

Climate Change Past and Future

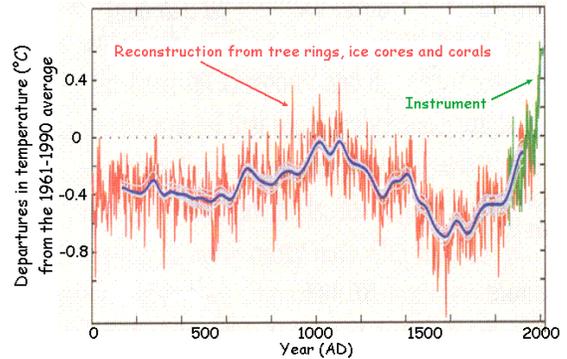
Atmospheric Warming and Climate Change

The global atmosphere warmed by 0.6°C during the 20th century. Although people tend to use the two terms interchangeably, global warming is only one aspect of climate change. Atmospheric warming affects other aspects of the climate system: the pressure and composition of the atmosphere; the temperature of surface air, land, water, and ice; the water content of air, clouds, snow and ice; wind and ocean currents; ocean temperature, density, and salinity; and physical processes such as precipitation and evaporation. Climate change manifests differently from one part of the world to another, and some regions, including northeastern Canada, have cooled.

The average person thinks of climate change as a gradual increase in average annual temperature and other aspects of climate. It also includes gradual changes in year-to-year natural climate variability, for example in the cyclical swings between cool, wet La Niña years and warm, dry El Niño years. It includes gradual changes in the frequency and/or severity of extreme events such as heat waves, droughts, and high-intensity rainfalls. And it may in future include abrupt and severe shifts in regional climate.

Such changes in regional climate affect natural systems and human communities.

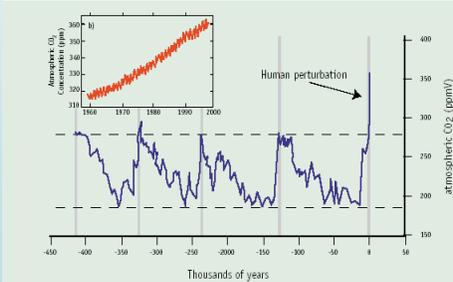
Temperature of Northern Hemisphere AD 1-2000



Modified from Moberg et al. 2005, Nature 433:613-617.

Past Changes in Atmospheric CO₂ Concentration

The recent human influence on the carbon cycle



Atmospheric CO₂ concentration from the Vostok ice core record with the recent human perturbation superimposed. The inset shows the observed contemporary increase in atmospheric CO₂ concentration from the Mauna Loa (Hawaii) Observatory. Sources: Petit et al. (1999) Nature 399, 429-436 and National Oceanic and Atmospheric Administration (NOAA), USA

Causes of Atmospheric Warming

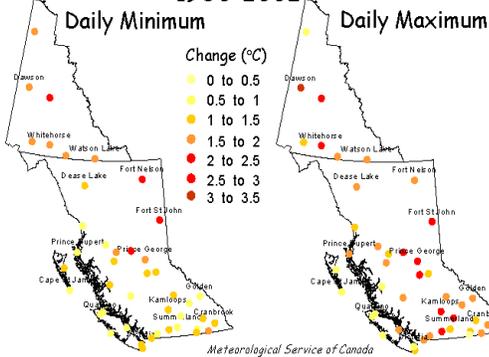
Climate varies naturally over time, and scientists have identified natural causes for such short- and long-term variability, including changes in the energy output from the Sun, the distribution of land and ocean due to tectonic plate movement, the reflectivity of the Earth's surface, the orbit of the Earth, and the occurrence of volcanic eruptions and other cataclysmic events.

There is strong scientific evidence, however, that most of the warming observed over the last 55 years is due to changes in the concentration of carbon dioxide (CO₂) and other greenhouse gases in the atmosphere, and to human activities that produce these gases, primarily the burning of fossil fuels. The concentration of CO₂ in the atmosphere increased from 280 parts per million (ppm) in 1750 to 370 ppm in 2005. CO₂ concentration is likely increasing faster than at any other time in the past 20,000 years.

Future climate change will depend on future greenhouse gas emissions. With a rapid shift away from fossil fuels and toward cleaner technologies, CO₂ concentrations in 2100 could be as low as 490 ppm. With continued reliance on fossil fuels and existing technology, CO₂ could increase to 1260 ppm.

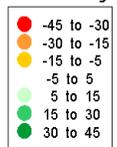
Past Climate Change in British Columbia

Trends in Annual Temperature 1950-2002



Trends in Seasonal Precipitation 1950-2002

Percent change



Meteorological Service of Canada

What Can We Expect in Future?

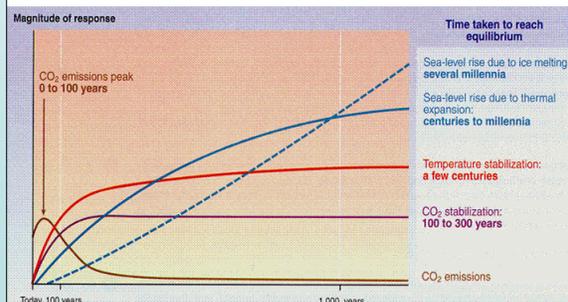
Climate scientists warn that further climate change is unavoidable. The global climate system will continue to respond to the excess greenhouse gases already in the atmosphere. It will take 100 to 300 years to stabilize the concentrations of greenhouse gases in the atmosphere. It will take a few centuries for temperature to stabilize. Sea level will continue to rise for millennia. Human communities therefore need to adapt to climate change and its impacts.

The amount of future warming will depend on how fast humans continue to add greenhouse gases to the atmosphere, and how the climate system responds. Climate change scenarios project that global temperature will rise by 1.4°C to 5.8°C between 1990 and 2100. The rate of warming projected for the 21st century is likely faster than at any other time in the past 10,000 years. While natural systems can adjust to climate change, in the past rapid changes have resulted in rapid loss of species.

Projected impacts on western North America include: 1°C to 4°C warming by 2100, with the interior and north of BC warming faster; proportionally greater warming in winter; increased precipitation, with more rain and less snow; reduced snow pack; glacier and ice pack retreat; earlier spring thaws; changes in river flow patterns; increases in the frequency and severity of fire, pest and disease outbreaks, and other natural disturbances; large scale ecosystem shifts; and loss of total area in some ecosystems.

Climate scientists agree that we cannot stop or reverse climate change, but that if we significantly reduce greenhouse gas emissions we may be able to slow the warming trend enough to allow biological systems and human communities more time to adapt.

CO₂ concentration, temperature and sea level will continue to rise for centuries



Intergovernmental Panel on Climate Change, 2001