Top Tools for Climate Adaptation and Planning in Minnesota

Climate trends, analyses, and projections

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This presentation is available at:

http://climateapps.dnr.state.mn.us/MCAP20.pptx
• Broad desire to understand climate trends, anticipate future changes, and develop adaptation plans

• Internet abounds with tools for these purposes

• Variations in scope, utility, geography, and quality

→ Often difficult to find or use
Purpose today

• Highlight some of the highest-quality, most relevant tools for adaptation planning in MN

My presentation specifically:

• Tools and resources for understanding Minnesota’s climate at multiple temporal (time) and geographical scales, past and present, tied into current conditions
• The following tools can be used to augment presentations, planning documents, case-studies etc.

• Graphical tools can be used as-is, or often, data can be extracted and formatted for use in other programs.

• Data quality does vary from station to station

• Contact the State Climatology Office with any questions you may have
Identify a climate question relevant to your area or work

Examples:

• Has it become wetter or drier recently in my area?
  \(\rightarrow\) And what time scale matters most?

• Is the May-September growing season getting warmer or cooler?

• How does this year’s precipitation to date compare with a “normal” year? How about a record year?

• What proportion of recent months have been warm, cold, wet, or dry (compared to normal)?

• What would “normal” temperatures and precipitation look like for June through August?

• How many below zero lows did we have last winter?
Other important questions

1. What can’t these tools and data do?
2. What do I wish they did?
3. What other information will help answer the questions I have?
DNR Climate Trends Tool

Minnesota Climate Trends

Area
- Select a geographic unit: Entire State of Minnesota

Data Options
- Select a climate variable: Average Temperature
- Select a time frame:
  - Time scale (avg): Annual
  - Month ending: January
- Data start year: 1895
- Data end year: 2019

Additional Options
- Compare to these years:
  - Start: 1900
  - End: 2000
- Show trend for these years:
  - Start: 1970
  - End: 2019
- Show smoothed time series

Download:

<table>
<thead>
<tr>
<th>Year</th>
<th>Avg Temp (°F)</th>
<th>1970-2019 Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>1895</td>
<td>38.53</td>
<td></td>
</tr>
<tr>
<td>1896</td>
<td>38.63</td>
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<td>1897</td>
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<td>1900</td>
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<tr>
<td>1901</td>
<td>40.01</td>
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</tbody>
</table>
Climate Trends Tool

- Select, retrieve, graph, and analyze variations and trends in Minnesota’s climate.

- Relies on “gridded” climate values averaged over the area or areas selected.

- Data come from the NOAA National Center for Environmental Information, and from PRISM via the Western Regional Climate Center.

https://arcgis.dnr.state.mn.us/ewr/climatetrends/#

→ **Uses**: assessing ongoing trends and variability of the climate on decadal (+) scales

→ **Hint**: Works best in Firefox or Chrome!
Steps

1. Select a geographic unit of interest (E.g., major watershed or county)

2. Select Average Temperature, 3-Month, and February


4. Try clicking boxes on right to add comparison period, trend line, and smoothing

5. Experiment with other climate variables, month ranges, years, trend periods etc.

6. Extract data using Excel icon

https://arcgis.dnr.state.mn.us/ewr/climatetrends/#
Example: 2010s wettest decade on record

Average Annual Precipitation by Decade, MN River Area

https://arcgis.dnr.state.mn.us/ewr/climatetrends/#
Example: Accumulated Temperature Change

Total temperature change, 1895 through Summer 2019

Annual Average
- + 3.5° F
- + 3.0° F
- + 1.9° F

Winter Lows
- + 7.1° F
- + 5.7° F
- + 4.7° F

Summer Highs
- + 1.1° F
- + 0.6° F
- - 0.9° F
Minnesota Average Temperature and Precipitation

Annual Precipitation (in.) vs. Annual Temperature (F)

Data Range: 1895-1986

1895-1986

Department of Natural Resources
State Climatology Office
Minnesota Average Temperature and Precipitation

Annual Precipitation (in.)

Annual Temperature (F)

1987-2019

1895-1986

2016

2019

DEPARTMENT OF NATURAL RESOURCES
State Climatology Office
Monthly precipitation or temperature anomalies

• Compares several consecutive years to 1981-2010 averages or “normal.”

• Normal values calculated from adjusted 1981-2010 averages by the NOAA National Center for Environmental Information (formerly NCDC).

https://www.dnr.state.mn.us/climate/climate_monitor/monthly-precipitation-anomaly-tool.html
https://www.dnr.state.mn.us/climate/climate_monitor/mthanomtool.html

→ Uses: looking back over multiple years to see predominant wet/dry or warm/cold conditions
Monthly precipitation or temperature anomalies

Steps
1. Select a location of interest (data quality will vary)

2. When graph appears, zoom in on portion of graph by clicking and dragging

3. Click “Reset zoom”

4. Change start year (from drop-down box) to different decade and examine differences

→ Hint: for precip, start with 1985 or 1986 and compare with default graph

https://www.dnr.state.mn.us/climate/climate_monitor/monthly-precipitation-anomaly-tool.html

https://www.dnr.state.mn.us/climate/climate_monitor/mthanomtool.html
Climographs: understanding “normal”

• Graph *normal* temperature and precipitation over the course of a year.

• Normal values calculated from adjusted 1981-2010 averages by the NOAA/ NCEI

• Steps: click location of interest and examine normal monthly climate values

https://www.dnr.state.mn.us/climate/summaries_and_publications/climographs.html
Year-to-date precipitation

• Compares accumulated precipitation to normal and record levels.

• Normal values calculated from adjusted 1981-2010 averages by the NOAA/NCEI

→ **Uses**: contextualizing current wet or dry years

https://www.dnr.state.mn.us/climate/climate_monitor/precipcharts.html
Year-to-date precipitation

Steps

1. Select a location of interest

2. Examine difference from average and record values

3. Examine daily values for contributions from single large events

https://www.dnr.state.mn.us/climate/climate_monitor/precipcharts.html
NWS Data Retrieval

- Daily or monthly-scale Temp and Precip data (including snowfall and snow depth)
- Ideal for deep, location-specific analyses
- Some stations better than others!

https://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html
Steps

1. Select a location of interest (data quality will vary)

2. Select Monthly or Daily data

3. Use data to create detailed analyses

https://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html
Examples...

• Data extracted, formatted, arranged, and then graphed

• (You have to know what interests you, but you can do just about anything!)

https://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html
Lowest Lows of Winter, Milan (MN), 1895-2019

 Degrees F

Avg of 15 coldest
10-yr avg (15 coldest)
Coldest of winter
10-yr average (coldest)
Combined trends: more snow AND more thaws

Avg Ann. Snowfall and Nov-Mar Lows above 32 Milan

- Annual Snowfall (in.)
- # Nov-Mar Lows above 32

Avg Snowfall
# Nov-Mar Lows Above Freezing

1900s 1910s 1920s 1930s 1940s 1950s 1960s 1970s 1980s 1990s 2000s 2010s

1/28/20
Liquid Precip Increasing During Winter

Avg # Nov-Mar Days With Rain or Melting Snow, Duluth

- Nov-Mar Days w meas. precip and Low >32
- Nov-Mar Days w 0.10"+ prec and Low >32
- Nov-Mar Days w meas prec and NO snow
Snow Depth Declining

November-March Snow Depth Statistics
Duluth

Average November-March Snow Depth (in.)

- Avg Nov-Mar Snow Depth
- Days 6" Snowcover Nov-Mar
- Days 12" Snowcover Nov-Mar
- Days no Snowcover Nov-Mar

Days Per Nov-Mar Season


1950s
1960s
1970s
1980s
1990s
2000s
2010s

4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0

-25% -35% +63%
DNR Watershed Climate Summaries

- From DNR Watershed Health Assessment Framework (WHAF) team
- Utilizes same data in Climate Trends Tool
- Comprehensive climate summaries for every major watershed in MN
- Essential for watershed management

Steps

1. Select a location of interest (data quality will vary)
2. Select Monthly or Daily data
3. Use data to create detailed analyses

https://www.dnr.state.mn.us/climate/historical/acis_stn_meta.html
Projections:

• **During 2020, the DNR will provide access to climate projection information from dynamically-downscaled climate models produced by scientists at the University of Minnesota (they are presenting here today!)**

• **Until that time, users have options for retrieving statistically-downscaled climate projections* from the following sources.**

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*Dynamical downscaling = physically based & more rigorous than statistical downscaling, which is less intensive computationally but more available*
https://crt-climate-explorer.nemac.org/
https://crt-climate-explorer.nemac.org/
MACA (Multivariate Adaptive Constructed Analogs) models

- Interactive platform enables users to extract customized maps, and download underlying data
- Variety of graphical options for displaying the information spatially and/or as changes through time

https://climate.northwestknowledge.net/MACA/index.php
MACA (Multivariate Adaptive Constructed Analogs) models

https://climate.northwestknowledge.net/MACA/index.php
Thank You!

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