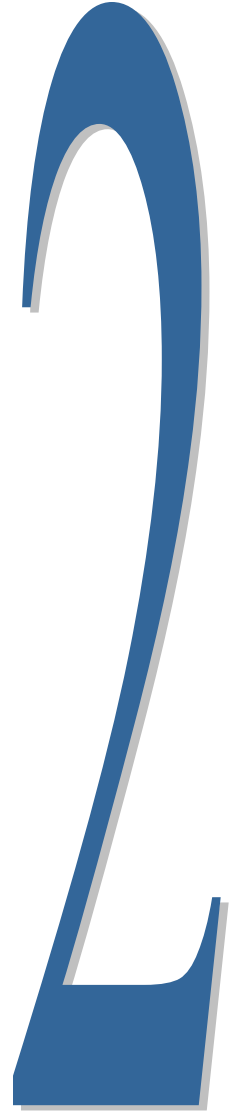


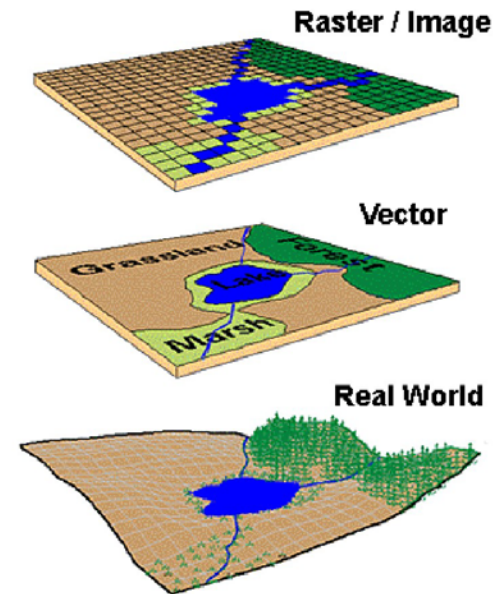


Raster Concepts



Geography as raster

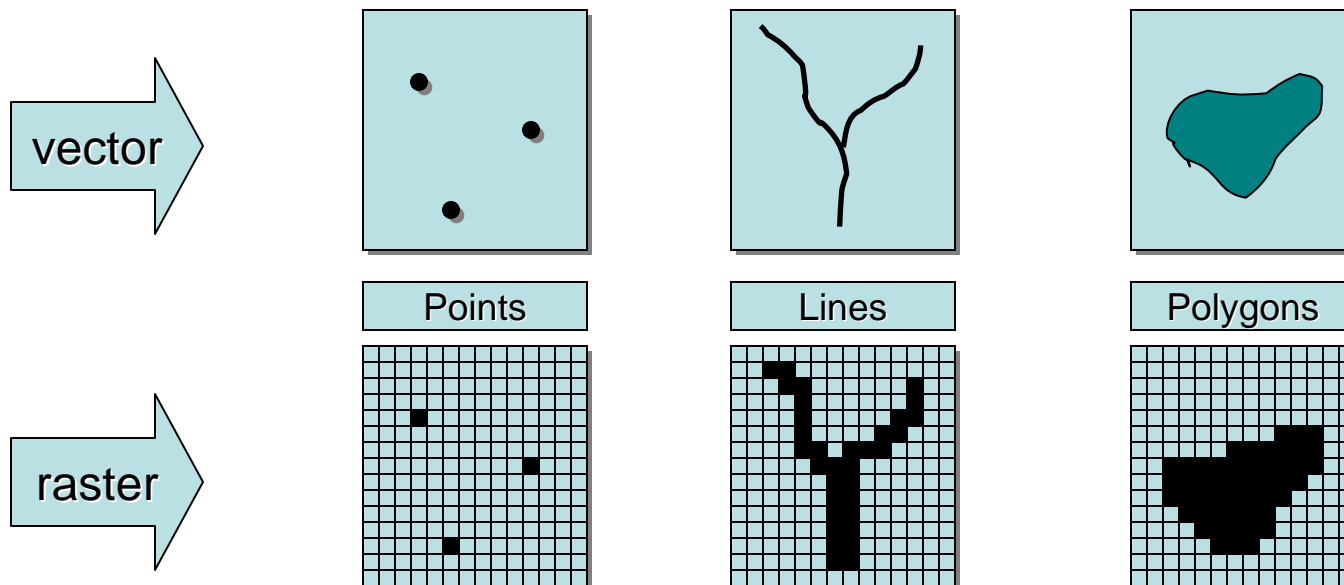
- ❑ Divides space into a matrix of equally-sized cells
 - Cells store a sample of geography in their area
- ❑ Advantages of raster over vector
 - Simpler data model
 - Faster processing and display
 - Additional analytic tools
 - Better for un-bounded phenomena (like soil pH and elevation)
- ❑ Disadvantages of raster
 - Generalization
 - Loss of feature uniqueness



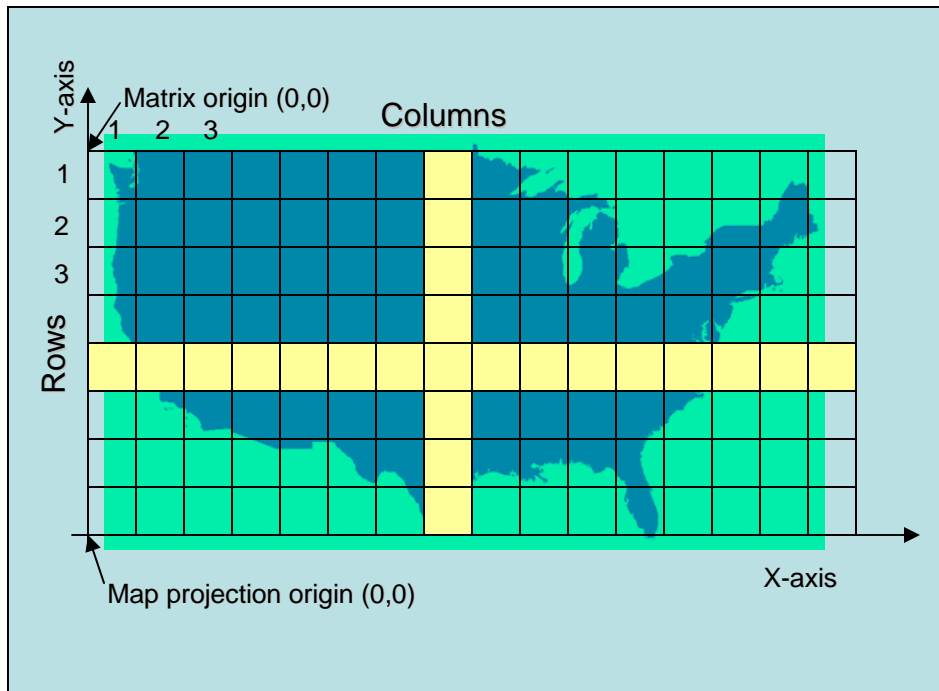
Features as raster

❑ Features lose uniqueness with raster representation

(a line becomes a collection of cells, not one feature)



Raster coordinate systems



Matrix

- Cells located by row/column position
- Origin at upper-left
- Rows and columns always perpendicular

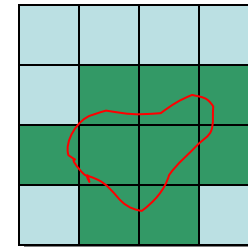
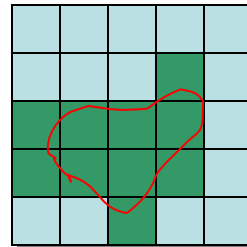
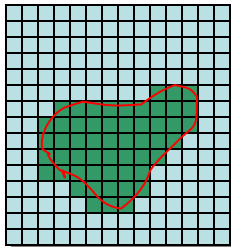
Cartesian

- Cells located by x,y
- May register to a map projection
- Used in ArcMap

Raster resolution

❑ Rasters always generalize spatial data

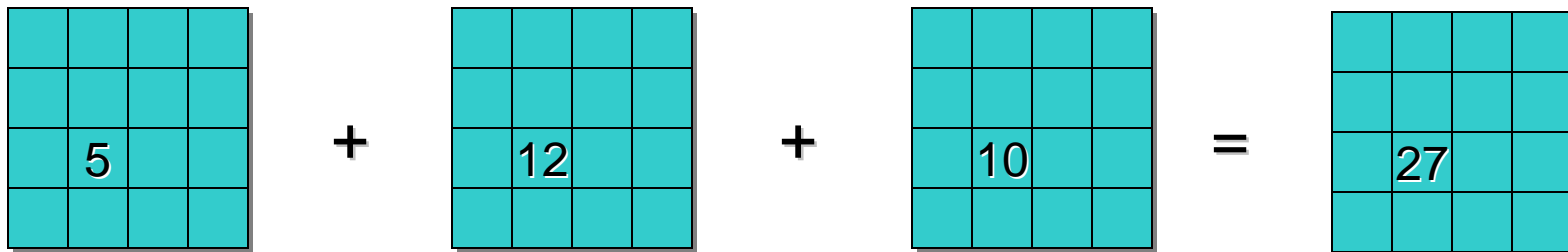
- A function of cell size (smaller cells = higher resolution)
- Impacts accuracy, processing speed, storage space



Cell size	100m	200m	400m
Matrix	16 x 16	5 x 5	4 x 4
Lake Cells	68	10	9

Raster cell coincidence

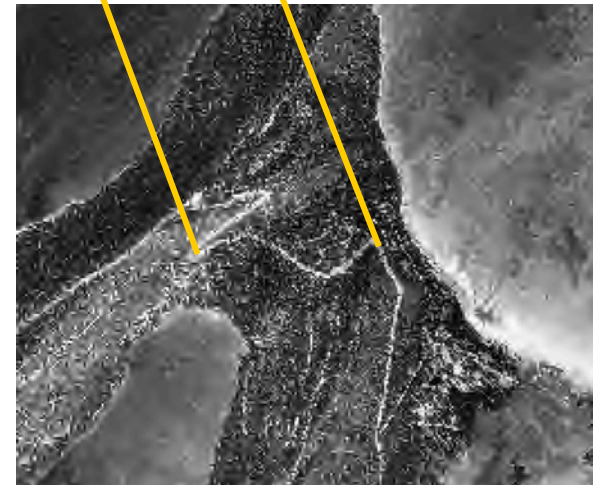
- ❑ Analysis between rasters compares values for cells
- ❑ Rasters must be registered to a common coordinate system



Raster registration

- ❑ **Rasters should be registered to a map projection**
 - Just like vector datasets
- ❑ **Use georeferencing tools**
 - Register to a projection
 - Set coordinates for cell locations
 - Part of ArcGIS
(do not need Spatial Analyst)
- ❑ **Use projection tools**
 - Change projection

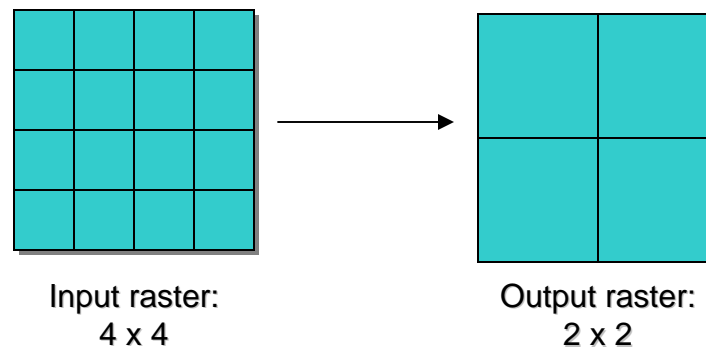
Map projection coordinate space



Raster coordinate space

Raster resampling

- ❑ How rasters with different cell geometries are combined
- ❑ Controlled by the output raster environment
 - Output cell center is compared to input cell centers
 - Nearest input cell value is used (other techniques available)



Raster cell values

- ❑ Raster cell values
- ❑ Integer or floating point — depends on raster format
 - ESRI grid, TIF, 1MG, and
 - ER Mapper support both
 - See help for details
- ❑ Integer: Discrete data
(like land use and vegetation)
- ❑ Floating point: Continuous data
(like distance and rainfall)
- ❑ NoData: Special flag value
 - Indicates no measurement for a cell
 - Numeric value varies with format

Integer				Vegetation 0 = Rock 1 = Forest 2 = Water
0	1	1	2	
No data	1	1	1	
no data	1	2	2	
1	1	2	2	

Floating				Rainfall (inches)
1.12	1.75	1.81	2.03	
0.26	1.63	1.87	1.98	
0.00	0.91	0.73	1.98	
10.00	0.18	no data	no data	

Raster attribute tables

- ❑ All single-band, integer rasters have “virtual” tables
 - Created on-the-fly by ArcGIS
 - Support ArcMap joins and relates



Attributes of 037076C8.TIF

ObjectID	Value	Red	Green	Blue
0	0	0	0	0
1	1	0.996108949416342	0.996108949416342	0.996108949416342
2	2	0	0.589852750438697	0.640634775310903
3	3	0.79298084992752	0	8.98451209277485E-02
4	4	0.511726558327611	0.257816433966583	0.144533455405508
5	5	0.785168230716411	0.914076447699702	0.613290608072023
6	6	0.535164415960937	0.199221789883268	0.500007629510948
7	7	0.996108949416342	0.914076447699702	0
8	8	0.652353704127565	0.882825970855268	0.882825970855268

Record: 1 Show: All Selected Records (0 out of 256 Selected.) Options

- ❑ Integer ESRI grids have real tables
 - Support ArcMap joins and relates
 - Support user-defined fields
 - Use fields in analysis and queries



Attributes of topoelev2

ObjectID	Value	Count
0	-3.27999997138977	1
1	-2.77999997138977	1
2	-2.57999992370605	1
3	-2.38000011444092	2
4	-2.27999997138977	2
5	-2.07999992370605	5
6	-1.9800001907349	4
7	-1.87999999523163	9
8	-1.77999997138977	3

Record: 1 Show: All Selected Records (0 out of 256 Selected.) Options

Raster zones and regions

❑ Organizations of cells within an integer raster

- **Zone:** All same-value cells in a raster, connected or not
 - Part of data model — a row in the attribute table
- **Region:** A group of connected same-(unique)-value cells
 - Not part of data model — concept only — also a zone

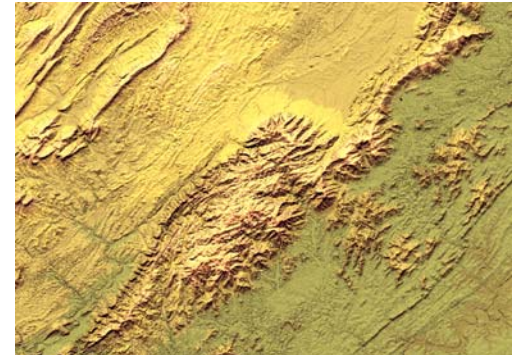
0	1	1	2
No data	1	1	1
no data	1	2	2
1	1	2	2

Vegetation
0 = Rock
1 = Forest
2 = Water

❑ Some Spatial Analyst tools work with zones and regions

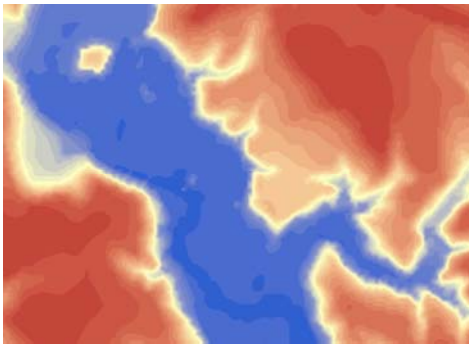
Raster formats

- ❑ The format is how cells are stored in a raster
- ❑ ArcGIS supports dozens of raster formats
 - Various image formats (SID, 1MG, TIF, more...)
 - ESRI grid and grid stack
 - ESRI ArcSDE raster
 - ESRI raster dataset
 - ESRI raster catalog
- ❑ All may be managed in ArcCatalog
- ❑ All may be used with Spatial Analyst tools



Raster format essentials

- ❑ • **All raster formats are basically the same**
 - Cells organized in a matrix of rows and columns
 - Content is more important than format: data or picture?



Raster data

- Elevation
- Land use codes
- Population density

Good for analysis

- Slope from elevation

Good for mapping

- Thematic layers
- Derivative products
(like shaded relief)



Raster pictures

- Scanned maps
- Satellite images
(classified)
- Photos of buildings

Good for mapping

- Backgrounds

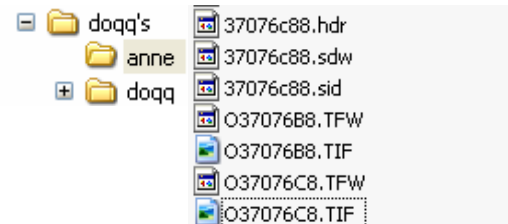
Good for attributes

- Picture of house

Bad for analysis

Image formats

- ❑ **Often have multiple files**
 - Like O37076C8.TIF and O37076C8.tfw
 - Easy to manage with ArcCatalog
- ❑ **Some are designed for pictures**
 - Do not store spatial information like projection
 - ArcGIS “enhances” with AUX, RRD files
- ❑ **Some are designed for geospatial data**
 - Have built-in support for spatial information
 - ERDAS IMG, Lizard Tech MrSID, GeoTIFF, etc.
- ❑ **Compression can slow analysis**
 - Spatial Analyst must de-compress first

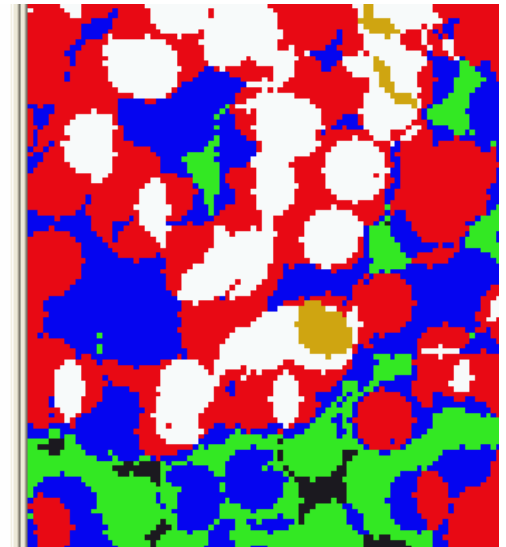


37076c88.hdr	2 KB	HDR File
37076c88.sdw	1 KB	SDW File
37076c88.sid	7,651 KB	SID File
O37076B8.TFW	1 KB	TFW File
O37076B8.TIF	9,189 KB	TIF Image
O37076C8.TFW	1 KB	TFW File
O37076C8.TIF	6,819 KB	TIF Image

ESRI grid format

❑ Native format for Spatial Analyst

- Default output from most tools
- A folder containing multiple files
- Have associated INFO tables (manage grids with ArcCatalog only)



❑ Two types:

- Floating point — continuous data (usually)
- Integer — discrete data (usually)
 - Integer grids may have user-defined attribute fields

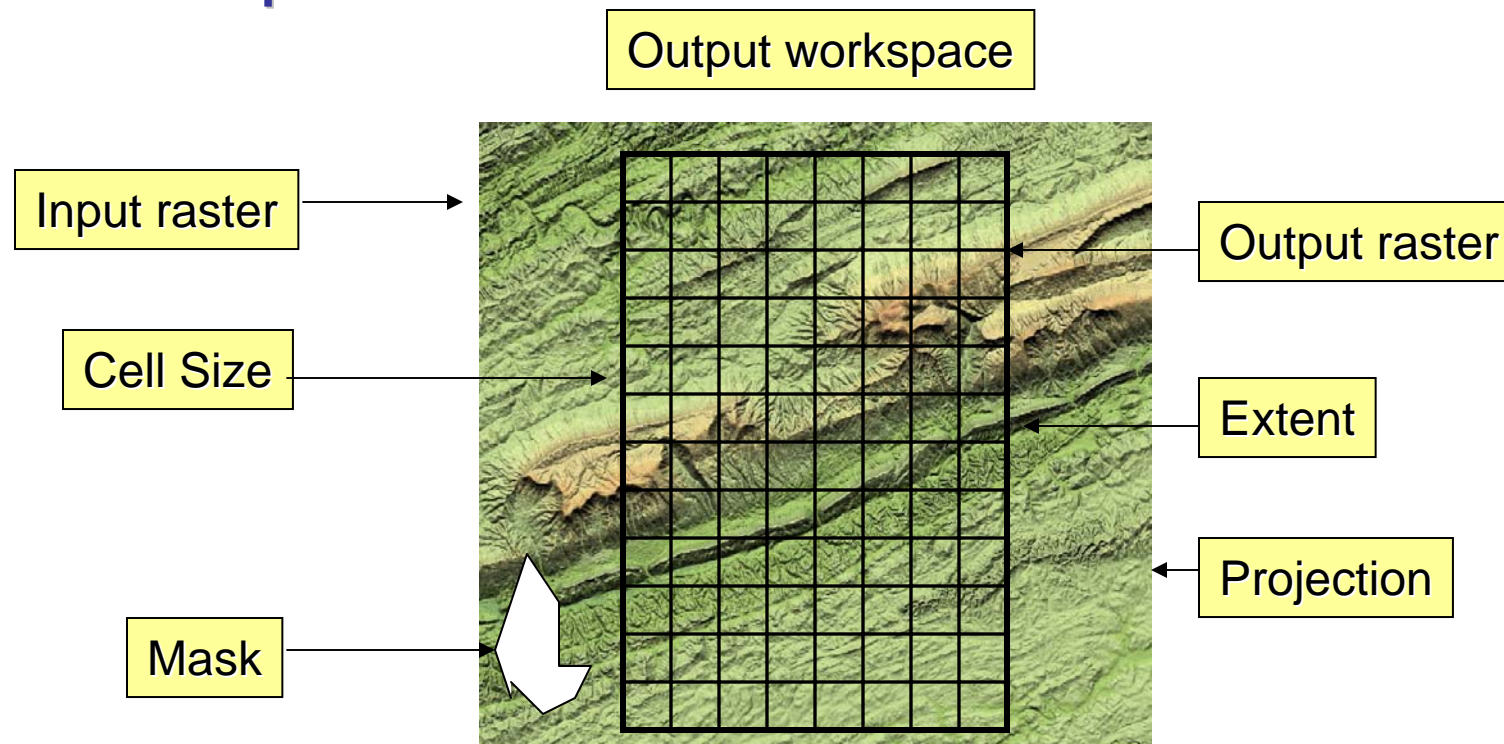
A screenshot of the 'Attributes of vegvar' dialog box. It displays a table with three columns: ObjectID, Value, and Count. The table contains eight rows of data. Below the table, there are navigation controls for records and a 'Show' dropdown menu.

ObjectID	Value	Count
0	1	30227
1	2	30384
2	3	43810
3	4	42495
4	5	23292
5	6	3703
6	7	515
7	8	73

Record: 1 Show: All Selected Records: (0 out of 8 Selected.) Options

The analysis environments

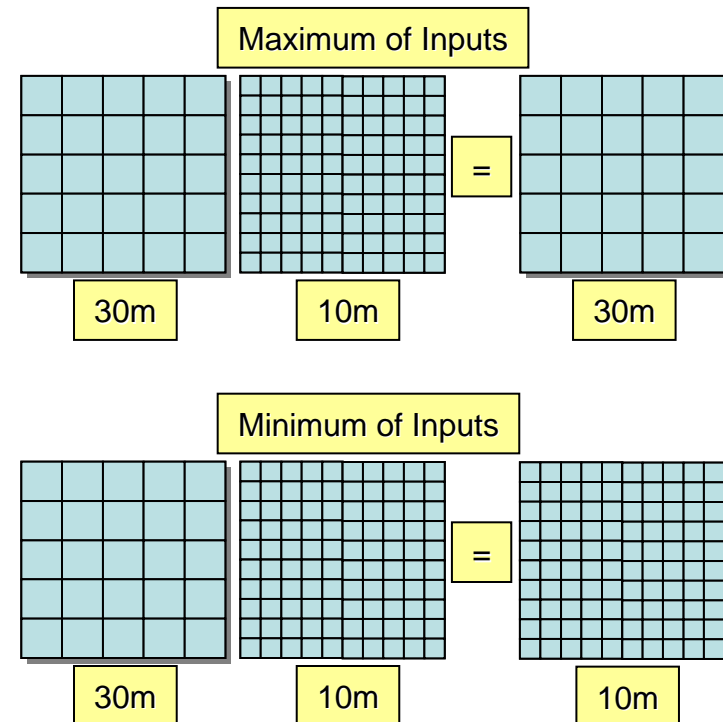
- ❑ Control how an output raster is created
 - Set for geoprocessing and Spatial Analyst toolbar — independent



Setting the output cell size

- ❑ **Rasters are resampled during analysis**
 - Combine rasters with different cell sizes, output another size

- ❑ **Output options:**
 - Maximum of inputs (default)
 - Minimum of inputs
 - Same as layer
 - As specified



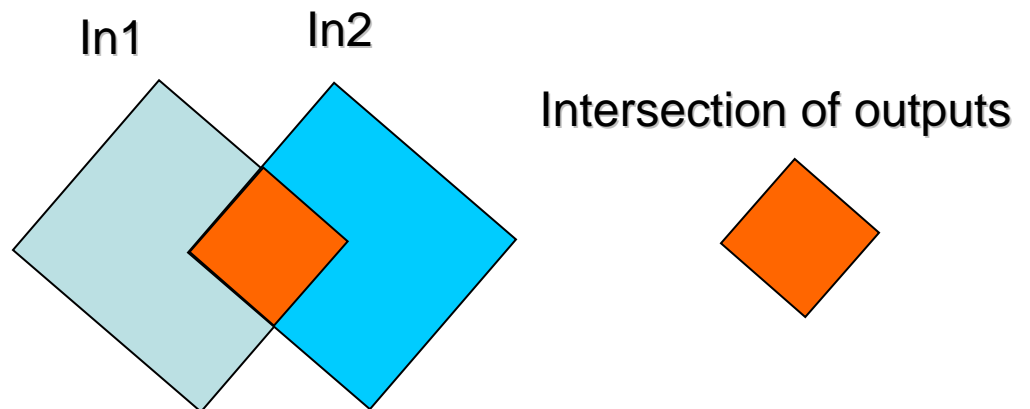
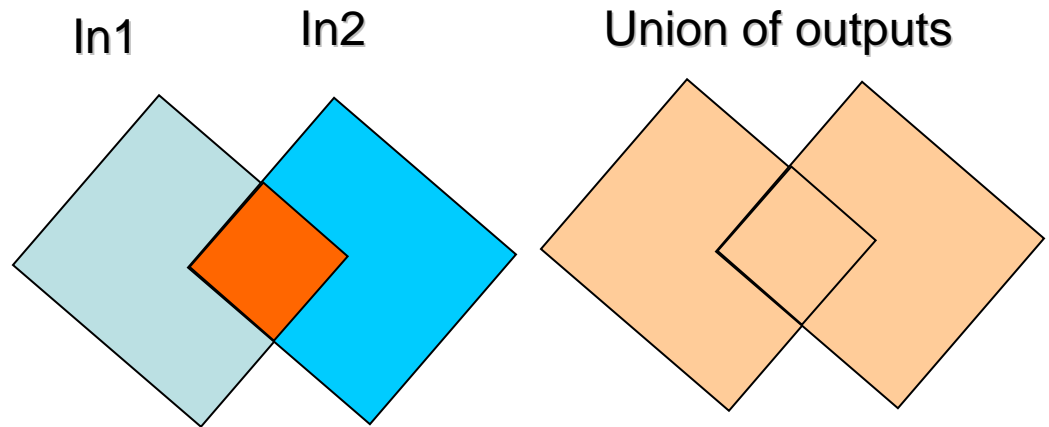
Setting the output extent

❑ Controls the width and height of the output raster

- Combine rasters with different extents, output another extent

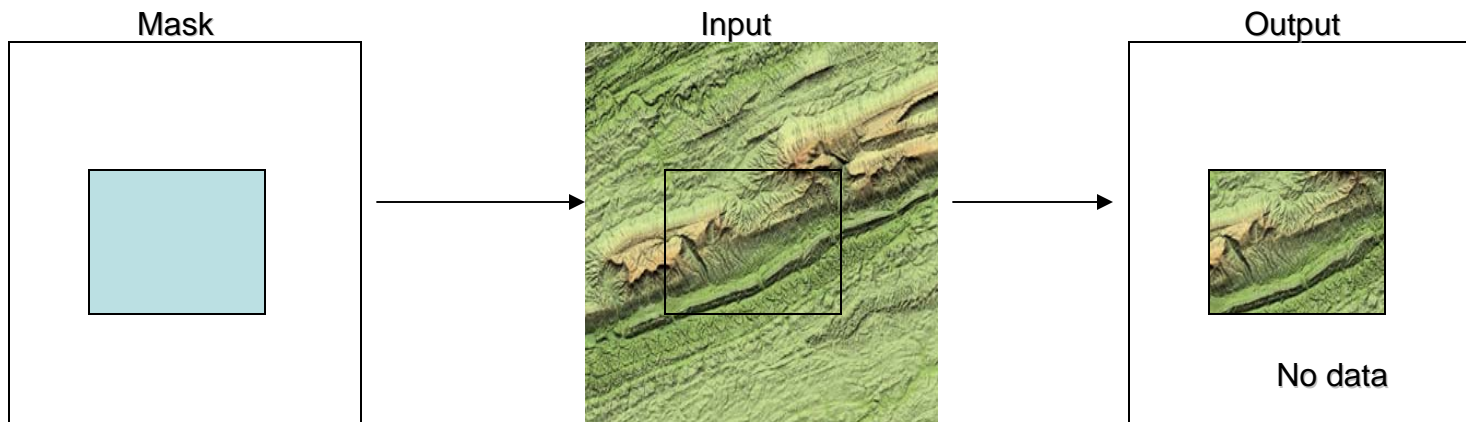
❑ Output options:

- Union of inputs (default)
- Intersection of inputs
- Same as layer
- Same as display
- As specified



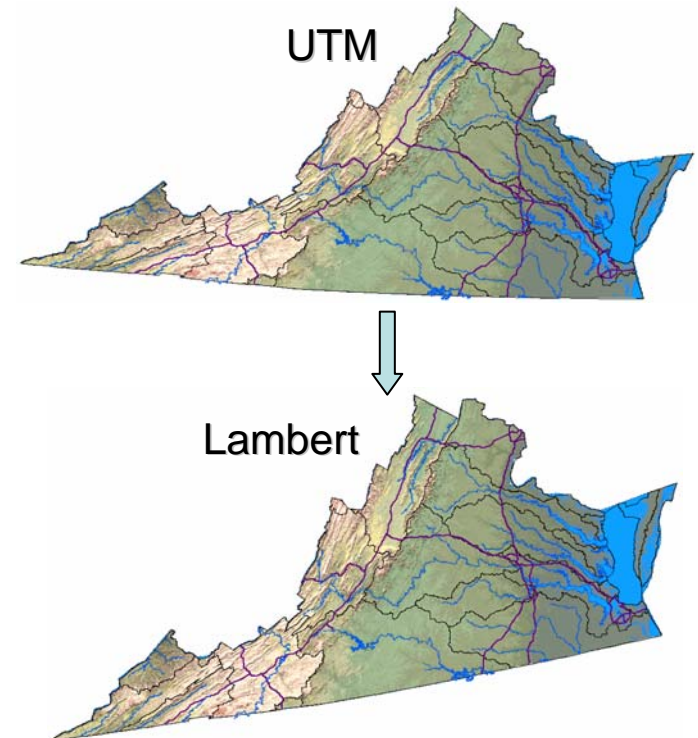
Setting the analysis mask

- ❑ **Defines areas where analysis is performed**
 - Useful for clipping to irregular shapes
- ❑ **Vector mask**
 - Only cells covered by features are output (others set to NoData)
 - Create a feature mask with selection and export
- ❑ **• Raster mask**
 - Only cells covered by valued cells are output (others set to NoData)
 - Create a raster mask with several Spatial Analyst techniques

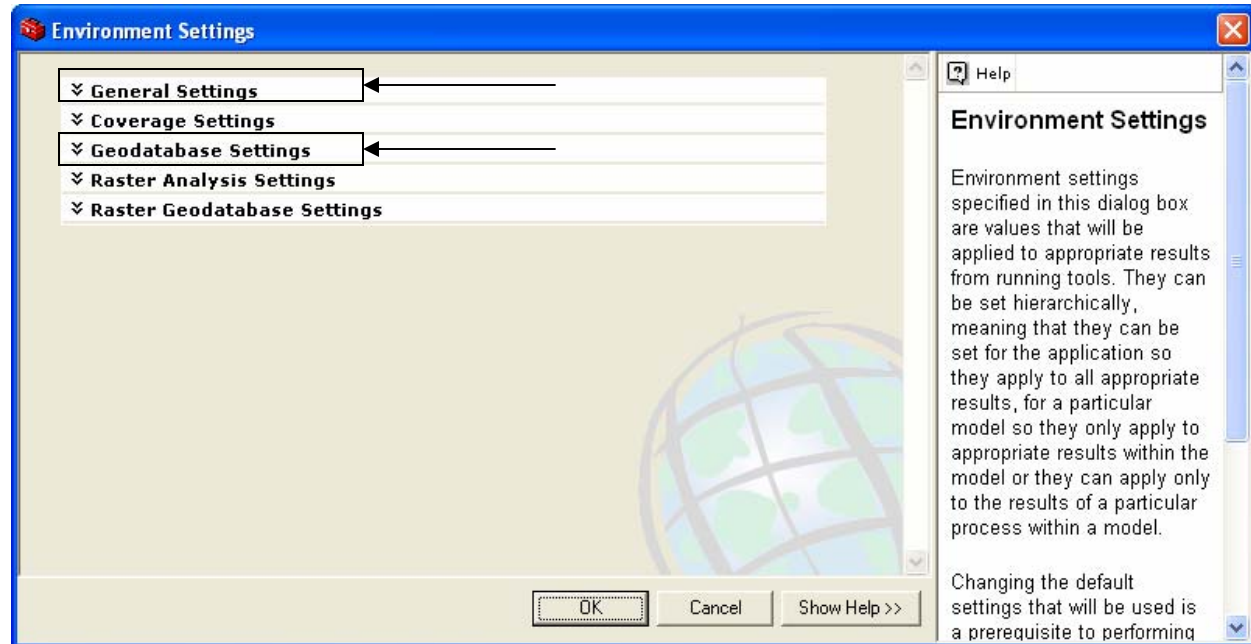
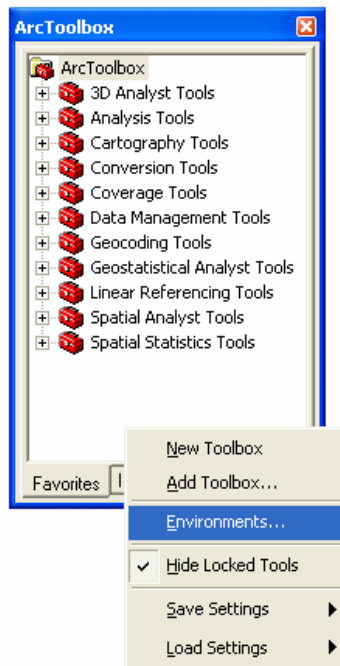


Setting the output projection

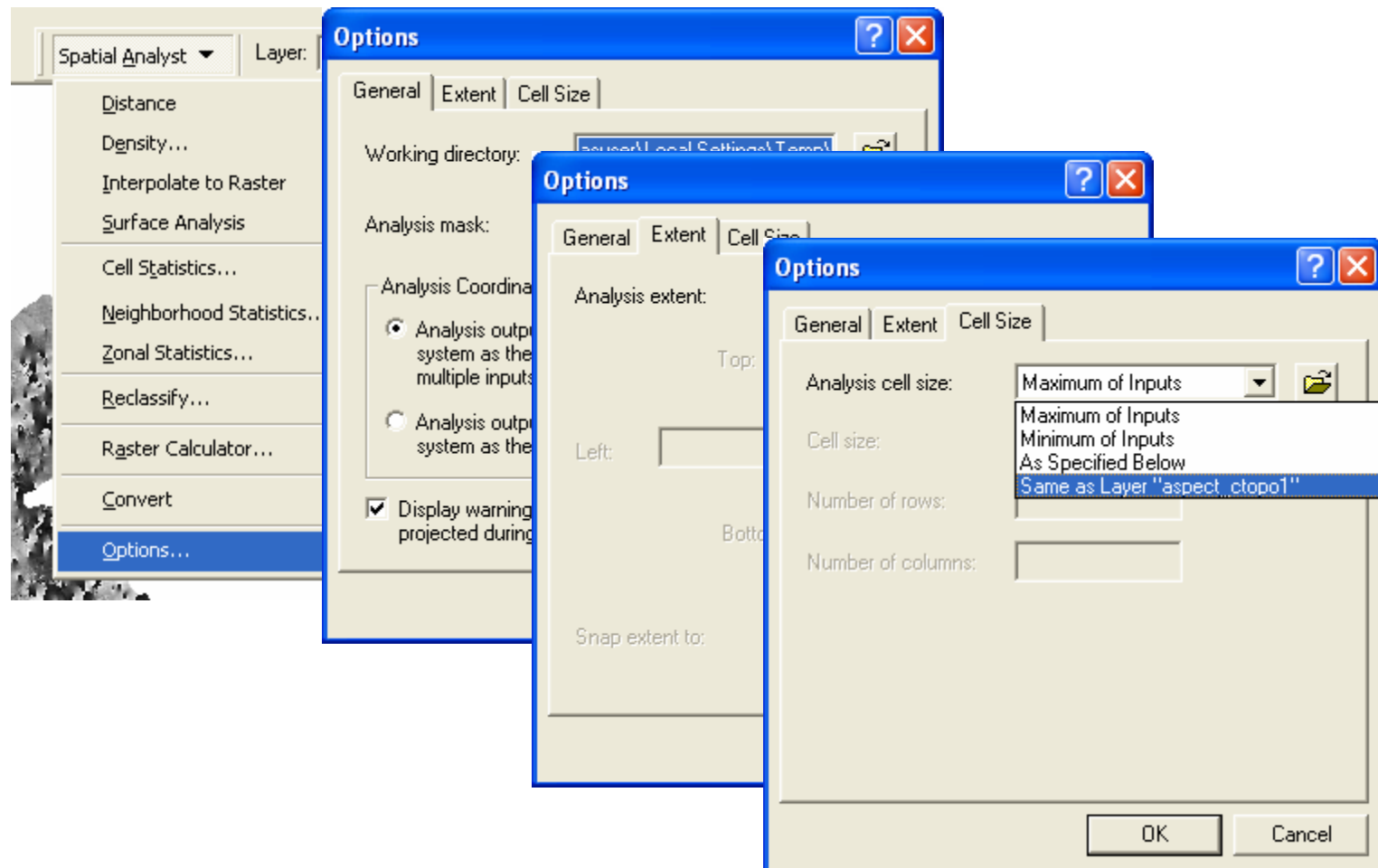
- ❑ Rasters may be projected during analysis
 - Combine rasters in different projections, output to another
- ❑ Output options:
 - Same as input
 - Same as display
 - Same as layer (geoprocessing only)
 - As specified (geoprocessing only)
- ❑ Uses “Fast project”
 - Best for small areas at low latitudes



Setting the geoprocessing environments



Setting the toolbar environments



Exercise 3 overview

- ❑ **Explore the analysis environment**
 - Cell size
 - Extent and snap raster
 - Mask
 - Projection

- ❑ **Clipping with the analysis environment**
 - With the extent (rectangular shape)
 - With the extent and mask (irregular shape)