Management, Access and Use of Imagery

Lawrie Jordan, Peter Becker
Maximizing the Value of Imagery

- **Providing imagery:**
  - Timely
    - Value is highest when new
  - Quickly
    - Fast display
  - Accurately
    - Correct location and metadata

- **Exploiting the rich information content:**
  - Resolution
    - Use full spatial content with maximum quality
  - Temporal change
    - Enable time control
  - Spectral range
    - Utilize multiple bands
  - Dynamic range
    - Utilize sensitivity for sensors
GIS and Imagery, Integrated and Accessible

- Actionable information and knowledge
- Unified geospatial workflows
Imagery is Core to a Complete GIS

- **Management**
  - All forms of geospatial data
    - Vector, Image, Maps, TIN, Networks, …
  - Image Data Management

- **Dissemination**
  - Accessibility to data, information and knowledge
    - Services, Sharing, Standards
  - Providing image accessibility

- **Visualization**
  - Interpretability and human understanding
  - Imagery display in many applications

- **Analysis**
  - Gain knowledge to make informed decisions
  - Extracting the information from imagery

ArcGIS is a Complete GIS Based Image System
Continued Innovation and Improvements

- V9.2 – Image Server
- V9.3 – Image Services & Image Extension
- V10 – Mosaic Dataset, Image Analyst Window
ArcGIS - For Image Data Management
Cataloging, Metadata and Processing

Wide Range of User Needs:

• **Work Station User**
  “What do I have? How can I easily work with it?”

• **Organizations with collections of existing imagery and rasters**
  “How do I serve all our orthoimages?”
  “How can I server my elevation data to multiple users”

• **Enterprises collecting new imagery**
  “How do I process and serve imagery that we acquire?”

Catalog all available imagery
Make it quickly accessible in the required form
Forms of Imagery and Rasters

- **Ortho Tiles**
  - Combines many image together
  - Single or Multiple images

- **Image Strips**
  - Ortho images along corridors
    - Pipelines, transmission lines, etc.

- **Processed Rasters**
  - Elevation Models
  - Analysis Results

- **Scenes**
  - From satellites
  - Georeferenced
  - Used for analysis

- **Sensor Images**
  - Raw / minimal pre-processing
  - Not georeferenced

**Simple Mgmt.**
- Primarily as Background
- Data is procured from a source

**Advanced Mgmt.**
- Primarily for Analysis or further processing
- Data is acquired

Each can exist in multiple formats
Image Data Management and Processing Methodologies

• Conventional
  – Image processing
  – Image mosaicking

• Dynamic Mosaicking & On-The-fly Processing
  – Catalog
  – Define processing
  – Process On-The-Fly
  – Dynamically Mosaic
Image Service Definitions - ArcGIS 9.3

- Authored using Image Service Definition Editor
- Required Image Extension to ArcGIS Server
- References original pixels as files or database
- Defined metadata, processing
- Defined as SHP + XML
- Compiled to ISCDef
- Served as Image Services
- Utilized own Service Provider
Mosaic Dataset – ArcGIS 10

Management of Small to Vast Collections of Imagery

- Catalog/Library of:
  - Imagery
  - Associated metadata
  - Processing functions to be applied
- Stored in GeoDatabase
- Massively Scalable
- References original pixels as files or database
- Define metadata, processing / functions

- Authored and Accessible directly in ArcGIS Desktop

- Automation using GeoProcessing Tools & ArcObjects

- Accessible as:
  - Image
    - Dynamically Mosaicked
    - Processed on the fly
  - Catalog
    - Table with geometry & metadata
Demo – Image Data Management
Dynamic Mosaicking
Mosaic Imagery On-demand

- Fuse of overlapping imagery from multiple sources
- User control of Image Order
  - By Date – ‘Latest’, ‘Closest to May 2001’
  - By Attribute – ‘Highest Sun Angle’
  - By Viewpoint – North, South, East, West
  - Seamline – Feathered blend
- User Query – ‘Landsat imagery, with no cloud, later than June 2001’
- By default users see best available imagery
Dynamic Mosaicking
Resolves Traditional Image Management Issues

- **Processing Time**: Reduces processing
- **Overlapping Imagery**: Maintain information
- **Disparate Datasets**: Handle large NoData areas
- **Image Quality**: Reduces resampling
- **Storage**: Reduces storage by removing redundancy
- **Multi-resolution Data**: No need to sample up or down
- **Maintenance**: Add imagery as required
- **Maintain Metadata**: Valuable information
On-The-Fly Processing
Create Multiple Products from a Single Source

- Define Processing functions as part of Mosaic Dataset
- Imagery Processed as Accessed

Processes
- Orthorectify
- PanSharpen
- Extract Bands
- Vegetation Index
- Classify
- Shaded Relief
- Crop to Footprint
- Enhance
- Color Correction
- ...

Utilize the image information content
On-The-Fly Processing
Resolves Issues with Traditional Image Processing

- Traditional Processing
- On-The-Fly Processing
- Resolves:
  - Processing time
  - Multiple intermediate products
  - Additional storage
  - Loss of information
  - Difficulty making changes or maintenance
  - High risk of delays
Patterns to Manage Imagery

*Generally want to minimize number of Mosaic Datasets*

- **Simple Collection**
  - Multiple Files
  - Format
  - Projections
Patterns to Manage Imagery

Generally want to minimize number of Mosaic Datasets

• Simple Collection

• Cascaded Mosaic

Consider each Mosaic as a Raster Dataset
Patterns to Manage Imagery

Generally want to minimize number of Mosaic Datasets

- **Simple Collection**

- **Cascaded Mosaic**

- **Multi-Source Collection**

Single Mosaic of many Sources
Patterns to Manage Imagery

Generally want to minimize number of Mosaic Datasets

- **Simple Collection**
- **Cascaded Mosaic**
- **Multi-Source Collection**
- **Merged Mosaics**

Mosaic of Mosaics, each managed separately
Reference Mosaics

- Mosaics derived from Mosaics
  - Additional processes
  - Queries
  - Properties
- Simplify derived product
- Reduces redundancy

Add NDVI Process

Where Sensor = QuickBird

Where Sensor = Landsat and Cloud <10% and Intersect with Spain
Dissemination
Providing Image Accessibility
Three Patterns for Image Access

Direct

Static

Dynamic

ArcGIS is unique in providing all three
Direct Access to Imagery

Traditional Workstation Access

- **Raster Datasets**
  - Nearly all image formats
    - TIF, IMG, NITF, JPEG2000, ...

- **Raster Types**
  - Common Imagery Sensors
    - QuickBird, Ikonos, SPOT, Aerial Frame, ...

- **Mosaic Dataset**
  - References to rasters, metadata and processing
Static Web Services

**Imagery Optimized for Web Delivery**

- **Map Cache**
  - Most scalable web delivery
  - Created and served using ArcGIS Server
  - Can utilize Mosaic Datasets as the source

- **Accessible**
  - ArcMap
  - ArcGIS Explorer
  - WebAPIs/Mashups

- **ArcGIS Online Provides**
  - World Imagery
  - Ikonos 1m 700+ metro. Areas
  - User submitted content

www.argisonline.com

*Imagery as a very fast background*
ArcGIS Image Services

*Extensive Web Based Image Functionality*

- Dynamic Image Service
  - User defined projection and rendering
- Directly from source raster dataset
- Changeable Compression
- Return image or pixel values

**Accessible**
- ArcMap
- ArcGIS Explorer
- WebAPIs (Silverlight, Flex, JavaScript)
- OCG WMS, WCS, KML
- 3rd Party Applications

*Imagery as Background & Analysis*
ArcGIS Server Image Extension
Serving Large Imagery Collections

• Serve Mosaic Dataset
• Image Services Accessible as:
  – Image
    • Dynamic Mosaicking
    • On-the-fly Processing
    • Identify
    • Export
  – Catalog
    • Query
    • Selection
    • Download, with clipping

Maximizing the Value of Imagery
Map Caching
*Imagery for optimized web delivery*

Use when expecting larger numbers of simple web

- Pre-Generated tiles optimized for web delivery
- Tiles can be web distributed
- Fastest most efficient and scalable form of image serving to the web
- Can only use as background image
- On Demand Caching
- V10 adds: Compact Cache and Mixed Mode

**Recommended Workflow:**
- Create Mosaic Dataset
- Serve image services to key users
- Create map cache for larger web community
- Maintain image services
- Update cache
Visualization

Visualize
ArcGIS - For Image Visualization
Better Interpretation and Understanding of Imagery

- Quick Access
- Improved Quality
- Fast / Accelerated Display
- Image Enhancement
- Multiple Applications
  - ArcGIS Desktop
  - ArcGIS Explorer
  - Web APIs
  - 3rd Party Applications
ArcGIS – For Image Analysis
Exploiting the Value of Imagery

- Search and Discovery
  - Simplified as part of use
  - Query for imagery
- Image Analysis Window
  - Enhancement
  - Interpretation
  - On-The-Fly Processing
- Image Classification Tools
  - Traditional Image Classification
ArcGIS – A Platform for Complete Imagery Solutions
Information Centric Workflows Enable Efficiency and Interoperability

- ESRI works closely with its Partners
- ArcGIS provides a platform
- Partners provide domain expertise

- Automated Feature Extraction
- Multispectral Analysis
- Hyperspectral Analysis
- Radar
- Specialized Sensor Support
- Stereo Display
- ...

DigitalGlobe
GeoEye
Trimble (Applanix)
SPOT
RapidEye
Microsoft (Vexcel)
Pictometry

i-cubed
PCI Geomatics
Trimble (Inpho)
MDA Federal

ITT VIS
BAE SYSTEMS
Overwatch

DAT/EM
PurVIEW
Qcoherent
Definiens
ArcGIS
The Platform for Fully Integrated GIS and Imagery

- Integrating Imagery as core to GIS
- Management, Dissemination, Visualization and Analysis
- Solution for wide range of user requirements
- Maximizes the value of imagery