Managing and Serving Elevation and Lidar Data

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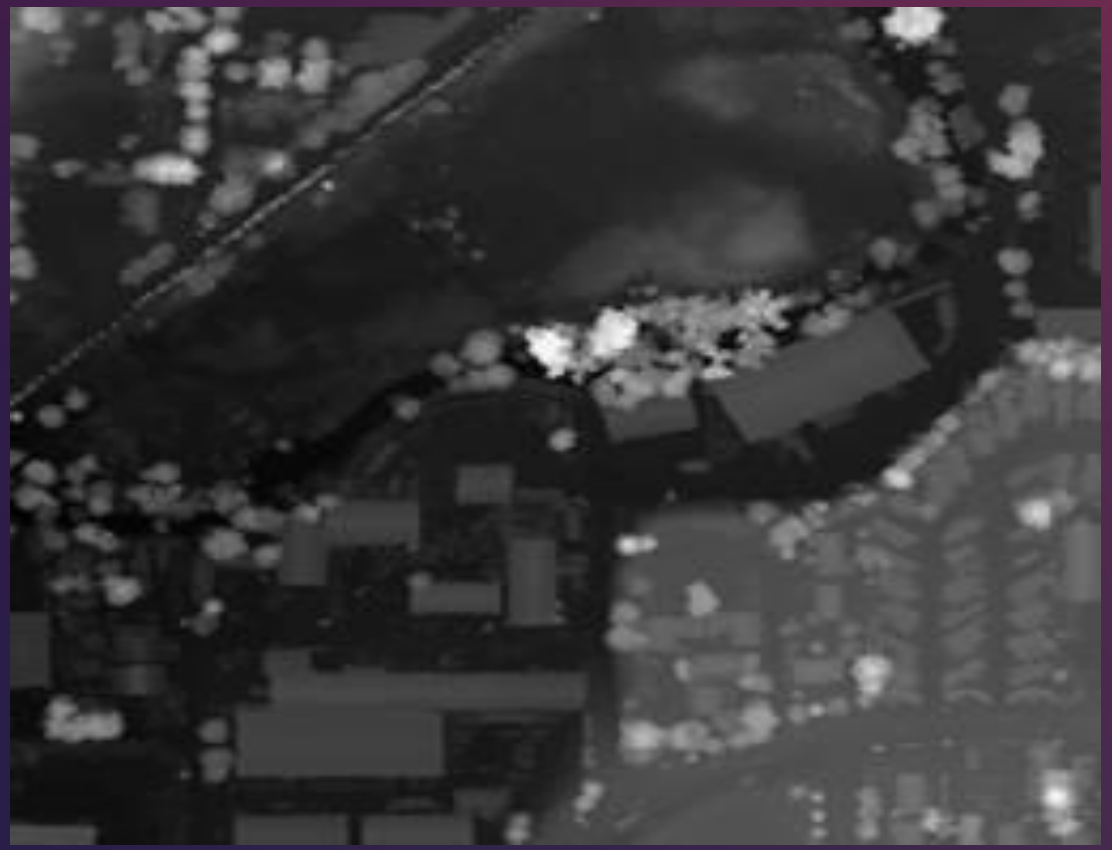
Outline

- Usage Modes
- Data Management
  - Architecture
  - Workflow
- Automation for Repeatability & Scalability
- A few options

Usage Modes of Elevation Data

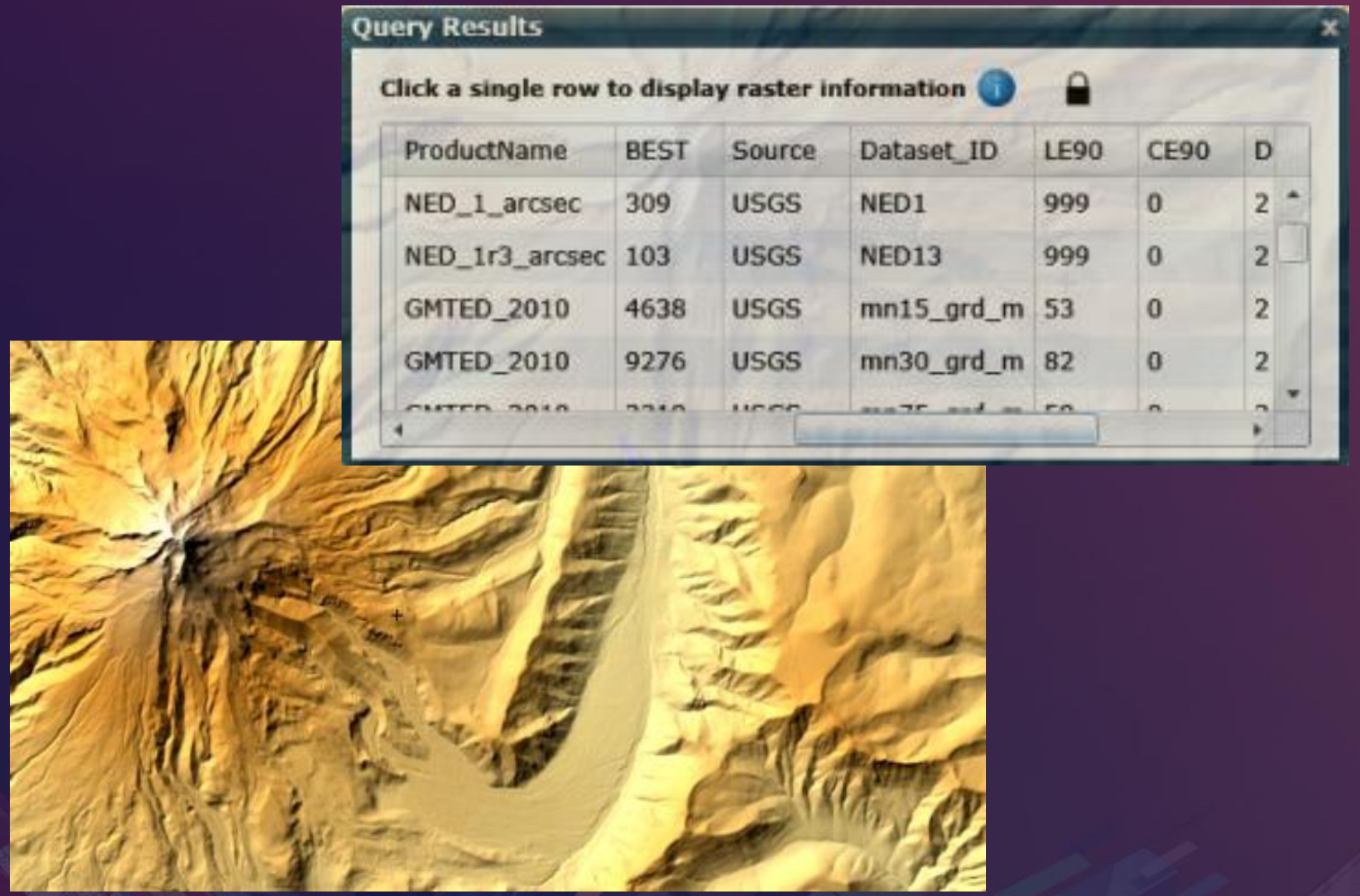
- Get Data Values
  - Orthorectification
  - Local analysis



Usage Modes of Elevation Data

- Get Data Values
  - Orthorectification
  - Local analysis

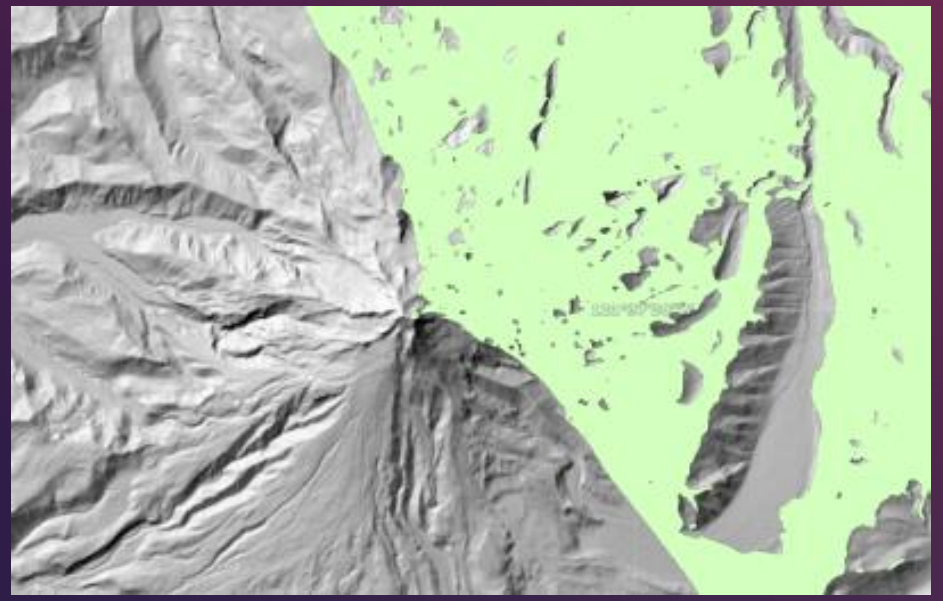
- Visual Interpretation
  - Including Metadata

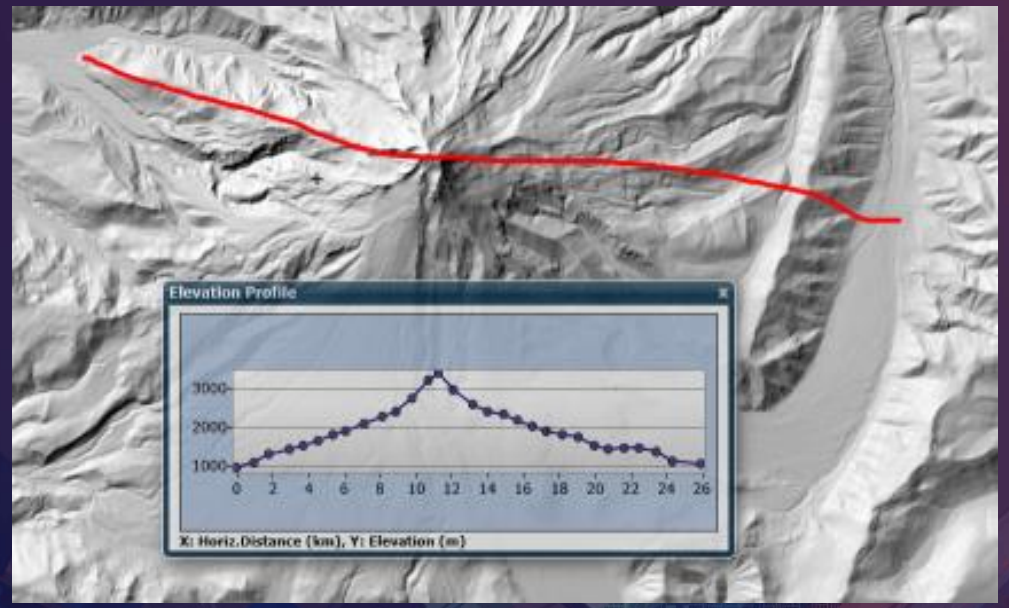


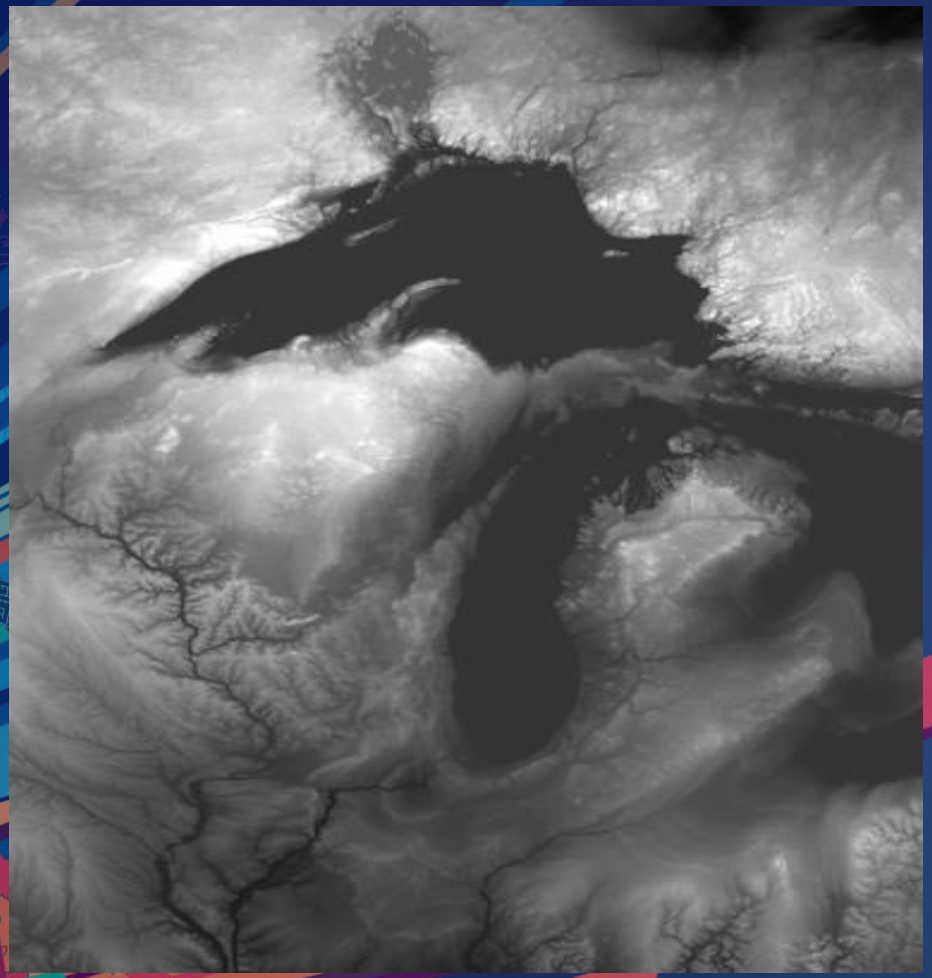
ProductName	BEST	Source	Dataset_ID	LE90	CE90	D
NED_1_arcsec	309	USGS	NED1	999	0	2
NED_1r3_arcsec	103	USGS	NED13	999	0	2
GMTED_2010	4638	USGS	mn15_grd_m	53	0	2
GMTED_2010	9276	USGS	mn30_grd_m	82	0	2

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)

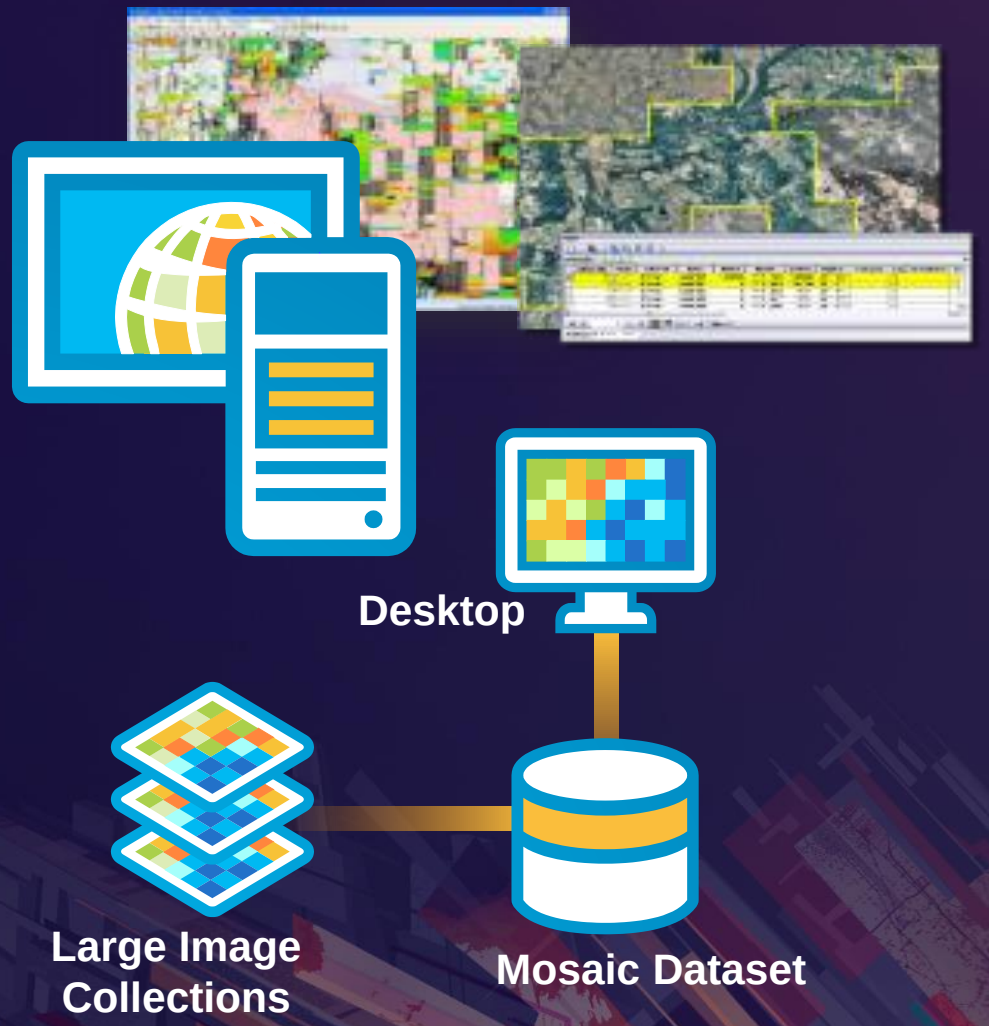
Data Management Objectives

- 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:

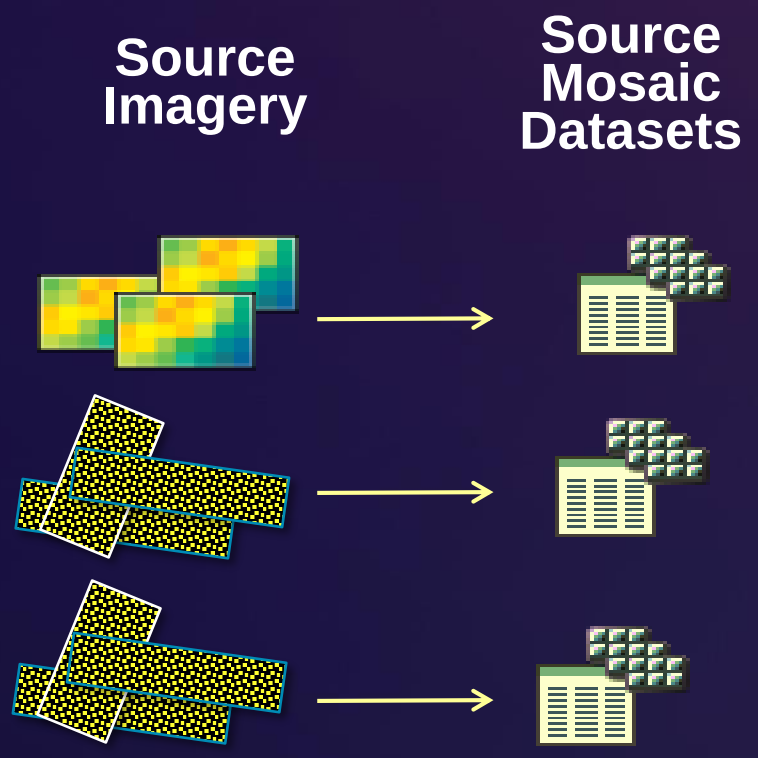
- On-the-fly Processing
- Dynamic Mosaicking

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

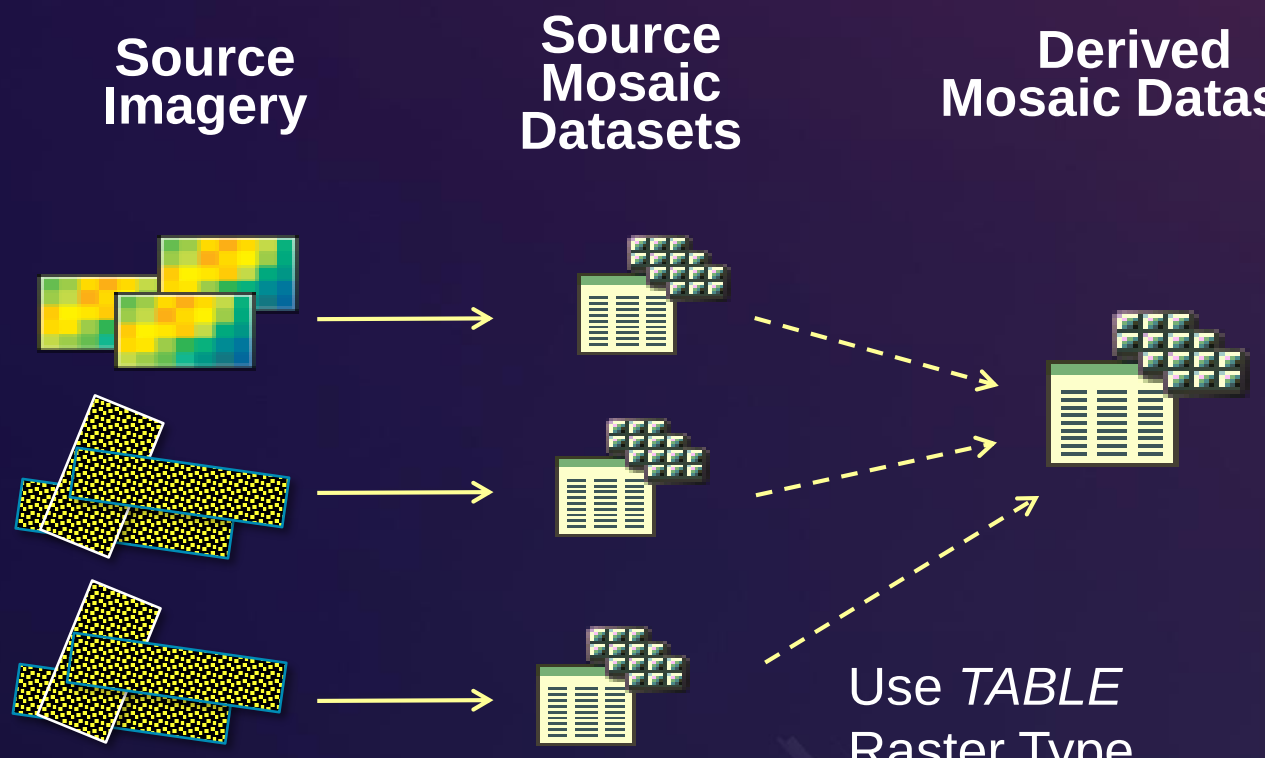


NED 10m

LiDAR Project #1

LiDAR Project #N

Combine into Derived Mosaic Dataset

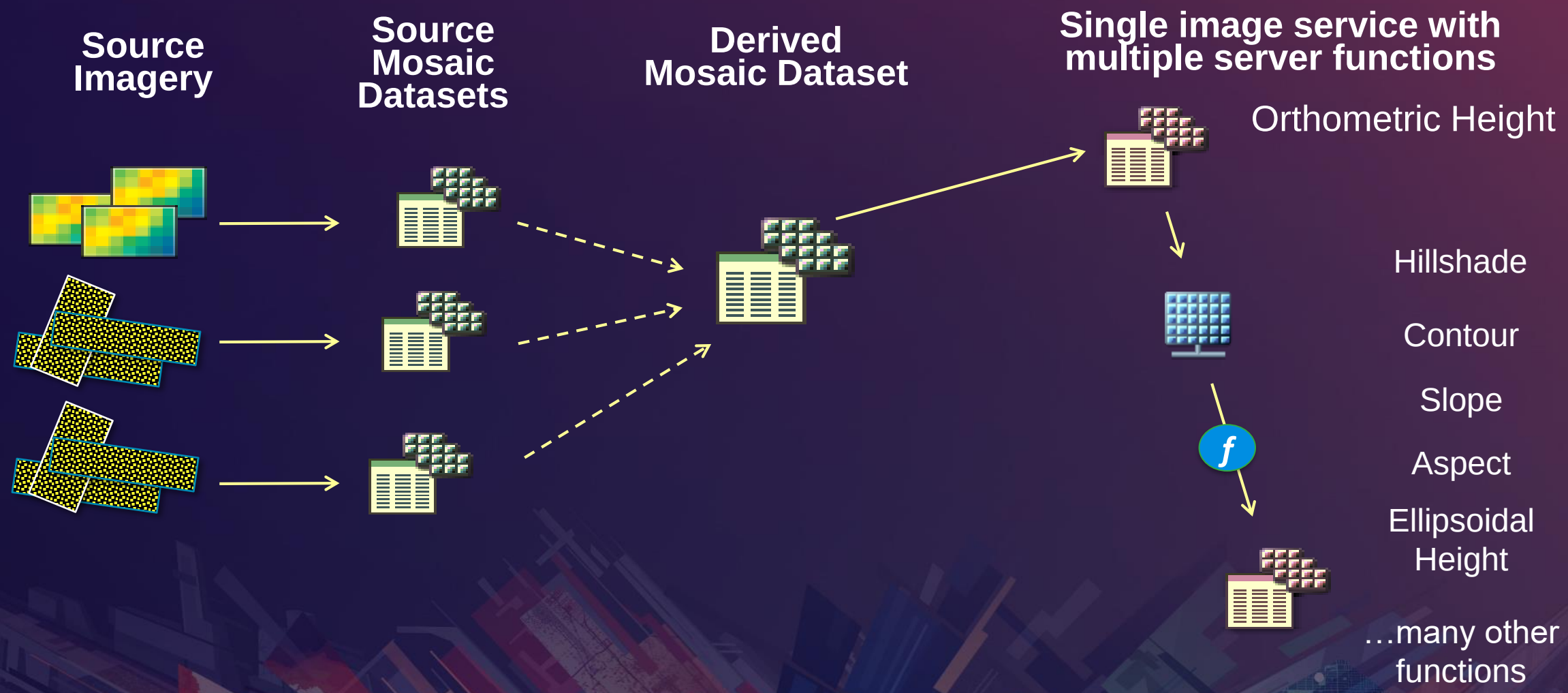


Multi-source, multi-resolution collection of elevation data

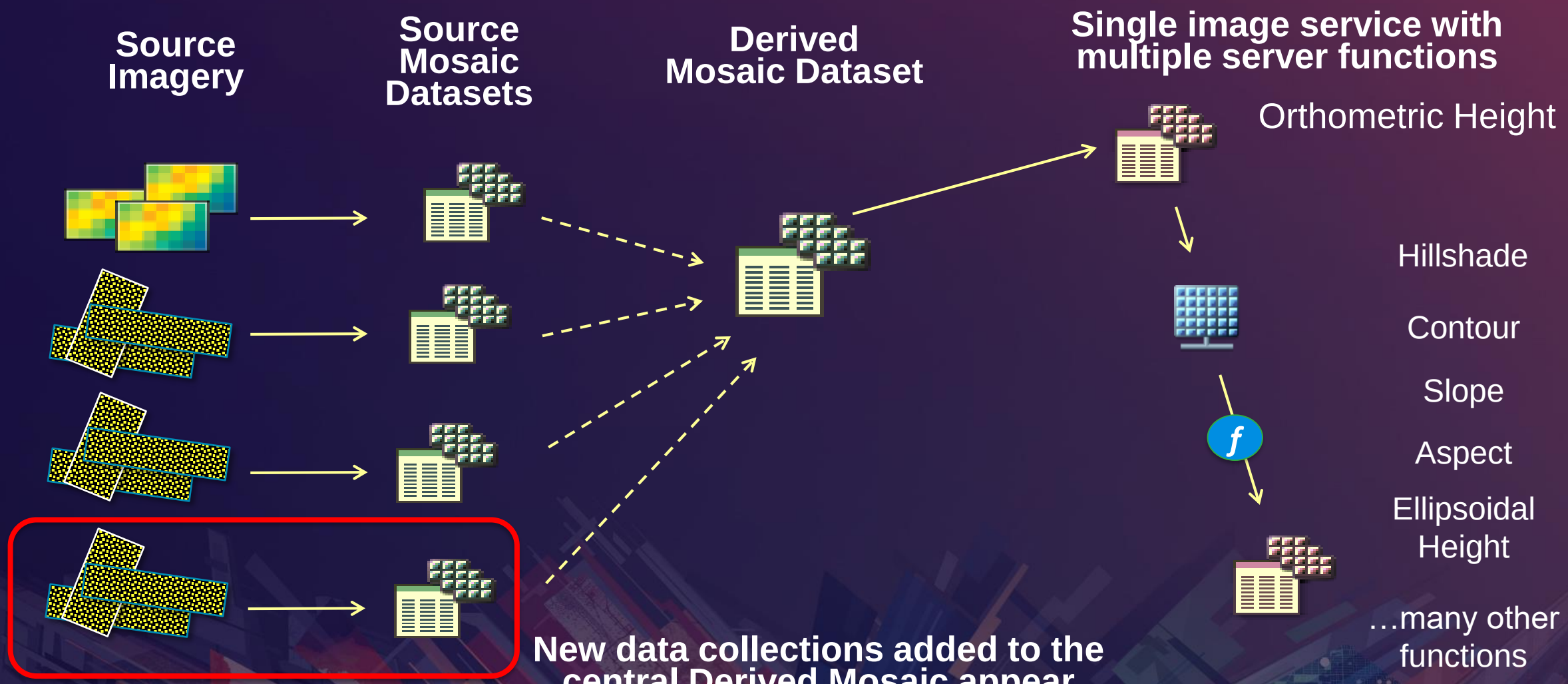
Use *TABLE* Raster Type

Advantage: All data available in a single location

Example – ArcGIS World Elevation – Server Raster Functions



Example – ArcGIS World Elevation – Update with new data

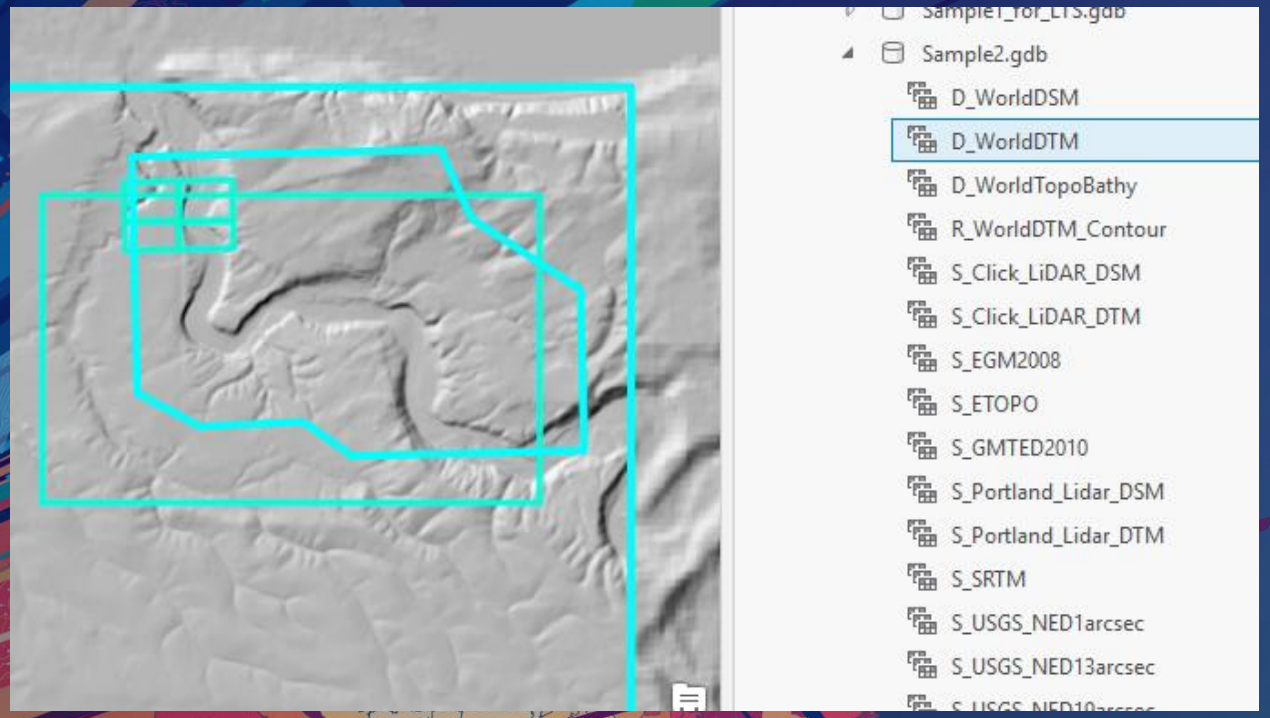


Create Source Mosaic Datasets

- 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
- <u>Assign</u> approximate statistics (do not calculate) *Set Raster Properties*
- Mosaic Method: By Attribute, “Best”



Geodatabase Model

Automated Build

MDCS

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

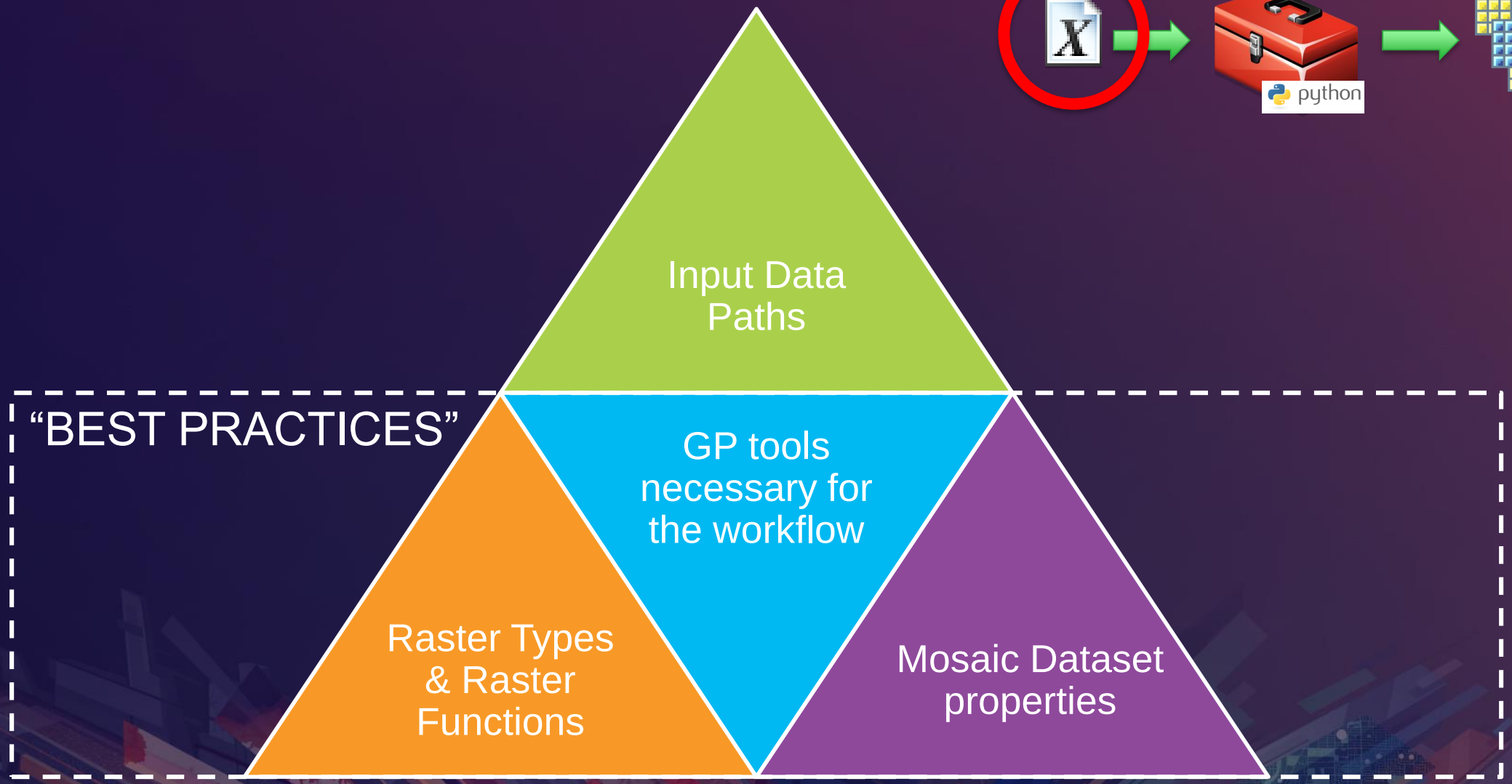
Advantages of MDCS

- 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
- Extensible: additional commands can be added

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

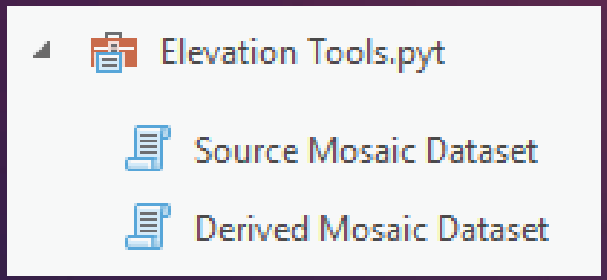


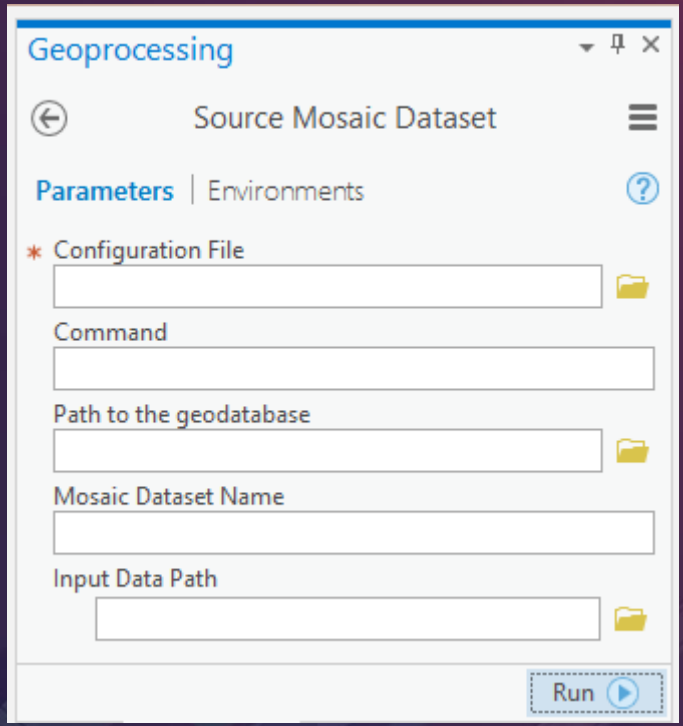
Configuration XML file

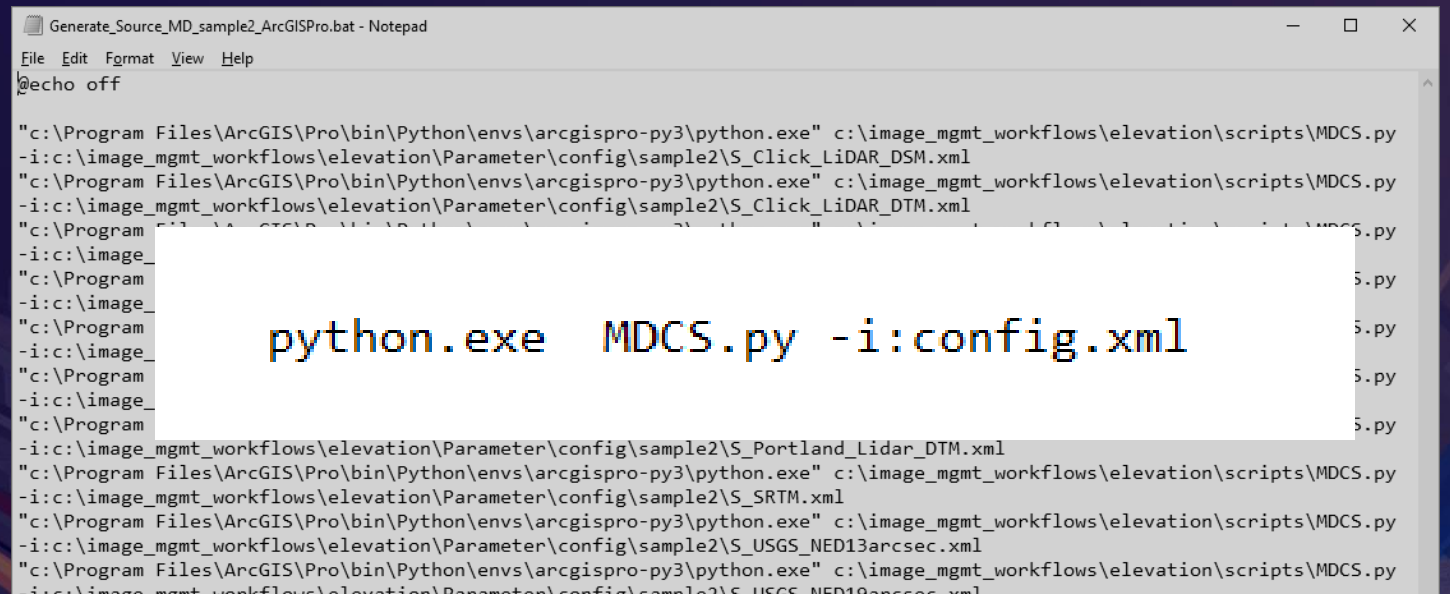

```
<AddRasters>
<DefaultProperties>
    <RasterPerMosaic>50</RasterPerMosaic>
    <MaxRequestSizeX>4000</MaxRequestSizeX>
    <MaxRequestSizeY>4000</MaxRequestSizeY>
    <allowed_compressions>LZ77;NONE;LERC</allowed_compressions>
    <default_compression_type>LERC</default_compression_type>
    <CompressionQuality>75</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
- Geoprocessing GUI version for simple introduction
- Command line batch files for programmatic implementation



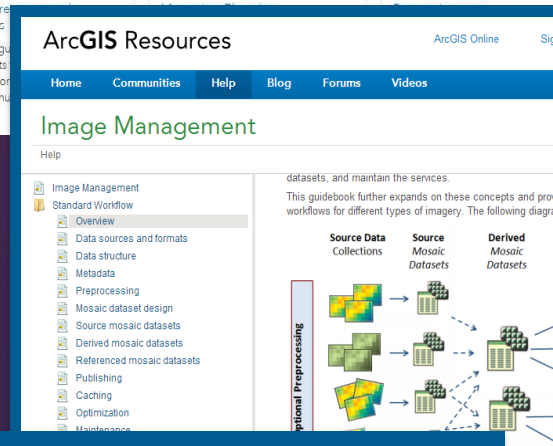


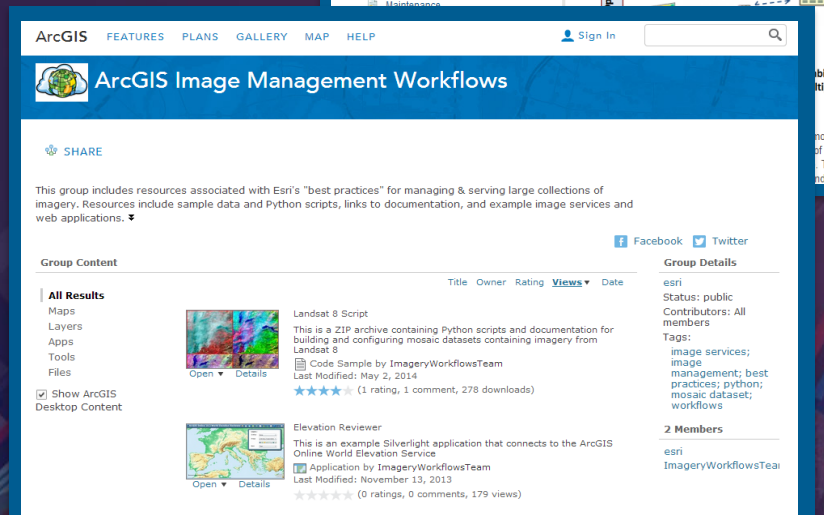


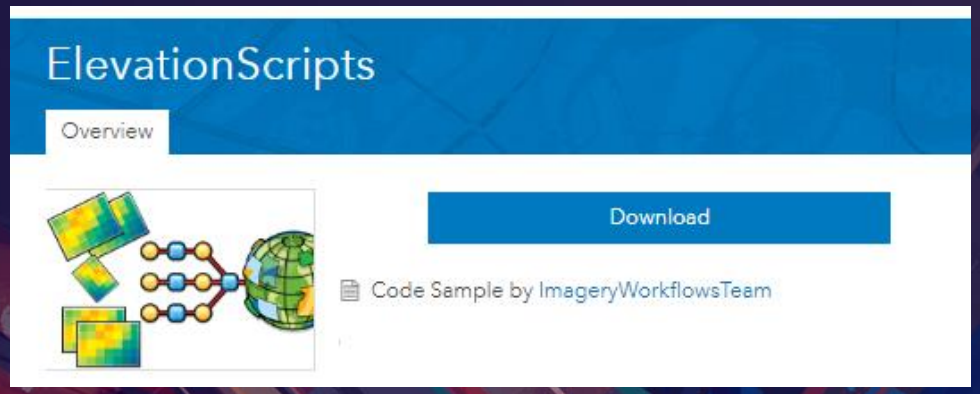
Imagery Workflows

Best Practice Workflows for Image Management, Analysis, & Use

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







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

Preprocessing

- **NOT typically necessary**
- **Restructure files (optional, but no resampling)**
  - **Tiled TIFF (5120 x 5120)**
  - **LZW or LERC compression**

- **Advanced (Next slide)**
  - **Copy data to cloud storage**
  - **MRF Format (optional)**
  - *OptimizeRasters* **tool**

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

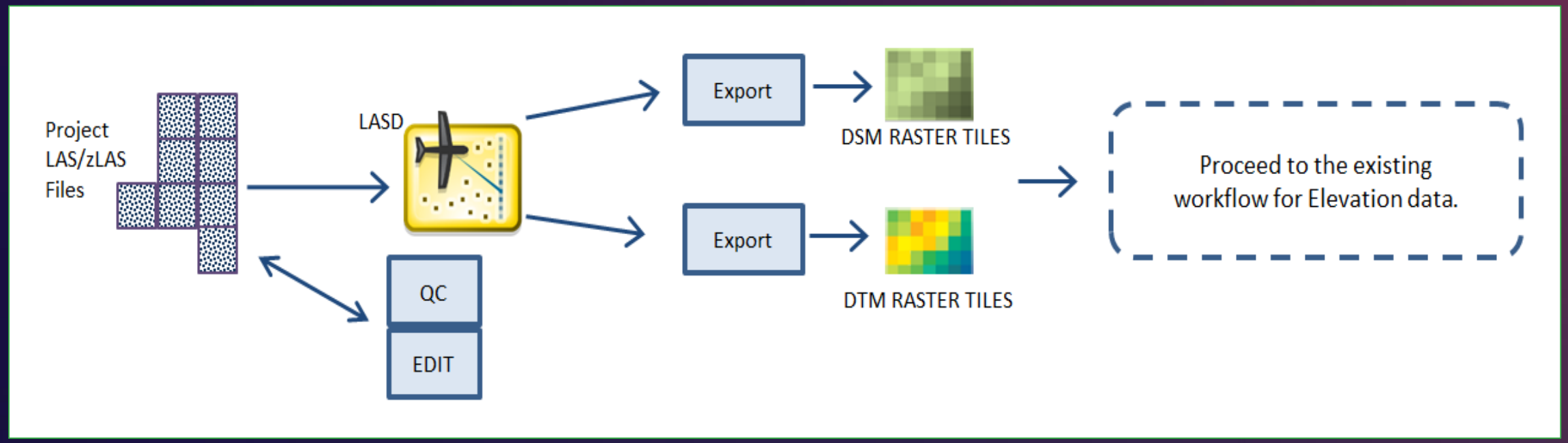
- MRF and LERC: http://esriurl.com/MRF

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”

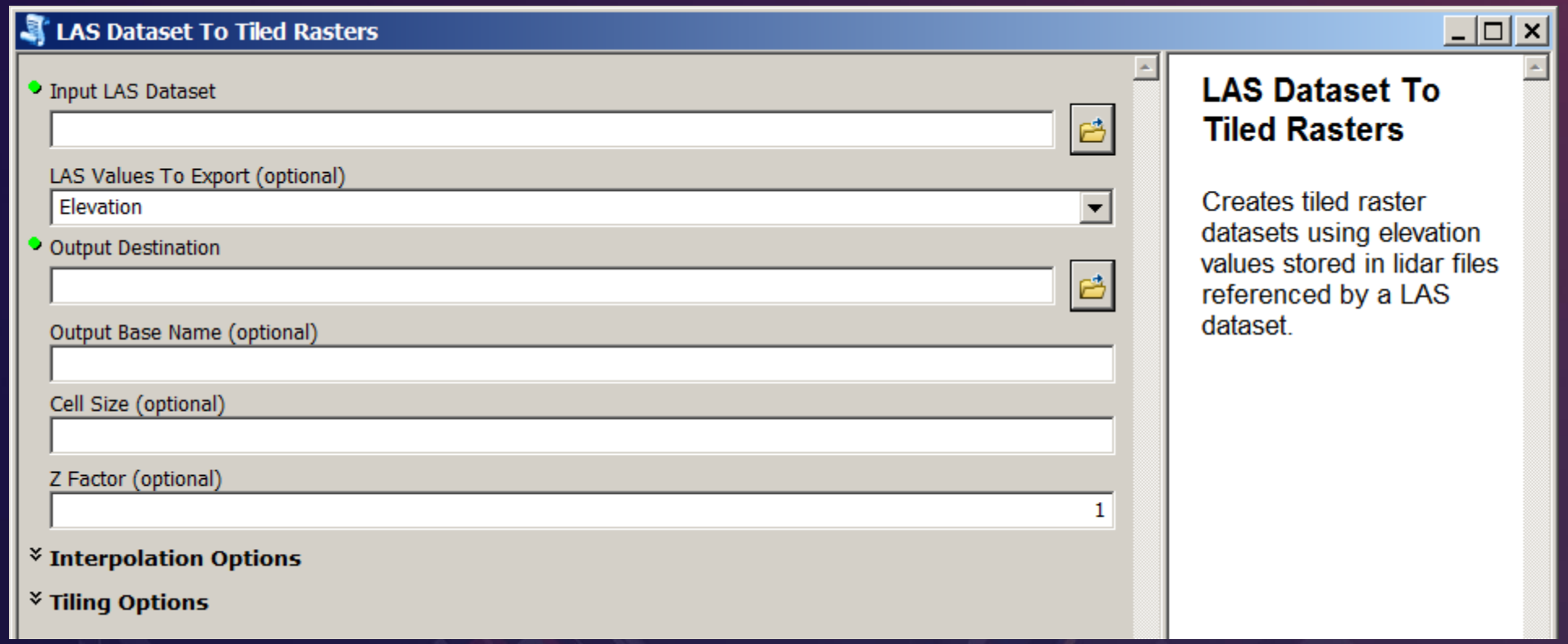


- Recommended method for best scalability
- Test before export to define best parameters
- Ensure tiles overlap
- Lidar data may be moved to offline storage

Data volume for DTM ~10% of LAS

DSM add another ~10%

Tool: LAS Dataset to Tiled Rasters



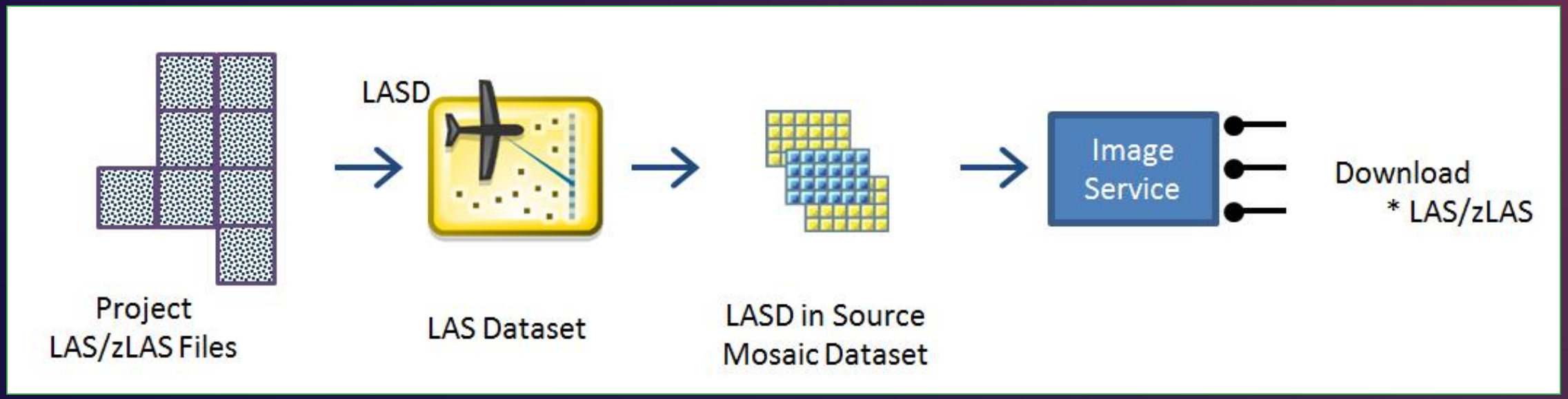
Download from http://links.esri.com/3dSamples

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://esrirurl.com/PublishI3S

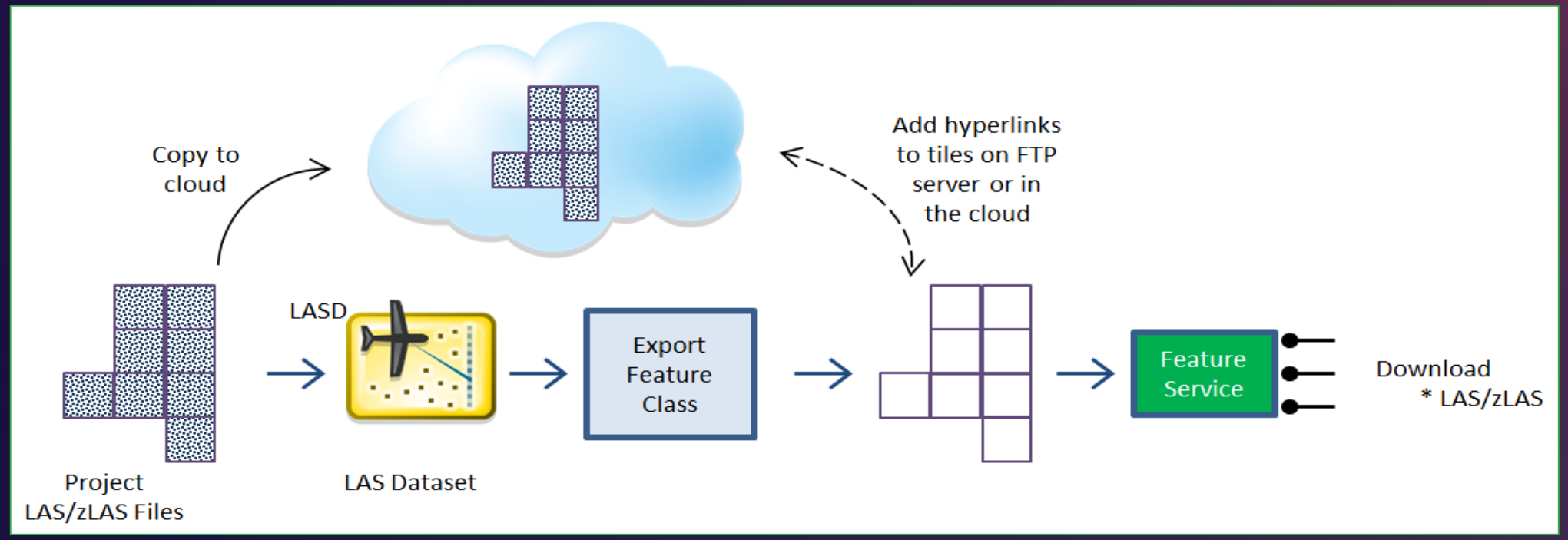
Streaming 3D points via *.i3s

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**

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



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

Resources

- **Imagery Workflows: http://esriurl.com/ImageryWorkflows**
- **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** (ArcMap 10.x only)

- **Contact information:**
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