Appendix: StateMod Input Type

2014-01-03

# Overview

The StateMod time series input type corresponds to the file format used by the State of Colorado's StateMod model, including:

* standard daily, monthly, average monthly (referred to as annual in the StateMod documentation) time series file formats
* water right input files that can be converted to cumulative decree time series
* specific output (\*.x\*) text files, including the \*.xop and \*.xpl files

See also the StateModB input type, which corresponds to StateMod binary output files and the StateCU input type, which corresponds to the State of Colorado’s StateCU consumptive use model.

The following example illustrates the format of the three main standard time series file formats. See the StateMod Documentation for a complete description of StateMod input files. Important comments about the file format are:

* The file is divided into a header section (top) and data section (bottom). Comments can occur only at the top and are lines that begin with #.
* One or more time series can be stored in a file.
* Consistency in the order and number of the stations is required for each year of data, within the file.
* Other than comments, the file is fixed-format, compatible with FORTRAN applications. See the StateMod Documentation for field specifications.
* The format is optimized to allow a full year of data to be read for the entire data set. Reading a time series for a single location for the full period requires reading through the entire file.
* In addition to the required values, a total/average value is accepted as the far-right value on each data line. This value may be ignored by applications (it can be computed from the data values on the line if necessary).
* The precision of data values may be controlled by software, resulting in more or fewer fractional digits. This may lead to round-off differences when comparing raw data values with the total/average in the optional end column.

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| # StateMod time series files can have 3 main forms (monthly, average monthly, daily) as# described below. The order of time series is important for# some files (e.g., order of diversion time series should match order of# diversion stations in .dds file); however, StateMod is being updated over# time to remove this requirement). Different StateMod input files have# slight variations on the general format (e.g., the reservoir target file# has two time series for each reservoir for minimum and maximum targets).# Missing data are typically indicated by -999.# The generic extension for StateMod time series files is .stm, although specific  # extensions are used in a StateMod data set.## 1) This is an example of a StateMod monthly time series for water year data:## Comments are lines at the top of the file starting with the # character.# The header may contain software-generated comments about the time series.# The remainder of the file is fixed format, with the first non-comment# line being a header with the following elements (i5,1x,i4,5x,i5,1x,i4,a5,a5):## Beginning month (1=Jan)# Beginning year (4-digit)# Ending month# Ending year# Data units (AF/M, ACFT, CFS or ""), where rates are for diversions and# flow, and volume is for reservoir contents. Units are not used for# dimensionless data (like weight or percent).# Year type (CYR=calendar, WYR=water, IYR=irrigation)## Data lines then follow with:# Year Station 12-monthly-values year-total/average (i4, 1x, a12, 12f8, f10)# The year value is optional and is generally not read as input but is # computed for output. The year in data lines corresponds to the calendar type.# An example follows: 10/1926 - 9/1998 ACFT WYR1927 08236000 1229.8 892.6 922.3 737.9 555.4 922.3 7049.4 32263.6 31000.1 14541.0 5662.9 8326.7 104104.01927 08235250 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 0.01927 08235700 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 0.01927 08236500 1047.3 595.1 614.9 614.9 555.4 1900.2 6769.7 31226.2 20338.8 14777.1 9465.3 4476.8 92381.5...  ## 2) This is an example of a StateMod average monthly time series for water year data:## The average monthly time series is a pattern of twelve monthly values# that are applied for each year in the period.# The format is exactly the same as a monthly time series; however, the# years in the header should be set to zero and year and month are ignored in data rows  # and can therefore be blank.## An example follows: 10/ 0 - 9/ 0 ACFT WYR 08236000 1229.8 892.6 922.3 737.9 555.4 922.3 7049.4 32263.6 31000.1 14541.0 5662.9 8326.7 104104.0 08235250 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 0.0 08235700 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 -999.0 0.0 08236500 1047.3 595.1 614.9 614.9 555.4 1900.2 6769.7 31226.2 20338.8 14777.1 9465.3 4476.8 92381.5...  ## 3) This is an example of a StateMod daily time series for water year data:## The daily time series is similar to the monthly time series except that# a year and month are included on the data lines and 28, 30, or 31 daily# data values can occur on each line (end values ignored, depending on month).# The data format is (i4, i4, 1x, a12, 31f8, f8). The month total/average# is optional and is generally read as input but is computed for output.  # Regardless of the calendar type in the header, the year and month in data records use  # calendar year (month 1 = January).## An example follows: 10/1926 - 9/1998 ACFT WYR1926 10 08236000 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 0.00 0.00...1927 4 08236000 38.00 42.00 42.00 67.00 90.00 90.00 100.00 118.00 93.00 80.00 93.00 80.00 80.00 80.00 80.00 80.00 68.00 80.00 68.00 68.00 80.00 80.00 106.00 136.00 170.00 229.00 250.00 296.00 322.00 348.00 0.00 114.651927 4 08235250 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 0.00 0.00... |

# StateMod Files and Standard Time Series Properties

The standard time series identifier for StateMod files is of the format:

Location...Interval~StateMod~PathToFile

StateMod files contain limited header information. Time series properties are set using the following guidelines:

* The location part of the time series identifier is taken from the identifier field in the data records (from the first year of data). A change in the year indicates that all time series have been identified.
* The data source part of the time series identifier is set to StateMod or blank. In the past this information was used to indicate the input type (file format) in the time series identifier; however, the new input type notation has a specific field for the input type and therefore data source can be used more appropriately. In the future, it may be possible to pass along the original input source but this information cannot currently be saved in the StateMod file format.
* The data type is often not assigned because it is not defined in the file. Currently no interpretation of the file name extension occurs. Some specific applications (e.g., the StateMod GUI) may set the data type, based on reading a StateMod data set response file (and therefore knowing the specific contents of the file).
* The data interval is assigned as Day or Month based on the file format (determined automatically).
* The scenario is typically not assigned. Older software may use the scenario to store the file name; however, the new time series identifier notation stores the file name as the input name field (see below).
* The input type part of the time series identifier is set to StateMod, indicating the file format. Software will use the interval and/or examine the file contents to verify whether the data are in daily or monthly format.
* The input name part of the time series identifier is set to the file name, either as the full path or a relative path to the working directory.
* The units are assigned to those indicated in the file header.
* The missing data value is assigned to -999.0.
* The description is set to the same value as the location. A verbose description can typically be determined by cross-referencing the identifier with another StateMod data file (e.g., diversion stations).
* The period is set based on the header information.

# Limitations

StateMod files have the following limitations:

* The format of the does not facilitate extracting one time series from the file. Software has been optimized to perform this within current constraints.
* Some time series properties are not explicitly included in StateMod files (e.g., data type). Therefore, general software like TSTool may not be able to provide default information. For example, a graph may show multiple time series with nearly the same legend text because more detailed information cannot be defaulted.
* If two time series for the same station are stored in the same file (e.g., reservoir maximum and minimum targets), there is no way to uniquely identify the two time series. The application or user must understand the file type and data organization. Some specific software (e.g., StateMod GUI) may be able to recognize the specific format.

# Water Right Files

StateMod water right input files can be converted to time series of cumulative decrees. See the explanation in the in the ReadStateMod() command documentation.

# Text Output Files

StateMod text output files (\*.x\*) can be read by the ReadStateMod() command, with the following notes:

* Identifiers that include period have the period replaced by underscore.
* The file formats are different from the standard time series files and include additional metadata information. For example, information about each time series often is listed above the numerical tables of time series data. This information is saved as time series properties.

The \*.xpl file has sections similar to the following where each “Plan ID” has a metadata section and blocks of “Plan Uses” containing 12 months and a total for the year.

Plan Summary ACFT

Plan Number = 1

Plan Type = 11 Accounting\_Plan

Plan ID = AgDSplit

Plan Name = AgriculturalDitchSplit

Plan Source = 0700502

River Location = AgDSplit

Use 1 ID = AgDitch.17 Admin # = 18415.00001 Name = Opr\_AgDitchSplit-Accts Opr Type = 46 Destination = CMAgPln Status = On

Use 2 ID = AgDitch.17 Admin # = 18415.00001 Name = Opr\_AgDitchSplit-Accts Opr Type = 46 Destination = CoorsAgPln Status = On

Use 3 ID = AgSpill.01 Admin # = 18415.00001 Name = Opr\_AgDSplit-Spill Opr Type = 29 Destination = NA Status = On

Plan Uses

Supply \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_...

Plan River Total Use 1 Use 2 Use 3 Use 4 Use 5 Use 6 …

ID ID Year Mo N/A (+) (+) (+) (+) (+) (+) …

( 1) ( 2) ( 3) ( 4) ( 5) ( 6) ( 7) …

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AgDSplit AgDSplit 1979 NOV 0.0 0.0 0.0 0.0 0.0 0.0 0.0 …

AgDSplit AgDSplit 1979 DEC 0.0 0.0 0.0 0.0 0.0 0.0 0.0 …

AgDSplit AgDSplit 1980 JAN 0.0 0.0 0.0 0.0 0.0 0.0 0.0 …

The file is handled as follows. Plan metadata are used to form unique time series identifiers that uniquely identify the time series and provide enough information to be understood without referencing other data. Each column in the output matching metadata results in a time series and a total annual time series also is created.

* The first month in the data section indicates the year type for the run and the year is always the calendar year (in the example above irrigation year 1980 is shown, which starts in NOV of 1979.
* The location part of the time series is set to:
  + Plan:Plan ID-Use:Use ID with periods replaced with underscores, for example Plan:AgDSplit-Use:AgDitch\_17. (Need to evaluate if this and scenario part is OK. An alternative would be to include source and destination in the location).
  + Plan:Plan ID-Src:Src ID, for example Plan:ArvBDCRFs-Src:In\_Priority.
  + If the detailed time series metadata are not parsed, then the Use ID or Src ID will be set to the column number (this is not desirable because it is inefficient for modelers and may result in lookup errors).
* The data source part of the time series is set to StateMod.
* The data type part of the time series is set to:
  + If the detailed time series metadata are parsed: PlanType-Description-OprType (e.g., 11-AccountingPlan-46)
  + If the detailed time series metadata are not parsed or operating rule is < 0: PlanType-Description (e.g., 11-AccountingPlan)
* The time series intervals for columns is Month, with Year being used for the annual total time series (year time series will be added if resources allow).
* The scenario part of the time series is set to the plan source and destination information as appropriate (Need to evaluate if this and the location part is OK):
  + For plan type 1: Source:Plan Source-Source, for example: Source:0700502-In\_Priority
  + For plan types 3 and 4: Source:Plan Source, for example: Source:0203910
  + For plan types 2, 8, 9, 10, 11 and 12: Source:Plan Source-Destination:Use Destination, for example: Source:0700502-Destination:CMAgPln
* The time series description/name is set to:
  + If the detailed time series metadata are parsed: the Plan Name-Use Name is used, for example AgriculturalDitchSplit-Opr\_AgDitchSplit-Accts.
  + If the detailed time series metadata are not parsed: the Plan Name is used, for example AgriculturalDitchSplit.

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