

## QGIS Exercise

# Image to Map Registration

In this exercise you will learn how to:

- Enabling Georeferencer core plugin
- Opening Georeferencer core plugin
- Assigning Ground Control Points (GCPs)
- Defining transformation parameters
- Georeferencing scanned map
- Checking accuracy of georeferencing
- Reproject the georeferenced raster

Estimated time: 45 minutes



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The purpose of this exercise is to understand the procedure of image to map registration.  
Data layers to use: **"TG-state.jpg"**

Georeferencing is the process of assigning real-world coordinates to each pixel of the raster. Many times these coordinates are obtained by doing field surveys - collecting coordinates with a GPS device for few easily identifiable features in the image or map. In some cases, where you are looking to digitize scanned maps, you can obtain the coordinates from the markings on the map image itself. Using these sample coordinates or GCPs (Ground Control Points), the image is warped and made to fit within the chosen coordinate system. Now, we use a scanned map and georeference it using QGIS.

The procedure for georeferencing a scanned map/image involves selecting multiple points on the raster, specifying their coordinates and choosing a relevant transformation type. Based on the input parameters and data, the algorithm will compute the world file parameters. The more coordinates you provide, the better the result will be. Use this procedure to convert scanned toposheets or images to convert them into spatial datasets for use in GIS analysis.


### Step 1: Load reference raster data in QGIS

- The first step is to start QGIS and load reference image (TG-state.jpg). Raster layers are loaded either by clicking on the Add Raster Layer  icon of Manage Layers toolbar or by selecting the menu Layer > Add Layer >  Add Raster Layer...


### Step 2: Open the Georeference core plugin

- Click on Raster menu > Georeferencer >  Georeferencer...

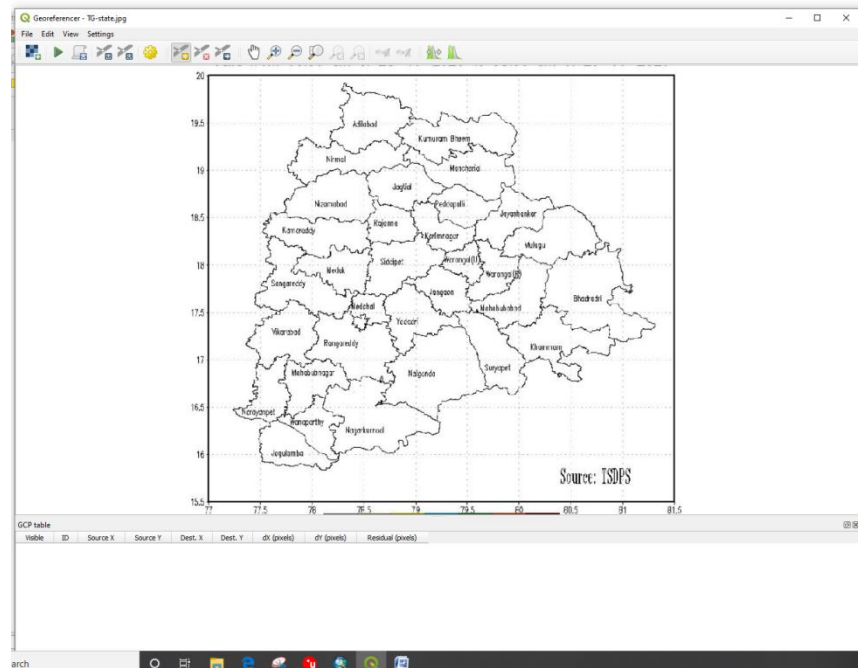
### Step 3: Load target image (TG-state.jpg) in Georeferencer window

- To start image to map registration, load the image "TG-state.jpg" using the Add Raster Layer  icon on Georeferencer window toolbar. The raster will show up in the Georeferencer window. If it asks for coordinate system selection, cancel the window. Once the raster is loaded, we start to enter reference points.




## Step 4: Assigning ground control points

- In the **Georeferencer** window, click on **Add Point**  icon to add a GCP to unregistered image. Pop-up window **Enter Map Coordinates** appears

- Zoom the image to top left corner where the intersection of longitude 77.0 and 20.0 exists. Now, enter X /East coordinate and Y/North coordinate values respectively for each GCP added. The X values are the longitude and Y values are the latitude of the GCPs. It is apparent from the image the lines of longitude and latitude.



- Click **OK** button at bottom. You will notice the **GCP table** now has a row with details of your first GCP.

- Repeat the same procedure to add more points, preferably at intersections of four corners. You should have at least four points, and the more points you can provide, the better the result will be. Use **Zoom In** , **Zoom Out**  or **Pan**  the working area in Georeferencer i windows in order to locate a relevant set of GCP points.

**Enter Map Coordinates**



Enter X and Y coordinates (DMS (*dd mm ss.ss*), DD (*dd.dd*) or projected coordinates (*mmmm.mmm*)) which correspond with the selected point on the image. Alternatively, click the button with icon of a pencil and then click a corresponding point on map canvas of QGIS to fill in coordinates of that point.

X / East  Y / North

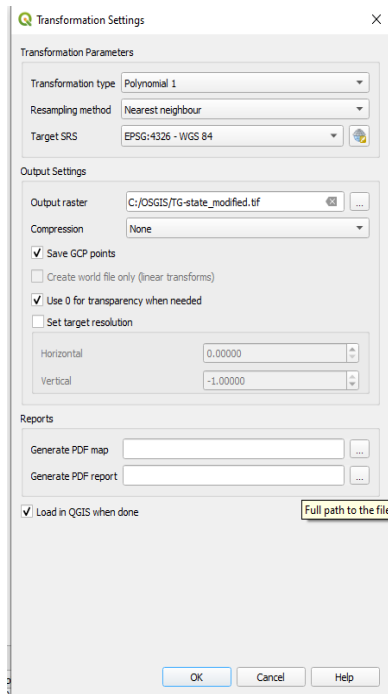
☒ Automatically hide georeferencer window


- A GCP table with the values of source and destination values with differentialand residual error appears.

GCP table								
Visible	ID	Source X	Source Y	Dest. X	Dest. Y	dX (pixels)	dY (pixels)	Residual (pixels)
<input checked="" type="checkbox"/>	0	32.4955	-18.4849	77	20	4.26326e-14	0.009224	0.009224
<input checked="" type="checkbox"/>	1	905.51	-18.5033	81.5	20	1.13687e-13	-0.009224	0.009224
<input checked="" type="checkbox"/>	2	905.51	-818.464	81.5	15.5	1.13687e-13	0.009224	0.009224
<input checked="" type="checkbox"/>	3	32.4955	-818.483	77	15.5	-7.81597e-14	-0.009224	0.009224

- To delete a GCP, use **Delete Point**  icon or to edit a GCP, use **Move GCP Point**  icon in the **Georeferencer** window


## Step 5: Defining transformation parameters



- After adding required number of GCPs, go to Settings > Transformation settings... or click the icon  from toolbar of Georeferencer window
- In the Transformation settings dialog, choose the Transformation type as Polynomial 1. Name your output raster as “TG-state-modified.tif” (see to store this file in your working directory as in the above figure). Choose Nearest neighbour for Resampling method. Choose EPSG:4018 as the Target SRS. Make sure the Load in QGIS when done option is checked. Click OK button
- Now check the status bar of Georeferencer window. On right side you will see error value (RMS Error). If the error is tolerable then proceed for next step. Otherwise, you should check existing GCPs and correct their location, if required or add more GCPs

Transform: Polynomial 1 Mean error: 0.018448 394.2,-851.2 None

## Step 6: Execute georeferencing process

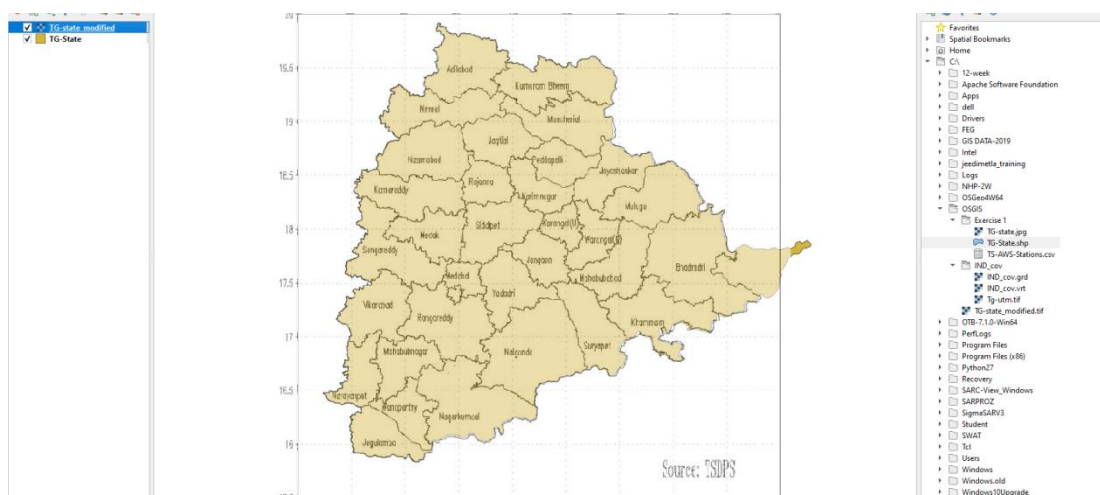
- In the Georeferencer window, go to File > Start georeferencing or click on  from toolbar. This will start the process of warping the image using the GCPs and creating the target raster




Once the process is finished, the georeferenced “tg1-modified.tif” is automatically loaded into QGIS window. You may save GCPs, if required.

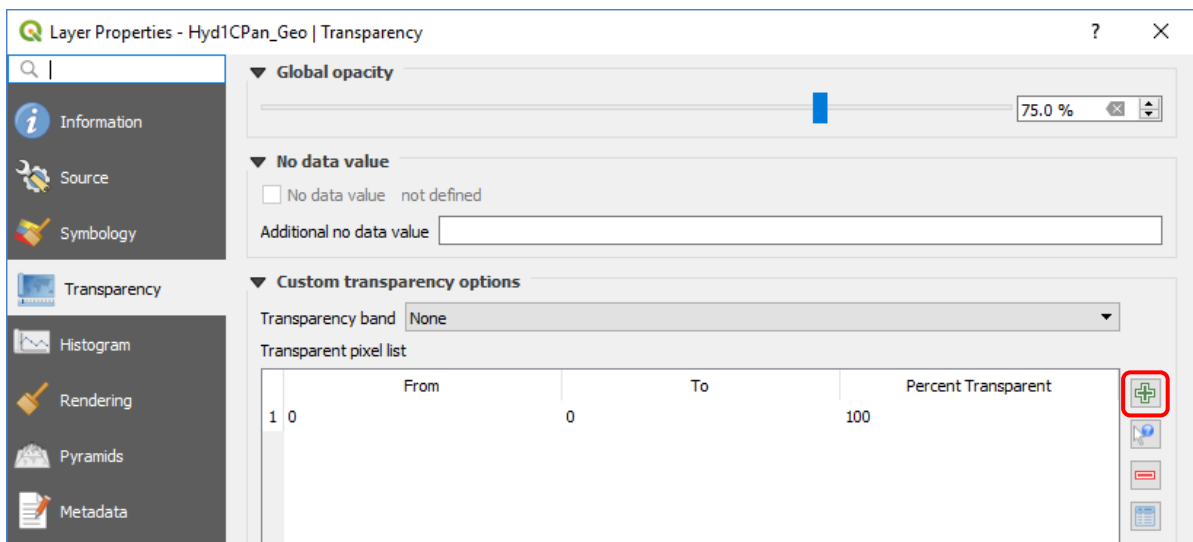
Close the Georeferencer window.

## Step 7: Check the accuracy of gerefereced image

The image to map registration is completed. Now check how accurately you registered the image. In QGIS main window open the TG-state.shp with the registered map and compare the boundaries by changing the transparency level of the images under properties.



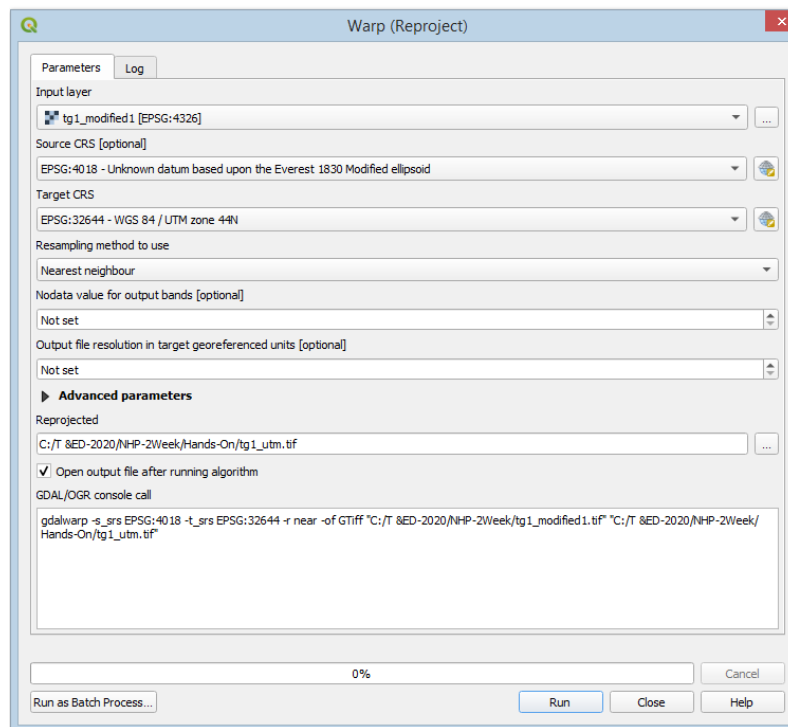
- Open the **Properties** window of the selected layer by clicking menu **Layer > Properties** or by double-clicking on the selected raster name in the **Layer** panel, or by right-clicking and choosing **Properties** from the context menu
- In the **Layer Properties** window, select the **Transparency** tab.
- Adjust the **Global opacity** slider to **50%**.
- Check the registered image with reference map by using **Zoom-in** , **Zoom Out**  and **Pan**  tools for accurate alignment of the respective features of the two images



## Step 8: Reprojecting the raster







- In order to reproject a raster image from one coordinate system to other, we use **Raster > Projections > Warp (Reproject...)**.
- In the **Warp (Reproject)** dialog, choose the **Input layer** **TG-state-modified.tif**.
- Choose **EPSG:4326** as the **Source CRS** (if not taken automatically) and **EPSG:32644** as **Target CRS**.
- Select **Resampling method to use** – **Nearest neighbour** and make sure the **Open output file after running algorithm** option is checked.
- Leave the default option of **Not set** for **Nodata value for output bands [Optional]**.
- If you know the original resolution of the input image then you type the same value (here 5.6 m) in **Output file resolution in target georeferenced units [optional]**. Otherwise leave it to default option **Not set**.

- Under **Advanced parameters**, click on three dots (...) on the right side of rectangle just below **Reprojected** and select **Save to File...** Define output file **tg1\_utm.tif** (see to store this file in your working directory).
- Click **Run** button to warp the image.

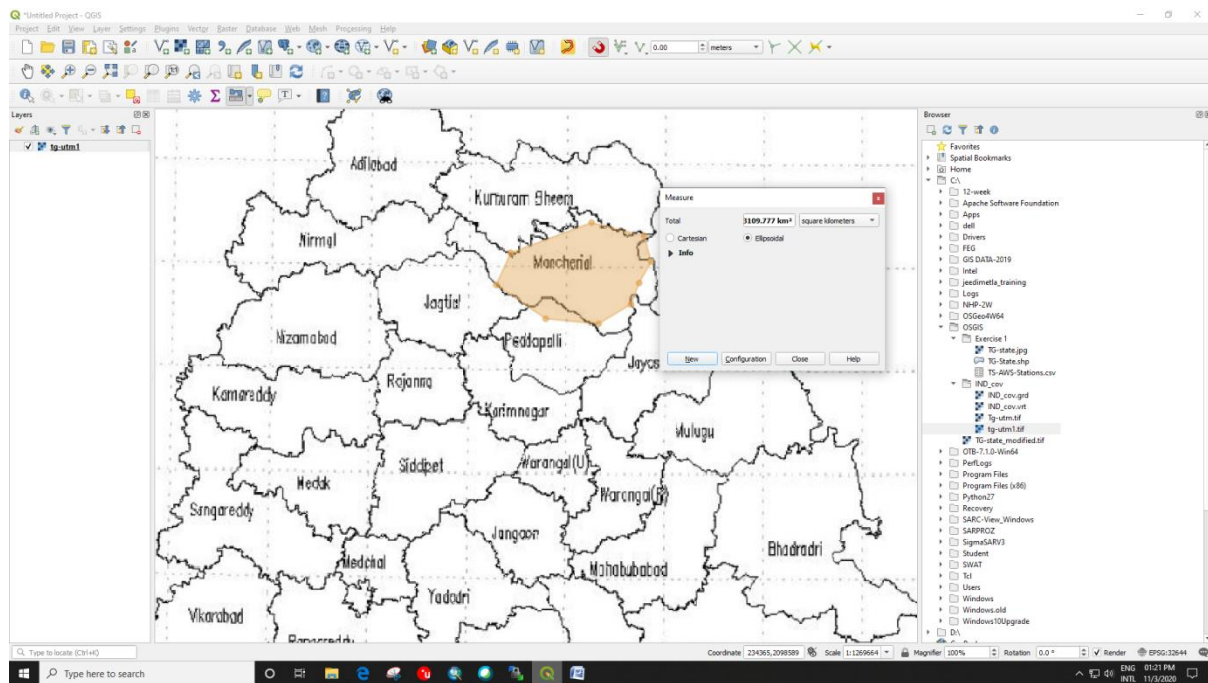


After execution of warp the output image is automatically loaded into QGIS main window.

## Step 9: Measuring features interactively on image

- To select a measure tool, click menu **View** > **Measure** and select the required measure tool.  
Or you can click on the small downward arrow on the right side of the icon  on **Attribute** toolbar. This helps you to switch between **Measure Line** , **Measure Area**  or **Measure Angle**  tools
- When you click either  or  tool, the relevant **Measure** dialog window opens and you can set the required units before measuring the feature's length or area. (By default, all measurements are as per defined ellipsoid unit of the layer CRS. In case, you wish to see the unit of the layer, open the **Layer Properties** window and select **Information** tab.)
- To measure, start clicking points along a line or boundary of a polygon on the image. To stop measuring, click your right mouse button at the last point you clicked.

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< end of exercise>