

EO Image Processing Techniques

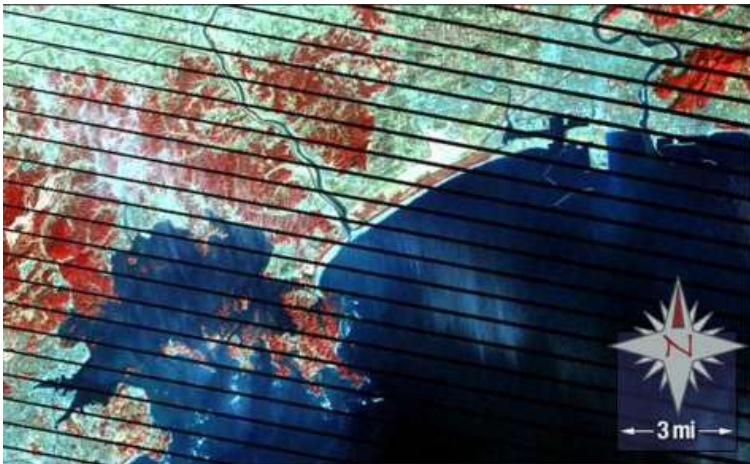
Aratos Technologies S.A.

Introduction

- There are many ways of processing raw satellite images.
- Some of the used techniques are:
 - Line replacement
 - RGB composites
 - Orthorectification of imagery
 - Coordinate system
 - Ground controls
 - Create model
 - Digital Elevation Models

Line Replacement

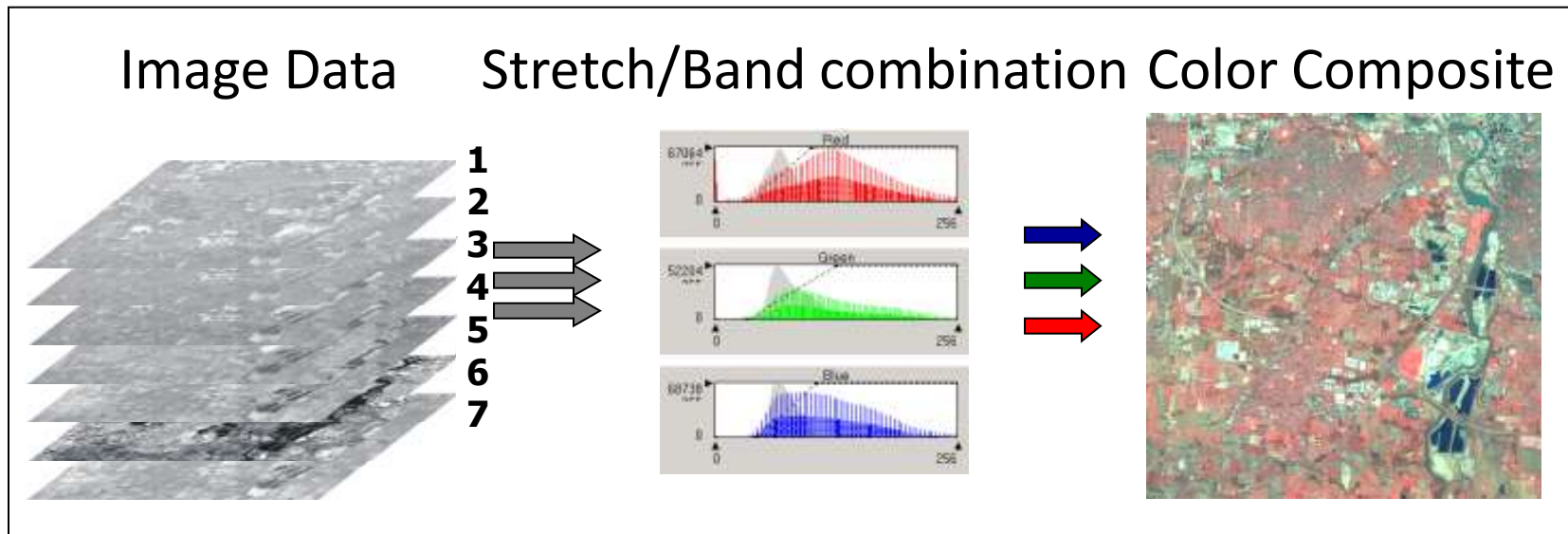
- Missing lines are "repaired," and other problems are resolved in each band
- Image line replacement is a simple procedure that allows the operator to fill-in missing lines with the line above, below, or with an average of the two.



Example of satellite image with missing lines

RGB composites (1)

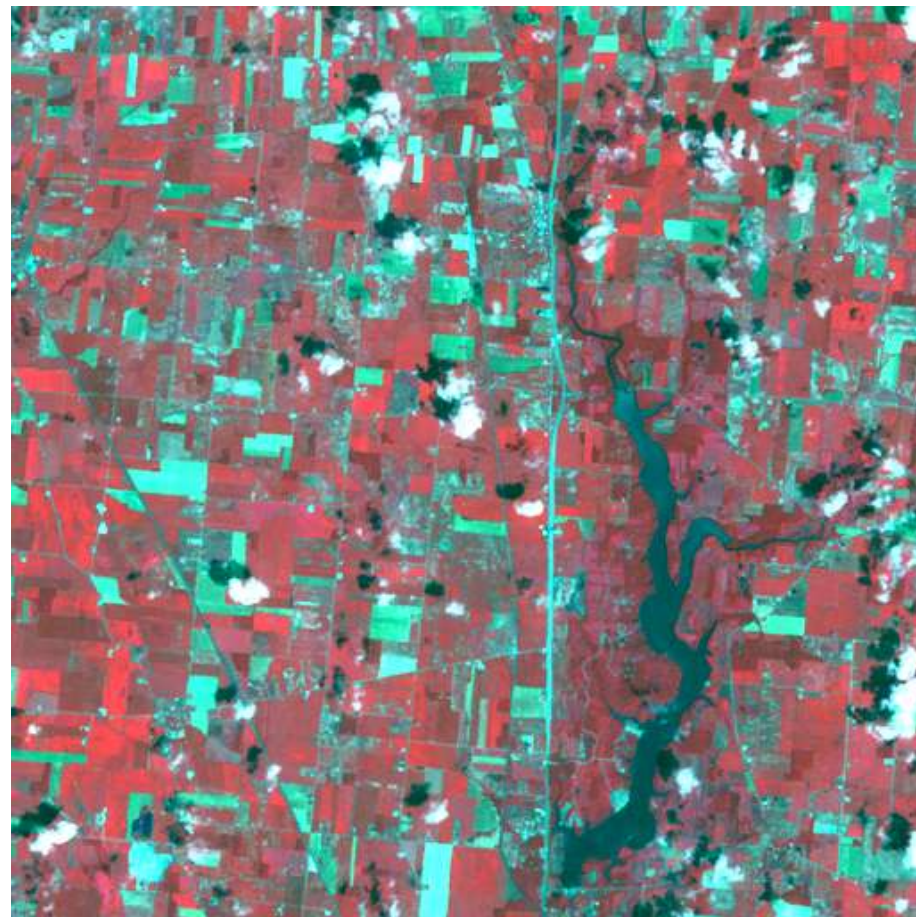
- The various bands are combined in order to create the RGB composites



RGB composites (2)

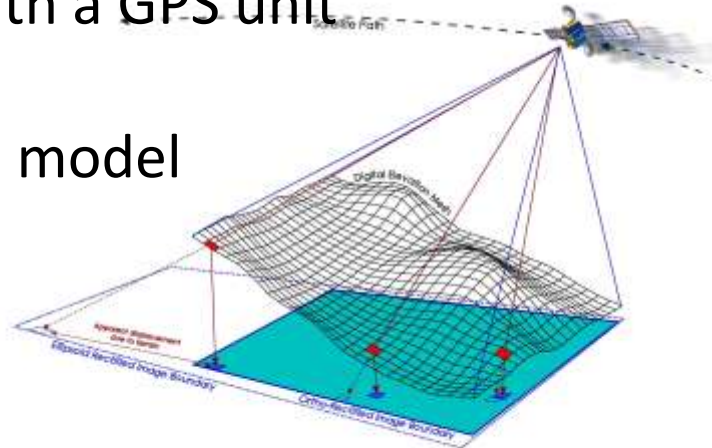


Natural color composite of a Landsat-7 Image
3,2,1 (bands combination)



False color composite of a Landsat-7 image
4,3,2 (bands combination)

Orthorectification of imagery

- Identification of ground control within the imagery
 - Collection of ground control points with a GPS unit
 - Development of a rectification model
 - Reprojection of the imagery using the model
 - Two accuracy checks
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- Three terms are defined:
 - **Rectification** fixes each feature in the imagery to the correct position on the earth
 - **Reprojection** involves transforming and rectifying the image to a standard projection such as Universal Transverse Mercator (UTM)
 - **Registration** involves having features in multiple scenes exactly match each other in location

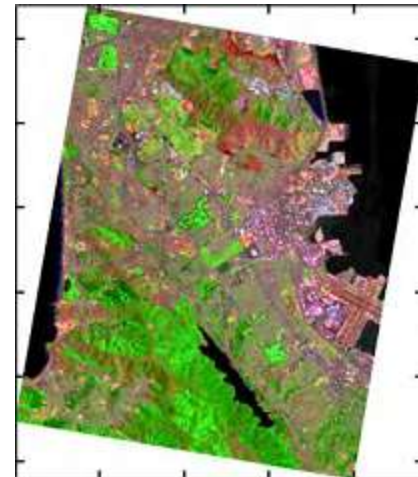
Satellite image rectification

- The goal of image rectification is to facilitate the overlay of additional imagery and other geographic data sets.
- A standard map area, with boundaries set in UTM, is established for each scene, thus all image files for the same region, once rectified, will occupy the same map area.
- The UTM bounds for the scene are established according to the file size and the minimum/maximum northing and easting required to contain the full scene area.



Left: RGB display of input raster set

Right: Output raster set (warped and reoriented to the UTM coordinate system)



Geometric Rectification (1)

- Geometric rectification of the imagery resamples or changes the pixel grid to fit that of a map projection or another reference image.
- This becomes especially important when scene to scene comparisons of individual pixels in applications such as change detection are being sought.

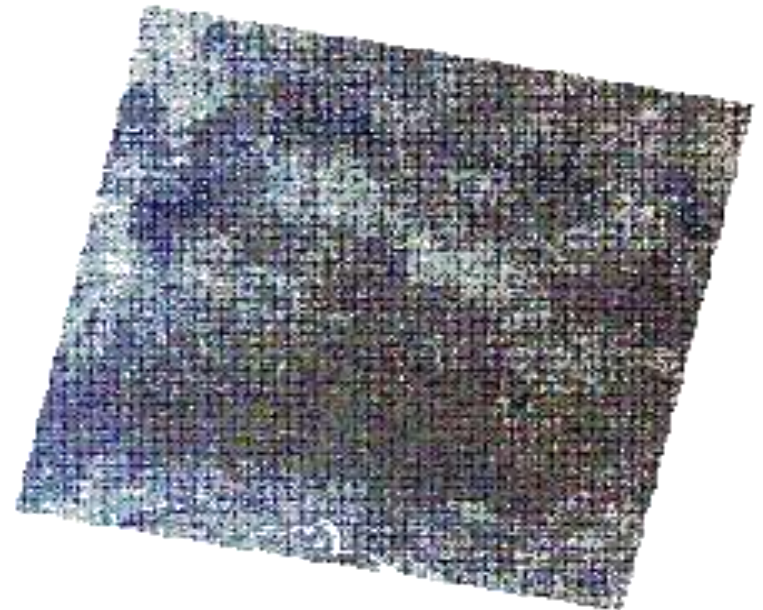
Geometric Rectification

Rectification of Landsat Thematic Mapper Imagery
Path/Row: 25/35, Image Date: September 18, 1984.



Raw Landsat Imagery

Figure by Author.



Rectified Imagery: Registered to UTM Zone 16, NAD 27
Utilizing the Nearest Neighbor Resampling Algorithm.

Digital Elevation Models

- Digital Surface Model represents the earth's surface and includes all objects on it
- Obtain elevation data with various techniques



A three dimensional perspective view created from an ASTER digital elevation model with a simulated natural color ASTER image

Radiometric Corrections

- Radiometric corrections are made to the raw digital image data to correct for brightness values, of the object on the ground, that have been distorted because of sensor calibration or sensor malfunction problems.
- The distortion of images is caused by the scattering of reflected electromagnetic light energy due to a constantly changing atmosphere. This is one source of sensor calibration error.



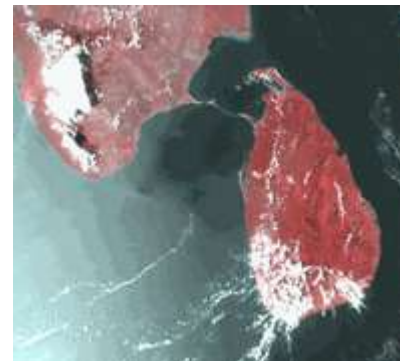
Geometric Corrections

- Geometric corrections are made to correct the inaccuracy between the location coordinates of the picture elements in the image data, and the actual location coordinates on the ground.
- Several types of geometric corrections include system, precision, and terrain corrections.



Left: NOAA image of Sri Lanka and part of India before Geometric Correction

Right: NOAA image of Sri Lanka and part of India after Geometric Correction



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