Using Sentinel-2 on google earth engine in Crop Type Identification for Irrigation Management in Eastern Nile

By
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Background of the Research

Irrigation operations manager in El Gezira scheme is responsible for the amount of water that every farmer needs to water his farm, but farmers in most times gives fake numbers of their cultivated areas and crop types.

Eastern Nile Technical Regional Office (ENTRO) of Nile Basin Initiative (NBI) is the technical center to support the equitable and adequate use of Nile Water, it has become a concern for it to find a simple tool to assess the use of water in the irrigated scheme to replace the traditional method of field visits. As a team from Sudan, Ethiopia and South Sudan, we provided them with valuable research project and gave them solutions.

In my part of this project I suggested building crop signature library for eastern Nile region and Used Java scripts API in Google earth engine environment to identify phenology parameters and signature for cultivated crops and creating maps for crop types and areas cultivated. In order to monitor small farms and reduce amount of water used in irrigation.

STUDY AREA – Kenana, SUDAN

1. Name: Kenana sugar Scheme

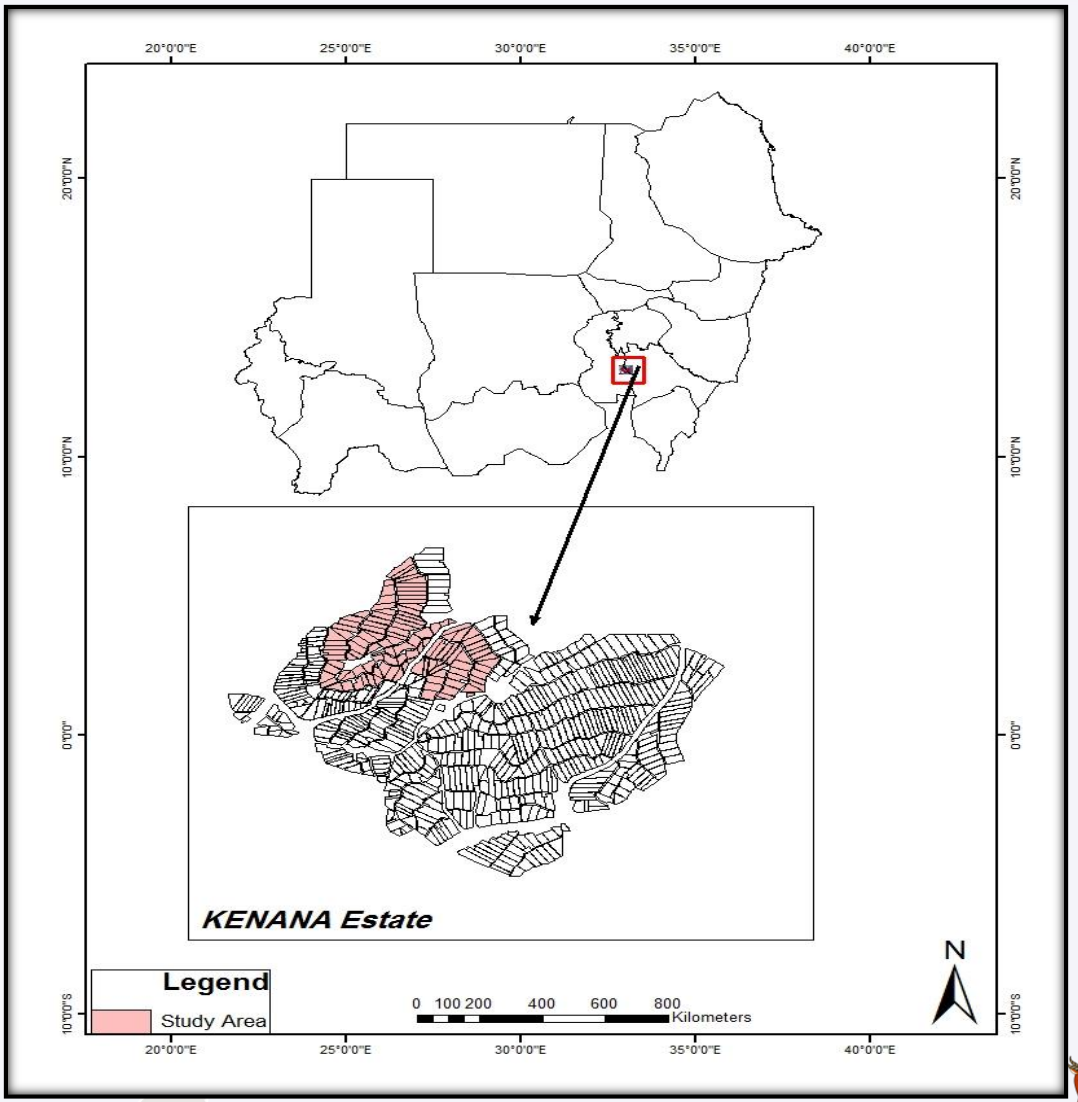
Location: On the eastern bank of the White Nile, approximately 300 Km south of Khartoum, covering an area of 70,000 ha.

Geographic location: it lies with latitudes 13 º 10 - 13.20°north and longitude 33 º 40 - 32.93°east, at an elevation of 410 m above sea level.

Soil type and topography: The soil of the scheme is fertile and consist mainly of base-saturated heavy textured vertisol of 60 to 70 % clay with a pH greater than 7.5. The area lies on an area of extensive clay plains between the White Nile and the Blue Nile, leading to a predominately flat topography with a gentle slope (0.5 m per Km) towards the White Nile.

Irrigation type: Sugarcane is irrigated by pumping water from the White Nile through six pumping stations that lifts water to 40m above the river level.

Fig : location of Kenana estate in Sudan.



STUDY AREA – Gezira , SUDAN

2. Name: Gezira Scheme.

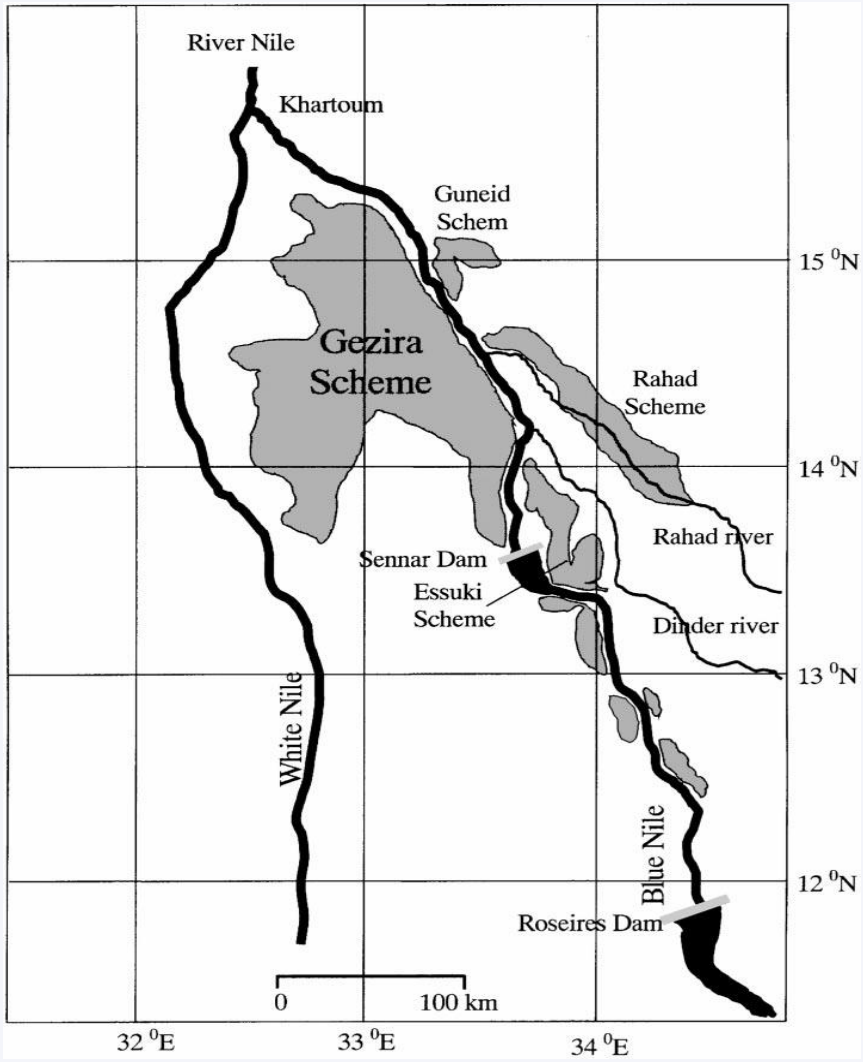
Location: On the western bank of the Blue Nile. The area is gradually Increasing by addition of new areas either by desire of people or government policy . 1910 starts with 600 fed. 1970 and later ends with 2.2 M fed.

Geographic location: The scheme is located between latitudes 13300 N and 15150 N, and longitudes 32150 E and 33450 E..

Climate, topography and rainy season: The climate of the region is arid and continental with low average annual precipitation (472 mm at Sennar dam and 160 mm near Khartoum). Altitude ranges from 420 S. to 380 (N. & W. STARTED 1925).The rainy season is 204 A.W. Abdelhadi et al. / Agricultural Water Management 45 (2000) 203±214 short (July-September) with moderate temperature and high humidity. The summer(April-June) is hot and the winter (November-February) is dry and cool. The rest of the period is transitional.

Irrigation type: The agriculture depends on supplementary irrigation from the Blue Nile. Furrow irrigation is the main irrigation system in the scheme.

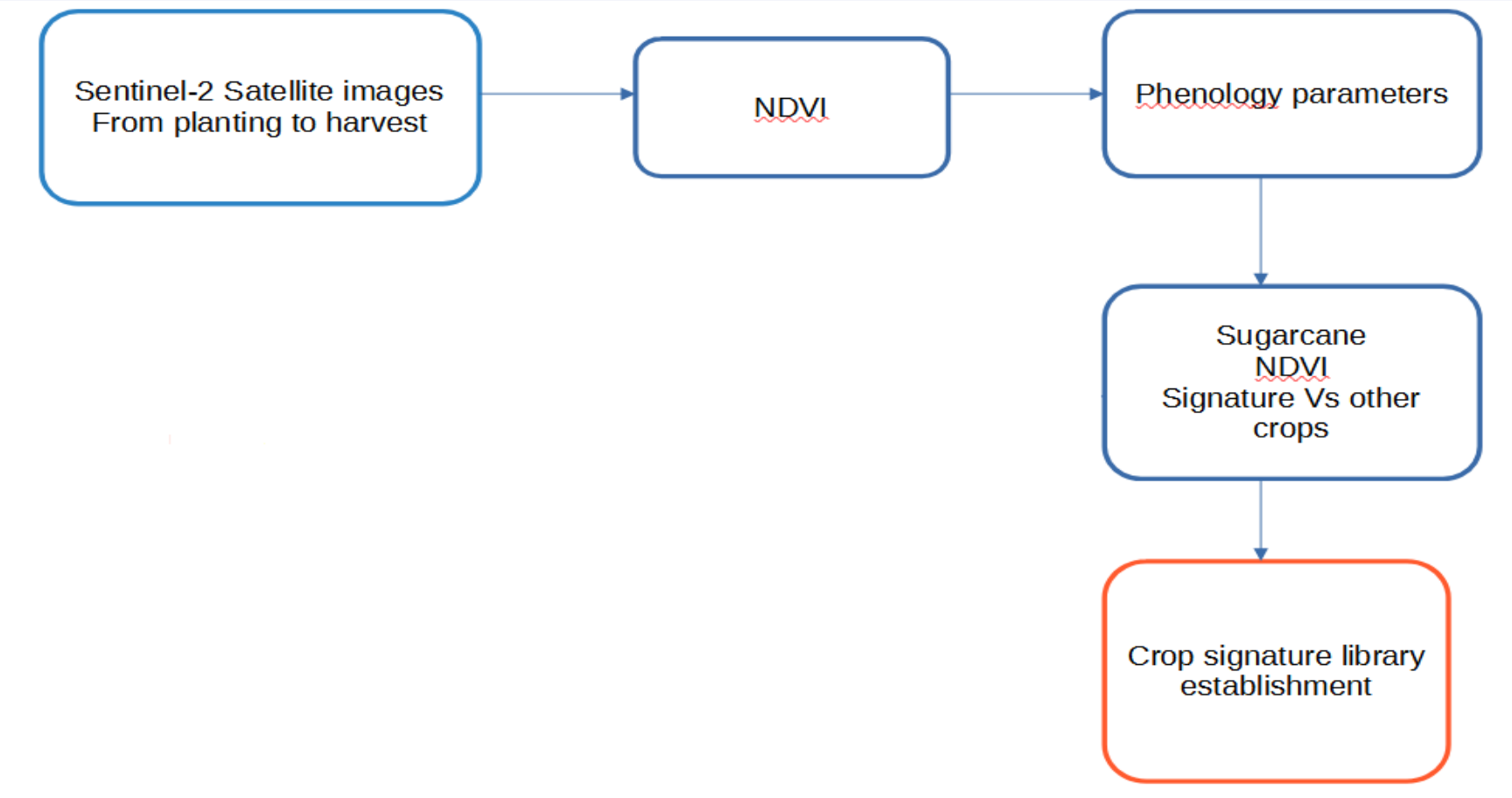
Fig: Major irrigation schemes of the Blue Nile dominated by the Gezira scheme.



Objectives

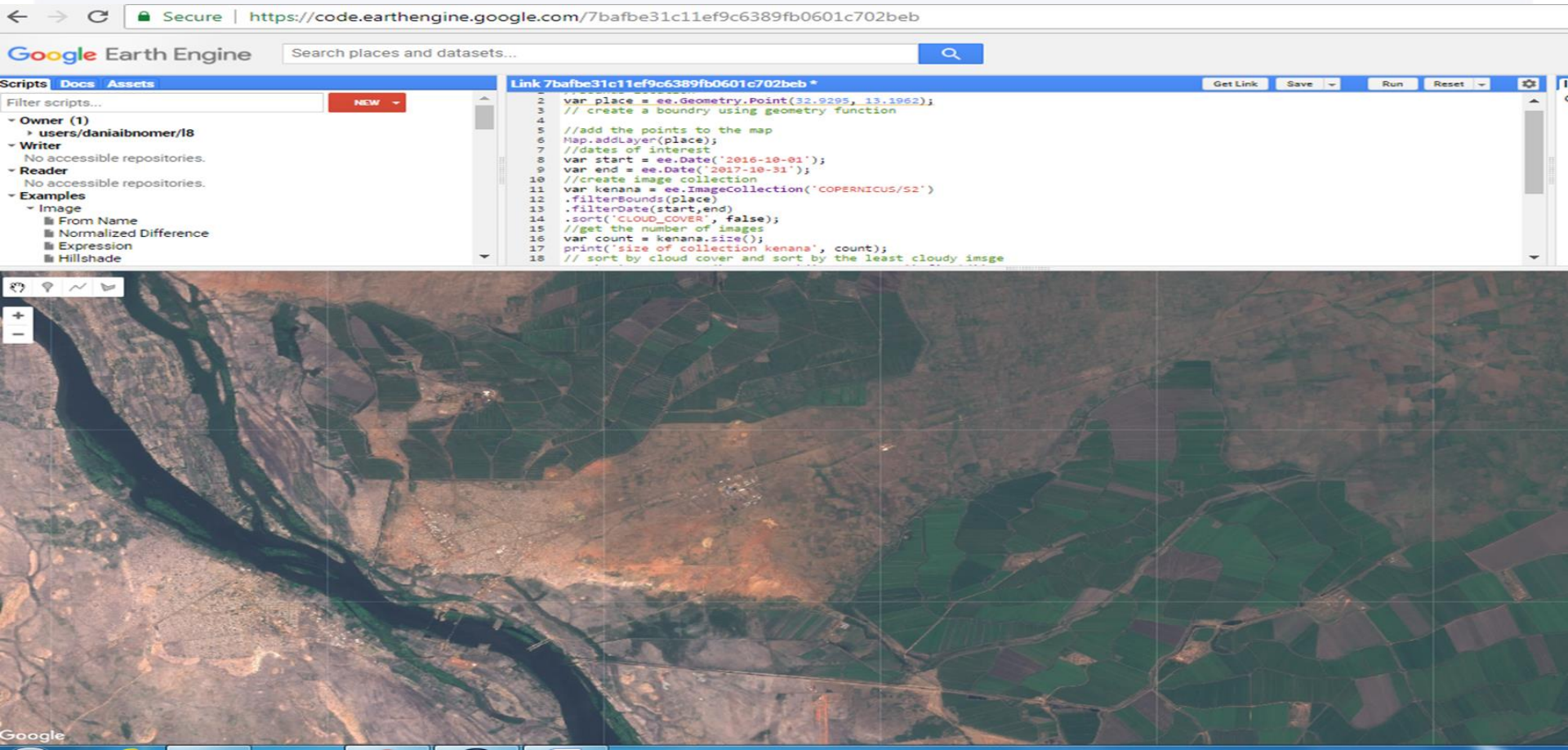
Crop type identification via crop library establishment for eastern Nile area.

Methodology



Methodology Cont.

1. Filter image collection of Sentinel-2A in earth engine with temporal resolution of 10 days from the planting date of crop up to harvest.

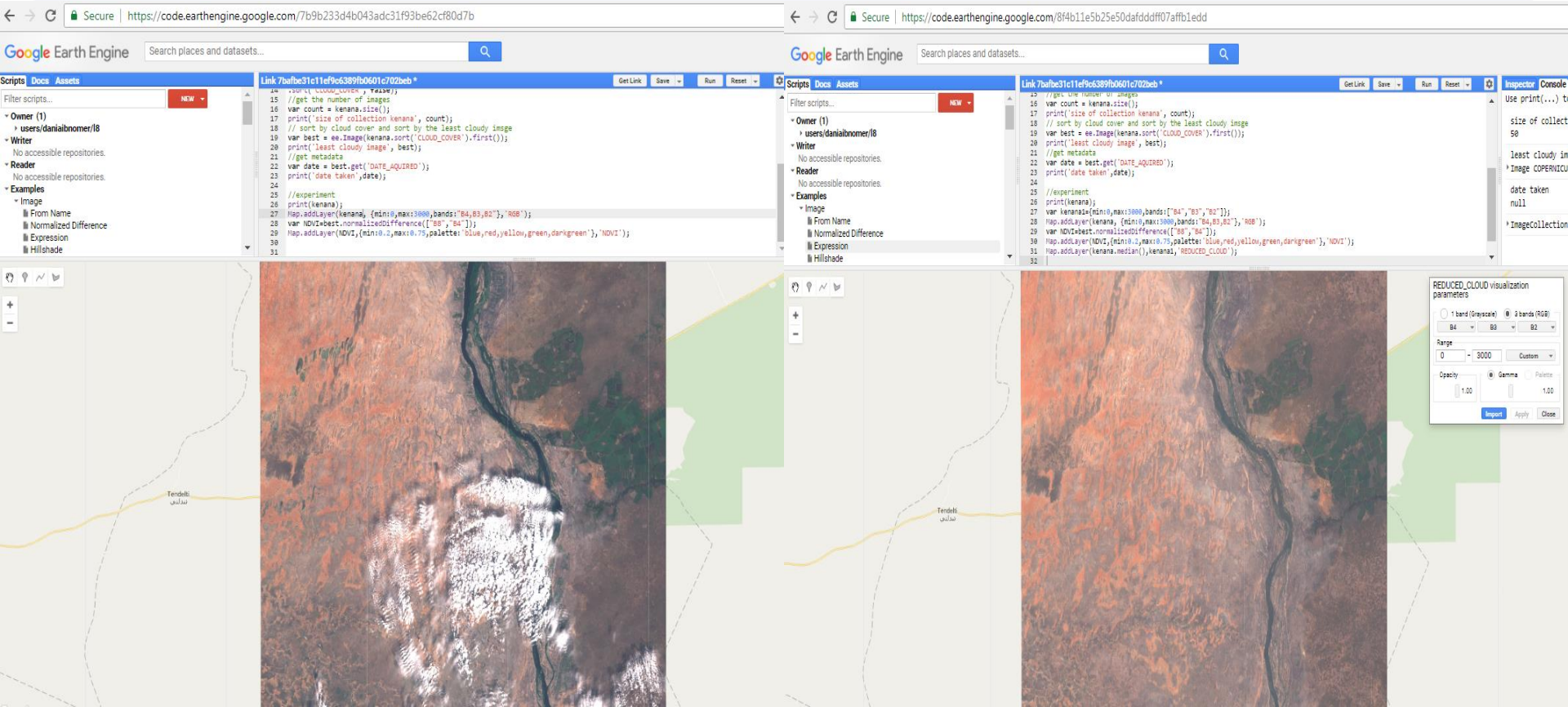


Methodology Cont.

2. Calculate NDVI for images in every single image in earth engine environment.

Methodology Cont.

Atmospheric correction have been done on RGB Sentinel-2A cloudy image then clouds have been reduced using median to eliminate the highest reflectance objects such as clouds.



Methodology Cont.

Kenana Area-1 Polygon have been uploaded.

New Script *

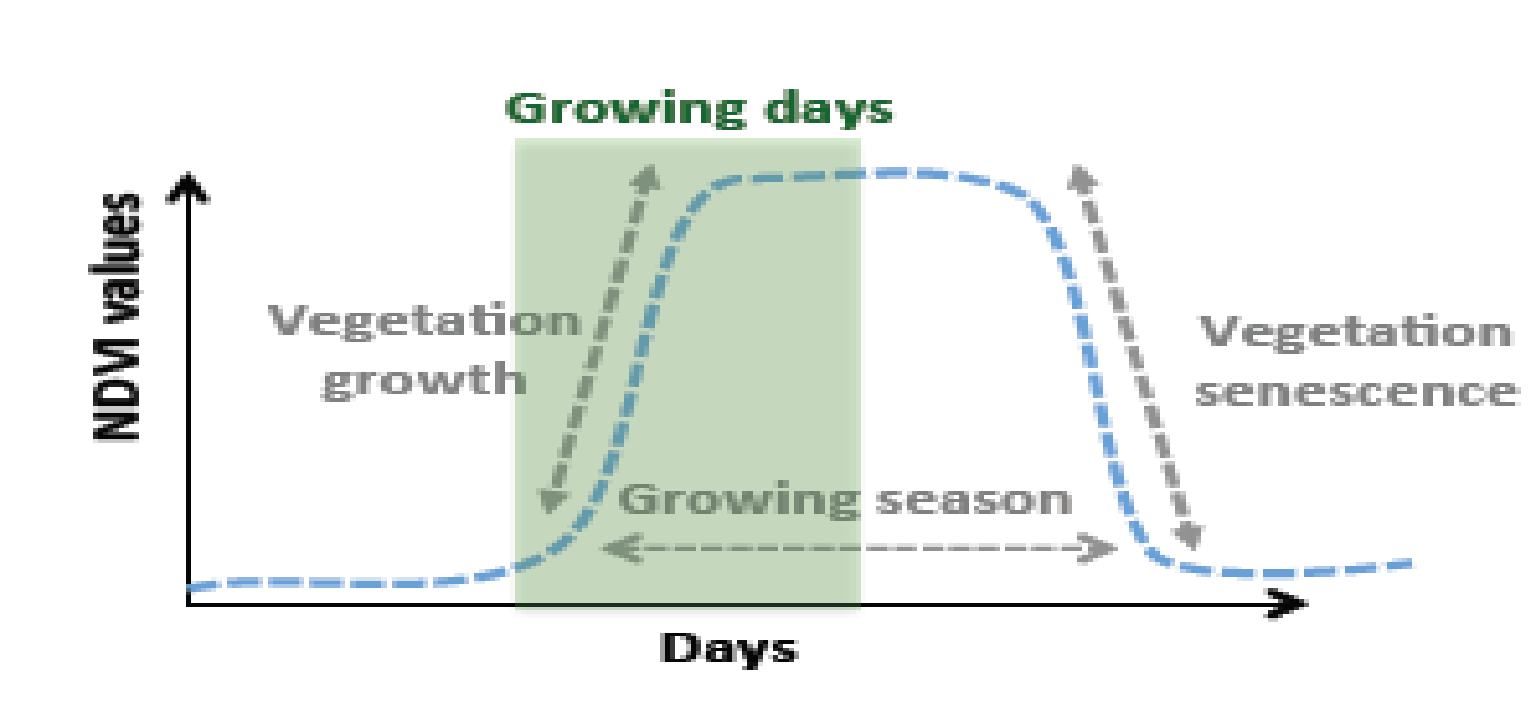
Get Link | Save | Run | Reset

```
Imports (1 entry)
  var table: Table users/daniaibnomer/dndn/area1
    type: FeatureCollection
    id: users/daniaibnomer/dndn/area1
    version: 1529650425936111
    columns: Object (7 properties)
    properties: Object (1 property)

1  print(table);
2
3
4  Map.addLayer(table);
5
```

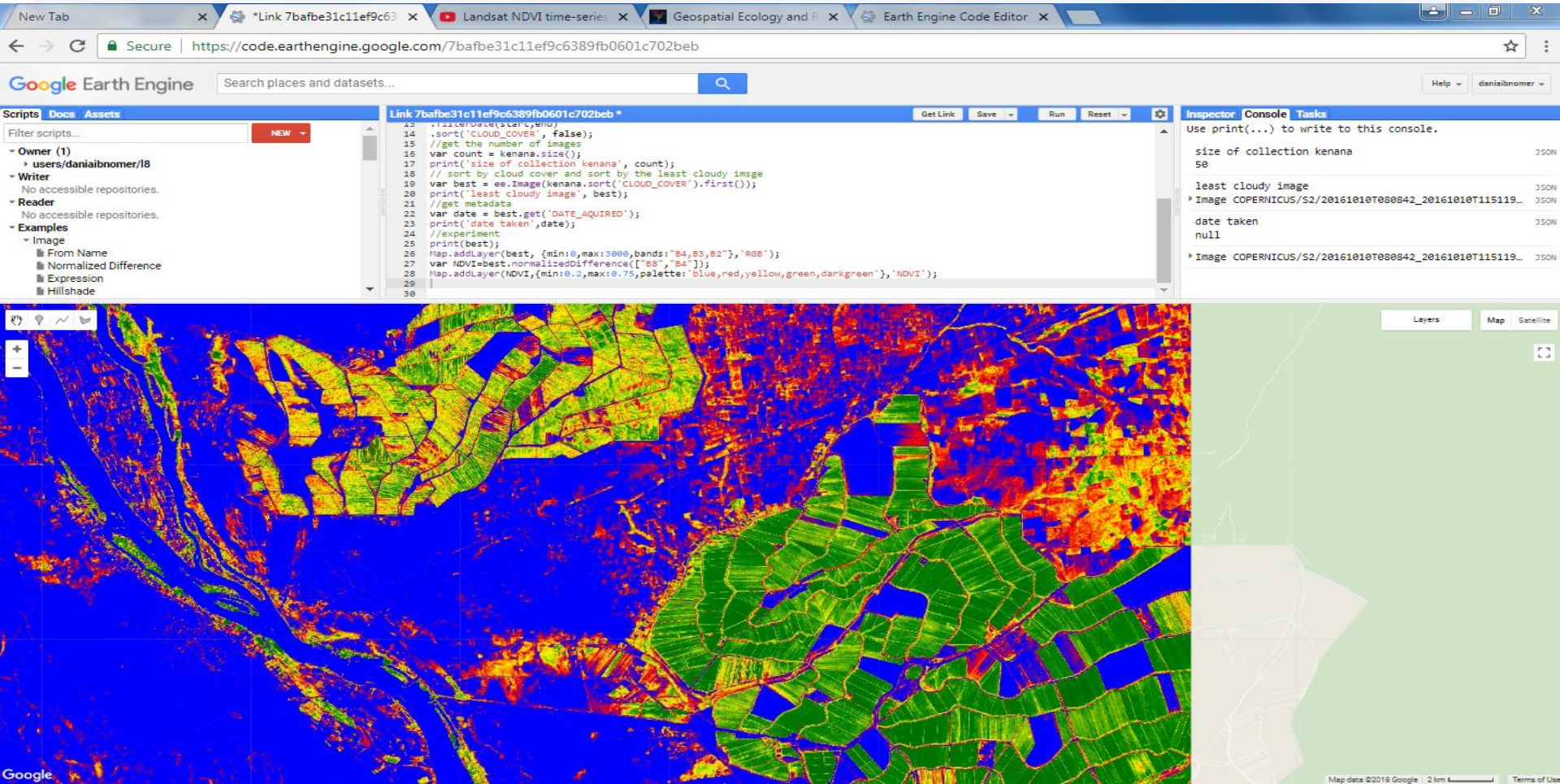
Methodology Cont.

3. Identify Phenology parameters from NDVI times Series in growing days to discriminate crops from each other.



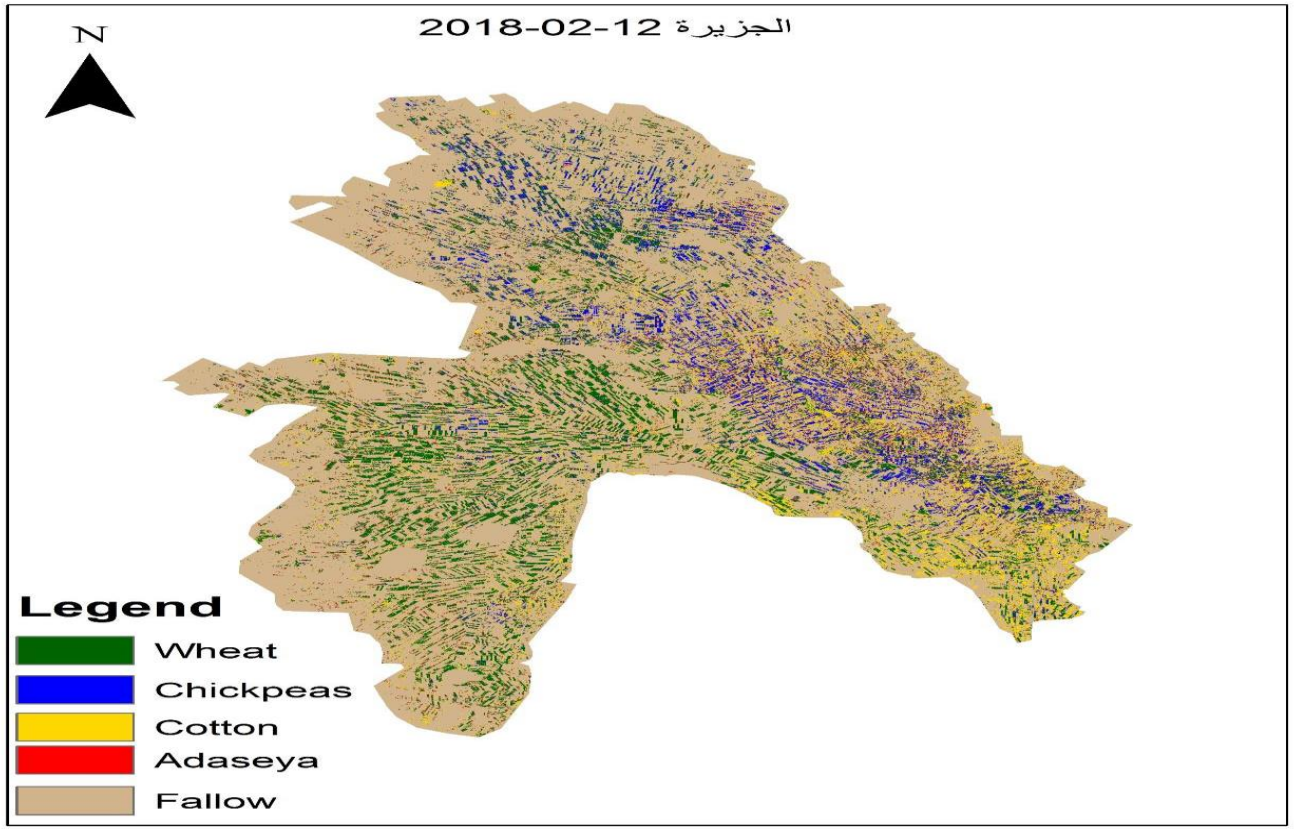
Methodology Cont.

NDVI time series in Kenana Area-1 . First define the year, month of season start time and month of season end. (Press the inspector to get the NDVI time series in any pixel).



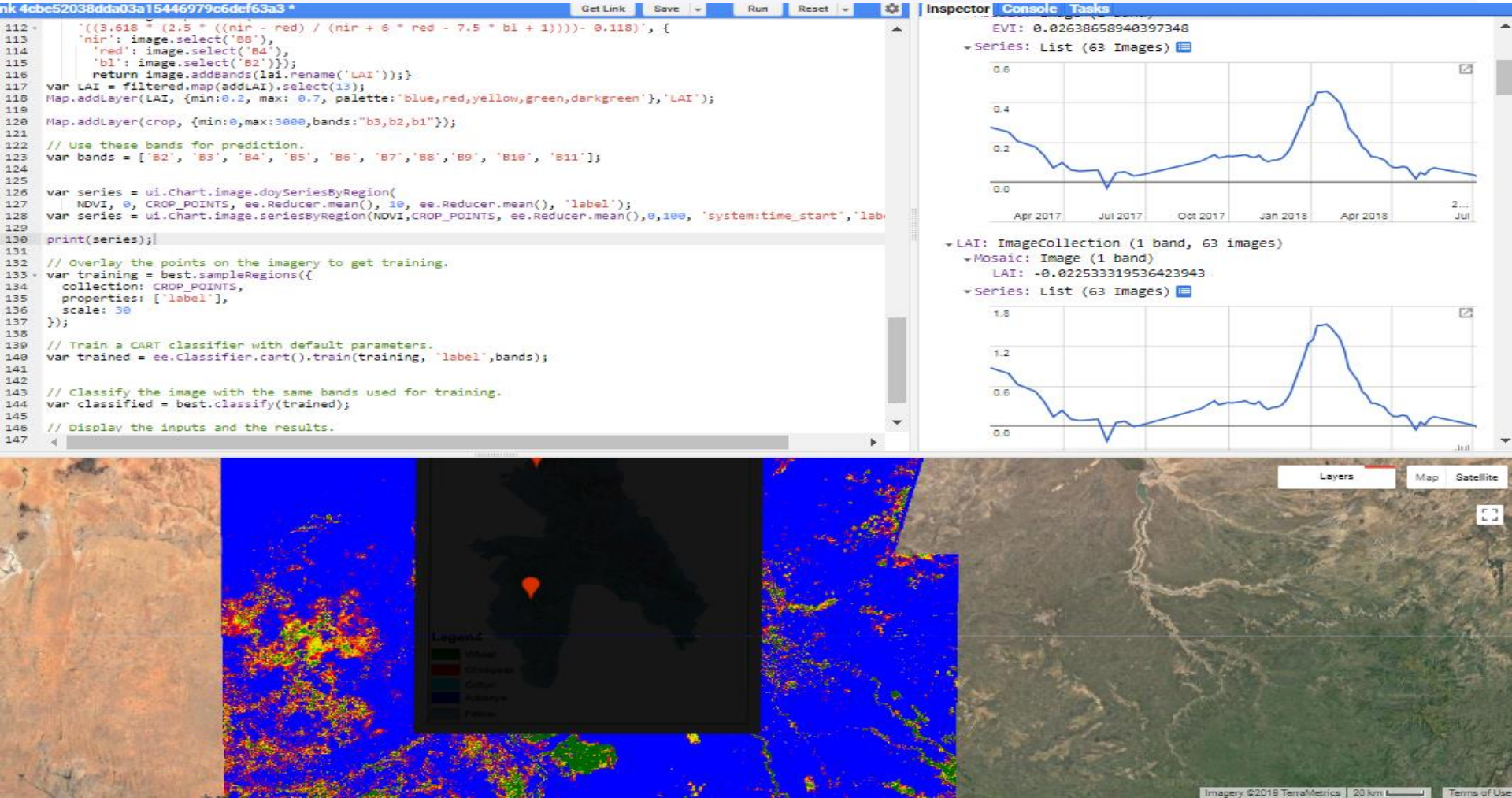
Methodology Cont.

Import Gezira scheme crops map and move NDVI time series to Gezira scheme, to identify different crops such as wheat and cotton and compare their NDVI signature.



Methodology Cont.

Display vegetation indices such as LAI, EVI and NDVI to identify subtle differences.

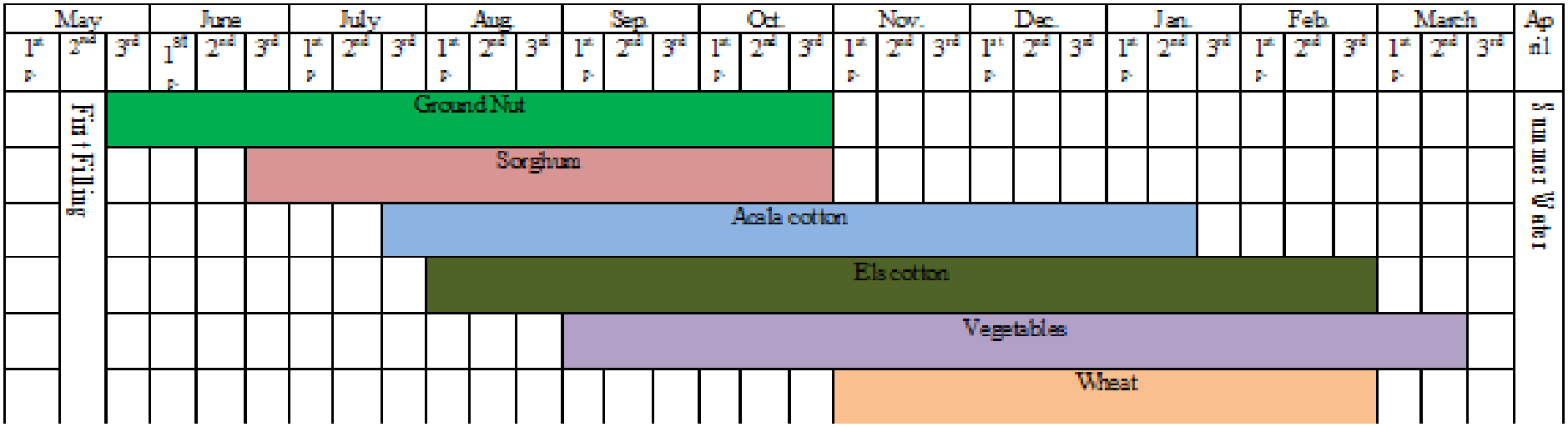


Methodology Cont.

4. Using crop calendar and NDVI time series to Identify different crops.

Gezira Scheme –Crop Calendar

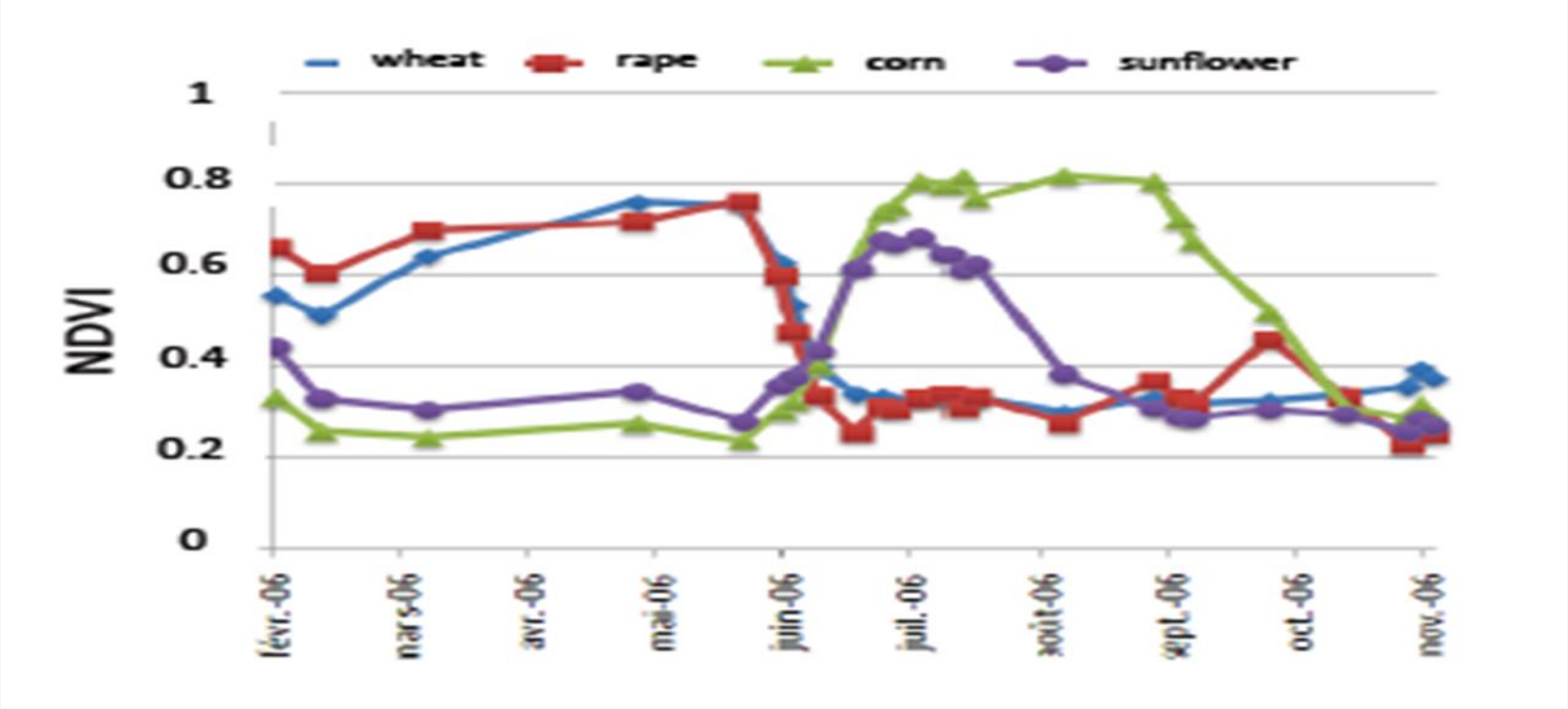
COMPLICATION



SUGAR CANE ONE CROP

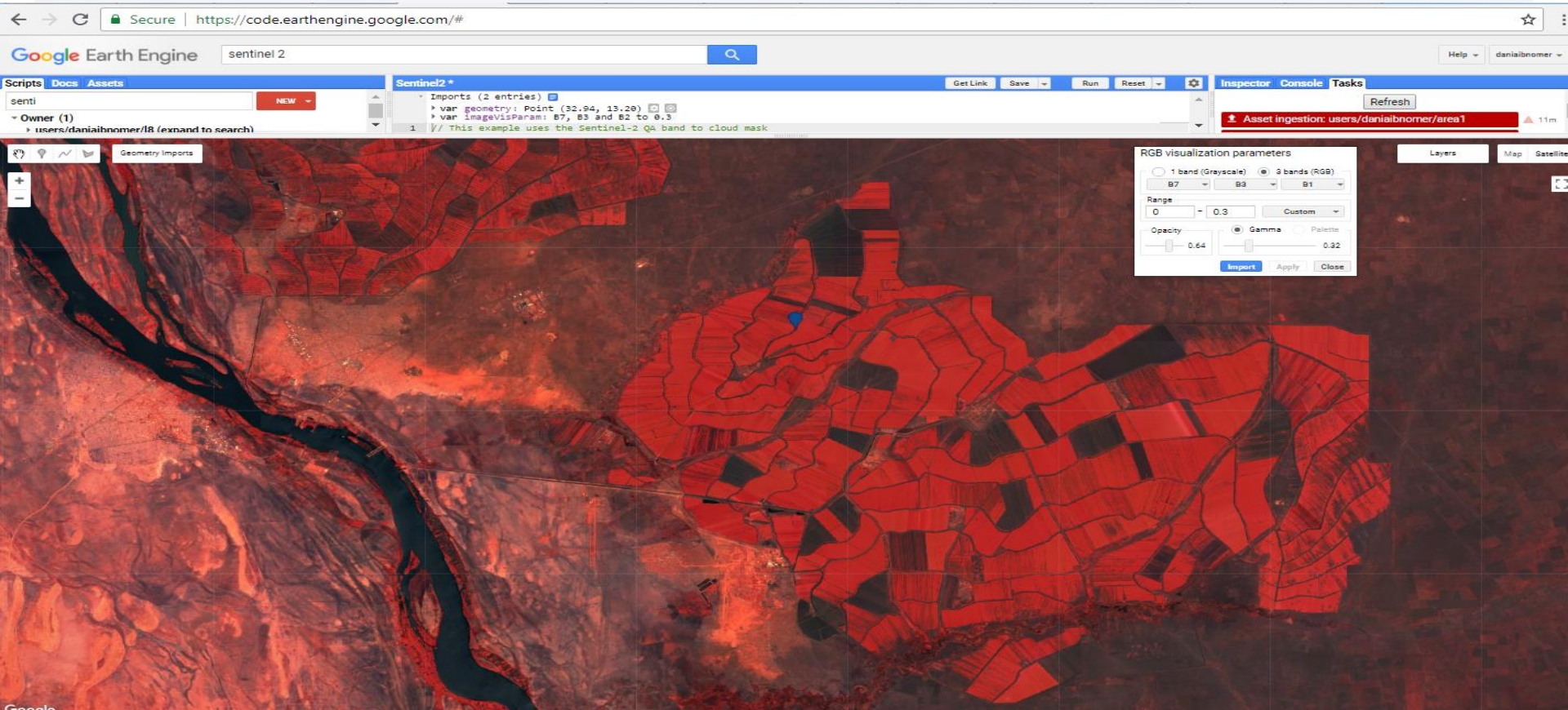
CLEAR EXAMPLE FOR DIFFERENCES

Methodology



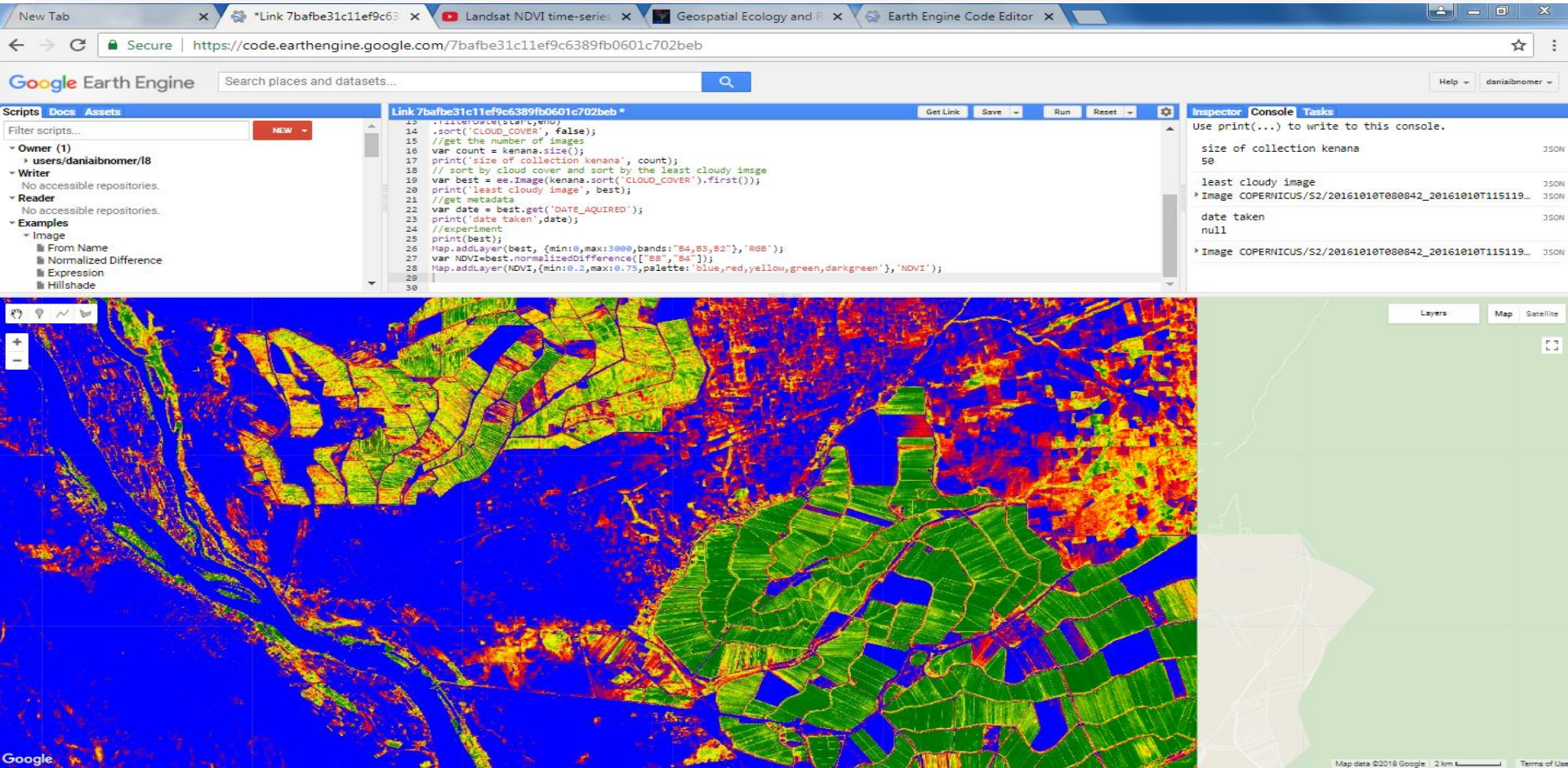
Results

1. Vegetation band combination (7,3,1) have been shown on sentinel 2A images using Earth Engine to highlight vegetated areas.



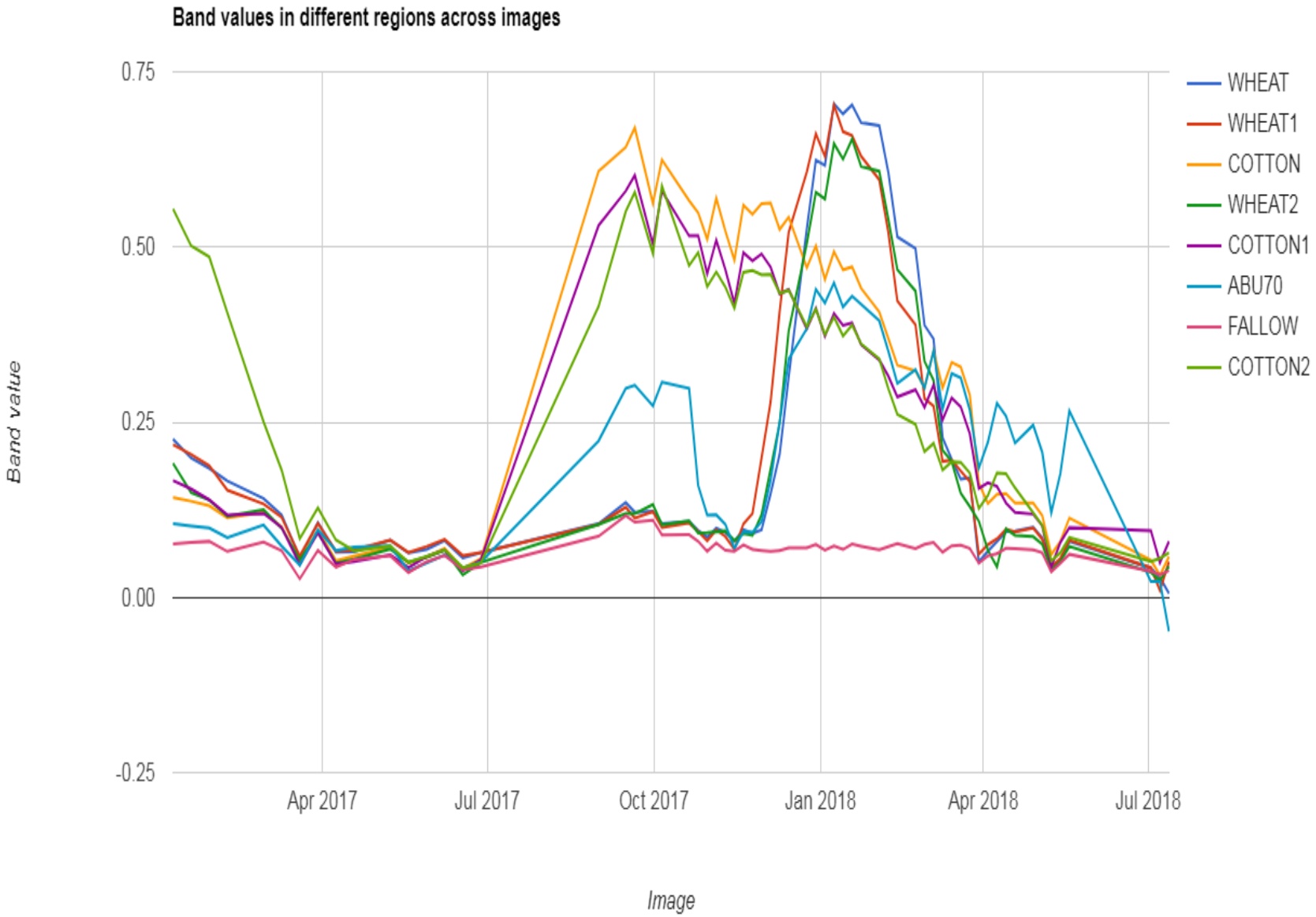
Results Cont.

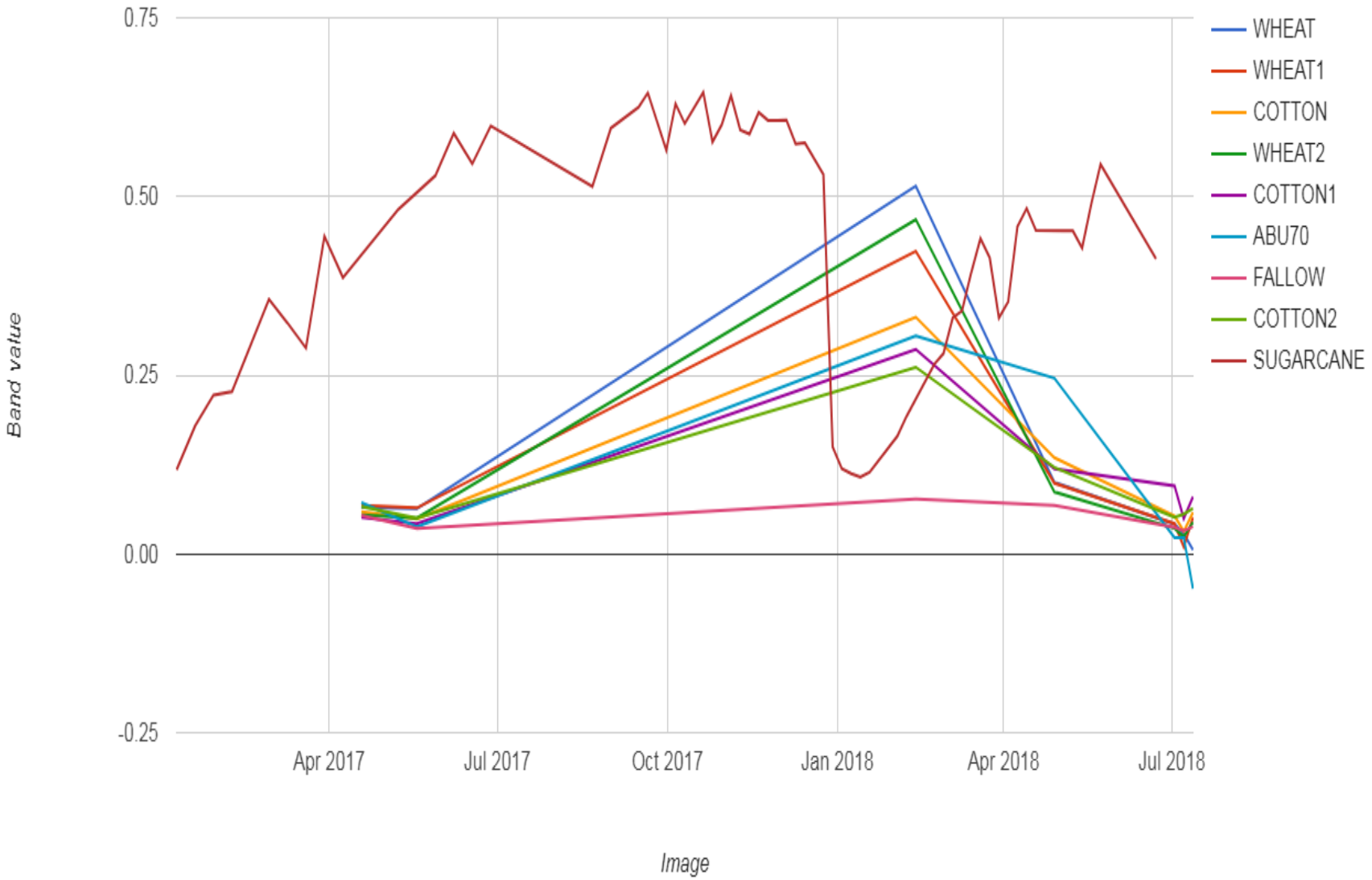
2. NDVI equation have been applied to identify vegetation health, planting stage and crop signature.



Results Cont.

3. NDVI time series for predefined points of cotton, wheat, abu70, sugarcane and fallow area have been displayed.

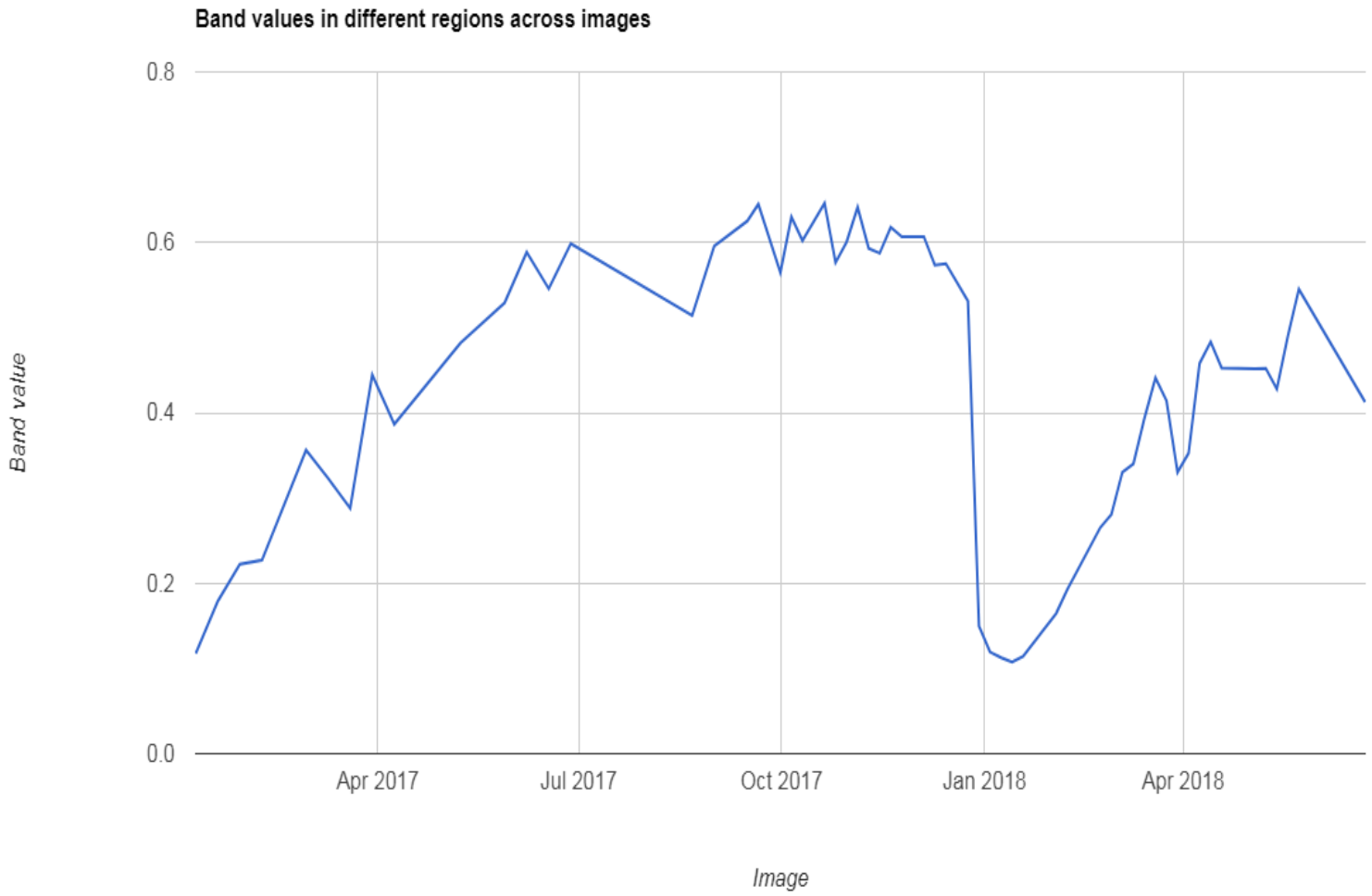

Band values in different regions across images
0.75
0.50
0.25
0.00
-0.25
Band value
Apr 2017
Jul 2017
Oct 2017
Jan 2018
Apr 2018
Jul 2018
Image
WHEAT
WHEAT1
COTTON
WHEAT2
COTTON1
ABU70
FALLOW
COTTON2


Band values in different regions across images
0.75
0.50
0.25
0.00
-0.25
Band value
Apr 2017
Jul 2017
Oct 2017
Jan 2018
Apr 2018
Jul 2018
Image
WHEAT
WHEAT1
COTTON
WHEAT2
COTTON1
ABU70
FALLOW
COTTON2
SUGARCANE

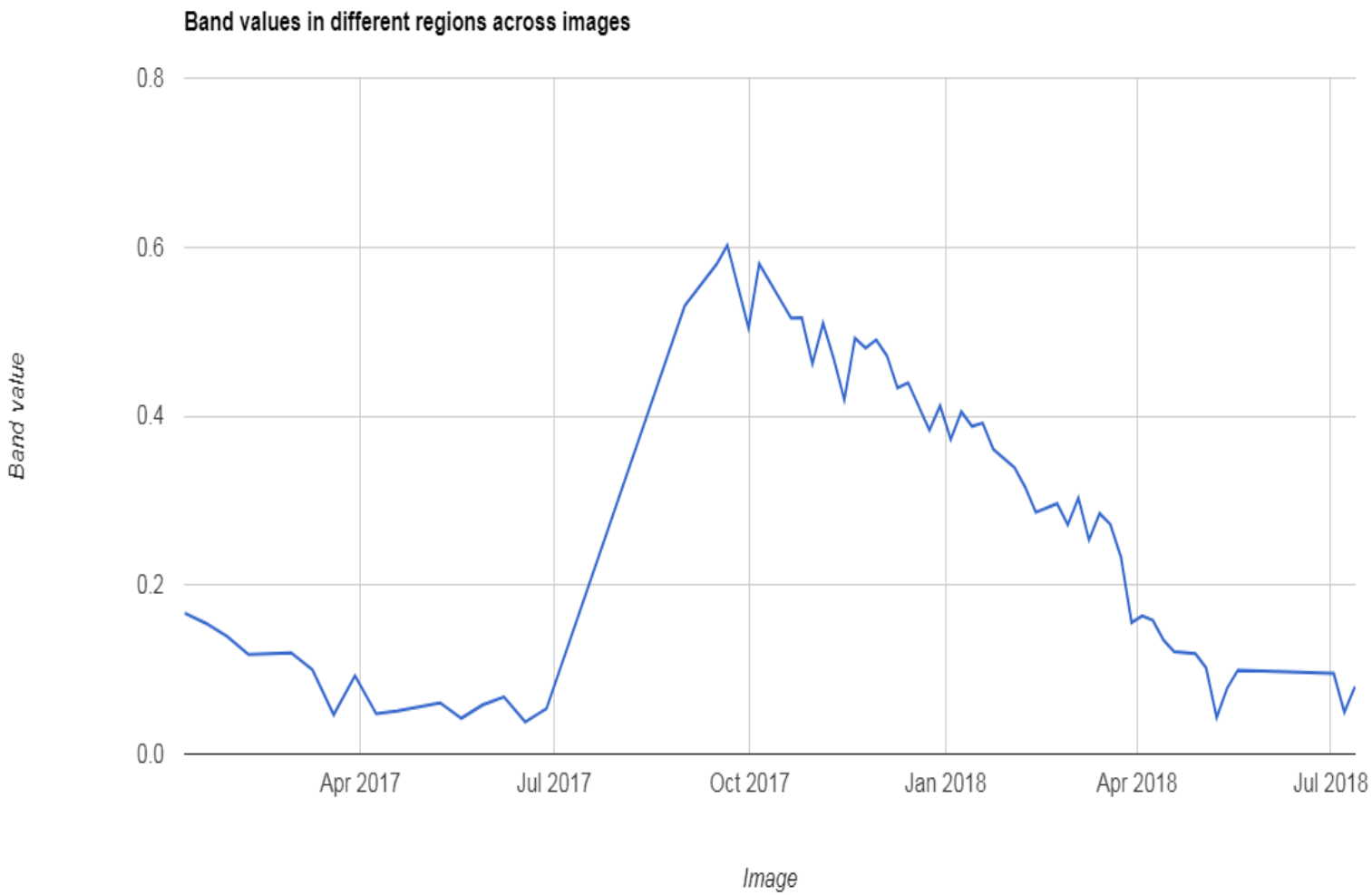
Results Cont.

4. Create separate NDVI signature profile for cotton, wheat, abu70, sugarcane and fallow area .

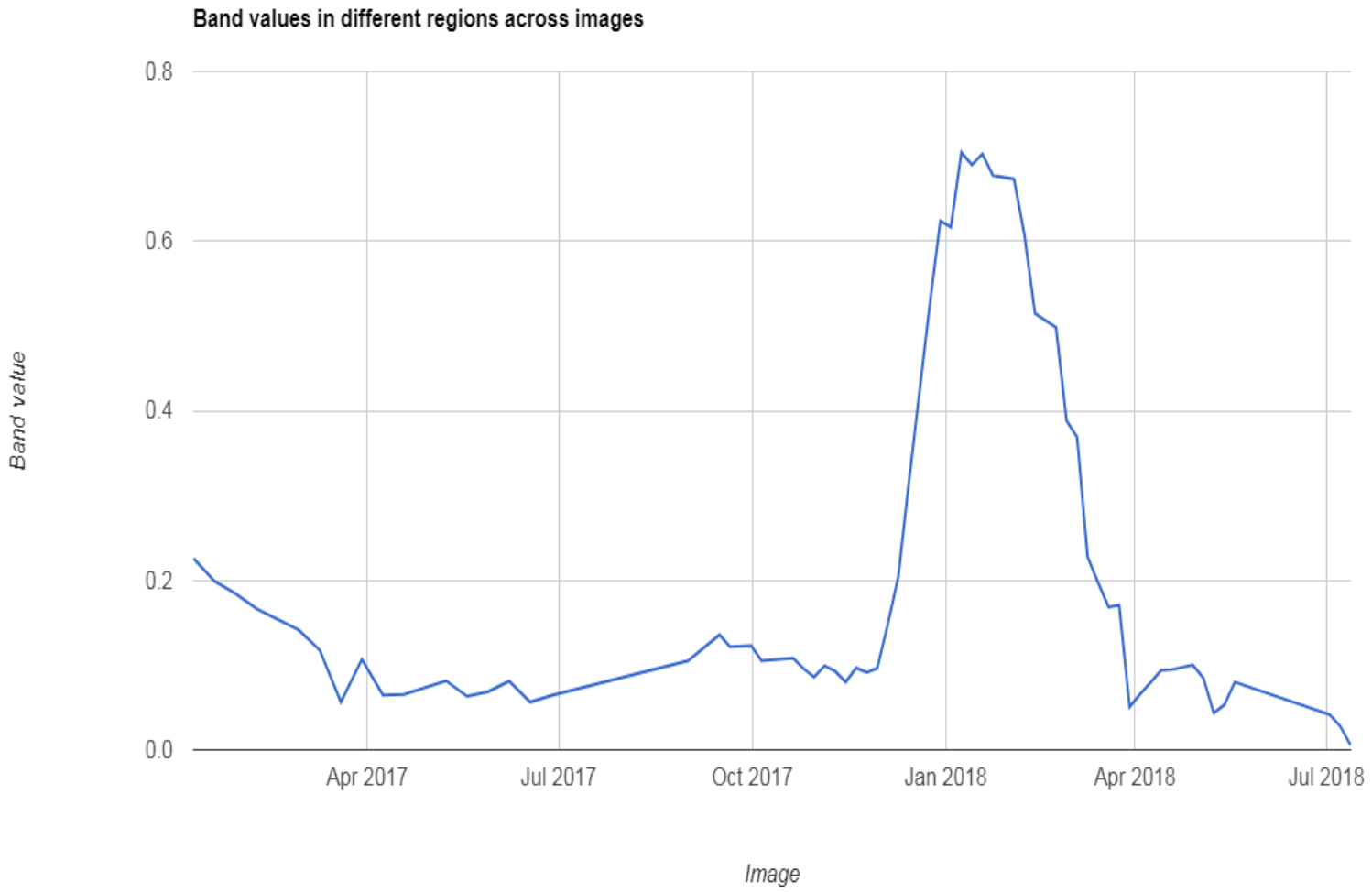
Sugarcane NDVI signature



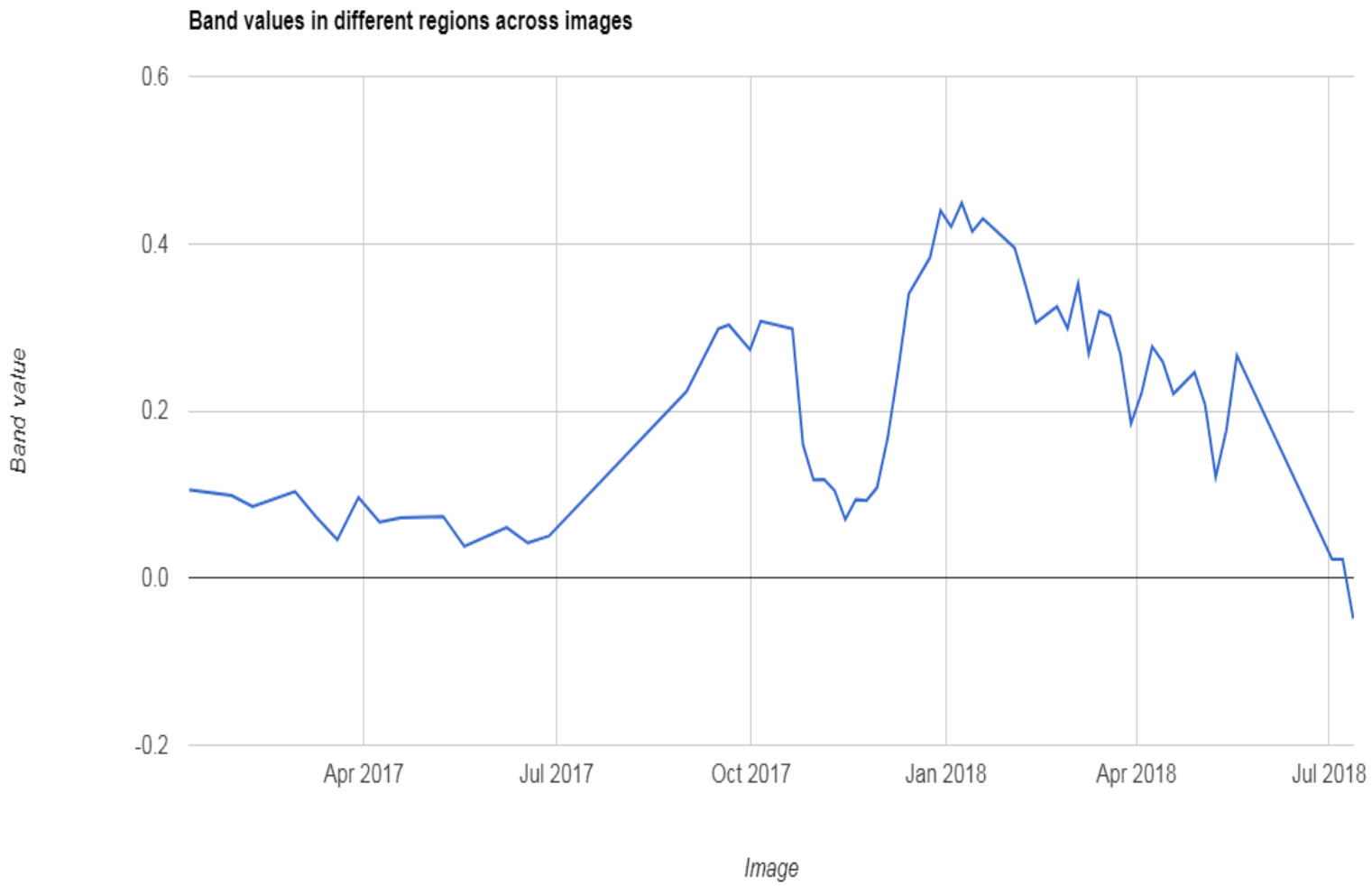
Cotton NDVI signature



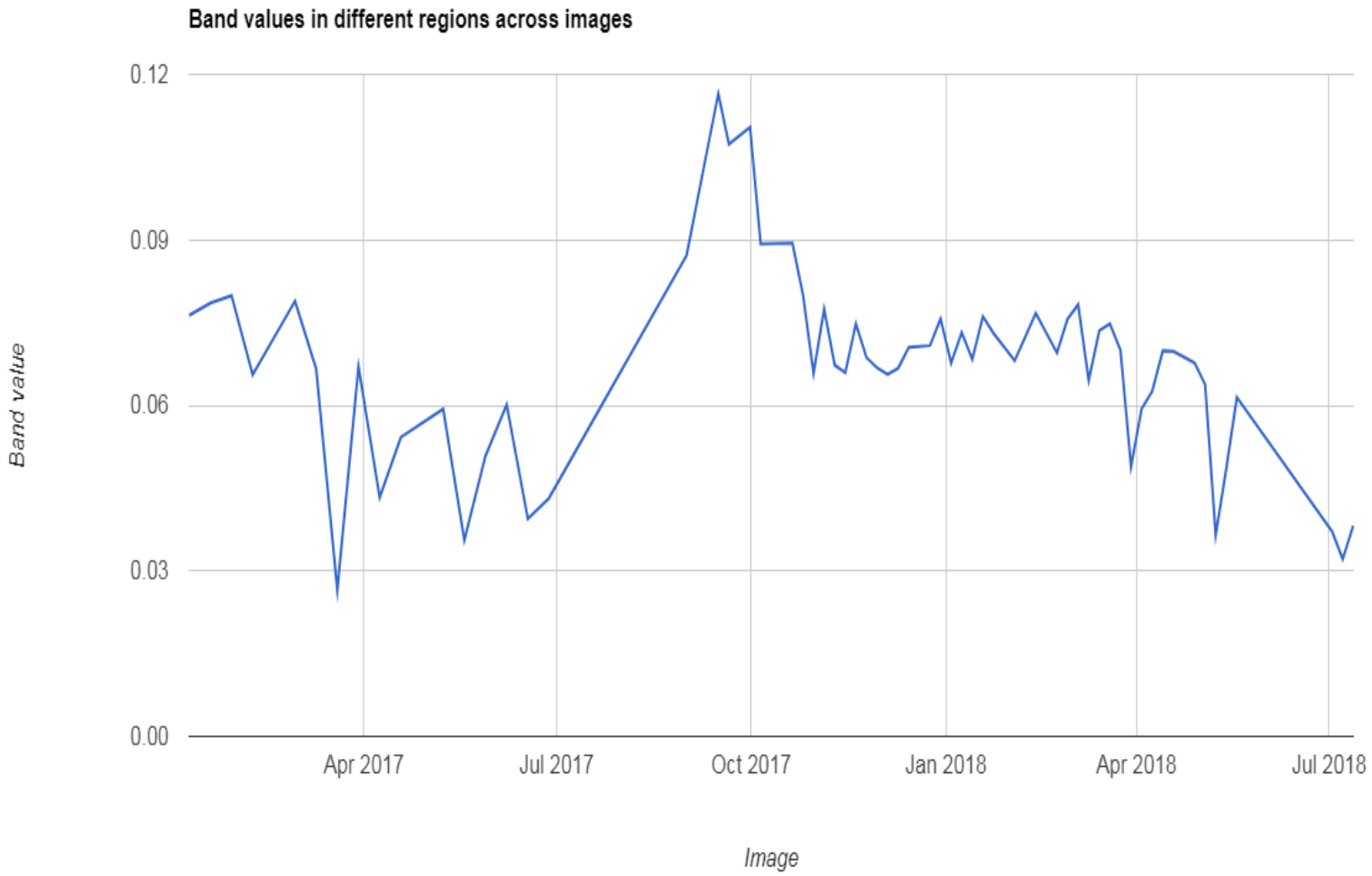
Wheat NDVI signature



Abu 70 NDVI signature



Fallow Area NDVI signature



Conclusion

Highest NDVI values of 0.7 have been obtained in wheat and sugarcane areas near harvest stage and the lowest values have been obtained on fallow areas which is a good indicator of crop stage and calendar.

The fluctuation in the NDVI time series chart is due to soil, clouds and other atmospheric effects which have be calibrated using different vegetation indices such as LAI, EVI.

NDVI time series chart have shown high correlation with the plant calendar, growth stage and health.

Crop NDVI signature library have been established for Eastern Nile area.

Recommendations

Advanced studies must be made specially in using different vegetation indices to eliminate soil, temperature, cloud and other atmospheric effects which affect the accuracy of crop identification and area calculations.

Continue building the crop library which we have established to make crop monitoring in Eastern Nile area easier and more precise.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THANK
YOU!