Lake bottom data

Lake sediments capture thousands of years of local climate information

Researchers are sampling over 70 lakes in Saskatchewan to increase our understanding of Saskatchewan's climate during the last 2000 years.

Every second of every day, lake sediments are accumulating. In these sediments is a record of the organisms that lived in and around the lake, the processes occurring in the lake, the composition of the lake's water, and the conditions of its watershed.

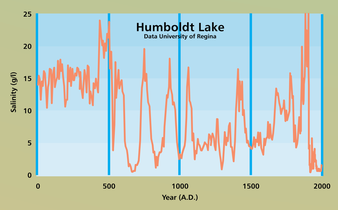
University of Regina researchers collect tubes of lake mud using the coring device seen here. This tube is pushed slowly into the sediments, and can be retrieved with the undisturbed mud remaining within the tube.

Paleolimnology is the reconstruction of lake histories based on sediment cores taken from lake bottoms. Depending on the length of the core, data going back thousands of years can be retrieved.

Microscopic algae known as diatoms provide one of the best ways to build these histories. Certain species prefer water with high salinity and are often found in salty lakes where water evaporates during typical drought years. Other species prefer freshwater with low salt content, conditions typical of wetter years. By identifying the types and abundance of each diatom species in each section of a lake core, scientists can reconstruct changes in regional climate conditions through time.

Diatoms have cell walls made of a glass-like material which can preserve in the sediments for 10s of 1000s of years. In addition, the pattern on each cell allows us to identify the species with little error. There are often over 100 diatom species in each sediment sample.

Researchers are discovering that the weather experienced during the 20th century is not representative of the past few thousand years. Preliminary findings indicate that severe droughts are a regular feature in central Saskatchewan. Long droughts (5-10 years) can be expected twice per century. Severe droughts have not occurred in the last century, but have a 48% chance of occurring by 2030. The regional climate as a whole also appears to have been more arid before 1200 A.D. Ironically, flooding seems to have been a reoccurring feature as well.



The recorded weather from the last 100 years gives us too brief a view of the natural variability of Saskatchewan's climate and makes it difficult to forecast the severity and duration of future droughts. Paleoclimatic research, such as this work on lake sediments, helps to provide a better perspective of the natural extremes of our climate.

Boring old trees

Tree rings reveal a record of local precipitation from the last several hundred years

Scientists study cores and cross sections of trees to determine what the climate was like hundreds of years ago.

Dendrochronology is the science of dating past events by studying tree ring growth. When trees are studied specifically to find out past climate information, the science is called **Dendroclimatology**. This science does not allow us to know exactly what the weather was like at a certain time, but rather what the climate trends were. By studying the growth patterns of trees the amount of precipitation in an area can be determined.

But where does one find really old trees on the prairies? University of Regina researchers have taken samples from a number of different sites in Canada and the United States including the Cypress Hills, the Bears Paw Mountains, the Sweet Grass Hills, and the Duck Mountains. By putting together the tree-ring chronologies from all of these localities researchers can analyze growth responses to drought across the Prairie Ecozone.

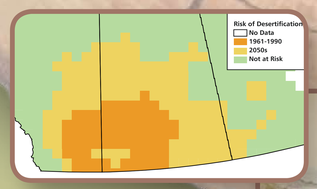
Even old wooden buildings contain climate data. Reseachers worked with local farmers and ranchers collecting information about when the logs were cut and who built the buildings.

Researchers from the University of Regina bore a sample core from a Limber Pine in the foothills in Alberta.

Tree samples are taken in the form of disks and cores. Cores are taken by boring into a live tree and taking a thin dowel-shaped cross section out. The exact age of the tree can be determined, since the tree was still alive when the core was taken and while alive, trees produce one new ring each year. Disk samples are taken from dead trees; the number of rings equals the total number of years of growth. Careful matching of the ring sequence to other samples from living trees allows a date range to given. The samples are sanded and the ring widths are measured to within .001mm using a 40X stereomicroscope and a computer software program. The spacing of the rings provides a record of the precipitation for each year in that location.

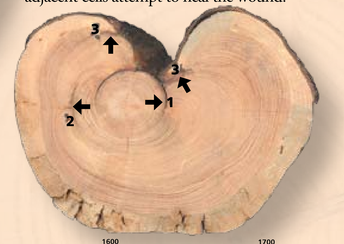
Tree ring analysis is one of the methods used to study global warming and climate change. Scientists construct climate patterns from the past and use these models to predict climate trends for the future. If research can tell us what will be happening to our climate in the future, we can be better prepared to properly manage our ecosystems. More specific to the prairies, however, is the phenomenon of drought.

Researchers are studying the frequency of droughts over the past few hundred years and the potential impacts of global warming. Global Climate Models predict that increased surface temperature and decreased net soil moisture will result in prolonged drought in the future. Data from tree ring analysis reveals that future climate extremes may exceed those experienced during the 20th century. When climate change models are applied to aridity on the Canadian Plains, the area of land at risk of desertification increases by 50% between recent conditions (1961-90) and the 2050s.



Approx. 1500–1800 A.D.
This sample from the Judith Mountains in Montana is from a 299 years old Douglas Fir tree.

Surviving the fires
This Lodgepole Pine tree sample collected in the Cypress Hills records the growth of the tree, but also shows evidence of three separate fires during its roughly 249 years of growth. Fire destroys the living cells and leaves a scar. Trees survive when damage is limited; growth from adjacent cells attempt to heal the wound.



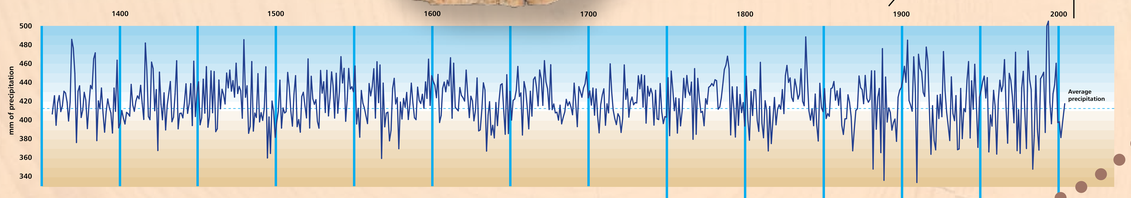
2004 — **1586**

This White Spruce core sample from Cornwall Island in the North West Territories records 418 years of local precipitation.

1997 — **1898**

This Lodgepole Pine sample is also from the Cypress Hills. It doesn't include the centre-most rings but provides data for over 99 years. It is one of over 60 samples used to compile the three bottom charts.

The last 100+ years of recorded weather are examined further in the panel to the right.



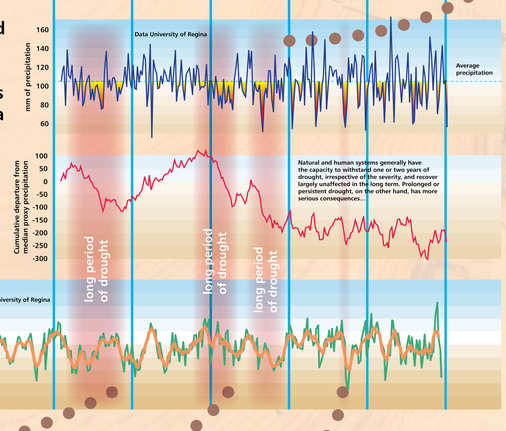
The graph above shows annual precipitation as reconstructed from tree ring data collected in the Wildcat Hills near Cochrane, just a few kms west of Calgary.

Locations of tree ring chronologies

The next three graphs were created using tree ring data collected in the Cypress Hills of Saskatchewan and Alberta. The first graph shows June and July rain fall for the area around Medicine Hat, Alberta.

To help show long term trends, this graph starts at zero, then adds or subtracts the difference from the average June and July rainfall.

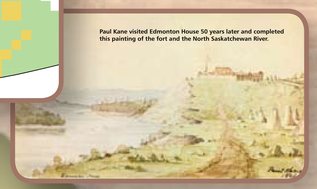
This last graph shows drought severity for South-eastern Alberta and south-western Saskatchewan.



Rivers running dry

Researchers combed through the Hudsons Bay Company's archives to see if outside sources confirmed their findings. These journal entries provide further evidence for the drought of the 1790s:

At Edmonton House, a large fire burned 'all around us' on April 27th (1796) and burned on both sides of the river. On May 7th, light canoes arrived from Buckingham House damaged from the shallow water. Timber intended to be used at Edmonton House could not be sent to the post 'for want of water' in the North Saskatchewan River. On May 2nd, William Tomison wrote to James Swain that furs could not be moved as, 'there being no water in the river'.



John Palliser (left) and fellow traveler James Hector

A poorly timed visit

The Canadian explorer John Palliser visited the prairies in 1859 and drew this famous conclusion:

This large belt of country embraces districts, some of which are valuable for the purposes of the agriculturalist, while others will forever be comparatively useless… The least valuable portion of the prairie country has an extent of about 80,000 square miles, and is that lying along the southern branch of the Saskatchewan, and southward from thence to the boundary line…

Dust Bowl: 1933–1937

Previously thought to be the worst drought on record in the southern Canadian Prairies, the Dust Bowl was relatively short compared with previous droughts. In the 1930s the ground was so dry at times that topsoil simply blew away in the wind, forming massive dust clouds. Since the Dust Bowl coincided with the Great Depression, a period of extremely high unemployment and deep economic recession, many families were forced to abandon their farms altogether.