Minnesota Winter Weakening in the Climate Change Era

Understanding long term warming and extreme event frequency in our state’s climate record

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Why care about winter?

Winter is the fastest warming season in Minnesota, and much of the US.
Winter weather has made a lot of headlines lately...

Jan. 28, 2019

Caught in extreme cold, Minnesota grinds to a halt

The lowest temperatures in a generation and windchills of 50-below forced the state into a deep freeze, with businesses and even government agencies shut down. Wednesday is shaping up to be worse.

By Eric Roper Star Tribune  |  JANUARY 30, 2019 — 8:32AM

Jan. 30, 2019

Minnesota winters ain’t what they used to be

By Eric Holthaus on Jan 28, 2019
Xcel Energy customers tested by bitter cold, power outages, pipeline rupture

By Susan Hogan Star Tribune | JANUARY 21, 2014 — 5:10AM

High winds and low temperatures and blowing snow made outdoor activities dangerous for the unprepared Sunday, January 26, 2014. A firefighter on Lake Harriet in Minneapolis Sunday afternoon. Blowing snow at times obscured the far

Harsh winter reveals weakness in Minnesota utility systems

by Steve Downer

A strong Arctic high-pressure system brought historic cold to the North and Central U.S. region on January 30-31, driving temperatures below 2014 polar vortex’ levels. The cold revealed either real or potential weaknesses in Minnesota electric and natural gas systems.

Temperatures were colder than any time since 2003, when the Midcontinent Independent System Operator (MISO) began operating the regional electric grid.

According to MISO, total electric generation outages during the cold spell were higher than

Thousands affected by power outages in metro

As of 5 a.m., more than 1,600 customers were still without power, according to the Xcel Energy outage map.
Is climate change causing more polar vortex disruption and increasing cold air outbreaks events?
Connections between Arctic warming and mid-latitude severe winter weather has been a point of debate amongst climate scientists.

What is happening in Minnesota? Do we see an increase in extreme cold events in our state’s climate record?
Long-term winter change
Time series data are often analyzed by the rate of change. For Minnesota winter temperature, the rate of change varies dramatically by the time period of estimation. A complementary approach is to examine how the 30-year climate normal periods have changed, as this may be more comprehensible to stakeholder audiences. These figures indicate that Minnesota’s changing winter may better be characterized by a shift in the mean state, rather than an increasing linear trend.
Long-term Changes in Minnesota Average Winter Temperature: Regime shift in 1979

Time series of Minnesota average annual winter (Dec-Feb) temperatures from 1896-2019 with average temperatures for the full period in gray, and those before and after the 1979 changepoint in blue and orange, respectively. Data retrieved from NOAA National Centers for Environmental Information.
Long-term changes in Minnesota Average Winter Temperature: Increase in Central Tendency after Changepoint

Probability density function of average annual winter temperatures for the full period in gray, and those before and after the 1979 changepoint in blue and orange, respectively. Data retrieved from NOAA National Centers for Environmental Information.
Winter extreme event changes
Cold air outbreaks in Duluth: is it really climate-proof?

CLIMATE CHANGE

Duluth, Minn.: The ‘Most Climate-Proof City’ in America?

By WHITNEY HURST, KENDRA PIERRE-LOUIS, JOE VAN EECHHOUT and CAROLINE KIM | Apr. 15, 2019 | 6:38

If extreme weather made your city unlivable, where would you move? Consider Duluth, Minn., a Harvard University climate adaptation expert says. He thinks the city’s cold temperatures, abundance of fresh water and industrial infrastructure make it an ideal climate refuge.

Related: Article: Want to Escape Global Warming? These Cities Promise Cool Relief

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Winter extreme event changes:

Cold Air Outbreak Events per year in Duluth, MN

Number of Cold Air Outbreak Events by year from 1941-2019 for Duluth, Minnesota. Data is daily average minimum temperatures from station data in Duluth, Minnesota from 1941-2019. Data retrieved from Midwestern Regional Climate Center, Duluth International Airport Station USW00014913.
12 Cold air outbreaks (37 years) 17 Cold air outbreaks (40 years)
Changepoint detection analysis identifies 1979 as a statistically significant time of increase in the winter average temperature record. The “historic” Minnesota winter has become significantly warmer after 1979.

Though Minnesota’s average winter state is considerably warmer, extreme cold events will still occur with regular frequency.

However, the definition of a cold air outbreak event may need to be modified to fit our new winter normal.
Thank you
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Questions? Contact me at biga0040@umn.edu