

# Lake Ice & Loss of Winter as we knew it? What is Happening?

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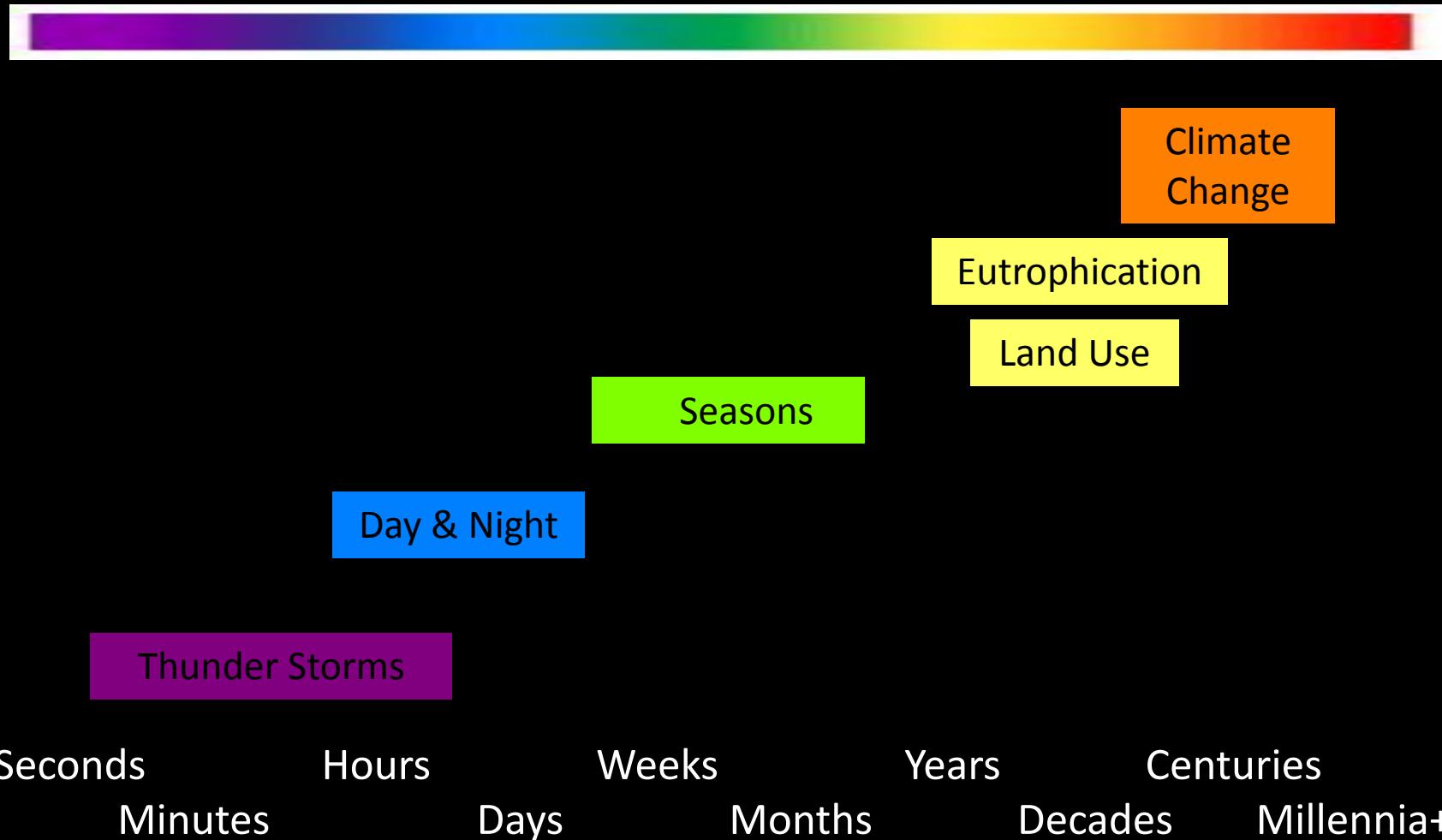
Lake Mendota WI, March 25, 2010 (Magnuson)

# First, How Do We Deal With Change?



Magnuson Photos

# Changes Occur Quickly and Slowly



Time Scales of Changes

Magnuson 2009

# An early quote about time

Marcus Auraelius Antonius,  
Roman Emperor & Philosopher



Time is sort of a river of passing events, and  
strong is its current;  
no sooner is a thing brought to sight than it is  
swept by  
and another takes its place, and this too will be  
swept away. (ca. 170)



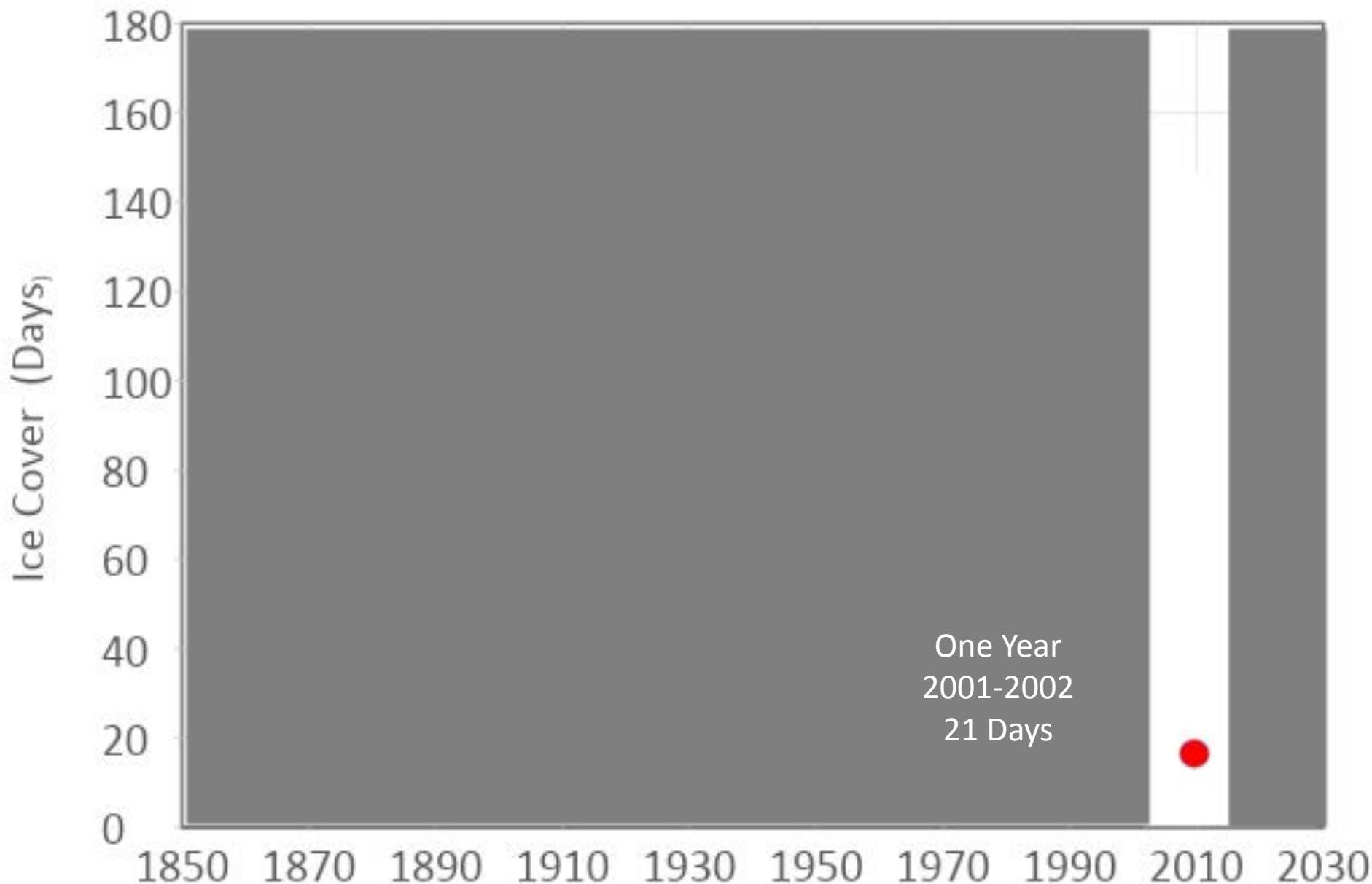
# The Invisible Present

# Lake Mendota Ice-on Day, January 20, 2007

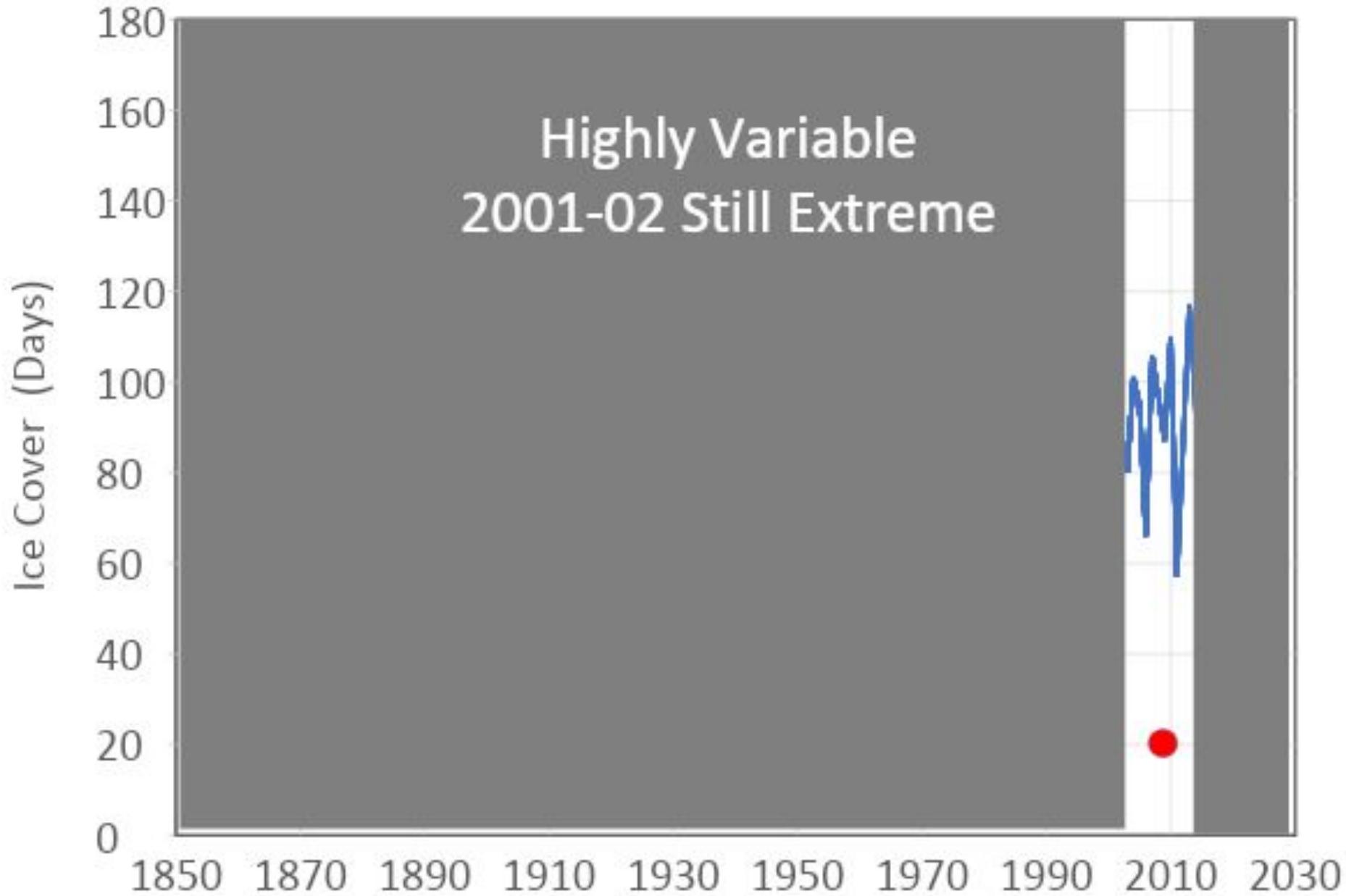


Peter W. Schmitz

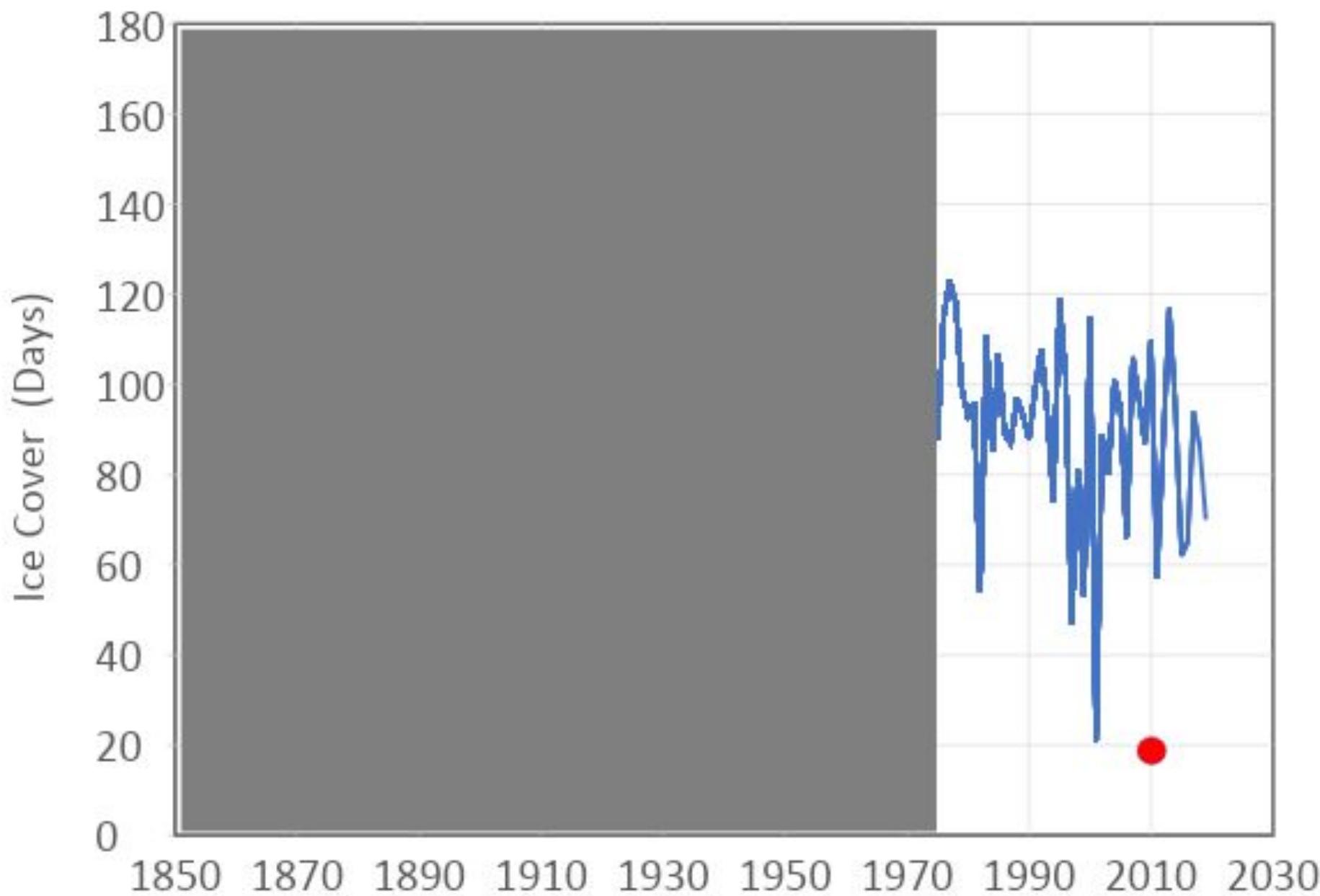
# Lake Mendota Ice Duration Invisible Present



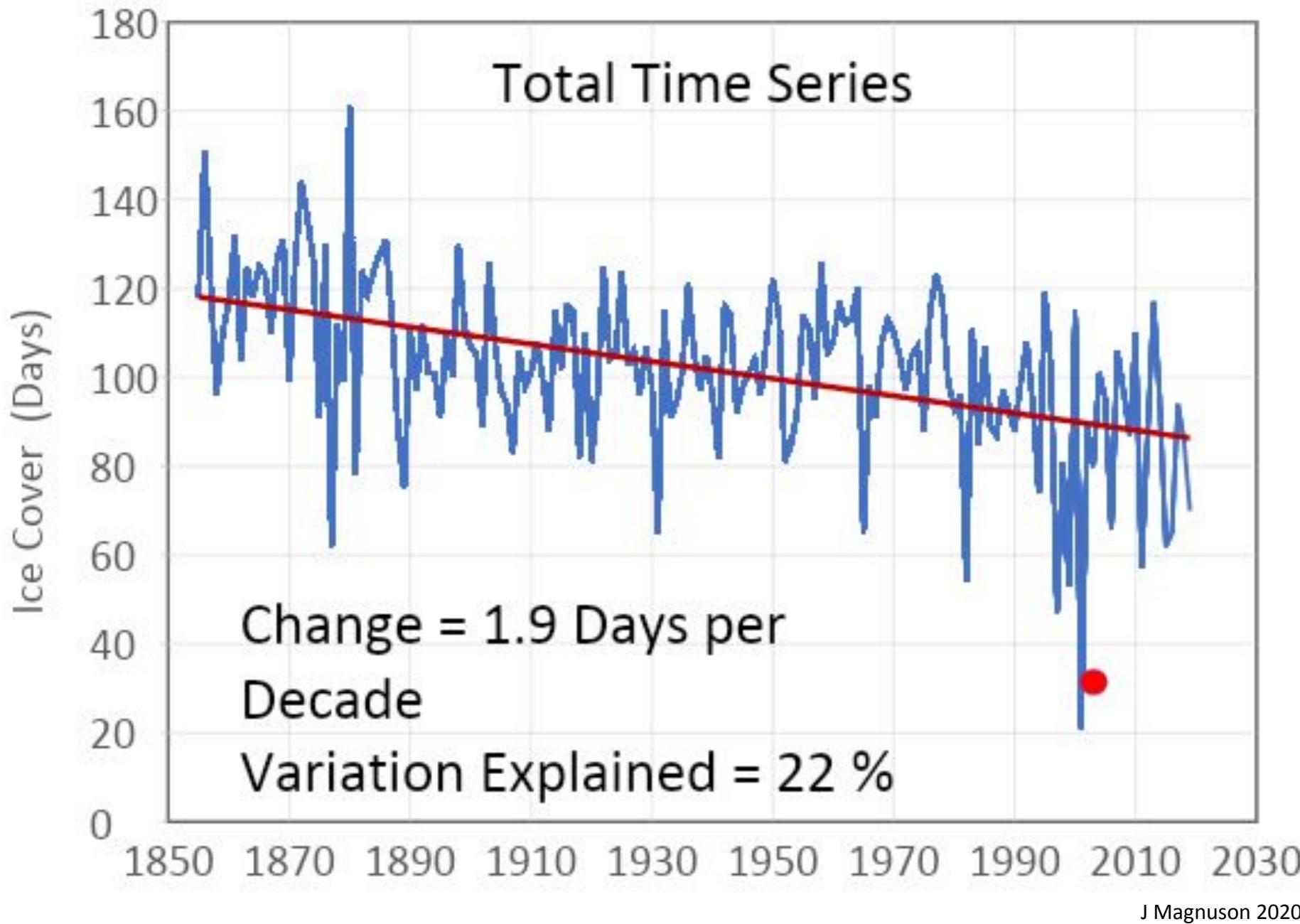
# Lake Mendota Ice Duration 10 Years



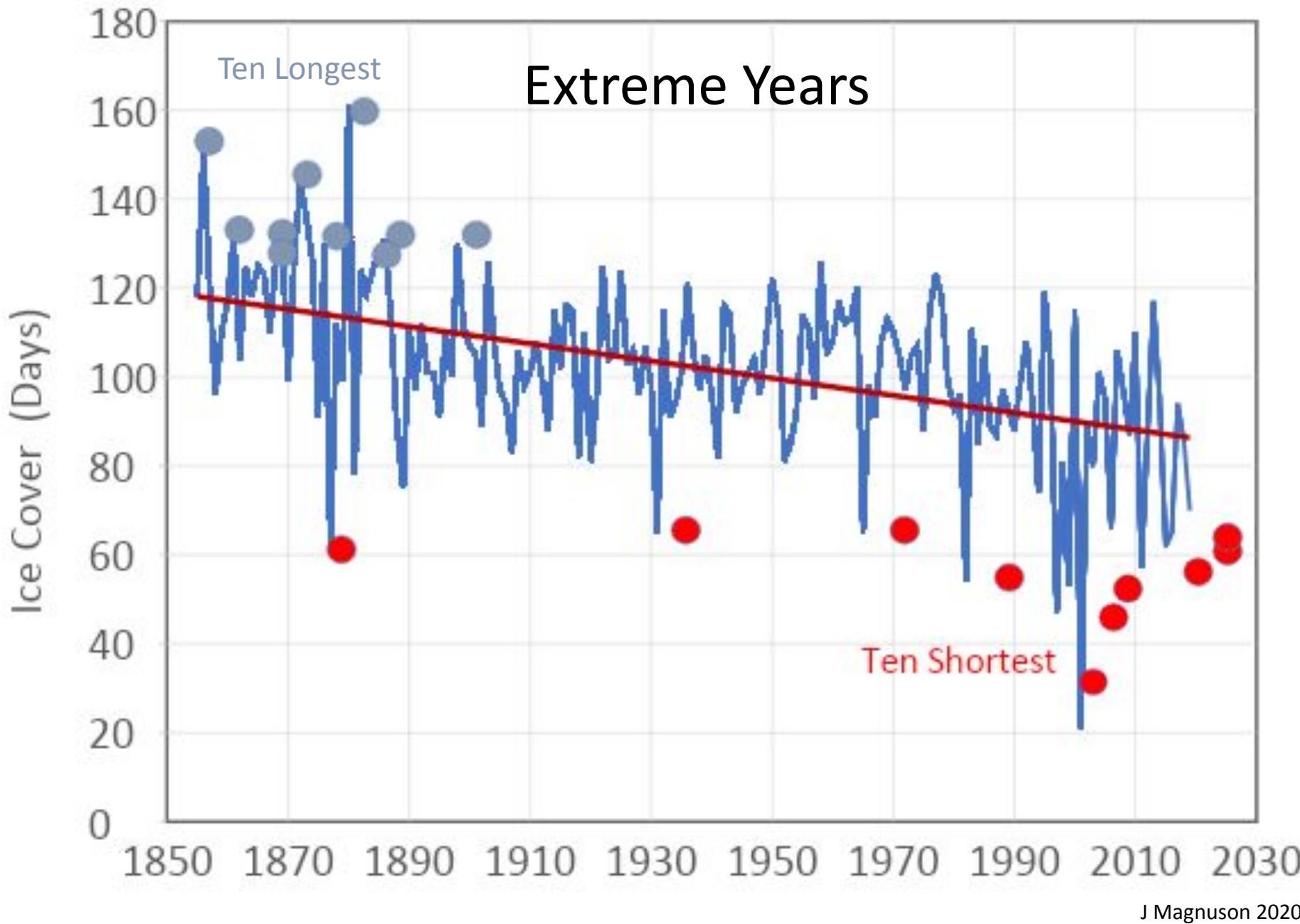
## Lake Mendota Ice Duration 50 Years



# Lake Mendota Ice Duration 1855-2020



# Lake Mendota Ice Duration 1855-2020



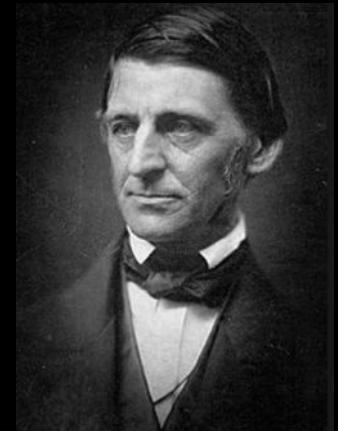


# The Invisible Place

# Quotes about Space

Ralph Waldo Emerson  
Essays IX Circles (1841)

The field can not be well seen from within the field.



Albert Arnold (Al) Gore  
The Earth in the Balance, Ecology and the Human Spirit  
(1992)

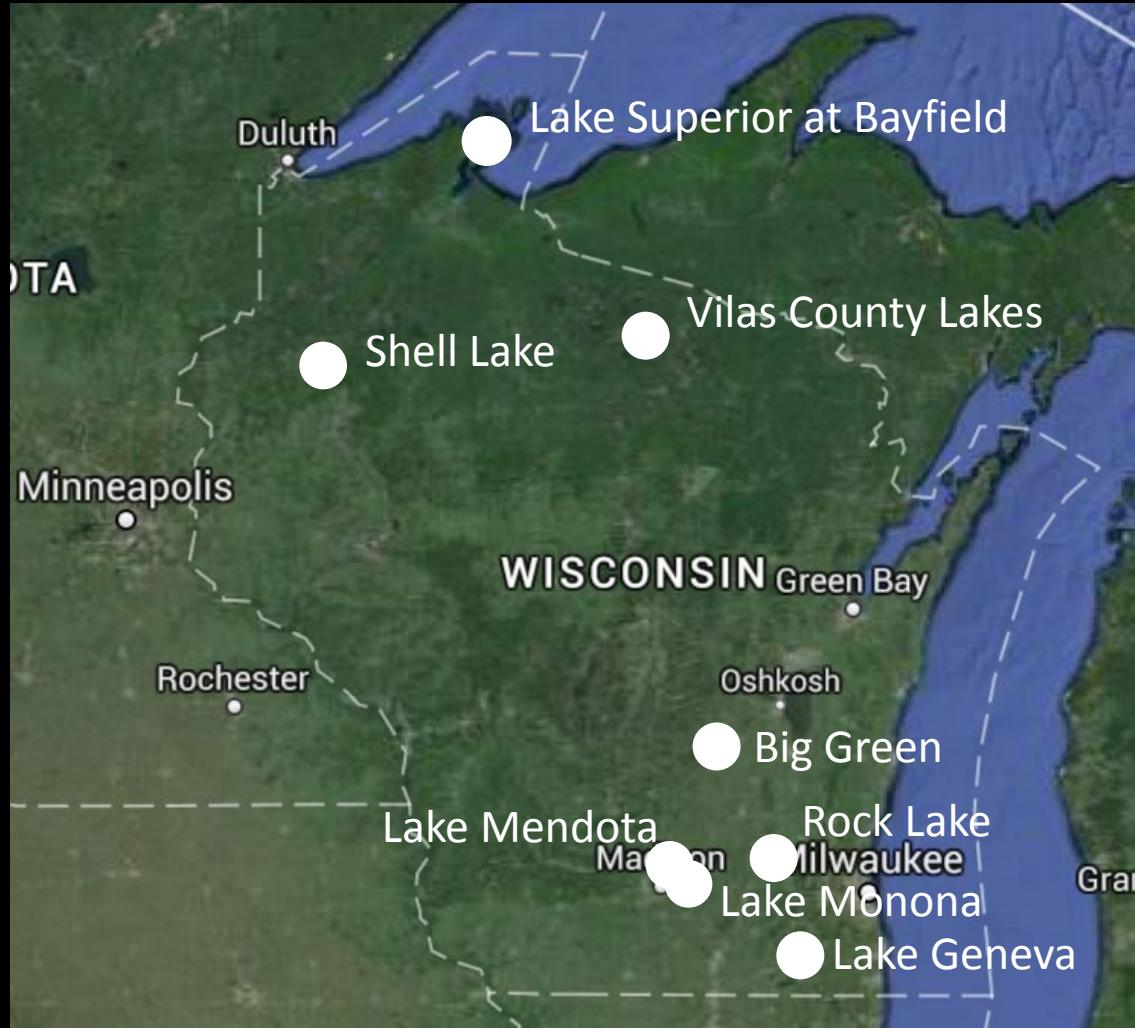
It is helpful to stand at some distance  
from any large pattern we are trying to comprehend.

John Heywood (mid1500s)

Not being able to see the forest for the trees.  
You cannot see the wood for the trees.

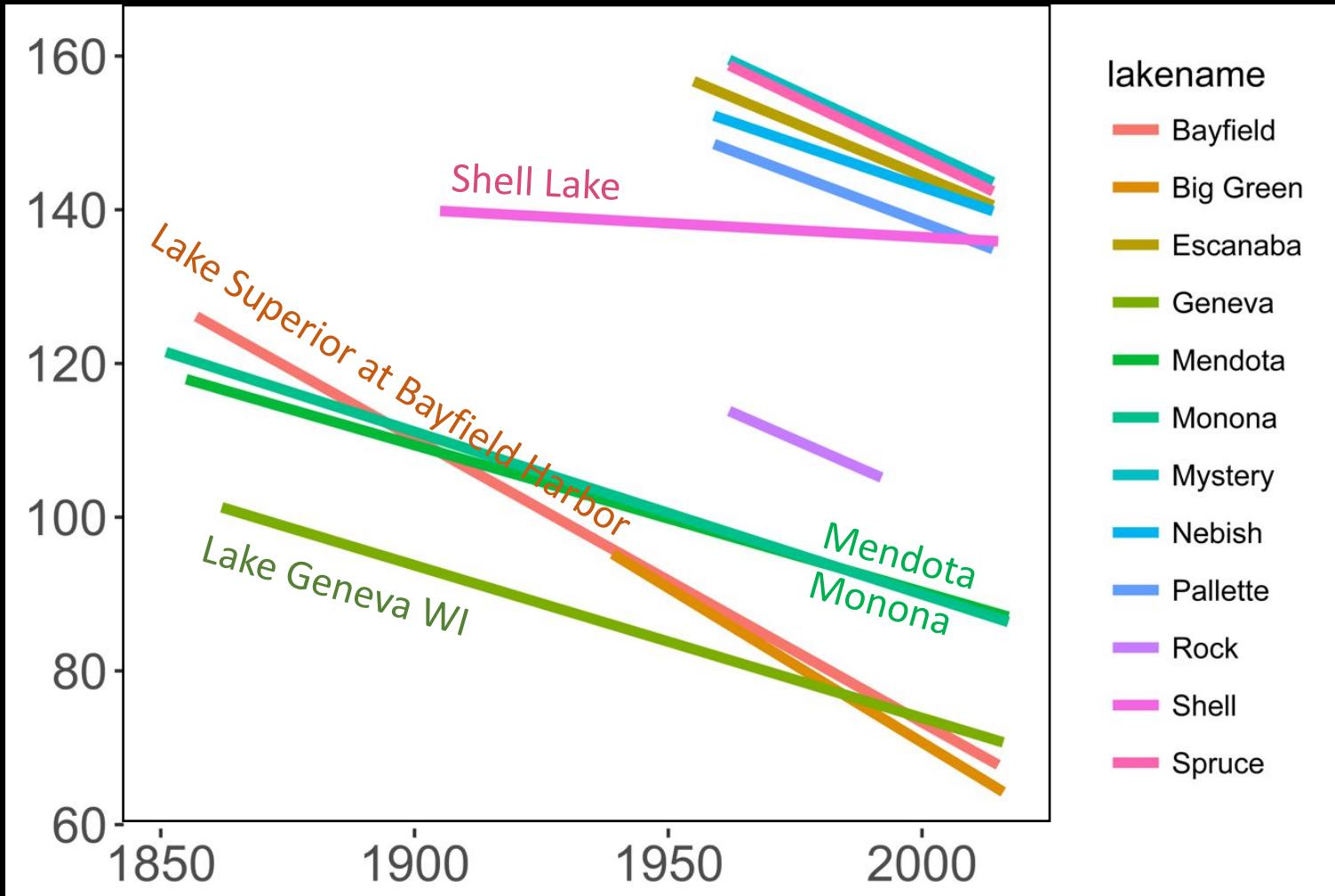


# Location of a few of the 46 Wisconsin lakes with ice cover observations



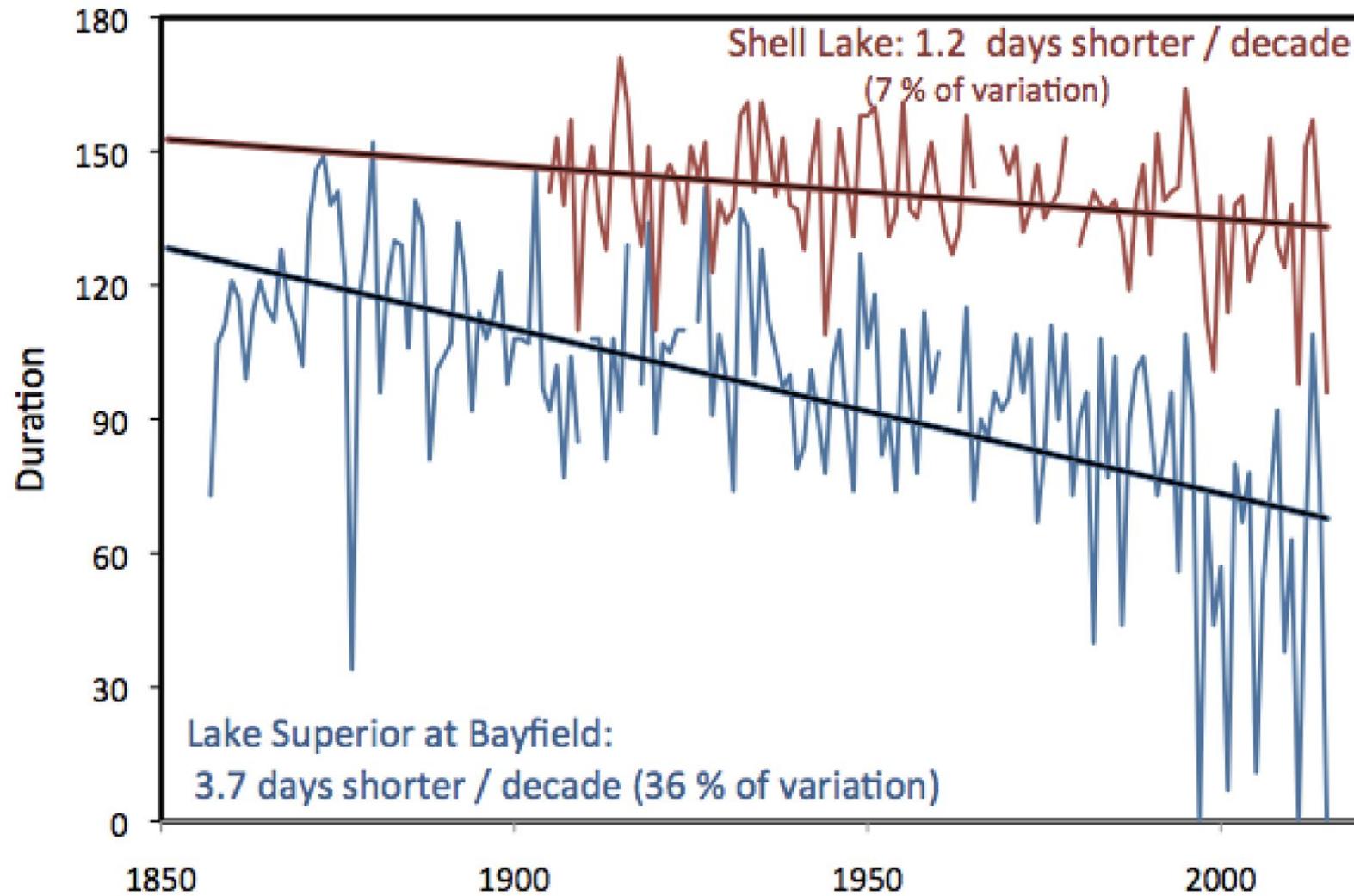
# Ice cover duration on a few of the 46 Wisconsin lakes with ice observations

Ice Cover Duration (days)

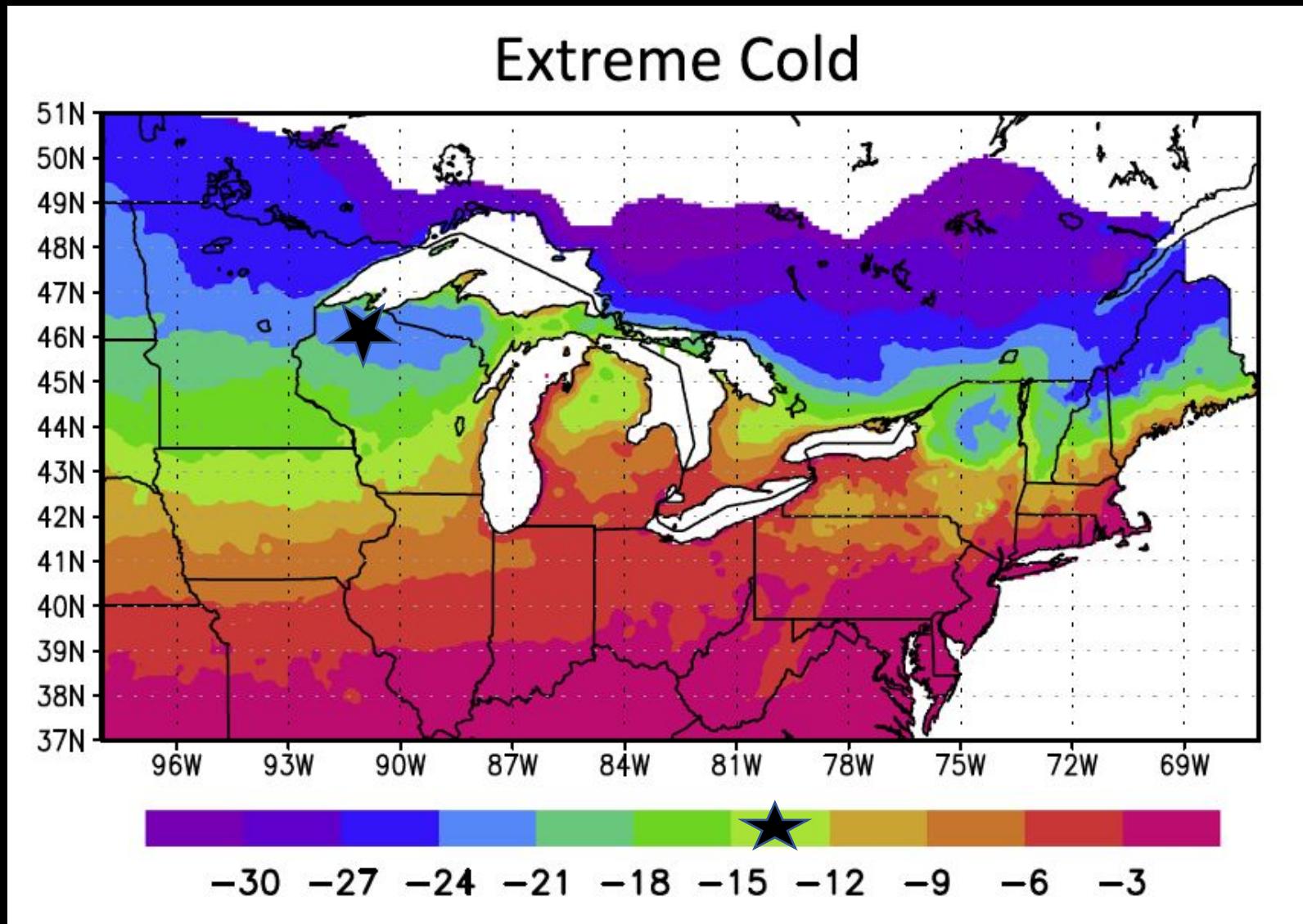


Longest Ice Records from Northern Wisconsin  
(Shell L. & L. Superior at Bayfield)

**Ice Cover Duration on Northern Wisconsin Lakes (1855-2015)**

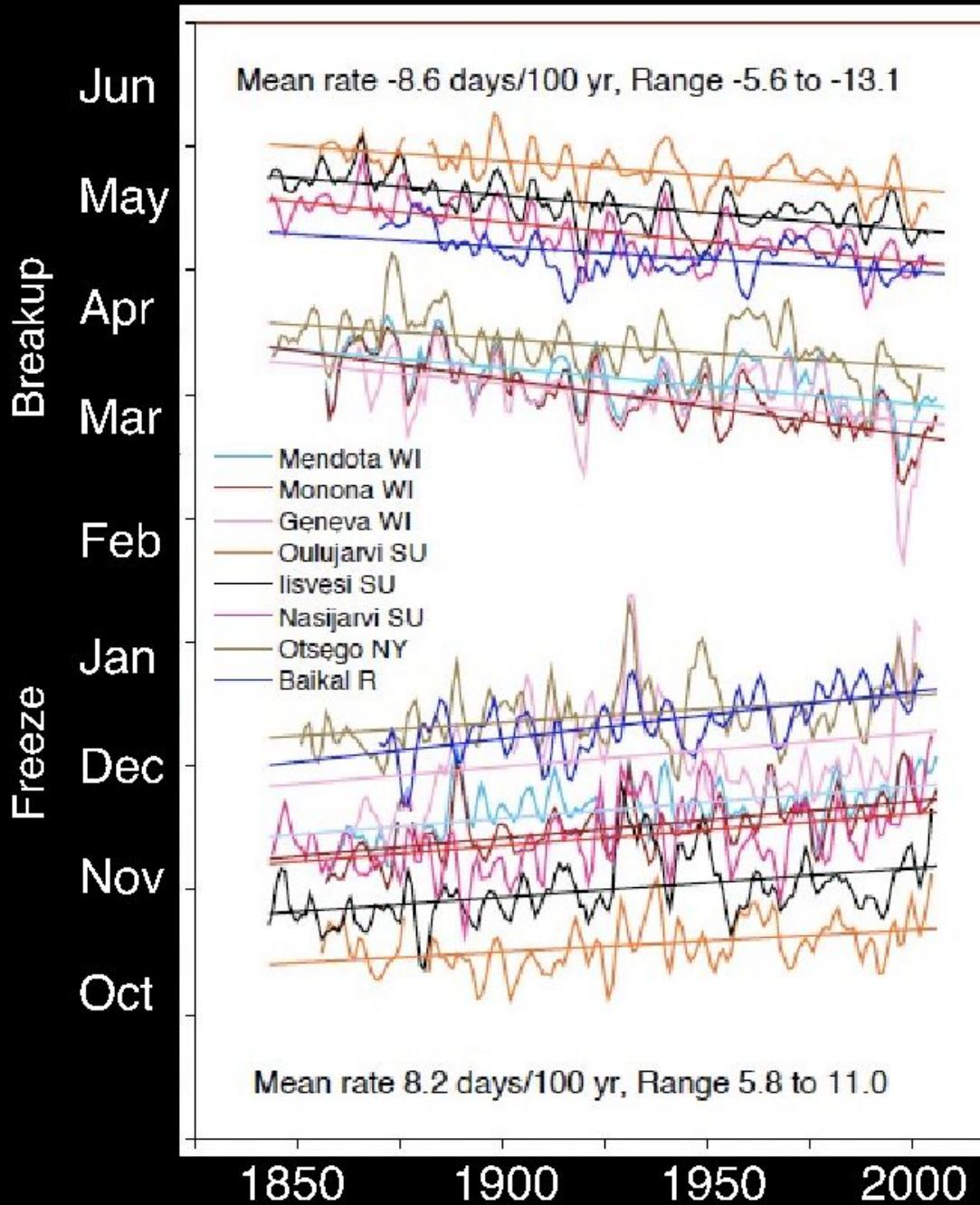


# Projected Decrease in Extreme Cold Days (<0°F) from 1961-2000 to 2046-2065



# Changes in Freeze and Breakup Dates

winters  
1843-4 to 2008-9  
(8 lakes)



# How Long Has Science Recognized the Importance of CO<sub>2</sub> in Warming the Atmosphere?

At least from 1896 through the works of Svante Arrhenius, a Swedish Chemist

Quote:

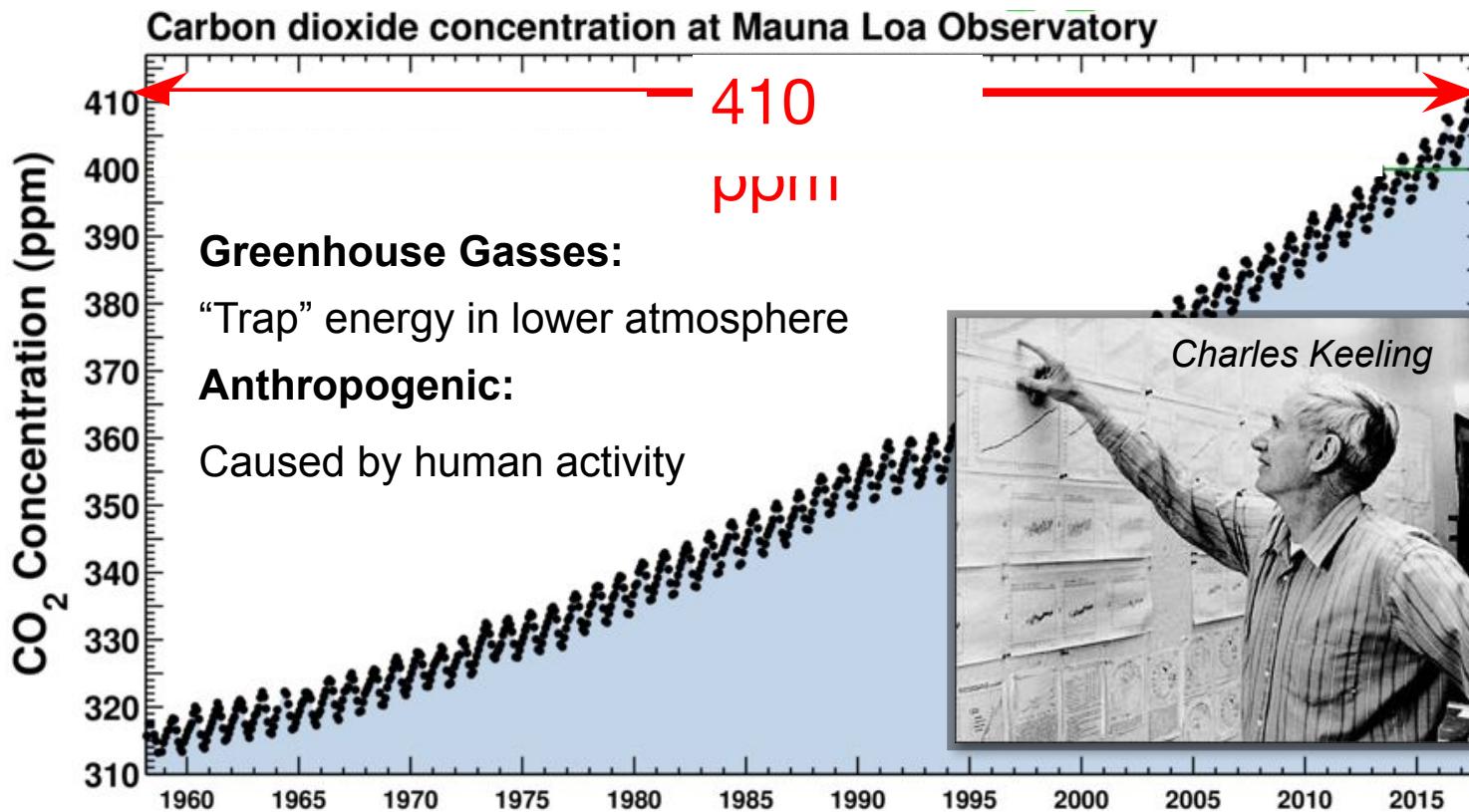
“if the carbon dioxide is increased by 2.5 to 3 times its present value, the temperature in the arctic regions must rise 8 to 9°C. and produce a climate as mild as that of the Eocene period.”

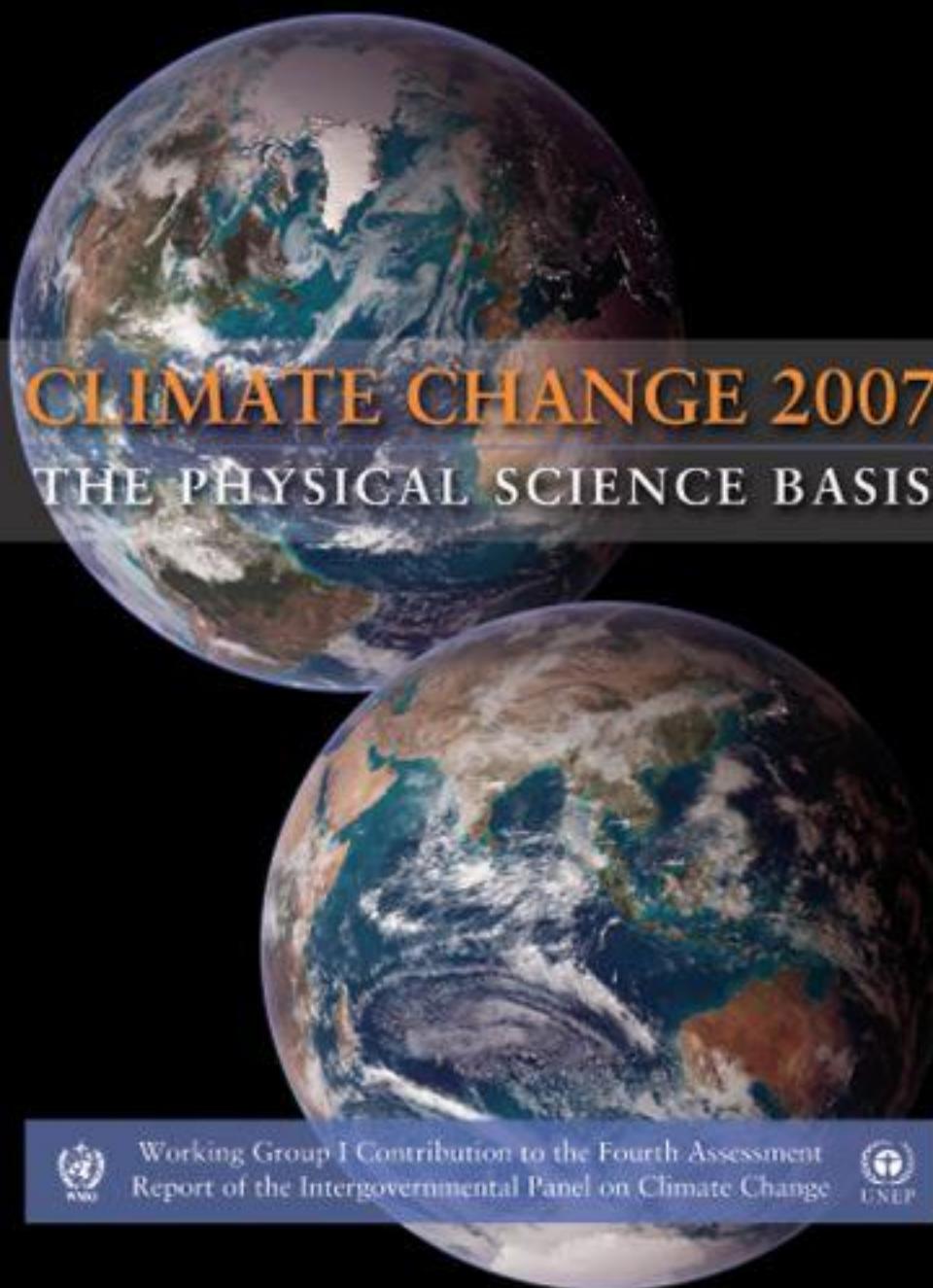


THE  
LONDON, EDINBURGH, AND DUBLIN  
PHILOSOPHICAL MAGAZINE  
AND  
JOURNAL OF SCIENCE.  
◆  
[FIFTH SERIES.]  
◆  
APRIL 1896.  
◆  
XXXI. *On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground.* By Prof. SVANTE ARRHENIUS \*.

# Greenhouse gasses are increasing owing to burning fossil fuels

CO<sub>2</sub>, reading on Jan 15, 2018: 407.8 ppm





# CLIMATE CHANGE 2007

## THE PHYSICAL SCIENCE BASIS



Working Group I Contribution to the Fourth Assessment  
Report of the Intergovernmental Panel on Climate Change





## INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE



IPCC delegation  
with Nobel Peace Prize Diploma  
and Gold Medal  
at the Oslo Town Hall

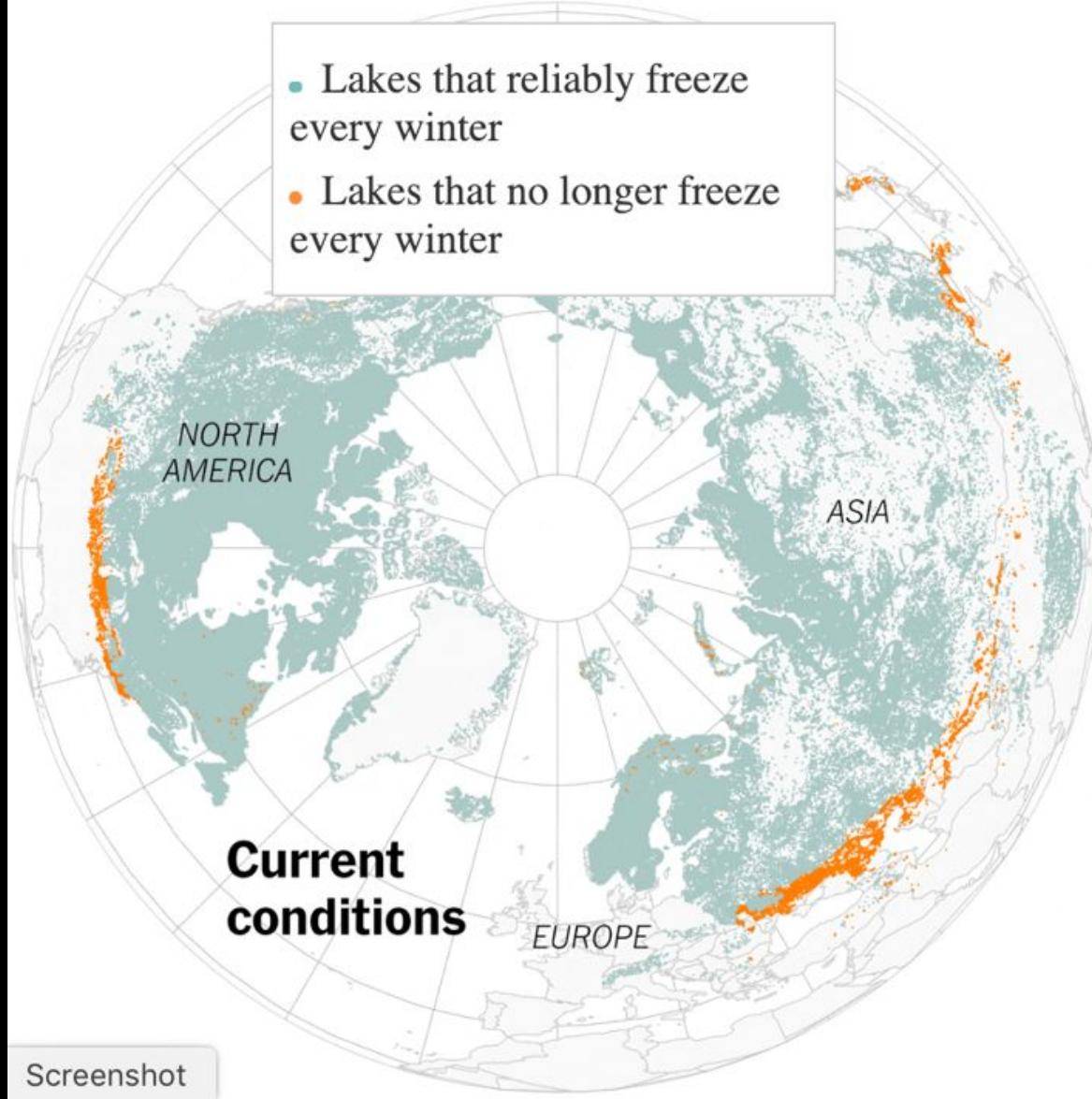
Raiendra Kumar Pachauri

2007



Robert Watson

# Lakes that do not freeze every winter (Projection)



## Lakes that do not freeze every winter (Projection)



Current  
Condition



Warming  
2 Degrees C



Warming  
4.5 Degrees C



Warming  
8 Degrees C

A photograph of a frozen lake. The foreground is covered in white snow and ice. In the middle ground, a dense forest of evergreen trees stands along the shore. The sky above is a pale blue with bright, sunburst-like rays of light filtering through the clouds.

# Lake Ice: a Miner's Canary for Climate Change

Magnuson photo  
Mystery Lake , mid 1970s

# Winter is a part of our “Sense of Place.”



# Ice Services to us Declining with Warming

A Winter Ice Roads



B Outdoor Ice Skating



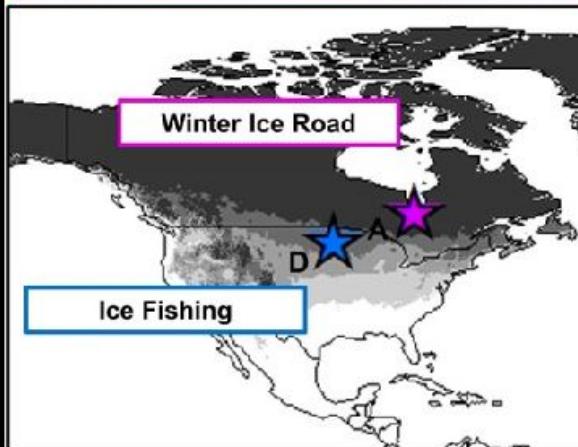
C Shinto Ritual



Winter Ice Road

Outdoor Ice Skating

Ice Fishing

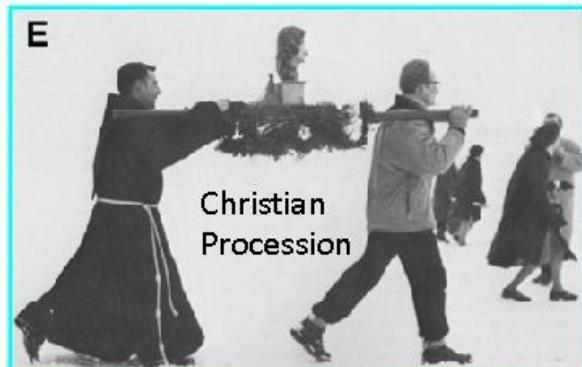


Religious Ice Ritual



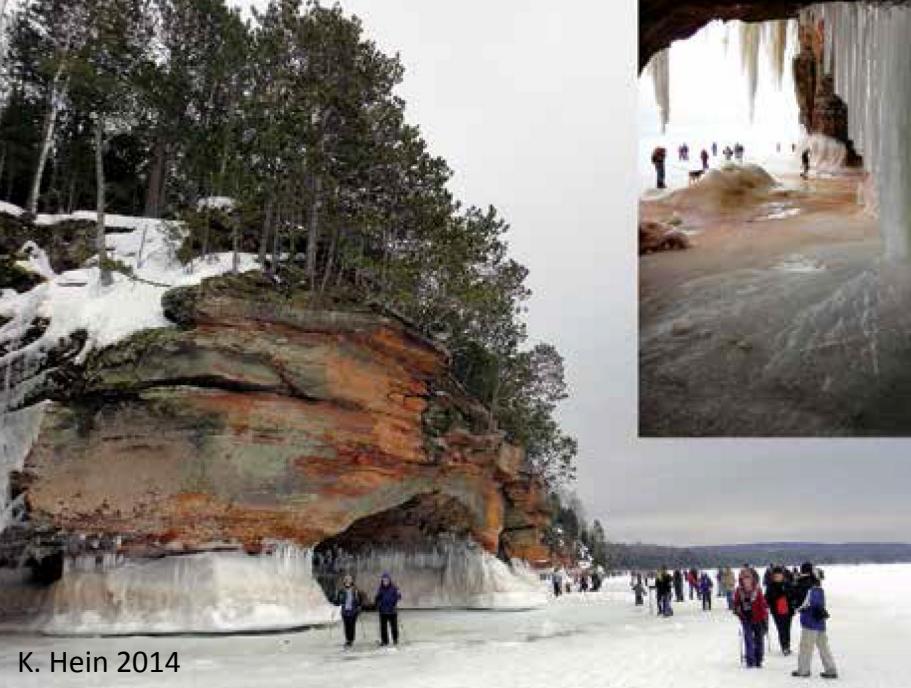
E

Christian Procession



## Photo Legend:

- (A) Stable Ice Road (Ontario, Canada). *Inset: Truck Through Ice (Manitoba, Canada).*
- (B) Ice Skating Race (Lake Mälaren, Sweden). *Inset: Ice Skater (Lake Fjärnöra, Sweden).*
- (C) Shinto Ritual (Lake Suwa, Japan)
- (D) International Eelpout Ice Fishing Festival (Leech Lake, Minnesota, USA).
- (E) Seegfrörne Procession (Lake Constance, Germany/Switzerland/Austria).



# Apostle Island National Lakeshore





# Ice Road from Madeline Island to Bayfield, Wisconsin

Sources: Bob Hanson  
[https://www.youtube.com/watch?v=d\\_tDfy6Ffc](https://www.youtube.com/watch?v=d_tDfy6Ffc)



How much longer  
can a good thing last?

Taken from an Article in Diane Daulton's Water Column  
(ddaulton@centurytel.net)

The Madeline Island Ferry was still running in February 2016.

Ice Cover = 0 days

The ferry can break through about 6 inches of ice.

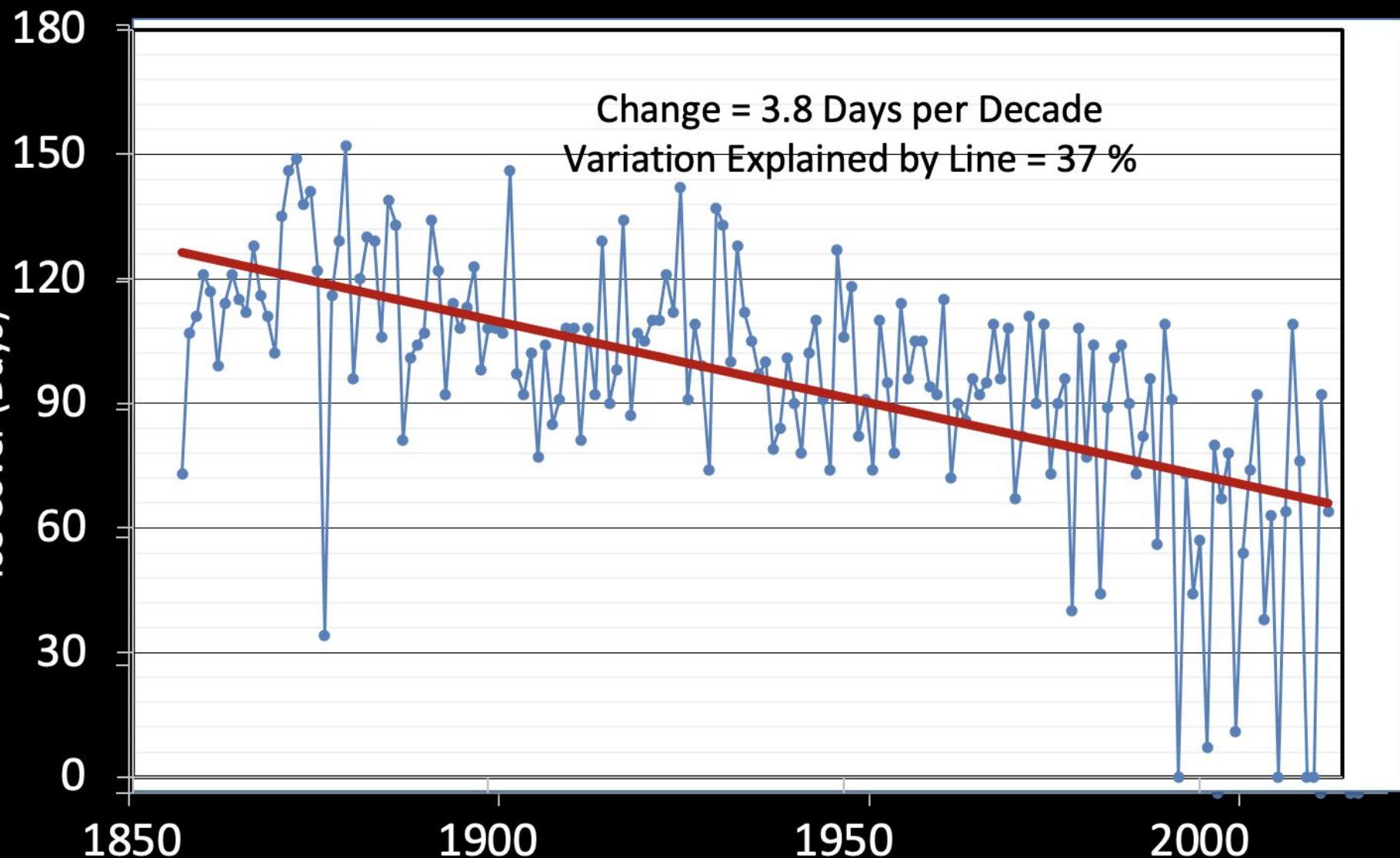
Boats may not have been as able to break ice as well in the early years.



*Photo courtesy of Jon Armstrong [www.apostlerentals.com](http://www.apostlerentals.com)*

# Bayfield Harbor, Lake Superior

## Days between Last Boat in Fall and First Boat in Spring



# Winter is a part of our “Sense of Place.”



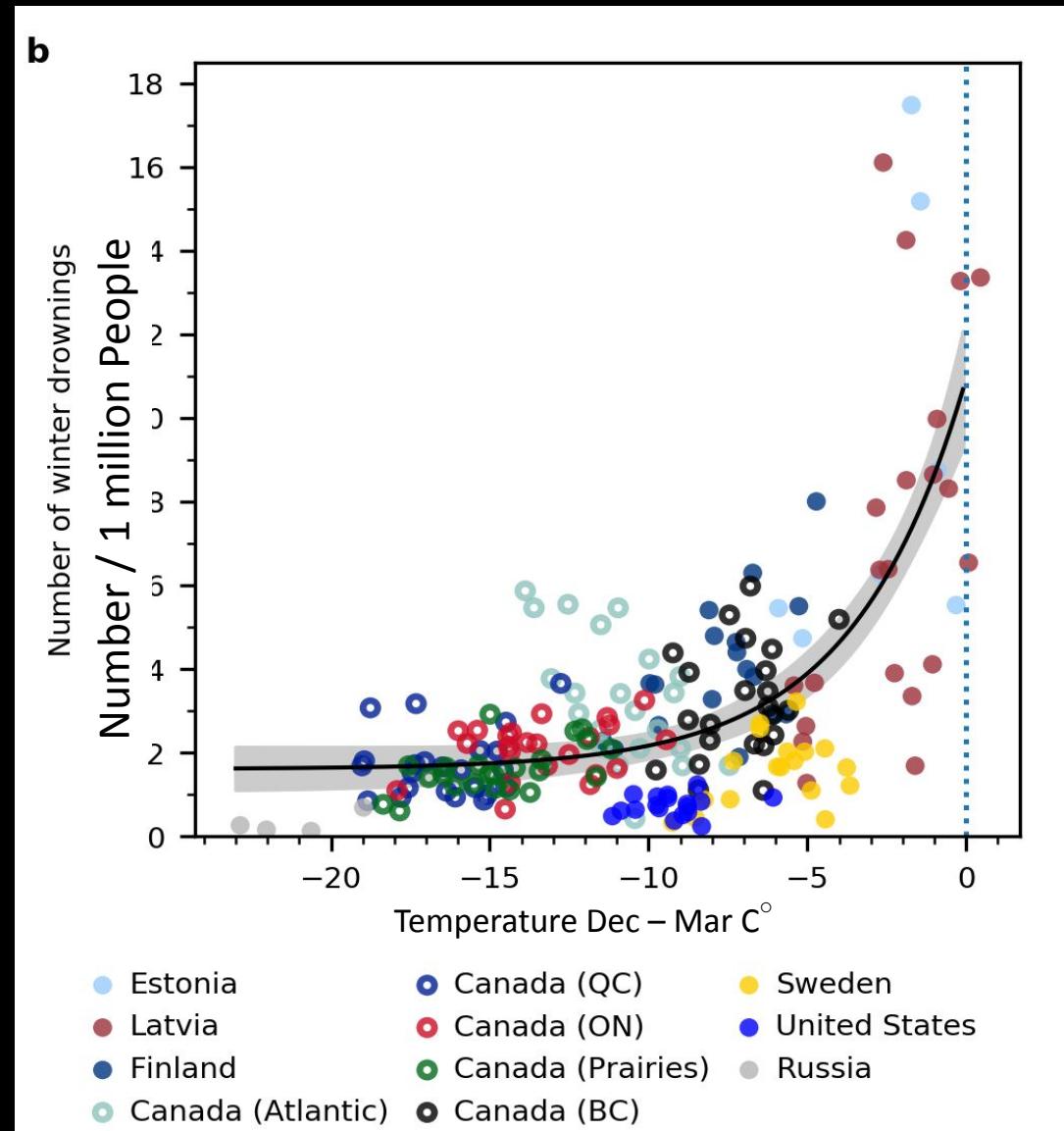
# Increased Winter Drownings in Warmer Winters.

Increased winter drownings on ice-covered lakes regions with warmer winters

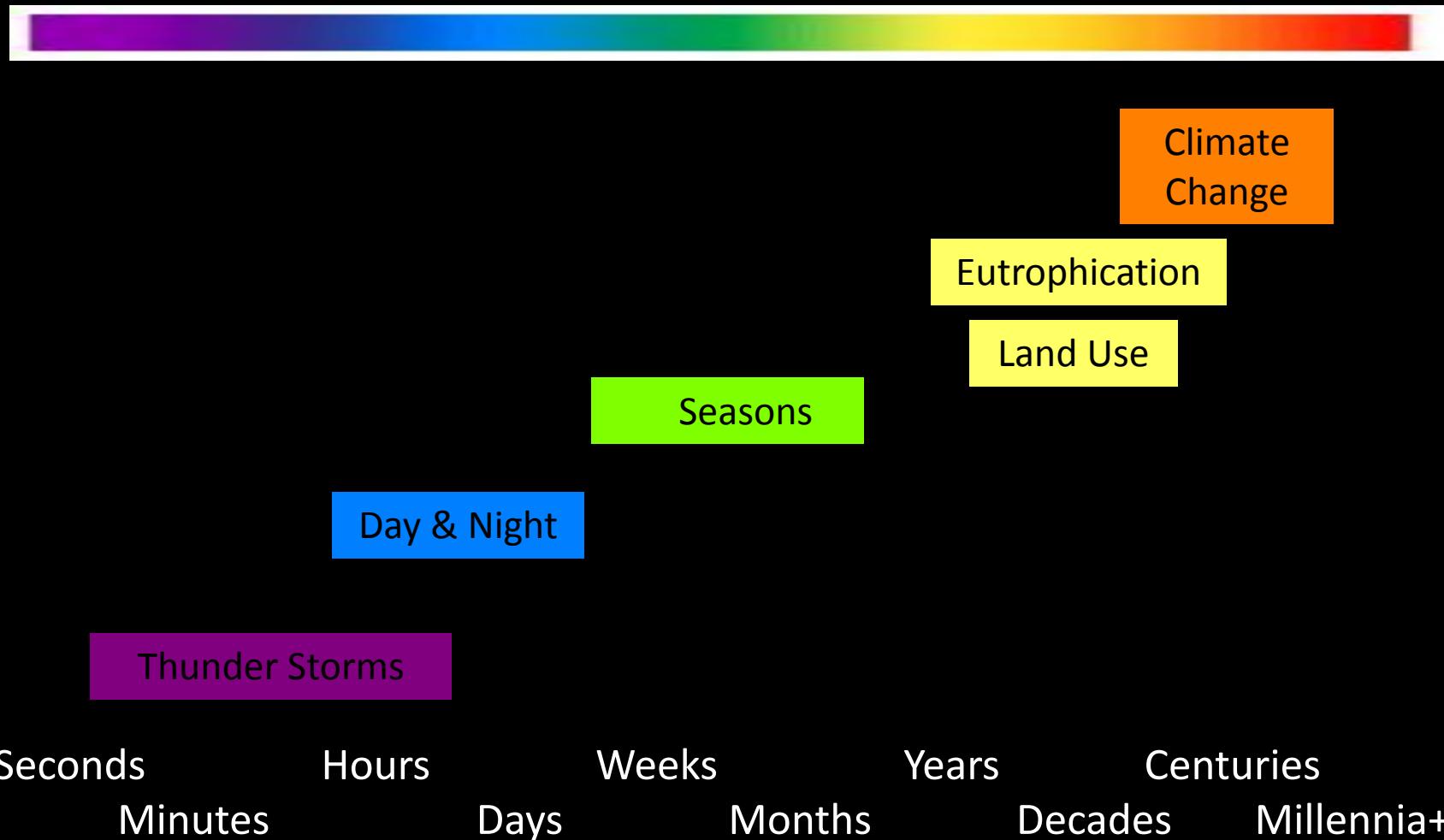
We analyzed of 4,000 winter drownings in 10 countries

About 20 % of total drownings

48 % of drownings are explained by winter temperatures



# Changes Occur Quickly and Slowly



Time Scales of Changes

Magnuson 2009

Lake Mendota's ice ridges mirror the complex interannual variability



So be aware & use what we learned today  
to help understand long-term change



Do not fall victims to living in:

# The Invisible Present The Invisible Place

# Think Ahead! Climate Change Adaptation & Mitigation



Magnuson Photos