Managing and Serving Elevation and Lidar Data

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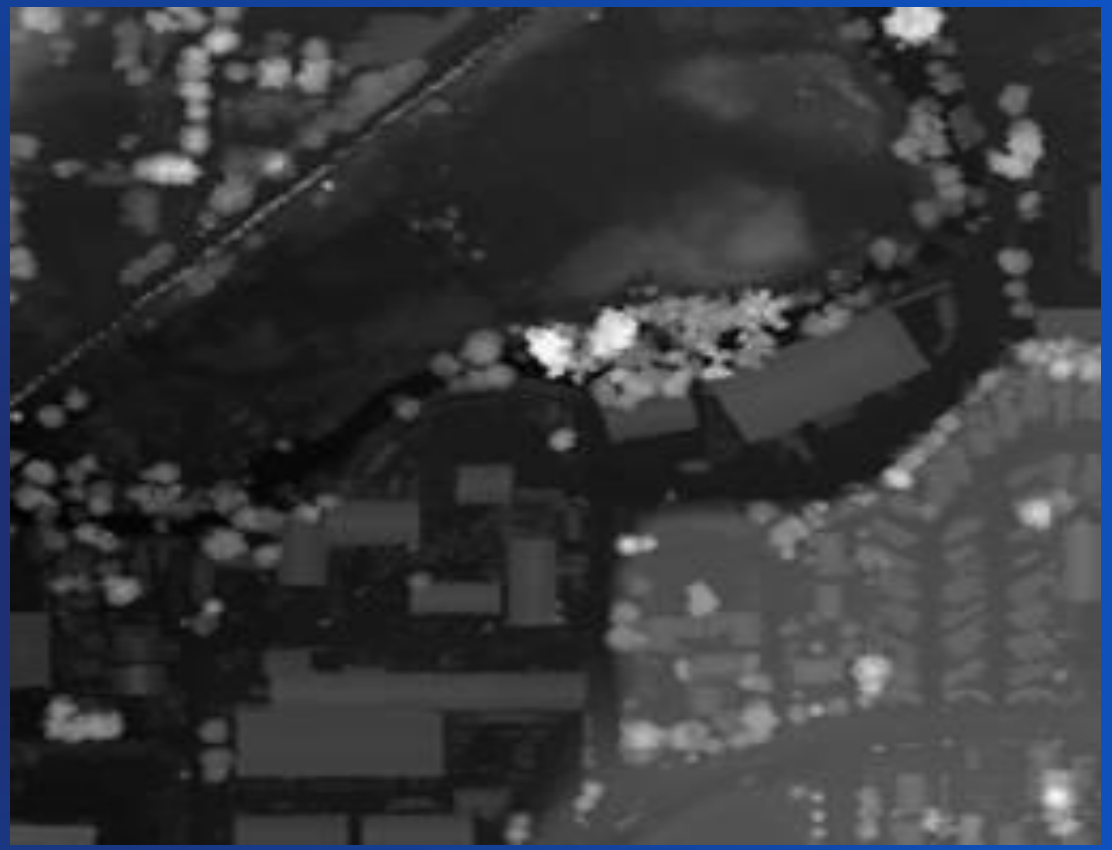
SEE
WHAT
OTHERS
CAN'T

Outline

- Usage Modes
- Elevation Data Management
  - Architecture
  - Workflow
- Lidar
- Automation for Repeatability & Scalability

Usage Modes of Elevation Data

- Get Data Values
  - Orthorectification
  - Local analysis

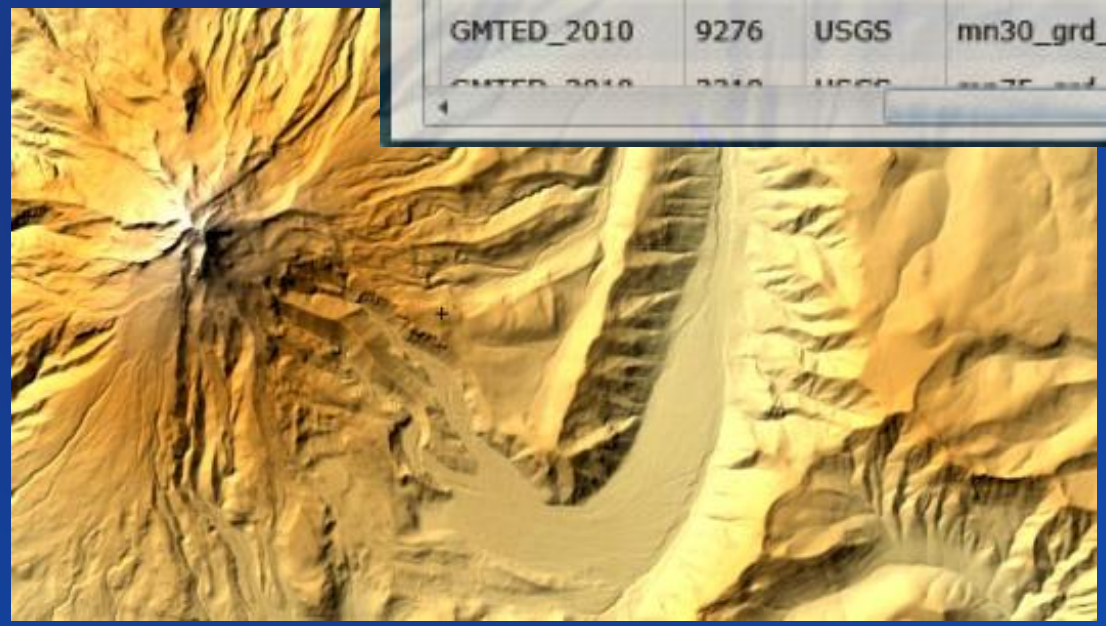


Usage Modes of Elevation Data

- Get Data Values
  - Orthorectification
  - Local analysis

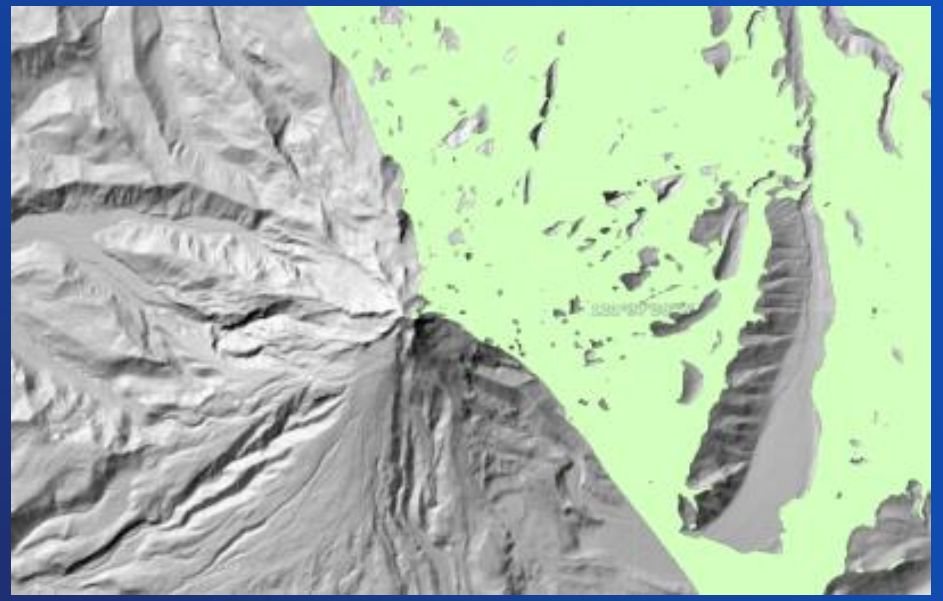
- Visual Interpretation
  - Including Metadata

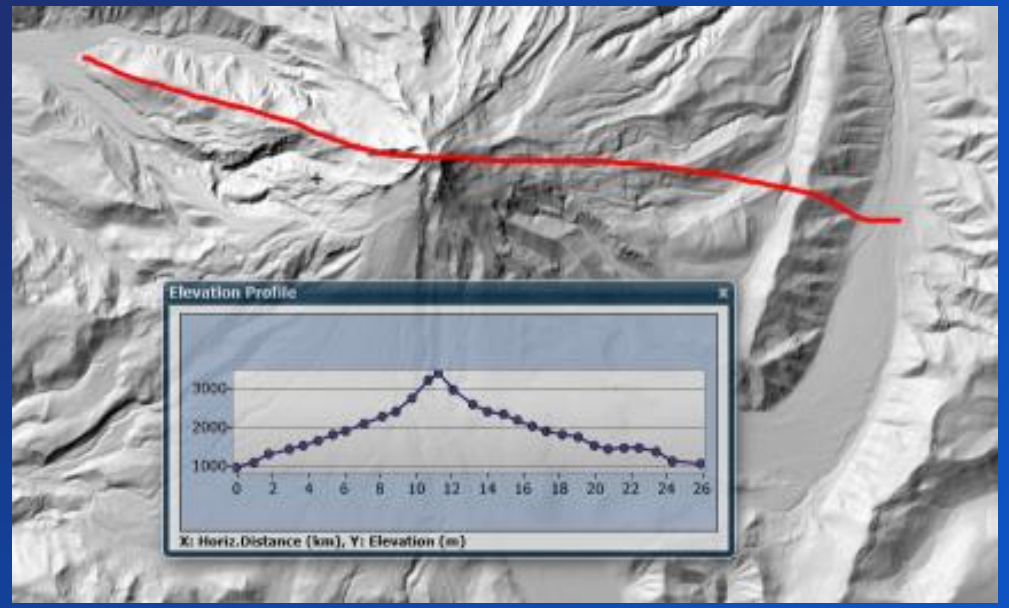
ProductName	BEST	Source	Dataset_ID	LE90	CE90	D
NED_1_arcsec	309	USGS	NED1	999	0	2
NED_1r3_arcsec	103	USGS	NED13	999	0	2
GMTED_2010	4638	USGS	mn15_grd_m	53	0	2
GMTED_2010	9276	USGS	mn30_grd_m	82	0	2

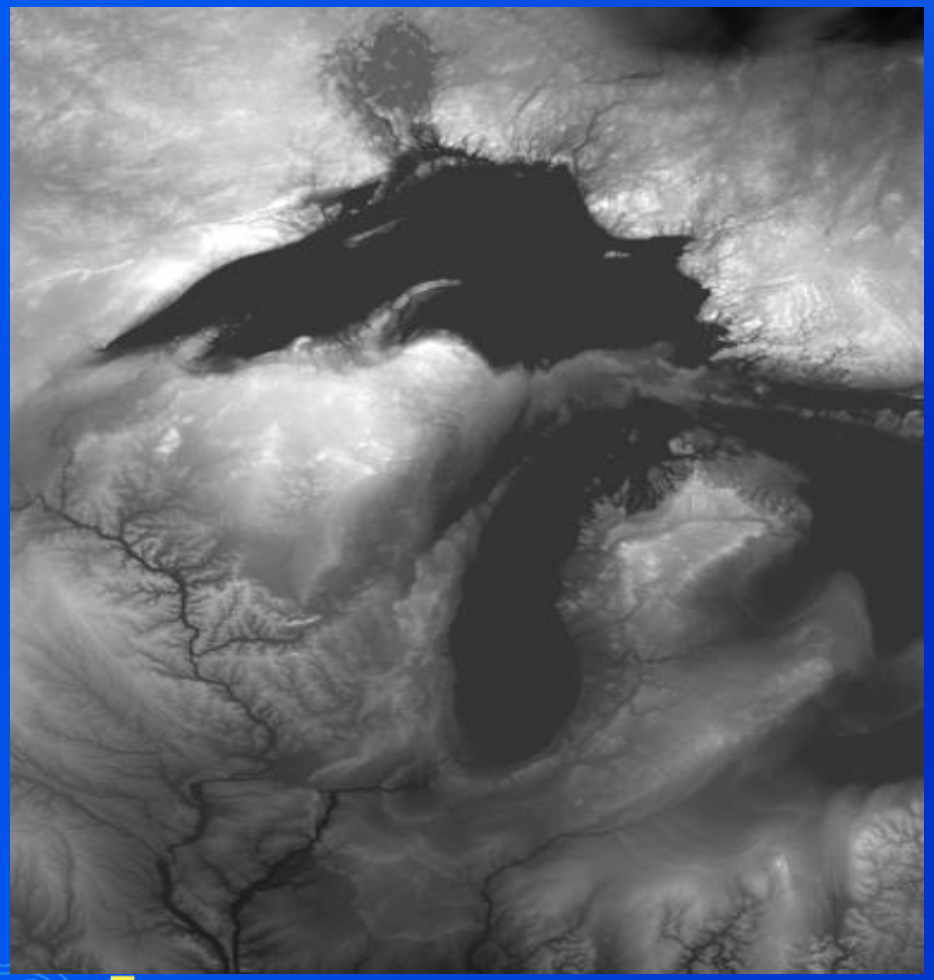


Usage Modes of Elevation Data

- Get Data Values
  - Orthorectification
  - Local analysis
- Visual Interpretation
  - Including Metadata
- **Server-side Analysis**
  - **Profile, Viewshed, Contours**







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)

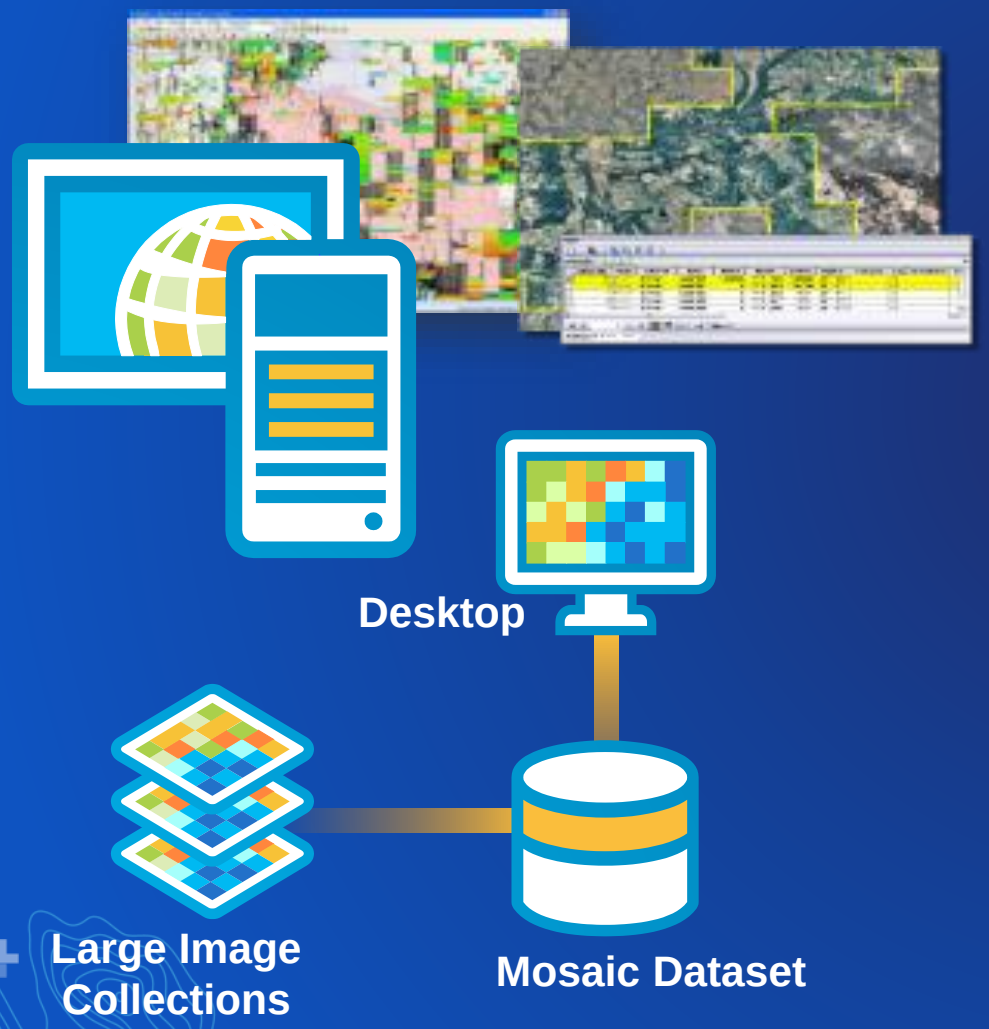
Data Management Objectives

- Support User Requirements
- Manage Cost vs. Performance
  - Implement In-house, Public Cloud?
- 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:

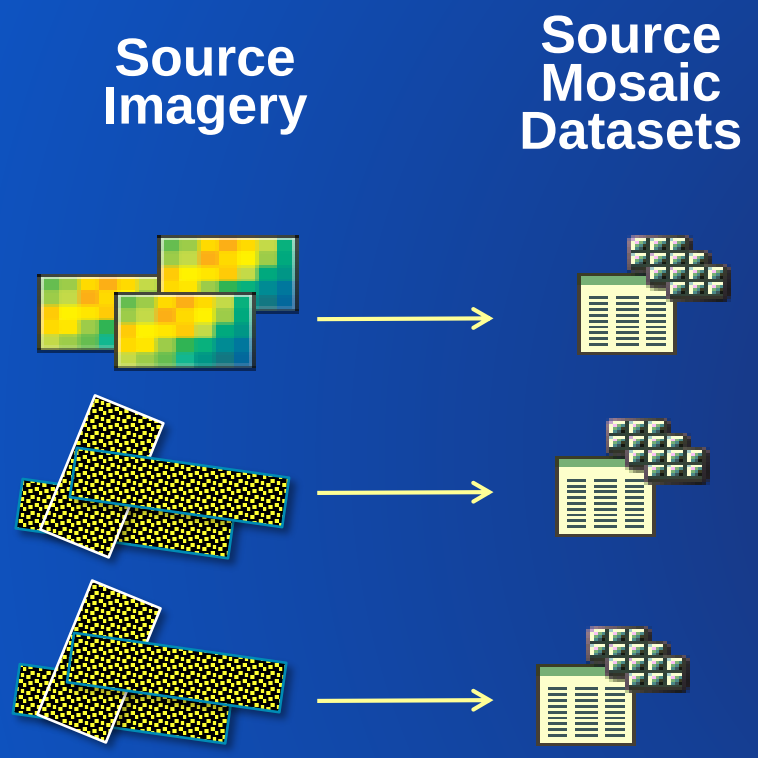
- On-the-fly Processing
- Dynamic Mosaicking

Access as Image or Catalog

Mosaic Dataset Design

- Key metadata → Attribute Table
  - Vertical Datum
  - Accuracy (CE90, LE90)
  - Date published
  - Link to detailed metadata
- Source / Derived Model

Source Mosaic Datasets – Elevation & Lidar example

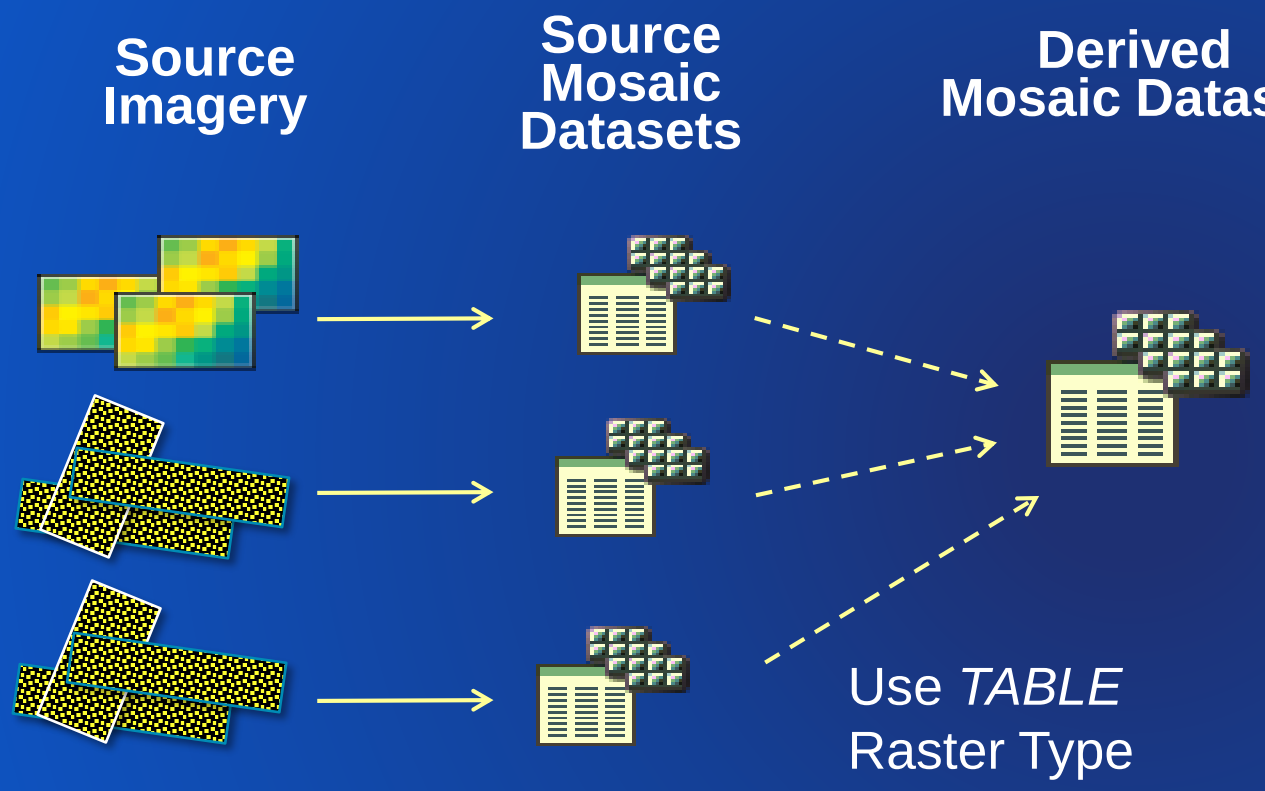


NED 10m

LiDAR Project #1

LiDAR Project #N

Combine into Derived Mosaic Dataset

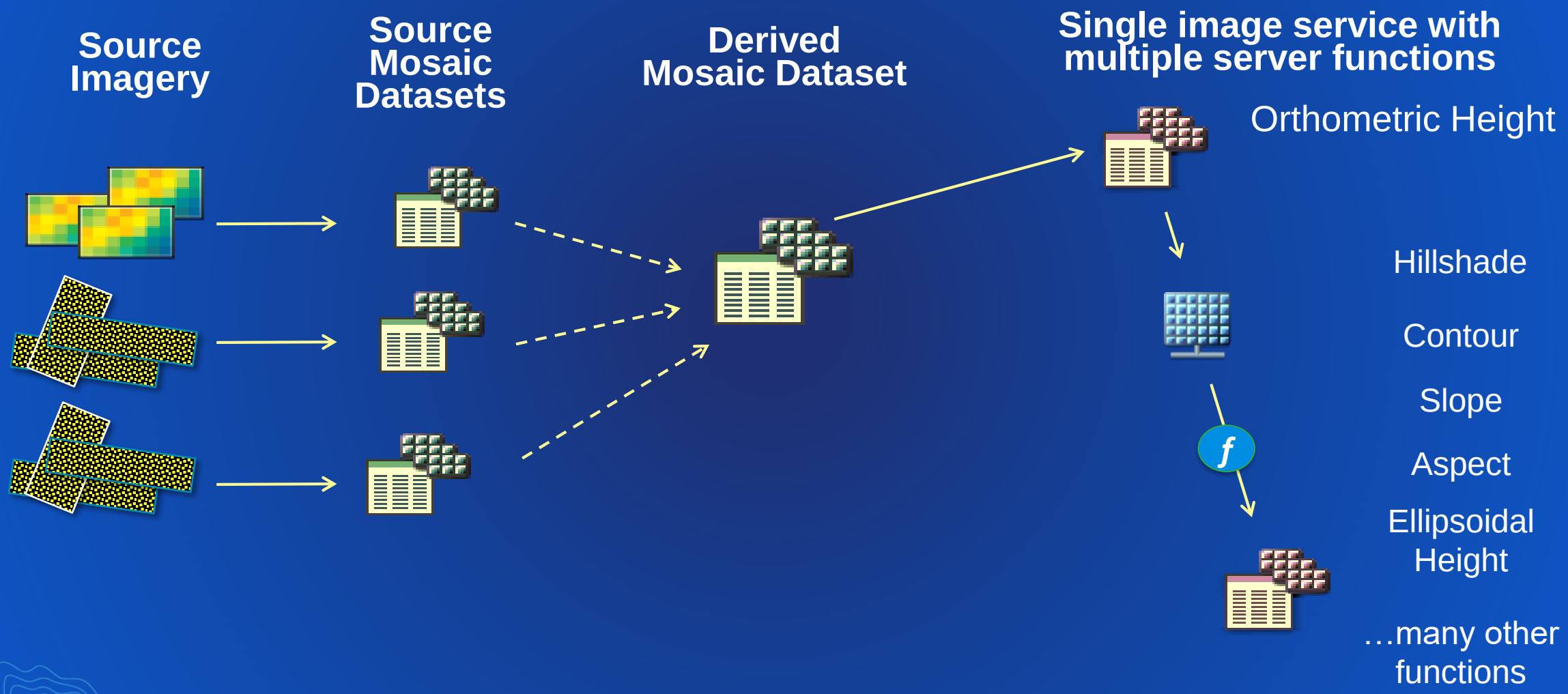


Multi-source, multi-resolution collection of elevation data

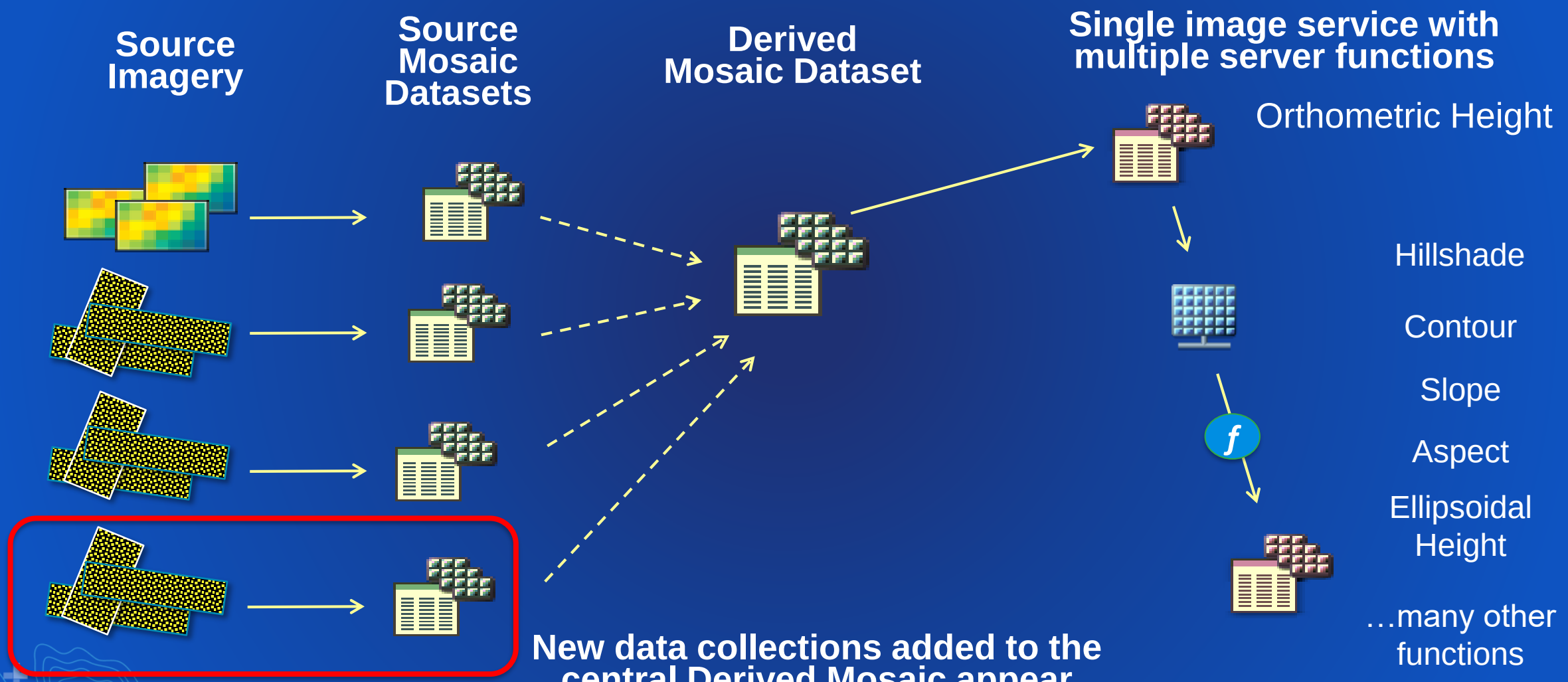
Advantage: All data* available in a single location

* All *elevation* data

Example – ArcGIS World Elevation – Server Raster Functions



Example – ArcGIS World Elevation – Update with new data



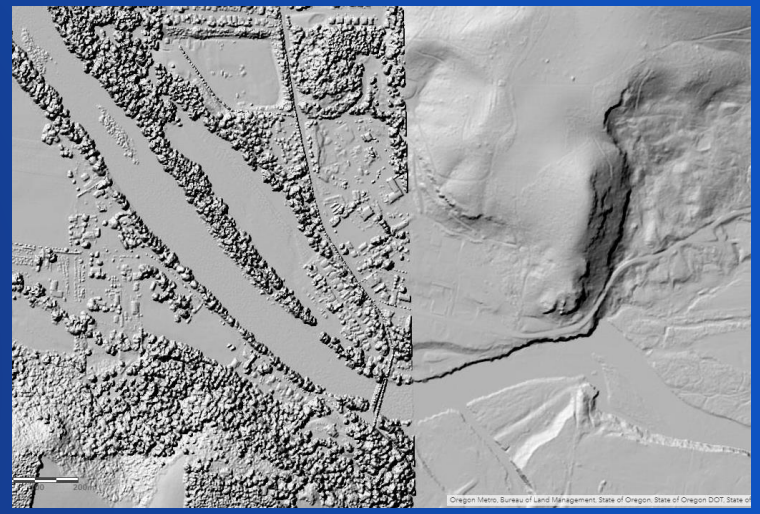
New data collections added to the central Derived Mosaic appear immediately in all services

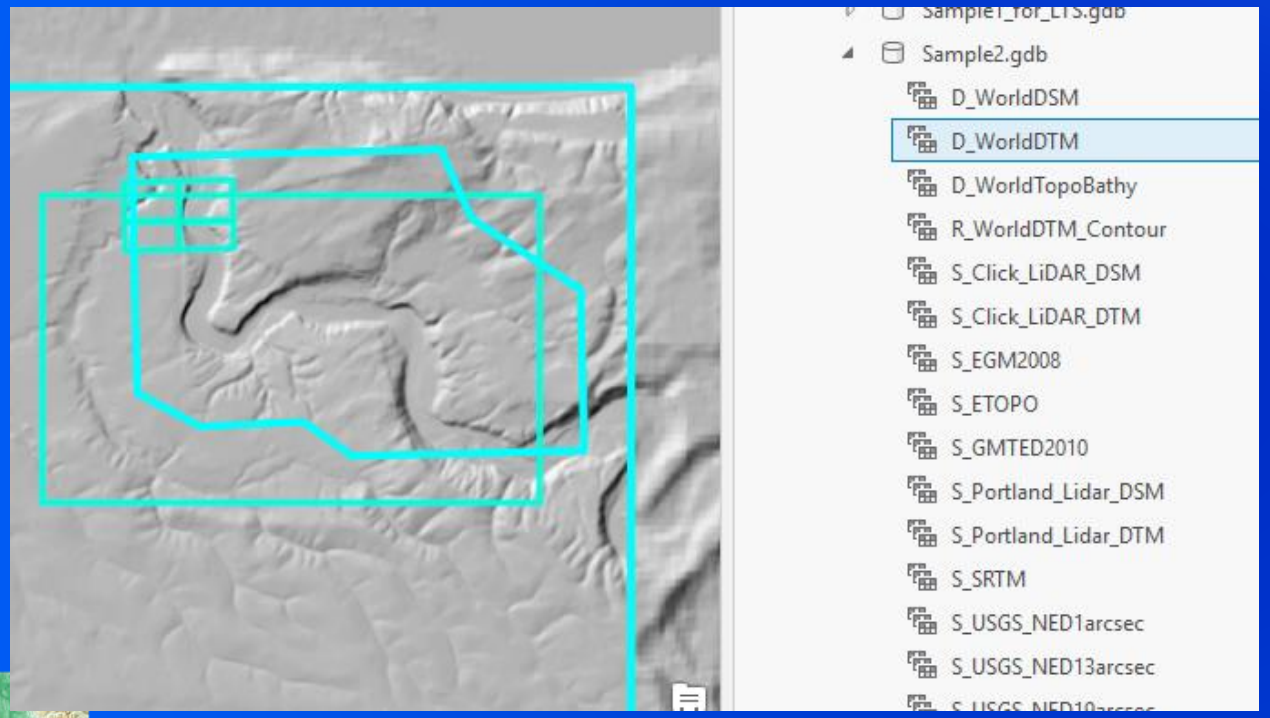
Create Source Mosaic Datasets

- 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 raster type
- Include low resolution datasets in lieu of OVRs
- Vertical adjustments
  - Rescale feet → meters (e.g. Lidar state plane data)
  - Convert datum to Derived MD
- <u>Assign</u> approximate statistics (do not calculate) *Set Raster Properties*
- Mosaic Method: By Attribute, "Best"





Geodatabase Model

Options/Additional Info

Sharing / Serving from the Cloud

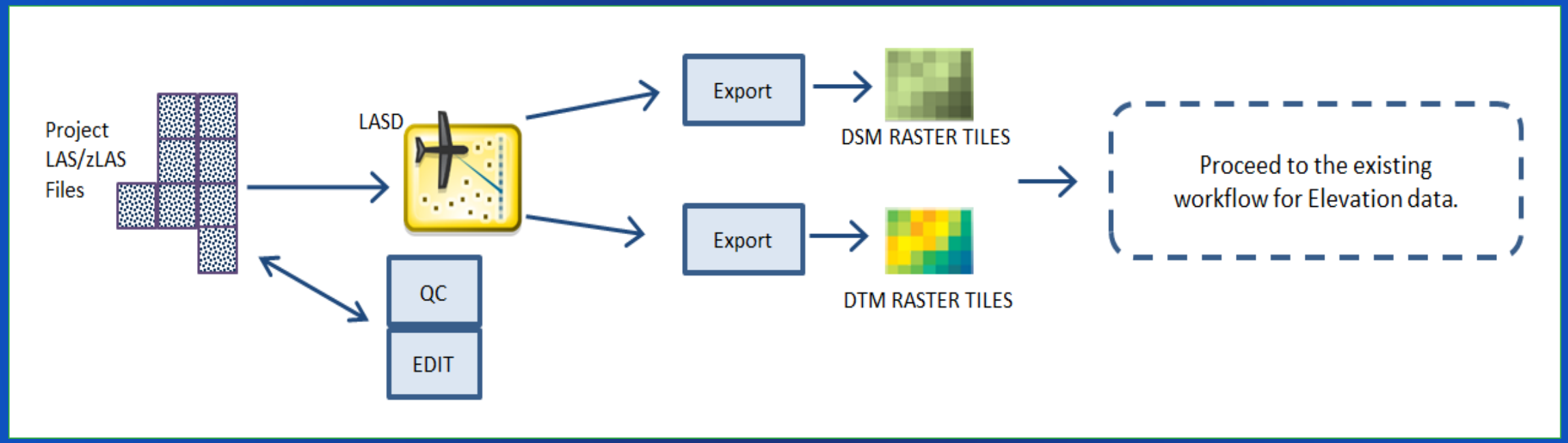
- NASA Meta-Raster Format (MRF) for S3 storage
  - Optimized for simple cloud storage (S3)
  - OptimizeRasters Geoprocessing tool http://esriurl.com/OptimizeRasters
  - Mosaic Dataset accesses local file (e.g. can configure on Desktop, copy all to cloud)
- LERC – Limited Error Raster Compression
  - Truncates 32 bit float values to user specified vertical error tolerance
- MRF and LERC: http://esriurl.com/MRF

Lidar workflow

Creation of Raster Surfaces - DSM & DTM
Publishing points as SLPK (*.i3s format)
Hosting LAS tiles for download

Export raster surfaces from LAS Dataset

“Workflow A”

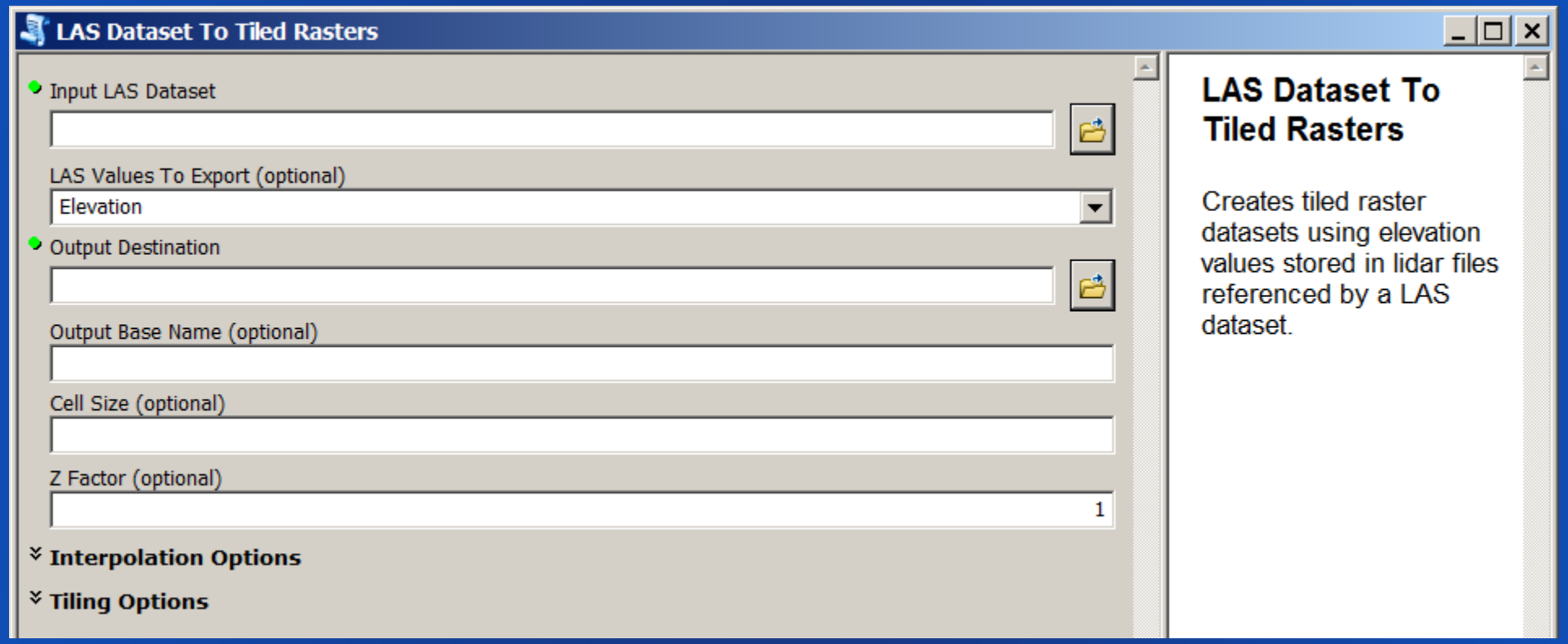


- Recommended method for best scalability
- Test before export to define best parameters
- Ensure tiles overlap
- Lidar data may be moved to offline storage

Data volume for DTM ~10% of LAS

DSM add another ~10%

Tool: LAS Dataset to *Tiled* Rasters



Download from http://links.esri.com/3dSamples

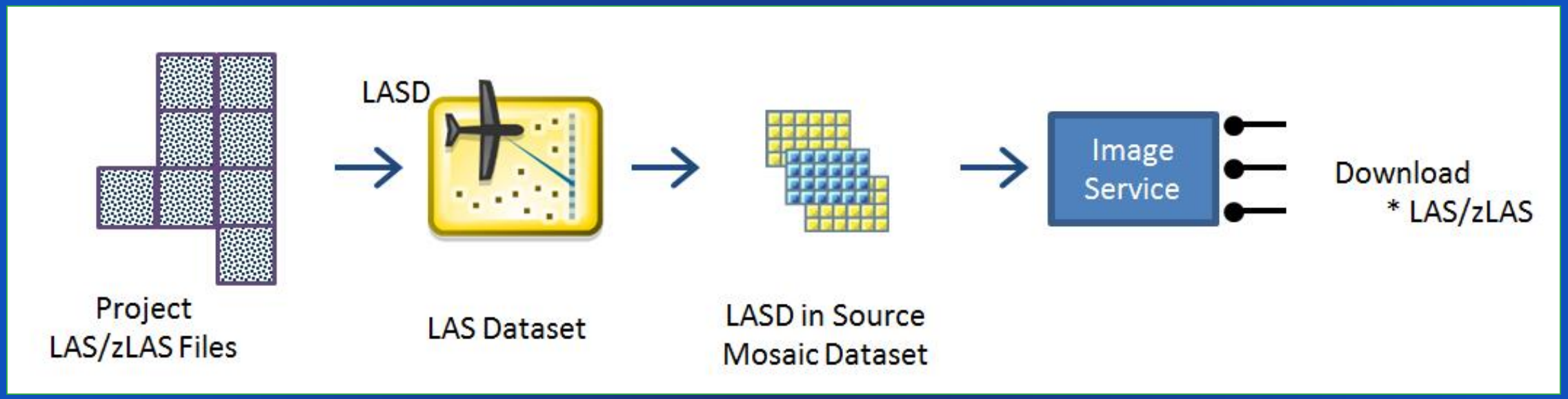
Publishing 3D data as scene services

- Indexed 3D Scene Layers (i3s) format accepted as OGC standard
  - http://esriurl.com/i3sOGC
- Four data types
  - Textured Mesh (3rd party tools e.g. Drone2Map, Pix4D, Vricon, Bentley Context Capture)
  - 3D objects (multipatch)
  - Point features with attributes
  - Point clouds
- Host scene service on Portal or ArcGIS Online
  - Scene Layer Package (SLPK) may also be read directly into ArcGIS Pro
- http://esriurl.com/PublishI3S

Streaming 3D points via *.i3s

Coming soon: Clip/Zip/Ship *.i3s to LAS

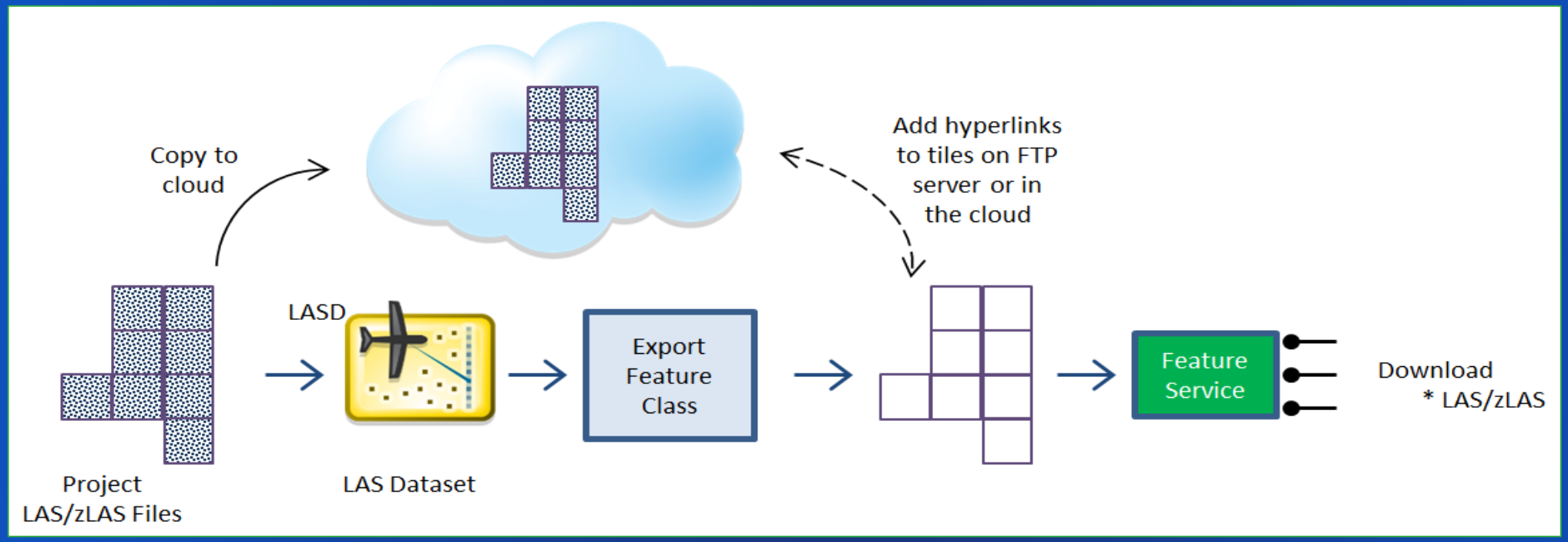
LAS / zLAS files exposed for download – ArcGIS for Server



- **Server must have local storage for LAS/zLAS files**
- **Client = ArcGIS Pro, ArcMap, or custom web client**

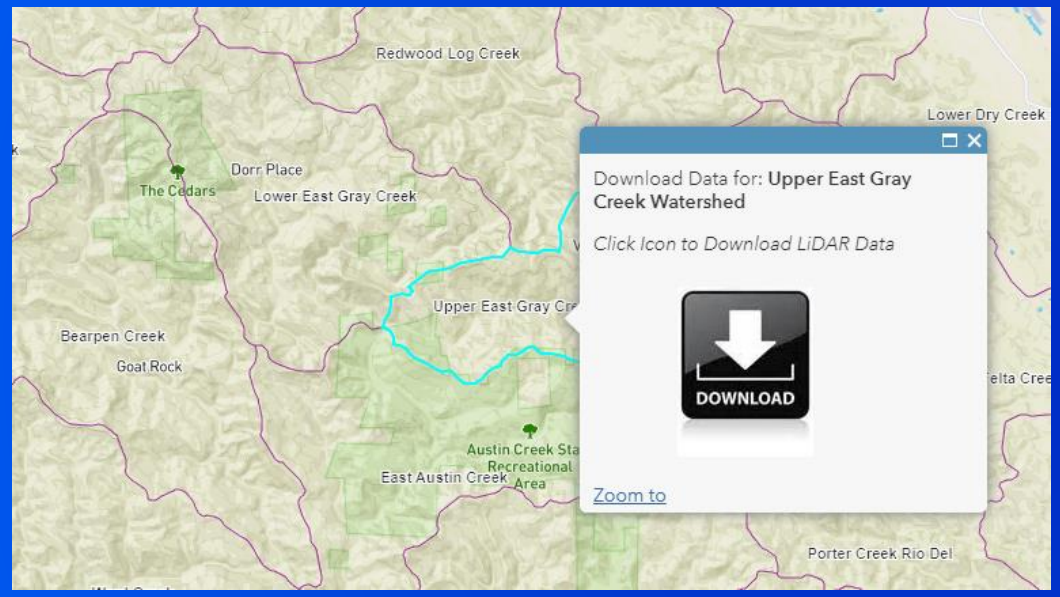
More secure

LAS / zLAS files exposed for download – Simple download (S3 / FTP)



- **Simple cloud storage for LAS/zLAS files, linked to AGOL Feature Service**
- **Client = browser**

More lightweight



Download Lidar tiles

Demo

Data from Sonoma County, CA

Automated Build

MDCS
(Mosaic Dataset Configuration Script)

Automated Workflows – for Repeatability & Scalability

- Simplicity
- Improve Productivity
  - Repeatability, Maintainability, Scalability
  - Documentation → Facilitate QA & QC, Design Review
- Training/Examples
  - Encapsulate best practices
  - Reusable templates

Python implementation - *Mosaic Dataset Configuration Script (MDCS)*

- Calling standard Geoprocessing tools from a single script
- Input configuration file contains complete information to:
  - Create,
  - Populate, and
  - Configure one mosaic dataset

  - Also generates detailed log files

Advantages of MDCS

- Configuration file encapsulates “Best practices” (mosaic dataset properties) based on image type

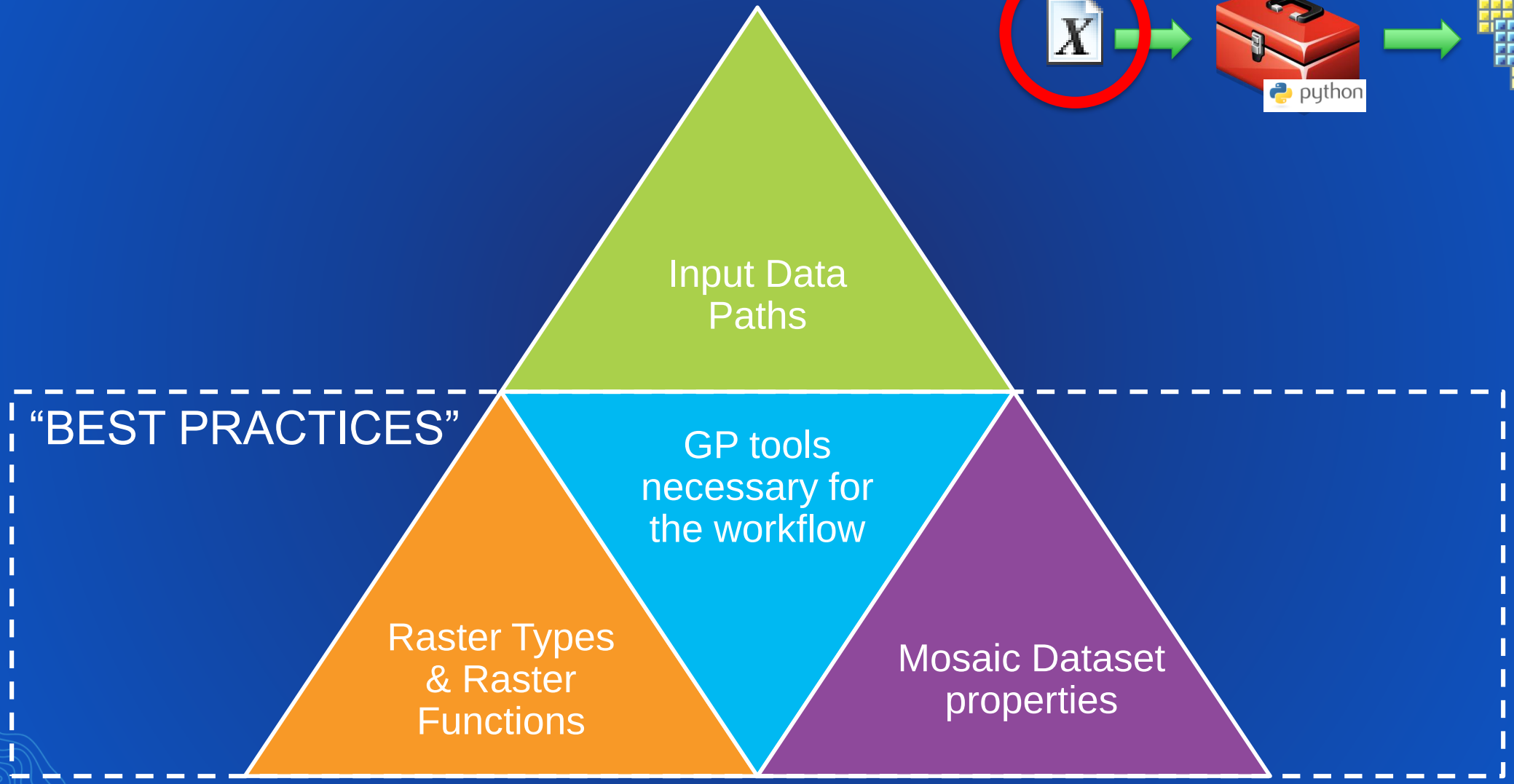
- “Self Documenting” –
  - Template is reusable for different image types, or multiple mosaic datasets within a more complex system
  - Compare versions (difficult with ModelBuilder)

- Automated Log files – Simple Review

Other features to note within MDCS

- Can run subsets of full configuration via command line options
- Built in version compatibility checks
- Extensible: additional commands can be added

Configuration file contents

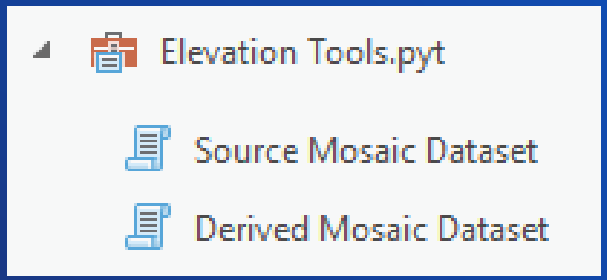


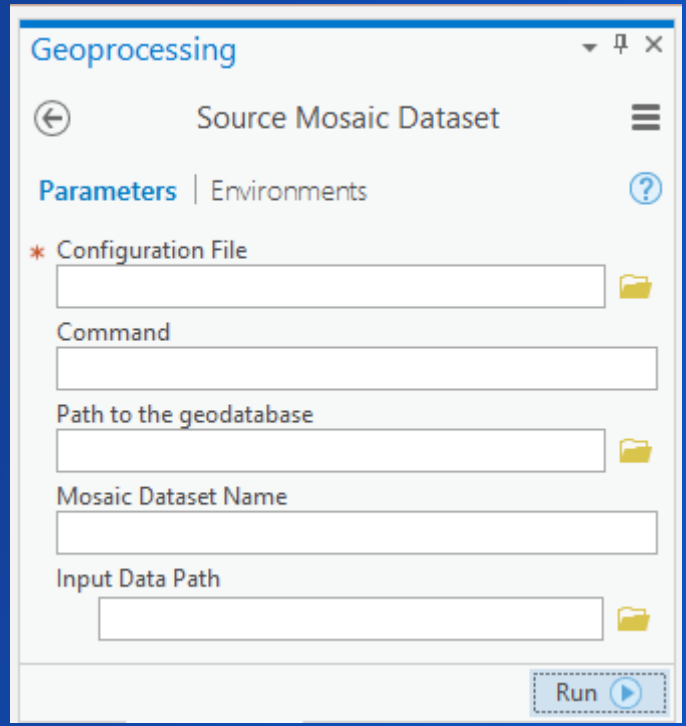
Configuration XML file

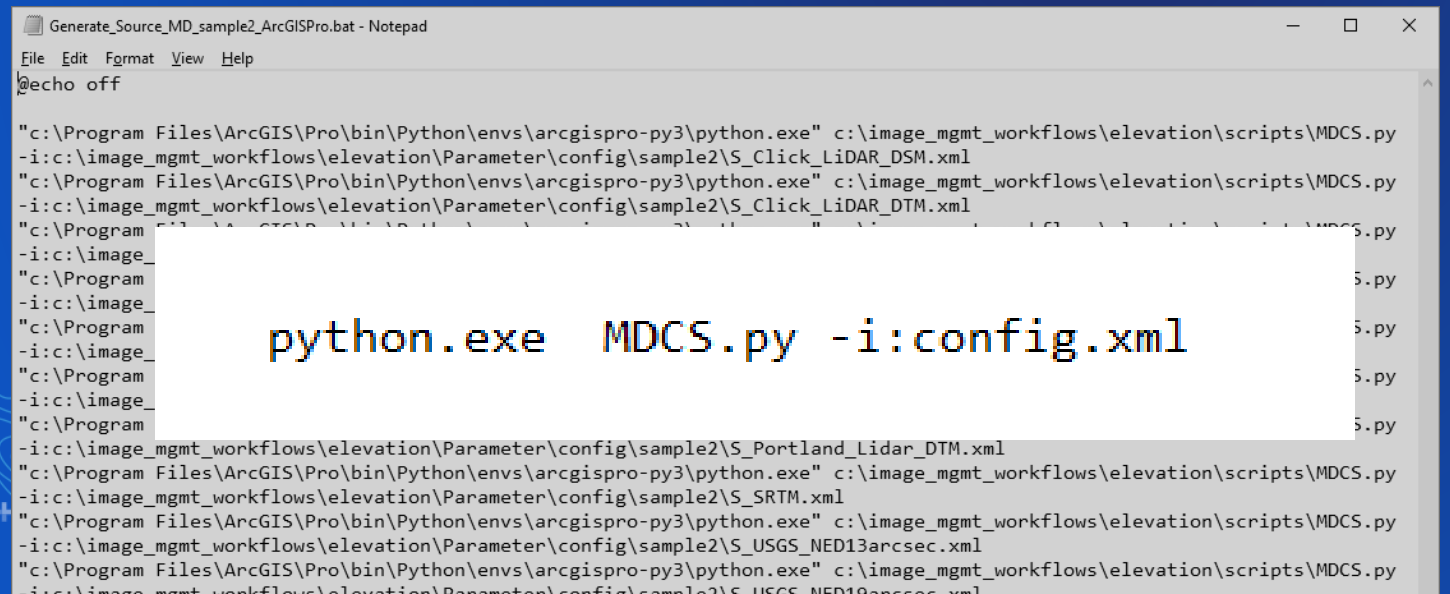

```
<AddRasters>
  <DefaultProperties>
    <RasterPerMosaic>50</RasterPerMosaic>
    <MaxRequestSizeX>4000</MaxRequestSizeX>
    <MaxRequestSizeY>4000</MaxRequestSizeY>
    <allowed_compressions>LZ77;NONE;LERC</allowed_compressions>
    <default_compression_type>LERC</default_compression_type>
    <CompressionQuality>75</CompressionQuality>
    <resampling_type>BILINEAR</resampling_type>
    <LERC_Tolerance>0.01</LERC_Tolerance>
    <clip_to_footprints>CLIP</clip_to_footprints>
    <clip_to_boundary>CLIP</clip_to_boundary>
    <color_correction>NOT_APPLY</color_correction>
    <footprints_may_contain_nodata>FOOTPRINTS_MAY_CONTAIN_NODATA</footprints_may_contain_no
    <allowed_mensuration_capabilities>BASIC</allowed_mensuration_capabilities>
    <default_mensuration_capabilities>BASIC</default_mensuration_capabilities>
    <allowed_mosaic_methods>LockRaster;ByAttribute;Seamline;None</allowed_mosaic_methods>
    <default_mosaic_method>ByAttribute</default_mosaic_method>
    <Order_field>BEST</Order_field>
    <order_base>0</order_base>
    <sorting_order>Ascending</sorting_order>
    <mosaic_operator>FIRST</mosaic_operator>
    <blend_width>10</blend_width>
    <view_point_x>300</view_point_x>
    <view_point_y>300</view_point_y>
    <max_num_per_mosaic>50</max_num_per_mosaic>
    <cell_size_tolerance>999</cell_size_tolerance>
    <cell_size>#</cell_size>
    <metadata_level>BASIC</metadata_level>
    <transmission_fields>Name;MinPS;MaxPS;LowPS;HighPS;ProductName;BEST;Source;LE90;CE90;D
    <use_time>DISABLED</use_time>
```

Elevation Scripts from Imagery Workflows

- Two downloads: sample scripts and data
- Command line batch files for programmatic implementation
- Geoprocessing GUI version for single mosaic datasets



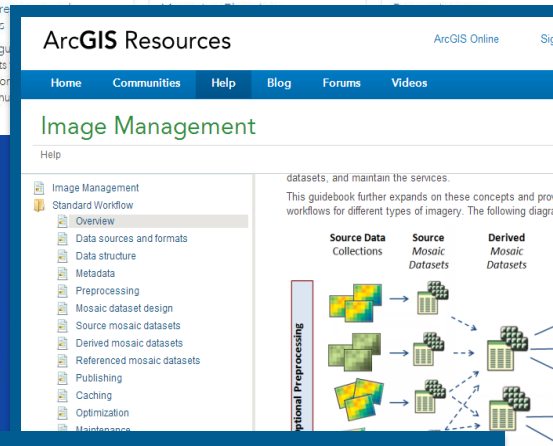


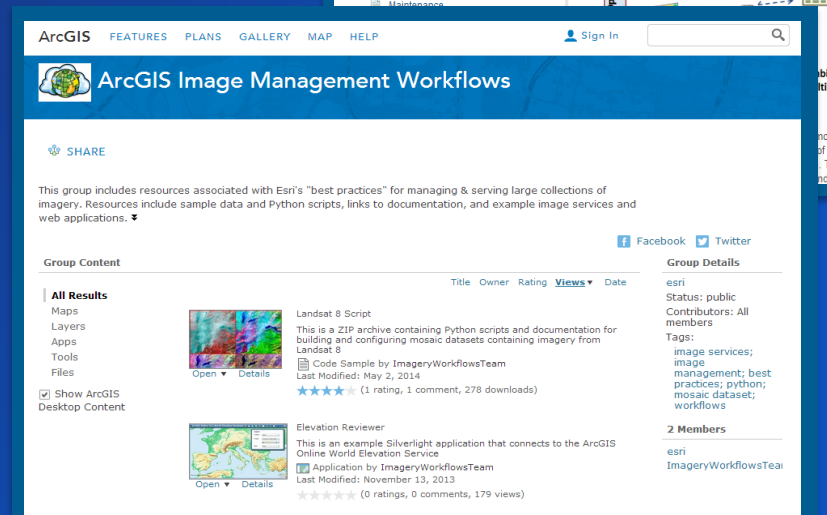


Imagery Workflows

Best Practice Workflows for Image Management, Analysis, & Use

- **Landing page**
  - http://esriurl.com/ImageryWorkflows
- **Workflow descriptions & best practices**
- **ArcGIS Online Group**
  - **Downloadable scripts & sample data**





Resources

- **Imagery Workflows:** http://esriurl.com/ImageryWorkflows
- **Elevation script:** http://www.esriurl.com/ElevationScript
- **Lidar workflow:** http://esriurl.com/LidarMgmt
- **ArcGIS Online Group:** http://esriurl.com/6539
- ***OptimizeRasters*:** http://esriurl.com/OptimizeRasters
- **MRF and LERC:** http://esriurl.com/MRF

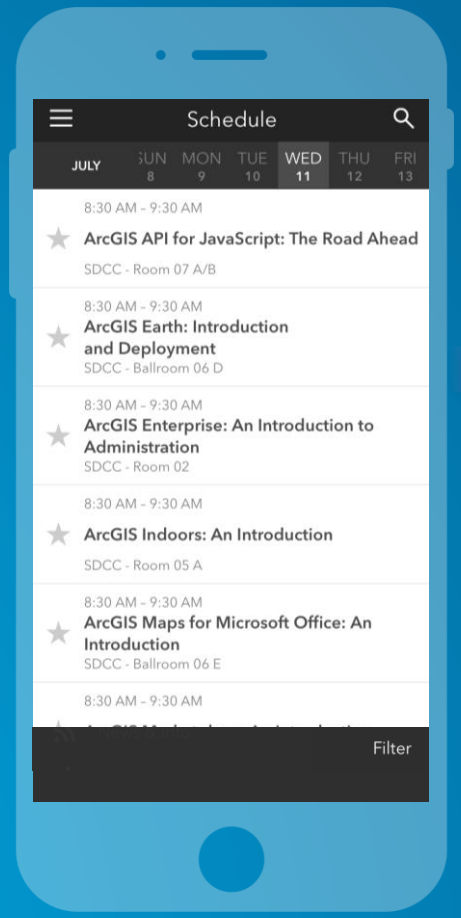
- **Optimized LAS tool:** http://esriurl.com/zlas
- **Tools from 3D Team:** http://links.esri.com/3dSamples

- **Contact information:**
  - Cody Benkelman cbenkelman@esri.com

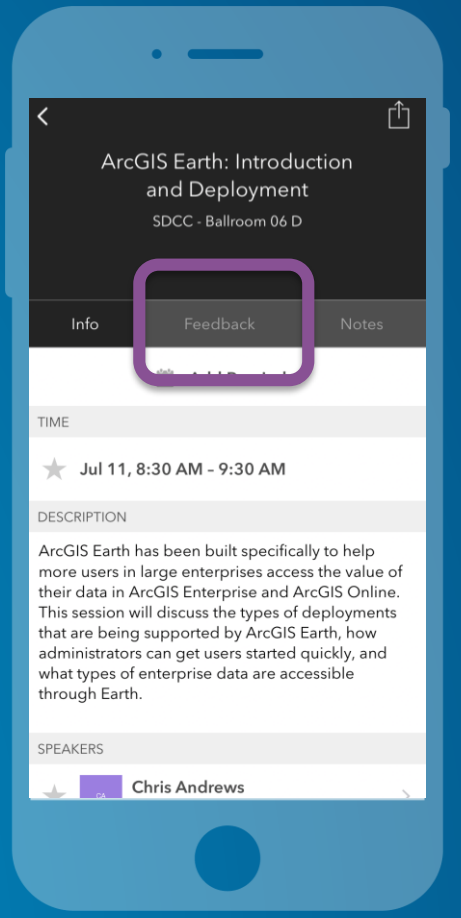
Please Take Our Survey on the App

Download the Esri Events app and find your event

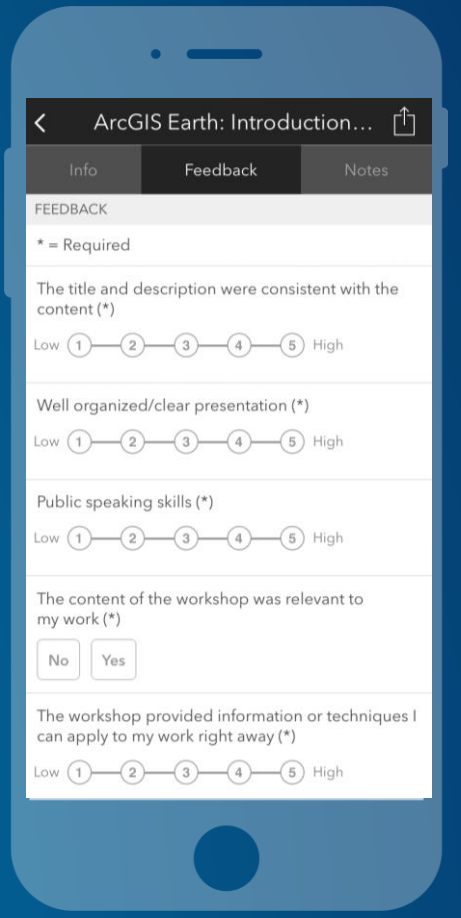
Select the session you attended



Scroll down to find the feedback section



Complete answers and select “Submit”



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