ArcGIS Enterprise
Building Raster Analytics Workflows

Mike Muller, Jie Zhang

GIS INSPIRING WHAT'S NEXT

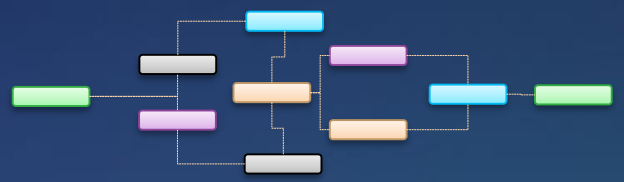
Introduction and Context

Raster Analytics

What is Raster Analytics?

- The ArcGIS way to create and execute spatial analysis models and image processing chains which leverage distributed storage and analytics
- ArcGIS Enterprise + ArcGIS Image Server

Single Functions and Modeling



Multiband Math

Arithmetic
Band Arithmetic

Math

Calculator
Abs
Divide
Exp
Exp10
Exp2
Float
Int
Ln, Log10
Log2
Minus
Mod
Negate
Plus
Power
Round Down
Round Up
Square
Square Root
Times

ACos
ACosH
ASin
ASinH
ATan
ATan2
ATanH
Cos
CosH
Sin
SinH
Tan
TanH

Con
Set Null

Bitwise
- And
- Left Shift
- Not
- Or
- Right Shift
- Xor

Boolean
- And
- Not
- Or
- Xor

Equal To
Greater Than
Greater Than Equal
Is Null
Less Than
Less Than Equal
Not Equal

Correction

Apparent Reflectance
Geometric Correction
Speckle Filtering (Lee,Frost,Kuan)
Thermal Noise
Radiometric Calibration

Data Management & Conversion

Raster to Vector
Vector to Raster
Colormap
Colormap To RGB
Complex
Grayscale
Remap / Reclass
Spectral Conversion
Unit Conversion
Vector Field
LAS to Raster
LAS Dataset to Raster
Clip
Composite
Extract Bands
Mask
Mosaic Rasters
Rasterize Features
Reproject
Nibble

Visualization & Appearance

Contrast and Brightness
Convolution
Pansharpening
Resample
Statistics and Histogram
Stretch

Interpolation

Interpolate Irregular Data
Nearest Neighbor
IDW
EBK
Swath

Surface Generation & Analysis

Aspect
Curvature
Elevation Void Fill
Hillshade
Shaded Relief
Slope
Viewshed
Contour

Analysis: Distance & Density

Euclidean Distance
Cost Distance
Least Cost Path
Kernel Density

Analysis: Overlay

Weighted Overlay
Weighted Sum

Analysis: Band Math & Indices

NDVI / NDVI Colorized
SAVI / MSAVI / TSAVI
GEMI
GVI (Landsat TM)
PVI
Tasseled Cap (Kauth-Thomas)
Binary Thresholding

Statistics:

Zonal Statistics
Cell Statistics
ArgStatistics

Analysis: Image Segmentation & Classification

Segmentation (Mean Shift)
Training (ISO, SVM, ML)
Supervised Classification

Analysis: Hydrology

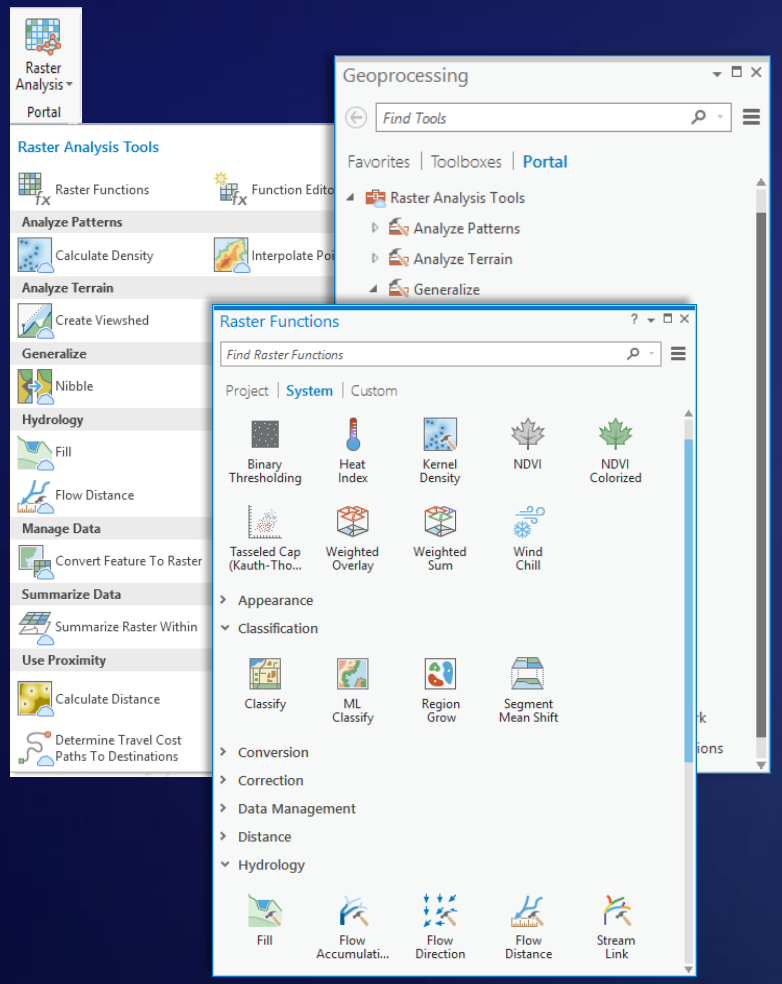
Fill
Flow Accumulation
Flow Direction
Flow Distance
Stream Link
Watershed

Python

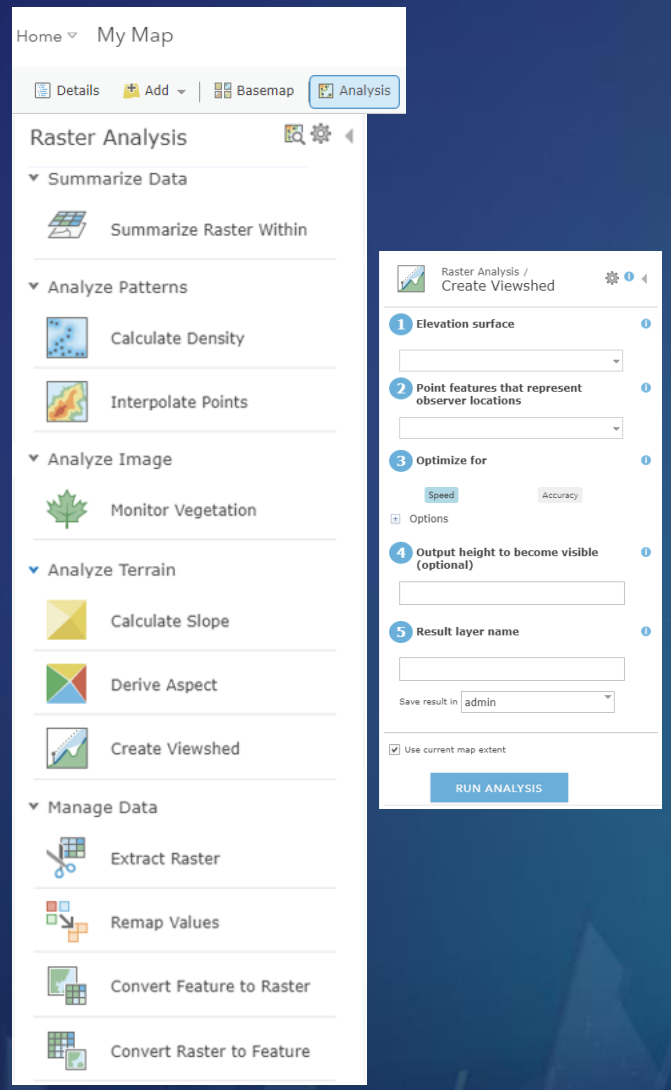
Custom Algorithms

Raster Analytics User Experiences

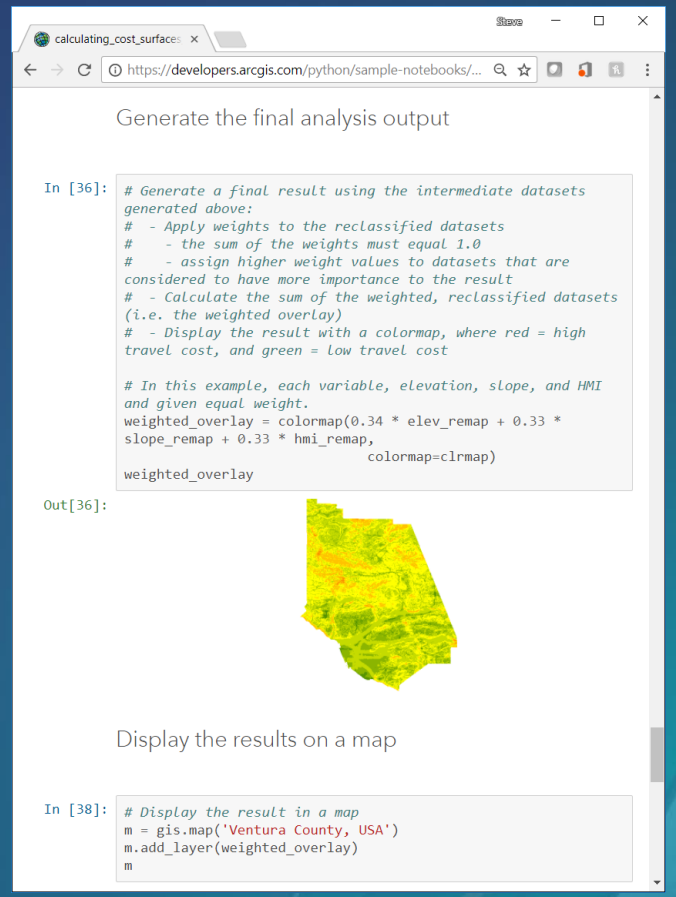
ArcGIS Pro



Web



ArcGIS API for Python



Raster Analytics

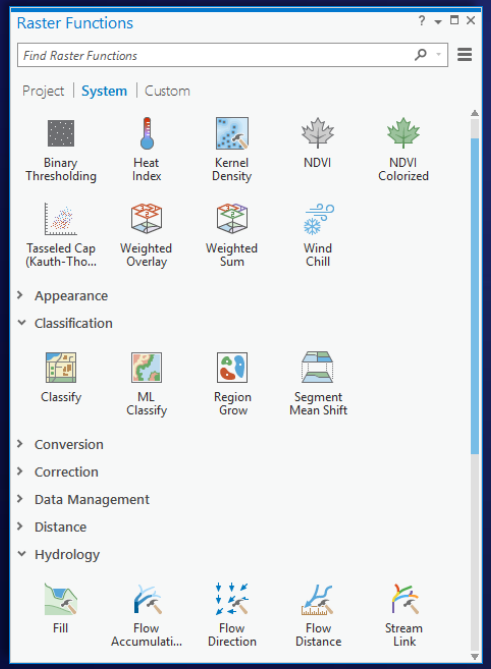
Workflows

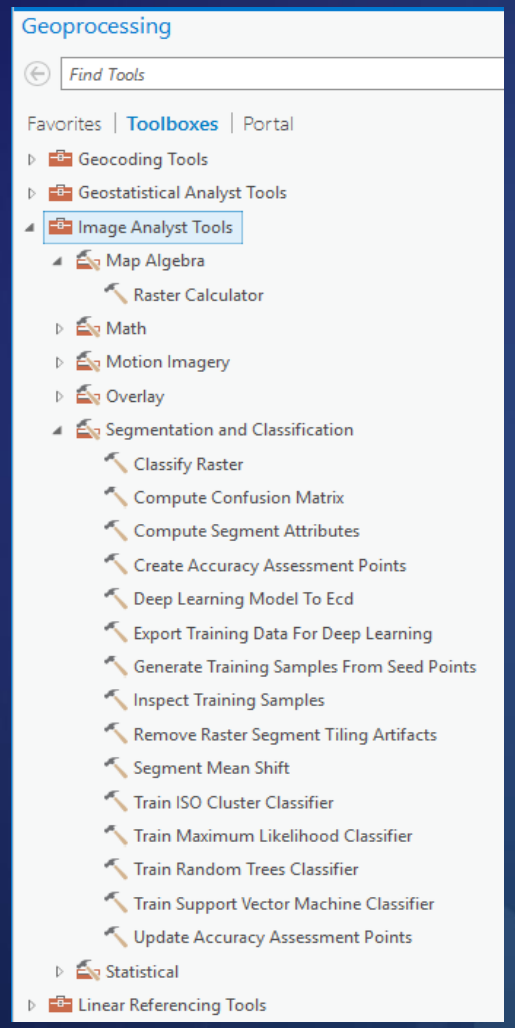
Raster Analytics Workflows

- ArcGIS Pro "Out of the Box" Analysis
- ArcGIS Pro Custom Analysis
- ArcGIS Enterprise "Out of the Box" Analysis
- ArcGIS Enterprise Custom Analysis
- Python for Developers and Systems Integrators
- ArcGIS API for Python and Jupyter Notebooks for Developers and Researchers
- ArcGIS REST API for Web Developers

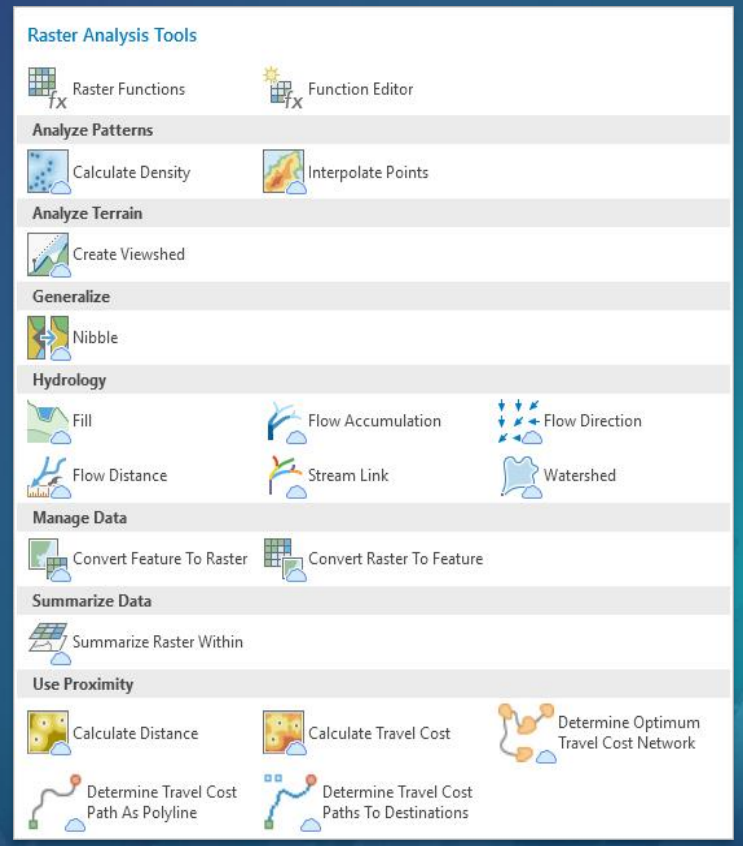
ArcGIS Pro "Out of the Box" Analysis

- **Local Processing**
  - "on the desktop"
  - Image Analyst Tools
  - enhanced parallel processing tools
  - geoprocessing Model Builder
  - leverage all geoprocessing tools
  - single raster functions



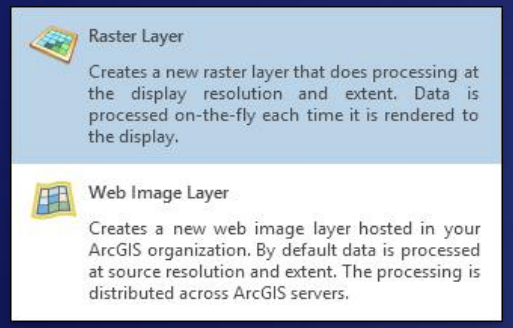


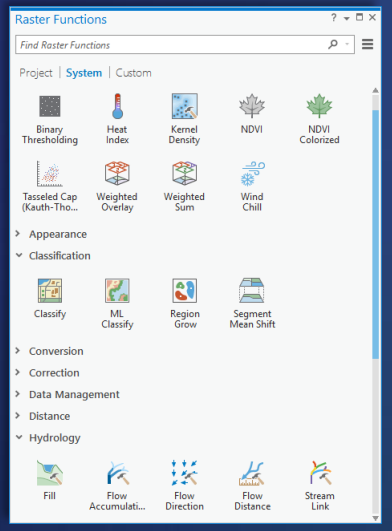
- **Distributed Processing**
  - "on the server"
  - run individually
  - best practice for modeling is writing a script tool



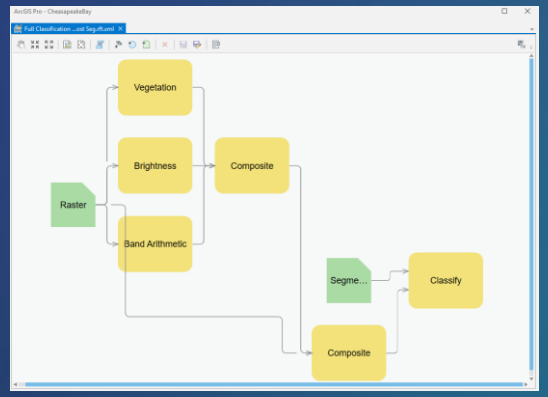
ArcGIS Pro Custom Analysis

- **Local Processing**
  - "on the desktop"
  - "on-the-fly" results
  - Raster Function Editor
  - Output Layer Type = Raster Layer

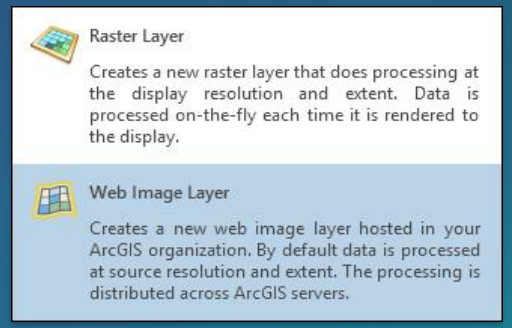


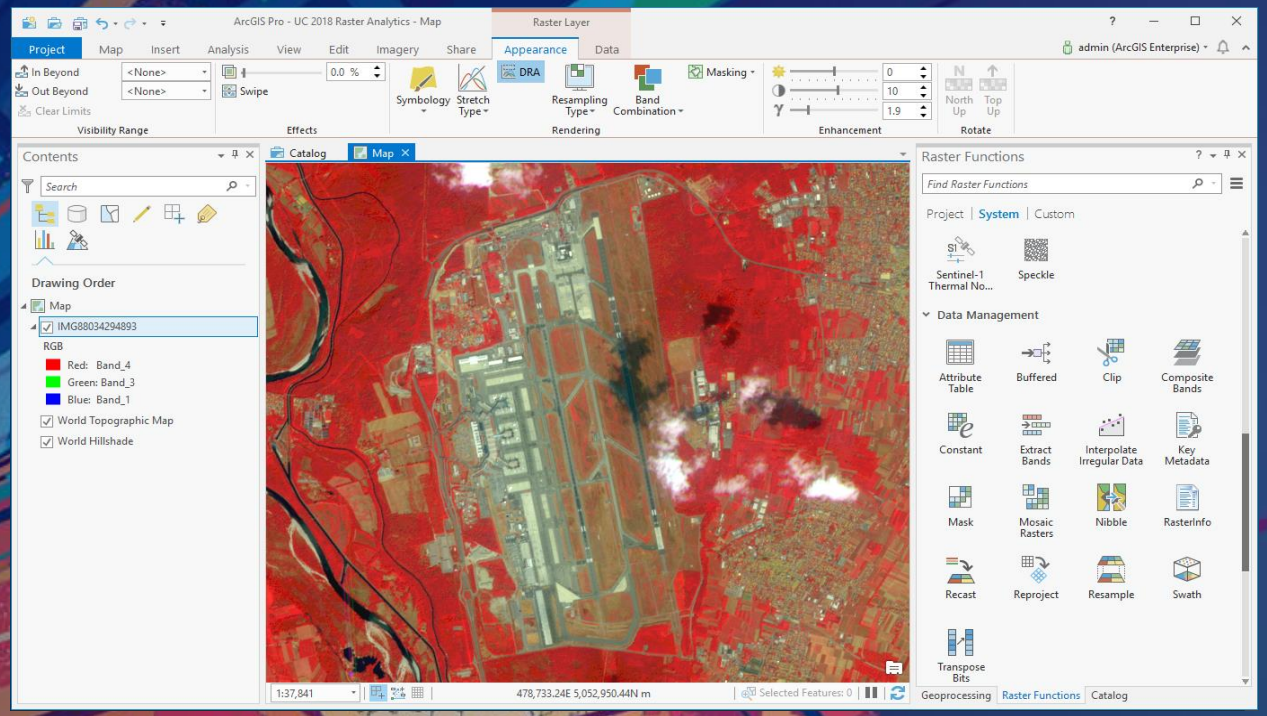


Visual Modeling



- **Distributed Processing**
  - "on the server"
  - full resolution persistent results
  - Raster Function Editor
  - Output Layer Type = Web Image Layer



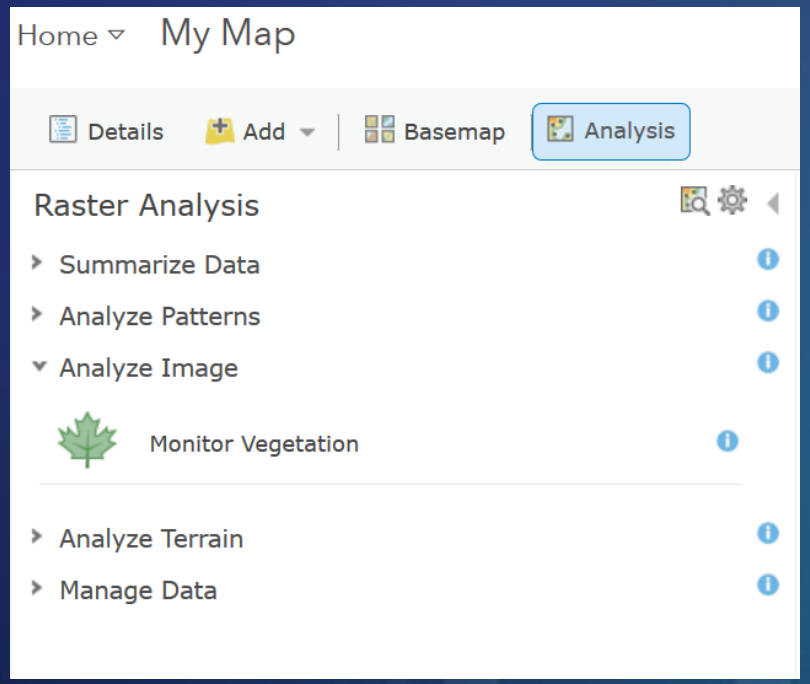


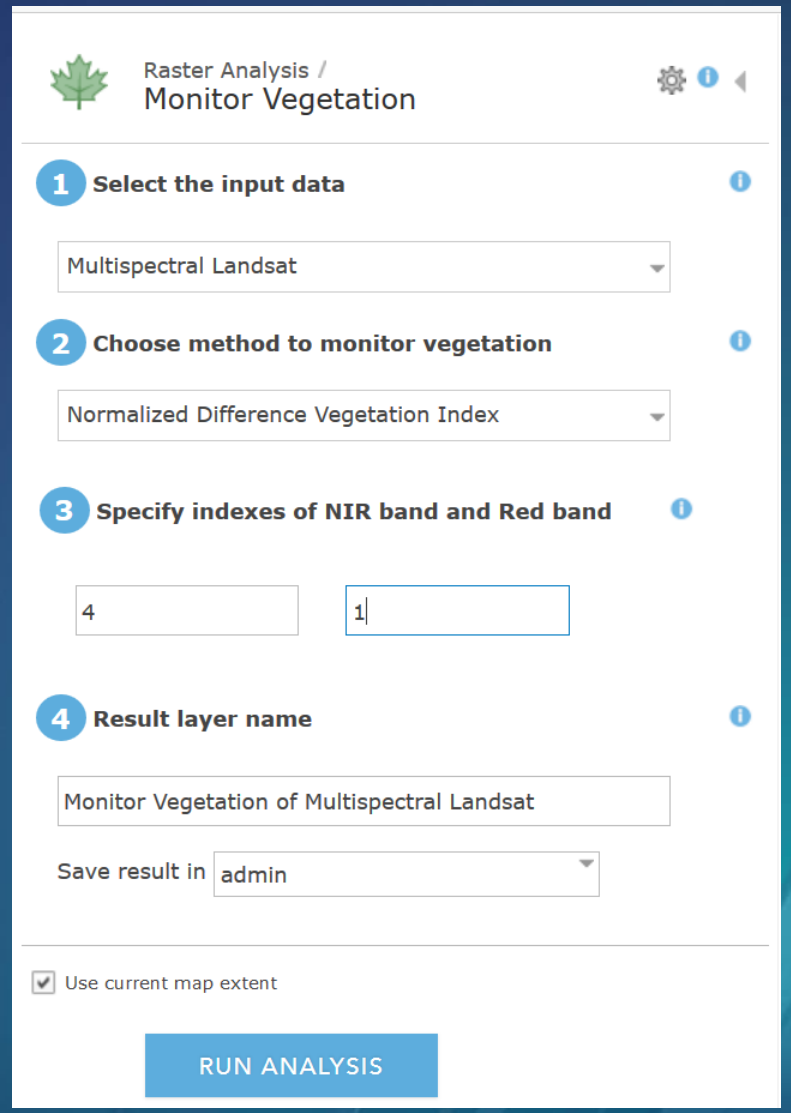
ArcGIS Pro Demo

Jie Zhang

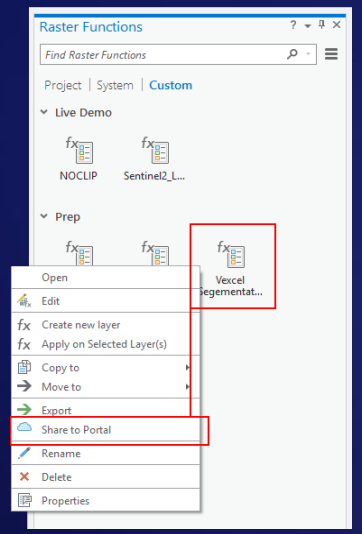
ArcGIS Enterprise "Out of the Box" Analysis

- **Distributed Processing**
  - "on the server"
  - full resolution persistent results
  - via Map Viewer

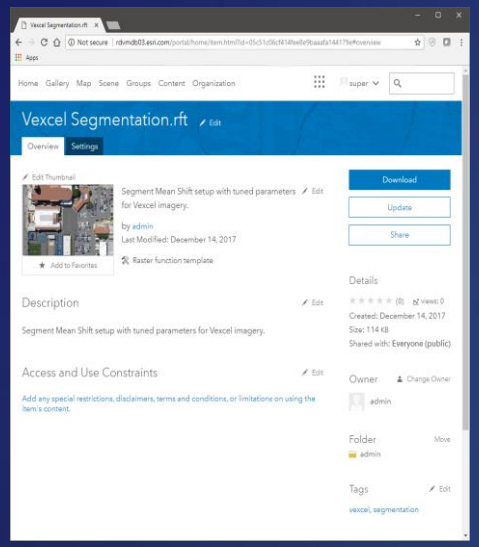




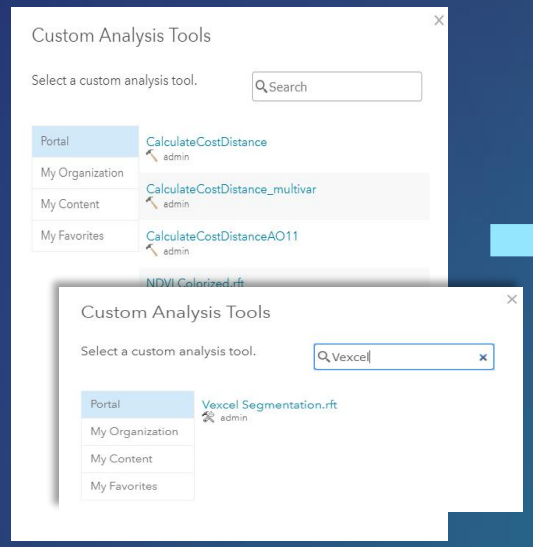
ArcGIS Enterprise Custom Analysis



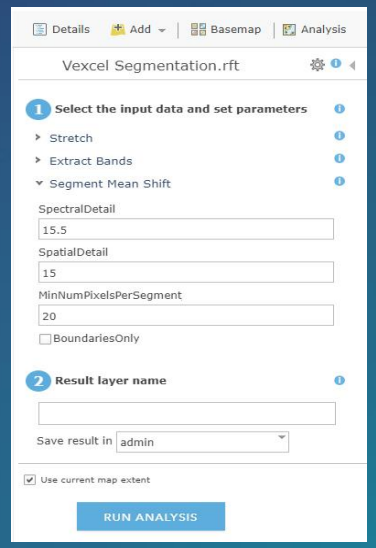
develop custom processing models and share to Portal from Pro



Raster Function Template item



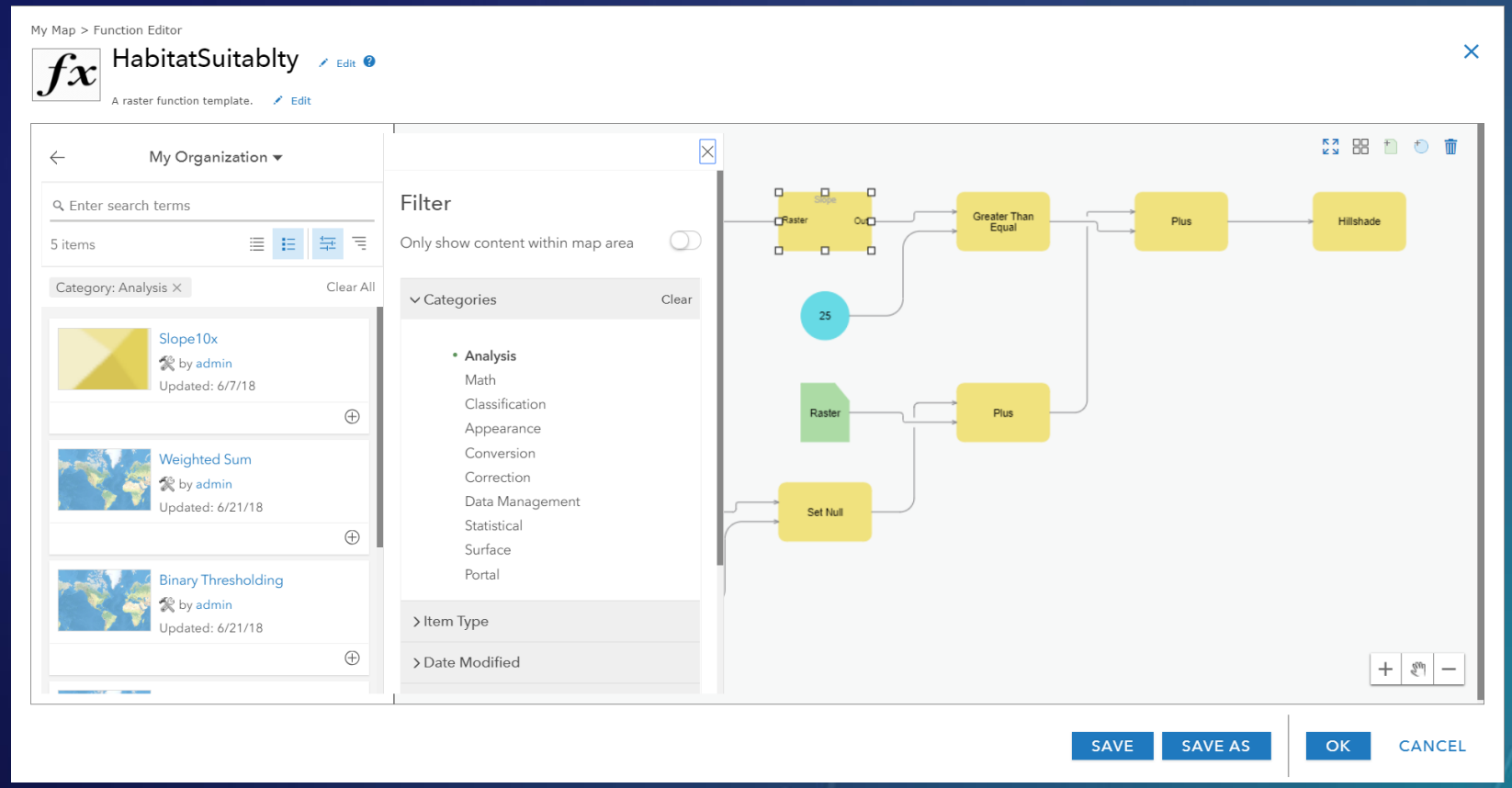
browse and search for Raster Function Template items



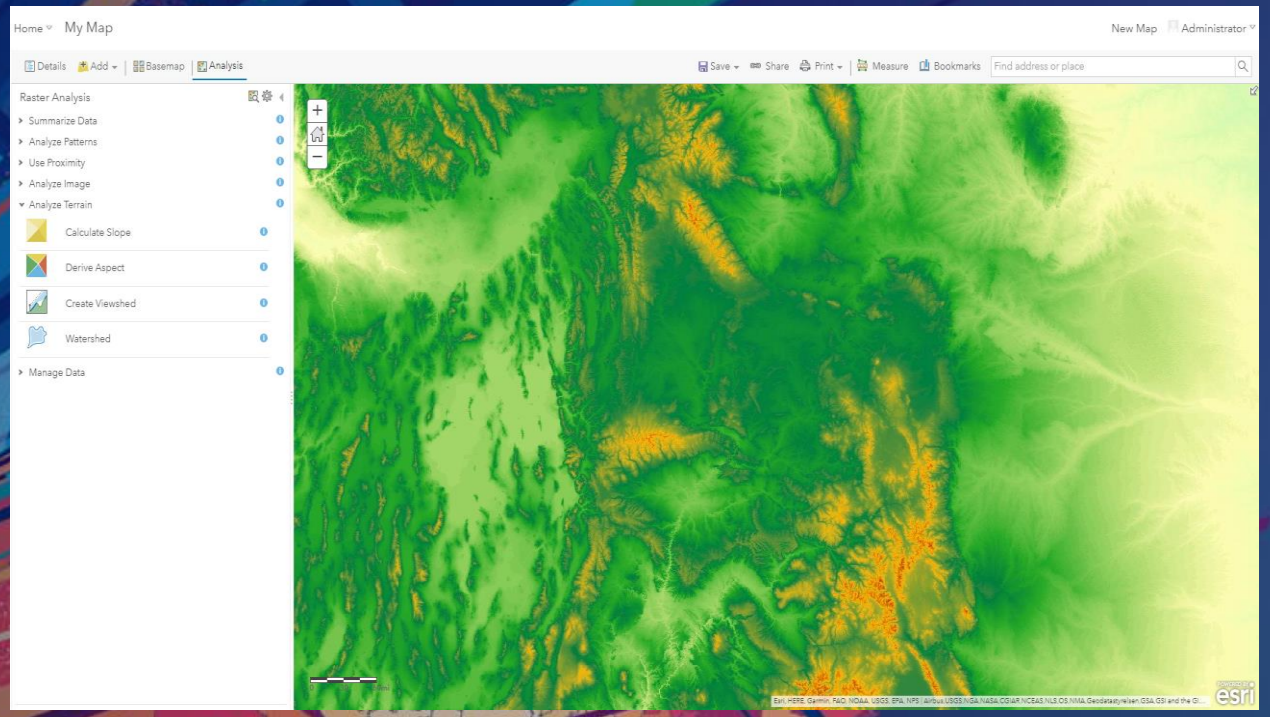
form generated, user supplies parameters and runs the custom analysis

ArcGIS Enterprise Custom Analysis

Coming Soon…



complete web user experience for visual modeling - "raster function editor for Map Viewer"



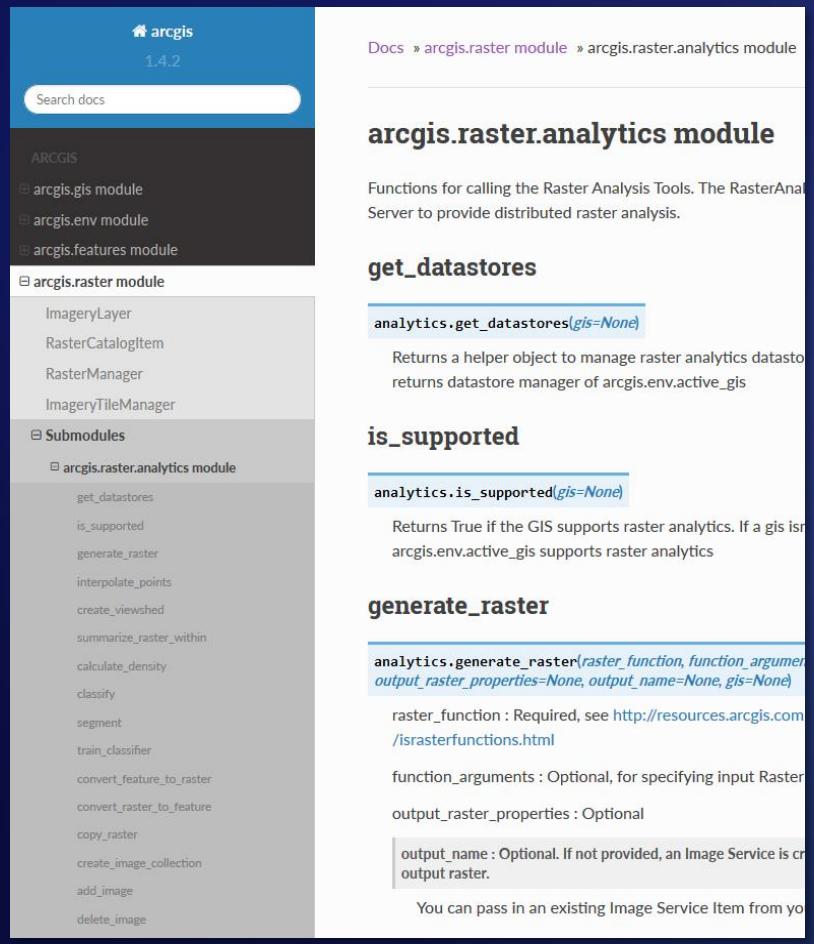
ArcGIS Enterprise Demo

Jie Zhang

Python for Developers and Systems Integrators

ArcGIS API for Python

[arcgis.raster.analytics]



distributed as part of the arcgis conda package

enterprise automation
enterprise integration
models built from existing functions

custom algorithms
leverage Python package ecosystem
use in ArcGIS Pro and ArcGIS Enterprise

Python Raster Function API

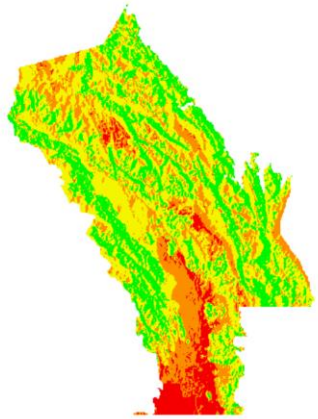
https://github.com/Esri/raster-functions

```python
import numpy as np

class HelloWorld():
    def __init__(self):
        self.name = "Hello World Function"

    def getParameterInfo(self):
        return [{
            'name': 'r',
            'dataType': 'raster'
        }]

    def updatePixels(self, tlc, shape, props, **pixelBlocks):
        r = pixelBlocks['r_pixels'] + 10
        pixelBlocks['output_pixels'] = r.astype(props['pixelType'])
        return pixelBlocks
```

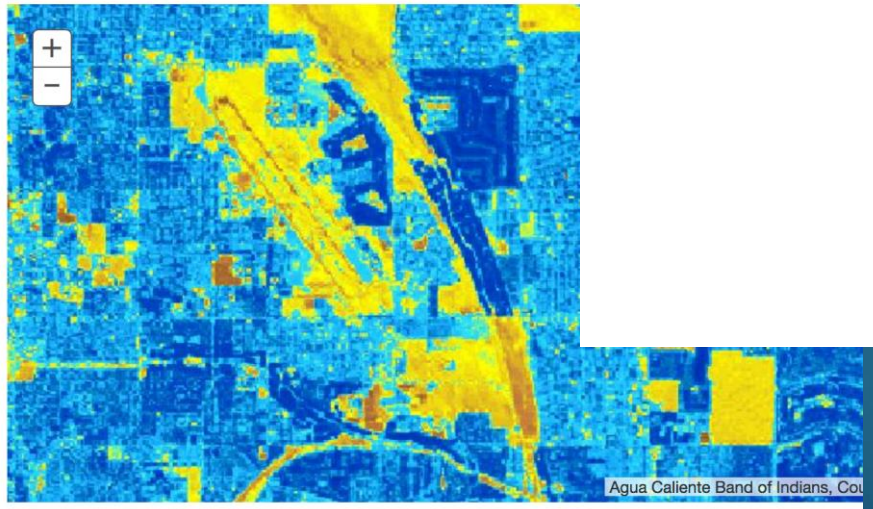
ArcGIS API for Python and Jupyter Notebooks for Developers and Researchers

- display Image Layers
- apply dynamic on-the-fly processing
- construct raster function chain (i.e. models in code)
- run models using distributed processing
- design, develop, prototype

```
In [7]: # Construct raster analysis workflow using raster function
        # 1. Create slope and aspect raster from DEM
        elevslope = slope(elev, slope_type="DEGREE", z_factor=1)
        elevaspect = aspect(elev)

In [8]: # 2. Apply suitability condition on slope raster (5 < slope < 60)
        sslope = boolean_and([greater_than([elevslope, 5]), less_than([elevslope, 60])])

In [9]: # 3. Apply suitability condition on aspect raster (0 < aspect < 200)
        saspect = boolean_and([greater_than([elevaspect, 0]), less_than([elevaspect, 200])])

In [10]: # 4. Apply suitability condition on DEM (30 < DEM < 400)
         selev = boolean_and([greater_than([elev, 30]), less_than([elev, 400])])

In [11]: # 5. Sum up using map algebra
         output_values = [0, 64, 128, 255]
         result = colormap(remap(sslope + saspect + selev,
                           input_ranges = [0,0,1,1,2,2,3,3],
                           output_values = output_values),
                           colorramp="Red To Green")

Out[11]:
```



```
In [8]: map = gis.map("Palm Spring", zoomlevel=13)
        map
```



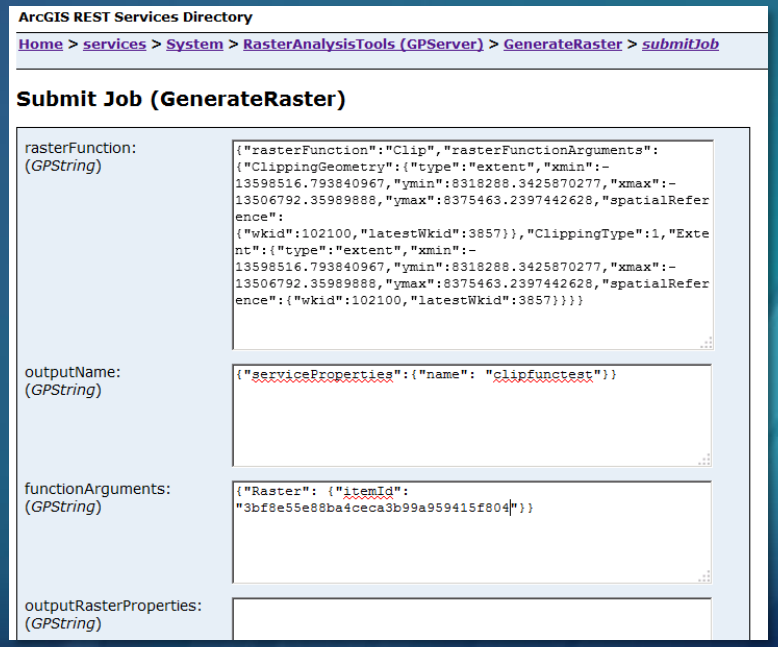

```
In [9]: map.add_layer(apply(l8layer, 'Normalized Difference Moisture Index Colorized'))
```

ArcGIS REST API for Web Developers

- run out of the box analytics
  - http://esriurl.com/rarestapi

- model analysis in JSON and run using distributed processing
  - http://esriurl.com/rasterfunc

JSON

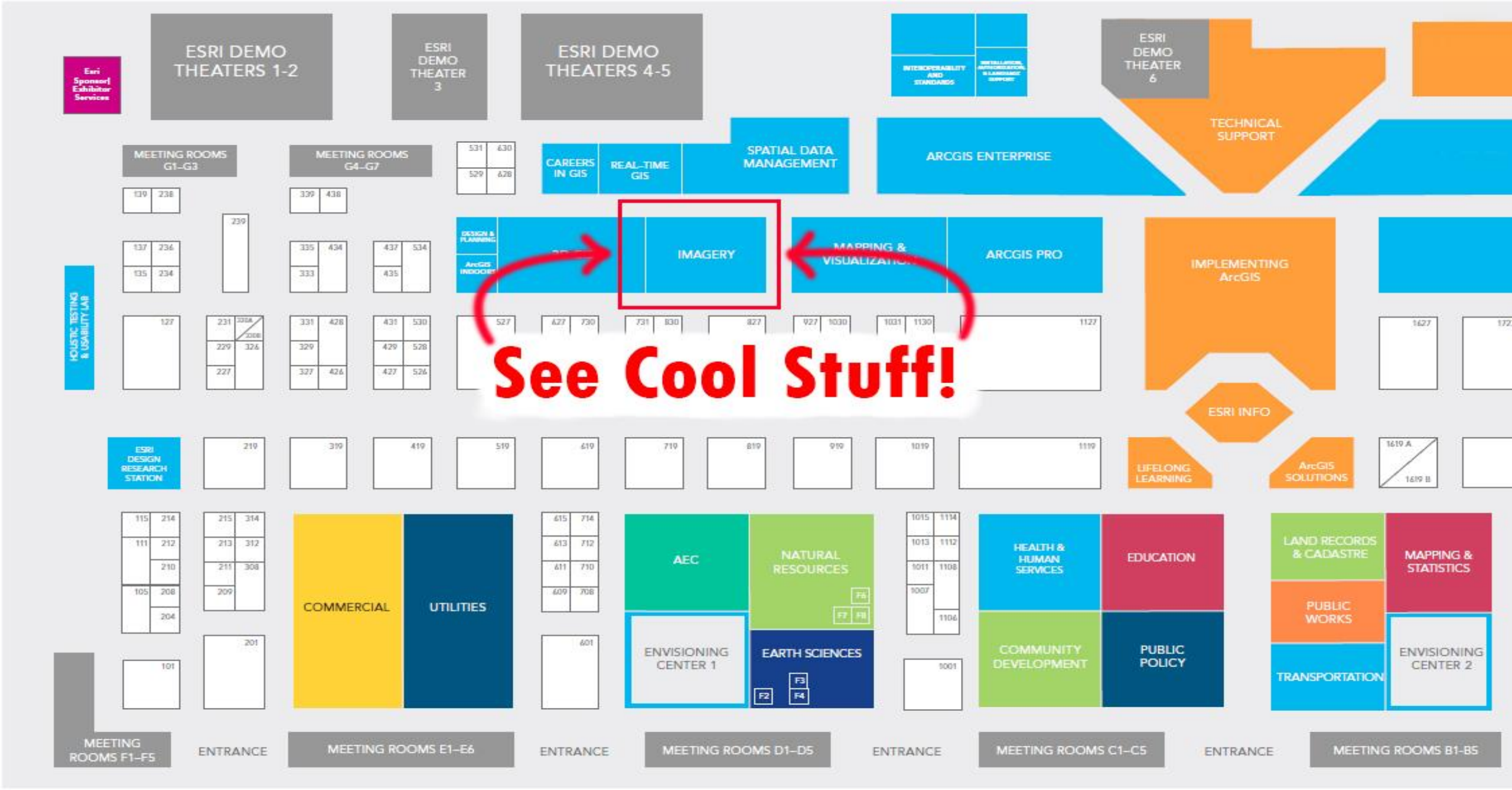


```python
def updatePixels(self, tlc, shape, props, **pixelBlocks):
        r1_inBlock = pixelBlocks['r1_pixels']  # a two band raster extracted from raster input 1
        r2_inBlock = pixelBlocks['r2_pixels']  # a two band raster extracted from raster input 2

        r1_nir = np.array(r1_inBlock[0], dtype='f4')                # extractbands ensures first ban
        r1_swir = np.array(r1_inBlock[1], dtype='f4')               # extractbands ensures second ba
        r2_nir = np.array(r2_inBlock[0], dtype='f4')                # extractbands ensures first ban
        r2_swir = np.array(r2_inBlock[1], dtype='f4')               # extractbands ensures second ba

        np.seterr(divide='ignore')
        r1_outBlock = (r1_nir - r1_swir) / (r1_swir + r1_nir)                    # compute NBR ((B4-
        r2_outBlock = (r2_nir - r2_swir) / (r2_swir + r2_nir)                    # compute NBR ((B4-
        outBlock = r1_outBlock - r2_outBlock                                     # compute delta NBR

        if self.applyScaling:
            outBlock = (outBlock * 100.0) + 100.0                 # apply a scale and offset to the t

        pixelBlocks['output_pixels'] = outBlock.astype(props['pixelType'])
        return pixelBlocks

    def updateKeyMetadata(self, names, bandIndex, **keyMetadata):
        if bandIndex == -1:
            keyMetadata['datatype'] = 'Processed'               # outgoing raster is now 'Processed'
        elif bandIndex == 0:
            keyMetadata['wavelengthmin'] = None                 # reset inapplicable band-specific key
            keyMetadata['wavelengthmax'] = None
            keyMetadata['bandname'] = 'NBR'
            return keyMetadata
```

buffer: dir: Downloads column: 12 stat: M-- modes: (Python AC Helm company ElDoc)

Developer Demo

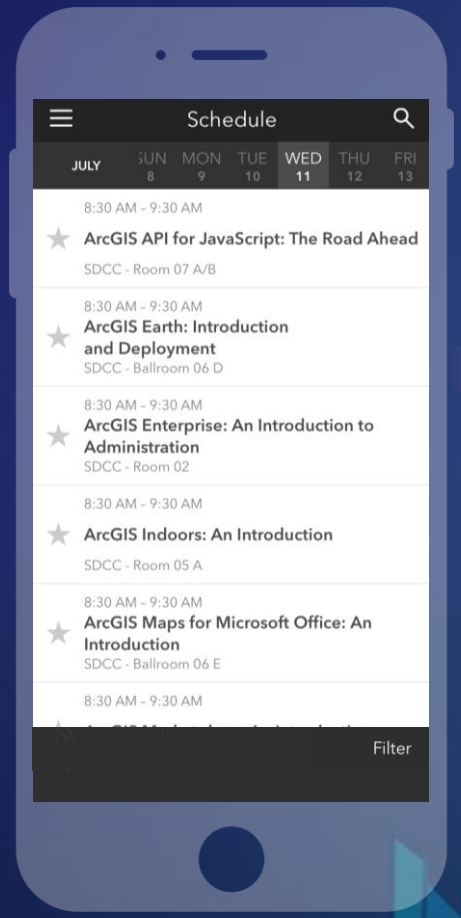
Jie Zhang


See Cool Stuff!
ESRI DEMO THEATERS 1-2
ESRI DEMO THEATER 3
ESRI DEMO THEATERS 4-5
ESRI DEMO THEATER 6
Esri Sponsor/ Exhibitor Services
INTEROPERABILITY AND STANDARDS
TECHNICAL SUPPORT
MEETING ROOMS G1–G3
MEETING ROOMS G4–G7
CAREERS IN GIS
REAL-TIME GIS
SPATIAL DATA MANAGEMENT
ARCGIS ENTERPRISE
DESIGN & PLANNING
ArcGIS INDOORS
IMAGERY
MAPPING & VISUALIZATION
ARCGIS PRO
IMPLEMENTING ArcGIS
HOLISTIC TESTING & USABILITY LAB
ESRI INFO
ESRI DESIGN RESEARCH STATION
LIFELONG LEARNING
ArcGIS SOLUTIONS
COMMERCIAL
UTILITIES
AEC
NATURAL RESOURCES
ENVISIONING CENTER 1
EARTH SCIENCES
HEALTH & HUMAN SERVICES
EDUCATION
COMMUNITY DEVELOPMENT
PUBLIC POLICY
LAND RECORDS & CADASTRE
MAPPING & STATISTICS
PUBLIC WORKS
TRANSPORTATION
ENVISIONING CENTER 2
MEETING ROOMS F1–F5
ENTRANCE
MEETING ROOMS E1–E6
ENTRANCE
MEETING ROOMS D1–D5
ENTRANCE
MEETING ROOMS C1–C5
ENTRANCE
MEETING ROOMS B1-B5
HALL C
HALL B

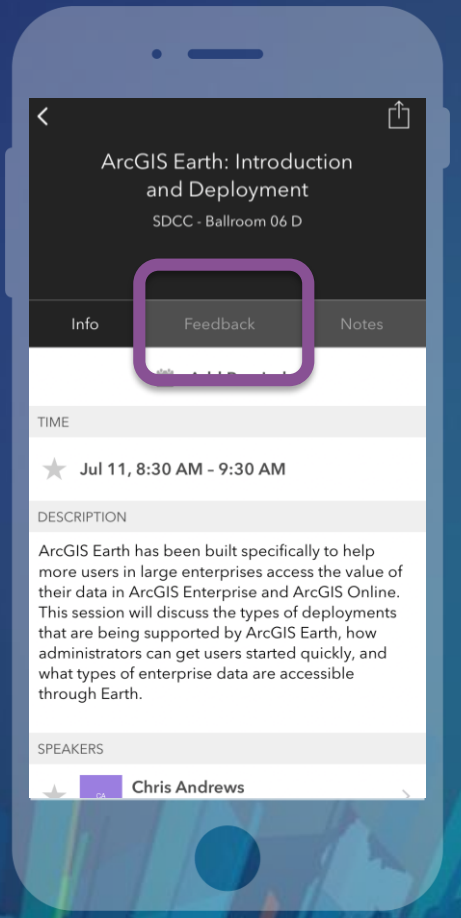
Please Take Our Survey on the App

Download the Esri Events app and find your event

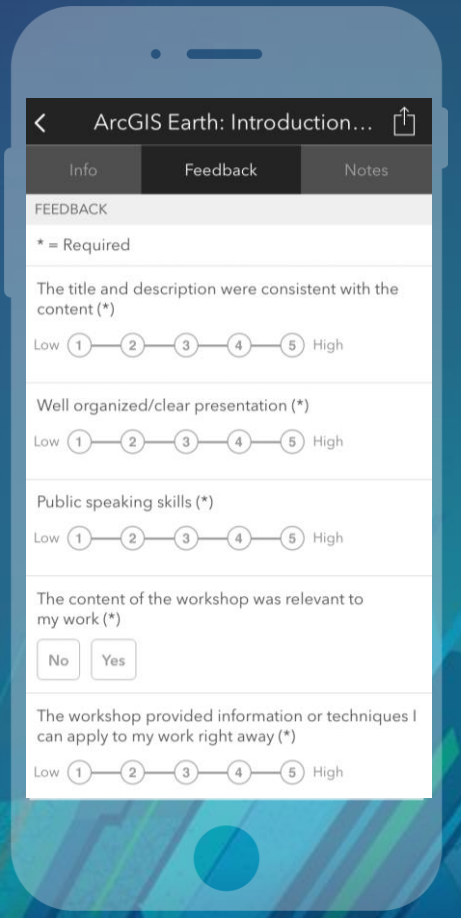
Select the session you attended



Select the Feedback tab



Complete answers and select “Submit”



esri | THE SCIENCE OF WHERE