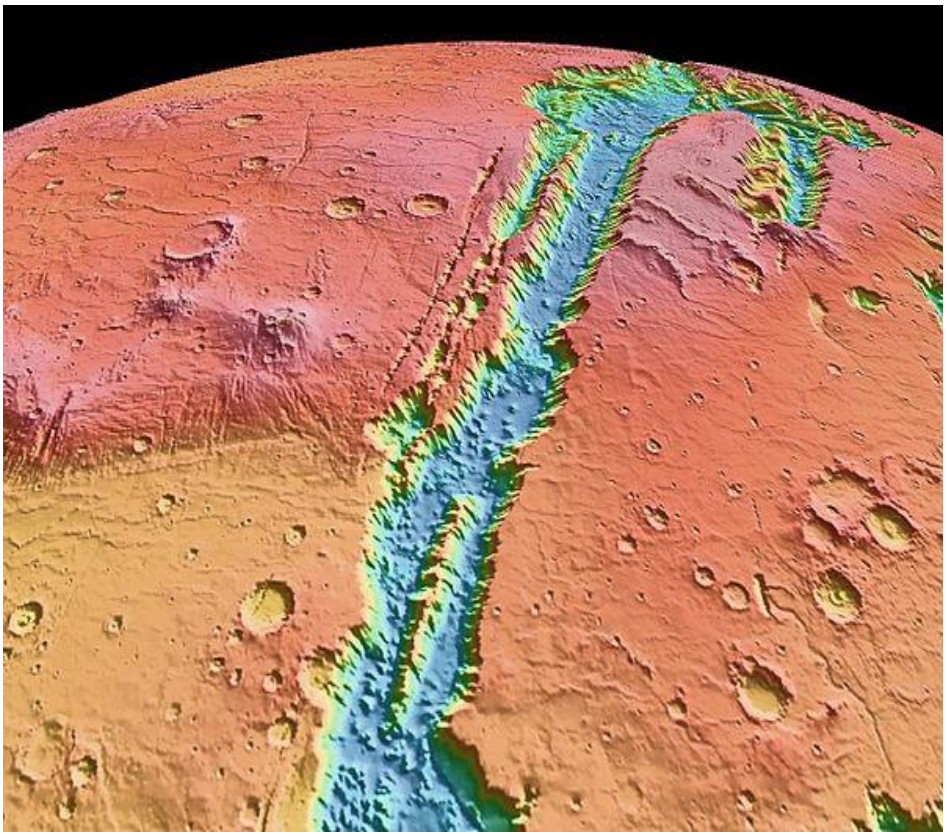
Title: Geo-Informatic & Earth System Data Term Paper

Author: Vijaya Nawale, Data Engineering

Student number: 30002931



MEGI001-210213 –

Geo-Information Systems

Topic Description:

1. Mars – Valles Marineris Export RGB & Pan-sharp

2. Agriculture crop production analysis.

Table of Content

I. Geo-Information System –

Mars – Valles Marineris: Export RGB & Pan-sharpening

1. Topic Description:

Mars – Valles Marineris:
Location of Valles Marineris is on the east side of the **Tharsis** Bulge along the **Mars equator** and extends for almost a quarter of the circumference of the planet. The great valley stretches more than 3,000 km in length, spans as many as 600 km in breadth, and delves as much as eight km deep. By comparison, in Arizona, USA, the Earth's Grand Canyon is 800 km long, 30 km wide and 1.8 km deep.

This paper will focus on getting Imagery and topography from the areas – Mars, Valles Marineris and then performing gdal algorithms on the imagery and topography. This will include Exporting RGB, creating contours and describing the landscape. Mosaicking RGB, creating pan-sharpened images from Nadir and RGB from each band and reprojection.

Tools used – Google earth pro & QGIS 3.10.2

2. Data and Methods used

Data:

"Mars Express Archive MEX-M-HRSC-5-REFDR-DTM-V1.0"

HRSC dataset downloaded from ESA PSA/PDS already in Level4, i.e. map projected.

ftp://psa.esac.esa.int/pub/mirror/MARS-EXPRESS/HRSC/MEX-M-HRSC-5-REFDR-DTM-V1.0/DATA/

Dataset format - **GTiff**

Dataset includes

- Images from the High resolution Stereo Camara (HRSC) onboard the MarsExpress spacecraft, released by the HRSC team.
- Supporting documentation confirm to Planetary Data System (PDS) Standards, Version 3.0, Jet Propulsion Laboratory (JPL) document JPL D-7669

Methods used:

1. **gdal_merge algorithm –**

   Used to mosaic set of images. This requires all the images to be equal coordinate system, data types and have a corresponding quantity of bands, but they may also overlap with one of a kind of resolutions. The closing picture will be copied over previous ones in overlap regions.

   -of <format> - output format in this project is GTiff.

   -ot <type> - Data type used is Byte.

2. **gdal_pansharpen algorithm –**

   Pan-sharpening is fusion of colour data set

   Performs pansharpen operation described by output dataset(GTiff or VRT).

   This uses different resampling algorithms as

   {nearest,bilinear,cubic (default),cubicspline,lanczos,average}

3. **gdalwrap algorithm –**

   This performs reprojection of image and wraping. There are many resampling methods, and here the default resampling method used i.e. **nearest neighbour resampling** as it is a fastest algorithm.

4. **Contour –**

   This is uses raster elevation model to build vector contour line and uses following parameters.

   - Input layer – raster layer
   - Interval between line - interval between the contour lines in the given units of the elevation raster. Here unit used is meters and Default value is 10.0. In this project used is 20.0.

3. HRSC Data visualization –

1. Export RGB

HRSC Level4 data in all available colour bands (R, G, B, RGB) have equal aspect ratio.

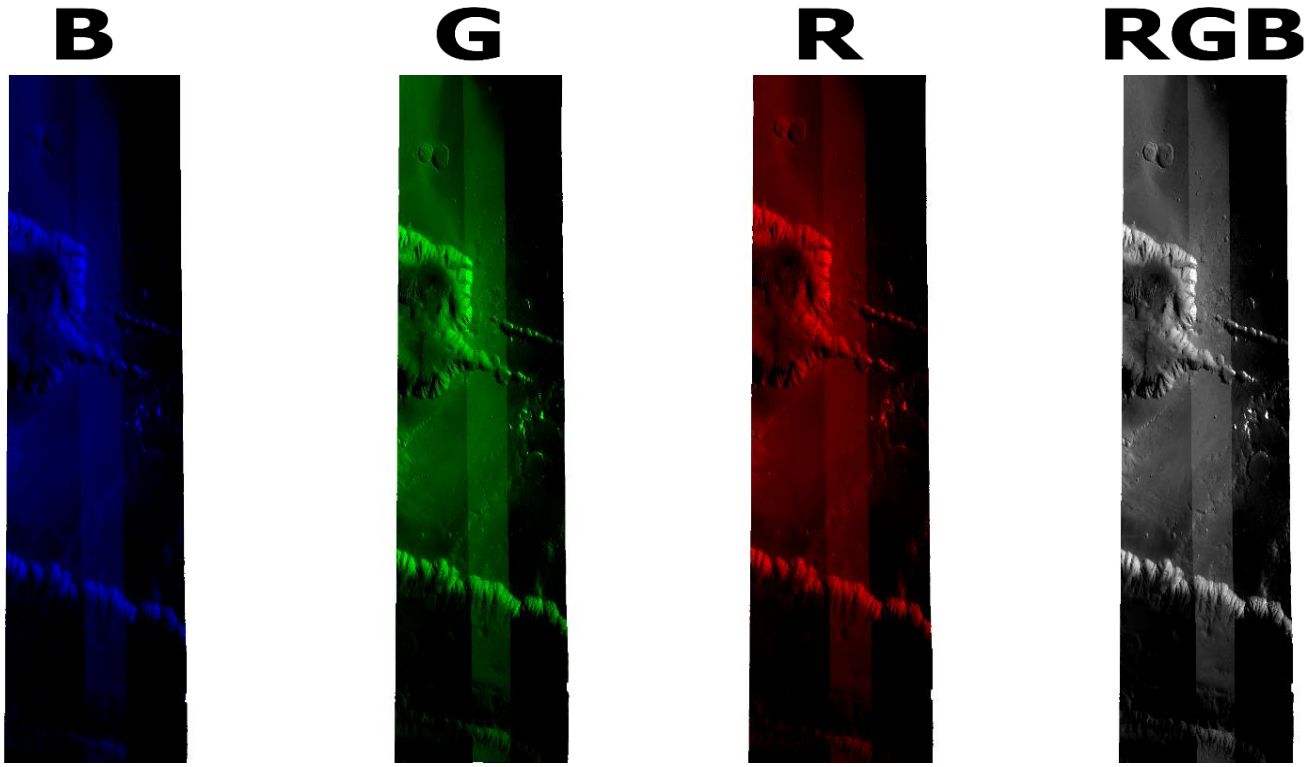


Figure 1: Export RGB

2. Creating contour –

Contours: contour map with black elevation lines.

Interval between every contour elevation line is by default 10.0 meters, here used is 20.0 meters like below exported images:

Contour

Figure 2: Contour

Zoom in - to describe land

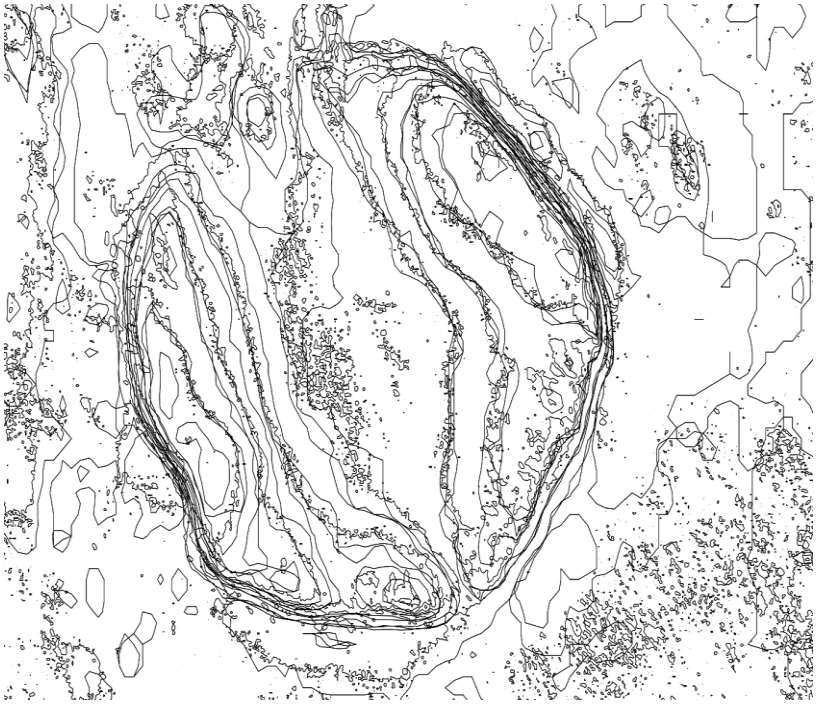


Figure 3: Contour land description

Contour with customized colouring

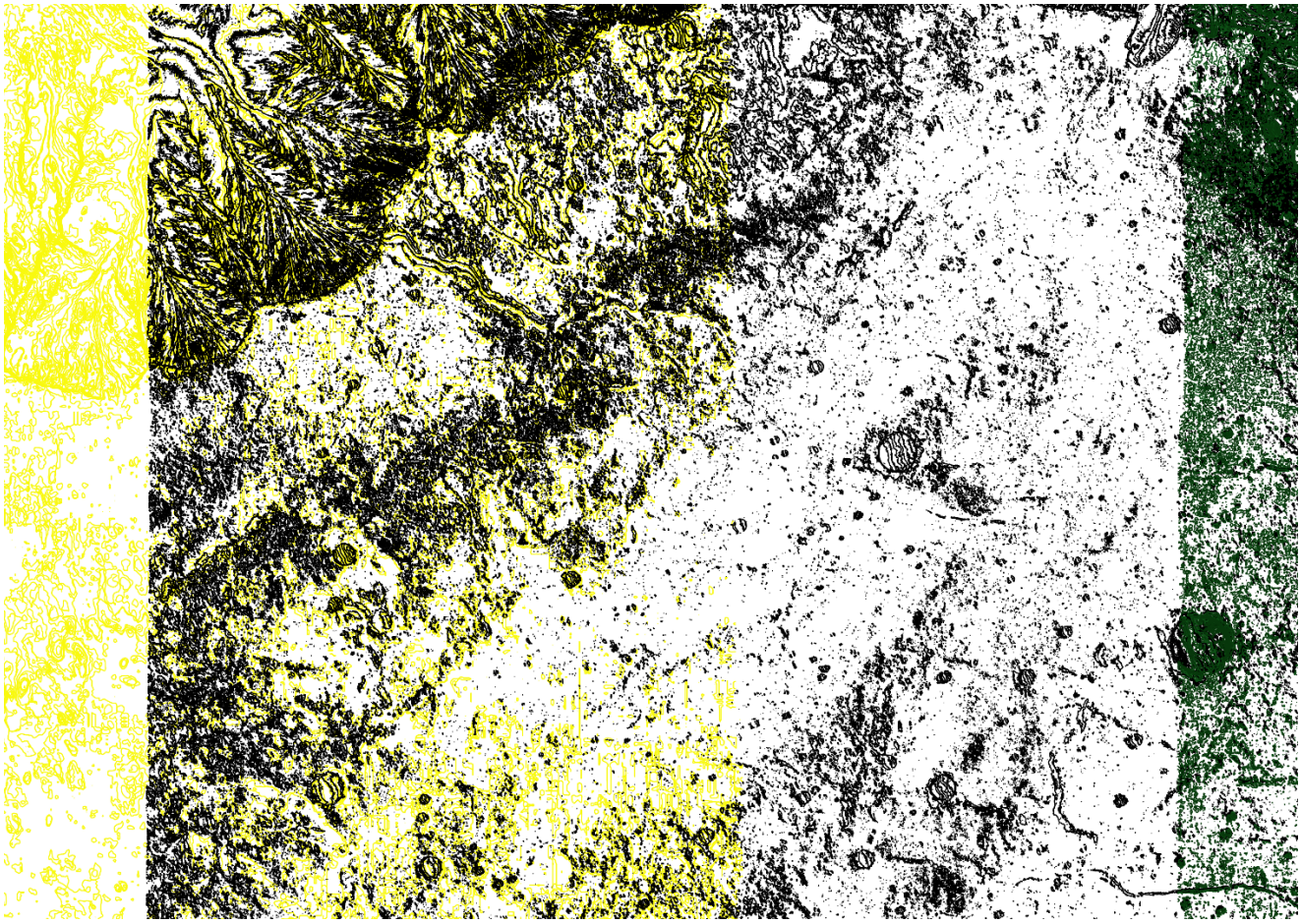


Figure 4: Customized colour contour

3. HRSC Mosaicking

Mosaic RGB

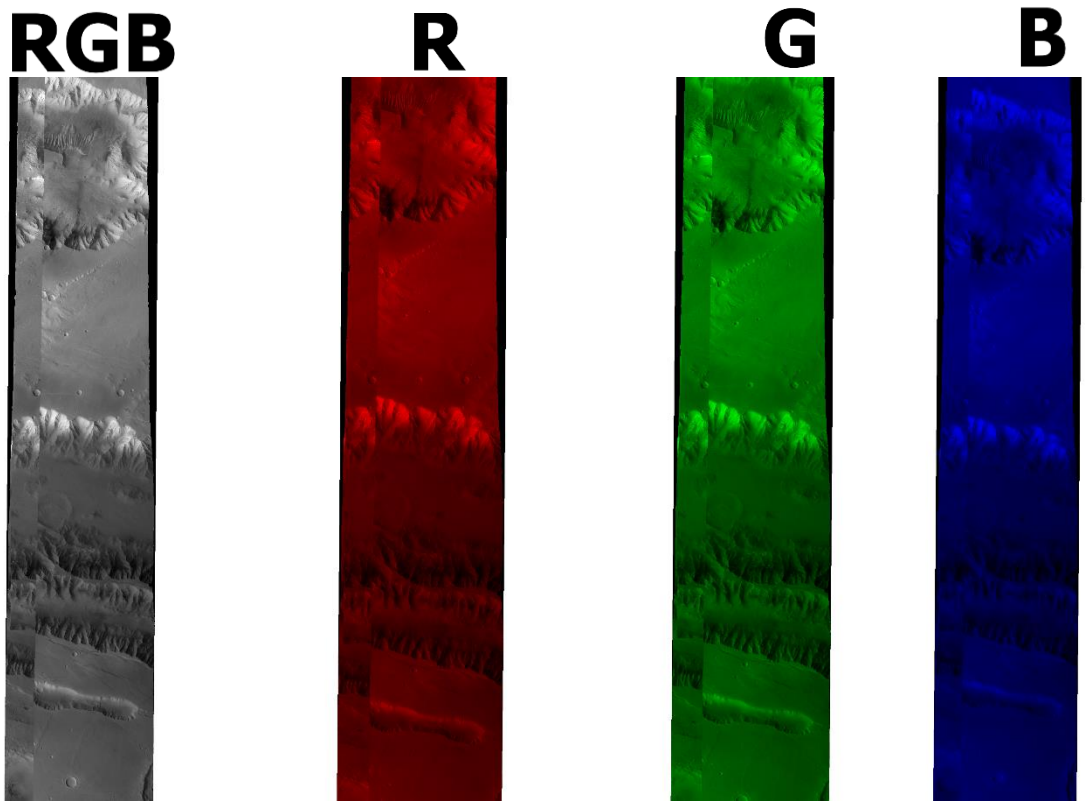


Figure 5: Mosaic RGB

4. RGB - Pan-sharpening

Pan-sharpened images from Nadir and RGB Pan-sharpening Algorithm

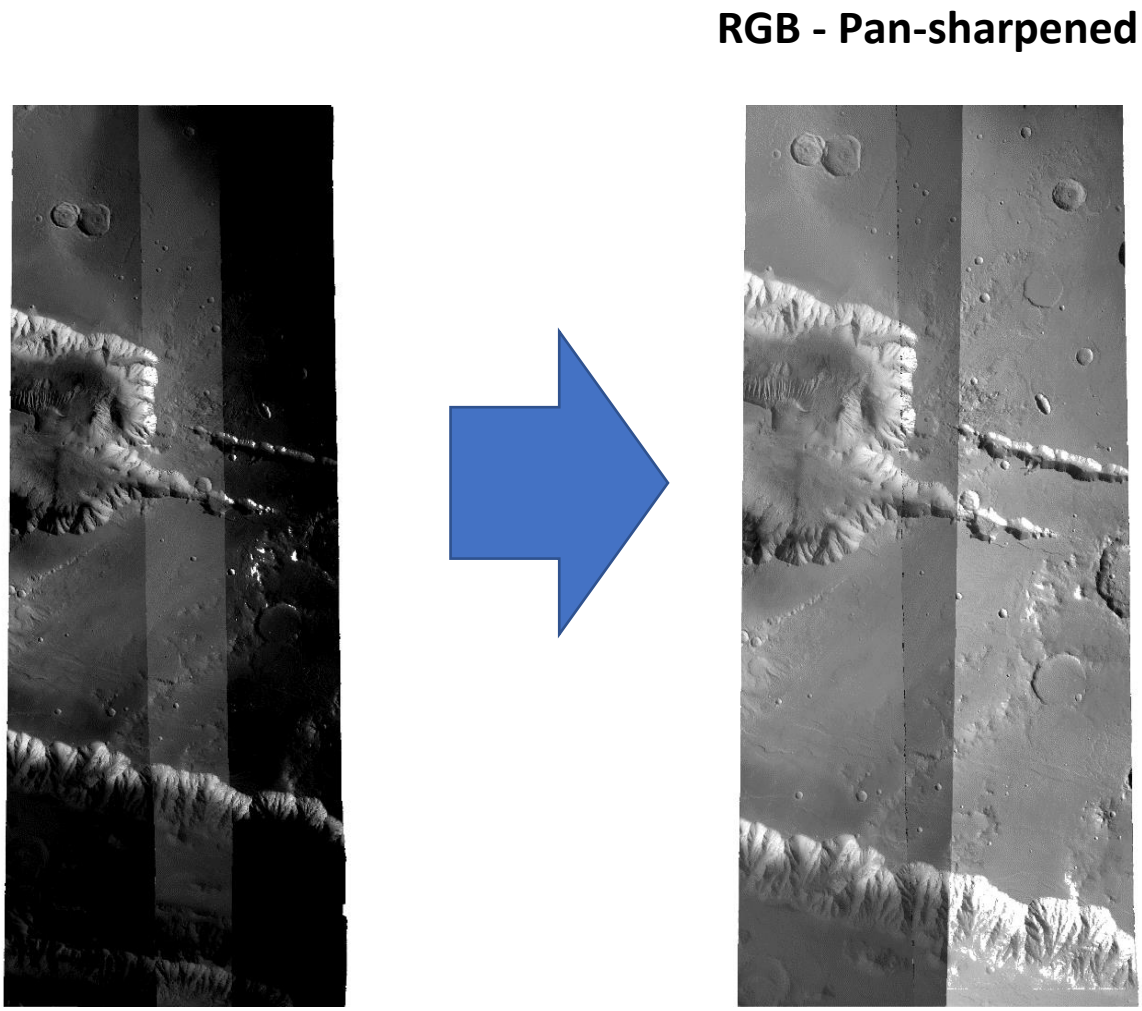


Figure 6: RGB Pan-sharp

5. Reprojection

This performs reprojection of image and wraping of layers of equal data type and bands.

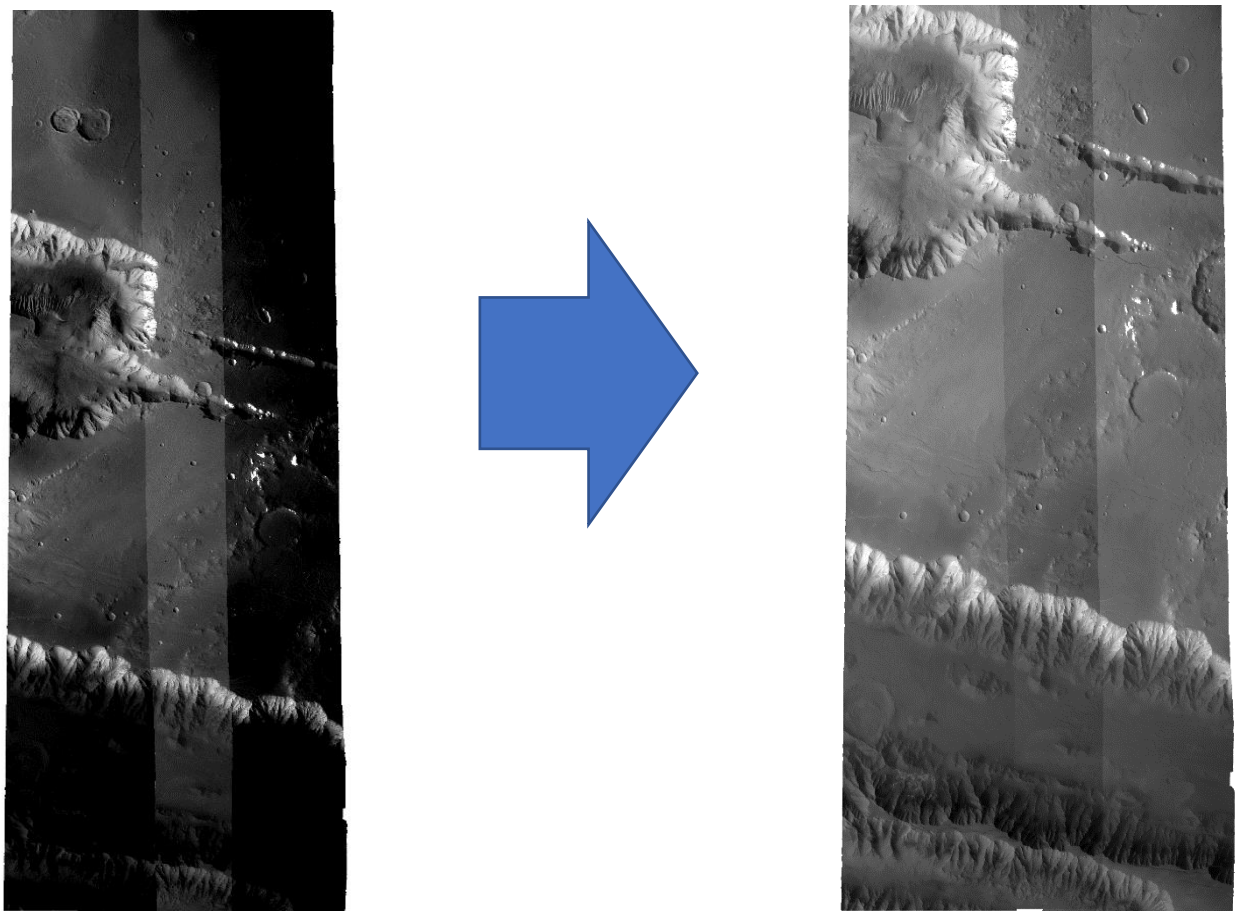


Figure 7: Reprojection

4. Result and Discussion –

As a result of this work done performed in QGIS

- Export RGB
- RGB Pan-sharp algorithm
- Contour algorithm
- RGB Mosaic
- Reprojection

II. Earth System Data –

Agricultural crop production analysis in Indian regions.

1. Topic Description

   Agricultural crop production analysis in Indian regions.

   Indian farmers had found and started cultivating many spices and sugarcane about 2500 years ago. Between the sixth and fourth centuries BC, it used to be in India that the Persians, accompanied by the Greeks, were locating the famous "breeds producing honey besides bees" being grown, called sugar. Structural changes are under way in India's agricultural economy. The share of GDP in agriculture dropped from 43 per cent to 16 per cent between 1970 and 2011. This is not due to a diminished agricultural value or a result of the agricultural policy. This is largely due to India's rapid growth in employment, industrial output, and non-agricultural sectors between 2000 and 2010. This paper finds analysis on the data of agriculture crop production in Indian regions

   Tool used – Python Jupyter

2. Data and Methods used

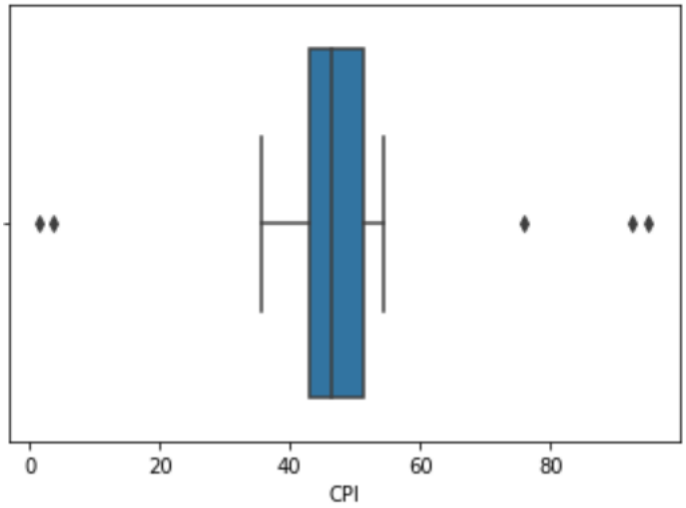
   - Dataset format – csv
   - Data analysis done in python
   - Tools used - Numpy, Pandas, matplot.

   Problem statement – Analysis of Crop Production Index (CPI) in last few years in Indian regions.

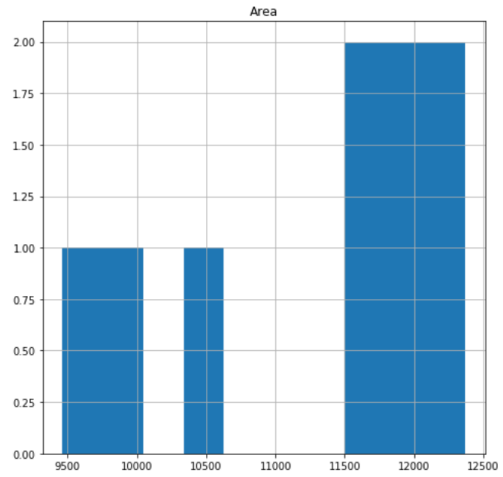
   - Area wise and production wise variation analysis.
   - Grouping with average area and production year wise
   - Crop Production Index (CPI) – Calculations
   - Removing outliers – boxplot plotting.
   - Histogram plotting – Area, CPI, Crop_Year, Production.

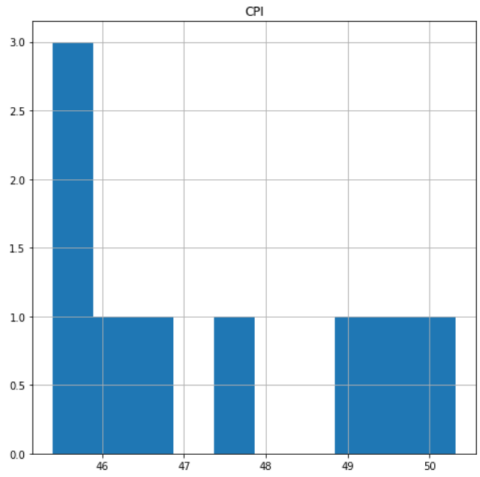
3. Implementation in Python Jupyter – Data analysis
   Supporting python file is given at piggy

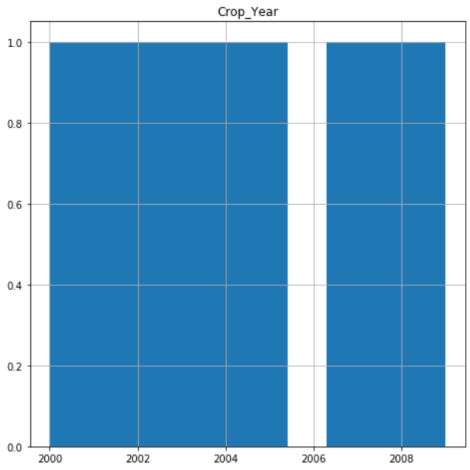
Boxplot - plotting to remove the outliers.
The range is 43 to 51-- remaining data are outliers

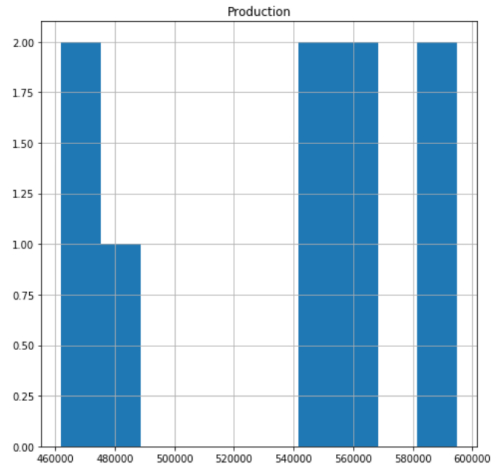


Histogram plotting –

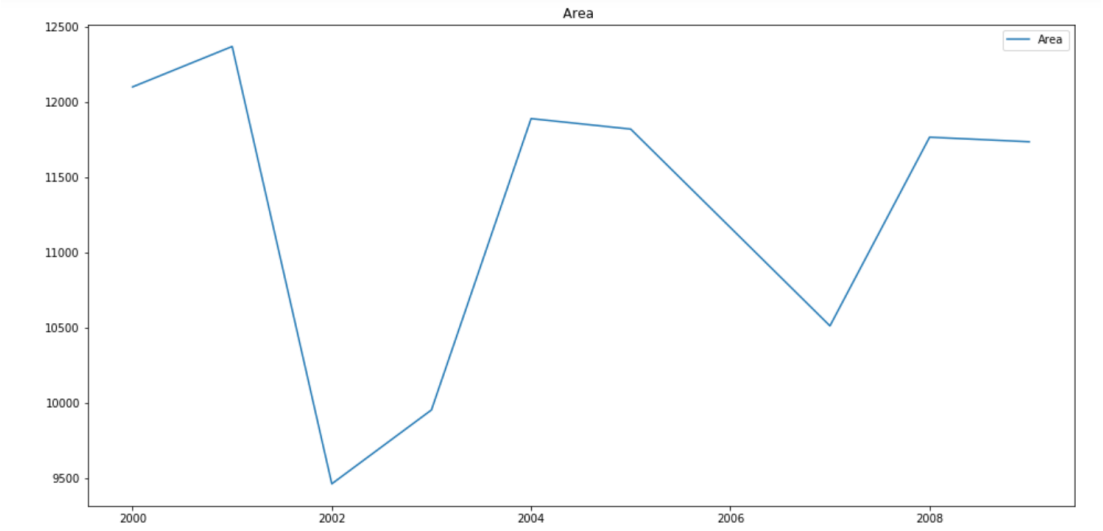




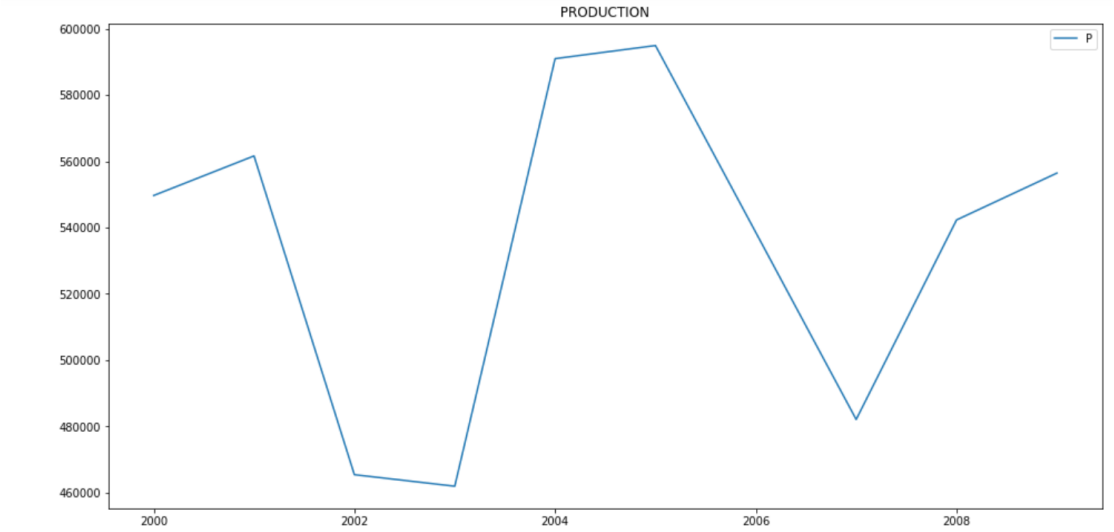




Analysis of variation in Area



Analysis of Variation in Production



4. Results and Discussion

As a result of this work done performed in Python-Jupyter

- Area wise and production wise variation analysis.
- Grouping with average area and production year wise.
- Crop Production Index (CPI) – Calculations.
- Removing outliers – boxplot plotting.
- Histogram plotting – Area, CPI, Crop_Year, Production.

III. Conclusion

The result of this work done is that utilized Geo-Information System to improve data visualization. The digital computer would enhance every ingestion performance and data delivery and software program resources that can be accessed remotely allowing users to search, view and modify statistics stored in shared databases of information.
The use of the Geographic Information System (GIS) is for recording, processing, editing, analyzing, handling and displaying spatial or geographical data. GIS applications are tools that allow users to create interactive queries, analyze spatial information, edit map data and present the results of all of these operations. GIS involves various technologies, procedures, techniques and methods. It has many applications like infrastructure, planning, management, transportation / logistics, insurance, telecommunications, and business.

IV. Outlook

Organization of archives planetary science data it has always been my curiosity while being a Data engineer and obviously if I got an opportunity, I would not let this chance go. I started working on study of Geo-Information System under very great guidance of Prof. Vikram Unnithan. It was really a brief but great experience working on this topic under GIS module in data engineering. As far as this field is concerned, I would love to be working on data analysis in Planetary science data under the guidance of Respected Prof. Vikram Unnithan.

V. References:

[1] https://en.wikipedia.org/wiki/Valles_Marineris
[2] ftp://psa.esac.esa.int/pub/mirror/MARS-EXPRESS/HRSC/MEX-M-HRSC-5-REFDR-DTM-V1.0/
[3] https://www.nasa.gov/multimedia/imagegallery/image_feature_83.html
[4] https://en.wikipedia.org/wiki/Agriculture_in_India
[5] https://data.gov.in/dataset-group-name/crop-production-statistics