Advancing your Curriculum with the Latest Image and Raster Analysis Tools in ArcGIS

esri

> "The willingness to experiment with innovative approaches to GIS has yielded benefits for numerous field-based teaching and research activities across the university.
>
> – Peter Knoop | University of Michigan

Webinar Housekeeping

- Microphones will be muted
- Please enter your questions in the chat box
- Q&A session at the conclusion of the webinar
- Webinar & slides will be available
- Survey following the webinar

Poll time…

Are you teaching Imagery & Remote Sensing?

Presenters

Peter Becker
Group Product Manager
ArcGIS Imagery Product team

Vinay Viswambharan
Principal Product Manager
ArcGIS Imagery Product team

Canserina Kurnia
Senior Solution Engineer
Education team

Agenda

- **Overview ArcGIS as a comprehensive imagery system and deployment options**
- **Explore Image and Raster analysis tools**
- **Deployment best practices for teaching and research**
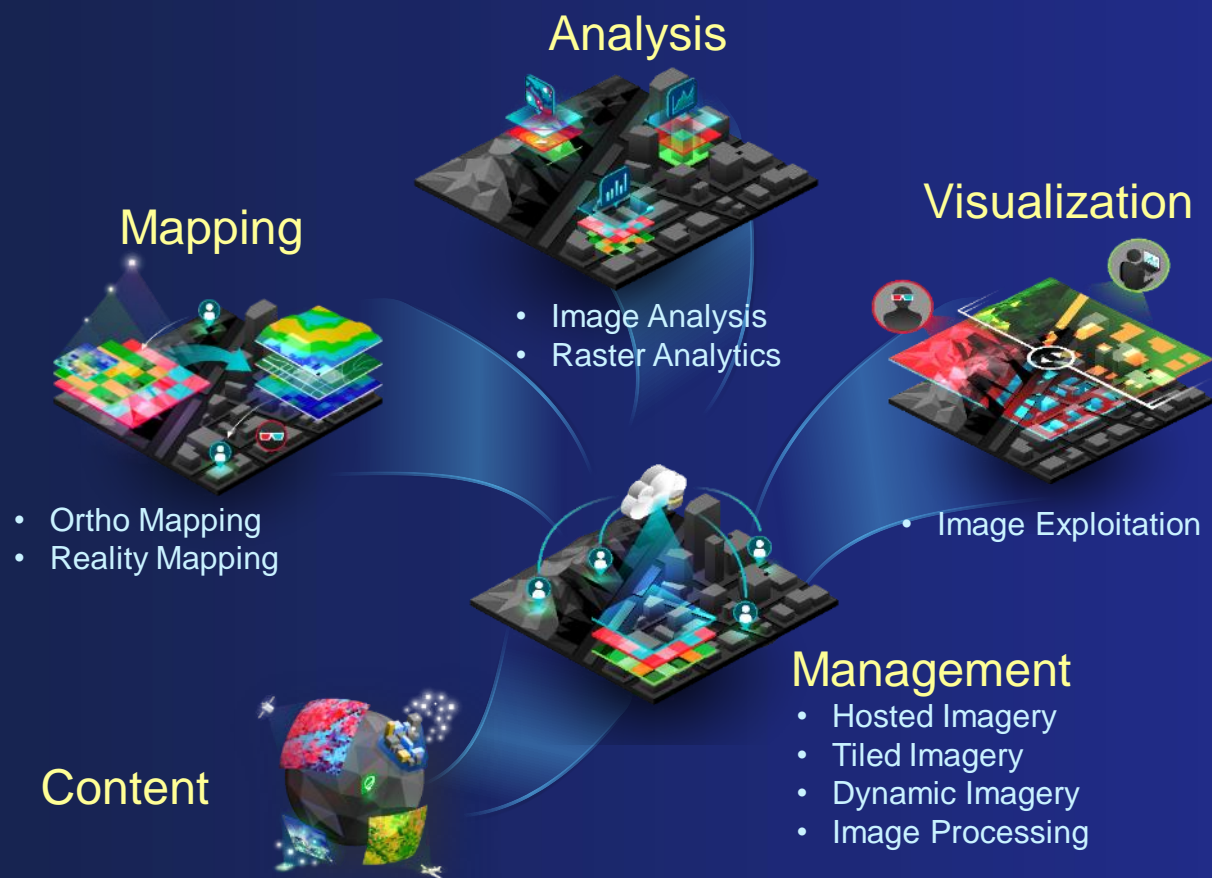- **Q&A and Resources**

ArcGIS Imagery Capabilities

A comprehensive imagery system

Analysis
- Image Analysis
- Raster Analytics

Mapping
- Ortho Mapping
- Reality Mapping

Visualization
- Image Exploitation

Management
- Hosted Imagery
- Tiled Imagery
- Dynamic Imagery
- Image Processing

Content

Enabling the Imagery Capabilities of ArcGIS

Deployment options to suit your needs

ArcGIS Image

Analysis

- Image Analysis
- Raster Analytics

Mapping

Visualization

- Ortho Mapping
- Reality Mapping

- Image Exploitation

Management
- Hosted Imagery
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Content

Desktop
ArcGIS Pro

ArcGIS Image Analyst

Enterprise
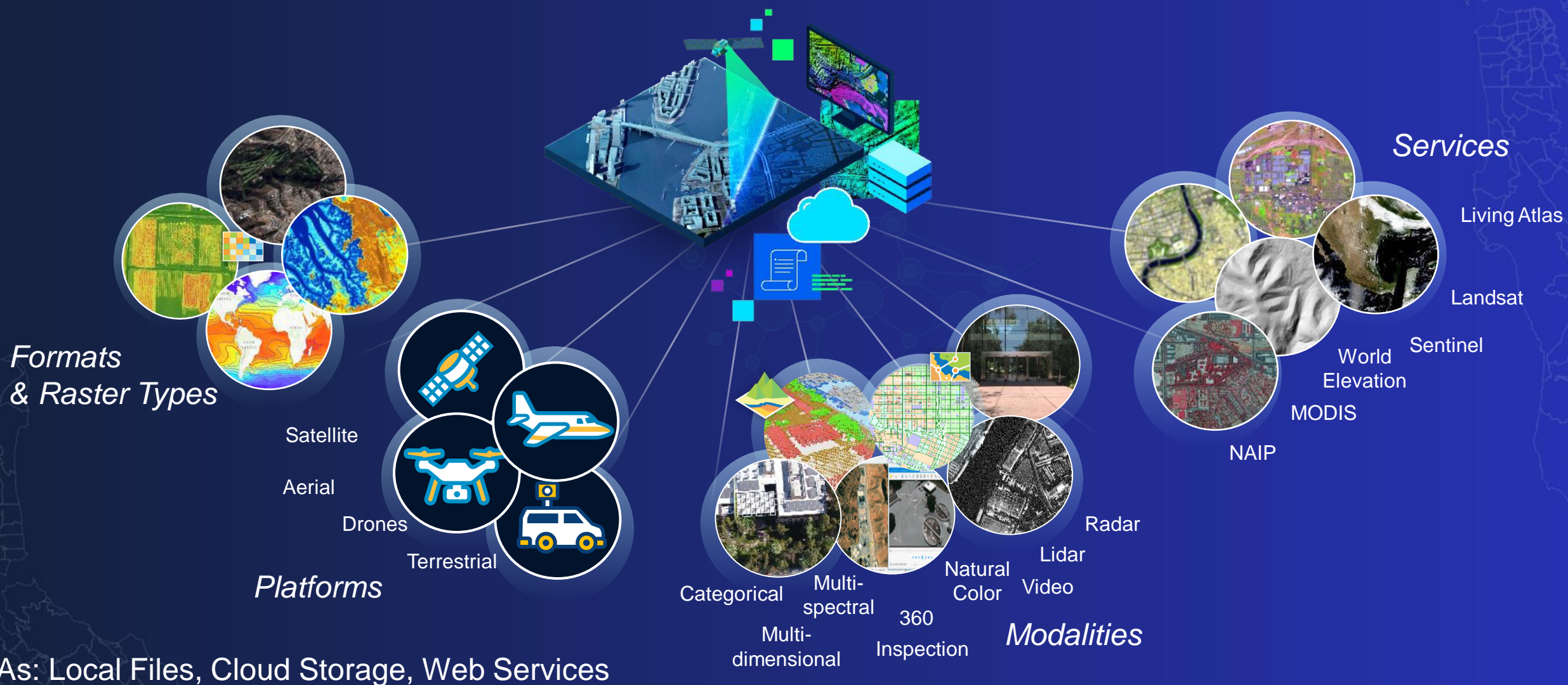ArcGIS Enterprise

ArcGIS Image Server

SaaS
ArcGIS Online

ArcGIS Image
for ArcGIS Online

Managed SaaS
Dedicated

ArcGIS Image Dedicated

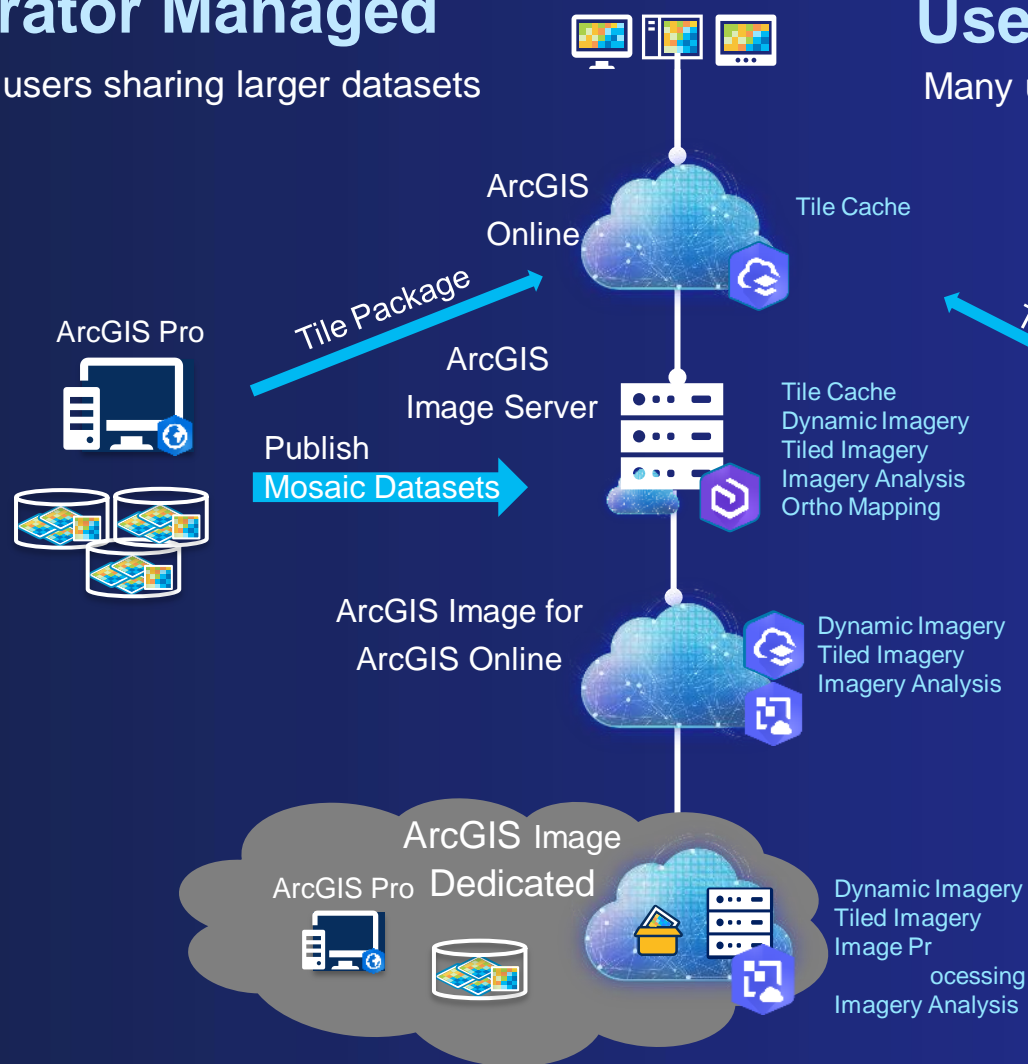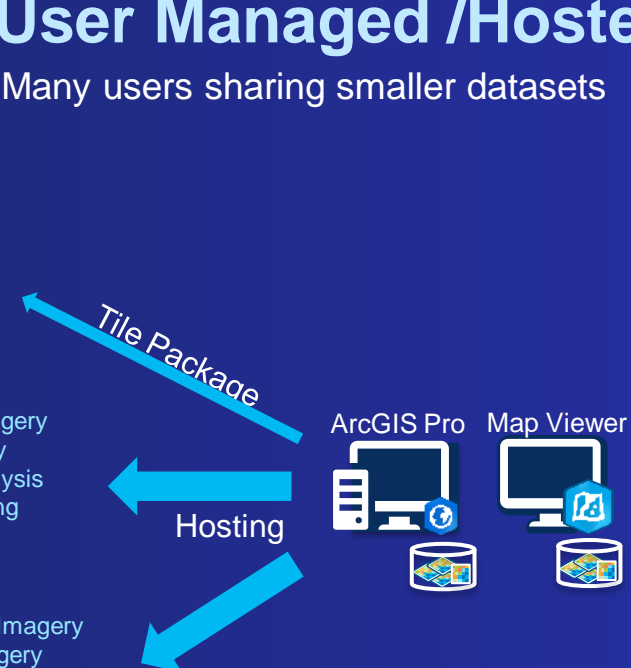# Content - Support for All Imagery and Rasters

Services

Living Atlas

Landsat

Sentinel

World
Elevation

MODIS

NAIP

*Formats
& Raster Types*

Satellite

Aerial

Drones

Terrestrial

Platforms

Categorical

Multi-
spectral

Multi-
dimensional

360
Inspection

Natural
Color

Video

Lidar

Radar

Modalities

As: Local Files, Cloud Storage, Web Services

Image Management Methodologies

Curator Managed
Few users sharing larger datasets

User Managed /Hosted
Many users sharing smaller datasets

ArcGIS
Online

Tile Cache

ArcGIS Pro

Tile Package

ArcGIS
Image Server

Publish
Mosaic Datasets

Tile Cache
Dynamic Imagery
Tiled Imagery
Imagery Analysis
Ortho Mapping

Tile Package

ArcGIS Pro   Map Viewer

Hosting

ArcGIS Image for
ArcGIS Online

Dynamic Imagery
Tiled Imagery
Imagery Analysis

ArcGIS Image
ArcGIS Pro Dedicated

Dynamic Imagery
Tiled Imagery
Image Pr
         ocessing
Imagery Analysis

Image Analysis in ArcGIS
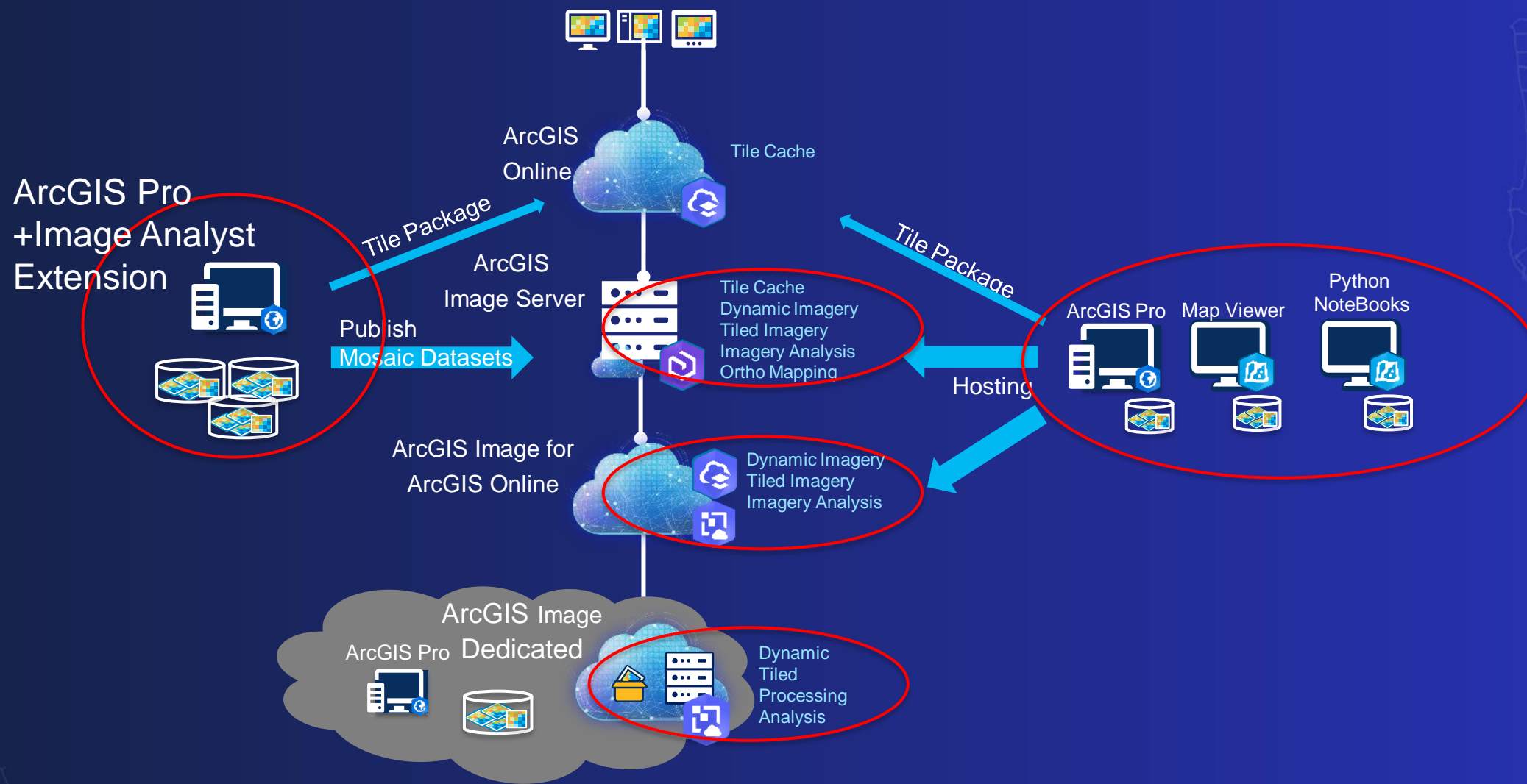
Poll time…

What primary tools are you using for image and raster analysis?

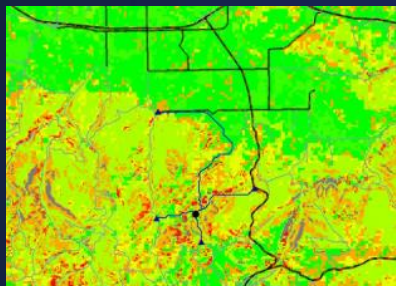# Explore Image and Raster analysis tools
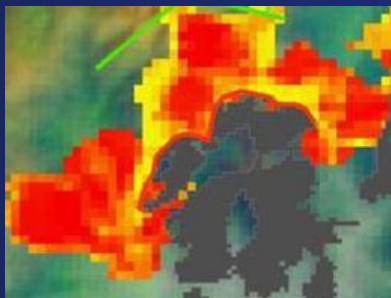
Raster Functions

Raster analysis and image processing

**Wildlife corridor assessments
Determining Routes**

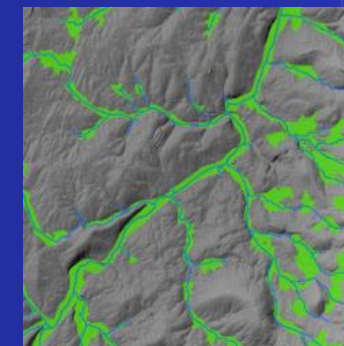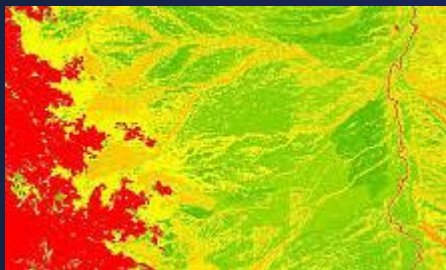**Modelling fire growth**

River classification

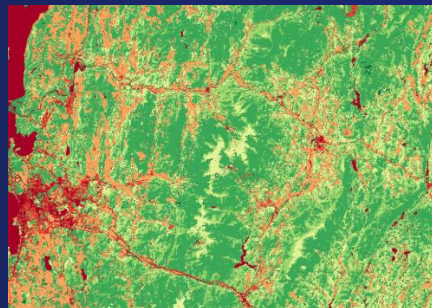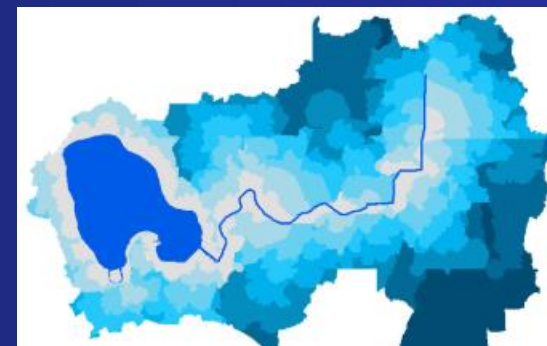**Identify errors in DEMs
Creating watersheds**

Cross Country Mobility

**Determining first responder
management areas**

Floodplain delineation

Raster Functions

ArcGIS Spatial Analyst
~20 additional Raster Functions

ArcGIS Image Analyst
~60 additional Raster Functions

ArcGIS Pro
~50 Raster Functions

Math Operators

Statistics

Conversion

Multiband Math

Interpolate

Band Math & Indices

Surface Generation & Analysis

Correction

Python Raster Functions

Image Segmentation

Classification

Overlay (Sum)

Statistics

Math

Distance & Density
Hydrology
Overlay (weighted)
Viewshed
Nibble

New functions (IAe Only)
Generate Trend*
Predict Using Trend*
Detect Change Using Change Analysis **
CCDC Analysis**
Compute Change**
Trend to RGB**

New functions in Pro
Aggregate (SA)
Multidimensional Filter (Basic)
Multidimensional Raster (Basic)
Random (Basic)
Process Raster Collection (IA/SA)
Linear Spectral Unmixing (IA/SA)
Find Argument Statistics (IA/SA)
Distance Accumulation (SA)
Distance Allocation (SA)

Updated functions in Pro
Cost Path (SA)*
Cell Statistics (IA/SA)*
Zonal Statistics (IA/SA)*

All functions are available on Enterprise and Online
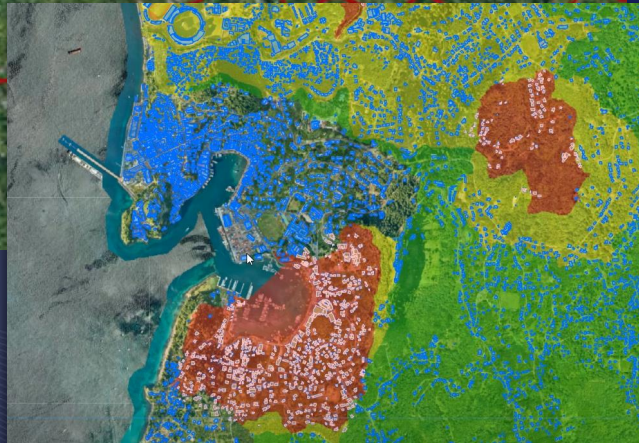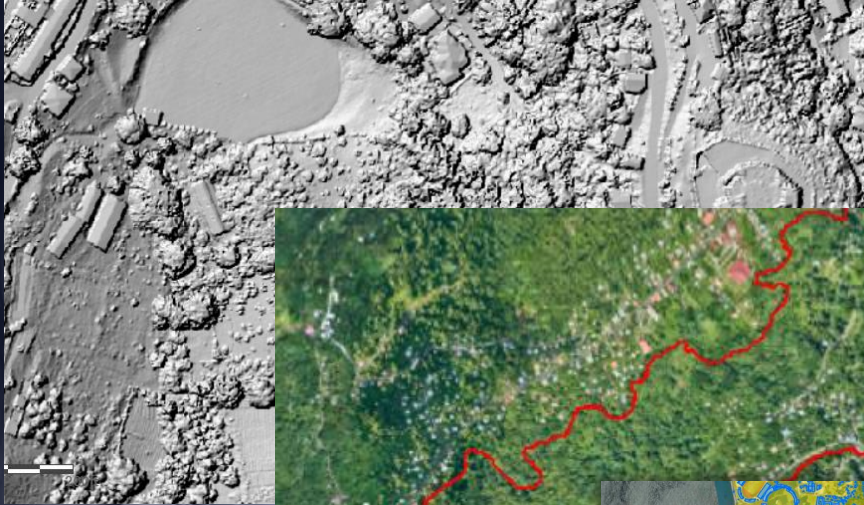
Image Processing and Raster Analysis

Raster functions – A tour

Multidimensional Analysis

Our world is changing…

Dimensions
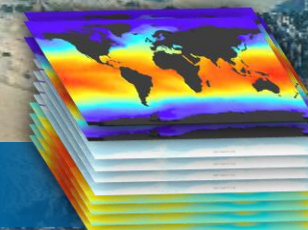
- X,Y,Z
- Time
- Pressure
- Depth

Variables

- Raster data
- Optical Imagery

Find anomalies
Explore trends
Predict and forecast
Evaluate changes
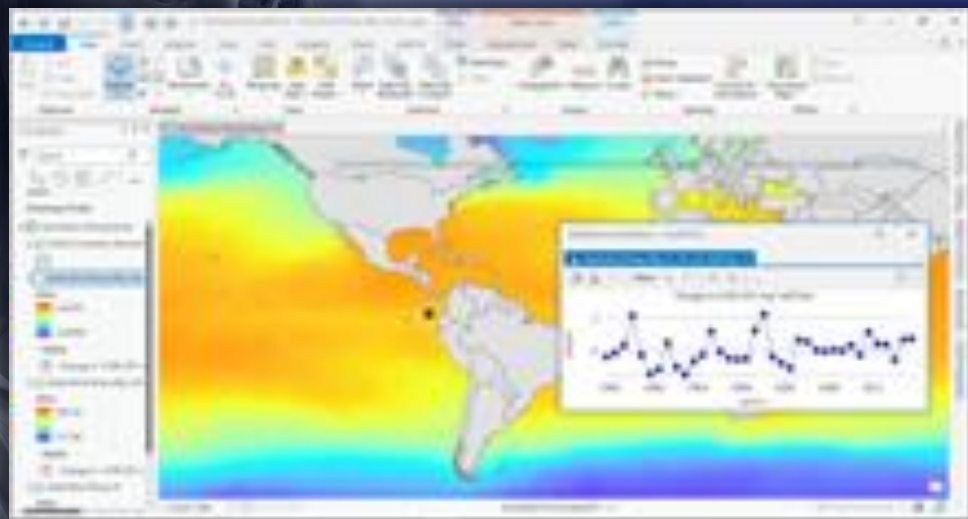
Demo – Multidimensional Analysis

- Visualizing Multidimensional data
- Predictive Analysis
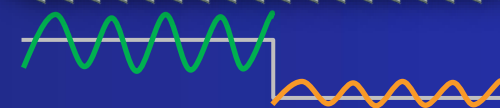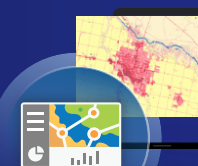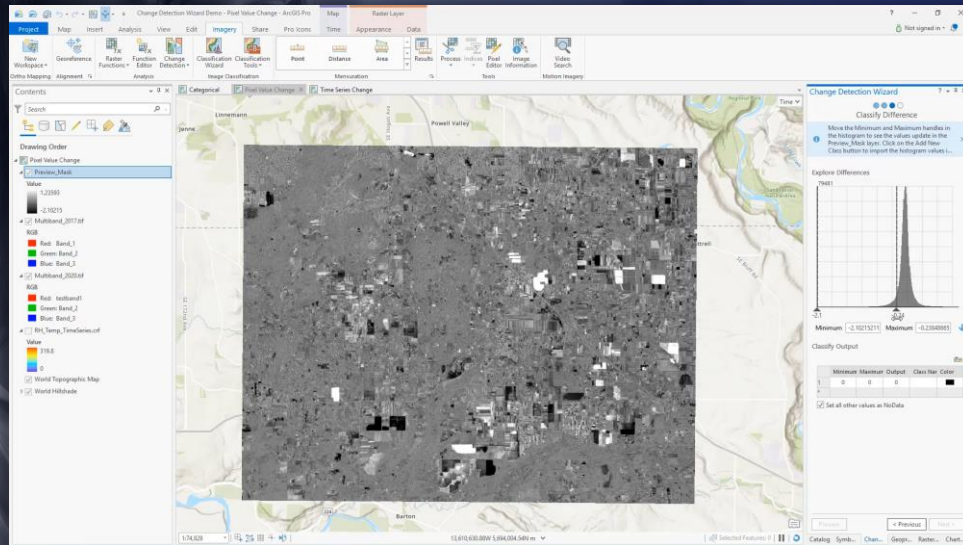
Demo - Change Detection

- Change detection wizard
- Analyze timber harvest patterns & Identify illegal logging

Demo - Change Detection

- Change detection wizard
- Analyze timber harvest patterns & Identify illegal logging

Why is deep learning important?

Traditional human data interpretation doesn't scale….

More sensors

Large volumes of imagery

Velocity of data

Automation

Accuracy

Deep Learning in ArcGIS

Data Management → Labelling → Data Prep → Train Model → Inferencing → Derive Insights → Sharing

ArcGIS provides comprehensive deep learning workflows

For Wide Range of Data Types

- Aerial
- Satellite
- Radar
- Text
- Lidar
- Features
- Motion Imagery
- Bathymetry
- Point Cloud
- Drone

Implementing Many Tasks

- Object Classification
- Object Detection
- Pixel Classification
- Image Translation
- Object Tracking
- Scanned Maps
- Feature processing
- Unstructured text processing

Deep Learning in ArcGIS
Pre-trained models

Image Management → Labelling → Data Prep → Train Model → Inferencing → Analysis to Derive Insights → Field Mobility, Monitoring

Pre-trained AI models
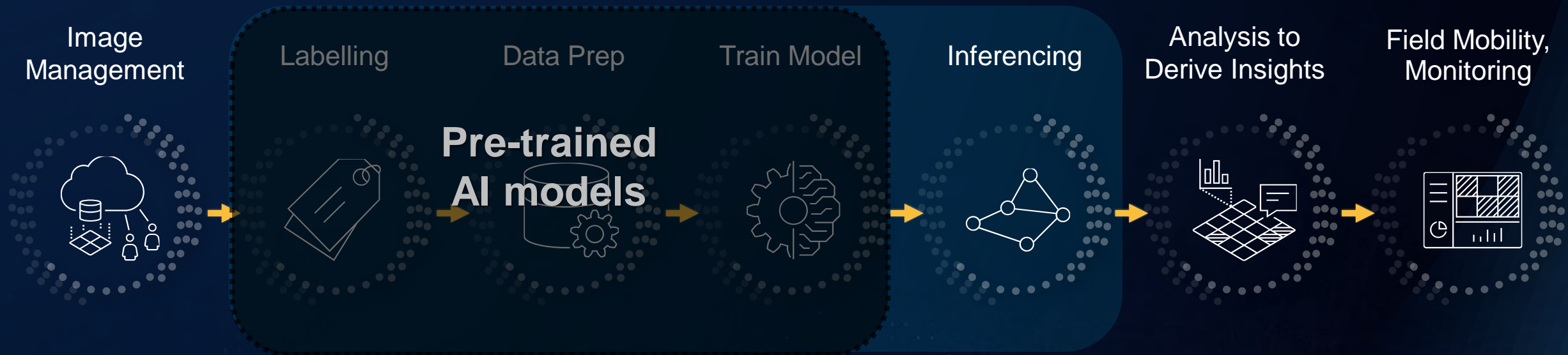
- Eliminates:
  - Imagery requirements for model training
  - Labelling requirements
  - Training AI models
  - Massive compute requirements
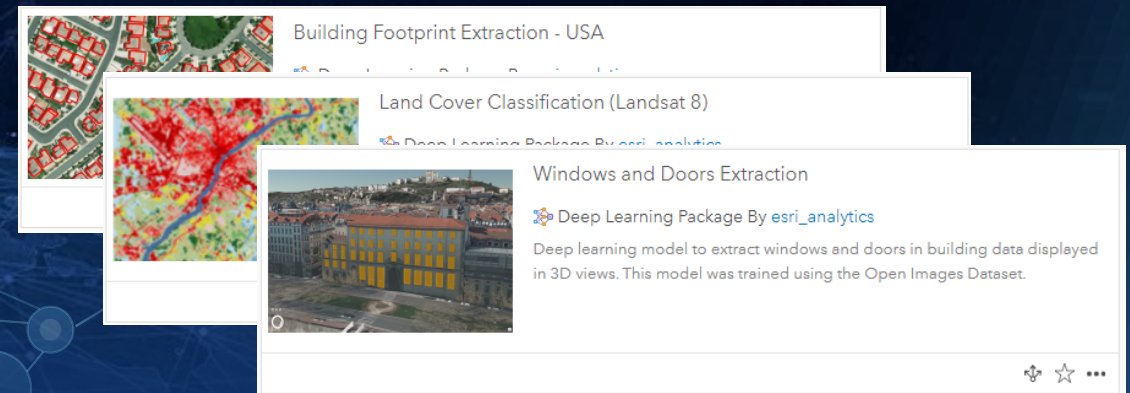
Building Footprint Extraction - USA

Land Cover Classification (Landsat 8)

Windows and Doors Extraction

Deep Learning Package By esri_analytics

Deep learning model to extract windows and doors in building data displayed in 3D views. This model was trained using the Open Images Dataset.

Python for multidimensional raster

Rich APIs for working with multidimensional raster

- **ArcGIS API for Python**
  - web and imagery layers
  - Distributed computing
  - Output as web layers

- **ArcPy**
  - Local data or web layers
  - Parallel processing
  - Output local dataset

Analysis: Classification

segment_mean_shift
train
classify

Analysis: Multidimensional

generate_trend_raster
predict_using_trend_raster
multidimensional_filter
...idimensional_raster
...dimensional_anomaly
...es_using_ccdc
...es_using_landtrendr
...using_change_analysis
...n_function
...nensional_raster
...mensional_raster
...mensional_raster
...ge_raster
..._statistics
...nensional_transpose

Data Management

rasterize_features
colormap
colormap_to_rgb
complex
grayscale
remap
spectral_conversion
unit_conversion
vector_field
clip
composite_band
extract_band
mask
reproject
nibble
colorspace_conversion
trend_to_rgb
vector_field_renderer
aggregate_cells
boundary_clean
buffered
constant
expand
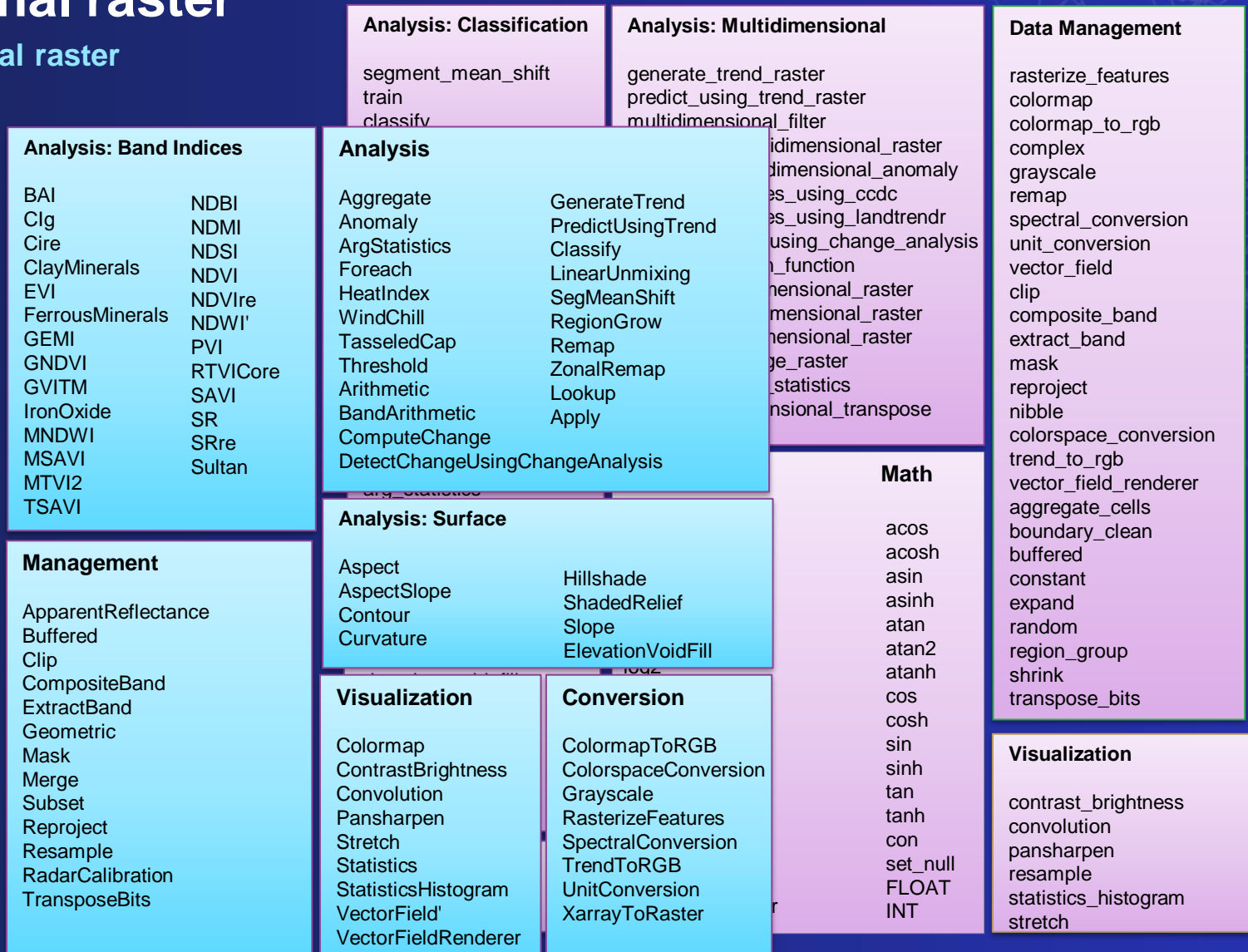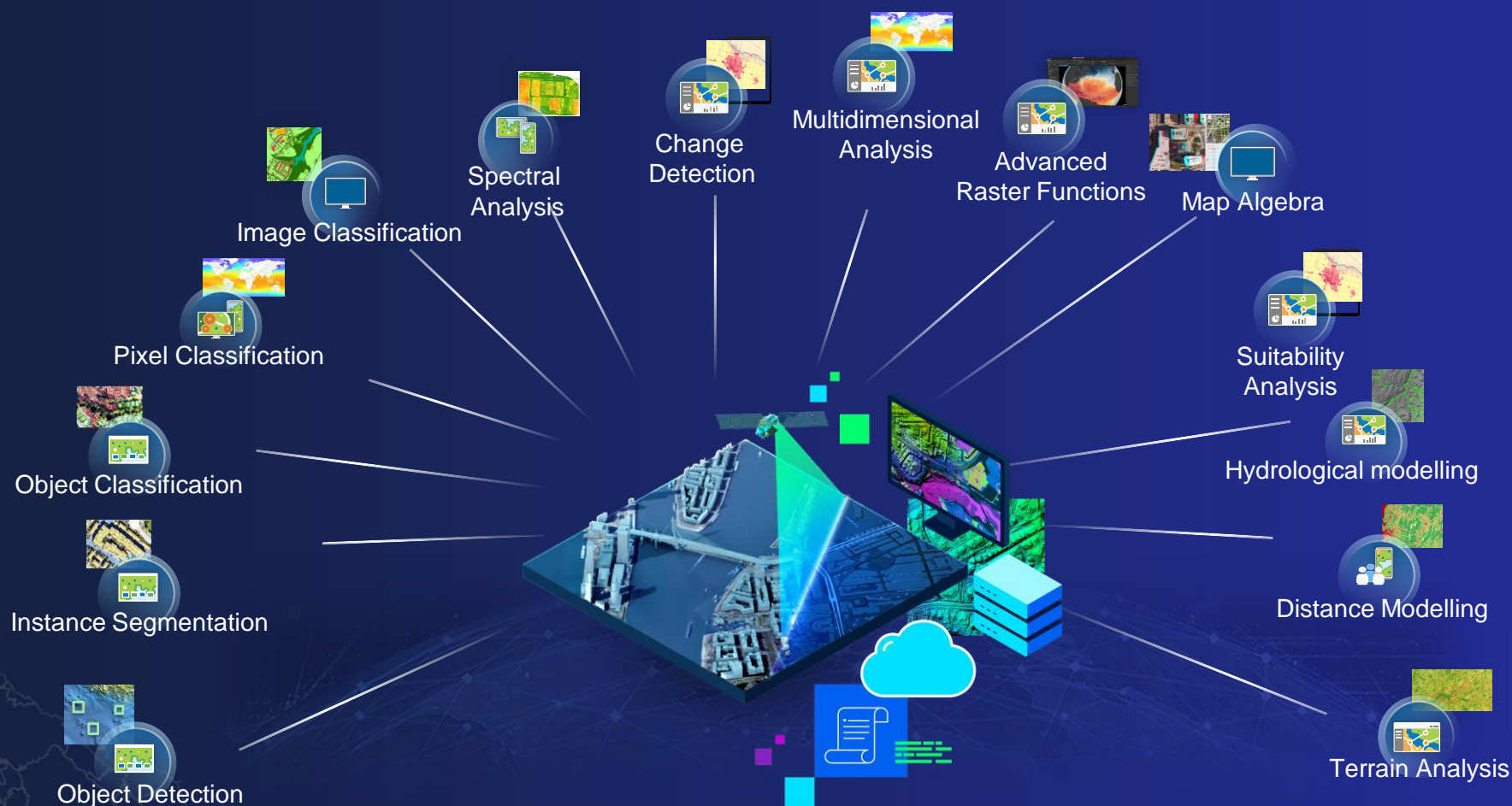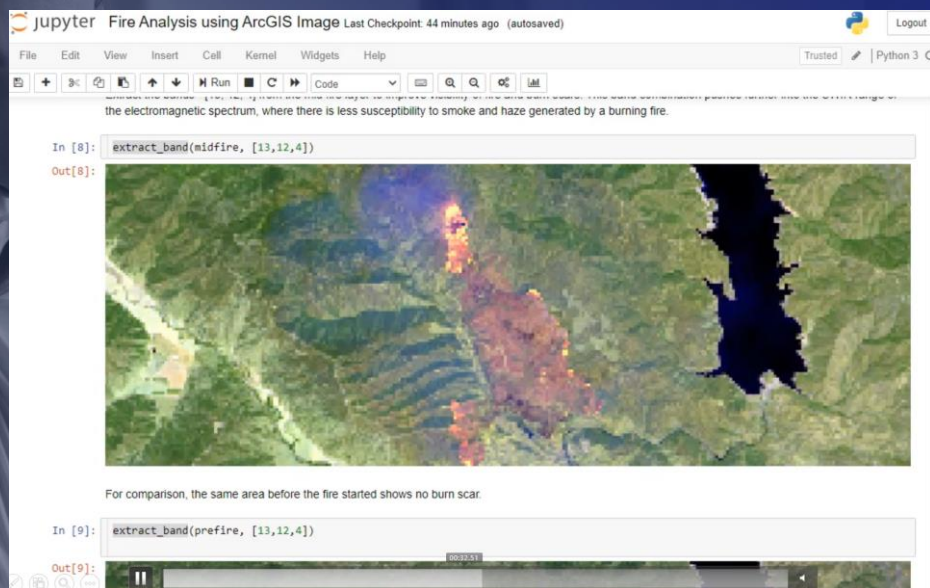random
region_group
shrink
transpose_bits

Analysis: Band Indices

BAI	NDBI
CIg	NDMI
Cire	NDSI
ClayMinerals	NDVI
EVI	NDVIre
FerrousMinerals	NDWI'
GEMI	PVI
GNDVI	RTVICore
GVITM	SAVI
IronOxide	SR
MNDWI	SRre
MSAVI	Sultan
MTVI2	
TSAVI	

Analysis

Aggregate	GenerateTrend
Anomaly	PredictUsingTrend
ArgStatistics	Classify
Foreach	LinearUnmixing
HeatIndex	SegMeanShift
WindChill	RegionGrow
TasseledCap	Remap
Threshold	ZonalRemap
Arithmetic	Lookup
BandArithmetic	Apply
ComputeChange	
DetectChangeUsingChangeAnalysis	

arg_statistics

Analysis: Surface

Aspect	Hillshade
AspectSlope	ShadedRelief
Contour	Slope
Curvature	ElevationVoidFill

Math

acos
acosh
asin
asinh
atan
atan2
atanh
cos
cosh
sin
sinh
tan
tanh
con
set_null
FLOAT
INT

Management

ApparentReflectance
Buffered
Clip
CompositeBand
ExtractBand
Geometric
Mask
Merge
Subset
Reproject
Resample
RadarCalibration
TransposeBits

Visualization

Colormap
ContrastBrightness
Convolution
Pansharpen
Stretch
Statistics
StatisticsHistogram
VectorField'
VectorFieldRenderer

Conversion

ColormapToRGB
ColorspaceConversion
Grayscale
RasterizeFeatures
SpectralConversion
TrendToRGB
UnitConversion
XarrayToRaster

Visualization

contrast_brightness
convolution
pansharpen
resample
statistics_histogram
stretch

Raster Analytics in ArcGIS Online
ArcGIS Image for ArcGIS Online

ArcGIS Image for ArcGIS Online

- 150 + raster functions
- 26 Ready-to-use tools
- Deep learning tools
- Raster function editor
- Supports tiled and dynamic layers
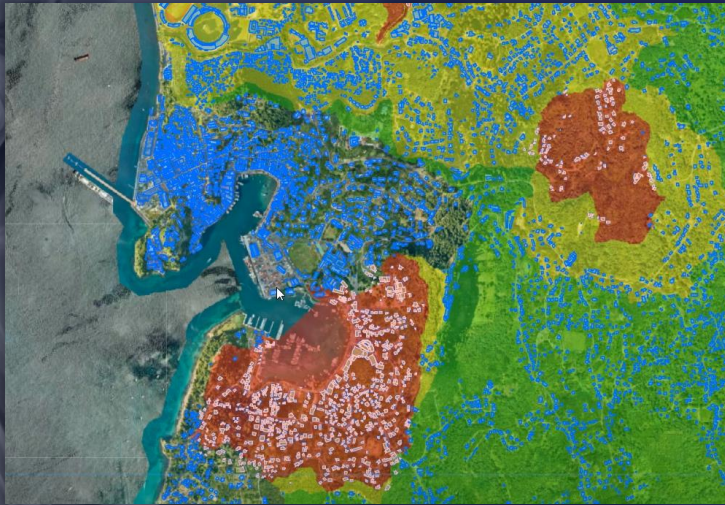- Can output tiled and dynamic layers

Image Classification

Spectral Analysis

Change Detection

Multidimensional Analysis

Advanced Raster Functions

Map Algebra

Pixel Classification

Suitability Analysis

Object Classification

Hydrological modelling

Instance Segmentation

Distance Modelling

Object Detection

Terrain Analysis

Demo – Raster analysis in ArcGIS Online

ArcGIS Api for Python – Burn scar dilineation

Demo: ArcGIS Image – Raster Analytics in ArcGIS Online

Burn scar assessment

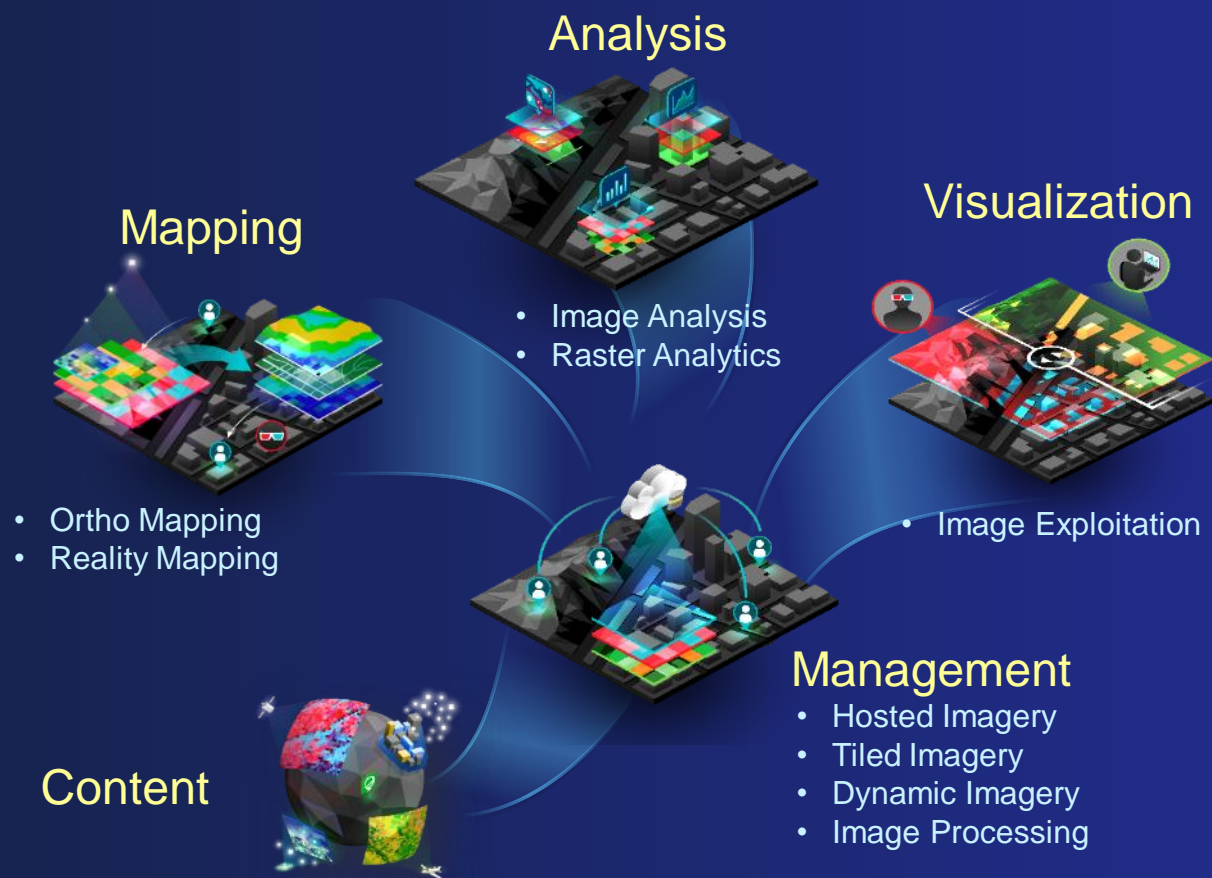# Deployment options for teaching and research

Imagery Enabling the Imagery Capabilities of ArcGIS

Deployments to suit your needs

Analysis

Mapping

Visualization

- Image Analysis
- Raster Analytics

- Ortho Mapping
- Reality Mapping

- Image Exploitation

Management
- Hosted Imagery
- Tiled Imagery
- Dynamic Imagery
- Image Processing

Content

ArcGIS Image

Desktop
ArcGIS Pro

ArcGIS Image Analyst

Enterprise
ArcGIS Enterprise

ArcGIS Image Server

SaaS
ArcGIS Online

ArcGIS Image
for ArcGIS Online

Managed SaaS
Dedicated

ArcGIS Image Dedicated

ArcGIS Image – Deployment Options for Teaching and Research

Desktop
ArcGIS Pro

ArcGIS Image Analyst

- Primary workstation for all image and raster processing and analysis tools
- Connected desktop - work locally and/or connected to the web
- Available to all teaching and research

Enterprise
ArcGIS Enterprise

ArcGIS Image Server

- Enterprise solution - For central management
- Serving Imagery, Hosted imagery, Scale up analytics
- Use Desktop, Web or Notebooks as clients
- Requires on-premise or cloud infrastructure

SaaS
ArcGIS Online

ArcGIS Image
for ArcGIS Online

* Release June 2021

- ArcGIS Online extended to Host, Analyze and Stream Imagery and Rasters
- Full SaaS – No infrastructure
- Consume credits
- Requires administrator to enable

Managed SaaS
Dedicated

ArcGIS Image Dedicated

* Release June 2021

- Managed SaaS deployment in the cloud
- For processing and analysis of very large global datasets
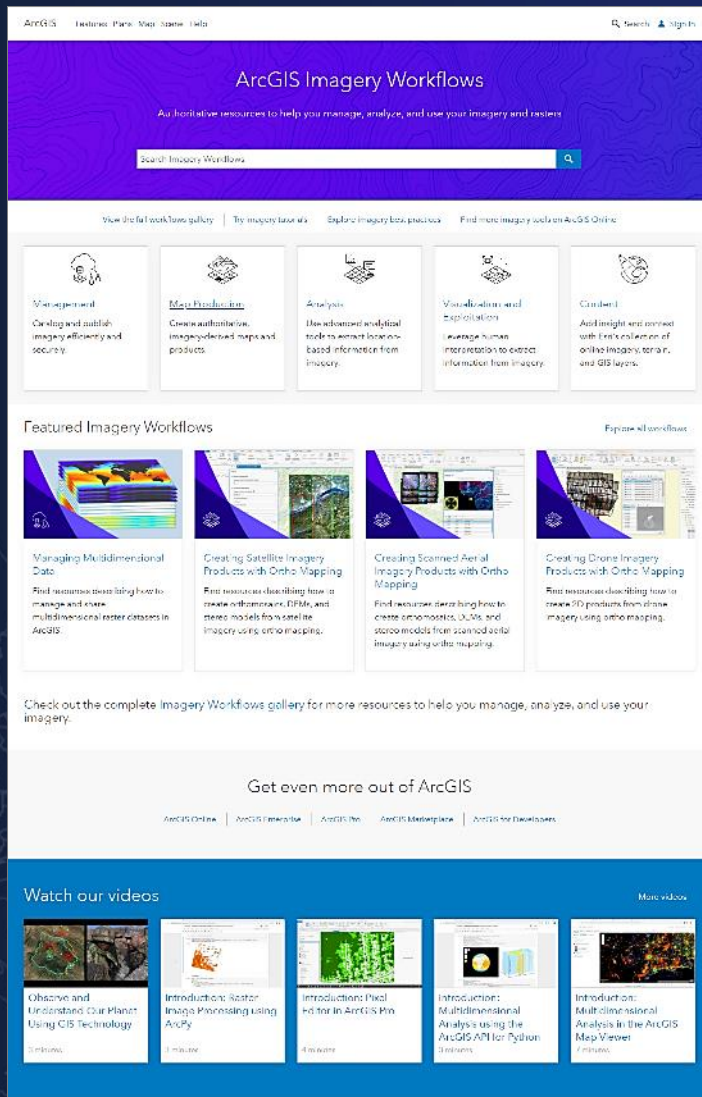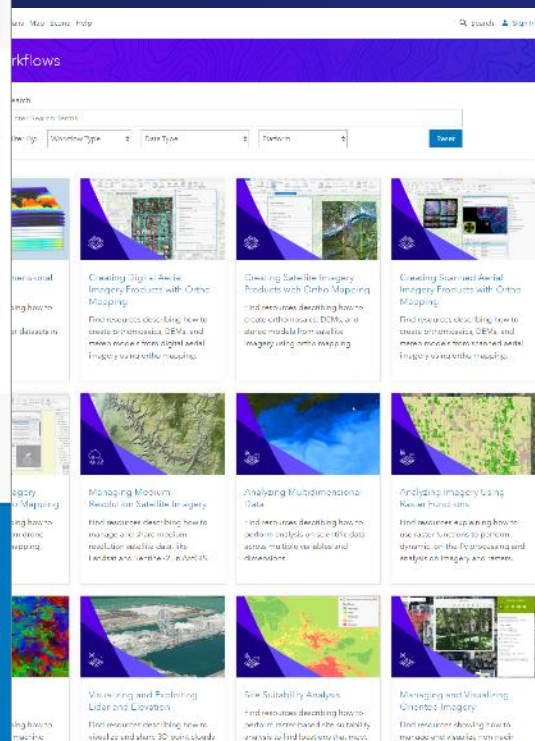- Esri managed infrastructure

Q/A Session

Resources

Imagery Workflows

Jumping-off point for accomplishing common imagery tasks with ArcGIS

- **Workflows** aggregate resources from across Esri
- **Tutorials** get you started with sample data and step-by-step instructions
- **Best Practices** offer a deep dive into the technical weeds

esriurl.com/imageryworkflows

New content

Workflows
- Visualizing and Exploiting Lidar and Elevation
- Performing Image Classification
- Analyzing Imagery Using Raster Functions
- Analyzing Multidimensional Data
- Managing Medium-Resolution Satellite Imagery
- Creating Drone Imagery Products with Ortho Mapping
- Creating Scanned Aerial Imagery Products with Ortho Mapping
- Creating Satellite Imagery Products with Ortho Mapping
- Creating Digital Aerial Imagery Products with Ortho Mapping
- Managing Multidimensional Data

Tutorials
- Creating drone imagery products in ArcGIS Pro
- Creating digital aerial imagery products in ArcGIS Pro
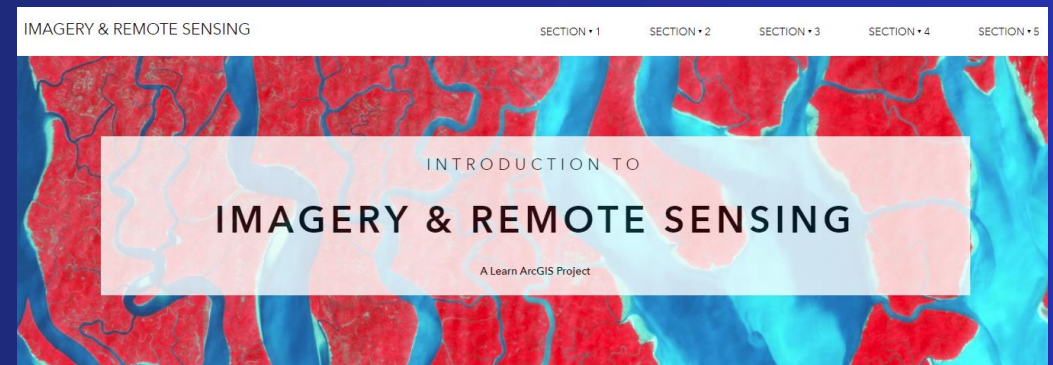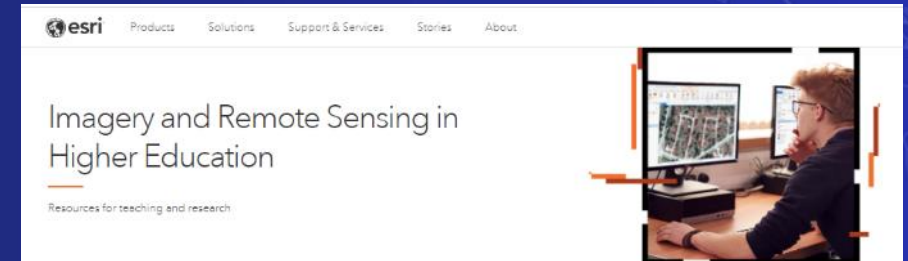- Creating satellite imagery products in ArcGIS Pro

Best practices
- Imagery in the Cloud
- Managing Multidimensional Data
- Using ortho mapping with scanned aerial imagery
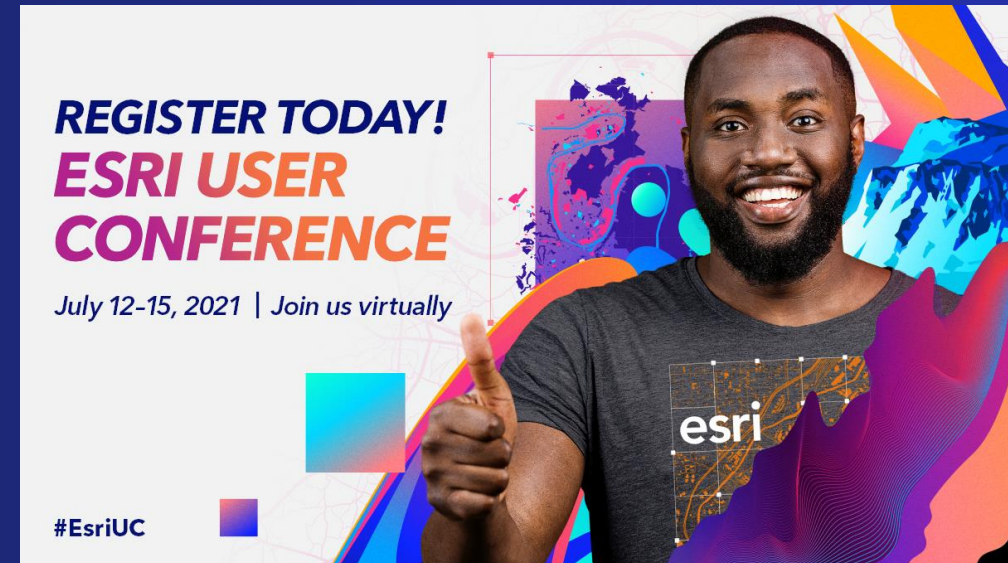
Resources
Imagery & Remote Sensing

We will send all the list of resources:

- Imagery Workflows:
  - Imagery Workflows
- Educational Resources:
  - Materials to aid the development of university-level curricula
  - Imagery in Action MOOC – starting August 11th
- Webpages:
  - Imagery and Remote Sensing in Higher Education
  - Imagery & Remote Sensing product page

Join us

Esri Education Summit
June 21-22, 2021
Join us virtually
REGISTER TODAY!

REGISTER TODAY!
ESRI USER CONFERENCE
July 12-15, 2021 | Join us virtually
#EsriUC

Stay tune for more Imagery and Remote Sensing webinars in Fall 2021