ArcGIS Enterprise
Raster Analytics in Image Server

Mike Muller, Vinay Viswambharan
Introduction and Context

The ArcGIS Platform and ArcGIS Image Server
manage and process imagery into authoritative data sources that are appropriately and efficiently disseminated to those that need access

derive actionable information from imagery and rasters by performing analytics on massive volumes of data available from multiple sources

enable access to imagery and analysis through a wide range of integrated desktop, mobile, and web applications that are interactive, informative, and engaging

manage and process imagery into authoritative data sources that are appropriately and efficiently disseminated to those that need access
ArcGIS Image Server 10.6.1

**Image Server**
- fast on-the-fly dynamic processing
- caching and serving tiled maps
- scalable raster analysis and image processing
- serve and analyze scientific data
- OGC services

---

**Powerful Desktop Apps**
- custom algorithms with Python
- spectral processing
- terrain analysis
- suitability analysis
- vegetation analysis
- persistent product generation

---

**Mobile Apps & Devices**
- compression control for low bandwidths
- orthorectification and mosaicking
- only process what’s being looked at
- 100+ analytic functions

---

**Web Apps**
- scale tile creation with additional servers
- update AOIs
- watermarking
- burn geographic features and text into tiles
- design multi-source, multi-LOD tiled services

---

**Web Maps** (reports)
- weather & climate
- HDF
- NetCDF
- GRIB
- multidimensional analysis

---

**故事 Maps** (reports)
- serve and analyze scientific data
- OGC services

---

**Systems Integration**
- store once, many products on-the-fly
- reduce storage costs
- only process what’s being looked at
- 100+ analytic functions

---

**Production Systems** (automation)
- compression control for low bandwidths
- orthorectification and mosaicking
- only process what’s being looked at
- 100+ analytic functions

---

**Developer Apps**
- custom algorithms with Python
- spectral processing
- terrain analysis
- suitability analysis
- vegetation analysis
- persistent product generation

---

**Networks**
- http
Raster Analytics
ArcGIS Enterprise and ArcGIS Image Server 10.6.1
What is Raster Analytics?

- The ArcGIS way to create and execute spatial analysis models and image processing chains which leverage distributed storage and analytics
  - Raster Analytics works with your existing GIS data and imagery
  - Raster Analytics can optimize your data for distributed analytics
  - Raster Analytics is designed to scale with your organization’s demands
The Foundation of Raster Analytics

- Dynamic Raster Models: on-the-fly processing
- Geoprocessing Models: powerful analytics
- Server-based Distributed Raster Analytics with Distributed Raster Data Storage: (persistent) distributed analytics with optional distributed storage for even greater scalability
- Web GIS Layers: rich geoinformation model
Problem Solving with Raster Analytics

• run models against data that is too big for single desktop
  - small and medium scale global rasters (big geography)
  - large scale local or regional rasters (high resolution)

• run models against massive collections and scale it

• run models and meet time constraints
### Single Functions and Modeling

#### Multiband Math
- **Arithmetic**
- **Band Arithmetic**

<table>
<thead>
<tr>
<th>Math</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculator</td>
<td>ACos, ACosH</td>
</tr>
<tr>
<td>Abs</td>
<td>ASin, ASinH</td>
</tr>
<tr>
<td>Divide</td>
<td>ATan, ATan2</td>
</tr>
<tr>
<td>Exp</td>
<td>Cos, CosH</td>
</tr>
<tr>
<td>Exp10</td>
<td>Sin, SinH, Not</td>
</tr>
<tr>
<td>Exp2</td>
<td>Tan, TanH, Xor</td>
</tr>
<tr>
<td>Float</td>
<td></td>
</tr>
<tr>
<td>Int</td>
<td></td>
</tr>
<tr>
<td>Ln, Log10</td>
<td></td>
</tr>
<tr>
<td>Log2</td>
<td></td>
</tr>
<tr>
<td>Minus</td>
<td></td>
</tr>
<tr>
<td>Mod</td>
<td></td>
</tr>
<tr>
<td>Negate</td>
<td></td>
</tr>
<tr>
<td>Plus</td>
<td></td>
</tr>
<tr>
<td>Power</td>
<td></td>
</tr>
<tr>
<td>Round Down</td>
<td></td>
</tr>
<tr>
<td>Round Up</td>
<td></td>
</tr>
<tr>
<td>Square</td>
<td></td>
</tr>
<tr>
<td>Square Root</td>
<td></td>
</tr>
<tr>
<td>Times</td>
<td></td>
</tr>
<tr>
<td>Bitwise</td>
<td></td>
</tr>
<tr>
<td>And</td>
<td></td>
</tr>
<tr>
<td>Left Shift</td>
<td></td>
</tr>
<tr>
<td>Not</td>
<td></td>
</tr>
<tr>
<td>Or</td>
<td></td>
</tr>
<tr>
<td>Right Shift</td>
<td></td>
</tr>
<tr>
<td>Xor</td>
<td></td>
</tr>
<tr>
<td>Equal To</td>
<td></td>
</tr>
<tr>
<td>Greater Than</td>
<td></td>
</tr>
<tr>
<td>Equal</td>
<td></td>
</tr>
<tr>
<td>Is Null</td>
<td></td>
</tr>
<tr>
<td>Less Than</td>
<td></td>
</tr>
<tr>
<td>Equal</td>
<td></td>
</tr>
<tr>
<td>Not Equal</td>
<td></td>
</tr>
</tbody>
</table>

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

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

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

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

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

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

#### Analysis: Overlay
- Weighted Overlay
- Weighted Sum

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

#### Python
- Custom Algorithms

#### Analysis: Python

- Statistics:
  - Zonal Statistics
  - Cell Statistics
  - ArgStatistics

#### Analysis: Surface Generation & Analysis
- Aspect
- Curvature
- Elevation Void Fill
- Hillshade
- Shaded Relief
- Slope
- Viewshed
- Contour
Raster Analytics Models Can Be Shared

develop custom processing models and share to Portal from Pro

Raster Function Template item

browse and search for Raster Function Template items

form generated, user supplies parameters and runs the custom analysis
Raster Analytics can power systems that need to execute spatial analysis and image processing models in a distributed and scalable environment. It is designed for users, developers, and system integrators.

Results are stored in distributed storage and are immediately available as new Web GIS Layers which are already optimized for further analytics.
Raster Analytics Deployment

- **deployed as ArcGIS Enterprise + ArcGIS Image Server**
  - Web GIS on-premise

- **your infrastructure can be…**
  - your hardware
  - your Amazon
  - your Azure

- **deployment tools**
  - Amazon CloudFormation Templates
  - ArcGIS Enterprise Cloud Builder for Microsoft Azure

- **Deploying Distributed Raster Analytics Session**
  - Session ID 1684, SDCC Room 30 E
  - Thursday 07/12 @ 13:00
Raster Analytics
Examples
Enterprise Raster Analytics Hydro Tools

- Distributed as of 10.6
  - Fill
  - Flow Distance
  - Flow Direction
  - Flow Accumulation
  - Watershed
  - Stream Link
  - Nibble

Mississippi (HUC2 Regions 7-12 @ 10m) ~105 billion cells

- Fill: 18h 39m 23s
- Flow Accumulation: 23h 40m 24s
- Flow Direction D8: 4h 46m 22s
- Flow Direction D∞: 13h 5m 21s

4 in-house commodity servers (desktops) running 8 RA processors each
Raster Analytics: Penn State Watershed Processing

**Input data**
- Penn State Watershed
  - 397 GB
  - Distributed datastore

**Processing**
1. Input data
2. Brightness/Veg/Chromaticity
3. False color composite
4. Segmentation
5. Classification
6. Output LandCover Map

**Output**
- LandCover Map
  - Distributed raster datastore

**Infrastructure**
- ArcGIS Enterprise on Azure
- Image Server Cluster
  - 10 Azure instances – 20 cores each

**100 billion pixels!**
- 1 hour 13 minutes
- 10 – 20 core Azure instances
See Cool Stuff!
Demos
Vinay Viswambharan
Please Take Our Survey on the App

Download the Esri Events app and find your event

Select the session you attended

Select the Feedback tab

Complete answers and select “Submit”