



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

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Updated tables from version 4.0.3 to version 5.2.1

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Table 2. Description of modules implemented in the Precipitation-Runoff Modeling System, version 5.2.1 (PRMS-V).

[HRU, Hydrologic Response Unit; CBH, climate by HRU]

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

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

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downslope groundwater reservoirs and stream segments.

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Streamflow process

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|                 |   |
|-----------------|---|
| muskingum       | Computes flow in the stream network using the Muskingum routing method (Linsley and others, 1982).  |
| muskingum_lake  | Computes flow in the stream network using the Muskingum routing method and flow and storage in on-channel lake using several methods.   |
| muskingum_mann  | Computes flow in the stream network using the Muskingum routing method with Manning's N equation.   |
| routing         | Computes common segment routing flows for modules <code>strmflow_in_out</code> and <code>Muskingum</code> .   |
| stream_temp     | Computes daily mean stream temperature for each stream segment in the stream network, module based on the Stream Network Temperature Model (SNTMP, Theurer and others, 1984). |
| strmflow        | Computes daily streamflow as the sum of surface runoff, shallow-subsurface flow (interflow), detention reservoir flow, and groundwater flow.                                  |
| strmflow_in_out | Routes water between segments in the stream network by setting the outflow to the inflow.   |

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Summary process

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

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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]

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

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

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

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

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

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

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

| Parameter name   | Description   | Option   | Number of Values          | Data type | Default value        |
|--|---|--|---------------------------|-----------|----------------------|
| Simulation execution and required input and output files |   |  |                           |           |                      |
| <b>data_file</b> <sup>2</sup>                            | Pathname(s) for measured input Data File(s), typically a single Data File is specified  | measured input   | number of Data Files      | 4         | prms.data            |
| <b>end_time</b>  | Simulation end date and time specified in order in the control item as: year, month, day, hour, minute, second  | time period  | 6                         | 1         | 2001, 9, 30, 0, 0, 0 |
| <b>model_mode</b>  | Flag to indicate the simulation mode (PRMS=version IV parameters; PRMS5=version V parameters; FROST=growing season for each HRU; WRITE_CLIMATE=write CBH files of minimum and maximum air temperature (variables <i>tminf</i> and <i>tmaxf</i> , in units: degrees Fahrenheit); precipitation (variable <i>hru_ppt</i> , in units: inches/day); solar radiation (variable <i>swrad</i> , in units: Langley/day); potential ET (variable <i>potet</i> , in units: inches/day); and/or transpiration flag (variable <i>transp_on</i> , in units: none); POTET=simulate processes in computation sequence to potential ET; TRANSPIRE=simulate processes in computation sequence to determine transpiration period; DOCUMENTATION=write files of all declared parameters and variables in the executable) | simulation mode selection  | 1                         | 4         | PRMS5                |
| <b>model_output_file</b> <sup>2</sup>                    | Pathname for Water-Budget File for results module <i>basin_sum</i>  | simulation output  | 1                         | 4         | prms.out             |
| <b>param_file</b> <sup>2</sup>                           | Pathname(s) for Parameter File(s)   | parameter input  | number of Parameter Files | 4         | prms.params          |
| <b>prms_warmup</b>                                       | Number of years to simulate before writing mapped results, Basin, <b>nhru</b> , <b>nsub</b> , or <b>nsegment</b> Summary Output Files   | <b>map_resultsON_OFF</b> = 1, <b>basinOutON_OFF</b> = 1, <b>nsubOutON_OFF</b> = 1, <b>nsegmentOutON_OFF</b> = 1 or 2, or <b>nhruOutON_OFF</b> = 1 or 2 | 1                         | 1         | 0                    |
| <b>start_time</b>  | Simulation start date and time specified in order in the control item as: year, month, day, hour, minute, second  | time period  | 6                         | 1         | 2000, 10, 1, 0, 0, 0 |
| Module selection and simulation options                  |   |  |                           |           |                      |
| <b>cascade_flag</b>                                      | Flag to indicate if HRU cascades are computed (0=no; 1=yes;   | cascade flow with <b>ncascade</b>  | 1                         | 1         | 1                    |



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

| Parameter name                     | Description   | Option  | Number of Values | Data type | Default value  |
|------------------------------------|---|---|------------------|-----------|----------------|
| <b>stream_temp_shade_flag</b>      | <b>strmflow_module</b> must be set to muskingum, muskingum_mann, strmflow_in_out, or muskingum_lake<br>Flag to indicate how shade is used in the stream_temp module (0 = compute shade; 1 = specified constant)   | stream temperature  | 1                | 1         | 0              |
| <b>strmflow_module</b>             | Module name for streamflow routing simulation method (strmflow, muskingum, muskingum_mann, strmflow_in_out, or muskingum_lake)  | module selection  | 1                | 4         | strmflow       |
| <b>strmtemp_humidity_flag</b>      | Flag to specify where humidity information is read from Data File for use by the stream_temp module (0=CBH File specified by control parameter <b>humidity_day</b> ; 1=parameter <b>seg_humidity</b> ; 2=Data File with values assigned based on parameter <b>seg_humidity_sta</b> ), <b>strmflow_module</b> must be set to muskingum, muskingum_mann, strmflow_in_out, or muskingum_lake | stream temperature  | 1                | 1         | 0              |
| <b>subbasin_flag</b>               | Flag to indicate if internal subbasins are computed (0=no; 1=yes)   | <b>nsub</b> > 0   | 1                | 1         | 1              |
| <b>temp_module</b>                 | Module name for temperature-distribution method (climate_hru, temp_1sta, temp_sta, temp_dist2, temp_laps, temp_map, ide_dist, or xyz_dist)  | module selection  | 1                | 4         | temp_1sta      |
| <b>transp_module</b>               | Module name for transpiration simulation method (climate_hru, transp_frost, or transp_tindex)   | module selection  | 1                | 4         | transp_tindex  |
| Climate-by-HRU Files               |   |   |                  |           |                |
| <b>albedo_cbh_flag</b>             | Flag to specify whether to input snowpack albedo in a CBH file (0=no; 1=yes)  | input options   | 1                | 1         | 0              |
| <b>albedo_day<sup>2</sup></b>      | Pathname of the CBH file of pre-processed snowpack albedo input data for each HRU to specify variable <i>albedo_hru</i> (units: decimal fraction)   | input options   | 1                | 4         | albedo.day     |
| <b>cbh_binary_flag</b>             | Flag to specify whether to input CBH files in a binary format using the same order of values as the text file version (0=no; 1=yes)   | input options   | 1                | 1         | 0              |
| <b>cloud_cover_cbh_flag</b>        | Flag to specify whether to input snowpack albedo in a CBH file (0=no; 1=yes)  | input options   | 1                | 1         | 0              |
| <b>cloud_cover_day<sup>2</sup></b> | Pathname of the CBH file of pre-processed snowpack albedo input data for each HRU to specify variable <i>albedo_hru</i> (units: decimal fraction)   | input options   | 1                | 4         | cloudcover.day |
| <b>humidity_cbh_flag</b>           | Flag to specify whether to input humidity in a CBH file (0=no; 1=yes)   | <b>et_module</b> = potet_pm or potet_pt, or <b>stream_temp_flag</b> = 1 and | 1                | 1         | 0              |

| Parameter name                   | Description   | Option                                | Number of Values | Data type | Default value |
|----------------------------------|---|---------------------------------------|------------------|-----------|---------------|
| <b>strmtemp_humidity_flag =</b>  |   |                                       |                  |           |               |
| 0                                |   |                                       |                  |           |               |
| <b>humidity_day<sup>2</sup></b>  | Pathname of the CBH file of pre-processed humidity input data for each HRU to specify variable <i>humidity_hru</i> (units: percentage)  | <b>et_module</b> = potet_pm           | 1                | 4         | humidity.day  |
| <b>orad_flag</b>                 | Flag to specify whether the variable <i>orad</i> is specified as the last column of the <b>swrad_day</b> CBH file (0=no; 1=yes)   | <b>solrad_module</b> =<br>climate_hru | 1                | 1         | 1             |
| <b>potet_day<sup>2</sup></b>     | Pathname of the CBH file of pre-processed potential-ET input data for each HRU to specify variable <i>potet</i> (units: inches/day)   | <b>et_module</b> =<br>climate_hru     | 1                | 4         | potet.day     |
| <b>precip_day<sup>2</sup></b>    | Pathname of the CBH file of pre-processed precipitation input data for each HRU to specify variable <i>precip</i> (units based on value specified for parameter <b>precip_units</b> ) | <b>precip_module</b> =<br>climate_hru | 1                | 4         | precip.day    |
| <b>snow_cloudcover_flag</b>      | Flag to indicate if approximation of cloud cover for snowpack computations is computed using HRU dimensioned variables (0=no; 1=yes)  | input options                         | 1                | 1         | 0             |
| <b>swrad_day<sup>2</sup></b>     | Pathname of the CBH file of pre-processed solar-radiation input data for each HRU to specify variable <i>swrad</i> (units: Langley/day)   | <b>solrad_module</b> =<br>climate_hru | 1                | 4         | swrad.day     |
| <b>tmax_day<sup>2</sup></b>      | Pathname of the CBH file of pre-processed maximum air temperature input data for each HRU to specify variable <i>tmaxf</i> (units: degrees Fahrenheit)                                | <b>temp_module</b> =<br>climate_hru   | 1                | 4         | tmax.day      |
| <b>tmin_day<sup>2</sup></b>      | Pathname of the CBH file of pre-processed minimum air temperature input data for each HRU to specify variable <i>tminf</i> (units: degrees Fahrenheit)                                | <b>temp_module</b> =<br>climate_hru   | 1                | 4         | tmin.day      |
| <b>transp_day<sup>2</sup></b>    | Pathname of the CBH file of pre-processed transpiration on or off flag for each HRU file to specify variable <i>transp_on</i> (units: none)   | <b>transp_module</b> =<br>climate_hru | 1                | 4         | transp.day    |
| <b>windspeed_cbh_flag</b>        | Flag to specify whether to input windspeed in a CBH file (0=no; 1=yes)  | <b>et_module</b> = potet_pm           | 1                | 1         | 0             |
| <b>windspeed_day<sup>2</sup></b> | Pathname of the CBH file of pre-processed wind speed input data for each HRU to specify variable <i>windspeed_hru</i> (units: meters/second)  | <b>et_module</b> = potet_pm           | 1                | 4         | windspeed.day |
| Dynamic Parameter Input          |   |                                       |                  |           |               |
| <b>covden_sum_dynamic</b>        | Pathname of the time series of pre-processed values for summer plant-cover density used to set values of <b>covden_sum</b> for each HRU   | <b>dyn_covden_flag</b> = 1 or 3       | 1                | 4         | dyncovsum     |
| <b>covden_win_dynamic</b>        | Pathname of the time series of pre-processed values for winter plant-cover density used to set values of <b>covden_win</b> for each HRU   | <b>dyn_covden_flag</b> = 2 or 3       | 1                | 4         | dyncovwin     |
| <b>covtype_dynamic</b>           | Pathname of the time series of pre-processed values used to set values of <b>cov_type</b> for each HRU  | <b>dyn_covtype_flag</b> = 1           | 1                | 4         | dyncovtype    |

| Parameter name             | Description  | Option   | Number of Values | Data type | Default value  |
|----------------------------|--|--|------------------|-----------|----------------|
| <b>dprst_depth_dynamic</b> | Pathname of the time series of pre-processed values used to set values of <b>dprst_depth_avg</b>   | <b>dyn_dprst_flag</b> = 2 or 3                         | 1                | 4         | dyndprst_depth |
| <b>dprst_frac_dynamic</b>  | Pathname of the time series of pre-processed values used to set values of <b>dprst_frac</b>  | <b>dyn_dprst_flag</b> = 1 or 3                         | 1                | 4         | dyndprst_frac  |
| <b>dyn_covden_flag</b>     | Flag to indicate if a time series of plant-canopy density values are input in a Dynamic Parameter File(s) (0=no; 1=file <b>covden_sum_dynamic</b> ; 2=file <b>covden_win_dynamic</b> ; 3=both)   | dynamic canopy cover density                           | 1                | 1         | 0              |
| <b>dyn_covtype_flag</b>    | Flag to indicate if a time series of plant-canopy type values are input in Dynamic Parameter File <b>covtype_dynamic</b> (0=no; 1=yes)   | dynamic canopy cover type                              | 1                | 1         | 0              |
| <b>dyn_dprst_flag</b>      | Flag to indicate if a time series of surface-depression values are input in a Dynamic Parameter File(s) (0=no; 1=file <b>dprst_frac_dynamic</b> ; 2=file <b>dprst_depth_dynamic</b> ; 3=both)  | dynamic surface depression                             | 1                | 1         | 0              |
| <b>dyn_fallfrost_flag</b>  | Flag to indicate if a time series of transpiration-start Julian day values are input in a Dynamic Parameter File(s) (0=no; 1=file <b>fallfrost_dynamic</b> )   | dynamic transpiration and transp_module = transp_frost | 1                | 1         | 0              |
| <b>dyn_imperv_flag</b>     | Flag to indicate if a time series of impervious values are input in a Dynamic Parameter File(s) (0=no; 1=file <b>imperv_frac_dynamic</b> ; 2=file <b>imperv_stor_dynamic</b> ; 3=both)   | dynamic impervious                                     | 1                | 1         | 0              |
| <b>dyn_intcp_flag</b>      | Flag to indicate if a time series of plant canopy interception values are input in a Dynamic Parameter File(s) (0=no; 1=file <b>wrain_intcp_dynamic</b> ; 2=file <b>srain_intcp_dynamic</b> ; 4=file <b>snow_intcp_dynamic</b> ; additive combinations, such as 3=file <b>wrain_intcp_dynamic</b> and <b>srain_intcp_dynamic</b> , but not <b>snow_intcp_dynamic</b> )   | dynamic interception                                   | 1                | 1         | 0              |
| <b>dyn_potet_flag</b>      | Flag to indicate if a time series of potential ET coefficient values are input in Dynamic Parameter File <b>potet_coef_dynamic</b> to update coefficients for the specified month for the selected potential ET module specified by control parameter <b>et_module</b> (0=no; 1=parameter <b>jh_coef</b> , <b>pt_alpha</b> , <b>hs_krs</b> , <b>hamon_coef</b> , <b>epan_coef</b> , <b>potet_cbh_adj</b> , and <b>pm_n_coef</b> used in <b>potet_jh</b> , <b>potet_pt</b> , <b>potet_hs</b> , <b>potet_hamon</b> , <b>potet_pan</b> , <b>climate_hru</b> , <b>potet_pm</b> , and <b>potet_pm_sta</b> modules, respectively; 2=parameter <b>jh_coef_hru</b> , <b>pm_d_coef</b> used in <b>potet_jh</b> , <b>potet_pm</b> , and <b>potet_pm_sta</b> modules, respectively) | dynamic potential ET                                   | 1                | 1         | 0              |
| <b>dyn_radtrncf_flag</b>   | Flag to indicate if a time series of solar radiation values are input in Dynamic Parameter File <b>radtrncf_dynamic</b> (0=no; 1=yes)  | dynamic solar radiation transmission                   | 1                | 1         | 0              |
| <b>dyn_soil_flag</b>       | Flag to indicate if a time series of soil-water capacity values are input in a Dynamic Parameter File(s) (0=no; 1=file   | dynamic soil moisture                                  | 1                | 1         | 0              |

| Parameter name                   | Description  | Option   | Number of Values | Data type | Default value          |
|----------------------------------|--|--|------------------|-----------|------------------------|
| <b>dyn_springfrost_flag</b>      | <b>soilmoist_dynamic</b> only, 2=file <b>soilrechr_dynamic</b> only; 3=both)<br>Flag to indicate if a time series of transpiration-start Julian day values are input in a Dynamic Parameter File(s) (0=no; 1=file <b>springfrost_dynamic</b> ) | dynamic transpiration and<br>transp_module =<br>transp_frost           | 1                | 1         | 0                      |
| <b>dyn_sro2dprst_perv_flag</b>   | Flag to indicate if a time series of fraction of surface runoff from the pervious portion of an HRU are input in Dynamic Parameter File <b>sro2dprst_perv_dyn</b> (0=no; 1=yes)  | dynamic surface depression   | 1                | 1         | 0                      |
| <b>dyn_sro2dprst_imperv_flag</b> | Flag to indicate if a time series of fraction of surface runoff from the impervious portion of an HRU are input in Dynamic Parameter File <b>sro2dprst_imperv_dynamic</b> (0=no; 1=yes)  | dynamic surface depression   | 1                | 1         | 0                      |
| <b>dyn_transp_flag</b>           | Flag to indicate if a time series of transpiration month values are input in a Dynamic Parameter File(s) (0=no; 1=file <b>transpbeg_dynamic</b> ; 2=file <b>transpend_dynamic</b> only, 3=both)  | dynamic transpiration and<br>transp_module =<br>transp_tindex          | 1                | 1         | 0                      |
| <b>dynamic_param_log_file</b>    | Pathname of the log file that summarizes dynamic parameter changes   | for all dynamic parameter<br>input                                     | 1                | 4         | dynamic_param_eter.out |
| <b>fallfrost_dynamic</b>         | Pathname of the time series of pre-processed values for dynamic parameter <b>fall_frost</b>  | <b>dyn_fallfrost_flag</b> = 1 and<br>transp_module =<br>transp_frost   | 1                | 4         | dynfallfrost           |
| <b>imperv_frac_dynamic</b>       | Pathname of the time series of pre-processed values for dynamic parameter <b>hru_percent_imperv</b>  | <b>dyn_imperv_flag</b> = 1 or 3  | 1                | 4         | dynimperv              |
| <b>imperv_stor_dynamic</b>       | Pathname of the time series of pre-processed values for dynamic parameter <b>imperv_stor_max</b>   | <b>dyn_imperv_flag</b> = 2 or 3  | 1                | 4         | dynimperv              |
| <b>potet_coef_dynamic</b>        | Pathname of the time series of pre-processed potential evapotranspiration coefficient values where the parameter is dependent on the value of <b>et_module</b>   | <b>dyn_potet_flag</b> = 1 or 2   | 1                | 4         | dynpotetcoef           |
| <b>radtrncf_dynamic</b>          | Pathname of the time series of pre-processed values for dynamic parameter <b>rad_trncf</b>   | <b>dyn_radtrncf_flag</b> = 1   | 1                | 4         | dynradtrncf            |
| <b>snow_intcp_dynamic</b>        | Pathname of the time series of pre-processed values for dynamic parameter <b>snow_intcp</b>  | <b>dyn_intcp_flag</b> = 4, 5, 6,<br>or 7                               | 1                | 4         | dynsnowintcp           |
| <b>soilmoist_dynamic</b>         | Pathname of the time series of pre-processed values for dynamic parameter <b>soil_moist_max</b>  | <b>dyn_soil_flag</b> = 1 or 3  | 1                | 4         | dynsoilmoist           |
| <b>soilrechr_dynamic</b>         | Pathname of the time series of pre-processed values for dynamic parameter <b>soil_rechr_max_frac</b>   | <b>dyn_soil_flag</b> = 2 or 3  | 1                | 4         | dynsoilrechr           |
| <b>springfrost_dynamic</b>       | Pathname of the time series of pre-processed values for dynamic parameter <b>spring_frost</b>  | <b>dyn_springfrost_flag</b> = 1<br>and transp_module =<br>transp_frost | 1                | 4         | dynspringfrost         |
| <b>srain_intcp_dynamic</b>       | Pathname of the time series of pre-processed values for dynamic parameter <b>srain_intcp</b>   | <b>dyn_intcp_flag</b> = 2, 3, 6, or<br>7                               | 1                | 4         | dynsrainintcp          |

| Parameter name                  | Description   | Option  | Number of Values | Data type | Default value        |
|---------------------------------|---|---|------------------|-----------|----------------------|
| <b>sro2dprst_perv_dynamic</b>   | Pathname of the time series of pre-processed values for dynamic parameter <b>sro_to_dprst_perv</b>                              | <b>dyn_sro2dprst_perv_flag</b> = 1                                | 1                | 4         | dynsrotodprst_perv   |
| <b>sro2dprst_imperv_dynamic</b> | Pathname of the time series of pre-processed values for dynamic parameter <b>sro_to_dprst_imperv</b>                            | <b>dyn_sro2dprst_imperv_flag</b> = 1                              | 1                | 4         | dynsrotodprst_imperv |
| <b>transpbeg_dynamic</b>        | Pathname of the time series of pre-processed values for dynamic parameter <b>transp_beg</b>                                     | <b>dyn_transp_flag</b> = 1 or 3 and transp_module = transp_tindex | 1                | 4         | dyntranspbeg         |
| <b>transpend_dynamic</b>        | Pathname of the time series of pre-processed values for dynamic parameter <b>transp_end</b>                                     | <b>dyn_transp_flag</b> = 2 or 3 and transp_module = transp_tindex | 1                | 4         | dyntranspend         |
| <b>wrain_intcp_dynamic</b>      | Pathname of the time series of pre-processed values for dynamic parameter <b>wrain_intcp</b>                                    | <b>dyn_intcp_flag</b> = 1, 3, 5, or 7                             | 1                | 4         | dynwrainintcp        |
| Water Use Input                 |   |   |                  |           |                      |
| <b>dprst_transfer_file</b>      | Pathname of the time series of pre-processed flow rates for transfers from surface-depression storage                           | <b>dprst_transferON_OFF</b> = 1 and <b>dprst_flag</b> = 1         | 1                | 4         | dprst.transfer       |
| <b>dprst_transferON_OFF</b>     | Flag to indicate to use time series of surface-depression transfer flow rates from the <b>dprst_transfer_file</b> (0=no; 1=yes) | surface depression transfer and <b>dprst_flag</b> = 1             | 1                | 1         | 0                    |
| <b>external_transfer_file</b>   | Pathname of the time series of pre-processed flow rates for transfers from external sources                                     | <b>external_transferON_OFF</b> = 1                                | 1                | 4         | ext.transfer         |
| <b>external_transferON_OFF</b>  | Flag to indicate to use external transfer flow rates from the <b>external_transfer_file</b> (0=no; 1=yes)                       | external transfer   | 1                | 1         | 0                    |
| <b>gwr_transfer_file</b>        | Pathname of the time series of pre-processed flow rates for transfers from groundwater reservoir storage                        | <b>gwr_transferON_OFF</b> = 1                                     | 1                | 4         | gwr.transfer         |
| <b>gwr_transferON_OFF</b>       | Flag to indicate to use groundwater transfer flow rates from the <b>gwr_transfer_file</b> (0=no; 1=yes)                         | groundwater transfer  | 1                | 1         | 0                    |
| <b>lake_transfer_file</b>       | Pathname of the time series of pre-processed flow rates for transfers from lake HRUs  | <b>lake_transferON_OFF</b> = 1                                    | 1                | 4         | lake.transfer        |
| <b>lake_transferON_OFF</b>      | Flag to indicate to use lake HRU transfer flow rates from the <b>lake_transfer_file</b> (0=no; 1=yes)                           | lake water transfer   | 1                | 1         | 0                    |
| <b>segment_transfer_file</b>    | Pathname of the time series of pre-processed flow rates for transfers from stream segments                                      | <b>segment_transferON_OFF</b> = 1                                 | 1                | 4         | seg.transfer         |
| <b>segment_transferON_OFF</b>   | Flag to indicate to use stream segment transfer flow rates from the <b>segment_transfer_file</b> (0=no; 1=yes)                  | stream water transfer   | 1                | 1         | 0                    |
| Debug options                   |   |   |                  |           |                      |
| <b>cbh_check_flag</b>           | Flag to indicate if CBH values are validated each time step (0=no; 1=yes)   | CBH input   | 1                | 1         | 1                    |
| <b>parameter_check_flag</b>     | Flag to indicate if selected parameter values validation checks are   | parameter validation check  | 1                | 1         | 1                    |

| Parameter name                      | Description   | Option                         | Number of Values | Data type | Default value |
|-------------------------------------|---|--------------------------------|------------------|-----------|---------------|
| <b>print_debug</b> <sup>1</sup>     | treated as warnings or errors (0=warnings; 1=errors; 2=check parameters and then stop)<br>Flag to indicate type of debug output (-2=minimal output to screen and no <b>model_output_file</b> ; -1=minimize screen output; 0=none; 1=water balances; 2=basin module; 4=basin_sum module; 5=soltab module; 7=soilzone module; 9=snowcomp module; 13=cascade module; 14=subbasin module)   | debug output                   | 1                | 1         | 0             |
| Statistic Variables (statvar) Files |   |                                |                  |           |               |
| <b>nstatVars</b>                    | Number of variables to include in Statistics Variables File and names specified in <b>statVar_names</b>   | <b>statsON_OFF = 1</b>         | 1                | 1         | 0             |
| <b>stat_var_file</b> <sup>2</sup>   | Pathname for Statistics Variables File  | <b>statsON_OFF = 1</b>         | 1                | 4         | statvar.out   |
| <b>statsON_OFF</b>                  | Switch to specify whether the Statistics Variables File is generated (0=no; 1=statvar text format; 2=CSV format)  | <b>statsON_OFF = 1</b>         | 1                | 1         | 0             |
| <b>statVar_element</b>              | List of identification numbers corresponding to variables specified in <b>statVar_names</b> list (1 to variable's dimension size)   | <b>statsON_OFF = 1</b>         | <b>nstatVars</b> | 4         | none          |
| <b>statVar_names</b>                | List of variable names for which output is written to Statistics Variables File   | <b>statsON_OFF = 1</b>         | <b>nstatVars</b> | 4         | none          |
| Initial Condition Files             |   |                                |                  |           |               |
| <b>init_vars_from_file</b>          | Flag to specify whether or not the Initial Conditions File is specified as an input file (0=no; 1=yes; 2=yes and use parameters <b>dprst_frac_init</b> , <b>snowpack_init</b> , <b>segment_flow_init</b> , <b>elevlake_init</b> , <b>gwstor_init</b> , ( <b>soil_rechr_init</b> , <b>soil_moist_init</b> , <b>ssstor_init</b> for <b>model_mode</b> =PRMS) or ( <b>soil_rechr_init_frac</b> , <b>soil_moist_init_frac</b> , <b>ssstor_init_frac</b> for <b>model_mode</b> =PRMS5), and <b>stream_tave_init</b> ; 3=yes and use parameter <b>snowpack_init</b> ; 4=yes and use parameter <b>elevlake_init</b> ; 5=yes and use parameters ( <b>soil_rechr_init</b> , <b>soil_moist_init</b> , <b>ssstor_init</b> for <b>model_mode</b> =PRMS) or ( <b>soil_rechr_init_frac</b> , <b>soil_moist_init_frac</b> , <b>ssstor_init_frac</b> for <b>model_mode</b> =PRMS5); 6=yes and use parameter <b>gwstor_init</b> ; 7=yes and use parameter <b>dprst_frac_init</b> ; 8=yes and use parameter <b>stream_tave_init</b> ) | initial conditions             | 1                | 1         | 0             |
| <b>save_vars_to_file</b>            | Flag to determine if an Initial Conditions File will be generated at the end of simulation (0=no; 1=yes)  | initial conditions             | 1                | 1         | 0             |
| <b>var_init_file</b> <sup>2</sup>   | Pathname for Initial Conditions input file  | <b>init_vars_from_file = 1</b> | 1                | 4         | prms_ic.in    |
| <b>var_save_file</b> <sup>2</sup>   | Pathname for the Initial Conditions File to be generated at end of simulation   | <b>save_vars_to_file = 1</b>   | 1                | 4         | prms_ic.out   |

| Parameter name                           | Description   | Option                        | Number of Values    | Data type | Default value |
|--|---|-------------------------------|---------------------|-----------|---------------|
| Animation Files                          |   |                               |                     |           |               |
| <b>ani_output_file</b> <sup>2</sup>      | Pathname for Animation File(s) to which a filename suffix based on dimension name associated with selected variables is appended  | <b>aniOutON_OFF</b> = 1       | 1                   | 4         | animation.out |
| <b>aniOutON_OFF</b>                      | Switch to specify whether Animation File(s) are generated (0=no; 1=yes)   | animation output              | 1                   | 1         | 0             |
| <b>aniOutVar_names</b>                   | List of variable names for which all values of the variable (that is, the entire dimension size) for each time step are written Animation Dimension File(s)   | <b>aniOutON_OFF</b> = 1       | <b>naniOutVars</b>  | 4         | none          |
| <b>naniOutVars</b>                       | Number of output variables specified in the <b>aniOutVar_names</b> list   | <b>aniOutON_OFF</b> = 1       | 1                   | 1         | 0             |
| Basin Summary Results Files              |   |                               |                     |           |               |
| <b>basinOutBaseFileName</b> <sup>2</sup> | String to define the prefix for each basin summary output file.   | <b>basinOutON_OFF</b> = 1     | 1                   | 4         | basinout_path |
| <b>basinOutON_OFF</b>                    | Switch to specify whether basin summary output files are generated (0=no; 1=yes)  | <b>basin</b> summary results  | 1                   | 1         | 0             |
| <b>basinOutVar_names</b>                 | List of variable names for which output is written to basin summary Comma Separated Values (CSV) output file(s). Each variable is written to files in the order specified in <b>basinOutVars</b> with the prefix of each file equal to the value of <b>basinOutBaseFileName</b> . The suffix of the files is based on the value of <b>basinOut_freq</b> and will be .csv; _meanyearly.csv; _yearly.csv; _meanmonthly.csv; or _monthly.csv; variables must be of type real or double | <b>basinOutON_OFF</b> = 1     | <b>basinOutVars</b> | 4         | none          |
| <b>basinOutVars</b>                      | Number of variables to include in basin summary output file(s)  | <b>basinOutON_OFF</b> = 1     | 1                   | 1         | 0             |
| <b>basinOut_freq</b>                     | Output frequency and type (1=daily; 2=monthly; 3=both; 4=mean monthly; 5=mean yearly; 6=yearly)   | <b>basinOutON_OFF</b> = 1     | 1                   | 1         | 1             |
| Mapped Results Files                     |   |                               |                     |           |               |
| <b>mapOutON_OFF</b>                      | Switch to specify whether mapped output file(s) by a specified number of columns (parameter <b>ncol</b> ) of daily, monthly, yearly, or total simulation results is generated (0=no; 1=yes)   | mapped results                | 1                   | 1         | 0             |
| <b>mapOutVar_names</b>                   | List of variable names for which output is written to mapped output files(s); variables must be of type real or double.   | <b>map_resultsON_OFF</b> = 1  | <b>nmapOutVars</b>  | 4         | none          |
| <b>nmapOutVars</b>                       | Number of variables to include in mapped output file(s)   | <b>map_resultsON_OFF</b> = 1  | 1                   | 1         | 0             |
| Nhru Summary Results Files               |   |                               |                     |           |               |
| <b>nhruOut_format</b>                    | Format of values (1=scientific notation with 4 significant digits (default); 2=2 decimal places; 3=3 decimal places; 4=4 decimal places; 5=5 decimal places)  | <b>nhruOutON_OFF</b> = 1 or 2 | 1                   | 1         | 1             |
| <b>nhruOut_freq</b>                      | Output frequency and type (1=daily; 2=monthly; 3=both; 4=mean monthly; 5=mean yearly; 6=yearly)   | <b>nhruOutON_OFF</b> = 1 or 2 | 1                   | 1         | 1             |
| <b>nhruOutBaseFileName</b> <sup>2</sup>  | String to define the prefix for each <b>nhru</b> summary output file.   | <b>nhruOutON_OFF</b> = 1 or 2 | 1                   | 4         | nhruout_path  |



| Parameter name                          | Description  | Option   | Number of Values   | Data type | Default value  |
|---|--|--|--------------------|-----------|----------------|
| <b>nhruOutNcol</b>                      | 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)   | <b>nhruOutON_OFF</b> = 1 or 2                                | 1                  | 1         | 0              |
| <b>nhruOutON_OFF</b>                    | Switch to specify whether <b>nhru</b> summary output files are generated (0=no; 1=yes; 2=yes and use values of <b>nhm_id</b> as column heading)  | <b>nhru</b> summary results                                  | 1                  | 1         | 0              |
| <b>nhruOutVar_names</b>                 | List of variable names for which output is written to <b>nhru</b> summary Comma Separated Values (CSV) output files(s). Each variable is written to a separate file with the prefix of each file equal to the value of <b>nhruOutBaseFileName</b> ; variables must be of type real or double. Each variable is written to a separate file with the prefix of each file equal to the value of <b>nhruOutBaseFileName</b> . The suffix of the files is based on the value of <b>nhruOut_freq</b> and will be .csv; _meanyearly.csv; _yearly.csv; _meanmonthly.csv; or _monthly.csv | <b>nhruOutON_OFF</b> = 1 or 2                                | <b>nhruOutVars</b> | 4         | none           |
| <b>nhruOutVars</b>                      | Number of variables to include in <b>nhru_summary</b> output file(s)   | <b>nhruOutON_OFF</b> = 1 or 2                                | 1                  | 1         | 0              |
| <b>outputSelectDatesON_OFF</b>          | Switch to indicate if <b>nhru_summary</b> output files are generated for a specified set of dates (0=no, output time series on basis of <b>nhruOut_freq</b> ; 1=yes, specify dates in file specified by <b>selectDatesFileName</b> )   | <b>nhru</b> summary results and <b>nhruOut_freq</b> = 1 or 3 | 1                  | 1         | 0              |
| <b>selectDatesFileName</b> <sup>2</sup> | String to define the filename of the set of dates to output values of <b>nhru_summary</b> output files in chronological order with dates specified as YEAR MONTH DAY with a space(s) and/or comma separating YEAR and MONTH and MONTH and DAY (e.g. 1959 09 01)  | <b>outputSelectDatesON_OFF</b> = 1                           | 1                  | 4         | selectDates.in |
| Nsub Summary Results Files              |  |  |                    |           |                |
| <b>nsubOutBaseFileName</b> <sup>2</sup> | String to define the prefix for each <b>nsub</b> summary output file.  | <b>nsubOutON_OFF</b> = 1                                     | 1                  | 4         | nsubout_path   |
| <b>nsubOutON_OFF</b>                    | Switch to specify whether <b>nsub</b> summary output files are generated (0=no; 1=yes)   | <b>nsub</b> summary results                                  | 1                  | 1         | 0              |
| <b>nsubOutVar_names</b>                 | List of variable names for which output is written to <b>nsub</b> summary Comma Separated Values (CSV) output files(s). Each variable is written to a separate file with the prefix of each file equal to the value of <b>nsubOutBaseFileName</b> ; variables must be of type real or double. The suffix of the files is based on the value of <b>nsubOut_freq</b> and will be .csv; _meanyearly.csv; _yearly.csv; _meanmonthly.csv; or _monthly.csv.  | <b>nsubOutON_OFF</b> = 1                                     | <b>nsubOutVars</b> | 4         | none           |
| <b>nsubOutVars</b>                      | Number of variables to include in <b>nsub</b> summary output file(s)   | <b>nsubOutON_OFF</b> = 1                                     | 1                  | 1         | 0              |
| <b>nsubOut_format</b>                   | Format of values (1=scientific notation with 4 significant digits (default); 2=2 decimal places; 3=3 decimal places; 4=4 decimal places; 5=5 decimal places)   | <b>nsubOutON_OFF</b> = 1                                     | 1                  | 1         | 1              |

| Parameter name                              | Description  | Option                               | Number of Values    | Data type | Default value    |
|---|--|--------------------------------------|---------------------|-----------|------------------|
| <b>nsubOut_freq</b>                         | Output frequency and type (1=daily; 2=monthly; 3=both; 4=mean monthly; 5=mean yearly; 6=yearly)  | <b>nsubOutON_OFF</b> = 1             | 1                   | 1         | 1                |
| Nsegment Summary Results Files              |  |                                      |                     |           |                  |
| <b>nsegmentOutBaseFileName</b> <sup>2</sup> | String to define the prefix for each <b>nsegment</b> summary output file.  | <b>nsegmentOutON_OFF</b> = 1<br>or 2 | 1                   | 4         | nsegmentout_path |
| <b>nsegmentOutON_OFF</b>                    | Switch to specify whether <b>nsegment</b> summary output files are generated (0=no; 1=yes; 2=yes and use values of <b>nhm_seg</b> as column heading)   | <b>nsegment</b> summary results      | 1                   | 1         | 0                |
| <b>nsegmentOutVar_names</b>                 | List of variable names for which output is written to <b>nsegment</b> summary Comma Separated Values (CSV) output files(s). Each variable is written to a separate file with the prefix of each file equal to the value of <b>nsegmentOutBaseFileName</b> ; variables must be of type real or double; the suffix of the files is based on the value of <b>nsegmentOut_freq</b> and will be .csv; _meanyearly.csv; _yearly.csv; _meanmonthly.csv; or _monthly.csv | <b>nsegmentOutON_OFF</b> = 1<br>or 2 | <b>nsubOutVars</b>  | 4         | none             |
| <b>nsegmentOutVars</b>                      | Number of variables to include in <b>nsegment</b> summary output file(s)   | <b>nsegmentOutON_OFF</b> = 1<br>or 2 | 1                   | 1         | 0                |
| <b>nsegmentOut_format</b>                   | Format of values (1=scientific notation with 4 significant digits (default); 2=2 decimal places; 3=3 decimal places; 4=4 decimal places; 5=5 decimal places)   | <b>nsegmentOutON_OFF</b> = 1<br>or 2 | 1                   | 1         | 1                |
| <b>nsegmentOut_freq</b>                     | Output frequency and type (1=daily; 2=monthly; 3=both; 4=mean monthly; 5=mean yearly; 6=yearly)  | <b>nsegmentOutON_OFF</b> = 1<br>or 2 | 1                   | 1         | 1                |
| PRMS Summary Results Files                  |  |                                      |                     |           |                  |
| <b>csvON_OFF</b>                            | Switch to specify whether or not the PRMS Comma-Separated-Values (CSV) output file is generated (0=no; 1=yes; 2=only output pairs of simulated and measured flows)   | PRMS summary results                 | 1                   | 1         | 0                |
| <b>csv_output_file</b> <sup>2</sup>         | Pathname of CSV output file  | <b>csvON_OFF</b> = 1                 | 1                   | 4         | prms_summary.csv |
| Runtime graphs                              |  |                                      |                     |           |                  |
| <b>dispGraphsBuffSize</b>                   | Number of time steps to wait before updating the runtime graph   | <b>ndispGraphs</b> > 0               | 1                   | 1         | 50               |
| <b>dispVar_element</b>                      | List of identification numbers corresponding to variables specified in <b>dispVar_names</b> list (1 to variable's dimension size)  | <b>ndispGraphs</b> > 0               | number of variables | 4         | none             |
| <b>dispVar_names</b>                        | List of variable names for which plots are output to the runtime graph   | <b>ndispGraphs</b> > 0               | number of variables | 4         | none             |
| <b>dispVar_plot</b>                         | List of variable names for which plots are output to the runtime graph   | <b>ndispGraphs</b> > 0               | number of variables | 4         | none             |
| <b>executable_desc</b>                      | Descriptive text to identify the PRMS executable   | <b>ndispGraphs</b> > 0               | 1                   | 4         | MOWS             |

| Parameter name                       | Description  | Option                 | Number of Values | Data type | Default value        |
|--------------------------------------|--|------------------------|------------------|-----------|----------------------|
| <b>executable_model</b> <sup>2</sup> | Pathname (full or relative) of the PRMS executable | <b>ndispGraphs</b> > 0 | 1                | 4         | executable<br>prmsIV |
| <b>initial_deltat</b>                | Initial time step for the simulation               | <b>ndispGraphs</b> > 0 | 1                | 2         | 24.0                 |
| <b>ndispGraphs</b>                   | Number of plots included in the runtime graph      | graphical output       | 1                | 1         | 0                    |

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

<sup>2</sup>Pathnames for all files can have a maximum of 256 characters.

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

[HRU, hydrologic response unit; GWR, groundwater reservoir; cfs, cubic feet per second; cms, cubic meters per second; ET, evapotranspiration; Id, number of modeling unit; dday, degree-day, the amount a day's average temperature departed from 65 degrees Fahrenheit; km, kilometer; m, meters; POI, point-of-interest; ELA, equilibrium line altitude, >, greater than; dimensions defined in table 1-1; control parameters **temp\_module**, **precip\_module**, **solrad\_module**, **et\_module**, **transp\_module**, **srunoff\_module**, **strmflow\_module**, **model\_mode**, **dprst\_flag**, **subbasin\_flag**, **cascade\_flag**, **cascadegw\_flag**, and **mapOutON\_OFF** defined in table 1-2; **green** text indicates deprecated but retained for PRMS-IV backward compatibility]

| Parameter name                      | Description   | Dimension <sup>1</sup> | Type    | Units             | Range                | Default | Required/condition |
|-------------------------------------|---|------------------------|---------|-------------------|----------------------|---------|--------------------|
| Basic physical attributes           |   |                        |         |                   |                      |         |                    |
| <b>elev_units</b>                   | Flag to indicate the units of elevation values (0=feet; 1=meters) | <b>one</b>             | integer | none              | 0 or 1               | 0       | required           |
| <b>hru_area</b>                     | Area of each HRU  | <b>nhru</b>            | real    | acres             | 0.0001 to 1.0E9      | 1.0     | required           |
| <b>hru_aspect</b>                   | Aspect of each HRU  | <b>nhru</b>            | real    | angular degrees   | 0.0 to 360.0         | 0.0     | required           |
| <b>hru_elev</b>                     | Mean elevation for each HRU                                       | <b>nhru</b>            | real    | <b>elev_units</b> | -1,000.0 to 30,000.0 | 0.0     | required           |
| <b>hru_lat</b>                      | Latitude of each HRU  | <b>nhru</b>            | real    | degrees North     | -90.0 to 90.0        | 40.0    | required           |
| <b>hru_lon</b>                      | Longitude of each HRU   | <b>nhru</b>            | real    | degrees East      | -360.0 to 360.0      | -105.0  | optional           |
| <b>hru_slope</b>                    | Slope of each HRU   | <b>nhru</b>            | real    | decimal fraction  | 0.0 to 10.0          | 0.0     | required           |
| <b>hru_type</b> <sup>5</sup>        | Type of each HRU (0=inactive; 1=land; 2=lake; 3=swale; 4=glacier) | <b>nhru</b>            | integer | none              | 0 to 4               | 1       | required           |
| <b>nhm_id</b> <sup>6</sup>          | National Hydrologic Model HRU ID                                  | <b>nhru</b>            | integer | none              | 1 to 9999999         | 1       | optional           |
| <b>nhm_seg</b> <sup>6</sup>         | National Hydrologic Model segment ID                              | <b>nsegment</b>        | integer | none              | 1 to 9999999         | 1       | optional           |
| <b>parent_gw</b> <sup>6</sup>       | Index in parent model for each GWR                                | <b>ngw</b>             | integer | none              | 1 to 9999999         | 1       | optional           |
| <b>parent_hru</b> <sup>6</sup>      | Index in parent model for each HRU                                | <b>nhru</b>            | integer | none              | 1 to 9999999         | 1       | optional           |
| <b>parent_poigages</b> <sup>6</sup> | Index in parent model for each POI gage                           | <b>npoigages</b>       | integer | none              | 1 to 9999999         | 1       | optional           |
| <b>parent_segment</b> <sup>6</sup>  | Index in parent model for each segment                            | <b>nsegment</b>        | integer | none              | 1 to 9999999         | 1       | optional           |
| <b>parent_ssr</b> <sup>6</sup>      | Index in parent model for each SSR                                | <b>nssr</b>            | integer | none              | 1 to 9999999         | 1       | optional           |

| Parameter name                                 | Description  | Dimension <sup>1</sup>          | Type    | Units                           | Range             | Default | Required/condition  |
|--|--|---------------------------------|---------|---------------------------------|-------------------|---------|---|
| Measured input                                 |  |                                 |         |                                 |                   |         |   |
| <b>outlet_sta</b>                              | Index of measured streamflow station corresponding to the basin outlet   | <b>one</b>                      | integer | none                            | 0 to <b>nobs</b>  | 0       | <b>nobs</b> > 0   |
| <b>precip_units</b>                            | Flag to indicate the units of measured precipitation values (0=inches; 1=mm)   | <b>one</b>                      | integer | none                            | 0 or 1            | 0       | required  |
| <b>rad_conv</b>                                | Conversion factor to Langleys for measured solar radiation   | <b>one</b>                      | real    | Langleys/<br>radiation<br>units | 0.1 to<br>100.0   | 1.0     | <b>nsol</b> > 0   |
| <b>rain_code</b>                               | Monthly (January to December) flag indicating rule for precipitation measurement station use (1=only precipitation if the regression stations have precipitation; 2=only precipitation if any station in the basin has precipitation; 3=precipitation if module <i>xyz_dist</i> computes any; 4=only precipitation if <i>rain_day</i> variable is set to 1; 5=only precipitation if <b>psta_freq_nuse</b> stations have precipitation) | <b>nmonths</b>                  | integer | none                            | 1 to 5            | 2       | <b>precip_module</b> =<br><i>xyz_dist</i>   |
| <b>runoff_units</b>                            | Measured streamflow units (0=cfs; 1=cms)   | <b>one</b>                      | integer | none                            | 0 or 1            | 0       | <b>nobs</b> > 0   |
| <b>temp_units</b>                              | Flag to indicate the units of measured air-temperature values (0=Fahrenheit; 1=Celsius)  | <b>one</b>                      | integer | none                            | 0 or 1            | 0       | required  |
| Water Use input                                |  |                                 |         |                                 |                   |         |   |
| <b>irr_type</b>                                | Application method of irrigation water for each HRU (0 = sprinkler method with interception only; 1=ditch/drip method with no interception; 2=ignore; 3=sprinkler across whole HRU with interception and throughfall; 4=sprinkler method with amount of water applied on the basis of cover density, such as a living filter), for options 1, 2, and 3 irrigation water is specified as an' HRU-area weighted average value            | <b>nhru</b>                     | integer | none                            | 0 to 4            | 0       | <b>nwateruse</b> > 1 and at least one water-use destination is the plant canopy, <i>dest_type</i> = 8 |
| Air temperature and precipitation distribution |  |                                 |         |                                 |                   |         |   |
| <b>adjmix_rain</b>                             | Monthly (January to December) factor to adjust rain proportion in a mixed rain/snow event  | <b>nhru,</b><br><b>nmonths</b>  | real    | decimal<br>fraction             | 0.0 to 3.0        | 1.0     | required  |
| <b>adjust_rain</b>                             | Monthly (January to December) rain downscaling adjustment factor for each precipitation measurement station  | <b>nrain,</b><br><b>nmonths</b> | real    | decimal<br>fraction             | -0.5 to 3.0       | -0.4    | <b>precip_module</b> =<br><i>ide_dist</i> or<br><i>xyz_dist</i>                                       |
| <b>adjust_snow</b>                             | Monthly (January to December) snow downscaling adjustment factor for each precipitation measurement station  | <b>nrain,</b><br><b>nmonths</b> | real    | decimal<br>fraction             | -0.5 to 3.0       | -0.4    | <b>precip_module</b> =<br><i>ide_dist</i> or<br><i>xyz_dist</i>                                       |
| <b>basin_tsta</b>                              | Index of temperature station used to compute basin temperature values  | <b>one</b>                      | integer | none                            | 0 to <b>ntemp</b> | 0       | <b>temp_module</b> =<br><i>temp_1sta</i> ,  |

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

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

| Parameter name         | Description  | Dimension <sup>1</sup>           | Type    | Units               | Range               | Default | Required/condition                    |
|------------------------|--|----------------------------------|---------|---------------------|---------------------|---------|---------------------------------------|
| <b>min_lapse</b>       | Monthly (January to December) minimum air temperature lapse rate for each direction (X, Y, and Z)  | <b>nlapse,</b><br><b>nmonths</b> | real    | none                | -100.0 to<br>100.0  | 0.0     | <b>temp_module</b> =<br>xyz_dist      |
| <b>monmax</b>          | Monthly maximum air temperature to constrain lowest maximum air temperatures for bad values on the basis of historical temperature for all measurement stations  | <b>nmonths</b>                   | real    | <b>temp_units</b>   | 0.0 to<br>115.0     | 100.0   | <b>temp_module</b> =<br>temp_dist2    |
| <b>monmin</b>          | Monthly minimum air temperature to constrain lowest maximum air temperatures for bad values on the basis of historical temperature for all measurement stations  | <b>nmonths</b>                   | real    | <b>temp_units</b>   | -60.0 to<br>65.0    | -60.0   | <b>temp_module</b> =<br>temp_dist2    |
| <b>ndist_psta</b>      | Number of precipitation measurement stations for inverse distance calculations   | <b>one</b>                       | integer | none                | 0 to <b>nrain</b>   | 0       | <b>precip_module</b> =<br>ide_dist    |
| <b>ndist_tsta</b>      | Number of air temperature measurement stations for inverse distance calculations   | <b>one</b>                       | integer | none                | 0 to <b>ntemp</b>   | 0       | <b>temp_module</b> =<br>ide_dist      |
| <b>padj_rn</b>         | Monthly (January to December) factor to adjust rain lapse rate computed between station <b>hru_psta</b> and station <b>hru_plaps</b> ; positive factors are multiplied times the lapse rate and negative factors are made positive and substituted for the computed lapse rate | <b>nrain,</b><br><b>nmonths</b>  | real    | <b>precip_units</b> | -2.0 to 10.0        | 1.0     | <b>precip_module</b> =<br>precip_laps |
| <b>padj_sn</b>         | Monthly (January to December) factor to adjust snow lapse rate computed between station <b>hru_psta</b> and station <b>hru_plaps</b> ; positive factors are multiplied times the lapse rate and negative factors are made positive and substituted for the computed lapse rate | <b>nrain,</b><br><b>nmonths</b>  | real    | <b>precip_units</b> | -2.0 to 10.0        | 1.0     | <b>precip_module</b> =<br>precip_laps |
| <b>pmn_mo</b>          | Mean monthly (January to December) precipitation for each lapse precipitation measurement station  | <b>nrain,</b><br><b>nmonths</b>  | real    | <b>precip_units</b> | 0.00001 to<br>100.0 | 1.0     | <b>precip_module</b> =<br>precip_laps |
| <b>potet_cbh_adj</b>   | Monthly (January to December) adjustment factor to potential evapotranspiration specified in CBH Files for each HRU  | <b>nhru,</b><br><b>nmonths</b>   | real    | decimal<br>fraction | 0.5 to 1.5          | 1.0     | <b>et_module</b> =<br>climate_hru     |
| <b>ppt_add</b>         | Mean value for the precipitation measurement station transformation equation   | <b>one</b>                       | real    | <b>precip_units</b> | -10.0 to<br>10.0    | 0.0     | <b>precip_module</b> =<br>xyz_dist    |
| <b>ppt_div</b>         | Standard deviation for the precipitation measurement station transformation equation (not 0 . 0)   | <b>one</b>                       | real    | <b>precip_units</b> | -10.0 to<br>10.0    | 1.0     | <b>precip_module</b> =<br>xyz_dist    |
| <b>ppt_lapse</b>       | Monthly (January to December) precipitation lapse rate for each direction (X, Y, and Z)  | <b>nlapse,</b><br><b>nmonths</b> | real    | none                | -10.0 to<br>10.0    | 0.0     | <b>precip_module</b> =<br>xyz_dist    |
| <b>ppt_zero_thresh</b> | Precipitation below this amount is set to 0.0  | <b>one</b>                       | real    | <b>precip_units</b> | 0.0 to 0.1          | 0.0     | required                              |
| <b>prcp_wght_dist</b>  | Monthly (January to December) precipitation weighting function for inverse distance calculations   | <b>nmonths</b>                   | real    | decimal<br>fraction | 0.0 to 1.0          | 0.5     | <b>precip_module</b> =<br>ide_dist    |
| <b>precip_map_adj</b>  | Monthly (January to December) multiplicative adjustment factor to mapped precipitation to account for differences in elevation, and so forth   | <b>nmap,</b><br><b>nmonths</b>   | real    | decimal<br>fraction | 0.5 to 2.0          | 1.0     | <b>precip_module</b> =<br>precip_map  |
| <b>psta_elev</b>       | Elevation of each precipitation measurement station  | <b>nrain</b>                     | real    | <b>elev_units</b>   | -300.0 to           | 0.0     | <b>precip_module</b> =                |



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

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

| Parameter name          | Description   | Dimension <sup>1</sup>    | Type | Units                             | Range                 | Default | Required/condition  |
|-------------------------|---|---------------------------|------|-----------------------------------|-----------------------|---------|---|
| <b>tmax_allsnow_sta</b> | Monthly (January to December) maximum air temperature when precipitation is assumed to be snow; if air temperature is less than or equal to this value, precipitation is snow | <b>nrain,<br/>nmonths</b> | real | <b>temp_units</b>                 | -10.0 to<br>40.0      | 38.0    | <b>temp_module =<br/>ide_dist</b>   |
| <b>tmax_cbh_adj</b>     | Monthly (January to December) adjustment factor to maximum air temperature for each HRU, estimated on the basis of slope and aspect   | <b>nhru,<br/>nmonths</b>  | real | <b>temp_units</b>                 | -10.0 to<br>10.0      | 0.0     | <b>temp_module =<br/>climate_hru</b>  |
| <b>tmax_div</b>         | Standard deviation for the air-temperature-measurement station transformation equation for maximum air temperature (not 0 . 0)  | <b>one</b>                | real | <b>temp_units</b>                 | -100.0 to<br>100.0    | 1.0     | <b>temp_module =<br/>xyz_dist</b>   |
| <b>tmax_map_adj</b>     | Monthly (January to December) additive adjustment factor to maximum air temperature for each mapped spatial unit estimated on the basis of slope and aspect                   | <b>nmap,<br/>nmonths</b>  | real | <b>temp_units</b>                 | -10.0 to<br>10.0      | 0.0     | <b>temp_module =<br/>temp_map</b>   |
| <b>tmax_lapse</b>       | Monthly (January to December) values representing the change in maximum air temperature per 1,000 <b>elev_units</b> of elevation change for each HRU                          | <b>nhru,<br/>nmonths</b>  | real | <b>temp_units/<br/>elev_units</b> | -20.0 to<br>20.0      | 3.0     | <b>temp_module =<br/>temp_1sta</b>  |
| <b>tmin_add</b>         | Mean value for the air-temperature-measurement station transformation equation for minimum air temperature  | <b>one</b>                | real | <b>temp_units</b>                 | -100.0 to<br>100.0    | 0.0     | <b>temp_module =<br/>xyz_dist</b>   |
| <b>tmin_adj</b>         | Adjustment to minimum air temperature for each HRU, estimated on the basis of slope and aspect  | <b>nhru,<br/>nmonths</b>  | real | <b>temp_units</b>                 | -10.0 to<br>10.0      | 0.0     | <b>temp_module =<br/>temp_1sta,<br/>temp_sta,<br/>temp_laps,<br/>temp_dist2,<br/>ide_dist or<br/>xyz_dist</b> |
| <b>tmin_cbh_adj</b>     | Monthly (January to December) adjustment factor to minimum air temperature for each HRU, estimated on the basis of slope and aspect   | <b>nhru,<br/>nmonths</b>  | real | <b>temp_units</b>                 | -10.0 to<br>10.0      | 0.0     | <b>temp_module =<br/>climate_hru</b>  |
| <b>tmin_div</b>         | Standard deviation for the air-temperature-measurement station transformation equation for minimum air temperature (not 0 . 0)  | <b>one</b>                | real | <b>temp_units</b>                 | -100.0 to<br>100.0    | 1.0     | <b>temp_module =<br/>xyz_dist</b>   |
| <b>tmin_map_adj</b>     | Monthly (January to December) additive adjustment factor to minimum air temperature for each mapped spatial unit, estimated on the basis of slope and aspect                  | <b>nmap,<br/>nmonths</b>  | real | <b>temp_units</b>                 | -10.0 to<br>10.0      | 0.0     | <b>temp_module =<br/>temp_map</b>   |
| <b>tmin_lapse</b>       | Monthly (January to December) values representing the change in minimum air temperature per 1,000 <b>elev_units</b> of elevation change for each HRU                          | <b>nhru,<br/>nmonths</b>  | real | <b>temp_units/<br/>elev_units</b> | -20.0 to<br>20.0      | 3.0     | <b>temp_module =<br/>temp_1sta</b>  |
| <b>tsta_elev</b>        | Elevation of each air-temperature-measurement station   | <b>ntemp</b>              | real | <b>elev_units</b>                 | -300.0 to<br>30,000.0 |         |   |
| <b>tsta_month_max</b>   | Average monthly (January to December) maximum air   | <b>ntemp,</b>             | real | <b>temp_units</b>                 | -100.0 to             | 0.0     | <b>temp_module =</b>  |

| Parameter name        | Description  | Dimension <sup>1</sup>         | Type    | Units             | Range                    | Default | Required/condition                                     |
|-----------------------|--|--------------------------------|---------|-------------------|--------------------------|---------|--|
| <b>tsta_month_min</b> | temperature at each air-temperature-measurement station<br>Average monthly (January to December) minimum air temperature at each air-temperature-measurement station | <b>nmonths</b>                 | real    | <b>temp_units</b> | 100.0<br>-100.0 to 100.0 | 0.0     | xyz_dist<br><b>temp_module</b> = xyz_dist              |
| <b>tsta_nuse</b>      | The subset of temperature stations used in the distribution regression (0=station not used; 1=station used)  | <b>nmonths</b>                 | integer | none              | 0 or 1                   | 0       | <b>temp_module</b> = ide_dist or xyz_dist              |
| <b>tsta_x</b>         | Longitude (X) for each air-temperature-measurement station in albers projection  | <b>ntemp</b>                   | real    | meters            | -1.0E7 to 1.0E7          | 0.0     | <b>temp_module</b> = ide_dist or xyz_dist              |
| <b>tsta_xlong</b>     | Longitude of each air-temperature-measurement station, State Plane Coordinate System   | <b>ntemp</b>                   | real    | feet              | -1.0E9 to 1.0E9          | 0.0     | <b>temp_module</b> = temp_dist2                        |
| <b>tsta_y</b>         | Latitude (Y) for each air-temperature-measurement station in albers projection   | <b>ntemp</b>                   | real    | meters            | -1.0E7 to 1.0E7          | 0.0     | <b>temp_module</b> = ide_dist or xyz_dist              |
| <b>tsta_ylat</b>      | Latitude of each air-temperature-measurement station, State Plane Coordinate System  | <b>ntemp</b>                   | real    | feet              | -1.0E9 to 1.0E9          | 0.0     | <b>temp_module</b> = temp_dist2                        |
| <b>x_add</b>          | Mean value for the climate station transformation equation for the longitude (X) coordinate  | <b>one</b>                     | real    | meters            | -1.0E7 to 1.0E7          | 0.0     | <b>precip_module</b> and <b>temp_module</b> = xyz_dist |
| <b>x_div</b>          | Standard deviation for the climate station transformation equation for the longitude (X) coordinate (not 0 . 0)  | <b>one</b>                     | real    | meters            | -1.0E7 to 1.0E7          | 1.0     | <b>precip_module</b> and <b>temp_module</b> = xyz_dist |
| <b>y_add</b>          | Mean value for the climate station transformation equation for the latitude (Y) coordinate   | <b>one</b>                     | real    | meters            | -1.0E7 to 1.0E7          | 0.0     | <b>precip_module</b> and <b>temp_module</b> = xyz_dist |
| <b>y_div</b>          | Standard deviation for the climate station transformation equation for the latitude (Y) coordinate   | <b>one</b>                     | real    | meters            | -1.0E7 to 1.0E7          | 1.0     | <b>precip_module</b> and <b>temp_module</b> = xyz_dist |
| <b>z_add</b>          | Mean value for the climate station transformation equation for the elevation (Z) coordinate  | <b>one</b>                     | real    | meters            | -1.0E7 to 1.0E7          | 0.0     | <b>precip_module</b> and <b>temp_module</b> = xyz_dist |
| <b>z_div</b>          | Standard deviation for the climate station transformation equation for the elevation (Z) coordinate (not 0 . 0)  | <b>one</b>                     | real    | meters            | -1.0E7 to 1.0E7          | 1.0     | <b>precip_module</b> and <b>temp_module</b> = xyz_dist |
| Solar radiation       |  |                                |         |                   |                          |         |  |
| <b>basin_solsta</b>   | Index of solar radiation station used to compute basin radiation values; used when dimension <b>nsol</b> >0  | <b>one</b>                     | integer | none              | 0 to <b>nsol</b>         | 0       | <b>nsol</b> > 0  |
| <b>ccov_intcp</b>     | Monthly (January to December) intercept in cloud-cover relationship  | <b>nhru,</b><br><b>nmonths</b> | real    | none              | 0.0 to 5.0               | 1.83    | <b>solrad_module</b> = ccsolrad                        |
| <b>ccov_slope</b>     | Monthly (January to December) coefficient in cloud-  | <b>nhru,</b>                   | real    | none              | -0.5 to                  | -0.13   | <b>solrad_module</b> =                                 |

| Parameter name                            | Description   | Dimension <sup>1</sup>                           | Type    | Units                      | Range               | Default | Required/condition  |
|---|---|--|---------|----------------------------|---------------------|---------|---|
| <b>crad_coef</b>                          | cover relationship<br>Coefficient(B) in Thompson (1976) equation; varies by region, contour map of values in reference  | <b>nmonths</b><br><b>nhru,</b><br><b>nmonths</b> | real    | none                       | -0.01<br>0.1 to 0.7 | 0.4     | <b>ccsolrad</b><br><b>solrad_module =</b><br><b>ccsolrad</b>    |
| <b>crad_exp</b>                           | Exponent(P) in Thompson (1976) equation   | <b>nhru,</b><br><b>nmonths</b>                   | real    | none                       | 0.2 to 0.8          | 0.61    | <b>solrad_module =</b><br><b>ccsolrad</b>                       |
| <b>dday_intcp</b>                         | Monthly (January to December) intercept in degree-day equation for each HRU   | <b>nhru,</b><br><b>nmonths</b>                   | real    | dday                       | -60.0 to<br>10.0    | -40.0   | <b>solrad_module =</b><br><b>ddsolrad</b>                       |
| <b>dday_slope</b>                         | Monthly (January to December) slope in degree-day equation for each HRU   | <b>nhru,</b><br><b>nmonths</b>                   | real    | dday/<br><b>temp_units</b> | 0.1 to 1.4          | 0.4     | <b>solrad_module =</b><br><b>ddsolrad</b>                       |
| <b>hru_solsta</b>                         | Index of solar radiation station associated with each HRU   | <b>nhru</b>                                      | integer | none                       | 0 to <b>nsol</b>    | 0       | <b>nsol &gt; 0</b>  |
| <b>ppt_rad_adj</b>                        | Monthly minimum precipitation, if HRU precipitation exceeds this value, radiation is multiplied by <b>radj_sppt</b> or <b>radj_wppt</b> precipitation adjustment factor | <b>nhru,</b><br><b>nmonths</b>                   | real    | inches                     | 0.0 to 0.5          | 0.02    | required  |
| <b>radadj_intcp</b>                       | Monthly (January to December) intercept in air temperature range adjustment to degree-day equation for each HRU   | <b>nhru,</b><br><b>nmonths</b>                   | real    | none                       | 0.0 to 1.0          | 1.0     | <b>solrad_module =</b><br><b>ddsolrad</b>                       |
| <b>radadj_slope</b>                       | Monthly (January to December) slope in air temperature range adjustment to degree-day equation for each HRU   | <b>nhru,</b><br><b>nmonths</b>                   | real    | 1/<br><b>temp_units</b>    | 0.0 to 1.0          | 0.0     | <b>solrad_module =</b><br><b>ddsolrad</b>                       |
| <b>radj_sppt</b>                          | Adjustment factor for computed solar radiation for summer day with greater than <b>ppt_rad_adj</b> inches of precipitation for each HRU                                 | <b>nhru</b>                                      | real    | decimal<br>fraction        | 0.0 to 1.0          | 0.44    | required  |
| <b>radj_wppt</b>                          | Adjustment factor for computed solar radiation for winter day with greater than <b>ppt_rad_adj</b> inches of precipitation for each HRU                                 | <b>nhru</b>                                      | real    | decimal<br>fraction        | 0.0 to 1.0          | 0.5     | required  |
| <b>radmax</b>                             | Monthly (January to December) maximum fraction of the potential solar radiation that may reach the ground due to haze, dust, smog, and so forth, for each HRU           | <b>nhru,</b><br><b>nmonths</b>                   | real    | decimal<br>fraction        | 0.1 to 1.0          | 0.8     | required  |
| <b>tmax_index</b>                         | Monthly (January to December) index temperature used to determine precipitation adjustments to solar radiation for each HRU   | <b>nhru,</b><br><b>nmonths</b>                   | real    | <b>temp_units</b>          | -10.0 to<br>110.0   | 50.0    | <b>solrad_module =</b><br><b>ddsolrad</b>                       |
| Potential evapotranspiration distribution |   |  |         |                            |                     |         |   |
| <b>crop_coef</b>                          | Monthly (January to December) crop coefficient for each HRU   | <b>nhru,</b><br><b>nmonths</b>                   | real    | decimal<br>fraction        | 0.0 to 2.0          | 1.0     | <b>et_module =</b><br><b>potet_pm</b> or<br><b>potet_pm_sta</b> |
| <b>epan_coef</b>                          | Monthly (January to December) evaporation pan coefficient for each HRU  | <b>nhru,</b><br><b>nmonths</b>                   | real    | decimal<br>fraction        | 0.01 to 3.0         | 1.0     | <b>et_module =</b><br><b>potet_pan</b>                          |
| <b>hamon_coef</b>                         | Monthly (January to December) air temperature coefficient used in Hamon potential ET computations for each HRU  | <b>nhru,</b><br><b>nmonths</b>                   | real    | none                       | 0.004 to<br>0.008   | 0.0055  | <b>et_module =</b><br><b>potet_hamon</b>                        |

| Parameter name                     | Description   | Dimension <sup>1</sup>         | Type    | Units                          | Range              | Default | Required/condition   |
|------------------------------------|---|--------------------------------|---------|--------------------------------|--------------------|---------|--|
| <b>hru_humidity_sta</b>            | Index of humidity measurement station for each HRU  | <b>nhru</b>                    | integer | none                           | 0 to <b>nhumid</b> | 0       | <b>et_module</b> =<br>potet_pm_sta and<br><b>nhumid</b> > 0  |
| <b>hru_pansta</b>                  | Index of pan evaporation station used to compute HRU potential ET   | <b>nhru</b>                    | integer | none                           | 0 to <b>nevap</b>  | 0       | <b>et_module</b> =<br>potet_pan and<br><b>nevap</b> > 0  |
| <b>hru_windspeed_sta</b>           | Index of wind speed measurement station for each HRU  | <b>nhru</b>                    | integer | none                           | 0 to <b>nwind</b>  | 0       | <b>et_module</b> =<br>potet_pm_sta and<br><b>nwind</b> > 0   |
| <b>hs_krs</b>                      | Monthly (January to December) adjustment factor used in Hargreaves-Samani potential ET computations for each HRU      | <b>nhru,</b><br><b>nmonths</b> | real    | decimal<br>fraction            | 0.01 to<br>0.24    | 0.0135  | <b>et_module</b> =<br>potet_hs   |
| <b>humidity_percent</b>            | Monthly humidity for each HRU   | <b>nhru,</b><br><b>nmonths</b> | real    | percentage                     | 0.0 to<br>100.0    | 0.0     | <b>et_module</b> =<br>potet_pm or<br>potet_pt and<br>humidity is not<br>specified in a CBH<br>File |
| <b>jh_coef</b>                     | Monthly (January to December) air temperature coefficient used in Jensen-Haise potential ET computations for each HRU | <b>nhru,</b><br><b>nmonths</b> | real    | per degrees<br>Fahrenheit      | -0.5 to 1.5        | 0.014   | <b>et_module</b> =<br>potet_jh   |
| <b>jh_coef_hru</b>                 | Air temperature coefficient used in Jensen-Haise potential ET computations for each HRU                               | <b>nhru</b>                    | real    | per degrees<br>Fahrenheit      | -99.0 to<br>150.0  | 13.0    | <b>et_module</b> =<br>potet_jh   |
| <b>pm_d_coef</b>                   | Monthly (January to December) Penman-Monteith potential ET D wind speed coefficient for each HRU                      | <b>nhru,</b><br><b>nmonths</b> | real    | seconds/<br>meter              | 0.25 to<br>0.45    | 0.34    | <b>et_module</b> =<br>potet_pm or<br>potet_pm_sta  |
| <b>pm_n_coef</b>                   | Monthly (January to December) Penman-Monteith potential ET N temperature coefficient for each HRU                     | <b>nhru,</b><br><b>nmonths</b> | real    | degrees<br>Celsius per<br>day  | 850.0 to<br>950.0  | 900.0   | <b>et_module</b> =<br>potet_pm or<br>potet_pm_sta  |
| <b>potet_cbh_adj</b>               | Monthly (January to December) adjustment factor to potential evapotranspiration specified in CBH Files for each HRU   | <b>nhru,</b><br><b>nmonths</b> | real    | degrees<br>decimal<br>fraction | 0.5 to 1.5         | 1.0     | <b>et_module</b> =<br>climate_hru  |
| <b>pt_alpha</b>                    | Monthly (January to December) adjustment factor used in Priestly-Taylor potential ET computations for each HRU        | <b>nhru,</b><br><b>nmonths</b> | real    | decimal<br>fraction            | 1.0 to 2.0         | 1.26    | <b>et_module</b> =<br>potet_pt   |
| Evapotranspiration and sublimation |   |                                |         |                                |                    |         |  |
| <b>fall_frost</b>                  | The solar date (number of days after winter solstice) of the first killing frost of the fall                          | <b>nhru</b>                    | integer | solar date                     | 1 to 366           | 264     | <b>transp_module</b> =<br>transp_frost   |
| <b>frost_temp</b>                  | Temperature of killing frost  | <b>nhru</b>                    | real    | <b>temp_units</b>              | -10.0 to<br>32.0   | 28.0    | <b>model_mode</b> =<br>FROST   |

| Parameter name      | Description  | Dimension <sup>1</sup> | Type    | Units             | Range          | Default | Required/condition                      |
|---------------------|--|------------------------|---------|-------------------|----------------|---------|---|
| <b>potet_sublim</b> | Fraction of potential ET that is sublimated from snow in the canopy and snowpack for each HRU  | <b>nhru</b>            | real    | decimal fraction  | 0.1 to 0.75    | 0.5     | required                                |
| <b>rad_trncf</b>    | Transmission coefficient for short-wave radiation through the winter vegetation canopy   | <b>nhru</b>            | real    | decimal fraction  | 0.0 to 1.0     | 0.5     | required                                |
| <b>soil_type</b>    | Soil type of each HRU (1=sand; 2=loam; 3=clay)   | <b>nhru</b>            | integer | none              | 1 to 3         | 2       | required                                |
| <b>spring_frost</b> | The solar date (number of days after winter solstice) of the last killing frost of the spring  | <b>nhru</b>            | integer | solar date        | 1 to 366       | 111     | <b>transp_module</b> =<br>transp_frost  |
| <b>transp_beg</b>   | Month to begin summing maximum air temperature for each HRU; when sum is greater than or equal to <b>transp_tmax</b> , transpiration begins  | <b>nhru</b>            | integer | month             | 1 to 12        | 1       | <b>transp_module</b> =<br>transp_tindex |
| <b>transp_end</b>   | Month to stop transpiration computations; transpiration is computed through the end of previous month  | <b>nhru</b>            | integer | month             | 1 to 13        | 13      | <b>transp_module</b> =<br>transp_tindex |
| <b>transp_tmax</b>  | Temperature index to determine the specific date of the start of the transpiration period; the maximum air temperature for each HRU is summed starting with the first day of month <b>transp_beg</b> ; when the sum exceeds this index, transpiration begins | <b>nhru</b>            | real    | <b>temp_units</b> | 0.0 to 1,000.0 | 1.0     | <b>transp_module</b> =<br>transp_tindex |
| Interception        |  |                        |         |                   |                |         |   |
| <b>cov_type</b>     | Vegetation cover type for each HRU (0=bare soil; 1=grasses; 2=shrubs; 3=trees; 4=coniferous)   | <b>nhru</b>            | integer | none              | 0 to 4         | 3       | required                                |
| <b>covden_sum</b>   | Summer vegetation cover density for the major vegetation type in each HRU  | <b>nhru</b>            | real    | decimal fraction  | 0.0 to 1.0     | 0.5     | required                                |
| <b>covden_win</b>   | Winter vegetation cover density for the major vegetation type in each HRU  | <b>nhru</b>            | real    | decimal fraction  | 0.0 to 1.0     | 0.5     | required                                |
| <b>snow_intcp</b>   | Snow interception storage capacity for the major vegetation type in each HRU   | <b>nhru</b>            | real    | inches            | 0.0 to 1.0     | 0.1     | required                                |
| <b>srain_intcp</b>  | Summer rain interception storage capacity for the major vegetation type in each HRU  | <b>nhru</b>            | real    | inches            | 0.0 to 1.0     | 0.1     | required                                |
| <b>wrain_intcp</b>  | Winter rain interception storage capacity for the major vegetation type in each HRU  | <b>nhru</b>            | real    | inches            | 0.0 to 1.0     | 0.1     | required                                |
| Snow computations   |  |                        |         |                   |                |         |   |
| <b>albset_rna</b>   | Fraction of rain in a mixed precipitation event above which the snow albedo is not reset; applied during the snowpack accumulation stage   | <b>one</b>             | real    | decimal fraction  | 0.5 to 1.0     | 0.8     | required                                |
| <b>albset_rnm</b>   | Fraction of rain in a mixed precipitation event above which the snow albedo is not reset; applied during the snowpack melt stage   | <b>one</b>             | real    | decimal fraction  | 0.4 to 1.0     | 0.6     | required                                |
| <b>albset_sna</b>   | Minimum snowfall, in water equivalent, needed to reset snow albedo during the snowpack accumulation stage  | <b>one</b>             | real    | inches            | 0.01 to 1.0    | 0.05    | required                                |
| <b>albset_snm</b>   | Minimum snowfall, in water equivalent, needed to reset   | <b>one</b>             | real    | inches            | 0.1 to 1.0     | 0.2     | required                                |

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

Glacier and frozen ground computations



| Parameter name           | Description  | Dimension <sup>1</sup> | Type    | Units                      | Range            | Default | Required/condition      |
|--------------------------|--|------------------------|---------|----------------------------|------------------|---------|-------------------------|
| <b>abl_elev_range</b>    | Average HRU snowfield ablation zones elevation range or approximate median-min elevation                                     | <b>nhru</b>            | real    | <b>elev_units</b>          | 0.0 to 17000.0   | 1000.0  | <b>glacier_flag = 1</b> |
| <b>albedo_coef</b>       | Coefficient in calculation of ice albedo   | <b>nhru</b>            | real    | none                       | 0.1 to 0.3       | 0.137   | <b>glacier_flag = 1</b> |
| <b>albedo_ice</b>        | Ice albedo 300 meters below equilibrium line altitude (ELA)  | <b>nhru</b>            | real    | decimal fraction           | 0.2 to 0.6       | 0.344   | <b>glacier_flag = 1</b> |
| <b>cfdgi_decay</b>       | Continuous frozen ground index (CFGI) daily decay of index; value of 1.0 is no decay   | <b>one</b>             | real    | decimal fraction           | 0.1 to 1.0       | 0.97    | <b>frozen_flag = 1</b>  |
| <b>cfdgi_thrshld</b>     | Continuous frozen ground index (CFGI) threshold value indicating frozen soil   | <b>one</b>             | real    | none                       | 1.0 to 500.0     | 52.55   | <b>frozen_flag = 1</b>  |
| <b>glacier_frac_init</b> | Initial fraction of glaciation (0=none; 1=100%) in glacier-capable HRU   | <b>nhru</b>            | real    | decimal fraction           | 0.0 to 1.0       | 0.0     | <b>glacier_flag = 1</b> |
| <b>glacr_freeh2o_cap</b> | Free-water holding capacity of glacier ice of the frozen water content of the glacier ice ( <i>glacr_pk_ice</i> )            | <b>nhru</b>            | real    | decimal fraction           | 0.0 to 0.1       | 0.002   | <b>glacier_flag = 1</b> |
| <b>glacr_layer</b>       | Active layer is 0 to 15 m (590.6 inches) thick at start of year, when melts will set daily <i>glacr_pk_temp</i> to 0         | <b>nhru</b>            | real    | inches                     | 0.0 to 590.6     | 0.0     | <b>glacier_flag = 1</b> |
| <b>glacrva_coef</b>      | Volume area scaling coefficient for glaciers, average value by region  | <b>nhru</b>            | real    | $m^{**}(3-2*glacrva\_exp)$ | 0.01 to 2.0      | 0.28    | <b>glacier_flag = 1</b> |
| <b>glacrva_exp</b>       | Volume area exponential coefficient for glaciers, average value by region  | <b>nhru</b>            | real    | none                       | 1.0 to 2.0       | 1.375   | <b>glacier_flag = 1</b> |
| <b>glette_frac_init</b>  | Initial fraction of glacierette (too small for glacier dynamics)   | <b>nhru</b>            | real    | decimal fraction           | 0.0 to 1.0       | 0.0     | <b>glacier_flag = 1</b> |
| <b>hru_length</b>        | Length of segment covering all of glacier-possible for each HRU  | <b>nhru</b>            | real    | km                         | 0.0 to 10000.0   | 0.0     | <b>glacier_flag = 1</b> |
| <b>hru_width</b>         | Width of glacier-possible for each HRU   | <b>nhru</b>            | real    | km                         | 0.0 to 10000.0   | 0.0     | <b>glacier_flag = 1</b> |
| <b>max_gldepth</b>       | Upper bound on glacier thickness, thickest glacier measured is Taku at 1.5 km, ice sheet 3 km                                | <b>nhru</b>            | real    | km                         | 0.1 to 3.0       | 1.5     | <b>glacier_flag = 1</b> |
| <b>stor_firm</b>         | Monthly (January to December) storage coefficient for firm melt on glaciers  | <b>nhru</b>            | real    | hours                      | 150.0 to 1000.0  | 400.0   | <b>glacier_flag = 1</b> |
| <b>stor_ice</b>          | Monthly (January to December) storage coefficient for ice melt on glaciers   | <b>nhru</b>            | real    | hours                      | 5.0 to 29.0      | 10.0    | <b>glacier_flag = 1</b> |
| <b>stor_snow</b>         | Monthly (January to December) storage coefficient for ice melt on glaciers   | <b>nhru</b>            | real    | hours                      | 30.0 to 149.0    | 80.0    | <b>glacier_flag = 1</b> |
| <b>tohru</b>             | Index of down-flowline HRU to which the HRU glacier melt flows, for non-glacier HRUs that do not flow to another HRU enter 0 | <b>nhru</b>            | integer | none                       | 0 to <b>nhru</b> | 0       | <b>glacier_flag = 1</b> |

Hortonian surface runoff, infiltration, and impervious storage

| Parameter name              | Description   | Dimension <sup>1</sup> | Type   | Units            | Range          | Default | Required/condition                                  |
|-----------------------------|---|------------------------|--------|------------------|----------------|---------|---|
| <b>carea_max</b>            | Maximum possible area contributing to surface runoff expressed as a portion of the HRU area   | <b>nhru</b>            | real   | decimal fraction | 0.0 to 1.0     | 0.6     | required  |
| <b>carea_min</b>            | Minimum possible area contributing to surface runoff expressed as a portion of the area for each HRU  | <b>nhru</b>            | real   | decimal fraction | 0.0 to 1.0     | 0.2     | <b>srunoff_module = srunoff_carea</b>               |
| <b>hru_percent_imperv</b>   | Fraction of each HRU area that is impervious  | <b>nhru</b>            | real   | decimal fraction | 0.0 to 0.999   | 0.0     | required  |
| <b>imperv_stor_max</b>      | Maximum impervious area retention storage for each HRU  | <b>nhru</b>            | real   | inches           | 0.0 to 0.5     | 0.05    | required  |
| <b>smidx_coef</b>           | Coefficient in non-linear contributing area algorithm for each HRU  | <b>nhru</b>            | real   | decimal fraction | 0.0 to 1.0     | 0.005   | <b>srunoff_module = srunoff_smidx</b>               |
| <b>smidx_exp</b>            | Exponent in non-linear contributing area algorithm for each HRU   | <b>nhru</b>            | real   | 1/inch           | 0.0 to 5.0     | 0.3     | <b>srunoff_module = srunoff_smidx</b>               |
| <b>snowinfil_max</b>        | Maximum snow infiltration per day for each HRU  | <b>nhru</b>            | real   | inches/day       | 0.0 to 20.0    | 2.0     | required  |
| Surface depression storage  |   |                        |        |                  |                |         |   |
| <b>dprst_area</b>           | Aggregate sum of surface-depression storage areas of each HRU (recommend that <b>dprst_frac_hru</b> be used instead of <b>dprst_area</b> )  | <b>nhru</b>            | real   | acres            | 0.0 to 1.0E9   | 0.0     | <b>dprst_flag = 1</b> and <b>model_mode = PRMS</b>  |
| <b>dprst_depth_avg</b>      | Average depth of storage depressions at maximum storage capacity  | <b>nhru</b>            | real   | inches           | 0.0 to 500.0   | 132.0   | <b>dprst_flag = 1</b>                               |
| <b>dprst_et_coef</b>        | Fraction of unsatisfied potential evapotranspiration to apply to surface-depression storage   | <b>nhru</b>            | real   | decimal fraction | 0.5 to 1.5     | 1.0     | <b>dprst_flag = 1</b>                               |
| <b>dprst_flow_coef</b>      | Coefficient in linear flow routing equation for open surface depressions for each HRU   | <b>nhru</b>            | real   | fraction/day     | 0.00001 to 0.5 | 0.05    | <b>dprst_flag = 1</b>                               |
| <b>dprst_frac_hru</b>       | Fraction of each HRU area that has surface depressions (If specified, the parameter <b>dprst_area</b> is ignored if it also is specified, default of -1.0 means use <b>dprst_area</b> ) | <b>nhru</b>            | real   | decimal fraction | -1.0 to 0.999  | -1.0    | <b>dprst_flag = 1</b> and <b>model_mode = PRMS</b>  |
| <b>dprst_frac</b>           | Fraction of each HRU area that has surface depressions  | <b>nhru</b>            | real   | decimal fraction | 0.0 to 0.999   | 0.0     | <b>dprst_flag = 1</b> and <b>model_mode = PRMS5</b> |
| <b>dprst_frac_init</b>      | Fraction of maximum surface-depression storage that contains water at the start of a simulation   | <b>nhru</b>            | real   | decimal fraction | 0.0 to 1.0     | 0.5     | <b>dprst_flag = 1</b>                               |
| <b>dprst_frac_open</b>      | Fraction of open surface-depression storage area within an HRU that can generate surface runoff as a function of storage volume   | <b>nhru</b>            | double | decimal fraction | 0.0 to 1.0     | 1.0     | <b>dprst_flag = 1</b>                               |
| <b>dprst_seep_rate_clos</b> | Coefficient used in linear seepage flow equation for closed surface depressions for each HRU  | <b>nhru</b>            | real   | fraction/day     | 0.0 to 0.2     | 0.02    | <b>dprst_flag = 1</b>                               |
| <b>dprst_seep_rate_open</b> | Coefficient used in linear seepage flow equation for open surface depressions for each HRU  | <b>nhru</b>            | real   | fraction/day     | 0.0 to 0.2     | 0.02    | <b>dprst_flag = 1</b>                               |
| <b>op_flow_thres</b>        | Fraction of open depression storage above which surface runoff occurs; any water above maximum open storage   | <b>nhru</b>            | real   | decimal fraction | 0.01 to 1.0    | 1.0     | <b>dprst_flag = 1</b>                               |

| Parameter name   | Description  | Dimension <sup>1</sup> | Type | Units            | Range            | Default | Required/condition                                  |
|--|--|------------------------|------|------------------|------------------|---------|---|
| <b>sro_to_dprst_imperv</b>   | capacity spills as surface runoff<br>Fraction of impervious surface runoff that flows into surface-depression storage; the remainder flows to a stream network for each HRU  | <b>nhru</b>            | real | decimal fraction | 0.0 to 1.0       | 0.2     | <b>dprst_flag = 1</b>                               |
| <b>sro_to_dprst</b>  | Fraction of pervious surface runoff that flows into surface-depression storage; the remainder flows to a stream network for each HRU   | <b>nhru</b>            | real | decimal fraction | 0.0 to 1.0       | 0.2     | <b>dprst_flag = 1</b> and <b>model_mode = PRMS</b>  |
| <b>sro_to_dprst_perv</b>   | Fraction of pervious surface runoff that flows into surface-depression storage; the remainder flows to a stream network for each HRU   | <b>nhru</b>            | real | decimal fraction | 0.0 to 1.0       | 0.2     | <b>dprst_flag = 1</b> and <b>model_mode = PRMS5</b> |
| <b>va_clos_exp</b>   | Coefficient in the exponential equation relating maximum surface area to the fraction that closed depressions are full to compute current surface area for each HRU; 0.001 is an approximate cylinder; 1.0 is a cone | <b>nhru</b>            | real | none             | 0.0001 to 10.0   | 0.001   | <b>dprst_flag = 1</b>                               |
| <b>va_open_exp</b>   | Coefficient in the exponential equation relating maximum surface area to the fraction that open depressions are full to compute current surface area for each HRU; 0.001 is an approximate cylinder; 1.0 is a cone   | <b>nhru</b>            | real | none             | 0.0001 to 10.0   | 0.001   | <b>dprst_flag = 1</b>                               |
| Soil zone storage, interflow, gravity drainage, Dunnian surface runoff |  |                        |      |                  |                  |         |   |
| <b>fastcoef_lin</b>  | Linear coefficient in equation to route preferential-flow storage downslope for each HRU   | <b>nhru</b>            | real | fraction/day     | 0.0 to 1.0       | 0.1     | required  |
| <b>fastcoef_sq</b>   | Non-linear coefficient in equation to route preferential-flow storage downslope for each HRU   | <b>nhru</b>            | real | none             | 0.0 to 1.0       | 0.8     | required  |
| <b>pref_flow_den</b>   | Fraction of the gravity reservoir in which preferential flow occurs for each HRU   | <b>nhru</b>            | real | decimal fraction | 0.0 to 0.5       | 0.0     | required  |
| <b>sat_threshold</b>   | Water holding capacity of the gravity and preferential-flow reservoirs; difference between field capacity and total soil saturation for each HRU   | <b>nhru</b>            | real | inches           | 0.00001 to 999.0 | 999.0   | required  |
| <b>slowcoef_lin</b>  | Linear coefficient in equation to route gravity-reservoir storage downslope for each HRU   | <b>nhru</b>            | real | fraction/day     | 0.0 to 1.0       | 0.015   | required  |
| <b>slowcoef_sq</b>   | Non-linear coefficient in equation to route gravity-reservoir storage downslope for each HRU   | <b>nhru</b>            | real | none             | 0.0 to 1.0       | 0.1     | required  |
| <b>soil_moist_init</b>   | Initial value of available water in capillary reservoir for each HRU   | <b>nhru</b>            | real | inches           | 0.0 to 20.0      | 3.0     | <b>model_mode = PRMS</b>                            |
| <b>soil_moist_init_frac</b>  | Initial fraction of available water in the capillary reservoir (fraction of <b>soil_moist_max</b> for each HRU)  | <b>nhru</b>            | real | decimal fraction | 0.0 to 1.0       | 0.0     | <b>model_mode = PRMS5</b>                           |
| <b>soil_moist_max</b>  | Maximum available water holding capacity of capillary reservoir from land surface to rooting depth of the major  | <b>nhru</b>            | real | inches           | 0.00001 to 20.0  | 2.0     | required  |

| Parameter name              | Description   | Dimension <sup>1</sup> | Type    | Units            | Range           | Default | Required/condition        |
|-----------------------------|---|------------------------|---------|------------------|-----------------|---------|---------------------------|
| <b>soil_rechr_init</b>      | vegetation type of each HRU<br>Initial storage for soil recharge zone (upper part of capillary reservoir where losses occur as both evaporation and transpiration) for each HRU; must be less than or equal to <b>soil_moist_init</b> | <b>nhru</b>            | real    | inches           | 0.0 to 20.0     | 1.0     | <b>model_mode = PRMS</b>  |
| <b>soil_rechr_init_frac</b> | Initial fraction of available water in the capillary reservoir where losses occur as both evaporation and transpiration (upper zone of capillary reservoir) for each HRU  | <b>nhru</b>            | real    | decimal fraction | 0.0 to 1.0      | 0.0     | <b>model_mode = PRMS5</b> |
| <b>soil_rechr_max</b>       | Maximum storage for soil recharge zone (upper portion of capillary reservoir where losses occur as both evaporation and transpiration); must be less than or equal to <b>soil_moist_max</b>   | <b>nhru</b>            | real    | inches           | 0.00001 to 20.0 | 1.5     | <b>model_mode = PRMS</b>  |
| <b>soil_rechr_max_frac</b>  | Fraction of the capillary reservoir water-holding capacity ( <b>soil_moist_max</b> ) where losses occur as both evaporation and transpiration (upper zone of capillary reservoir) for each HRU  | <b>nhru</b>            | real    | decimal fraction | 0.00001 to 1.0  | 1.0     | <b>model_mode = PRMS5</b> |
| <b>soil2gw_max</b>          | Maximum amount of the capillary reservoir excess that is routed directly to the GWR for each HRU  | <b>nhru</b>            | real    | inches           | 0.0 to 5.0      | 0.0     | Required                  |
| <b>ssr2gw_exp</b>           | Non-linear coefficient in equation used to route water from the gravity reservoirs to the GWR for each HRU  | <b>nssr</b>            | real    | none             | 0.0 to 3.0      | 1.0     | Required                  |
| <b>ssr2gw_rate</b>          | Linear coefficient in equation used to route water from the gravity reservoir to the GWR for each HRU   | <b>nssr</b>            | real    | inches/day       | 0.0001 to 999.0 | 0.1     | Required                  |
| <b>ssstor_init</b>          | Initial storage of the gravity and preferential-flow reservoirs for each HRU  | <b>nssr</b>            | real    | inches           | 0.0 to 10.0     | 0.0     | <b>model_mode = PRMS</b>  |
| <b>ssstor_init_frac</b>     | Initial fraction of available water in the gravity plus preferential-flow reservoirs (fraction of <b>sat_threshold</b> ) for each HRU   | <b>nssr</b>            | real    | decimal fraction | 0.0 to 1.0      | 0.0     | <b>model_mode = PRMS5</b> |
| Groundwater flow            |   |                        |         |                  |                 |         |                           |
| <b>gwflow_coef</b>          | Linear coefficient in the equation to compute groundwater discharge for each GWR  | <b>ngw</b>             | real    | fraction/day     | 0.0 to 0.5      | 0.015   | required                  |
| <b>gwsink_coef</b>          | Linear coefficient in the equation to compute outflow to the groundwater sink for each GWR  | <b>ngw</b>             | real    | fraction/day     | 0.0 to 1.0      | 0.0     | required                  |
| <b>gwstor_init</b>          | Storage in each GWR at the beginning of a simulation  | <b>ngw</b>             | real    | inches           | 0.0 to 50.0     | 2.0     | required                  |
| <b>gwstor_min</b>           | Minimum storage in each GWR to ensure storage is greater than specified value to account for inflow from deep aquifers or injection wells with the water source outside the basin   | <b>ngw</b>             | real    | inches           | 0.0 to 1.0      | 0.0     | required                  |
| Streamflow                  |   |                        |         |                  |                 |         |                           |
| <b>hru_segment</b>          | Segment index to which an HRU contributes lateral   | <b>nhru</b>            | integer | none             | 0 to            | 0       | <b>strmflow_module =</b>  |

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

| Parameter name       | Description   | Dimension <sup>1</sup> | Type    | Units            | Range              | Default | Required/condition   |
|----------------------|---|------------------------|---------|------------------|--------------------|---------|--|
| <b>segment_type</b>  | Segment type (0=segment; 1= headwater; 2=lake; 3=replace inflow; 4=inbound to NHM; 5=outbound from NHM; 6=inbound to region; 7=outbound from region; 8=drains to ocean; 9=sink; 10=inbound from Great Lakes; 11=outbound to Great Lakes, add 100 to flag that the value is updated) | <b>nsegment</b>        | integer | none             | 0 to 111           | 0       | muskingum_mann<br><b>strmflow_module</b> = muskingum, strmflow_in_out, muskingum_lake,<br>or<br>muskingum_mann |
| <b>tosegment</b>     | Index of downstream segment to which the segment streamflow flows; for segments that do not flow to another segment enter 0   | <b>nsegment</b>        | integer | none             | 0 to 9999999       | 0       | <b>strmflow_module</b> = muskingum, strmflow_in_out, muskingum_lake,<br>or<br>muskingum_mann                   |
| <b>tosegment_nhm</b> | National Hydrologic Model downstream segment ID   | <b>nsegment</b>        | integer | none             | 0 to 9999999       | 0       | optional   |
| <b>x_coef</b>        | The amount of attenuation of the flow wave, called the Muskingum routing weighting factor; enter 0.0 for reservoirs, diversions, and segment(s) flowing out of the basin  | <b>nsegment</b>        | real    | decimal fraction | 0.0 to 0.5         | 0.2     | <b>strmflow_module</b> = muskingum or muskingum_mann   |
| Lake routing         |   |                        |         |                  |                    |         |  |
| <b>elev_outflow</b>  | Elevation of the main outflow point for each lake using broad-crested weir routing  | <b>nlake</b>           | real    | feet             | -300.0 to 10,000.0 | 0.0     | <b>strmflow_module</b> = muskingum_lake  |
| <b>elevlake_init</b> | Initial lake surface elevation for each lake using broad-crested weir routing or gate opening routing   | <b>nlake</b>           | real    | feet             | -300.0 to 10,000.0 | 1.0     | <b>strmflow_module</b> = muskingum_lake  |
| <b>gw_seep_coef</b>  | Linear coefficient in equation to compute lakebed seepage to the GWR and groundwater discharge to each lake using broad-crested weir routing or gate opening routing  | <b>ngw</b>             | real    | fraction/day     | 0.001 to 0.05      | 0.015   | <b>strmflow_module</b> = muskingum_lake  |
| <b>lake_coef</b>     | Coefficient in equation to route storage to streamflow for each lake using linear routing   | <b>nlake</b>           | real    | fraction/day     | 0.0001 to 1.0      | 0.1     | <b>strmflow_module</b> = muskingum_lake  |
| <b>lake_din1</b>     | Initial inflow to each lake using Puls or linear storage routing  | <b>nlake</b>           | real    | cfs              | 0.0 to 1.0E7       | 0.1     | <b>strmflow_module</b> = muskingum_lake  |
| <b>lake_evap_adj</b> | Monthly (January to December) adjustment factor for potential ET for each lake  | <b>nhru</b>            | real    | decimal fraction | 0.5 to 1.5         | 1.0     | <b>strmflow_module</b> = muskingum_lake  |
| <b>lake_hru_id</b>   | Identification number of the lake associated with an HRU; more than one HRU can be associated with each lake  | <b>nhru</b>            | integer | none             | 0 to <b>nlake</b>  | 0       | <b>strmflow_module</b> = muskingum_lake  |
| <b>lake_init</b>     | Initial storage in each lake using Puls or linear storage routing   | <b>nlake</b>           | real    | cfs-days         | 0.0 to 1.0E7       | 0.0     | <b>strmflow_module</b> = muskingum_lake  |
| <b>lake_out2</b>     | Switch to specify a second outflow point from each lake   | <b>nlake</b>           | integer | none             | 0 or 1             | 0       | <b>strmflow_module</b> =   |

| Parameter name         | Description   | Dimension <sup>1</sup>           | Type    | Units     | Range              | Default | Required/condition  |
|------------------------|---|----------------------------------|---------|-----------|--------------------|---------|---|
|                        | using gate opening routing (0=no; 1=yes)  |                                  |         |           |                    |         | muskingum_lake  |
| <b>lake_out2_a</b>     | Coefficient A in outflow equation for each lake with a second outlet using gate opening routing   | <b>nlake</b>                     | real    | cfs/feet  | 0.0 to 10,000.0    | 1.0     | <b>strmflow_module</b> = muskingum_lake                             |
| <b>lake_out2_b</b>     | Coefficient B in outflow equation for each lake with a second outlet using gate opening routing   | <b>nlake</b>                     | real    | cfs       | 0.0 to 10,000.0    | 100.0   | <b>strmflow_module</b> = muskingum_lake                             |
| <b>lake_qro</b>        | Initial daily mean outflow from each lake   | <b>nlake</b>                     | real    | cfs       | 0.0 to 1.0E7       | 0.1     | <b>strmflow_module</b> = muskingum_lake                             |
| <b>lake_seep_elev</b>  | Elevation over which lakebed seepage to the GWR occurs for lake HRUs using broad-crested weir routing or gate opening routing             | <b>nlake</b>                     | real    | feet      | -300.0 to 10,000.0 | 1.0     | <b>strmflow_module</b> = muskingum_lake                             |
| <b>lake_segment_id</b> | Index of lake associated with a segment   | <b>nsegment</b>                  | integer | none      | 0 to <b>nlake</b>  | 0       | <b>strmflow_module</b> = muskingum_lake and <b>cascade_flag</b> = 1 |
| <b>lake_type</b>       | Type of lake routing method (1=Puls routing; 2=linear routing; 3=flow through; 4=broad crested weir; 5=gate opening; and 6=measured flow) | <b>nlake</b>                     | integer | none      | 1 to 6             | 1       | <b>strmflow_module</b> = muskingum_lake                             |
| <b>lake_vol_init</b>   | Initial lake volume for each lake using broad-crested weir or gate opening routing  | <b>nlake</b>                     | real    | acre-feet | 0.0 to 1.0E7       | 0.0     | <b>strmflow_module</b> = muskingum_lake                             |
| <b>nsos</b>            | Number of storage/outflow values in table for each lake using Puls routing  | <b>mxnsos,</b><br><b>nlake</b>   | integer | none      | 0 to <b>mxnsos</b> | 0       | <b>strmflow_module</b> = muskingum_lake                             |
| <b>o2</b>              | Outflow values in outflow/storage tables for each lake using Puls routing   | <b>mxnsos,</b><br><b>nlake</b>   | real    | cfs       | 0.0 to 1.0E7       | 0.0     | <b>strmflow_module</b> = muskingum_lake                             |
| <b>obsout_lake</b>     | Index of streamflow measurement station that specifies outflow from each lake using measured flow replacement                             | <b>nlake</b>                     | integer | none      | 0 to <b>nobs</b>   | 0       | <b>strmflow_module</b> = muskingum_lake                             |
| <b>rate_table</b>      | Rating table with stage (rows) and gate opening (cols) for rating table 1 for lakes using gate opening routing and <b>nratetbl</b> >0     | <b>nstage,</b><br><b>ngate</b>   | real    | cfs       | -100.0 to 1,000.0  | 5.0     | <b>strmflow_module</b> = muskingum_lake                             |
| <b>rate_table2</b>     | Rating table with stage (rows) and gate opening (cols) for rating table 2 for lakes using gate opening routing and <b>nratetbl</b> >1     | <b>nstage2,</b><br><b>ngate2</b> | real    | cfs       | -100.0 to 1,000.0  | 5.0     | <b>strmflow_module</b> = muskingum_lake                             |
| <b>rate_table3</b>     | Rating table with stage (rows) and gate opening (cols) for rating table 3 for lakes using gate opening routing and <b>nratetbl</b> >2     | <b>nstage3,</b><br><b>ngate3</b> | real    | cfs       | -100.0 to 1,000.0  | 5.0     | <b>strmflow_module</b> = muskingum_lake                             |
| <b>rate_table4</b>     | Rating table with stage (rows) and gate opening (cols) for rating table 4 for lakes using gate opening routing and <b>nratetbl</b> >3     | <b>nstage4,</b><br><b>ngate4</b> | real    | cfs       | -100.0 to 1,000.0  | 5.0     | <b>strmflow_module</b> = muskingum_lake                             |
| <b>ratetbl_lake</b>    | Index of lake associated with each rating table for each lake using gate opening routing  | <b>nratetbl</b>                  | integer | none      | 0 to <b>nlake</b>  | 0       | <b>strmflow_module</b> = muskingum_lake                             |
| <b>s2</b>              | Storage values in outflow/storage table for each lake   | <b>mxnsos,</b>                   | real    | cfs       | 0.0 to             | 0.0     | <b>strmflow_module</b> =  |

| Parameter name                | Description  | Dimension <sup>1</sup>       | Type    | Units            | Range                | Default | Required/condition  |
|-------------------------------|--|------------------------------|---------|------------------|----------------------|---------|---|
| <b>tbl_gate</b>               | using Puls routing<br>Gate openings for each column for rating table 1 for lakes using gate opening routing and <b>nratetbl</b> >0   | <b>nlake</b><br><b>ngate</b> | real    | inches           | 1.0E7<br>0.0 to 20.0 | 0.0     | muskingum_lake<br><b>strmflow_module</b> = muskingum_lake |
| <b>tbl_gate2</b>              | Gate openings for each column for rating table 2 for lakes using gate opening routing and <b>nratetbl</b> >1   | <b>ngate2</b>                | real    | inches           | 0.0 to 20.0          | 0.0     | <b>strmflow_module</b> = muskingum_lake                   |
| <b>tbl_gate3</b>              | Gate openings for each column for rating table 3 for lakes using gate opening routing and <b>nratetbl</b> >2   | <b>ngate3</b>                | real    | inches           | 0.0 to 20.0          | 0.0     | <b>strmflow_module</b> = muskingum_lake                   |
| <b>tbl_gate4</b>              | Gate openings for each column for rating table 4 for lakes using gate opening routing and <b>nratetbl</b> >3   | <b>ngate4</b>                | real    | inches           | 0.0 to 20.0          | 0.0     | <b>strmflow_module</b> = muskingum_lake                   |
| <b>tbl_stage</b>              | Stage values for each row for rating table 1 for lakes using gate opening routing and <b>nratetbl</b> >0   | <b>nstage</b>                | real    | feet             | -100.0 to 1,000.0    | 5.0     | <b>strmflow_module</b> = muskingum_lake                   |
| <b>tbl_stage2</b>             | Stage values for each row for rating table 2 for lakes using gate opening routing and <b>nratetbl</b> >1   | <b>nstage2</b>               | real    | feet             | -100.0 to 1,000.0    | 5.0     | <b>strmflow_module</b> = muskingum_lake                   |
| <b>tbl_stage3</b>             | Stage values for each row for rating table 3 for lakes using gate opening routing and <b>nratetbl</b> >2   | <b>nstage3</b>               | real    | feet             | -100.0 to 1,000.0    | 5.0     | <b>strmflow_module</b> = muskingum_lake                   |
| <b>tbl_stage4</b>             | Stage values for each row for rating table 4 for lakes using gate opening routing and <b>nratetbl</b> >3   | <b>nstage4</b>               | real    | feet             | -100.0 to 1,000.0    | 5.0     | <b>strmflow_module</b> = muskingum_lake                   |
| <b>weir_coef</b>              | Coefficient for lakes using broad-crested weir routing   | <b>nlake</b>                 | real    | none             | 2.0 to 3.0           | 2.7     | <b>strmflow_module</b> = muskingum_lake                   |
| <b>weir_len</b>               | Weir length for lakes using broad-crested weir routing   | <b>nlake</b>                 | real    | feet             | 1.0 to 1,000.0       | 5.0     | <b>strmflow_module</b> = muskingum_lake                   |
| Output options                |  |                              |         |                  |                      |         |   |
| <b>print_freq</b>             | Flag to select the output frequency; for combinations, add index numbers, e.g., daily plus yearly = 10; yearly plus total = 3 (0=none; 1=run totals; 2=yearly; 4=monthly; 8=daily; or additive combinations) | <b>one</b>                   | integer | none             | 0 to 15              | 3       | required  |
| <b>print_type</b>             | Flag to select the type of results written to the output file (0=measured and simulated flow only; 1=water balance table; 2=detailed output)   | <b>one</b>                   | integer | none             | 0 to 2               | 1       | required  |
| Subbasin parameters           |  |                              |         |                  |                      |         |   |
| <b>hru_subbasin</b>           | Index of subbasin assigned to each HRU   | <b>nhru</b>                  | integer | none             | 0 to user defined    | 0       | <b>subbasin_flag</b> = 1                                  |
| <b>subbasin_down</b>          | Index number for the downstream subbasin whose inflow is outflow from this subbasin  | <b>nsub</b>                  | integer | none             | 0 to <b>nsub</b>     | 0       | <b>subbasin_flag</b> = 1                                  |
| Stream temperature simulation |  |                              |         |                  |                      |         |   |
| <b>albedo</b>                 | Short-wave solar radiation reflected by streams  | <b>one</b>                   | real    | decimal fraction | 0.0 to 1.0           | 0.1     | <b>stream_temp_flag</b> = 1                               |
| <b>alte</b>                   | East bank topographic altitude of each segment   | <b>nsegment</b>              | real    | radians          | 0.0 to 1.570796      | 0.0     | <b>stream_temp_flag</b> = 1                               |



| Parameter name          | Description   | Dimension <sup>1</sup>   | Type    | Units            | Range                 | Default | Required/condition          |
|-------------------------|---|--------------------------|---------|------------------|-----------------------|---------|-----------------------------|
| <b>altw</b>             | West bank topographic altitude of each segment                                      | <b>nsegment</b>          | real    | radians          | 0.0 to 1.570796       | 0.0     | <b>stream_temp_flag = 1</b> |
| <b>azrh</b>             | Azimuth angle of each segment   | <b>nsegment</b>          | real    | radians          | -1.570796 to 1.570796 | 0.0     | <b>stream_temp_flag = 1</b> |
| <b>gw_tau</b>           | Average residence time in groundwater flow  | <b>nsegment</b>          | integer | days             | 1 to 365              | 365     | <b>stream_temp_flag = 1</b> |
| <b>lat_temp_adj</b>     | Correction factor to adjust the bias of the temperature of the lateral inflow       | <b>nsegment, nmonths</b> | real    | decimal fraction | -5.0 to 5.0           | 0.0     | <b>stream_temp_flag = 1</b> |
| <b>maxiter_sntemp</b>   | Maximum number of Newton-Raphson iterations to compute stream temperature           | <b>one</b>               | integer | none             | 10 to 2000            | 1000    | <b>stream_temp_flag = 1</b> |
| <b>melt_temp</b>        | Temperature at which snowmelt enters a stream                                       | <b>one</b>               | real    | degrees Celsius  | 0.0 to 10.0           | 1.5     | <b>stream_temp_flag = 1</b> |
| <b>seg_elev</b>         | Segment elevation at midpoint   | <b>nsegment</b>          | real    | meters           | -1000.0 to 30000.0    | 0.0     | <b>stream_temp_flag = 1</b> |
| <b>seg_humidity</b>     | Mean monthly humidity for each segment, used when values not input in CBH File      | <b>nsegment, nmonths</b> | real    | decimal fraction | 0.0 to 1.0            | 0.7     | <b>stream_temp_flag = 1</b> |
| <b>seg_lat</b>          | Latitude of each segment  | <b>nsegment</b>          | real    | degrees North    | -90.0 to 90.0         | 40.0    | <b>stream_temp_flag = 1</b> |
| <b>segshade_sum</b>     | Total shade fraction for summer vegetation  | <b>nsegment</b>          | real    | decimal fraction | 0.0 to 1.0            | 0.0     | <b>stream_temp_flag = 1</b> |
| <b>segshade_win</b>     | Total shade fraction for winter vegetation  | <b>nsegment</b>          | real    | decimal fraction | 0.0 to 1.0            | 0.0     | <b>stream_temp_flag = 1</b> |
| <b>ss_tau</b>           | Average residence time of subsurface interflow                                      | <b>nsegment</b>          | integer | days             | 1 to 365              | 30      | <b>stream_temp_flag = 1</b> |
| <b>stream_tave_init</b> | Initial average stream temperature in each segment at the beginning of a simulation | <b>nsegment</b>          | real    | degrees Celsius  | -10.0 to 100.0        | 0.0     | <b>stream_temp_flag = 1</b> |
| <b>vce</b>              | East bank average vegetation crown width for each segment                           | <b>nsegment</b>          | real    | meters           | 0.0 to 15.0           | 0.0     | <b>stream_temp_flag = 1</b> |
| <b>vcw</b>              | West bank average vegetation crown width for each segment                           | <b>nsegment</b>          | real    | meters           | 0.0 to 15.0           | 0.0     | <b>stream_temp_flag = 1</b> |
| <b>vdemn</b>            | Minimum east bank vegetation density for each segment                               | <b>nsegment</b>          | real    | decimal fraction | 0.0 to 1.0            | 0.0     | <b>stream_temp_flag = 1</b> |
| <b>vdemx</b>            | Maximum east bank vegetation density for each segment                               | <b>nsegment</b>          | real    | decimal fraction | 0.0 to 1.0            | 0.0     | <b>stream_temp_flag = 1</b> |
| <b>vdwmn</b>            | Minimum west bank vegetation density for each segment                               | <b>nsegment</b>          | real    | decimal fraction | 0.0 to 1.0            | 0.0     | <b>stream_temp_flag = 1</b> |
| <b>vdwmx</b>            | Maximum west bank vegetation density for each segment                               | <b>nsegment</b>          | real    | decimal fraction | 0.0 to 1.0            | 0.0     | <b>stream_temp_flag = 1</b> |
| <b>vhe</b>              | East bank average vegetation height for each segment                                | <b>nsegment</b>          | real    | meters           | 0.0 to 30.0           | 0.0     | <b>stream_temp_flag = 1</b> |

| Parameter name                           | Description  | Dimension <sup>1</sup> | Type    | Units            | Range                          | Default | Required/condition   |
|--|--|------------------------|---------|------------------|--------------------------------|---------|--|
| <b>vhw</b>                               | West bank average vegetation height for each segment   | <b>nsegment</b>        | real    | meters           | 0.0 to 30.0                    | 0.0     | <b>stream_temp_flag = 1</b>  |
| <b>voe</b>                               | East bank vegetation offset for each segment   | <b>nsegment</b>        | real    | meters           | 0.0 to 100.0                   | 0.0     | <b>stream_temp_flag = 1</b>  |
| <b>vow</b>                               | West bank vegetation offset for each segment   | <b>nsegment</b>        | real    | meters           | 0.0 to 100.0                   | 0.0     | <b>stream_temp_flag = 1</b>  |
| <b>width_alpha</b>                       | Alpha coefficient in power function for width calculation  | <b>nsegment</b>        | real    | unknown          | 0.0001 to 2.0                  | 0.015   | <b>stream_temp_flag = 1</b>  |
| <b>width_m</b>                           | M value in power function for width calculation  | <b>nsegment</b>        | real    | unknown          | 0.0001 to 2.0                  | 0.015   | <b>stream_temp_flag = 1</b>  |
| Mapped results parameters                |  |                        |         |                  |                                |         |  |
| <b>gvr_cell_id<sup>9</sup></b>           | Index of the grid cell associated with each gravity reservoir  | <b>nhru cell</b>       | integer | none             | 0 to <b>ngwcell</b>            | 0       | <b>mapOutON_OFF = 1</b>  |
| <b>gvr_cell_pct<sup>9</sup></b>          | Proportion of the grid cell area associated with each gravity reservoir  | <b>nhru cell</b>       | real    | decimal fraction | 0.0 to 1.0                     | 1.0     | <b>mapOutON_OFF = 1</b>  |
| <b>gvr_hru_id<sup>9</sup></b>            | Index of the HRU associated with each gravity reservoir  | <b>nhru cell</b>       | integer | none             | 0 to <b>nhru cell</b>          | 1       | <b>mapOutON_OFF = 1</b>  |
| <b>mapvars_freq</b>                      | Flag to specify the output frequency (0=none; 1=monthly; 2=yearly; 3=total; 4=monthly and yearly; 5=monthly, yearly, and total; 6=weekly; 7=daily)               | <b>one</b>             | integer | none             | 0 to 7                         | 0       | <b>mapOutON_OFF = 1</b>  |
| <b>mapvars_units</b>                     | Flag to specify the output units of mapped results (0=units of the variable; 1=inches to feet; 2=inches to centimeters; 3=inches to meters; as states or fluxes) | <b>one</b>             | integer | none             | 0 to 3                         | 0       | <b>mapOutON_OFF = 1</b>  |
| <b>ncol</b>                              | Number of columns for each row of the mapped results   | <b>one</b>             | integer | none             | 1 to 50000                     | 1       | <b>mapOutON_OFF = 1</b>  |
| Summary results CSV file parameters      |  |                        |         |                  |                                |         |  |
| <b>poi_gage_id</b>                       | USGS stream gage ID for each POI gage  | <b>npoigages</b>       | string  | none             | user defined                   | 0       | <b>npoigages &gt; 0 and csvON_OFF = 1</b>  |
| <b>poi_gage_segment</b>                  | Segment index for each POI gage  | <b>npoigages</b>       | integer | none             | 0 to <b>nsegment</b>           | 0       | <b>npoigages &gt; 0 and csvON_OFF = 1</b>  |
| <b>poi_type</b>                          | Type code for each POI gage (0=non-calibration gage, 1=calibration gage, 2=flow replacement gage)  | <b>npoigages</b>       | integer | none             | 1                              | 1       | <b>optional</b>  |
| Parameters for cascading-flow simulation |  |                        |         |                  |                                |         |  |
| <b>cascade_flg</b>                       | Flag to indicate cascade type (0=allow many to many; 1=force one to one)   | <b>one</b>             | integer | none             | 0 or 1                         | 0       | <b>cascade_flg = 1 and ncascade &gt; 0 and/or cascdegw_flg = 1 ncascdgw &gt; 0</b> |
| <b>cascade_tol</b>                       | Cascade area below which a cascade link is ignored   | <b>one</b>             | real    | acres            | 0.0 to 7.5% of <b>hru_area</b> | 5.0     | <b>cascade_flg = 1 and ncascade &gt; 0 and/or cascdegw_flg = 1 ncascdgw &gt; 0</b> |

| Parameter name                  | Description   | Dimension <sup>1</sup> | Type    | Units            | Range                | Default | Required/condition   |
|---------------------------------|---|------------------------|---------|------------------|----------------------|---------|--|
| <b>circle_switch</b>            | Switch to check for circles (0=no check; 1=check)   | <b>one</b>             | integer | none             | 0 or 1               | 1       | <b>cascade_flag = 1 and ncascdgw &gt; 0 and/or cascdegw_flag = 1 and ncascdgw &gt; 0</b> |
| <b>gw_down_id</b> <sup>3</sup>  | Index number of the downslope GWR to which the upslope GWR contributes flow                                 | <b>ncascdgw</b>        | integer | none             | 0 to <b>ngw</b>      | 0       | <b>cascdegw_flag = 1 and ncascdgw &gt; 0</b>   |
| <b>gw_pct_up</b>                | Fraction of GWR area used to compute flow contributed to a downslope GWR or stream segment for cascade area | <b>ncascdgw</b>        | real    | decimal fraction | 0.0 to 1.0           | 1.0     | <b>cascdegw_flag = 1 and ncascdgw &gt; 0</b>   |
| <b>gw_strmseg_down_id</b>       | Index number of the stream segment that cascade area contributes flow                                       | <b>ncascdgw</b>        | integer | none             | 0 to <b>nsegment</b> | 0       | <b>cascdegw_flag = 1 and ncascdgw &gt; 0</b>   |
| <b>gw_up_id</b>                 | Index of GWR containing cascade area  | <b>ncascdgw</b>        | integer | none             | 1 to <b>ngw</b>      | 0       | <b>cascdegw_flag = 1 and ncascdgw &gt; 0</b>   |
| <b>hru_down_id</b> <sup>4</sup> | Index number of the downslope HRU to which the upslope HRU contributes flow                                 | <b>ncascade</b>        | integer | none             | 0 to <b>nhru</b>     | 0       | <b>cascade_flag = 1 and ncascdgw &gt; 0</b>  |
| <b>hru_pct_up</b>               | Fraction of HRU area used to compute flow contributed to a downslope HRU or stream segment for cascade area | <b>ncascade</b>        | real    | decimal fraction | 0.0 to 1.0           | 1.0     | <b>cascade_flag = 1 and ncascdgw &gt; 0</b>  |
| <b>hru_strmseg_down_id</b>      | Index number of the stream segment that cascade area contributes flow                                       | <b>ncascade</b>        | integer | none             | 0 to <b>nsegment</b> | 0       | <b>cascade_flag = 1 and ncascdgw &gt; 0</b>  |
| <b>hru_up_id</b>                | Index of HRU containing cascade area  | <b>ncascade</b>        | integer | none             | 0 to <b>nhru</b>     | 0       | <b>cascade_flag = 1 and ncascdgw &gt; 0</b>  |

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

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

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

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

<sup>6</sup>Parameter is not used by the code and exists for use in the National Hydrologic Model (NHM) PRMS application meters.

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

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

**Table 1-4.** Time-series input variables that may be included in the Data File for the Precipitation-Runoff Modeling System, version 5 (PRMS-V).  
[cfs, cubic feet per second; cms, cubic meters per second; **runoff\_units**, 0=cfs; 1=cms; **precip\_units**, 0=inches; 1=millimeters; **temp\_units**, 0=degrees Fahrenheit; 1=degrees Celsius; >=, greater than or equal to]

| Variable          | Definition   | Units                    | Valid range     | Dimension <sup>1</sup> |
|-------------------|--|--------------------------|-----------------|------------------------|
| <i>gate_ht</i>    | Height of the gate opening at each dam with a gate                           | inches                   | >=0.0           | <b>nratetbl</b>        |
| <i>humidity</i>   | Relative humidity at each measurement station                                | percentage               | 0.0 to 1.0      | <b>nhumid</b>          |
| <i>lake_elev</i>  | Elevation of each simulated lake surface                                     | feet                     | unlimited       | <b>nlakeelev</b>       |
| <i>pan_evap</i>   | Pan evaporation at each measurement station                                  | inches                   | >=0.0           | <b>nevap</b>           |
| <i>precip</i>     | Precipitation at each measurement station                                    | <b>precip_units</b>      | >=0.0           | <b>nrain</b>           |
| <i>rain_day</i>   | Flag to set the form of any precipitation to rain (0=determine form; 1=rain) | none                     | 0 or 1          | <b>one</b>             |
| <i>runoff</i>     | Streamflow at each measurement station                                       | <b>runoff_units</b>      | >=0.0           | <b>nobs</b>            |
| <i>snowdepth</i>  | Snow depth at each measurement station                                       | inches                   | >=0.0           | <b>nsnow</b>           |
| <i>solrad</i>     | Solar radiation at each measurement station                                  | Langley's                | >=0.0           | <b>nsol</b>            |
| <i>tmax</i>       | Maximum air temperature at each measurement station                          | <b>temp_units</b>        | -150.0 to 200.0 | <b>ntemp</b>           |
| <i>tmin</i>       | Minimum air temperature at each measurement station                          | <b>temp_units</b>        | -150.0 to 200.0 | <b>ntemp</b>           |
| <i>wind_speed</i> | Wind speed at each measurement station                                       | <b>meters per second</b> | 0.0 to 500.0    | <b>nwind</b>           |

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

**Table CBH (NEW).** Time-series input variables that can be specified in Climate-by-HRU Files for the Precipitation-Runoff Modeling System, version 5 (PRMS-V).

[ET, evapotranspiration; **precip\_units**, 0=inches; 1=millimeters; **temp\_units**, 0=degrees Fahrenheit; 1=degrees Celsius; >=, greater than or equal to; **red** text indicates new for PRMS-5.2.1]

| Variable                 | Definition   | Units               | Valid range     | Dimension <sup>1</sup> | Used in Modules                      |
|--------------------------|--|---------------------|-----------------|------------------------|--------------------------------------|
| <i>albedo_hru</i>        | Snowpack albedo of each HRU read from CBH File                   | decimal fraction    | 0.0 to 1.0      | <b>nhru</b>            | snowcomp                             |
| <i>cloud_cover_cbh</i>   | Cloud_cover of each HRU read from CBH File                       | decimal fraction    | 0.0 to 1.0      | <b>nhru</b>            | ccsolrad                             |
| <i>hru_ppt</i>           | Precipitation distributed to each HRU                            | <b>precip_units</b> | >=0.0           | <b>nhru</b>            | precipitation distribution process   |
| <i>humidity_hru</i>      | Relative humidity of each HRU read from CBH File                 | percentage          | 0.0 to 100.0    | <b>nhru</b>            | potet_pm, potet_pt, and stream_temp  |
| <i>potet</i>             | Potential ET for each HRU  | inches              | >=0.0           | <b>nhru</b>            | potential evapotranspiration process |
| <i>swrad</i>             | Shortwave radiation distributed to each HRU                      | Langleys            | >=0.0           | <b>nhru</b>            | solar radiation process              |
| <i>tmax</i> <sup>2</sup> | Maximum air temperature distributed to each HRU                  | <b>temp_units</b>   | -150.0 to 200.0 | <b>nhru</b>            | temperature distribution process     |
| <i>tmin</i> <sup>3</sup> | Minimum air temperature distributed to each HRU                  | <b>temp_units</b>   | -150.0 to 200.0 | <b>nhru</b>            | temperature distribution process     |
| <i>transp_on</i>         | Flag indicating whether transpiration is occurring (0=no; 1=yes) | none                | 0 or 1          | <b>nhru</b>            | transpiration period process         |
| <i>windspeed_hru</i>     | Wind speed for each HRU read from CBH File                       | meters per second   | >=0.0           | <b>nhru</b>            | potet_pm                             |

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

<sup>2</sup>Values used to set *tmaxf* and *tmaxc*.

<sup>3</sup>Values used to set *tminf* and *tminc*.

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

[HRU, hydrologic response unit; GWR, groundwater reservoir; CBH, climate-by-HRU; ET, evapotranspiration; cfs: cubic feet per second; cms: cubic meters per second; >, greater than; Ngl, number of glaciers counted by termini; Ntp, number of tops of glaciers; **runoff\_units**, 0=cfs; 1=cms; **precip\_units**, 0=inches; 1=millimeters; **temp\_units**, 0=degrees Fahrenheit; 1=degrees Celsius; control parameters **temp\_module**, **precip\_module**, **et\_module**, **strmflow\_module**, **model\_mode**, **dprst\_flag**, **subbasin\_flag**, **cascade\_flag**, and **cascadegw\_flag** defined in table 1-2; green highlight indicates new for PRMS-V **water\_use\_flag** = 1 if **segment\_transferON\_OFF**=1 or **gwr\_transferON\_OFF**=1 or **external\_transferON\_OFF**=1 or **dprst\_transferON\_OFF**=1 or **lake\_transferON\_OFF**=1 or **nconsumed**>0 or **nwateruse**>0; ; **red** text indicates new for PRMS-5.2.1]

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

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

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



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

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

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

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

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

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

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

| Variable name              | Description  | Dimension <sup>1</sup> | Units                                      | Data type | Availability/condition  |
|----------------------------|--|------------------------|--|-----------|-------------------------|
| <i>glacr_pk_den</i>        | Density of the icepack on each glacier HRU, hard coded to equal 0.917  | <b>nhru</b>            | gm/cm <sup>3</sup>                         | real      | <b>glacier_flag = 1</b> |
| <i>glacr_pk_depth</i>      | Depth of icepack on each glacier HRU, make essentially infinite  | <b>nhru</b>            | inches                                     | double    | <b>glacier_flag = 1</b> |
| <i>glacr_pk_ice</i>        | Storage of frozen water in the icepack on each glacier HRU   | <b>nhru</b>            | inches                                     | real      | <b>glacier_flag = 1</b> |
| <i>glacr_pk_temp</i>       | Temperature of the glacier on each HRU   | <b>nhru</b>            | degrees Celsius                            | real      | <b>glacier_flag = 1</b> |
| <i>glacr_pkwater_ante</i>  | Antecedent icepack water equivalent on each glacier HRU  | <b>nhru</b>            | inches                                     | double    | <b>glacier_flag = 1</b> |
| <i>glacr_pkwater_equiv</i> | Icepack water equivalent on each glacier HRU   | <b>nhru</b>            | inches                                     | double    | <b>glacier_flag = 1</b> |
| <i>glacr_pss</i>           | Previous glacier pack water equivalent plus new ice  | <b>nhru</b>            | inches                                     | double    | <b>glacier_flag = 1</b> |
| <i>glacr_pst</i>           | While an icepack exists, <i>glacr_pst</i> tracks the maximum ice water equivalent of that icepack  | <b>nhru</b>            | inches                                     | double    | <b>glacier_flag = 1</b> |
| <i>glacr_slope_init</i>    | Glacier surface slope mean over HRU at initiation extrapolating to 100% glacierized HRU  | <b>nhru</b>            | <b>elev_units</b>                          | real      | <b>glacier_flag = 1</b> |
| <i>glacr_tag</i>           | Identifies which glacier each HRU belongs to   | <b>nhru</b>            | none                                       | integer   | <b>glacier_flag = 1</b> |
| <i>glacrb_melt</i>         | Glacier basal melt, goes to soil   | <b>nhru</b>            | inches/day                                 | real      | <b>glacier_flag = 1</b> |
| <i>glacrcov_area</i>       | Ice-covered area (no snowpack) on each glacier HRU or HRU with glacierette at start of time step   | <b>nhru</b>            | decimal fraction                           | real      | <b>glacier_flag = 1</b> |
| <i>glacrmelt</i>           | Melt from icepack on each glacier HRU, includes rain water that does not absorb  | <b>nhru</b>            | inches                                     | real      | <b>glacier_flag = 1</b> |
| <i>glnet_ar_delta</i>      | Sum of area change of each glacier since start year, indexed by <i>glacr_tag</i>   | <b>nhru</b>            | acres                                      | double    | <b>glacier_flag = 1</b> |
| <i>glrette_frac</i>        | Fraction of snow field (too small for glacier dynamics)  | <b>nhru</b>            | decimal fraction                           | real      | <b>glacier_flag = 1</b> |
| <i>glrette_melt</i>        | Amount of glacierette surface melt (snow, ice, rain) from an HRU   | <b>nhru</b>            | inches                                     | real      | <b>glacier_flag = 1</b> |
| <i>hru_elev_ts</i>         | HRU elevation for timestep, which can change for glaciers; used in computations in modules: <i>ide_dist</i> , <i>xyz_dist</i> , <i>precip_laps</i> , <i>temp_1sta</i> , <i>temp_laps</i> , and <i>temp_dist2</i> | <b>nhru</b>            | <b>elev_units</b>                          | real      | <b>glacier_flag = 1</b> |
| <i>hru_glres_melt</i>      | Amount of glacier surface melt (snow, ice, rain) from an HRU that goes into reservoirs   | <b>nhru</b>            | inches                                     | real      | <b>glacier_flag = 1</b> |
| <i>hru_mb_ycumul</i>       | Mass balance for a glacier HRU, cumulative for year  | <b>nhru</b>            | inches                                     | double    | <b>glacier_flag = 1</b> |
| <i>hru_mb_yrend</i>        | Glacier HRU mass balance at end of previous hydrological year  | <b>nhru</b>            | inches                                     | real      | <b>glacier_flag = 1</b> |
| <i>hru_slope_ts</i>        | HRU slope for timestep, which can change for glaciers  | <b>nhru</b>            | decimal fraction                           | real      | <b>glacier_flag = 1</b> |
| <i>ikeep_gl</i>            | Glacier integer variables keeping from first year  | <b>nhru</b>            | none                                       | integer   | <b>glacier_flag = 1</b> |
| <i>keep_gl</i>             | Glacier real variables keeping from first year   | <b>nhru</b>            | none                                       | integer   | <b>glacier_flag = 1</b> |
| <i>nhruagl</i>             | Number of at least partially glacierized HRUs at initiation  | <b>nhru</b>            | none                                       | integer   | <b>glacier_flag = 1</b> |
| <i>ode_glacrva_coef</i>    | Estimate of <b>glacrva_coef</b> from ODE basal topography of each glacier, indexed by <i>glacr_tag</i>   |                        | m <sup>**</sup> (3-2* <b>glacrva_exp</b> ) | real      | <b>glacier_flag = 1</b> |



| Variable name               | Description  | Dimension <sup>1</sup> | Units             | Data type | Availability/condition                                 |
|-----------------------------|--|------------------------|-------------------|-----------|--|
| <i>order_flowline</i>       | Order of flowlines that belong together as glaciers, Ntp of these  | <b>nhru</b>            | none              | integer   | <b>glacier_flag</b> = 1                                |
| <i>prev_area</i>            | Previous year glacier-covered area above each HRU where all branches of the glacier are included             | <b>nhru, nglres</b>    | inches squared    | real      | <b>glacier_flag</b> = 1                                |
| <i>prev_out</i>             | Antecedent outflow of the 3 reservoirs in each glacier, indexed by <i>glacr_tag</i>                          | <b>nhru</b>            | inches cubed      | real      | <b>glacier_flag</b> = 1                                |
| <i>prev_outi</i>            | Antecedent outflow of the 3 reservoirs in each glacier for only ice (firn) melt, indexed by <i>glacr_tag</i> | <b>nhru</b>            | inches cubed      | real      | <b>glacier_flag</b> = 1                                |
| <i>prev_vol</i>             | Previous volume of each glacier, indexed by <i>glacr_tag</i>   | <b>nhru</b>            | inches cubed      | real      | <b>glacier_flag</b> = 1                                |
| <i>term</i>                 | HRU number at terminus of each glacier, Ngl of these   | <b>nhru</b>            | none              | integer   | <b>glacier_flag</b> = 1                                |
| <i>top</i>                  | HRU number at tops of each glacier, Ntp of these   | <b>nhru</b>            | none              | integer   | <b>glacier_flag</b> = 1                                |
| <i>top_tag</i>              | Identifies which glacier top each HRU is fed by. If = -1, then has multiple feeders                          | <b>nhru</b>            | none              | integer   | <b>glacier_flag</b> = 1                                |
| <i>yrdays5</i>              | Number of days since last 5-year mark  | <b>nhru</b>            | days              | integer   | <b>glacier_flag</b> = 1                                |
| Evapotranspiration          |  |                        |                   |           |  |
| <i>basin_actet</i>          | Basin area-weighted average actual ET  | <b>one</b>             | inches            | double    | Always   |
| <i>basin_actet_mo</i>       | Monthly basin area-weighted average actual ET  | <b>one</b>             | inches            | double    | Always   |
| <i>basin_actet_tot</i>      | Total simulation basin area-weighted average actual ET   | <b>one</b>             | inches            | double    | always   |
| <i>basin_actet_yr</i>       | Yearly basin area-weighted average actual ET   | <b>one</b>             | inches            | double    | always   |
| <i>basin_dprst_evap</i>     | Basin area-weighted average evaporation from surface depression storage                                      | <b>one</b>             | inches            | double    | <b>dprst_flag</b> = 1                                  |
| <i>basin_fall_frost</i>     | Basin area-weighted average fall frost   | <b>one</b>             | <b>solar date</b> | real      | <b>model_mode</b> = FROST                              |
| <i>basin_humidity</i>       | Basin area-weighted average humidity   | <b>one</b>             | percentage        | double    | <b>et_module</b> = potet_pm, potet_pm_sta, or potet_pt |
| <i>basin_imperv_evap</i>    | Basin area-weighted average evaporation from impervious area   | <b>one</b>             | inches            | double    | always   |
| <i>basin_lakeevap</i>       | Basin area-weighted average lake evaporation   | <b>one</b>             | inches            | double    | <b>nlake</b> > 0                                       |
| <i>basin_intcp_evap</i>     | Basin area-weighted evaporation from the canopy  | <b>one</b>             | inches            | double    | always   |
| <i>basin_intcp_evap_mo</i>  | Monthly basin area-weighted average interception evaporation   | <b>one</b>             | inches            | double    | always   |
| <i>basin_intcp_evap_tot</i> | Total simulation basin area-weighted average interception evaporation  | <b>one</b>             | inches            | double    | always   |
| <i>basin_intcp_evap_yr</i>  | Yearly basin area-weighted average interception evaporation  | <b>one</b>             | inches            | double    | always   |
| <i>basin_perv_et</i>        | Basin area-weighted average ET from capillary reservoirs   | <b>one</b>             | inches            | double    | always   |
| <i>basin_potet</i>          | Basin area-weighted average potential ET   | <b>one</b>             | inches            | double    | always   |
| <i>basin_potet_mo</i>       | Monthly area-weighted average potential ET   | <b>one</b>             | inches            | double    | always   |
| <i>basin_potet_tot</i>      | Total simulation area-weighted average potential ET  | <b>one</b>             | inches            | double    | always   |
| <i>basin_potet_yr</i>       | Yearly area-weighted average potential ET  | <b>one</b>             | inches            | double    | always   |
| <i>basin_snowevap</i>       | Basin area-weighted average evaporation and sublimation from   | <b>one</b>             | inches            | double    | always   |

| Variable name             | Description   | Dimension <sup>1</sup> | Units             | Data type | Availability/condition   |
|---------------------------|---|------------------------|-------------------|-----------|--|
| <i>basin_spring_frost</i> | snowpack (not including glacier)<br>Basin area-weighted average spring frost                    | <b>one</b>             | <b>solar date</b> | real      | <b>model_mode</b> = FROST  |
| <i>basin_swale_et</i>     | Basin area-weighted average ET from swale HRUs  | <b>one</b>             | inches            | double    | always   |
| <i>basin_transp_on</i>    | Flag indicating whether transpiration is occurring anywhere in the basin (0=no; 1=yes)          | <b>one</b>             | none              | integer   | always   |
| <i>basin_windspeed</i>    | Basin area-weighted average wind speed  | <b>one</b>             | meters per second | double    | <b>et_module</b> = potet_pm or potet_pm_sta  |
| <i>dprst_evap_hru</i>     | Evaporation from surface-depression storage for each HRU  | <b>nhru</b>            | inches            | real      | <b>dprst_flag</b> = 1  |
| <i>fall_frost</i>         | The solar date (number of days after winter solstice) of the first killing frost of the fall    | <b>nhru</b>            | <b>solar date</b> | real      | <b>model_mode</b> = FROST  |
| <i>hru_actet</i>          | Actual ET for each HRU  | <b>nhru</b>            | inches            | real      | always   |
| <i>hru_et_yr</i>          | Yearly area-weighted average actual ET for each HRU   | <b>nhru</b>            | inches            | double    | <b>print_freq</b> = 2  |
| <i>hru_intcpevap</i>      | Evaporation from the canopy for each HRU  | <b>nhru</b>            | inches            | real      | always   |
| <i>imperv_evap</i>        | Evaporation from impervious area for each HRU   | <b>nhru</b>            | inches            | real      | always   |
| <i>intcp_evap</i>         | Evaporation from the canopy for each HRU  | <b>nhru</b>            | inches            | real      | always   |
| <i>lake_evap</i>          | Total evaporation from each lake HRU  | <b>nlake</b>           | cfs               | double    | <b>nlake</b> > 0   |
| <i>pan_evap</i>           | Pan evaporation at each measurement station   | <b>nevap</b>           | inches            | real      | <b>nevap</b> > 0   |
| <i>perv_actet</i>         | Actual ET from the capillary reservoir of each HRU  | <b>nhru</b>            | inches            | real      | always   |
| <i>potet</i>              | Potential ET for each HRU   | <b>nhru</b>            | inches            | real      | always   |
| <i>potet_lower</i>        | Potential ET in the lower zone of the capillary reservoir for each HRU                          | <b>nhru</b>            | inches            | real      | always   |
| <i>potet_rechr</i>        | Potential ET in the recharge zone of the capillary reservoir for each HRU                       | <b>nhru</b>            | inches            | real      | always   |
| <i>seginc_potet</i>       | Area-weighted average potential ET for each segment from HRUs contributing flow to the segment  | <b>nsegment</b>        | inches            | double    | <b>strmflow_module</b> = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann<br>always |
| <i>snow_evap</i>          | Evaporation and sublimation from snowpack on each HRU   | <b>nhru</b>            | inches            | real      |  |
| <i>spring_frost</i>       | The solar date (number of days after winter solstice) of the last killing frost of the spring   | <b>nhru</b>            | <b>solar date</b> | real      | <b>model_mode</b> = FROST  |
| <i>subinc_actet</i>       | Area-weighted average actual ET from associated HRUs to each subbasin                           | <b>nsub</b>            | inches            | double    | <b>subbasin_flag</b> = 1   |
| <i>subinc_potet</i>       | Area-weighted average potential ET from associated HRUs to each subbasin                        | <b>nsub</b>            | inches            | double    | <b>subbasin_flag</b> = 1   |
| <i>swale_actet</i>        | Evaporation from the gravity and preferential-flow reservoirs that exceeds <b>sat_threshold</b> | <b>nhru</b>            | inches            | real      | always   |

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

| Variable name              | Description   | Dimension <sup>1</sup> | Units            | Data type | Availability/condition                                     |
|----------------------------|---|------------------------|------------------|-----------|--|
| <i>basin_sroff_yr</i>      | Yearly basin area-weighted average surface runoff   | <b>one</b>             | inches           | double    | always   |
| <i>basin_sroffi</i>        | Basin area-weighted average surface runoff from impervious areas  | <b>one</b>             | inches           | double    | always   |
| <i>basin_sroffp</i>        | Basin area-weighted average surface runoff from pervious areas  | <b>one</b>             | inches           | double    | always   |
| <i>contrib_fraction</i>    | Contributing area of each HRU pervious area   | <b>nhru</b>            | decimal fraction | real      | always   |
| <i>hortonian_flow</i>      | Hortonian surface runoff reaching stream network for each HRU   | <b>nhru</b>            | inches           | real      | always   |
| <i>hortonian_lakes</i>     | Surface runoff to lakes for each HRU  | <b>nhru</b>            | inches           | double    | <b>cascade_flag = 1, ncascade &gt; 0, and nlake &gt; 0</b> |
| <i>hru_hortn_cascflow</i>  | Cascading Hortonian surface runoff leaving each HRU   | <b>nhru</b>            | inches           | double    | <b>cascade_flag = 1 and ncascade &gt; 0</b>                |
| <i>hru_imperv</i>          | Area of HRU that is impervious  | <b>nhru</b>            | acres            | real      | always   |
| <i>hru_impervstor</i>      | Storage on impervious area for each HRU   | <b>nhru</b>            | inches           | real      | always   |
| <i>hru_perv</i>            | Area of HRU that is pervious  | <b>nhru</b>            | acres            | real      | always   |
| <i>hru_sroffi</i>          | Surface runoff from impervious areas for each HRU   | <b>nhru</b>            | inches           | real      | always   |
| <i>hru_sroffp</i>          | Surface runoff from pervious areas for each HRU   | <b>nhru</b>            | inches           | real      | always   |
| <i>imperv_stor</i>         | Storage on impervious area for each HRU   | <b>nhru</b>            | inches           | real      | always   |
| <i>infil</i>               | Infiltration to the capillary reservoir for each HRU  | <b>nhru</b>            | inches           | real      | always   |
| <i>seginc_sroff</i>        | Area-weighted average surface runoff for each segment from HRUs contributing flow to the segment                              | <b>nsegment</b>        | cfs              | double    | <b>nsegment &gt; 0</b>                                     |
| <i>sroff<sup>8</sup></i>   | Surface runoff to the stream network for each HRU   | <b>nhru</b>            | inches           | real      | always   |
| <i>sub_sroff</i>           | Area-weighted average Hortonian plus Dunnian surface runoff from associated HRUs to each subbasin and from upstream subbasins | <b>nsub</b>            | cfs              | double    | <b>subbasin_flag = 1</b>                                   |
| <i>subinc_sroff</i>        | Area-weighted average Hortonian plus Dunnian surface runoff from associated HRUs to each subbasin                             | <b>nsub</b>            | cfs              | double    | <b>subbasin_flag = 1</b>                                   |
| <i>upslope_hortonian</i>   | Hortonian surface runoff received from upslope HRUs   | <b>nhru</b>            | inches           | double    | <b>cascade_flag = 1 and ncascade &gt; 0</b>                |
| Surface depression storage |   |                        |                  |           |  |
| <i>basin_dprst_seep</i>    | Basin area-weighted average seepage surface-depression storage  | <b>one</b>             | inches           | double    | <b>dprst_flag = 1</b>                                      |
| <i>basin_dprst_sroff</i>   | Basin area-weighted average surface runoff from open surface-depression storage   | <b>one</b>             | inches           | double    | <b>dprst_flag = 1</b>                                      |
| <i>basin_dprst_volcl</i>   | Basin area-weighted average storage volume in closed surface depressions  | <b>one</b>             | inches           | double    | <b>dprst_flag = 1</b>                                      |
| <i>basin_dprst_volop</i>   | Basin area-weighted average storage volume in open surface depressions  | <b>one</b>             | inches           | double    | <b>dprst_flag = 1</b>                                      |
| <i>dprst_area_clos</i>     | Surface area of closed surface depressions based on volume for  | <b>nhru</b>            | acres            | real      | <b>dprst_flag = 1</b>                                      |

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

| Variable name                     | Description  | Dimension <sup>1</sup> | Units            | Data type | Availability/condition   |
|-----------------------------------|--|------------------------|------------------|-----------|--|
|                                   |  |                        |                  |           | <b>ncascade</b> > 0  |
| <i>basin_dunnian</i>              | Basin area-weighted average Dunnian surface runoff that flows to the stream network                        | <b>one</b>             | inches           | double    | always   |
| <i>basin_dunnian_gvr</i>          | Basin area-weighted average excess flow to preferential-flow reservoirs from gravity reservoirs            | <b>one</b>             | inches           | double    | always   |
| <i>basin_dunnian_pfr</i>          | Basin area-weighted average excess infiltration to preferential-flow reservoirs from variable <i>infil</i> | <b>one</b>             | inches           | double    | always   |
| <i>basin_dunnianflow</i>          | Basin area-weighted average cascading Dunnian flow   | <b>one</b>             | inches           | double    | always   |
| <i>basin_gvr2pfr</i>              | Basin area-weighted average excess flow to preferential-flow reservoir storage from gravity reservoirs     | <b>one</b>             | inches           | double    | always   |
| <i>basin_gvr_stor_frac</i>        | Basin area-weighted average fraction of gravity reservoir storage of the maximum storage                   | <b>one</b>             | decimal fraction | double    | always   |
| <i>basin_interflow_max</i>        | Basin area-weighted average maximum interflow that flows from gravity reservoirs                           | <b>one</b>             | inches           | double    | always   |
| <i>basin_lakeinsz</i>             | Basin area-weighted average lake inflow from land HRUs   | <b>one</b>             | inches           | double    | <b>cascade_flag</b> = 1, <b>ncascade</b> > 0, and <b>nlake</b> > 0 |
| <i>basin_pfr_stor_frac</i>        | Basin area-weighted average fraction of preferential-flow reservoir storage of the maximum storage         | <b>one</b>             | decimal fraction | double    | always   |
| <i>basin_pref_flow_infil</i>      | Basin area-weighted average infiltration to preferential-flow reservoir storage                            | <b>one</b>             | inches           | double    | always   |
| <i>basin_pref_stor</i>            | Basin area-weighted average storage in preferential-flow reservoirs  | <b>one</b>             | inches           | double    | always   |
| <i>basin_prefflow</i>             | Basin area-weighted average interflow from preferential-flow reservoirs to the stream network              | <b>one</b>             | inches           | double    | always   |
| <i>basin_recharge</i>             | Basin area-weighted average recharge to GWRs   | <b>one</b>             | inches           | double    | always   |
| <i>basin_slowflow</i>             | Basin area-weighted average interflow from gravity reservoirs to the stream network                        | <b>one</b>             | inches           | double    | always   |
| <i>basin_slstor</i>               | Basin area-weighted average storage of gravity reservoirs  | <b>one</b>             | inches           | double    | always   |
| <i>basin_sm2gvr</i>               | Basin area-weighted average excess flow from capillary reservoirs to gravity reservoir storage             | <b>one</b>             | inches           | double    | always   |
| <i>basin_sm2gvr_maxin</i>         | Basin area-weighted average maximum excess flow from capillary reservoirs that flows to gravity reservoirs | <b>one</b>             | inches           | double    | always   |
| <i>basin_soil_lower_stor_frac</i> | Basin area-weighted average fraction of soil lower zone storage of the maximum storage                     | <b>one</b>             | decimal fraction | double    | always   |
| <i>basin_soil_moist</i>           | Basin area-weighted average capillary reservoir storage  | <b>one</b>             | inches           | double    | always   |
| <i>basin_soil_moist_tot</i>       | Basin area-weighted average total soil-zone water storage  | <b>one</b>             | inches           | double    | always   |
| <i>basin_soil_rechr</i>           | Basin area-weighted average storage for recharge zone; upper   | <b>one</b>             | inches           | double    | always   |

| Variable name                     | Description   | Dimension <sup>1</sup> | Units            | Data type | Availability/condition                      |
|-----------------------------------|---|------------------------|------------------|-----------|---|
|                                   | portion of capillary reservoir where both evaporation and transpiration occurs  |                        |                  |           |   |
| <i>basin_soil_rechr_stor_frac</i> | Basin area-weighted average fraction of soil recharge zone storage of the maximum storage                             | <b>one</b>             | decimal fraction | double    | always                                      |
| <i>basin_soil_to_gw</i>           | Basin area-weighted average excess flow to capillary reservoirs that drains to GWRs                                   | <b>one</b>             | inches           | double    | always                                      |
| <i>basin_ssflow</i>               | Basin area-weighted average interflow from gravity and preferential-flow reservoirs to the stream network             | <b>one</b>             | inches           | double    | always                                      |
| <i>basin_ssflow_cfs</i>           | Basin area-weighted average interflow from gravity and preferential-flow reservoirs to the stream network             | <b>one</b>             | cfs              | double    | always                                      |
| <i>basin_ssflow_mo</i>            | Monthly basin area-weighted average interflow   | <b>one</b>             | inches           | double    | always                                      |
| <i>basin_ssflow_tot</i>           | Simulation total basin area-weighted average interflow  | <b>one</b>             | inches           | double    | always                                      |
| <i>basin_ssflow_yr</i>            | Yearly basin area-weighted average interflow  | <b>one</b>             | inches           | double    | always                                      |
| <i>basin_ssin</i>                 | Basin area-weighted average inflow to gravity and preferential-flow reservoir storage                                 | <b>one</b>             | inches           | double    | always                                      |
| <i>basin_ssstor</i>               | Basin area-weighted average gravity and preferential-flow reservoir storage   | <b>one</b>             | inches           | double    | always                                      |
| <i>basin_sz2gw</i>                | Basin area-weighted average drainage from gravity reservoirs to GWRs  | <b>one</b>             | inches           | double    | always                                      |
| <i>basin_sz_stor_frac</i>         | Basin area-weighted average fraction of soil zone storage of the maximum storage                                      | <b>one</b>             | decimal fraction | double    | always                                      |
| <i>cap_infil_tot</i>              | Infiltration and cascading interflow and Dunnian flow added to capillary reservoir storage for each HRU               | <b>nhru</b>            | inches           | real      | always                                      |
| <i>cap_waterin</i>                | Infiltration and any cascading interflow and Dunnian surface runoff added to capillary reservoir storage for each HRU | <b>nhru</b>            | inches           | real      | always                                      |
| <i>dunnian_flow</i>               | Dunnian surface runoff that flows to the stream network for each HRU  | <b>nhru</b>            | inches           | real      | always                                      |
| <i>hru_sz_cascadeflow</i>         | Cascading interflow and Dunnian surface runoff from each HRU  | <b>nhru</b>            | inches           | real      | <b>cascade_flag = 1 and ncascade &gt; 0</b> |
| <i>pref_flow</i>                  | Interflow from the preferential-flow reservoir that flows to the stream network for each HRU                          | <b>nhru</b>            | inches           | real      | always                                      |
| <i>pref_flow_in</i>               | Infiltration and flow from gravity reservoir storage to the preferential-flow reservoir                               | <b>nhru</b>            | inches           | real      | always                                      |
| <i>pref_flow_infil</i>            | Infiltration to the preferential-flow reservoir storage for each HRU  | <b>nhru</b>            | inches           | real      | always                                      |
| <i>pref_flow_max</i>              | Maximum storage of the preferential-flow reservoir for each HRU   | <b>nhru</b>            | inches           | real      | always                                      |
| <i>pref_flow_stor</i>             | Storage in preferential-flow reservoir for each HRU   | <b>nhru</b>            | inches           | real      | always                                      |
| <i>pref_flow_thrsh</i>            | Soil storage threshold defining storage between field capacity  | <b>nhru</b>            | inches           | real      | always                                      |

| Variable name              | Description   | Dimension <sup>1</sup> | Units            | Data type | Availability/condition   |
|----------------------------|---|------------------------|------------------|-----------|--------------------------|
|                            | and maximum soil saturation minus the any' preferential-flow storage  |                        |                  |           |                          |
| <i>recharge</i>            | Recharge to the associated GWR as the sum of <i>soil_to_gw</i> , <i>ssr_to_gw</i> , and <i>dprst_seep_hru</i> for each HRU    | <b>nhru</b>            | inches           | real      | always                   |
| <i>seginc_ssflow</i>       | Area-weighted average interflow for each segment from HRUs contributing flow to the segment                                   | <b>nsegment</b>        | cfs              | double    | <b>nsegment</b> > 0      |
| <i>slow_flow</i>           | Interflow from gravity reservoir that flows to the stream network for each HRU  | <b>nhru</b>            | inches           | real      | always                   |
| <i>slow_stor</i>           | Storage of gravity reservoir for each HRU   | <b>nhru</b>            | inches           | real      | always                   |
| <i>soil_lower</i>          | Storage in the lower zone of the capillary reservoir that is only available for transpiration for each HRU                    | <b>nhru</b>            | inches           | real      | always                   |
| <i>soil_lower_ratio</i>    | Water content ratio in the lower zone of the capillary reservoir for each HRU   | <b>nhru</b>            | decimal fraction | real      | always                   |
| <i>soil_moist</i>          | Storage of capillary reservoir for each HRU   | <b>nhru</b>            | inches           | real      | always                   |
| <i>soil_moist_tot</i>      | Total soil-zone storage ( <i>soil_moist</i> + <i>ssres_stor</i> ) for each HRU  | <b>nhru</b>            | inches           | real      | always                   |
| <i>soil_rechr</i>          | Storage for recharge zone (upper portion) of the capillary reservoir that is available for both evaporation and transpiration | <b>nhru</b>            | inches           | real      | always                   |
| <i>soil_saturated</i>      | Flag set if infiltration saturates capillary reservoir (0=no, 1=yes)  | <b>nhru</b>            | none             | integer   | always                   |
| <i>soil_to_gw</i>          | Portion of excess flow to the capillary reservoir that drains to the associated GWR for each HRU                              | <b>nhru</b>            | inches           | real      | always                   |
| <i>soil_to_ssr</i>         | Portion of excess flow to the capillary reservoir that flows to the gravity reservoir for each HRU                            | <b>nhru</b>            | inches           | real      | always                   |
| <i>ssr_to_gw</i>           | Drainage from the gravity-reservoir to the associated GWR for each HRU  | <b>nssr</b>            | inches           | real      | always                   |
| <i>ssres_flow</i>          | Interflow from gravity and preferential-flow reservoirs to the stream network for each HRU                                    | <b>nssr</b>            | inches           | real      | always                   |
| <i>ssres_in</i>            | Inflow to the gravity and preferential-flow reservoirs for each HRU   | <b>nssr</b>            | inches           | real      | always                   |
| <i>ssres_stor</i>          | Storage in the gravity and preferential-flow reservoirs for each HRU  | <b>nssr</b>            | inches           | real      | always                   |
| <i>sub_interflow</i>       | Area-weighted average interflow from associated HRUs to each subbasin and from upstream subbasins                             | <b>nsub</b>            | cfs              | double    | <b>subbasin_flag</b> = 1 |
| <i>subinc_capstor_frac</i> | Area-weighted average fraction of capillary reservoir water content storage for associated HRUs of each subbasin              | <b>nsub</b>            | decimal fraction | double    | <b>subbasin_flag</b> = 1 |
| <i>subinc_interflow</i>    | Area-weighted average interflow from associated HRUs to each subbasin   | <b>nsub</b>            | cfs              | double    | <b>subbasin_flag</b> = 1 |
| <i>subinc_recharge</i>     | Area-weighted average recharge from associated HRUs to each subbasin  | <b>nsub</b>            | inches           | double    | <b>subbasin_flag</b> = 1 |
| <i>subinc_szstor_frac</i>  | Area-weighted average fraction of soil-zone water content   | <b>nsub</b>            | decimal fraction | double    | <b>subbasin_flag</b> = 1 |



| Variable name                  | Description   | Dimension <sup>1</sup> | Units       | Data type | Availability/condition                            |
|--------------------------------|---|------------------------|-------------|-----------|---|
| <i>upslope_dunnianflow</i>     | storage for associated HRUs of each subbasin<br>Cascading Dunnian surface runoff that flows to the capillary reservoir of each downslope HRU for each upslope HRU | <b>nhru</b>            | inches      | double    | <b>cascade_flag = 1 and<br/>ncascade &gt; 0</b>   |
| <i>upslope_interflow</i>       | Cascading interflow runoff that flows to the capillary reservoir of each downslope HRU for each upslope HRU   | <b>nhru</b>            | inches      | double    | <b>cascade_flag = 1 and<br/>ncascade &gt; 0</b>   |
| Groundwater flow               |   |                        |             |           |   |
| <i>basin_gwflow</i>            | Basin area-weighted average groundwater flow to the stream network  | <b>one</b>             | inches      | double    | always  |
| <i>basin_gwflow_cfs</i>        | Basin area-weighted average groundwater flow to the stream network  | <b>one</b>             | cfs         | double    | always  |
| <i>basin_gwflow_mo</i>         | Monthly basin area-weighted average groundwater discharge   | <b>one</b>             | inches      | double    | always  |
| <i>basin_gwflow_tot</i>        | Total simulation basin area-weighted average groundwater discharge  | <b>one</b>             | inches      | double    | always  |
| <i>basin_gwflow_yr</i>         | Yearly basin area-weighted average groundwater discharge  | <b>one</b>             | inches      | double    | always  |
| <i>basin_gwin</i>              | Basin area-weighted average inflow to GWRs  | <b>one</b>             | inches      | double    | always  |
| <i>basin_gwsink</i>            | Basin area-weighted average GWR outflow to the groundwater sink   | <b>one</b>             | inches      | double    | always  |
| <i>basin_gwstor</i>            | Basin area-weighted average storage in GWRs   | <b>one</b>             | inches      | double    | always  |
| <i>basin_gwstor_minarea_wb</i> | Basin area-weighted average storage added to each GWR when storage is less than <b>gwstor_min</b>   | <b>one</b>             | inches      | double    | always  |
| <i>gw_upslope</i>              | Groundwater flow received from upslope GWRs for each GWR  | <b>ngw</b>             | acre-inches | double    | <b>cascadegw_flag = 1 and<br/>ncascdgw &gt; 0</b> |
| <i>gwres_flow</i>              | Groundwater discharge from each GWR to the stream network   | <b>ngw</b>             | inches      | real      | always  |
| <i>gwres_in</i>                | Total inflow to each GWR from associated capillary and gravity reservoirs   | <b>ngw</b>             | acre-inches | double    | always  |
| <i>gwres_sink</i>              | Outflow from GWRs to the groundwater sink; water is considered underflow or flow to deep aquifers and does not flow to the stream network                         | <b>ngw</b>             | inches      | real      | always  |
| <i>gwres_stor</i>              | Storage in each GWR   | <b>ngw</b>             | inches      | double    | always  |
| <i>gwstor_minarea_wb</i>       | Storage added to each GWR when storage is less than <b>gwstor_min</b>   | <b>ngw</b>             | inches      | double    | always  |
| <i>hru_gw_cascadeflow</i>      | Cascading groundwater flow from each GWR  | <b>ngw</b>             | inches      | double    | <b>cascadegw_flag = 1 and<br/>ncascdgw &gt; 0</b> |
| <i>lakein_gwflow</i>           | Groundwater flow received from upslope GWRs for each Lake GWR   | <b>nlake</b>           | acre-inches | double    | <b>nlake &gt; 0</b>                               |
| <i>seginc_gwflow</i>           | Area-weighted average groundwater discharge for each segment from HRUs contributing flow to the segment   | <b>nsegment</b>        | cfs         | double    | <b>nsegment &gt; 0</b>                            |
| <i>sub_gwflow</i>              | Area-weighted average groundwater discharge from associated   | <b>nsub</b>            | cfs         | double    | <b>subbasin_flag = 1</b>                          |

| Variable name                | Description   | Dimension <sup>1</sup> | Units            | Data type | Availability/condition   |
|------------------------------|---|------------------------|------------------|-----------|--|
| <i>subinc_gwflow</i>         | GWRs to each subbasin and from upstream subbasins<br>Area-weighted average groundwater discharge from associated<br>GWRs to each subbasin | <b>nsub</b>            | cfs              | double    | <b>subbasin_flag</b> = 1   |
| Streamflow                   |   |                        |                  |           |  |
| <i>basin_cfs</i>             | Streamflow leaving the basin through the stream network   | <b>one</b>             | cfs              | double    | always   |
| <i>basin_cfs_mo</i>          | Monthly total streamflow to stream network  | <b>one</b>             | cfs              | double    | <b>print_debug</b> > -2  |
| <i>basin_cfs_tot</i>         | Total simulation basin area-weighted average streamflow   | <b>one</b>             | cfs              | double    | <b>print_debug</b> > -2  |
| <i>basin_cfs_yr</i>          | Yearly total streamflow to stream network   | <b>one</b>             | cfs              | double    | <b>print_debug</b> > -2  |
| <i>basin_cms</i>             | Streamflow leaving the basin through the stream network   | <b>one</b>             | cms              | double    | always   |
| <i>basin_runoff_ratio</i>    | Basin area-weighted average discharge/precipitation ratio   | <b>one</b>             | decimal fraction | double    | <b>print_debug</b> > -2  |
| <i>basin_runoff_ratio_mo</i> | Monthly area-weighted average discharge/precipitation ratio   | <b>one</b>             | decimal fraction | double    | <b>print_debug</b> > -2  |
| <i>basin_segment_storage</i> | Basin area-weighted average storage in the stream network   | <b>one</b>             | inches           | double    | <b>strmflow_module</b> =<br>muskingum,<br>muskingum_lake, or<br>muskingum_mann                     |
| <i>basin_stflow_in</i>       | Basin area-weighted average lateral flow entering the stream<br>network   | <b>one</b>             | inches           | double    | always   |
| <i>basin_stflow_mo</i>       | Monthly basin area-weighted average simulated streamflow  | <b>one</b>             | inches           | double    | <b>print_debug</b> > -2  |
| <i>basin_stflow_out</i>      | Basin area-weighted average streamflow leaving through the<br>stream network  | <b>one</b>             | inches           | double    | <b>print_debug</b> > -2  |
| <i>basin_stflow_tot</i>      | Total simulation basin area-weighted average simulated<br>streamflow  | <b>one</b>             | inches           | double    | <b>print_debug</b> > -2  |
| <i>basin_stflow_yr</i>       | Yearly basin area-weighted average simulated streamflow   | <b>one</b>             | inches           | double    | <b>print_debug</b> > -2  |
| <i>flow_headwater</i>        | Total flow out of headwater segments ( <b>segment_type</b> =1)  | <b>one</b>             | cfs              | double    | <b>strmflow_module</b> =<br>muskingum,<br>strmflow_in_out,<br>muskingum_lake, or<br>muskingum_mann |
| <i>flow_in_great_lakes</i>   | Total flow into model domain from Great Lakes<br>( <b>segment_type</b> =10)   | <b>one</b>             | cfs              | double    | <b>strmflow_module</b> =<br>muskingum,<br>strmflow_in_out,<br>muskingum_lake, or<br>muskingum_mann |
| <i>flow_in_nation</i>        | Total flow into model domain from Mexico or Canada<br>( <b>segment_type</b> =4)   | <b>one</b>             | cfs              | double    | <b>strmflow_module</b> =<br>muskingum,<br>strmflow_in_out,<br>muskingum_lake, or<br>muskingum_mann |

| Variable name              | Description  | Dimension <sup>1</sup> | Units | Data type | Availability/condition   |
|----------------------------|--|------------------------|-------|-----------|--|
| <i>flow_in_region</i>      | Total flow into region ( <b>segment_type=6</b> )                             | <b>one</b>             | cfs   | double    | <b>strmflow_module</b> = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann |
| <i>flow_out</i>            | Total flow out of model domain   | <b>one</b>             | cfs   | double    | <b>strmflow_module</b> = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann |
| <i>flow_out_NHM</i>        | Total flow out of model domain to Mexico or Canada ( <b>segment_type=5</b> ) | <b>one</b>             | cfs   | double    | <b>strmflow_module</b> = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann |
| <i>flow_out_region</i>     | Total flow out of region ( <b>segment_type=7</b> )                           | <b>one</b>             | cfs   | double    | <b>strmflow_module</b> = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann |
| <i>flow_replacement</i>    | Total flow out from replacement flow ( <b>segment_type=3</b> )               | <b>one</b>             | cfs   | double    | <b>strmflow_module</b> = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann |
| <i>flow_terminus</i>       | Total flow to terminus segments ( <b>segment_type=9</b> )                    | <b>one</b>             | cfs   | double    | <b>strmflow_module</b> = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann |
| <i>flow_to_great_lakes</i> | Total flow to Great Lakes ( <b>segment_type=11</b> )                         | <b>one</b>             | cfs   | double    | <b>strmflow_module</b> = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann |
| <i>flow_to_lakes</i>       | Total flow to lakes ( <b>segment_type=2</b> )                                | <b>one</b>             | cfs   | double    | <b>strmflow_module</b> = muskingum, strmflow_in_out,                                   |

| Variable name             | Description   | Dimension <sup>1</sup> | Units               | Data type | Availability/condition   |
|---------------------------|---|------------------------|---------------------|-----------|--|
| <i>flow_to_ocean</i>      | Total flow to oceans ( <b>segment_type</b> =8)  | <b>one</b>             | cfs                 | double    | muskingum_lake, or<br>muskingum_mann<br><b>strmflow_module</b> =<br>muskingum,<br>strmflow_in_out,<br>muskingum_lake, or<br>muskingum_mann |
| <i>hru_outflow</i>        | Total flow leaving each HRU   | <b>nhru</b>            | cfs                 | double    | always   |
| <i>hru_streamflow_out</i> | Total flow to stream network from each HRU  | <b>nhru</b>            | cfs                 | double    | always   |
| <i>obs_runoff_mo</i>      | Monthly measured streamflow at basin outlet   | <b>one</b>             | cfs                 | double    | <b>print_debug</b> > -2  |
| <i>obs_runoff_tot</i>     | Total simulation measured streamflow at basin outlet  | <b>one</b>             | cfs                 | double    | <b>print_debug</b> > -2  |
| <i>obs_runoff_yr</i>      | Yearly measured streamflow at basin outlet  | <b>one</b>             | cfs                 | double    | <b>print_debug</b> > -2  |
| <i>obsq_inches</i>        | Measured streamflow at specified outlet station   | <b>one</b>             | inches              | double    | <b>print_debug</b> > -2  |
| <i>obsq_inches_mo</i>     | Monthly measured streamflow at specified outlet station   | <b>one</b>             | inches              | double    | <b>print_debug</b> > -2  |
| <i>obsq_inches_tot</i>    | Total simulation basin area-weighted average measured streamflow at specified outlet station                              | <b>one</b>             | inches              | double    | <b>print_debug</b> > -2  |
| <i>obsq_inches_yr</i>     | Yearly measured streamflow at specified outlet station  | <b>one</b>             | inches              | double    | <b>print_debug</b> > -2  |
| <i>runoff</i>             | Streamflow at each measurement station  | <b>nobs</b>            | <b>runoff_units</b> | real      | <b>nobs</b> > 0  |
| <i>seg_gwflow</i>         | Area-weighted average groundwater discharge for each segment from HRUs contributing flow to the segment and upstream HRUs | <b>nsegment</b>        | inches              | double    | <b>strmflow_module</b> =<br>muskingum,<br>strmflow_in_out,<br>muskingum_lake, or<br>muskingum_mann   |
| <i>seg_inflow</i>         | Total flow entering a segment   | <b>nsegment</b>        | cfs                 | double    | <b>strmflow_module</b> =<br>muskingum,<br>strmflow_in_out,<br>muskingum_lake, or<br>muskingum_mann   |
| <i>seg_lateral_inflow</i> | Lateral inflow entering a segment   | <b>nsegment</b>        | cfs                 | double    | <b>strmflow_module</b> =<br>muskingum,<br>strmflow_in_out,<br>muskingum_lake, or<br>muskingum_mann   |
| <i>seg_outflow</i>        | Streamflow leaving a segment  | <b>nsegment</b>        | cfs                 | double    | <b>strmflow_module</b> =<br>muskingum,<br>strmflow_in_out,<br>muskingum_lake, or<br>muskingum_mann   |

| Variable name                  | Description  | Dimension <sup>1</sup> | Units            | Data type | Availability/condition   |
|--------------------------------|--|------------------------|------------------|-----------|--|
| <i>seg_sroff</i>               | Area-weighted average surface runoff for each segment from HRUs contributing flow to the segment and upstream HRUs | <b>nsegment</b>        | inches           | double    | <b>strmflow_module</b> = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann |
| <i>seg_ssflow</i>              | Area-weighted average interflow for each segment from HRUs contributing flow to the segment and upstream HRUs      | <b>nsegment</b>        | inches           | double    | <b>strmflow_module</b> = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann |
| <i>seg_upstream_inflow</i>     | Sum of inflow from upstream segments   | <b>nsegment</b>        | cfs              | double    | <b>strmflow_module</b> = muskingum, strmflow_in_out, muskingum_lake, or muskingum_mann |
| <i>segment_delta_flow</i>      | Cumulative flow minus flow out for each stream segment   | <b>nsegment</b>        | cfs              | double    | <b>strmflow_module</b> = muskingum, muskingum_lake, or muskingum_mann                  |
| <i>streamflow_cfs</i>          | Streamflow at each measurement station   | <b>nobs</b>            | cfs              | double    | <b>nobs</b> > 0  |
| <i>streamflow_cms</i>          | Streamflow at each measurement station   | <b>nobs</b>            | cms              | double    | <b>nobs</b> > 0  |
| <i>strm_seg_in<sup>3</sup></i> | Flow in stream segments as a result of cascading flow in each stream segment                                       | <b>nsegment</b>        | cfs              | double    | <b>cascade_flag</b> = 1 and <b>ncascade</b> > 0  |
| <i>sub_cfs</i>                 | Total streamflow leaving each subbasin   | <b>nsub</b>            | cfs              | double    | <b>subbasin_flag</b> = 1   |
| <i>sub_cms</i>                 | Total streamflow leaving each subbasin   | <b>nsub</b>            | cms              | double    | <b>subbasin_flag</b> = 1   |
| <i>sub_inq</i>                 | Sum of streamflow from upstream subbasins to each subbasin   | <b>nsub</b>            | cfs              | double    | <b>subbasin_flag</b> = 1   |
| Stream Temperature             |  |                        |                  |           |  |
| <i>seg_ccov</i>                | Area-weighted average cloud cover fraction for each segment from HRUs contributing flow to the segment             | <b>nsegment</b>        | decimal fraction | real      | <b>stream_temp_flag</b> = 1  |
| <i>seg_daylight</i>            | Hours of daylight  | <b>nsegment</b>        | hours            | real      | <b>stream_temp_flag</b> = 1  |
| <i>seg_humid</i>               | Area-weighted average relative humidity for each segment from HRUs contributing flow to the segment                | <b>nsegment</b>        | decimal fraction | real      | <b>stream_temp_flag</b> = 1  |
| <i>seg_melt</i>                | Area-weighted average snowmelt for each segment from HRUs contributing flow to the segment                         | <b>nsegment</b>        | inches           | real      | <b>stream_temp_flag</b> = 1  |
| <i>seg_potet</i>               | Area-weighted average rainfall for each segment from HRUs contributing flow to the segment                         | <b>nsegment</b>        | inches           | real      | <b>stream_temp_flag</b> = 1  |
| <i>seg_shade</i>               | Area-weighted average shade fraction for each segment  | <b>nsegment</b>        | decimal fraction | real      | <b>stream_temp_flag</b> = 1  |
| <i>seg_tave_air</i>            | Area-weighted average air temperature for each segment from  | <b>nsegment</b>        | degrees Celsius  | real      | <b>stream_temp_flag</b> = 1  |

| Variable name            | Description  | Dimension <sup>1</sup> | Units           | Data type | Availability/condition                                       |
|--------------------------|--|------------------------|-----------------|-----------|--|
|                          | HRUs contributing flow to the segment  |                        |                 |           |  |
| <i>seg_tave_gw</i>       | Groundwater temperature  | <b>nsegment</b>        | degrees Celsius | real      | <b>stream_temp_flag = 1</b>                                  |
| <i>seg_tave_lat</i>      | Lateral flow temperature   | <b>nsegment</b>        | degrees Celsius | real      | <b>stream_temp_flag = 1</b>                                  |
| <i>seg_tave_ss</i>       | Subsurface temperature   | <b>nsegment</b>        | degrees Celsius | real      | <b>stream_temp_flag = 1</b>                                  |
| <i>seg_tave_upstream</i> | Temperature of streamflow entering each segment  | <b>nsegment</b>        | degrees Celsius | real      | <b>stream_temp_flag = 1</b>                                  |
| <i>seg_tave_water</i>    | Computed daily mean stream temperature for each segment  | <b>nsegment</b>        | degrees Celsius | real      | <b>stream_temp_flag = 1</b>                                  |
| <i>seg_width</i>         | Width of each segment  | <b>nsegment</b>        | meters          | real      | <b>stream_temp_flag = 1</b>                                  |
| Lake dynamics            |  |                        |                 |           |  |
| <i>basin_2ndstflow</i>   | Streamflow from second output point for lake HRUs using gate opening routing                         | <b>one</b>             | inches          | double    | <b>strmflow_module = muskingum_lake</b>                      |
| <i>basin_lake_seep</i>   | Basin area-weighted average lake-bed seepage to GWRs   | <b>one</b>             | acre-feet       | double    | <b>strmflow_module = muskingum_lake</b>                      |
| <i>basin_lake_stor</i>   | Basin volume-weighted average storage for all lakes using broad-crested weir or gate opening routing | <b>one</b>             | inches          | double    | <b>strmflow_module = muskingum_lake</b>                      |
| <i>din1</i>              | Inflow to each lake HRU using Puls or linear storage routing   | <b>nlake</b>           | cfs             | double    | <b>strmflow_module = muskingum_lake</b>                      |
| <i>elevlake</i>          | Surface elevation of each lake   | <b>nlake</b>           | feet            | real      | <b>strmflow_module = muskingum_lake and nratetbl &gt; 0</b>  |
| <i>gate_ht</i>           | Height of the gate opening at each dam with a gate   | <b>nratetbl</b>        | inches          | real      | <b>strmflow_module = muskingum_lake and nratetbl &gt; 0</b>  |
| <i>gw_seep_lakein</i>    | Groundwater discharge to each lake HRU for each GWR  | <b>ngw</b>             | acre-feet       | double    | <b>strmflow_module = muskingum_lake</b>                      |
| <i>lakein_sz</i>         | Cascading interflow and Dunnian surface runoff to lake HRUs from each upslope HRU                    | <b>nhru</b>            | inches          | double    | <b>cascade_flag = 1, ncascade &gt; 0, and nlake &gt; 0</b>   |
| <i>lake_2gw</i>          | Total seepage from each lake using broad-crested weir or gate opening routing                        | <b>nlake</b>           | cfs             | double    | <b>strmflow_module = muskingum_lake</b>                      |
| <i>lake_elev</i>         | Elevation of each simulated lake surface   | <b>nlakeelev</b>       | feet            | real      | <b>strmflow_module = muskingum_lake and nlakeelev &gt; 0</b> |
| <i>lake_gwflow</i>       | Total groundwater flow into each lake  | <b>nlake</b>           | cfs             | double    | <b>strmflow_module = muskingum_lake</b>                      |
| <i>lake_inflow</i>       | Total inflow to each lake  | <b>nlake</b>           | cfs             | double    | <b>strmflow_module = muskingum_lake</b>                      |
| <i>lake_interflow</i>    | Total interflow into each lake   | <b>nlake</b>           | cfs             | double    | <b>strmflow_module = muskingum_lake</b>                      |

| Variable name              | Description   | Dimension <sup>1</sup> | Units       | Data type | Availability/condition                  |
|----------------------------|---|------------------------|-------------|-----------|---|
| <i>lake_invol</i>          | Inflow to each lake using broad-crested weir or gate opening routing                      | <b>nlake</b>           | acre-feet   | double    | <b>strmflow_module</b> = muskingum_lake |
| <i>lake_lateral_inflow</i> | Lateral inflow to each lake   | <b>nlake</b>           | cfs         | double    | <b>strmflow_module</b> = muskingum_lake |
| <i>lake_outcfs</i>         | Streamflow leaving each lake, includes any second outlet flow                             | <b>nlake</b>           | cfs         | double    | <b>strmflow_module</b> = muskingum_lake |
| <i>lake_outcms</i>         | Streamflow leaving each lake, includes any second outlet flow                             | <b>nlake</b>           | cms         | double    | <b>strmflow_module</b> = muskingum_lake |
| <i>lake_outflow</i>        | Evaporation and seepage from each lake  | <b>nlake</b>           | cfs         | double    | <b>strmflow_module</b> = muskingum_lake |
| <i>lake_outq2</i>          | Streamflow from second outlet for each lake with a second outlet                          | <b>nlake</b>           | cfs         | double    | <b>strmflow_module</b> = muskingum_lake |
| <i>lake_outvol</i>         | Outflow from each lake using broad-crested weir or gate opening routing                   | <b>nlake</b>           | acre-feet   | double    | <b>strmflow_module</b> = muskingum_lake |
| <i>lake_outvol_ts</i>      | Outflow from each lake using broad-crested weir or gate opening routing for the time step | <b>nlake</b>           | acre-inches | double    | <b>strmflow_module</b> = muskingum_lake |
| <i>lake_seep_in</i>        | Total seepage into each lake using broad-crested weir or gate opening routing             | <b>nlake</b>           | cfs         | double    | <b>strmflow_module</b> = muskingum_lake |
| <i>lake_seepage</i>        | Lake-bed seepage from each lake to the associated GWR                                     | <b>ngw</b>             | acre-feet   | double    | <b>strmflow_module</b> = muskingum_lake |
| <i>lake_seepage_gwr</i>    | Net lake-bed seepage to associated GWR  | <b>ngw</b>             | inches      | double    | <b>strmflow_module</b> = muskingum_lake |
| <i>lake_sroff</i>          | Total surface runoff into each lake   | <b>nlake</b>           | cfs         | double    | <b>cascade_flag</b> = 1                 |
| <i>lake_sto</i>            | Storage in each lake using Puls or linear storage routing                                 | <b>nlake</b>           | cfs-days    | double    | <b>strmflow_module</b> = muskingum_lake |
| <i>lake_stream_in</i>      | Total streamflow to each lake   | <b>nlake</b>           | cfs         | double    | <b>strmflow_module</b> = muskingum_lake |
| <i>lake_vol</i>            | Storage in each lake using broad-crested weir or gate opening routing                     | <b>nlake</b>           | acre-feet   | double    | <b>strmflow_module</b> = muskingum_lake |
| Water balance              |   |                        |             |           |   |
| <i>basin_capillary_wb</i>  | Basin area-weighted average capillary reservoir storage                                   | <b>one</b>             | inches      | double    | <b>print_debug</b> = 1                  |
| <i>basin_dprst_wb</i>      | Basin area-weighted average surface-depression storage                                    | <b>one</b>             | inches      | double    | <b>print_debug</b> = 1                  |
| <i>basin_gravity_wb</i>    | Basin area-weighted average gravity reservoir storage                                     | <b>one</b>             | inches      | double    | <b>print_debug</b> = 1                  |
| <i>basin_soilzone_wb</i>   | Basin area-weighted average storage in soilzone reservoirs                                | <b>one</b>             | inches      | double    | <b>print_debug</b> = 1                  |
| <i>basin_storage</i>       | Basin area-weighted average storage in all water-storage reservoirs                       | <b>one</b>             | inches      | double    | always                                  |
| <i>basin_storvol</i>       | Basin area-weighted average storage volume in all water-storage reservoirs                | <b>one</b>             | acre-inches | double    | always                                  |

| Variable name                | Description  | Dimension <sup>1</sup> | Units  | Data type | Availability/condition   |
|------------------------------|--|------------------------|--------|-----------|--------------------------|
| <i>basin_surface_storage</i> | Basin area-weighted average storage in all water storage reservoirs                                  | <b>one</b>             | inches | double    | <b>csvON_OFF</b> = 1     |
| <i>basin_total_storage</i>   | Basin area-weighted average storage in all water storage reservoirs                                  | <b>one</b>             | inches | double    | <b>csvON_OFF</b> = 1     |
| <i>hru_lateral_flow</i>      | Lateral flow to stream network from each HRU   | <b>nhru</b>            | inches | double    | always                   |
| <i>hru_storage</i>           | Storage for each HRU   | <b>nhru</b>            | inches | double    | always                   |
| <i>last_basin_stor</i>       | Basin area-weighted average storage in all water storage reservoirs from previous time step          | <b>one</b>             | inches | double    | <b>print_debug</b> = 1   |
| <i>subinc_deltastor</i>      | Change in storage for each subbasin  | <b>nsub</b>            | inches | double    | <b>subbasin_flag</b> = 1 |
| <i>subinc_stor</i>           | Area-weighted average total water content in storage reservoirs for associated HRUs of each subbasin | <b>nsub</b>            | inches | double    | <b>subbasin_flag</b> = 1 |
| <i>subinc_wb</i>             | Water balance for each subbasin  | <b>nsub</b>            | inches | double    | <b>subbasin_flag</b> = 1 |
| <i>watbal_sum</i>            | Water balance aggregate  | <b>one</b>             | inches | double    | always                   |

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

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

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

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

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



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