Imagery Management in ArcGIS:

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Imagery Management – Intermediate Level

• Who should be here?
  - Users that manage imagery in ArcGIS, or need to
  - Users familiar with ArcGIS’ imagery capabilities
  - Users that have a basic understanding of ArcGIS’ imagery terminology
  - Users that have are using imagery in one way and might want to use it in new ways
  - Users who are actively using imagery in ArcGIS and have questions
General Topics Outline

*Imagery management in ArcGIS*

- What does image management mean?
- How use affects imagery management
- Behavior and performance
- Managing imagery on a personal level
- Managing imagery for a group
- Large scale image management
Use implies management, so what are the uses of the imagery?

- User needs
  - Imagery visualization
  - Image processing
  - Derived product generation
  - Feature extraction
  - Observations
Data drives management

- Collection
- Modality
- Size
  - Images
  - collections
- Metadata
- Geometry
- Formats
Architecture can drive management choices

- Architecture considerations
  - Bandwidth
  - Services: Imagery, functionality
  - Storage models: Local, network, cloud
  - Process frameworks: GP vs. RF vs. RA
Scaling the use of imagery
What are my choices when working with imagery

- **One image at a time**
  - Files
  - Image Analysis Window (IAW) / Image Ribbon
  - Geoprocessing

- **Collections of images**
  - Mosaic Datasets
  - Image Analysis Window (IAW) / Image Ribbon
  - Geoprocessing

- **Imagery as a Service**
  - Web
  - Image Analysis Window (IAW) / Image Ribbon
  - Developer APIs / Web apps
  - ArcGIS Online / Portal
ArcGIS Imagery Information Model
design, concepts, and terminology
Underlying Design Principles
ArcGIS Imagery Information Model

- **Only process what you need, …when you need it**
  - Operate on the original source imagery – no preprocessing
  - Request-Based processing

- **Intelligent use of the metadata**
  - Virtual Products (e.g. NDVI on-the-fly)
  - Mensuration

- **Optimize storage requirements**
  - reference the imagery files - don’t move or make copies
  - derive many products from a single source and storage

- **Manage massive collections of imagery and make them easily accessible**
  - manage imagery in the enterprise (Mosaic Datasets)
  - web-enable imagery (Image Services, ArcGIS Online, Portal for ArcGIS, caching tools, …)
**Architectural Principles**

**ArcGIS Imagery Information Model**

- **An ArcGIS Information Model is…**
  - A data model + business logic
  - Stored in a Geodatabase (File, Enterprise, …)
  - Cross product (desktop, server, mobile, web,…)
  - Rich and robust
  - Accessible via Public APIs
Model Components
ArcGIS Imagery Information Model

• 6 Key Components
  - Raster Dataset
  - Raster Type
  - Raster Function
  - Raster Product
  - Mosaic Dataset
  - Image Service

• component names == terminology
  - “You web enable your imagery by publishing your Mosaic Dataset as an Image Service.”
The Raster Dataset is the primary information model component which represents a basic image with basic behavior.

It's role is to read and write image storage (pixels) and metadata.

Comprehensive Support:
- 1 or N Bands
- 1-64 bits per band
- compressed or uncompressed
- > 80 formats supported
- pyramids (rrd, ovr, internal…)

Read image files directly – no need to convert

“It’s what you get if you drag a GeoTIFF into ArcMap.”
Raster Type
ArcGIS Imagery Information Model

- The Raster Type is the primary information model component which represents the intelligent business logic for a particular sensor or image product coming from a vendor.

- It’s role is too...
  - Define pixel storage and metadata schema
  - Define the rules for ingesting imagery into ArcGIS
  - Define the default processing chains
  - Define the georeferencing (sensor model + parameters)

- Sensor and/or Format Specification specific

- 60+ Raster Types
  - Applanix
  - CADRG
  - ECRG
  - CIB
  - DMCii
  - DTED
  - Formosat-2
  - GeoEye-1
  - HRE
  - IKONOS
  - ISAT
  - Kompsat-2
  - Landsat 1-5 MSS
  - Landsat 1-5 TM
  - Landsat 7 ETM+
  - Landsat 8
  - LAS
  - NITF
  - Pleiades-1
  - Quickbird
  - RapidEye
  - Radarsat 2
  - SOCET (SUP)
  - SPOT 5
  - SPOT 6
  - WorldView-1
  - WorldView-2
  - WorldView-3
  - …
The Raster Function is the primary information model component which processes image data.

It’s role is to take input pixels and produce altered output pixels.

A Raster Function

- processes a single pixel or block of pixels (not the full image)
- can make geometric modifications to the pixels (orthorectify, project, clip,…)
- can make radiometric modifications to the pixels (band math, convolution filters, Tasseled Cap,…)

Raster Functions are chained together to create simple or advanced processing chains

- pixels that flow through the chain are virtual in nature (“on-the-fly” processing)

50+ Raster Functions
Raster Function
ArcGIS Imagery Information Model
Raster Function or Geoprocessing Tool?
ArcGIS Imagery Information Model

• Geoprocessing Tools
  - Esri does not implement what I need as a Raster Function
  - My processing requires integration of feature data (vectors)
  - I have complex GP Models (conditionals, iterations, custom script tools)
  - Algorithms which are not well suited for block level processing (cost distance)

• Raster Functions
  - If you can, you should (storage savings, time savings, flexibility to change,..)
  - Esri provides all the Raster Functions I need to produce my products
  - It’s acceptable in my application to use an ephemeral or intermediate results
    - Visualization
    - Analysis results which can be consumed per request based on an AOI
Raster Product
ArcGIS Imagery Information Model

- The Raster Product is the primary information model component which makes it easy to use intelligence which is provided by the Raster Type
- It's role is to represent Imagery Information Model intelligence as products and product information to the user
- A Raster Product
  - enables ArcGIS user interface shortcuts to well known band combinations and processing chains
  - allows the user to think about products and not files
- Sensor and/or Format Specification specific
  - they are based on Raster Type(s)
- ArcMap Catalog window / ArcCatalog
Mosaic Dataset
ArcGIS Imagery Information Model

- The Mosaic Dataset is the primary information model component which manages massive collections of imagery

- It’s role is to provide...
  - an image library for management (cataloging, indexing, metadata, searching, …)
  - dynamic, on-the-fly, product generation (mosaicking, processing and analysis)
  - a workflow to shorten the time from sensor to use (quickly ingest, dynamic product immediately available)

- Scalable (1 to millions of images)
- homogeneous or heterogeneous collections (one sensor or a mix)
- Dynamic product generation for visualization or analysis
Image Management Using Mosaic Datasets
An information model for managing large image and raster collections

- Create Mosaic Dataset
  - Reference Sources
  - Ingest & Define Metadata
  - Define Processing to be Applied
    - On-the-fly
    - Dynamic Mosaicking
    - Create Overviews
- Use directly in Desktop
- Serve as Image Service
  - Access from: Desktop, Web & Mobile Apps
  - Refine processing to be applied by Server
Image Service
ArcGIS Imagery Information Model

- The Image Service is the primary information model component which web enables imagery
- It’s role is to provide *Imagery as a Service* (one aspect of GIS as a Service)
ICS provides an undistorted view in natural orientation

Map on an Image…. vs. Image on a Map...

Processing, **Exploitation**, Dissemination

**Geographic Coordinate System** - GCS

**Image Coordinate System** - ICS
Processing, Exploitation, Dissemination
ArcGIS and Imagery

- Make basic to advanced products accessible in the enterprise and on the web

Mosaic Dataset

Image Service

Metadata
Pixels
Pictures
WMS
WCS
KML

APIs
- ArcObjects
- ArcGIS Runtime SDK
- SOAP
- REST

Apps
- Desktop
- Web
- Mobile
Processing, Exploitation, Dissemination

ArcGIS and Imagery

- Create multiple products from a single source without the additional storage resource costs
Putting it all together
Considerations and trades
Information Flow in an Image Service

Collection

Raster Types

Harvests Metadata

Imagery Native Form

Points to original Imagery

Mosaic Dataset

Raster Functions

Raster Products

Publishing

ArcGIS Server

Image Service

ArcGIS Desktop

Desktop

Web

Device
Making imagery “carpets”

- Building mosaic datasets and selecting imagery
- Processing
- Caching
Processing, Exploitation, Dissemination
ArcGIS and Imagery

- Process images to create new images (traditional image processing)
- Process images on-the-fly to create dynamic virtual products
- Process images to create tiled image maps
  - Georeferencing
  - Orthomapping
    - Orthorectification
    - Color Balancing
    - Seam line generation
  - Caching to tiles
- Geoprocessing tools
  - 95+ tools for image management and processing
- Raster Functions
  - Can be applied to Raster Datasets, Mosaic Datasets, and Image Services
Exploitation workgroup level example

- Shared LAN
- Shared access to imagery
- Revolving imagery store
Processing, Exploitation, Dissemination

ArcGIS and Imagery

- **Take advantage of ArcGIS ready-to-use imagery**
  - ArcGIS Online World Imagery Base Map, Landsat GLS, Landsat 8, NAIP
  - Consume Premium Services available by Partners on the ArcGIS Marketplace

- **Visualize images**
  - as a single image
  - as a dynamically mosaicked product

- **Extract feature data from imagery**
  - manually capture features using imagery as a backdrop
  - image classification
  - custom image processing with R2V and vector tools for cleanup

- **Take measurements (Mensuration Tools)**
Cloud based resources

- Storage
- Templates
- Elastic resources
Image Management Workflows

Best practices

- Best Practice Workflows for:
  - Orthophotos, High Res Satellite
  - Multispectral Satellite, Elevation Browse, Lidar, Aerial, Drone2Map
  - Historic Aerial, Oblique, Scientific

http://esriurl.com/ImageManagement

Image Management Group on ArcGIS Online
http://www.arcgis.com/home/group.html?id=b65f2601e0084e32afab3eb488fa8a67

- Support for storage in:
  - AWS (S3 + Elastic EC2)
  - Azure (Azure Blob Storage)
  (see OptimizeRasters on GitHub)
Summary
ArcGIS is an imagery platform for GIS

- Imagery is an integral aspect of GIS
- ArcGIS provides a rich set of imagery tools
- ArcGIS can manage massive image collections

- Spend time understanding the information model and technologies of ArcGIS
  - Reference Documentation, Resource Center, Blogs, Workshops, Webinars

- Outside the scope of this presentation…
  - Learn more about our Imagery Business Partners
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