## THE POWER OF CLIMATE CHANGE

### Minnesota Meteorologists Explain Climate Change

Minnesotans love to talk about the weather. But when weather patterns change, experts encourage people to shift their conversations to climate change.



"Climate is what you expect. Weather is what you get.
Climate change tilts the odds towards extreme weather,
the way steroids pump up a baseball player. You can't
prove any single home run was sparked by steroid use, but
you did see how it increased the player's batting average."

Paul Douglas, Meteorologist



"When I see changes in data from our own backyard, I take notice."

Dr. Mark Seeley, University of Minnesota Extension Climatologist and Meteorologist

### By the Numbers

For decades, Dr. Mark Seeley and other climatologists have tracked three climate trends—**rising temperatures, extreme storms** and **higher dew points**—driving the frequency and intensity of **extreme weather** in Minnesota.

#### **Temperatures Are Rising**

The temperature in Minnesota has increased 1°F to 2°F since the 1980s, after decades of essentially no change. The closer to the present that the trend is assessed, the greater the rate of observed increase.

Projected increases: 2°F to 6°F more by 2050 and 5°F to 10°F by 2100.

#### **Extreme Storms**

Yearly frequency of the largest storms—those with three inches or more of rainfall in a single day—have more than doubled in just over 50 years.

In the past decade, such dramatic rains have increased by more than 70%.

Scientists project that extreme weather events will occur more frequently.

#### **Dew Points Are Higher**

Dew point measures the air's moisture. When dew point temperatures reach 70-plus degrees Fahrenheit they are tropical. We are experiencing greater frequency of 70°F dew points. When the dew point and air temperature are high, so is the heat index, a measure of how the temperature feels with the two combined.

Minnesota had never recorded an 80°F dew point until the summer of 1966. Since then, 80°F dew points have occurred more frequently.



Seven of Minnesota's 10 warmest years occurred in the last 15 years.



Since 2004, Minnesota has had three 1,000-year flash floods.



On July 19, 2011, Moorhead was the hottest, most humid spot on Earth. Its 88°F dew point and 134°F heat index eclipsed the Amazon Jungle—the only other place in the Western Hemisphere with a dew point in the 80s.

## **How We Cause Climate Change**

Ninety-seven percent of scientists—including the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA)—agree that humans are causing climate change.

"Changes in temperature, precipitation patterns, snow and ice cover, and sea level have naturally happened throughout history," Dr. Mark Seeley said. "What's different now is how quickly changes are happening, given increasing levels of greenhouse gases in the atmosphere."

Burning fossil fuels (oil, coal, natural gas) to run our power plants, vehicles and factories produces carbon dioxide, the most predominant greenhouse gas. The Earth's atmosphere acts like a pane of glass in a greenhouse, trapping the sun's heat in the lower atmosphere and causing the Earth's surface to warm.



## **Minnesota Experts and Economists Raise Flags**

While total costs of some climate change impacts, such as heat-related illnesses and water quality issues, are still unknown, two costs are hitting people's pocketbooks now.

## Already Paying the Price for Climate Change

The cost associated with climate change is real—not just a projection for the future. We are already paying the price.

Climate change makes weather events like severe drought more likely and is causing sea levels to rise.

As the frequency and intensity of extreme weather increases, so do our home insurance rates, the number heat-related health emergencies, and disturbances to our crops and other industries.



#### **Disaster Costs**

We also pay the costs of responding to climate-related emergency situations and rebuilding afterwards.

Since 1997, 32 severe weather natural disasters cost Minnesota nearly \$500 million. This is the price we pay for not adapting ourselves. And, we will continue to pay the price if we do not work together.

## Billions in Damages from Electricity Generation

University of Minnesota economists estimate the total annual health and environmental damages from electricity generation in Minnesota are more than \$2 billion.

That is \$800 million in health costs—largely related to respiratory and cardiovascular health impacts from "criteria air pollutant" emissions (sulfur dioxide, nitrous oxides, particulates, ammonia and volatile organic compounds).

More than \$1.2 billion is from damages related to global climate change.

Emissions from coal-fired electricity generation contribute to more than 90% of the total damages.

Further, the
American Lung
Association
estimates particulate
matter from coalburning power
plants cause 24,000
premature deaths,
550,000 asthma
attacks and 38,000
heart attacks per
year nationally.



## Drought and Floods at Once?

New precipitation trends have the potential to cause both increased flooding and drought, based on the localized nature of storms and their intensity, leaving parts of the state drenched and others dry. In 2007. 24 Minnesota counties received drought designation, while seven counties were declared flood disasters. "At first, we thought that vast discrepancy was a singularity, a sample of one," Dr. Mark Seeley said. "But in 2012, 55 Minnesota counties received federal drought designation at the same time 11 counties declared flood emergencies. Two times in 10 years is no longer a singularity."



Flooding in 2012 in Northeast
Minnesota damaged roads and bridges,
water and sewer systems and other
infrastructure, costing \$108 million.
More than 1,700 homes and 100
businesses were damaged or destroyed,
costing more than \$12 million.

## About that Polar Vortex — Earth Still Logged Its Fourth-Warmest January

Despite bone-chilling cold in Minnesota, the 2014 Polar Vortex was an icy blip in a hotter global story.



Meteorologist Paul Douglas explains: "We are all hard-wired to react to weather, not the longer, slower (global) climate trends that have so many scientists concerned. You'd never know it staring at the thermometer in your backyard, but the planet continues to run a low-grade fever." Here's a clip from Climate Central: "[January 2014] was the fourth-warmest January since recordkeeping began in 1880. It was also the 347th consecutive month with above-average temperatures compared to the 20th century average, which has been fueled in large part by climate change."

## THE POWER OF CLIMATE CHANGE

## In ways both plain and simple, the world's climate is changing. As is Minnesota's.

Scientists have issued their strongest position on climate change, warning that changes are happening now and are no longer a far-off concern. Moreover, problems will grow substantially worse unless greenhouse gas emissions are brought under control, particularly in the next 15 years, to forestall the worst effects of global warming.

In Minnesota, climate change has hit home, with three 1,000-year floods since 2004 and dozens more intense weather events—from hailstorms to tornadoes to droughts.

Financial impacts are just as real. In 2013, Minnesota had some of the highest weather-related disaster claims in the country, even topping some tornado- and hurricane-prone states. And, University of Minnesota economists estimate that electricity generation annually causes more than \$2 billion in environmental and health damages, such as asthma aggravated by air pollutants.

Scientific predictions of extreme heat, poor air and water quality, and sweeping changes to Minnesota's wildlife and fish habitats foreshadow significant changes in the way we work, live and play.

# **CLIMATE CHANGE: WHAT'S AT STAKE?**





### WORK

#### **Businesses Face Risks**

Climate change has the power to contribute to lower gross domestic products, higher food and commodity costs, and greater financial risk.



Minnesotans may be surprised to hear that familiar companies, such as Coca-Cola and Chipotle, are already preparing for disruptions in water and ingredient sources.

### **Good News, Bad News for Farmers**

Longer growing seasons are a blessing for farmers, but severe weather and heat-loving pests, invasive species and plant diseases could wipe out their gains. Extreme heat is another factor, which causes stress illness and even death in livestock



Apple production in Minnesota was as much as 47% below normal in 2012. A hard frost in April followed an unusually warm March, damaging buds. A few months later, apples suffered damage from hail and drought.

#### **Tough Conditions for Outdoor Workers**

Summer heat and poor air quality could make it difficult for construction workers, landscapers and other outdoor workers to keep cool and breathe easily.

#### Heat and Smog

With more days topping 100-degrees Fahrenheit, Minnesotans could experience more days with poor air quality, causing respiratory and cardiovascular problems.

LIVE



With more extreme heat comes the higher risk of heat-related illness.

#### 100°F

### **Floods and Drought**

Intense, local thunderstorms mean some Minnesotans will experience heavy rain and flooding, while others will face severe drought and the risk of wildfires.

#### **Water Woes**

Drought could reduce drinking water supplies. Drinking water could smell or taste bad, thanks to heat-induced algae growth. And chances of waterborne disease outbreaks increase with more flooding.

#### Wheezing, Sneezing

A longer allergy season is likely—and allergies may be more severe. Health officials say this can worsen asthma symptoms for vulnerable populations, such as kids and the elderly.

#### **Food Security**

Volatile weather, more heat-loving pests—and even longer growing seasons—cause swings in food production, costs, availability and nutritional value.



#### **Road Bumps**

Increased freeze-thaw cycles in winter will degrade Minnesota's roads more quickly and increase replacement costs. More winter ice and rain (vs. snow) will make it even harder to keep roads safe. And, more summer heat means more buckled roadways.

A Changing Forest

It is likely that iconic spruce, fir, aspen and birch trees will retreat northward, and the Boundary Waters Canoe Area (BWCA) may give way to hardwood forests.



#### **Shorter Snowmobile, Ski and Sled Season**

Minnesota might have a shorter season of snow and ice cover, resulting in fewer winter recreational opportunities.

#### Less Lake Fun

It may be difficult to boat, ski or swim in some lakes with excessive algae blooms or more rooted-plants plaguing lakes. Both grow due to nutrient-loading (from residential and agriculture runoff), warmer water temperatures and longer growing seasons.

### **More Disease-Carrying Pests**

Tick- and mosquito-borne illnesses are already on the rise. Health officials say climate change may explain a geographic spread of ticks, especially in northern Minnesota.

### **Heads Up, Hunters and Anglers**

From the North Shore to prairie country, the diversity of fish and wildlife is changing, as factors such as heat stress and flooding alter the availability of food, water and habitat.



Northeastern Minnesota's moose population has dropped 52% since 2010.
Scientists have attributed some deaths to parasites and overall poor physical condition. Both may be linked to warming temperatures.



37% of all freshwater aquatic animal species, from trout in North Shore streams to walleye in Lake Pepin, could be at risk. This risk poses potential economic and cultural losses.



