Workflows for Managing and Serving Elevation (and Lidar) Data

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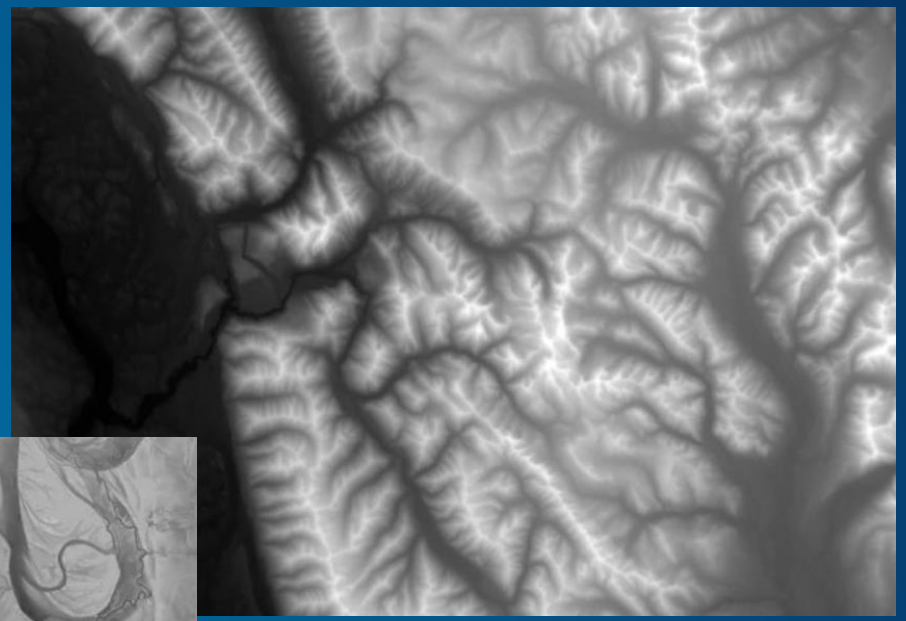
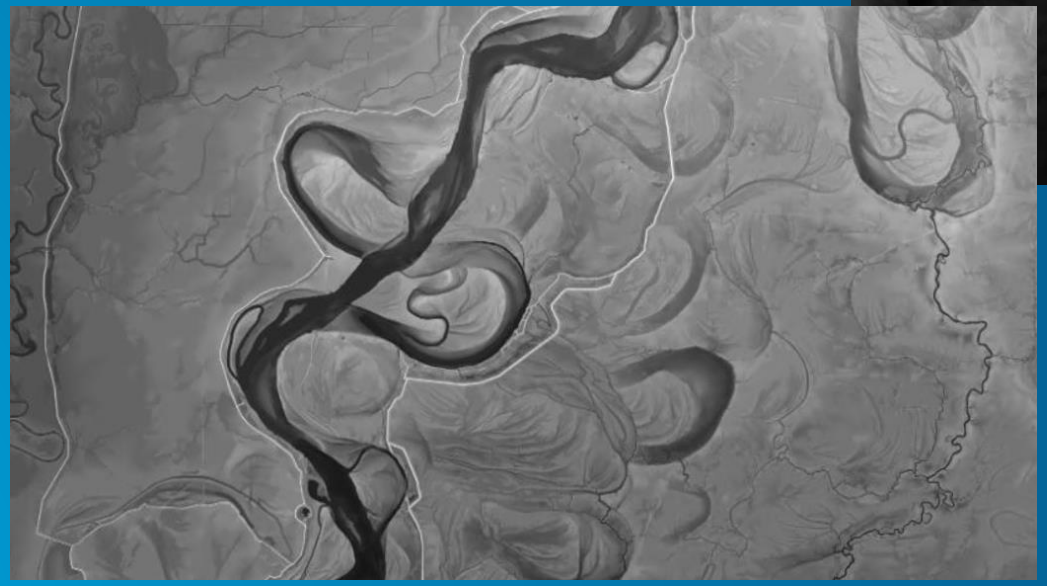
Outline

- 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**



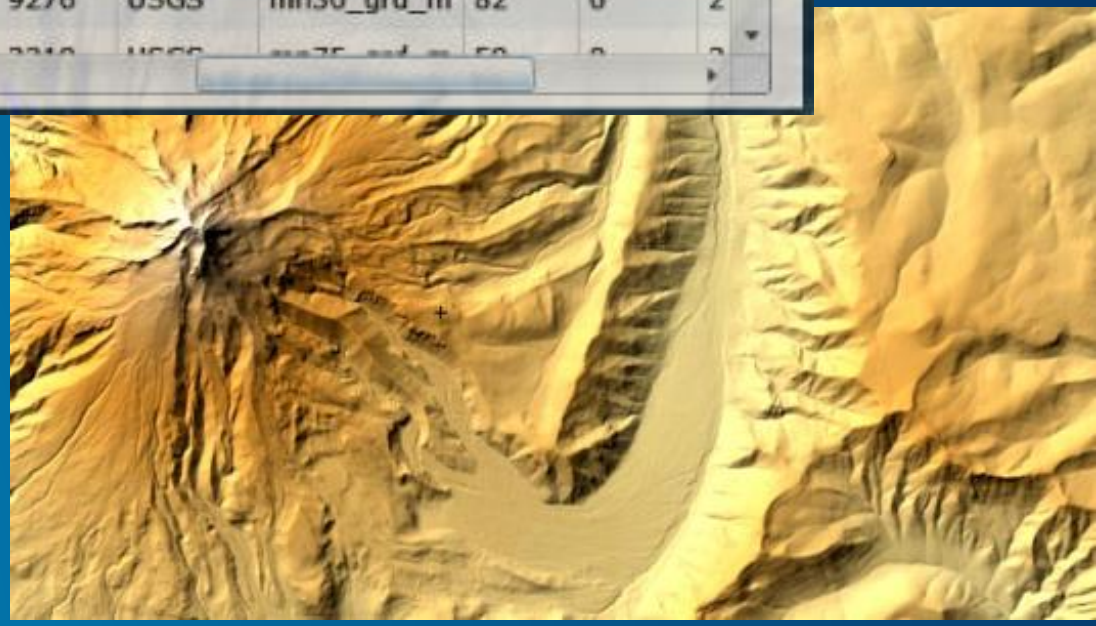


Usage Modes of Elevation Data

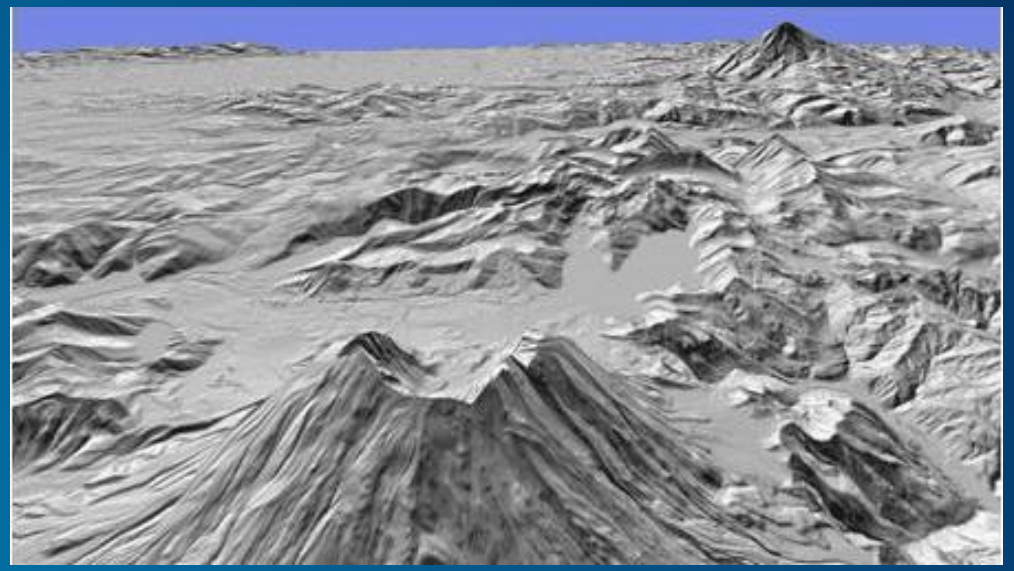
- Get Data Values
  - Orthorectification
  - Local analysis

- **Visual Interpretation**
  - **Including Metadata**
  - **Faster performance** *(8 bit jpg vs. float 32)*

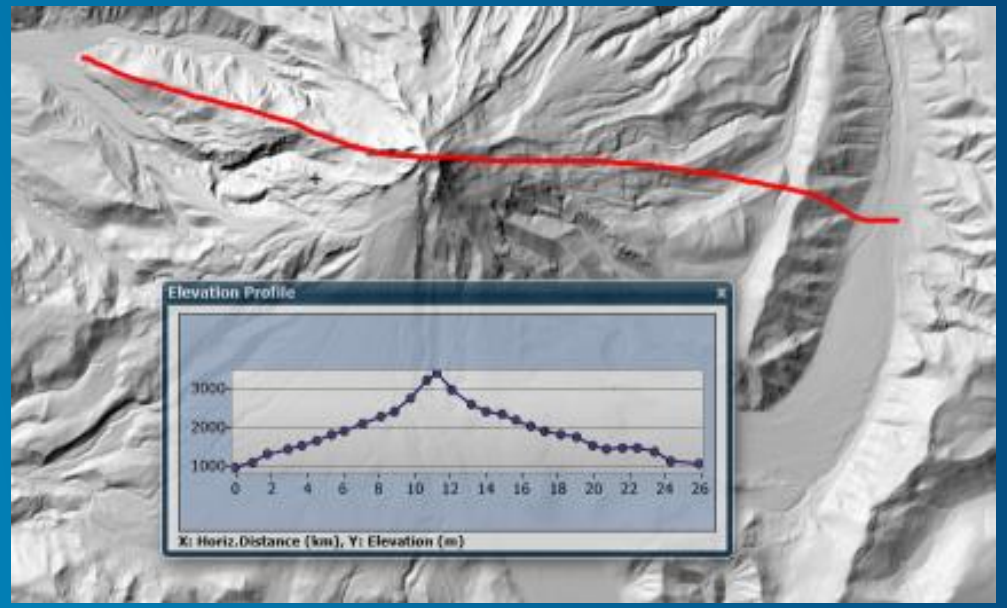
ProductName	BEST	Source	Dataset_ID	LE90	CE90	D
NED_1_arcsec	309	USGS	NED1	999	0	2
NED_1r3_arcsec	103	USGS	NED13	999	0	2
GMTED_2010	4638	USGS	mn15_grd_m	53	0	2
GMTED_2010	9276	USGS	mn30_grd_m	82	0	2

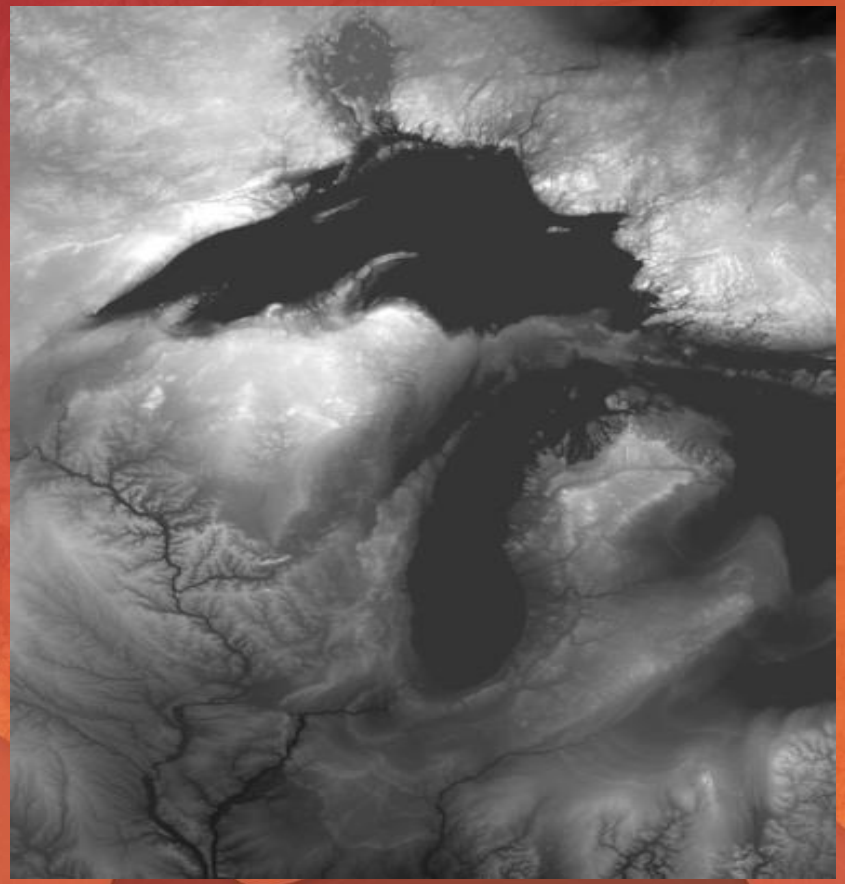


Usage Modes of Elevation Data



- Get Data Values
  - Orthorectification
  - Local analysis
- Visual Interpretation
  - Including Metadata
  - Faster performance *(8 bit jpg vs. float 32)*
- **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

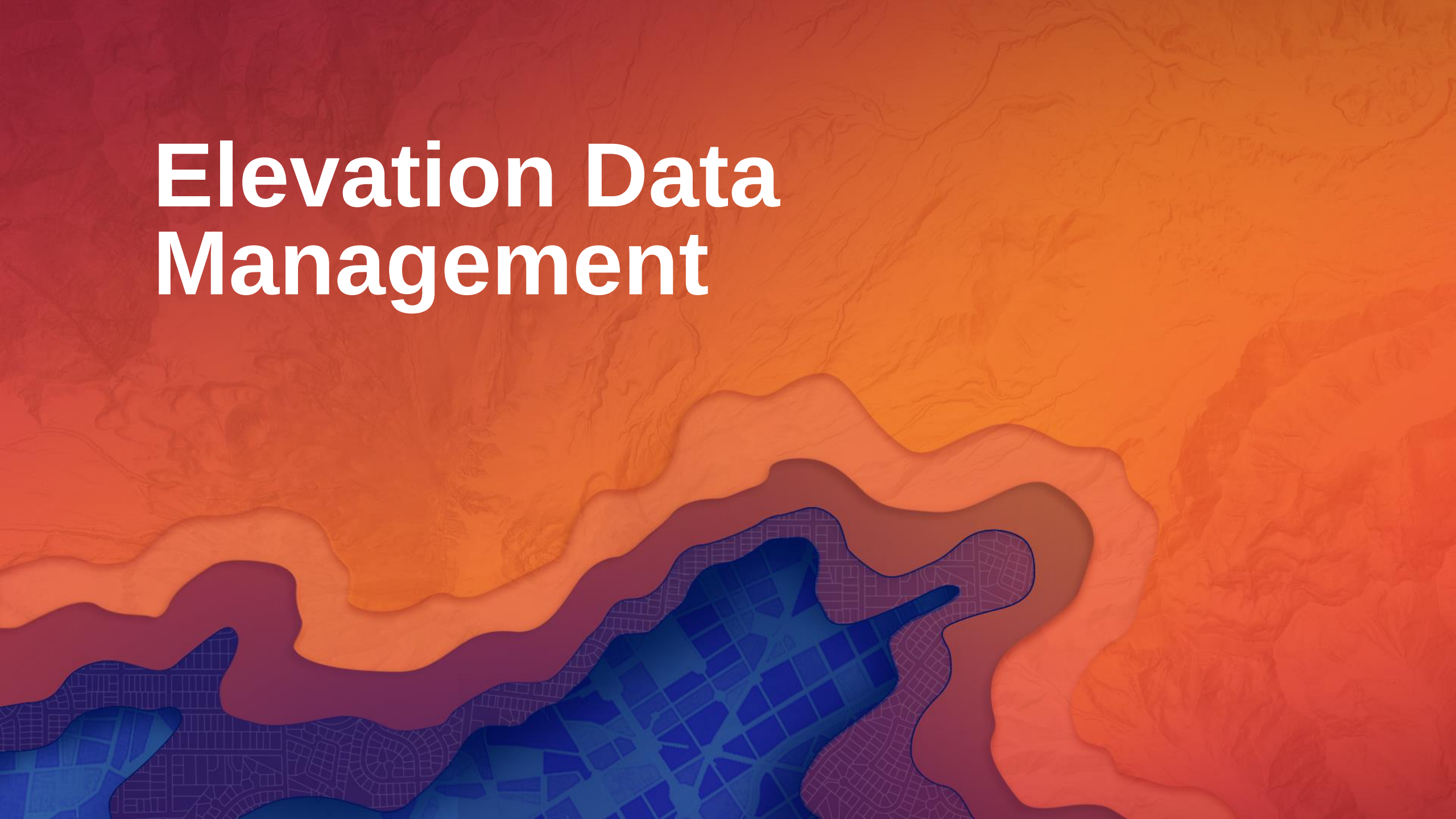
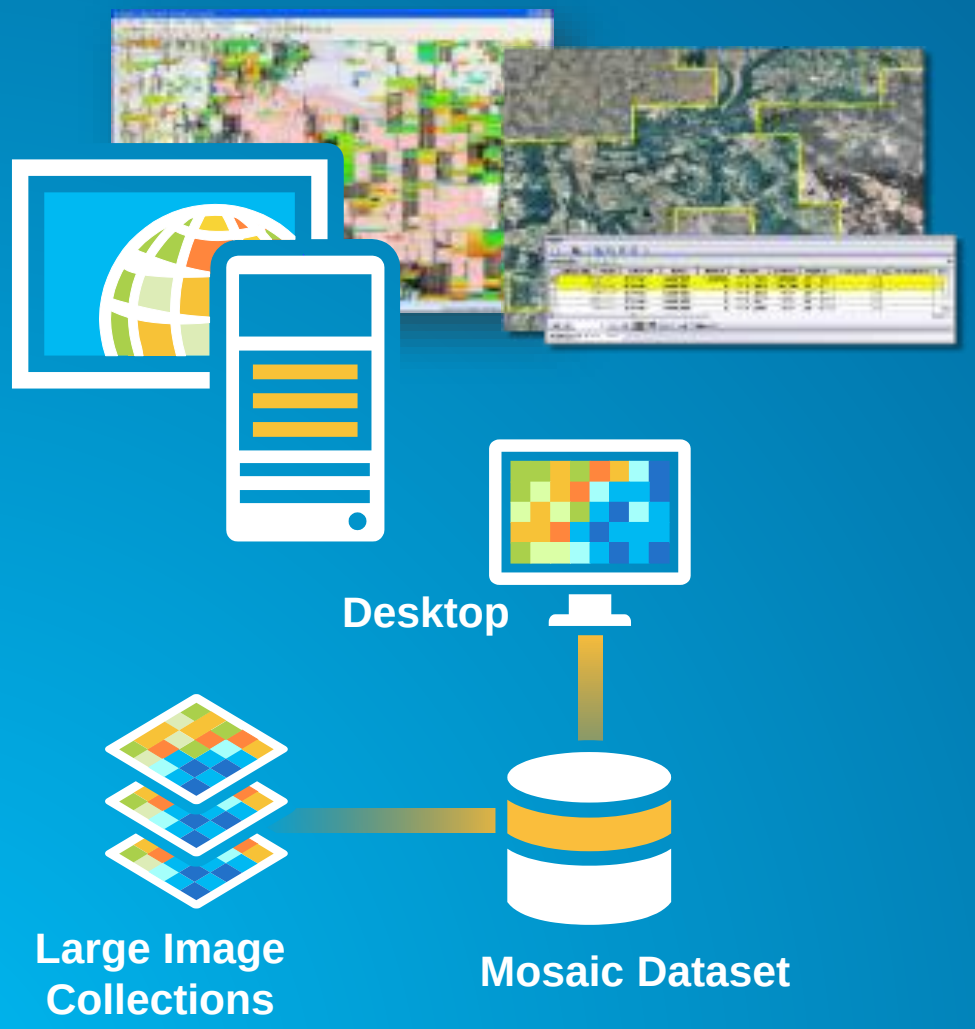


Image Management Workflow Using Mosaic Datasets

Highly Scalable, From Small to Massive Volumes of Imagery



Create Catalog of Imagery

- Reference Sources
- Ingest & Define Metadata
- Define Processing to be Applied

Apply:

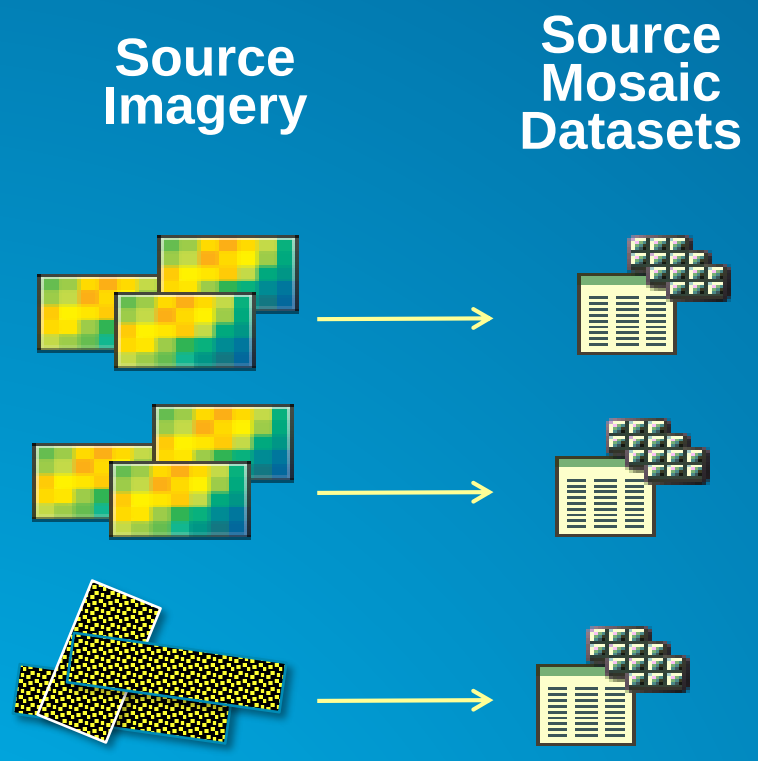
- On-the-fly Processing
- Dynamic Mosaicking

Access as Image or Catalog

Mosaic Dataset Design

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

Source Mosaic Datasets – Elevation & Lidar example



SRTM

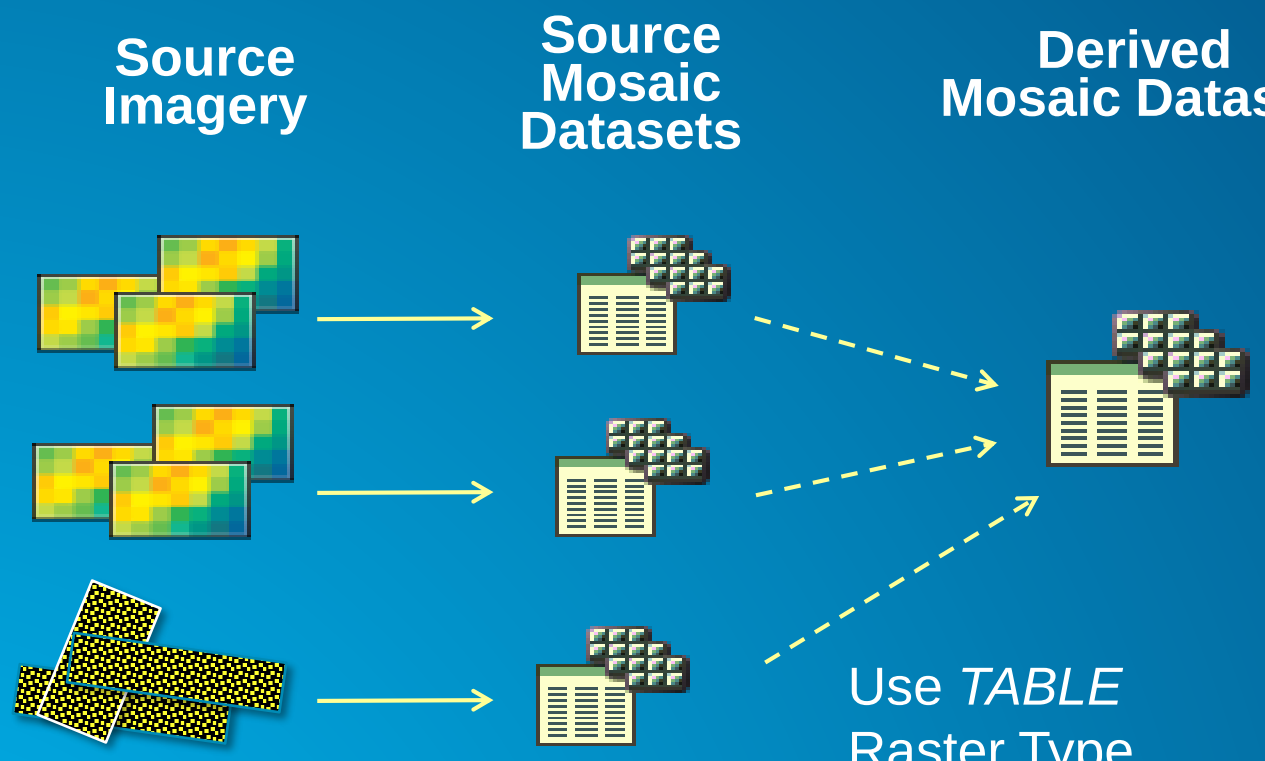
NED 1/3 arcsec

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

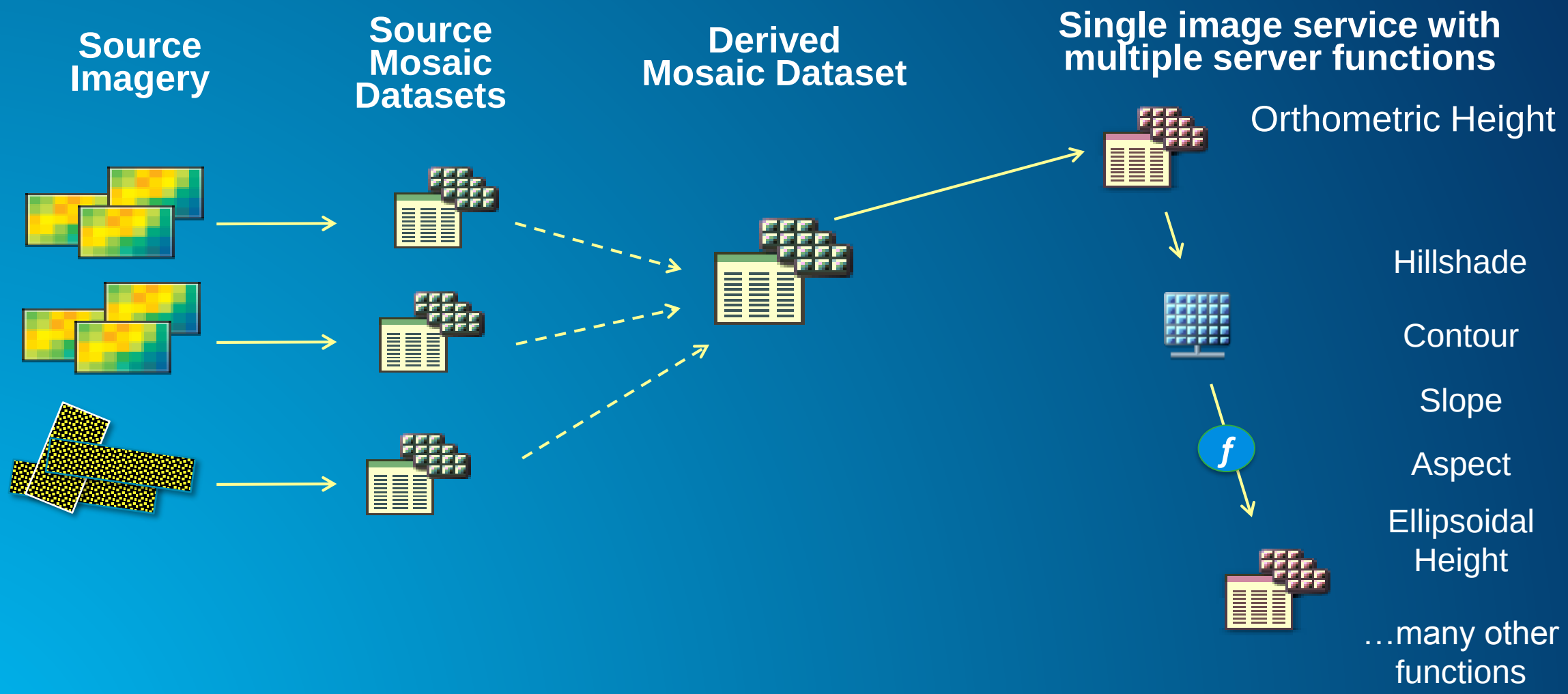


Multi-source, multi-resolution collection of elevation data

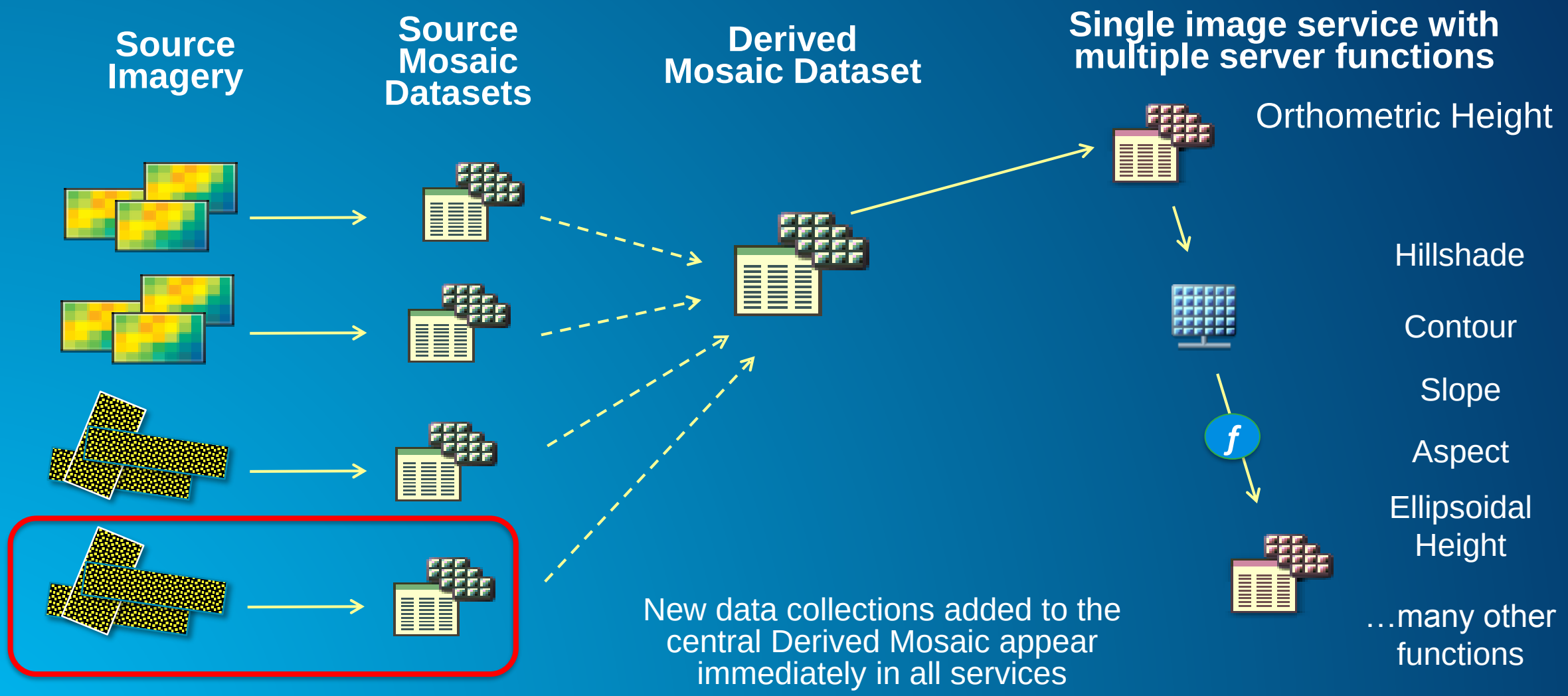
Use *TABLE* Raster Type

Advantage: All data available in a single location

Example – ArcGIS World Elevation – Server Raster Functions



Example – ArcGIS World Elevation – Update with new data



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

Automated Build

2 slides, then fast demo in Pro

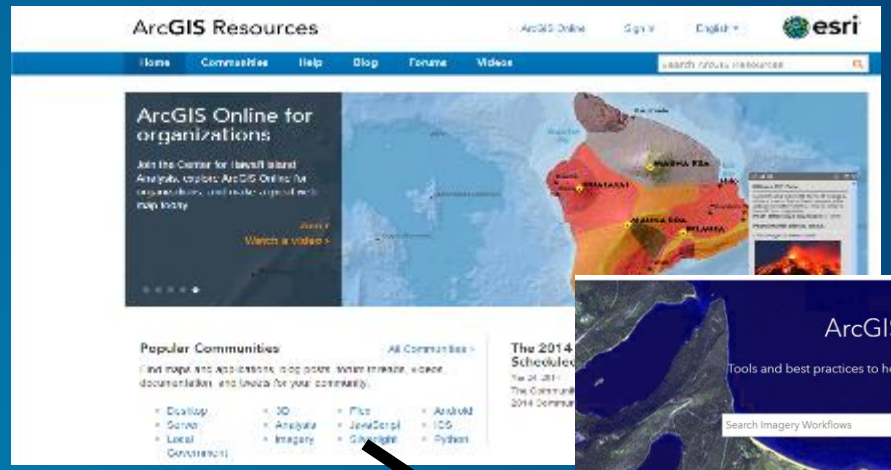
Automated Workflows – for Repeatability & Scalability

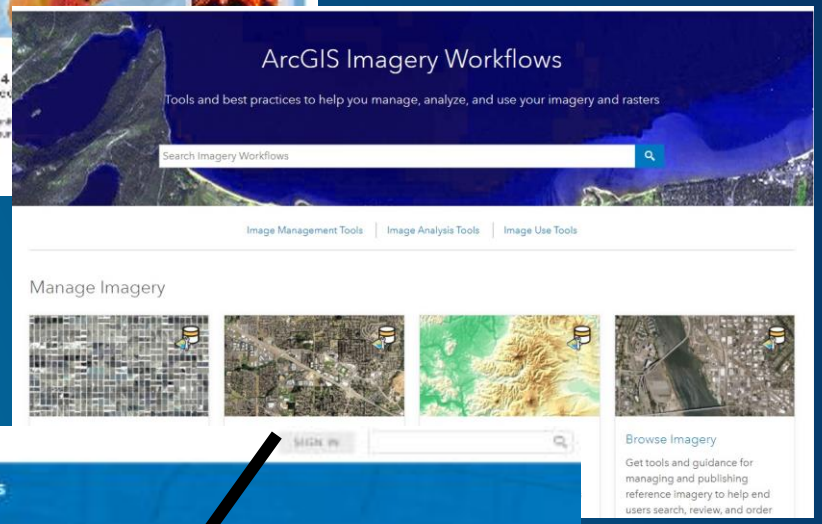
- Simplicity
- Improve Productivity
  - Repeatability, Maintainability, Scalability
  - Documentation → Facilitate QA & QC, Design Review
- Training/Examples
  - Encapsulate best practices
  - Reusable templates

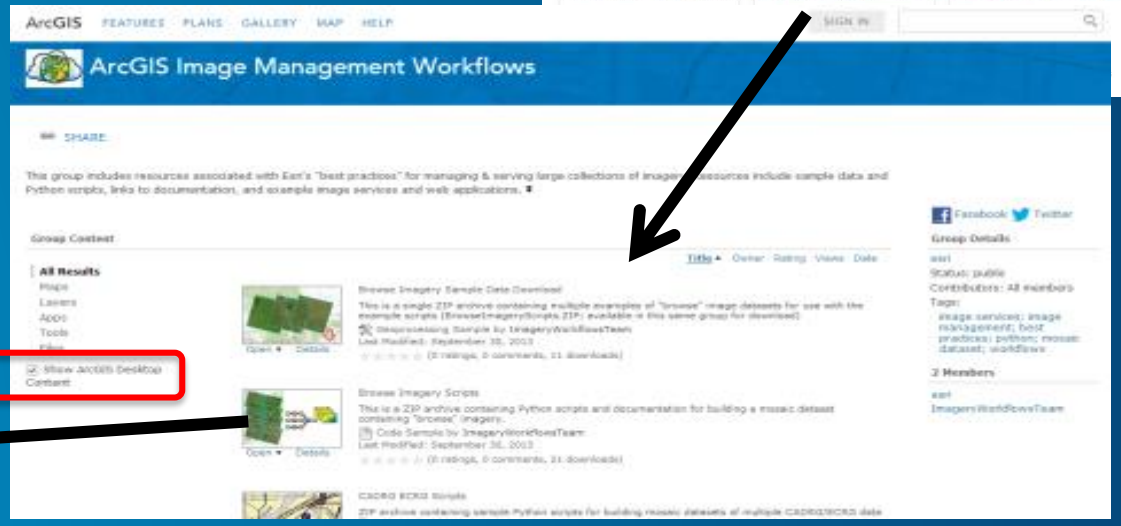
Image Management Workflows – Landing page

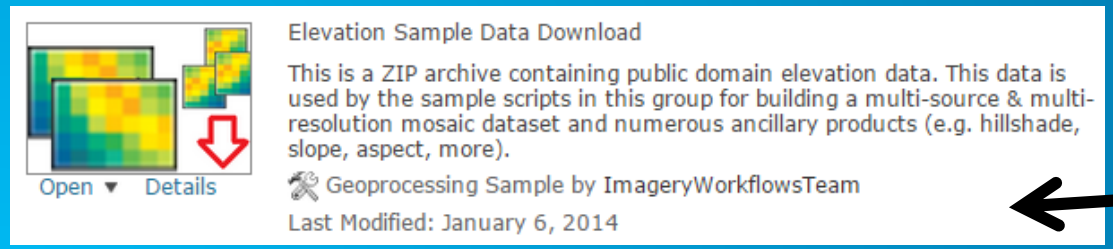
http://resources.arcgis.com

- 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

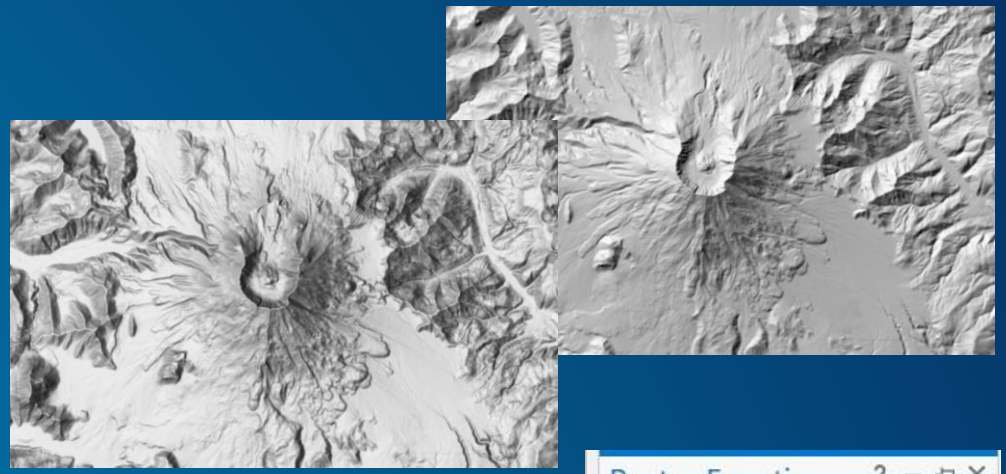
Sharing / Serving from the Cloud

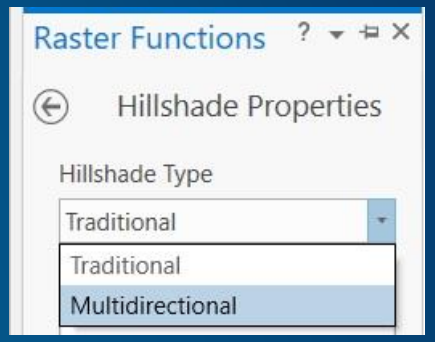
- **NASA Meta-Raster Format (MRF) for S3 storage**
  - **Optimized for simple cloud storage (S3)**
  - **Mosaic Dataset accesses local file (e.g. can configure on Desktop, copy all to cloud)**
  - ***OptimizeRasters* Geoprocessing tool http://esriurl.com/OptimizeRasters**

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

- See whitepaper: **http://esriurl.com/MRF**

Additional Raster Functions



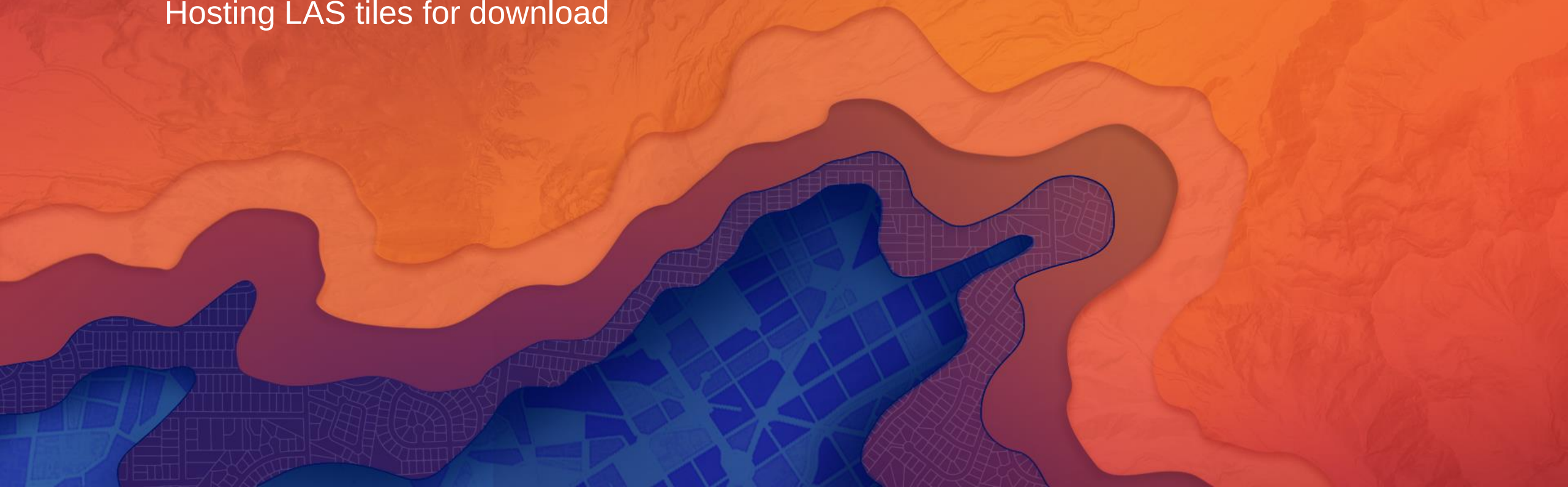


- **Multidirectional Hillshade**
  - http://esriurl.com/MultiDirHillshadeFunction
  - **Now part of core ArcGIS Pro 2.0**
- **Raster Contours**
  - http://esriurl.com/ContourFunction
  - **Not yet built into core – must download & install**

Lidar workflow

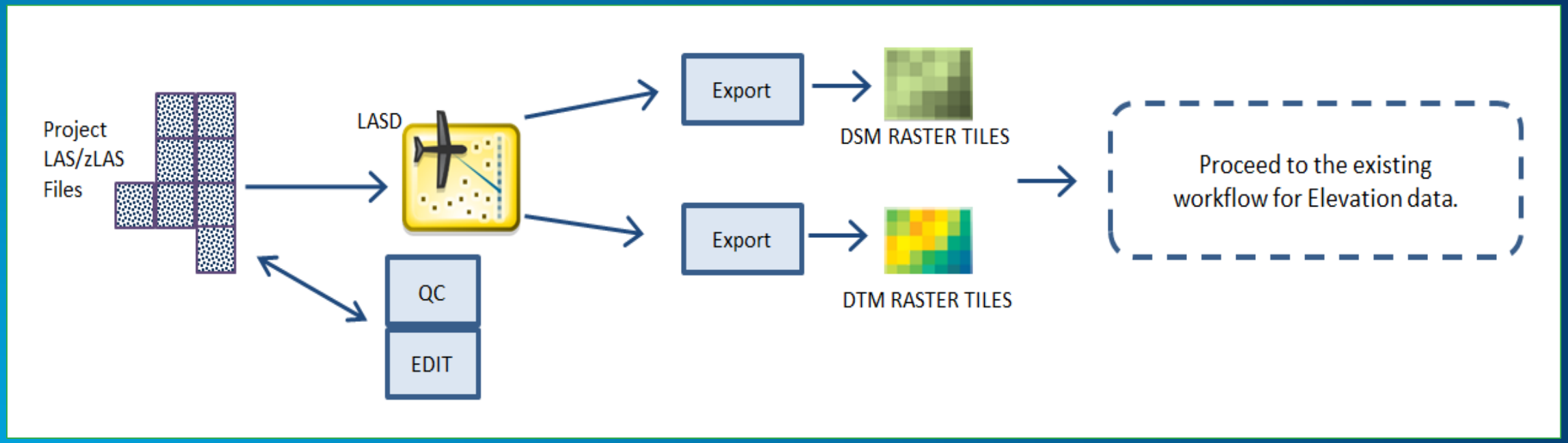
Creation of Raster Surfaces - DSM & DTM

Hosting LAS tiles for download



Export raster surfaces from LAS Dataset

“Workflow A”

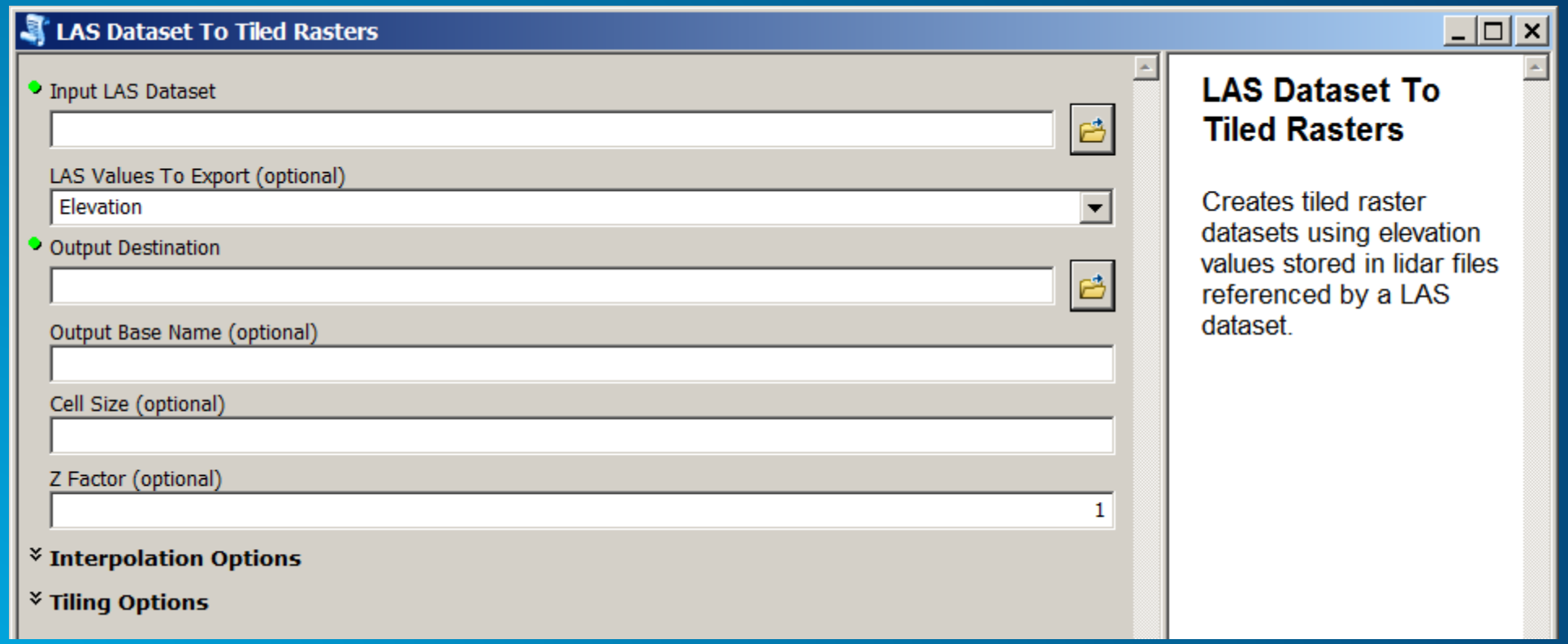


- Recommended method for best scalability
- Test before export to define best parameters
- Ensure tiles overlap
- Lidar data may be moved to offline storage

Data volume for DTM ~10% of LAS

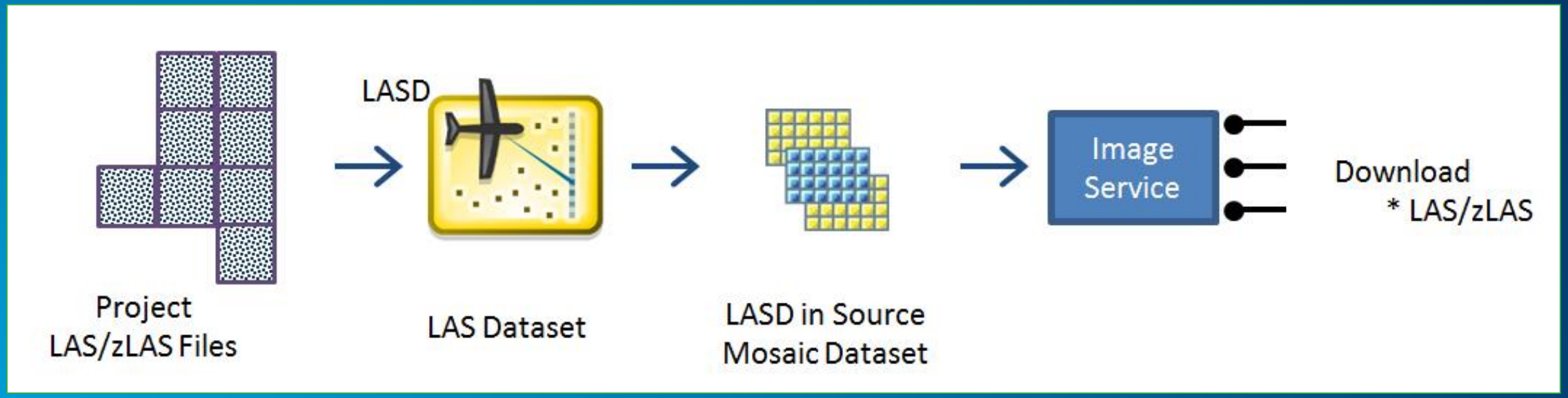
DSM add another ~10%

Tool: LAS Dataset to Tiled Rasters



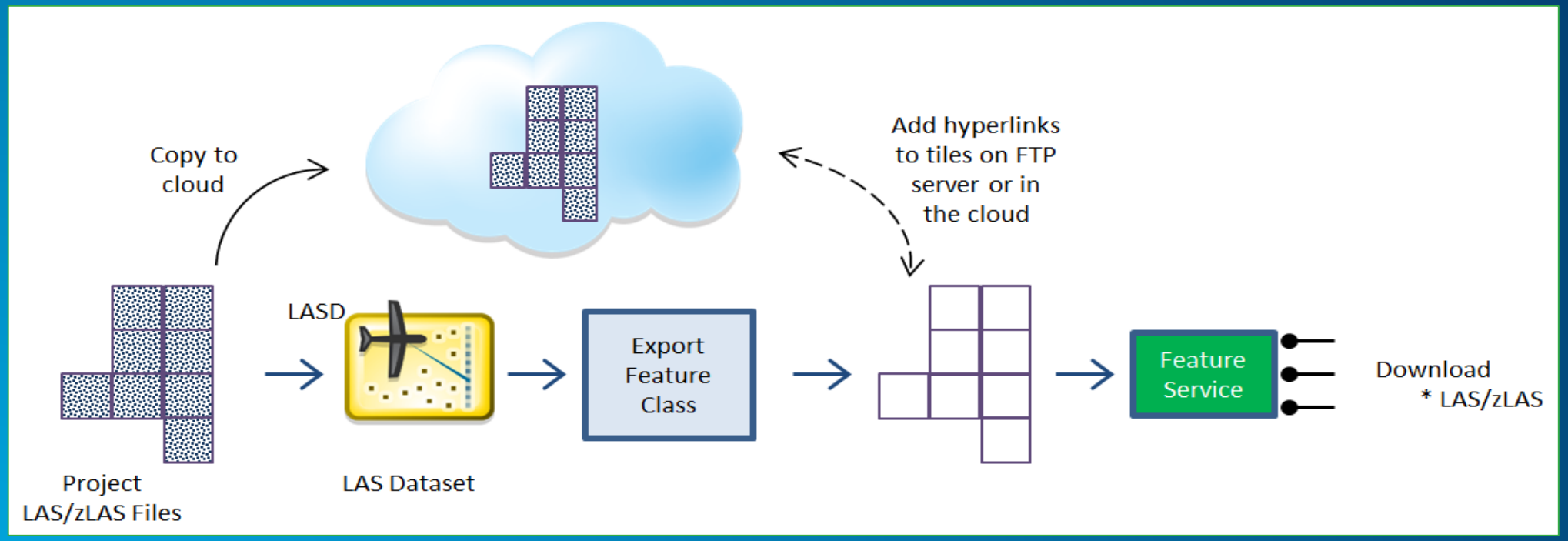
Download from http://links.esri.com/3dSamples

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**

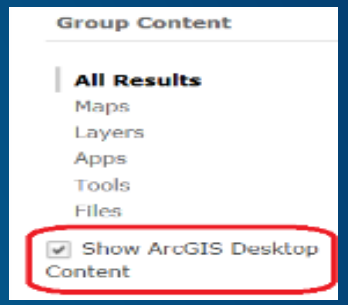
LAS / zLAS files exposed for download – Simple download (S3 / FTP)



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

Resources

- **Image Management Workflows: http://esriurl.com/ImageManagement**
- **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**

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

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