Imagery in a WebGIS

Wenxue Ju & Naila Khan

What’s in store for today’s session…

- Introduction to ArcGIS Image Services
- Capabilities of Image Services in ArcGIS Online and Portal for ArcGIS
- Imagery support in Web AppBuilder for ArcGIS
- Creating rich applications using ArcGIS API for JavaScript
- All new ArcGIS API for JavaScript 4.0
- Road Ahead
- Summary
- Q&A

Introduction to Image Services

Image Services: Data + Visualization + Analysis

- An image service provides access to raster data through a web service
- Raster data and it's processing capabilities can be shared through ArcGIS Server and Portal
- Can be published with WMS and WCS capabilities

- Supported by many clients
  - Desktop, mobile, Web Clients, REST etc.

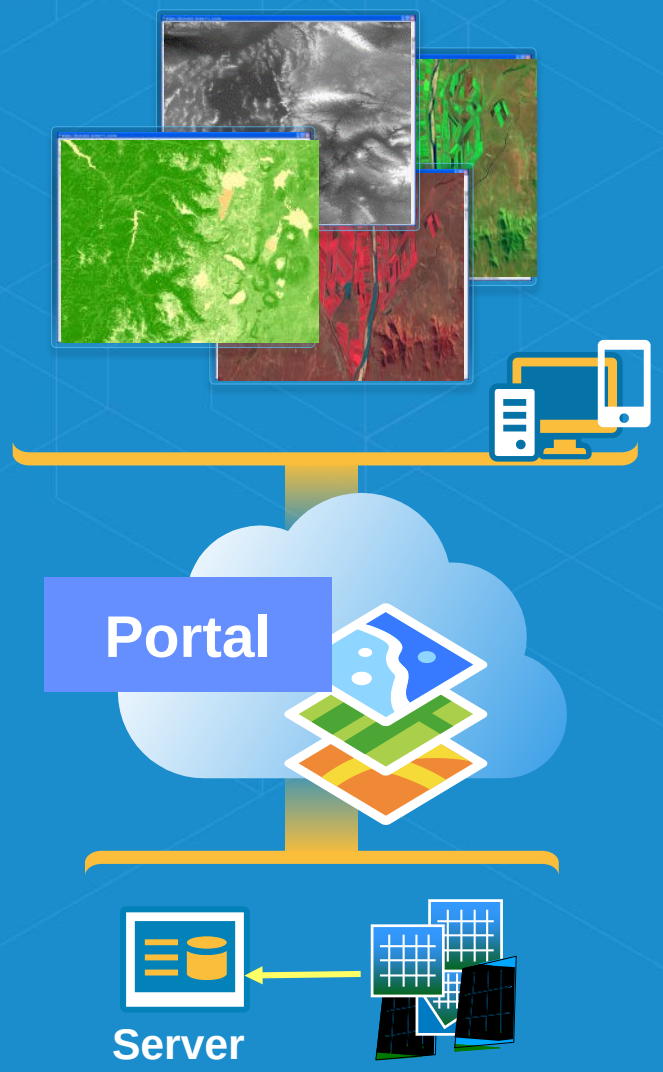
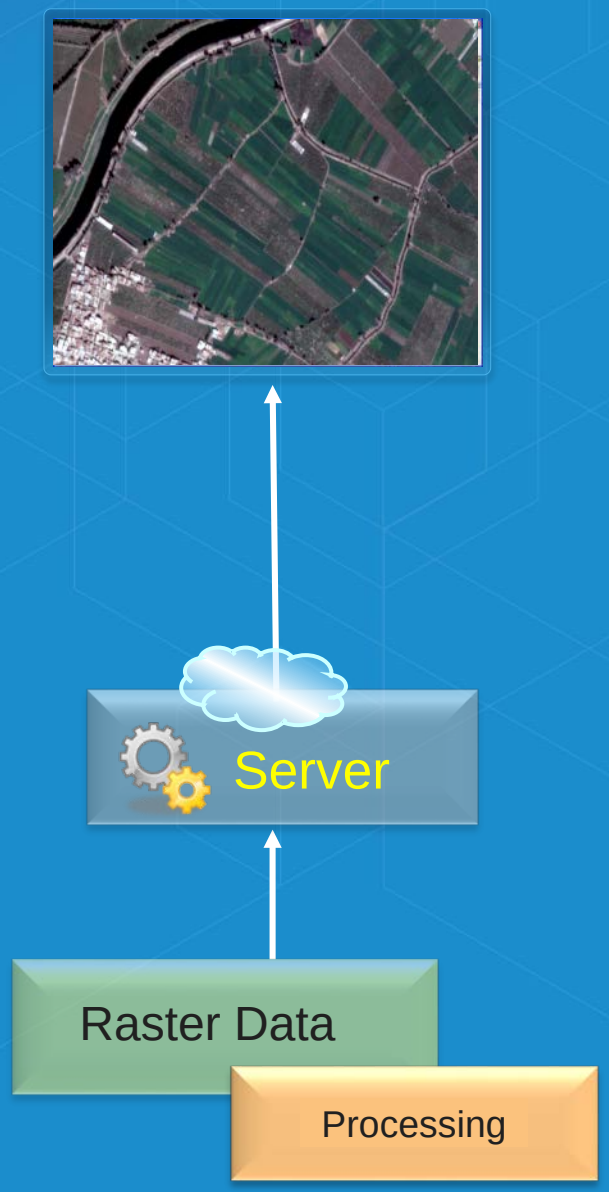


Image services in

ArcGIS Online

Image Service: Capabilities

- Visualization
  - Fast dynamic display
- Image catalog
  - Identify
  - Query
- Processing
  - Well-known server-side raster functions
  - Register raster models with image service
  - Client-side processing



Demo

Imagery capabilities in ArcGIS Online

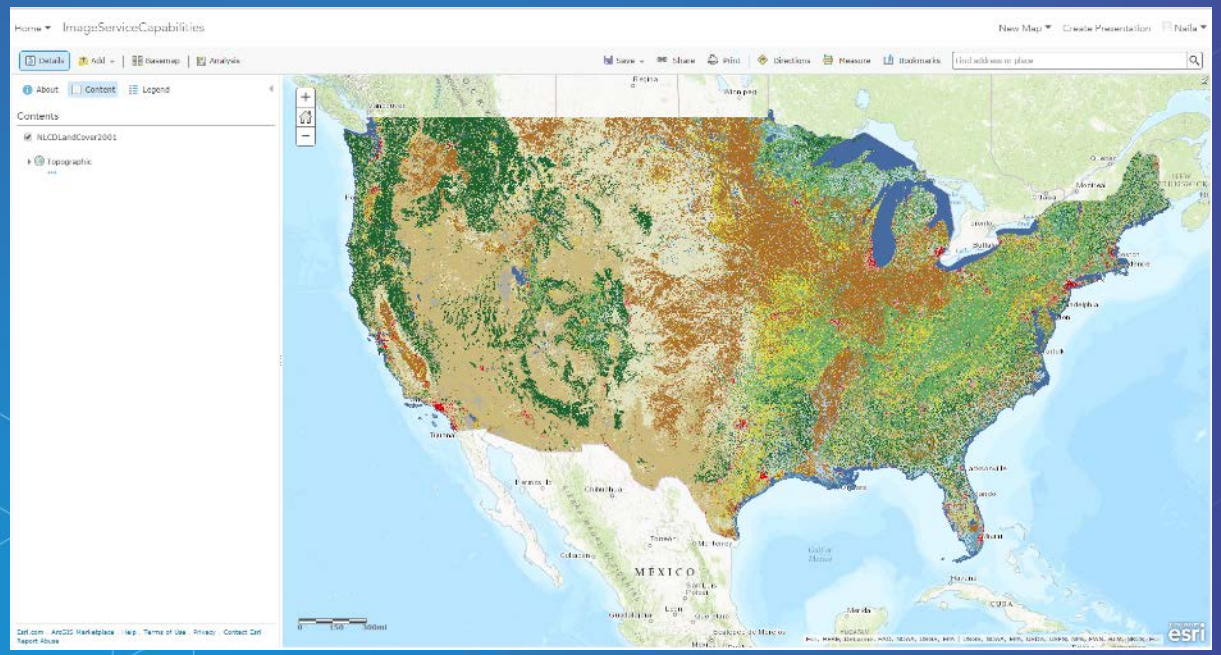


Image services in

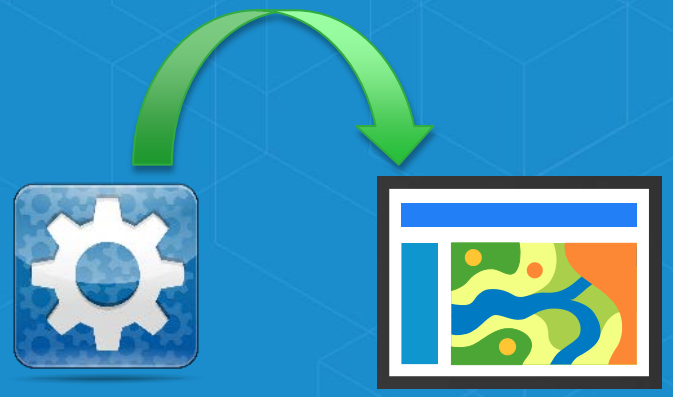
Web AppBuilder for ArcGIS

Web AppBuilder for ArcGIS

- Enables new apps to be created without coding
- Interactive user experience
- Runs on any device; in a web browser
- Built using ArcGIS API for JavaScript and HTML 5 technology
- Extensible
- Fully integrated with the ArcGIS Platform

Web AppBuilder: Available Imagery widgets

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



* Specifically designed to work with image services

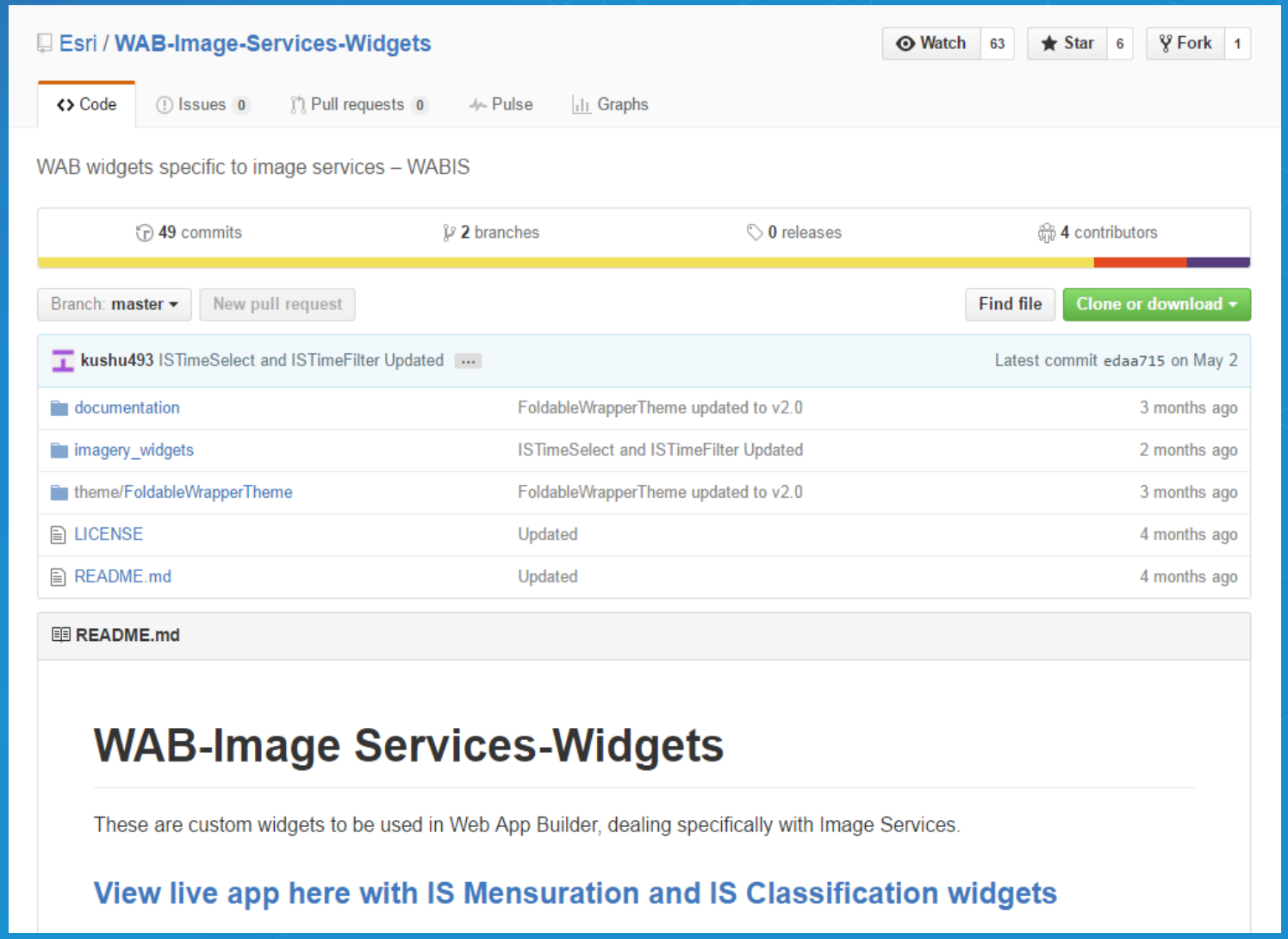
Demo

Application built using Web AppBuilder for ArcGIS

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

- Designed to work specifically with image services
- Live apps
- Download and unzip the file
- Follow instructions in the ‘WEBAPP BUILDER USER DOC.docx’

- Renderer, Time Filter, Swipe, Change Detection, Image Classification and Spectral Profile



Unlock Earth’s Secrets:

http://www.esri.com/landing-pages/software/landsat/unlock-earths-secrets

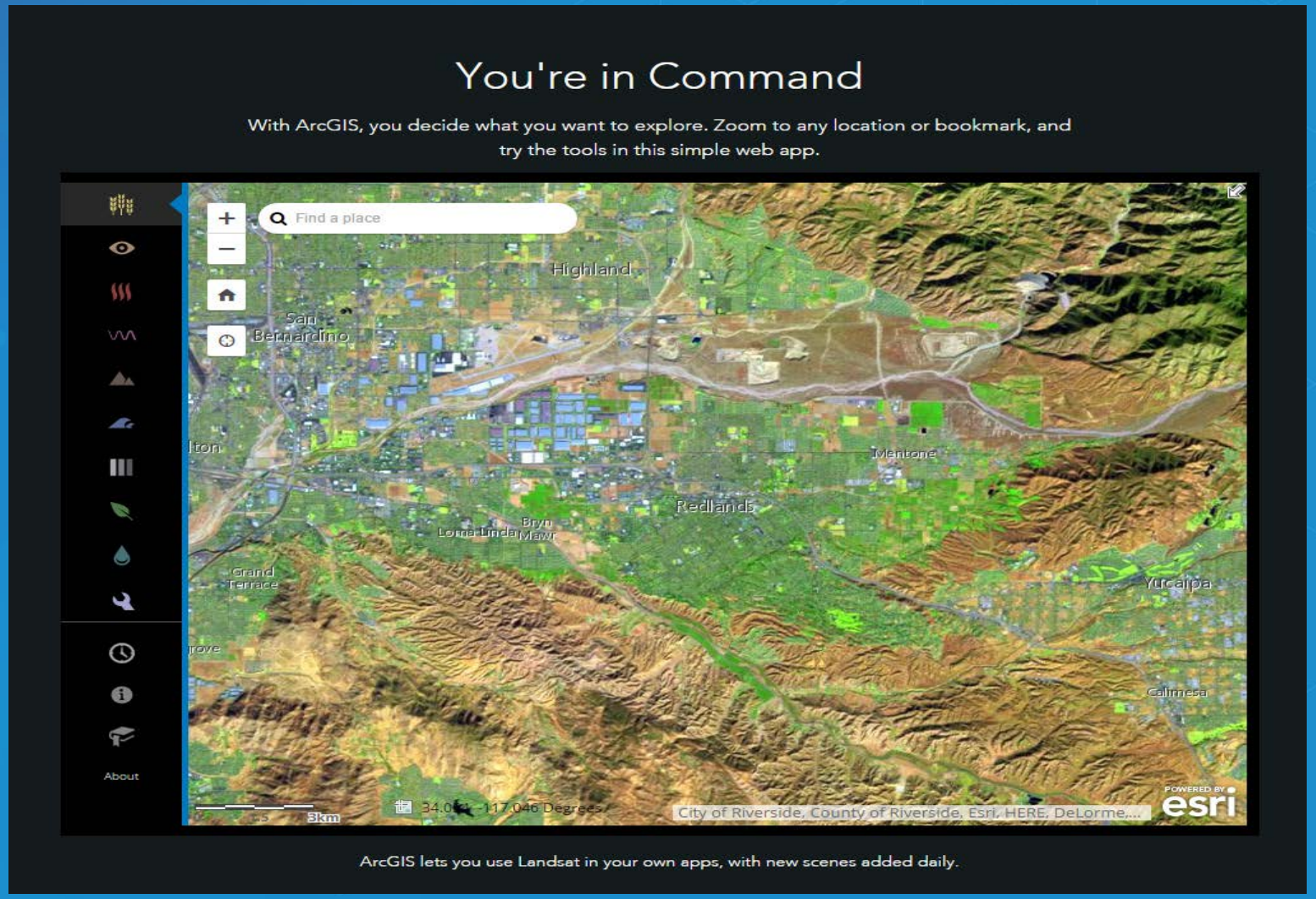


Image services in

ArcGIS API for JavaScript

ArcGIS API for JavaScript: Image Service Layers

*esri/layers/**

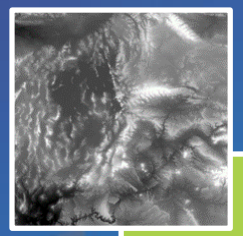
ArcGISTiledMapServiceLayer	Renders image data, retrieves cached image tiles
ArcGISImageServiceLayer	Renders image data, retrieves data as an image (PNG, JPEG, JPGPNG, etc.)
RasterLayer	Renders image data, retrieves data as pixels (PNG, JPEG, TIFF, LERC etc.), support client side pixel filtering
ArcGISImageServiceVectorLayer	Renders image data as vectors, retrieves data as pixels, supports scientific data, define symbology

Image Service Layers: Constructor

```
var imageLayer  = new ArcGISImageServiceLayer(url, options)
                = new RasterLayer(url, options)
                = new ArcGISImageServiceVectorLayer(url, options)
```

- url: http://sampleserver6.arcgisonline.com/arcgis/rest/services/CharlotteLAS/ImageServer
- options:
  - opacity
  - visible
  - useMapTime
  - ImageServiceParameters (format, bandIds, compressionQuality, interpolation, noData, timeExtent)

Image Service Layers: Common Properties and Methods

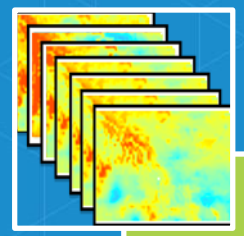


Raster Dataset

- Pixel Size
- Pixel Type
- Rendering Rule
- Raster Attribute Table
- KeyProperties
- Identify

Mosaic Dataset (MD)

- +
- MosaicRule
- VisibleRasters
- Query

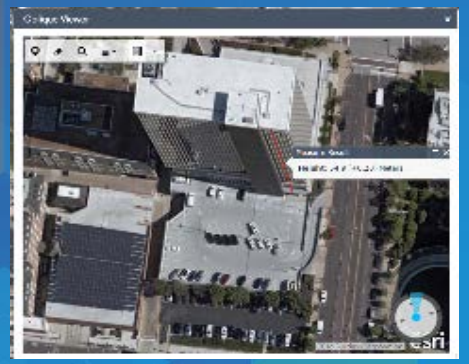


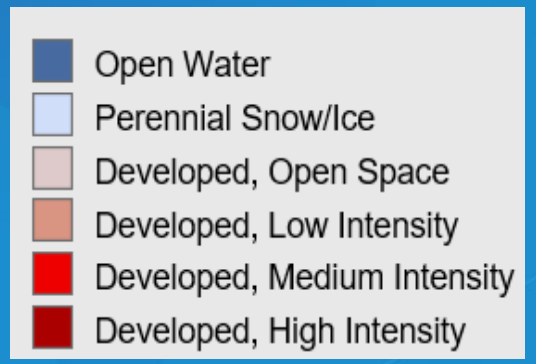
MultiDimensional MD

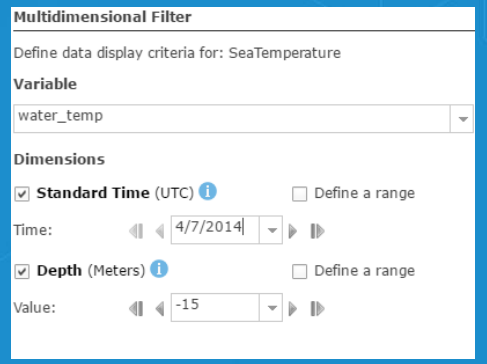
- +
- MultiDimensional Info
- Dimensional Definition

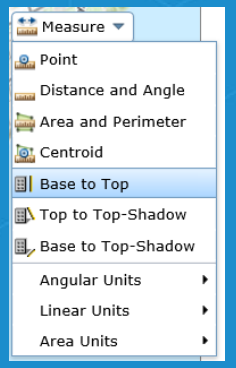
Image Service Layers: Webmap and Widgets

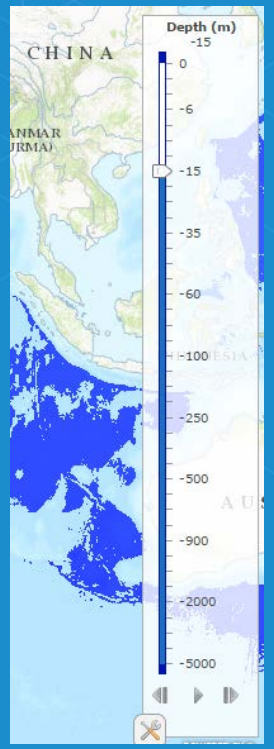
- WebMap: (query definition, display order, server template, popup, etc.)
- Widgets: Legend, Popup, ImageServiceMeasure, ObliqueViewer, MultidimensionalFilter, MultidimensionalSlider, mosaicRule, renderingRule

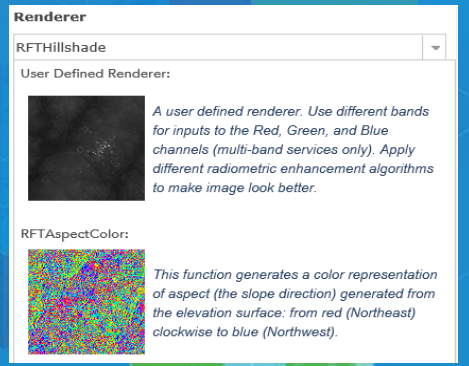


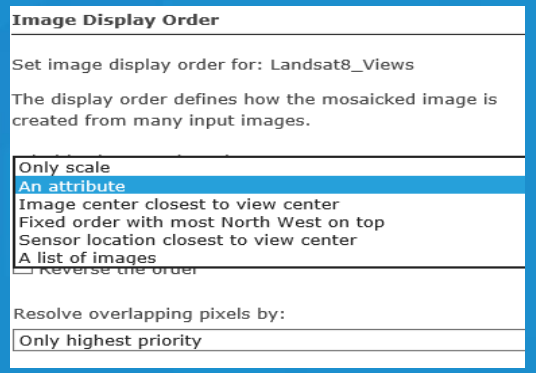


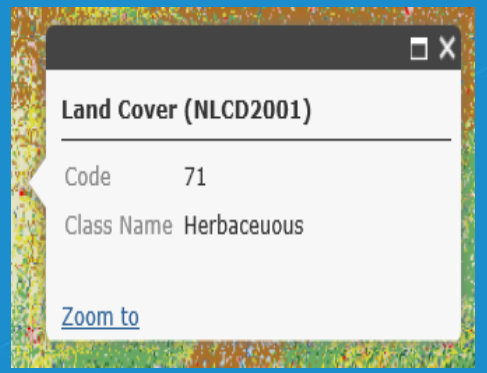












Demo

Custom application built using ArcGIS API for JavaScript

Processing & Visualization: Client Side Pixel Filter

HTML ArcGISImageServiceLayer VS RasterLayer

- IMG:

Can only handle jpeg, png, gif (http url or inline base64)

- ***CANVAS**: <canvas/>*

Puts in RGBA array → data manipulation in JS

ctx.putImageData(imagedata, dx, dy)

- http://www.html5rocks.com/en/tutorials/canvas/imagefilters/

Processing & Visualization: Client Side Pixel Filter

LERC -- Limited Error Raster Compression

- Request raster data from server (10.3+)
- Decode raster data (typed arrays, JS API 3.13+)
- Manipulate pixels
- Put RGBA data to canvas

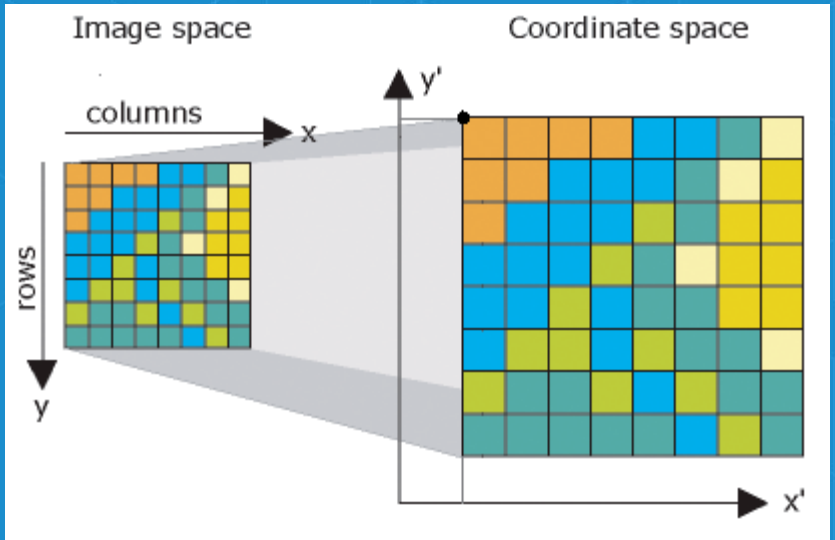
On Github (Apache 2.0 License)

- https://github.com/Esri/lerc
- http://esri.github.io/lerc/js/

Processing & Visualization: Client Side Pixel Filter

PixelBlock (esri/layers/PixelBlock)

```
{
 width: 1200,
 height: 800,
 pixels: [[32.5, 82.9, 25.2, ...], [], [], ...],
 pixelType: "F32",
 statistics: [{minValue:-50.8, maxValue:80.5}, {}, {}, ...],
 mask : [1,0,1,1,0,...]
}
```



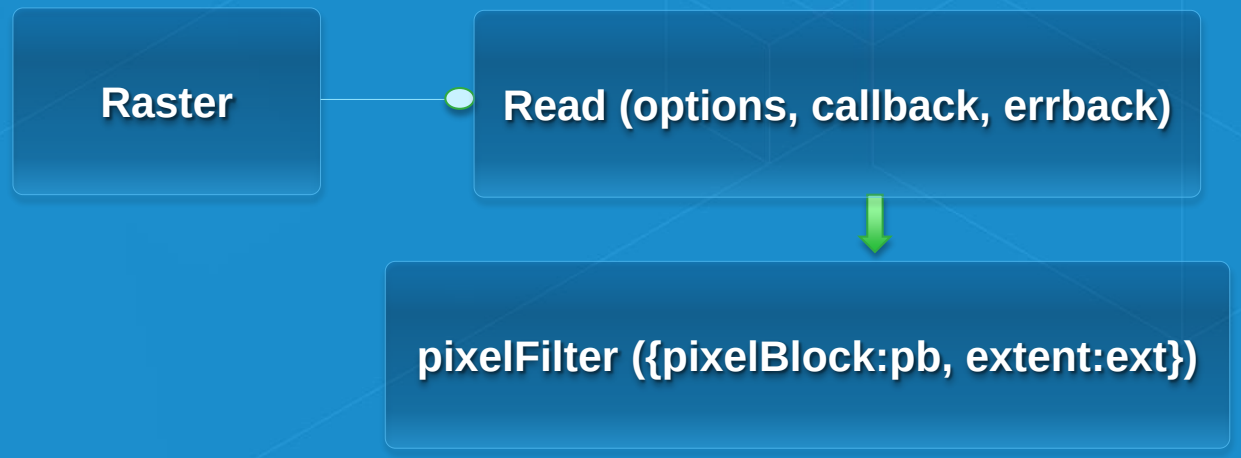
Pixels array structure is BSQ, representing pixels in image space. Each element is an array representing a band, pixels are organized row by row. For each row, it goes from the first column to last.

Processing & Visualization: Client Side Pixel Filter

Raster (esri/layers/Raster)

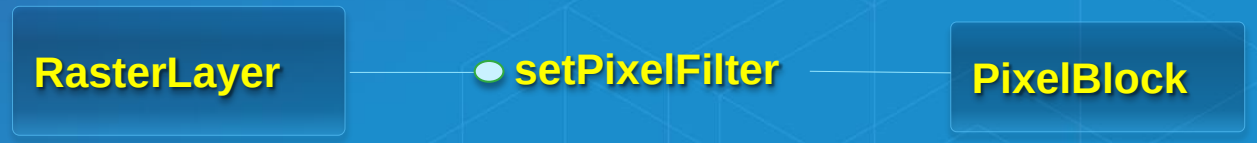
- Makes exportImage request to image service
- Calls decoders to decode the returned data

  --- Supports LERC, BIL, BSQ, JPG, PNG format
- Stores data in PixelBlock



Processing & Visualization: Client Side Pixel Filter

RasterLayer (esri/layers/RasterLayer)

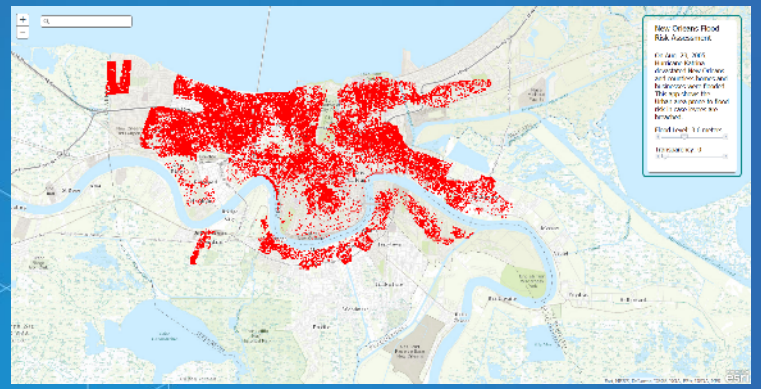


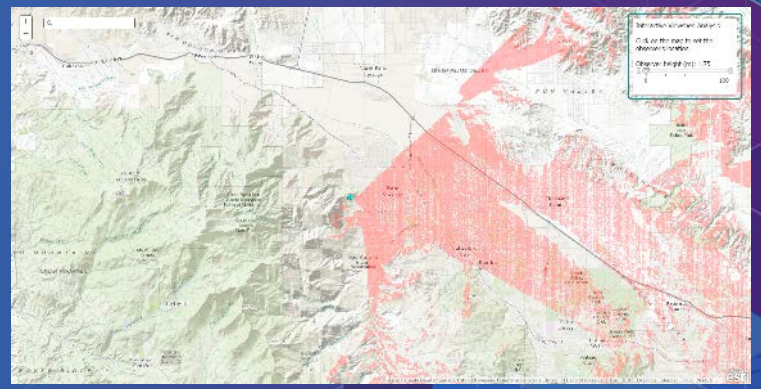
- Modern browsers
- Support your own pixel filters
- WebGL ok (IE11, Firefox, Chrome, Safari)

```
var isRasterLayer = new RasterLayer(isUrl, { opacity: 1, pixelFilter: maskPixels });

function maskPixels(pixelData) {
        var pixelBlock = pixelData.pixelBlock;
        var pixels = pixelBlock.pixels;
        var band1 = pixels[0];
        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;
        }
      }
```

Demo

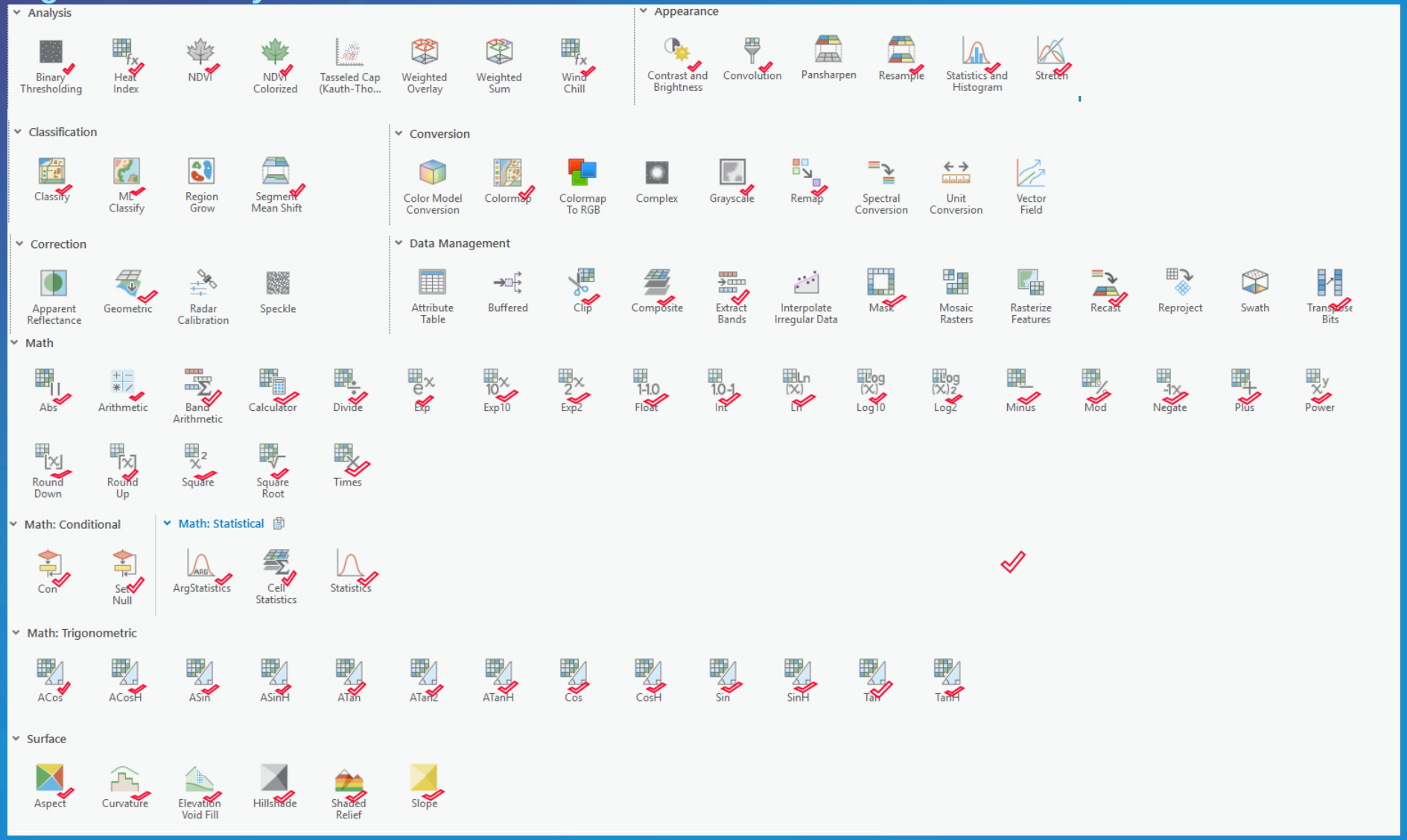
Client Side Pixel Filters





Processing & Visualization: Server Side Raster Functions

Algorithms ready with ArcGIS Server

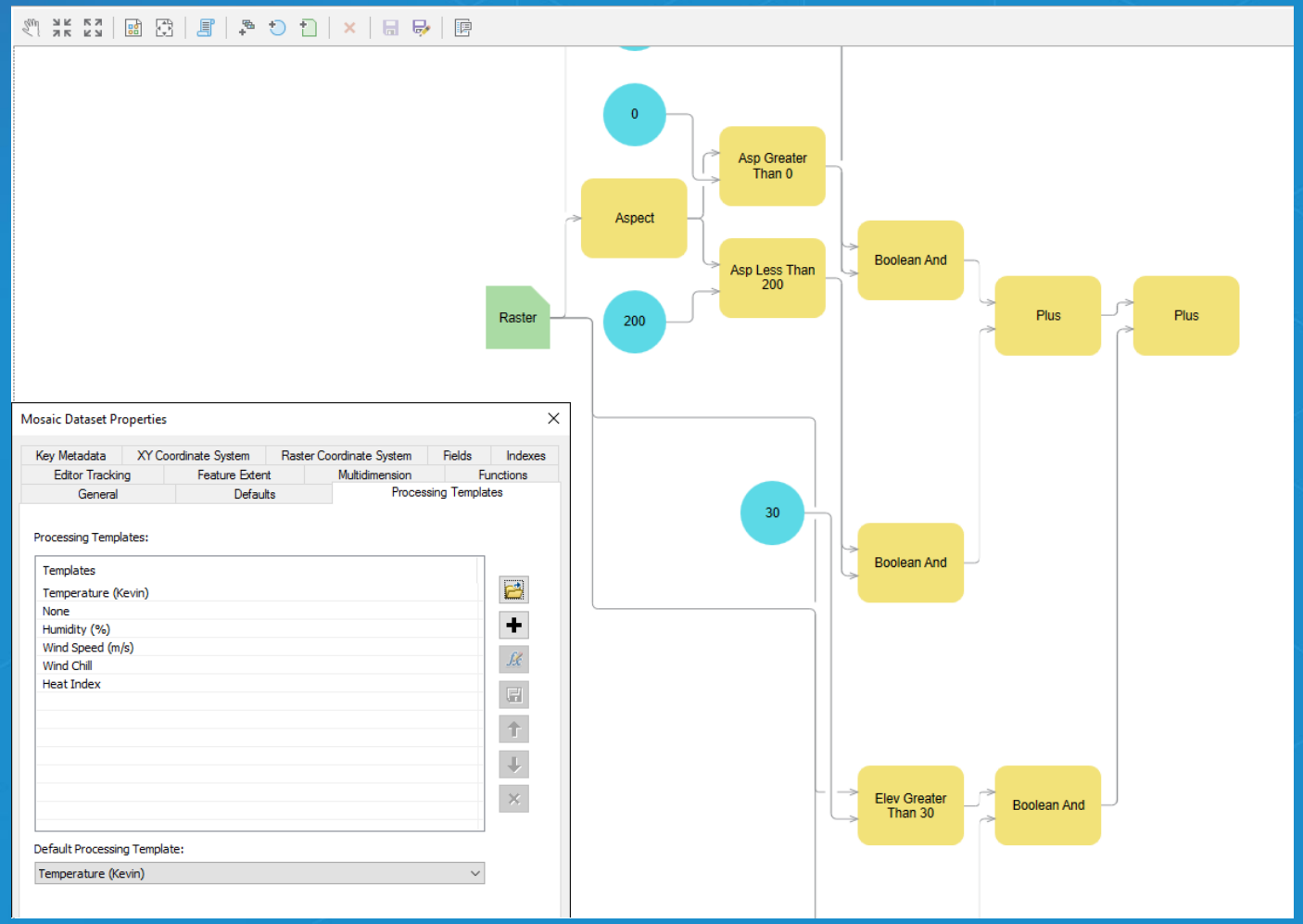


- Well known functions
  - Aspect
  - Slope
  - Hillshade
  - ShadedRelief
  - Colormap
  - NDVI
  - Statistics
  - Stretch
  - Convolution
  - Remap
  - BandArithmetic
  - Clip
  - Geometric
  - Mask
  - Arithmetic
  - ContrastBrightness
  - ExtractBand
  - CompositeBand
  - MLClassify
  - Local
  - Threshold
  - ArgStatistics
  - Recast
  - Resample
  - SegmentMeanShift
  - Classify
  - UnitConversion
  - VectorFieldRenderer
  - TransposeBits
  - ElevationVoidFill
  - Curvature

Processing & Visualization: Server Side Raster Functions

Chaining, customizing

- Templating: raster function editor
- Extending: python or ArcObjects



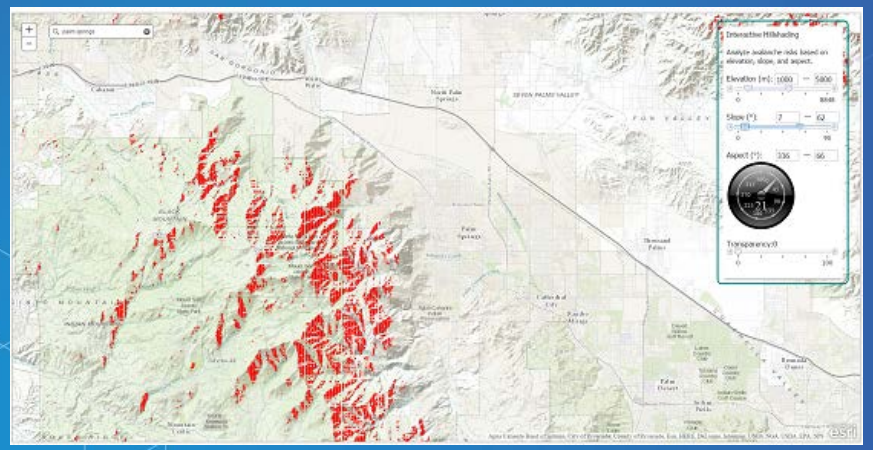
Processing & Visualization: Server Side Raster Functions

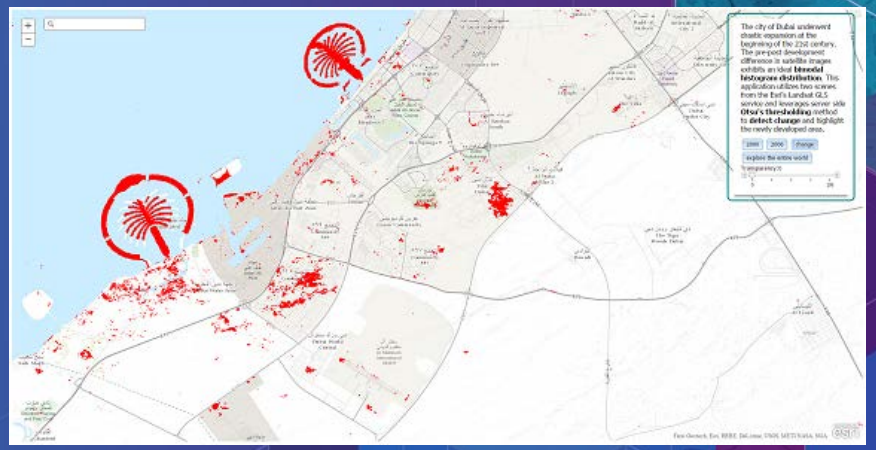
Raster Functions (esri/layers/RasterFunction)

```
var rf = new RasterFunction();
rf.functionName = "Remap";
rf.functionArguments = {
  "InputRanges" : [0,100,101,200],
  "OutputValues" : [5,125],
  "ZFactor":0.3,
  "Raster":<another_raster_function_object_if_chaining_or_do_not_set_this_property>,
};
rasterLayer.setRenderingRule(rf);

//Can be used on ArcGISImageServiceLayer and RasterLayer.
```

Demo

Server Side Raster Functions





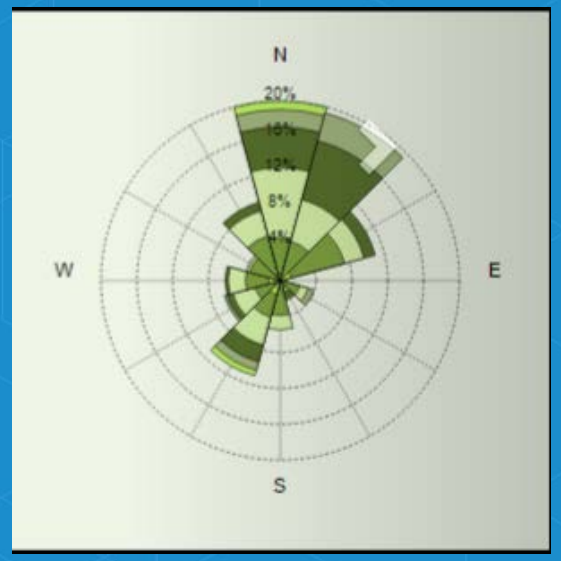
Vectorization and Charting

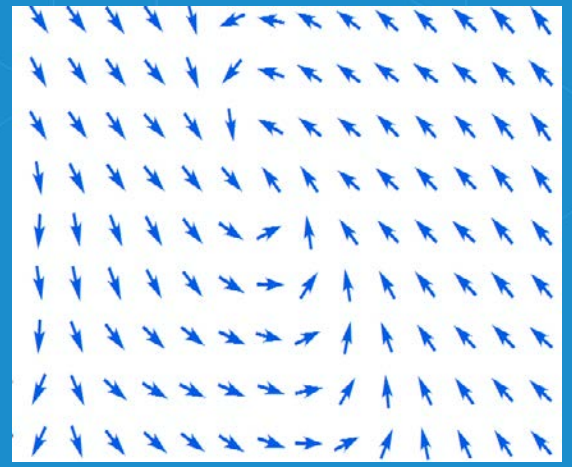
- **PixelBlock**

  Client decides what to do with all pixel values
- **identify / getSamples**

  Ask server for pixel values at multiple locations: profile, wind rose
- **computeStatisticsHistograms**

  Ask server for histograms of given geometry: column chart





Vectorization and Charting: Vector Field Data

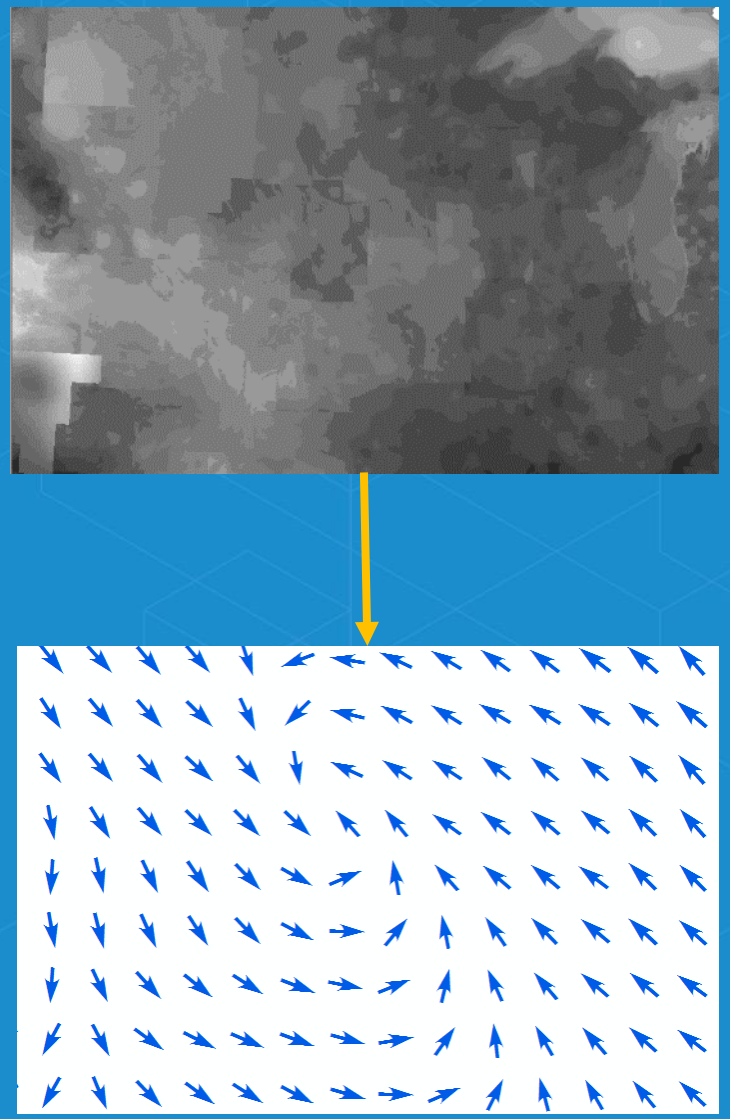
ArcGISImageServiceVectorLayer (esri/layers/ ArcGISImageServiceVectorLayer)

- **Draws raster data as vectors using predefined symbology**

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

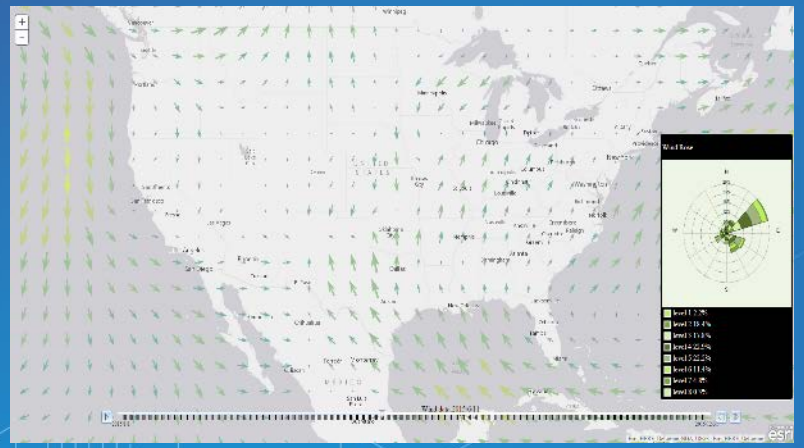
- **Decodes the returned data**
- **Visualize wind, Ocean current**
- **Default pixelFilter: computeMagnitudeAndDirection**

```
Var isVectorLayer = new ArcGISImageServiceVectorLayer(isUrl,
                    {   imageServiceParameters: params,
                          symbolTileSize: 60,
                          rendererStyle: "single_arrow“
                     });
var mr = new MosaicRule();
mr.multidimensionalDefinition = [];
mr.multidimensionalDefinition.push(new DimensionalDefinition({
  variableName:"Salinity",dimensionName:"StdZ", values:[-20]}));
```



Demo

Vectorization & Charting



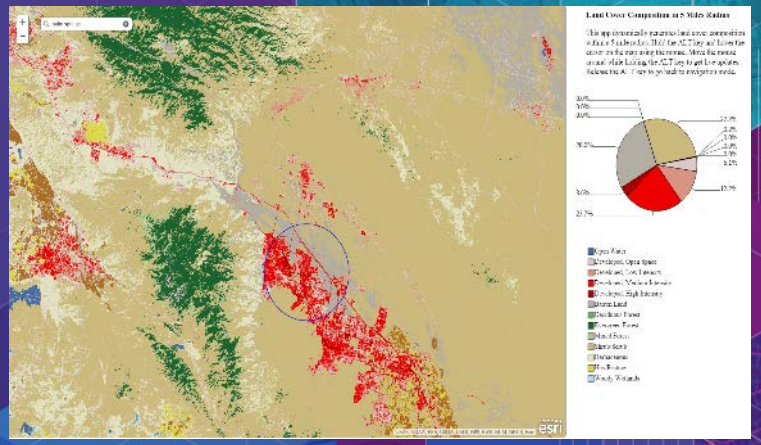
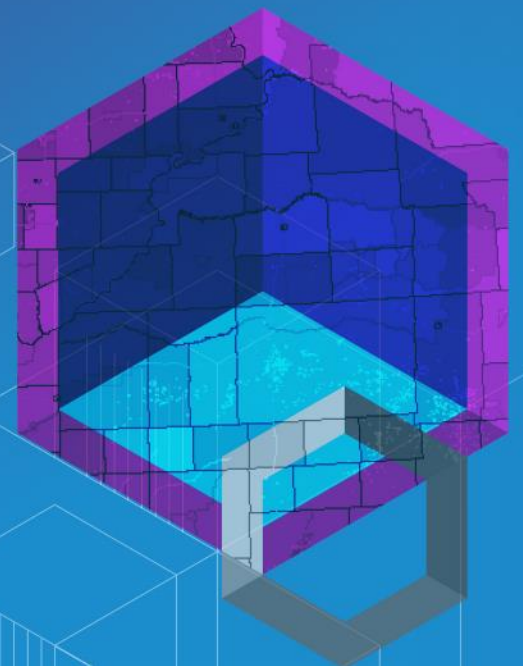


Image services in

ArcGIS API for JavaScript 4.0



ArcGIS API for JavaScript 4.0: 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

ArcGIS API for JavaScript 4.0: ImageryLayer

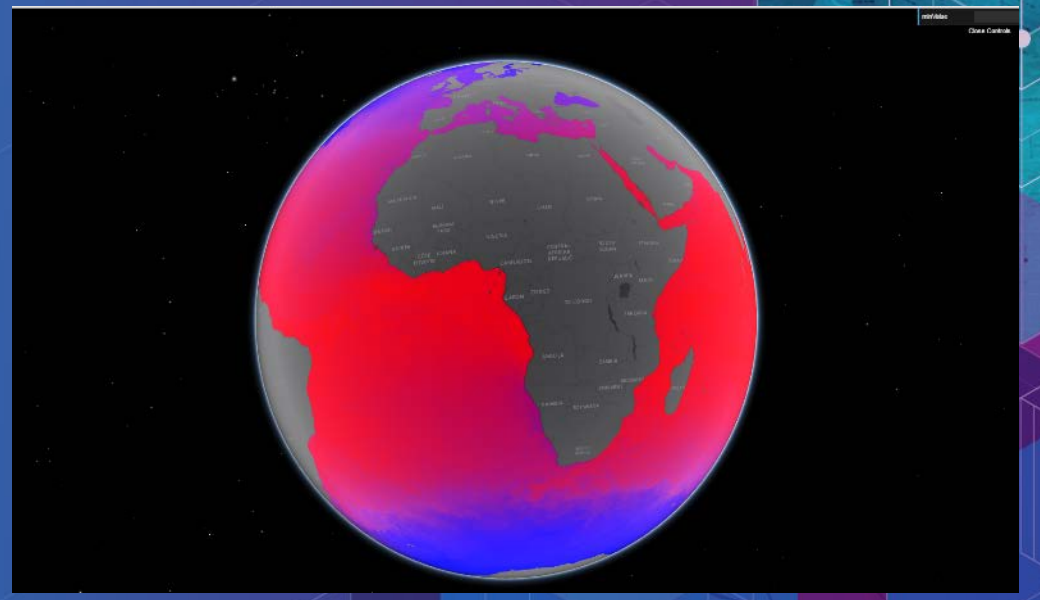
ImageryLayer

- PixelFilter
- MosaicRule
- RenderingRule

```
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
});
```

Demo

Visualization and processing in 2D & 3D



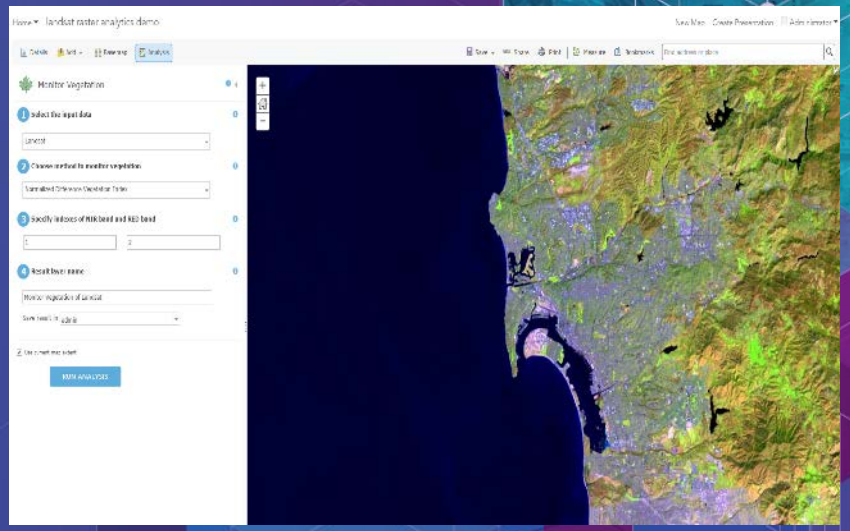
Imagery in a WebGIS

Road Ahead…

Road Ahead: ArcGIS Online and Portal for ArcGIS

- ArcGIS Online: Enhancements in the Image Display UX

- Portal For ArcGIS: Raster Analytics
  - Execute spatial analysis and raster models which leverages distributed storage and analytics
  - Creates persisted products and optimizes your data for distributed analytics
  - Works with your existing GIS data and imagery and is designed to scale with your organization's demands.



Road Ahead: ArcGIS API for JavaScript

- 3.x:
  - WCS layer
  - Raster Analytics widgets
  - More client-side processing algorithms
- 4.x:
  - Visualizing pixels as vectors (ArcGISImageServiceVectorLayer)
  - Improve performance of ImageryLayer by supporting tiled request
  - Imagery specific widgets

Documentation Resources

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

- **ArcGIS API for JavaScript 4.0**
  https://developers.arcgis.com/javascript

- **Web AppBuilder Online help documentation**
  https://doc.arcgis.com/en/web-appbuilder

- **Web AppBuilder Developer Edition help documentation**
  https://developers.arcgis.com/web-appbuilder/guide/xt-welcome.htm

Summary

- Capabilities of image services
- Support of image services in applications like ArcGIS Online map viewer and Web AppBuilder
- ArcGIS API for JavaScript:
  - Different layer types
  - Widgets
  - Client-side processing using pixel filters
  - Server-side processing
  - Multi-dimensional API
- ArcGIS API for JavaScript 4.0:
  - Imagery layer and it’s capabilities
  - 2D and 3D support

Thank you…

- Please fill out the session survey in your mobile app
- Search and select the technical workshop ‘Imagery in a WebGIS’
- Go to the feedback section and answer a few short questions

Q & A