Imagery in ArcGIS

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Sponsors
Themes for today’s presentation

- Overview of Imagery capabilities in the ArcGIS Platform
- Options and patterns for hosting and accessing your own imagery
- Remote Sensing data in the Living Atlas
- Other topics of interest and ways to learn
5 Key Imagery Capabilities of ArcGIS - Web and Desktop

Visualization & Exploitation

Content

Analysis

Management

Map Production
ArcGIS is a Comprehensive Imagery Platform
Empowering users to make informed decisions

System of Insight
Extract Information from Imagery

Professional Imagery & Geospatial Analysts
Content: ArcGIS Online Partners, Org

System of Engagement
Share imagery products and information to those that need it

System of Record
Manage and process all your imagery
Management:
Working with Imagery
What is a Mosaic Dataset?
The ArcGIS Imagery Information Model

- Catalog of
  - Imagery
  - Associated metadata
  - Processing to be applied
- Stored in Geodatabase
- Authored using ArcGIS for Desktop
- Enables
  - Dynamic Mosaicking (overlay)
  - On-the-fly processing
Image Management Using Mosaic Datasets
The optimum model for managing large image and raster collections

- Support multiple sources and modalities
- Support multiple metadata formats
- Support multiple formats
- Maintain Image quality
- Handle overlapping and disparate datasets
- Support over 50 Raster (Sensor) Types
- Support Rich Web services (Image Services)
Image Management Using Mosaic Datasets
The optimum 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
What is ArcGIS Image Server

Server dedicated to the
Efficient Processing, Analysis and Dissemination of Imagery and Rasters

• Dynamic Image Services – ‘Making your imagery accessible’
  - Serve large collections of imagery and rasters with dynamic mosaicking and on-the-fly processing

• Raster Analytics – ‘Extracting information from imagery’
  - Enabling massive distributed processing and analysis of imagery and rasters
Demo
Imagery in ArcGIS Pro: Mosaics, Raster Layers and Image Services
Map Production:
Drones and ArcGIS
Map Production
Creating precise imagery derived products

Satellite, Aerial, Drones

Orthophoto production
Aerotriangulation
Block Adjustment
Digital Elevation Model Generation (DSM & DTM)

Photogrammetric data model supporting many use cases
Dynamic image services (orthorectify on the fly)
Creation of custom basemaps
Stereo display and 3D feature extraction
Oblique imagery
Image coordinate system & Mensuration

ArcGIS Pro Advanced - Ortho Mapping
ArcGIS Image Server - Ortho Maker
ArcGIS Image Analyst Extension - Stereo
Drone2Map
Orthorectification workflows in ArcGIS

Drone2Map (Desktop)

Ortho Mapping ArcGIS Pro | Ortho Maker
Desktop | Web App

Drone, Aerial, Satellite

DSM, Orthomosaic, 3D Products

DTM & Dynamic Orthomosaic + Image Space

ArcGIS Online

Image Server

ArcGIS Enterprise

Desktop, Web, Mobile
Demo
- Ortho Maker workflow
- Drones in ArcGIS Pro
Content:
Living Atlas and ArcGIS Online
Esri builds Imagery Services for our User Community

- How we build them
- Sensors
  - Landsat
  - Sentinel-2
  - MODIS
  - Weather Satellites
  - MDA NaturalVue
  - DigitalGlobe WorldViews
Esri builds Imagery Services for our User Community

• How to use them!
  - Add them to apps
  - Do Analysis in ArcGIS Pro
  - Use our pre-build Apps
    - Sentinel 2 Explorer: https://sentinel2explorer.esri.com/
    - Landsat Explorer - https://landsatexplorer.esri.com/
How we’re doing this

- Imagery for Landsat and Sentinel is hosted by AWS in a public S3 Bucket
- Esri hosts Image Servers in the right AWS region(s) to access these images
- Scheduled tasks run OptimizeRasters
- Mosaics are updated and users get live access to new images
- Register Services into Living Atlas for users to inspect
Demo
Web Map Viewer
Landsat Explorer for Flood Analysis
Visualization and Exploitation:
Apps for Imagery
Imagery Web Apps

- Web Map Viewer
- Pre-Built Apps: Landsat Explorer etc.
- Template Apps in the portal: Imagery Viewer, Image Interpretation...
- Web AppBuilder – Image Service Widgets (Landsat Explorer)
- Excalibur – focused on image extraction
ArcGIS Excalibur v1.0 - Features and Benefits

- **Imagery Management**
  - Interactive search and discovery capabilities
  - Simplified access to imagery through numerous experiences
  - Analysis ready imagery content based on authoritative enterprise imagery services.
  - User defined search settings to refine discovery results.

- **Exploitation**
  - Tools for on-the-fly processing and dynamic visualization.
  - Fully integrated, side-by-side visualization of imagery in "map" and "image" spaces.
  - Image annotation and sketching with automatic, accurate transformation to geographic features.
ArcGIS Excalibur - Features and Benefits

• Imagery Projects
  - Dynamic, focused workflows to organize and accomplish image-based tasks.
  - Track and measure specific imagery related tasks.
  - Leverage existing web maps containing reference layers for contextual use in imagery projects.
  - Streamline object collection management workflows.

• Imagery Derived Products
  - Create products for interactive briefings.
  - Utilize dynamic analysis layers for use in additional platform application.
  - Enable temporal monitoring of observations.
  - Perform traceability of analytical assessments.
Demo

- Imagery in the Web Map Viewer
- Excalibur
Imagery and Raster Analysis
Analysis

Extracting Information from Imagery

Machine Learning, Prediction, Classification, Deep Learning

Tools built into ArcGIS

Integration with External Toolkits

Scaling using Raster Analytics

ArcGIS Pro Image Analyst Extension
ArcGIS Pro Spatial Analyst Extension
ArcGIS Image Server - Raster Analytics
### Raster Functions - Complete List

#### ArcGIS Pro
- **50 Raster Functions**

#### Analysis: Band Math & Indices
- NDVI / NDVI Colorized
- SAVI / MSAVI / TSAVI
- GEMI
- GVI (Landsat TM)
- PVI
- Tasseled Cap (Kauth-Thomas)
- Binary Thresholding
- Heat Index
- Wind Chill

#### Statistics
- ArgStatistics

#### Visualization & Appearance
- Contrast and Brightness
- Convolution
- Pansharpening
- Resample
- Statistics and Histogram
- Stretch

#### Correction
- Apparent Reflectance
- Geometric Correction
- Speckle Filtering (Lee,Frost,Kuan)
- Thermal noise
- Radiometric Calibration

#### Interpolation
- Interpolate Irregular Data
- Nearest Neighbor
- IDW
- EBK
- Swath

#### Data Management & Conversion
- Raster to Vector
- Vector to Raster
- Colormap
- Colormap To RGB
- Complex
- Grayscale
- Remap / Reclass
- Spectral Conversion
- Unit Conversion
- Vector Field
- LAS to Raster
- LAS Dataset to Raster
- Clip
- Composite
- Extract Bands
- Mask
- Mosaic Rasters
- Rasterize Features
- Reproject
- Region Group
- Lookup

#### Surface Generation & Analysis
- Aspect
- Curvature
- Elevation Void Fill
- Hillshade
- Shaded Relief
- Slope
- Contour

#### Python
- Custom Algorithms

#### Analysis: Image Segmentation & Classification
- Segmentation (Mean Shift)
- Training (ISO, SVM, ML, Random trees)
- Supervised Classification

#### Analysis: Overlay
- Weighted Sum

#### Statistics
- Zonal Statistics
- Cell Statistics
- Focal Statistics

#### Analysis: Distance & Density
- Euclidean Distance
- Cost Distance
- Least Cost Path
- Kernel Density
- Path Allocation
- Path Distance
- Path Distance backlink

#### Analysis: Hydrology
- Fill
- Flow Accumulation
- Flow Direction
- Flow Distance
- Stream Link
- Watershed

#### Analysis: Overlay
- Weighted Overlay

#### Surface Generation & Analysis
- Viewshed

#### Data Management
- Nibble

* Released in Pro 2.3
Raster Analytics Test Case: Terrain Suitability

Global SRTM 90m

terrain suitability model
- compute slope
- compute aspect
- remap
- overlay

esri virtual machine
- 16GB RAM, 8 cores, NAS storage

Raster Analytics Processors
- 13.12 hours
- 80 minutes

global terrain suitability raster
Raster Analytics Test Case: Solar Power Plant Suitability

WebGIS (w/ RasterAnalytics) on Amazon
- 8 c3.2xlarge instances (8 vCPUs, 16GB RAM)

ArcGIS Desktop (ArcMap or ArcGIS Pro)
- 5 hours 45 minutes

Raster Analytics
- 9 minutes
Raster Analytics Test Case: Landsat Processing

**Infrastructure**
- Esri Web GIS on AWS
- Distributed Raster Analytics Cluster
  - Single node
  - AWS c3.8xlarge
  - 60GB RAM, 32 cores, 500GB SSD
  - 200 Raster Analytics Processors

**Input Collection**
- Landsat GLS 1990
  - 7422 Multispectral Scenes
  - S3 storage

**Processing**
1. (foreach) input scene
2. mask no data
3. top of atmosphere correction
4. modified soil adjusted vegetation index
5. remap to classes
6. output thematic raster

**Output**
- Thematic Rasters
  - 7422 Thematic Rasters
  - Distributed Raster Datastore

**Performance**
- 2 hours 48 minutes
- 44 scenes per minute
- ¾ scene per second
ArcGIS Notebook Server
Host Python notebooks in your infrastructure

A powerful data science platform
- Uses Docker containers to isolate each notebook author’s workspace
- Code with the Python API and ArcPy
- Dynamic mapping and visualization

Integrated with your portal
- Users are granted notebook privileges via portal user roles
- Add and reference portal items
- Share notebooks in the portal

Comes with a rich gallery of sample notebooks to illustrate workflows
Demo

Jupyter Notebooks

Building a change detection app using Jupyter Dashboard

The Python API, along with the Jupyter Dashboard project enables Python developers to quickly build and prototype interactive web apps. This sample illustrates one such app which can be used to detect the changes in vegetation between the two dates. Increases in vegetation are shown in green, and decreases are shown in magenta.

Newer: 2006-09-26
Older: 2000-09-17

Location: New Orleans, Louisiana

Detect changes
Closing and Summary

Using Imagery in ArcGIS – ArcGIS Pro / Image Services / Dedicated Web Apps

Living Atlas includes many imagery layers accessible to all ArcGIS users

For more information:
- Start @ Imagery Workflows Website - https://doc.arcgis.com/en/imagery/workflows/

- Contact us! libby@esri.com -- scott.beckstrom@geodata.no

- Any Questions?