



PRMS-IV, the Precipitation-Runoff Modeling System, Version 4

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Table 2. Description of modules implemented in the Precipitation-Runoff Modeling System, **version 5 (PRMS-V)**,

[HRU, Hydrologic Response Unit; CBH, climate by HRU; **red** highlight indicates new for PRMS-5.2; **pink** highlight indicates new for PRMS-5.1.0; **green** highlight indicates new for PRMS-5.0; ~~strickethrough~~ indicates items removed]

Module name	Description
Basin definition process	
basin	Defines shared watershed-wide and hydrologic response unit (HRU) physical parameters and variables.
Cascading flow process	
cascade	Determines computational order of the HRUs and groundwater reservoirs for routing flow downslope.
Solar table process	
soltab	Compute potential solar radiation and sunlight hours for each HRU for each day of year.
Time series data process	
obs	Reads and stores observed data from all specified measurement stations.
dynamic_param_read	Reads and makes available dynamic parameters by HRU from pre-processed files.
water_use_read	Reads and makes available water-use data (diversions and gains) from pre-processed files.
Temperature distribution process	
temp_1sta	Distributes maximum and minimum temperatures to each HRU by using temperature data measured at one station and specified monthly lapse rates. Note, each HRU uses data from a single station, but, multiple stations can be used in a model with each HRU assigned data from one of those stations.
temp_laps	Distributes maximum and minimum temperatures to each HRU by computing a daily lapse rate with temperature data measured at a base station and a lapse station with differing altitudes.
temp_dist2	Distributes maximum and minimum temperatures to each HRU by using a basin-wide lapse rate applied to the temperature data, adjusted for distance, measured at each station.
temp_map	Distributes maximum and minimum temperatures to each HRU by using time series temperature data using an area-weighted method and correction factors to each HRU.
temp_sta	Distributes maximum and minimum temperatures to each HRU by using temperature data measured at one station, similar to temp_1sta except there is no lapse rate.
climate_hru	Reads distributed minimum and maximum air temperature values for each HRU directly from pre-processed files.
Precipitation distribution process	
precip_1sta	Determines the form of precipitation and distributes it to each HRU by using monthly correction factors to account for differences in altitude, spatial variation, topography, and measurement gage efficiency and observed data from one station. Note, each HRU uses data from a single station, but, multiple stations can be used in a model with each HRU assigned data from one of those stations.
precip_laps	Determines the form of precipitation and distributes it to each HRU by using monthly lapse rates.
precip_dist2	Determines the form of precipitation and distributes it to each HRU by using an inverse distance weighting scheme.
precip_map	Distributes precipitation and determines form to each HRU by using time series precipitation data using an area-weighted method and correction factors to each HRU.
climate_hru	Reads distributed precipitation values for each HRU directly from pre-processed files.
Combined climate distribution process	
ide_dist	Determines the form of precipitation and distributes precipitation and temperatures to each HRU on the basis of measurements at stations with closest elevation or shortest distance to the respective HRU.

xyz_dist	Determines the form of precipitation and distributes precipitation and temperatures to each HRU by using a multiple linear regression of measured data from a group of measurement stations or from atmospheric model simulation.
climate_hru	Reads distributed minimum and maximum air temperature and precipitation values for each HRU directly from pre-processed files.
Solar radiation distribution process	
ddsolrad	Distributes solar radiation to each HRU and estimates missing solar radiation data using a maximum temperature per degree-day relation.
ccsolrad	Distributes solar radiation to each HRU and estimates missing solar radiation data using a relation between solar radiation and cloud cover.
climate_hru	Reads distributed solar radiation values for each HRU directly from pre-processed files.
Transpiration period process	
transp_frost	Determines whether the current time step is in a period of active transpiration by the killing frost method.
transp_tindex	Determines whether the current time step is in a period of active transpiration by the temperature index method.
climate_hru	Reads distributed transpiration values for each HRU directly from pre-processed files.
Potential evapotranspiration process	
potet_hamon	Computes the potential evapotranspiration by using the Hamon formulation (Hamon, 1961).
potet_jh	Computes the potential evapotranspiration by using the Jensen-Haise formulation (Jensen and Haise, 1963).
potet_hs	Computes the potential evapotranspiration by using the Hargreaves-Samani formulation (Hargreaves and Samani, 1982).
potet_pt	Computes the potential evapotranspiration by using the Priestley-Taylor formulation (Priestley and Taylor, 1972).
potet_pm	Computes the potential evapotranspiration by using the Penman-Monteith formulation (Penman, 1948; Monteith, 1965); requires windspeed and humidity specified in CBH Files.
potet_pm_sta	Computes the potential evapotranspiration by using the Penman-Monteith formulation (Penman, 1948; Monteith, 1965); requires windspeed and humidity specified in the Data File.
potet_pan	Computes the potential evapotranspiration for each HRU by using pan-evaporation data.
climate_hru	Reads distributed potential evapotranspiration values for each HRU directly from pre-processed files.
Canopy Interception process	
intcp	Computes volume of intercepted precipitation, evaporation from intercepted precipitation, and throughfall (net precipitation) that reaches the soil or snowpack.
Snow process	
snowcomp	Initiates development of a snowpack and simulates snow accumulation and depletion processes by using an energy-budget approach.
glacr_melt	Computes glacier dynamics using three linear reservoirs (snow, firn, ice) with time lapsed and ability to advance or retreat according to volume-area scaling.
Surface runoff process	
srunoff_smidx	Computes surface runoff and infiltration for each HRU by using a nonlinear variable-source-area method allowing for cascading flow.
srunoff_carea	Computes surface runoff and infiltration for each HRU by using a linear variable-source-area method allowing for cascading flow.
Soil-zone process	
soilzone	Computes inflows to and outflows from the soil zone of each HRU and includes inflows from infiltration, groundwater, and upslope HRUs, and outflows to gravity drainage, interflow, and surface runoff to down-slope HRUs.
Groundwater process	

gwflo	Sums inflow to and outflow from PRMS groundwater reservoirs; outflow can be routed to downslope groundwater reservoirs and stream segments.
Streamflow process	
muskingum	Computes flow in the stream network using the Muskingum routing method (Linsley and others, 1982).
muskingum_lake	Computes flow in the stream network using the Muskingum routing method and flow and storage in on-channel lake using several methods.
muskingum_mann	Computes flow in the stream network using the Muskingum routing method with Manning's N equation.
routing	Computes common segment routing flows for modules <code>strmflow_in_out</code> and <code>Muskingum</code> .
stream_temp	Computes daily mean stream temperature for each stream segment in the stream network, module based on the Stream Network Temperature Model (SNTMP, Theurer and others, 1984).
strmflow	Computes daily streamflow as the sum of surface runoff, shallow-subsurface flow (interflow), detention reservoir flow, and groundwater flow.
strmflow_in_out	Routes water between segments in the stream network by setting the outflow to the inflow.
strmflow_lake	Computes basin on channel reservoir storage and outflows.
Summary process	
basin_sum	Computes daily, monthly, yearly, and total flow summaries of volumes and flows for all HRUs.
basin_summary	Write user-selected results for variables of dimension one to separate CSV Files at daily, monthly, mean monthly, mean yearly, and yearly total time steps when control parameter basinOutON_OFF is specified equal to 1.
convert_params	Writes values for new PRMS-V parameters to a file based on a PRMS-IV Parameter File when control parameter model_mode is specified equal to CONVERT. Writes values for old PRMS-IV parameters to a file based on a PRMS-V Parameter File when control parameter model_mode is specified equal to CONVERT4.
frost_date	Writes a parameter file of the last spring frost and first fall frost for each HRU based on the simulation time period and distributed temperature as required by the <code>transp_frost</code> module; land, subsurface, and stream processes are not computed.
map_results	Writes HRU summaries to a user specified target map at weekly, monthly, yearly, and total time steps.
nhru_summary	Writes user-selected results dimensioned by the value of dimension nhru to separate CSV Files at daily, monthly, mean monthly, mean yearly, and yearly total time steps when control parameter nhruOutON_OFF is specified equal to 1 or 2.
nsegment_summary	Writes user-selected results dimensioned by the value of dimension nsegment to separate CSV Files at daily, monthly, mean monthly, mean yearly, and yearly total time steps when control parameter nsegmentOutON_OFF is specified equal to 1 or 2.
nsub_summary	Writes user-selected results dimensioned by the value of dimension nsub to separate CSV Files at daily, monthly, mean monthly, mean yearly, and yearly total time steps when control parameter nsubOutON_OFF is specified equal to 1 or 2.
prms_summary	Writes selected basin area-weighted results to a Comma-Separated Values (CSV) File when control parameter csvON_OFF is specified equal to 1.
subbasin	Computes streamflow at internal basin nodes and variables by subbasin.
write_climate_hru	Writes climate-by-HRU Files of user-selected climate variables on the basis of distributed climate; land, subsurface, and stream processes are not computed.

Table 1-1. Dimensions used in the Precipitation-Runoff Modeling System, version 5 (PRMS-V).

[HRU, hydrologic response unit; GWR, groundwater reservoir; >, greater than; POI, points-of-interest; control parameters **temp_module**, **precip_module**, **solrad_module**, **et_module**, **strmflow_module**, **subbasin_flag**, **cascade_flag**, **cascadegw_flag**, and **mapOutON_OFF** defined in table 1-2; parameter **hru_solsta** defined in table 1-3; **red** highlight indicates new for PRMS-5.2; **pink** highlight indicates new for PRMS-5.1.0; **green** highlight indicates new for PRMS-5.0]

Dimension ³	Description	Default	Required/Condition
Spatial dimensions			
ngw ²	Number of GWRs	1	required
ngwcell	Number of spatial units in the target map for mapped results	0	mapOutON_OFF = 1
nhru	Number of hydrologic response units	1	required
nhruccell	Number of unique intersections between HRUs and spatial units of a target map for mapped results	0	mapOutON_OFF = 1
nlake	Number of lakes	0	required when any HRU has hru_type specified equal to 2
nlake_hrus	Number of lake HRUs	0	required when any HRU has hru_type specified equal to 2
nsegment	Number of stream-channel segments	0	strmflow_module = muskingum_lake , muskingum , muskingum_mann , or strmflow_in_out or cascade_flag = 1 or 2 or cascadegw_flag = 1 or 2
nssr ²	Number of subsurface reservoirs	1	required
nsub	Number of internal subbasins	0	subbasin_flag = 1
Time-series input data dimensions ¹			
nconsumed	Number of consumptive water-use destinations	0	optional
nevap	Number of pan-evaporation data sets	0	et_module = potet_pan
nexternal	Number of external water-use sources or destinations	0	optional
nhumid	Number of relative humidity measurement stations	0	optional
nlakeelev	Maximum number of lake elevations for any rating table data set	0	strmflow_module = muskingum_lake
nmap	Number of spatial units in mapped climate	0	temp_module = temp_map or precip_module = precip_map
nmap2hru	Number of intersections between HRUs and spatial units in mapped climate	0	temp_module = temp_map or precip_module = precip_map
nobs	Number of streamflow-measurement stations	0	replacement flow when strmflow_module = muskingum_lake , muskingum , muskingum_mann , or strmflow_in_out
npoigages	Number of points-of-interest streamflow gages	0	optional
nrain	Number of precipitation-measurement stations	0	precip_module = precip_1sta , precip_laps , precip_dist2 , ide_dist , or xyz_dist
nratetbl	Number of rating-table data sets for lake elevations	0	strmflow_module = muskingum_lake
nsnow	Number of snow-depth measurement stations	0	optional

Dimension ³	Description	Default	Required/Condition
nsol	Number of solar-radiation measurement stations	0	computation of solar radiation distribution using parameter hru_solsta
ntemp	Number of air-temperature-measurement stations	0	temp_module = temp_1sta, temp_sta, temp_laps, temp_dist2, ide_dist, or xyz_dist
nwateruse	Number of unique sources and destinations	0	Input of water-use information
nwind	Number of wind-speed measurement stations	0	optional
Computation dimensions			
ncascade	Number of HRU links for cascading flow	0	cascade_flag = 1 or 2
ncascdgw	Number of GWR links for cascading flow	0	cascadegw_flag = 1 or 2
ndepl	Number of snow-depletion curves	1	required
ndeplval	Number of values in all snow-depletion curves (set to ndepl *11)	11	required
Lake computation dimensions			
mxnsos	Maximum number of storage/outflow table values for storage-detention reservoirs and lakes connected to the stream network using Puls routing	0	strmflow_module = muskingum_lake
ngate	Maximum number of reservoir gate-opening values (columns) for lake rating table 1	0	strmflow_module = muskingum_lake and nratetbl > 0
ngate2	Maximum number of reservoir gate-opening values (columns) for lake rating table 2	0	strmflow_module = muskingum_lake and nratetbl > 1
ngate3	Maximum number of reservoir gate-opening values (columns) for lake rating table 3	0	strmflow_module = muskingum_lake and nratetbl > 2
ngate4	Maximum number of reservoir gate-opening values (columns) for lake rating table 4	0	strmflow_module = muskingum_lake and nratetbl > 3
nstage	Maximum number of lake elevations values (rows) for lake rating table 1	0	strmflow_module = muskingum_lake and nratetbl > 0
nstage2	Maximum number of lake elevations values (rows) for lake rating table 2	0	strmflow_module = muskingum_lake and nratetbl > 1
nstage3	Maximum number of lake elevations values (rows) for lake rating table 3	0	strmflow_module = muskingum_lake and nratetbl > 2
nstage4	Maximum number of lake elevations values (rows) for lake rating table 4	0	strmflow_module = muskingum_lake and nratetbl > 3
Fixed dimensions			
four	Number of glacier variables in integer array	4	glacier_flag = 1
ndays	Maximum number of days in a year	366	optional
nglres	Number of reservoirs in a glacier	3	glacier_flag = 1
nlapse	Number of lapse rates in X, Y, and Z directions	3	precip_module = xyz_dist
nmonths	Number of months in a year	12	optional
one	Dimension of scalar parameters and variables	1	optional
seven	Number of glacier variables in real array	7	glacier_flag = 1

¹All associated data specified in Data File can be used for calibration purposes. While the default value for these dimensions is 0, there must be at least one column of measured data in the Data File, which could be a column of zeros.

²Use of **nssr** and **ngw** not equal to **nhru** is deprecated.

³Dimensions that do not have an associated parameter specified in the Parameter File or variable specified in the Data File are optional.

Table 1-2. Parameters specified in the Control File for the Precipitation-Runoff Modeling System, version 4 (PRMS-IV).

[Data Type: 1=integer, 2=single precision floating point (real), 3=double precision floating point (double); 4=character string; HRU, hydrologic response unit; GWR, groundwater reservoir; CBH, climate-by-HRU; ET, evapotranspiration; PET, potential evapotranspiration; >, greater than; dimensions **ncascade**, **ncascdgw**, and **nsub** defined in table 1-1; the first two blocks of control parameters listed in the table are recommended for every simulation, though all parameters are optional depending appropriateness of the default values; **red** highlight indicates new for PRMS-5.2; **pink** highlight indicates new for PRMS 5.1.0; **green** highlight indicates new for PRMS-5.0; **maximum value specified for integer parameters having a single value is 128**]

Parameter name	Description	Option	Number of Values	Data type	Default value
Simulation execution and required input and output files					
data_file ²	Pathname(s) for measured input Data File(s), typically a single Data File is specified	measured input	number of Data Files	4	prms.data
end_time	Simulation end date and time specified in order in the control item as: year, month, day, hour, minute, second	time period	6	1	2001, 9, 30, 0, 0, 0
model_mode	Flag to indicate the simulation mode (PRMS=version IV parameters; PRMS5=version V parameters; FROST=growing season for each HRU; WRITE_CLIMATE=write CBH files of minimum and maximum air temperature (variables <i>tminf</i> and <i>tmaxf</i> , in units: degrees Fahrenheit); precipitation (variable <i>hru_ppt</i> , in units: inches/day); solar radiation (variable <i>swrad</i> , in units: Langleys/day); potential ET (variable <i>potet</i> , in units: inches/day); and/or transpiration flag (variable <i>transp_on</i> , in units: none); POTET=simulate processes in computation sequence to potential ET; TRANSPIRE=simulate processes in computation sequence to determine transpiration period; DOCUMENTATION=write files of all declared parameters and variables in the executable)	simulation mode selection	1	4	PRMS5
model_output_file ²	Pathname for Water-Budget File for results module <i>basin_sum</i>	simulation output	1	4	prms.out
param_file ²	Pathname(s) for Parameter File(s)	parameter input	number of Parameter Files	4	prms.params
prms_warmup	Number of years to simulate before writing mapped results, Basin, nhru , nsub , or nsegment Summary Output Files	map_resultsON_OFF = 1, basinOutON_OFF = 1, nsubOutON_OFF = 1, nsegmentOutON_OFF = 1 or 2, or nhruOutON_OFF = 1 or 2	1	1	0
start_time	Simulation start date and time specified in order in the control item as: year, month, day, hour, minute, second	time period	6	1	2000, 10, 1, 0, 0, 0

Module selection and simulation options

Parameter name	Description	Option	Number of Values	Data type	Default value
cascade_flag	Flag to indicate if HRU cascades are computed (0=no; 1=yes; 2=simple cascades defined by parameter hru_segment)	cascade flow with ncascade > 0	1	1	1
cascadegw_flag	Flag to indicate if GWR cascades are computed (0=no; 1=yes; 2 = GWR cascades are set equal to the HRU cascades and parameters gw_up_id , gw_strmseg_down_in , gw_down_id , and gw_pct_up are not required)	cascade flow with ncascdgw > 0	1	1	1
dprst_flag	Flag to indicate if depression-storage simulation is computed (0=no; 1=yes)	surface-depression storage	1	1	0
et_module	Module name for potential evapotranspiration method (climate_hru , potet_jh , potet_hamon , potet_hs , potet_pt , potet_pm , potet_pm_sta , or potet_pan)	module selection	1	4	potet_jh
frozen_flag	Flag to indicate if continuous frozen ground index simulation is computed (0=no; 1=yes)	frozen ground	1	1	0
glacier_flag	Flag to indicate if glacier simulation is computed (0=no; 1=yes)	glacier	1	1	0
gwr_swale_flag	Flag to indicate if GWR swales are allowed (0=no; 1=groundwater flow goes to groundwater sink; 3=groundwater flow goes to stream segment specified using parameter hru_segment)	swales	1	1	0
mbInit_flag	Flag to indicate initial mass balance of glaciers (0=no optimization; 1=use first year of climate data; 2=constant mass balance gradient above and below equilibrium line altitude (ELA))	glacier_flag = 1	1	1	0
precip_module	Module name for precipitation-distribution method (climate_hru , ide_dist , precip_1sta , precip_dist2 , precip_laps , precip_map , or xyz_dist)	module selection	1	4	precip_1sta
snarea_curve_flag	Flag to specify snow depletion curve calculation method. (0=specify snow depletion curves with parameter hru_deplcrv and snarea_curve ; 1=compute using parameters snarea_a , snarea_b , snarea_c , and snarea_d)	optional	1	1	0
soilzone_aet_flag	Flag to specify soil-water evapotranspiration (ET) compute method. Either it's based on unsatisfied potential ET (PET) (0=compute soil-water ET based on unsatisfied ET and old upper zone replenishment method; 1=based on PET and new replenishment method); set to 0 for downward compatibility of old models, though it is recommended setting to 1 for new models	optional	1	1	0
solrad_module	Module name for solar-radiation-distribution method (ccsolrad or ddsolrad)	module selection	1	4	ddsolrad
srunoff_module	Module name for surface-runoff/infiltration computation method (srunoff_carea or srunoff_smidx)	module selection	1	4	srunoff_smidx

Parameter name	Description	Option	Number of Values	Data type	Default value
stream_temp_flag	Flag to specify whether to simulate stream temperature; strmflow_module must be set to muskingum, muskingum_mann, strmflow_in_out, or muskingum_lake	stream temperature	1	1	0
stream_temp_shade_flag	Flag to indicate how shade is used in the stream_temp module (0 = compute shade; 1 = specified constant)	stream temperature	1	1	0
strmflow_module	Module name for streamflow routing simulation method (strmflow, muskingum, muskingum_mann, strmflow_in_out, or muskingum_lake)	module selection	1	4	strmflow
strmtemp_humidity_flag	Flag to specify where humidity information is read from Data File for use by the stream_temp module (0=CBH File specified by control parameter humidity_day ; 1=parameter seg_humidity ; 2=Data File with values assigned based on parameter seg_humidity_sta), strmflow_module must be set to muskingum, muskingum_mann, strmflow_in_out, or muskingum_lake	stream temperature	1	1	0
subbasin_flag	Flag to indicate if internal subbasins are computed (0=no; 1=yes)	nsub > 0	1	1	1
temp_module	Module name for temperature-distribution method (climate_hru, temp_1sta, temp_sta, temp_dist2, temp_laps, temp_map, ide_dist, or xyz_dist)	module selection	1	4	temp_1sta
transp_module	Module name for transpiration simulation method (climate_hru, transp_frost, or transp_tindex)	module selection	1	4	transp_tindex
Climate-by-HRU Files					
cbh_binary_flag	Flag to specify whether to input CBH files in a binary format using the same order of values as the text file version (0=no; 1=yes)	input options	1	1	0
humidity_day²	Pathname of the CBH file of pre-processed humidity input data for each HRU to specify variable <i>humidity_hru</i> (units: percentage)	et_module = potet_pm	1	4	humidity.day
orad_flag	Flag to specify whether the variable <i>orad</i> is specified as the last column of the swrad_day CBH file (0=no; 1=yes)	solrad_module = climate_hru	1	1	1
potet_day²	Pathname of the CBH file of pre-processed potential-ET input data for each HRU to specify variable <i>potet</i> (units: inches/day)	et_module = climate_hru	1	4	potet.day
precip_day²	Pathname of the CBH file of pre-processed precipitation input data for each HRU to specify variable <i>precip</i> (units based on value specified for parameter precip_units)	precip_module = climate_hru	1	4	precip.day
swrad_day²	Pathname of the CBH file of pre-processed solar-radiation input data for each HRU to specify variable <i>swrad</i> (units: Langley/day)	solrad_module = climate_hru	1	4	swrad.day
tmax_day²	Pathname of the CBH file of pre-processed maximum air	temp_module =	1	4	tmax.day

Parameter name	Description	Option	Number of Values	Data type	Default value
	temperature input data for each HRU to specify variable <i>tmaxf</i> (units: degrees Fahrenheit)	<i>climate_hru</i>			
tmin_day²	Pathname of the CBH file of pre-processed minimum air temperature input data for each HRU to specify variable <i>tminf</i> (units: degrees Fahrenheit)	temp_module = <i>climate_hru</i>	1	4	<i>tmin.day</i>
transp_day²	Pathname of the CBH file of pre-processed transpiration on or off flag for each HRU file to specify variable <i>transp_on</i> (units: none)	transp_module = <i>climate_hru</i>	1	4	<i>transp.day</i>
windspeed_day²	Pathname of the CBH file of pre-processed wind speed input data for each HRU to specify variable <i>windspeed_hru</i> (units: meters/second)	et_module = <i>potet_pm</i>	1	4	<i>windspeed.day</i>
Dynamic Parameter Input					
covden_sum_dynamic	Pathname of the time series of pre-processed values for summer plant-cover density used to set values of covden_sum for each HRU	dyn_covden_flag = 1 or 3	1	4	<i>dyncovsum</i>
covden_win_dynamic	Pathname of the time series of pre-processed values for winter plant-cover density used to set values of covden_win for each HRU	dyn_covden_flag = 2 or 3	1	4	<i>dyncovwin</i>
covtype_dynamic	Pathname of the time series of pre-processed values used to set values of cov_type for each HRU	dyn_covtype_flag = 1	1	4	<i>dyncovtype</i>
dprst_depth_dynamic	Pathname of the time series of pre-processed values used to set values of dprst_depth_avg	dyn_dprst_flag = 2 or 3	1	4	<i>dyndprst_depth</i>
dprst_frac_dynamic	Pathname of the time series of pre-processed values used to set values of dprst_frac	dyn_dprst_flag = 1 or 3	1	4	<i>dyndprst_frac</i>
dyn_covden_flag	Flag to indicate if a time series of plant-canopy density values are input in a Dynamic Parameter File(s) (0=no; 1=file covden_sum_dynamic ; 2=file covden_win_dynamic ; 3=both)	dynamic canopy cover density	1	1	0
dyn_covtype_flag	Flag to indicate if a time series of plant-canopy type values are input in Dynamic Parameter File covtype_dynamic (0=no; 1=yes)	dynamic canopy cover type	1	1	0
dyn_dprst_flag	Flag to indicate if a time series of surface-depression values are input in a Dynamic Parameter File(s) (0=no; 1=file dprst_frac_dynamic ; 2=file dprst_depth_dynamic ; 3=both)	dynamic surface depression	1	1	0
dyn_fallfrost_flag	Flag to indicate if a time series of transpiration-start Julian day values are input in a Dynamic Parameter File(s) (0=no; 1=file fallfrost_dynamic)	dynamic transpiration and <i>transp_module</i> = <i>transp_frost</i>	1	1	0
dyn_imperv_flag	Flag to indicate if a time series of impervious values are input in a Dynamic Parameter File(s) (0=no; 1=file imperv_frac_dynamic ; 2=file imperv_stor_dynamic ; 3=both)	dynamic impervious	1	1	0
dyn_intep_flag	Flag to indicate if a time series of plant canopy interception values	dynamic interception	1	1	0

Parameter name	Description	Option	Number of Values	Data type	Default value
	are input in a Dynamic Parameter File(s) (0=no; 1=file wrain_intcp_dynamic ; 2=file srain_intcp_dynamic ; 4=file snow_intcp_dynamic ; additive combinations, such as 3=file wrain_intcp_dynamic and srain_intcp_dynamic , but not snow_intcp_dynamic)				
dyn_potet_flag	Flag to indicate if a time series of potential ET coefficient values are input in Dynamic Parameter File potet_coef_dynamic to update coefficients for the specified month for the selected potential ET module specified by control parameter et_module (0=no; 1=parameter jh_coef , pt_alpha , hs_krs , hamon_coef , epan_coef , potet_cbh_adj , and pm_n_coef used in potet_jh , potet_pt , potet_hs , potet_hamon , potet_pan , climate_hru , potet_pm , and potet_pm_sta modules, respectively; 2=parameter jh_coef_hru , pm_d_coef used in potet_jh , potet_pm , and potet_pm_sta modules, respectively)	dynamic potential ET	1	1	0
dyn_radtrncf_flag	Flag to indicate if a time series of solar radiation values are input in Dynamic Parameter File radtrncf_dynamic (0=no; 1=yes)	dynamic solar radiation transmission	1	1	0
dyn_soil_flag	Flag to indicate if a time series of soil-water capacity values are input in a Dynamic Parameter File(s) (0=no; 1=file soilmoist_dynamic only, 2=file soilrechr_dynamic only; 3=both)	dynamic soil moisture	1	1	0
dyn_springfrost_flag	Flag to indicate if a time series of transpiration-start Julian day values are input in a Dynamic Parameter File(s) (0=no; 1=file springfrost_dynamic)	dynamic transpiration and transp_module = transp_frost	1	1	0
dyn_sro2dprst_perv_flag	Flag to indicate if a time series of fraction of surface runoff from the pervious portion of an HRU are input in Dynamic Parameter File sro2dprst_perv_dyn (0=no; 1=yes)	dynamic surface depression	1	1	0
dyn_sro2dprst_imperv_flag	Flag to indicate if a time series of fraction of surface runoff from the impervious portion of an HRU are input in Dynamic Parameter File sro2dprst_imperv_dynamic (0=no; 1=yes)	dynamic surface depression	1	1	0
dyn_transp_flag	Flag to indicate if a time series of transpiration month values are input in a Dynamic Parameter File(s) (0=no; 1=file transpbeg_dynamic ; 2=file transpend_dynamic only, 3=both)	dynamic transpiration and transp_module = transp_tindex	1	1	0
dynamic_param_log_file	Pathname of the log file that summarizes dynamic parameter changes	for all dynamic parameter input	1	4	dynamic_parameter.out
fallfrost_dynamic	Pathname of the time series of pre-processed values for dynamic parameter fall_frost	dyn_fallfrost_flag = 1 and transp_module = transp_frost	1	4	dynfallfrost
imperv_frac_dynamic	Pathname of the time series of pre-processed values for dynamic	dyn_imperv_flag = 1 or 3	1	4	dynimperv

Parameter name	Description	Option	Number of Values	Data type	Default value
imperv_stor_dynamic	parameter hru_percent_imperv Pathname of the time series of pre-processed values for dynamic	dyn_imperv_flag = 2 or 3	1	4	dynimperv
potet_coef_dynamic	parameter imperv_stor_max Pathname of the time series of pre-processed potential evapotranspiration coefficient values where the parameter is dependent on the value of et_module	dyn_potet_flag = 1 or 2	1	4	dynpotetcoef
radtrncf_dynamic	Pathname of the time series of pre-processed values for dynamic parameter rad_trncf	dyn_radtrncf_flag = 1	1	4	dynradtrncf
snow_intcp_dynamic	Pathname of the time series of pre-processed values for dynamic parameter snow_intcp	dyn_intcp_flag = 4, 5, 6, or 7	1	4	dynsnowintcp
soilmoist_dynamic	Pathname of the time series of pre-processed values for dynamic parameter soil_moist_max	dyn_soil_flag = 1 or 3	1	4	dynsoilmoist
soilrechr_dynamic	Pathname of the time series of pre-processed values for dynamic parameter soil_rechr_max_frac	dyn_soil_flag = 2 or 3	1	4	dynsoilrechr
springfrost_dynamic	Pathname of the time series of pre-processed values for dynamic parameter spring_frost	dyn_springfrost_flag = 1 and transp_module = transp_frost	1	4	dynspringfrost
srain_intcp_dynamic	Pathname of the time series of pre-processed values for dynamic parameter srain_intcp	dyn_intcp_flag = 2, 3, 6, or 7	1	4	dynsrainintcp
sro2dprst_perv_dynamic	Pathname of the time series of pre-processed values for dynamic parameter sro_to_dprst_perv	dyn_sro2dprst_perv_flag = 1	1	4	dynsrotodprst_perv
sro2dprst_imperv_dynamic	Pathname of the time series of pre-processed values for dynamic parameter sro_to_dprst_imperv	dyn_sro2dprst_imperv_flag = 1	1	4	dynsrotodprst_imperv
transpbeg_dynamic	Pathname of the time series of pre-processed values for dynamic parameter transp_beg	dyn_transp_flag = 1 or 3 and transp_module = transp_tindex	1	4	dyntranspbeg
transpend_dynamic	Pathname of the time series of pre-processed values for dynamic parameter transp_end	dyn_transp_flag = 2 or 3 and transp_module = transp_tindex	1	4	dyntranspend
wrain_intcp_dynamic	Pathname of the time series of pre-processed values for dynamic parameter wrain_intcp	dyn_intcp_flag = 1, 3, 5, or 7	1	4	dynwrainintcp
Water Use Input					
dprst_transfer_file	Pathname of the time series of pre-processed flow rates for transfers from surface-depression storage	dprst_transferON_OFF = 1 and dprst_flag = 1	1	4	dprst.transfer
dprst_transferON_OFF	Flag to indicate to use time series of surface-depression transfer flow rates from the dprst_transfer_file (0=no; 1=yes)	surface depression transfer and dprst_flag = 1	1	1	0
external_transfer_file	Pathname of the time series of pre-processed flow rates for transfers	external_transferON_OFF	1	4	ext.transfer

Parameter name	Description	Option	Number of Values	Data type	Default value
	from external sources	= 1			
external_transferON_OFF	Flag to indicate to use external transfer flow rates from the external_transfer_file (0=no; 1=yes)	external transfer	1	1	0
gwr_transfer_file	Pathname of the time series of pre-processed flow rates for transfers from groundwater reservoir storage	gwr_transferON_OFF = 1	1	4	<code>gwr.transfer</code>
gwr_transferON_OFF	Flag to indicate to use groundwater transfer flow rates from the gwr_transfer_file (0=no; 1=yes)	groundwater transfer	1	1	0
lake_transfer_file	Pathname of the time series of pre-processed flow rates for transfers from lake HRUs	lake_transferON_OFF = 1	1	4	<code>lake.transfer</code>
lake_transferON_OFF	Flag to indicate to use lake HRU transfer flow rates from the lake_transfer_file (0=no; 1=yes)	lake water transfer	1	1	0
segment_transfer_file	Pathname of the time series of pre-processed flow rates for transfers from stream segments	segment_transferON_OFF = 1	1	4	<code>seg.transfer</code>
segment_transferON_OFF	Flag to indicate to use stream segment transfer flow rates from the segment_transfer_file (0=no; 1=yes)	stream water transfer	1	1	0
Debug options					
cbh_check_flag	Flag to indicate if CBH values are validated each time step (0=no; 1=yes)	CBH input	1	1	1
parameter_check_flag	Flag to indicate if selected parameter values validation checks are treated as warnings or errors (0=warnings; 1=errors; 2=check parameters and then stop)	parameter validation check	1	1	1
print_debug¹	Flag to indicate type of debug output (-2=minimal output to screen and no model_output_file ; -1=minimize screen output; 0=none; 1=water balances; 2=basin module; 4=basin_sum module; 5=soltab module; 7=soilzone module; 9=snowcomp module; 13=cascade module; 14=subbasin module)	debug output	1	1	0
Statistic Variables (statvar) Files					
nstatVars	Number of variables to include in Statistics Variables File and names specified in statVar_names	statsON_OFF = 1	1	1	0
stat_var_file²	Pathname for Statistics Variables File	statsON_OFF = 1	1	4	<code>statvar.out</code>
statsON_OFF	Switch to specify whether the Statistics Variables File is generated (0=no; 1=statvar text format; 2=CSV format)	statsON_OFF = 1	1	1	0
statVar_element	List of identification numbers corresponding to variables specified in statVar_names list (1 to variable's dimension size)	statsON_OFF = 1	nstatVars	4	none
statVar_names	List of variable names for which output is written to Statistics Variables File	statsON_OFF = 1	nstatVars	4	none

Parameter name	Description	Option	Number of Values	Data type	Default value
Initial Condition Files					
init_vars_from_file	Flag to specify whether or not the Initial Conditions File is specified as an input file (0=no; 1=yes; 2=yes and use parameters dprst_frac_init , snowpack_init , segment_flow_init , elevlake_init , gwstor_init , (soil_rechr_init , soil_moist_init , ssstor_init for model_mode =PRMS) or (soil_rechr_init_frac , soil_moist_init_frac , ssstor_init_frac for model_mode =PRMS5), and stream_tave_init ; 3=yes and use parameter snowpack_init ; 4=yes and use parameter elevlake_init ; 5=yes and use parameters (soil_rechr_init , soil_moist_init , ssstor_init for model_mode =PRMS) or (soil_rechr_init_frac , soil_moist_init_frac , ssstor_init_frac for model_mode =PRMS5); 6=yes and use parameter gwstor_init ; 7=yes and use parameter dprst_frac_init ; 8=yes and use parameter stream_tave_init)	initial conditions	1	1	0
save_vars_to_file	Flag to determine if an Initial Conditions File will be generated at the end of simulation (0=no; 1=yes)	initial conditions	1	1	0
var_init_file ²	Pathname for Initial Conditions input file	init_vars_from_file = 1	1	4	prms_ic.in
var_save_file ²	Pathname for the Initial Conditions File to be generated at end of simulation	save_vars_to_file = 1	1	4	prms_ic.out
Animation Files					
ani_output_file ²	Pathname for Animation Files(s) to which a filename suffix based on dimension name associated with selected variables is appended	aniOutON_OFF = 1	1	4	animation.out
aniOutON_OFF	Switch to specify whether Animation File(s) are generated (0=no; 1=yes)	animation output	1	1	0
aniOutVar_names	List of variable names for which all values of the variable (that is, the entire dimension size) for each time step are written Animation Dimension Files(s)	aniOutON_OFF = 1	naniOutVars	4	none
naniOutVars	Number of output variables specified in the aniOutVar_names list	aniOutON_OFF = 1	1	1	0
Basin Summary Results Files					
basinOutBaseFileName ²	String to define the prefix for each basin summary output file.	basinOutON_OFF = 1	1	4	basinout_path
basinOutON_OFF	Switch to specify whether basin summary output files are generated (0=no; 1=yes)	basin summary results	1	1	0
basinOutVar_names	List of variable names for which output is written to basin summary Comma Separated Values (CSV) output file(s). Each variable is written to files in the order specified in basinOutVars with the prefix of each file equal to the value of basinOutBaseFileName . The suffix of the files is based on the value of basinOut_freq and will be .csv; _meanyearly.csv; _yearly.csv; _meanmonthly.csv; or	basinOutON_OFF = 1	basinOutVars	4	none

Parameter name	Description	Option	Number of Values	Data type	Default value
	_monthly.csv; variables must be of type real or double				
basinOutVars	Number of variables to include in basin summary output file(s)	basinOutON_OFF = 1	1	1	0
basinOut_freq	Output frequency and type (1=daily; 2=monthly; 3=both; 4=mean monthly; 5=mean yearly; 6=yearly)	basinOutON_OFF = 1	1	1	1
Mapped Results Files					
mapOutON_OFF	Switch to specify whether mapped output file(s) by a specified number of columns (parameter ncol) of daily, monthly, yearly, or total simulation results is generated (0=no; 1=yes)	mapped results	1	1	0
mapOutVar_names	List of variable names for which output is written to mapped output files(s); variables must be of type real or double.	map_resultsON_OFF = 1	nmapOutVars	4	none
nmapOutVars	Number of variables to include in mapped output file(s)	map_resultsON_OFF = 1	1	1	0
Nhru Summary Results Files					
nhruOut_format	Format of values (1=scientific notation with 4 significant digits (default); 2=2 decimal places; 3=3 decimal places; 4=4 decimal places; 5=5 decimal places)	nhruOutON_OFF = 1 or 2	1	1	1
nhruOut_freq	Output frequency and type (1=daily; 2=monthly; 3=both; 4=mean monthly; 5=mean yearly; 6=yearly)	nhruOutON_OFF = 1 or 2	1	1	1
nhruOutBaseFileName ²	String to define the prefix for each nhru summary output file.	nhruOutON_OFF = 1 or 2	1	4	nhruout_path
nhruOutNcol	Number of columns written per line, which can be used to generate gridded output (0=all values for each timestep are written on a single line as in previous versions; >0 number of columns)	nhruOutON_OFF = 1 or 2	1	1	0
nhruOutON_OFF	Switch to specify whether nhru summary output files are generated (0=no; 1=yes; 2=yes and use values of nhm_id as column heading)	nhru summary results	1	1	0
nhruOutVar_names	List of variable names for which output is written to nhru summary Comma Separated Values (CSV) output files(s). Each variable is written to a separate file with the prefix of each file equal to the value of nhruOutBaseFileName ; variables must be of type real or double. Each variable is written to a separate file with the prefix of each file equal to the value of nhruOutBaseFileName . The suffix of the files is based on the value of nhruOut_freq and will be .csv; _meanyearly.csv; _yearly.csv; _meanmonthly.csv; or _monthly.csv	nhruOutON_OFF = 1 or 2	nhruOutVars	4	none
nhruOutVars	Number of variables to include in nhru_summary output file(s)	nhruOutON_OFF = 1 or 2	1	1	0
outputSelectDatesON_OFF	Switch to indicate if nhru_summary output files are generated for a specified set of dates (0=no, output time series on basis of nhruOut_freq ; 1=yes, specify dates in file specified by selectDatesFileName)	nhru summary results and nhruOut_freq = 1 or 3	1	1	0
selectDatesFileName ²	String to define the filename of the set of dates to output values of	outputSelectDatesON_OF	1	4	selectDates.in

Parameter name	Description	Option	Number of Values	Data type	Default value
	nhru_summary output files in chronological order with dates specified as YEAR MONTH DAY with a space(s) and/or comma separating YEAR and MONTH and MONTH and DAY (e.g. 1959 09 01)	F = 1			
Nsub Summary Results Files					
nsubOutBaseFileName²	String to define the prefix for each nsub summary output file.	nsubOutON_OFF = 1	1	4	nsubout_path
nsubOutON_OFF	Switch to specify whether nsub summary output files are generated (0=no; 1=yes)	nsub summary results	1	1	0
nsubOutVar_names	List of variable names for which output is written to nsub summary Comma Separated Values (CSV) output files(s). Each variable is written to a separate file with the prefix of each file equal to the value of nsubOutBaseFileName ; variables must be of type real or double. The suffix of the files is based on the value of nsubOut_freq and will be .csv; _meanyearly.csv; _yearly.csv; _meanmonthly.csv; or _monthly.csv.	nsubOutON_OFF = 1	nsubOutVars	4	none
nsubOutVars	Number of variables to include in nsub summary output file(s)	nsubOutON_OFF = 1	1	1	0
nsubOut_format	Format of values (1=scientific notation with 4 significant digits (default); 2=2 decimal places; 3=3 decimal places; 4=4 decimal places; 5=5 decimal places)	nsubOutON_OFF = 1	1	1	1
nsubOut_freq	Output frequency and type (1=daily; 2=monthly; 3=both; 4=mean monthly; 5=mean yearly; 6=yearly)	nsubOutON_OFF = 1	1	1	1
Nsegment Summary Results Files					
nsegmentOutBaseFileName²	String to define the prefix for each nsegment summary output file.	nsegmentOutON_OFF = 1 or 2	1	4	nsegmentout_path
nsegmentOutON_OFF	Switch to specify whether nsegment summary output files are generated (0=no; 1=yes; 2=yes and use values of nhm_seg as column heading)	nsegment summary results	1	1	0
nsegmentOutVar_names	List of variable names for which output is written to nsegment summary Comma Separated Values (CSV) output files(s). Each variable is written to a separate file with the prefix of each file equal to the value of nsegmentOutBaseFileName ; variables must be of type real or double; the suffix of the files is based on the value of nsegmentOut_freq and will be .csv; _meanyearly.csv; _yearly.csv; _meanmonthly.csv; or _monthly.csv	nsegmentOutON_OFF = 1 or 2	nsubOutVars	4	none
nsegmentOutVars	Number of variables to include in nsegment summary output file(s)	nsegmentOutON_OFF = 1 or 2	1	1	0
nsegmentOut_format	Format of values (1=scientific notation with 4 significant digits (default); 2=2 decimal places; 3=3 decimal places; 4=4 decimal	nsegmentOutON_OFF = 1 or 2	1	1	1

Parameter name	Description	Option	Number of Values	Data type	Default value
nsegmentOut_freq	places; 5=5 decimal places) Output frequency and type (1=daily; 2=monthly; 3=both; 4=mean monthly; 5=mean yearly; 6=yearly)	nsegmentOutON_OFF = 1 or 2	1	1	1
PRMS Summary Results Files					
csvON_OFF	Switch to specify whether or not the PRMS Comma-Separated-Values (CSV) output file is generated (0=no; 1=yes; 2=only output pairs of simulated and measured flows)	PRMS summary results	1	1	0
csv_output_file ²	Pathname of CSV output file	csvON_OFF = 1	1	4	prms_summary.csv
Runtime graphs					
dispGraphsBuffSize	Number of time steps to wait before updating the runtime graph	ndispGraphs > 0	1	1	50
dispVar_element	List of identification numbers corresponding to variables specified in dispVar_names list (1 to variable's dimension size)	ndispGraphs > 0	number of variables	4	none
dispVar_names	List of variable names for which plots are output to the runtime graph	ndispGraphs > 0	number of variables	4	none
dispVar_plot	List of variable names for which plots are output to the runtime graph	ndispGraphs > 0	number of variables	4	none
executable_desc	Descriptive text to identify the PRMS executable	ndispGraphs > 0	1	4	MOWS executable
executable_model ²	Pathname (full or relative) of the PRMS executable	ndispGraphs > 0	1	4	prmsIV
initial_deltat	Initial time step for the simulation	ndispGraphs > 0	1	2	24.0
ndispGraphs	Number of plots included in the runtime graph	graphical output	1	1	0

¹File and screen output options: 1=water balance output files written in current directory, for `intcp` module file `intcp.wbal`; for `snowcomp` module `snowcomp.wbal`; for `srunoff` module `srunoff_smidx.wbal` or `srunoff_carea.wbal`; for `soilzone` module `soilzone.wbal`; for `gwflow` module `gwflow.wbal`; 2=basin module output written to screen; 4=basin_sum debug information written to file `basin_sum.dbg` in current directory; 5=soltab module output written to the file `soltab_debug` in current directory; 7=soilzone debug information concerning input parameter consistency written to file `soilzone.dbg` in current directory; 9=arrays of *net_rain*, *net_snow*, and *snowmelt* written to screen; 13=subbasin error and warning messages and cascade paths are written to the file `cascade.msgs` in current directory; 14=subbasin computation order written to file `tree_structure` in current directory.

²Pathnames for all files can have a maximum of 256 characters.

Table 1-3. Parameters listed by usage with the associated modules in which they are used for the Precipitation-Runoff Modeling System, version 4 (PRMS-IV).

[HRU, hydrologic response unit; GWR, groundwater reservoir; cfs, cubic feet per second; cms, cubic meters per second; ET, evapotranspiration; Id, number of modeling unit; dday, degree-day, the amount a day's average temperature departed from 65 degrees Fahrenheit; **km, kilometer; m, meters**; POI, point-of-interest; ELA, equilibrium line altitude, >, greater than; dimensions defined in table 1-1; control parameters **temp_module**, **precip_module**, **solrad_module**, **et_module**, **transp_module**, **srutoff_module**, **strmflow_module**, **model_mode**, **dprst_flag**, **subbasin_flag**, **cascade_flag**, **cascadegw_flag**, and **mapOutON_OFF** defined in table 1-2; **red** highlight indicates new for PRMS-5.2; **pink** highlight indicates new for PRMS-5.1; **green** highlight indicates new for PRMS-5.0; **turquoise** highlight indicates deprecated but retained for PRMS-IV backward compatibility; ~~strike through~~ indicates items removed]

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
Basic physical attributes							
elev_units	Flag to indicate the units of elevation values (0=feet; 1=meters)	one	integer	none	0 or 1	0	required
hru_area	Area of each HRU	nhru	real	acres	0.0001 to 1.0E9	1.0	required
hru_aspect	Aspect of each HRU	nhru	real	angular degrees	0.0 to 360.0	0.0	required
hru_elev	Mean elevation for each HRU	nhru	real	elev_units	-1,000.0 to 30,000.0	0.0	required
hru_lat	Latitude of each HRU	nhru	real	degrees North	-90.0 to 90.0	40.0	required
hru_lon	Longitude of each HRU	nhru	real	degrees East	-360.0 to 360.0	-105.0	optional
hru_slope	Slope of each HRU	nhru	real	decimal fraction	0.0 to 10.0	0.0	required
hru_type⁵	Type of each HRU (0=inactive; 1=land; 2=lake; 3=swale; 4=glacier)	nhru	integer	none	0 to 4	1	required
nhm_id	National Hydrologic Model HRU ID	nhru	integer	none	1 to 9999999	1	optional
nhm_seg	National Hydrologic Model segment ID	nsegment	integer	none	1 to 9999999	1	optional
parent_gw	Index in parent model for each GWR	ngw	integer	none	1 to 9999999	1	optional
parent_hru	Index in parent model for each HRU	nhru	integer	none	1 to 9999999	1	optional
parent_poigages	Index in parent model for each POI gage	npoigages	integer	none	1 to 9999999	1	optional
parent_segment	Index in parent model for each segment	nsegment	integer	none	1 to 9999999	1	optional
parent_ssr	Index in parent model for each SSR	nssr	integer	none	1 to 9999999	1	optional

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
9999999							
Measured input							
outlet_sta	Index of measured streamflow station corresponding to the basin outlet	one	integer	none	0 to nobs	0	nobs > 0
precip_units	Flag to indicate the units of measured precipitation values (0=inches; 1=mm)	one	integer	none	0 or 1	0	required
rad_conv	Conversion factor to Langleys for measured solar radiation	one	real	Langleys/ radiation units	0.1 to 100.0	1.0	nsol > 0
rain_code	Monthly (January to December) flag indicating rule for precipitation measurement station use (1=only precipitation if the regression stations have precipitation; 2=only precipitation if any station in the basin has precipitation; 3=precipitation if module <code>xyz_dist</code> computes any; 4=only precipitation if <code>rain_day</code> variable is set to 1; 5=only precipitation if <code>psta_freq_nuse</code> stations have precipitation)	nmonths	integer	none	1 to 5	2	precip_module = <code>xyz_dist</code>
runoff_units	Measured streamflow units (0=cfs; 1=cms)	one	integer	none	0 or 1	0	nobs > 0
temp_units	Flag to indicate the units of measured air-temperature values (0=Fahrenheit; 1=Celsius)	one	integer	none	0 or 1	0	required
Water Use input							
irr_type	Application method of irrigation water for each HRU (0 = sprinkler method with interception only; 1=ditch/drip method with no interception; 2=ignore; 3=sprinkler across whole HRU with interception' and throughfall; 4=sprinkler method with amount of water applied on the basis of cover density, such as a living filter), for options 1, 2, and 3 irrigation water is specified as an' HRU-area weighted average value	nhru	integer	none	0 to 4	0	nwateruse > 1 and at least one water-use destination is the plant canopy, <code>dest_type</code> = 8
Air temperature and precipitation distribution							
adjmix_rain	Monthly (January to December) factor to adjust rain proportion in a mixed rain/snow event	nhru, nmonths	real	decimal fraction	0.0 to 3.0	1.0	required
adjust_rain	Monthly (January to December) rain downscaling adjustment factor for each precipitation measurement station	nrain, nmonths	real	decimal fraction	-0.5 to 3.0	-0.4	precip_module = <code>ide_dist</code> or <code>xyz_dist</code>
adjust_snow	Monthly (January to December) snow downscaling adjustment factor for each precipitation measurement station	nrain, nmonths	real	decimal fraction	-0.5 to 3.0	-0.4	precip_module = <code>ide_dist</code> or <code>xyz_dist</code>
basin_tsta	Index of temperature station used to compute basin	one	integer	none	0 to ntemp	0	temp_module =

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
	temperature values						temp_1sta, temp_sta, temp_dist2, or temp_laps
conv_flag	Elevation conversion flag (0=none; 1=feet to meters; 2=meters to feet)	one	integer	none	0 to 2	0	precip_module and temp_module = xyz_dist
dist_exp	Exponent for inverse distance calculations	one	real	none	0.0 to 10.0	2.0	precip_module and temp_module = ide_dist
dist_max	Maximum distance from an HRU to a measurement station for use in calculations	one	real	feet	0.0 to 1.0E9	1.0E9	precip_module = precip_dist2 and/or temp_module = temp_dist2
hru2map_id	HRU identification number for each HRU to mapped spatial units' intersection	nmap2hru	integer	none	0 to nmap	0	precip_module = precip_map and/or temp_module = temp_map
hru2map_pct	Portion of HRU associated with each HRU to map intersection	nmap2hru	real	decimal fraction	0.0 to 1.0	0.0	precip_module = precip_map and/or temp_module = temp_map
hru_plaps	Index of the lapse precipitation measurement station used for lapse rate calculations for each HRU	nhru	integer	none	0 to nrain	0	precip_module = precip_laps
hru_psta	Index of the base precipitation measurement station used for lapse rate calculations for each HRU	nhru	integer	none	0 to nrain	0	precip_module = precip_1sta or precip_laps
hru_tlaps	Index of the lapse temperature station used for lapse rate calculations	nhru	integer	none	0 to ntemp	0	temp_module = temp_laps
hru_tsta	Index of the base temperature station used for lapse rate calculations	nhru	integer	none	0 to ntemp	0	temp_module = temp_1sta, temp_sta, or temp_laps
hru_x	Longitude (X) of each HRU for the centroid in albers projection	nhru	real	meters	-1.0E7 to 1.0E7	0.0	precip_module and temp_module = ide_dist or xyz_dist
hru_xlong	Longitude of each HRU for the centroid, State Plane Coordinate System	nhru	real	feet	-1.0E9 to 1.0E9	0.0	temp_module = temp_dist2 or precip_module =

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
hru_y	Latitude (Y) of each HRU for the centroid in albers projection	nhru	real	meters	-1.0E7 to 1.0E7	0.0	precip_dist2 precip_module and temp_module = ide_dist or xyz_dist
hru_ylat	Latitude of each HRU for the centroid, State Plane Coordinate System	nhru	real	feet	-1.0E9 to 1.0E9	0.0	temp_module = temp_dist2 and/or precip_module = precip_dist2
lapsemax_max	Monthly (January to December) maximum lapse rate to constrain lowest maximum lapse rate based on historical daily air temperatures for all air temperature-measurement stations	nmonths	real	temp_units/ feet	-3.0 to 3.0	2.0	temp_module = temp_dist2
lapsemax_min	Monthly (January to December) maximum lapse rate to constrain lowest minimum lapse rate on the basis of historical daily air temperatures for all air temperature-measurement stations	nmonths	real	temp_units/ feet	-7.0 to -3.0	-6.5	temp_module = temp_dist2
lapsemin_max	Monthly (January to December) minimum lapse rate to constrain lowest maximum lapse rate on the basis of historical daily air temperatures for all air temperature-measurement stations	nmonths	real	temp_units/ feet	-2.0 to 4.0	3.0	temp_module = temp_dist2
lapsemin_min	Monthly (January to December) minimum lapse rate to constrain lowest minimum lapse rate on the basis of historical daily air temperatures for all air temperature-measurement stations	nmonths	real	temp_units/ feet	-7.0 to -3.0	-4.0	temp_module = temp_dist2
map2hru_id	Mapped spatial unit identification number for each HRU to map intersection	nmap2hru	integer	none	0 to nhru	0	precip_module = precip_map and/or temp_module = temp_map
max_lapse	Monthly (January to December) maximum air temperature lapse rate for each direction (X, Y, and Z)	nlapse, nmonths	real	none	-100.0 to 100.0	0.0	temp_module = xyz_dist
max_missing	Maximum number of consecutive missing values allowed for any air temperature measurement station; missing value set to last valid value; 0=unlimited	one	integer	none	0 to 10	3	temp_module = temp_1sta, temp_sta, or temp_laps
max_psta	Maximum number of precipitation measurement stations to use for distributing precipitation to an HRU	one	integer	none	0 to nrain	0	precip_module = precip_dist2
max_tsta	Maximum number of air temperature measurement stations to use for distributing temperature to an HRU	one	integer	none	0 to ntemp	0	temp_module = temp_dist2
maxday_prec	Maximum measured precipitation value above which	one	real	precip_units	0.0 to 20.0	15.0	precip_module =

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
min_lapse	precipitation is assumed to be in error Monthly (January to December) minimum air temperature lapse rate for each direction (X, Y, and Z)	nlapse, nmonths	real	none	-100.0 to 100.0	0.0	precip_dist2 temp_module = xyz_dist
monmax	Monthly maximum air temperature to constrain lowest maximum air temperatures for bad values on the basis of historical temperature for all measurement stations	nmonths	real	temp_units	0.0 to 115.0	100.0	temp_module = temp_dist2
monmin	Monthly minimum air temperature to constrain lowest maximum air temperatures for bad values on the basis of historical temperature for all measurement stations	nmonths	real	temp_units	-60.0 to 65.0	-60.0	temp_module = temp_dist2
ndist_psta	Number of precipitation measurement stations for inverse distance calculations	one	integer	none	0 to nrain	0	precip_module = ide_dist
ndist_tsta	Number of air temperature measurement stations for inverse distance calculations	one	integer	none	0 to ntemp	0	temp_module = ide_dist
padj_rn	Monthly (January to December) factor to adjust precipitation lapse rate computed between station hru_psta and station hru_plaps ; positive factors are multiplied times the lapse rate and negative factors are made positive and substituted for the computed lapse rate	nrain, nmonths	real	precip_units	-2.0 to 10.0	1.0	precip_module = precip_laps
padj_sn	Monthly (January to December) factor to adjust precipitation lapse rate computed between station hru_psta and station hru_plaps ; positive factors are multiplied times the lapse rate and negative factors are made positive and substituted for the computed lapse rate	nrain, nmonths	real	precip_units	-2.0 to 10.0	1.0	precip_module = precip_laps
pmn_mo	Mean monthly (January to December) precipitation for each lapse precipitation measurement station	nrain, nmonths	real	precip_units	0.00001 to 100.0	1.0	precip_module = precip_laps
potet_cbh_adj	Monthly (January to December) adjustment factor to potential evapotranspiration specified in CBH Files for each HRU	nhru, nmonths	real	decimal fraction	0.5 to 1.5	1.0	et_module = climate_hru
ppt_add	Mean value for the precipitation measurement station transformation equation	one	real	precip_units	-10.0 to 10.0	0.0	precip_module = xyz_dist
ppt_div	Standard deviation for the precipitation measurement station transformation equation (not 0 . 0)	one	real	precip_units	-10.0 to 10.0	1.0	precip_module = xyz_dist
ppt_lapse	Monthly (January to December) precipitation lapse rate for each direction (X, Y, and Z)	nlapse, nmonths	real	none	-10.0 to 10.0	0.0	precip_module = xyz_dist
ppt_zero_thresh	Precipitation below this amount is set to 0.0	one	real	precip_units	0.0 to 0.1	0.0	required
prcp_wght_dist	Monthly (January to December) precipitation weighting function for inverse distance calculations	nmonths	real	decimal fraction	0.0 to 1.0	0.5	precip_module = ide_dist
precip_map_adj	Monthly (January to December) multiplicative	nmap,	real	decimal	0.5 to 2.0	1.0	precip_module = precip_map

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
	adjustment factor to mapped precipitation to account for differences in elevation, and so forth	nmonths		fraction			
psta_elev	Elevation of each precipitation measurement station	nrain	real	elev_units	-300.0 to 30,000.0	0.0	precip_module = ide_dist, xyz_dist, or precip_laps
psta_freq_nuse	The subset of precipitation measurement stations used to determine if there is precipitation in the basin (0=station not used; 1=station used)	nrain	integer	none	0 or 1	1	precip_module = xyz_dist
psta_mon	Monthly (January to December) factor to precipitation at each measured station to adjust precipitation distributed to each HRU to account for differences in elevation, and so forth	nrain, nmonths	real	precip_units	0.0 to 50.0	1.0	precip_module = precip_dist2
psta_month_ppt	Average monthly (January to December) maximum precipitation at each precipitation measurement station	nrain, nmonths	real	precip_units	0.0 to 20.0	0.0	precip_module = xyz_dist
psta_nuse	The subset of precipitation measurement stations used in the distribution regression (0=station not used; 1=station used)	nrain	integer	none	0 or 1	1	precip_module = ide_dist or xyz_dist
psta_x	Longitude (X) for each precipitation measurement station in albers projection	nrain	real	meters	-1.0E7 to 1.0E7	0.0	precip_module = ide_dist or xyz_dist
psta_xlong	Longitude of each precipitation measurement station, State Plane Coordinate System	nrain	real	feet	-1.0E9 to 1.0E9	0.0	precip_module = precip_dist2
psta_y	Latitude (Y) for each precipitation measurement station in albers projection	nrain	real	meters	-1.0E7 to 1.0E7	0.0	precip_module = ide_dist or xyz_dist
psta_ylat	Latitude of each precipitation measurement station, State Plane Coordinate System	nrain	real	feet	-1.0E9 to 1.0E9	0.0	precip_module = precip_dist2
rain_adj	Monthly (January to December) factor to adjust measured precipitation on each HRU to account for differences in elevation, and so forth	nhru, nmonths	real	decimal fraction	0.5 to 10.0	1.0	precip_module = precip_1sta
rain_cbh_adj	Monthly (January to December) adjustment factor to measured precipitation determined to be rain on each HRU to account for differences in elevation, and so forth	nhru, nmonths	real	decimal fraction	0.5 to 2.0	1.0	precip_module = climate_hru
rain_mon	Monthly (January to December) factor to rain on each HRU to adjust precipitation distributed to each HRU to account for differences in elevation, and so forth	nhru, nmonths	real	precip_units	0.0 to 50.0	1.0	precip_module = precip_dist2
snow_adj	Monthly (January to December) factor to adjust measured precipitation on each HRU to account for differences in elevation, and so forth	nhru, nmonths	real	decimal fraction	0.5 to 2.5	1.0	precip_module = precip_1sta

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
snow_cbh_adj	Monthly (January to December) adjustment factor to measured precipitation determined to be snow on each HRU to account for differences in elevation, and so forth	nhru, nmonths	real	decimal fraction	0.5 to 2.0	1.0	precip_module = climate_hru
snow_mon	Monthly (January to December) factor to snow on each HRU to adjust precipitation distributed to each HRU to account for differences in elevation, and so forth	nhru, nmonths	real	precip_units	0.0 to 50.0	1.0	precip_module = precip_dist2
solrad_elev	Elevation of the solar radiation station used for the degree-day curves to distribute temperature	one	real	meters	-300.0 to 30,000.0	0.0	temp_module = ide_dist or xyz_dist
temp_wght_dist	Monthly (January to December) temperature weighting function for inverse distance calculations	nmonths	real	decimal fraction	0.0 to 1.0	0.5	temp_module = ide_dist
tmax_add	Mean value for the air-temperature measurement station transformation equation for maximum air temperature	one	real	temp_units	-100.0 to 100.0	0.0	temp_module = xyz_dist
tmax_adj	Adjustment to maximum air temperature for each HRU, estimated on the basis of slope and aspect	nhru, nmonths	real	temp_units	-10.0 to 10.0	0.0	temp_module = temp_1sta, temp_sta, temp_laps, temp_dist2, ide_dist or xyz_dist
tmax_allrain	Monthly (January to December) maximum air temperature when precipitation is assumed to be rain; if HRU air temperature is greater than or equal to this value, precipitation is rain	nhru, nmonths	real	temp_units	-8.0 to 75.0	38.0	model_mode = PRMS
tmax_allrain_dist	Monthly (January to December) maximum air temperature when precipitation is assumed to be rain; if HRU air temperature is greater than or equal to this value, precipitation is rain	nmonths	real	temp_units	-8.0 to 75.0	38.0	temp_module = xyz_dist
tmax_allrain_offset	Monthly (January to December) maximum air temperature when precipitation is assumed to be rain; if HRU air temperature is greater than or equal to tmax_allsnow plus this value, precipitation is rain	nhru, nmonths	real	temp_units	0.0 to 50.0	1.0	model_mode = PRMS5
tmax_allrain_sta	Monthly (January to December) maximum air temperature when precipitation is assumed to be rain; if air temperature is greater than or equal to this value, precipitation is rain	nrain, nmonths	real	temp_units	-8.0 to 75.0	38.0	temp_module = ide_dist
tmax_allsnow	Monthly (January to December) maximum air temperature when precipitation is assumed to be snow; if HRU air temperature is less than or equal to this value, precipitation is snow	nhru, nmonths	real	temp_units	-10.0 to 40.0	32.0	required

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
tmax_allsnow_dist	Maximum air temperature when precipitation is assumed to be snow; if mean air temperature is less than or equal to this value, precipitation is snow	one	real	temp_units	-10.0 to 40.0	32.0	temp_module = xyz_dist
tmax_allsnow_sta	Monthly (January to December) maximum air temperature when precipitation is assumed to be snow; if air temperature is less than or equal to this value, precipitation is snow	nrain, nmonths	real	temp_units	-10.0 to 40.0	38.0	temp_module = ide_dist
tmax_cbh_adj	Monthly (January to December) adjustment factor to maximum air temperature for each HRU, estimated on the basis of slope and aspect	nhru, nmonths	real	temp_units	-10.0 to 10.0	0.0	temp_module = climate_hru
tmax_div	Standard deviation for the air-temperature-measurement station transformation equation for maximum air temperature (not 0.0)	one	real	temp_units	-100.0 to 100.0	1.0	temp_module = xyz_dist
tmax_map_adj	Monthly (January to December) additive adjustment factor to maximum air temperature for each mapped spatial unit estimated on the basis of slope and aspect	nmap, nmonths	real	temp_units	-10.0 to 10.0	0.0	temp_module = temp_map
tmax_lapse	Monthly (January to December) values representing the change in maximum air temperature per 1,000 elev_units of elevation change for each HRU	nhru, nmonths	real	temp_units/ elev_units	-20.0 to 20.0	3.0	temp_module = temp_1sta
tmin_add	Mean value for the air-temperature-measurement station transformation equation for minimum air temperature	one	real	temp_units	-100.0 to 100.0	0.0	temp_module = xyz_dist
tmin_adj	Adjustment to minimum air temperature for each HRU, estimated on the basis of slope and aspect	nhru, nmonths	real	temp_units	-10.0 to 10.0	0.0	temp_module = temp_1sta, temp_sta, temp_laps, temp_dist2, ide_dist or xyz_dist
tmin_cbh_adj	Monthly (January to December) adjustment factor to minimum air temperature for each HRU, estimated on the basis of slope and aspect	nhru, nmonths	real	temp_units	-10.0 to 10.0	0.0	temp_module = climate_hru
tmin_div	Standard deviation for the air-temperature-measurement station transformation equation for minimum air temperature (not 0.0)	one	real	temp_units	-100.0 to 100.0	1.0	temp_module = xyz_dist
tmin_map_adj	Monthly (January to December) additive adjustment factor to minimum air temperature for each mapped spatial unit, estimated on the basis of slope and aspect	nmap, nmonths	real	temp_units	-10.0 to 10.0	0.0	temp_module = temp_map
tmin_lapse	Monthly (January to December) values representing the change in minimum air temperature per 1,000 elev_units of elevation change for each HRU	nhru, nmonths	real	temp_units/ elev_units	-20.0 to 20.0	3.0	temp_module = temp_1sta

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
tsta_elev	Elevation of each air-temperature-measurement station	ntemp	real	elev_units	-300.0 to 30,000.0		
tsta_month_max	Average monthly (January to December) maximum air temperature at each air-temperature-measurement station	ntemp, nmonths	real	temp_units	-100.0 to 100.0	0.0	temp_module = xyz_dist
tsta_month_min	Average monthly (January to December) minimum air temperature at each air-temperature-measurement station	ntemp, nmonths	real	temp_units	-100.0 to 100.0	0.0	temp_module = xyz_dist
tsta_nuse	The subset of temperature stations used in the distribution regression (0=station not used; 1=station used)	ntemp	integer	none	0 or 1	0	temp_module = ide_dist or xyz_dist
tsta_x	Longitude (X) for each air-temperature-measurement station in albers projection	ntemp	real	meters	-1.0E7 to 1.0E7	0.0	temp_module = ide_dist or xyz_dist
tsta_xlong	Longitude of each air-temperature-measurement station, State Plane Coordinate System	ntemp	real	feet	-1.0E9 to 1.0E9	0.0	temp_module = temp_dist2
tsta_y	Latitude (Y) for each air-temperature-measurement station in albers projection	ntemp	real	meters	-1.0E7 to 1.0E7	0.0	temp_module = ide_dist or xyz_dist
tsta_ylat	Latitude of each air-temperature-measurement station, State Plane Coordinate System	ntemp	real	feet	-1.0E9 to 1.0E9	0.0	temp_module = temp_dist2
x_add	Mean value for the climate station transformation equation for the longitude (X) coordinate	one	real	meters	-1.0E7 to 1.0E7	0.0	precip_module and temp_module = xyz_dist
x_div	Standard deviation for the climate station transformation equation for the longitude (X) coordinate (not 0 . 0)	one	real	meters	-1.0E7 to 1.0E7	1.0	precip_module and temp_module = xyz_dist
y_add	Mean value for the climate station transformation equation for the latitude (Y) coordinate	one	real	meters	-1.0E7 to 1.0E7	0.0	precip_module and temp_module = xyz_dist
y_div	Standard deviation for the climate station transformation equation for the latitude (Y) coordinate	one	real	meters	-1.0E7 to 1.0E7	1.0	precip_module and temp_module = xyz_dist
z_add	Mean value for the climate station transformation equation for the elevation (Z) coordinate	one	real	meters	-1.0E7 to 1.0E7	0.0	precip_module and temp_module = xyz_dist
z_div	Standard deviation for the climate station transformation equation for the elevation (Z) coordinate (not 0 . 0)	one	real	meters	-1.0E7 to 1.0E7	1.0	precip_module and temp_module = xyz_dist
Solar radiation							
basin_solsta	Index of solar radiation station used to compute basin radiation values; used when dimension nsol >0	one	integer	none	0 to nsol	0	nsol > 0

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
ccov_intcp	Monthly (January to December) intercept in cloud-cover relationship	nhru, nmonths	real	none	0.0 to 5.0	1.83	solrad_module = ccsolrad
ccov_slope	Monthly (January to December) coefficient in cloud-cover relationship	nhru, nmonths	real	none	-0.5 to -0.01	-0.13	solrad_module = ccsolrad
crad_coef	Coefficient(B) in Thompson (1976) equation; varies by region, contour map of values in reference	nhru, nmonths	real	none	0.1 to 0.7	0.4	solrad_module = ccsolrad
crad_exp	Exponent(P) in Thompson (1976) equation	nhru, nmonths	real	none	0.2 to 0.8	0.61	solrad_module = ccsolrad
dday_intcp	Monthly (January to December) intercept in degree-day equation for each HRU	nhru, nmonths	real	dday	-60.0 to 10.0	-40.0	solrad_module = ddsolrad
dday_slope	Monthly (January to December) slope in degree-day equation for each HRU	nhru, nmonths	real	dday/ temp_units	0.1 to 1.4	0.4	solrad_module = ddsolrad
hru_solsta	Index of solar radiation station associated with each HRU	nhru	integer	none	0 to nsol	0	nsol > 0
ppt_rad_adj	Monthly minimum precipitation, if HRU precipitation exceeds this value, radiation is multiplied by radj_sppt or radj_wppt precipitation adjustment factor	nhru, nmonths	real	inches	0.0 to 0.5	0.02	Required
radadj_intcp	Monthly (January to December) intercept in air temperature range adjustment to degree-day equation for each HRU	nhru, nmonths	real	none	0.0 to 1.0	1.0	solrad_module = ddsolrad
radadj_slope	Monthly (January to December) slope in air temperature range adjustment to degree-day equation for each HRU	nhru, nmonths	real	1/ temp_units	0.0 to 1.0	0.0	solrad_module = ddsolrad
radj_sppt	Adjustment factor for computed solar radiation for summer day with greater than ppt_rad_adj inches of precipitation for each HRU	nhru	real	decimal fraction	0.0 to 1.0	0.44	required
radj_wppt	Adjustment factor for computed solar radiation for winter day with greater than ppt_rad_adj inches of precipitation for each HRU	nhru	real	decimal fraction	0.0 to 1.0	0.5	required
radmax	Monthly (January to December) maximum fraction of the potential solar radiation that may reach the ground due to haze, dust, smog, and so forth, for each HRU	nhru, nmonths	real	decimal fraction	0.1 to 1.0	0.8	required
tmax_index	Monthly (January to December) index temperature used to determine precipitation adjustments to solar radiation for each HRU	nhru, nmonths	real	temp_units	-10.0 to 110.0	50.0	solrad_module = ddsolrad
Potential evapotranspiration distribution							
crop_coef	Monthly (January to December) crop coefficient for each HRU	nhru, nmonths	real	decimal fraction	0.0 to 2.0	1.0	et_module = potet_pm or potet_pm_sta
epan_coef	Monthly (January to December) evaporation pan coefficient for each HRU	nhru, nmonths	real	decimal fraction	0.01 to 3.0	1.0	et_module = potet_pan

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
hamon_coef	Monthly (January to December) air temperature coefficient used in Hamon potential ET computations for each HRU	nhru, nmonths	real	none	0.004 to 0.008	0.0055	et_module = potet_hamon
hru_humidity_sta	Index of humidity measurement station for each HRU	nhru	integer	none	0 to nhumid	0	et_module = potet_pm_sta and nhumid > 0
hru_pansta	Index of pan evaporation station used to compute HRU potential ET	nhru	integer	none	0 to nevap	0	et_module = potet_pan and nevap > 0
hru_windspeed_sta	Index of wind speed measurement station for each HRU	nhru	integer	none	0 to nwind	0	et_module = potet_pm_sta and nwind > 0
hs_krs	Monthly (January to December) adjustment factor used in Hargreaves-Samani potential ET computations for each HRU	nhru, nmonths	real	decimal fraction	0.01 to 0.24	0.0135	et_module = potet_hs
humidity_percent	Monthly humidity for each HRU	nhru, nmonths	real	percentage	0.0 to 100.0	0.0	et_module = potet_pm or potet_pt and humidity is not specified in a CBH File
jh_coef	Monthly (January to December) air temperature coefficient used in Jensen-Haise potential ET computations for each HRU	nhru, nmonths	real	per degrees Fahrenheit	-0.5 to 1.5	0.014	et_module = potet_jh
jh_coef_hru	Air temperature coefficient used in Jensen-Haise potential ET computations for each HRU	nhru	real	per degrees Fahrenheit	-99.0 to 150.0	13.0	et_module = potet_jh
pm_d_coef	Monthly (January to December) Penman-Monteith potential ET D wind speed coefficient for each HRU	nhru, nmonths	real	seconds/ meter	0.25 to 0.45	0.34	et_module = potet_pm or potet_pm_sta
pm_n_coef	Monthly (January to December) Penman-Monteith potential ET N temperature coefficient for each HRU	nhru, nmonths	real	degrees Celsius per day	850.0 to 950.0	900.0	et_module = potet_pm or potet_pm_sta
potet_cbh_adj	Monthly (January to December) adjustment factor to potential evapotranspiration specified in CBH Files for each HRU	nhru, nmonths	real	degrees decimal fraction	0.5 to 1.5	1.0	et_module = climate_hru
pt_alpha	Monthly (January to December) adjustment factor used in Priestly-Taylor potential ET computations for each HRU	nhru, nmonths	real	decimal fraction	1.0 to 2.0	1.26	et_module = potet_pt
Evapotranspiration and sublimation							
fall_frost	The solar date (number of days after winter solstice) of	nhru	integer	solar date	1 to 366	264	transp_module =

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
frost_temp	the first killing frost of the fall Temperature of killing frost	nhru	real	temp_units	-10.0 to 32.0	28.0	transp_frost model_mode = FROST
potet_sublim	Fraction of potential ET that is sublimated from snow in the canopy and snowpack for each HRU	nhru	real	decimal fraction	0.1 to 0.75	0.5	required
rad_trncf	Transmission coefficient for short-wave radiation through the winter vegetation canopy	nhru	real	decimal fraction	0.0 to 1.0	0.5	required
soil_type	Soil type of each HRU (1=sand; 2=loam; 3=clay)	nhru	integer	none	1 to 3	2	required
spring_frost	The solar date (number of days after winter solstice) of the last killing frost of the spring	nhru	integer	solar date	1 to 366	111	transp_module = transp_frost
transp_beg	Month to begin summing maximum air temperature for each HRU; when sum is greater than or equal to transp_tmax , transpiration begins	nhru	integer	month	1 to 12	1	transp_module = transp_tindex
transp_end	Month to stop transpiration computations; transpiration is computed through the end of previous month	nhru	integer	month	1 to 13	13	transp_module = transp_tindex
transp_tmax	Temperature index to determine the specific date of the start of the transpiration period; the maximum air temperature for each HRU is summed starting with the first day of month transp_beg ; when the sum exceeds this index, transpiration begins	nhru	real	temp_units	0.0 to 1,000.0	1.0	transp_module = transp_tindex
Interception							
cov_type	Vegetation cover type for each HRU (0=bare soil; 1=grasses; 2=shrubs; 3=trees; 4=coniferous)	nhru	integer	none	0 to 4	3	required
covden_sum	Summer vegetation cover density for the major vegetation type in each HRU	nhru	real	decimal fraction	0.0 to 1.0	0.5	required
covden_win	Winter vegetation cover density for the major vegetation type in each HRU	nhru	real	decimal fraction	0.0 to 1.0	0.5	required
snow_intcp	Snow interception storage capacity for the major vegetation type in each HRU	nhru	real	inches	0.0 to 1.0	0.1	required
srain_intcp	Summer rain interception storage capacity for the major vegetation type in each HRU	nhru	real	inches	0.0 to 1.0	0.1	required
wrain_intcp	Winter rain interception storage capacity for the major vegetation type in each HRU	nhru	real	inches	0.0 to 1.0	0.1	required
Snow computations							
albset_rna	Fraction of rain in a mixed precipitation event above which the snow albedo is not reset; applied during the snowpack accumulation stage	one	real	decimal fraction	0.5 to 1.0	0.8	required
albset_rnm	Fraction of rain in a mixed precipitation event above which the snow albedo is not reset; applied during the snowpack melt stage	one	real	decimal fraction	0.4 to 1.0	0.6	required

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
albset_sna	Minimum snowfall, in water equivalent, needed to reset snow albedo during the snowpack accumulation stage	one	real	inches	0.01 to 1.0	0.05	required
albset_snm	Minimum snowfall, in water equivalent, needed to reset snow albedo during the snowpack melt stage	one	real	inches	0.1 to 1.0	0.2	required
cecn_coef	Monthly (January to December) convection condensation energy coefficient for each HRU	nhru, nmonths	real	calories per degree Celsius > 0	0.02.0 to 20.0	5.0	required
den_init	Initial density of new-fallen snow	nhru	real	grams/cubic centimeters	0.01 to 0.5	0.1	required
den_max	Average maximum snowpack density	nhru	real	grams/cubic centimeters	0.1 to 0.8	0.6	required
emis_noppt	Average emissivity of air on days without precipitation for each HRU	nhru	real	decimal fraction	0.757 to 1.0	0.757	required
freeh2o_cap	Free-water holding capacity of snowpack expressed as a decimal fraction of the frozen water content of the snowpack (<i>pk_ice</i>) for each HRU	nhru	real	decimal fraction	0.01 to 0.2	0.05	required
hru_deplcrv	Index number for the snowpack areal depletion curve associated with each HRU	nhru	integer	none	1 to ndepl	1	snarea_curve_flag=0
melt_force	Julian date to force snowpack to spring snowmelt stage; varies with region depending on length of time that permanent snowpack exists for each HRU	nhru	integer	Julian day	1 to 366	140	required
melt_look	Julian date to start looking for spring snowmelt stage; varies with region depending on length of time that permanent snowpack exists for each HRU	nhru	integer	Julian day	1 to 366	90	required
settle_const	Snowpack settlement time constant	nhru	real	decimal fraction	0.01 to 0.5	0.1	required
snarea_a	Snow area depletion curve minimum snow-water equivalent (SWE) value for each HRU	nhru	real	inches	0.0 to 1.0	0.0	snarea_curve_flag=1
snarea_b	Snow area depletion curve B coefficient used in computing values off an S curve for each HRU	nhru	real	none	0.5 to 20.0	2.0	snarea_curve_flag=1
snarea_c	Snow area depletion curve C coefficient used in computing values off an S curve for each HRU	nhru	real	none	0.001 to 3.0	1.5	snarea_curve_flag=1
snarea_d	Snow area depletion curve D coefficient used in computing values off an S curve for each HRU	nhru	real	none	0.0 to 3.0	0.975	snarea_curve_flag=1
snarea_curve	Snow area depletion curve values, 11 values for each curve (0.0 to 1.0 in 0.1 increments)	ndeplval	real	decimal fraction	0.0 to 1.0	1.0	snarea_curve_flag=0
snarea_thresh	Maximum threshold snowpack water equivalent below which the snow-covered-area curve is applied	nhru	real	inches	0.0 to 200.0	50.0	required
snowpack_init	Storage of snowpack in each HRU at the beginning of a simulation	nhru	real	inches	0.0 to 5000.0	0.0	required

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
tstorm_mo	Monthly indicator for prevalent storm type (0=frontal storms; 1=convective storms) for each HRU	nhru, nmonths	integer	none	0 or 1	0	required
Glacier and frozen ground computations							
abl_elev_range	Average HRU snowfield ablation zones elevation range or approximate median-min elevation	nhru	real	elev_units	0.0 to 17000.0	1000.0	glacier_flag = 1
albedo_coef	Coefficient in calculation of ice albedo	nhru	real	none	0.1 to 0.3	0.137	glacier_flag = 1
albedo_ice	Ice albedo 300 meters below equilibrium line altitude (ELA)	nhru	real	decimal fraction	0.2 to 0.6	0.344	glacier_flag = 1
cfdi_decay	Continuous frozen ground index (CFGI) daily decay of index; value of 1.0 is no decay	one	real	decimal fraction	0.1 to 1.0	0.97	frozen_flag = 1
cfdi_thrshld	Continuous frozen ground index (CFGI) threshold value indicating frozen soil	one	real	none	1.0 to 500.0	52.55	frozen_flag = 1
glacier_frac_init	Initial fraction of glaciation (0=none; 1=100%)	nhru	real	decimal fraction	0.0 to 1.0	0.0	glacier_flag = 1
glacr_freeh2o_cap	Free-water holding capacity of glacier ice of the frozen water content of the glacier ice (<i>glacr_pk_ice</i>)	nhru	real	decimal fraction	0.0 to 0.1	0.002	glacier_flag = 1
glacr_layer	Active layer is 0 to 15 m (590.6 inches) thick at start of year, when melts will set daily <i>glacr_pk_temp</i> to 0	nhru	real	inches	0.0 to 590.6	0.0	glacier_flag = 1
glacrva_coef	Volume area scaling coefficient for glaciers, average value by region	nhru	real	$m^{**}(3-2*glacrva_exp)$	0.01 to 2.0	0.28	glacier_flag = 1
glacrva_exp	Volume area exponential coefficient for glaciers, average value by region	nhru	real	none	1.0 to 2.0	1.375	glacier_flag = 1
glrette_frac_init	Initial fraction of glacierette (too small for glacier dynamics)	nhru	real	decimal fraction	0.0 to 1.0	0.0	glacier_flag = 1
hru_length	Length of segment covering all of glacier-possible for each HRU	nhru	real	km	0.0 to 10000.0	0.0	glacier_flag = 1
hru_width	Width of glacier-possible for each HRU	nhru	real	km	0.0 to 10000.0	0.0	glacier_flag = 1
max_gldepth	Upper bound on glacier thickness, thickest glacier measured is Taku at 1.5 km, ice sheet 3 km	nhru	real	km	0.1 to 3.0	1.5	glacier_flag = 1
stor_firm	Monthly (January to December) storage coefficient for firm melt on glaciers	nhru	real	hours	150.0 to 1000.0	400.0	glacier_flag = 1
stor_ice	Monthly (January to December) storage coefficient for ice melt on glaciers	nhru	real	hours	5.0 to 29.0	10.0	glacier_flag = 1
stor_snow	Monthly (January to December) storage coefficient for ice melt on glaciers	nhru	real	hours	30.0 to 149.0	80.0	glacier_flag = 1
tohru	Index of down-flowline HRU to which the HRU glacier	nhru	integer	none	0 to nhru	0	glacier_flag = 1

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
	melt flows, for non-glacier HRUs that do not flow to another HRU enter 0						
Hortonian surface runoff, infiltration, and impervious storage							
carea_max	Maximum possible area contributing to surface runoff expressed as a portion of the HRU area	nhru	real	decimal fraction	0.0 to 1.0	0.6	required
carea_min	Minimum possible area contributing to surface runoff expressed as a portion of the area for each HRU	nhru	real	decimal fraction	0.0 to 1.0	0.2	srunoff_module = srunoff_carea
hru_percent_imperv	Fraction of each HRU area that is impervious	nhru	real	decimal fraction	0.0 to 0.999	0.0	required
imperv_stor_max	Maximum impervious area retention storage for each HRU	nhru	real	inches	0.0 to 0.5	0.05	required
smidx_coef	Coefficient in non-linear contributing area algorithm for each HRU	nhru	real	decimal fraction	0.0 to 1.0	0.005	srunoff_module = srunoff_smidx
smidx_exp	Exponent in non-linear contributing area algorithm for each HRU	nhru	real	1/inch	0.0 to 5.0	0.3	srunoff_module = srunoff_smidx
snowinfil_max	Maximum snow infiltration per day for each HRU	nhru	real	inches/day	0.0 to 20.0	2.0	required
Surface depression storage							
dprst_area	Aggregate sum of surface-depression storage areas of each HRU (recommend that dprst_frac_hru be used instead of dprst_area)	nhru	real	acres	0.0 to 1.0E9	0.0	dprst_flag = 1 and model_mode = PRMS
dprst_depth_avg	Average depth of storage depressions at maximum storage capacity	nhru	real	inches	0.0 to 500.0	132.0	dprst_flag = 1
dprst_et_coef	Fraction of unsatisfied potential evapotranspiration to apply to surface-depression storage	nhru	real	decimal fraction	0.5 to 1.5	1.0	dprst_flag = 1
dprst_flow_coef	Coefficient in linear flow routing equation for open surface depressions for each HRU	nhru	real	fraction/day	0.00001 to 0.5	0.05	dprst_flag = 1
dprst_frac_hru	Fraction of each HRU area that has surface depressions (If specified, the parameter dprst_area is ignored if it also is specified, default of -1.0 means use dprst_area)	nhru	real	decimal fraction	-1.0 to 0.999	-1.0	dprst_flag = 1 and model_mode = PRMS
dprst_frac	Fraction of each HRU area that has surface depressions	nhru	real	decimal fraction	0.0 to 0.999	0.0	dprst_flag = 1 and model_mode = PRMS5
dprst_frac_init	Fraction of maximum surface-depression storage that contains water at the start of a simulation	nhru	real	decimal fraction	0.0 to 1.0	0.5	dprst_flag = 1
dprst_frac_open	Fraction of open surface-depression storage area within an HRU that can generate surface runoff as a function of storage volume	nhru	double	decimal fraction	0.0 to 1.0	1.0	dprst_flag = 1
dprst_seep_rate_clos	Coefficient used in linear seepage flow equation for closed surface depressions for each HRU	nhru	real	fraction/day	0.0 to 0.2	0.02	dprst_flag = 1
dprst_seep_rate_open	Coefficient used in linear seepage flow equation for	nhru	real	fraction/day	0.0 to 0.2	0.02	dprst_flag = 1

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
op_flow_thres	open surface depressions for each HRU Fraction of open depression storage above which surface runoff occurs; any water above maximum open storage capacity spills as surface runoff	nhru	real	decimal fraction	0.01 to 1.0	1.0	dprst_flag = 1
sro_to_dprst_imperv	Fraction of impervious surface runoff that flows into surface-depression storage; the remainder flows to a stream network for each HRU	nhru	real	decimal fraction	0.0 to 1.0	0.2	dprst_flag = 1
sro_to_dprst	Fraction of pervious surface runoff that flows into surface-depression storage; the remainder flows to a stream network for each HRU	nhru	real	decimal fraction	0.0 to 1.0	0.2	dprst_flag = 1 and model_mode = PRMS
sro_to_dprst_perv	Fraction of pervious surface runoff that flows into surface-depression storage; the remainder flows to a stream network for each HRU	nhru	real	decimal fraction	0.0 to 1.0	0.2	dprst_flag = 1 and model_mode = PRMS5
va_clos_exp	Coefficient in the exponential equation relating maximum surface area to the fraction that closed depressions are full to compute current surface area for each HRU; 0.001 is an approximate cylinder; 1.0 is a cone	nhru	real	none	0.0001 to 10.0	0.001	dprst_flag = 1
va_open_exp	Coefficient in the exponential equation relating maximum surface area to the fraction that open depressions are full to compute current surface area for each HRU; 0.001 is an approximate cylinder; 1.0 is a cone	nhru	real	none	0.0001 to 10.0	0.001	dprst_flag = 1
Soil zone storage, interflow, gravity drainage, Dunnian surface runoff							
fastcoef_lin	Linear coefficient in equation to route preferential-flow storage downslope for each HRU	nhru	real	fraction/day	0.0 to 1.0	0.1	required
fastcoef_sq	Non-linear coefficient in equation to route preferential-flow storage downslope for each HRU	nhru	real	none	0.0 to 1.0	0.8	required
pref_flow_den	Fraction of the gravity reservoir in which preferential flow occurs for each HRU	nhru	real	decimal fraction	0.0 to 0.5	0.0	required
sat_threshold	Water holding capacity of the gravity and preferential-flow reservoirs; difference between field capacity and total soil saturation for each HRU	nhru	real	inches	0.00001 to 999.0	999.0	required
slowcoef_lin	Linear coefficient in equation to route gravity-reservoir storage downslope for each HRU	nhru	real	fraction/day	0.0 to 1.0	0.015	required
slowcoef_sq	Non-linear coefficient in equation to route gravity-reservoir storage downslope for each HRU	nhru	real	none	0.0 to 1.0	0.1	required
soil_moist_init	Initial value of available water in capillary reservoir for each HRU	nhru	real	inches	0.0 to 20.0	3.0	model_mode = PRMS
soil_moist_init_frac	Initial fraction of available water in the capillary	nhru	real	decimal	0.0 to 1.0	0.0	model_mode =

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
soil_moist_max	reservoir (fraction of soil_moist_max for each HRU Maximum available water holding capacity of capillary reservoir from land surface to rooting depth of the major vegetation type of each HRU	nhru	real	fraction inches	0.00001 to 20.0	2.0	PRMS5 required
soil_rechr_init	Initial storage for soil recharge zone (upper part of capillary reservoir where losses occur as both evaporation and transpiration) for each HRU; must be less than or equal to soil_moist_init	nhru	real	inches	0.0 to 20.0	1.0	model_mode = PRMS
soil_rechr_init_frac	Initial fraction of available water in the capillary reservoir where losses occur as both evaporation and transpiration (upper zone of capillary reservoir) for each HRU	nhru	real	decimal fraction	0.0 to 1.0	0.0	model_mode = PRMS5
soil_rechr_max	Maximum storage for soil recharge zone (upper portion of capillary reservoir where losses occur as both evaporation and transpiration); must be less than or equal to soil_moist_max	nhru	real	inches	0.00001 to 20.0	1.5	model_mode = PRMS
soil_rechr_max_frac	Fraction of the capillary reservoir water-holding capacity (soil_moist_max) where losses occur as both evaporation and transpiration (upper zone of capillary reservoir) for each HRU	nhru	real	decimal fraction	0.00001 to 1.0	1.0	model_mode = PRMS5
soil2gw_max	Maximum amount of the capillary reservoir excess that is routed directly to the GWR for each HRU	nhru	real	inches	0.0 to 5.0	0.0	Required
ssr2gw_exp	Non-linear coefficient in equation used to route water from the gravity reservoirs to the GWR for each HRU	nssr	real	none	0.0 to 3.0	1.0	Required
ssr2gw_rate	Linear coefficient in equation used to route water from the gravity reservoir to the GWR for each HRU	nssr	real	inches/day	0.0001 to 999.0	0.1	Required
ssstor_init	Initial storage of the gravity and preferential-flow reservoirs for each HRU	nssr	real	inches	0.0 to 10.0	0.0	model_mode = PRMS
ssstor_init_frac	Initial fraction of available water in the gravity plus preferential-flow reservoirs (fraction of sat_threshold) for each HRU	nssr	real	decimal fraction	0.0 to 1.0	0.0	model_mode = PRMS5
		Groundwater flow					
gwflow_coef	Linear coefficient in the equation to compute groundwater discharge for each GWR	ngw	real	fraction/day	0.0 to 0.5	0.015	required
gwsink_coef	Linear coefficient in the equation to compute outflow to the groundwater sink for each GWR	ngw	real	fraction/day	0.0 to 1.0	0.0	required
gwstor_init	Storage in each GWR at the beginning of a simulation	ngw	real	inches	0.0 to 50.0	2.0	required
gwstor_min	Minimum storage in each GWR to ensure storage is greater than specified value to account for inflow from deep aquifers or injection wells with the water source	ngw	real	inches	0.0 to 1.0	0.0	required

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
outside the basin							
hru_segment	Segment index to which an HRU contributes lateral flows (surface runoff, interflow, and groundwater discharge)	Streamflow nhru	integer	none	0 to nsegment	0	strmflow_module = muskingum, strmflow in out, muskingum_lake, or muskingum_mann
K_coef	Travel time of flood wave from one segment to the next downstream segment, called the Muskingum storage coefficient; enter 1 . 0 for reservoirs, diversions, and segment(s) flowing out of the basin	nsegment	real	hours	0.01 to 24.0	1.0	strmflow_module = muskingum
mann_n	Manning's roughness coefficient for each segment	nsegment	real	dimensionless	0.001 to 0.15	0.04	strmflow_module = muskingum_mann
obsin_segment	Index of measured streamflow station that replaces inflow to a segment	nsegment	integer	none	0 to nobs	0	strmflow_module = muskingum, strmflow in out, muskingum_lake, or muskingum_mann
obsout_segment	Index of measured streamflow station that replaces outflow from a segment	nsegment	integer	none	0 to nobs	0	strmflow_module = muskingum, strmflow in out, muskingum_lake, or muskingum_mann
seg_depth	Segment river depth at bank full; shallowest depth from Blackburn-Lynch (2017); Congo is deepest at 250 m but in the US, it is probably the Hudson at 66 m	nsegment	real	meters	0.03 to 250.0	1.0	strmflow_module = muskingum_mann
seg_length	Length of each segment, bounds based on CONUS	nsegment	real	meters	1.0 to 100000.0	1000.0	strmflow_module = muskingum_mann or stream_temp_flag = 1
seg_slope	Surface slope of each segment as approximation for bed slope of stream	nsegment	real	decimal fraction	0.0 to 2.0	0.0001	strmflow_module = muskingum_mann or stream_temp_flag = 1
segment_flow_init	Initial flow in each stream segment	nsegment	real	cfs	0 to 1.0E7	0.0	strmflow_module = muskingum,

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
segment_type	Segment type (0=segment; 1= headwater; 2=lake; 3=replace inflow; 4=inbound to NHM; 5=outbound from NHM; 6=inbound to region; 7=outbound from region; 8=drains to ocean; 9=sink; 10=inbound from Great Lakes; 11=outbound to Great Lakes, add 100 to flag that the value is updated)	nsegment	integer	none	0 to 111	0	strmflow_in out, muskingum_lake, or muskingum_mann strmflow_module = muskingum, strmflow_in out, muskingum_lake, or muskingum_mann
tosegment	Index of downstream segment to which the segment streamflow flows; for segments that do not flow to another segment enter 0	nsegment	integer	none	0 to 9999999	0	strmflow_module = muskingum, strmflow_in out, muskingum_lake, or muskingum_mann
tosegment_nhm	National Hydrologic Model downstream segment ID	nsegment	integer	none	0 to 9999999	0	optional
x_coef	The amount of attenuation of the flow wave, called the Muskingum routing weighting factor; enter 0.0 for reservoirs, diversions, and segment(s) flowing out of the basin	nsegment	real	decimal fraction	0.0 to 0.5	0.2	strmflow_module = muskingum or muskingum_mann
Lake routing							
elev_outflow	Elevation of the main outflow point for each lake using broad-crested weir routing	nlake	real	feet	-300.0 to 10,000.0	0.0	strmflow_module = muskingum_lake
elevlake_init	Initial lake surface elevation for each lake using broad-crested weir routing or gate opening routing	nlake	real	feet	-300.0 to 10,000.0	1.0	strmflow_module = muskingum_lake
gw_seep_coef	Linear coefficient in equation to compute lakebed seepage to the GWR and groundwater discharge to each lake using broad-crested weir routing or gate opening routing	ngw	real	fraction/day	0.001 to 0.05	0.015	strmflow_module = muskingum_lake
lake_coef	Coefficient in equation to route storage to streamflow for each lake using linear routing	nlake	real	fraction/day	0.0001 to 1.0	0.1	strmflow_module = muskingum_lake
lake_din1	Initial inflow to each lake using Puls or linear storage routing	nlake	real	cfs	0.0 to 1.0E7	0.1	strmflow_module = muskingum_lake
lake_evap_adj	Monthly (January to December) adjustment factor for potential ET for each lake	nhru	real	decimal fraction	0.5 to 1.5	1.0	strmflow_module = muskingum_lake
lake_hru	Index of HRU for each lake	nlake	integer	none	0 to nhru	0	strmflow_module = strmflow_lake
lake_hru_id	Identification number of the lake associated with an	nhru	integer	none	0 to nlake	0	strmflow_module =

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
	HRU; more than one HRU can be associated with each lake						muskingum_lake
lake_init	Initial storage in each lake using Puls or linear storage routing	nlake	real	cfs-days	0.0 to 1.0E7	0.0	strmflow_module = muskingum_lake
lake_out2	Switch to specify a second outflow point from each lake using gate opening routing (0=no; 1=yes)	nlake	integer	none	0 or 1	0	strmflow_module = muskingum_lake
lake_out2_a	Coefficient A in outflow equation for each lake with a second outlet using gate opening routing	nlake	real	cfs/feet	0.0 to 10,000.0	1.0	strmflow_module = muskingum_lake
lake_out2_b	Coefficient B in outflow equation for each lake with a second outlet using gate opening routing	nlake	real	cfs	0.0 to 10,000.0	100.0	strmflow_module = muskingum_lake
lake_qro	Initial daily mean outflow from each lake	nlake	real	cfs	0.0 to 1.0E7	0.1	strmflow_module = muskingum_lake
lake_seep_elev	Elevation over which lakebed seepage to the GWR occurs for lake HRUs using broad-crested weir routing or gate opening routing	nlake	real	feet	-300.0 to 10,000.0	1.0	strmflow_module = muskingum_lake
lake_segment_id	Index of lake associated with a segment	nsegment	integer	none	0 to nlake	0	strmflow_module = muskingum_lake and cascade_flag = 1
lake_type	Type of lake routing method (1=Puls routing; 2=linear routing; 3=flow through; 4=broad crested weir; 5=gate opening; and 6=measured flow)	nlake	integer	none	1 to 6	1	strmflow_module = muskingum_lake
lake_vol_init	Initial lake volume for each lake using broad-crested weir or gate opening routing	nlake	real	acre-feet	0.0 to 1.0E7	0.0	strmflow_module = muskingum_lake
nsos	Number of storage/outflow values in table for each lake using Puls routing	mxnsos , nlake	integer	none	0 to mxnsos	0	strmflow_module = muskingum_lake
o2	Outflow values in outflow/storage tables for each lake using Puls routing	mxnsos , nlake	real	cfs	0.0 to 1.0E7	0.0	strmflow_module = muskingum_lake
obsout_lake	Index of streamflow measurement station that specifies outflow from each lake using measured flow replacement	nlake	integer	none	0 to nobs	0	strmflow_module = muskingum_lake
rate_table	Rating table with stage (rows) and gate opening (cols) for rating table 1 for lakes using gate opening routing and nratetbl >0	nstage , ngate	real	cfs	-100.0 to 1,000.0	5.0	strmflow_module = muskingum_lake
rate_table2	Rating table with stage (rows) and gate opening (cols) for rating table 2 for lakes using gate opening routing and nratetbl >1	nstage2 , ngate2	real	cfs	-100.0 to 1,000.0	5.0	strmflow_module = muskingum_lake
rate_table3	Rating table with stage (rows) and gate opening (cols) for rating table 3 for lakes using gate opening routing and nratetbl >2	nstage3 , ngate3	real	cfs	-100.0 to 1,000.0	5.0	strmflow_module = muskingum_lake
rate_table4	Rating table with stage (rows) and gate opening (cols)	nstage4 ,	real	cfs	-100.0 to	5.0	strmflow_module =

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
	for rating table 4 for lakes using gate opening routing and nratetbl >3	ngate4			1,000.0		muskingum_lake
ratetbl_lake	Index of lake associated with each rating table for each lake using gate opening routing	nratetbl	integer	none	0 to nlake	0	strmflow_module = muskingum_lake
s2	Storage values in outflow/storage table for each lake using Puls routing	mxnsos , nlake	real	cfs	0.0 to 1.0E7	0.0	strmflow_module = muskingum_lake
tbl_gate	Gate openings for each column for rating table 1 for lakes using gate opening routing and nratetbl >0	ngate	real	inches	0.0 to 20.0	0.0	strmflow_module = muskingum_lake
tbl_gate2	Gate openings for each column for rating table 2 for lakes using gate opening routing and nratetbl >1	ngate2	real	inches	0.0 to 20.0	0.0	strmflow_module = muskingum_lake
tbl_gate3	Gate openings for each column for rating table 3 for lakes using gate opening routing and nratetbl >2	ngate3	real	inches	0.0 to 20.0	0.0	strmflow_module = muskingum_lake
tbl_gate4	Gate openings for each column for rating table 4 for lakes using gate opening routing and nratetbl >3	ngate4	real	inches	0.0 to 20.0	0.0	strmflow_module = muskingum_lake
tbl_stage	Stage values for each row for rating table 1 for lakes using gate opening routing and nratetbl >0	nstage	real	feet	-100.0 to 1,000.0	5.0	strmflow_module = muskingum_lake
tbl_stage2	Stage values for each row for rating table 2 for lakes using gate opening routing and nratetbl >1	nstage2	real	feet	-100.0 to 1,000.0	5.0	strmflow_module = muskingum_lake
tbl_stage3	Stage values for each row for rating table 3 for lakes using gate opening routing and nratetbl >2	nstage3	real	feet	-100.0 to 1,000.0	5.0	strmflow_module = muskingum_lake
tbl_stage4	Stage values for each row for rating table 4 for lakes using gate opening routing and nratetbl >3	nstage4	real	feet	-100.0 to 1,000.0	5.0	strmflow_module = muskingum_lake
weir_coef	Coefficient for lakes using broad-crested weir routing	nlake	real	none	2.0 to 3.0	2.7	strmflow_module = muskingum_lake
weir_len	Weir length for lakes using broad-crested weir routing	nlake	real	feet	1.0 to 1,000.0	5.0	strmflow_module = muskingum_lake
Output options							
print_freq	Flag to select the output frequency; for combinations, add index numbers, e.g., daily plus yearly = 10; yearly plus total = 3 (0=none; 1=run totals; 2=yearly; 4=monthly; 8=daily; or additive combinations)	one	integer	none	0 to 15	3	required
print_type	Flag to select the type of results written to the output file (0=measured and simulated flow only; 1=water balance table; 2=detailed output)	one	integer	none	0 to 2	1	required
Subbasin parameters							
hru_subbasin	Index of subbasin assigned to each HRU	nhru	integer	none	0 to user defined	0	subbasin_flag = 1
subbasin_down	Index number for the downstream subbasin whose inflow is outflow from this subbasin	nsub	integer	none	0 to nsub	0	subbasin_flag = 1

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
Stream temperature simulation							
albedo	Short-wave solar radiation reflected by streams	one	real	decimal fraction	0.0 to 1.0	0.1	stream_temp_flag = 1
alte	East bank topographic altitude of each segment	nsegment	real	radians	0.0 to 1.570796	0.0	stream_temp_flag = 1
altw	West bank topographic altitude of each segment	nsegment	real	radians	0.0 to 1.570796	0.0	stream_temp_flag = 1
azrh	Azimuth angle of each segment	nsegment	real	radians	-1.570796 to 1.570796	0.0	stream_temp_flag = 1
gw_tau	Average residence time in groundwater flow	nsegment	integer	days	1 to 365	365	stream_temp_flag = 1
lat_temp_adj	Correction factor to adjust the bias of the temperature of the lateral inflow	nsegment, nmonths	real	decimal fraction	-5.0 to 5.0	0.0	stream_temp_flag = 1
maxiter_sntemp	Maximum number of Newton-Raphson iterations to compute stream temperature	one	integer	none	10 to 2000	1000	stream_temp_flag = 1
melt_temp	Temperature at which snowmelt enters a stream	one	real	degrees Celsius	0.0 to 10.0	1.5	stream_temp_flag = 1
seg_elev	Segment elevation at midpoint	nsegment	real	meters	-1000.0 to 30000.0	0.0	stream_temp_flag = 1
seg_humidity	Mean monthly humidity for each segment, used when values not input in CBH File	nsegment, nmonths	real	decimal fraction	0.0 to 1.0	0.7	stream_temp_flag = 1
seg_lat	Latitude of each segment	nsegment	real	degrees North	-90.0 to 90.0	40.0	stream_temp_flag = 1
segshade_sum	Total shade fraction for summer vegetation	nsegment	real	decimal fraction	0.0 to 1.0	0.0	stream_temp_flag = 1
segshade_win	Total shade fraction for winter vegetation	nsegment	real	decimal fraction	0.0 to 1.0	0.0	stream_temp_flag = 1
ss_tau	Average residence time of subsurface interflow	nsegment	integer	days	1 to 365	30	stream_temp_flag = 1
stream_tave_init	Initial average stream temperature in each segment at the beginning of a simulation	nsegment	real	degrees Celsius	-10.0 to 100.0	0.0	stream_temp_flag = 1
vce	East bank average vegetation crown width for each segment	nsegment	real	meters	0.0 to 15.0	0.0	stream_temp_flag = 1
vcw	West bank average vegetation crown width for each segment	nsegment	real	meters	0.0 to 15.0	0.0	stream_temp_flag = 1
vdemn	Minimum east bank vegetation density for each segment	nsegment	real	decimal fraction	0.0 to 1.0	0.0	stream_temp_flag = 1
vdemx	Maximum east bank vegetation density for each segment	nsegment	real	decimal fraction	0.0 to 1.0	0.0	stream_temp_flag = 1
vdwmn	Minimum west bank vegetation density for each	nsegment	real	decimal	0.0 to 1.0	0.0	stream_temp_flag = 1

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
vdwmx	segment Maximum west bank vegetation density for each segment	nsegment	real	fraction decimal	0.0 to 1.0	0.0	stream_temp_flag = 1
vhe	East bank average vegetation height for each segment	nsegment	real	fraction meters	0.0 to 30.0	0.0	stream_temp_flag = 1
vhw	West bank average vegetation height for each segment	nsegment	real	meters	0.0 to 30.0	0.0	stream_temp_flag = 1
voe	East bank vegetation offset for each segment	nsegment	real	meters	0.0 to 100.0	0.0	stream_temp_flag = 1
vow	West bank vegetation offset for each segment	nsegment	real	meters	0.0 to 100.0	0.0	stream_temp_flag = 1
width_alpha	Alpha coefficient in power function for width calculation	nsegment	real	meters	0.0001 to 1000.0	1.0	stream_temp_flag = 1
width_m	M value in power function for width calculation	nsegment	real	unknown	0.0001 to 2.0	0.015	stream_temp_flag = 1
Mapped results parameters							
gvr_cell_id ⁹	Index of the grid cell associated with each gravity reservoir (default of -1 means HRUs and grid cells are equivalent)	nhru cell	integer	none	-1 to 999999999	-1	mapOutON_OFF = 1
gvr_cell_pct ⁹	Proportion of the grid cell area associated with each gravity reservoir	nhru cell	real	decimal fraction	0.0 to 1.0	1.0	mapOutON_OFF = 1
gvr_hru_id ⁹	Index of the HRU associated with each gravity reservoir	nhru cell	integer	none	0 to nhru cell	1	mapOutON_OFF = 1
mapvars_freq	Flag to specify the output frequency (0=none; 1=monthly; 2=yearly; 3=total; 4=monthly and yearly; 5=monthly, yearly, and total; 6=weekly; 7=daily)	one	integer	none	0 to 7	0	mapOutON_OFF = 1
mapvars_units	Flag to specify the output units of mapped results (0=units of the variable; 1=inches to feet; 2=inches to centimeters; 3=inches to meters; as states or fluxes)	one	integer	none	0 to 3	0	mapOutON_OFF = 1
ncol	Number of columns for each row of the mapped results	one	integer	none	1 to 50000	1	mapOutON_OFF = 1
prms_warmup	Number of years to simulate before writing mapped results	one	integer	years	0 to user defined	1	mapOutON_OFF = 1 or nhruOutON_OFF = 1
Summary results CSV file parameters							
poi_gage_id	USGS stream gage ID for each POI gage	npoigages	string	none	user defined	0	npoigages > 0 and csvON_OFF = 1
poi_gage_segment	Segment index for each POI gage	npoigages	integer	none	0 to nsegment	0	npoigages > 0 and csvON_OFF = 1
poi_type	Type code for each POI gage (0=non-calibration gage, 1=calibration gage, 2=flow replacement gage)	npoigages	integer	none	1	1	optional

Parameter name	Description	Dimension ¹	Type	Units	Range	Default	Required/condition
Parameters for cascading-flow simulation							
cascade_flg	Flag to indicate cascade type (0=allow many to many; 1=force one to one)	one	integer	none	0 or 1	0	cascade_flag = 1 and ncascade > 0 and/or cascadegw_flag = 1 and ncascdgw > 0
cascade_tol	Cascade area below which a cascade link is ignored	one	real	acres	0.0 to 7.5 % of hru_area	5.0	cascade_flag = 1 and ncascade > 0 and/or cascadegw_flag = 1 and ncascdgw > 0
circle_switch	Switch to check for circles (0=no check; 1=check)	one	integer	none	0 or 1	1	cascade_flag = 1 and ncascade > 0 and/or cascadegw_flag = 1 and ncascdgw > 0
gw_down_id ³	Index number of the downslope GWR to which the upslope GWR contributes flow	ncascdgw	integer	none	0 to ngw	0	cascadegw_flag = 1 and ncascdgw > 0
gw_pct_up	Fraction of GWR area used to compute flow contributed to a downslope GWR or stream segment for cascade area	ncascdgw	real	decimal fraction	0.0 to 1.0	1.0	cascadegw_flag = 1 and ncascdgw > 0
gw_strmseg_down_id	Index number of the stream segment that cascade area contributes flow	ncascdgw	integer	none	0 to nsegment	0	cascadegw_flag = 1 and ncascdgw > 0
gw_up_id	Index of GWR containing cascade area	ncascdgw	integer	none	1 to ngw	0	cascadegw_flag = 1 and ncascdgw > 0
hru_down_id ⁴	Index number of the downslope HRU to which the upslope HRU contributes flow	ncascade	integer	none	0 to nhru	0	cascade_flag = 1 and ncascade > 0
hru_pct_up	Fraction of HRU area used to compute flow contributed to a downslope HRU or stream segment for cascade area	ncascade	real	decimal fraction	0.0 to 1.0	1.0	cascade_flag = 1 and ncascade > 0
hru_strmseg_down_id	Index number of the stream segment that cascade area contributes flow	ncascade	integer	none	0 to nsegment	0	cascade_flag = 1 and ncascade > 0
hru_up_id	Index of HRU containing cascade area	ncascade	integer	none	0 to nhru	0	cascade_flag = 1 and ncascade > 0

¹Dimensions defined in table 1-1.

³ If the value of **gw_strmseg_down_id**>0 for cascade link, this value is ignored.

⁴If the value of **hru_strmseg_down_id**>0 for cascade link, this value is ignored.

⁵Parameter can be modified if the code determines an HRU is a swale, based on values of the cascade parameters.

⁹Parameter name is based on parameter of same name specified for the Groundwater and Surface-Water Flow (GSFLOW) model (Markstrom and others, 2008).

Only required if the HRU map is different than the target map, that is, dimension **nhru** not equal to **ngwcell**.

Table 1-4. Time-series input variables that may be included in the Data File for the Precipitation-Runoff Modeling System, **version 5 (PRMS-V)**.
[cfs, cubic feet per second; cms, cubic meters per second; **runoff_units**, 0=cfs; 1=cms; **precip_units**, 0=inches; 1=millimeters; **temp_units**, 0=degrees Fahrenheit; 1=degrees Celsius; >=, greater than or equal to; **pink** highlight indicates new for PRMS-5.1.0; **green** highlight indicates new for PRMS-5.0]

Variable	Definition	Units	Valid range	Dimension ¹
<i>gate_ht</i>	Height of the gate opening at each dam with a gate	inches	>=0.0	nratetbl
<i>humidity</i>	Relative humidity at each measurement station	percentage	0.0 to 1.0	nhumid
<i>lake_elev</i>	Elevation of each simulated lake surface	feet	unlimited	nlakeelev
<i>pan_evap</i>	Pan evaporation at each measurement station	inches	>=0.0	nevap
<i>precip</i>	Precipitation at each measurement station	precip_units	>=0.0	nrain
<i>rain_day</i>	Flag to set the form of any precipitation to rain (0=determine form; 1=rain)	none	0 or 1	one
<i>runoff</i>	Streamflow at each measurement station	runoff_units	>=0.0	nobs
<i>snowdepth</i>	Snow depth at each measurement station	inches	>=0.0	nsnow
<i>solrad</i>	Solar radiation at each measurement station	Langleys	>=0.0	nsol
<i>tmax</i>	Maximum air temperature at each measurement station	temp_units	-99.0 to 150.0	ntemp
<i>tmin</i>	Minimum air temperature at each measurement station	temp_units	-99.0 to 150.0	ntemp
<i>wind_speed</i>	Wind speed at each measurement station	meters per second	0.0 to 500.0	nwind

¹Dimensions defined in table 1-1.

Table 1-5. Input and output variables for the Precipitation-Runoff Modeling System, **version 5 (PRMS-V).**

[HRU, hydrologic response unit; GWR, groundwater reservoir; CBH, climate-by-HRU; ET, evapotranspiration; cfs: cubic feet per second; cms: cubic meters per second; >, greater than; Ngl, number of glaciers counted by termini; Ntp, number of tops of glaciers; **runoff_units**, 0=cfs; 1=cms; **precip_units**, 0=inches; 1=millimeters; **temp_units**, 0=degrees Fahrenheit; 1=degrees Celsius; control parameters **temp_module**, **precip_module**, **et_module**, **strmflow_module**, **model_mode**, **dprst_flag**, **subbasin_flag**, **cascade_flag**, and **cascadegw_flag** defined in table 1-2; **green** highlight indicates new for PRMS-V **water_use_flag = 1 if segment transferON_OFF=1 or gwr_transferON_OFF=1 or external_transferON_OFF=1 or dprst_transferON_OFF=1 or lake_transferON_OFF=1 or nconsumed>0 or nwateruse>0**; **red** highlight indicates new for PRMS-5.2; **pink** highlight indicates new for PRMS-5.1.0; **green** highlight indicates new for PRMS-5.0; ~~strike through~~ indicates items removed]

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
Climate distribution					
<i>basin_lakeprecip</i>	Basin area-weighted average precipitation on lake HRUs	one	inches	double	nlake > 0
<i>basin_lapse_max</i>	Basin area-weighted average maximum air temperature lapse rate per 1,000 feet	one	temp_units/ feet	real	temp_module = temp_dist2
<i>basin_lapse_min</i>	Basin area-weighted average minimum air temperature lapse rate per 1,000 feet	one	temp_units/ feet	real	temp_module = temp_dist2
<i>basin_max_temp_mo</i>	Monthly basin area-weighted average maximum air temperature	one	temp_units	double	always
<i>basin_max_temp_tot</i>	Total simulation basin area-weighted average maximum air temperature	one	temp_units	double	always
<i>basin_max_temp_yr</i>	Yearly basin area-weighted average maximum air temperature	one	temp_units	double	always
<i>basin_min_temp_mo</i>	Monthly basin area-weighted average minimum air temperature	one	temp_units	double	always
<i>basin_min_temp_tot</i>	Total simulation basin area-weighted average minimum air temperature	one	temp_units	double	always
<i>basin_min_temp_yr</i>	Yearly basin area-weighted average minimum air temperature	one	temp_units	double	always
<i>basin_net_ppt</i>	Basin area-weighted average net precipitation	one	inches	double	always
<i>basin_net_ppt_mo</i>	Monthly basin area-weighted average net precipitation	one	inches	double	always
<i>basin_net_ppt_yr</i>	Yearly basin area-weighted average net precipitation	one	inches	double	always
<i>basin_obs_ppt</i>	Basin area-weighted measured average precipitation	one	inches	double	always
<i>basin_ppt</i>	Basin area-weighted average precipitation	one	inches	double	always
<i>basin_ppt_mo</i>	Monthly basin area-weighted average precipitation	one	inches	double	always
<i>basin_ppt_tot</i>	Total simulation basin area-weighted average precipitation	one	inches	double	always
<i>basin_ppt_yr</i>	Yearly basin area-weighted average precipitation	one	inches	double	always
<i>basin_rain</i>	Basin area-weighted average rainfall	one	inches	double	always
<i>basin_snow</i>	Basin area-weighted average snowfall	one	inches	double	always
<i>basin_temp</i>	Basin area-weighted average air temperature	one	temp_units	double	always
<i>basin_tmax</i>	Basin area-weighted maximum air temperature	one	temp_units	double	always
<i>basin_tmin</i>	Basin area-weighted minimum air temperature	one	temp_units	double	always
<i>hru_ppt</i>	Precipitation distributed to each HRU	nhru	inches	real	always
<i>hru_rain</i>	Rain distributed to each HRU	nhru	inches	real	always

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>hru_snow</i>	Snow distributed to each HRU	nhru	inches	real	always
<i>humidity</i>	Relative humidity at each measurement station	nhumid	percentage	real	nhumid > 0
<i>humidity_hru</i>	Relative humidity for each HRU	nhru	percentage	real	et_module = potet_pm, or potet_pt
<i>is_rain_day</i>	Flag to indicate if it is raining anywhere in the basin	one	none	integer	precip_module = ide_dist or xyz_dist
<i>lake_precip</i>	Total precipitation into each lake HRU	nlake	cfs	double	strmflow_module = muskingum_lake
<i>newsnow</i> ²	Flag to indicate if new snow fell on each HRU (0=no; 1=yes)	nhru	none	integer	always
<i>pptmix</i> ²	Flag to indicate if precipitation is a mixture of rain and snow for each HRU (0=no; 1=yes)	nhru	none	integer	always
<i>precip</i>	Precipitation at each measurement station	nrain	precip_units	real	nrain > 0
<i>prmx</i>	Fraction of rain in a mixed precipitation event for each HRU	nhru	decimal fraction	real	always
<i>subinc_precip</i>	Area-weighted average precipitation on associated HRUs to each subbasin	nsub	inches	double	subbasin_flag = 1
<i>subinc_rain</i>	Area-weighted average rain from associated HRUs to each subbasin	nsub	inches	double	subbasin_flag = 1
<i>subinc_snow</i>	Area-weighted average snow on associated HRUs to each subbasin	nsub	inches	double	subbasin_flag = 1
<i>subinc_tavgc</i>	Area-weighted average air temperature for associated HRUs to each subbasin	nsub	degrees Celsius	double	subbasin_flag = 1
<i>subinc_tmaxc</i>	Area-weighted average maximum air temperature for associated HRUs to each subbasin	nsub	degrees Celsius	double	subbasin_flag = 1
<i>subinc_tminc</i>	Area-weighted average minimum air temperature for associated HRUs to each subbasin	nsub	degrees Celsius	double	subbasin_flag = 1
<i>tavgc</i>	Average air temperature distributed to each HRU	nhru	degrees Celsius	real	always
<i>tavgf</i>	Average air temperature distributed to each HRU	nhru	degrees Fahrenheit	real	always
<i>tmax</i>	Maximum air temperature at each measurement station	ntemp	temp_units	real	ntemp > 0
<i>tmax_rain_sta</i>	Maximum air temperature distributed to the precipitation stations	nrain	degrees Fahrenheit	real	precip_module = ide_dist or xyz_dist
<i>tmaxc</i>	Maximum air temperature distributed to each HRU	nhru	degrees Celsius	real	always
<i>tmaxf</i>	Maximum air temperature distributed to each HRU	nhru	degrees Fahrenheit	real	always
<i>tmin</i>	Minimum air temperature at each measurement station	ntemp	temp_units	real	ntemp > 0
<i>tmin_hru</i>	Minimum air temperature distributed to each HRU	nhru	temp_units	real	always
<i>tmin_rain_sta</i>	Minimum air temperature distributed to the precipitation measurement stations	nrain	degrees Fahrenheit	real	precip_module = ide_dist or xyz_dist
<i>tminc</i>	Minimum air temperature distributed to each HRU	nhru	degrees Celsius	real	always

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>tminf</i>	Minimum air temperature distributed to each HRU	nhru	degrees Fahrenheit	real	always
<i>wind_speed</i>	Wind speed at each measurement station	nwind	miles per hour	real	nwind > 0
<i>wind_speed_hru</i>	Wind speed for each HRU	nhru	miles per hour	real	et_module = potet_pm
Solar radiation distribution					
<i>basin_cloud_cover</i>	Basin area-weighted average cloud cover proportion	one	decimal fraction	double	solrad_module = ccsolrad
<i>basin_horad</i>	Potential shortwave radiation for the basin centroid	one	Langleys	double	always
<i>basin_orad</i>	Basin area-weighted average shortwave radiation on a horizontal surface	one	Langleys	double	solrad_module = ccsolrad or ddsolrad
<i>basin_potsw</i>	Basin area-weighted average shortwave radiation	one	Langleys	double	always
<i>basin_radadj</i>	Basin area-weighted average potential radiation adjustment for cloud cover	one	decimal fraction	double	solrad_module = ccsolrad
<i>basin_swrad</i>	Basin area-weighted average shortwave radiation	one	Langleys	double	always
<i>cloud_cover_hru</i>	Cloud cover proportion of each HRU	nhru	decimal fraction	double	solrad_module = ccsolrad
<i>cloud_radadj</i>	Radiation adjustment for cloud cover of each HRU	nhru	decimal fraction	double	solrad_module = ccsolrad
<i>lwrad_net</i>	Net long-wave radiation for each HRU	nhru	Megajoules/m**2/day	real	et_module = potet_pm, potet_pm_sta, or potet_pt
<i>orad</i>	Measured or computed solar radiation on a horizontal surface	one	Langleys	real	solrad_module = ccsolrad or ddsolrad
<i>orad_hru</i>	Solar radiation on a horizontal surface for each HRU	one	Langleys	double	solrad_module = ccsolrad or ddsolrad
<i>seginc_swrad</i>	Area-weighted average solar radiation for each segment from HRUs contributing flow to the segment	nsegment	Langleys	double	nsegment > 0
<i>solrad</i>	Solar radiation at each measurement station	nsol	Langleys	real	nsol > 0
<i>solrad_tmax</i> ⁵	Basin maximum air temperature for use with solar radiation calculations	one	temp_units	real	always
<i>solrad_tmin</i> ⁵	Basin minimum air temperature for use with solar radiation calculations	one	temp_units	real	always
<i>solrad_horad_potsw</i>	Potential solar radiation on a horizontal plane for each Julian Day, for each HRU	ndays, nhru	Langleys	double	always
<i>solrad_potsw</i>	Potential solar radiation for each Julian Day, for each HRU	ndays, nhru	Langleys	double	always
<i>subinc_swrad</i>	Area-weighted average shortwave radiation distributed to associated HRUs of each subbasin	nsub	Langleys	double	subbasin_flag = 1
<i>swrad</i>	Shortwave radiation distributed to each HRU	nhru	Langleys	real	always
Water Use					
<i>basin_hru_apply</i>	Basin area-weighted average <i>canopy_gain</i>	one	inches	double	water_use_flag = 1
<i>basin_net_apply</i>	Basin area-weighted average <i>net_apply</i>	one	inches	double	water_use_flag = 1

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
canopy_gain	Transfer gains to the canopy reservoir for each HRU for each time step	nhru	cfs	real	water_use_flag = 1
canopy_gain_tot	Transfer gains to the canopy reservoir for each HRU for the simulation	nhru	cfs	real	water_use_flag = 1 and nconsumed > 0
consumed_gain	Transfer gains to each water-use consumption destination for each time step	nconsumed	cfs	real	water_use_flag = 1 and nconsumed > 0
consumed_gain_tot	Transfer gains to each water-use consumption destination for the simulation	nconsumed	cfs	real	water_use_flag = 1 and nconsumed > 0
dprst_gain	Transfer gains to surface-depression storage for each HRU for each time step	nhru	cfs	real	dprst_transferON_OFF = 1 and dprst_flag = 1
dprst_gain_tot	Transfer gains to surface-depression storage for each HRU for the simulation	nhru	cfs	real	dprst_transferON_OFF = 1 and dprst_flag = 1
dprst_transfer	Transfer flow rate from surface-depression storage for each HRU for each time step	nhru	cfs	real	dprst_transferON_OFF = 1 and dprst_flag = 1
dprst_transfer_tot	Transfer flow rate from surface-depression storage for each HRU for the simulation	nhru	cfs	real	dprst_transferON_OFF = 1 and dprst_flag = 1
external_gain	Transfer gains to each external location for each time step	nexternal	cfs	real	external_transferON_OFF = 1 and nexternal > 1
external_gain_tot	Transfer gains to each external location for the simulation	nexternal	cfs	real	external_transferON_OFF = 1 and nexternal > 1
external_transfer	Transfer flow rate from each external location for each time step	nexternal	cfs	real	external_transferON_OFF = 1 and nexternal > 1
external_transfer_tot	Transfer flow rate from each external location for the simulation	nexternal	cfs	real	external_transferON_OFF = 1 and nexternal > 1
gwr_gain	Transfer gains to the groundwater reservoir of each HRU for each time step	nhru	cfs	real	water_use_flag = 1
gwr_gain_tot	Transfer gains to the groundwater reservoir of each HRU for the simulation	nhru	cfs	real	water_use_flag = 1
gwr_transfer	Transfer flow rate from the groundwater reservoir of each HRU for each time step	nhru	cfs	real	gwr_transferON_OFF = 1
gwr_transfer_tot	Transfer flow rate from the groundwater reservoir of each HRU for the simulation	nhru	cfs	real	gwr_transferON_OFF = 1
lake_gain	Transfer gains to each lake HRU for each time step	nhru	cfs	real	water_use_flag = 1 and strmflow_module = muskingum_lake
lake_gain_tot	Transfer gains to each lake HRU for the simulation	nhru	cfs	real	water_use_flag = 1 and strmflow_module = muskingum_lake

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
lake_transfer	Transfer flow rate from each lake HRU for each time step	nhru	cfs	real	lake_transferON_OFF = 1 and strmflow_module = muskingum_lake
lake_transfer_tot	Transfer flow rate from each lake HRU for the simulation	nhru	cfs	real	lake_transferON_OFF = 1 and strmflow_module = muskingum_lake
net_apply	<i>canopy_gain</i> minus interception	nhru	inches	real	water_use_flag = 1
segment_gain	Transfer gains to each stream segment for each time step	nhru	cfs	real	water_use_flag = 1 and strmflow_module = muskingum , strmflow_in out , muskingum_lake , or muskingum_mann
segment_gain_tot	Transfer gains to each stream segment for the simulation	nhru	cfs	real	water_use_flag = 1 and strmflow_module = muskingum , strmflow_in out , muskingum_lake , or muskingum_mann
segment_transfer	Transfer flow rate from each stream segment for each time step	nhru	cfs	real	segment_transferON_OFF = 1 and strmflow_module = muskingum , strmflow_in out , muskingum_lake , or muskingum_mann
segment_transfer_tot	Transfer flow rate from each stream segment for the simulation	nhru	cfs	real	segment_transferON_OFF = 1 and strmflow_module = muskingum , strmflow_in out , muskingum_lake , or muskingum_mann
soilzone_gain	Transfer gains to the capillary reservoir within the soilzone for each HRU for each time step	nhru	cfs	real	water_use_flag = 1
soilzone_gain_tot	Transfer gains to the capillary reservoir within the soilzone for each HRU for the simulation	nhru	cfs	real	water_use_flag = 1
total_canopy_gain	Transfer gains to all canopy reservoirs for each time step	one	cfs	double	water_use_flag = 1
total_consumed_gain	Transfer flow rates to all water-use consumption destinations for each time step	one	cfs	double	water_use_flag = 1

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>total_dprst_gain</i>	Transfer gains to all surface-depression storage for each time step	one	cfs	double	water_use_flag = 1 and dprst_flag = 1
<i>total_dprst_transfer</i>	Transfer flow rates from all surface-depression storage for each time step	one	cfs	double	dprst_transferON_OFF = 1 and dprst_flag = 1
<i>total_external_gain</i>	Transfer gains to all external locations for each time step	one	cfs	double	water_use_flag = 1
<i>total_external_transfer</i>	Transfer flow rates from all external locations for each time step	one	cfs	double	external_transferON_OFF = 1 and nexternal > 1
<i>total_gwr_gain</i>	Transfer gains to all groundwater reservoirs for each time step	one	cfs	double	water_use_flag = 1
<i>total_gwr_transfer</i>	Transfer flow rates from all groundwater reservoirs for each time step	one	cfs	double	water_use_flag = 1 and gwr_transferON_OFF = 1
<i>total_lake_gain</i>	Transfer gains to all lake HRUs for each time step	one	cfs	double	water_use_flag = 1 and strmflow_module = muskingum_lake
<i>total_lake_transfer</i>	Transfer flow rates from all lake HRUs for each time step	one	cfs	double	lake_transferON_OFF = 1 and strmflow_module = muskingum_lake
<i>total_segment_gain</i>	Transfer gains to all stream segments for each time step	one	cfs	double	water_use_flag = 1 and strmflow_module = muskingum, strmflow in out, muskingum_lake , or muskingum_mann
<i>total_segment_transfer</i>	Transfer flow rates from all stream segments for each time step	one	cfs	double	segment_transferON_OFF = 1 and strmflow_module = muskingum, strmflow in out, muskingum_lake , or muskingum_mann
<i>total_soilzone_gain</i>	Transfer gains to all capillary reservoirs for each time step	one	cfs	double	water_use_flag = 1
<i>total_transfers</i>	Transfer of all water-use transfers for each time step	one	cfs	double	water_use_flag = 1
<i>transfesr_rate</i>	Transfer of each water-use transfer for each time step	nwateruse	cfs	double	water_use_flag = 1
Interception					
<i>basin_changeover</i>	Basin area-weighted average water released from a change over of canopy cover type	one	inches	double	always
<i>basin_intcp_stor</i>	Basin area-weighted average interception storage	one	inches	double	always
<i>basin_net_rain</i>	Basin area-weighted average rain net precipitation	one	inches	double	always
<i>basin_net_snow</i>	Basin area-weighted average snow net precipitation	one	inches	double	always

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>canopy_covden</i>	Canopy cover density for each HRU	nhru	decimal fraction	real	always
<i>hru_intcpstor</i>	Interception storage in the canopy for each HRU	nhru	inches	real	always
<i>intcp_changeover</i>	Water released from a change over of canopy cover type for each HRU	nhru	inches	real	always
<i>intcp_form</i>	Form (0=rain; 1=snow) of interception for each HRU	nhru	none	integer	always
<i>intcp_on</i>	Flag indicating interception storage for each HRU (0=no; 1=yes)	nhru	none	integer	always
<i>intcp_stor</i>	Interception storage in canopy for cover density for each HRU	nhru	inches	real	always
<i>net_ppt</i>	Precipitation (rain and/or snow) that falls through the canopy for each HRU	nhru	inches	real	always
<i>net_rain</i>	Rain that falls through canopy for each HRU	nhru	inches	real	always
<i>net_snow</i>	Snow that falls through canopy for each HRU	nhru	inches	real	always
Snow computations					
<i>ai</i>	Maximum snowpack for each HRU	nhru	inches	real	always
<i>albedo</i>	Snow surface albedo or the fraction of radiation reflected from the snowpack surface for each HRU	nhru	decimal fraction	real	always
<i>basin_pk_precip</i>	Basin area-weighted average precipitation added to snowpack	one	inches	double	always
<i>basin_pweqv</i>	Basin area-weighted average snowpack water equivalent (not including glacier)	one	inches	double	always
<i>basin_snowcov</i>	Basin area-weighted average snow-covered area	one	decimal fraction	double	always
<i>basin_snowmelt</i>	Basin area-weighted average snowmelt (not on including snow on glacier)	one	inches	double	always
<i>basin_snowmelt_mo</i>	Monthly basin area-weighted average snowmelt	one	inches	double	always
<i>basin_snowmelt_tot</i>	Total simulation basin area-weighted average snowmelt	one	inches	double	always
<i>basin_snowmelt_yr</i>	Yearly basin area-weighted average snowmelt	one	inches	double	always
<i>basin_tcal</i>	Basin area-weighted average net snowpack energy balance	one	Langleys	double	always
<i>frac_swe</i>	Fraction of maximum snow-water equivalent (snarea_thresh) on each HRU	nhru	decimal fraction	real	always
<i>freeh2o</i>	Storage of free liquid water in the snowpack on each HRU	nhru	inches	real	always
<i>iasw</i>	Flag indicating that snow covered area is interpolated between previous location on curve and maximum (1), or is on the defined curve (0)	nhru	none	integer	always
<i>int_alb</i>	Flag to indicate (1: accumulation season curve; 2: use of the melt season curve)	nhru	none	integer	always
<i>iso</i>	Flag to indicate if time is before (1) or after (2) the day to force melt season (melt_force)	nhru	none	integer	always
<i>lso</i>	Counter for tracking the number of days the snowpack is at or above 0 degrees Celsius	nhru	number of iterations	integer	always

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>lst</i>	Flag indicating whether there was new snow that was insufficient to reset the albedo curve (1) (albset_snm or albset_sna), otherwise (0)	nhru	none	integer	always
<i>mso</i>	Flag to indicate if time is before (1) or after (2) the first potential day for melt season (melt_look)	nhru	none	integer	always
<i>pk_def</i>	Heat deficit, amount of heat necessary to make the snowpack isothermal at 0 degrees Celsius	nhru	Langleys	real	always
<i>pk_den</i>	Density of the snowpack on each HRU	nhru	grams/cubic centimeters	real	always
<i>pk_depth</i>	Depth of snowpack on each HRU	nhru	inches	double	always
<i>pk_ice</i>	Storage of frozen water in the snowpack on each HRU	nhru	inches	real	always
<i>pk_precip</i>	Precipitation added to snowpack for each HRU	nhru	inches	real	always
<i>pk_temp</i>	Temperature of the snowpack on each HRU	nhru	temp_units	real	always
<i>pksv</i>	Snowpack water equivalent when there is new snow and in melt phase; used to interpolate between depletion curve and 100 percent on each HRU	nhru	inches	real	always
<i>pkwater_ante</i>	Antecedent snowpack water equivalent on each HRU	nhru	inches	double	always
<i>pkwater_equiv</i>	Snowpack water equivalent on each HRU	nhru	inches	double	always
<i>pptmix_nopack</i>	Flag indicating that a mixed precipitation event has occurred with no snowpack present on an HRU (1), otherwise (0)	nhru	none	integer	always
<i>pss</i>	Previous snowpack water equivalent plus new snow	nhru	inches	real	always
<i>pst</i>	While a snowpack exists, <i>pst</i> tracks the maximum snow water equivalent of that snowpack	nhru	inches	real	always
<i>salb</i>	Days since last new snow to reset albedo for each HRU	nhru	days	real	always
<i>scrv</i>	Snowpack water equivalent plus a portion of new snow on each HRU	nhru	inches	double	always
<i>slst</i>	Days since last new snow for each HRU	nhru	days	real	always
<i>snow</i>	Snow depth at each measurement station	nsnow	inches	real	nsnow > 0
<i>snow_free</i>	Fraction of snow-free surface for each HRU	nhru	decimal fraction	real	always
<i>snowcov_area</i>	Snow-covered area on each HRU prior to melt and sublimation unless snowpack depleted	nhru	decimal fraction	real	always
<i>snowcov_areasy</i>	Snow cover fraction when there is new snow and in melt phase; used to interpolate between depletion curve and 100 percent on each HRU	nhru	decimal fraction	real	always
<i>snowmelt</i>	Snowmelt from snowpack on each HRU (not including snow on glacier)	nhru	inches	real	always
<i>snsy</i>	Tracks the cumulative amount of new snow until there is enough to reset the albedo curve (albset_snm or albset_sna)	nhru	inches	real	always

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>subinc_pkweqv</i>	Area-weighted average snowpack water equivalent from associated HRUs of each subbasin	nsub	inches	double	subbasin_flag = 1
<i>subinc_snowcov</i>	Area-weighted average snow-covered area from associated HRUs to each subbasin	nsub	decimal fraction	double	subbasin_flag = 1
<i>subinc_snowmelt</i>	Area-weighted average snowmelt from associated HRUs of each subbasin	nsub	inches	double	subbasin_flag = 1
<i>tcal</i>	Net snowpack energy balance on each HRU	nhru	Langleys	real	always
Glacier and frozen ground computations					
<i>alt_above_ela</i>	Altitude above equilibrium line altitude (ELA)	nhru	elev_units	real	glacier_flag = 1
<i>ann_tempe</i>	Current average year air temperature over each HRU	nhru	degrees Celsius	real	glacier_flag = 1
<i>av_basal_slope</i>	Glacier average basal slope at flowline location, indexed by <i>glacr_tag</i>	nhru	decimal fraction	real	glacier_flag = 1
<i>av_fgrad</i>	Glacier average HRU mass balance gradient with elevation at flowline at end of each hydrological year, Ngl of these	nhru	decimal fraction	real	glacier_flag = 1
<i>basal_elev</i>	Glacier basal elevation mean over HRU	nhru	elev_units	real	glacier_flag = 1
<i>basal_slope</i>	Glacier basal slope down flowline mean over each HRU	nhru	decimal fraction	real	glacier_flag = 1
<i>basin_gl_area</i>	Basin area-weighted average glacier-covered area	one	decimal fraction	double	glacier_flag = 1
<i>basin_gl_cfs</i>	Basin glacier surface melt (rain, snow, ice) leaving the basin through the stream network	one	cfs	double	glacier_flag = 1
<i>basin_gl_ice_melt</i>	Basin area-weighted glacier ice (firn) melt coming out of termini of all glaciers and glacierettes	one	inches	double	glacier_flag = 1
<i>basin_gl_storage</i>	Basin area-weighted average storage change in glacier reservoirs	one	inches	double	glacier_flag = 1
<i>basin_gl_storstart</i>	Basin area-weighted average storage estimated start in glacier reservoirs	one	inches	double	glacier_flag = 1
<i>basin_gl_storvol</i>	Basin storage volume in glacier storage reservoirs	one	acre-inches	double	glacier_flag = 1
<i>basin_gl_top_gain</i>	Basin area-weighted glacier surface gain (snow and rain minus evaporation) for all glaciers and glacierettes	one	inches	double	glacier_flag = 1
<i>basin_gl_top_melt</i>	Basin area-weighted glacier surface melt (snow, ice and rain) coming out of termini of all glaciers and glacierettes	one	inches	double	glacier_flag = 1
<i>basin_glacrb_melt</i>	Basin area-weighted average basal melt of glacier, goes to soil	one	inches	double	glacier_flag = 1
<i>basin_glacrevap</i>	Basin area-weighted average glacier ice evaporation and sublimation	one	inches	double	glacier_flag = 1
<i>basin_snowicecov</i>	Basin area-weighted average snow and glacier and glacierette covered area	one	decimal fraction	double	glacier_flag = 1
<i>cfgi</i>	Continuous Frozen Ground Index for each HRU	nhru	none	integer	frozen_flag = 1
<i>cfgi_prev</i>	Continuous Frozen Ground Index from previous time step for each HRU	nhru	none	integer	frozen_flag = 1

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
delta_volyr	Year total volume change for each glacier, indexed by <i>glacr_tag</i> for each HRU	nhru	inches cubed	double	glacier_flag = 1
ela	HRU number at ELA corresponding to each top in each glacier, Ntp of these	nhru	none	integer	glacier_flag = 1
frozen	Flag for frozen ground for each HRU (0=no; 1=yes)	nhru	none	integer	frozen_flag = 1
gl_area	Area of each glacier, indexed by <i>glacr_tag</i>	nhru	acres	double	glacier_flag = 1
gl_ice_melt	Amount of glacier ice (firm) melt coming out of terminus of glacier, indexed by <i>glacr_tag</i>	nhru	inches	real	glacier_flag = 1
gl_mb_cumul	Cumulative mass balance for each glacier since start day, indexed by <i>glacr_tag</i>	nhru	inches	double	glacier_flag = 1
gl_mb_ycumul	Yearly mass balance for each glacier, indexed by <i>glacr_tag</i>	nhru	inches	real	glacier_flag = 1
gl_top_melt	Amount of glacier surface melt (snow, ice, rain) coming out of terminus of glacier, indexed by <i>glacr_tag</i>	nhru	inches	real	glacier_flag = 1
glacier_frac	Fraction of glaciation (0=none; 1=100%)	nhru	decimal fraction	real	glacier_flag = 1
glacr_5avsnow	Current 5-yr average snow over glacier or glacierette HRUs	nhru	inches/year	real	glacier_flag = 1
glacr_5avsnow1	First 5-yr average snow over glacier or glacierette HRUs	nhru	inches/year	real	glacier_flag = 1
glacr_air_5avtemp	Current 5-yr average summer (June July Aug) air temperature over glacier or glacierette HRUs	nhru	degrees Celsius	real	glacier_flag = 1
glacr_air_5avtemp1	First 5-yr average summer temperature over glacier or glacierette HRUs	nhru	degrees Celsius	real	glacier_flag = 1
glacr_air_delttemp	Change in 5-yr average air temperature over glacier or glacierette HRUs from first time step	nhru	degrees Celsius	real	glacier_flag = 1
glacr_albedo	Ice surface albedo or the fraction of radiation reflected from the icepack surface for each glacier HRU	nhru	decimal fraction	real	glacier_flag = 1
glacr_delsnow	Change in 5-yr average snow over glacier or glacierette for each HRU from first time step	nhru	inches/year	real	glacier_flag = 1
glacr_elev_init	Glacier surface elevation mean over each HRU at initiation extrapolating to 100% glacierized HRU	nhru	elev_units	real	glacier_flag = 1
glacr_evap	Evaporation and sublimation from icepack on each glacier HRU	nhru	inches	real	glacier_flag = 1
glacr_flow	Glacier melt and rain from HRU to stream network, only nonzero at termini HRUs and snowfield HRUs	nhru	inches cubed	real	glacier_flag = 1
glacr_freeh2o	Storage of free liquid water in the icepack on each glacier HRU	nhru	inches	real	glacier_flag = 1
glacr_freeh2o_capm	Free-water holding capacity of glacier ice, changes to 0 if active layer melts	nhru	decimal fraction	real	glacier_flag = 1
glacr_pk_def	Heat deficit, amount of heat necessary to make the glacier snowpack isothermal at 0 degrees Celsius	nhru	Langleys	real	glacier_flag = 1
glacr_pk_den	Density of the icepack on each glacier HRU, hard coded to equal 0.917	nhru	gm/cm3	real	glacier_flag = 1

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>glacr_pk_depth</i>	Depth of icepack on each glacier HRU, make essentially infinite	nhru	inches	double	glacier_flag = 1
<i>glacr_pk_ice</i>	Storage of frozen water in the icepack on each glacier HRU	nhru	inches	real	glacier_flag = 1
<i>glacr_pk_temp</i>	Temperature of the glacier on each HRU	nhru	degrees Celsius	real	glacier_flag = 1
<i>glacr_pkwater_ante</i>	Antecedent icepack water equivalent on each glacier HRU	nhru	inches	double	glacier_flag = 1
<i>glacr_pkwater_equiv</i>	Icepack water equivalent on each glacier HRU	nhru	inches	double	glacier_flag = 1
<i>glacr_pss</i>	Previous glacier pack water equivalent plus new ice	nhru	inches	double	glacier_flag = 1
<i>glacr_pst</i>	While an icepack exists, <i>glacr_pst</i> tracks the maximum ice water equivalent of that icepack	nhru	inches	double	glacier_flag = 1
<i>glacr_slope_init</i>	Glacier surface slope mean over HRU at initiation extrapolating to 100% glacierized HRU	nhru	elev_units	real	glacier_flag = 1
<i>glacr_tag</i>	Identifies which glacier each HRU belongs to	nhru	none	integer	glacier_flag = 1
<i>glacrb_melt</i>	Glacier basal melt, goes to soil	nhru	inches/day	real	glacier_flag = 1
<i>glacrcov_area</i>	Ice-covered area on each glacier HRU or HRU with glacierette at start of time step	nhru	decimal fraction	real	glacier_flag = 1
<i>glacrmelt</i>	Melt from icepack on each glacier HRU, includes rain water that does not absorb	nhru	inches	real	glacier_flag = 1
<i>glnet_ar_delta</i>	Sum of area change of each glacier since start year, indexed by <i>glacr_tag</i>	nhru	acres	double	glacier_flag = 1
<i>glrette_frac</i>	Fraction of snow field (too small for glacier dynamics)	nhru	decimal fraction	real	glacier_flag = 1
<i>glrette_melt</i>	Amount of glacierette surface melt (snow, ice, rain) from an HRU	nhru	inches	real	glacier_flag = 1
<i>hru_elev_ts</i>	HRU elevation for timestep, which can change for glaciers; used in computations in modules: <i>ide_dist</i> , <i>xyz_dist</i> , <i>precip_laps</i> , <i>temp_1sta</i> , <i>temp_laps</i> , and <i>temp_dist2</i>	nhru	elev_units	real	glacier_flag = 1
<i>hru_glres_melt</i>	Amount of glacier surface melt (snow, ice, rain) from an HRU that goes into reservoirs	nhru	inches	real	glacier_flag = 1
<i>hru_mb_ycumul</i>	Mass balance for a glacier HRU, cumulative for year	nhru	inches	double	glacier_flag = 1
<i>hru_mb_yrend</i>	Glacier HRU mass balance at end of previous hydrological year	nhru	inches	real	glacier_flag = 1
<i>hru_slope_ts</i>	HRU slope for timestep, which can change for glaciers	nhru	decimal fraction	real	glacier_flag = 1
<i>ikeep_gl</i>	Glacier integer variables keeping from first year	nhru	none	integer	glacier_flag = 1
<i>keep_gl</i>	Glacier real variables keeping from first year	nhru	none	integer	glacier_flag = 1
<i>nhrugl</i>	Number of at least partially glacierized HRUs at initiation	nhru	none	integer	glacier_flag = 1
<i>ode_glacrva_coef</i>	Estimate of glacrva_coef from ODE basal topography of each glacier, indexed by <i>glacr_tag</i>		m**(3-2* glacrva_exp)	real	glacier_flag = 1
<i>order_flowline</i>	Order of flowlines that belong together as glaciers, Ntp of these	nhru	none	integer	glacier_flag = 1
<i>prev_area</i>	Previous year glacier-covered area above each HRU where all	nhru, nglres	inches squared	real	glacier_flag = 1

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
prev_out	branches of the glacier are included Antecedent outflow of the 3 reservoirs in each glacier, indexed by <i>glacr_tag</i>	nhru	inches cubed	real	glacier_flag = 1
prev_outi	Antecedent outflow of the 3 reservoirs in each glacier for only ice (firn) melt, indexed by <i>glacr_tag</i>	nhru	inches cubed	real	glacier_flag = 1
prev_vol	Previous volume of each glacier, indexed by <i>glacr_tag</i>	nhru	inches cubed	real	glacier_flag = 1
term	HRU number at terminus of each glacier, Ngl of these	nhru	none	integer	glacier_flag = 1
top	HRU number at tops of each glacier, Ntp of these	nhru	none	integer	glacier_flag = 1
top_tag	Identifies which glacier top each HRU is fed by. If = -1, then has multiple feeders	nhru	none	integer	glacier_flag = 1
yrdays5	Number of days since last 5-year mark	nhru	days	integer	glacier_flag = 1
Evapotranspiration					
<i>basin_actet</i>	Basin area-weighted average actual ET	one	inches	double	Always
<i>basin_actet_mo</i>	Monthly basin area-weighted average actual ET	one	inches	double	Always
<i>basin_actet_tot</i>	Total simulation basin area-weighted average actual ET	one	inches	double	always
<i>basin_actet_yr</i>	Yearly basin area-weighted average actual ET	one	inches	double	always
<i>basin_dprst_evap</i>	Basin area-weighted average evaporation from surface depression storage	one	inches	double	dprst_flag = 1
<i>basin_fall_frost</i>	Basin area-weighted average fall frost	one	solar date	real	model_mode = FROST
<i>basin_humidity</i>	Basin area-weighted average humidity	one	percentage	double	et_module = potet_pm, potet_pm_sta, or potet_pt
<i>basin_imperv_evap</i>	Basin area-weighted average evaporation from impervious area	one	inches	double	always
<i>basin_lakeevap</i>	Basin area-weighted average lake evaporation	one	inches	double	nlake > 0
<i>basin_intcp_evap</i>	Basin area-weighted evaporation from the canopy	one	inches	double	always
<i>basin_intcp_evap_mo</i>	Monthly basin area-weighted average interception evaporation	one	inches	double	always
<i>basin_intcp_evap_tot</i>	Total simulation basin area-weighted average interception evaporation	one	inches	double	always
<i>basin_intcp_evap_yr</i>	Yearly basin area-weighted average interception evaporation	one	inches	double	always
<i>basin_perv_et</i>	Basin area-weighted average ET from capillary reservoirs	one	inches	double	always
<i>basin_potet</i>	Basin area-weighted average potential ET	one	inches	double	always
<i>basin_potet_mo</i>	Monthly area-weighted average potential ET	one	inches	double	always
<i>basin_potet_tot</i>	Total simulation area-weighted average potential ET	one	inches	double	always
<i>basin_potet_yr</i>	Yearly area-weighted average potential ET	one	inches	double	always
<i>basin_snowevap</i>	Basin area-weighted average evaporation and sublimation from snowpack (not including glacier)	one	inches	double	always
<i>basin_spring_frost</i>	Basin area-weighted average spring frost	one	solar date	real	model_mode = FROST

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>basin_swale_et</i>	Basin area-weighted average ET from swale HRUs	one	inches	double	always
<i>basin_transp_on</i>	Flag indicating whether transpiration is occurring anywhere in the basin (0=no; 1=yes)	one	none	integer	always
<i>basin_windspeed</i>	Basin area-weighted average wind speed	one	meters per second	double	et_module = potet_pm or potet_pm_sta
<i>dprst_evap_hru</i>	Evaporation from surface-depression storage for each HRU	nhru	inches	real	dprst_flag = 1
<i>fall_frost</i>	The solar date (number of days after winter solstice) of the first killing frost of the fall	nhru	solar date	real	model_mode = FROST
<i>hru_actet</i>	Actual ET for each HRU	nhru	inches	real	always
<i>hru_et_yr</i>	Yearly area-weighted average actual ET for each HRU	nhru	inches	double	print_freq = 2
<i>hru_intcpevap</i>	Evaporation from the canopy for each HRU	nhru	inches	real	always
<i>imperv_evap</i>	Evaporation from impervious area for each HRU	nhru	inches	real	always
<i>intcp_evap</i>	Evaporation from the canopy for each HRU	nhru	inches	real	always
<i>lake_evap</i>	Total evaporation from each lake HRU	nlake	cfs	double	nlake > 0
<i>pan_evap</i>	Pan evaporation at each measurement station	nevap	inches	real	nevap > 0
<i>perv_actet</i>	Actual ET from the capillary reservoir of each HRU	nhru	inches	real	always
<i>potet</i>	Potential ET for each HRU	nhru	inches	real	always
<i>potet_lower</i>	Potential ET in the lower zone of the capillary reservoir for each HRU	nhru	inches	real	always
<i>potet_rechr</i>	Potential ET in the recharge zone of the capillary reservoir for each HRU	nhru	inches	real	always
<i>perv_avail_et</i>	Unsatisfied ET available to the capillary reservoir of each HRU	nhru	inches	real	always
<i>seginc_potet</i>	Area-weighted average potential ET for each segment from HRUs contributing flow to the segment	nsegment	inches	double	strmflow_module = muskingum, strmflow in out, muskingum lake, or muskingum mann
<i>snow_evap</i>	Evaporation and sublimation from snowpack on each HRU	nhru	inches	real	always
<i>spring_frost</i>	The solar date (number of days after winter solstice) of the last killing frost of the spring	nhru	solar date	real	model_mode = FROST
<i>subinc_actet</i>	Area-weighted average actual ET from associated HRUs to each subbasin	nsub	inches	double	subbasin_flag = 1
<i>subinc_potet</i>	Area-weighted average potential ET from associated HRUs to each subbasin	nsub	inches	double	subbasin_flag = 1
<i>swale_actet</i>	Evaporation from the gravity and preferential-flow reservoirs that exceeds sat_threshold	nhru	inches	real	always
<i>tempc_dewpt</i>	Air temperature at dew point for each HRU	nhru	degrees Celsius	real	et_module = potet_pm, potet_pm_sta, or

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>transp_on</i>	Flag indicating whether transpiration is occurring (0=no; 1=yes)	nhru	none	integer	potet_pt always
<i>unused_potet</i>	Unsatisfied potential evapotranspiration	nhru	inches	real	always
<i>vp_actual</i>	Actual vapor pressure for each HRU	nhru	kilopascals	real	et_module = potet_pm , potet_pm_sta , or potet_pt
<i>vp_sat</i>	Saturation vapor pressure for each HRU	nhru	kilopascals	real	et_module = potet_pm , potet_pm_sta , or potet_pt
<i>vp_slope</i>	Slope of saturation vapor pressure versus air temperature curve for each HRU	nhru	kilopascals/degrees Celsius	real	et_module = potet_pm , potet_pm_sta , or potet_pt
Hortonian surface runoff, infiltration, and impervious storage					
<i>basin_cap_infil_tot</i>	Basin area-weighted average infiltration with cascading flow into capillary reservoirs	one	inches	double	always
cap_upflow_max	Maximum infiltration and any cascading interflow and Dunnian surface runoff that can be added to capillary reservoir storage for each HRU	nhru	inches	real	always
<i>cap_waterin</i>	Infiltration and any cascading interflow and Dunnian surface runoff added to capillary reservoir storage for each HRU	nhru	inches	real	always
cascade_dunnianflow	Cascading Dunnian flow for each HRU	nhru	inches	real	cascade_flag = 1 and ncascade > 0
cascade_interflow	Cascading interflow for each HRU	nhru	inches	real	cascade_flag = 1 and ncascade > 0
<i>basin_contrib_fraction</i>	Basin area-weighted average contributing area of the pervious area of each HRU	one	decimal fraction	double	always
<i>basin_hortonian</i>	Basin area-weighted average Hortonian runoff	one	inches	double	always
<i>basin_hortonian_lakes</i>	Basin area-weighted average Hortonian surface runoff to lakes	one	inches	double	cascade_flag = 1 and ncascade > 0
<i>basin_imperv_stor</i>	Basin area-weighted average storage on impervious area	one	inches	double	always
<i>basin_infil</i>	Basin area-weighted average infiltration to the capillary reservoirs	one	inches	double	always
<i>basin_sroff</i>	Basin area-weighted average surface runoff to the stream network	one	inches	double	always
<i>basin_sroff_cfs</i>	Basin area-weighted average surface runoff to the stream network	one	cfs	double	always
<i>basin_sroff_down</i>	Basin area-weighted average cascading surface runoff	one	inches	double	cascade_flag = 1 and

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
					ncascade > 0
<i>basin_sroff_mo</i>	Monthly basin area-weighted average surface runoff	one	inches	double	always
<i>basin_sroff_tot</i>	Total simulation basin area-weighted average surface runoff	one	inches	double	always
<i>basin_sroff_upslope</i>	Basin area-weighted average cascading surface runoff received from upslope HRUs	one	inches	double	cascade_flag = 1 and ncascade > 0
<i>basin_sroff_yr</i>	Yearly basin area-weighted average surface runoff	one	inches	double	always
<i>basin_sroffi</i>	Basin area-weighted average surface runoff from impervious areas	one	inches	double	always
<i>basin_sroffp</i>	Basin area-weighted average surface runoff from pervious areas	one	inches	double	always
<i>contrib_fraction</i>	Contributing area of each HRU pervious area	nhru	decimal fraction	real	always
<i>hortonian_flow</i>	Hortonian surface runoff reaching stream network for each HRU	nhru	inches	real	always
<i>hortonian_lakes</i>	Surface runoff to lakes for each HRU	nhru	inches	double	cascade_flag = 1, ncascade > 0, and nlake > 0
<i>hru_frac_perv</i>	Fraction of HRU that is pervious	nhru	decimal fraction	real	always
<i>hru_hortn_cascflow</i>	Cascading Hortonian surface runoff leaving each HRU	nhru	inches	double	cascade_flag = 1 and ncascade > 0
<i>hru_imperv</i>	Area of HRU that is impervious	nhru	acres	real	always
<i>hru_impervstor</i>	Storage on impervious area for each HRU	nhru	inches	real	always
<i>hru_perv</i>	Area of HRU that is pervious	nhru	acres	real	always
<i>hru_sroffi</i>	Surface runoff from impervious areas for each HRU	nhru	inches	real	always
<i>hru_sroffp</i>	Surface runoff from pervious areas for each HRU	nhru	inches	real	always
<i>imperv_stor</i>	Storage on impervious area for each HRU	nhru	inches	real	always
<i>infil</i>	Infiltration to the capillary reservoir for each HRU	nhru	inches	real	always
<i>seginc_sroff</i>	Area-weighted average surface runoff for each segment from HRUs contributing flow to the segment	nsegment	cfs	double	nsegment > 0
<i>sroff²</i>	Surface runoff to the stream network for each HRU	nhru	inches	real	always
<i>sub_sroff</i>	Area-weighted average Hortonian plus Dunnian surface runoff from associated HRUs to each subbasin and from upstream subbasins	nsub	cfs	double	subbasin_flag = 1
<i>subinc_sroff</i>	Area-weighted average Hortonian plus Dunnian surface runoff from associated HRUs to each subbasin	nsub	cfs	double	subbasin_flag = 1
<i>upslope_hortonian</i>	Hortonian surface runoff received from upslope HRUs	nhru	inches	double	cascade_flag = 1 and ncascade > 0
Surface depression storage					
<i>basin_dprst_seep</i>	Basin area-weighted average seepage surface-depression storage	one	inches	double	dprst_flag = 1

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>basin_dprst_sroff</i>	Basin area-weighted average surface runoff from open surface-depression storage	one	inches	double	dprst_flag = 1
<i>basin_dprst_volcl</i>	Basin area-weighted average storage volume in closed surface depressions	one	inches	double	dprst_flag = 1
<i>basin_dprst_volop</i>	Basin area-weighted average storage volume in open surface depressions	one	inches	double	dprst_flag = 1
<i>dprst_area_clos</i>	Surface area of closed surface depressions based on volume for each HRU	nhru	acres	real	dprst_flag = 1
<i>dprst_area_clos_max</i>	Aggregate sum of closed surface-depression storage areas of each HRU	nhru	acres	real	dprst_flag = 1
<i>dprst_area_max</i>	Aggregate sum of surface-depression storage areas of each HRU	nhru	acres	real	dprst_flag = 1
<i>dprst_area_open</i>	Surface area of open surface depressions based on volume for each HRU	nhru	acres	real	dprst_flag = 1
<i>dprst_area_open_max</i>	Aggregate sum of open surface-depression storage areas of each HRU	nhru	acres	real	dprst_flag = 1
<i>dprst_insroff_hru</i>	Surface runoff from pervious and impervious portions into surface depression storage for each HRU	nhru	inches	real	dprst_flag = 1
<i>dprst_seep_hru</i>	Seepage from surface-depression storage to associated GWR for each HRU	nhru	inches	double	dprst_flag = 1
<i>dprst_sroff_hru</i>	Surface runoff from open surface-depression storage for each HRU	nhru	inches	double	dprst_flag = 1
<i>dprst_stor_hru</i>	Surface-depression storage for each HRU	nhru	inches	double	dprst_flag = 1
<i>dprst_vol_clos</i>	Storage volume in closed surface depressions for each HRU	nhru	acre-inches	double	dprst_flag = 1
<i>dprst_vol_clos_frac</i>	Fraction of closed surface-depression storage of the maximum storage for each HRU	nhru	decimal fraction	double	dprst_flag = 1
<i>dprst_vol_frac</i>	Fraction of surface-depression storage of the maximum storage for each HRU	nhru	decimal fraction	double	dprst_flag = 1
<i>dprst_vol_open</i>	Storage volume in open surface depressions for each HRU	nhru	acre-inches	double	dprst_flag = 1
<i>dprst_vol_open_frac</i>	Fraction of open surface-depression storage of the maximum storage for each HRU	nhru	decimal fraction	double	dprst_flag = 1
Soil zone storage, interflow, gravity drainage, Dunnian surface runoff					
<i>basin_cap_infil_tot</i>	Basin area-weighted average infiltration with cascading flow into capillary reservoirs	one	inches	double	always
<i>basin_cap_up_max</i>	Basin area-weighted average maximum cascade flow that flows to capillary reservoirs	one	inches	double	cascade_flag = 1 and ncascade > 0
<i>basin_capwaterin</i>	Basin area-weighted average infiltration and any cascading interflow and Dunnian flow added to capillary reservoir storage	one	inches	double	always

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>basin_cpr_stor_frac</i>	Basin area-weighted average fraction of capillary reservoir storage of the maximum storage	one	decimal fraction	double	always
<i>basin_dncascadeflow</i>	Basin area-weighted average cascading interflow and Dunnian surface runoff	one	inches	double	cascade_flag = 1 and ncascade > 0
<i>basin_dndunnianflow</i>	Basin area-weighted average cascading Dunnian flow	one	inches	double	cascade_flag = 1 and ncascade > 0
<i>basin_dninterflow</i>	Basin area-weighted average cascading interflow	one	inches	double	cascade_flag = 1 and ncascade > 0
<i>basin_dunnian</i>	Basin area-weighted average Dunnian surface runoff that flows to the stream network	one	inches	double	always
<i>basin_dunnian_gvr</i>	Basin area-weighted average excess flow to preferential-flow reservoirs from gravity reservoirs	one	inches	double	always
<i>basin_dunnian_pfr</i>	Basin area-weighted average excess infiltration to preferential-flow reservoirs from variable <i>infil</i>	one	inches	double	always
<i>basin_dunnianflow</i>	Basin area-weighted average cascading Dunnian flow	one	inches	double	always
<i>basin_gvr2pfr</i>	Basin area-weighted average excess flow to preferential-flow reservoir storage from gravity reservoirs	one	inches	double	always
<i>basin_gvr_stor_frac</i>	Basin area-weighted average fraction of gravity reservoir storage of the maximum storage	one	decimal fraction	double	always
<i>basin_interflow_max</i>	Basin area-weighted average maximum interflow that flows from gravity reservoirs	one	inches	double	always
<i>basin_lakeinsz</i>	Basin area-weighted average lake inflow from land HRUs	one	inches	double	cascade_flag = 1, ncascade > 0, and nlake > 0
<i>basin_pfr_stor_frac</i>	Basin area-weighted average fraction of preferential-flow reservoir storage of the maximum storage	one	decimal fraction	double	always
<i>basin_pref_flow_infil</i>	Basin area-weighted average infiltration to preferential-flow reservoir storage	one	inches	double	always
<i>basin_pref_stor</i>	Basin area-weighted average storage in preferential-flow reservoirs	one	inches	double	always
<i>basin_prefflow</i>	Basin area-weighted average interflow from preferential-flow reservoirs to the stream network	one	inches	double	always
<i>basin_recharge</i>	Basin area-weighted average recharge to GWRs	one	inches	double	always
<i>basin_slowflow</i>	Basin area-weighted average interflow from gravity reservoirs to the stream network	one	inches	double	always
<i>basin_slstor</i>	Basin area-weighted average storage of gravity reservoirs	one	inches	double	always
<i>basin_sm2gvr</i>	Basin area-weighted average excess flow from capillary reservoirs to gravity reservoir storage	one	inches	double	always

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>basin_sm2gvr_maxin</i>	Basin area-weighted average maximum excess flow from capillary reservoirs that flows to gravity reservoirs	one	inches	double	always
<i>basin_soil_lower_stor_frac</i>	Basin area-weighted average fraction of soil lower zone storage of the maximum storage	one	decimal fraction	double	always
<i>basin_soil_moist</i>	Basin area-weighted average capillary reservoir storage	one	inches	double	always
<i>basin_soil_moist_tot</i>	Basin area-weighted average total soil-zone water storage	one	inches	double	always
<i>basin_soil_rechr</i>	Basin area-weighted average storage for recharge zone; upper portion of capillary reservoir where both evaporation and transpiration occurs	one	inches	double	always
<i>basin_soil_rechr_stor_frac</i>	Basin area-weighted average fraction of soil recharge zone storage of the maximum storage	one	decimal fraction	double	always
<i>basin_soil_to_gw</i>	Basin area-weighted average excess flow to capillary reservoirs that drains to GWRs	one	inches	double	always
<i>basin_ssflow</i>	Basin area-weighted average interflow from gravity and preferential-flow reservoirs to the stream network	one	inches	double	always
<i>basin_ssflow_cfs</i>	Basin area-weighted average interflow from gravity and preferential-flow reservoirs to the stream network	one	cfs	double	always
<i>basin_ssflow_mo</i>	Monthly basin area-weighted average interflow	one	inches	double	always
<i>basin_ssflow_tot</i>	Simulation total basin area-weighted average interflow	one	inches	double	always
<i>basin_ssflow_yr</i>	Yearly basin area-weighted average interflow	one	inches	double	always
<i>basin_ssin</i>	Basin area-weighted average inflow to gravity and preferential-flow reservoir storage	one	inches	double	always
<i>basin_ssstor</i>	Basin area-weighted average gravity and preferential-flow reservoir storage	one	inches	double	always
<i>basin_sz2gw</i>	Basin area-weighted average drainage from gravity reservoirs to GWRs	one	inches	double	always
<i>basin_sz_stor_frac</i>	Basin area-weighted average fraction of soil zone storage of the maximum storage	one	decimal fraction	double	always
<i>cap_infil_tot</i>	Infiltration and cascading interflow and Dunnian flow added to capillary reservoir storage for each HRU	nhru	inches	real	always
<i>cap_waterin</i>	Infiltration and any cascading interflow and Dunnian surface runoff added to capillary reservoir storage for each HRU	nhru	inches	real	always
<i>epr_stor_frac</i>	Fraction of capillary reservoir storage of the maximum storage for each HRU	nhru	decimal fraction	real	always
<i>dunnian_flow</i>	Dunnian surface runoff that flows to the stream network for each HRU	nhru	inches	real	always
<i>gvr_stor_frac</i>	Fraction of gravity reservoir storage of the maximum storage for each HRU	nhru	decimal fraction	real	always
<i>hru_sz_cascadeflow</i>	Cascading interflow and Dunnian surface runoff from each	nhru	inches	real	cascade_flag = 1 and

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
	HRU				ncascade > 0
interflow_max	Maximum interflow for each HRU	nhru	inches	real	always
<i>pfr_stor_frae</i>	Fraction of preferential-flow reservoir storage of the maximum storage for each HRU	nhru	decimal fraction	real	always
<i>pref_flow</i>	Interflow from the preferential-flow reservoir that flows to the stream network for each HRU	nhru	inches	real	always
<i>pref_flow_in</i>	Infiltration and flow from gravity reservoir storage to the preferential-flow reservoir	nhru	inches	real	always
<i>pref_flow_infil</i>	Infiltration to the preferential-flow reservoir storage for each HRU	nhru	inches	real	always
<i>pref_flow_max</i>	Maximum storage of the preferential-flow reservoir for each HRU	nhru	inches	real	always
<i>pref_flow_stor</i>	Storage in preferential-flow reservoir for each HRU	nhru	inches	real	always
<i>pref_flow_thrsh</i>	Soil storage threshold defining storage between field capacity and maximum soil saturation minus the any' preferential-flow storage	nhru	inches	real	always
<i>recharge</i>	Recharge to the associated GWR as the sum of <i>soil_to_gw</i> , <i>ssr_to_gw</i> , and dprst_seep_hru for each HRU	nhru	inches	real	always
<i>seginc_ssflow</i>	Area-weighted average interflow for each segment from HRUs contributing flow to the segment	nsegment	cfs	double	nsegment > 0
<i>slow_flow</i>	Interflow from gravity reservoir that flows to the stream network for each HRU	nhru	inches	real	always
<i>slow_stor</i>	Storage of gravity reservoir for each HRU	nhru	inches	real	always
<i>soil_lower</i>	Storage in the lower zone of the capillary reservoir that is only available for transpiration for each HRU	nhru	inches	real	always
<i>soil_lower_ratio</i>	Water content ratio in the lower zone of the capillary reservoir for each HRU	nhru	decimal fraction	real	always
<i>soil_moist</i>	Storage of capillary reservoir for each HRU	nhru	inches	real	always
<i>soil_moist_frae</i>	Fraction soil-zone storage of the maximum storage for each HRU	nhru	decimal fraction	real	always
<i>soil_moist_tot</i>	Total soil-zone storage (<i>soil_moist</i> + <i>ssres_stor</i>) for each HRU	nhru	inches	real	always
<i>soil_rechr</i>	Storage for recharge zone (upper portion) of the capillary reservoir that is available for both evaporation and transpiration	nhru	inches	real	always
<i>soil_rechr_ratio</i>	Water content ration in the recharge zone of the capillary reservoir for each HRU	nhru	decimal fraction	real	always
soil_saturated	Flag set if infiltration saturates capillary reservoir (0=no, 1=yes)	nhru	none	integer	always
<i>soil_to_gw</i>	Portion of excess flow to the capillary reservoir that drains to the associated GWR for each HRU	nhru	inches	real	always

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>soil_to_ssr</i>	Portion of excess flow to the capillary reservoir that flows to the gravity reservoir for each HRU	nhru	inches	real	always
<i>soil_zone_max</i>	Maximum storage of all soil zone reservoirs	nhru	inches	real	always
<i>ssr_to_gw</i>	Drainage from the gravity-reservoir to the associated GWR for each HRU	nssr	inches	real	always
<i>ssres_flow</i>	Interflow from gravity and preferential-flow reservoirs to the stream network for each HRU	nssr	inches	real	always
<i>ssres_in</i>	Inflow to the gravity and preferential-flow reservoirs for each HRU	nssr	inches	real	always
<i>ssres_stor</i>	Storage in the gravity and preferential-flow reservoirs for each HRU	nssr	inches	real	always
<i>sub_interflow</i>	Area-weighted average interflow from associated HRUs to each subbasin and from upstream subbasins	nsub	cfs	double	subbasin_flag = 1
<i>subinc_capstor_frac</i>	Area-weighted average fraction of capillary reservoir water content storage for associated HRUs of each subbasin	nsub	decimal fraction	double	subbasin_flag = 1
<i>subinc_interflow</i>	Area-weighted average interflow from associated HRUs to each subbasin	nsub	cfs	double	subbasin_flag = 1
<i>subinc_recharge</i>	Area-weighted average recharge from associated HRUs to each subbasin	nsub	inches	double	subbasin_flag = 1
<i>subinc_szstor_frac</i>	Area-weighted average fraction of soil-zone water content storage for associated HRUs of each subbasin	nsub	decimal fraction	double	subbasin_flag = 1
<i>upslope_dunnianflow</i>	Cascading Dunnian surface runoff that flows to the capillary reservoir of each downslope HRU for each upslope HRU	nhru	inches	double	cascade_flag = 1 and ncascade > 0
<i>upslope_interflow</i>	Cascading interflow runoff that flows to the capillary reservoir of each downslope HRU for each upslope HRU	nhru	inches	double	cascade_flag = 1 and ncascade > 0
Groundwater flow					
<i>basin_gwflow</i>	Basin area-weighted average groundwater flow to the stream network	one	inches	double	always
<i>basin_gwflow_cfs</i>	Basin area-weighted average groundwater flow to the stream network	one	cfs	double	always
<i>basin_gwflow_mo</i>	Monthly basin area-weighted average groundwater discharge	one	inches	double	always
<i>basin_gwflow_tot</i>	Total simulation basin area-weighted average groundwater discharge	one	inches	double	always
<i>basin_gwflow_yr</i>	Yearly basin area-weighted average groundwater discharge	one	inches	double	always
<i>basin_gwin</i>	Basin area-weighted average inflow to GWRs	one	inches	double	always
<i>basin_gwsink</i>	Basin area-weighted average GWR outflow to the groundwater sink	one	inches	double	always
<i>basin_gwstor</i>	Basin area-weighted average storage in GWRs	one	inches	double	always

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>basin_gwstor_minarea_wb</i>	Basin area-weighted average storage added to each GWR when storage is less than gwstor_min	one	inches	double	always
<i>gw_upslope</i>	Groundwater flow received from upslope GWRs for each GWR	ngw	acre-inches	double	cascadegw_flag = 1 and ncascdgw > 0
<i>gwres_flow</i>	Groundwater discharge from each GWR to the stream network	ngw	inches	real	always
<i>gwres_in</i>	Total inflow to each GWR from associated capillary and gravity reservoirs	ngw	acre-inches	double	always
<i>gwres_sink</i>	Outflow from GWRs to the groundwater sink; water is considered underflow or flow to deep aquifers and does not flow to the stream network	ngw	inches	real	always
<i>gwres_stor</i>	Storage in each GWR	ngw	inches	double	always
<i>gwstor_minarea_wb</i>	Storage added to each GWR when storage is less than gwstor_min	ngw	inches	double	always
<i>hru_gw_cascadeflow</i>	Cascading groundwater flow from each GWR	ngw	inches	double	cascadegw_flag = 1 and ncascdgw > 0
lakein_gwflow	Groundwater flow received from upslope GWRs for each Lake GWR	nlake	acre-inches	double	nlake > 0
<i>seginc_gwflow</i>	Area-weighted average groundwater discharge for each segment from HRUs contributing flow to the segment	nsegment	cfs	double	nsegment > 0
<i>sub_gwflow</i>	Area-weighted average groundwater discharge from associated GWRs to each subbasin and from upstream subbasins	nsub	cfs	double	subbasin_flag = 1
<i>subinc_gwflow</i>	Area-weighted average groundwater discharge from associated GWRs to each subbasin	nsub	cfs	double	subbasin_flag = 1
Streamflow					
<i>basin_cfs</i>	Streamflow leaving the basin through the stream network	one	cfs	double	always
<i>basin_cfs_mo</i>	Monthly total streamflow to stream network	one	cfs	double	print_debug > -2
<i>basin_cfs_tot</i>	Total simulation basin area-weighted average streamflow	one	cfs	double	print_debug > -2
<i>basin_cfs_yr</i>	Yearly total streamflow to stream network	one	cfs	double	print_debug > -2
<i>basin_cms</i>	Streamflow leaving the basin through the stream network	one	cms	double	always
<i>basin_runoff_ratio</i>	Basin area-weighted average discharge/precipitation ratio	one	decimal fraction	double	print_debug > -2
<i>basin_runoff_ratio_mo</i>	Monthly area-weighted average discharge/precipitation ratio	one	decimal fraction	double	print_debug > -2
<i>basin_segment_storage</i>	Basin area-weighted average storage in the stream network	one	inches	double	strmflow_module = muskingum, muskingum_lake , or muskingum_mann
<i>basin_stflow_in</i>	Basin area-weighted average lateral flow entering the stream network	one	inches	double	always
<i>basin_stflow_mo</i>	Monthly basin area-weighted average simulated streamflow	one	inches	double	print_debug > -2

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>basin_stflow_out</i>	Basin area-weighted average streamflow leaving through the stream network	one	inches	double	print_debug > -2
<i>basin_stflow_tot</i>	Total simulation basin area-weighted average simulated streamflow	one	inches	double	print_debug > -2
<i>basin_stflow_yr</i>	Yearly basin area-weighted average simulated streamflow	one	inches	double	print_debug > -2
<i>flow_headwater</i>	Total flow out of headwater segments (segment_type=1)	one	cfs	double	strmflow_module = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
<i>flow_in_great_lakes</i>	Total flow into model domain from Great Lakes (segment_type=10)	one	cfs	double	strmflow_module = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
<i>flow_in_nation</i>	Total flow into model domain from Mexico or Canada (segment_type=4)	one	cfs	double	strmflow_module = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
<i>flow_in_region</i>	Total flow into region (segment_type=6)	one	cfs	double	strmflow_module = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
<i>flow_out</i>	Total flow out of model domain	one	cfs	double	strmflow_module = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
<i>flow_out_NHM</i>	Total flow out of model domain to Mexico or Canada (segment_type=5)	one	cfs	double	strmflow_module = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
<i>flow_out_region</i>	Total flow out of region (segment_type=7)	one	cfs	double	strmflow_module = muskingum, strmflow_in_out,

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>flow_replacement</i>	Total flow out from replacement flow (segment_type =3)	one	cfs	double	muskingum lake, or muskingum mann strmflow_module = muskingum, strmflow in out, muskingum lake, or muskingum mann
<i>flow_terminus</i>	Total flow to terminus segments (segment_type =9)	one	cfs	double	strmflow_module = muskingum, strmflow in out, muskingum lake, or muskingum mann
<i>flow_to_great_lakes</i>	Total flow to Great Lakes (segment_type =11)	one	cfs	double	strmflow_module = muskingum, strmflow in out, muskingum lake, or muskingum mann
<i>flow_to_lakes</i>	Total flow to lakes (segment_type =2)	one	cfs	double	strmflow_module = muskingum, strmflow in out, muskingum lake, or muskingum mann
<i>flow_to_ocean</i>	Total flow to oceans (segment_type =8)	one	cfs	double	strmflow_module = muskingum, strmflow in out, muskingum lake, or muskingum mann
<i>hru_outflow</i>	Total flow leaving each HRU	nhru	cfs	double	always
<i>hru_streamflow_out</i>	Total flow to stream network from each HRU	nhru	cfs	double	always
<i>obs_runoff_mo</i>	Monthly measured streamflow at basin outlet	one	cfs	double	print_debug > -2
<i>obs_runoff_tot</i>	Total simulation measured streamflow at basin outlet	one	cfs	double	print_debug > -2
<i>obs_runoff_yr</i>	Yearly measured streamflow at basin outlet	one	cfs	double	print_debug > -2
<i>obsq_inches</i>	Measured streamflow at specified outlet station	one	inches	double	print_debug > -2
<i>obsq_inches_mo</i>	Monthly measured streamflow at specified outlet station	one	inches	double	print_debug > -2
<i>obsq_inches_tot</i>	Total simulation basin area-weighted average measured streamflow at specified outlet station	one	inches	double	print_debug > -2
<i>obsq_inches_yr</i>	Yearly measured streamflow at specified outlet station	one	inches	double	print_debug > -2
<i>runoff</i>	Streamflow at each measurement station	nobs	runoff_units	real	nobs > 0

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>seg_gwflow</i>	Area-weighted average groundwater discharge for each segment from HRUs contributing flow to the segment and upstream HRUs	nsegment	inches	double	strmflow_module = muskingum, strmflow in out, muskingum lake, or muskingum mann
<i>seg_inflow</i>	Total flow entering a segment	nsegment	cfs	double	strmflow_module = muskingum, strmflow in out, muskingum lake, or muskingum mann
<i>seg_lateral_inflow</i>	Lateral inflow entering a segment	nsegment	cfs	double	strmflow_module = muskingum, strmflow in out, muskingum lake, or muskingum mann
<i>seg_outflow</i>	Streamflow leaving a segment	nsegment	cfs	double	strmflow_module = muskingum, strmflow in out, muskingum lake, or muskingum mann
<i>seg_sroff</i>	Area-weighted average surface runoff for each segment from HRUs contributing flow to the segment and upstream HRUs	nsegment	inches	double	strmflow_module = muskingum, strmflow in out, muskingum lake, or muskingum mann
<i>seg_ssflow</i>	Area-weighted average interflow for each segment from HRUs contributing flow to the segment and upstream HRUs	nsegment	inches	double	strmflow_module = muskingum, strmflow in out, muskingum lake, or muskingum mann
<i>seg_upstream_inflow</i>	Sum of inflow from upstream segments	nsegment	cfs	double	strmflow_module = muskingum, strmflow in out, muskingum lake, or muskingum mann
<i>segment_delta_flow</i>	Cumulative flow minus flow out for each stream segment	nsegment	cfs	double	strmflow_module = muskingum, muskingum lake, or

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
					muskingum_mann
<i>streamflow_cfs</i>	Streamflow at each measurement station	nobs	cfs	double	nobs > 0
<i>streamflow_cms</i>	Streamflow at each measurement station	nobs	cms	double	nobs > 0
<i>strm_seg_in</i> ³	Flow in stream segments as a result of cascading flow in each stream segment	nsegment	cfs	double	cascade_flag = 1 and ncascade > 0
<i>sub_cfs</i>	Total streamflow leaving each subbasin	nsub	cfs	double	subbasin_flag = 1
<i>sub_cms</i>	Total streamflow leaving each subbasin	nsub	cms	double	subbasin_flag = 1
<i>sub_inq</i>	Sum of streamflow from upstream subbasins to each subbasin	nsub	cfs	double	subbasin_flag = 1
Stream Temperature					
<i>seg_ccov</i>	Area-weighted average cloud cover fraction for each segment from HRUs contributing flow to the segment	nsegment	decimal fraction	real	stream_temp_flag = 1
<i>seg_daylight</i>	Hours of daylight	nsegment	hours	real	stream_temp_flag = 1
<i>seg_humid</i>	Area-weighted average relative humidity for each segment from HRUs contributing flow to the segment	nsegment	decimal fraction	real	stream_temp_flag = 1
<i>seg_melt</i>	Area-weighted average snowmelt for each segment from HRUs contributing flow to the segment	nsegment	inches	real	stream_temp_flag = 1
<i>seg_potet</i>	Area-weighted average rainfall for each segment from HRUs contributing flow to the segment	nsegment	inches	real	stream_temp_flag = 1
<i>seg_shade</i>	Area-weighted average shade fraction for each segment	nsegment	decimal fraction	real	stream_temp_flag = 1
<i>seg_tave_air</i>	Area-weighted average air temperature for each segment from HRUs contributing flow to the segment	nsegment	degrees Celsius	real	stream_temp_flag = 1
<i>seg_tave_gw</i>	Groundwater temperature	nsegment	degrees Celsius	real	stream_temp_flag = 1
<i>seg_tave_lat</i>	Lateral flow temperature	nsegment	degrees Celsius	real	stream_temp_flag = 1
<i>seg_tave_ss</i>	Subsurface temperature	nsegment	degrees Celsius	real	stream_temp_flag = 1
<i>seg_tave_upstream</i>	Temperature of streamflow entering each segment	nsegment	degrees Celsius	real	stream_temp_flag = 1
<i>seg_tave_water</i>	Computed daily mean stream temperature for each segment	nsegment	degrees Celsius	real	stream_temp_flag = 1
<i>seg_width</i>	Width of each segment	nsegment	meters	real	stream_temp_flag = 1
Lake dynamics					
<i>basin_2ndstflow</i>	Streamflow from second output point for lake HRUs using gate opening routing	one	inches	double	strmflow_module = muskingum_lake
<i>basin_lake_seep</i>	Basin area-weighted average lake-bed seepage to GWRs	one	acre-feet	double	strmflow_module = muskingum_lake
<i>basin_lake_stor</i>	Basin volume-weighted average storage for all lakes using broad-crested weir or gate opening routing	one	inches	double	strmflow_module = muskingum_lake
<i>dinl</i>	Inflow to each lake HRU using Puls or linear storage routing	nlake	cfs	double	strmflow_module = muskingum_lake

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>elevlake</i>	Surface elevation of each lake	nlake	feet	real	strmflow_module = muskingum_lake and nratetbl > 0
<i>gate_ht</i>	Height of the gate opening at each dam with a gate	nratetbl	inches	real	strmflow_module = muskingum_lake and nratetbl > 0
<i>gw_seep_lakein</i>	Groundwater discharge to each lake HRU for each GWR	ngw	acre-feet	double	strmflow_module = muskingum_lake
<i>lakein_sz</i>	Cascading interflow and Dunnian surface runoff to lake HRUs from each upslope HRU	nhru	inches	double	cascade_flag = 1, ncascade > 0, and nlake > 0
<i>lake_2gw</i>	Total seepage from each lake using broad-crested weir or gate opening routing	nlake	cfs	double	strmflow_module = muskingum_lake
<i>lake_elev</i>	Elevation of each simulated lake surface	nlakeelev	feet	real	strmflow_module = muskingum_lake and nlakeelev > 0
lake_gwflow	Total groundwater flow into each lake	nlake	cfs	double	strmflow_module = muskingum_lake
<i>lake_inflow</i>	Total inflow to each lake	nlake	cfs	double	strmflow_module = muskingum_lake
<i>lake_interflow</i>	Total interflow into each lake	nlake	cfs	double	strmflow_module = muskingum_lake
<i>lake_invol</i>	Inflow to each lake using broad-crested weir or gate opening routing	nlake	acre-feet	double	strmflow_module = muskingum_lake
<i>lake_lateral_inflow</i>	Lateral inflow to each lake	nlake	cfs	double	strmflow_module = muskingum_lake
<i>lake_outcfs</i>	Streamflow leaving each lake, includes any second outlet flow	nlake	cfs	double	strmflow_module = muskingum_lake
<i>lake_outcms</i>	Streamflow leaving each lake, includes any second outlet flow	nlake	cms	double	strmflow_module = muskingum_lake
<i>lake_outflow</i>	Evaporation and seepage from each lake	nlake	cfs	double	strmflow_module = muskingum_lake
lake_outq2	Streamflow from second outlet for each lake with a second outlet	nlake	cfs	double	strmflow_module = muskingum_lake
<i>lake_outvol</i>	Outflow from each lake using broad-crested weir or gate opening routing	nlake	acre-feet	double	strmflow_module = muskingum_lake
lake_outvol_ts	Outflow from each lake using broad-crested weir or gate opening routing for the time step	nlake	acre-inches	double	strmflow_module = muskingum_lake
<i>lake_seep_in</i>	Total seepage into each lake using broad-crested weir or gate opening routing	nlake	cfs	double	strmflow_module = muskingum_lake

Variable name	Description	Dimension ¹	Units	Data type	Availability/condition
<i>lake_seepage</i>	Lake-bed seepage from each lake to the associated GWR	ngw	acre-feet	double	strmflow_module = muskingum_lake
<i>lake_seepage_gwr</i>	Net lake-bed seepage to associated GWR	ngw	inches	double	strmflow_module = muskingum_lake
<i>lake_sroff</i>	Total surface runoff into each lake	nlake	cfs	double	cascade_flag = 1
<i>lake_sto</i>	Storage in each lake using Puls or linear storage routing	nlake	cfs-days	double	strmflow_module = muskingum_lake
<i>lake_stream_in</i>	Total streamflow to each lake	nlake	cfs	double	strmflow_module = muskingum_lake
<i>lake_vol</i>	Storage in each lake using broad-crested weir or gate opening routing	nlake	acre-feet	double	strmflow_module = muskingum_lake
Water balance					
<i>basin_capillary_wb</i>	Basin area-weighted average capillary reservoir storage	one	inches	double	print_debug = 1
<i>basin_dprst_wb</i>	Basin area-weighted average surface-depression storage	one	inches	double	print_debug = 1
<i>basin_gravity_wb</i>	Basin area-weighted average gravity reservoir storage	one	inches	double	print_debug = 1
<i>basin_soilzone_wb</i>	Basin area-weighted average storage in soilzone reservoirs	one	inches	double	print_debug = 1
<i>basin_storage</i>	Basin area-weighted average storage in all water-storage reservoirs	one	inches	double	always
<i>basin_storvol</i>	Basin area-weighted average storage volume in all water-storage reservoirs	one	acre-inches	double	always
<i>basin_surface_storage</i>	Basin area-weighted average storage in all water storage reservoirs	one	inches	double	csvON_OFF = 1
<i>basin_total_storage</i>	Basin area-weighted average storage in all water storage reservoirs	one	inches	double	csvON_OFF = 1
<i>hru_lateral_flow</i>	Lateral flow to stream network from each HRU	nhru	inches	double	always
<i>hru_storage</i>	Storage for each HRU	nhru	inches	double	always
<i>last_basin_stor</i>	Basin area-weighted average storage in all water storage reservoirs from previous time step	one	inches	double	print_debug = 1
<i>subinc_deltastor</i>	Change in storage for each subbasin	nsb	inches	double	subbasin_flag = 1
<i>subinc_stor</i>	Area-weighted average total water content in storage reservoirs for associated HRUs of each subbasin	nsb	inches	double	subbasin_flag = 1
<i>subinc_wb</i>	Water balance for each subbasin	nsb	inches	double	subbasin_flag = 1
<i>watbal_sum</i>	Water balance aggregate	one	inches	double	always

¹Dimension variables defined in table 1-1.

²Set by precipitation distribution module and can be modified by the interception module if all precipitation captured in canopy.

³Initially set by surface runoff module and can be modified by the soilzone module if Dunnian surface runoff occurs.

⁴Reflects availability of variables based on module selections. See variable description for the reason(s) a variable is conditional or always available.

⁵Values are set to the last valid computed value; value is < -99.0 or > 150.

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