



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

By Steven L. Markstrom, R. Steven Regan, Lauren E. Hay, Roland J. Viger, Richard M. T. Webb, Robert A. Payn, and Jacob H. LaFontaine

**Updated tables from version 4.0.3 to version 5.0.0**

**May 30, 2019**

Suggested citation:

Markstrom, S.L., Regan, R.S., Hay, L.E., Viger, R.J., Webb, R.M.T., Payn, R.A., and LaFontaine, J.H., 2015, PRMS-IV, the precipitation-runoff modeling system, version 4: U.S. Geological Survey Techniques and Methods, book 6, chap. B7, 158 p.

Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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

[**green** highlight indicates new for PRMS-V; ~~strike through~~ 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.
<b>dynamic_param_read</b>	Read and makes available dynamic parameters by HRU from pre-processed files.
<b>water_use_read</b>	Read 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.
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.
<b>temp_sta</b>	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 temperature values directly from files.
Precipitation distribution process	
precip_1sta	Determines the form of precipitation and distributes it from one or more stations to each HRU by using monthly correction factors to account for differences in altitude, spatial variation, topography, and measurement gage efficiency.
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.
climate_hru	Reads distributed precipitation values directly from 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 climate values directly from 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 directly from 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 the state of transpiration directly from 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 directly from files.
Canopy Interception process	
intcp	Computes volume of intercepted precipitation, evaporation from intercepted precipitation, and throughfall 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.
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 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	
gwflow	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.
muskingum_lake	Computes flow in the stream network using the Muskingum routing method and flow and storage in on-channel lake using several methods.
routing	Computes common segment routing flows for modules <code>strmflow_in_out</code> and <code>Muskingum</code> .
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 <b>one</b> to separate CSV Files at daily, monthly, mean monthly, mean yearly, and yearly total time steps when control parameter <b>basinOutON_OFF</b> 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 <b>model_mode</b> 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 <b>model_mode</b> 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	Write user-selected results dimensioned by the value of dimension <b>nhru</b> to separate CSV Files at daily, monthly, mean monthly, <b>mean yearly, and yearly</b> total time steps when control parameter <b>nhruOutON_OFF</b> is specified equal to 1.
nsegment_summary	Write user-selected results dimensioned by the value of dimension <b>nsegment</b> to separate CSV Files at daily, monthly, mean monthly, mean yearly, and yearly total time steps when control parameter <b>nsegmentOutON_OFF</b> is specified equal to 1 or 2.
nsub_summary	Write user-selected results dimensioned by the value of dimension <b>nsub</b> to separate CSV Files at daily, monthly, mean monthly, mean yearly, and yearly total time steps when control parameter <b>nsubOutON_OFF</b> is specified equal to 1 or 2.
prms_summary	Writes selected basin area-weighted results to a Comma-Seperated Values (CSV) File when control parameter <b>csvON_OFF</b> 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; **green** highlight indicates new for PRMS-V]

Dimension <sup>3</sup>	Description	Default	Required/Condition
Spatial dimensions			
<b>ngw</b> <sup>2</sup>	Number of GWRs	1	required
<b>ngwcell</b>	Number of spatial units in the target map for mapped results	0	<b>mapOutON_OFF</b> = 1
<b>nhru</b>	Number of hydrologic response units	1	required
<b>nhruccell</b>	Number of unique intersections between HRUs and spatial units of a target map for mapped results	0	<b>mapOutON_OFF</b> = 1
<b>nlake</b>	Number of lakes	0	required when any HRU has <b>hru_type</b> specified equal to 2
<b>nsegment</b>	Number of stream-channel segments	0	<b>strmflow_module</b> = <b>muskingum_lake</b> , muskingum, or <b>strmflow_in_out</b> or <b>cascade_flag</b> = 1 or 2 or <b>cascadegw_flag</b> = 1 or 2
<b>nssr</b> <sup>2</sup>	Number of subsurface reservoirs	1	required
<b>nsub</b>	Number of internal subbasins	0	<b>subbasin_flag</b> = 1
Time-series input data dimensions <sup>1</sup>			
<b>nconsumed</b>	Number of consumptive water-use destinations	0	optional
<b>nevap</b>	Number of pan-evaporation data sets	0	<b>et_module</b> = potet_pan
<b>nexternal</b>	Number of external water-use sources or destinations	0	optional
<b>nhumid</b>	Number of relative humidity measurement stations	0	optional
<b>nlakeelev</b>	Maximum number of lake elevations for any rating table data set	0	<b>strmflow_module</b> = <b>muskingum_lake</b>
<b>nobs</b>	Number of streamflow-measurement stations	0	replacement flow when <b>strmflow_module</b> = <b>muskingum_lake</b> , muskingum, or <b>strmflow_in_out</b>
<b>npoigages</b>	Number of points-of-interest streamflow gages	0	optional
<b>nrain</b>	Number of precipitation-measurement stations	0	<b>precip_module</b> = precip_1sta, precip_laps, precip_dist2, ide_dist, or xyz_dist
<b>nratetbl</b>	Number of rating-table data sets for lake elevations	0	<b>strmflow_module</b> = <b>muskingum_lake</b>
<b>nsnow</b>	Number of snow-depth measurement stations	0	optional
<b>nsol</b>	Number of solar-radiation measurement stations	0	computation of solar radiation distribution using parameter <b>hru_solsta</b>
<b>ntemp</b>	Number of air-temperature-measurement stations	0	<b>temp_module</b> = temp_1sta, <b>temp_sta</b> , temp_laps, temp_dist2, ide_dist, or xyz_dist
<b>nwind</b>	Number of wind-speed measurement stations	0	Optional

Dimension <sup>3</sup>	Description	Default	Required/Condition
Computation dimensions			
<b>ncascade</b>	Number of HRU links for cascading flow	0	<b>cascade_flag</b> = 1 or 2
<b>ncascgdw</b>	Number of GWR links for cascading flow	0	<b>cascadegw_flag</b> = 1 or 2
<b>ndepl</b>	Number of snow-depletion curves	1	required
<b>ndeplval</b>	Number of values in all snow-depletion curves (set to <b>ndepl</b> *11)	11	required
Lake computation dimensions			
<b>mxnsos</b>	Maximum number of storage/outflow table values for storage-detention reservoirs and lakes connected to the stream network using Puls routing	0	<b>strmflow_module</b> = muskingum_lake
<b>ngate</b>	Maximum number of reservoir gate-opening values (columns) for lake rating table 1	0	<b>strmflow_module</b> = muskingum_lake and <b>nratetbl</b> > 0
<b>ngate2</b>	Maximum number of reservoir gate-opening values (columns) for lake rating table 2	0	<b>strmflow_module</b> = muskingum_lake and <b>nratetbl</b> > 1
<b>ngate3</b>	Maximum number of reservoir gate-opening values (columns) for lake rating table 3	0	<b>strmflow_module</b> = muskingum_lake and <b>nratetbl</b> > 2
<b>ngate4</b>	Maximum number of reservoir gate-opening values (columns) for lake rating table 4	0	<b>strmflow_module</b> = muskingum_lake and <b>nratetbl</b> > 3
<b>nstage</b>	Maximum number of lake elevations values (rows) for lake rating table 1	0	<b>strmflow_module</b> = muskingum_lake and <b>nratetbl</b> > 0
<b>nstage2</b>	Maximum number of lake elevations values (rows) for lake rating table 2	0	<b>strmflow_module</b> = muskingum_lake and <b>nratetbl</b> > 1
<b>nstage3</b>	Maximum number of lake elevations values (rows) for lake rating table 3	0	<b>strmflow_module</b> = muskingum_lake and <b>nratetbl</b> > 2
<b>nstage4</b>	Maximum number of lake elevations values (rows) for lake rating table 4	0	<b>strmflow_module</b> = muskingum_lake and <b>nratetbl</b> > 3
Fixed dimensions			
<b>ndays</b>	Maximum number of days in a year	366	optional
<b>nlapse</b>	Number of lapse rates in X, Y, and Z directions	3	<b>precip_module</b> = xyz_dist
<b>nmonths</b>	Number of months in a year	12	optional
<b>one</b>	Dimension of scalar parameters and variables	1	optional

<sup>1</sup>All associated data specified in Data File can be used for calibration purposes.

<sup>2</sup>Use of **nssr** and **ngw** not equal to **nhru** is deprecated.

<sup>3</sup>Dimensions 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; >, 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; **green** highlight indicates new for PRMS-V]

Parameter name	Description	Option	Number of Values	Data type	Default value
Simulation execution and required input and output files					
<b>data_file</b> <sup>2</sup>	Pathname(s) for measured input Data File(s), typically a single Data File is specified	measured input	number of Data Files	4	prms.data
<b>end_time</b>	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
<b>model_mode</b>	Flag to indicate the simulation mode (PRMS or GSFLOW=version IV parameters; PRMS5 or GSFLOW5=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> -Fahrenheit); precipitation (variable <i>hru_ppt</i> -inches); solar radiation (variable <i>swrad</i> -Langleys); potential ET (variable <i>potet</i> -inches); and/or transpiration flag (variable <i>transp_on</i> -none); POTET=simulate to potential ET; TRANSPIRE=simulate to transpiration period; DOCUMENTATION=write files of all declared parameters and variables in the executable)	simulation mode selection	1	4	PRMS
<b>model_output_file</b> <sup>2</sup>	Pathname for Water-Budget File for results module <i>basin_sum</i>	simulation output	1	4	prms.out
<b>param_file</b> <sup>2</sup>	Pathname(s) for Parameter File(s)	parameter input	number of Parameter Files	4	prms.params
<b>prms_warmup</b>	Number of years to simulate before writing mapped results, Basin, <b>nhru</b> , <b>nsub</b> , or <b>nsegment</b> Summary Output Files	<b>map_resultsON_OFF = 1,</b> <b>basinOutON_OFF = 1,</b> <b>nsubOutON_OFF = 1,</b> <b>nsegmentOutON_OFF = 1</b> or 2, or <b>nhruOutON_OFF = 1 or 2</b>	1	1	1
<b>start_time</b>	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					
<b>cascade_flag</b>	Flag to indicate if HRU cascades are computed (0=no; 1=yes; 2=simple cascades defined by parameter <b>hru_segment</b> )	cascade flow with <b>ncascade</b> > 0	1	1	1



Parameter name	Description	Option	Number of Values	Data type	Default value
<b>cascadegw_flag</b>	Flag to indicate if GWR cascades are computed (0=no; 1=yes; 2 = GWR cascades are set equal to the HRU cascades and parameters <b>gw_up_id</b> , <b>gw_strmseg_down_in</b> , <b>gw_down_id</b> , and <b>gw_pct_up</b> are not required)	cascade flow with <b>ncascdgw</b> > 0	1	1	1
<b>dprst_flag</b>	Flag to indicate if depression-storage simulation is computed (0=no; 1=yes)	surface-depression storage	1	1	0
<b>et_module</b>	Module name for potential evapotranspiration method (climate_hru, potet_jh, potet_hamon, potet_hs, potet_pt, potet_pm, <b>potet_pm_sta</b> , or potet_pan)	module selection	1	4	potet_jh
<b>gwr_swale_flag</b>	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 <b>hru_segment</b> )	swales	1	1	0
<b>precip_module</b>	Module name for precipitation-distribution method (climate_hru, ide_dist, precip_1sta, precip_dist2, precip_laps, or xyz_dist)	module selection	1	4	precip_1sta
<b>solrad_module</b>	Module name for solar-radiation-distribution method (ccsolrad or ddsolrad)	module selection	1	4	ddsolrad
<b>srunoff_module</b>	Module name for surface-runoff/infiltration computation method (srunoff_carea or srunoff_smidx)	module selection	1	4	srunoff_smidx
<b>strmflow_module</b>	Module name for streamflow routing simulation method (strmflow, muskingum, strmflow_in_out, or <b>muskingum_lake</b> )	module selection	1	4	strmflow
<b>subbasin_flag</b>	Flag to indicate if internal subbasin are computed (0=no; 1=yes)	<b>nsub</b> > 0	1	1	1
<b>temp_module</b>	Module name for temperature-distribution method (climate_hru, temp_1sta, <b>temp_sta</b> , temp_dist2, temp_laps, ide_dist, or xyz_dist)	module selection	1	4	temp_1sta
<b>transp_module</b>	Module name for transpiration simulation method (climate_hru, transp_frost, or transp_tindex)	module selection	1	4	transp_tindex
Climate-by-HRU Files					
<b>cbh_binary_flag</b>	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
<b>humidity_day<sup>2</sup></b>	Pathname of the CBH file of pre-processed humidity input data for each HRU to specify variable <i>humidity_hru</i> -percentage	<b>et_module</b> = potet_pm	1	4	humidity.day
<b>orad_flag</b>	Flag to specify whether or not the variable <i>orad</i> is specified as the last column of the <b>swrad_day</b> CBH file (0=no; 1=yes)	<b>solrad_module</b> = climate_hru	1	1	1
<b>potet_day<sup>2</sup></b>	Pathname of the CBH file of pre-processed potential-ET input data for each HRU to specify variable <i>potet</i> -inches	<b>et_module</b> = climate_hru	1	4	potet.day

Parameter name	Description	Option	Number of Values	Data type	Default value
<b>precip_day<sup>2</sup></b>	Pathname of the CBH file of pre-processed precipitation input data for each HRU to specify variable <i>precip</i> -inches	<b>precip_module</b> = climate_hru	1	4	precip.day
<b>swrad_day<sup>2</sup></b>	Pathname of the CBH file of pre-processed solar-radiation input data for each HRU to specify variable <i>swrad</i> -Langleys	<b>solrad_module</b> = climate_hru	1	4	swrad.day
<b>tmax_day<sup>2</sup></b>	Pathname of the CBH file of pre-processed maximum air temperature input data for each HRU to specify variable <i>tmaxf</i> -degrees Fahrenheit	<b>temp_module</b> = climate_hru	1	4	tmax.day
<b>tmin_day<sup>2</sup></b>	Pathname of the CBH file of pre-processed minimum air temperature input data for each HRU to specify variable <i>tminf</i> -degrees Fahrenheit	<b>temp_module</b> = climate_hru	1	4	tmin.day
<b>transp_day<sup>2</sup></b>	Pathname of the CBH file of pre-processed transpiration on or off flag for each HRU file to specify variable <i>transp_on</i> -none	<b>transp_module</b> = climate_hru	1	4	transp.day
<b>windspeed_day<sup>2</sup></b>	Pathname of the CBH file of pre-processed wind speed input data for each HRU to specify variable <i>windspeed_hru</i> -meters/second	<b>et_module</b> = potet_pm	1	4	windspeed.day

#### Dynamic Parameter Input

<b>covden_sum_dynamic</b>	Pathname of the time series of pre-processed values for summer plant-cover density used to set values of <b>covden_sum</b> for each HRU	<b>dyn_covden_flag</b> = 1 or 3	1	4	dyncovsum
<b>covden_win_dynamic</b>	Pathname of the time series of pre-processed values for winter plant-cover density used to set values of <b>covden_win</b> for each HRU	<b>dyn_covden_flag</b> = 2 or 3	1	4	dyncovwin
<b>covtype_dynamic</b>	Pathname of the time series of pre-processed values used to set values of <b>cov_type</b> for each HRU	<b>dyn_covtype_flag</b> = 1	1	4	dyncovtype
<b>dprst_depth_dynamic</b>	Pathname of the time series of pre-processed values used to set values of <b>dprst_depth_avg</b>	<b>dyn_dprst_flag</b> = 2 or 3	1	4	dyndprst_depth
<b>dprst_frac_dynamic</b>	Pathname of the time series of pre-processed values used to set values of <b>dprst_frac</b>	<b>dyn_dprst_flag</b> = 1 or 3	1	4	dyndprst_frac
<b>dyn_covden_flag</b>	Flag to indicate if a time series of plant-canopy density values are input in a Dynamic Parameter File(s) (0=no; 1=file <b>covden_sum_dynamic</b> ; 2=file <b>covden_win_dynamic</b> ; 3=both)	dynamic canopy cover density	1	1	0
<b>dyn_covtype_flag</b>	Flag to indicate if a time series of plant-canopy type values are input in Dynamic Parameter File <b>covtype_dynamic</b> (0=no; 1=yes)	dynamic canopy cover type	1	1	0
<b>dyn_dprst_flag</b>	Flag to indicate if a time series of surface-depression values are input in a Dynamic Parameter File(s) (0=no; 1=file <b>dprst_frac_dynamic</b> ; 2=file <b>dprst_depth_dynamic</b> ; 3=both)	dynamic surface depression	1	1	0
<b>dyn_fallfrost_flag</b>	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 <b>fallfrost_dynamic</b> )	dynamic transpiration and <b>transp_module</b> = <b>transp_frost</b>	1	1	0

Parameter name	Description	Option	Number of Values	Data type	Default value
<b>dyn_imperv_flag</b>	Flag to indicate if a time series of impervious values are input in a Dynamic Parameter File(s) (0=no; 1=file <b>imperv_frac_dynamic</b> ; 2=file <b>imperv_stor_dynamic</b> ; 3=both)	dynamic impervious	1	1	0
<b>dyn_intcp_flag</b>	Flag to indicate if a time series of plant canopy interception values are input in a Dynamic Parameter File(s) (0=no; 1=file <b>wrain_intcp_dynamic</b> ; 2=file <b>srain_intcp_dynamic</b> ; 4=file <b>snow_intcp_dynamic</b> ; additive combinations)	dynamic interception	1	1	0
<b>dyn_potet_flag</b>	Flag to indicate if a time series of potential ET coefficient values are input in Dynamic Parameter File <b>potet_coef_dynamic</b> to update coefficients for the specified month for the selected potential ET module specified by control parameter <b>et_module</b> (0=no; 1=parameter <b>jh_coef</b> , <b>pt_alpha</b> , <b>hs_krs</b> , <b>hamon_coef</b> , <b>epan_coef</b> , <b>potet_cbh_adj</b> , and <b>pm_n_coef</b> used in <b>potet_jh</b> , <b>potet_pt</b> , <b>potet_hs</b> , <b>potet_hamon</b> , <b>potet_pan</b> , <b>climate_hru</b> , <b>potet_pm</b> , and <b>potet_pm_sta</b> modules, respectively; 2=parameter <b>jh_coef_hru</b> , <b>pm_d_coef</b> used in <b>potet_jh</b> , <b>potet_pm</b> , and <b>potet_pm_sta</b> modules, respectively)	dynamic potential ET	1	1	0
<b>dyn_radtrncf_flag</b>	Flag to indicate if a time series of solar radiation values are input in Dynamic Parameter File <b>radtrncf_dynamic</b> (0=no; 1=yes)	dynamic solar radiation transmission	1	1	0
<b>dyn_soil_flag</b>	Flag to indicate if a time series of soil-water capacity values are input in a Dynamic Parameter File(s) (0=no; 1=file <b>soilmoist_dynamic</b> only, 2=file <b>soilrechr_dynamic</b> only; 3=both)	dynamic soil moisture	1	1	0
<b>dyn_springfrost_flag</b>	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 <b>springfrost_dynamic</b> )	dynamic transpiration and transp_module = transp_frost	1	1	0
<b>dyn_sro2dprst_perv_flag</b>	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 <b>sro2dprst_perv_dyn</b> (0=no; 1=yes)	dynamic surface depression	1	1	0
<b>dyn_sro2dprst_imperv_flag</b>	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 <b>sro2dprst_imperv_dynamic</b> (0=no; 1=yes)	dynamic surface depression	1	1	0
<b>dyn_transp_flag</b>	Flag to indicate if a time series of transpiration month values are input in a Dynamic Parameter File(s) (0=no; 1=file <b>transpbeg_dynamic</b> ; 2=file <b>transpend_dynamic</b> only, 3=both)	dynamic transpiration and transp_module = transp_tindex	1	1	0
<b>fallfrost_dynamic</b>	Pathname of the time series of pre-processed values for dynamic parameter <b>fall_frost</b>	<b>dyn_fallfrost_flag</b> = 1 and transp_module = transp_frost	1	4	dynfallfrost
<b>imperv_frac_dynamic</b>	Pathname of the time series of pre-processed values for dynamic	<b>dyn_imperv_flag</b> = 1 or 3	1	4	dynimperv

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

Parameter name	Description	Option	Number of Values	Data type	Default value
<b>external_transferON_OFF</b>	from external sources Flag to indicate to use external transfer flow rates from the <b>external_transfer_file</b> (0=no; 1=yes)	= 1 external transfer	1	1	0
<b>gwr_transfer_file</b>	Pathname of the time series of pre-processed flow rates for transfers from groundwater reservoir storage	<b>gwr_transferON_OFF</b> = 1	1	4	gwr.transfer
<b>gwr_transferON_OFF</b>	Flag to indicate to use groundwater transfer flow rates from the <b>gwr_transfer_file</b> (0=no; 1=yes)	groundwater transfer	1	1	0
<b>lake_transfer_file</b>	Pathname of the time series of pre-processed flow rates for transfers from lake HRUs	<b>lake_transferON_OFF</b> = 1	1	4	lake.transfer
<b>lake_transferON_OFF</b>	Flag to indicate to use lake HRU transfer flow rates from the <b>lake_transfer_file</b> (0=no; 1=yes)	lake water transfer	1	1	0
<b>segment_transfer_file</b>	Pathname of the time series of pre-processed flow rates for transfers from stream segments	<b>segment_transferON_OFF</b> = 1	1	4	seg.transfer
<b>segment_transferON_OFF</b>	Flag to indicate to use stream segment transfer flow rates from the <b>segment_transfer_file</b> (0=no; 1=yes)	stream water transfer	1	1	0
Debug options					
<b>cbh_check_flag</b>	Flag to indicate if CBH values are validated each time step (0=no; 1=yes)	CBH input	1	1	1
<b>parameter_check_flag</b>	Flag to indicate if selected parameter values validation checks are treated as warnings or errors (0=no; 1=yes; 2=check parameters and then stop)	parameter validation check	1	1	1
<b>print_debug</b> <sup>1</sup>	Flag to indicate type of debug output (-2=minimal output to screen and no <b>model_output_file</b> ; -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					
<b>nstatVars</b>	Number of variables to include in Statistics Variables File and names specified in <b>statVar_names</b>	<b>statsON_OFF</b> = 1	1	1	0
<b>stat_var_file</b> <sup>2</sup>	Pathname for Statistics Variables File	<b>statsON_OFF</b> = 1	1	4	statvar.out
<b>statsON_OFF</b>	Switch to specify whether or not the Statistics Variables File is generated (0=no; 1=statvar text format; 2=CSV format)	<b>statsON_OFF</b> = 1	1	1	0
<b>statVar_element</b>	List of identification numbers corresponding to variables specified in <b>statVar_names</b> list (1 to variable's dimension size)	<b>statsON_OFF</b> = 1	<b>nstatVars</b>	4	none
<b>statVar_names</b>	List of variable names for which output is written to Statistics Variables File	<b>statsON_OFF</b> = 1	<b>nstatVars</b>	4	none

Parameter name	Description	Option	Number of Values	Data type	Default value
Initial Condition Files					
<b>init_vars_from_file</b>	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 <b>dprst_frac_init</b> , <b>snowpack_init</b> , <b>segment_flow_init</b> , <b>elevlake_init</b> , <b>gwstor_init</b> , and ( <b>soil_rechr_init</b> , <b>soil_moist_init</b> , <b>ssstor_init</b> for <b>model_mode</b> =PRMS or GSFLOW) or ( <b>soil_rechr_init_frac</b> , <b>soil_moist_init_frac</b> , <b>ssstor_init_frac</b> for <b>model_mode</b> =PRMS5 or GSFLOW5); 3=yes and use parameter <b>snowpack_init</b> ; 4=yes and use parameter <b>elevlake_init</b> ; 5=yes and use parameters ( <b>soil_rechr_init</b> , <b>soil_moist_init</b> , <b>ssstor_init</b> for <b>model_mode</b> =PRMS or GSFLOW) or ( <b>soil_rechr_init_frac</b> , <b>soil_moist_init_frac</b> , <b>ssstor_init_frac</b> for <b>model_mode</b> =PRMS5 or GSFLOW5); 6=yes and use parameter <b>gwstor_init</b> ; 7=yes and use parameter <b>dprst_frac_init</b> )	initial condntions	1	1	0
<b>save_vars_to_file</b>	Flag to determine if an Initial Conditions File will be generated at the end of simulation (0=no; 1=yes)	initial condntions	1	1	0
<b>var_init_file</b> <sup>2</sup>	Pathname for Initial Conditions input file	<b>init_vars_from_file</b> = 1	1	4	prms_ic.in
<b>var_save_file</b> <sup>2</sup>	Pathname for the Initial Conditions File to be generated at end of simulation	<b>save_vars_to_file</b> = 1	1	4	prms_ic.out
Animation Files					
<b>ani_output_file</b> <sup>2</sup>	Pathname for Animation Files(s) to which a filename suffix based on dimension name associated with selected variables is appended	<b>aniOutON_OFF</b> = 1	1	4	animation.out
<b>aniOutON_OFF</b>	Switch to specify whether or not Animation File(s) are generated (0=no; 1=yes)	animation output	1	1	0
<b>aniOutVar_names</b>	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)	<b>aniOutON_OFF</b> = 1	<b>naniOutVars</b>	4	none
<b>naniOutVars</b>	Number of output variables specified in the <b>aniOutVar_names</b> list	<b>aniOutON_OFF</b> = 1	1	1	0
Basin Summary Results Files					
<b>basinOutBaseFileName</b> <sup>2</sup>	String to define the prefix for each basin summary output file.	<b>basinOutON_OFF</b> = 1	1	4	none
<b>basinOutON_OFF</b>	Switch to specify whether or not basin summary output files are generated (0=no; 1=yes)	<b>basin</b> summary results	1	1	0
<b>basinOutVar_names</b>	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 <b>basinOutVars</b> with the prefix of each file equal to the value of <b>basinOutBaseFileName</b> . The suffix of the files is based on the value of <b>basinOut_freq</b> and will be .csv; _meanyearly.csv; _yearly.csv; _meanmonthly.csv; or	<b>basinOutON_OFF</b> = 1	<b>basinOutVars</b>	4	none

Parameter name	Description	Option	Number of Values	Data type	Default value
	_monthly.csv. Variables must be of type real or double				
<b>basinOutVars</b>	Number of variables to include in basin summary output file(s)	<b>basinOutON_OFF</b> = 1	1	1	0
<b>basinOut_freq</b>	Output frequency and type (1=daily; 2=monthly; 3=both; 4=mean monthly; 5=mean yearly; 6=yearly)	<b>basinOutON_OFF</b> = 1	1	1	1
	Mapped Results Files				
<b>mapOutON_OFF</b>	Switch to specify whether or not mapped output file(s) by a specified number of columns (parameter <b>ncol</b> ) of daily, monthly, yearly, or total simulation results is generated (0=no; 1=yes)	mapped results	1	1	0
<b>mapOutVar_names</b>	List of variable names for which output is written to mapped output files(s); variables must be of type real or double.	<b>map_resultsON_OFF</b> = 1	<b>nmapOutVars</b>	4	none
<b>nmapOutVars</b>	Number of variables to include in mapped output file(s)	<b>map_resultsON_OFF</b> = 1	1	1	0
	Nhru Summary Results Files				
<b>nhruOutBaseFileName</b> <sup>2</sup>	String to define the prefix for each <b>nhru</b> summary output file.	<b>nhruOutON_OFF</b> = 1 or 2	1	4	none
<b>nhruOutON_OFF</b>	Switch to specify whether or not <b>nhru</b> summary output files are generated (0=no; 1=yes; 2=yes and use values of <b>nhm_id</b> as column heading)	<b>nhru</b> summary results	1	1	0
<b>nhruOutVar_names</b>	List of variable names for which output is written to <b>nhru</b> 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 <b>nhruOutBaseFileName</b> ; 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 <b>nhruOutBaseFileName</b> . The suffix of the files is based on the value of <b>nhruOut_freq</b> and will be .csv; _meanyearly.csv; _yearly.csv; _meanmonthly.csv; or _monthly.csv. Variables must be of type real or double	<b>nhruOutON_OFF</b> = 1 or 2	<b>nhruOutVars</b>	4	none
<b>nhruOutVars</b>	Number of variables to include in <b>nhru</b> summary output file(s)	<b>nhruOutON_OFF</b> = 1 or 2	1	1	0
<b>nhruOut_format</b>	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)	<b>nhruOutON_OFF</b> = 1 or 2	1	1	1
<b>nhruOut_freq</b>	Output frequency and type (1=daily; 2=monthly; 3=both; 4=mean monthly; 5=mean yearly; 6=yearly)	<b>nhruOutON_OFF</b> = 1 or 2	1	1	1
	<b>Nsub Summary Results Files</b>				
<b>nsubOutBaseFileName</b> <sup>2</sup>	String to define the prefix for each <b>nsub</b> summary output file.	<b>nsubOutON_OFF</b> = 1	1	4	none
<b>nsubOutON_OFF</b>	Switch to specify whether or not <b>nsub</b> summary output files are generated (0=no; 1=yes)	<b>nsub</b> summary results	1	1	0
<b>nsubOutVar_names</b>	List of variable names for which output is written to <b>nsub</b> summary Comma Separated Values (CSV) output files(s). Each variable is	<b>nsubOutON_OFF</b> = 1	<b>nsubOutVars</b>	4	none

Parameter name	Description	Option	Number of Values	Data type	Default value
	written to a separate file with the prefix of each file equal to the value of <b>nsubOutBaseFileName</b> ; 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 <b>nsubOutBaseFileName</b> . The suffix of the files is based on the value of <b>nsubOut_freq</b> and will be .csv; _meanyearly.csv; _yearly.csv; _meanmonthly.csv; or _monthly.csv. Variables must be of type real or double				
<b>nsubOutVars</b>	Number of variables to include in <b>nsub</b> summary output file(s)	<b>nsubOutON_OFF</b> = 1	1	1	0
<b>nsubOut_format</b>	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)	<b>nsubOutON_OFF</b> = 1	1	1	1
<b>nsubOut_freq</b>	Output frequency and type (1=daily; 2=monthly; 3=both; 4=mean monthly; 5=mean yearly; 6=yearly)	<b>nsubOutON_OFF</b> = 1	1	1	1
<b>Nsegment Summary Results Files</b>					
<b>nsegmentOutBaseFileName</b>	String to define the prefix for each <b>nsegment</b> summary output file.	<b>nsegmentOutON_OFF</b> = 1 or 2	1	4	none
<b>nsegmentOutON_OFF</b>	Switch to specify whether or not <b>nsegment</b> summary output files are generated (0=no; 1=yes; 2=yes and use values of <b>nhm_seg</b> as column heading)	<b>nsegment</b> summary results	1	1	0
<b>nsegmentOutVar_names</b>	List of variable names for which output is written to <b>nsegment</b> 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 <b>nsegmentOutBaseFileName</b> ; 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 <b>nsegmentOutBaseFileName</b> . The suffix of the files is based on the value of <b>nsegmentOut_freq</b> and will be .csv; _meanyearly.csv; _yearly.csv; _meanmonthly.csv; or _monthly.csv. Variables must be of type real or double	<b>nsegmentOutON_OFF</b> = 1 or 2	<b>nsubOutVars</b>	4	none
<b>nsegmentOutVars</b>	Number of variables to include in <b>nsegment</b> summary output file(s)	<b>nsegmentOutON_OFF</b> = 1 or 2	1	1	0
<b>nsegmentOut_format</b>	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)	<b>nsegmentOutON_OFF</b> = 1 or 2	1	1	1
<b>nsegmentOut_freq</b>	Output frequency and type (1=daily; 2=monthly; 3=both; 4=mean monthly; 5=mean yearly; 6=yearly)	<b>nsegmentOutON_OFF</b> = 1 or 2	1	1	1
<b>PRMS Summary Results Files</b>					
<b>csvON_OFF</b>	Switch to specify whether or not common-separated values (CSV)	PRMS summary results	1	1	0



Parameter name	Description	Option	Number of Values	Data type	Default value
<b>csv_output_file</b> <sup>2</sup>	summary output files are generated (0=no; 1=yes) Pathname of CSV output file	<b>csvON_OFF</b> = 1	1	4	none
	Runtime graphs				
<b>dispGraphsBuffSize</b>	Number of time steps to wait before updating the runtime graph	<b>ndispGraphs</b> > 0	1	1	50
<b>dispVar_element</b>	List of identification numbers corresponding to variables specified in <b>dispVar_names</b> list (1 to variable's dimension size)	<b>ndispGraphs</b> > 0	number of variables	4	none
<b>dispVar_names</b>	List of variable names for which plots are output to the runtime graph	<b>ndispGraphs</b> > 0	number of variables	4	none
<b>dispVar_plot</b>	List of variable names for which plots are output to the runtime graph	<b>ndispGraphs</b> > 0	number of variables	4	none
<b>executable_desc</b>	Descriptive text to identify the PRMS executable	<b>ndispGraphs</b> > 0	1	4	MOWS executable
<b>executable_model</b> <sup>2</sup>	Pathname (full or relative) of the PRMS executable	<b>ndispGraphs</b> > 0	1	4	prmsIV
<b>initial_deltat</b>	Initial time step for the simulation	<b>ndispGraphs</b> > 0	1	2	24.0
<b>ndispGraphs</b>	Number of plots included in the runtime graph	graphical output	1	1	0

<sup>1</sup>File 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.

<sup>2</sup>Pathnames 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; dday, degree-day, the amount a day's average temperature departed from 65 degrees Fahrenheit; POI, point-of-interest; >, greater than; dimensions defined in table 1-1; control parameters **temp\_module**, **precip\_module**, **solrad\_module**, **et\_module**, **transp\_module**, **srunoff\_module**, **strmflow\_module**, **model\_mode**, **dprst\_flag**, **subbasin\_flag**, **cascade\_flag**, **cascadegw\_flag**, and **mapOutON\_OFF** defined in table 1-2; **green** highlight indicates new for PRMS-V; **blue** highlight indicates deprecated but retained for PRMS-IV downward compatibility; ~~strike through~~ indicates items removed]

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
Basic physical attributes							
<b>elev_units</b>	Flag to indicate the units of elevation values (0=feet; 1=meters)	<b>one</b>	integer	none	0 or 1	0	required
<b>hru_area</b>	Area of each HRU	<b>nhru</b>	real	acres	0.0001 to 1.0E9	1.0	required
<b>hru_aspect</b>	Aspect of each HRU	<b>nhru</b>	real	angular degrees	0.0 to 360.0	0.0	required <sup>6</sup>
<b>hru_elev</b>	Mean elevation for each HRU	<b>nhru</b>	real	<b>elev_units</b>	-1,000.0 to 30,000.0	0.0	required
<b>hru_lat</b>	Latitude of each HRU	<b>nhru</b>	real	degrees North	-90.0 to 90.0	40.0	required <sup>6</sup>
<b>hru_lon</b>	Longitude of each HRU	<b>nhru</b>	real	degrees East	-360.0 to 360.0	-105.0	optional
<b>hru_slope</b>	Slope of each HRU	<b>nhru</b>	real	decimal fraction	0.0 to 10.0	0.0	required <sup>6</sup>
<b>hru_type<sup>5</sup></b>	Type of each HRU (0=inactive; 1=land; 2=lake; 3=swale)	<b>nhru</b>	integer	none	0 to 3	1	required
<b>nhm_id</b>	National Hydrologic Model HRU ID	<b>nhru</b>	integer	none	1 to 9999999	1	optional
<b>nhm_seg</b>	National Hydrologic Model segment ID	<b>nsegment</b>	integer	none	1 to 9999999	1	optional
<b>parent_gw</b>	Lumen index in parent model for each GWR	<b>ngw</b>	integer	none	1 to 9999999	1	optional
<b>parent_hru</b>	Lumen index in parent model for each HRU	<b>nhru</b>	integer	none	1 to 9999999	1	optional
<b>parent_poigages</b>	Lumen index in parent model for each POI gage	<b>npoigages</b>	integer	none	1 to 9999999	1	optional
<b>parent_segment</b>	Lumen index in parent model for each segment	<b>nsegment</b>	integer	none	1 to 9999999	1	optional

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
<b>parent_ssr</b>	Lumen index in parent model for each SSR	<b>nssr</b>	integer	none	1 to 9999999	1	optional
Measured input							
<b>outlet_sta</b>	Index of measured streamflow station corresponding to the basin outlet	<b>one</b>	integer	none	0 to <b>nobs</b>	0	<b>nobs</b> > 0
<b>precip_units</b>	Flag to indicate the units of measured precipitation values (0=inches; 1=mm)	<b>one</b>	integer	none	0 or 1	0	required
<b>rad_conv</b>	Conversion factor to Langleys for measured solar radiation	<b>one</b>	real	Langleys/ radiation units	0.1 to 100.0	1.0	<b>nsol</b> > 0
<b>rain_code</b>	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 xyz_dist computes any; 4=only precipitation if <i>rain_day</i> variable is set to 1; 5=only precipitation if <b>psta_freq_nuse</b> stations have precipitation)	<b>nmonths</b>	integer	none	1 to 5	2	<b>precip_module</b> = xyz_dist
<b>runoff_units</b>	Measured streamflow units (0=cfs; 1=cms)	<b>one</b>	integer	none	0 or 1	0	<b>nobs</b> > 0
<b>temp_units</b>	Flag to indicate the units of measured air-temperature values (0=Fahrenheit; 1=Celsius)	<b>one</b>	integer	none	0 or 1	0	required
Water Use input							
<b>irr_type</b>	Method of application of water for each application time-series (0=sprinkler (intercep applies); 1=furrow/drip (no intercept); 2=ignore)	<b>nhru</b>	real	none	0 to 2	0	<b>nwateruse</b> = 1
Air temperature and precipitation distribution							
<b>adjmix_rain</b>	Monthly (January to December) factor to adjust rain proportion in a mixed rain/snow event	<b>nhru,</b> <b>nmonths</b>	real	decimal fraction	<b>0.0 to 3.0</b>	1.0	required
<b>adjust_rain</b>	Monthly (January to December) rain downscaling adjustment factor for each precipitation measurement station	<b>nrain,</b> <b>nmonths</b>	real	decimal fraction	-0.5 to 0.5	-0.4	<b>precip_module</b> = ide_dist or xyz_dist
<b>adjust_snow</b>	Monthly (January to December) snow downscaling adjustment factor for each precipitation measurement station	<b>nrain,</b> <b>nmonths</b>	real	decimal fraction	-0.5 to 0.5	-0.4	<b>precip_module</b> = ide_dist or xyz_dist
<b>basin_tsta</b>	Index of temperature station used to compute basin temperature values	<b>one</b>	integer	none	0 to <b>ntemp</b>	0	<b>temp_module</b> = temp_1sta, <b>temp_sta</b> , temp_dist2, or temp_laps

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
<b>conv_flag</b>	Elevation conversion flag (0=none; 1=feet to meters; 2=meters to feet)	<b>one</b>	integer	none	0 to 2	0	<b>precip_module</b> and <b>temp_module</b> = xyz_dist
<b>dist_exp</b>	Exponent for inverse distance calculations	<b>one</b>	real	none	0.0 to 10.0	2.0	<b>precip_module</b> and <b>temp_module</b> = ide_dist
<b>dist_max</b>	Maximum distance from an HRU to a measurement station for use in calculations	<b>one</b>	real	feet	0.0 to 1.0E9	1.0E9	<b>precip_module</b> = precip_dist2 and/or <b>temp_module</b> = temp_dist2
<b>hru_plaps</b>	Index of the lapse precipitation measurement station used for lapse rate calculations for each HRU	<b>nhru</b>	integer	none	0 to <b>nrain</b>	0	<b>precip_module</b> = precip_laps
<b>hru_psta</b>	Index of the base precipitation measurement station used for lapse rate calculations for each HRU	<b>nhru</b>	integer	none	0 to <b>nrain</b>	0	<b>precip_module</b> = precip_1sta or precip_laps
<b>hru_tlaps</b>	Index of the lapse temperature station used for lapse rate calculations	<b>nhru</b>	integer	none	0 to <b>ntemp</b>	0	<b>temp_module</b> = temp_laps
<b>hru_tsta</b>	Index of the base temperature station used for lapse rate calculations	<b>nhru</b>	integer	none	0 to <b>ntemp</b>	0	<b>temp_module</b> = temp_1sta, temp_sta, or temp_laps
<b>hru_x</b>	Longitude (X) for each HRU in albers projection	<b>nhru</b>	real	meters	-1.0E7 to 1.0E7	0.0	<b>precip_module</b> and <b>temp_module</b> = ide_dist or xyz_dist
<b>hru_xlong</b>	Longitude of each HRU for the centroid, State Plane Coordinate System	<b>nhru</b>	real	feet	-1.0E9 to 1.0E9	0.0	<b>temp_module</b> = temp_dist2 or <b>precip_module</b> = precip_dist2
<b>hru_y</b>	Latitude (Y) for each HRU in albers projection	<b>nhru</b>	real	meters	-1.0E7 to 1.0E7	0.0	<b>precip_module</b> and <b>temp_module</b> = ide_dist or xyz_dist
<b>hru_ylat</b>	Latitude of each HRU for the centroid, State Plane Coordinate System	<b>nhru</b>	real	feet	-1.0E9 to 1.0E9	0.0	<b>temp_module</b> = temp_dist2 and/or <b>precip_module</b> = precip_dist2
<b>lapsemax_max</b>	Monthly (January to December) maximum lapse rate to constrain lowest maximum lapse rate based on historical daily air temperatures for all air temperature-	<b>nmonths</b>	real	<b>temp_units</b> /feet	-3.0 to 3.0	2.0	<b>temp_module</b> = temp_dist2

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
<b>lapsemax_min</b>	measurement stations 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	<b>nmonths</b>	real	<b>temp_units/</b> feet	-7.0 to -3.0	-6.5	<b>temp_module</b> = temp_dist2
<b>lapsemin_max</b>	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	<b>nmonths</b>	real	<b>temp_units/</b> feet	-2.0 to 4.0	3.0	<b>temp_module</b> = temp_dist2
<b>lapsemin_min</b>	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	<b>nmonths</b>	real	<b>temp_units/</b> feet	-7.0 to -3.0	-4.0	<b>temp_module</b> = temp_dist2
<b>max_lapse</b>	Monthly (January to December ) maximum air temperature lapse rate for each direction (X, Y, and Z) )	<b>nlapse,</b> <b>nmonths</b>	real	none	-100.0 to 100.0	0.0	<b>temp_module</b> = xyz_dist
<b>max_missing</b>	Maximum number of consecutive missing values allowed for any air temperature measurement station; missing value set to last valid value; 0=unlimited	<b>one</b>	integer	none	0 to 10	3	<b>temp_module</b> = temp_1sta, temp_sta, or temp_laps
<b>max_psta</b>	Maximum number of precipitation measurement stations to distribute to an HRU	<b>one</b>	integer	none	0 to <b>nrain</b>	0	<b>precip_module</b> = precip_dist2
<b>max_tsta</b>	Maximum number of air temperature measurement stations to use for distributing temperature to any HRU	<b>one</b>	integer	none	0 to <b>ntemp</b>	0	<b>temp_module</b> = temp_dist2
<b>maxday_prec</b>	Maximum measured precipitation value above which precipitation is assumed to be in error	<b>one</b>	real	<b>precip_units</b>	0.0 to 20.0	15.0	<b>precip_module</b> = precip_dist2
<b>min_lapse</b>	Monthly (January to December ) minimum air temperature lapse rate for each direction (X, Y, and Z)	<b>nlapse,</b> <b>nmonths</b>	real	none	-100.0 to 100.0	0.0	<b>temp_module</b> = xyz_dist
<b>monmax</b>	Monthly maximum air temperature to constrain lowest maximum air temperatures for bad values on the basis of historical temperature for all measurement stations	<b>nmonths</b>	real	<b>temp_units</b>	0.0 to 115.0	100.0	<b>temp_module</b> = temp_dist2
<b>monmin</b>	Monthly minimum air temperature to constrain lowest maximum air temperatures for bad values on the basis of historical temperature for all measurement stations	<b>nmonths</b>	real	<b>temp_units</b>	-60.0 to 65.0	-60.0	<b>temp_module</b> = temp_dist2
<b>ndist_psta</b>	Number of precipitation measure stations for inverse distance calculations	<b>one</b>	integer	none	0 to <b>nrain</b>	0	<b>precip_module</b> = ide_dist
<b>ndist_tsta</b>	Number of air temperature measurement stations for inverse distance calculations	<b>one</b>	integer	none	0 to <b>ntemp</b>	0	<b>temp_module</b> = ide_dist
<b>padj_rn</b>	Monthly (January to December) factor to adjust precipitation lapse rate computed between station <b>hru_psta</b> and station <b>hru_plaps</b> ; positive factors are	<b>nrain,</b> <b>nmonths</b>	real	<b>precip_units</b>	-2.0 to 10.0	1.0	<b>precip_module</b> = precip_laps

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
<b>padj_sn</b>	multiplied times the lapse rate and negative factors are made positive and substituted for the computed lapse rate Monthly (January to December) factor to adjust precipitation lapse rate computed between station <b>hru_psta</b> and station <b>hru_plaps</b> ; positive factors are multiplied times the lapse rate and negative factors are made positive and substituted for the computed lapse rate	<b>nrain,</b> <b>nmonths</b>	real	<b>precip_units</b>	-2.0 to 10.0	1.0	<b>precip_module</b> = precip_laps
<b>pmn_mo</b>	Mean monthly (January to December) precipitation for each lapse precipitation measurement station	<b>nrain,</b> <b>nmonths</b>	real	<b>precip_units</b>	0.00001 to 100.0	1.0	<b>precip_module</b> = precip_laps
<b>potet_cbh_adj</b>	Monthly (January to December) adjustment factor to potential evapotranspiration specified in CBH Files for each HRU	<b>nhru,</b> <b>nmonths</b>	real	decimal fraction	0.5 to 1.5	1.0	<b>et_module</b> = climate_hru
<b>ppt_add</b>	Mean value for the precipitation measurement station transformation equation	<b>one</b>	real	<b>precip_units</b>	-10.0 to 10.0	0.0	<b>precip_module</b> = xyz_dist
<b>ppt_div</b>	Standard deviation for the precipitation measurement station transformation equation (not 0.0)	<b>one</b>	real	<b>precip_units</b>	-10.0 to 10.0	1.0	<b>precip_module</b> = xyz_dist
<b>ppt_lapse</b>	Monthly (January to December) precipitation lapse rate for each direction (X, Y, and Z)	<b>nlapse,</b> <b>nmonths</b>	real	none	-10.0 to 10.0	0.0	<b>precip_module</b> = xyz_dist
<b>prcp_wght_dist</b>	Monthly (January to December) precipitation weighting function for inverse distance calculations	<b>nmonths</b>	real	decimal fraction	0.0 to 1.0	0.5	<b>precip_module</b> = ide_dist
<b>psta_elev</b>	Elevation of each precipitation measurement station	<b>nrain</b>	real	<b>elev_units</b>	-300.0 to 30,000.0	0.0	<b>precip_module</b> = ide_dist, xyz_dist, or precip_laps
<b>psta_freq_nuse</b>	The subset of precipitation measurement stations used to determine if there is precipitation in the basin (0=station not used; 1=station used)	<b>nrain</b>	integer	none	0 or 1	1	<b>precip_module</b> = xyz_dist
<b>psta_mon</b>	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	<b>nrain,</b> <b>nmonths</b>	real	<b>precip_units</b>	0.0 to 50.0	1.0	<b>precip_module</b> = precip_dist2
<b>psta_month_ppt</b>	Average monthly (January to December) maximum precipitation at each precipitation measurement station	<b>nrain,</b> <b>nmonths</b>	real	<b>precip_units</b>	0.0 to 20.0	0.0	<b>precip_module</b> = xyz_dist
<b>psta_nuse</b>	The subset of precipitation measurement stations used in the distribution regression (0=station not used; 1=station used)	<b>nrain</b>	integer	none	0 or 1	1	<b>precip_module</b> = ide_dist or xyz_dist
<b>psta_x</b>	Longitude (X) for each precipitation measurement station in albers projection	<b>nrain</b>	real	meters	-1.0E7 to 1.0E7	0	<b>precip_module</b> = ide_dist or

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
<b>psta_xlong</b>	Longitude of each precipitation measurement station, State Plane Coordinate System	<b>nrain</b>	real	feet	-1.0E9 to 1.0E9	0.0	xyz_dist <b>precip_module</b> = precip_dist2
<b>psta_y</b>	Latitude (Y) for each precipitation measurement station in albers projection	<b>nrain</b>	real	meters	-1.0E7 to 1.0E7	0	<b>precip_module</b> = ide_dist or xyz_dist
<b>psta_ylat</b>	Latitude of each precipitation measurement station, State Plane Coordinate System	<b>nrain</b>	real	feet	-1.0E9 to 1.0E9	0.0	<b>precip_module</b> = precip_dist2
<b>rain_adj</b>	Monthly (January to December) factor to adjust measured precipitation on each HRU to account for differences in elevation, and so forth	<b>nhru,</b> <b>nmonths</b>	real	decimal fraction	0.5 to 2.5	1.0	<b>precip_module</b> = precip_1sta
<b>rain_cbh_adj</b>	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	<b>nhru,</b> <b>nmonths</b>	real	decimal fraction	0.5 to 2.0	1.0	<b>precip_module</b> = climate_hru
<b>rain_mon</b>	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	<b>nhru,</b> <b>nmonths</b>	real	<b>precip_units</b>	0.0 to 50.0	1.0	<b>precip_module</b> = precip_dist2
<b>snow_adj</b>	Monthly (January to December) factor to adjust measured precipitation on each HRU to account for differences in elevation, and so forth	<b>nhru,</b> <b>nmonths</b>	real	decimal fraction	0.5 to 2.5	1.0	<b>precip_module</b> = precip_1sta
<b>snow_cbh_adj</b>	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	<b>nhru,</b> <b>nmonths</b>	real	decimal fraction	0.5 to 2.0	1.0	<b>precip_module</b> = climate_hru
<b>snow_mon</b>	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	<b>nhru,</b> <b>nmonths</b>	real	<b>precip_units</b>	0.0 to 50.0	1.0	<b>precip_module</b> = precip_dist2
<b>solrad_elev</b>	Elevation of the solar radiation station used for the degree-day curves to distribute temperature	<b>one</b>	real	meters	-300.0 to 30,000.0	0.0	<b>temp_module</b> = ide_dist or xyz_dist
<b>temp_wght_dist</b>	Monthly (January to December) temperature weighting function for inverse distance calculations	<b>nmonths</b>	real	decimal fraction	0.0 to 1.0	0.5	<b>temp_module</b> = ide_dist
<b>tmax_add</b>	Mean value for the air-temperature measurement station transformation equation for maximum air temperature	<b>one</b>	real	<b>temp_units</b>	-100.0 to 100.0	0.0	<b>temp_module</b> = xyz_dist
<b>tmax_adj</b>	Adjustment to maximum air temperature for each HRU, estimated on the basis of slope and aspect	<b>nhru,</b> <b>nmonths</b>	real	<b>temp_units</b>	-10.0 to 10.0	0.0	<b>temp_module</b> = temp_1sta, temp_sta, temp_laps, temp_dist2, ide_dist or xyz_dist

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
<b>tmax_allrain</b>	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	<b>nhru,</b> <b>nmonths</b>	real	<b>temp_units</b>	-8.0 to 75.0	38.0	<b>model_mode = PRMS</b> <b>or GSFLOW</b>
<b>tmax_allrain_dist</b>	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	<b>nmonths</b>	real	<b>temp_units</b>	-8.0 to 75.0	38.0	<b>temp_module =</b> <b>xyz_dist</b>
<b>tmax_allrain_offset</b>	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	<b>nhru,</b> <b>nmonths</b>	real	<b>temp_units</b>	0.0 to 50.0	38.0	<b>model_mode =</b> <b>PRMS5 or GSFLOW5</b>
<b>tmax_allrain_sta</b>	Monthly (January to December) maximum air temperature when precipitation is assumed to be rain; if precipitation measurement air temperature is greater than or equal to this value, precipitation is rain	<b>nrain,</b> <b>nmonths</b>	real	<b>temp_units</b>	-8.0 to 75.0	38.0	<b>temp_module =</b> <b>ide_dist</b>
<b>tmax_allsnow</b>	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	<b>nhru,</b> <b>nmonths</b>	real	<b>temp_units</b>	-10.0 to 40.0	32.0	required
<b>tmax_allsnow_dist</b>	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	<b>one</b>	real	<b>temp_units</b>	-10.0 to 40.0	38.0	<b>temp_module =</b> <b>xyz_dist</b>
<b>tmax_allsnow_sta</b>	Monthly (January to December) maximum air temperature when precipitation is assumed to be snow; if precipitation measurement air temperature is less than or equal to this value, precipitation is snow	<b>nrain,</b> <b>nmonths</b>	real	<b>temp_units</b>	-10.0 to 40.0	38.0	<b>temp_module =</b> <b>ide_dist</b>
<b>tmax_cbh_adj</b>	Monthly (January to December) adjustment factor to maximum air temperature for each HRU, estimated on the basis of slope and aspect	<b>nhru,</b> <b>nmonths</b>	real	<b>temp_units</b>	-10.0 to 10.0	0.0	<b>temp_module =</b> <b>climate_hru</b>
<b>tmax_div</b>	Standard deviation for the air-temperature-measurement station transformation equation for maximum air temperature (not 0 . 0)	<b>one</b>	real	<b>temp_units</b>	-100.0 to 100.0	1.0	<b>temp_module =</b> <b>xyz_dist</b>
<b>tmax_lapse</b>	Monthly (January to December) values representing the change in maximum air temperature per 1,000 <b>elev_units</b> of elevation change for each HRU	<b>nhru,</b> <b>nmonths</b>	real	<b>temp_units/</b> <b>elev_units</b>	-20.0 to 20.0	3.0	<b>temp_module =</b> <b>temp_1sta</b>
<b>tmin_add</b>	Mean value for the air-temperature-measurement station transformation equation for minimum air temperature	<b>one</b>	real	<b>temp_units</b>	-100.0 to 100.0	0.0	<b>temp_module =</b> <b>xyz_dist</b>
<b>tmin_adj</b>	Adjustment to minimum air temperature for each HRU, estimated on the basis of slope and aspect	<b>nhru,</b> <b>nmonths</b>	real	<b>temp_units</b>	-10.0 to 10.0	0.0	<b>temp_module =</b> <b>temp_1sta,</b>



Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
							<b>temp_sta,</b> temp_laps, temp_dist2, ide_dist or xyz_dist
<b>tmin_cbh_adj</b>	Monthly (January to December) adjustment factor to minimum air temperature for each HRU, estimated on the basis of slope and aspect	<b>nhru,</b> <b>nmonths</b>	real	<b>temp_units</b>	-10.0 to 10.0	0.0	<b>temp_module</b> = climate_hru
<b>tmin_div</b>	Standard deviation for the air-temperature-measurement station transformation equation for minimum air temperature (not 0.0)	<b>one</b>	real	<b>temp_units</b>	-100.0 to 100.0	1.0	<b>temp_module</b> = xyz_dist
<b>tmin_lapse</b>	Monthly (January to December) values representing the change in minimum air temperature per 1,000 <b>elev_units</b> of elevation change for each HRU	<b>nhru,</b> <b>nmonths</b>	real	<b>temp_units/</b> <b>elev_units</b>	-20.0 to 20.0	3.0	<b>temp_module</b> = temp_1sta
<b>tsta_elev</b>	Elevation of each air-temperature-measurement station	<b>ntemp</b>	real	<b>elev_units</b>	-300.0 to 30,000.0		
<b>tsta_month_max</b>	Average monthly (January to December) maximum air temperature at each air-temperature-measurement station	<b>ntemp,</b> <b>nmonths</b>	real	<b>temp_units</b>	-100.0 to 100.0	0.0	<b>temp_module</b> = xyz_dist
<b>tsta_month_min</b>	Average monthly (January to December) minimum air temperature at each air-temperature-measurement station	<b>ntemp,</b> <b>nmonths</b>	real	<b>temp_units</b>	-100.0 to 100.0	0.0	<b>temp_module</b> = xyz_dist
<b>tsta_nuse</b>	The subset of temperature stations used in the distribution regression (0=station not used; 1=station used)	<b>ntemp</b>	integer	none	0 or 1	0	<b>temp_module</b> = ide_dist or xyz_dist
<b>tsta_x</b>	Longitude (X) for each air-temperature-measurement station in albers projection	<b>ntemp</b>	real	meters	-1.0E7 to 1.0E7	0.0	<b>temp_module</b> = ide_dist or xyz_dist
<b>tsta_xlong</b>	Longitude of each air-temperature-measurement station, State Plane Coordinate System	<b>ntemp</b>	real	feet	-1.0E9 to 1.0E9	0.0	<b>temp_module</b> = temp_dist2
<b>tsta_y</b>	Latitude (Y) for each air-temperature-measurement station in albers projection	<b>ntemp</b>	real	meters	-1.0E7 to 1.0E7	0.0	<b>temp_module</b> = ide_dist or xyz_dist
<b>tsta_ylat</b>	Latitude of each air-temperature-measurement station, State Plane Coordinate System	<b>ntemp</b>	real	feet	-1.0E9 to 1.0E9	0.0	<b>temp_module</b> = temp_dist2
<b>x_add</b>	Mean value for the climate station transformation equation for the longitude (X) coordinate	<b>one</b>	real	meters	-1.0E7 to 1.0E7	0.0	<b>precip_module</b> and <b>temp_module</b> = xyz_dist
<b>x_div</b>	Standard deviation for the climate station transformation equation for the longitude (X) coordinate (not 0.0)	<b>one</b>	real	meters	-1.0E7 to 1.0E7	1.0	<b>precip_module</b> and <b>temp_module</b> = xyz_dist
<b>y_add</b>	Mean value for the climate station transformation	<b>one</b>	real	meters	-1.0E7 to	0.0	<b>precip_module</b> and

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
	equation for the latitude (Y) coordinate				1.0E7		<b>temp_module = xyz_dist</b>
<b>y_div</b>	Standard deviation for the climate station transformation equation for the latitude (Y) coordinate	<b>one</b>	real	meters	-1.0E7 to 1.0E7	1.0	<b>precip_module and temp_module = xyz_dist</b>
<b>z_add</b>	Mean value for the climate station transformation equation for the elevation (Z) coordinate	<b>one</b>	real	meters	-1.0E7 to 1.0E7	0.0	<b>precip_module and temp_module = xyz_dist</b>
<b>z_div</b>	Standard deviation for the climate station transformation equation for the elevation (Z) coordinate (not 0.0)	<b>one</b>	real	meters	-1.0E7 to 1.0E7	1.0	<b>precip_module and temp_module = xyz_dist</b>
Solar radiation							
<b>basin_solsta</b>	Index of solar radiation station used to compute basin radiation values; used when dimension <b>nsol</b> >0	<b>one</b>	integer	none	0 to <b>nsol</b>	0	<b>nsol &gt; 0</b>
<b>ccov_intcp</b>	Monthly (January to December) intercept in cloud-cover relationship	<b>nhru, nmonths</b>	real	none	0.0 to 5.0	1.83	<b>solrad_module = ccsolrad</b>
<b>ccov_slope</b>	Monthly (January to December) coefficient in cloud-cover relationship	<b>nhru, nmonths</b>	real	none	-0.5 to -0.01	-0.13	<b>solrad_module = ccsolrad</b>
<b>crad_coef</b>	Coefficient(B) in Thompson (1976) equation; varies by region, contour map of values in reference	<b>nhru, nmonths</b>	real	none	0.1 to 0.7	0.4	<b>solrad_module = ccsolrad</b>
<b>crad_exp</b>	Exponent(P) in Thompson (1976) equation	<b>nhru, nmonths</b>	real	none	0.2 to 0.8	0.61	<b>solrad_module = ccsolrad</b>
<b>dday_intcp</b>	Monthly (January to December) intercept in degree-day equation for each HRU	<b>nhru, nmonths</b>	real	dday	-60.0 to 10.0	-40.0	<b>solrad_module = ddsolrad</b>
<b>dday_slope</b>	Monthly (January to December) slope in degree-day equation for each HRU	<b>nhru, nmonths</b>	real	dday/ <b>temp_units</b>	0.1 to 1.4	0.4	<b>solrad_module = ddsolrad</b>
<b>hru_solsta</b>	Index of solar radiation station associated with each HRU	<b>nhru</b>	integer	none	0 to <b>nsol</b>	0	<b>nsol &gt; 0</b>
<b>ppt_rad_adj</b>	Monthly minimum precipitation, if HRU precipitation exceeds this value, radiation is multiplied by <b>radj_sppt</b> or <b>radj_wppt</b> precipitation adjustment factor	<b>nhru, nmonths</b>	real	inches	0.0 to 0.5	0.02	Required
<b>radadj_intcp</b>	Monthly (January to December) intercept in air temperature range adjustment to degree-day equation for each HRU	<b>nhru, nmonths</b>	real	dday	0.0 to 1.0	1.0	<b>solrad_module = ddsolrad</b>
<b>radadj_slope</b>	Monthly (January to December) slope in air temperature range adjustment to degree-day equation for each HRU	<b>nhru, nmonths</b>	real	dday/ <b>temp_units</b>	0.0 to 1.0	0.0	<b>solrad_module = ddsolrad</b>
<b>radj_sppt</b>	Adjustment factor for computed solar radiation for summer day with greater than <b>ppt_rad_adj</b> inches precipitation for each HRU	<b>nhru</b>	real	decimal fraction	0.0 to 1.0	0.44	required
<b>radj_wppt</b>	Adjustment factor for computed solar radiation for	<b>nhru</b>	real	decimal	0.0 to 1.0	0.5	required

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
<b>radmax</b>	winter day with greater than <b>ppt_rad_adj</b> inches precipitation for each HRU 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	<b>nhru,</b> <b>nmonths</b>	real	fraction decimal fraction	0.1 to 1.0	0.8	required
<b>tmax_index</b>	Monthly (January to December) index temperature used to determine precipitation adjustments to solar radiation for each HRU	<b>nhru,</b> <b>nmonths</b>	real	<b>temp_units</b>	-10.0 to 110.0	50.0	<b>solrad_module =</b> ddsolrad
Potential evapotranspiration distribution							
<b>crop_coef</b>	Monthly (January to December) crop coefficient for each HRU	<b>nhru,</b> <b>nmonths</b>	real	decimal fraction	0.0 to 2.0	1.0	<b>et_module =</b> potet_pm or potet_pm_sta
<b>epan_coef</b>	Monthly (January to December) evaporation pan coefficient for each HRU	<b>nhru,</b> <b>nmonths</b>	real	decimal fraction	0.01 to 3.0	1.0	<b>et_module =</b> potet_pan
<b>hamon_coef</b>	Monthly (January to December) air temperature coefficient used in Hamon potential ET computations for each HRU	<b>nhru,</b> <b>nmonths</b>	real	none	0.004 to 0.008	0.0055	<b>et_module =</b> potet_hamon
<b>hru_humidity_sta</b>	Index of humidity measurement station for each HRU	<b>nhru</b>	integer	none	0 to <b>nhumid</b>	0	<b>et_module =</b> potet_pm_sta and <b>nhumid &gt; 0</b>
<b>hru_pansta</b>	Index of pan evaporation station used to compute HRU potential ET	<b>nhru</b>	integer	none	0 to <b>nevap</b>	0	<b>et_module =</b> potet_pan and <b>nevapl &gt; 0</b>
<b>hru_windspeed_sta</b>	Index of wind speed measurement station for each HRU	<b>nhru</b>	integer	none	0 to <b>nwind</b>	0	<b>et_module =</b> potet_pm_sta and <b>nwind &gt; 0</b>
<b>hs_krs</b>	Monthly (January to December) adjustment factor used in Hargreaves-Samani potential ET computations for each HRU	<b>nhru,</b> <b>nmonths</b>	real	decimal fraction	0.01 to 0.24	0.0135	<b>et_module =</b> potet_hs
<b>humidity_percent</b>	Monthly humidity for each HRU	<b>nhru,</b> <b>nmonths</b>	real	percentage	0.0 to 100.0	0.0	<b>et_module =</b> potet_pm or potet_pt and humidity is not specified in a CBH File
<b>jh_coef</b>	Monthly (January to December) air temperature coefficient used in Jensen-Haise potential ET computations for each HRU	<b>nhru,</b> <b>nmonths</b>	real	per degrees Fahrenheit	<b>-0.5 to 1.5</b>	0.014	<b>et_module =</b> potet_jh
<b>jh_coef_hru</b>	Air temperature coefficient used in Jensen-Haise potential ET computations for each HRU	<b>nhru</b>	real	per degrees Fahrenheit	-99.0 to 150.0	13.0	<b>et_module =</b> potet_jh

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
<b>pm_d_coef</b>	Monthly (January to December) Penman-Monteith potential ET D wind speed coefficient for each HRU	<b>nhru,</b> <b>nmonths</b>	real	seconds/ meter	0.25 to 0.45	0.34	<b>et_module =</b> potet_pm or potet_pm_sta
<b>pm_n_coef</b>	Monthly (January to December) Penman-Monteith potential ET N temperature coefficient for each HRU	<b>nhru,</b> <b>nmonths</b>	real	degrees Celsius per day	850.0 to 950.0	900.0	<b>et_module =</b> potet_pm or potet_pm_sta
<b>potet_cbh_adj</b>	Monthly (January to December) adjustment factor to potential evapotranspiration specified in CBH Files for each HRU	<b>nhru,</b> <b>nmonths</b>	real	degrees decimal fraction	0.5 to 1.5	1.0	<b>et_module =</b> climate_hru
<b>pt_alpha</b>	Monthly (January to December) adjustment factor used in Priestly-Taylor potential ET computations for each HRU	<b>nhru,</b> <b>nmonths</b>	real	decimal fraction	1.0 to 2.0	1.26	<b>et_module =</b> potet_pt
Evapotranspiration and sublimation							
<b>fall_frost</b>	The solar date (number of days after winter solstice) of the first killing frost of the fall	<b>nhru</b>	integer	solar date	1 to 366	264	<b>transp_module =</b> transp_frost
<b>frost_temp</b>	Temperature of killing frost	<b>nhru</b>	real	<b>temp_units</b>	-10.0 to 32.0	28.0	<b>model_mode =</b> FROST
<b>potet_sublim</b>	Fraction of potential ET that is sublimated from snow in the canopy and snowpack for each HRU	<b>nhru</b>	real	decimal fraction	0.1 to 0.75	0.5	required
<b>rad_trncf</b>	Transmission coefficient for short-wave radiation through the winter vegetation canopy	<b>nhru</b>	real	decimal fraction	0.0 to 1.0	0.5	required
<b>soil_type</b>	Soil type of each HRU (1=sand; 2=loam; 3=clay)	<b>nhru</b>	integer	none	1 to 3	2	required
<b>spring_frost</b>	The solar date (number of days after winter solstice) of the last killing frost of the spring	<b>nhru</b>	integer	solar date	1 to 366	111	<b>transp_module =</b> transp_frost
<b>transp_beg</b>	Month to begin summing maximum air temperature for each HRU; when sum is greater than or equal to <b>transp_tmax</b> , transpiration begins	<b>nhru</b>	integer	month	1 to 12	1	<b>transp_module =</b> transp_tindex
<b>transp_end</b>	Month to stop transpiration computations; transpiration is computed thru end of previous month	<b>nhru</b>	integer	month	1 to 13	13	<b>transp_module =</b> transp_tindex
<b>transp_tmax</b>	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 <b>transp_beg</b> ; when the sum exceeds this index, transpiration begins	<b>nhru</b>	real	<b>temp_units</b>	0.0 to 1,000.0	1.0	<b>transp_module =</b> transp_tindex
Interception							
<b>cov_type</b>	Vegetation cover type for each HRU (0=bare soil; 1=grasses; 2=shrubs; 3=trees; 4=coniferous)	<b>nhru</b>	integer	none	0 to 4	3	required
<b>covden_sum</b>	Summer vegetation cover density for the major vegetation type in each HRU	<b>nhru</b>	real	decimal fraction	0.0 to 1.0	0.5	required
<b>covden_win</b>	Winter vegetation cover density for the major vegetation	<b>nhru</b>	real	decimal	0.0 to 1.0	0.5	required

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
<b>snow_intcp</b>	type in each HRU Snow interception storage capacity for the major vegetation type in each HRU	<b>nhru</b>	real	fraction inches	0.0 to 1.0	0.1	required
<b>srain_intcp</b>	Summer rain interception storage capacity for the major vegetation type in each HRU	<b>nhru</b>	real	inches	0.0 to 1.0	0.1	required
<b>wrain_intcp</b>	Winter rain interception storage capacity for the major vegetation type in each HRU	<b>nhru</b>	real	inches	0.0 to 1.0	0.1	required
Snow computations							
<b>albset_rna</b>	Fraction of rain in a mixed precipitation event above which the snow albedo is not reset; applied during the snowpack accumulation stage	<b>one</b>	real	decimal fraction	0.5 to 1.0	0.8	required
<b>albset_rnm</b>	Fraction of rain in a mixed precipitation event above which the snow albedo is not reset; applied during the snowpack melt stage	<b>one</b>	real	decimal fraction	0.4 to 1.0	0.6	required
<b>albset_sna</b>	Minimum snowfall, in water equivalent, needed to reset snow albedo during the snowpack accumulation stage	<b>one</b>	real	inches	0.01 to 1.0	0.05	required
<b>albset_snm</b>	Minimum snowfall, in water equivalent, needed to reset snow albedo during the snowpack melt stage	<b>one</b>	real	inches	0.1 to 1.0	0.2	required
<b>cecn_coef</b>	Monthly (January to December) convection condensation energy coefficient for each HRU	<b>nhru, nmonths</b>	real	calories per degree Celsius > 0	0.02.0 to 20.0	5.0	required
<b>den_init</b>	Initial density of new-fallen snow	<b>one</b>	real	grams/cubic centimeters	0.01 to 0.5	0.1	required
<b>den_max</b>	Average maximum snowpack density	<b>one</b>	real	grams/cubic centimeters	0.1 to 0.8	0.6	required
<b>emis_noppt</b>	Average emissivity of air on days without precipitation for each HRU	<b>nhru</b>	real	decimal fraction	0.757 to 1.0	0.757	required
<b>freeh2o_cap</b>	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	<b>nhru</b>	real	decimal fraction	0.01 to 0.2	0.05	required
<b>hru_deplcrv</b>	Index number for the snowpack areal depletion curve associated with each HRU	<b>nhru</b>	integer	none	1 to <b>ndepl</b>	1	required
<b>melt_force</b>	Julian date to force snowpack to spring snowmelt stage; varies with region depending on length of time that permanent snowpack exists for each HRU	<b>nhru</b>	integer	Julian day	1 to 366	140	required
<b>melt_look</b>	Julian date to start looking for spring snowmelt stage; varies with region depending on length of time that permanent snowpack exists for each HRU	<b>nhru</b>	integer	Julian day	1 to 366	90	required
<b>settle_const</b>	Snowpack settlement time constant	<b>one</b>	real	decimal fraction	0.01 to 0.5	0.1	required

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
<b>snarea_curve</b>	Snow area depletion curve values, 11 values for each curve (0.0 to 1.0 in 0.1 increments)	<b>ndeplval</b>	real	decimal fraction	0.0 to 1.0	1.0	required
<b>snarea_thresh</b>	Maximum threshold snowpack water equivalent below which the snow-covered-area curve is applied	<b>nhru</b>	real	inches	0.0 to 200.0	50.0	required
<b>snowpack_init</b>	Storage of snowpack in each HRU at the beginning of a simulation	<b>nhru</b>	real	inches	0.0 to 5000.0	0.0	required
<b>tstorm_mo</b>	Monthly indicator for prevalent storm type (0=frontal storms; 1=convective storms) for each HRU	<b>nhru, nmonths</b>	integer	none	0 or 1	0	required
Hortonian surface runoff, infiltration, and impervious storage							
<b>carea_max</b>	Maximum possible area contributing to surface runoff expressed as a portion of the HRU area	<b>nhru</b>	real	decimal fraction	0.0 to 1.0	0.6	required
<b>carea_min</b>	Minimum possible area contributing to surface runoff expressed as a portion of the area for each HRU	<b>nhru</b>	real	decimal fraction	0.0 to 1.0	0.2	<b>srunoff_module = srunoff_carea</b>
<b>hru_percent_imperv<sup>2</sup></b>	Fraction of each HRU area that is impervious	<b>nhru</b>	real	decimal fraction	0.0 to 0.999	0.0	required
<b>imperv_stor_max</b>	Maximum impervious area retention storage for each HRU	<b>nhru</b>	real	inches	0.0 to 0.5	0.05	required
<b>smidx_coef</b>	Coefficient in non-linear contributing area algorithm for each HRU	<b>nhru</b>	real	decimal fraction	0.0 to 1.0	0.005	<b>srunoff_module = srunoff_smidx</b>
<b>smidx_exp</b>	Exponent in non-linear contributing area algorithm for each HRU	<b>nhru</b>	real	1/inch	0.0 to 5.0	0.3	<b>srunoff_module = srunoff_smidx</b>
<b>snowinfil_max</b>	Maximum snow infiltration per day for each HRU	<b>nhru</b>	real	inches/day	0.0 to 20.0	2.0	required
Surface depression storage							
<b>dprst_area</b>	Aggregate sum of surface-depression storage areas of each HRU (recommend that <b>dprst_frac_hru</b> be used instead of <b>dprst_area</b> )	<b>nhru</b>	real	acres	0.0 to 1.0E9	0.0	<b>dprst_flag = 1 and model_mode = PRMS</b>
<b>dprst_depth_avg</b>	Average depth of storage depressions at maximum storage capacity	<b>nhru</b>	real	inches	0.0 to 500.0	132.0	<b>dprst_flag = 1</b>
<b>dprst_et_coef</b>	Fraction of unsatisfied potential evapotranspiration to apply to surface-depression storage	<b>nhru</b>	real	decimal fraction	0.5 to 1.5	1.0	<b>dprst_flag = 1</b>
<b>dprst_flow_coef</b>	Coefficient in linear flow routing equation for open surface depressions for each HRU	<b>nhru</b>	real	fraction/day	0.00001 to 0.5	0.05	<b>dprst_flag = 1</b>
<b>dprst_frac_hru</b>	Fraction of each HRU area that has surface depressions (If specified the parameter <b>dprst_area</b> is ignored if it also is specified, default of -1.0 means use <b>dprst_area</b> )	<b>nhru</b>	real	decimal fraction	-1.0 to 0.999	-1.0	<b>dprst_flag = 1 and model_mode = PRMS or GSFLOW</b>
<b>dprst_frac</b>	Fraction of each HRU area that has surface depressions (If specified the parameter <b>dprst_area</b> is ignored if it also is specified)	<b>nhru</b>	real	decimal fraction	0.0 to 0.999	0.0	<b>dprst_flag = 1 and model_mode = PRMS5 or GSFLOW5</b>
<b>dprst_frac_init</b>	Fraction of maximum surface-depression storage that	<b>nhru</b>	real	decimal	0.0 to 1.0	0.5	<b>dprst_flag = 1</b>

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
<b>dprst_frac_open</b>	contains water at the start of a simulation Fraction of open surface-depression storage area within an HRU that can generate surface runoff as a function of storage volume	<b>nhru</b>	double	fraction decimal fraction	0.0 to 1.0	1.0	<b>dprst_flag = 1</b>
<b>dprst_seep_rate_clos</b>	Coefficient used in linear seepage flow equation for closed surface depressions for each HRU	<b>nhru</b>	real	fraction/day	0.0 to 0.2	0.02	<b>dprst_flag = 1</b>
<b>dprst_seep_rate_open</b>	Coefficient used in linear seepage flow equation for open surface depressions for each HRU	<b>nhru</b>	real	fraction/day	0.0 to 0.2	0.02	<b>dprst_flag = 1</b>
<b>op_flow_thres</b>	Fraction of open depression storage above which surface runoff occurs; any water above maximum open storage capacity spills as surface runoff	<b>nhru</b>	real	decimal fraction	0.01 to 1.0	1.0	<b>dprst_flag = 1</b>
<b>sro_to_dprst_imperv</b>	Fraction of impervious surface runoff that flows into surface-depression storage; the remainder flows to a stream network for each HRU	<b>nhru</b>	real	decimal fraction	0.0 to 1.0	0.2	<b>dprst_flag = 1</b>
<b>sro_to_dprst</b>	Fraction of pervious surface runoff that flows into surface-depression storage; the remainder flows to a stream network for each HRU	<b>nhru</b>	real	decimal fraction	0.0 to 1.0	0.2	<b>dprst_flag = 1 and model_mode = PRMS or GSFLOW</b>
<b>sro_to_dprst_perv</b>	Fraction of pervious surface runoff that flows into surface-depression storage; the remainder flows to a stream network for each HRU	<b>nhru</b>	real	decimal fraction	0.0 to 1.0	0.2	<b>dprst_flag = 1 and model_mode = PRMS5 or GSFLOW5</b>
<b>va_clos_exp</b>	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 rectangle; 1.0 is a triangle	<b>nhru</b>	real	none	0.0001 to 10.0	0.001	<b>dprst_flag = 1</b>
<b>va_open_exp</b>	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 rectangle; 1.0 is a triangle	<b>nhru</b>	real	none	0.0001 to 10.0	0.001	<b>dprst_flag = 1</b>
Soil zone storage, interflow, gravity drainage, dunnian surface runoff							
<b>fastcoef_lin</b>	Linear coefficient in equation to route preferential-flow storage downslope for each HRU	<b>nhru</b>	real	fraction/day	0.0 to 1.0	0.1	required <sup>§</sup>
<b>fastcoef_sq</b>	Non-linear coefficient in equation to route preferential-flow storage downslope for each HRU	<b>nhru</b>	real	none	0.0 to 1.0	0.8	required <sup>§</sup>
<b>pref_flow_den</b>	Fraction of the soil zone in which preferential flow occurs for each HRU	<b>nhru</b>	real	decimal fraction	0.0 to 0.5	0.0	required <sup>§</sup>
<b>sat_threshold</b>	Water holding capacity of the gravity and preferential-flow reservoirs; difference between field capacity and total soil saturation for each HRU	<b>nhru</b>	real	inches	0.00001 to 999.0	999.0	required <sup>§</sup>

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
<b>slowcoef_lin</b>	Linear coefficient in equation to route gravity-reservoir storage downslope for each HRU	<b>nhru</b>	real	fraction/day	0.0 to 1.0	0.015	required <sup>8</sup>
<b>slowcoef_sq</b>	Non-linear coefficient in equation to route gravity-reservoir storage downslope for each HRU	<b>nhru</b>	real	none	0.0 to 1.0	0.1	required <sup>8</sup>
<b>soil_moist_init</b>	Initial value of available water in capillary reservoir for each HRU	<b>nhru</b>	real	inches	0.0 to 10.0	3.0	<b>model_mode = PRMS or GSFLOW</b>
<b>soil_moist_init_frac</b>	Initial fraction of available water in the capillary reservoir (fraction of <b>soil_moist_max</b> for each HRU	<b>nhru</b>	real	decimal fraction	0.0 to 1.0	0.0	<b>model_mode = PRMS5 or GSFLOW5</b>
<b>soil_moist_max</b>	Maximum available water holding capacity of capillary reservoir from land surface to rooting depth of the major vegetation type of each HRU	<b>nhru</b>	real	inches	0.00001 to 20.0	2.0	required
<b>soil_rechr_init</b>	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 <b>soil_moist_init</b>	<b>nhru</b>	real	inches	0.0 to 10.0	1.0	<b>model_mode = PRMS or GSFLOW</b>
<b>soil_rechr_init_frac</b>	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	<b>nhru</b>	real	decimal fraction	0.0 to 1.0	0.0	<b>model_mode = PRMS5 or GSFLOW5</b>
<b>soil_rechr_max</b>	Maximum storage for soil recharge zone (upper portion of capillary reservoir where losses occur as both evaporation and transpiration) of must be less than or equal to <b>soil_moist_max</b>	<b>nhru</b>	real	inches	0.00001 to 5.0	1.5	<b>model_mode = PRMS or GSFLOW</b>
<b>soil_rechr_max_frac</b>	Fraction of the capillary reservoir water-holding capacity ( <b>soil_moist_max</b> ) where losses occur as both evaporation and transpiration (upper zone of capillary reservoir) for each HRU	<b>nhru</b>	real	decimal fraction	0.00001 to 1.0	1.0	required
<b>soil2gw_max</b>	Maximum amount of the capillary reservoir excess that is routed directly to the GWR for each HRU	<b>nhru</b>	real	inches	0.0 to 5.0	0.0	required
<b>ssr2gw_exp</b>	Non-linear coefficient in equation used to route water from the gravity reservoirs to the GWR for each HRU	<b>nssr</b>	real	none	0.0 to 3.0	1.0	required
<b>ssr2gw_rate</b>	Linear coefficient in equation used to route water from the gravity reservoir to the GWR for each HRU	<b>nssr</b>	real	fraction/day	0.0001 to 1.0	0.1	required
<b>ssstor_init</b>	Initial storage of the gravity and preferential-flow reservoirs for each HRU	<b>nssr</b>	real	inches	0.0 to 5.0	0.0	<b>model_mode = PRMS or GSFLOW</b>
<b>ssstor_init_frac</b>	Initial fraction of available water in the gravity plus preferential-flow reservoirs (fraction of <b>sat_threshold</b> ) for each HRU	<b>nssr</b>	real	decimal fraction	0.0 to 1.0	0.0	required
		Groundwater flow					
<b>gwflow_coef</b>	Linear coefficient in the equation to compute	<b>ngw</b>	real	fraction/day	0.0 to 0.5	0.015	required



Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
<b>gwsink_coef</b>	groundwater discharge for each GWR Linear coefficient in the equation to compute outflow to the groundwater sink for each GWR	<b>ngw</b>	real	fraction/day	0.0 to <b>1.0</b>	0.0	required
<b>gwstor_init</b>	Storage in each GWR at the beginning of a simulation	<b>ngw</b>	real	inches	0.0 to <b>50.0</b>	2.0	required
<b>gwstor_min</b>	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 outside the basin	<b>ngw</b>	real	inches	0.0 to 1.0	0.0	required
<b>hru_segment</b>	Segment index to which an HRU contributes lateral flows (surface runoff, interflow, and groundwater discharge)	Streamflow <b>nhru</b>	integer	none	0 to <b>nsegment</b>	0	<b>strmflow_module</b> = muskingum, strmflow_in_out, or muskingum_lake
<b>K_coef</b>	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	<b>nsegment</b>	real	hours	0.01 to 24.0	1.0	<b>strmflow_module</b> = muskingum
<b>obsin_segment</b>	Index of measured streamflow station that replaces inflow to a segment	<b>nsegment</b>	integer	none	0 to <b>nobs</b>	0	<b>strmflow_module</b> = muskingum, strmflow_in_out, or muskingum_lake
<b>obsout_segment</b>	Index of measured streamflow station that replaces outflow from a segment	<b>nsegment</b>	integer	none	0 to <b>nobs</b>	0	<b>strmflow_module</b> = muskingum, strmflow_in_out, or muskingum_lake
<b>segment_flow_init</b>	Initial flow in each stream segment	<b>nsegment</b>	real	cfs	0 to 1.0E7	0.0	<b>strmflow_module</b> = muskingum, strmflow_in_out, or muskingum_lake
<b>segment_type</b>	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)	<b>nsegment</b>	integer	none	0 to <b>111</b>	0	<b>strmflow_module</b> = muskingum, strmflow_in_out, or muskingum_lake

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
<b>tosegment</b>	Index of downstream segment to which the segment streamflow flows; for segments that do not flow to another segment enter 0	<b>nsegment</b>	integer	none	-11 to 1000000	0	<b>strmflow_module</b> = muskingum, strmflow_in_out, or muskingum_lake
<b>tosegment_nhm</b>	National Hydrologic Model downstream segment ID	<b>nsegment</b>	integer	none	0 to 9999999	0	optional
<b>x_coef</b>	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	<b>nsegment</b>	real	decimal fraction	0.0 to 0.5	0.2	<b>strmflow_module</b> = muskingum
Lake routing							
<b>elev_outflow</b>	Elevation of the main outflow point for each lake using broad-crested weir routing	<b>nlake</b>	real	feet	-300.0 to 10,000.0	0.0	<b>strmflow_module</b> = muskingum_lake
<b>elevlake_init</b>	Initial lake surface elevation for each lake using broad-crested weir routing or gate opening routing	<b>nlake</b>	real	feet	-300.0 to 10,000.0	1.0	<b>strmflow_module</b> = muskingum_lake
<b>gw_seep_coef</b>	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	<b>ngw</b>	real	fraction/day	0.001 to 0.05	0.015	<b>strmflow_module</b> = muskingum_lake
<b>lake_coef</b>	Coefficient in equation to route storage to streamflow for each lake using linear routing	<b>nlake</b>	real	fraction/day	0.0001 to 1.0	0.1	<b>strmflow_module</b> = muskingum_lake
<b>lake_din1</b>	Initial inflow to each lake using Puls or linear storage routing	<b>nlake</b>	real	cfs	0.0 to 1.0E7	0.1	<b>strmflow_module</b> = muskingum_lake
<b>lake_evap_adj</b>	Monthly (January to December) adjustment factor for potential ET for each lake	<b>nhru</b>	real	decimal fraction	0.5 to 1.0	1.0	<b>strmflow_modu</b> = muskingum_lake
<b>lake_hru</b>	Index of HRU for each lake	<b>nlake</b>	integer	none	0 to <b>nhru</b>	0	<b>strmflow_module</b> = strmflow_lake
<b>lake_hru_id</b>	Identification number of the lake associated with an HRU; more than one HRU can be associated with each lake	<b>nhru</b>	integer	none	0 to <b>nlake</b>	0	<b>strmflow_module</b> = muskingum_lake
<b>lake_init</b>	Initial storage in each lake using Puls or linear storage routing	<b>nlake</b>	real	cfs-days	0.0 to 1.0E7	0.0	<b>strmflow_module</b> = muskingum_lake
<b>lake_out2</b>	Switch to specify a second outflow point from each lake using gate opening routing (0=no; 1=yes)	<b>nlake</b>	integer	none	0 or 1	0	<b>strmflow_module</b> = muskingum_lake
<b>lake_out2_a</b>	Coefficient A in outflow equation for each lake with a second outlet using gate opening routing	<b>nlake</b>	real	cfs/feet	0.0 to 10,000.0	1.0	<b>strmflow_module</b> = muskingum_lake
<b>lake_out2_b</b>	Coefficient B in outflow equation for each lake with a second outlet using gate opening routing	<b>nlake</b>	real	cfs	0.0 to 10,000.0	100.0	<b>strmflow_module</b> = muskingum_lake
<b>lake_qro</b>	Initial daily mean outflow from each lake	<b>nlake</b>	real	cfs	0.0 to	0.1	<b>strmflow_module</b> =

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
<b>lake_seep_elev</b>	Elevation over which lakebed seepage to the GWR occurs for lake HRUs using broad-crested weir routing or gate opening routing	<b>nlake</b>	real	feet	1.0E7 -300.0 to 10,000.0	1.0	<b>muskingum_lake</b> <b>strmflow_module =</b> <b>muskingum_lake</b>
<b>lake_segment_id</b>	Index of lake associated with a segment	<b>nsegment</b>	integer	none	0 to <b>nlake</b>	0	<b>strmflow_module =</b> <b>muskingum_lake</b> and <b>cascade_flag = 1</b> <b>strmflow_module =</b> <b>muskingum_lake</b>
<b>lake_type</b>	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)	<b>nlake</b>	integer	none	1 to 6	1	<b>strmflow_module =</b> <b>muskingum_lake</b>
<b>lake_vol_init</b>	Initial lake volume for each lake using broad-crested weir or gate opening routing	<b>nlake</b>	real	acre-feet	0.0 to 1.0E7	0.0	<b>strmflow_module =</b> <b>muskingum_lake</b>
<b>nsos</b>	Number of storage/outflow values in table for each lake using Puls routing	<b>mxnsos,</b> <b>nlake</b>	integer	none	0 to <b>mxnsos</b>	0	<b>strmflow_module =</b> <b>muskingum_lake</b>
<b>o2</b>	Outflow values in outflow/storage tables for each lake using Puls routing	<b>mxnsos,</b> <b>nlake</b>	real	cfs	0.0 to 1.0E7	0.0	<b>strmflow_module =</b> <b>muskingum_lake</b>
<b>obsout_lake</b>	Index of streamflow measurement station that specifies outflow from each lake using measured flow replacement	<b>nlake</b>	integer	none	0 to <b>nobs</b>	0	<b>strmflow_module =</b> <b>muskingum_lake</b>
<b>rate_table</b>	Rating table with stage (rows) and gate opening (cols) for rating table 1 for lakes using gate opening routing and <b>nratetbl</b> >0	<b>nstage,</b> <b>ngate</b>	real	cfs	-100.0 to 1,000.0	5.0	<b>strmflow_module =</b> <b>muskingum_lake</b>
<b>rate_table2</b>	Rating table with stage (rows) and gate opening (cols) for rating table 2 for lakes using gate opening routing and <b>nratetbl</b> >1	<b>nstage2,</b> <b>ngate2</b>	real	cfs	-100.0 to 1,000.0	5.0	<b>strmflow_module =</b> <b>muskingum_lake</b>
<b>rate_table3</b>	Rating table with stage (rows) and gate opening (cols) for rating table 3 for lakes using gate opening routing and <b>nratetbl</b> >2	<b>nstage3,</b> <b>ngate3</b>	real	cfs	-100.0 to 1,000.0	5.0	<b>strmflow_module =</b> <b>muskingum_lake</b>
<b>rate_table4</b>	Rating table with stage (rows) and gate opening (cols) for rating table 4 for lakes using gate opening routing and <b>nratetbl</b> >3	<b>nstage4,</b> <b>ngate4</b>	real	cfs	-100.0 to 1,000.0	5.0	<b>strmflow_module =</b> <b>muskingum_lake</b>
<b>ratetbl_lake</b>	Index of lake associated with each rating table for each lake using gate opening routing	<b>nratetbl</b>	integer	none	0 to <b>nlake</b>	0	<b>strmflow_module =</b> <b>muskingum_lake</b>
<b>s2</b>	Storage values in outflow/storage table for each lake using Puls routing	<b>mxnsos,</b> <b>nlake</b>	real	cfs	0.0 to 1.0E7	0.0	<b>strmflow_module =</b> <b>muskingum_lake</b>
<b>tbl_gate</b>	Gate openings for each column for rating table 1 for lakes using gate opening routing and <b>nratetbl</b> >0	<b>ngate</b>	real	inches	0.0 to 20.0	0.0	<b>strmflow_module =</b> <b>muskingum_lake</b>
<b>tbl_gate2</b>	Gate openings for each column for rating table 2 for lakes using gate opening routing and <b>nratetbl</b> >1	<b>ngate2</b>	real	inches	0.0 to 20.0	0.0	<b>strmflow_module =</b> <b>muskingum_lake</b>
<b>tbl_gate3</b>	Gate openings for each column for rating table 3 for	<b>ngate3</b>	real	inches	0.0 to 20.0	0.0	<b>strmflow_module =</b>

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
<b>tbl_gate4</b>	lakes using gate opening routing and <b>nratetbl</b> >2 Gate openings for each column for rating table 4 for lakes using gate opening routing and <b>nratetbl</b> >3	<b>ngate4</b>	real	inches	0.0 to 20.0	0.0	<b>muskingum_lake</b> <b>strmflow_module = muskingum_lake</b>
<b>tbl_stage</b>	Stage values for each row for rating table 1 for lakes using gate opening routing and <b>nratetbl</b> >0	<b>nstage</b>	real	feet	-100.0 to 1,000.0	5.0	<b>strmflow_module = muskingum_lake</b>
<b>tbl_stage2</b>	Stage values for each row for rating table 2 for lakes using gate opening routing and <b>nratetbl</b> >1	<b>nstage2</b>	real	feet	-100.0 to 1,000.0	5.0	<b>strmflow_module = muskingum_lake</b>
<b>tbl_stage3</b>	Stage values for each row for rating table 3 for lakes using gate opening routing and <b>nratetbl</b> >2	<b>nstage3</b>	real	feet	-100.0 to 1,000.0	5.0	<b>strmflow_module = muskingum_lake</b>
<b>tbl_stage4</b>	Stage values for each row for rating table 4 for lakes using gate opening routing and <b>nratetbl</b> >3	<b>nstage4</b>	real	feet	-100.0 to 1,000.0	5.0	<b>strmflow_module = muskingum_lake</b>
<b>weir_coef</b>	Coefficient for lakes using broad-crested weir routing	<b>nlake</b>	real	none	2.0 to 3.0	2.7	<b>strmflow_module = muskingum_lake</b>
<b>weir_len</b>	Weir length for lakes using broad-crested weir routing	<b>nlake</b>	real	feet	1.0 to 1,000.0	5.0	<b>strmflow_module = muskingum_lake</b>
Output options							
<b>print_freq</b>	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)	<b>one</b>	integer	none	0 to 15	3	required
<b>print_type</b>	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)	<b>one</b>	integer	none	0 to 2	1	required
Subbasin parameters							
<b>hru_subbasin</b>	Index of subbasin assigned to each HRU	<b>nhru</b>	integer	none	0 to user defined	0	<b>subbasin_flag = 1</b>
<b>subbasin_down</b>	Index number for the downstream subbasin whose inflow is outflow from this subbasin	<b>nsub</b>	integer	none	0 to <b>nsub</b>	0	<b>subbasin_flag = 1</b>
Mapped results parameters							
<b>gvr_cell_id<sup>9</sup></b>	Index of the grid cell associated with each gravity reservoir (default of -1 means HRUs and grid cells are equivalent)	<b>nhrucell</b>	integer	none	-1 to 999999999	-1	<b>mapOutON_OFF = 1</b>
<b>gvr_cell_pct<sup>9</sup></b>	Proportion of the grid cell area associated with each gravity reservoir	<b>nhrucell</b>	real	decimal fraction	0.0 to 1.0	1.0	<b>mapOutON_OFF = 1</b>
<b>gvr_hru_id<sup>9</sup></b>	Index of the HRU associated with each gravity reservoir	<b>nhrucell</b>	integer	none	0 to <b>nhrucell</b>	1	<b>mapOutON_OFF = 1</b>
<b>mapvars_freq</b>	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)	<b>one</b>	integer	none	0 to 7	0	<b>mapOutON_OFF = 1</b>

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
<b>mapvars_units</b>	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)	<b>one</b>	integer	none	0 to 3	0	<b>mapOutON_OFF = 1</b>
<b>ncol</b>	Number of columns for each row of the mapped results	<b>one</b>	integer	none	1 to 50000	1	<b>mapOutON_OFF = 1</b>
<b>prms_warmup</b>	Number of years to simulate before writing mapped results	<b>one</b>	integer	years	0 to user defined	±	<b>mapOutON_OFF = 1</b> or <b>nhruOutON_OFF = ±</b>
Summary results CSV file parameters							
<b>poi_gage_id</b>	USGS stream gage for each POI gage	<b>npoigages</b>	string	none	user defined	0	<b>npoigages &gt; 0</b> and <b>csvON_OFF = 1</b>
<b>poi_gage_segment</b>	Segment index for each POI gage	<b>npoigages</b>	integer	none	0 to <b>nsegment</b>	0	<b>npoigages &gt; 0</b> and <b>csvON_OFF = 1</b>
<b>poi_type</b>	Type code for each POI gage	<b>npoigages</b>	integer	none	1	1	<b>optional</b>
Parameters for cascading-flow simulation							
<b>cascade_flg</b>	Flag to indicate cascade type (0=allow many to many; 1=force one to one)	<b>one</b>	integer	none	0 or 1	0	<b>cascade_flg = 1</b> and <b>ncascade &gt; 0</b> and/or <b>cascadegw_flg = 1</b> and <b>ncascdgw &gt; 0</b>
<b>cascade_tol</b>	Cascade area below which a cascade link is ignored	<b>one</b>	real	acres	0.0 to 0.75% of <b>hru_area</b>	5.0	<b>cascade_flg = 1</b> and <b>ncascade &gt; 0</b> and/or <b>cascadegw_flg = 1</b> and <b>ncascdgw &gt; 0</b>
<b>circle_switch</b>	Switch to check for circles (0=no check; 1=check)	<b>one</b>	integer	none	0 or 1	1	<b>cascade_flg = 1</b> and <b>ncascade &gt; 0</b> and/or <b>cascadegw_flg = 1</b> and <b>ncascdgw &gt; 0</b>
<b>gw_down_id<sup>3</sup></b>	Index number of the downslope GWR to which the upslope GWR contributes flow	<b>ncascdgw</b>	integer	none	0 to <b>ngw</b>	0	<b>cascadegw_flg = 1</b> and <b>ncascdgw &gt; 0</b>
<b>gw_pct_up</b>	Fraction of GWR area used to compute flow contributed to a downslope GWR or stream segment for cascade area	<b>ncascdgw</b>	real	decimal fraction	0.0 to 1.0	1.0	<b>cascadegw_flg = 1</b> and <b>ncascdgw &gt; 0</b>
<b>gw_strmseg_down_id</b>	Index number of the stream segment that cascade area contributes flow	<b>ncascdgw</b>	integer	none	0 to <b>nsegment</b>	0	<b>cascadegw_flg = 1</b> and <b>ncascdgw &gt; 0</b>
<b>gw_up_id</b>	Index of GWR containing cascade area	<b>ncascdgw</b>	integer	none	1 to <b>ngw</b>	0	<b>cascadegw_flg = 1</b> and <b>ncascdgw &gt; 0</b>
<b>hru_down_id<sup>4</sup></b>	Index number of the downslope HRU to which the upslope HRU contributes flow	<b>ncascade</b>	integer	none	0 to <b>nhru</b>	0	<b>cascade_flg = 1</b> and <b>ncascade &gt; 0</b>
<b>hru_pct_up</b>	Fraction of HRU area used to compute flow contributed to a downslope HRU or stream segment for cascade area	<b>ncascade</b>	real	decimal fraction	0.0 to 1.0	1.0	<b>cascade_flg = 1</b> and <b>ncascade &gt; 0</b>

Parameter name	Description	Dimension <sup>1</sup>	Type	Units	Range	Default	Required/condition
<b>hru_strmseg_down_id</b>	Index number of the stream segment that cascade area contributes flow	<b>ncascade</b>	integer	none	0 to <b>nsegment</b>	0	<b>cascade_flag = 1</b> and <b>ncascade &gt; 0</b>
<b>hru_up_id</b>	Index of HRU containing cascade area	<b>ncascade</b>	integer	none	0 to <b>nhru</b>	0	<b>cascade_flag = 1</b> and <b>ncascade &gt; 0</b>

<sup>1</sup>Dimensions defined in table 1-1.

<sup>3</sup> If the value of **gw\_strmseg\_down\_id**>0 for cascade link, this value is ignored.

<sup>4</sup>If the value of **hru\_strmseg\_down\_id**>0 for cascade link, this value is ignored.

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

<sup>9</sup>Parameter 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]

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

<sup>1</sup>Dimensions 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; **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**; ~~strikethrough~~ indicates items removed]

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



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

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

	step					
<b>canopy_gain_tot</b>	Transfer gain to the canopy reservoir for each HRU for the simulation	<b>nconsumed</b>	cfs	real	<b>water_use_flag = 1 and nconsumed &gt; 0</b>	
<b>consumed_gain</b>	Transfer gain to each water-use consumption destination for each time step	<b>nconsumed</b>	cfs	real	<b>water_use_flag = 1 and nconsumed &gt; 0</b>	
<b>consumed_gain_tot</b>	Transfer gain to each water-use consumption destination for the simulation	<b>nconsumed</b>	cfs	real	<b>water_use_flag = 1 and nconsumed &gt; 0</b>	
<b>dprst_gain</b>	Transfer gain to surface-depression storage for each HRU for each time step	<b>nhru</b>	cfs	real	<b>dprst_transferON_OFF = 1 and dprst_flag = 1</b>	
<b>dprst_gain_tot</b>	Transfer gain to surface-depression storage for each HRU for the simulation	<b>nhru</b>	cfs	real	<b>dprst_transferON_OFF = 1 and dprst_flag = 1</b>	
<b>dprst_transfer</b>	Transfer flow rate from surface-depression storage for each HRU for each time step	<b>nhru</b>	cfs	real	<b>dprst_transferON_OFF = 1 and dprst_flag = 1</b>	
<b>dprst_transfer_tot</b>	Transfer flow rate from surface-depression storage for each HRU for the simulation	<b>nhru</b>	cfs	real	<b>dprst_transferON_OFF = 1 and dprst_flag = 1</b>	
<b>external_gain</b>	Transfer gain to each external location for each time step	<b>nexternal</b>	cfs	real	<b>external_transferON_OFF = 1 and nexternal &gt; 1</b>	
<b>external_gain_tot</b>	Transfer gain to each external location for the simulation	<b>nexternal</b>	cfs	real	<b>external_transferON_OFF = 1 and nexternal &gt; 1</b>	
<b>external_transfer</b>	Transfer flow rate from each external location for each time step	<b>nexternal</b>	cfs	real	<b>external_transferON_OFF = 1 and nexternal &gt; 1</b>	
<b>external_transfer_tot</b>	Transfer flow rate from each external location for the simulation	<b>nexternal</b>	cfs	real	<b>external_transferON_OFF = 1 and nexternal &gt; 1</b>	
<b>gwr_gain</b>	Transfer gain to the groundwater reservoir of each HRU for each time step	<b>nhru</b>	cfs	real	<b>water_use_flag = 1</b>	
<b>gwr_gain_tot</b>	Transfer gain to the groundwater reservoir of each HRU for the simulation	<b>nhru</b>	cfs	real	<b>water_use_flag = 1</b>	
<b>gwr_transfer</b>	Transfer flow rate from the groundwater reservoir of each HRU for each time step	<b>nhru</b>	cfs	real	<b>gwr_transferON_OFF = 1</b>	
<b>gwr_transfer_tot</b>	Transfer flow rate from the groundwater reservoir of each HRU for the simulation	<b>nhru</b>	cfs	real	<b>gwr_transferON_OFF = 1</b>	
<b>lake_gain</b>	Transfer gain to each lake HRU for each time step	<b>nhru</b>	cfs	real	<b>water_use_flag = 1 and strmflow_module = muskingum_lake</b>	
<b>lake_gain_tot</b>	Transfer gain to each lake HRU for the simulation	<b>nhru</b>	cfs	real	<b>water_use_flag = 1 and strmflow_module = muskingum_lake</b>	
<b>lake_transfer</b>	Transfer flow rate from each lake HRU for each time step	<b>nhru</b>	cfs	real	<b>lake_transferON_OFF = 1 and strmflow_module =</b>	

<b>lake_transfer_tot</b>	Transfer flow rate from each lake HRU for the simulation	<b>nhru</b>	cfs	real	muskingum_lake <b>lake_transferON_OFF</b> = 1 and <b>strmflow_module</b> = muskingum_lake
<b>net_apply</b>	<i>canopy_gain</i> minus interception	<b>nhru</b>	inches	real	<i>water_use_flag</i> = 1
<b>segment_gain</b>	Transfer gain to each stream segment for each time step	<b>nhru</b>	cfs	real	<i>water_use_flag</i> = 1 and <b>strmflow_module</b> = muskingum, strmflow_in_out, or muskingum_lake
<b>segment_gain_tot</b>	Transfer gain to each stream segment for the simulation	<b>nhru</b>	cfs	real	<i>water_use_flag</i> = 1 and <b>strmflow_module</b> = muskingum, strmflow_in_out, or muskingum_lake
<b>segmen_transfer</b>	Transfer flow rate from each stream segment for each time step	<b>nhru</b>	cfs	real	<b>segment_transferON_OFF</b> = 1 and <b>strmflow_module</b> = muskingum, strmflow_in_out, or muskingum_lake
<b>segment_transfer_tot</b>	Transfer flow rate from each stream segment for the simulation	<b>nhru</b>	cfs	real	<b>segment_transferON_OFF</b> = 1 and <b>strmflow_module</b> = muskingum, strmflow_in_out, or muskingum_lake
<b>soilzone_gain</b>	Transfer gain to the capillary reservoir within the soilzone for each HRU for each time step	<b>nhru</b>	cfs	real	<i>water_use_flag</i> = 1
<b>soilzone_gain_tot</b>	Transfer gain to the capillary reservoir within the soilzone for each HRU for the simulation	<b>nhru</b>	cfs	real	<i>water_use_flag</i> = 1
<b>total_canopy_gain</b>	Transfer gains to all canopy reservoirs for each time step	<b>one</b>	cfs	double	<i>water_use_flag</i> = 1
<b>total_consumed_gain</b>	Transfer flow rates to all water-use consumption destinations for each time step	<b>one</b>	cfs	double	<i>water_use_flag</i> = 1
<b>total_dprst_gain</b>	Transfer gains to all surface-depression storage for each time step	<b>one</b>	cfs	double	<i>water_use_flag</i> = 1 and <b>dprst_flag</b> = 1
<b>total_dprst_transfer</b>	Transfer flow rates from all surface-depression storage for each time step	<b>one</b>	cfs	double	<b>dprst_transferON_OFF</b> = 1 and <b>dprst_flag</b> = 1
<b>total_external_gain</b>	Transfer gains to all external locations for each time step	<b>one</b>	cfs	double	<i>water_use_flag</i> = 1
<b>total_external_transfer</b>	Transfer flow rates from all external locations for each time step	<b>one</b>	cfs	double	<b>external_transferON_OFF</b> = 1 and <b>nexternal</b> > 1

<b>total_gwr_gain</b>	Transfer gains to all groundwater reservoir for each time step	<b>one</b>	cfs	double	<i>water_use_flag</i> = 1
<b>total_gwr_transfer</b>	Transfer flow rates from all groundwater reservoirs for each time step	<b>one</b>	cfs	double	<i>water_use_flag</i> = 1 and <b>gwr_transferON_OFF</b> = 1
<b>total_lake_gain</b>	Transfer gains to all lake HRUs for each time step	<b>one</b>	cfs	double	<i>water_use_flag</i> = 1 and <b>strmflow_module</b> = muskingum_lake
<b>total_lake_transfer</b>	Transfer flow rates from all lake HRUs for each time step	<b>one</b>	cfs	double	<b>lake_transferON_OFF</b> = 1 and <b>strmflow_module</b> = muskingum_lake
<b>total_segment_gain</b>	Transfer gains to all stream segments for each time step	<b>one</b>	cfs	double	<i>water_use_flag</i> = 1 and <b>strmflow_module</b> = muskingum, strmflow_in_out, or muskingum_lake
<b>total_segment_transfer</b>	Transfer flow rates from all stream segments for each time step	<b>one</b>	cfs	double	<b>segment_transferON_OFF</b> = 1 and <b>strmflow_module</b> = muskingum, strmflow_in_out, or muskingum_lake
<b>total_soilzone_gain</b>	Transfer gains to all capillary reservoirs for each time step	<b>one</b>	cfs	double	<i>water_use_flag</i> = 1
<b>total_transfers</b>	Transfer of all water-use transfers for each time step	<b>one</b>	cfs	double	<i>water_use_flag</i> = 1
<b>transfesr_rate</b>	Transfer of each water-use transfer for each time step	<b>nwateruse</b>	cfs	double	<i>water_use_flag</i> = 1
Interception					
<b>basin_changeover</b>	Basin area-weighted average water released from a change over of canopy cover type	<b>one</b>	inches	double	always
<b>basin_intcp_stor</b>	Basin area-weighted average interception storage	<b>one</b>	inches	double	always
<b>basin_net_rain</b>	Basin area-weighted average rain throughfall	<b>one</b>	inches	double	always
<b>basin_net_snow</b>	Basin area-weighted average snow throughfall	<b>one</b>	inches	double	always
<b>canopy_covden</b>	Canopy cover density fo each HRU	<b>nhru</b>	decimal fraction	real	always
<b>hru_intcpstor</b>	Interception storage in the canopy for each HRU	<b>nhru</b>	inches	real	always
<b>intcp_changeover</b>	Water released from a change over of canopy cover type for each HRU	<b>nhru</b>	inches	real	always
<b>intcp_form</b>	Form (rain or snow) of interception for each HRU	<b>nhru</b>	none	integer	always
<b>intcp_on</b>	Flag indicating interception storage for each HRU (0=no; 1=yes)	<b>nhru</b>	none	integer	always
<b>intcp_stor</b>	Interception storage in canopy for cover density for each HRU	<b>nhru</b>	inches	real	always
<b>net_ppt</b>	Precipitation (rain and/or snow) that falls through the canopy for each HRU	<b>nhru</b>	inches	real	always
<b>net_rain</b>	Rain that falls through canopy for each HRU	<b>nhru</b>	inches	real	always
<b>net_snow</b>	Snow that falls through canopy for each HRU	<b>nhru</b>	inches	real	always

Snow computations

<i>ai</i>	Maximum snowpack for each HRU	<b>nhru</b>	inches	real	always
<i>albedo</i>	Snow surface albedo or the fraction of radiation reflected from the snowpack surface for each HRU	<b>nhru</b>	decimal fraction	real	always
<i>basin_pk_precip</i>	Basin area-weighted average precipitation added to snowpack	<b>one</b>	inches	double	always
<i>basin_pweqv</i>	Basin area-weighted average snowpack water equivalent	<b>one</b>	inches	double	always
<i>basin_snowcov</i>	Basin area-weighted average snow-covered area	<b>one</b>	decimal fraction	double	always
<i>basin_snowmelt</i>	Basin area-weighted average snowmelt	<b>one</b>	inches	double	always
<i>basin_snowmelt_mo</i>	Monthly basin area-weighted average snowmelt	<b>one</b>	inches	double	always
<i>basin_snowmelt_tot</i>	Total simulation basin area-weighted average snowmelt	<b>one</b>	inches	double	always
<i>basin_snowmelt_yr</i>	Yearly basin area-weighted average snowmelt	<b>one</b>	inches	double	always
<i>basin_tcal</i>	Basin area-weighted average net snowpack energy balance	<b>one</b>	Langleys	double	always
<i>frac_swe</i>	Fraction of maximum snow-water equivalent (snarea_thresh) on each HRU	<b>nhru</b>	decimal fraction	real	always
<i>freeh2o</i>	Storage of free liquid water in the snowpack on each HRU	<b>nhru</b>	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)	<b>nhru</b>	none	integer	always
<i>int_alb</i>	Flag to indicate (1: accumulation season curve; 2: use of the melt season curve)	<b>nhru</b>	none	integer	always
<i>iso</i>	Flag to indicate if time is before (1) or after (2) the day to force melt season ( <b>melt_force</b> )	<b>nhru</b>	none	integer	always
<i>lso</i>	Counter for tracking the number of days the snowpack is at or above 0 degrees Celsius	<b>nhru</b>	number of iterations	integer	always
<i>lst</i>	Flag indicating whether there was new snow that was insufficient to reset the albedo curve (1) ( <b>albset_snm</b> or <b>albset_sna</b> ), otherwise (0)	<b>nhru</b>	none	integer	always
<i>mso</i>	Flag to indicate if time is before (1) or after (2) the first potential day for melt season ( <b>melt_look</b> )	<b>nhru</b>	none	integer	always
<i>pk_def</i>	Heat deficit, amount of heat necessary to make the snowpack isothermal at 0 degrees Celsius	<b>nhru</b>	Langleys	real	always
<i>pk_den</i>	Density of the snowpack on each HRU	<b>nhru</b>	grams/cubic centimeters	real	always
<i>pk_depth</i>	Depth of snowpack on each HRU	<b>nhru</b>	inches	double	always
<i>pk_ice</i>	Storage of frozen water in the snowpack on each HRU	<b>nhru</b>	inches	real	always
<i>pk_precip</i>	Precipitation added to snowpack for each HRU	<b>nhru</b>	inches	real	always
<i>pk_temp</i>	Temperature of the snowpack on each HRU	<b>nhru</b>	<b>temp_units</b>	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	<b>nhru</b>	inches	real	always

	percent on each HRU					
<i>pkwater_ante</i>	Antecedent snowpack water equivalent on each HRU	<b>nhru</b>	inches	double		always
<i>pkwater_equiv</i>	Snowpack water equivalent on each HRU	<b>nhru</b>	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)	<b>nhru</b>	none	integer		always
<i>pss</i>	Previous snowpack water equivalent plus new snow	<b>nhru</b>	inches	real		always
<i>pst</i>	While a snowpack exists, <i>pst</i> tracks the maximum snow water equivalent of that snowpack	<b>nhru</b>	inches	real		always
<i>salb</i>	Days since last new snow to reset albedo for each HRU	<b>nhru</b>	days	real		always
<i>scrsv</i>	Snowpack water equivalent plus a portion of new snow on each HRU	<b>nhru</b>	inches	double		always
<i>slst</i>	Days since last new snow for each HRU	<b>nhru</b>	days	real		always
<i>snow</i>	Snow depth at each measurement station	<b>nsnow</b>	inches	real		<b>nsnow</b> > 0
<i>snow_free</i>	Fraction of snow-free surface for each HRU	<b>nhru</b>	decimal fraction	real		always
<i>snowcov_area</i>	Snow-covered area on each HRU prior to melt and sublimation unless snowpack depleted	<b>nhru</b>	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	<b>nhru</b>	decimal fraction	real		always
<i>snowmelt</i>	Snowmelt from snowpack on each HRU	<b>nhru</b>	inches	real		always
<i>snsy</i>	Tracks the cumulative amount of new snow until there is enough to reset the albedo curve ( <b>albset_snm</b> or <b>albset_sna</b> )	<b>nhru</b>	inches	real		always
<i>subinc_pkweqv</i>	Area-weighted average snowpack water equivalent from associated HRUs of each subbasin	<b>nsb</b>	inches	double		<b>subbasin_flag</b> = 1
<i>subinc_snowcov</i>	Area-weighted average snow-covered area from associated HRUs to each subbasin	<b>nsb</b>	decimal fraction	double		<b>subbasin_flag</b> = 1
<i>subinc_snowmelt</i>	Area-weighted average snowmelt from associated HRUs of each subbasin	<b>nsb</b>	inches	double		<b>subbasin_flag</b> = 1
<i>tcal</i>	Net snowpack energy balance on each HRU	<b>nhru</b>	Langleys	real		always
Evapotranspiration						
<i>basin_actet</i>	Basin area-weighted average actual ET	<b>one</b>	inches	double		always
<i>basin_actet_mo</i>	Monthly basin area-weighted average actual ET	<b>one</b>	inches	double		always
<i>basin_actet_tot</i>	Total simulation basin area-weighted average actual ET	<b>one</b>	inches	double		always
<i>basin_actet_yr</i>	Yearly basin area-weighted average actual ET	<b>one</b>	inches	double		always
<i>basin_dprst_evap</i>	Basin area-weighted average evaporation from surface depression storage	<b>one</b>	inches	double		<b>dprst_flag</b> = 1
<i>basin_fall_frost</i>	Basin area-weighted average fall frost	<b>one</b>	<b>solar date</b>	real		<b>model_mode</b> = FROST
<i>basin_humidity</i>	Basin area-weighted average average humidity	<b>one</b>	percentage	double		<b>et_module</b> = potet_pm, potet_pm_sta, or

<i>basin_imperv_evap</i>	Basin area-weighted average evaporation from impervious area	<b>one</b>	inches	double	<b>potet_pt</b> always
<i>basin_lakeevap</i>	Basin area-weighted average lake evaporation	<b>one</b>	inches	double	<b>nlake &gt; 0</b>
<i>basin_intcp_evap</i>	Basin area-weighted evaporation from the canopy	<b>one</b>	inches	double	always
<i>basin_intcp_evap_mo</i>	Monthly basin basin area-weighted average interception evaporation	<b>one</b>	inches	double	always
<i>basin_intcp_evap_tot</i>	Total simulation basin basin area-weighted average interception evaporation	<b>one</b>	inches	double	always
<i>basin_intcp_evap_yr</i>	Yearly basin basin area-weighted average interception evaporation	<b>one</b>	inches	double	always
<i>basin_perv_et</i>	Basin area-weighted average ET from capillary reservoirs	<b>one</b>	inches	double	always
<i>basin_potet</i>	Basin area-weighted average potential ET	<b>one</b>	inches	double	always
<i>basin_potet_mo</i>	Monthly area-weighted average potential ET	<b>one</b>	inches	double	always
<i>basin_potet_tot</i>	Total simulation area-weighted average potential ET	<b>one</b>	inches	double	always
<i>basin_potet_yr</i>	Yearly area-weighted average potential ET	<b>one</b>	inches	double	always
<i>basin_snowevap</i>	Basin area-weighted average evaporation and sublimation from snowpack	<b>one</b>	inches	double	always
<i>basin_spring_frost</i>	Basin area-weighted average spring frost	<b>one</b>	<b>solar date</b>	real	<b>model_mode = FROST</b>
<i>basin_swale_et</i>	Basin area-weighted average ET from swale HRUs	<b>one</b>	inches	double	always
<i>basin_transp_on</i>	Flag indicating whether transpiration is occurring anywhere in the basin (0=no; 1=yes)	<b>one</b>	none	integer	always
<i>basin_windspeed</i>	Basin area-weighted average average wind speed	<b>one</b>	decimal fraction	double	<b>et_module = potet_pm or potet_pm_sta</b>
<i>dprst_evap_hru</i>	Evaporation from surface-depression storage for each HRU	<b>nhru</b>	inches	real	<b>dprst_flag = 1</b>
<i>fall_frost</i>	The solar date (number of days after winter solstice) of the first killing frost of the fall	<b>nhru</b>	<b>solar date</b>	real	<b>model_mode = FROST</b>
<i>hru_actet</i>	Actual ET for each HRU	<b>nhru</b>	inches	real	always
<i>hru_et_yr</i>	Yearly area-weighted average actual ET for each HRU	<b>nhru</b>	inches	double	<b>print_freq = 2</b>
<i>hru_intcpevap</i>	Evaporation from the canopy for each HRU	<b>nhru</b>	inches	real	always
<i>imperv_evap</i>	Evaporation from impervious area for each HRU	<b>nhru</b>	inches	real	always
<i>intcp_evap</i>	Evaporation from the canopy for each HRU	<b>nhru</b>	inches	real	always
<i>lake_evap</i>	Total evaporation from each lake HRU	<b>nlake</b>	cfs	double	<b>nlake &gt; 0</b>
<i>pan_evap</i>	Pan evaporation at each measurement station	<b>nevap</b>	inches	real	<b>nevap &gt; 0</b>
<i>perv_actet</i>	Actual ET from the capillary reservoir of each HRU	<b>nhru</b>	inches	real	always
<i>potet</i>	Potential ET for each HRU	<b>nhru</b>	inches	real	always
<i>potet_lower</i>	Potential ET in the lower zone of the capillary reservoir for each HRU	<b>nhru</b>	inches	real	always
<i>potet_rechr</i>	Potential ET in the recharge zone of the capillary reservoir for each HRU	<b>nhru</b>	inches	real	always



<i>perv_avail_et</i>	Unsatisfied ET available to the capillary reservoir of each HRU	<b>nhru</b>	inches	real	always
<i>seginc_potet</i>	Area-weighted average potential ET for each segment from HRUs contributing flow to the segment	<b>nsegment</b>	inches	double	<b>strmflow_module</b> = muskingum, strmflow in_out, or muskingum_lake
<i>snow_evap</i>	Evaporation and sublimation from snowpack on each HRU	<b>nhru</b>	inches	real	always
<i>spring_frost</i>	The solar date (number of days after winter solstice) of the last killing frost of the spring	<b>nhru</b>	<b>solar date</b>	real	<b>model_mode</b> = FROST
<i>subinc_actet</i>	Area-weighted average actual ET from associated HRUs to each subbasin	<b>nsub</b>	inches	double	<b>subbasin_flag</b> = 1
<i>subinc_potet</i>	Area-weighted average potential ET from associated HRUs to each subbasin	<b>nsub</b>	inches	double	<b>subbasin_flag</b> = 1
<i>swale_actet</i>	Evaporation from the gravity and preferential-flow reservoirs that exceeds <b>sat_threshold</b>	<b>nhru</b>	inches	real	always
<i>tempc_dewpt</i>	air temperature at dew point for each HRU	<b>nhru</b>	degrees Celsius	real	<b>et_module</b> = potet_pm, potet_pm_sta, or potet_pt
<i>transp_on</i>	Flag indicating whether transpiration is occurring (0=no; 1=yes)	<b>nhru</b>	none	integer	always
<i>unused_potet</i>	Unsatisfied potential evapotranspiration	<b>nhru</b>	inches	real	always
<i>vp_actual</i>	Actual vapor pressure for each HRU	<b>nhru</b>	kilopascals	real	<b>et_module</b> = potet_pm, potet_pm_sta, or potet_pt
<i>vp_sat</i>	Saturation vapor pressure for each HRU	<b>nhru</b>	kilopascals	real	<b>et_module</b> = potet_pm, potet_pm_sta, or potet_pt
<i>vp_slope</i>	Slope of saturation vapor pressure versus air temperature curve for each HRU	<b>nhru</b>	kilopascals/degrees Celsius	real	<b>et_module</b> = 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	<b>one</b>	inches	double	always
<i>cap_upflow_max</i>	Maximum infiltration and any cascading interflow and Dunnian surface runoff that can be added to capillary reservoir storage for each HRU	<b>nhru</b>	inches	real	always
<i>cap_waterin</i>	Infiltration and any cascading interflow and Dunnian surface runoff added to capillary reservoir storage for each HRU	<b>nhru</b>	inches	real	always
<i>cascade_dunnianflow</i>	Cascading Dunnian flow for each HRU	<b>nhru</b>	inches	real	<b>cascade_flag</b> = 1 and <b>ncascade</b> > 0
<i>cascade_interflow</i>	Cascading interflow for each HRU	<b>nhru</b>	inches	real	<b>cascade_flag</b> = 1 and <b>ncascade</b> > 0
<i>basin_contrib_fraction</i>	Basin area-weighted average contributing area of the pervious area of each HRU	<b>one</b>	decimal fraction	double	always
<i>basin_hortonian</i>	Basin area-weighted average Hortonian runoff	<b>one</b>	inches	double	always

<i>basin_hortonian_lakes</i>	Basin area-weighted average Hortonian surface runoff to lakes	<b>one</b>	inches	double	<b>cascade_flag = 1 and ncascade &gt; 0</b>
<i>basin_imperv_stor</i>	Basin area-weighted average storage on impervious area	<b>one</b>	inches	double	always
<i>basin_infil</i>	Basin area-weighted average infiltration to the capillary reservoirs	<b>one</b>	inches	double	always
<i>basin_sroff</i>	Basin area-weighted average surface runoff to the stream network	<b>one</b>	inches	double	always
<i>basin_sroff_cfs</i>	Basin area-weighted average surface runoff to the stream network	<b>one</b>	cfs	double	always
<i>basin_sroff_down</i>	Basin area-weighted average cascading surface runoff	<b>one</b>	inches	double	<b>cascade_flag = 1 and ncascade &gt; 0</b>
<i>basin_sroff_mo</i>	Monthly basin area-weighted average surface runoff	<b>one</b>	inches	double	always
<i>basin_sroff_tot</i>	Total simulation basin area-weighted average surface runoff	<b>one</b>	inches	double	always
<i>basin_sroff_upslope</i>	Basin area-weighted average cascading surface runoff received from upslope HRUs	<b>one</b>	inches	double	<b>cascade_flag = 1 and ncascade &gt; 0</b>
<i>basin_sroff_yr</i>	Yearly basin area-weighted average surface runoff	<b>one</b>	inches	double	always
<i>basin_sroffi</i>	Basin area-weighted average surface runoff from impervious areas	<b>one</b>	inches	double	always
<i>basin_sroffp</i>	Basin area-weighted average surface runoff from pervious areas	<b>one</b>	inches	double	always
<i>contrib_fraction</i>	Contributing area of each HRU pervious area	<b>nhru</b>	decimal fraction	real	always
<i>hortonian_flow</i>	Hortonian surface runoff reaching stream network for each HRU	<b>nhru</b>	inches	real	always
<i>hortonian_lakes</i>	Surface runoff to lakes for each HRU	<b>nhru</b>	inches	double	<b>cascade_flag = 1, ncascade &gt; 0, and nlake &gt; 0</b>
<i>hru_frac_perv</i>	Fraction of HRU that is pervious	<b>nhru</b>	decimal fraction	real	always
<i>hru_hortn_cascflow</i>	Cascading Hortonian surface runoff leaving each HRU	<b>nhru</b>	inches	double	<b>cascade_flag = 1 and ncascade &gt; 0</b>
<i>hru_imperv</i>	Area of HRU that is impervious	<b>nhru</b>	acres	real	always
<i>hru_impervstor</i>	Storage on impervious area for each HRU	<b>nhru</b>	inches	real	always
<i>hru_perv</i>	Area of HRU that is pervious	<b>nhru</b>	acres	real	always
<i>hru_sroffi</i>	Surface runoff from impervious areas for each HRU	<b>nhru</b>	inches	real	always
<i>hru_sroffp</i>	Surface runoff from pervious areas for each HRU	<b>nhru</b>	inches	real	always
<i>imperv_stor</i>	Storage on impervious area for each HRU	<b>nhru</b>	inches	real	always
<i>infil</i>	Infiltration to the capillary reservoir for each HRU	<b>nhru</b>	inches	real	always
<i>seginc_sroff</i>	Area-weighted average surface runoff for each segment from HRUs contributing flow to the segment	<b>nsegment</b>	cfs	double	<b>nsegment &gt; 0</b>
<i>sroff<sup>3</sup></i>	Surface runoff to the stream network for each HRU	<b>nhru</b>	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	<b>nsub</b>	cfs	double	<b>subbasin_flag = 1</b>
<i>subinc_sroff</i>	Area-weighted average Hortonian plus Dunnian surface runoff from associated HRUs to each subbasin	<b>nsub</b>	cfs	double	<b>subbasin_flag = 1</b>

<i>upslope_hortonian</i>	Hortonian surface runoff received from upslope HRUs	<b>nhru</b>	inches	double	<b>cascade_flag = 1</b> and <b>ncascade</b> > 0
Surface depression storage					
<i>basin_dprst_seep</i>	Basin area-weighted average seepage surface-depression storage	<b>one</b>	inches	double	<b>dprst_flag = 1</b>
<i>basin_dprst_sroff</i>	Basin area-weighted average surface runoff from open surface-depression storage	<b>one</b>	inches	double	<b>dprst_flag = 1</b>
<i>basin_dprst_volcl</i>	Basin area-weighted average storage volume in closed surface depressions	<b>one</b>	inches	double	<b>dprst_flag = 1</b>
<i>basin_dprst_volop</i>	Basin area-weighted average storage volume in open surface depressions	<b>one</b>	inches	double	<b>dprst_flag = 1</b>
<i>dprst_area_clos</i>	Surface area of closed surface depressions based on volume for each HRU	<b>nhru</b>	acres	real	<b>dprst_flag = 1</b>
<i>dprst_area_clos_max</i>	Aggregate sum of closed surface-depression storage areas of each HRU	<b>nhru</b>	acres	real	<b>dprst_flag = 1</b>
<i>dprst_area_max</i>	Aggregate sum of surface-depression storage areas of each HRU	<b>nhru</b>	acres	real	<b>dprst_flag = 1</b>
<i>dprst_area_open</i>	Surface area of open surface depressions based on volume for each HRU	<b>nhru</b>	acres	real	<b>dprst_flag = 1</b>
<i>dprst_area_open_max</i>	Aggregate sum of open surface-depression storage areas of each HRU	<b>nhru</b>	acres	real	<b>dprst_flag = 1</b>
<i>dprst_insroff_hru</i>	Surface runoff from pervious and impervious portions into surface depression storage for each HRU	<b>nhru</b>	inches	real	<b>dprst_flag = 1</b>
<i>dprst_seep_hru</i>	Seepage from surface-depression storage to associated GWR for each HRU	<b>nhru</b>	inches	double	<b>dprst_flag = 1</b>
<i>dprst_sroff_hru</i>	Surface runoff from open surface-depression storage for each HRU	<b>nhru</b>	inches	double	<b>dprst_flag = 1</b>
<i>dprst_stor</i>	Surface-depression storage for each HRU	<b>nhru</b>	inches	double	<b>dprst_flag = 1</b>
<i>dprst_vol_clos</i>	Storage volume in closed surface depressions for each HRU	<b>nhru</b>	acre-inches	double	<b>dprst_flag = 1</b>
<i>dprst_vol_clos_frac</i>	Fraction of closed surface-depression storage of the maximum storage for each HRU	<b>nhru</b>	decimal fraction	double	<b>dprst_flag = 1</b>
<i>dprst_vol_frac</i>	Fraction of surface-depression storage of the maximum storage for each HRU	<b>nhru</b>	decimal fraction	double	<b>dprst_flag = 1</b>
<i>dprst_vol_open</i>	Storage volume in open surface depressions for each HRU	<b>nhru</b>	acre-inches	double	<b>dprst_flag = 1</b>
<i>dprst_vol_open_frac</i>	Fraction of open surface-depression storage of the maximum storage for each HRU	<b>nhru</b>	decimal fraction	double	<b>dprst_flag = 1</b>
<i>hru_frac_perv</i>	Fraction of HRU that has surface-depression storage	<b>nhru</b>	decimal fraction	real	<b>dprst_flag = 1</b>
Soil zone storage, interflow, gravity drainage, 50unnian surface runoff					
<i>basin_cap_infil_tot</i>	Basin area-weighted average infiltration with cascading flow into capillary reservoirs	<b>one</b>	inches	double	always
<i>basin_cap_up_max</i>	Basin area-weighted average maximum cascade flow that flows	<b>one</b>	inches	double	<b>cascade_flag = 1</b> and <b>ncascade</b>

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

<i>basin_sm2gvr</i>	Basin area-weighted average excess flow from capillary reservoirs to gravity reservoir storage	<b>one</b>	inches	double	always
<i>basin_sm2gvr_maxin</i>	Basin area-weighted average maximum excess flow from capillary reservoirs that flows to gravity reservoirs	<b>one</b>	inches	double	always
<i>basin_soil_lower_stor_frac</i>	Basin area-weighted average fraction of soil lower zone storage of the maximum storage	<b>one</b>	decimal fraction	double	always
<i>basin_soil_moist</i>	Basin area-weighted average capillary reservoir storage	<b>one</b>	inches	double	always
<i>basin_soil_moist_tot</i>	Basin area-weighted average total soil-zone water storage	<b>one</b>	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	<b>one</b>	inches	double	always
<i>basin_soil_rechr_stor_frac</i>	Basin area-weighted average fraction of soil recharge zone storage of the maximum storage	<b>one</b>	decimal fraction	double	always
<i>basin_soil_to_gw</i>	Basin area-weighted average excess flow to capillary reservoirs that drains to GWRs	<b>one</b>	inches	double	always
<i>basin_ssflow</i>	Basin area-weighted average interflow from gravity and preferential-flow reservoirs to the stream network	<b>one</b>	inches	double	always
<i>basin_ssflow_cfs</i>	Basin area-weighted average interflow from gravity and preferential-flow reservoirs to the stream network	<b>one</b>	cfs	double	always
<i>basin_ssflow_mo</i>	Monthly basin area-weighted average interflow	<b>one</b>	inches	double	always
<i>basin_ssflow_tot</i>	Simulation total basin area-weighted average interflow	<b>one</b>	inches	double	always
<i>basin_ssflow_yr</i>	Yearly basin area-weighted average interflow	<b>one</b>	inches	double	always
<i>basin_ssin</i>	Basin area-weighted average inflow to gravity and preferential-flow reservoir storage	<b>one</b>	inches	double	always
<i>basin_ssstor</i>	Basin area-weighted average gravity and preferential-flow reservoir storage	<b>one</b>	inches	double	always
<i>basin_sz2gw</i>	Basin area-weighted average drainage from gravity reservoirs to GWRs	<b>one</b>	inches	double	always
<i>basin_sz_stor_frac</i>	Basin area-weighted average fraction of soil zone storage of the maximum storage	<b>one</b>	decimal fraction	double	always
<i>cap_infil_tot</i>	Infiltration and cascading interflow and Dunnian flow added to capillary reservoir storage for each HRU	<b>nhru</b>	inches	real	always
<i>cap_waterin</i>	Infiltration and any cascading interflow and Dunnian surface runoff added to capillary reservoir storage for each HRU	<b>nhru</b>	inches	real	always
<i>epr_stor_frae</i>	Fraction of capillary reservoir storage of the maximum storage for each HRU	<b>nhru</b>	decimal fraction	real	always
<i>dunnian_flow</i>	Dunnian surface runoff that flows to the stream network for each HRU	<b>nhru</b>	inches	real	always
<i>gvr_stor_frae</i>	Fraction of gravity reservoir storage of the maximum storage for each HRU	<b>nhru</b>	decimal fraction	real	always

<i>hru_sz_cascadeflow</i>	Cascading interflow and Dunnian surface runoff from each HRU	<b>nhru</b>	inches	real	<b>cascade_flag = 1 and ncascade &gt; 0</b>
<b>interflow_max</b>	Maximum interflow for each HRU	<b>nhru</b>	inches	real	always
<i>pfr_stor_frae</i>	<del>Fraction of preferential flow reservoir storage of the maximum storage for each HRU</del>	<del><b>nhru</b></del>	<del>decimal fraction</del>	<del>real</del>	<del>always</del>
<i>pref_flow</i>	Interflow from the preferential-flow reservoir that flows to the stream network for each HRU	<b>nhru</b>	inches	real	always
<i>pref_flow_in</i>	Infiltration and flow from gravity reservoir storage to the preferential-flow reservoir	<b>nhru</b>	inches	real	always
<i>pref_flow_infil</i>	Infiltration to the preferential-flow reservoir storage for each HRU	<b>nhru</b>	inches	real	always
<i>pref_flow_max</i>	Maximum storage of the preferential-flow reservoir for each HRU	<b>nhru</b>	inches	real	always
<i>pref_flow_stor</i>	Storage in preferential-flow reservoir for each HRU	<b>nhru</b>	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	<b>nhru</b>	inches	real	always
<i>recharge</i>	Recharge to the associated GWR as sum of <i>soil_to_gw</i> and' <i>ssr_to_gw</i> for each HRU	<b>nhru</b>	inches	real	always
<i>seginc_ssflow</i>	Area-weighted average interflow for each segment from HRUs contributing flow to the segment	<b>nsegment</b>	cfs	double	<b>nsegment &gt; 0</b>
<i>slow_flow</i>	Interflow from gravity reservoir that flows to the stream network for each HRU	<b>nhru</b>	inches	real	always
<i>slow_stor</i>	Storage of gravity reservoir for each HRU	<b>nhru</b>	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	<b>nhru</b>	inches	real	always
<i>soil_lower_ratio</i>	Water content ration in the lower zone of the capillary reservoir for each HRU	<b>nhru</b>	decimal fraction	real	always
<i>soil_moist</i>	Storage of capillary reservoir for each HRU	<b>nhru</b>	inches	real	always
<del><i>soil_moist_frae</i></del>	<del>Fraction soil zone storage of the maximum storage for each HRU</del>	<del><b>nhru</b></del>	<del>decimal fraction</del>	<del>real</del>	<del>always</del>
<i>soil_moist_tot</i>	Total soil-zone storage ( <i>soil_moist</i> + <i>ssres_stor</i> ) for each HRU	<b>nhru</b>	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	<b>nhru</b>	inches	real	always
<del><i>soil_rechr_ratio</i></del>	<del>Water content ration in the recharge zone of the capillary reservoir for each HRU</del>	<del><b>nhru</b></del>	<del>decimal fraction</del>	<del>real</del>	<del>always</del>
<i>soil_to_gw</i>	Portion of excess flow to the capillary reservoir that drains to the associated GWR for each HRU	<b>nhru</b>	inches	real	always
<i>soil_to_ssr</i>	Portion of excess flow to the capillary reservoir that flows to the gravity reservoir for each HRU	<b>nhru</b>	inches	real	always
<del><i>soil_zone_max</i></del>	<del>Maximum storage of all soil zone reservoirs</del>	<del><b>nhru</b></del>	<del>inches</del>	<del>real</del>	<del>always</del>
<i>ssr_to_gw</i>	Drainage from the gravity-reservoir to the associated GWR for	<b>nssr</b>	inches	real	always

<i>ssres_flow</i>	each HRU Interflow from gravity and preferential-flow reservoirs to the stream network for each HRU	<b>nssr</b>	inches	real	always
<i>ssres_in</i>	Inflow to the gravity and preferential-flow reservoirs for each HRU	<b>nssr</b>	inches	real	always
<i>ssres_stor</i>	Storage in the gravity and preferential-flow reservoirs for each HRU	<b>nssr</b>	inches	real	always
<i>sub_interflow</i>	Area-weighted average interflow from associated HRUs to each subbasin and from upstream subbasins	<b>nsub</b>	cfs	double	<b>subbasin_flag = 1</b>
<i>subinc_capstor_frac</i>	Area-weighted average fraction of capillary reservoir water content storage for associated HRUs of each subbasin	<b>nsub</b>	decimal fraction	double	<b>subbasin_flag = 1</b>
<i>subinc_interflow</i>	Area-weighted average interflow from associated HRUs to each subbasin	<b>nsub</b>	cfs	double	<b>subbasin_flag = 1</b>
<i>subinc_recharge</i>	Area-weighted average recharge from associated HRUs to each subbasin	<b>nsub</b>	inches	double	<b>subbasin_flag = 1</b>
<i>subinc_szstor_frac</i>	Area-weighted average fraction of soil-zone water content storage for associated HRUs of each subbasin	<b>nsub</b>	decimal fraction	double	<b>subbasin_flag = 1</b>
<i>upslope_dunnianflow</i>	Cascading Dunnian surface runoff that flows to the capillary reservoir of each downslope HRU for each upslope HRU	<b>nhru</b>	inches	double	<b>cascade_flag = 1 and ncascade &gt; 0</b>
<i>upslope_interflow</i>	Cascading interflow runoff that flows to the capillary reservoir of each downslope HRU for each upslope HRU	<b>nhru</b>	inches	double	<b>cascade_flag = 1 and ncascade &gt; 0</b>
Groundwater flow					
<i>basin_gwflow</i>	Basin area-weighted average groundwater flow to the stream network	<b>one</b>	inches	double	always
<i>basin_gwflow_cfs</i>	Basin area-weighted average groundwater flow to the stream network	<b>one</b>	cfs	double	always
<i>basin_gwflow_mo</i>	Monthly basin area-weighted average groundwater discharge	<b>one</b>	inches	double	always
<i>basin_gwflow_tot</i>	Total simulation basin area-weighted average groundwater discharge	<b>one</b>	inches	double	always
<i>basin_gwflow_yr</i>	Yearly basin area-weighted average groundwater discharge	<b>one</b>	inches	double	always
<i>basin_gwin</i>	Basin area-weighted average inflow to GWRs	<b>one</b>	inches	double	always
<i>basin_gwsink</i>	Basin area-weighted average GWR outflow to the groundwater sink	<b>one</b>	inches	double	always
<i>basin_gwstor</i>	Basin area-weighted average storage in GWRs	<b>one</b>	inches	double	always
<i>basin_gwstor_minarea_wb</i>	Basin area-weighted average storage added to each GWR when storage is less than <b>gwstor_min</b>	<b>one</b>	inches	double	always
<i>gw_upslope</i>	Groundwater flow received from upslope GWRs for each GWR	<b>ngw</b>	acre-inches	double	<b>cascadegw_flag = 1 and ncascdgw &gt; 0</b>
<i>gwres_flow</i>	Groundwater discharge from each GWR to the stream network	<b>ngw</b>	inches	real	always

<i>gwres_in</i>	Total inflow to each GWR from associated capillary and gravity reservoirs	<b>ngw</b>	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	<b>ngw</b>	inches	real	always
<i>gwres_stor</i>	Storage in each GWR	<b>ngw</b>	inches	double	always
<i>gwstor_minarea_wb</i>	Storage added to each GWR when storage is less than <b>gwstor_min</b>	<b>ngw</b>	inches	double	always
<i>hru_gw_cascadeflow</i>	Cascading groundwater flow from each GWR	<b>ngw</b>	inches	double	<b>cascadegw_flag</b> = 1 and <b>ncascdgw</b> > 0
<i>seginc_gwflow</i>	Area-weighted average groundwater discharge for each segment from HRUs contributing flow to the segment	<b>nsegment</b>	cfs	double	<b>nsegment</b> > 0
<i>sub_gwflow</i>	Area-weighted average groundwater discharge from associated GWRs to each subbasin and from upstream subbasins	<b>nsub</b>	cfs	double	<b>subbasin_flag</b> = 1
<i>subinc_gwflow</i>	Area-weighted average groundwater discharge from associated GWRs to each subbasin	<b>nsub</b>	cfs	double	<b>subbasin_flag</b> = 1
Streamflow					
<i>basin_cfs</i>	Streamflow leaving the basin through the stream network	<b>one</b>	cfs	double	always
<i>basin_cfs_mo</i>	Monthly total streamflow to stream network	<b>one</b>	cfs	double	<b>print_debug</b> > -2
<i>basin_cfs_tot</i>	Total simulation basin area-weighted average streamflow	<b>one</b>	cfs	double	<b>print_debug</b> > -2
<i>basin_cfs_yr</i>	Yearly total streamflow to stream network	<b>one</b>	cfs	double	<b>print_debug</b> > -2
<i>basin_cms</i>	Streamflow leaving the basin through the stream network	<b>one</b>	cms	double	always
<i>basin_runoff_ratio</i>	Basin area-weighted average discharge/precipitation	<b>one</b>	decimal fraction	double	<b>print_debug</b> > -2
<i>basin_runoff_ratio_mo</i>	Monthly area-weighted average discharge/precipitation	<b>one</b>	decimal fraction	double	<b>print_debug</b> > -2
<i>basin_segment_storage</i>	Basin area-weighted average storage in the stream network	<b>one</b>	inches	double	<b>strmflow_module</b> = muskingum, or muskingum_lake
<i>basin_stflow_in</i>	Basin area-weighted average lateral flow entering the stream network	<b>one</b>	inches	double	always
<i>basin_stflow_mo</i>	Monthly basin area-weighted average simulated streamflow	<b>one</b>	inches	double	<b>print_debug</b> > -2
<i>basin_stflow_out</i>	Basin area-weighted average streamflow leaving through the stream network	<b>one</b>	inches	double	<b>print_debug</b> > -2
<i>basin_stflow_tot</i>	Total simulation basin area-weighted average simulated streamflow	<b>one</b>	inches	double	<b>print_debug</b> > -2
<i>basin_stflow_yr</i>	Yearly basin area-weighted average simulated streamflow	<b>one</b>	inches	double	<b>print_debug</b> > -2
<b>flow_headwater</b>	Total flow out of headwater segments ( <b>segment_type</b> =1)	<b>one</b>	cfs	double	<b>strmflow_module</b> = muskingum, or muskingum_lake, or strmflow_in_out



<b>flow_in_great_lakes</b>	Total flow out into model domain from Great Lakes (segment_type=10)	<b>one</b>	cfs	double	<b>strmflow_module</b> = muskingum, or muskingum_lake, or strmflow_in_out
<b>flow_in_nation</b>	Total flow into model domain from Mexico or Canada (segment_type=4)	<b>one</b>	cfs	double	<b>strmflow_module</b> = muskingum, or muskingum_lake, or strmflow_in_out
<b>flow_in_region</b>	Total flow into region (segment_type=6)	<b>one</b>	cfs	double	<b>strmflow_module</b> = muskingum, or muskingum_lake, or strmflow_in_out
<i>flow_out</i>	Total flow out of model domain	<b>one</b>	cfs	double	<b>strmflow_module</b> = muskingum, or <b>muskingum_lake</b> , or strmflow_in_out
<b>flow_out_NHM</b>	Total flow out of model domain to Mexico or Canada (segment_type=5)	<b>one</b>	cfs	double	<b>strmflow_module</b> = muskingum, or muskingum_lake, or strmflow_in_out
<b>flow_out_region</b>	Total flow out of region (segment_type=7)	<b>one</b>	cfs	double	<b>strmflow_module</b> = muskingum, or muskingum_lake, or strmflow_in_out
<b>flow_replacement</b>	Total flow out from replacement flow (segment_type=3)	<b>one</b>	cfs	double	<b>strmflow_module</b> = muskingum, or muskingum_lake, or strmflow_in_out
<b>flow_terminus</b>	Total flow to terminus segments (segment_type=9)	<b>one</b>	cfs	double	<b>strmflow_module</b> = muskingum, or muskingum_lake, or strmflow_in_out
<b>flow_to_great_lakes</b>	Total flow to Great Lakes (segment_type=11)	<b>one</b>	cfs	double	<b>strmflow_module</b> = muskingum, or muskingum_lake, or strmflow_in_out
<b>flow_to_lakes</b>	Total flow to lakes (segment_type=2)	<b>one</b>	cfs	double	<b>strmflow_module</b> = muskingum, or muskingum_lake, or strmflow_in_out

<b>flow_to_ocean</b>	Total flow to oceans ( <b>segment_type=8</b> )	<b>one</b>	cfs	double	<b>strmflow_module</b> = muskingum, or muskingum_lake, or strmflow_in_out
<i>hru_outflow</i>	Total flow leaving each HRU	<b>nhru</b>	cfs	double	always
<i>hru_streamflow_out</i>	Total flow to stream network from each HRU	<b>nhru</b>	cfs	double	always
<i>obs_runoff_mo</i>	Monthly measured streamflow at basin outlet	<b>one</b>	cfs	double	<b>print_debug &gt; -2</b>
<i>obs_runoff_tot</i>	Total simulation measured streamflow at basin outlet	<b>one</b>	cfs	double	<b>print_debug &gt; -2</b>
<i>obs_runoff_yr</i>	Yearly measured streamflow at basin outlet	<b>one</b>	cfs	double	<b>print_debug &gt; -2</b>
<i>obsq_inches</i>	Measured streamflow at specified outlet station	<b>one</b>	inches	double	<b>print_debug &gt; -2</b>
<i>obsq_inches_mo</i>	Monthly measured streamflow at specified outlet station	<b>one</b>	inches	double	<b>print_debug &gt; -2</b>
<i>obsq_inches_tot</i>	Total simulation basin area-weighted average measured streamflow at specified outlet station	<b>one</b>	inches	double	<b>print_debug &gt; -2</b>
<i>obsq_inches_yr</i>	Yearly measured streamflow at specified outlet station	<b>one</b>	inches	double	<b>print_debug &gt; -2</b>
<i>runoff</i>	Streamflow at each measurement station	<b>nobs</b>	<b>runoff_units</b>	real	<b>nobs &gt; 0</b>
<i>seg_gwflow</i>	Area-weighted average groundwater discharge for each segment from HRUs contributing flow to the segment and upstream HRUs	<b>nsegment</b>	inches	double	<b>strmflow_module</b> = muskingum, or muskingum_lake, or strmflow_in_out
<i>seg_inflow</i>	Total flow entering a segment	<b>nsegment</b>	cfs	double	<b>strmflow_module</b> = muskingum, or muskingum_lake, or strmflow_in_out
<i>seg_lateral_inflow</i>	Lateral inflow entering a segment	<b>nsegment</b>	cfs	double	<b>strmflow_module</b> = muskingum, or muskingum_lake, or strmflow_in_out
<i>seg_outflow</i>	Streamflow leaving a segment	<b>nsegment</b>	cfs	double	<b>strmflow_module</b> = muskingum, or muskingum_lake, or strmflow_in_out
<i>seg_sroff</i>	Area-weighted average surface runoff for each segment from HRUs contributing flow to the segment and upstream HRUs	<b>nsegment</b>	inches	double	<b>strmflow_module</b> = muskingum, or muskingum_lake, or strmflow_in_out
<i>seg_ssflow</i>	Area-weighted average interflow for each segment from HRUs contributing flow to the segment and upstream HRUs	<b>nsegment</b>	inches	double	<b>strmflow_module</b> = muskingum, or muskingum_lake, or strmflow_in_out

<i>seg_upstream_inflow</i>	Sum of inflow from upstream segments	<b>nsegment</b>	cfs	double	<b>strmflow_module</b> = muskingum, or muskingum_lake, or strmflow_in_out
<i>segment_delta_flow</i>	Cummulative flow minus flow out for each stream segment	<b>nsegment</b>	cfs	double	<b>strmflow_module</b> = muskingum or muskingum_lake
<i>streamflow_cfs</i>	Streamflow at each measurement station	<b>nobs</b>	cfs	double	<b>nobs</b> > 0
<i>streamflow_cms</i>	Streamflow at each measurement station	<b>nobs</b>	cms	double	<b>nobs</b> > 0
<i>strm_seg_in<sup>3</sup></i>	Flow in stream segments as a result of cascading flow in each stream segment	<b>nsegment</b>	cfs	double	<b>cascade_flag</b> = 1 and <b>ncascade</b> > 0
<i>sub_cfs</i>	Total streamflow leaving each subbasin	<b>nsub</b>	cfs	double	<b>subbasin_flag</b> = 1
<i>sub_cms</i>	Total streamflow from each subbasin	<b>nsub</b>	cms	double	<b>subbasin_flag</b> = 1
<i>sub_inq</i>	Sum of streamflow from upstream subbasins to each subbasin	<b>nsub</b>	cfs	double	<b>subbasin_flag</b> = 1
Lake dynamics					
<i>basin_2ndstflow</i>	Streamflow from second output point for lake HRUs using gate opening routing	<b>one</b>	inches	double	<b>strmflow_module</b> = muskingum_lake
<i>basin_lake_seep</i>	Basin area-weighted average lake-bed seepage to GWRs	<b>one</b>	acre-feet	double	<b>strmflow_module</b> = muskingum_lake
<i>basin_lake_stor</i>	Basin volume-weighted average storage for all lakes using broad-crested weir or gate opening routing	<b>one</b>	inches	double	<b>strmflow_module</b> = muskingum_lake
<i>dinl</i>	Inflow to each lake HRU using Puls or linear storage routing	<b>nlake</b>	cfs	double	<b>strmflow_module</b> = muskingum_lake
<i>elevlake</i>	Surface elevation of each lake	<b>nlake</b>	feet	real	<b>strmflow_module</b> = muskingum_lake and <b>nratetbl</b> > 0
<i>gate_ht</i>	Height of the gate opening at each dam with a gate	<b>nratetbl</b>	inches	real	<b>strmflow_module</b> = muskingum_lake and <b>nratetbl</b> > 0
<i>gw_seep_lakein</i>	Groundwater discharge to each lake HRU for each GWR	<b>ngw</b>	acre-feet	double	<b>strmflow_module</b> = muskingum_lake
<i>lakein_sz</i>	Cascading interflow and Dunnian surface runoff to lake HRUs for each upslope HRU	<b>nhru</b>	inches	double	<b>cascade_flag</b> = 1, <b>ncascade</b> > 0, and <b>nlake</b> > 0
<i>lake_2gw</i>	Total seepage from each lake using broad-crested weir or gate	<b>nlake</b>	cfs	double	<b>strmflow_module</b> =

<i>lake_elev</i>	opening routing Elevation of each simulated lake surface	<b>nlakeelev</b>	feet	real	<b>muskingum_lake</b> <b>strmflow_module =</b> <b>muskingum_lake</b> and <b>nlakeelev &gt; 0</b>
<b>lake_gwflow</b>	Total groundflow into each lake	<b>nlake</b>	cfs	double	<b>strmflow_module =</b> <b>muskingum_lake</b>
<i>lake_inflow</i>	Total inflow to each lake	<b>nlake</b>	cfs	double	<b>strmflow_module =</b> <b>muskingum_lake</b>
<i>lake_interflow</i>	Total interflow into each lake	<b>nlake</b>	cfs	double	<b>strmflow_module =</b> <b>muskingum_lake</b>
<i>lake_invol</i>	Inflow to each lake using broad-crested weir or gate opening routing	<b>nlake</b>	acre-feet	double	<b>strmflow_module =</b> <b>muskingum_lake</b>
<i>lake_lateral_inflow</i>	Lateral inflow to each lake	<b>nlake</b>	cfs	double	<b>strmflow_module =</b> <b>muskingum_lake</b>
<i>lake_outcfs</i>	Streamflow leaving each lake, includes any second outlet flow	<b>nlake</b>	cfs	double	<b>strmflow_module =</b> <b>muskingum_lake</b>
<i>lake_outcms</i>	Streamflow leaving each lake, includes any second outlet flow	<b>nlake</b>	cms	double	<b>strmflow_module =</b> <b>muskingum_lake</b>
<i>lake_outflow</i>	Evaporation and seepage from each lake	<b>nlake</b>	cfs	double	<b>strmflow_module =</b> <b>muskingum_lake</b>
<b>lake_outq2</b>	Streamflow from second outlet for each lake with a second outlet	<b>nlake</b>	cfs	double	<b>strmflow_module =</b> <b>muskingum_lake</b>
<i>lake_outvol</i>	Outflow to each lake using broad-crested weir or gate opening routing	<b>nlake</b>	acre-feet	double	<b>strmflow_module =</b> <b>muskingum_lake</b>
<b>lake_outvol_ts</b>	Outflow from each lake using broad-crested weir or gate opening routing for the time step	<b>nlake</b>	acre-inches	double	<b>strmflow_module =</b> <b>muskingum_lake</b>
<i>lake_seep_in</i>	Total seepage into each lake using broad-crested weir or gate opening routing	<b>nlake</b>	cfs	double	<b>strmflow_module =</b> <b>muskingum_lake</b>
<i>lake_seepage</i>	Lake-bed seepage from each lake to the associated GWR	<b>ngw</b>	<b>acre-feet</b>	<b>double</b>	<b>strmflow_module =</b> <b>muskingum_lake</b>
<i>lake_seepage_gwr</i>	Net lake-bed seepage to associated GWR	<b>ngw</b>	inches	<b>double</b>	<b>strmflow_module =</b> <b>muskingum_lake</b>
<i>lake_sroff</i>	Total surface runoff into each lake	<b>nlake</b>	cfs	double	<b>cascade_flag = 1</b>
<i>lake_sto</i>	Storage in each lake using Puls or linear storage routing	<b>nlake</b>	cfs-days	double	<b>strmflow_module =</b> <b>muskingum_lake</b>
<i>lake_stream_in</i>	Total streamflow to each lake	<b>nlake</b>	cfs	double	<b>strmflow_module =</b> <b>muskingum_lake</b>
<i>lake_vol</i>	Storage in each lake using broad-crested weir or gate opening routing	<b>nlake</b>	acre-feet	double	<b>strmflow_module =</b> <b>muskingum_lake</b>

Water balance

<i>basin_capillary_wb</i>	Basin area-weighted average capillary reservoir storage	<b>one</b>	inches	double	<b>print_debug = 1</b>
<i>basin_dprst_wb</i>	Basin area-weighted average surface-depression storage	<b>one</b>	inches	double	<b>print_debug = 1</b>
<i>basin_gravity_wb</i>	Basin area-weighted average gravity reservoir storage	<b>one</b>	inches	double	<b>print_debug = 1</b>
<i>basin_soilzone_wb</i>	Basin area-weighted average storage in soilzone reservoirs	<b>one</b>	inches	double	<b>print_debug = 1</b>
<i>basin_storage</i>	Basin area-weighted average storage in all water-storage reservoirs	<b>one</b>	inches	double	always
<i>basin_storvol</i>	Basin area-weighted average storage volume in all water-storage reservoirs	<b>one</b>	acre-inches	double	always
<i>basin_surface_storage</i>	Basin area-weighted average storage in all water storage reservoirs	<b>one</b>	inches	double	<b>csvON_OFF = 1</b>
<i>basin_total_storage</i>	Basin area-weighted average storage in all water storage reservoirs	<b>one</b>	inches	double	<b>csvON_OFF = 1</b>
<i>hru_lateral_flow</i>	Lateral flow to stream network from each HRU	<b>nhru</b>	cfs	double	always
<i>hru_storage</i>	Storage for each HRU	<b>nhru</b>	inches	double	always
<i>last_basin_stor</i>	Basin area-weighted average storage in all water storage reservoirs from previous time step	<b>one</b>	inches	double	<b>print_debug = 1</b>
<i>subinc_deltastor</i>	Change in storage for each subbasin	<b>nsub</b>	inches	double	<b>subbasin_flag = 1</b>
<i>subinc_stor</i>	Area-weighted average total water content in storage reservoirs associated HRUs of each subbasin	<b>nsub</b>	inches	double	<b>subbasin_flag = 1</b>
<i>subinc_wb</i>	Water balance for each subbasin	<b>nsub</b>	inches	double	<b>subbasin_flag = 1</b>
<i>watbal_sum</i>	Water balance aggregate	<b>one</b>	inches	double	always

<sup>1</sup>Dimension variables defined in table 1-1.

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

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

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

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

