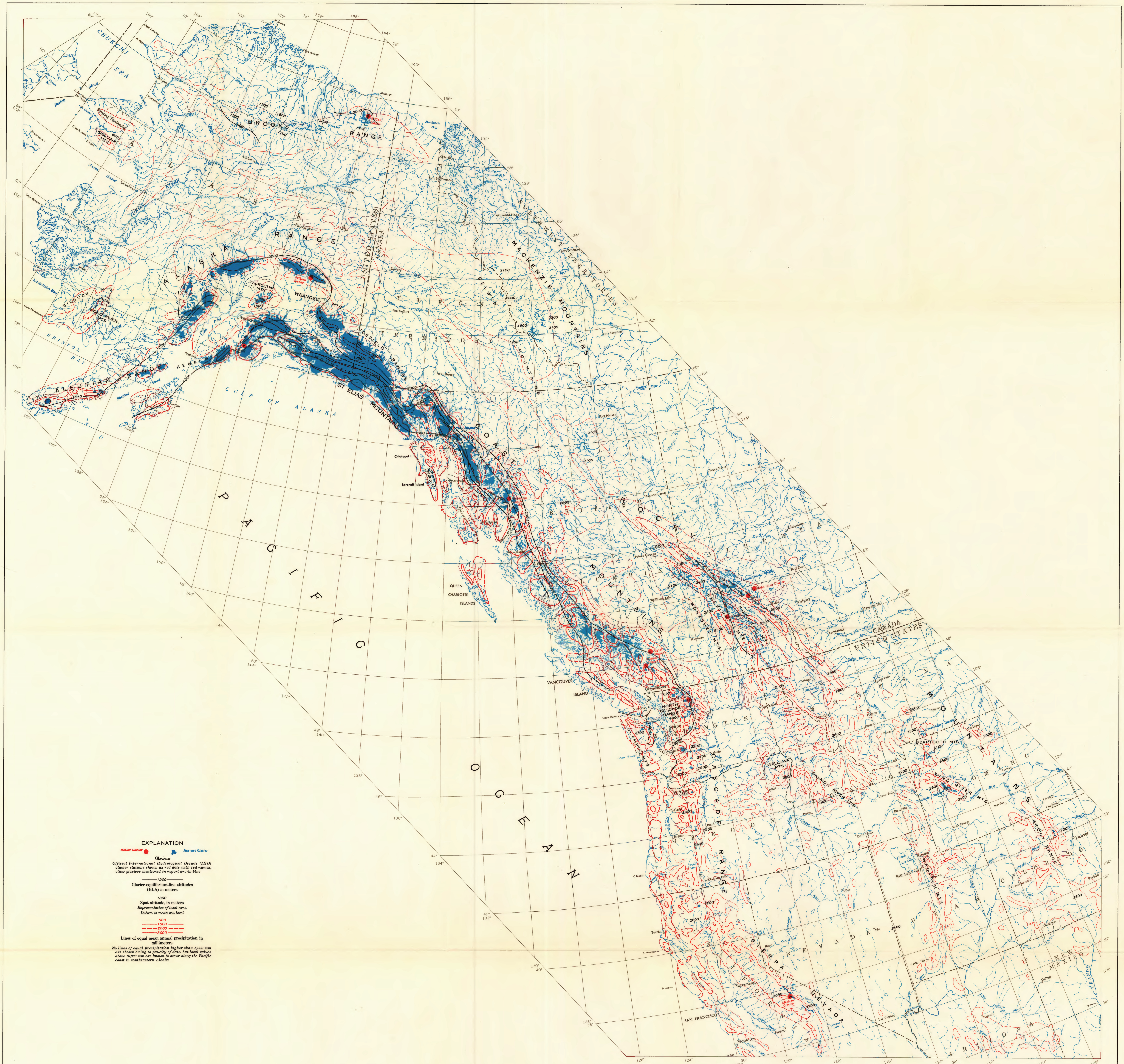
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PROFESSIONAL PAPER 715-A
PLATE 1



Base from U.S. Geological Survey Geologic Map of North America 1:5,000,000, 1965

SCALE 1:5 000 000

100 0 100 200 300 400 500 600 KILOMETERS

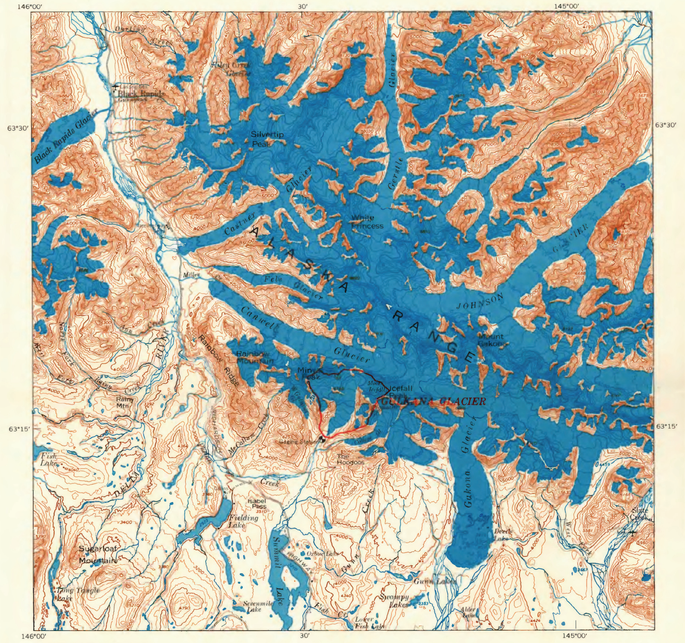
100 0 100 200 300 MILES

DATUM IS MEAN SEA LEVEL

Glaciers shown in conterminous United States from Meier (1960); in Canada from Falconer, Henoch, and Østrem (1966), Henoch and Stanley (1967a, b); and in Alaska compiled from existing large-scale maps and aerial photography by Austin Post. Precipitation values are modified from ESSA-Weather Bureau data in conterminous United States; modified from Canadian government records in British Columbia, Yukon, and Northwest Territories; and compiled by L. R. Mayo from ESSA-Weather Bureau records and U.S. Geological Survey topographic maps, runoff and glaciological data in Alaska. Glacier equilibrium-line altitudes compiled by Austin Post and M.F.Meier from aerial photographs and topographic maps.

MAP OF NORTHWESTERN NORTH AMERICA SHOWING LOCATION OF STUDY GLACIERS AND DISTRIBUTION OF PRECIPITATION AND GLACIER EQUILIBRIUM LINES

429-265 O - 71 (In pocket)

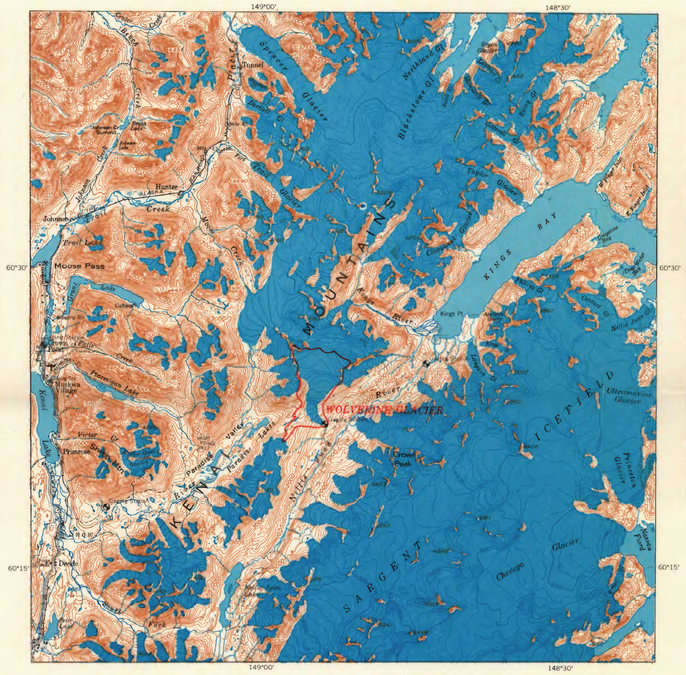


Base from U.S. Geological Survey
Mt. Hayes, Alaska, 1955

A. GULKANA GLACIER, ALASKA RANGE, CENTRAL ALASKA

Gulkana Glacier

Photograph shows conditions on August 31, 1967. Ice flowing from four tributaries unites to form the main glacier. Irregular and folded medial moraines suggest that this glacier surges, but no recent advances have been observed. In recent decades the glacier has been shrinking rapidly; note the large barren area in front of the terminus recently exposed by the melting ice



Base from U.S. Geological Survey
Seward, Alaska, 1953

B. WOLVERINE GLACIER, KENAI MOUNTAINS, ALASKA

Wolverine Glacier

Photograph shows conditions on September 3, 1966. The glacier heads in a broad basin but terminates in a narrow gorge. Crevasses indicate this glacier is flowing quite rapidly. Relatively little retreat in recent decades is demonstrated by the narrow areas of recently exposed bedrock along the margins of the ice

Base from U.S. Geological Survey
Concrete, United States: Canada, 1962

C. SOUTH CASCADE GLACIER, NORTH CASCADE RANGE, WASHINGTON

1928

1965

South Cascade Glacier

The 1928 photograph is by Lage Wernstedt, U.S. Forest Service, and was taken presumably in the autumn. The 1965 photograph was taken September 23, 1965. Note that the transient snowline is very near the same position in 1965 as in 1928, so that accumulation areas for both years are similar in size. The higher altitude glaciers and perennial snowfields shown in these photographs have changed very little in size. However, because the exposed ice areas below the equilibrium line were much larger in 1928, ice loss would be much greater in 1928 than in 1965 even with similar meteorological conditions. Most of the mass loss in the 1928–65 interval occurred below the present equilibrium line

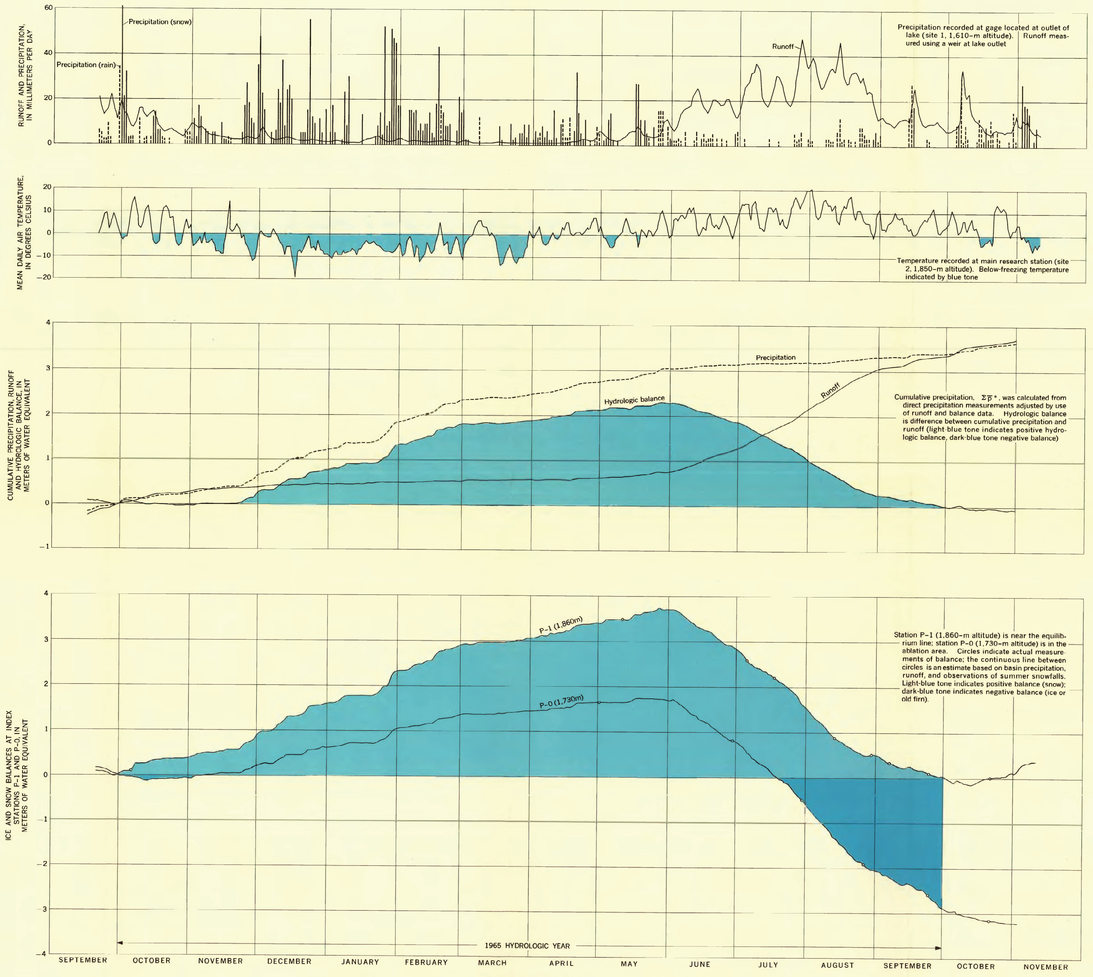
Base from U.S. Geological Survey
Mariposa, California-Nevada, 1957

D. MACLURE GLACIER, SIERRA NEVADA, CALIFORNIA

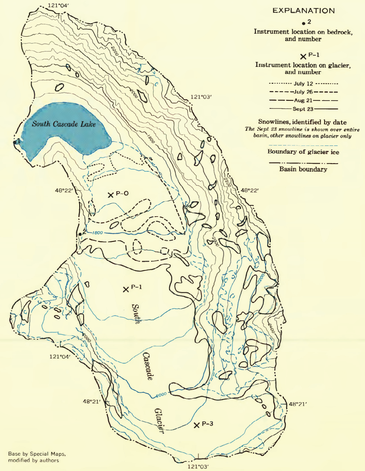
SCALE 1:250 000
5 0 5 10 15 20 25 30 KILOMETERS
5 0 5 10 15 MILES
CONTOUR INTERVAL 200 FEET (61 METERS)
DATUM IS MEAN SEA LEVEL

MAPS AND PHOTOGRAPHS SHOWING PHYSICAL SETTING OF GULKANA, WOLVERINE, SOUTH CASCADE AND MACLURE GLACIERS, WESTERN CONTINENTAL UNITED STATES

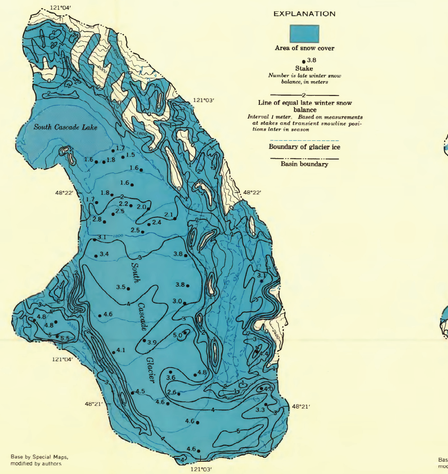
428-265 O - 71 (In pocket)



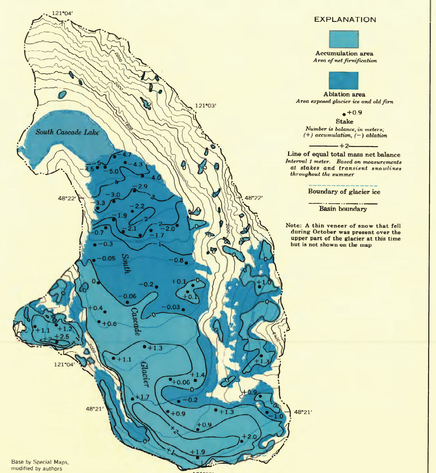
D. PRECIPITATION, RUNOFF, AIR TEMPERATURE, AND BALANCES, SEPTEMBER 20, 1964, TO NOVEMBER 1, 1965



A. INSTRUMENT LOCATIONS AND SELECTED TRANSIENT SNOWLINES



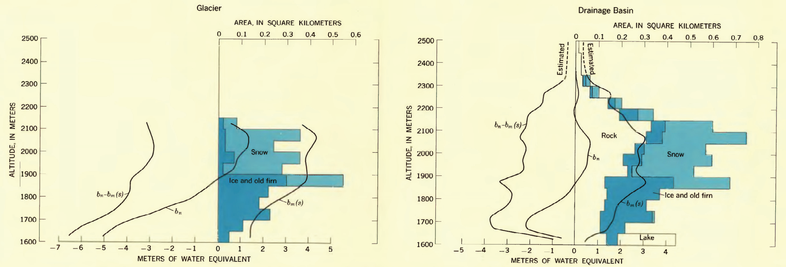
B. LATE-WINTER SNOW BALANCE, $b_m(s)$, MAY 12, 1965



C. TOTAL MASS NET BALANCE, b_n, NOVEMBER 2, 1965

SCALE 1:20 000

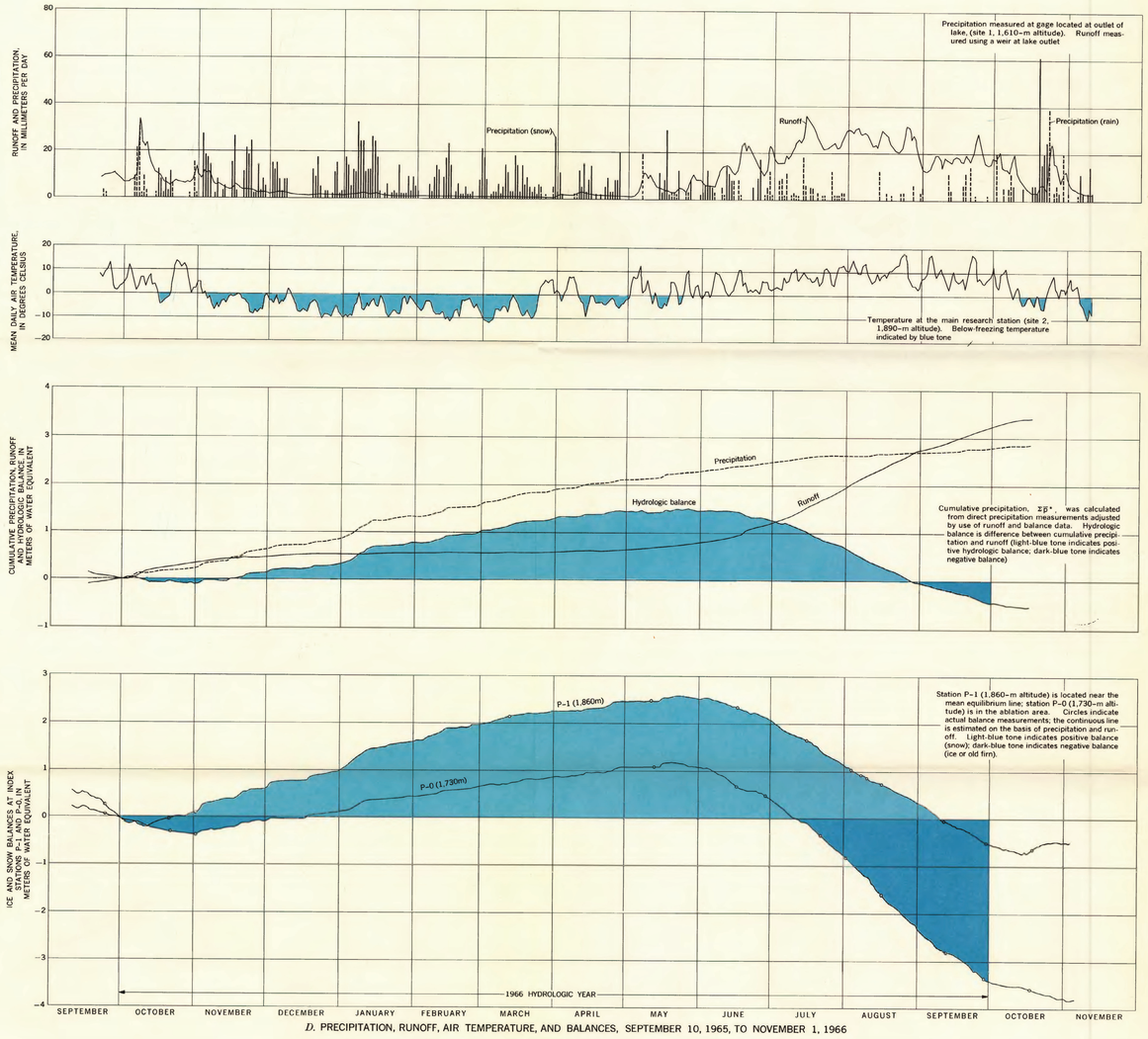
CONTOUR INTERVAL 50 METERS
DATUM IS MEAN SEA LEVEL



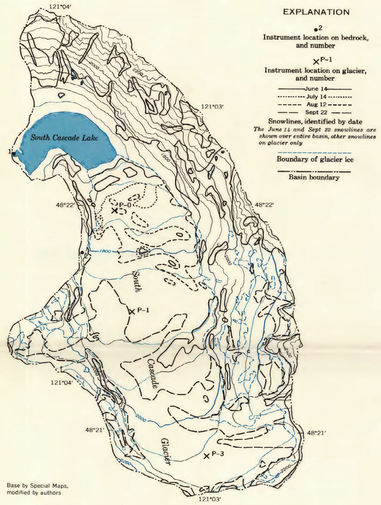
E. NET BALANCE, b_n, LATE-WINTER SNOW BALANCE, $b_m(s)$, AND THE SUMMER STORAGE CHANGE, $b_n - b_m(s)$, AS FUNCTIONS OF ALTITUDE

MAPS AND GRAPHS SHOWING DATA FOR 1965 HYDROLOGIC YEAR, SOUTH CASCADE GLACIER, NORTH CASCADE RANGE, WASHINGTON

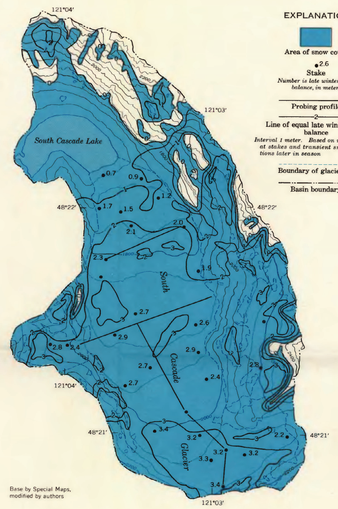
623-265 O - 71 (In pocket)



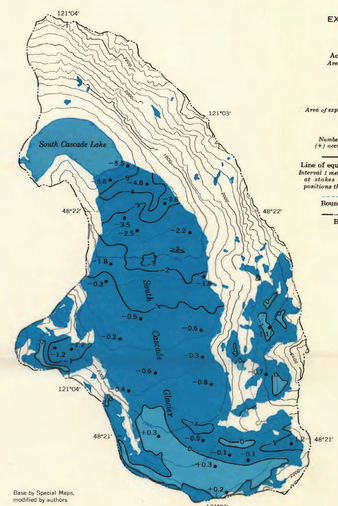
D. PRECIPITATION, RUNOFF, AIR TEMPERATURE, AND BALANCES, SEPTEMBER 10, 1965, TO NOVEMBER 1, 1966



A. INSTRUMENT LOCATIONS AND SELECTED TRANSIENT SNOWLINES

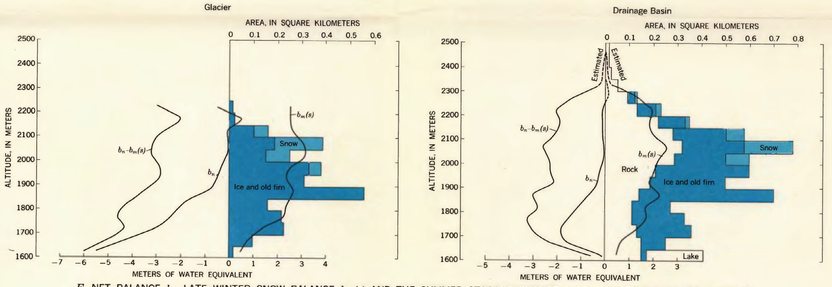


B. LATE-WINTER SNOW BALANCE, $b_m(s)$, MAY 10–14, 1966



C. TOTAL MASS NET BALANCE, b_n, OCTOBER 16, 1966

SCALE 1:20 000
CONTOUR INTERVAL 50 METERS
DATUM IS MEAN SEA LEVEL



E. NET BALANCE, b_n, LATE-WINTER SNOW BALANCE, $b_m(s)$, AND THE SUMMER STORAGE CHANGE, $b_n - b_m(s)$, AS FUNCTIONS OF ALTITUDE

MAPS AND GRAPHS SHOWING DATA FOR 1966 HYDROLOGIC YEAR, SOUTH CASCADE GLACIER, NORTH CASCADE RANGE, WASHINGTON

439-265 O - 71 (In pocket)

UNITED STATES DEPARTMENT OF THE INTERIOR
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PLATE 5

Updated and modified by authors to 1966 conditions

A. INSTRUMENT LOCATIONS AND SELECTED TRANSIENT SNOWLINES

EXPLANATION

A — Index station on glacier, and identification

1 — Stream-gaging station and number
Installed September 16, 1966

June 25
July 13
July 26
Snowlines identified by date

Boundary of glacier ice

Basin boundary

Updated and modified by authors to 1966 conditions

B. LATE-WINTER SNOW BALANCE, $b_m(s)$, MAY 18, 1966

SCALE 1:40 000

1 .5 0 1 2 3 4 5 KILOMETERS

1 ½ 0 1 2 MILES

CONTOUR INTERVAL 100 METERS
DATUM IS MEAN SEA LEVEL

EXPLANATION

Area of snow cover

Ablation area
Area of glacial ice and old firn

Snow probe
Snow depth measurements obtained

Snow pit
Snow density measurements obtained

0.5 — Line of equal late winter snow balance
Dashed where approximately located. Interval 0.5 meter. Based on measurements at snow probes and pits and on transient snowline positions later in season. Lines in the accumulation area of the glacier are shaped after the distribution of convex and concave areas and the location of large snow dunes

Boundary of glacier ice

Basin boundary

Updated and modified by authors to 1966 conditions

E. ANNUAL FIRN AND ICE BALANCE, $b_a(fi)$, SEPTEMBER 30, 1966

EXPLANATION

Accumulation area
Area of net firnification

Ablation area
Area of glacial ice and old firn

−1.8 — Stake
Number is balance, in meters

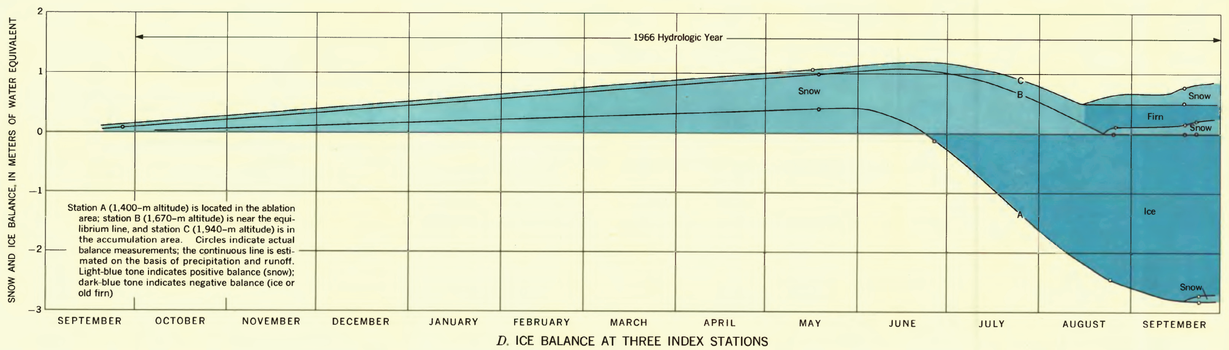
Snow probe

+3 — Snow pit
Number is snow accumulation, in meters

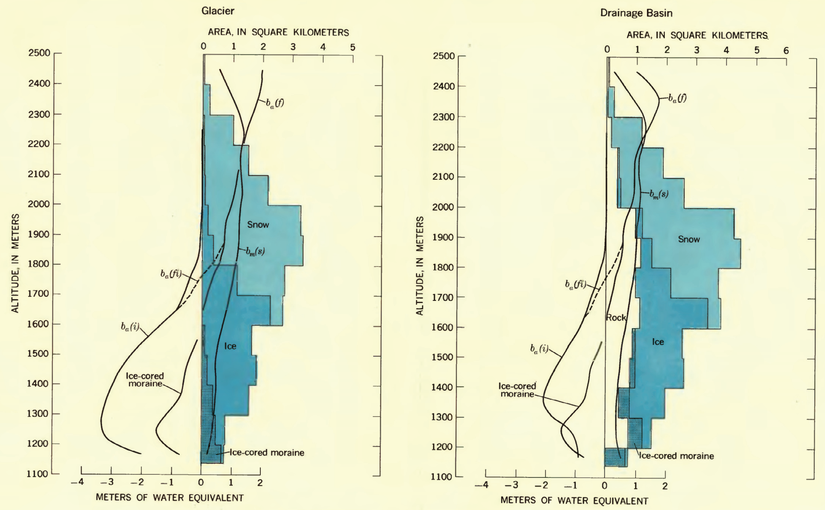
2 — Line of equal annual firn and ice balance
Dashed where approximately located. Interval 1 meter. Based on measurements at stakes, snow probes, and snow pits and on transient snowline positions throughout the summer in the ablation areas and distribution of convex and concave surfaces in the accumulation areas

Boundary of glacier ice

Basin boundary



D. ICE BALANCE AT THREE INDEX STATIONS



C. LATE-WINTER SNOW BALANCE, $b_m(s)$, ANNUAL FIRNIFICATION, $b_a(f)$, AND ANNUAL ICE BALANCE, $b_a(i)$, AS FUNCTIONS OF ALTITUDE

MAPS AND GRAPHS SHOWING DATA FOR 1966 HYDROLOGIC YEAR GULKANA GLACIER, ALASKA RANGE, CENTRAL ALASKA

429-265 O - 71 (In pocket)

Base from U.S. Geological Survey
Seward B–5 and B–6 1:63,360, 1951

A. INSTRUMENT LOCATIONS AND SELECTED TRANSIENT SNOWLINES

EXPLANATION

×B Index station on glacier, and identification

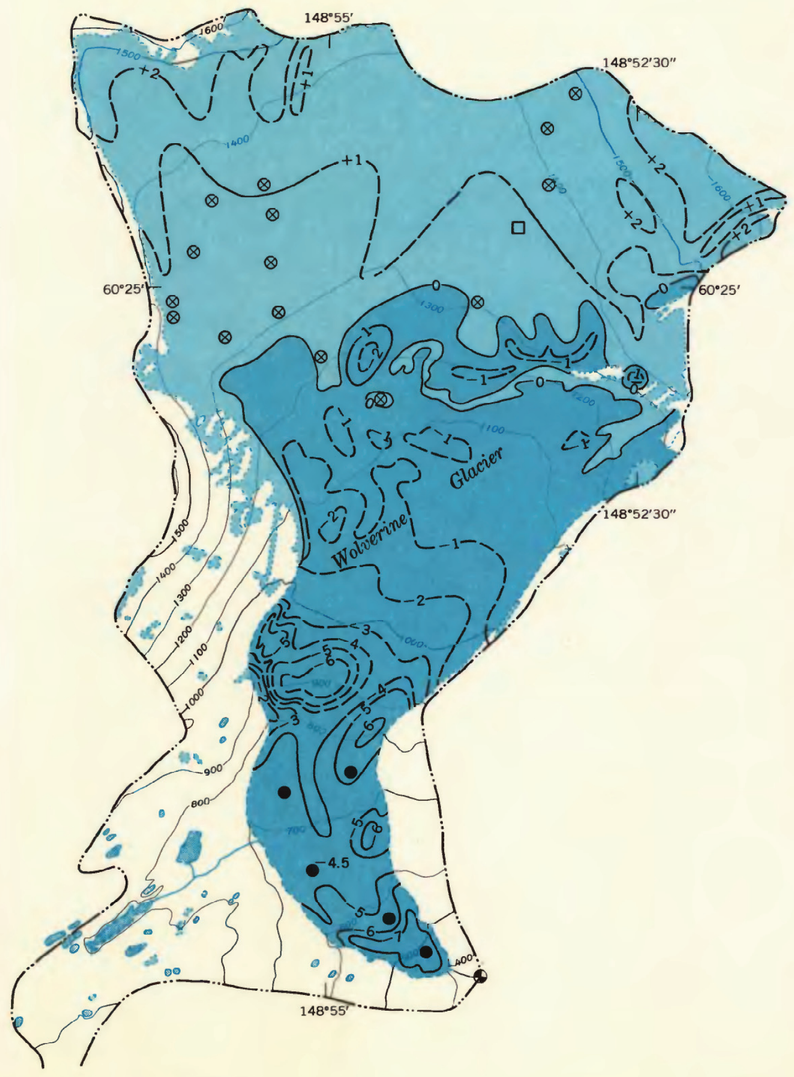
Stream-gaging station

April 23
June 17
July 18
Sept 3 (Snow edge)
Sept 3 (Firn edge)

Snowlines identified by date

Boundary of glacier ice
Coincides with September 3 snow edge snowline

Basin boundary



Base from U.S. Geological Survey
Seward B–5 and B–6 1:63,360, 1951

D. ANNUAL FIRN AND ICE BALANCE, $b_a(fi)$, SEPTEMBER 30, 1966

EXPLANATION

Accumulation area
Area of net firnification

Ablation area
Area of glacial ice and old firn

4.5 Stake
Number is balance, in meters

Snow probe

Snow pit

Gaging station

+1 Line of equal annual firn and ice balance
Dashed where approximately located. Interval 1 meter. Based on measurements at stakes, snow probes, and snow pits and on transient snowline positions throughout the summer in the ablation areas and distribution of convex and concave surfaces in the accumulation areas

Boundary of glacier ice

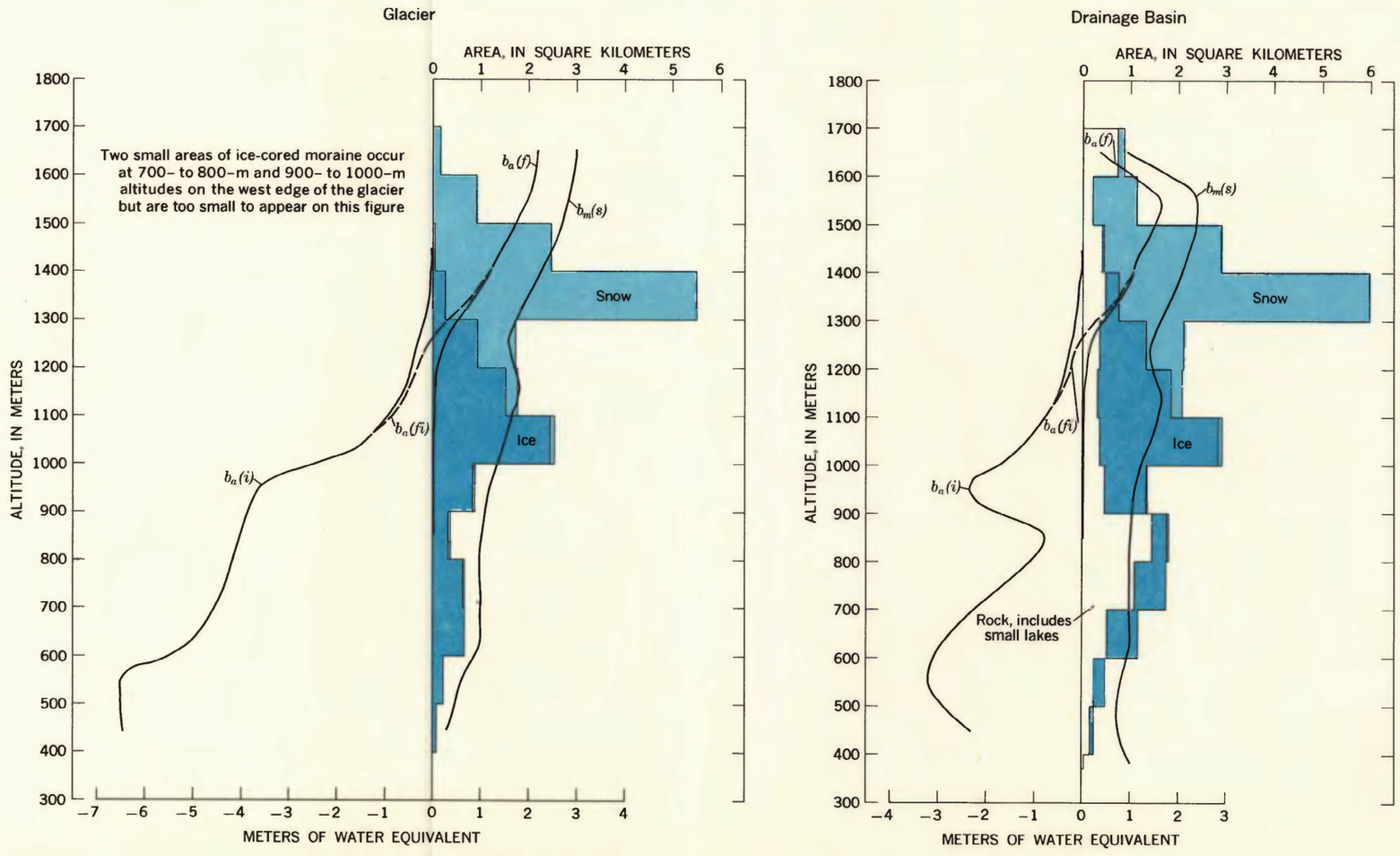
Basin boundary

SCALE 1:40 000

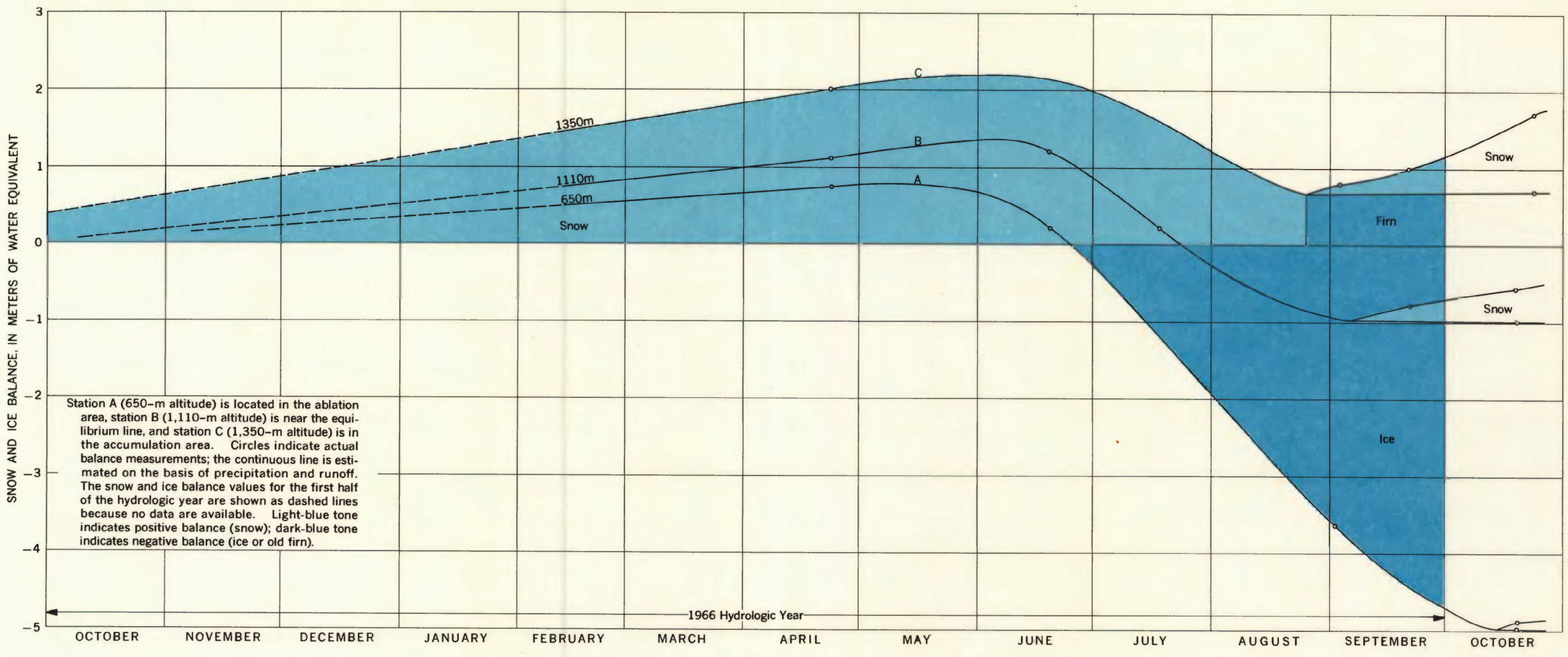
1 .5 0 1 2 3 4 5 KILOMETERS

1 ½ 0 1 2 MILES

CONTOUR INTERVAL 100 METERS
DATUM IS PRE-1964 MEAN SEA LEVEL



B. LATE-WINTER SNOW BALANCE, $b_m(s)$, ANNUAL FIRNIFICATION, $b_a(f)$, AND ANNUAL ICE BALANCE, $b_a(i)$, AS FUNCTIONS OF ALTITUDE



C. ICE BALANCE AT THREE INDEX STATIONS

MAPS AND GRAPHS SHOWING DATA FOR 1966 HYDROLOGIC YEAR WOLVERINE GLACIER, KENAI MOUNTAINS, ALASKA

429-265 O - 71 (In pocket)