CENG 463 Homework 3 due to 12th November 2022 at 13.00.

Curve fitting to Crop Phenologies

Description:

We are going to fit linear (lines) functions to corn and cotton data in the Harran Plain. Discuss outputs and fit qualities. Each step requires a brief discussion as markdowns in your notebook files. Use HW3Data.csv as input. Fit curves to both corn and cotton crops at each year. Plot your fittings: group plots for each question.

You may start with the Lecture 5 Jupyter Notebook or from the scratch

Tasks:

1. Fit curves to corn and cotton NDVI vs days. In 2013. Solve both manually and SKLearn, then compare errors.
2. Estimate EVI and MSAVI from NDVI by using curve fitting in 2013 (EVI and MSAVI vs NDVI) .Solve both manually and SKLeaarn, then compare errors.
3. Estimate 2014 NDVI, EVI and MSAVI values from 2013's NDVI curve data by using curve fitting.
4. Add discussion at each step and describe the limitations of linear curve fitting for this data set. Select appropriate quality metrics then analyze fitting quality. Discuss the suitability of estimation for corn and cotton. Is there any difference between crop phenologies?

Notes:

You may group with another student, teams of 2 students are allowed. I expect equal or similar contribution.

Only your notebooks for your group will be submitted. Add Student ID and your initials such as MT1223456789_SecondStudentInitialsSecondStudentID.ipynb, put full names & IDs in the top of the file. The file and data are available in course GDrive share.

Add code comments and discuss your findings in the notebook. Markdowns and discussions should be in English.

Elegant code, useful comments and extra efforts will be graded handsomely.

You may ask your questions in lecture 7 on 11th November.

Good Luck

Dr. Mustafa Teke

Appendix Vegetation Indices

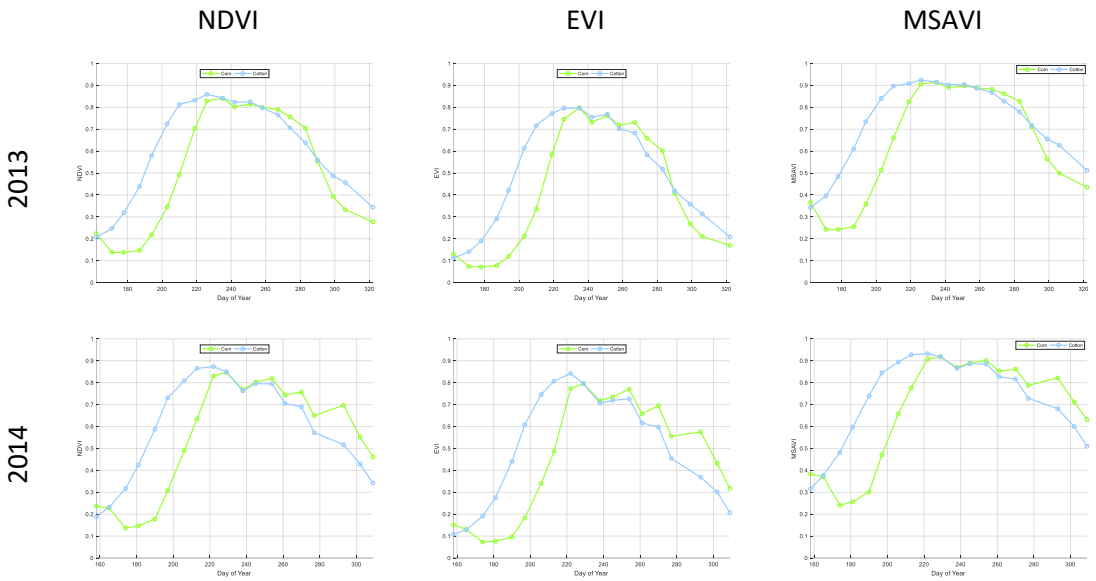

Figure 1: Depiction of corn and cotton phenologies by NDVI, EVI, and MSAVI vegetation indices.

1.1.Phenology Feature Extraction

In this section, vegetation indices that are used to extract phenological features are presented. Their formulas are given in the form of band names. Vegetation indices have values in the range of $[-1, 1]$.

1.1.1. Normalized Difference Vegetation Index (NDVI)

NDVI is the most used vegetation index. Chlorophyll pigments in leaves absorb visible light while the cell structure of the leaf reflects the majority of the light in near-infrared (NIR) wavelengths. NDVI is formulated as:

$$NDVI = \frac{NIR - Red}{NIR + Red} \quad (1)$$

Healthy photosynthetically active vegetation generally has higher NDVI values. Vegetation has NDVI values of greater than 0.3.

1.1.2. Enhanced Vegetation Index (EVI)

EVI index is an optimized index for detecting vegetation biomass without affecting canopy (vegetation structure) background noise and atmospheric effects.

The Enhanced Vegetation Index is an improved vegetation index that compensates canopy cover and atmospheric effects. C1 and C2 are atmospheric terms for red and blue bands, while L is the canopy background adjustment factor (A. Huete et al., 2002).

$$EVI = \frac{NIR - Red}{NIR + C1 \times Red - C2 \times Blue + L} \quad (2)$$

L is canopy background adjustment; C1 and C2 are aerosol resistance coefficients. EVI reduces saturation, atmospheric noise, and background noise. *C1 = 7.5, C2 = 6* and L = 1 are used for Landsat 8(*Landsat 8 Surface Reflectance Product Guide v1.2*, 2015). While NDVI is chlorophyll sensitive, EVI is more sensitive to vegetation canopy changes.

1.1.3. Modified Soil Adjusted Vegetation Index (MSAVI)

Modified Soil Adjusted Vegetation Index replaces L in SAVI with an inductive function(Qi et al., 1994). Instead of computing the soil line experimentally, MSAVI computes L value from NIR and Red bands. Soil adjusted vegetation indices aim to improve the insensitivity of NDVI to canopy cover changes with the addition of soil line parameters. In this text, MSAVI refers to the second version of MSAVI: MSAVI2.

$$MSAVI = \frac{\left(2 \times NIR + 1 - \sqrt{(2 \times NIR + 1)^2 - 8 \times (NIR - Red)}\right)}{2} \quad (3)$$