

Georeferencing a Toposheet

Using Quantum GIS

Tutorial ID: IGET_GIS_003



This tutorial has been developed by BVIIEER as part of the IGET web portal intended to provide easy access to geospatial education. This tutorial is released under the Creative Commons license. Your support will help our team to improve the content and to continue to offer high quality geospatial educational resources. For suggestions and feedback please visit www.dst-iget.in.

Georeferencing a Toposheet using QGIS

Objective: To georeference a toposheet by using graticule intersections in a known coordinate system and datum.

Software: Quantum GIS 2.0.1

Level: Beginner

Time required: 2 Hour

Prerequisites and Geospatial Skills

1. Quantum GIS should be installed on the computer
2. Basic knowledge about the QGIS interface
3. Should have completed *Exercise ID: IGET_QGIS_001* before starting this tutorials

Reading

1. Sutton, T., Dassau, O., & Sutton, M. (2009). [A gentle introduction to GIS](#). Chief Directorate: Spatial Planning & Information, Eastern Cape.

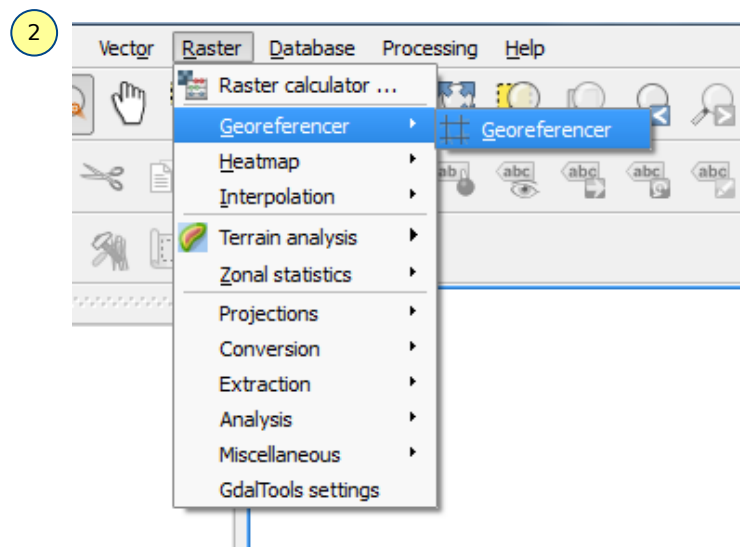
Tutorial Data: Tutorial data can be downloaded from [IGET_GIS_003](#).

Introduction

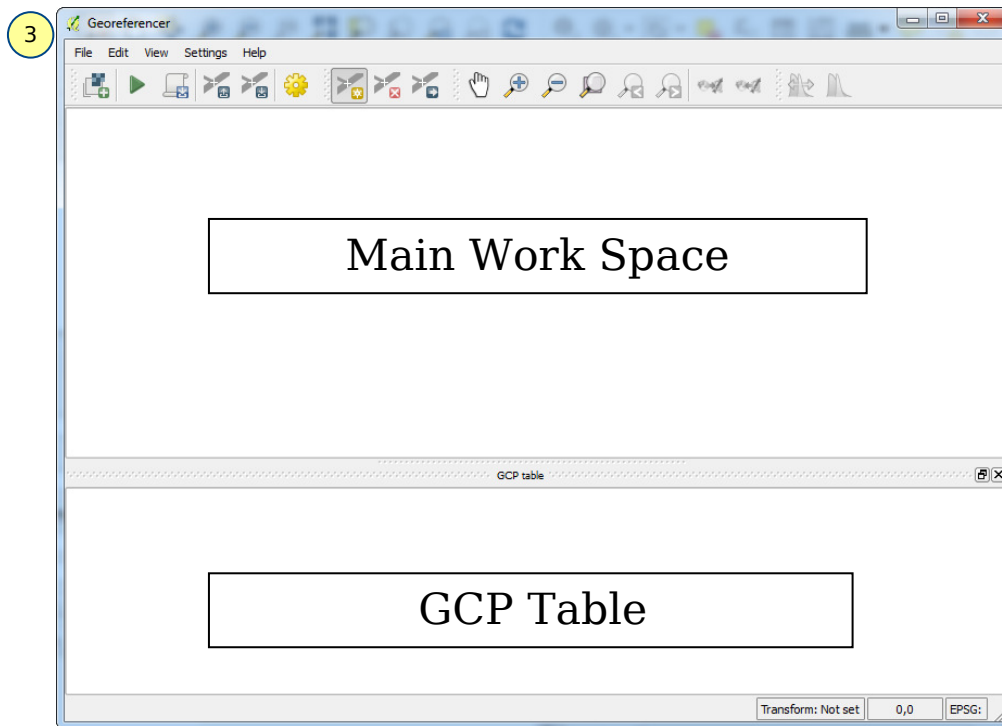
Georeferencing is a process of establishing a mathematical relationship between the image coordinate system and the real world spatial coordinate system. This mathematical relationship can be assigned by any one of the transformation settings, viz. Polynomial order 1, 2 or 3, Linear, Projective and Thin Plate Spline etc. Polynomial order 2 is the most widely used transformation in Georeferencing. Recently Thin plate Spline gaining popularity due its ability of incorporating the local deformations in the data, this is very useful when we are dealing with low resolution data. However in this practical we are using traditional polynomial order 2 transformation to perform georeferencing/rectification of the Toposheet.


In this exercise, we will use a topographic Map of South Pune, prepared by Institute of Environment Education and Research(IEER), BharatiVidyapeeth University(BVU), Pune. This map is in the Universal Transverse Mercator(UTM) projection based on WGS 84 Datum.

1. First, we open Quantum GIS (QGIS) via the Start menu. (*Start → All Programs → QGIS Dufour → QGIS Desktop 2.0.1*)
2. We then open QGIS **Georeferencer** via the menu bar. (*Raster → Georeferencer → Georeferencer*).

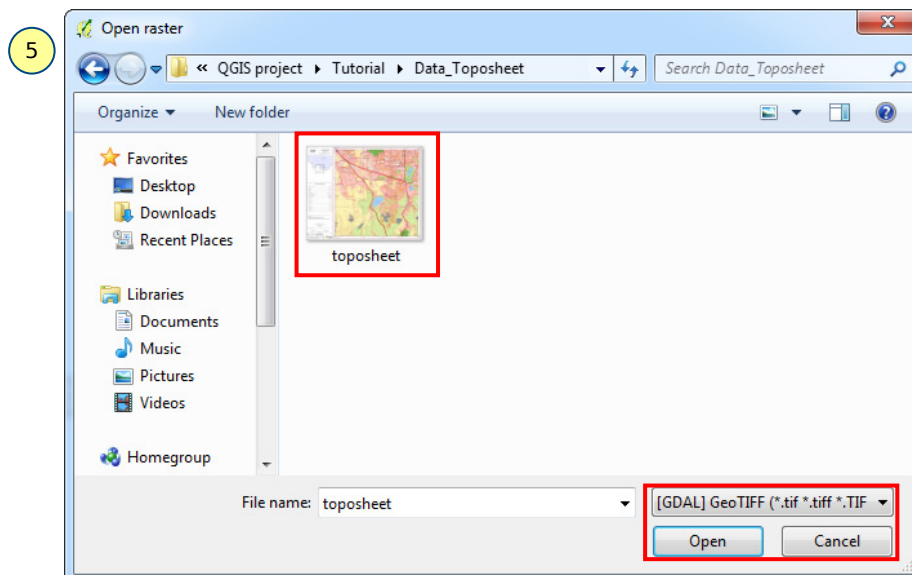


3. The **Georeferencer** is in the form of a window with two parts to it. The upper part is called as '**Main Work Space**' dedicated to display the Raster Map to be georeferenced and it allows the user to input the geographic or projected coordinates of control points. The lower part, titled '**GCP table**', is where the Ground Control Point data and residuals will be displayed.

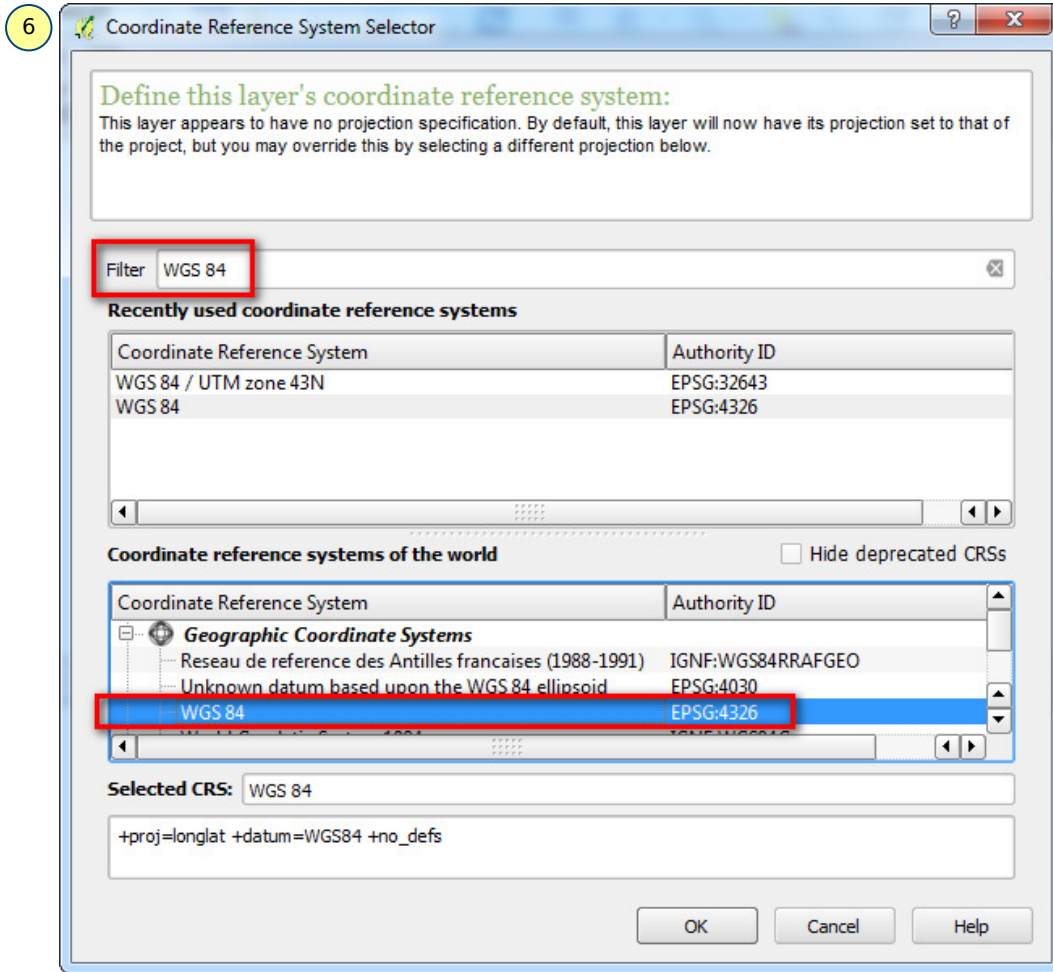


4. Add the toposheet to the **Georeferencer** by clicking on the  **'Open Raster'** button or from the *File* menu (*File* → *Open Raster*).

5. You will then be presented with a popup window, navigate to the tutorial data folder in which the '*toposheet.tif*' file is kept. Click on the drop down menu right to the '*File name*' and select '**[GDAL] GeoTIFF**'. Now select the '*toposheet.tif*' and click '**Open**'.

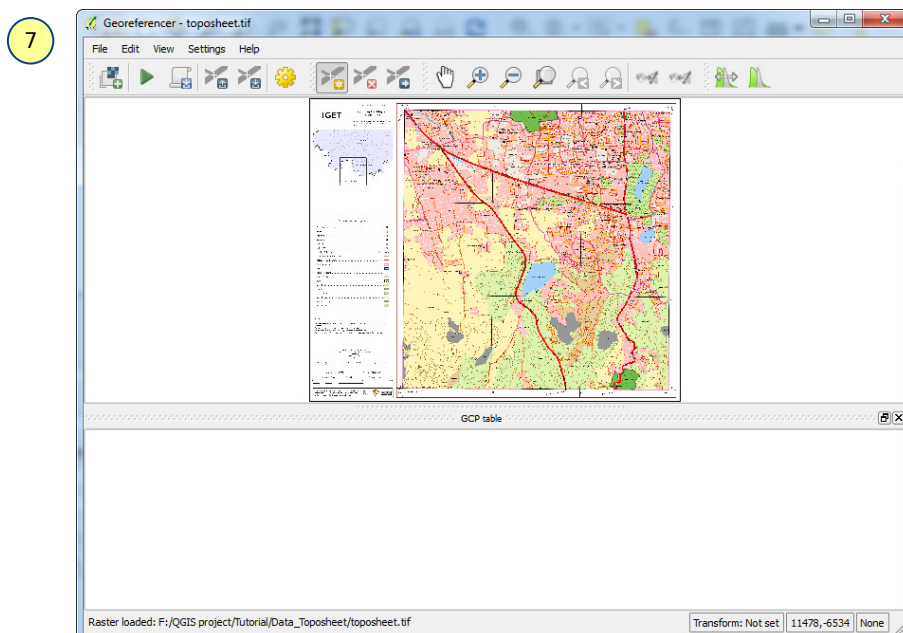





6. You will then be presented with the '*Coordinate Reference System Selector*' window, from which we will select the '**WGS 84**' under *Coordinate reference system of the world* section.

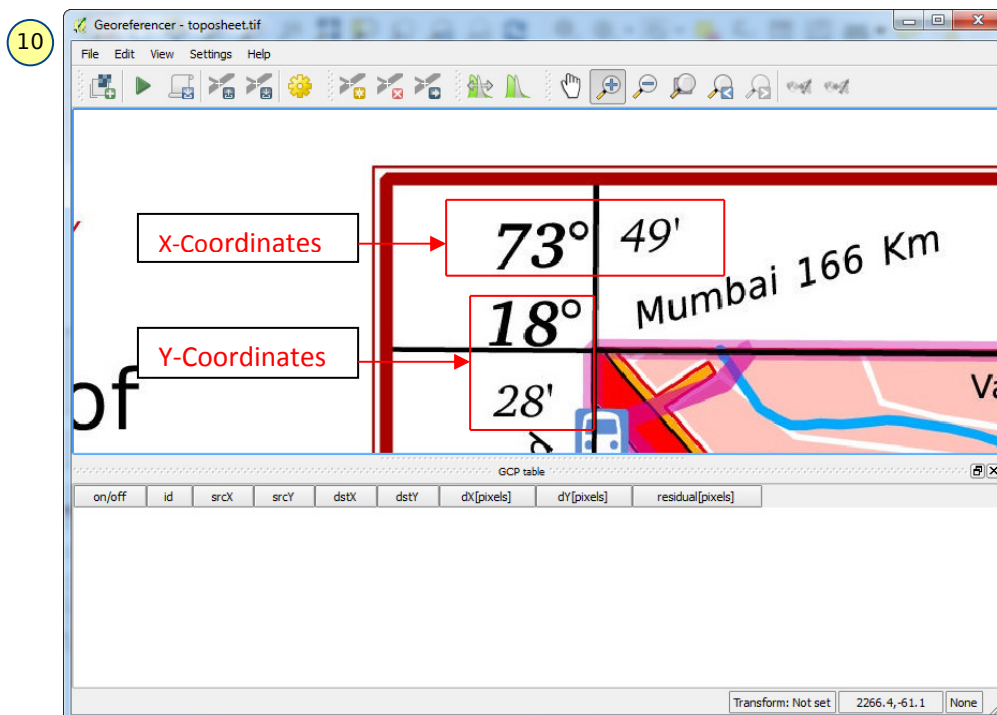


Tip: Type in 'WGS 84' in the filter space as shown in above picture. This will bring up all the CRS using WGS 84 ellipsoid.

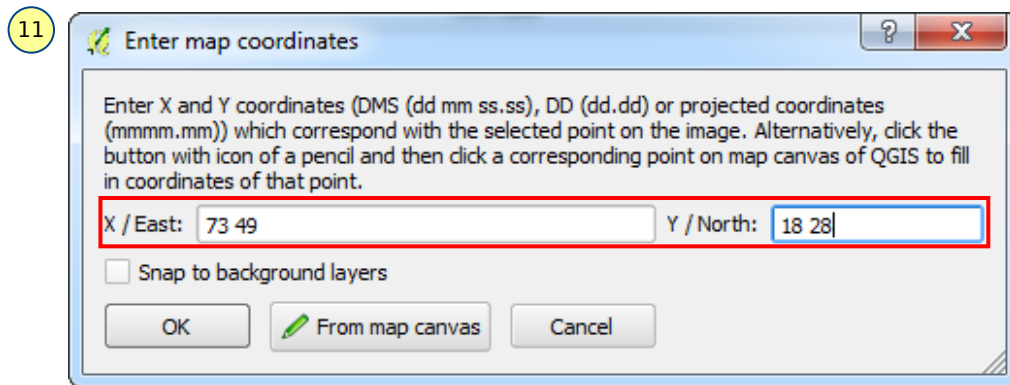
7. The toposheet will be loaded in the **Georeferencer** window and should look like below




8. To georeference an image we use Ground Control Points (GCPs). GCP is a location on the earth's surface with known coordinates on both earth and Toposheet/ imagery, i.e., geographic and pixel coordinates respectively. In this tutorial we use graticule intersections as GCPs.
9. To start adding GCPs to our map, we first zoom to a corner of the map where we can easily identify the intersection of the latitude and longitude. Use the scroll wheel of the mouse to zoom in and out of the map. Use the  '**Pan**' Button when needed.
10. To add a GCP click on the  '**Add point**' button, or go via the menu (*Edit* → *Add Point*). The mouse will transform into a '+' sign, which we use to click on the centre of the intersection. Use '**View tool**'  when needed.

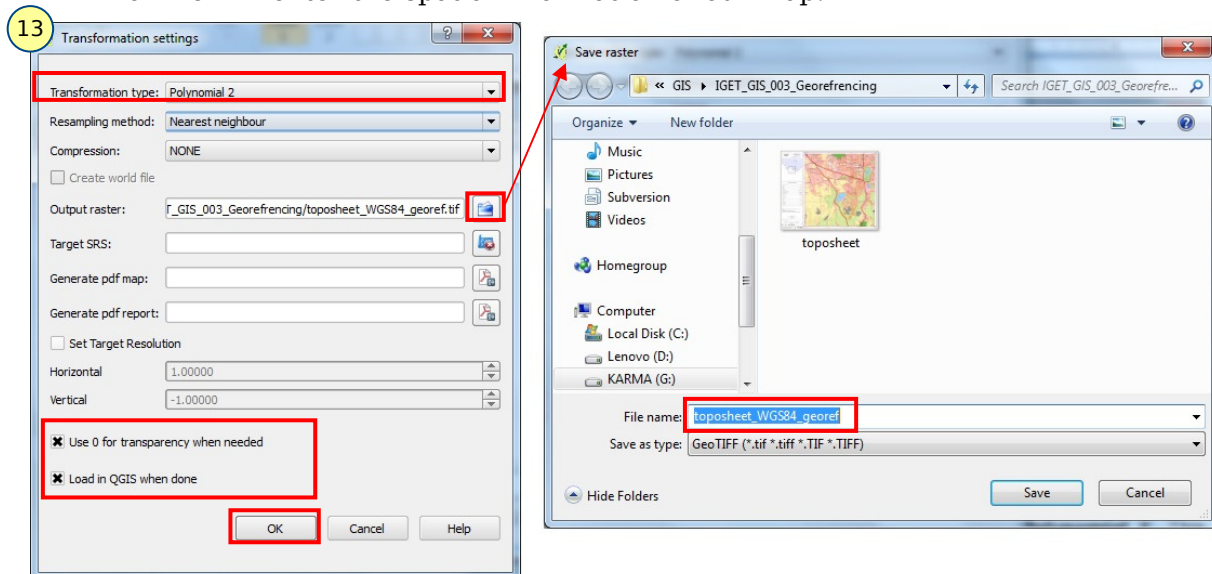


11. A window '*Enter map coordinates*' will pop up where we enter the coordinates of the point which we take from the map. Always enter '*Longitude or Easting*' in **X** field and '*Latitude or Northing*' in **Y** field. Use '*space bar*' in the key board to separate the Degree value from Minutes value and then click '**OK**'.




12. In this exercise we are using the '*Polynomial 2*' transformation to georeference the image. For the '*Polynomial 2*' transformation we will require minimum 6+1(for check) i.e., 7 GCPs or more GCPs on the map. There fore, we need to mark atleast 7 GCPs. The GCPs locations should be spread out as much as possible and they should not be co-linear at the same time they should enclose our whole area. Use the above procedure to mark six more contraol points.

13. We now set the spatial reference settings for the toposheet by clicking on the  '**Transformation Settings**' button. The '**Transformation Settings**' window pops up in which we will enter the spatial information of our map.



14. Click on the '*Transformation type*' drop-down menu and select '**Polynomial 2**'. This means we will be using a second order polynomial transformation.

15. Click on the button next to  '**Output Raster**'. A dialogue box will appear in which we enter the name of our output file. It is recommended to include the name of the original file in this file for example '*Toposheet_WGS84_georef.tif* ', This helps us to keep track of our work.

16. **'Check'** the check box *'Load in QGIS when done'* and *'Use 0 for transparency when needed'*, leave the rest of the values as default and click **'OK'**.



17. After Click **'OK'**, the last column *'residual [pixels]'* displays some values. These are the error values associated with the GCPs. An error value of 1 or less would be satisfactory.


17

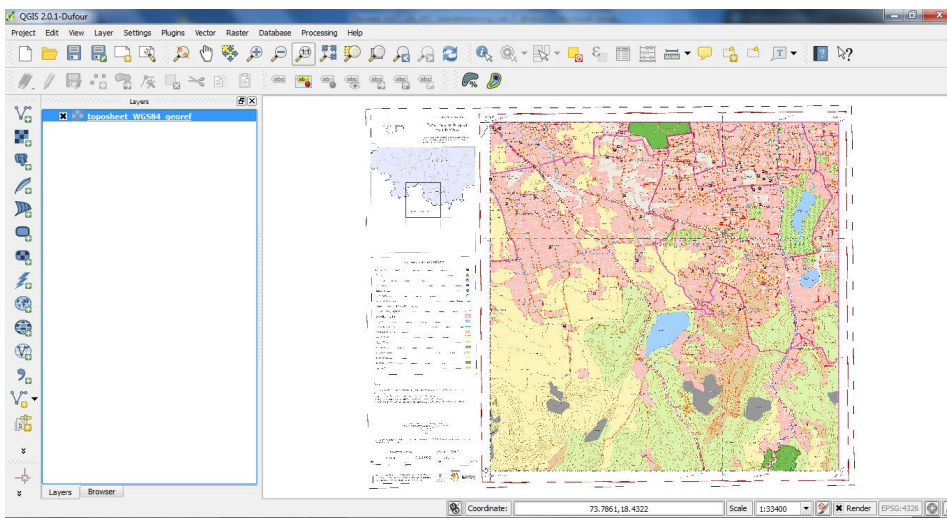
on/off	id	srcX	srcY	dstX	dstY	dX[pixels]	dY[pixels]	residual[pixels]
<input checked="" type="checkbox"/>	0	2239.98	-274.97	73.82	18.47	0.01	-0.00	0.01
<input checked="" type="checkbox"/>	1	8479.98	-315.04	73.87	18.47	-0.06	-0.10	0.11
<input checked="" type="checkbox"/>	2	8439.00	-6853.96	73.87	18.42	-0.01	0.00	0.01
<input checked="" type="checkbox"/>	3	2197.00	-6813.99	73.82	18.42	0.06	0.10	0.11
<input checked="" type="checkbox"/>	4	4306.02	-2467.98	73.83	18.45	-0.05	0.02	0.05
<input checked="" type="checkbox"/>	5	6385.97	-2481.03	73.85	18.45	0.20	0.28	0.35
<input checked="" type="checkbox"/>	6	4292.03	-4648.00	73.83	18.43	-0.14	-0.30	0.34



Transform: Polynomial 2 Mean error: 0.510613 4285.50, -4650.05 None

18. Double check and adjust the GCP locations if the value is greater than 1. To adjust a

point click on the **'Move GCP Point'**  button, and then click and drag the point to the desired location. Use **'Delete Point'**  button to delete an erroneous GCP. We can also enable and disable the GCPs by using check boxes under **'on/off'** column in **'GCP Table'**.

19. Once the error is around or below 1, click the **'Start Georeferencing'**  Button. The processing will take at about 2 minutes. The georeferenced image will be found at the location specified for the *'Output File'* in step 15. You can also notice, the out put file loaded in QGIS canvas.



20. It is useful to save the GCPs for later use if the georeferencing needs to be done again, or if corrections are required. To save them, click on the  **'Save GCPs as'** button. In the pop up window enter an appropriate name for the GCP file, preferably the same as that of the image. This file can be loaded later on by clicking on the  **'Load GCP points'** button in **'Georeferencer'** window after adding toposheet, and selecting it from the pop up window.

Task 1: What are the advantages of *Polynomial 2* over *Polynomial 1* transformation?