What Does a Warmer Winter Mean?

Brian Amiro, Ph.D., P.Ag., and Paul Bullock, Ph.D., P.Ag., are Professors in Soil Science at the University of Manitoba, specializing in agricultural meteorology and climatology.

What is going on?

Analyses of trends over the past few decades indicate that the warming across Canada has been greatest in winter[1,2]. The winter warming has likely contributed to the date of the last spring frost occurring earlier, resulting in a longer frost-free season across the Prairies[3,4]. For Alberta, the earlier last spring frost, coupled with a later fall frost, has increased the frost-free period[5]. If such changes continue, and are predictable without increased variability, new agricultural opportunities are likely.

What's coming up?

Projections by climate models indicate that climate warming will be greater in winter, with increases of about 3°C in the average temperature by about 2050[6]. The uncertainty in this estimate ranges from about 2°C to 4°C for the December to February period. Expectations are that the eastern Prairies may warm slightly more than the west.

Does it matter?

It is instructive to consider if we can learn from current climates as possible analogues. For example, what would be the implications if Edmonton became more like Medicine Hat, or perhaps Grande Prairie became like Edmonton? Such analogues are not perfect because of important differences in daylength, precipitation and soil types. However, we have decades of experience with these temperature regimes and how they relate to agriculture. Let's investigate the dynamics of January temperatures as an indicator of the impact of a warmer winter. Figure 1 shows 40 years of mean January temperatures for the three locations. These locations represent a range of 5°C in mean January temperature with differences of about 2 and 3°C between individual stations, similar to the predicted change by 2050. The mean monthly temperature varies by more than 20°C among years at each location over this period. Potential mean temperature increases by 2050 of about 3°C seem relatively small given this current large inter-annual variability. Despite the large variability, the last decade appears warmer than the first decade of this series.

"winter warming of about 3°C by 2050 is small compared to the current range of extreme temperatures at any given location: Prairie agriculture will still need to address a wide range of conditions"

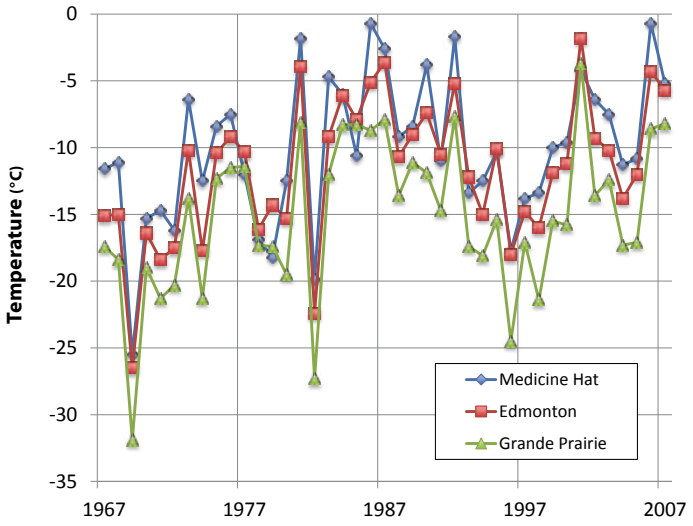

Figure 1: *Mean January air temperature at Medicine Hat, Edmonton (Stony Plain), and Grande Prairie, Alberta, for the 1967-2007 period[7]. The 40-year average is -10.1°C for Medicine Hat, -11.7°C for Edmonton, and -15.1°C for Grande Prairie.*

However, mean temperature is often not the best indicator of the driving forces that affect agriculture. For example, extreme cold temperatures create heating challenges for cattle or can kill off overwintering pests. Extreme warm temperatures can remove snow cover or create icy conditions that affect both crops and cattle. Figure 2 shows the frequency of the January extreme minimum temperatures, an indicator that can be limiting for some organisms. For this time period, January temperatures below -35°C were experienced about 30% of the years in Edmonton and Medicine Hat, and 75% of the years in Grande Prairie. Further, the year-to-year variability exceeds 20°C at any location. Temperatures of -20°C are of similar frequencies at all sites, about 90%. The year-to-year variability in maximum January temperature is less, but still greater than 10°C at any location. For the 40-year period, all three locations experienced thawing events and the frequency of exceeding 10°C was 40% for Medicine Hat, 22% for Edmonton and 7% for Grande Prairie. We can argue that the frequency of "climatological significant" events will change with a warming climate, but that we currently experience such events and have developed mechanisms to cope with these, although they stress our agricultural production system.

What is being done?

Our current range of winter temperatures on the Prairies is extraordinary, exceeding 50°C from minimum to maximum January temperatures. This range reflects "weather" whereas the overall mean and the projections are more about "climate". Projections for mean temperature increases of about 3°C by 2050 are relatively small compared to the range of extremes. It is difficult to project whether the warming climate will increase the variability beyond which we currently experience. It is more likely that we will need to adapt to a new frequency of events, even if the agricultural impact of each event (cold or warm) is not a new experience.

It is likely that warmer winters may create some competitive advantages in other parts of the world. For example, winter cropping could be more sustainable in more parts of North America, which could offset some losses caused by summer heat stress. Such a change could affect the competitiveness of Prairie agriculture, since it is unlikely that our climate will allow much winter cropping by 2050.

The bottom line is that warmer winters by 2050 will likely not change our current experience and Prairie agriculture will still need to address a wide range of conditions. However, the change in frequency of events will likely alter the way we undertake some practices. If warmer winters contribute to longer growing seasons, there could be reduced risk of growing a wider variety of crops, providing that water is not limiting.

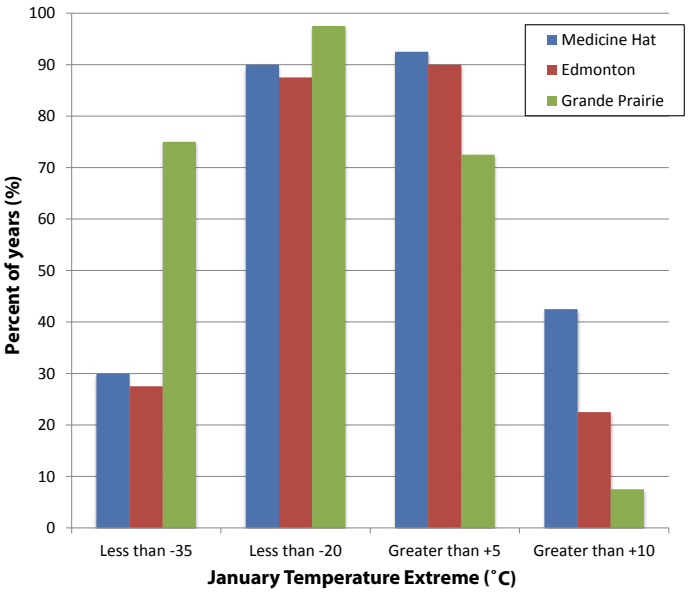

Figure 2: *Percentage of years exceeding a January extreme minimum or maximum air temperature at Medicine Hat, Edmonton (Stony Plain), and Grande Prairie, Alberta during the period 1967-2007[7]. Note that all locations had a thaw period (greater than 0°C) every year.*