A High-Quality Reprocessed MODIS Leaf Area Index Dataset (HiQ-LAI)

1. Data Description

The High-Quality Leaf Area Index (HiQ-LAI) is derived from reprocessed MODIS LAI C6.1 product by Spatio-Temporal Information Compositing Algorithm (STICA). This method integrates information from multiple dimensions, including pixel quality information, spatiotemporal correlation, and original observations, to improve the raw MODIS LAI retrievals with poor quality. The HiQ-LAI is available in various projections and spatial resolutions. Essential details regarding the product are outlined in Table 1.

Table 1. Dataset characteristics of the HiQ-LAI Product

Characteristics	HiQ-LAI Product
Temporal Coverage	February 18, 2000 – December 31,2022
Area	Global Vegetated Land
Projection	Sinusoidal/WGS1984
Spatial Resolution	500m/5km
Temporal Resolution	8 days
Fill Value	255
Data Type	Uint8
File Format	TIFF(.tif)

The HiQ-LAI product offers 5 Science Datasets (Fig. 1), comprising LAI, original quality control information, relative temporal stability of MODIS LAI and HiQ-LAI, and the absolute difference between HiQ-LAI and MODIS LAI. To address considerations regarding data storage size, the original values have been adjusted to integers. Users are advised to refer to the scaling factors provided in Table 2 for value restoration when utilizing the data.

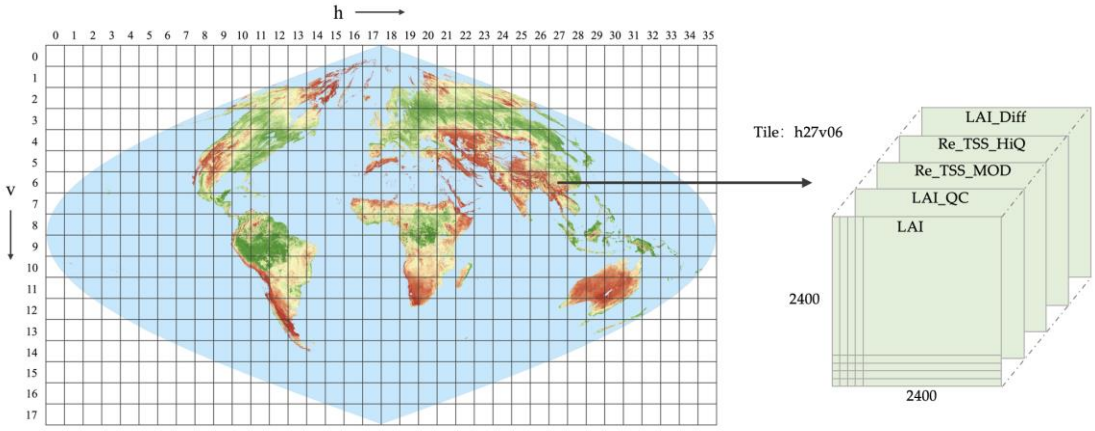

Fig. 1 Scientific Datasets of the HiQ-LAI

Table 2. Scientific Datasets included in the HiQ-LAI Product

Scientific Data Sets	Definition	Bite Type	Fill Value	Valid Range	Scale Factor
LAI	HiQ 500M Leaf Area Index	uint8	249-255	0-100	×0.1
LAI_QC	QC for LAI	uint8	255	0-254	Null
Re_TSS_MOD	Relative Time-series Stability for MODIS-LAI	uint8	255	0-10	×0.001
Re_TSS_HiQ	Relative Time-series Stability for HiQ-LAI	uint8	255	0-10	×0.001
LAI_Diff	Difference of Leaf Area Index between MODIS LAI and HiQ-LAI	uint8	Null	0-255	−100

The HiQ-LAI is available in two projections of different spatial resolutions (Table 3). Data sets at 500m were stored in Google Earth Engine for users to mix and match with other datasets and the availability of this dataset in the GEE platform would significantly benefit the GEE community, fostering easier access and utilization of this valuable resource. A 5km projection of HiQ-LAI for WGS84 (EPSG:4326) can be found in Zenodo.

Table 3. Projections and spatial/temporal resolutions of HiQ-LAI

Dataset	Projection	Spatial Resolution	Temporal Resolution	Repository
500m_8day	WGS1984/ Sinusoidal	500m	8 days	GEE
5km_8day	WGS1984	5km	8 days	Zenodo

2. Filenames Convention

The HiQ-LAI product file name follows certain naming convention, providing useful information about a specific product. For example, the filename HiQ_LAI_WGS84_5km_8day_2022361.tif indicates:

- HiQ：Product Short Name
- LAI：Land Surface Type
- WGS84：Projection Information.
- 5km: Spatial Resolution
- 8day: Temporal Resolution
- 2022361：Julian Date of Acquisition（YYYYDDD）, DDD=DOY (Day of Year)
- .tif：Data Format

3. Data Availability

The dataset links are as follows:

1) https://doi.org/10.5281/zenodo.8296768 (spatial resolution is 5km and temporal resolution is 8 days)

2) https://code.earthengine.google.com/?asset=projects/verselab-398313/assets/HiQ_LAI/wgs_500m_8d (spatial resolution is 500m and temporal resolution is 8 days)

4. Data Read Example (For Google Earth Engine)

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

```
var Year = 2021
var HiQ = ee.ImageCollection('projects/verselab-398313/assets/HiQ_LAI/wgs_500m_8d')
print(HiQ) // // print HiQ dataset information to console

var HiQ _filter = HiQ.filterDate(Year+'-01-01', Year+'-12-31')
                                    //.select('LAI', 'LAI_QC')
// // If user wants to filter the year or month:
// var HiQ_Filtet_Y = HiQ.filter(ee.Filter.calendarRange(i, j, 'year'))
// var HiQ_Filtet_M = HiQ.filter(ee.Filter.calendarRange(i, j, 'month'))

var colorizedVis = {
  min: 0,
  max: 100, // 10, 100,
  palette: [
    'FFFFFF', 'CE7E45', 'DF923D', 'F1B555', 'FCD163', '99B718', '74A901',
    '66A000', '529400', '3E8601', '207401', '056201', '004C00', '023B01',
    '012E01', '011D01', '011301'
  ],
};

// // add special band to map layer
// .first(): add the first image of imageCollection
Map.addLayer(HiQ _filter.select('LAI').first(), colorizedVis, 'LAI');
Map.addLayer(HiQ _filter.select('LAI_QC'), {}, 'QC');
Map.addLayer(HiQ _filter.select(' Re_TSS_MOD'),{}, 'TSS_M');
Map.addLayer(HiQ _filter.select(' Re_TSS_HiQ'),{}, 'TSS_Overall');
Map.addLayer(HiQ _filter.select(' LAI_Diff'),{}, 'Diff');
```

5. Data Read Example (For Python)

Here is a python example for the version that spatial resolution is 5km and temporal resolution is 8 days:

```
import numpy as np
from osgeo import gdal
import matplotlib.pyplot as plt

def readTif(fileName):
    dataset = gdal.Open(fileName)
    if dataset == None:
        print(fileName+" Failed to open")
    return dataset

def render_Img (data, title='', savepath='', color=plt.cm.jet, axisType = 'off'):
    plt.imshow(data, cmap = color)    # cmap= plt.cm.jet
    plt.title(title, family='Times New Roman', fontsize=18)
    plt.rcParams['font.size'] = 13
    plt.rcParams['font.family'] = 'Times New Roman'
    # plt.colorbar()
    plt.axis(axisType)
    if issave :plt.savefig(savepath, dpi=300)
    plt.show()

year = 2021
for idx in range(1, 362, 8):
    ## read data
    file = readTif(f'HiQ_LAI_WGS84_5km_8day_{year}{idx:03d}.tif').ReadAsArray()
    ## Visually display the HiQ-LAI and LAI_QC
    render_Img(file[0]/10, title='LAI')
    render_Img(file[1], title='QC')
```

6. Data Read Example (For Matlab)

Here is a matlab example for the version that spatial resolution is 5km and temporal resolution is 8 days:

```
clear;clc
% set the input dir
inpath = '.\HiQ_LAI\WGS84_5km_8d\';
year = 2021;
for doy=161 %1:8:361
 % check the prefix
prefix = ' HiQ_LAI_WGS84_5km_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;
 LAI_Diff=data(:,:,7)-100;
 % Visually display the HiQ-LAI, Difference of LAI between MODIS LAI and HiQ-LAI
 figure(1); imagesc(LAI);
 figure(2); imagesc(LAI_Diff);
 end
```

7. Contact

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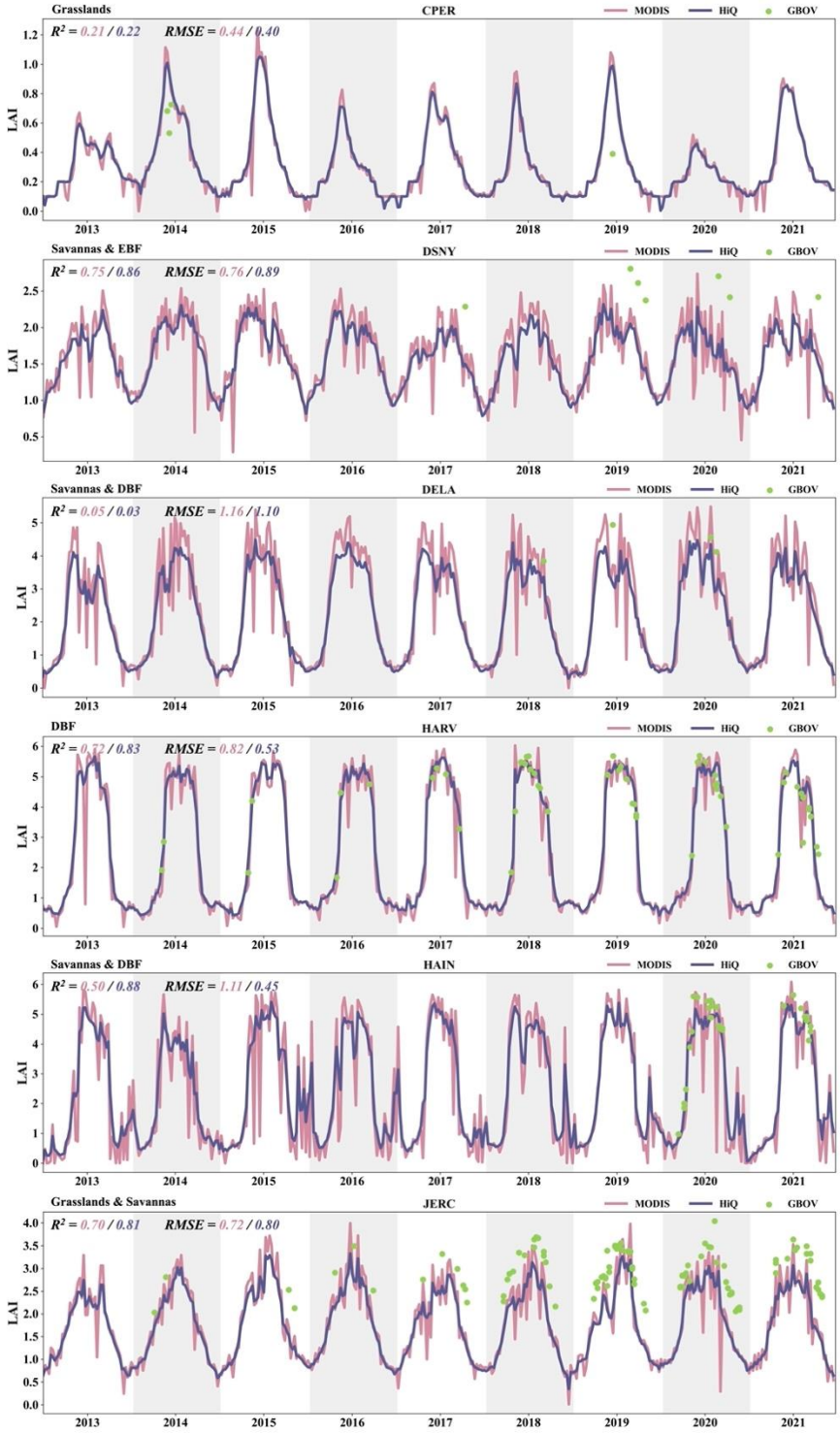
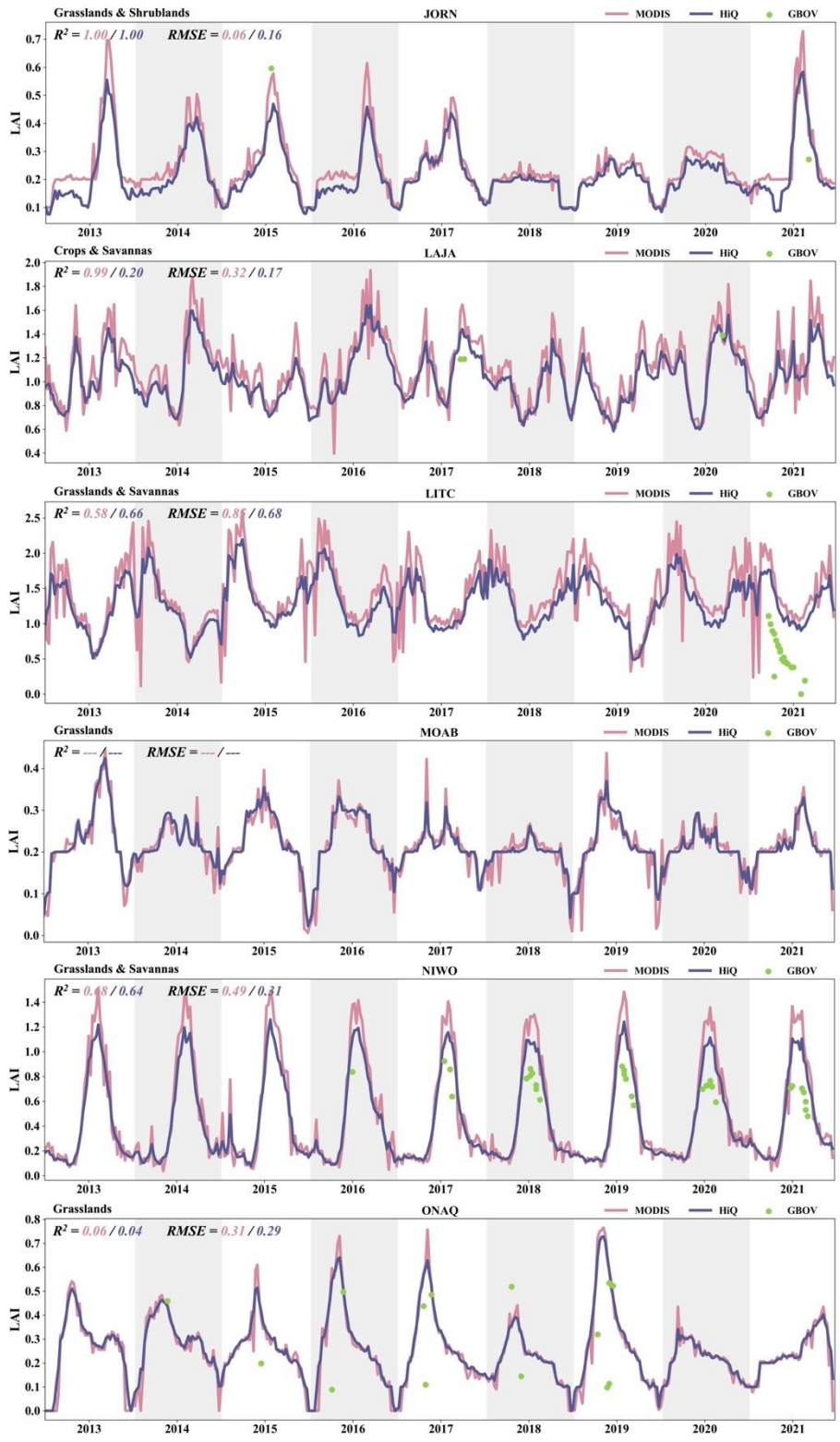
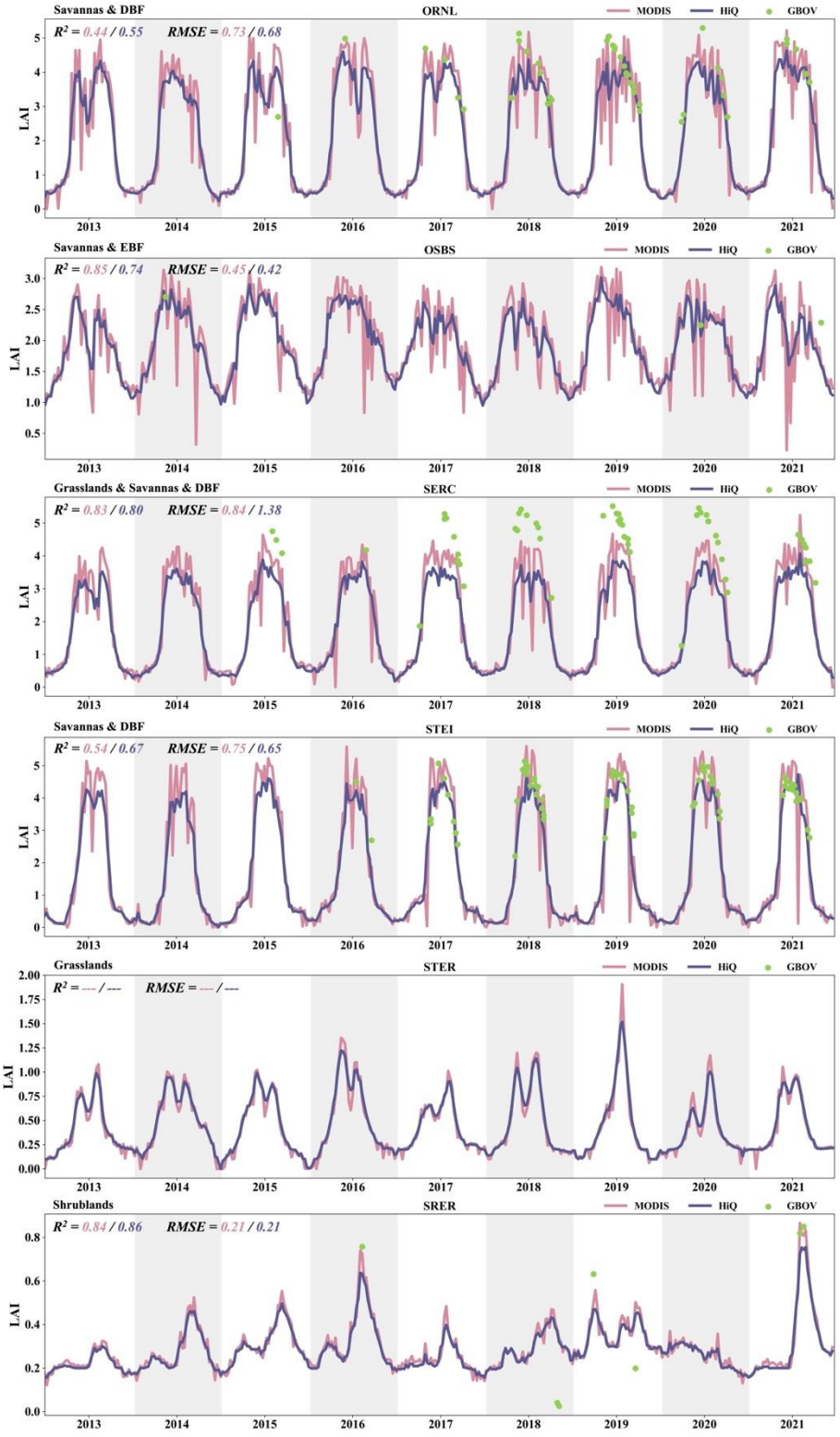
Supplementary.




Grasslands & Shrublands
JORN
MODIS
HiQ
GBOV
R^2 = 1.00 / 1.00
RMSE = 0.06 / 0.16
LAI
Crops & Savannas
LAJA
R^2 = 0.99 / 0.20
RMSE = 0.32 / 0.17
Grasslands & Savannas
LITC
R^2 = 0.58 / 0.66
RMSE = 0.85 / 0.68
Grasslands
MOAB
R^2 = --- / ---
RMSE = --- / ---
Grasslands & Savannas
NIWO
R^2 = 0.48 / 0.64
RMSE = 0.49 / 0.31
Grasslands
ONAQ
R^2 = 0.06 / 0.04
RMSE = 0.31 / 0.29
2013
2014
2015
2016
2017
2018
2019
2020
2021


Savannas & DBF
ORNL
MODIS
HiQ
GBOV
R^2 = 0.44 / 0.55
RMSE = 0.73 / 0.68
LAI
Savannas & EBF
OSBS
R^2 = 0.85 / 0.74
RMSE = 0.45 / 0.42
Grasslands & Savannas & DBF
SERC
R^2 = 0.83 / 0.80
RMSE = 0.84 / 1.38
Savannas & DBF
STEI
R^2 = 0.54 / 0.67
RMSE = 0.75 / 0.65
Grasslands
STER
R^2 = --- / ---
RMSE = --- / ---
Shrublands
SRER
R^2 = 0.84 / 0.86
RMSE = 0.21 / 0.21
2013
2014
2015
2016
2017
2018
2019
2020
2021

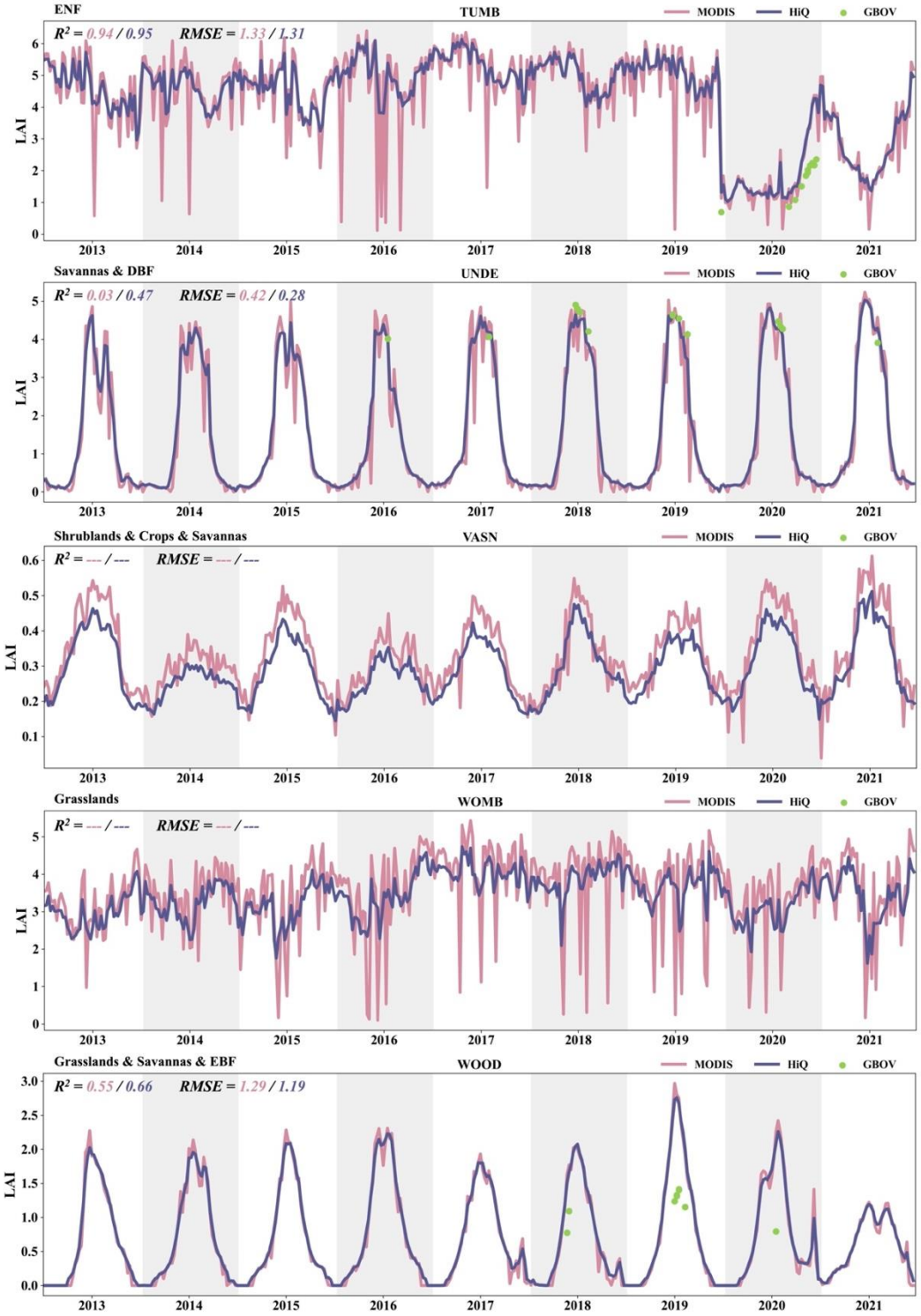


Figure S1 Same as Fig. 3 but for other 25 sites.