

EnvSci 360 – Computer and Analytical Cartography

Lecture 7
***Mapping Images,
Surfaces,
and 3-D Data***

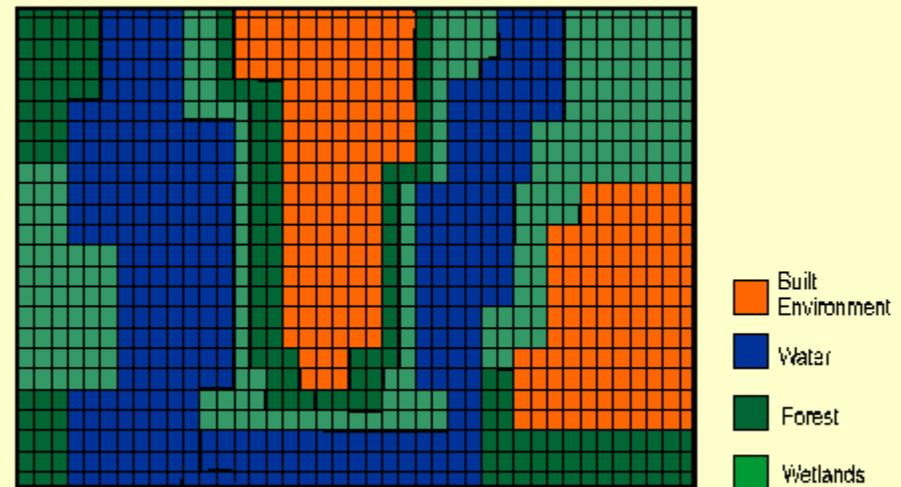


Brief Overview of Imagery

✦ **What is Imagery?** A spatial data model that defines space as an array of equally sized cells (pixels) arranged in rows and columns, and composed of single or multiple bands.

- Each cell contains an attribute value and location coordinates.
- Groups of cells that share the same value represent the same type of geographic feature.

The Raster View of the World



The Raster GIS references phenomena by grid cell location in a matrix. The grid cell is the smallest unit of resolution and may vary from centimeters to kilometers depending on the application.

Image from Kenneth E. Foote and Donald J. Huebner, *The Geographer's Craft Project*, Department of Geography, The University of Colorado at Boulder

Brief Overview of Imagery

- ✦ An image is stored as a "raster dataset" (the term used in ArcGIS) of binary, integer, or floating point values that represent the intensity of reflected light, heat, or other range of values on the electromagnetic spectrum, or some other value ("Z") at an X,Y location.

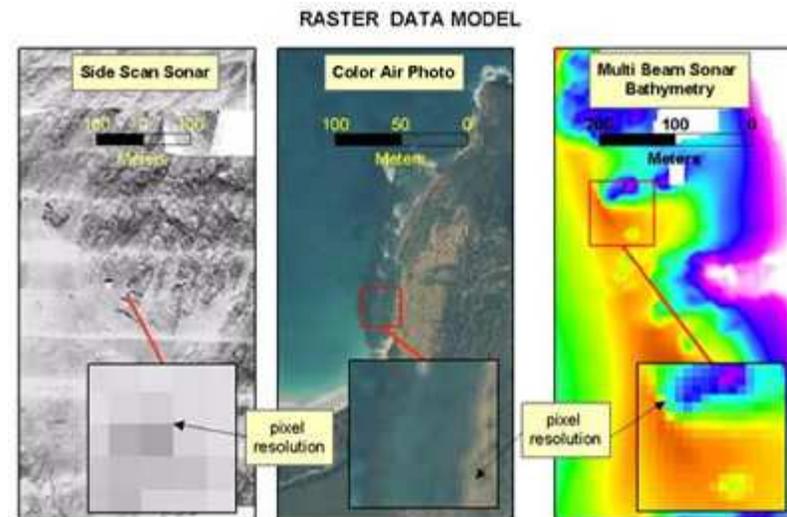
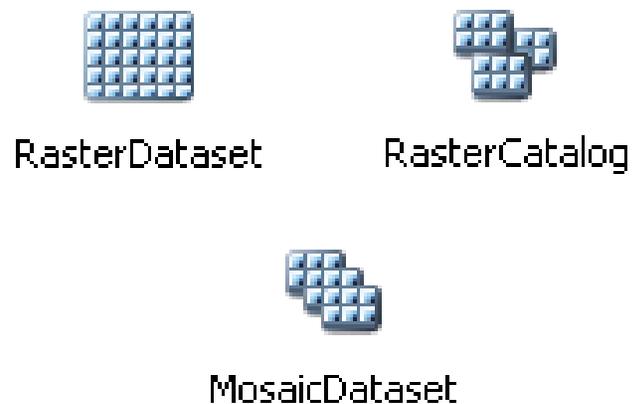
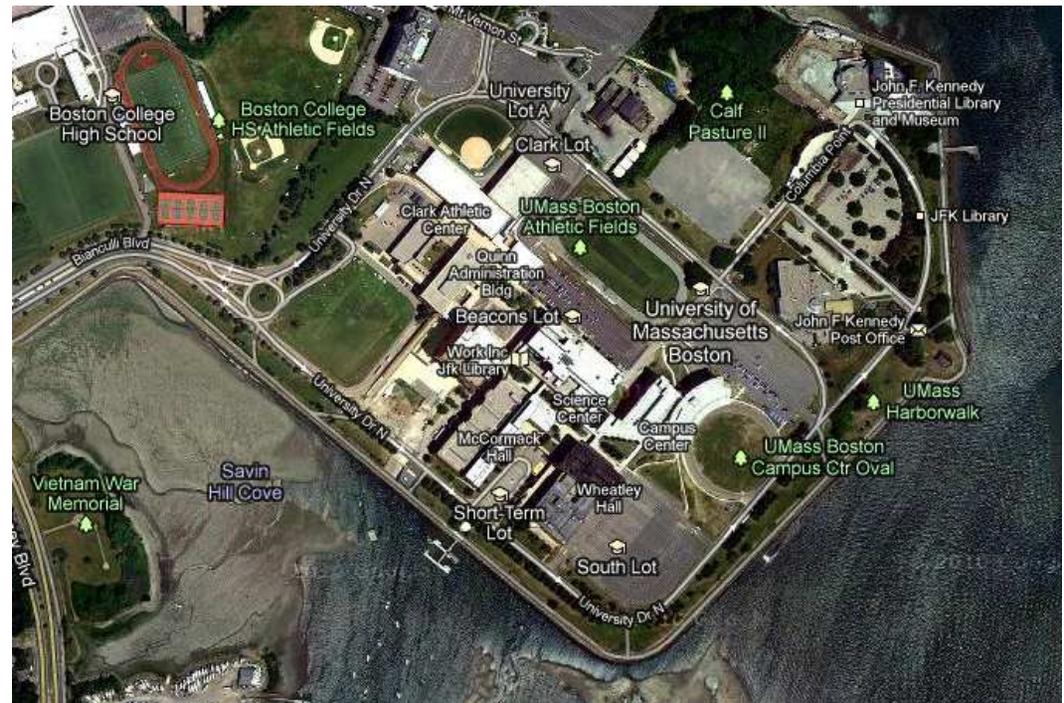


Image from NOAA Coastal Services Center

Why Use Imagery?

- ✦ Mapping - Background or Basemap, Reference
- ✦ Data development (on-screen digitizing)
- ✦ Data QA/QC
- ✦ Historical mapping



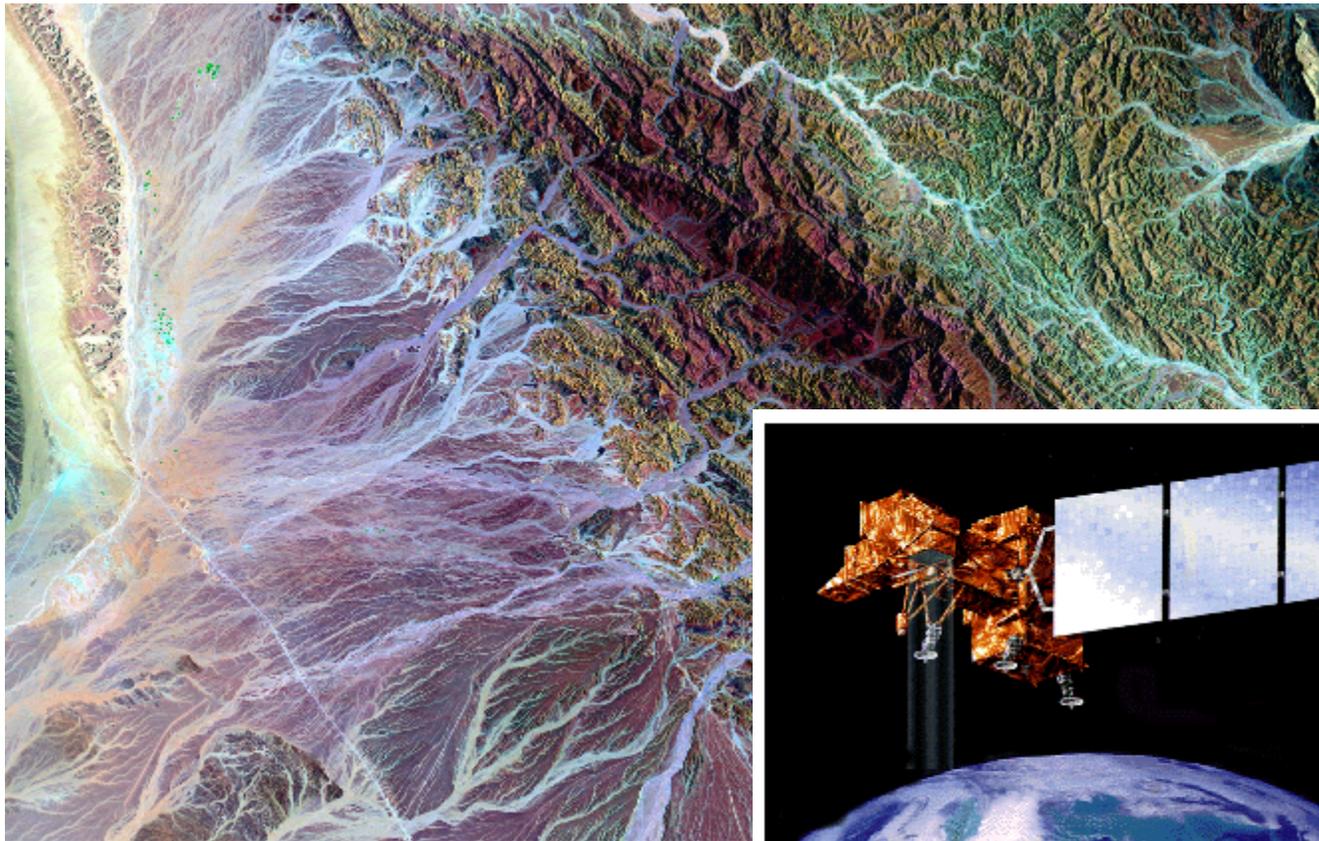
Common Image Formats

- ✦ Geodatabase rasters
 - Raster Dataset, Raster Catalog, Mosaic Dataset
 - Personal, File, ArcSDE
- ✦ Tiff, GeoTiff
- ✦ MrSID, JPEG, JPEG 2000
 - Built-in compression
- ✦ ESRI Grid
- ✦ ERDAS Imagine
- ✦ Other file-based formats
- ✦ Web services

See “raster formats,
list of supported” in
ArcGIS Help

Common Types of Images

✦ Satellite images



Common Types of Images

✦ Ortho imagery

- Aerial-based photography from which distortions from camera tilt and ground relief have been removed; has the same scale throughout and can be used as a map.

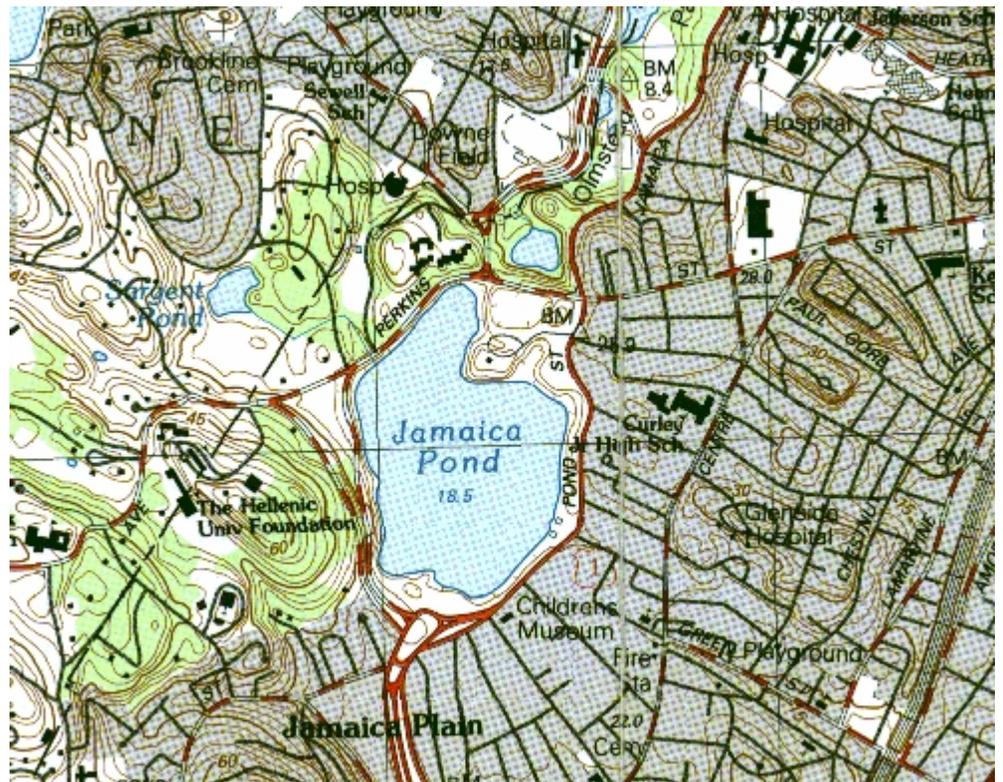


30-cm ortho image from MassGIS

Common Types of Images

✦ Scanned maps/DRGs (Digital Raster Graphics)

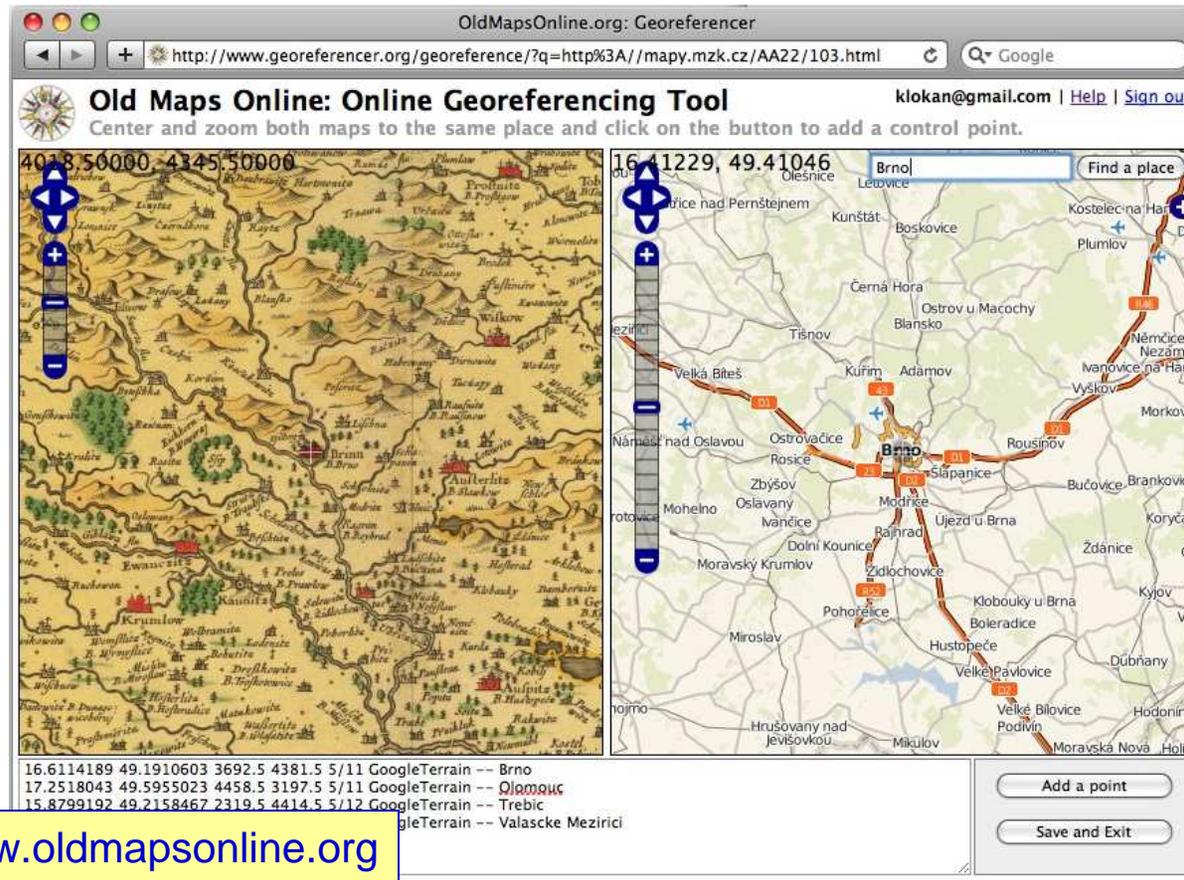
- Digital data created by scanning hard-copy maps, which are then geo-referenced for use in a GIS or other mapping software.



Scanned USGS 1:25,000 topographic map

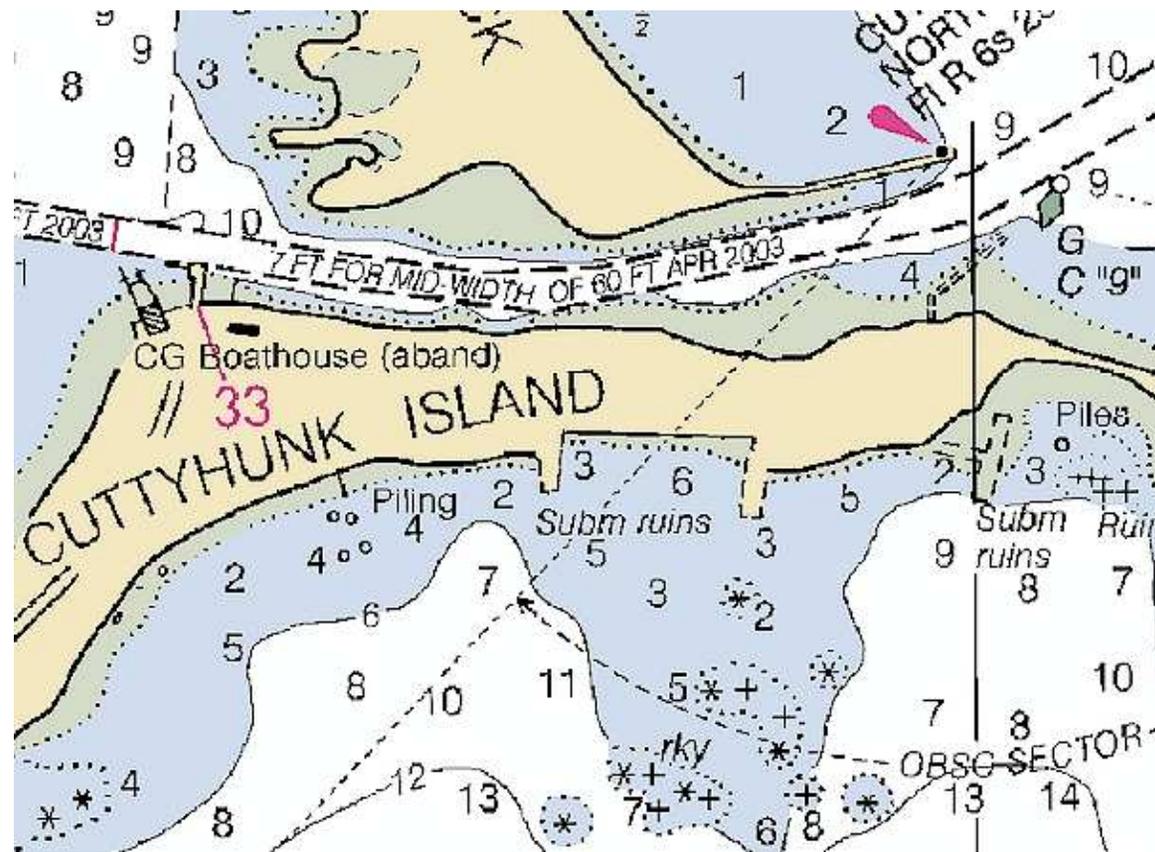
Common Types of Images

✦ Historical maps



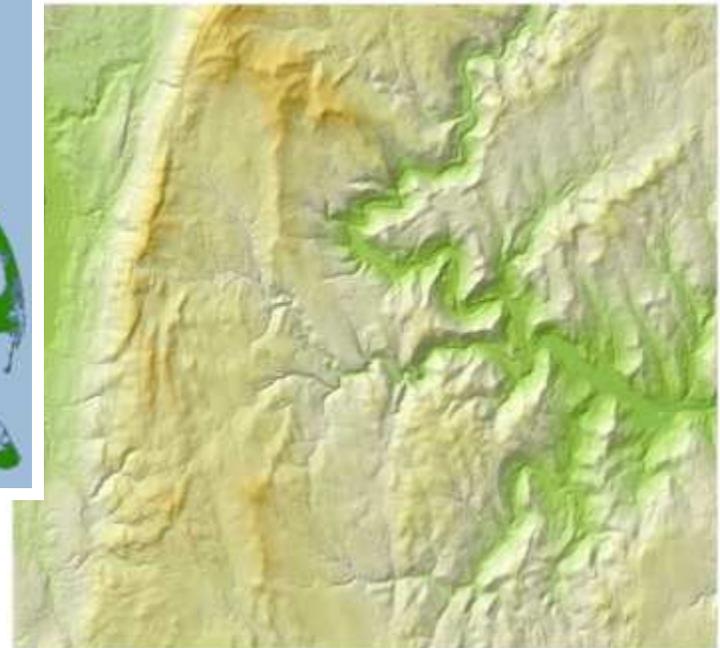
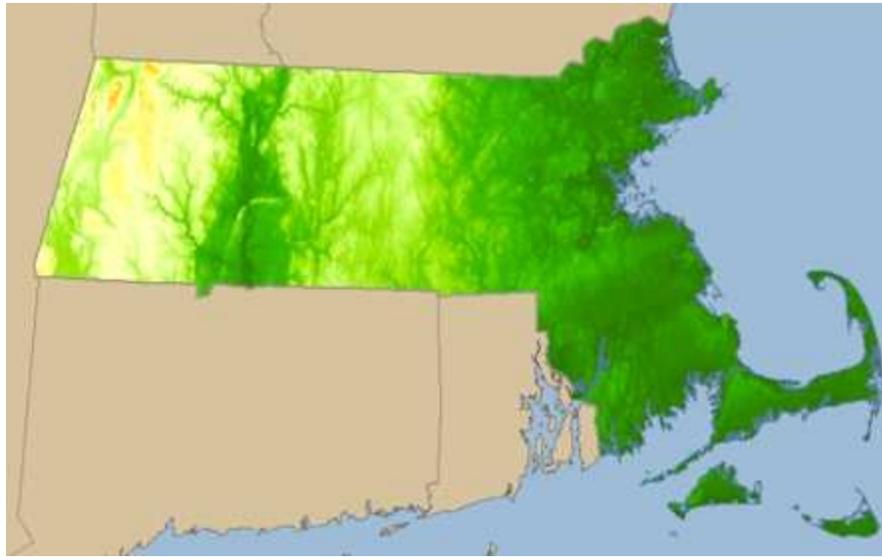
Common Types of Images

✧ NOAA Charts



Common Types of Images

- ✦ Digital Elevation Models (DEMs), hillshade (shaded relief)



For more examples see
<http://www.reliefshading.com/>

Common Types of Images

✦ Land cover

<http://landcover.usgs.gov/>



NATIONAL LAND COVER DATASET

-  Open Water
-  Ice and Snow
-  Low Intensity Residential
-  High Intensity Residential
-  Commercial/Industrial/Transportation
-  Bare Rock/Sand/Clay
-  Quarries
-  Transitional
-  Deciduous Forest
-  Evergreen Forest
-  Mixed Forest
-  Shrubland
-  Orchard/Vineyard
-  Grassland/Herbaceous
-  Pasture / Hay
-  Row Crops
-  Small Grains
-  Fallow
-  Urban Recreational Grasses
-  Woody Wetlands
-  Emergent Herbaceous Wetlands

Common Types of Images

- ✦ Impervious surface; Interpolated/modeled datasets



■ Impervious Surface areas (pixel value 1)
Non-Impervious Surface areas (pixel value 0)
are represented by the white background.

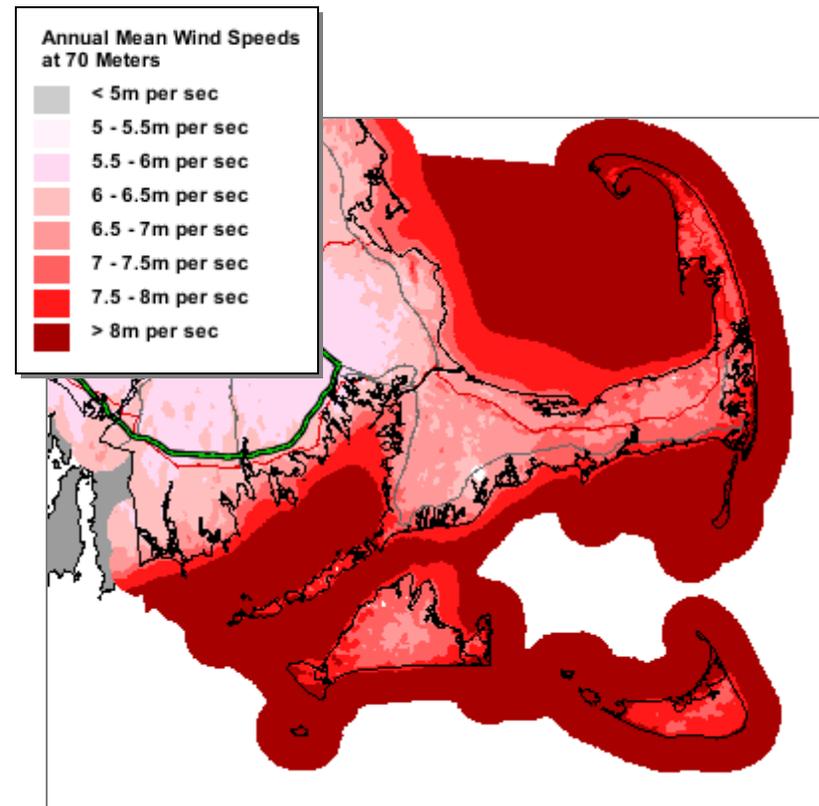
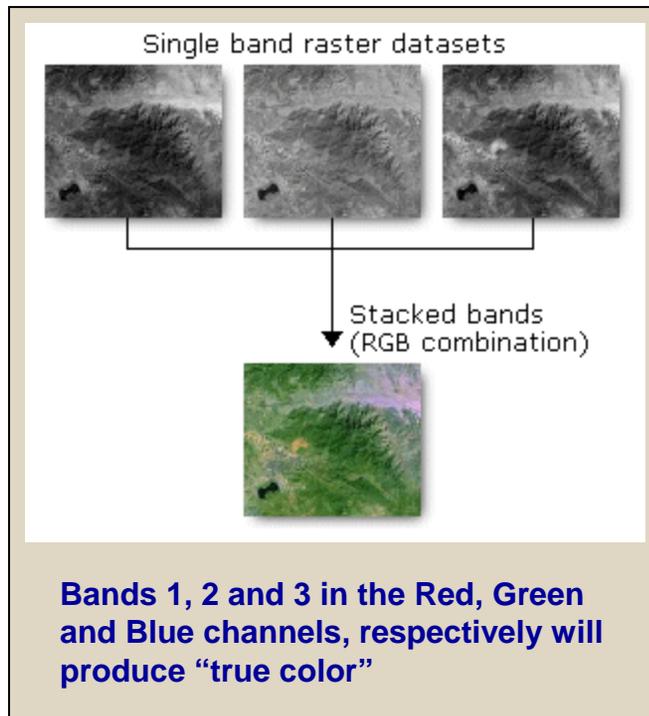


Image Bands

✦ Single to multiple

- With multi-band imagery, you can decide which bands to display, and to what channels (red/green/blue) they will be assigned.



2005 MassGIS ortho imagery shown with bands 4 (near infrared), 2 and 1

Image Bands

✦ RGB composite Symbology in ArcMap

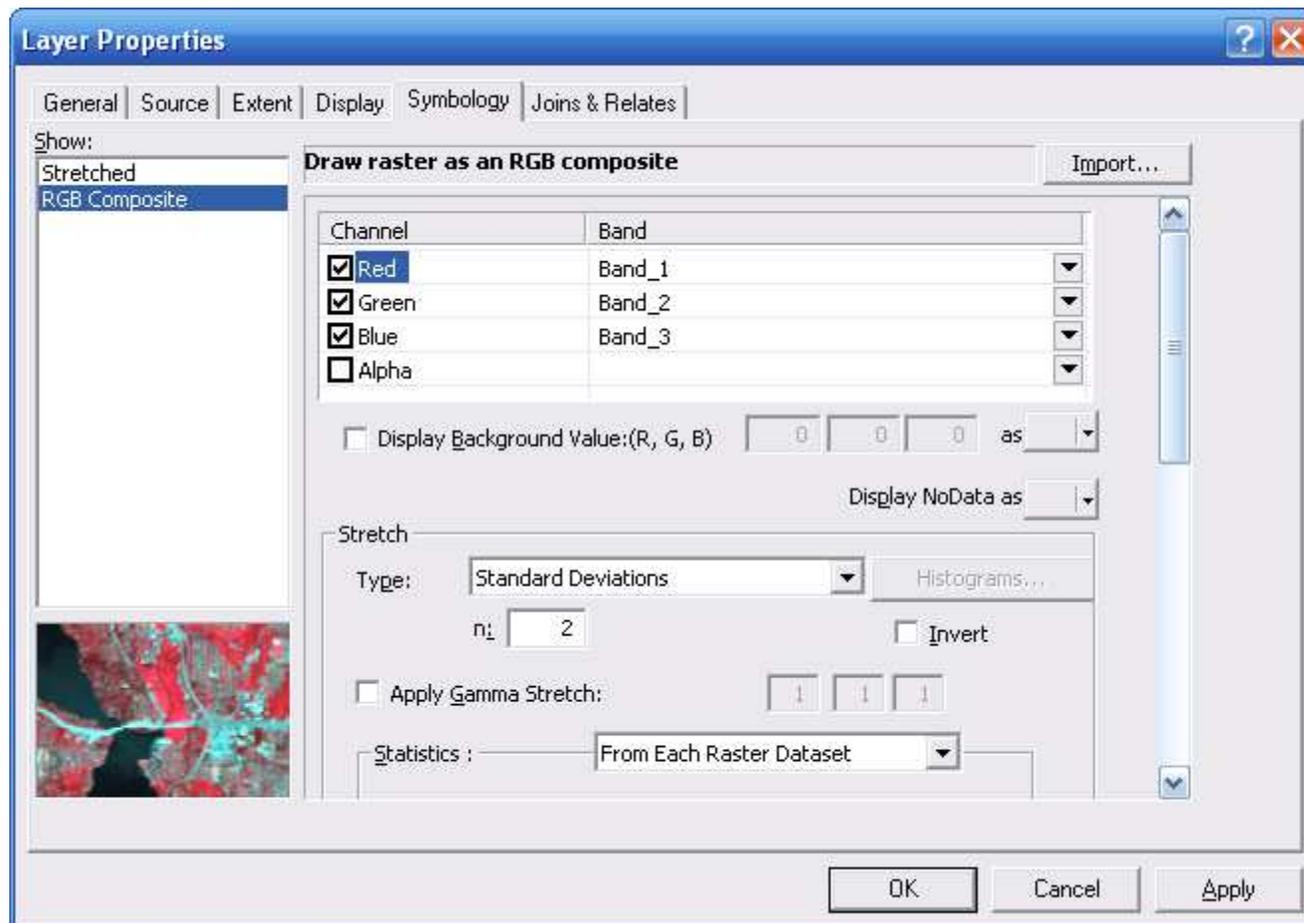
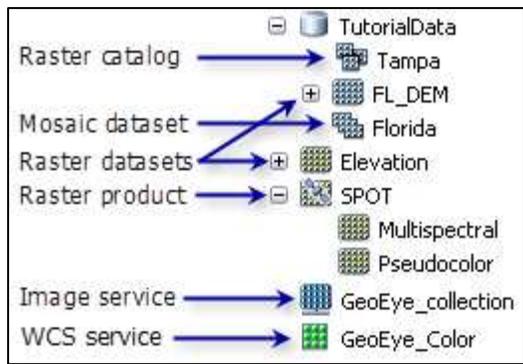


Image Symbology in ArcMap

✦ See <http://desktop.arcgis.com/en/arcmap/latest/manage-data/raster-and-images/a-quick-tour-of-displaying-image-and-raster-data.htm>



A screenshot of the ArcMap Table of Contents window with several annotations. Blue arrows point from text labels to specific items in the TOC: 'Mosaic dataset' points to 'Image', 'Single-band raster dataset' points to '01x01.ft', 'Multi-band raster dataset (added as raster product)' points to 'Multispectral', and 'Raster catalog' points to 'Archive'. Orange arrows point from the 'Image' and '01x01.ft' items to a zoomed-in view of a city map on the right, which shows a grid overlay. The TOC window shows a 'New Data Frame' containing 'My_city', 'Boundary', 'Footprint', 'Image' (with RGB bands: Red: Band_1, Green: Band_2, Blue: Band_3), '01x01.ft' (with Value High: 516.106, Low: 371.072), 'Multispectral' (with RGB bands: Red: NearInfrared, Green: Red, Blue: Green), 'Archive', 'Basemap', 'Topographic', and 'Topographic Infr...

Image Symbology in ArcMap

✦ Depends on image type and number of bands

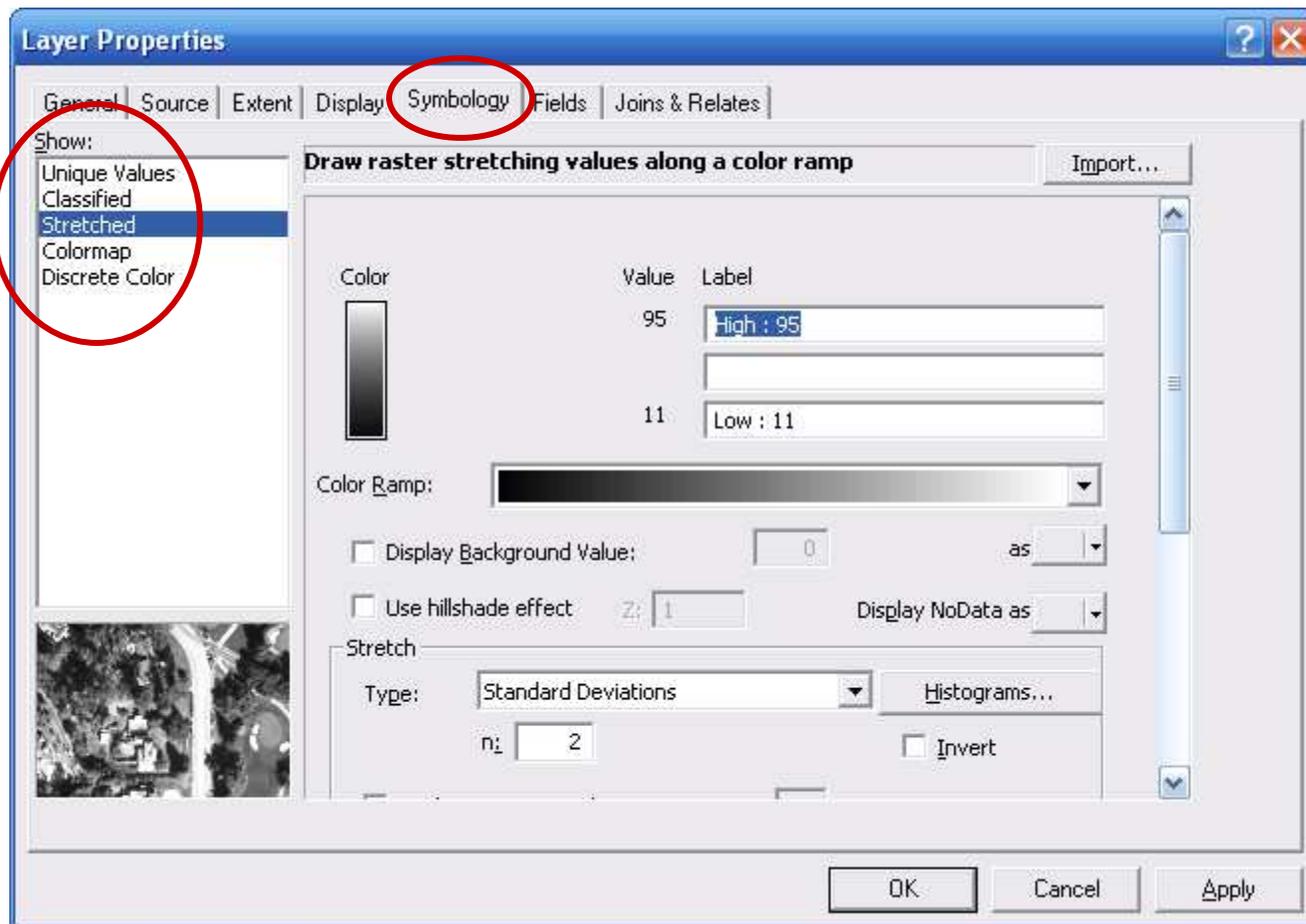


Image Symbology in ArcMap

✦ Symbology and Display tabs in image's Properties dialog

- Display resampling
- Contrast, Brightness, Transparency
- Stretching

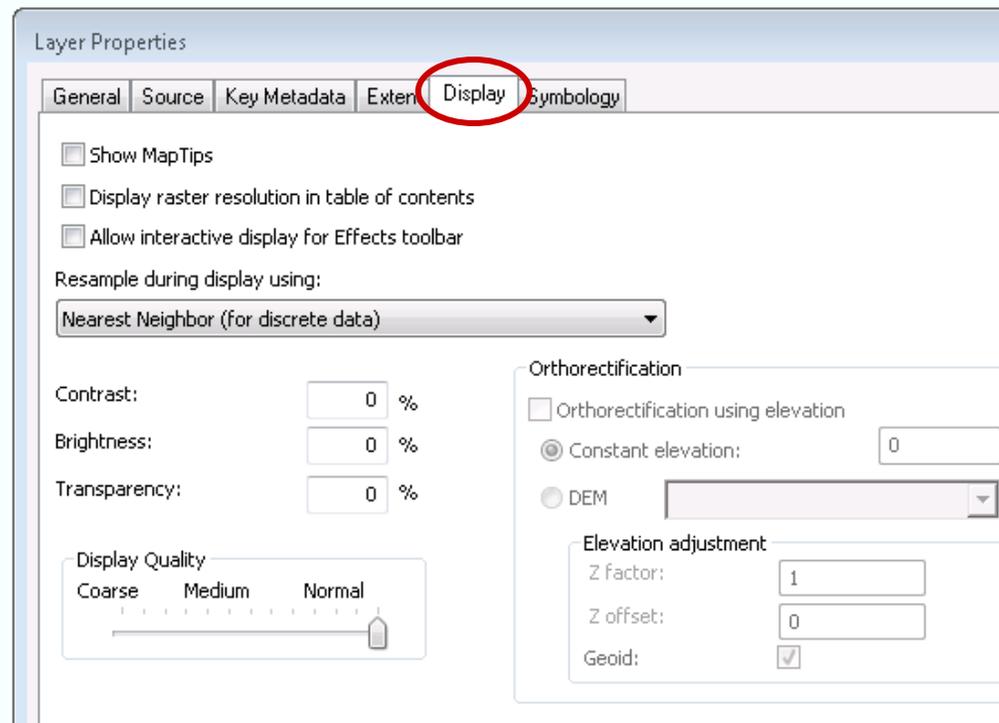


Image Symbology in ArcMap

✦ Effects toolbar in ArcMap



-  **Adjust Contrast**—Adjusts the contrast of the selected layer.
-  **Adjust Brightness**—Adjusts the brightness of the selected layer.
-  **Adjust Transparency**—Adjusts the selected layer's transparency.
-  **Adjust Dim Level**—Allows you to set a dim level for a map layer that enables other layers to take visual precedence. Dim is only available for basemap layers.
-  **Swipe Layer**—Allows you to use the swipe tool to interactively peel the selected layer back and see underneath it (Cool!!)
-  **Flicker Layer**—Allows you to have the layer blink off and on continuously. Enter the number of milliseconds (thousandths of a second) that define the flicker rate.

Image Symbology in ArcMap

- ✦ Image Analysis window:
Display section
 - Windows > Image Analysis

<http://desktop.arcgis.com/en/arcmap/latest/manage-data/raster-and-images/image-analysis-window-display-section.htm>

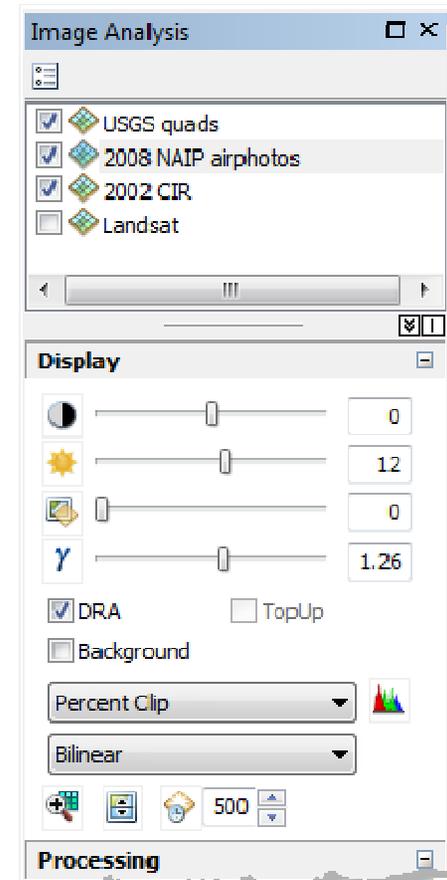
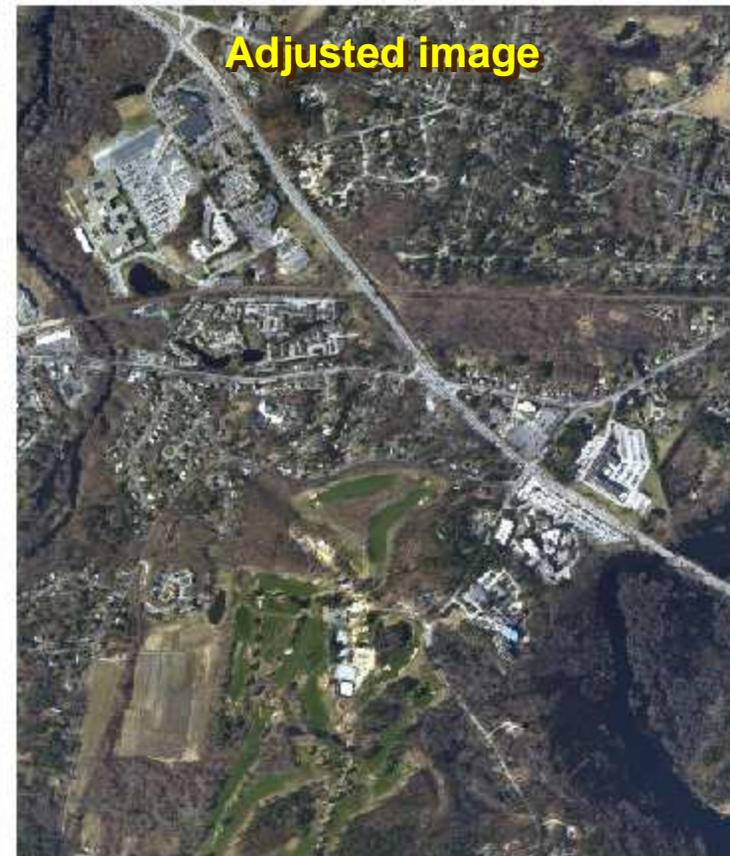
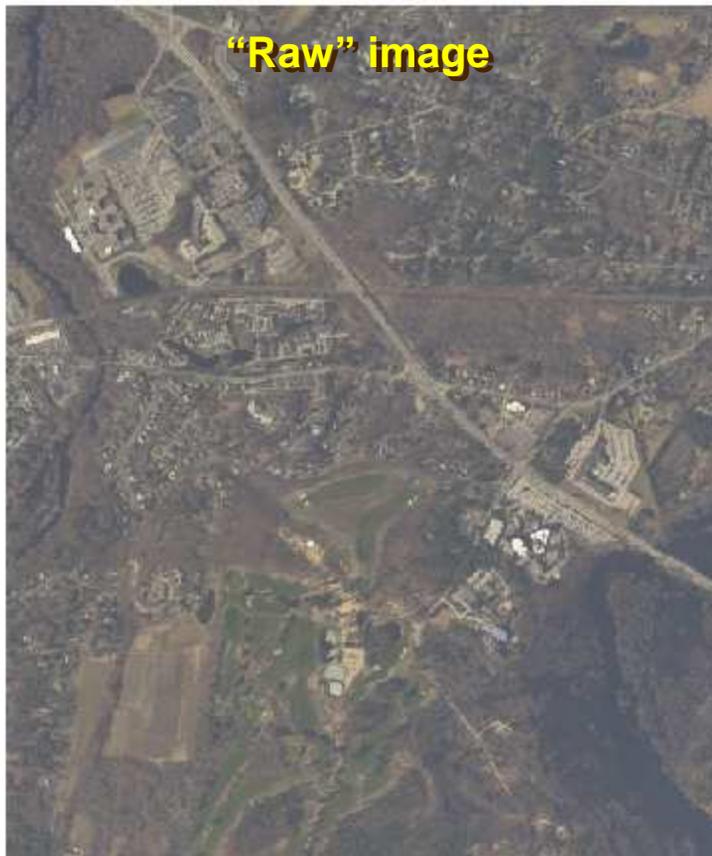


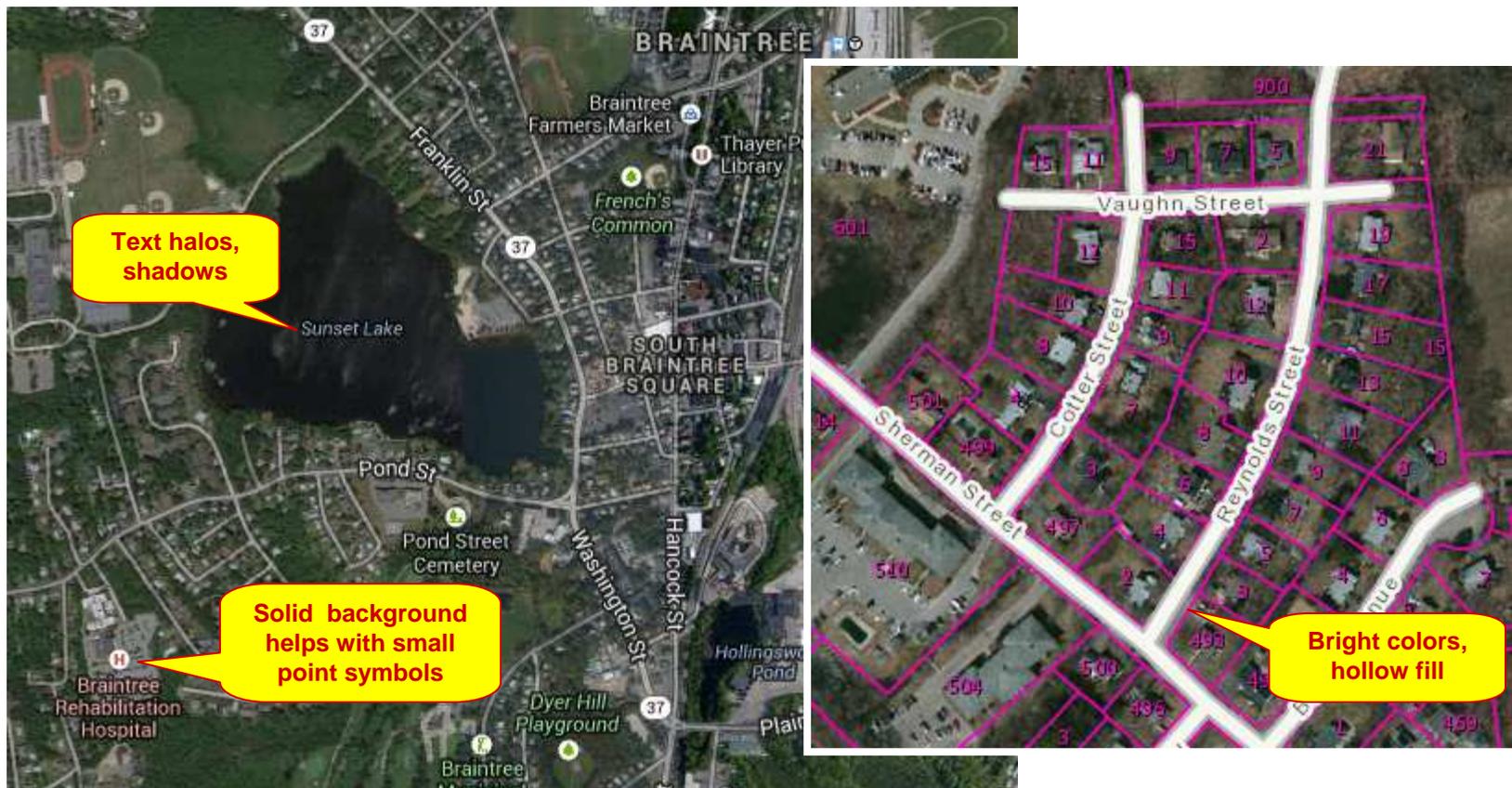
Image Symbology in ArcMap

- ✦ Improve image appearance by applying a stretch and adjusting brightness and contrast



Mapping with Imagery in ArcMap

- ✦ Display of vector layers, labels and graphics must be optimized so they stand out atop imagery.

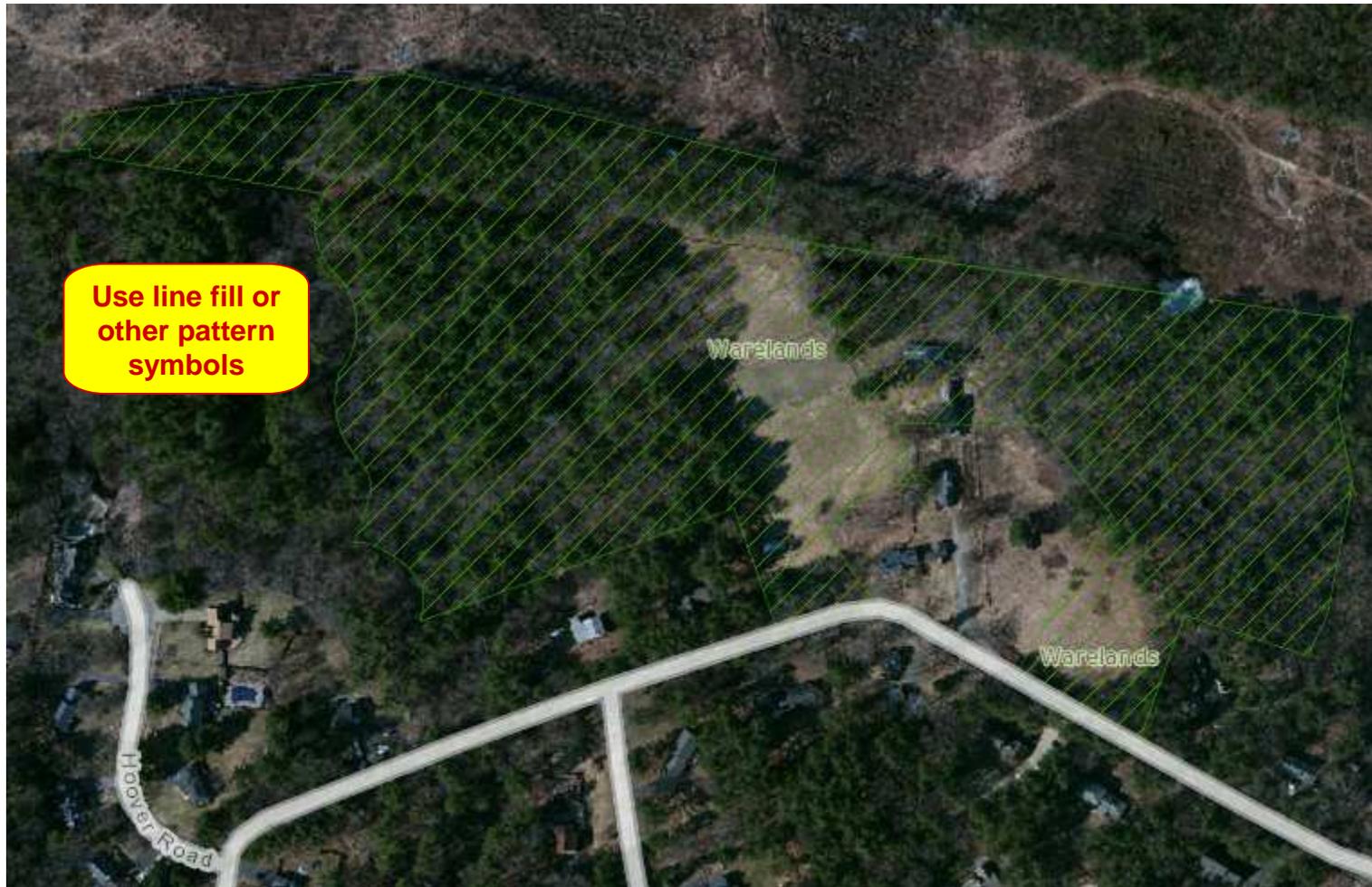


Mapping with Imagery in ArcMap

Set transparency
for vector
overlays

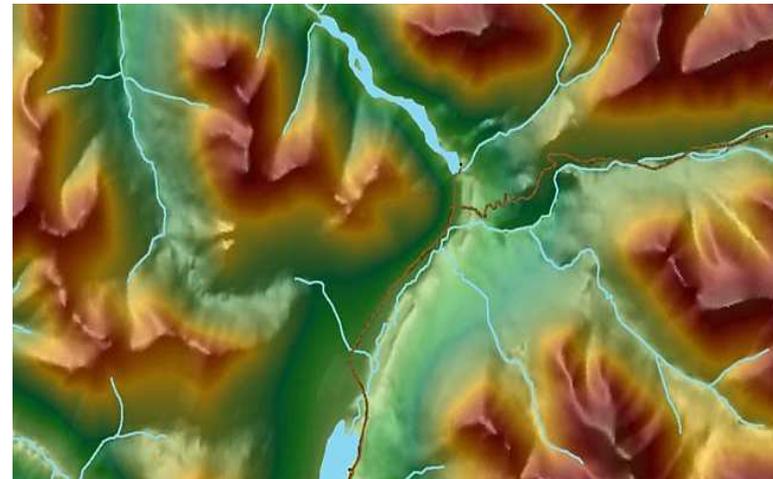


Mapping with Imagery in ArcMap



Brief Overview of Surfaces

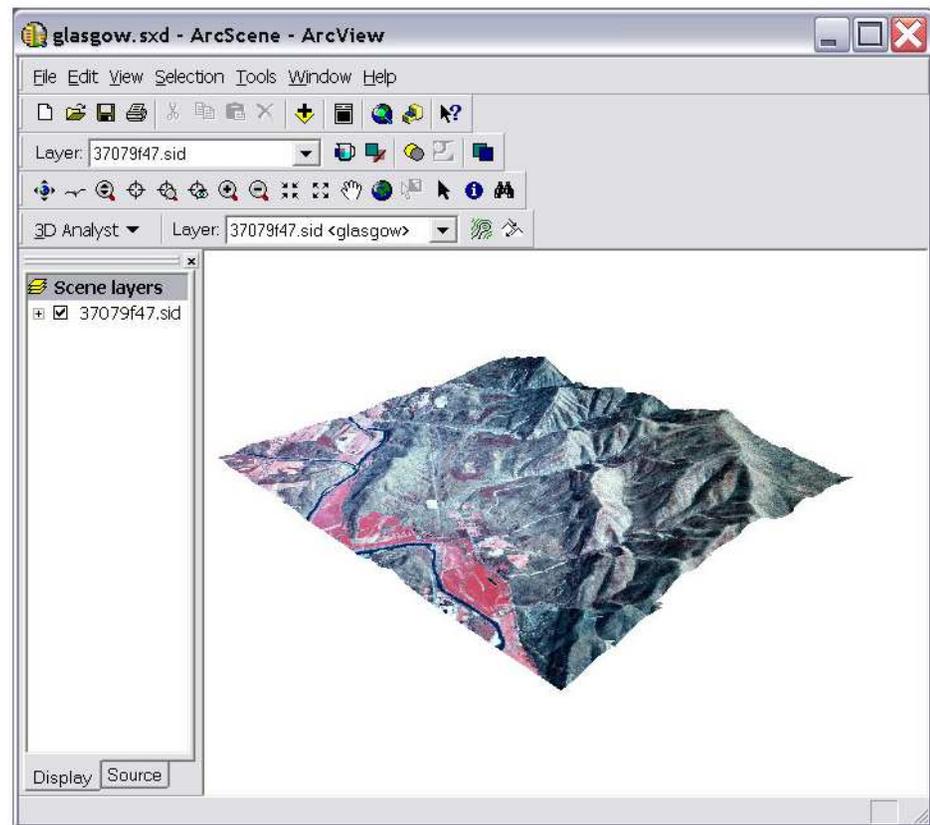
- ✦ A representation of a geographic feature or phenomenon that can be **measured continuously** across some part of the earth's surface (for example, elevation).
- ✦ A surface model is an approximation of a surface, **generalized** from sample data.
- ✦ Surface models are stored and displayed as **rasters, TINs, or terrains.**



Surfaces in ArcGIS

- ✦ Display in ArcMap (2-D) and ArcScene and ArcGlobe (3-D) (and ArcGIS Pro)
- ✦ Process with Spatial Analyst and 3-D Analyst tools

**Draped ortho
image atop a
surface**

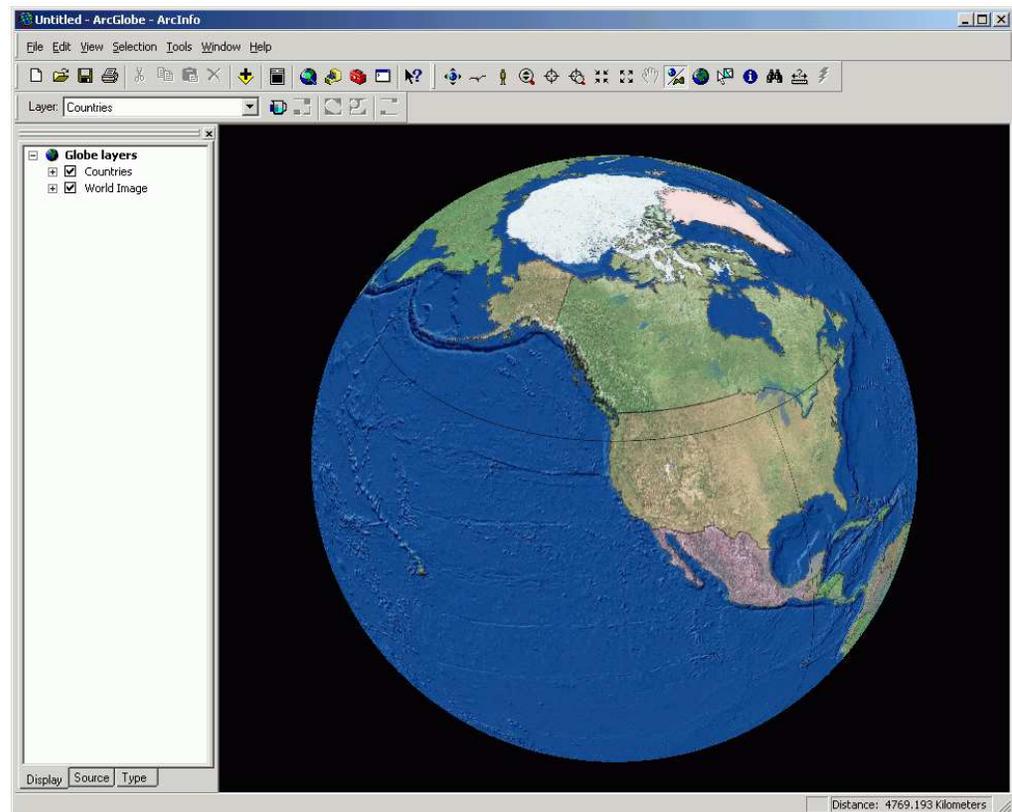


Brief Overview of 3-D Data

- ✦ A representation of a three-dimensional, real-world object in a map or scene, with elevation values (**z-values**) stored within the feature's geometry.
- ✦ Besides geometry, 3D features (e.g. 3D shapefiles, or “**multipatch**” features) may have attributes stored in a feature table.
- ✦ In applications such as CAD, 3D features are often referred to as **3D models**.

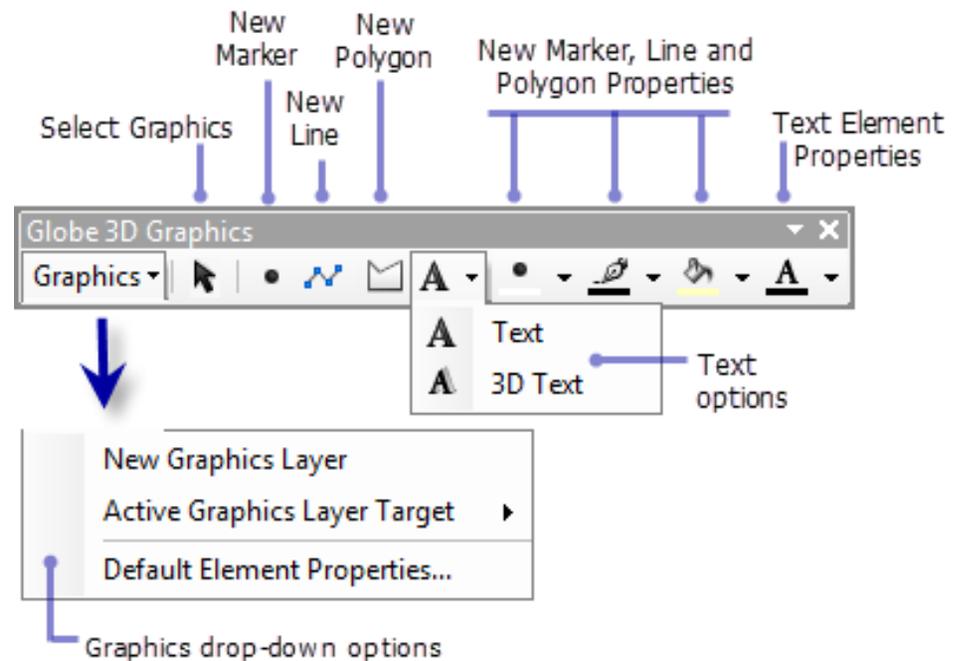
3-D Data in ArcGIS

- ✦ Display in ArcScene and ArcGlobe
- ✦ Process with 3D Analyst tools



3-D Graphics in ArcGIS

- ✦ Use the Globe 3D Graphics toolbar in ArcGlobe



<http://desktop.arcgis.com/en/arcmap/latest/extensions/3d-analyst/displaying-3d-graphics-in-arcglobe.htm>

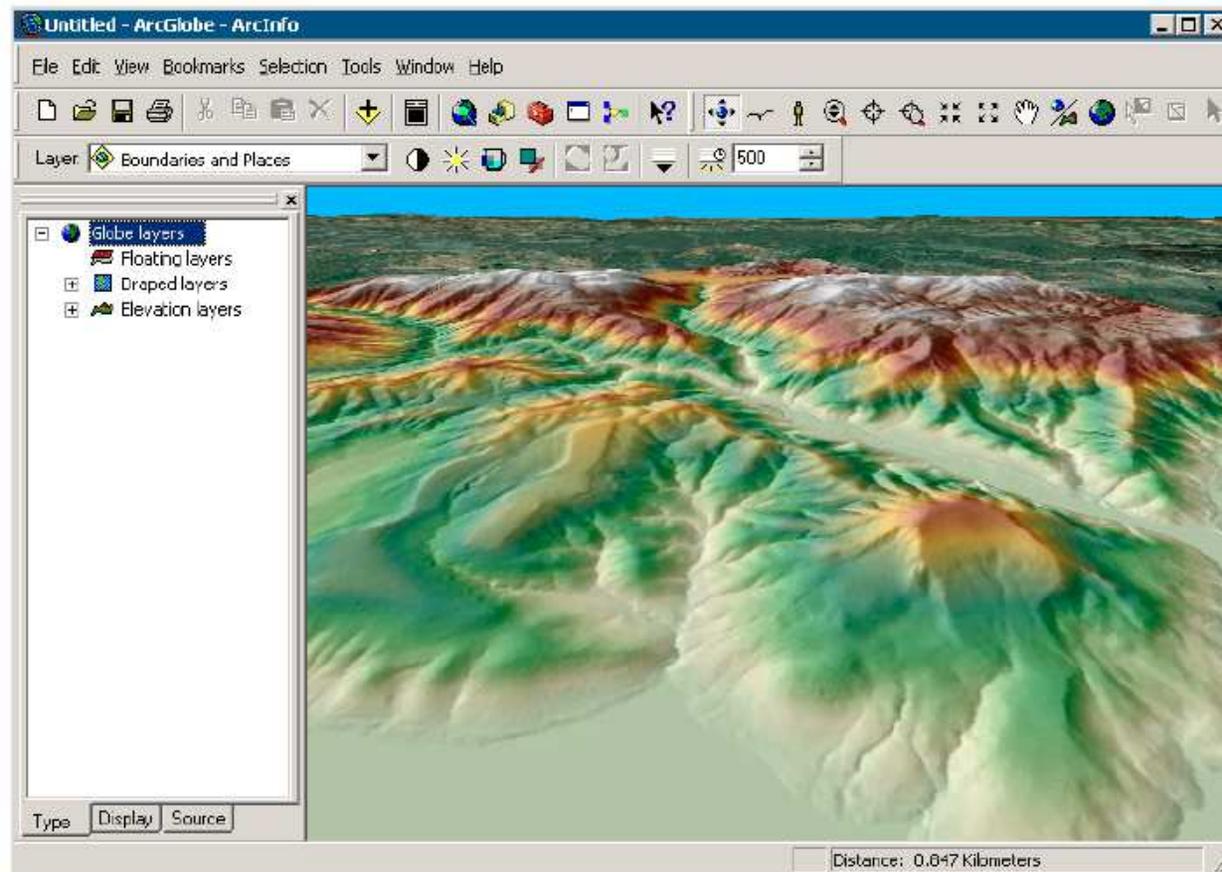
3-D Data in ArcGIS

- ✦ Extruded 3-D shapefiles (buildings)
 - Sometimes referred to as “2.5-D”



3-D Data in ArcGIS

✦ Multiple layers displayed in ArcGlobe



3-D Data in ArcGIS

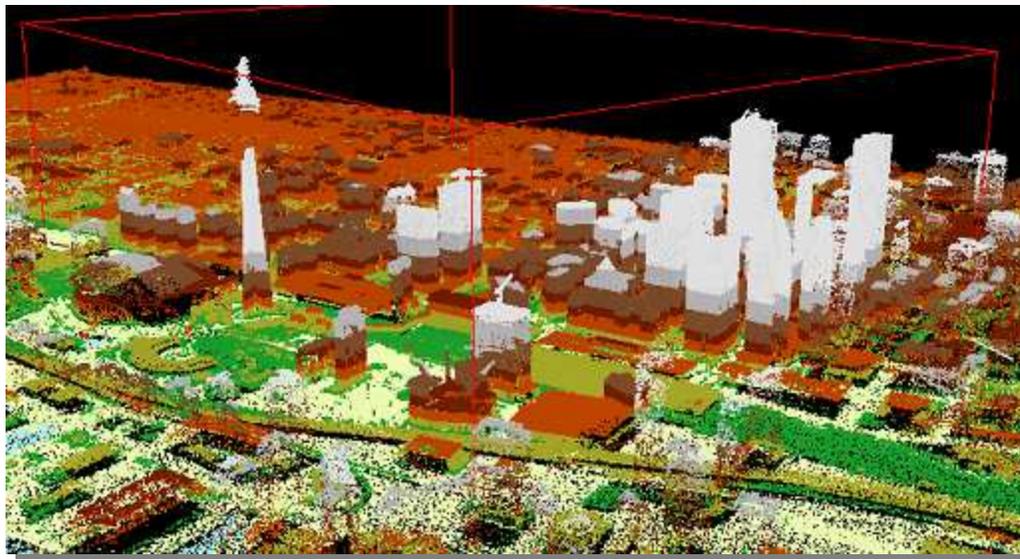
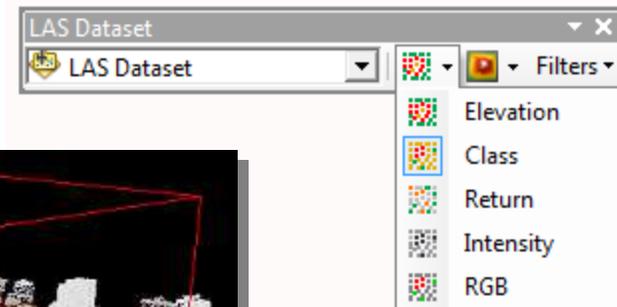
✦ 3-D shapes, in ArcScene



LiDAR Data in ArcGIS

✦ LAS Datasets

Light Detection And Ranging - a remote-sensing technique that uses laser light to densely sample the surface of the earth with x,y,z measurements

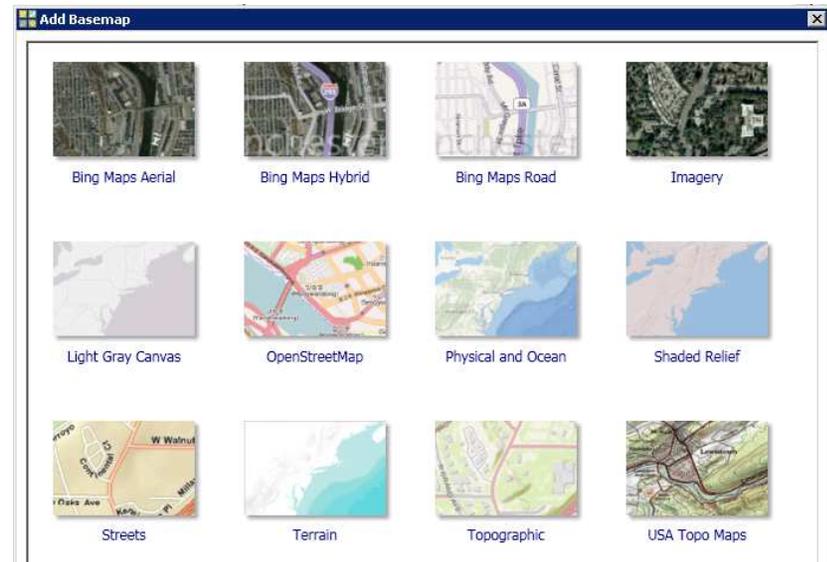
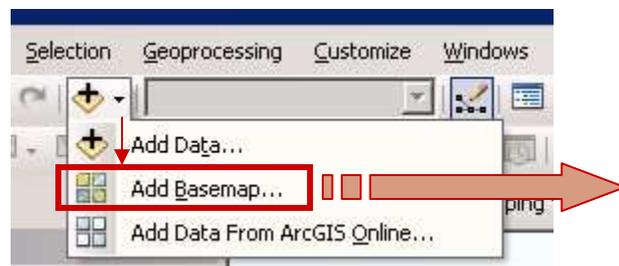


ArcGIS Online

- ✦ Web map services that display ready-to-use basemaps as images in ArcGIS (Desktop, Server, Explorer, Pro) or online

<http://www.arcgis.com/home/gallery.html>

<http://massgis.maps.arcgis.com>



ArcGIS Online

The image shows a screenshot of the ArcGIS Online web interface. At the top, there is a search bar and navigation links for 'Data' and 'Groups'. Below this, a 'Featured' section displays a grid of layer packages. A software menu is overlaid on the top right, with the 'Add Data From ArcGIS Online...' option highlighted in a red box. A red arrow points from this menu option to the 'Add' button on the 'USA Federal Lands' layer package. A yellow callout bubble points to this 'Add' button with the text 'Click 'Add' to add image service to ArcMap'. The 'USA Federal Lands' layer package includes a thumbnail map, a description, and links for 'Details' and 'Add'. Other layer packages visible include 'USA Counties', 'USA Population by Zip Code', 'USA Public Land Survey System (PLSS)', 'USA State Plane Zones', 'USA Zip Code Boundaries', 'West Virginia MapWV map', and 'World Administrative Divisions'.

ArcGIS Online

The screenshot shows the ArcGIS Online search interface. At the top, there is a search bar containing the text "massgis". A yellow callout box with a red arrow points to the search bar, labeled "Search". To the right of the search bar are links for "Data" and "Groups", and a "Sign in" button. Below the search bar, the results are displayed in a grid. The search term is "massgis" and the results are arranged by "Relevance". There are 31 results in total. The results are as follows:

- MassGIS Detailed Features**: Map Service by [afreeman_massgis](#), 9/26/2013. Includes "Details" and "Add" links.
- MassGIS Statewide Basemap**: Map Service by [afreeman_massgis](#), 9/26/2013. Includes "Details" and "Add" links.
- Digital Globe 2011-12 Ortho Image Base Map**: Map Service by [afreeman_massgis](#), 9/26/2013. Includes "Details" and "Add" links.
- Structures**: Map Service by [afreeman_massgis](#), 9/26/2013. Includes "Details" and "Add" links.
- Tax Parcels**: Map Service by [afreeman_massgis](#), 9/26/2013. Includes "Details" and "Add" links.
- Massachusetts Town Boundaries**: Map Service by [afreeman_massgis](#), 10/18/2013. Includes "Details" and "Add" links.
- MassGis Ortho 0809**
- Massachusetts Data from MassGIS (GeoServe)**

Esri CityEngine

- ✦ Licensed product with user interface and workflow to transform 2D GIS data into “smart 3D city models”.
- ✦ CityEngine 3D Web Viewer to present 3D city scenes online (examples at <http://www.arcgis.com/home/group.html?id=d731c2294ded45f6a1ad37ef5f87cd6d>).



<http://www.esri.com/software/cityengine>

Resources

✦ ArcGIS 10 Help raster topics

- What is raster data?
- <http://desktop.arcgis.com/en/arcmap/latest/manage-data/raster-and-images/what-is-raster-data.htm>
- Essential raster data vocabulary
- <http://desktop.arcgis.com/en/arcmap/latest/manage-data/raster-and-images/essential-raster-data-vocabulary.htm>

✦ Imagery and 3D in ArcGIS Pro

- <http://desktop.arcgis.com/en/imagery/>
- <http://desktop.arcgis.com/en/3d/>

✦ Map Practical: Cartography Tools

- <http://mappractical.blogspot.com/2010/01/cartography-tools.html>