Raster models in GIS

- What is GIS modeling
- Why GIS modeling
- Raster models
- Binary models
- Index models
- Regression models

What is a GIS model?

- It's spatially explicit!
- Abstraction and simplification of reality
- Often used to identify locations that meet specific criteria
- Can be used to infer an unknown quality or quantity using relationships with known or measurable quantities or qualities
- Can be used to generate new data

Why GIS modeling?

- Simplification of reality
- Increases the understanding of a situation or system
- Provides useful guidance
- Predicting the future
- Extrapolation of information to other areas
- Evaluations of scenarios
- Explain trends

Applications in Natural Resources

- Predicting future conditions
- Predicting impact of alternative management actions
- Land use planning
- Site selection
- Risk assessment - Identify areas of possible concern

Raster data structure

- Pixels!
  - Resolution is expressed in terms of pixel size: 30m X 30m for a USGS DEM
  - Best for representing continuous gradients (e.g., elevations, image brightness values etc.)
  - Can represent continuous or categorical (thematic) information
  - Not as precise as the vector model for calculating area and length
  - "Slivers" as a result of data overlay is less of a problem in raster data compared to vector data

Binary models

- Represent presence or absence of a phenomena as 1 or 0 respectively
- Categorical and very simple
- Often used as components in more complex models
- Uses include habitat models and site selection models

Craig Mountain Slope
Green – < 20 degrees
Yellow - > 20 degrees
### Raster Index Models

- Calculates an index value for each pixel and creates a ranked map.
- Weighted linear combinations is a common method.
- The importance of each factor is evaluated against each other.
- Commonly the data for each criteria is standardized (scaled to an interval between 0 and 1)

### Raster regression models

- Are based on linear or logistic regression.
- Variables are entered as grid (raster) cell values and outputs are rendered as grids.
- This is a regression model based estimate of foliar biomass (Kg/ha) from lidar canopy height data.

**Equation:**

\[
FB = 0.05*TB \\
TB = 5.5 + 0.0385*(CH)^2
\]

Where: 
CH is Canopy Height 
and TB is Total Biomass

### Modeling Process

1. Define objectives and purpose
2. State assumptions
3. Identify model variables
4. Locate GIS data representing the model variables at the desired scale
5. Implement the model
6. Evaluate model results

### Example: Coeur d’Alene Salamander

1. Define objectives and purpose
   - To create a model for potential habitat for the Coeur d’Alene Salamander
2. State assumptions
   - This model will be developed at a 30 m scale for the state of Idaho. Species specific information from adjacent states apply to Idaho.
3. Identify model variables
   - Rangemaps, elevation, vegetation, distance to water

### 4. Locate GIS data

- Criteria for Coeur d’Alene salamander habitat, Idaho GAP
  - Northern Idaho
  - < 90m from water
  - < 1525m elevation
  - Mesic forest and riparian

Idaho Gap Analysis Project 2001
5. Final Habitat Model

Coeur d’Alene Salamander Final WHR Model

6. Model evaluation

<table>
<thead>
<tr>
<th>Actual</th>
<th>Present</th>
<th>Omission (OM)</th>
<th>Absent</th>
<th>Correct Present (CP)</th>
<th>Commission (CO)</th>
<th>Correct Absent (CA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>% Omission = OM / (CP + OM)</td>
<td></td>
<td>% Commission = CO / (CP + CO)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

563x42

6. Model evaluation

Raster Calculator in Spatial Analyst

Syntax can be tricky!

Identify areas of aspect > 90 and < 270

Aspect > 90 AND Aspect < 270

in Raster Calculator

[aspect] > 90 & [aspect] < 270

Select southerly aspects

Identify areas of aspect > 270 and < 90

Aspect > 270 OR Aspect < 90

in Raster Calculator

[aspect] > 270 | [aspect] < 90

Select northerly aspects

Grass and shrub on southerly aspects?

vegetation


Select southerly aspects

Grass and shrub on southerly aspects?

vegetation


Select southerly aspects
<table>
<thead>
<tr>
<th>[veg] == grass</th>
<th>[veg] == shrub</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>[aspect] &gt; 90</th>
<th>[aspect] &lt; 270</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Image" /></td>
<td><img src="image4" alt="Image" /></td>
</tr>
</tbody>
</table>

Or do it in multiple steps!