



Imagery and Raster Data in ArcGIS

An Introduction

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Introduction

Imagery in ArcGIS

- **Opening Remarks**
- **Who should be here?**
 - New to ArcGIS
 - Users interested ArcGIS' imagery capabilities
 - Users struggling in your use of imagery
 - Users struggling with Esri terminology
 - Users with questions about what imagery is available
 - Users that have you used imagery in one way and want to use it in new ways

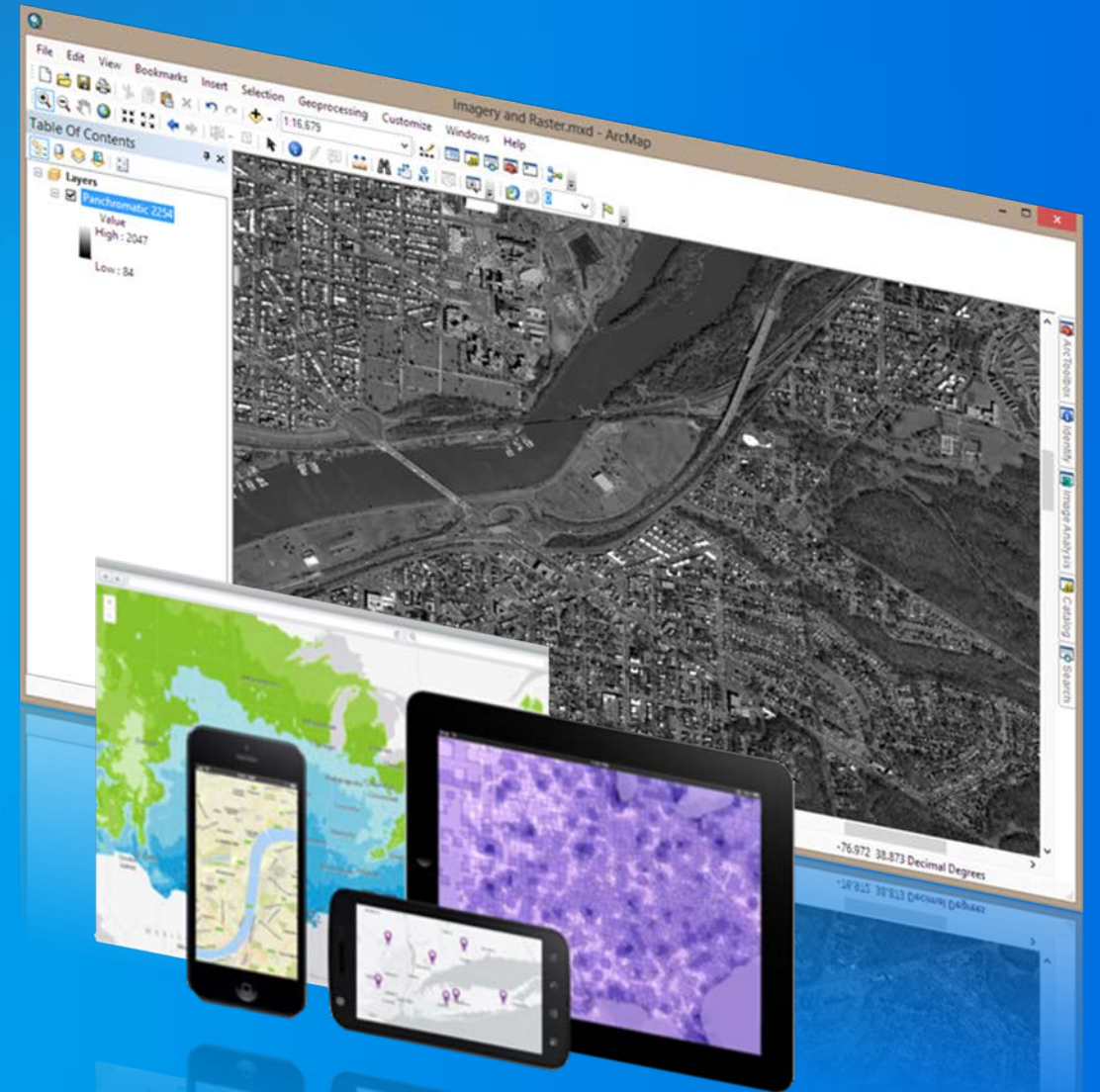
Welcome

Esri UC 2015

General Outline

Imagery in ArcGIS

- Why use imagery in a GIS?
- Sources of imagery
- ArcGIS Imagery Information Model
- What can I do with imagery in ArcGIS?





Why use imagery in GIS?



Imagery

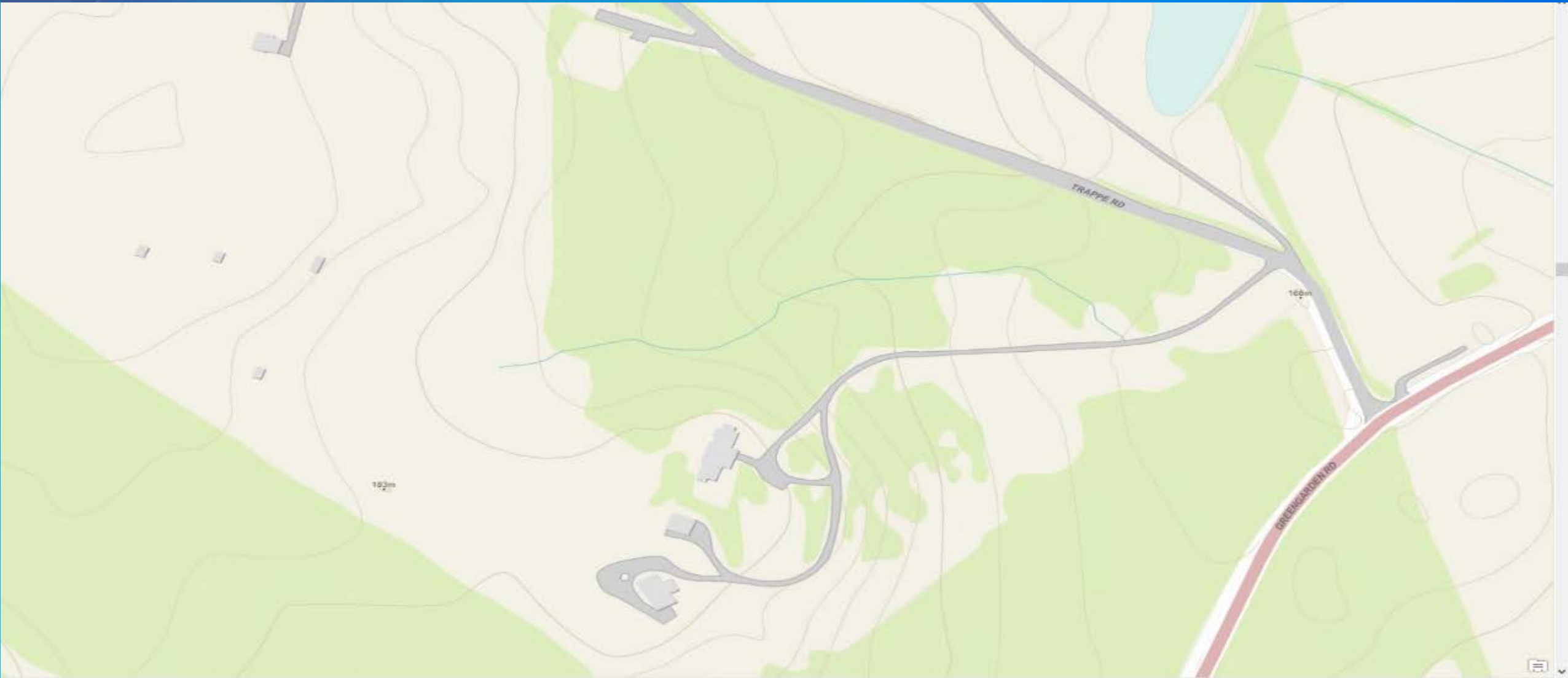
If I see it, I can understand it...

...Understanding our world

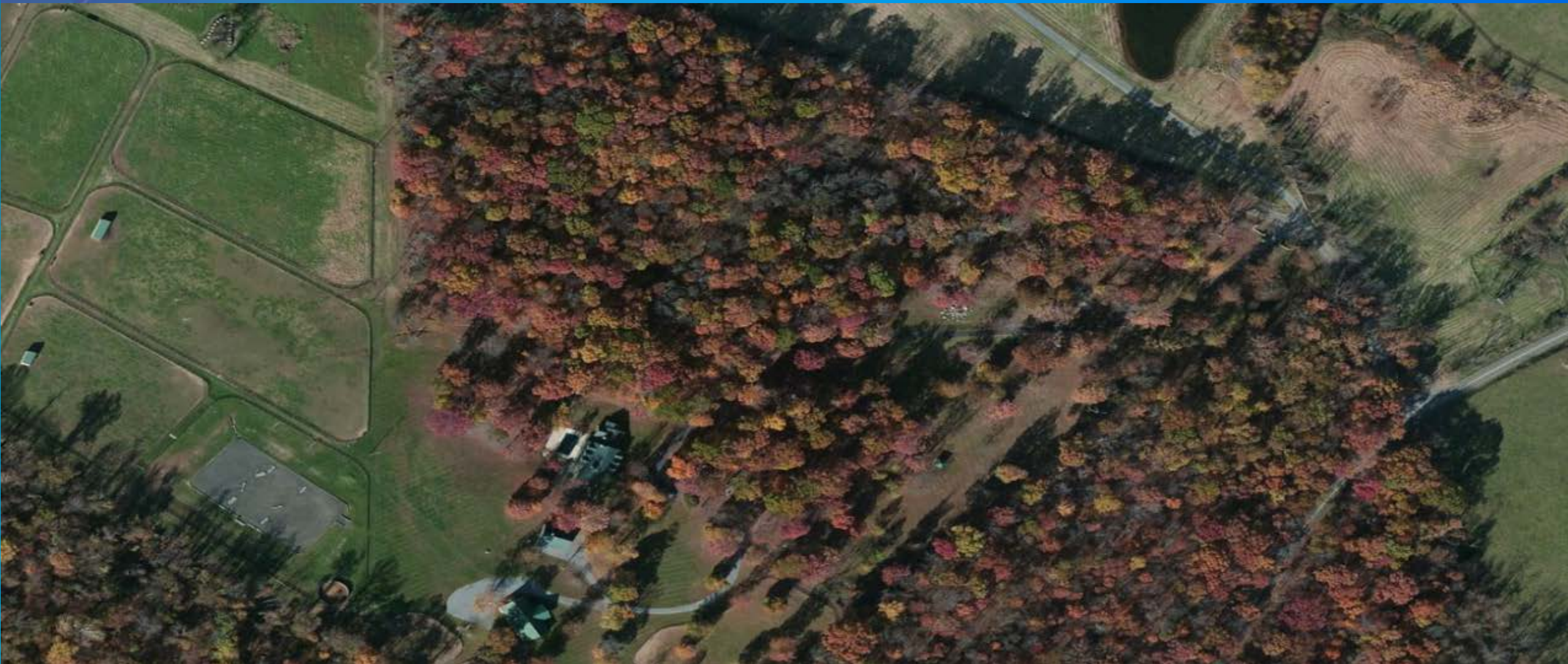
A friend asked me to check out his farm...



A friend asked me to check out his farm...



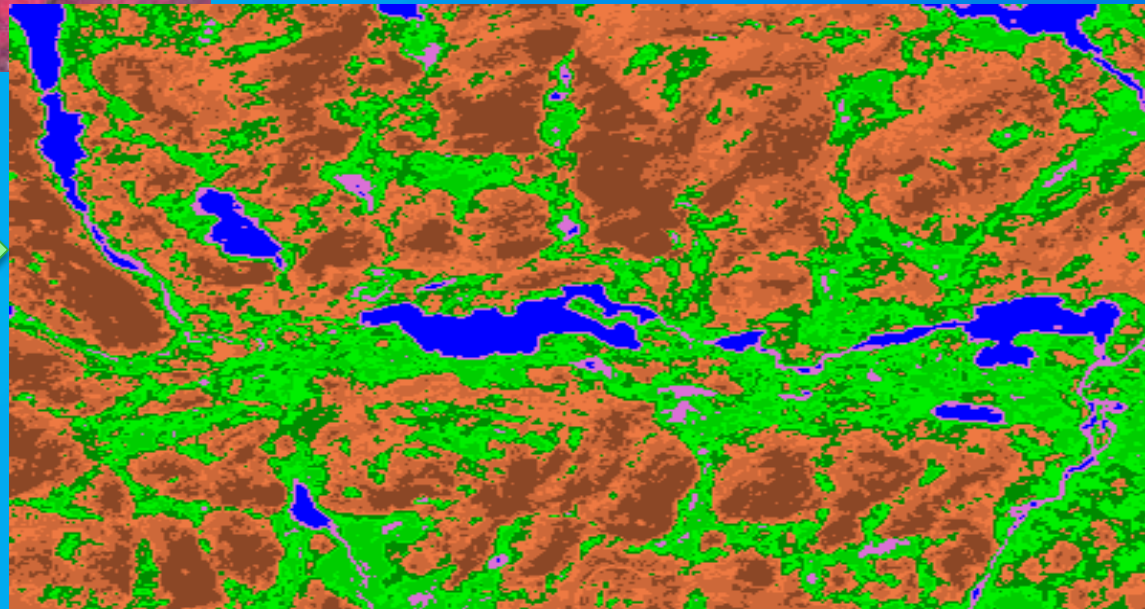
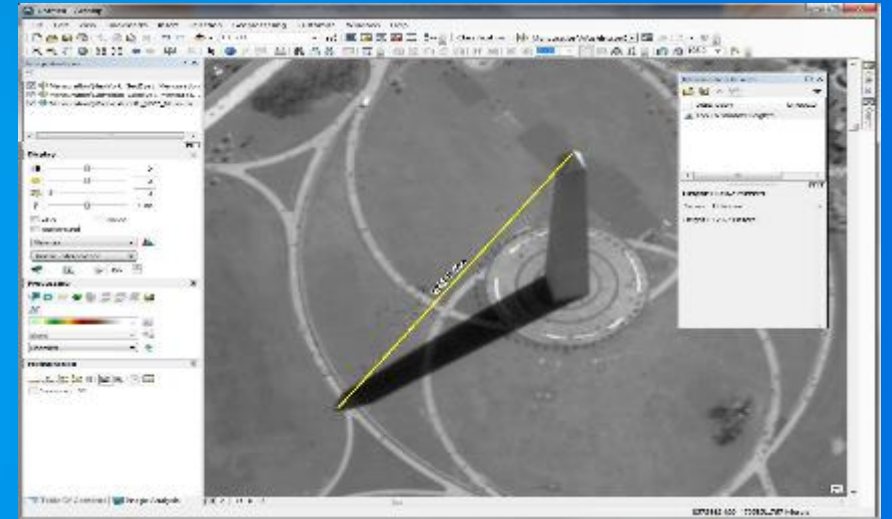
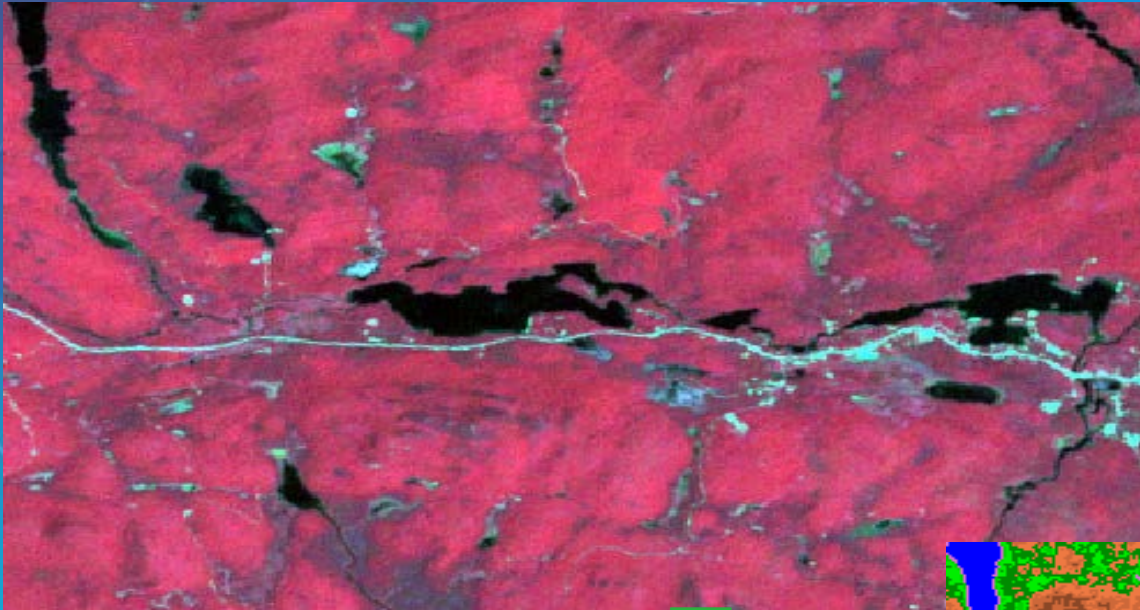
A friend asked me to check out his farm...



Imagery Characteristics - Timely



Imagery Characteristics - Metric





Sources of Imagery

Imagery Base Maps

Sources of Imagery

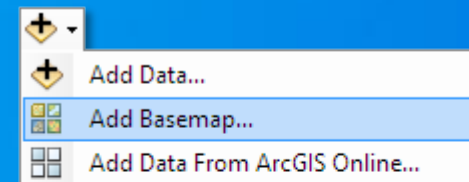
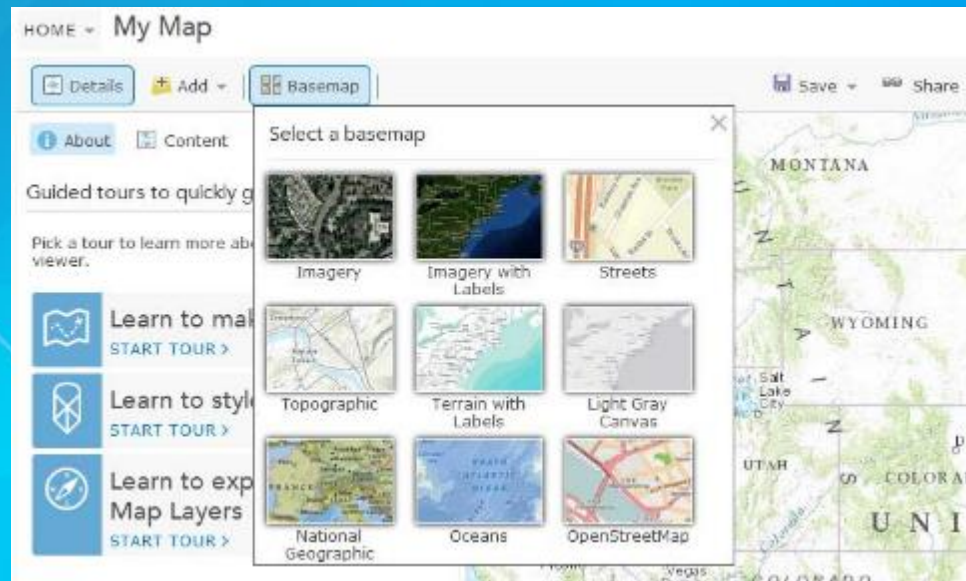
- **Most often used as a “only a backdrop”**
 - georeferenced picture for visualization
 - cached imagery (lossful in many ways)
- **Typically stored in a data structure...**
 - which is extremely efficient for visualization (tiles)
 - which works well on all devices and platforms
- **Often free “to the user”**
- **Timeliness can be an issue**
- **Limited analytical capabilities**



ArcGIS Imagery Base Maps

Sources of Imagery

Base map	Source	GSD	Features	Timeliness
AGOL World Imagery	Varied	Typical 1m – 0.15m	Manmade	1-3 year



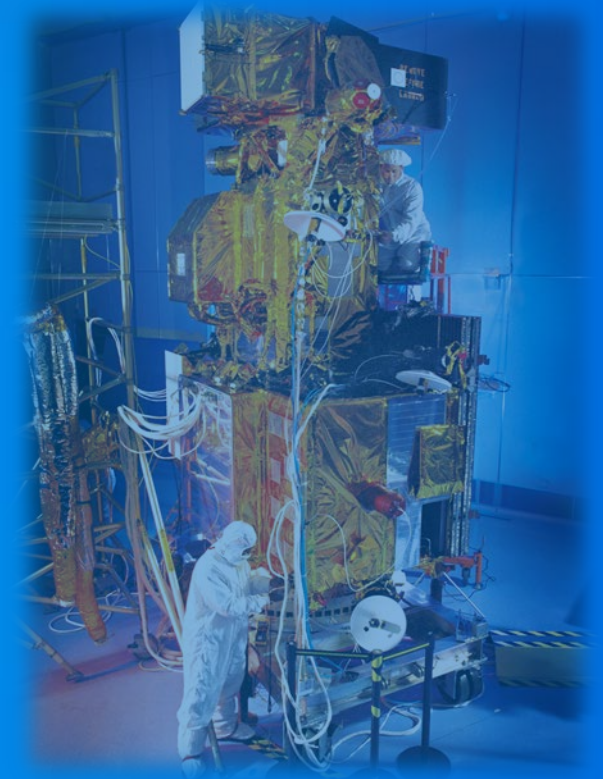
Add Basemap

Choose a basemap from ArcGIS Online. These basemaps are map services that require an Internet connection for them to draw in your map.

Analytical Sources

Sources of Imagery

- **Primarily used to acquire feature data**
- **Typically derived from Remote Sensing devices**
 - Satellite, Aerial, RADAR,...
- **Typically stored in a data structure...**
 - which is designed for full analytical capabilities
 - which is rich with metadata
- **Vary in cost and are rarely free**
 - Modality vs. Timeliness vs. GSD vs. Product Level
- **Analytical in nature**
 - interpretation and exploitation, classification, change detection, feature extraction



ArcGIS Analytical Imagery

Sources of Imagery

Image Service	Source	GSD	Features	Timeliness
Landsat GLS	Landsat GLS	15m pansharpened	Natural	Historic epic
Landsat 8	Landsat 8	15m pansharpened	Natural	Most recent
NAIP (US only)	4 bands	1m	Manmade/natural	Current year

Products


Landsat Imagery

Main Enhancements Viewer Image Services Tours More Info

Image Services

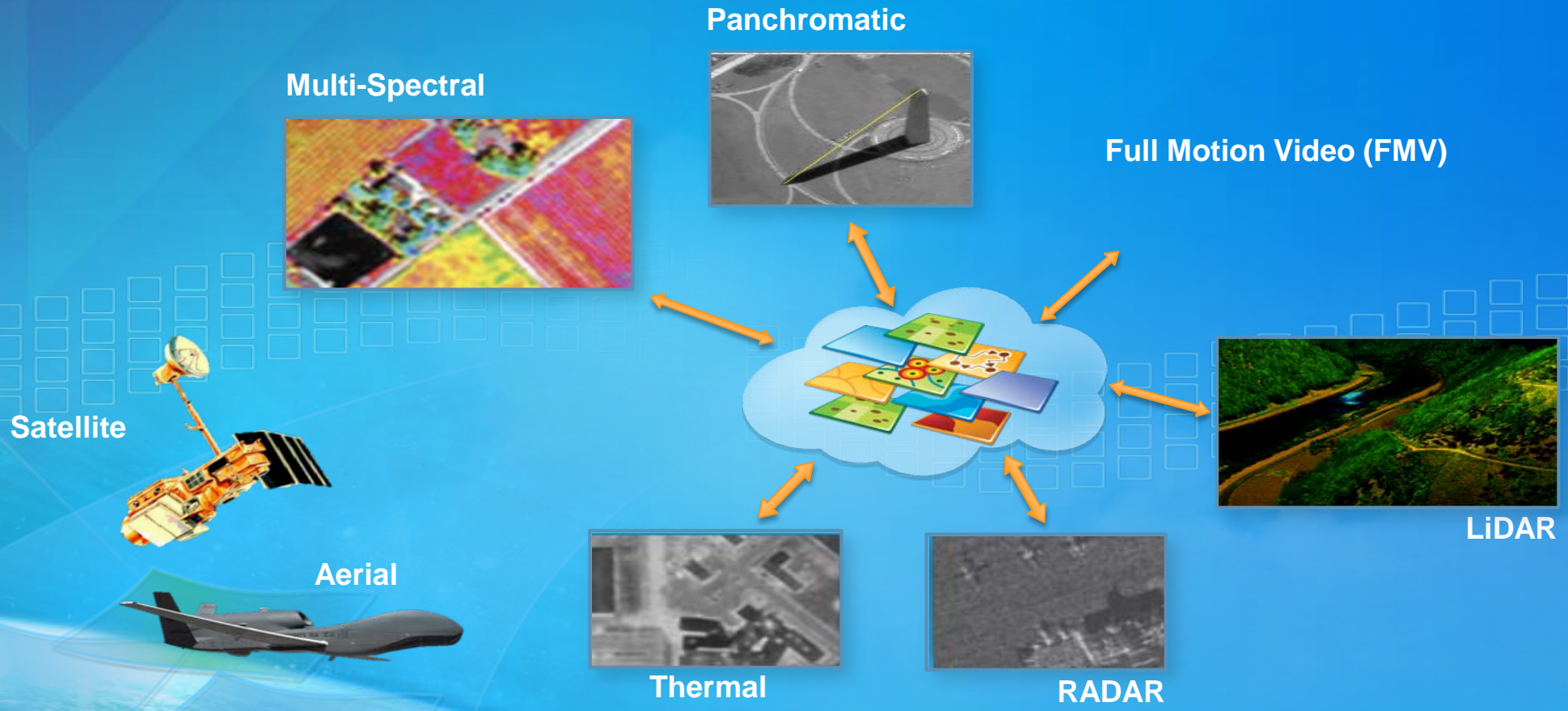
Access to multitemporal, multispectral worldwide Landsat 8 and Landsat GLS data.

[Access Image Services](#)



ArcGIS integrates all types, sources, and sensor models

Sources of Imagery

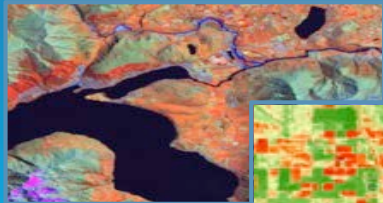


... Imagery is a Fundamental Part of the Systems

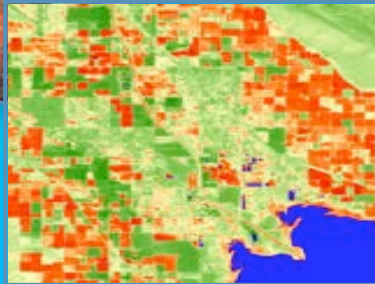
ArcGIS includes many tools for Visualization, Analysis, and Data Management of imagery

Sources of Imagery

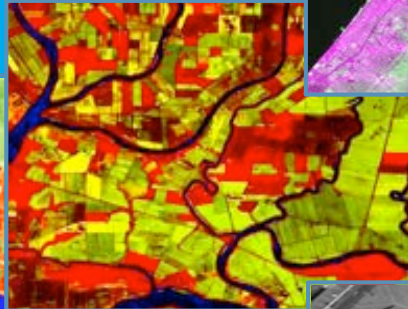
Color Balance



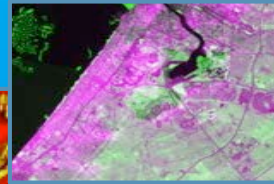
Mosaicking



Ortho-Rectification



Change Analysis



Classification



Pan Sharpen



3D Measurement



Automatic Alignment



Open and Leveraged by Partners

Demo

Sources of Imagery



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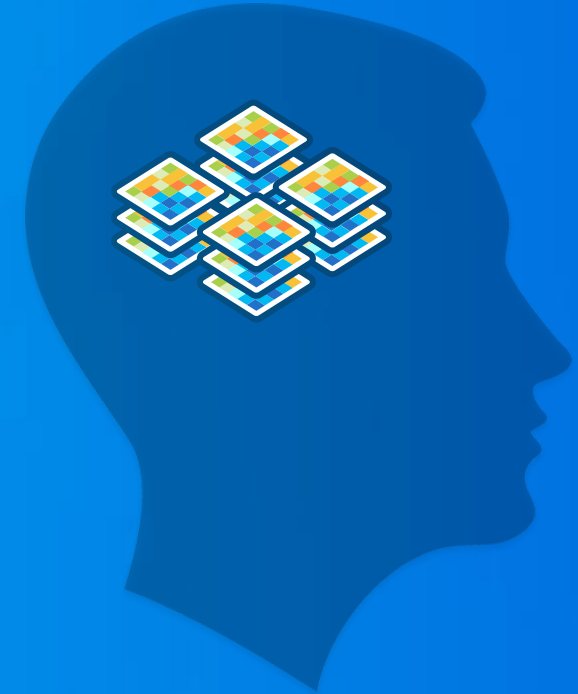
The ArcGIS Imagery Information Model

design, concepts, and terminology

Underlying Design Principles

ArcGIS Imagery Information Model

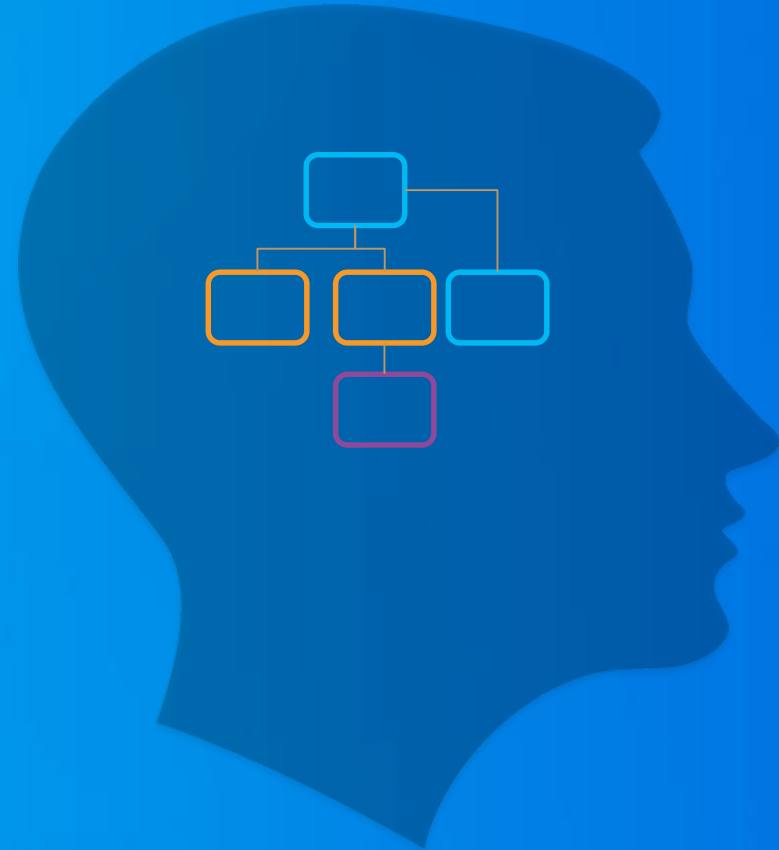
- **Only process what you need, ...when you need it**
 - Operate on the original source imagery – no preprocessing
 - Request-Based processing
- **Intelligent use of the metadata**
 - Virtual Products (e.g. NDVI on-the-fly)
 - Mensuration
- **Optimize storage requirements**
 - reference the imagery files - don't move or make copies
 - derive many products from a single source and storage
- **Manage massive collections of imagery and make them easily accessible**
 - manage imagery in the enterprise (Mosaic Datasets)
 - web-enable imagery (Image Services, ArcGIS Online, Portal for ArcGIS, caching tools,...)



Architectural Principles

ArcGIS Imagery Information Model

- **An ArcGIS Information Model is...**
 - A data model + business logic
 - Stored in a Geodatabase (File, Enterprise, ...)
 - Cross product (desktop, server, mobile, web,...)
 - Rich and robust
 - Accessible via Public APIs



Model Components

ArcGIS Imagery Information Model

- **6 Key Components**

- **Raster Dataset**
- **Raster Type**
- **Raster Function**
- **Raster Product**
- **Mosaic Dataset**
- **Image Service**

- **component names == terminology**

- *“You web enable your imagery by publishing your Mosaic Dataset as an Image Service.”*



Raster Dataset

ArcGIS Imagery Information Model

- The Raster Dataset is the primary information model component which represents a basic image with basic behavior.
- It's role is to read and write image storage (pixels) and metadata
- **Comprehensive Support**
 - 1 or N Bands
 - 1-64 bits per band
 - compressed or uncompressed
 - > 80 formats supported
 - pyramids (rrd, ovr, internal...)
- Read image files directly – no need to convert
- *"It's what you get if you drag a GeoTIFF into ArcMap."*



Demo

Raster Dataset



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Raster Type

ArcGIS Imagery Information Model

- The Raster Type is the primary information model component which represents the intelligent business logic for a particular sensor or image product coming from a vendor.

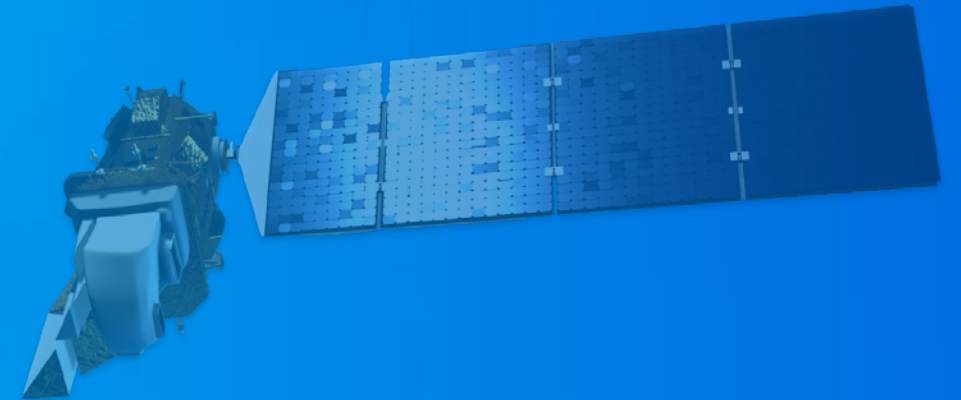
- It's role is too...

- Define pixel storage and metadata schema
- Define the rules for ingesting imagery into ArcGIS
- Define the default processing chains
- Define the georeferencing (sensor model + parameters)

- Sensor and/or Format Specification specific

- 40+ Raster Types

- | | | | | |
|--------------|---------------|---------------|---------------|---------------|
| ✓ Applanix | ✓ GeoEye-1 | ✓ Landsat 1-5 | ✓ Pleiades-1 | ✓ WorldView-1 |
| ✓ CADRG | ✓ HRE | TM | ✓ Quickbird | ✓ WorldView-2 |
| ✓ ECRG | ✓ IKONOS | ✓ Landsat 7 | ✓ RapidEye | ✓ WorldView-3 |
| ✓ CIB | ✓ ISAT | ETM+ | ✓ Radarsat 2 | |
| ✓ DMCii | ✓ Kompsat-2 | ✓ Landsat 8 | ✓ SOCET (SUP) | |
| ✓ DTED | ✓ Landsat 1-5 | ✓ LAS | ✓ SPOT 5 | |
| ✓ Formosat-2 | MSS | ✓ NITF | ✓ SPOT 6 | |



Demo

Raster Type



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Raster Function

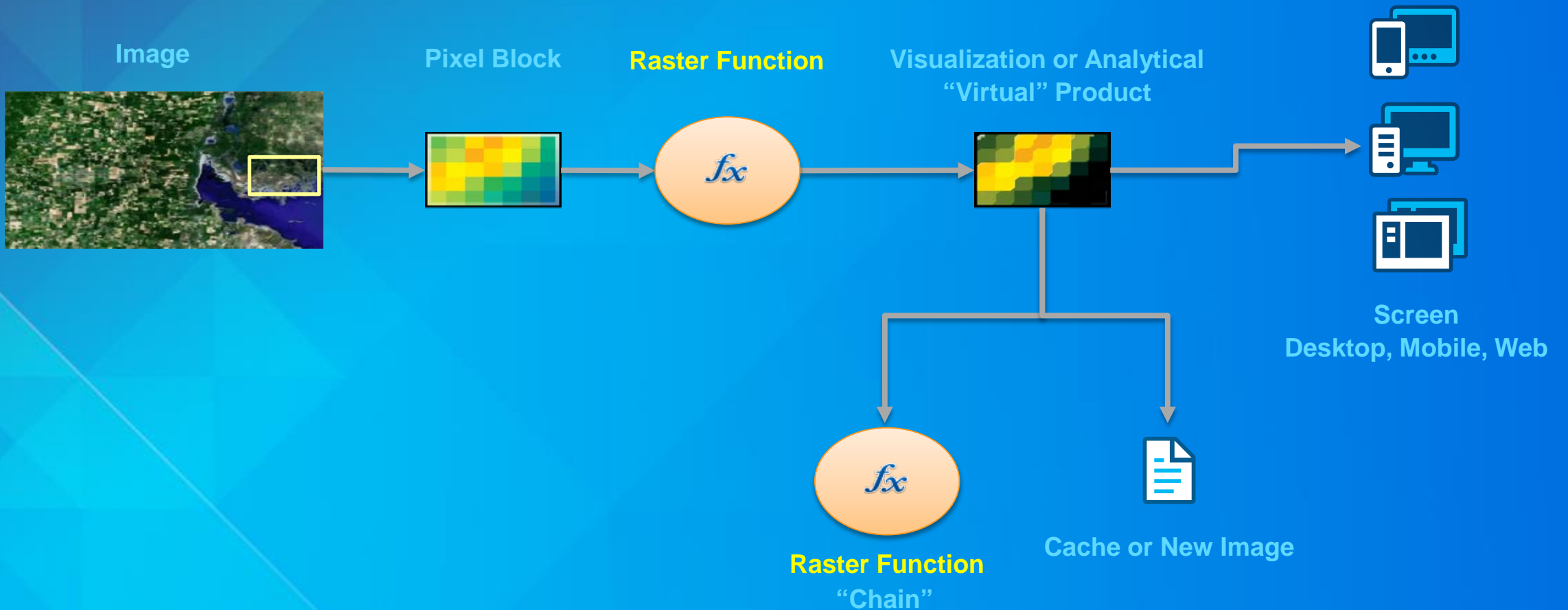
ArcGIS Imagery Information Model

- **The Raster Function is the primary information model component which processes image data.**
- **It's role is to take input pixels and produce altered output pixels**
- **A Raster Function**
 - processes a single pixel or block of pixels (not the full image)
 - can make geometric modifications to the pixels (orthorectify, project, clip,...)
 - can make radiometric modifications to the pixels (band math, convolution filters, Tasseled Cap,...)
- **Raster Functions are chained together to create simple or advanced processing chains**
 - pixels that flow through the chain are virtual in nature (“on-the-fly” processing)
- **50+ Raster Functions**



Raster Function

ArcGIS Imagery Information Model



Raster Function or Geoprocessing Tool?

ArcGIS Imagery Information Model

- **Geoprocessing Tools**

- Esri does not implement what I need as a Raster Function
- My processing requires integration of feature data (vectors)
- I have complex GP Models (conditionals, iterations, custom script tools)
- Algorithms which are not well suited for block level processing (cost distance)

- **Raster Functions**

- If you can, you should (storage savings, time savings, flexibility to change,..)
- Esri provides all the Raster Functions I need to produce my products
- It's acceptable in my application to use an ephemeral or intermediate results
 - Visualization
 - Analysis results which can be consumed per request based on an AOI



Demo

Raster Function

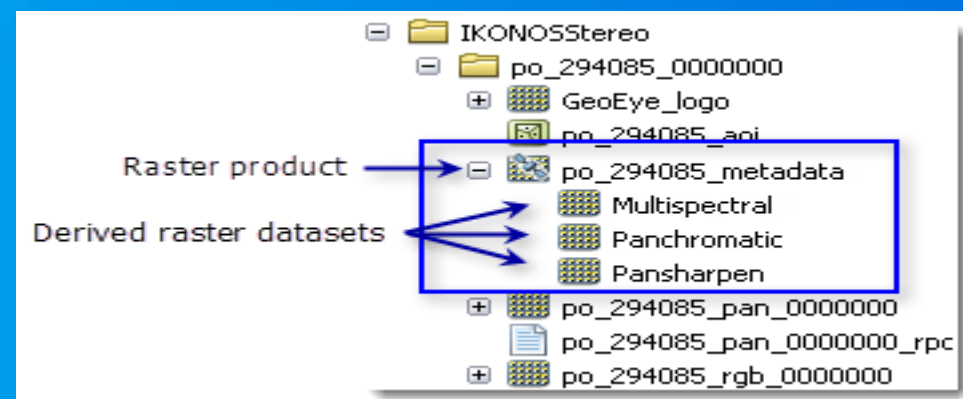


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Raster Product

ArcGIS Imagery Information Model

- The Raster Product is the primary information model component which makes it easy to use intelligence which is provided by the Raster Type
- It's role is to represent Imagery Information Model intelligence as products and product information to the user
- A Raster Product
 - enables ArcGIS user interface shortcuts to well known band combinations and processing chains
 - allows the user to think about products and not files
- Sensor and/or Format Specification specific
 - they are based on Raster Type(s)
- ArcMap Catalog window / ArcCatalog



Demo

Raster Product

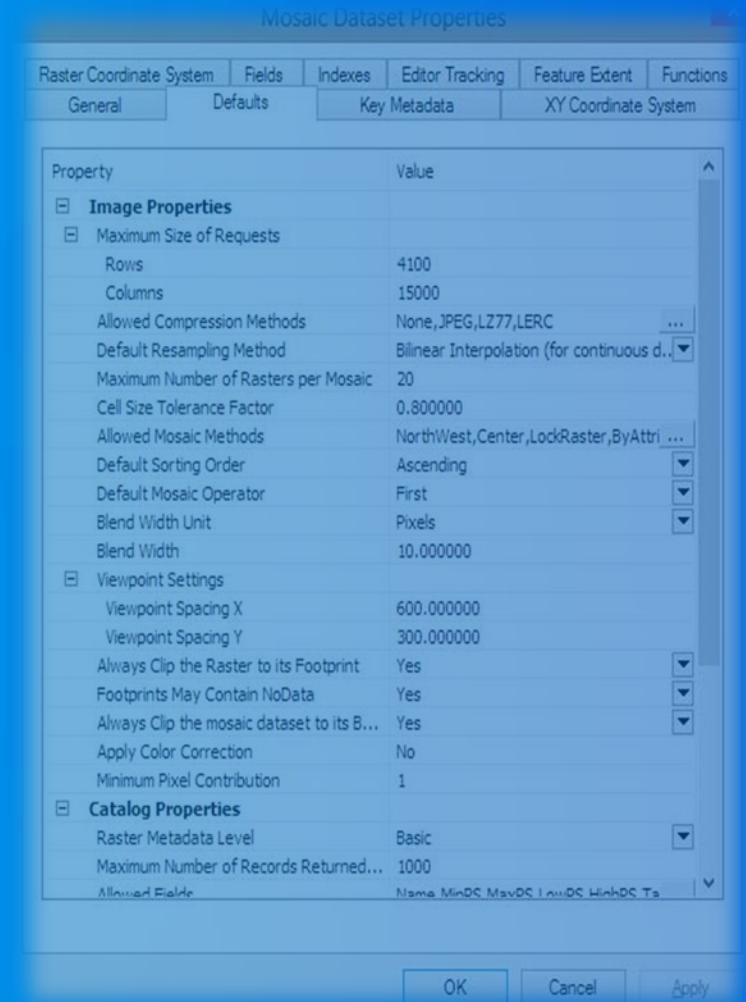


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Mosaic Dataset

ArcGIS Imagery Information Model

- **The Mosaic Dataset is the primary information model component which manages massive collections of imagery**
- **It's role is to provide...**
 - an image library for management (cataloging, indexing, metadata, searching,...)
 - dynamic, on-the-fly, product generation (mosaicking, processing and analysis)
 - a workflow to shorten the time from sensor to use (quickly ingest, dynamic product immediately available)
- **Scalable (1 to millions of images)**
- **homogeneous or heterogeneous collections (one sensor or a mix)**
- **Dynamic product generation for visualization or analysis**



Demo

Mosaic Dataset

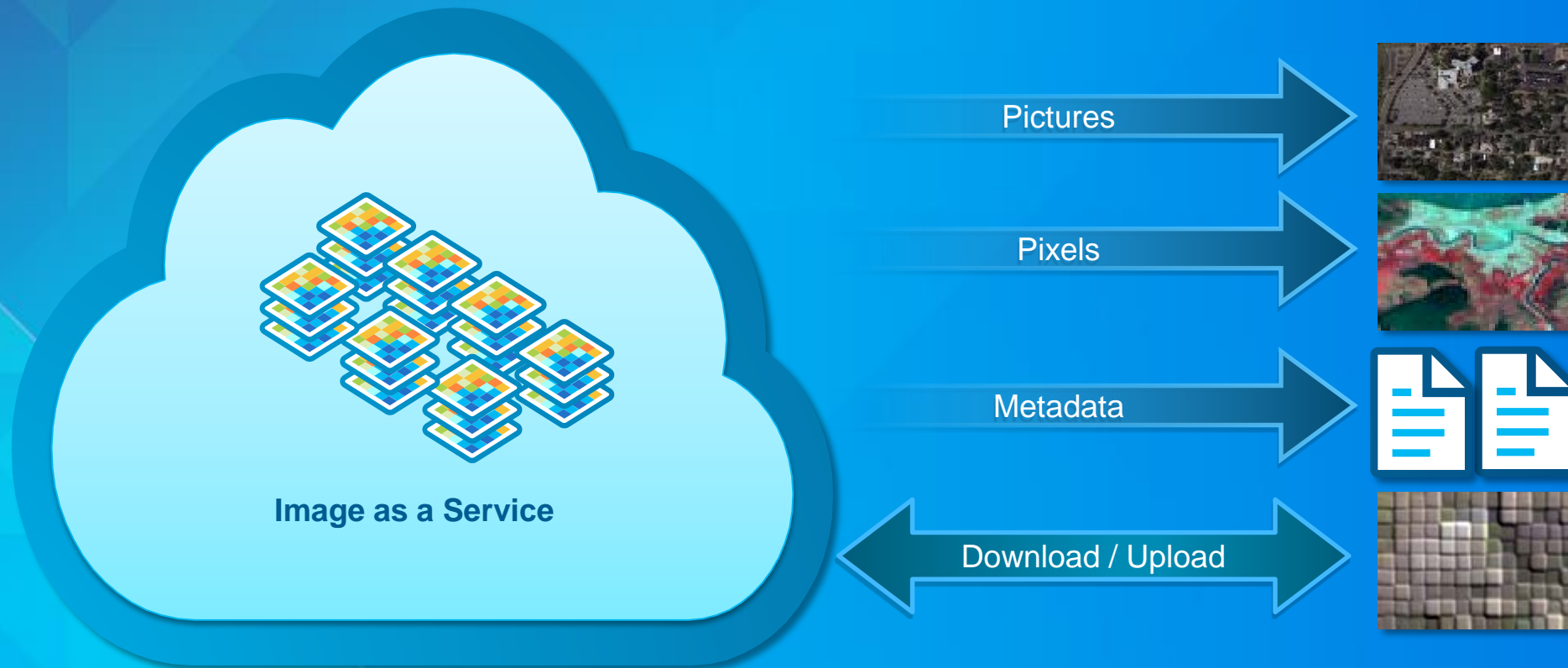


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Image Service

ArcGIS Imagery Information Model

- The Image Service is the primary information model component which web enables imagery
- It's role is to provide *Imagery as a Service* (one aspect of GIS as a Service)



Demo

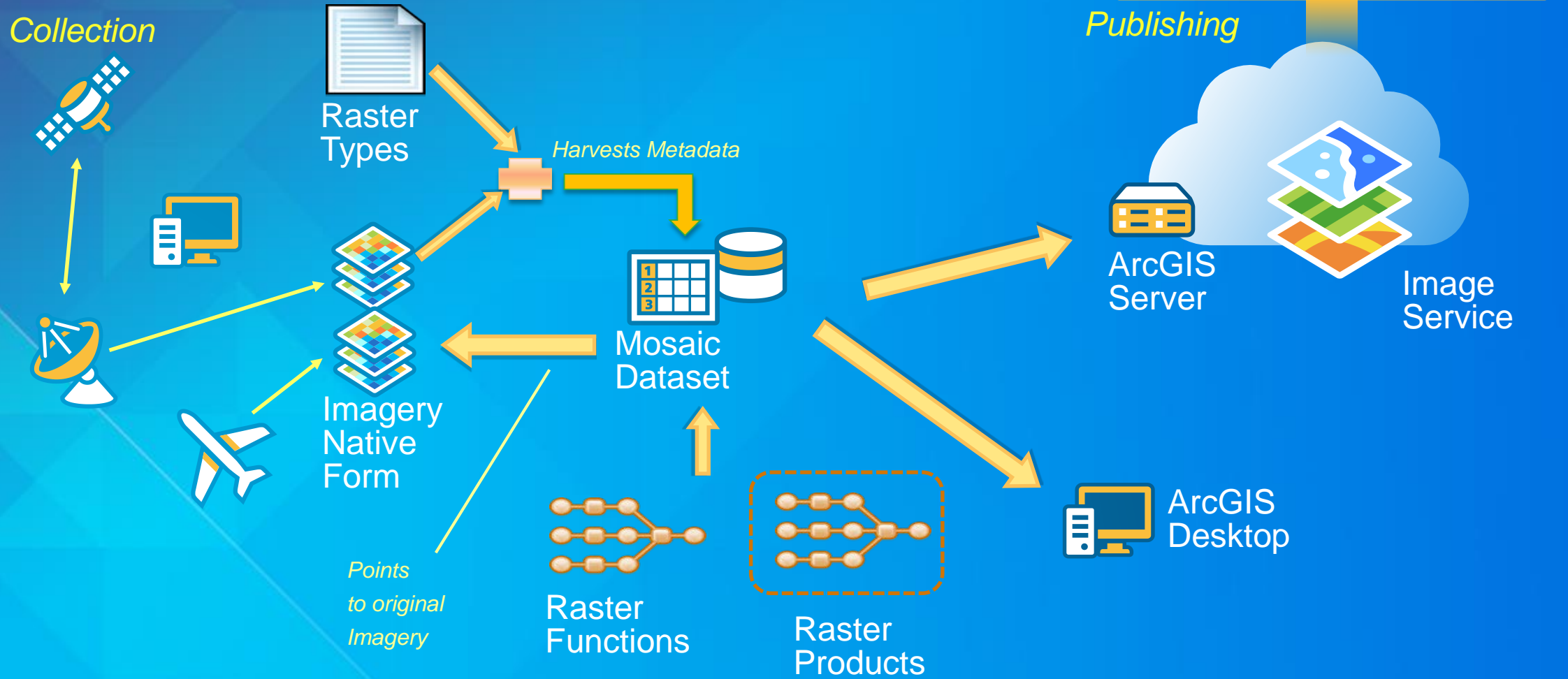
Image Service



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Putting it all together

Collection





**What can I do with
imagery in ArcGIS?**

What are my choices when working with imagery

ArcGIS and Imagery

- **One image at a time**

- Files
- Image Analysis Window (IAW)
- Geoprocessing



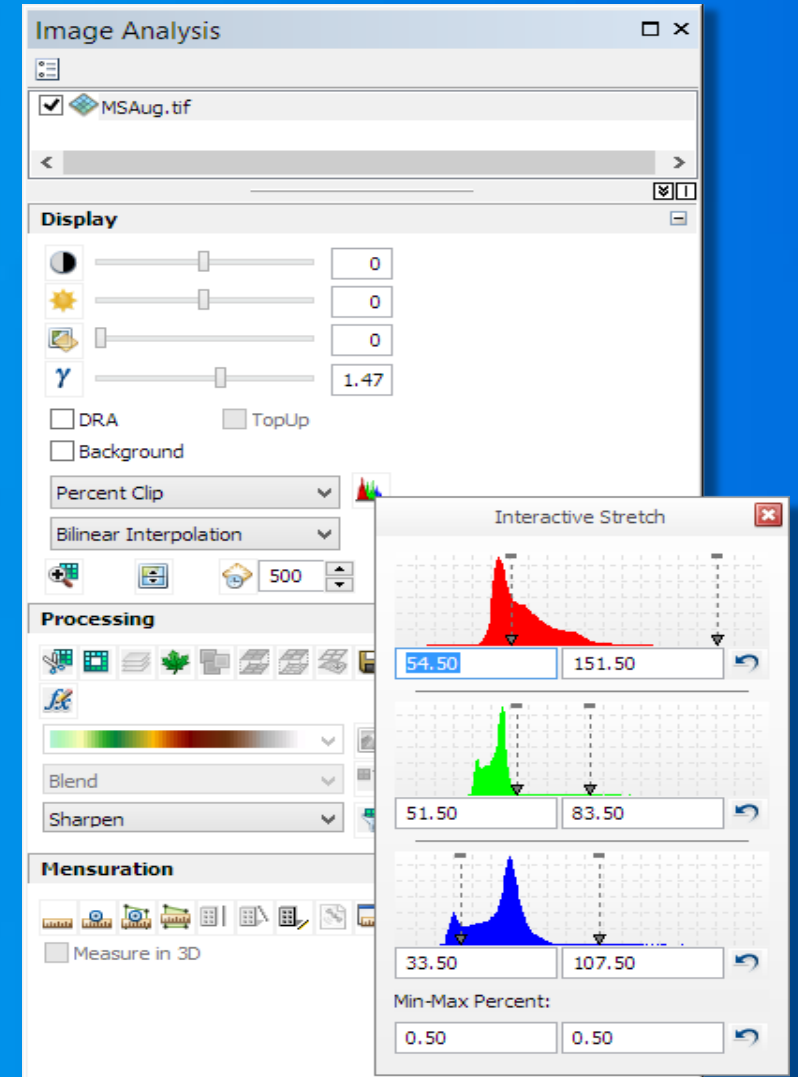
- **Collections of images**

- Mosaic Datasets
- Image Analysis Window (IAW)
- Geoprocessing



- **Imagery as a Service**

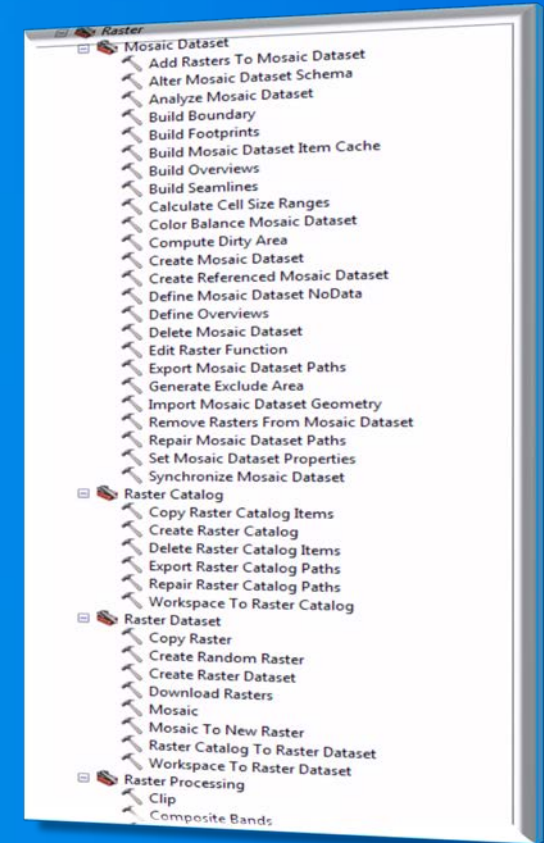
- Web
- Image Analysis Window (IAW)
- Developer APIs
- ArcGIS Online



Processing, Exploitation, Dissemination

ArcGIS and Imagery

- Process images to create new images (traditional image processing)
- Process images on-the-fly to create dynamic virtual products
- Process images to create tiled image maps
- Geoprocessing tools
 - Georeferencing and Orthorectification
 - Color Balancing
 - Seam line generation
 - Caching to tiles
- Geoprocessing tools
 - 95+ tools for image management and processing
- Raster Functions
 - Can be applied to Raster Datasets, Mosaic Datasets, and Image Services



Processing, Exploitation, Dissemination ArcGIS and Imagery

- **Take advantage of ArcGIS ready-to-use imagery**
 - ArcGIS Online World Imagery Base Map, Landsat GLS, Landsat 8, NAIP
 - Consume Premium Services available by Partners on the ArcGIS Marketplace
- **Visualize images**
 - as a single image
 - as a dynamically mosaicked product
- **Extract feature data from imagery**
 - manually capture features using imagery as a backdrop
 - image classification
 - custom image processing with R2V and vector tools for cleanup
- **Take measurements (Mensuration Tools)**



Processing, Exploitation, Dissemination

ICS provides an undistorted view in natural orientation

did you know?



Geographic Coordinate System - GCS



Image Coordinate System - ICS

Map on an Image.... vs. Image on a Map...

Demo

Image Coordinate
System

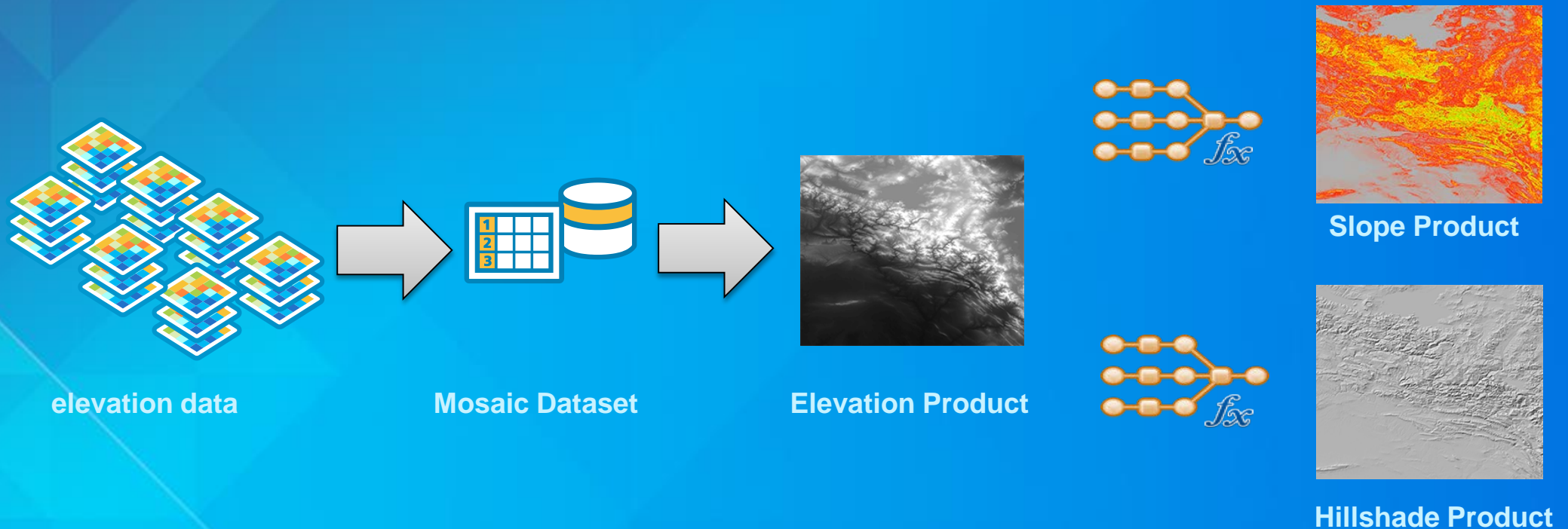


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Processing, Exploitation, Dissemination

ArcGIS and Imagery

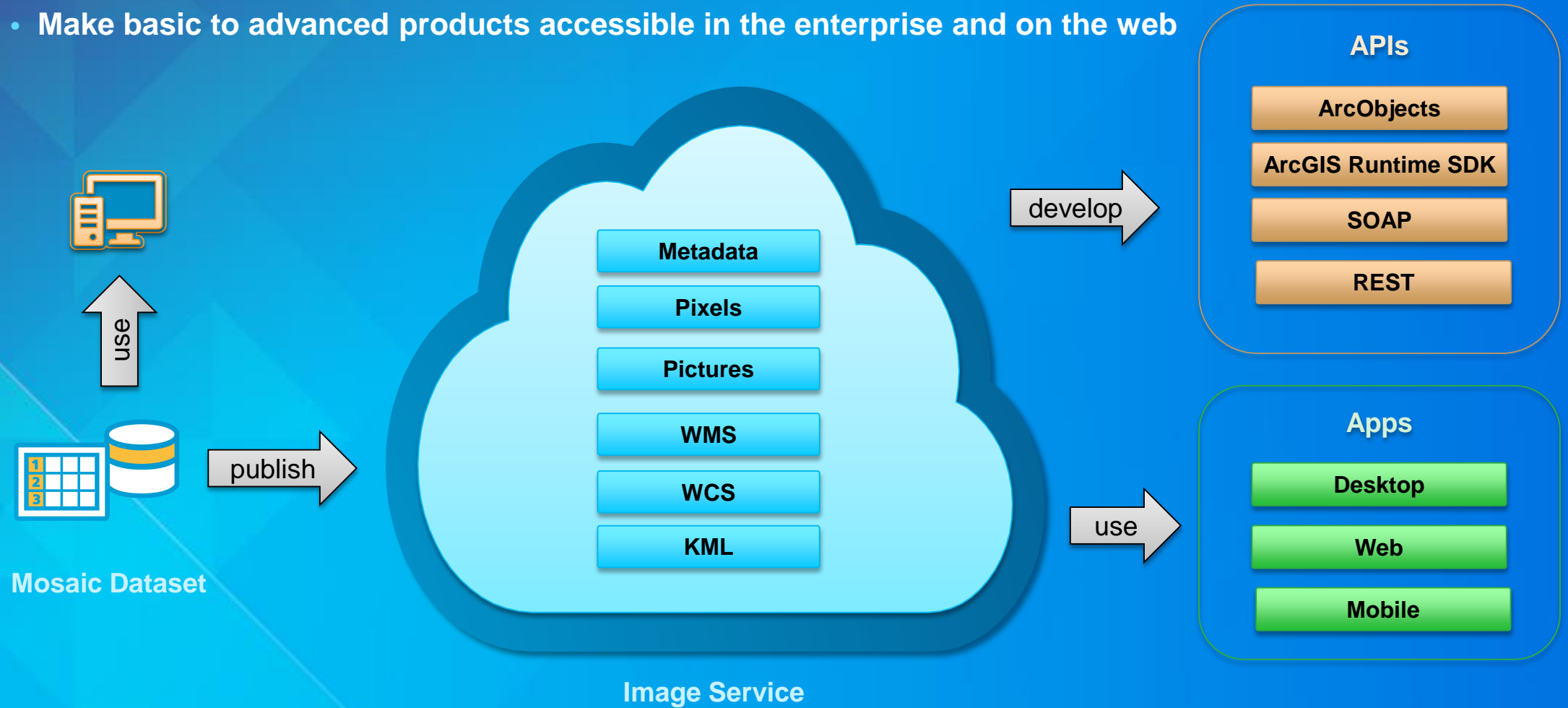
- Create multiple products from a single source without the additional storage resource costs



Processing, Exploitation, Dissemination

ArcGIS and Imagery

- Make basic to advanced products accessible in the enterprise and on the web



Summary

ArcGIS is an imagery platform for GIS (and pure PED)

- **Imagery is an integral aspect of GIS**
- **Imagery is readily available**
- **ArcGIS comes with imagery**
- **ArcGIS provides advanced imagery tools**
- **ArcGIS can manage massive image collections**
- **Spend time understanding the information model and technologies of ArcGIS**
 - Reference Documentation, Resource Center, Blogs, Workshops, Webinars
- **Outside the scope of this presentation...**
 - Learn more about our Imagery Business Partners

Want to learn more?

- **UC 2015**

- Managing Imagery and Raster Data Using Mosaic Datasets
 - Room 32A, Tuesday 3:15 & Wednesday 1:30
- Imagery Island (Showcase)

- **Documentation**

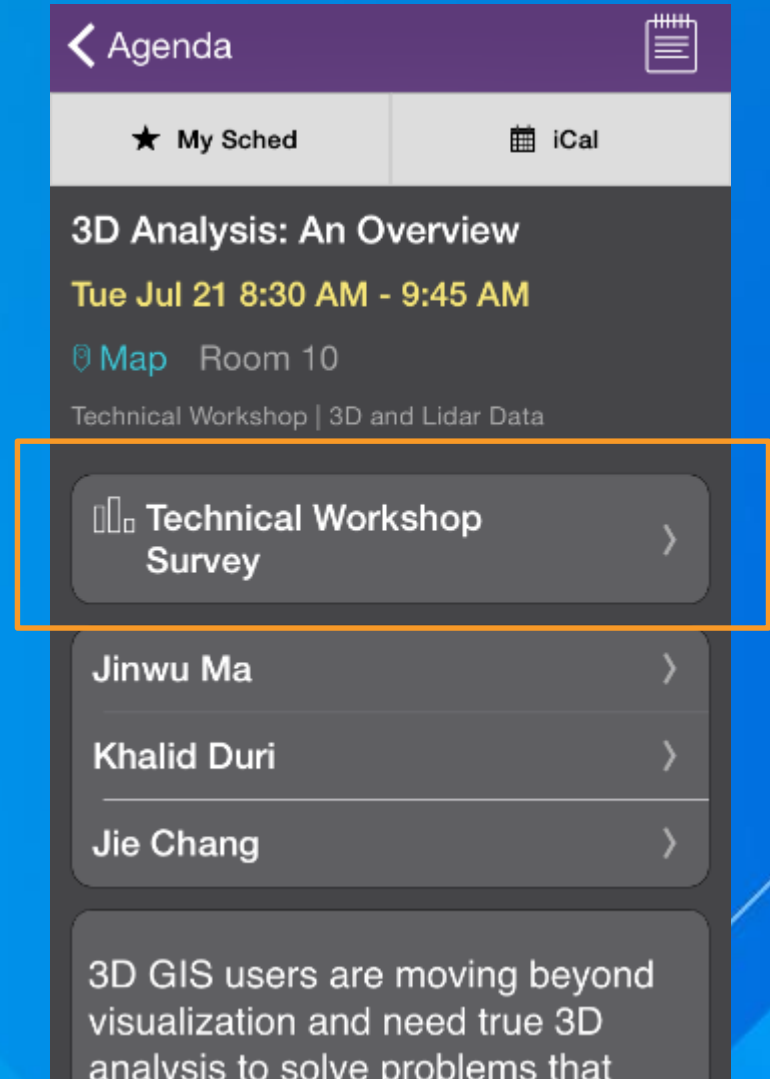
- <http://desktop.arcgis.com/en/imagery> (substitute language for “en”)

- **Get Involved**

- <https://geonet.esri.com/community/gis/imagery-and-remote-sensing>

Thank you...

- Please fill out the session survey in your mobile app
- Select **Imagery and Raster Data in ArcGIS: An Introduction**
 - use the Search Feature to quickly find this title
- Click “Technical Workshop Survey”
- Answer a few short questions and enter any comments





Understanding our world.