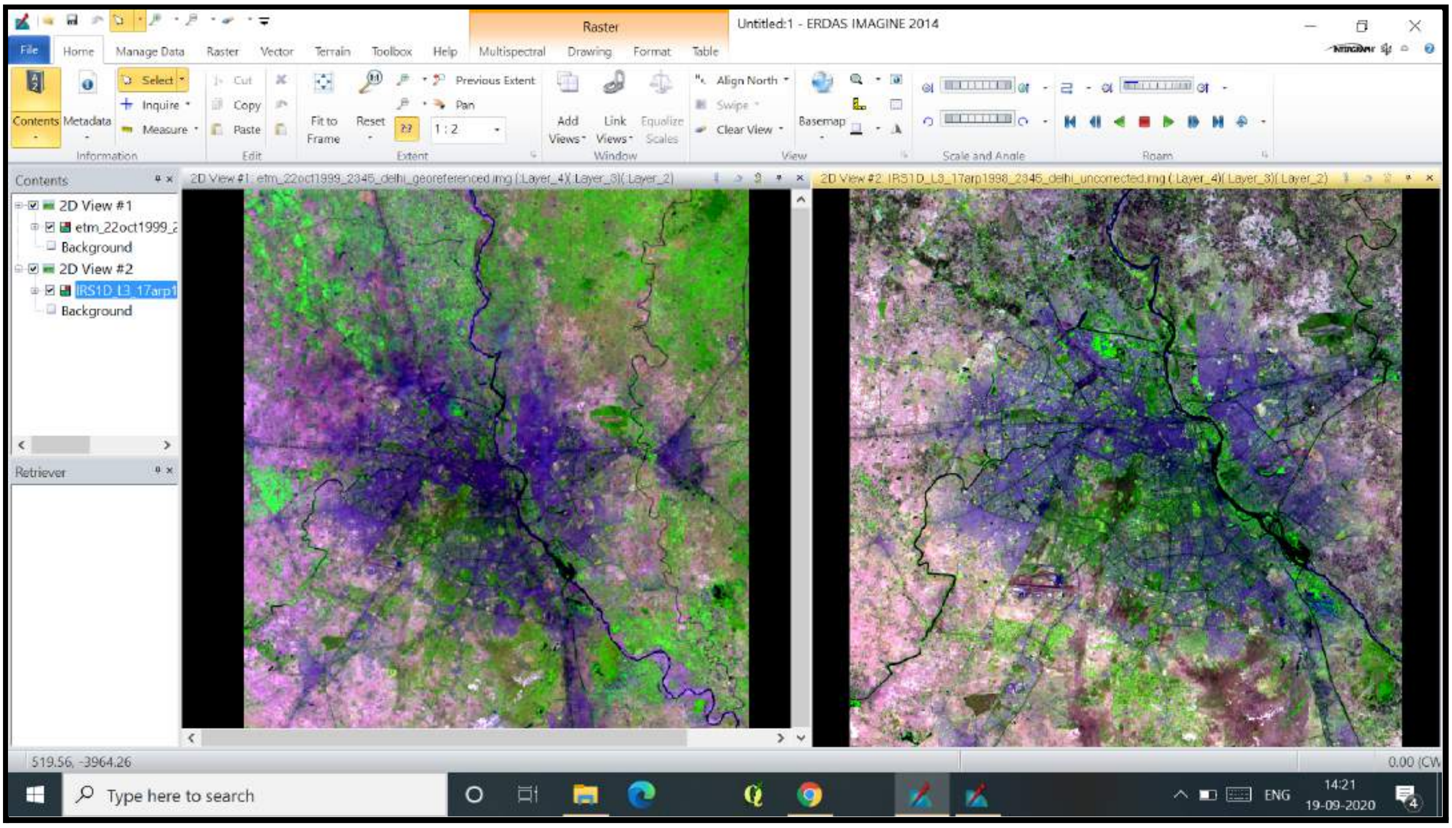
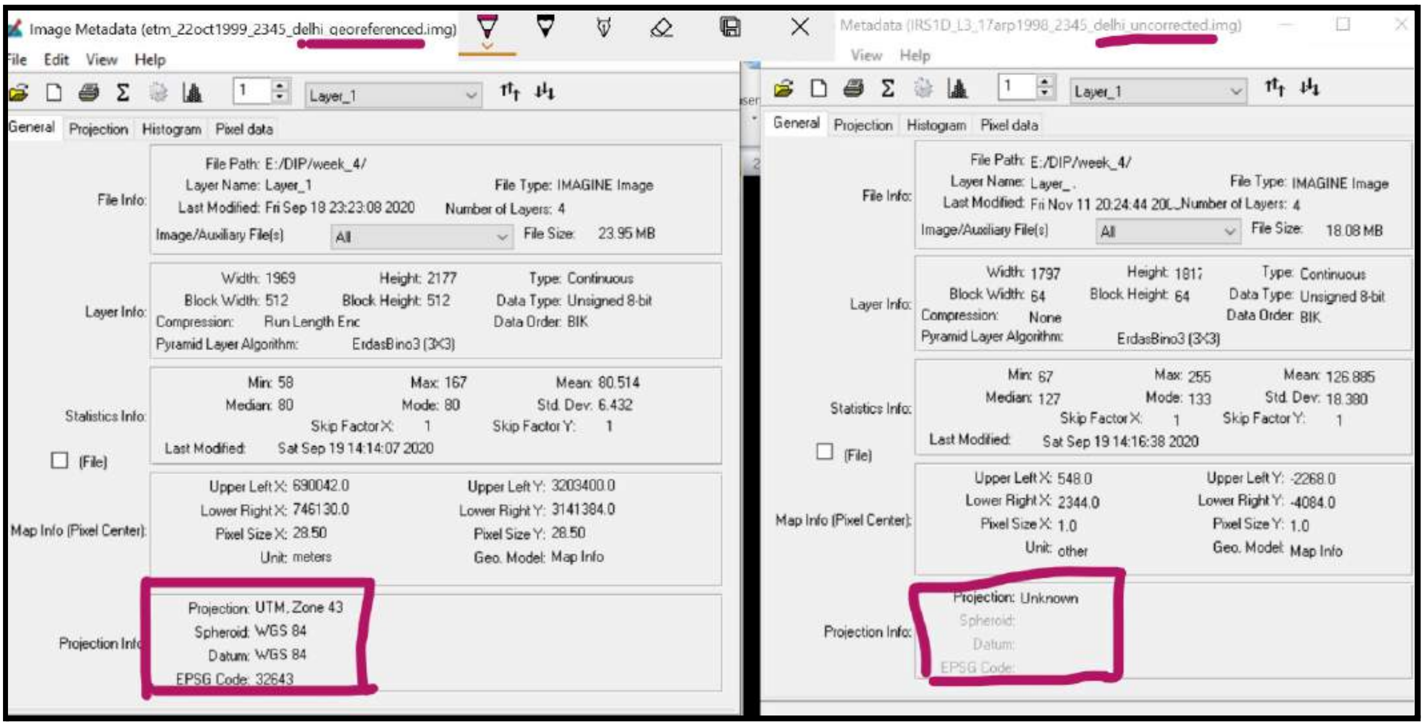
PART-1

IMAGE TO IMAGE REGISTRATION

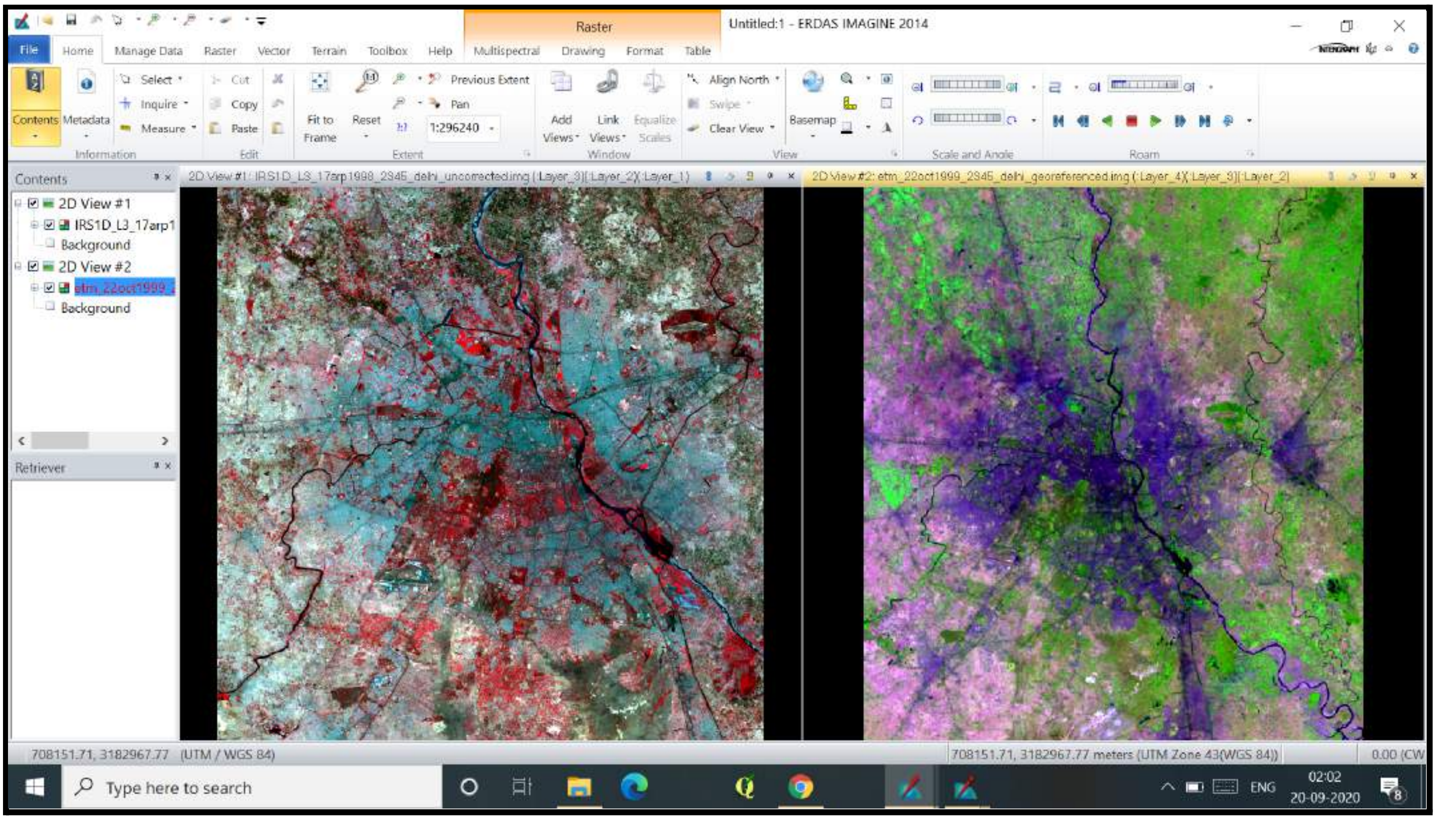
Step-1 Split the window into 2 parts and open both the images- **georeferenced image and image to be georeferenced.**



Can check by placing cursor or from metadata whether the image is georeferenced or not.

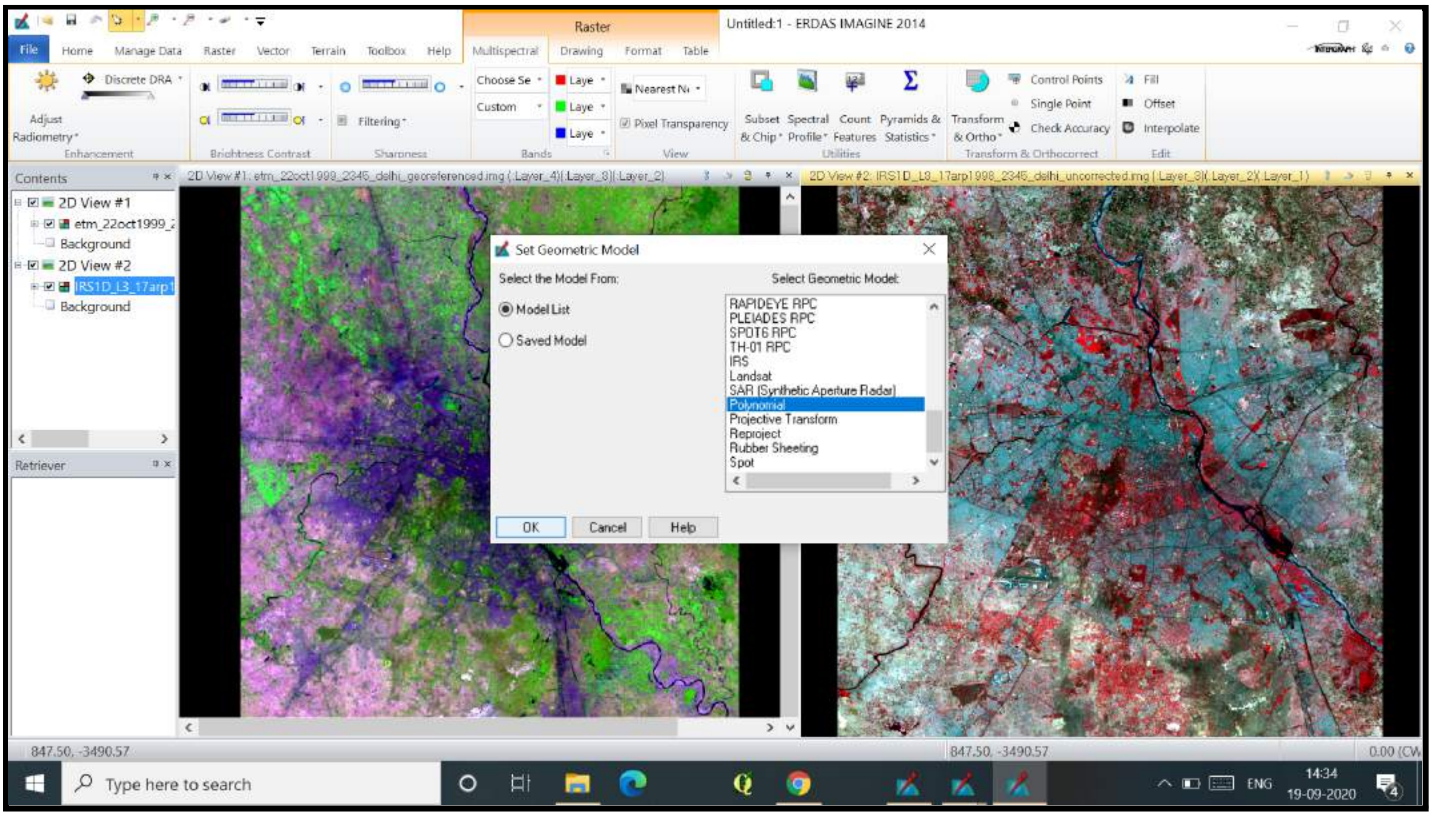


Step-2 Change the band combination to easily differentiate between both the images.

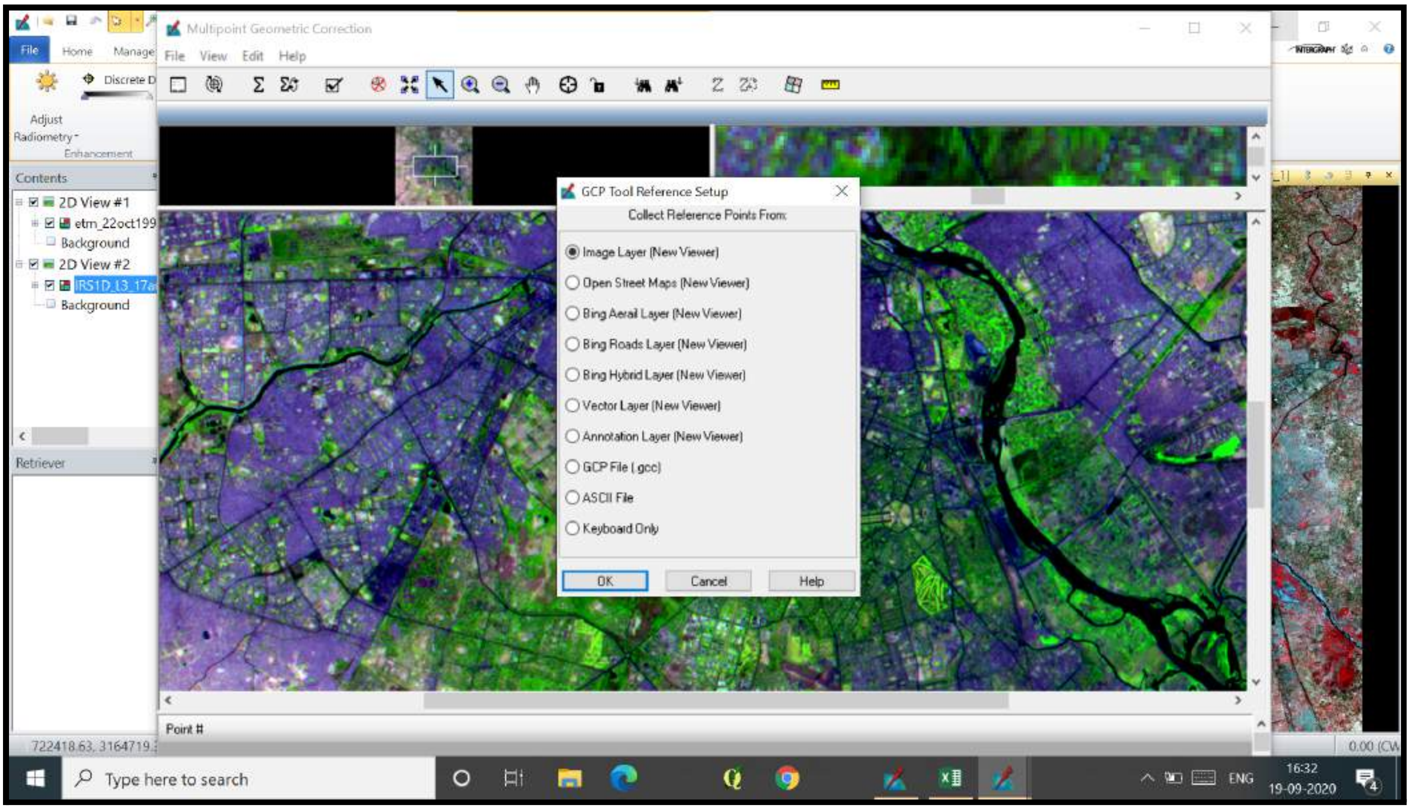


Step-3 **Raster > Multispectral > Control Points.**

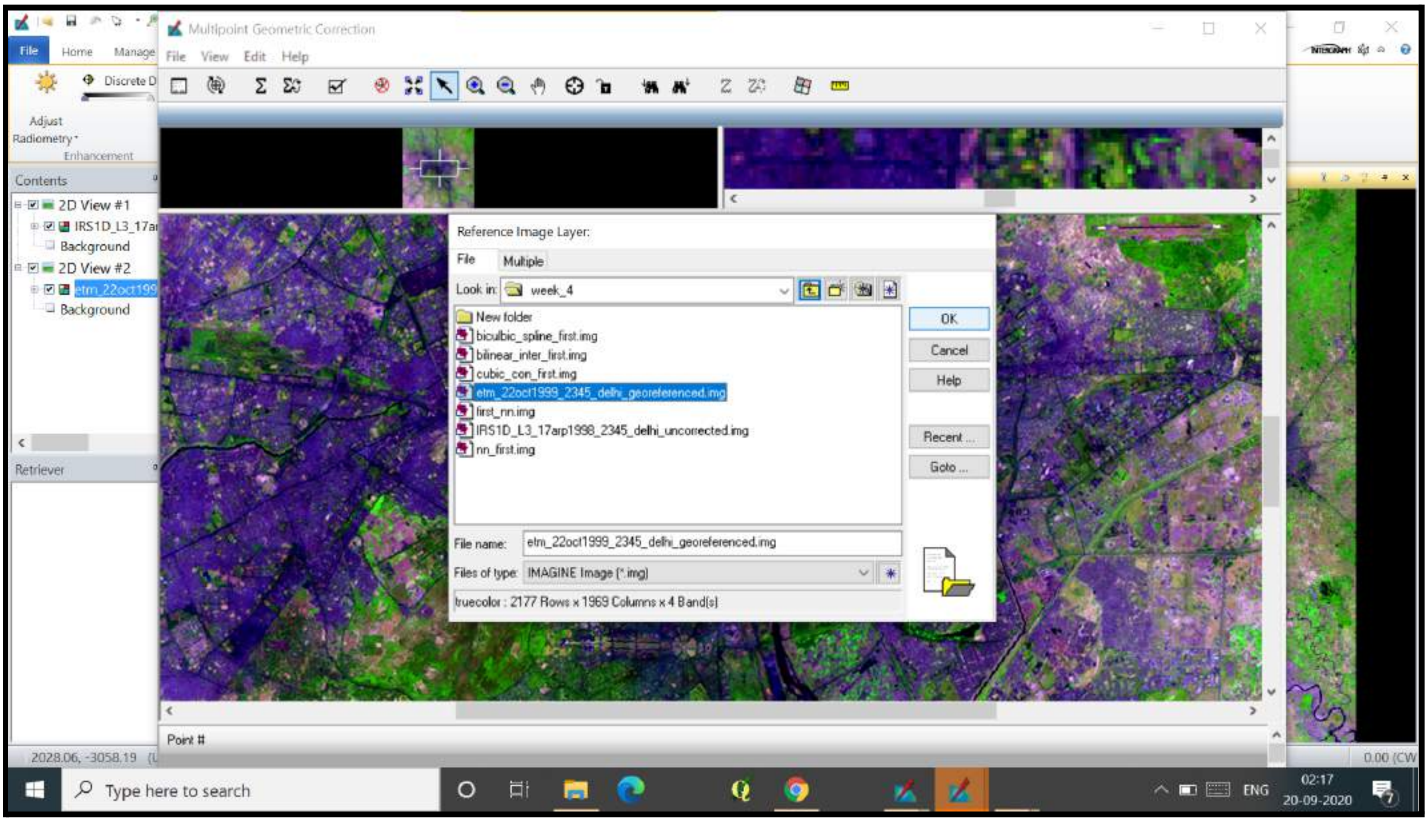
Set Geometric model tab appears. Choose **Polynomial** from select geometric model and then click ok.



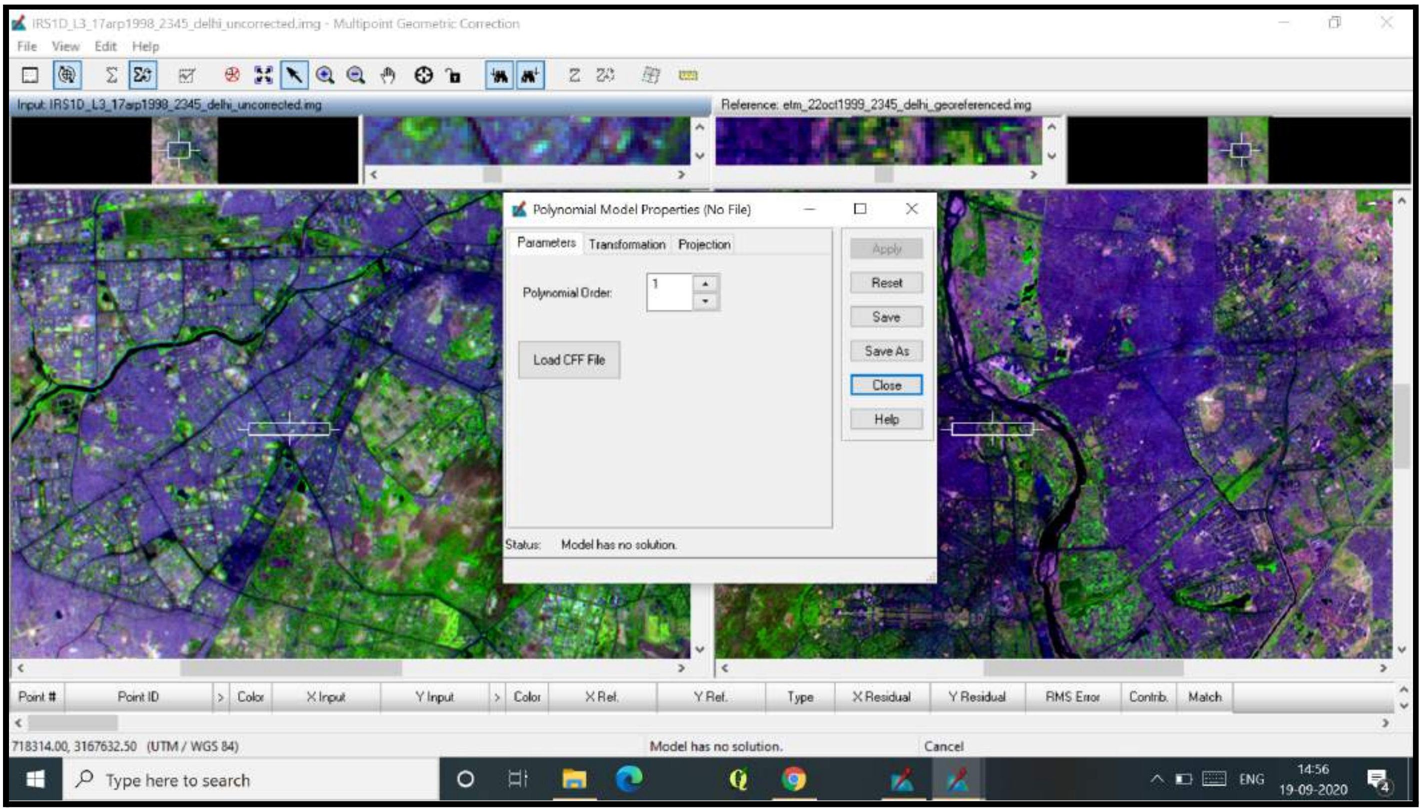
Step-4 GCP Tool Reference Setup tab appears. Choose **Image Layer** and click **OK.**



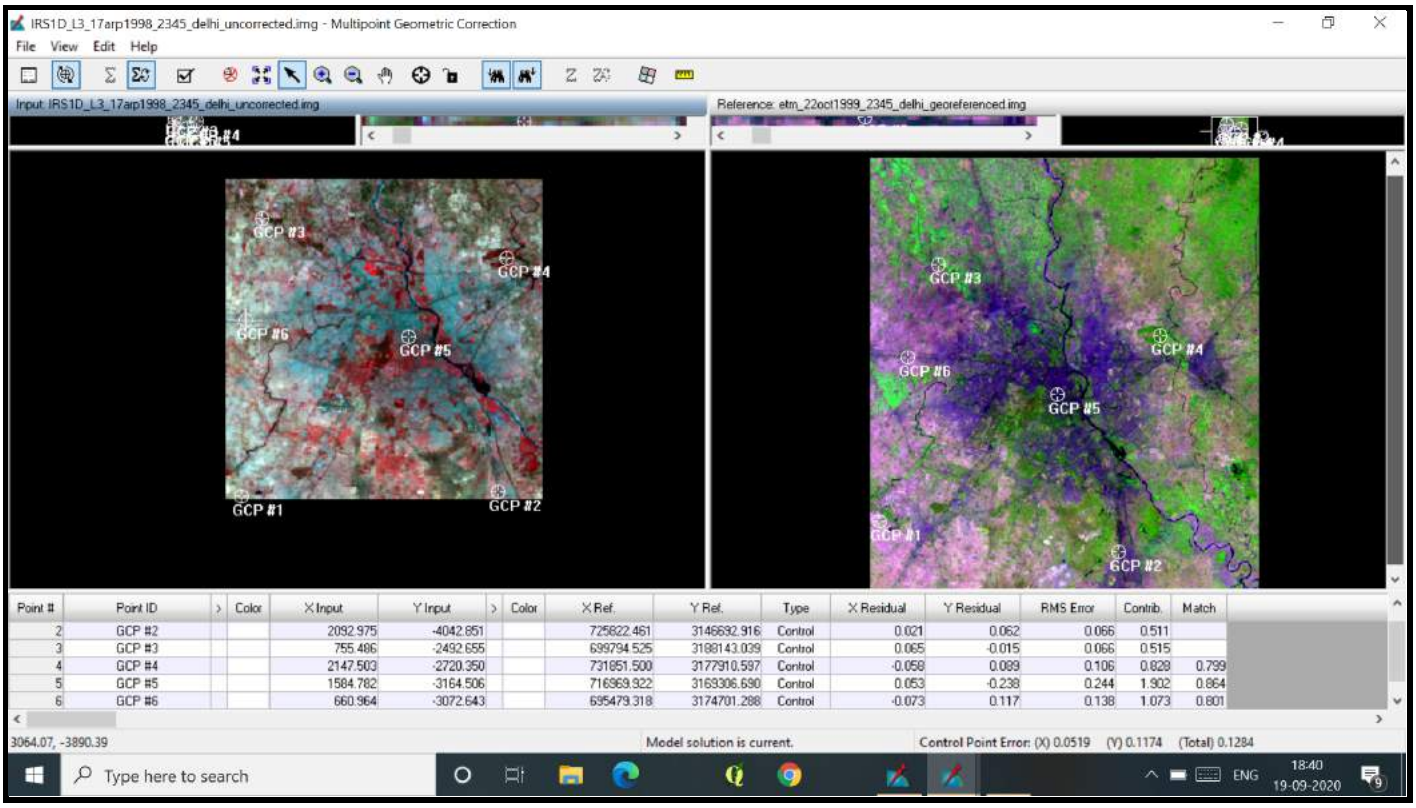
Step-5 Browse the georeferenced image. After browsing the image, the **Reference Map Information** tab opens. Click OK.



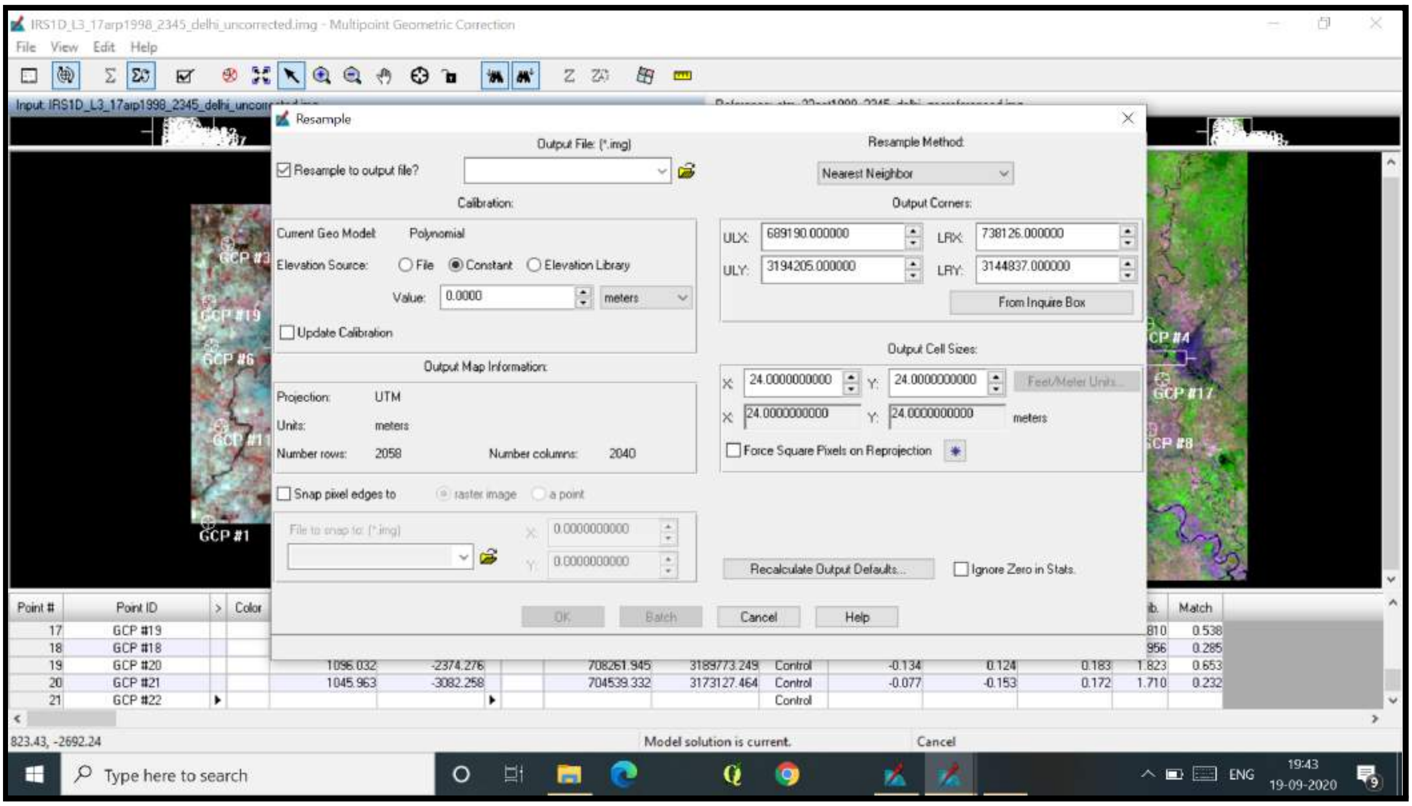
Step-6 **Polynomial Model Properties** tab appears. **Do not close** this tab, just minimize it. Change the band combination of non-georeferenced image to differentiate easily. And start marking the points on the image using the **GCP tool.**



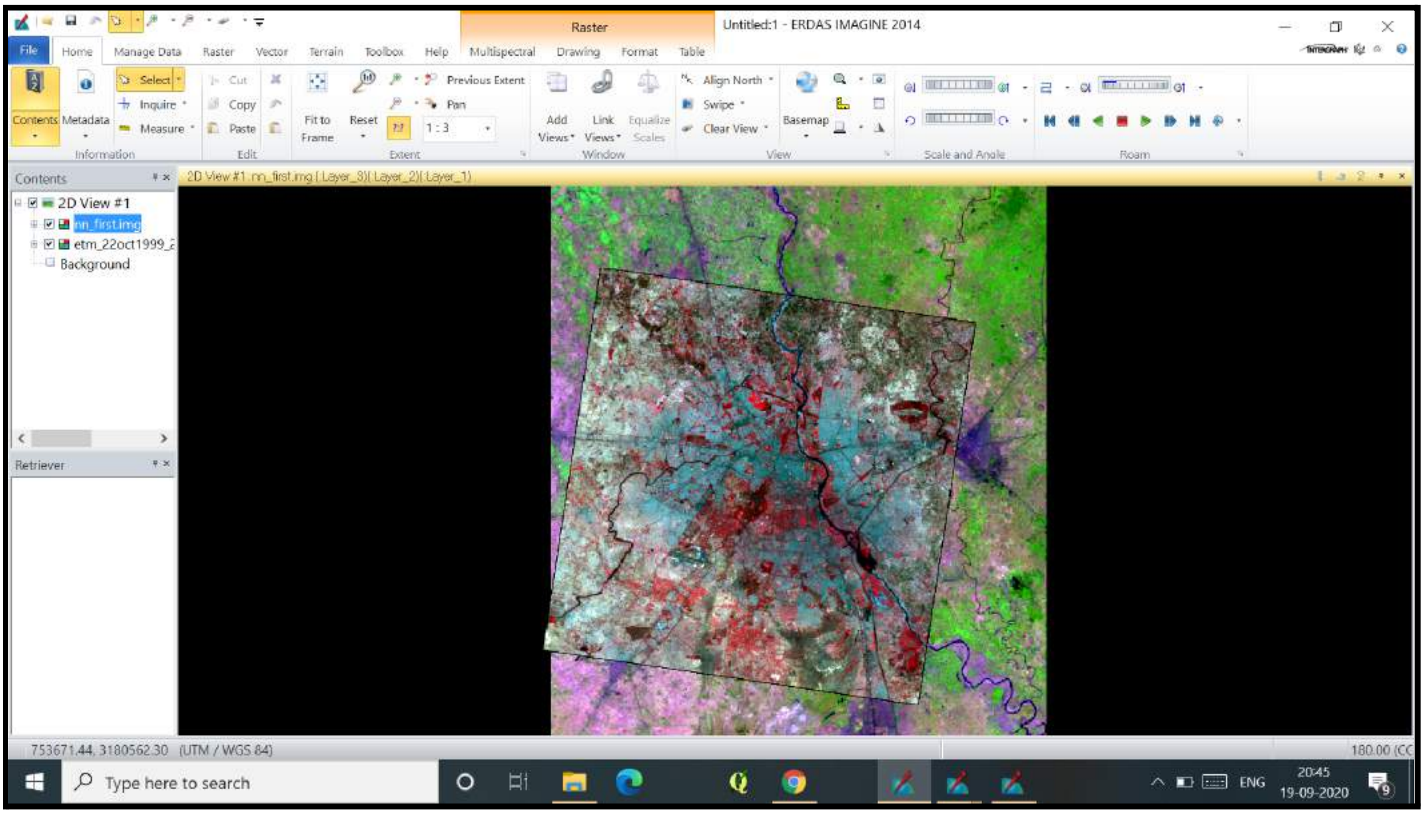
Step-7 Mark the points and click on **Set Automatic Transformation Calculation** and check that **total RMS error** should be **<1.**



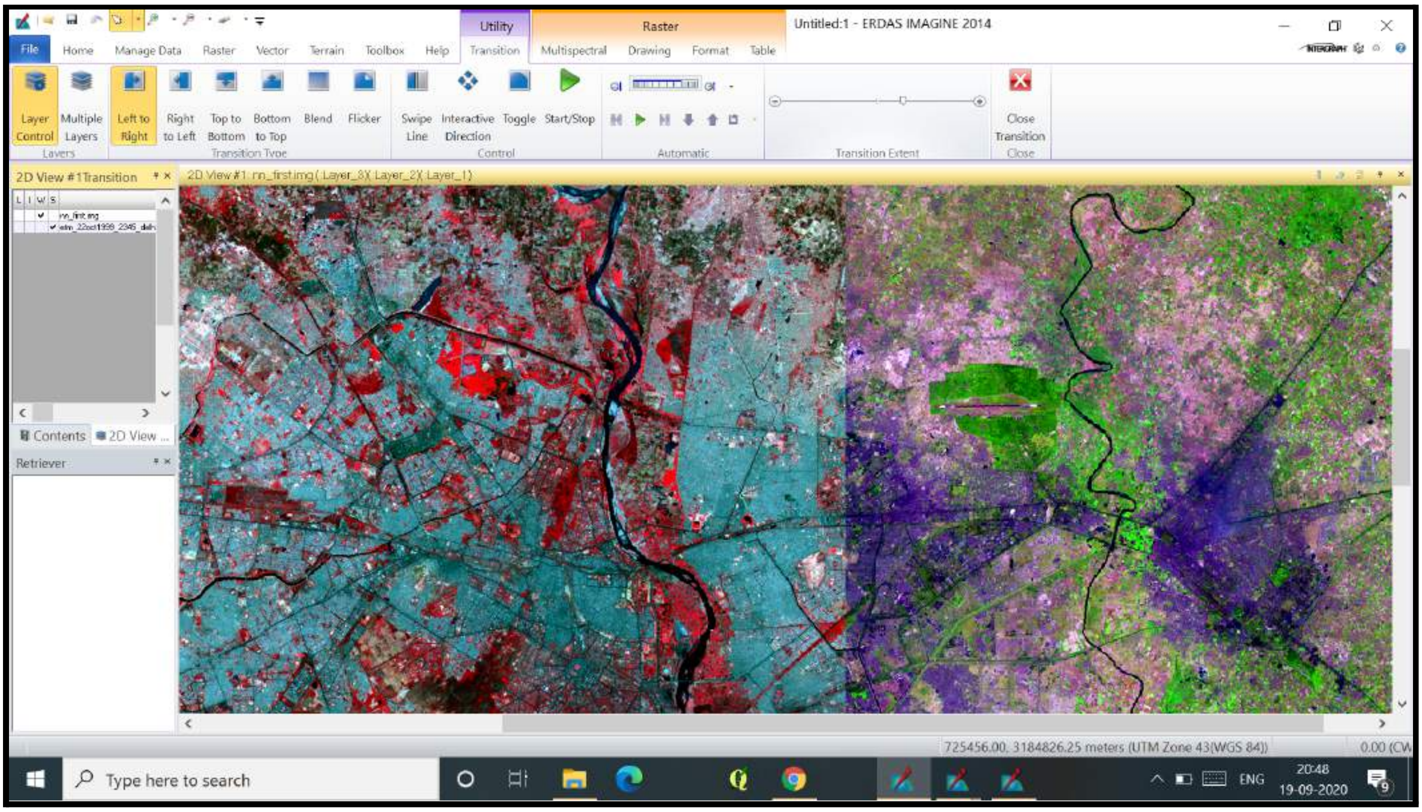
Step-8 Go to **the Resample Tool** to export the output georeferenced image and choose the **resample method.**



Step-9 Open the georeferenced images, they will superimpose.



Step 10- To check the accuracy of georeferencing, go to **Home > SWIPE**



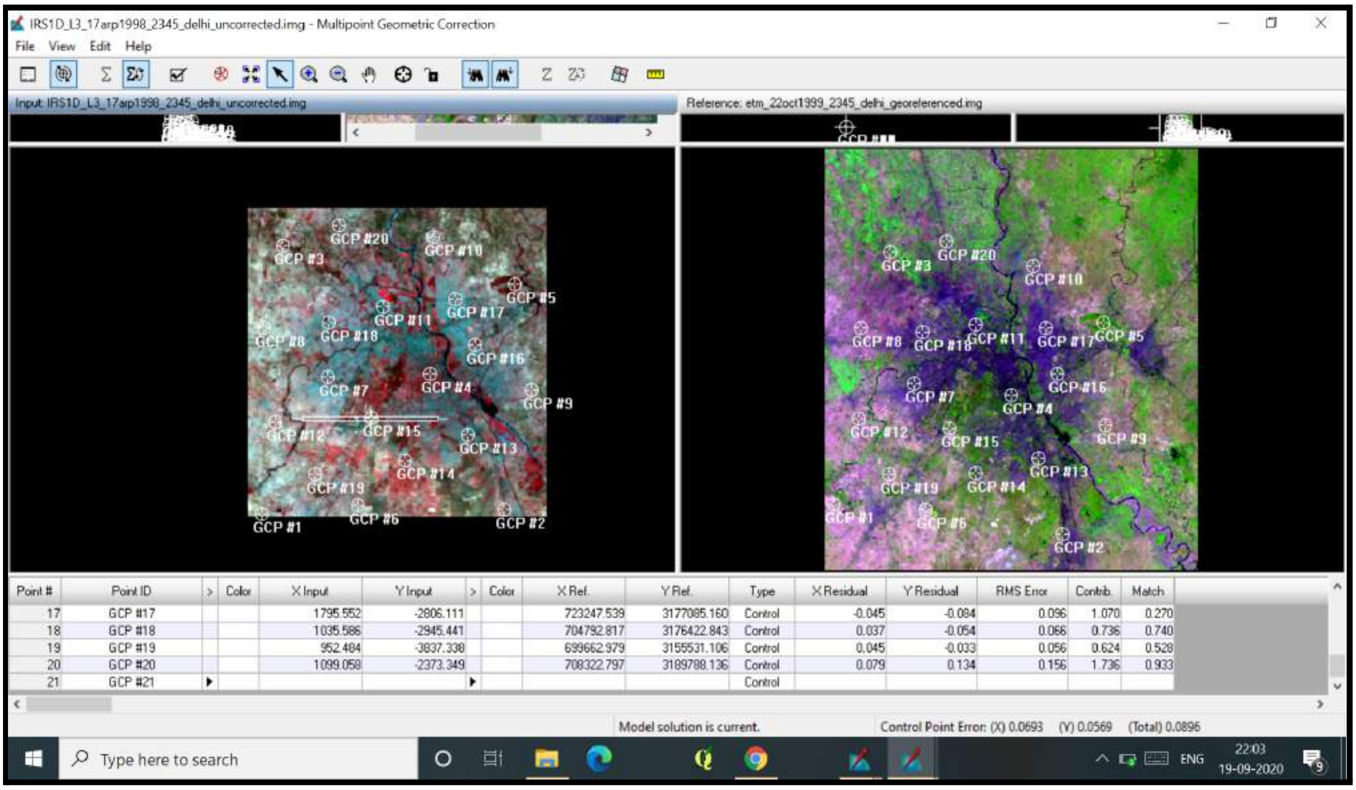
Video checking georeferenced image and its fit

[Untitled_1 - ERDAS IMAGINE 2014 2020-09-21 04-14-12.mp4]

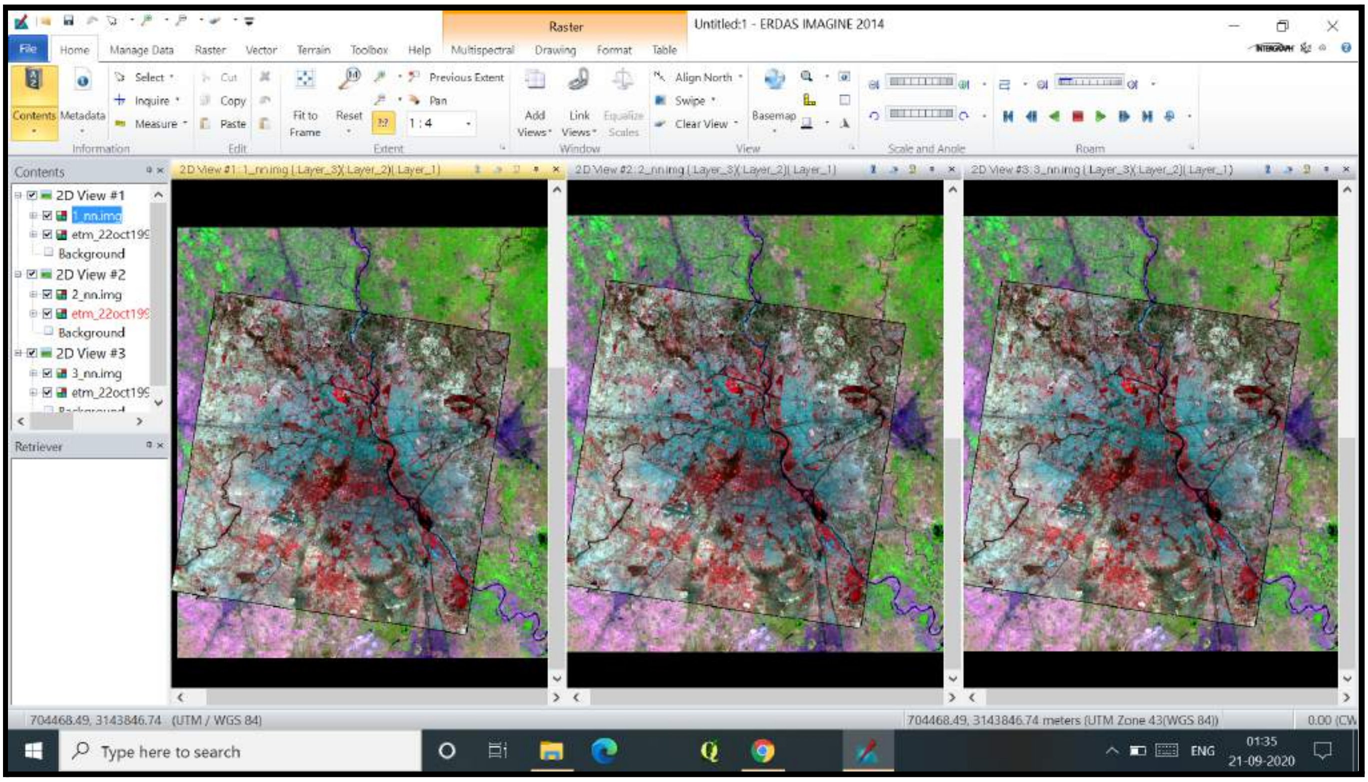
PART-2A

***Display output using** 1st, 2nd and 3rd order polynomials with minimum 20 randomly distributed GCPs.*

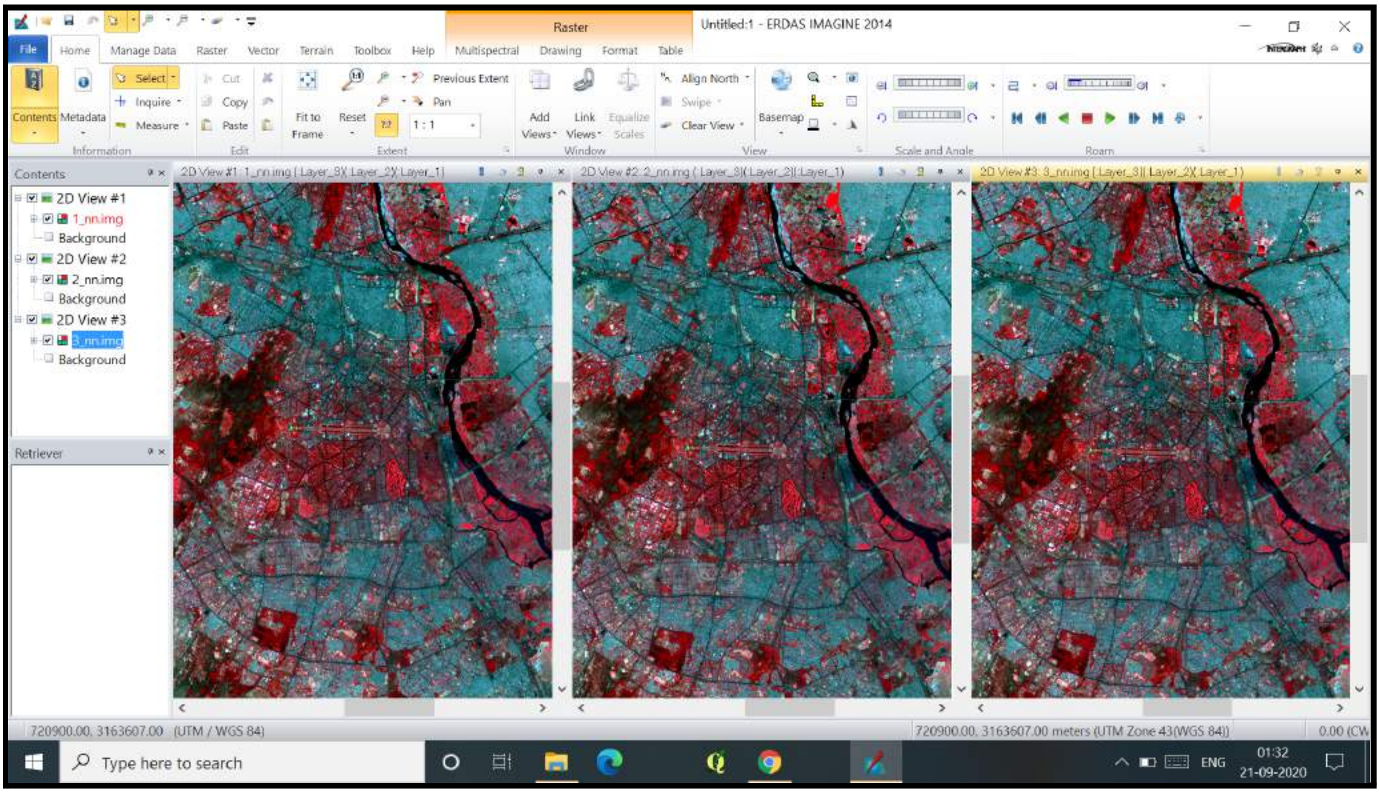
Step-1 Mark all the 20 points on the image and change the order of polynomials in the Polynomial **Model Properties** tab and export them using the Resample Tool. Give the output file name, Choose the **Resample method** and **enable ignore 0 in stats.** And click ok. After computation, open the georeferenced image. Repeat the same procedure for other orders.



Step-2 Display all the 3 images with different polynomial order (Nearest Neighbour) to ***compare the fit.***



Output using 1,2,3 polynomial order (1:1 zoom)



Videos of comparing the fit (superimposition) of different polynomial order

Untitled_1 - ERDAS IMAGINE 2014_2020-09-21 01-42-09.mp4

Untitled_1 - ERDAS IMAGINE 2014_2020-09-21 01-44-21.mp4 (1:1 Zoom)

The georeferenced images of all the 3 orders have a **good fit** and it is difficult to demarcate the differences as it is a **plain area.** Hence, there is not much difference between the three orders. However, the **best fit is in third order** i.e. best superimposition and the image has been georeferenced more accurately. The results can be cross checked by RMS error. But as there's not much difference, even the first order image can be used.

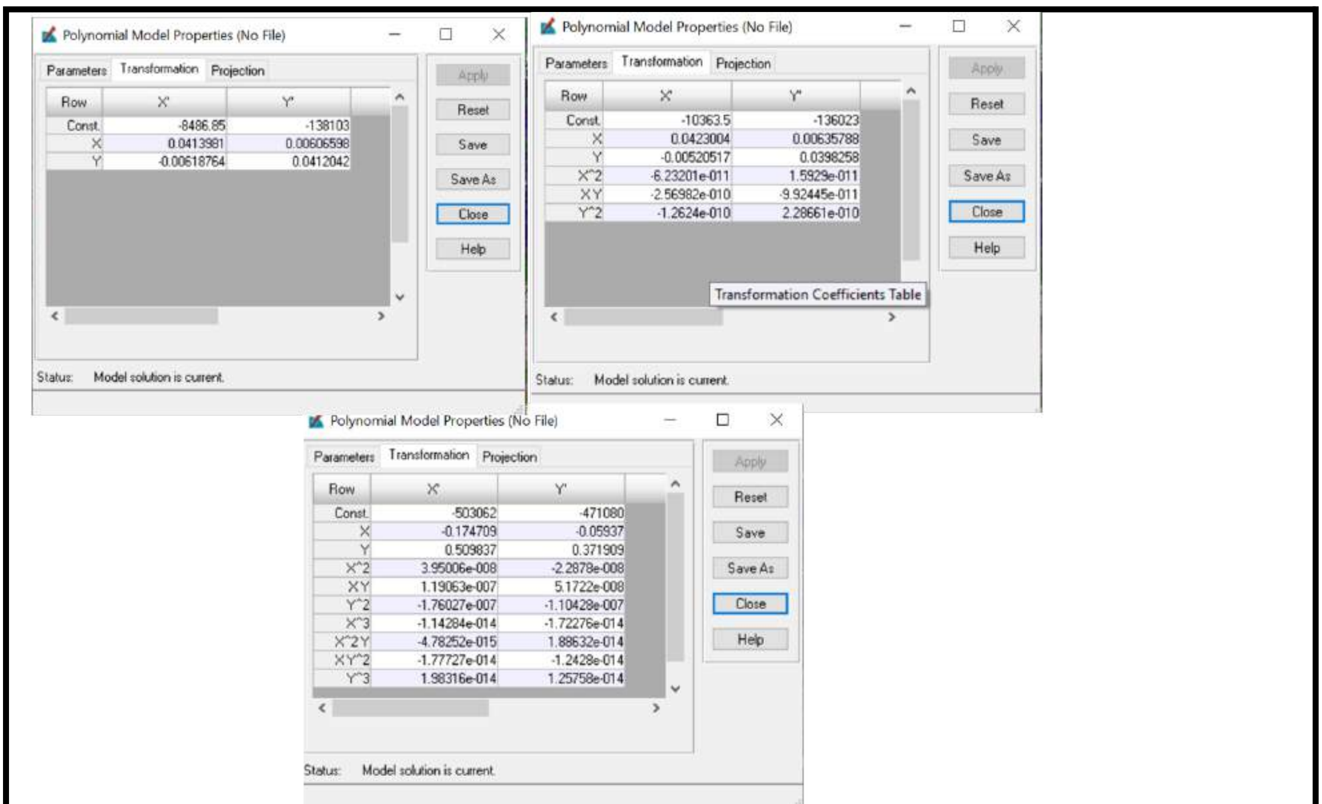
Higher polynomial order often produces a **more accurate fit** for areas surrounding the GCP. However, other geometric errors come at a large distance from the GCP. Therefore, generally first order polynomials are used whenever possible. Higher orders are used if there are serious geometric errors in the image.

PART-2b

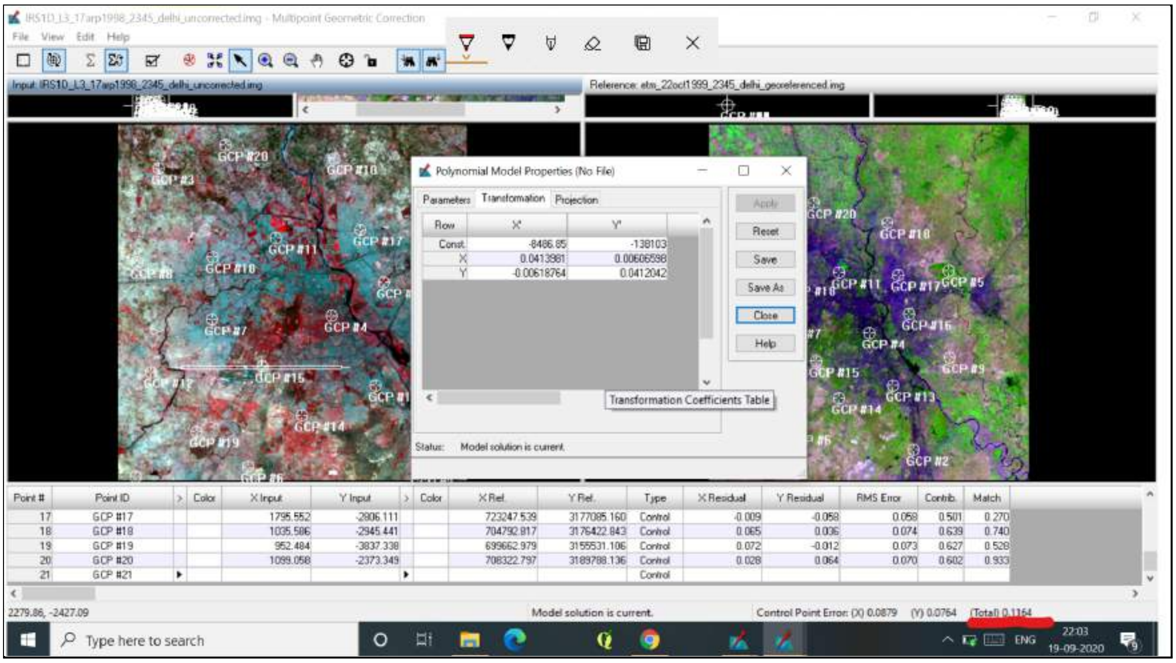
Polynomial Equations and Root Mean Square Error

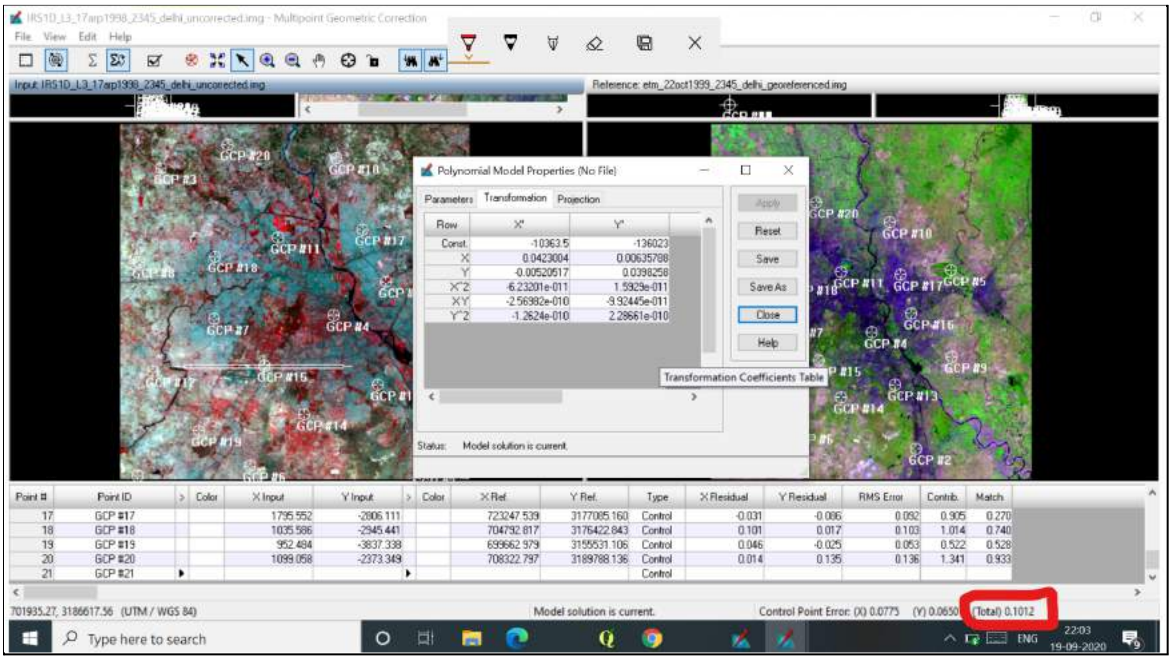
Polynomial Order	**Equations**	**RMS Error**
First order	$X' = -8486.85 + (0.0413981)X - (0.00618764)Y$ $Y' = -138103 + (0.00606598)X + 0.0412042Y$	0.11
Second Order	$X' = -10363.5 + (0.0423004)X - (0.00520517)Y - (6.23201e\text{-}011)X^2 - (2.56982e\text{-}011)XY - (1.2624e\text{-}010)Y^2$ $Y' = -136023 + (0.00635788)X + (0.0398258)Y + (1.5929e\text{-}011)X^2 - (9.92445e\text{-}011)XY + (2.28661e\text{-}010)Y^2$	0.10
Third Order	$X' = -503062 - (0.174709)X + (0.509837)Y + (3.95006e\text{-}008)X^2 + (1.19063e\text{-}007)XY - 1.76027e\text{-}007\,Y^2 - (1.14284e\text{-}014)X^3 - (4.78252e\text{-}015)X^2Y - (1.77727e\text{-}014)XY^2 + 1.98316e\text{-}014\,Y^3$ $Y' = -471080 - (0.05937)X + (0.371909)Y - (2.2878e\text{-}008)X^2 + (5.1722e\text{-}008)XY - (1.10428e\text{-}007)Y^2 - (1.72276e\text{-}014)X^3 + (1.88632e\text{-}014)X^2Y - (1.2428e\text{-}014)XY^2 + 1.25758e\text{-}014\,Y^3$	0.08

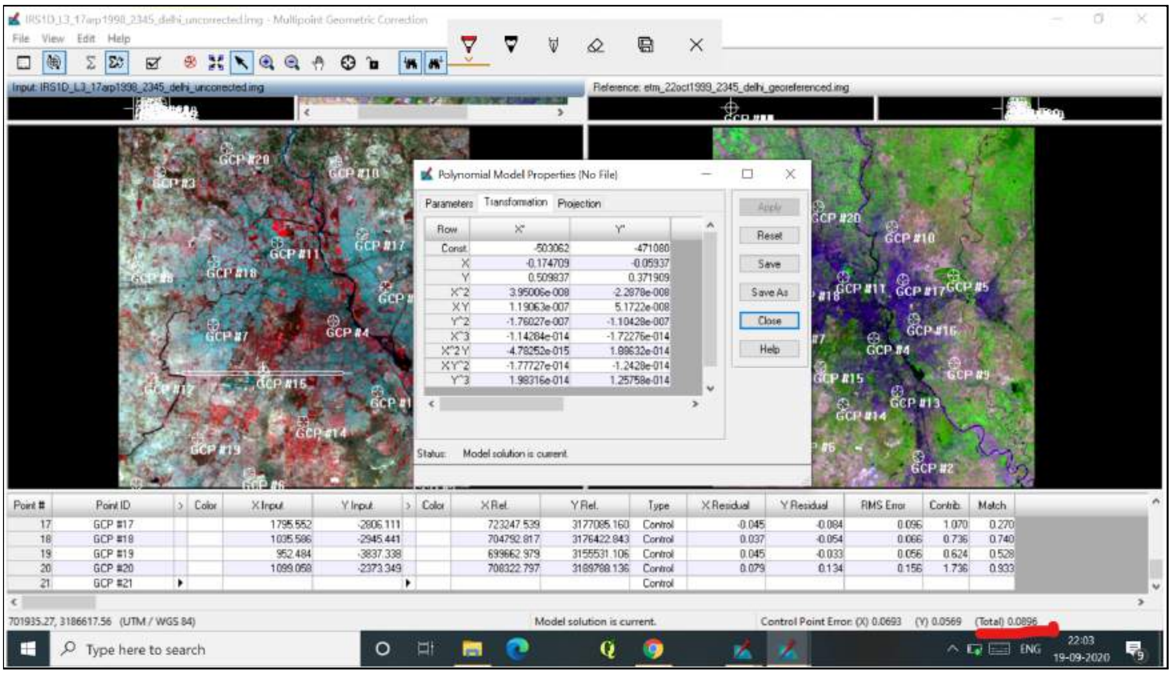
Values of unknown variable



SRM Error Value



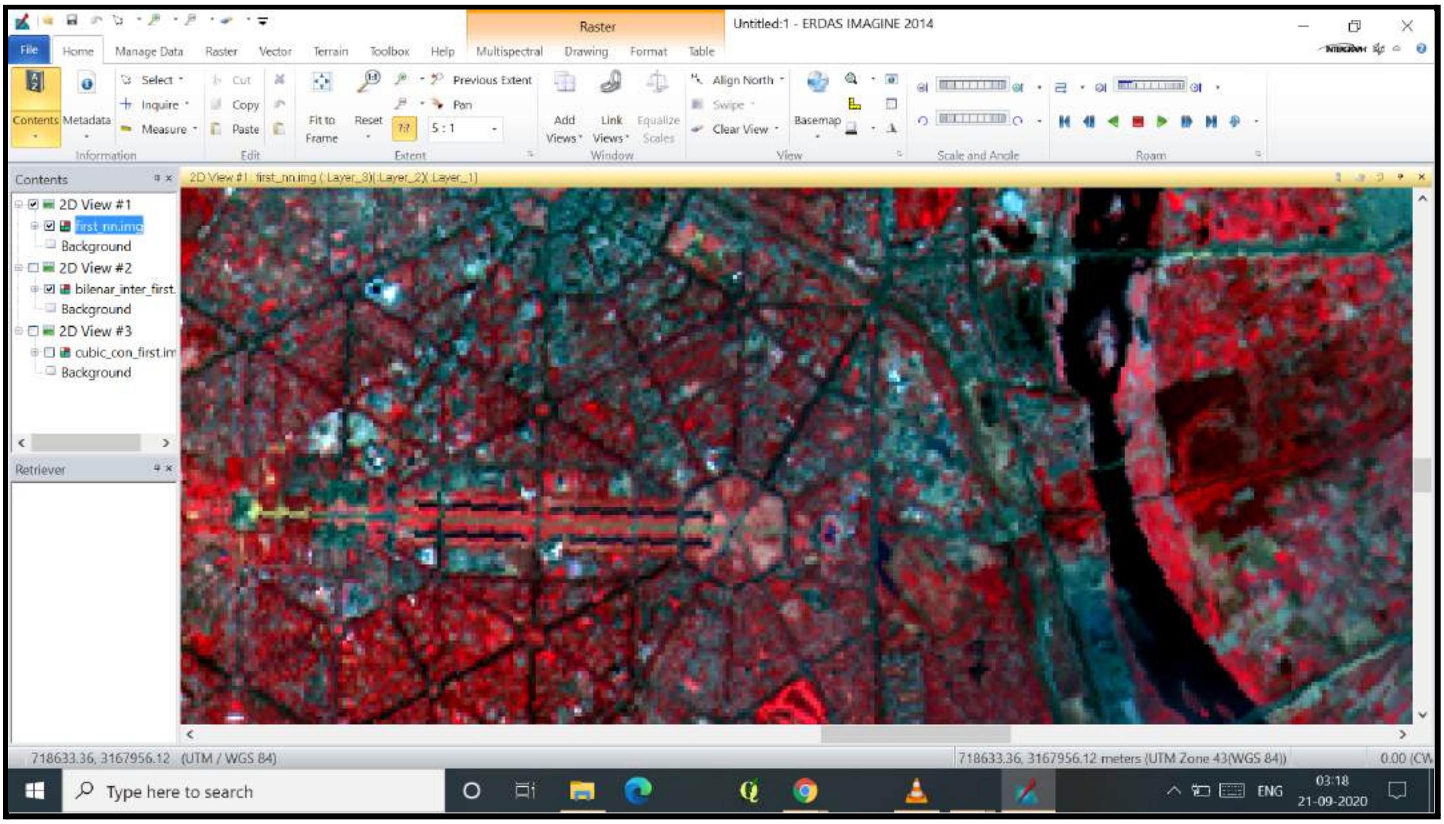




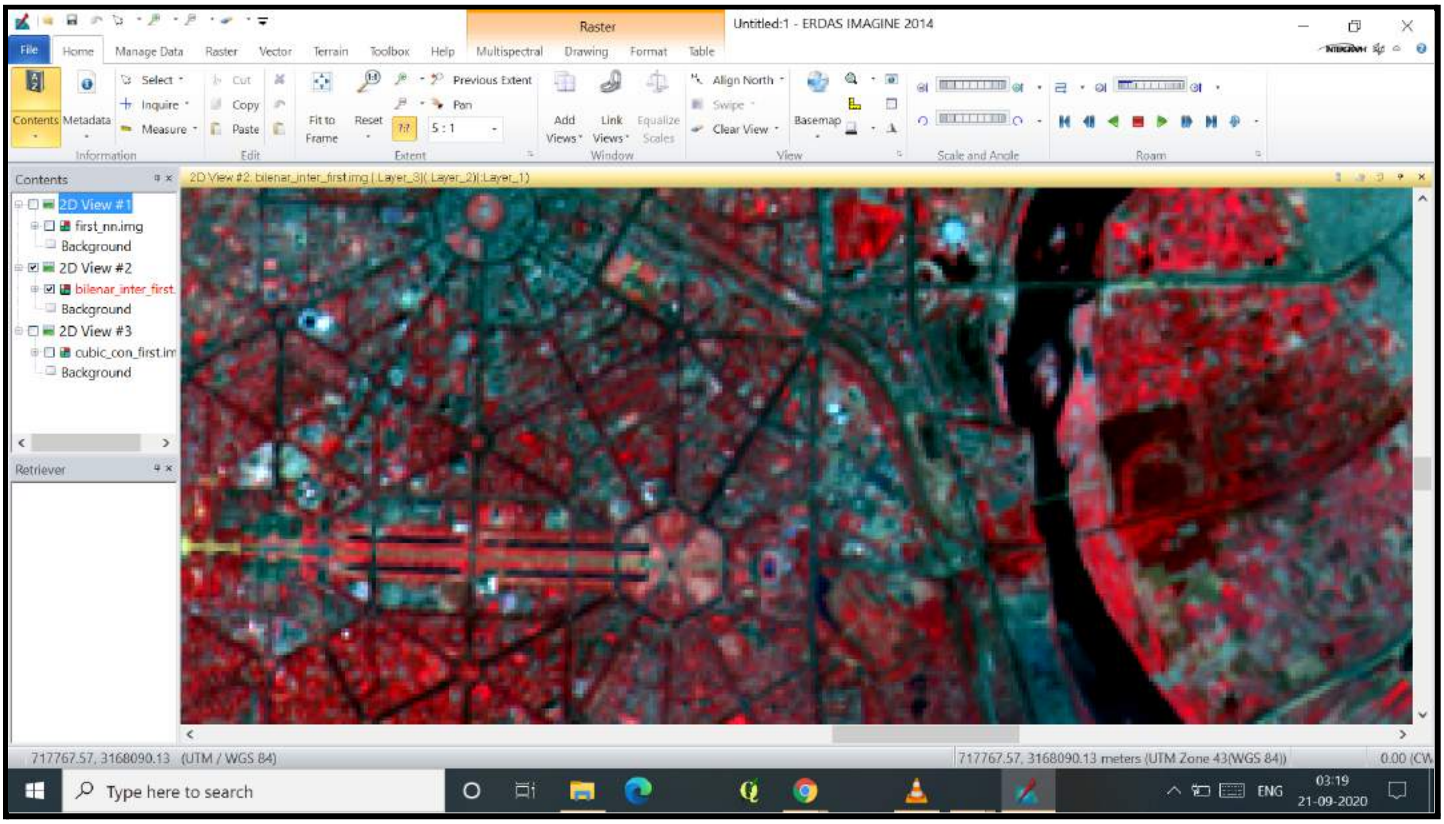
PART-3

Compare 1st order correction using three different types of resampling techniques. (2:1 zoom)

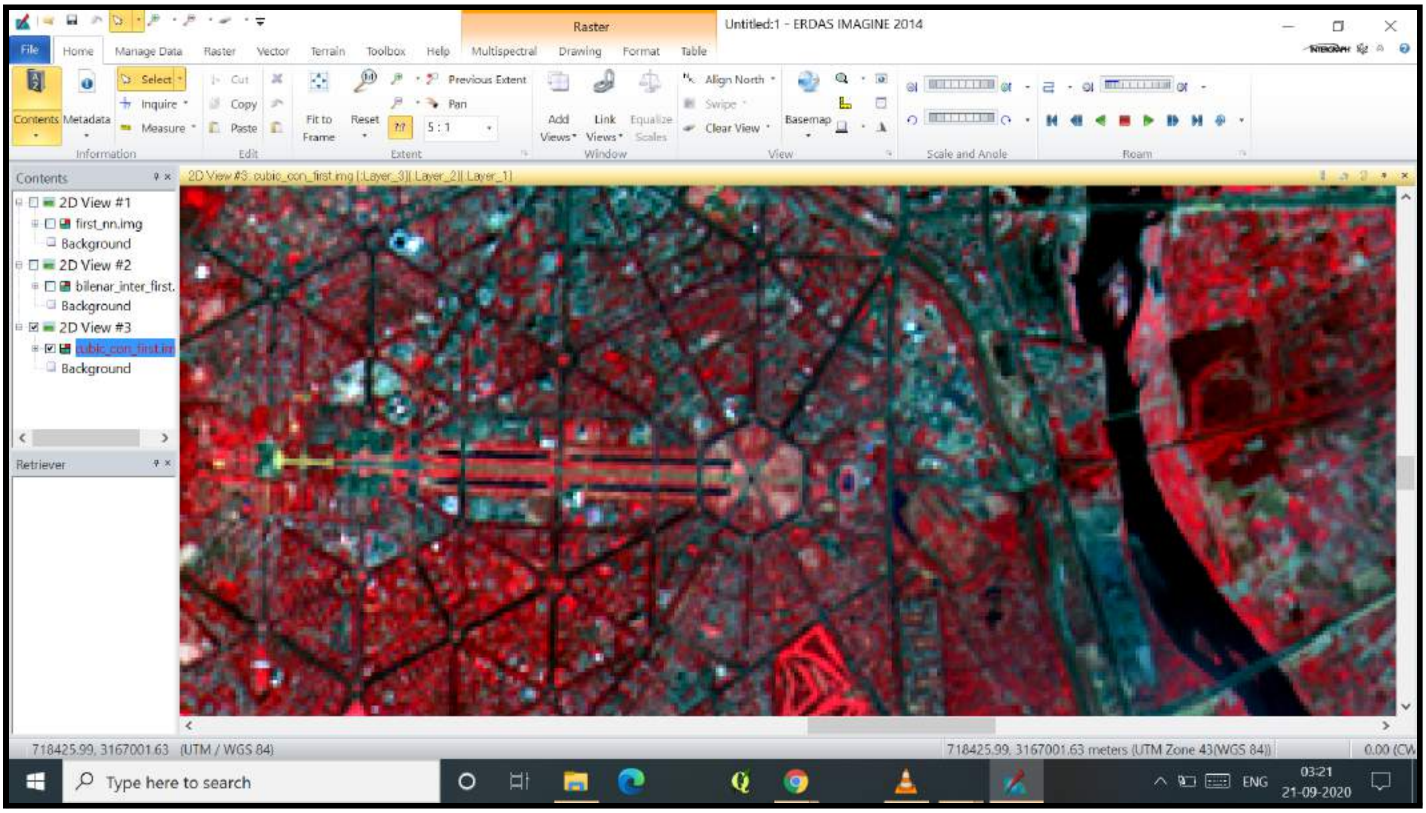
1.Nearest Neighbour Interpolation



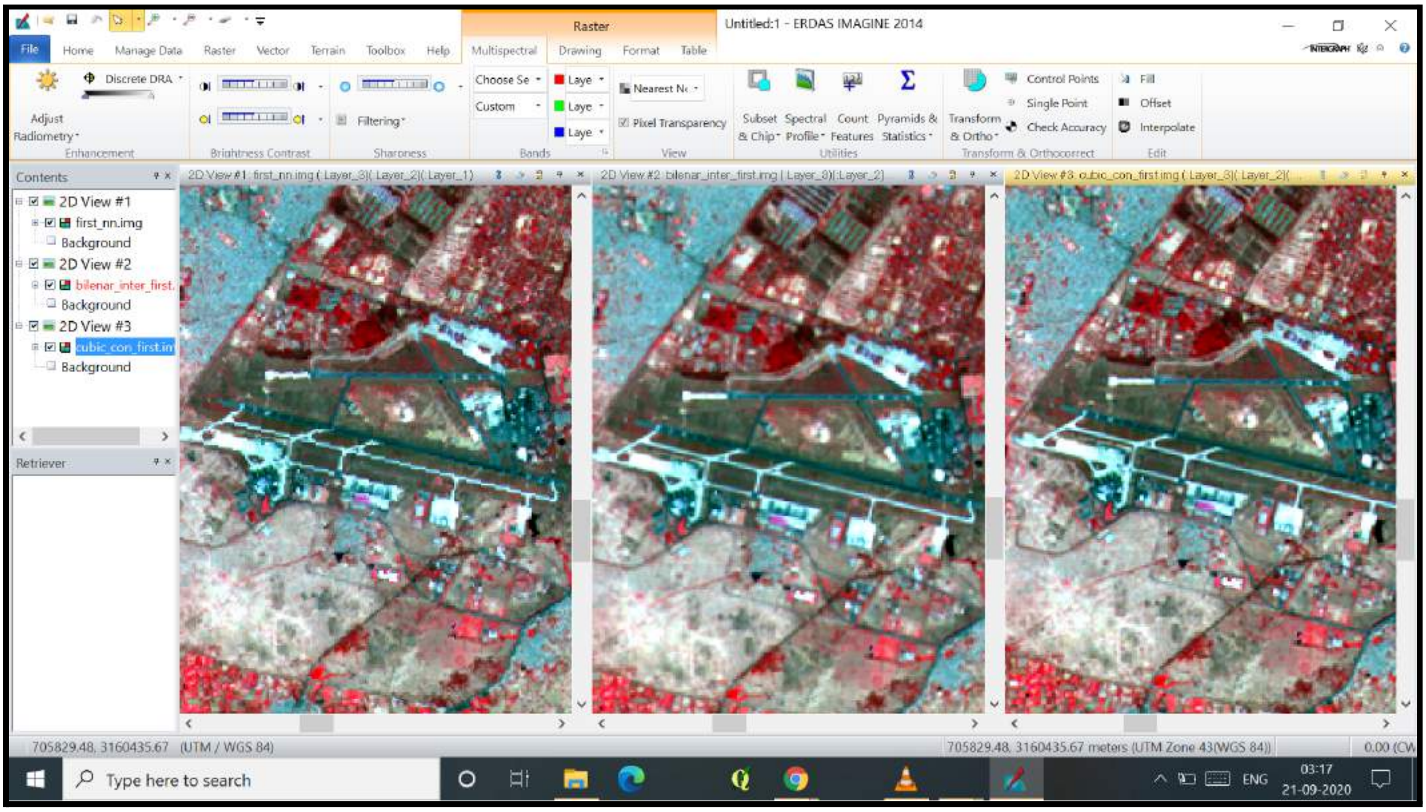
2. Bilinear Interpolation



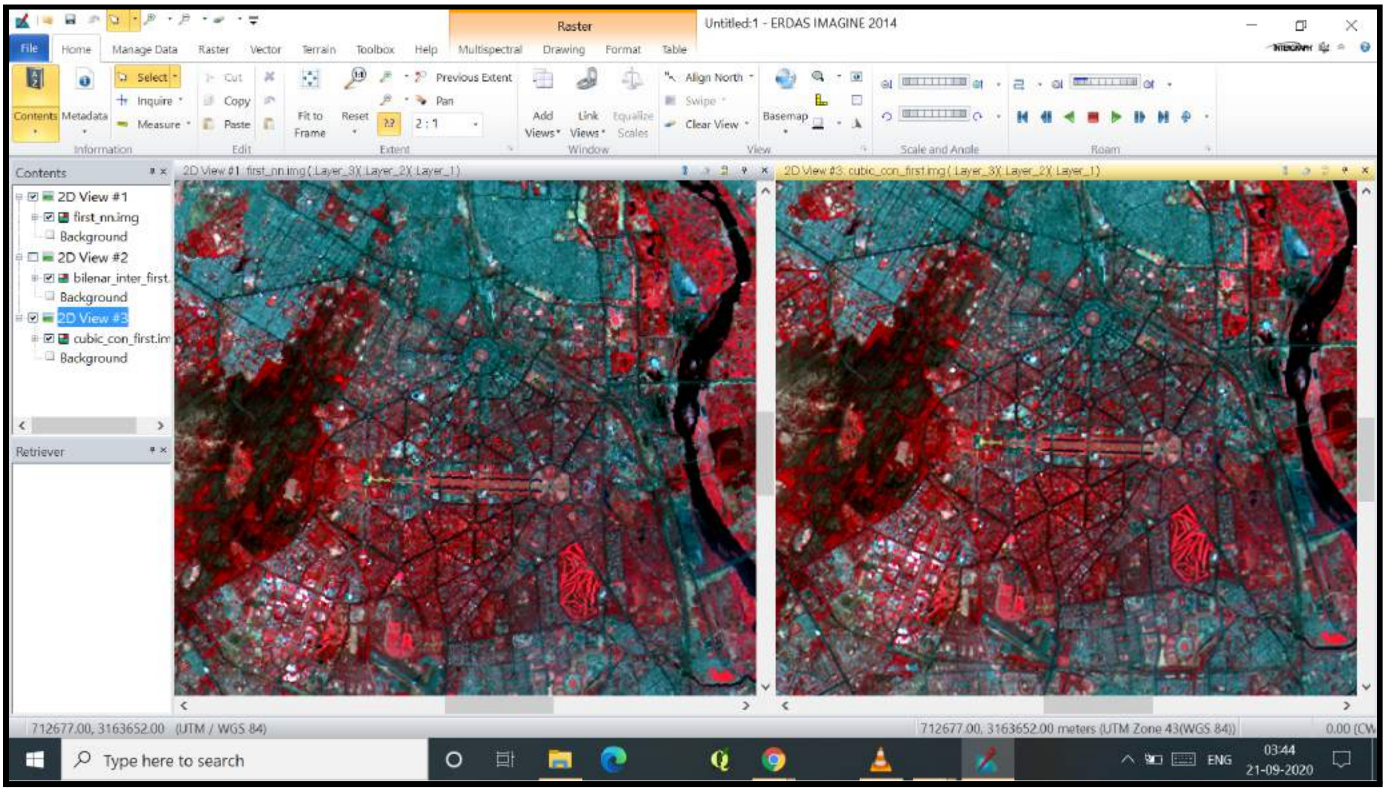
3. Cubic convolution



Comparing the 3 resampling techniques



Nearest Neighbour and cubic convolution



Video comparing the quality of 3 resampling technique (2:1 zoom)

[Untitled_1 - ERDAS IMAGINE 2014_2020-09-21 03-45-10.mp4]

Change in the quality of the images is clearly visible. The nearest neighbour resampling technique has **zig-zag lines** clearly visible and has a **rough** overall look. Whereas in the linear interpolation and cubic convolution the image is **smoother** and quality has improved.

Quality- **Nearest Neighbour < Bilinear interpolation < Cubic Convolution**

As in nearest neighbour the brightness values are not changed but only change is in positions whereas in case of bilinear interpolation and cubic convolution, the new brightness values takes an average of 4 and 16 pixels respectively . Thus, **subduing the extreme brightness values and providing smoothness to the output image.**