CLIMATE SUMMARY FOR:
SOUTH COAST REGION

PART OF A SERIES ON THE RESOURCE REGIONS OF BRITISH COLUMBIA

PACIFIC CLIMATE IMPACTS CONSORTIUM

ABOUT THIS SERIES

There is a strong scientific consensus that the Earth's climate is changing, primarily due to greenhouse gas emissions. This series of climate summaries, for the eight resource regions of British Columbia, is meant to help inform readers about past climate and future projected changes. It is intended that the series will be updated with new information as research progresses.

GENERAL OVERVIEW

British Columbia's climate exhibits large variations over short distances, due to complex topography.

Long-term historical trends show warming, more rapid for night-time low temperatures than day-time highs and more rapid in winter than summer. Precipitation trends are less certain due to data limitations and also exhibit increases, except in the winter season when large variability results in trends that depend highly on the period considered.

Further warming and precipitation changes are projected throughout the 21st century. The magnitude of the projected warming is relatively large compared to historical variability. Some possible consequences of these projected changes on resource operations are considered.

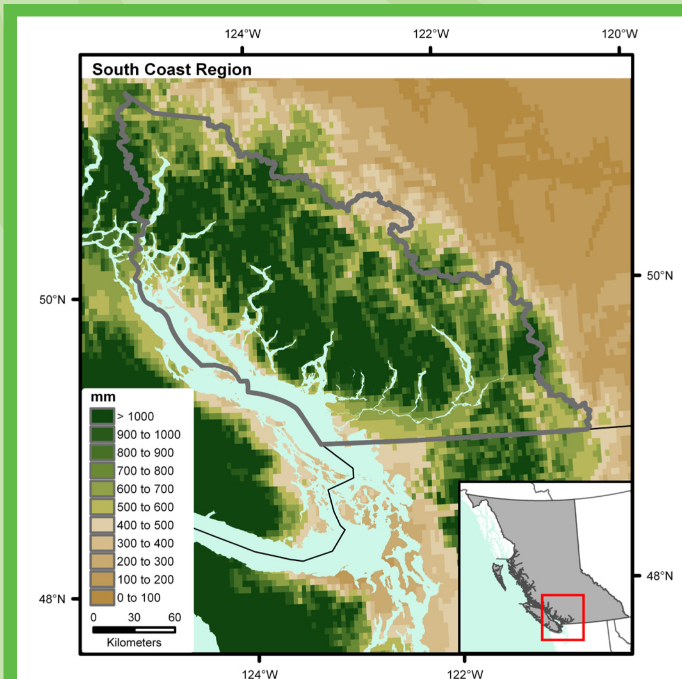

Figure 1: Winter precipitation for the region. The region is bounded in grey and the red box shows its location in BC.

ABOUT THIS REGION

The South Coast is the most populous region in the province, with over 2,500,000 people. It is located in the southwestern corner of British Columbia (Figure 1). The region has extremely varied terrain that contains part of the Lower Fraser drainage basin, as well as a large number of small coastal watersheds. Owing to the complex topography, which includes part of the Coast Mountain System, part of the Cascade Mountains and the Fraser Lowland, as well as both delta and coast locations, the area's climate varies considerably over short distances. Also, two major Pacific climate patterns—El Niño and the Pacific Decadal Oscillation—exert their influence over the region's year-to-year variability.

This mountainous region is dominated by coastal Douglas-fir, western hemlock and western redcedar forests, with mountain hemlock, alpine communities and glaciers occurring at the higher elevations. Interior Douglas-fir and lodgepole pine forests occur in the dry, eastern valleys. The economy is largely

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dominated by retail and wholesale trade, health care, tourism, professional and scientific services and education.

Precipitation is historically greatest in the autumn and winter seasons, and least in the summer. Precipitation varies considerably throughout the region and seasonally. Areas with the least winter precipitation historically include the rainshadow of Vancouver Island and the Coast Mountains. By contrast, several locations have estimated winter precipitation over 500 mm and at the highest elevations well over 1000 mm.

HISTORICAL TRENDS

The historical annual trend (based on the CANGRID dataset[1]) indicates that about 1 °C of warming has already occurred during the 20th century. Summer and winter trends are plotted in Figures 2 and 3, while trends for all seasons are provided in Tables 1 and 2. The warming trend is greater over the 1951-2009 period, except in autumn. These trends are regional averages. In regions with complex topography, trends could vary considerably with elevation.

Warming has occurred in all seasons. In most cases trends are large relative to historical variability, as indicated by statistical significance.

The historical mean seasonal precipitation for the region is greatest in the winter (about 440 mm). Precipitation varies considerably across the region and from year to year, as shown in Figure 3.

Precipitation in the region has been increasing

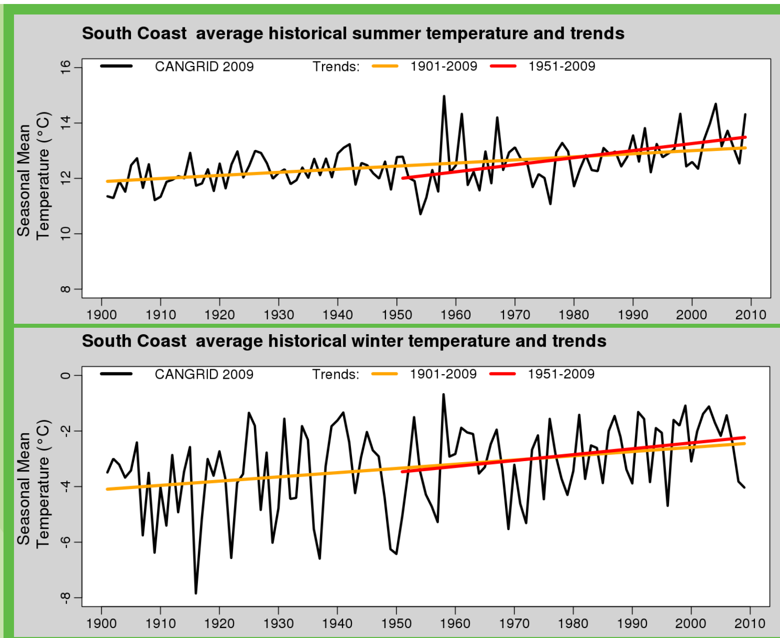

Figure 2: Historic summer and winter temperature time series, 1901-2009.

Table 1: Temperature Trends (°C per decade) for the South Coast Region

Period	Trend* 1901-2009	Statistical Uncertainty in Trend[3] 1901-2009	Trend* 1951-2009	Statistical Uncertainty in Trend[3] 1951-2009
Spring (MAM)	**0.11**	0.04 to 0.17	**0.18**	0.02 to 0.38
Summer (JJA)	**0.11**	0.07 to 0.15	**0.26**	0.14 to 0.37
Autumn (SON)	**0.10**	0.04 to 0.16	0.08	-0.08 to 0.26
Winter (DJF)	**0.15**	0.06 to 0.25	0.21	-0.01 to 0.42
Annual	**0.12**	0.08 to 0.17	**0.20**	0.08 to 0.30

*The reported trend is the trend that best describes the change over time in the observations. **Bold** indicates a trend that is statistically significant at the 5% significance level. Multiply the trend by 5 or 10 to get the total amount of change over a 50 or 100-year period, respectively.

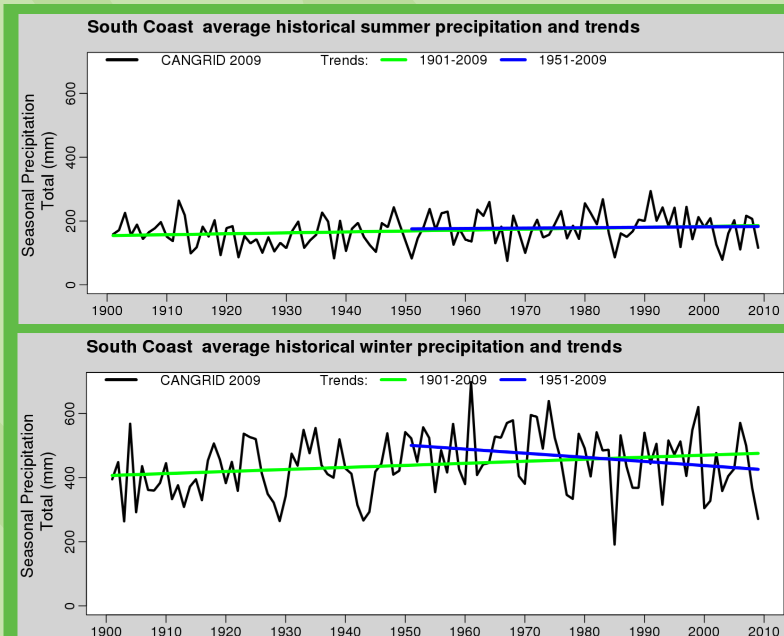

Figure 3: Historic summer and winter precipitation time series, 1901-2009.

Table 2: Precipitation Trends (mm/season per decade) for the South Coast Region				
Period	Trend* 1901-2009	Statistical Uncertainty in Trend[3] 1901-2009	Trend* 1951-2009	Statistical Uncertainty in Trend[3] 1951-2009
Spring (MAM)	**6**	3 to 9	**10**	2 to 19
Summer (JJA)	**3**	0 to 6	1	-7 to 9
Autumn (SON)	5	-1 to 11	4	-10 to 17
Winter (DJF)	6	-1 to 13	-13	-28 to 3

*The reported trend is the trend that best describes the change over time in the observations. **Bold** indicates a trend that is statistically significant at the 5% significance level. Multiply the trend by 5 or 10 to get the total amount of change over a 50 or 100-year period, respectively.

over both time periods during all seasons, with the exception of 1951-2009 winter precipitation, which has a negative trend. Low confidence in precipitation observations in the early part of the century implies a need for caution in interpreting the difference between short- and long-term winter precipitation trends. Large year-to-year and decade-to-decade variability in winter precipitation and the choice of time period used for fitting trends also affect this result.

FUTURE CLIMATE PROJECTIONS

Climate models project[4] warming throughout the 21^{st} century for all seasons that is large compared to historical variability (Figure 4). The black bar shows historical interannual variability as represented by ± one standard deviation of temperature around the 1961-1990 average (vertical line). The projected change in the average is shown for three future periods.

Summer is projected to warm slightly more than other seasons, by 2.0 °C (1.4 °C to 2.8 °C) by the 2050s and 3.1 °C (1.9 °C to 5.0 °C) by the 2080s.

Projected precipitation changes are relatively modest compared to historical variability, as shown in Figure 4. By the 2080s the median projection indicates an increase of about 10 %, relative to the 1961-1990 baseline, in all seasons but summer, when a decrease of over 10 % is projected.

Note that in Table 3 and Figure 4, the projections from two different emissions scenarios (A2 and B1) are combined to give a range of anticipated future change. In the early and middle of the 21^{st} century, the emissions scenario has little influence on the amount of projected change. The ensemble projected annual warming is 2.7 °C (1.5 °C to 4.1°C) by the 2080s. The projections following the higher (A2)

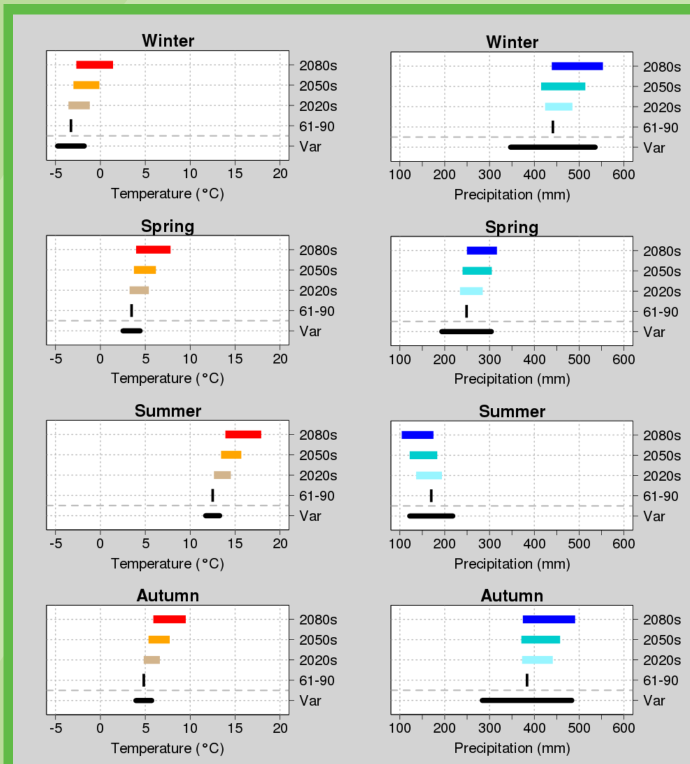

Figure 4: Cumulative seasonal precipitation and mean seasonal temperature projections for three future periods, the 2020s (2011-2040), 2050s (2041-2070) and 2080s (2071-2100). These are 30-year regional averages. The width of the bands indicate the range of projections. The thin, upper black line and the lower band indicate the average and the variability, respectively, over the 1961-1990 reference period.

emissions scenario represent the warmer portion of the projected range of change (and vice versa for lower emissions, B1).

The summer mean temperature for the South Coast region during the 20^{th} century was about 13 °C. The warmest 10 % of summers were about 2 °C warmer than this average, about 15 °C averaged across the entire region. Under the median summer warming of 3.1 °C, over two-thirds of summers in the 2080s would be warmer than the warmest 10 % of summers in the past even if no change in the distribution of temperature extremes occurs.

SUMMARY OF PROJECTED CHANGE

Table 3 is from Plan2Adapt.ca, a PCIC product that provides projections for the 21st century, as well as interactive maps and information on impacts.

By the 2050s, there are substantial projected decreases in spring snowfall and a decrease in heating degree days. An increase in frost-free days and growing degree days is indicated.

POTENTIAL IMPACTS

Changes to the overall climate of the region can result in a variety of associated impacts. This section makes use of Plan2Adapt, which displays impacts that could potentially be associated with the amount of temperature and precipitation change projected for the region.

Warming will decrease snowpack throughout much of the region. Increases to high-intensity precipitation and seasonal moisture variability affect a variety of habitats. A seasonal increase in hot and dry conditions would increase the possibility of water shortages, increase plant and livestock stress, and place thermal stress on fish and their habitats.

A change in agricultural productivity could result from a longer growing season, seasonally waterlogged soil and decreased water availability. New crops and varieties may become viable.

Animal and plant species are likely to migrate in response to warming. If the dry season increases in length, this could increase forest fire severity.

Both river flooding and ocean storm surge events may increase in frequency and magnitude; stream bank erosion and strain on flood protection infrastructure may increase. Storm surge events may impact farmland in coastal and delta areas through soil salination, inundation and the salination of irrigation water sources. Increasing storm surges could require new design guidelines for flood control levels.

There could be a transition to rainfall-dominant watersheds, causing an increased need for water conservation and storage.

1. CANGRID is a historical gridded data set with a spatial resolution of 50 km based on station observations, composed by Environment Canada (Zhang et al., 2000: Temperature and precipitation trends in Canada during the 20th century. *Atmosphere Ocean*, **38**, 395-429.).
2. These values are from the PRISM data set, the details of which are given in: Daly, C., et al., 2008. Physiographically-sensitive mapping of temperature and precipitation across the conterminous United States. *International Journal of Climatology*, **28**, 2031-2064.
3. The statistical uncertainty indicates the range of trend estimates that are plausibly consistent with the year-to-year variation in seasonal means. This range is calculated as a statistical "95 % confidence interval."
4. The projected change given is the median from an ensemble of 30 global climate model projections from the Coupled Model Intercomparison Project 3 (CMIP3). The range, in brackets, is the 10th to 90th percentile of projected changes. Details about the ensemble, known as PCIC30, are given in: Murdock, T. Q. and D. L. Spittlehouse, 2011: Selecting and Using Climate Change Scenarios for British Columbia. Pacific Climate Impacts Consortium, University of Victoria, Victoria, British Columbia.

Table 3: Summary of Climate Projections for the South Coast Region

Climate Variable	Season	Projected Change from 1961-1990 Baseline	
		Ensemble Median	Range (10th-90th %ile)
Mean Temperature, 2050s (°C)	Annual	+1.7 °C	+1.1 °C to +2.5 °C
Precipitation, 2050s (%)	Annual	+6%	-2% to +11%
	Summer	-14%	-23% to +3%
	Winter	+6%	-4% to +14%
Snowfall*, 2050s (%)	Winter	-24%	-40% to -10%
	Spring	-52%	-73% to -14%
Growing Degree Days*, 2050s (degree days)	Annual	+336 degree days	+205 to +506 degree days
Heating Degree Days*, 2050s (degree days)	Annual	-593 degree days	-896 to -372 degree days
Frost-Free Days*, 2050s (days)	Annual	+24 days	+14 to +36 days

The table above shows projected changes in average (mean) temperature, precipitation and several derived climate variables from the baseline historical period (1961-1990) for the 2050s. The ensemble median is a mid-point value, chosen from a PCIC standard set of Global Climate Model (GCM) projections (Murdock and Spittlehouse 2011). The range values represent the low and high results within the set. Further information, including projections for the 2020s and 2080s see www.Plan2Adapt.ca.

* Derived from temperature and precipitation.