

V.3.3-CHANGE-T CHANGE TIME SERIES DATA TIME INTERVAL OPERATION

Identifier: CHANGE-T

Application: All programs

Description: This Operation changes a time series with a given data time interval to a time series with a larger or smaller data time interval.

It will also convert a mean daily flow time series to an instantaneous discharge time series with a smaller data time interval.

The following rules and options apply to this Operation:

1. Both the input and output time series must have the same units except when changing a mean daily flow time series to instantaneous discharge.
2. The data time intervals can be either increasing or decreasing or equal.
3. The data time intervals must be multiples of each other.
4. Both the input and output time series must have the same time scales (i.e., MEAN, ACCM or INST - see Section V.2.2) with one exception which follows.
5. Changing a mean daily flow time series to instantaneous discharge is allowed if the data time interval is decreasing.
6. Missing values are allowed.

The procedure used by this Operation is dependent on and described according to which of the following conditions exists:

1. Both time series have MEAN or ACCM time scales and the data time interval is increasing: The input time values are summed over the data time interval of the output time series. For MEAN time scales, the sum is divided by the number of input values per output value.
2. Both time series have INST time scales and data time interval is increasing: Input values that coincide with the data time interval of the output time series are picked off as output time series values.
3. Both time series have MEAN or ACCM time scales and data time interval is decreasing: Each output time series value within a given data time interval of the input time series is equal to the input time series value for that interval. For ACCM time scales the output values are also divided by the number of

output values per input value.

4. Both time series have INST time scales and data time interval is decreasing: Under this condition there are two options:
 - a. Output values for times that do not exist in the input time series are computed using linear interpolation between the two surrounding input time series values. The output time series values are set to missing when the input values needed for interpolation are missing. This option must be used when the output time series cannot contain missing values.
 - b. Only non-missing values in the input time series are transferred to the output time series. There is no interpolation under this option. All intermediate values in the output time series are set to missing. This option is generally used when observed data time series are being converted to a smaller data time interval for display.
5. Mean daily flow to instantaneous discharge with decreasing data time interval: The output instantaneous values for any data time interval are computed using the current, next and previous mean daily values. At the end of the time series when no next mean daily value exists, this next value is set equal to the current mean daily value. Initial estimates of the instantaneous values are derived by the following rules:
 - a. If there are no significant changes between the current mean and the previous and next means, then the instantaneous values for that interval are assigned the same value as the mean daily value.
 - b. If the current mean is either a peak or trough, then an instantaneous peak (or trough) is first estimated. The magnitude of the peak is estimated by adding 1/4 of the average differences between the current mean and the previous and next means, to the current mean. The time of the peak is initially set at the midpoint of the interval but is skewed toward whichever mean (previous or next) is closest in magnitude to the current mean. Once the instantaneous peak magnitude and time are estimated, the remaining instantaneous values for the interval are computed using linear interpolation between the peak and the midnight instantaneous values. The instantaneous midnight value for the current day is set 1/4 of the way between the next mean and the current mean.
 - c. The current mean may be on a continuing rise or fall. For either case, the instantaneous value at the endpoint of the interval is set at 1/4 of the way between the current and next mean daily values. The difference between the current and previous means is checked to see if it is less than the difference between the current and next means. If it is less, then the output values are computed by adding small but increasing increments to the previous, instantaneous

midnight value until the last point of the interval is reached; which is set equal to the estimated endpoint. If the previous difference in means is not less than the next difference then the output values are computed by starting at the endpoint and working backwards while subtracting small but increasing increments from the endpoint.

After initial estimates of the instantaneous values are derived they are adjusted so that the volume they represent is within a specified tolerance of the input mean daily volume.

It should be noted that this procedure of converting from mean daily flow to instantaneous discharge may not be particularly suited to flashy streams or flashy reservoir releases (such as a power wave) which may have multiple peaks in one 24 hour data time interval.

A note of caution is warranted regarding the data type codes for this case. Converting a data type that allows missing values, e.g. QME, to one not allowing missing, e.g. QINE, cannot be done. This restriction can be circumvented by identifying the external QME time series as SQME (which does not allow missing data) within the program. This can be done in the define time series (DEF-TS) step by specifying SQME when the type is QME on the external file. Then, SQME is used on the input card for CHANGE-T.

6. Both time series have the same data time interval:
 - a. Missing values in the input time series are generated using linear interpolation from the two surrounding non-missing values. The non-missing and generated values in the input time series are then transferred to the output time series.
 - b. If the input and output time series have different units the unit of the output time series will be used. This option uses the units of the output time series and transfers the non-missing and generated values from step 6a to the output time series. This option can be used to convert a mean flow time series from a MEAN time scale to an INST time scale. The mean and instantaneous flow time series can therefore be plotted in the same plot of a PLOT-TUL Operation.

Allowable Data Time Intervals: 1, 2, 3, 4, 6, 8, 12 and 24 hours except when converting mean daily flow to instantaneous discharge in which case the time interval must be 24 hours for the input time series

Time Series Used: Time series used in this Operation are as follows:

Form of Data Missing

General Type	Dimn	Units	Use	Required	Output T.S.	Time Interval	Values Allowed
Time series whose data time interval will be changed (time series A)	any	standard units for data type	I	yes	N/A	any <u>1</u> /	yes
Time series with new data time interval (time series B)		same as for time series A <u>4</u> /	O	yes	replaces	any <u>2</u> /	Yes <u>3</u> /

- 1/ The computational time interval for the Operation is the time interval for the input time series.
- 2/ Must be an even multiple or must divide evenly into the time interval for time series A.
- 3/ If the output data type code cannot contain missing values then the data type code for the input time series also cannot allow missing values.
- 4/ Exception is when converting mean daily flow (Units=CMSD and Dimn=L3) to instantaneous discharge (Units=CMS and Dimn=L3/T).

Input Summary: The card input for this Operation is as follows:

Card	Format	Columns	Contents
1	2X,2A4	3-10	Internal identifier for the input time series (time series A) whose time interval will be changed
	1X,A4	12-15	Data type code for time series A
	3X,I2	19-20	Data time interval in hours for time series A
	2X,2A4	23-30	Internal identifier for the output time series (time series B)
	1X,A4	32-35	Data type code for time series B
	3X,I2	39-40	Data time interval in hours for time series B
	1X,A4	42-45	No interpolation option; enter 'NTRP' if there is to be no interpolation between values in the input time series; default is to interpolate ('NTRP' can only be used for case with INST time scale, time

Card	Format	Columns	Contents
			interval is decreasing and output time series can contain missing values)
2X,A3		48-50	Read carryover indicator; default is to set carryover to zero; enter 'YES' if carryover is to be read from card, other-wise leave blank; carryover is needed for: <ol style="list-style-type: none"> 1. MEAN or ACCM time scale with increasing data time interval 2. INST time scale with decreasing data time interval 3. mean daily flow to instantaneous discharge conversion
2F10.0		51-70	Initial carryover values; only needed if 'YES' entered in previous field; carryover should be: <ol style="list-style-type: none"> 1. one value for MEAN or ACCM, the sum of the values in the current interval 2. one value for INST, the previous instantaneous value 3. two values for mean daily flow to instantaneous discharge, the first is the previous instantaneous midnight value and the second is the previous mean daily value

Sample Input and Output: Sample input is shown in Figure 1. Sample output from the parameter print routine is shown in Figure 2. There is no execution routine output.

Error and Warning Messages: The error and warning messages generated by this Operation and the corrective action to take when they occur are as follows:

A. Messages that can occur during setup:

1. ****ERROR**** UNITS - XXXX AND YYYY - ARE DIFFERENT.

Action: Make sure that both time series have the same units.

2. ****ERROR**** TIME SCALES - XXXX AND YYYY - ARE NOT COMPATIBLE.

Action: Make sure that both time scales are the same or are 'ACCM' and 'INST' when converting mean daily flow to instantaneous discharge.

3. ****ERROR**** INPUT TIME INTERVAL SHOULD BE 24 NOT XXX FOR THE CASE OF MEAN TO INST.

Action: Check that input time interval is 24 when converting mean daily flow to instantaneous discharge.

4. ****ERROR**** OPERATION IS ONLY FOR DECREASING TIME INTERVAL WHEN DATA TYPE CODES ARE MEAN TO INST.

Action: Check that time interval is decreasing when converting mean daily flow to instantaneous discharge.

5. ****ERROR**** TIME INTERVALS ARE NOT MULTIPLES OF EACH OTHER.

Action: Check to make sure that time intervals are multiples of each other.

6. ****ERROR**** INPUT TIME SERIES CAN HAVE MISSING VALUES BUT OUTPUT TIME SERIES CANNOT.

Action: Check to make sure that input time series does not allow missing values if the output time series does not allow missing values. Also check if input data type is QME. If so, may have to define the QME as SQME (as discussed earlier in the description section).

7. ****ERROR**** MEAN TO INST CONVERSION CAN ONLY BE USED FOR INPUT TIME SERIES WITH UNITS=CMSD. INPUT UNITS ARE XXXX.

Action: Make sure that input time series is mean daily flow.

8. ****WARNING**** THE 'NTRP' OPTION IS NOT ALLOWED SINCE THE OUTPUT TIME SERIES CANNOT CONTAIN MISSING VALUES. OPTION IS TURNED OFF.

Action: Check that action taken is okay.

B. Messages that occur during execution: None

C. Messages that can occur during carryover transfer:

1. ****WARNING**** OLD CARRYOVER CANNOT BE USED. DEFAULT CO OF ZERO USED.

Cause: Carryover is needed, but old carryover can only be used for the case of an INST time series, MEAN to INST conversion or when time intervals are the same. Otherwise, a default carryover value of zero is used.

D. Messages that can occur when punching cards:

1. ****WARNING**** CHECK PUNCHED CARRYOVER. CHARACTER CONVERSION IMPOSSIBLE.

Cause: Initial carryover is to be punched but an error occurred converting the carryover value to a character string.

Carryover Transfer Rules: This Operation has carryover when:

1. the data time interval is increasing and time scales are MEAN or ACCM
2. the data time interval is decreasing, time scale is INST and the 'NTRP' option is off or
3. mean daily flow to instantaneous discharge conversion is desired

In carryover transfer, the old carryover value is used for the new Operation for cases 1 and 2 above if carryover is needed by both Operations. If carryover is needed for both and case 1 is present, then the old carryover is used only if the old and new output time intervals are the same. Otherwise, a default value of zero is used for carryover in case 1.

Punched Card Limitations: None

Figure 1. Sample Card Input For Operation CHANGE-T

```

              - Column -
          5   10   15   20   25   30   35   40   45   50   55   60   65   70   75   80
-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
CHANGE-T      BFR
AFTNC        BFR      24  AFTNC      BFR      6  NTRP
    
```

Figure 2. Sample Output From Operation CHANGE-T Print Parameter Routine

```

*****
CHANGE-T OPERATION      NAME=BFR          PREVIOUS NAME=
*****

      FOLLOWING IS INFORMATION USED BY THE OPERATION  FOR CHANGING
      THE TIME INTERVAL OF A TIME SERIES.

      TIME          DATA      TIME      TIME
      SERIES      I.D.      TYPE      SCALE      INTERVAL(HRS.)
      -----      -
      1.)      AFTNC      BFR      INST      24
      2.)      AFTNC      BFR      INST      6

      WILL THERE BE INTERPOLATION?  NO

      CARRYOVER NEEDED?  NO
    
```