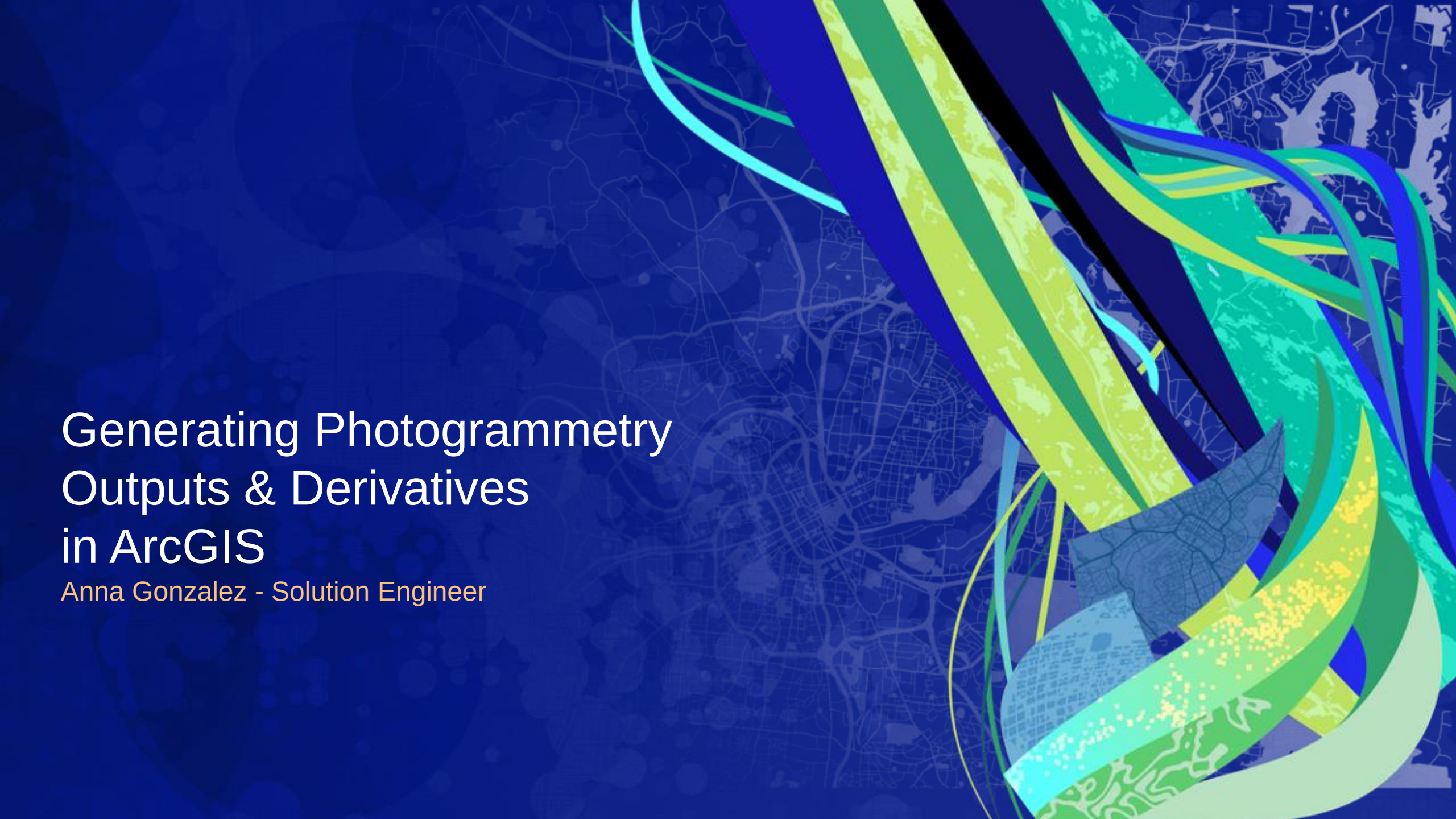


Generating Photogrammetry Outputs & Derivatives in ArcGIS

Anna Gonzalez - Solution Engineer

ArcGIS is a Comprehensive Imagery System

Integrating all aspects of imagery within ArcGIS

Reality Mapping

Creating Foundation Content

- Drone, Aerial & Satellite
- True Ortho
- DSM & DTM
- 3D Mesh & Point Cloud

Analysis

Extracting Information & Scalable Analytics

- GeoAI
- Classification
- Change Detection
- Feature Extraction

Visualization

Enabling Human Understanding

- Apps
- Image Interpretation
- Map & Image Space
- Oriented Imagery
- Stereo, Video

Data Management

Providing Access to Imagery

- All Formats & Types
- Tiled and Dynamic Services
- Open Standards

Desktop, Enterprise, SaaS & Managed SaaS

Content

- Your data
- ArcGIS Living Atlas
- Content Providers

Reality Mapping

Creating Accurate Digital Representations of the World

Point Cloud

True Ortho

Surface Model

Terrain Model

Multispectral

Thermal

Geospatial Video

Oriented Imagery

3D Mesh

Data courtesy of Aerometrex

Generate Foundational Content

Accurate and Analysis Ready

Monitor Vegetation

Analyze Terrain

Track Progress

Extract Information

Inspect Infrastructure

Build an Intuitive 3D GIS

Create Simulations

Model the Environment

Integrate BIM

Manage Assets

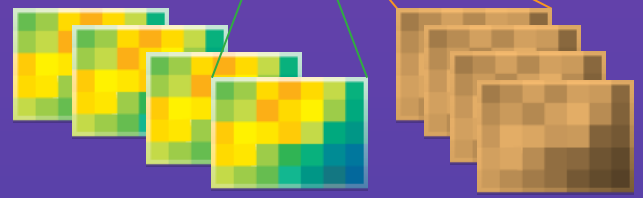
Bring 2D GIS to Life

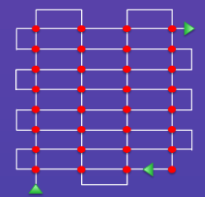
…Supporting the Creation of Digital Twins Across ArcGIS

Drone Mapping Workflow

Providing an end-to-end workflow for drone image capture

1 Flight Planning & Capture





2 Process, Manage, & Analyze (Photogrammetry Software)

3 Disseminate & Collaborate

Drone Mapping Workflow with ArcGIS

Providing an end-to-end workflow for drone image capture

1 Flight Planning & Capture

Flight App (iOS)

+

2 Process, Manage, & Analyze (Photogrammetry Software)

Site Scan for ArcGIS

ArcGIS Drone2Map

3 Disseminate & Collaborate

Drone (photogrammetry) outputs:

From sensor to accurate derived products

Orthomosaics

3D Point Clouds & Meshes

360º Panoramas

Digital Elevation Models

Thermal Orthomosaics

Inspection Oriented Imagery

Photogrammetry Products

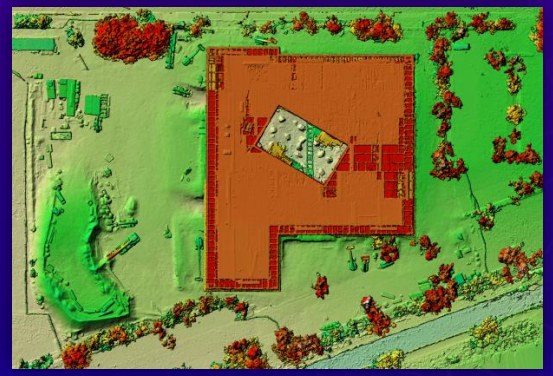
Creating foundational content

2D

- (True) Orthomosaic

2.5D

- Digital Terrain Model (DTM)
- Digital Surface Model (DSM)



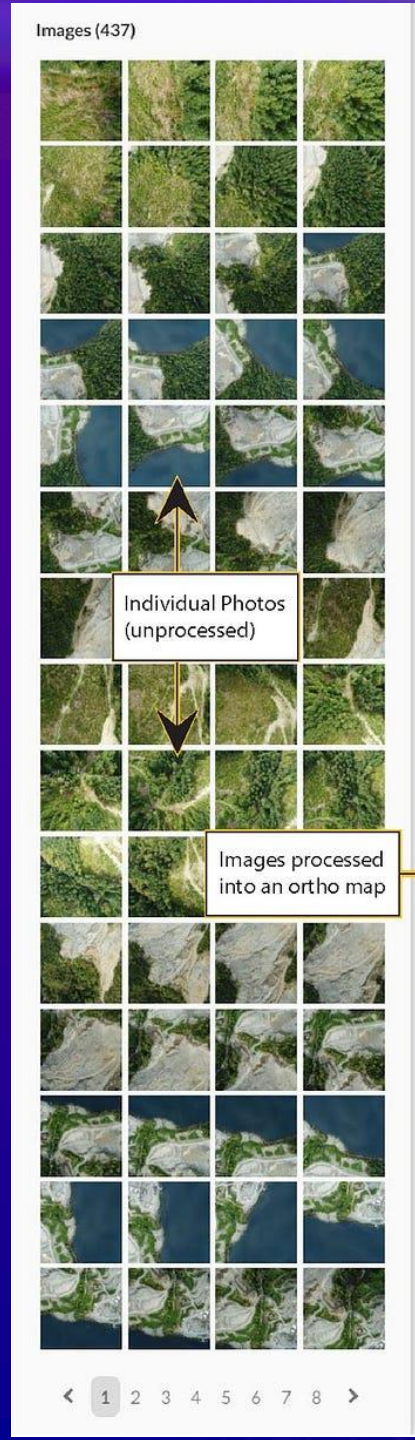
3D

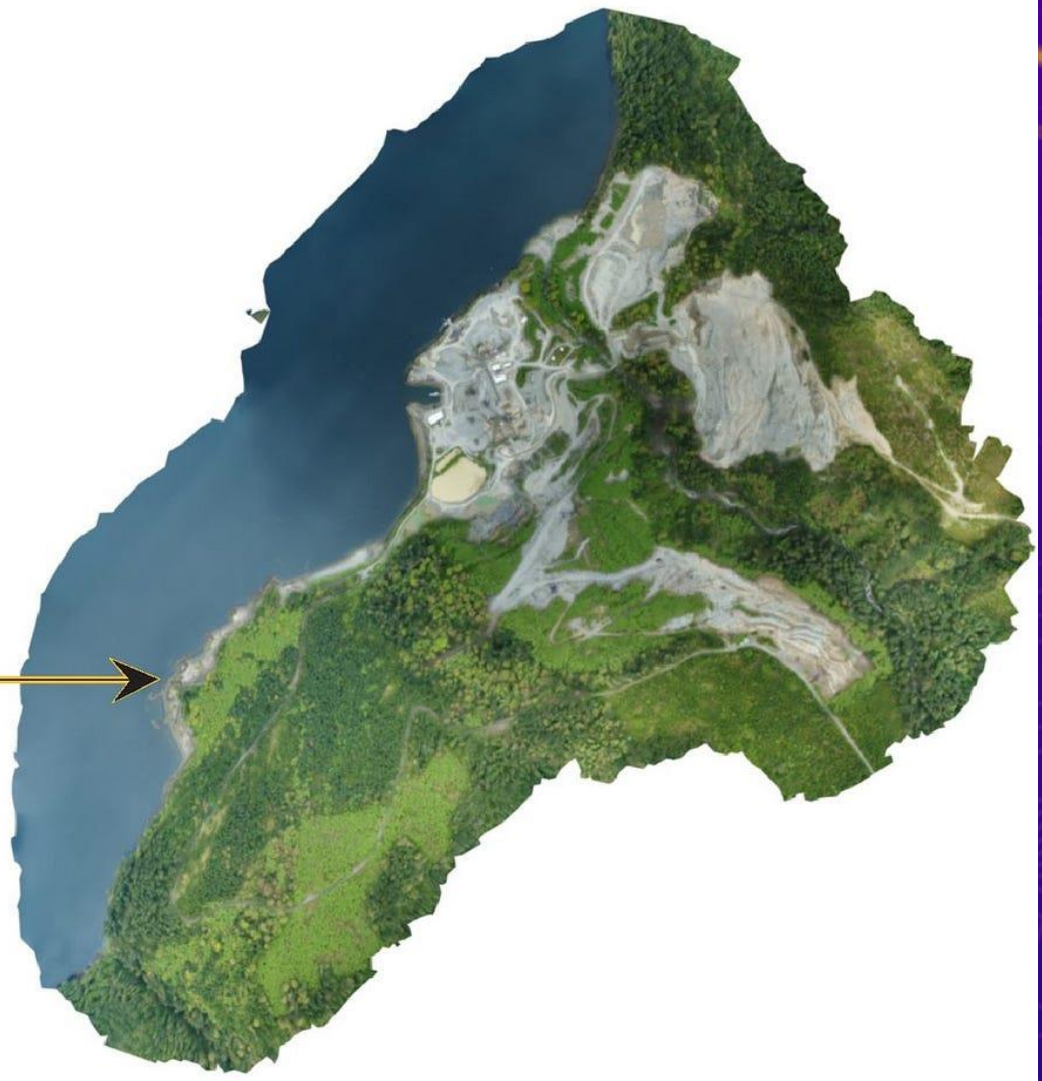
- Point Cloud
- Mesh

2D Products:

- **What is an Orthomosaic?**

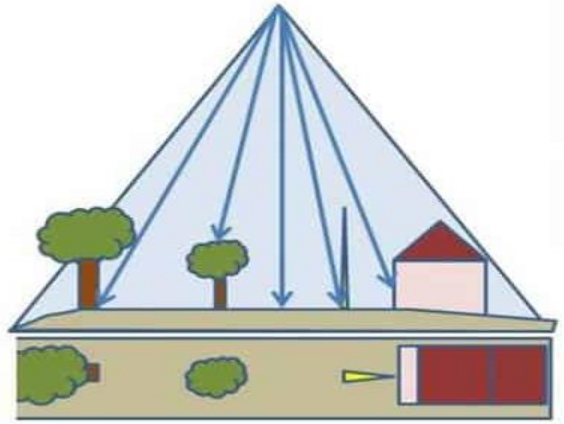
- Traditional Orthomosaic
  - is created by stitching photos together into a single seamless image.

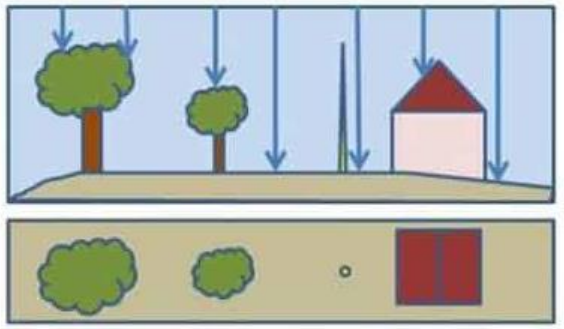




2D Products:

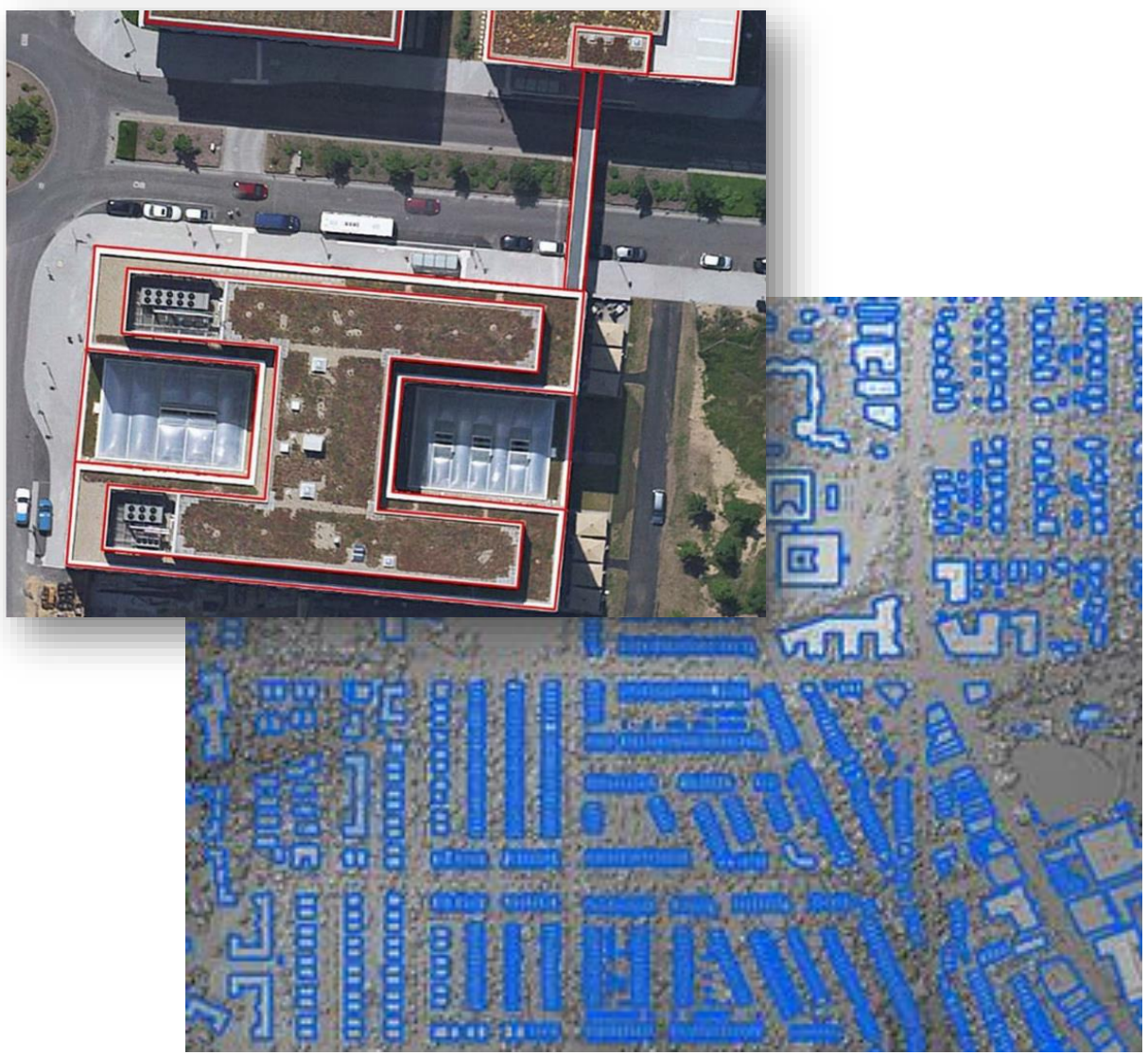
- **What is an Orthomosaic vs True Orthomosaic?**
- Traditional Orthomosaic
  - is created by stitching photos together into a single seamless image.
- True Orthomosaic
  - has undergone additional processing so everything is viewed from directly above and truly orthographic at every pixel.





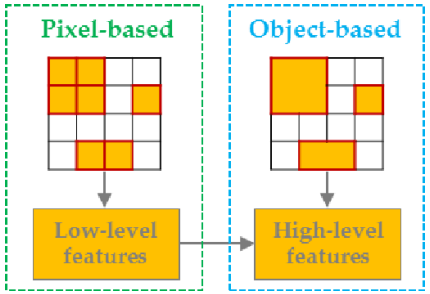
2D Products:

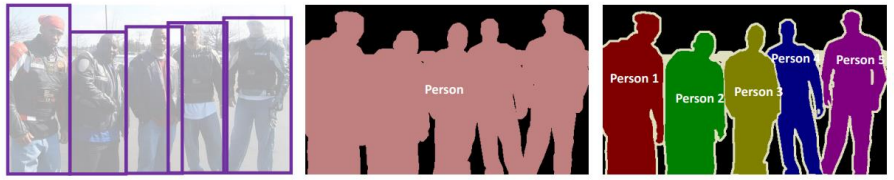
- **What are its strengths?**
  - Accuracy
    - for 2D measurements
    - for digitization
    - for fusion
- **What are its limitations?**
  - No off-nadir/oblique (3D) information



2D Products:

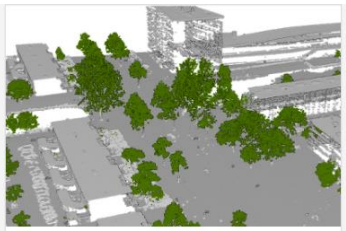
- **What are its uses and/or derivatives?**
  - Feature Extractions
    - pixel-based
    - object-based
    - segmentation



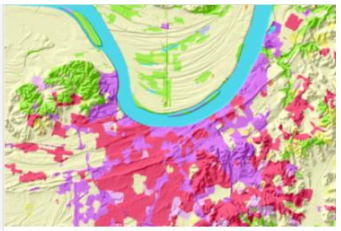


Object Detection | Semantic Segmentation | **Instance Segmentation**

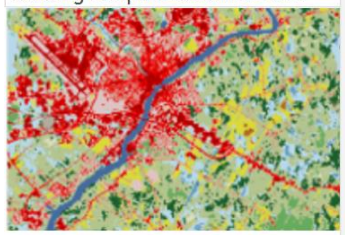
Building Footprint Extraction - USA



Tree Point Classification

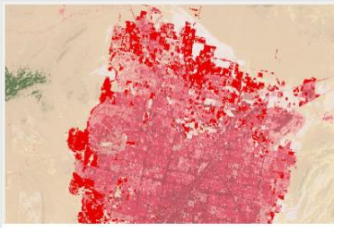


Land Cover Classification (Sentinel-2)



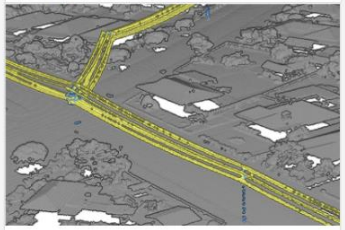
Land Cover Classification (Landsat 8)

Road Extraction - North America

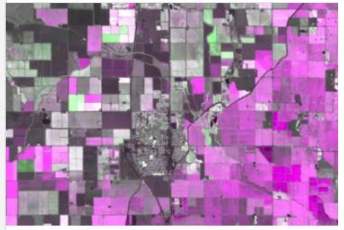


Visualize Urban Sprawl

Windows and Doors Extraction



Power Line Classification



Vegetative Differerence Image

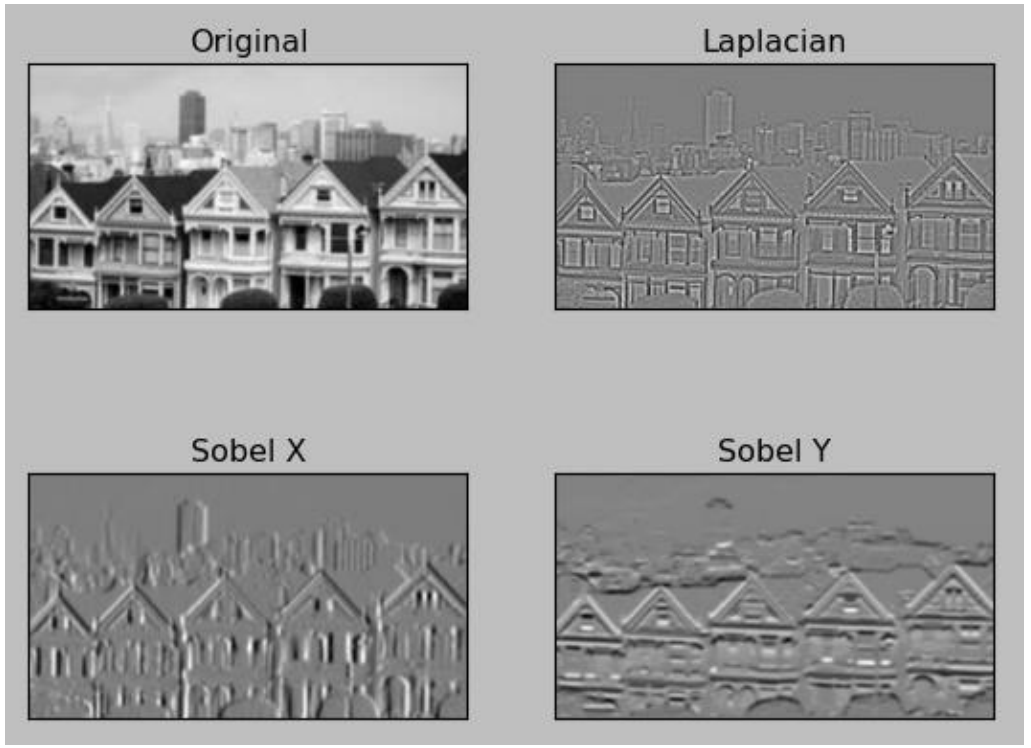
Building Footprint Extraction - Africa

Car Detection - USA

License Plate Blurring

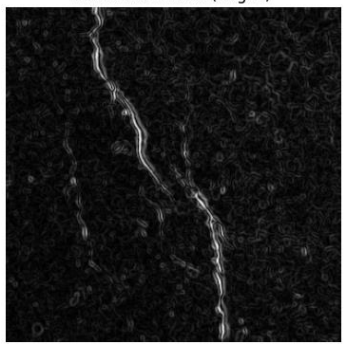
2D Products:

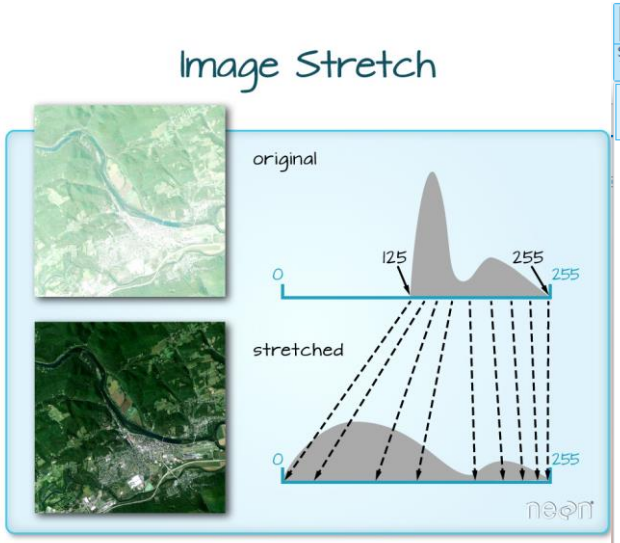
- **What are its uses and/or derivatives?**
  - Image Enhancements
    - Convolution Filters:
      - High-pass (sharpen)
      - Low-pass (blurring)
      - Laplacian (edge detect)
      - Sobel (directional edge)
    - Stretches
      - Minimum – Maximum
      - Percent Clip
      - Standard Deviation
      - Histogram Equalize

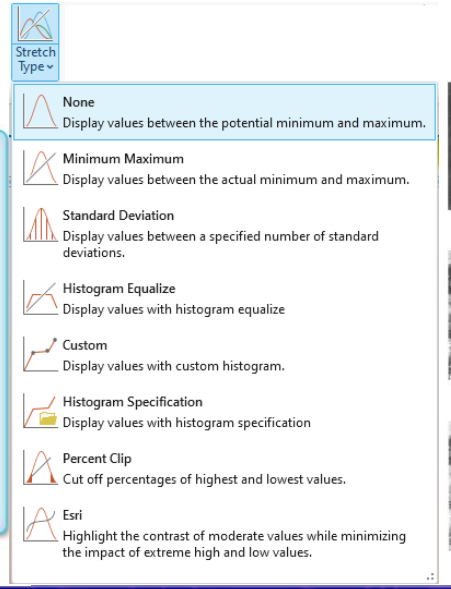


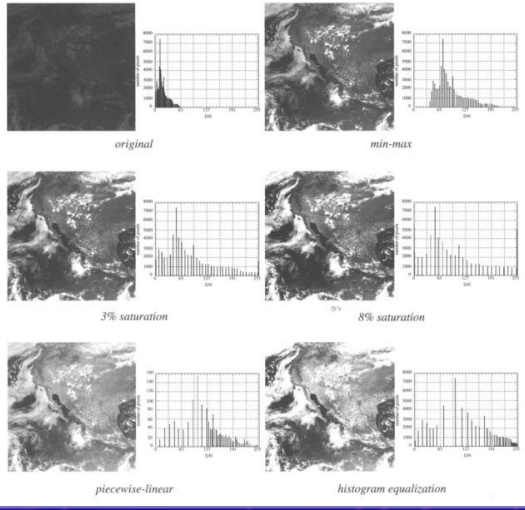
Original Concrete Surface Image

Detected Cracks (Edges)









Photogrammetry Products

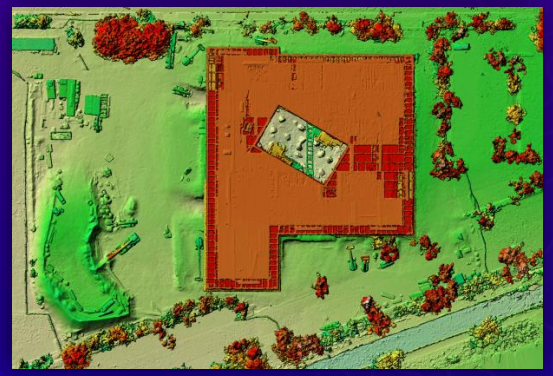
Creating foundational content

2D

- (True) Orthomosaic

2.5D

- Digital Terrain Model (DTM)
- Digital Surface Model (DSM)

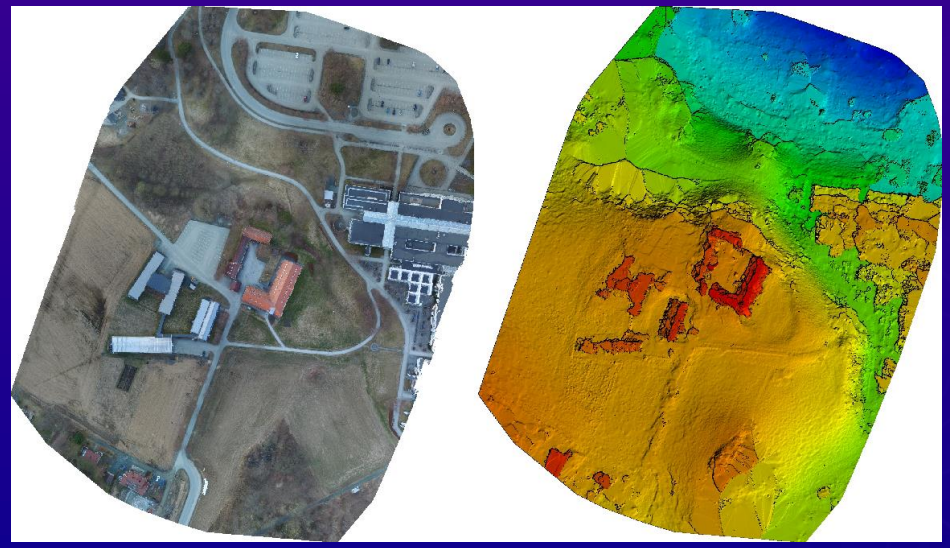


3D

- Point Cloud
- Mesh

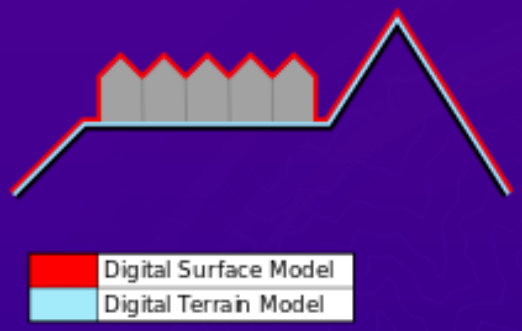
2.5D Products:

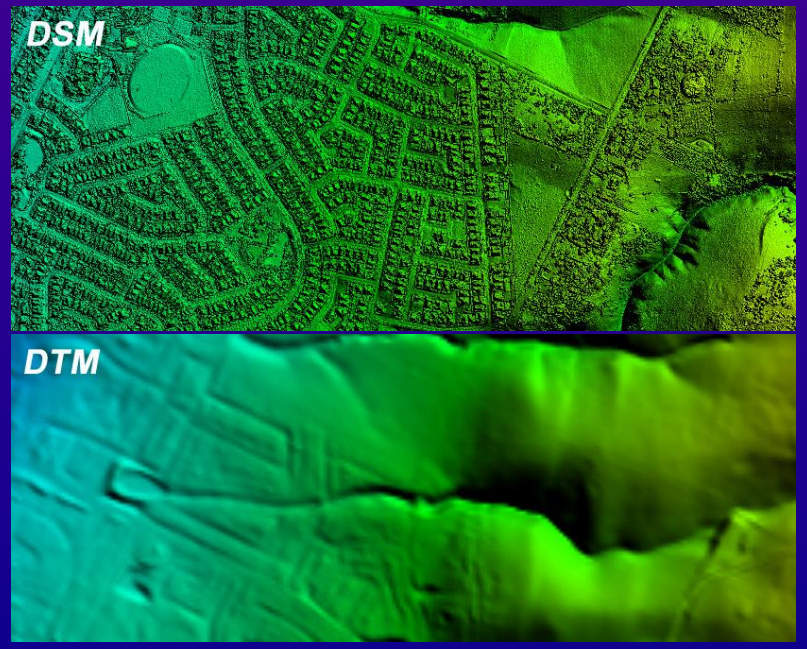
- **What type of data is stored in Digital Elevation Models (DEMs)?**
  - it stores elevation instead of spectral data
  - is a 3D computer graphics representation of elevation data to represent terrain or overlaying objects across a surface.



2.5D Products:

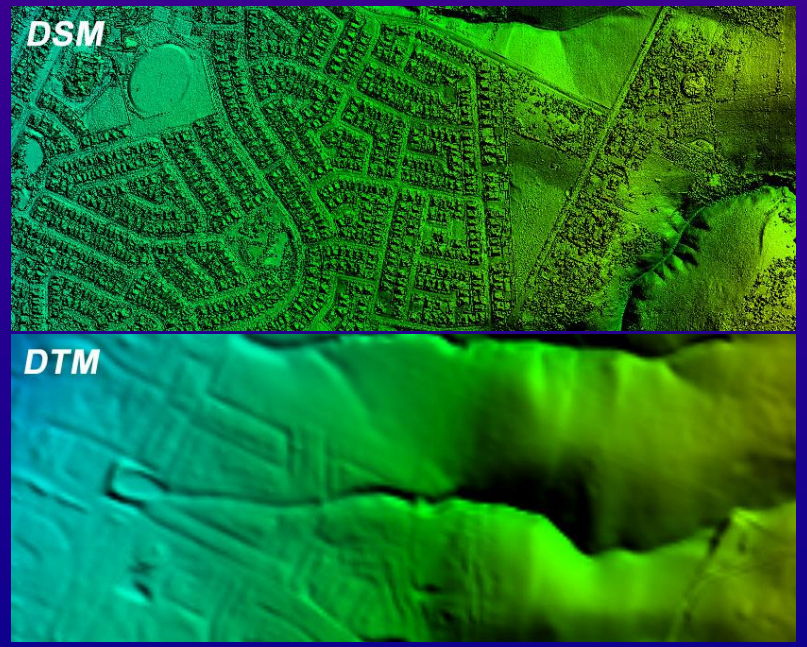
- **What are the different types of Digital Elevation Models (DEMs)?**
  - Digital Surface Model (DSM)
  - Digital Terrain Model (DTM)





2.5D Products:

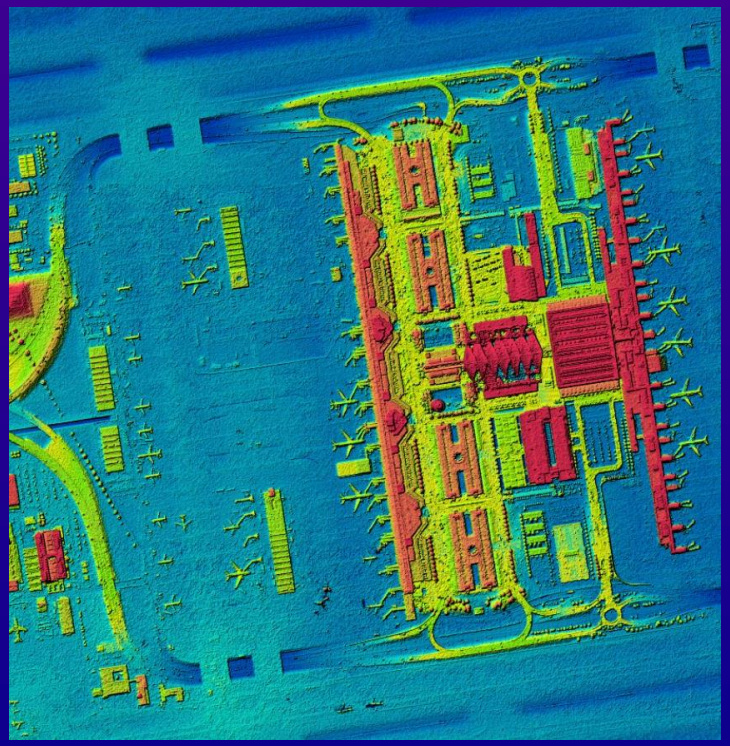
- **What are the different types of Digital Elevation Models (DEMs)?**
  - Digital Surface Model (DSM)
  - Digital Terrain Model (DTM)

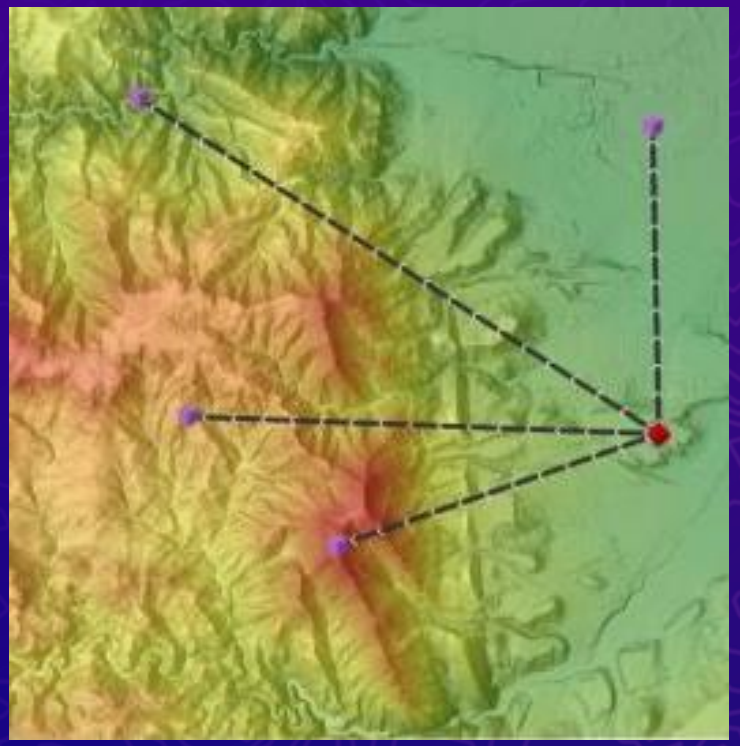


- **What are the strengths of each?**
  - ~~Accurate models of the terrain, e.g. stream modeling~~
  - Accurate models of the surface, e.g. line of sight
  - Subtraction of DSM - DTM equals = height modeling
- **What are the limitations?**
  - File Size: Surface models (rasters) are larger file sizes than contours (vectors).

2.5D Products:

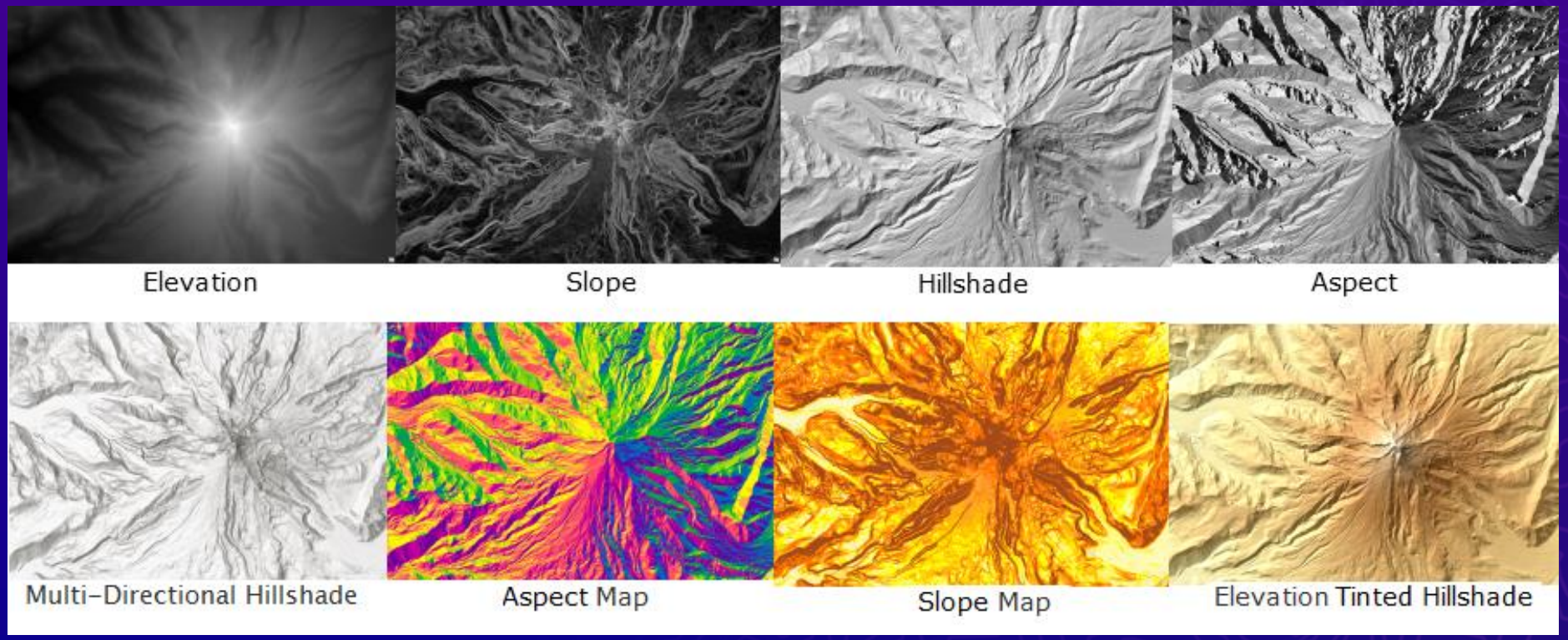
- **What are some uses?**
  - Digital Surface Model (DSM)
    - Can symbolize/colorize, create line of sight, create viewsheds, etc.





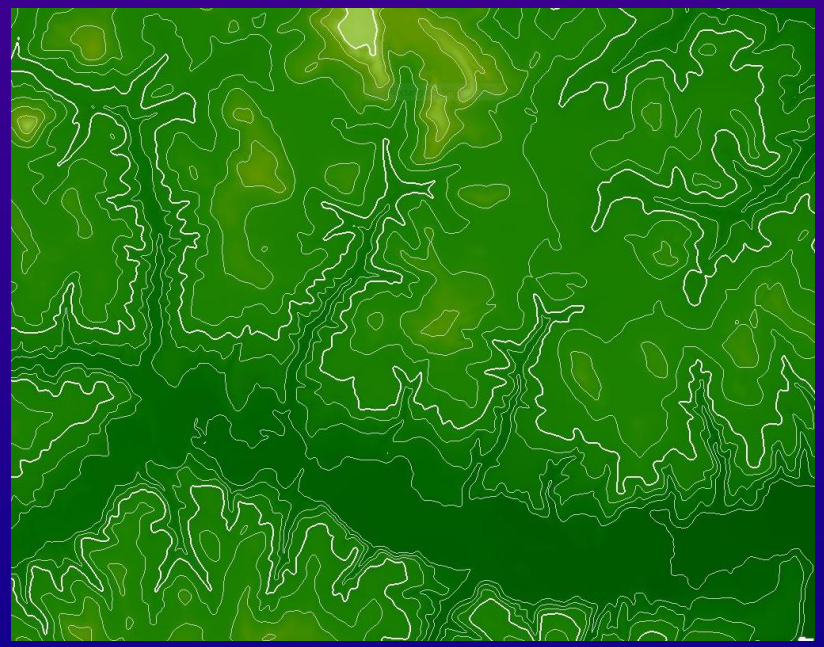
2.5D Products:

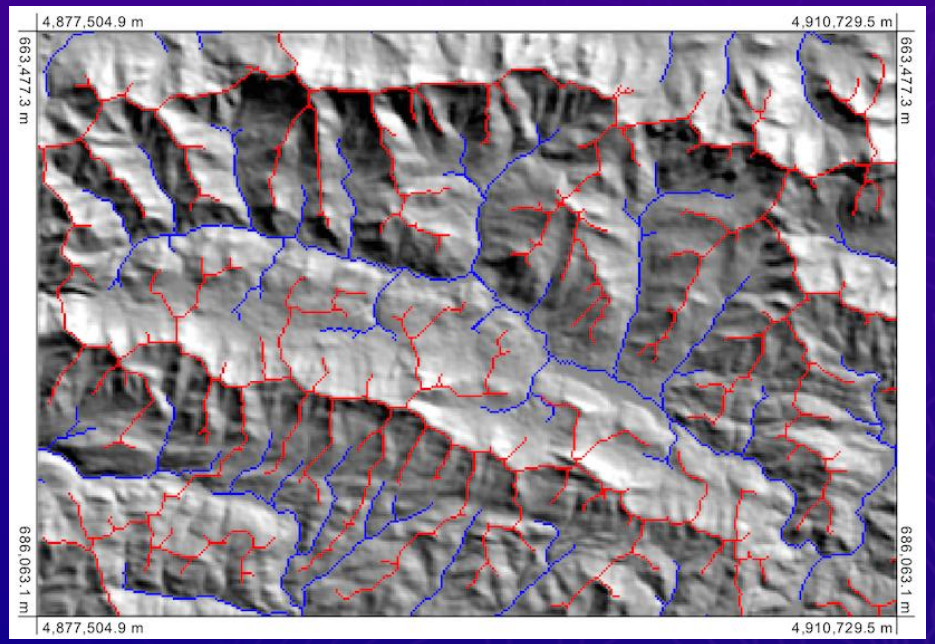
- **What are some derivatives?**
  - Digital Terrain Model (DTM)
    - Can be converted into subsequent products:

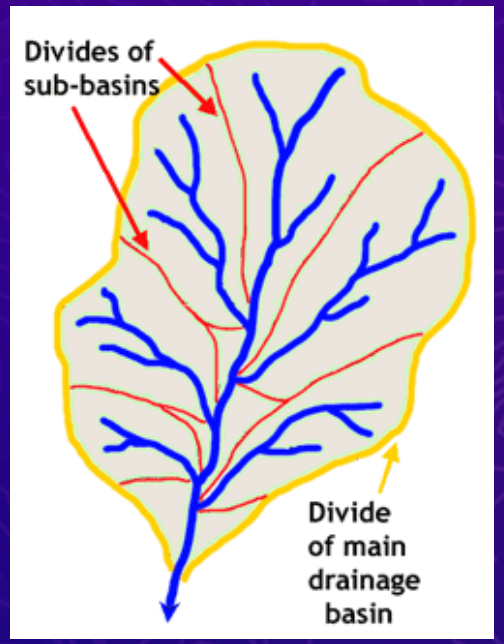


2.5D Products:

- **Why are these products 2.5D?**
  - Digital Terrain Model (DTM)
    - Can be converted into subsequent products:
      - Contour lines, ridge/valley extractions, stream ordering, watersheds, hydrology hierarchies, etc.

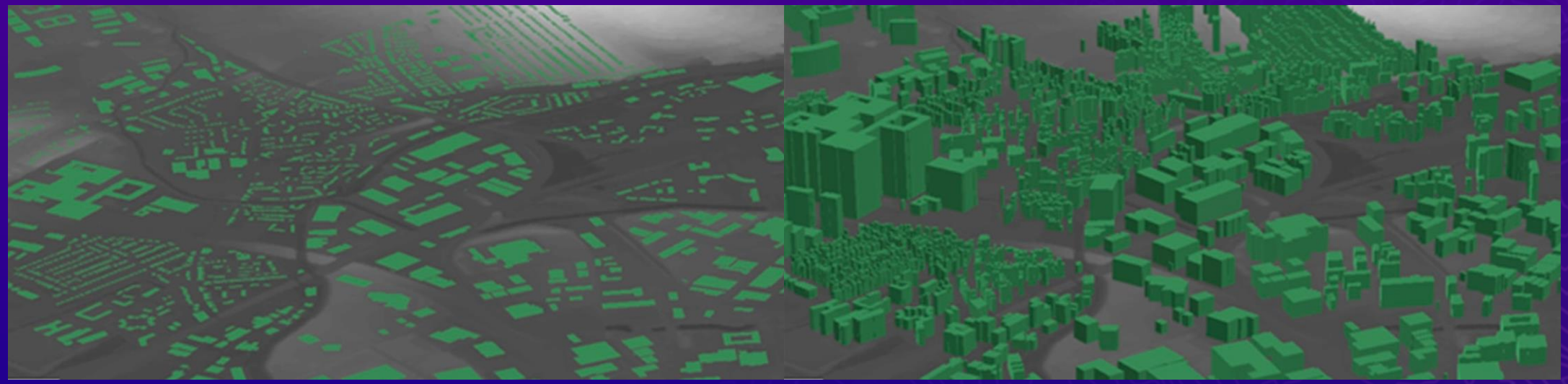






2.5D Products:

- **What are some derivatives?**
  - Subtraction of DSM - DTM equals = normalized DSM (height modeling)



Photogrammetry Products

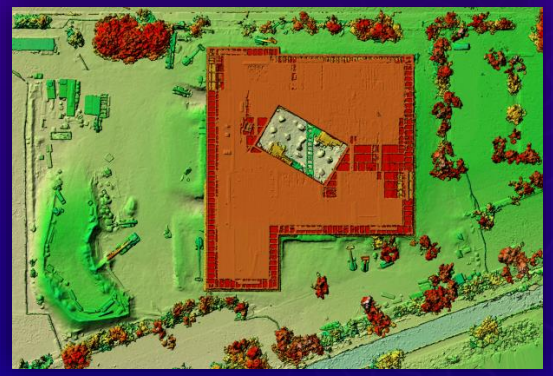
Creating foundational content

2D

- (True) Orthomosaic

2.5D

- Digital Terrain Model (DTM)
- Digital Surface Model (DSM)

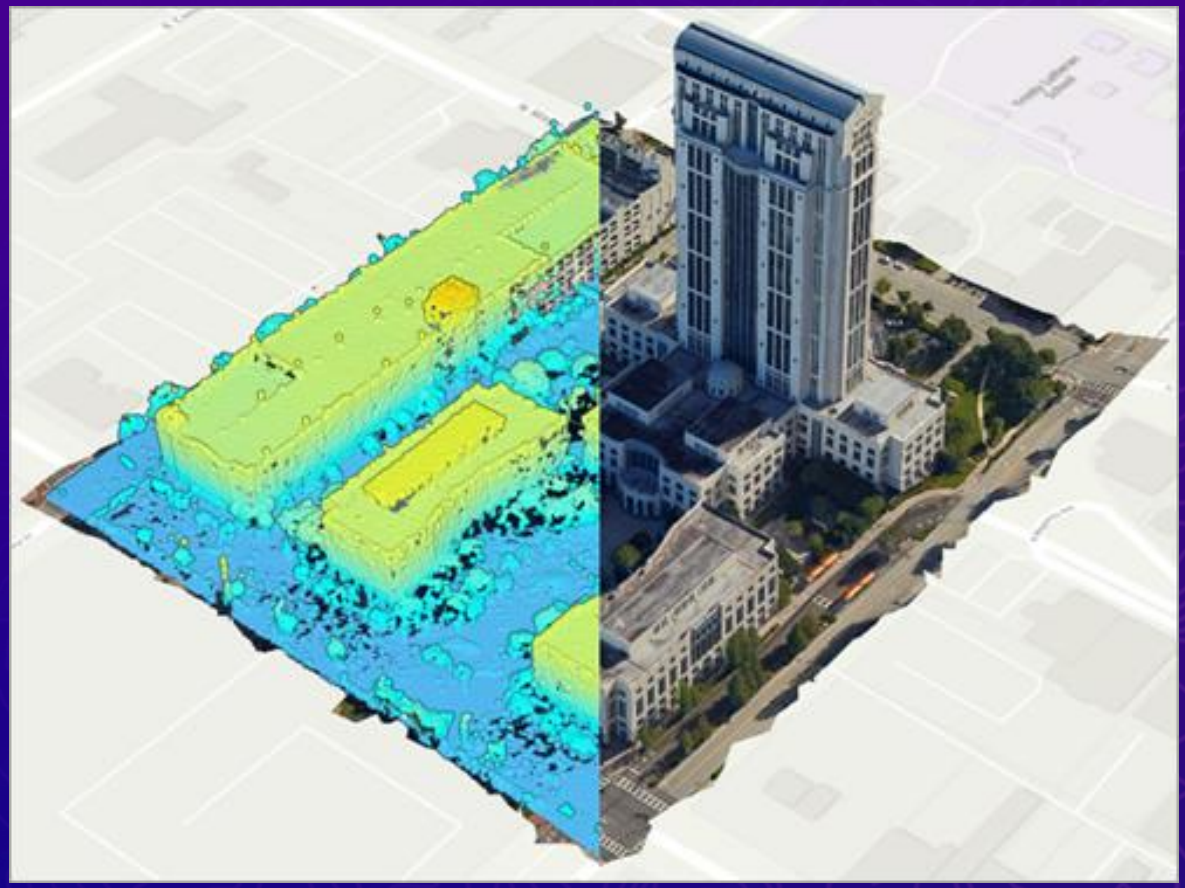


3D

- Point Cloud
- Mesh

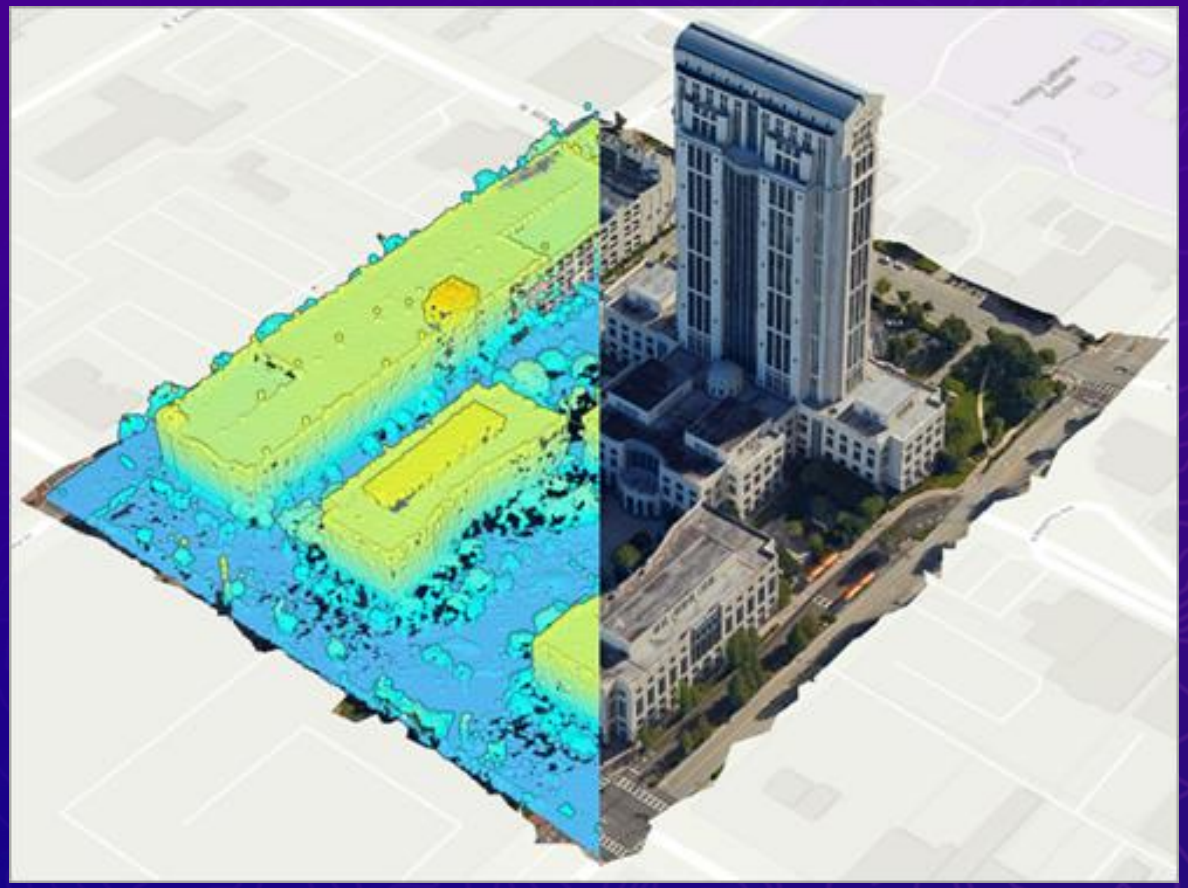
3D Products:

- **What are the two 3D products?**
  - Point Cloud
    - Collection of data points representing real-world object or space with (x,y,z coordinates).
  - Mesh
    - Continuous smooth surface made from vertices that have been refined from the original point clouds.



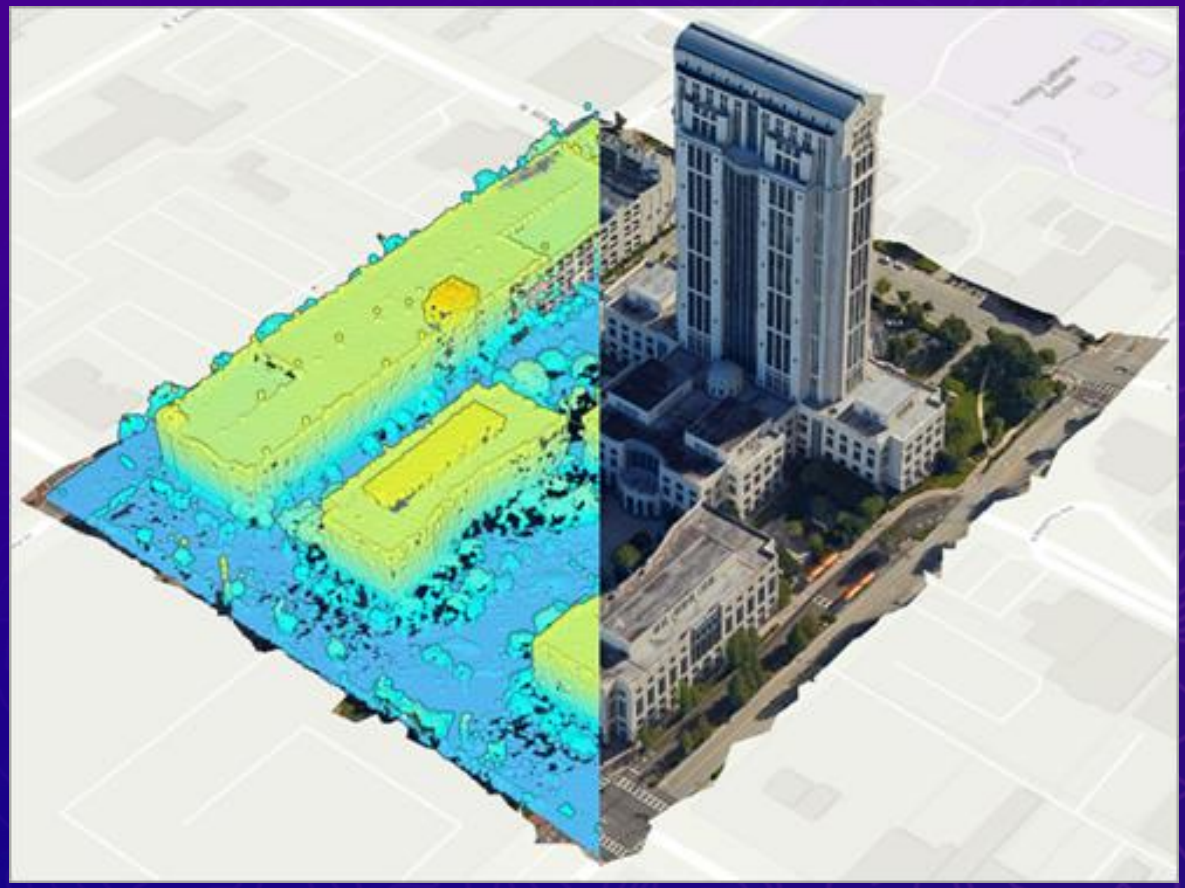
3D Products:

- **What are their strengths?**
  - Point Cloud –
    - accurate and faithful to the original data
    - good for representing complex objects with a finite number of points
    - Can render the point color based on different attributes, e.g. height, class code, RGB value, and return value
    - ideal for mensuration
  - Mesh –
    - Intuitive view of a 3D scene, has natural color texturing applied
    - compatible with most 3D software and formats



3D Products:

- **What are their limitations?**
  - Point Cloud –
    - less intuitive to visualize
    - less accurate than lidar
  - Mesh –
    - more subject to hiding noise and holes
    - requires significant processing resources
  - Both –
    - file sizes, viewer compatibilities, expertise (people not knowing how to use)



3D Products:

- **What are some applications?**
  - CAD & BIM models
  - Architecture Engineering & Construction
    - e.g. progress tracking, providing measurements/volumetrics
  - Digital twin assets
    - e.g. temporal change detection

Drone (photogrammetry) outputs:

From sensor to accurate derived products

Orthomosaics

3D Point Clouds & Meshes

360º Panoramas

Digital Elevation Models

Thermal True Orthomosaics

Inspection Oriented Imagery

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