

4. Climate

A Fortress of Ice and Snow

Climate is defined as the generalized weather conditions of a place, measured over long periods of time. Along with the rugged mountain landscape, climate is a powerful force which defines the Crown of the



Continent. That's no wonder, since the climate and topography here are tightly intertwined.

The Crown of the Continent experiences wide variations in climate and weather for three key reasons:

1. The Crown of the Continent is located within the planet's mid-latitudes, the zone on the globe given to wide seasonal shifts.
2. The Crown's position in North America is along the Continental Divide, the general boundary between maritime and continental conditions, and somewhat near the Pacific Ocean.
3. The rugged topography and wide ranges in elevation create localized microclimates.

Temperature and Precipitation

The two main aspects of climate are temperature and precipitation. These are measured in both averages and ranges. In the Crown of the Continent, winters are long, summers short. The average January temperature in West Glacier is -6°C (22°F); the average January

temperature in Waterton is -8°C (17°F). The hottest days of summer reach -35°C (95°F) or higher, and during the coldest spells temperatures drop to around -35°C (-31°F) or lower. A typical range of annual

temperatures is from 25°C (77°F) to -15°C (5°F). Indeed, the coldest temperature ever recorded in the contiguous United States was recorded at Montana's Rogers Pass, at the southern end of the Crown of the Continent. On January 20, 1954, the thermometer there read -57°C (-70°F).

Precipitation varies greatly over the Crown of the Continent, particularly from west to east. For example, Fernie, B.C., receives 115 centimeters (46 inches) of precipitation a year, and Cameron Lake (near the Continental Divide) receives 152 centimeters (59 inches). Continuing east, the Waterton



Park townsite receives 107 centimeters (42 inches), and the eastern boundary of Waterton Lakes National Park receives 76 centimeters (30 inches).

The Crown of the Continent receives most of its precipitation as winter snow and often experiences summer droughts. These conditions favor coniferous trees over deciduous ones. The abundance or scarcity of snowpack (and thus seasonal runoff) is vitally important throughout the year.

Compared to many parts of western North America, the Crown of the Continent receives abundant precipitation. Snow piles up very deep in the mountains in the winter, and snow may fall any month of the year. But beyond that, it's difficult to generalize about the climate in the Crown of the Continent. It is a land of variable and localized microclimates.

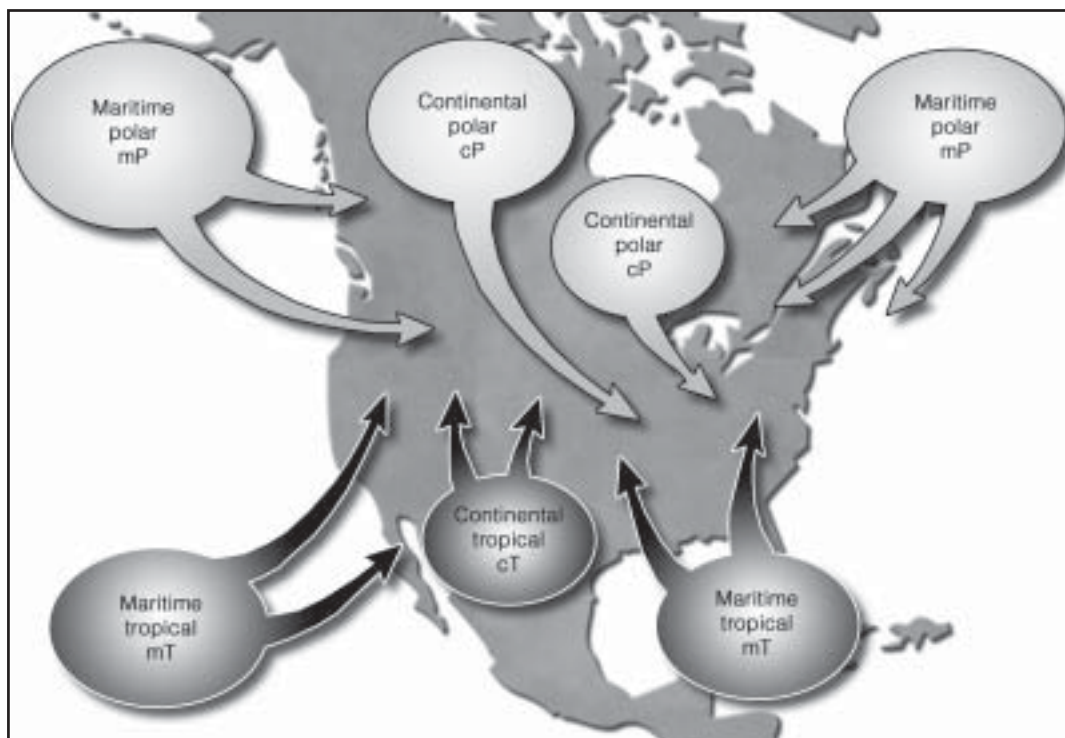
Climate determines what plants grow where, and thus what animals inhabit a particular area. Some organisms (such as the snowshoe hare, lynx, and subalpine fir) are superbly adapted to snowy, cold climates. Other creatures (like coyotes, whitetail deer,

and human beings) are not as specialized and have a harder time getting through the cold months. Relatively few people live in the Crown of the Continent now—and considerably fewer people lived here in centuries past. Part of the reason is the climate.

Patterns of temperature and precipitation also determine how often forest fires will burn and how intensely. The snowpack, and the rate at which it melts into streams, determines spawning conditions for cutthroat trout in the spring and bull trout in the autumn. It is also a critical determinant of the amount of water that will be available to irrigate crops and generate hydropower. A drought will leave grasslands depleted, limiting the number of young deer and elk or livestock it can support.

Caught Between Two Climatic Giants

The Crown of the Continent is in the crosshairs of two major, hemispheric weather patterns and conditions: maritime and continental. Maritime air masses—often quite moist and of moderate temperature—blow inland from the Pacific Ocean. The continen-



tal air masses tend to be cold, drier air moving southerly from northern Canada. While maritime air masses generally produce wet, moderate weather, the continental air masses tend to produce more extreme weather conditions—low rainfall and very hot in the summer and very cold in the winter.

Of the two air masses, the maritime is dominant in the Crown of the Continent. There are exceptions, but the Crown of the Continent's weather tends to arrive from the west. The Crown of the Continent sits at the end of a storm track, a weather pattern which funnels moist Pacific air inland. The mountains generally protect western Montana and British Columbia from frigid, polar air masses that can settle over the plains of Alberta and eastern Montana and the eastern edge of the Crown of the Continent.

The Continental Divide forms a wall that the maritime air masses must climb to spill over onto the plains. In order to crest the divide, the Pacific air masses rise, causing cooling and condensation and, thus, rain or snow. That's why the western forest of the Crown of the Continent is much more lush than the eastern slope prairies and forests.



As an example of how the Continental Divide influences local precipitation, consider the towns of Fernie, B.C., and Pincher Creek, Alberta. They are on opposite sides of the divide over Crowsnest Pass, at roughly the

same elevation and latitude. Fernie, on the west side, receives 117 centimeters (47 inches) of moisture annually. Over the mountains about 60 kilometers (40 miles) to the east, Pincher Creek receives 47 centimeters (18 inches) of moisture. Pincher Creek residents also see less snow and fewer cloudy days, a condition referred to as “rain shadow.” Similar rain shadow type conditions are created by the Whitefish Range along the west side of the



North Fork of the Flathead Valley. The western side of the range receives copious rainfall, and thus may grow a lush blanket of trees, while the sheltered slopes are dry. In the Whitefish Range, the wet western slopes grow dense forests of spruce. Only a few kilometers away north of Polebridge, an arid piece of land at Big Prairie receives only enough rain to support bunchgrass, sagebrush, and pine. The Continental Divide itself creates a giant rain shadow.

When maritime and continental air masses collide, the result can be dramatic. A meter of snow can fall in hours when warm, moist maritime air masses meet frigid, dry continental air. Temperatures can fluctuate wildly in a matter of hours, shooting up or tumbling down. Cold winds pour over low passes, such as Crowsnest or Marias, at cutting speeds.

This mountainous landscape is a complex puzzle of peaks, ridges, valleys, narrow troughs, and broad plains creating numerous micro-climates. North-facing slopes do not

receive as much direct sunshine as south-facing slopes. Temperatures are cooler and, therefore, the growing season is shorter. Snow melts more slowly and is absorbed by the soil, providing water for a more dense growth of vegetation than is found on south-facing slopes. In winter, south-facing slopes are bathed in sunlight, while north-facing slopes are chilled in a nearly constant shadow.

Climate also varies greatly with elevation. Low valleys are considerably warmer than mountain peaks. (However, this truism is temporarily turned on its head during winter inversions, when cold air is trapped in the valleys and the mountains are bathed in warm sunlight.)

High peaks also receive far more precipitation than lowlands. Snow can drift up to 20 meters (66 feet) deep in the high mountains, while low valleys may not have snow accumulate in some mild winters. Some mountain cirques receive 254 centimeters (100 inches) of moisture in an average year, mostly in snow. On the other hand, some grasslands near Augusta have a fairly lush year if they receive 30 centimeters (12 inches).

Chinook Winds

Another weather phenomenon characteristic of the Crown of the Continent is the chinook wind. During chinooks, winter snow is frequently blown away and melted by

rapidly rising temperatures. Winds up to 100 kilometers an hour (60 miles per hour) can tear road signs in half and derail freight trains. During chinooks, temperatures rocket upward. In Waterton, on average, chinook winds blow 30 out of 120 days a winter.

Chinooks are found where prevailing winds cross mountain ranges lying across their direction of movement. The wind turbulence over a mountain is similar to the action of river water when it hits a rock. A chinook is a strong wind that becomes warm and very dry while rapidly descending the lee side of mountain slopes. Often, a distinctive band of clouds forms on the high crest of the air “wave.” This band is called a *chinook arch*, and it runs parallel to the mountains. Chinooks can last a few hours, or several days.

The chinook has profound ecological

effects, particularly on the Rocky Mountain Front where these winds are most extreme. For example, chinooks blow grass clear of snow, enabling grazing animals to forage more easily and survive the



winter. Certain tree species—such as limber pine—can endure strong winds and wild fluctuations in temperatures, while others cannot. Some people find these winds unpleasant. In addition, wildly fluctuating barometric pressure can trigger migraine headaches.

The Changing Climate

Like everything else, climates change. During the Little Ice Age (roughly 1200-1800 A.D.), temperatures cooled worldwide, and more snow fell in the high country during the Crown's winters than could melt during its short summers. As a result, small glaciers developed in mountain cirques. But that trend is now reversed, and today's glaciers melt faster than snow can rebuild them.

When Montana's Glacier National Park was created in 1910, it contained more than one hundred glaciers. Today, it has fewer than forty. Glaciers are expected to disappear from the park altogether in the next 30 years.

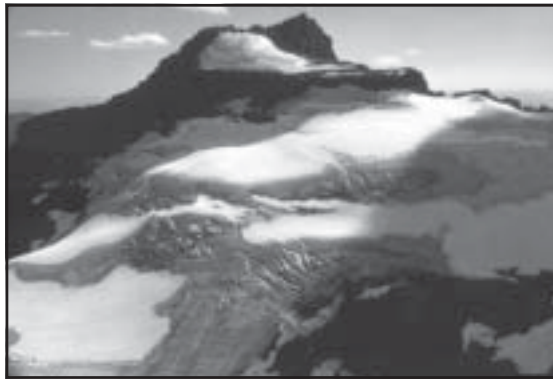
According to leading climate specialists, the region could see average temperatures climb 4°F in the summer and 5°F in the winter by 2100 A.D. In climates that are influenced by the ocean, such as the west side of the Crown of the Continent, warmer cli-

mate does not necessarily mean drier. A warmer atmosphere may cause more evaporation from the ocean and thus send more rain and snow inland.

However, climate experts expect the east side of the ecosystem to grow drier, with prairie grasslands gradually replacing low-elevation forests. Warming temperatures will have a broad impact on everything from local water supply to forest fire seasons. If snowpack melts earlier, there may be less water in streams when the bull trout spawn in autumn.

Recent research demonstrates that the earth's long term climate is not stable. While there is little scientific doubt that the earth is now growing

warmer, there is debate about how much of that increase is due to human activity. Climate experts predict that a warmer planet will make day-to-day weather patterns more dramatic and erratic.



**Boulder Glacier
Glacier National Park
1932**



**Boulder Glacier
Glacier National Park
1988**

Sources

Gadd, Ben. *Handbook of the Canadian Rockies*. 2000 edition. Jasper, Alberta: Corax Press.

Rockwell, David. *Glacier National Park: A Natural History Guide*. New York: Houghton Mifflin Co., 1995.

