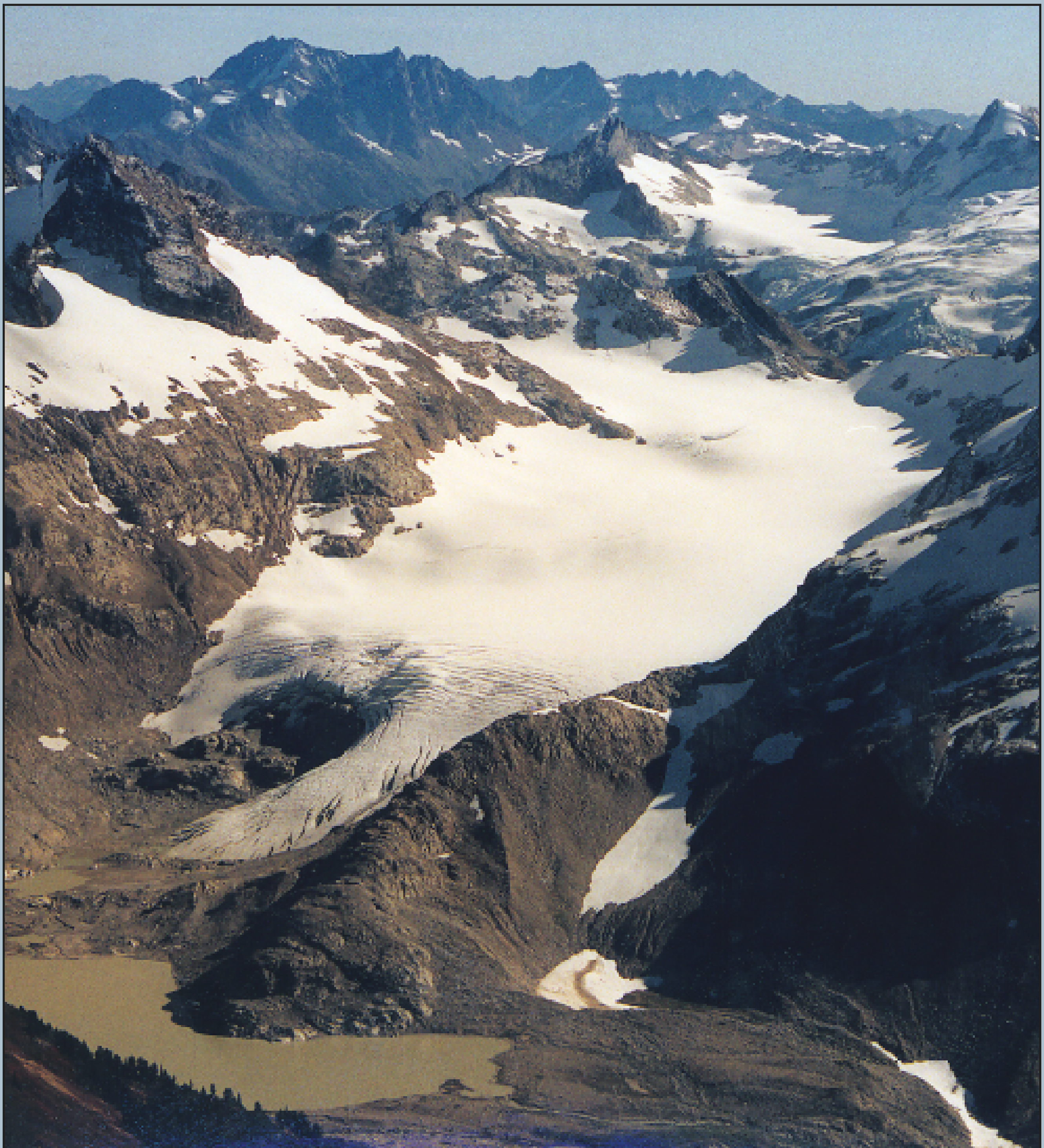
# WATER, ICE, AND METEOROLOGICAL MEASUREMENTS AT SOUTH CASCADE GLACIER, WASHINGTON, 2000-01 BALANCE YEARS

**U.S. GEOLOGICAL SURVEY**
**Water-Resources Investigations Report 02-4165**



South Cascade Glacier, looking approximately south, October 5, 2000

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By Robert M. Krimmel

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# CONVERSION FACTORS, VERTICAL DATUM, AND SYMBOLS

## CONVERSION FACTORS

| Multiply | By | To obtain |
|---|---|---|
| millimeter (mm) | 0.03937 | inch |
| meter (m) | 3.281 | foot |
| kilometer (km) | 0.6214 | mile |
| square kilometer ($km^2$) | 0.3861 | square mile |
| kilogram per cubic meter ($kg/m^3$) | 0.06242 | pound per cubic foot |
| kilogram (kg) | 2.205 | pound avoirdupois |

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:
°F=1.8 °C+32

## VERTICAL DATUM

**Sea level**: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

## SYMBOLS

| Symbol | Meaning |
|---|---|
| $\overline{b}_0$ | The change in balance between the minimum balance near the beginning of the water year and October 1. |
| $\overline{b}_i$ | The change in balance between the minimum balance near the end of the water year and September 30. |
| $\overline{b}_a$ | The change in snow, firn, and ice storage between the beginning and end of some fixed period, which here is the water year |
| $\overline{b}_m(s)$ | The snow above the previously formed summer surface as measured directly by field work in late spring as near as possible to the time of greatest glacier mass. |
| $\overline{b}_n$ | The change in snow, firn, and ice storage between times of minimum mass. |
| q | River discharge. |
| S | River stage. |
| X | Approximate east/west position in the local survey net. |
| Y | Approximate north/south position in the local survey net. |
| Z | Altitude above NGVD of 1929. |

# WATER, ICE, AND METEOROLOGICAL MEASUREMENTS AT SOUTH CASCADE GLACIER, WASHINGTON, 2000-01 BALANCE YEARS

Robert M. Krimmel

## ABSTRACT

Winter snow accumulation and summer snow, firn, and ice melt were measured at South Cascade Glacier, Washington, to determine the winter and net balances for the 2000 and 2001 balance years. In 2000, the winter balance, averaged over the glacier, was 3.32 meters, and the net balance was 0.38 meters. The winter balance was the ninth highest since the record began in 1959. The net balance was greater than 33 of the 41 years since 1959. In 2001, the winter balance was 1.90 meters, and net balance was -1.57 meters. The winter balance was lower than all but 4 years since 1959, and the net balance was more negative than all but 5 other years. Runoff was measured from the glacier basin and an adjacent non-glacierized basin. Air temperature, precipitation, humidity, wind speed and solar radiation were measured nearby. Ice displacements were measured for the 1998–2001 period.

## INTRODUCTION

The mass balance program at South Cascade Glacier is part of a larger U.S. Geological Survey (USGS) effort to monitor glacier mass balance throughout the Western States. Mass balance at two other glaciers, Gulkana Glacier and Wolverine Glacier, both in Alaska, is also monitored by the USGS (Kennedy, 1995; March, 1998). The broad USGS glacier monitoring program is discussed in a separate document (Fountain and others, 1997), and South Cascade Glacier is considered to be a “benchmark glacier” as described in that document. The collective records from these glaciers, which are some of the longest available for North America, have formed the basis for the analysis of glacier-climate relations on a synoptic scale (Hodge and others, 1998).

South Cascade Glacier is a small valley glacier near the crest of the North Cascade Range, Washington State (fig. 1). Numerous variables relating to the glacier regime have been measured on and near South Cascade Glacier since the late 1950s. The long-term goal of this project is to understand the climate-glacier relation. A short-term goal is to document the measurements with sufficient detail so that an internally consistent record of conditions on and around the glacier can be assembled regardless of personnel changes, discontinuous records, and changing methods of data collection and analysis. Some periods of record at South Cascade Glacier have been documented. Work from 1957–64 is described by Meier and Tangborn (1965), work from 1965–67 is described by Meier and others (1971) and by Tangborn and others (1977). Hydrologic and meteorological data for 1957–67 are presented by Sullivan (1994). Mass balance results for 1958-85 are summarized by Krimmel (1989), and are presented in detail for 1986-99 (Krimmel, 1993, 1994, 1995, 1996a, 1997, 1998, 1999, 2000, 2001). The purpose of this report is to document the measurements of the 2000 and 2001 balance years that are relevant to the relation between South Cascade Glacier and climate. These measurements include precipitation, air temperature, snow thickness and density, ice ablation, and surface altitude. In 2001, relative humidity, wind speed, and solar radiation measurements were also made.

## Description and Climate of the Area

South Cascade Glacier is located at the head of the South Fork of the Cascade River, a tributary to the Skagit River, which flows into Puget Sound about 100 kilometer (km) to the west. The region is dominated by steep terrain, with local relief of more than 1,000 meters (m). Areas within the basin not covered by glacier ice or water are thinly veneered bedrock. The bedrock is either mantled by a thin layer of soil and, in places, with scrub conifer, heather, or other vegetation typical of the high North Cascade Range, or covered by glacial moraine or outwash material.

South Cascade Lake Basin (fig. 1) has an area of 6.14 $km^2$ and spans from 1,615 to 2,518 m altitude. The area of this basin has been previously reported as 6.02 and 6.11 $km^2$. These differences are due to different interpretations of the drainage divide. A subbasin of the South Cascade Lake Basin is the 4.46-$km^2$ Middle Tarn Basin (unofficial name), which constitutes the southern two-thirds of the South Cascade Lake Basin. Virtually all icemelt within the South Cascade Lake Basin takes place in the Middle Tarn Basin, though a small, debris-covered area of perennial ice lies outside of the Middle Tarn Basin.

Salix Basin is an unglacierized basin adjacent to the South Cascade Lake Basin. It has an area of 0.22 $km^2$, but with poorly defined drainage divides, spans from 1,587 to 2,140 m altitude, and is predominantly south facing.

The climate of the region is maritime. Near the glacier, typical winter low temperatures are about -10ºC, and typical summer high temperatures are about 20ºC. Most of the precipitation, which commonly amounts to 4.5 m annually (Meier and others, 1971), falls as snow in the period October to May.

## Measurement Systems

Glacier mass balance definitions of Mayo and others, 1972 are adhered to in this report, and the stratigraphic system, which is more field compatible than the fixed date system, is usually used. The specific terms are defined where first used. Other mass balance nomenclatures are in use, notably those described by Østrem and Brugman (1991), which could also be used to report these results. The definitions by Mayo and others (1972) are used to maintain consistency with earlier reports on South Cascade Glacier work.

The balance year, defined by Mayo and others (1972) as the interval between the minimum glacier mass in one year and the minimum glacier mass the following year, is used in this report because most of the field measurements reference the surface formed at the end of the previous balance year. This report contains recorded data for the 2000 water year (WY), October 1, 1999, through September 30, 2000. The WY is identical to the hydrologic year that was used in earlier mass balance reports (Mayo and others, 1972; Meier and others, 1971). Where information concerning these variables is required, but is outside of the WY, the required data are discussed.

All local geodetic coordinates are in meters, in which the local +Y axis is approximately true north. Vertical locations are in meters above the National Geodetic Vertical Datum of 1929. Horizontal locations are defined by a local system that can be converted to Universal Transverse Mercator (UTM) zone 10 coordinates by

$$\text{UTM easting} = \text{local } X\ (0.99985) + 642{,}000, \text{ and}$$
$$\text{UTM northing} = \text{local } Y\ (0.99985) + 5{,}355{,}000.$$

Densities are given as a decimal fraction of the density of water, the density of which is considered to be 1,000 kilograms per cubic meter. All balance measurements are given as water equivalents unless otherwise stated.

## 2000 BALANCE YEAR

### Recorded Variables

Air temperature was measured at the Salix Creek gaging station, the South Fork Cascade River gaging station, the Middle Tarn gaging station, and the Hut (fig. 1). These records are shown graphically (fig. 2). Air temperature was measured instantaneously once per hour at each station. Temperature is estimated to be accurate to ±1ºC. Daily maximum (highest of the 24 hourly readings), minimum (lowest of the 24 hourly readings), and average temperatures are given in tables 1, 2, 3, and 4.

Precipitation (fig. 3) was measured at the Salix Creek gaging station. The tipping bucket gage catch was accumulated for 1 hour and recorded digitally. The gage orifice was 200 mm in diameter and had no wind screen. The precipitation gage was sensitive to 0.024 mm of precipitation. The gage operated until mid-October and from February through September, but because it was not heated, measurements during March and April may be dramatically affected by snow and freezing conditions.

Water stage at Salix Creek, South Fork Cascade River, and Middle Tarn were recorded digitally. The sensors are floats with a steel tape driving a potentiometer. Stage records are shown in figure 3. The stage recorders are sensitive to ±3 mm and are estimated to be accurate to ±3 mm.

The records for some of these variables were partial in balance year 2000, because an avalanche destroyed the South Fork Cascade River gaging station in early 2000, or instruments failed. These partial records are included in this report because they were used to help determine the date of the end of the 1999 balance year.

### Intermittent Measurements

Aerial photography recorded the condition of the glacier on September 11, 2000, (fig. 4) and October 4, 2000. The intent on both dates was to record the glacier conditions at a time when no fresh snow covered the glacier. Unfortunately, fresh snow covered nearly the entire glacier on both dates. The former set of photographs showed better surface definition and was used in the photogrammetric measurements. This photography was taken at a scale of 1:12,000 with a cartographic camera on 230-mm-wide color film.

The terminus of the glacier (fig. 5) was digitized from the photographs by photogrammetrically measuring the locations of numerous points along the edge of the glacier. The location of the points is estimated to be accurate to ±1 m. The area of the glacier near the end of the 1999 balance year was 1.961 $km^2$ (Krimmel, 2001). Assuming that the area of the glacier south of Y=2,900 m was unchanged since 1999, the area of the glacier near the end of the 2000 balance year was 1.952 $km^2$. The retreat from 1999–2000 was subjectively averaged to be 12 m (fig. 5).

For most years, a digital elevation model (DEM) is photogrammetrically measured from the vertical photography. The 2000 photography was only suitable to form a DEM on the lower portion of the glacier, where there was enough surface definition that reliable altitudes could be measured. Over most of the glacier, altitudes could not be measured because stereo fusion was impossible in the areas of uniformly white snow cover. In areas where the altitude at the specific location of grid points could not be measured, some spot altitudes could be measured near crevasses or other places where the surface could be seen in the stereo view. These were compared to the 1999 South Cascade Glacier DEM, and in all areas the 2000 altitudes were within a few meters (vertically) of nearby points of the 1999 DEM, and with no obvious bias. For the year 2000, the 1999 DEM was used, except in the lower glacier area, the points of which are shown in figure 5. The portion of the 2000 DEM that did not change from 1999 is not reproduced in this report, but may be found in the South Cascade Glacier annual report for 1999 (Krimmel, 2001).

Snow depth was measured by probing at 18 locations near the centerline of the glacier on May 7-8, 2000 (fig. 5, table 5). Snow density was measured near P1 (fig. 1) on May 7, 2000. The level of snow on several stakes (fig. 1) was measured several times during the ablation season.

## Precipitation

A precipitation gage at the Salix Creek gaging station operated from October 1–15, 1999, and from February through September, 2000 (fig. 3). Incremental precipitation gage catch was accumulated for each day, and the daily total precipitation is shown graphically in figure 6 and table 6. Although it was operational, the unheated tipping bucket type gage was probably snow filled until late March. The Salix Creek precipitation measurement site is not representative of either basin because of local variations in precipitation, the difficulty of measuring precipitation when the weather is windy, and the instrumental difficulty of measuring precipitation that falls as snow. The importance of the record is to compare it with records from other years, to indicate the time of precipitation events, and to indicate general precipitation conditions.

## Runoff

Salix Creek water stage measurements (fig. 3) were converted to instantaneous discharge values, averaged for each day, and converted to a basin-averaged daily runoff (fig. 6, table 7). The Salix Creek stage recorder operated from October 1 through November 20, 1999, and from September 22 through September 30, 2000. The flow of Salix Creek at the gaging station is controlled by a weir supported by bedrock. No visible changes of the control occurred during the year, so, the rating used to convert stage to discharge was the same used since measurements began in 1960:

$$q = S^{2.57} \times 2.71 ,$$

where $q$ is discharge in cubic feet per second and $S$ is stage in feet. The equation for the rating is in English units for the convenience of the author and reader, because the original stage data are in feet and the machine-readable files are in feet. Except in these two instances, stage has been converted to meters.

The South Fork Cascade River stage was recorded from October 1 – 15, 1999. A snow avalanche destroyed the recorder and the building it was in during the following winter, causing lost record since mid-October. The facility has not been repaired.

The available South Fork Cascade River stage measurements (fig. 3) are converted to instantaneous discharge values, averaged for each day, and converted to a basin-averaged daily runoff (fig. 6, table 8). The controlling weir is built on glacial outwash and moraine and is known to be unstable. Because there was no basis for any change in the rating table and because of the short length of record, the 1998 rating was used. The rating used to convert stage to discharge was

$$q = 17.45 - 43.14 \times S + 40.94 \times S^2 - 0.90 \times S^3 .$$

Errors in the South Fork Cascade River discharge calculations may be ±25 percent of the determined values.

Middle Tarn gaging station stage was recorded from October 1–15, 1999, and record after that was lost by damage to the station by heavy snow load. The facility was repaired, but no stage record was collected for the remainder of the water year. Stage measurements (fig. 3) were converted to discharge, and subsequently to runoff (fig. 6, table 9), using a rating determined from 14 discharge measurements made between September 8, 1992, and September 16, 1994. The outlet from Middle Tarn gaging station is a bedrock channel that does not change; therefore the rating curve is expected to remain stable at Middle Tarn gaging station. The rating curve used to convert stage to discharge was

$$q = 2.064 - 3.673 \times S + 24.770 \times S^2 .$$

## Winter Balance

A vertical column of snow, extracted with a coring auger at P1 on May 7, 2000, was measured for density and observed for stratigraphy. The bottom of the column was at a depth of 7.77 m. A definite horizon between snow-like material and ice-like material was found at 7.69 m. The upper level of the ice-like material was formed at the end of the 1998 balance year, which was a very negative balance year, leaving relatively old material at the end of that balance year. The material immediately above the 1998 horizon consisted of firn that remained at the end of the 1999 balance year, and above the 1999 firn was snow from the winter of 1999–2000.

The snow–firn horizon was not found in the core. At the end of the 1999 balance year, 1.70 m of firn remained at P1 (Krimmel, 2001), so 5.99 m of the snow-like material at P1 on May 7, 2000, was snow from the winter of 1999–2000 (fig.7). Bulk density of the upper 5.99 m of material was 0.50, and below that increased to near 0.60. Bulk density of spring snow at the P1 altitude is usually near 0.50, and density of firn is typically about 0.60. The only indication that firn was encountered in the core column was the change in density near the 6.0-m depth.

Balance year 1998 was very negative, resulting in a fall surface of very old material that was easily detected under the snow of the following winter. Balance year 1999 was positive, resulting in a 1999 fall horizon of 1-year-old firn, which could not be detected under the snow of the following winter. The 1998 horizon was easily detected and became a surrogate horizon for measurements in 2000. Balance year 2000 was also positive, again resulting in a fall horizon of first-year firn that could not be detected under the following winter's snow. The 1998 horizon was also used as reference for the 2001 measurements. Balance year 2001 was very negative, melting all the 1999 and 2000 firn away from the P1 area. The fall 2001 surface was of very old material, and will be easily detected under the snow of balance year 2002. Minor variations in the absolute snow and firn depths may occur because measurement sites from year to year may be separated by up to 50 m, and because of surface roughness.

Snow depth was probed at P1 on May 7, 2000, but the probe rod penetrated into the 1999 firn; this can be expected when there is no well-defined horizon between the snow and firn layers. Three probes were made up-glacier from P1, but each was to greater than 7.3 m deep, deeper than the expected snow depth, and still did not reach a definite increased resistance. These probe measurements were not considered valid, and no additional probes were made above the P1 altitude. The snow was probed for depth at 16 locations between P1 and the terminus; but only the 12 most northern, which were below the 1999 equilibrium line, were considered valid (fig. 5).

Snow depth and density was also measured near the South Fork Cascade River gaging station (fig. 1) at the snow course on May 7, 2000. The eight measurements along the snow course averaged 3.02 m in depth, with an average density of 0.50.

The snow depth (and density) as a function of altitude was well determined between the P1 level and terminus, but above P1 there were no data for winter balance. The only point on the 2000 winter accumulation balance-altitude curve was determined by assuming that the summer ablation high on the glacier was, as has been measured for many of the previous years, about the same as at P1. The snow thickness at the end of the balance year at the altitude of 2,010 m was determined, and to that was added the amount of snow ablated at P1, giving a spring snow depth at 2,010 m of 7.3 m, or 3.65 m water equivalent balance.

The snow water equivalent at the lower glacier points, P1, and at the 2,010 m altitude on May 7, 2000, are plotted in figure 8, and through these points is a hand-drawn line to approximate the balance over the altitude span of the glacier. Points along that line are picked (table 10), and linear interpolations are made between those points to determine balance at every point on the 2000 DEM. The average of the balances at each incremental point is the glacier average measured winter balance, $\overline{b}_m(s)$, of 3.32 m. No basis exists to adjust $\overline{b}_m(s)$ to a maximum winter balance.

## Net Balance

The lack of a well-defined 1999 summer horizon also complicated the net balance measurements for 2000. As with the 2000 winter balance measurements, the 1998 summer horizon was the only usable horizon.

As discussed in the previous section, balance year 1998 was very negative (-1.86 m), and the material at P1 at the end of the 1998 balance year was very old firn or ice. Balance year 1999 was positive, and 1999 snow remained on the surface over most of glacier above about 1,820 m altitude, and at the P1 location 1.70 m snow remained (Krimmel, 2001, table 8). In the spring of 2000, a snow layer several meters thick would be expected to overlie the 1.70 m of residual 1999 snow (firn), which would overlie the much older material left at the surface at the end of the 1998 balance year. However, the snow depth was very difficult to determine in spring of 2000. A core sample at P1 (stake 2-00) on May 7 showed that the combined 1999 firn and 2000 snow was 7.69 m thick. The horizon between the 1999 firn and 2000 snow was not found.

On September 20, 2000, a core sample was again taken at stake 2-00, and 2.50 m of material was found above the 1998 horizon, but again, no horizon could be found to mark the 1999–2000 interface. On October 5, 2000, another core sample was taken at stake 2-00, and a core was also taken about 15 m away at stake 2-99. The 1999–2000 horizon was not found in either core. The combined 2000 and 1999 material was respectively 2.04 and 2.00 m thick at those points.

The 1999 stake at P1 (2-99) was found and measured on September 21, 2000, and again on October 5, 2000. The reading on October 15, 1999, combined with the readings on September 21, October 5, 2000, and the core data indicated 0.3 m of 2000 snow at P1 on October 5, 2000 (fig. 7).

The 2000 snow depth at altitudes greater than P1 were also difficult to measure. Five cores (open circles, (fig. 1) were taken above P1 on September 21, 2000. The 1998–99 horizon was found in cores at 1,871, 1,943, 1,972, and 2,010 m altitudes at 2.4, 3.0, 3.35, and 4.8 m depth, respectively. At 2,042 m altitude, the depth of the 1998–99 horizon was deeper than the 4.8-m core hole depth. In none of the cores was the1999–00 horizon found. The core at 2,010 m altitude was within 15 m horizontally of a 1999 core, at which there was 3.35 m of 1999 snow left on September 3, 1999. It is estimated that there was 0.45 m loss of material at the 1999 location after September 3, 1999, until the end of the 1999 balance year, leaving 2.9 m of 1999 snow. These data and estimates suggest that at 2,010 m altitude there were 1.9 m of 2000 snow on September 21, 2000, and by the end of the 2000 balance year late season, melt reduced the snow depth to 1.75 m, which was assumed to be of a typical firn density of 0.6. With the P1 and 2,010 m data points, the accumulation portion of the year 2000 balance-altitude curve were formed.

Only one stake in the ablation area survived the entire season. Stake 11-98 (fig. 1), at 1,871 m altitude, showed a 0.82 m loss of ice for a 0.74 m water equivalent loss in balance year 2000. For lower altitudes, the balance-altitude curve is estimated based on knowledge of the spring snow depth (from probing), ablation at P1, and the relative rate of ablation at P1 and lower altitudes as determined in previous years.

Aerial observations on September 26, 2000, showed a small band of year 1999 firn exposed. This observation is consistent with the field measurements made on September 21.

As was done to determine the winter balance-altitude function, these net balance data at specific altitudes were plotted (fig. 9). These three points, combined with knowledge gained from previous years when more data were available, were used to form the balance-altitude curve for balance year 2000. Several points (table 11) were picked along the hand-drawn line to allow linear interpolation to the altitude at each point in the 2000 DEM, and the average of the incremental balance values was the glacier net balance, $\bar{b}_{\mathrm{n}}$, of 0.38 m.

## Balance Year to Water Year Adjustments

A system using fixed dates at the beginning and end of a balance interval is sometimes useful for analyses using other types of data, for instance, average annual temperatures, annual precipitation, or runoff. Often these types of data are summarized in the interval October 1 through September 30. The balance year values of net balance can be converted to the October 1 through September 30 period by adding small values at both ends of the balance year. These terms are described in Mayo and others (1972).

The final balance increment, $\bar{b}_1$, for the 1999 balance year was estimated at 0.05 m water equivalent (Krimmel, 2001). This value becomes the initial balance increment, $\bar{b}_0$, for the 2000 balance year.

The glacier was visited on October 5, 2000, at which time there was a trace of new snow on the glacier above 1,800 m altitude. The temperature remained above freezing, or nearly so, until the end of October at the altitude of the Hut (1,842 m). October had mostly overcast weather, with precipitation on many days. The temperature, precipitation, and runoff records suggest there was not much snow or ice ablation in October of 2000. This was verified by a reading of stake 14-00 (fig. 1) very near the terminus in the spring of 2001, when the level of ice (beneath the snow of 2001) was found to be almost the same as the prior October 5 measurement. The glacier probably reached the time of minimum mass in early October 2000, but with an undetermined date. It is estimated that the net reduction of mass during October, called $\bar{b}_1$, was 0.02 m.

The annual balance, $\bar{b}_{\mathrm{a}}$, is defined by Mayo and others (1972) as the change in snow, firn, and ice storage between the beginning and end of a fixed period, which here is the water year.

The values of $\bar{b}_0$, $\bar{b}_1$, and $\bar{b}_n$ at South Cascade Glacier for the 2000 balance year can be used to derive the annual balance, $\bar{b}_a$, where $\bar{b}_a = \bar{b}_n + \bar{b}_0 - \bar{b}_1 = 0.41$ m.

## Balance Measurement Errors

Errors in glacier balance measurements are difficult to quantify. In prior years of balance measurements at South Cascade Glacier, error values ranging around 0.10 m were placed on the balance values (Meier and others, 1971). In 1965 and 1966, more information was used to derive the balances than in 2000. The availability of less information in 2000 would suggest that greater errors should be assigned to the 2000 balance. The relative paucity of data for 2000 is offset somewhat, however, by the experience gained since the mid-1960s, when 20 to 30 ablation stakes were used, and it was found that spatial variations in balance were similar from year to year (Meier and Tangborn, 1965). It is more difficult to measure a large accumulation of snow as occurred in the winter of 2000 than a thinner accumulation, so the estimated error in $\bar{b}_m(s)$ is ±0.40 m. In addition, it is more difficult to measure snow depth when the previous balance year’s surface was young (first-year) firn because the buried ablation surface may contain only a small amount of dirt, and textural differences between young firn and snow are minor. This condition continues through the balance year, making it more difficult to measure net balance. Thus the net balance error for 2000 is increased to $\bar{b}_n$, ±0.3 m. Other errors are estimated for $\bar{b}_0$ and $\bar{b}_1$, ±0.05 m; the calculated error for $\bar{b}_a$ is ±0.31 m. Although other factors that affect the balance, such as internal accumulation of ice, superimposed ice, internal melt, and basal melt, are possible, they are not considered in this report. These unknowns are thought to be small and do not change the error estimations.

# 2001 BALANCE YEAR

## Recorded Variables

Air temperature was measured at the Salix Creek gaging station, the Middle Tarn gaging station, and the Hut (fig. 1). These records are shown graphically (fig. 10). Air temperature was measured instantaneously once per hour at each station. Temperature is estimated to be accurate to ±1ºC. Daily maximum (highest of the 24 hourly readings), minimum (lowest of the 24 hourly readings), and average temperatures are given in tables 12, 13, and 14.

Precipitation was measured at the Salix Creek gaging station (fig. 11). The tipping bucket gage catch was accumulated for 1 hour and recorded digitally. The gage orifice was 200 mm in diameter and had no wind screen. The precipitation gage was sensitive to 0.024 mm of precipitation. The gage operated all year, but because it was not heated, measurements during October through April may be dramatically affected by snow and freezing conditions.

Water stage at Salix Creek and Middle Tarn were recorded digitally. Stage records are shown in figure 11. The stage recorders are sensitive to ±3 mm and are estimated to be accurate to ±3 mm.

A portable meteorological station was installed at the Hut and recorded incoming solar radiation (fig. 11), relative humidity (fig. 12), and wind speed (fig. 12). In late July, this station was moved to the terminus and recorded air temperature (fig. 10), relative humidity (fig. 12), and wind speed (fig. 12).

## Intermittent Measurements

Aerial photography recorded the condition of the glacier on September 20 (fig. 13) and October 3, 2001. The September 20 photography was at a scale of about 1:12,000, and was taken on a day with a high, thin overcast, so areas that are often in deep shadow are shown well. The October 3 photography was at a scale of about 1:6,000 and does not cover the west side of the glacier. Because of mild, dry weather during late September, the transient firn line continued its increase in altitude, which required the latter photography. Color film, 230 mm wide, was used on both dates.

The terminus of the glacier (fig. 5) was digitized from the photographs by photogrammetrically measuring the locations of numerous points along the edge of the glacier. The location of the points is estimated to be accurate to ±1 m. The area of the glacier near the end of the 2000 balance year was 1.952 km$^2$. Assuming that the area of the glacier south of Y=2,900 m is unchanged since 2000, the area of the glacier near the end of the 2001 balance year was 1.920 km$^2$. The retreat from 2000–2001 was subjectively averaged to be 30 m (fig. 5).

By October 3, 2001, the area of glacier covered by 2001 snow was reduced to a narrow band along the west side (fig. 14). The accumulation area ratio for 2001 was 0.03. The average equilibrium line altitude was above the glacier.

A DEM was formed photogrammetrically from the vertical photography. Both dates of photography were useful for this purpose, and the DEM is a combination of results from both sets of photography. If the difference in measured altitude for the same grid point from the different models was greater than ±3 m, the point was checked. Because the glacier surface was easily seen in the stereo models, and because of the redundancy of data, the altitudes in the 2001 DEM are accurate to ±2 m. The 2001 DEM is shown in figure 14 and table 15.

At the time of the 2001 photography (both dates), most of the 2001, 2000, and 1999 snow had been melted away from the glacier surface, leaving the 2001 surface very similar to the 1998 surface, particularly in the center two-thirds of the glacier (1,800–1,950 m altitude). This allowed surface displacement to be measured by the location of the same surface feature in 1998 and 2001. These displacements are given in table 16 and shown in figure 15.

## Precipitation

A precipitation gage at the Salix Creek gaging station operated the entire water year. Incremental precipitation gage catch was accumulated for each day, and the daily total precipitation is shown graphically in figure 16 and table 17. Although it was operational, the unheated tipping-bucket-type gage was probably snow filled for long intervals from sometime in October until sometime in May, and all measurements during the October to May period may be influenced by the snow. The Salix Creek precipitation measurement site is not representative of either basin because of local variations in precipitation, the difficulty of measuring precipitation when the weather is windy, and the difficulty of measuring precipitation that falls as snow. The importance of the record is to compare it with records from other years, to indicate the time of precipitation events, and to indicate general precipitation conditions.

## Runoff

Pressure transducers were installed at the Salix Creek and Middle Tarn gaging stations on September 21, 2000. These transducers are vented to the atmosphere, thus measure the change in water pressure as the stage varies, with a sensitivity of 0.01 foot. No other changes were made at either gaging station during the 2001 water year, and it is assumed that the rating curves did not changed from that used in prior years. The Salix Creek gage recorded stage continuously (fig. 11), and it is thought that the well did not freeze during the winter. The Middle Tarn gage recorded continuously beginning in early October, but the well was found frozen in early May and likely had become frozen on December 12 and remained frozen until May 26. The Middle Tarn transducer record is preserved in this report (fig. 11), but discharge calculations are made only for periods when the well was unfrozen, October 5 to December 12, 2000, and May 26 to September, 2001. The stage records for both stations were converted to discharge and daily runoff (fig. 16, tables 18, 19) using the same rating curves that were used in 2000.

## Winter Balance

Winter accumulation measurements were made at South Cascade Glacier on May 10, 2001. Snow pack density was measured near P1 (fig. 1) at 1,855 m altitude. The top 1.74 m were measured using samples from the wall of a pit, and the remainder of the 2001 winter snow was measured using samples of a core extracted with an auger. The upper 0.60 m of snow was relatively fresh, and a faint dirt band separated it from snow that fell prior to a mild, dry period in mid- to late April. At a depth of 4.29 m a faint dirt layer was found, which was the horizon formed at the end of the 2000 balance year. Bulk density of the 2001 snow was 0.45. A very hard ice layer was found from 4.44 to 4.49 m from the surface. The firn–ice horizon formed at the end of the 1998 balance year was found at 6.03 m below the surface (fig. 7). The bulk density of the 1.74 m of 1999 and 2000 firn was 0.64. The bulk density of the snowpack was also measured from samples taken from the wall of a snow pit near the old South Fork Cascade River gaging station at 1,618 m altitude. The depth was 1.97 m, and the density was 0.53.

Snow depth probings were made along a longitudinal profile over the entire altitude span of the glacier (fig. 17, table 20). The snow was consistently soft, and probes consistently stopped at a very hard layer. The core at P1 suggested the hard layer was 0.15 m below the snow–firn interface; 0.15 m was subtracted from all probing measurements above 1,830 m altitude (the approximate altitude below which no firn overlaid the ice). All probes above the 1,830 m altitude were converted to water equivalent values using a constant density of 0.45. Probe depths below 1,830 m altitude were converted to water equivalent values using a linear density gradient based on the 1,618-m and 1,855-m density measurements.

The collection of probe measurements, converted to water equivalent, were used to form a balance-altitude curve (fig. 18, table 21), which was then used in conjunction with the 2000 digital elevation model (DEM) to determine the winter balance using the grid-index method (Krimmel, 1996b). The measured winter balance was 1.90 m. No adjustment of the measured winter balance was necessary, and is considered equal to the maximum winter balance.

## Net Balance

Nearly all the snow from the winter of 2000–01 was melted from the glacier during the summer and early fall of 2001. Aerial photography was acquired on two dates, September 20, 2001, (fig. 13) and October 3, 2001, and by comparison with aerial photos taken on September 14, 1998 (the most recent past year with a large magnitude negative balance), it was evident that most of the glacier surface was ice material, firn from 1999, or firn from 2000. The only snow from 2001 that remained was along the steep west edge of the upper glacier. The aerial photography alone would be enough to correctly state that balance year 2001 was very negative.

The net loss of material between the end of balance year 2000 and the end of balance year 2001 was directly measured at 3 stakes. Very near the terminus, at 1,645 m altitude, there was a net loss of 5.92 m water equivalent which was all ice melt; at 1,770 m altitude, the net loss was 2.29 m water equivalent, which was all ice melt, and at the index station, 1,855 m, the net loss was 1.42 m water equivalent, which included melt of all the 2000 firn, 1999 firn, and 0.3 m of ice material that was at the surface in 1998 (fig. 7).

The net loss was estimated at one more location, at 2,050 m, with knowledge of spring snow depth (from probing measurements), assuming the material melted at a factor of 0.9, the rate of melt at P1 (from measurements at South Cascade Glacier 1992-97), and that the firn melted had a density of 0.55. The net balance at 2,050 m was -1.16 m water equivalent. These 4 net balance values are plotted (fig. 19, table 22). A hand-drawn line is formed based on those 4 points and experience gained in previous balance years, and the area-integrated glacier net balance is calculated using the grid-index method based on the 2001 DEM. The South Cascade Glacier 2001 net balance was -1.57 m water equivalent.

## Balance Year to Water Year Adjustments

The final balance increment, $\overline{b}_1$, for the 2000 balance year was estimated at 0.02 m water equivalent. This value becomes the initial balance increment, $\overline{b}_0$, for the 2001 balance year.

The glacier was visited on October 28, 2001, at which time there was more than 0.5 m of new snow at the terminus, and the balance year had clearly ended by that time. The temperature remained above freezing, or nearly so, until October 6, 2001, at the altitude of the Hut (1,842 m) and at Middle Tarn (1,631 m) until October 9. The first major precipitation event occurred on October 12, followed by precipitation events on October 12, 21, 22, and 25. The temperature, precipitation, and runoff records suggest that little or no ablation occurred after October 8, 2001, and from these records it is estimated that the net reduction of mass during October, called $\overline{b}_1$, was 0.05 m.

The annual balance, $\overline{b}_a$, is defined by Mayo and others (1972) as the change in snow, firn, and ice storage between the beginning and end of a fixed period, which here is the water year. The measured values of $\overline{b}_0$, $\overline{b}_1$, and $\overline{b}_n$ at South Cascade Glacier for the 2000 balance year can be used to derive the annual balance, $\overline{b}_a$, where $\overline{b}_a = \overline{b}_n + \overline{b}_0 - \overline{b}_1 = -1.60$ m.

## Balance Measurement Errors

The winter snow of 2001 was thinner than in the prior 2 years, thus more easily measured, but because the underlying reference surface was soft firn, the spring snow depth probes penetrated into firn from 1999 and 2000 in the upper glacier areas.

For this reason, the estimated error in $\overline{b}_m(s)$ is ±0.30 m. The net balance measurements were made with confidence over the lower glacier, but in the upper glacier areas there was some ambiguity to the underlying reference surface. Thus, the net balance error for 2000 is increased to $\overline{b}_n$, ±0.25 m. Other errors are estimated for $\overline{b}_0$ and $\overline{b}_1$, ±0.05 m; the calculated error for $\overline{b}_a$ is ±0.26 m. Although other factors that affect the balance, such as internal accumulation of ice, superimposed ice, internal melt, and basal melt, are possible, they are not considered in this report. These unknowns are thought to be small and do not change the error estimations.

## CONCLUSIONS

The snow accumulation during the winter of 1999–2000 was the ninth highest since the winter balance record began in 1959 (fig. 20, table 23). The net balance was greater than 33 of the 41 years since 1959. The winter snow accumulation of 2000–01 was the fifth lowest since 1959, and since 1959 only 5 years had a more negative net balance than 2001. Of the years 1996–2000, four years had positive balances. Despite this positive balance trend, the glacier continued its retreat, as has been the case in all years of measurement except 1972, when exceptionally heavy snow covered the terminus most of the ablation season. The glacier requires many years of positive balance before ice at the terminus becomes active enough to advance. Balance year 2001 was negative enough that nearly all material gained since 1998 was melted away, and because the terminus was bare of snow early in the summer, glacier retreat was much greater than in 2000. The cumulative balance since 1959 (fig. 21) demonstrates the continuation of the long term trend in mass loss from South Cascade Glacier.

These two balance years are examples of relatively positive and negative balance and demonstrate that the variability of weather (and year-to-year balance) dominates changes due to any climate change that is occurring. The change in size and thickness of the glacier tends to integrate the extreme weather patterns, and thus the glacier is an indicator of climate change. South Cascade Glacier remains larger than the present (or presently changing) climate will allow, suggesting that today's climate is less "glacier friendly" than the climate of the previous century or more.

A second and more practical result of the contrasting weather in these two years is demonstrated by the relative success of the data collection program. In 2000, heavy snow damaged the Middle Tarn gaging station and subsequently data were lost, an avalanche destroyed the South Fork Cascade River gaging station (fig. 22), and heavy snow damaged the Hut and made field measurements more difficult. In 2001, a relatively light winter snow did no damage to facilities or instruments, and field measurements were simplified.

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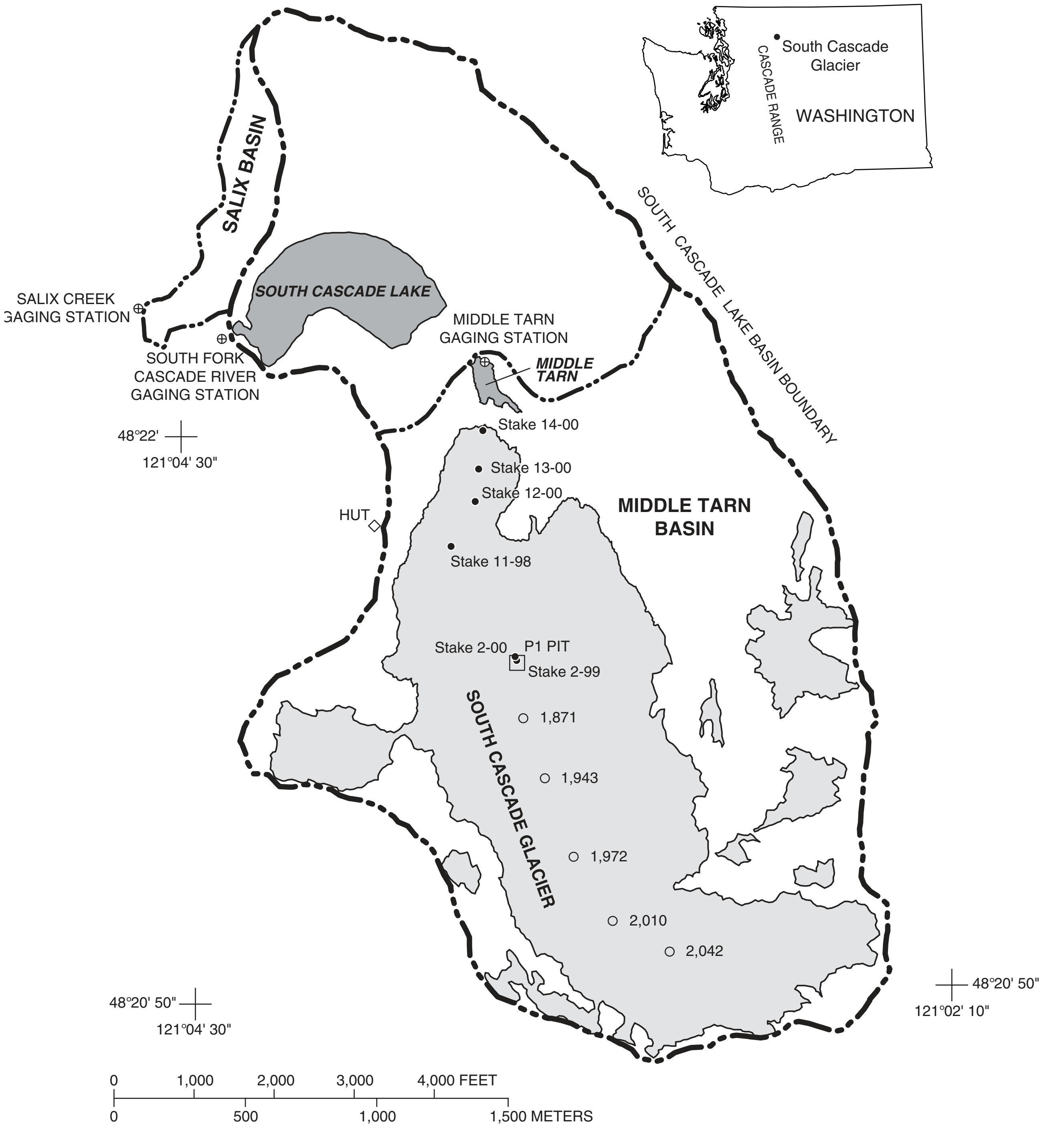


**Figure 1.** South Cascade Glacier and vicinity.

Stakes used in 2000 are shown as closed circles, core locations for 2000 are shown as open circles with altitudes. The 2001 stakes were near the positions of Stake 14-00, Stake 11-98, and Stake 2-00.

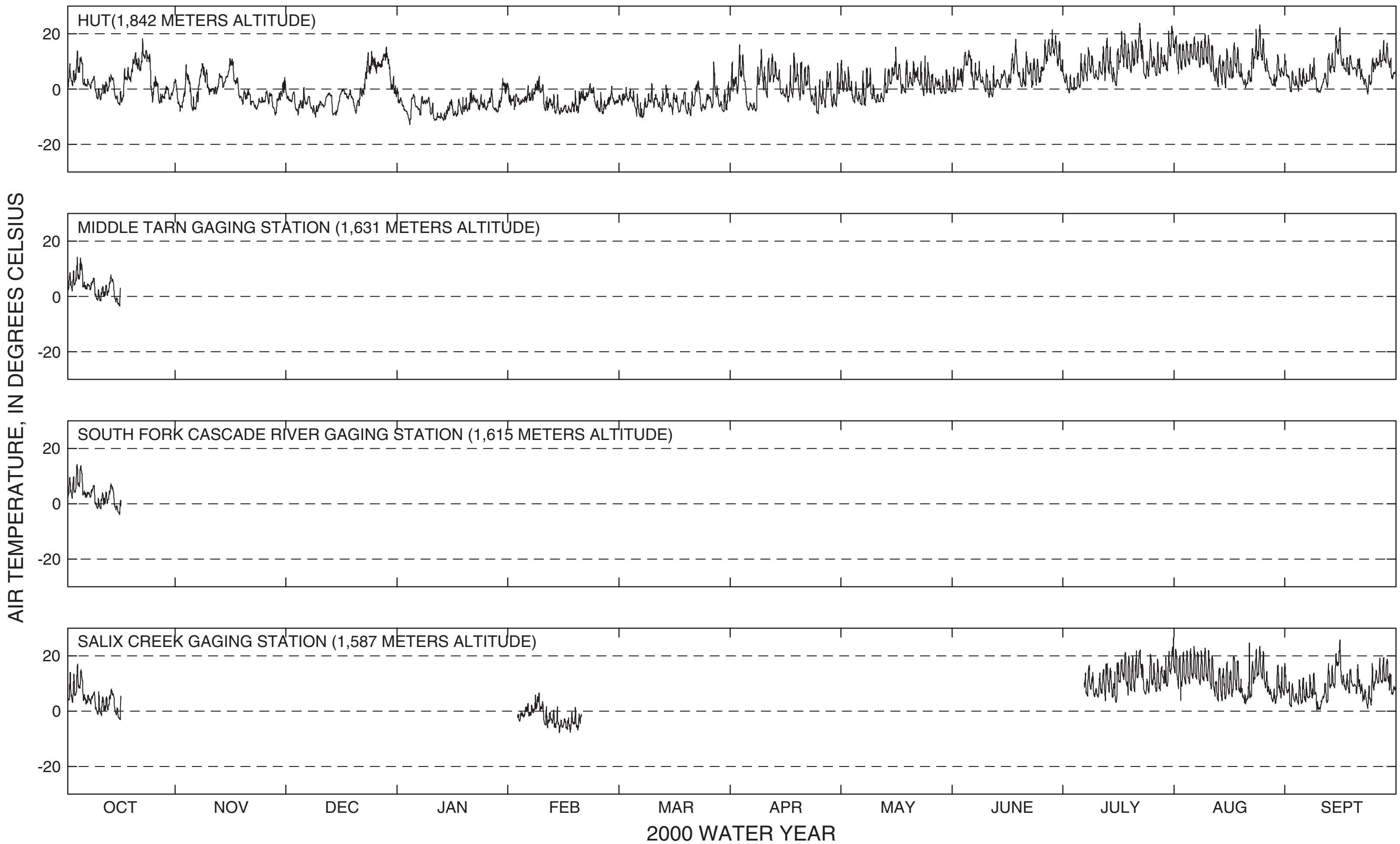


**Figure 2.** Air temperature near South Cascade Glacier during the 2000 water year.

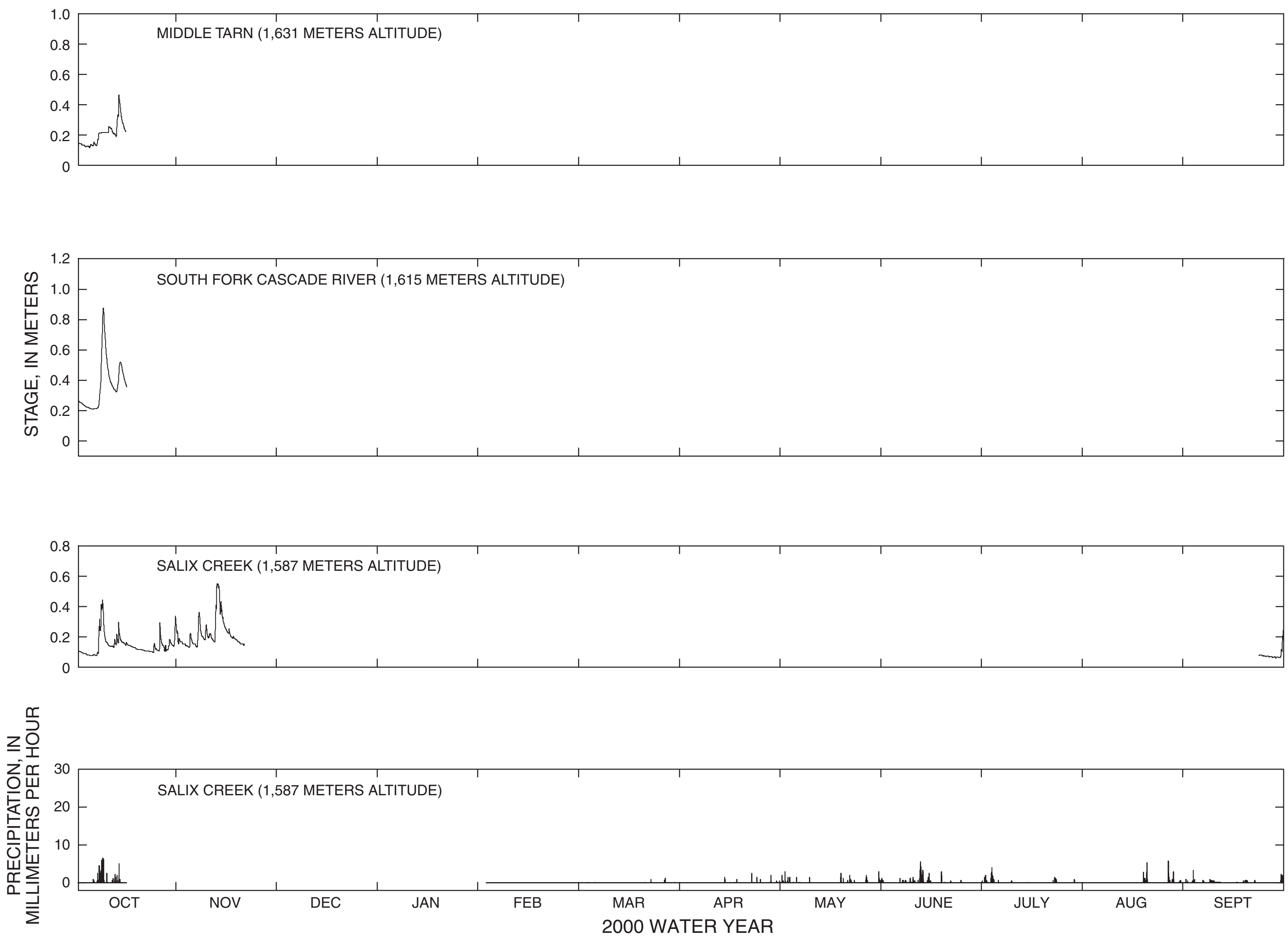


**Figure 3.** Instantaneous water stages and hourly precipitation at gaging stations near South Cascade Glacier during the 2000 water year.

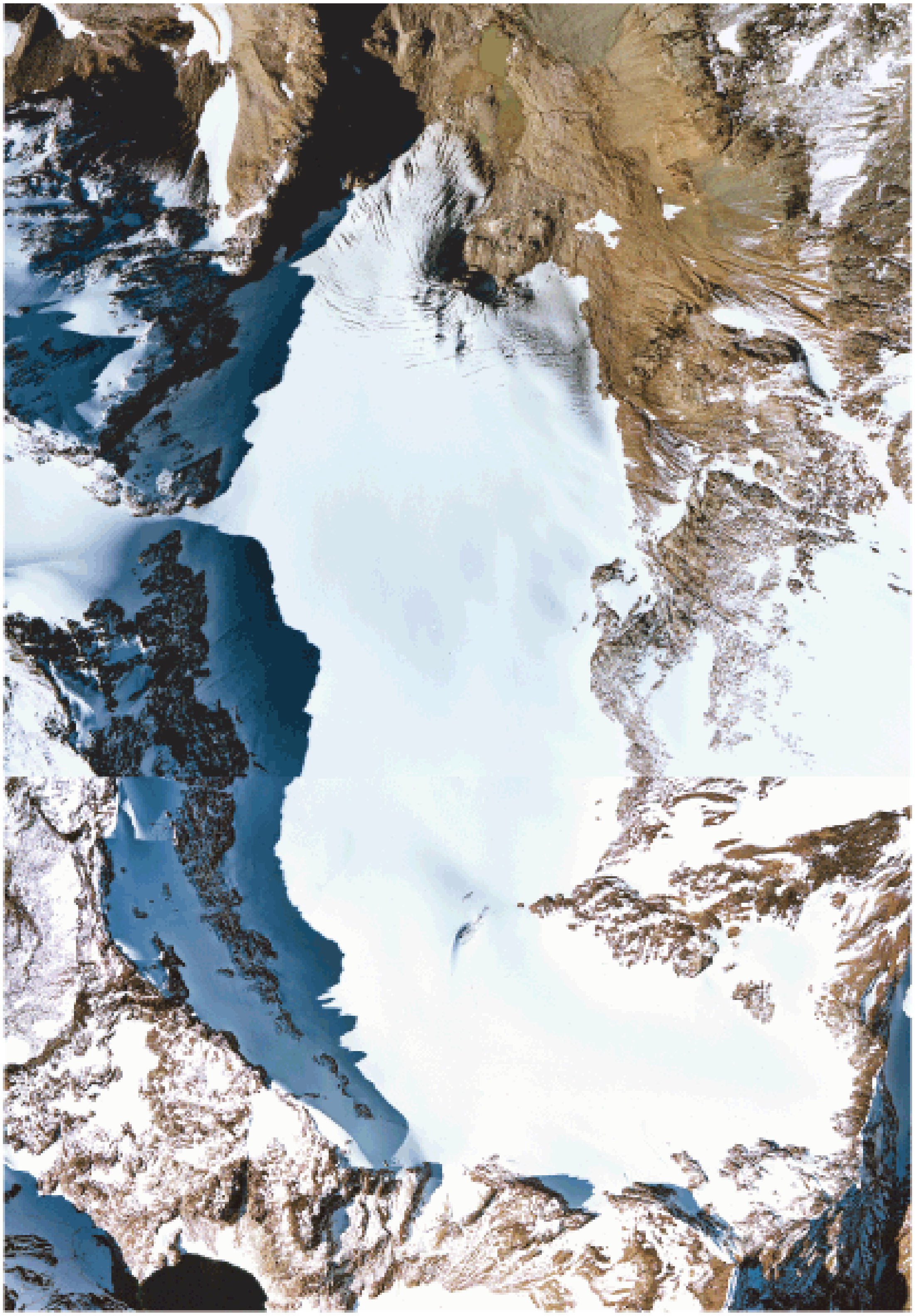

**Figure 4.** South Cascade Glacier, September 11, 2000.
The maximum width of the glacier is about 1 kilometer. North is approximately up.

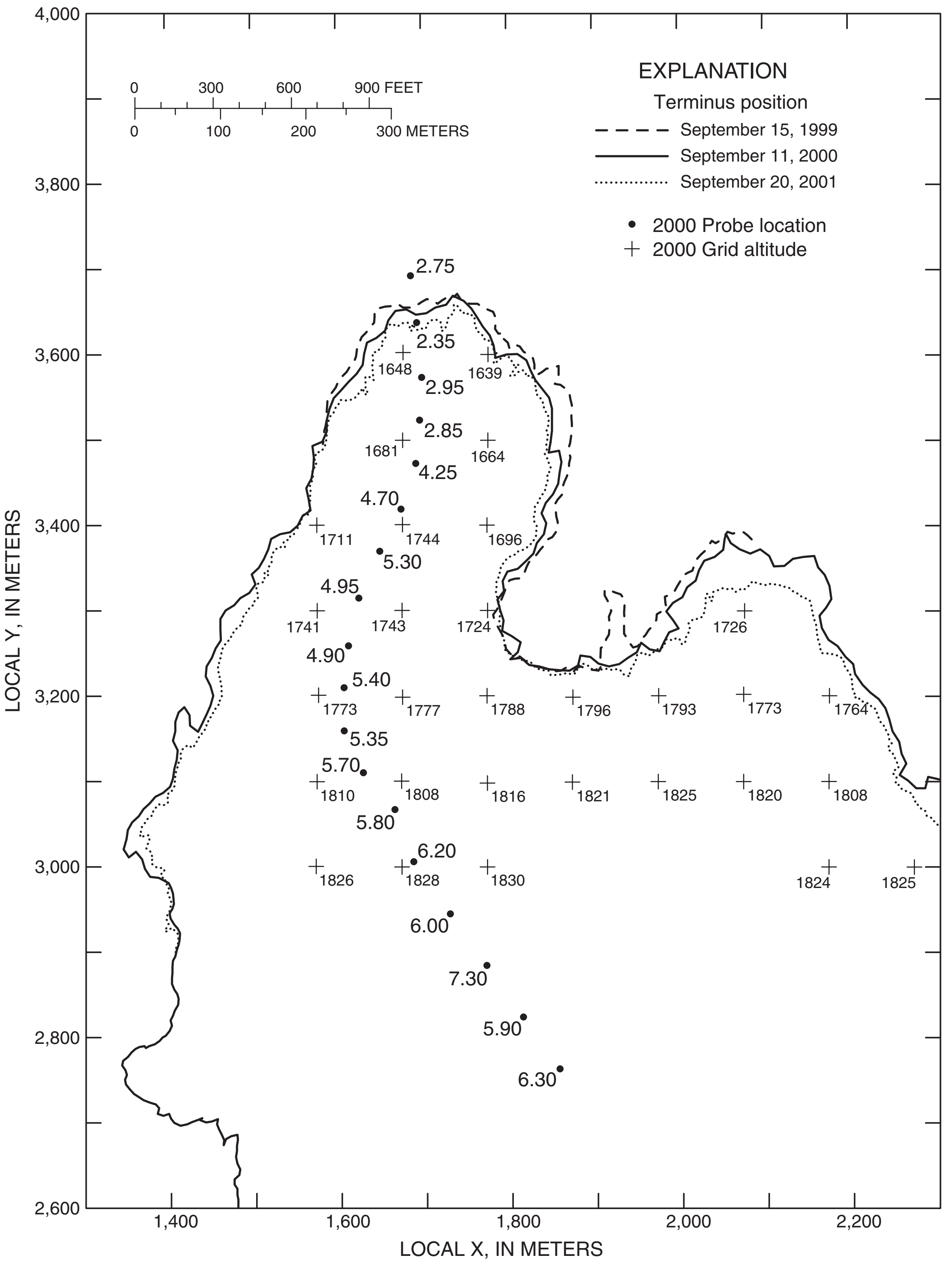


**Figure 5.** South Cascade Glacier terminus positions for September 15, 1999, September 11, 2000, and September 20, 2001, probe positions on May 7, 2000, and grid altitudes for 2000.

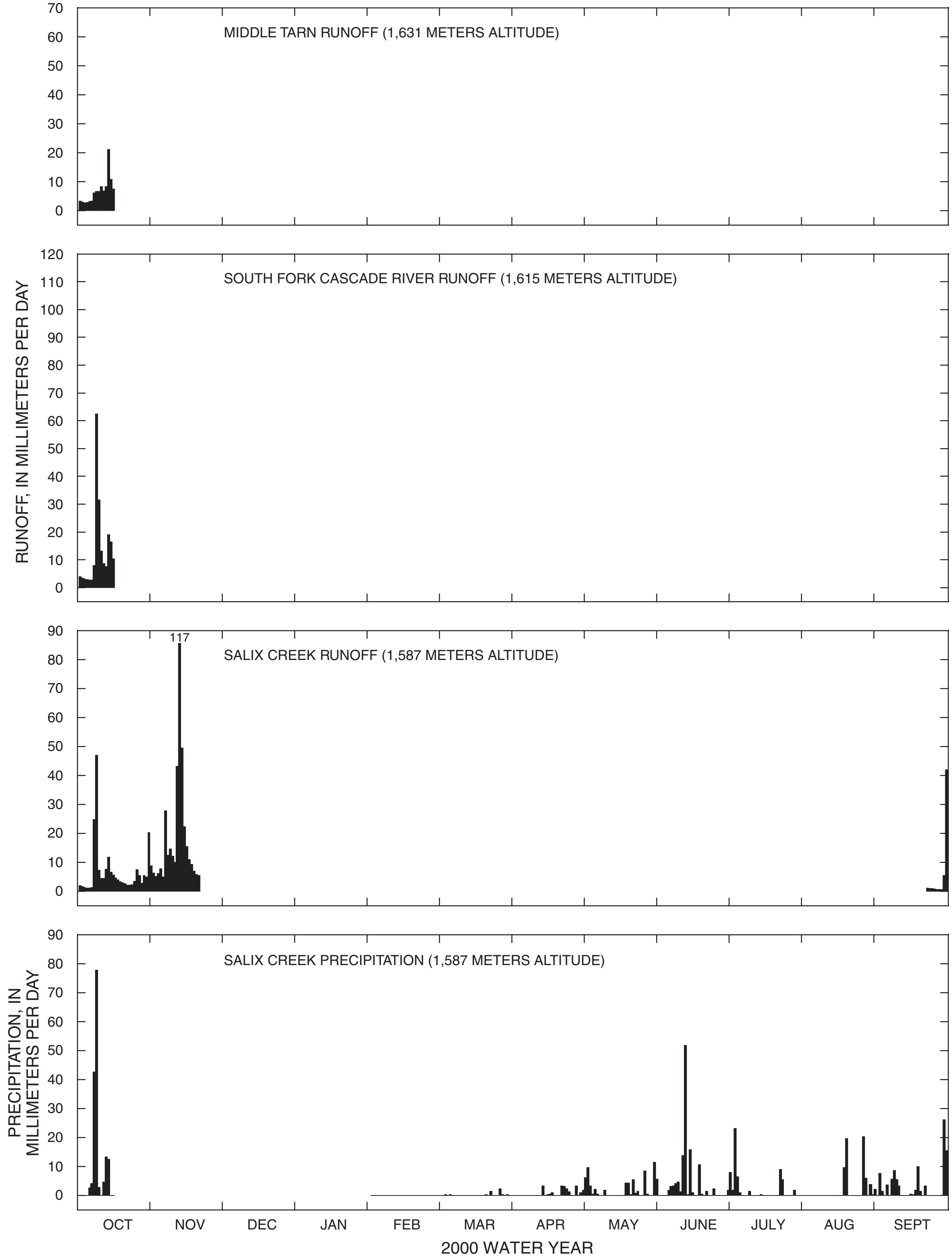


**Figure 6.** Daily runoff and precipitation at gaging stations near South Cascade Glacier during the 2000 water year. Data are missing when no "zero" line is shown.

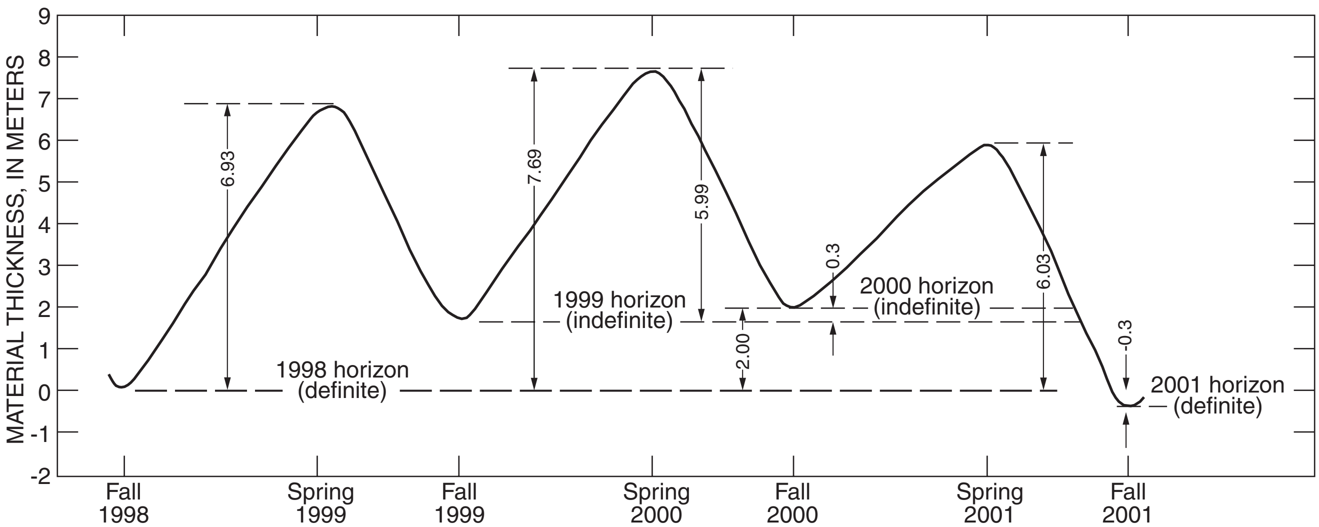


**Figure 7.** South Cascade Glacier balance years 1999–2001.

Balance year 1998 was very negative, resulting in a fall surface of very old material that was easily detected under the snow of the following winter. Balance year 1999 was positive, resulting in a 1999 fall horizon of 1-year-old firn, which could not be detected under the snow of the following winter. The 1998 horizon was easily detected and became a surrogate horizon for measurements in 2000. Balance year 2000 was also positive, again resulting in a fall horizon of first-year firn that could not be detected under the following winter's snow. The 1998 horizon was also used as reference for the 2001 measurements. Balance year 2001 was very negative, melting all the 1999 and 2000 firn away from the P1 area. The fall 2001 surface was of very old material, and will be easily detected under the snow of balance year 2002. Minor variations in the absolute snow and firn depths may occur because measurement sites from year to year may be separated by up to 50 m, and because of surface roughness.

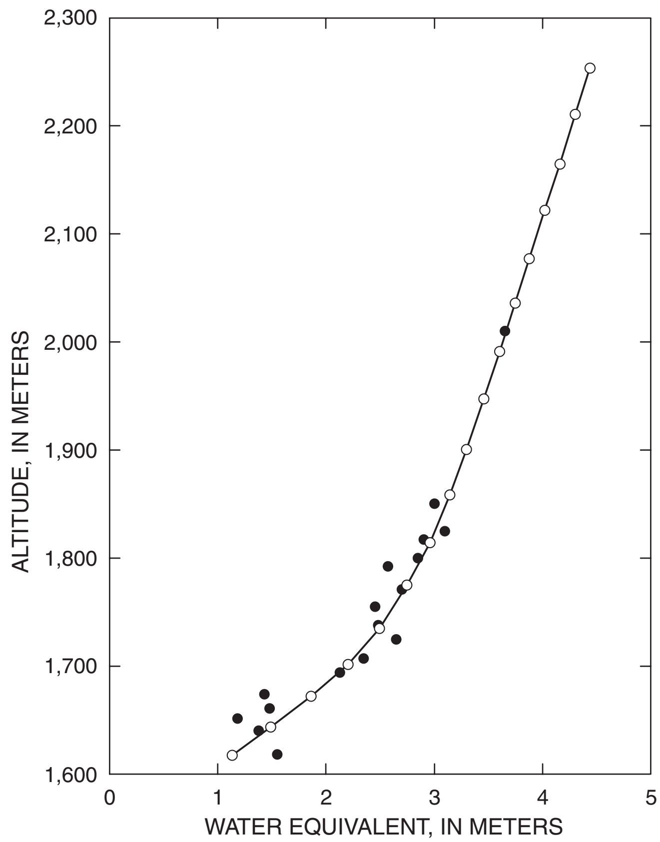


**Figure 8.** Measured winter snow balance at South Cascade Glacier, May 7, 2000.

Solid circles are measured points, open circles are along a hand-drawn curve used for interpolation.

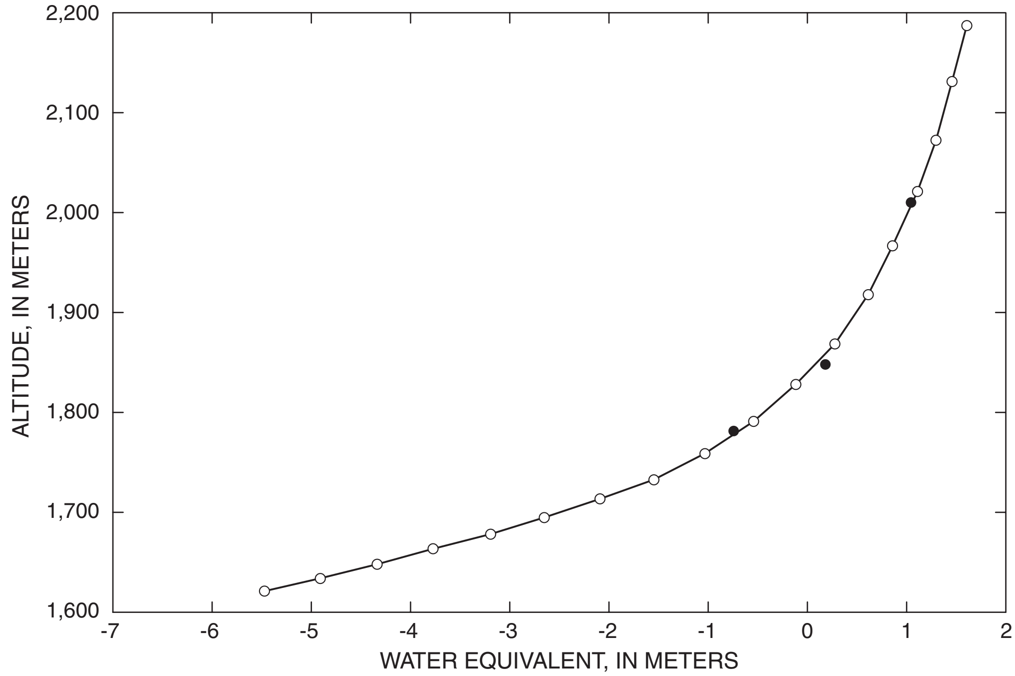


**Figure 9.** Net balance as a function of altitude at South Cascade Glacier, 2000. Solid circles are measured points, open circles are along a hand-drawn curve used for interpolation.

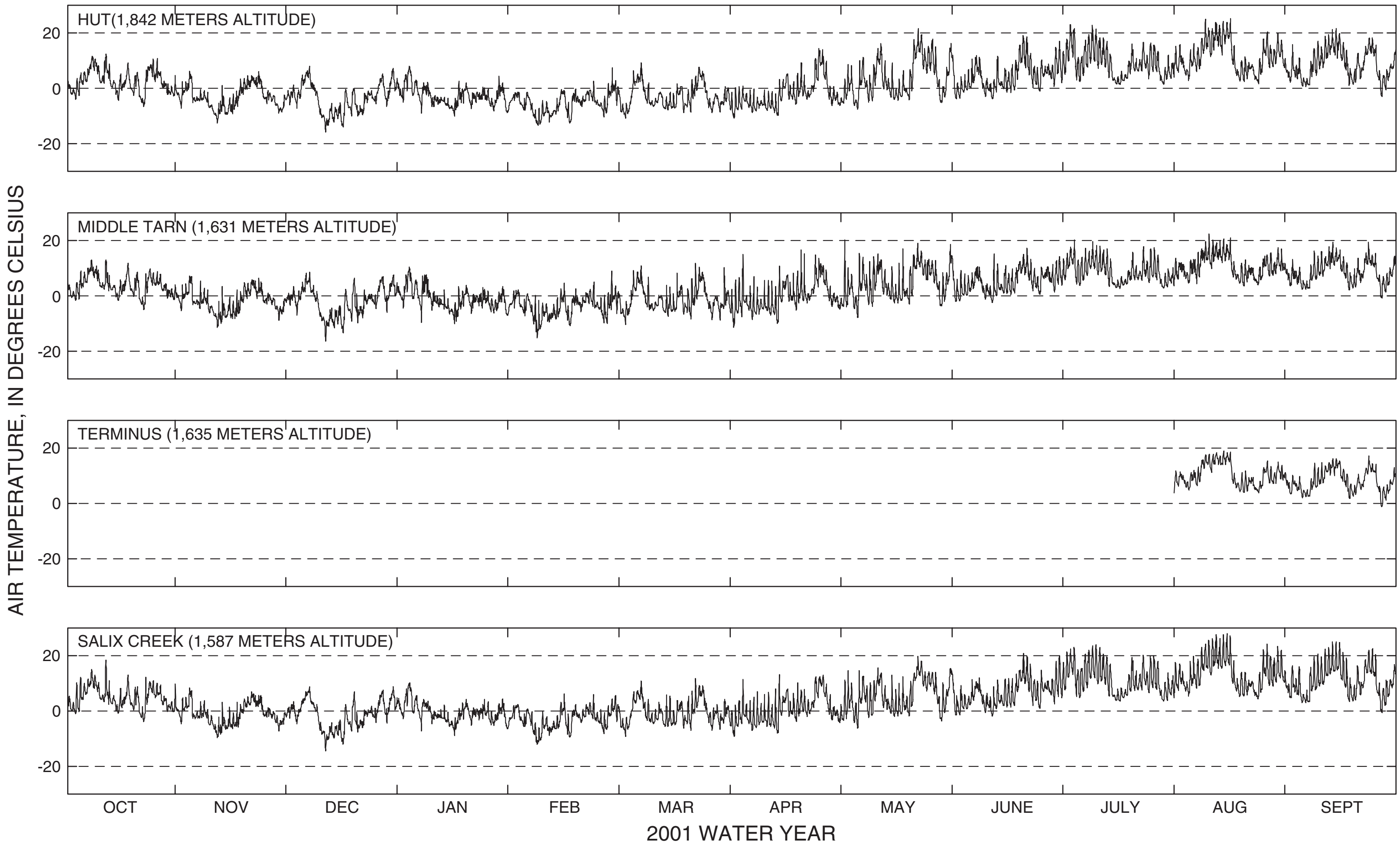


**Figure 10.** Air temperature near South Cascade Glacier during the 2001 water year.

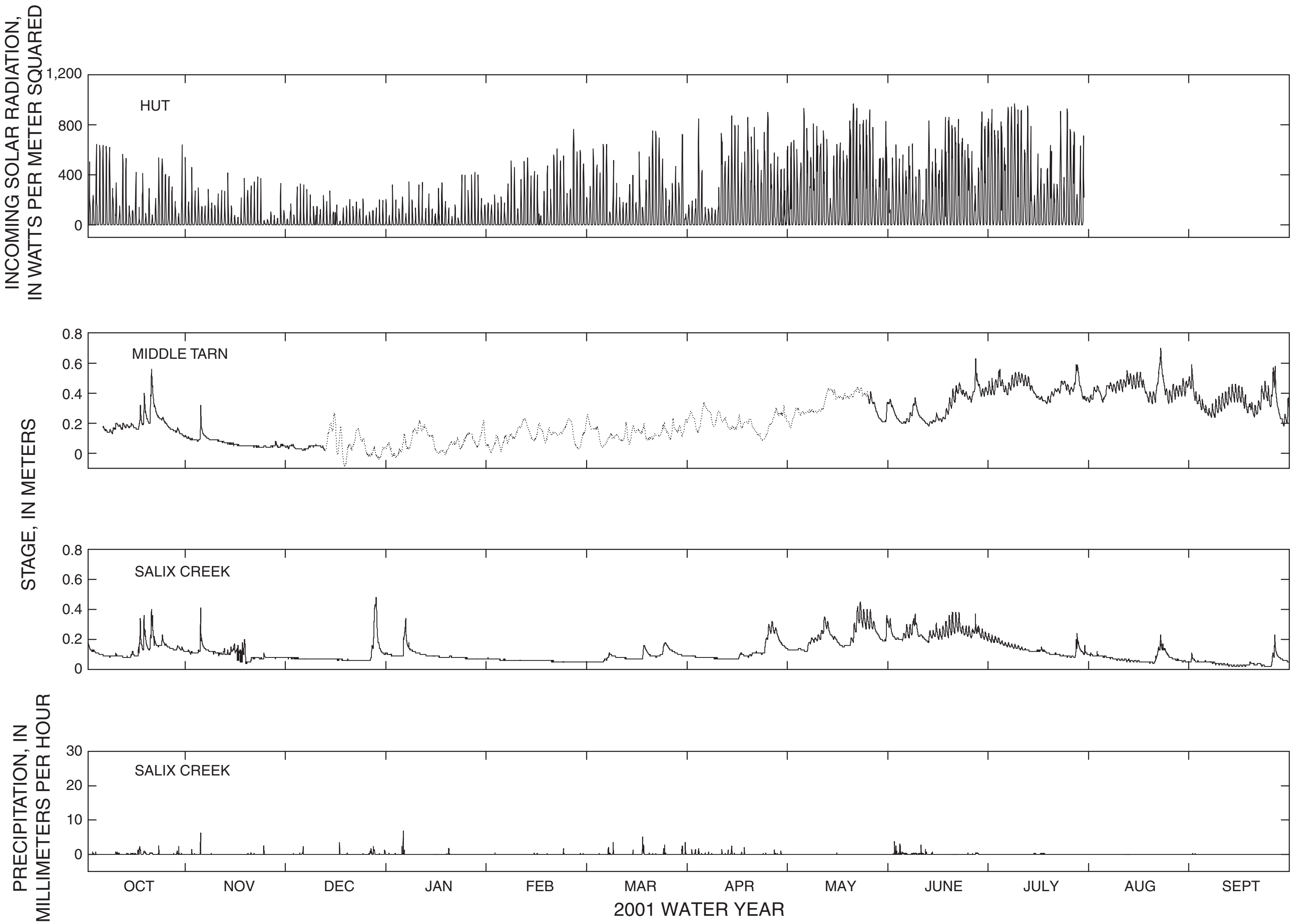


**Figure 11.** Instantaneous water stages and hourly precipitation at gaging stations near South Cascade Glacier, and radiation at the Hut during the 2001 water year.

Middle Tarn well intake was probably frozen from December 12 to May 26, and water stage is shown as a dotted line for that period.

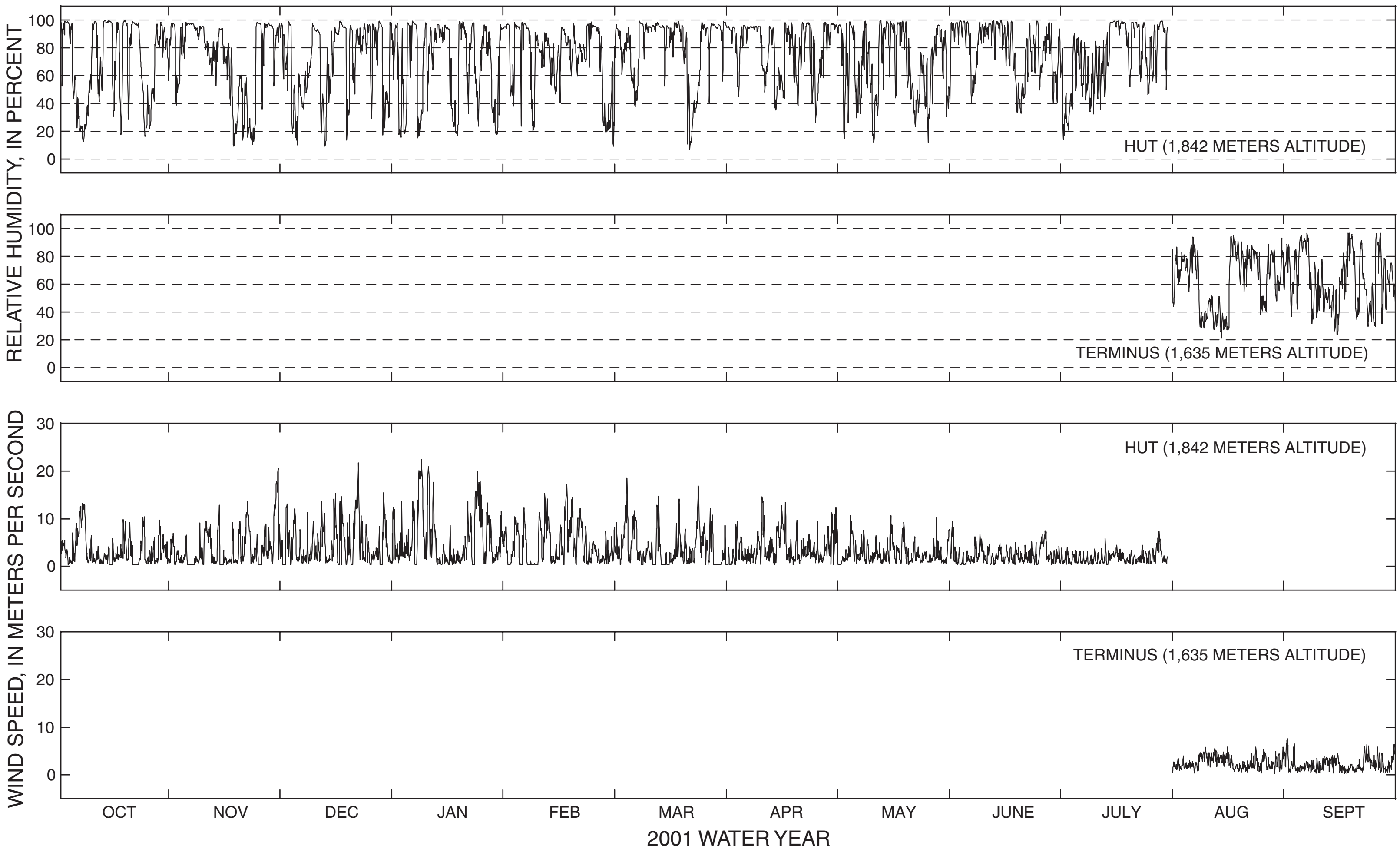


**Figure 12.** Relative humidity and wind speed near South Cascade Glacier during the 2001 water year. The anemometer was tilted for part of the August-to-September period for terminus.

**Figure 13.** South Cascade Glacier, September 20, 2001.
The maximum width of the glacier is about 1 kilometer. North is toward the page top.

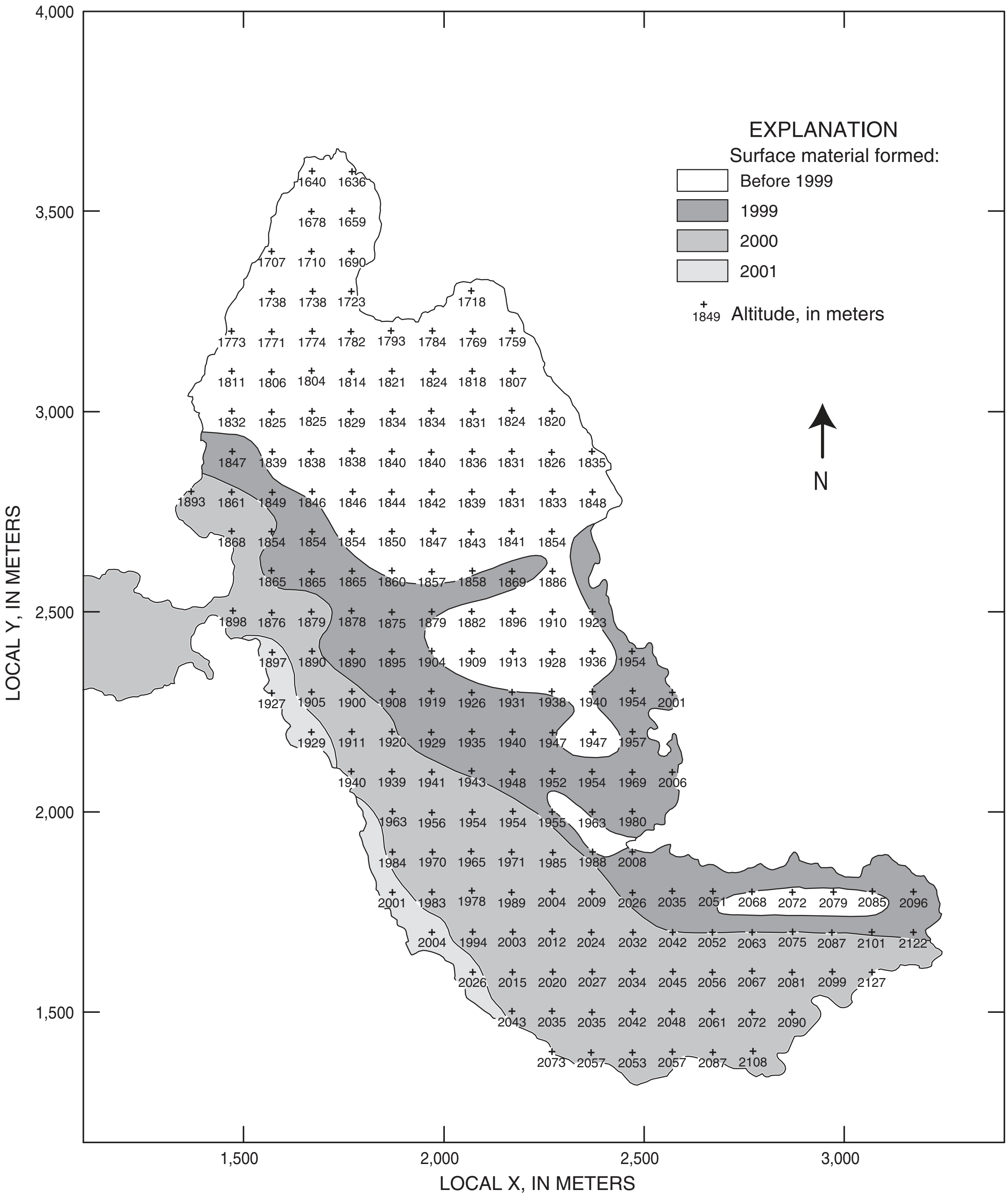


**Figure 14.** Altitude grid for South Cascade Glacier, measured from stereo vertical photographs taken on September 20 and October 3, 2001.

Tabular data are in table 15. At the end of balance year 2001, a small area of snow remained, and firn formed in 1999 and 2000 dominated the surface of the upper glacier.

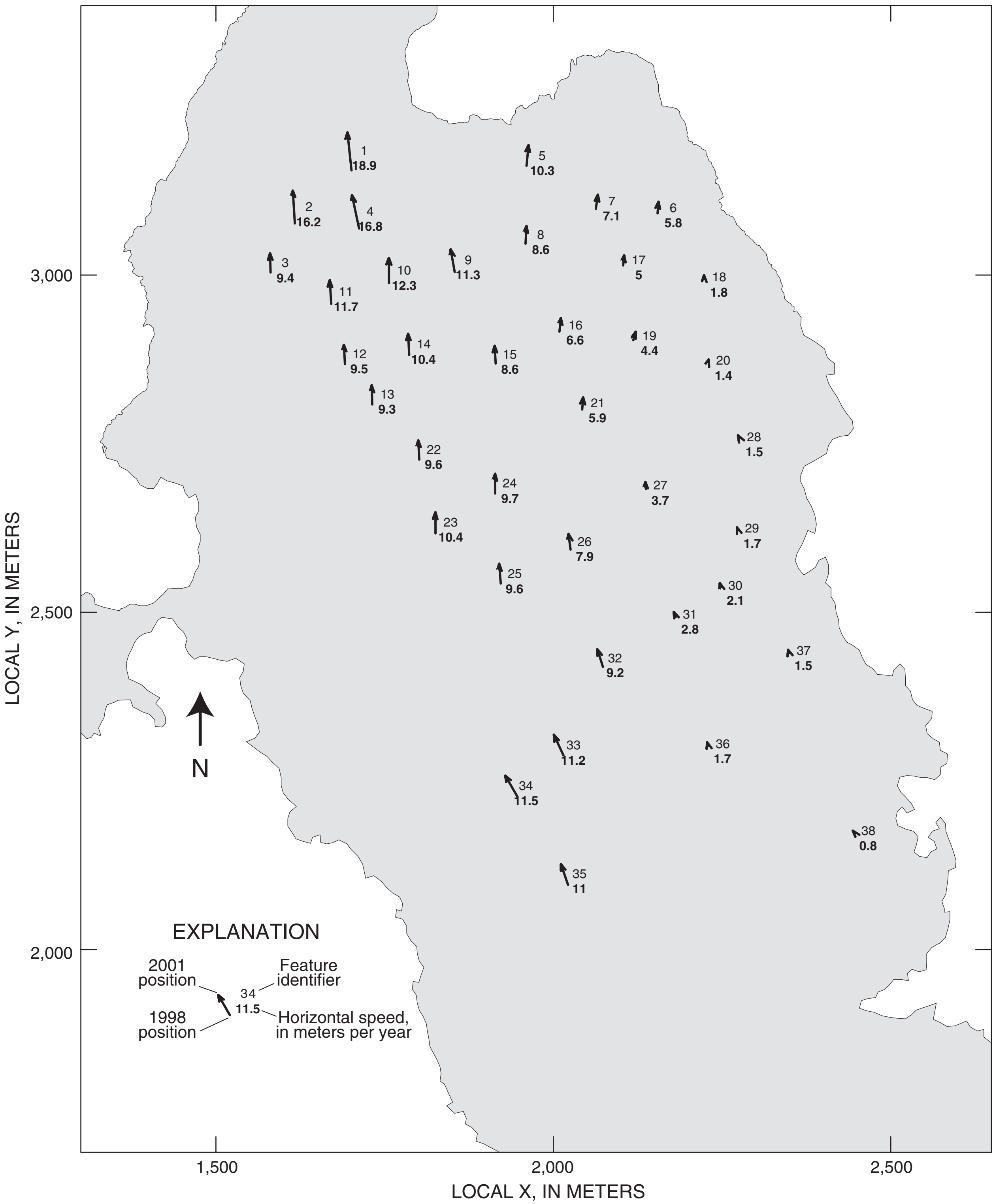


**Figure 15.** South Cascade Glacier surface velocity, measured from vertical photographs taken on September 14, 1998 and September 20, 2001.

The vector tail is at the 1998 position, and the vector head is at the 2001 position. At each vector the upper number is the feature identifier (table 16), and the lower number is the horizontal speed, in meters per year. The glacier outline is from 2001.

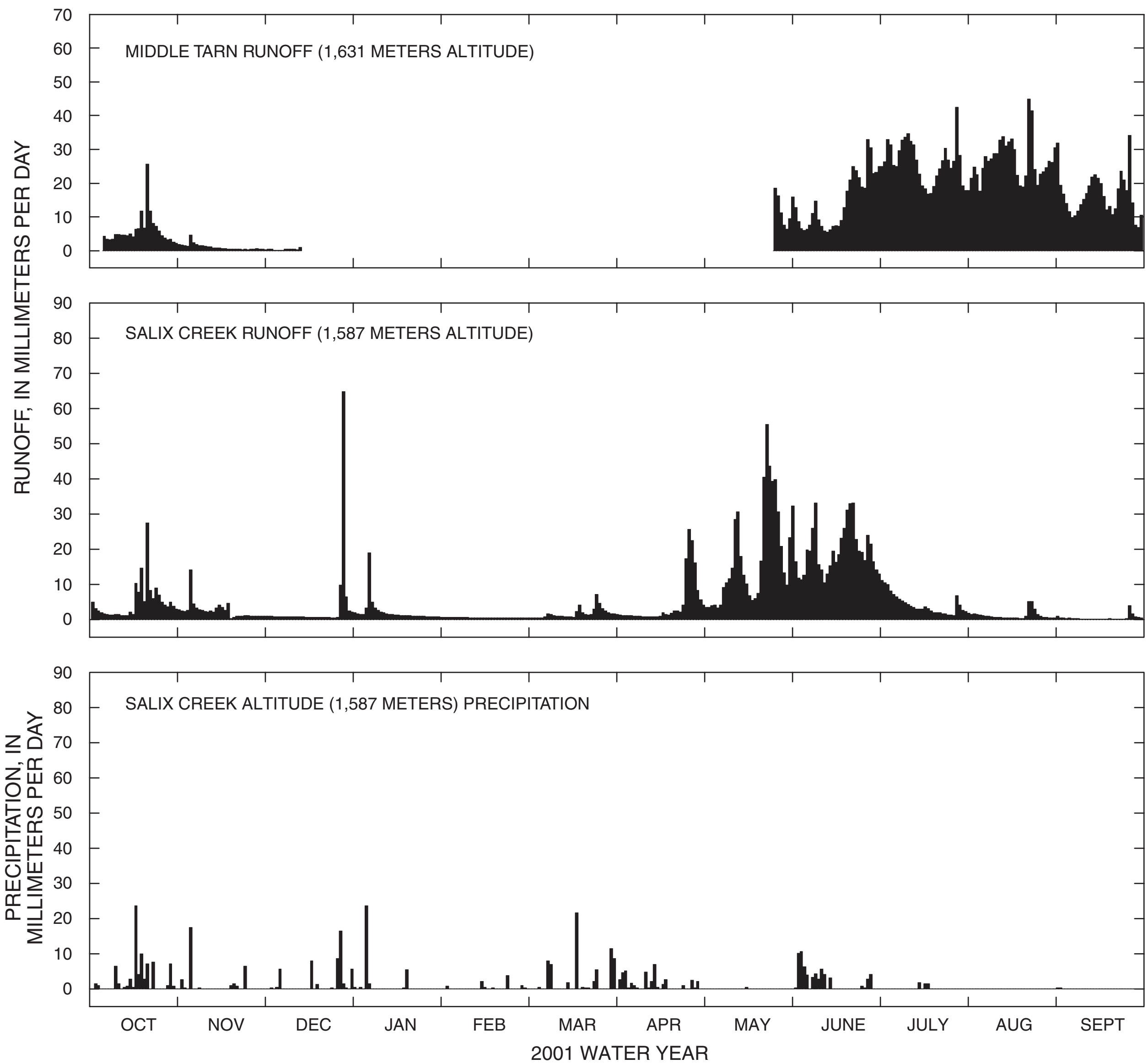


**Figure 16.** Daily runoff and precipitation at gaging stations near South Cascade Glacier during the 2001 water year. Data are missing when no “zero” line is shown.

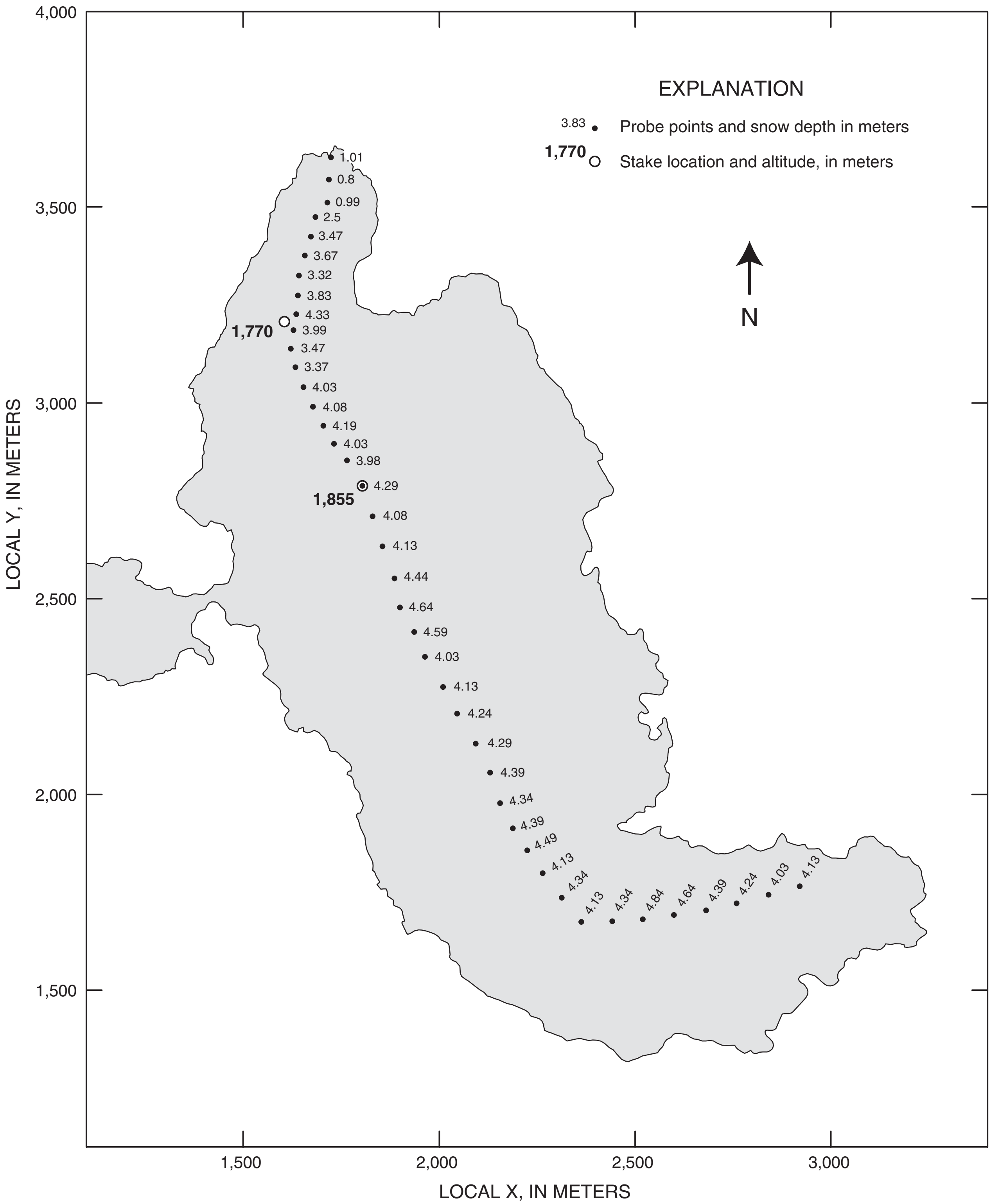


**Figure 17.** Snow depths, in meters, on South Cascade Glacier on May 10, 2001.
Stake locations are shown as circles, with the altitudes underlined. Table 21 gives the locations of the probe points.

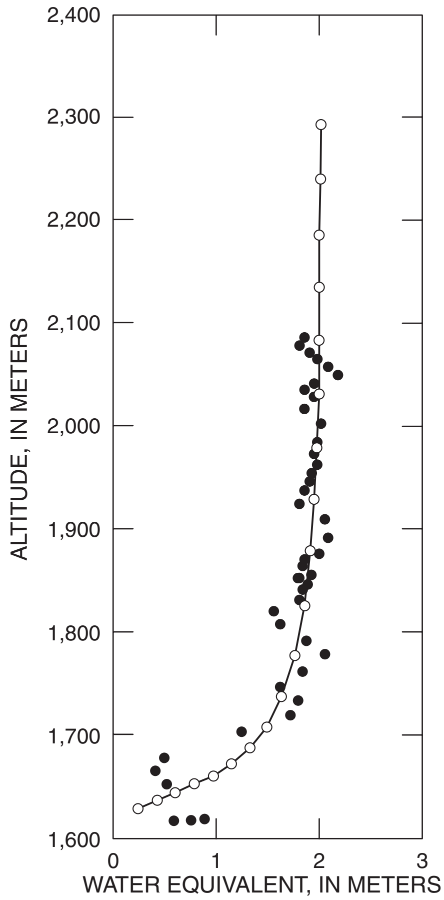


**Figure 18.** Measured winter snow balance at South Cascade Glacier, May 10, 2001.

Solid circles are measured points, open circles are along a hand-drawn curve used for interpolation.

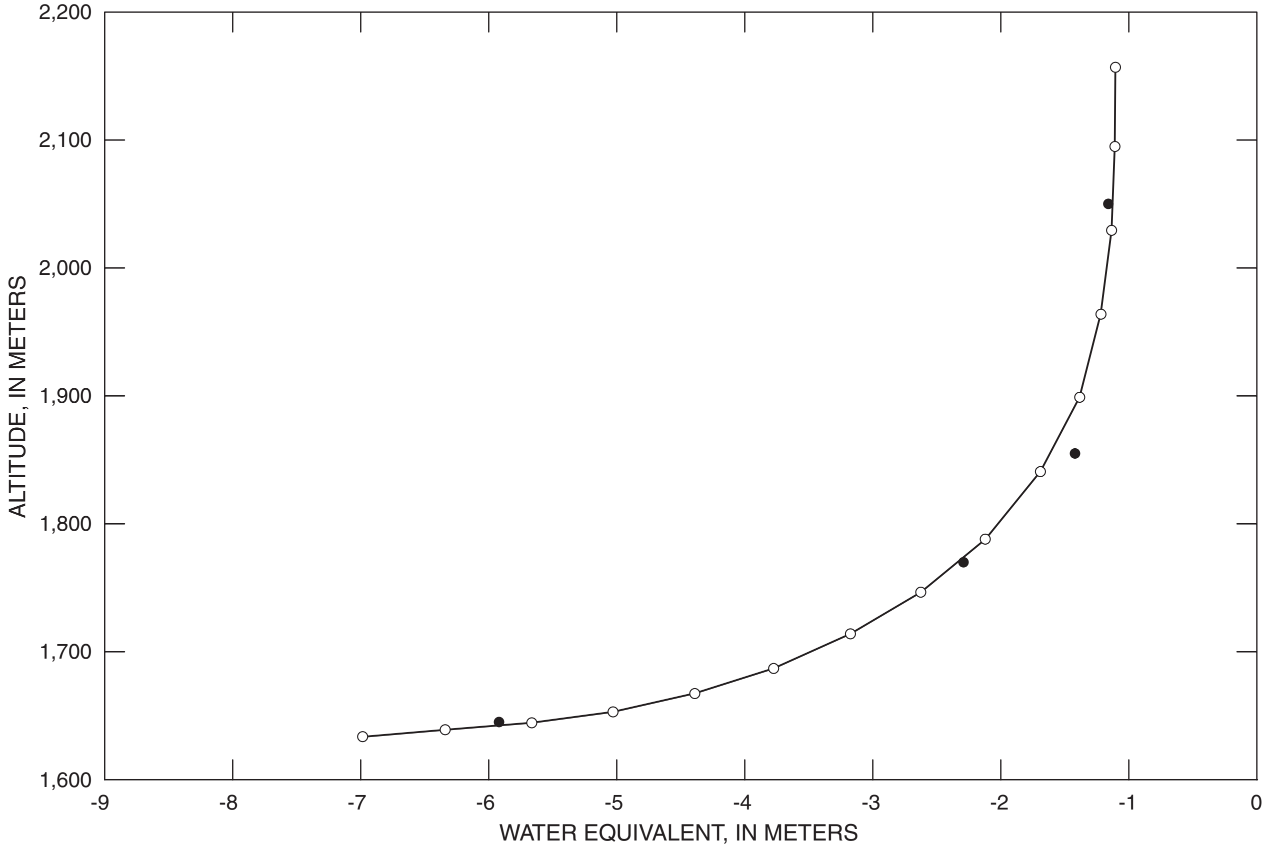


**Figure 19.** Net balance as a function of altitude at South Cascade Glacier, 2001. Solid circles are measured points, open circles are along a hand-drawn curve used for interpolation.

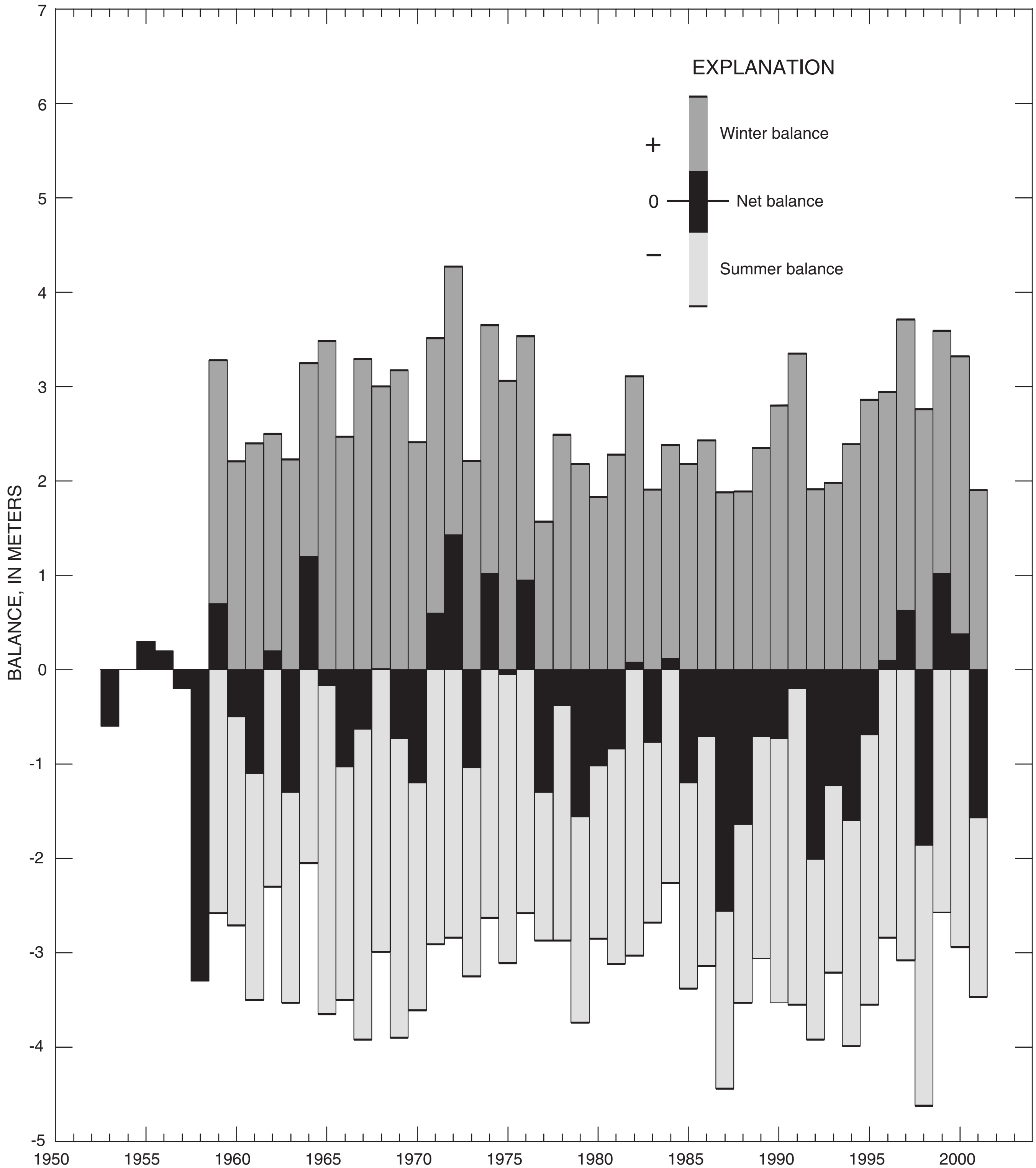


**Figure 20.** South Cascade Glacier balances, 1953–2001.

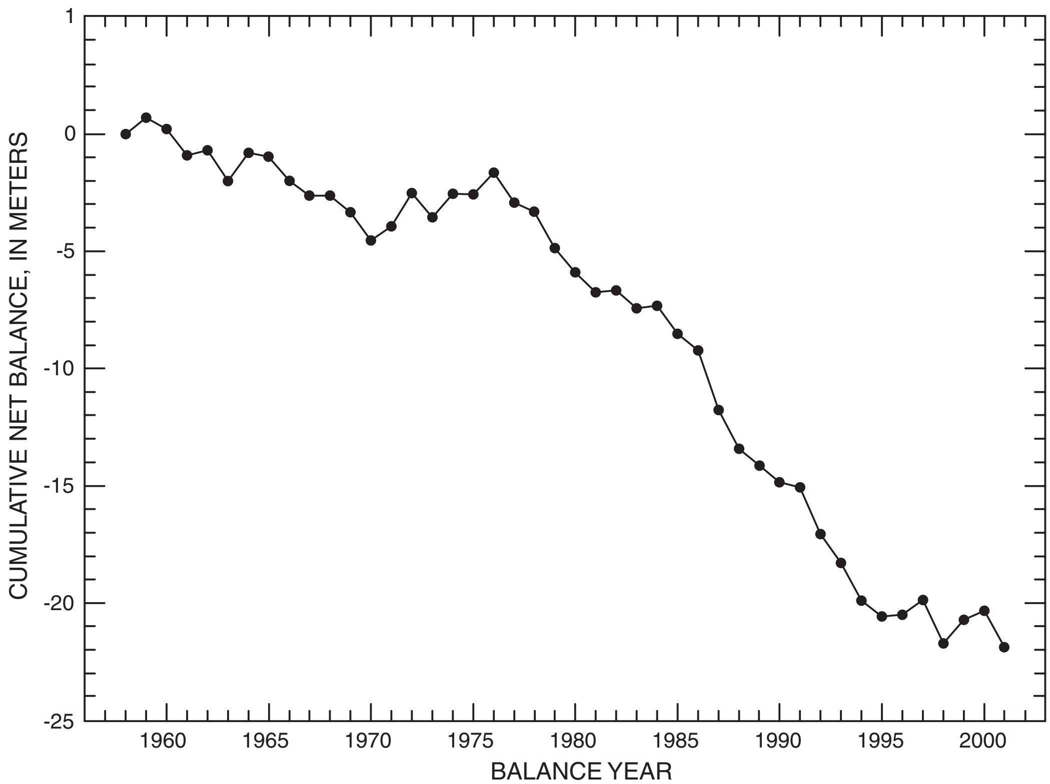


**Figure 21.** Cumulative net balance at South Cascade Glacier.

**Figure 22.** South Fork Cascade River gage house after it was hit by an avalanche.

The gage house at the South Fork Cascade River gaging station was hit by an avalanche during the winter of 2000. The building was displaced about 50 meters from its original location that spanned the outlet stream in the foreground. The gaging station was decommissioned and the building removed.

**Table 1**. Air temperature at 1,587 meters altitude, Salix Creek gaging station, South Cascade Glacier Basin, 2000 water year

[Daily maximum, minimum, and average air temperature, in degrees Celsius. Air temperature is sampled once an hour at the Salix Creek gaging station; –, no data]

| | October | | | November | | | December | | | January | | | February | | | March | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Day** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** |
| 1 | 14.1 | 4.0 | 7.0 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 2 | 13.4 | 3.2 | 6.9 | – | – | – | – | – | – | – | – | – | 0.1 | -3.6 | -1.8 | – | – | – |
| 3 | 17.0 | 5.6 | 10.1 | – | – | – | – | – | – | – | – | – | 1.6 | -2.1 | -.7 | – | – | – |
| 4 | 15.0 | 8.4 | 11.3 | – | – | – | – | – | – | – | – | – | 2.8 | -1.7 | .4 | – | – | – |
| 5 | 11.2 | 3.8 | 5.7 | – | – | – | – | – | – | – | – | – | 2.2 | -1.4 | .0 | – | – | – |
| 6 | 5.8 | 2.7 | 4.3 | – | – | – | – | – | – | – | – | – | 5.9 | .0 | 1.8 | – | – | – |
| 7 | 5.9 | 2.6 | 4.4 | – | – | – | – | – | – | – | – | – | 6.7 | .3 | 3.8 | – | – | – |
| 8 | 7.0 | .5 | 4.0 | – | – | – | – | – | – | – | – | – | 3.4 | -3.7 | .6 | – | – | – |
| 9 | 7.0 | -1.1 | .8 | – | – | – | – | – | – | – | – | – | 1.6 | -5.9 | -3.5 | – | – | – |
| 10 | 5.2 | -1.6 | 1.9 | – | – | – | – | – | – | – | – | – | -.4 | -4.3 | -2.5 | – | – | – |
| 11 | 5.2 | .3 | 2.3 | – | – | – | – | – | – | – | – | – | .4 | -5.8 | -3.2 | – | – | – |
| 12 | 7.6 | .5 | 3.8 | – | – | – | – | – | – | – | – | – | 1.6 | -5.9 | -3.8 | – | – | – |
| 13 | 8.1 | .8 | 5.4 | – | – | – | – | – | – | – | – | – | -3.2 | -7.7 | -5.4 | – | – | – |
| 14 | 1.3 | -2.4 | -.4 | – | – | – | – | – | – | – | – | – | -2.7 | -6.0 | -4.2 | – | – | – |
| 15 | – | – | – | – | – | – | – | – | – | – | – | – | -2.3 | -6.5 | -4.9 | – | – | – |
| 16 | – | – | – | – | – | – | – | – | – | – | – | – | -.3 | -7.5 | -4.3 | – | – | – |
| 17 | – | – | – | – | – | – | – | – | – | – | – | – | 1.5 | -5.7 | -3.4 | – | – | – |
| 18 | – | – | – | – | – | – | – | – | – | – | – | – | -1.0 | -6.8 | -3.8 | – | – | – |
| 19 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 20 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 21 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 22 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 23 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 24 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 25 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 26 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 27 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 28 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 29 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 30 | – | – | – | – | – | – | – | – | – | – | – | – | | | | – | – | – |
| 31 | – | – | – | | | | – | – | – | – | – | – | | | | – | – | – |
| | Monthly average | | | | | | | | | | | | | | | | | |
| | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |

**Table 1**. Air temperature at 1,587 meters altitude, Salix Creek gaging station, South Cascade Glacier Basin, 2000 water year—*Continued*

| | April | | | May | | | June | | | July | | | August | | | September | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Day** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** |
| 1 | – | – | – | – | – | – | – | – | – | – | – | – | 19.9 | 4.0 | 13.6 | 10.1 | 1.6 | 5.4 |
| 2 | – | – | – | – | – | – | – | – | – | – | – | – | 21.4 | 9.1 | 14.6 | 6.4 | 3.2 | 4.5 |
| 3 | – | – | – | – | – | – | – | – | – | – | – | – | 21.8 | 9.9 | 15.4 | 11.4 | 2.5 | 6.0 |
| 4 | – | – | – | – | – | – | – | – | – | – | – | – | 22.6 | 10.1 | 15.4 | 12.1 | 2.8 | 6.4 |
| 5 | – | – | – | – | – | – | – | – | – | – | – | – | 23.5 | 11.8 | 16.4 | 10.4 | 3.4 | 5.6 |
| 6 | – | – | – | – | – | – | – | – | – | – | – | – | 21.4 | 11.3 | 15.7 | 13.3 | 4.9 | 7.3 |
| 7 | – | – | – | – | – | – | – | – | – | 16.7 | 5.5 | 10.9 | 21.8 | 9.6 | 14.8 | 13.9 | 5.9 | 8.4 |
| 8 | – | – | – | – | – | – | – | – | – | 14.1 | 6.5 | 9.9 | 22.8 | 11.1 | 16.2 | 5.9 | .4 | 2.0 |
| 9 | – | – | – | – | – | – | – | – | – | 8.3 | 5.3 | 6.6 | 22.0 | 10.7 | 15.3 | 5.2 | .6 | 3.0 |
| 10 | – | – | – | – | – | – | – | – | – | 13.9 | 5.0 | 8.3 | 19.8 | 8.0 | 13.3 | 10.3 | 3.8 | 6.7 |
| 11 | – | – | – | – | – | – | – | – | – | 15.1 | 6.5 | 10.3 | 10.8 | 4.6 | 7.9 | 17.2 | 3.0 | 9.5 |
| 12 | – | – | – | – | – | – | – | – | – | 17.2 | 3.9 | 11.3 | 15.7 | 3.6 | 9.8 | 16.6 | 9.1 | 11.2 |
| 13 | – | – | – | – | – | – | – | – | – | 15.6 | 6.8 | 10.9 | 15.4 | 3.8 | 9.2 | 20.9 | 8.5 | 15.5 |
| 14 | – | – | – | – | – | – | – | – | – | 14.3 | 4.2 | 7.2 | 17.8 | 4.4 | 10.4 | 25.8 | 12.7 | 18.9 |
| 15 | – | – | – | – | – | – | – | – | – | 17.7 | 3.2 | 10.6 | 14.8 | 5.3 | 9.8 | 13.1 | 8.8 | 10.7 |
| 16 | – | – | – | – | – | – | – | – | – | 18.6 | 10.5 | 14.3 | 19.8 | 6.7 | 13.4 | 13.4 | 7.6 | 9.6 |
| 17 | – | – | – | – | – | – | – | – | – | 21.3 | 10.5 | 15.5 | 18.2 | 7.6 | 12.4 | 15.3 | 6.6 | 10.7 |
| 18 | – | – | – | – | – | – | – | – | – | 20.1 | 5.8 | 13.3 | 11.7 | 5.0 | 7.6 | 9.8 | 8.9 | 9.4 |
| 19 | – | – | – | – | – | – | – | – | – | 20.1 | 7.5 | 12.5 | 6.0 | 2.6 | 4.6 | 16.8 | 6.4 | 10.9 |
| 20 | – | – | – | – | – | – | – | – | – | 21.8 | 7.0 | 13.7 | 24.7 | 4.2 | 7.4 | 9.9 | 3.7 | 7.8 |
| 21 | – | – | – | – | – | – | – | – | – | 22.2 | 12.5 | 17.4 | 18.0 | 5.3 | 11.3 | 7.8 | 3.1 | 5.4 |
| 22 | – | – | – | – | – | – | – | – | – | 17.1 | 6.9 | 12.0 | 22.5 | 11.6 | 15.6 | 9.3 | 1.0 | 4.5 |
| 23 | – | – | – | – | – | – | – | – | – | 11.6 | 6.2 | 8.4 | 23.5 | 13.2 | 17.2 | 17.3 | 2.2 | 8.8 |
| 24 | – | – | – | – | – | – | – | – | – | 20.7 | 6.6 | 13.6 | 21.6 | 10.0 | 14.8 | 14.9 | 8.7 | 11.8 |
| 25 | – | – | – | – | – | – | – | – | – | 17.4 | 8.5 | 11.9 | 14.4 | 7.1 | 10.3 | 19.2 | 10.1 | 12.9 |
| 26 | – | – | – | – | – | – | – | – | – | 18.9 | 7.0 | 11.6 | 8.1 | 4.3 | 6.3 | 19.5 | 10.3 | 13.3 |
| 27 | – | – | – | – | – | – | – | – | – | 16.2 | 7.5 | 11.9 | 8.1 | 2.9 | 4.6 | 18.8 | 10.5 | 13.8 |
| 28 | – | – | – | – | – | – | – | – | – | 19.7 | 9.5 | 12.1 | 16.6 | 3.5 | 10.3 | 13.6 | 6.3 | 10.2 |
| 29 | – | – | – | – | – | – | – | – | – | 21.6 | 9.1 | 14.3 | 16.0 | 4.9 | 8.4 | 9.2 | 6.1 | 7.9 |
| 30 | – | – | – | – | – | – | – | – | – | 26.6 | 13.4 | 18.4 | 17.3 | 5.9 | 10.7 | 9.3 | 4.5 | 7.3 |
| 31 | | | | – | – | – | | | | 22.5 | 12.1 | 17.0 | 10.7 | 2.1 | 6.3 | | | |
| | Monthly average | | | | | | | | | | | | | | | | | |
| | – | – | – | – | – | – | – | – | – | 18.0 | 7.5 | 12.2 | 17.7 | 6.9 | 11.6 | 13.2 | 5.6 | 8.8 |

**Table 2.** Air temperature at 1,615 meters altitude, South Fork Cascade River gaging station, South Cascade Glacier Basin, 2000 water year

[Daily maximum, minimum, and average air temperature, in degrees Celsius. Air temperature is sampled once an hour at the South Fork Cascade River gaging station;. –, no data]

| | October | | | November | | | December | | | January | | | February | | | March | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Day** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** |
| 1 | 9.5 | 2.8 | 5.6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 2 | 9.9 | 2.0 | 5.3 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 3 | 14.1 | 4.3 | 8.5 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 4 | 13.8 | 6.2 | 10.2 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 5 | 8.1 | 2.4 | 4.1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 6 | 4.3 | 2.4 | 3.5 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 7 | 5.8 | 2.4 | 4.1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 8 | 6.6 | -1.2 | 2.6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 9 | 2.0 | -1.7 | -.6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 10 | 3.9 | -1.7 | 1.2 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 11 | 4.3 | .0 | 1.6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 12 | 7.3 | 1.2 | 4.0 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 13 | 6.6 | -.4 | 3.8 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 14 | -.8 | -2.9 | -1.8 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 15 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 16 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 17 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
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| 22 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 23 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
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| 25 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 26 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 27 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 28 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 29 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 30 | – | – | – | – | – | – | – | – | – | – | – | – | | | | – | – | – |
| 31 | – | – | – | | | | – | – | – | – | – | – | | | | – | – | – |
| | Monthly average | | | | | | | | | | | | | | | | | |
| | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |

**Table 2**. Air temperature at 1,615 meters altitude, South Fork Cascade River gaging station, South Cascade Glacier Basin, 2000 water year—*Continued*

| | April | | | May | | | June | | | July | | | August | | | September | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Day** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** |
| 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 2 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 3 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 4 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 5 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 7 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 8 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 9 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
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| 14 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
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| 28 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
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| 30 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 31 | | | | – | – | – | | | | – | – | – | – | – | – | | | |
| | Monthly average | | | | | | | | | | | | | | | | | |
| | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |

**Table 3.** Air temperature at 1,631 meters altitude, Middle Tarn gaging station, South Cascade Glacier Basin, 2000 water year

[Daily, maximum, minimum, and average air temperature, in degrees Celsius. Air temperature is sampled once an hour at the Salix Creek gaging station (fig. 1). -- indicates no data

| | October | | | November | | | December | | | January | | | February | | | March | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Day** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** |
| 1 | 8.7 | 2.5 | 5.1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 2 | 9.3 | 2.0 | 4.9 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 3 | 14.2 | 4.8 | 8.1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 4 | 13.8 | 6.3 | 9.6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 5 | 9.4 | 2.9 | 4.4 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 6 | 4.7 | 2.7 | 3.6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 7 | 5.6 | 2.4 | 4.2 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 8 | 6.7 | -.8 | 2.8 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 9 | 2.4 | -1.6 | -.3 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 10 | 3.7 | -1.6 | 1.3 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 11 | 4.1 | .2 | 1.9 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 12 | 7.9 | 1.6 | 4.2 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 13 | 6.8 | -.3 | 4.1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 14 | -.5 | -2.7 | -1.4 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 15 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
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| 31 | – | – | – | | | | – | – | – | – | – | – | | | | – | – | – |
| | Monthly average | | | | | | | | | | | | | | | | | |
| | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |

**Table 3**. Air temperature at 1,631 meters altitude, Middle Tarn gaging station, South Cascade Glacier Basin, 2000 water year—*Continued*

| | April | | | May | | | June | | | July | | | August | | | September | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Day** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** |
| 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 2 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
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| 5 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 6 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 7 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
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| 11 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 12 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 13 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 14 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 15 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 16 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 17 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 18 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 19 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 20 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 21 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 22 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 23 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 24 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 25 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 26 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 27 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 28 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 29 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 30 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| 31 | | | | – | – | – | | | | – | – | – | – | – | – | | | |
| | Monthly average | | | | | | | | | | | | | | | | | |
| | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |

**Table 4.** Air temperature at 1,848 meters altitude, the Hut, South Cascade Glacier Basin, 2000 water year

[Daily maximum, minimum, and average air temperature, in degrees Celsius. Air temperature is sampled once an hour at the Hut.]

| | October | | | November | | | December | | | January | | | February | | | March | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Day | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg |
| 1 | 9.2 | .9 | 4.4 | -1.8 | -6.8 | -5.0 | -1.5 | -4.5 | -3.7 | -5.8 | -7.8 | -7.0 | -1.7 | -6.2 | -3.2 | -1.7 | -5.7 | -3.7 |
| 2 | 6.7 | 1.2 | 3.7 | 8.9 | -2.5 | 2.9 | -1.0 | -7.7 | -4.6 | -7.8 | -11.8 | -9.5 | -3.9 | -5.5 | -4.8 | .6 | -3.9 | -2.4 |
| 3 | 13.8 | 3.2 | 7.9 | 5.1 | -4.1 | 1.8 | -4.1 | -9.4 | -6.8 | -2.5 | -12.8 | -6.6 | -2.5 | -4.7 | -2.2 | .1 | -4.3 | -2.6 |
| 4 | 11.6 | 6.0 | 9.4 | -2.7 | -7.8 | -6.5 | .6 | -7.0 | -4.5 | -1.8 | -6.4 | -4.5 | 1.3 | -4.7 | -3.8 | -.6 | -6.6 | -4.1 |
| 5 | 9.6 | 1.2 | 3.3 | 1.1 | -7.3 | -4.1 | -1.1 | -5.5 | -4.5 | -6.3 | -9.4 | -7.5 | -.3 | -4.1 | -2.8 | -1.7 | -9.7 | -6.5 |
| 6 | 3.7 | 1.1 | 1.9 | 8.6 | 1.0 | 4.7 | -2.5 | -6.7 | -4.4 | -2.5 | -9.4 | -4.8 | 1.8 | -1.8 | -.3 | -4.9 | -10.4 | -8.8 |
| 7 | 3.5 | .3 | 2.0 | 9.2 | 2.5 | 5.9 | -6.0 | -9.0 | -7.5 | -3.9 | -5.3 | -4.5 | 4.6 | -1.3 | 1.4 | -3.3 | -10.0 | -7.1 |
| 8 | 4.6 | -2.5 | 1.6 | 7.1 | -1.9 | 2.4 | -5.7 | -10.1 | -7.7 | -3.0 | -9.2 | -5.8 | 1.6 | -6.1 | -1.1 | -1.5 | -6.6 | -4.6 |
| 9 | .3 | -3.6 | -2.3 | .3 | -1.7 | -.4 | -4.3 | -7.0 | -5.3 | -4.9 | -11.4 | -8.9 | -2.7 | -7.7 | -6.3 | 2.0 | -4.8 | -3.1 |
| 10 | 1.7 | -3.9 | -1.0 | .9 | -1.7 | -.6 | -3.6 | -6.6 | -5.5 | -8.6 | -11.2 | -10.3 | -3.4 | -6.8 | -4.7 | -2.0 | -6.5 | -3.9 |
| 11 | 2.6 | -1.5 | .6 | 5.6 | -.7 | 2.4 | -1.4 | -3.2 | -2.2 | -8.5 | -10.5 | -9.9 | -2.0 | -8.6 | -5.4 | -3.9 | -6.8 | -5.7 |
| 12 | 5.2 | -.8 | 2.1 | 4.7 | .7 | 3.0 | -1.7 | -9.4 | -4.3 | -8.5 | -11.3 | -10.2 | -1.9 | -8.7 | -6.6 | -.6 | -8.2 | -5.2 |
| 13 | 4.7 | -1.7 | 2.5 | 4.7 | 2.0 | 3.7 | -7.8 | -9.4 | -8.7 | -6.2 | -9.0 | -7.6 | -6.7 | -9.2 | -7.9 | 1.4 | -5.2 | -2.4 |
| 14 | -2.2 | -5.1 | -3.4 | 11.0 | 4.8 | 8.0 | -2.0 | -8.1 | -5.0 | -3.8 | -8.7 | -5.8 | -5.7 | -8.0 | -6.9 | -1.8 | -6.5 | -5.4 |
| 15 | -.7 | -5.7 | -3.9 | 10.9 | 2.8 | 6.9 | .0 | -1.9 | -.7 | -8.0 | -9.7 | -9.1 | -2.0 | -8.6 | -5.4 | -1.4 | -9.2 | -4.7 |
| 16 | 7.5 | -3.5 | 1.2 | 4.1 | -1.0 | 2.6 | -.6 | -3.2 | -2.0 | -3.6 | -9.5 | -6.2 | -6.2 | -8.6 | -7.6 | -2.2 | -8.3 | -5.0 |
| 17 | 7.9 | 3.2 | 4.6 | -1.5 | -4.4 | -2.9 | -.2 | -3.6 | -2.0 | -3.0 | -9.2 | -7.3 | -4.5 | -8.4 | -6.8 | -3.9 | -8.2 | -6.1 |
| 18 | 10.8 | 2.7 | 5.6 | -.6 | -5.5 | -2.7 | -2.7 | -7.2 | -4.6 | -3.2 | -7.9 | -6.5 | -.6 | -8.2 | -5.5 | -1.0 | -7.5 | -3.6 |
| 19 | 13.2 | 8.8 | 10.5 | -.2 | -3.5 | -2.0 | -3.9 | -8.7 | -6.1 | -.3 | -7.4 | -4.8 | -.8 | -8.6 | -5.3 | -4.9 | -8.9 | -7.4 |
| 20 | 11.3 | 6.7 | 8.7 | -1.7 | -5.8 | -4.1 | .5 | -6.0 | -2.2 | -2.2 | -4.7 | -3.4 | -.3 | -3.9 | -2.4 | -.9 | -9.6 | -5.8 |
| 21 | 18.3 | 7.1 | 11.8 | -4.5 | -7.4 | -6.0 | 5.9 | -2.0 | 1.1 | -3.5 | -7.1 | -4.8 | 2.1 | -2.2 | -.6 | 1.6 | -5.9 | -2.1 |
| 22 | 14.0 | 10.1 | 12.3 | -3.3 | -7.0 | -5.1 | 13.2 | 3.6 | 7.8 | -2.0 | -7.5 | -4.9 | .7 | -5.3 | -1.7 | 3.1 | -6.1 | -.4 |
| 23 | 12.6 | .7 | 9.0 | -2.9 | -4.7 | -4.3 | 13.6 | 5.7 | 9.4 | -4.0 | -7.3 | -6.0 | -4.1 | -7.7 | -6.1 | -5.3 | -8.0 | -6.7 |
| 24 | 2.5 | -4.7 | -.8 | -.6 | -4.5 | -2.5 | 11.2 | 5.8 | 8.9 | -4.2 | -7.5 | -5.6 | -1.1 | -8.7 | -6.5 | -2.0 | -7.4 | -4.8 |
| 25 | 4.6 | -2.8 | 1.7 | -1.3 | -5.3 | -2.9 | 9.8 | 7.8 | 8.7 | .0 | -6.7 | -3.4 | -4.2 | -9.0 | -6.7 | -2.0 | -6.5 | -3.5 |
| 26 | -1.7 | -5.1 | -3.8 | -1.9 | -8.8 | -6.0 | 12.7 | 7.8 | 10.2 | -6.7 | -7.9 | -7.2 | -2.9 | -6.1 | -4.9 | 9.9 | -6.8 | .3 |
| 27 | .3 | -3.4 | -2.3 | -3.4 | -9.3 | -6.0 | 15.3 | 10.5 | 12.3 | -3.9 | -8.4 | -6.4 | 1.0 | -4.0 | -2.4 | 1.3 | -5.3 | -2.1 |
| 28 | 1.0 | -3.6 | -.7 | -.8 | -3.9 | -2.2 | 10.8 | .1 | 6.5 | 3.9 | -4.7 | -.1 | -3.9 | -5.5 | -4.6 | -4.3 | -7.6 | -5.9 |
| 29 | -.6 | -3.8 | -2.3 | 4.3 | -1.3 | 1.5 | 4.6 | -1.5 | .9 | 2.3 | -1.5 | .9 | -2.2 | -4.9 | -3.7 | -.2 | -8.2 | -5.6 |
| 30 | 3.6 | -.5 | 1.8 | -1.0 | -4.2 | -3.0 | 1.3 | -4.8 | -1.6 | 1.0 | -5.7 | -2.7 | | | | 2.6 | -7.6 | -2.4 |
| 31 | -.8 | -7.9 | -4.5 | | | | -3.1 | -5.7 | -4.3 | -2.3 | -7.3 | -4.5 | | | | 9.8 | -3.8 | 2.1 |
| | Monthly average | | | | | | | | | | | | | | | | | |
| | 5.8 | -0.2 | 2.6 | 1.9 | -3.2 | -0.7 | 1.5 | -3.4 | -1.0 | -3.7 | -8.2 | -6.0 | -1.7 | -6.2 | -4.2 | -0.6 | -7.1 | -4.2 |

**Table 4**. Air temperature at 1,848 meters altitude, the Hut, South Cascade Glacier Basin, 2000 water year—*Continued*

| | April | | | May | | | June | | | July | | | August | | | September | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Day** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** |
| 1 | 4.5 | -.8 | 2.4 | 6.5 | -.8 | 2.5 | 7.3 | .8 | 3.5 | 5.4 | -.4 | 2.5 | 16.2 | 5.6 | 11.2 | 6.6 | -1.0 | 2.4 |
| 2 | 16.1 | -1.5 | 5.5 | 8.1 | -.8 | 2.2 | 7.5 | 1.1 | 4.5 | 5.2 | -1.3 | 1.1 | 16.5 | 7.1 | 12.2 | 4.6 | 1.1 | 2.2 |
| 3 | 12.5 | 2.8 | 7.2 | 2.9 | -4.3 | -1.0 | 13.4 | 2.2 | 9.4 | 4.1 | -.3 | 1.0 | 17.4 | 8.1 | 12.7 | 7.4 | -.7 | 3.2 |
| 4 | 3.1 | -7.3 | -2.6 | 2.7 | -4.9 | -2.2 | 14.1 | 8.7 | 11.0 | 5.9 | .1 | 2.4 | 16.3 | 8.9 | 12.6 | 7.4 | 1.1 | 3.6 |
| 5 | -4.9 | -7.6 | -6.3 | -1.0 | -5.3 | -3.5 | 12.0 | .9 | 6.2 | 12.9 | .7 | 5.5 | 19.0 | 10.8 | 14.2 | 5.6 | 2.0 | 3.1 |
| 6 | -4.9 | -7.6 | -6.6 | 6.7 | -5.7 | -2.0 | 9.4 | .1 | 4.4 | 12.4 | 2.9 | 6.5 | 17.3 | 8.7 | 12.8 | 9.0 | 3.0 | 4.8 |
| 7 | 8.1 | -8.0 | -.9 | 7.6 | -5.9 | 1.2 | 10.0 | 2.4 | 5.0 | 15.1 | 3.0 | 9.2 | 17.4 | 7.9 | 12.6 | 11.3 | 3.7 | 6.1 |
| 8 | 14.5 | 1.7 | 7.1 | 7.7 | -1.8 | 1.4 | 4.4 | .7 | 2.4 | 12.0 | 5.3 | 8.2 | 19.8 | 9.0 | 14.0 | 4.0 | -1.1 | .3 |
| 9 | 8.1 | -1.1 | 2.6 | 1.6 | -3.7 | -2.0 | 7.1 | -1.0 | 1.9 | 6.9 | 3.8 | 4.7 | 19.5 | 8.9 | 13.5 | 2.3 | -1.1 | .4 |
| 10 | 11.3 | -3.0 | 4.1 | -1.9 | -5.0 | -3.6 | 3.1 | -3.0 | -1.0 | 10.0 | 3.4 | 6.4 | 15.9 | 5.8 | 10.6 | 5.9 | 2.4 | 3.9 |
| 11 | 12.6 | 2.6 | 7.0 | -1.3 | -4.6 | -3.3 | 9.4 | .1 | 4.4 | 15.4 | 5.3 | 8.9 | 7.6 | 2.8 | 5.1 | 12.8 | .6 | 7.0 |
| 12 | 10.0 | 3.3 | 5.8 | 7.4 | -4.5 | .1 | 10.0 | 2.4 | 5.0 | 18.4 | 3.0 | 11.6 | 12.3 | .9 | 7.0 | 13.0 | 5.9 | 9.0 |
| 13 | 7.1 | -1.1 | 3.0 | 7.3 | -1.3 | 2.9 | 4.4 | .7 | 2.4 | 15.3 | 5.1 | 8.8 | 10.5 | 1.6 | 6.2 | 19.4 | 6.3 | 13.1 |
| 14 | -.4 | -2.3 | -1.4 | 7.8 | 1.9 | 4.5 | 7.1 | -1.0 | 1.9 | 7.9 | 1.9 | 4.2 | 14.6 | .4 | 7.9 | 22.2 | 10.6 | 15.7 |
| 15 | 1.6 | -4.3 | -1.6 | 15.3 | 3.6 | 7.3 | 3.1 | -3.0 | -1.0 | 14.7 | 1.2 | 8.1 | 11.4 | 3.9 | 6.9 | 11.1 | 7.4 | 8.9 |
| 16 | 8.7 | -4.5 | -.1 | 9.1 | 1.6 | 5.8 | 12.8 | 2.4 | 7.8 | 20.9 | 9.6 | 13.2 | 16.8 | 3.9 | 10.6 | 11.4 | 5.8 | 8.1 |
| 17 | 13.0 | -3.0 | 3.4 | 1.8 | -1.6 | .1 | 18.0 | 7.3 | 11.9 | 20.0 | 8.0 | 13.8 | 15.0 | 5.8 | 10.0 | 12.3 | 5.3 | 8.9 |
| 18 | 9.2 | -.3 | 4.0 | 10.5 | -1.3 | 3.9 | 7.8 | 1.6 | 4.7 | 16.4 | 7.4 | 11.0 | 9.2 | 3.1 | 5.3 | 7.9 | 7.2 | 7.6 |
| 19 | 9.8 | -4.0 | 2.0 | 6.0 | .6 | 3.1 | 7.5 | .9 | 2.7 | 17.2 | 6.0 | 10.5 | 3.5 | .4 | 2.2 | 11.1 | 4.6 | 8.0 |
| 20 | 8.1 | -1.8 | 2.8 | 10.0 | 1.2 | 4.5 | 13.5 | 1.0 | 7.3 | 17.9 | 8.8 | 13.3 | 6.8 | 2.0 | 4.0 | 10.5 | 3.7 | 5.9 |
| 21 | 8.6 | .9 | 4.3 | 7.8 | 2.7 | 4.8 | 9.5 | .7 | 6.1 | 23.8 | 11.0 | 17.4 | 14.7 | 2.6 | 8.6 | 3.9 | .7 | 2.5 |
| 22 | .2 | -4.9 | -2.9 | 10.0 | .1 | 3.2 | 11.1 | 1.4 | 6.0 | 17.7 | 4.9 | 10.5 | 21.6 | 11.1 | 13.8 | 5.1 | -1.7 | 1.3 |
| 23 | 1.1 | -8.6 | -4.4 | 12.0 | -2.3 | 3.1 | 10.9 | 1.4 | 5.9 | 10.0 | 3.9 | 6.2 | 23.3 | 10.7 | 16.6 | 11.2 | 1.6 | 6.8 |
| 24 | 3.5 | -9.0 | -3.7 | 9.6 | -1.3 | 3.2 | 8.1 | 2.4 | 5.4 | 18.0 | 4.6 | 11.6 | 18.2 | 8.3 | 13.0 | 11.2 | 7.3 | 9.3 |
| 25 | 2.9 | -5.3 | -3.1 | 5.5 | -1.4 | 2.0 | 9.5 | .7 | 6.1 | 11.8 | 5.9 | 8.9 | 11.1 | 6.4 | 7.9 | 14.3 | 8.1 | 10.4 |
| 26 | 6.4 | -6.6 | -.8 | 4.1 | -1.9 | 1.6 | 17.9 | 6.7 | 11.1 | 17.0 | 4.9 | 8.9 | 6.3 | 2.0 | 3.9 | 17.7 | 9.9 | 11.7 |
| 27 | 6.4 | -3.8 | 2.4 | 3.7 | -1.1 | 1.5 | 18.0 | 10.3 | 14.1 | 15.0 | 5.6 | 9.4 | 5.3 | 1.1 | 2.3 | 16.7 | 9.4 | 12.1 |
| 28 | -1.8 | -6.4 | -4.4 | 4.6 | -1.6 | .1 | 21.4 | 12.1 | 15.3 | 12.3 | 7.0 | 9.6 | 12.5 | 2.9 | 7.8 | 11.2 | 4.0 | 7.8 |
| 29 | 9.5 | -6.1 | -.6 | 7.1 | -1.6 | 1.8 | 19.4 | 9.5 | 14.6 | 21.1 | 6.7 | 13.0 | 7.7 | 4.5 | 6.1 | 6.5 | 3.7 | 5.4 |
| 30 | 10.5 | -1.6 | 4.0 | 5.0 | -.8 | .8 | 17.3 | 6.9 | 11.7 | 22.9 | 12.1 | 17.9 | 12.6 | 4.8 | 7.9 | 7.1 | 2.9 | 5.5 |
| 31 | | | | 8.0 | -.9 | 1.5 | | | | 19.2 | 9.5 | 15.2 | 5.3 | -.3 | 3.7 | | | |
| | Monthly average | | | | | | | | | | | | | | | | | |
| | 6.5 | -3.3 | 0.9 | 6.2 | -1.7 | 1.5 | 10.7 | 2.7 | 6.4 | 14.3 | 4.8 | 9.0 | 13.6 | 5.2 | 9.1 | 10.0 | 3.8 | 6.5 |

**Table 5.** Snow depths at South Cascade Glacier, May 7–8, 2000

[X and Y are local coordinates, ±10 meters; depths in meters, ±0.05 meter, measured with a probe rod; surface altitude (Z) in meters; locations mapped on figure 5]

| X | Y | Z | Snow depth (meters) | X | Y | Z | Snow depth (meters) |
|---|---|---|---|---|---|---|---|
| 1,854 | 2,762 | 1,850 | 6.30 | 1,607 | 3,258 | 1,755 | 4.90 |
| 1,812 | 2,823 | 1,845 | 5.90 | 1,619 | 3,314 | 1,738 | 4.95 |
| 1,769 | 2,884 | 1,841 | 7.30 | 1,643 | 3,369 | 1,725 | 5.30 |
| 1,726 | 2,944 | 1,833 | 6.00 | 1,668 | 3,418 | 1,707 | 4.70 |
| 1,684 | 3,005 | 1,825 | 6.20 | 1,686 | 3,472 | 1,694 | 4.25 |
| 1,661 | 3,066 | 1,817 | 5.80 | 1,690 | 3,523 | 1,674 | 2.85 |
| 1,624 | 3,110 | 1,800 | 5.70 | 1,692 | 3,573 | 1,661 | 2.95 |
| 1,602 | 3,158 | 1,792 | 5.35 | 1,686 | 3,637 | 1,651 | 2.35 |
| 1,602 | 3,209 | 1,771 | 5.40 | 1,679 | 3,692 | 1,640 | 2.75 |

**Table 6.** Precipitation (gage catch) at 1,587 meters altitude, Salix Creek gaging station, South Cascade Glacier Basin, 2000 water year

[Precipitation is summed every hour; the daily sum is given in millimeters.–, no data]

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.00 | – | – | – | 0.00 | 0.00 | 0.00 | 6.10 | 0.00 | 7.87 | 0.00 | 0.00 |
| 2 | .00 | – | – | – | .00 | .00 | .00 | 9.65 | .00 | 1.78 | .00 | 7.62 |
| 3 | .00 | – | – | – | .00 | .00 | .00 | 3.30 | .00 | 23.11 | .00 | 1.52 |
| 4 | .00 | – | – | – | .00 | .25 | .00 | .51 | .00 | 6.35 | .00 | .00 |
| 5 | 2.54 | – | – | – | .00 | .00 | .00 | 2.03 | 1.78 | 1.02 | .00 | 3.56 |
| 6 | 4.06 | – | – | – | .00 | .25 | .00 | .51 | 3.05 | .00 | .00 | .00 |
| 7 | 42.67 | – | – | – | .00 | .00 | .00 | .00 | 3.30 | .00 | .00 | 5.59 |
| 8 | 77.72 | – | – | – | .00 | .00 | .00 | .00 | 4.06 | .00 | .00 | 8.64 |
| 9 | 2.79 | – | – | – | .00 | .00 | .00 | 1.78 | 4.57 | 1.52 | .00 | 5.33 |
| 10 | .00 | – | – | – | .00 | .00 | .00 | .00 | 1.27 | .00 | .00 | 3.30 |
| 11 | 4.57 | – | – | – | .00 | .00 | .00 | .00 | 13.72 | .00 | .00 | .00 |
| 12 | 13.21 | – | – | – | .00 | .00 | .00 | .00 | 51.82 | .00 | .00 | .00 |
| 13 | 12.45 | – | – | – | .00 | .00 | 3.30 | .00 | .25 | .00 | .00 | .00 |
| 14 | .00 | – | – | – | .00 | .00 | .00 | .00 | 15.75 | .25 | .00 | .00 |
| 15 | .00 | – | – | – | .00 | .00 | .25 | .00 | 1.02 | .00 | .00 | .51 |
| 16 | – | – | – | – | .00 | .00 | .51 | .00 | .00 | .00 | .00 | .25 |
| 17 | – | – | – | – | .00 | .00 | 1.02 | .00 | .00 | .00 | .00 | 1.78 |
| 18 | – | – | – | – | .00 | .00 | .00 | 4.32 | 10.67 | .00 | 9.65 | 9.91 |
| 19 | – | – | – | – | .00 | .00 | .00 | 4.32 | .51 | .00 | 19.56 | 1.52 |
| 20 | – | – | – | – | .00 | .25 | .00 | .25 | .00 | .00 | .00 | .00 |
| 21 | – | – | – | – | .00 | .00 | 3.30 | 5.33 | 1.52 | .00 | .00 | 3.30 |
| 22 | – | – | – | – | .00 | 1.52 | 3.05 | .76 | .00 | 8.89 | .00 | .00 |
| 23 | – | – | – | – | .00 | .00 | 2.29 | 1.52 | .00 | 5.33 | .00 | .00 |
| 24 | – | – | – | – | .00 | .00 | 1.27 | .00 | 2.29 | .00 | .00 | .00 |
| 25 | – | – | – | – | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 |
| 26 | – | – | – | – | .00 | 2.29 | .00 | 8.38 | .00 | .00 | 20.32 | .00 |
| 27 | – | – | – | – | .00 | .25 | 3.30 | .51 | .00 | .00 | 5.84 | .00 |
| 28 | – | – | – | – | .00 | .00 | .00 | .00 | .00 | 1.78 | .00 | .00 |
| 29 | – | – | – | – | .00 | .25 | 1.02 | .00 | .00 | .00 | 3.81 | 26.16 |
| 30 | – | – | – | – | | .00 | 1.78 | 11.43 | 1.78 | .00 | .25 | 15.49 |
| 31 | – | – | – | – | | .00 | | 5.59 | | .00 | 2.03 | |
| Total | – | – | – | – | – | – | 21.09 | 66.29 | 117.06 | 57.90 | 61.55 | 94.48 |

**Table 7.** Runoff from Salix Creek Basin, 2000 water year

[Daily runoff in millimeters, averaged over the basin; –, no data]

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.0 | 6.3 | – | – | – | – | – | – | – | – | – | – |
| 2 | 1.6 | 5.0 | – | – | – | – | – | – | – | – | – | – |
| 3 | 1.3 | 6.2 | – | – | – | – | – | – | – | – | – | – |
| 4 | 1.1 | 7.7 | – | – | – | – | – | – | – | – | – | – |
| 5 | 1.1 | 4.9 | – | – | – | – | – | – | – | – | – | – |
| 6 | 1.2 | 27.8 | – | – | – | – | – | – | – | – | – | – |
| 7 | 24.7 | 12.4 | – | – | – | – | – | – | – | – | – | – |
| 8 | 46.9 | 14.6 | – | – | – | – | – | – | – | – | – | – |
| 9 | 7.3 | 12.0 | – | – | – | – | – | – | – | – | – | – |
| 10 | 4.4 | 9.9 | – | – | – | – | – | – | – | – | – | – |
| 11 | 4.4 | 43.1 | – | – | – | – | – | – | – | – | – | – |
| 12 | 7.6 | 117.0 | – | – | – | – | – | – | – | – | – | – |
| 13 | 11.7 | 49.4 | – | – | – | – | – | – | – | – | – | – |
| 14 | 6.5 | 22.3 | – | – | – | – | – | – | – | – | – | – |
| 15 | 5.5 | 15.3 | – | – | – | – | – | – | – | – | – | – |
| 16 | 4.5 | 10.8 | – | – | – | – | – | – | – | – | – | – |
| 17 | 3.9 | 9.3 | – | – | – | – | – | – | – | – | – | – |
| 18 | 3.2 | 7.0 | – | – | – | – | – | – | – | – | – | – |
| 19 | 2.8 | 5.7 | – | – | – | – | – | – | – | – | – | – |
| 20 | 2.6 | 5.5 | – | – | – | – | – | – | – | – | – | – |
| 21 | 2.2 | – | – | – | – | – | – | – | – | – | – | – |
| 22 | 2.1 | – | – | – | – | – | – | – | – | – | – | 1.1 |
| 23 | 2.2 | – | – | – | – | – | – | – | – | – | – | 1.0 |
| 24 | 3.4 | – | – | – | – | – | – | – | – | – | – | .85 |
| 25 | 7.4 | – | – | – | – | – | – | – | – | – | – | .75 |
| 26 | 5.4 | – | – | – | – | – | – | – | – | – | – | .67 |
| 27 | 2.7 | – | – | – | – | – | – | – | – | – | – | .61 |
| 28 | 5.4 | – | – | – | – | – | – | – | – | – | – | .62 |
| 29 | 5.0 | – | – | – | | – | – | – | – | – | – | 5.4 |
| 30 | 20.2 | – | – | – | | – | – | – | – | – | – | 41.9 |
| 31 | 8.7 | | – | – | | – | | – | | – | – | |
| Total | 208.9 | – | – | – | – | – | – | – | – | – | – | – |

**Table 8.** Runoff from South Fork Cascade River Basin, 2000 water year

[Daily runoff in millimeters, averaged over the basin; –, no data]

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.90 | – | – | – | – | – | – | – | – | – | – | – |
| 2 | 3.39 | – | – | – | – | – | – | – | – | – | – | – |
| 3 | 3.04 | – | – | – | – | – | – | – | – | – | – | – |
| 4 | 2.84 | – | – | – | – | – | – | – | – | – | – | – |
| 5 | 2.78 | – | – | – | – | – | – | – | – | – | – | – |
| 6 | 2.83 | – | – | – | – | – | – | – | – | – | – | – |
| 7 | 7.93 | – | – | – | – | – | – | – | – | – | – | – |
| 8 | 62.41 | – | – | – | – | – | – | – | – | – | – | – |
| 9 | 31.63 | – | – | – | – | – | – | – | – | – | – | – |
| 10 | 13.20 | – | – | – | – | – | – | – | – | – | – | – |
| 11 | 8.65 | – | – | – | – | – | – | – | – | – | – | – |
| 12 | 7.57 | – | – | – | – | – | – | – | – | – | – | – |
| 13 | 19.09 | – | – | – | – | – | – | – | – | – | – | – |
| 14 | 16.52 | – | – | – | – | – | – | – | – | – | – | – |
| 15 | 10.36 | – | – | – | – | – | – | – | – | – | – | – |
| 16 | – | – | – | – | – | – | – | – | – | – | – | – |
| 17 | – | – | – | – | – | – | – | – | – | – | – | – |
| 18 | – | – | – | – | – | – | – | – | – | – | – | – |
| 19 | – | – | – | – | – | – | – | – | – | – | – | – |
| 20 | – | – | – | – | – | – | – | – | – | – | – | – |
| 21 | – | – | – | – | – | – | – | – | – | – | – | – |
| 22 | – | – | – | – | – | – | – | – | – | – | – | – |
| 23 | – | – | – | – | – | – | – | – | – | – | – | – |
| 24 | – | – | – | – | – | – | – | – | – | – | – | – |
| 25 | – | – | – | – | – | – | – | – | – | – | – | – |
| 26 | – | – | – | – | – | – | – | – | – | – | – | – |
| 27 | – | – | – | – | – | – | – | – | – | – | – | – |
| 28 | – | – | – | – | – | – | – | – | – | – | – | – |
| 29 | – | – | – | – | – | – | – | – | – | – | – | – |
| 30 | – | – | – | – | – | – | – | – | – | – | – | – |
| 31 | – | | – | – | | – | | – | | – | – | |
| Total | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

**Table 9.** Runoff from Middle Tarn Basin, 2000 water year

[Daily runoff in millimeters, averaged over the basin; –, no data]

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.25 | – | – | – | – | – | – | – | – | – | – | – |
| 2 | 2.87 | – | – | – | – | – | – | – | – | – | – | – |
| 3 | 2.63 | – | – | – | – | – | – | – | – | – | – | – |
| 4 | 2.72 | – | – | – | – | – | – | – | – | – | – | – |
| 5 | 3.05 | – | – | – | – | – | – | – | – | – | – | – |
| 6 | 3.24 | – | – | – | – | – | – | – | – | – | – | – |
| 7 | 6.09 | – | – | – | – | – | – | – | – | – | – | – |
| 8 | 6.55 | – | – | – | – | – | – | – | – | – | – | – |
| 9 | 6.57 | – | – | – | – | – | – | – | – | – | – | – |
| 10 | 8.31 | – | – | – | – | – | – | – | – | – | – | – |
| 11 | 6.77 | – | – | – | – | – | – | – | – | – | – | – |
| 12 | 8.20 | – | – | – | – | – | – | – | – | – | – | – |
| 13 | 21.10 | – | – | – | – | – | – | – | – | – | – | – |
| 14 | 10.72 | – | – | – | – | – | – | – | – | – | – | – |
| 15 | 7.40 | – | – | – | – | – | – | – | – | – | – | – |
| 16 | – | – | – | – | – | – | – | – | – | – | – | – |
| 17 | – | – | – | – | – | – | – | – | – | – | – | – |
| 18 | – | – | – | – | – | – | – | – | – | – | – | – |
| 19 | – | – | – | – | – | – | – | – | – | – | – | – |
| 20 | – | – | – | – | – | – | – | – | – | – | – | – |
| 21 | – | – | – | – | – | – | – | – | – | – | – | – |
| 22 | – | – | – | – | – | – | – | – | – | – | – | – |
| 23 | – | – | – | – | – | – | – | – | – | – | – | – |
| 24 | – | – | – | – | – | – | – | – | – | – | – | – |
| 25 | – | – | – | – | – | – | – | – | – | – | – | – |
| 26 | – | – | – | – | – | – | – | – | – | – | – | – |
| 27 | – | – | – | – | – | – | – | – | – | – | – | – |
| 28 | – | – | – | – | – | – | – | – | – | – | – | – |
| 29 | – | – | – | – | – | – | – | – | – | – | – | – |
| 30 | – | – | – | – | | – | – | – | – | – | – | – |
| 31 | – | – | – | – | | – | | – | | – | – | |
| Total | – | – | – | – | – | – | – | – | – | – | – | – |

**Table 10.** Values used to interpolate snow water equivalent at an altitude on South Cascade Glacier, May 7, 2000

[Values in meters]

| Altitude | Snow water equivalent | Altitude | Snow water equivalent |
|---|---|---|---|
| 1,617 | 1.13 | 1,947 | 3.46 |
| 1,644 | 1.49 | 1,991 | 3.60 |
| 1,672 | 1.86 | 2,036 | 3.75 |
| 1,702 | 2.20 | 2,077 | 3.88 |
| 1,735 | 2.49 | 2,122 | 4.02 |
| 1,775 | 2.75 | 2,164 | 4.16 |
| 1,814 | 2.96 | 2,211 | 4.30 |
| 1,859 | 3.15 | 2,254 | 4.44 |
| 1,901 | 3.30 | 1,617 | 1.13 |

**Table 11.** Values used to interpolate net balance at an altitude on South Cascade Glacier, 2000

[Values in meters]

| Altitude | Net balance | Altitude | Net balance |
|---|---|---|---|
| 1,621 | -5.47 | 1,791 | -0.54 |
| 1,634 | -4.91 | 1,828 | -0.11 |
| 1,648 | -4.33 | 1,868 | 0.28 |
| 1,663 | -3.77 | 1,918 | 0.62 |
| 1,678 | -3.19 | 1,967 | 0.86 |
| 1,695 | -2.65 | 2,021 | 1.11 |
| 1,713 | -2.09 | 2,072 | 1.30 |
| 1,732 | -1.55 | 2,131 | 1.46 |
| 1,759 | -1.03 | 2,187 | 1.61 |

**Table 12.** Air temperature at 1,587 meters altitude, Salix Creek gaging station, South Cascade Glacier Basin, 2001 water year

[Daily maximum, minimum, and average air temperature, in degrees Celsius. Air temperature is sampled once an hour at the Salix Creek gaging station.]

| | October | | | November | | | December | | | January | | | February | | | March | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Day** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** |
| 1 | 5.4 | 0.6 | 2.9 | 4.8 | -4.6 | -0.2 | 2.4 | -2.5 | 0.7 | 6.2 | -2.8 | 1.7 | 2.5 | -0.6 | 1.5 | 2.4 | -5.1 | -0.3 |
| 2 | 3.3 | .2 | 1.1 | 5.1 | .3 | 2.2 | 3.5 | -4.6 | -.8 | 10.0 | 1.8 | 7.5 | .3 | -3.7 | -2.5 | -2.5 | -6.7 | -5.3 |
| 3 | 10.2 | -1.0 | 3.1 | 8.4 | 1.4 | 4.9 | .9 | -4.6 | -.9 | 10.3 | -.4 | 4.6 | -1.0 | -5.5 | -4.0 | -2.2 | -9.2 | -5.7 |
| 4 | 12.3 | -.1 | 5.5 | 7.5 | -2.8 | -.2 | 4.4 | .1 | 2.8 | 5.6 | -.8 | 3.0 | .8 | -2.4 | -.4 | .1 | -6.0 | -3.0 |
| 5 | 10.0 | 4.2 | 6.8 | .0 | -2.5 | -1.7 | 7.0 | 4.0 | 5.5 | 2.4 | -2.9 | -.5 | -.1 | -7.4 | -4.2 | 7.1 | .3 | 3.3 |
| 6 | 11.7 | 6.4 | 8.7 | 3.4 | -2.5 | -.7 | 8.9 | 3.0 | 6.2 | 4.2 | -7.1 | .4 | -4.2 | -12.0 | -8.3 | 7.5 | 2.8 | 5.4 |
| 7 | 15.0 | 9.2 | 11.8 | 3.8 | -2.0 | .0 | 3.4 | 1.1 | 2.4 | 3.6 | 1.1 | 2.4 | -5.9 | -11.8 | -9.6 | 10.8 | 4.3 | 6.5 |
| 8 | 13.1 | 8.3 | 10.2 | .7 | -5.0 | -2.7 | 2.5 | -3.4 | -.1 | 2.2 | -2.4 | .4 | .1 | -10.1 | -5.5 | 5.3 | -2.1 | 1.2 |
| 9 | 10.5 | 4.6 | 7.3 | -1.6 | -5.1 | -3.8 | -3.9 | -8.3 | -6.2 | .0 | -4.5 | -2.0 | -1.9 | -6.9 | -4.7 | 4.3 | -3.6 | -1.0 |
| 10 | 5.9 | 3.5 | 4.6 | -4.7 | -8.7 | -6.5 | -7.1 | -14.3 | -9.5 | -.9 | -2.5 | -1.6 | -5.7 | -8.7 | -7.0 | -.5 | -4.5 | -3.0 |
| 11 | 18.5 | 3.5 | 9.2 | -2.2 | -9.5 | -7.1 | -5.6 | -11.4 | -9.1 | .6 | -2.5 | -1.7 | -3.6 | -6.8 | -5.6 | .6 | -4.4 | -2.6 |
| 12 | 11.1 | 2.5 | 4.8 | 3.2 | -8.4 | -4.2 | -4.2 | -8.7 | -6.9 | 2.2 | -3.7 | -2.2 | -1.5 | -6.4 | -4.9 | 3.2 | -3.1 | -.5 |
| 13 | 5.6 | 2.6 | 3.8 | -2.8 | -6.6 | -5.5 | -5.2 | -9.8 | -7.2 | -.3 | -5.6 | -3.6 | 3.3 | -5.0 | -.7 | .9 | -5.0 | -2.0 |
| 14 | 3.5 | -.7 | .9 | 1.4 | -5.8 | -3.5 | -3.1 | -8.7 | -5.8 | -3.6 | -5.9 | -4.7 | 6.2 | -5.0 | .1 | 5.9 | -5.6 | -2.6 |
| 15 | 8.3 | .1 | 3.4 | -.6 | -6.3 | -4.5 | -6.7 | -11.9 | -9.8 | -2.4 | -8.8 | -5.8 | -1.0 | -9.3 | -6.2 | 5.4 | -5.4 | -1.7 |
| 16 | 5.5 | 2.2 | 4.0 | 3.2 | -5.8 | -3.7 | 2.5 | -6.3 | -1.1 | 1.1 | -4.3 | -2.0 | .0 | -9.1 | -4.5 | .3 | -5.0 | -3.4 |
| 17 | 13.0 | 5.5 | 8.5 | 2.5 | -3.6 | -.2 | -3.7 | -7.2 | -4.9 | 3.0 | -2.9 | .0 | 2.4 | -1.9 | .0 | 3.9 | -4.7 | -.6 |
| 18 | 5.3 | 1.4 | 2.8 | 4.5 | -.8 | 2.0 | 7.1 | -7.1 | 1.6 | 4.2 | .7 | 2.0 | -.9 | -3.6 | -2.0 | 3.7 | .1 | 1.8 |
| 19 | 8.6 | .5 | 4.5 | 5.2 | 1.5 | 2.9 | -.4 | -7.5 | -4.6 | 1.1 | -5.2 | -1.8 | .6 | -4.1 | -1.9 | .3 | -6.2 | -3.5 |
| 20 | 8.8 | -1.2 | 3.2 | 7.1 | 2.3 | 4.6 | -3.1 | -6.1 | -4.6 | 1.3 | -3.6 | -.7 | 2.4 | -2.2 | .0 | 5.5 | -4.5 | -1.4 |
| 21 | 1.6 | -3.8 | -1.9 | 6.3 | 1.7 | 3.9 | .4 | -5.9 | -2.3 | .8 | -3.2 | -.7 | 3.0 | -1.2 | .5 | 7.3 | -6.9 | -1.1 |
| 22 | 12.3 | -2.8 | 3.2 | 5.7 | 1.7 | 3.6 | .5 | -1.9 | -.6 | 1.1 | -2.8 | -.4 | 6.0 | -3.2 | -.6 | 11.8 | -.8 | 3.3 |
| 23 | 10.7 | 4.8 | 8.5 | 5.6 | -1.4 | 1.6 | 1.8 | -1.9 | -.3 | 4.3 | -1.5 | .5 | -.4 | -4.0 | -2.7 | 9.3 | 1.8 | 5.9 |
| 24 | 11.1 | 5.6 | 7.6 | .3 | -2.1 | -1.1 | 1.1 | -4.1 | -1.7 | 3.4 | -2.9 | -.5 | .6 | -6.1 | -3.6 | 9.2 | 2.1 | 6.5 |
| 25 | 10.1 | 4.9 | 7.0 | 1.3 | -1.9 | -.2 | 5.9 | -.4 | 2.7 | -.2 | -5.0 | -3.1 | -.6 | -8.2 | -5.2 | 4.7 | -1.9 | 1.2 |
| 26 | 9.4 | 3.4 | 6.0 | -.1 | -3.0 | -1.3 | 7.6 | 2.2 | 5.4 | -1.1 | -5.2 | -3.0 | 2.1 | -6.6 | -2.4 | -.3 | -5.7 | -3.0 |
| 27 | 5.5 | 2.2 | 3.7 | -1.5 | -5.6 | -3.6 | 2.1 | -4.3 | -1.1 | 2.6 | -3.0 | .1 | 4.4 | -1.8 | .7 | 1.2 | -6.9 | -2.9 |
| 28 | 4.4 | -.1 | 1.7 | -3.4 | -7.2 | -4.7 | 5.0 | -.1 | 2.9 | 4.5 | -1.9 | 1.5 | 5.7 | -3.8 | 1.2 | 2.4 | -3.8 | -.8 |
| 29 | 3.4 | -.2 | 1.5 | -.5 | -4.7 | -2.2 | 8.8 | .5 | 5.7 | -1.0 | -6.4 | -4.4 | | | | -.9 | -6.6 | -3.3 |
| 30 | 9.8 | -.2 | 2.1 | 1.5 | -2.2 | -.3 | 4.9 | 1.0 | 2.8 | -2.3 | -5.7 | -3.3 | | | | 4.2 | -4.4 | -.6 |
| 31 | .7 | -3.2 | -.6 | | | | 4.1 | -1.4 | .7 | 2.0 | -2.8 | -.7 | | | | 2.1 | -3.6 | .0 |
| | Monthly average | | | | | | | | | | | | | | | | | |
| | 8.5 | 2.0 | 4.7 | 2.1 | -3.3 | -1.1 | 1.3 | -4.2 | -1.2 | 2.1 | -3.3 | -.6 | 0.5 | -5.6 | -2.9 | 3.6 | -3.6 | -0.4 |

**Table 12**. Air temperature at 1,587 meters altitude, Salix Creek gaging station, South Cascade Glacier Basin, 2001 water year—*Continued*

| | April | | | May | | | June | | | July | | | August | | | September | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Day | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg |
| 1 | 0.3 | -8.1 | -4.1 | 2.5 | -4.1 | -1.6 | 13.6 | -1.1 | 7.0 | 17.6 | 4.9 | 10.5 | 17.7 | 4.8 | 10.9 | 9.9 | 5.0 | 7.4 |
| 2 | 2.3 | -9.1 | -4.6 | 11.3 | -3.3 | 1.8 | 5.7 | -1.4 | 1.1 | 21.5 | 7.6 | 14.0 | 17.1 | 7.5 | 12.2 | 16.5 | 4.8 | 10.2 |
| 3 | 3.9 | -5.6 | -1.8 | 14.7 | -2.7 | 3.9 | 9.2 | -1.3 | 2.6 | 22.5 | 12.3 | 17.0 | 14.4 | 8.9 | 10.8 | 11.9 | 6.0 | 8.5 |
| 4 | 11.4 | -4.6 | .3 | 10.3 | -.2 | 3.9 | 6.1 | .9 | 2.7 | 23.0 | 9.3 | 16.7 | 10.6 | 6.5 | 8.3 | 16.1 | 4.8 | 8.9 |
| 5 | 2.7 | -3.1 | -1.3 | 3.0 | -4.4 | -1.7 | 5.5 | .9 | 2.8 | 15.1 | 5.3 | 10.5 | 18.0 | 5.5 | 10.9 | 6.1 | 3.1 | 4.5 |
| 6 | 3.9 | -4.9 | -2.6 | 14.6 | -6.2 | 2.1 | 11.4 | 2.4 | 5.0 | 15.5 | 4.8 | 10.6 | 19.9 | 10.1 | 12.8 | 7.7 | 3.0 | 4.3 |
| 7 | 5.1 | -7.0 | -2.9 | 12.7 | 2.8 | 8.0 | 10.6 | 5.0 | 8.1 | 20.6 | 7.0 | 13.6 | 18.9 | 8.2 | 12.9 | 15.8 | 3.5 | 8.8 |
| 8 | 7.0 | -6.0 | -2.1 | 9.2 | -.5 | 4.6 | 12.0 | 6.7 | 8.6 | 22.1 | 8.5 | 15.3 | 23.0 | 9.4 | 16.3 | 19.6 | 7.7 | 12.2 |
| 9 | 2.8 | -5.0 | -2.3 | 10.3 | -2.4 | 2.6 | 6.2 | .9 | 3.9 | 23.7 | 11.8 | 17.0 | 24.3 | 14.7 | 18.8 | 20.6 | 8.0 | 12.9 |
| 10 | 6.0 | -4.0 | -1.9 | 11.1 | -1.5 | 4.0 | 6.5 | -.6 | 2.4 | 24.1 | 11.1 | 16.8 | 25.7 | 14.0 | 18.9 | 19.7 | 9.9 | 13.2 |
| 11 | 6.9 | -5.6 | -1.6 | 15.7 | 5.5 | 9.8 | 5.2 | -1.2 | 1.6 | 23.0 | 9.9 | 15.3 | 26.2 | 13.1 | 18.5 | 22.5 | 9.7 | 14.7 |
| 12 | 2.5 | -5.5 | -2.9 | 13.8 | 3.4 | 10.5 | 8.9 | -1.8 | 1.9 | 20.7 | 10.9 | 15.0 | 27.7 | 16.7 | 21.1 | 23.0 | 12.8 | 16.1 |
| 13 | 8.0 | -7.0 | -2.8 | 9.3 | 1.2 | 4.6 | 11.2 | .8 | 5.0 | 19.6 | 7.6 | 13.7 | 26.2 | 15.4 | 19.3 | 25.0 | 13.8 | 17.6 |
| 14 | 13.2 | -7.9 | -.3 | 4.4 | .6 | 2.2 | 5.8 | 2.8 | 3.9 | 17.1 | 5.4 | 11.0 | 27.7 | 15.5 | 20.2 | 25.1 | 14.4 | 17.8 |
| 15 | 5.4 | -1.5 | 2.0 | 13.1 | -.8 | 2.5 | 11.6 | 2.0 | 5.5 | 6.9 | 4.3 | 5.4 | 28.0 | 16.4 | 20.9 | 24.8 | 12.3 | 17.5 |
| 16 | 8.0 | 3.1 | 5.8 | 7.9 | -1.9 | 1.0 | 11.8 | 1.5 | 5.3 | 8.0 | 3.8 | 5.0 | 27.2 | 11.4 | 18.6 | 21.2 | 9.1 | 14.0 |
| 17 | 3.6 | -1.9 | .1 | 10.1 | -1.7 | 1.8 | 11.8 | 1.4 | 5.4 | 8.4 | 3.6 | 5.4 | 18.3 | 8.5 | 11.4 | 19.3 | 4.4 | 10.3 |
| 18 | 6.5 | -2.4 | .5 | 12.4 | -.9 | 3.4 | 13.5 | 2.0 | 7.0 | 7.8 | 4.9 | 6.0 | 11.9 | 5.7 | 8.1 | 12.1 | 3.4 | 6.5 |
| 19 | 10.3 | -3.7 | .5 | 5.5 | -.3 | 1.9 | 14.8 | 7.3 | 11.6 | 13.2 | 5.6 | 9.1 | 14.0 | 5.2 | 9.3 | 9.4 | 3.6 | 5.5 |
| 20 | 7.6 | -.8 | 2.9 | 10.8 | -1.7 | 3.6 | 20.8 | 10.9 | 14.1 | 19.4 | 7.2 | 12.8 | 14.0 | 5.4 | 9.2 | 16.5 | 6.8 | 11.3 |
| 21 | 7.8 | -.5 | 2.0 | 13.9 | 2.0 | 9.3 | 19.9 | 10.1 | 13.7 | 14.7 | 7.5 | 9.8 | 11.3 | 5.8 | 8.9 | 10.4 | 5.9 | 8.5 |
| 22 | 4.2 | -2.0 | .5 | 19.8 | 12.0 | 14.7 | 17.0 | 6.0 | 10.3 | 13.5 | 7.6 | 10.2 | 10.9 | 7.0 | 9.4 | 18.6 | 8.9 | 14.3 |
| 23 | 3.4 | .1 | 1.7 | 18.1 | 11.6 | 14.9 | 11.4 | 2.1 | 7.1 | 20.3 | 7.7 | 13.8 | 7.6 | 5.3 | 6.1 | 22.0 | 13.9 | 16.9 |
| 24 | 12.4 | 1.3 | 7.3 | 14.2 | 8.5 | 10.8 | 10.8 | 1.7 | 5.5 | 14.2 | 7.7 | 11.2 | 14.0 | 4.4 | 8.5 | 22.7 | 13.0 | 16.3 |
| 25 | 12.5 | 4.8 | 9.4 | 14.2 | 7.3 | 10.9 | 14.9 | 1.1 | 7.3 | 19.8 | 6.6 | 13.0 | 22.2 | 7.8 | 14.5 | 20.4 | 6.7 | 12.2 |
| 26 | 13.0 | 6.4 | 9.8 | 14.0 | 8.8 | 11.5 | 10.3 | 7.1 | 8.4 | 20.1 | 8.4 | 13.4 | 24.2 | 11.1 | 16.3 | 10.2 | .1 | 4.8 |
| 27 | 9.9 | 2.2 | 5.6 | 14.1 | 4.5 | 8.3 | 10.9 | 6.9 | 8.7 | 18.1 | 7.9 | 12.1 | 19.9 | 9.2 | 13.8 | 8.3 | -.6 | 4.4 |
| 28 | 6.1 | -2.7 | .6 | 5.2 | -2.8 | 1.2 | 11.6 | 5.1 | 8.0 | 8.3 | 4.0 | 5.9 | 19.3 | 9.1 | 13.4 | 11.2 | 2.3 | 6.1 |
| 29 | 1.6 | -3.2 | -.7 | 10.3 | -3.6 | 2.0 | 18.0 | 2.6 | 9.9 | 10.4 | 3.7 | 6.6 | 23.5 | 10.4 | 16.0 | 11.5 | 5.7 | 9.0 |
| 30 | .4 | -3.7 | -1.4 | 7.9 | -.5 | 4.3 | 20.1 | 5.3 | 12.1 | 13.9 | 3.9 | 8.0 | 22.1 | 12.0 | 15.6 | 16.8 | 9.1 | 13.0 |
| 31 | | | | 15.5 | 7.4 | 12.3 | 10.3 | 7.1 | 8.4 | 12.8 | 5.9 | 8.6 | 14.6 | 8.4 | 11.0 | 10.2 | .1 | 4.8 |
| | Monthly average | | | | | | | | | | | | | | | | | |
| | 6.3 | -2.9 | 0.5 | 11.3 | 1.2 | 5.5 | 11.6 | 2.9 | 6.6 | 16.6 | 7.0 | 11.4 | 19.4 | 9.5 | 13.6 | 16.5 | 7.0 | 10.9 |

**Table 13.** Air temperature at 1,631 meters altitude, Middle Tarn gaging station, South Cascade Glacier Basin, 2001 water year

[Daily maximum, minimum, and average air temperature, in degrees Celsius. Air temperature is sampled once an hour at the Middle Tarn gaging station.]

| | October | | | November | | | December | | | January | | | February | | | March | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Day** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** | **Max** | **Min** | **Avg** |
| 1 | 4.1 | .2 | 2.3 | 4.0 | -5.3 | -1.1 | 0.9 | -3.4 | -0.9 | 7.6 | -4.4 | 1.1 | 2.3 | -.9 | .9 | 1.6 | -5.6 | -1.0 |
| 2 | 1.7 | -.5 | .3 | 4.4 | -.5 | 1.2 | 3.4 | -5.7 | -1.0 | 10.4 | 1.4 | 7.2 | .8 | -4.4 | -3.1 | -4.6 | -7.6 | -6.0 |
| 3 | 4.8 | -1.6 | 1.3 | 7.2 | .7 | 4.3 | 1.9 | -7.0 | -1.5 | 9.9 | -.9 | 3.9 | -1.2 | -7.2 | -4.6 | -2.0 | -10.3 | -6.2 |
| 4 | 9.1 | -1.1 | 3.8 | 7.0 | -3.2 | -.8 | 5.0 | -1.2 | 2.0 | 5.8 | -1.0 | 3.1 | .9 | -2.4 | -.8 | 2.1 | -6.5 | -3.6 |
| 5 | 8.6 | 3.2 | 5.7 | -1.4 | -3.1 | -2.4 | 8.2 | 1.5 | 4.7 | 2.9 | -3.7 | -1.1 | -2.6 | -8.8 | -5.4 | 9.2 | -.2 | 2.7 |
| 6 | 10.0 | 4.8 | 7.4 | 5.4 | -4.5 | -1.6 | 8.6 | 1.2 | 4.8 | 7.2 | -9.5 | -.1 | .2 | -14.1 | -9.0 | 8.6 | 1.9 | 5.2 |
| 7 | 13.0 | 8.8 | 10.2 | 2.9 | -2.5 | -.7 | 3.8 | -.5 | 1.3 | 7.7 | .5 | 4.9 | -1.6 | -15.2 | -10.7 | 10.8 | 3.6 | 6.1 |
| 8 | 10.8 | 6.7 | 8.5 | 2.2 | -6.2 | -3.0 | 1.6 | -3.2 | -1.0 | 3.0 | -2.9 | .2 | -2.5 | -10.7 | -6.6 | 3.7 | -2.8 | .5 |
| 9 | 9.5 | 3.7 | 6.5 | -3.6 | -6.0 | -4.5 | -4.0 | -9.0 | -6.8 | 1.6 | -5.1 | -1.5 | -2.7 | -9.2 | -5.8 | 6.8 | -4.9 | -1.3 |
| 10 | 4.8 | 2.6 | 3.6 | -5.7 | -8.4 | -7.0 | -7.5 | -16.4 | -10.3 | .1 | -3.7 | -1.8 | -6.2 | -9.4 | -7.8 | -2.7 | -5.4 | -3.9 |
| 11 | 13.0 | 2.5 | 7.1 | -1.9 | -11.3 | -7.9 | -7.1 | -12.9 | -9.9 | -.8 | -4.0 | -2.6 | -3.0 | -7.7 | -6.0 | -2.2 | -5.0 | -3.6 |
| 12 | 7.5 | 1.9 | 3.8 | 3.5 | -9.9 | -5.4 | -4.4 | -9.5 | -7.4 | 2.3 | -4.8 | -2.8 | -.6 | -8.4 | -6.0 | .3 | -3.6 | -1.4 |
| 13 | 3.9 | 2.2 | 2.9 | -3.4 | -7.7 | -6.7 | -4.9 | -11.5 | -8.1 | -.9 | -6.6 | -4.1 | 2.7 | -5.9 | -1.8 | .3 | -5.6 | -2.6 |
| 14 | 3.2 | -1.6 | .2 | -.4 | -8.0 | -4.6 | -3.5 | -10.1 | -6.4 | -4.7 | -7.0 | -5.5 | 4.7 | -5.6 | -1.1 | 3.8 | -6.9 | -4.2 |
| 15 | 5.8 | -.8 | 2.2 | -1.8 | -8.2 | -6.0 | -5.3 | -13.4 | -10.3 | -2.4 | -9.9 | -6.7 | -3.5 | -10.5 | -7.2 | 3.3 | -7.3 | -2.9 |
| 16 | 5.5 | 1.9 | 3.7 | 2.2 | -7.6 | -4.6 | 2.5 | -8.6 | -1.5 | 3.5 | -7.4 | -3.3 | -.9 | -10.7 | -5.4 | .8 | -5.5 | -4.1 |
| 17 | 11.9 | 5.4 | 8.4 | 1.6 | -6.1 | -2.1 | -4.5 | -8.3 | -5.6 | 1.9 | -4.8 | -1.1 | 2.6 | -3.3 | -1.1 | 8.3 | -5.0 | -1.0 |
| 18 | 5.1 | 1.3 | 2.6 | 4.8 | -2.3 | 1.2 | 6.4 | -9.1 | .8 | 3.9 | .4 | 1.5 | -.5 | -5.4 | -2.7 | 3.9 | -.3 | 1.8 |
| 19 | 7.6 | -.2 | 3.5 | 4.6 | -.9 | 1.7 | .8 | -9.7 | -5.3 | .9 | -6.3 | -2.4 | -.3 | -5.7 | -2.5 | -.2 | -6.6 | -4.3 |
| 20 | 8.6 | -1.5 | 3.3 | 5.8 | .2 | 3.4 | -3.7 | -6.9 | -5.4 | .7 | -5.4 | -1.6 | 1.2 | -2.4 | -.6 | 2.6 | -5.9 | -2.6 |
| 21 | -.3 | -5.0 | -2.7 | 5.6 | -.8 | 3.2 | 2.3 | -7.9 | -2.6 | .3 | -3.6 | -1.1 | 2.4 | -2.7 | -.3 | 6.2 | -8.4 | -1.9 |
| 22 | 8.0 | -4.7 | 1.7 | 6.4 | -.9 | 2.0 | .7 | -3.0 | -1.1 | 1.1 | -4.4 | -1.5 | 5.1 | -4.3 | -1.3 | 11.8 | -3.3 | 2.0 |
| 23 | 9.9 | 5.6 | 7.6 | 5.0 | -2.0 | 1.1 | .7 | -2.1 | -.8 | 3.1 | -2.5 | .2 | -2.2 | -4.5 | -3.5 | 10.5 | .6 | 5.0 |
| 24 | 8.4 | 3.9 | 5.6 | .1 | -3.0 | -1.6 | .5 | -4.6 | -2.4 | 1.8 | -3.4 | -1.4 | -.6 | -7.0 | -4.5 | 8.7 | 1.5 | 6.3 |
| 25 | 8.9 | 3.8 | 5.2 | 1.0 | -2.0 | -.5 | 5.9 | -1.2 | 2.6 | -.9 | -5.8 | -3.5 | .3 | -9.8 | -6.4 | 5.1 | -2.4 | .7 |
| 26 | 7.8 | 2.3 | 5.0 | -.7 | -3.4 | -1.7 | 7.0 | 2.5 | 5.2 | -1.4 | -6.1 | -4.0 | 1.2 | -9.9 | -4.2 | -1.9 | -6.4 | -4.1 |
| 27 | 4.4 | 1.9 | 2.9 | -3.6 | -6.5 | -4.6 | 1.8 | -6.0 | -1.6 | 1.5 | -4.4 | -1.3 | 9.0 | -5.0 | -.2 | -.4 | -8.6 | -3.7 |
| 28 | 4.2 | -.7 | 1.4 | -3.8 | -8.8 | -6.0 | 4.7 | -.7 | 2.1 | 3.4 | -2.4 | .6 | 3.7 | -6.3 | -.5 | -.1 | -4.5 | -1.8 |
| 29 | 2.6 | -.4 | .8 | -.9 | -5.7 | -3.0 | 7.7 | .1 | 4.6 | -.9 | -7.0 | -4.9 | | | | -2.5 | -8.7 | -4.4 |
| 30 | 4.1 | -1.3 | .7 | 1.0 | -2.4 | -.7 | 4.9 | .3 | 2.2 | -2.8 | -6.3 | -3.7 | | | | 10.2 | -4.5 | -.5 |
| 31 | .9 | -3.3 | -1.0 | | | | 2.8 | -1.5 | .1 | 1.9 | -4.4 | -1.5 | | | | 2.0 | -4.2 | -.3 |
| Monthly average | 6.7 | 1.3 | 3.7 | 1.6 | -4.5 | -1.9 | 1.2 | -5.4 | -1.9 | 2.2 | -4.4 | -1.1 | .3 | -7.0 | -3.9 | 3.4 | -4.5 | -1.1 |

**Table 13**. Air temperature at 1,631 meters altitude, Middle Tarn gaging station, South Cascade Glacier Basin, 2001 water year—*Continued*

| | April | | | May | | | June | | | July | | | August | | | September | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Day | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg |
| 1 | 2.4 | -9.5 | -5.1 | -0.8 | -4.7 | -2.9 | 14.5 | -1.5 | 6.3 | 13.5 | 3.8 | 7.7 | 13.7 | 3.6 | 8.6 | 9.6 | 3.8 | 6.6 |
| 2 | 5.8 | -11.4 | -4.4 | 20.3 | -3.8 | 2.4 | 6.1 | -2.0 | .7 | 15.5 | 5.8 | 10.4 | 12.0 | 6.1 | 9.4 | 13.2 | 3.6 | 7.5 |
| 3 | 6.7 | -6.1 | -1.9 | 10.3 | -3.9 | 1.9 | 9.3 | -1.8 | 2.1 | 17.6 | 10.7 | 13.9 | 12.0 | 7.1 | 9.8 | 9.1 | 4.3 | 7.2 |
| 4 | 15.1 | -7.6 | .2 | 7.8 | -.7 | 3.2 | 8.0 | .3 | 2.1 | 20.3 | 7.4 | 13.4 | 8.5 | 4.7 | 7.1 | 10.5 | 4.0 | 6.7 |
| 5 | .3 | -3.6 | -2.0 | -.2 | -6.1 | -3.1 | 7.4 | .3 | 2.8 | 13.0 | 4.2 | 8.2 | 13.0 | 4.9 | 8.9 | 5.6 | 2.4 | 3.7 |
| 6 | 3.7 | -5.5 | -3.1 | 15.4 | -7.7 | 2.2 | 8.5 | 1.7 | 4.1 | 14.0 | 3.8 | 8.4 | 13.3 | 8.1 | 10.3 | 5.5 | 2.5 | 3.4 |
| 7 | 7.0 | -8.5 | -3.9 | 14.0 | 2.0 | 7.1 | 10.6 | 3.8 | 7.0 | 17.2 | 5.6 | 10.2 | 15.9 | 4.5 | 9.4 | 11.2 | 2.8 | 6.1 |
| 8 | 3.3 | -6.5 | -3.5 | 7.8 | -.8 | 3.1 | 10.6 | 5.4 | 7.5 | 16.2 | 7.5 | 11.3 | 17.0 | 8.2 | 13.7 | 16.3 | 6.0 | 9.9 |
| 9 | -1.1 | -6.6 | -3.6 | 12.5 | -3.2 | 1.3 | 5.8 | .4 | 3.0 | 19.6 | 9.9 | 13.1 | 19.6 | 12.1 | 15.3 | 14.5 | 6.1 | 9.4 |
| 10 | 5.7 | -4.7 | -2.6 | 14.2 | -3.7 | 4.0 | 4.5 | -1.1 | 1.6 | 18.2 | 9.3 | 13.0 | 22.5 | 11.7 | 15.1 | 16.0 | 7.1 | 10.6 |
| 11 | 5.6 | -6.3 | -2.4 | 15.3 | 3.7 | 8.6 | 3.7 | -1.8 | .8 | 18.0 | 7.6 | 11.6 | 20.3 | 9.8 | 14.1 | 14.2 | 8.6 | 11.3 |
| 12 | 5.5 | -6.9 | -3.9 | 13.1 | 2.9 | 9.6 | 15.3 | -2.3 | 2.3 | 16.6 | 9.0 | 11.9 | 19.3 | 13.8 | 16.3 | 17.8 | 9.9 | 12.4 |
| 13 | 3.4 | -8.7 | -4.6 | 9.7 | .6 | 4.3 | 11.7 | .1 | 4.5 | 17.0 | 6.2 | 11.1 | 20.1 | 13.2 | 15.5 | 19.4 | 11.3 | 14.1 |
| 14 | 10.9 | -9.9 | -1.7 | 4.6 | .2 | 2.1 | 4.3 | 2.0 | 2.9 | 13.5 | 3.4 | 8.3 | 20.7 | 12.0 | 15.8 | 17.5 | 11.1 | 13.7 |
| 15 | 5.4 | -2.1 | 1.6 | 10.7 | -1.4 | 2.6 | 11.0 | 1.1 | 4.6 | 5.9 | 3.5 | 4.4 | 18.6 | 12.6 | 15.9 | 16.7 | 9.9 | 13.3 |
| 16 | 7.6 | 2.4 | 5.2 | 4.3 | -2.5 | -.2 | 8.3 | .8 | 3.8 | 5.9 | 3.1 | 3.9 | 21.1 | 8.9 | 14.4 | 14.2 | 7.7 | 10.0 |
| 17 | 5.1 | -2.0 | .0 | 11.9 | -2.6 | 1.1 | 9.9 | .4 | 4.0 | 7.1 | 2.7 | 4.6 | 12.4 | 6.9 | 9.0 | 12.1 | 3.2 | 8.0 |
| 18 | 8.2 | -3.0 | .0 | 17.0 | -1.5 | 3.0 | 10.3 | 1.0 | 5.4 | 6.0 | 3.8 | 4.8 | 7.8 | 4.6 | 6.6 | 8.4 | 2.2 | 4.8 |
| 19 | 9.0 | -5.2 | .4 | 2.8 | -.8 | .9 | 12.5 | 6.1 | 10.1 | 9.3 | 4.3 | 6.7 | 11.8 | 4.6 | 7.5 | 9.9 | 2.9 | 4.7 |
| 20 | 16.6 | -.7 | 2.9 | 10.6 | -2.9 | 3.4 | 15.1 | 8.3 | 11.1 | 15.9 | 5.8 | 9.7 | 13.1 | 3.6 | 7.4 | 13.7 | 4.9 | 8.9 |
| 21 | 15.2 | -1.7 | 1.4 | 14.9 | .2 | 8.5 | 17.3 | 7.3 | 11.2 | 11.0 | 5.9 | 7.7 | 11.0 | 5.0 | 8.1 | 9.3 | 4.9 | 6.9 |
| 22 | .9 | -2.5 | -.6 | 19.1 | 9.8 | 13.0 | 13.3 | 4.7 | 7.9 | 9.1 | 5.8 | 7.6 | 10.2 | 5.9 | 8.9 | 15.7 | 8.1 | 12.1 |
| 23 | 2.6 | -.2 | 1.2 | 16.3 | 9.3 | 12.6 | 10.1 | 1.8 | 5.5 | 17.8 | 5.7 | 10.9 | 6.9 | 4.8 | 5.6 | 19.4 | 11.5 | 13.7 |
| 24 | 14.8 | 1.3 | 6.7 | 13.0 | 5.9 | 9.1 | 7.0 | 1.2 | 3.9 | 12.7 | 6.3 | 9.2 | 10.4 | 4.1 | 6.9 | 14.8 | 10.9 | 12.4 |
| 25 | 13.7 | 3.3 | 8.6 | 13.3 | 5.8 | 9.5 | 10.4 | .6 | 5.5 | 17.1 | 4.8 | 10.0 | 14.4 | 6.5 | 10.6 | 15.5 | 6.2 | 10.0 |
| 26 | 11.1 | 4.7 | 8.6 | 12.9 | 6.8 | 9.5 | 9.7 | 6.3 | 7.5 | 17.5 | 6.9 | 10.7 | 14.9 | 9.3 | 12.1 | 7.7 | -.6 | 4.1 |
| 27 | 9.5 | 1.6 | 4.8 | 12.8 | 3.3 | 6.7 | 10.7 | 5.1 | 8.2 | 14.8 | 5.8 | 9.7 | 15.6 | 7.2 | 10.6 | 7.1 | -.7 | 3.5 |
| 28 | 3.7 | -3.2 | -.4 | 5.2 | -3.5 | .6 | 11.5 | 3.3 | 6.4 | 8.1 | 3.2 | 5.1 | 12.2 | 7.5 | 9.5 | 8.2 | 1.4 | 4.4 |
| 29 | 1.1 | -3.7 | -1.2 | 8.5 | -3.6 | .4 | 12.8 | 1.4 | 7.0 | 8.2 | 2.8 | 4.9 | 17.5 | 8.2 | 12.8 | 10.2 | 4.1 | 7.4 |
| 30 | .0 | -4.4 | -1.9 | 8.4 | -1.5 | 3.9 | 14.2 | 4.2 | 8.8 | 9.8 | 3.2 | 6.3 | 17.1 | 9.1 | 11.6 | 14.4 | 8.0 | 11.5 |
| 31 | | | | 18.6 | 5.6 | 11.8 | | | | 10.2 | 4.3 | 6.5 | 11.8 | 8.0 | 9.9 | | | |
| | Monthly average | | | | | | | | | | | | | | | | | |
| | 6.6 | -3.9 | -.2 | 11.1 | 0.0 | 4.5 | 10.1 | 1.9 | 5.3 | 13.4 | 5.6 | 8.9 | 14.7 | 7.6 | 10.9 | 12.6 | 5.6 | 8.6 |

**Table 14.** Air temperature at 1,842 meters altitude, the Hut, South Cascade Glacier Basin, 2001 water year

[Daily maximum, minimum, and average air temperature, in degrees Celsius. Air temperature is sampled once an hour at the Hut.]

| | October | | | November | | | December | | | January | | | February | | | March | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Day | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg |
| 1 | 2.5 | -1.9 | 0.4 | 2.4 | -7.2 | -2.6 | 0.3 | -5.9 | -2.6 | 5.0 | -4.9 | 0.6 | -1.4 | -3.4 | -2.1 | 0.7 | -7.4 | -2.2 |
| 2 | .1 | -2.1 | -1.4 | 2.4 | -1.4 | .0 | 1.2 | -6.0 | -2.8 | 8.1 | -1.0 | 4.7 | -1.4 | -6.2 | -4.9 | -5.5 | -9.3 | -7.8 |
| 3 | 3.7 | -3.9 | -.6 | 6.3 | -.3 | 3.1 | -.5 | -7.1 | -2.6 | 7.9 | -2.5 | 2.5 | -3.6 | -7.9 | -6.5 | -5.3 | -10.7 | -8.4 |
| 4 | 5.6 | -2.5 | 2.2 | 4.2 | -5.2 | -2.1 | 4.9 | -2.9 | 1.7 | 3.0 | -2.1 | 1.0 | -1.3 | -4.0 | -2.8 | -2.7 | -8.8 | -6.0 |
| 5 | 6.1 | 1.4 | 3.7 | -3.0 | -4.7 | -4.1 | 6.4 | 2.1 | 4.6 | .2 | -4.8 | -2.5 | -4.1 | -9.8 | -6.8 | 6.5 | -3.2 | 1.2 |
| 6 | 7.1 | 2.4 | 4.6 | -.3 | -4.6 | -3.3 | 8.1 | .5 | 4.4 | 2.1 | -8.9 | -3.0 | -7.8 | -12.5 | -10.4 | 5.2 | 2.0 | 3.2 |
| 7 | 11.6 | 6.5 | 9.2 | -.7 | -3.9 | -2.9 | 2.1 | -1.0 | .5 | 2.3 | -2.3 | -.1 | -7.1 | -13.4 | -11.5 | 9.2 | 2.4 | 4.8 |
| 8 | 10.6 | 6.4 | 8.6 | -1.3 | -7.0 | -5.0 | .1 | -5.5 | -2.2 | .8 | -4.5 | -1.9 | -4.3 | -12.2 | -8.7 | 3.3 | -3.9 | -1.0 |
| 9 | 8.2 | 2.6 | 5.8 | -5.9 | -8.0 | -6.7 | -5.7 | -10.5 | -8.7 | -2.6 | -6.5 | -4.7 | -4.7 | -9.5 | -7.8 | 2.0 | -5.4 | -3.0 |
| 10 | 4.7 | 2.0 | 2.8 | -8.2 | -10.9 | -9.4 | -9.5 | -15.7 | -11.5 | -3.2 | -5.7 | -4.1 | -8.2 | -12.1 | -9.8 | -4.3 | -6.5 | -5.6 |
| 11 | 12.5 | 1.9 | 8.2 | -5.4 | -12.6 | -9.2 | -9.5 | -13.3 | -12.0 | -3.1 | -5.4 | -4.4 | -7.9 | -9.8 | -8.8 | -3.5 | -6.4 | -5.1 |
| 12 | 8.8 | .8 | 4.3 | 1.1 | -8.4 | -4.9 | -5.3 | -11.0 | -8.5 | -3.2 | -6.1 | -4.7 | -3.6 | -9.4 | -7.2 | -1.3 | -5.1 | -2.8 |
| 13 | 2.8 | .4 | 1.4 | -5.8 | -9.4 | -8.4 | -6.7 | -12.2 | -9.1 | -3.6 | -7.4 | -5.9 | -.3 | -5.9 | -3.0 | -1.8 | -7.2 | -4.4 |
| 14 | 1.8 | -4.3 | -1.4 | -3.4 | -8.9 | -6.7 | -5.2 | -11.0 | -8.1 | -6.3 | -7.9 | -7.0 | -.7 | -7.1 | -2.7 | -3.0 | -7.8 | -6.3 |
| 15 | 5.3 | -3.1 | 1.3 | -2.0 | -9.2 | -6.3 | -7.0 | -13.9 | -11.9 | -3.6 | -10.0 | -7.0 | -5.0 | -12.5 | -8.8 | -1.3 | -7.6 | -5.0 |
| 16 | 2.9 | .3 | 1.7 | -1.0 | -6.6 | -4.2 | -.3 | -9.8 | -3.4 | 2.6 | -7.0 | -2.6 | -2.3 | -12.3 | -8.0 | -1.8 | -7.2 | -5.8 |
| 17 | 9.2 | 3.0 | 5.9 | 3.4 | -3.4 | -.7 | -5.9 | -9.2 | -7.1 | -.2 | -5.3 | -2.0 | -.2 | -4.9 | -3.0 | 1.6 | -6.8 | -2.9 |
| 18 | 3.2 | -1.3 | .3 | 3.7 | -2.2 | .8 | -.1 | -10.0 | -2.6 | 2.0 | -1.4 | .0 | -2.8 | -6.2 | -4.4 | .7 | -2.2 | -.4 |
| 19 | 4.7 | -2.5 | 1.6 | 4.7 | -.4 | 1.9 | -5.1 | -10.0 | -7.4 | -1.5 | -7.4 | -4.3 | -2.8 | -6.6 | -4.6 | -1.9 | -8.7 | -6.3 |
| 20 | 5.9 | -3.1 | 1.3 | 4.6 | .6 | 2.7 | -6.1 | -9.5 | -8.1 | -1.5 | -5.7 | -3.2 | -.9 | -4.7 | -2.8 | -.3 | -6.7 | -4.3 |
| 21 | -3.2 | -6.6 | -4.6 | 4.1 | .6 | 2.5 | -1.8 | -9.5 | -5.6 | -1.3 | -5.2 | -2.7 | -.6 | -4.3 | -1.8 | 3.3 | -8.6 | -2.9 |
| 22 | 6.6 | -5.5 | .9 | 6.0 | .4 | 3.0 | -1.0 | -5.1 | -2.8 | -1.5 | -4.0 | -2.8 | 2.7 | -4.9 | -2.8 | 4.4 | -2.7 | .7 |
| 23 | 8.7 | 5.3 | 7.4 | 3.0 | -3.5 | -.2 | -.8 | -3.9 | -2.5 | .5 | -3.9 | -1.6 | -4.1 | -6.1 | -5.3 | 7.6 | .3 | 4.7 |
| 24 | 10.7 | 3.0 | 6.4 | -1.4 | -5.5 | -3.6 | -2.4 | -5.5 | -4.1 | -.2 | -5.1 | -3.1 | -5.1 | -7.6 | -6.2 | 6.2 | .7 | 4.1 |
| 25 | 10.8 | 2.4 | 5.7 | -.8 | -4.3 | -2.5 | 3.6 | -1.7 | .7 | -3.6 | -7.2 | -5.6 | -2.8 | -10.3 | -7.1 | 2.5 | -4.3 | -1.2 |
| 26 | 6.0 | 1.2 | 4.2 | -2.6 | -5.0 | -3.5 | 5.2 | .4 | 2.9 | -.9 | -8.1 | -5.3 | 1.8 | -8.9 | -3.6 | -3.6 | -7.9 | -6.1 |
| 27 | 2.7 | .2 | 1.4 | -5.1 | -7.8 | -6.1 | .1 | -6.6 | -3.5 | 4.5 | -3.7 | -.9 | 7.4 | -2.7 | .1 | -2.5 | -8.7 | -5.6 |
| 28 | 1.6 | -2.2 | -.5 | -7.0 | -8.9 | -7.8 | 4.1 | -3.5 | .1 | 2.1 | -2.4 | -.4 | 2.9 | -6.1 | -.9 | -2.0 | -6.1 | -3.5 |
| 29 | .8 | -2.2 | -1.1 | -2.4 | -7.8 | -5.2 | 7.2 | -1.0 | 4.3 | -3.6 | -8.7 | -6.7 | | | | -4.7 | -8.5 | -5.9 |
| 30 | 4.6 | -2.7 | -.5 | -.8 | -4.1 | -2.8 | 3.7 | -.4 | 1.0 | -4.3 | -8.2 | -5.7 | | | | .6 | -5.9 | -3.6 |
| 31 | -1.4 | -4.7 | -2.7 | | | | .8 | -3.5 | -1.7 | -1.5 | -4.4 | -3.3 | | | | .2 | -5.8 | -2.1 |
| | Monthly average | | | | | | | | | | | | | | | | | |
| | 5.3 | -0.3 | 2.5 | -0.4 | -5.3 | -3.1 | -0.8 | -6.5 | -3.5 | -0.1 | -5.4 | -2.8 | -2.4 | -7.9 | -5.4 | 0.3 | -5.6 | -2.9 |

**Table 14**. Air temperature at 1,842 meters altitude, the Hut, South Cascade Glacier Basin, 2001 water year—*Continued*

| | April | | | May | | | June | | | July | | | August | | | September | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Day | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg |
| 1 | -1.3 | -10.1 | -6.7 | -3.3 | -6.1 | -4.9 | 12.1 | -2.8 | 5.4 | 13.5 | 2.1 | 7.8 | 15.3 | 4.1 | 9.2 | 6.7 | 2.6 | 4.9 |
| 2 | .3 | -10.7 | -6.4 | 3.4 | -5.3 | -2.1 | 2.0 | -3.8 | -1.4 | 17.8 | 5.1 | 11.8 | 15.9 | 5.9 | 10.1 | 15.8 | 2.2 | 7.8 |
| 3 | .7 | -7.8 | -5.0 | 8.7 | -4.0 | 1.4 | 4.2 | -3.5 | -.3 | 23.1 | 10.1 | 16.7 | 11.9 | 6.4 | 9.1 | 8.5 | 3.4 | 5.9 |
| 4 | .9 | -7.5 | -3.8 | 8.3 | -2.4 | 1.7 | 5.0 | -1.3 | .7 | 21.7 | 7.8 | 16.2 | 6.8 | 3.8 | 5.8 | 11.1 | 3.3 | 6.5 |
| 5 | -1.8 | -5.5 | -4.0 | -4.2 | -6.8 | -5.3 | 6.9 | -.6 | 1.8 | 11.3 | 3.1 | 7.4 | 14.0 | 2.9 | 8.3 | 3.8 | .8 | 2.1 |
| 6 | -.6 | -7.1 | -5.2 | 10.0 | -7.5 | -.4 | 10.7 | .3 | 3.0 | 11.7 | 2.4 | 7.3 | 16.3 | 8.3 | 10.7 | 3.7 | .7 | 1.9 |
| 7 | -.2 | -8.7 | -6.4 | 11.3 | 1.2 | 5.7 | 11.8 | 2.9 | 7.5 | 17.4 | 4.7 | 11.0 | 14.8 | 6.0 | 10.2 | 9.9 | 1.2 | 4.8 |
| 8 | -3.2 | -8.2 | -6.0 | 3.1 | -2.3 | .9 | 11.2 | 4.6 | 7.3 | 19.4 | 7.6 | 13.0 | 18.1 | 7.0 | 13.1 | 14.4 | 5.6 | 10.1 |
| 9 | -4.3 | -7.2 | -5.5 | 4.9 | -5.0 | -.9 | 6.4 | -.9 | 1.5 | 22.9 | 9.1 | 15.5 | 25.0 | 12.6 | 16.9 | 17.1 | 4.6 | 10.6 |
| 10 | -.5 | -7.3 | -5.2 | 8.6 | -4.5 | 1.9 | 3.6 | -2.9 | .1 | 21.4 | 9.8 | 14.8 | 21.8 | 13.2 | 17.6 | 15.0 | 7.1 | 10.6 |
| 11 | -.9 | -7.9 | -5.7 | 14.4 | 3.9 | 9.3 | 1.8 | -3.1 | -.5 | 18.3 | 7.2 | 12.9 | 21.7 | 11.4 | 16.4 | 18.8 | 7.4 | 12.8 |
| 12 | -1.1 | -7.2 | -5.5 | 16.3 | 2.1 | 10.2 | 3.3 | -3.8 | -.6 | 18.3 | 8.7 | 12.5 | 23.8 | 17.0 | 19.8 | 19.4 | 11.1 | 14.3 |
| 13 | -1.9 | -9.5 | -7.1 | 10.0 | -.2 | 3.3 | 11.6 | -1.3 | 4.3 | 17.0 | 6.7 | 11.7 | 22.9 | 15.2 | 18.4 | 21.3 | 13.0 | 16.1 |
| 14 | 3.2 | -9.7 | -4.0 | 3.7 | -1.3 | .9 | 2.4 | .7 | 1.6 | 12.4 | 3.8 | 8.3 | 24.3 | 12.1 | 18.6 | 21.6 | 10.9 | 16.3 |
| 15 | 3.3 | -4.5 | -.9 | 9.3 | -3.1 | .5 | 7.3 | -.1 | 3.0 | 5.2 | 2.3 | 3.4 | 23.8 | 16.6 | 20.2 | 19.9 | 11.1 | 16.2 |
| 16 | 5.3 | .0 | 3.0 | -.2 | -3.9 | -2.5 | 6.1 | -1.3 | 2.1 | 4.2 | 1.6 | 2.4 | 25.3 | 11.4 | 18.9 | 16.6 | 8.0 | 12.2 |
| 17 | 1.2 | -4.0 | -1.7 | 3.4 | -4.3 | -1.7 | 8.7 | -1.6 | 3.1 | 6.3 | 1.5 | 3.0 | 15.4 | 6.6 | 10.1 | 13.9 | 4.6 | 8.7 |
| 18 | 2.4 | -4.2 | -2.1 | 6.5 | -2.9 | -.1 | 10.2 | -.6 | 4.7 | 5.0 | 2.8 | 3.7 | 6.8 | 3.7 | 5.3 | 7.3 | 1.1 | 4.1 |
| 19 | 5.5 | -5.7 | -1.6 | .0 | -2.6 | -1.1 | 15.7 | 4.7 | 10.6 | 9.9 | 3.6 | 6.5 | 10.0 | 2.6 | 6.1 | 7.1 | 1.4 | 3.2 |
| 20 | 9.2 | -2.1 | 1.3 | 6.8 | -4.2 | 1.1 | 19.1 | 9.5 | 13.7 | 16.1 | 5.3 | 10.3 | 11.5 | 2.5 | 6.3 | 12.7 | 3.7 | 9.1 |
| 21 | 4.9 | -2.8 | -.6 | 17.7 | -.9 | 9.5 | 18.6 | 7.4 | 12.3 | 10.9 | 6.3 | 7.6 | 9.5 | 3.5 | 6.8 | 7.8 | 3.5 | 6.2 |
| 22 | -.8 | -4.0 | -2.7 | 21.7 | 11.1 | 14.8 | 12.6 | 4.2 | 8.1 | 10.4 | 6.3 | 7.9 | 8.7 | 5.5 | 7.5 | 15.2 | 6.6 | 11.4 |
| 23 | 1.1 | -2.4 | -.5 | 19.4 | 11.2 | 15.5 | 8.1 | .3 | 4.5 | 16.7 | 6.3 | 11.8 | 5.2 | 2.9 | 3.8 | 18.2 | 12.3 | 14.8 |
| 24 | 10.9 | -.2 | 5.3 | 14.4 | 6.7 | 9.8 | 7.7 | -.6 | 2.8 | 12.1 | 4.9 | 8.8 | 10.8 | 1.7 | 5.8 | 18.3 | 12.6 | 14.6 |
| 25 | 14.4 | 2.9 | 8.9 | 15.2 | 5.5 | 10.5 | 10.3 | -1.0 | 4.6 | 16.4 | 3.4 | 10.5 | 17.9 | 5.8 | 12.0 | 15.7 | 4.9 | 10.8 |
| 26 | 14.1 | 4.1 | 8.7 | 17.8 | 6.4 | 12.2 | 8.0 | 4.2 | 5.7 | 15.7 | 6.1 | 10.9 | 20.4 | 11.5 | 15.3 | 6.5 | -1.9 | 3.0 |
| 27 | 9.9 | -.6 | 3.9 | 15.0 | 2.6 | 7.3 | 8.8 | 4.9 | 6.3 | 13.5 | 6.0 | 9.2 | 15.6 | 7.4 | 11.0 | 4.6 | -2.9 | 1.6 |
| 28 | .8 | -5.5 | -2.5 | 3.3 | -4.9 | -.7 | 8.5 | 3.2 | 5.4 | 6.1 | 2.2 | 3.7 | 14.1 | 7.8 | 10.7 | 6.8 | -.6 | 3.1 |
| 29 | .7 | -6.1 | -3.1 | .7 | -5.1 | -2.5 | 14.8 | .6 | 8.1 | 7.7 | 1.5 | 4.0 | 19.9 | 9.5 | 14.7 | 8.8 | 4.0 | 6.7 |
| 30 | -1.3 | -5.8 | -3.8 | 7.7 | -3.2 | 2.2 | 17.1 | 5.3 | 9.8 | 12.1 | 3.4 | 6.6 | 17.4 | 10.2 | 13.4 | 13.9 | 7.0 | 10.1 |
| 31 | | | | 16.2 | 4.8 | 11.1 | | | | 9.2 | 3.6 | 6.4 | 10.8 | 5.9 | 8.6 | | | |
| | Monthly average | | | | | | | | | | | | | | | | | |
| | 2.4 | -5.2 | -2.2 | 8.7 | -08 | 3.5 | 9.2 | 0.8 | 4.5 | 13.7 | 5.0 | 9.1 | 16.0 | 7.8 | 11.6 | 12.7 | 5.0 | 8.7 |

**Table 15.** South Cascade Glacier altitude grid, 2001

[Surface altitude (Z), in meters, was measured near the central point for each grid cell. Coordinates X and Y, in meters, are local, ±2 meters; Z is accurate to ±2 meters.]

| X | Y | Z | X | Y | Z | X | Y | Z | X | Y | Z | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,369 | 2,801 | 1,893 | 1,770 | 2,400 | 1,890 | 19,72 | 2,700 | 1,847 | 2,170 | 2,899 | 1,831 | 2,471 | 1,700 | 2,032 |
| 1,472 | 2,502 | 1,898 | 1,770 | 2,502 | 1,878 | 1,970 | 2,799 | 1,842 | 2,169 | 3001, | 1,824 | 2,470 | 17,99 | 2,026 |
| 1,470 | 2,700 | 1,868 | 1,771 | 2,602 | 1,865 | 1,969 | 2,899 | 1,840 | 2,171 | 3,101 | 1,807 | 2,470 | 1,900 | 2,008 |
| 1,470 | 2799, | 1,861 | 1,770 | 2701, | 1,854 | 1,969 | 3,001 | 1,834 | 2,170 | 3,201 | 1,759 | 2,470 | 2,001 | 1,980 |
| 1,471 | 2,899 | 1,847 | 1772, | 2,799 | 1,846 | 1,972 | 3,100 | 1,824 | 2,269 | 1,401 | 2,073 | 2,470 | 2,099 | 1,969 |
| 1,470 | 3,001 | 1,832 | 1,770 | 2901, | 1,838 | 1,970 | 3,201 | 1,784 | 2,270 | 1,502 | 2,035 | 2,471 | 2,201 | 1,957 |
| 1,470 | 3,100 | 1,811 | 1,768 | 2,999 | 1,829 | 2,072 | 1,600 | 2,026 | 2,271 | 1,600 | 2,020 | 2,471 | 2,302 | 1,954 |
| 1,470 | 3,200 | 1,773 | 1,770 | 3,100 | 1,814 | 2,072 | 1,700 | 1,994 | 2,270 | 1,701 | 2,012 | 2,469 | 2,402 | 1,954 |
| 1,569 | 2,297 | 1,927 | 1,768 | 3,201 | 1,782 | 2,069 | 1,803 | 1,978 | 2,270 | 1,800 | 2,004 | 2,570 | 1,400 | 2,057 |
| 1,572 | 2,399 | 1,897 | 1,769 | 3,300 | 1,723 | 2,069 | 1,901 | 1,965 | 2,271 | 1,899 | 1,985 | 2,569 | 1,501 | 2,048 |
| 1,569 | 2,499 | 1,876 | 1,769 | 3,400 | 1,690 | 2,071 | 2,000 | 1,954 | 2,270 | 2,000 | 1,955 | 2,571 | 1,600 | 2,045 |
| 1,570 | 2,602 | 1,865 | 1,770 | ,3500 | 1,659 | 2,069 | 2,101 | 1,943 | 2,271 | 2,100 | 1,952 | 2,572 | 1,700 | 2,042 |
| 1,570 | 2,700 | 1,854 | 1,770 | 3,600 | 1,636 | 2,070 | ,2200 | 1,935 | 2,272 | 2,198 | 1,947 | 2,571 | 1,801 | 2,035 |
| 1,571 | 2,800 | 1,849 | 1,871 | 1,799 | 2,001 | 2,070 | 2,298 | 1,926 | 2,270 | 2,301 | 1,938 | 2,571 | 2,099 | 2,006 |
| 1,572 | 2,900 | 1,839 | 1,871 | 1,899 | 1,984 | 2,070 | 2,401 | 1,909 | 2,270 | 2,399 | 1,928 | 2,571 | 2,299 | 2,001 |
| 1,570 | 2,999 | 1,825 | 1,872 | 2,001 | 1,963 | 2,069 | 2,500 | 1,882 | 2,271 | 2,500 | 1,910 | 2,671 | 1,399 | 2,087 |
| 1,570 | 3,099 | 1,806 | 1,870 | 2,101 | 1,939 | 2,071 | 2,602 | 1,858 | 2,271 | 2,601 | 1,886 | 2,670 | 1,501 | 2,061 |
| 1,569 | 3,198 | 1,771 | 1,871 | 2,200 | 1,920 | 2069 | 2,699 | 1,843 | 2,270 | 2,701 | 1,854 | 2,669 | 1,600 | 2,056 |
| 1,570 | 3,300 | 1,738 | 1,871 | 2,300 | 1,908 | 2070, | 2,799 | 1,839 | 2,271 | 2,800 | 1,833 | 2,670 | 1,699 | 2,052 |
| 1,570 | 3,399 | 1,707 | 1,870 | 2,400 | 1,895 | 2,071 | 2,900 | 1,836 | 2,269 | 2,899 | 1,826 | 2,671 | 1,801 | 2,051 |
| 1,669 | 2,199 | 1,929 | 1,870 | 2,498 | 1,875 | 2,072 | 2,999 | 1,831 | 2,269 | 3,001 | 1,820 | 2,772 | 1,402 | 2,108 |
| 1,669 | 2,301 | 1,905 | 1,870 | 2,601 | 1,860 | 2,070 | 3,101 | 1,818 | 2,369 | 1,399 | 2,057 | 2,770 | 1,500 | 2,072 |
| 1,671 | 2,401 | 1,890 | 1,870 | 2,701 | 1,850 | 2,072 | 3,201 | 1,769 | 2,369 | 1,500 | 2,035 | 2,769 | 1,601 | 2,067 |
| 1,669 | 2,500 | 1,879 | 1,870 | 2,799 | 1,844 | 2,068 | 3,301 | 1,718 | 2,371 | 1,601 | 2,027 | 2,770 | 1,699 | 2,063 |
| 1,670 | 2,600 | 1,865 | 1,870 | 2,899 | 1,840 | 2,170 | 1,502 | 2,043 | 2,369 | 1,699 | 2,024 | 2,770 | 1,801 | 2,068 |
| 1,671 | 2,701 | 1,854 | 1,871 | 3,000 | 1,834 | 2,171 | 1,600 | 2,015 | 2,370 | 1,800 | 2,009 | 2,870 | 1,500 | 2,090 |
| 1,671 | 28,00 | 1,846 | 1,870 | 3,101 | 1,821 | 2,171 | 1,701 | 2,003 | 2,370 | 1,900 | 1,988 | 2,869 | 1,600 | 2,081 |
| 1,669 | 2,900 | 1,838 | 1,868 | 3,202 | 1,793 | 2,169 | 1,799 | 1,989 | 2,370 | 1,999 | 1,963 | 2,871 | 1,701 | 2,075 |
| 1,671 | 3,001 | 1,825 | 1,970 | 1,700 | 2,004 | 2,169 | 1,900 | 1,971 | 2,369 | 2,100 | 1,954 | 2,871 | 1,799 | 2,072 |
| 1,669 | 3,102 | 1,804 | 1,970 | 1,800 | 1,983 | 2,171 | 2,000 | 1,954 | 2,372 | 2,200 | 1,947 | 2,970 | 1,601 | 2,099 |
| 1,671 | 3,200 | 1,774 | 1,970 | 1,900 | 1,970 | 2,171 | 2,099 | 1,948 | 2,371 | 2,300 | 1,940 | 2,969 | 1,698 | 2,087 |
| 1,672 | 33,00 | 1,738 | 1,970 | 1,998 | 1,956 | 2,171 | 2,199 | 1,940 | 2,371 | 2,402 | 1,936 | 2,972 | 1,800 | 2,079 |
| 1,669 | 3,399 | 1,710 | 1,970 | 2,100 | 1,941 | 2,170 | 2,299 | 1,931 | 2,371 | 2,499 | 1,923 | 3,068 | 1,600 | 2,127 |
| 1,670 | 3,499 | 1,678 | 1,969 | 2,199 | 1,929 | 2,171 | 2,400 | 1,913 | 2,371 | 2,799 | 1,848 | 3,068 | 1,699 | 2,101 |
| 1,671 | 3,600 | 1,640 | 1,969 | 2,301 | 19,19 | 2,171 | 2,500 | 1,896 | 2,370 | 2,900 | 1,835 | 3,070 | 1,801 | 2,085 |
| 1,769 | 2,100 | 1,940 | 1,970 | 2,401 | 1,904 | 2,170 | 2,600 | 1,869 | 2,470 | 1,399 | 2,053 | 3,172 | 1,699 | 2,122 |
| 1,771 | 2,199 | 1,911 | 1,970 | 2,499 | 1,879 | 2,169 | 2,701 | 1,841 | 2,470 | 1,501 | 2,042 | 3,173 | 1,800 | 2,096 |
| 1,771 | 2,300 | 1,900 | 1,970 | 2,600 | 1,857 | 2,170 | 2,799 | 18,31 | 24,70 | 1,00 | 2,034 | | | |

**Table 16.** Positions of velocity features, ±1.0 meter, on South Cascade Glacier on September 14, 1998, and September 20, 2001

[Coordinates X, Y, and Z are local, in meters]

| | September 14, 1998 | | | | September 20, 2001 | | |
|---|---|---|---|---|---|---|---|
| ID | X | Y | Z | ID | X | Y | Z |
| 1 | 1,700.7 | 3,155.2 | 1,791.1 | 1 | 1,694.3 | 3,211.8 | 1,773.0 |
| 2 | 1,616.8 | 3,076.8 | 1,809.6 | 2 | 1,613.6 | 3,125.5 | 1,798.3 |
| 3 | 1,580.6 | 3,004.2 | 1,823.4 | 3 | 1,580.4 | 3,032.4 | 1,820.4 |
| 4 | 1,711.7 | 3,068.9 | 1,814.2 | 4 | 1,701.1 | 3,118.4 | 1,804.3 |
| 5 | 1,959.8 | 3,161.9 | 1,805.9 | 5 | 1,963.1 | 3,192.9 | 1,796.4 |
| 6 | 2,153.9 | 3,091.3 | 1,815.2 | 6 | 2,155.6 | 3,108.7 | 1,808.3 |
| 7 | 2,062.3 | 3,098.3 | 1,819.5 | 7 | 2,065.7 | 3,119.4 | 1,813.8 |
| 8 | 1,958.5 | 3,046.9 | 1,828.6 | 8 | 1,959.6 | 3,072.7 | 1,827.7 |
| 9 | 1,853.3 | 3,004.9 | 1,833.2 | 9 | 1,847.8 | 3,038.4 | 1,831.3 |
| 10 | 1,756.3 | 2,988.4 | 1,827.3 | 10 | 1,756.2 | 3,025.6 | 1,826.0 |
| 11 | 1,670.8 | 2,957.2 | 1,829.1 | 11 | 1,668.3 | 2,992.4 | 1,825.9 |
| 12 | 1,690.9 | 2,868.5 | 1,839.6 | 12 | 1,689.3 | 2,897.0 | 1,838.3 |
| 13 | 1,731.2 | 2,808.6 | 1,846.6 | 13 | 1,731.0 | 2,836.6 | 1,843.0 |
| 14 | 1,786.0 | 2,881.7 | 1,838.9 | 14 | 1,784.3 | 2,913.1 | 1,837.4 |
| 15 | 1,914.1 | 2,869.3 | 1,842.2 | 15 | 1,912.7 | 2,895.3 | 1,840.0 |
| 16 | 2,008.6 | 2,916.4 | 1,839.7 | 16 | 2,010.7 | 2,936.2 | 1,838.5 |
| 17 | 2,102.9 | 3,014.6 | 1,827.9 | 17 | 2,105.0 | 3,029.5 | 1,822.8 |
| 18 | 2,223.3 | 2,994.5 | 1,827.2 | 18 | 2,223.5 | 3,000.1 | 1,826.3 |
| 19 | 2,117.9 | 2,903.7 | 1,835.9 | 19 | 2,121.5 | 2,916.3 | 1,834.2 |
| 20 | 2,228.7 | 2,870.9 | 1,831.0 | 20 | 2,229.8 | 2,874.8 | 1,830.6 |
| 21 | 2,042.5 | 2,800.7 | 1,839.6 | 21 | 2,044.0 | 2,818.6 | 1,840.3 |
| 22 | 1,801.0 | 2,726.3 | 1,849.6 | 22 | 1,799.7 | 2,755.2 | 1,846.7 |
| 23 | 1,825.1 | 2,617.0 | 1,859.2 | 23 | 1,824.7 | 2,648.2 | 1,858.4 |
| 24 | 1,913.5 | 2,676.2 | 1,849.5 | 24 | 1,913.3 | 2,705.4 | 1,848.1 |
| 25 | 1,921.4 | 2,542.9 | 1,866.2 | 25 | 1,919.4 | 2,571.7 | 1,862.5 |
| 26 | 2,025.3 | 2,592.9 | 1,859.1 | 26 | 2,022.5 | 2,616.5 | 1,855.5 |
| 27 | 2,136.8 | 2,683.0 | 1,843.1 | 27 | 2,135.9 | 2,694.0 | 1,839.8 |
| 28 | 2,275.7 | 2758.2, | 1,840.3 | 28 | 2,273.3 | 2,762.2 | 1,839.2 |
| 29 | 2,273.2 | 2,621.7 | 1,878.8 | 29 | 2,271.5 | 2,626.4 | 1,876.9 |
| 30 | 2,248.2 | 2,537.3 | 1,901.6 | 30 | 2,246.5 | 2,543.4 | 1,900.5 |
| 31 | 2,181.4 | 2,493.4 | 1,899.6 | 31 | 2,178.4 | 2,501.3 | 1,898.1 |
| 32 | 2,073.2 | 2,419.1 | 1,904.3 | 32 | 2,065.1 | 2,445.6 | 1,898.2 |
| 33 | 2,014.6 | 2,287.8 | 1,923.6 | 33 | 2,000.1 | 2,318.5 | 1,921.1 |
| 34 | 1,945.7 | 2,228.1 | 1,923.8 | 34 | 1,928.4 | 2,258.3 | 1,920.0 |
| 35 | 2,021.8 | 2,095.9 | 1,941.4 | 35 | 2,010.9 | 2,127.1 | 1,939.6 |
| 36 | 2,229.0 | 2,302.5 | 1,934.0 | 36 | 2,227.8 | 2,307.6 | 1,935.2 |
| 37 | 2,348.7 | 24,40.4 | 1,929.2 | 37 | 2,347.4 | 2,444.7 | 1,927.0 |
| 38 | 2,445.1 | 2,174.7 | 1,957.5 | 38 | 2,443.6 | 2,176.5 | 1,956.9 |

**Table 17.** Precipitation (gage catch) at 1,587 meters altitude, Salix Creek gaging station, South Cascade Glacier Basin, 2001 water year

[Precipitation is summed every hour; the daily sum is given in millimeters]

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.0 | 2.5 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 |
| 2 | 1.5 | .3 | .3 | .5 | .0 | .0 | 2.5 | .0 | .3 | .0 | .0 | .3 |
| 3 | 1.0 | .0 | .0 | .0 | .0 | .0 | 4.6 | .0 | 10.2 | .0 | .0 | .0 |
| 4 | .0 | 17.5 | .5 | 23.6 | .0 | .0 | 5.1 | .0 | 10.7 | .0 | .0 | .0 |
| 5 | .0 | .0 | 5.6 | 1.5 | .0 | .5 | .3 | .0 | 6.3 | .0 | .0 | .0 |
| 6 | .0 | .0 | .0 | .0 | .0 | .0 | 1.5 | .0 | 4.0 | .0 | .0 | .0 |
| 7 | .0 | .3 | .0 | .0 | .0 | .0 | 1.0 | .0 | .0 | .0 | .0 | .0 |
| 8 | .0 | .0 | .0 | .0 | .0 | 7.9 | .3 | .0 | 3.3 | .0 | .0 | .0 |
| 9 | 6.3 | .0 | .0 | .0 | .0 | 6.9 | .0 | .0 | 4.3 | .0 | .0 | .0 |
| 10 | 1.5 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | 2.8 | .0 | .0 | .0 |
| 11 | .0 | .0 | .0 | .0 | .0 | .0 | 4.8 | .0 | 5.5 | .0 | .0 | .0 |
| 12 | .5 | .0 | .0 | .0 | .0 | .0 | .3 | .0 | 4.1 | .0 | .0 | .0 |
| 13 | .8 | .0 | .0 | .0 | .0 | .0 | 2.0 | .0 | .0 | .0 | .0 | .0 |
| 14 | 2.8 | .0 | .0 | .0 | .0 | .0 | 6.9 | .0 | 3.0 | .0 | .0 | .0 |
| 15 | .5 | .0 | .0 | .0 | .0 | 1.8 | .5 | .0 | .0 | 1.8 | .0 | .0 |
| 16 | 23.6 | .0 | 7.9 | .0 | .0 | .0 | .0 | .5 | .0 | .0 | .0 | .0 |
| 17 | 4.1 | .0 | .0 | .3 | .3 | .0 | 1.3 | .0 | .0 | 1.5 | .0 | .0 |
| 18 | 9.9 | 1.0 | 1.3 | 5.3 | .0 | 21.6 | 2.5 | .0 | .0 | 1.5 | .0 | .0 |
| 19 | 2.8 | 1.5 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 20 | 7.1 | .8 | .0 | .0 | .0 | .5 | .0 | .0 | .0 | .0 | .0 | .0 |
| 21 | .0 | .0 | .0 | .0 | .0 | .3 | .0 | .0 | .0 | .0 | .0 | .0 |
| 22 | 7.6 | .0 | .0 | .0 | 3.8 | .3 | .0 | .0 | .0 | .0 | .0 | .0 |
| 23 | .0 | 6.3 | .3 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| 24 | .0 | .0 | .0 | .0 | .0 | 2.0 | 1.0 | .0 | .0 | .0 | .0 | .0 |
| 25 | .0 | .0 | 8.6 | .0 | .0 | 5.3 | .0 | .0 | .8 | .0 | .0 | .0 |
| 26 | .0 | .0 | 16.5 | .0 | .0 | .0 | .0 | .0 | .3 | .0 | .0 | .0 |
| 27 | 1.0 | .0 | 1.5 | .0 | 1.0 | .0 | 2.5 | .0 | 2.8 | .0 | .0 | .0 |
| 28 | 7.1 | .0 | .3 | .0 | .3 | .0 | .3 | .0 | 4.0 | .0 | .0 | .0 |
| 29 | .8 | .0 | .0 | .0 | | .0 | 2.0 | .0 | .0 | .0 | .0 | .0 |
| 30 | .0 | .0 | 5.6 | .0 | | 11.4 | .0 | .0 | .0 | .0 | .0 | .0 |
| 31 | .0 | | .5 | .0 | | 8.6 | | .0 | | .0 | .0 | |
| Total | 78.8 | 30.2 | 48.7 | 31.2 | 8.6 | 67.0 | 39.3 | 0.5 | 62.1 | 4.8 | 0.0 | 0.5 |

**Table 18.** Runoff from Salix Creek Basin, 2001 water year

[Daily runoff in millimeters, averaged over the basin]

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.9 | 2.4 | 0.9 | 1.6 | 0.6 | 0.4 | 1.4 | 4.2 | 32.3 | 12.9 | 1.8 | 0.9 |
| 2 | 3.1 | 2.2 | .9 | 1.5 | .7 | .4 | 1.3 | 3.3 | 16.5 | 11.0 | 1.5 | .5 |
| 3 | 2.4 | 2.6 | .8 | 1.5 | .6 | .4 | 1.2 | 3.3 | 11.8 | 10.5 | 1.6 | .4 |
| 4 | 2.0 | 14.1 | .8 | 3.3 | .6 | .4 | 1.1 | 3.9 | 11.3 | 9.9 | 1.4 | .3 |
| 5 | 1.6 | 4.4 | .7 | 18.9 | .6 | .4 | 1.1 | 4.0 | 12.5 | 8.2 | 1.2 | .4 |
| 6 | 1.4 | 3.2 | .7 | 5.0 | .6 | .4 | 1.0 | 3.3 | 19.8 | 7.0 | 1.1 | .3 |
| 7 | 1.2 | 2.7 | .7 | 3.2 | .6 | .7 | 1.0 | 4.1 | 19.4 | 6.4 | 1.0 | .3 |
| 8 | 1.2 | 2.6 | .8 | 2.6 | .6 | 1.6 | .9 | 9.2 | 26.0 | 5.8 | .8 | .2 |
| 9 | 1.5 | 2.2 | .8 | 2.2 | .5 | 1.4 | .9 | 10.5 | 33.1 | 5.3 | .7 | .2 |
| 10 | 1.4 | 2.1 | .8 | 1.9 | .5 | 1.1 | 1.0 | 11.5 | 15.6 | 4.8 | .6 | .1 |
| 11 | 1.1 | 2.5 | .7 | 1.7 | .5 | 1.0 | .8 | 14.6 | 14.1 | 4.3 | .6 | .1 |
| 12 | 1.1 | 2.1 | .7 | 1.5 | .5 | .9 | .8 | 28.4 | 10.4 | 3.8 | .6 | .1 |
| 13 | 1.0 | 3.2 | .7 | 1.4 | .4 | .9 | .8 | 30.6 | 12.8 | 3.4 | .5 | .1 |
| 14 | 2.1 | 4.1 | .7 | 1.2 | .4 | .8 | .7 | 17.9 | 15.3 | 3.0 | .5 | .1 |
| 15 | 1.4 | 3.3 | .7 | 1.2 | .4 | .7 | .7 | 12.7 | 19.5 | 2.9 | .4 | .1 |
| 16 | 10.3 | 2.6 | .6 | 1.1 | .4 | .7 | .9 | 10.1 | 16.3 | 3.0 | .4 | .1 |
| 17 | 7.7 | 4.6 | .6 | 1.0 | .4 | .6 | 2.0 | 6.8 | 18.4 | 3.6 | .3 | .1 |
| 18 | 14.6 | .3 | .6 | 1.0 | .4 | 2.2 | 1.5 | 5.4 | 23.1 | 3.1 | .4 | .1 |
| 19 | 5.0 | .6 | .6 | 1.1 | .4 | 4.0 | 1.3 | 6.0 | 25.9 | 2.4 | .3 | .2 |
| 20 | 27.4 | .9 | .6 | 1.0 | .4 | 1.9 | 1.8 | 7.5 | 31.1 | 2.0 | .3 | .1 |
| 21 | 8.2 | .9 | .6 | 1.0 | .4 | 1.3 | 2.4 | 16.5 | 32.9 | 1.9 | .9 | .1 |
| 22 | 6.0 | .8 | .6 | .9 | .4 | 1.2 | 2.5 | 40.3 | 33.1 | 1.9 | 5.1 | .1 |
| 23 | 8.9 | 1.1 | .5 | .9 | .4 | 1.4 | 2.1 | 55.5 | 22.7 | 1.6 | 5.1 | .1 |
| 24 | 6.8 | 1.0 | .5 | .8 | .4 | 2.9 | 4.0 | 43.6 | 19.4 | 1.5 | 2.9 | .1 |
| 25 | 5.0 | 1.0 | .6 | .8 | .4 | 7.1 | 17.3 | 39.3 | 19.1 | 1.3 | 1.4 | .0 |
| 26 | 4.1 | 1.0 | 9.7 | .8 | .3 | 4.6 | 25.6 | 39.7 | 16.7 | 1.2 | .8 | 3.8 |
| 27 | 3.6 | 1.0 | 64.7 | .7 | .3 | 3.1 | 22.5 | 30.6 | 23.9 | 1.1 | .6 | 1.6 |
| 28 | 4.9 | .9 | 6.3 | .7 | .4 | 2.4 | 16.0 | 20.7 | 21.3 | 6.7 | .5 | .8 |
| 29 | 3.8 | 1.0 | 2.4 | .7 | | 2.0 | 8.3 | 13.2 | 16.4 | 4.1 | .4 | .6 |
| 30 | 3.0 | .9 | 2.1 | .7 | | 1.6 | 5.6 | 9.7 | 14.1 | 2.6 | .4 | .4 |
| 31 | 2.8 | | 1.8 | .6 | | 1.5 | 25.6 | 23.3 | 16.7 | 2.3 | .3 | |
| Total | 149.5 | 72.3 | 104.2 | 62.5 | 13.1 | 50.0 | 128.2 | 529.7 | 604.8 | 139.5 | 34.4 | 12.5 |

**Table 19.** Runoff from Middle Tarn Basin, 2001 water year

[Daily runoff in millimeters, averaged over the basin; –, no data]

| Day | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | – | 1.6 | 0.5 | – | – | – | – | – | 15.9 | 25.0 | 17.8 | 31.9 |
| 2 | – | 1.5 | .5 | – | – | – | – | – | 12.8 | 25.0 | 21.5 | 19.4 |
| 3 | – | 1.4 | .2 | – | – | – | – | – | 8.6 | 26.4 | 24.8 | 16.9 |
| 4 | – | 4.7 | .2 | – | – | – | – | – | 6.6 | 32.8 | 22.5 | 14.0 |
| 5 | 4.3 | 2.4 | .2 | – | – | – | – | – | 6.0 | 31.4 | 17.6 | 11.6 |
| 6 | 3.5 | 1.8 | .2 | – | – | – | – | – | 6.5 | 25.2 | 24.4 | 9.9 |
| 7 | 3.2 | 1.5 | .4 | – | – | – | – | – | 7.6 | 24.9 | 28.0 | 10.4 |
| 8 | 3.5 | 1.5 | .4 | – | – | – | – | – | 11.1 | 29.6 | 26.5 | 11.8 |
| 9 | 4.9 | 1.4 | .5 | – | – | – | – | – | 14.8 | 32.8 | 27.3 | 13.8 |
| 10 | 4.7 | 1.2 | .4 | – | – | – | – | – | 9.2 | 33.6 | 28.9 | 15.3 |
| 11 | 4.6 | 1.1 | .3 | – | – | – | – | – | 7.3 | 34.7 | 28.8 | 17.0 |
| 12 | 4.7 | .9 | 1.0 | – | – | – | – | – | 5.9 | 32.4 | 32.8 | 19.3 |
| 13 | 4.5 | .8 | – | – | – | – | – | – | 5.5 | 31.3 | 33.7 | 21.8 |
| 14 | 5.1 | .8 | – | – | – | – | – | – | 6.2 | 26.9 | 31.1 | 22.5 |
| 15 | 4.1 | .7 | – | – | – | – | – | – | 7.3 | 22.7 | 32.2 | 21.5 |
| 16 | 6.3 | .6 | – | – | – | – | – | – | 7.4 | 19.2 | 33.1 | 20.0 |
| 17 | 6.6 | .5 | – | – | – | – | – | – | 7.2 | 18.3 | 29.9 | 16.1 |
| 18 | 11.8 | .5 | – | – | – | – | – | – | 8.9 | 16.7 | 22.4 | 12.2 |
| 19 | 6.8 | .5 | – | – | – | – | – | – | 12.9 | 17.0 | 19.3 | 13.2 |
| 20 | 25.7 | .4 | – | – | – | – | – | – | 17.6 | 19.0 | 18.8 | 10.7 |
| 21 | 11.8 | .4 | – | – | – | – | – | – | 21.0 | 22.2 | 22.1 | 12.5 |
| 22 | 8.1 | .4 | – | – | – | – | – | – | 25.0 | 24.3 | 44.9 | 18.3 |
| 23 | 7.3 | .4 | – | – | – | – | – | – | 23.7 | 26.7 | 41.5 | 23.5 |
| 24 | 5.9 | .4 | – | – | – | – | – | – | 21.7 | 30.3 | 24.2 | 20.9 |
| 25 | 4.5 | .4 | – | – | – | – | – | – | 18.8 | 26.9 | 19.5 | 17.9 |
| 26 | 3.8 | .5 | – | – | – | – | – | 18.5 | 18.6 | 24.4 | 22.7 | 34.1 |
| 27 | 3.3 | .6 | – | – | – | – | – | 16.2 | 33.0 | 26.5 | 23.3 | 14.2 |
| 28 | 3.5 | .5 | – | – | – | – | – | 11.3 | 30.5 | 42.5 | 24.6 | 7.7 |
| 29 | 2.6 | .5 | – | – |  | – | – | 7.7 | 22.8 | 28.2 | 26.5 | 6.8 |
| 30 | 2.2 | .4 | – | – |  | – | – | 6.3 | 23.3 | 19.2 | 26.1 | 10.6 |
| 31 | 1.9 |  | – | – |  | – |  | 9.5 |  | 17.9 | 30.5 |  |
| Total |  | 30.3 | – | – | – | – | – | – | 423.7 | 814.0 | 827.3 | 495.8 |

**Table 20.** Snow depths at South Cascade Glacier, May 10, 2001

[X and Y are local coordinates, ±10 meters; depths in meters, ±0.05 meter, measured with a probe rod; surface altitude (Z), in meters; locations mapped on figure 17]

| X | Y | Z | Snow depth (meters) | X | Y | Z | Snow depth (meters) |
|---|---|---|---|---|---|---|---|
| 1,830 | 2,709 | 1,864 | 4.08 | 2,920 | 1,764 | 2,086 | 4.13 |
| 1,856 | 2,632 | 1,870 | 4.13 | 1,805 | 2,788 | 1,855 | 4.29 |
| 1,887 | 2,551 | 1,876 | 4.44 | 1,765 | 2,852 | 1,852 | 3.98 |
| 1,901 | 2,477 | 1,891 | 4.64 | 1,732 | 2,895 | 1,852 | 4.03 |
| 1,936 | 2,414 | 1,909 | 4.59 | 1,705 | 2,941 | 1,846 | 4.19 |
| 1,965 | 2,350 | 1,924 | 4.03 | 1,678 | 2,989 | 1,841 | 4.08 |
| 2,010 | 2,274 | 1,937 | 4.13 | 1,654 | 3,039 | 1,831 | 4.03 |
| 2,047 | 2,206 | 1,946 | 4.24 | 1,634 | 3,090 | 1,820 | 3.37 |
| 2,094 | 2,129 | 1,954 | 4.29 | 1,622 | 3,138 | 1,807 | 3.47 |
| 2,131 | 2,054 | 1,962 | 4.39 | 1,629 | 3,185 | 1,791 | 3.99 |
| 2,157 | 1,977 | 1,973 | 4.34 | 1,636 | 3,226 | 1,778 | 4.33 |
| 2,188 | 1,913 | 1,984 | 4.39 | 1,640 | 3,273 | 1,761 | 3.83 |
| 2,225 | 1,857 | 2,002 | 4.49 | 1,642 | 3,324 | 1,746 | 3.32 |
| 2,265 | 1,797 | 2,016 | 4.13 | 1,658 | 3,376 | 1,733 | 3.67 |
| 2,313 | 1,735 | 2,028 | 4.34 | 1,674 | 3,424 | 1,719 | 3.47 |
| 2,363 | 1,673 | 2,035 | 4.13 | 1,685 | 3,474 | 1,703 | 2.50 |
| 2,442 | 1,675 | 2,041 | 4.34 | 1,716 | 3,511 | 1,677 | .99 |
| 2,520 | 1,680 | 2,049 | 4.84 | 1,720 | 3,570 | 1,665 | .80 |
| 2,600 | 1,691 | 2,057 | 4.64 | 1,724 | 3,626 | 1,652 | 1.01 |
| 2,682 | 1,703 | 2,065 | 4.39 | 1,602 | 4,042 | 1,618 | 1.68 |
| 2,759 | 1,721 | 2,071 | 4.24 | 1,573 | 4,062 | 1,617 | 1.43 |
| 2,841 | 1,742 | 2,078 | 4.03 | 1,547 | 4,078 | 1,616 | 1.12 |

**Table 21.** Values used to interpolate snow water equivalent at an altitude on South Cascade Glacier, May 10, 2001

[Values in meters]

| Altitude | Snow water equivalent | Altitude | Snow water equivalent |
|---|---|---|---|
| 1,628 | 0.24 | 1,825 | 1.85 |
| 1,636 | 0.43 | 1,878 | 1.91 |
| 1,643 | 0.61 | 1,928 | 1.95 |
| 1,652 | 0.79 | 1,978 | 1.97 |
| 1,659 | 0.97 | 2,030 | 1.99 |
| 1,671 | 1.15 | 2,082 | 1.99 |
| 1,687 | 1.32 | 2,134 | 2.00 |
| 1,706 | 1.49 | 2,185 | 2.00 |
| 1,736 | 1.63 | 2,239 | 2.01 |
| 1,776 | 1.76 | 2,292 | 2.02 |

**Table 22.** Values used to interpolate net balance at an altitude on South Cascade Glacier, 2001

[Values in meters]

| Altitude | Net balance | Altitude | Net balance |
|---|---|---|---|
| 1,633 | -6.98 | 1,787 | -2.11 |
| 1,638 | -6.34 | 1,840 | -1.68 |
| 1,644 | -5.66 | 1,898 | -1.38 |
| 1,653 | -5.02 | 1,963 | -1.22 |
| 1,667 | -4.39 | 2,029 | -1.13 |
| 1,686 | -3.77 | 2,094 | -1.10 |
| 1,713 | -3.17 | 2,156 | -1.10 |
| 1,746 | -2.62 | | |

**Table 23.** Mass balance time series at South Cascade Glacier

[**Year**: for example, balance year 1959 is from the minimum balances in 1958 to the minimum balance in 1959, and the 1959 $\bar{b}_m(s)$ occurred in the spring of 1959; $\bar{b}_n$ for years 1959 through 1964 from Meier and Tangborn (1965; Years 1965 through 1966 from Meier and others (1971); Year 1967 from Tangborn and others (1977); $\bar{b}_n$ for years1968 through 1985 from Krimmel (1989). **Other**: For years 1986–91, net balance, $\bar{b}_n$, was determined by the index regression method discussed by Krimmel (1989) and has an error of 0.23 meter (m). For years 1959–64 and 1968–82, winter balance, $\bar{b}_m(s)$, was determined from unpublished snow accumulation maps and has an error of 0.12 m. For years 1983–91, $\bar{b}_m(s)$ was determined using the index station regression discussed in Krimmel (1989) and has an error of 0.23 m. For years 1992–98, $\bar{b}_n$ and $\bar{b}_m(s)$ were determined by the grid-index method (Krimmel, 1996b).]

| Year | $\bar{b}_m(s)$ (m) | $\bar{b}_n$ (m) | Year[1] | $\bar{b}_m(s)$ (m) | $\bar{b}_n$ (m) |
|---|---|---|---|---|---|
| 1959 | 3.28 | 0.70 | 1981 | 2.28 | -0.84 |
| 1960 | 2.21 | -.50 | 1982 | 3.11 | .08 |
| 1961 | 2.40 | -1.10 | 1983 | 1.91 | -.77 |
| 1962 | 2.50 | .20 | 1984 | 2.38 | .12 |
| 1963 | 2.23 | -1.30 | 1985 | 2.18 | -1.20 |
| 1964 | 3.25 | 1.20 | 1986 | 2.43 | -.71 |
| 1965 | 3.48 | -.17 | 1987 | 1.88 | -2.56 |
| 1966 | 2.47 | -1.03 | 1988 | 1.89 | -1.64 |
| 1967 | 3.29 | -.63 | 1989 | 2.35 | -.71 |
| 1968 | 3.00 | .01 | 1990 | 2.80 | -.73 |
| 1969 | 3.17 | -.73 | 1991 | 3.35 | -.20 |
| 1970 | 2.41 | -1.20 | 1992 | 1.91 | -2.01 |
| 1971 | 3.51 | .60 | 1993 | 1.98 | -1.23 |
| 1972 | 4.27 | 1.43 | 1994 | 2.39 | -1.60 |
| 1973 | 2.21 | -1.04 | 1995 | 2.86 | -.69 |
| 1974 | 3.65 | 1.02 | 1996 | 2.94 | 0.10 |
| 1975 | 3.06 | -.05 | 1997 | 3.71 | 0.63 |
| 1976 | 3.53 | .95 | 1998 | 2.76 | -1.86 |
| 1977 | 1.57 | -1.30 | 1999 | 3.59 | 1.02 |
| 1978 | 2.49 | -.38 | 2000 | 3.32 | 0.38 |
| 1979 | 2.18 | -1.56 | 2001 | 1.90 | -1.57 |
| 1980 | 1.83 | -1.02 | | | |

R.M. Krimmel

South Cascade Glacier, 2000-01 Balance Years

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