VIII.3.3-SNOW-17 HYDRO-17 SNOW MODEL OPERATION

Identifier: SNOW-17

Operation Number: 19

Parameter Array: The FORTRAN identifier used for the parameter array is PS. The contents of the PS array are:

Position	Contents
1	Operation version number
2-6	Header information
7-8	Identifier of precipitation time series
9	Data type code of precipitation time series
10	Data time interval of precipitation time series (units of HR)
11-12	Identifier of air temperature time series
13	Data type code of air temperature time series
14	Data time interval of temperature time series (units of HR)
15	Read carryover indicator: 0 = carryover set to no snow conditions 1 = major initial carryover values input 2 = all initial carryover values input
16	Number of values in PS array
17	Location of information for rain plus melt time series in the PS array: 1/ 0 = no rain plus melt time series
18	Location of information for percent snowfall time series in the PS array: 1/ 0 = no percent snowfall time series
19	Location of information for observed water-equivalent time series in the PS array: 2/ 0 = none used
20	Location of information for simulated water-equivalent time series in the PS array: 2/ 0 = none used
21	Location of information for observed areal extent of

Position	Contents
	snow cover time series in the PS array: 2/ 0 = none used
22	Location of information for simulated areal extent of snow cover time series in the PS array: 2/ 0 = none used
23	Location of sums of water balance and melt components in the PS array: 3/ 0 = sums not stored
24	Print control: 0 = no printout 1 = print all days with snow 2 = print only significant days
25	Location of snow model parameters in the PS array 4/
26	Location of areal depletion curve in the PS array 5/
27	Location of temperature parameters in the PS array: 6/ 0 = not needed
28	Location of updating parameters in the PS array: 7/ 0 = not used
29	Location of the seasonal melt-factor variation: 8/ 0 = not used
30	Location of information needed to use rain-snow elevation time series: 9/ 0 = not used
31	Location of information for simulated snow depth time series in the PS array: 10/ 0 = not used
32-34	Unused

Notes:

1/ The contents of the 3 array positions for the rain plus melt and percent snowfall time series information are:
- o identifier (2 values)
- o data type code

2/ The contents of the 4 array positions for the observed and simulated water-equivalent and observed and simulated areal extent of snow cover time series information are:
- o identifier (2 values)
- o data type code
- o data time interval

3/ Sums of water balance and melt components:
1. precipitation
2. snowfall
3. rain plus melt
4. non-rain melt
5. rain melt
6. rain on bare ground
7. residual

4/ Order of snow model parameters is:
1. PXADJ
2. ELEV
3. SCF
4. MFMAX
5. MFMIN
6. UADJ
7. SI
8. NMF
9. TIPM
10. MBASE
11. PXTEMP
12. PLWHC
13. DAYGM
14. ALAT

5/ Areal depletion curve consists of decimal fraction areal extent of snow cover values at WE/Ai ratios of 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 and 0.9. Areal extent when WE/Ai=0.0 is set to 0.05 and areal extent is 1.0 when WE/Ai=1.0.

6/ Temperature parameters:
1. elevation of temperature data
2. maximum temperature lapse rate
3. minimum temperature lapse rate

7/ Updating parameters (all 7 values stored for Operational Forecast System programs - 2 values stored for Calibration System programs):
1. water-equivalent tolerance
2. areal cover tolerance
3. unused
4. unused
5. melt factor correction
6. snowfall correction
7. wind correction

8/ Melt-factor variation (12 positions - decimal fraction that melt factor lies between MFMIN and MFMAX on the 16th of each month from January to December).

9/ Information needed to use the rain-snow elevation time series:
1. Number of pairs used to define the area-elevation curve (NPTAE)
2. Units in which the area-elevation curve was input:
0 = English units (elevations input in FT)

Position	Contents
	1 = Metric units (elevations input in M)
3-4.	Identifier of the rain-snow elevation time series
5.	Data type code for the rain-snow elevation time series
6 thru 5+(NPTAE·2).	Area elevation curve (stored as pairs of Elevation (M) and decimal fraction of area below the elevation - elevations in increasing order)

10/ The contents of the 4 array positions for the simulated snow depth time series information are:

- o identifier (2 values)
- o data type code
- o data time interval

Carryover Array: The FORTRAN identifier used for the carryover array is CS. The contents of the CS array are:

Position	Contents
1	Solid (ice) portion of water-equivalent (MM)
2	Heat deficit (MM)
3	Liquid water storage (MM)
4	Temperature index (DEGC)
5	Maximum water-equivalent since snow began to accumulate (MM)
6	SB (MM)
7	SBAESC (decimal fraction)
8	SBWS (MM)
9	Excess liquid-water in storage (MM)
10	Areal extent of snow cover adjustment (MM)
11 thru 10 + n	Lagged excess liquid-water (MM) n=(5/timeint)+2 where timeint is the time interval of precipitation data
10 + n + 1	Snow depth (CM)
10 + n + 2	Average snow temperature (DEGC)

Subroutines Names and Functions: Subroutines associated with this Operation are:

Subroutine	Function
PIN19	Input cards and stores values in PS array
CKCO19	Check carryover
PRP19	Print information in PS array
PRC19	Print information in CS array
TAB19	Make entries into the Operations Table
EX19	Execution control subroutine
PACK19	Execute the Operation for one computation time interval
MELT19	Compute non-rain melt
AESC19	Compute areal extent of snow cover
ROUT19	Route excess water through the snow cover
ZERO19	Set carryover to zero when no snow exists
ADJC19	Adjust carryover for a change in water-equivalent
PRCO19	Print carryover during debug
AECO19	Adjust state variables for a change in the areal extent of snow cover
UPDT19	Update water-equivalent and snow cover
CSAV19	Store carryover values in the CS array
PRSN19	Print execution output
PUC19	Punch information in PS and CS arrays
COX19	Perform carryover transfer

Subroutines PIN19, PRP19, PRC19, COX19 and PUC19 have the standard argument lists for these subroutines as given in Section VIII.4.3.

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SUBROUTINE EX19
(PS,CS,PX,TA,RM,PCTS,RSTS,OWE,SWE,OSC,COVER,PPX,PPCTS,
                PRM,TALR)
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Function: This is the execution subroutine for Operation SNOW-17.

Argument List:

Variable	Input/ Output	Type	Dimension	Description
PS	Input	R*4	Variable	Parameter array
CS	Both	R*4	Variable	Carryover array
PX	Input	R*4	Variable	Precipitation data
TA	Input	R*4	Variable	Temperature data
RM	Output	R*4	Variable	Rain+melt values
PCTS	Input	R*4	Variable	Percent snowfall data
RSTS	Input	R*4	Variable	Rain-snow elevation data
OWE	Input	R*4	Variable	Observed water-equivalent data
SWE	Output	R*4	Variable	Simulated water-equivalent values
OSC	Input	R*4	Variable	Observed areal extent of snow cover data
COVER	Output	R*4	Variable	Simulated areal extent of snow cover values
PPX	-	R*4	Variable	Work space
PPCTS	-	R*4	Variable	Work space
PRM	-	R*4	Variable	Work space
TALR	-	R*4	Variable	Work space

SUBROUTINE PACK19 (KDA,KHR,NDT,TA,PX,PCTS,RSL,OWE,OSC,PGM,RM,TWE,
COVER,CWE,CAESC,IFUT,IDT,IBUG,IMN)

Function: This routine executes the Operation SNOW-17 for one computational time interval.

Argument List:

Variable	Input/ Output	Type	Dimension	Description
KDA	Input	I*4	1	Current julian day-internal clock
KHR	Input	I*4	1	Current hour-internal clock
NDT	Input	I*4	1	Number of precipitation, percent snowfall and rain plus melt values per computational time interval
TA	Input	R*4	1	Air temperature (DEGC)
PX	Input	R*4	NDT	Precipitation (MM)
PCTS	Input	R*4	NDT	Percent snowfall(decimal fraction)
RSL	Input	R*4	1	Rain-snow elevation (M)
OWE	Input	R*4	1	Observed water-equivalent (MM)
OSC	Input	R*4	1	Observed areal extent of snow cover (decimal fraction)
PGM	Input	R*4	1	Ground melt (MM)
RM	Output	R*4	NDT	Rain plus melt (MM)
TWE	Output	R*4	1	Simulated water-equivalent (MM)
COVER	Output	R*4	1	Simulated areal extent of snow cover (decimal fraction)
CWE	Output	R*4	1	Computed water-equivalent before any updating (MM)
CAESC	Output	R*4	1	Computed areal extent of snow cover before any updating (decimal fraction)
IFUT	Input	I*4	1	Future period indicator: 0 = observed data period 1 = forecast (future) period

Variable	Input/ Output	Type	Dimension	Description
IDT	Input	I*4	1	Length of computational time interval (HR)
IBUG	Input	I*4	1	Debug print indicator: 0 = do not print debug output 1 = print debug output
IDN	Input	I	1	Current day number since March 21
IMN	Input	I	1	Current month number

SUBROUTINE TAB19
(TO,LEFT,IUSET,NXT,LPS,PS,LCS,TS,MTS,NWORK,LWORK,IDT)

Function: This is the Operations Table entry subroutine for Operation SNOW-17.

Argument List: The arguments for this subroutine are similar to the arguments for the Operations Table entry subroutines for other Operations. A description of the arguments is contained in section VIII.4.2-TAB.

Operation Table Array: The contents of the TO array are:

Position	Contents
1	Operation number
2	Location in the T array of the next Operation to be executed
3	Location of the parameter array for the Operation in the P array
4	Location of the carryover array for the Operation in the C array
5	Location of precipitation data in the D array
6	Location of temperature data in the D array
7	Location of rain plus melt data in the D array: 0 = not used
8	Location of percent snowfall data in the D array; 0 = none used
9	Location of observed water-equivalent data in the D array: 0 = none used
10	Location of rain-snow elevation data in the D array: 0 = none used
11	Location of simulated water-equivalent data in the D array: 0 = none used
12	Location of observed areal extent data in the D array: 0 = none used
13	Location of simulated areal extent data in the D array:

Position	Contents
	0 = not used
14	Location of simulated snow depth data in the D array: 0 = not used
15	Location of working space in the D array