Example model SubModel_4.gsm (in the General Examples/SubModel folder in your GoldSim directory) provides a simple illustration of such an application. In this model, the outer model is a dynamic deterministic simulation, and the SubModel is a static deterministic optimization. The objective function in the SubModel is a function of a parameter that is passed in from the outer model (and changes every timestep). Hence, every timestep, the SubModel carries out a new optimization and the results are used in the parent model for the next timestep.

Tracking Model Changes

GoldSim provides the ability to track changes that you have made to your model file. This feature (referred to as ***versioning***) allows you to quickly determine the differences between the current version of your model file and some previous version of the file.

Providing this configuration management capability is particularly useful for:

- coordinating model changes when multiple people can access and modify the model file;
- as a Quality Assurance/Quality Control feature enabling you to demonstrate and document when and what changes have been made to a model file.

Versioning Overview

Changes to a model file are tracked by creating model file versions. A version is an internal "snapshot" of your model file at a particular point in time. You must tell GoldSim when to take a "snapshot" by creating a version, and assigning it a title (e.g., "1-12-2002", "Initial Model", "Revision A"). Once you have created at least one version, you can then compare the current model (the model as it exists right now) to any previous model version you have created.

GoldSim can report the differences between the current model and any previous version. Note that GoldSim does not actually tell you *how* a model has changed; in general, it only reports *what* has changed.

For example, if you change some of the inputs to a Reservoir element between versions, GoldSim will report that the element has been changed, but it does not store or report which inputs changed or what their previous values were. Similarly, if you delete an element from a Container, GoldSim will report that an element with a particular ID was deleted from the Container, but it does not record the type of element (or the manner in which the element was defined). This keeps the size of the model file (where all of the changes are stored) manageable.

Generally, you will want to create a version whenever some project milestone has been met. The milestone might be the end of a particular phase of the project, or after you have made some major modification to the model. In some cases, you may want to create versions on a regular basis (e.g., every Friday).

Immediately after you create a version, it may be useful to archive a copy of the model file . If you do so, you will then be able to determine the details of the changes that were made between versions.

Read more: *Saving, Opening and Closing GoldSim Files (page 74).*

For example, when GoldSim reports that element A was modified between version X and the current version, you can open and compare the file that was archived when version X was created to determine how the element was defined at that point. When you archive a copy of your current model, GoldSim records

the name of the archived file (along with the version number) in your current model.

Read more: *Changes Tracked Between Versions (page 774).*

Enabling Versioning

In order to enable versioning in a file, select **Model|Versioning…** from the main menu. The first time you do this, a message is displayed asking you to confirm that you want to enable versioning.

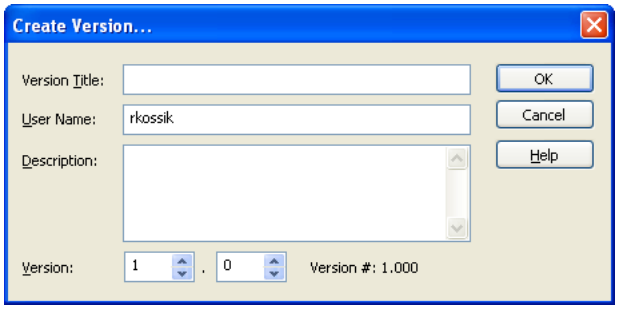
After confirming your request, you will immediately be prompted to create a version of the file (take a "snapshot" of the current model file and "stamp" it as a version).

Once you create the first version, versioning will be enabled, and will remain enabled until you choose to disable it.

Read more: *Disabling Versioning (page 774).*

Creating Versions

When you first enable versioning, or whenever you choose to create additional versions via the Version Manager , a dialog for creating versions is displayed.



Read more: *The Version Manager (page 773).*

You must assign a **Version Title** to each version. This Title is not required to be unique (although in most cases it should be). It is used in messages and reports when comparing versions, and should be something meaningful and explicit (e.g., "Draft #1", "Final Model", "Jim's Modifications", "January 12").

The **User Name** will also appear in difference reports and messages, and is intended to identify the model user who created the version. By default, the Windows user name will appear, although you can edit this.

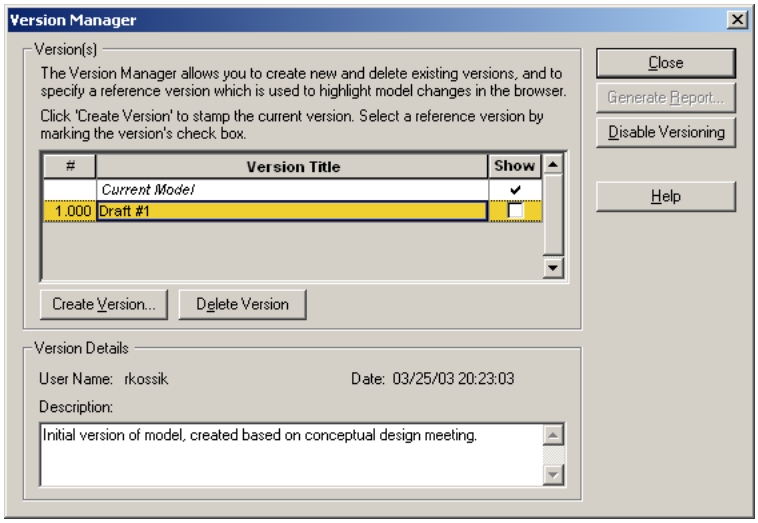
The **Description** field can be used to add descriptive text for each new version.

Finally, you must assign a **Version** number of the form X.yyy (e.g., 1.003). GoldSim ensures that new version numbers are always greater than the previous version number.

The Version Manager

Once you have defined your first version, or if you select **Model|Versioning…** after versioning has already been enabled, the Version Manager dialog is displayed.

The Version Manager lists all the versions that you have created. If you select one of these versions, the details of that version (user name, date created, and description) are displayed at the bottom of the dialog:



You can edit the **Description** here, but cannot change any other details about the version.

You can create new versions by pressing the **Create Version…** button, which provides access to the Create Version dialog.

Read more: *Creating Versions (page 773).*

Deleting a Version

You can delete an existing version by selecting it in the Version Manager and pressing the **Delete Version** button. Note, however, that when you delete a version, you also automatically delete all previous versions.

When you delete a version, the version number is never used again. For example, if you had a single version (1.000), and you deleted this version and then re-enabled versioning and created another major version, it would be numbered as 2.000.

If you choose to delete the most recent version (and hence all versions in the model), GoldSim will automatically disable versioning (until you enable it again by creating a new version).

Specifying the Reference Version

Once you have created at least one version, you can then compare the current model (the model as it exists right now) to any previous model version you have created. In order to do so, you must identify the ***Reference Version*** (the version to which the current model is compared).

This is done by selecting the checkbox to the right of the version in the Version Manager. Only one checkbox can be selected at a time (i.e., there can be only one Reference Version).

You can readily change the Reference Version while you are viewing differences.

Read more: *Displaying Version Differences (page 776).*

Disabling Versioning

You disable (remove) versioning by pressing the **Disable Versioning** button in the Version Manager dialog. When you disable versioning, all versioning information is deleted (and cannot be recovered). Hence, before doing so, GoldSim will ask you to confirm that you want to delete all versioning information.

Changes Tracked Between Versions

When versioning is enabled, GoldSim can report the differences between the current model and any previous version. GoldSim does not actually tell you *how* a model has changed; it only reports *what* has changed. For example, if you

modify an input field of an element, GoldSim does not store what field was edited or what the previous value was. Rather, it simply reports that "one or more of the element's attributes have been changed".

The changes that are logged by GoldSim can be divided into two categories: global changes and element-specific changes. Global changes pertain to the entire model. Element-specific changes pertain to a particular element.

The following global changes are recorded and stored within the model file when versioning is enabled:

- A new version is created.
- A version is deleted.
- Versioning is disabled.
- The model filename has changed via a Saved As command (the previous filename is recorded).
- The model filename has been changed outside of GoldSim since the file was last opened (the previous filename is recorded).
- The model file has been archived (the archived filename is recorded).
- One or more of the Simulation Settings have changed.
- A user-defined unit has been created or modified.
- An array label set has been added, deleted or changed.
- A global database download has been carried out.
- A file has been locked onto or unlocked by a Spreadsheet, External or File element.
- One or more options in the Options dialog associated with an extension module have changed.

The following element-specific changes are recorded and stored within the model file when versioning is enabled:

- An element is added, moved, deleted.
- An element is cloned or a cloned element is freed.
- The element's ID has been changed (the previous ID is recorded).
- The element's description has changed (the previous description is recorded).
- Any of the element's attributes or input definitions have changed.
- A database download to the element is carried out.
- Data is imported into a Lookup Table or a Time Series element.
- The checkbox in the Options dialog controlling whether or not Timed Events are mapped to the next timestep has changed.

The following points regarding the changes tracked by GoldSim should be noted:

- A Container is considered to be changed if an element is added to, removed from, or deleted from it.

- Locking/unlocking and sealing a Container are not recorded as changes.
- Purely graphical or cosmetic modifications to the model such as changing an element's symbol or adding a graphic or text to the graphics pane are not recorded as changes.
- Adding, deleting or editing a Note to an element is not recorded as a change.
- If an element is changed multiple time between versions, GoldSim records that the element has changed, but does not record the number of times or the number of changes that have been made.
- If an element is changed and then changed back (e.g., if the ID is changed and then changed back to its original ID), GoldSim still records this as a change.

Displaying Version Differences

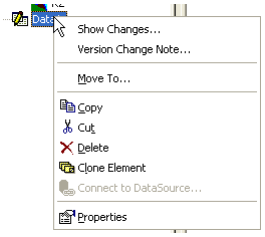
In order to display the differences between the current model and any previous version, you must specify the Reference Version in the Version Manager dialog.

Once a Reference Version is specified, GoldSim identifies changed elements in all browsers as follows:

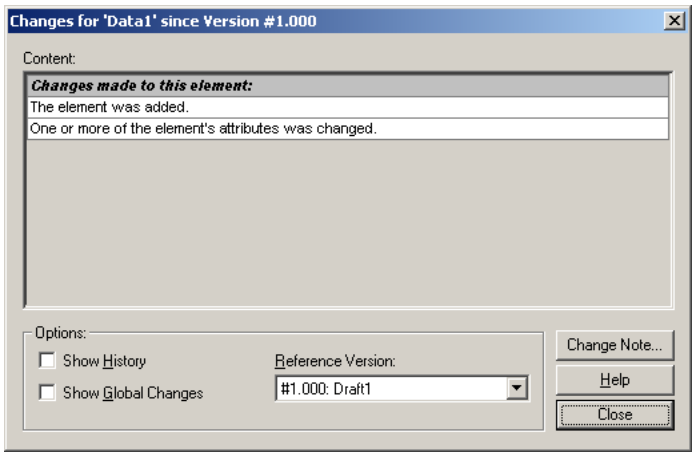
- If an element has been changed since the reference version, the element will appear red in all browsers. (If it is sealed or locked *and* it has changed, it will appear light red.)
- If any element inside a Container has been modified, but the Container itself has not been modified (e.g., no elements have been added or removed from it), the Container will appear blue in all browsers. (If the Container is sealed or locked and elements within it have been changed, it will appear light blue.)

Warning: If a Reference Version is not selected, none of the changed elements will be indicated in the browser. Hence, you must specify a Reference Version in order to view changes.

If you right-click on a colored element (e.g., a red element or a blue Container) in the browser, a menu item, **Show Changes…**, is available toward the top of the menu:

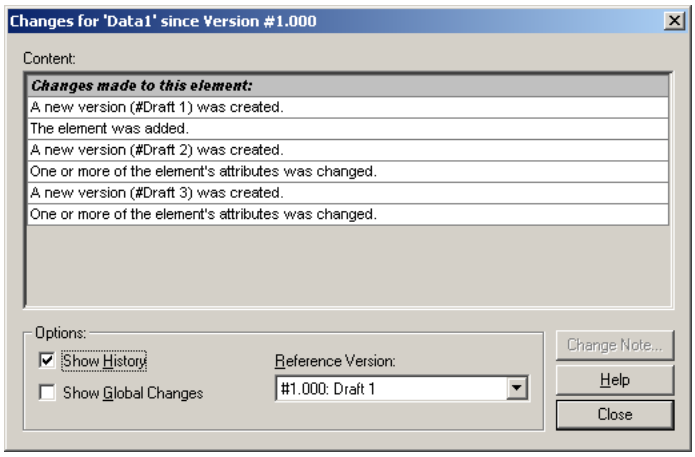


If you select this menu option, the Changes dialog is displayed:



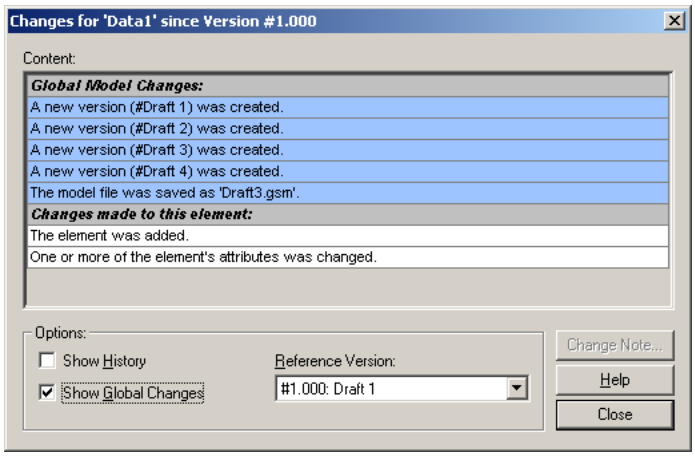
This dialog displays all of the changes that have been made to the element since the specified Reference Version. The Reference Version (selected in the Version Manager) is displayed at the bottom of the dialog. You can change the Reference Version directly from this dialog by selecting a version from the drop-list.

Clicking the **Show History** checkbox shows a history of all the changes between the Reference Version and the current model.

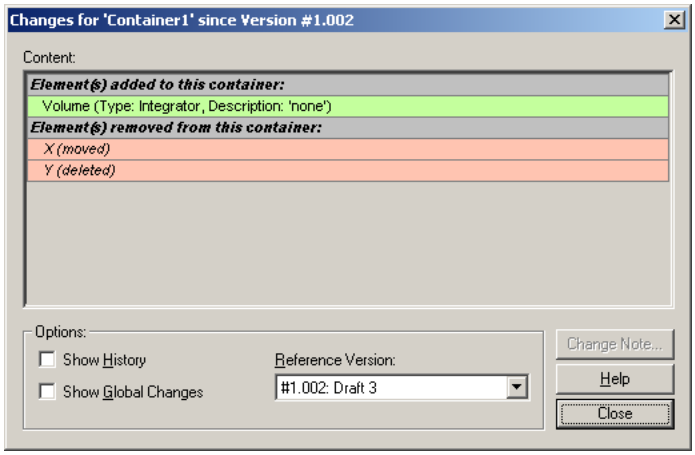


If the **Show History** box is cleared, only a summary of the differences between the Reference Version and the current model are shown. Hence, if the element was changed several different times, the Show History display will indicate this, while the summary display (with **Show History** cleared) will only indicate that the element has changed since the Reference Version.

Clicking the **Show Global Changes** checkbox displays the Global changes to the model (in addition to the changes to elements):



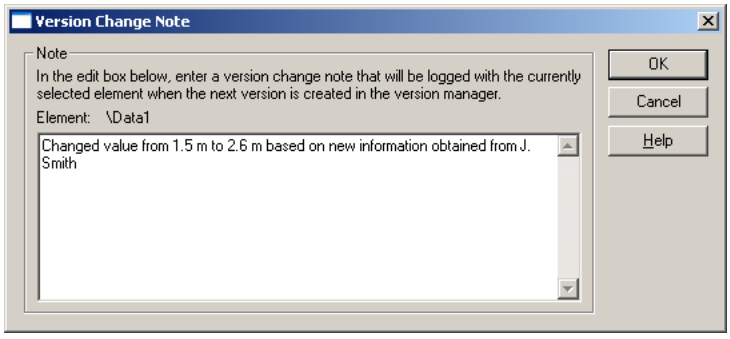
If the selected element is a Container, the Changes dialog identifies any elements added to the Container, any elements removed (or deleted) from the Container, and whether any Container properties (e.g., conditionality settings) have been changed.



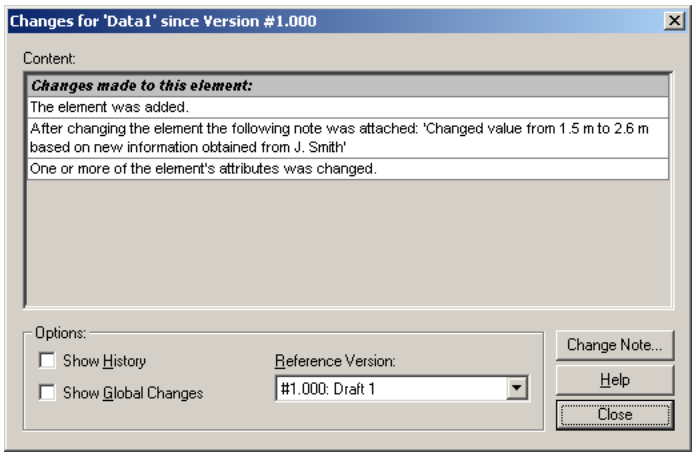
Manually Documenting Changes to an Element

After an element has been changed, you can add a Change Note to the element that will also be displayed in the Changes dialog.

If an element has been changed since the last (most recent) version stamp, the **Version Change Note…** option is available in the context menu for the element, and the **Change Note…** button is available on the Changes dialog for the element. Selecting either of these buttons will display a dialog for adding a change note to the element:



If you add a note, the note is saved with the next version that is created, and is displayed in the element's Changes dialog.

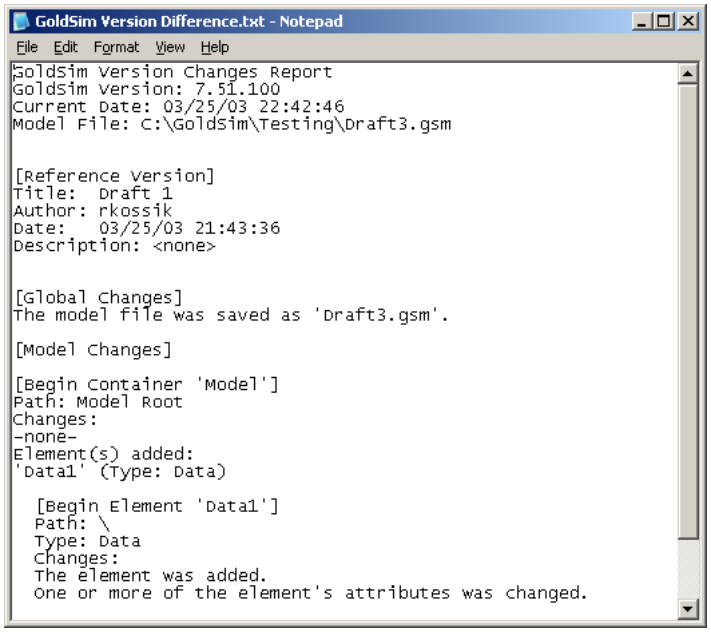


Note: A Change Note is intended to be applied for a particular version. Therefore, whenever a new version is created, the element Change Notes for that version are recorded with the version and then immediately cleared. As a result, if you create a subsequent version, the previous note does not appear in the Changes dialog for the new version.

Generating a Version Report

In some cases, rather than viewing changes to individual elements, you may want to create a report of all of the changes made between the Reference Version and the current model. You can do so by pressing the **Generate Report…** button in the Version Manager dialog.

An ASCII text file summarizing all the changes will be generated and immediately opened in the default application associated with .txt files (e.g., Notepad):



This file is written to the directory containing the model file. If it cannot be saved there (due to access issues), GoldSim will save it to the user's temporary folder (and provide the location of the file in a message).

By default, the name of the Version Report file is "GoldSim Version Difference.txt".

Note: On rare occasions, you may want to instruct GoldSim to insert the model filename into the name of the Version Report filename. To do this, you must edit the Windows Registry. In particular, add a DWORD registry key under HKEY_CURRENT_USER\Software\GTG\Settings named *VersionReportEmbedModelName* and set it to a non-zero value. If you do so, the name of the Version Report file will be "ModelFilename _VersionReport.txt. For example, if the model filename was called "Example.gsm", the Version Report file would be named "Example_VersionReport.txt".

Linking Elements to a Database

In simulations which require a great deal of input, it may be desirable (or even mandated) that the simulation model can access the various data sources directly to facilitate and ensure the quality of the data transfer.

One way to accomplish this in GoldSim is to import data from spreadsheets into a Spreadsheet element or into Lookup Tables or Time Series elements.

Read more: *Linking a Lookup Table to a Spreadsheet (page 262)*; *Importing Data into a Time Series from a Spreadsheet (page 186)*; *Spreadsheet Elements (page 689)*.

GoldSim also provides a more powerful method. In particular, GoldSim data entry elements can be linked directly to an ODBC-compliant database.

After defining the linkage, you can then instruct GoldSim to download the data at any time. When it does this, GoldSim internally records the time and date at which the download occurred, along with other reference information retrieved from the database (e.g., document references), and this is stored with the model in the Run Log. This information is also displayed in the tool-tip for the linked element.

This allows you to confirm that the correct data were loaded into your model, and provides very strong and defensible quality control over your model input data.

The following elements can be downloaded from a database:

- Data elements;
- 1-D and 2-D Lookup Table elements; and
- Stochastic elements.

There are three steps involved in linking an element to a database:

1. Creating a database which is compatible with GoldSim;
2. Adding the database as a *data source* to your computer; and
3. Linking an element to the database and downloading the data.

Creating a Compatible Database

GoldSim can interact with three types of databases: 1) a Generic Database; 2) a Simple GoldSim Database; and 3) a Yucca Mountain Database. Each of these databases have specific formats and different capabilities, as outlined below:

Generic Database: Generic databases have a very simple format (consisting of a single table). They can download only to scalar, vector and