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

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==Updated tables from version 4.0.3 to version 5.1.0==

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

[HRU, Hydrologic Response Unit; CBH, climate by HRU; ==green== highlight indicates new for PRMS-V; ==pink== highlight indicates new for PRMS 5.1.0; ~~strikethrough~~ indicates items removed]

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

	Solar radiation distribution process	
ddsolrad	Distributes solar radiation to each HRU and estimates missing solar radiation data using a maximum temperature per degree-day relation.
ccsolrad	Distributes solar radiation to each HRU and estimates missing solar radiation data using a relation between solar radiation and cloud cover.
climate_hru	Reads distributed solar radiation values for each HRU directly from pre-processed files.

	Transpiration period process	
transp_frost	Determines whether the current time step is in a period of active transpiration by the killing frost method.
transp_tindex	Determines whether the current time step is in a period of active transpiration by the temperature index method.
climate_hru	Reads distributed transpiration values for each HRU directly from pre-processed files.

	Potential evapotranspiration process	
potet_hamon	Computes the potential evapotranspiration by using the Hamon formulation (Hamon, 1961).
potet_jh	Computes the potential evapotranspiration by using the Jensen-Haise formulation (Jensen and Haise, 1963).
potet_hs	Computes the potential evapotranspiration by using the Hargreaves-Samani formulation (Hargreaves and Samani, 1982).
potet_pt	Computes the potential evapotranspiration by using the Priestley-Taylor formulation (Priestley and Taylor, 1972).
potet_pm	Computes the potential evapotranspiration by using the Penman-Monteith formulation (Penman, 1948; Monteith, 1965); requires windspeed and humidity specified in CBH Files.
potet_pm_sta	Computes the potential evapotranspiration by using the Penman-Monteith formulation (Penman, 1948; Monteith, 1965); requires windspeed and humidity specified in the Data File.
potet_pan	Computes the potential evapotranspiration for each HRU by using pan-evaporation data.
climate_hru	Reads distributed potential evapotranspiration values for each HRU directly from pre-processed files.

	Canopy Interception process	
intcp	Computes volume of intercepted precipitation, evaporation from intercepted precipitation, and throughfall 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 the soil zone of each HRU and includes inflows from infiltration, groundwater, and upslope HRUs, and outflows to gravity drainage, interflow, and surface runoff to down-slope HRUs.

	Groundwater process	
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 (Linsley and others, 1982).
muskingum_lake	Computes flow in the stream network using the Muskingum routing method and flow and storage in

	on-channel lake using several methods.
muskingum_mann	Computes flow in the stream network using the Muskingum routing method with Manning's N equation.
routing	Computes common segment routing flows for modules `strmflow_in_out` and `Muskingum`.
stream_temp	Computes daily mean stream temperature for each stream segment in the stream network, module based on the Stream Network Temperature Model (SNTEMP, Theurer and others, 1984).
strmflow	Computes daily streamflow as the sum of surface runoff, shallow-subsurface flow (interflow), detention reservoir flow, and groundwater flow.
strmflow_in_out	Routes water between segments in the stream network by setting the outflow to the inflow.
~~strmflow_lake~~	~~Computes basin on-channel reservoir storage and outflows.~~

Summary process	
basin_sum	Computes daily, monthly, yearly, and total flow summaries of volumes and flows for all HRUs.
basin_summary	Write user-selected results for variables of dimension **one** to separate CSV Files at daily, monthly, mean monthly, mean yearly, and yearly total time steps when control parameter **basinOutON_OFF** is specified equal to 1.
convert_params	Writes values for new PRMS-V parameters to a file based on a PRMS-IV Parameter File when control parameter **model_mode** is specified equal to CONVERT. Writes values for old PRMS-IV parameters to a file based on a PRMS-V Parameter File when control parameter **model_mode** is specified equal to CONVERT4.
frost_date	Writes a parameter file of the last spring frost and first fall frost for each HRU based on the simulation time period and distributed temperature as required by the `transp_frost` module; land, subsurface, and stream processes are not computed.
map_results	Writes HRU summaries to a user specified target map at weekly, monthly, yearly, and total time steps.
nhru_summary	Writes user-selected results dimensioned by the value of dimension **nhru** to separate CSV Files at daily, monthly, mean monthly, mean yearly, and yearly total time steps when control parameter **nhruOutON_OFF** is specified equal to 1.
nsegment_summary	Writes user-selected results dimensioned by the value of dimension **nsegment** to separate CSV Files at daily, monthly, mean monthly, mean yearly, and yearly total time steps when control parameter **nsegmentOutON_OFF** is specified equal to 1 or 2.
nsub_summary	Writes user-selected results dimensioned by the value of dimension **nsub** to separate CSV Files at daily, monthly, mean monthly, mean yearly, and yearly total time steps when control parameter **nsubOutON_OFF** is specified equal to 1 or 2.
prms_summary	Writes selected basin area-weighted results to a Comma-Seperated Values (CSV) File when control parameter **csvON_OFF** is specified equal to 1.
subbasin	Computes streamflow at internal basin nodes and variables by subbasin.
write_climate_hru	Writes climate-by-HRU Files of user-selected climate variables on the basis of distributed climate; land, subsurface, and stream processes are not computed.

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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; pink highlight indicates new for PRMS 5.1.0]

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

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Dimension[3]	Description	Default	Required/Condition
			`temp_dist2`, `ide_dist`, or `xyz_dist`
nwind	Number of wind-speed measurement stations	0	optional
	Computation dimensions		
ncascade	Number of HRU links for cascading flow	0	**cascade_flag** = 1 or 2
ncascdgw	Number of GWR links for cascading flow	0	**cascadegw_flag** = 1 or 2
ndepl	Number of snow-depletion curves	1	required
ndeplval	Number of values in all snow-depletion curves (set to **ndepl***11)	11	required
	Lake computation dimensions		
mxnsos	Maximum number of storage/outflow table values for storage-detention reservoirs and lakes connected to the stream network using Puls routing	0	**strmflow_module** = `muskingum_lake`
ngate	Maximum number of reservoir gate-opening values (columns) for lake rating table 1	0	**strmflow_module** = `muskingum_lake` and **nratetbl** > 0
ngate2	Maximum number of reservoir gate-opening values (columns) for lake rating table 2	0	**strmflow_module** = `muskingum_lake` and **nratetbl** > 1
ngate3	Maximum number of reservoir gate-opening values (columns) for lake rating table 3	0	**strmflow_module** = `muskingum_lake` and **nratetbl** > 2
ngate4	Maximum number of reservoir gate-opening values (columns) for lake rating table 4	0	**strmflow_module** = `muskingum_lake` and **nratetbl** > 3
nstage	Maximum number of lake elevations values (rows) for lake rating table 1	0	**strmflow_module** = `muskingum_lake` and **nratetbl** > 0
nstage2	Maximum number of lake elevations values (rows) for lake rating table 2	0	**strmflow_module** = `muskingum_lake` and **nratetbl** > 1
nstage3	Maximum number of lake elevations values (rows) for lake rating table 3	0	**strmflow_module** = `muskingum_lake` and **nratetbl** > 2
nstage4	Maximum number of lake elevations values (rows) for lake rating table 4	0	**strmflow_module** = `muskingum_lake` and **nratetbl** > 3
	Fixed dimensions		
ndays	Maximum number of days in a year	366	optional
nlapse	Number of lapse rates in X, Y, and Z directions	3	**precip_module** = `xyz_dist`
nmonths	Number of months in a year	12	optional
one	Dimension of scalar parameters and variables	1	optional

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

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

[3]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; PET, potential evapotranspiration; >, greater than; dimensions **ncascade**, **ncascdgw**, and **nsub** defined in table 1-1; the first two blocks of control parameters listed in the table are recommended for every simulation, though all parameters are optional depending appropriateness of the default values; <mark>green</mark> highlight indicates new for PRMS-V; <mark>pink</mark> highlight indicates new for PRMS 5.1.0]

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

Parameter name	Description	Option	Number of Values	Data type	Default value
cascade_flag	Flag to indicate if HRU cascades are computed (0=no; 1=yes; 2=simple cascades defined by parameter **hru_segment**)	cascade flow with **ncascade** > 0	1	1	1
cascadegw_flag	Flag to indicate if GWR cascades are computed (0=no; 1=yes; 2 = GWR cascades are set equal to the HRU cascades and parameters **gw_up_id**, **gw_strmseg_down_in**, **gw_down_id**, and **gw_pct_up** are not required)	cascade flow with **ncascdgw** > 0	1	1	1
dprst_flag	Flag to indicate if depression-storage simulation is computed (0=no; 1=yes)	surface-depression storage	1	1	0
et_module	Module name for potential evapotranspiration method (`climate_hru`, `potet_jh`, `potet_hamon`, `potet_hs`, `potet_pt`, `potet_pm`, `potet_pm_sta`, or `potet_pan`)	module selection	1	4	`potet_jh`
gwr_swale_flag	Flag to indicate if GWR swales are allowed (0=no; 1=groundwater flow goes to groundwater sink; 3=groundwater flow goes to stream segment specified using parameter **hru_segment**	swales	1	1	0
precip_module	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`
snarea_curve_flag	Flag to specify snow depletion curve calculation method. (0=specify snow depletion curves with parameter **hru_deplcrv** and **snarea_curve**; 1=compute using parameters **snarea_a**, **snarea_b**, **snarea_c**, and **snarea_d**)	required	1	1	0
soilzone_aet_flag	Flag to specify soil-water evapotranspiration (ET) compute method. Either it's based on unsatisfied potential ET (PET) and for GSFLOW or GSFLOW5 modes replenish the upper zone of capillary reservoir using the fraction of the upper zone of the capillary reservoir (as was done in previous versions) or it's based on PET when specified equal to 1 and replenish by first filling the lower zone and then the upper zone to their maximum water-holding capacities (0=compute soil-water ET based on unsatisfied ET and old upper zone replenishment method; 1=based on PET and new replenishment method); set to 0 for downward compatibility of old models, though it is recommended setting to 1 for new models	required	1	1	0
solrad_module	Module name for solar-radiation-distribution method (`ccsolrad` or `ddsolrad`)	module selection	1	4	`ddsolrad`
srunoff_module	Module name for surface-runoff/infiltration computation method (`srunoff_carea` or `srunoff_smidx`)	module selection	1	4	`srunoff_smidx`
stream_temp_flag	Flag to specify whether to simulate stream temperature, **strmflow_module** must be set to `muskingum`,	stream temperature	1	1	0

Parameter name	Description	Option	Number of Values	Data type	Default value
	`muskingum_mann`, `strmflow_in_out`, or `muskingum_lake`				
strmflow_module	Module name for streamflow routing simulation method (`strmflow`, `muskingum`, `muskingum_mann`, `strmflow_in_out`, or `muskingum_lake`)	module selection	1	4	`strmflow`
strmtemp_humidity_flag	Flag to specify where humidity information is read for use by the `stream_temp` module (0=CBH File specified by control parameter **humidity_day**; 1=parameter **seg_humidity**; 2=Data File with values assigned based on parameter **seg_humidity_sta**), **strmflow_module** must be set to `muskingum`, `muskingum_mann`, `strmflow_in_out`, or `muskingum_lake`	stream temperature	1	1	`0`
subbasin_flag	Flag to indicate if internal subbasin are computed (0=no; 1=yes)	**nsub** > 0	1	1	`1`
temp_module	Module name for temperature-distribution method (`climate_hru`, `temp_1sta`, `temp_sta`, `temp_dist2`, `temp_laps`, `ide_dist`, or `xyz_dist`)	module selection	1	4	`temp_1sta`
transp_module	Module name for transpiration simulation method (`climate_hru`, `transp_frost`, or `transp_tindex`)	module selection	1	4	`transp_tindex`
Climate-by-HRU Files					
cbh_binary_flag	Flag to specify whether to input CBH files in a binary format using the samer order of values as the text file version (0=no; 1=yes)	input options	1	1	`0`
humidity_day[2]	Pathname of the CBH file of pre-processed humidity input data for each HRU to specify variable *humidity_hru*-percentage	**et_module** = `potet_pm`	1	4	`humidity.day`
orad_flag	Flag to specify whether or not the variable *orad* is specified as the last column of the **swrad_day** CBH file (0=no; 1=yes)	**solrad_module** = `climate_hru`	1	1	`1`
potet_day[2]	Pathname of the CBH file of pre-processed potential-ET input data for each HRU to specify variable *potet*-inches	**et_module** = `climate_hru`	1	4	`potet.day`
precip_day[2]	Pathname of the CBH file of pre-processed precipitation input data for each HRU to specify variable *precip*-inches	**precip_module** = `climate_hru`	1	4	`precip.day`
swrad_day[2]	Pathname of the CBH file of pre-processed solar-radiation input data for each HRU to specify variable *swrad*-Langleys	**solrad_module** = `climate_hru`	1	4	`swrad.day`
tmax_day[2]	Pathname of the CBH file of pre-processed maximum air temperature input data for each HRU to specify variable *tmaxf*-degrees Fahrenheit	**temp_module** = `climate_hru`	1	4	`tmax.day`
tmin_day[2]	Pathname of the CBH file of pre-processed minimum air temperature input data for each HRU to specify variable *tminf*-degrees Fahrenheit	**temp_module** = `climate_hru`	1	4	`tmin.day`

Parameter name	Description	Option	Number of Values	Data type	Default value
transp_day[2]	Pathname of the CBH file of pre-processed transpiration on or off flag for each HRU file to specify variable *transp_on*-none	**transp_module** = `climate_hru`	1	4	`transp.day`
windspeed_day[2]	Pathname of the CBH file of pre-processed wind speed input data for each HRU to specify variable *windspeed_hru*-meters/second	**et_module** = `potet_pm`	1	4	`windspeed.day`
Dynamic Parameter Input					
covden_sum_dynamic	Pathname of the time series of pre-processed values for summer plant-cover density used to set values of **covden_sum** for each HRU	**dyn_covden_flag** = 1 or 3	1	4	`dyncovsum`
covden_win_dynamic	Pathname of the time series of pre-processed values for winter plant-cover density used to set values of **covden_win** for each HRU	**dyn_covden_flag** = 2 or 3	1	4	`dyncovwin`
covtype_dynamic	Pathname of the time series of pre-processed values used to set values of **cov_type** for each HRU	**dyn_covtype_flag** = 1	1	4	`dyncovtype`
dprst_depth_dynamic	Pathname of the time series of pre-processed values used to set values of **dprst_depth_avg**	**dyn_dprst_flag** = 2 or 3	1	4	`dyndprst_depth`
dprst_frac_dynamic	Pathname of the time series of pre-processed values used to set values of **dprst_frac**	**dyn_dprst_flag** = 1 or 3	1	4	`dyndprst_frac`
dyn_covden_flag	Flag to indicate if a time series of plant-canopy density values are input in a Dynamic Parameter File(s) (0=no; 1=file **covden_sum_dynamic**; 2=file **covden_win_dynamic**; 3=both)	dynamic canopy cover density	1	1	`0`
dyn_covtype_flag	Flag to indicate if a time series of plant-canopy type values are input in Dynamic Parameter File **covtype_dynamic** (0=no; 1=yes)	dynamic canopy cover type	1	1	`0`
dyn_dprst_flag	Flag to indicate if a time series of surface-depression values are input in a Dynamic Parameter File(s) (0=no; 1=file **dprst_frac_dynamic**; 2=file **dprst_depth_dynamic**; 3=both)	dynamic surface depression	1	1	`0`
dyn_fallfrost_flag	Flag to indicate if a time series of transpiration start Julian day values are input in a Dynamic Parameter File(s) (0=no; 1 =file **fallfrost_dynamic**)	dynamic transpiration and transp_module = `transp_frost`	1	1	`0`
dyn_imperv_flag	Flag to indicate if a time series of impervious values are input in a Dynamic Parameter File(s) (0=no; 1=file **imperv_frac_dynamic**; 2=file **imperv_stor_dynamic**; 3=both)	dynamic impervious	1	1	`0`
dyn_intcp_flag	Flag to indicate if a time series of plant canopy interception values are input in a Dynamic Parameter File(s) (0=no; 1=file **wrain_intcp_dynamic**; 2=file **srain_intcp_dynamic**; 4=file **snow_intcp_dynamic**; additive combinations, such as 3=file wrain_intcp_dynamic and srain_intcp_dynamic, but not snow_intcp_dynamic)	dynamic interception	1	1	`0`
dyn_potet_flag	Flag to indicate if a time series of potential ET coefficient values	dynamic potential ET	1	1	`0`

Parameter name	Description	Option	Number of Values	Data type	Default value
	are input in Dynamic Parameter File **potet_coef_dynamic** to update coefficients for the specified month for the selected potential ET module specified by control parameter **et_module** (0=no; 1=parameter **jh_coef**, **pt_alpha**, **hs_krs**, **hamon_coef**, **epan_coef**, **potet_cbh_adj**, and **pm_n_coef** used in potet_jh, potet_pt, potet_hs, potet_hamon, potet_pan, climate_hru, potet_pm, and potet_pm_sta modules, respectively; 2=parameter **jh_coef_hru, pm_d_coef** used in potet_jh , potet_pm, and potet_pm_sta modules, respectively)				
dyn_radtrncf_flag	Flag to indicate if a time series of solar radiation values are input in Dynamic Parameter File **radtrncf_dynamic** (0=no; 1=yes)	dynamic solar radiation transmission	1	1	0
dyn_soil_flag	Flag to indicate if a time series of soil-water capacity values are input in a Dynamic Parameter File(s) (0=no; 1=file **soilmoist_dynamic** only, 2=file **soilrechr_dynamic** only; 3=both)	dynamic soil moisture	1	1	0
dyn_springfrost_flag	Flag to indicate if a time series of transpiration start Julian day values are input in a Dynamic Parameter File(s) (0=no; 1=file **springfrost_dynamic**)	dynamic transpiration and transp_module = transp_frost	1	1	0
dyn_sro2dprst_perv_flag	Flag to indicate if a time series of fraction of surface runoff from the pervious portion of an HRU are input in Dynamic Parameter File **sro2dprst_perv_dyn** (0=no; 1=yes)	dynamic surface depression	1	1	0
dyn_sro2dprst_imperv_flag	Flag to indicate if a time series of fraction of surface runoff from the impervious portion of an HRU are input in Dynamic Parameter File **sro2dprst_imperv_dynamic** (0=no; 1=yes)	dynamic surface depression	1	1	0
dyn_transp_flag	Flag to indicate if a time series of transpiration month values are input in a Dynamic Parameter File(s) (0=no; 1=file **transpbeg_dynamic**; 2=file **transpend_dynamic** only, 3=both)	dynamic transpiration and transp_module = transp_tindex	1	1	0
dynamic_param_log_file	Pathname of the log file that summarizes dynamic parameter changes	for all dynamic parameter input	1	4	dynamic_parameter.out
fallfrost_dynamic	Pathname of the time series of pre-processed values for dynamic parameter **fall_frost**	**dyn_fallfrost_flag** = 1 and transp_module = transp_frost	1	4	dynfallfrost
imperv_frac_dynamic	Pathname of the time series of pre-processed values for dynamic parameter **hru_percent_imperv**	**dyn_imperv_flag** = 1 or 3	1	4	dynimperv
imperv_stor_dynamic	Pathname of the time series of pre-processed values for dynamic parameter **imperv_stor_max**	**dyn_imperv_flag** = 2 or 3	1	4	dynimperv
potet_coef_dynamic	Pathname of the time series of pre-processed potential evapotranspiration coefficient values where the parameter is dependent on the value of **et_module**	**dyn_potet_flag** = 1 or 2	1	4	dynpotetcoef

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

Parameter name	Description	Option	Number of Values	Data type	Default value
	gwr_transfer_file (0=no; 1=yes)				
lake_transfer_file	Pathname of the time series of pre-processed flow rates for transfers from lake HRUs	lake_transferON_OFF = 1	1	4	`lake.transfer`
lake_transferON_OFF	Flag to indicate to use lake HRU transfer flow rates from the lake_transfer_file (0=no; 1=yes)	lake water transfer	1	1	`0`
segment_transfer_file	Pathname of the time series of pre-processed flow rates for transfers from stream segments	segment_transferON_OFF = 1	1	4	`seg.transfer`
segment_transferON_OFF	Flag to indicate to use stream segment transfer flow rates from the segment_transfer_file (0=no; 1=yes)	stream water transfer	1	1	`0`
Debug options					
cbh_check_flag	Flag to indicate if CBH values are validated each time step (0=no; 1=yes)	CBH input	1	1	`1`
parameter_check_flag	Flag to indicate if selected parameter values validation checks are treated as warnings or errors (0=no; 1=yes; 2=check parameters and then stop)	parameter validation check	1	1	`1`
print_debug[1]	Flag to indicate type of debug output (-2=minimal output to screen and no model_output_file; -1 =minimize screen output; 0=none; 1=water balances; 2=basin module; 4=basin_sum module; 5=soltab module; 7=soilzone module; 9=snowcomp module; 13=cascade module; 14=subbasin module)	debug output	1	1	`0`
Statistic Variables (statvar) Files					
nstatVars	Number of variables to include in Statistics Variables File and names specified in statVar_names	statsON_OFF = 1	1	1	`0`
stat_var_file[2]	Pathname for Statistics Variables File	statsON_OFF = 1	1	4	`statvar.out`
statsON_OFF	Switch to specify whether or not the Statistics Variables File is generated (0=no; 1=statvar text format; 2=CSV format)	statsON_OFF = 1	1	1	`0`
statVar_element	List of identification numbers corresponding to variables specified in statVar_names list (1 to variable's dimension size)	statsON_OFF = 1	nstatVars	4	none
statVar_names	List of variable names for which output is written to Statistics Variables File	statsON_OFF = 1	nstatVars	4	none
Initial Condition Files					
init_vars_from_file	Flag to specify whether or not the Initial Conditions File is specified as an input file (0=no; 1=yes; 2=yes and use parameters dprst_frac_init, snowpack_init, segment_flow_init, elevlake_init, gwstor_init, (soil_rechr_init, soil_moist_init, ssstor_init for model_mode=PRMS or GSFLOW) or	initial condtions	1	1	`0`

Parameter name	Description	Option	Number of Values	Data type	Default value
	(**soil_rechr_init_frac**, **soil_moist_init_frac**, **ssstor_init_frac** for **model_mode**=PRMS5 or GSFLOW5), and **stream_tave_init**; 3=yes and use parameter **snowpack_init**; 4=yes and use parameter **elevlake_init**; 5=yes and use parameters (**soil_rechr_init**, **soil_moist_init**, **ssstor_init** for **model_mode**=PRMS or GSFLOW) or (**soil_rechr_init_frac**, **soil_moist_init_frac**, **ssstor_init_frac** for **model_mode**=PRMS5 or GSFLOW5); 6=yes and use parameter **gwstor_init**; 7=yes and use parameter **dprst_frac_init**; 8=yes and use parameter **stream_tave_init**)				
save_vars_to_file	Flag to determine if an Initial Conditions File will be generated at the end of simulation (0=no; 1=yes)	initial condtions	1	1	0
var_init_file[2]	Pathname for Initial Conditions input file	**init_vars_from_file** = 1	1	4	prms_ic.in
var_save_file[2]	Pathname for the Initial Conditions File to be generated at end of simulation	**save_vars_to_file** = 1	1	4	prms_ic.out
	Animation Files				
ani_output_file[2]	Pathname for Animation Files(s) to which a filename suffix based on dimension name associated with selected variables is appended	**aniOutON_OFF** = 1	1	4	animation.out
aniOutON_OFF	Switch to specify whether or not Animation File(s) are generated (0=no; 1=yes)	animation output	1	1	0
aniOutVar_names	List of variable names for which all values of the variable (that is, the entire dimension size) for each time step are written Animation Dimension Files(s)	**aniOutON_OFF** = 1	**naniOutVars**	4	none
naniOutVars	Number of output variables specified in the **aniOutVar_names** list	**aniOutON_OFF** = 1	1	1	0
	Basin Summary Results Files				
basinOutBaseFileName[2]	String to define the prefix for each basin summary output file.	**basinOutON_OFF** = 1	1	4	none
basinOutON_OFF	Switch to specify whether or not basin summary output files are generated (0=no; 1=yes)	**basin** summary results	1	1	0
basinOutVar_names	List of variable names for which output is written to basin summary Comma Separated Values (CSV) output file(s). Each variable is written to files in the order specified in **basinOutVars** with the prefix of each file equal to the value of **basinOutBaseFileName**. The suffix of the files is based on the value of basinOut_freq and will be .csv; _meanyearly.csv; _yearly.csv; _meanmonthly.csv; or _monthly.csv. Variables must be of type real or double	**basinOutON_OFF** = 1	**basinOutVars**	4	none
basinOutVars	Number of variables to include in basin summary output file(s)	**basinOutON_OFF** = 1	1	1	0
basinOut_freq	Output frequency and type (1=daily; 2=monthly; 3=both; 4=mean monthly; 5=mean yearly; 6=yearly)	**basinOutON_OFF** = 1	1	1	1

Parameter name	Description	Option	Number of Values	Data type	Default value
		Mapped Results Files			
mapOutON_OFF	Switch to specify whether or not mapped output file(s) by a specified number of columns (parameter **ncol**) of daily, monthly, yearly, or total simulation results is generated (0=no; 1=yes)	mapped results	1	1	0
mapOutVar_names	List of variable names for which output is written to mapped output files(s); variables must be of type real or double.	**map_resultsON_OFF** = 1	nmapOutVars	4	none
nmapOutVars	Number of variables to include in mapped output file(s)	**map_resultsON_OFF** = 1	1	1	0
		Nhru Summary Results Files			
nhruOutBaseFileName[2]	String to define the prefix for each **nhru** summary output file.	**nhruOutON_OFF** = 1 or 2	1	4	none
nhruOutNcol	Number of columns written per line, which can be used to generate gridded output (0=all values for each timestep are written on a single line as in previous versions; >0 number of columns)	**nhruOutON_OFF** = 1 or 2	1	1	0
nhruOutON_OFF	Switch to specify whether or not **nhru** summary output files are generated (0=no; 1=yes; 2=yes and use values of **nhm_id** as column heading)	**nhru** summary results	1	1	0
nhruOutVar_names	List of variable names for which output is written to **nhru** summary Comma Separated Values (CSV) output files(s). Each variable is written to a separate file with the prefix of each file equal to the value of **nhruOutBaseFileName**; variables must be of type real or double. Each variable is written to a separate file with the prefix of each file equal to the value of **nhruOutBaseFileName**. The suffix of the files is based on the value of **nhruOut_freq** and will be .csv; _meanyearly.csv; _yearly.csv; _meanmonthly.csv; or _monthly.csv. Variables must be of type real or double	**nhruOutON_OFF** = 1 or 2	nhruOutVars	4	none
nhruOutVars	Number of variables to include in **nhru** summary output file(s)	**nhruOutON_OFF** = 1 or 2	1	1	0
nhruOut_format	Format of values (1=scientific notation with 4 significant digits (default); 2=2 decimal places; 3=3 decimal places; 4=4 decimal places; 5=5 decimal places)	**nhruOutON_OFF** = 1 or 2	1	1	1
nhruOut_freq	Output frequency and type (1=daily; 2=monthly; 3=both; 4=mean monthly; 5=mean yearly; 6=yearly)	**nhruOutON_OFF** = 1 or 2	1	1	1
		Nsub Summary Results Files			
nsubOutBaseFileName[2]	String to define the prefix for each **nsub** summary output file.	**nsubOutON_OFF** = 1	1	4	none
nsubOutON_OFF	Switch to specify whether or not **nsub** summary output files are generated (0=no; 1=yes)	**nsub** summary results	1	1	0
nsubOutVar_names	List of variable names for which output is written to **nsub** summary Comma Separated Values (CSV) output files(s). Each variable is written to a separate file with the prefix of each file equal to the	**nsubOutON _OFF** = 1	nsubOutVars	4	none

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

Parameter name	Description	Option	Number of Values	Data type	Default value
	pairs of simulated and measured flows)				
csv_output_file[2]	Pathname of CSV output file	**csvON_OFF** = 1	1	4	none
	Runtime graphs				
dispGraphsBuffSize	Number of time steps to wait before updating the runtime graph	**ndispGraphs** > 0	1	1	50
dispVar_element	List of identification numbers corresponding to variables specified in **dispVar_names** list (1 to variable's dimension size)	**ndispGraphs** > 0	number of variables	4	none
dispVar_names	List of variable names for which plots are output to the runtime graph	**ndispGraphs** > 0	number of variables	4	none
dispVar_plot	List of variable names for which plots are output to the runtime graph	**ndispGraphs** > 0	number of variables	4	none
executable_desc	Descriptive text to identify the PRMS executable	**ndispGraphs** > 0	1	4	MOWS executable
executable_model[2]	Pathname (full or relative) of the PRMS executable	**ndispGraphs** > 0	1	4	prmsIV
initial_deltat	Initial time step for the simulation	**ndispGraphs** > 0	1	2	24.0
ndispGraphs	Number of plots included in the runtime graph	graphical output	1	1	0

[1]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.

[2]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; Id, numbere of modeling unit; 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 retaine for PRMS-IV downward compatibility; pink highlight indicates new for PRMS 5.1.0; ~~strikethrough~~ indicates items removed]

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

Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
parent_ssr	Lumen index in parent model for each SSR	nssr	integer	none	1 to 9999999	1	optional
Measured input							
outlet_sta	Index of measured streamflow station corresponding to the basin outlet	one	integer	none	0 to nobs	0	nobs > 0
precip_units	Flag to indicate the units of measured precipitation values (0=inches; 1=mm)	one	integer	none	0 or 1	0	required
rad_conv	Conversion factor to Langleys for measured solar radiation	one	real	Langleys/ radiation units	0.1 to 100.0	1.0	nsol > 0
rain_code	Monthly (January to December) flag indicating rule for precipitation measurement station use (1=only precipitation if the regression stations have precipitation; 2=only precipitation if any station in the basin has precipitation; 3=precipitation if module xyz_dist computes any; 4=only precipitation if *rain_day* variable is set to 1; 5=only precipitation if **psta_freq_nuse** stations have precipitation)	nmonths	integer	none	1 to 5	2	precip_module = xyz_dist
runoff_units	Measured streamflow units (0=cfs; 1=cms)	one	integer	none	0 or 1	0	nobs > 0
temp_units	Flag to indicate the units of measured air-temperature values (0=Fahrenheit; 1=Celsius)	one	integer	none	0 or 1	0	required
Water Use input							
irr_type	Method of application of water for each application time-series (0=sprinkler (intercep applies); 1=furrow/drip (no intercept); 2=ignore)	nhru	real	none	0 to 2	0	nwateruse = 1
Air temperature and precipitation distribution							
adjmix_rain	Monthly (January to December) factor to adjust rain proportion in a mixed rain/snow event	nhru, nmonths	real	decimal fraction	0.0 to 3.0	1.0	required
adjust_rain	Monthly (January to December) rain downscaling adjustment factor for each precipitation measurement station	nrain, nmonths	real	decimal fraction	-0.5 to 0.5	-0.4	precip_module = ide_dist or xyz_dist
adjust_snow	Monthly (January to December) snow downscaling adjustment factor for each precipitation measurement station	nrain, nmonths	real	decimal fraction	-0.5 to 0.5	-0.4	precip_module = ide_dist or xyz_dist
basin_tsta	Index of temperature station used to compute basin temperature values	one	integer	none	0 to ntemp	0	temp_module = temp_1sta, temp_sta, temp_dist2, or temp_laps

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

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

Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
	multiplied times the lapse rate and negative factors are made positive and substituted for the computed lapse rate						
padj_sn	Monthly (January to December) factor to adjust precipitation lapse rate computed between station **hru_psta** and station **hru_plaps**; positive factors are multiplied times the lapse rate and negative factors are made positive and substituted for the computed lapse rate	**nrain**, **nmonths**	real	**precip_units**	-2.0 to 10.0	1.0	**precip_module** = `precip_laps`
pmn_mo	Mean monthly (January to December) precipitation for each lapse precipitation measurement station	**nrain**, **nmonths**	real	**precip_units**	0.00001 to 100.0	1.0	**precip_module** = `precip_laps`
potet_cbh_adj	Monthly (January to December) adjustment factor to potential evapotranspiration specified in CBH Files for each HRU	**nhru**, **nmonths**	real	decimal fraction	0.5 to 1.5	1.0	**et_module** = `climate_hru`
ppt_add	Mean value for the precipitation measurement station transformation equation	**one**	real	**precip_units**	-10.0 to 10.0	0.0	**precip_module** = `xyz_dist`
ppt_div	Standard deviation for the precipitation measurement station transformation equation (not `0.0`)	**one**	real	**precip_units**	-10.0 to 10.0	1.0	**precip_module** = `xyz_dist`
ppt_lapse	Monthly (January to December) precipitation lapse rate for each direction (X, Y, and Z)	**nlapse**, **nmonths**	real	none	-10.0 to 10.0	0.0	**precip_module** = `xyz_dist`
ppt_zero_thresh	Precipitation below this amount is set to 0.0	**one**	real	**precip_units**	0.0 to 0.1	0.0	required
prcp_wght_dist	Monthly (January to December) precipitation weighting function for inverse distance calculations	**nmonths**	real	decimal fraction	0.0 to 1.0	0.5	**precip_module** = `ide_dist`
psta_elev	Elevation of each precipitation measurement station	**nrain**	real	**elev_units**	-300.0 to 30,000.0	0.0	**precip_module** = `ide_dist`, `xyz_dist`, or `precip_laps`
psta_freq_nuse	The subset of precipitation measurement stations used to determine if there is precipitation in the basin (`0`=station not used; `1`=station used)	**nrain**	integer	none	0 or 1	1	**precip_module** = `xyz_dist`
psta_mon	Monthly (January to December) factor to precipitation at each measured station to adjust precipitation distributed to each HRU to account for differences in elevation, and so forth	**nrain**, **nmonths**	real	**precip_units**	0.0 to 50.0	1.0	**precip_module** = `precip_dist2`
psta_month_ppt	Average monthly (January to December) maximum precipitation at each precipitation measurement station	**nrain**, **nmonths**	real	**precip_units**	0.0 to 20.0	0.0	**precip_module** = `xyz_dist`
psta_nuse	The subset of precipitation measurement stations used in the distribution regression (`0`=station not used; `1`=station used)	**nrain**	integer	none	0 or 1	1	**precip_module** = `ide_dist` or `xyz_dist`
psta_x	Longitude (X) for each precipitation measurement	**nrain**	real	meters	-1.0E7 to	0	**precip_module** =

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

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

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

Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
y_add	Mean value for the climate station transformation equation for the latitude (Y) coordinate	**one**	real	meters	-1.0E7 to 1.0E7	0.0	**precip_module** and **temp_module** = xyz_dist
y_div	Standard deviation for the climate station transformation equation for the latitude (Y) coordinate	**one**	real	meters	-1.0E7 to 1.0E7	1.0	**precip_module** and **temp_module** = xyz_dist
z_add	Mean value for the climate station transformation equation for the elevation (Z) coordinate	**one**	real	meters	-1.0E7 to 1.0E7	0.0	**precip_module** and **temp_module** = xyz_dist
z_div	Standard deviation for the climate station transformation equation for the elevation (Z) coordinate (not 0.0)	**one**	real	meters	-1.0E7 to 1.0E7	1.0	**precip_module** and **temp_module** = xyz_dist

Solar radiation

Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
basin_solsta	Index of solar radiation station used to compute basin radiation values; used when dimension **nsol**>0	**one**	integer	none	0 to **nsol**	0	**nsol** > 0
ccov_intcp	Monthly (January to December) intercept in cloud-cover relationship	**nhru, nmonths**	real	none	0.0 to 5.0	1.83	**solrad_module** = ccsolrad
ccov_slope	Monthly (January to December) coefficient in cloud-cover relationship	**nhru, nmonths**	real	none	-0.5 to -0.01	-0.13	**solrad_module** = ccsolrad
crad_coef	Coefficient(B) in Thompson (1976) equation; varies by region, contour map of values in reference	**nhru, nmonths**	real	none	0.1 to 0.7	0.4	**solrad_module** = ccsolrad
crad_exp	Exponent(P) in Thompson (1976) equation	**nhru, nmonths**	real	none	0.2 to 0.8	0.61	**solrad_module** = ccsolrad
dday_intcp	Monthly (January to December) intercept in degree-day equation for each HRU	**nhru, nmonths**	real	dday	-60.0 to 10.0	-40.0	**solrad_module** = ddsolrad
dday_slope	Monthly (January to December) slope in degree-day equation for each HRU	**nhru, nmonths**	real	dday/ **temp_units**	0.1 to 1.4	0.4	**solrad_module** = ddsolrad
hru_solsta	Index of solar radiation station associated with each HRU	**nhru**	integer	none	0 to **nsol**	0	**nsol** > 0
ppt_rad_adj	Monthly minimum precipitation, if HRU precipitation exceeds this value, radiation is multiplied by **radj_sppt** or **radj_wppt** precipitation adjustment factor	**nhru, nmonths**	real	inches	0.0 to 0.5	0.02	Required
radadj_intcp	Monthly (January to December) intercept in air temperature range adjustment to degree-day equation for each HRU	**nhru, nmonths**	real	dday	0.0 to 1.0	1.0	**solrad_module** = ddsolrad
radadj_slope	Monthly (January to December) slope in air temperature range adjustment to degree-day equation for each HRU	**nhru, nmonths**	real	dday/ **temp_units**	0.0 to 1.0	0.0	**solrad_module** = ddsolrad
radj_sppt	Adjustment factor for computed solar radiation for summer day with greater than **ppt_rad_adj** inches precipitation for each HRU	**nhru**	real	decimal fraction	0.0 to 1.0	0.44	required

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

Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
	potential ET computations for each HRU			Fahrenheit	150.0		potet_jh
pm_d_coef	Monthly (January to December) Penman-Monteith potential ET D wind speed coefficient for each HRU	**nhru**, **nmonths**	real	seconds/ meter	0.25 to 0.45	0.34	**et_module** = potet_pm or potet_pm_sta
pm_n_coef	Monthly (January to December) Penman-Monteith potential ET N temperature coefficient for each HRU	**nhru**, **nmonths**	real	degrees Celsius per day	850.0 to 950.0	900.0	**et_module** = potet_pm or potet_pm_sta
potet_cbh_adj	Monthly (January to December) adjustment factor to potential evapotranspiration specified in CBH Files for each HRU	**nhru**, **nmonths**	real	degrees decimal fraction	0.5 to 1.5	1.0	**et_module** = climate_hru
pt_alpha	Monthly (January to December) adjustment factor used in Priestly-Taylor potential ET computations for each HRU	**nhru**, **nmonths**	real	decimal fraction	1.0 to 2.0	1.26	**et_module** = potet_pt
	Evapotranspiration and sublimation						
fall_frost	The solar date (number of days after winter solstice) of the first killing frost of the fall	**nhru**	integer	solar date	1 to 366	264	**transp_module** = transp_frost
frost_temp	Temperature of killing frost	**nhru**	real	**temp_units**	-10.0 to 32.0	28.0	**model_mode** = FROST
potet_sublim	Fraction of potential ET that is sublimated from snow in the canopy and snowpack for each HRU	**nhru**	real	decimal fraction	0.1 to 0.75	0.5	required
rad_trncf	Transmission coefficient for short-wave radiation through the winter vegetation canopy	**nhru**	real	decimal fraction	0.0 to 1.0	0.5	required
soil_type	Soil type of each HRU (1=sand; 2=loam; 3=clay)	**nhru**	integer	none	1 to 3	2	required
spring_frost	The solar date (number of days after winter solstice) of the last killing frost of the spring	**nhru**	integer	solar date	1 to 366	111	**transp_module** = transp_frost
transp_beg	Month to begin summing maximum air temperature for each HRU; when sum is greater than or equal to **transp_tmax**, transpiration begins	**nhru**	integer	month	1 to 12	1	**transp_module** = transp_tindex
transp_end	Month to stop transpiration computations; transpiration is computed thru end of previous month	**nhru**	integer	month	1 to 13	13	**transp_module** = transp_tindex
transp_tmax	Temperature index to determine the specific date of the start of the transpiration period;' the maximum air temperature for each HRU is summed starting with the first day of month **transp_beg**; when the sum exceeds this index, transpiration begins	**nhru**	real	**temp_units**	0.0 to 1,000.0	1.0	**transp_module** = transp_tindex
	Interception						
cov_type	Vegetation cover type for each HRU (0=bare soil; 1=grasses; 2=shrubs; 3=trees; 4=coniferous)	**nhru**	integer	none	0 to 4	3	required
covden_sum	Summer vegetation cover density for the major vegetation type in each HRU	**nhru**	real	decimal fraction	0.0 to 1.0	0.5	required

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

Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
				fraction			
snarea_a	Snow area depletion curve minimum snow-water equivalent (SWE) value for each HRU	nhru	real	inches	0.0 to 1.0	0.0	snarea_curve_flag=1
snarea_b	Snow area depletion curve B coefficient used in computing values off an S curve for each HRU	nhru	real	none	0.5 to 20.0	2.0	snarea_curve_flag=1
snarea_c	Snow area depletion curve C coefficient used in computing values off an S curve for each HRU	nhru	real	none	0.001 to 3.0	1.5	snarea_curve_flag=1
snarea_d	Snow area depletion curve D coefficient used in computing values off an S curve for each HRU	nhru	real	none	0.0 to 3.0	0.975	snarea_curve_flag=1
snarea_curve	Snow area depletion curve values, 11 values for each curve (0.0 to 1.0 in 0.1 increments)	ndeplval	real	decimal fraction	0.0 to 1.0	1.0	snarea_curve_flag=0
snarea_thresh	Maximum threshold snowpack water equivalent below which the snow-covered-area curve is applied	nhru	real	inches	0.0 to 200.0	50.0	required
snowpack_init	Storage of snowpack in each HRU at the beginning of a simulation	nhru	real	inches	0.0 to 5000.0	0.0	required
tstorm_mo	Monthly indicator for prevalent storm type (0=frontal storms; 1=convective storms) for each HRU	nhru, nmonths	integer	none	0 or 1	0	required
	Hortonian surface runoff, infiltration, and impervious storage						
carea_max	Maximum possible area contributing to surface runoff expressed as a portion of the HRU area	nhru	real	decimal fraction	0.0 to 1.0	0.6	required
carea_min	Minimum possible area contributing to surface runoff expressed as a portion of the area for each HRU	nhru	real	decimal fraction	0.0 to 1.0	0.2	srunoff_module = srunoff_carea
hru_percent_imperv[2]	Fraction of each HRU area that is impervious	nhru	real	decimal fraction	0.0 to 0.999	0.0	required
imperv_stor_max	Maximum impervious area retention storage for each HRU	nhru	real	inches	0.0 to 0.5	0.05	required
smidx_coef	Coefficient in non-linear contributing area algorithm for each HRU	nhru	real	decimal fraction	0.0 to 1.0	0.005	srunoff_module = srunoff_smidx
smidx_exp	Exponent in non-linear contributing area algorithm for each HRU	nhru	real	1/inch	0.0 to 5.0	0.3	srunoff_module = srunoff_smidx
snowinfil_max	Maximum snow infiltration per day for each HRU	nhru	real	inches/day	0.0 to 20.0	2.0	required
	Surface depression storage						
dprst_area	Aggregate sum of surface-depression storage areas of each HRU (recommend that dprst_frac_hru be used instead of dprst_area)	nhru	real	acres	0.0 to 1.0E9	0.0	dprst_flag = 1 and model_mode = PRMS
dprst_depth_avg	Average depth of storage depressions at maximum storage capacity	nhru	real	inches	0.0 to 500.0	132.0	dprst_flag = 1
dprst_et_coef	Fraction of unsatisfied potential evapotranspiration to apply to surface-depression storage	nhru	real	decimal fraction	0.5 to 1.5	1.0	dprst_flag = 1
dprst_flow_coef	Coefficient in linear flow routing equation for open	nhru	real	fraction/day	0.00001 to	0.05	dprst_flag = 1

Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
	surface depressions for each HRU				0.5		
dprst_frac_hru	Fraction of each HRU area that has surface depressions (If specified, the parameter dprst_area is ignored if it also is specified, default of -1.0 means use dprst_area)	nhru	real	decimal fraction	-1.0 to 0.999	-1.0	dprst_flag = 1 and model_mode = PRMS or GSFLOW
dprst_frac	Fraction of each HRU area that has surface depressions	nhru	real	decimal fraction	0.0 to 0.999	0.0	dprst_flag = 1 and model_mode = PRMS5 or GSFLOW5
dprst_frac_init	Fraction of maximum surface-depression storage that contains water at the start of a simulation	nhru	real	decimal fraction	0.0 to 1.0	0.5	dprst_flag = 1
dprst_frac_open	Fraction of open surface-depression storage area within an HRU that can generate surface runoff as a function of storage volume	nhru	double	decimal fraction	0.0 to 1.0	1.0	dprst_flag = 1
dprst_seep_rate_clos	Coefficient used in linear seepage flow equation for closed surface depressions for each HRU	nhru	real	fraction/day	0.0 to 0.2	0.02	dprst_flag = 1
dprst_seep_rate_open	Coefficient used in linear seepage flow equation for open surface depressions for each HRU	nhru	real	fraction/day	0.0 to 0.2	0.02	dprst_flag = 1
op_flow_thres	Fraction of open depression storage above which surface runoff occurs; any water above maximum open storage capacity spills as surface runoff	nhru	real	decimal fraction	0.01 to 1.0	1.0	dprst_flag = 1
sro_to_dprst_imperv	Fraction of impervious surface runoff that flows into surface-depression storage; the remainder flows to a stream network for each HRU	nhru	real	decimal fraction	0.0 to 1.0	0.2	dprst_flag = 1
sro_to_dprst	Fraction of pervious surface runoff that flows into surface-depression storage; the remainder flows to a stream network for each HRU	nhru	real	decimal fraction	0.0 to 1.0	0.2	dprst_flag = 1 and model_mode = PRMS or GSFLOW
sro_to_dprst_perv	Fraction of pervious surface runoff that flows into surface-depression storage; the remainder flows to a stream network for each HRU	nhru	real	decimal fraction	0.0 to 1.0	0.2	dprst_flag = 1 and model_mode = PRMS5 or GSFLOW5
va_clos_exp	Coefficient in the exponential equation relating maximum surface area to the fraction that closed depressions are full to compute current surface area for each HRU; 0.001 is an approximate cylinder; 1.0 is a cone	nhru	real	none	0.0001 to 10.0	0.001	dprst_flag = 1
va_open_exp	Coefficient in the exponential equation relating maximum surface area to the fraction that open depressions are full to compute current surface area for each HRU; 0.001 is an approximate cylinder; 1.0 is a cone	nhru	real	none	0.0001 to 10.0	0.001	dprst_flag = 1
	Soil zone storage, interflow, gravity drainage, dunnian surface runoff						
fastcoef_lin	Linear coefficient in equation to route preferential-flow	nhru	real	fraction/day	0.0 to 1.0	0.1	required[8]

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Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
	storage downslope for each HRU						
fastcoef_sq	Non-linear coefficient in equation to route preferential-flow storage downslope for each HRU	**nhru**	real	none	0.0 to 1.0	0.8	required[8]
pref_flow_den	Fraction of the soil zone in which preferential flow occurs for each HRU	**nhru**	real	decimal fraction	0.0 to 0.5	0.0	required[8]
sat_threshold	Water holding capacity of the gravity and preferential-flow reservoirs; difference between field capacity and total soil saturation for each HRU	**nhru**	real	inches	0.00001 to 999.0	999.0	required[8]
slowcoef_lin	Linear coefficient in equation to route gravity-reservoir storage downslope for each HRU	**nhru**	real	fraction/day	0.0 to 1.0	0.015	required[8]
slowcoef_sq	Non-linear coefficient in equation to route gravity-reservoir storage downslope for each HRU	**nhru**	real	none	0.0 to 1.0	0.1	required[8]
soil_moist_init	Initial value of available water in capillary reservoir for each HRU	**nhru**	real	inches	0.0 to 20.0	3.0	**model_mode** = PRMS or GSFLOW
soil_moist_init_frac	Initial fraction of available water in the capillary reservoir (fraction of **soil_moist_max** for each HRU	**nhru**	real	decimal fraction	0.0 to 1.0	0.0	**model_mode** = PRMS5 or GSFLOW5
soil_moist_max	Maximum available water holding capacity of capillary reservoir from land surface to rooting depth of the major vegetation type of each HRU	**nhru**	real	inches	0.00001 to 20.0	2.0	required
soil_rechr_init	Initial storage for soil recharge zone (upper part of capillary reservoir where losses occur as both evaporation and transpiration) for each HRU; must be less than or equal to **soil_moist_init**	**nhru**	real	inches	0.0 to 20.0	1.0	**model_mode** = PRMS or GSFLOW
soil_rechr_init_frac	Initial fraction of available water in the capillary reservoir where losses occur as both evaporation and transpiration (upper zone of capillary reservoir) for each HRU	**nhru**	real	decimal fraction	0.0 to 1.0	0.0	**model_mode** = PRMS5 or GSFLOW5
soil_rechr_max	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 **soil_moist_max**	**nhru**	real	inches	0.00001 to 20.0	1.5	**model_mode** = PRMS or GSFLOW
soil_rechr_max_frac	Fraction of the capillary reservoir water-holding capacity (**soil_moist_max**) where losses occur as both evaporation and transpiration (upper zone of capillary reservoir) for each HRU	**nhru**	real	decimal fraction	0.00001 to 1.0	1.0	**model_mode** = PRMS5 or GSFLOW5
soil2gw_max	Maximum amount of the capillary reservoir excess that is routed directly to the GWR for each HRU	**nhru**	real	inches	0.0 to 5.0	0.0	required
ssr2gw_exp	Non-linear coefficient in equation used to route water from the gravity reservoirs to the GWR for each HRU	**nssr**	real	none	0.0 to 3.0	1.0	required
ssr2gw_rate	Linear coefficient in equation used to route water from	**nssr**	real	fraction/day	0.0001 to	0.1	required

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Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
	the gravity reservoir to the GWR for each HRU				1.0		
ssstor_init	Initial storage of the gravity and preferential-flow reservoirs for each HRU	**nssr**	real	inches	0.0 to 10.0	0.0	**model_mode** = PRMS or GSFLOW
ssstor_init_frac	Initial fraction of available water in the gravity plus preferential-flow reservoirs (fraction of **sat_threshold**) for each HRU	**nssr**	real	decimal fraction	0.0 to 1.0	0.0	**model_mode** = PRMS5 or GSFLOW5

		Groundwater flow					
gwflow_coef	Linear coefficient in the equation to compute groundwater discharge for each GWR	**ngw**	real	fraction/day	0.0 to 0.5	0.015	required
gwsink_coef	Linear coefficient in the equation to compute outflow to the groundwater sink for each GWR	**ngw**	real	fraction/day	0.0 to 1.0	0.0	required
gwstor_init	Storage in each GWR at the beginning of a simulation	**ngw**	real	inches	0.0 to 50.0	2.0	required
gwstor_min	Minimum storage in each GWR to ensure storage is greater than specified value to account for inflow from deep aquifers or injection wells with the water source outside the basin	**ngw**	real	inches	0.0 to 1.0	0.0	required

		Streamflow					
hru_segment	Segment index to which an HRU contributes lateral flows (surface runoff, interflow, and groundwater discharge)	**nhru**	integer	none	0 to **nsegment**	0	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
K_coef	Travel time of flood wave from one segment to the next downstream segment, called the Muskingum storage coefficient; enter 1.0 for reservoirs, diversions, and segment(s) flowing out of the basin	**nsegment**	real	hours	0.01 to 24.0	1.0	**strmflow_module** = muskingum
mann_n	Mannings roughness coefficient for each segment	**nsegment**	real	dimensionless	0.001 to 0.15	0.04	**strmflow_module** = muskingum_mann
obsin_segment	Index of measured streamflow station that replaces inflow to a segment	**nsegment**	integer	none	0 to **nobs**	0	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
obsout_segment	Index of measured streamflow station that replaces outflow from a segment	**nsegment**	integer	none	0 to **nobs**	0	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake,

Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
							or `muskingum_mann`
seg_depth	Segment river depth at bankfull, shallowest from Blackburn-Lynch 2017,Congo is deepest at 250 m but in the US it is probably the Hudson at 66 m	nsegment	real	meters	0.03 to 250.0	1.0	strmflow_module = `muskingum_mann`
seg_length	Length of each segment, bounds based on CONUS	nsegment	real	meters	0.001 to 200000.0	1000.0	strmflow_module = `muskingum_mann` or stream_temp_flag = 1
seg_slope	Surface slope of each segment as approximation for bed slope of stream	nsegment	real	decimal fraction	0.0 to 2.0	0.0001	strmflow_module = `muskingum_mann` or stream_temp_flag = 1
segment_flow_init	Initial flow in each stream segment	nsegment	real	cfs	0 to 1.0E7	0.0	strmflow_module = `muskingum`, `strmflow_in_out`, `muskingum_lake`, or `muskingum_mann`
segment_type	Segment type (0=segment; 1= headwater; 2=lake; 3=replace inflow; 4=inbound to NHM; 5=outbound from NHM; 6=inbound to region; 7=outbound from region; 8=drains to ocean; 9=sink; 10=inbound from Great Lakes; 11=outbound to Great Lakes, add 100 to flag that the value is updated)	nsegment	integer	none	0 to 111	0	strmflow_module = `muskingum`, `strmflow_in_out`, `muskingum_lake`, or `muskingum_mann`
tosegment	Index of downstream segment to which the segment streamflow flows; for segments that do not flow to another segment enter `0`	nsegment	integer	none	-11 to 1000000	0	strmflow_module = `muskingum`, `strmflow_in_out`, `muskingum_lake`, or `muskingum_mann`
tosegment_nhm	National Hydrologic Model downstream segment ID	nsegment	integer	none	0 to 9999999	0	optional
x_coef	The amount of attenuation of the flow wave, called the Muskingum routing weighting factor; enter `0.0` for reservoirs, diversions, and segment(s) flowing out of the basin	nsegment	real	decimal fraction	0.0 to 0.5	0.2	strmflow_module = `muskingum` or `muskingum_mann`
				Lake routing			
elev_outflow	Elevation of the main outflow point for each lake using	nlake	real	feet	-300.0 to	0.0	strmflow_module =

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Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
	broad-crested weir routing				10,000.0		muskingum_lake
elevlake_init	Initial lake surface elevation for each lake using broad-crested weir routing or gate opening routing	nlake	real	feet	-300.0 to 10,000.0	1.0	strmflow_module = muskingum_lake
gw_seep_coef	Linear coefficient in equation to compute lakebed seepage to the GWR and groundwater discharge to each lake using broad-crested weir routing or gate opening routing	ngw	real	fraction/day	0.001 to 0.05	0.015	strmflow_module = muskingum_lake
lake_coef	Coefficient in equation to route storage to streamflow for each lake using linear routing	nlake	real	fraction/day	0.0001 to 1.0	0.1	strmflow_module = muskingum_lake
lake_din1	Initial inflow to each lake using Puls or linear storage routing	nlake	real	cfs	0.0 to 1.0E7	0.1	strmflow_module = muskingum_lake
lake_evap_adj	Monthly (January to December) adjustment factor for potential ET for each lake	nhru	real	decimal fraction	0.5 to 1.5	1.0	strmflow_modu muskingum_lake
~~lake_hru~~	~~Index of HRU for each lake~~	~~nlake~~	~~integer~~	~~none~~	~~0 to nhru~~	~~0~~	~~strmflow_module = strmflow_lake~~
lake_hru_id	Identification number of the lake associated with an HRU; more than one HRU can be associated with each lake	nhru	integer	none	0 to nlake	0	strmflow_module = muskingum_lake
lake_init	Initial storage in each lake using Puls or linear storage routing	nlake	real	cfs-days	0.0 to 1.0E7	0.0	strmflow_module = muskingum_lake
lake_out2	Switch to specify a second outflow point from each lake using gate opening routing (0=no; 1=yes)	nlake	integer	none	0 or 1	0	strmflow_module = muskingum_lake
lake_out2_a	Coefficient A in outflow equation for each lake with a second outlet using gate opening routing	nlake	real	cfs/feet	0.0 to 10,000.0	1.0	strmflow_module = muskingum_lake
lake_out2_b	Coefficient B in outflow equation for each lake with a second outlet using gate opening routing	nlake	real	cfs	0.0 to 10,000.0	100.0	strmflow_module = muskingum_lake
lake_qro	Initial daily mean outflow from each lake	nlake	real	cfs	0.0 to 1.0E7	0.1	strmflow_module = muskingum_lake
lake_seep_elev	Elevation over which lakebed seepage to the GWR occurs for lake HRUs using broad-crested weir routing or gate opening routing	nlake	real	feet	-300.0 to 10,000.0	1.0	strmflow_module = muskingum_lake
lake_segment_id	Index of lake associated with a segment	nsegment	integer	none	0 to nlake	0	strmflow_module = muskingum_lake and cascade_flag = 1
lake_type	Type of lake routing method (1=Puls routing; 2=linear routing; 3=flow through; 4=broad crested weir; 5=gate opening; and 6=measured flow)	nlake	integer	none	1 to 6	1	strmflow_module = muskingum_lake
lake_vol_init	Initial lake volume for each lake using broad-crested weir or gate opening routing	nlake	real	acre-feet	0.0 to 1.0E7	0.0	strmflow_module = muskingum_lake
nsos	Number of storage/outflow values in table for each lake	mxnsos,	integer	none	0 to	0	strmflow_module =

Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
	using Puls routing	**nlake**			**mxnsos**		muskingum_lake
o2	Outflow values in outflow/storage tables for each lake using Puls routing	**mxnsos, nlake**	real	cfs	0.0 to 1.0E7	0.0	**strmflow_module** = muskingum_lake
obsout_lake	Index of streamflow measurement station that specifies outflow from each lake using measured flow replacement	**nlake**	integer	none	0 to **nobs**	0	**strmflow_module** = muskingum_lake
rate_table	Rating table with stage (rows) and gate opening (cols) for rating table 1 for lakes using gate opening routing and **nratetbl**>0	**nstage, ngate**	real	cfs	-100.0 to 1,000.0	5.0	**strmflow_module** = muskingum_lake
rate_table2	Rating table with stage (rows) and gate opening (cols) for rating table 2 for lakes using gate opening routing and **nratetbl**>1	**nstage2, ngate2**	real	cfs	-100.0 to 1,000.0	5.0	**strmflow_module** = muskingum_lake
rate_table3	Rating table with stage (rows) and gate opening (cols) for rating table 3 for lakes using gate opening routing and **nratetbl**>2	**nstage3, ngate3**	real	cfs	-100.0 to 1,000.0	5.0	**strmflow_module** = muskingum_lake
rate_table4	Rating table with stage (rows) and gate opening (cols) for rating table 4 for lakes using gate opening routing and **nratetbl**>3	**nstage4, ngate4**	real	cfs	-100.0 to 1,000.0	5.0	**strmflow_module** = muskingum_lake
ratetbl_lake	Index of lake associated with each rating table for each lake using gate opening routing	**nratetbl**	integer	none	0 to **nlake**	0	**strmflow_module** = muskingum_lake
s2	Storage values in outflow/storage table for each lake using Puls routing	**mxnsos, nlake**	real	cfs	0.0 to 1.0E7	0.0	**strmflow_module** = muskingum_lake
tbl_gate	Gate openings for each column for rating table 1 for lakes using gate opening routing and **nratetbl**>0	**ngate**	real	inches	0.0 to 20.0	0.0	**strmflow_module** = muskingum_lake
tbl_gate2	Gate openings for each column for rating table 2 for lakes using gate opening routing and **nratetbl**>1	**ngate2**	real	inches	0.0 to 20.0	0.0	**strmflow_module** = muskingum_lake
tbl_gate3	Gate openings for each column for rating table 3 for lakes using gate opening routing and **nratetbl**>2	**ngate3**	real	inches	0.0 to 20.0	0.0	**strmflow_module** = muskingum_lake
tbl_gate4	Gate openings for each column for rating table 4 for lakes using gate opening routing and **nratetbl**>3	**ngate4**	real	inches	0.0 to 20.0	0.0	**strmflow_module** = muskingum_lake
tbl_stage	Stage values for each row for rating table 1 for lakes using gate opening routing and **nratetbl>**0	**nstage**	real	feet	-100.0 to 1,000.0	5.0	**strmflow_module** = muskingum_lake
tbl_stage2	Stage values for each row for rating table 2 for lakes using gate opening routing and **nratetbl**>1	**nstage2**	real	feet	-100.0 to 1,000.0	5.0	**strmflow_module** = muskingum_lake
tbl_stage3	Stage values for each row for rating table 3 for lakes using gate opening routing and **nratetbl**>2	**nstage3**	real	feet	-100.0 to 1,000.0	5.0	**strmflow_module** = muskingum_lake
tbl_stage4	Stage values for each row for rating table 4 for lakes using gate opening routing and **nratetbl**>3	**nstage4**	real	feet	-100.0 to 1,000.0	5.0	**strmflow_module** = muskingum_lake
weir_coef	Coefficient for lakes using broad-crested weir routing	**nlake**	real	none	2.0 to 3.0	2.7	**strmflow_module** = muskingum_lake

Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
weir_len	Weir length for lakes using broad-crested weir routing	**nlake**	real	feet	1.0 to 1,000.0	5.0	**strmflow_module** = muskingum_lake

Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
print_freq	Flag to select the output frequency; for combinations, add index numbers, e.g., daily plus yearly = 10; yearly plus total = 3 (0=none; 1=run totals; 2=yearly; 4=monthly; 8=daily; or additive combinations)	**one**	integer	none	0 to 15	3	required
print_type	Flag to select the type of results written to the output file (0=measured and simulated flow only; 1=water balance table; 2=detailed output)	**one**	integer	none	0 to 2	1	required

Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
hru_subbasin	Index of subbasin assigned to each HRU	**nhru**	integer	none	0 to user defined	0	**subbasin_flag** = 1
subbasin_down	Index number for the downstream subbasin whose inflow is outflow from this subbasin	**nsub**	integer	none	0 to **nsub**	0	**subbasin_flag** = 1

Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
albedo	Short-wave solar radiation reflected by streams	**one**	real	decimal fraction	0.0 to 1.0	0.1	**stream_temp_flag** = 1
alte	East bank topographic altitude of each segment	**nsegment**	real	radians	0.0 to 1.570796	0.0	**stream_temp_flag** = 1
altw	West bank topographic altitude of each segment	**nsegment**	real	radians	0.0 to 1.570796	0.0	**stream_temp_flag** = 1
azrh	Azimith angle of each segment	**nsegment**	real	radians	-1.570796 to 1.570796	0.0	**stream_temp_flag** = 1
gw_tau	Average residence time in groundwater flow	**nsegment**	integer	days	1 to 365	365	**stream_temp_flag** = 1
lat_temp_adj	Correction factor to adjust the bias of the temperature of the lateral inflow	**nsegment, nmonths**	real	decimal fraction	-5.0 to 5.0	0.0	**stream_temp_flag** = 1
maxiter_sntemp	Maximum number of Newton-Raphson iterations to compute stream temperature	**one**	integer	none	10 to 2000	1000	**stream_temp_flag** = 1
melt_temp	Temperature at which snowmelt enters a stream	**one**	real	degrees Celsius	0.0 to 10.0	1.5	**stream_temp_flag** = 1
seg_elev	Segment elevation at midpoint	**nsegment**	real	meters	-1000.0 to 30000.0	0.0	**stream_temp_flag** = 1
seg_humidity	Mean monthly humidity for each segment, used when values not input in CBH File	**nsegment, nmonths**	real	decimal fraction	0.0 to 1.0	0.7	**stream_temp_flag** = 1
seg_lat	Latitiude of each segment	**nsegment**	real	degrees North	-90.0 to 90.0	40.0	**stream_temp_flag** = 1
segshade_sum	Total shade fraction for summer vegetation	**nsegment**	real	decimal	0.0 to 1.0	0.0	**stream_temp_flag** =

Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
				fraction			**stream_temp_flag** = 1
segshade_win	Total shade fraction for winter vegetation	**nsegment**	real	decimal fraction	0.0 to 1.0	0.0	**stream_temp_flag** = 1
ss_tau	Average residence time of subsurface interflow	**nsegment**	integer	days	1 to 365	30	**stream_temp_flag** = 1
stream_tave_init	Initial average stream temperature in each segment at the beginning of a simulation	**nsegment**	real	degrees Celsius	-10.0 to 100.0	0.0	**stream_temp_flag** = 1
vce	East bank average vegetation crown width for each segment	**nsegment**	real	meters	0.0 to 15.0	0.0	**stream_temp_flag** = 1
vcw	West bank average vegetation crown width for each segment	**nsegment**	real	meters	0.0 to 15.0	0.0	**stream_temp_flag** = 1
vdemn	Minimum east bank vegetation density for each segment	**nsegment**	real	decimal fraction	0.0 to 1.0	0.0	**stream_temp_flag** = 1
vdemx	Maximum east bank vegetation density for each segment	**nsegment**	real	decimal fraction	0.0 to 1.0	0.0	**stream_temp_flag** = 1
vdwmn	Minimum west bank vegetation density for each segment	**nsegment**	real	decimal fraction	0.0 to 1.0	0.0	**stream_temp_flag** = 1
vdwmx	Maximum west bank vegetation density for each segment	**nsegment**	real	decimal fraction	0.0 to 1.0	0.0	**stream_temp_flag** = 1
vhe	East bank average vegetation height for each segment	**nsegment**	real	meters	0.0 to 30.0	0.0	**stream_temp_flag** = 1
vhw	West bank average vegetation height for each segment	**nsegment**	real	meters	0.0 to 30.0	0.0	**stream_temp_flag** = 1
voe	East bank vegetation offset for each segment	**nsegment**	real	meters	0.0 to 100.0	0.0	**stream_temp_flag** = 1
vow	West bank vegetation offset for each segment	**nsegment**	real	meters	0.0 to 100.0	0.0	**stream_temp_flag** = 1
width_alpha	Alpha coefficient in power function for width calculation	**nsegment**	real	unknown	0.0001 to 2.0	0.015	**stream_temp_flag** = 1
width_m	M value in power function for width calculation	**nsegment**	real	unknown	0.0001 to 2.0	0.015	**stream_temp_flag** = 1
	Mapped results parameters						
gvr_cell_id[9]	Index of the grid cell associated with each gravity reservoir (default of -1 means HRUs and grid cells are equivalent)	**nhrucell**	integer	none	-1 to 999999999	-1	**mapOutON_OFF** = 1
gvr_cell_pct[9]	Proportion of the grid cell area associated with each gravity reservoir	**nhrucell**	real	decimal fraction	0.0 to 1.0	1.0	**mapOutON_OFF** = 1
gvr_hru_id[9]	Index of the HRU associated with each gravity reservoir	**nhrucell**	integer	none	0 to **nhrucell**	1	**mapOutON_OFF** = 1
mapvars_freq	Flag to specify the output frequency (0=none;	**one**	integer	none	0 to 7	0	**mapOutON_OFF** = 1

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Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
	1=monthly; 2=yearly; 3=total; 4=monthly and yearly; 5=monthly, yearly, and total; 6=weekly; 7=daily)						
mapvars_units	Flag to specify the output units of mapped results (0=units of the variable; 1=inches to feet; 2=inches to centimeters; 3=inches to meters; as states or fluxes)	**one**	integer	none	0 to 3	0	**mapOutON_OFF** = 1
ncol	Number of columns for each row of the mapped results	**one**	integer	none	1 to 50000	1	**mapOutON_OFF** = 1
~~prms_warmup~~	~~Number of years to simulate before writing mapped results~~	~~one~~	~~integer~~	~~years~~	~~0 to user defined~~	~~1~~	~~**mapOutON_OFF** = 1 or **nhruOutON_OFF** = 1~~
		Summary results CSV file parameters					
poi_gage_id	USGS stream gage ID for each POI gage	**npoigages**	string	none	user defined	0	**npoigages** > 0 and **csvON_OFF** = 1
poi_gage_segment	Segment index for each POI gage	**npoigages**	integer	none	0 to **nsegment**	0	**npoigages** > 0 and **csvON_OFF** = 1
poi_type	Type code for each POI gage (0=non-calibration gage, 1=calibration gage, 2=flow replacement gage)	**npoigages**	integer	none	1	1	**optional**
		Parameters for cascading-flow simulation					
cascade_flg	Flag to indicate cascade type (0=allow many to many; 1=force one to one)	**one**	integer	none	0 or 1	0	**cascade_flag** = 1 and **ncascade** > 0 and/or **cascadegw_flag** = 1 **ncascdgw** > 0
cascade_tol	Cascade area below which a cascade link is ignored	**one**	real	acres	0.0 to 0.75% of **hru_area**	5.0	**cascade_flag** = 1 and **ncascade** > 0 and/or **cascadegw_flag** = 1 **ncascdgw** > 0
circle_switch	Switch to check for circles (0=no check; 1=check)	**one**	integer	none	0 or 1	1	**cascade_flag** = 1 and **ncascade** > 0 and/or **cascadegw_flag** = 1 **ncascdgw** > 0
gw_down_id[3]	Index number of the downslope GWR to which the upslope GWR contributes flow	**ncascdgw**	integer	none	0 to **ngw**	0	**cascadegw_flag** = 1 and **ncascdgw** > 0
gw_pct_up	Fraction of GWR area used to compute flow contributed to a downslope GWR or stream segment for cascade area	**ncascdgw**	real	decimal fraction	0.0 to 1.0	1.0	**cascadegw_flag** = 1 and **ncascdgw** > 0
gw_strmseg_down_id	Index number of the stream segment that cascade area contributes flow	**ncascdgw**	integer	none	0 to **nsegment**	0	**cascadegw_flag** = 1 and **ncascdgw** > 0
gw_up_id	Index of GWR containing cascade area	**ncascdgw**	integer	none	1 to **ngw**	0	**cascadegw_flag** = 1 and **ncascdgw** > 0
hru_down_id[4]	Index number of the downslope HRU to which the upslope HRU contributes flow	**ncascade**	integer	none	0 to **nhru**	0	**cascade_flag** = 1 and

Parameter name	Description	Dimension[1]	Type	Units	Range	Default	Required/condition
							ncascade > 0
hru_pct_up	Fraction of HRU area used to compute flow contributed to a downslope HRU or stream segment for cascade area	**ncascade**	real	decimal fraction	0.0 to 1.0	1.0	**cascade_flag** = 1 and **ncascade** > 0
hru_strmseg_down_id	Index number of the stream segment that cascade area contributes flow	**ncascade**	integer	none	0 to **nsegment**	0	**cascade_flag** = 1 and **ncascade** > 0
hru_up_id	Index of HRU containing cascade area	**ncascade**	integer	none	0 to **nhru**	0	**cascade_flag** = 1 and **ncascade** > 0

[1]Dimensions defined in table 1-1.

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

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

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

[9]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, <mark>version 5 (PRMS-V).</mark>

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

[1]Dimensions defined in table 1-1.

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

[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; <mark style="background:lime">green</mark> highlight indicates new for PRMS-V <mark style="background:lime">**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</mark>; ~~strikethrough~~ indicates items removed]

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

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

Variable name	Description	Dimension[1]	Units	Data type	Availabilty/condition
	measurement stations				or `xyz_dist`
tminc	Minimum air temperature distributed to each HRU	**nhru**	degrees Celsius	real	always
tminf	Minimum air temperature distributed to each HRU	**nhru**	degrees Fahrenheit	real	always
wind_speed	Wind speed at each measurement station	**nwind**	miles per hour	real	**nwind** > 0
wind_speed_hru	Wind speed for each HRU	**nhru**	miles per hour	real	**et_module** = `potet_pm`

<div align="center">Solar radiation distribution</div>

Variable name	Description	Dimension[1]	Units	Data type	Availabilty/condition
basin_cloud_cover	Basin area-weighted average cloud cover proportion	**one**	decimal fraction	double	**solrad_module** = `ccsolrad`
basin_horad	Potential shortwave radiation for the basin centroid	**one**	Langleys	double	always
basin_orad	Basin area-weighted average shortwave radiation on a horizontal surface	**one**	Langleys	double	**solrad_module** = `ccsolrad` or `ddsolrad`
basin_potsw	Basin area-weighted average shortwave radiation	**one**	Langleys	double	always
basin_radadj	Basin area-weighted average potential radiation adjustment for cloud cover	**one**	decimal fraction	double	**solrad_module** = `ccsolrad`
basin_swrad	Basin area-weighted average shortwave radiation	**one**	Langleys	double	always
cloud_cover_hru	Cloud cover proportion of each HRU	**nhru**	decimal fraction	double	**solrad_module** = `ccsolrad`
cloud_radadj	Radiation adjustment for cloud cover of each HRU	**nhru**	decimal fraction	double	**solrad_module** = `ccsolrad`
lwrad_net	Net long-wave radiation for each HRU	**nhru**	Megajoules/m**2/day	real	**et_module** = `potet_pm`, `potet_pm_sta`, or `potet_pt`
orad	Measured or computed solar radiation on a horizontal surface	**one**	Langleys	real	**solrad_module** = `ccsolrad` or `ddsolrad`
orad_hru	Solar radiation on a horizontal surface for each HRU	**one**	Langleys	double	**solrad_module** = `ccsolrad` or `ddsolrad`
seginc_swrad	Area-weighted average solar radiation for each segment from HRUs contributing flow to the segment	**nsegment**	Langleys	double	**nsegment** > 0
solrad	Solar radiation at each measurement station	**nsol**	Langleys	real	**nsol** > 0
solrad_tmax[5]	Basin maximum air temperature for use with solar radiation calculations	**one**	**temp_units**	real	always
solrad_tmin[5]	Basin minimum air temperature for use with solar radiation calculations	**one**	**temp_units**	real	always
soltab_horad_potsw	Potential solar radiation on a horizontal plane for each Julian Day, for each HRU	**ndays, nhru**	Langleys	double	always
soltab_potsw	Potential solar radiation for each Julian Day, for each HRU	**ndays, nhru**	Langleys	double	always
subinc_swrad	Area-weighted average shortwave radiation distributed to associated HRUs of each subbasin	**nsub**	Langleys	double	**subbasin_flag** = 1
swrad	Shortwave radiation distributed to each HRU	**nhru**	Langleys	real	always

<div align="center">Water Use</div>

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Variable name	Description	Dimension[1]	Units	Data type	Availabilty/condition
basin_hru_apply	Basin area-weighted average canopy_gain	**one**	inches	double	**water_use_flag** = 1
basin_net_apply	Basin area-weighted average *net_apply*	**one**	inches	double	**water_use_flag** = 1
canopy_gain	Transfer gain to the canopy reservoir for each HRU for each time step	**nhru**	cfs	real	**water_use_flag** = 1
canopy_gain_tot	Transfer gain to the canopy reservoir for each HRU for the simulation	**nhru**	cfs	real	**water_use_flag** = 1 and **nconsumed** > 0
consumed_gain	Transfer gain to each water-use consumption destination for each time step	**nconsumed**	cfs	real	**water_use_flag** = 1 and **nconsumed** > 0
consumed_gain_tot	Transfer gain to each water-use consumption destination for the simulation	**nconsumed**	cfs	real	**water_use_flag** = 1 and **nconsumed** > 0
dprst_gain	Transfer gain to surface-depression storage for each HRU for each time step	**nhru**	cfs	real	**dprst_transferON_OFF** = 1 and **dprst_flag** = 1
dprst_gain_tot	Transfer gain to surface-depression storage for each HRU for the simulation	**nhru**	cfs	real	**dprst_transferON_OFF** = 1 and **dprst_flag** = 1
dprst_transfer	Transfer flow rate from surface-depression storage for each HRU for each time step	**nhru**	cfs	real	**dprst_transferON_OFF** = 1 and **dprst_flag** = 1
dprst_transfer_tot	Transfer flow rate from surface-depression storage for each HRU for the simulation	**nhru**	cfs	real	**dprst_transferON_OFF** = 1 and **dprst_flag** = 1
external_gain	Transfer gain to each external location for each time step	**nexternal**	cfs	real	**external_transferON_OFF** = 1 and **nexternal** > 1
external _gain_tot	Transfer gain to each external location for the simulation	**nexternal**	cfs	real	**external_transferON_OFF** = 1 and **nexternal** > 1
external_transfer	Transfer flow rate from each external location for each time step	**nexternal**	cfs	real	**external_transferON_OFF** = 1 and **nexternal** > 1
external _transfer_tot	Transfer flow rate from each external location for the simulation	**nexternal**	cfs	real	**external_transferON_OFF** = 1 and **nexternal** > 1
gwr_gain	Transfer gain to the groundwater reservoir of each HRU for each time step	**nhru**	cfs	real	**water_use_flag** = 1
gwr_gain _tot	Transfer gain to the groundwater reservoir of each HRU for the simulation	**nhru**	cfs	real	**water_use_flag** = 1
gwr_transfer	Transfer flow rate from the groundwater reservoir of each HRU for each time step	**nhru**	cfs	real	**gwr_transferON_OFF** = 1
gwr_transfer_tot	Transfer flow rate from the groundwater reservoir of each HRU for the simulation	**nhru**	cfs	real	**gwr_transferON_OFF** = 1
lake_gain	Transfer gain to each lake HRU for each time step	**nhru**	cfs	real	**water_use_flag** = 1 and **strmflow_module** = `muskingum_lake`

Variable name	Description	Dimension[1]	Units	Data type	Availabilty/condition
lake_gain _tot	Transfer gain to each lake HRU for the simulation	**nhru**	cfs	real	**water_use_flag** = 1 and **strmflow_module** = muskingum_lake
lake_transfer	Transfer flow rate from each lake HRU for each time step	**nhru**	cfs	real	**lake_transferON_OFF** = 1 and **strmflow_module** = muskingum_lake
lake_transfer_tot	Transfer flow rate from each lake HRU for the simulation	**nhru**	cfs	real	**lake_transferON_OFF** = 1 and **strmflow_module** = muskingum_lake
net_apply	*canopy_gain* minus interception	**nhru**	inches	real	**water_use_flag** = 1
segment_gain	Transfer gain to each stream segment for each time step	**nhru**	cfs	real	**water_use_flag** = 1 and **strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
segment_gain _tot	Transfer gain to each stream segment for the simulation	**nhru**	cfs	real	**water_use_flag** = 1 and **strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
segmen _transfer	Transfer flow rate from each stream segment for each time step	**nhru**	cfs	real	**segment_transferON_OFF** = 1 and **strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
segment_transfer_tot	Transfer flow rate from each stream segment for the simulation	**nhru**	cfs	real	**segment_transferON_OFF** = 1 and **strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
soilzone_gain	Transfer gain to the capillary reservoir within the soilzone for each HRU for each time step	**nhru**	cfs	real	**water_use_flag** = 1
soilzone_gain _tot	Transfer gain to the capillary reservoir within the soilzone for each HRU for the simulation	**nhru**	cfs	real	**water_use_flag** = 1

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Variable name	Description	Dimension[1]	Units	Data type	Availabilty/condition
total_canopy_gain	Transfer gains to all canopy reservoirs for each time step	**one**	cfs	double	**water_use_flag** = 1
total_consumed_gain	Transfer flow rates to all water-use consumption destinations for each time step	**one**	cfs	double	**water_use_flag** = 1
total_dprst_gain	Transfer gains to all surface-depression storage for each time step	**one**	cfs	double	**water_use_flag** = 1 and **dprst_flag** = 1
total_dprst_transfer	Transfer flow rates from all surface-depression storage for each time step	**one**	cfs	double	**dprst_transferON_OFF** = 1 and **dprst_flag** = 1
total_external_gain	Transfer gains to all external locations for each time step	**one**	cfs	double	**water_use_flag** = 1
total_external_transfer	Transfer flow rates from all external locations for each time step	**one**	cfs	double	**external_transferON_OFF** = 1 and **nexternal** > 1
total_gwr_gain	Transfer gains to all groundwater reservoir for each time step	**one**	cfs	double	**water_use_flag** = 1
total_gwr_transfer	Transfer flow rates from all groundwater reservoirs for each time step	**one**	cfs	double	**water_use_flag** = 1 and **gwr_transferON_OFF** = 1
total_lake_gain	Transfer gains to all lake HRUs for each time step	**one**	cfs	double	**water_use_flag** = 1 and **strmflow_module** = `muskingum_lake`
total_lake_transfer	Transfer flow rates from all lake HRUs for each time step	**one**	cfs	double	**lake_transferON_OFF** = 1 and **strmflow_module** = `muskingum_lake`
total_segment_gain	Transfer gains to all stream segments for each time step	**one**	cfs	double	**water_use_flag** = 1 and **strmflow_module** = `muskingum`, `strmflow_in_out`, `muskingum_lake`, or `muskingum_mann`
total_segment_transfer	Transfer flow rates from all stream segments for each time step	**one**	cfs	double	**segment_transferON_OFF** = 1 and **strmflow_module** = `muskingum`, `strmflow_in_out`, `muskingum_lake`, or `muskingum_mann`
total_soilzone_gain	Transfer gains to all capillary reservoirs for each time step	**one**	cfs	double	**water_use_flag** = 1
total_transfers	Transfer of all water-use transfers for each time step	**one**	cfs	double	**water_use_flag** = 1
transfesr_rate	Transfer of each water-use transfer for each time step	**nwateruse**	cfs	double	**water_use_flag** = 1
	Interception				
basin_changeover	Basin area-weighted average water released from a change over of canopy cover type	**one**	inches	double	always

Variable name	Description	Dimension[1]	Units	Data type	Availabilty/condition
basin_intcp_stor	Basin area-weighted average interception storage	**one**	inches	double	always
basin_net_rain	Basin area-weighted average rain throughfall	**one**	inches	double	always
basin_net_snow	Basin area-weighted average snow throughfall	**one**	inches	double	always
canopy_covden	Canopy cover density fo each HRU	**nhru**	decimal fraction	real	always
hru_intcpstor	Interception storage in the canopy for each HRU	**nhru**	inches	real	always
intcp_changeover	Water released from a change over of canopy cover type for each HRU	**nhru**	inches	real	always
intcp_form	Form (rain or snow) of interception for each HRU	**nhru**	none	integer	always
intcp_on	Flag indicating interception storage for each HRU (0=no; 1=yes)	**nhru**	none	integer	always
intcp_stor	Interception storage in canopy for cover density for each HRU	**nhru**	inches	real	always
net_ppt	Precipitation (rain and/or snow) that falls through the canopy for each HRU	**nhru**	inches	real	always
net_rain	Rain that falls through canopy for each HRU	**nhru**	inches	real	always
net_snow	Snow that falls through canopy for each HRU	**nhru**	inches	real	always
	Snow computations				
ai	Maximum snowpack for each HRU	**nhru**	inches	real	always
albedo	Snow surface albedo or the fraction of radiation reflected from the snowpack surface for each HRU	**nhru**	decimal fraction	real	always
basin_pk_precip	Basin area-weighted average precipitation added to snowpack	**one**	inches	double	always
basin_pweqv	Basin area-weighted average snowpack water equivalent	**one**	inches	double	always
basin_snowcov	Basin area-weighted average snow-covered area	**one**	decimal fraction	double	always
basin_snowmelt	Basin area-weighted average snowmelt	**one**	inches	double	always
basin_snowmelt_mo	Monthly basin area-weighted average snowmelt	**one**	inches	double	always
basin_snowmelt_tot	Total simulation basin area-weighted average snowmelt	**one**	inches	double	always
basin_snowmelt_yr	Yeary basin area-weighted average snowmelt	**one**	inches	double	always
basin_tcal	Basin area-weighted average net snowpack energy balance	**one**	Langleys	double	always
frac_swe	Fraction of maximum snow-water equivalent (snarea_thresh) on each HRU	**nhru**	decimal fraction	real	always
freeh2o	Storage of free liquid water in the snowpack on each HRU	**nhru**	inches	real	always
iasw	Flag indicating that snow covered area is interpolated between previous location on curve and maximum (1), or is on the defined curve (0)	**nhru**	none	integer	always
int_alb	Flag to indicate (1: accumulation season curve; 2: use of the melt season curve)	**nhru**	none	integer	always
iso	Flag to indicate if time is before (1) or after (2) the day to force melt season (**melt_force**)	**nhru**	none	integer	always

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Variable name	Description	Dimension[1]	Units	Data type	Availabilty/condition
lso	Counter for tracking the number of days the snowpack is at or above 0 degrees Celsius	**nhru**	number of iterations	integer	always
lst	Flag indicating whether there was new snow that was insufficient to reset the albedo curve (1) (**albset_snm** or **albset_sna**), otherwise (0)	**nhru**	none	integer	always
mso	Flag to indicate if time is before (1) or after (2) the first potential day for melt season (**melt_look**)	**nhru**	none	integer	always
pk_def	Heat deficit, amount of heat necessary to make the snowpack isothermal at 0 degrees Celsius	**nhru**	Langleys	real	always
pk_den	Density of the snowpack on each HRU	**nhru**	grams/cubic centimeters	real	always
pk_depth	Depth of snowpack on each HRU	**nhru**	inches	double	always
pk_ice	Storage of frozen water in the snowpack on each HRU	**nhru**	inches	real	always
pk_precip	Precipitation added to snowpack for each HRU	**nhru**	inches	real	always
pk_temp	Temperature of the snowpack on each HRU	**nhru**	**temp_units**	real	always
pksv	Snowpack water equivalent when there is new snow and in melt phase; used to interpolate between depletion curve and 100 percent on each HRU	**nhru**	inches	real	always
pkwater_ante	Antecedent snowpack water equivalent on each HRU	**nhru**	inches	double	always
pkwater_equiv	Snowpack water equivalent on each HRU	**nhru**	inches	double	always
pptmix_nopack	Flag indicating that a mixed precipitation event has occurred with no snowpack present on an HRU (1), otherwise (0)	**nhru**	none	integer	always
pss	Previous snowpack water equivalent plus new snow	**nhru**	inches	real	always
pst	While a snowpack exists, *pst* tracks the maximum snow water equivalent of that snowpack	**nhru**	inches	real	always
salb	Days since last new snow to reset albedo for each HRU	**nhru**	days	real	always
scrv	Snowpack water equivalent plus a portion of new snow on each HRU	**nhru**	inches	double	always
slst	Days since last new snow for each HRU	**nhru**	days	real	always
snow	Snow depth at each measurement station	**nsnow**	inches	real	**nsnow** > 0
snow_free	Fraction of snow-free surface for each HRU	**nhru**	decimal fraction	real	always
snowcov_area	Snow-covered area on each HRU prior to melt and sublimation unless snowpack depleted	**nhru**	decimal fraction	real	always
snowcov_areasv	Snow cover fraction when there is new snow and in melt phase; used to interpolate between depletion curve and 100 percent on each HRU	**nhru**	decimal fraction	real	always
snowmelt	Snowmelt from snowpack on each HRU	**nhru**	inches	real	always
snsv	Tracks the cumulative amount of new snow until there is	**nhru**	inches	real	always

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Variable name	Description	Dimension[1]	Units	Data type	Availabilty/condition
	enough to reset the albedo curve (**albset_snm** or **albset_sna**)				
subinc_pkweqv	Area-weighted average snowpack water equivalent from associated HRUs of each subbasin	**nsub**	inches	double	**subbasin_flag** = 1
subinc_snowcov	Area-weighted average snow-covered area from associated HRUs to each subbasin	**nsub**	decimal fraction	double	**subbasin_flag** = 1
subinc_snowmelt	Area-weighted average snowmelt from associated HRUs of each subbasin	**nsub**	inches	double	**subbasin_flag** = 1
tcal	Net snowpack energy balance on each HRU	**nhru**	Langleys	real	always
	Evapotranspiration				
basin_actet	Basin area-weighted average actual ET	**one**	inches	double	always
basin_actet_mo	Monthly basin area-weighted average actual ET	**one**	inches	double	always
basin_actet_tot	Total simulation basin area-weighted average actual ET	**one**	inches	double	always
basin_actet_yr	Yearly basin area-weighted average actual ET	**one**	inches	double	always
basin_dprst_evap	Basin area-weighted average evaporation from surface depression storage	**one**	inches	double	**dprst_flag** = 1
basin_fall_frost	Basin area-weighted average fall frost	**one**	**solar date**	real	**model_mode** = FROST
basin_humidity	Basin area-weighted average average humidity	**one**	percentage	double	**et_module** = potet_pm, potet_pm_sta, or potet_pt
basin_imperv_evap	Basin area-weighted average evaporation from impervious area	**one**	inches	double	always
basin_lakeevap	Basin area-weighted average lake evaporation	**one**	inches	double	**nlake** > 0
basin_intcp_evap	Basin area-weighted evaporation from the canopy	**one**	inches	double	always
basin_intcp_evap_mo	Monthly basin basin area-weighted average interception evaporation	**one**	inches	double	always
basin_intcp_evap_tot	Total simulation basin basin area-weighted average interception evaporation	**one**	inches	double	always
basin_intcp_evap_yr	Yearly basin basin area-weighted average interception evaporation	**one**	inches	double	always
basin_perv_et	Basin area-weighted average ET from capillary reservoirs	**one**	inches	double	always
basin_potet	Basin area-weighted average potential ET	**one**	inches	double	always
basin_potet_mo	Monthly area-weighted average potential ET	**one**	inches	double	always
basin_potet_tot	Total simulation area-weighted average potential ET	**one**	inches	double	always
basin_potet_yr	Yearly area-weighted average potential ET	**one**	inches	double	always
basin_snowevap	Basin area-weighted average evaporation and sublimation from snowpack	**one**	inches	double	always
basin_spring_frost	Basin area-weighted average spring frost	**one**	**solar date**	real	**model_mode** = FROST
basin_swale_et	Basin area-weighted average ET from swale HRUs	**one**	inches	double	always

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

Variable name	Description	Dimension[1]	Units	Data type	Availabilty/condition
transp_on	Flag indicating whether transpiration is occurring (0=no; 1=yes)	**nhru**	none	integer	always
unused_potet	Unsatisfied potential evapotranspiration	**nhru**	inches	real	always
vp_actual	Actual vapor pressure for each HRU	**nhru**	kilopascals	real	**et_module** = potet_pm, potet_pm_sta, or potet_pt
vp_sat	Saturation vapor pressure for each HRU	**nhru**	kilopascals	real	**et_module** = potet_pm, potet_pm_sta, or potet_pt
vp_slope	Slope of saturation vapor pressure versus air temperature curve for each HRU	**nhru**	kilopascals/degrees Celsius	real	**et_module** = potet_pm, potet_pm_sta, or potet_pt

	Hortonian surface runoff, infiltration, and impervious storage				
basin_cap_infil_tot	Basin area-weighted average infiltration with cascading flow into capillary reservoirs	**one**	inches	double	always
~~*cap_upflow_max*~~	~~Maximum infiltration and any cascading interflow and Dunnian surface runoff that can be added to capillary reservoir storage for each HRU~~	~~**nhru**~~	~~inches~~	~~real~~	~~always~~
cap_waterin	Infiltration and any cascading interflow and Dunnian surface runoff added to capillary reservoir storage for each HRU	**nhru**	inches	real	always
~~*cascade_dunnianflow*~~	~~Cascading Dunnian flow for each HRU~~	~~**nhru**~~	~~inches~~	~~real~~	~~**cascade_flag** = 1 and **ncascade** > 0~~
~~*cascade_interflow*~~	~~Cascading interflow for each HRU~~	~~**nhru**~~	~~inches~~	~~real~~	~~**cascade_flag** = 1 and **ncascade** > 0~~
basin_contrib_fraction	Basin area-weighted average contributing area of the pervious area of each HRU	**one**	decimal fraction	double	always
basin_hortonian	Basin area-weighted average Hortonian runoff	**one**	inches	double	always
basin_hortonian_lakes	Basin area-weighted average Hortonian surface runoff to lakes	**one**	inches	double	**cascade_flag** = 1 and **ncascade** > 0
basin_imperv_stor	Basin area-weighted average storage on impervious area	**one**	inches	double	always
basin_infil	Basin area-weighted average infiltration to the capillary reservoirs	**one**	inches	double	always
basin_sroff	Basin area-weighted average surface runoff to the stream network	**one**	inches	double	always
basin_sroff_cfs	Basin area-weighted average surface runoff to the stream network	**one**	cfs	double	always
basin_sroff_down	Basin area-weighted average cascading surface runoff	**one**	inches	double	**cascade_flag** = 1 and **ncascade** > 0

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Variable name	Description	Dimension[1]	Units	Data type	Availabilty/condition
basin_sroff_mo	Monthly basin area-weighted average surface runoff	**one**	inches	double	always
basin_sroff_tot	Total simulation basin area-weighted average surface runoff	**one**	inches	double	always
basin_sroff_upslope	Basin area-weighted average cascading surface runoff received from upslope HRUs	**one**	inches	double	**cascade_flag** = 1 and **ncascade** > 0
basin_sroff_yr	Yearly basin area-weighted average surface runoff	**one**	inches	double	always
basin_sroffi	Basin area-weighted average surface runoff from impervious areas	**one**	inches	double	always
basin_sroffp	Basin area-weighted average surface runoff from pervious areas	**one**	inches	double	always
contrib_fraction	Contributing area of each HRU pervious area	**nhru**	decimal fraction	real	always
hortonian_flow	Hortonian surface runoff reaching stream network for each HRU	**nhru**	inches	real	always
hortonian_lakes	Surface runoff to lakes for each HRU	**nhru**	inches	double	**cascade_flag** = 1, **ncascade** > 0, and **nlake > 0**
hru_frac_perv	Fraction of HRU that is pervious	**nhru**	decimal fraction	real	always
hru_hortn_cascflow	Cascading Hortonian surface runoff leaving each HRU	**nhru**	inches	double	**cascade_flag** = 1 and **ncascade** > 0
hru_imperv	Area of HRU that is impervious	**nhru**	acres	real	always
hru_impervstor	Storage on impervious area for each HRU	**nhru**	inches	real	always
hru_perv	Area of HRU that is pervious	**nhru**	acres	real	always
hru_sroffi	Surface runoff from impervious areas for each HRU	**nhru**	inches	real	always
hru_sroffp	Surface runoff from pervious areas for each HRU	**nhru**	inches	real	always
imperv_stor	Storage on impervious area for each HRU	**nhru**	inches	real	always
infil	Infiltration to the capillary reservoir for each HRU	**nhru**	inches	real	always
seginc_sroff	Area-weighted average surface runoff for each segment from HRUs contributing flow to the segment	**nsegment**	cfs	double	**nsegment** > 0
sroff[3]	Surface runoff to the stream network for each HRU	**nhru**	inches	real	always
sub_sroff	Area-weighted average Hortonian plus Dunnian surface runoff from associated HRUs to each subbasin and from upstream subbasins	**nsub**	cfs	double	**subbasin_flag** = 1
subinc_sroff	Area-weighted average Hortonian plus Dunnian surface runoff from associated HRUs to each subbasin	**nsub**	cfs	double	**subbasin_flag** = 1
upslope_hortonian	Hortonian surface runoff received from upslope HRUs	**nhru**	inches	double	**cascade_flag** = 1 and **ncascade** > 0
Surface depression storage					
basin_dprst_seep	Basin area-weighted average seepage surface-depression storage	**one**	inches	double	**dprst_flag** = 1
basin_dprst_sroff	Basin area-weighted average surface runoff from open surface-	**one**	inches	double	**dprst_flag** = 1

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Variable name	Description	Dimension[1]	Units	Data type	Availabilty/condition
	depression storage				
basin_dprst_volcl	Basin area-weighted average storage volume in closed surface depressions	**one**	inches	double	**dprst_flag** = 1
basin_dprst_volop	Basin area-weighted average storage volume in open surface depressions	**one**	inches	double	**dprst_flag** = 1
dprst_area_clos	Surface area of closed surface depressions based on volume for each HRU	**nhru**	acres	real	**dprst_flag** = 1
dprst_area_clos_max	Aggregate sum of closed surface-depression storage areas of each HRU	**nhru**	acres	real	**dprst_flag** = 1
dprst_area_max	Aggregate sum of surface-depression storage areas of each HRU	**nhru**	acres	real	**dprst_flag** = 1
dprst_area_open	Surface area of open surface depressions based on volume for each HRU	**nhru**	acres	real	**dprst_flag** = 1
dprst_area_open_max	Aggregate sum of open surface-depression storage areas of each HRU	**nhru**	acres	real	**dprst_flag** = 1
dprst_insroff_hru	Surface runoff from pervious and impervious portions into surface depression storage for each HRU	**nhru**	inches	real	**dprst_flag** = 1
dprst_seep_hru	Seepage from surface-depression storage to associated GWR for each HRU	**nhru**	inches	double	**dprst_flag** = 1
dprst_sroff_hru	Surface runoff from open surface-depression storage for each HRU	**nhru**	inches	double	**dprst_flag** = 1
dprst_stor	Surface-depression storage for each HRU	**nhru**	inches	double	**dprst_flag** = 1
dprst_vol_clos	Storage volume in closed surface depressions for each HRU	**nhru**	acre-inches	double	**dprst_flag** = 1
dprst_vol_clos_frac	Fraction of closed surface-depression storage of the maximum storage for each HRU	**nhru**	decimal fraction	double	**dprst_flag** = 1
dprst_vol_frac	Fraction of surface-depression storage of the maximum storage for each HRU	**nhru**	decimal fraction	double	**dprst_flag** = 1
dprst_vol_open	Storage volume in open surface depressions for each HRU	**nhru**	acre-inches	double	**dprst_flag** = 1
dprst_vol_open_frac	Fraction of open surface-depression storage of the maximum storage for each HRU	**nhru**	decimal fraction	double	**dprst_flag** = 1
Soil zone storage, interflow, gravity drainage, 54unnian surface runoff					
basin_cap_infil_tot	Basin area-weighted average infiltration with cascading flow into capillary reservoirs	**one**	inches	double	always
basin_cap_up_max	Basin area-weighted average maximum cascade flow that flows to capillary reservoirs	**one**	inches	double	**cascade_flag** = 1 and **ncascade** > 0
basin_capwaterin	Basin area-weighted average infiltration and any cascading interflow and Dunnian flow added to capillary reservoir storage	**one**	inches	double	always
basin_cpr_stor_frac	Basin area-weighted average fraction of capillary reservoir	**one**	decimal fraction	double	always

Variable name	Description	Dimension[1]	Units	Data type	Availabilty/condition
	storage of the maximum storage				
basin_dncascadeflow	Basin area-weighted average cascading interflow and Dunnian surface runoff	**one**	inches	double	**cascade_flag** = 1 and **ncascade** > 0
basin_dndunnianflow	Basin area-weighted average cascading Dunnian flow	**one**	inches	double	**cascade_flag** = 1 and **ncascade** > 0
basin_dninterflow	Basin area-weighted average cascading interflow	**one**	inches	double	**cascade_flag** = 1 and **ncascade** > 0
basin_dunnian	Basin area-weighted average Dunnian surface runoff that flows to the stream network	**one**	inches	double	always
basin_dunnian_gvr	Basin area-weighted average excess flow to preferential-flow reservoirs from gravity reservoirs	**one**	inches	double	always
basin_dunnian_pfr	Basin area-weighted average excess infiltration to preferential-flow reservoirs from variable *infil*	**one**	inches	double	always
basin_dunnianflow	Basin area-weighted average cascading Dunnian flow	**one**	inches	double	always
basin_gvr2pfr	Basin area-weighted average excess flow to preferential-flow reservoir storage from gravity reservoirs	**one**	inches	double	always
basin_gvr_stor_frac	Basin area-weighted average fraction of gravity reservoir storage of the maximum storage	**one**	decimal fraction	double	always
basin_interflow_max	Basin area-weighted average maximum interflow that flows from gravity reservoirs	**one**	inches	double	always
basin_lakeinsz	Basin area-weighted average lake inflow from land HRUs	**one**	inches	double	**cascade_flag** = 1, **ncascade** > 0, and **nlake > 0**
basin_pfr_stor_frac	Basin area-weighted average fraction of preferential-flow reservoir storage of the maximum storage	**one**	decimal fraction	double	always
basin_pref_flow_infil	Basin area-weighted average infiltration to preferential-flow reservoir storage	**one**	inches	double	always
basin_pref_stor	Basin area-weighted average storage in preferential-flow reservoirs	**one**	inches	double	always
basin_prefflow	Basin area-weighted average interflow from preferential-flow reservoirs to the stream network	**one**	inches	double	always
basin_recharge	Basin area-weighted average recharge to GWRs	**one**	inches	double	always
basin_slowflow	Basin area-weighted average interflow from gravity reservoirs to the stream network	**one**	inches	double	always
basin_slstor	Basin area-weighted average storage of gravity reservoirs	**one**	inches	double	always
basin_sm2gvr	Basin area-weighted average excess flow from capillary reservoirs to gravity reservoir storage	**one**	inches	double	always
basin_sm2gvr_maxin	Basin area-weighted average maximum excess flow from	**one**	inches	double	always

Variable name	Description	Dimension[1]	Units	Data type	Availabilty/condition
	capillary reservoirs that flows to gravity reservoirs				
basin_soil_lower_stor_frac	Basin area-weighted average fraction of soil lower zone storage storage of the maximum storage	**one**	decimal fraction	double	always
basin_soil_moist	Basin area-weighted average capillary reservoir storage	**one**	inches	double	always
basin_soil_moist_tot	Basin area-weighted average total soil-zone water storage	**one**	inches	double	always
basin_soil_rechr	Basin area-weighted average storage for recharge zone; upper portion of capillary reservoir where both evaporation and transpiration occurs	**one**	inches	double	always
basin_soil_rechr_stor_frac	Basin area-weighted average fraction of soil recharge zone storage storage of the maximum storage	**one**	decimal fraction	double	always
basin_soil_to_gw	Basin area-weighted average excess flow to capillary reservoirs that drains to GWRs	**one**	inches	double	always
basin_ssflow	Basin area-weighted average interflow from gravity and preferential-flow reservoirs to the stream network	**one**	inches	double	always
basin_ssflow_cfs	Basin area-weighted average interflow from gravity and preferential-flow reservoirs to the stream network	**one**	cfs	double	always
basin_ssflow_mo	Monthly basin area-weighted average interflow	**one**	inches	double	always
basin_ssflow_tot	Simulation total basin area-weighted average interflow	**one**	inches	double	always
basin_ssflow_yr	Yearly basin area-weighted average interflow	**one**	inches	double	always
basin_ssin	Basin area-weighted average inflow to gravity and preferential-flow reservoir storage	**one**	inches	double	always
basin_ssstor	Basin area-weighted average gravity and preferential-flow reservoir storage	**one**	inches	double	always
basin_sz2gw	Basin area-weighted average drainage from gravity reservoirs to GWRs	**one**	inches	double	always
basin_sz_stor_frac	Basin area-weighted average fraction of soil zone storage of the maximum storage	**one**	decimal fraction	double	always
cap_infil_tot	Infiltration and cascading interflow and Dunnian flow added to capillary reservoir storage for each HRU	**nhru**	inches	real	always
cap_waterin	Infiltration and any cascading interflow and Dunnian surface runoff added to capillary reservoir storage for each HRU	**nhru**	inches	real	always
~~*cpr_stor_frac*~~	~~Fraction of capillary reservoir storage of the maximum storage for each HRU~~	~~**nhru**~~	~~decimal fraction~~	~~real~~	~~always~~
dunnian_flow	Dunnian surface runoff that flows to the stream network for each HRU	**nhru**	inches	real	always
~~*gvr_stor_frac*~~	~~Fraction of gravity reservoir storage of the maximum storage for each HRU~~	~~**nhru**~~	~~decimal fraction~~	~~real~~	~~always~~
hru_sz_cascadeflow	Cascading interflow and Dunnian surface runoff from each HRU	**nhru**	inches	real	**cascade_flag** = 1 and **ncascade** > 0

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

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

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

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Variable name	Description	Dimension[1]	Units	Data type	Availabilty/condition
basin_stflow_yr	Yearly basin area-weighted average simulated streamflow	**one**	inches	double	**print_debug** > -2
flow_headwater	Total flow out of headwater segments (**segment_type**=1)	**one**	cfs	double	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
flow_in_great_lakes	Total flow out into model domain from Great Lakes (**segment_type**=10)	**one**	cfs	double	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
flow_in_nation	Total flow into model domain from Mexico or Canada (**segment_type**=4)	**one**	cfs	double	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
flow_in_region	Total flow into region (**segment_type**=6)	**one**	cfs	double	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
flow_out	Total flow out of model domain	**one**	cfs	double	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
flow_out_NHM	Total flow out of model domain to Mexico or Canada (**segment_type**=5)	**one**	cfs	double	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
flow_out_region	Total flow out of region (**segment_type**=7)	**one**	cfs	double	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
flow_replacement	Total flow out from replacement flow (**segment_type**=3)	**one**	cfs	double	**strmflow_module** = muskingum,

Variable name	Description	Dimension[1]	Units	Data type	Availabilty/condition
					strmflow_in_out, muskingum_lake, or muskingum_mann
flow_terminus	Total flow to terminus segments (**segment_type**=9)	**one**	cfs	double	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
flow_to_great_lakes	Total flow to Great Lakes (**segment_type**=11)	**one**	cfs	double	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
flow_to_lakes	Total flow to lakes (**segment_type**=2)	**one**	cfs	double	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
flow_to_ocean	Total flow to oceans (**segment_type**=8)	**one**	cfs	double	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
hru_outflow	Total flow leaving each HRU	**nhru**	cfs	double	always
hru_streamflow_out	Total flow to stream network from each HRU	**nhru**	cfs	double	always
obs_runoff_mo	Monthly measured streamflow at basin outlet	**one**	cfs	double	**print_debug** > -2
obs_runoff_tot	Total simulation measured streamflow at basin outlet	**one**	cfs	double	**print_debug** > -2
obs_runoff_yr	Yearly measured streamflow at basin outlet	**one**	cfs	double	**print_debug** > -2
obsq_inches	Measured streamflow at specified outlet station	**one**	inches	double	**print_debug** > -2
obsq_inches_mo	Monthly measured streamflow at specified outlet station	**one**	inches	double	**print_debug** > -2
obsq_inches_tot	Total simulation basin area-weighted average measured streamflow at specified outlet station	**one**	inches	double	**print_debug** > -2
obsq_inches_yr	Yearly measured streamflow at specified outlet station	**one**	inches	double	**print_debug** > -2
runoff	Streamflow at each measurement station	**nobs**	**runoff_units**	real	**nobs** > 0
seg_gwflow	Area-weighted average groundwater discharge for each segment from HRUs contributing flow to the segment and upstream HRUs	**nsegment**	inches	double	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or

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Variable name	Description	Dimension[1]	Units	Data type	Availabilty/condition
					muskingum_mann
seg_inflow	Total flow entering a segment	**nsegment**	cfs	double	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
seg_lateral_inflow	Lateral inflow entering a segment	**nsegment**	cfs	double	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
seg_outflow	Streamflow leaving a segment	**nsegment**	cfs	double	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
seg_sroff	Area-weighted average surface runoff for each segment from HRUs contributing flow to the segment and upstream HRUs	**nsegment**	inches	double	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
seg_ssflow	Area-weighted average interflow for each segment from HRUs contributing flow to the segment and upstream HRUs	**nsegment**	inches	double	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
seg_upstream_inflow	Sum of inflow from upstream segments	**nsegment**	cfs	double	**strmflow_module** = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann
segment_delta_flow	Cummulative flow minus flow out for each stream segment	**nsegment**	cfs	double	**strmflow_module** = muskingum, muskingum_lake, or muskingum_mann
streamflow_cfs	Streamflow at each measurement station	**nobs**	cfs	double	**nobs** > 0
streamflow_cms	Streamflow at each measurement station	**nobs**	cms	double	**nobs** > 0
strm_seg_in[3]	Flow in stream segments as a result of cascading flow in each	**nsegment**	cfs	double	**cascade_flag** = 1 and

Variable name	Description	Dimension[1]	Units	Data type	Availabilty/condition
	stream segment				**ncascade** > 0
sub_cfs	Total streamflow leaving each subbasin	**nsub**	cfs	double	**subbasin_flag** = 1
sub_cms	Total streamflow from each subbasin	**nsub**	cms	double	**subbasin_flag** = 1
sub_inq	Sum of streamflow from upstream subbasins to each subbasin	**nsub**	cfs	double	**subbasin_flag** = 1
		Stream Temperature			
seg_ccov	Area-weighted average cloud cover fraction for each segment from HRUs contributing flow to the segment	**nsegment**	decimal fraction	real	**stream_temp_flag** = 1
seg_daylight	Hours of daylight	**nsegment**	hours	real	**stream_temp_flag** = 1
seg_humid	Area-weighted average relative humidity for each segment from HRUs contributing flow to the segment	**nsegment**	decimal fraction	real	**stream_temp_flag** = 1
seg_melt	Area-weighted average snowmelt for each segment from HRUs contributing flow to the segment	**nsegment**	inches	real	**stream_temp_flag** = 1
seg_potet	Area-weighted average rainfall for each segment from HRUs contributing flow to the segment	**nsegment**	inches	real	**stream_temp_flag** = 1
seg_shade	Area-weighted average shade fraction for each segment	**nsegment**	decimal fraction	real	**stream_temp_flag** = 1
seg_tave_air	Area-weighted average air temperature for each segment from HRUs contributing flow to the segment	**nsegment**	degrees Celsius	real	**stream_temp_flag** = 1
seg_tave_gw	groundwater temperature	**nsegment**	degrees Celsius	real	**stream_temp_flag** = 1
seg_tave_lat	lateral flow temperature	**nsegment**	degrees Celsius	real	**stream_temp_flag** = 1
seg_tave_ss	subsurface temperature	**nsegment**	degrees Celsius	real	**stream_temp_flag** = 1
seg_tave_upstream	Temperature of streamflow entering each segment	**nsegment**	degrees Celsius	real	**stream_temp_flag** = 1
seg_tave_water	Computed daily mean stream temperature for each segment	**nsegment**	degrees Celsius	real	**stream_temp_flag** = 1
seg_width	Width of each segment	**nsegment**	meters	real	**stream_temp_flag** = 1
		Lake dynamics			
basin_2ndstflow	Streamflow from second output point for lake HRUs using gate opening routing	**one**	inches	double	**strmflow_module** = `muskingum_lake`
basin_lake_seep	Basin area-weighted average lake-bed seepage to GWRs	**one**	acre-feet	double	**strmflow_module** = `muskingum_lake`
basin_lake_stor	Basin volume-weighted average storage for all lakes using broad-crested weir or gate opening routing	**one**	inches	double	**strmflow_module** = `muskingum_lake`
din1	Inflow to each lake HRU using Puls or linear storage routing	**nlake**	cfs	double	**strmflow_module** = `muskingum_lake`
elevlake	Surface elevation of each lake	**nlake**	feet	real	**strmflow_module** = `muskingum_lake` and **nratetbl** > 0
gate_ht	Height of the gate opening at each dam with a gate	**nratetbl**	inches	real	**strmflow_module** =

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

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

[1]Dimension variables defined in table 1-1.

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

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

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

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

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