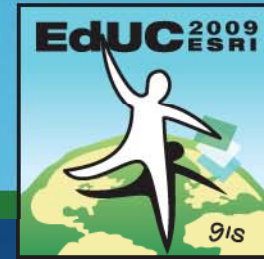


2009 ESRI Education User Conference

July 11–14, 2009

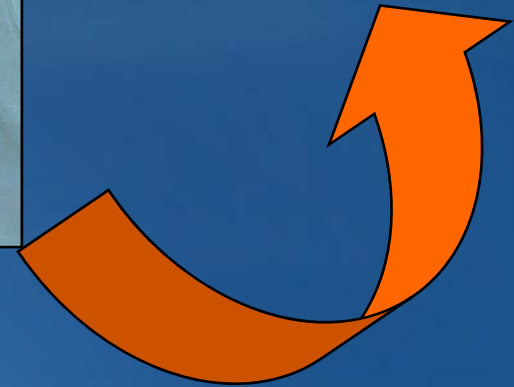
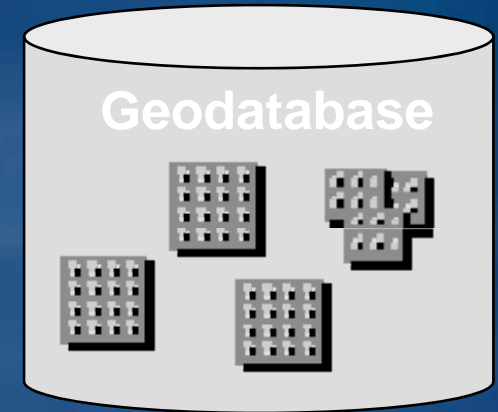
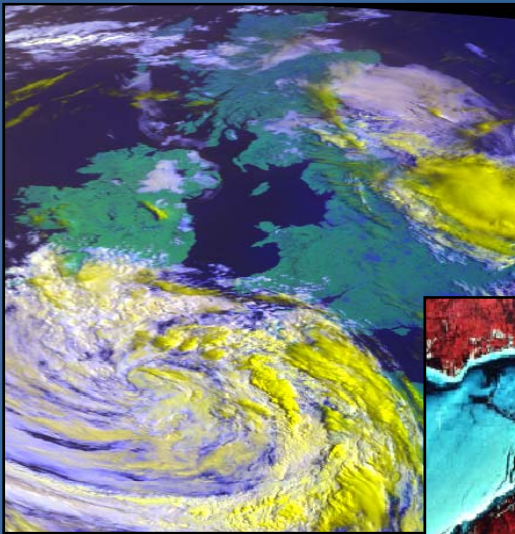


Using Raster Data

Matthew Baker
ESRI Educational Services
Redlands, CA

Lesson Overview

- Raster data
- Raster in a geodatabase
 - Datasets
 - Catalogs
 - Attributes



What is a Raster

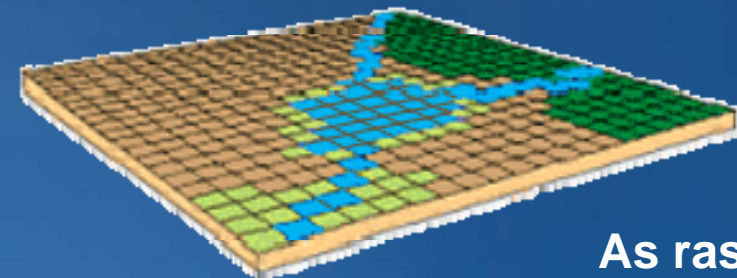
- A matrix of cells/pixels/squares
 - Cells store a number representing the feature found in the cell area
- Advantages
 - Simpler data model
 - Faster processing and display
 - Additional analytic tools
 - Better for unbounded phenomena (like soil pH and elevation)
- Disadvantages
 - Generalization
 - Loss of feature uniqueness



Real world



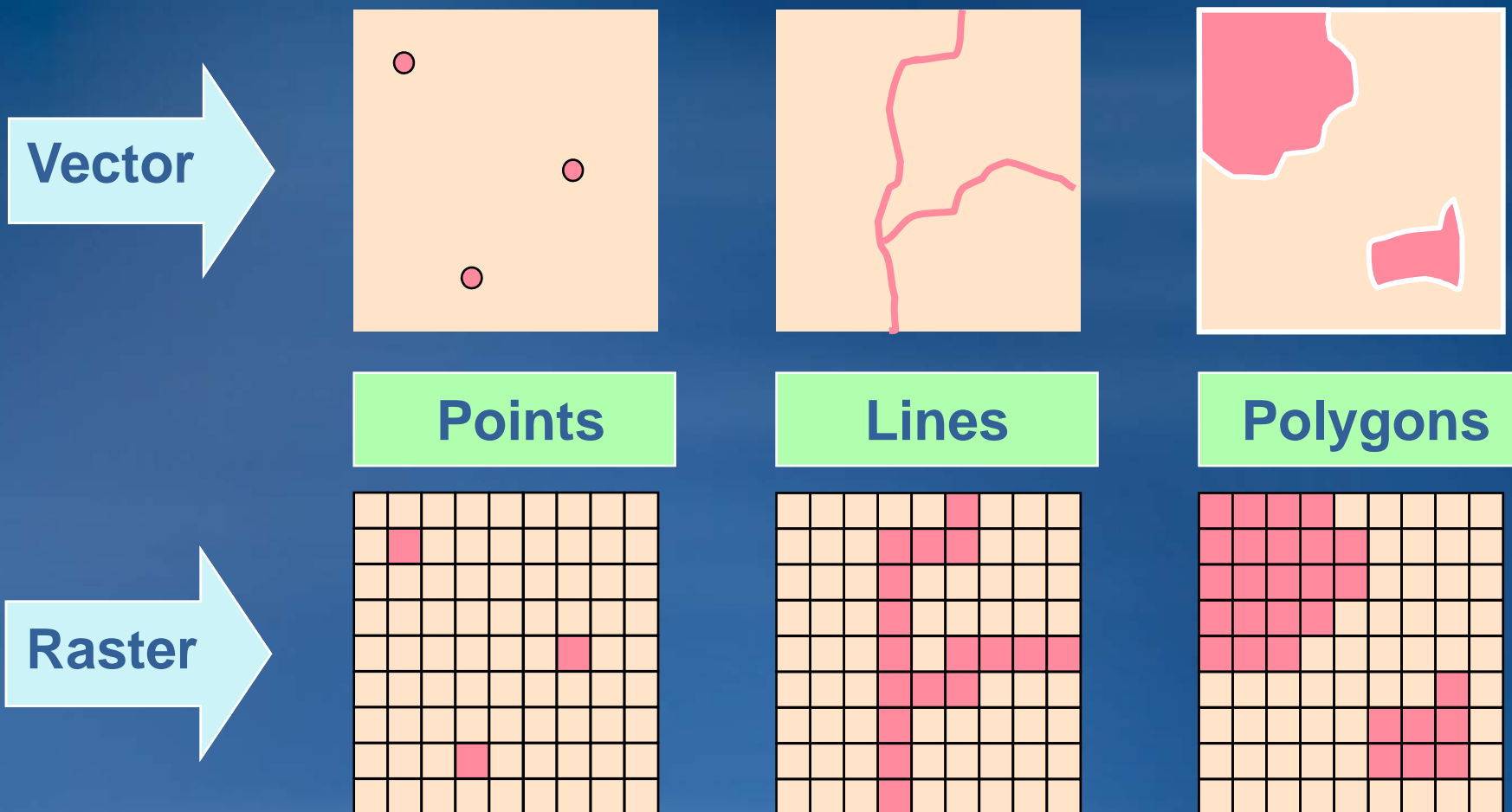
As vector



As raster

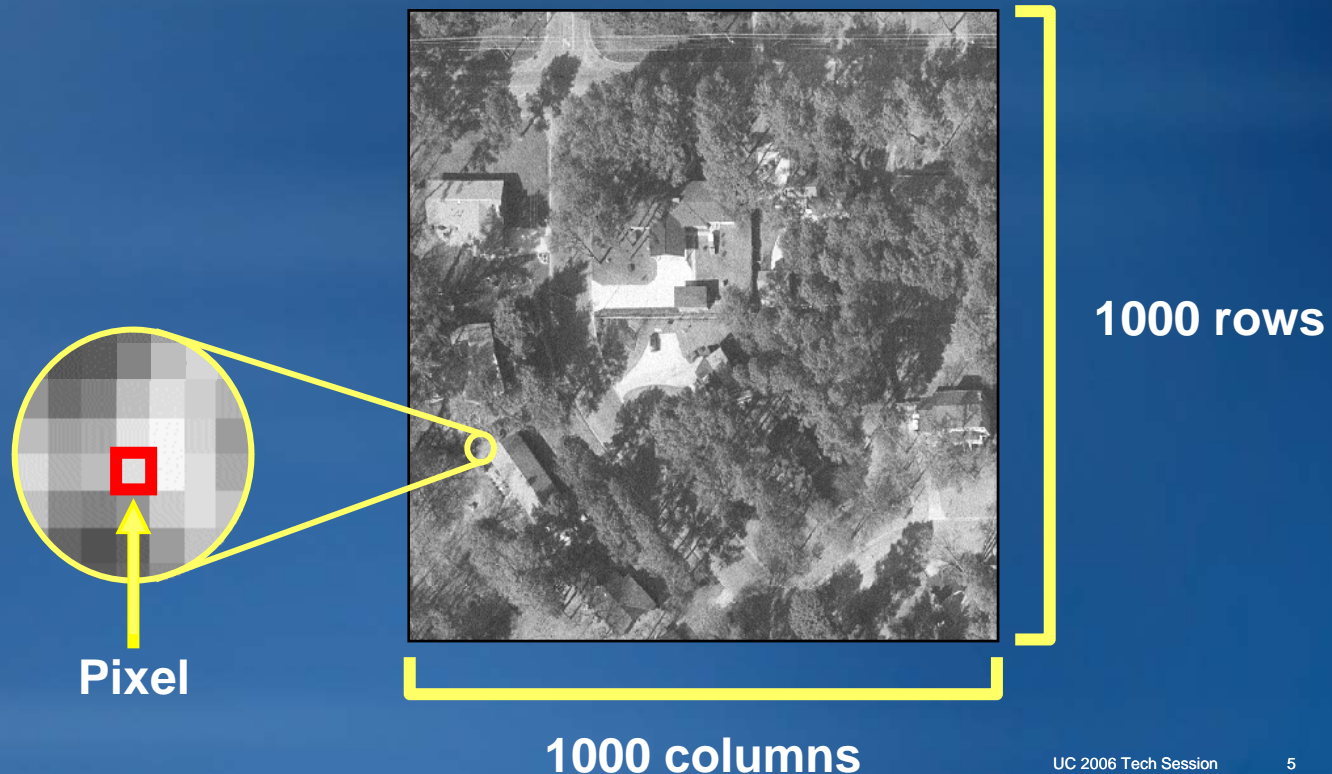
Features as raster

- Features lose uniqueness with raster representation
 - A line becomes a collection of cells, not one feature



Raster cells/pixels

- Cell properties & characteristics
 - Arranged in a matrix of columns and rows
 - Each cell has a numeric **value**
 - Integer
 - Floating point
 - NoData
 - Cells may have one or more **values/bands**
 - Each cell is independent



Raster Bands

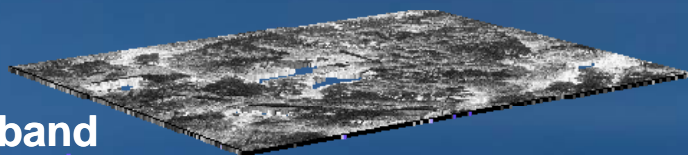
- Defined as layer of cell values for one variable
- Raster can consist of one or many bands

- Single-band

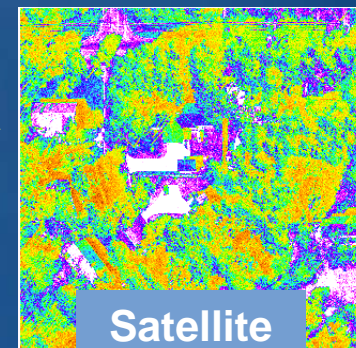
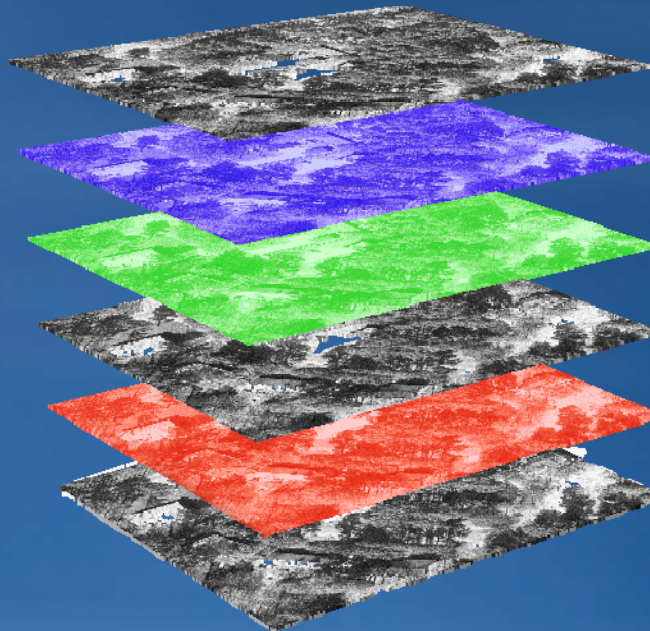
- Single variable

- Multi-band

- Multiple variables per band
- Each band covers same area
- Stored in one raster dataset
- Up to three bands can be displayed together



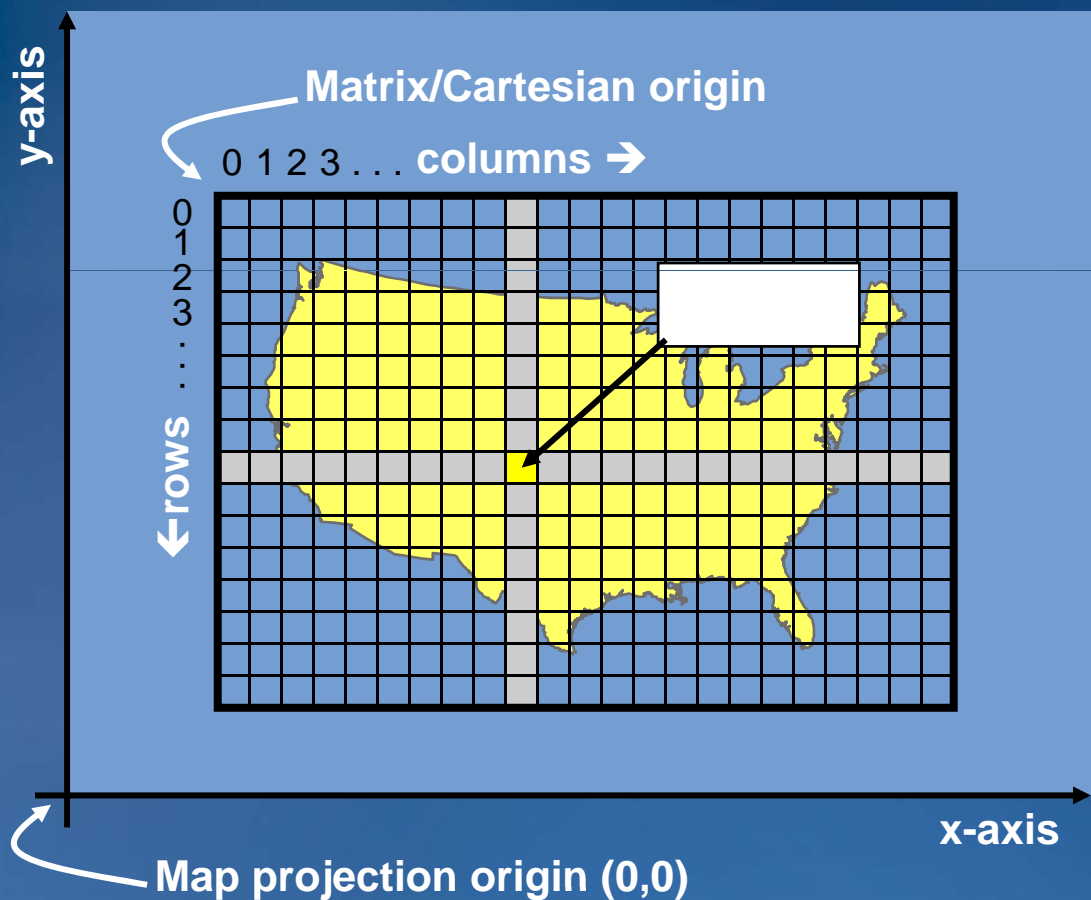
Aerial Photo



Satellite Image

Raster coordinate systems

- Both cell matrix and Cartesian



Matrix

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

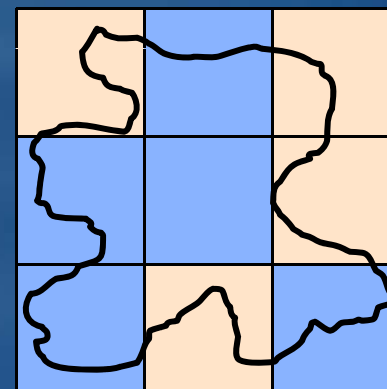
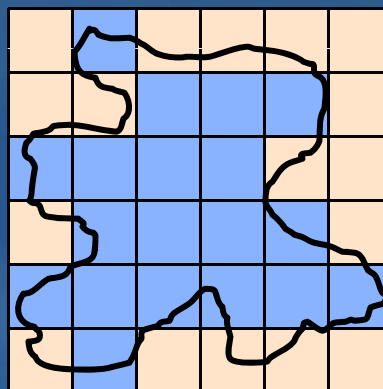
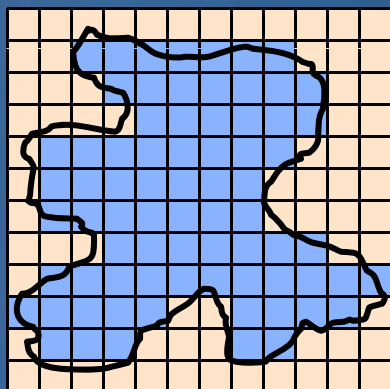
Cartesian

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

Resolution

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

True lake area
745,322 m²



Cell size

100 m

200 m

400 m

Matrix

12x12

6x6

3x3

Lake cells

74

19

5

Area

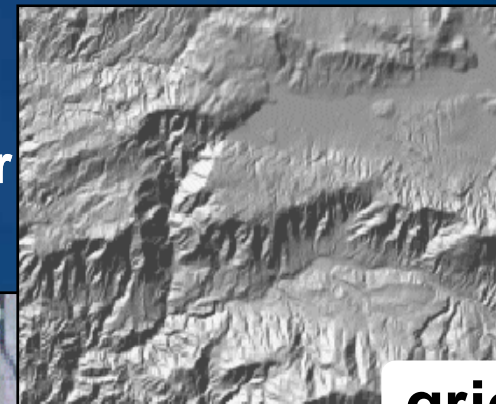
740,000 m²

760,000 m²

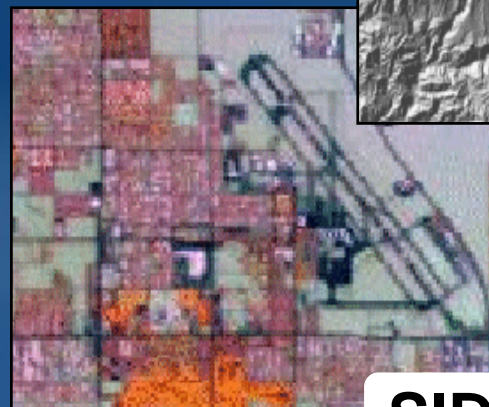
800,000 m²

Raster formats

- The format is how cells are stored in a raster
- ArcGIS supports dozens of raster formats
 - Various image formats (SID, IMG, TIF, etc.)
 - 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



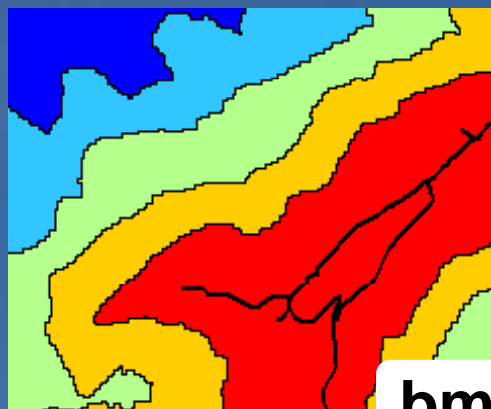
grid



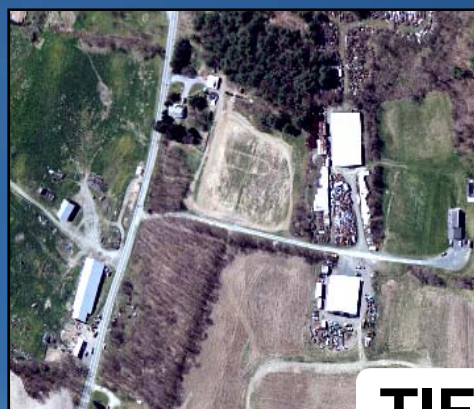
SID



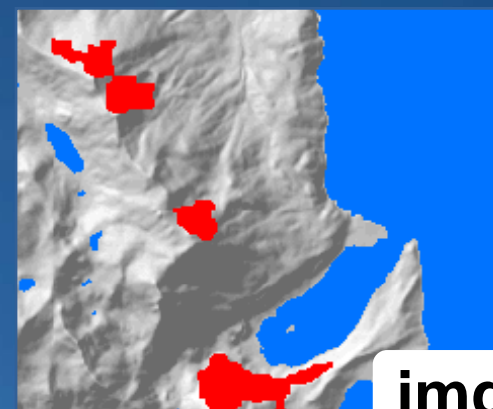
gif



bmp



TIF



img

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

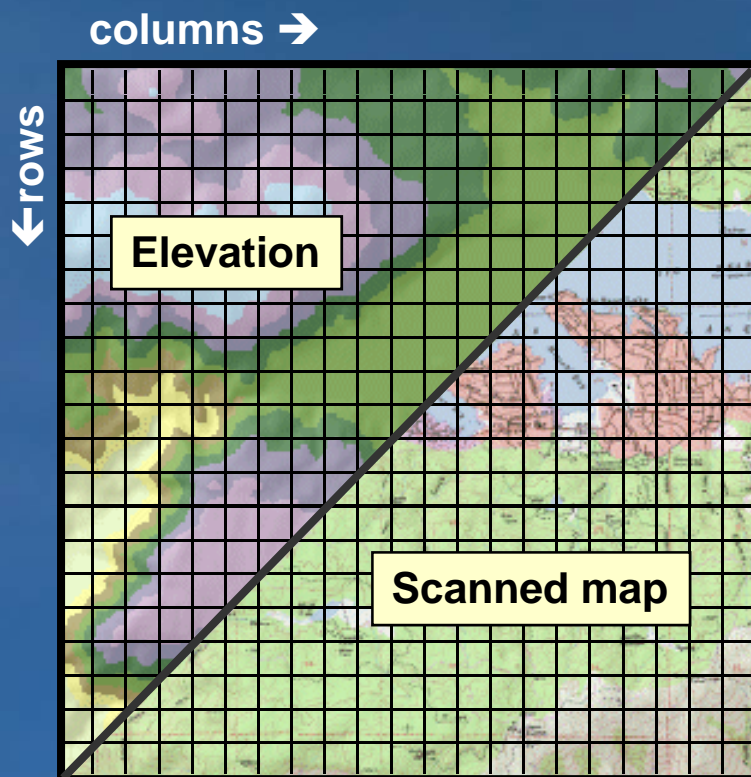
- Elevation
- Landuse codes
- Population density

Good for analysis

- Slope from elevation

Good for mapping

- Thematic layers
- Derivative products (like shaded relief)



Raster Pictures

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

Good for mapping

- Backgrounds

Good for attributes

- Picture of house

Bad for analysis

Raster attribute tables

- All single-band integer rasters have *virtual* tables
 - Created on the fly by ArcGIS
 - Support ArcMap joins and relates
- Integer ESRI grids have *real* tables
 - Support ArcMap joins and relates
 - Support user-defined fields
 - Use fields in analysis and queries

Virtual table
for TIF image



Value	Count	Soil_suit	Soil_text	Soil_desc
101	88	3	Al	Alluvial, Loamy
103	1253	6	Cs	Colluvial, Stony
106	146	8	P	Pits And Dumps
901	12349			

ObjectID	Value	Count
0	0	262679
1	1	611010
2	2	28071924
3		12367

Tables have one record for each unique value except NoData.

ArcGIS raster support

- Core support for raster in:

- ArcMap

- Draw, query, georeference

- ArcCatalog

- Copy, rename, delete

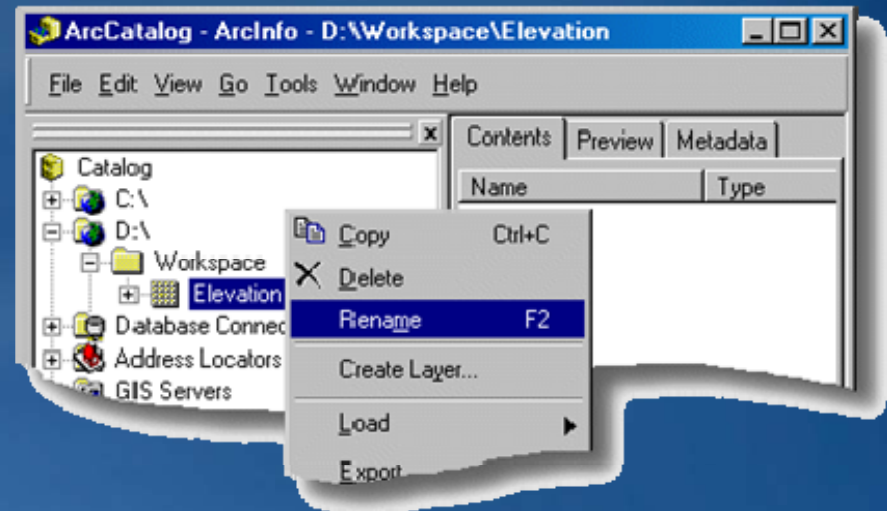
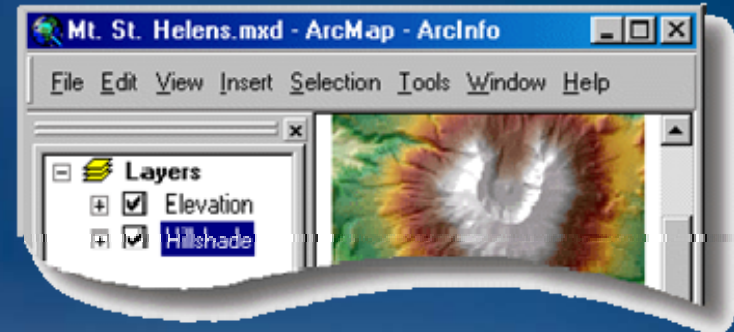
- ArcToolbox

- Convert, project, merge, clip

- Geodatabase

- Storage as:

- Raster datasets or
- Raster catalogs



* Spatial Analyst extension adds more functionality and analysis

Geodatabase raster storage options

- **Raster dataset**
 - Any valid raster format



- **Raster catalog**
 - A collection of raster datasets stored in a table (like digital aerial photographs)



OBJECTID	Shape	Name	Shape_Length	Shape_Area
1	Long binary data	e_07351426.tif	10000	6000000
2	Long binary data	e_07351428.tif	10000	6000000
3	Long binary data	e_07351430.tif	10000	6000000
4	Long binary data	e_07351432.tif	10000	6000000
5	Long binary data	e_07381426.tif	10000	6000000
6	Long binary data	e_07381428.tif	10000	6000000
7	Long binary data	e_07381430.tif	10000	6000000
8	Long binary data	e_07411426.tif	10000	6000000
9	Long binary data	e_07411428.tif	10000	6000000

- **Raster attribute**
 - Use for feature attributes
 - One field of type raster per table

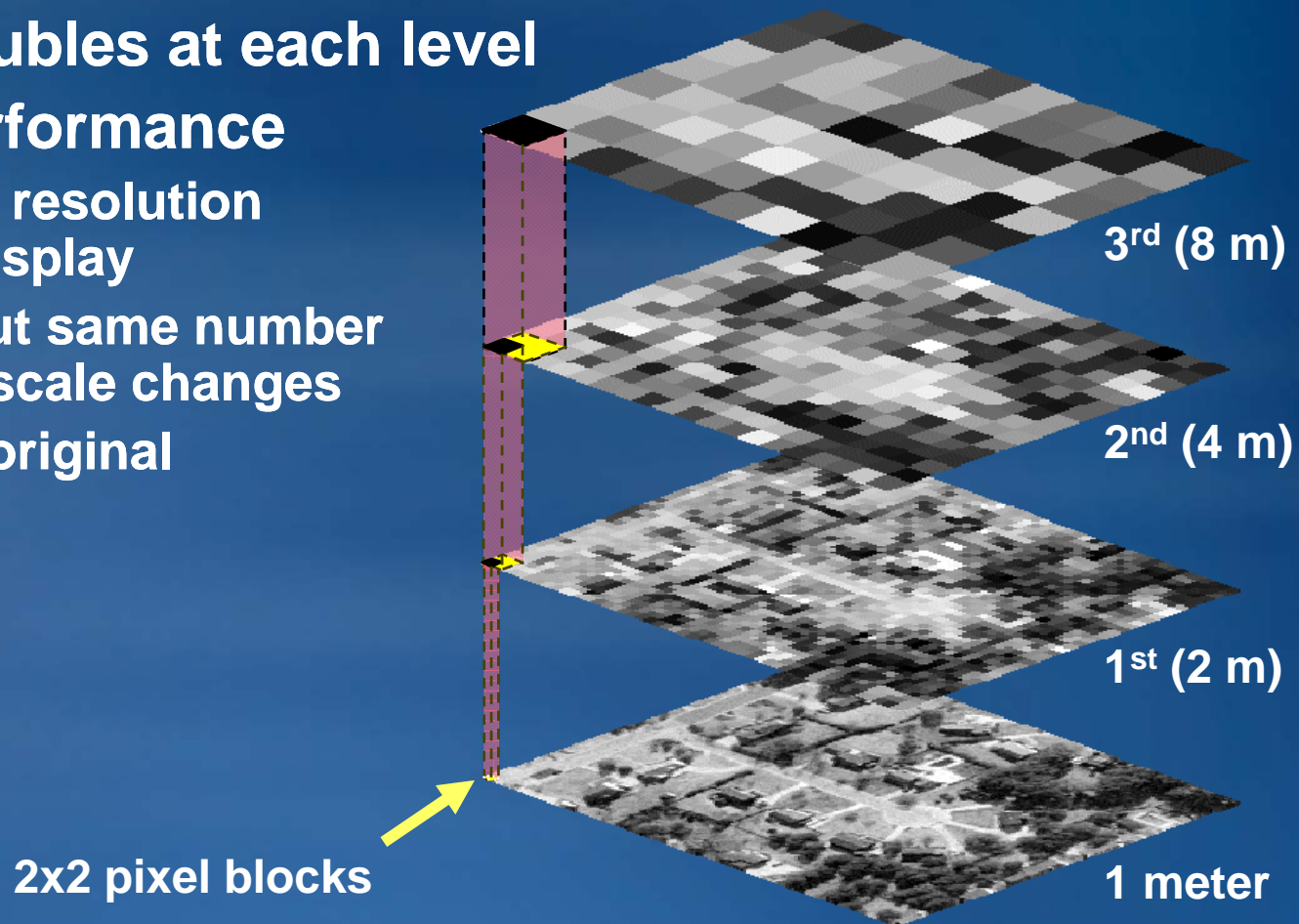


Field Name	Data
Shape	Geometry
MBL	Text
ADR2	Text
CITY	Text
Shape_Length	Double
Shape_Area	Double
House_pictures	Raster



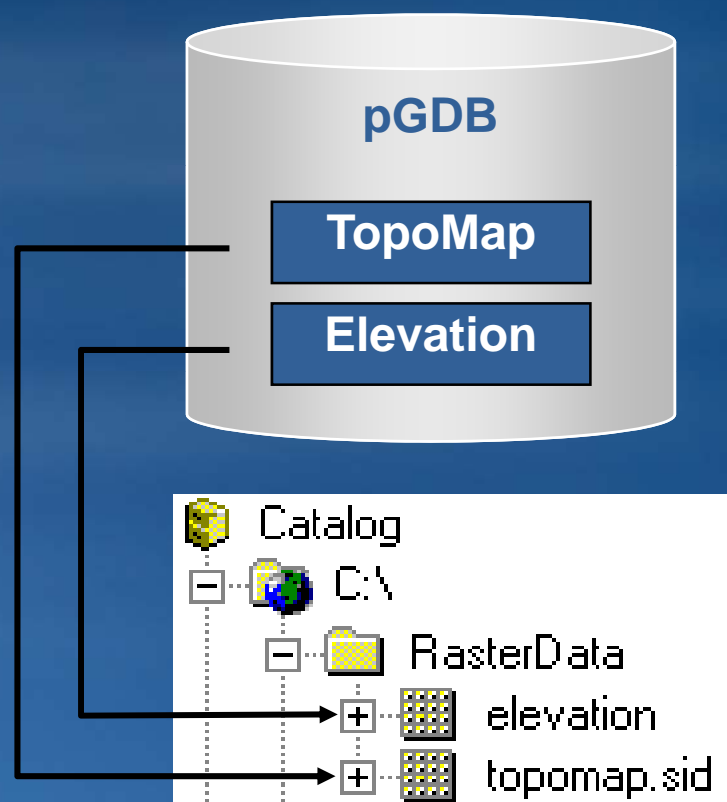
Pyramids

- Reduced resolution copies
- Pixel size doubles at each level
- Improves performance
 - Returns best resolution for screen display
 - Returns about same number of pixels as scale changes
 - Analysis on original



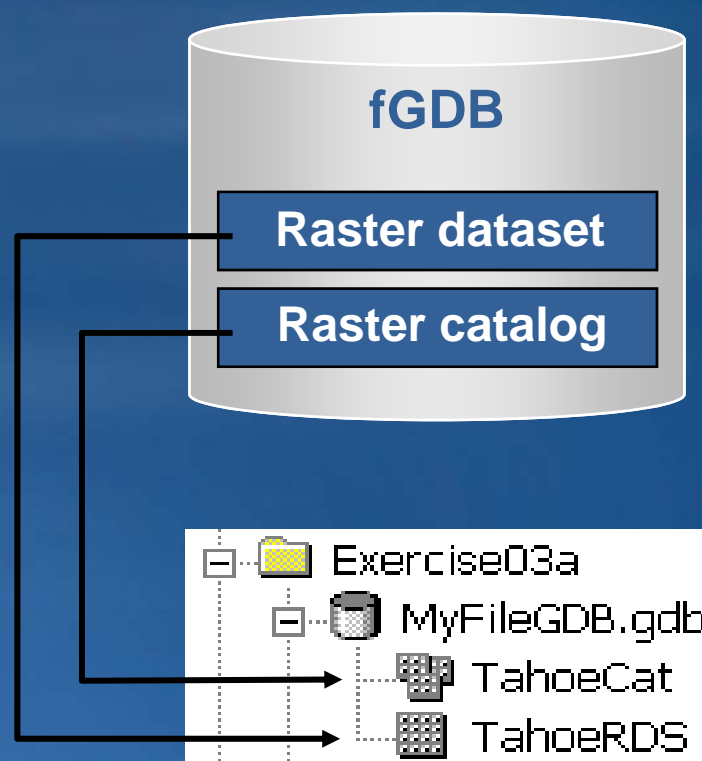
Rasters in a personal geodatabase

- **Manages rasters**
- **Stores a reference to external file-based rasters**
 - Microsoft Access MDB file is limited to 2 GB total size
 - Provides centralized access to rasters
- **Manages raster datasets**
 - Single raster
- **manages raster catalogs**
 - Collection of rasters



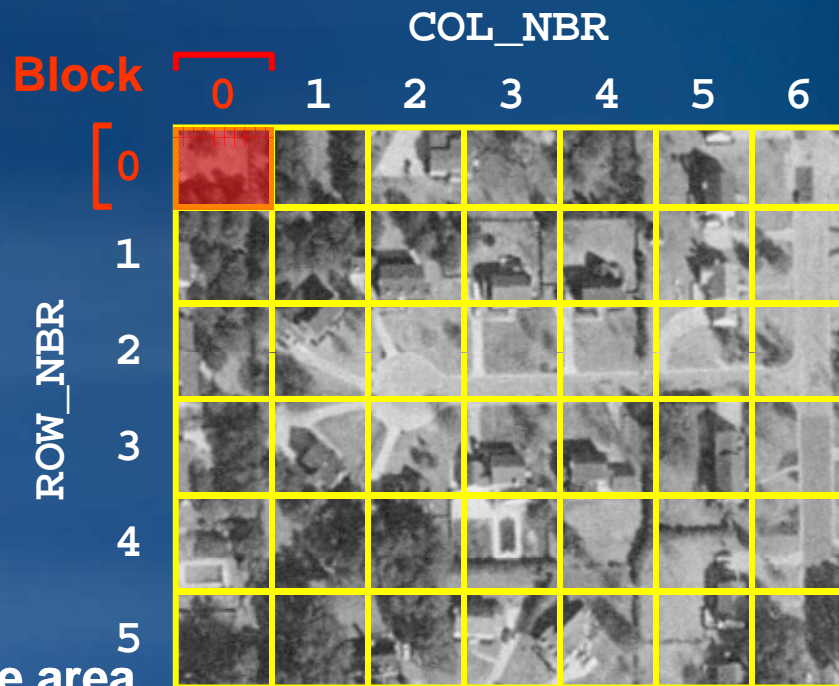
Rasters in a file geodatabase

- Stores raster catalogs and raster datasets internally
 - Up to one terabyte for each raster dataset or raster catalog
 - Provides centralized access to rasters
- File Geodatabase rasters intended for:
 - single user and small work groups
 - Some readers and one writer



Rasters in an ArcSDE geodatabase

- Stored internally
- ArcSDE subdivides raster into **blocks** for storage
 - Size set by user
 - Automatic and required
 - Invisible to end users
- The raster is a table; a block is a row in the table
- Provides faster access to data
 - ArcSDE returns blocks for visible area
 - Improves display performance



Geodatabase raster datasets

- A single raster in a geodatabase
 - Good for analysis and mapping
 - Seamless
 - Fast display at any scale
 - May load many rasters into one raster dataset (mosaic)

Personal Geodatabase storage

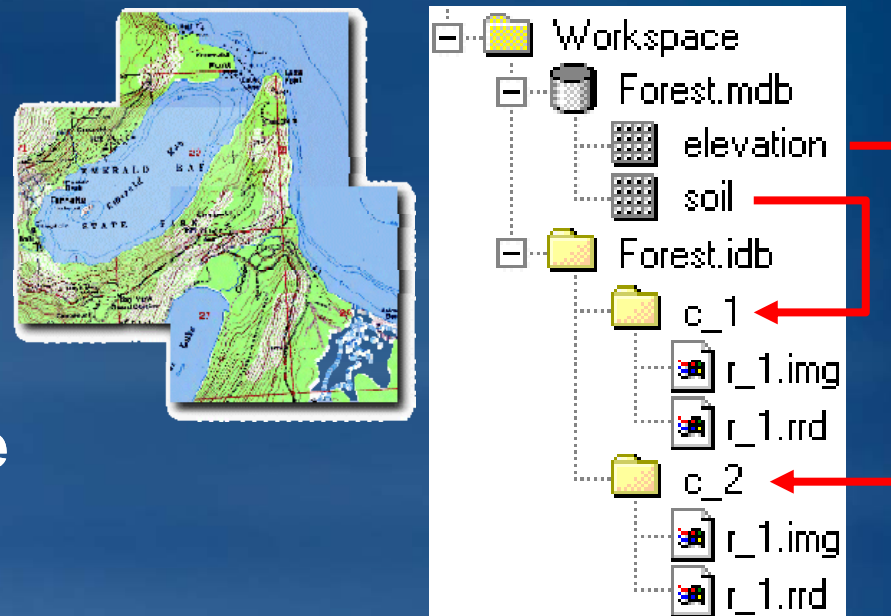


Image1

+



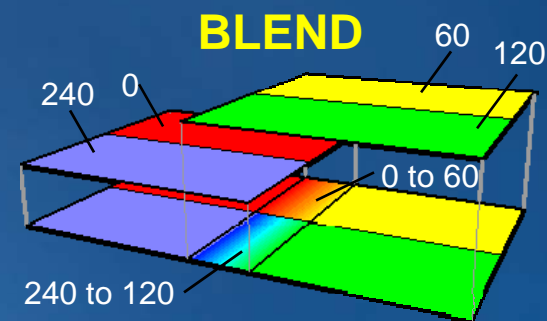
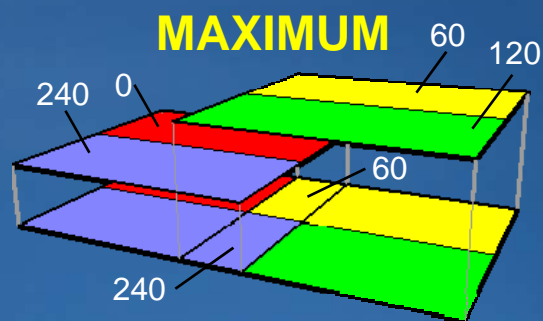
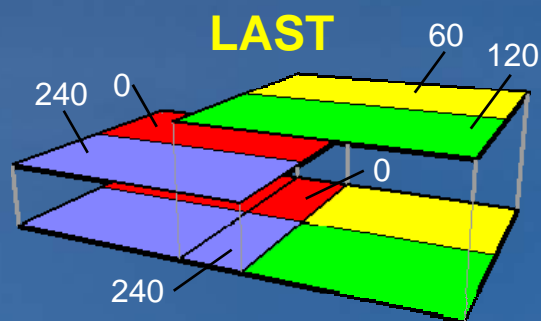
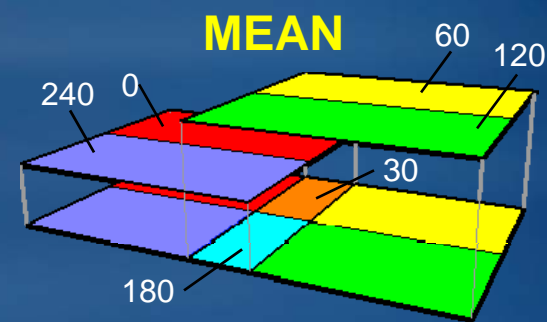
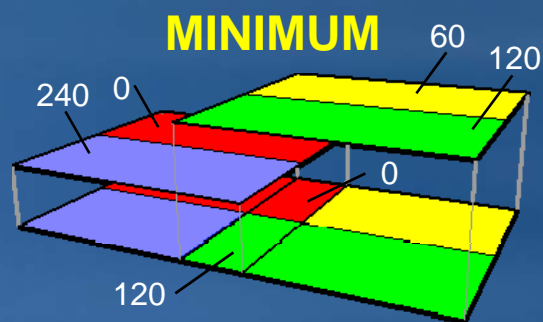
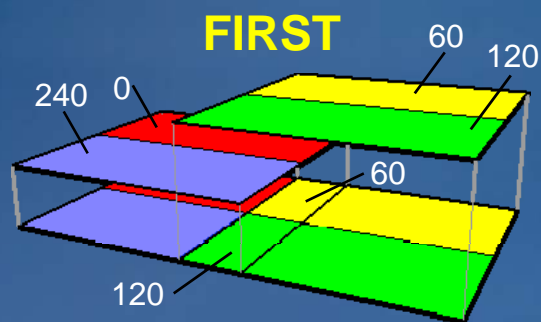
Image2



Mosaic

Mosaic cell overlap options

- Six options
- Combine multiple rasters into one
 - Mosaic and Mosaic To New Raster tools

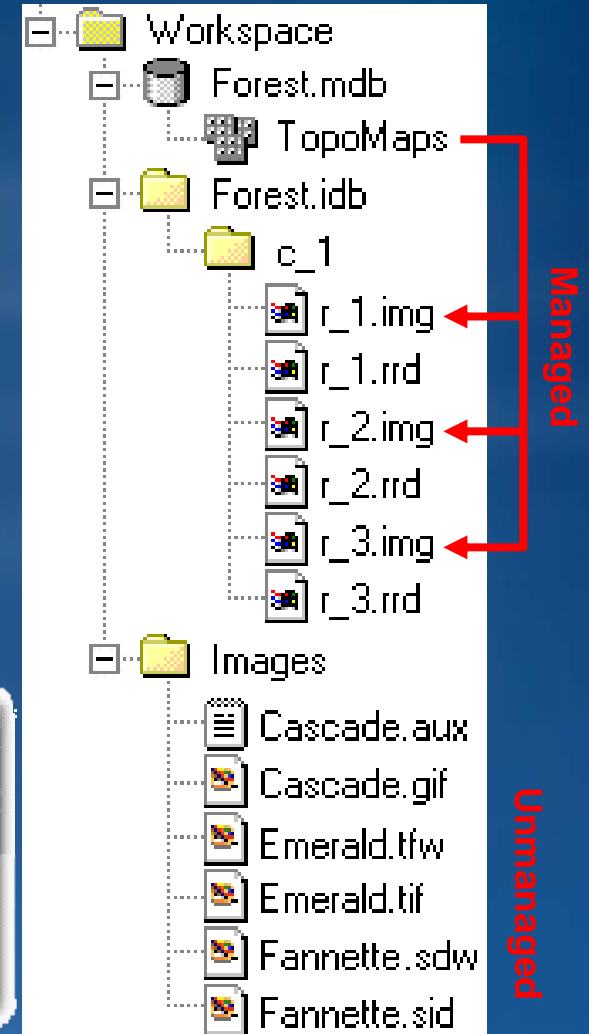


← Discrete →

← Continuous →

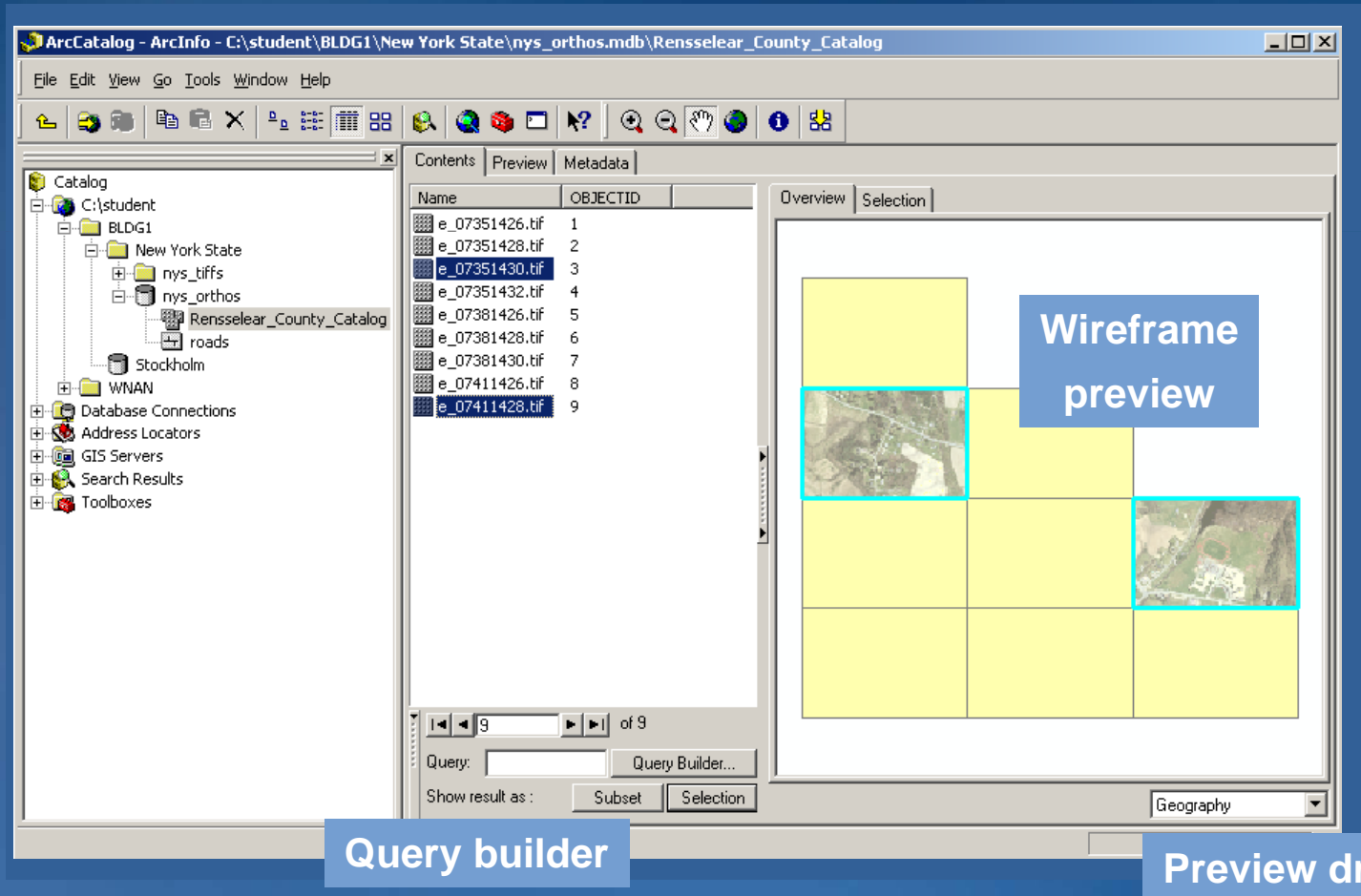
Geodatabase raster catalogs

- A collection of raster datasets
 - Behave as one, but stored separately (rows in a table)
 - May overlap, have gaps, different cell sizes, bit depths
 - Must have same spatial reference
 - Good for archives, display, and mapping




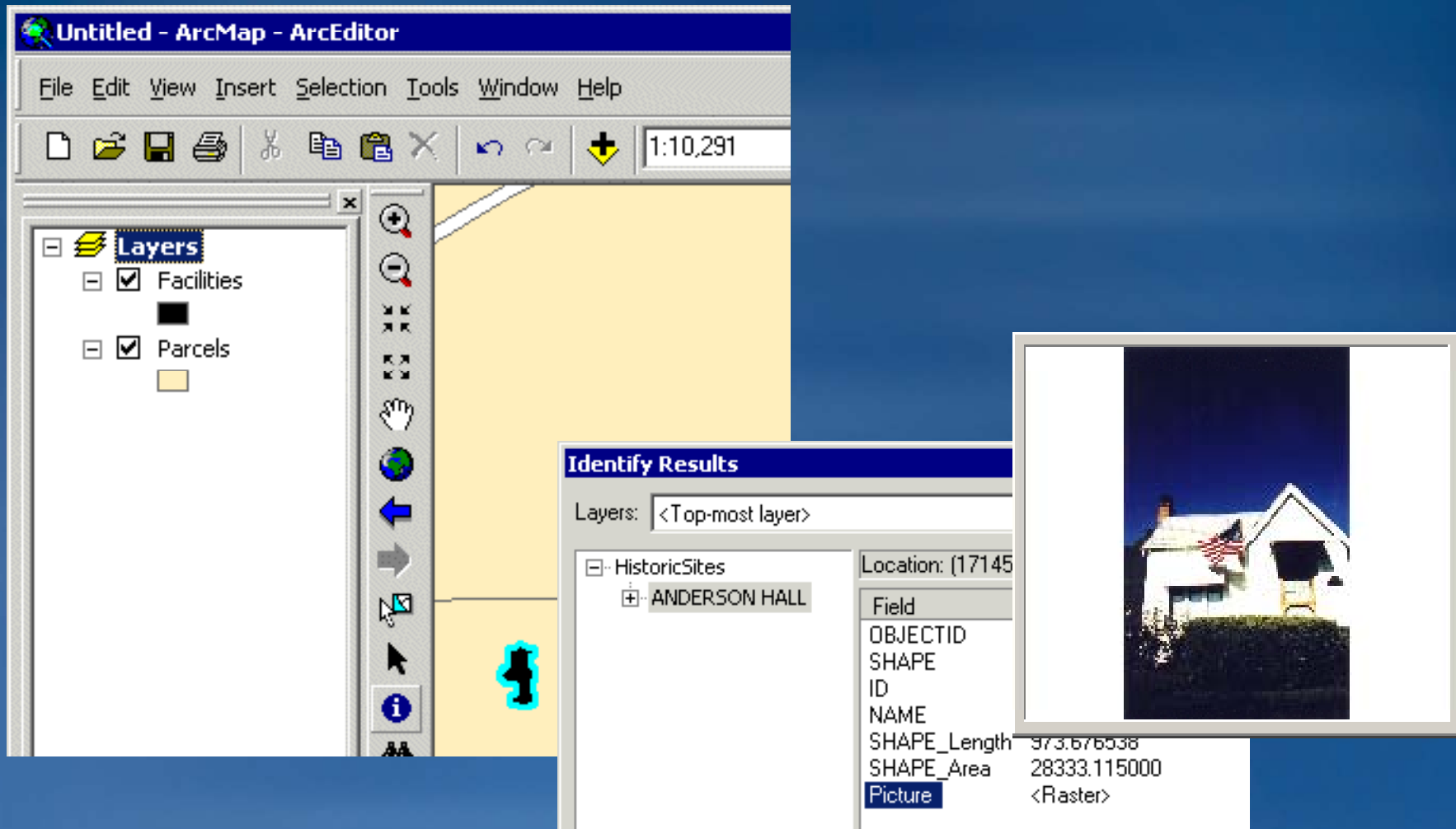
Managing raster catalogs in ArcCatalog

- Contents tab
 - Properties, Geography, Metadata, and Bands preview options



Raster attributes

- Pointer stored as a value ion a Raster field
 - View with the Identify tool  or in the attribute table



The screenshot shows the ArcMap - ArcEditor interface. The main map area displays a yellow background with a small red-outlined polygon representing a parcel. The Identify Results dialog box is open, showing the following information:


Layers: <Top-most layer>

HistoricSites

- ANDERSON HALL

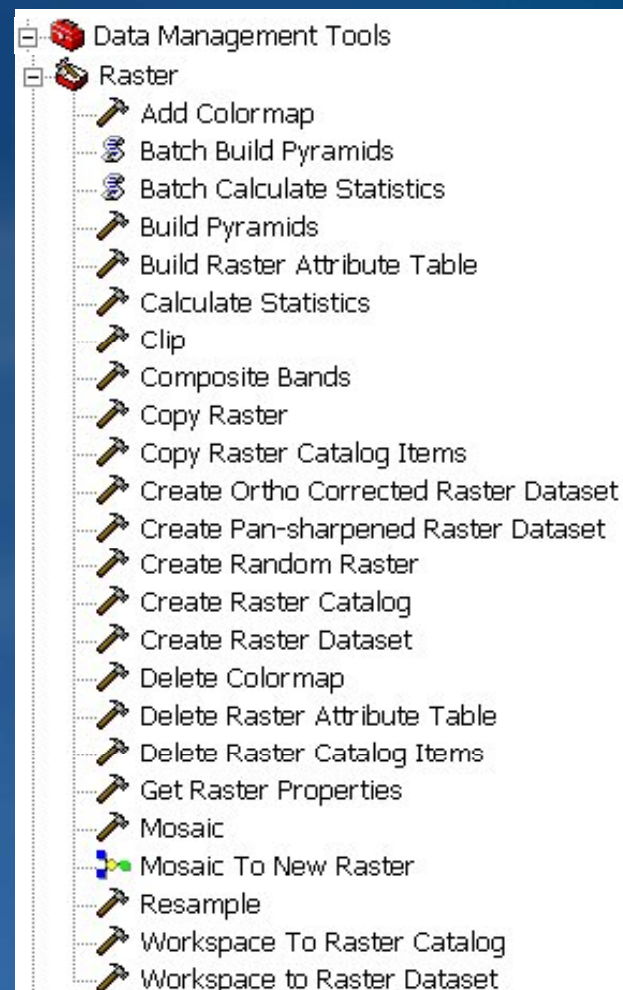
Location: (17145)

Field	
OBJECTID	
SHAPE	
ID	
NAME	
SHAPE_Length	973.676538
SHAPE_Area	28333.115000
Picture	<Raster>



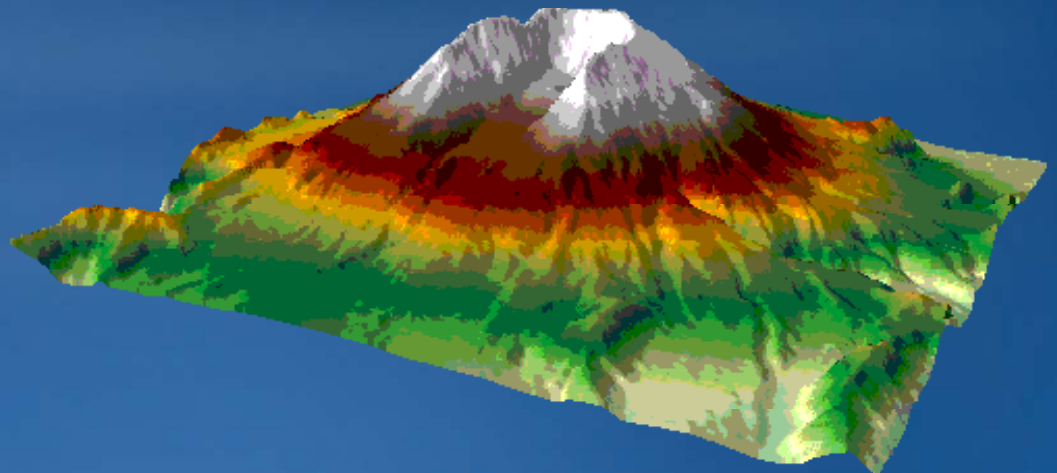
Raster management tools - Geoprocessing

- **General raster database management tools**
 - Copy, paste, delete, calculate statistics, set spatial reference
- **Data organization/preparation**
 - Mosaicking
 - Raster catalogs
- **Raster data storage**
 - Pyramids
 - GDB technology



Exercise

- Explore raster storage
- Create a raster dataset
- Create a raster catalog
- Use rasters as feature attributes



Questions ?