PACIFIC CLIMATE IMPACTS CONSORTIUM

2019 IN BC, IN CLIMATOLOGICAL CONTEXT

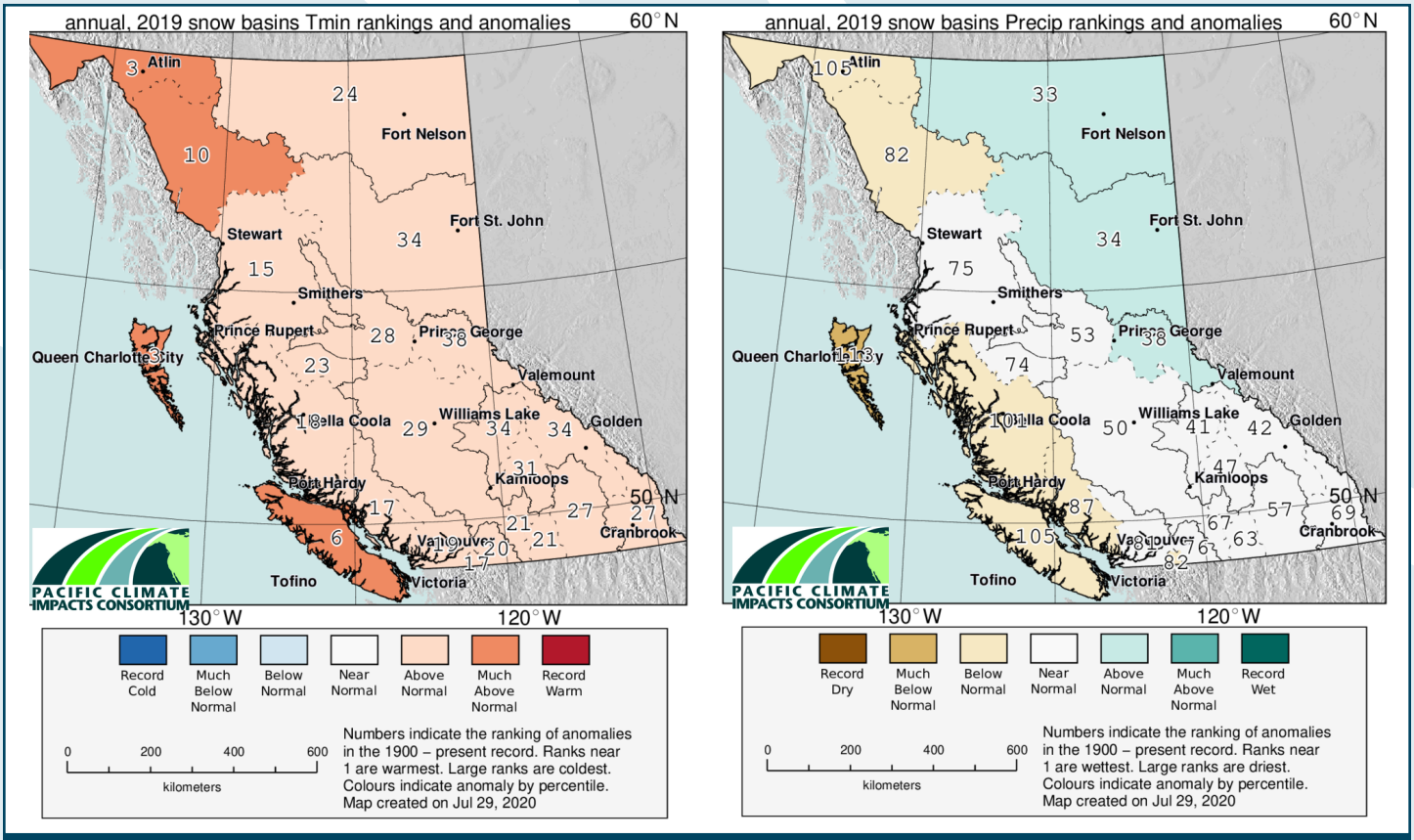

Figure 1: 2019 Temperature and Precipitation Anomalies
Annual anomalies[1] in average daily minimum temperature (left panel) and total annual precipitation (right panel) for 2019 in British Columbia. Quantiles defining the colour scale are as indicated above. Numbers on the map correspond to ranking in the 120 observation years from 1900 through 2019.

A moderate El Niño likely contributed to a slightly warmer than normal 2019 in British Columbia (BC).

Anomalous warmth peaked in spring, forcing rapid melt of a near-normal winter snowpack.

Precipitation in summer and fall was above-to-much-above normal across the province.

Trends in temperature are positive for the period 1950 – 2019 with minimum temperatures (Tmin) increasing faster than maximum temperatures (Tmax). Precipitation shows no significant trend over the same period.

INTRODUCTION

The Climate Analysis and Monitoring theme at PCIC assesses anomalies[1] in temperature and precipitation data in British Columbia on a monthly basis. Each year, the theme combines this understanding with snow water supply data from the BC River Forecast Centre to develop a picture of the seasonal evolution of temperature, precipitation and runoff, referred to collectively as, "the hydroclimate." The seasonal conditions that transpire have impacts on numerous aspects of BC's economic and ecological function, ranging from water supplies and wildfire activity, to direct day-to-day impacts of weather extremes on human activities. This article describes aspects of the seasonal weather

1. Anomalies here refers to the difference between observed conditions and the average conditions for a given period.

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anomalies experienced during the 2019 calendar year using data aggregated over the entire BC province as part of BC's Climate Related Monitoring Program, with additional information on snow accumulation and melt from BC's River Forecast Centre. The effects of a weak El Niño event are also described. Finally, the long-term trends in temperature and precipitation are presented.

2019 - A YEAR IN CONTEXT

We first discuss temperature and precipitation averaged over the year. The data are mapped in Figure 1. Temperatures for 2019 were higher than normal across British Columbia as a whole when compared with the long-term (1900–2019) record. Vancouver Island, Haida Gwaii and Northwestern BC saw average daily minimum temperatures ranking in the top 10 among years in the long-term record. The rest of the province saw average daily minimum temperatures in the top third quantile of the instrumental record, ranking from 38th warmest to 15th warmest. Averages for daily maximum temperature were closer to median values, with temperature ranking in the middle one-third quantile throughout the province, with the exception of the north and westernmost regions, where rankings reached the top 10% in the long-term record.

Precipitation anomalies across the province were mixed. Dry conditions extended along the west coast and into Northwestern BC, with total annual precipitation anomalies ranking from 19th to 8th driest. Central and Southern BC were near normal while Northeastern BC saw above-normal precipitation, with rankings from 38th to 33rd wettest. Trends in temperature and precipitation can be found in Table 1. It is worth noting that the confidence in the ranking of precipitation anomalies is lower than those of temperature anomalies, owing to the sparsity of precipitation observations.

The evolution of BC's snowpack during the winter of 2018-2019 has been described by the BC River Forecast Center (2019). Snow measurements showed mostly typical snow amounts through the winter and were punctuated by the warm, dry conditions of the spring. The situation evolved rapidly during May and by the 31st, the snowpack had dropped to half of the normal amount throughout most of BC with the exception of the central Rocky Mountains and Kootenay. The rapid transition from near normal amounts

TABLE 1: CLIMATE TRENDS

	1900 – 2019	1950 – 2019
Tmax (°C yr-1)	**0.008**	**0.021**
Tmin (°C yr-1)	**0.022**	**0.030**
Precip. (% yr-1)	/	0.069

Table 1: Climate Trends

This table displays trends in annual average of daily minimum and daily maximum temperature and for annual total precipitation. Analysis periods are 1900 – 2019 and 1950 – 2019. Bold type values are statistically significant ($p < 0.05$). The long-term trend for precipitation is not reported due to low confidence in the spatial representativeness of the precipitation network early in the century.

of snow to extremely low snowpack suggests early rapid melting and an early peak in the spring freshet[2]. The transition to the earlier loss of seasonal snow aligns with climate projections for BC (ul Islam et al. 2017) although we cannot directly attribute the conditions during the spring of 2019 to climate change.

The observed anomalous temperature conditions were likely due in part to ongoing climate warming in BC and El Niño Southern Oscillation[3] (ENSO) activity. There was a weak El Niño during the winter of 2018/2019 and such events correspond to warmer than normal conditions in BC especially in late-winter and spring and typically are accompanied by warm annual average temperatures (Stahl et al. 2006). Winter temperature was near normal, but spring was warm, so we suspect that El Niño may have helped induce the observed warm spring and the overall warm annual average temperature in BC.

Using the province-wide seasonal and annual temperature and precipitation anomalies, trends have been calculated for the full record spanning from 1900 through 2019 and for the period 1950 through 2019. Note that precipitation data early in the record are sparse and of greater uncertainty than those for temperature, thus we exclude the long-term precipitation trends. Temperature trends are more certain because of the reduced spatial and interannual variability of temperature anomalies compared to precipitation. The trend values for annual average daily minimum temperature and those for annual average daily maximum temperature are positive and statistically signif-

2. The streamflow caused by the spring thaw.
3. The El Niño Southern Oscillation is a climate pattern with global effects that results from periodic variations in the sea surface temperature across the equatorial Pacific Ocean. It has an effect on regional and global weather.

icant ($p < 0.05$) for both the full and 1950 onward records. The trend in annual average daily minimum temperature is greater than that for daily average maximum temperature by a factor of two in the long-term record and a factor of 1.5 in the 1950-onward record. The trends in precipitation are positive, but they are not statistically different from zero. The trends are likely to reflect both the ongoing climate warming and the influence natural low-frequency variability such as that associated with the occurrence of ENSO events. The presence of such variability implies that it remains possible that we may experience decade-long periods with no or downward temperature change and periods of low or high precipitation amounts.

REFERENCES

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