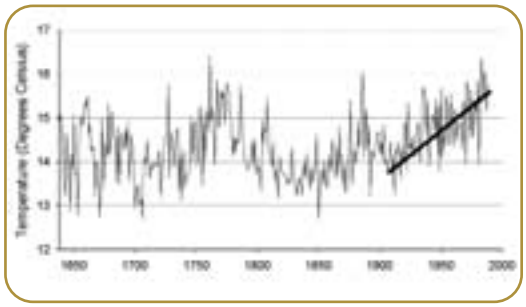
Measuring the past

Historic climate change

Over the last 400,000 years, the Earth's climate has been variable, changing from warm interglacial periods to ice-age climates in as few as several decades. Such rapid changes suggest that our planet is quite sensitive to natural factors that drive the climate system. These naturally-driven changes include such occurrences as volcanic eruptions and variations in the sun's energy output. Many of the mass extinction events in biological history, when a large fraction of the world's species disappeared, coincide with relatively abrupt changes in global climate that are similar in magnitude to changes predicted for the coming century.

Approximately 125,000 years ago, during an interglacial period, temperatures were about two degrees warmer than they are today. Since the last ice age approximately 10,000 years ago, global temperatures have been relatively stable and have not varied by more than 1˚C in a century. Temperatures experienced during the peak of the current interglacial period some 6,000 – 8,000 years ago were about 1 degree warmer than today. The Medieval Warm Period of about 1,000 years ago appears to have been warm in regions surrounding the North Atlantic but not in other parts of the Northern Hemisphere, and average temperatures for the entire hemisphere during that period were cooler than those of the past century.



Estimated June and July temperatures from tree ring records, Tombstone, Yukon 1638 to 1988. There is a warming trend since 1988.

Graph Source: 1999 Yukon State of the Environment Report. Data obtained from Holdsworth, G., H.R. Krouse, and M. Nosal. Ice core climate signals from Mt. Logan, Yukon, A.D. 1700-1987. In: Bradley, R.S. and Jones, P.D., eds. *Climate Since A.D. 1500*: Routledge. 483-504

How do we measure historic climate change?

Temperature measurements began only in about 1860. To find out about temperatures before this time, we must rely on indirect evidence, or proxy data. Proxy data are interpretations of local climate conditions. Using a combination of measurements and models, scientists can convert proxy data into temperature data. Historical temperature patterns can be interpreted from sediment cores from the bottoms of oceans and lakes, tree growth rings, corals, ice cores from glaciers, and polar ice caps. To find out more about research into past climates in northern Canada, search the NCE Infosources Database using the keyword 'paleoclimate' at http://yukon.taiga.net/infosources/.

The past 100 years: is climate change natural or human induced?

Natural climate variability suggests that some of the climate change we are experiencing could be due to natural causes. Indeed, studies show that during the first half of the 20th century, a significant part of the warming was likely due to a combination of increased solar radiation, decreased volcanic dust in the atmosphere, and rising greenhouse gas concentrations. However, during the past 50 years, solar intensity has varied and more frequent major volcanic eruptions have, on average, increased the level of volcanic dust in the atmosphere with time. Therefore, over the past 50 years, natural forcings, by themselves, would have caused global *cooling*. This contradicts the observed climate record, which shows a rapid *warming* in recent decades. As a result, the Intergovernmental Panel on Climate Change concluded that, while the changes during the past century are due to a combination of natural and human factors, changes over the past 50 years are predominately the result of human influences.

The importance of understanding past climates

The study of past climates (paleoclimatology) provides important insights into the significance of the rate and magnitude of future changes that are projected by climate models. An understanding of past climates also allows us to gain an understanding of natural factors that influence climate. For example, proxy records have shown us that the 20th century warming in the Northern Hemisphere is unprecedented in at least the past 1,000 years, and that the 1990s was the warmest decade, and 1998 and 2001 the two single warmest years, for that time period. Proxy data also gives scientists a way of checking the reliability of climate models by running them backwards in time and comparing model predictions to actual climate conditions.

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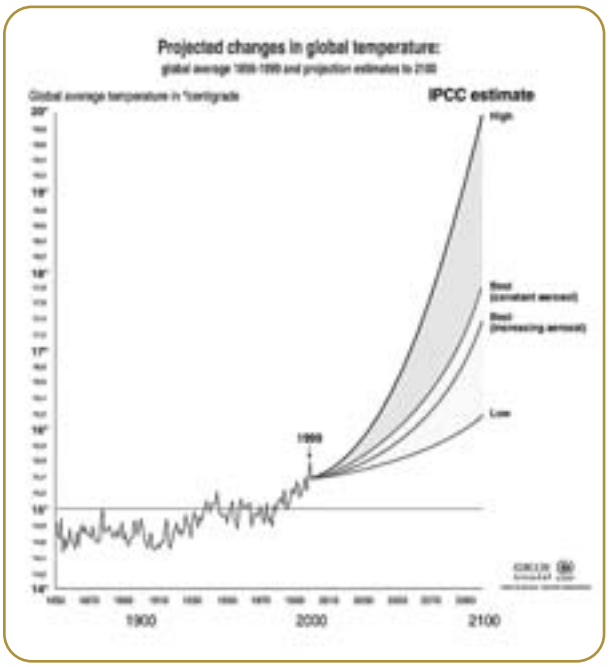
Predicting the future



Climate models predict that the global mean surface temperature could rise by about 1.4˚C to 5.8˚C by 2100. The actual amount of warming that we will experience will depend upon global efforts to reduce greenhouse gas emissions.

GRAPH SOURCE:
United Nations Environment Programme and GRID-Arendal. Available at Vital Climate Graphics: www.climateark.org

Climate scenarios

Climate scenarios are descriptions of the future climate that are based on computer models of the atmosphere-ocean system. These models are able to project long-term average conditions over broad climate regions. Models mathematically simulate the interactions of the land, sea, and air, which together determine the Earth's climate. Each scenario is based on different levels of future greenhouse gas emissions, since we are not able to predict precisely what greenhouse gas emissions will be in the future. Researchers commonly use a range of scenarios when projecting the impacts of climate change.

In Canada, the Canadian Climate Impacts and Scenarios (CICS) group at the University of Victoria provides climate scenario information and advice on use of climate scenarios. On the CICS website, http://www.cics.uvic.ca/scenarios/, you can view maps, create custom plots, and download data.

How reliable are projections of future climate?

There are many reasons to have confidence in models that project future climate. Climate models are based on physical laws of nature and are able to reproduce many of the observed features of the atmosphere and ocean. Current research efforts are focusing on fine-tuning these models and on developing regional climate models that are capable of projecting future climates at the local level.

The weather in Old Crow is changing rapidly each year. It is getting warmer and warmer with all the seasons.

Old Crow Elder

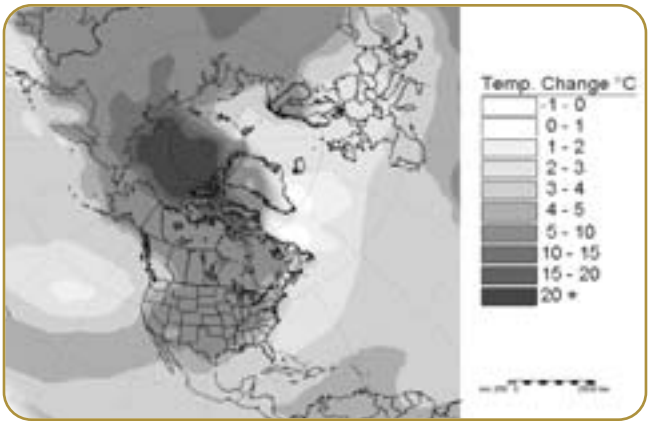
cited from Arctic Borderlands Ecological Knowledge Co-operative's *2002 Community Monitoring Report*. Quotations used with permission. www.taiga.net/coop

Climate change projections for the Yukon

The rate and magnitude of temperature change is predicted to be greatest in high latitude regions of the Northern Hemisphere, and may rise by as much as 5˚C to 7˚C. Yukon-specific projections include the following changes in Yukon climate:

- Higher year-round temperatures
  - Winters warming more than summers, with the winter warming being greater farther north.
  - Summers warming more in the south and central Yukon than in the north, due to the moderating effect of the Beaufort Sea.
- More snow in the winter, with the change being greater farther north. (There will be little change in average summer precipitation levels.)
- More and larger storms (both winter storms and heavy summer rainfall storms, with more thunder and lightning).

Some of these changes have already become evident, but researchers cannot predict exactly when, or if, we will see all of them.



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