

The Sensor-Independent LAI/FPAR climate dataset record (CDR) is derived from high quality LAI/FPAR from MOD15AH C6, MYD15A2H C6, and VNP15A2H C1 products. The low-quality LAI/FPARs were first removed by quality control method and the high-quality LAI/FPARs were merged into Filtered Sensor-Independent LAI/FPAR data. The missing values are then gap filled by spatial-temporal tensor (ST-Tensor) completion model. The Sensor-Independent LAI/FPAR CDR is produced based on different projections and spatial/temporal resolutions. The characteristic of the Sensor-Independent LAI/FPAR CDR can be found in Table 1.

**Table 1.** Data description of Sensor-Independent LAI/FPAR CDR

|  |  |
| --- | --- |
| Data Name | Sensor-Independent LAI/FPAR CDR |
| Raw Dataset | MOD15AH C6 (February 18, 2000 – December 31,20), MYD15A2H C6 (July 14, 2002 – December 31,20), VNP15A2H C1 (January 17, 2012 – December 31,20), LAI/FPAR products |
| Area | Global Vegetation Area |
| Projection | Sinusoidal/WGS1984 |
| Spatial Resolution | 500m/5km/0.05 degree |
| Temporal Resolution | 8 days/Half month |
| Temporal Coverage | February 18, 2000 – December 31,2022 |
| Fill Value | 255 |
| Data Type | Uint8 |
| Valid Range | 0 ~ 70 for LAI and 0 ~ 100 for FPAR |
| Multiply By Scale Factor | 0.1 for LAI and 0.01 for FPAR |
| Data Sets | First Layer for LAI and Second Layer for FPAR |
| File Format | TIFF(.tif) |

There are six versions of Sensor-Independent LAI/FPAR CDR in different projections and spatial/temporal resolutions (Table 2). Two versions of Sensor-Independent LAI/FPAR CDR with a spatial resolution of 500m were uploaded to Google Earth Engine for users to mix and match with other datasets and the ease of using this in Google Earth Engine. These two versions were reprojected to WGS1984 using the gdalwarp function with a crs of EPSG:4326 for ease of ingestion. The other four versions of Sensor-Independent LAI/FPAR CDR can be found in Zenodo.

**Table 2.** Projections and spatial/temporal resolutions of Sensor-Independent LAI/FPAR CDR

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Name | Projection | Spatial Resolution | Temporal Resolution | Dimensions | Repository |
| 500m\_8d | WGS1984 | 500m | 8 days | 43200 x 86400 rows/columns | GEE |
| 500m\_bimonth | WGS1984 | 500m | Half month | 43200 x 86400 rows/columns | GEE |
| 5km\_8d | Sinusoidal | 5km | 8 days | 4320 x 8640 rows/columns | Zenodo |
| 5km\_bimonth | Sinusoidal | 5km | Half month | 4320 x 8640 rows/columns | Zenodo |
| 0.05degree\_8d | WGS1984 | 0.05 degree | 8 days | 3600 x 7200 rows/columns | Zenodo |
| 0.05degree\_bimonth | WGS1984 | 0.05 degree | Half month | 3600 x 7200 rows/columns | Zenodo |

**2. FILE NAMING CONVENTION**

The Sensor-Independent LAI/FPAR CDR that provided by Zenodo follow a naming convention that gives useful information regarding the specific product. For example, the filename

1. **SI\_LAI\_FPAR\_CDR\_Sin\_5km\_8day\_2000049.tif**

* SI\_LAI\_FPAR\_CDR: Product Short Name
* Sin: The projection is Sinusoidal
* 5km: The spatial resolution is 5km
* 8day: The temporal resolution is 8 days
* 2000049: Julian Date of Acquisition (YYYYDDD)
* tif: Data Format

1. **SI\_LAI\_FPAR\_CDR\_Sin\_5km\_bimonth\_20000301.tif**

* SI\_LAI\_FPAR\_CDR: Product Short Name
* Sin: The projection is Sinusoidal
* 5km: The spatial resolution is 5km
* bimonth: The temporal resolution is half month
* 20000301: First half of the March 2000 (YYYYMMP, P means first or second half of month)
* tif: Data Format

1. **SI\_LAI\_FPAR\_CDR\_WGS84\_0.05degree\_8day\_2000129.tif**

* SI\_LAI\_FPAR\_CDR: Product Short Name
* WGS84: The projection is WGS1984
* 0.05degree: The spatial resolution is 0.05 degree
* 8day: The temporal resolution is 8 days
* 2000129: Julian Date of Acquisition (YYYYDDD)
* tif: Data Format

1. **SI\_LAI\_FPAR\_CDR\_WGS84\_0.05degree\_bimonth\_20000302.tif**

* SI\_LAI\_FPAR\_CDR: Product Short Name
* WGS84: The projection is WGS1984
* 0.05degree: The spatial resolution is 0.05 degree
* bimonth: The temporal resolution is half month
* 20000302: Second half of the March 2000 (YYYYMMP, P means first or second half of month)
* tif: Data Format

**3. DATA AVAILABLITY**

The dataset links are as follows:

1. <https://doi.org/10.5281/zenodo.8076540> (spatial resolution is 5km/0.05degree and temporal resolution is 8 days/half month)
2. <https://code.earthengine.google.com/?asset=projects/sat-io/open-datasets/BU_LAI_FPAR/wgs_500m_8d> (spatial resolution is 500m and temporal resolution is 8 days)
3. <https://code.earthengine.google.com/?asset=projects/sat-io/open-datasets/BU_LAI_FPAR/wgs_500m_bimonthly> (spatial resolution is 500m and temporal resolution is half month)

**4. DATA READ EXAMPLE (For Google Earth Engine)**

1) Here is a Google Earth Engine example for the version that spatial resolution is 500m and temporal resolution is 8 days:

//1.Get the information about the Sensor-Independent LAI/FPAR CDR

var wgs\_500m\_8d = ee.ImageCollection("projects/sat-io/open-datasets/BU\_LAI\_FPAR/wgs\_500m\_8d")

print(wgs\_500m\_8d)// Print Sensor-Independent LAI/FPAR CDR (500m and 8days) to console

////////////////////////////////////////////////////////

//2. Add Sensor-Independent LAI/FPAR CDR (Year=2010, DOY=201) As Map Layes

Map.addLayer(wgs\_500m\_8d.filterDate('2010-201').first().select('LAI').multiply(0.1),{min:0,max:6,palette: ['#a89247','#5e963b','#75b84f','#8bd162','#f3e24d','#f7eb6b','#fbe789']},'LAI sample')

Map.addLayer(wgs\_500m\_8d.filterDate('2010-201').first().select('FPAR').multiply(0.01),{min:0,max:0.9,palette:['#ff0000','#ff4500','#ff7f00','#ffa500','#ffcf00','#ffff00','#ffff66']},'FPAR sample')

////////////////////////////////////////////////////////

//3. Define a Crop Region and Generate a LAI timeseries from 2010-01-01 to 2022-12-31

var Maize = ee.Feature(

ee.Geometry.Rectangle(123.269, 48.0495, 123.272, 48.0511),

{label: 'Maize'});

var Corn = ee.Feature(

ee.Geometry.Rectangle(123.2892, 48.0599, 123.2907, 48.0582),

{label: 'Corn'});

var Soybean = ee.Feature(

ee.Geometry.Rectangle(123.2442, 48.0813, 123.2455, 48.0799),

{label: 'Soybean'});

var cropRegions = new ee.FeatureCollection([Maize,Corn,Soybean]);//Define a Crop Region

//

var CDR= wgs\_500m\_8d.filterDate('2010-01-01', '2022-12-31')

.filterBounds(cropRegions);//Define a Time Period from 2010-01-01 to 2022-12-31

var LAITimeSeries = ui.Chart.image.seriesByRegion({

imageCollection: CDR,

regions: cropRegions,

reducer: ee.Reducer.mean(),

band: 'LAI',

scale: 10,

xProperty: 'system:time\_start',

seriesProperty: 'label'

});//Generating a LAI Timeseries

var COLOR = {

SOYBEAN: '7FFF00',

MAIZE: 'ff0000',

CORN: '0000ff'

};//Define the color for three crops

LAITimeSeries.setChartType('ScatterChart');

LAITimeSeries.setOptions({

title: 'Crop Sensor-Independent LAI CDR',

vAxis: {

title: 'LAI (Scale:0.1)'

},

lineWidth: 1,

pointSize: 4,

series: {

0: {color: COLOR.MAIZE},

1: {color: COLOR.CORN},

2: {color: COLOR.SOYBEAN}

}

});//Generate One Fiugre

print(LAITimeSeries);

////////////////////////////////////////////////////////

2) Here is a Google Earth Engine example for the version that spatial resolution is 500m and temporal resolution is half month:

//1.Get the information about the Sensor-Independent LAI/FPAR CDR

var wgs\_500m\_bimonthly = ee.ImageCollection("projects/sat-io/open-datasets/BU\_LAI\_FPAR/wgs\_500m\_bimonthly")

print(wgs\_500m\_bimonthly)// Print Sensor-Independent LAI/FPAR CDR (500m and half month) to console

////////////////////////////////////////////////////////

//2. Add Sensor-Independent LAI/FPAR CDR (Year=2010, first half of July) As Map Layes

Map.addLayer(wgs\_500m\_bimonthly.filterDate('2020-07-01','2020-07-31').filter(ee.Filter.eq('month\_half',1)).first().select('LAI').multiply(0.1),{min:0,max:6,palette: ['#a89247','#5e963b','#75b84f','#8bd162','#f3e24d','#f7eb6b','#fbe789']},'LAI sample')

Map.addLayer(wgs\_500m\_bimonthly.filterDate('2020-07-01','2020-07-31').filter(ee.Filter.eq('month\_half',1)).first().select('FPAR').multiply(0.01),{min:0,max:0.9,palette:['#ff0000','#ff4500','#ff7f00','#ffa500','#ffcf00','#ffff00','#ffff66']},'FPAR sample')

////////////////////////////////////////////////////////

//3. Define a Crop Region and Generate a LAI timeseries from 2010-01-01 to 2022-12-31

var Maize = ee.Feature(

ee.Geometry.Rectangle(123.269, 48.0495, 123.272, 48.0511),

{label: 'Maize'});

var Corn = ee.Feature(

ee.Geometry.Rectangle(123.2892, 48.0599, 123.2907, 48.0582),

{label: 'Corn'});

var Soybean = ee.Feature(

ee.Geometry.Rectangle(123.2442, 48.0813, 123.2455, 48.0799),

{label: 'Soybean'});

var cropRegions = new ee.FeatureCollection([Maize,Corn,Soybean]);//Define a Crop Region

//

var CDR= wgs\_500m\_bimonthly.filterDate('2010-01-01', '2022-12-31')

.filterBounds(cropRegions);//Define a Time Period from 2010-01-01 to 2022-12-31

var LAITimeSeries = ui.Chart.image.seriesByRegion({

imageCollection: CDR,

regions: cropRegions,

reducer: ee.Reducer.mean(),

band: 'LAI',

scale: 10,

xProperty: 'system:time\_start',

seriesProperty: 'label'

});//Generating a LAI Timeseries

var COLOR = {

SOYBEAN: '7FFF00',

MAIZE: 'ff0000',

CORN: '0000ff'

};//Define the color for three crops

LAITimeSeries.setChartType('ScatterChart');

LAITimeSeries.setOptions({

title: 'Crop Sensor-Independent LAI CDR',

vAxis: {

title: 'LAI (Scale:0.1)'

},

lineWidth: 1,

pointSize: 4,

series: {

0: {color: COLOR.MAIZE},

1: {color: COLOR.CORN},

2: {color: COLOR.SOYBEAN}

}

});//Generate One Fiugre

print(LAITimeSeries);

////////////////////////////////////////////////////////

**5. DATA READ EXAMPLE (For Matlab)**

Here is a Matlab example for the version that spatial resolution is 0.05 degree and temporal resolution is 8 days:

clear;clc

% set the input dir

inpath = 'D:\SI\_LAI\_FPAR\_CDR\WGS84\_0.05degree\_8d\';

year = 2020;

for doy=161 %1:8:361

% check the prefix

prefix = 'SI\_LAI\_FPAR\_CDR\_WGS84\_0.05degree\_8day\_';

inname = strcat(inpath,prefix,num2str(year\*1000+doy),'.tif');

% read data

data = imread(inname);

data = double(data);

data(data == 255) = nan;

LAI=data(:,:,1)/10;

FPAR=data(:,:,2)/100;

% Visually check the SI\_LAI\_FPAR\_CDR

figure(1); imagesc(LAI);

figure(2); imagesc(FPAR);

end

-------------------------------------------------------------------------------------------------------------------------------

\* Any questions about the dataset can be corresponded to Jiabin Pu (om7759@bu.edu)