



Forest Service
U.S. DEPARTMENT OF AGRICULTURE




RegRake User Guide


Version: 14 September, 2021


Step 1: Put your polygon shapefile in a zipped folder

unit1a.cpg	7/6/2021 11:13 AM	CPG File	1 KB
unit1a.dbf	7/6/2021 11:13 AM	DBF File	4 KB
unit1a.prj	7/6/2021 11:13 AM	PRJ File	1 KB
unit1a.sbn	7/6/2021 11:13 AM	SBN File	1 KB
unit1a.sbx	7/6/2021 11:13 AM	SBX File	1 KB
unit1a.shp	7/6/2021 11:13 AM	SHP File	569 KB
unit1a.shp	7/6/2021 11:13 AM	XML Document	22 KB
unit1a.shx	7/6/2021 11:13 AM	SHX File	1 KB

 Move to OneDrive

7-Zip >

 Scan with Windows Defender...

 Share

Send to >

Cut


Copy


Create shortcut


Delete


Rename


Properties


 Bluetooth device


 Compressed (zipped) folder


 Desktop (create shortcut)


 Documents

 Fax recipient

 Mail recipient

 DVD RW Drive (E:)

 srsfia (\\166.4.173.18) (M:)

 fs (\\usda.net) (T:)

Step 2a: Upload your shapefile

RegRake: A Small Area Estimation Tool

1. Choose shapefile (*.zip) ?

Browse...

unit1a.zip

Upload complete

2. Choose FIA survey unit ?

Unit 1

3. Select Output Estimates

☐ Basal Area

☐ Volume

☐ Land Use

☐ Per Acre

Go to 4A to create a shapefile. Go to 4B to create a raster.

4A. Calculate Small Area Estimates

Calculate Shapefile

5A. Download your shapefile with the estimates

Download Shapefile

4B. Calculate rasters

Calculate Raster

5B Download raster

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Forest Service
U.S. Department of Agriculture

THE UNIVERSITY OF
TENNESSEE
KNOXVILLE



This program is an implementation of [A Regularized Raking Estimator for Small Area Mapping from Forest Inventory Surveys](#) by Nagle, Schroeder, and Rose in *Forests* (2019), 10, 1045; doi:10.3390/f10111045

Warning! These are not official FIA estimates. The estimates herein are designed as an alternative to the FIA's official estimates for user-specified regions. The official FIA estimates are available at: [Tools and Data - Forest Inventory and Analysis National Program \(fs.fed.us\)](#)

The regularized raking algorithm is designed to provide more small area estimates than the traditional raking algorithm (Deming, W. E.; Stephan, F. F. (1940). [On a Least Squares Adjustment of a Sampled Frequency Table When the Expected Marginal Totals are Known](#) . The regularized raking estimator provides a compromise between purely design-based estimates and model-based estimates.

To get started, advance to the map tab and upload a zipped shapefile.

Programming by:

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Step 2b: Advance to the “Map” tab

RegRake: A Small Area Estimation Tool

1. Choose shapefile (*.zip)

Browse... unit1a.zip

Upload complete

2. Choose FIA survey unit

Unit 1

3. Select Output Estimates

☐ Basal Area

☐ Volume

☐ Land Use

☐ Per Acre

Go to 4A to create a shapefile. Go to 4B to create a raster.

4A. Calculate Small Area Estimates

Calculate Shapefile

5A. Download your shapefile with the estimates

Download Shapefile

4B. Calculate rasters

Calculate Raster

5B Download raster

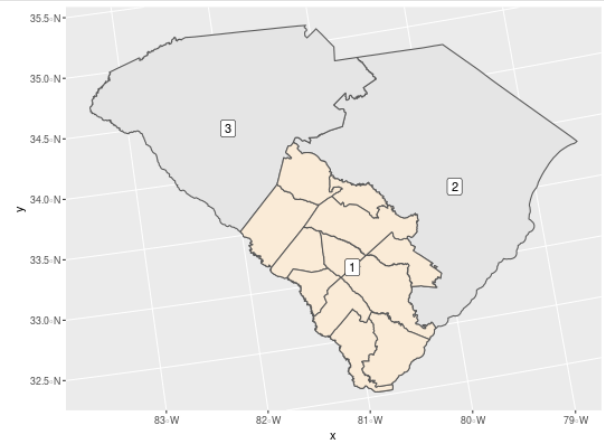
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Done.

Step 3: Choose survey unit

RegRake: A Small Area Estimation Tool

1. Choose shapefile (*.zip)

Browse... unit1a.zip

Upload complete

2. Choose FIA survey unit

Unit 1

3. Select Output Estimates

☐ Basal Area

☐ Volume

☐ Land Use

☐ Per Acre

Go to 4A to create a shapefile. Go to 4B to create a raster.

4A. Calculate Small Area Estimates

Calculate Shapefile

5A. Download your shapefile with the estimates

Download Shapefile

4B. Calculate rasters

Calculate Raster

5B Download raster

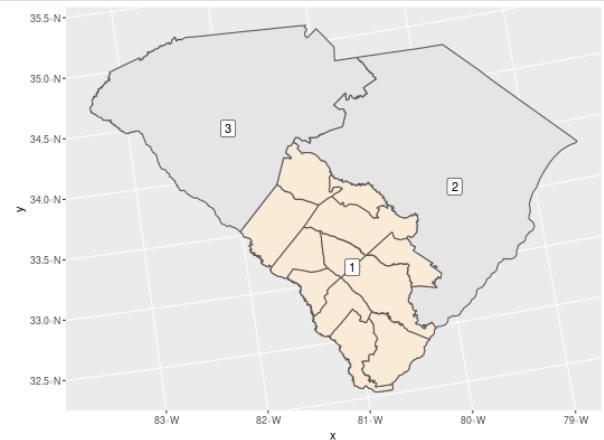
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Done.

Step 4: Choose output estimates (any or all)

RegRake: A Small Area Estimation Tool

1. Choose shapefile (*.zip)

Browse...

unit1a.zip

Upload complete

2. Choose FIA survey unit

Unit 1

3. Select Output Estimates

☒ Basal Area

☒ Volume

☒ Land Use

☒ Per Acre

Go to 4A to create a shapefile. Go to 4B to create a raster.

4A. Calculate Small Area Estimates

Calculate Shapefile

5A. Download your shapefile with the estimates

Download Shapefile

4B. Calculate rasters

Calculate Raster

5B Download raster

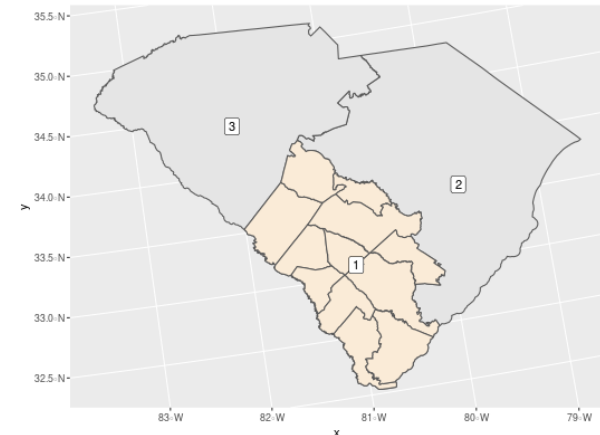
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Done.

Land use is generalized

LAND_USE_SRS	Meaning
1	Timberland
2	Other forest land
10	Agricultural
11	Cropland
12	Pasture
13	Idle farmland
14	Orchard
15	Christmas tree plantation
16	Maintained wildlife opening
17	Windbreak/Shelterbelt
20	Rangeland
30	Developed
31	Cultural
32	Rights of way
33	Recreation
34	Mining
40	Other
41	Nonvegetated
42	Wetland
43	Beach
91	Census Water
92	Noncensus Water

RegRake categories are:

Forest
Agricultural
Developed
Other

Surface water will not appear in the output

NLCD Land Class 11 approximates Census Water

NLCD Land Class 31:

-- is small (very few plots land in it)
-- doesn't fit easily into FIA land use
(It could be idle farmland, mining, nonvegetated, beach, etc.)

NLCD Land Cover

- 11 Open Water
- 21 Open Developed
- 22 Low Density Developed
- 23 Medium Density Developed
- 24 High Density Developed
- 31 Barren Land
- 41 Deciduous Forest
- 42 Evergreen Forest
- 43 Mixed Forest
- 52 Shrub/Scrub
- 71 Grassland/Herbaceous
- 81 Pasture/Hay
- 82 Cultivated Crops
- 90 Woody Wetlands
- 95 Emergent Herbaceous Wetlands

Step 5: Calculate shapefile

RegRake: A Small Area Estimation Tool

1. Choose shapefile (*.zip)

Browse... unit1a.zip

Upload complete

2. Choose FIA survey unit

Unit 1

3. Select Output Estimates

☒ Basal Area

☒ Volume

☒ Land Use

☒ Per Acre

Go to 4A to create a shapefile. Go to 4B to create a raster.

4A. Calculate Small Area Estimates

Calculate Shapefile

5A. Download your shapefile with the estimates

Download Shapefile

4B. Calculate rasters

Calculate Raster

5B Download raster

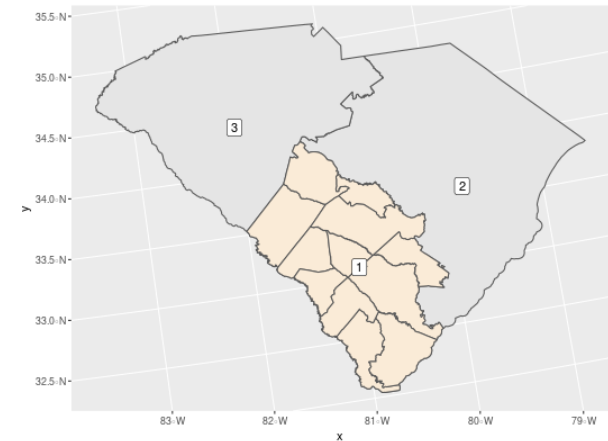
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Done.

Step 6: Output will be on the "Table" tab

RegRake: A Small Area Estimation Tool

1. Choose shapefile (*.zip)

Browse... unit1a.zip

Upload complete

2. Choose FIA survey unit

Unit 1

3. Select Output Estimates

☒ Basal Area

☒ Volume

☒ Land Use

☐ Per Acre

Go to 4A to create a shapefile. Go to 4B to create a raster.

4A. Calculate Small Area Estimates

Calculate Shapefile

5A. Download your shapefile with the estimates

Download Shapefile

4B. Calculate rasters

Calculate Raster

5B Download raster

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Show 25 entries

Search:

COUNTYFP00	ACRES_UNADJ	BALIVE_TOT	VOL_TOT	FOREST	AG	URBAN	OTHER
003	679329.3	40561771	756254791	461087.6	110741.1	98685.1	8815.6
005	261423.6	16972046	325833715	184099.4	45406.4	27902.9	4014.9
009	252022.4	16659327	321658693	179100.7	42677.7	26370.0	3874.0
011	350629.7	22926074	435760019	252452.2	53255.5	39755.8	5166.1
013	359807.3	17388041	337619285	183842.7	32733.1	41744.9	101486.6
017	244542.4	14786614	283714984	160919.8	51690.4	28541.9	3390.4
029	665208.1	47679681	943808604	493949.3	70004.5	56203.6	45050.7
035	362408.6	26206570	522132284	269663.0	45847.6	40906.3	5991.7
049	357571.8	25156490	492003787	265372.6	51085.8	35185.3	5928.1
053	411168.9	29283394	573754492	307002.3	35498.8	35686.5	32981.3
063	441908.7	23579438	440014145	269461.8	77629.2	89978.6	4839.1
075	705076.2	42729816	824908312	460679.8	149204.5	85253.8	9938.0

COUNTYFP00ACRES_UNADJBALIVE_TOTVOL_TOTFORESTAGURBANOTHER

Showing 1 to 12 of 12 entries

Previous1Next

Basal area is about 5% low compared to Evalidator

	Land class	
Unit code	Total	Accessible forest
Total	1,280,802,001	1,280,802,001
4501 South Carolina: Southern Coastal Plain	340,362,222	340,362,222
4502 South Carolina: Northern Coastal Plain	479,241,980	479,241,980
4503 South Carolina: Piedmont	461,197,799	461,197,799

Net cubic foot volume is about 6.5% low compared to Evalidator

	Land class	
Unit code	Total	Accessible forest
Total	24,123,167,701	24,123,167,701
4501 South Carolina: Southern Coastal Plain	6,698,486,198	6,698,486,198
4502 South Carolina: Northern Coastal Plain	8,605,945,454	8,605,945,454
4503 South Carolina: Piedmont	8,818,736,049	8,818,736,049

Shapefiles along a unit boundary can spill into the next unit

RegRake: A Small Area Estimation Tool

1. Choose shapefile (*.zip) [?](#)

Browse... unit1b.zip

Upload complete

2. Choose FIA survey unit [?](#)

Unit 2

3. Select Output Estimates

☒ Basal Area

☒ Volume

☒ Land Use [?](#)

☒ Per Acre [?](#)

Go to 4A to create a shapefile. Go to 4B to create a raster.

4A. Calculate Small Area Estimates

Calculate Shapefile

5A. Download your shapefile with the estimates

Download Shapefile

4B. Calculate rasters

Calculate Raster

5B Download raster

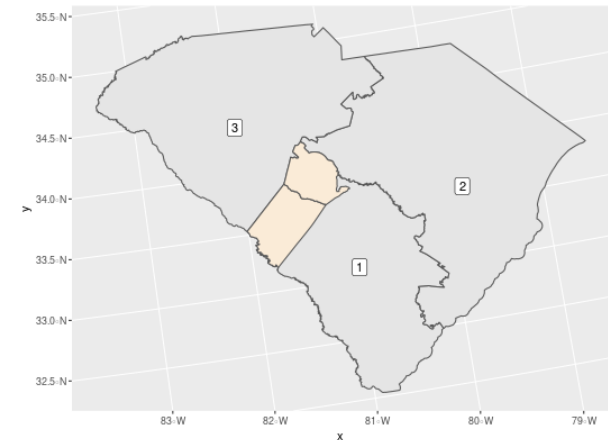
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Done.

Shapefiles along a unit boundary can spill into the next unit

RegRake: A Small Area Estimation Tool

1. Choose shapefile (*.zip) ?

Browse...

unit1b.zip

Upload complete

2. Choose FIA survey unit ?

Unit 2

3. Select Output Estimates

☒ Basal Area

☒ Volume

☒ Land Use

☒ Per Acre

Go to 4A to create a shapefile. Go to 4B to create a raster.

4A. Calculate Small Area Estimates

Calculate Shapefile

5A. Download your shapefile with the estimates

Download Shapefile

4B. Calculate rasters

Calculate Raster

5B Download raster

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Show

25

entries

Search:

COUNTYFP00	ACRES_UNADJ	BALIVE_TOT	BALIVEperAC	VOL_TOT	VOLperAC	FOREST	AG	URBAN	OTHER	FOREST_perA
003	0.000000	0.0000		0.00000		0.000000	0.0000000	0.0000000	0.0000000	
063	4.664773	339.2719	72.73063	57.10412	12.24156	3.944759	0.2078874	0.3879873	0.1241391	0.8456487

COUNTYFP00

ACRES_UNADJ

BALIVE_TOT

BALIVEperAC

VOL_TOT

VOLperAC

FOREST

AG

URBAN

OTHER

FOREST_perA

Showing 1 to 2 of 2 entries

Previous

1

Next

Step 7: Download shapefile (if desired)

RegRake: A Small Area Estimation Tool

1. Choose shapefile (*.zip)

Browse...

unit1b.zip

Upload complete

2. Choose FIA survey unit

Unit 2

3. Select Output Estimates

☒ Basal Area

☒ Volume

☒ Land Use

☒ Per Acre

Go to 4A to create a shapefile. Go to 4B to create a raster.

4A. Calculate Small Area Estimates

Calculate Shapefile

5A. Download your shapefile with the estimates

Download Shapefile

4B. Calculate rasters

Calculate Raster

5B Download raster

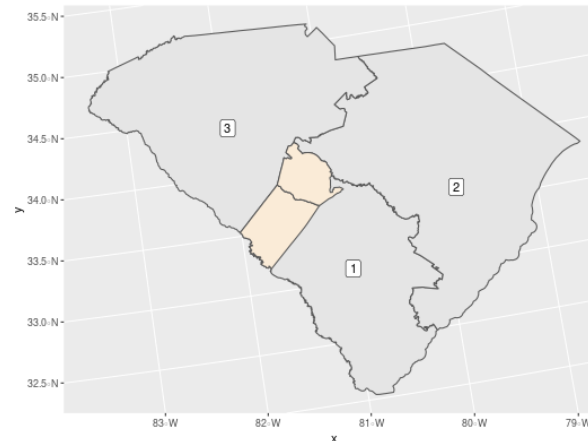
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Done.

Downloaded shapefile will have fields attached

Table

file533d71805547

COUNTYF	CNTYIDF	NAME00	NAMELSA	LSAD00	CLASSFP	MTFCC00	UR00	FUNCSTA	unit	ACRES_U	BALIVE_	BALIVEA	VOL_TOT	VOLprAC	FOREST	AG	URBAN	OTHER	FOREST_	AG_prAC	URBAN_A	OTHER_A
003	45003	Aiken	Aiken County	06	H1	G4020	M	A	1	0	0	0	0	0	0	0	0	0	0	0	0	0
063	45063	Lexington	Lexington County	06	H1	G4020	M	A	1	4.664773	339.271891	72.730632	57.104117	12.241564	3.944759	0.207887	0.387987	0.124139	0.845649	0.044565	0.083174	0.026612

Step 8: Calculate raster

RegRake: A Small Area Estimation Tool

1. Choose shapefile (*.zip)

Browse...

unit1a.zip

Upload complete

2. Choose FIA survey unit

Unit 1

3. Select Output Estimates

☒ Basal Area

☒ Volume

☒ Land Use

☒ Per Acre

Go to 4A to create a shapefile. Go to 4B to create a raster.

4A. Calculate Small Area Estimates

Calculate Shapefile

5A. Download your shapefile with the estimates

Download Shapefile

4B. Calculate rasters

Calculate Raster

5B Download raster

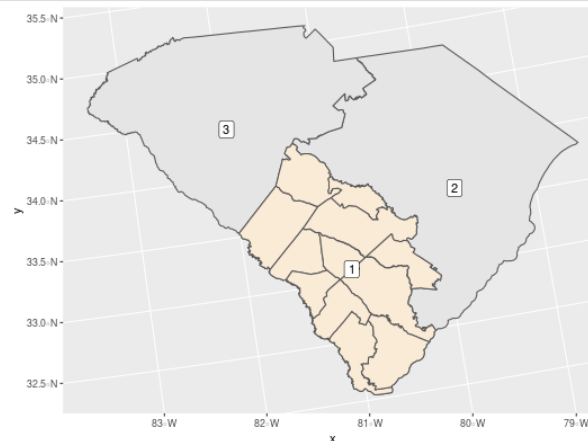
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Done.

Output will be displayed on the “Map” tab

RegRake: A Small Area Estimation Tool

1. Choose shapefile (*.zip)

Browse...

unit1a.zip

Upload complete

2. Choose FIA survey unit

Unit 1

3. Select Output Estimates

☒ Basal Area

☒ Volume

☒ Land Use

☒ Per Acre

Go to 4A to create a shapefile. Go to 4B to create a raster.

4A. Calculate Small Area Estimates

Calculate Shapefile

5A. Download your shapefile with the estimates

Download Shapefile

4B. Calculate rasters

Calculate Raster

5B Download raster

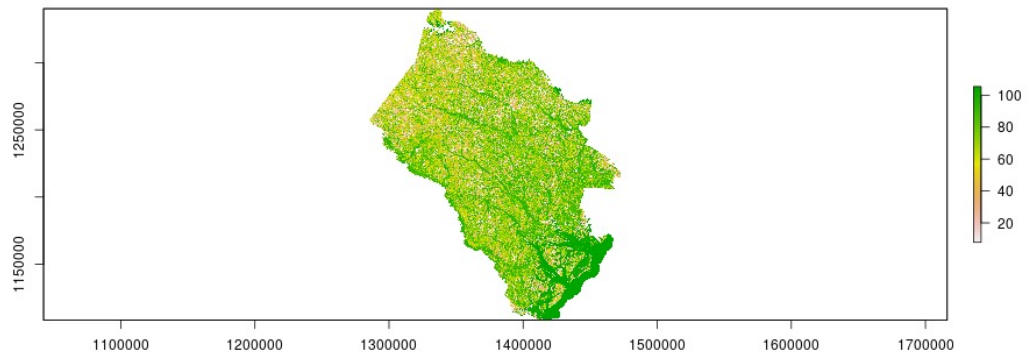
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Done.

Step 9: Download raster (if desired)

RegRake: A Small Area Estimation Tool

1. Choose shapefile (*.zip)

Browse...

unit1a.zip

Upload complete

2. Choose FIA survey unit

Unit 1

3. Select Output Estimates

☒ Basal Area

☒ Volume

☒ Land Use

☒ Per Acre

Go to 4A to create a shapefile. Go to 4B to create a raster.

4A. Calculate Small Area Estimates

Calculate Shapefile

5A. Download your shapefile with the estimates

Download Shapefile

4B. Calculate rasters

Calculate Raster

5B Download raster

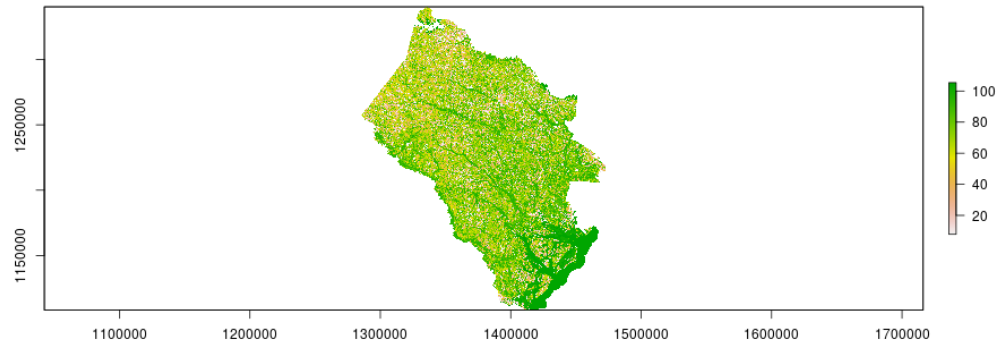
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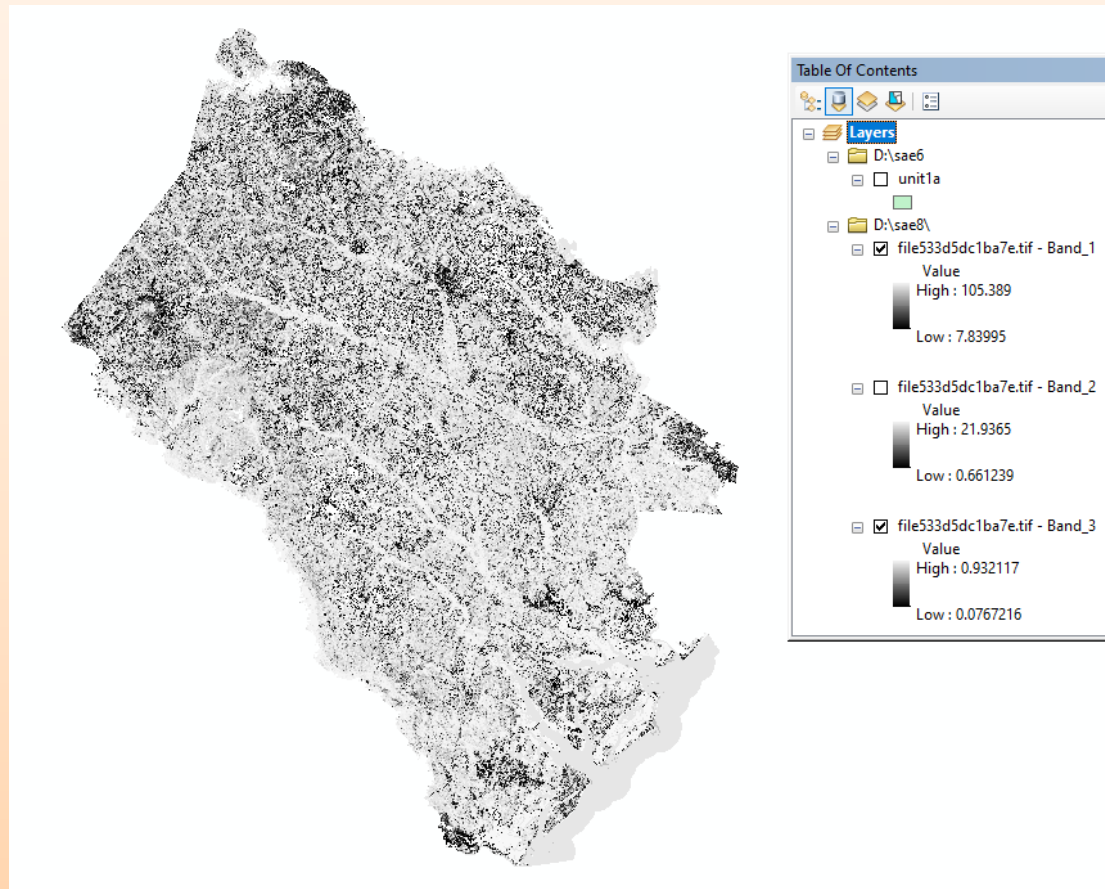
Map

Table



Done.

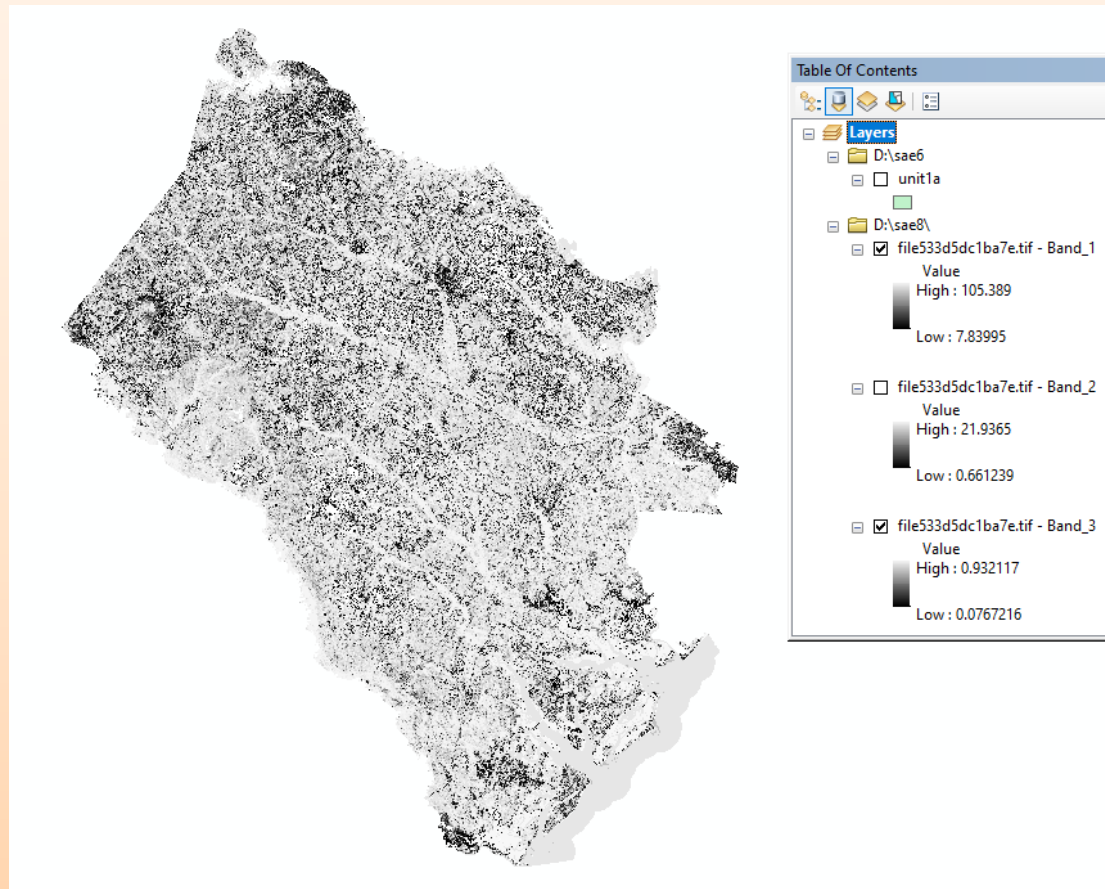
If requested, Basal area will be the lowest numbered band.



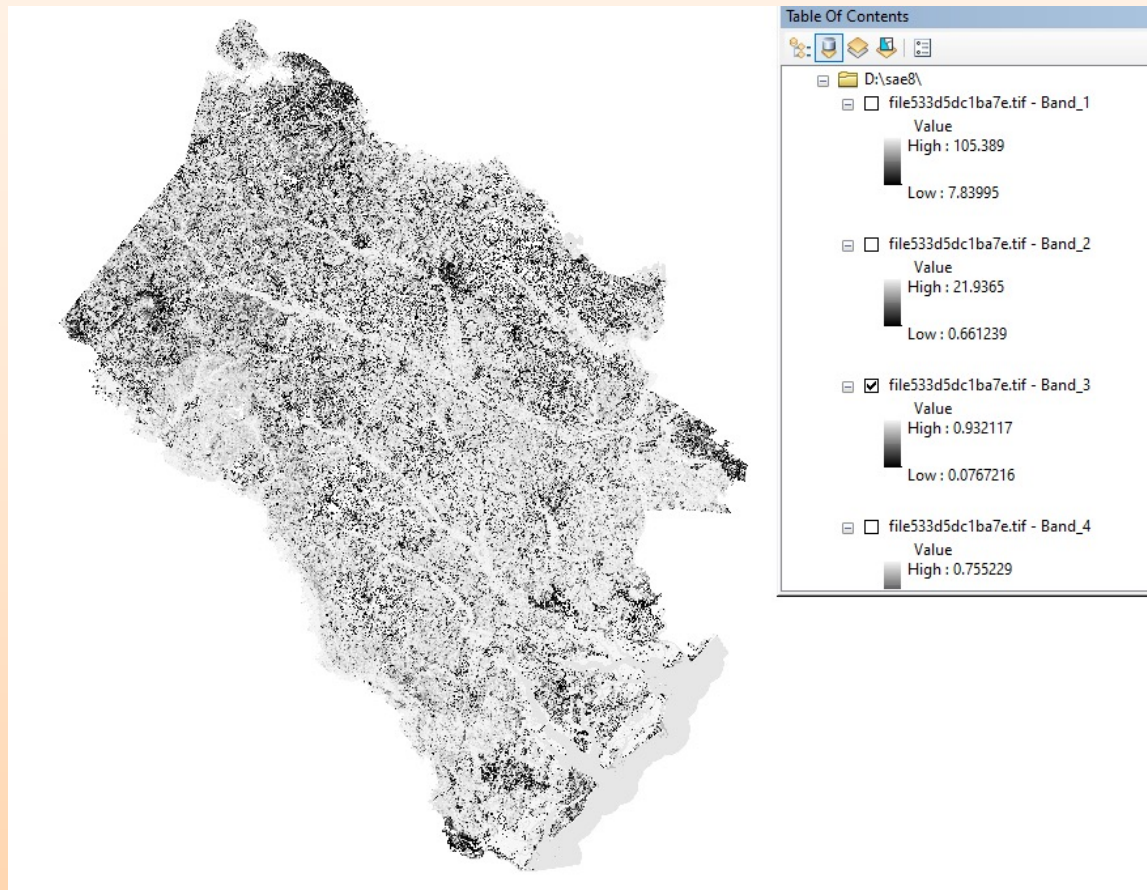
The sum of the pixels will be equal to the tabular output.

```
#####  
library(tiff)  
x = readTIFF("d:\\sae_1\\band_1.tif")  
# change the above line for each band  
p = matrix(data=0,nrow=nrow(x)*ncol(x),ncol=1)  
k = 1  
s = 0  
for (iin 1:nrow(x))  
  for (j in 1:ncol(x))  
    {if ((x[i,j] >= 0) && (x[i,j] <= 9999))  
      {p[k] = x[i,j]  
       k = k + 1  
       s = s + x[i,j]  
      }  
    }  
#####  
  
sum(s)  
  
#####
```

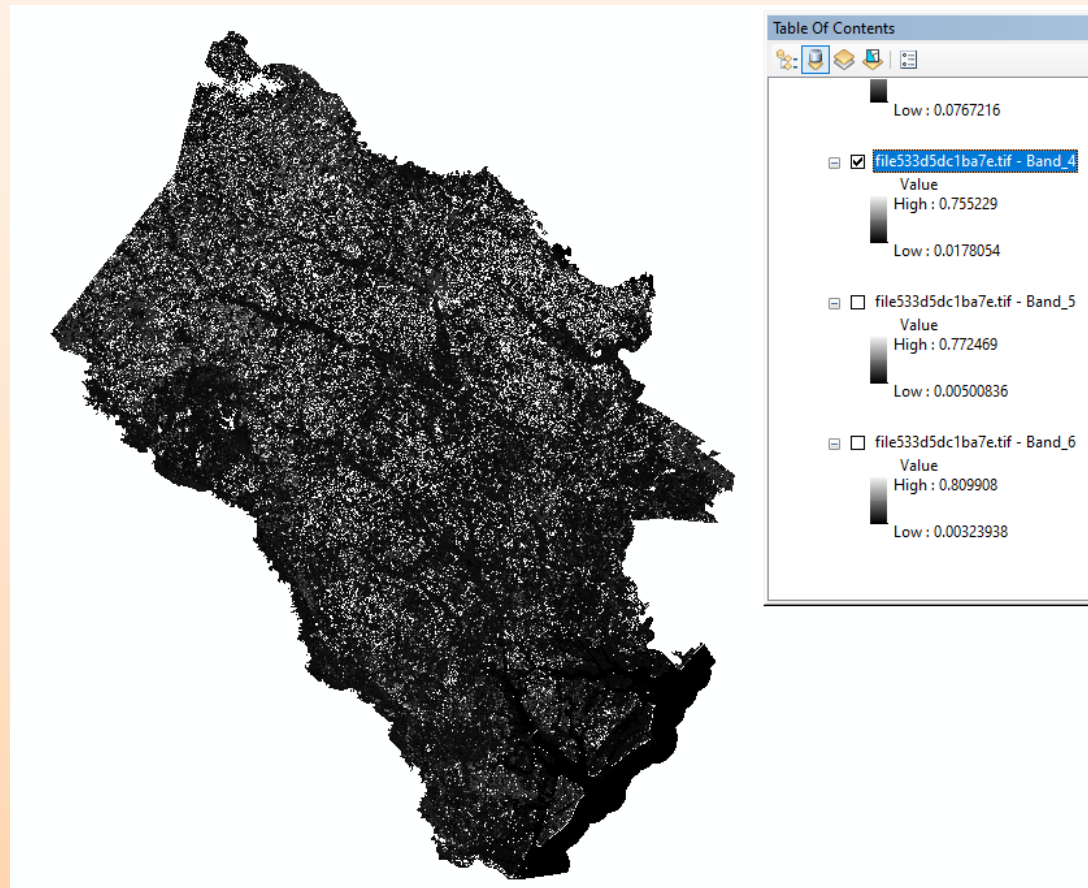
Volume will be the next band.



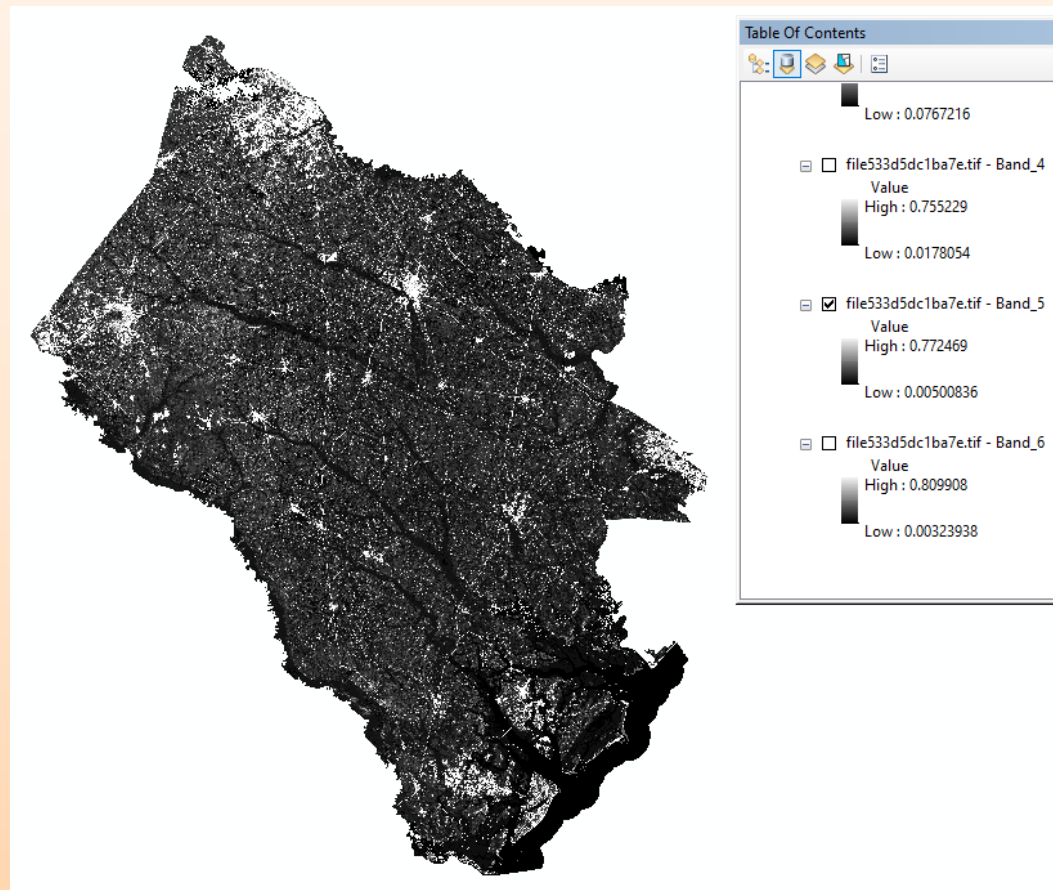
Forest is the next band band (pixels sum to acres)



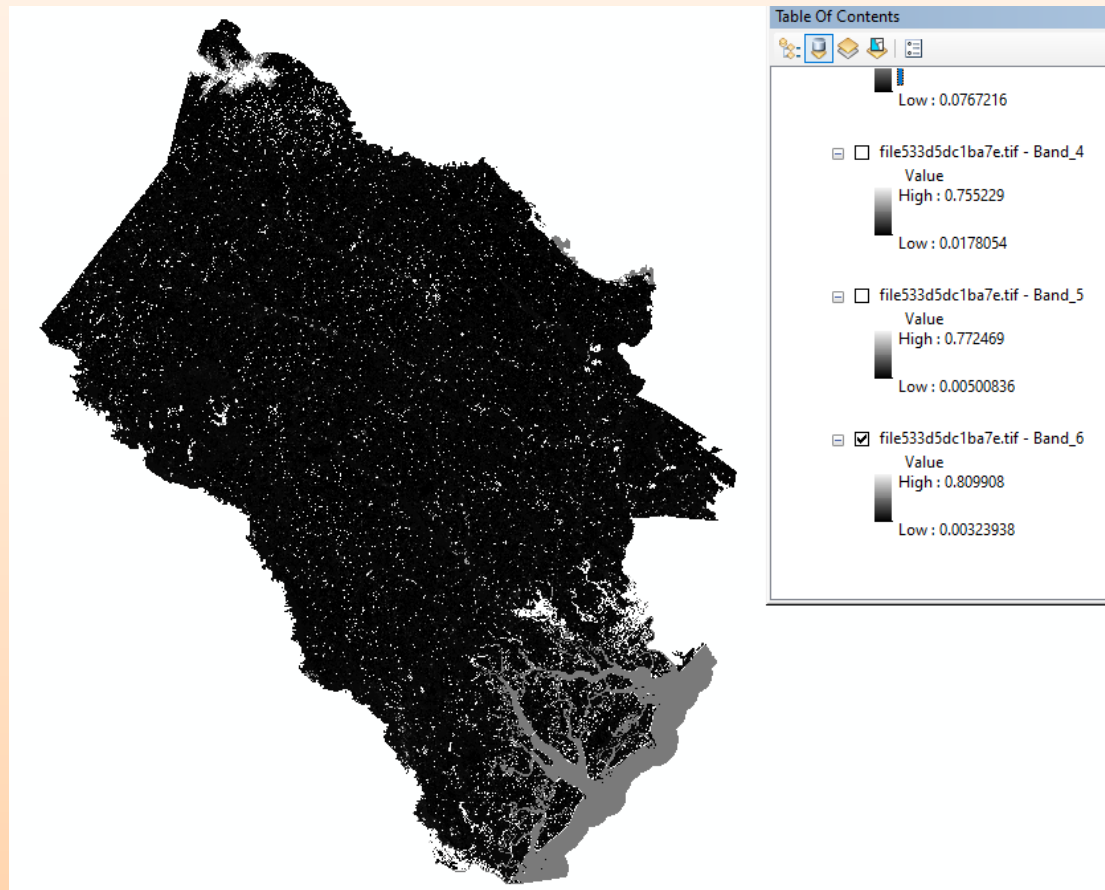
Percent agriculture is the next band.



Percent developed is the next band.



Percent other is the next band.



Gaps in the raster



NLCD Land Class 11

NLCD Land Class 31

Gaps in the raster

Users should be aware that the land cover data used to develop the small area patches was pre-processed to remove the classes barren (NLCD class 31) and open water (NLCD class 11) most likely to be devoid of vegetation. As a result, the raster-based small area estimates produced by RegRake will not have predicted values in these areas (see example). In some instances, this also results in missing data in other land cover types, due to the merging that occurs during the development of the small area patches. The holes in the raster outputs are mostly confined to barren and water, although occasionally the missing data occurs in other land cover classes. The missing predictions in the other land cover classes are relatively minor and should not impact the landscape-level estimates produced by RegRake.