Presentation Overview

- ArcGIS raster data models
- Which model to use
- Mosaic dataset storage and properties
- Build a mosaic dataset
- Migrate to mosaic datasets

- Q&A

Please fill out the evaluation forms before you leave the session
Imagery Management Challenges

- Many sources
  - Aerial photographs
  - Satellite imagery from many sensors
  - DEM and scanned maps
  - Analytical data, pictures
- High resolution and large volume

- Requirements:
  - Store efficiently
  - Easy to search
  - Fast to process
  - Accessible
Evolution of Raster Data Models in ArcGIS

- **Raster dataset (8.0)**
  - A single image

- **Raster catalog (9.0)**
  - A collection of raster datasets
  - Members can be accessed
  - Managed/unmanaged

- **Raster attribute (9.0)**
  - A table or feature class field containing picture attributes

- **Mosaic dataset (10.0)**
  - Enhanced raster catalog with mosaic view and on the fly processing capability
  - Managing and serving a collection of images
Image Management Recommendations in ArcGIS 10

- Manage individual images using raster datasets
- Manage image collections using new mosaic datasets
- Manage pictures/raster attributes using raster field in table or feature class
Image Management Recommendations in ArcGIS 10

- Manage individual images using **raster datasets**
- Manage image collections using **mosaic datasets**
- Manage pictures/raster attributes using raster field in table or feature class
  - **Adding raster datasets as attributes in a feature class**
Raster Datasets - Formats

• Many file formats
  - TIFF, GRID, Mrsid, JP2000, JPEG, NITF, CADRG, etc
  - Geodatabases

• Improved the raster format support
  - Support for BigTIFF in ArcGIS 10 (new)
  - Compressed TIFF with LZW/JPEG/PackBits/CCITT/RLE (new)

• Support for custom raster formats (improved)
  - Resources.arcgis.com image management code gallery
**Raster Datasets - Properties**

- **Pyramids**
  - Reduced resolution copies of the source
  - Improve display performance
  - Support three resample methods
  - Can be compressed *(new)*
  - Set in GeoProcessing environment

- **Statistics**
  - Enhance visual display

- **Build Pyramids and Statistics tool *(new)*

Unstretched: Min: 24
Max: 241

Stretched: Min: 0
Max: 255

Factor of 2

Resample methods:
- Nearest neighbor
- Bilinear interpolation
- Cubic convolution
Raster Datasets – Recommendations

• Use it “as is”
  - Especially for compressed formats

• Better performance
  - Convert to tiled TIFF using the CopyRaster tool
  - JPEG compressed TIFF if lossy compression is allowed

  - File Geodatabase raster dataset is also a comparable format
Demo: Raster Data Models

Raster datasets

Raster catalogs

Mosaic datasets
Managing Imagery Collections

- Solution in 9.3 is raster catalog
  - image service definition

- Solution in 10 is mosaic dataset
Raster Catalogs

- A data model for managing a collection of images in 9.3
  - Stores footprints and rasters in a table
  - Managed/unmanaged
- Uses
  - Catalog images and maintain overlaps
  - Search based on attributes and location
  - Access selected members
  - Display footprint/pixel view
- Limitations
  - Do not support sensor data and metadata
  - No overview
  - Can’t be served by ArcGIS server
ArcGIS Image Server

• A way of serving a collection of images in 9.3
  - Image service definition
  - Shape file to store footprints
  - Reference images on disk

• Uses
  - Serve a seamless image mosaic
  - On-the-fly mosaicking and image processing
  - Sensor data and metadata data

• Limitations
  - Limit to 2 million records
  - Does not support LINIX
  - Have to manage two servers
  - Different customization pattern
Mosaic Datasets - New Geodatabase Data Model

- Manage and serve collection of images
  - Supported in SDE/FGDB/PGDB
  - Does not load source pixels into geodatabase, instead references imagery

- Manage data with an internal raster catalog

- Displays like a raster dataset

- On-the-fly image processing
Mosaic Datasets - Advantages

- **Processing Time**
  - Reduces processing

- **Storage**
  - Eliminates redundancy

- **Scalable**
  - Catalog large image collections

- **Sensor support**
  - Support multiple sensors

- **Preserves information**
  - Overlapping Imagery

- **Maintenance**
  - Streamlines image updates

- **Image Quality**
  - Reduces resampling

- **Seamless Display**
  - at all scales

- **Metadata**
  - Maintains valuable information

- **Disparate Datasets**
  - Manages large NoData areas
Data Management Recommendations

- Use your existing data model if they continue to meet your existing application requirements
- Use the mosaic dataset for new applications
- Migrate to the mosaic dataset to take advantages of its new features
Mosaic Dataset – Usage

• A composite layer of
  - Boundary/Footprint/Image

• Use as a catalog
  - Search images
  - View metadata
  - Add selected images to Map
  - Time aware

• Use as a raster dataset
  - Display like a raster layer
  - Export a raster dataset
  - Use as an input to geoprocessing tool

• Serve as an image service
Mosaic Dataset – Mosaic Rules

- Control which raster/pixels to display

- Mosaic method to sort the rasters
  - Closest to center (default)
  - By attribute
  - Closest to nadir
  - North west
  - Seamline

- Mosaic operator to resolve the overlaps
  - First/Min/Max/Mean/Blend

Closest to the center

By attribute: cloud cover
Demo: Using Mosaic Datasets
Mosaic Dataset Storage Schema

- Stored as a set of internal geodatabase tables
- Some can be modified through user interface
  - DO NOT modify using database SQL statements

<table>
<thead>
<tr>
<th>Name</th>
<th>Purpose</th>
<th>Viewable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catalog</td>
<td>A raster catalog that stores function rasters and the footprints</td>
<td>Yes</td>
</tr>
<tr>
<td>Boundary</td>
<td>A feature class that defines the mosaic dataset boundary</td>
<td>Yes</td>
</tr>
<tr>
<td>Seamline</td>
<td>A feature class that maintains the seamlines for advanced mosaicking operations</td>
<td>Yes</td>
</tr>
<tr>
<td>Raster Type</td>
<td>A table holding each raster type instance</td>
<td>Yes</td>
</tr>
<tr>
<td>Log</td>
<td>A table that logs operations that have been performed</td>
<td>Yes</td>
</tr>
<tr>
<td>Overview</td>
<td>A table that stores references to the overview rasters</td>
<td>No</td>
</tr>
<tr>
<td>Cell size level</td>
<td>A feature class with cell size levels for overview generation</td>
<td>No</td>
</tr>
<tr>
<td>Stereo</td>
<td>A table that stores the stereo pair</td>
<td>No</td>
</tr>
<tr>
<td>Color correction</td>
<td>A table of derived rasters for color correction</td>
<td>No</td>
</tr>
</tbody>
</table>
### Mosaic Dataset Storage – Catalog Table

<table>
<thead>
<tr>
<th>OID</th>
<th>Shape</th>
<th>Raster</th>
<th>Name</th>
<th>LowPS</th>
<th>HighPS</th>
<th>MinPS</th>
<th>MaxP</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Polygon</td>
<td>&lt;Raster&gt;</td>
<td>P01.met</td>
<td>10</td>
<td>30</td>
<td>0</td>
<td>90</td>
<td>Primary</td>
</tr>
<tr>
<td>2</td>
<td>Polygon</td>
<td>&lt;Raster&gt;</td>
<td>P02.met</td>
<td>10</td>
<td>30</td>
<td>0</td>
<td>90</td>
<td>Primary</td>
</tr>
<tr>
<td>5</td>
<td>Polygon</td>
<td>&lt;Raster&gt;</td>
<td>filename1.tif</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>270</td>
<td>Overviews</td>
</tr>
</tbody>
</table>

- **A special raster catalog**
  - Shape field stores the footprints
  - Raster field stores function raster datasets

- **Function raster datasets**
  - Contains functions and input of the functions
  - Defined by raster type and populated when rasters are added

- **MinPS and MaxPS define the visible ranges of the rasters**
Build a Mosaic Dataset

- Mosaic dataset toolset
- Automate with model and python

Typical workflow
- Create a mosaic dataset
- Add rasters
  - Calculate cell size range
  - Build boundary
- Build overviews (optional)
- Edit properties (optional)
Build a Mosaic Dataset - Create

• Create table schema and define pixel properties

• Spatial reference (required)
  - Used in footprints and overviews
  - Define a proper one
  - Datum consideration

• Number of bands
  - Taken from the first added raster

• Pixel type
  - Taken from the first added raster
Build a Mosaic Dataset – Add Rasters

- Use Add Rasters to Mosaic Dataset tool

- Choose a raster type
  - Define the format to crawl
  - Metadata to read and fields to create
  - Processes to apply

- Support many raster types
  - Raster Dataset/NITF/CADRG/etc.
  - QB/IKONOS/GeoEYE/WorldView/etc
    - Working with Sensor Image Data in ArcGIS
  - Web Services
  - Table/Image Service Definition
Build a Mosaic Dataset – Cell Size Ranges

- MinPS and MaxPS define the visibility of the rasters
- Use Calculate Cell Size Ranges tool
- Based on source and overlaps
- Default cell size range factor is 10

<table>
<thead>
<tr>
<th>OBJECTID</th>
<th>Raster</th>
<th>Name</th>
<th>MinPS</th>
<th>MaxPS</th>
<th>LowPS</th>
<th>HighPS</th>
<th>Category</th>
<th>Tag</th>
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<tbody>
<tr>
<td></td>
<td>&lt;Raster</td>
<td>Campus_08May2008</td>
<td>0</td>
<td>12.329262</td>
<td>0.616453</td>
<td>1.232926</td>
<td>1</td>
<td>Dataset</td>
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<tr>
<td></td>
<td>&lt;Raster</td>
<td>Campus_14May2008</td>
<td>0</td>
<td>11.338233</td>
<td>0.566912</td>
<td>1.133823</td>
<td>1</td>
<td>Dataset</td>
</tr>
</tbody>
</table>

- 30m visible range 0-300
- 5m visible range 0-50 → 5-30
- 1m visible range 0-5
Build a Mosaic Dataset - Boundary

- Define the boundary of the mosaic dataset
  - Pixels outside the boundary will be clipped

- Build using Build Boundary tool
  - Calculated based on footprints

- Can be modified using Editor

- Import using Import Mosaic Dataset Geometry tool
Build a Mosaic Dataset – Overviews

- Resampled rasters
  - Multiple levels
  - Multiple tiles for each level

- Seamless image display

Overview: 180m (range: 180-1800)
Overviews: 60m (range: 60-180)
Sources: 20m (range: 0-20)

PS=100
Build a Mosaic Dataset – Overviews (Cont…)

- Build Overviews tool
  - Generate overview images
- Define Overviews tool
  - Redefine the default parameters
- Optionally add an external raster as overview

Default overview parameters:
- TIFF format with JPEG
- Size is 5120x5120
- Factor of 3
- Overview location

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<th>MaxPS</th>
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<th>...</th>
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<td>&lt;Raster&gt;</td>
<td>P02.met</td>
<td>10</td>
<td>30</td>
<td>0</td>
<td>90</td>
<td>Primary</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Polygon</td>
<td>&lt;Raster&gt;</td>
<td>filename1.tif</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>900</td>
<td>Overviews</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Polygon</td>
<td>&lt;Raster&gt;</td>
<td>filename2.tif</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>900</td>
<td>Overviews</td>
<td></td>
</tr>
</tbody>
</table>
Building a Mosaic Dataset – Managing Background

• Footprint
  - Build Footprint tool
  - Edit using Editor
  - Import using Import Mosaic Dataset Geometry tool

• Define NoData
  - Set NoData based on a value
  - Set NoData based on a range
Building a Mosaic Dataset – Update

• Add new rasters
  - Use Add Raster tool
  - Use Synchronize Mosaic Dataset tool

• Remove Rasters
  - Use Remove Rasters from Mosaic Dataset tool

• Sources rasters are changed
  - Changes in geometric/metadata/etc.
  - Update with Synchronize Mosaic Dataset tool
Demo: Build Mosaic Datasets

- Build a mosaic dataset
- Automate using geoprocessing model
Mosaic Dataset – Advanced Mosaicking

- Color correction
  - Balance to a color surface
  - Balance to an existing target
  - Support excluded area
  - Color Correction window

- Seamline
  - Build Seamline tool
  - Modify seamline using Editor
  - Import seamline feature class
Mosaic Dataset – Editing Raster Functions

• Process image on-the-fly
  - Image enhancement
  - Orthorectification, Pan-sharpen
  - Shaded relief, hillshade, etc

• Add at mosaic dataset level
• Add at raster level
  - Apply to the raster
Moving a Mosaic Dataset

• Move all
  - Copy/paste the mosaic dataset
  - Copy the source and overview images
  - Use Repair dialog to repair the paths

• Extract a portion
  - Create a target FGDB in a new folder
  - Use Distributed Geodatabase toolbar
  - Copy/move the whole folder
  - Mosaic dataset is ready
    - No need to run the Repair tool
Reference Mosaic Dataset

• References an external mosaic dataset or raster catalog
  - Supported in GDB and file (.amd)
  - Catalog table is not editable

• Created by specifying
  - Definition query
  - Area of interest

• Provides multiple views of the source mosaic dataset
• Prevents editing of the source mosaic dataset

Boundary = My County
Where Sensor = Landsat
and Cloud <10%
Add NDVI processing

Where Sensor = Landsat
and Cloud <10%

Add NDVI processing
Image Management Patterns

- Create mosaic datasets with data of similar type
  - Elevation
  - Ortho images of same date
  - Imagery with similar sensor, number of bands, and bit depth
    - QuickBird/IKONOS
    - Landsat 5 or 7

- Create referenced mosaic datasets to publish
Publishing Raster Data

- Raster dataset and mosaic dataset can be published as image services
- Image services from the mosaic dataset
  - Can be accessed as an image and a catalog
  - Support selection and definition query
  - Downloading
  - Time aware
- Image services from raster datasets have only mosaic view

- For further information, attend the workshop:
  - Working with ArcGIS Server Image Services
Migrating to Mosaic Datasets

- From image service definitions

<table>
<thead>
<tr>
<th>Image service Definitions</th>
<th>Mosaic dataset</th>
</tr>
</thead>
<tbody>
<tr>
<td>\Amberg.ISDef</td>
<td>Mosaic dataset</td>
</tr>
<tr>
<td>ImageService.ISDef</td>
<td>Mosaic dataset</td>
</tr>
<tr>
<td>Footprint.dbf</td>
<td>Footprint feature class</td>
</tr>
<tr>
<td>Boundary.dbf</td>
<td>Boundary feature class</td>
</tr>
<tr>
<td>Seamline.dbf</td>
<td>Seamline feature class</td>
</tr>
<tr>
<td>\RPDefs\rasteris.RPDefs</td>
<td>Function raster datasets</td>
</tr>
</tbody>
</table>

- Workflow
  - Create a mosaic dataset
  - Use Image Service Definition raster type
  - Add the ISDef file
  - Raster Process Definition raster type

- From a raster catalog
  - Create a mosaic dataset
  - Use Table type to add
  - Raster datasets are re-added as function raster datasets
Licensing

- **Mosaic Dataset**
  - View: ArcView license
  - Create / edit: ArcInfo/ArcEditor license
  - Serve: ArcGIS server + **Image extension license**

- **Raster Dataset**
  - View: ArcView license
  - Create / edit: ArcInfo/ArcEditor license
  - Serve: ArcGIS server
Summary

• Use raster dataset to manage individual images

• Use mosaic dataset for image collections
  - Mosaic dataset schema
  - Mosaic dataset usage
  - Build a mosaic dataset
  - Migrate to mosaic datasets
**Raster Product Sessions**

<table>
<thead>
<tr>
<th>Session</th>
<th>Tuesday</th>
<th>Wednesday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using Imagery and Raster Data</td>
<td>8:30 AM – 6D</td>
<td>1:30 PM – 6D</td>
</tr>
<tr>
<td>Managing Imagery and Raster Data</td>
<td>10:15 AM – 6D</td>
<td>3:15 PM – 6D</td>
</tr>
<tr>
<td>What's New in Imagery and Raster at ArcGIS 10</td>
<td>12:00 PM – 6D</td>
<td>12:00 PM – 6D</td>
</tr>
<tr>
<td>Building Web Applications for Image Services</td>
<td>11:00 AM</td>
<td></td>
</tr>
<tr>
<td>Georeferencing Raster Data</td>
<td>1:00 PM GDB Island</td>
<td></td>
</tr>
<tr>
<td>Creating Mosaic Datasets</td>
<td>11:00 AM GDB Island</td>
<td></td>
</tr>
<tr>
<td>Using the Image Analysis Window</td>
<td></td>
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</table>
## Imagery @ UC 2010

<table>
<thead>
<tr>
<th></th>
<th>Omni Ballroom A/B</th>
<th>Exhibit Hall and Demo Theaters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tuesday</strong></td>
<td>Imagery Plenary</td>
<td>GeoEye</td>
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<tr>
<td></td>
<td>Keynote speakers</td>
<td>PCI Geomatics</td>
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<tr>
<td></td>
<td>Imagery Highlights</td>
<td>Ricoh</td>
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<td></td>
<td>Case Studies</td>
<td>ESRI Canada</td>
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<tr>
<td><strong>Wednesday</strong></td>
<td>Moderated Paper Sessions</td>
<td>Valtus</td>
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<td>Industry Panel Discussions</td>
<td>Earthmine</td>
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<td>Special Interest Group Meeting</td>
<td>i-cubed</td>
</tr>
<tr>
<td></td>
<td>Imagery Social (Ballroom C)</td>
<td>ITT VIS</td>
</tr>
</tbody>
</table>
Evaluations

Please fill out the evaluation forms…

Your comments help us meet your conference needs each year.

THANK YOU VERY MUCH FOR ATTENDING!
Questions?

Additional resources:
Desktop/Online Help
Imagery section at resources.arcgis.com