Assessment of seasonal patterns in crop rotation with Google Earth Engine

Submitted by
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• Define the study area (use the shapefile provided to define the study area of Castilla La-Mancha)

For spain 'castilla La-Mancha' study area has been defined in the code (attached).

And for Bangladesh study area 'BGD_adm3' has been defined in the code (attached).

• Add the time series: The script provided uses MODIS data but the student can adapt the script to Landsat data if the agricultural plots are very small

Time series data (Modis) has been added in the GEE File.

• Estimate the spectral metric used as ecological indicator: The script provided estimates the vegetation index NDVI but the student can consider other metric based on their knowledge of the study area.

NDVI has been calculated in both for Castalia_la_Mancha and Bangladesh.

• Estimate the trend and evaluate if it is necessary to detrend the time series (add a map of the trend in the report indicating maximum, minimum and mean values)

There are seasonality patterns seen in the graph, so it is necessary to detrend the time series.

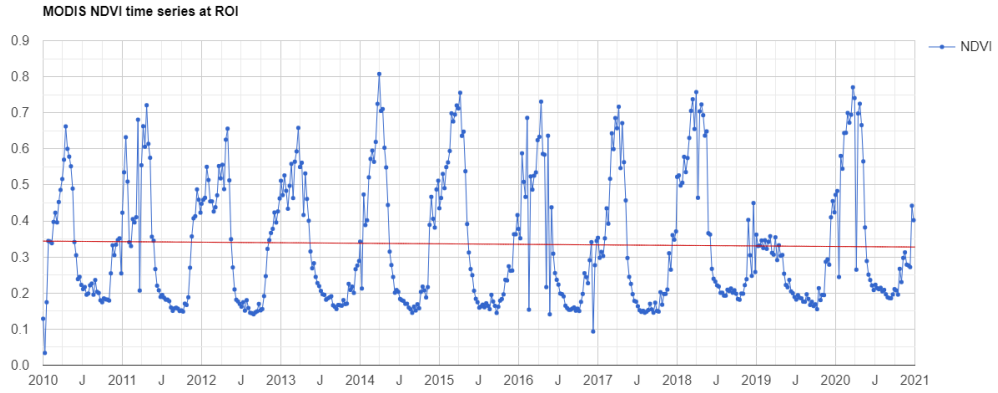


Fig: NDVI Trend chart of Castalia_la_Mancha (Maximum: 0.851, minimum: -0.008 and mean: 0.340)

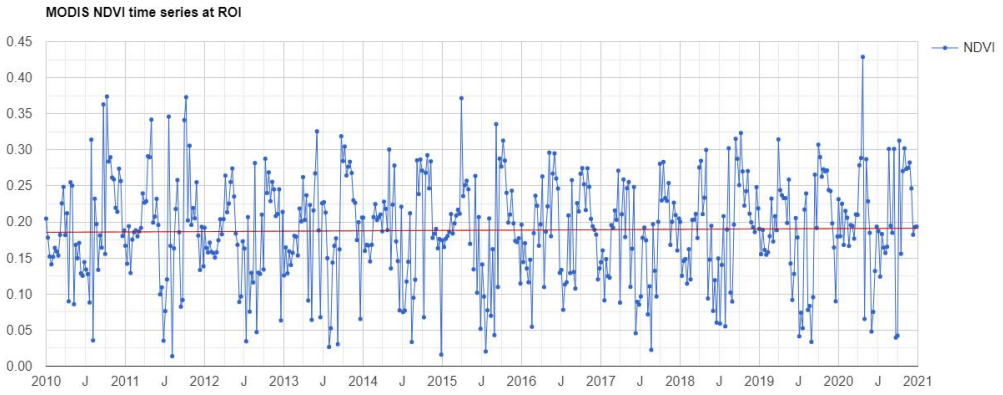


Fig: NDVI Trend chart of Bangladesh (Maximum: 0.429, minimum: 0.014 and mean: 0.188)

- **Define harmonic Function**

Harmonic function, also termed spectral analysis or Fourier analysis, decomposes a time dependent periodic phenomenon into a series of sinusoidal functions, each defined by unique amplitude and phase values. Each harmonic term accounts for a proportion of the variance in the original time series.

From the trigonometric identity a harmonic function is written as:

$\alpha \text{ sen } (\omega t+\delta) = A \text{ sen}(\omega t)+ B \cos(\omega t)$

Where the amplitude α and the phase δ verify:

$\alpha^2 = A^{2+} B^2$

$\delta = \arctan (-B/A)$

$Y_t = \mu + A \text{ sen}(\omega t)+ B \cos(\omega t) + e$

• Estimate the amplitude of the phenological cycle (add a map of the amplitude in the report indicating maximum, minimum and mean values)

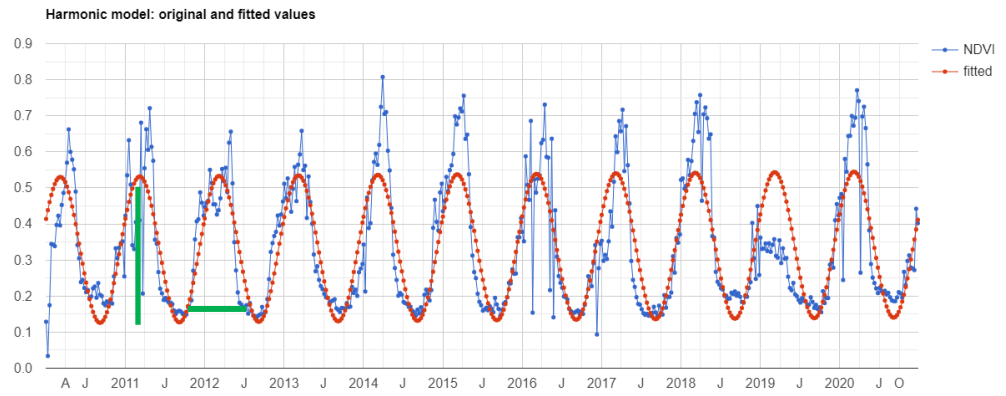


Fig: Harmonic model for Castallia_la_mancha. Vertical green line shows the amplitude and horizontal line shows the phase of harmonic line.

For Castallia_la_mancha, Spain: Maximum = 0.545, Minimum = 0.126 and mean = 0.336

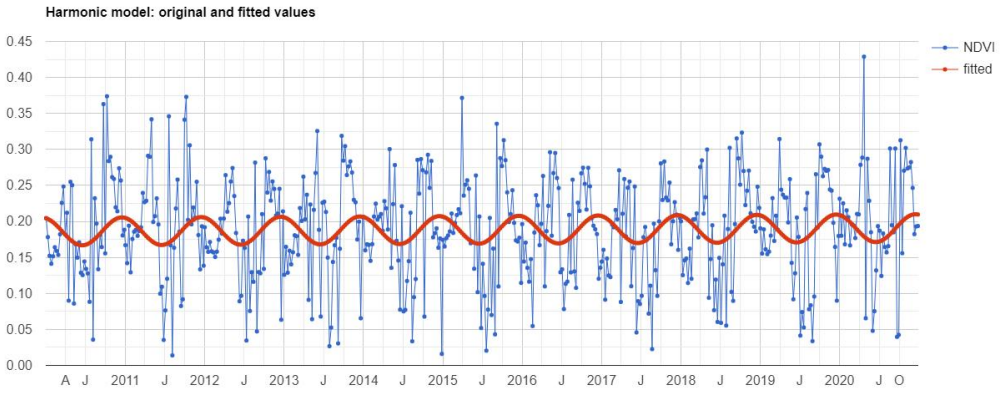
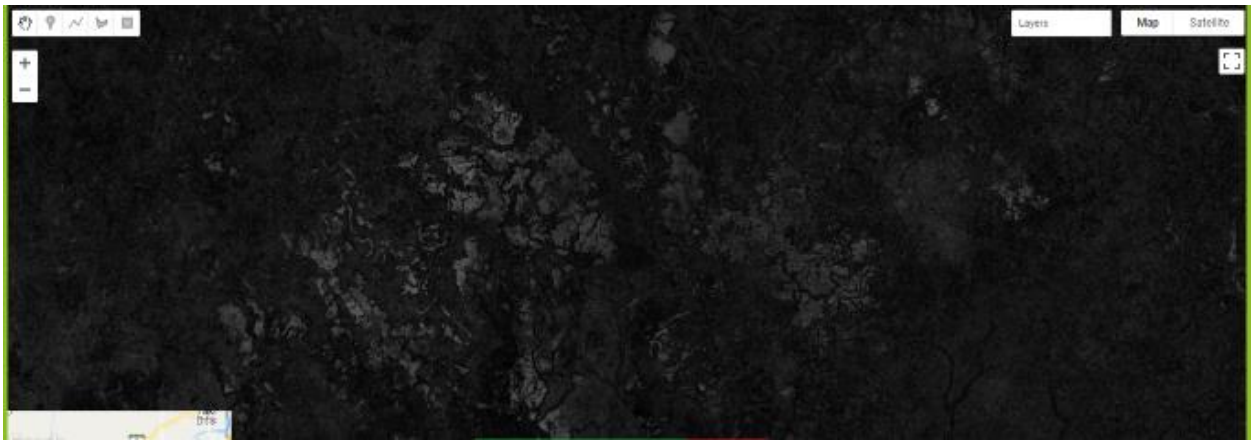


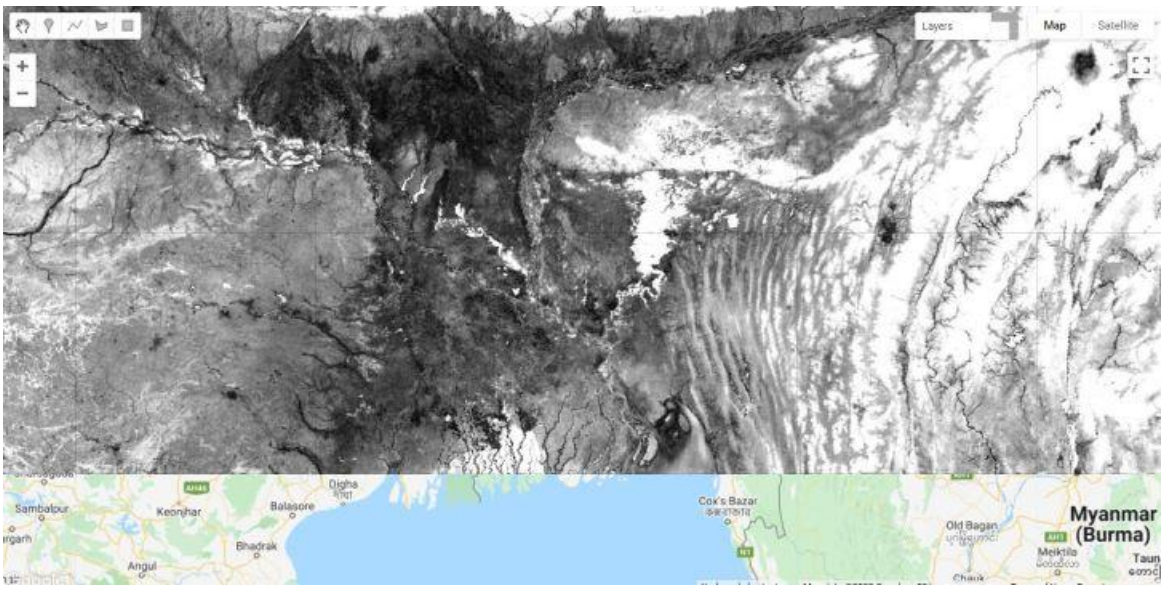
Fig: Harmonic Model for BD

For Bangladesh: Maximum = 0.556, Minimum = 0.378 and mean = 0.466

• Estimate the autocorrelation function. Select the most appropriate lag to be considered. (Add the maps of the autocorrelation values at the selected lag)



Autocorrelation map at lag value 9 for Castallia_la_mancha.



Autocorrelation map at lag value 9 for Bangladesh.

• Combine the different seasonal metrics to identify and map different crop rotations.

• Display a map with the result and some examples of time series of the different classes.

• Repeat the same step choosing an agricultural area in Bangladesh.

• Describe the different crop rotation systems found and the differences between study areas.

• Include the script(s) used in the assessment report.

Separate notepad file has been attached on moodle.