How Raster Functions Revolutionized the World Population Estimate

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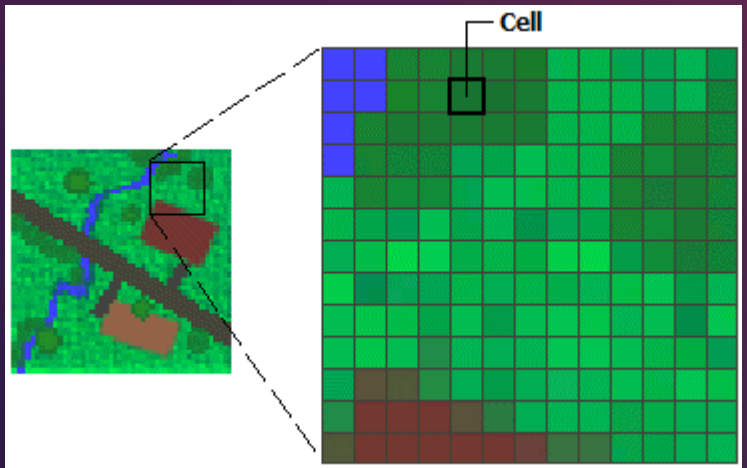
ESRI USER CONFERENCE

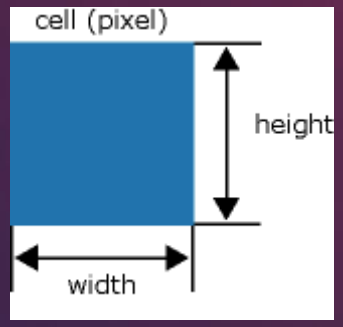
Agenda

- Who are we?
- What you can expect.
- Review raster definitions and nomenclature
  - What is a raster?
  - What is a mosaic dataset?
  - What is a raster function/template?
- World Population Estimate (WPE)

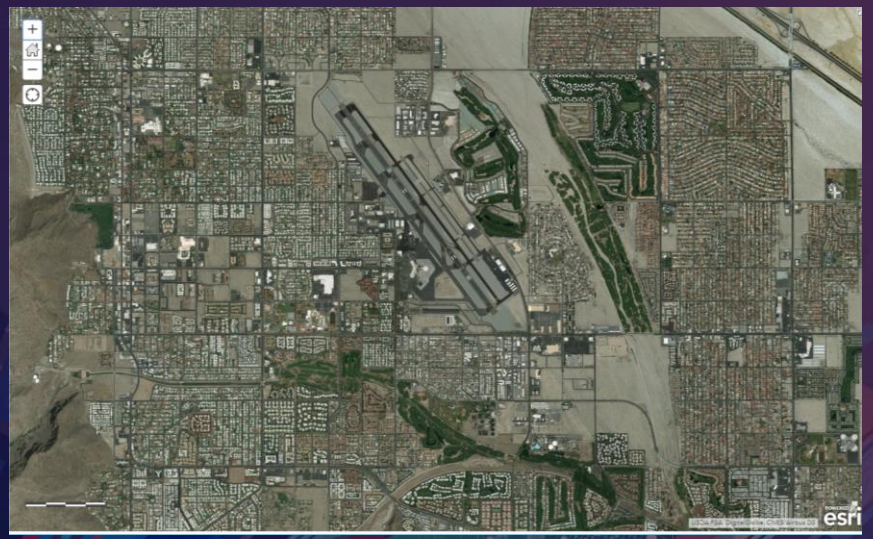
What is a raster?

Raster Definition & Properties





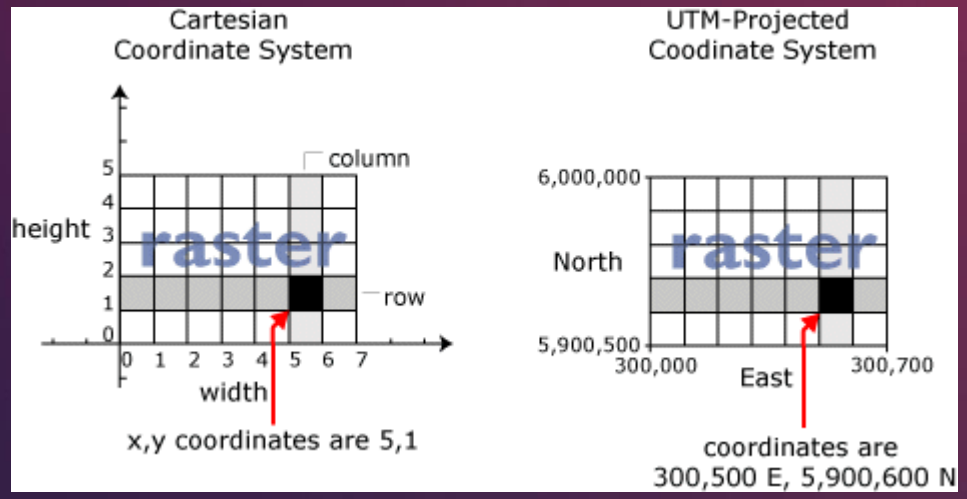
- A data model
  - Matrix of cells
  - Organized in rows & columns
  - Cells called picture elements (pixels)
  - Pixels store values
    - Temperature, precipitation, elevation, electromagnetic spectrum (light)
  - Spatial relationship to Earth's surface
- Common raster datasets
  - Satellite/aerial imagery
  - Digital elevation model (DEM)
  - Temperature



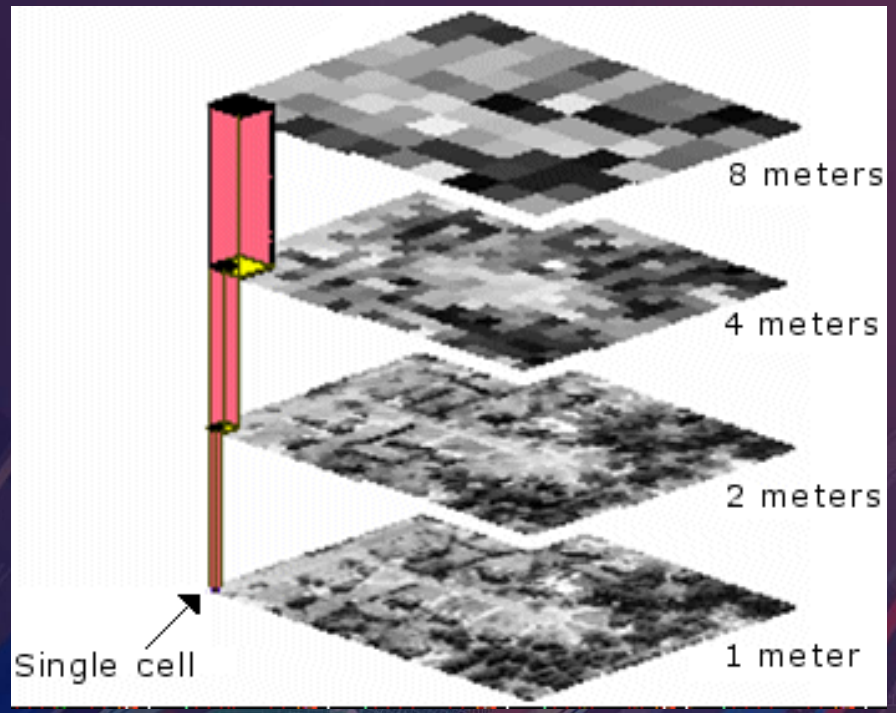
Raster Definition & Properties

- Basic raster properties
  - Row & column location
  - Cell value
  - Pixel size (resolution)
  - Value type (bit depth)

1	1	0	0
	1	2	2
4	0	0	2
4	0	1	1



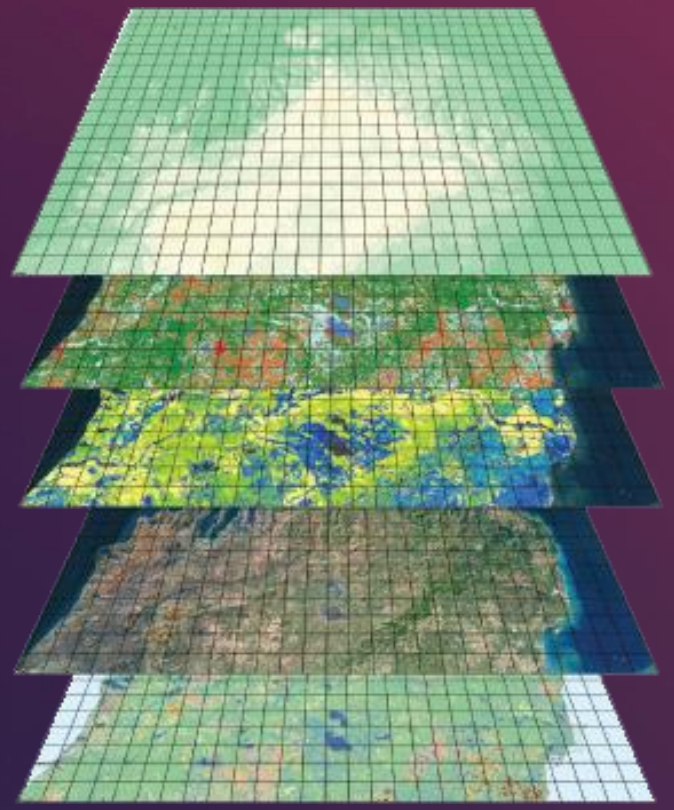
- Raster types
  - Discrete (thematic: land-use category, soils data
  - Continuous: temperature, elevation, images

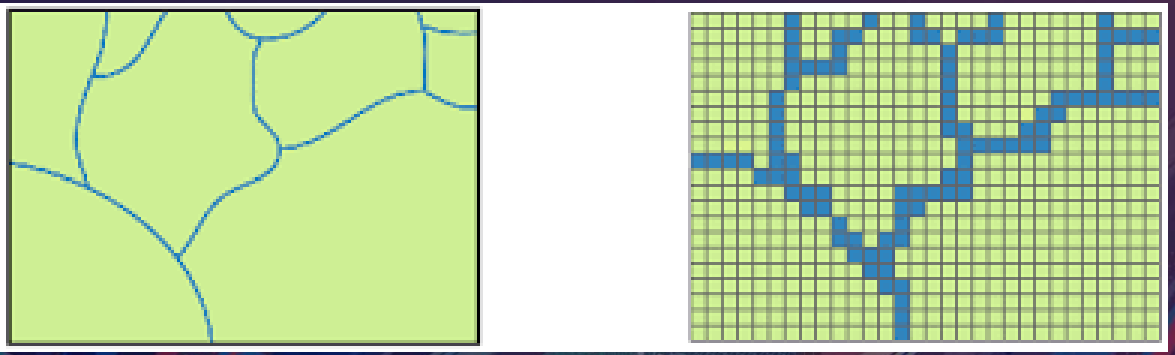


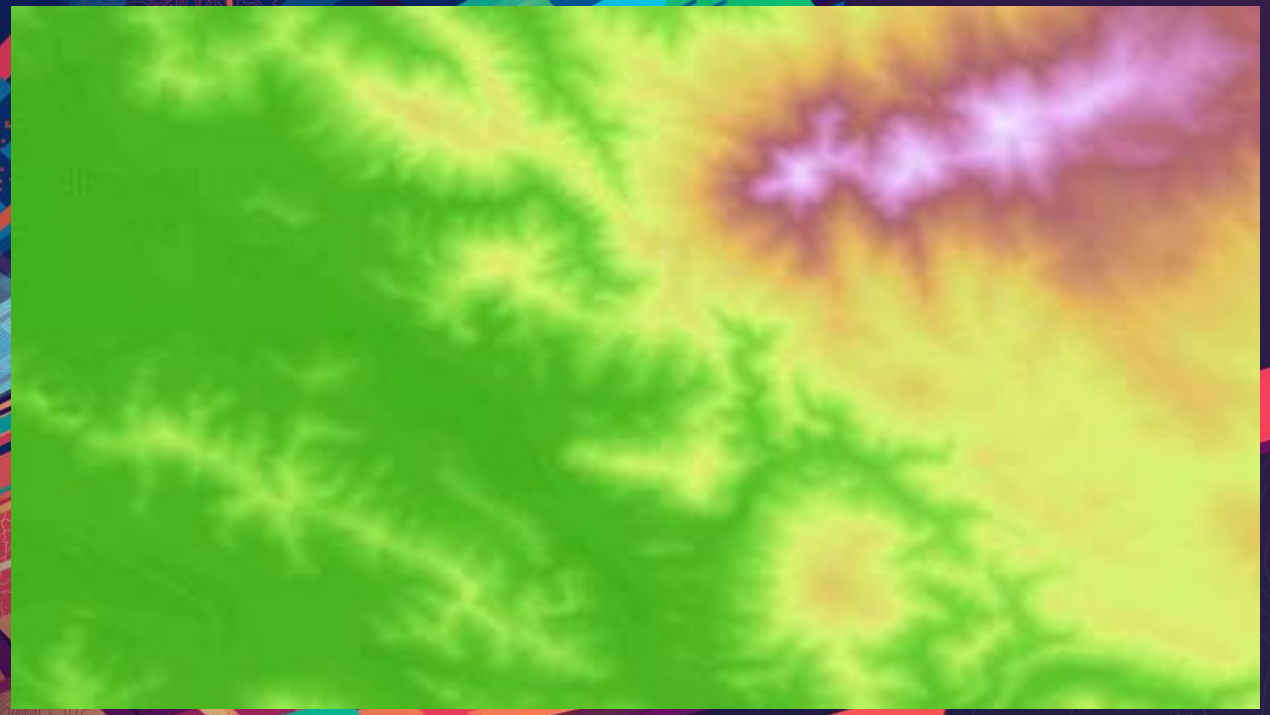
Raster Definition & Properties

- Why should you care?
  - Simple data structure
  - Powerful format for advanced analysis
  - Perform fast overlays with complex data

- Good to know…
  - Limitations imposed by cell size
  - Potentially very large datasets
    - Reduce cell size in half ➡ 4x storage





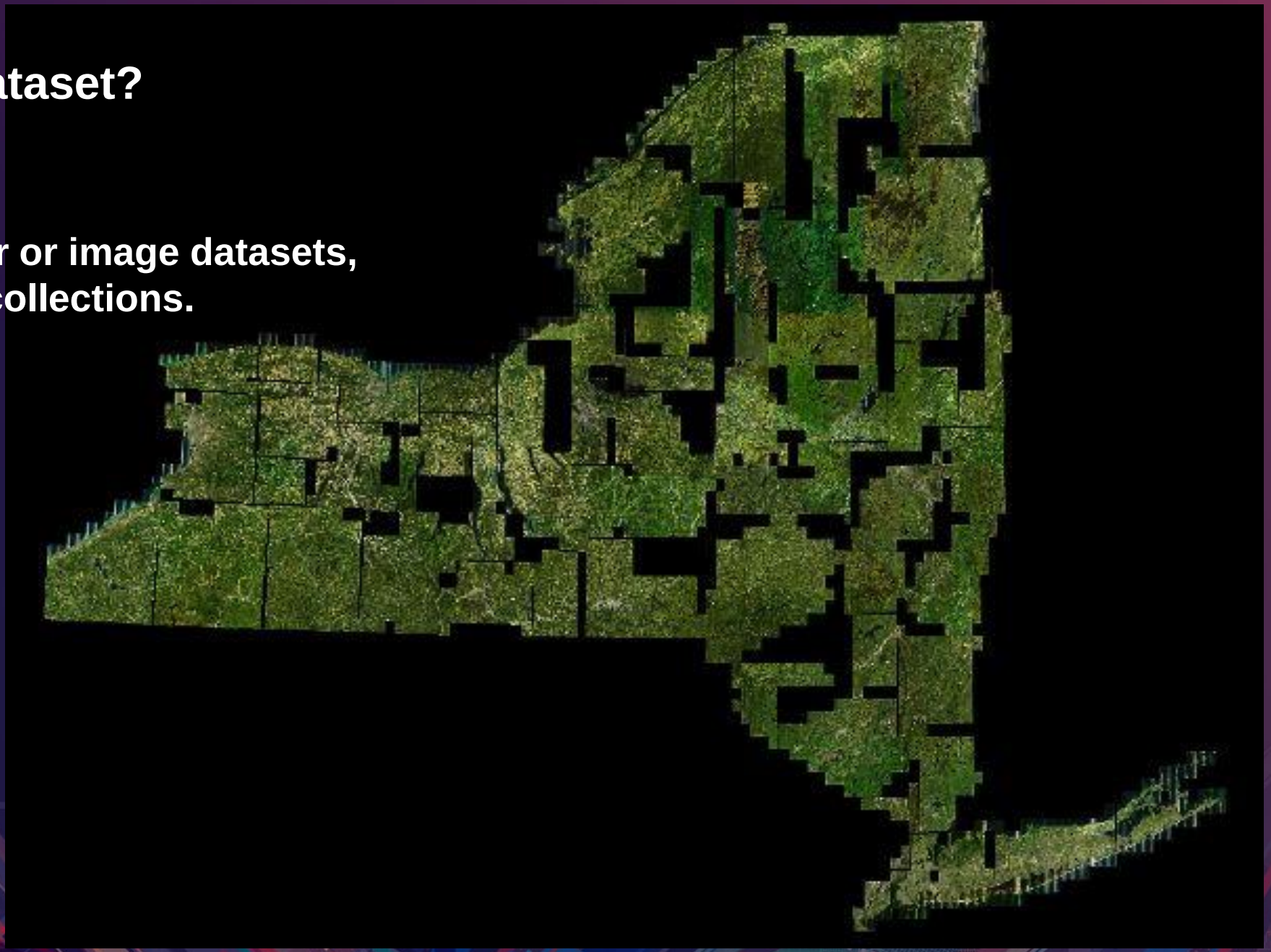


Demo –
Raster Examples

What is a Mosaic Dataset?

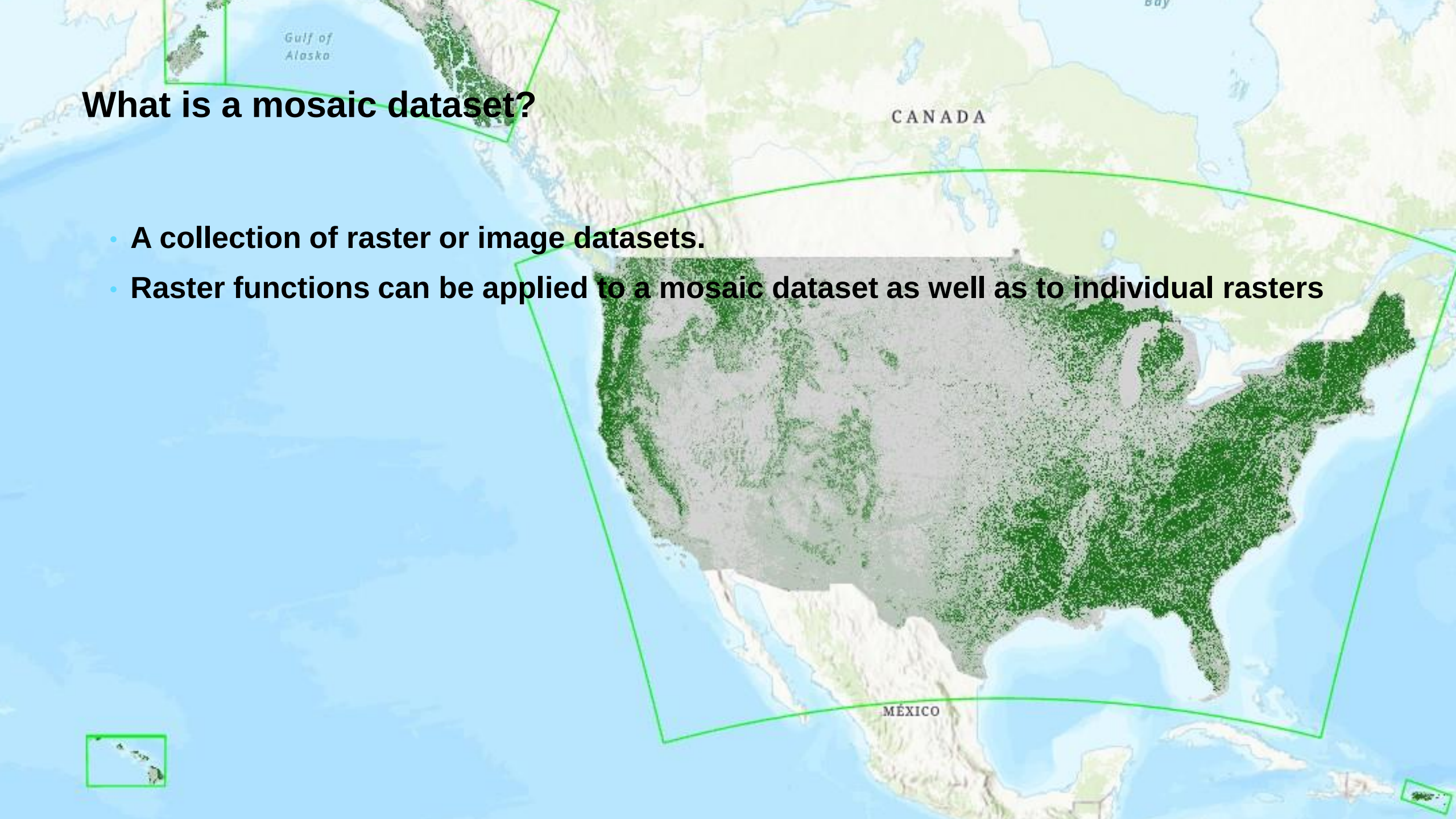
What is a mosaic dataset?

- A collection of raster or image datasets, optimized for large collections.



What is a mosaic dataset?

- A collection of raster or image datasets.
- Raster functions can be applied to a mosaic dataset as well as to individual rasters



Mosaic Datasets

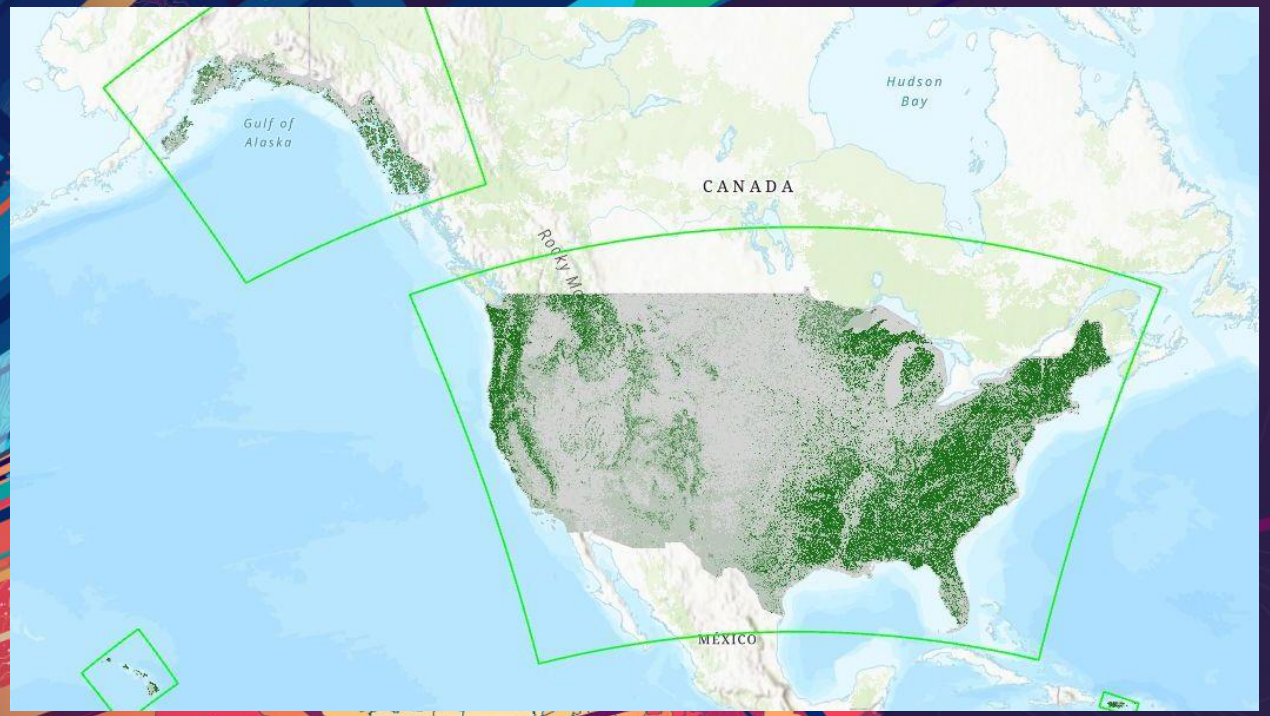
- Why should you care?
  - Facilitates work with ginormous datasets
  - Raster functions may be applied to individual rasters but also a whole set of them when organized in a mosaic.
- Good to know…
  - A mosaic dataset can be an input raster to another mosaic dataset

Creating a mosaic dataset in pro: two steps

- Create Mosaic Dataset
- Add Rasters To Mosaic Dataset

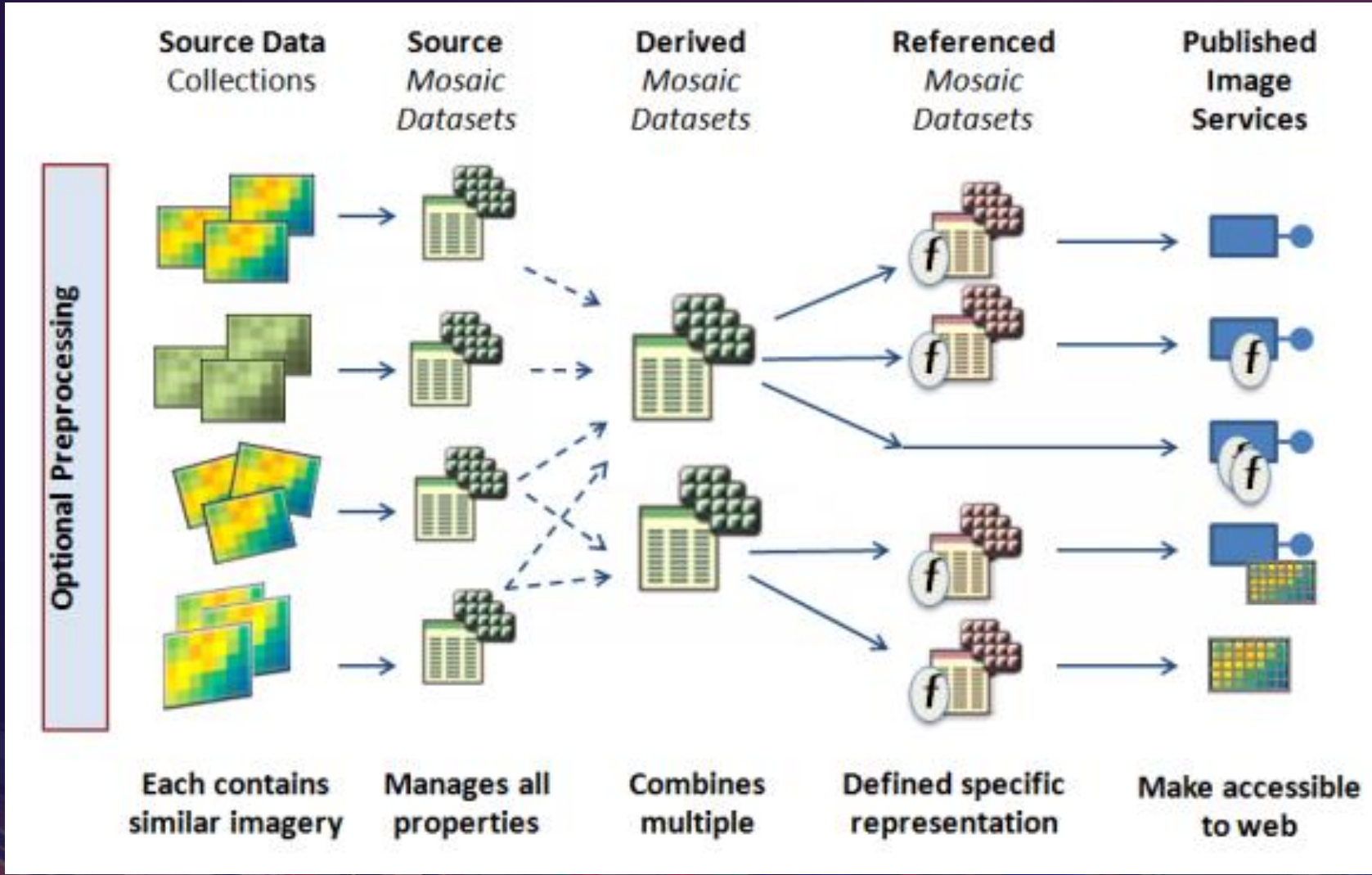
Managing imagery through using Mosaic Datasets and Image Services

Thursday, 1-2pm Room 32 a/b



Demo – Mosaic Dataset

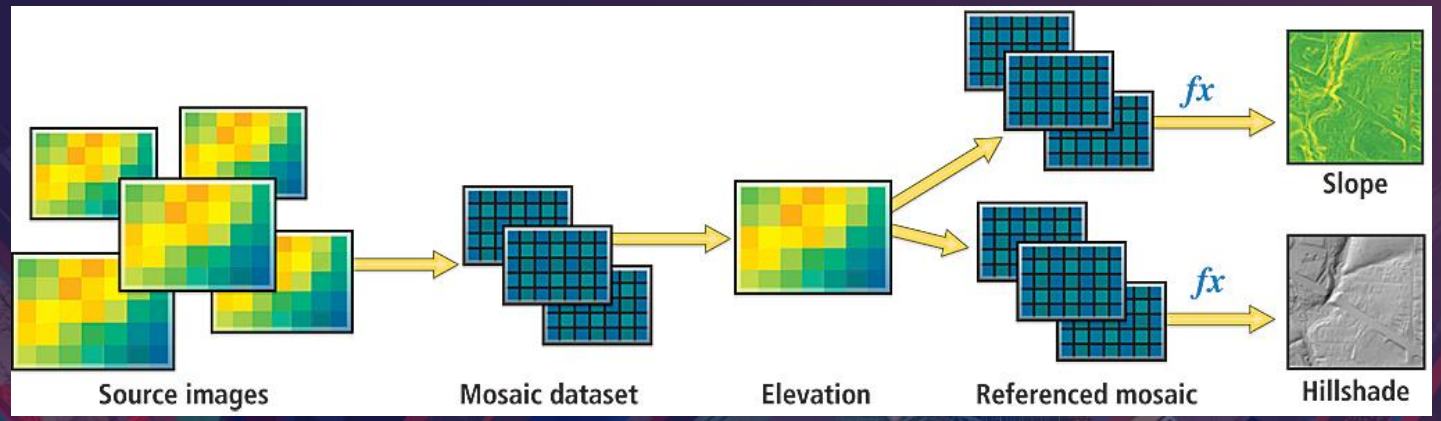
Did you know you can make a mosaic dataset out of mosaic datasets?



What is a Raster Function?

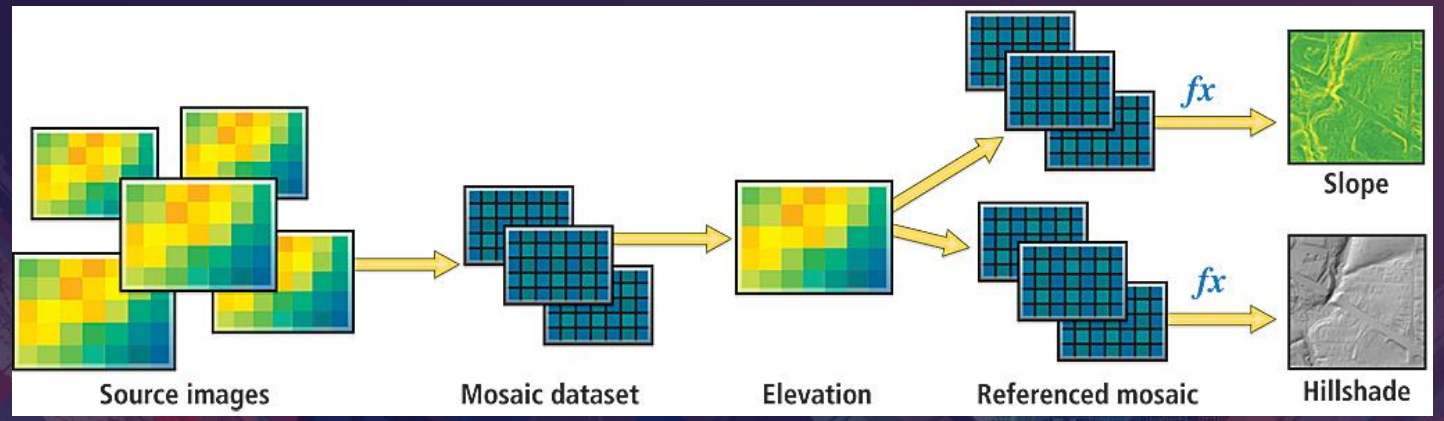
Raster Functions – What are they?

- Processing applied on-the-fly to one or more rasters
- Applied dynamically as the rasters are accessed
- Output is a virtual raster layer
- Source data are NOT changed; operations NOT permanently applied
  - Observe data through filter
- Functions chained together form advanced image processing equations
- Results may be saved/exported



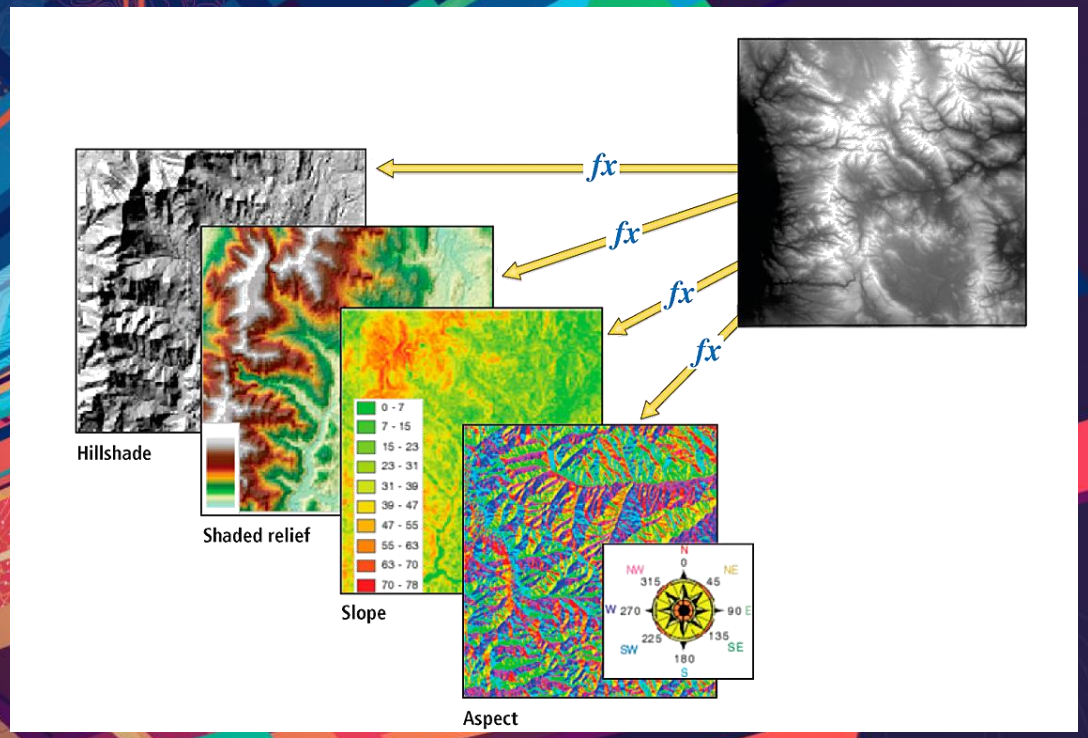
Raster Functions – What are they?

- Three types of functions
  - Local, Global, Custom (not compatible w/ Arcpy)
- Not compatible with geoprocessing models
- Custom raster function community on GitHub
  - https://github.com/Esri/raster-functions



Raster Functions – Why should you care?

- Straight forward and efficient way to process and analyze
- Saves disk space and processing time
- Fast!
  - Only pixels visible on screen are processed
  - No intermediate datasets
- Out-of-the-box functions
  - radiometric correction, geometric correction, data management, visualization, analysis



Demo – Raster Function

Normalized Burn Ratio (NBR)

$$NBR = \frac{NIR - SWIR}{NIR + SWIR}$$

NIR = Near Infrared (Band 5)
SWIR = Short Wavelength Infrared (Band 7)

Things you can do with raster functions

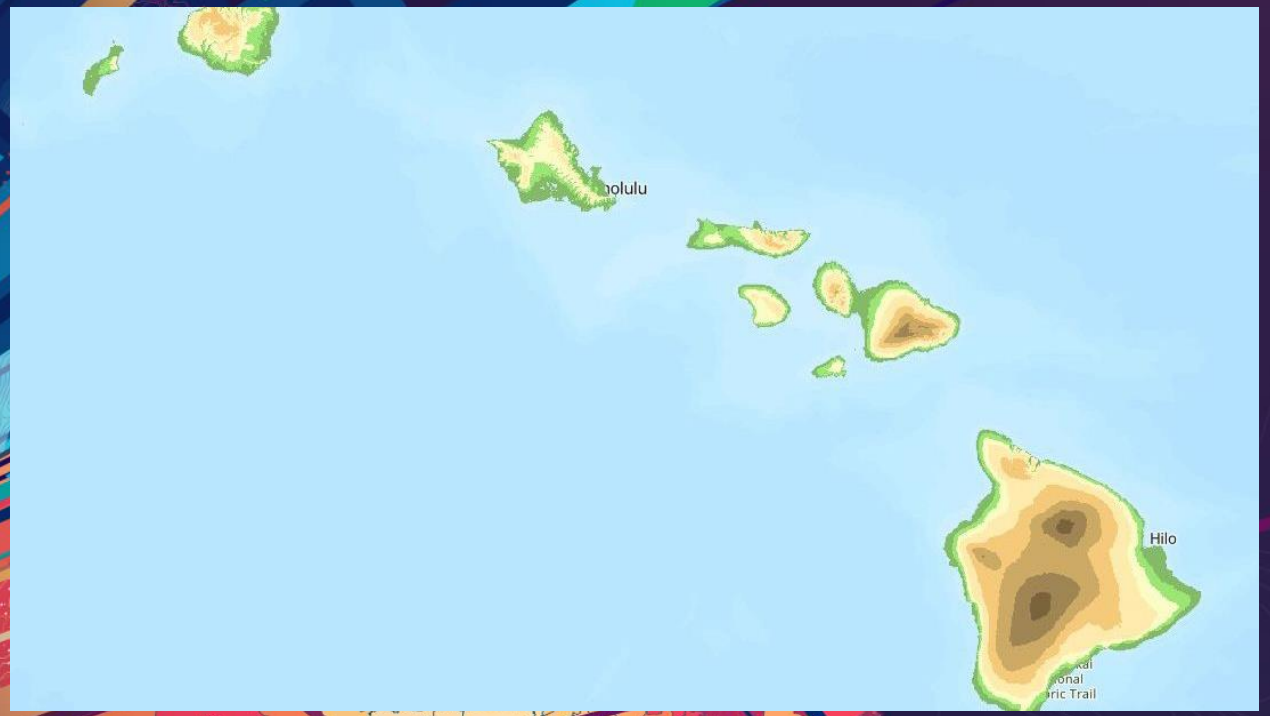
- Convert features to raster
- Slope, Aspect, Hillshade
- Resample
- Reclassify
- Clip and mask
- Viewshed and Watershed
- Flow direction/Flow accumulation
- Trigonometry/math/Boolean
- NDVI, weighted overlay
- Apply an attribute table

Function Chains & Templates

The output of a raster function can be another input.
You've made a Raster Function Chain.

$$output = \frac{x + 3}{5}$$

Raster Function Chain:
First apply x+3 function
Then apply /5 function to the output of that



Demo – Function Chains & Templates

Some important things to know

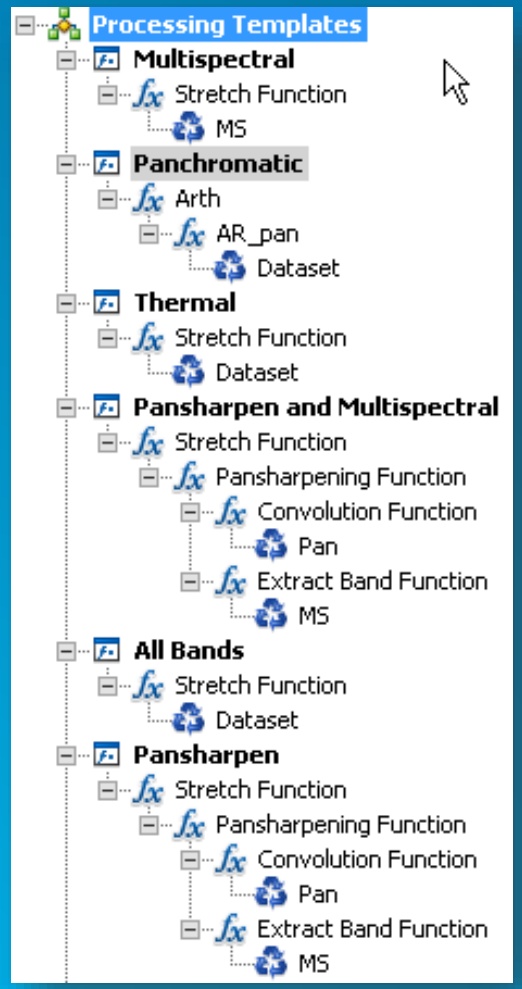
- Raster functions do not supplant geoprocessing, they are just an additional paradigm.
- Some things are not available (yet) as a raster function:
  Neighborhood analysis
  - Interpolation (IDW/Kriging)
- If you plan on applying more than one raster function to the same mosaic dataset in the same function chain, make a referenced mosaic dataset or a copy of the mosaic dataset and then apply the different functions to each copy.

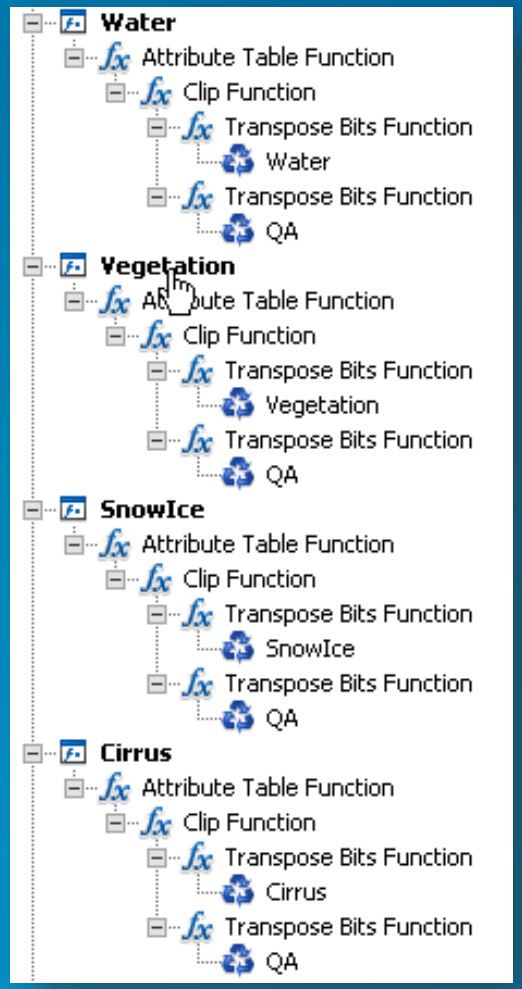
Case study: World Population Estimate

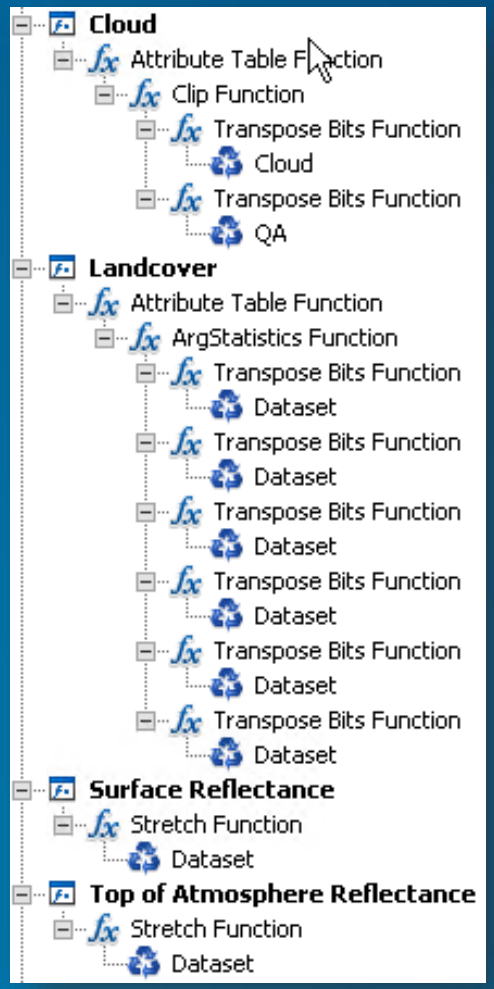
- Footprint of human settlement
  - Global imagery, classified landcover, street intersections
- GP tools to Raster Functions
- Landsat 8 Top of Atmosphere Correction (TOA)
- Reduced processing time from <u>90 to 32 days</u>

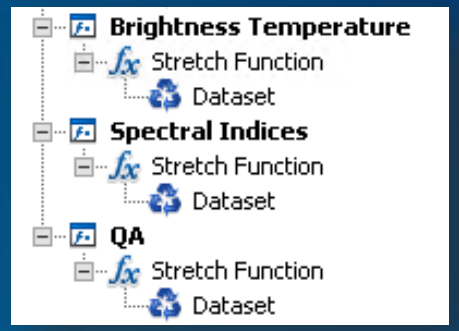
Custom Raster Type for Landsat8 TOA provided with MDCS

So happy not to be coding this myself!









- **This can be viewed via the Add Rasters to Mosaic tool once the custom raster type file has been loaded.**

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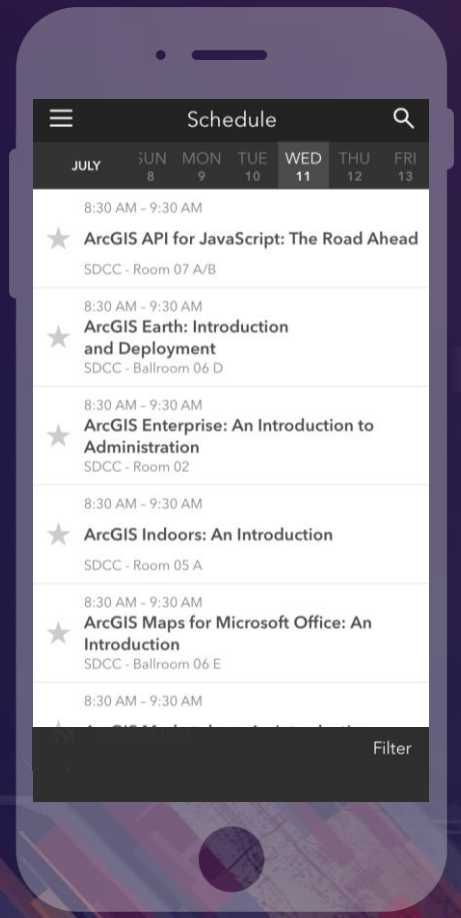
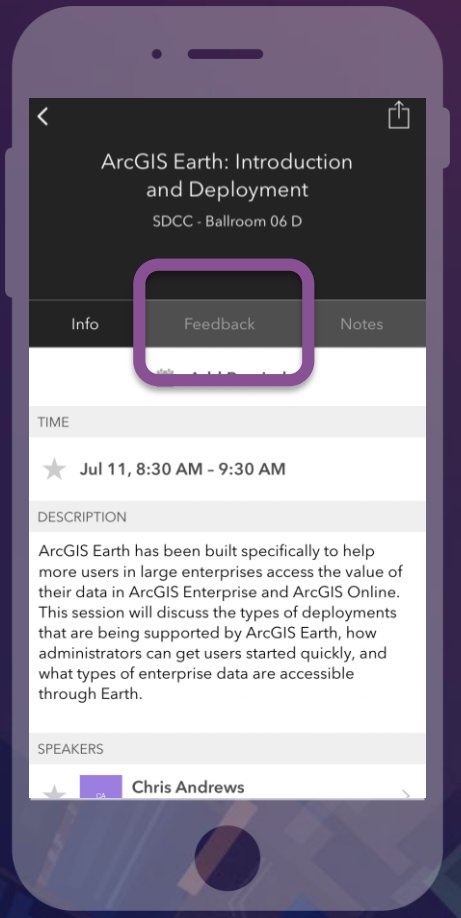
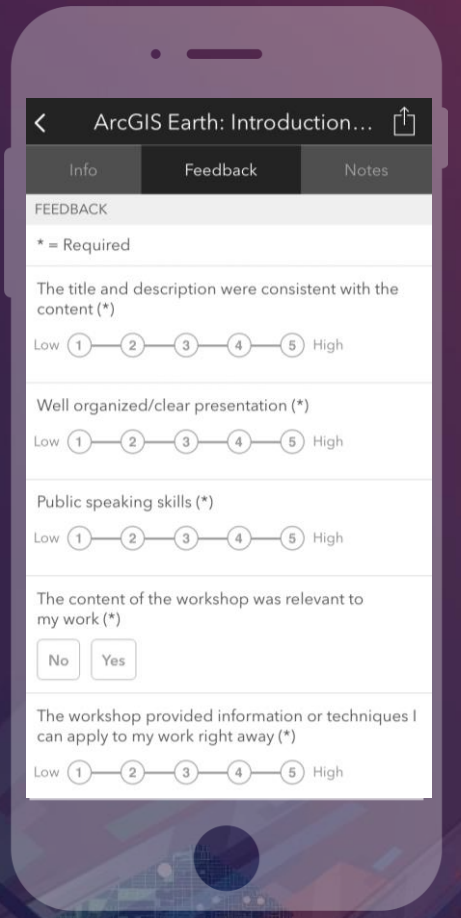


Scroll down to find the feedback section



Complete answers and select “Submit”



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