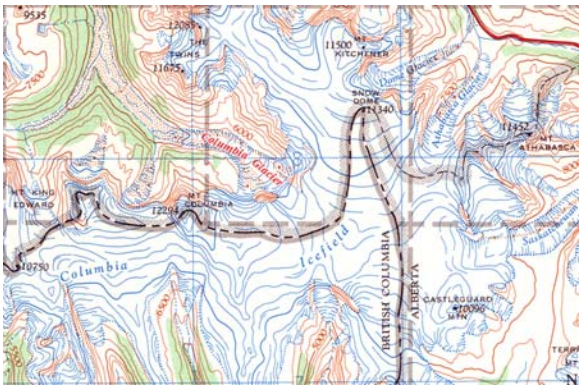
Columbia Glacier, Canada

Location: Columbia Glacier, Alberta – British Columbia, Canada
Date: 1988, 1999, and 2006
Image Source: Landsat 5 and Landsat 7
Inset Image: Portion of 1:50,000 Topographic Map Sheet 083C03

World Ice Sheets and Glaciers



Approximately seventy-seven percent of the Earth's freshwater is frozen. More than 7 million cubic miles (29 million km3) of ice covers the Earth's surface. Most of this ice is concentrated in two places – Antarctica and Greenland. The remaining ice is spread across mountain ranges and alpine valleys of four continents as glaciers, ice sheets, and permanent icefields. The freshwater ice that breaks away from Antarctica and Greenland as iceflows and icebergs floats directly into the oceans and mixes with salt water. The freshwater from melting icebergs is not readily available for human use even though various plans have been proposed to move icebergs to critical areas needing freshwater. The glaciers, ice sheets, and icefields located in the mountain ranges and alpine valleys feed many of the rivers that flow across the land and provide freshwater to farmlands and cities. It is these freshwater sources that society needs to monitor and protect.

Columbia Icefield

Straddling the boundary between the Canadian provinces of Alberta and British Columbia, the Columbia Icefield is the largest ice mass in North America, south of the Arctic Circle. Situated in the Canadian Rockies, this icefield covers an area of 130 square miles (365 sq. km.), has a maximum depth of 1,200 feet (365 m), and the height of the Empire State Building in New York City. The Columbia Icefield occupies a high, flat-lying plateau; the average elevation of the icefield is about 10,000 feet (3,000 m). The average snowfall across the icefield is 23 feet (7 m) per year.

Six large outlet glaciers emerge from the Columbia Icefield. They are the Athabasca, Castleguard, Columbia, Dome, Saskatchewan, and Stutfield glaciers. The Columbia Icefield provides ice to six large glaciers and numerous smaller ones. The meltwater from these glaciers is freshwater that flows into three different oceans: the Atlantic, Pacific, and Arctic. This water-divide into three world oceans watersheds is unique and is referred to as the "hydrographic apex of North America," basically the center of water distribution in North America. Only one other similar divide exists and it is in northern Siberia.

Columbia Glacier

The Columbia Glacier is the major outlet glacier on the northwest section of the icefield. Meltwater from it feeds the Athabasca River which enters Lake Athabasca in northeastern Alberta. From this point the water moves into the Slave River and Great Slave Lake to the Mackenzie River and then to the Arctic Ocean, a distance of 2,500 miles (4,000 km). The glacier drops rapidly from the icefield forming an ice fall. This drop creates alternating bands of light and dark ice at the base of the fall. The bands bend down-glacier due to the faster flow in the center of the glacier than along the sides of the valley walls. The dark bands represent ice that moved over the fall during the summer season and the light bands denote ice that came over the fall during the winter season when little or no melting occurs to form ridges. Meltwater from the glacier moves immediately into a proglacial lake formed behind a terminal moraine. All three Landsat images illustrate the fall, banding and the proglacial lake.

Through establishing a chronology based on recessional moraines, it was determined that the glacier retreated 1293 feet (394 m) between 1723 and 1924, which corresponds to the end of the Little Ice Age through the height of the Industrial Age. The glacier continued its rapid recession between the 1920s to the 1960s but from 1966 to 1986 it advanced 1.25 miles (2 km). Its advance completely filled the proglacial lake. What initiated the advance is not known. However, the three satellite images show that the glacier is retreating again. The September 2, 1988 image exhibits chunks of ice in the lake indicating the breakup of the previous position of the glacier, a result of the 1966 – 1986 advance. The images are false-color composites. The red areas represent green vegetation, mainly evergreen forests, and the grayish areas are bare surface. The combination of these two colors on the valley sides provides markers as to the location of the glacier's terminus. The distance the glacier has retreated can be observed and measured in the August 24, 1999 and the August 26, 2006 images using these markers. Based on the number of years separating the three images and the location of the front of the glacier with respect to the vegetation/bare surface markers, the Columbia Glacier is retreating quickly. The glacier also is shrinking in width. Lateral moraines that parallel both sides of the glacier indicate its earlier breadth. The sharp line differentiating the forest and bare rock surface along valley walls identifies where the glacier had been in the distant past.

Interpretive Learning…

1) Look up the relationship between an icefield and a glacier and the definition of the terms: lateral moraine, recessional moraine, and terminal moraine. A physical geography textbook might help.
2) Determine how much the Columbia Glacier will melt back by the year 2020. Assume a constant melt back rate. Measure the distance between the front of the glacier in1988 and in 2006 (use a ruler) and divide that distance by the number of years between the two dates. Multiply this rate by the difference between 2006 and 2020 and subtract this figure from the front of the 2006 glacier and show where the 2020 front of the Columbia Glacier would be.
3) Identify what other areas of North America receive freshwater from the Columbia Icefield. Check the Columbia River and Saskatchewan River basins.
4) Find the Columbia Glacier on Google Earth (Hint: west of Highway 93 approximately 60 miles south of Jasper and 50 miles north of Banff).

Explore More…

Baumann, P.R. 2006. Drought in the Colorado River Basin: Shrinkage of Lake Powell. *Geocarto International*. 21(4) 75-79.

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Sources:

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Topping, G. 1997. *Glen Canyon and the San Juan Country*. Moscow, Idaho: University of Idaho Press.

Acknowledgements:

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