

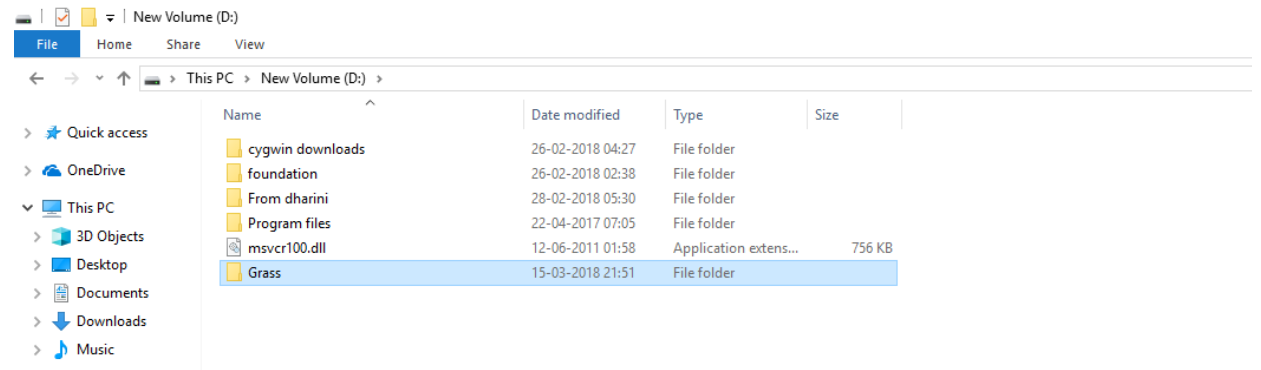


Introduction to Grass GIS

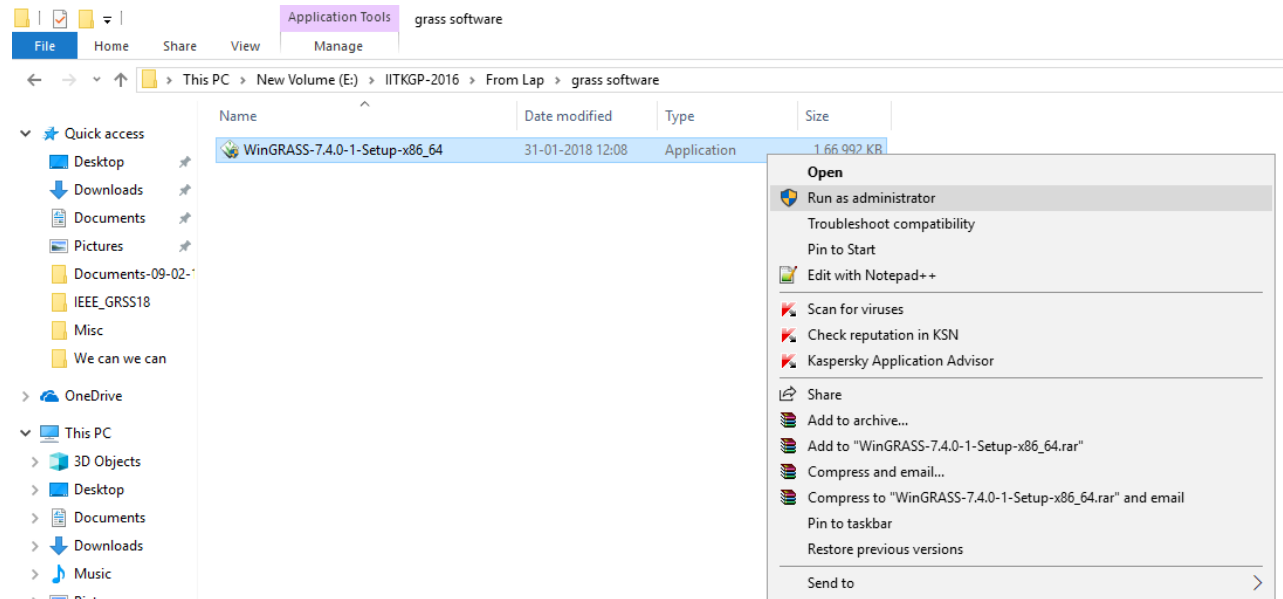
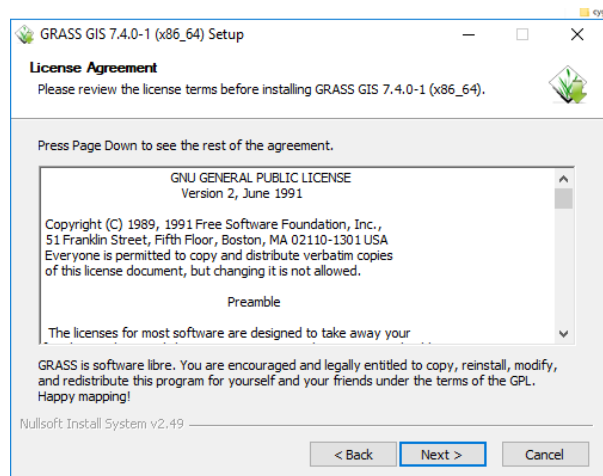


Chandan M C
IIT-KGP

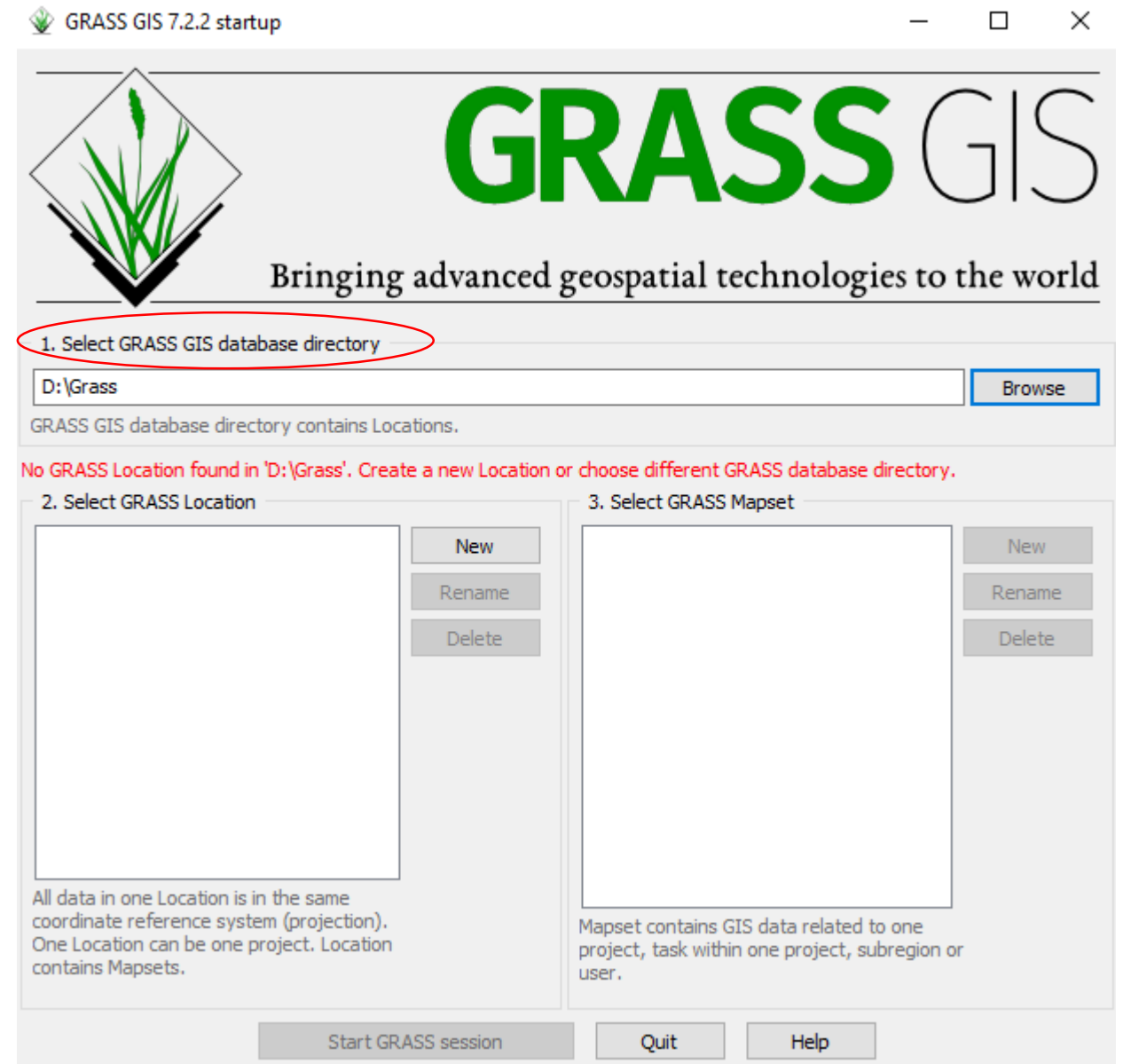
- Create a new folder in your local drive (for ex: D or E drive) and rename it as Grass. Do not add any folders inside this.



- Install Grass latest version.



1. Select “Grass” folder that you created in the previous step. All the analysis files will be stored in this directory.

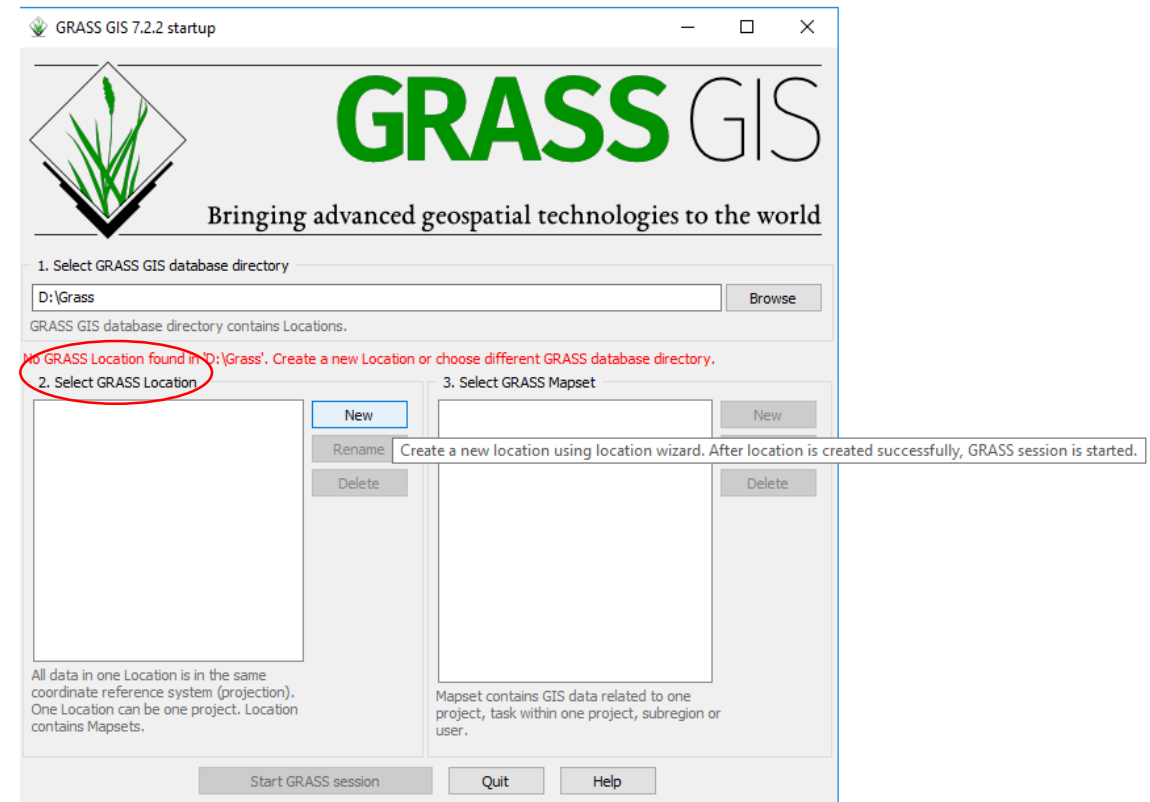
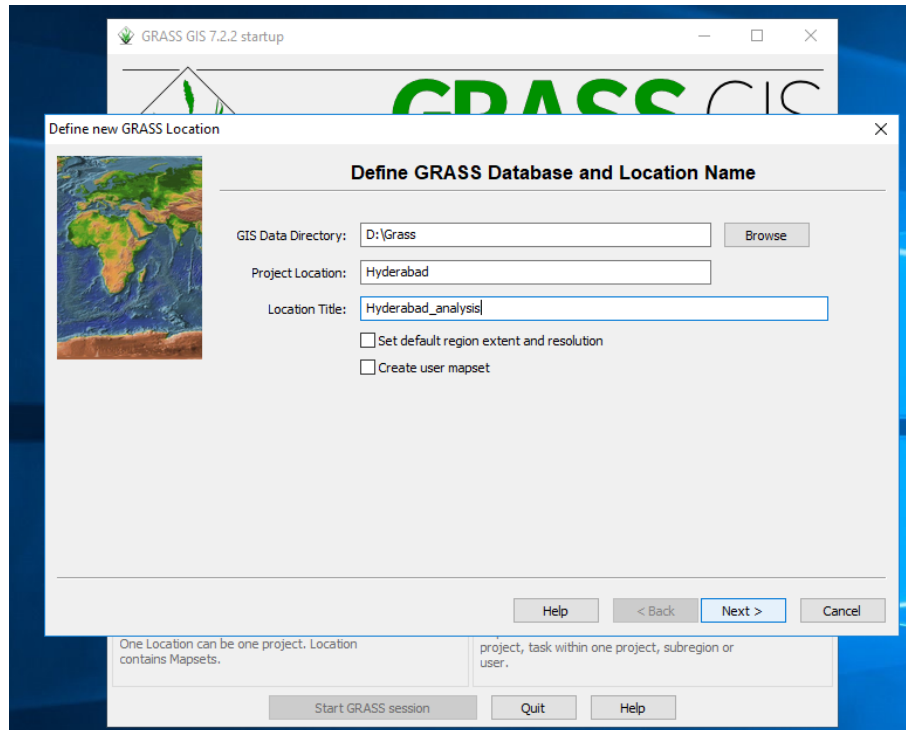


2. Select Grass location. Click on “New” tab.

Specify Project location as your study area name (ex: Hyderabad)

Specify location title

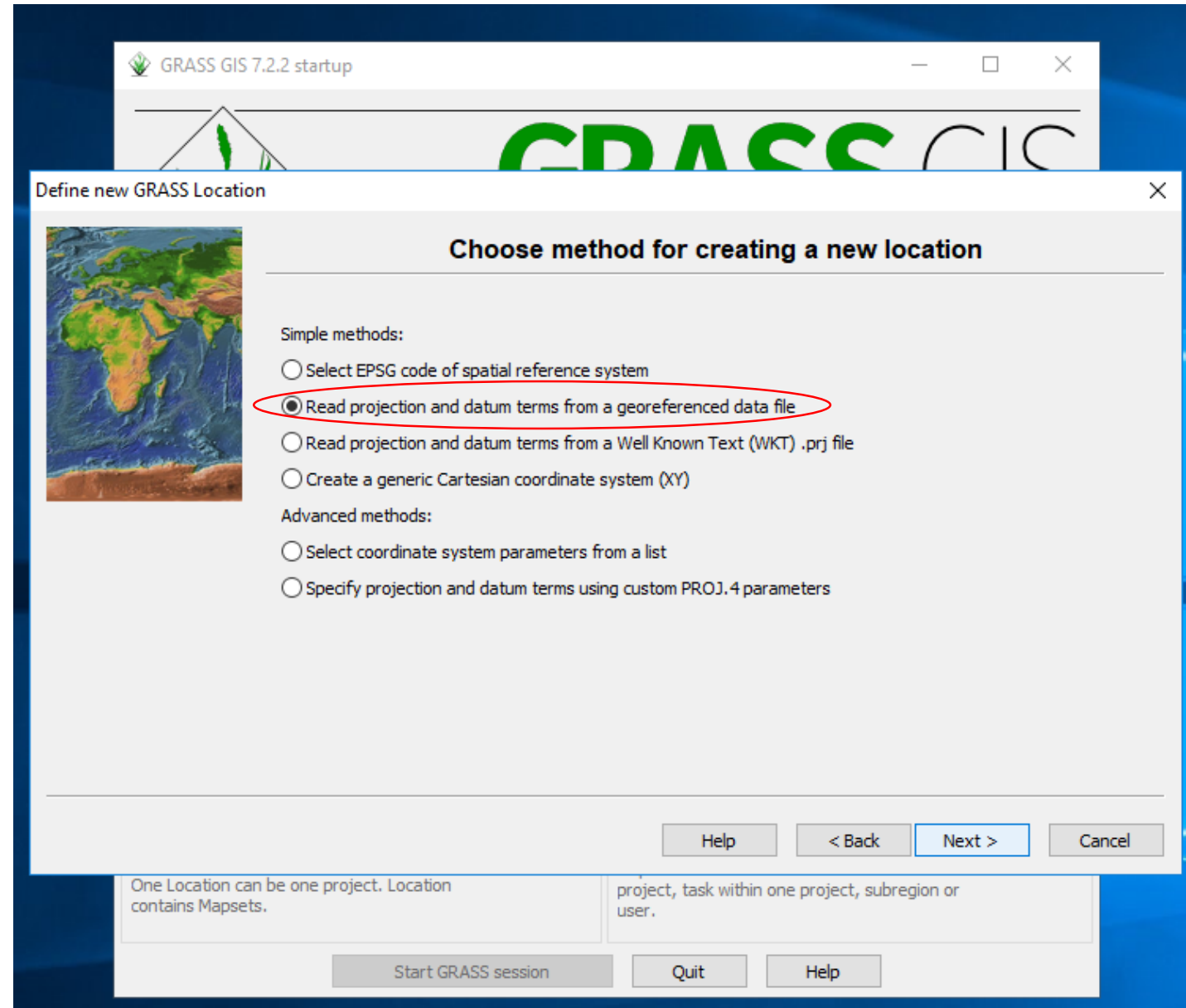
(ex: Hyderabad_analysis) and click next.



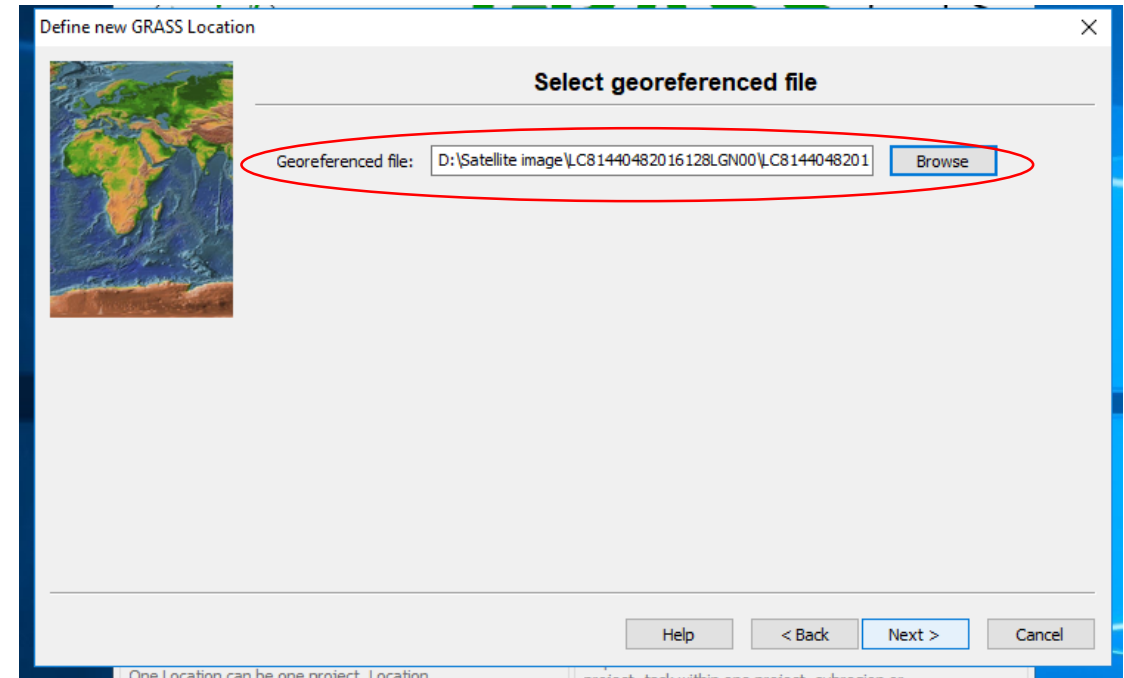
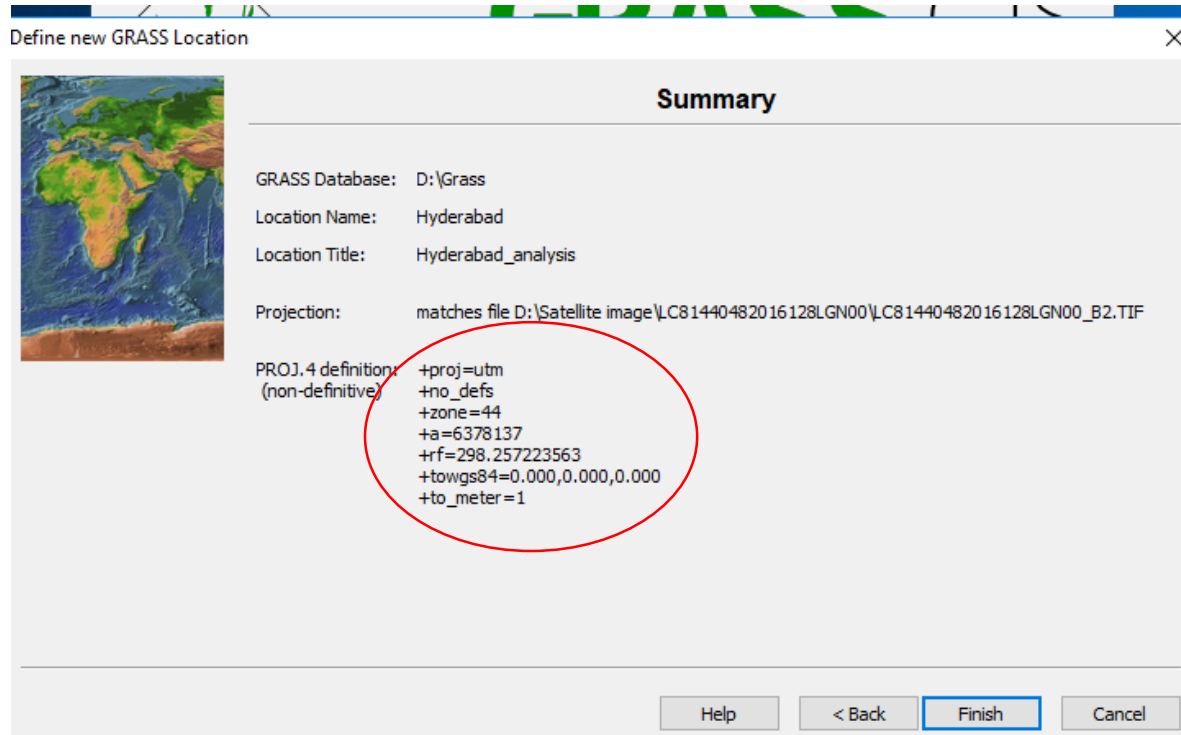
Note: Grass is a c language oriented software, hence avoid giving space, use underscore (_) instead.

- In this step we will specify a method to create location details and coordinate extent of the area of interest.

Select option “Read projection and datum terms from a georeferenced data file” and press next.



- Select any georeferenced file (preferably in UTM coordinate system). Ex: Landsat 8, band 2
- Click next
- Carefully examine projection information and click finish.



- In the next dilouge, Click “ok” and select import data “Yes”. Import successful, click “ok”.

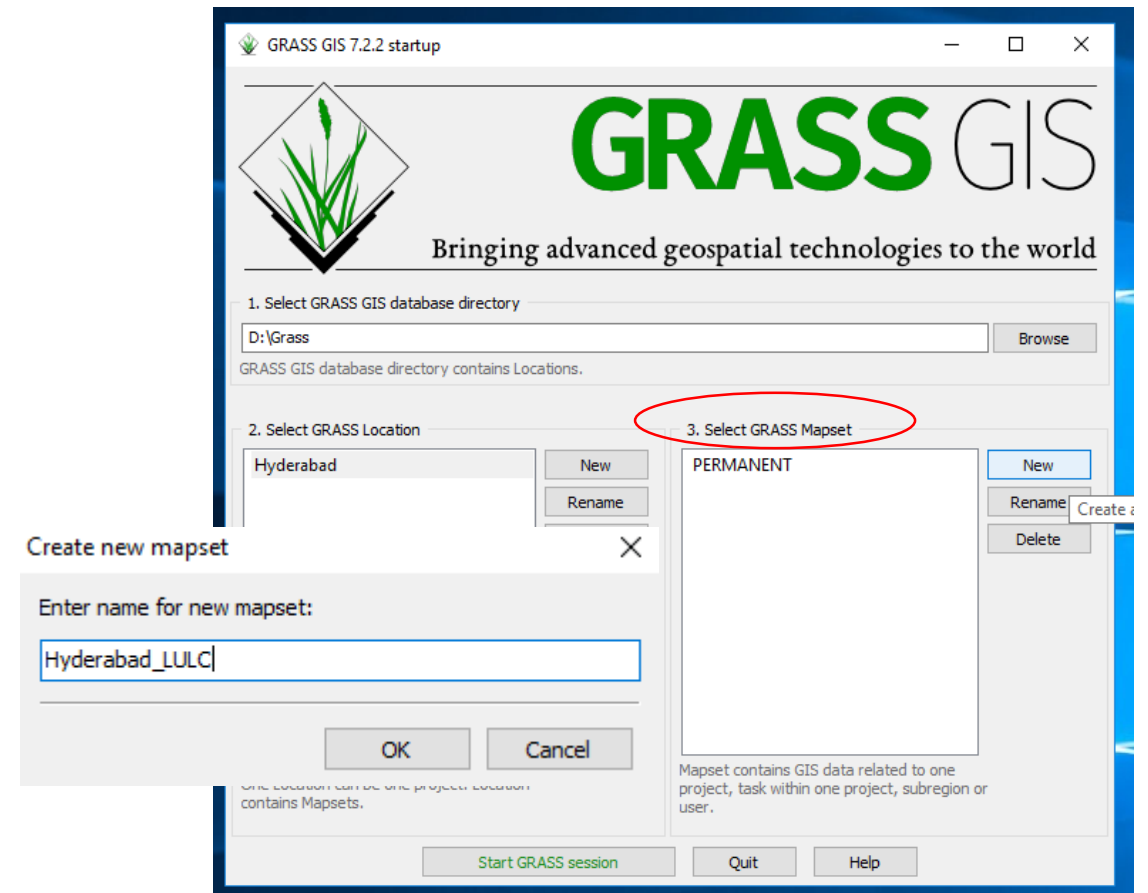
3. Creating Mapset.

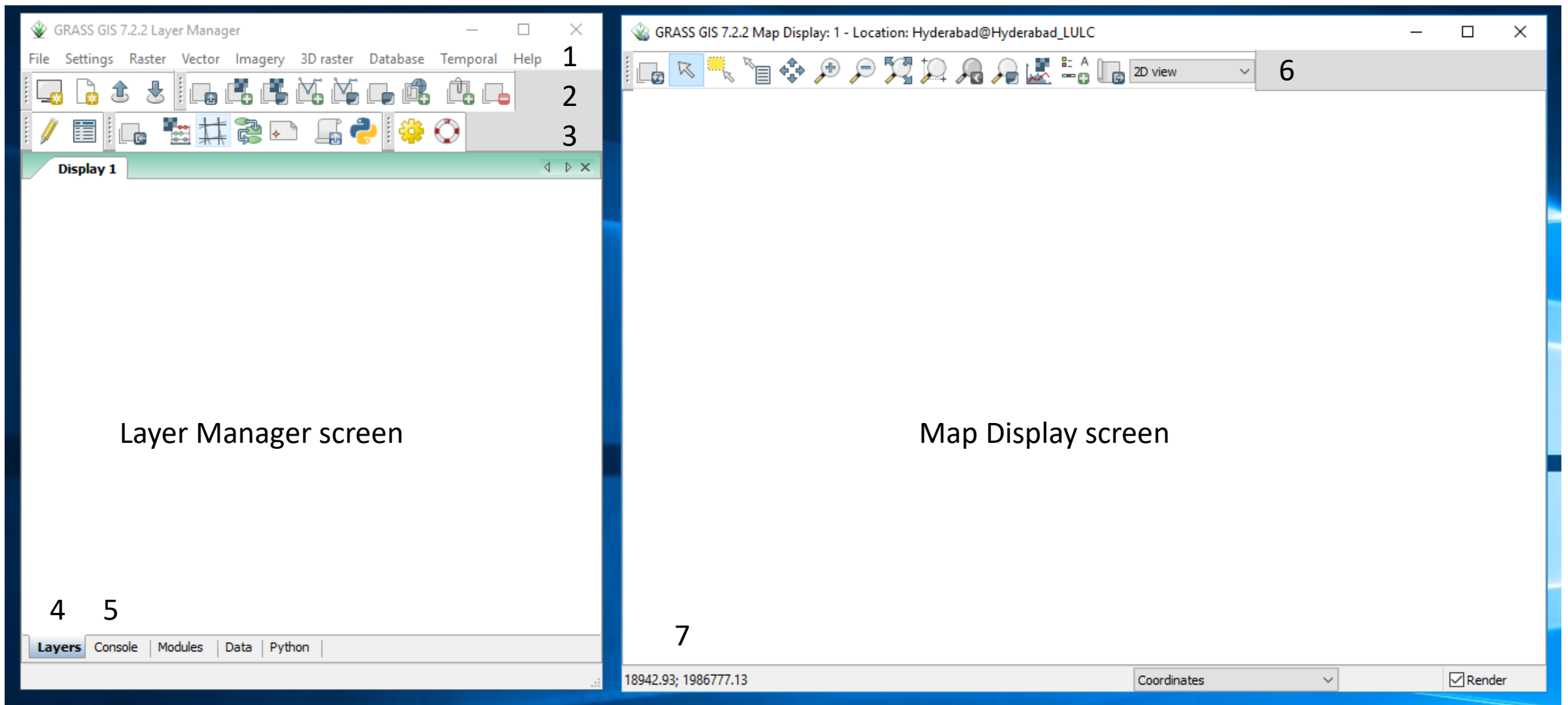
Click on “New”

Ex: Name new mapset as
“Hydrabad_LULC”.

Click on ok.

Click on “Start GRASS session”.





Layer Manager screen

Map Display screen

- 1 Tool bar
- 2 Layer manager options
- 3 Editing and other options
- 4 Layer details
- 5 Command console

- 6 Map display tool bar
- 7 Coordinates

Type	Commands used	Description
Vector commands	v.in.ogr	Importing vector file
	v.out.ogr	Exporting vector file
	v.to.rast	Vector to Raster conversion
	v.proj	To project a vector file
	v.build.polylines	To correct line features
Raster commands	r.in.gdal	Importing raster file
	r.out.gdal	Exporting raster file
	r.reclass	Raster reclassification
	r.colors	Assigning colors to raster map
	r.report	Raster report
	r.mapcalc	Raster map calculator
	r.composite	Raster map composition
	r.patch	Raster map patching
Image commands	i.colors.enhance	To enhance raw satellite band
	i.group	To group images
	i.gensig	To generate signatures
	i.maxlik	Maximum likelihood classifier

IMPORTING RASTER

Command: `r.in.gdal`

Under source type choose directory, browse to navigate to the satellite image folder.

Ex: Landsat folder

Layer name is editable. Rename B2 as Blue, B3 as Green, B4 as Red and B5 as NIR.

Click on Import.

Import raster data

Profiles

Load: Save Remove

Source type

☐ File ☒ Directory ☐ Database ☐ Protocol

Source input

Format: GeoTIFF Extension: tif

Directory: D:\Satellite image\LC81440482016128LGN00 Browse

List of raster layers - right click to (un)select all

Layer id	Layer name	Projection ma...	Name for output GRASS map (editable)
☐ 1	LC81440482016128LGN00_B1.TIF	Yes	LC81440482016128LGN00_B1
☐ 2	LC81440482016128LGN00_B10.TIF	Yes	LC81440482016128LGN00_B10
☐ 3	LC81440482016128LGN00_B11.TIF	Yes	LC81440482016128LGN00_B11
☒ 4	LC81440482016128LGN00_B2.TIF	Yes	Blue
☒ 5	LC81440482016128LGN00_B3.TIF	Yes	Green
☒ 6	LC81440482016128LGN00_B4.TIF	Yes	Red
☒ 7	LC81440482016128LGN00_B5.TIF	Yes	NIR
☐ 8	LC81440482016128LGN00_B6.TIF	Yes	LC81440482016128LGN00_B6
☐ 9	LC81440482016128LGN00_B7.TIF	Yes	LC81440482016128LGN00_B7
☐ 10	LC81440482016128LGN00_B8.TIF	Yes	LC81440482016128LGN00_B8
☐ 11	LC81440482016128LGN00_B9.TIF	Yes	LC81440482016128LGN00_B9
☐ 12	LC81440482016128LGN00_BQA.TIF	Yes	LC81440482016128LGN00_BQA

☐ Override projection check (use current location's projection)

☐ Allow output files to overwrite existing files

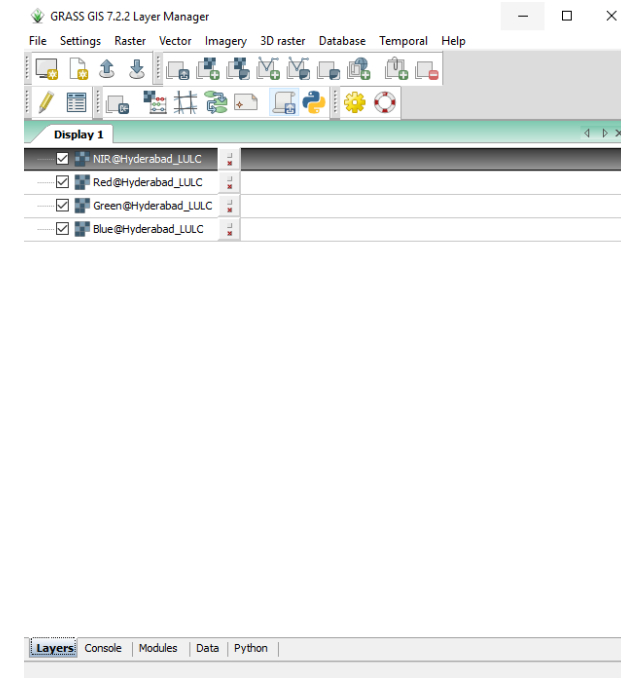
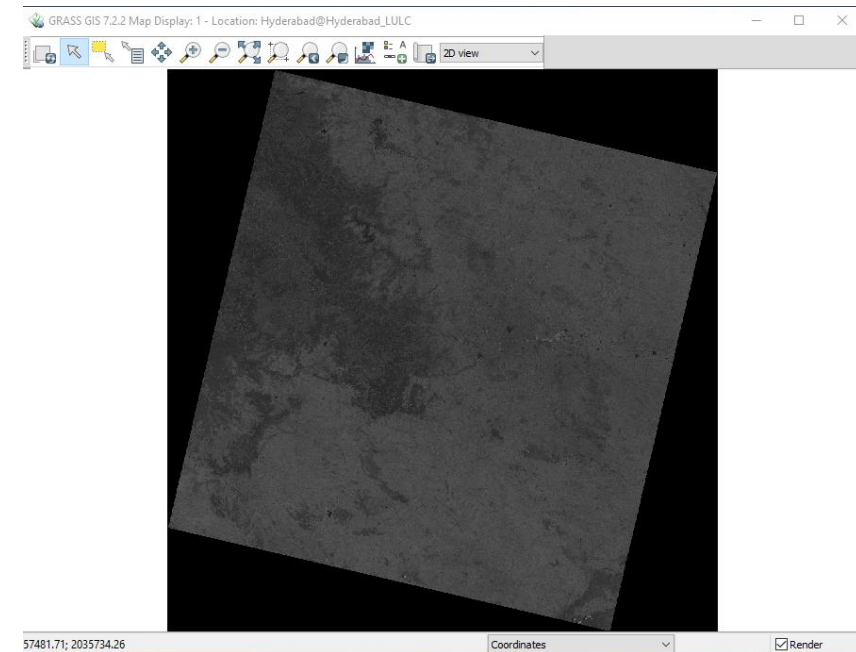
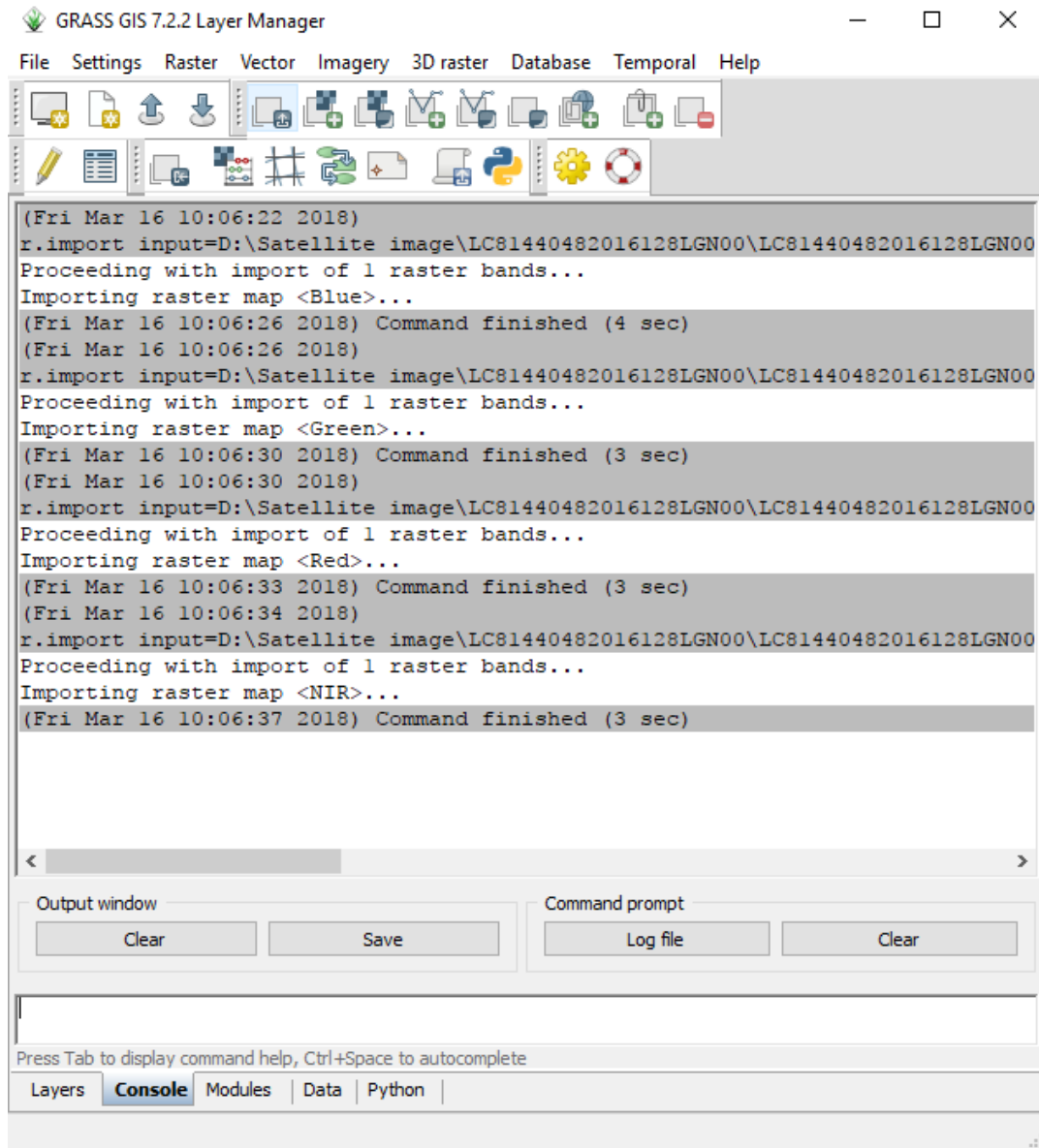
☒ Add imported layers into layer tree

☐ Close dialog on finish

Close Import

Source settings Import settings

IMPORTING RASTER



IMPORTING VECTOR

Command: v.in.ogr

Under source type choose file, browse to navigate to the boundary shapefile folder.

Ex: Hyderabad boundary.

Make sure Projection information is present (yes).

Click on Import.

Import vector data

Profiles

Load: Save Remove

Source type

☒ File ☐ Directory ☐ Database ☐ Protocol

Source input

File: Browse

List of vector layers - right click to (un)select all

Layer id	Layer name	Feature type	Projection...	Name for output GRASS map (...)
☒ 1	HMDA_Boundary_UTM	3dpolygon	Yes	HMDA_Boundary_UTM

☐ Override projection check (use current location's projection)

☐ Allow output files to overwrite existing files

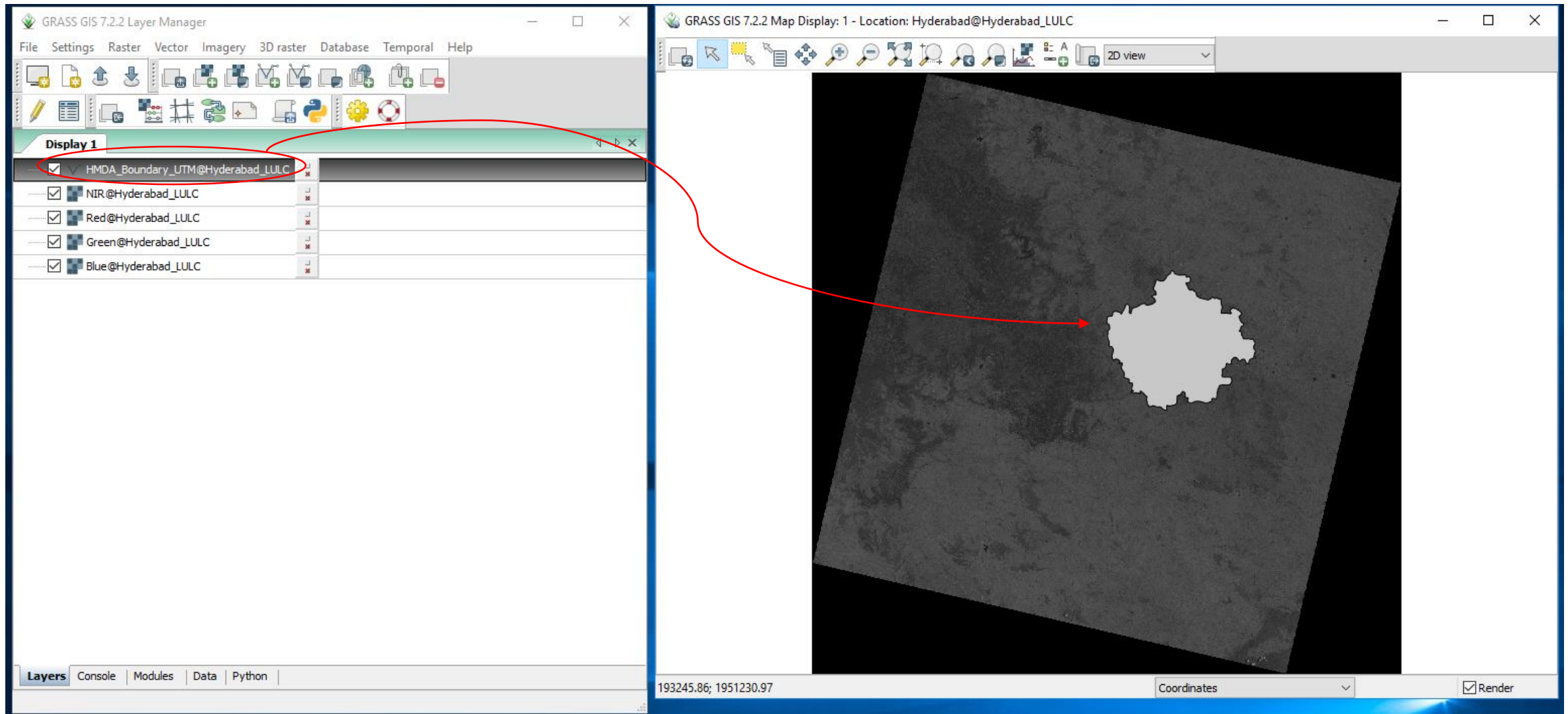
☒ Add imported layers into layer tree

☐ Close dialog on finish

Close Import

Source settings Import settings

IMPORTING VECTOR



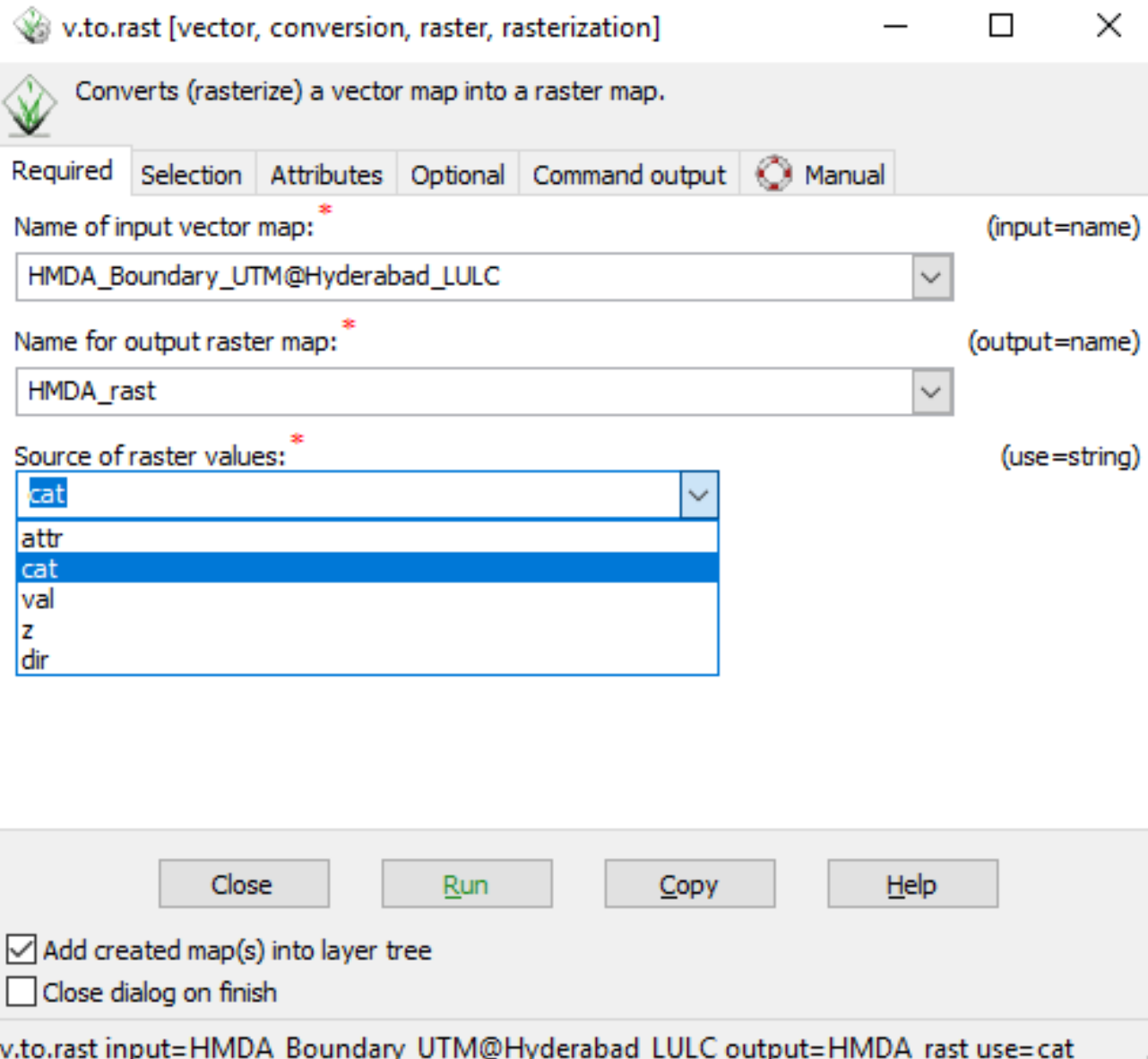
CONVERTING VECTOR TO RASTER

Command: v.to.rast

Give input and output name.

Select source of raster values as cat (category).

Click on Run.



The screenshot shows the 'v.to.rast' dialog box in QGIS. The title bar reads 'v.to.rast [vector, conversion, raster, rasterization]'. The description states 'Converts (rasterize) a vector map into a raster map.' The dialog has five tabs: 'Required', 'Selection', 'Attributes', 'Optional', and 'Command output'. The 'Required' tab is active. It contains three input fields: 'Name of input vector map:' with the value 'HMDA_Boundary_UTM@Hyderabad_LULC' and a dropdown arrow, 'Name for output raster map:' with the value 'HMDA_rast' and a dropdown arrow, and 'Source of raster values:' with a list box containing 'cat', 'attr', 'cat', 'val', 'z', and 'dir'. The 'cat' option is selected. To the right of each field is a label: '(input=name)', '(output=name)', and '(use=string)'. At the bottom, there are four buttons: 'Close', 'Run' (highlighted in green), 'Copy', and 'Help'. Below the buttons are two checkboxes: 'Add created map(s) into layer tree' (checked) and 'Close dialog on finish' (unchecked). At the very bottom, a status bar shows the command: 'v.to.rast input=HMDA_Boundary_UTM@Hyderabad_LULC output=HMDA_rast use=cat'.

v.to.rast [vector, conversion, raster, rasterization]

Converts (rasterize) a vector map into a raster map.

Required Selection Attributes Optional Command output Manual

Name of input vector map: * (input=name)
HMDA_Boundary_UTM@Hyderabad_LULC

Name for output raster map: * (output=name)
HMDA_rast

Source of raster values: * (use=string)
cat
attr
cat
val
z
dir

Close Run Copy Help

☒ Add created map(s) into layer tree
☐ Close dialog on finish

v.to.rast input=HMDA_Boundary_UTM@Hyderabad_LULC output=HMDA_rast use=cat

CROPPING SATELLITE IMAGE ACCORDING TO STUDY AREA.

Command: r.mapcalc

Give Output (New name)

Give Map1*Map2 in Expression tab.

Ex: Blue band * Hmda_rast =
blue_crop (cropped blue band
according to hmda).

Click on Run.

The screenshot shows the GRASS GIS Raster Map Calculator window. The 'Operators' panel contains a grid of mathematical and logical operators. The 'Output' panel has a dropdown menu for the 'Name for new raster map to create' set to 'Blue_crop'. The 'Operands' panel has two dropdown menus for 'Insert mapcalc function' and 'Insert existing raster map'. The 'Expression' panel contains a text box with the expression 'Blue@Hyderabad_LULC * HMDA_rast@Hyderabad_LULC |'. At the bottom, there are buttons for 'Load', 'Save', 'Copy', 'Help', 'Run', and 'Close'. Below these buttons are three checkboxes: 'Generate random seed for rand()' (checked), 'Allow output files to overwrite existing files' (unchecked), and 'Add created raster map into layer tree' (checked). A 'Seed:' input field is next to the first checkbox. At the very bottom, a status bar displays the command: 'r.mapcalc expression="Blue_crop = Blue@Hyderabad_LULC * HMDA_rast@Hyderabad_LULC"'.

GRASS GIS Raster Map Calculator

Operators

+	-	&&	
*	/	&	
>	>=	&&&	
<	<=	<<	>>
==	!=	>>>	!
%	^	a ? b : c	~

Output

Name for new raster map to create

Blue_crop

Operands

Insert mapcalc function

Insert existing raster map

() Clear

Expression

Blue@Hyderabad_LULC * HMDA_rast@Hyderabad_LULC |

Load Save Copy Help Run Close

☒ Generate random seed for rand() Seed:

☐ Allow output files to overwrite existing files

☒ Add created raster map into layer tree

r.mapcalc expression="Blue_crop = Blue@Hyderabad_LULC * HMDA_rast@Hyderabad_LULC"

NDVI ANALYSIS

Command: r.mapcalc

Give Output (New name)

Ex. Expression

$\text{float}(\text{float}(\text{Num}) / \text{float}(\text{Den}))$

Click on Run.

The screenshot shows the GRASS GIS Raster Map Calculator window. The title bar reads "GRASS GIS Raster Map Calculator". The window is divided into several sections:

- Operators:** A grid of buttons for mathematical and logical operations. The exponentiation operator (^) is highlighted with a blue border.
- Output:** A section for defining the output map. The "Name for new raster map to create" dropdown menu is set to "NDVI_HMDA".
- Operands:** Two dropdown menus for inserting mapcalc functions and existing raster maps. The first dropdown is set to "float(x)".
- Expression:** A large text area containing the expression: `float( float( nir_crop@Hyderabad_LULC - Red@Hyderabad_LULC )/ float(nir_crop@Hyderabad_LULC +| Red@Hyderabad_LULC ))`. The text is partially cut off on the right.
- Buttons:** A row of buttons at the bottom: "Load", "Save", "Copy", "Help", "Run" (highlighted in green), and "Close".
- Options:** Three checkboxes at the bottom left: "Generate random seed for rand()" (checked), "Allow output files to overwrite existing files" (unchecked), and "Add created raster map into layer tree" (checked). A "Seed:" input field is next to the first checkbox.
- Status Bar:** At the very bottom, it displays the command: `r.mapcalc expression="NDVI_HMDA = float( float( nir_crop@Hyderabad_LULC - Red@Hyderabad_LULC )/ float`.

NDVI ANALYSIS

Command: r.colors

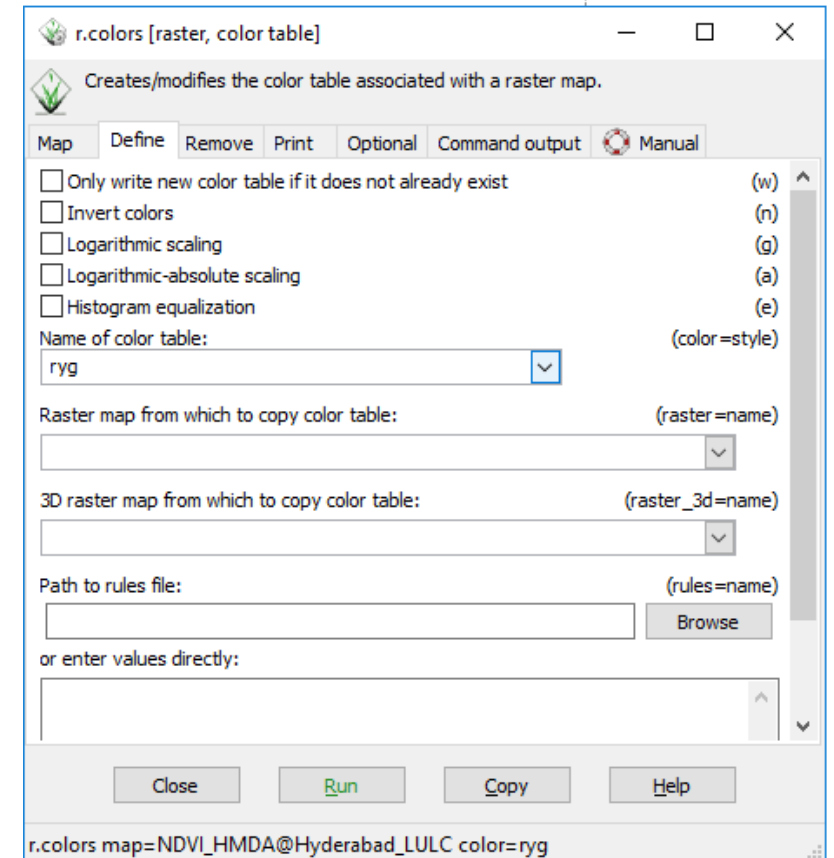
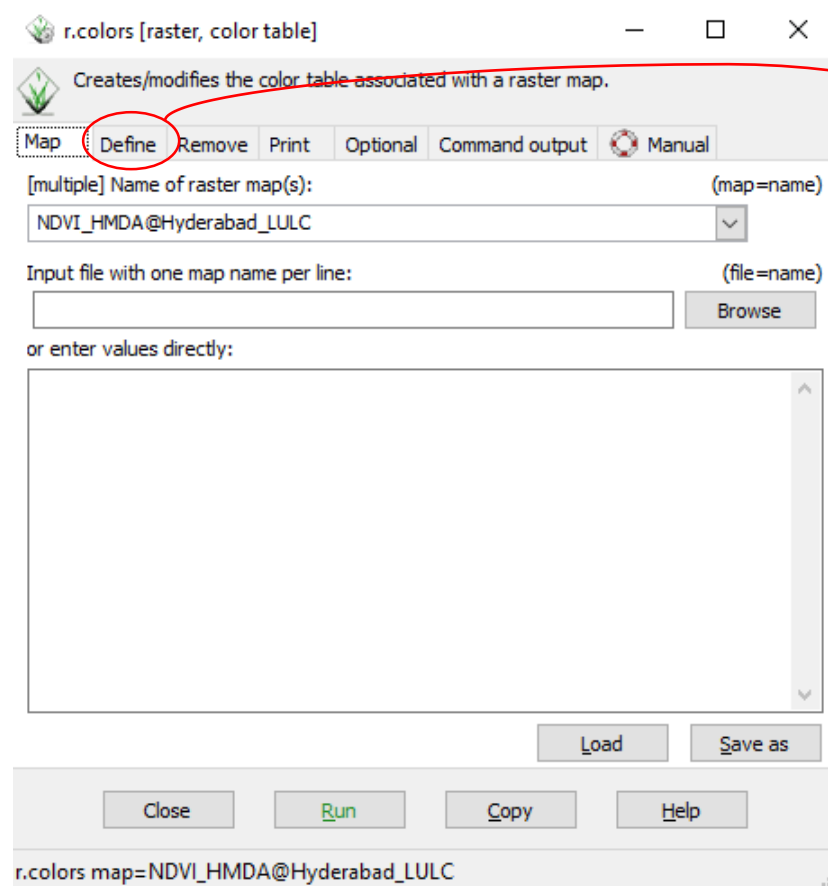
Choose NDVI map

Go to “Define” tab

Select “ryg”

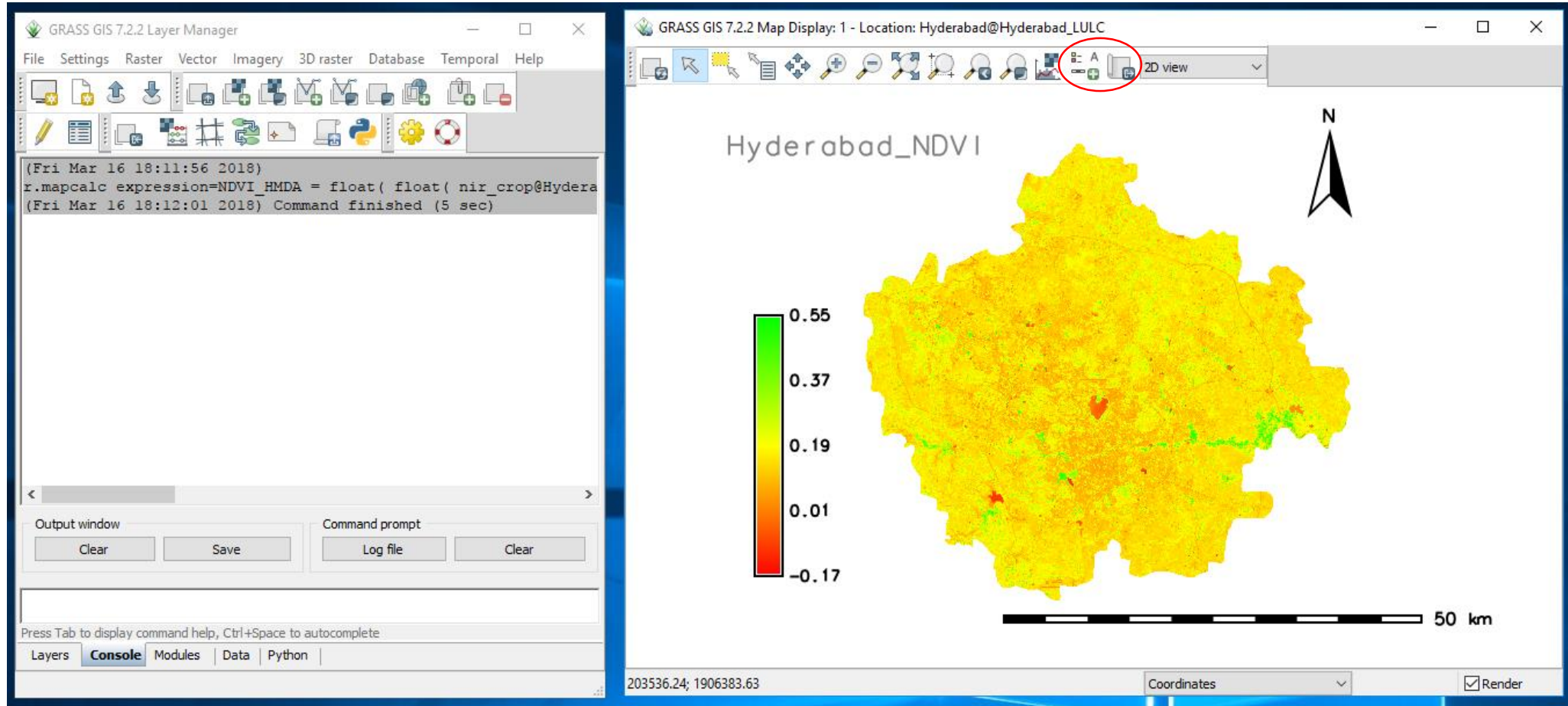
for Name of color table

Click on Run.



NDVI analysis

- Insert map elements like text, north arrow, scale and legend. Export map as jpeg (using save display to file option).



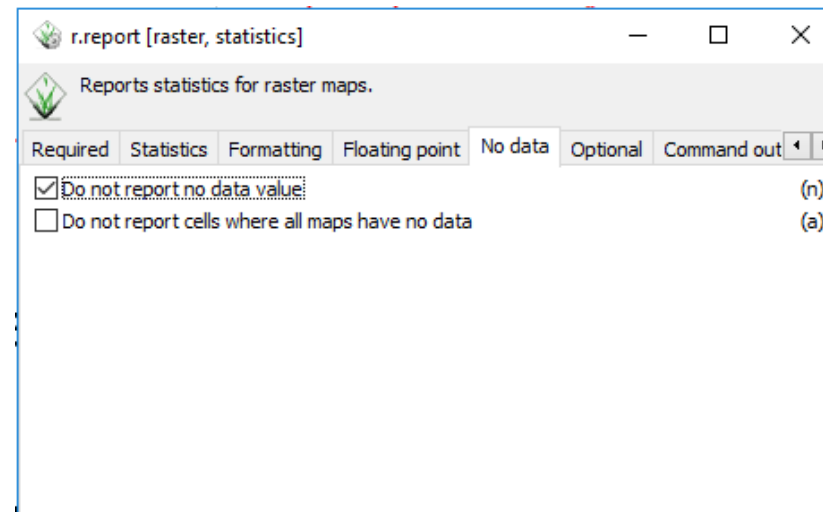
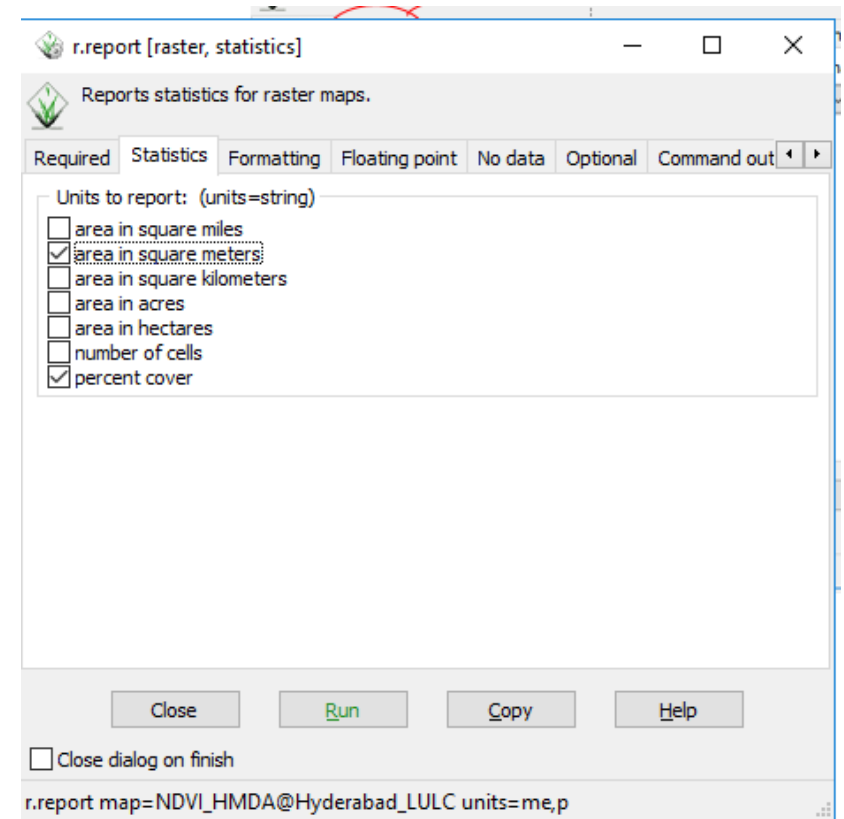
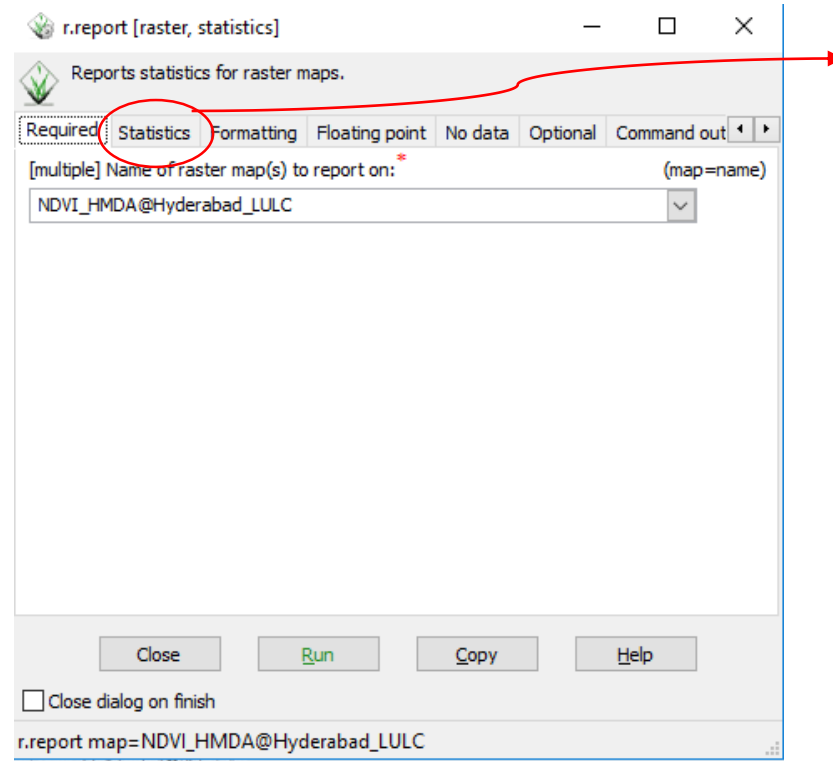
NDVI ANALYSIS - REPORT

Command: r.report

Choose NDVI map

- Go to “Statistics” tab
- Select required units
- Go to “No data” tab and check “Do not report no data value” option

Click on Run.



CREATING FALSE COLOR COMPOSITE (FCC)

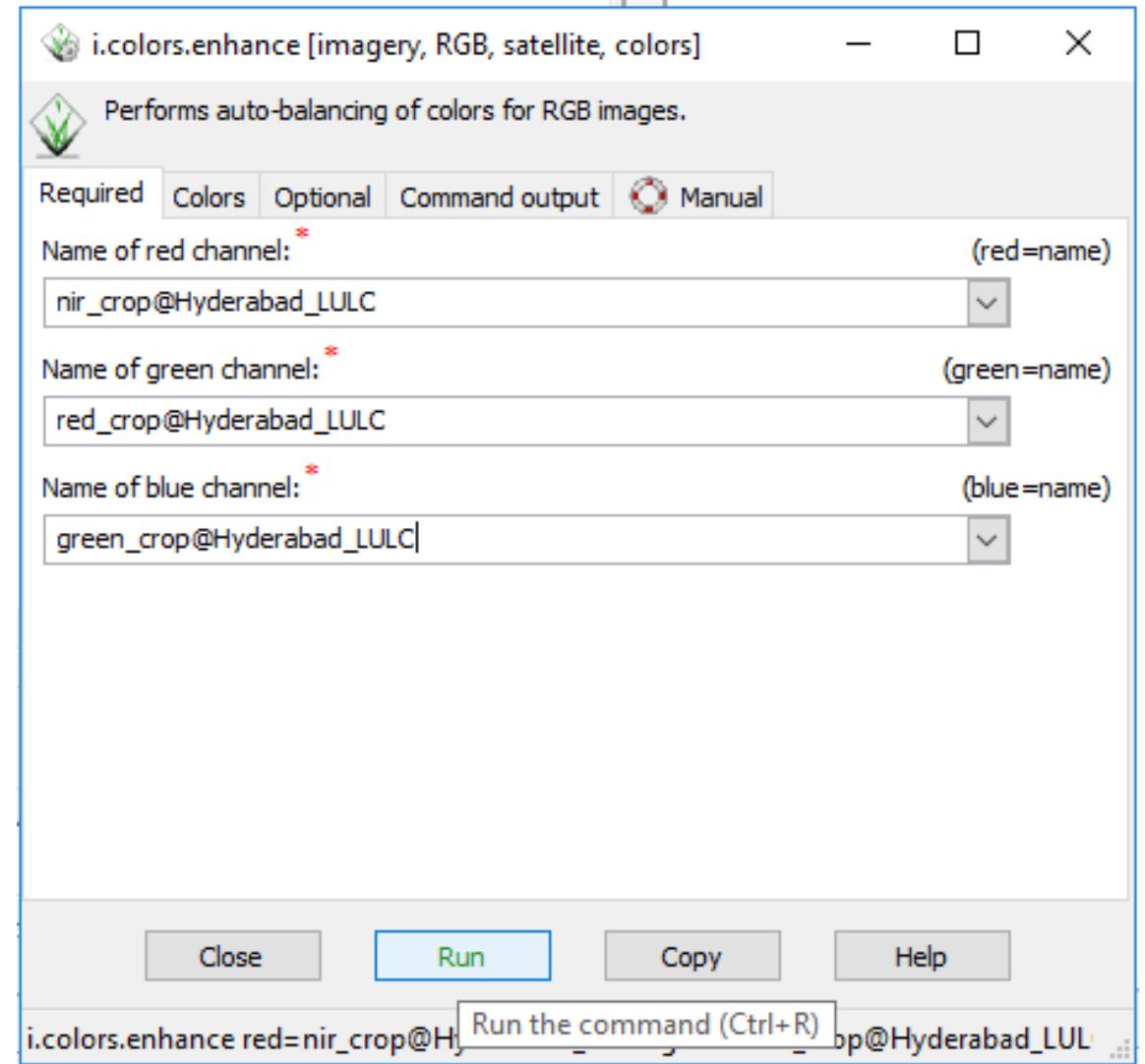
Command: i.colors.enhance

Red channel = nir cropped

Green channel = red cropped

Blue channel = green cropped

Click on Run.



CREATING FCC

Command: r.composite

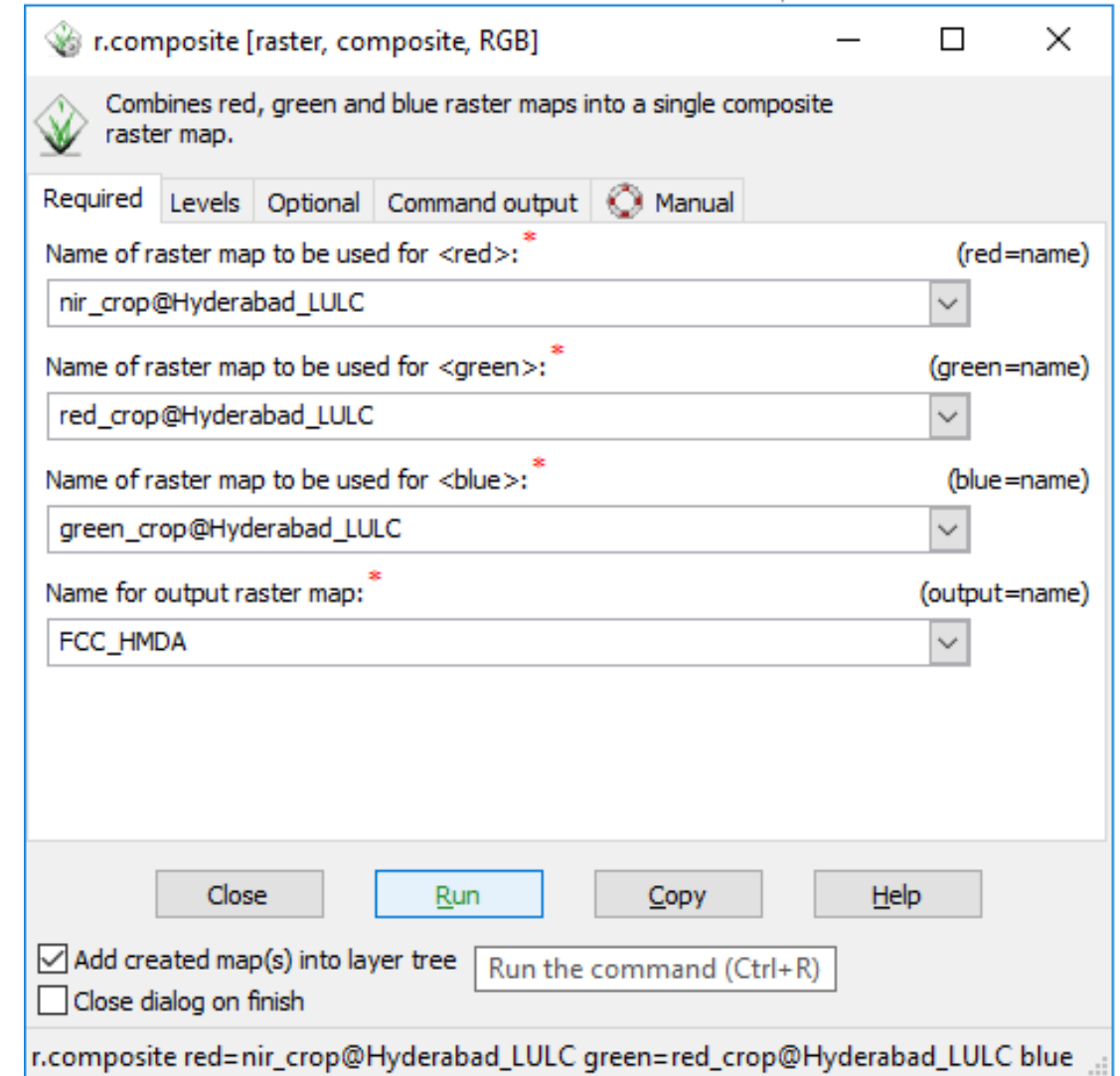
Red channel = nir cropped

Green channel = red cropped

Blue channel = green cropped

Specify Output name (new name)

Click on Run.

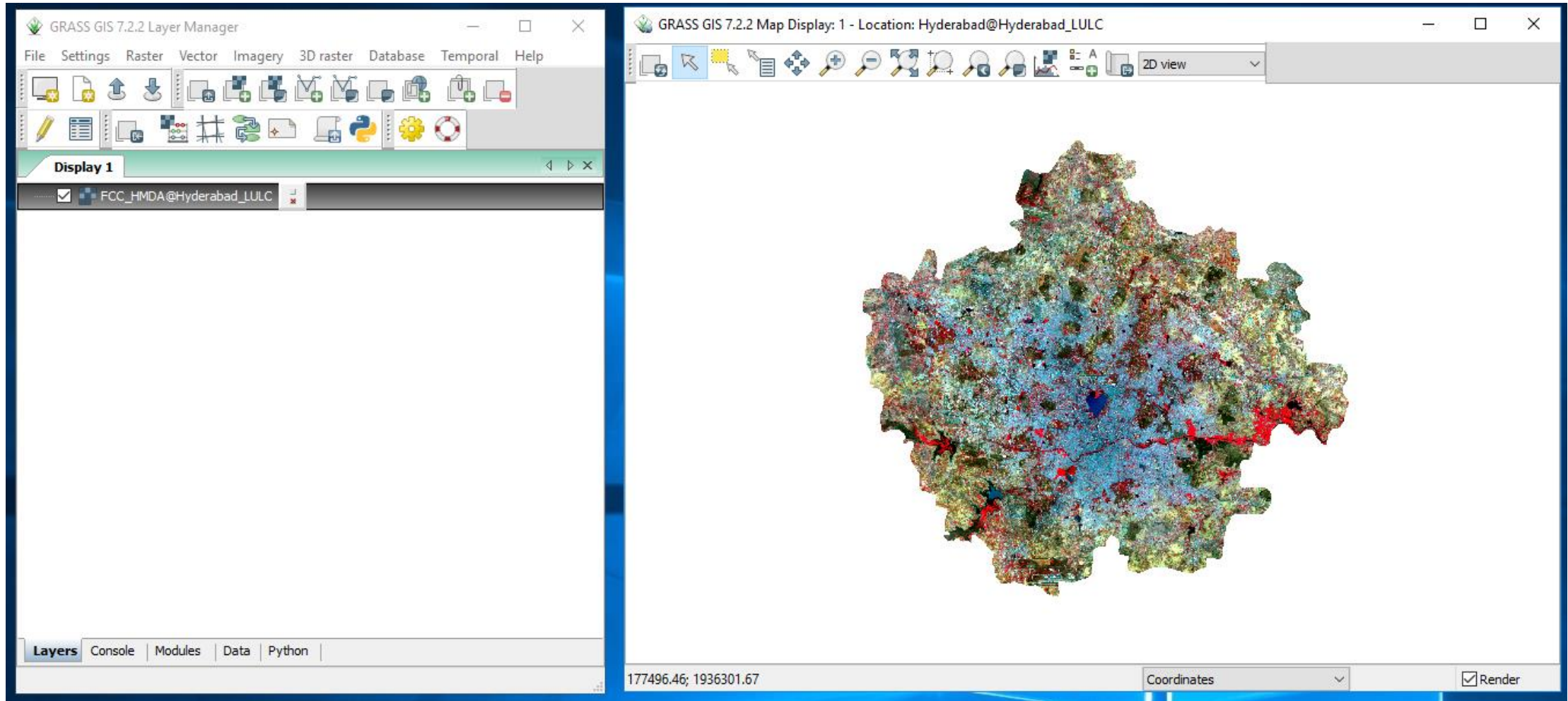


The screenshot shows the 'r.composite' dialog box in QGIS. The title bar reads 'r.composite [raster, composite, RGB]'. Below the title bar is a description: 'Combines red, green and blue raster maps into a single composite raster map.' The dialog has five tabs: 'Required', 'Levels', 'Optional', 'Command output', and 'Manual'. The 'Required' tab is active. It contains four input fields with dropdown menus:

- 'Name of raster map to be used for <red>:' (red=name) with the value 'nir_crop@Hyderabad_LULC'.
- 'Name of raster map to be used for <green>:' (green=name) with the value 'red_crop@Hyderabad_LULC'.
- 'Name of raster map to be used for <blue>:' (blue=name) with the value 'green_crop@Hyderabad_LULC'.
- 'Name for output raster map:' (output=name) with the value 'FCC_HMDA'.

At the bottom of the dialog, there are four buttons: 'Close', 'Run' (highlighted in blue), 'Copy', and 'Help'. Below these buttons are two checkboxes: 'Add created map(s) into layer tree' (checked) and 'Close dialog on finish' (unchecked). To the right of the checkboxes is a button labeled 'Run the command (Ctrl+R)'. At the very bottom, a text box displays the command: 'r.composite red=nir_crop@Hyderabad_LULC green=red_crop@Hyderabad_LULC blue'.

CREATING FCC

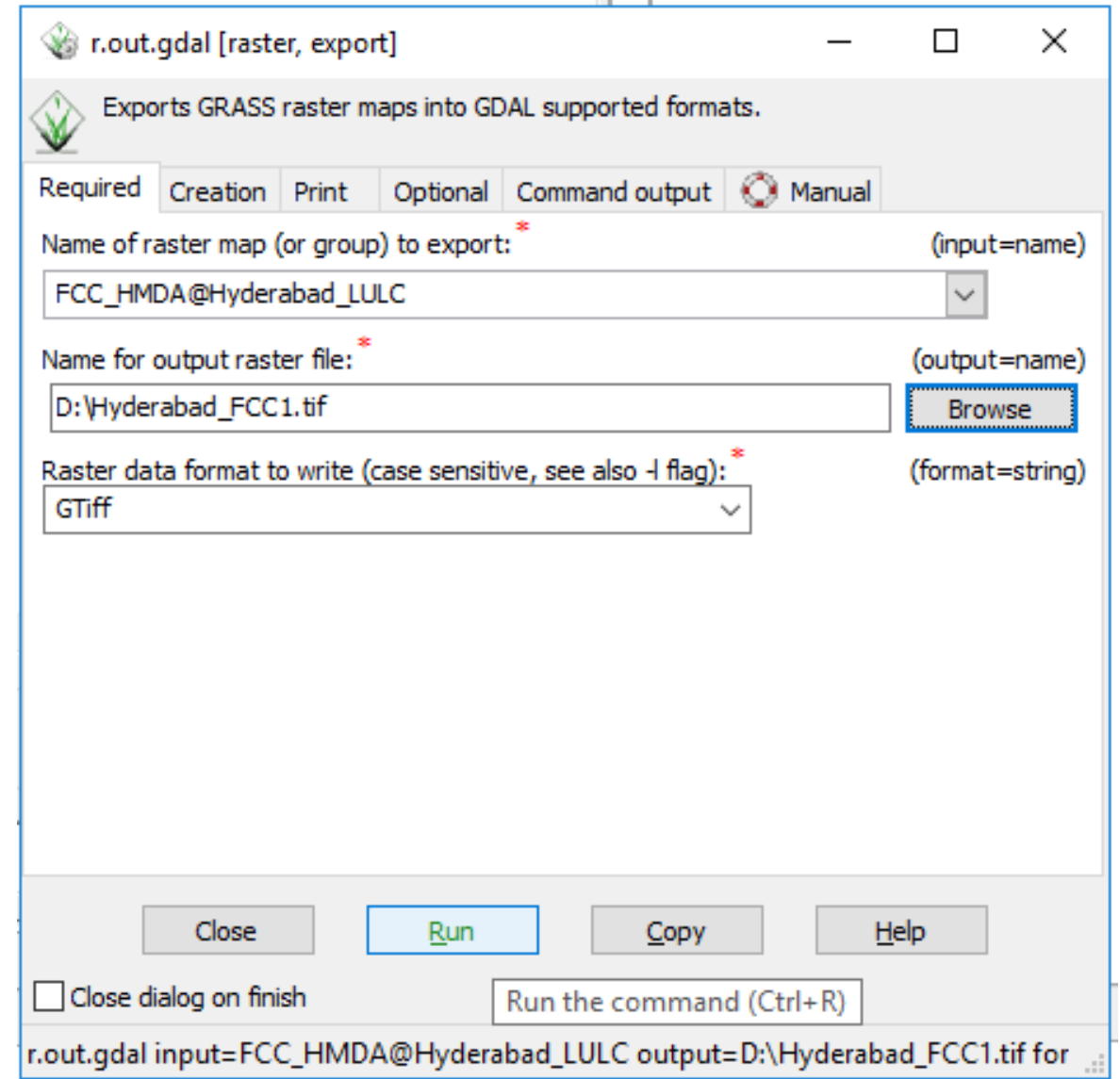


EXPORTING RASTER

Command: r.out.gdal

Output raster: Specify path by browsing. Make sure extension is <filename.tif>

Click on Run.



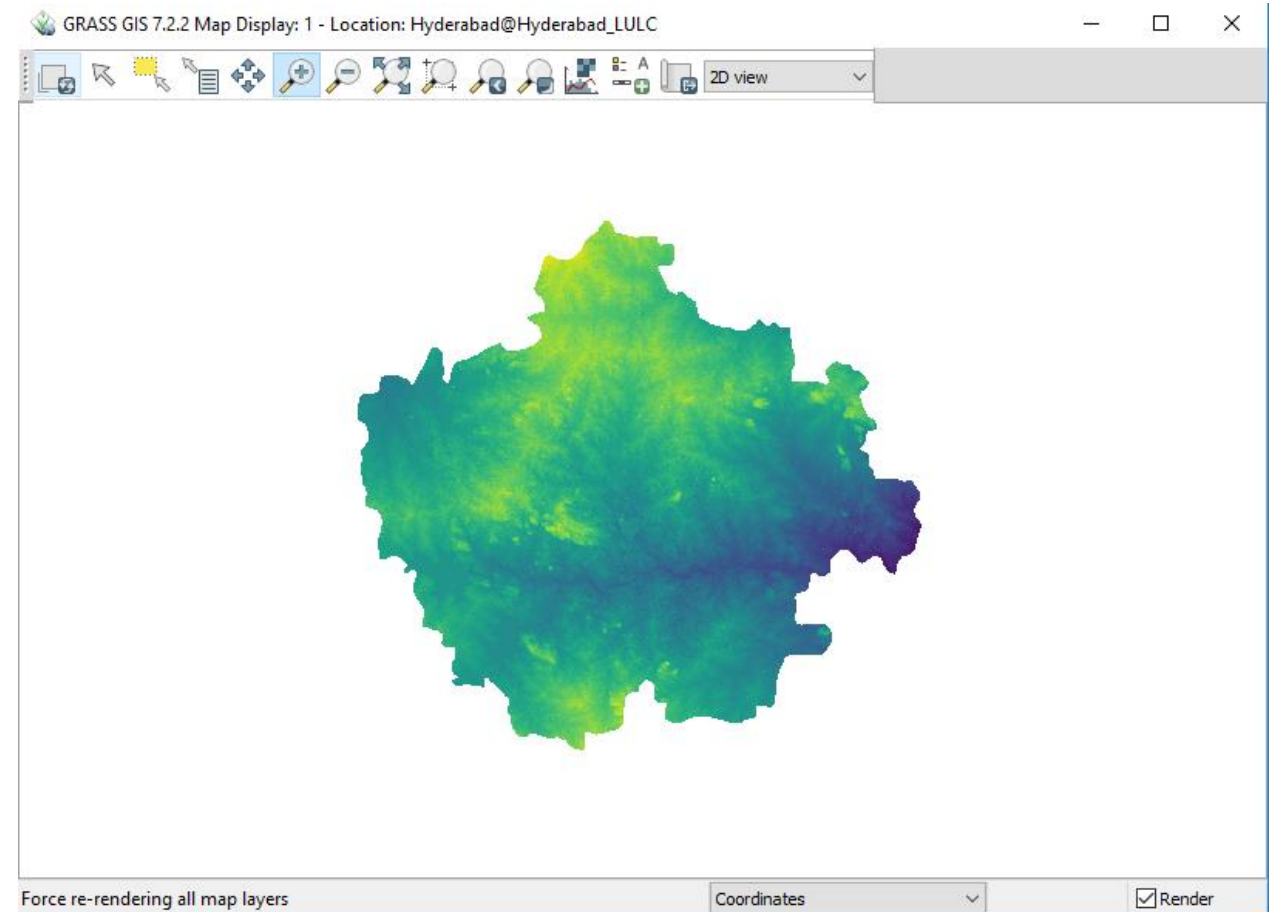
WATERSHED ANALYSIS

Import DEM and crop according to study area.

Command: `r.in.gdal`

Command: `r.mapcalc`

Note: DEM should be in UTM projection system.



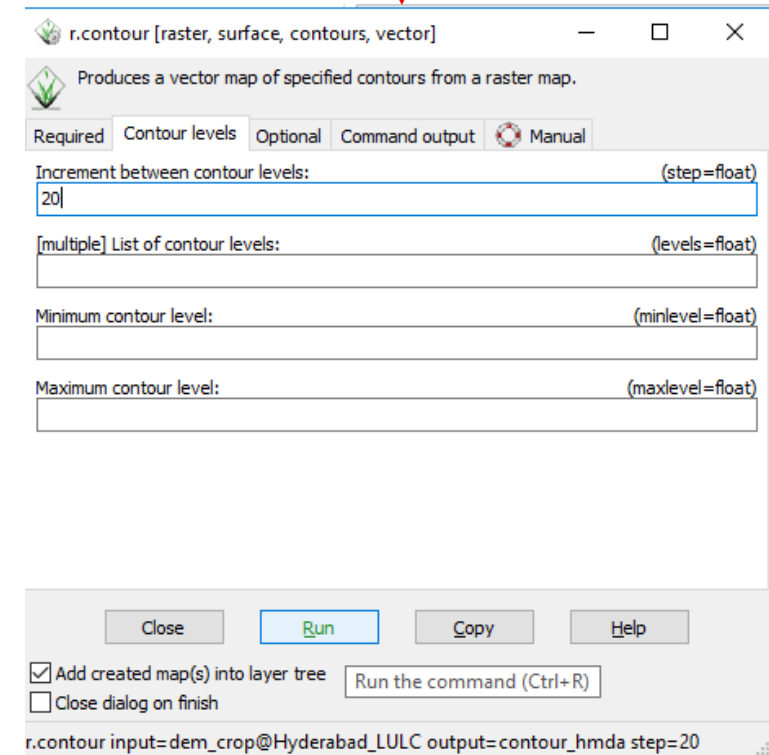
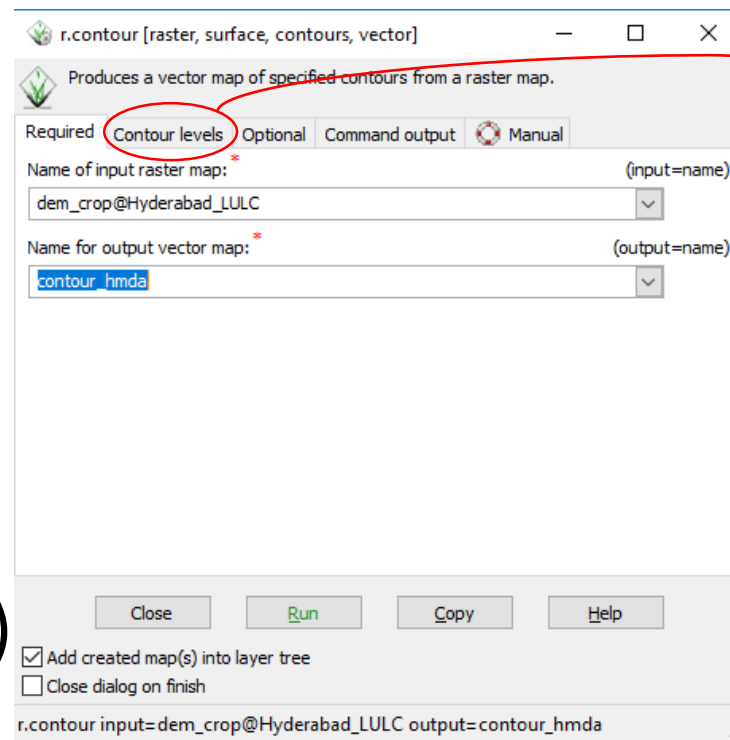
WATERSHED ANALYSIS

Command: r.contours

Contour levels tab choose
contour interval (increment)

Click on Run.

Note: Output will be vector file.

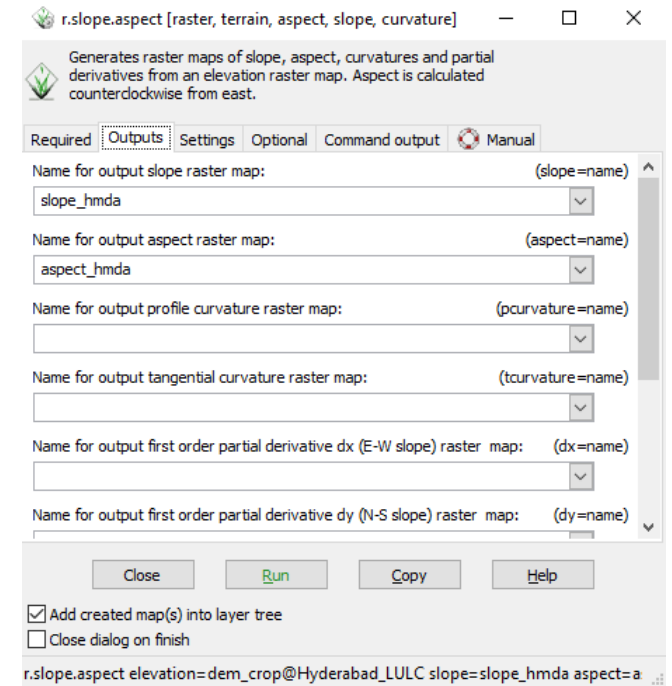
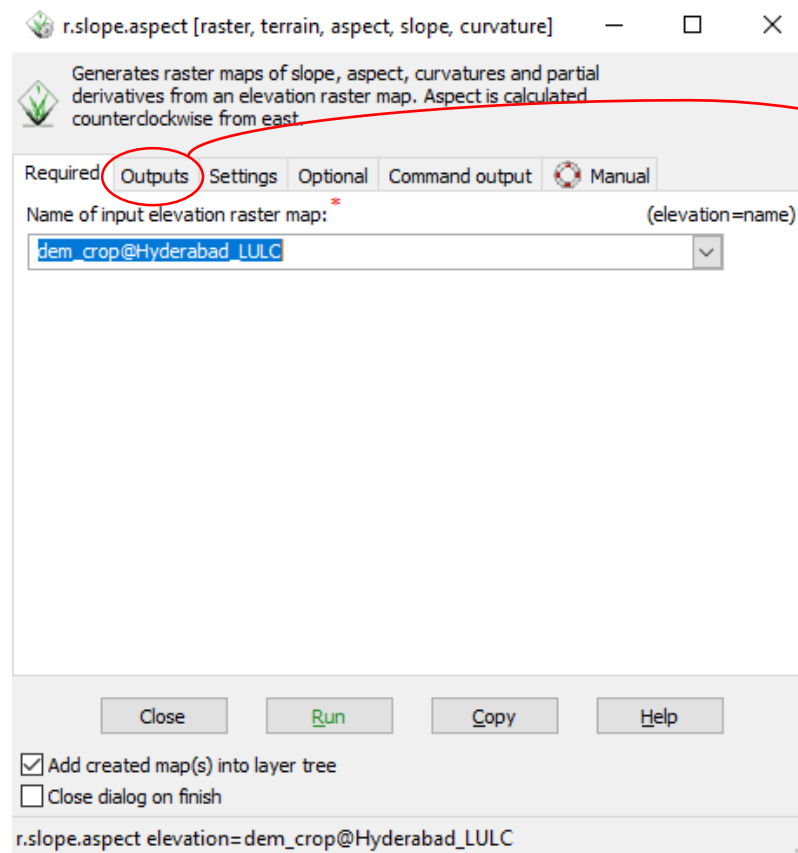


WATERSHED ANALYSIS

Command: `r.slope.aspect`

- Select DEM image for input.
- Output tab, specify name for slope and aspect map.

Click on Run.

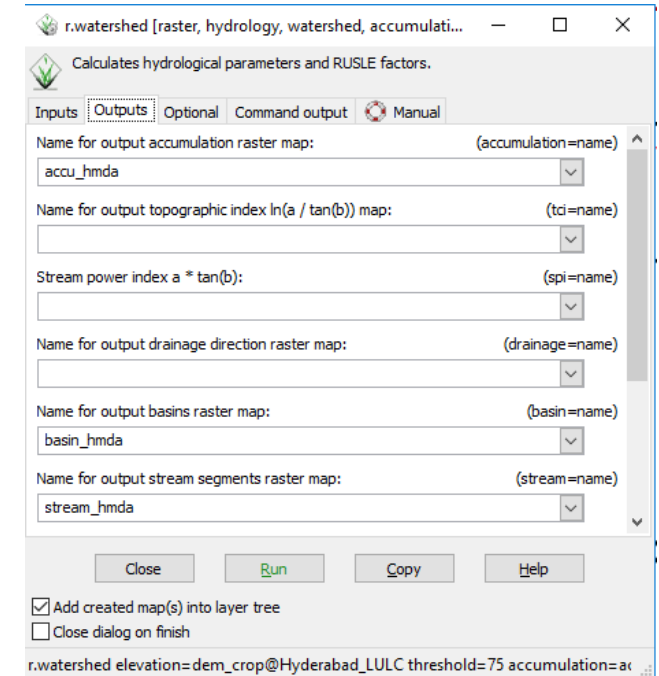
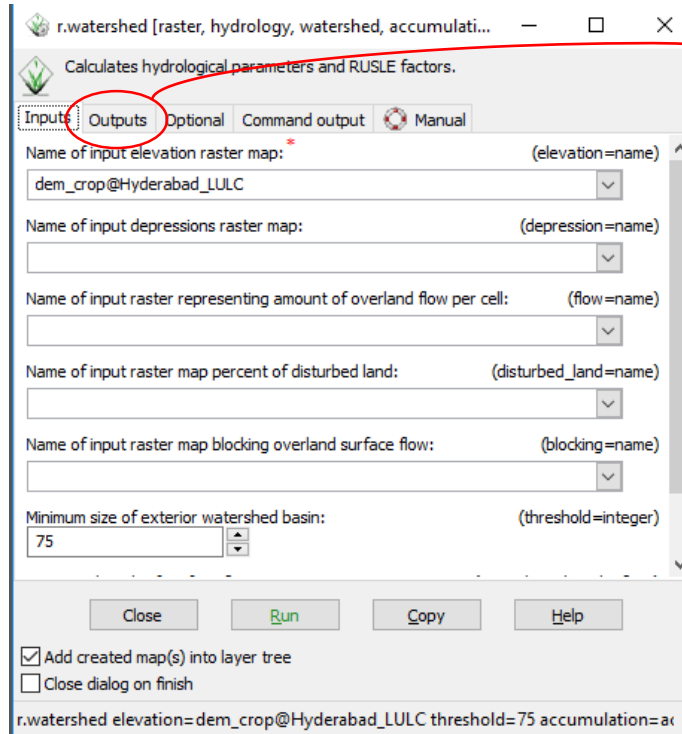


WATERSHED ANALYSIS

Command: r.watershed

- Select DEM image for input. Specify minimum size as 75.
- Output tab, specify name for accumulation, basin and stream.

Click on Run.



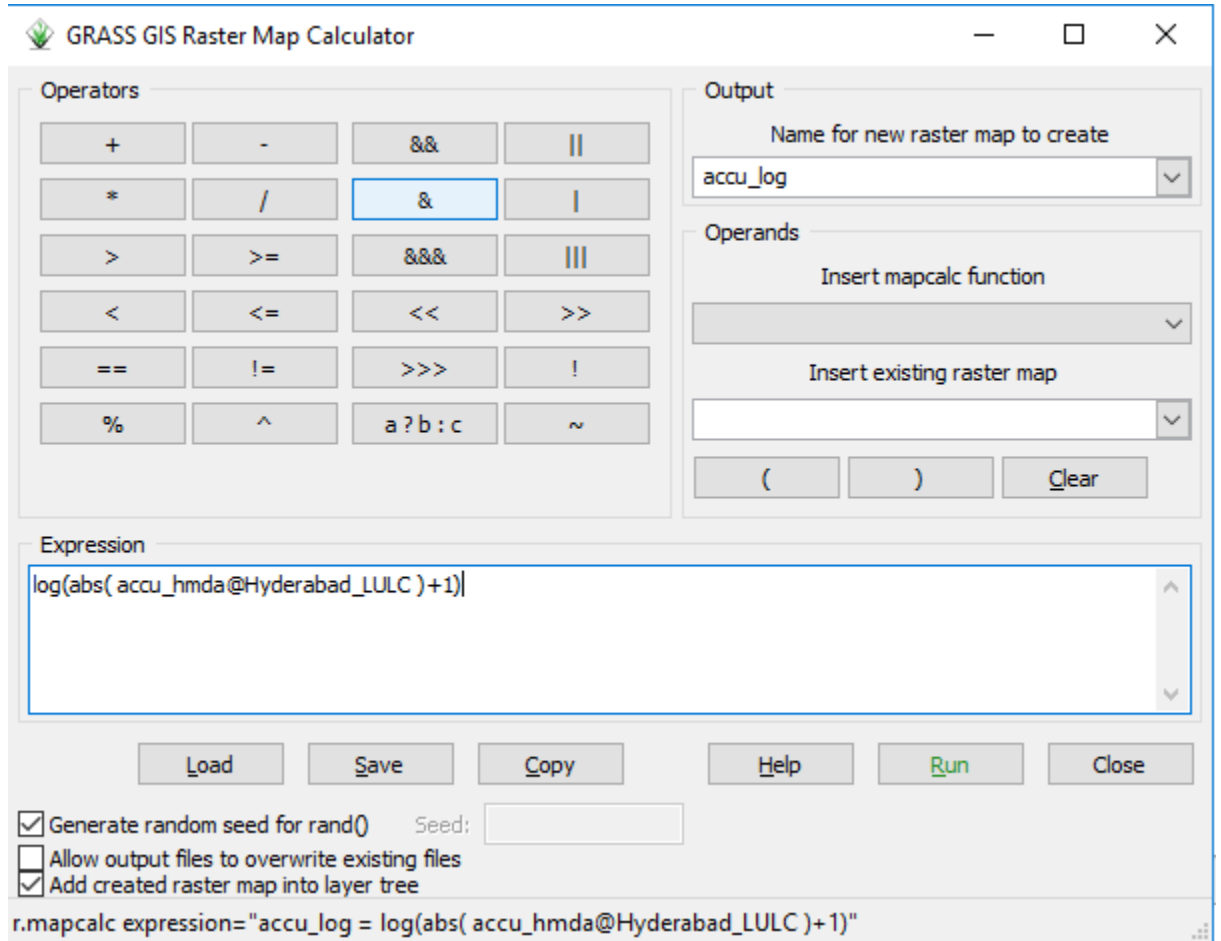
RIVER NETWORK EXTRACTION

Used to detect main channels.

Command: r.mapcalc

- Specify output name. Ex. <accu_log>
- Use expression
 $\log(\text{abs}(\text{accumulation_map})+1)$

Click on Run.



RIVER NETWORK EXTRACTION

Used to get river network.

Command: r.mapcalc

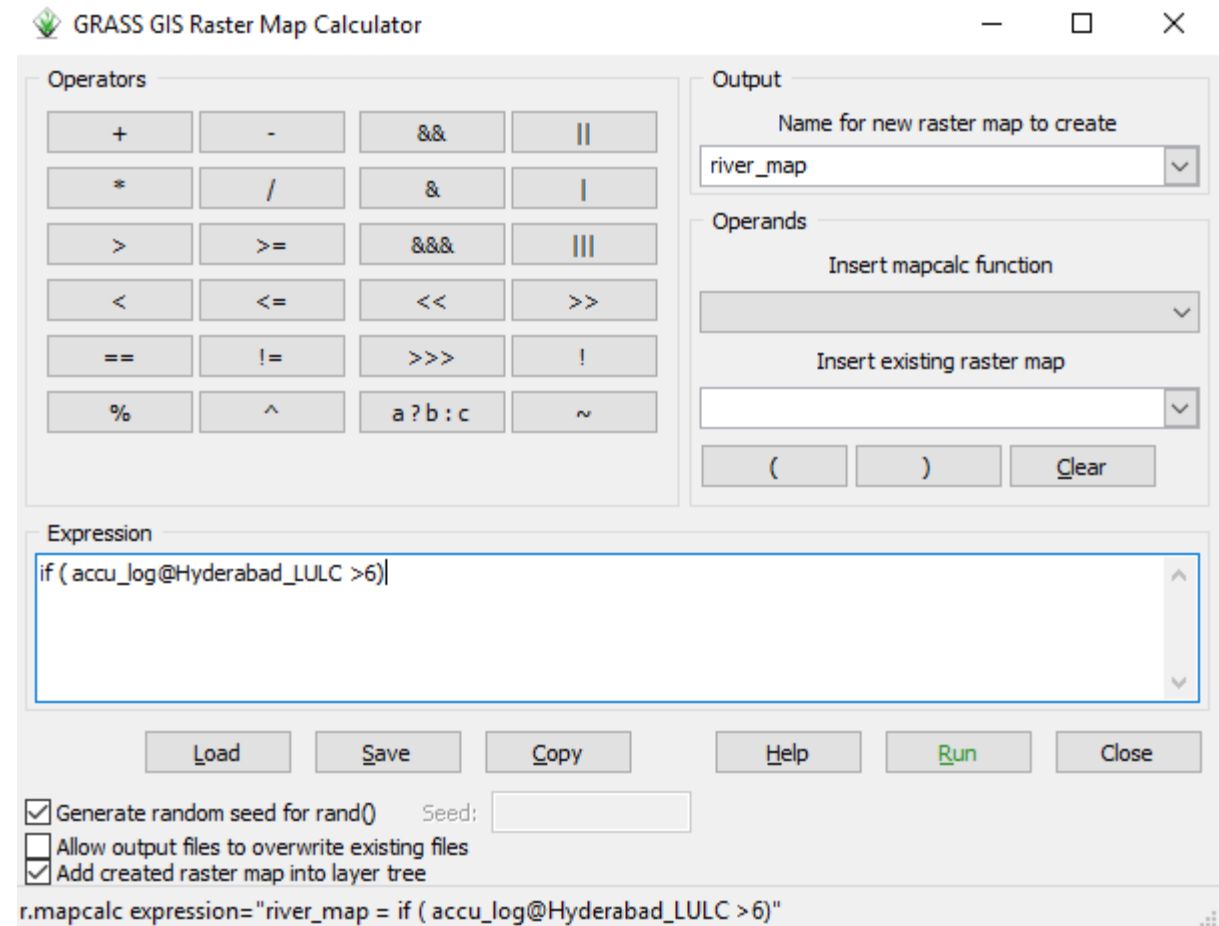
- Specify output name. Ex. <river_map>

- Use expression

If (accu_log_map > 6)

Click on Run.

Note: The number 6 is arbitrary. It may change according to study area selected.



RIVER NETWORK EXTRACTION

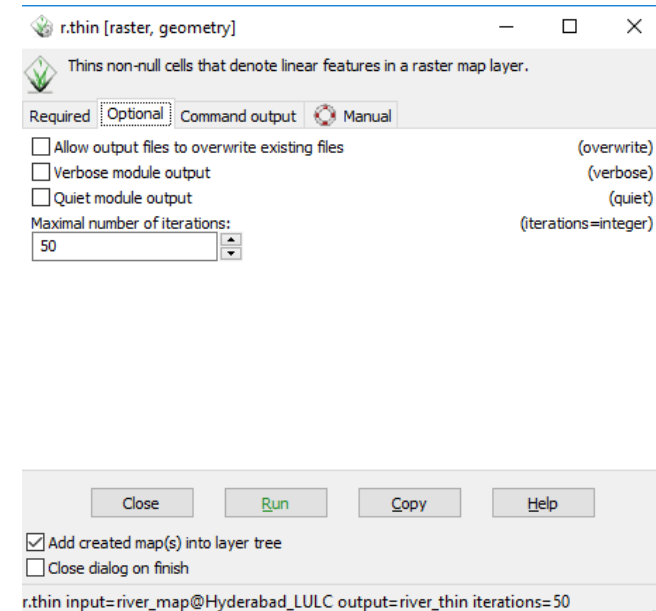
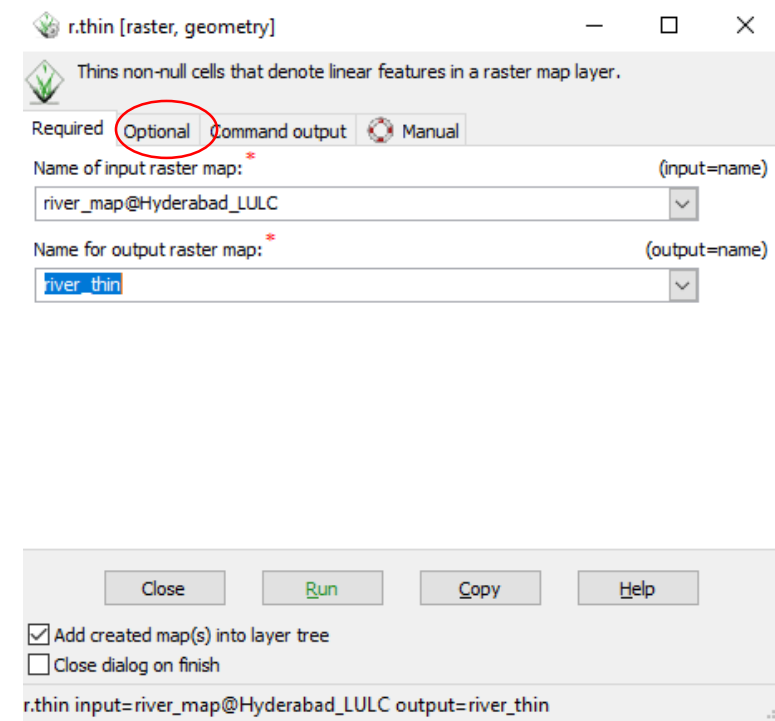
To thin raster map. Removes null cells and highlights only linear raster features.

Command: r.thin

- Specify output name. Ex. <river_thin>
- Optional tab, specify number of iterations as 50.

Click on Run.

Note: The number 50 is arbitrary. It may change according to study area selected. This process takes time depending on number of iterations specified.



RIVER NETWORK EXTRACTION

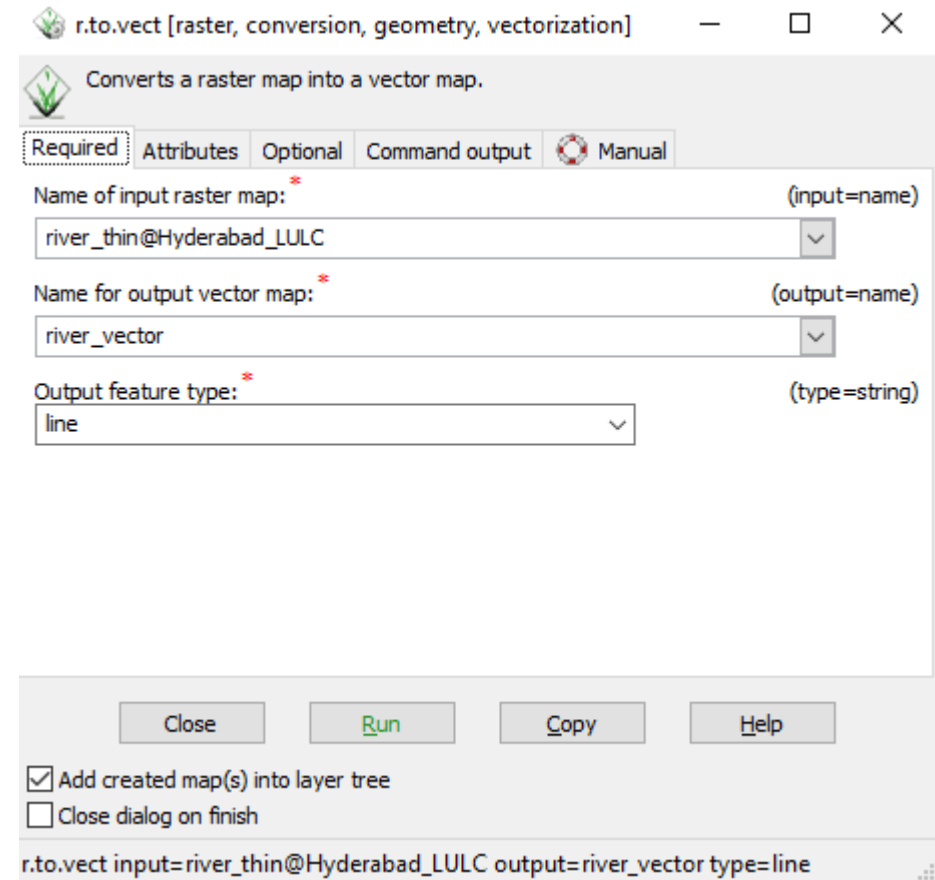
To convert raster to vector.

Command: r.to.vect

- Specify output name. Ex. <river_vector>
- Output feature type “line”.

Click on Run.

Note: This process takes time. The output vector can be exported and compared overlaying on Google earth.



THANK YOU.