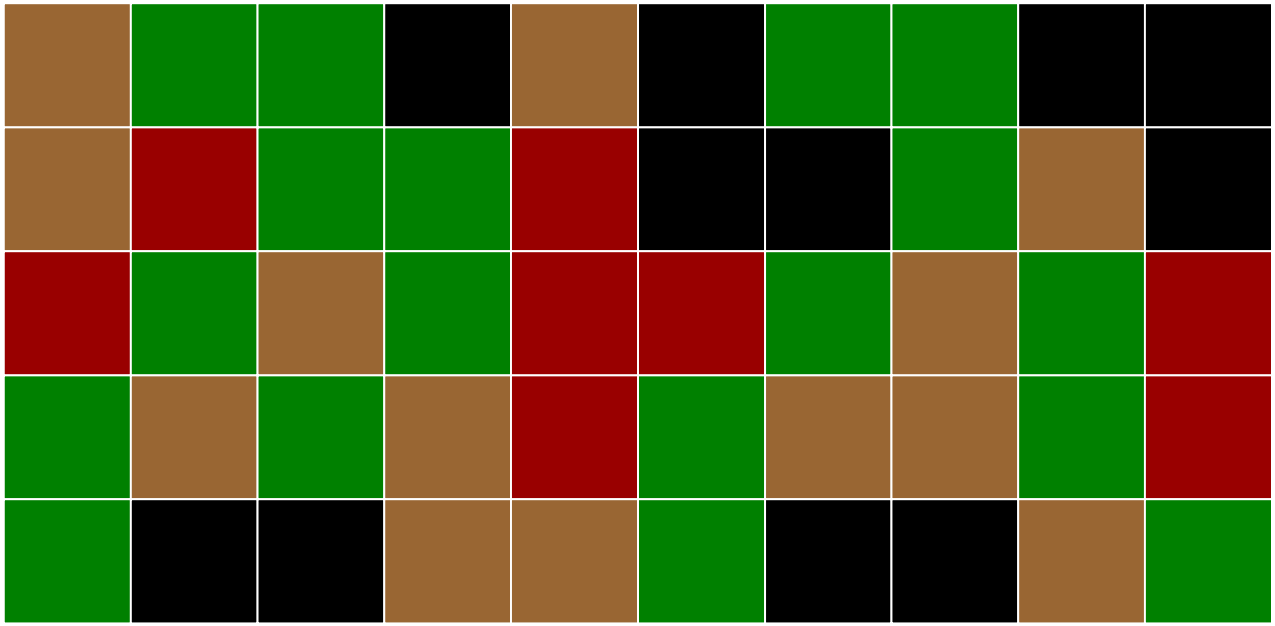
5. Zonal Analysis

5.1 Definition of a zone
5.2 Zonal statistics
5.3 Zonal statistics as table
5.4 Zonal geometry
5.5 Zonal geometry as table
5.6 Zonal histogram

5.1 Definition of a zone

A zone is all the cells in a raster that have the same value, regardless of whether or not they are contiguous.

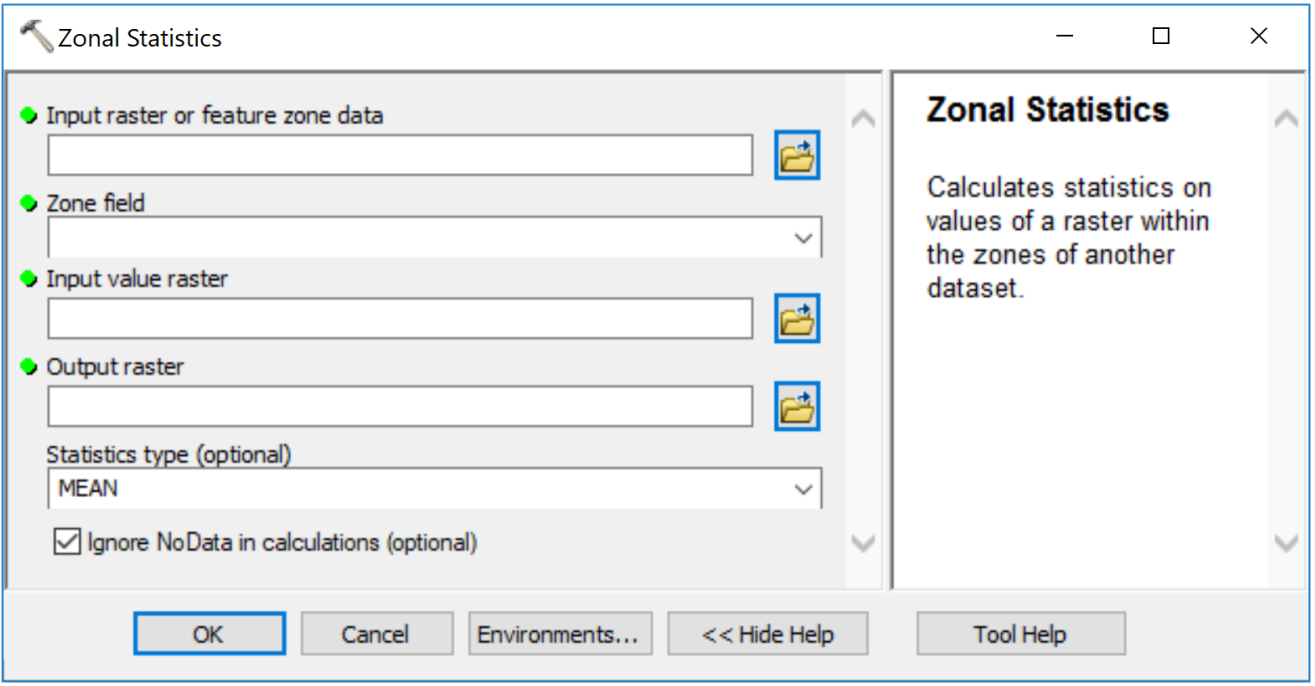


Four zones in a raster

5.2 Zonal statistics

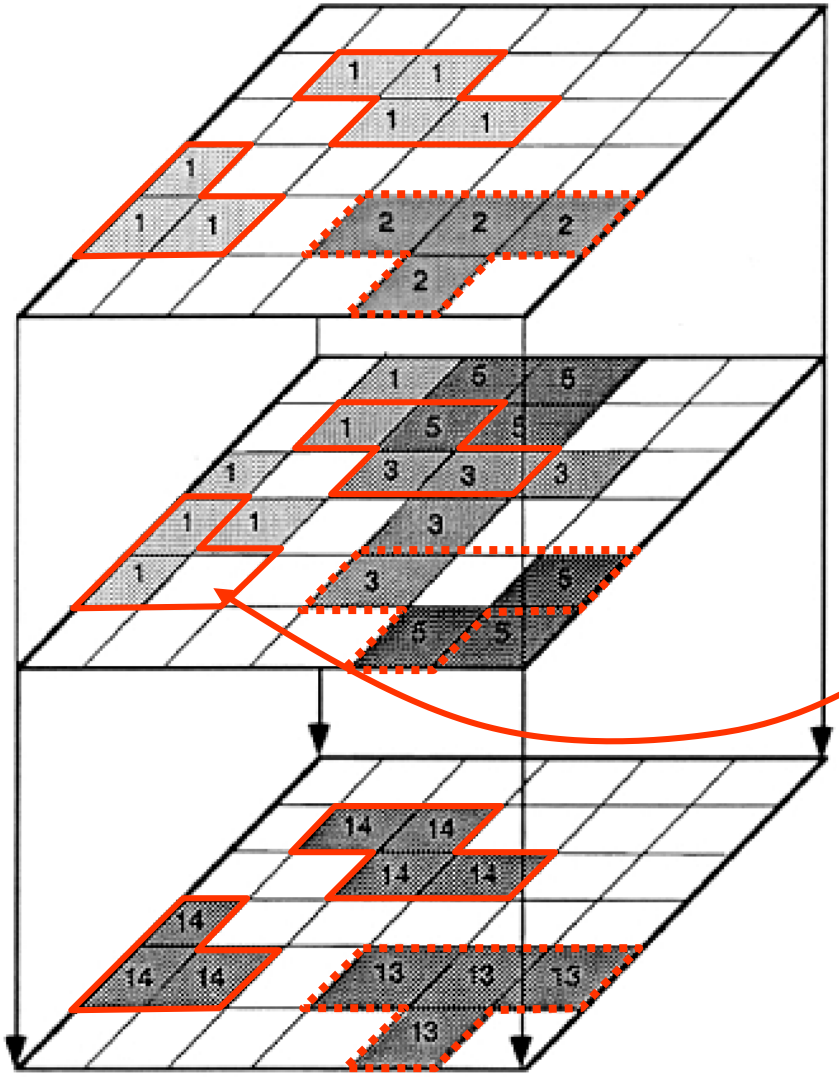
ArcToolbox → Spatial Analyst Tools → Zonal

Zonal statistical functions perform statistics on a per-zone basis; a single output value is computed for every zone in the input zone dataset.



- Majority
- Maximum
- Mean
- Median
- Minimum
- Minority
- Range
- Standard Deviation
- Sum
- Variety

5.3 Zonal statistics (cont.)



Zone Data Layer
(can be a raster or feature dataset)

Value Raster

☑ Ignore NoData in calculations (optional)

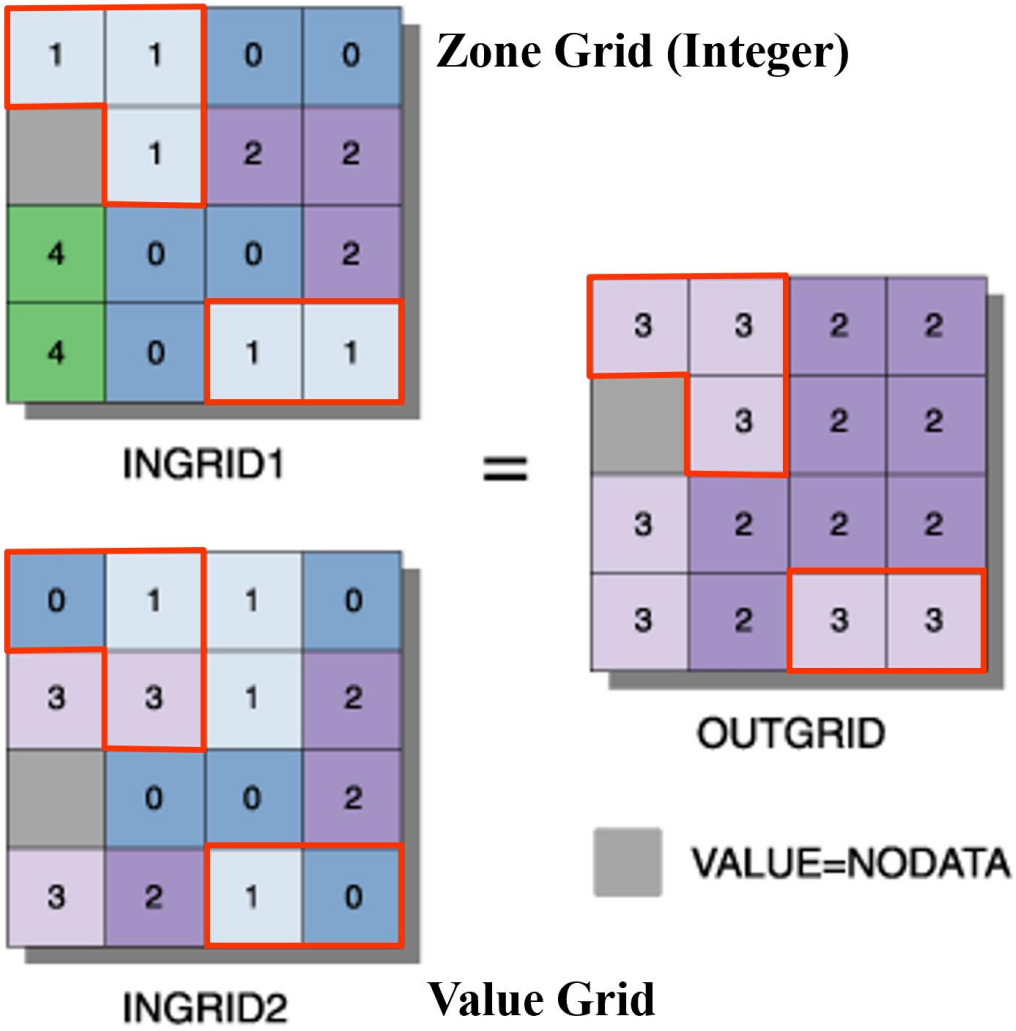
Output Raster (Zonal Sum)

Zone 1: 1+5+3+3+1+1 = 14

Zone 2: 3+5+5 = 13

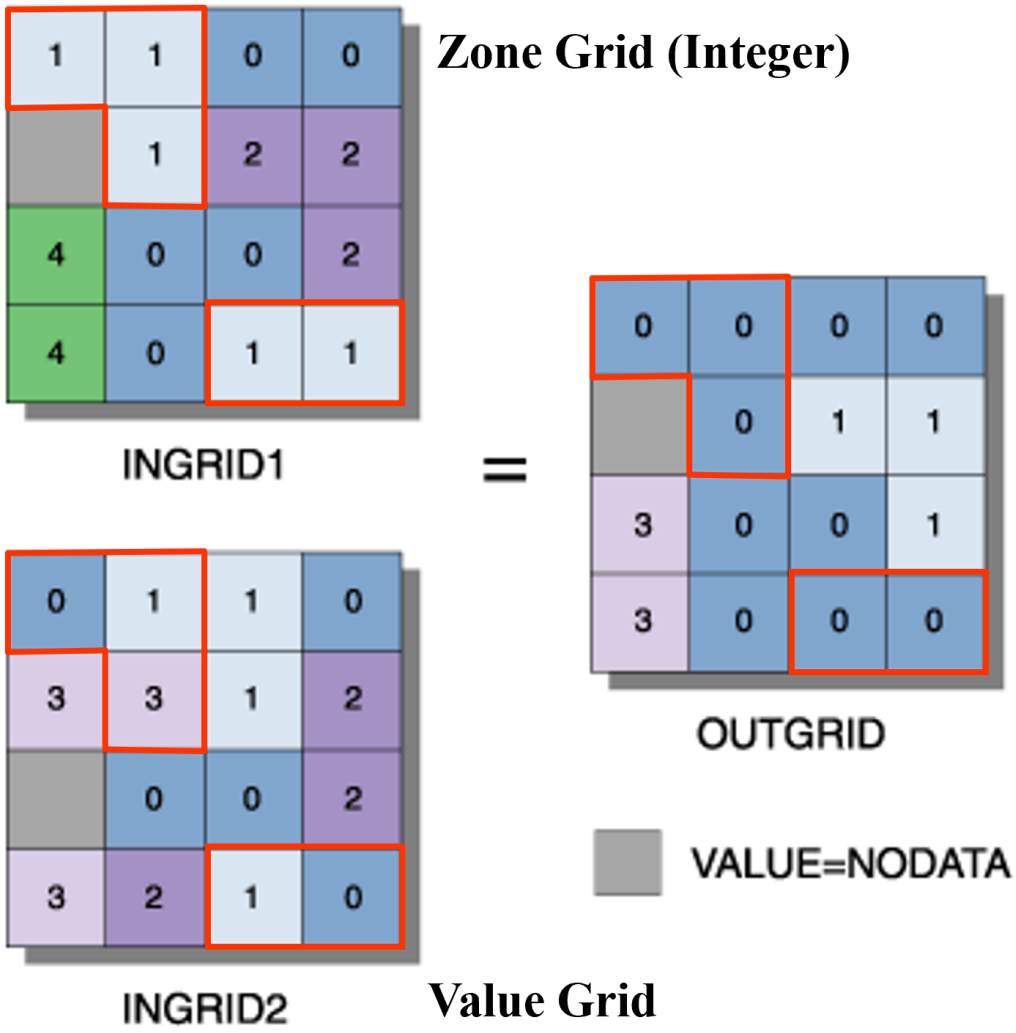
5.3 Zonal statistics (cont.)

Zonal Max



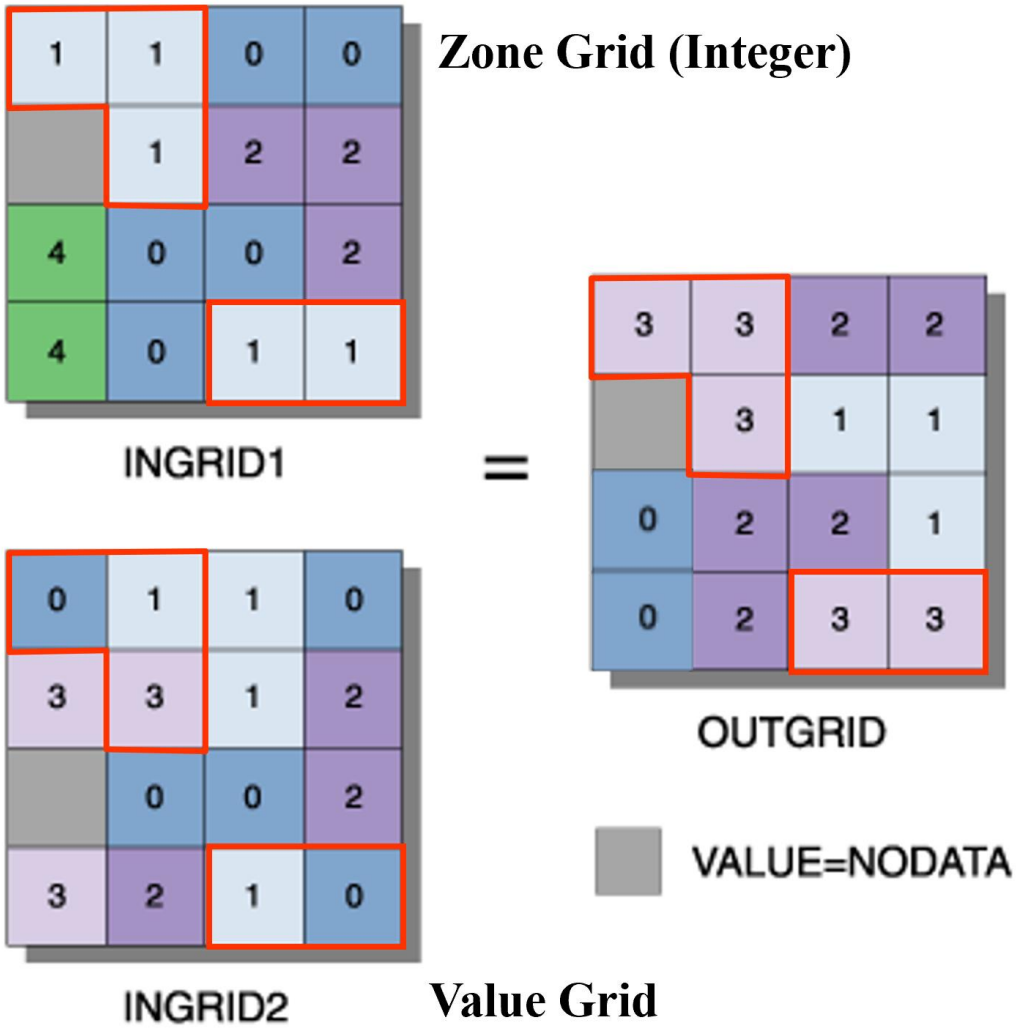
5.3 Zonal statistics (cont.)

Zonal Min



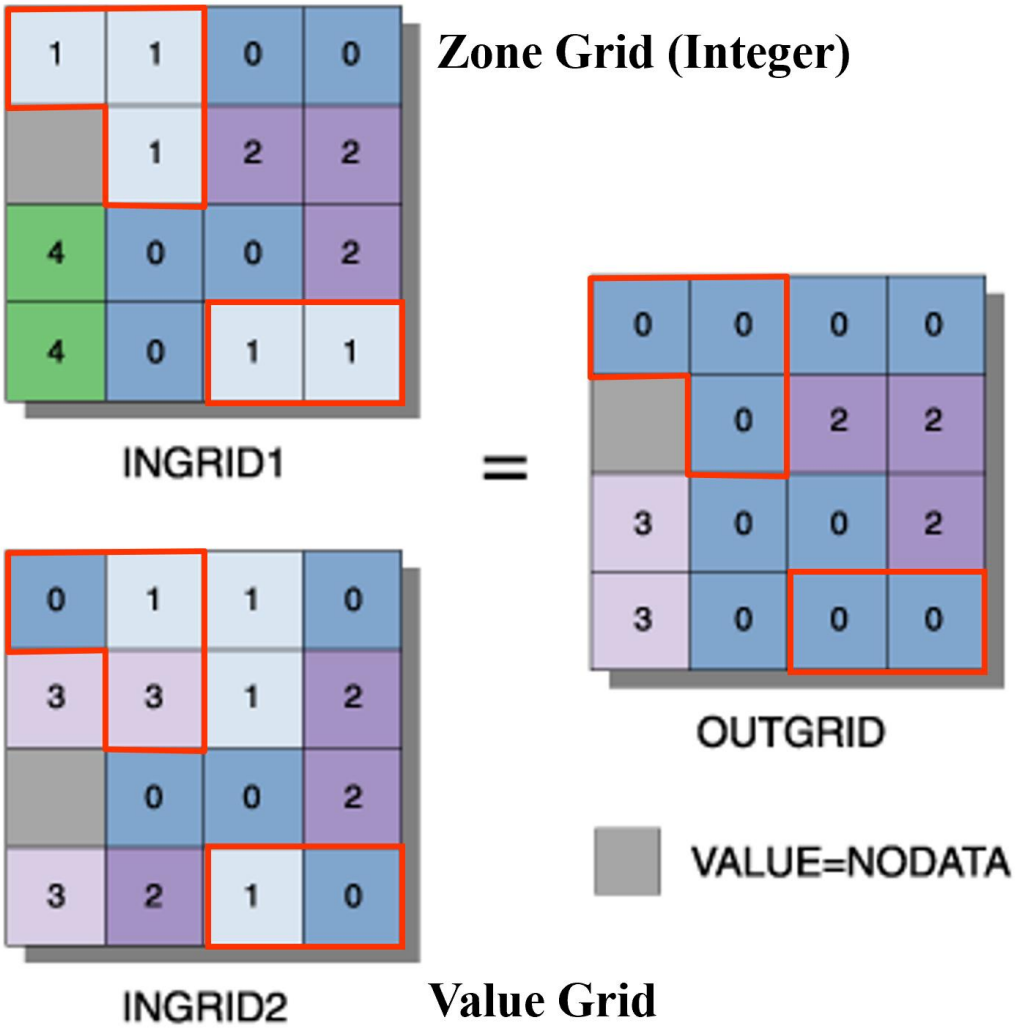
5.3 Zonal statistics (cont.)

Zonal Range



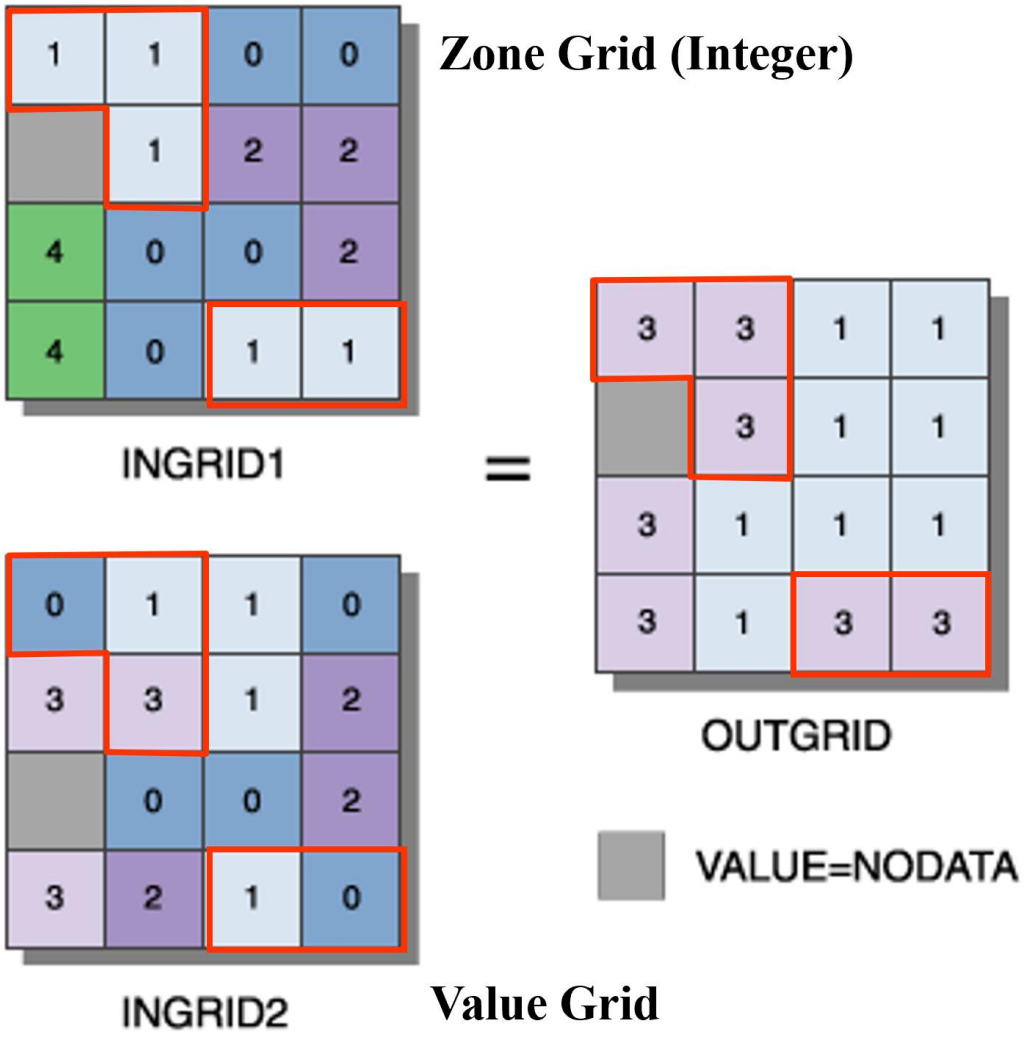
5.3 Zonal statistics (cont.)

Zonal Majority



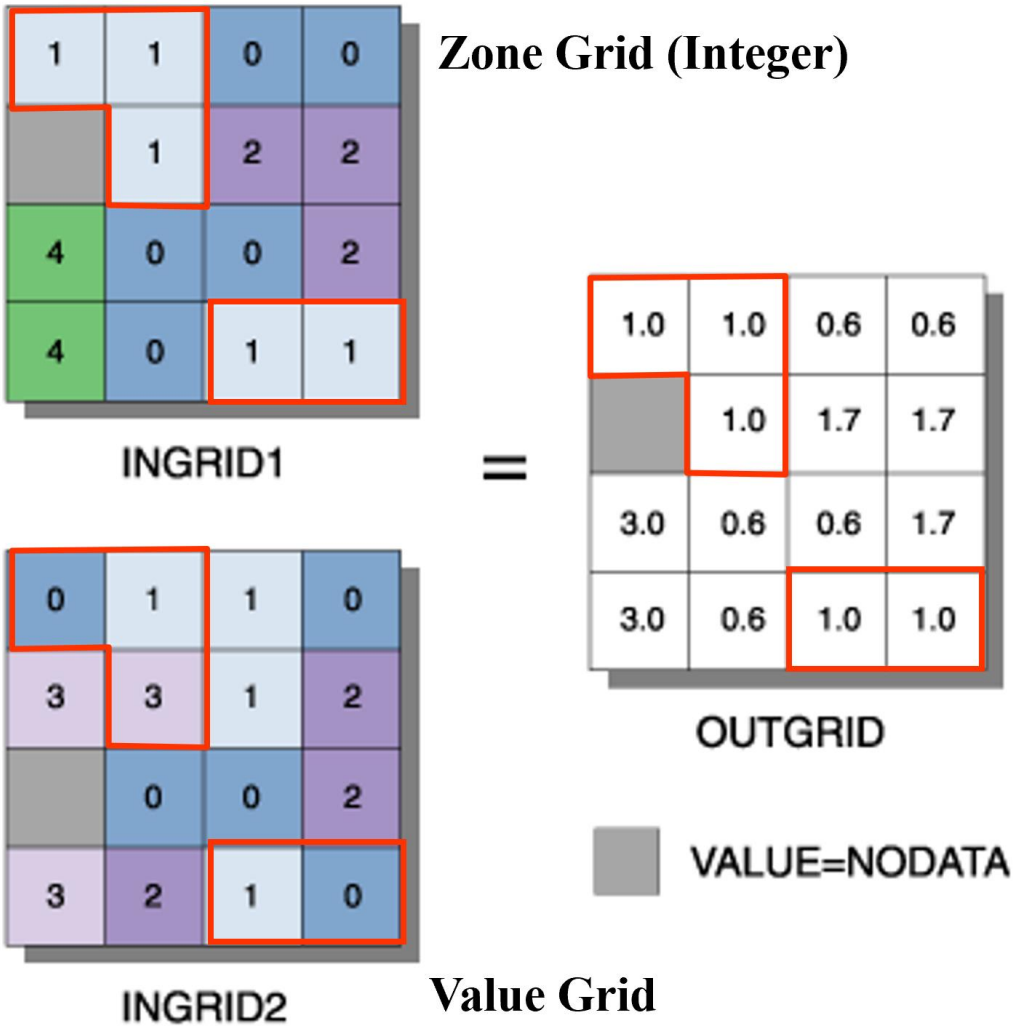
5.3 Zonal statistics (cont.)

Zonal Minority



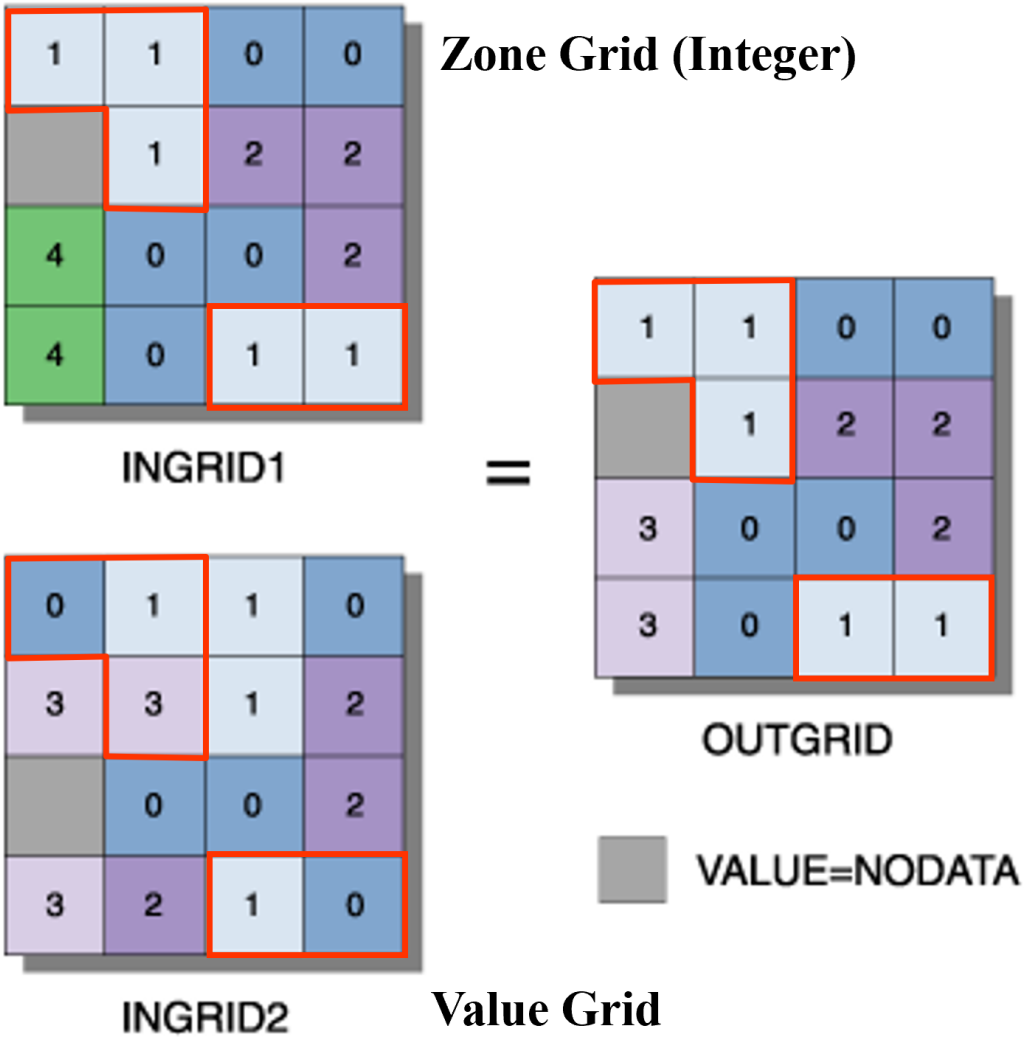
5.3 Zonal statistics (cont.)

Zonal Mean



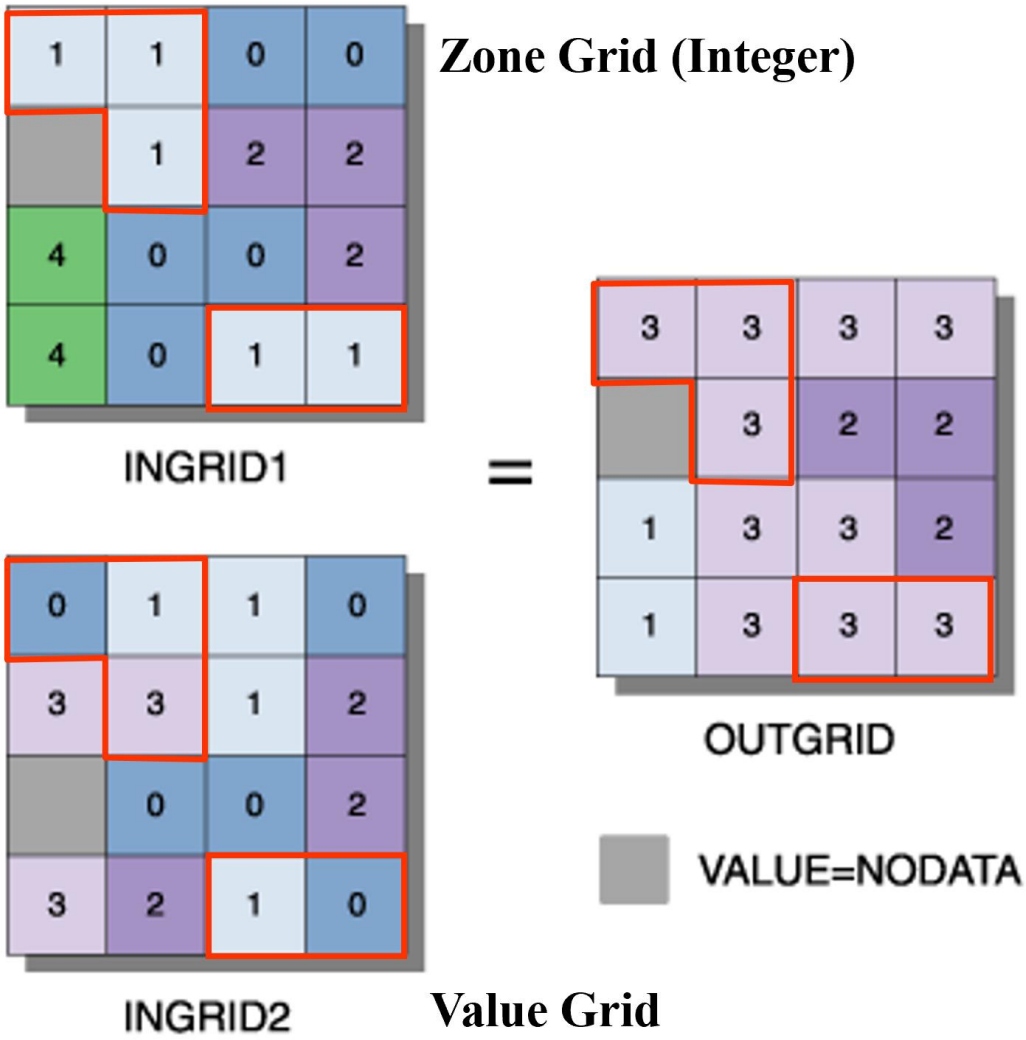
5.3 Zonal statistics (cont.)

Zonal Median



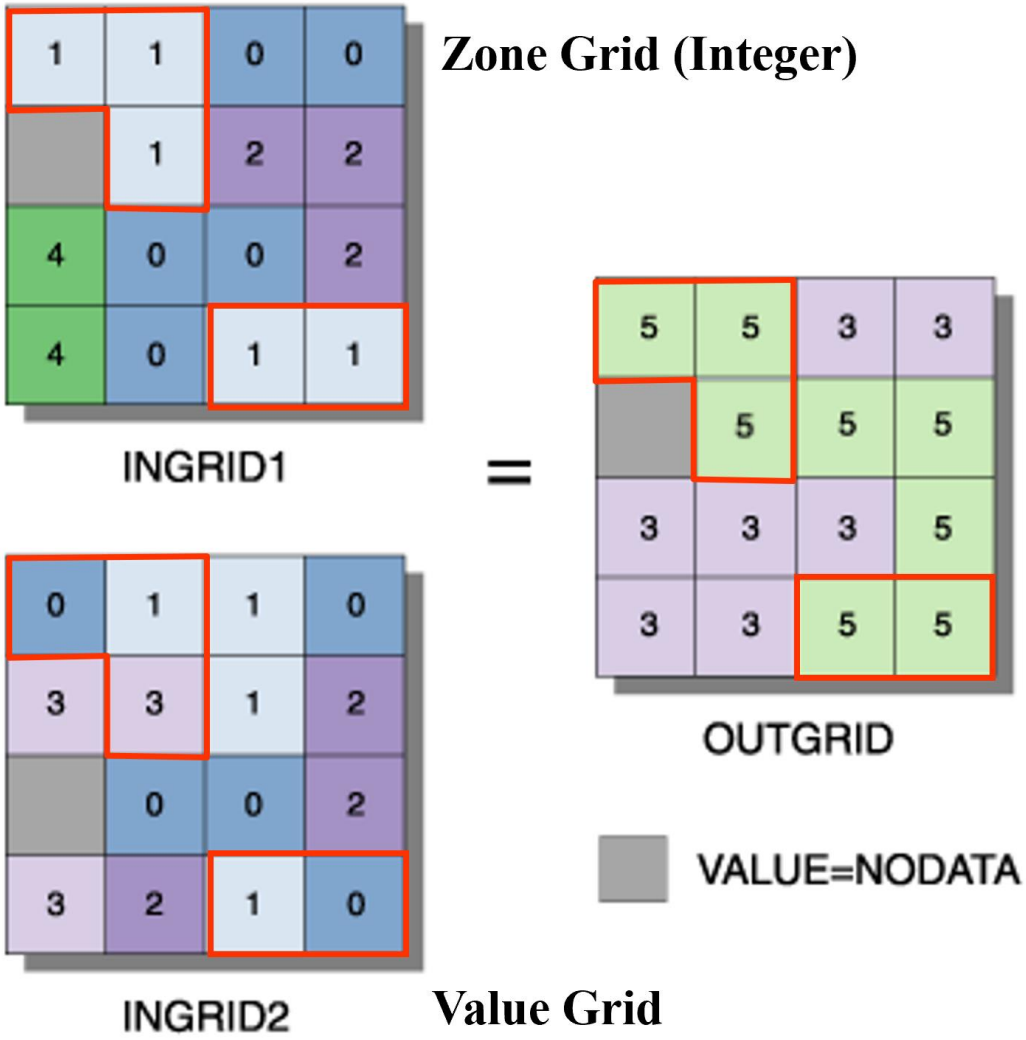
5.3 Zonal statistics (cont.)

Zonal Variety



5.3 Zonal statistics (cont.)

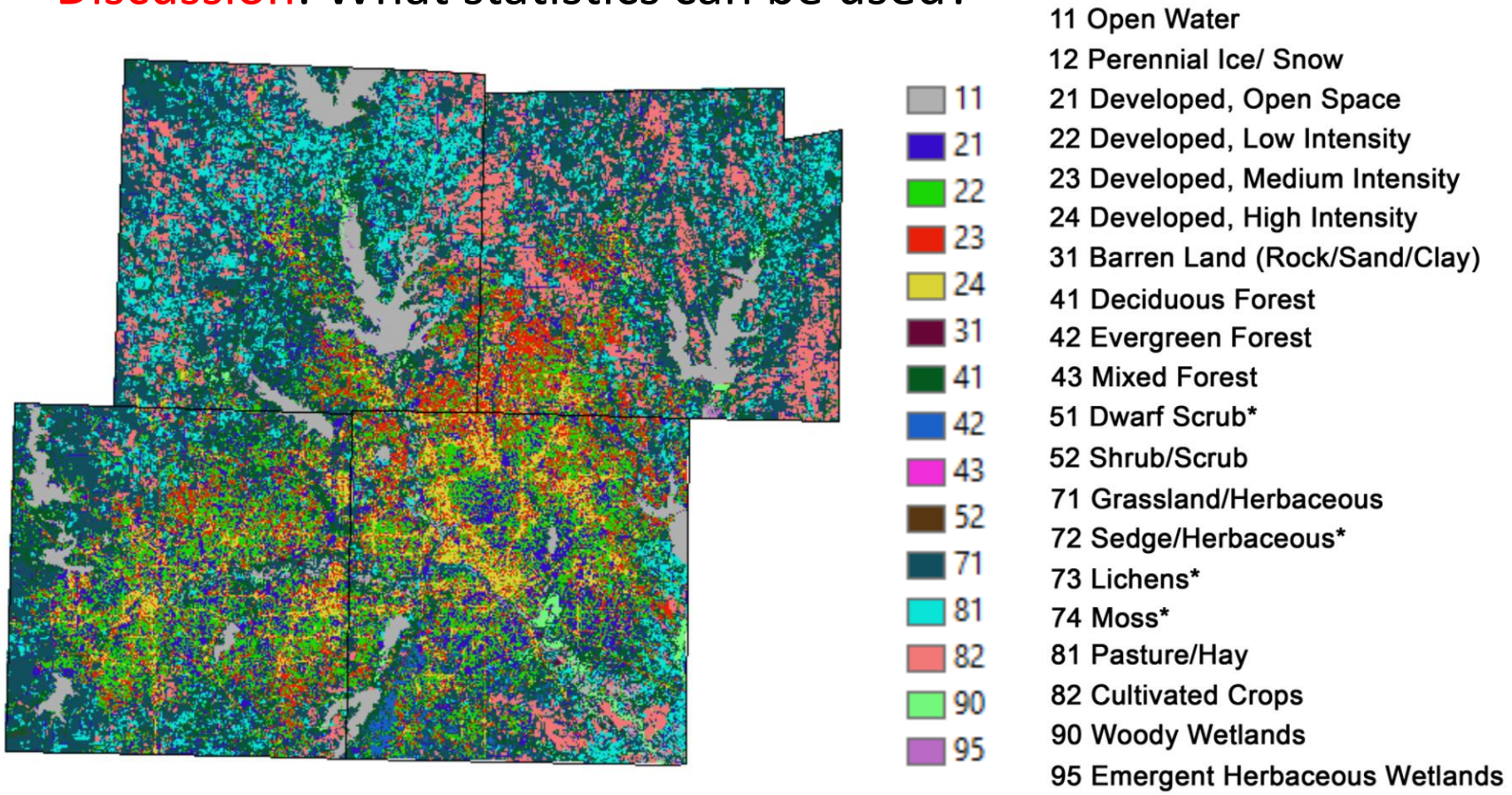
Zonal Sum



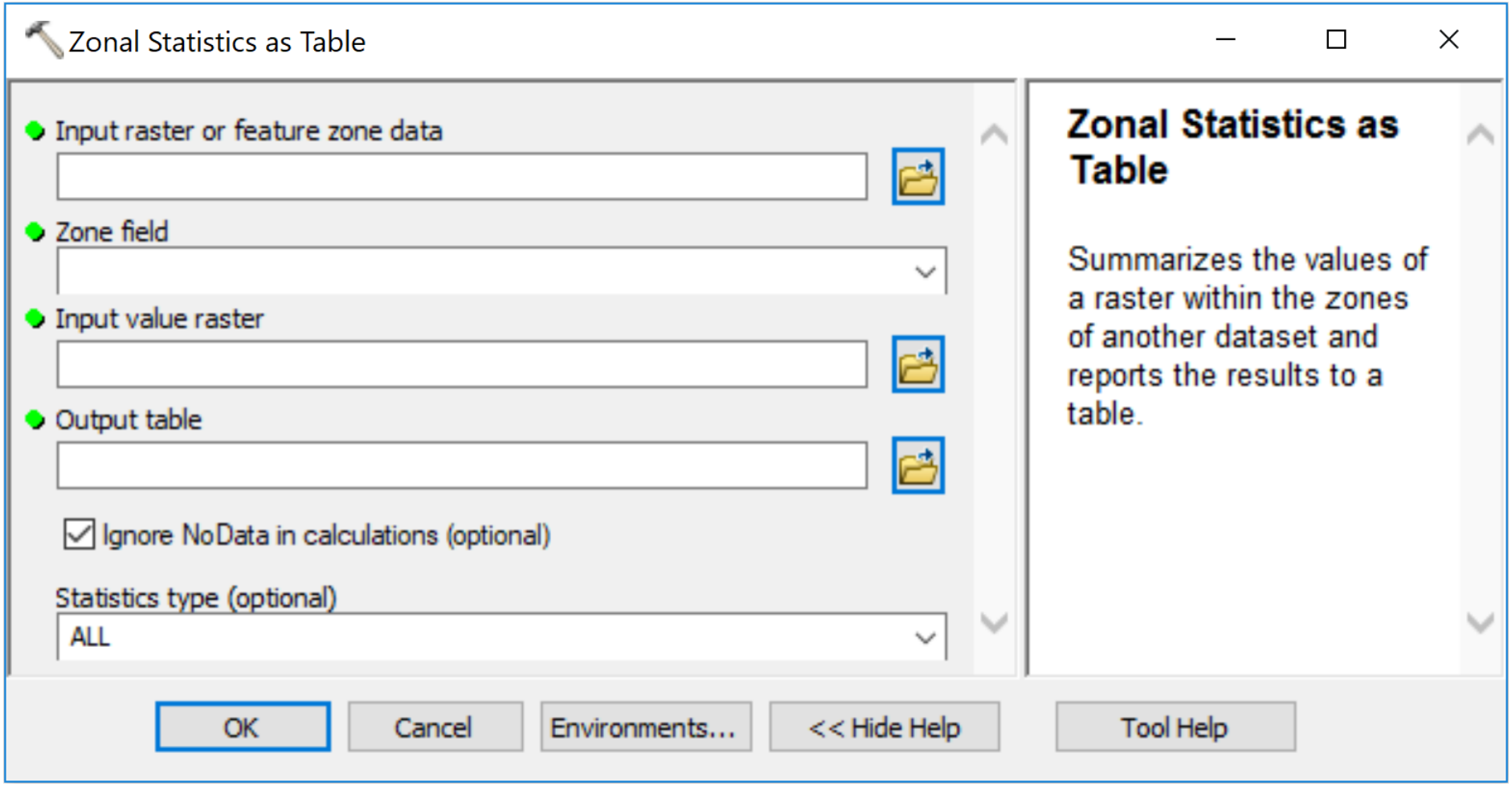
5.3 Zonal statistics (cont.)

Example 1: Zonal statistics of land cover types in Collin, Dallas, Denton, and Tarrant

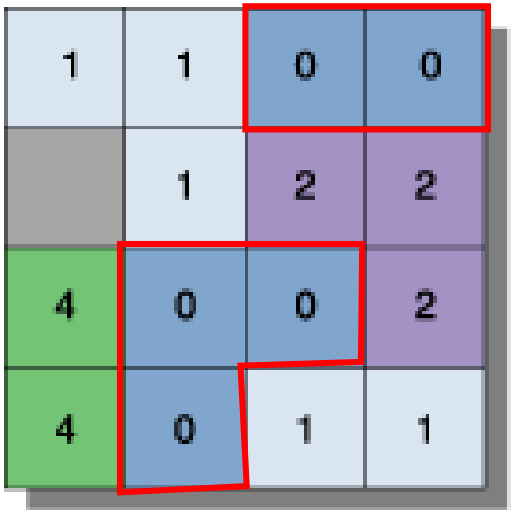
- Use county polygons as zones, and NLCD data as raster data;
- Discussion: What statistics can be used?



5.3 Zonal statistics as table

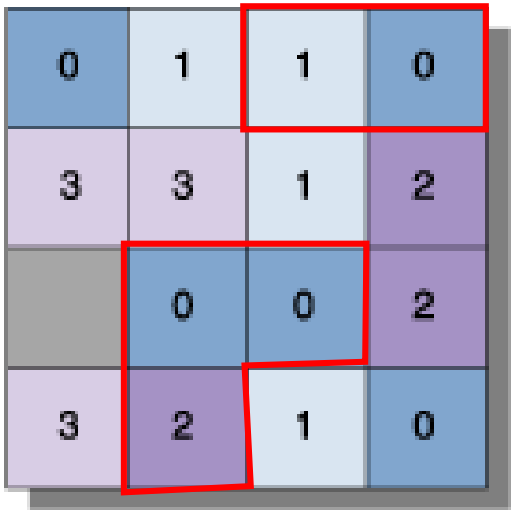


5.3 Zonal statistics as table (cont.)



INGRID1

Zone Grid



INGRID2

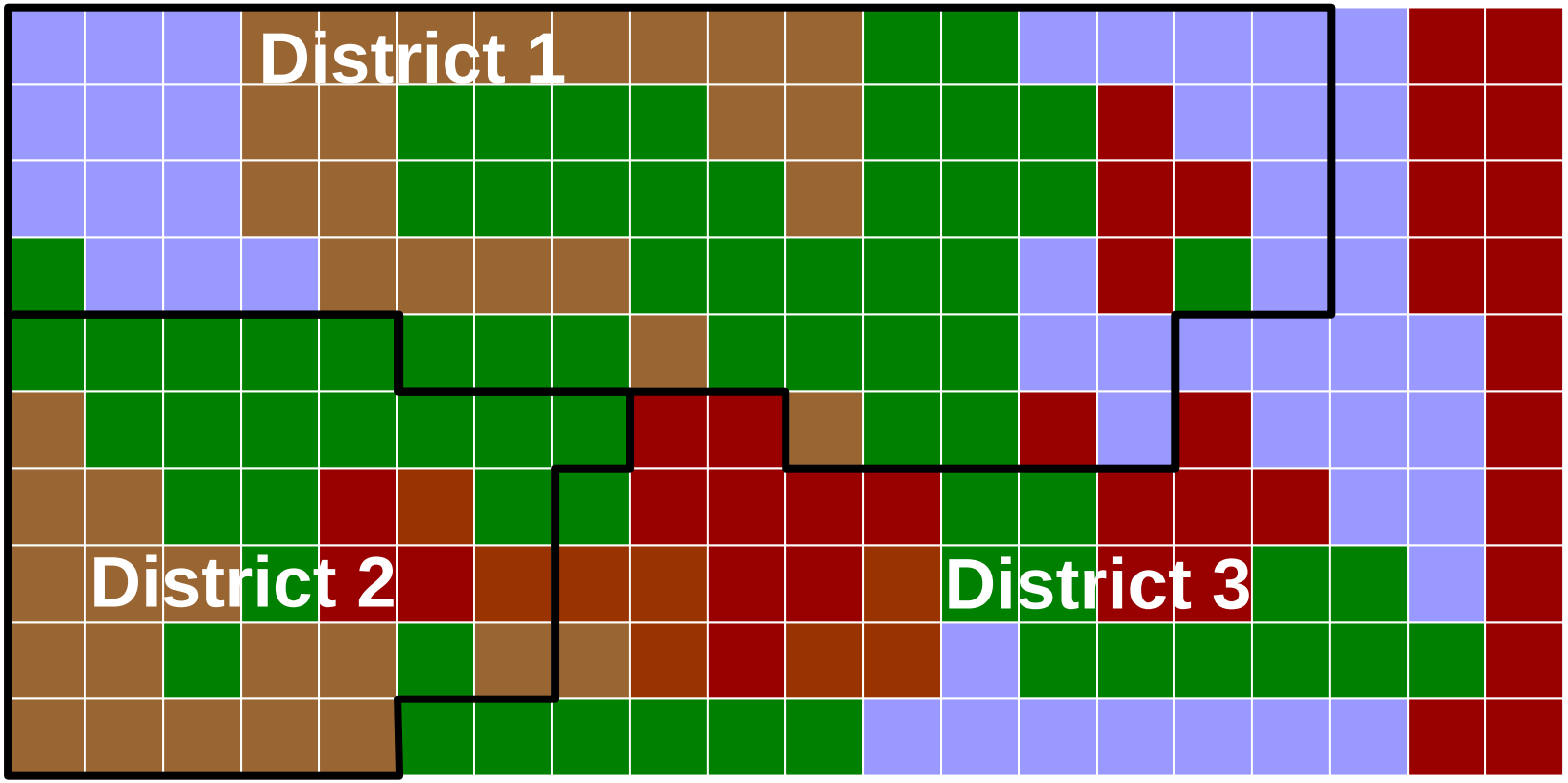
Value Grid

Output INFO table:

VALUE	COUNT	AREA	MEAN	MIN	MAX	...
0	5	125.0000	0.6	0.0	2.0	...
1	5	125.0000	1.0	0.0	3.0	...
2	3	75.0000	1.667	1.0	2.0	...
4	2	50.0000	3.0	3.0	3.0	...

5.3 Zonal statistics as table (cont.)

Example 2: Neighborhood Housing Density



1 2 3 4

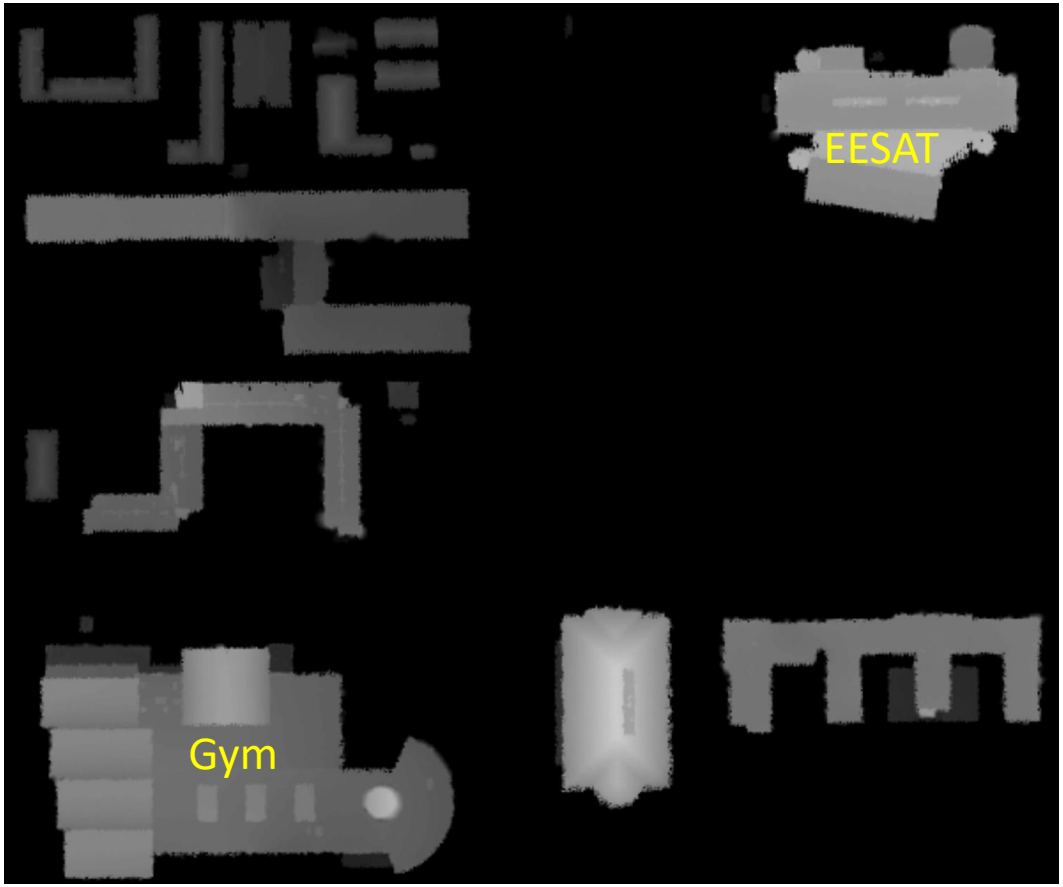
(Number of houses per acre)

	Majority	Minority	Variety	…
District 1	4	3	…	
District 2	4	3	…	
District 3	3	2	…	

5.3 Zonal statistics as table (cont.)

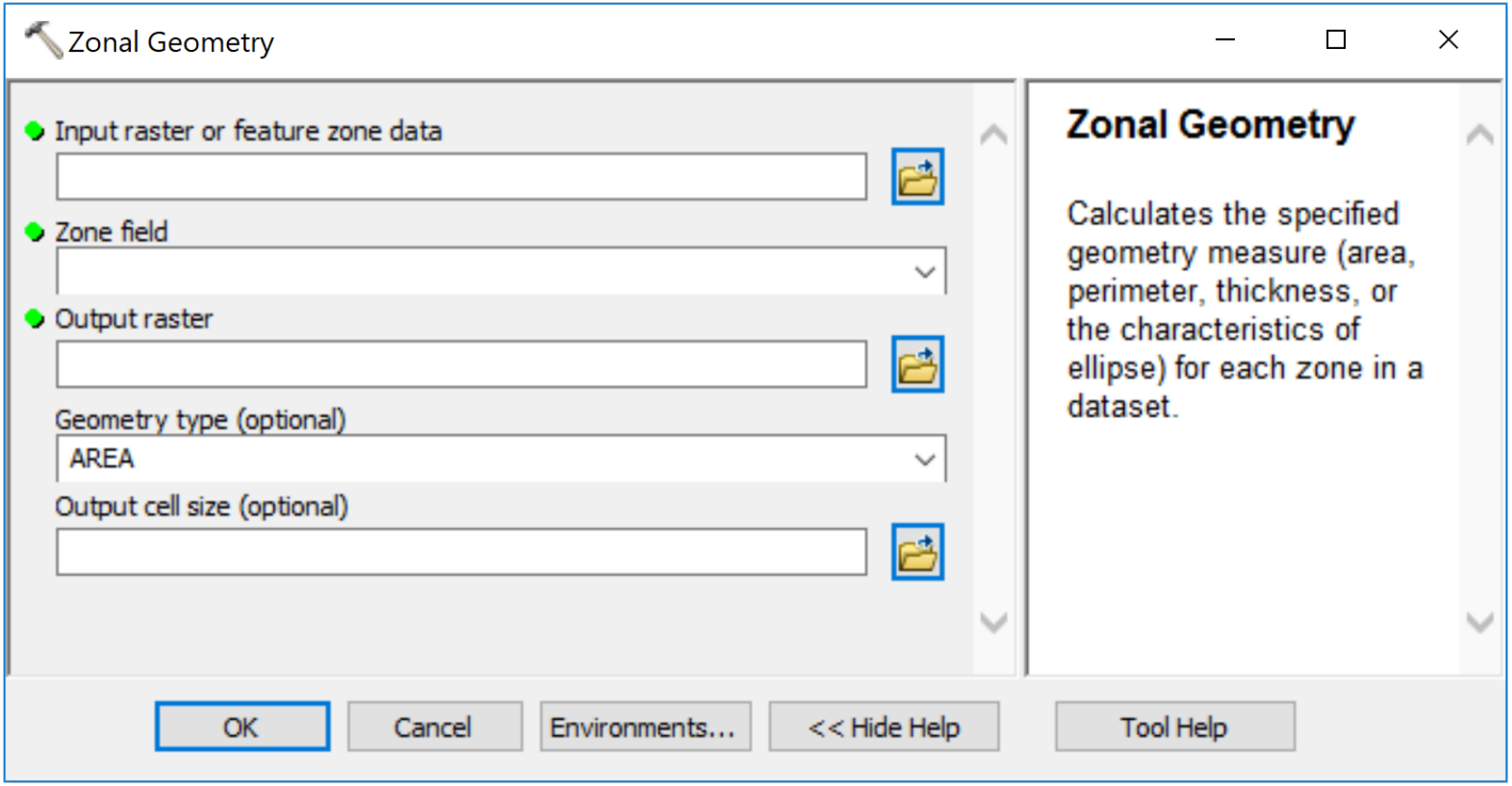
Example 3: Calculating building volume using LiDAR-derived digital height models (DHM) – 0's for ground surface, other cells for building heights.

Discussion: How?



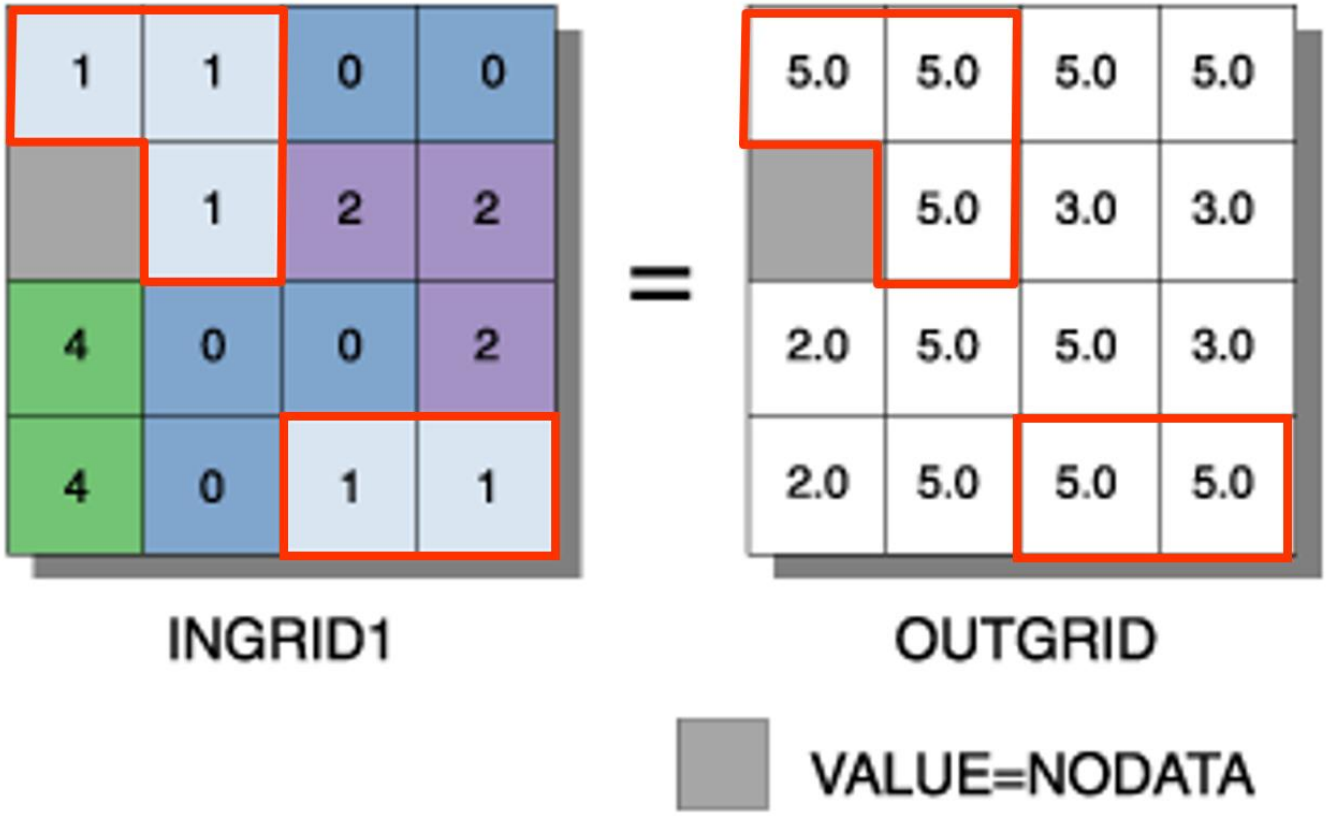
5.4 Zonal geometry

- Area
- Perimeter
- Thickness
- Centroid



5.4 Zonal geometry (cont.)

Area

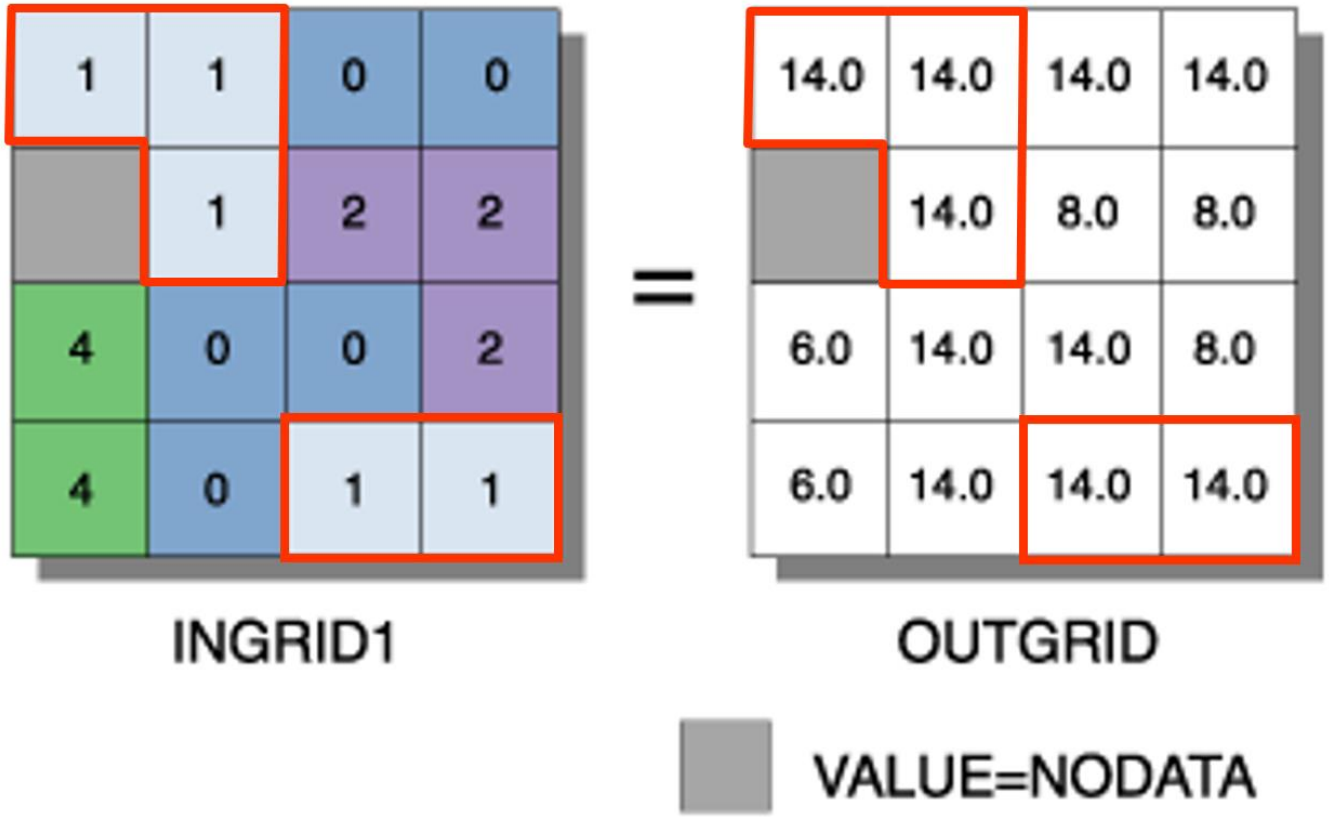


(Esri)

Cell size = 1

5.4 Zonal geometry (cont.)

Perimeter



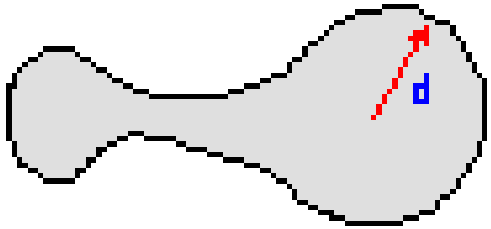
(Esri)

Cell size = 1

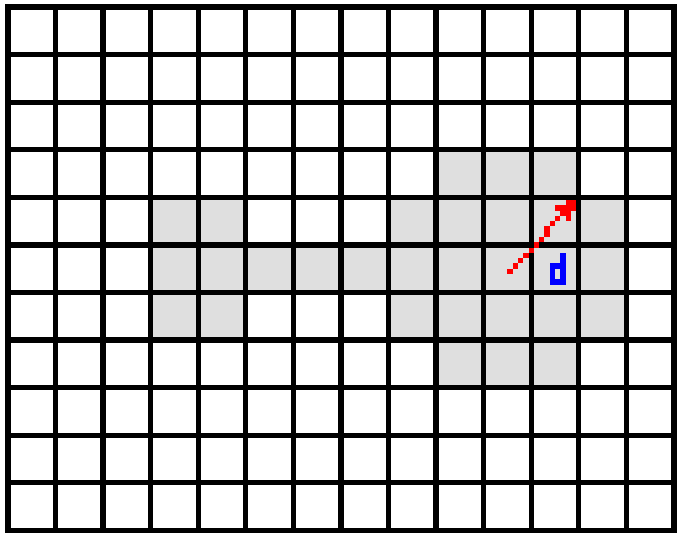
5.4 Zonal geometry (cont.)

Thickness

The radius (in cells) of the largest circle that can be drawn within each zone without including any cells outside the zone.



Forest polygon

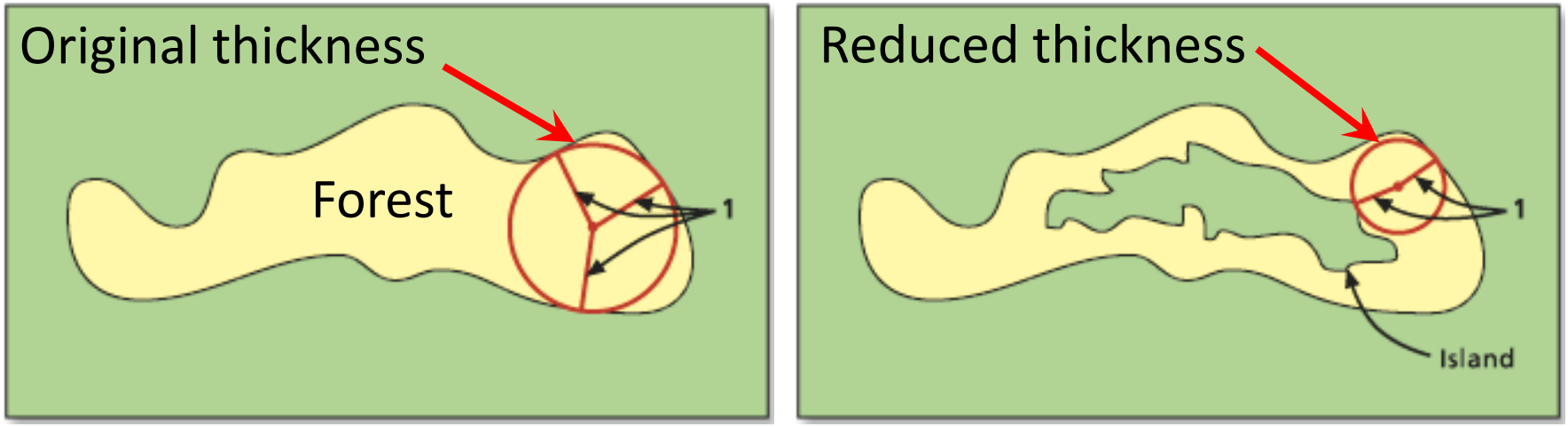


ZONALTHICKNESS on forest zone

(Esri)

5.4 Zonal geometry (cont.)

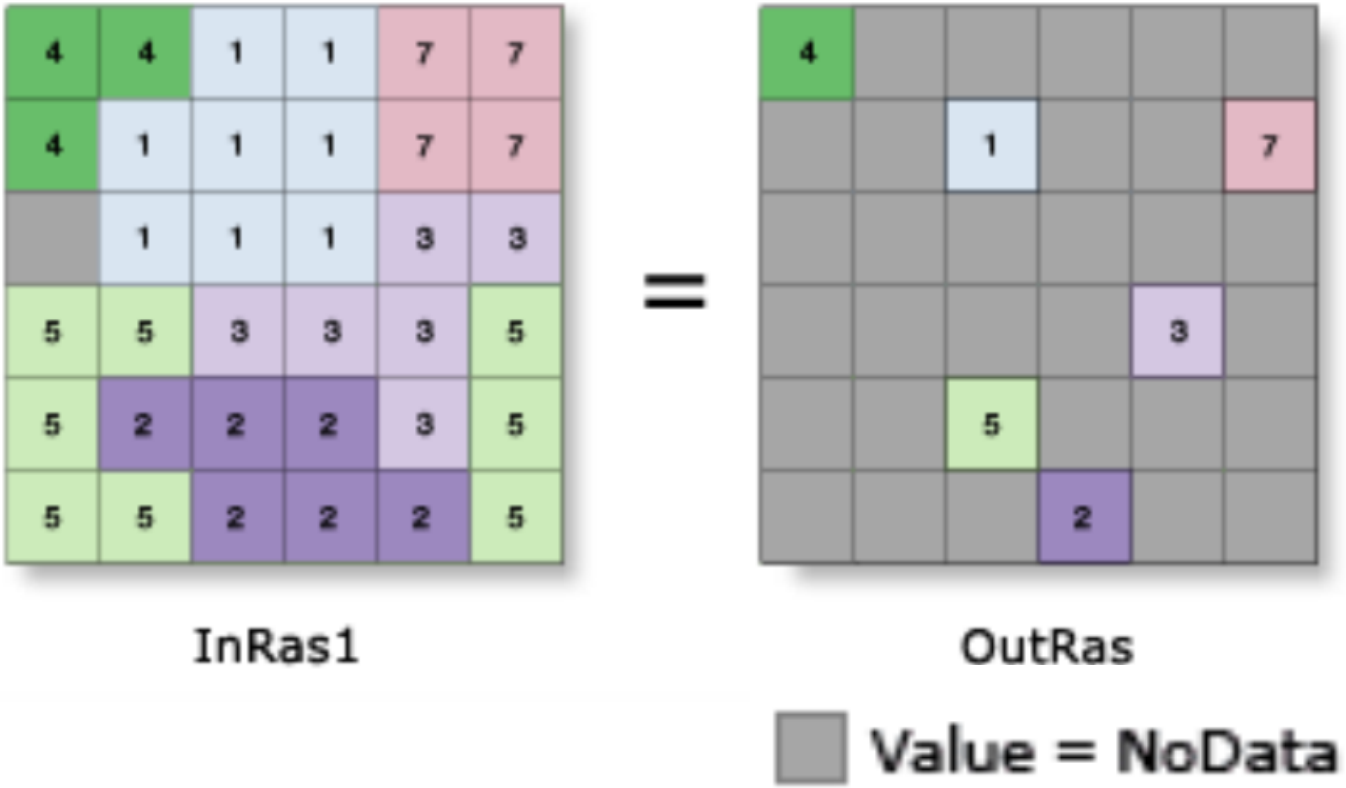
Thickness



(Esri)

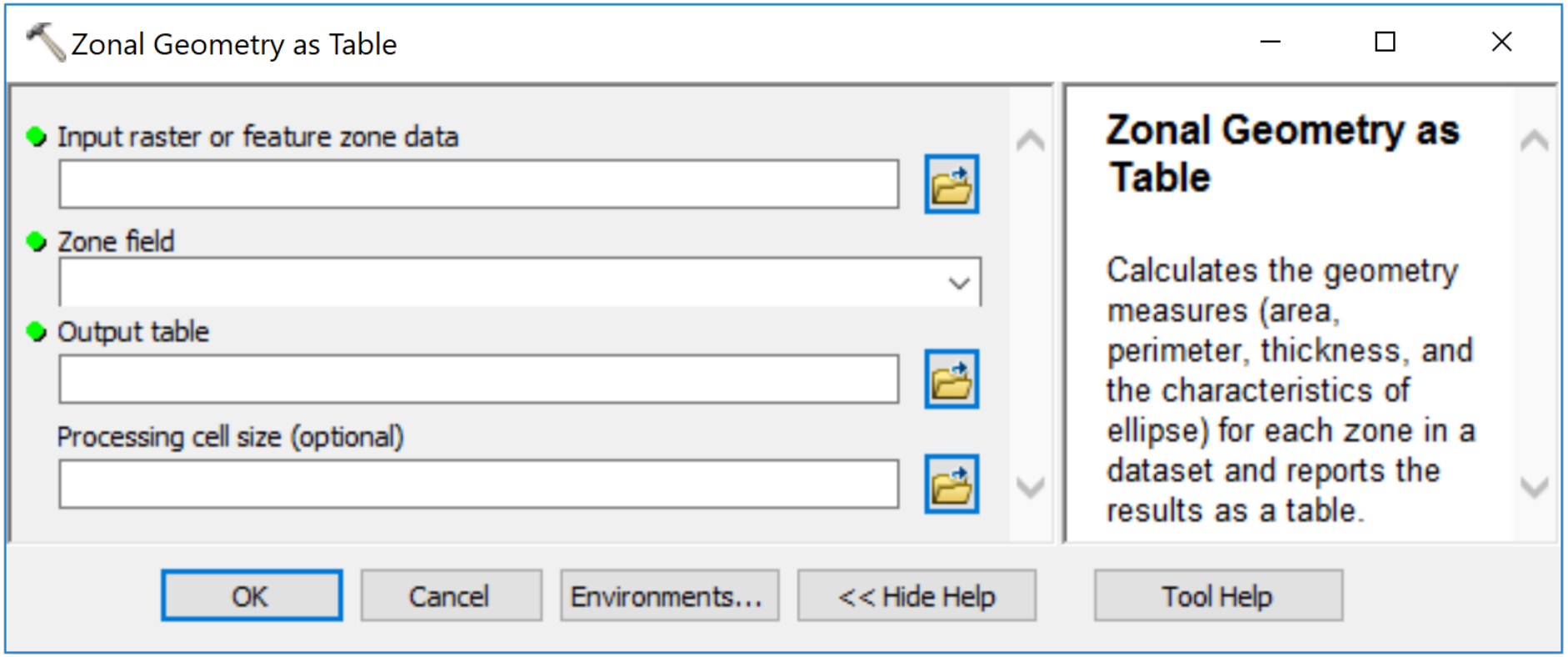
5.4 Zonal geometry (cont.)

Centroid



(Esri)

5.5 Zonal geometry as table



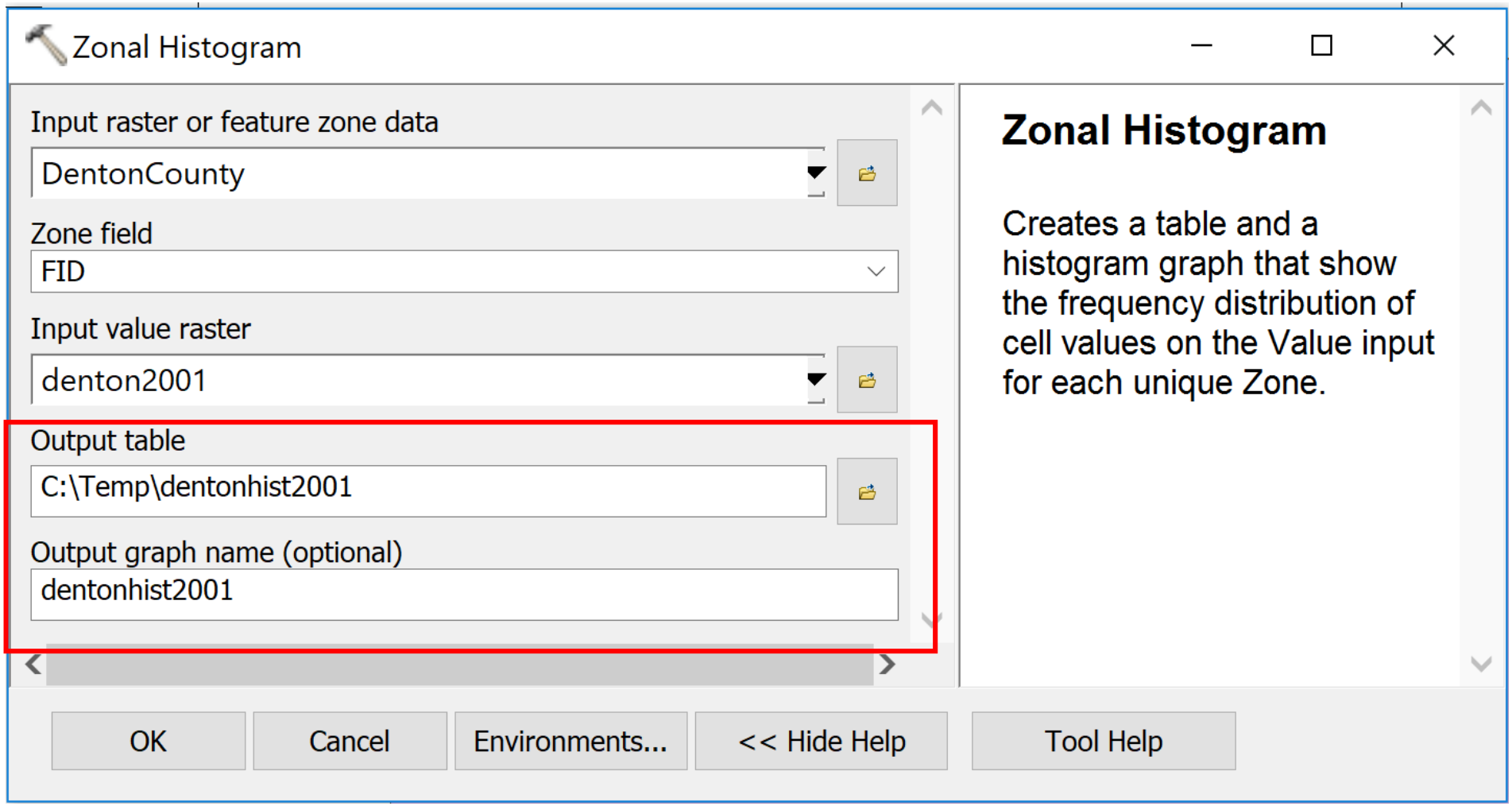
5.5 Zonal geometry as table (cont.)

InRas

VALUE	AREA	PERIMETER	THICKNESS	XCENTROID	YCENTROID	MAJORAXIS	MINORAXIS	ORIENTATION
0	5.0	14.0	0.5	2.300	2.100	2.338	0.681	60.714
1	5.0	14.0	0.5	1.900	2.100	2.668	0.596	126.061
2	3.0	8.0	0.5	3.167	2.167	1.286	0.743	135.000
4	2.0	6.0	0.5	0.500	1.000	1.128	0.564	90.000

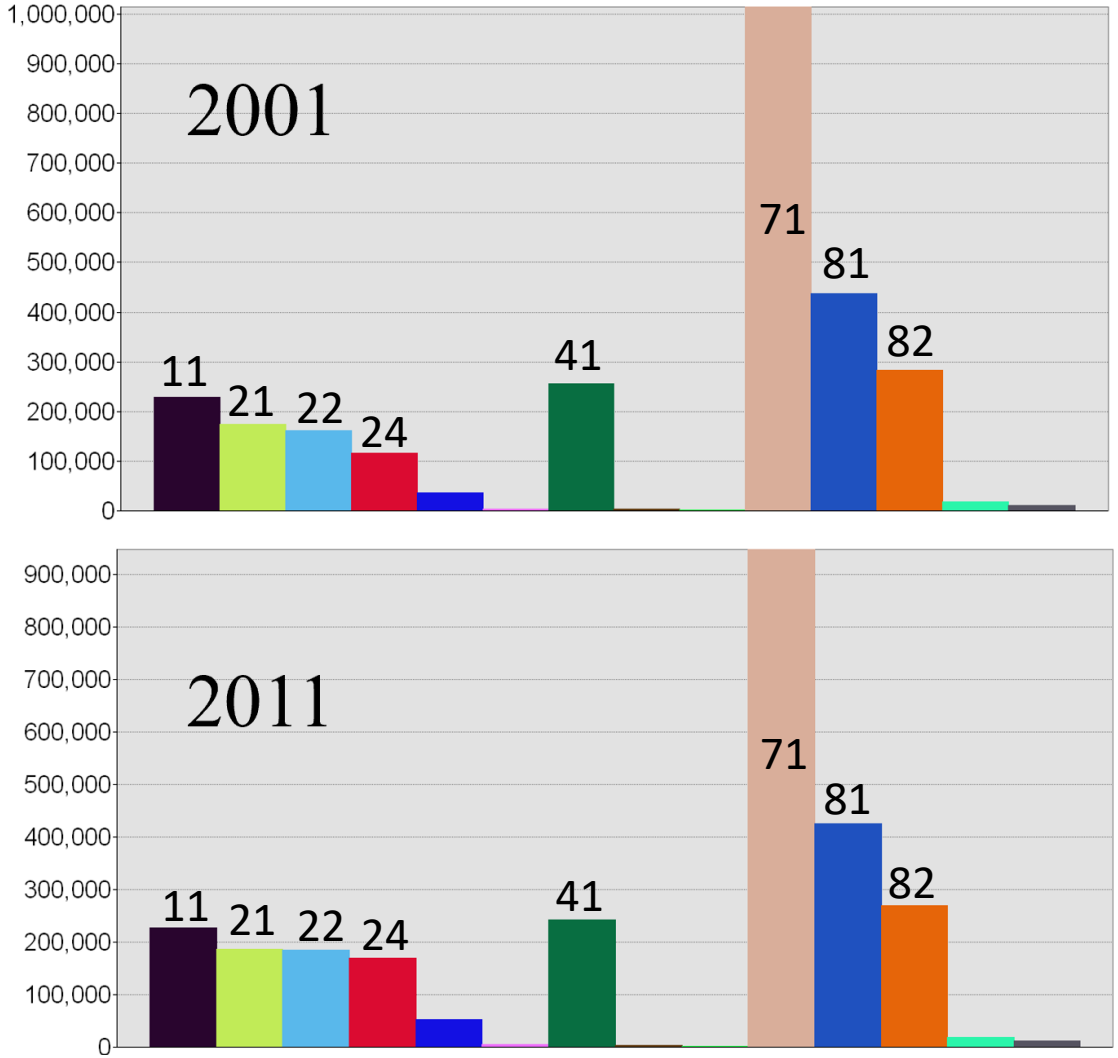
(Esri)

5.6 Zonal histogram



5.6 Zonal histogram

Example 4: Denton NLCD histograms for 2001 and 2011



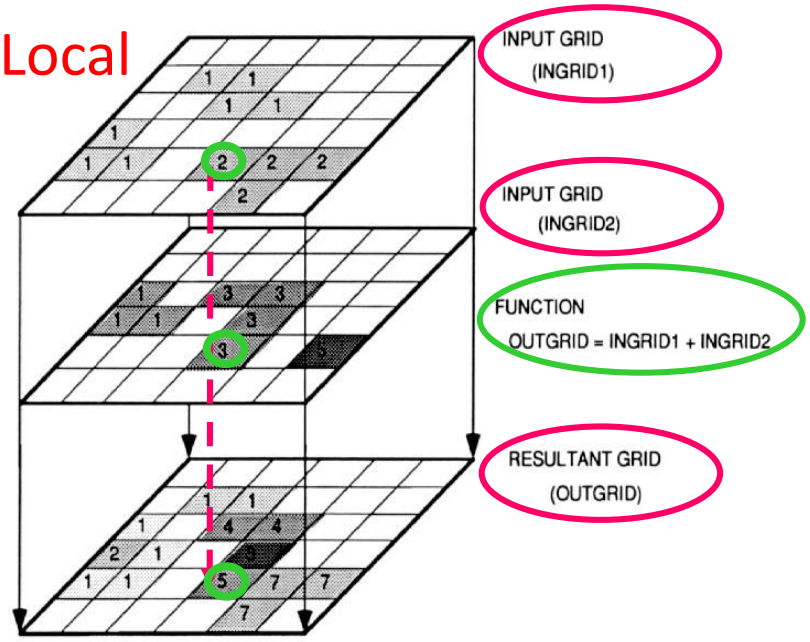
11 Open Water
12 Perennial Ice/ Snow
21 Developed, Open Space
22 Developed, Low Intensity
23 Developed, Medium Intensity
24 Developed, High Intensity
31 Barren Land (Rock/Sand/Clay)
41 Deciduous Forest
42 Evergreen Forest
43 Mixed Forest
51 Dwarf Scrub*
52 Shrub/Scrub
71 Grassland/Herbaceous
72 Sedge/Herbaceous*
73 Lichens*
74 Moss*
81 Pasture/Hay
82 Cultivated Crops
90 Woody Wetlands
95 Emergent Herbaceous Wetlands

Summary

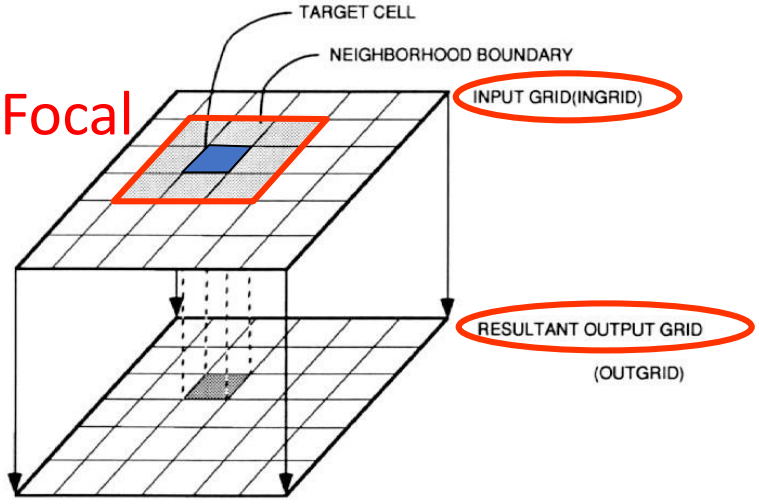
- Zonal Statistics
  - Majority
  - Maximum
  - Mean
  - Median
  - Minimum
  - Minority
  - Range
  - Standard Deviation
  - Sum
  - Variety
- Zonal Geometry
  - Area
  - Centroid (balancing point or center of mass)
  - Perimeter
  - Thickness
- Zonal Histogram

Local, Focal, and Zonal Analyses: A Comparison

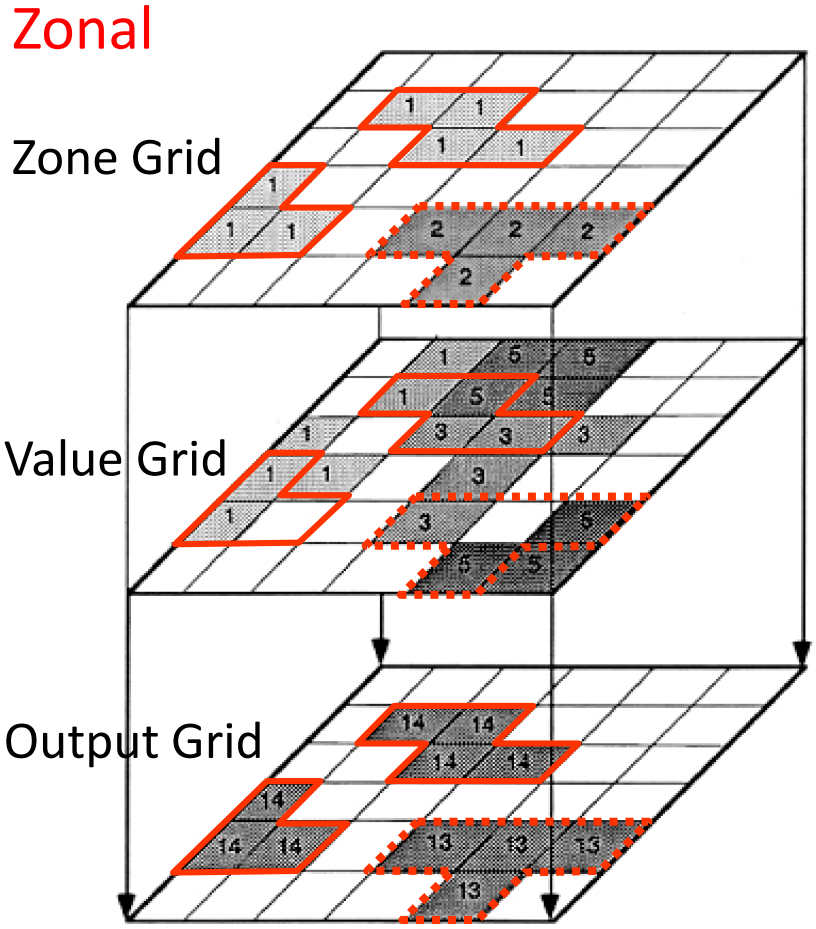
Local



Focal



Zonal



Review

5.1 Definition of a zone
5.2 Zonal statistics
5.3 Zonal statistics as table
5.4 Zonal geometry
5.5 Zonal geometry as table
5.6 Zonal histogram