Spatial Analyst
Introduction to Raster Processing
Tip of the day:
Add data from ArcGIS Online
You can select and export some shapefile data onto your USB.
Search: world imagery

**World Imagery**
This map service presents satellite imagery for the world and high-resolution imagery for the United States, Great Britain, and hundreds of cities around the world.

**World Transportation**
This reference map service provides a transportation and street name labels reference overlay that is particularly useful on top of imagery.

**Imagery**
This LPK combines the World Imagery service and World Transportation and World Boundaries and Places reference overlay services in one convenient group layer.

**World Boundaries and Places**
This reference map presents country, state/province, and county or equivalent boundaries and place-names for the world for overlaying on dark basemaps.

**Bing Maps Aerial**
This LPK file contains the Bing Maps aerial imagery web mapping service. Requires ArcGIS 9.3.1 or more recent. See the Details for this entry for information about the free

**World Boundaries and Places Alternate**
This reference map service presents country, state/province, county or equivalent boundaries and place-names for the world suitable for overlaying on light basemaps.
Raster data will usually work as a basemap only (can’t be exported)
Raster Data

What are the values of these pixels?
Raster Data

Red: 47
Green: 75
Blue: 14
Raster Data

- Surface of values composed of square **pixels** each with a specific value

<table>
<thead>
<tr>
<th>2</th>
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<th>5</th>
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<td>6</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>
Raster data are made of pixels

- Surface of values composed of square pixels each with a specific value
- Pixels are a specific size (ex. 10 m)
Pixel Size = Spatial Resolution

![Layer Properties window with Raster Information properties](image-url)
Raster vs. Vector

- Pixel size matters!!
Why Don’t We Use 1 m (or less) Resolution for Every Raster Dataset?
Advantages of Raster Data

• Represents a data surface. Every location within the raster extents has a value
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• Sometimes smaller file size than shapefiles containing the same amount of data
Advantages of Raster Data

• Represents a data surface. Every location within the raster extents has a value
• Sometimes smaller file size than shapefiles containing the same amount of data
• Looks good on a map if you’re not close to the raster resolution
Disadvantages of Raster Data

• What shape is a pixel?

• Why is this important when converting between coordinate systems?
Disadvantages of Raster Data

- Changing coordinate systems alters the data
Disadvantages of Raster Data

- Changing coordinate systems alters the data
- Doesn’t look so good on a map if you try to zoom in close to the raster resolution
Disadvantages of Raster Data

• Changing coordinate systems alters the data
• Doesn’t look so good on a map if you try to zoom in close to the raster resolution
• Coarse resolution raster data don’t translate well to finer resolutions
Types of Raster Data

Continuous
- Floating point or Integer
- Examples: Topography, satellite imagery, distance grids

Discrete
Types of Raster Data

Continuous

Discrete
- Could be binary (1,0)
- Could be limited number of unique values
- Examples: Land cover classification, true/false suitability
You can always *Reclassify* Continuous to Discrete, but never Discrete to Continuous.
Vector Analysis: Buffers

Buffer

Creates buffer polygons to a specified distance around the Input Features. An optional dissolve can be performed to remove overlapping buffers.

INPUT

OUTPUT

Buffering window with input features, distance field, linear unit, side type, end type, and dissolve options.
Raster Analysis: Distance
Topographic (Surface) Analysis

Hillshade
- Creates a shaded relief map from a DEM

Slope
- Creates a slope map (degree or percent) from a DEM

Aspect
- Creates a slope direction (0-360°) from a DEM
Raster Calculator

Raster grid algebra (e.g., create a new grid of elevation greater than 600 m)

Combine suitability layers using ‘AND’ or ‘OR’ statements
Vector Analysis: Intersect or Clip

Intersect

Computes a geometric intersection of the Input Features. Features or portions of features which overlap in all layers and/or feature classes will be written to the Output Feature Class.
Raster Analysis: ‘AND’ statements

Multiply two raster layers (usually one is binary or discrete!!) to achieve a raster “intersect” or “erase”
& (Boolean And)

Summary
Performs a Boolean And operation on the cell values of two input rasters.

Illustration

| Value = NoData

\[
\text{OutRas} = \text{Raster("InRas1")} \& \text{Raster("InRas2")}
\]
Vector Analysis: Union
Raster Analysis: ‘OR’ statements

The | symbol (‘OR’) achieves a raster ‘union’. All non-zero values get an output value of 1 = true.
**Summary**

Performs a Boolean Or operation on the cell values of two input rasters.

**Illustration**

```
1 1 0 0
4 0 0 2
4 0 1 1

0 1 1 0
3 3 1 2
0 0 2
3 2 1 0

1 1 1 1 0
1 1 1
0 0 1
1 1 1 1
```

\[
\text{OutRas} = \text{Raster("InRas1") \lor Raster("InRas2")}
\]
Dead Bird Analysis with Vector

Vector processing:
- Buffer
- Clip
- Erase
Dead Bird Analysis with Raster

Euclidean Distance

Input raster or feature source data
deadbird

Output distance raster
C:\Users\Bethany\Documents\ArcGIS\Default.gdb\EucDist

Maximum distance (optional)
2000

Output cell size (optional)
25

Output direction raster (optional)

OK Cancel Environments... Show Help >>
Dead Bird Analysis with Raster

1 = “yes”

0 = “no”
Dead Bird Analysis with Raster

1 = “yes” 0 = “no”
Dead Bird Analysis with Raster

1 = “yes” 0 = “no”
Dead Bird Analysis with Raster

Raster ‘AND’ identifies all pixels with a value of 1 = “true”
Dead Bird Vector vs Raster
Suitability Analysis: Renewable Energy in CO
Discrete categories of wind potential

NREL Wind Potential at 50 m
How was this grid created?

Distance to Transmission Lines
Discrete categories of land cover

Ideal Land Cover
Discrete categories of population

Population Density
Binary suitable/unsuitable map

Federal Lands Mask
Suitability Analysis

<table>
<thead>
<tr>
<th>GIS Model Score</th>
<th>Mean NREL Wind Potential</th>
<th>Area (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90–100%</td>
<td>94%</td>
<td>41 850</td>
</tr>
<tr>
<td>80–89%</td>
<td>64%</td>
<td>720 675</td>
</tr>
<tr>
<td>70–79%</td>
<td>39%</td>
<td>6 961 275</td>
</tr>
<tr>
<td>60–69%</td>
<td>21%</td>
<td>11 574 225</td>
</tr>
<tr>
<td>50–59%</td>
<td>16%</td>
<td>5 478 975</td>
</tr>
</tbody>
</table>
Interesting map of the day
Suitability Exercise

• What sorts of spatial layers would you want to define suitability for your target species? List some examples.

• Use a computer or smart phone to look on Mass GIS – how could you use the available spatial layers either directly or indirectly (as a proxy) in your suitability analysis?