SMART INDIA HACKATHON 2020
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NM372 - ISRO : Extraction of crop cycle parameters from multi-temporal data

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Introduction

Agriculture is one of the most important sectors for India. It is necessary for our country to arrange enough food for the people of our country. Around 50% of our population is involved in agriculture. Proper planning for this sector requires relevant and reliable information in timely manner. But for large countries like India where a large chunks of land are devoted for farming, it is essential to develop techniques that can quickly and effectively assess crop parameters and provide insights about vegetation, crop cycle, date of harvesting, etc.

Objective

The aim of this project is to develop a system which extracts crop cycle parameters for the given set of multispectral multi-temporal data with timestamp of one year or more. We developed an algorithmic technique that can be utilized to extract parameters such as date of sowing, date of harvesting and number of harvests based on temporal profile of the data provided.

Pipeline

The images are loaded and converted to a numpy array and prepared for preprocessing

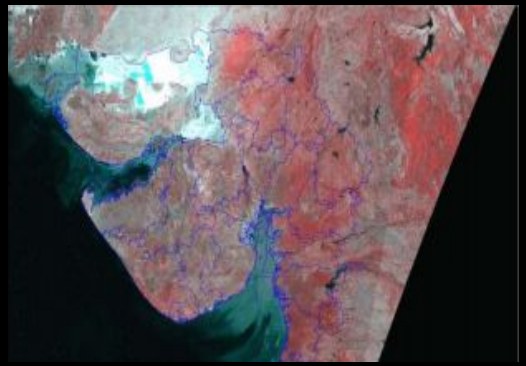
The images are preprocessed. A critical step involves smoothening the data with SavGol filter

Identification of peaks in the NDVI values over time. Higher NDVI values imply healthier vegetation. Number of such peaks gives the number of crop cycles.

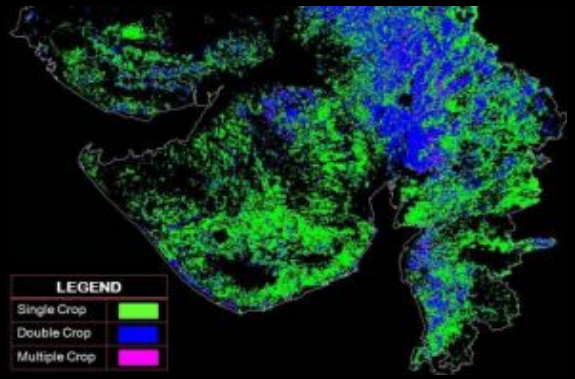
The harvesting is done typically after the vegetation attains its peak. Finding the time of peak values, gives the date of harvest.

Expected Outcome

Sample image



Outcome of the Algorithm



NDVI

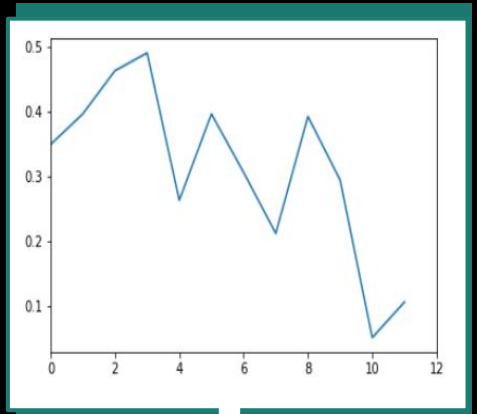
Normalised Difference Vegetation Index (NDVI) utilises the absorptive and reflective characteristics of vegetation in the red and near infrared portions of the electromagnetic spectrum. Therefore, changes in the NDVI time-series indicate changes in vegetation conditions proportional to the absorption of photosynthetically active radiation. We calculated NDVI using surface reflectance values from the red (620–670 nm), NIR (841– 875 nm) bands using following equation:

$$NDVI = \frac{NIR - Red}{NIR + Red}$$

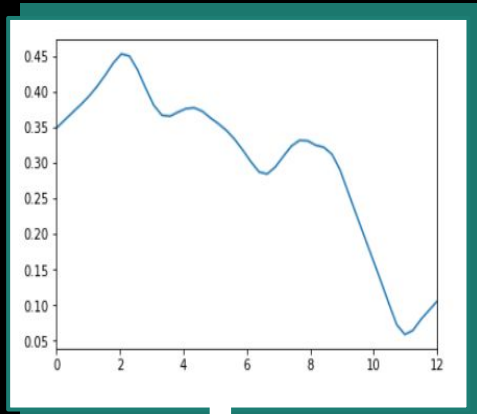
Data Filtering

The high level of noise present in data often makes it difficult to determine the number of annual seasons. For this reason, smoothed NDVI data is used instead of raw NDVI series. The noise may be due to instrumentation behaviour, changes in sensor angle, atmospheric conditions (clouds and haze) and ground conditions. We used SavGol filter to smooth data, which fits a polynomial over the data points over a window. This process reduces the noise and outliers and provides a smoothened sequence of values

Effect of Smoothing



NDVI Values before smoothening



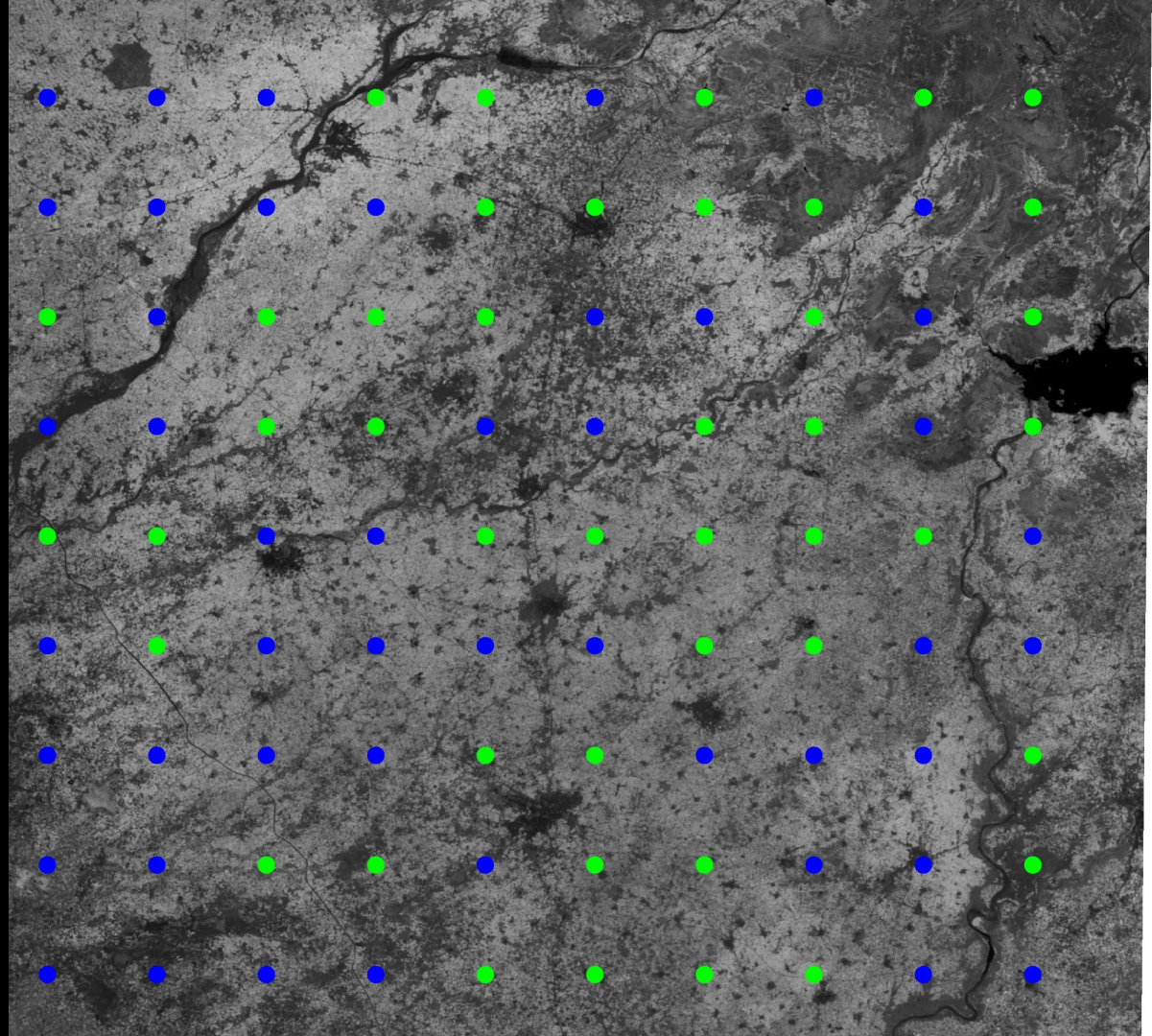
After smoothing(SavGol filter)

Algorithm

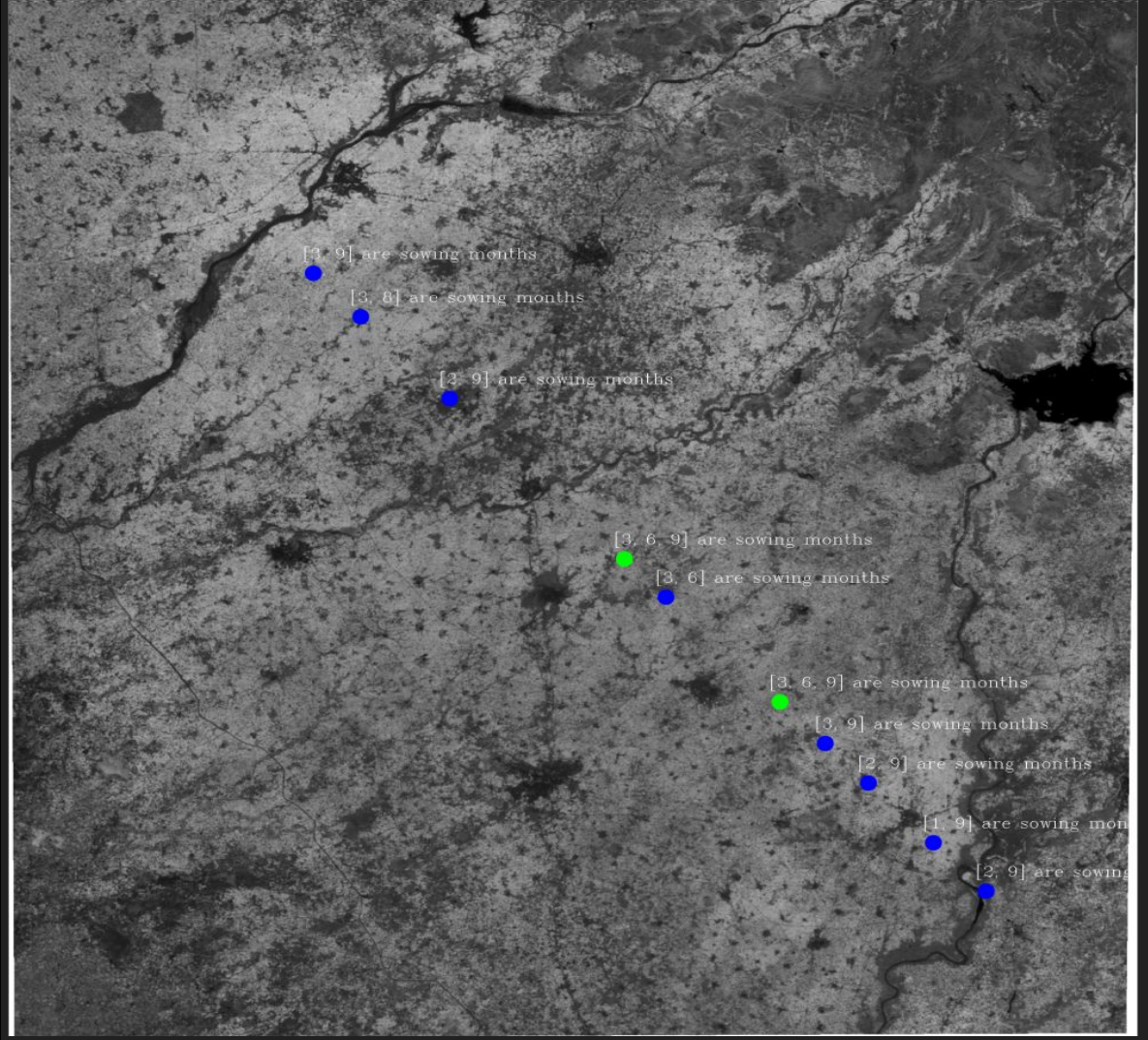
```
for v in val:
    pix_2017 = []
    for filename in os.listdir(os.getcwd()):
        if filename.endswith("2_clipped.tif"):
            im = Image.open(filename)
            imarray = np.array(im)
            imarray =  imarray/255
            if filename.startswith("awifs_ndvi_2017"):
                pix_2017.append(imarray[v[0]][v[1]])
        inp = pix_2017
    new_len = 48
    delta = (len(inp)-1) / (new_len-1)
    outp = [interpolate(inp, i*delta) for i in range(new_len)]
    res = savgol_filter(outp, 5, 3)
    indexes = peakutils.peak.indexes(np.array(res), min_dist=10)
    indexes_mod = [i//4 for i in indexes]
    harvest_dates.append(indexes_mod)
    cycles.append(len(indexes))
```

Obtained Image for the given dataset

Blue: 1 Crop Cycle
Green: 2 Crop Cycles



Obtained Image for the given dataset



Thank You