Collaboratory on Adaptation to Climate Change

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"Adaptation is adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities", IPCC
Climate change adaptation raises fundamental questions about the relationship of humans to natural systems, questions that transcend disciplinary boundaries.
Run a Climate Projection
Using one or more climate envelope models (CEMs)
Legal/Policy

Browse, Search Upload or Comment on Adaptation Planning Efforts

A clearinghouse of scientific, legal and regulatory information relevant to adaptation planning
Q12. In your opinion, within the next 100 years, how likely will the earth’s average temperature increase?

- not at all likely
- not very likely
- rather likely
- very likely

Survey Expert Opinion
Browse results of an extensive scientific survey
Citizen Science

Community Discussion
Ask a question or browse answers in our public forum
Decision Making

Use Tools to Make Decisions
Navigating the uncertainty
Cyberinfrastructure = HUB

Online simulation… and more!
“Collaboratory is a virtual organization relying on cyber infrastructure for data sharing and modeling, shared computational resources, networking, community building, expert advise and to pursue pioneering inter-disciplinary integration and sound policy development.”
A decision flow
A decision flow

Understand Potential Impacts

Evaluate Climate Impact

Consider how changing climatic conditions will affect essential ecosystem features or their components, including representative habitats, select species and ecological processes.

Example:
Climate models predict that the shrub-steppe habitat in Eastern Washington, USA will experience increases in temperature and altered precipitation patterns.

Tools:
- Climate Wizard

Resources:
- Publications
- Case Studies
- Online Resources

Discussion:
- View Responses
- Post Response
- Discuss this Step
Species vulnerability

- Determining the most vulnerable species of plants and/or animals to climate change

*NatureServe Climate Change Vulnerability Index* can help identify plant and animal species that are particularly vulnerable to the effects of climate change.
Climate Change Vulnerability Index (CCVI) Tool

The NatureServe Change Vulnerability Index

Release 2.1 © 7 April 2011: Bruce Young, Elizabeth Byers, Kelly Gravuer, Kim Hall, Geoff Hammerson, Alan Redder
With input from: Jay Cardeno, Kristin Szabo
Funding for Release 2.0 generously provided by the Duke Energy Corporation.

Web Tool Iteration 2.0

* = Required Field

Geographic Area Assessed: Coastal Plain
Assessment Name: RanaSylvaticaCoastal
Assessor: anna 63
Species Scientific Name: Rana sylvatica
Major Taxonomic Group: Amphibian
States: □ Alabama □ Alaska □ Arizona
English Name: wood frog
G-Rank: 5
S-Rank: 3

Relation of Species’ Range to Assessment Area:
Check if species is an obligate of caves or groundwater aquatic systems:
Check if this assessment will be stored as "private" - only you can view it:

Reviewers have the ability to make comments on assessments for which they have been requested to do so. Collaborators have the same privilege and can also update the original assessment to fix errors or make improvements.

Assessment Notes (to document special methods and data sources)

Reviewer Comments:
Climate Change Vulnerability Index (CCVI) Tool

Climate Change Vulnerability Index for *Rana sylvatica* in Lower Mississippi River Bottomlands

**Moderately Vulnerable**

Confidence in Species Information: Low

Notes:

Confidence in Species Information

Definitions of Index Values

- **Extremely Vulnerable (EV):** Abundance and/or range extent within geographical area assessed extremely likely to substantially decrease or disappear by 2050.
- **Highly Vulnerable (HV):** Abundance and/or range extent within geographical area assessed likely to decrease significantly by 2050.
- **Moderately Vulnerable (MV):** Abundance and/or range extent within geographical area assessed likely to decrease by 2050.
- **Not Vulnerable/Presumed Stable (PS):** Available evidence does not suggest that abundance and/or range extent within the geographical area assessed will change (increase/decrease) substantially by 2050. Actual range boundaries may change.

To save this projection with results to the database, go to "General Information tab", click "Save to DB" button.
Species Distribution Modeling

- Generate niche-based models from species data.
- Typical input:
  - species occurrences
  - environmental variables
- Tasked with predicting environmental suitability for species (species niche).
- Applications include:
  - Guiding field surveys
  - Projecting impacts of climate change
  - Guiding reintroduction of endangered species
Forming knowledge of the factors that determine where species live and predictions about their distributions is important for developing strategies in the realms of ecological conservation and sustainability.
Species distribution modeling
- Process of combining occurrence data with ecological and environmental variables to create a model for species niche requirements

Challenges:

Number of actual observations are often quite small relative to the size of the geography that they occupy (*class imbalance*)

Non-occurrences can either be genuine absences or more commonly areas lacking occurrence information (*how to evaluate?*)
Evaluation Considerations

- Evaluated using: the area under the Receiver Operating Characteristic curve (AUROC), and the area under the Precision-Recall curve (AUPR)
  - AUROC can present an overly optimistic view of an algorithm’s performance if there is a large skew in the class distribution
  - AUPR captures the natural trade-off between successfully identifying positive instances while remaining parsimonious in predictions.
Data

- **Environmental coverage:**
  - Constitute North American grid with 10 arc-minute square cells.
  - Consist of 18 bioclimatic variables derived from monthly temperature and rainfall values during the period 1950 to 2000.
  - Each coverage is defined over a 302 x 391 grid, of which 67,570 points have data for all coverages.

- **Species presence data:**
  - Pertains to North America and is derived from the Global Biodiversity Information Facility (GBIF).
Species Projections – V. olivaceus

MaxEnt

AUROC: 0.842
AUPR: 0.400

Hellinger Distance Decision Trees (HDDT)

AUROC: 0.890
AUPR: 0.604
### Species Projections – Model Comparison

<table>
<thead>
<tr>
<th>Species</th>
<th>MAXENT</th>
<th>HDDT</th>
<th>C4.5</th>
<th>LR</th>
<th>NB</th>
<th>RF</th>
<th>RF-SMT</th>
<th>CART</th>
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</thead>
<tbody>
<tr>
<td><em>Vireo bellii</em></td>
<td>0.185</td>
<td><strong>0.212</strong></td>
<td>0.151</td>
<td>0.101</td>
<td>0.050</td>
<td>0.161</td>
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<tr>
<td><em>Vireo cassinii</em></td>
<td>0.320</td>
<td><strong>0.417</strong></td>
<td>0.321</td>
<td>0.343</td>
<td>0.062</td>
<td>0.248</td>
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<td>0.330</td>
<td>0.147</td>
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<td><em>Vireo griseus</em></td>
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<td><strong>0.564</strong></td>
<td>0.412</td>
<td>0.450</td>
<td>0.132</td>
<td>0.342</td>
<td>0.315</td>
<td>0.265</td>
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<tr>
<td><em>Vireo huttoni</em></td>
<td>0.430</td>
<td><strong>0.512</strong></td>
<td>0.326</td>
<td>0.351</td>
<td>0.035</td>
<td>0.298</td>
<td>0.236</td>
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<tr>
<td><em>Vireo olivaceus</em></td>
<td>0.400</td>
<td><strong>0.604</strong></td>
<td>0.080</td>
<td>0.424</td>
<td>0.201</td>
<td>0.346</td>
<td>0.295</td>
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<td><em>Vireo philadelphicus</em></td>
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<td>0.192</td>
<td>0.204</td>
<td>0.153</td>
<td>0.094</td>
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<td><em>Vireo solitarius</em></td>
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<tr>
<td><em>Vireo vicinior</em></td>
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<td>0.107</td>
<td>0.086</td>
<td>0.077</td>
<td>0.011</td>
<td>0.085</td>
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<td><strong>Average</strong></td>
<td>0.301</td>
<td><strong>0.391</strong></td>
<td>0.250</td>
<td>0.288</td>
<td>0.100</td>
<td>0.256</td>
<td>0.230</td>
<td>0.161</td>
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</table>
Regulatory Frameworks also Matter

Geographical space

Constraints

Regulatory + Scenarios
Welcome to the Adaptation Collaboratory!

This website is a resource for research, education, and collaboration in the area of adaptation and climate change. It is funded by the National Science Foundation and the University of Notre Dame. Our team at Notre Dame, and our outreach partners at The Nature Conservancy's Great Lakes Project, invite you to share your information needs, ideas, tools, and experiences in climate change adaptation. Click on a task in the slide show or choose an activity from the menus and start adapting!

If you are new to our site, you might start with our Collaboratory Tutorial
Our People

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Research Interests: Machine learning, data mining, network science/complex networks, climate data science, and prospective health care.

Jessica Hellmann
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Patrick Doran
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<tr>
<th>Graduate Students</th>
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<tbody>
<tr>
<td><strong>Jennifer Carroll</strong></td>
<td><strong>Christopher Dalbey</strong></td>
</tr>
<tr>
<td>Advisor: Jessica Hellmann</td>
<td>Advisor: Alejandro Camacho</td>
</tr>
<tr>
<td>Biological Sciences</td>
<td>University of California, Irvine School of Law</td>
</tr>
<tr>
<td>University of Notre Dame</td>
<td></td>
</tr>
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<td><a href="mailto:jennifer.carroll.86@nd.edu">jennifer.carroll.86@nd.edu</a></td>
<td><a href="mailto:cdalbey@uci.edu">cdalbey@uci.edu</a></td>
</tr>
<tr>
<td><strong>Dylan Johnson</strong></td>
<td><strong>Reid Johnson</strong></td>
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<tr>
<td>Advisor: Alejandro Camacho</td>
<td>Advisor: Nitesh Chawla</td>
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<tr>
<td>Notre Dame Law School</td>
<td>Computer Science and Engineering</td>
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<td>University of Notre Dame</td>
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<tr>
<td><a href="mailto:dylan.johnson@gmail.com">dylan.johnson@gmail.com</a></td>
<td><a href="mailto:reid.johnson.562@nd.edu">reid.johnson.562@nd.edu</a></td>
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<tr>
<td><strong>Greg Shufeldt</strong></td>
<td></td>
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<tr>
<td>Advisors: Benjamin Radcliff and Debra Javeline</td>
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<td>Political Science</td>
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<tr>
<td>University of Notre Dame</td>
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<tr>
<td><a href="mailto:gshufeld@nd.edu">gshufeld@nd.edu</a></td>
<td></td>
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</tbody>
</table>
Join us at http://adapt.nd.edu to
"convene|converge|collaborate"

Email: adapt@nd.edu

Supported In Part by NSF Grant 1029584 (OCI)
The 2012 Conference on Intelligent Data Understanding (CIDU 2012) is organized under the theme of "Bringing Data and Models Together" and will attract top researchers and practitioners in the field of data mining focusing on applications to Earth & Environmental Systems, Space Science, and Aerospace & Engineering Systems. The Organizing Committee is soliciting theme-oriented papers that advance one of these areas through the use of data mining, machine learning, or computational intelligence techniques. We invite papers that include a clear link between the domain and analysis methods, and papers that give perspectives on methods to bring data-driven and model-based methods together are particularly sought. We also invite submission of 2-page extended abstracts for posters reporting new and interesting results, ideas, or work-in-progress.

All papers and posters will be peer-reviewed based on technical merit, significance, originality, relevance, and clarity. Papers should be no more than 8 pages and describe original work not previously published in a refereed conference or journal. The CIDU 2012 proceedings will be indexed by IEEE Xplore and DBLP. Selected papers will be invited to be extended for consideration in the journal Statistical Analysis & Data Mining.