

2015: A YEAR IN REVIEW

F.S. ANSLOW



**PACIFIC CLIMATE
IMPACTS CONSORTIUM**

INTRODUCTION

Recently, three of the major centres for global climate monitoring determined with high confidence that 2015 was the warmest year on record, globally. Not only that, but it was warmer by a large margin relative to the next warmest year, 2014. This result has been confirmed by the World Meteorological Organization and all centres point toward greenhouse warming coupled with the development of a very strong El Niño as causes of the record warmth. The cyclical La Niña/El Niño influences global climate by storing (during La Niña) and then releasing (during El Niño) energy in the deeper waters (down to 700 metres depth or so) of the tropical Pacific Ocean. The seasonal weather of British Columbia is directly influenced by El Niño because the phenomenon impacts the circulation of the atmosphere over the Pacific Ocean and North America. Furthermore, during the winters of 2013, 2014 and 2015 the relative dearth of storms over the Northeast Pacific resulted in a very large region of record warm ocean surface temperatures to the west of British Columbia – a pattern coined “The Blob” by climatologists in Washington State. Combined, these events had a strong warming influence on the weather that British Columbia experienced throughout 2015.

As part of the British Columbia Ministry of Environment’s Climate Related Monitoring Program, PCIC collects and publicly shares weather observations made by BC Ministries, Environment Canada and BC Hydro. This store of information allows the analysis of conditions in the province and a comparison of the regional weather of BC with that experienced globally. In this article we use these observations to discuss conditions in the province in terms of seasonal averages of daily minimum and maximum temperature and precipitation. For seasons, we combine three complete months such as December, January and February for winter and March, April and May for spring and etc. Because of this, the annual anomalies computed over the months of 2015 are slightly different than what would be computed combining the individual seasons because, seasonally, December 2014 is included in the analysis of 2015.

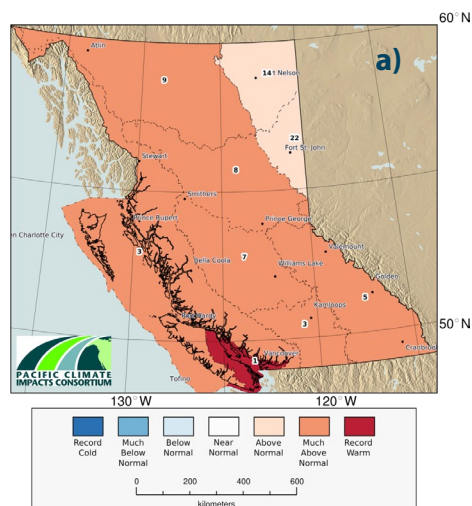
A WARM WINTER

During the winter (spanning December, 2014 through February, 2015) the conditions that led to the maintenance of “The Blob” were also associated with higher than normal pressure over British Columbia which, in turn, led to warmer than normal temperatures across the entire province for the season. The storms that did come through dropped enough precipitation to keep the province at or above normal for rain and snowfall, with the central part of the province receiving larger than normal precipitation amounts (Fig. 1c). For both daily maximum and minimum temperature (Fig. 1a and 1b), the far southwestern corner of the province experienced record-breaking warmth and all but the northeast corner of the province experienced much warmer than normal temperatures with values that rank in the top 10 for the past 116 years.

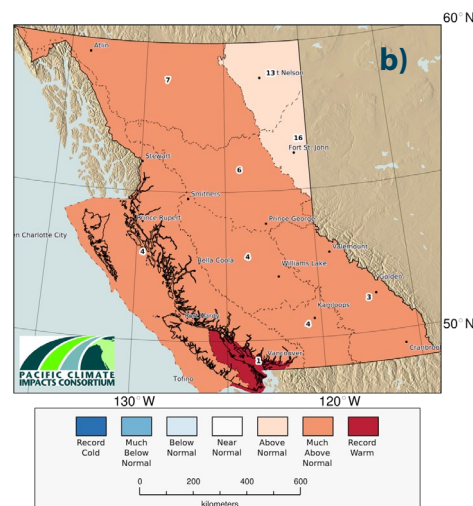
*THREE OF THE MAJOR
CENTRES FOR GLOBAL CLIMATE
MONITORING DETERMINED
WITH HIGH CONFIDENCE THAT
2015 WAS THE WARMEST YEAR
ON RECORD GLOBALLY*

2015 Winter

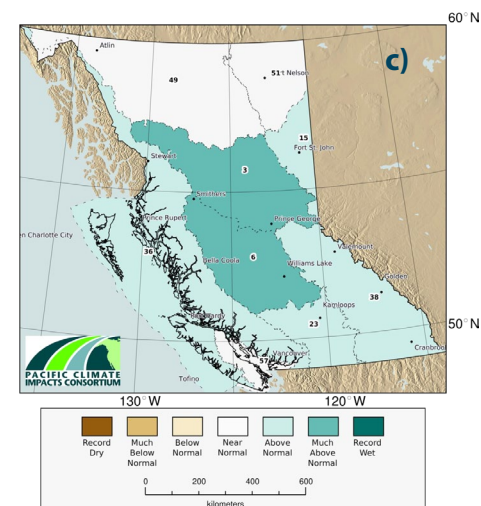
Maximum Temperature



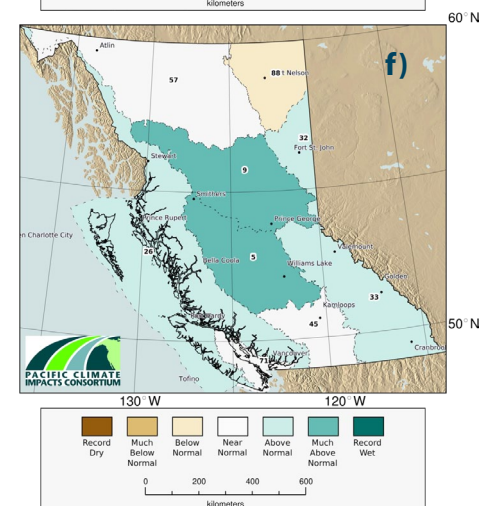
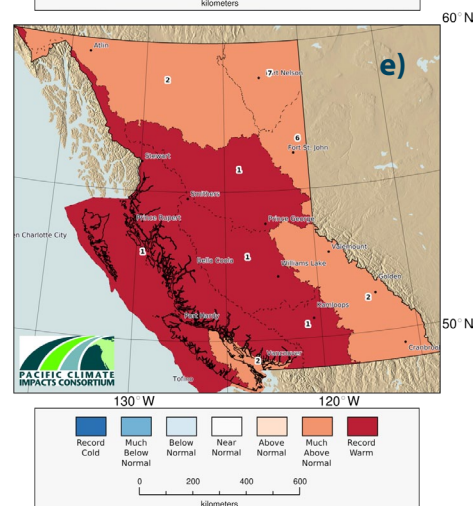
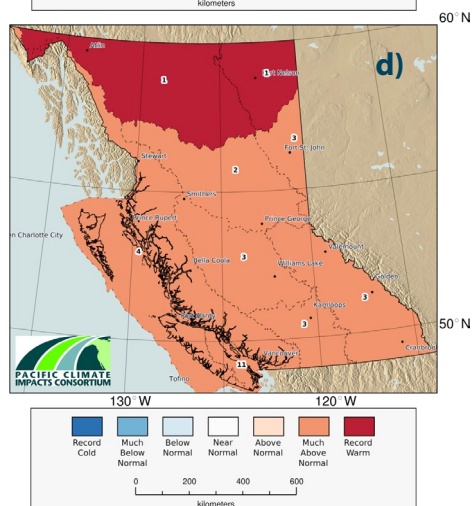
Minimum Temperature



Precipitation Anomalies



2015 Spring



2015 Summer

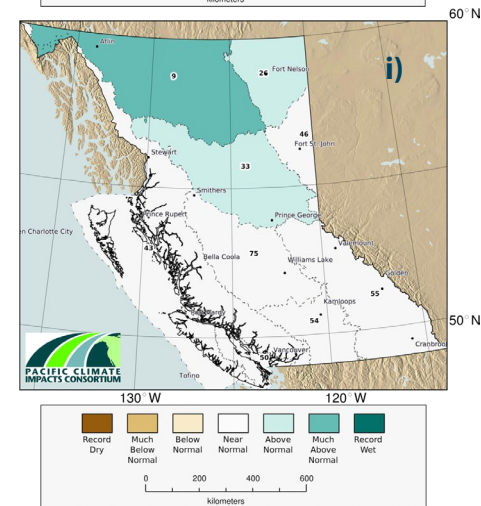
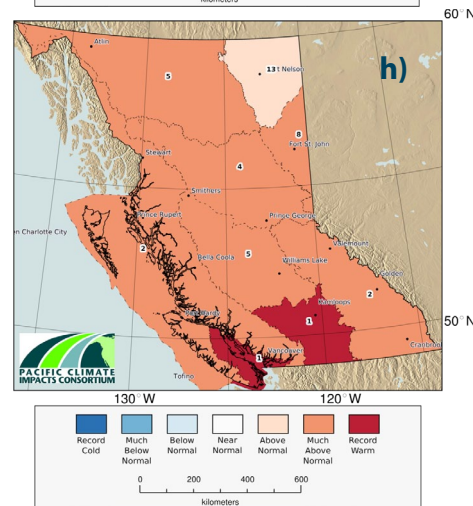
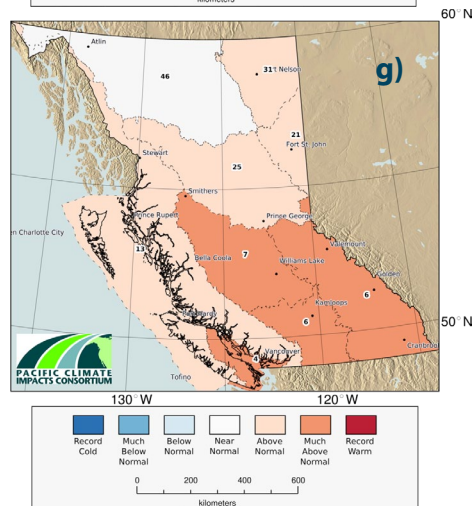


Figure 1: Seasonal and annual ranked anomalies for the ecoprovinces of British Columbia in the winter, spring and summer of 2015. Panels a), b) and c) show maximum temperature, minimum temperature and precipitation anomalies respectively for winter, 2015. Panels d), e) and f) show the same respective variables for spring. Panels g), h) and i) show the same respective variables for summer.

THE HEAT CONTINUES INTO SPRING

The warmth and relative wetness of winter set the stage for spring. Over the period from March through May, precipitation patterns remained similar to those of winter, with much above normal precipitation amounts in the central parts of the province and above normal precipitation everywhere except the far northeast corner, where precipitation was below normal (Fig. 1f). Temperatures continued to be very warm. Last spring's average daily minimum temperatures (i.e., nighttime temperatures) were amongst the warmest ever observed (within the warmest seven years since 1900). Spring average daily maximum temperature (i.e., daytime temperatures) were similarly warm, with spring 2015 ranking amongst the 4 warmest years in most regions. The warm spring conditions likely contributed to an early start to the fire season in the province and what would become a much more active than normal fire season in BC. These warm spring conditions also led to much lower than normal late spring snowpacks in much of the province and, eventually, the earlier than normal loss of the winter's snow despite relatively wet conditions.

A MODERATE SUMMER AND FALL

Although summer started very warm, conditions began to moderate as the season progressed, eventually leading to a relatively cool and wet August. Overall, minimum temperatures were still very warm (Fig. 1h). Records were still broken in the southwest part of the province where daily minimum temperature averages were in the top eight warmest years for all regions but the far northeast. The behaviour of maximum and minimum temperatures continued to diverge, with average maximum temperatures reaching much above normal values in the southeast with near or above normal conditions for the remainder of the province. Precipitation was near normal for the southern half of the province and ranged from above normal to much above normal in the north (Fig. 1i). The simultaneous much above normal precipitation and minimum temperature, combined with near normal maximum temperature suggests that unusually warm, cloudy conditions prevailed in the north. We speculate that the warm ocean temperature associated with "The Blob" helped to provide warm, moist conditions leading to this combination of seasonal anomalies. This season was punctuated by a very strong cyclonic storm that impacted southwest British Columbia in the last few days of August and caused thousands of BC Hydro customers to lose power. The trend toward more normal conditions continued into the fall (Figs. 2a, 2b and 2c). During this period temperature returned to near normal with all of the province near or above normal for both daily maximums and minimums. For precipitation, conditions were similarly near normal, with only the southeast corner of the province above or much above normal.

Despite the transition to more typical conditions in the latter part of 2015, when conditions for the entire year are compared to the past, 2015 was unique for most of the province and among very rare years for the rest in terms of temperature. Starting with minimum temperature, all but the northern 1/3 of the province experienced record-breaking warmth with the

*THE WARMTH AND RELATIVE
WETNESS OF WINTER SET THE
STAGE FOR SPRING.*

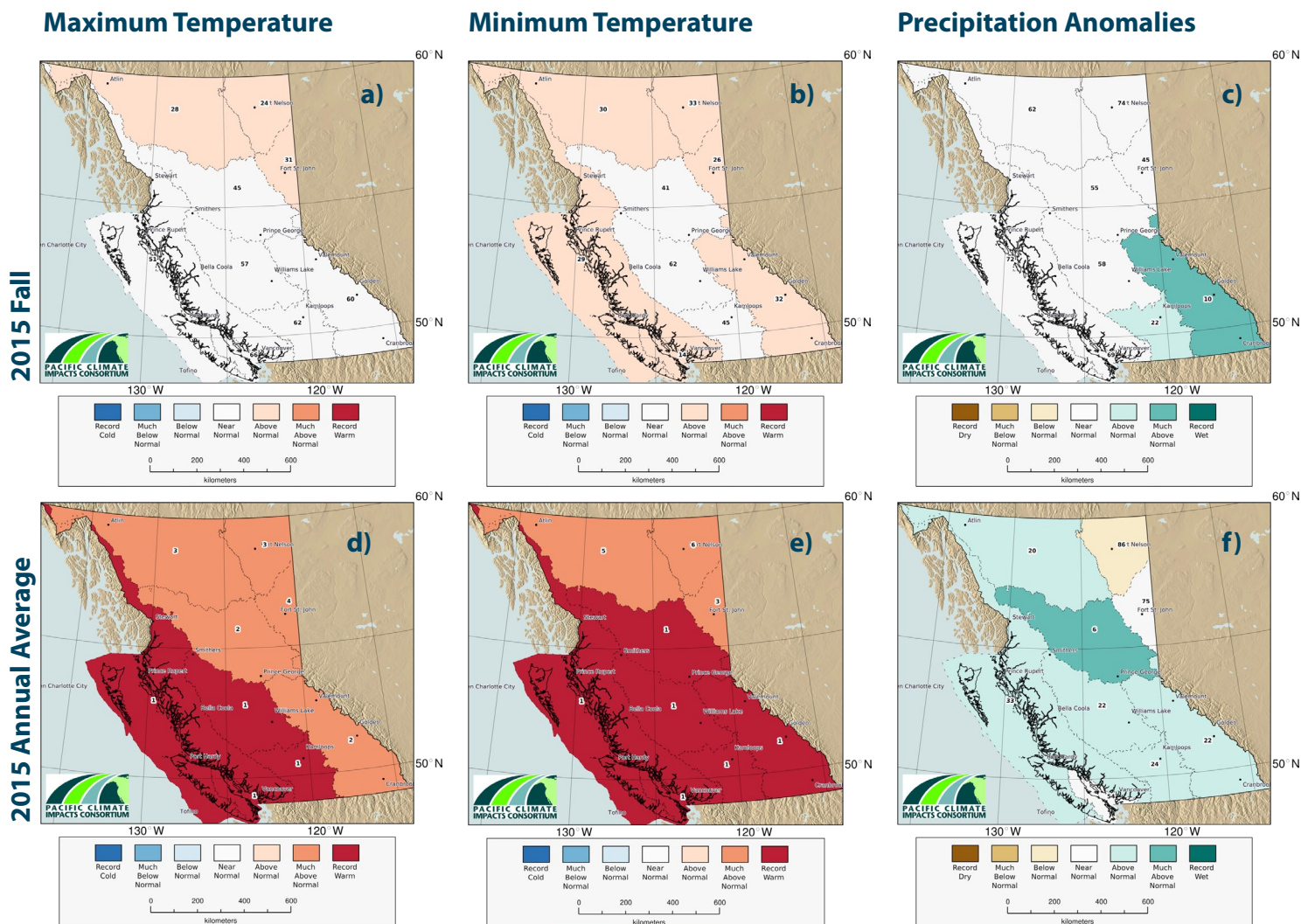


Figure 2: Seasonal and annual ranked anomalies for the ecoprovinces of British Columbia in the fall of 2015 and for the 2015 annual mean. Panels a), b) and c) show maximum temperature, minimum temperature and precipitation anomalies respectively for fall, 2015. Panels d), e) and f) show the same respective variables for the 2015 annual mean. As noted in Figure 1, generally speaking, these figures depict a consistently warmer and wetter than normal state for most of the year in British Columbia.

remainder of the province in the top 6 years in the 116-year record (Fig. 2e). For maximum temperatures, conditions were slightly less extreme, though the west and southwest broke records (Fig. 2d). The remainder of the province was in the top four warmest years in the full record. These temperatures accompanied a wetter than normal year for all but the northeast of the province.

SEEING THE FUTURE CLIMATE OF BRITISH COLUMBIA THROUGH THE LENS OF 2015

Interestingly, 2015 may represent a preview of the temperature and precipitation that British Columbia will experience under a warming climate. All projections of future climate in British Columbia under increasing greenhouse gas concentrations point toward warmer temperatures and many suggest that precipitation will increase in winter but decrease during summer. A major difference, however, is that the warmth of 2015 was more concentrated near the coast and the southwest while climate change projections suggest that the greatest rates of warming will occur in the northeast of the province as a result of a rapidly warming Arctic. This underscores the differences between seasonal weather and long-term climate change averages. The observed pattern of anomalies highlights the likelihood that the interplay of conditions that helped form “The Blob” and the subsequent influence of “The Blob” on spring and summer weather in BC helped produce the temperature anomaly pattern observed in 2015. For precipitation during the winter of 2015, extreme rainfall was experienced in the coastal regions of BC with some areas reporting minor flooding despite an overall near-normal precipitation amount for the season. This reflects climate projections that indicate precipitation events are likely to be heavier even where longer term totals are similar to historical values, and underscores the need for extremes analysis in understanding climate change impacts.

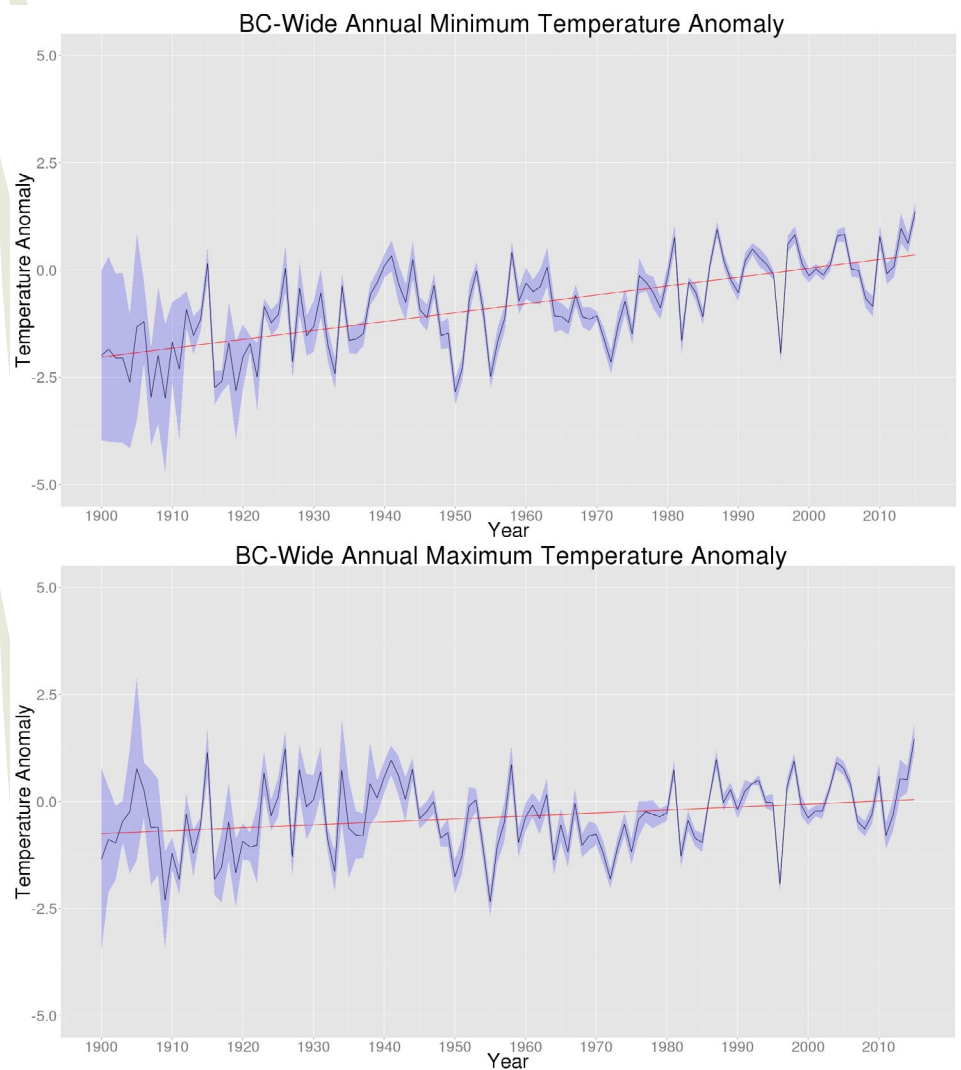
LOOKING AHEAD TO 2016

Looking ahead, it is expected that 2016 will also be warm, owing to the influence of El Niño on British Columbia, which tends to produce warmer than normal conditions. Furthermore, the El Niño is expected to continue into the first half of 2016, providing ample time for its warming influence to be felt. Looking into the second half of the year, some longer-term forecasts suggest that a weak La Niña may develop which would likely mitigate some of the warmth experienced earlier in the year. We can also be fairly confident that “The Blob” will be gone in 2016. Research has shown that ocean temperature patterns like “The Blob” are erased by the occurrence of El Niño and much of this erasure has already occurred as of February. Because of this, there is likely to be a reduced warming influence from the Pacific Ocean during the summer of 2016. According to the Ministry of Forests, Lands and Natural Resource Operations’ River Forecast Centre, snowpacks in the province are near or above normal for much of the southern part of BC but are much below normal moving northward, with the most northern regions of the province reporting snowpacks 50% of normal as of February 1st. The ongoing El Niño may balance this picture somewhat. El Niño warmth typically influences snow accumulation negatively in the southern part of the province where warm and possibly dry conditions are more likely. The ongoing El Niño may help promote deeper snow in the north

WHEN CONDITIONS FOR THE ENTIRE YEAR ARE COMPARED TO THE PAST, 2015 WAS UNIQUE FOR MOST OF THE PROVINCE AND AMONG VERY RARE YEARS FOR THE REST IN TERMS OF TEMPERATURE.

IT IS EXPECTED THAT 2016 WILL ALSO BE WARM, OWING TO THE INFLUENCE OF EL NIÑO

Figure 3: When averaged province-wide, the annual mean of daily minimum temperature was warmer than any year in the past although the uncertainty (purple shading, representing the 95% confidence intervals) in estimating the province-wide value leaves open the possibility that 2013 was warmer (Fig. 3). We also see that there is a very strong warming trend in minimum temperature (upper panel) through the long-term record. The trend is less strong, but still statistically significant, for maximum temperature (lower panel). Still, 2015 was warmer than any average value for any year previous, but large uncertainty in the early part of the record prevent us from stating that 2015 had the warmest maximum temperatures for the whole province.



2015 WAS A VERY EXTREME YEAR IN TERMS OF SEASONAL AND ANNUAL AVERAGES FOR BRITISH COLUMBIA

where precipitation is less influenced by El Niño and temperature is typically cold enough for snow even in warmer than normal years. This notion is supported by seasonal forecasts produced by Environment Canada, who use a state-of-the-art climate model that is capable of simulating how El Niño evolves through time. These forecasts show a very high probability of warmer than normal conditions for all of British Columbia (in fact, for almost all of Canada) over the February through April period, but a likelihood of wetter than normal conditions in the northwest of BC.

CONCLUSIONS

Overall, 2015 was a very extreme year in terms of seasonal and annual averages for BC. Although subsequent years may not be as extreme in the seasonal sense, climate projections consistently suggest that short-term extremes in temperature and precipitation will become more frequent, so the effects of heavy precipitation or hot temperatures are ever more likely to be felt in coming years even if monthly, seasonal, or yearlong extremes similar to 2015 are not surpassed.

© The Pacific Climate Impacts Consortium, 2016

**University House 1, University of Victoria
PO Box 1700 STN CSC, Victoria, British Columbia
Canada V8W 3R4**

Phone: 250-721-6236

Fax: 250-721-7217

pacificclimate.org