Workflows for Managing and Serving Elevation (and Lidar) Data

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Outline

• Usage Modes
• Data Management
  - Architecture
  - Workflow
• Automation for Repeatability & Scalability
• A few options re: Cloud, Lidar, & Geoprocessing Services
Usage Modes of Elevation Data

- Get Data Values
  - Orthorectification
  - Local analysis
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- Visual Interpretation
  - Including Metadata
  - Faster performance (8 bit jpg vs. float 32)
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• Server-side Analysis & Processing
  - Profile, Viewshed, Contours, more
ArcGIS Online World Terrain

Orthometric Height
Derived Products
Visualizations
Server-side GP Tools
Characteristics of Elevation Data

- Typically 32 bit float (sometimes 16)
- Likely to include NoData areas
- Different projections
- Different vertical datums
- May be in different units (XY vs. Z)
Data Management Objectives

- Support User Requirements
- Manage Cost vs. Performance
  - Implement In-house, DIY Cloud, ArcGIS Online → http://esriurl.com/CommunityElevation
- Avoid resampling
- Scalability
- Maintainability
- Automation
Elevation Data Management
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
Mosaic Dataset Design

- Key metadata \( \rightarrow \) Attribute Table
  - Vertical Datum
  - Accuracy (CE90, LE90)
  - Date published
  - Link to detailed metadata

- Source / Derived Model
Source Mosaic Datasets – Elevation & Lidar example

Source Imagery → Source Mosaic Datasets

- SRTM
- NED 1/3 arcsec
- LiDAR Project #N

Additional notes:

1) Create overviews on Source Mosaics, then use SRTM (instead of overviews) to fill in “background” elevation values.
2) Don’t calculate statistics – it takes too long and statistics for elevation datasets aren’t really meaningful – instead, use **Set Raster Properties** to manually insert approximate statistics.
Combine into Derived Mosaic Dataset

Source Imagery → Source Mosaic Datasets → Derived Mosaic Dataset

- Multi-source, multi-resolution collection of elevation data
- Use TABLE Raster Type
- Advantage: All data available in a single location
Example – ArcGIS World Elevation – Server Raster Functions

Source Imagery → Source Mosaic Datasets → Derived Mosaic Dataset → Single image service with multiple server functions

- Orthometric Height
- Hillshade
- Contour
- Slope
- Aspect
- Ellipsoidal Height
- …many other functions

Example – Single Image Service with Multiple Server Functions

- ArcGIS World Elevation
- Server Raster Functions
Example – ArcGIS World Elevation – Update with new data

Source Imagery → Source Mosaic Datasets → Derived Mosaic Dataset → Single image service with multiple server functions

Orthometric Height
Hillshade
Contour
Slope
Aspect
Ellipsoidal Height
…many other functions

New data collections added to the central Derived Mosaic appear immediately in all services
Preprocessing

• NOT typically necessary – but advice follows

• Restructure files (optional, but ensure no resampling)
  - Tiled TIFF (5120 x 5120)
  - LZW or LERC compression

• Advanced
  - Copy data to cloud storage
  - MRF Format (optional)
  - OptimizeRasters tool
Create Source Mosaic Datasets

- Projection = same as source
- Cell Sizes: default
- NoData: define NoData value
- Footprints: calculate approximate footprint, do not clip
- Overviews:
  - Not generally required (use other low resolution datasets in Derived MD)
  - Exception: build OVRs if next available resolution is > 10x difference or larger
- Complete QC of each Source MD
Derived Mosaic Dataset

- DTM (bare earth)
- DSM (first return surface) if applicable
  - Must decide desired behavior at edges – show DTM, or NoData?
- Add Source_MDs using TABLE
- Include low res datasets in lieu of OVRs
- Vertical adjustments
  - Rescale feet → meters (Lidar state plane data)
  - Convert datum to Derived MD
- **Assign** approximate statistics (do not calculate) *Set Raster Properties*
- Mosaic Method: By Attribute, “Best”
Automated Build

2 slides, then fast demo in Pro
Automated Workflows – for Repeatability & Scalability

- Simplicity
- Improve Productivity
  - Repeatability, Maintainability, Scalability
  - Documentation → Facilitate QA & QC, Design Review
- Training/Examples
  - Encapsulate best practices
  - Reusable templates
Image Management Workflows – Landing page
http://resources.arcgis.com

- Overview of Workflows
- Guidebook
  - Part of Online Doc
- ArcGIS Online Group
  - Gallery of downloadable items
Options/Additional Info
Sharing Geoprocessing Services – Data and Tools in the Cloud

*Move the Processing to the Data, not the Data to the Processing*

- Take advantage of storage and computing power in the cloud or on a private server
- Expose Geoprocessing Tools as services
- Viewshed, Line of sight, Volume calculations, etc.
- Accessible to Desktop, Web, and Mobile clients
Sharing / Serving from the Cloud

- NASA Meta-Raster Format (MRF) for S3 storage
  - Optimized for simple cloud storage (S3)
  - Mosaic Dataset accesses local file (e.g. can configure on Desktop, copy all to cloud)

- LERC – Limited Error Raster Compression
  - Truncates 32 bit float values to user specified vertical error tolerance

- See whitepaper: [http://esriurl.com/MRF](http://esriurl.com/MRF)
Additional Raster Functions

• **Multidirectional Hillshade**
  - [http://esriurl.com/MultiDirHillshadeFunction](http://esriurl.com/MultiDirHillshadeFunction)
  - Now part of core ArcGIS Pro 2.0

• **Raster Contours**
  - [http://esriurl.com/ContourFunction](http://esriurl.com/ContourFunction)
  - Not yet built into core – must download & install
Lidar workflow
Creation of Raster Surfaces - DSM & DTM
Hosting LAS tiles for download
Export raster surfaces from LAS Dataset

“Workflow A”

- Recommended method for best scalability
- Test before export to define best parameters
- Ensure tiles overlap
- Lidar data may be moved to offline storage

Data volume for DTM ~10% of LAS
DSM add another ~10%
Tool: LAS Dataset to Tiled Rasters

Download from http://links.esri.com/3dSamples
LAS / zLAS files exposed for download – ArcGIS for Server

- Server must have local storage for LAS/zLAS files
- Client = ArcGIS Desktop or custom web client
Simple cloud storage for LAS/zLAS files, linked to AGOL Feature Service

Client = browser
Resources

- Guidebook in ArcGIS Help:  http://esriurl.com/6007
- ArcGIS Online Group:  http://esriurl.com/6539
- OptimizeRasters:  http://esriurl.com/OptimizeRasters
- MRF and LERC:  http://esriurl.com/MRF
- Recorded Webinar on lidar data management:  http://esriurl.com/LTSLidarMgmt
- Optimized LAS tool:  http://esriurl.com/zlas
- Tools from 3D Team:  http://links.esri.com/3dSamples

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