Managing Water Resources in a Changing Climate

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WICCI Climate Analysis
Chris Kucharik - UW Agronomy

Dan Vimont, Steve Vavrus, Michael Notaro,
David Lorenz - UW Center for Climatic Research
Humans experience climate as weather…

...and weather can take a human toll!

What about climate concerns us?
38 River gauges broke records
810 Square miles of land flooded
161 Communities overflowed 90 million gallons raw sewage
2,500 Drinking water wells tested - 28% contaminated

$34M in damage claims paid

Source: FEMA, WEM
Milwaukee, July 22, 2010

6.73” in one hour

2,000 calls for sewer backups into basements

CSO of around 2 billion gallons

Beaches closed through July 25th.
Scientific consensus on climate change

“There is a strong, credible body of evidence, based on multiple lines of research, documenting that climate is changing, and that these changes are in large part caused by human activities.”

— US National Research Council, 2010

Wisconsin Initiative on Climate Change Impacts

- Understanding ways we can adapt to the consequences of climate change.

www.wicci.wisc.edu
WICCI Mission

Create regionally relevant climate history and climate projections

Assess climate change impacts on specific Wisconsin natural resources, ecosystems

Evaluate potential climate vulnerabilities of industry, agriculture, tourism, and other human activities

Identify climate adaptation strategies

Facilitate climate outreach and learning
Wisconsin has warmed by 1°-1.5°F since 1950.
Temperature Extremes

Sub-zero nights: much less frequent

Very hot days: little change
Dates of Spring and Fall Freeze

Wisconsin growing season lengthened by 1-4 weeks since 1950
Annual Average Precipitation Change

Wisconsin rainfall has changed ↑7” - ↓4” since 1950
WICCI Climate Assessments and Projections
UW-Center for Climatic Research

- Statistical downscaling of climate projections across the East and central Landscape Conservation Cooperatives (LCCs)

- Objective to statistically downscale global climate model simulations to scales relevant for decision makers (around 10 km resolution)
Summary of Wisconsin’s Projected Climate

- More frequent hot days
- Significant increase in heat waves
- Warmer nighttime and winter temperatures
- Increased frequency and intensity of precipitation
- Significant increase in rain during winter
- Impact on short term variability (weather) not projected
Change in Daily Max °F

1961-2000 vs 2081-2100

Midwest:

Annual

Winter: ≈10°F
Spring:
Summer: ≈6°F
Autumn: Annual

Best case CO₂ projection
Change in days/year ↑90°F  1961-2000 vs. 2081-2100

~20 days

~45 days
Likelihood of the Warmest Day of the Year

![Graph showing likelihood of warmest day of the year and indicating a shift in extremes.]

Extremes shift too
Increase in heat waves

1981-2000 vs. 2046-2065

More frequent and longer
Temperature Impacts

More high dewpoint days and nights = heat stress

Higher summer daytime temperature = increases in ozone

Source: Holloway et al. 2008
Change in Precipitation (inches/yr) 1961-2000 vs. 2081-2100

**Midwest:**
- **0 to +4”**
- **0 to +7”**

**Best case CO₂ projection**
Change in days/decade of ↑2” rain 1961-2000 vs. 2081-2100

B1 ~3-5 days

A2 ~4-8 days
Projected Winter Precipitation
1980 to 2055

- Precipitation as snow reduced by 20% by mid-century
  - 30% decrease in midwinter snow depth
  - Increased winter rainfall

Notaro et al. 2010
Groundwater Flooding from Increased Recharge

Spring Green - 2008

Seasonal rise in water table can increase system infiltration
Increased Heavy Rainfall = Sanitary Sewer Overflows

Milwaukee’s projected frequency of ↑2.5-inch daily rainfalls (=CSOs)

<table>
<thead>
<tr>
<th>1971-2000</th>
<th>2041-2070</th>
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<tbody>
<tr>
<td>Observed: 3.0 years</td>
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<tr>
<td>Projected: 2.3 years</td>
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Observation: 3.0 years
Projected: 2.3 years  
Vavrus

Precipitation events associated with CSOs increase from 3 times per decade to 4-7 times per decade by 2050
Storm frequency

Storm intensity

Both are projected to increase.

-Vavrus and Behnke
How do we adapt?

Vulnerability Analysis

Flowrate Variability

A hypothetical example:

- **pk./av. = 5**
- **peak/avg = 4**
- **pk./av. = 2.5**

- **normal flow range**: 200-600 gpm

Ned Paschke, UW-Madison
How do we adapt?

Resiliency

If a system is prepared for current variability, it’s likely to be prepared for future trends.

Today’s extreme events are consistent with projected precipitation trends.
Planning with Climate Data

USEPA
Climate Ready Water Utilities

Climate Resilience Evaluation & Awareness Tool (CREAT)

CREAT Process: Application of climate information and utility knowledge to adapt to climate change.
Questions?

Slides and references available from:

http://epd.engr.wisc.edu/pd/liebl/CSWEAReferences.zip