Single Reservoir Regulation (RES-SNGL) Model

1. Description of Algorithm

https://vlab.ncep.noaa.gov/documents/207461/1893022/24ress__intro.pdf

2. Model Parameters

RES-SNGL uses the existing NWSRFS operation definition for defining model parameters. The NWSRFS operation definition is enclosed within a single parameter element named "OPERATION_CONTENTS". An example is shown below. For further information see:

https://vlab.ncep.noaa.gov/documents/207461/1893022/533ress__intro.pdf

Example definition:

```
KEYSTONE DAM (KEYO2)
GENERAL
TITLE 'KEYSTONE LAKE (DCP) '
UNITS ENGLISH ACFT
PARMS
ELVSSTOR      654.40   660.00   666.00   670.00   674.00   &
               680.00   684.00   690.00   696.00   700.00   &
               706.00   710.00   716.00   724.00   730.00   &
               740.00   746.00   754.00   759.90            &
                  0.      538.    5086.    11043.   20137.   &
              40669.   59872.   97793.   147742.  188148.   &
             260917.  316586.  412930.   581682.  746032.   &
            1088393. 1341098 1737811. 2080077.
INTERP LINEAR
ENDP
TIME-SERIES
INSTQIN       KEYO2 SQIN   6
MEANQIN       KEYO2 SQME   6
MEANQOUT KEYO2     RQMP   6
INSTQOUT      KEYO2 QINE   6
POOL          KEYO2 SPEL   6
ENDTS
CARRYOVER
INFLOW        6117.36
Q-MEAN        24303.00
Q-INST       24434.00
POOL0          741.01
POOL1          740.74
STORAGE  1119558.38
ENDCO
ENDGENL
```

```
SPECIFIC
SETQ(1)
PARMS
QVALUE TS
OPTION    1
ENDP
TIME-SERIES
SQTS            KEYO2 RQOT    6
ENDTS
CARRYOVER
OLDQ         24303.00
ENDCO
ENDSETQ
ADJUST(1)
PARMS
BLEND    4
CFACTOR DIFF
ENDP
TIME-SERIES
OBSQO           KEYO2 RQOT    6
OBSQOM          KEYO2 RQME    6
OBSH            KEYO2 PELV    6
ADJH            KEYO2 PELE    6
ENDTS
CARRYOVER
QDIFF    -0.01
STEPS    20
ENDCO
ENDADJ
ENDSPEC
RCL
DO SETQ
ENDRCL
END
```

3. Model States

RES-SNGL model states are defined in a property file format. An example is shown below. The model state property names are:

Property Name	Description
UNIT	Units for State Variables (always METRIC)
INSTANTANEOUS_INFLOW	Instantaneous inflow at start of run
MEAN_DISCHARGE	Mean discharge at start of run
INSTANTANEOUS_DISCHARGE	Instantaneous discharge at start of run
POOL_ELEVATION_ONE_PERIOD_BACK	Pool elevation one period before start of run
POOL_ELEVATION	Pool elevation at start of run
STORAGE_CONTENTS	Pool storage at start of run (unit in fraction of **CMSD**[1])
SETQ**1**_#0 – SETQ**n**_#N	Instantaneous or mean discharge (N <= 50)

Property Name	Description
SETH**1**_#0 – SETH**n**_#N	Pool elevation (N = 50)
FILLSPILL**1**_#0 - FILLSPILL**n**_#0	Non-spillway discharge
SPILLWAY**1**_#0 - SPILLWAY**n**_#0	Non-spillway discharge
STPOOLQ**1**_#0 – STPOOLQ**n**_#N	. Previous period discharge for local flow at gage 1 . Four values for gage 1 . Four values for gage 2 (N <= 9)
INDSRCHGE**1**_#0 – INDSRCHGE**n**_#N	. Instantaneous inflow two periods prior to start of run . Pool elevation two periods prior to start of run . Increment/decrement of pool elevation above the values two periods prior to start of run . Max. elevation reached in surcharge operation . Discharge corresponding to max. elevation reached in surcharge operation . Max discharge reached in surcharge operation (N = 6)
FLASHBDS**1**_#0 – FLASHBDS**n**_#N	. Number of large boards down . Number of small boards down . Gate opening (N <=3)
POWERGEN**1**_#0 – POWERGEN**n**_#N	Time interval mean discharge values (N<= 24)
RULEADJ**1**_#0 – RULEADJ**n**_#N	. Number of missing observed elevations at the start of run . Values of differential elevations (N <= 101)
ADJUST**1**_#0 – ADJUST**n**_#N	. Discharge difference or discharge ratio . Number of periods of missing data prior to the start of run (N <= 2)
BACKFLOW**1**_#0 – BACKFLOW**n**_#0	Pool elevation one period before start of run

CMSD[1]: (ACFT /70.045339)*(24-hour/model data time interval)
70.045339 = 86400/43560 *((1./0.3048)**3.0)

n = the level of scheme/utility definition

Sample state definition:

UNIT=METRIC
INSTANTANEOUS_INFLOW=173.222214
MEAN_DISCHARGE=688.175842
INSTANTANEOUS_DISCHARGE=691.885315
POOL_ELEVATION_ONE_PERIOD_BACK=225.859848
POOL_ELEVATION=225.777542
STORAGE_CONTENTS=63933.101562
SETQ1_#0=688.191284
ADJUST1_#0=-0.010000
ADJUST1_#1=20.010000

4. Model Time Series

There are 6 GENERAL time series. The first 3 are required and the second 3 are optional.
The SPECIFIC time series for all schemes/utilities require 8-input, 6-output; and optional 12-input.

Time Series Type	Internal Model Units	Time Step	Missing Values Allowed	Required [Yes or No]
GENERAL TIME SERIES: Input				
Instantaneous inflow (INSTQIN)	CMS	any	No	Yes
Mean inflow (MEANQIN)	CMSD	1/	No	Yes
SPECIFIC TIME SERIES: Input				
Discharge (SQTS)	CMS/CMSD	any	Yes	No
Elevation (SHTS)	M	any	Yes	No
Proposed limiting discharge (QLIM)	CMSD	any	Yes	No
Generation discharge (QGEN)	CMSD	any	Yes	No
Non-generation discharge (QSLUICE)	CMSD	any	Yes	No
Local runoff for gage1 (LOCAL1)	CMS	any	No	No
Local runoff for gage2 (LOCAL2)	CMS	any	No	No
Observed number of large boards down (LARGEBDS)	DLES	any	Yes	No
Observed number of small boards down (SMALLBDS)	DLES	any	Yes	No
Observed flood gate	M	any	Yes	No

Time Series Type	Internal Model Units	Time Step	Missing Values Allowed	Required [Yes or No]
openings (GATE)				
Observed and projected generation discharge (GENQ)	CMSD	any	Yes	No
Observed and projected sluice discharge (SLUICEQ)	CMSD	any	Yes	No
Observed pool elevation (ELEV)	M	any	Yes	Yes
Precipitation (PCPN)	MM	any	No	Yes
Evaporation cure (EVAP)	MM	24	No	Yes
Observed instantaneous discharge (OBSQO)	CMS	any	Yes	Yes
Observed mean discharge (OBSQOM)	CMSD	any	Yes	Yes
Observed pool elevation (OBSH)	M	any	Yes	Yes
Observed mean discharge (OBSQ)	CMSD	24	Yes	Yes

Time Series Type	Internal Model Units	Time Step	Missing Values Allowed	Required [Yes or No]
GENERAL TIME SERIES: Output				
Simulated mean outflow (MEANQOUT)	CMSD	1/	No	Yes
Simulated instantaneous outflow (INSTQOUT)	CMS	2/	No	No
Simulated pool elevation (POOL)	M	2/	No	No
Simulated storage contents (STORAGE)	CMSD	2/	No	No
SPECIFIC TIME SERIES: Output				
Volume generated by rain/evaporation on reservoir surface (ADDQ)	CMSD	any	No	Yes

Time Series Type	Internal Model Units	Time Step	Missing Values Allowed	Required [Yes or No]
Adjusted instantaneous discharge (ADJQO)	CMS	any	No	Yes
Adjusted mean discharge (ADJQOM)	CMSD	any	No	Yes
Adjusted pool elevation(ADJH)	M	any	No	Yes
Adjusted storage (ADJS)	CMSD	any	No	Yes
Adjusted inflow (NEWQ)	CMS	any	No	Yes

1/ Time interval must be same as time interval of INSTQIN. This is the computational time interval of the operation
2/ Time interval must be even multiple of time interval of INSTQIN.

Input[1]: suggested data type = RQOT
Input[2]: suggested data type = RQME
Input[3]: suggested data type = PELV
Output[1]: suggested data type = RQIE or QINE
Output[2]: suggested data type = RQMP
Output[3]: suggested data type = PELE
Output[4]: suggested data type = RSTE

5. Modifications (Mods)

The RES-SNGL model has one mod it accounts for.

Parameter Id	Internal Model Units	Time Step	Description
SETQMEAN	CMS	any[1]	mean discharge over each RES-SNGL data time interval

[1] an equidistant time series; must coincide with the model time step; the date for each value must coincide with a model time step

6. Notes about configuring Model in FEWS workflow

The REGULATE technique uses to control outflow time series. If the regulate switch is off (i.e. REGULATE = FALSE), then force the reservoirs to pass inflow. The default value is "FALSE".

In CHPS, the REGULATE technique will be defined as a property in the runInfo.xml file. For example,

<string key="REGULATE" value="TRUE"/>

Examples:

Module Configuration File
ModuleConfigFiles\RESSNGL_DWSC2_DWSC2_Forecast.xml

Module Parameter File
ModuleParFiles\RESSNGL_DWSC2_DWSC2_UpdateStates.xml

7. FEWS Adapter Used

The RES-SNGL model uses the OHDFewsadapter to communicate. Information about this adapter can be found at OHDFewsadapter