2 Introduction

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The StateMod GUI is a graphical user interface for the StateMod software, which is the water allocation modeling software used within Colorado's Decision Support Systems (CDSS). The StateMod software is a command-line program that does not itself include a graphical user interface. The following resources provide background information about StateMod data files and modeling approach:

- StateMod documentation – provides details about how to use the StateMod software to implement a basin model.
- StateDMI documentation – provides details about how to create StateMod input files using automated procedures.
- TSTool documentation – provides information about general capabilities to create StateMod time series files (the StateDMI documentation focuses on StateMod data sets and related procedures, whereas the TSTool documentation is more general).

Although the StateMod software has been applied mainly within CDSS, the software also is suitable to model basins outside of Colorado and the CDSS effort.

The StateMod GUI simplifies modeling tasks, including:

- Visualizing data
- Modifying data files for "what if" questions (see discussion below related to using StateDMI and TSTool to edit an existing data set)
- Running StateMod
- Visualizing results
- Using advanced tools for data analysis

The StateMod GUI operates on StateMod data sets described by a response file, which lists all the files that are part of a data set (see the StateMod model documentation for more information about response files). It is assumed that StateMod GUI users are also familiar with the StateMod software, including data files and model functionality. If an existing data set is used without modifications (e.g., data and results are viewed but the model is not run), then a relatively limited understanding of StateMod is necessary to use the StateMod GUI.

Because of the large amount of data stored in StateMod files, it generally is not practical to create a large data set from scratch using the GUI. Within CDSS, data management utilities (DMIs) are used to create baseline data sets, which can then be run and modified using the StateMod GUI. For example, the StateDMI software can be used to create the model network, station files, water rights, and other supporting files, using the HydroBase database for data. The TSTool software can be used to create the StateMod time series files. The comments at the top of StateMod input files indicate the program(s) and commands that have been used to create the files. Using DMI programs in CDSS automates processing of large amounts of data, eliminating the need to enter data into a data set using the StateMod GUI or text editors. For systems other than CDSS, a similar approach can be taken, although HydroBase as a data source may need to be replaced with an alternative.

It is possible to use StateDMI and TSTool to automate creation of "what if" StateMod datasets, which results in a clear trail of modifications to data sets and is consistent with the data-centered approach used by the State of Colorado:

1. Start with the master data set, for example from the State of Colorado's website.
2. Copy the data set to a scenario folder, naming the top-level folder as appropriate. Keep all of the individual StateMod names the same so that changes to files and processing can be minimized.
3. Create StateDMI and TSTool command files to automate modification of the dataset. Note that this approach clearly identifies changes to a dataset, whereas recreating the dataset using modified versions of the original command files may hide the changes that are being made. For example, to automate editing a data set to add a new reservoir:
    a. Use a StateDMI command file to read the original reservoir stations file (for example from the data set in the master copy of the data set), and set data for an additional reservoir. StateDMI "Write" commands have a parameter to "Update" or "Overwrite" a file, and the latter adds additional information to the comments at the top of the file to indicate edits.
    b. Similarly, use a StateDMI command file to automate changes to the reservoir rights file.
    c. Use TSTool to read the reservoir target time series, define a new time series, and write the updated file.
    d. The network **.net* file must be updated interactively using the StateDMI network editor. In the future, StateDMI commands may be implemented to automate insertion of a new network node, minimizing or eliminating the need to use the network editor for this task.
4. Open the dataset in StateMod GUI to visualize data and run the model.
5. The model can also be run on the command line and then use tools such as TSTool to view time series.
6. Tools like TSTool can be used to read data and results from multiple datasets for comparison.

The above automated editing approach ensures that a scenario data set is constructed consistent with the CDSS data-centered approach, and it allows the scenario data set to be recreated if the master data set should change (e.g., the State of Colorado extends the data set with more historical data). The above approach also overcomes limitations in the GUI's editing capabilities (see limitations in **Release Notes**).

The StateMod GUI does not check that all user-supplied data are reasonable, although many checks are in place and additional checks are added over time (early StateMod GUI versions relied on the StateMod data-check run mode). After editing data, StateMod should be run in data-check mode to find possible user errors (see **Chapter 6 – Running StateMod**). It is the user's responsibility to read messages generated by StateMod and make appropriate changes to the data set (or acknowledge that the data are acceptable). StateMod creates a log file in the data set directory with a name matching the data set and the extension *.log*. This log file should be reviewed to resolve problems. The StateMod GUI does attempt to minimize data errors by providing choices of appropriate values for data items and for maintaining the relationships between data files.

When a data set is selected, the StateMod GUI reads most of the data for the data set into computer memory. When data are edited, the changes are made to the copy of the data within memory (instead of immediately writing to the data files for each change, which would be slow). The StateMod GUI will automatically detect when changes to data occur and will notify the user before making a model run or closing the StateMod GUI. The user can then choose to save the StateMod input files so that the StateMod software will use the changes. The StateMod GUI will only write the changes to the appropriate files when ***File…Save…*** is selected. If the changes are not saved to files, then the next run of the StateMod model will use the previously saved version of the data files. This type of edit tracking is

necessary because the StateMod GUI and StateMod model are separate programs. **The GUI currently does not flag edited data in the StateMod data files – this is a requirement that is being evaluated**.

StateMod data sets are divided into groups of data set components. Each group includes a primary component and secondary components. For example, for diversion data, the primary component is diversion stations; secondary components include diversion water rights and time series associated with the diversion stations. The diversion station identifier is the primary link between data components. Important data component groups have display windows that list all the data for the group. Where appropriate, additional windows are provided and can be accessed by clicking on the appropriate button within the main data window. For example, a window is shown for diversion data; however, to view water rights for a diversion station, a button is pressed to display a secondary window.

The StateMod data shown in this document are not discussed in detail. For more information about the model, the data necessary to run the model, and modeling guidelines, see the StateMod software documentation. The StateDMI and TSTool documentation includes information about creating data files.

A typical StateMod GUI session consists of the following steps:

1. Run the StateMod GUI. A shortcut may have been configured on the desktop, or for CDSS, the following menu may have been configured: ***Start…All Programs…CDSS…StateModGUI-Version***. Immediately after starting, the StateMod GUI will run `statemod -version` to determine the StateMod model version. This confirms that StateMod can be found and identifies the StateMod version for subsequent actions.
2. Select a data set by selecting a StateMod response file using the ***File…Open*** menu (see **Section 3.4**).
3. View and edit data using the ***Data*** menu (see **Chapter 4 – The Model Network** and **Chapter 5 – Viewing and Editing Data**).
4. Run the model using the ***Run*** menu (see **Chapter 6 – Running StateMod**).
5. View output using the ***Results*** menu (see **Chapter 7 – Viewing Model Results**).
6. Perform additional analysis using the ***Tools*** menu (see **Chapter 9 – Tools**).
7. Exit the StateMod GUI using ***File…Exit***.
8. Optionally use software like TSTool to perform additional data and results viewing and analysis (see the TSTool documentation for more information).

This documentation is organized consistent with the StateMod GUI interface, with chapters for every major menu. There are also appendices for configuration information and documentation that is shared with other software documents. The following chapters are available in this documentation:

Chapter 1 Acknowledgements – recognizes contributors to the development and maintenance of the StateMod GUI software.

Chapter 2 Introduction (this chapter) – provides background information about the StateMod GUI and its interaction with StateMod.

Chapter 3 Getting Started – describes the main interface, including the map features. Refer to this section for questions about how to interact with the map in the StateMod GUI. Refer to the GeoView Mapping Tools appendix for general information about the map interface.

Chapter 4 The Model Network – discusses how to create new data sets and view or modify an existing model network.

Chapter 5 Viewing and Editing Data – describes the main data windows, which are used to view and edit StateMod data.

Chapter 6 Running StateMod – describes how to run StateMod software from the StateMod GUI.

Chapter 7 Viewing Model Results – describes how to view StateMod output as graphs and text.

Chapter 8 Using the Map – describes how to use the map interface. This chapter is currently a placeholder and material from other chapters will be moved here in the future.

Chapter 9 Tools – describes how to use advanced analysis tools, including adding summary information to the map.

Chapter 10 Troubleshooting – discusses common problems and how to resolve them.

Appendix – StateMod GUI Installation and Configuration – describes how to install and configure the StateMod GUI.

Appendix – Release Notes – summarizes software update information.

Appendix – TSView Time Series Viewing Tools – discusses the general time series viewing tools used in the StateMod GUI and other CDSS software.

Appendix – GeoView Mapping Tools – provides an overview of the mapping interface, which is also used in other software in Colorado's Decision Support Systems.