ArcGIS is a Comprehensive Imagery Platform

Imagery is integral to the ArcGIS Platform

System of Insight
Extract Information from Imagery

Professional Imagery & Geospatial Analysts

System of Record
Manage and process all your imagery

System of Engagement
Share imagery products and information to those that need it
Manage and Serve Imagery from a Wide Range of Sensors

ArcGIS Integrates imagery from multiple sources

Satellite
UAS (Drone)
Aerial
Lidar
Multi-Spectral
Radar
Thermal
Panchromatic
Full Motion Video (FMV)
Professional Imagery / Geospatial Analysts
Server
What is Image Management?

- Provide Image Accessibility:
  - Easy
  - Fast
  - Full information content

- Manage Multiple Sources:
  - Sensors
  - Format, Types, Bands, Bits, ..

- Create and Serve Multiple Image Products:
  - Natural Color, NDVI, ..
  - Elevation, Hillshade, Slope, ..
ArcGIS Manages Massive Image Collections
Providing Accessibility to all Forms of Imagery and Rasters

Wide Range of Sensors & Sources:
- Satellite, Aerial, Scanned, Processed
- Nadir, Oblique, FMV, Lidar, Radar
- Pan, Multispectral, Float, Categorical

Levels of Imagery:
- Static Cache (Backdrop)
- Preprocessed (GIS Ready)
- Raw (Unprocessed)
Image Management Workflow Using Mosaic Datasets
Highly Scalable, From Small to Massive Volumes of Imagery

Create Catalog of Imagery
- Reference Sources
- Ingest & Define Metadata
- Define Processing to be Applied

Apply:
- On-the-fly Processing
- Dynamic Mosaicking

Access as Image or Catalog
Serving Imagery
Making Imagery Fully Accessible

- **Serve as Image Services**
  - Rich web access to all apps
- **Register With ArcGIS Online**
  - Massive Accessibility
  - Content Management
Caching Imagery
Create Highly Scalable Basemaps

- Use Desktop to convert to Tile Cache
  - Load to ArcGIS Online
- User Server to convert to Tile Cache
  - Persisted or OnDemand
Mosaic Dataset Uses:

- **Collection of similar images for use in desktop**
  - Working with collections of imagery

- **Source for Image Service to serve to:**
  - Desktop, Web and Mobile Apps

- **Source for creating tile cache**
  - Generate tile cache to serve through Server or ArcGIS Online

- **Future for collections in Raster Analytics**
Mosaic Dataset Concept

- Catalog of rasters
  - Defined in Geodatabase (File or Enterprise)
- References sources
- Defines metadata of source
- Defines processing to be applied when accessed

A Mosaic dataset should contain similar imagery
- Natural Color, RGB vs Multispectral vs Elevation vs Multidimensional
- Not mix say elevation and multispectral in single mosaic dataset
- Can mix different:
  - Projections
  - PixelSize
  - Processing levels (eg Orthorectified + On-The-Fly Orthorectified)
Representation of a Mosaic Dataset

- **Group Layer**
  - Boundary
  - Seamline (optional)
  - Footprint
    - Catalog of Rasters, Attribute table, Properties
  - Image
Demo
Mosaic Dataset Coordinate System

- Coordinate system for the Mosaic Dataset
- Need only encompass all required data
- Used as coordinate system for
  - Footprints, Boundary, Overviews
  - Internal spatial search
  - Default if not defined as part of raster dataset
- Often ‘WGS1984 Web Mercator (auxiliary sphere)’ used
Footprint

- Geometry of raster
- Used to
  - Spatially Search
  - Optionally clip image
- Build Footprints
  - By Radiometry
  - By Geometry
- Is Editable
Boundary - Extents of All Imagery

- Optionally Clips Imagery
- Built from Footprints
- Simplification Options:
  - None
  - ConvexHull
  - Extent
- Is Editable
Table

- Attributes of each Raster
  - ObjID, Raster, Name,
  - MinPS, MaxPS, LowPS, HighPS
  - Category, Tag, GroupName, ProductName
  - CenterX, CenterY
  - ZOrder, SOrder
- Attributes of Sensor
- User Definable and Extendable
Raster Pyramids

- Provide Faster Access to Imagery at lower resolutions
- Typically Factor of 2x

Eg

<table>
<thead>
<tr>
<th>Resolution</th>
<th>0.5m</th>
<th>1m</th>
<th>2m</th>
<th>4m</th>
</tr>
</thead>
</table>

At pixel size of 1.3m the 1m level would be read
At pixel size of 0.6m the 0.5m level would be read
Pixel Sizes / Cell Sizes

- **LowPS, HighPS**
  - What (usable) pixels sizes exist in dataset
  - If values are different then pyramids exist

- **MinPS, MaxPS**
  - What sizes (scales) should be displayed
  - MinPS typically 0, if can zoom in to any scale
  - Use ‘Calculate Item Visibility’ to compute
  - Can often be defined (use calculate) to a specific value

- Scale = Pixel Size (m) * 96/0.0254
- Pixel Size (m) = Scale * 0.0254/96
Overviews

- Used for faster access at small scales over complete mosaic dataset
- Think of as Pyramid of the Mosaic Dataset
- They are optional:
  - If not created then blank at small scales
  - Use other low resolution imagery
- Use ‘Define Overview’ + ‘Build Overviews’ to create
- Created at Base value (pixel size)
  - factor 2x or 3x
Controlling Display Scales

LoPS = 0.5
HiPS = 4
MaxPS = 6
MinPS = 0
Controlling Display Scales

- 12m
- 6m
- 3m

MaxPS = 20
HiPS = 12
LoPS = 3
MinPS = 0

LoPS = 3
HiPS = 12
MaxPS = 20
Controlling Display Scales

- LoPS = 0.5
- HiPS = 4
- MaxPS = 6
- MinPS = 0

- LoPS = 3
- HiPS = 12
- MaxPS = 20
- MinPS = 0
Controlling Display Scales

- **LoPS = 0.5**
  - **HiPS = 4**
  - **MaxPS = 6**
  - **MinPS = 120 MaxPS = 120**
  - **MinPS = 180 MaxPS = 500**

- **LoPS = 2**
  - **HiPS = 12**
  - **MaxPS = 20**
  - **MinPS = 60 MaxPS = 60**
  - **MinPS = 60 MaxPS = 180**

- **LoPS = 6**
  - **HiPS = 30**
  - **MaxPS = 60**
  - **MinPS = 4 MaxPS = 60**
  - **MinPS = 60 MaxPS = 180**

- **LoPS = 20**
  - **HiPS = 120**
  - **MaxPS = 200**
  - **MinPS = 20 MaxPS = 200**
  - **MinPS = 60 MaxPS = 500**
Controlling What is Displayed

- **Rasters are Filtered by:**
  - Any Query Definition (including time)
    - Where Year > 1993 and Year < 2000
  - $\geq$ MinPS & $<$ MaxPS (Except when using Lock Raster)

- **Rasters Ordered by:**
  - ZOrder
    - 0 – Controlled by Mosaic Method
    - $>$0 – Force Back, $<$0 – Force Forward
  - CellSize Tolerance
  - Mosaic Method (For raster where ZOrder=0)
Mosaic Methods
Define Ordering of Images

- North-West
- Closest To Center
- Lock Raster
- By Attribute
  - Order Field
  - Order Base Value: 0
- Closest to Nadir
- Closest to Viewpoint
- Seamline
- None

By center
By Attribute (CloudCover)
Mosaic Dataset Properties

- Many properties, including:
  - Compression for transmission
  - Allowed Mosaic Method
  - Clip to footprints
  - Footprint may contain no data
Mosaic Dataset / Image Service Concept

• Dynamic Mosaicking

• On-The-Fly Processing
Raster Functions – Perform On-the-fly processing

- Refining Radiometry
  - Stretching Imagery, Atmospheric Correction
  - Band Extraction, Band Math
  - PanSharpen
  - ...

- Refining Geometry
  - Re-projections
  - Georeferencing (2D and 3D)
  - Clipping

- Applied on:
  - Each Item
  - Mosaic Data
  - By client (if serving as image service)
Demo
Support for Raster Formats & Raster Datasets

• TIF, NITF, FLT, JP2, MrSID, ECW, JPEG, …
  - Includes many different compressions: JPEG, LZ77, Deflate, JPEG2000, ….

• TIF recommended (in most cases)
  - Open Standard
  - Fast to Access
  - Enables multiple compression – For visual imagery use JPEG (YCbCr) compression
  - Supports >4GB (BigTIFF is supported in ArcGIS)

• Meta Data in Aux.xml
  - Extensible XML structure
  - Supported by GDAL

• Also consider using Tile Cache
Pyramids

- Faster access at smaller scales
- External `<.ovr> .rrd`
  - Separate side car files
  - Use Build Pyramids in ArcGIS
- Internal
  - Built in for some formats: JP2, MrSID, ECW
  - Optional in others: TIF, NITF
- Sampling methods:
  - Bilinear (average) – Use for continuous images
  - Nearest – Use for discrete rasters
- Generally generate pyramid for >3000 Cols
Stats & Other Metadata

- **Statistics** - for the complete Raster
  - Min, Max, Mean, StdDev, Histogram, Covariance for Multispectral
  - Use of Skip factor speeds up process
  - Generate Stats for:
    - None Processed or Elevation
    - Many datasets do Not Need stats
  - Best to Check NoData values, before generating

- **Other Metadata**
  - Stored as part of Raster Dataset or stored in Aux.XML
  - Metadata often available as tables (see table Raster type later)
Build Pyramids and Statistics

- Takes in Dataset or Workspace
- Parallel Processing
What can go into a Mosaic Dataset

- Pre-generated Orthoimage tiles - Collection of orthos
- Single Orthoimage mosaics – 1 large ortho per area
- High Res Satellite – Pleiades, WV3, Ikonos, …
- Medium Res Satellite – Landsat, SPOT, RapidEye, …
- Aerial Frames – UltraCam, RC30, …
- UAS Frames – From Drones
- Historical Aerial – Scanned Aerials
- Scanned maps – Scanned Topo, Eng. Drawings
- Categorical – Landuse, NLCD, …
- Scientific Data – NetCDF, HDR or GRIB of Temperature etc.
- Elevation grids – SRTM, DEMs, …
- Lidar – LAS files, LAS Datasets
- Bathymetric – Similar to Elevation but water subsurface
- Browse Imagery – Archive overviews
- Full Motion Video - (captured frames)
Raster Types

- Similar to ‘Raster Product’ but for many rasters
- Provided for Many Sensors
- Create derived products
- Ingest metadata
Ways to Create Mosaic Datasets

- Manually using Tools in ArcGIS for Desktop
  - Context Menu
  - ArcTool Box
- Using Model Builder
- Develop specialize python scripts
- Using Workflow Scripts
  - From Resource Center
  - Uses MDCS (Mosaic Dataset Configuration Scripts)
  - As Tool, Model or Batch
  - Configurable to define best practice
  - Can be extended
Resources: Image Management Workflows

- **ArcGIS Help**

- **Imagery Community**
  - [http://esriurl.com/6005](http://esriurl.com/6005)

- **Image Mgmt Workflows & FAQ**
  - [http://esriurl.com/ImageManagement](http://esriurl.com/ImageManagement)

- **Image Mgmt Guidebook (ArcGIS Help)**
  - [http://esriurl.com/6007](http://esriurl.com/6007)

- **ArcGIS Online Group**
  - [http://esriurl.com/6539](http://esriurl.com/6539)

- **Enterprise Image Management White Paper**
  - [http://esriurl.com/EIMWP](http://esriurl.com/EIMWP)
Demo
Scaling Mosaic Datasets

Source Data Collections → Source Mosaic Datasets → Derived Mosaic Datasets → Published Image Services

Optional Preprocessing
Questions ?
Questions?

Thank you…

- Please fill out the feedback section in your mobile app
- In Schedule, select [Managing Imagery and Raster Data Using Mosaic Datasets]
  Jun 30, 3:15 – 4:30 PM
- Answer a few short questions and enter any comments

Additional Resources

- ArcGIS Help
- Imagery Community:
  - http://esriurl.com/6005
- Image Mgmt Workflows & FAQ:
- Image Mgmt Guidebook (ArcGIS Help):
  - http://esriurl.com/6007
- ArcGIS Online Group:
  - http://esriurl.com/6539
- Enterprise Image Management White Paper:
  - http://esriurl.com/EIMWP