CLIMATE CHANGE

I. What is the issue? Why are we concerned?

Climate change – global warming – is one of the biggest challenges facing Planet Earth and the people living on it. Temperatures have risen, and are predicted to rise further and faster. Sea levels also are rising as arctic ice melts.[1] Polar bears are threatened.[2] Malaria-carrying mosquitoes are appearing at elevations formerly too cool to support them.[3]

There is a near consensus among scientists, and a growing awareness among members of the public, that climate change is real, that it is accelerating and that its implications for our natural environment and the way we live are profound. At the higher end, the roughly 3.5 to 7.5 degrees Fahrenheit increase predicted in the Earth's average temperature over the next century[4] would be about as great a change as the warming that has occurred since the last ice age 20,000 years ago.

There also is widespread agreement among scientists that the warming the Earth has experienced, and is experiencing, is the result of human activity.

There is very high confidence that the net effect of human activities since 1750 has been one of warming," the Intergovernmental Panel on Climate Change concluded in a major report released Nov. 17. The IPCC, a prestigious scientific organization sponsored by the United Nations, also concluded that it was "very likely" that global temperature increases over the last half of the 20th Century resulted from increases in the atmosphere of the so-called "greenhouse gases." The gases, produced in large measure from the burning of fossil fuels such as coal and gasoline, are carbon dioxide, methane and nitrous oxide.

For Minnesotans, predicted big temperature increases over the next century mean many of us would be considerably more uncomfortable in the summertime -- "I say it's going to be something like Southern Illinois," predicts Peter Ciborowski, a Minnesota Environmental Protection Agency research scientist who is the agency's expert on climate change – and it means our character-building winters often would be puny imitations of what they once were.

For Minnesota's surface and sub-surface waters, the climate change projected over the next century is likely to have major consequences:

- There is disagreement about whether the state will get wetter or drier, and over what time period. If precipitation decreases or stays relatively constant, streams and stream-fed lakes could become smaller as a result of heightened evaporation in warmer summers and less ice cover in the winter. Some wetlands also could disappear. If precipitation increases, as it has over the last century, water levels in lakes, rivers and wetlands could rise. [5]

- More flooding, and perhaps more erosion and more water pollution from runoff, would occur as a result of a trend toward more storms with heavy rainfall.[6] Ground water supplies could decrease if there is less rain or less-frequent, but heavier rains.

- Cold-water fish, such as brook trout and lake trout would die out in many areas. Cool-water fish, like walleyes and northern pike, and warmer-water species, like bluegills and smallmouth bass, would move northward.[7]

- Less ice cover in the winter would decrease the "winterkill" of fish in shallow lakes. Greater summer stratification in lakes would produce bigger oxygen-depleted zones in the lakes' depths and could lead to fish die-offs.[8]

- Blue-green algae would form in lakes earlier in the summer.

- The loon, Minnesota's state bird, could disappear from much of its current range across the northern and northeastern parts of the state.[9]

- Lake Superior, whose water level hit a historic low this fall, could drop further because of evaporation caused by decreased ice cover.[10]

II. What are the trends?

There is little doubt that the world has been getting warmer. Globally, eleven of the last 12 years are among the top 12 warmest years since 1850, according to the Intergovernmental Panel on Climate Change's latest report. The IPCC found an approximate 1.4 degree Fahrenheit increase in the world's average temperature over the last century, with a bigger increase in northern latitudes. "It is very likely that over the past 50 years cold days, cold nights and frosts have become less frequent over most land areas, and hot days and hot nights have become more frequent," the IPCC said. "It is likely that heat waves have become more frequent over most land areas."

The same IPCC report said average Northern Hemisphere temperatures over the last half of the 20th Century were very likely the highest temperatures for any similar period in the last 500 years.

In Minnesota, average annual temperatures have increased about 1.5 to 2 degrees Fahrenheit over the last 100 years, with the biggest increases recorded in the Northwest, North Central and East Central parts of the state. The rate of increase has increased significantly in about the last decade. Daytime temperatures have not increased dramatically, but nights are warmer.

"We're basically losing our winter…My guess is we've lost two to three weeks of winter, two on the spring side and one on the fall side," said Ciborowski, the Minnesota PCA scientist.

Over the last century, average yearly precipitation has also increased in Minnesota, about 10 percent statewide. The increase has predominately occurred in the summer, and it has been concentrated in the southern two-thirds of the state.

Predictions about how the weather will change over the next 100 years and how weather changes would affect fresh water are imprecise and speculative. Computer modeling relies on major assumptions about how the Earth's atmosphere reacts to greenhouse gases, how much future warming will occur because of changes the gases already have produced, and the rate at which the gases will be released in the future. But the potential weather changes predicted by the IPCC over the short span of a century are more dramatic than any similar changes in the historic record.

The potential climate changes projected by the IPCC are based on a survey of a range of modeling with varying assumptions about the susceptibility of the world's climate to increases in greenhouse gases and similarly varied assumptions about the worldwide population, economic, technological and regulatory changes that could affect the release of those gases.

The international panel's modeling maps for worldwide temperature and precipitation changes project an average increase of about 7 degrees Fahrenheit for Minnesota over the course of this century. It predicts wetter Minnesota winters and summers that would perhaps be a bit drier.

III. Why is this issue important to address?

Some areas of the world may have isolated environmental and public health crises that are more pressing, but global warming almost certainly is the biggest environmental issue facing the world as a whole. In Minnesota, climate change's impact on other areas of the environment, for example the state's forests, may be greater than its impact on water.

IV. What factors contribute to this issue?

Scientists can't say with precision how much greenhouse gas is too much, when emissions would reach a tipping point and produce irreversible, cataclysmic changes.

While scientists generally agree climate change already has occurred and is going to occur at a faster rate, some political leaders and the citizens they represent deny or are skeptical of the link between human activity and global warming. Two polls, conducted in January and July, offer pictures of public opinion.

The January poll by the Pew Research Center For The People And The Press[11] reported that 77 percent of U.S. residents believed there was solid evidence that global warming is occurring. Forty-seven percent said the warming was caused by human activity, and 20 percent said it was due to natural weather patterns. The July poll, conducted by Yale University, Gallup and the ClearVision Institute,[12] found that 62 percent of Americans either strongly agreed or agreed somewhat with the proposition that "Life on Earth will continue

without major disruptions only if we take immediate and drastic action to reduce global warming."

A potential obstacle to action on global warming could come from the fact that future warming would play out differently in different parts of the world. For example, the IPCC predicts that by the 2020s food production in parts of Africa could be reduced by 50 percent. But in North America, the same warming could increase crop yields by 5-20 percent.

The biggest obstacle to action could be a conflict between developed nations and developing ones over how much each group should suffer in reduced standards of living to control emissions.

V. What is the regulatory oversight?

The primary worldwide oversight is the Kyoto Protocol, which set limits on carbon dioxide and other greenhouse gas emissions for 35 industrialized countries. The international treaty, was negotiated in 1997 in Kyoto, Japan. In the years since then, more than 140 countries have signed the treaty, which expires in 2012. The United States, which helped shape the treaty, has not signed the pact. Until late this year, Australia also had not signed the treaty, but on Dec. 3, the new Labor government of Prime Minister Kevin Rudd announced Australia would accept it.

The Kyoto Protocol, intended to be a precursor to a later agreement in which developing nations would also promise to limit emissions, calls for the European Union to reduce emissions 8 percent below 1990 levels, for Japan and Canada to reduce emissions 6 percent, and for Russia to limit emissions to its 1990 level. The pact called for the United States to reduce emissions by 7 percent from its 1990 level. Australia, one of only three industrialized countries allowed to increase emissions under the treaty, has a target of limiting its increase to 8 percent.

At present, there is little federal or state regulation of greenhouse gases.

But, in a major 5-4 decision in April 2007, the U.S. Supreme Court ruled that the federal Clean Air Act gives the federal Environmental Protection Agency authority to regulate greenhouse gases as pollutants. The EPA and President Bush had resisted doing that. The opinion did not require the EPA to regulate greenhouse gases or to conclude that the gases contribute to global warming. But the opinion, which came in a case initiated by Massachusetts and 11 other states, said the EPA can avoid regulating the gases "only if it determines that greenhouse gases do not contribute to climate change, or if it provides some reasonable explanation as to why it cannot or will not exercise its discretion to determine whether they do."[13]

At least four regional groups of states have begun efforts to regulate greenhouse gases: the Midwestern Greenhouse Gas Reduction Accord, the West Coast Global Warming Initiative,

the Southwest Climate Change Initiative and the Western Regional Climate Change Initiative.

The Midwestern effort, which includes Minnesota, aims to set targets and timelines for reductions in emissions and develop a market-based system that would allow industries to buy and sell rights to increased or reduced emissions.

In Minnesota, legislation enacted in 2007 targeted greenhouse gas emissions by requiring 25 percent of the state's electricity to come from renewable sources by 2025.

A 51-member Climate Change Advisory Group has been meeting since April and working with a consultant to prepare recommendations for the Minnesota Commerce Department, which was required by law to forward a report and recommendations to the governor and Legislature by Feb. 1, 2008. The report is supposed to recommend means by which Minnesota residents and businesses can reduce their greenhouse gas emissions 30 percent from 2005 levels by 2025, and achieve an 80 percent reduction by 2050.

VI. Is this an issue for other non-governmental groups?

It's a priority for a number of non-governmental groups. Four environmental groups -- Fresh Energy, the Izaak Walton League, the Minnesota Center for Environmental Advocacy and the Environmental Advocates of Minnesota – have representatives serving as members of the Climate Change Advisory Group.

VII. Who are the primary stakeholders?

Everyone who lives on the planet. Undeveloped countries seeking to grow their economies.

VIII. What is working?

In the United States, the regional compacts among the states show progress toward regulation of the greenhouse gases.

In addition, Americans seem to be moving toward recognition that global warming is a serious problem. Ciborowski , the PCA's climate change expert, said he believed a change in public opinion is occurring and is being driven by compelling "visual evidence from the Arctic" of melting ice and the threat the melting poses to polar bears facing starvation or drowning because of the disappearance of ice floes from which the bears hunt seals.

IX. What is necessary to show real gains?

Technological breakthroughs. Political change, such as the 2007 election in Australia that led that nation to accept the Kyoto Protocol and the change that recently led U.S. House and Senate negotiators to agree to require automakers to improve car and truck mileage by 40 percent. Increased awareness by individuals that global warming is real and is increasing, and a change of heart by individuals that will lead them to change their lifestyles and demand political action.

Ciborowski predicted that individuals are most likely to change, and to demand change, when they see evidence in their own immediate environment of global warming. "It's got to be experiential," he said. "You've got to go outside your cabin in the north woods and see all the birches are dying."

X. For more information

Intergovernmental Panel on Climate Change, a international scientific body established in 1988 by the World Meteorological Organization and the United Nations Environmental Programme. www.ipcc.ch.

Union of Concerned Scientists. www.ucsusa.org.
Pew Center on Global Climate Change. http://www.pewclimate.org.
Minnesota Climate Change Advisory Group. www.mnclimatechange.us.
George C. Marshall Institute, a Washington, D.C., think tank on the environment and defense that takes a skeptical view of global warming. www.marshall.org.
U.S. Environmental Protection Agency at http://epa.gov/climatechange/index.html.
National Oceanic and Atmospheric Administration's National Climatic Data Center at www.ncdc.noaa.gov/oa/ncdc.html.
Woods Hole Oceanographic Institution's Ocean and Climate Change Institute at www.whoi.edu.

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[1] References to temperatures, ice melting and sea levels are from the "Summary for Policymakers of the Synthesis Report of the IPCC Fourth Assessment Report, released in mid-November by the Intergovernmental Panel on Climate Change, a scientific body established by the World Meteorological Organization and the United Nations Environmental Programme in 1988. The report and the summary document are available on the IPCC Web site, www.ipcc.ch.

[2] Media reports.

[3] "Global Climate Change," a fact sheet issued by the Minnesota Pollution Control Agency, http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf

[4] Intergovernmental Panel on Climate Change Fourth Assessment Report. www.ipcc.ch.

[5] Three views on precipitation. "Climate Change and Minnesota," a 1997 publication of the U.S. Environmental Protection Agency, available at www.epa.gov. Lucinda B. Johnson, an aquatic ecologist at the Natural Resources Research Institute at the University of Minnesota, Duluth, who has written about the implications of Minnesota climate change for the Union of Concerned Scientists, said in an interview that Union of Concerned Scientists forecasts for climate change in Minnesota anticipate annual precipitation will stay about the same, but fail to keep pace with summer evaporation. Peter Ciborowski, the Minnesota Pollution Control Agency's climatologist, said in an interview that he believed precipitation will likely continue to increase, as it has over the last 100 years of warming in Minnesota, at least in the initial decades of this century. Ciborowski favors climatic scenarios that expect a net, after-evaporation, increase in precipitation and some increase in lake and river levels.

[6] Ciborowski expects "fewer, but more intense, rains." "Confronting Climate Change in the Great Lakes Region: Impacts on Minnesota Communities and Ecosystems," the Union of Concerned Scientists publication, predicts a 50-100 percent increase in 24-hour and multiday rains. The publication is available at www.ucsusa.org.

[7] Johnson.

[8] Johnson and Ciborowski.

[9] S. Matthews, et al.. 2004. Atlas of Climate Change Effects on 150 Bird Species in the Eastern United States, USDA USFS, General Technical Publication NE-318, map section page 16.

[10] http://www.d.umn.edu/~jaustin/ICE.html

[11] Pew Research Center.

[12] http://environment.yale.edu/news/5305-american-opinions-on-global-warming/

[13] http://www.supremecourtus.gov/opinions/06pdf/05-1120.pdf.