



Reclassifying and
calculating raster data:

An application to landslide
susceptibility mapping



Data Needed:

- Land cover (MODIS.tif)
- Soil (Soils_Madang_GCS.shp)
- DEM (SRTM90m.tif)



Plugin Needed:

- Raster Terrain Analysis



Research Paper:

- Landslide Risk Analysis of Miyun Reservoir Area Based on RS and GIS

Yu, Yang, Tian, Zhang

1. Load all layers
2. Open attribute table of soil layer
3. Reclassify existing soil category to the required category

QGIS 2.18.9

Project Edit View Layer Settings Plugins Vector Raster Web SCP Processing Help

Layers Panel

- Zoom to Layer
- Show in Overview
- Remove
- Duplicate
- Set Layer Scale Visibility
- Set Layer CRS
- Set Project CRS from Layer
- Styles
- Open Attribute Table**
- Toggle Editing
- Save As...
- Save As Layer Definition File...
- Filter...
- Show Feature Count
- Properties
- Rename

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Soils_Madang_GCS :: Features total: 51, filtered: 51, selected: 0

id	ID_1	NAME_1	SoilC	SoilDesc	SoilClass	SoilClassC
1	9	Hela	bPo/Po/aH	Brown Podzolics/...	Brown	1
2	9	Hela	bPo/Po/aH	Brown Podzolics/...	Brown	1
3	9	Hela	bPo/Po/aH	Brown Podzolics/...	Brown	1
4	9	Hela	bPo/Po/aH	Brown Podzolics/...	Brown	1
5	0	3 Chimbu	hbl/gP/R	Humic Brown Lat...	Brown	1
6	0	5 East Sepik	Reg/aBf	Regosolic Brown ...	Brown	1
7	0	6 Eastern Highlands	hbl/gP/R	Humic Brown Lat...	Brown	1
8	0	7 Enga	hbl/gP/R	Humic Brown Lat...	Brown	1
9	0	10 Jiwaka	hbl/gP/R	Humic Brown Lat...	Brown	1
10	0	11 Madang	Al/hB	Alluvial Soils/Half ...	Alluvial	7
11	0	21 Western Highlands	hbl/gP/R	Humic Brown Lat...	Brown	1
12	0	5 East Sepik	saPMS	Saline Peats, Mu...	Moisture	2
13	0	11 Madang	Reg/aBf	Regosolic Brown ...	Brown	1
14	0	11 Madang	A	Andosols	Cinnamon	3
15	0	11 Madang	Al/hB	Alluvial Soils/Half ...	Alluvial	7
16	0	11 Madang	Bf/P	Brown Forest Soil...	Brown	1
17	0	11 Madang	Reg/aBf	Regosolic Brown ...	Brown	1
18	0	14 Morobe	Reg/aBf	Regosolic Brown ...	Brown	1
19	0	6 Eastern Highlands	Al/hB	Alluvial Soils/Half ...	Alluvial	7
20	0	14 Morobe	Al/hB	Alluvial Soils/Half ...	Alluvial	7
21	0	5 East Sepik	hB/B/Al	Half Bog Soils/Bo...	Alluvial	7

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Soil classification

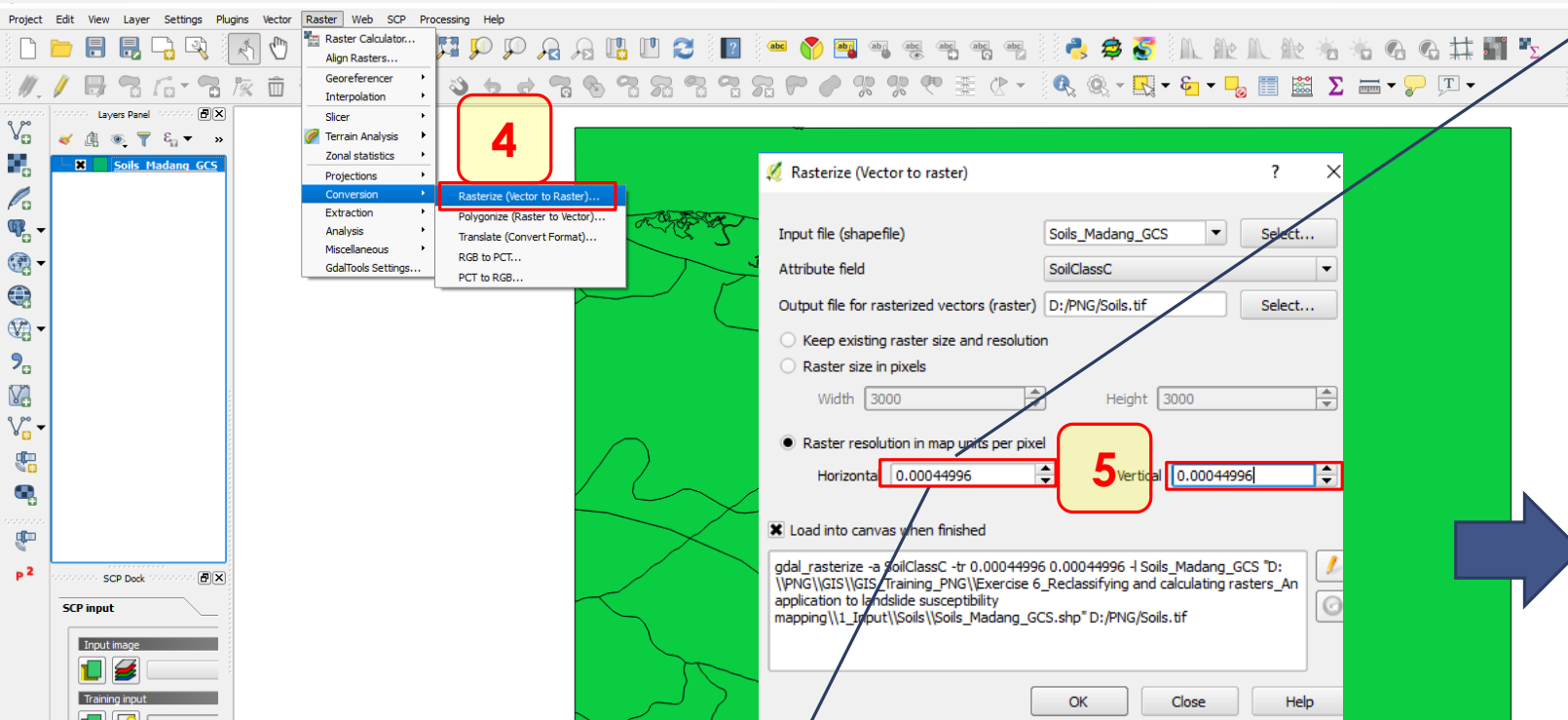
Soil Type	Brown	Moisture	Cinnamon	Skeleton	Alluvial	Paddy
Level	1	2	3	6	7	9

Convert vector to raster layer

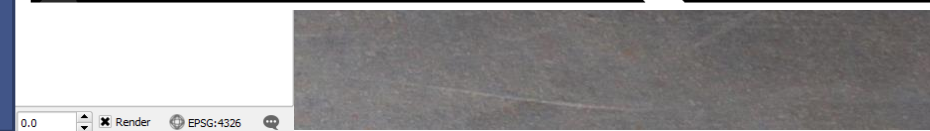
4. Click Rasterize under Raster menu/Conversion
5. Define pixel resolution

Raster resolution of 50 meters in terms of degrees is computed as follows:

$$50/111120 = 0.00044996 \text{ degrees}$$

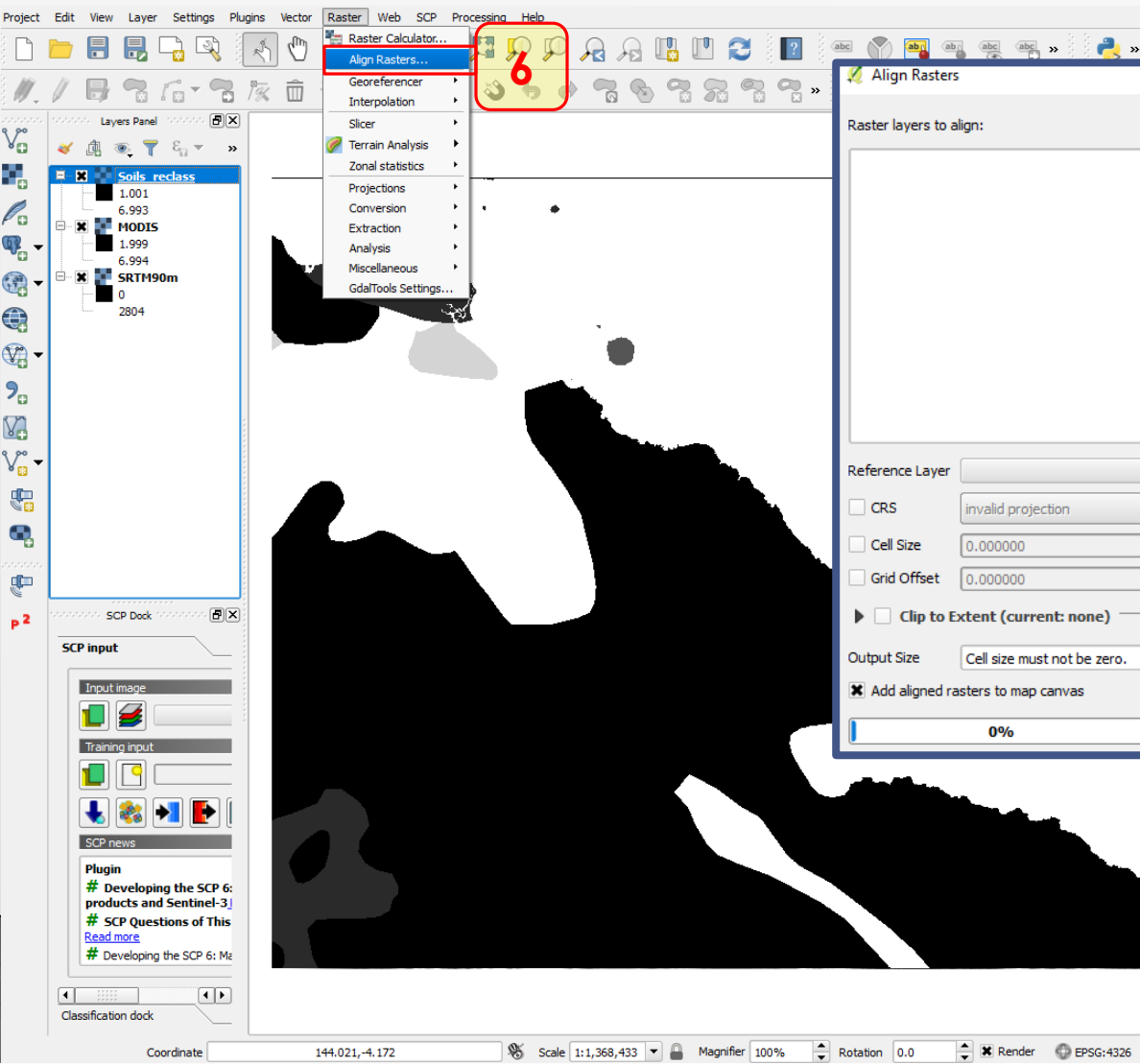


When defining raster pixel resolution, value will depend on layer's coordinate system e.g. in terms of meters if using projected system, or in degrees if using geographic coordinate system (1 degree = 111120 meters)

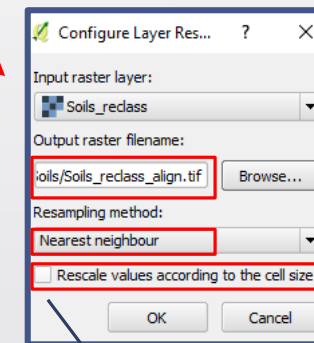


Align raster layers to standardize extent and resolution

6. Click Align Rasters



7. One by one, add each layer (e.g. MODIS.tif, Soils_reclass.tif, SRTM90m.tif) and save to new filename (newly adjusted raster)



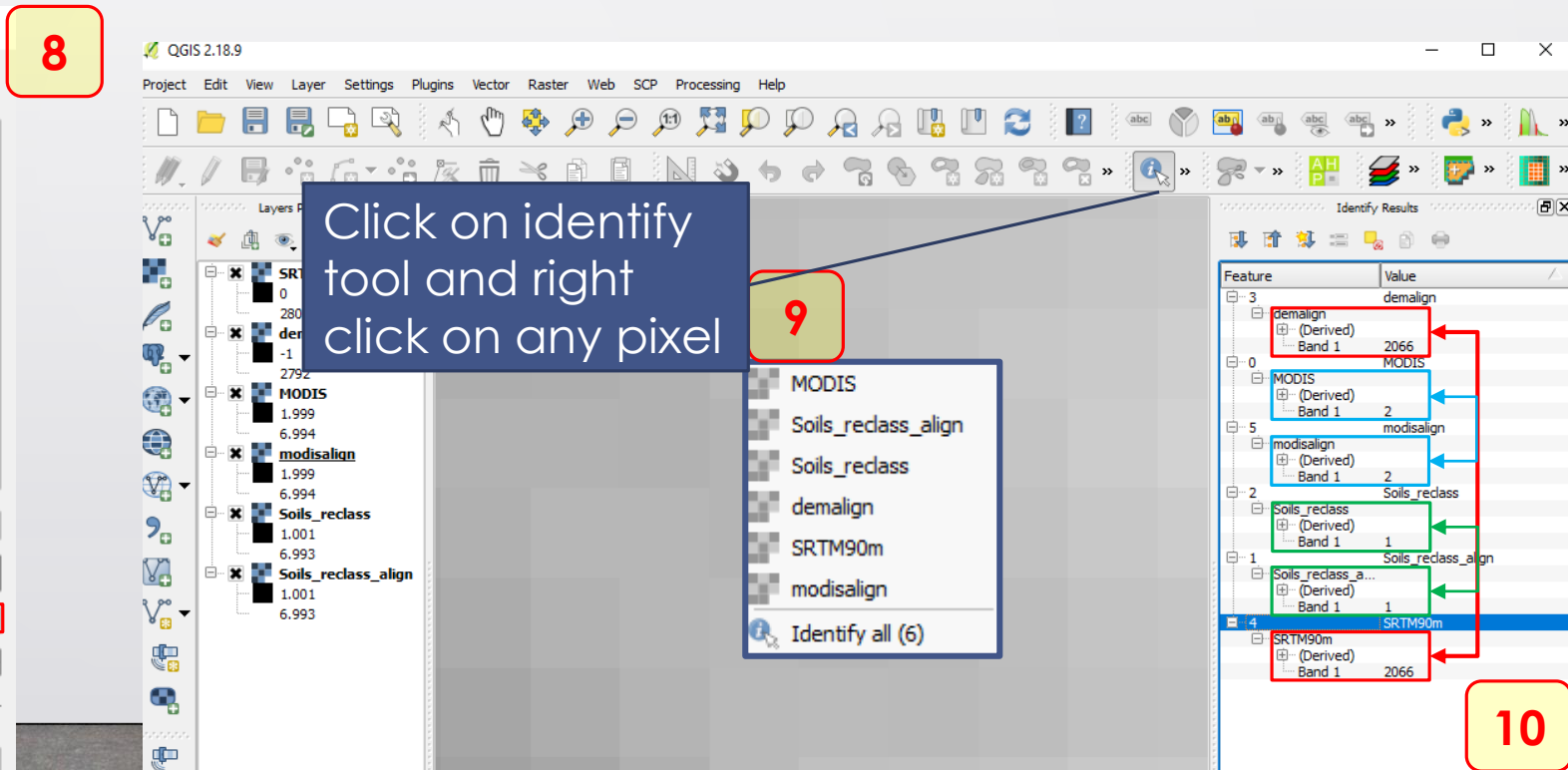
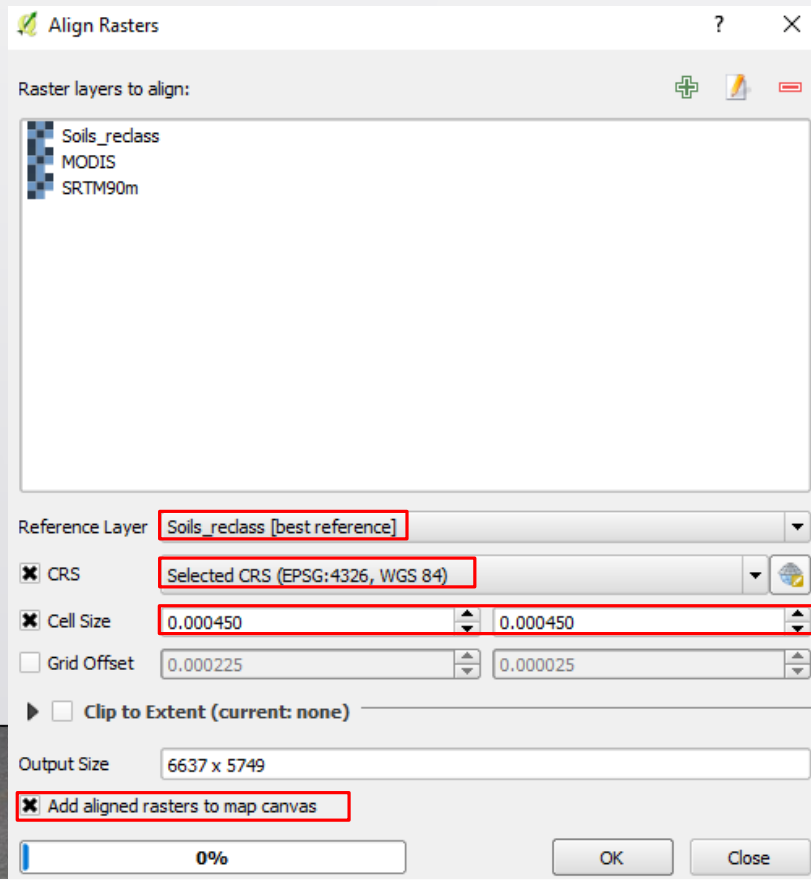
Note: Don't tick

Align raster layers to standardize extent and resolution

8. Set parameters

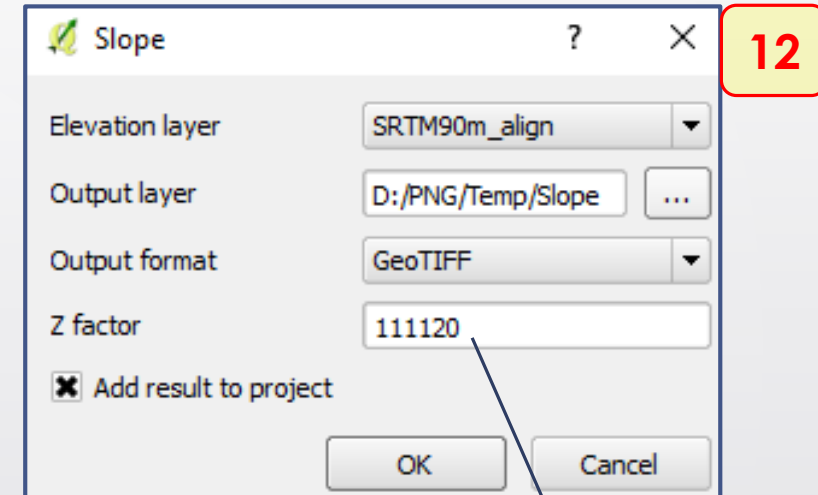
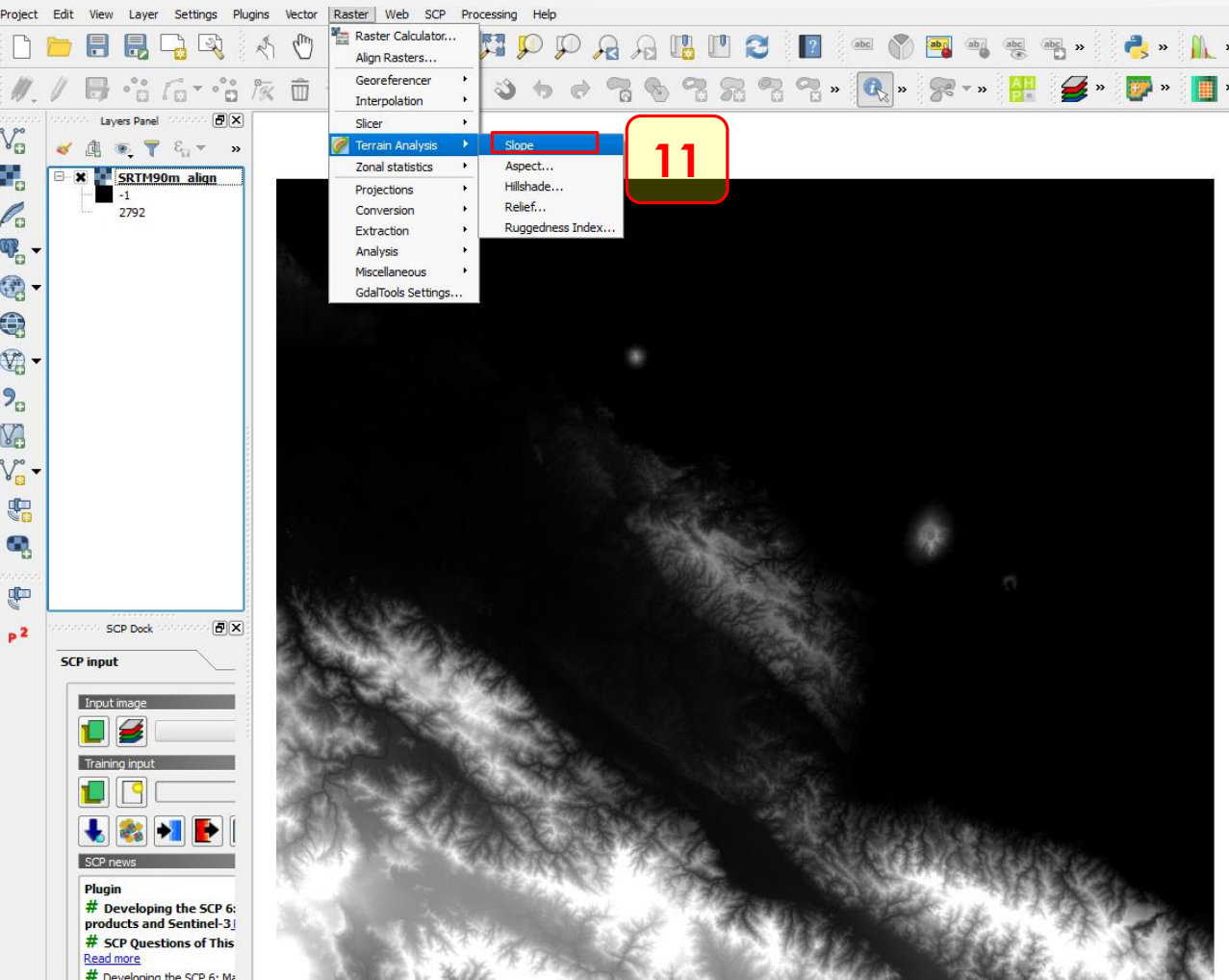
9. Click on identify tool and right click on a pixel

10. Check that pairs of original and aligned raster layers have the same values



Generating slope

11. Select Terrain Analysis/Slope under Raster menu
12. Define Z factor



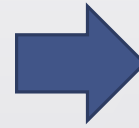
Note:

- Z factor is 1 when units of x,y,z are the same e.g. if layer is using projected coordinate system (all units of x,y,z are in meters) then z factor is 1
- If layer is using geographic coordinate system (GCS) wherein x (longitude) and y (latitude) are in degrees, while z is usually in meters, then conversion between degrees to meters is necessary and defined in z factor.
- 1 degree is approximately 111120 meters

Image reclassification

1	2	2	3	5
2	3	3	4	6
1	1	1	1	7
2	2	3	8	9
1	2	3	3	3

Old	New
1-3	1
4-6	2
7-9	3



1	1	1	1	2
1	1	1	2	2
1	1	1	1	3
1	1	1	3	3
1	1	1	1	1

Reclassifying rasters

For each raster reclassify according to the required range of categories (usually based on existing paper or expert advice)

13. Prepare lookup table in notepad for slope and elevation (table should conform to required range of categories)

The image displays a workflow for reclassifying rasters based on a scientific paper. The central window shows a PDF document titled 'Landslide.pdf' with several classification tables. Two Notepad windows are open, each containing a lookup table derived from the PDF. A red arrow indicates the mapping from the 'Slope factor' table to the 'slopeLookup.txt' file, and a green arrow indicates the mapping from the 'Elevation band factor' table to the 'DEMLookup.txt' file.

PDF Document: Table 1: Classification of each factor level

Slope factor

Range (°)	0 ~ 10	10 ~ 20	20 ~ 30	30 ~ 45	45 ~ 55	55 ~ 86
Level	8	7	1	2	4	5

Vegetation cover factor

Range	<0.1	<0.3	<0.6	<0.8	<1
Level	5	1	3	7	9

Land use

Land Type	Unused	plough	Building land	Water area	grassland	Forest
Level	1	3	4	7	9	5

Soil classification

Soil Type	Brown	Moisture	Cinnamon	Skeleton	Alluvial	Paddy
Level	1	2	3	6	7	9

Rainfall Factor

Range (mm)	454 ~ 560	560 ~ 600	600 ~ 620	620 ~ 640	640 ~ 660	660 ~ 682
Level	9	6	5	3	2	1

Elevation band factor

Range(m)	0 ~ 200	200 ~ 400	400 ~ 600	600 ~ 800	800 ~ 1000	1000 ~ 1200	1200 ~ 1400	1400 ~ 1600
Level	9	8	3	1	5	6	7	2

Notepad Windows:

DEMLookup.txt

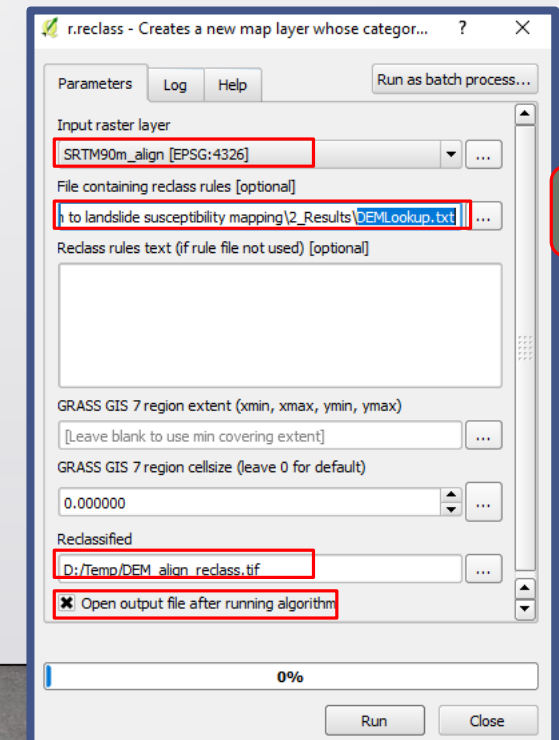
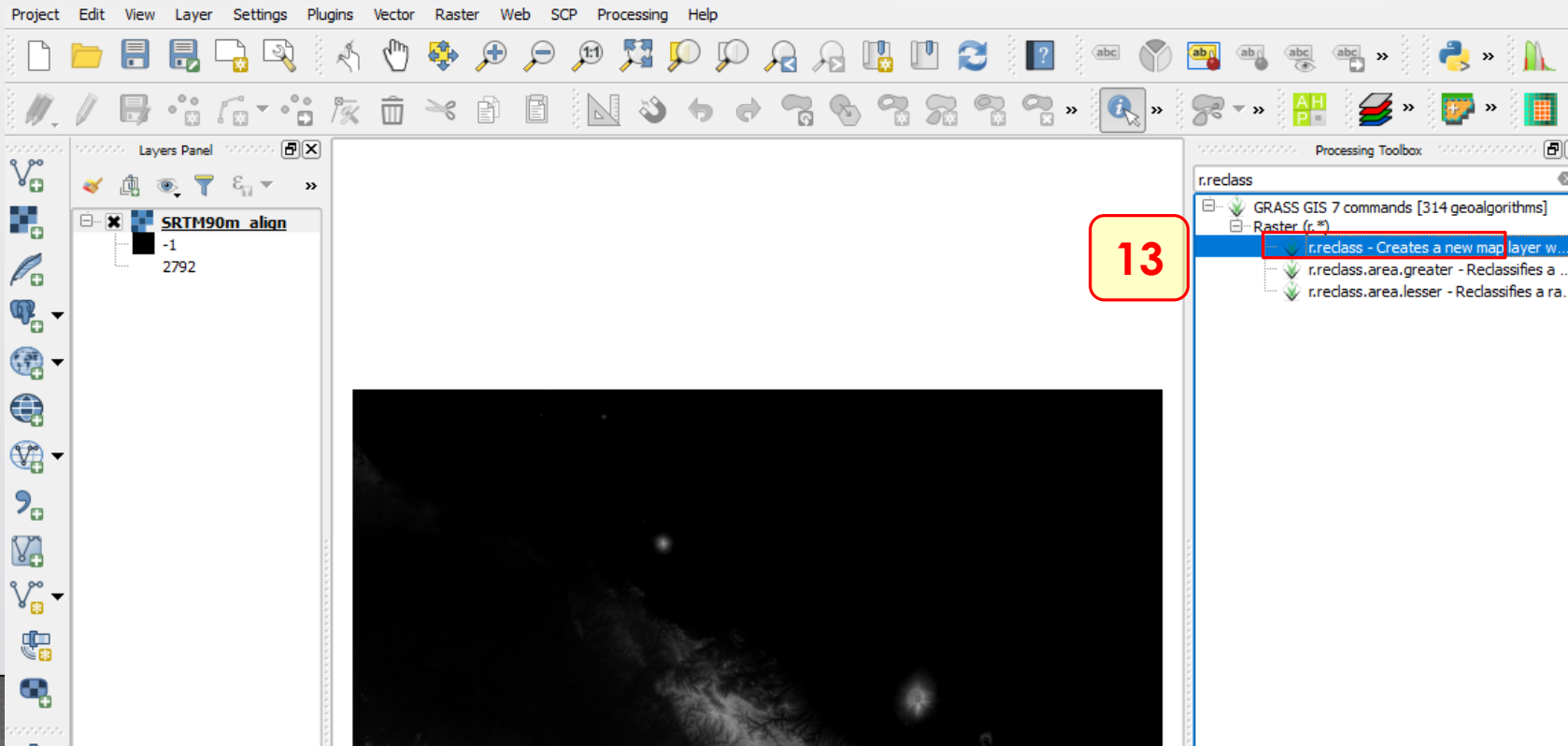
```
1 0 thru 10 = 8
2 10 thru 20 = 7
3 20 thru 30 = 1
4 30 thru 45 = 2
5 45 thru 55 = 4
6 55 thru 86 = 5
```

slopeLookup.txt

```
1 0 thru 200 = 9
2 200 thru 400 = 8
3 400 thru 600 = 3
4 600 thru 800 = 1
5 800 thru 1000 = 5
6 1000 thru 1200 = 6
7 1200 thru 1400 = 7
8 1400 thru 5000 = 2
```

Reclassifying rasters

13. Select Toolbox under Processing menu, search r.reclass
14. In dialog box, select DEMLookup.txt when reclassifying elevation and slopeLookup.txt when reclassifying slope



Reclassifying rasters

15. Using identify tool, check whether the rasters have been reclassified correctly

Layers Panel:

- SRM90m_align_reclass
- 1
- 9
- SRM90m_align
- 1
- 2792

Identify Results:

Feature	Value
0	SRM90m_align
Band 1	123
(Derived)	
1	SRM90m_align_reclass
Band 1	9
(Derived)	

Landslide.pdf - Adobe Acrobat Reader DC

File Edit View Window Help

Home Tools Landslide.pdf x

2569 (3 of 7) 100%

YU Guoqing et al. / Procedia Environmental Sciences 10 (2011) 2567 – 2573

Evaluation of the above factors for each classification to quantify, with 1 to 9 to represent the change factor on the size of the impact of landslides: Level 1 is the greatest influence on the landslide, which most likely lead to landslides; Level 2 is prone to landslide... Grade 9, said the least impact on the landslide. Rank value is assigned the following table (refer with: Table 1):

Table 1 Classification of each factor level

Slope factor						
Range (°)	0 ~ 10	10 ~ 20	20 ~ 30	30 ~ 45	45 ~ 55	55 ~ 86
Level	8	7	1	2	4	5

Vegetation cover factor					
Range	<0.1	<0.3	<0.6	<0.8	<1
Level	5	1	3	7	9


Land use						
Land Type	Unused	plough	Building land	Water area	grassland	Forest
Level	1	3	4	7	9	5

Soil classification						
Soil Type	Brown	Moisture	Cinnamon	Skeleton	Alluvial	Paddy
Level	1	2	3	6	7	9

Rainfall Factor						
Range (mm)	454 ~ 560	560 ~ 600	600 ~ 620	620 ~ 640	640 ~ 660	660 ~ 682
Level	9	6	5	3	2	1

Elevation band factor								
Range(m)	0 ~ 200	200 ~ 400	400 ~ 600	600 ~ 800	800 ~ 1000	1000 ~ 1200	1200 ~ 1400	1400 ~ 1600
Level	9	8	3	1	5	6	7	2

A



1	2	2
2	3	3
1	1	1

 $A * 0.4$

0.4	0.8	0.8
0.8	1.2	1.2
0.4	0.4	0.4

B

1	3	1
2	1	2
3	3	2

 $B * 0.6$

0.6	1.8	0.6
1.2	0.6	1.2
1.8	1.8	1.8



Raster calculation

$$\text{Equation} = A * 0.4 + B * 0.6$$

1	2.6	1.4
2	1.8	2.4
2.2	2.2	1.6

Calculating rasters

16. Load all aligned and reclassified rasters that will be used to calculate landslide susceptibility equation e.g. DEM, slope, landcover, soil

17. Select Raster Calculator under raster menu and input equation based on paper

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Click Current layer extent

Table 2 Factors Weights

Factors	Vegetation Index(VI)	Soil type(ST)	Slope(S)	Elevation (E)	Rainfall(R)	Land use(L)
Weights	0.18	0.05	0.4	0.03	0.26	0.08

Landslide risk analysis model in the study area

According to the evaluation of selected factors and the calculated weight of each evaluation factor the study area, landslide risk assessment model as:

$$E = 0.18 * VI + 0.05 * ST + 0.4 * S + 0.03 * E + 0.26 * R + 0.08 * L$$

Note: Since vegetation and rainfall layers are not available, for demonstration purposes, only 4 parameters were used

Raster calculator expression

$$(0.05 * \text{Soils_reclass_align@1}) + (0.4 * \text{Slope_reclass@1}) + (0.03 * \text{SRTM90m_align_reclass@1}) + (0.08 * \text{MODIS@1})$$



Thank you