THE UNIVERSITY OF ARIZONA

BE/BAT 485/585

Remote Sensing Data and Methods

Lab – 13

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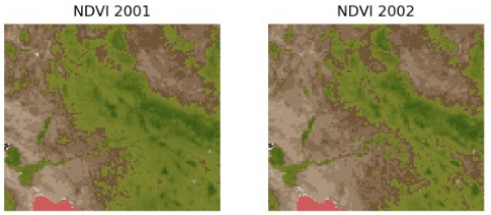
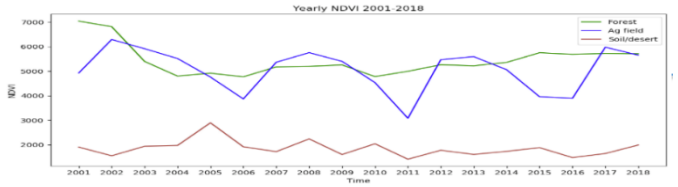
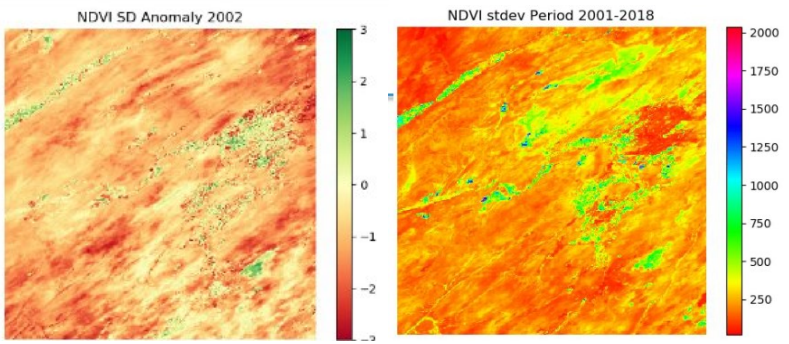
Exercise #1: NDVI Timeseries & Anomalies

- Read 16-day MODIS NDVI files for 19 years
  - Each year contains 23 files corresponding at 16-day intervals
- Plot NDVI Timeseries for a few locations.
  - Observe the curve profiles
- Plot NDVI Timeseries masked by Land Cover
  - Pick few example LC
- Average the Timeseries into one annual value using the RANK as data quality filtering flag (to help discard poor quality data)
  - **Retain only good data for the long-term average computation**
- Homework:
  - Save Yearly dataCube to BSQ or HDF
  - Plot NDVI timeseries for all the Land cover types in the image
  - Display all the NDVI yearly bands, put appropriate label
  - Compute Yearly Anomalies by Land Cover

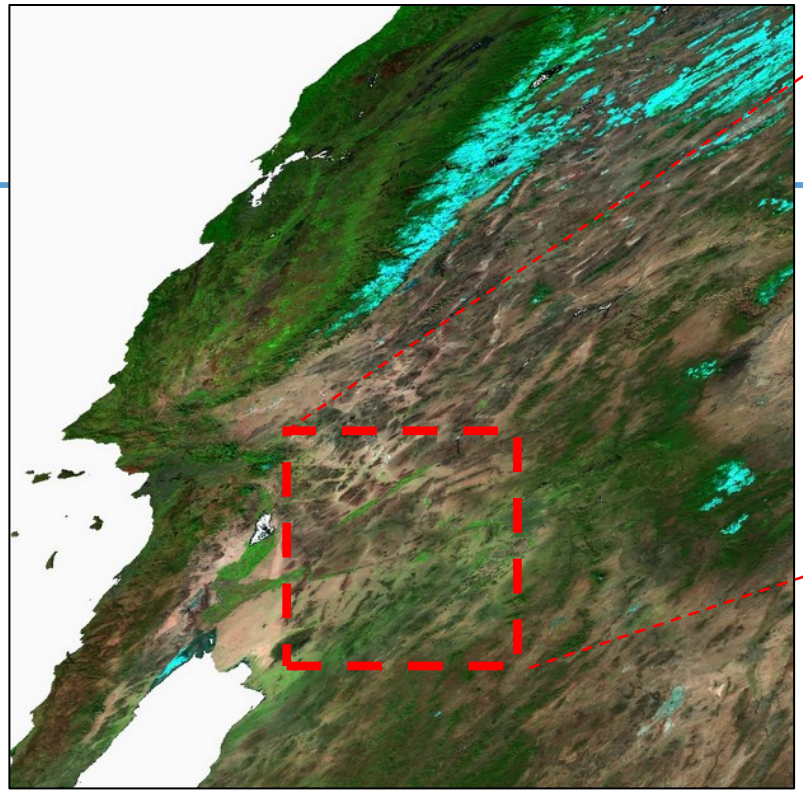




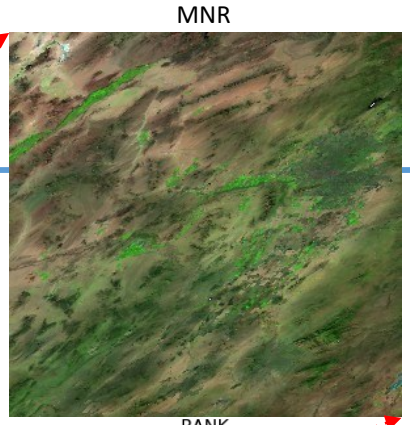


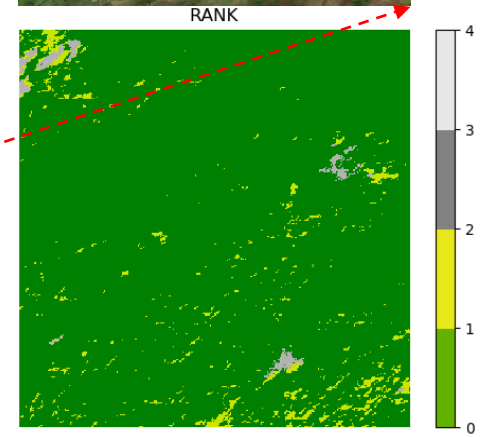
Instructions:

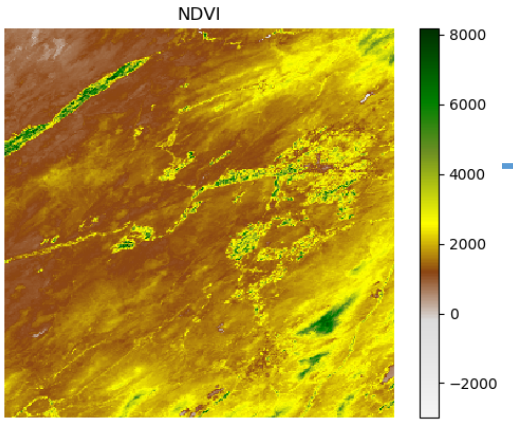
- Download files:
  - Data files: dataC16.zip, MCD12Q1.A2017001.h08v05.006.LC.bsq
  - Library: viplab_lib5.py
  - Python script: BE485_Lab13_Ex1.ipynb

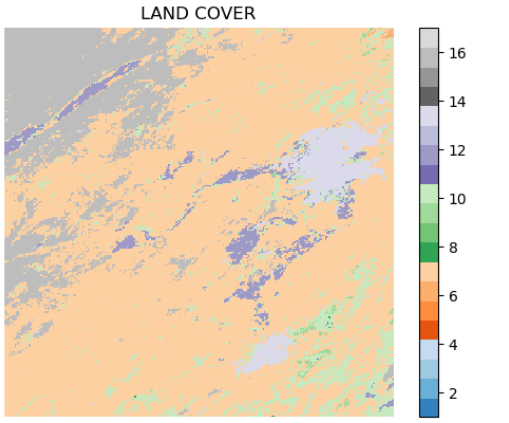


MODIS Tile H08V05, 1km (sinusoidal)









Tile H08V05 was subset to speed up processing as you will be reading & processing 437 files. Be patient in this lab as every processing task will take a few minutes.

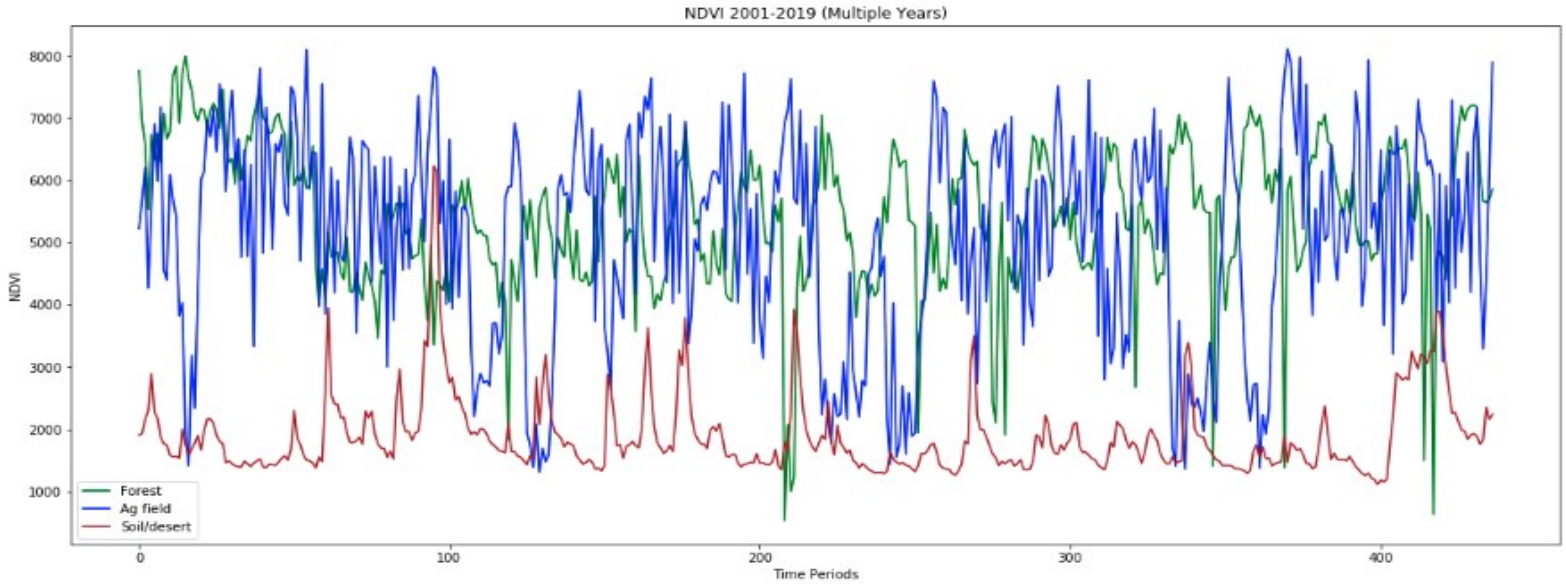
RANK classes

0: Good
1: Marginal
2: Snow/Ice
3: Clouds

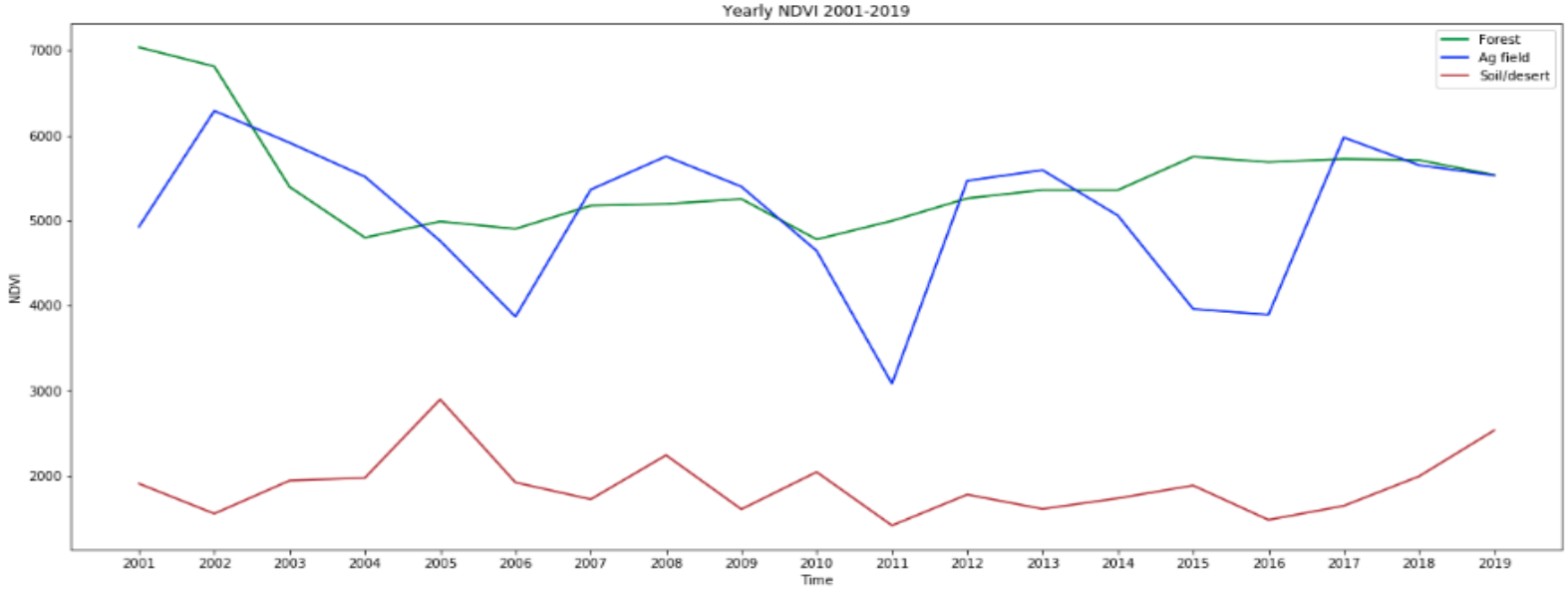
Land Cover T1

7: Open Shrubland
10: Grasslands
12: Croplands
13: Urban built up
16: Barren

NDVI Timeseries



Every cycle for 19 years



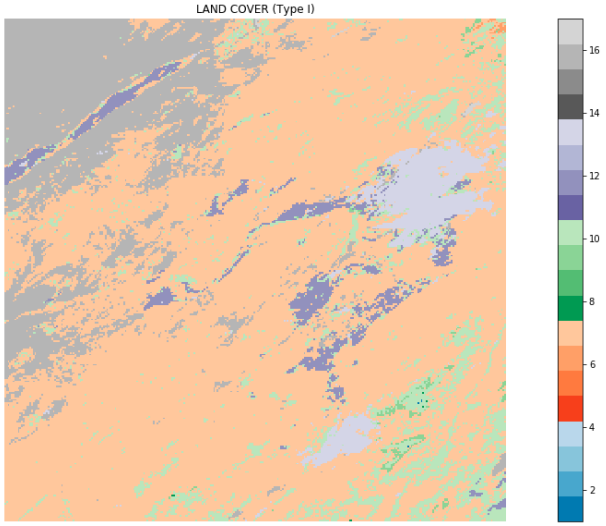
Summarized to yearly

Land Cover Types: Use is the mask

```
    Data set name: 'LC_Type1'
    Data type: 8-bit unsigned integer

attributes
    Number of attributes: 21
            long_name:      Land_Cover_Type_1
            Evergreen Needleleaf Forests:   1
            Evergreen Broadleaf Forests:    2
            Deciduous Needleleaf Forests:   3
            Deciduous Broadleaf Forests:    4
            Mixed Forests:  5
            Closed Shrublands:      6
            Open Shrublands:        7
            Woody Savannas: 8
            Savannas:       9
            Grasslands:     10
            Permanent Wetlands:     11
            Croplands:      12
            Urban and Built-up Lands:       13
            Cropland/Natural Vegetation Mosaics:    14
            Permanent Snow and Ice: 15
            Barren: 16
            Water Bodies:   17
            Unclassified:   255
            valid_range:    1, 17
            _FillValue:     255
```

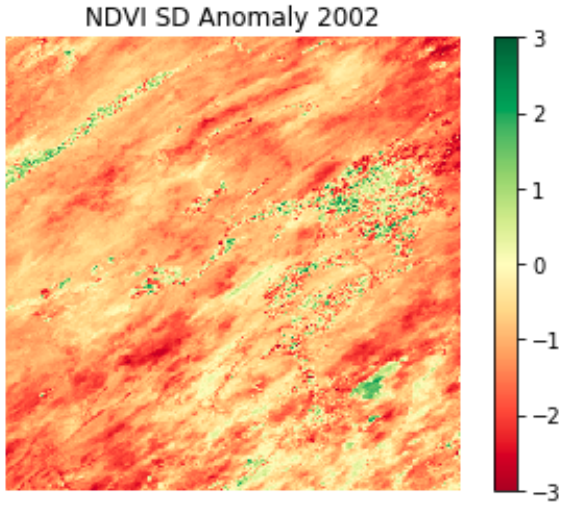
```
    Data set name: 'LC_Type2'
    Data type: 8-bit unsigned integer

attributes
    Number of attributes: 20
            long_name:      Land_Cover_Type_2
            Water Bodies:   0
            Evergreen Needleleaf Forests:   1
            Evergreen Broadleaf Forests:    2
            Deciduous Needleleaf Forests:   3
            Deciduous Broadleaf Forests:    4
            Mixed Forests:  5
            Closed Shrublands:      6
            Open Shrublands:        7
            Woody Savannas: 8
            Savannas:       9
            Grasslands:     10
            Permanent Wetlands:     11
            Croplands:      12
            Urban and Built-up Lands:       13
            Cropland/Natural Vegetation Mosaics:    14
            Barren: 15
            Unclassified:   255
            valid_range:    0, 15
            _FillValue:     255
```

```
    Data set name: 'LC_Type3'
    Data type: 8-bit unsigned integer

attributes
    Number of attributes: 15
            long_name:      Land_Cover_Type_3
            Water Bodies:   0
            Grasslands:     1
            Shrublands:     2
            Broadleaf Croplands:    3
            Savannas:       4
            Evergreen Broadleaf Forests:    5
            Deciduous Broadleaf Forests:    6
            Evergreen Needleleaf Forests:   7
            Deciduous Needleleaf Forests:   8
            Unvegetated:    9
            Urban and Built-up Lands:       10
            Unclassified:   255
            valid_range:    0, 10
            _FillValue:     255
```

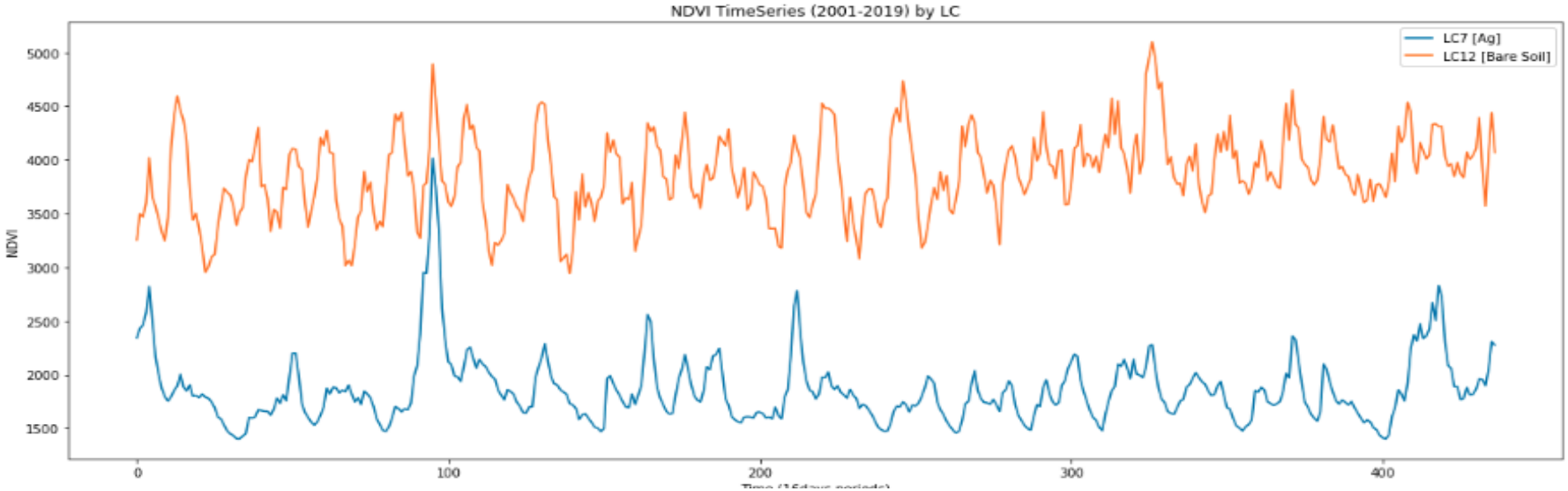


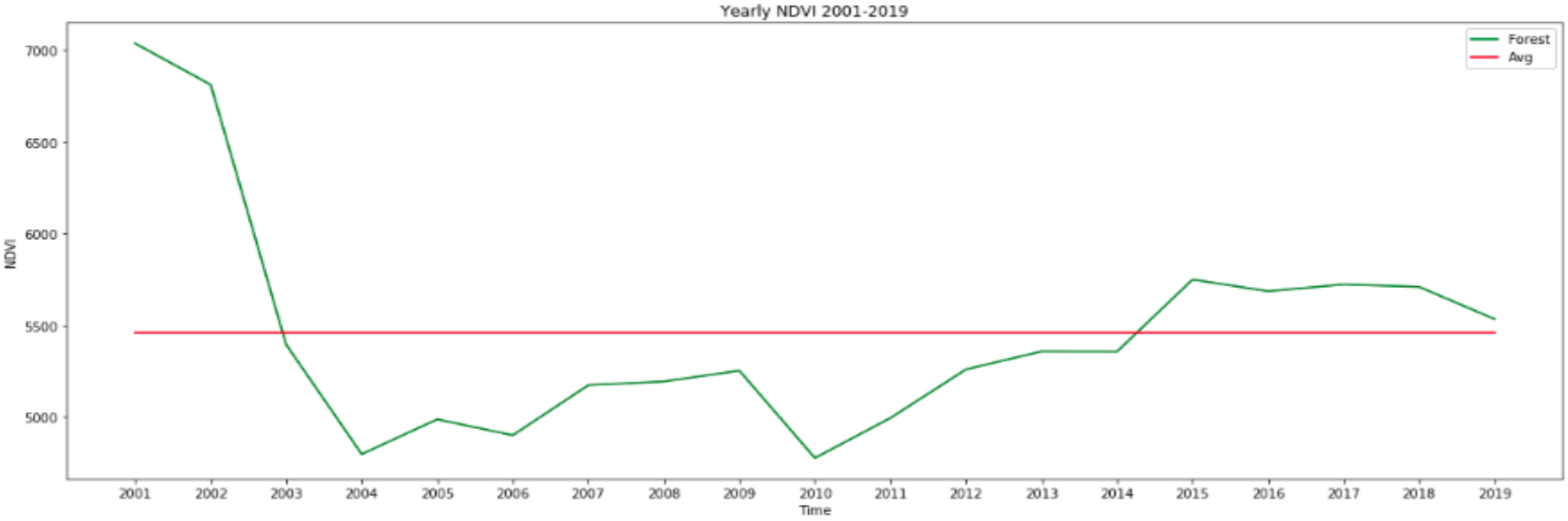
Anomalies

SD Anomaly = (X – Xavg) / XStdev

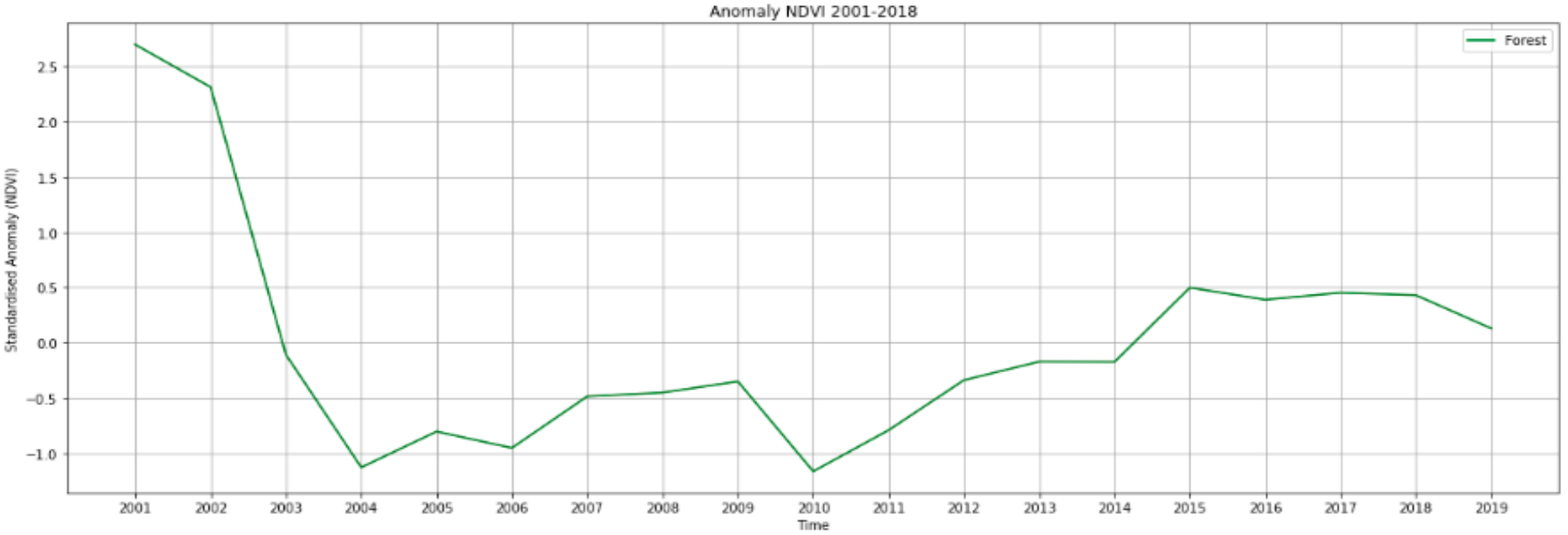


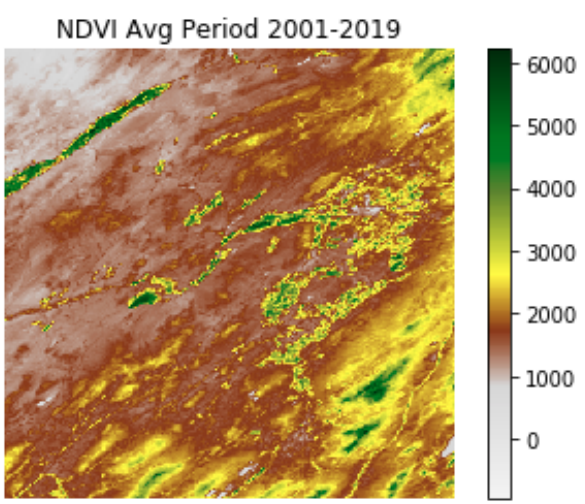
Timeseries by Land Cover

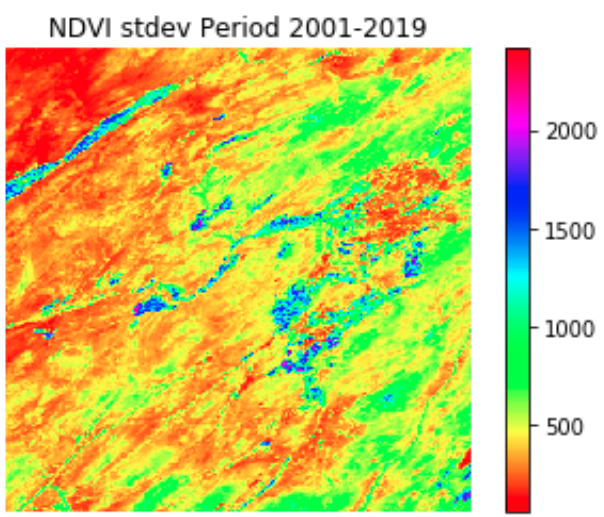


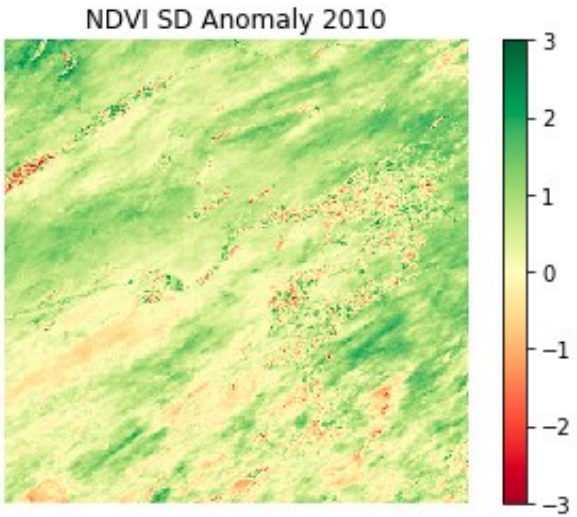


NDVI SD Anomalies







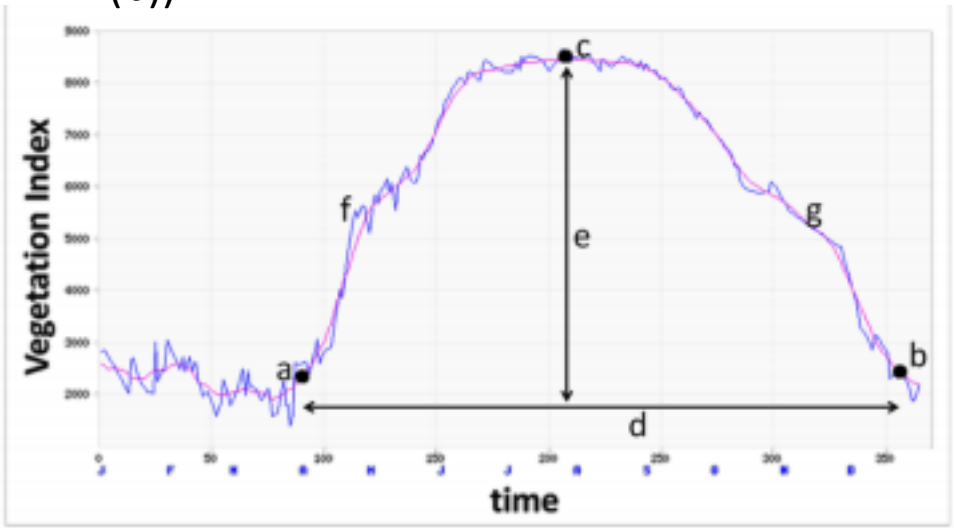


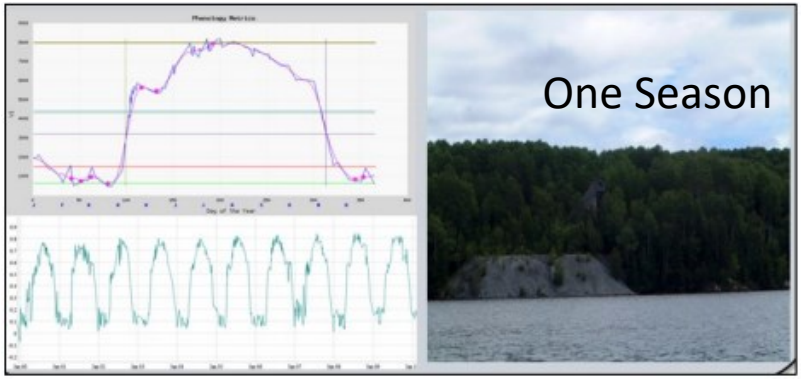
VI Phenology

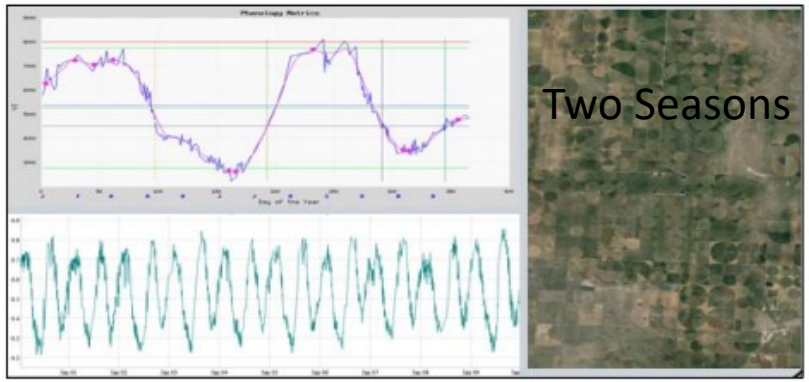
The Yearly NDVI cycle from the timeseries is used to derive phenology metrics, which are measures of great environmental & climatic events.

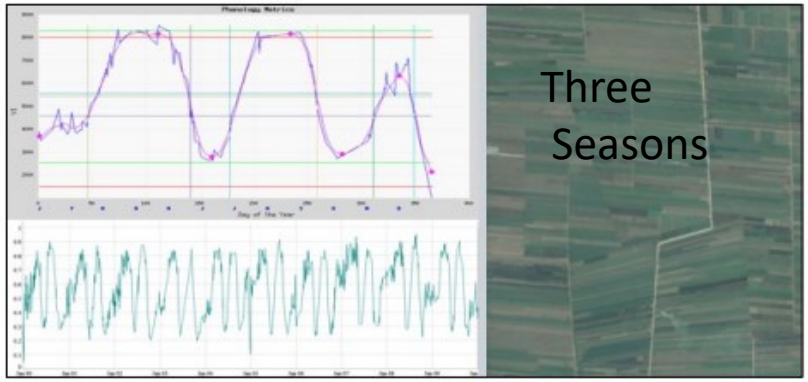
Phenology Metrics:

- Start of season (a)
- End of the season (b)
- Length of the season (d),
- Day of peak (c, time),
- Magnitude of peak (e, VI),
- Rate of greening (ΔVI/Δt between (a) and (c)),
- Rate of senescence (ΔVI/Δt, between (c) and (b))



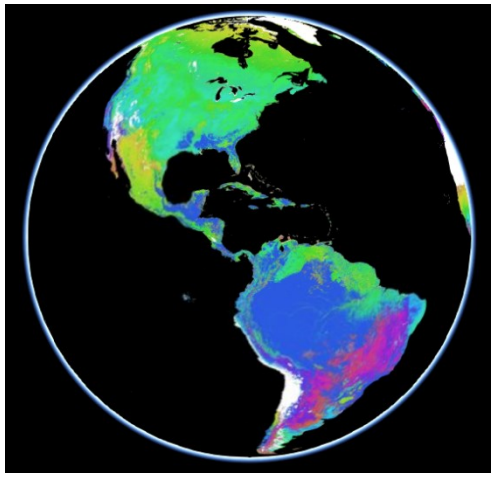


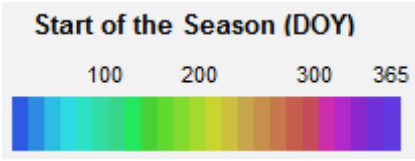




Exercise #2: NDVI Phenology

- Read 1 year of 16 day NDVI times series
- Compute Phenology metrics using the **Half-Max** Algorithm/method
- For a pixel location:
  - Extract NDVI values for each date
  - Smooth NDVI time series
  - Run phenology
  - Plot all information
- Compute Phenology for the full image
  - SOS (Start of season), EOS (End of season), DOP (Day of peak)
- Display phenology metric images
- **Homework**:
  - Compute LOS (Length of Season). Use **PhenoLOS.dsr** Color lut.
  - Run Phenology for Year 2001, 2005, 2010, 2015 and 2019 for a pixel
    - Display the metrics and plot them

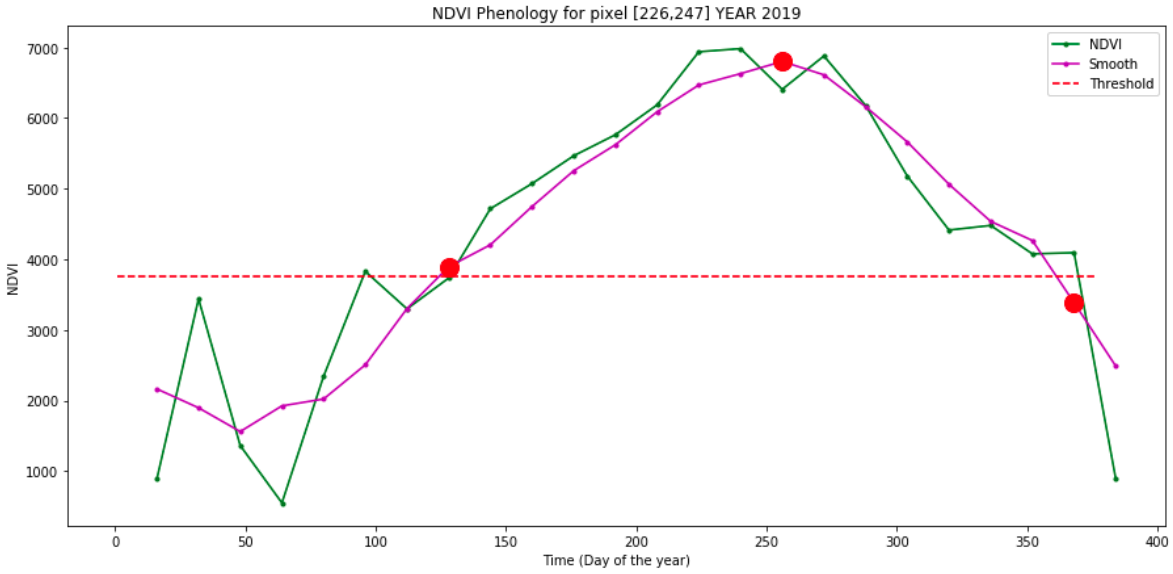




Instructions:

- Download files:
  - HDF files: same from Ex1.
  - PhenoSOS_EOS.dsr, PhenoDOP.dsr, PhenoLOS.dsr
  - Python script: BE485_Lab13_Ex2.ipynb

Exercise #2: (cont)




```
 NDVI Phenology for pixel [226,247] YEAR 2019
Start of Season= 113
Day of Peak= 241
End of Season= 353
```