Science Theme #1

Climate Assessments and Projections for Decision Making by Resource Managers

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David Lorenz

Jana Stewart
USGS – WI Water Science Center
WDNR - John Lyons, Matthew Mitro, Paul Cunningham
USGS - Steve Westenbroek, Alex Covert, Jim McKenna
MSU – Dana Infante, Dan Wieferich, Damon Krueger
MI IFR – Kevin Wehrly
IJC – Lizhu Wang

John Walker
USGS – WI Water Science Center
USGS – Randy Hunt, Kevin Kenow
UW Limonology – Paul Hansen
WDNR – Michael Meyer
Climate Assessments and Projections

• **Steve Vavrus (Consortium speaker)**
  -- Meteorology, Climate Modeling, Climate Change
  -- Member of **WICCI** (WI Initiative on Climate Change Impacts)
  -- Assessing projected climate change (weather extremes)
  -- Statistical downscaling of climate models over Wisconsin

• **Jana Stewart (Stakeholder speaker)**
  --Understanding impacts of climate change on stream temperature, fish species occurrence and distribution
  -- Vulnerability of fish species to climate change (UMGL LCC and NECSC); WI Fish Climate Change (WDNR/USGS); NorEaST Stream Temperature Mapper (NECSC)
  -- Walker > Using loosely coupled models to assess climate impacts on loon occurrence in northern WI (Focus on Energy)
Climate Assessments and Projections

• Science background

-- “Statistical Downscaling of Climate Projections Across the Landscape Conservation Cooperatives of Central-Eastern North America”

-- Supported by Upper Midwest and Great Lakes LCC

-- Objective to statistically downscale global climate model simulations to scales relevant for decision makers (around 10 km resolution)
Climate Assessments and Projections

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-- Supported by Upper Midwest and Great Lakes LCC
-- Objective to statistically downscale global climate model simulations to scales relevant for decision makers (around 10 km resolution)
## Statistical Downscaling Product

<table>
<thead>
<tr>
<th>Source</th>
<th>13 CMIP3 / IPCC AR4 global climate models</th>
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</table>
| Scenarios            | A2, A1B, B1  
  A2 = High GHG emissions  
  B1 = Lower emissions |
| Time Periods         | 1961-2000, 2046-2065, and 2081-2100         |
| Temporal Resolution  | Daily                                       |
| Spatial Resolution   | 0.1° x 0.1°                                 |
| Region               | LCCs east of the Rockies                    |
| Variables            | Maximum & Minimum temperature, Precipitation|
| Format               | Cumulative Distribution Functions or Multiple Realizations |
| Data Type            | Netcdf                                     |

**Global Climate Model Output** (coarse resolution)  

**Downscaled Climate Model Output** (fine resolution)
Change in Maximum Daily Temperature (F): 2081-2100 vs. 1961-2000

Midwest:
- B1: ≈6°F
- A2: ≈10°F

Least warming
Change in Precipitation (inches/yr): 2081-2100 vs. 1961-2000

**B1**
- Midwest: 0 to +4”
- Annual
- Winter
- Spring
- Summer
- Autumn

**A2**
- Midwest: 0 to +7”
- Nodal Line
- Annual
- Winter
- Spring
- Summer
- Autumn
Change in 
# 90°F+ 
Days Per 
Year

2081-2100 
vs. 1961-2000

Change in 
# Days of 
2”+ 
Precipitation 
Per Decade

2081-2100 
vs. 1961-2000
1. Assess Vulnerability of Fish species to Climate Change

Project changes in stream temperature
Project changes in fish species occurrence
Score vulnerability of fish species/stream reaches
Use the results to inform management plans
ADAPTATION STRATEGIES

1) Identify and allocate management resources to those coldwater species most likely to succeed (i.e. brown trout vs brook trout)

2) Develop activities (land, shoreline, water management, instream restoration) to offset impact of rising air and water temperatures and changes in precipitation

WDNR – Confronting Change in Cold Water Fisheries

Driftless Area Master Planning (Cunningham, WNDR)

Where should we spend our limited land acquisition dollars and our fish biologist’s time?
Focus on:

Where is best natural habitat?
Where are the fish?
How and where do we manage?
Where is the existing access?
How will conditions change?

Stream Health and Habitat Quality
Sport Fishery Performance
Thermal Resilience of trout streams
Response of trout & SMB to Climate Warming
Public Access for trout & SMB angling
Stream restoration work

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### REPORT CARD

**Pecatonica River Region**

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<tr>
<th>Watersheds</th>
<th>Upper Branch</th>
<th>Blackwater Branch</th>
<th>Backwater Branch</th>
<th>Big Pecatonica River</th>
<th>Pecatonica River</th>
<th>Starved Lake Pecatonica River</th>
<th>Pecatonica River (SM)</th>
<th>Pig's Eye River</th>
<th>Lapoint Branch</th>
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<td>Angling opportunities</td>
<td>Percent of trout stream miles with public access</td>
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<td>Percent of smallmouth bass stream miles with public access</td>
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<td>Supply relative to demand</td>
<td>Miles of public accessible trout and SMB streams per 100K people within a trout drain</td>
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**Percent of Trout Stream Predicted Thermally Resilient**

A (> 50%)
B (33%-50%)
C (11-33%)
D (<11%)

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**Resilience Grade for Brook Trout**

- A (3.1 - 15.2 miles)
- B (1.3 - 3.1 miles)
- C (0.01-1.3 miles)
- D (0 miles)
- Not Present
2. Assess climate impacts on common loon occurrence

Logistic Regression
(secchi depth + habitat suitability + pH) = probability of loon occurrence
Crystal Lake

EXPLANATION

Emission Scenarios

<table>
<thead>
<tr>
<th>A2</th>
<th>A1b</th>
<th>B1</th>
<th>Maximum</th>
<th>Average for 6 GCMs</th>
<th>Minimum</th>
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USGS — science for a changing world
COMMON LOON – PROBABILITY OF OCCURRENCE

- Escanaba: not much change
- White Birch: if habitat worse, could see decline
- Little Rock: if habitat improved, could see increase

- 3 lakes
- 3 TP levels (no change, 10% and 25% increase)
- 3 Habitat conditions: (worse – same – better)
- 2 Time periods: (2050 ……… 2090)
Quantifying and conveying uncertainty in climate change, impacts

Most useful way to “package” climate model output for decision makers
WISCONSIN

Change in Temperature (°F)
2081-2100 vs. 1961-2000

Greatest Warming in Winter

WISCONSIN

Change in Precipitation (inches/month)
2081-2100 vs. 1961-2000

Wetter in Spring and Autumn
Change in Average T (F): 2081-2100 vs. 1961-2000 (A2)

Downscaling produces amplified warming, especially in winter.