Talking Trees

A Long View of Prairie Water & Climate

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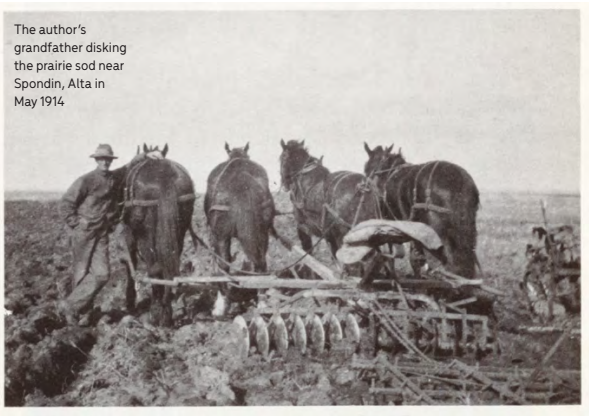


The author's grandfather disking the prairie sod near Spondin, Alta in May 1914

PHOTO COURTESY J SAUCHYN

One day early next year, I'll give my 500th invited presentation on climate change.

The audience often includes agricultural producers with a genuine interest in weather and climate and thought-provoking questions and comments. For example, following a talk in Taber, Alta, the manager of an irrigation district, said, "Nice talk Dave, but I'll believe in climate change if we get weather I don't expect." I've quoted him hundreds of times with his permission because his comment was a great definition of climate change from an ag producer's perspective. If weather is unexpected, you either haven't experienced enough weather or the climate has changed.

Last summer, a farmer at Davidson, Sask. told a newspaper reporter that the drought of 2021 was the worst he'd ever seen. The newspaper gave his age as 44, so we know how much weather he's seen. On the other hand, government officials often refer to extreme weather events as "unprecedented," as if they have never happened before. This is also how the premier of Saskatchewan characterized the flooding of 2015.

Similarly, the B.C. flooding of 2021 was also described as unprecedented by B.C.'s deputy premier. This reaction to natural disasters is so common that there's a name for it — 'exceptionalism.' There's a natural tendency for humans to exaggerate the severity of the most recent events. Unfortunately, it has consequences. We can be unprepared for the next disaster because we think it can't possibly be as bad as the previous one. Also, public officials can invoke exceptionalism to avoid responsibility for damages and as an excuse for being unprepared.

Our research centre, Prairie Adaptative Research Collaborative (PARC), examines this phenomenon because if weather events really are 'unprecedented,' then the local climate has changed, and the weather has moved outside the historical range of variability.

We analyze data from weather and water gauges to determine whether a drought or flood is the worst on record and how much the weather each year departs from normal or average conditions. On the Canadian Prairies, "average weather" is a strange concept. We have one of the most variable climates on earth due to our location in the middle latitudes and a long distance from the main source of our water — the Pacific Ocean. In some years, the circulation of the atmosphere brings moisture to the prairies; in other years, it does not.

So, that leads to the next question: are weather and water records, or a long life spent living in the prairies, long enough to conclude that recent events have never occurred before? Fortunately, we can also examine this question in our Tree Ring Lab at the University of Regina.

We have collected thousands of samples of old wood from the treed uplands, valleys, and montane and boreal forests of four provinces, two territories, and two U.S. states. We sand and polish pencil-sized cores gathered from living trees and cross-sections of dead wood to highlight the annual rings. Using image-analysis software, we measure the width of each tree ring to within 0.001 mm.

Unlike tropical and warm coastal forests where the trees never stop growing, in our dry and seasonal climate, tree growth is limited yearly by water availability. On the margins of the grasslands and in some of the prairie valleys and uplands, trees record the amount of water generated by rain and snowmelt and stored in the soil, rivers and lakes. Variations in the annual growth of these trees replicate the year-to-year fluctuations in measured rainfall, water levels and river flow.

We use the statistical relationship between the tree ring data and measurements from weather and water stations to reconstruct the climate from the time long before weather and water monitoring.

This tree ring record shows that the low water levels of the 20th and early 21st centuries are not the worst hydrological droughts in terms of severity or duration. Drought was more severe in the 1700s.

This cross-section is from a dead Limber pine that was a seedling in the year 542

Geological studies show that the sand dune fields of southern Saskatchewan were much more active back then than today.

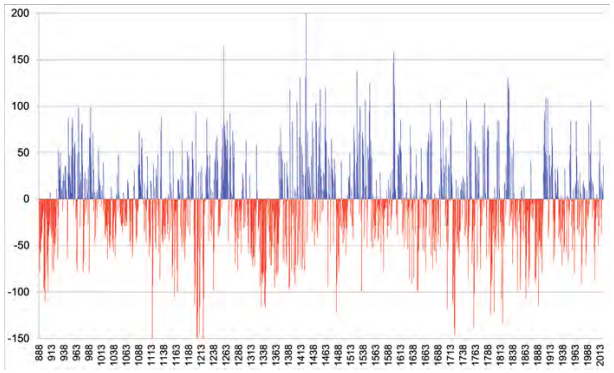
The 30+ years from 1850 to the 1880s was a long spell of low water levels. In the 1860s, Captain John Palliser declared that the southern prairies would be "forever comparatively useless" and advised the sponsors of his expedition to discourage settlement of the region. The first edition of the Medicine Hat newspaper in 1891 stated that "It would be almost criminal to bring settlers here." Shortly afterwards, the climate shifted to a wet cycle, and the prairies were flooded with homesteaders—including my grandparents.

One of the more significant findings of our tree ring research is the clear evidence of a multi-decadal climate cycle. The blocks of red and blue in the graph reveal wetter and drier periods of one to several decades.

Recognizing this mode of variability is important for at least two reasons. First, the most challenging future climate event will be a prolonged drought like those in the tree ring record, but it will occur in a warmer climate than in the past.

Second, a decade or two of wetter or drier weather can be misinterpreted as climate change. Unless the climate continues to be warm and wet or warm and dry for at least three decades (and ideally more), it has not changed; it is naturally varying and likely will cycle back to a different phase of climate conditions. Given the importance of this multi-decadal variability, we've attempted to document and explain it.

To understand climate cycles, you have to look to where our weather comes from— to the west, and the Pacific Ocean, the source of nearly all of our water. Pacific Ocean currents have a strong influence on our weather and climate. There is a link, or so-called teleconnection, between sea surface temperatures and the climate of Western Canada. Much of the year-to-year variability is tied to El Niño and La Niña, when the water off the coast of South America is unusually warm or cold, respectively. A longer Pacific Decadal Oscillation (PDO) in sea-surface temperature correlates with the decadal scale variability in our climate and water supplies. So while El Nino and La Nina bring single years of drought and rain to the Canadian Prairies, during the two phases of the PDO, there tends to be decades or longer of mostly dry or frequently wet years.



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This graph is our reconstruction of water levels in the South Saskatchewan River basin at Medicine Hat from 888–2019. The blue bars represent above-average river flow, and the red bars represent years of below-average river flow. The median indicates the average annual flow of metres cubed per second (m3/s)

While we have to take a global view of climate to explain the natural cycles, they are evident to any keen observer of tree rings, such as the cattleman I met a few years ago.

The Welch family ranches at the southern end of the Porcupine Hills. It's a typical scenic southwestern Alberta ranch of rolling hills of fescue prairie with montane forest at higher elevations. In September 2012, I asked Reno Welch for his permission to collect some samples of old Douglas Fir. He responded the same way as all the farmers and ranchers we ask; he was happy to help and invited us up to the house for coffee and conversation, mostly about weather and climate. Reno told us that we probably wouldn't find very old trees because he once had a sawmill. Then he said:

"I found looking at the tree ring growth, that there's an approximate 60-year weather cycle in this country, but 60 years isn't definite, it could be 70 years, and it could be even less, with the weather there's nothing written in stone."

After decades of research, we proved that Reno Welch is right; nothing about the weather is written in stone, but it is written in the tree rings. ∞C