Developing Imagery Apps Using the ArcGIS API for JavaScript and WebApp Builder

Naila Khan, Chayanika Khatua

What are we talking about today…

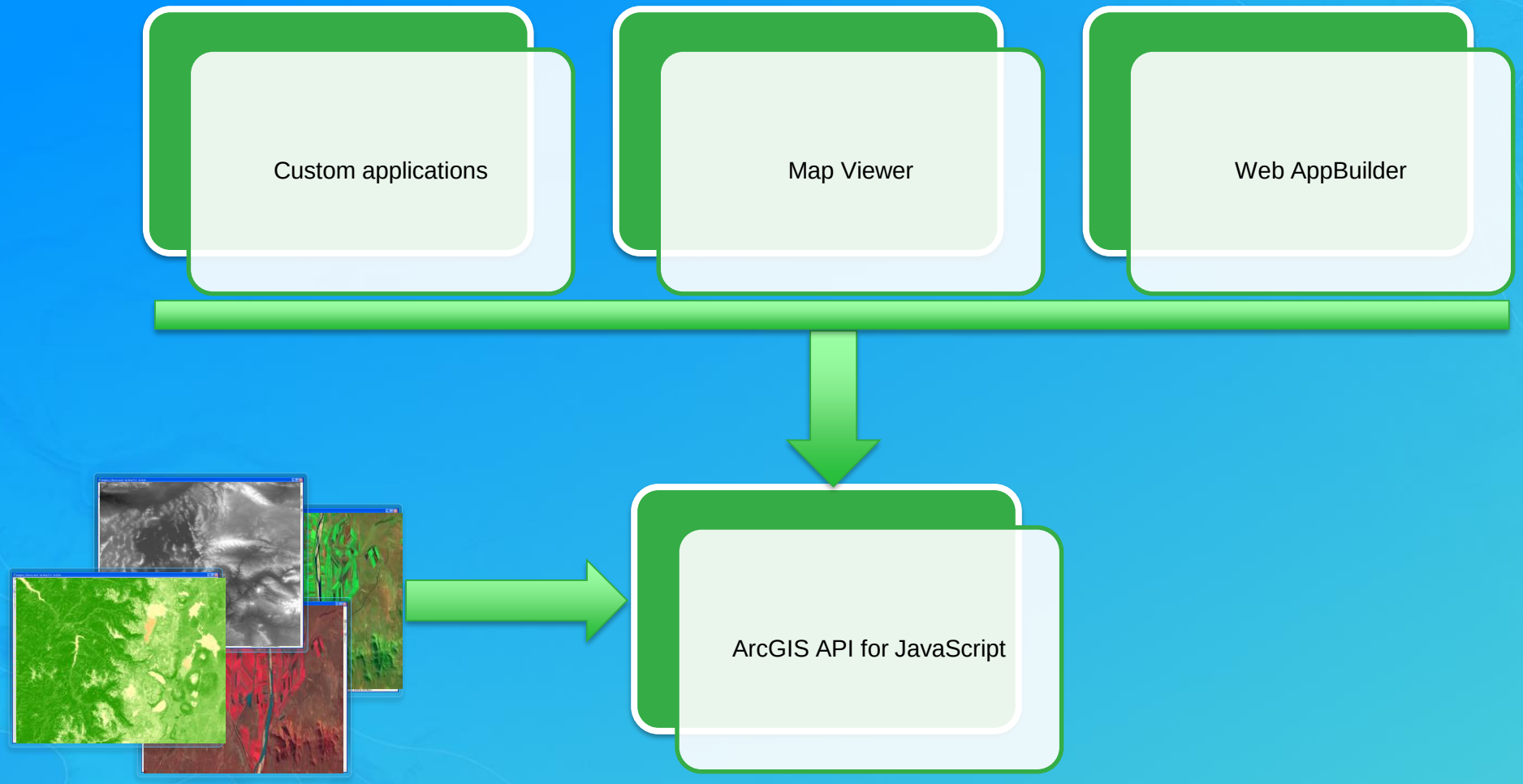
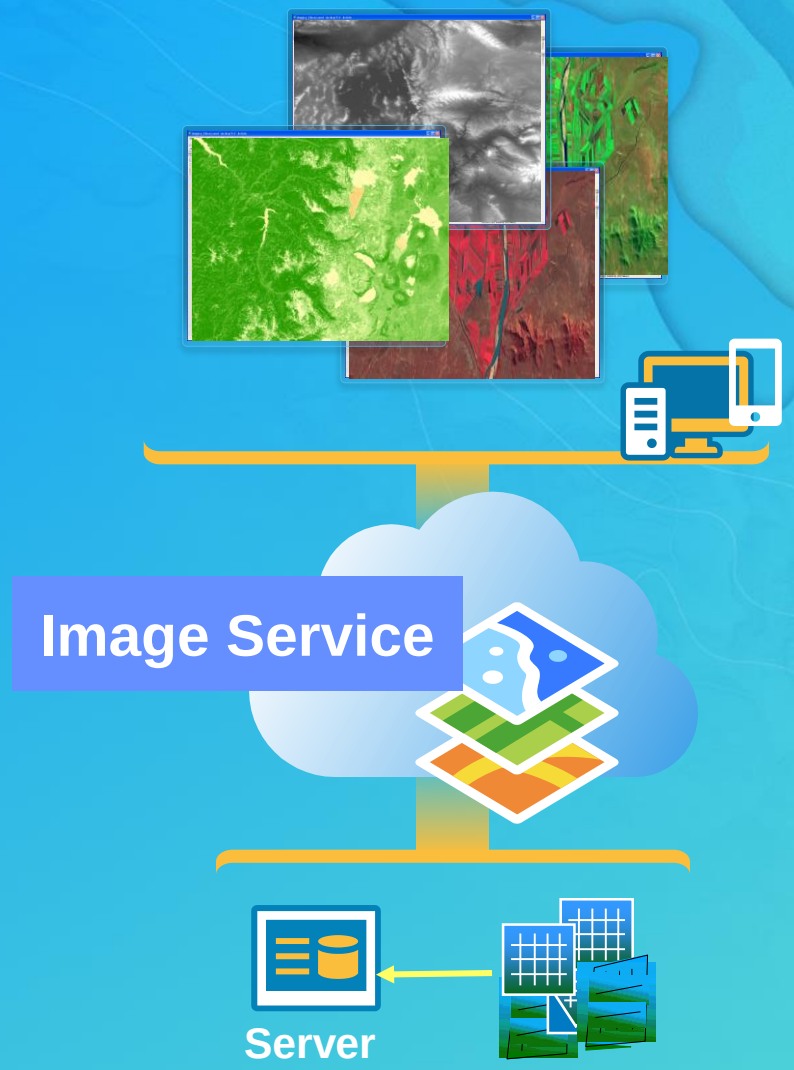
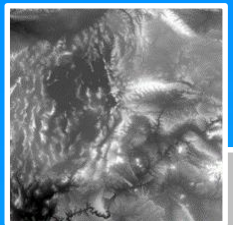


Image Services

- **Data:**
  - shared through ArcGIS Server
  - accessed by any device that supports connecting to a web service
  - Single image or a collection of images
- **Visualization:**
  - Fast dynamic display
- **Processing**
  - Well-known server-side raster functions
  - Register raster models with image service
  - Client-side processing



ImageServices



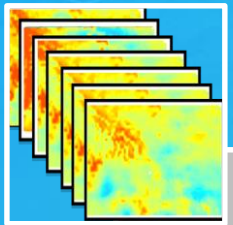
Raster Dataset

- Format
- Interpolation
- Rendering Rule

- GetRasterAttributeTable
- GetKeyProperties

Mosaic Dataset (MD)

- +
- MosaicRule
- QueryVisibleRasters



MultiDimensional MD

- +
- MultiDimensional Info
- Dimensional Definition

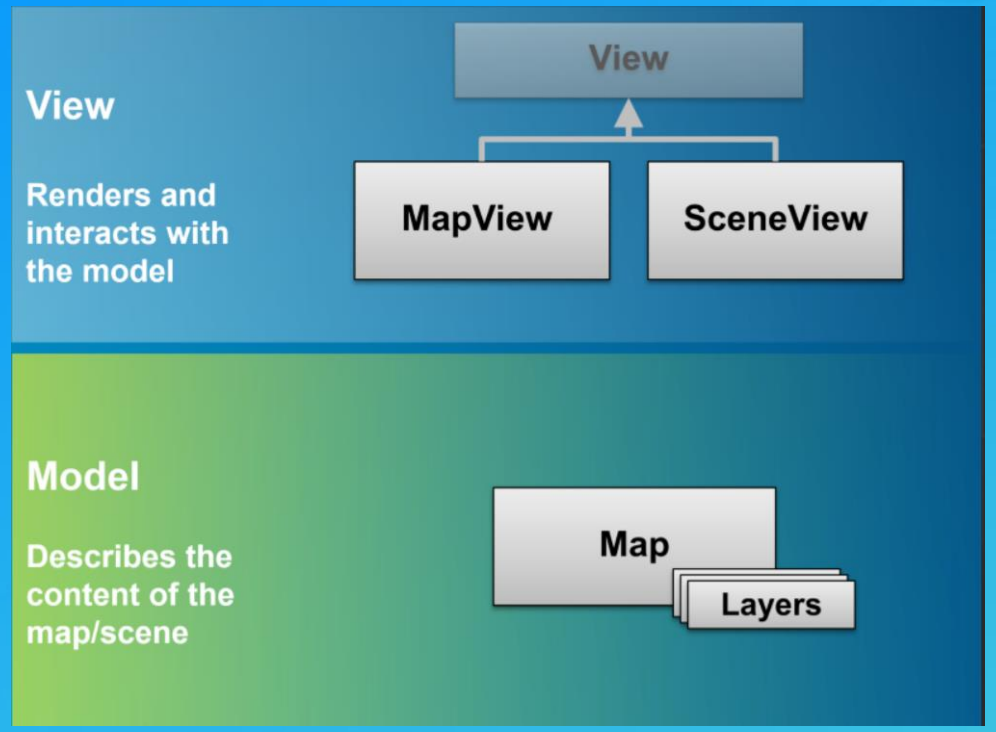
ArcGIS API for JavaScript

4.x

Overview

- Brand new API to visualize 2D and 3D
- New architecture
- New development pattern for widgets
- New Portal API to provide better integration with WebMap
- AMD only
- Modern browser support: IE11+

Map and View architecture



ImageryLayer

- Renders image data
- Retrieves data as pixels
- Supports LERC, BIL, BSQ, JPG, PNG formats
- View Popups
- Query
- Load webmap
- Apply client side processing using PixelFilters
- Define server side processing using raster functions
- Multi-dimensional API
- Supports 2D & 3D visualization

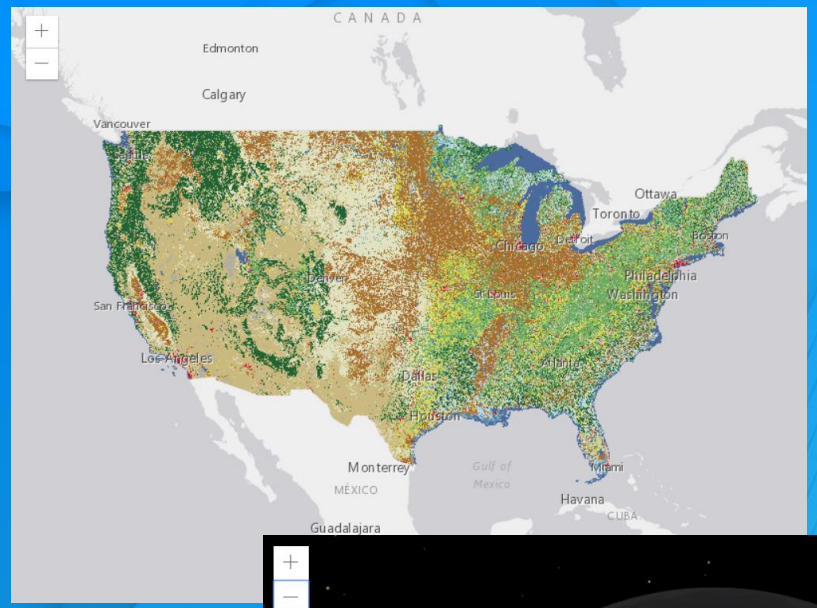
ImageryLayer

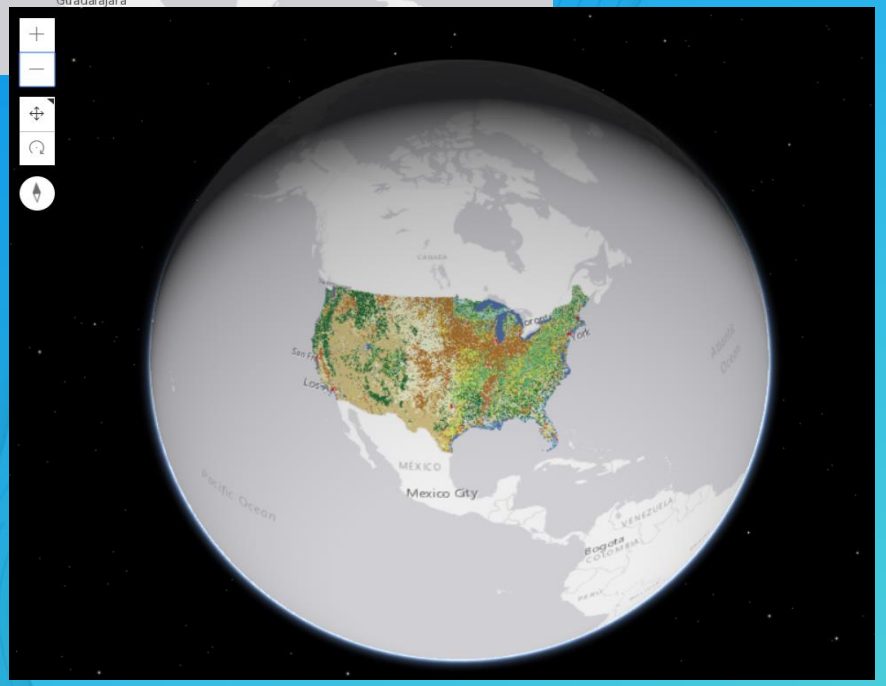
esri/layers/ImageryLayer

```
var layer = new ImageryLayer({
  url: "https://myServer.arcgisonline.com/arcgis/rest/services/NLCDLandCover/ImageServer"
});

/*************************
 * Add image layer to map
 ************************/

var map = new Map({
  basemap: "gray",
  layers: [layer]
});

var view = new MapView({
  container: "viewDiv",
  map: map,
  center: [-100, 40],
  zoom: 5
});
```

ImageryLayer

- visible
- format
- CompressionQuality
- interpolation
- mosaicRule
- renderingRule
- pixelFilter





Imagery layer in 2D and 3D

ImageryLayer: Display

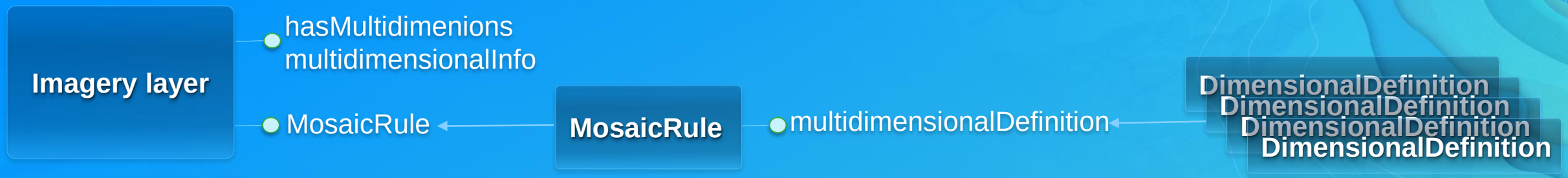
MosaicRule defines how overlapping images are mosaicked together [esri/layers/support/MosaicRule]

- Selection using the where clause
- Method: none | center | nadir | viewpoint | attribute | lock-raster | northwest | seamline
- Sort using sort field and value

```
// Define the way overlapping images are mosaicked together
var mosaicRule = new MosaicRule({
  ascending: true,
  method: "center",
  operation: "last"
});
```

ImageryLayer: **Multidimensional Data**

Filters data based on slices or ranges in one or more dimensions [esri/layers/support/DimensionalDefinition]



- Variables can be temperature, humidity or wind speed
- Dimensions can be time and depth

```
var dimInfo = []; // Define dimensional definition as array
// DEPTH: show only temperatures at sea surface
dimInfo.push(new DimensionalDefinition({
  variableName: "water_temp",
  dimensionName: "StdZ", // Water depth
  values: [0], // Sea surface or 0ft
  isSlice: true
}));
// TIME: only show temperatures for the week of April 7, 2014
dimInfo.push(new DimensionalDefinition({
  variableName: "water_temp",
  dimensionName: "StdTime", // time temp was recorded
  values: [1396828800000], // Week of April 7, 2014
  isSlice: true
}));

var mr = new MosaicRule({
  multidimensionalDefinition: dimInfo
});
```

ImageryLayer: Processing

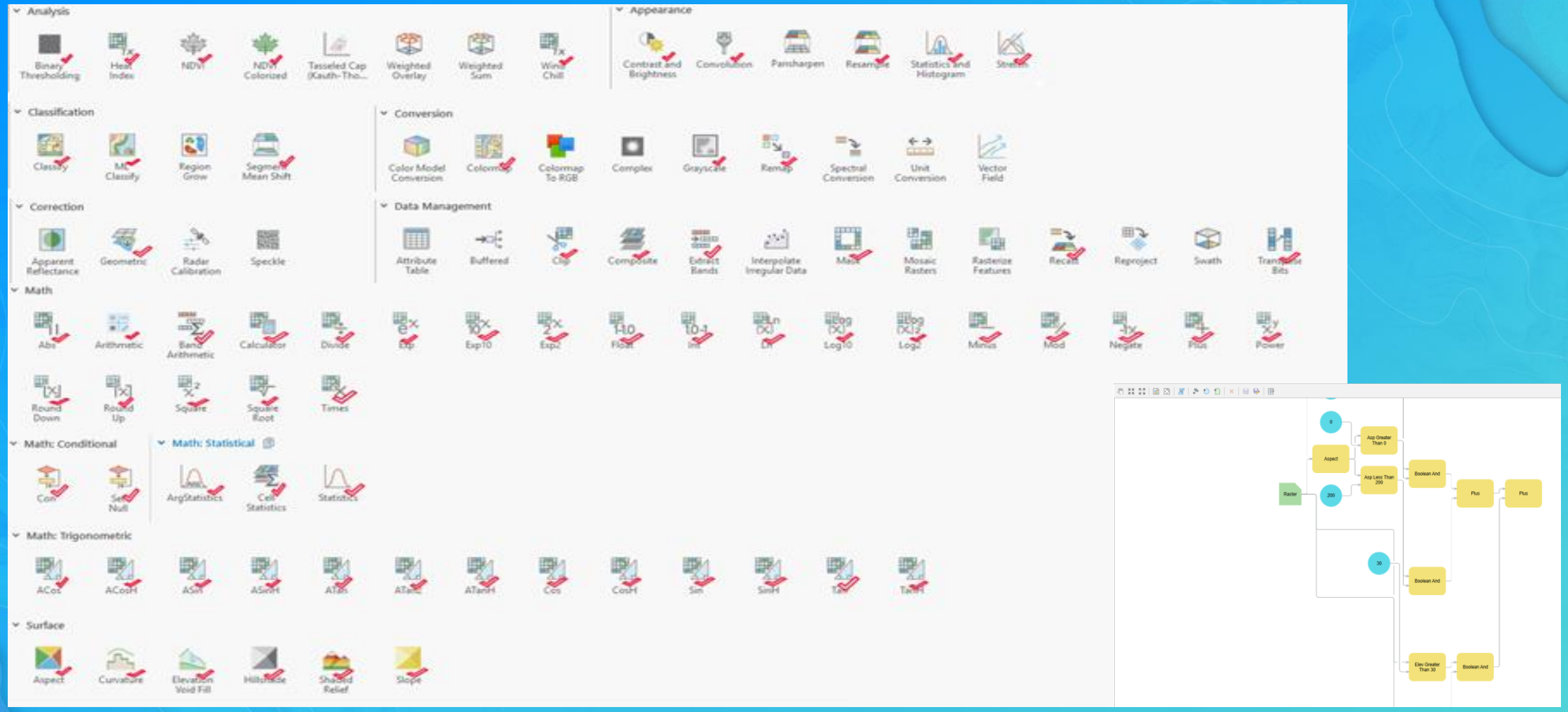
RenderingRule defines how an image should be processed [esri/layers/support/RasterFunction]

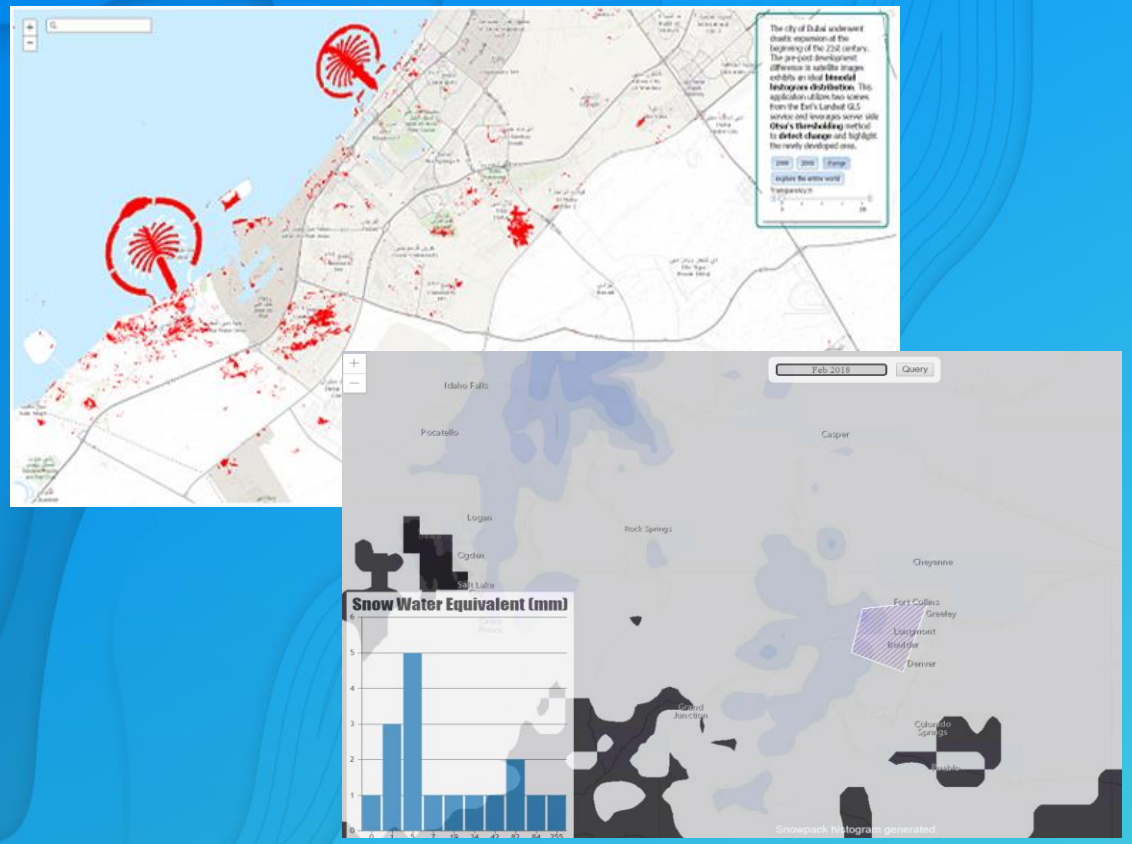
- **Defines how the image is rendered**
- **Single function or a chain of functions**

```
// Defines a Remap raster function. Remap reclassifies pixel
// values to new values. In this case we want to separate
// two landcover types: forested areas and non-forested areas

var remapRF = new RasterFunction({
  functionName: "Remap",
  functionArguments: {
    inputRanges: [0, 41, 41, 44, 44, 255],
    outputValues: [1, 2, 1],
    // $$(default) refers to the entire image service,
    // $id refers to a specific image in the image service
    raster: "$$"
  }
});

var layer = new ImageryLayer({
  url: "https://sampleserver6.arcgisonline.com/arcgis/rest/services/NLCDLandCover2001
    /ImageServer",
  // apply the defined raster function
  renderingRule: remapRF
});
```

ImageryLayer: Processing

RenderingRule defines how an image should be processed [esri/layers/support/RasterFunction]





Change detection and histogram using raster functions

ImageryLayer: Processing

PixelFilter manipulates pixels of an image for display or analytics

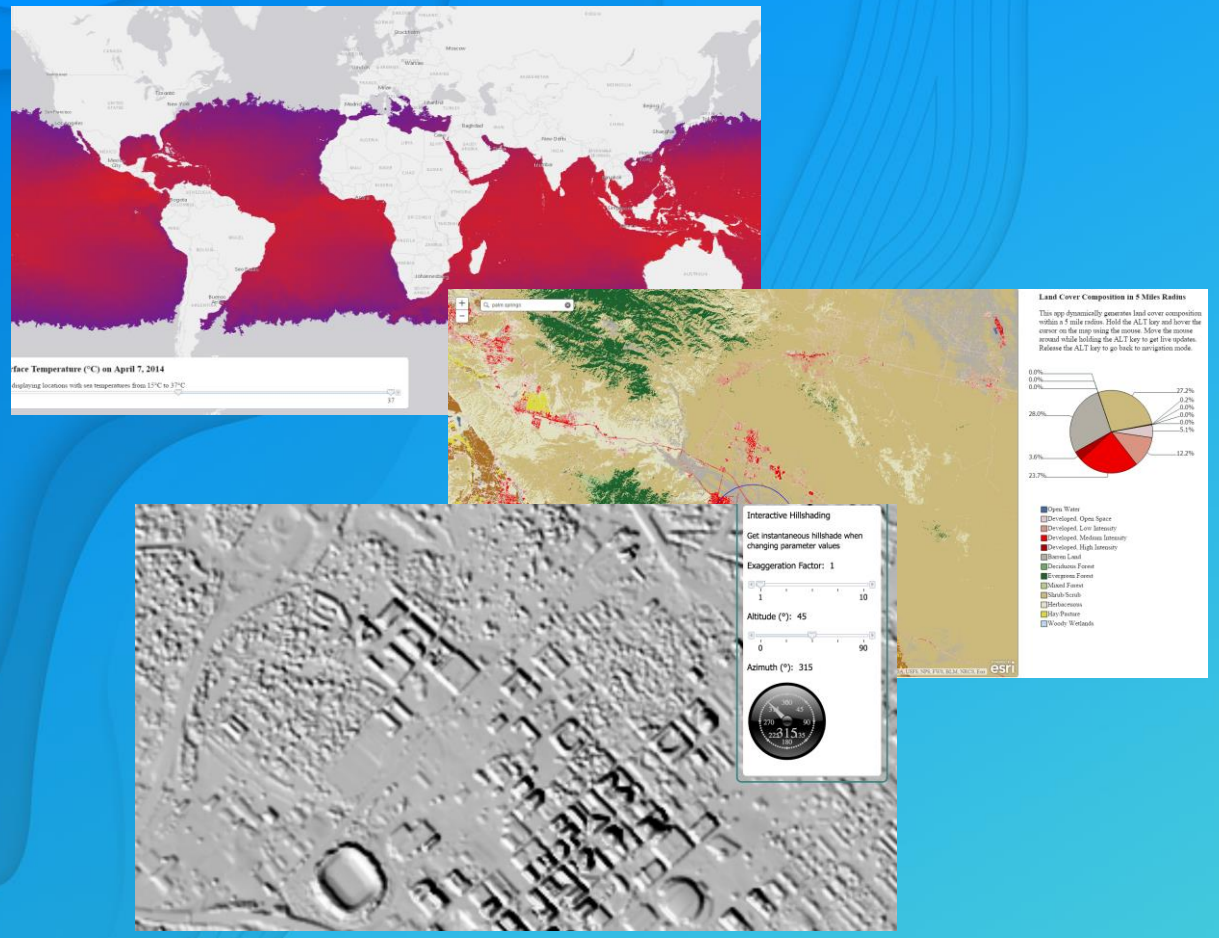
- Process on the client-side
- Defined using the pixelFilter property of ImageryLayer

```
function maskPixels(pixelData) {

  if (pixelData === null || pixelData.pixelBlock === null ||
    pixelData.pixelBlock.pixels === null) {
    return;
  }

  // The pixelBlock stores the values of all pixels visible in the view
  var pixelBlock = pixelData.pixelBlock;
  var pixels = pixelBlock.pixels;
  var band1 = pixels[0];

  // The mask is an array that determines which pixels are visible to the client
  var mask = pixelBlock.mask;
  var numPixels = pixelBlock.width * pixelBlock.height;

  for (var i = 0; i < numPixels; i++) {
     mask[i] = (band1[i] >= Math.floor(currentMin) &&
      band1[i] <= Math.floor(currentMax)) ? 1 : 0;
   }
}

var layer = new ImageryLayer({
  url: url,
  pixelFilter: maskPixels,
});
```

ImageryLayer: PixelBlock

Represents pixels in the view: esri/layers/support/PixelBlock

- Used for accessing pixels
- Decodes the returned data
- Supports LERC, JPG, PNG, BIL, BSQ format
    - Width: number of columns
    - Height: number of rows
    - Pixels: two dimensional array
    - PixelType: s8 | s16 | s32 | u8 | u16 | u32 | f32 | f64
    - Mask: array of 0 or 1
    - Statistics: array of objects containing the min and max values



Pixel Filter Pie-Chart

ArcGIS API for JavaScript

3.x

Imagery Layers

JS API 3.x

Raster

- Renders image data
- Retrieves data as pixels (PNG, JPEG, TIFF, LERC etc.)
- Processing using raster functions
- Processing using pixel filters

…

ArcGISImageService

- Renders image data
- Retrieves data as an image (PNG, JPEG, TIFF, etc.)
- Processing using raster functions

…

ArcGISImageServiceVector

- Renders vector data
- Retrieves data as pixels
- Supports scientific data
- Define Symbology

…

WCS

- Renders raster data using OGC WCS specs
- Processing using client side filters

ArcGISImageServiceLayer and RasterLayer

- **Render raster data**
- **Supports:**

  format, compression, mosaicRule, renderinRule, raster functions, multidimensional API

- **Only Raster layer supports pixelFilters**
- **Define renderers using *setRenderer()*:**

  Unique Value, class breaks, stretch

```
// Add five breaks to the renderer.
// If you have ESRI's ArcMap available, this can be a good way to determine break values.
// You can also copy the RGB values from the color schemes ArcMap applies, or use colors
// from a site like www.colorbrewer.org
//
// alternatively, ArcGIS Server's generate renderer task could be used
var renderer = new ClassBreaksRenderer(symbol, "POP07_SQMI");
renderer.addBreak(0, 25, new SimpleFillSymbol().setColor(new Color([56, 168, 0, 0.5])));
renderer.addBreak(25, 75, new SimpleFillSymbol().setColor(new Color([139, 209, 0, 0.5])));
renderer.addBreak(75, 175, new SimpleFillSymbol().setColor(new Color([255, 255, 0, 0.5])));
renderer.addBreak(175, 400, new SimpleFillSymbol().setColor(new Color([255, 128, 0, 0.5])));
renderer.addBreak(400, Infinity, new SimpleFillSymbol().setColor(new Color([255, 0, 0, 0.5])));
```

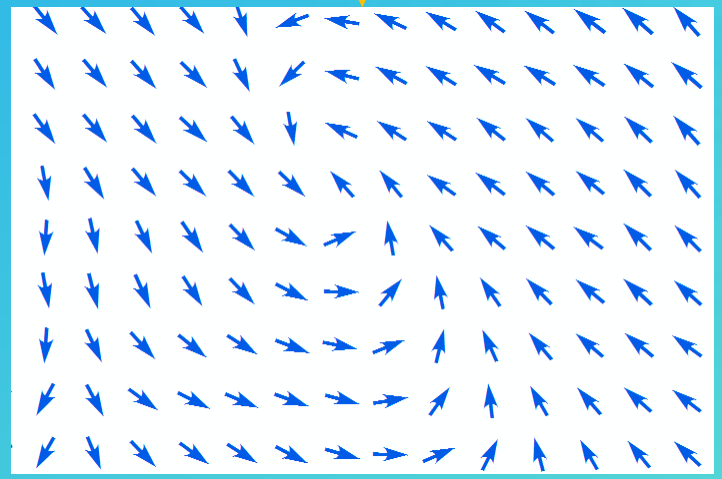
ArcGISImageServiceVectorLayer: Symbology

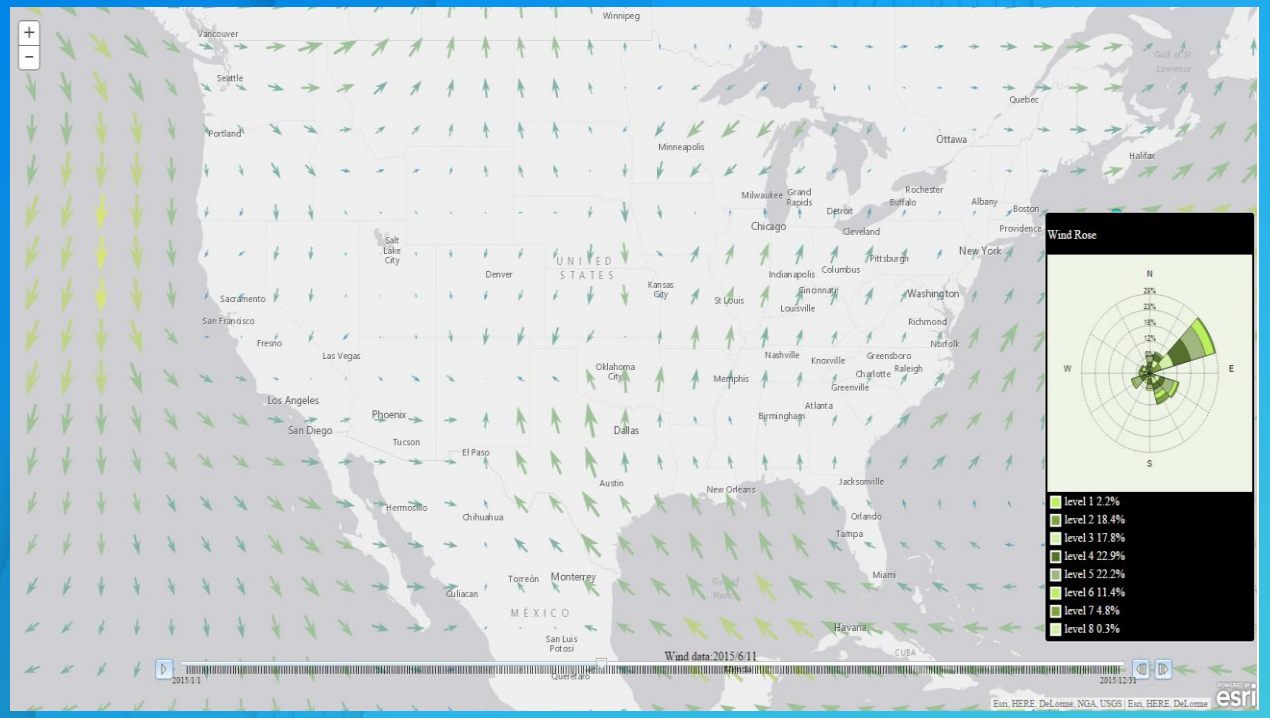
- **Visualize wind, Ocean current**
- **Draws raster data as vectors using the VectorFieldRenderer:**

  Single Arrow, Simple Scalar. Wind Barbs, Beaufort Wind, Ocean Current

- **Default pixelFilter for conversion of U-V to Magnitude-Direction**

```
Var layer = new ArcGISImageServiceVectorLayer(url,
    {
      imageServiceParameters: params,
      symbolTileSize: 60,
      rendererStyle: "single_arrow"
    });
```





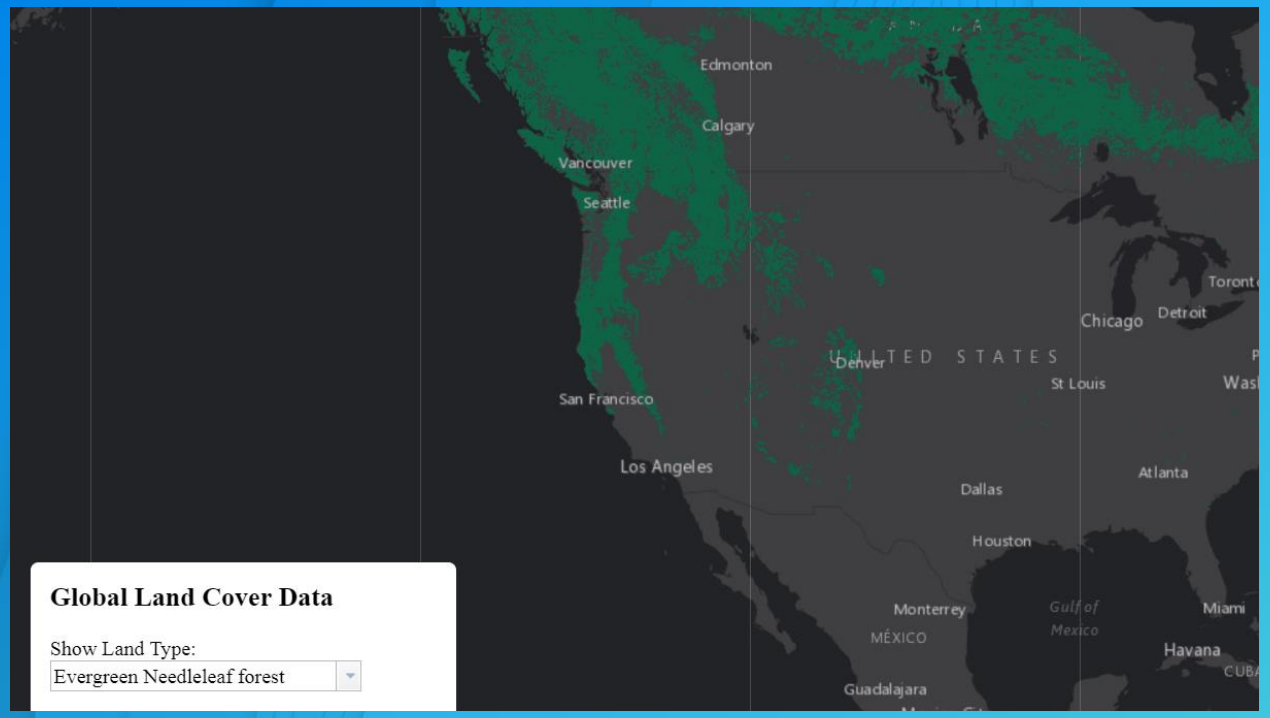
Vector Field Data

WCS Layer

provides access to coverage data in forms that are useful for client-side rendering, as input into scientific models, and for other clients

- Enable Web Coverage Service on image services
- Get server info: coverages, formats, interpolations, versions, etc.
- Support for identify
- Client side pixel filters too!
- Fully documented SDK

```
var wcsUrl = "//sampleserver6.arcgisonline.com/arcgis/services/ScientificData/MODIS_Landcover/ImageServer/WCSServer";
var wcsLayer = new WCSLayer(wcsUrl, {
  version: "1.0.0",
  pixelFilter: colorizer }
);
```



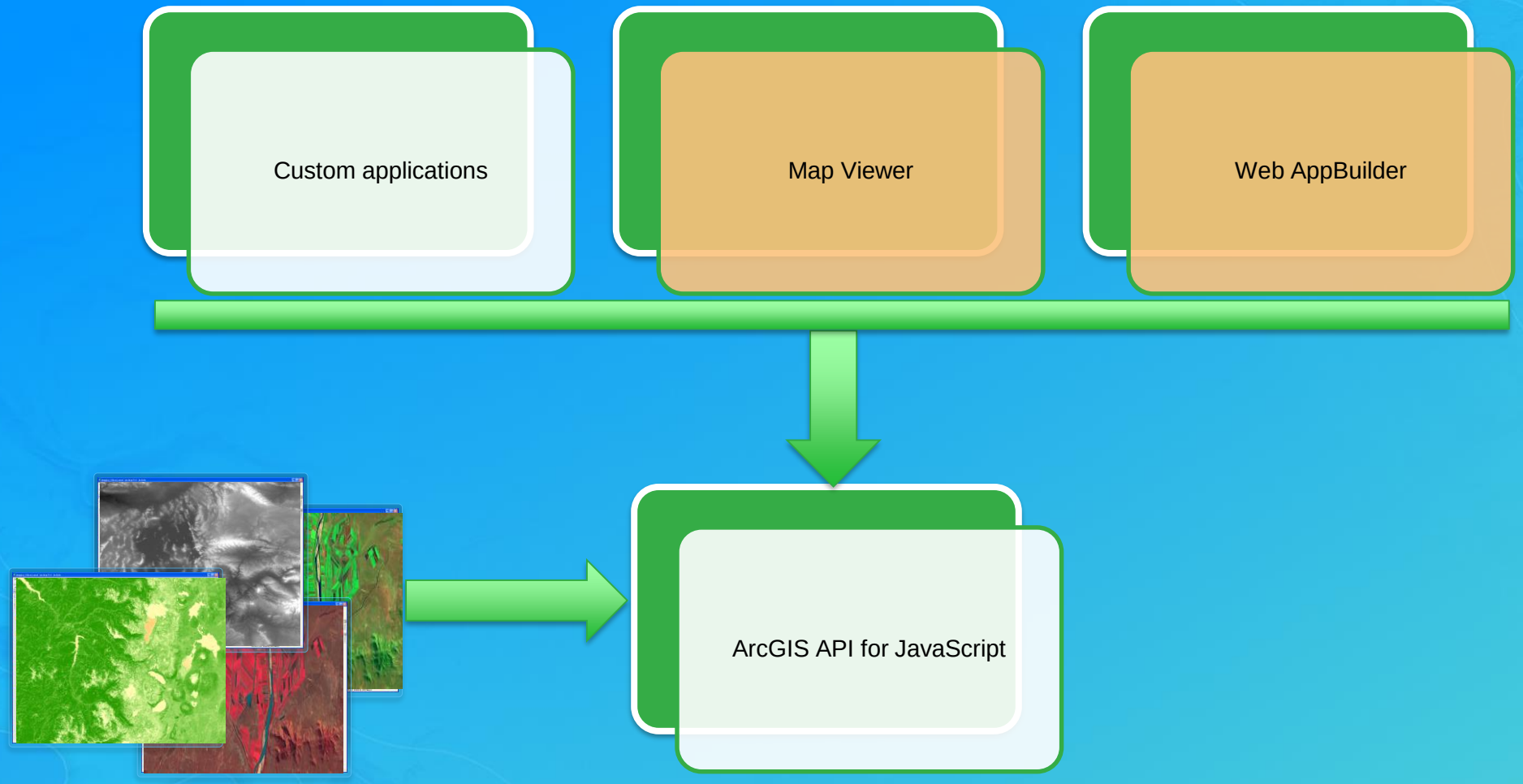
Global Land Cover Data

Documentation Resources

- **ArcGIS API for JavaScript:**
  https://developers.arcgis.com/javascript/3/

- **ArcGIS API for JavaScript 4.x**
  https://developers.arcgis.com/javascript

What are we talking about today…



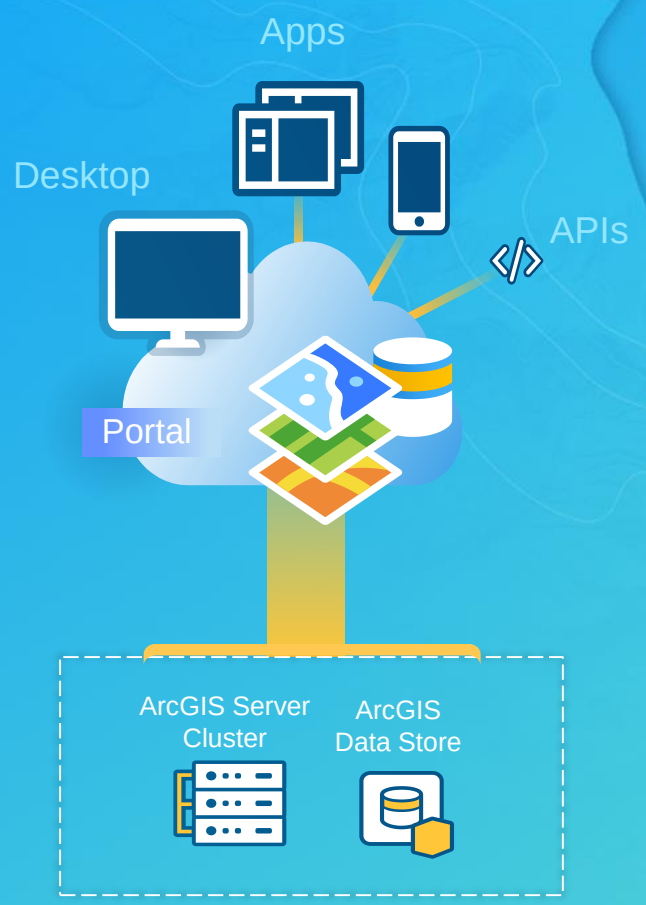
ArcGIS Enterprise Map Viewer

Map Viewer capabilities

- Symbology
  - Stretch, Classify and Unique Value renderers
  - Leverages the rendering capability added in the ArcGIS API for JavaScript 3.x
  - Through the image display pane
- Image Processing
  - Dynamic processing (on the fly): Server processing templates
  - Persisted output: Raster Analysis (Enterprise only)

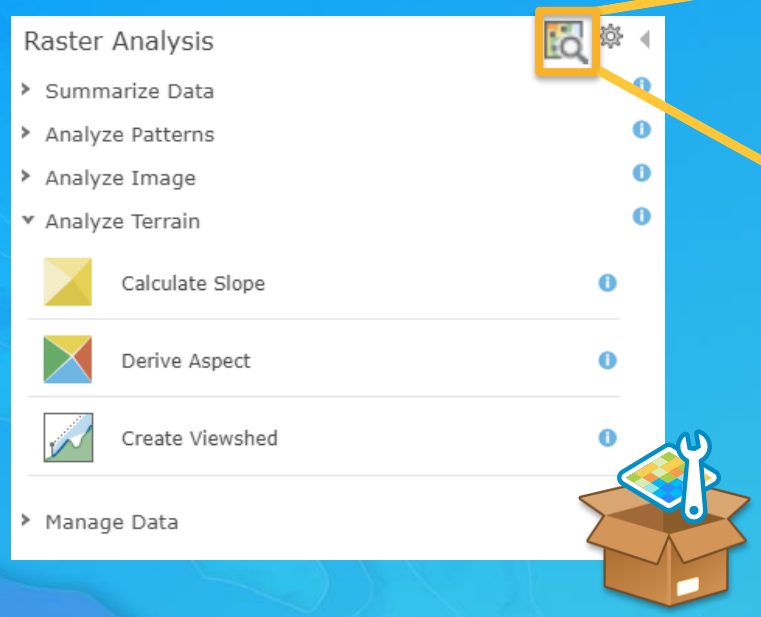
Raster Analysis

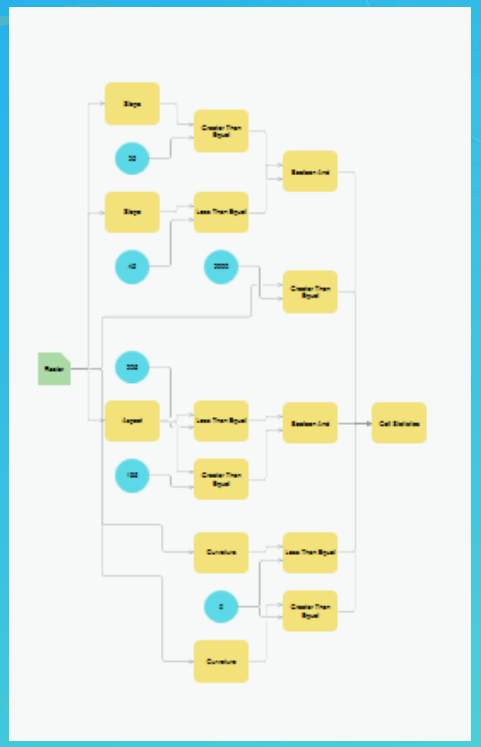
- Quickly extract information using spatial analysis and raster models by leveraging distributed processing and storage
- Optimized raster format: CRF (Cloud Raster Format)
  - Multi-band, block based, multiple readers and writers, fast
- Can be accessed by different clients (Pro and Map viewer) and have a REST API to access services
- Once finished, results immediately available in your Web GIS

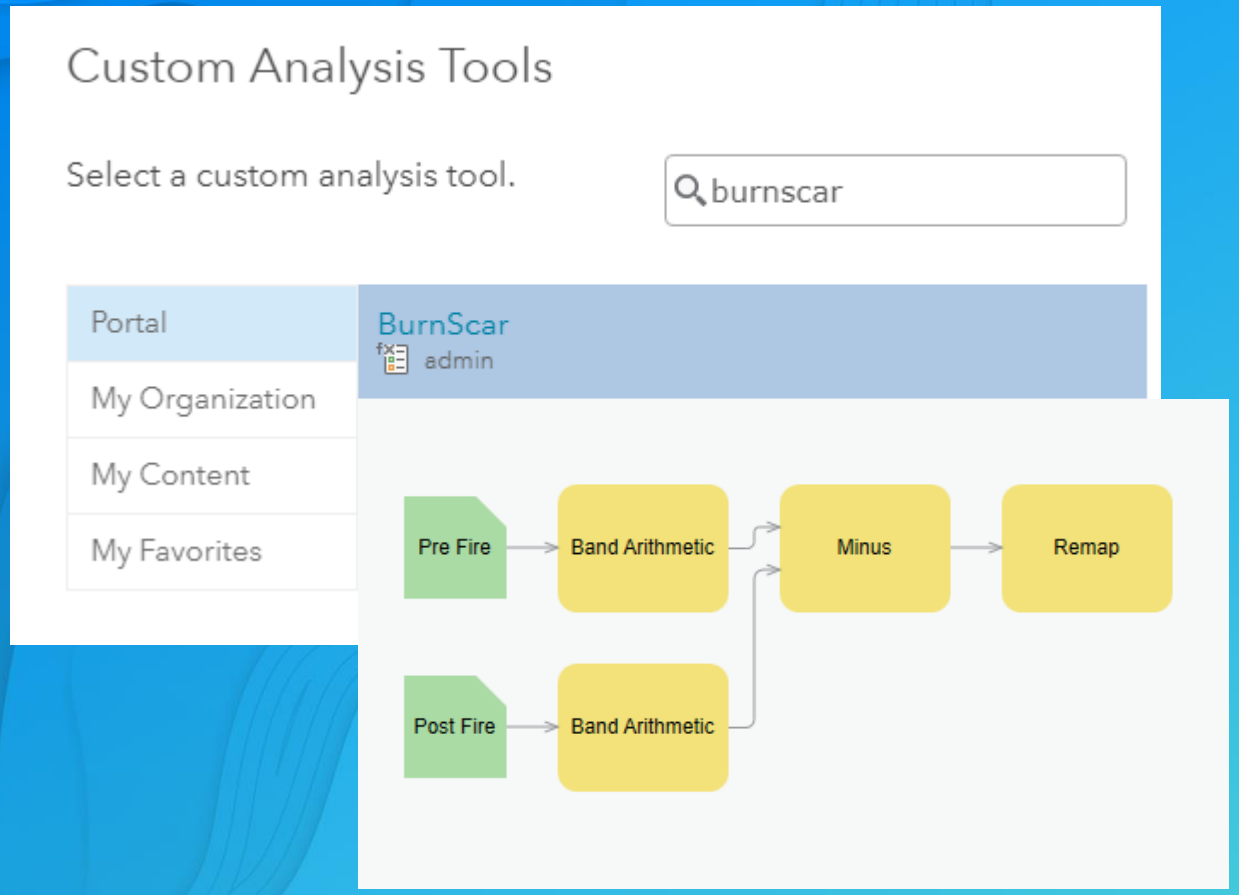


Raster Analysis using ArcGIS Enterprise map viewer

- 11 out of the box tools added in 10.5
- Ability to share and apply custom processing models(RFT) added in 10.6
- Build and edit custom templates, later this year







Custom Analysis Tools

Added at 10.6

Upcoming: Raster Function Editor in Map Viewer

- View, build and edit raster function templates in Portal.
- Save and share new or updated templates.
- Run it as an analysis operation to produce a persisted output.
- Scheduled for release later this year.

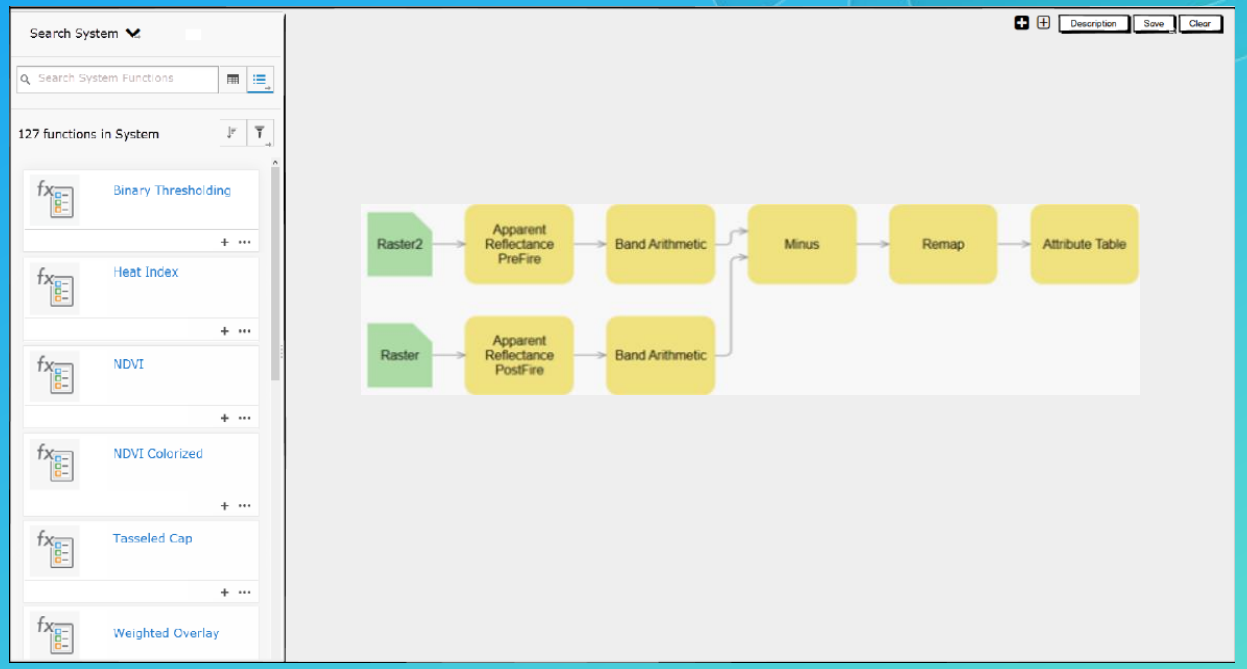
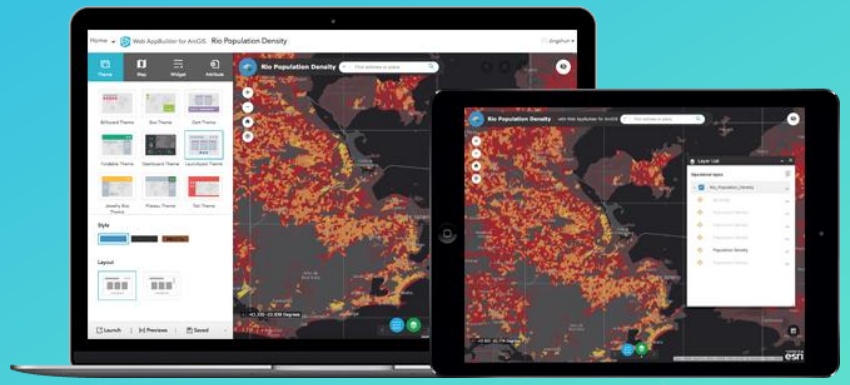


Image Services in

Web AppBuilder for ArcGIS

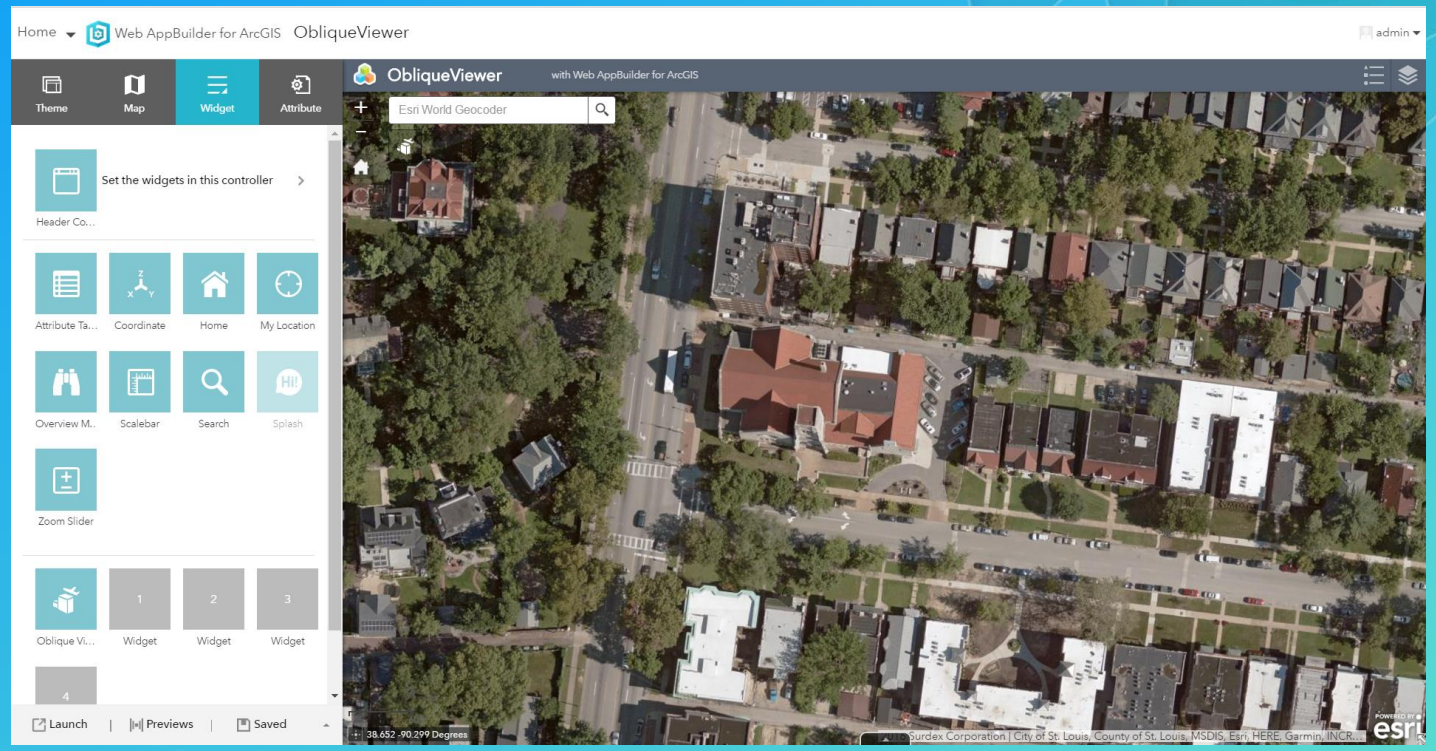
Web AppBuilder for ArcGIS

- Quickly author customized apps, no coding required
- Fully integrated with the ArcGIS platform
- Extensible framework with the developer edition
- Built using the ArcGIS API for JavaScript
- Runs in a browser on tablets, smartphones or desktops



Imagery support in Web AppBuilder for ArcGIS

- Layer List
- Legend
- Query
- Attribute Table
- Popups
- Image Measurement*
- Oblique viewer*

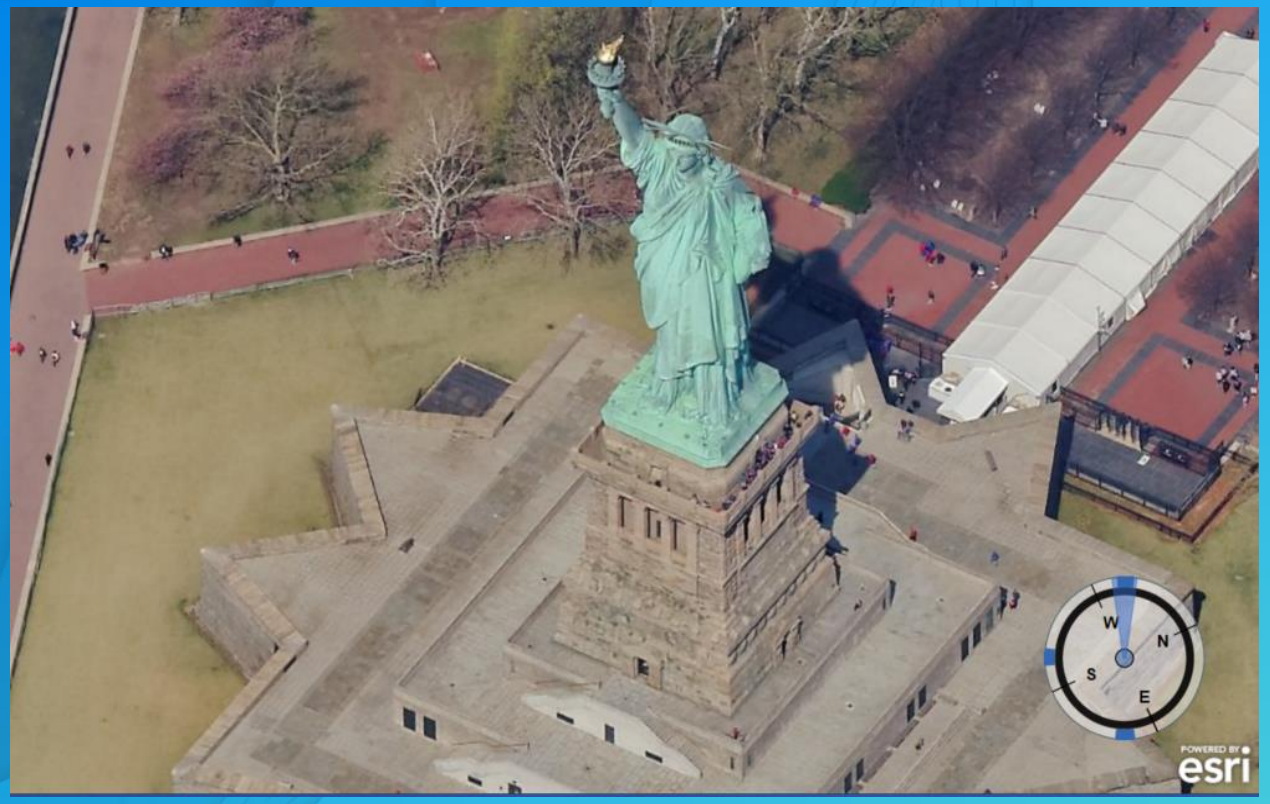


*** Specifically designed to work with image services**

Oblique Viewer

- Displays oblique images without distortion
- Provides a natural view from the camera location
- View features from different perspectives
- Available through the ArcGIS API for JavaScript 3.x and as a Web AppBuilder widget

```
oblique = new ObliqueViewer({
  map: map,
  imageServiceLayer: imageServiceLayer,
  rotationDiv: document.getElementById("obliqueRotationDiv")
});
```

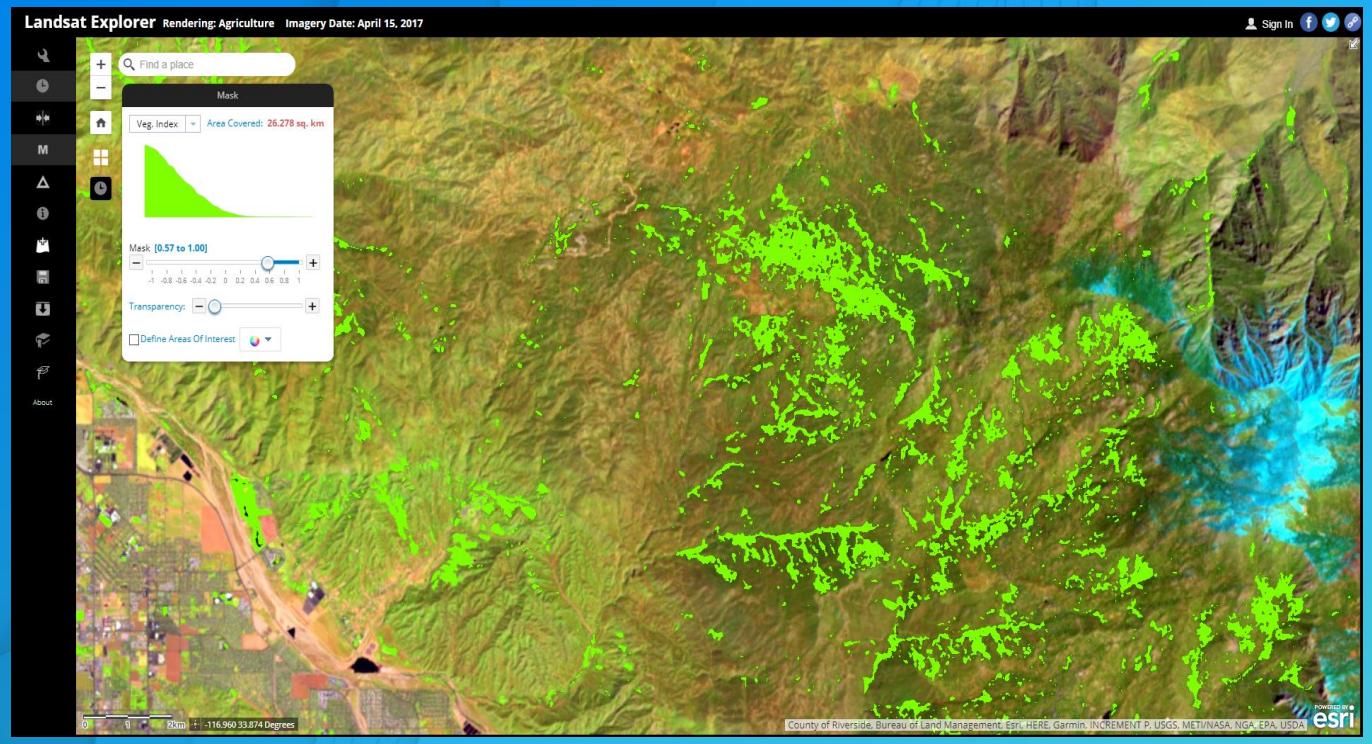


Oblique Viewer

Web AppBuilder

ArcGIS API for JavaScript

http://esriurl.com/ObliqueViewer



Custom Imagery Widgets

http://landsatexplorer.esri.com/

Web AppBuilder widgets for Image Services (WABIS)

Subhead Here

- Widgets specifically designed for imagery workflows.
- Change detection, image selection, mask.
- Process imagery, export and share your results!
- Web AppBuilder widgets
- Imagery Interpretation template (beta)

https://github.com/Esri/WAB-Image-Services-Widgets

Summary

- **ArcGIS API for JavaScript:**
  - **Different layers in 4.x and 3.x for displaying raster data**
  - **How to manipulate display using mosaicRule and renderers**
  - **Server-side and Client-side processing using raster functions and pixel filters**
  - **Display vectors using ArcGISImageServiceVector layer**
  - **Visualize raster data using WCS layer**
- **Map viewer:**
  - **Define symbology and process data using the power of Raster analytics**
- **Web AppBuilder:**
  - **Built-in and custom imagery widgets**

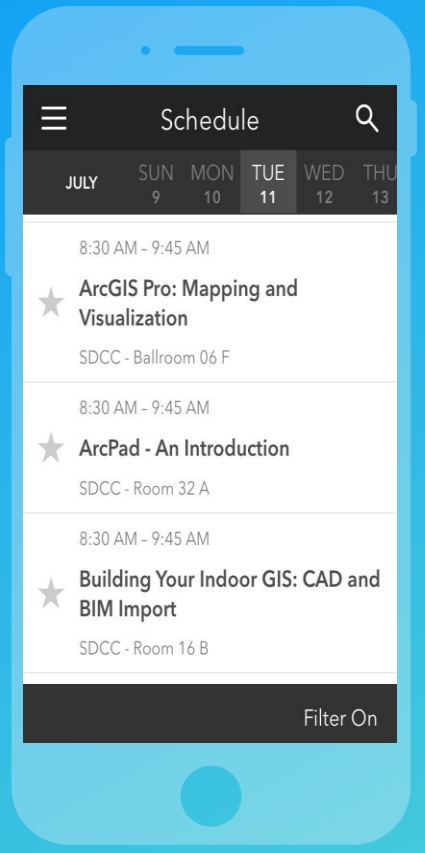
esri

THE SCIENCE OF WHERE

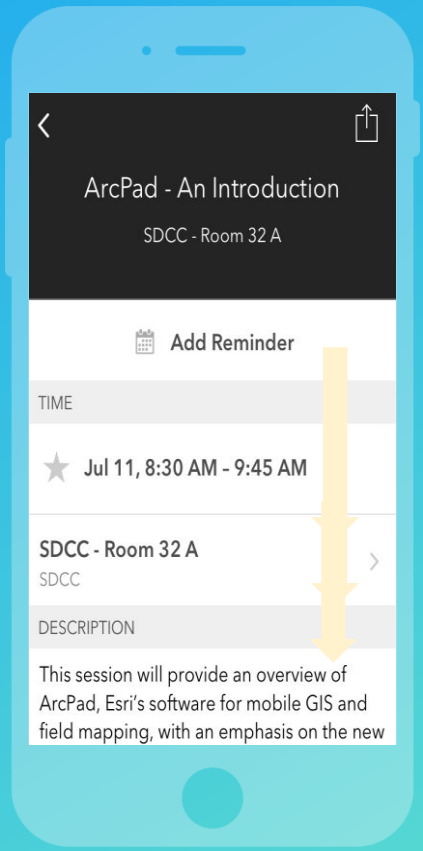
Please Take Our Survey on the **Esri Events App!**

Download the Esri Events app and find your event

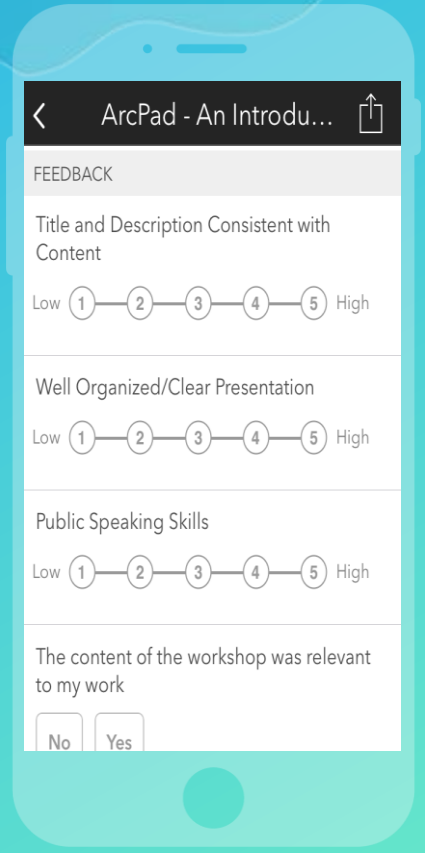
Select the session you attended



Scroll down to find the survey



Complete Answers and Select "Submit"



esri

THE SCIENCE OF WHERE