The Local Forecast — Mostly Cloudy with 99 Percent Chance of Global Warming

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The forecast for northern Minnesota calls for warmer temperatures year round, wetter winters, and snow cover that disappears by March. That's what current climate forecast models looking 50-100 years into the future predict. To some people, this may sound like an improvement. Unless, of course, you live in the southwest United States. Then it's grim news all around — hotter and dryer.

Tom Johnson, paleoclimatologist with the Large Lakes Observatory at the University of Minnesota Duluth, shared that perspective and much more with a full-house audience at the "Ask a Scientist" session presented by Minnesota Sea Grant on April 1.

Paleoclimatology is the study of climate change taken on the scale of the entire history of Earth. It uses records from ice sheets (ice cores), tree rings, sediment cores, and rocks to determine the past state of the climate system on Earth.

Johnson's research has focused on the analysis of sediment cores extracted from lake beds in African regions as well as closer to home here in Minnesota. Through the application of various analytical techniques, some of which have only recently been developed, climate data such as temperature, atmospheric composition, relative rainfall and other information can be extracted and associated with specific historic or geologic time frames. From this information, the earth's climate at various times in the past can be reconstructed.

So how much can understanding the climate of 10,000 years ago be of use to us today? Plenty, says Johnson.

First, understanding the past allows us to identify climatic variations that can be attributed to natural causes. Analyses of ice cores from Greenland and Antarctic glaciers reveal abrupt

temperature changes that have occurred in the past, at times following extended periods of gradual warming. Scientists have hypothesized that these abrupt changes are a result of the disruption of the North Atlantic current caused by the relatively rapid introduction of fresh water from a melting Greenland icecap. This scenario bears an uncomfortable similarity to present-day circumstance.

Second, decoding ancient climate information provides an environmental context for social upheaval. As an example, Johnson cited evidence in lake bottom sediment cores taken from Lake Turkana in present-day Kenya that document a period of extreme drought approximately 4,300 years ago. Lake Turkana is situated near the headwaters of the Nile River, and it is reasonable to conclude that a severe drought there would have a major impact on the Nile delta as well. Is it just coincidental then, that the Old Kingdom in Egypt collapsed at a time that coincides approximately with this period of severe drought? Similar paleoclimatological data can be found to support declines in Mesopotamian (Middle East) and Mayan (Central America) civilizations.

Third, paleoclimatology provides a means to test the increasingly complex climate forecast computer models being developed. By running a forecast model using data derived from paleoclimate studies, the results generated by the model can be compared to known historical outcomes. Weaknesses in the model can be identified and corrected.

The most recent report released by the Intergovernmental Panel on Climate Change (IPCC) is based on the averaged results of 21 different forecast models. The results, said Johnson, are largely consistent. The global average air temperature near the Earth's surface rose 1.33 ± 0.32 degrees Fahrenheit during the hundred years ending in 2005. The IPCC concludes "most of the observed increase in globally averaged temperatures since the mid-twentieth century is very likely due to the observed increase in anthropogenic (human-produced) greenhouse gas concentrations. Johnson said that 99.9 percent of the scientists working the field of climatology agree with these findings.

Furthermore, projections summarized by the IPCC indicate that average global temperature will likely rise an additional 2.0 to 11.5 degrees Fahrenheit during the 21st century. The degree of

increase varies depending on the different scenarios that are considered for reducing the generation of greenhouse gases. In any case, said Johnson, we will see an increase in average temperature of at least 1.5 degrees regardless of what we do now.

A member of the audience commented that 1.5 degrees didn't sound like much of a change. Johnson agreed, but pointed out that the last ice age represented only a 4-degree difference.

"The concern is that we may be approaching a threshold," said Johnson. "The big question that we can't answer today is how fast the Greenland icecap is melting."

Whether you look to ancient climates or just to the last century, one fact seems inescapable — our climate has changed, is changing, and will continue to change.

"It's not a question of will we survive," Johnson concluded. "It's whether societies will cope with it in a civilized manner."

On that matter, the jury is still out.