

**Federal GIS Conference**

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# **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 used imagery in one way and want to use it in new ways

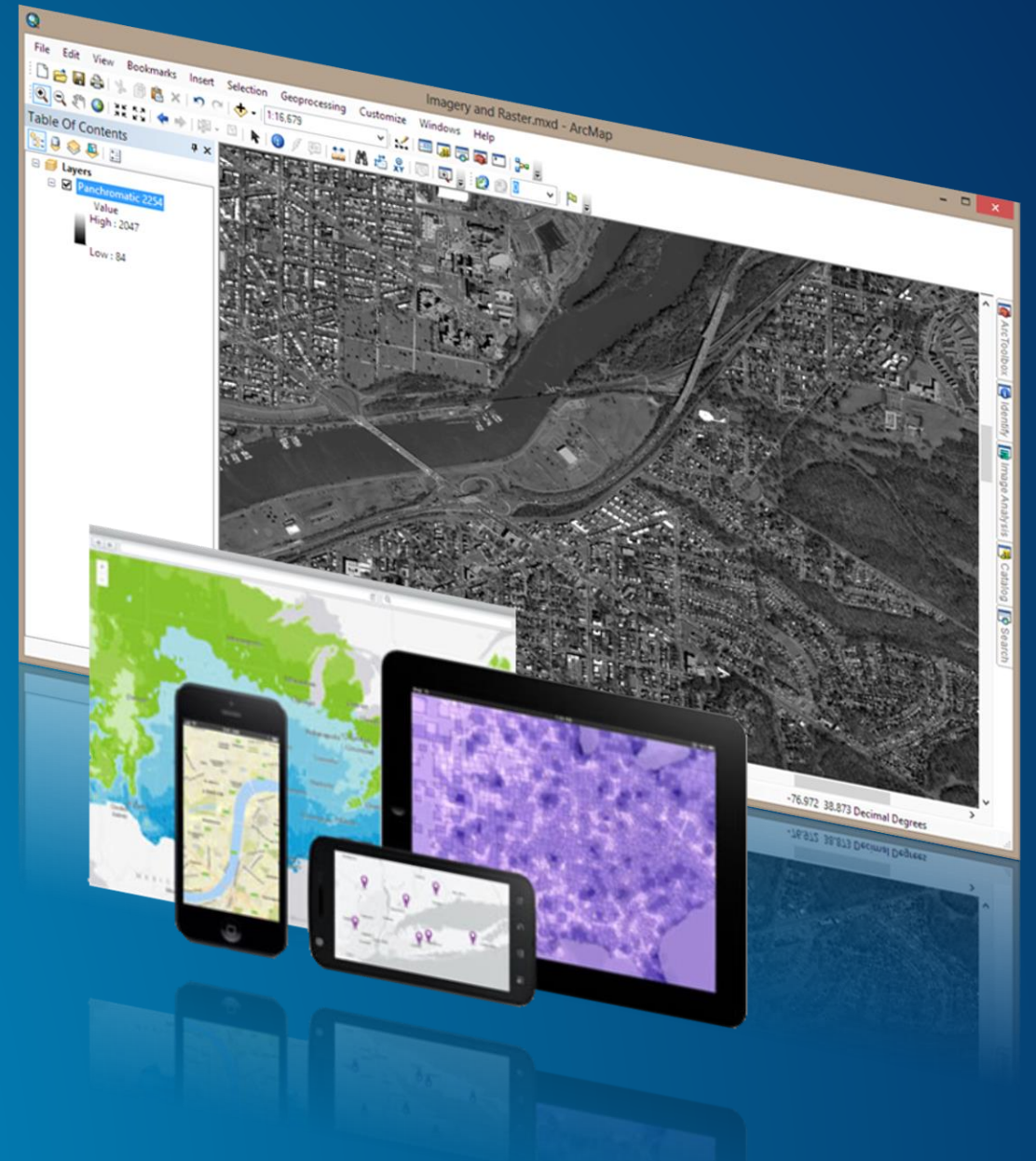
Welcome

Fed GIS 2015

# General Outline

## Imagery in ArcGIS

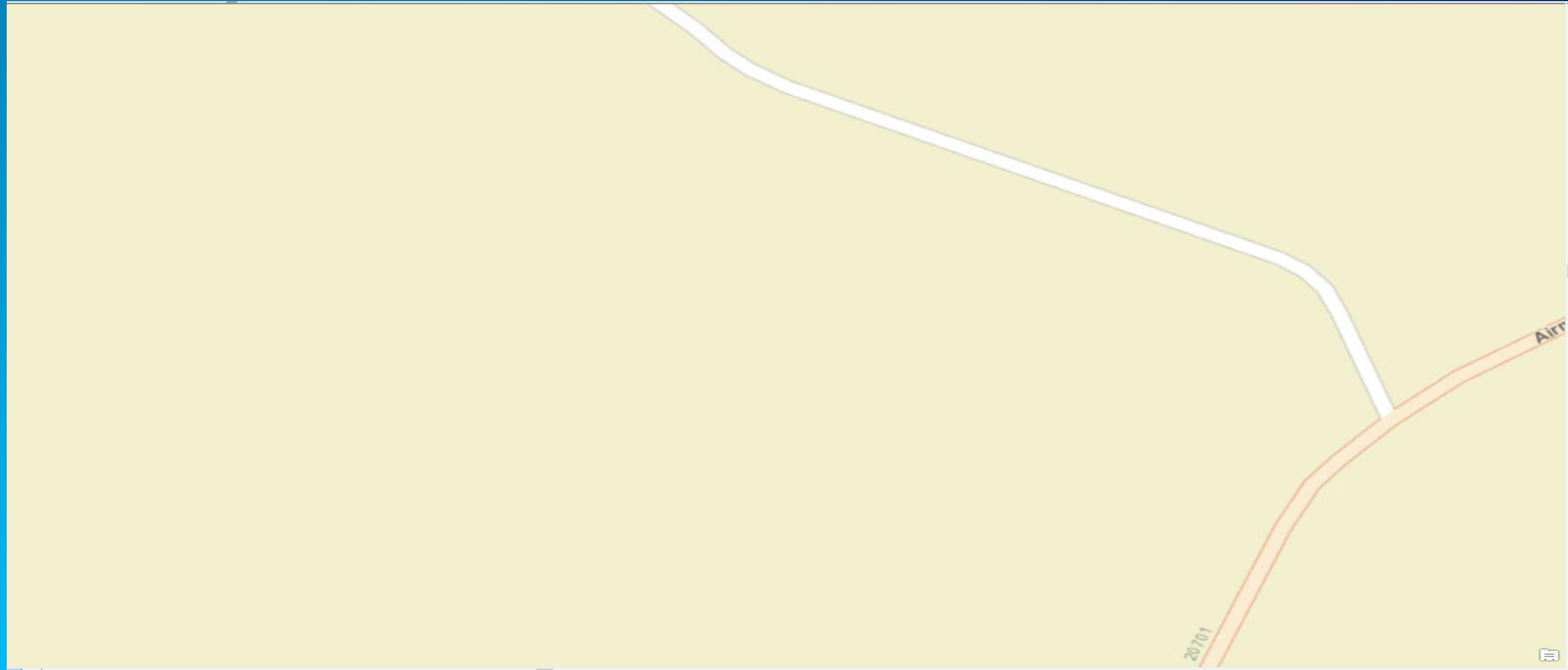
- Why use imagery in a GIS?
- Sources of imagery
- ArcGIS Imagery Information Model
- What can I do with imagery in ArcGIS?



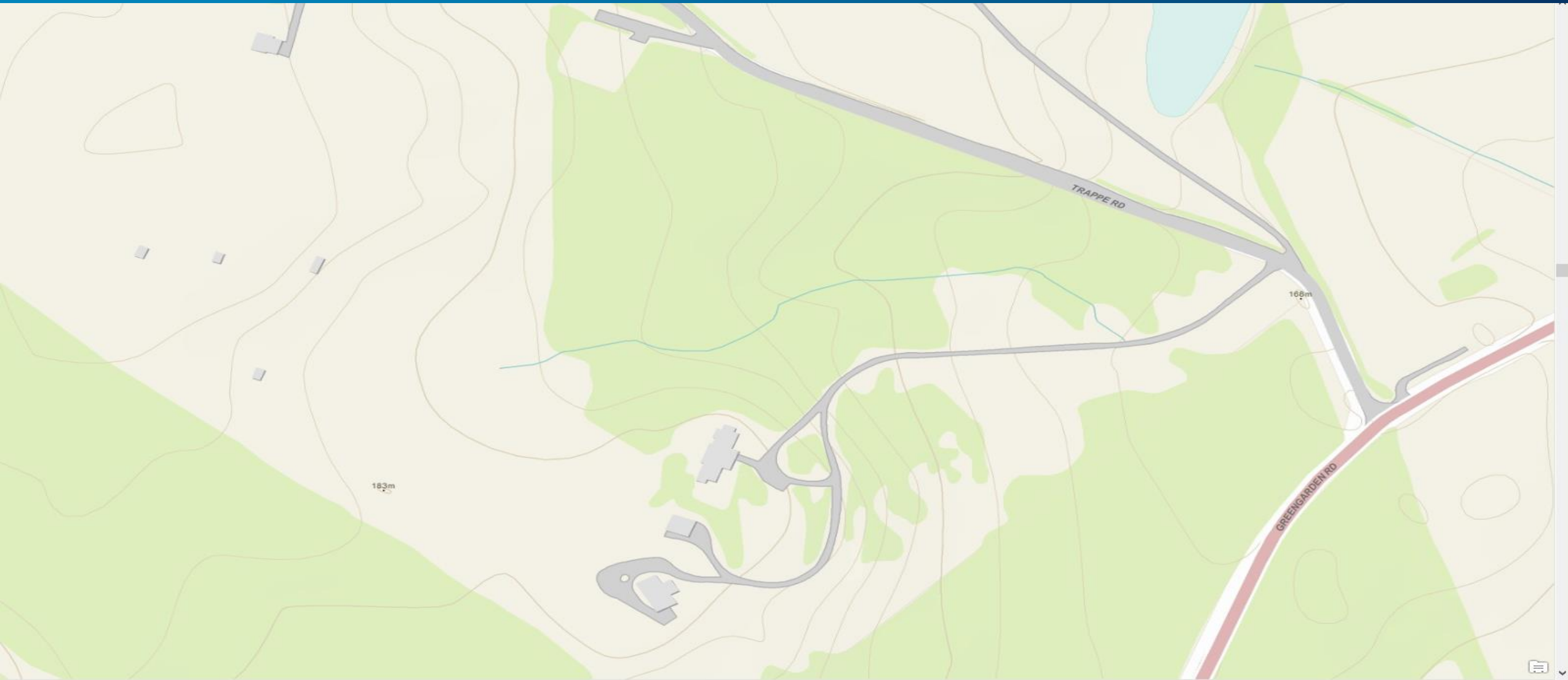
**Why use imagery in GIS?**



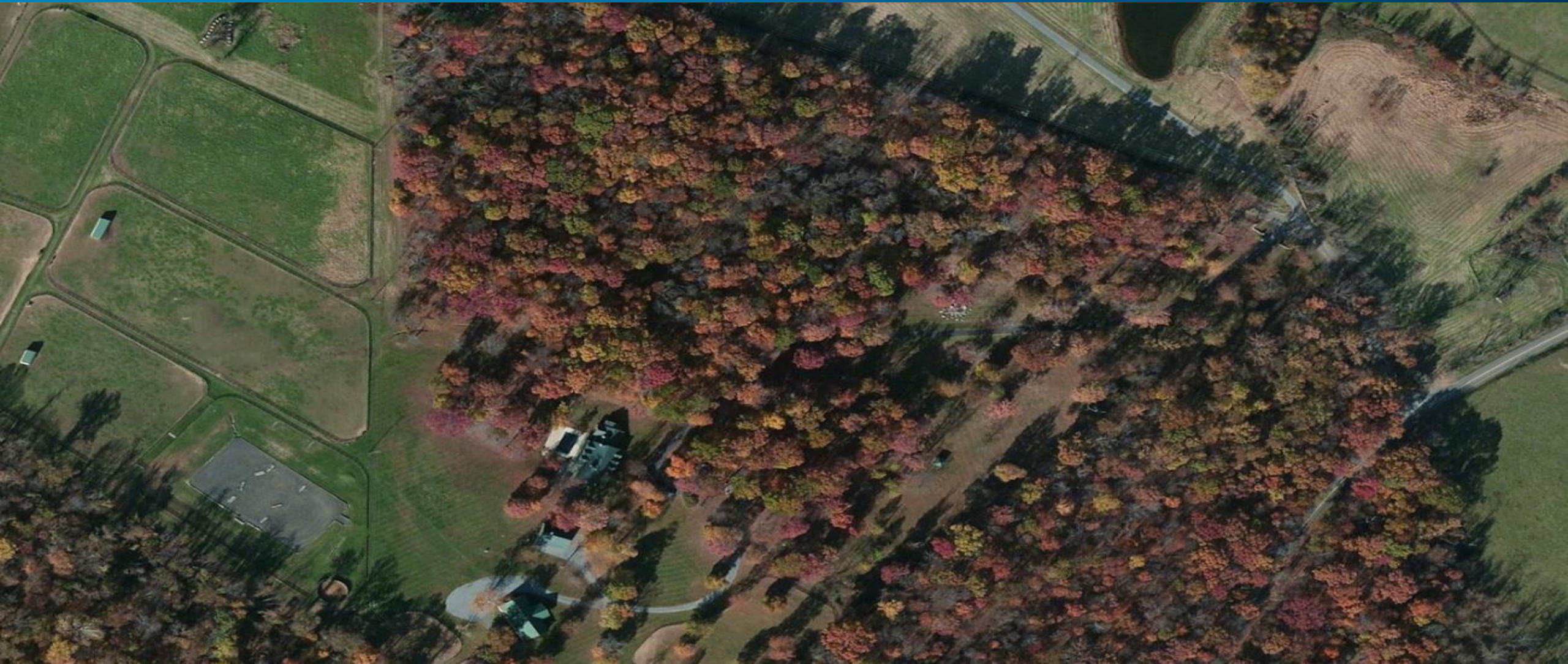
A friend asked me to check out his farm...



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



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

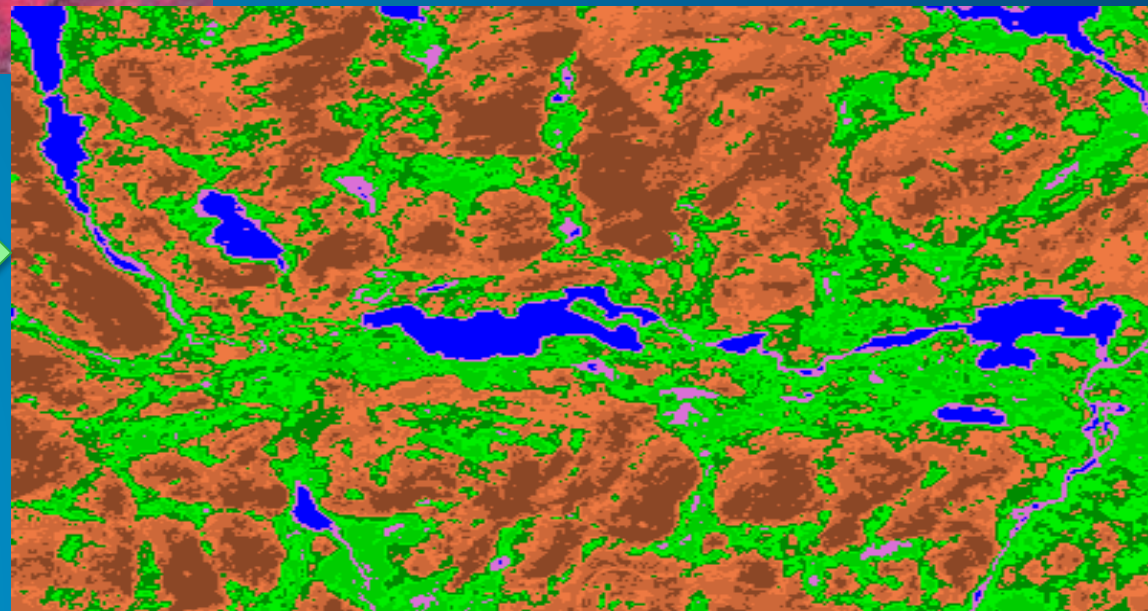
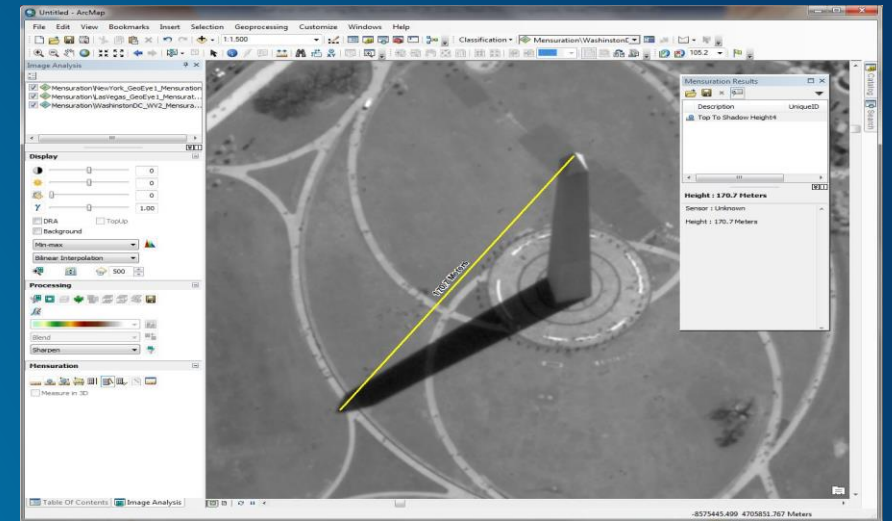
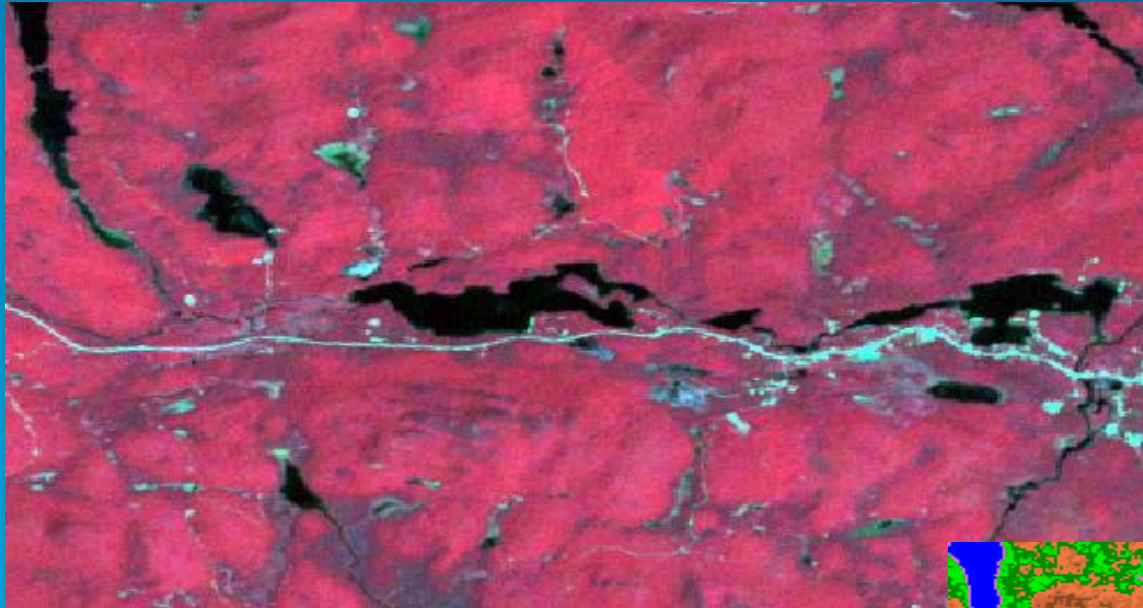


# Imagery Characteristics - Timely

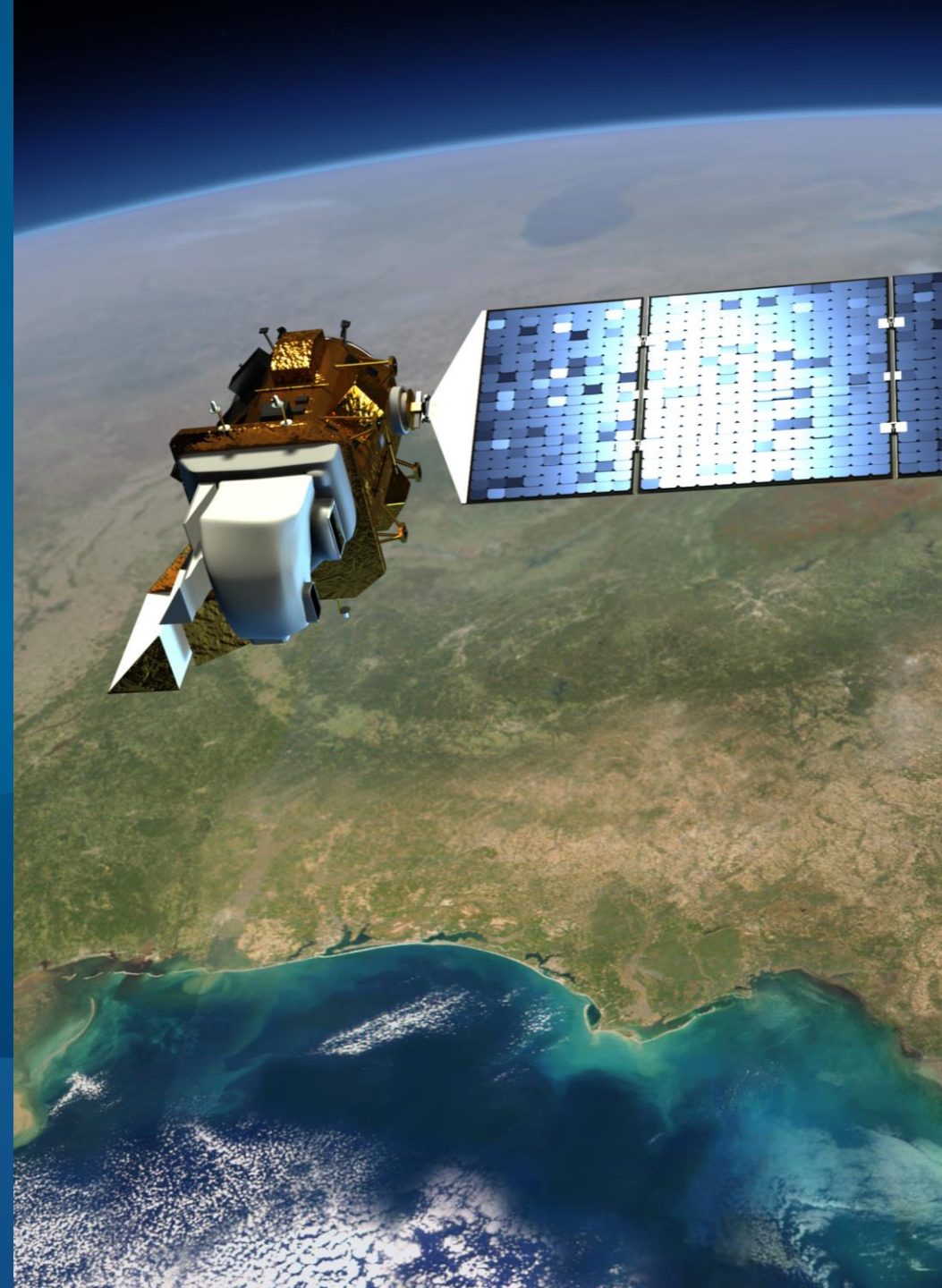




# Imagery Characteristics - Metric



# Sources of Imagery



# Imagery Base Maps

## Sources of Imagery

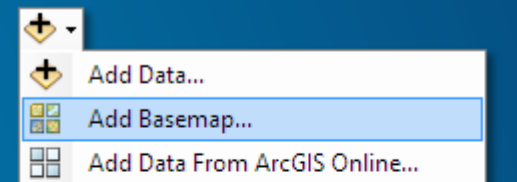
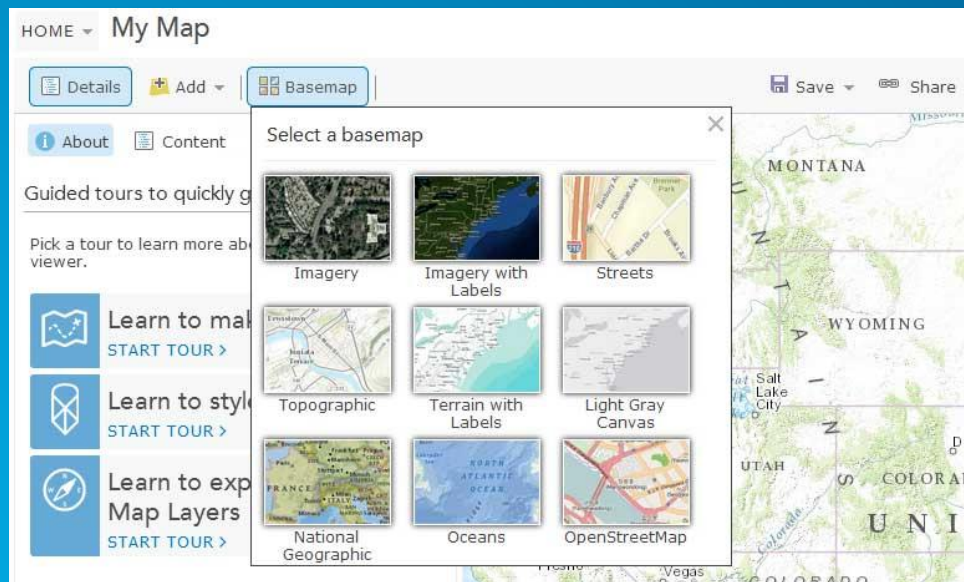
- **Most often used as a “only a backdrop”**
  - georeferenced picture for visualization
  - cached imagery (lossful in many ways)
- **Typically stored in a data structure...**
  - which is extremely efficient for visualization (tiles)
  - which works well on all devices and platforms
- **Often free “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

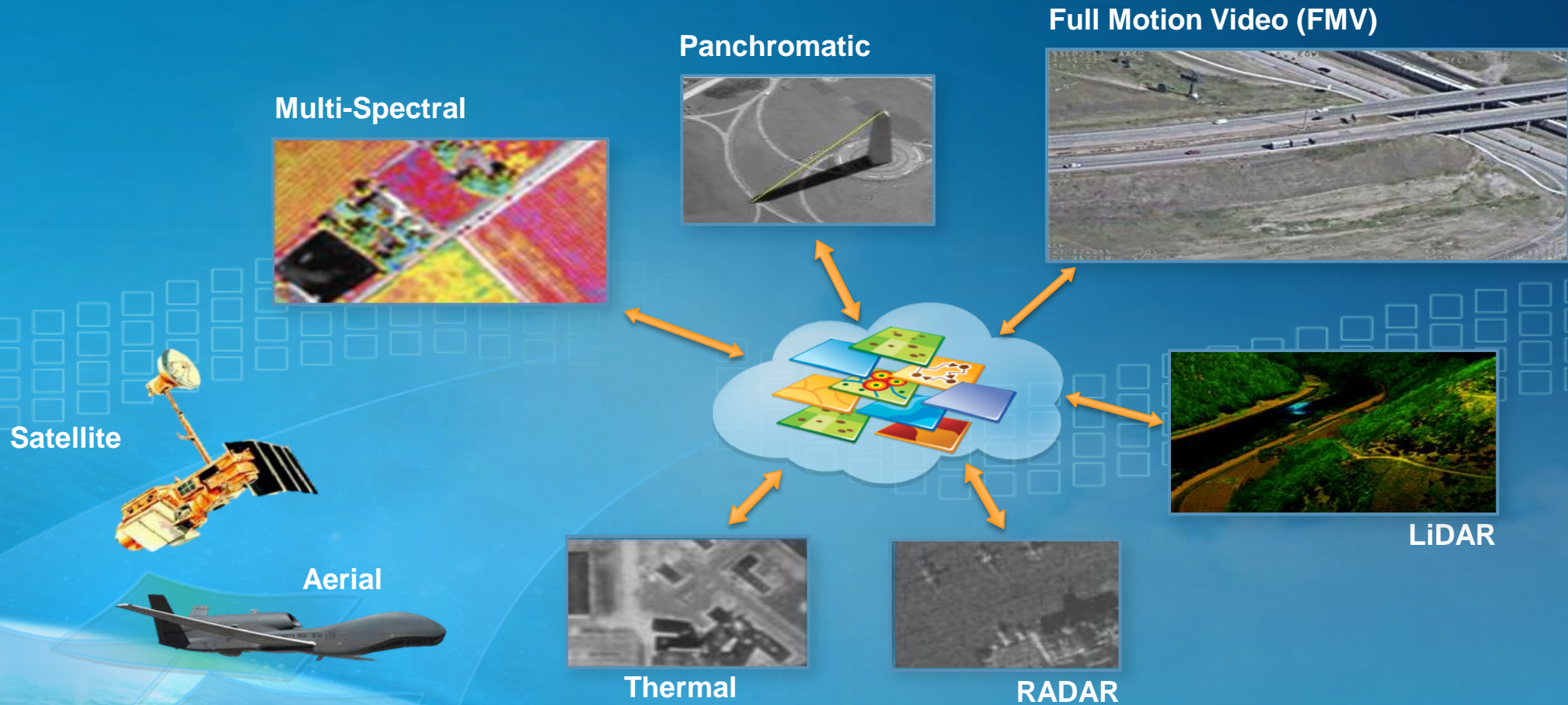
## Sources of Imagery

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

The screenshot shows the 'Landsat Imagery' web application interface. At the top, there is a 'Products' link. Below it, the title 'Landsat Imagery' is displayed. A navigation menu includes 'Main', 'Enhancements', 'Viewer', 'Image Services', 'Tours', and 'More Info'. The 'Image Services' section is highlighted, featuring the text: 'Access to multitemporal, multispectral worldwide Landsat 8 and Landsat GLS data.' Below this text is a green button labeled 'Access Image Services'. To the right of the text is a stack of three satellite imagery maps showing different time periods of the same geographic area, illustrating the multitemporal capability.

# ArcGIS integrates all types, sources, and sensor models

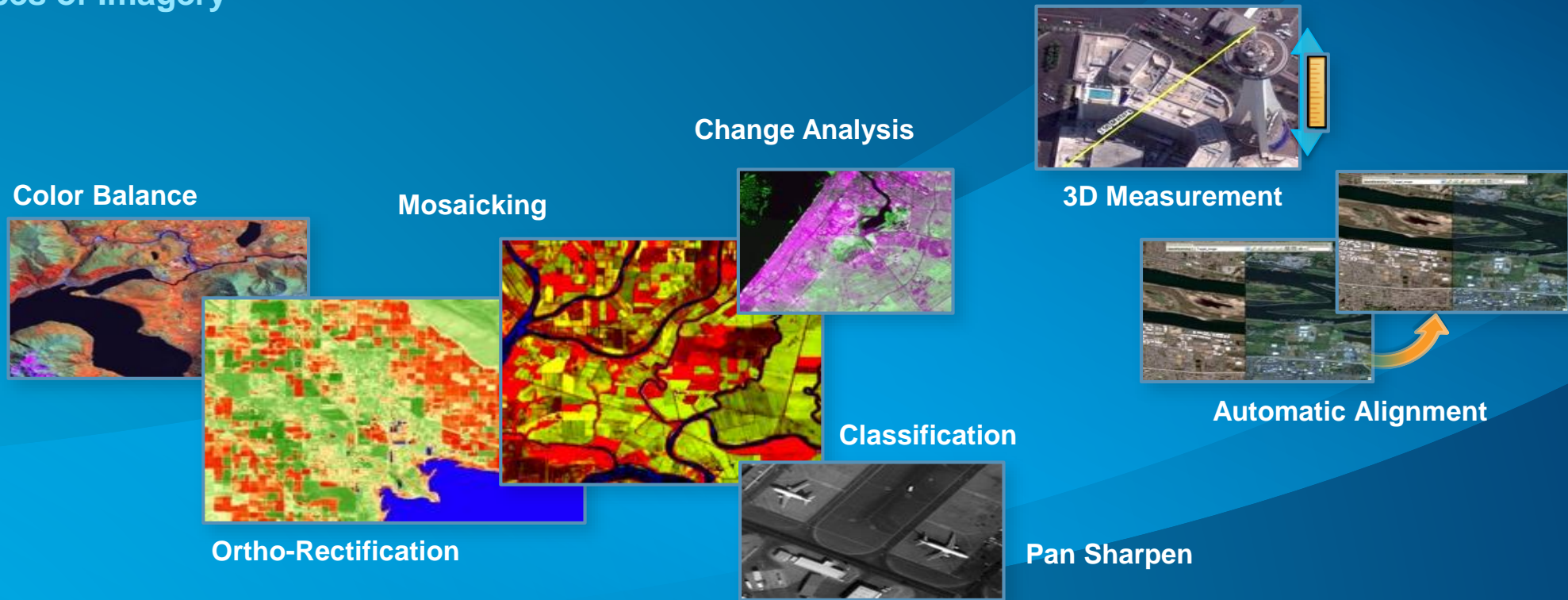
## Sources of Imagery



*... Making Imagery a Fundamental Part of the Systems*

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

Sources of Imagery

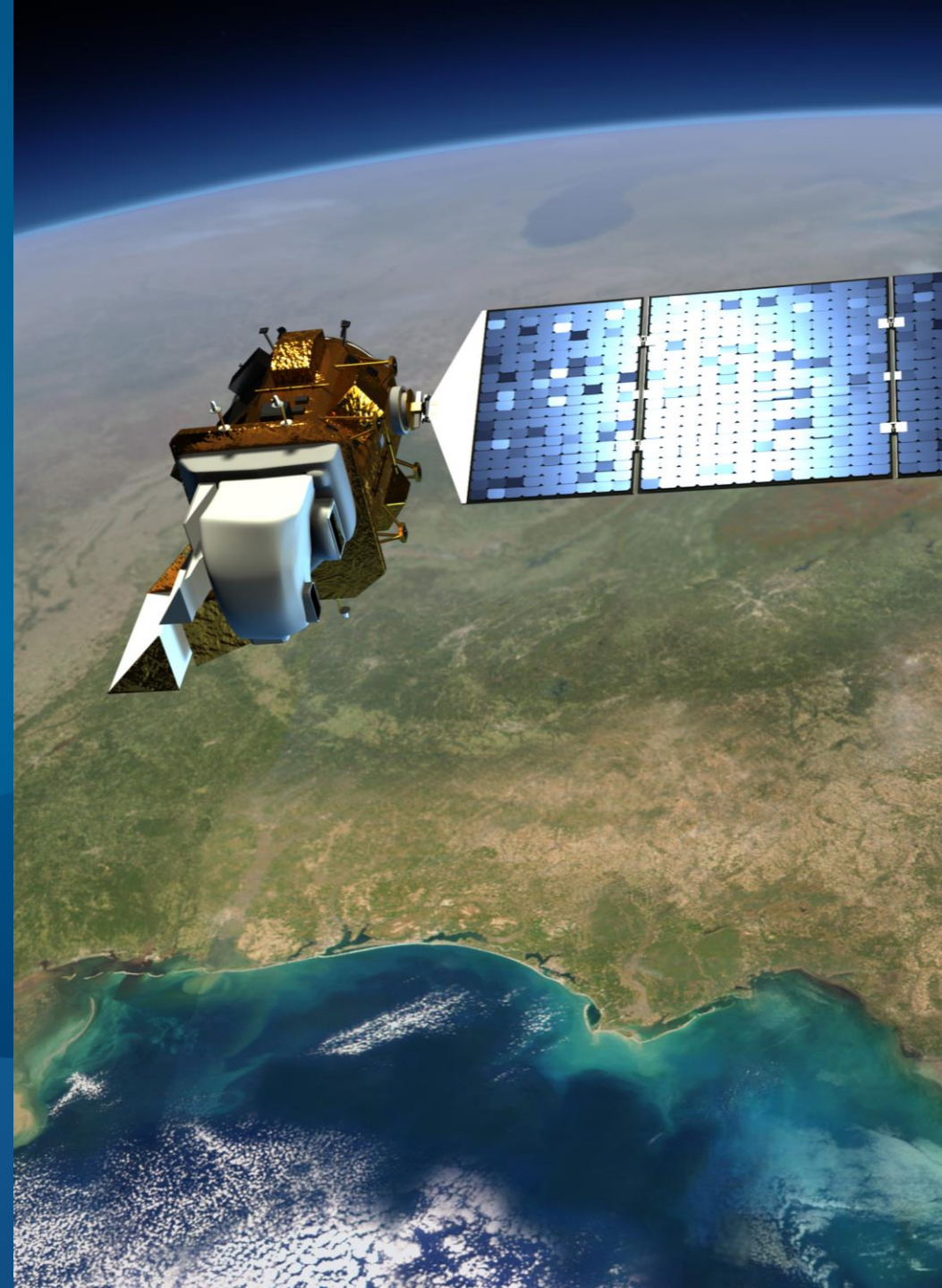


*Open and Leveraged by Partners*



# Demonstration

Sources of Imagery



# Imagery Information Model



# Underlying Design Principles

## ArcGIS Imagery Information Model

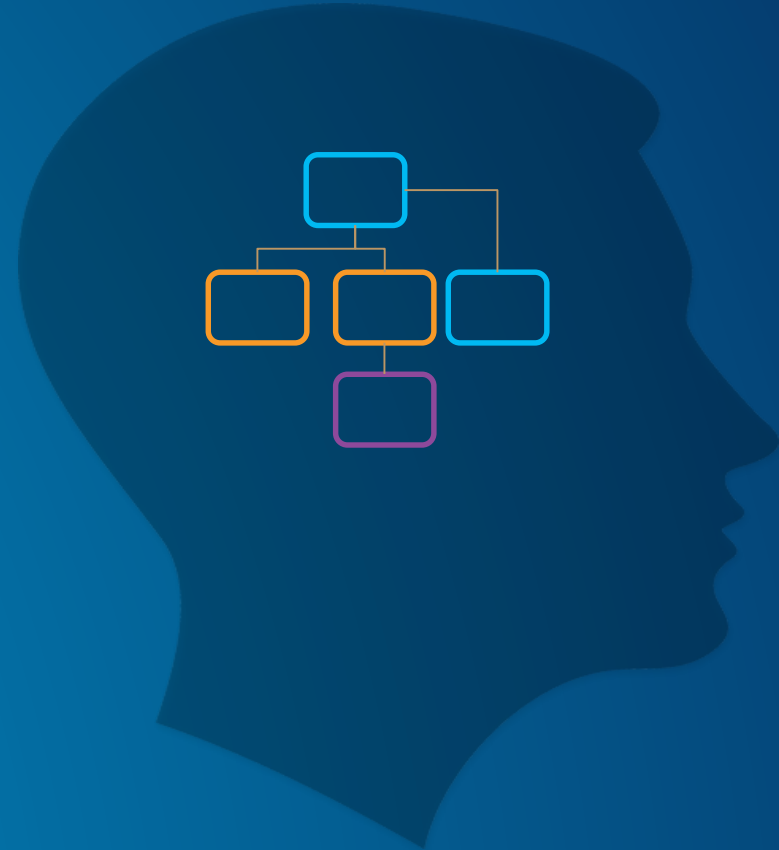
- **Only process what you need, ...when you need it**
  - Operate on the original source imagery – no preprocessing
  - Request-Based processing
- **Intelligent use of the metadata**
  - Virtual Products (e.g. NDVI on-the-fly)
  - Mensuration
- **Optimize storage requirements**
  - reference the imagery 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

Jim Michel

# 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.

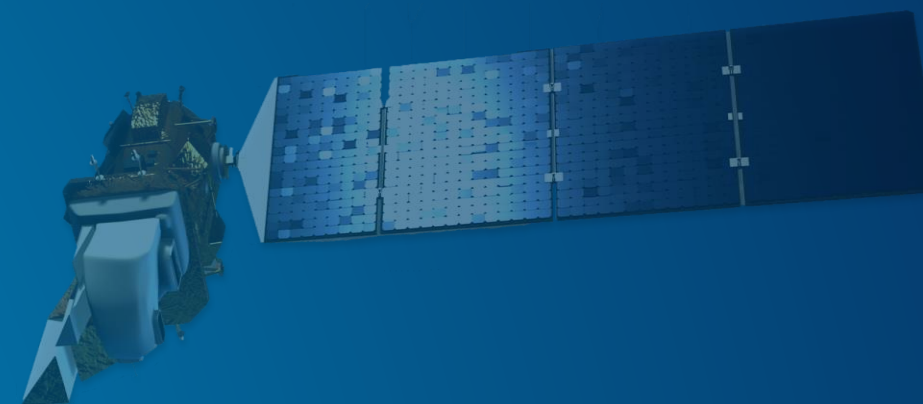
- It's role is too...

- 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    |               |
| ✓ 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      |               |





# Raster Function

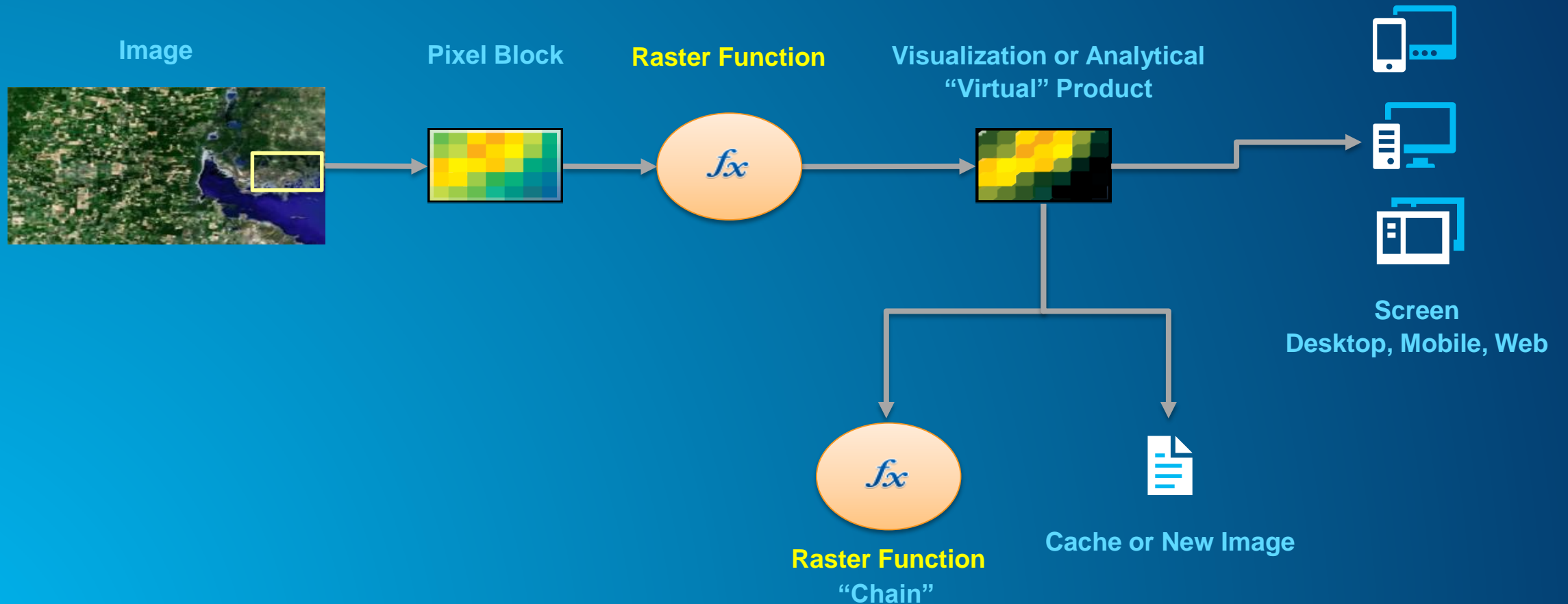
## ArcGIS Imagery Information Model

- **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)
- **30+ 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)

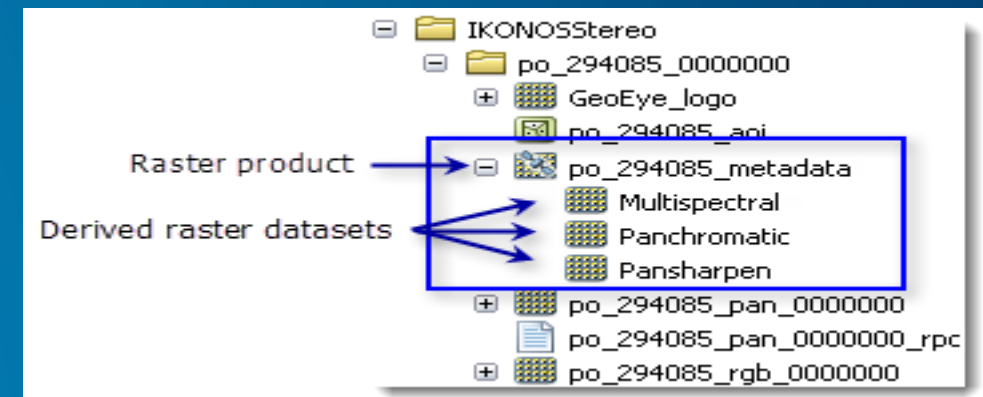
- **Raster Functions**

- 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

# 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



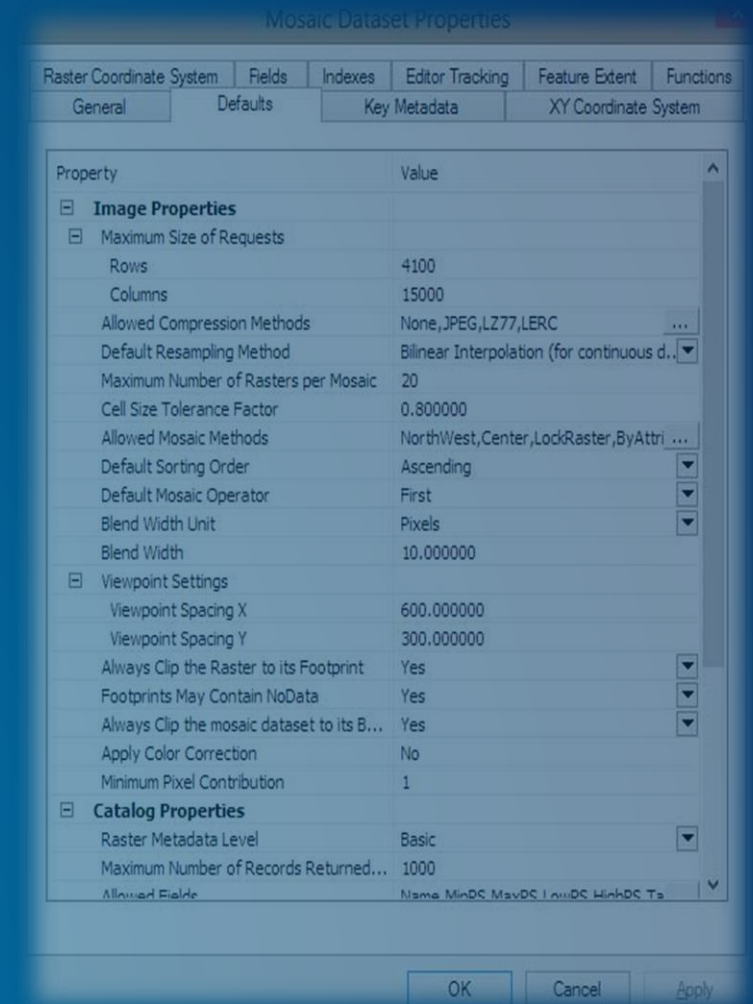
# Demo – Raster Type, Raster Function, Raster Product

Jim Michel

# 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**



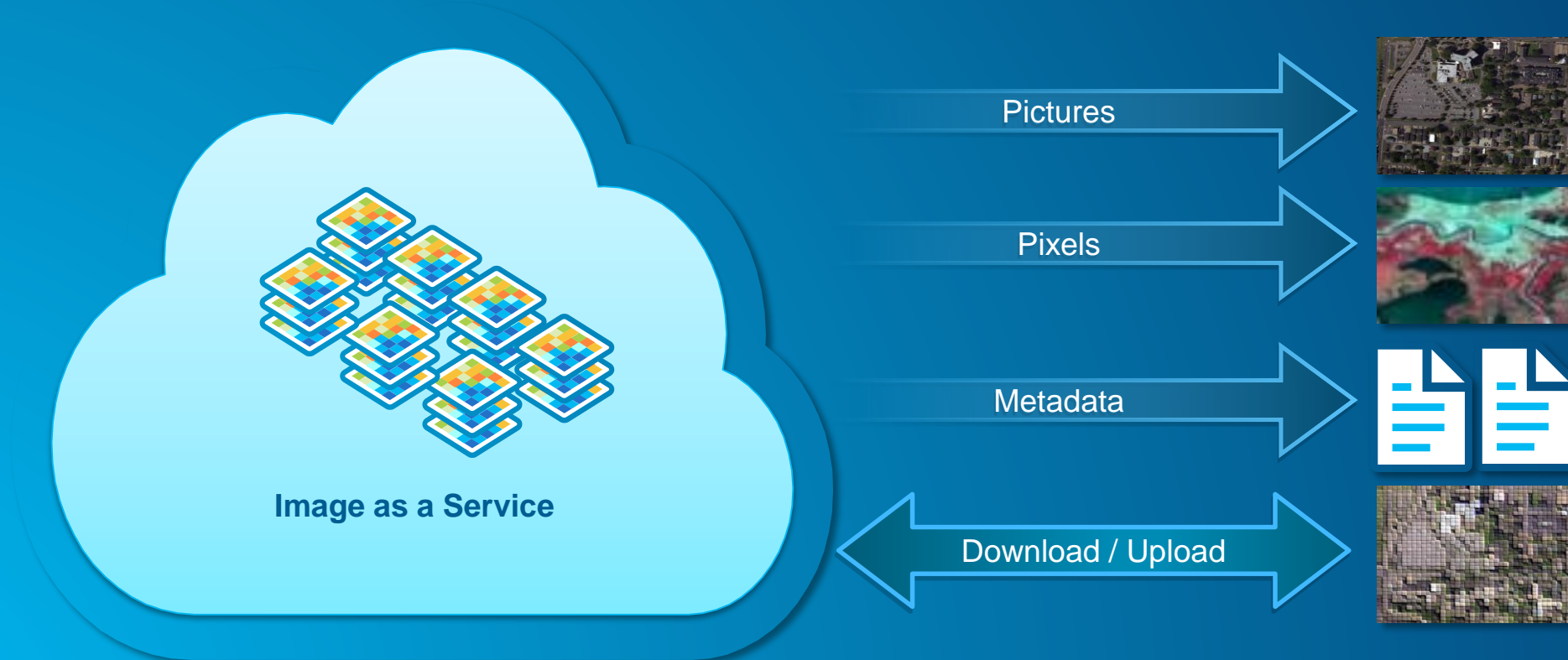
# Demo – Mosaic Dataset

Jim Michel

# 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)

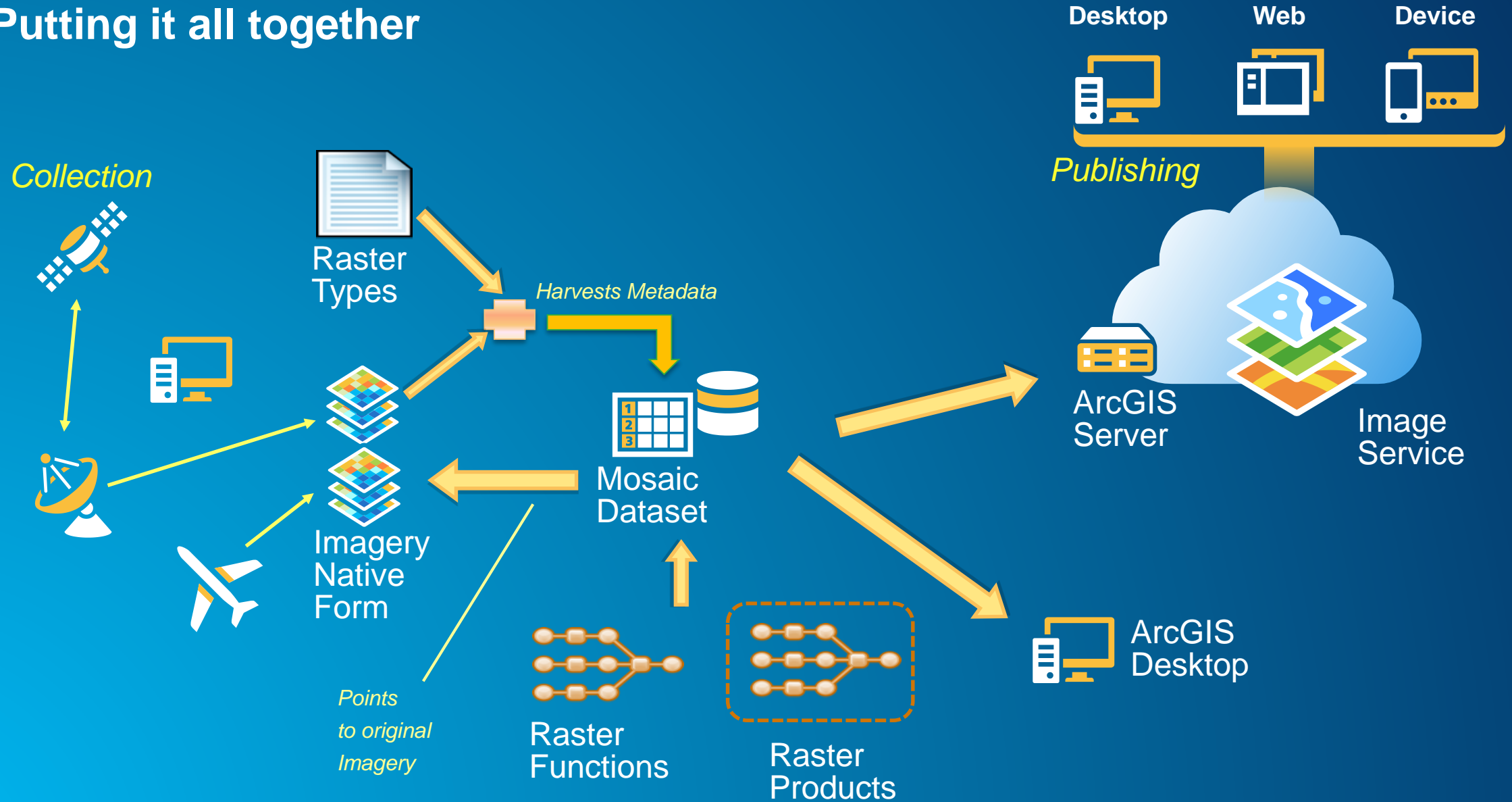




# Demo – Image Service

Jim Michel

# Putting it all together



What can I do with imagery in ArcGIS?



# What are my choices when working with imagery

## ArcGIS and Imagery

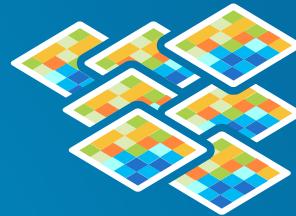
- **One image at a time**

- Files
- Image Analysis Window (IAW)
- Geoprocessing



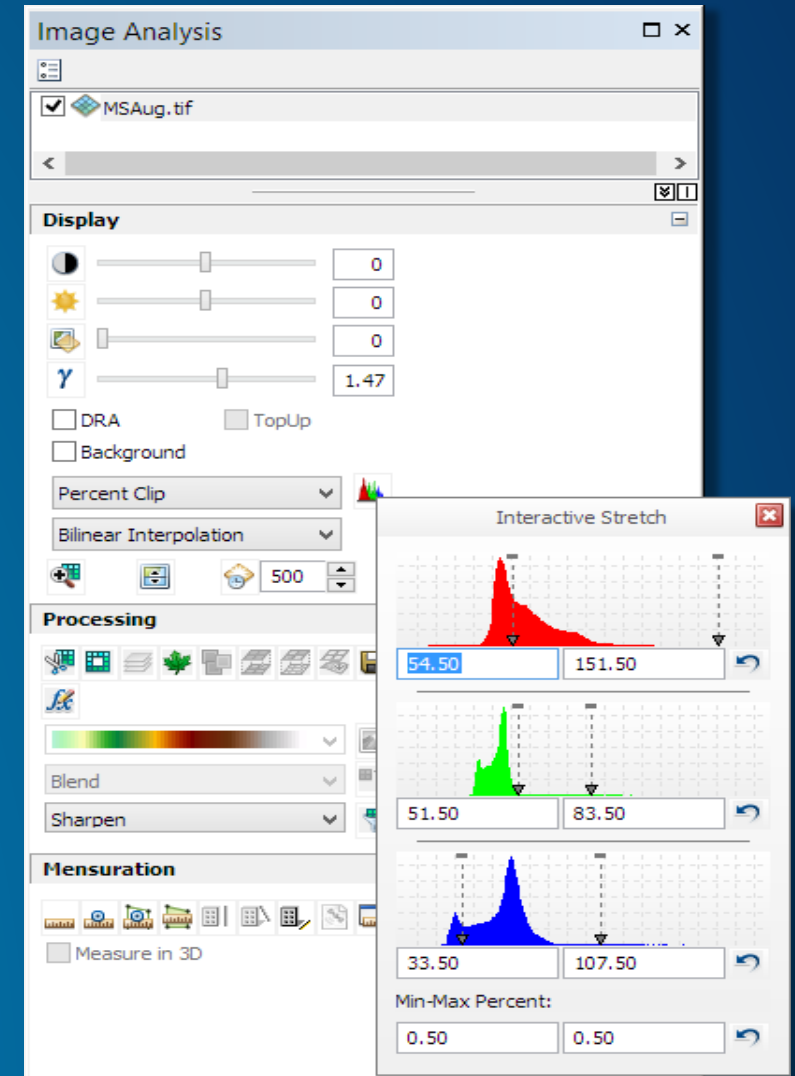
- **Collections of images**

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



- **Imagery as a Service**

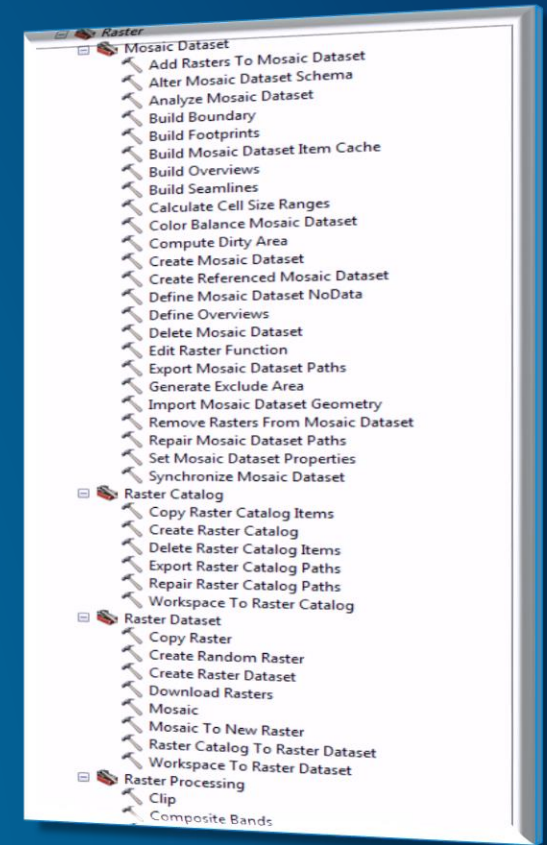
- Web
- Image Analysis Window (IAW)
- Developer APIs
- ArcGIS Online



# 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**
  - Georeferencing and Orthorectification
  - Color Balancing
  - Seam line generation
  - Caching to tiles
- **Geoprocessing tools**
  - More than 80 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

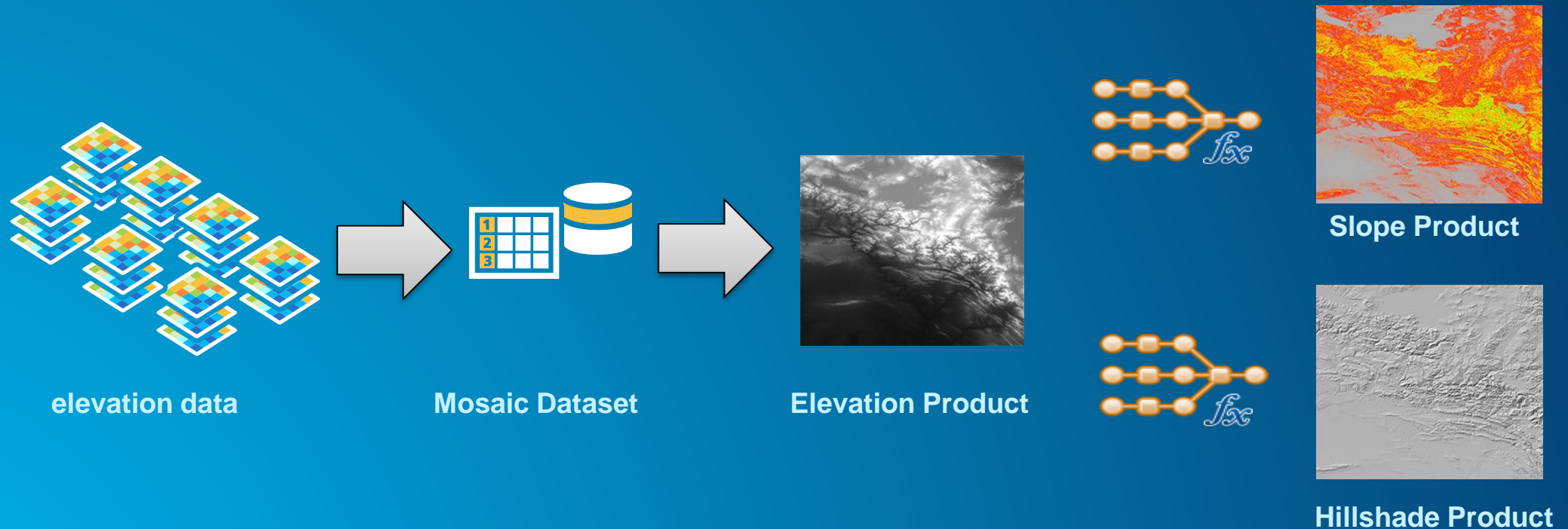
- **Take advantage of ArcGIS ready-to-use imagery**
  - ArcGIS Online World Imagery Base Map, Landsat GLS, Landsat 8, NAIP
  - Consume Premium Services available by Partners on the ArcGIS Marketplace
- **Visualize images**
  - as a single image
  - as a dynamically mosaicked product
- **Extract feature 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

## ArcGIS and Imagery

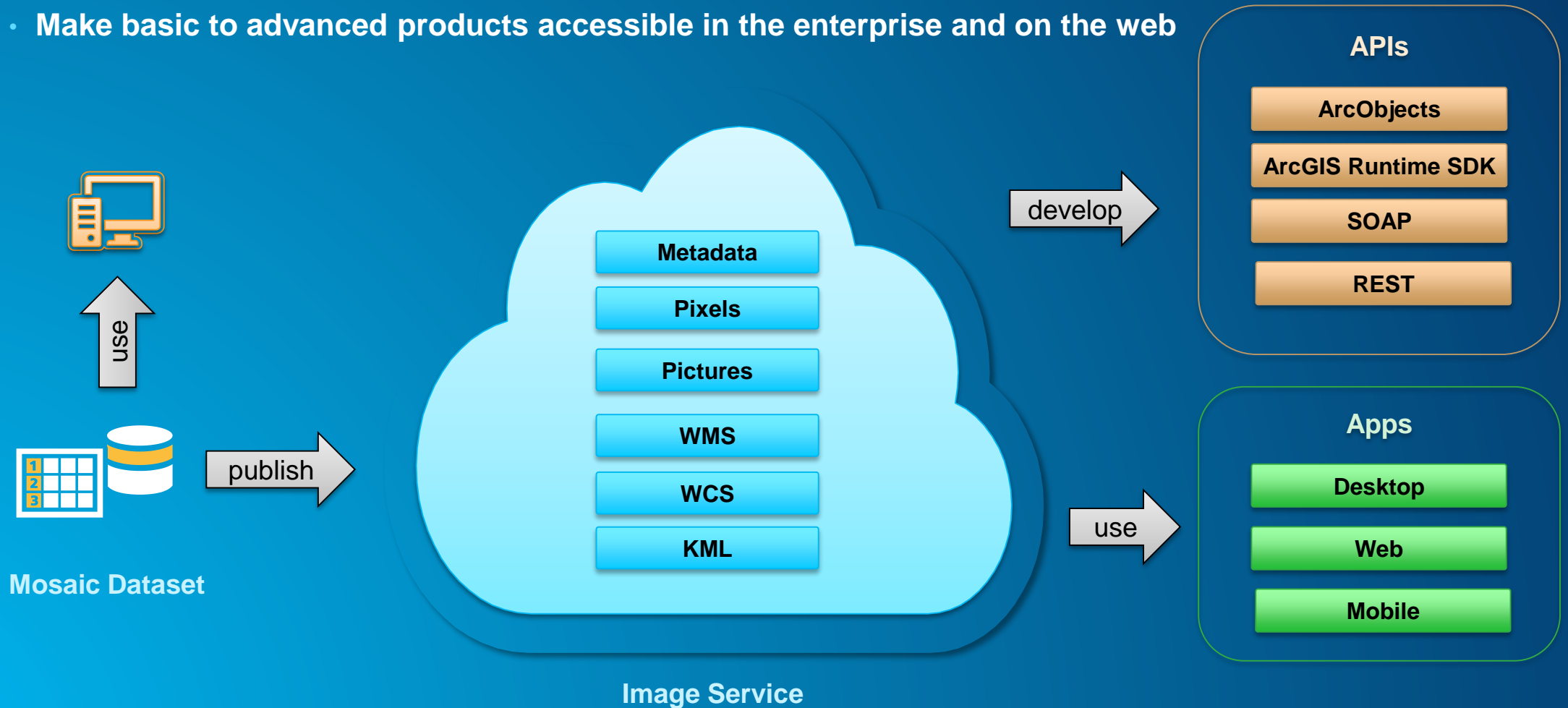
- Create multiple products from a single source without the additional storage resource costs



# 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



Understanding our world.