Draft requirements for streamflow averages

Background

Averages are but one of the many required statistical parameters relating to data analysis and product generation. They are perhaps more used than any other single calculated statistical parameter and are essential in quantifying current or historical conditions. Averages give us our sense of normalcy or extremes.

In a general sense, the calculation of an average is a very simple process; it is simply the sum of ‘n’ observations divided by n. Averages can of course be calculated for any time period and any data type. There are some data types that will require a pre-processing in order to generate the appropriate adjusted time series for calculation of averages. Streamflow is one data type that will need significant pre-processing.

Again, in a general sense, one can calculate the average of an observed monthly streamflow volume of a 30 year period or a period of record timeframe. For streamflow records where there is no significant water management, processing the observed streamflow data is appropriate. For those sites significantly affected by diversions and reservoirs or other water management, an adjusted record is required. The adjusted record is the sum of the observed streamflow and all other diversions and reservoir storage, positive or negative. This becomes the streamflow data series that approximates natural flow – that flow that would have occurred if there had been no water management or that flow which we can predict with various climatological indices.

The generation of this adjusted streamflow time series is prerequisite to the generation of a 30-year average (or any time-period average).

Description

Synthetic time series generation is the sum of several discrete time series to create an adjusted record. It involves an observed time series (such as observed streamflow) to which other time series, such as a diversion, are added or subtracted. A diversion, since it is water taken from the stream, would be an example of an addition back to the original series. A reservoir is an example of a situation that would have both additive and subtractive characteristics. When storing water (in essence, diverting water from natural flow), the change in storage needs to be added back to the observed streamflow data to achieve a natural flow condition. Later in the year, on the other hand, the reservoir will be in a draw-down circumstance – in essence adding water to the stream. Here, the additional water must be subtracted from the observed streamflow to achieve a natural condition.

The observed time series must be complete over the period of time for the analysis (i.e. if April-June is the period of concern, then each month must have a value, recognizing that zero is a valid number). Adjusting time series should also be serially complete, although many times estimates or averages must be used.

Timing

These time series are generated each time the averages are calculated and when forecast equations are generated or updated.

Process responsibility

The NRCS DCO staffs, the forecast hydrologists, etc.

Current workload

If done manually, this process can take several hours! Each DCO has had to maintain additional local databases as spreadsheets in order to generate these time series. The actual calculations and quality control and subsequent reloading to the "corporate database" takes weeks, not counting the time spent on updating the local database, which the DCO's no longer maintain.

Input data required

The data required for this application are: 1) observed, serially complete streamflow data and 2) observed adjustment data such as diversions and reservoirs. The reservoir data is a calculated time series as well, in that it is the change in storage value calculated from the observed end-of-month reservoir storage data.

How is this task done now

The data are collected from the responsible agencies and entered into spreadsheets, where the adjustments can be automatically calculated, using cell formulas. The adjusted time series are then extracted from the .xls file and uploaded to the database manually.

Development process and required results

The results required are: 1) an adjusted time series that reflects natural streamflow upon which an average may be calculated and 2) adjusted streamflow averages generated. That is to say, in the database, a calculated value should be stored for each month's streamflow constituting time series data.

The algorithm would be: Adjusted flow = Observed flow + delta reservoir(1) + delta reservoir(2) …+ delta reservoir(n) + diversion(1) + diversion(2) … + diversion(n).

Delta reservoir = observed volume res month(n) – observed volume res month(n-1).

If the diversion data are not there, the user can enter an average, a value or assume zero (per user discretion).

If reservoir data are not there, the user can enter an average, a value or assume zero (per user discretion).

Data flags should be associated with the data as follows: 1) if all data is present for calculations, a flag C should be entered for complete; 2) if less than 100% of the data are available, a flag P for provisional should be entered and stored with the data.

The time series calculated data with associated quality flags is to be posted to the database under the same station name and number as the observed data, but with an adjusted data header and a listing of the adjustments. For an example, see Table 1. This will assist in readily ascertaining that it is adjusted data and precisely what those adjustments are.

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DUCHESNE - RANDLETT, NR                                    09302000 DURU1 “C”
    AVG     24    30    34    33    37    42    39   100   154    35   6.9  10.2   328
 + CURRANT CK - CURRANT CK RES                              09288395 CRUU1
    AVG   10.8  10.8  10.8  10.8  10.8  10.9  11.4  12.1  12.4  12.6  12.5  12.5   1.7
 + DUCHESNE - DUCHESNE TUN, KAMAS, NR                       09288395 DCTU1
    AVG    0.5   0.4   0.4   0.4   0.4   0.5   1.0   7.3   6.5   3.0   0.7   0.5  17.8
 + LAKE FORK - MOON LK RES, MTN HOME, NR                    09290500 LAAU1
    AVG     25    27    29    31    32    33    34    33    43    37    29    25   3.9
 + ROCK CK - UPPER STILLWATER RES                           09278000 USTU1
    AVG   11.0   6.8   5.3   5.4   5.8   5.0   5.3  18.3    32    23    21  17.6  17.9
 + STRAWBERRY - STARVATION RES, DUCHESNE, NR                09288395 STAU1
    AVG    132   133   135   137   139   140   140   151   157   149   138   131   9.7
 + STRAWBERRY - STRAWBERRY RES                              09288395 STIU1
    AVG    218   221   225   228   234   241   252   277   276   260   241   231  19.3
 + STRAWBERRY TUN                                           09288395 SRTU1
    AVG    1.2   0.3   0.3   0.3   0.3   0.3   0.6   4.2  12.8  18.8  16.9   6.5    36
 + SYAR TUNN                                                09288395 SYRU1
    AVG    0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
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Table 1

These are monthly volume data series and the output should be expressed in 1000’s of acre-feet (KAF). It is important that the output should be in KAF regardless of how big or little the output is, rather than using conversion factors.

In a spreadsheet scenario, there is one excellent feature in that once you have replicated the formula, any number of vacant slots may have that characteristic and when you enter data, it automatically updates the adjusted value without having to issue a separate command. This would be needed in the database streamflow averages application as well.

Business constraints

This software must be completed on or before January 1, 2001. In all probability, the edited water year 2000 streamflow and adjustment data will not be available prior to this date. However, once the edited data is available, the DCO offices will have just nine months to complete adjusted, monthly streamflow average calculations.

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