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The Climate of the Central and Northern Interior of B.C.

Clifford Raphael
Department of Geography
College of New Caledonia
Prince George, British Columbia V2N 1P8

The climate of central and northern interior British Columbia is examined. Although physiographically diverse with a variety of sub-regional and local climates, sufficient unifying influences exist to support the notion of a regional climate. Variations in temperature and precipitation across the region are related to latitude, elevation, and other local conditions. The greatest variability in temperature occurs in winter. Variations in temperature at Fort St. James are shown to be representative of variations at many other locations. Spring is the driest season over most of the region. Extremes in temperature and precipitation are related to anticyclonic blocking in the westerly flow. The alignment, location, intensity, and duration of the block are significant influences on the resulting temperature and precipitation. Analyses of trends in temperature and precipitation reveal changes that need to be assessed in the context of large scale causal mechanisms and in the context of CO_2-induced climate change.

Introduction

Climate is the collective expression of weather conditions characteristic of a particular place in the long term. It is most often described using averages of the various weather elements. However, a complete description of the climate of a locality must also include the probabilities of conditions such as departures from long-term averages, variations, and extremes.

The purpose of this paper is to provide an overview of some aspects of the climate of the central and northern interior of British Columbia. There is a dearth of information on the regional climate and sub-regional variations in the climate for this area. The major focus here will be on the mean patterns of temperature and precipitation although consideration will be given to other climate elements. Temperature and precipitation are the two key climate elements influencing vegetation, soils and human activities. To identify sub-regional variations, spatial and temporal trends in temperature and precipitation will be considered.

For the purposes of this paper, the "region" defined as the central and northern interior of British Columbia covers an area of approximately 7° latitude by 7° longitude. The boundaries of the region have been defined to correspond to the locations of existing climate stations (Figure 1). This is a convenient definition. It can be assumed that the data recorded at a particular station are representative of some surrounding district. This means that the "true boundaries" of the region can be extended somewhat beyond the perimeter defined by the stations themselves. The region is physiographically diverse and contains sections of the Interior Plateau, the Northern and Central Plateaux and Mountains, and the Great Plains physiographic regions of British Columbia (after Holland 1964).

The diverse nature of the region suggests that a variety of subregional and local climates can be expected and has been recognized in various climate schema for British Columbia (Chapman, 1952; Kerr, 1952; Chilton, 1981; and Tuller, 1986). This variety notwithstanding, a number of factors combine to give credence to the notion of a regional climate. These include: the influence of Arctic airstreams on temperature and precipitation; location in the lee of the Coast Mountains and, in the case of the Great Plains section of the region, in the lee of the Rockies; influence of summer storms because of the northward shift of cyclone tracks, and the reduced to non-existent influence of the Pacific anticyclone in summer. Kerr (1952) suggested that, in spite of the variations across the region, there is more uniformity than diversity in climate throughout the area.

Data from twelve stations located within the various physiographic regions are used in this discussion. These data were obtained from the Scientific Services Division, Atmospheric Environment Service, Pacific Region, and the AES publications—*Monthly Meteorological Summary*, *Canadian Climate Normals 1951–1980*, and *Canadian Climate Normals 1961–1990*. The length of the climate record utilized is variable. Two stations, Barkerville and Fort St. James, cover 100 years of record with all other stations in the range covering 30–60 years except Ootsa Lake with a record of 22 years (Table 1, see Appendix). This discussion differs from the

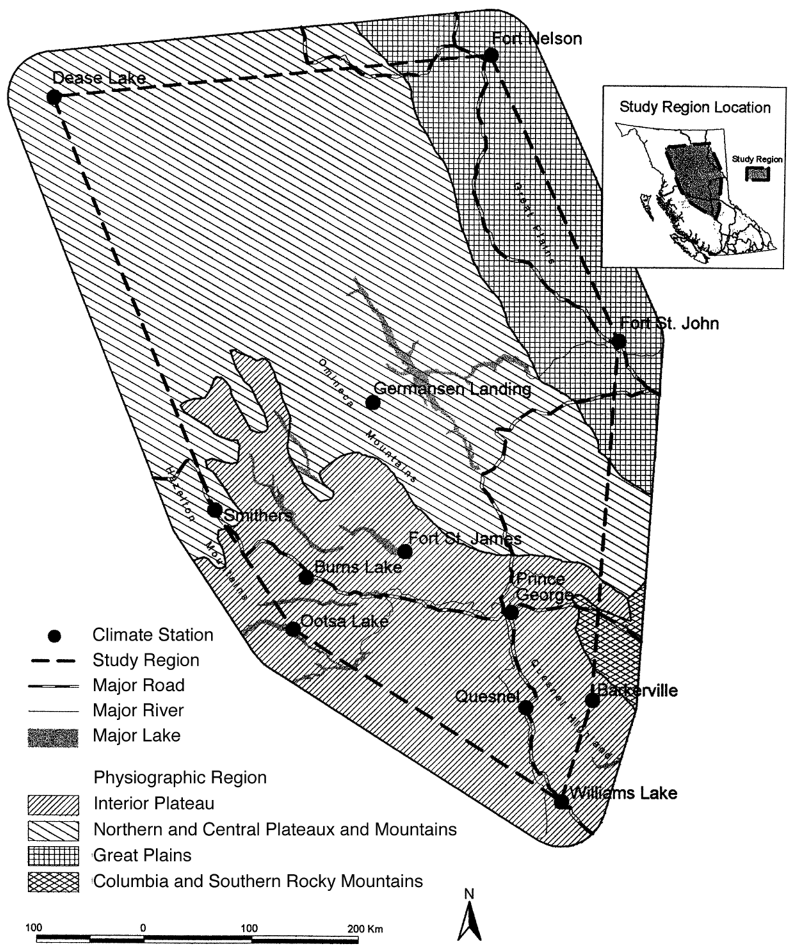

Figure 1 Map of the study region showing station location

earlier climate studies in its specific focus on the climate of central and northern interior British Columbia.

General Climate Controls

Climate controls refer to those large-scale factors which influence the climate of a given location. For British Columbia as a whole, and for the study region in particular, several of these large-scale controls can be identified.

Latitude

Latitude influences the angle of incidence of the sun's rays (solar altitude) and day length. Together, these influence the temperature of a given location. The study region spans approximately 7° degrees of latitude (Williams Lake 52° 11′ N, Fort Nelson 58° 50″ N). Some of the variations in temperature across the region will be the result of variations in latitude.

Latitude also influences a location's prevailing winds. British Columbia's latitude places it within the belt of the Northern hemisphere westerlies. The dominant airflow is west to east across the province. Due to the presence of the Pacific Ocean upwind of BC, maritime influences are advected onto the coast, significantly influencing both the thermal and moisture regimes. For central and northern interior British Columbia, this maritime influence, although still important, is sharply reduced because of mountain barriers.

Mountain Barriers

The topographic profile of British Columbia is dominated by NW to SE trending mountain chains (the Western cordillera). The study region is bounded by the Coast Mountains to the west and the Rockies to the east, except for the Great Plains portion of the region which lies to the east of the Rockies. Location in the lee of the Coast mountains means that stations in the region receive greatly reduced precipitation compared to coastal stations and are more continental in their thermal regimes. The Rockies, on the other hand, restrict the penetration of cold Arctic air into major sections of the region in winter (Tuller, 1986). Cold air access is usually limited to the wide low passes north of 54° such as Monkman Pass, the Peace River Gap and Pine Pass (Tyner, 1957). However, in late winter Arctic air may be deep enough to spill over the tops of the mountains (Bryson and Hare 1974).

Air Masses, Fronts and Synoptic Scale Disturbances

Air masses (immense bodies of air with distinctive temperature and humidity characteristics) play a crucial role in the climate of British Columbia as a whole. The temperature and humidity characteristics that an air mass brings to a given region are determined by the characteristics of the source region and the modifications that occur in transit. Fronts form the boundaries between air masses with contrasting properties. Chapman (1952) proposed a three-front model for British Columbia: the Arctic Front, separating continental Arctic air from Maritime polar air, the Maritime (Arctic) Front separating Maritime Arctic air from Maritime polar air, and the Pacific Polar front separating Maritime Polar air from Maritime Tropical air (Figure 2).

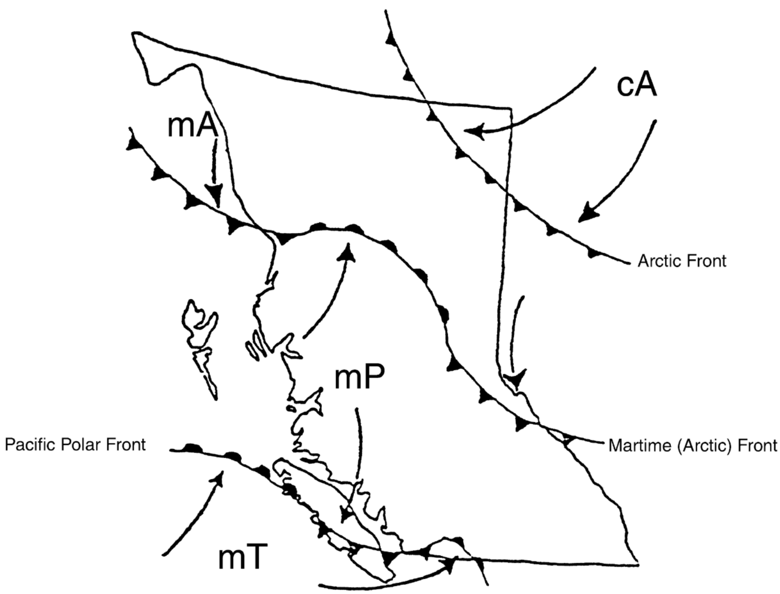

Figure 2 Three front model for British Columbia (modified after Chapman, 1952)

Air masses with either Pacific or Arctic origins vie for dominance in central and northern interior British Columbia. In the mean for the study region, Pacific air masses dominate the circulation for 6–9 months (nine months in western and southern sections six months in north and northeast sections). Arctic air masses dominate for the remainder of the time. The relative dominance of these air masses, their latitudes and their characteristics change with the seasons (Bryson and Hare, 1974). The frequency, intensity, duration and areal extent of each air mass determine the changeability of the weather for the region and also the long-term climate.

The central and western Pacific regions upwind from the British Columbia coast are important source areas for synoptic-scale disturbances—the familiar migratory cyclones and anticyclones that cause large day-to-day variations in the weather (Klein, 1957; Reitan, 1974; Hare and Hay, 1974). The bulk of precipitation over British Columbia is a result of the eastward movement of these cyclones and their accompanying frontal systems. These disturbances affect the region in all seasons. They are, therefore, important in determining mean patterns of temperature and precipitation.

Large scale breakdowns in the normal succession of transient disturbances determine the extremes in climate experienced across the region. These breakdowns are usually associated with the development of blocking anticyclones—strong, warm-cored ridges occurring in the westerly flow. Anticyclones can develop in all seasons but especially in spring and summer. They may be centred over the Gulf of Alaska, the northern interior of British Columbia, the interior plateaux of the northwest United States, and the Pacific, west of the BC coast. These blocking systems disrupt the regular west-to-east progress of migratory systems and can produce anomalous weather conditions over long periods of time and large areas (Hare and Hay, 1974; Knox and Hay, 1984). The impacts of blocking anticyclones on temperature and precipitation patterns will be more fully developed in a subsequent section.

Semi-Permanent Pressure Centres

Three semi-permanent pressure centres influence the weather and long term climate of British Columbia. They are the Aleutian Low, the Hawaiian High (Pacific anticyclone), and the Canadian High (associated with the Arctic front). The influence of the Hawaiian High is seen mainly in the summer in coastal and interior regions of southern British Columbia. It results in periods of clear, settled weather in this part of the province but its influence rarely extends to affect the study area. Winter and spring thermal and precipitation regimes, especially over the northern parts of the region, are significantly affected by the cold, dry conditions associated with the Canadian High. Cyclonic disturbances in the winter time over all of British Columbia, and in the summer time over northern British Columbia, are related to the activities of the Aleutian Low.

Local Controls

Sub-regional and local variations in climate are influenced by variations in relief across the physiographic regions included in the area, elevation, local relief (valley-bottom versus valley sides), aspect (north versus south facing slopes), and urban influences.

Climate Elements

Climate elements are influenced primarily by the large scale and local controls just outlined. A seasonal description and explanation of various climate elements will be the topic of this section. The standard divisions for the seasons (meteorological seasons) are as follows:

Winter: December–February
Spring: March–May
Summer: June–August
Fall: September–November

The meteorological seasons change about three weeks ahead of the conventional "solar" seasons. Unless otherwise noted, the "meteorological seasons" will be utilized.

Solar and Net Radiation

Temporal and spatial variations in solar radiation are key determinants of the variations in many other climate elements and processes. Variations in net radiation often mirror variations in solar radiation. The amount of solar radiation received is influenced by a location's latitude and elevation, the time of year, the time of day, and the state of the atmosphere (especially cloud cover). In addition to the factors noted for solar radiation, net radiation is also influenced by the albedo of the surface, air temperature, and surface temperature.

Mean monthly global solar radiation values and mean monthly net radiation values for two stations, Prince George, latitude 53° 53′, and Fort Nelson, latitude 58° 50′, are depicted in Figures 3 and 4. The typical patterns of solar radiation expected for middle to high latitude locations in the Northern Hemisphere are seen at these two stations; radiation values are at a minimum in December (the time of the winter solstice) and at a maximum in June (the time of the summer solstice). With the exception of April and May radiation values are higher at Prince George than at Fort Nelson. These higher values can largely be attributed to the difference in latitude between the two stations.

Mean monthly net radiation values at both locations (Tuller, 1986) essentially mirror the pattern of mean global solar radiation values. Summertime net radiation values are higher at Fort Nelson.

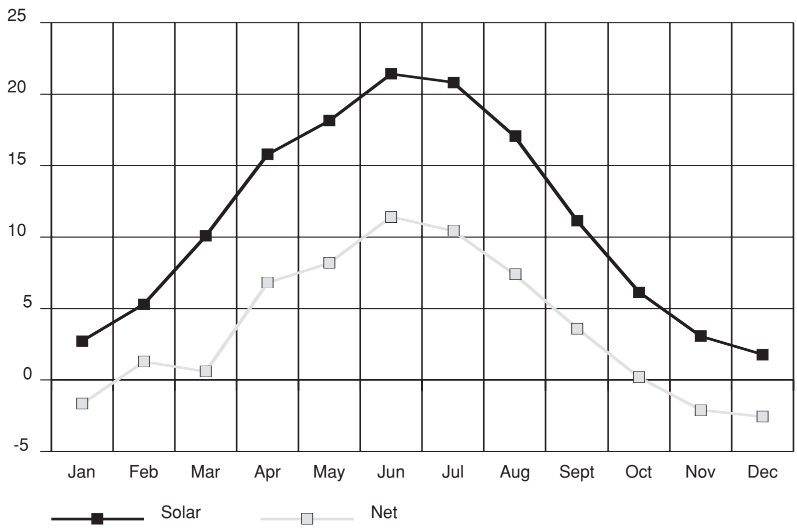

Figure 3 Mean global solar radiation and net radiation for Prince George

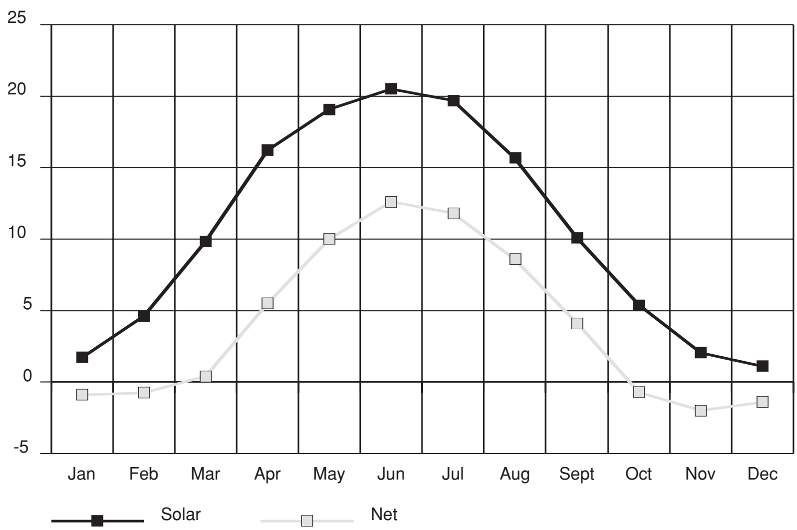

Figure 4 Mean global solar radiation and net radiation for Fort Nelson

Negative values of net radiation occur from October through February at Fort Nelson and November through February at Prince George. These negative values probably occur as a result of a combination of low solar and long wave radiation inputs and high surface albedos as a result of snow. January albedos are estimated to be approximately 45% at Prince George and 55% at Fort Nelson (Hay and Hare, 1974; Tuller, 1986). Temporal variations in solar and net radiation values observed for Prince George and Fort Nelson are believed to be representative of patterns across the region.

Temperature (Air Temperature at Screen Level)

The thermal regime of a location is controlled primarily by the available net radiation, air mass advection, and the storage and release of heat energy which are a function of surface type. Land absorbs and releases heat energy quickly whereas water absorbs and releases heat energy slowly. As a result, air temperatures for locations surrounded by land are more extreme than for locations in proximity to bodies of water.

Stations in the region experience greater extremes in temperatures (continentality) compared to their coastal counterparts. These extremes result from their interior location and their location in the lee of the Coast Mountain Range which acts as a barrier to the moderating influence of the ocean (maritime influence). For example, the normal mean January temperatures for Prince Rupert and Prince George (at approximately the same latitude) are 0.8° C and -9.9° C respectively. The normal mean temperatures for August (Prince Rupert) and July (Prince George), the warmest months, are 13.3° C and 15.3° C respectively. Temperature range for Prince Rupert is 12.5° C and for Prince George it is 25.2° C.

Annual Temperatures

Temperature data for stations in the central and northern interior B.C. are presented in Tables 2–13 (see Appendix) and Figures 5–16. Data are the normals for the period 1961–1990. Mean annual temperature generally decreases with increasing latitude and elevation. At Fort Nelson (most northerly location) it is -1.1° C. For Williams Lake (most southerly location) it is 4.1° C, and at Barkerville (highest elevation) it is 1.7° C. In addition to the latitude factor, lower temperatures in the northern part of the region are a result of the longer duration of Arctic air over this area. On an annual basis, Dease Lake, Fort Nelson, and Barkerville rank as the three coldest locations. Quesnel (4.9° C) is typically the warmest location. This reflects a combination of lower latitude, lower eleva-

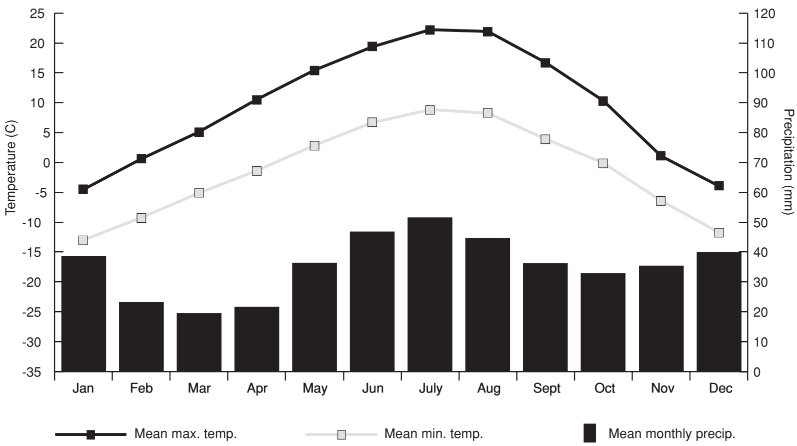

Figure 5 Climograph for Williams Lake

tion, and other local site factors. (Note: the Williams Lake station, though further south, is approximately 400m higher than the Quesnel station.)

The timing of the occurrence of extremes in mean annual temperatures across the region is very consistent. For most locations the three coldest years on record were 1950, 1951, and 1955. The coldest year on record at Fort St. James was 1900 when the mean annual temperature was -1.0° C.

As will be demonstrated in a later section, temperature variations at Fort St. James are highly correlated with variations at the other stations. This fact would imply that 1900 was a cold year across the region. The two warmest years on record at most locations were 1981 and 1987. In addition, mean annual temperatures generally tend to be higher in the 1980s and early 1990s.

Winter (December–February). Seasonal variations in mean temperatures generally reflect the patterns of solar and net radiation. Winter is the coldest season, with January typically being the coldest month. (The lowest temperature lags the time of lowest radiation inputs). January temperatures are lowest in the northeast sector of the region (Fort Nelson -22° C) and highest in the south (Williams Lake -8.7° C) for a range of 13.3° C across the region. Similar mean January temperatures occur for stations on a west to east line between Smithers and Prince George. Mean January temperature at Barkerville (-9.2° C) is comparable to that of stations at much lower elevations. A possible explanation is that Barkerville

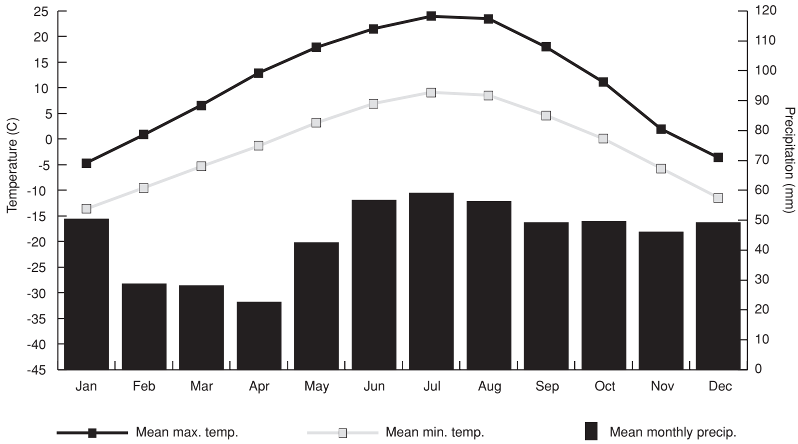

Figure 6 Climograph for Quesnel

lies above the bulk of the cold Arctic air usually occupying the valleys at this time resulting in a milder than expected January mean.

The role of advection in influencing mean winter temperatures on time scales of days to decades cannot be underestimated. Analyses of monthly temperatures at Prince George demonstrate that the occurrence of the lowest mean monthly temperature in a given year is determined largely by the timing, intensity and duration of Arctic air incursions and not necessarily by the time of lowest radiation inputs. These cold air incursions are related to the northwest to southeast migration of cold anticyclones developed over the Mackenzie-Yukon-Beaufort sea region during the winter (Bryson and Hare, 1974). For Prince George, January was the coldest month 50% of the time with November, December, and February making up the other 50%. Hare and Thomas (1979) and Bryson and Hare (1974) have suggested that the changing dominance of Arctic and Pacific air masses over the region is an important controlling influence on the winter climate. Several scenarios based on this drama of air mass frequencies can be identified:

1. Arctic air lies over the northern parts of the region for most of the winter (winters are cold in the north and “warm” in the south, e.g., winter of 1976–1977).

2. Arctic air covers the entire region reaching down into southern and coastal B.C. associated with outflow winds in coastal areas. Winters are bitterly cold throughout the region (e.g., winters of 1949–50, 1968–69, and 1995–96).

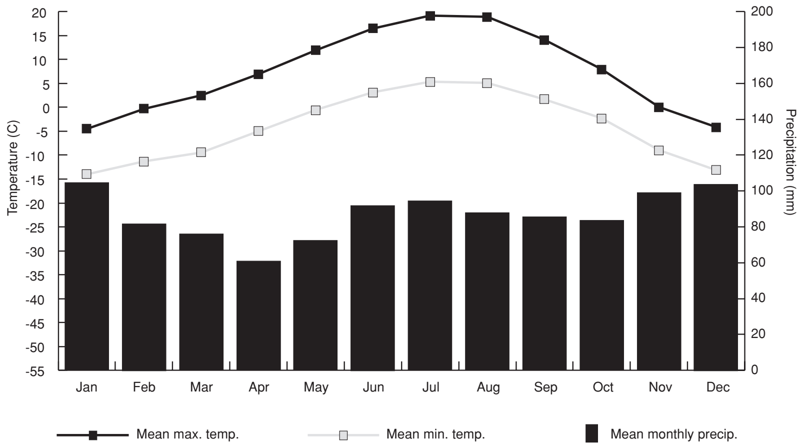

Figure 7 Climograph for Barkerville

3. Several advances and retreats of Arctic air occur alternating with air of Pacific origin. Winters are characterized by alternating periods of relative warmth and bitter cold (e.g., winter of 1981–82).

4. On other occasions Pacific air dominates a substantial portion of the region for most of the winter so that winter temperatures are well above normal (winters of 1976–77, 1991–92, and 1997–98).

Extremes in temperature are also associated with this changing air mass dominance. The lowest extreme minimum temperatures occur in the northern part of the region (Fort Nelson - 51.7° C) but temperatures as low as -42.2° C have been recorded at Williams Lake, the most southerly location. The lowest extreme minimum temperatures at the other locations lie between these two values. These minimum temperature extremes are associated with Arctic air incursions. In addition, intense radiative cooling as a consequence of clear skies and low humidity associated with Arctic air masses helps to depress further the extreme minimum temperatures.

Extreme maximum temperatures in January are associated with air of Pacific (or southerly) origins. Lower values tend to be associated with stations at high elevation, high latitude or both. The lowest extreme maximum value occurs at Dease Lake (8.9° C) and the highest value (15.6° C) occurs at Smithers. Walker (1961) has shown that high minimum temperatures in winter are associated with southerly flow at the 700 mb level.

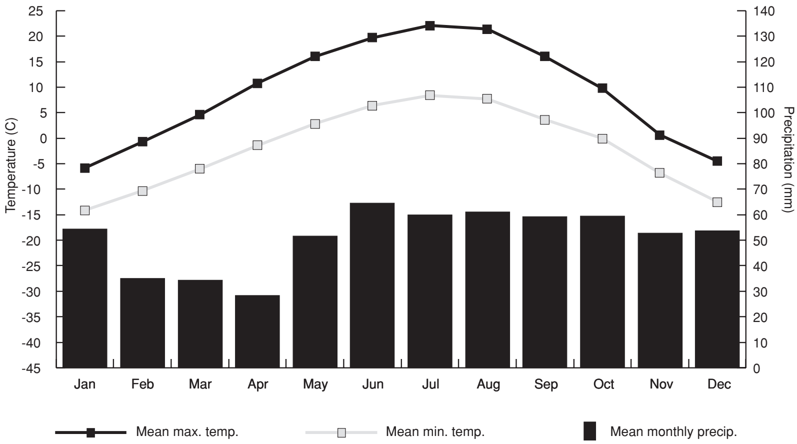

Figure 8 Climograph for Prince George

Summer (June–August): Summer is the warmest season with July being the warmest month. The occurrence of the highest mean temperatures in July illustrates the lag in air temperatures that occurs with respect to the time of maximum radiation inputs. This is typical for interior locations. Variations are apparent in mean July temperatures across the region. Highest mean July temperatures are observed at Fort Nelson (16.7° C), Quesnel (16.6° C), and Fort St. John (15.8° C). Lowest mean July temperatures are observed at Barkerville (12.2° C), Dease Lake (12.6° C), and Germansen Landing (13.8° C). Lower temperatures are affected by the latitude and elevation of a location. Williams Lake, the most southerly location, has a mean July temperature of 15.5° C. This lower than expected value is directly related to its elevation of 940 m above sea level.

High mean July temperatures at Fort Nelson are a consequence of several factors: protection from the maritime influence by two intervening mountain ranges and longer days with greater numbers of sunshine hours (Chapman, 1952; Chilton, 1981). The coincidence of highest mean July temperature and lowest mean January temperature gives Fort Nelson the distinction of being the location with the most continental thermal regime. The temperature range is 38.7° C. Mean July temperatures at the other stations lie between the extremes mentioned above and may incorporate other influences such as the presence of local water bodies (e.g., Fort St. James).

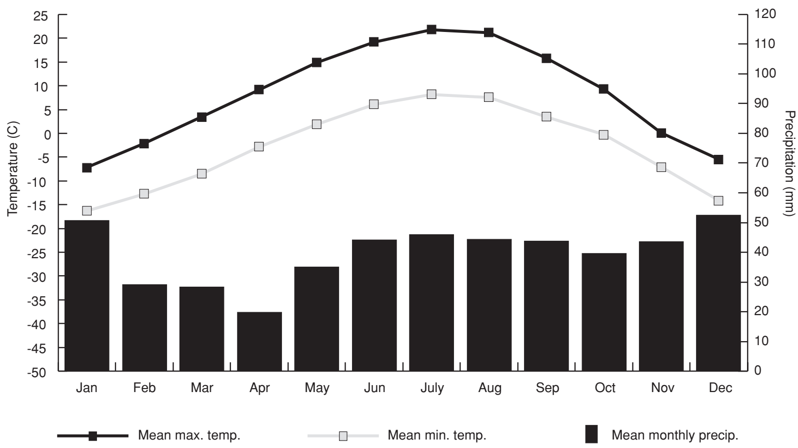

Figure 9 Climograph for Fort St. James

The range in mean July temperatures across the region is 4.5° C, substantially less than the 13.3° C value noted for winter. The reduced variability is a result of the fact that summer temperatures are predominantly radiatively driven and are therefore more conservative in contrast to the advectively driven temperatures of winter.

The temporal and spatial distribution of record extreme monthly maximum temperatures is noteworthy. The extremes appear to be independent of both latitude and elevation. The highest value, 37.7° C, occurs at Fort Nelson, Quesnel, and Fort St. James. The lowest value, 33.6° C, occurs at Fort St. John. In addition, the extremes are not limited to the summer months. Record extreme maximum temperatures occur in July at four locations, in August at two locations, in May at five locations, and in September at one location.

The spatial pattern of extreme summer minimum temperatures is rather chaotic. The lowest value, (-7.8° C), occurs at Barkerville and Fort St. James. The highest value, (-1.2° C), occurs at Fort St. John. The extreme minimum temperature value (-3.3° C) at Fort Nelson is higher than the value at five more southerly locations in the region. Extreme summer minimum temperatures exhibit a bimodal temporal distribution. Stations in the west and south of the region (Smithers, Burns Lake, Ootsa Lake, Quesnel, and Williams Lake) experience their extreme values in

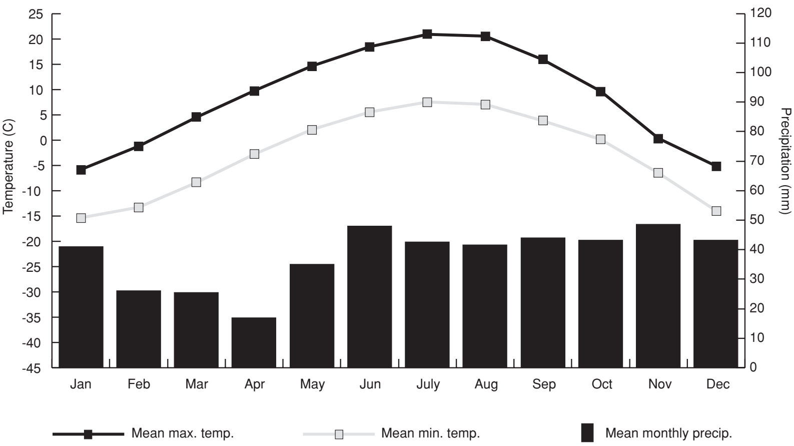

Figure 10 Climograph for Burns Lake

June. Stations to the north and east record their extreme values in August.

In addition to the role played by local site factors, (e.g., aspect, exposure, cold air drainage) several other explanations are possible to help clarify the observed temporal and spatial distributions. The occurrence of extreme minimum temperatures in June may be related to the late departure of Arctic air from the region in some years. It is instructive to note that all of the June extremes occur within the first two weeks of the month. The August observations are related to the early incursion of Arctic air into the region. Again, it is instructive to note that all of the August extremes are recorded in the last two weeks of the month. The northeast sector is most susceptible to these early outbreaks. According to Chapman (1952), summer frost is a hazard in the northeast sector as a result of these early outbreaks. The higher extreme minimum values in the Fort St. John–Fort Nelson region may result from strong summer surface heating which is intense enough to modify significantly the lower levels of the invading air mass thus producing the higher than expected values observed.

Spring (March–May) and Fall (September–November): Mean temperatures in spring and fall are intermediate between the winter and summer values. Temperatures for April and October (mid-season months) are lowest at Dease Lake, Barkerville, and Fort Nelson. Lower temperatures in the north are a function of the dominance of Arctic air over this part of the region during these months

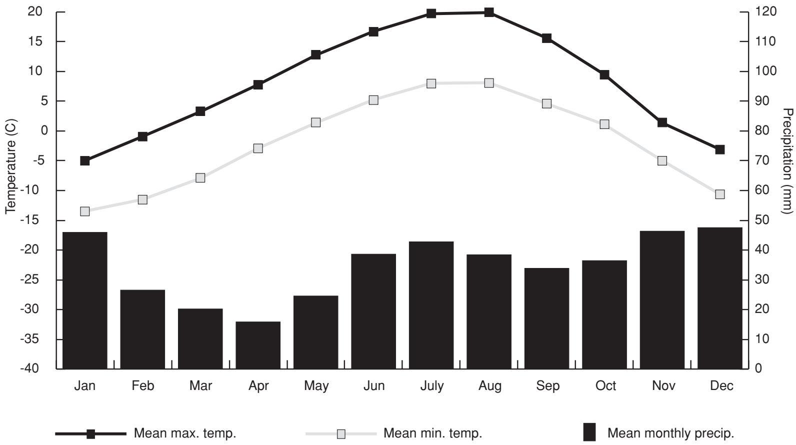

Figure 11 Climograph for Ootsa lake

(Bryson and Hare, 1974) and high albedo surfaces (lingering snow cover or early snowfall) significantly reducing the net radiation. Quesnel is the warmest location in both seasons: 5.8° C in April and 5.7° C in October. Mean April temperature across the region (3.2° C) is slightly lower than the mean October value of 3.9° C. The range in mean April temperatures (5.4° C) and mean October temperatures (4.7° C) is slightly higher than the range for July but again significantly lower than the 13.3° C value for January. Winter (January) then emerges as the season of greatest variability in mean temperatures.

Extreme maximum temperatures in spring occur in May and range between 31.5° C at Barkerville to 36.5° C at Quesnel. Extremes in the Fall occur in September and vary between 28.9° C at Dease Lake to 36.1° C at Quesnel. Extreme temperature minima in spring (March) and Fall (November), and to some extent April and October in the north of the region, more closely resemble the extremes of the winter months lending credence to the suggestion of a natural winter season for the region extending from November through March. Minima in the spring (March) range from a low of -42.8° C at Dease Lake to a high of -31.7° C at Williams Lake with a mean value across the region of -37.7° C. Minima in the Fall (November) range from a low of -42.5° C at Dease Lake to a high of -32.4° C at Smithers with a mean value across the region of -39.1° C. Lower minima in both seasons tend to occur in the north of the

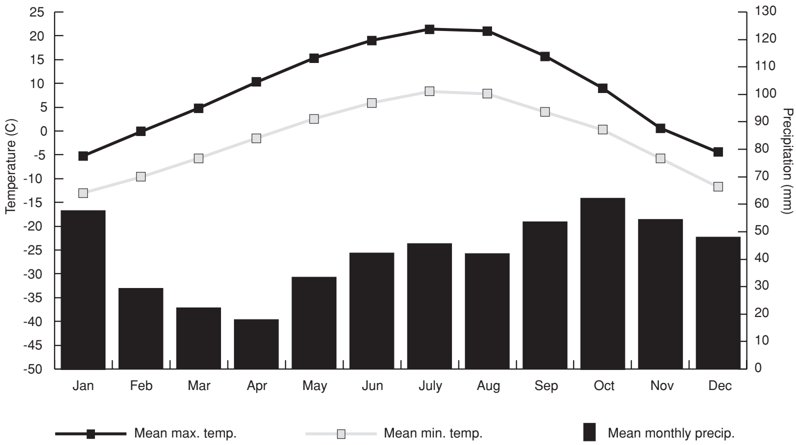

Figure 12 Climograph for Smithers

region and at higher elevations. The role of Arctic air in influencing the observed distribution has already been alluded to.

Precipitation

Precipitation requires the presence of water vapour in the air column and condensation mechanisms to produce raindrops or snowflakes large enough to fall to the surface. Several factors influence the availability of water vapour in the air column and the incidence of precipitation at the surface over British Columbia as a whole and the central and northern interior region in particular. The vapour flux over the area (derived mainly from the Pacific Ocean) results from zonal inflow which is stronger in the winter because the westerly flow is stronger at this time of the year. Precipitable water—the amount of moisture in the air column available to fall as precipitation—decreases in a west to east direction and is lower in January than in July (Hare and Hay, 1974). This means that more moisture is available over coastal locations than over interior locations and more moisture is available in July than in January. However, the key to the incidence and distribution of precipitation over British Columbia and its subregion is not the availability of water vapour or the flux of that vapour but rather the operation of uplift from the scale of the local thunderstorm to the frontal/cyclonic complex.

Over a region dominated by mountains such as is the case for British Columbia, orographic uplift functions mainly to enhance

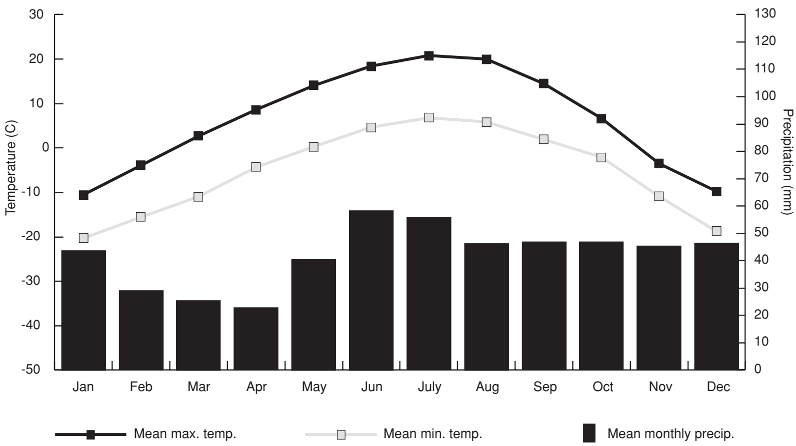

Figure 13 Climograph for Germansen Landing

frontal/cyclonic precipitation or enhance local convective uplift in constricted terrain (Hare and Hay, 1974). Augmentation of precipitation occurs on the windward slopes with substantial reduction on the lee side of the mountain range. The rain shadow effect increases with distance downwind of the mountain range. This drastic reduction in precipitation is seen in the contrast amongst mean annual precipitation totals for four locations: Prince George (609.8 mm) and Prince Rupert (2414.5 mm); Williams Lake (401.6 mm) and Bella Coola (1530.2 mm). Values at the interior locales are 25% and 26% of their coastal counterparts. Although most locations in the Central and Northern Interior show this reduction, appreciable variations in the temporal and spatial distribution in precipitation exist for the region. In addition to variations produced by the operation of different precipitation mechanisms, the overall pattern of precipitation across the region is conditioned further by local site factors such as elevation, aspect and exposure. The data portrayed in Figures 5–16 and contained in Tables 2–13 (see Appendix) capture these variations.

Annual Precipitation

Mean annual precipitation ranges from a high of 1042 mm at Barkerville to a low of 416.6 mm at Ootsa Lake. Dease Lake (421.6 mm) and Williams Lake (426 mm) also have low annual totals. At most of the other stations mean annual precipitation is less than 520 mm with the exception of Quesnel (538.5 mm) and Prince

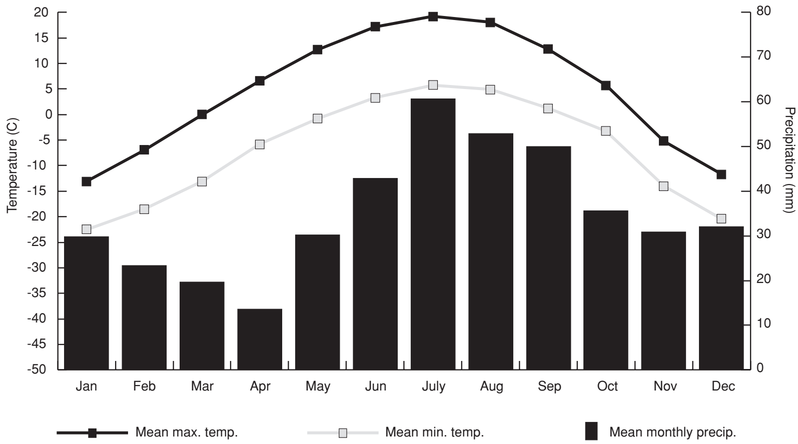

Figure 14 Climograph for Dease Lake

George (614.7 mm). Across the region, rainfall is from 50%–70% of the annual precipitation, being generally less important as latitude and elevation increase. Barkerville's high annual precipitation is related to its location in the Quesnel Highland (Cariboo Mountains), at 1265 m a.s.l., and illustrates the impact of orographic lifting on precipitation enhancement. The effects of convergence and uplift occurring in the airstream as it encounters topographic barriers such as the Quesnel Highland can also be seen in the increased precipitation at Quesnel and Prince George (Chilton, 1981). The low annual total at Dease Lake reflect a combination of dry Arctic air in the winter and spring months, isolation with respect to the southerly flow of moist air in the winter (Tuller, 1986), and reduced summer convective activity as a result of higher elevation (cooler temperatures).

Barkerville (1860.7 mm, 1948) and Prince George (843.7 mm, 1967) record the highest maximum annual precipitation. Williams Lake (232.9 mm, 1970) and Fort St. John (251.3, 1945) record the lowest minimum annual precipitation (Table 14, see Appendix). Although the timing of the occurrence of extremes varies across the region, two patterns emerge when the annual data for all locations are examined: 1) the general tendency for record wet years to be wet across most of the region (e.g. 1959 and 1962) and for record dry years to be dry across most of the region (e.g. 1943 and 1970); 2) opposite patterns in northern and southern sections; that is, wet in the south dry in the north, or the reverse.

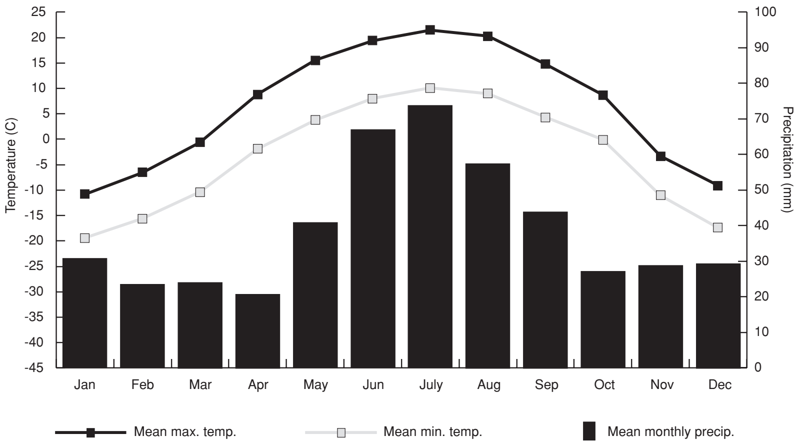

Figure 15 Climograph for Fort St. John

The seasonal cycle of precipitation in the central and northern interior region shows a distinct minimum in spring at all stations except Fort Nelson where winter is the season of minimum precipitation. This dry period actually extends from February through May with April being the driest month at most locations (Figures 5–16). Precipitation distribution across the rest of the year is more spatially variable.

A distinct summer maximum is apparent at stations in the southern and northern parts of the region. At Williams Lake and Quesnel, total summer precipitation is 33.5% and 32% of the total annual precipitation respectively. For Dease Lake, Fort St. John and Fort Nelson, values range between 37.1% and 47.1% of the annual totals. A weak summer maximum exists at three other locations: Fort St. James, Prince George, and Germansen Landing. For locations with a summer maximum in precipitation, June and July are usually the two wettest months. At the four remaining locations, maximum precipitation occurs in the fall (as at Smithers 32.8% of the annual total) or precipitation is fairly evenly distributed across the summer-fall-winter period. This even distribution is best exemplified by the seasonal precipitation percentages for Barkerville: summer (26.3%); fall (25.7%) and winter (27.9%). Except for perhaps the two stations in the northeast, the preceding observations support the conclusion that precipitation falling in the colder seasons determines the annual precipitation pattern across the region (Walker, 1961).

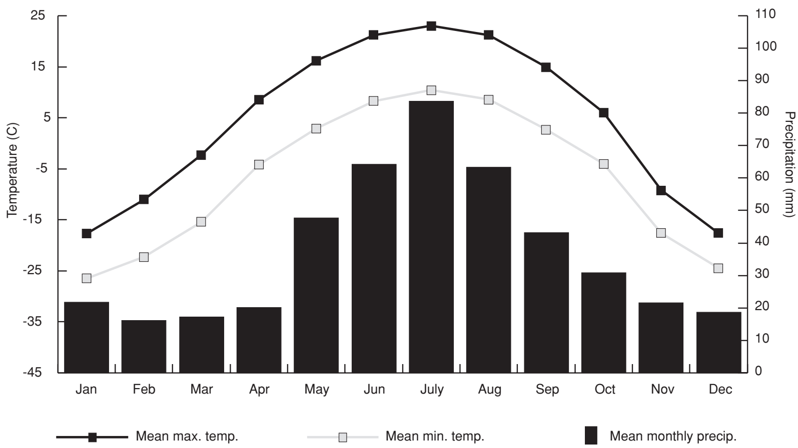

Figure 16 Climograph for Fort Nelson

Winter (December–February): Precipitation in the winter is predominantly in the form of snow with December and January being equally represented as the snowiest month. However, rainfall in some winters can be a significant fraction of the overall winter total. For example, at Quesnel on December 10, 1980, 22 mm of rain was recorded. This represents 17.1% of the normal total winter precipitation. The importance of rainfall to total precipitation amounts (both absolute and relative) increases with decreasing latitude and altitude. At the three northern stations rainfall is less than 1 % of the normal winter total. At Barkerville, rainfall is 6.5% and, at Quesnel, 16% of total winter precipitation.

Air temperature and ground surface conditions (cold or snow-covered or both) in winter, render convective air motions essentially impossible. The absence of convective activity is replaced by an increase in frontal/cyclonic activity. Winter precipitation is almost exclusively frontal/cyclonic in origin (Walker, 1961). Winter is the season of the strongest westerly flow and the season of maximum intensity and frequency for cyclogenesis off the coast of British Columbia. Although the main storm tracks are centred far to the south at around 45° N, the central and northern interior region still experiences significant frontal activity (Bryson and Hare, 1974). The percentage of precipitation falling at Prince George when fronts are present is: January, 100%; April, 75%; July, 41%; and October, 95% (Walker, 1961).

Mean winter precipitation values are highest at Barkerville (290.2 mm), Prince George (143.2 mm), and Smithers (135.1 mm). The lowest mean winter precipitation occurs at Fort Nelson (56.7 mm), Fort St. John (83.7 mm), and Dease Lake (85.5 mm). The suppression of winter precipitation in the north and northeastern sections of the region is of note. As mentioned earlier, this is primarily a result of the presence of cold, dry, stable Arctic air over these areas. In years (for example, winters of 1968–69 and 1949–50) when the Arctic air extends to cover most if not all of the region, low values of precipitation are also recorded at other locations for the duration of the outbreak event. Heavy precipitation can result when a change in circulation causes the Arctic air to be replaced by a southerly flow of Pacific origin. The type and amount of precipitation depend on factors such as the stability, temperature and moisture content of the new air mass, elevation and exposure of the location, and the temperature of the cold air trapped at the surface.

Extreme maxima and minima in winter season precipitation across the region are presented in Table 14 (see Appendix). The driest winter on record (22.9 mm) occurred at Dease Lake in 1968–69. With the exclusion of Barkerville, the wettest winter on record (313.2 mm) occurred at Smithers in 1946–47. Anomalously wet or dry winters tend to occur on a region-wide basis. For example, the winter of 1981–82 was one of record precipitation at both Fort St. James and Prince George with very wet/snowy conditions everywhere else. The winter of 1986–87 was one of record dry conditions at Quesnel, with dry conditions occurring throughout the region.

Spring (March–May): Spring is the season of transition between the cyclonic storms regime of winter and the instability of summer. Dry Arctic air still dominates most of the region north of 53° N while at the same time there is a decrease in the strength of the westerlies. Frontal/cyclonic activity still plays an important but diminished role in the precipitation occurring across the region (Walker, 1961; Bryson and Hare, 1974; Tuller, 1986). Precipitation in the spring is a mixture of snow and rain. Rainfall makes up the greater percentage (up to 79.8% at Quesnel) of spring precipitation at all stations except Barkerville (38.6%), Dease Lake (43.1%) and Fort St. John (49.2%).

The dryness of spring has already been noted. Ootsa Lake and Dease Lake are by far the driest locations with a mean total spring precipitation of 60.5 mm and 63.5 mm respectively. Barkerville is the wettest location with a mean spring precipitation of 209.1 mm. Fort Nelson (85.1 mm) and Fort St. John (85.8 mm) are both wetter in the spring than stations in the western and southern parts of the region (e.g., Smithers and Williams Lake). The unexpectedly higher spring precipitation at these two northeast locations is influenced by the dramatic increase in precipitation in the month of May especially evident at Fort Nelson (Figure 16). This sharp increase in precipitation in May could be the result of decreased influence of Arctic air combined with an increase in convective activity related to increased solar radiation inputs.

Spring precipitation extrema are given in Table 14 (see Appendix). The lowest spring precipitation value among the stations (16.8 mm) was recorded at Dease Lake in 1945. Dease Lake also has the distinction of being the location with the lowest extreme maximum spring precipitation total (114.4 mm in 1981). These data indicate that Dease Lake, in addition to being one of the coldest locations, is also one of the driest locations in the region. Barkerville (449 mm, 1948) and Fort Nelson (182.7 mm, 1988) are the locations with the highest record maximum spring precipitation.

The spring precipitation distribution is more spatially variable than the winter pattern—more sub-regional variations are apparent (Table 14, see Appendix). For example, dry springs occur in the west and northwest with wet conditions elsewhere, or wet springs occur in the northeast and west with dry conditions in other parts of the region. The influence of local conditions may help to explain some of this variation. Exceptions to the above would be the region-wide very wet springs of 1981 and 1988 and the very dry springs of 1956 and 1991.

Summer (June–August): Summer is the season of maximum precipitation at many stations across the region. Precipitation is mainly in the form of rain although most stations have recorded small amounts of snow in at least one of the summer months. Mean values for total summer precipitation range between 119.7 mm and 274.3 mm. Ootsa Lake and Smithers are the two driest locations with Barkerville being the wettest. (Barkerville's elevation and location make it the wettest station in the region in all seasons.) High values of mean summer precipitation are recorded for the Fort Nelson–Fort St. John area.

A number of factors combine to explain the incidence of precipitation across the region in the summer. Increased solar radiation input coupled with late spring surges of cool, unstable air give rise to strong convective activity leading to increases in precipitation in June (Schaefer, 1978). Impacts of convective activity on summer precipitation are best exemplified by the precipitation patterns at Fort Nelson and Fort St. John. The strong summer maximum in precipitation is typical of the convectional precipitation regime of true continental climates. Results from Tuller (1986) indicated that the Peace River region has the highest values for high intensity convectional rainfall—15-minute rainfall totals with a 10-year return period—for all of British Columbia.

In addition to strengthened convective activity, a series of cold lows—pools of cold air aloft which become "cut off" from the upper-level westerly flow—with their inherent instability normally cross the province in late spring and early summer giving rise to frequent showers and thundershowers (Schaefer, 1978; Oke and Hay 1994). Analyses of summer data for the period 1947–1955 showed that Cold Lows tracked through the study region about 39% of the time (Hage, 1947 in Walker, 1961). Some estimates suggest that precipitation associated with Cold Lows might reach 51 mm in the summer season, a large percentage of total summer precipitation for many locations in the central and northern interior region (Walker, 1961).

A third factor influencing summer precipitation is the major changes that occur in the atmospheric circulation. The Hawaiian High (Pacific anticyclone) extends northward in the upper troposphere and at lower elevations usually around mid-June, although the timing may vary from year to year (Bryson and Hare, 1974). As the Hawaiian High develops the Cold Lows are displaced (Schaefer, 1978). There is also a concomitant northward shift in the main storm tracks which are now centred around 54° N. A decreased latitudinal temperature gradient means that the westerly flow is weak. Although Pacific cyclones are less frequent and less vigorous than in winter as a result, they still track through the region and play an important role in summer precipitation (Bryson and Hare, 1974; Hare and Hay, 1974; Walker, 1961).

Extreme maximum summer precipitation values range from 620.3 mm at Barkerville to 203.7 mm at Ootsa Lake. Fort Nelson (450.8 mm), Fort St. John (361.5 mm), and Dease Lake (339.2 mm) also record high maximum values (Table 14, see Appendix). Record low summer precipitation values range from 33.1 mm at Fort St. James to 98.1 mm at Barkerville. Williams Lake (33.3 mm) and Ootsa Lake (47.2 mm) are the locations with the next lowest record minimum summer precipitation.

Although the timing of minima and maxima varies from one location to the next, extreme minimum precipitation at one location tends to occur in the context of regional dryness (e.g., summers of 1967 and 1992). Record wet summers tend to follow a similar pattern (e.g., the summers of 1957, 1962, and 1993). Very wet summers may result from a combination of enhanced frontal activity, enhanced cold low activity and enhanced convective activity.

Fall (September–October): Fall, like spring, is a transitional season between the regimes of summer and winter. Several changes important to fall precipitation patterns occur in the circulation in early to mid fall. The Aleutian Low, which had weakened and been displaced north and west as the Hawaiian High shifted north, reappears dramatically in August (Walker, 1961) as if to signal the end of summer. The westerlies strengthen, expand and develop a very zonal (west to east) flow pattern. The main storm tracks shift to be centred on 48° N (Bryson and Hare, 1974). An increase occurs in the frequency and intensity of travelling cyclones and anticyclones and the Arctic regime establishes itself over the northern sections of the region by late November (Hare and Hay, 1974). The sum of these changes determines the nature and magnitude of fall precipitation.

Fall precipitation across the region is a mix of snow and rain with rainfall greater than 55% at all locations except Fort Nelson (49.7%), and up to 77% at Smithers. Snow begins to dominate the mix late in the season. For example, the normal snowfall for November at Prince George is 68.5% of the total precipitation. The main causal mechanisms for precipitation in early fall are frontal/cyclonic systems and late season convective activity. By October, frontal/cyclonic systems dominate. (Walker, 1961). The increased frequency and intensity of these frontal/cyclonic systems is shown by the continued high precipitation amounts in the fall (compared to summer) at locations such as Prince George and by the increased totals over summer at locations such as Smithers (Figures 8 and 12).

Mean total precipitation value is, again, highest at Barkerville (268.3 mm). Across the rest of the area, high values occur at Prince George (171.4 mm) and Smithers (170.5 mm). Lowest mean total precipitation values occur at Fort Nelson (95.4 mm), Fort St. John (99.8 mm), and Williams Lake (101.4 mm). Reduction in solar inputs suppressing convective activity, increasing isolation from the southerly flow of moist air and the onset of the cold, dry, stable Arctic regime produce a marked decrease in fall precipitation for the Fort Nelson–Fort St. John region (northeast sector). The Williams Lake value probably results from a decrease in convective activity and less impact of the increased frontal/cyclonic activity that characterizes the fall.

Not surprisingly, extreme minimum Fall precipitation totals (Table14, see Appendix) are lowest in the northeast. Fort St. John, 27.4 mm; Fort Nelson, 34.8 mm. Williams Lake in the south has a record minimum of 37 mm. Barkerville (455 mm) and Smithers (287.9 mm) have the highest extreme maximum values. Although there are sub-regional variations in some years, extreme dryness/wetness at any location tends to occur in the context of regional dryness/wetness. For example, the fall of 1943 was the driest fall on record at four widely spaced location: Fort Nelson, Fort St. John, Prince George, and Smithers. The fall of 1986 was the wettest fall on record at both Dease Lake and Germansen Landing with above normal precipitation everywhere else across the region.

Anomalies in Temperature and Precipitation

The extremes in temperature and precipitation for all seasons described in earlier sections represent substantial departures from the long-term mean values at any location within the study area. These anomalies can usually be related to the development of blocking anticyclones in the westerly circulation. The association between blocking and unusual weather has been well documented (Andrews, 1955; Baudat and Wright, 1969; Namias, 1969; Knox and Hay, 1984). Blocking anticyclones are associated with positive anomalies in the mean pressure field at the surface and various other levels in the atmosphere. The strength, duration, location, and alignment of the blocking ridge are all important components affecting the resulting weather. Several examples of blocking anticyclones and their impacts on extremes in weather for the study region are presented in this section.

Figures 17–23 are maps of the 500 mb level, showing the mean pressure field and anomalies for the periods indicated. Four periods from the winters of 1968–69 and 1997–98 are depicted on Figures 17–20. Of note for the winter of 1968–69 (Figures 17 and 18) is the strong ridge positioned off the coast of British Columbia aligned southeast to northwest and the deep trough over western Canada. This alignment interrupts the normal west-to-east progression of migratory systems and allows cold Arctic air to be pulled down in the trough behind the ridge covering all of the study region. Record low temperatures and below normal precipitation were reported for a number oflocations throughout British Columbia, including five locations in the study region, during these two events (Baudat and Wright, 1969). In contrast, for the winter of 1997–98, ridging at the 500 mb level was less intense with the blocking ridge centered on two different locations. In early January 1998 (Figure 19), the ridge was centred off the coast of

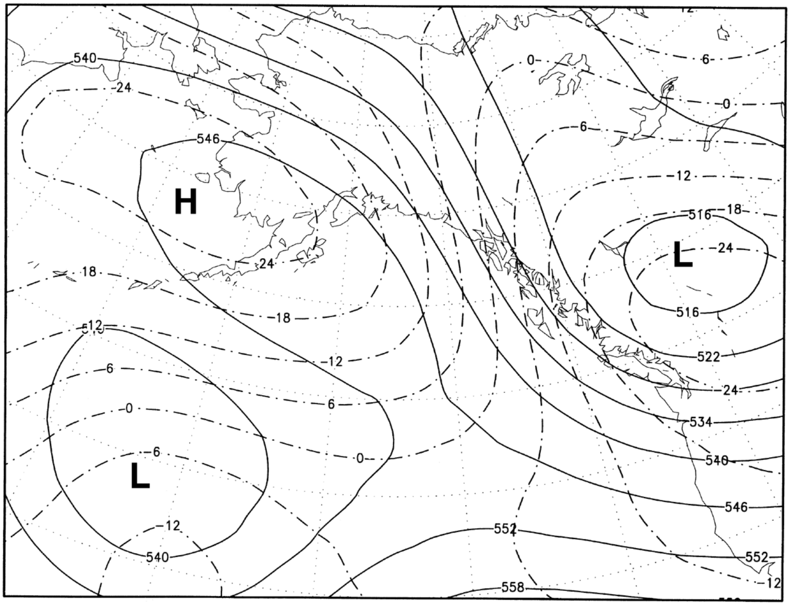

Figure 17 Map of the 500 mb level showing the mean pressure field and anomalies for December 25–31, 1968

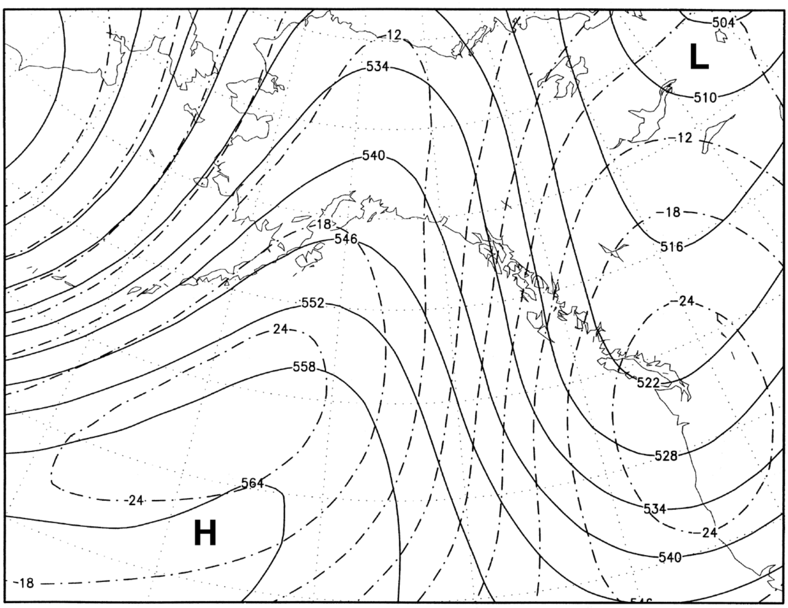

Figure 18 Map of the 500 mb level showing the mean pressure field and anomalies for January 23–30, 1969

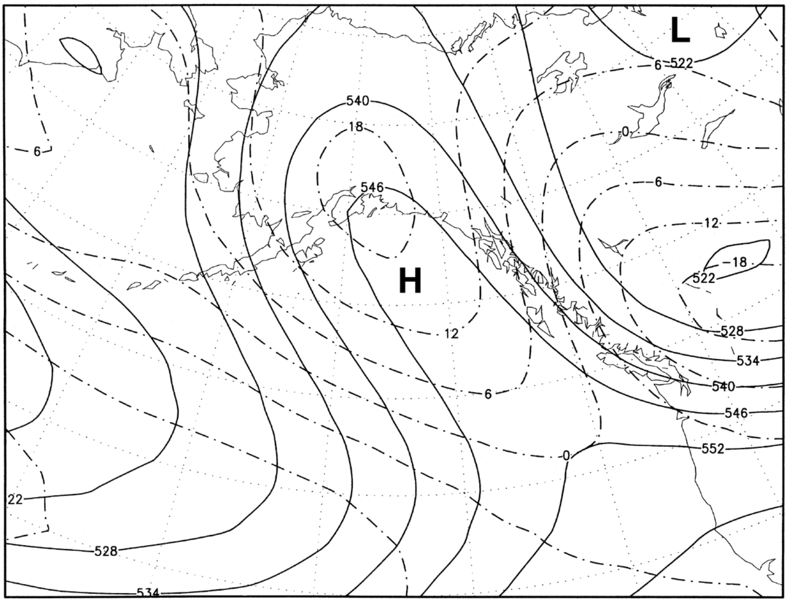

Figure 19 Map of the 500 mb level showing the mean pressure field and anomalies for January 8–11, 1998

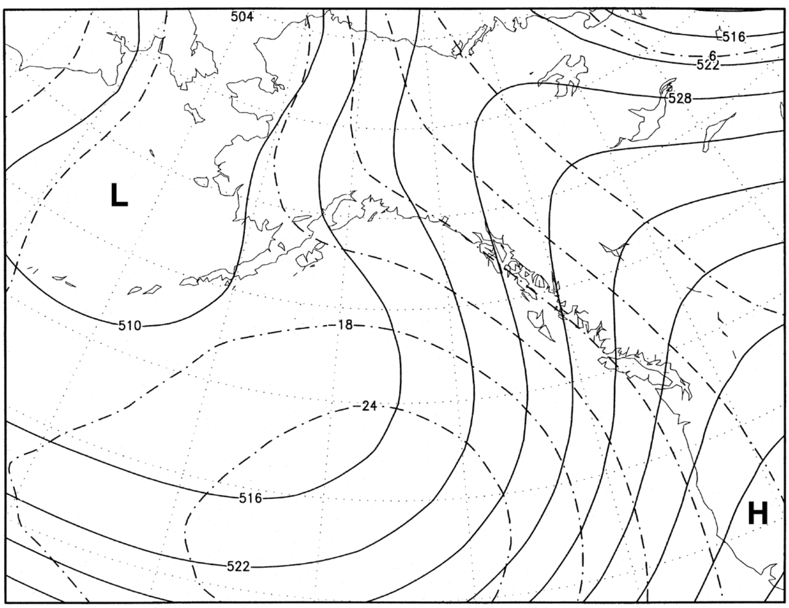

Figure 20 Map of the 500 mb level showing the mean pressure field and anomalies for January 25–31, 1998

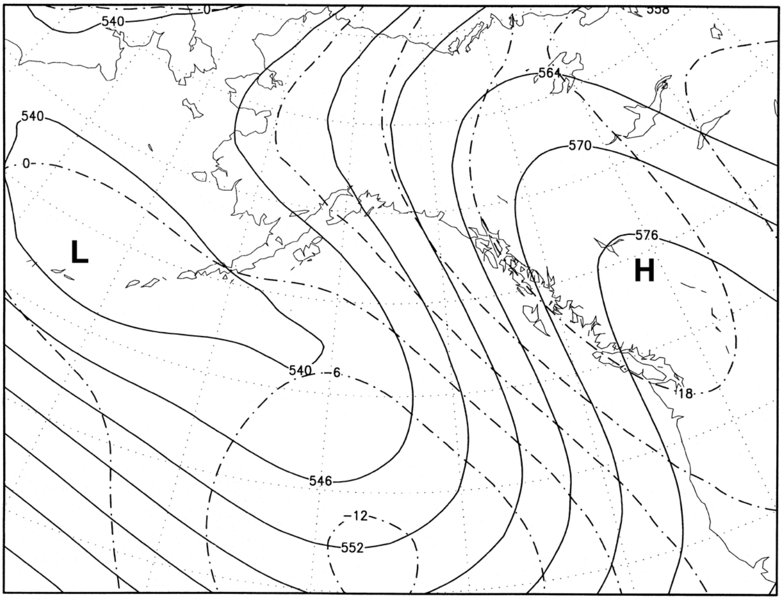

Figure 21 Map of the 500 mb level showing the mean pressure field and anomalies for May 27–31, 1983

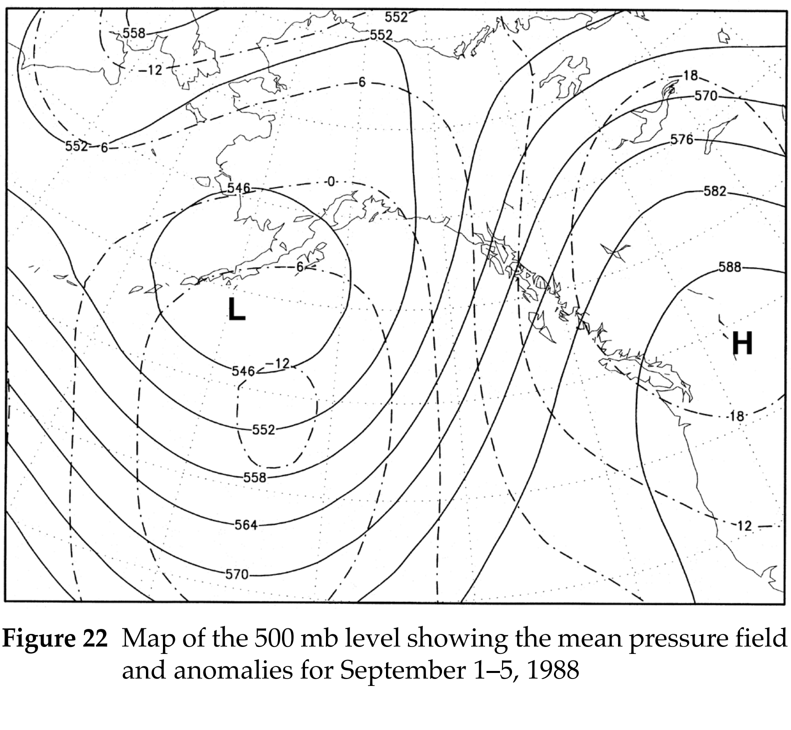

Figure 22 Map of the 500 mb level showing the mean pressure field and anomalies for September 1–5, 1988

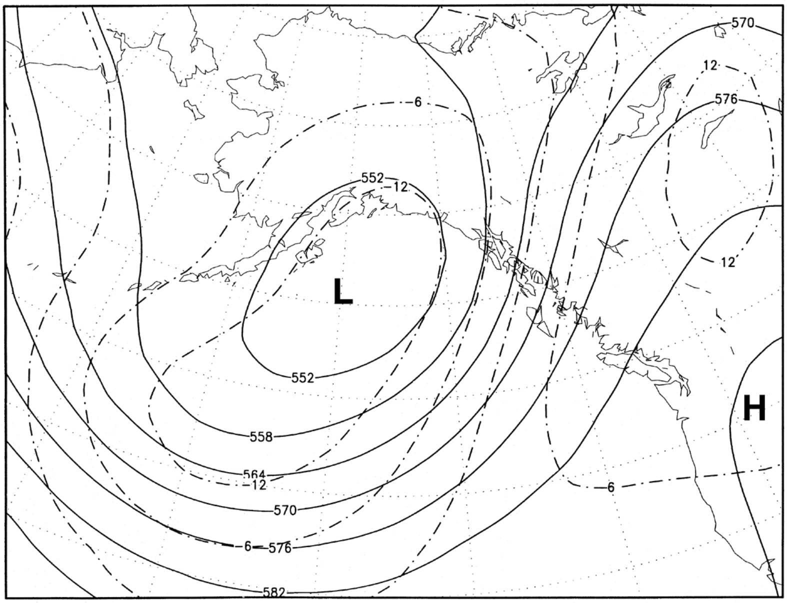

Figure 23 Map of the 500 mb level showing the mean pressure field and anomalies for July 9–12, 1990

British Columbia allowing, cold air to invade the trough over western Canada; temperatures were below normal but substantially warmer than in 1968–69. In the latter part of January 1998 (Figure 20), the ridge was centred over western Canada. The southwest-to-northeast alignment of the isobars favoured advection of warm air from the southwest at middle and upper levels. Temperatures were substantially above normal during the period.

Examples of anticyclonic blocking in spring, summer and fall are shown on Figures 21–23. Although there are some differences in the intensity, location, and alignment of the blocking ridge, in each instance, the ridge configuration facilitates the flow of warmer air into the region. In May 1983 and September 1988, record or above normal temperatures were observed at all locations in the study region.

Anomalously dry conditions can generally be linked to blocking systems. Anomalously wet conditions can conceivably occur in conjunction with blocking (the location of the anticyclonic centre would be important) but may result from a variety of different factors. For example, due to the strong zonality in the westerly flow in the fall, extreme or above normal fall wetness across the region may be related to more frequent and intense frontal/cyclonic systems crossing the region.

Climate Trends, Variability and Change

Variability

Several aspects of the temporal and spatial variability in temperature and precipitation across the region have already been discussed. Some further comments on variability will be the topic of this section.

The difference in mean temperature from year to year (the interannual variation), can be used as a measure of temporal and spatial variability in the temperature field. Time series of interannual variations in seasonal and annual temperatures were derived for several locations: Prince George, Smithers, Quesnel, Williams Lake, Fort Nelson, Dease Lake, and Fort St. James. Interannual variations at the other locations were compared to the Fort St. James data (Fort St. James is the location with the longest, most reliable, complete record for temperature and precipitation in the region). Results for two locations, Prince George and Fort Nelson, for the winter season are shown on Figures 24 and 25. It is quite clear from the data presented that a high degree of correspondence exists between interannual variations at Fort St. James and these two locations in winter.

The correlation between interannual variations at Fort St. James and the six other locations was assessed for seasonal and annual values. Figure 26 shows the correlation coefficients plotted against straight line distance of the station from Fort St. James. Even though mean winter temperatures show the greatest range across the region, interannual variations in seasonal temperatures across the region tend to be most conservative in winter and most variable in spring. Correlation coefficients in all seasons are statistically significant: highest at Prince George and lowest at Fort Nelson. Some directionality is apparent; that is, Smithers to the west, has lower correlations than Quesnel, to the south, even though it is closer to Fort St. James. This may be related to the fact that stations are in different physiographic regions. Results also indicate that data at Fort St. James can be used to represent temperature variations over large sections of the study region and would therefore be useful for additional analyses of the climate of the region. The spatial patterns are indicative of similar forcing factors for temperature across the area and further support the regional designation assumed herein. The consistently lower correlations for Fort Nelson suggest that this location should be treated separately.

Variations in precipitation were assessed using the coefficient of variation (standard deviation/mean), a relative measure of the dispersion in a data set (see Table 14, Appendix). In all seasons and at all locations, the year to year variation in precipitation is high. Greatest variability at a given locale and across the region tends to occur in the summer. This is a reflection in part of the role of local-scale convectional precipitation in influencing summer totals. The least variability exists for annual precipitation totals. The greatest variability in precipitation across the seasons occurs for Williams Lake and Fort St. John. The least variability occurs for Burns Lake and Prince George.

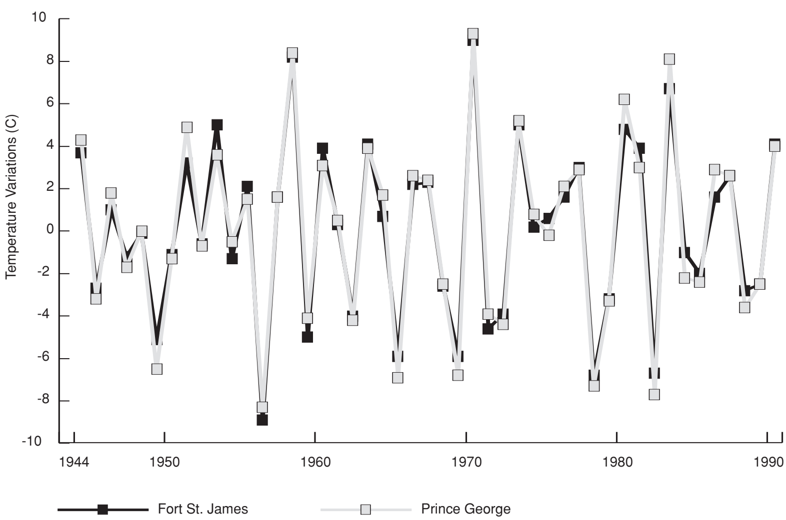

Figure 24 Comparison of interannual variations in winter temperatures for Fort St. James and Prince George

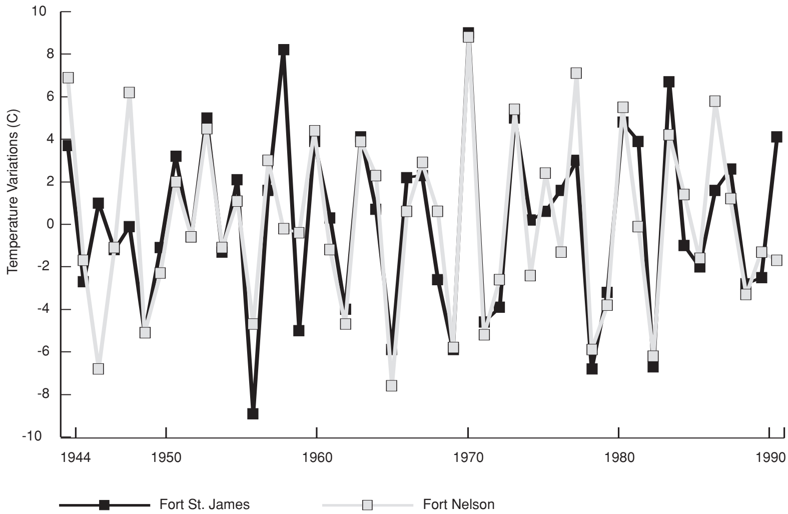

Figure 25 Comparison of interannual variations in winter temperatures for Fort St. James and Fort Nelson

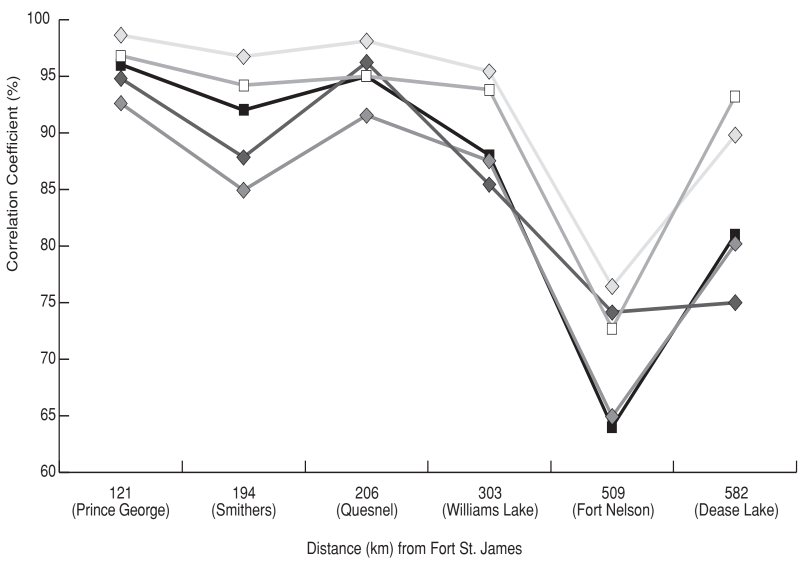

Figure 26 Interannual temperature correlation: Variation with distance

Climate Trends and Change

The concern over climate change as a result of CO_2-induced greenhouse warming is an issue for this region. Climate change, typically indicated by changes in temperature, would affect several spheres of human activity (e.g., energy utilization and forestry practices) (Raphael, 1993). Change, if any, must be assessed in the context of the historical climate record for a region. Ideally, trends in the existing record must be identified, analyzed and explained before anything definitive can be said about CO_2-induced warming. A recent study, (Raphael, 1993), assessed the temperature trends at Prince George for the period 1943–1991. Results indicated significant increases in winter, spring, summer and annual mean temperatures at this location over the 49-year period. Changes in winter and spring were the most important. Temperature trends were similar to Canadian, northern hemisphere, and global trends for the same period (Berry,1991). Similar trends were also observed at other locations in the region (e.g., Smithers).

In addition to the Raphael (1993) study, trends in temperature for the region were assessed using data at Fort St. James. Decadal means were derived for annual and seasonal mean minimum and mean maximum temperatures. Ten decades are represented in the data. Decades were chosen to coincide with the 10-year periods of the Canadian Climate Normals. For example, the period 1971 through 1980 constitutes the decade of the 1970s. The period 1895–1900 is used to represent the decade of the 1890s. The deviations of the decadal means from the 1961–1990 climate normals were calculated and are depicted on Figures 27 and 28. These graphs indicate that: 1) all decades are colder than the 1961–1990 normals except the 1980s; 2) there is a warming trend in mean minimum temperature with the 1980s being the warmest decade, and 3) the most recent climate normals represent a warmer (at least with respect to mean minimum temperatures) sequence in the climate of the region. Results for mean maximum temperatures (not shown) are more variable but also show the 1980s as one of the warmest decades.

Cumulative deviations from the long-term mean were also calculated for annual and seasonal mean minimum temperatures. The cumulative deviation is the difference between the element value(in this case mean minimum temperature) for a particular year and the long-term mean for the data set, plus the sum of the deviations from all preceding years. Decreasing values of the cumulative deviations are associated with years in which element

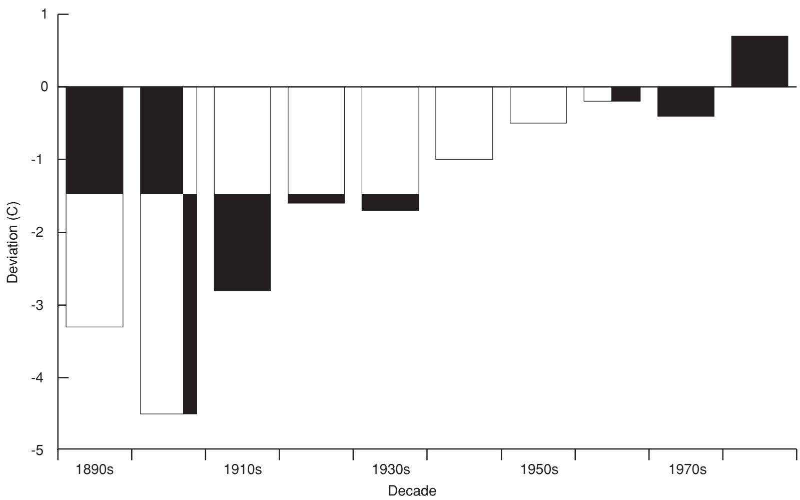

Figure 27 Fort St. James: Mean minimum temperature (annual values); deviation from the 1961–1990 normal

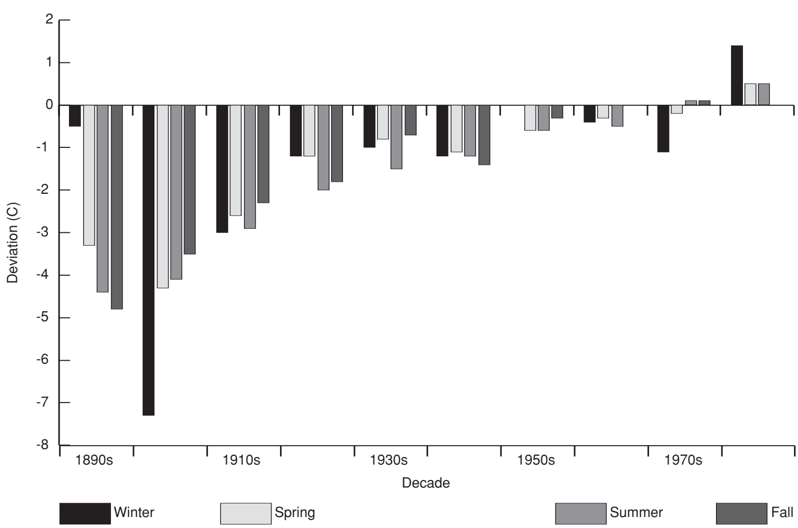

Figure 28 Fort St. James: Mean minimum temperature (seasonal values); deviation from the 1961–1990 normal

values are below the long-term mean. Increasing values are associated with years in which element values are above the long-term mean. Cumulative deviations can be used to identify the timing and nature of climate variations at a particular location (Linacre, 1992 and Raphael, 1993). Figure 29 shows cumulative deviations for annual and winter mean minimum temperatures. The annual values fall into three distinct periods: a period of below average mean minimum temperatures from 1895–1922; a transitional period (with values close to the long-term mean) from 1922–1950; and a period of above average mean minimum temperatures from 1951–1990. Winter values are much more variable. The period of below average values from 1895–1922 is largely present; subsequent to this, several periods alternating between above/below average temperatures are evident.

Analyses of long term precipitation data for Fort St. James using cumulative deviations (Figures 30 and 31) reveal important trends in annual and seasonal precipitation: the period prior to the mid-1940s being characterized by below average precipitation and the period until about the early 1980s characterized by above average precipitation. Large scale causal mechanisms (e.g., El Nino, air-mass frequency changes) are implicated in these temperature and precipitation trends. The role of these mechanisms needs to be resolved definitively before any understanding of the impacts of CO_2-induced climate change on the region can be fully realized.

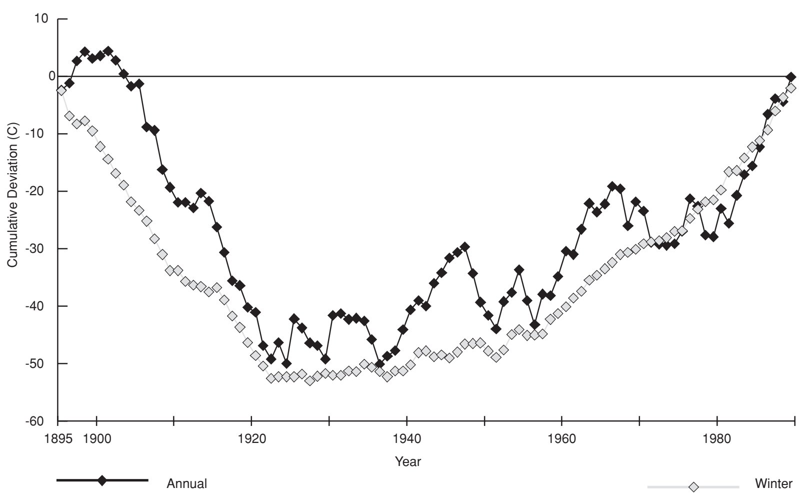

Figure 29 Fort St. James: Mean minimum temperature; deviation from the 1895–1990 mean

Figure 30 Fort St. James annual precipitation: deviation from the 1900–1990 mean

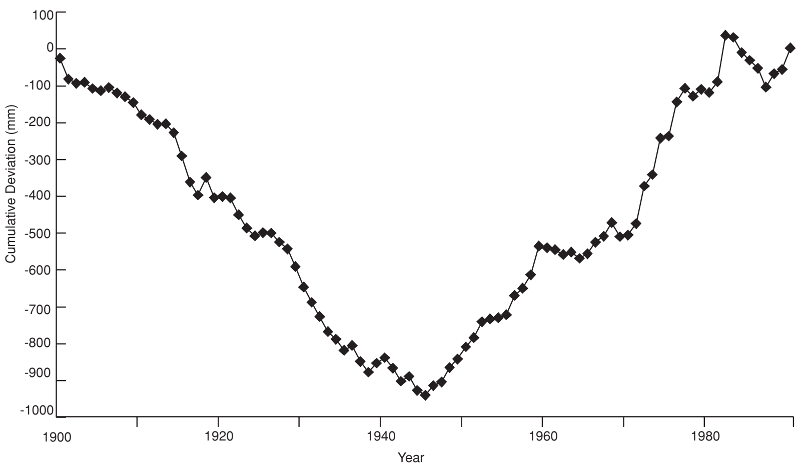

Figure 31 Fort St. James winter precipitation: deviation from the 1900–1991 mean

Conclusion

The aim of this paper has been to provide an overview of some aspects of the climate of the central and northern interior of British Columbia. Local scale variations dictate that there be several sub-regional variants in climate over such a large area. However, the perspective adopted in this paper is that there are enough unifying factors (e.g., the role of Arctic airmasses) to view the climate of this region as a single entity, distinct from coastal climates or climates of the southern interior of British Columbia.

The climate of the central and northern interior of British Columbia region is, in essence, a climate of austerity. It is characterized by long, cold and sometimes very severe winters especially in the northern sections and cool to warm (occasionally hot), and in most instances, wet summers. Every season can be given to extremes in temperature and precipitation. The inhabitants of this region must be commended for their adaptability and resilience in the face of a harsh and sometimes unforgiving climate.

Acknowledgements

Data for this study were courtesy of Environment Canada. I am grateful to the many College of New Caledonia students who assisted as work-study students at various stages of this project. The efforts of Jason Gilkes, Jennifer Hay, D'arcy Henderson, and Carell James are especially noteworthy. Brendan Murphy's assistance in producing a number of the figures is worthy of note. I am also grateful to Drs. Michael Church, Marilyn Raphael, and Stan Tuller who reviewed the manuscript and provided many helpful comments. Finally, I give thanks to God for his enabling grace.

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Appendix

Table 1 Location, period of record and length of record for climate stations in the study region.

Station Name Name	*Latitude*	*Longitude*	*Elevation (m.a.s.l.)*	*Period of Record*	*Length of Record (Years)*
Barkerville	53° 04′	121° 31′	1265	1888-1992	104
Burns Lake	54° 14′	125° 46′	704	1969-1990	22
Dease Lake	58° 25′	130° 00′	816	1947-1994	48
Fort St. James	54° 27′	124° 15′	695	1895-1994	100
Fort St. John	56° 14′	120° 44′	695	1942-1994	53
Fort Nelson	58° 50′	122° 35′	382	1938-1994	57
Germansen Landing	55° 47′	124° 42′	747	1952-1992	43
Ootsa Lake	53° 46′	125° 58′	861	1956-1992	37
Prince George	53° 53′	122° 40′	676	1942-1994	53
Quesnel	53° 02′	122° 31′	545	1946-1992	47
Smithers	53° 49′	127° 11′	523	1942-1994	53
Williams Lake	52° 11′	122° 04′	940	1961-1994	34

Table 2 Temperature and precipitation statistics for Williams Lake (All data are the official climate normals for the period 1961-1990)

	Jan	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct.*	*Nov*	*Dec*	*Annual*
Mean monthly minimum temperature (°C)	-13.0	-9.3	-5.1	-1.4	2.8	6.7	8.8	8.3	3.9	-0.1	-6.4	-11.7	-1.4
Mean monthly maximum temperature (°C)	-4.5	0.6	5.1	10.5	15.4	19.4	22.2	21.9	16.7	10.3	1.1	-3.9	9.6
Mean monthly temperature (°C)	-8.7	-4.3	-0.3	4.6	9.1	13.1	15.5	15.1	10.3	5.1	-2.6	-.7.7	4.1
Extreme monthly minimum temperature (°C)	-42.2	-34.6	-31.7	-16.7	-5.8	-2.2	0.0	-1.7	-8.9	-28.6	-41.6	-42.8	-42.8
Date	1969 /28	1989 /2	1976 /3	1966 /11	1986 /14	1973 /2	1971 /2	1973 /19	1972 /27	1984 /31	1985 /27	1968 /30	
Extreme monthly maximum temperature (°C)	12.8	12.8	17.1	28.8	34.5	32.2	34.4	33.3	35.8	27.1	16.7	11.2	35.8
Date	1968 /20	1963 /6	1990 /29	1977 /25	1983 /29	1969 /18	1971 /31	1981 /11	1988 /4	1987 /1	1975 /4	1980 /15	
Mean monthly rainfall (mm)	3.5	2.8	3.8	11.3	33.6	46.3	51.4	44.6	35.2	25.5	8.7	2.0	268.8
Mean monthly snowfall (cm)	44.5	25.9	18.3	11.1	2.6	0.3	0.0	0.0T	1.0	8.1	31.8	49.1	192.8
Mean monthly total precipitation (mm)	38.5	23.2	19.5	21.5	36.4	46.7	51.4	44.6	36.2	32.9	35.4	39.9	426.0

Table 3 Temperature and precipitation statistics for Quesnel (All data are the official climate normals for the period 1961-1990)

	Jan	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct.*	*Nov*	*Dec*	*Annual*
Mean monthly minimum temperature (°C)	-13.6	-9.5	-5.3	-1.3	3.2	6.9	9.1	8.5	4.6	0.1	-5.7	-11.5	-1.2
Mean monthly maximum temperature (°C)	-4.7	0.9	6.6	12.9	17.9	21.5	24.0	23.5	18.0	11.1	2.0	-3.6	10.8
Mean monthly temperature (°C)	-9.1	-4.2	0.7	5.8	10.5	14.2	16.6	16.1	11.3	5.7	-1.8	-7.5	4.9
Extreme monthly minimum temperature (°C)	-46.7	-42.2	-38.9	-20.0	-10.0	-3.3	0.6	-1.7	-8.9	-28.4	-37.8	-41.1	-46.7
Date	1950 /24	1956 /15	1955 /4	1954 /4	1954 /1	1955 /7	1949 /2	1947 /20	1951 /26	1984 /31	1955 /26	1968 /30	
Extreme monthly maximum temperature (°C)	13.9	15.1	19.4	31.0	36.5	35.6	36.7	36.2	36.1	26.8	17.2	12.2	36.7
Date	1968 /20	1986 /25	1960 /25	1977 /25	1983 /29	1969 /18	1961 /13	1990 /5	1988 /4	1988 /4	1949 /2	1952 /13	
Mean monthly rainfall (mm)	6.1	7.5	14.1	18.4	42.0	56.7	59.0	56.3	49.0	44.0	17.3	6.9	377.2
Mean monthly snowfall (cm)	55.8	25.4	15.3	4.3	0.4	0.0	0.0	0.0	0.3	5.7	31.9	50.6	189.4
Mean monthly total precipitation (mm)	50.5	28.7	28.2	22.6	42.5	56.7	59.0	56.3	49.3	49.6	46.0	49.3	538.5

Table 4 Temperature and precipitation statistics for Barkerville (All data are the official climate normals for the period 1961-1990)

	Jan	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct.*	*Nov*	*Dec*	*Annual*
Mean monthly minimum temperature (°C)	-14.0	-11.3	-9.4	-5.0	-0.6	3.1	5.3	5.1	1.7	-2.3	-9.0	-13.1	-4.1
Mean monthly maximum temperature (°C)	-4.5	-0.3	2.5	6.9	11.9	16.5	19.1	18.9	14.1	7.9	0.0	-4.2	7.4
Mean monthly temperature (°C)	-9.2	-5.7	-3.3	1.0	5.7	9.8	12.2	12.1	7.9	2.9	-4.4	-8.6	1.7
Extreme monthly minimum temperature (°C)	-46.7	-43.3	-37.2	-26.1	-15.0	-6.7	-3.9	-7.8	-13.3	-30.5	-42.0	-41.7	-46.7
Date	1947 /31	1893 /2	1955 /4	1954 /2	1945 /1	1945 /12	1945 /4	1947 /20	1926 /23	1984 /31	1985 /27	1968 /28	
Extreme monthly maximum temperature (°C)	10.0	15.0	17.2	27.8	31.5	32.2	35.6	33.9	32.5	26.7	18.9	14.4	35.6
Date	1986 /13	1954 /7	1930 /28	1926 /28	1983 /29	1978 /3	1941 /17	1897 /20	1988 /4	1935 /3	1892 /3	1907 /4	
Mean monthly rainfall (mm)	6.7	5.7	7.0	15.1	58.6	91.1	94.4	87.9	82.2	57.3	13.8	6.6	526.4
Mean monthly snowfall (cm)	97.7	76.1	69.1	45.7	13.7	1.0	0.0	0.0	3.4	26.2	85.3	97.3	515.5
Mean monthly total precipitation (mm)	104.6	81.8	76.0	60.8	72.3	92.0	94.4	87.9	85.6	83.6	99.1	103.8	1013.8

Table 5 Temperature and precipitation statistics for Prince George (All data are the official climate normals for the period 1961-1990)

	Jan	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct.*	*Nov*	*Dec*	*Annual*
Mean monthly minimum temperature (°C)	-14.1	-10.3	-6.0	-1.4	2.8	6.4	8.4	7.7	3.6	-0.1	-6.8	-12.5	-1.9
Mean monthly maximum temperature (°C)	-5.8	-0.7	4.6	10.8	16.0	19.7	22.1	21.4	16.0	9.8	0.6	-4.5	9.2
Mean monthly temperature (°C)	-9.9	-5.4	-0.7	4.7	9.4	13.1	15.3	14.6	9.8	4.8	-3.1	-8.4	3.7
Extreme monthly minimum temperature (°C)	-50.0	-45.0	-37.8	-25.6	-8.3	-2.8	-1.7	-3.9	-12.2	-26.5	-41.7	-45.6	-50.0
Date	1950 /2	1956 /15	1955 /24	1954 /4	1954 /1	1949 /26	1950 /31	1973 /19	1951 /26	1984 /31	1955 /26	1964 /16	
Extreme monthly maximum temperature (°C)	12.8	12.8	17.8	29.7	36.0	33.9	34.4	33.4	31.4	25.2	17.4	11.7	36.0
Date	1981 /22	1986 /27	1960 /20	1977 /25	1983 /29	1958 /24	1961 /13	1981 /9	1988 /4	1987 /1	1981 /11	1952 /13	
Mean monthly rainfall (mm)	5.3	8.2	12.0	19.5	49.2	64.5	60.0	61.2	58.6	51.4	16.6	8.7	415.2
Mean monthly snowfall (cm)	60.1	31.6	25.2	8.8	2.5	0.0	0.0	0.0	0.8	8.0	42.7	54.1	233.8
Mean monthly total precipitation (mm)	54.4	35.0	34.3	28.3	51.7	64.5	60.0	61.2	59.3	59 .4	52.7	53.8	614.7

Table 6 Temperature and precipitation statistics for Fort St. James (All data are the official climate normals for the period 1961-1990)

	Jan	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct.*	*Nov*	*Dec*	*Annual*
Mean monthly minimum temperature (°C)	-16.3	-12.7	-8.5	-2.8	1.9	6.1	8.2	7.6	3.5	-0.3	-7.1	-14.1	-2.9
Mean monthly maximum temperature (°C)	-7.2	-2.1	3.4	9.2	14.9	19.2	21.8	21.2	15.8	9.3	0.1	-5.5	8.3
Mean monthly temperature (°C)	-11.7	-7.3	-2.5	3.3	8.4	12.7	15.0	14.4	9.7	4.5	-3.4	-9.7	2.8
Extreme monthly minimum temperature (°C)	-49.4	-49.4	-39.4	-29.4	-11.7	-6.1	-5.6	-7.8	-13.3	-23.0	-37.8	-47.2	-49.4
Date	1928 /1	1907 /3	1902 /15	1911 /4	1954 /1	1895 /5	1933 /29	1900 /26	1926 /23	1984 /31	1896 /20	1927 /31	
Extreme monthly maximum temperature (°C)	12.0	13.0	16.7	24.4	35.0	33.9	36.7	35.6	29.6	26.5	16.1	11.0	36.7
Date	19811 /2	1986 /27	1928 /20	1934 /25	1983 /29	1950 /18	1941 /17	1939 /9	1946 /1	1987 /1	1907 /30	1980 /15	
Mean monthly rainfall (mm)	2.6	3.0	4.9	13.1	33.9	44.2	45.9	44.3	43.2	32.2	10.5	3.6	281.4
Mean monthly snowfall (cm)	48.0	26.1	23.4	6.7	1.1	0	0	0	0.5	7.5	33.0	48.8	195.0
Mean monthly total precipitation (mm)	50.6	29.1	28.3	19.8	35.0	44.2	45.9	44.3	43.7	39.6	43.6	52.4	476.4

Table 7 Temperature and precipitation statistics for Burns Lake (All data are the official climate normals for the period 1961-1990)

	Jan	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct.*	*Nov*	*Dec*	*Annual*
Mean monthly minimum temperature (°C)	15.4	-13.3	-8.4	-2.8	2.0	5.5	7.5	7.0	3.8	0.1	-6.5	-14.0	-2.9
Mean monthly maximum temperature (°C)	-5.9	-1.2	4.5	9.7	14.6	18.4	20.9	20.5	15.9	9.6	0.3	-5.2	8.5
Mean monthly temperature (°C)	-10.6	-7.2	-1.9	3.5	8.3	12.0	14.2	13.8	9.9	4.9	-3.0	-9.6	2.9
Extreme monthly minimum temperature (°C)	-46.7	-40.0	-40.0	-18.9	-7.0	-2.2	-0.6	-0.8	-8.9	-21.5	-37.3	-42.7	-46.7
Date	1972 /24	1979 /14	1976 /2	1975 /5	1986 /14	1973 /10	1973 /22	1985 /25	1972 /27	1984 /31	1985 /27	1984 /31	
Extreme monthly maximum temperature (°C)	11.0	10.3	15.4	27.3	34.0	33.3	32.8	33.4	30.9	25.6	14.5	11.3	34.0
Date	19811 /2	1988 /20	1979 /22	1979 /28	1983 /29	1969 /11	1971 /31	1981/9 /9	1988 /4	1987 /1	1978 /1	1980 /15	
Mean monthly rainfall (mm)	4.8	2.1	3.5	11.1	34.1	48.0	42.6	41.6	43.1	36.3	16.6	3.7	287.5
Mean monthly snowfall (cm)	42.5	27.7	23.1	5.5	1.1	0	0	0	0.6	7.4	34.4	44.7	187.0
Mean monthly total precipitation (mm)	41.1	26.1	25.4	16.9	35.1	48.0	42.6	41.6	44.0	43.3	48.6	43.2	455.9

Table 8 Temperature and precipitation statistics for Ootsa Lake (All data are the official climate normals for the period 1961-1990)

	Jan	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct.*	*Nov*	*Dec*	*Annual*
Mean monthly minimum temperature (°C)	-13.5	-11.5	-7.9	-2.9	1.4	5.2	8.0	8.1	4.6	1.1	-5.0	-10.6	-1.9
Mean monthly maximum temperature (°C)	-5.0	-0.9	3.3	7.8	12.8	16.7	19.7	19.9	15.6	9.5	1.4	-3.1	8.1
Mean monthly temperature (°C)	-9.2	-6.1	-2.3	2.4	7.1	11.0	13.9	14.0	10.1	5.3	-1.7	-6.8	3.1
Extreme monthly minimum temperature (°C)	-42.2	-39.0	-34.4	-22.2	-6.1	-1.7	-1.0	0.6	-5.0	-2.1	-36.0	-40.0	-42.2
Date	1972 /25	1979 /14	1962 /3	1963 /1	1957 /22	1977 /3	1984 /6	1969 /22	1961 /26	1984 /31	1985 /27	1968 /29	
Extreme monthly maximum temperature (°C)	12.2	12.2	15.0	24.4	34.0	31.1	32.8	33.3	29.0	25.0	16.7	11.1	34.0
Date	1968 /21	1968 /27	1962 /30	1977 /24	1983 /29	1969 /17	1971 /27	1960 /9	1988 /4	1987 /1	1978 /1	1956 /26	
Mean monthly rainfall (mm)	5.4	3.9	2.5	9.7	23.6	38.6	42.7	38.4	33.3	31.0	14.1	6.2	249.4
Mean monthly snowfall (cm)	40.5	22.6	17.7	6.1	0.8	0	0	0	0.4	5.3	31.8	41.3	166.5
Mean monthly total precipitation (mm)	46.0	26.5	20.2	15.8	24.5	38.6	42.7	38.4	33.8	36.4	46.3	47.5	416.6

Table 9 Temperature and precipitation statistics for Smithers (All data are the official climate normals for the period 1961-1990)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct.	Nov	Dec	Annual
Mean monthly minimum temperature (°C)	-13.0	-9.6	-5.7	-1.5	2.6	5.9	8.3	7.8	4.0	0.3	-5.7	-11.7	-1.5
Mean monthly maximum temperature (°C)	-5.2	-0.1	4.8	10.3	15.3	19.0	21.4	21.0	15.7	9.0	0.6	-4.4	9.0
Mean monthly temperature (°C)	-9.0	-4.8	-0.4	4.4	9.0	12.5	14.9	14.4	9.8	4.7	-2.5	-8.0	3.8
Extreme monthly minimum temperature (°C)	-43.9	-35.6	-33.3	-18.3	-7.2	-4.1	-1.1	-2.2	-6.7	-22.0	-32.4	-36.7	-43.9
Date	1950 /13	1956 /15	1955 /3	1948 /4	1954 /1	1988 /2	1947 /2	1948 /28	1948 /23	19841 /3	1985 /27	1968 /29	
Extreme monthly maximum temperature (°C)	15.6	11.9	16.0	24.3	35.8	33.9	34.4	35.2	31.1	24.4	15.6	11.5	35.8
Date	1963 /6	1990 /22	1986 /20	1979 /28	1983 /30	1969 /11	1971 /30	1990 /12	1988 /3	1987 /1	1967 /21	1980 /15	
Mean monthly rainfall (mm)	11.6	6.3	5.8	12.1	32.7	42.2	45.7	42.1	53.5	55.5	22.3	7.5	337.4
Mean monthly snowfall (cm)	60.7	29.7	19.7	6.9	0.9	0.0	0.0	0.0	0.2	7.3	39.2	51.9	216.4
Mean monthly total precipitation (mm)	57.8	29.3	22.3	18.0	33.5	42.2	45.7	42.1	53.7	62.3	54.5	48.0	509.5

Table 10 Temperature and precipitation statistics for Germansen Landing (All data are the official climate normals for the period 1961-1990)

	Jan	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct.*	*Nov*	*Dec*	*Annual*
Mean monthly minimum temperature (°C)	-20.3	-15.5	-11.0	-4.3	0.3	4.6	6.8	5.8	1.9	-2.1	-10.9	-18.7	-5.3
Mean monthly maximum temperature (°C)	-10.6	-3.9	2.7	8.6	14.1	18.4	20.8	20.0	14.5	6.6	-3.5	-9.8	6.5
Mean monthly temperature (°C)	-15.3	-9.7	-4.1	2.2	7.2	11.5	13.8	12.9	8.2	2.3	-7.2	-14.1	0.6
Extreme monthly minimum temperature (°C)	-48.8	-44.4	-41.1	-26.1	-12.8	-3.3	-2.2	-3.9	-12.5	-30.0	-39.5	-45.8	-48.8
Date	1979 /15	1956 /15	1976 /2	1954 /4	1954 /1	1974 /4	1963 /27	1969 /23	1983 /28	1951 /31	1985 /27	1978 /31	
Extreme monthly maximum temperature (°C)	11.7	11.1	15.6	27.0	34.5	32.2	32.8	33.0	29.5	23.0	11.7	9.7	34.5
Date	1963 /6	1954 /2	1965 /10	1977 /25	1983 /29	1969 /16	1971 /30	1990 /12	1988 /4	1987 /1	1969 /2	1980 /15	
Mean monthly rainfall (mm)	1.8	1.4	2.5	13.3	38.5	58.1	55.9	46.3	45.6	32.6	6.0	1.3	303.3
Mean monthly snowfall (cm)	52.3	34.9	29.1	12.0	2.2	0.3	0.0	0.0	2.0	15.9	49.5	55.2	253.4
Mean monthly total precipitation (mm)	43.8	29.1	25.5	22.8	40.5	58.4	55.9	46.3	46.9	46.9	45.4	46.4	507.9

Table 11 Temperature and precipitation statistics for Dease Lake (All data are the official climate normals for the period 1961-1990)

	Jan	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct.*	*Nov*	*Dec*	*Annual*
Mean monthly minimum temperature (°C)	-22.5	-18.5	-13.1	-5.8	-0.8	3.3	5.8	4.9	1.2	-3.2	-14.0	-20.4	-6.9
Mean monthly maximum temperature (°C)	-13.1	-6.9	0.0	6.6	12.7	17.2	19.2	18.1	12.8	5.7	-5.2	-11.7	4.6
Mean monthly temperature (°C)	-17.7	-12.6	-6.5	0.4	6.0	10.3	12.6	11.5	7.0	1.3	-9.5	-16.0	-1.1
Extreme monthly minimum temperature (°C)	-51.2	-48.3	-42.8	-31.7	-11.1	-5.6	-2.2	-6.1	-15.0	-27.3	-42.5	-46.1	-51.2
Date	1947 /31	1968 /2	1955 /3	1948 /2	1972 /1	1952 /15	1976 /17	1950 /15	1951 /26	1984 /29	1985 /26	1949 /29	
Extreme monthly maximum temperature (°C)	8.9	11.7	12.8	22.2	35.3	33.9	31.7	32.2	28.9	20.6	14.4	7.8	35.3
Date	1958 /6	1968 /27	1962 /30	1976 /30	1983 /30	1950 /18	1951 /10	1971 /1	1967 /17	1948 /1	1949 /2/	1985 20	
Mean monthly rainfall (mm)	0.8	0.0	0.3	2.0	25.1	42.5	59.7	52.8	48.7	19.9	2.6	0.5	255.0
Mean monthly snowfall (cm)	41.2	32.3	27.7	14.6	5.6	0.3	1.0	0.0	1.4	17.9	40.8	44.2	227.1
Mean monthly total precipitation (mm)	29.8	23.3	19.7	13.6	30.2	42.9	60.7	52.9	50.0	35.6	30.9	32.1	421.6

Table 12 Temperature and precipitation statistics for Fort St. John (All data are the official climate normals for the period 1961-1990)

	Jan	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct.*	*Nov*	*Dec*	*Annual*
Mean monthly minimum temperature (°C)	-19.4	-15.6	-10.4	-1.9	3.8	8.0	10.1	9.0	4.3	-0.1	-11.0	-17.4	-3.4
Mean monthly maximum temperature (°C)	-10.8	-6.5	-0.6	8.8	15.5	19.4	21.5	20.3	14.8	8.7	-3.3	-9.1	6.6
Mean monthly temperature (°C)	-15.0	-11.0	-5.5	3.5	9.7	13.7	15.8	14.7	9.6	4.3	-7.1	-13.2	1.6
Extreme monthly minimum temperature (°C)	-47.2	-42.2	-36.7	-28.9	-10.6	-0.6	2.2	-1.2	-12.8	-25.0	-39.2	-40.6	-47.2
Date	1947 /30	1947 /1	1955 /3	1954 /1	1959 /1	1951 /25	1975 /30	1977 /31	1974 /30	1984 /31	1985 /26	1948 /8	
Extreme monthly maximum temperature (°C)	10.6	12.8	13.9	27.9	31.8	31.7	33.3	33.6	30.0	25.6	18.3	11.4	33.6
Date	1965 /15	1968 /27	1966 /28	1977 /25	1983 /29	1970 /3	1944 /19	1981 /9	1944 /9	1943 /2	1949 /3	1980 /15	
Mean monthly rainfall (mm)	0.7	0.2	0.8	7.3	34.1	66.5	73.7	56.7	39.7	12.8	2.6	0.7	295.9
Mean monthly snowfall (cm)	35.9	28.4	28.3	14.0	6.6	0.4	0	0.8	4.3	15.1	29.6	34.8	198.2
Mean monthly total precipitation (mm)	30.8	23.5	24.1	20.8	40.9	67.0	73.7	57.5	43.9	27.1	28.8	29.4	467.5

Table 13 Temperature and precipitation statistics for Fort Nelson (All data are the official climate normals for the period 1961-1990)

	Jan	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct.*	*Nov*	*Dec*	*Annual*
Mean monthly minimum temperature (°C)	-26.5	-22.3	-15.4	-4.2	2.9	8.3	10.4	8.6	2.7	-4.0	-17.6	-24.5	-6.8
Mean monthly maximum temperature (°C)	-17.7	-11.0	-2.3	8.5	16.2	21.2	23.0	21.2	14.9	6.0	-9.2	-17.6	4.5
Mean monthly temperature (°C)	-22.0	-16.5	-8.8	2.2	9.6	14.8	16.7	14.9	8.8	1.0	-13.3	-20.3	-1.1
Extreme monthly minimum temperature (°C)	-51.7	-48.3	-39.4	-34.4	-15.0	-1.1	1.1	-3.3	-16.7	-28.6	-41.1	-47.8	-51.7
Date	1947 /30	1947 /2	1955 /3	1954 /2	1974 /2	1957 /10	1953 /28	1982 /26	1974 /30	1984 /30	1963 /22	1938 /29	
Extreme monthly maximum temperature (°C)	10.7	15.0	17.8	27.3	32.1	33.9	36.7	34.4	32.8	25.6	18.3	10.7	36.7
Date	1981 /19	1968 /29	1966 /29	1977 /24	1983 /29	1969 /15	1942 /1	1981 /8	1938 /2	1943 /6	1969 /2	1985 /25	
Mean monthly rainfall (mm)	0.3	0.2	0.3	5.2	41.1	64.2	83.7	63.1	38.4	8.0	1.0	0.2	305.7
Mean monthly snowfall (cm)	29.7	21.8	24.9	19.5	7.7	0.1	0.0	0.2	5.0	25.7	29.6	27.0	191.2
Mean monthly total precipitation (mm)	21.8	16.2	17.2	20.2	47.7	64.3	83.7	63.3	43.1	30.8	21.5	18.7	448.5

Table 14 Precipitation extremes and other statistics for the twelve stations in the study region. (All values in (mm) except for the coefficient of variation.)

Station	*Period*	*Coefficient of Variation*	*Standard Deviation*	*Mean*	*Record Low*	*Year*	*Record High*	*Year*
Barkerville	Annual	0.19	193.7	1028.2	523.6	1896	1860.7	1948
	Spring	0.29	59.5	206.1	90.9	1895	449	1948
	Summer	0.3	83.6	277	98.1	1896	620.3	1948
	Fall	0.25	68.6	270.1	116.1	1976	455	1947
	Winter	0.39	106.6	275.1	85.4	1903	612.2	1947
Fort St. James	Annual	0.21	90.7	435.8	266.7	1916	738.5	1959
	Spring	0.37	27	73.3	18.6	1909	163.6	1960
	Summer	0.36	45.6	127.8	33.1	1922	272.3	1957
	Fall	0.3	35.8	118.4	51.3	1900	226.3	1959
	Winter	0.35	40.3	116.2	42.1	1916	238.7	1982
Burns Lake	Annual	0.13	60.	455.5	334.3	1985	608.8	1971
	Spring	0.26	19.9	77.3	29.5	1983	118.8	1986
	Summer	0.28	37.5	132.1	59.9	1974	221	1976
	Fall	0.21	28	135.8	66.2	1979	204.5	1975
	Winter	0.35	39	110.3	43.2	1991	211.1	1972

Table 14 continued

Station	*Period*	*Coefficient of Variation*	*Standard Deviation*	*Mean*	*Record Low*	*Year*	*Record High*	*Year*
Dease Lake	Annual	0.17	68.3	411.8	296.5	1951	574	1962
	Spring	0.36	21.4	59	16.8	1945	111.4	1981
	Summer	0.29	44.8	152.7	59.2	1992	329.2	1962
	Fall	0.31	35.7	115.2	60.5	1957	239.9	1986
	Winter	0.32	27.2	84.8	22.9	1969	145.8	1967
Germansen Landing	Annual	0.16	80.9	513.4	334.8	1970	683.4	1987
	Spring	0.4	34.7	87.1	33.5	1991	173.4	1988
	Summer	0.32	50.8	159	76.7	1967	291.1	1957
	Fall	0.2	27.1	137.8	83.8	1870	193.5	1986
	Winter	0.27	35.2	129.4	60.5	1978	197.6	1959
Fort St. John	Annual	0.21	94.1	455.5	251.3	1945	620.7	1972
	Spring	0.4	32.2	81.5	20.6	1945	150.8	1964
	Summer	0.38	73	192.6	88.4	1945	361.5	1987
	Fall	0.36	34.3	95.6	27.4	1943	204.3	1957
	Winter	0.38	33	85.9	29.9	1987	144.7	1963

Table 14 continued

Station	*Period*	*Coefficient of Variation*	*Standard Deviation*	*Mean*	*Record Low*	*Year*	*Record High*	*Year*
Dease Lake	Annual	0.17	68.3	411.8	296.5	1951	574	1962
Fort Nelson	Annual	0.19	84.1	438.7	299.2	1938	682.8	1962
	Spring	0.42	34.5	83	23.3	1985	182.7	1988
	Summer	0.37	73.1	198.6	77.2	1939	450.8	1976
	Fall	0.3	28	93.4	34.8	1943	188.2	1944
	Winter	0.45	28.5	63.7	30.6	1984	148.3	1947
Ootsa Lake	Annual	0.19	80.8	423.5	254.5	1986	588.3	1957
	Spring	0.24	21.6	64	21.6	1973	120.7	1957
	Summer	0.4	49	122.2	47.2	1970	203.7	1957
	Fall	0.28	32.2	115.4	58.3	1979	217.6	1975
	Winter	0.33	39.8	121.9	77.3	1975	244.1	1958
Prince George	Annual	0.15	92.9	609.8	443.6	1943	843.7	1964
	Spring	0.24	25.9	107.2	67.3	1983	153.2	1984
	Summer	0.3	57	188.7	95	1967	318.1	1983
	Fall	0.26	43.5	166.6	81.8	1943	266	1992
	Winter	0.28	40.9	147.3	79.8	1983	256.3	1982

Table 14 continued

Station	*Period*	*Coefficient of Variation*	*Standard Deviation*	*Mean*	*Record Low*	*Year*	*Record High*	*Year*
Dease Lake	Annual	0.17	68.3	411.8	296.5	1951	574	1962
Quesnel	Annual	0.16	86.1	536.4	283.5	1987	724.1	1948
	Spring	0.27	23.6	88.3	35.8	1985	135.3	1980
	Summer	0.33	57.8	177.7	63.5	1951	310.9	1948
	Fall	0.32	43.9	137.4	60.4	1987	246.4	1961
	Winter	0.32	42.9	133	48.1	1987	223.2	1972
Smithers	Annual	0.16	82.3	513	311.2	1944	759	1947
	Spring	0.31	23.9	77.7	37	1956	149.6	1993
	Summer	0.32	41.6	130.4	52.9	1992	246.5	1993
	Fall	0.25	41.5	168.2	69.9	1943	287.9	1991
	Winter	0.35	47.8	136.7	64.3	1970	313.2	1947
Williams Lake	Annual	0.21	89.8	424.1	232.9	1970	633.4	1982
	Spring	0.36	27.6	76.8	39.9	1970	148.9	1980
	Summer	0.43	61.6	144.5	33.3	1961	291.1	1982
	Fall	0.35	36.1	103.1	37	1987	199.3	1985
	Winter	0.37	36.8	99.7	44.2	1983	183.7	1970