“Time Series Satellite Data Visualizer”

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1 INTRODUCTION:

The aim of the software is to develop a tool to show the colormap of image captured by the satellite which are of a particular area and in the TIFF/TIF format.TIFF is a computer file format for storing raster graphics images, popular among graphic artists, the publishing industry and both amateur and professional photographers in general. The TIFF format is widely supported by image manipulation applications, by publishing and page layout applications and other applications. The TIFF file contains raster data. A raster data is, in essence, any type of digital image represented by reducible and enlargeable grids.

Raster data type consists of rows and columns of cells, with each cell storing a single value. Raster data can be images (raster images) with each pixel (or cell) containing a color value. Additional values recorded for each cell may be a discrete value, such as land use, a continuous value, such as temperature, or a null value if no data is available. While a raster cell stores a single value, it can be extended by using raster bands to represent RGB (red, green, blue) colors, colormaps (a mapping between a thematic code and RGB value), or an extended attribute table with one row for each unique cell value. The resolution of the raster data set is its cell width in ground units.

Raster data is stored in various formats; from a standard file-based structure of TIFF, JPEG, etc. to binary large object (BLOB) data stored directly in a relational database management system (RDBMS) similar to other vector-based feature classes. Database storage, when properly indexed, typically allows for quicker retrieval of the raster data but can require storage of millions of significantly sized records.

Vector

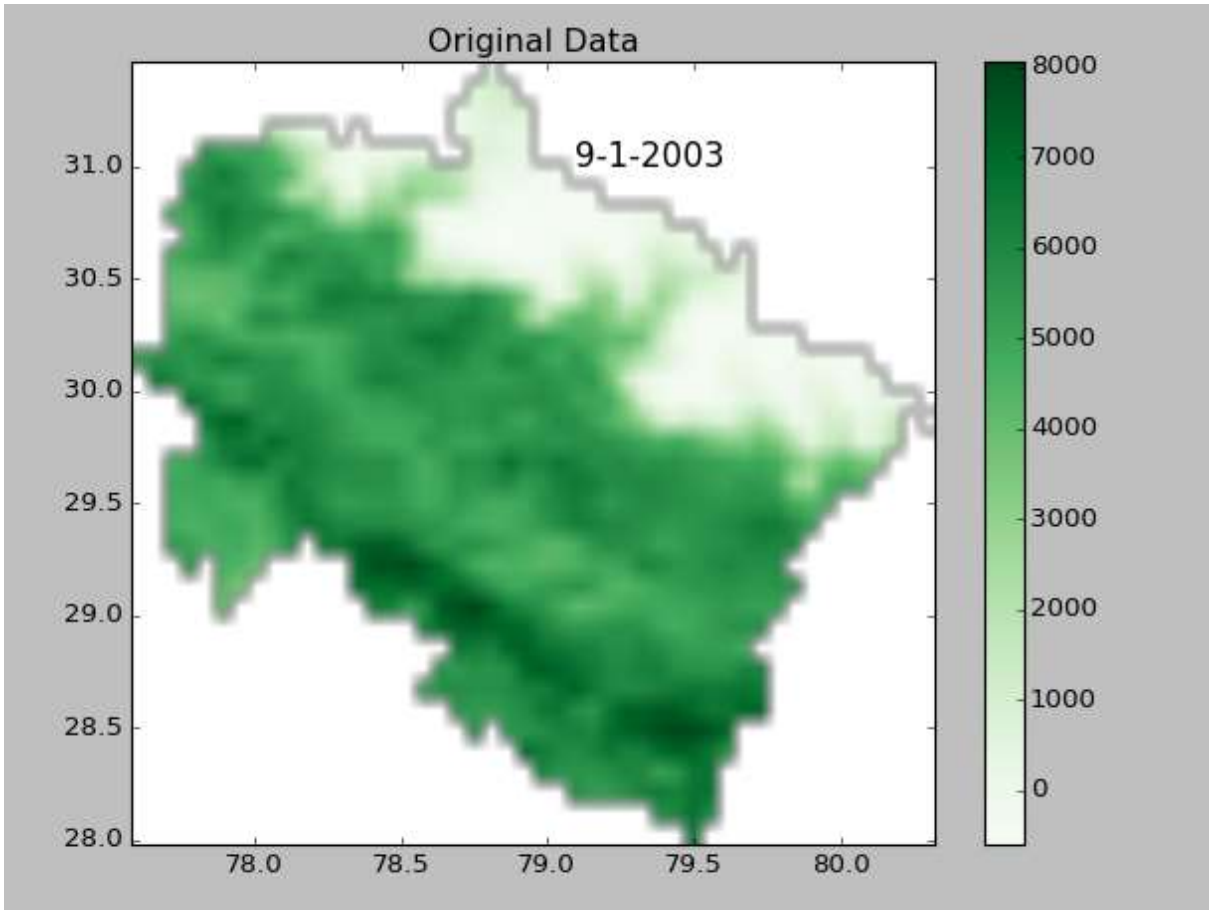
In a GIS, geographical features are often expressed as vectors, by considering those features as geometrical shapes.

The aim of the Software to express the phenology by showing the images in green colormap so that the study of level of vegetation can be done.

2 Case Study:

2.1 Case Study 1

MIN-MAX Stretching: In the Min-Max Stretching the object is show the original colormap of an image which is in TIF format. In the image where the data is not available it puts nan(not a number) .



Showing Green colormap of Uttrakhand at the month of January 2003

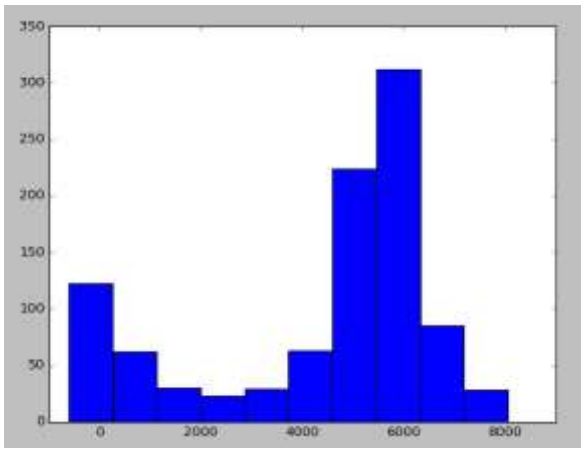
2.2 Case Study 2

Histogram Stretching: Histogram equalization is a method in image processing of contrast adjustment using the image's histogram.

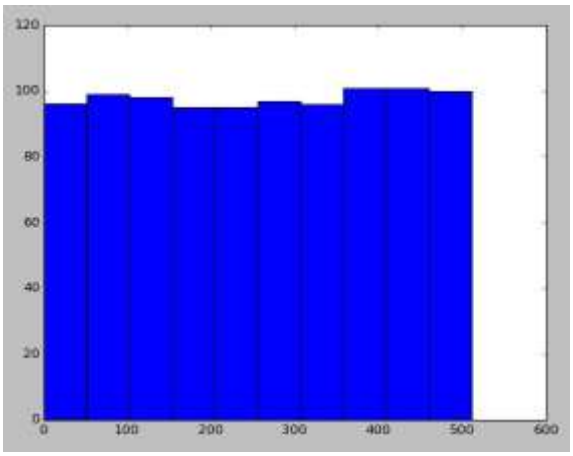
Overview

This method usually increases the global contrast of many images, especially when the usable data of the image is represented by close contrast values. Through this adjustment, the intensities can be better distributed on the histogram. This allows for areas of lower local contrast to gain a higher contrast. Histogram equalization accomplishes this by effectively spreading out the most frequent intensity values.

The method is useful in images with backgrounds and foregrounds that are both bright or both dark. In particular, the method can lead to better views of bone structure in x-ray images, and to better detail in photographs that are over or under-exposed. A key advantage of the method is that it is a fairly straightforward technique and an invertible operator. So in theory, if the histogram equalization function is known, then the original histogram can be recovered. The calculation is not computationally intensive. A disadvantage of the method is that it is indiscriminate. It may increase the contrast of background noise, while decreasing the usable signal.

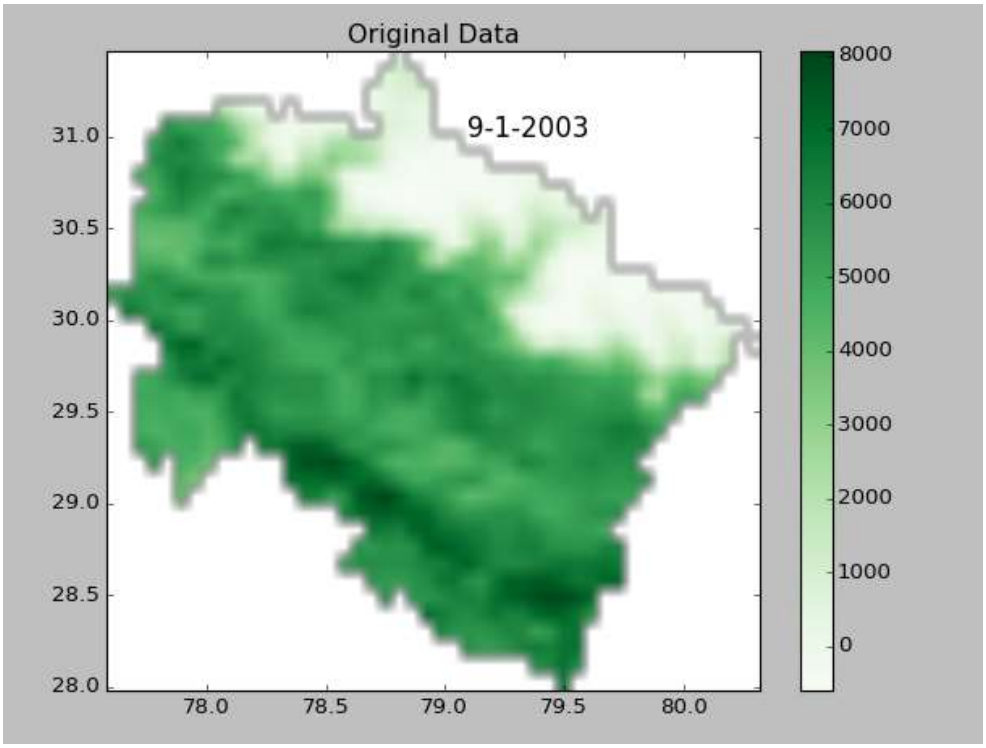


Original Data

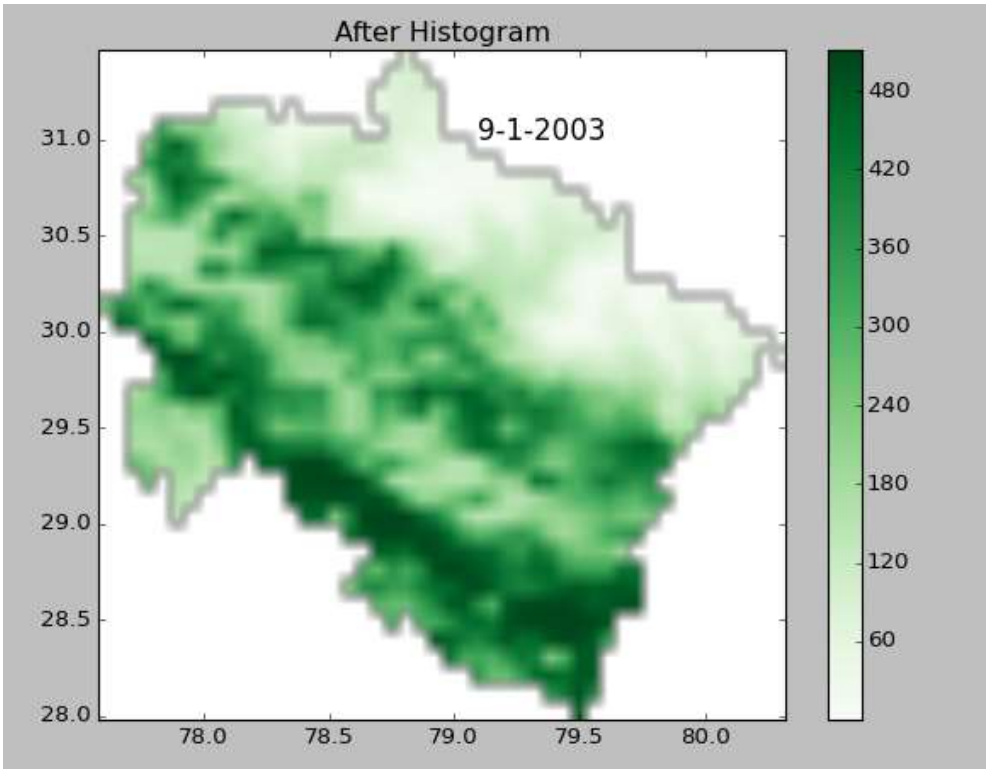


Histogram Equalisation

Example:



Original Data



Histogram Equalisation

2.2 Case Study 3

2 Inter Quartile Range:

In descriptive statistics , the interquartile range (IQR), also called the mid spread or middle fifty , is a measure of statistical dispersion , being equal to the difference between the upper and lower quartiles ,[1][2] IQR = Q 3 − Q 1 . In other words, the IQR is the 1st quartile subtracted from the 3rd quartile; these quartiles can be clearly seen on a box plot on the data. It is a trimmed estimator, defined as the 25% trimmed range, and is the most significant basic robust measure of scale.

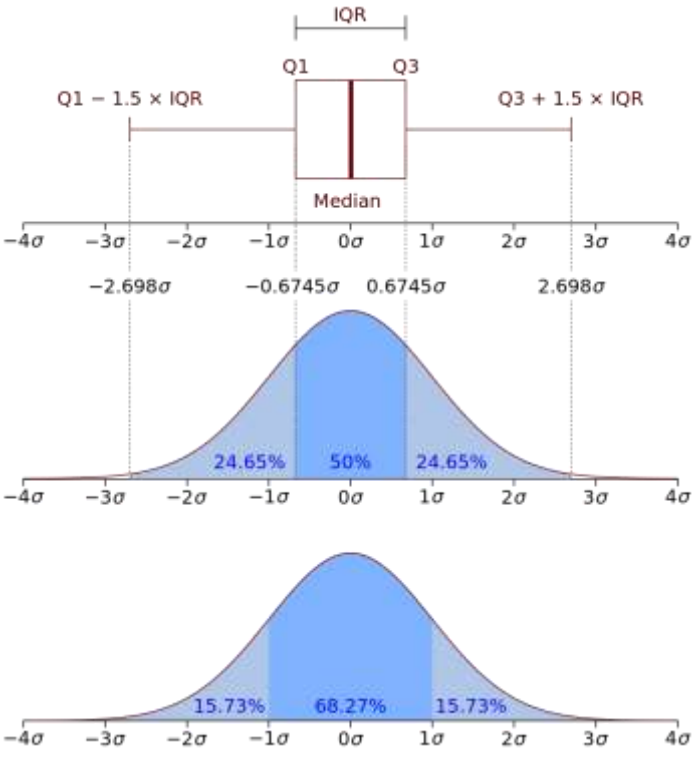
Use

Unlike (total) range, the interquartile range has a breakdown point of 50%, and is thus often preferred to the total range.

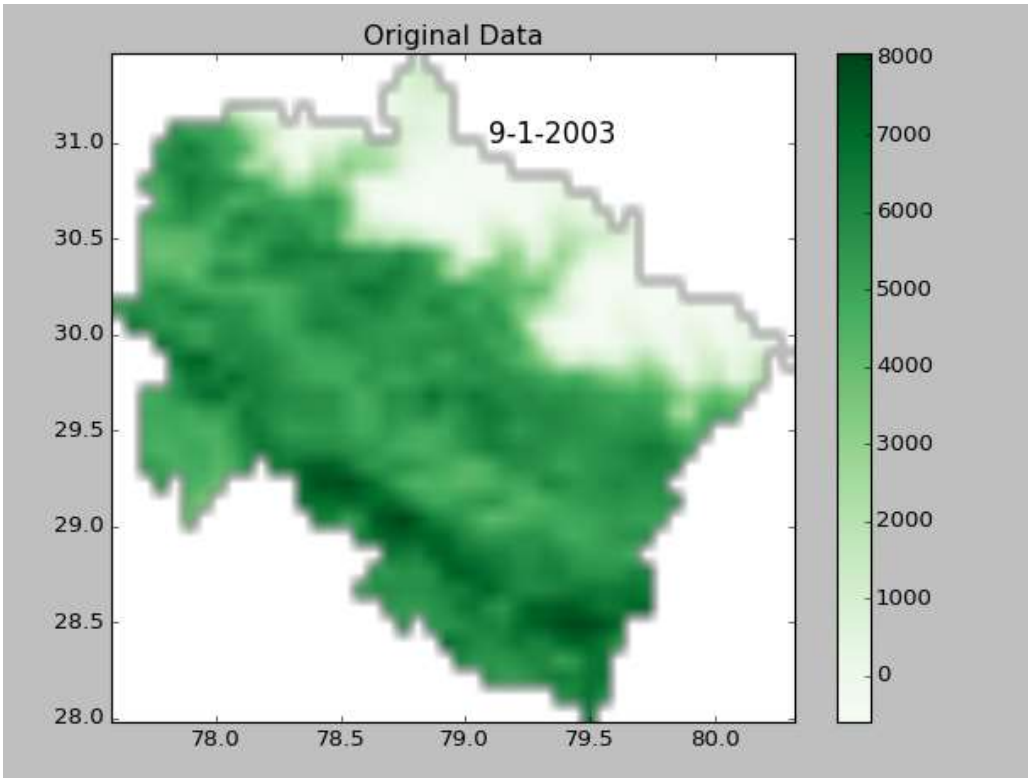
The IQR is used to build box plots, simple graphical representations of a probability distribution.

For a symmetric distribution (where the median equals the midhinge , the average of the first and third quartiles), half the IQR equals the median absolute deviation (MAD).

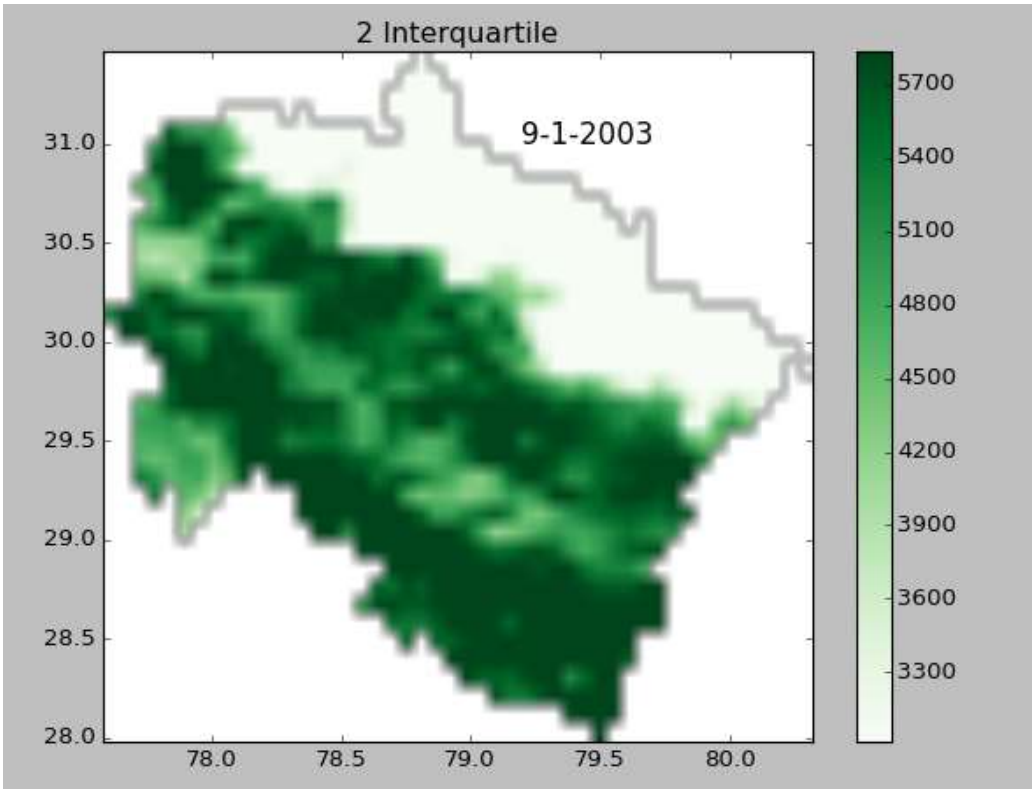
The median is the corresponding measure of central tendency.



Example:



Original Data



2 Inter Quartile Range

2.2 Case Study 4

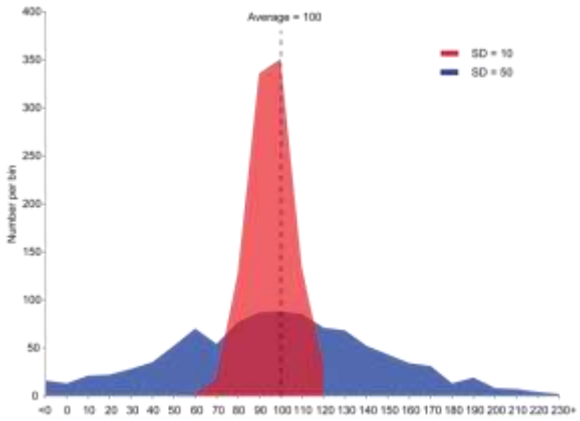
Standard Deviation:

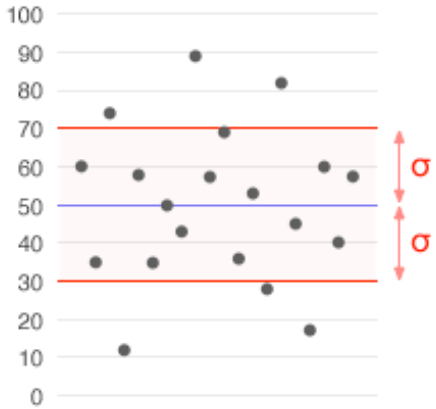
In statistics, the standard deviation (SD, also represented by the Greek letter sigma, σ) is a measure that is used to quantify the amount of variation or dispersion of a set of data values.

A standard deviation close to 0 indicates that the data points tend to be very close to the mean (also called the expected value) of the set, while a high standard deviation indicates that the data points are spread out over a wider range of values.

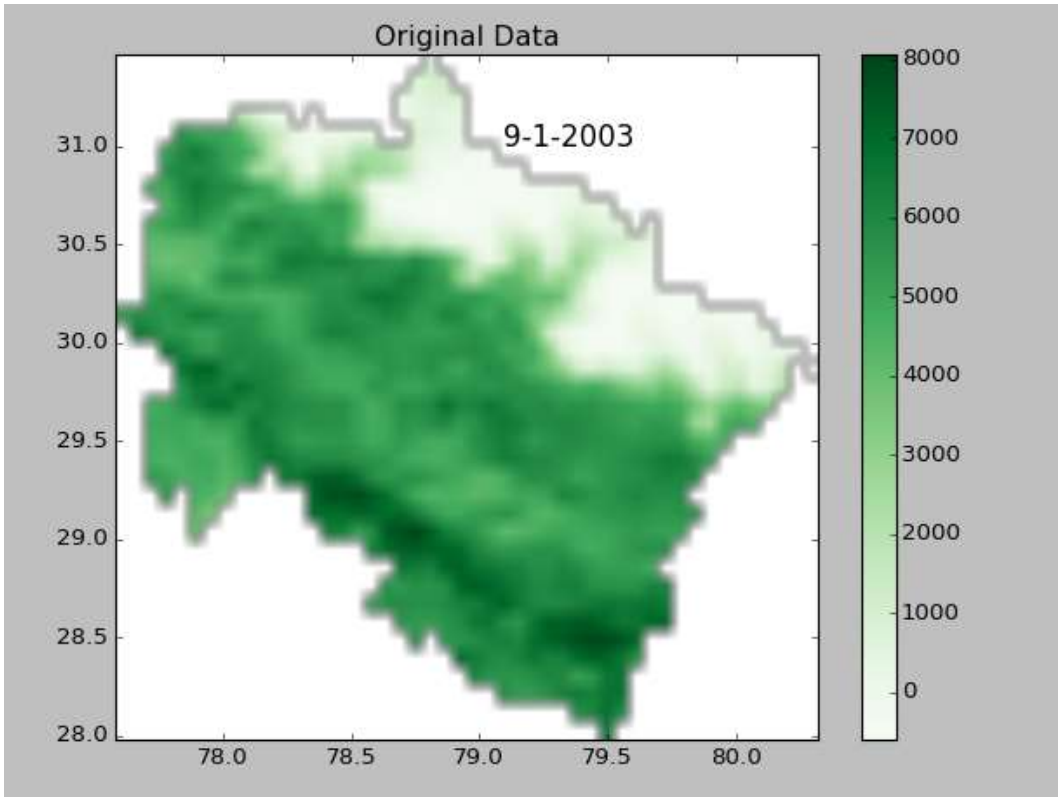
The standard deviation of a random variable, statistical population, data set, or probability distribution is the square root of its variance. It is algebraically simpler, though in practice less robust, than the average absolute deviation.

A useful property of the standard deviation is that, unlike the variance, it is expressed in the same units as the data. There are also other measures of deviation from the norm, including mean absolute deviation, which provide different mathematical properties from standard deviation.

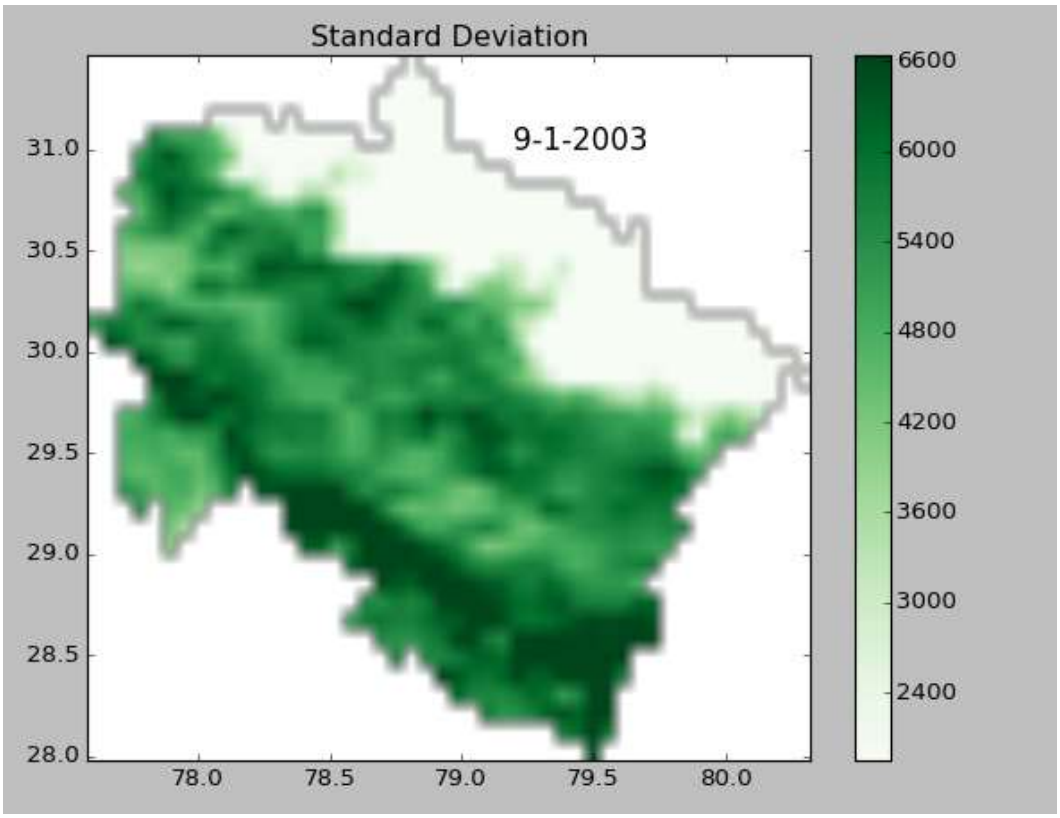




Example:



Original Data

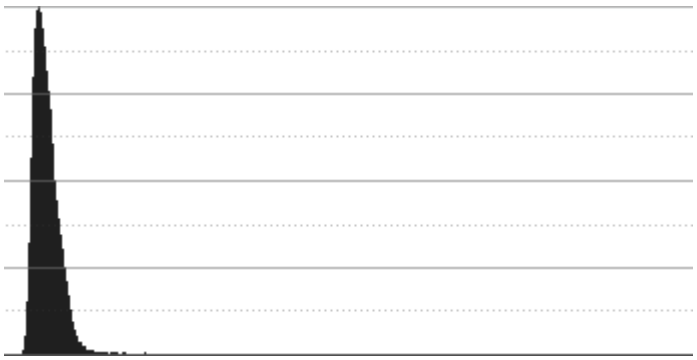


Standard Deviation

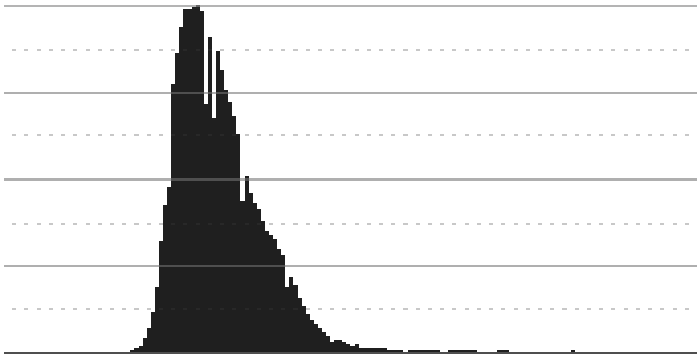
2.2 Case Study 5

Percentile Clipping:

In the Percentile clipping user must give the input (ex: 10 or 10, 20). If User give input as 10 or something else (in single digit), total percentage of that will clipped from both lowest and highest side. If User give input as 10, 20 or something else (in two digit), total percentage of first digit will be clipped from lowest side and total percentage of second digit will be clipped from Highest Side.

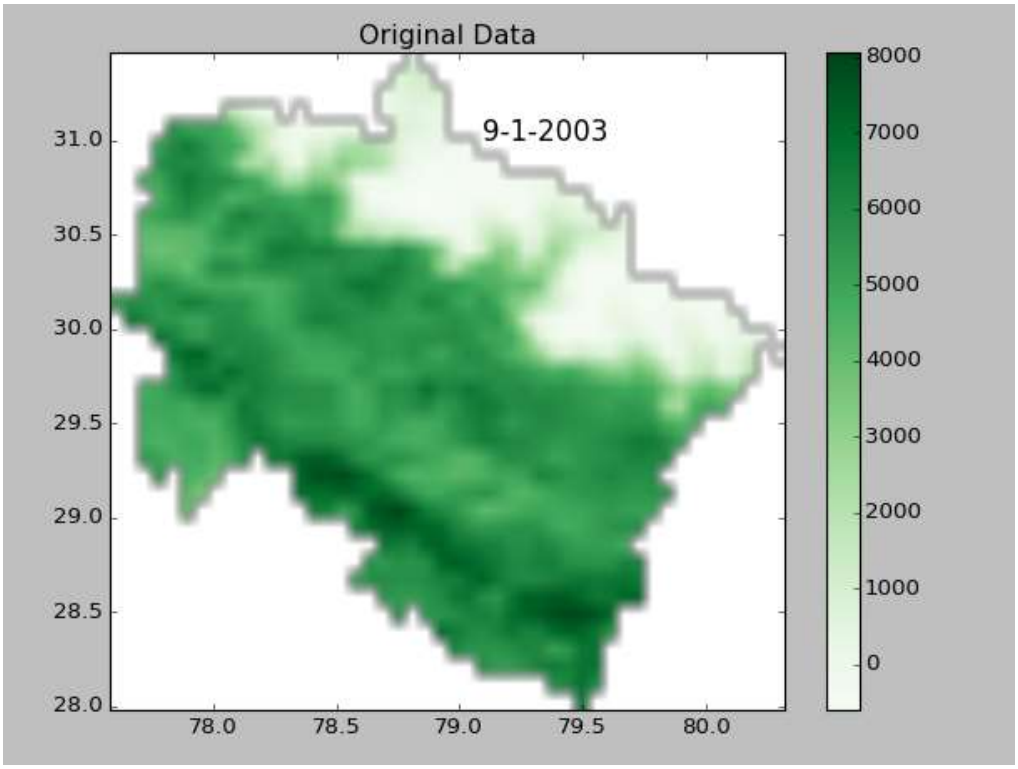


Original Data

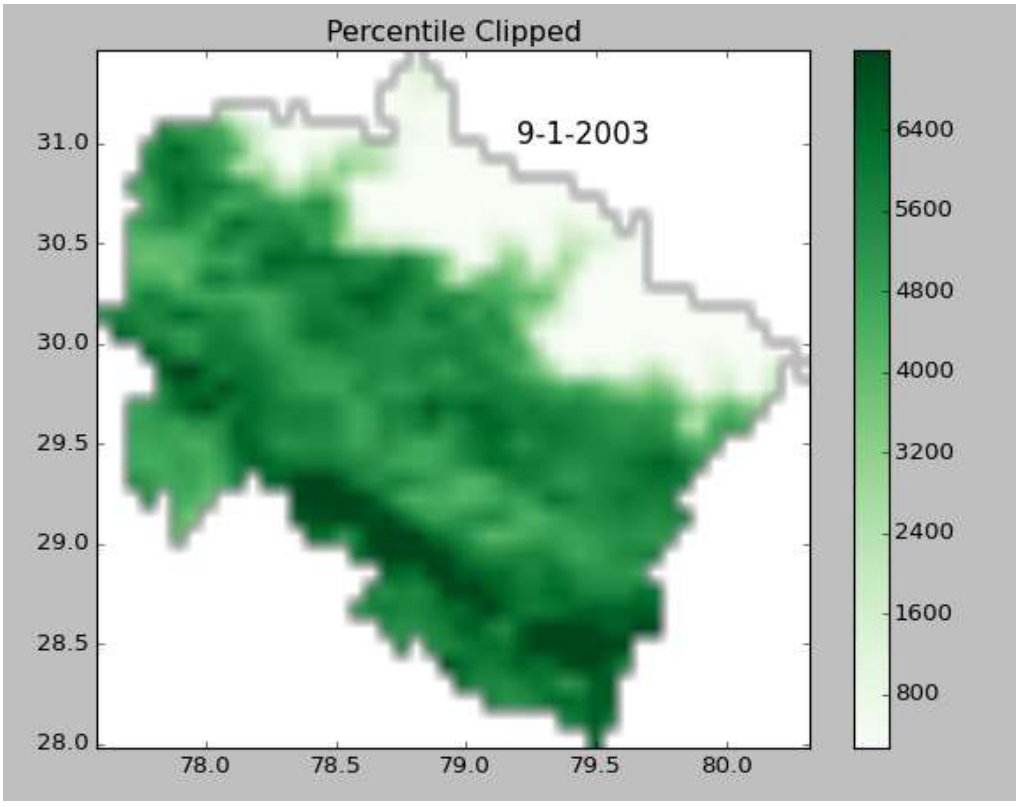


Trimmed Data

Example:



Original Data



10% Clipped Data

3 Software Specification:

3.1 Requirements:

3.1.1Software Requirements:

"Time Series Satellite Data Visualizer" works in two mode:

1. **Window Application Mode:**

   Just run TSSDV.exe file. Advantage of running of Window application mode is use don't need to install python software and its libraries. Tested on Windows 8.1 64bit edition.

2. **Python Mode:** User have to install various Software and Libraries of Python which are listed Below:
   I. Applications:
      1. python-2.7.9.amd64.msi
      2. vcredist_x64.exe
      3. gdal-111-1600-x64-core.msi
      4. GDAL-1.11.1.win-amd64-py2.7.msi
      5. PyQt4-4.11.3-gpl-Py2.7-Qt4.8.6-x64.exe
      6. py2exe-0.6.9.win64-py2.7.amd64.exe

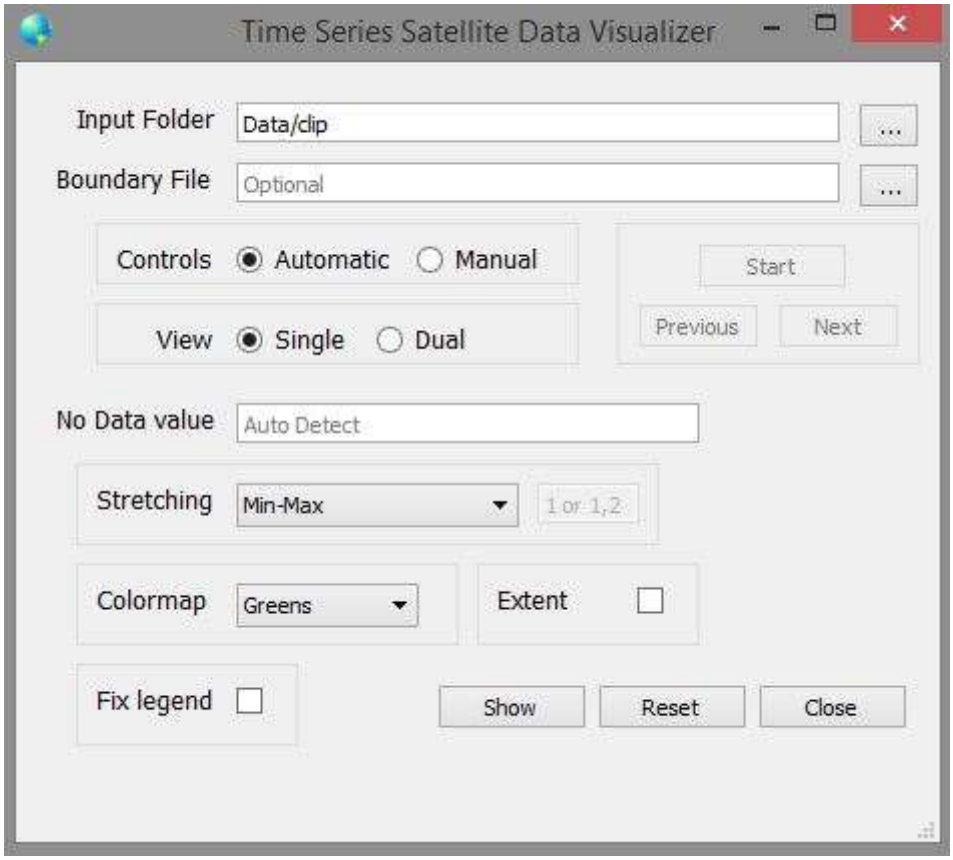
   II. Libraries:
      1. pyshp-1.2.3.tar.gz
      2. Pillow-2.1.0.win-amd64-py2.7.exe
         a. imtools.py (copy imtools.py in C:\Python27\Lib\site-packages\PIL\)
      3. palettable-2.1.1-py2.py3-none-any.whl
      4. numpy-MKL-1.9.1.win-amd64-py2.7.exe
      5. jdcal-1.0.tar.gz
      6. getch-1.0-python2.tar.gz
      7. matplotlib-1.4.3.win-amd64-py2.7.exe
         a. pyparsing-2.0.3-py2-none-any.whl
         b. python_dateutil-2.4.2-py2.py3-none-any.whl
         c. pytz-2015.4-py2.py3-none-any.whl
         d. scipy-0.15.1-cp27-none-win_amd64.whl
         e. setuptools-17.1.1-py2.py3-none-any.whl
         f. six-1.9.0-py2.py3-none-any.whl

3.1.2Hardware Requirements:

1. 1GHz or Greater Processor
2. 1 GB RAM
3. 1 GB disk space

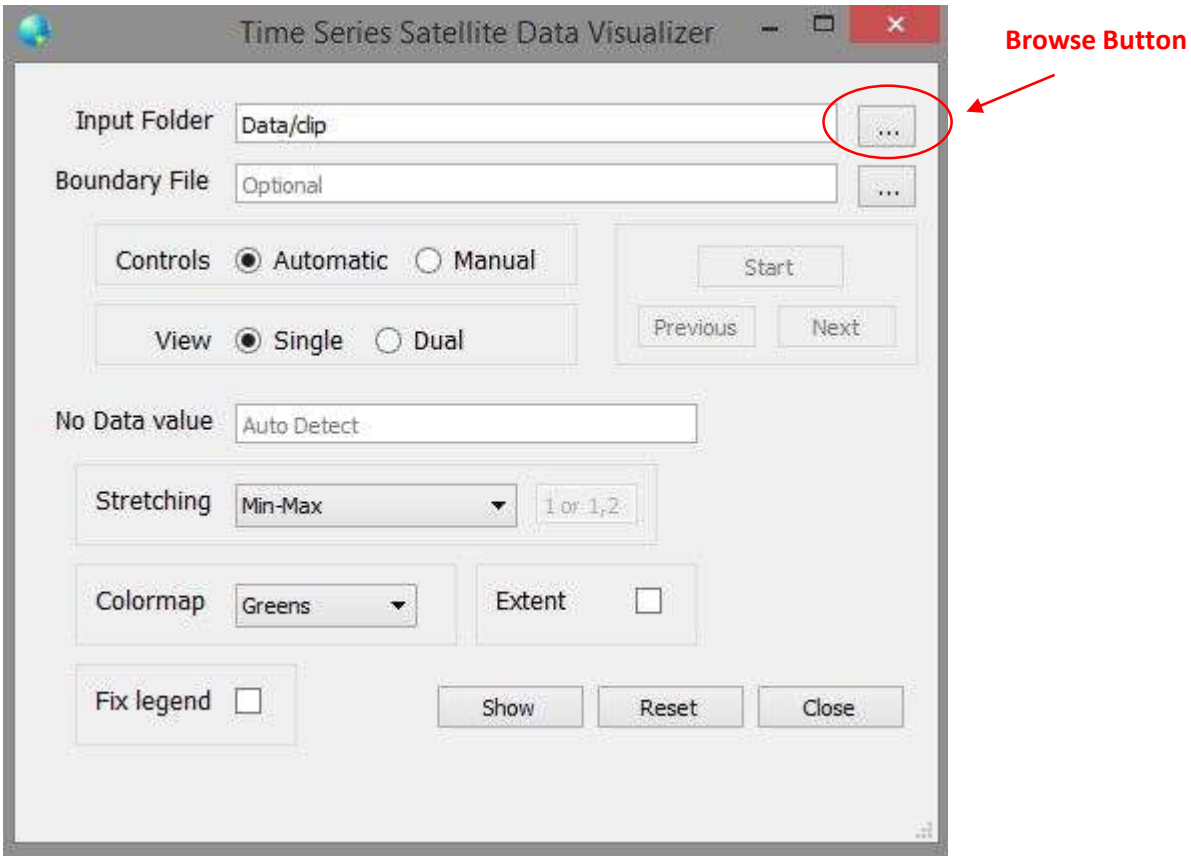
3.2 Architecture/Design:

"Time Series Satellite Data Visualizer" is completely Python Based Software which has built in python 2.7. Algorithm and Backend architecture is designed in Python 2.7 and Front End GUI (Graphic User Inter face) has been designed in PyQT4.

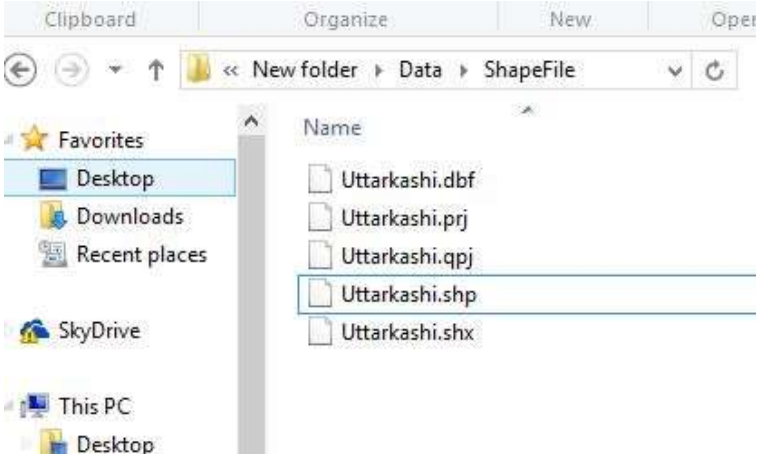


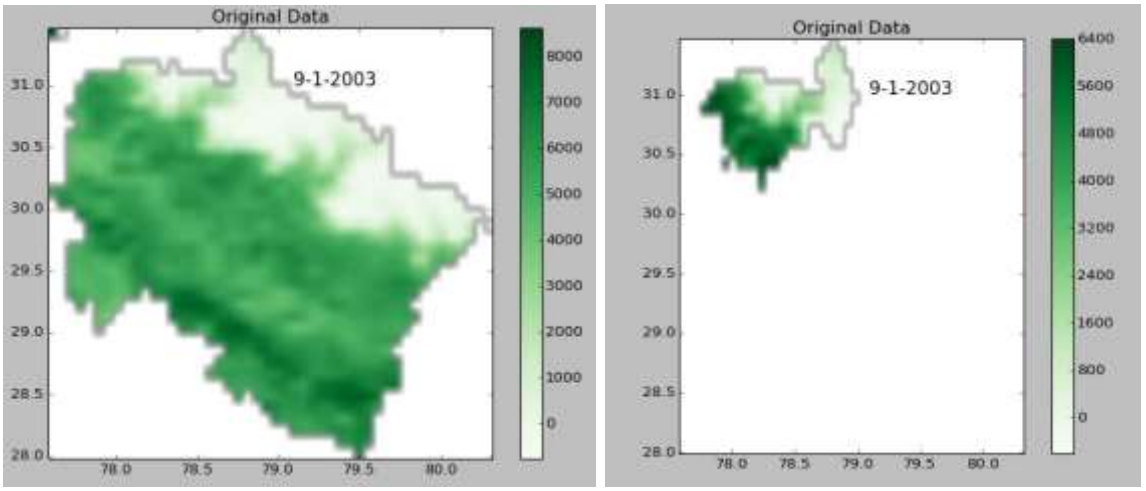
4 End User Manual:

1. Input Folder: User have to input the path of the folder for which the colormap to be shown and where the .tif images are stored. It can be Entered by text or by clicking on browse button.



2. Boundary File: (optional) User have to input the path of Boundary file (.shp file). It is taken to be carefully in the mind the file associated with the shapefile must be in same folder the same name of shapefile. Example Below:



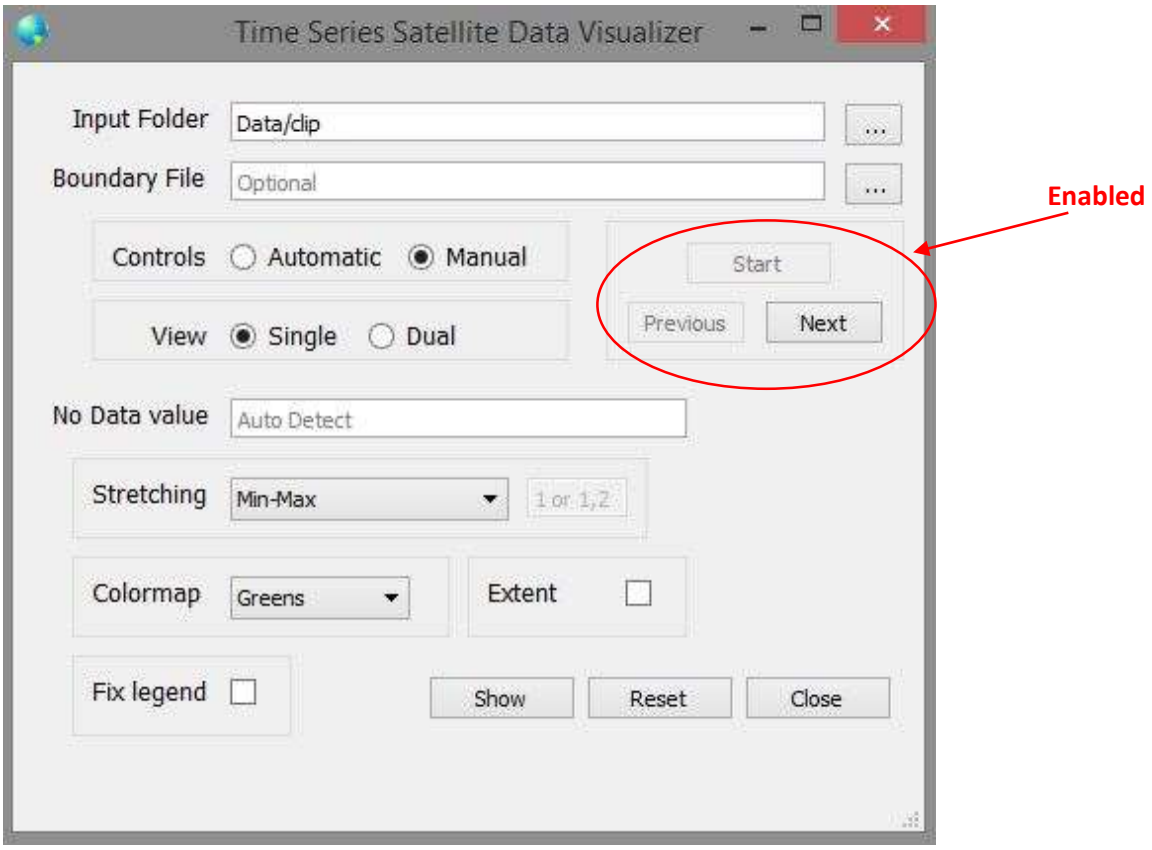


Original Data Clipped Data

Note: For using clipping/Boundary File user must install the below files:

1. vcredist_x64.exe
2. gdal-111-1600-x64-core.msi
3. GDAL-1.11.1.win-amd64-py2.7.msi

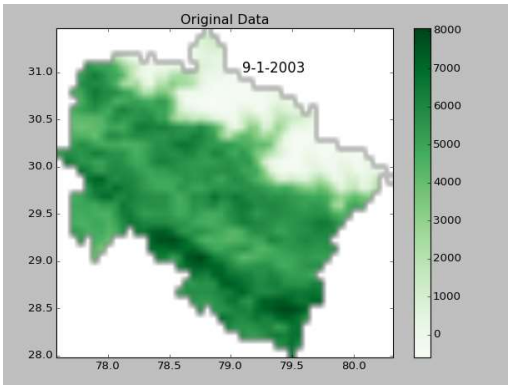
3. Controls: Two options are available:
   - Automatic: In this all the file in folder will be animated by the time interval of 0.5 second. Until all file would be displayed, Software window will be locked.
   - Manual: In this mode Start, Previous and Next Button will be enabled and user can view any file in the folder by pressing these directional buttons.



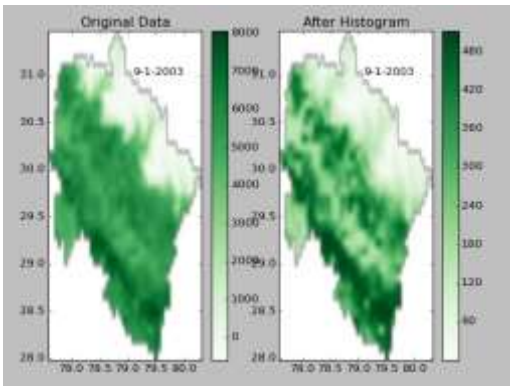
4. View: Two options are available:

   Single: In the Single Mode User have to Select Stretching Option. By Default it is "Min-Max".

   Dual: In the Dual Mode User gave to Select 2nd Stretching to be viewed with the 1st Stretching which is By Default Min-Max. User cannot change 1st Stretching Option but can choose 2nd. By Default 2nd Stretching is Histogram



Single View

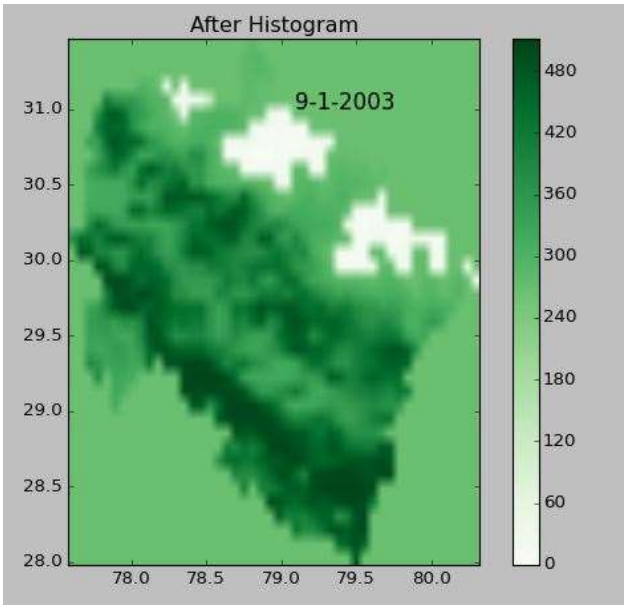


Dual View

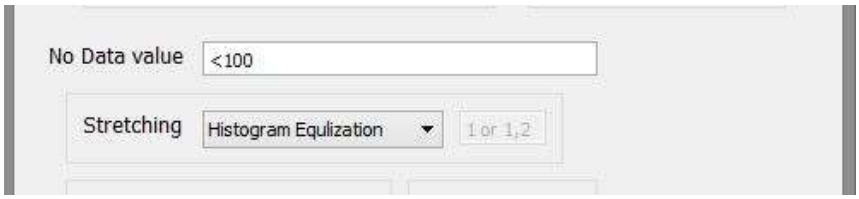
5. No Data Value: (Optional) By Default it is Zero (0) which after converted to np.nan. User can give single or many values separated by commas (,) ex: 10,20,30 which user want to convert in np.nan.

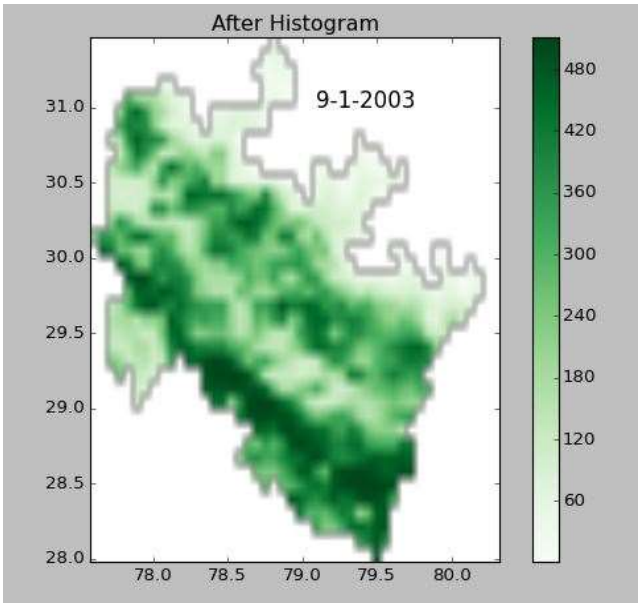
   User also can input value as: <100,<200,10,20,>300

   Example: a) When value: 10, 20, 30



a) When value is : <100





6. Stretching:

Five Options are available:

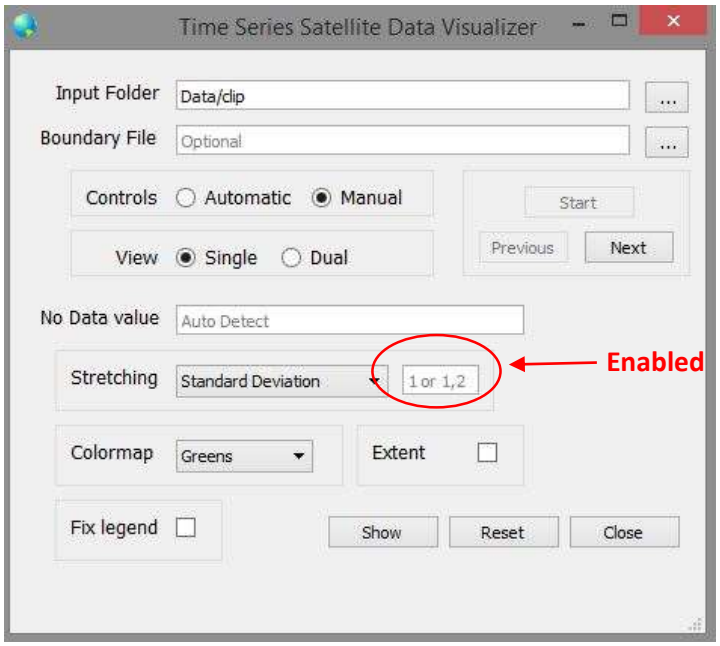
1. Min-Max
2. Histogram
3. 2 Inter Quartile Range
   Explanation has been given in Case Study Part.

4. Standard Deviation: In the Standard deviation user must give the input (ex: 1 or 1, 2).If User give input as 1 or something else (in single digit), total data which is lower/higher than the multiple of Standard Deviation is clipped. If User give input as 1,2 or something else (in two digit), total data which is lower than the multiple of first digit will be clipped from lowest side and total data which is Higher than the multiple of first digit will be clipped from Highest Side.

5. Percentile Clipping: In the Percentile clipping user must give the input (ex: 10 or 10, 20).If User give input as 10 or something else (in single digit), total percentage of that will clipped from both lowest and highest side. If User give input as 10, 20 or something else (in two digit),

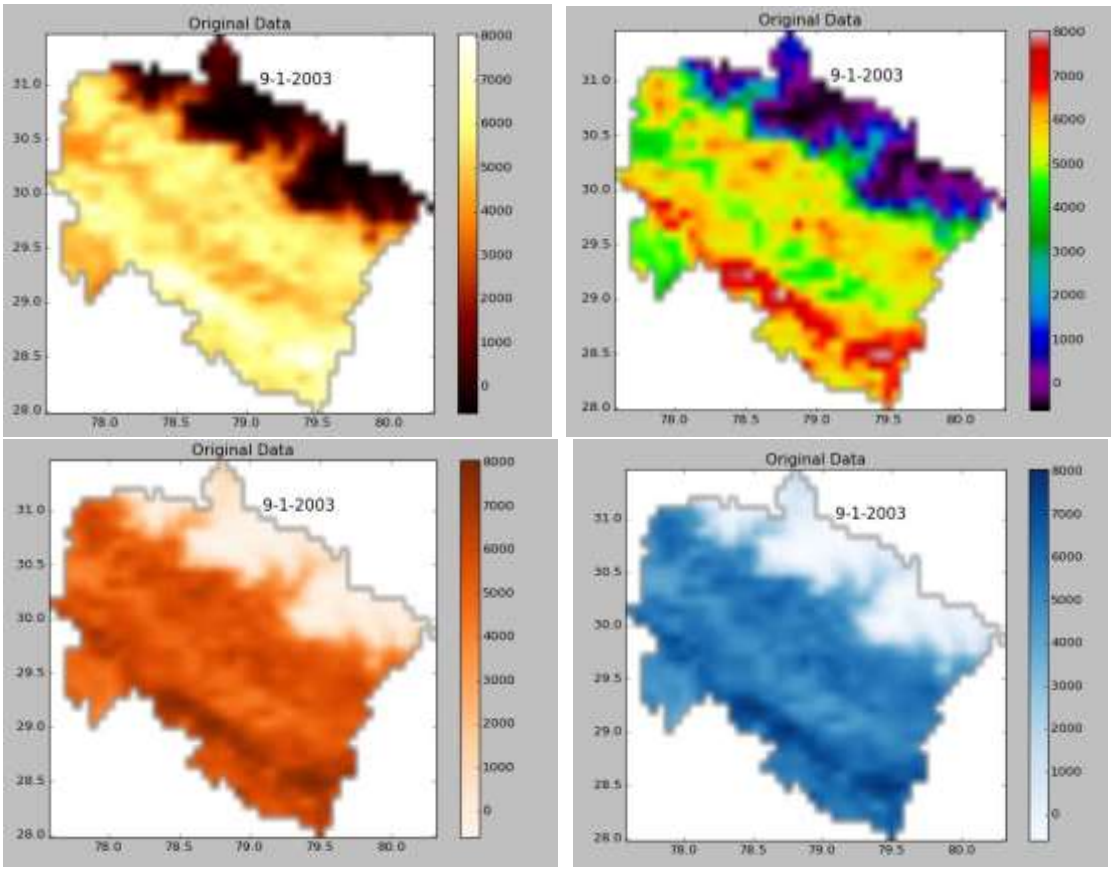
total percentage of first digit will be clipped from lowest side and total percentage of second digit will be clipped from Highest Side.

Note: When use select Standard Deviation or Percentile Clipping from the combo box only then text box in which input has to be been is enabled. Other 3 option it remains disabled.



7. Extent: By selecting this option Value (legend) of X-axis and Y-axis became constant. First it check all the files in the folder, then find the maximum and minimum value of both axis of all files and then set the legend of axis according to the highest/lowest value among all the files. Benefit of doing this if user have no of files which have data of different area, then user set the maximum-minimum value of the axis.

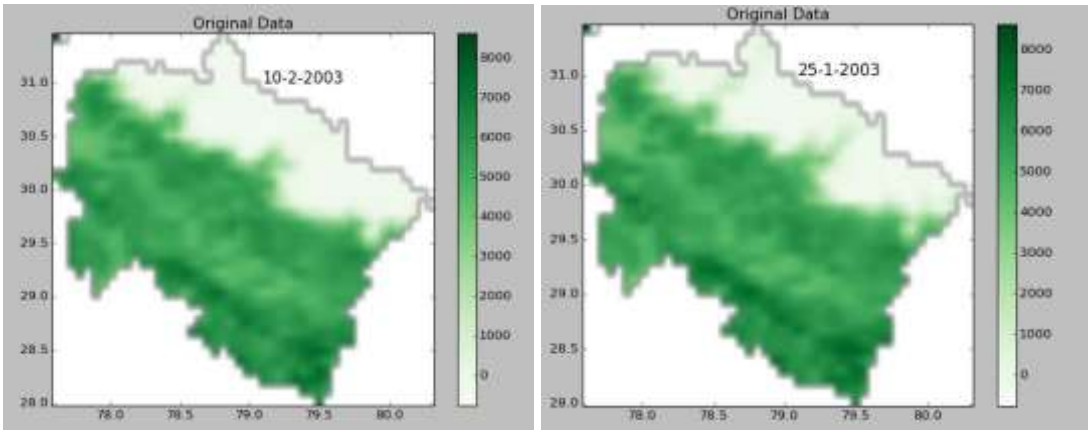
8. Colormap: User can select various Colormap given in the List by Default it is set to "Greens"

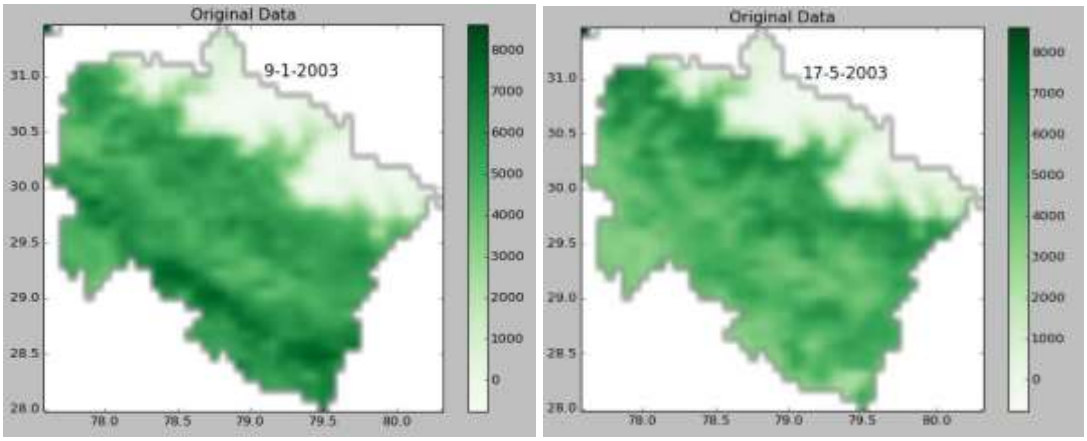


9. Fix-Legend: (optional) Fix-Legend is used to set the minimum and maximum value of Colormap by taking minimum/maximum value of Colormap of the all files containing in the Input Folder.

   Note: When Histogram option is selected in Stretching, Fix-Legends will be disabled because in histogram minimum/maximum value already fixed (generally 0-256).

   Example: In given example Data of various moth is given but minimum/maximum value of Colormap is same for all Data



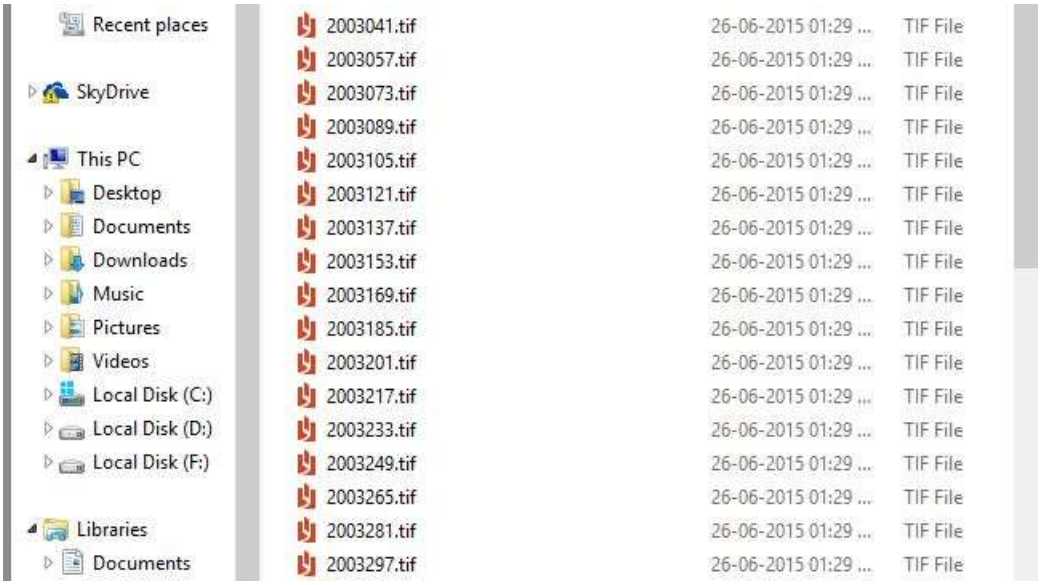


10. Show: Show Button is used to display the plotting Window after selecting all above options.

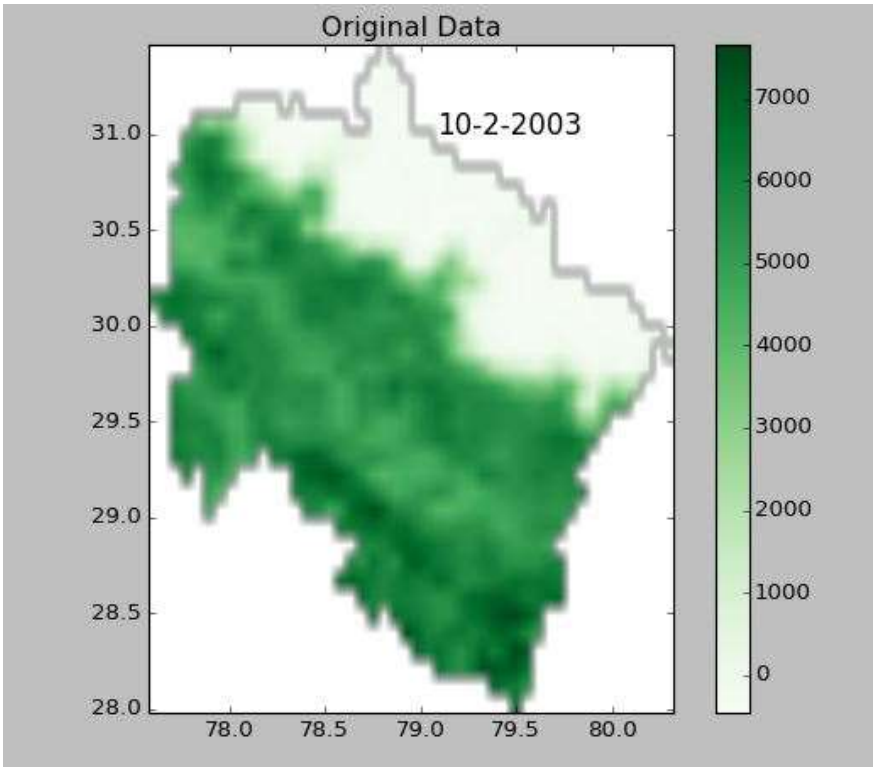
11. Reset: Reset Button is used to reset all options.

    1 Clears the Folder and Shapefile path, No Data value
    2 Set Controls to Automatic, View to Single, Stretching to Min-Max, Colormap to "Greens"
    3 Unmark the Fix-Legend
    4 Close Plot Window.

12. Image Name Format / Date: User have to give image name in Julian Calendar Date Format starts from 2003.



Software will convert this Julien Date to Original Date and plot on the graph.
In the Example: 2003041
2003 is the year of the image captured
041 is the 41th day of the year than the original date will be like that
31 day of January + 10 Day of February = 10th February 2003 (10-2-2003)



13. Close: It closes Software as well as Plot Window.

5 ABOUT:

Software Name:	Time Series Satellite Data Visualizer
Version:	1.0.0
Developed By:	Umang Gupta
Instructor:	Mr Prasun Gupta
Developed at:	Indian Institute of Remote Sensing, Indian Space Research Organisation, Dehradun, Uttrakhand.
Duration:	1 Month