Georeferencing a Toposheet

Using SAGA GIS

Tutorial ID: IGET_RS_004

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Georeferencing a Toposheet using SAGA GIS

Objective: To georeference a toposheet by using graticule ticks/intersections in a known coordinate system and datum by using SAGA GIS

Software: SAGA GIS (6.4.0)

Level: Beginner

Time required: 2 Hour

Prerequisites and Geospatial Skills:

1. SAGA should be installed on the computer
2. Familiarity with the SAGA interface is preferred
3. Student must have completed exercise IGET_RS_001

Reading

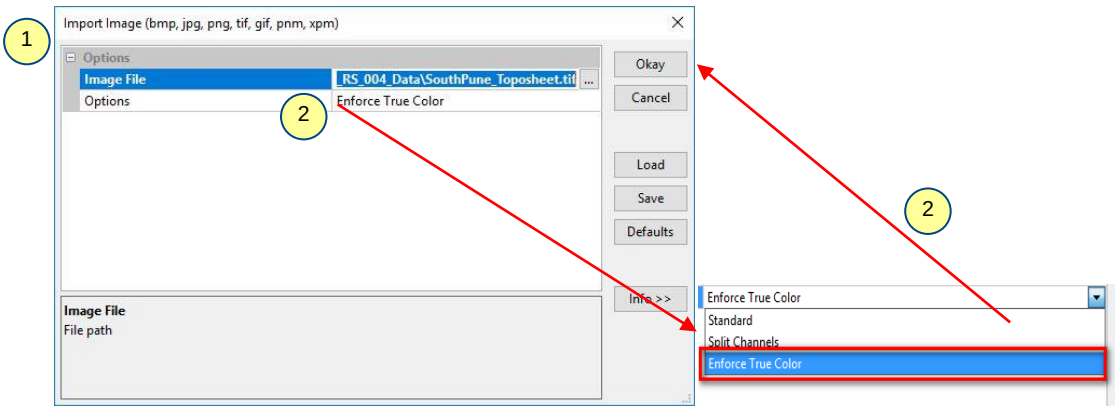
1. Maling, D. H. 1991. *Coordinate systems and map projections for GIS*. Maguire, DJ.
2. Peter H. Dana. 1995. *Map Projection.* The Geographer's Craft Project, Department of Geography. The University of Colorado at Boulder.
   http://www.colorado.edu/geography/gcraft/notes/mapproj/mapproj_f.html

Tutorial Data: The toposheet required for this exercise can be downloaded from IGET_RS_004

Introduction

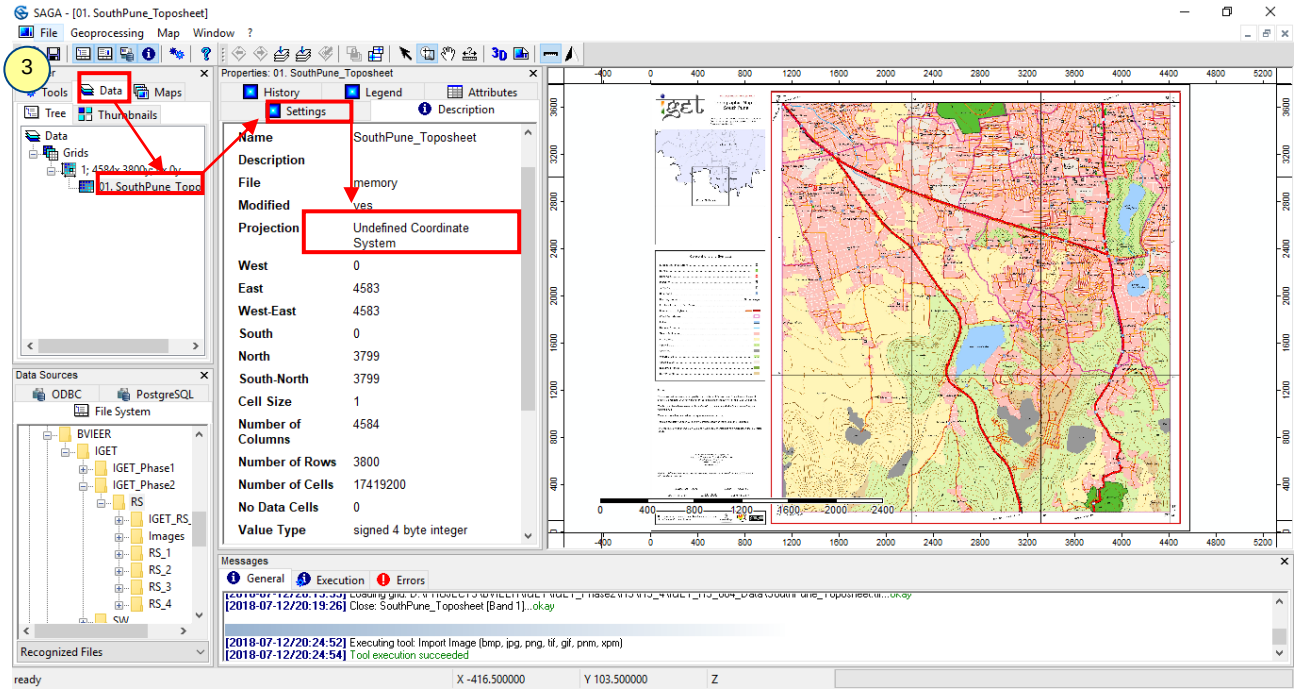
Georeferencing *is a process of establishing a mathematical relationship between the image coordinate system to the real world spatial coordinate system.* In this exercise, we will use a topographical map of South Pune, prepared by *Institute of Environment Education and Research (IEER)*, Bharati Vidyapeeth University (BVU), Pune. This map is in the Universal Transverse Mercator (UTM) projection based on WGS 84 Datum.

1. Start SAGA GIS on computer. To open the toposheet we must first import it into SAGA GIS. Open the '***Import Image***' module via the menu (*Geoprocessing → File → Grid → Import → Import Image*). In the '***Import Image***' dialog box click on the '*Image File*', now we set the path to the toposheet by clicking on the ... button and then navigating to the 'SouthPune_Toposheet.tif' supplied to you with the tutorial data, select the toposheet and click on '***Open***' in '*Open popup window*'.



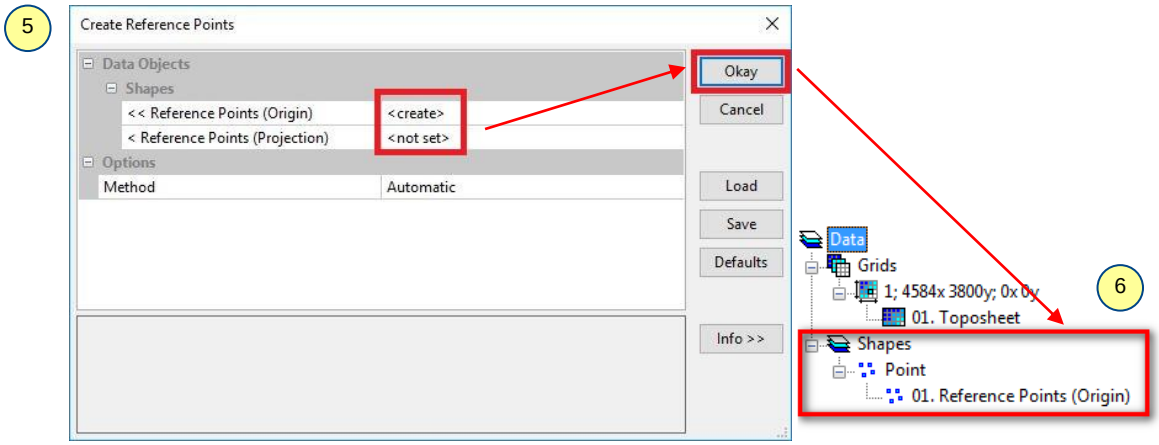
2. Click on the '***Options***' field and change it to '***Enforce True Color***'. – This keeps the colour balance of the image. Click '***Okay***'.

3. You can view the toposheet in the viewer by double-clicking on its entry under the '***Data***' tab. Then click on the Description '***Description***' tab in the *Object Properties* window. Look at the entry next to '***Projection***'. You will see that it is given as an '*Undefined Coordinate System*'. This indicates that the toposheet is not georeferenced and also not associated with any projection system.



4. To georeference a raster image we use ground control points (GCPs) to assign a real-world coordinate system. It means in the process of georeferencing, we will establish a relationship between pixel coordinate system of the raster file to the geographical or projected coordinate system of the earth. For this, we need to use distinct sharp features which can be easily identifiable. In satellite images we use road junctions and building corners, but in the case of our toposheet we will use the graticule intersections of the latitude and longitude, because we know the geographical coordinates of them.

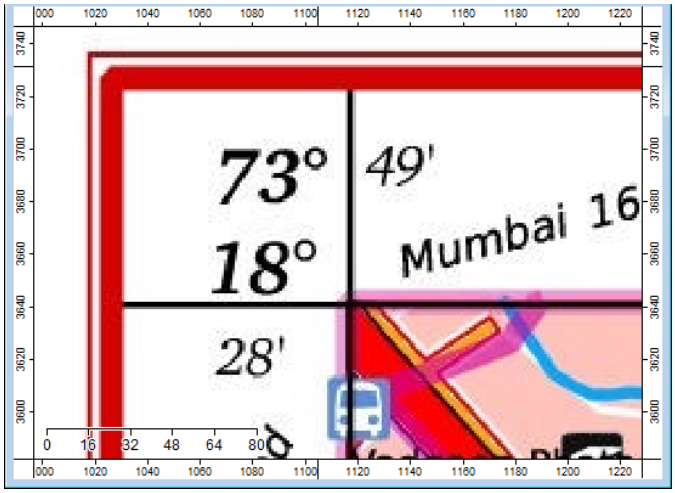
5. To start adding GCPs, start the '***Create Reference Points***' module (*Geoprocessing → Projections → Georeferencing → Create Reference Points [interactive]*). This module is marked as [interactive] because it requires the user to input data while the module is running. When the module opens click '***Okay***'. This will start the module. A new point shapefile layer will be seen in the data list.



6. In SAGA GIS, the *Reference Point module* basically creates a shapefile with 2 attributes, X and Y which are used to store the *Latitude* and *Longitude* of a point as defined by the user. However the coordinates of this shapefile itself are linked to the pixel coordinates of original image. Hence it has the attached *'[Origin]'* tag.

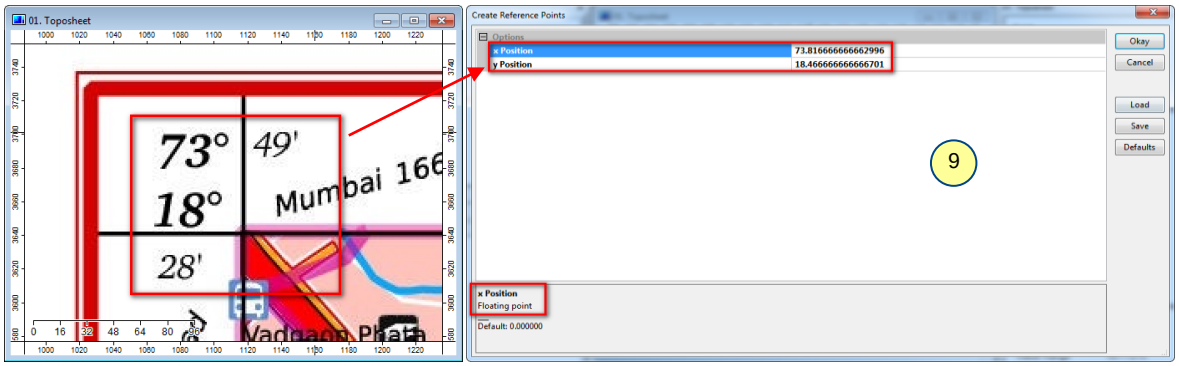
7. Use the *'Zoom'* tool to view the area next to the top left corner of the toposheet. Zoom in further to the intersection of the coordinates. We will mark the first GCP in the middle of the graticule intersection.

7



8. Note down the coordinates of the intersection (It will be ***73° 49' E, 18° 28' N***). Click on the 'Action' button (the cursor will change to a '+' sign) and then click on the centre of the intersection. This will open a ***'Create Reference Points'*** window which will require you to input the X and Y coordinates of the GCP.

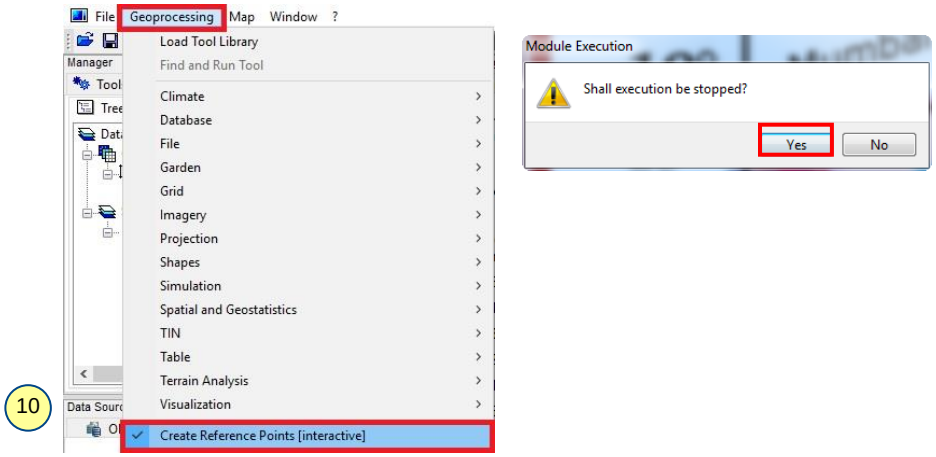
8



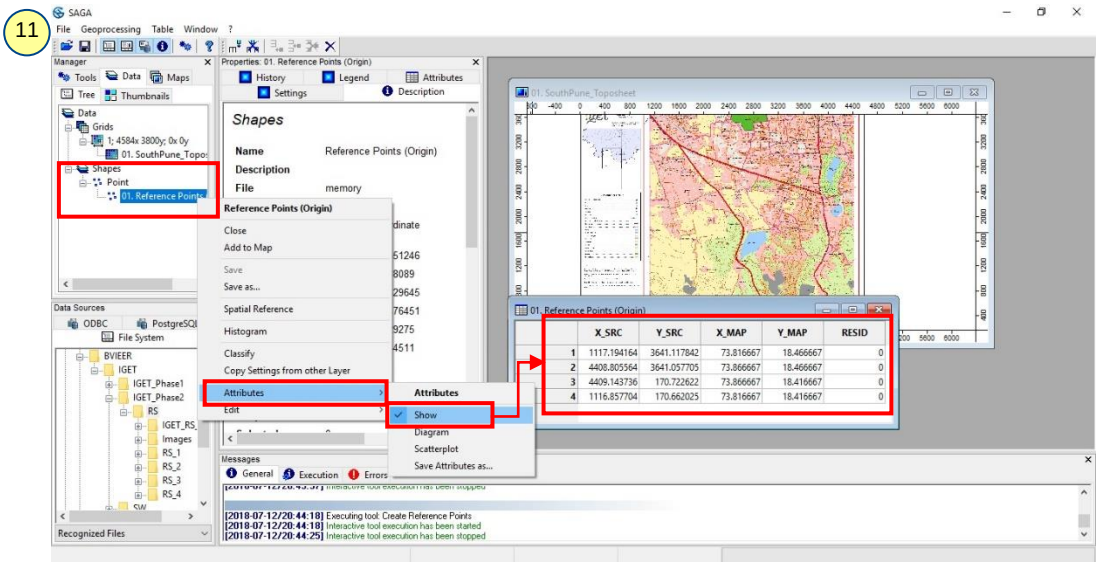
9. Click on the 'x position' entry. You will see that at the lower half of the window a comment appears 'X Position Floating point'. This means that the coordinates will have to be entered in the ***Decimal Degree (DD)*** format. However, our coordinates are in ***Degree Minutes Seconds (DMS)*** format. To convert from DMS to DD, simply divide the Minutes' value by 60 and add it to the Degrees' value. Now enter *Longitude* in *X position* and *Latitude* in *Y position* click on ***'Okay'***.

Thus for the DMS coordinate value of 73° 49’, it would translate to 73.816666666667 in DD format. Similarly, 18° 28’ would become 18.4666666666667. (In case of Seconds we divide the Seconds’ value by 3600 and add it to the DD value)

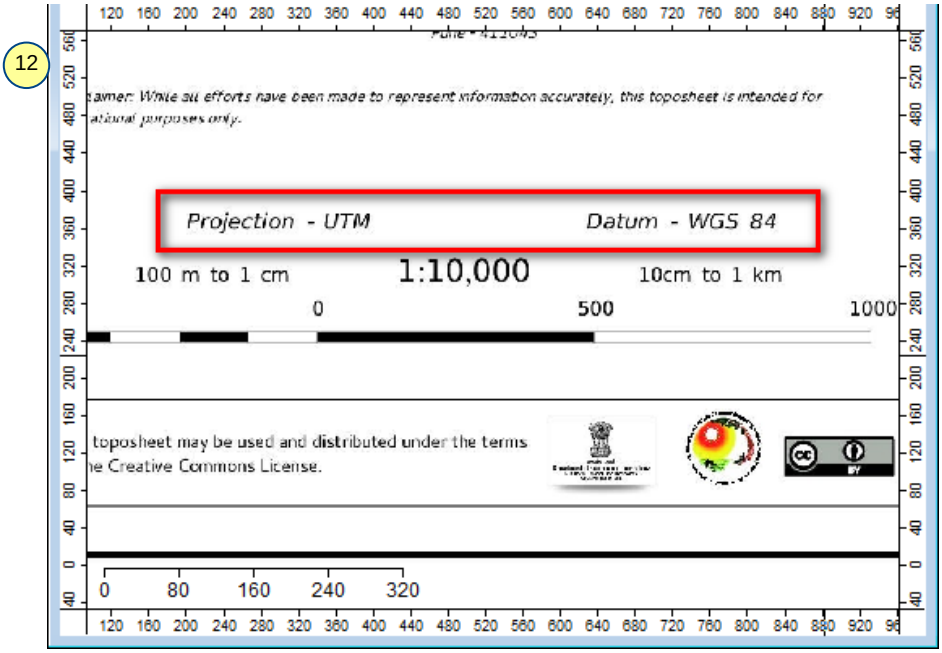
10. Similarly we mark 3 more GCPs on the other corners of the toposheet, use *scroll button* in the mouse for navigation. Once you are done with adding GCPs, end the module by unchecking it from the menu bar (*Geoprocessing → Create Reference Points*). Click ‘***Yes***’ on the pop up window.



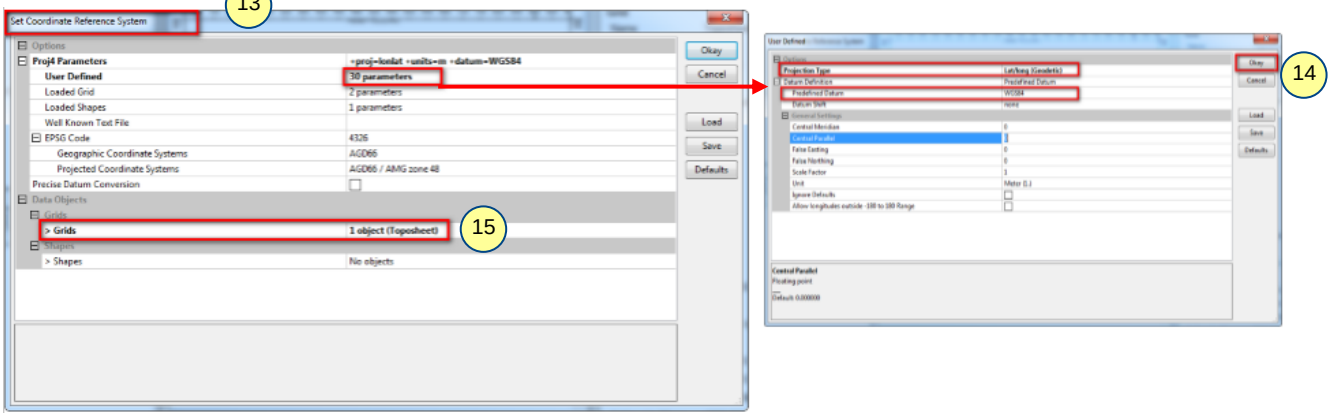
11. After adding GCPs to the image, you can have a look of added GCP’s and the pixel coordinates associated with it. Now right click on the ‘*Reference Point [interactive]*’ under ‘*Shapes*’ in the *Data* tab → point the cursor to the ‘*Attributes*’ and Click on ‘***Show***’. Now a new popup window will appear, it shows the GCP coordinates we entered. Close the ‘***Table***’ by click on Red Cross.



12. Now, we have to assign a coordinate reference system to the image. The coordinate system information will be published at the time of map print, in our map it is printed just above the scale bar. Use the Zoom tool to zoom into the lower left part of the toposheet just above the scale bar. The datum used for the toposheet is given as '***WGS 84***', and the projection is '***UTM***'. We will use this information to assign projection to the toposheet. Since we entered the *spherical coordinates* i.e., *latitude and longitude* values, which corresponds to the datum. Therefore we will georeference this map in *Geographic Coordinate System (GCS)* of *WGS 84*.



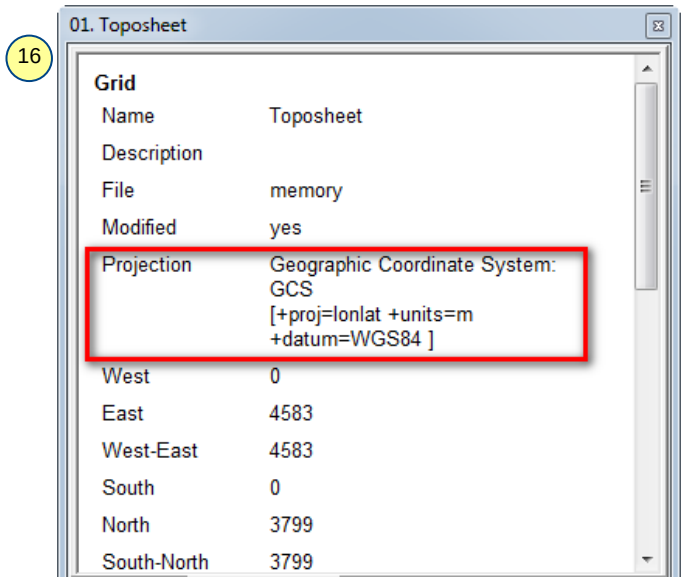
13. Open the ***Coordinate Reference System*** module via the menu (*Geoprocessing → Projection → Set Coordinate Reference System*). This will open a window with options for changing/assign the projection to datasets. Select the space next to '***User Defined***' marked as '***30 parameters***' and then click on the ... button.



14. A Dialog box will open containing several parameters for our projection. Change the '*Projection Type*' to '***Lat/long (Geodatic alias)***'. Change the 'Predefined datum to '***WGS 84***', click '***Okay***'.

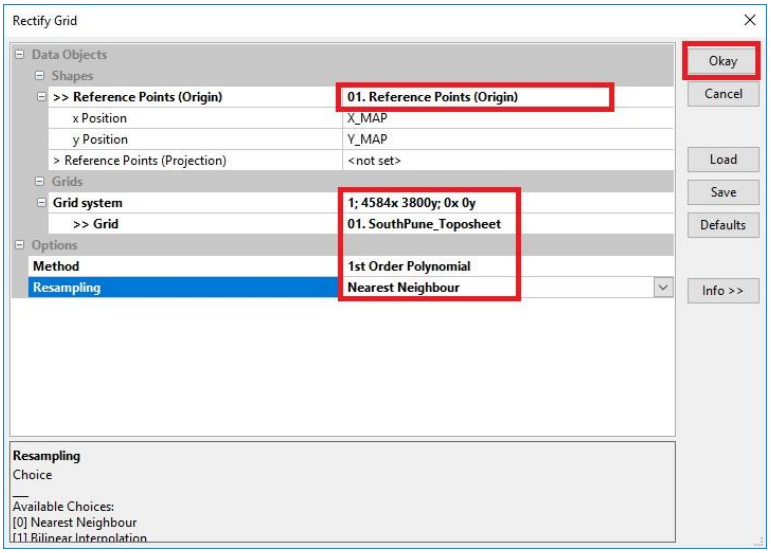
15. Now go to the '***Data Objects***' section in *Set Coordinate Reference System* window. Click on the entry '***No objects***' of '*Grids*' and then click on the ... button which appears to the right. This will open a window from where we choose the layer to be projected. Now select the layer 'Toposheet' on left side the press on > button you can see it transferred to right side, click '***Okay***'. Now click on '***Okay***' to finish

16. Now select the '*Toposheet*' under Data list. Then click on the Description '***Description***' tab in the *Object Properties* window. Look at the entry next to '***Projection***'. You will see that it is given as '*GCS WGS84*'. This indicates that the toposheet is assigned to GCS projection of WGS 84. Now we are ready to perform georeferencing.

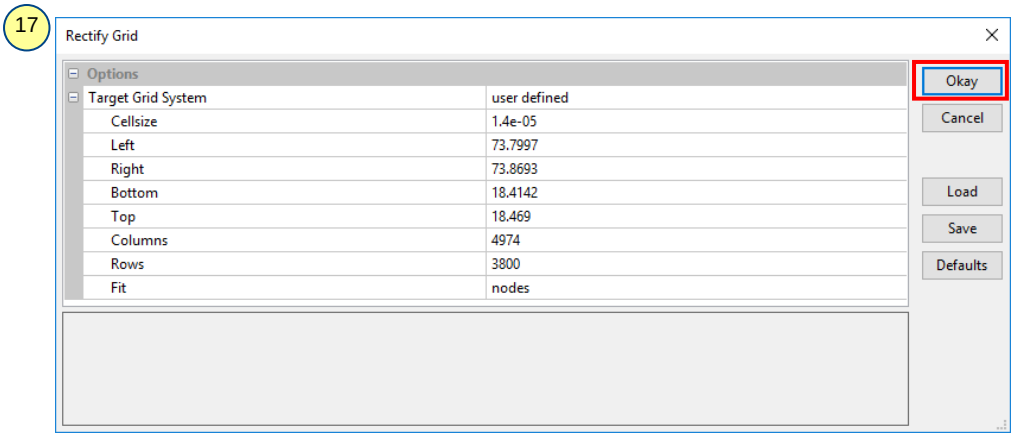


17. Open the Georeferencing module (*Geoprocessing* → *Projections* → *Georeferencing* → *Rectify Grid*) and fill in each of the fields as shown below. Click '***Okay***'.

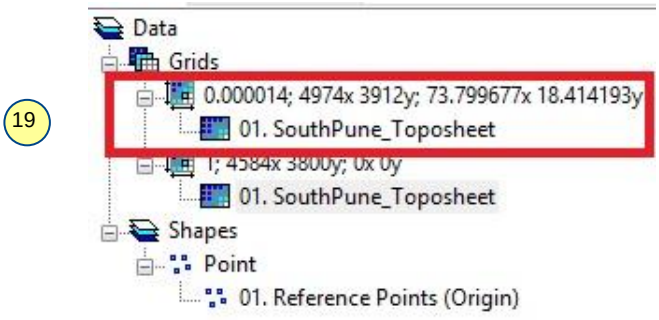
17



18. Another dialogue box will be open describing the *User Defined Grid*, with the extents, cell size and number of rows and columns. Click on '***Okay***'.

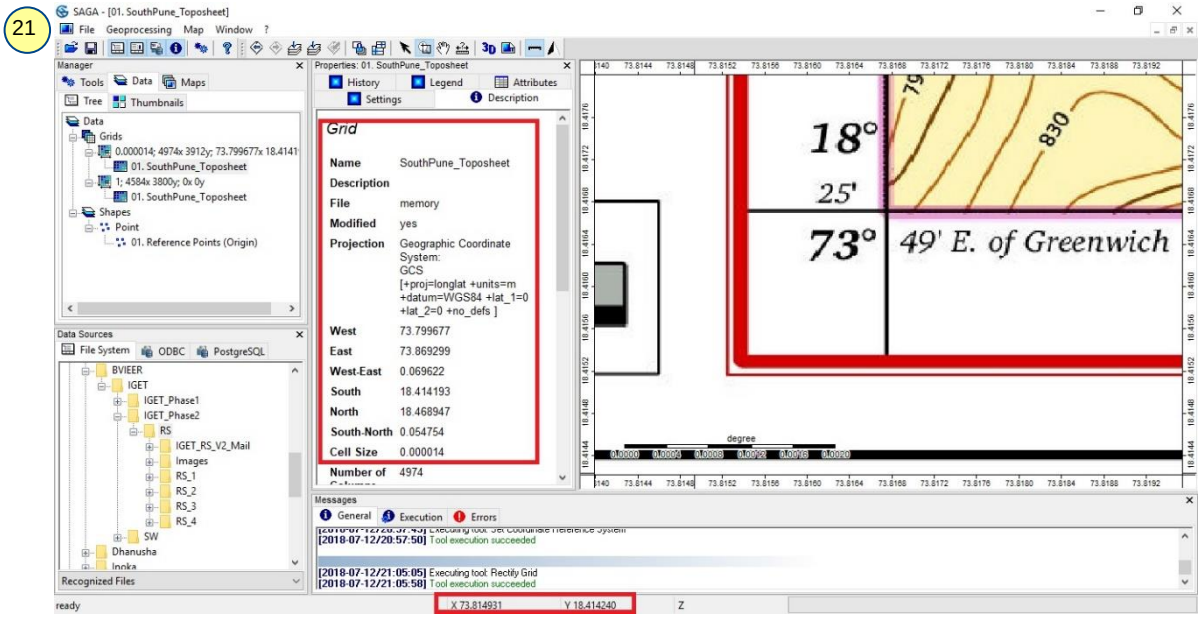


19. The newly created layer will be placed in a new grid system.

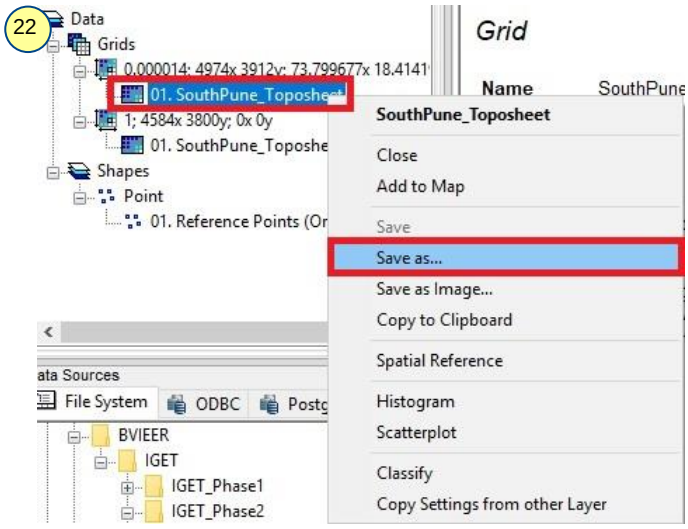


20. Open the new georeferenced toposheet in a new map window by double-clicking over it under *Data* tab. If it is not in true color, click on Settings tab in '*Object properties*' section change *colors Type* to '***RGB Coded Values***' and click on '***Apply***'.

21. Now check the georeferencing by placing the mouse cursor over any corner tick of map. Compare the values left to the *status bar* located at the right bottom of SAGA interface.



22. Don't forget to save the georeferenced image. Right-click on the Georeferenced toposheet under *Data* tab, then select '***Save As***'. Navigate to the desired output folder in '*Save Grid*' window. Name it as '*Geo_WGS84_punetoposheet*' and save as type as '*.sgrd' click on '***Save***' to finish.



23. Now load the 'Geo_WGS84_punetoposheet.sgrd' to the SAGA by using '*Load*' utility.

24. Close the project via, Main menu bar (*File → Exit*) press '***Yes***' to close. If you want to save any unsaved layers '***Check***' the corresponding check boxes of layers, then browse for the desired location on your hard drive, give a proper name and click on '***Okay***'. If you don't want to save simply press on '***Okay***' without checking any check boxes.