Appendix B
Glossary and Notation

B-1. Glossary

The following is a summary of terms used in this manual that are common to snow hydrology and its related fields.

Albedo
The ratio of the amount of shortwave radiation reflected by a surface to the total flux incident to the surface.

Back-radiation
Long-wave (terrestrial) radiation emanating from clouds, forest canopy, atmospheric particles, etc., and directed towards the earth.

Blackbody (radiation)
A body that radiates for every wavelength the maximum intensity of radiation possible for a given temperature. (The term does not imply that the radiating substance is colored black.)

Calorie (gram-calorie)
The amount of heat required to raise a gram of water 1 °C, from 14.5 to 15.5 °C.

Cold content
The amount of energy required to raise a snowpack to 0 °C, expressed in terms of the amount of water needed to be produced at the surface to release energy by freezing. Applied primarily to determine initial losses during wintertime rain on snow.

Condensation
Heat energy (and snowmelt) produced through the phase change of water from a vapor to a liquid.

Conduction
Heat energy (and snowmelt) produced by heat transferred through a solid body by molecular activity. Applied to heat conducted from the ground in snow hydrology.

Continuous simulation
Simulation with a generalized hydrological model in which the model is operated continuously through dry as well as storm periods. Requires the ability to simulate evapotranspiration as well as other phenomena.

Convection
Heat energy (and snowmelt) produced by the transfer of heat through the movement of the air (or any fluid), brought about by natural or induced pressure differences. Also called sensible heat transfer.

Degree-day factor
See *melt-rate coefficient.*

Dew point
The temperature to which the air must be cooled—at constant pressure without the removal or addition of moisture—to produce condensation of water vapor.

Distributed (parameter) model
A category of conceptual models, in which the watershed parameters are defined by breaking down the total basin into smaller, independently computed subunits. This leads to an improved and more physically based model definition as compared with a *Lumped model.*

Elevation bands
Zones of equal elevation in a watershed model. One method of achieving a degree of distribution in defining a hydrological model of a basin.

Energy budget
A method of snowmelt analysis and simulation for which the energy flux components are explicitly accounted.

Energy flux
The rate of change of energy (e.g., shortwave radiation) per unit time.

Extended streamflow prediction (ESP)
A forecasting technique in which future conditions are simulated by using for future input (e.g., precipitation and temperature) a number of historical time series, all beginning with the model's current state (e.g., soil moisture, snowpack).

Gravitational water
Liquid water in a snowpack that is in transit through the pack under the influence of gravity.

Ground conduction melt
See *Conduction*.

Hygroscopic water
Liquid water held in the snowpack crystal matrix that is not available for runoff until the snow crystals have melted.

Hypothetical floods
Simulated floods used for design, in which the magnitude is typically expressed in terms of probability of occurrence or as a maximum probable event.

Incident radiation
Solar radiation that falls on a surface.

Insolation
Total solar radiation flux received on a horizontal surface.

Joule
A measure of heat energy or work in the SI system of units, equal to one watt per second. One gram-calorie equals 4.186 joules.

Langley
A measure of solar radiation equal to one calorie per square centimeter.

Latent heat
The heat quantity taken in or given off when a substance changes its state, e.g., from liquid to gas.

Liquid-water holding capacity
The capacity of a snowpack to retain nongravitational liquid water.

Long-wave radiation
Radiation energy from terrestrial sources, occurring with wavelength of 6.8 to 100 µm. Also called *Thermal radiation*.

Lumped model
A conceptual model in which a single set of parameters defines the system. See also *Distributed model*.

Melt-Rate coefficient
A coefficient used in the *Temperature index* equation for snowmelt. Also called a *Degree-day factor*.

Metamorphism
The change in the character of a snowpack as it matures, in which individual crystals become rounded and bound together and the snowpack becomes more dense and is warmed to 0 °C.

Precipitation
Rain, snow, hail, etc., falling to the ground.

Primed snowpack
A mature snowpack in which the temperature of the snow has become isothermal at 0 °C and the liquid water deficiency is satisfied, and is ready for runoff-producing melt.

Radioisotopic gauge
A method of measuring *Snow water equivalent* (SWE) by sensing the attenuation of radiation emitted from a source.

Rain melt
Snowmelt produced by the heat given up after rainwater has fallen on the snowpack.

Relative humidity
The ratio of the water vapor content of the air compared with the saturated content at the same temperature. It can be computed by dividing the actual vapor pressure by the saturated vapor pressure.

Residual
In correlation analysis, the difference between the predicted and observed value of the independent variable.

Ripeness
The degree of maturity of a snowpack as measured by the internal temperature, character of the snow crystals, and liquid-water content.

Saturated vapor pressure
In meteorology, the vapor pressure when the air has reached its capacity for water vapor; it is saturated. This is a function of air temperature. See *Vapor pressure*.

Sensible heat melt
See *Convection.*

Shortwave radiation
Radiation emitted by the sun, with wavelength of 0.2 to 2.2 µm.

SNOTEL
Acronym for SNow TELemetry system, an automated snow data collection system managed by the U.S. Natural Resource Service in the western United States.

Snow
The form of precipitation that falls as ice in a crystalline form, each crystal having a unique shape, with sharply defined edges and abrupt points.

Snow condition
A relative measure of a snowpack's degree of *Metamorphism*, as it changes from a fresh, dry state to a mature, *Ripe* state. Applied to *Cold content* determinations.

Snow cover depletion curve
A curve that defines the percentage of areal snow cover of a basin as a function of percent of total anticipated runoff. Used for estimating snow cover and snowline elevation in simulation models.

Snow course
A manual snow-sampling station at which several *Snow tube* samples are taken to get representative values of depth, density, and SWE.

Snow density
Theoretically, the mass of a unit volume of snow, expressed in kilograms/cubic meter. More commonly, it is expressed as a percentage—for a unit area, the depth of the *SWE* divided by the depth of the snow (10% = 100 kg/m^3).

Snow pillow
A device that automatically measures the snowpack *SWE*, consisting of a rubber or stainless steel pillow filled with liquid.

Snow survey
A general term for the manual sampling of snow.

Snow water equivalent (SWE)
The liquid-water equivalent of the snowpack, expressed in terms of depth.

Snowfall
The depth of newly fallen snow, measured before it becomes compacted.

Solar constant
The radiant solar energy flux received outside the Earth's atmosphere, on a surface normal to the sun's rays. Established at 1.365 kW/m^2.

Solar radiation
Radiation emitted by the sun. See *Shortwave radiation.*

Stefan-Boltzmann equation
A fundamental relationship that states that energy radiated by a blackbody is equal to the fourth power of its Kelvin temperature times the Stefan-Boltzmann constant.

Temperature index
A simplified method of computing snowmelt in which air temperature is used to index all the energy sources involved.

Terrestrial radiation
See *Long-wave radiation*.

Thermal quality
Ratio of heat required to melt a unit mass of snow to that of ice at 0 °C.

Thermal radiation
See *Long-wave radiation.*

Turbulent transfer/exchange
The physical mechanism occurring in the 2 to 3 m (6 to 10 ft) of the atmosphere immediately above the snow surface by which sensible and latent heat energy fluxes are transferred to the snow surface.

Vapor pressure
In meteorological applications, the partial pressure exerted by water vapor in the atmosphere, expressed in millibars or millimeters of mercury. This is an absolute measure of the amount of water vapor in the air. See *Saturated vapor pressure.*

B-2. Notation

The following is a listing of notations used in the equations presented in this manual. Widely known and accepted notations (e.g., meters, kilograms) are not included. Since both SI and English units are used in this manual, both systems could be shown for most variables; however, where one convention has been used exclusively in the manual, only those units are shown.

ϵ emissivity of snow, decimal fraction

ρ_s density of snow, g/cc, kg/m^3, percent

ρ_w density of water, kg/m^3

σ Stefan-Boltzmann constant, kJ/m^2 s K^4 or ly/min K^4

A cross section area

a snow surface albedo, decimal fraction

B thermal quality of snow, decimal fraction

BF base-flow index in runoff-volume forecast equation, units of depth

cal calorie

CF_a correction factor for temperature-measurement height adjustment, decimal fraction

CF_b correction factor for wind-velocity measurement height adjustment, decimal fraction

C_m melt-rate coefficient in temperature-index equation, inches/degree-day

C_p specific heat of water, kJ/kg °C

C_r conversion factor, cold-content simulation equation, inches/degree-day

d depth of snow, inches or centimeters

df degrees of freedom

e_a vapor pressure of air, millibars

e_s saturation vapor pressure of air, millibars

F basin forest-canopy cover shading from shortwave radiation, decimal fraction

FP fall index in runoff-volume forecast, units of depth

I_i solar insolation flux, ly/day, mJ/day m^2, W/m^2

J joule

K Kelvins

k basin wind exposure factor in energy budget equation, decimal fraction

k' basin shortwave radiation melt factor in energy budget equation, decimal fraction

kJ kilo-joules

L latent heat, kJ/kg or cal/g

ly langley

M combined melt from all energy sources, inches or millimeters

M_c snowmelt due to latent heat of condensation, inches or millimeters

M_{ce} combined snowmelt, condensation, and convection, inches or millimeters

M_e snowmelt due to convection heat transfer, inches or millimeters

M_l snowmelt due to long-wave radiation heat, inches or millimeters

M_r snowmelt due to heat released from rainwater, inches or millimeters

M_s snowmelt due to shortwave radiation heat, inches or millimeters

N cloud cover, decimal fraction

p atmospheric pressure at location

p_0 atmospheric pressure at sea level

P_r daily rainfall, inches or millimeters

Q heat energy (general), typically $kJ/m^2 \cdot day$, mJ/m day, ly/day, W/m^2

Q_c energy flux from condensation

Q_e energy flux from convection from the air

Q_g energy flux from ground conduction

Q_i internal energy in snowpack

Q_{lb} long-wave back (towards the earth) radiation flux

Q_l net long-wave radiation

Q_m total heat energy flux available to produce snowmelt

Q_r energy flux from rainwater

Q_s energy flux from shortwave radiation

S SWE index in runoff-volume forecast equation

SP spring precipitation index in runoff-volume forecast equation

SWE snow water equivalent, inches or mm

T_a air temperature, °C or °F

T_b base temperature in temperature-index equation, °C or °F

T'_c difference between cloud and snow surface temperatures, °C or °F

T'_d difference between dew point and snow surface temperatures, °C or °F

T'_s snow-temperature deficit below freezing, °C or °F

T_d dew-point temperature, °C or °F

T_r temperature of rain, °C or °F

T_s temperature of snow, °C or °F

v wind velocity, mph or km/hour

W watt

W_c cold content, inches

WP winter-precipitation index in runoff-volume forecast equation

Y seasonal runoff volume (dependent variable) in runoff-volume forecast equation

z_a height of temperature measurement, feet or meters

z_b height of wind velocity measurement, feet or meters