Coupling Species Distribution Modeling with Machine Learning Classification Analyses for Predictive Vegetation Mapping

Erica E. Johnson, Courtni D. Holness, Jada A. Macharie, Robert P. Anderson
Land-use & land cover change

• Major drivers of biodiversity loss.

• Alters ecosystem function and services.

• Potential impacts on human health and well-being.

• Need accurate estimates of current and future land cover to design effective land-use policies.
## Approaches to vegetation mapping

<table>
<thead>
<tr>
<th>Land cover classification maps</th>
<th>Species distribution models</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Uses remote sensing tools to produce very accurate land cover maps.</td>
<td>• Estimate suitable habitat by linking occurrences + environmental requirements.</td>
</tr>
<tr>
<td>• Labor-intensive &amp; typically static*.</td>
<td>• Predictions can be projected spatially and temporally.</td>
</tr>
<tr>
<td>• Lack predictive ability.</td>
<td>• <strong>Typically ignore biotic interactions.</strong></td>
</tr>
</tbody>
</table>
Assess utility of coupling SDMs with machine learning classification and RS data for predictive vegetation mapping.
Methods

- Vegetation SDMs
  - Points from land cover polygons
  - Bioclimatic variables + Soil

- Boundary delimitation
  - Winner-by-cell
  - Support vector machines
    - Spatial
    - Spatial-environmental

- Tree cover mask
  - MODIS VCF
Methods: SDMs

OCCURRENCE POINTS

- INEGI land cover (2017)
- MODIS VCF threshold

PREDICTOR VARIABLES

- CHELSA Bioclimatic variables
- INEGI Soil type (2007)

MODEL OUTPUTS

- 0.5° point-radius buffer
- Spatial block partition
- Model tuning
- Cloglog output
- MTP threshold
Methods: Boundary delimitation

- **Winner-by-cell:** Used only habitat suitability values.

- **Support Vector Machines:**
  - *Spatial*: only spatial coordinates as inputs
  - *Spatial-environmental*: spatial coordinates + SDMs as inputs.
Methods: Tree cover masking

<table>
<thead>
<tr>
<th>Vegetation type</th>
<th>Tree cover density</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cloud forest</td>
<td>Dense</td>
<td>&gt; 60%</td>
</tr>
<tr>
<td>Pine-oak forest</td>
<td>Moderate</td>
<td>&gt; 40%</td>
</tr>
<tr>
<td>Scrubland</td>
<td>Sparse</td>
<td>&lt; 20%</td>
</tr>
</tbody>
</table>

MODIS VCF
Results: Boundary delimitation

*Cloud forest*

- SDM
- Habitat suitability
  - High
  - Low
- WBC
- SVM spatial
- SVM spatial-env

Scale: 0 25 50 km
Results: Boundary delimitation

WBC
SVM spatial
SVM spatial-environmental
Results: Tree cover masking

Cloud forest

Pine-oak forest

Submontane scrubland

Area (Km²)

SVM$_{SPENV}$  SVM$_{SP}$  WBC
Future Directions

- Validate coupled ENM-classifier models.
- Test coupled model predictive ability across space.
  - Explore applications of model transfer in time (e.g., climate change).
- Estimate impact of including biotic interactions & anthropogenic activities on habitat suitability values.
Thank you!


UNAM: Carmen Guzman-Cornejo, Griselda Montiel-Parra, Lazaro Guevara, Alejandro Oceguera, Andrea Jimenez, Andrea Rebollo.