SWAT+ Editor 2.0 Documentation

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SWAT+ Documentation

About SWAT+

Over the past 20 years, the Soil and Water Assessment Tool (SWAT) has become widely used across the globe. The large numbers of applications across the globe have also revealed limitations and identified model development needs. Numerous additions and modifications of the model and its individual components have made the code increasingly difficult to manage and maintain. In order to face present and future challenges in water resources modeling SWAT code has undergone major modifications over the past few years, resulting in SWAT+, a completely revised version of the model.

Even though the basic algorithms used to calculate the processes in the model have not changed, the structure and organization of both the code (object based) and the input files (relational based) have undergone considerable modification. This is expected to facilitate model maintenance, future code modifications, and foster collaboration with other researchers to integrate new science into SWAT modules. SWAT+ provides a more flexible spatial representation of interactions and processes within a watershed.

> The Soil and Water Assessment Tool Plus (SWAT+) is a public domain model jointly developed by the USDA Agricultural Research Service (USDA-ARS) and Texas A&M AgriLife Research, part of The Texas A&M University System. SWAT+ is a small watershed to river basin-scale model to simulate the quality and quantity of surface and ground water and predict the environmental impact of land use, land management practices, and climate change. SWAT is widely used in assessing soil erosion prevention and control, non-point source pollution control and regional management in watersheds.

Installation

1. Install QGIS 3

If you plan to use QSWAT+ to set up your watershed, please install QGIS 3 before installing SWAT+. It can be downloaded from the QGIS download page, where you should select the **Long term release repository**, and the **64 bit standalone installer**. Version 3.16 is recommended. Use the default folder `C:\Program Files\QGIS 3.16` as the installation folder. See the QSWAT+ manual for further instructions.

Please note you must use QGIS version 3, not version 2.

2. SWAT+ 2.0.0 Installer

This release includes **SWAT+ rev. 60.5.2**, **QSWAT+ 2.0.4**, and **SWAT+ Editor 2.0.0**. To install the SWAT+ model and interface components, please use an installer linked below for your operating system. The installer is for 64-bit machines. Administrator privileges are not required.

Operating System	Link	Release Date	Version
Windows 64-bit	Download (zipped installer, 111 MB)	24 Feb 2021	2.0.0
Linux 64-bit	Coming soon	Spring 2021	
MacOS 64-bit	Coming soon	Spring 2021	

→ Release Notes /release-notes

SWAT+ Model (Command Line Executable)

The model itself is packaged with SWAT+ Editor and we recommend using the editor to modify your inputs and run the model. However, if you would like to download just the command line executable file, it is available below.

Windows 64bit - SWAT+ rev. 60.5.2 rev60.5.2_64_windows.zip - 8MB

SWAT+ SQLite Datasets

We recommend using the SWAT+ Tools installer above for installing the SWAT+ datasets databases to their proper locations. However, if you need to access these components individually, they are linked below:

- SWAT+ datasets
- SWAT+ global weather generator data
- SWAT+ US SSURGO/STATSGO soil data

These files should be placed in `SWATPlus/Databases`

Getting Started

What you'll need

> ⓘ Make sure you have downloaded and installed QSWAT+, SWAT+ wgn and soils databases, and SWAT+ Editor as described in the installation section linked below.

→ Installation /installation

The following guide will show you how to get started with SWAT+ Editor. This guide does not cover how to set up your watershed in QSWAT+. Please refer to the QSWAT+ manual for this step.

Demo project files

Please use the following Robit demo project, which has already been set up in QSWAT+. Alternatively, you may use the Robit project you set up on your own after following the steps in the QSWAT+ manual.

robit_demo_2.0.zip robit_demo_2.0.zip - 4MB

Watch the SWAT+ Editor guide video

Please watch the guide video before launching SWAT+ Editor. This video will quickly walk you through the steps needed to bring your QSWAT+ project into the editor, as well as show you how to catch and report errors. If you prefer a written guide instead of or in addition to the video, a walk through is shown below.

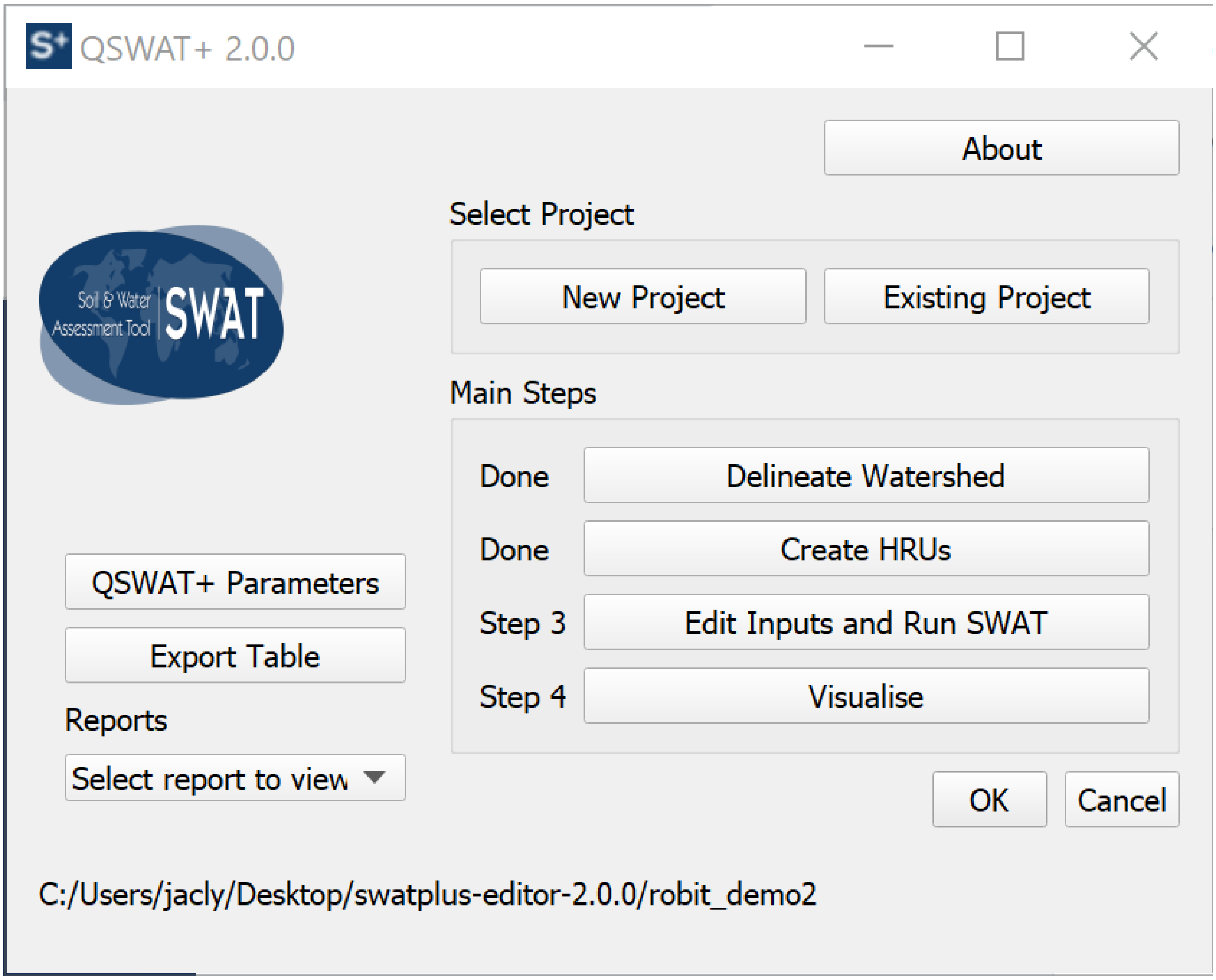
Walk through guide for SWAT+ Editor

If you do not want to watch a video, follow the steps below. This guide shows the basic steps you need to take to set up your model, but does not cover all input parameters available through the editor. Please refer to the SWAT+ Editor documentation section for help editing specific input parameters.

→ SWAT+ Editor Documentation /user/editor

Set up your project in QSWAT+

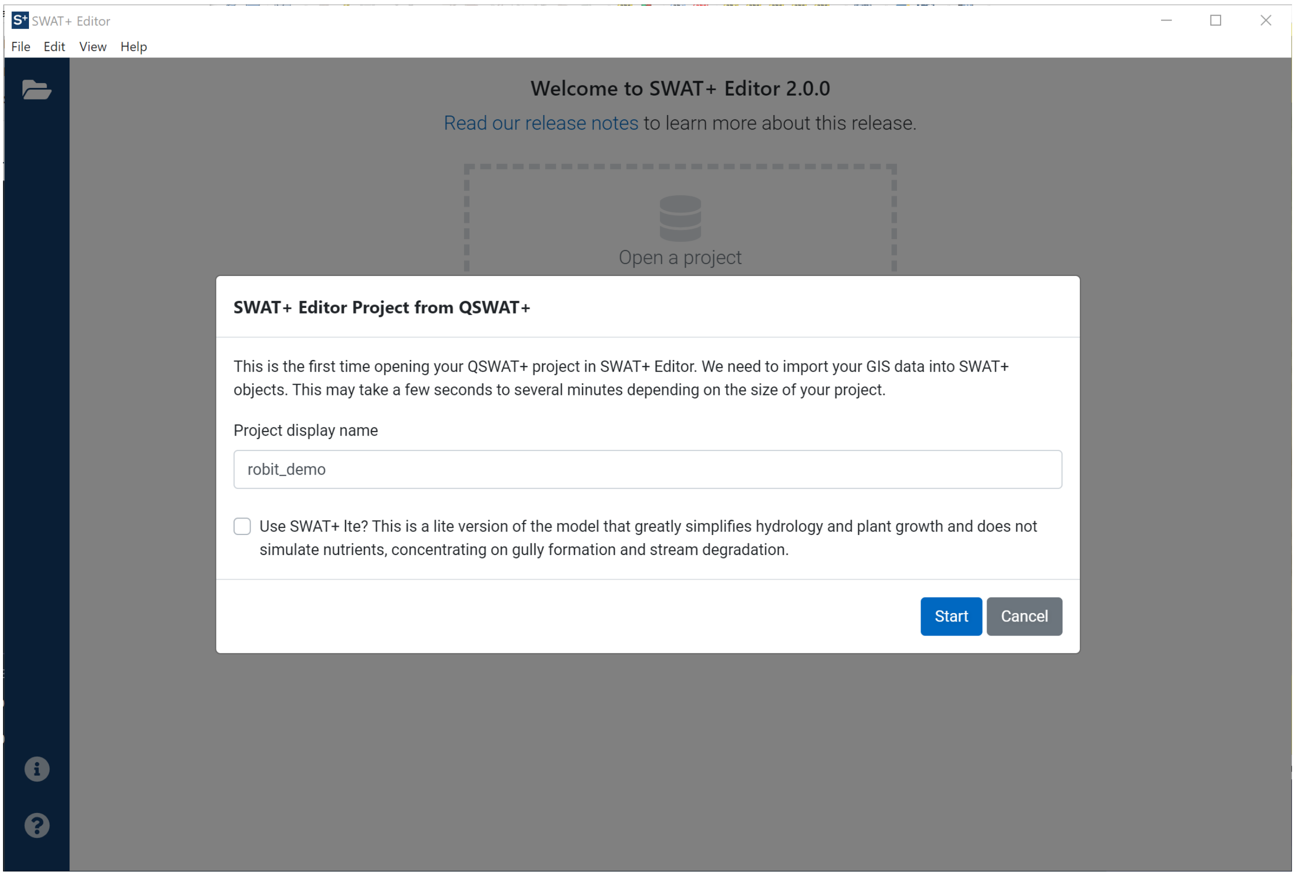
Follow the QSWAT+ manual to set up your watershed. To open SWAT+ Editor from within QSWAT+, click the button for Step 3: Edit Inputs and Run SWAT.



C:/Users/jacly/Desktop/swatplus-editor-2.0.0/robit_demo2

Open your project in the editor

The first time your open your QSWAT+ project in SWAT+ Editor, your data must be imported from the GIS tables into SWAT+ database format. This may take a few seconds to several minutes depending on the size of your watershed.



Welcome to SWAT+ Editor 2.0.0

Read our release notes to learn more about this release.

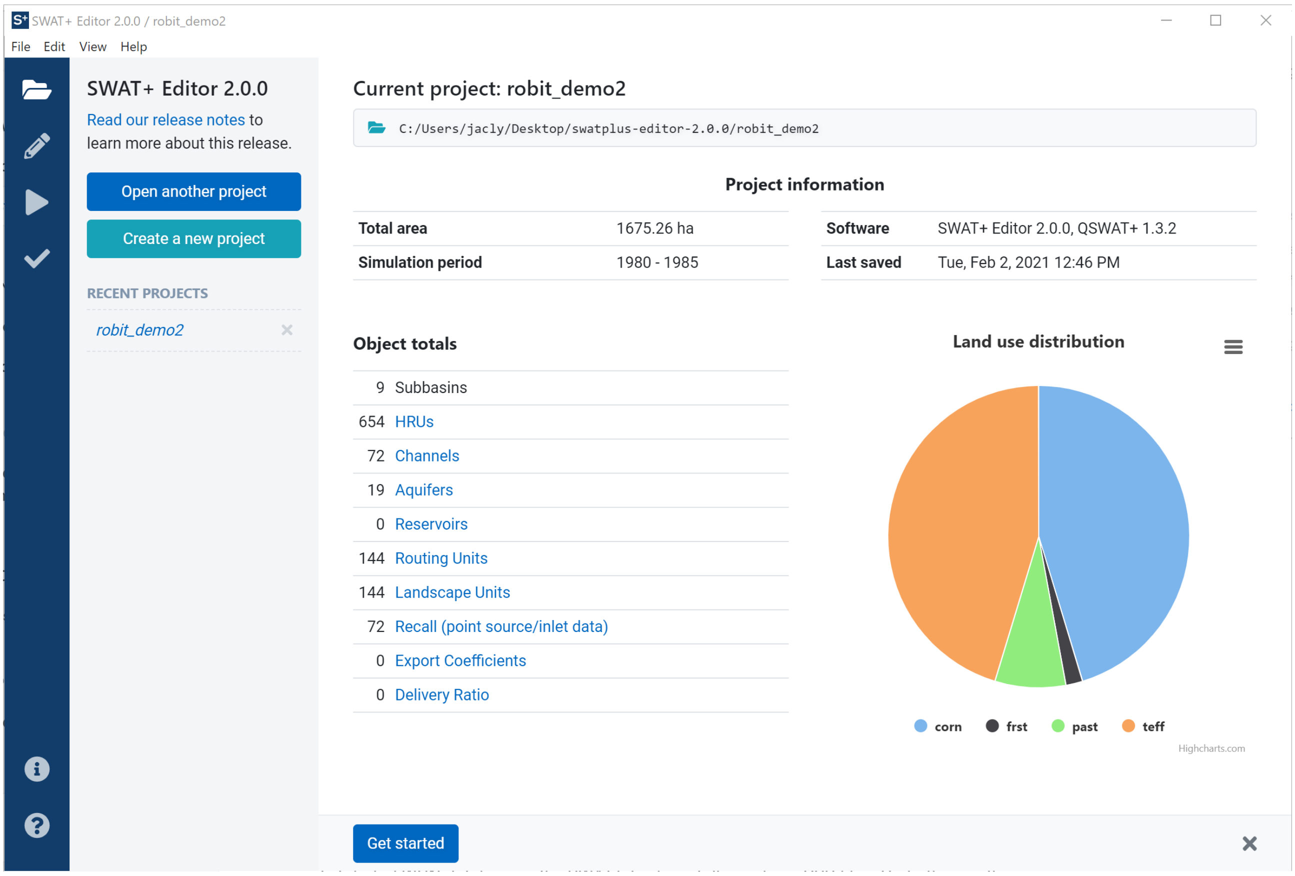
SWAT+ Editor Project from QSWAT+

This is the first time opening your QSWAT+ project in SWAT+ Editor. We need to import your GIS data into SWAT+ objects. This may take a few seconds to several minutes depending on the size of your project.

Project display name: robit_demo

□ Use SWAT+ lte? This is a lite version of the model that greatly simplifies hydrology and plant growth and does not simulate nutrients, concentrating on gully formation and stream degradation.

When your GIS data is done loading, your project will be displayed in the center. Click the get started button at the bottom to begin editing your inputs.



SWAT+ Editor 2.0.0

Read our release notes to learn more about this release.

Current project: robit_demo2

C:/Users/jacly/Desktop/swatplus-editor-2.0.0/robit_demo2

Project information

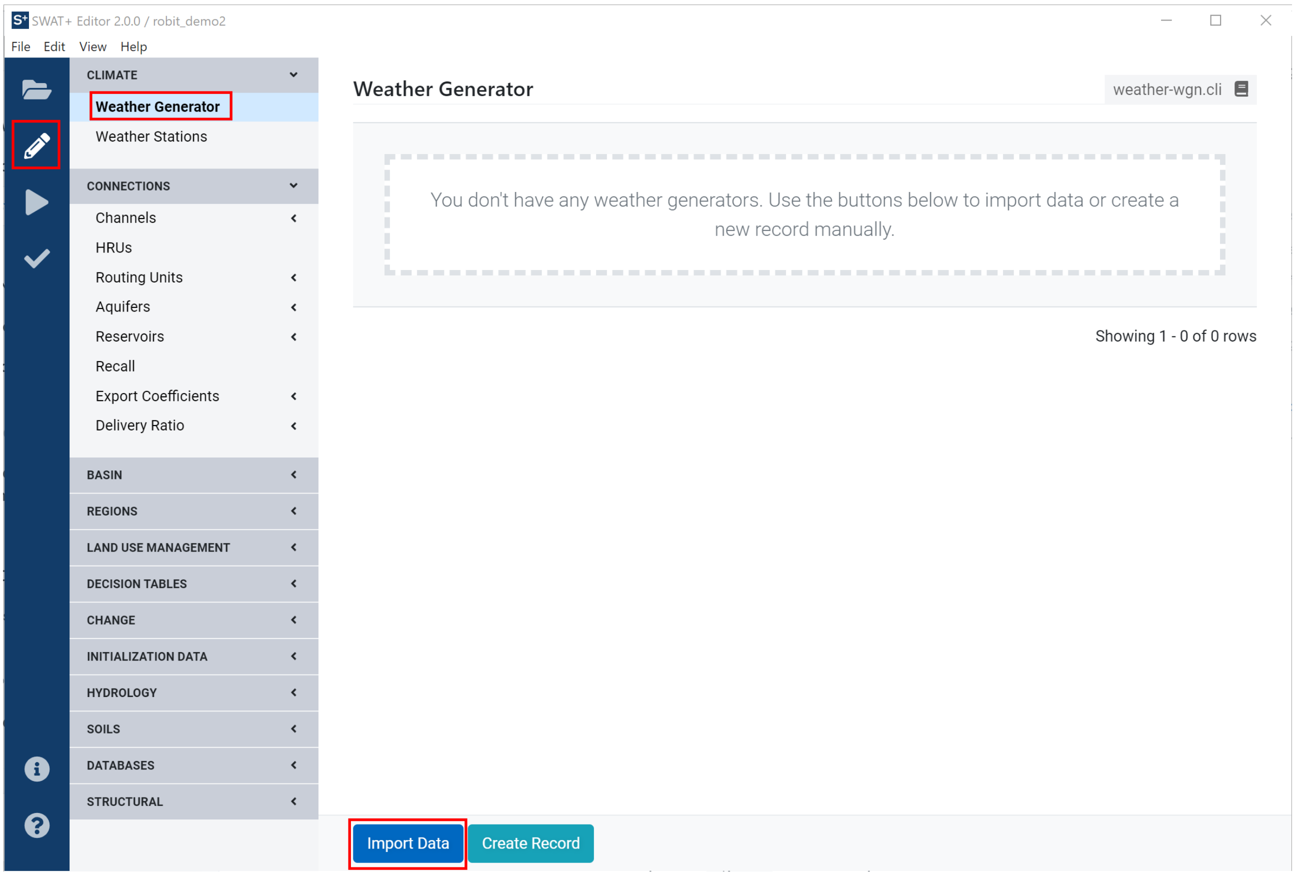
Total area	1675.26 ha	**Software**	SWAT+ Editor 2.0.0, QSWAT+ 1.3.2
Simulation period	1980 - 1985	**Last saved**	Tue, Feb 2, 2021 12:46 PM

Object totals

9	Subbasins
654	HRUs
72	Channels
19	Aquifers
0	Reservoirs
144	Routing Units
144	Landscape Units
72	Recall (point source/inlet data)
0	Export Coefficients
0	Delivery Ratio

Edit SWAT+ inputs

The first step you should take is to add weather generator (WGN) data. It may be imported from the distributed WGN database in the SWAT+ Tools installer, or from CSV files. Go to the weather generator section and click the import data button as shown in the screenshot below.

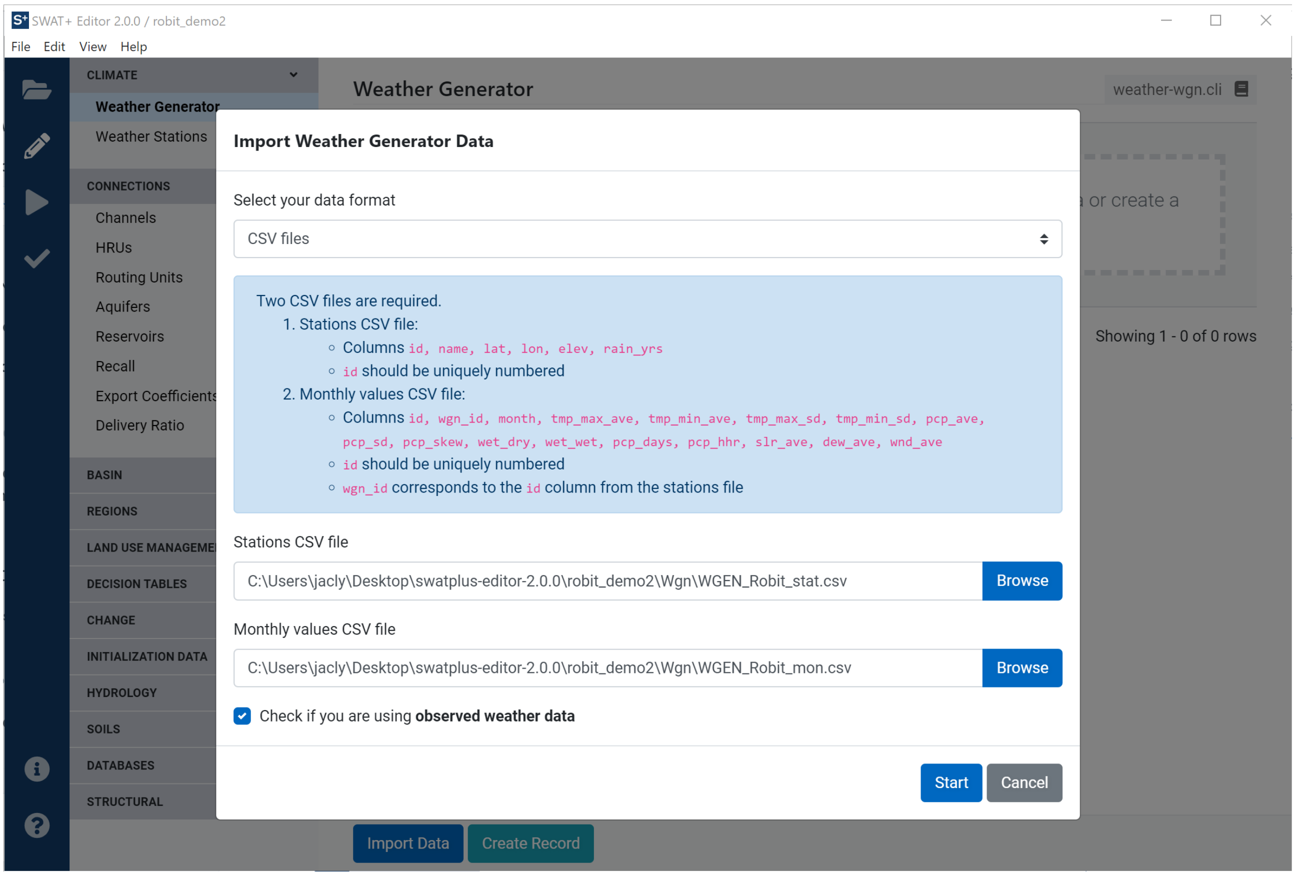


You don't have any weather generators. Use the buttons below to import data or create a new record manually.

Showing 1 - 0 of 0 rows

The database import option is selected by default, with the global CSFR weather generator table chosen. Click in the box to see other table options. `wgn_us` is weather generator data for the United States. `wgn` is an empty table you may populate with your own data if desired.

Alternatively, select CSV files from the top pull-down menu. In the Robit demo dataset, we have provided CSV files to use for weather generators, located in the Wgn folder of the sample project linked at the top of this page. Select these files in the editor as shown in the screenshot below, check the box to use observed weather data, then click the start import button.



Import Weather Generator Data

Select your data format

CSV files

Two CSV files are required.

1. Stations CSV file:
   - Columns `id, name, lat, lon, elev, rain_yrs`
   - `id` should be uniquely numbered
2. Monthly values CSV file:
   - Columns `id, wgn_id, month, tmp_max_ave, tmp_min_ave, tmp_max_sd, tmp_min_sd, pcp_ave, pcp_sd, pcp_skew, wet_dry, wet_wet, pcp_days, pcp_hhr, slr_ave, dew_ave, wnd_ave`
   - `id` should be uniquely numbered
   - `wgn_id` corresponds to the `id` column from the stations file

Stations CSV file

C:\Users\jacly\Desktop\swatplus-editor-2.0.0\robit_demo2\Wgn\WGEN_Robit_stat.csv Browse

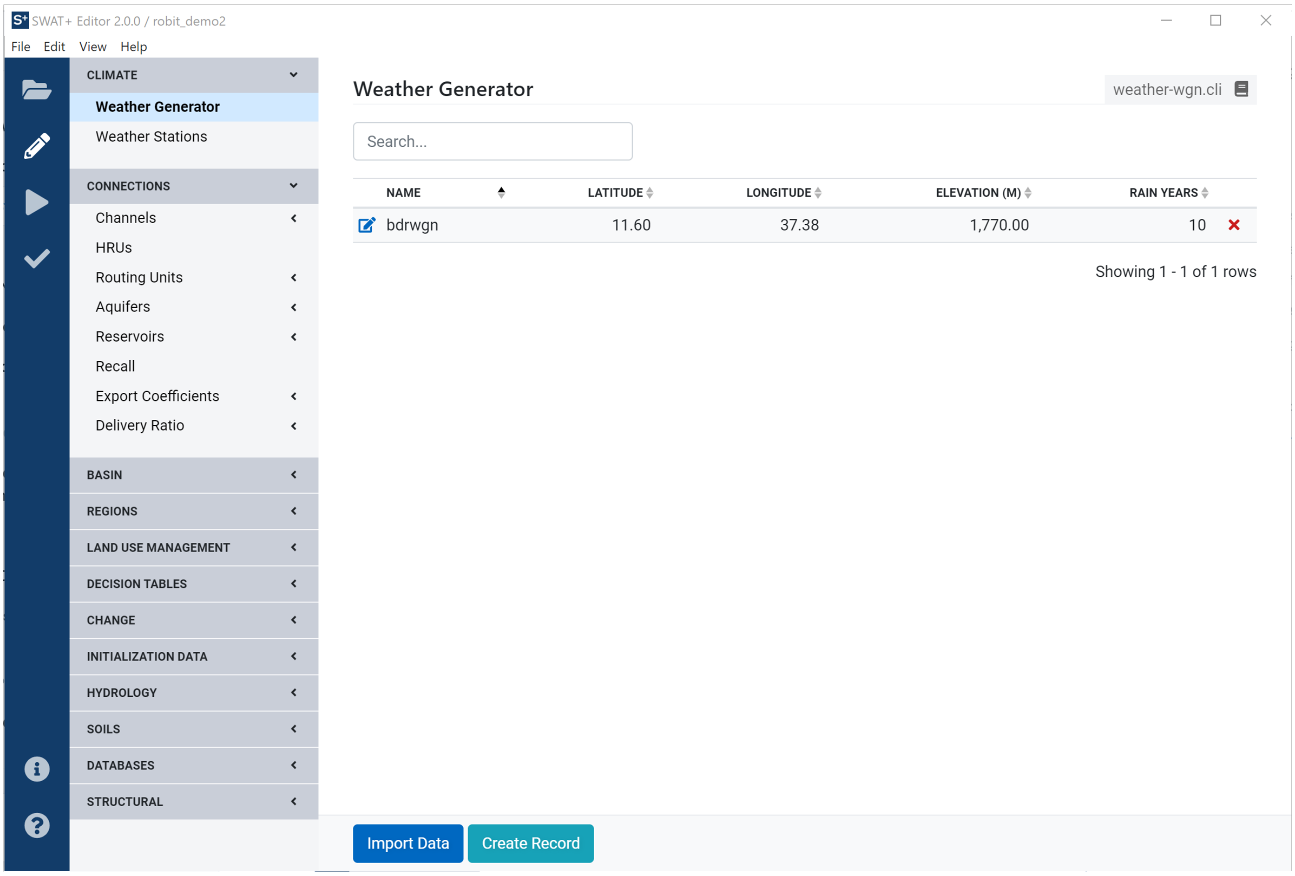
Monthly values CSV file

C:\Users\jacly\Desktop\swatplus-editor-2.0.0\robit_demo2\Wgn\WGEN_Robit_mon.csv Browse

☑ Check if you are using **observed weather data**

Start Cancel

You should now see one weather generator station added. Next, we need to add observed weather data. From the left menu in the editor, click the Weather Stations link.

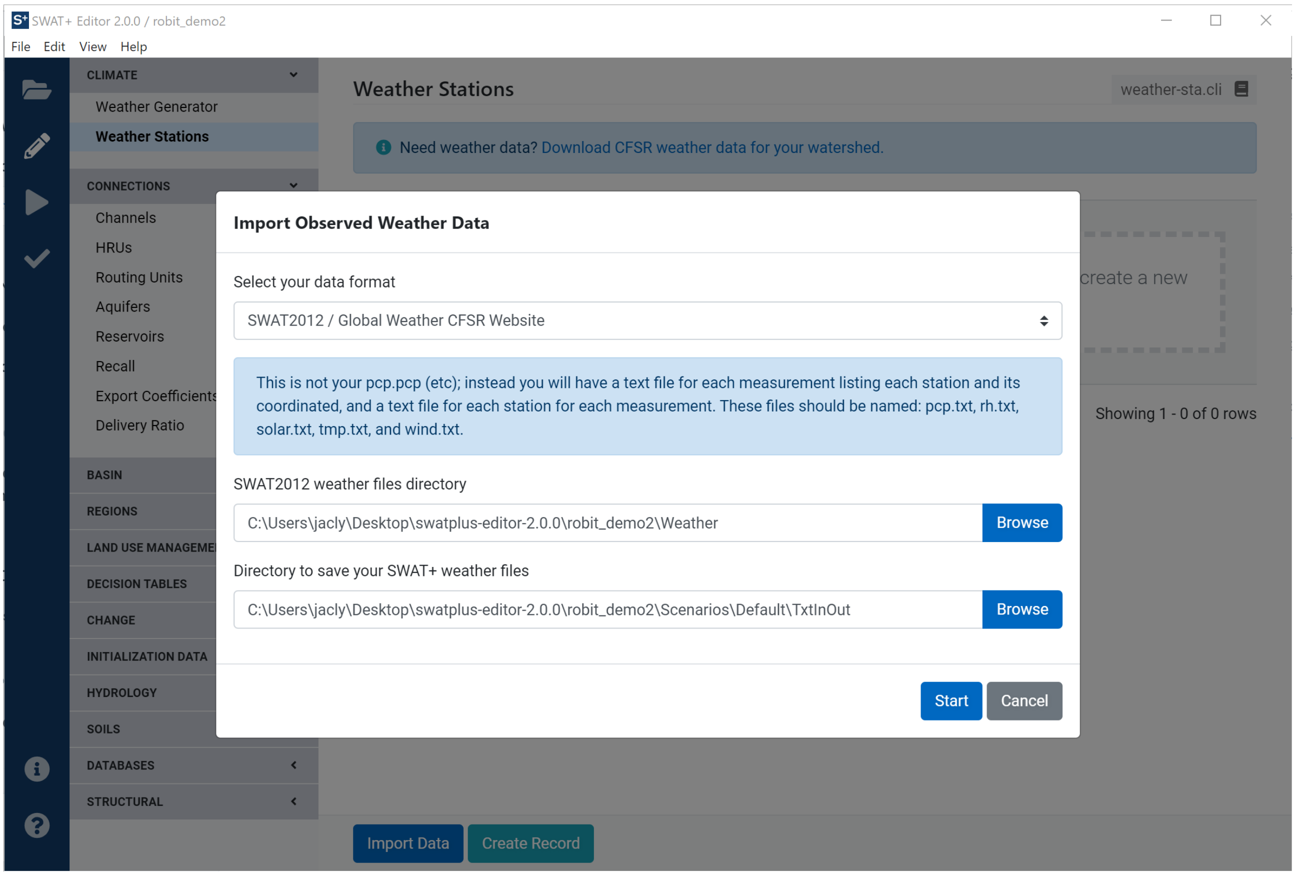


Weather Generator

NAME	LATITUDE	LONGITUDE	ELEVATION (M)	RAIN YEARS
bdrwgn	11.60	37.38	1,770.00	10

Showing 1 - 1 of 1 rows

Click the import data button to import your files. In the Robit demo dataset, we have provided weather data in SWAT2012 format in the Weather directory. Select this folder as the SWAT2012 weather files directory in the editor's import form. You may also choose where to save the files when they are converted to SWAT+ format. By default, your TxtInOut folder is selected. Click the start button to continue.



Import Observed Weather Data

Select your data format

SWAT2012 / Global Weather CFSR Website

This is not your pcp.pcp (etc); instead you will have a text file for each measurement listing each station and its coordinated, and a text file for each station for each measurement. These files should be named: pcp.txt, rh.txt, solar.txt, tmp.txt, and wind.txt.

SWAT2012 weather files directory

C:\Users\jacly\Desktop\swatplus-editor-2.0.0\robit_demo2\Weather

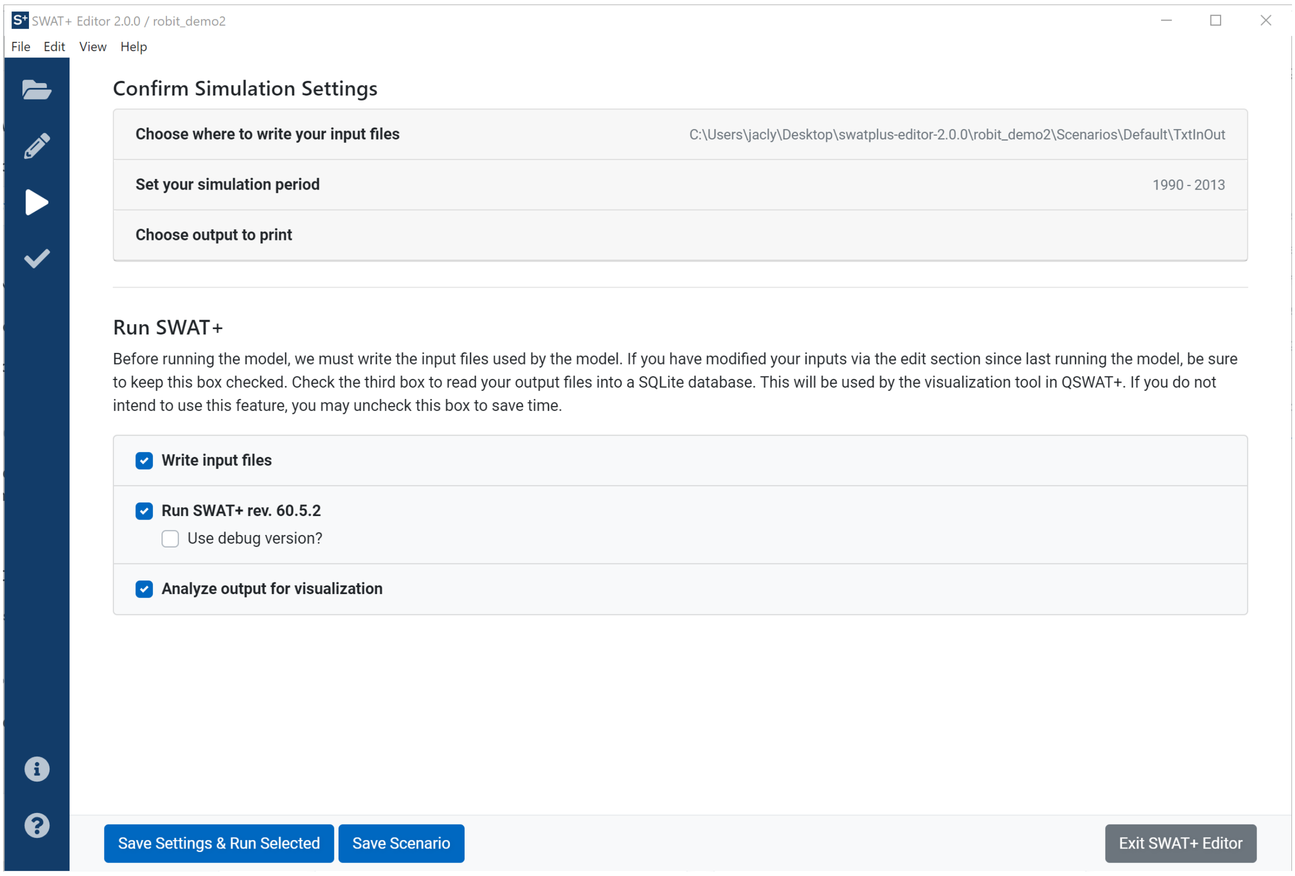
Directory to save your SWAT+ weather files

C:\Users\jacly\Desktop\swatplus-editor-2.0.0\robit_demo2\Scenarios\Default\TxtInOut

You should now see one weather station added. You can click on the name of the files to open them directly from the editor. You'll see this station is automatically connected to the weather generator created in the last step. This weather station is also connected to all of your spatial connection objects during import. In projects where you have more than one station, it is automatically assigned by closest latitude/longitude.

This concludes the last required section for editing SWAT+ inputs before writing files and running the model. The remaining sections are not covered in this walk-through, however you can look through the SWAT+ Editor Documentation section for more information.

In this demo, we'll go ahead and proceed to the next step. From the navy ribbon on the left side of the editor, click on the play/triangle icon.



Confirm Simulation Settings

Choose where to write your input files C:\Users\jacly\Desktop\swatplus-editor-2.0.0\robit_demo2\Scenarios\Default\TxtInOut

Set your simulation period 1990 - 2013

Choose output to print

Run SWAT+

Before running the model, we must write the input files used by the model. If you have modified your inputs via the edit section since last running the model, be sure to keep this box checked. Check the third box to read your output files into a SQLite database. This will be used by the visualization tool in QSWAT+. If you do not intend to use this feature, you may uncheck this box to save time.

☑ Write input files

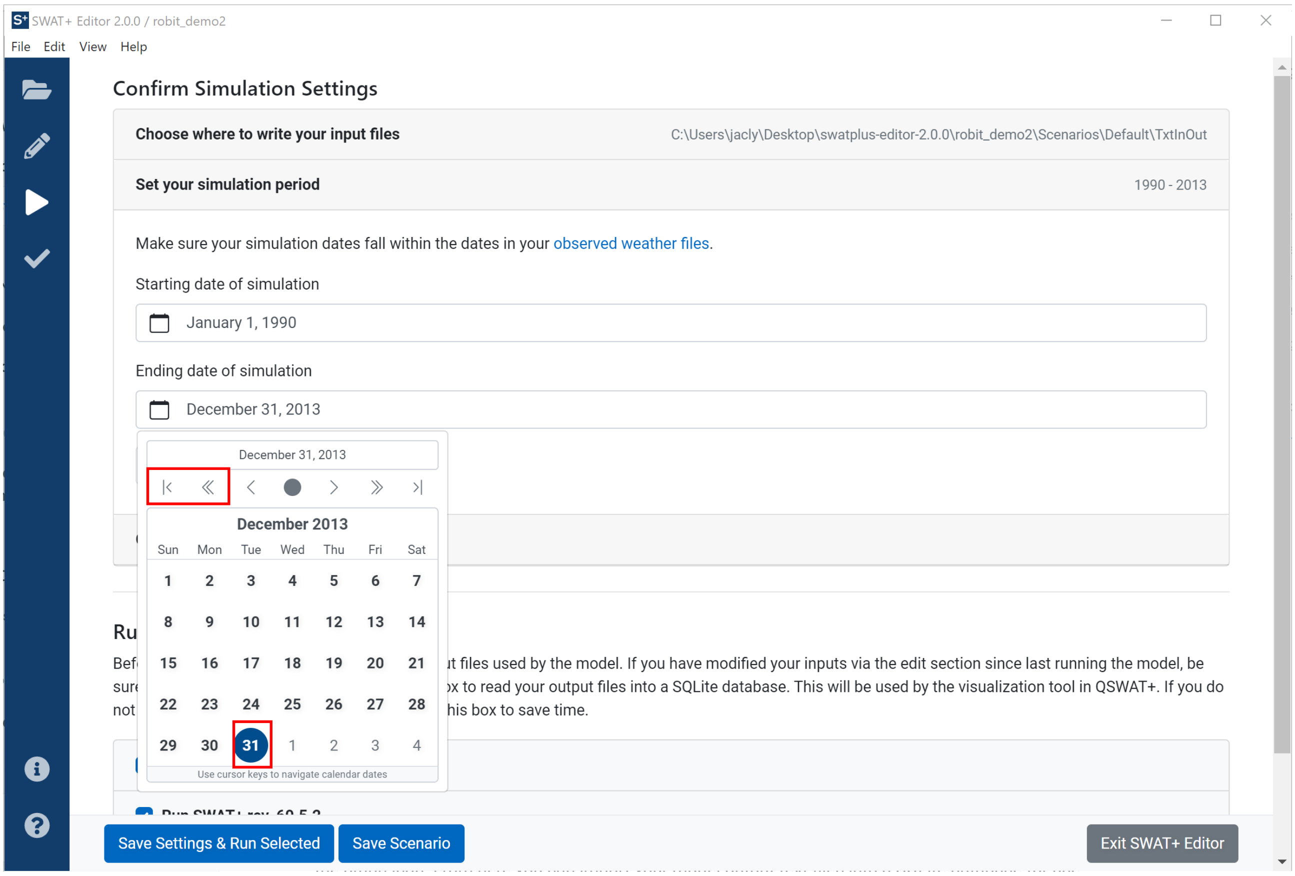
☑ Run SWAT+ rev. 60.5.2

□ Use debug version?

☑ Analyze output for visualization

You will see three sections up top to adjust your simulation settings if desired. Your input files will be saved to `[Project Directory]/Scenarios/Default/TxtInOut` by default. Click on "Set your simulation period" to adjust your starting and ending simulation dates.

When you click on a date picker, please note that you may use the arrows at the top of the date picker to move between decades and years. For this demo, set the ending simulation date to December 31, 2000. Use the arrows to find the year 2000, then click on the 31 in December to confirm the new date.



Confirm Simulation Settings

Choose where to write your input files C:\Users\jacly\Desktop\swatplus-editor-2.0.0\robit_demo2\Scenarios\Default\TxtInOut

Set your simulation period 1990 - 2013

Make sure your simulation dates fall within the dates in your observed weather files.

Starting date of simulation

January 1, 1990

Ending date of simulation

December 31, 2013

December 31, 2013

December 2013

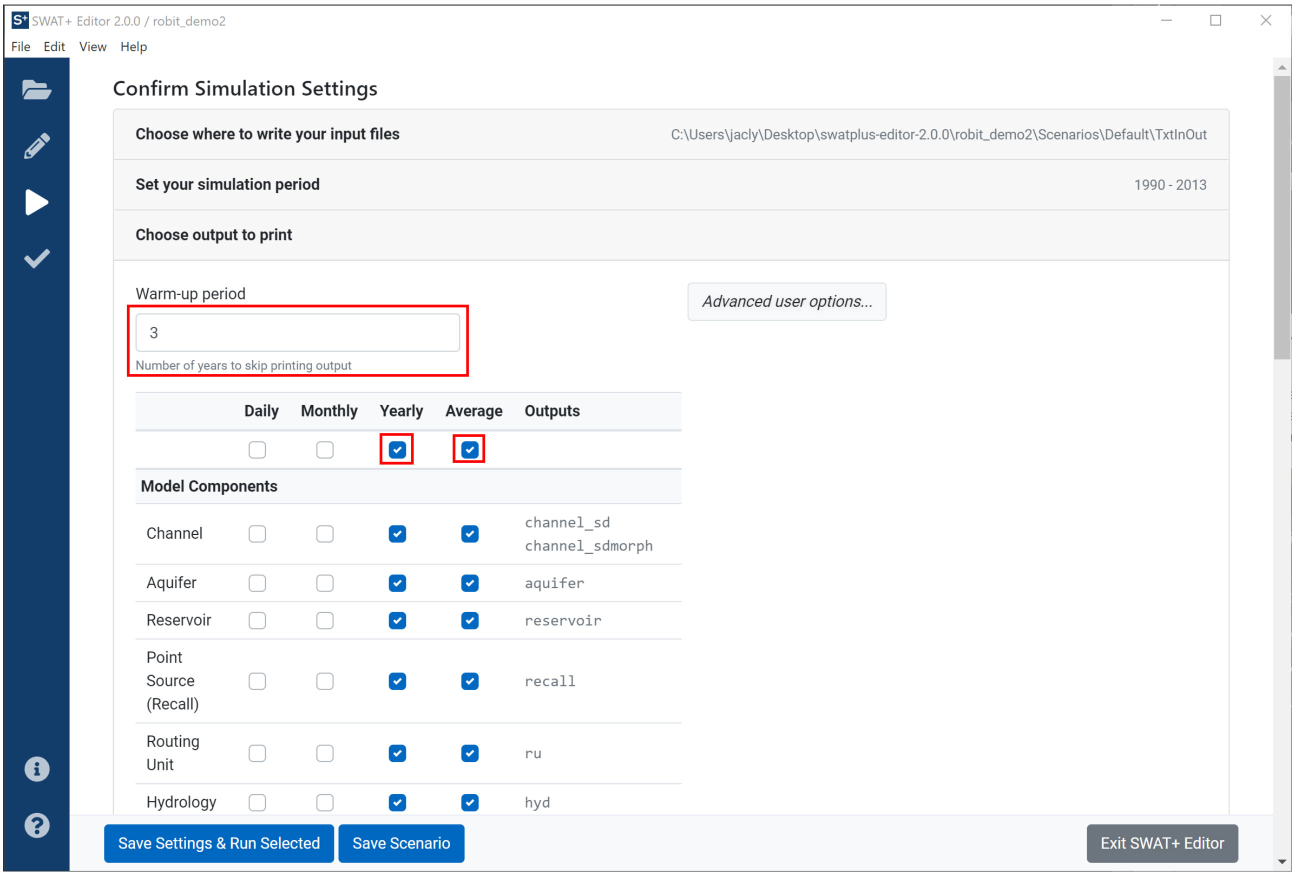
Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	1	2	3	4

Use cursor keys to navigate calendar dates

Ru

Bef ut files used by the model. If you have modified your inputs via the edit section since last running the model, be sure ox to read your output files into a SQLite database. This will be used by the visualization tool in QSWAT+. If you do not this box to save time.

Click on the next section: choose output to print. Adjust your warm-up period to 3 years. Scroll to see all the available outputs to print. Use the top row of check boxes to select all yearly and average annual outputs.



Confirm Simulation Settings

Choose where to write your input files C:\Users\jacly\Desktop\swatplus-editor-2.0.0\robit_demo2\Scenarios\Default\TxtInOut

Set your simulation period 1990 - 2013

Choose output to print

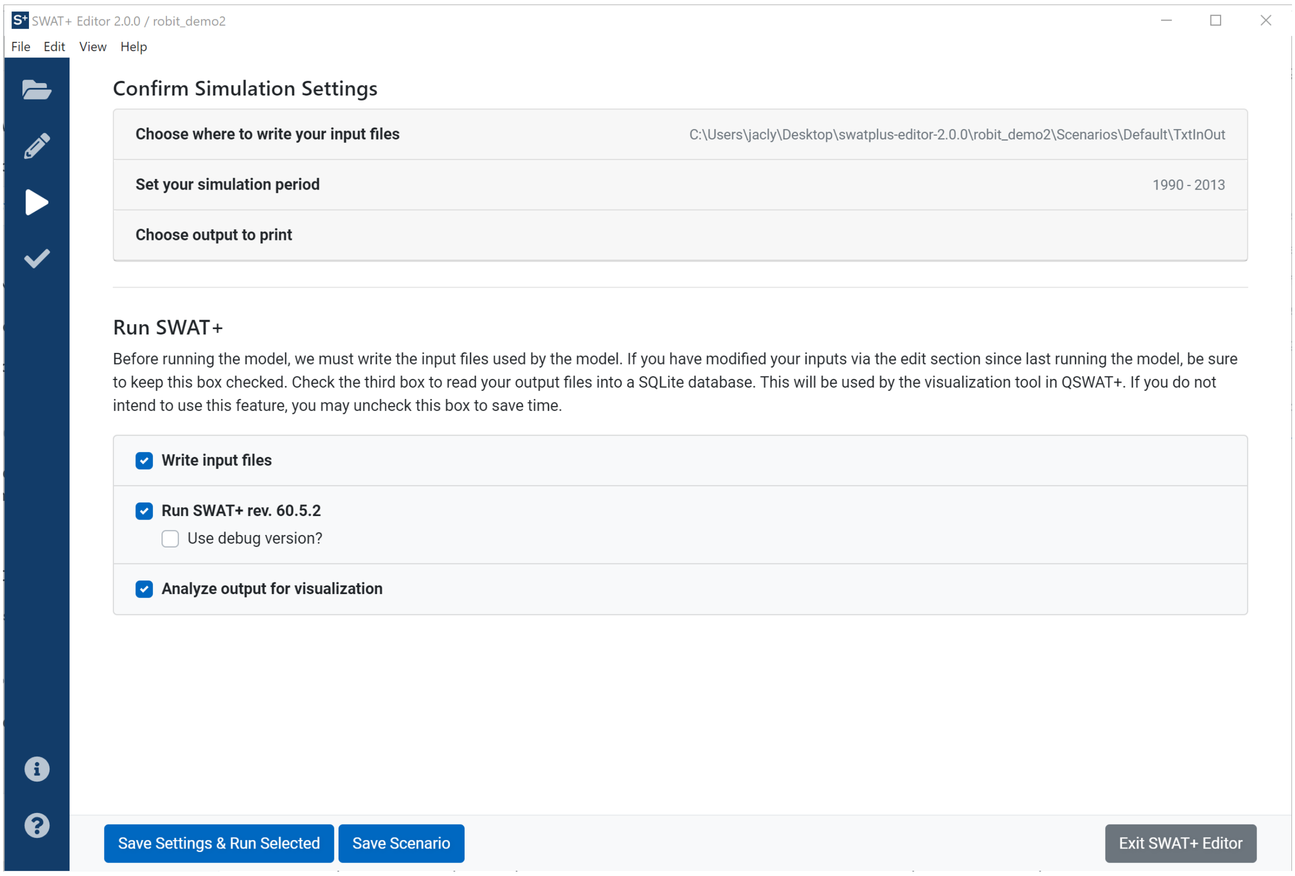
Warm-up period

3

Number of years to skip printing output

	Daily	Monthly	Yearly	Average	Outputs
	□	□	☑	☑	
Model Components					
Channel	□	□	☑	☑	channel_sd channel_sdmorph
Aquifer	□	□	☑	☑	aquifer
Reservoir	□	□	☑	☑	reservoir
Point Source (Recall)	□	□	☑	☑	recall
Routing Unit	□	□	☑	☑	ru
Hydrology	□	□	☑	☑	hyd

Scroll down, or click on "choose output to print" again to collapse the section. Now you will see three checkboxes of tasks: write inputs, run the model, and analyze output.



Confirm Simulation Settings

Choose where to write your input files C:\Users\jacly\Desktop\swatplus-editor-2.0.0\robit_demo2\Scenarios\Default\TxtInOut

Set your simulation period 1990 - 2013

Choose output to print

Run SWAT+

Before running the model, we must write the input files used by the model. If you have modified your inputs via the edit section since last running the model, be sure to keep this box checked. Check the third box to read your output files into a SQLite database. This will be used by the visualization tool in QSWAT+. If you do not intend to use this feature, you may uncheck this box to save time.

☑ Write input files

☑ Run SWAT+ rev. 60.5.2

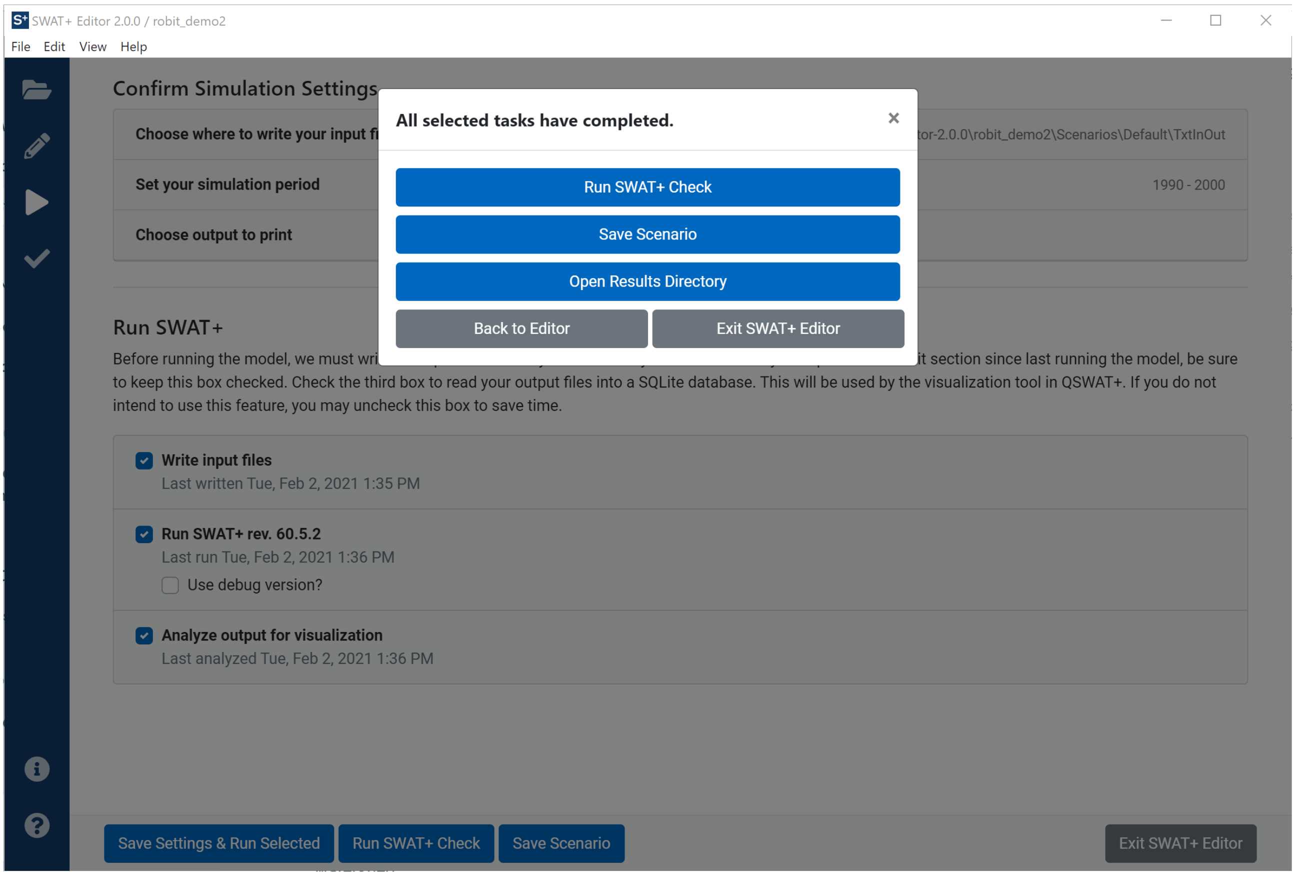
□ Use debug version?

☑ Analyze output for visualization

Here is a brief description of each task:

1. **Write input files**
   Translate your data saved from the edit inputs section in your project SQLite database to text files read by SWAT+. Any time you make edits, be sure to keep this box checked to re-write your files.
2. **Run SWAT+**
   Execute a compiled version of the model.
3. **Analyze output for visualization**
   Read the output text files generated by the model into a SQLite database used for SWAT+ check and the QSWAT+ visualization tool

For this demo, and because it is our first time running the simulation, keep all three boxes checked. Click the "Save Settings & Run Selected" button to continue. When the tasks complete, you'll be presented with a menu of options for what to do next.



All selected tasks have completed.

Confirm Simulation Settings

Choose where to write your input fi	tor-2.0.0\robit_demo2\Scenarios\Default\TxtInOut
Set your simulation period	1990 - 2000
Choose output to print	

Run SWAT+

Before running the model, we must wri it section since last running the model, be sure to keep this box checked. Check the third box to read your output files into a SQLite database. This will be used by the visualization tool in QSWAT+. If you do not intend to use this feature, you may uncheck this box to save time.

☑ Write input files
Last written Tue, Feb 2, 2021 1:35 PM

☑ Run SWAT+ rev. 60.5.2
Last run Tue, Feb 2, 2021 1:36 PM
□ Use debug version?

☑ Analyze output for visualization
Last analyzed Tue, Feb 2, 2021 1:36 PM

You may click to run SWAT+ Check to check for potential model problems. You may also save your scenario, which will make a copy of all of your inputs and outputs. After saving completes, any additional changes made to your project will not affect the saved scenario. You may load the saved scenario back to the editor from the project setup screen.

This concludes the introductory walk-through of SWAT+ Editor. You may close the editor by clicking the "Exit SWAT+ Editor" button from the interface, or by clicking the X in the top right of the editor window, or by going to File->Exit from the editor's menu.

After exiting the editor, you may proceed to QSWAT+ step 4: visualization. Please refer to the QSWAT+ manual for more information about this process.

Get Help

User Groups

Because there are 3 distinct pieces to SWAT+, we have created user groups for each. Please identify which area you are having difficulty with and choose the appropriate group:

QSWAT+ user group
For issues defining your watershed in QGIS and using the QSWAT+ plugin.

SWAT+ Editor user group
For issues related to the editor interface.

SWAT+ model user group
For questions and discussion related to the model itself, not the editor or GIS interfaces.

SWAT+ Editor Bug/Issue Reporting

For SWAT+ Editor bugs or technical issues, report to the user groups or the Bitbucket issue tracker. However, please use this only for **Editor software problems**, and continue to use the google group for data-related issues.

Troubleshooting

I received an error setting up my watershed in QSWAT+

Make sure you have installed the most recent version of QSWAT+ and followed the manual's installation instructions closely.

If you received an error during steps 1, 2, or 4 of the QSWAT+ interface, please consult the QSWAT+ user group. Check existing questions to see if anyone else had the same problem. If not, please post your error and be as descriptive as possible about what you were doing when you received the error message.

I received an error in SWAT+ Editor

SWAT+ Editor is most often accessed during step 3 of the QSWAT+ plugin. It may also be launched on its own. Make sure you have installed the most recent version of SWAT+ Editor.

If your error is not covered by the solutions below, please consult the SWAT+ Editor user group.

"Unable to get project information from database."

If you receive this message when you first launch your project in the editor, it is a sign the editor did not load its services correctly.

Click the question mark icon in the lower left corner to open the help page. Scroll to the bottom and looking for the "Troubleshooting" section. If you see a message stating "Unable to connect to SWAT+ API", please try the following steps before contacting support:

Open a command prompt window. Make sure you are in the drive where you installed SWAT+. Browse to the location below, then run the swatplus_rest_api.exe file.

```
> cd C:\SWAT\SWATPlus\SWATPlusEditor\resources\app.asar.unpacked\api_dist
> swatplus_rest_api.exe
```

If it is working properly, you should receive something similar to the following:

```
* Serving Flask app "swatplus_rest_api" (lazy loading)
* Environment: production
WARNING: Do not use the development server in a production environment.
Use a production WSGI server instead.
* Debug mode: off
* Running on http://127.0.0.1:5000/ (Press CTRL+C to quit)
```

If this is what you received, please simply close SWAT+ Editor and try launching it again.

If you get no message on the screen at all, it might be a permission or error related to your computer settings. Try installing to another location on your machine, such as another hard drive, or even install to a flash drive. If this still does not work, try another machine.

If you still cannot get it to open, you may need to try the Python version of the editor. You will need to install Python version 3.x on your machine first. Make note of your Python PATH variable (typically `python` on Windows or `python3` on Linux/MacOS). Contact the developer for a custom Python installer of the editor.

After install, go to where you installed the editor and open the `appsettings.json` file located in the `resources/app.asar.unpacked` directory. Set your python PATH variable in the appropriate section of the file.

I received an error importing GIS data or updating my project

Please post the error message to the SWAT+ Editor user group **AND include your project files**. This error is likely project specific and we cannot help you without seeing your project files.

Other SWAT+ Editor errors

If you receive any other error messages from SWAT+ Editor, from its menu go to View -> Toggle Developer Tools. In the windows that pops open, toggle the Console tab and take a screenshot or copy an errors received and post to the SWAT+ Editor user group.

I received an error running the SWAT+ model

If you received an error running the model, first make sure you have run it in debug mode and checked the detailed error received. If you are not able to make sense of the source of the model error, please post to the SWAT+ model user group **AND include your project files**. This error is likely project specific and we cannot help you without seeing your project files.

Release Notes

SWAT+ revision 60.5.2

Download the revision notes for the model below.

SWATPlus-Rev-Notes-60-60.5.2.pdf SWATPlus-Rev-Notes-60-60.5.2.pdf - 472KB

SWAT+ Editor revision 2.0.0

We recommend using new projects created in the new QSWAT+ 2.0.x with version 2 of the editor. However, if this is not feasible, an upgrade function is available when you load your older projects in the editor. If you are using the land use management (lum.dtl) default decision tables provided in previous versions of the editor, we recommend manually updating them. The old ones have an error causing crops not to be planted. Download instructions below:

Decision Table Update Instruct... swatplus-editor-2.0.0-dtable-update-instructions.txt - 5KB

Editor feature updates:

- New feature: save and load scenarios. After running the model, make a copy of your inputs and outputs. Any changes made after saving will not affect the saved scenario. Load the scenario back to the editor anytime from the project setup screen.
- New feature: SWAT+ Check. Features from SWAT Check have been brought in for SWAT+ and built in directly to the editor. This is still a work in progress.
- New feature: constituents section available under initialization data editing section. Pesticides and pathogens are available to be configured.
- User interface redesigned and enhanced:
    - Project setup screen simplified and project information shown here after project is loaded.

    - SWAT+ lte (simplified model with just channels and HRUs) option now available for all projects when importing GIS.
    - Connections editing screens simplified to combine connect file inputs and properties into one.
    - Bulk editing mode now available when clicking edit on any item and using the pull down arrow on the right of the Save Changes button. Filtering available by subbasin, landuse, and HRU if applicable.
    - Table views may now be filtered.
    - Copy feature added to most sections (click on edit to an item). Does not apply to connection objects.
- Import from GIS functionality updated. Aquifers now read from QSWAT+ routing tables, speeding up import. Users are recommended to install the most recent QSWAT+ 2.0.x for this feature.
- Default project data updated:
    - Set values for hydrology.hyd variables perco, cn3_swf, and latq_co based on soil hyd. group and HRU slope
- Project database structure and dataset updates to match revisions in SWAT+ rev. 60.5.x (see model revision notes linked in section above).

Source Code

Repository Links

- SWAT+ source code repository
- SWAT+ Editor source code repository
- QSWAT+ source code repository

Download Docs

Need to access this documentation offline? Please download a PDF export of this documentation website linked below. We recommend you also make sure you have downloaded a copy of the QSWAT+ manual and SWAT+ IO docs.

→ **QSWAT+ Manual** /user/qswat+

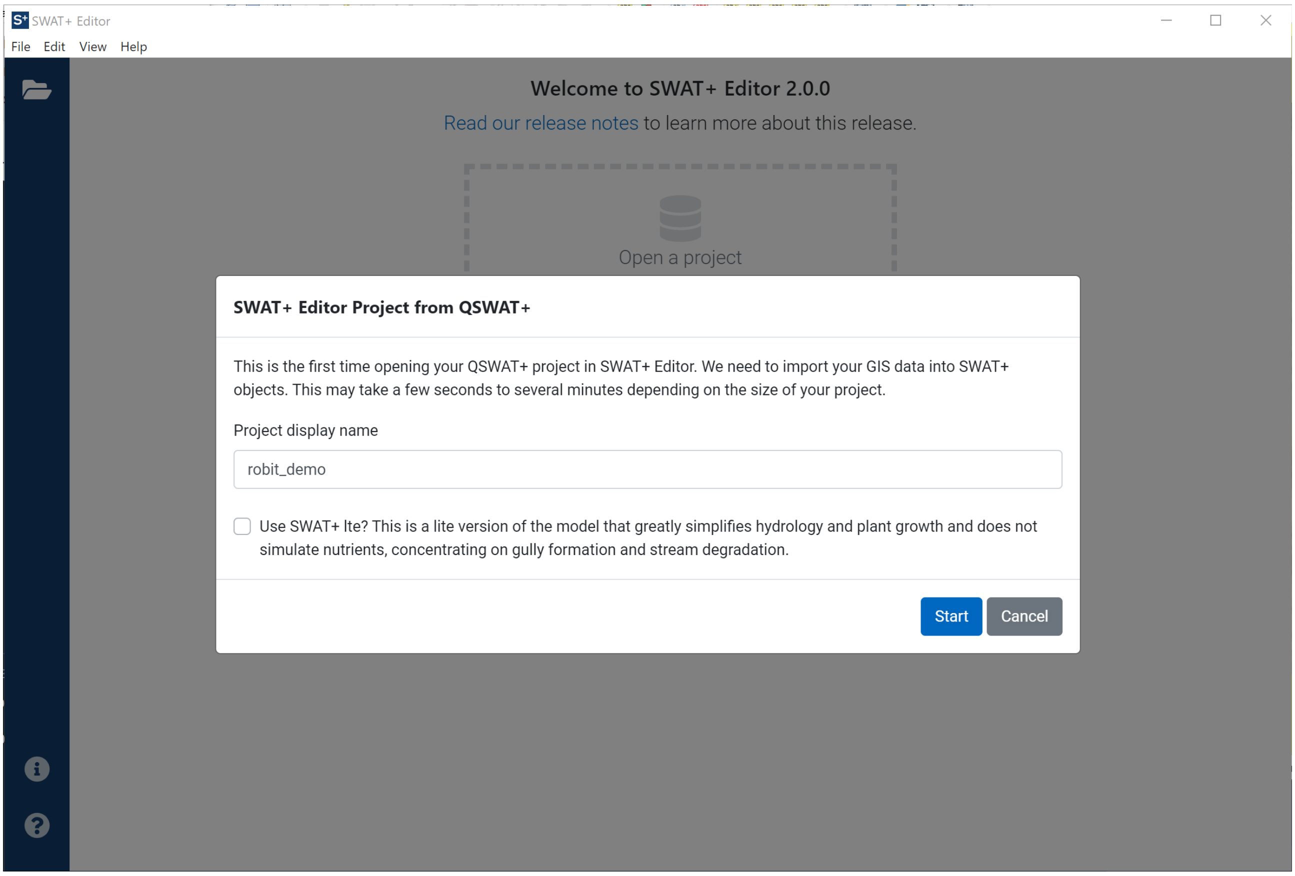
→ **SWAT+ IO Documentation** /user/io

User Docs

SWAT+ Editor Documentation

Project Setup

When you open SWAT+ Editor, you are taken to the project setup screen. If you are coming from QSWAT+, an overlay will appear with the option to change your project display name and optionally use the lite version of the mode: SWAT+ lte.


SWAT+ Editor
File Edit View Help
Welcome to SWAT+ Editor 2.0.0
Read our release notes to learn more about this release.
Open a project

SWAT+ Editor Project from QSWAT+

This is the first time opening your QSWAT+ project in SWAT+ Editor. We need to import your GIS data into SWAT+ objects. This may take a few seconds to several minutes depending on the size of your project.

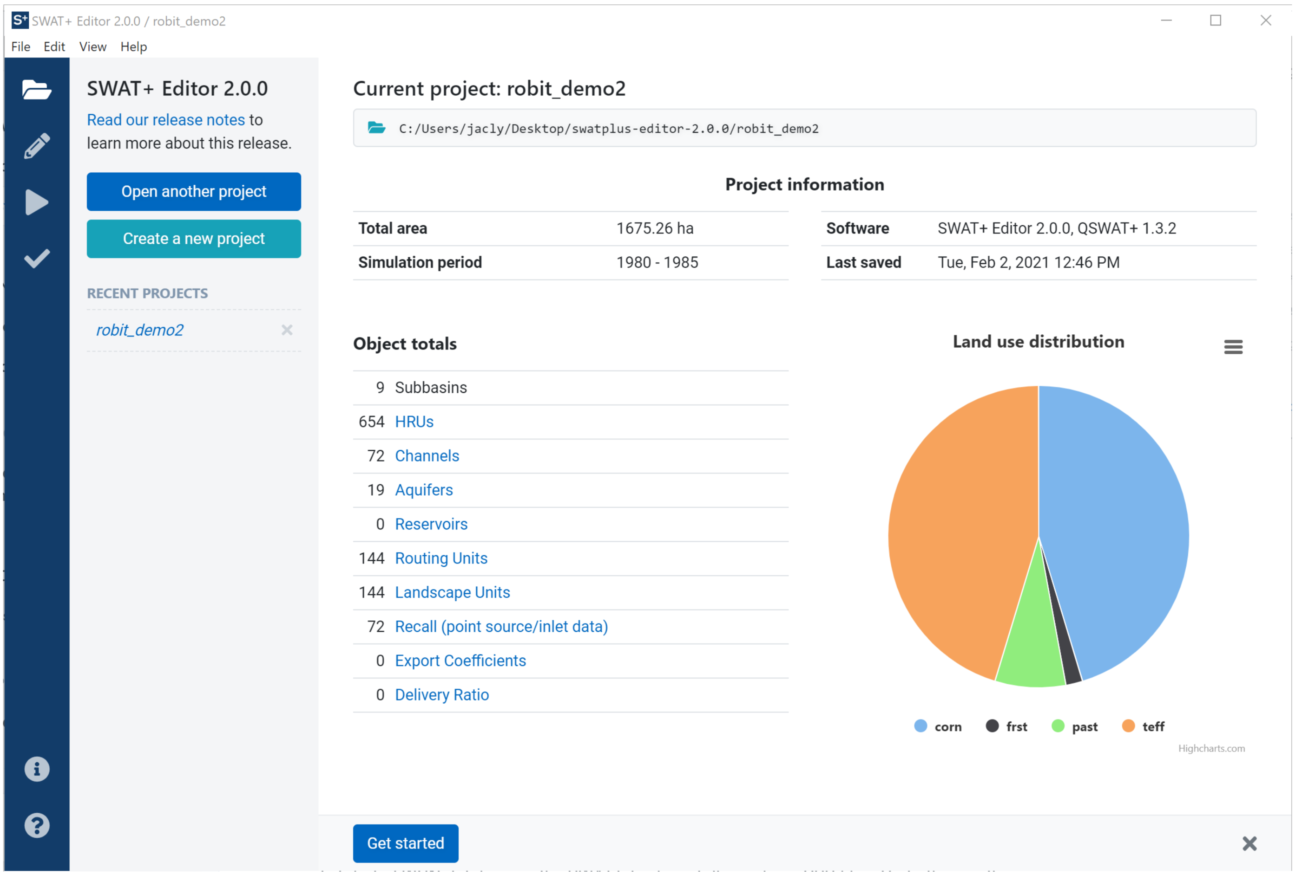
Project display name

robit_demo

□ Use SWAT+ lte? This is a lite version of the model that greatly simplifies hydrology and plant growth and does not simulate nutrients, concentrating on gully formation and stream degradation.

When your project is done importing from GIS, it will be selected as your current project and displayed in the recent projects sidebar on the left as well as in the center screen.

From here you can start editing your SWAT+ inputs by clicking the "Get started" button at the bottom, or by clicking the pencil icon in the far left blue-colored menu.



SWAT+ Editor 2.0.0

Read our release notes to learn more about this release.

Current project: robit_demo2

```
C:/Users/jacly/Desktop/swatplus-editor-2.0.0/robit_demo2
```

Project information

Total area	1675.26 ha	**Software**	SWAT+ Editor 2.0.0, QSWAT+ 1.3.2
Simulation period	1980 - 1985	**Last saved**	Tue, Feb 2, 2021 12:46 PM

Object totals

9	Subbasins
654	HRUs
72	Channels
19	Aquifers
0	Reservoirs
144	Routing Units
144	Landscape Units
72	Recall (point source/inlet data)
0	Export Coefficients
0	Delivery Ratio

SWAT+ lte

SWAT+ lte is a version of the SWAT+ model that greatly simplifies hydrology and plant growth and does not simulate nutrients, concentrating on gully formation and stream degradation. It only uses channel and HRU objects.

Using the editor without GIS

If you are not coming from QSWAT+, you may open the editor and create a new project from scratch. A project database will be created for you and you will need to input your spatial connections and all other data manually.

Edit SWAT+ Inputs

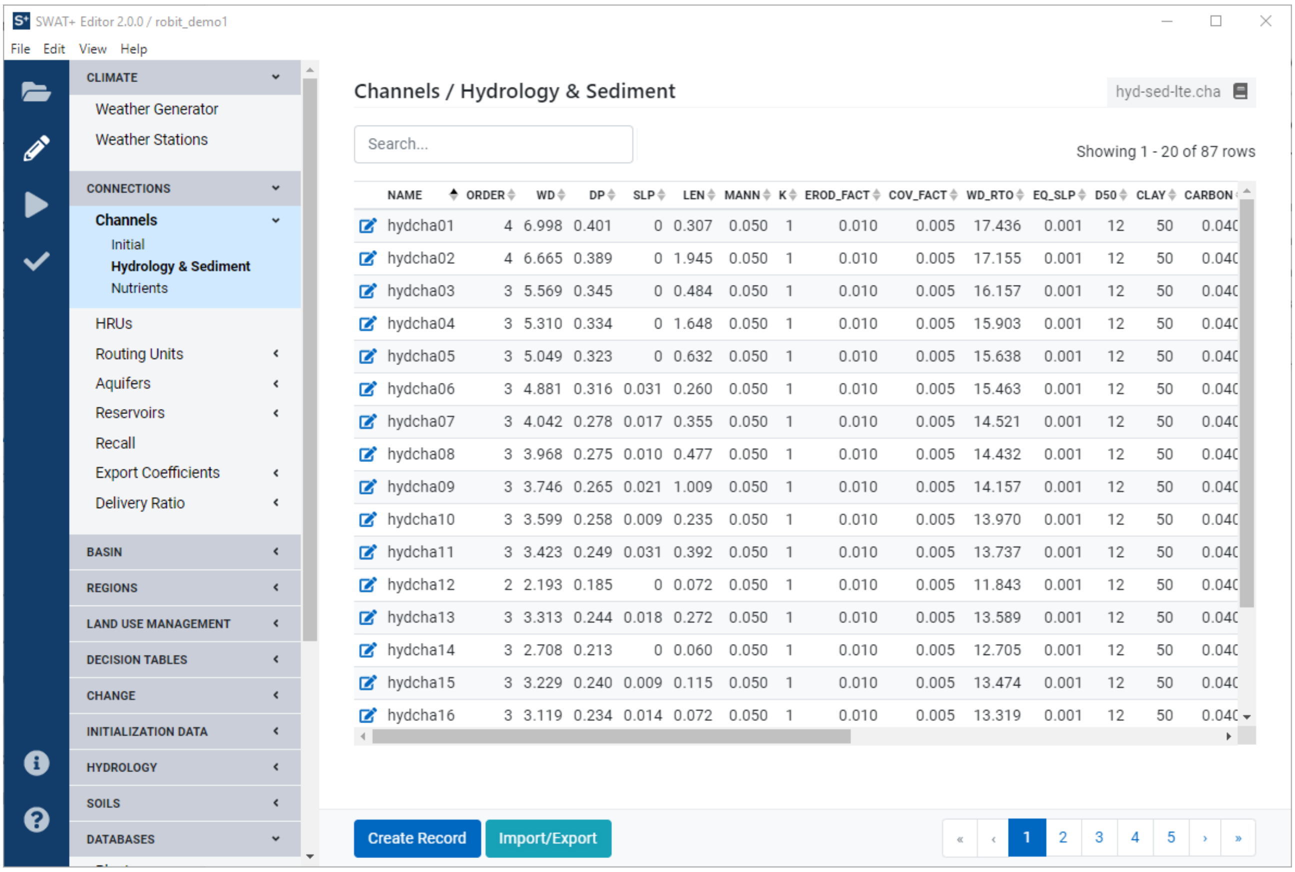
Click the pencil icon in the leftmost blue toolbar to enter the editing section. Most editors in this section are a literal representation of the SWAT+ input files. The collapsible dark-gray headings on the left correspond to the section lines in the master watershed file (file.cio).

When you click on an editor section from the left menu, you'll find the default SWAT+ file name with which the section corresponds. This enables you to quickly look up further information in the SWAT+ input/output documentation.

Navigating the Editor

Most data is presented in a tabular format. When you click a row, you're presented with a form where you can make changes and save. The following features are common across many editor sections.

Tables



Channels / Hydrology & Sediment

Showing 1 - 20 of 87 rows

NAME	ORDER	WD	DP	SLP	LEN	MANN	K	EROD_FACT	COV_FACT	WD_RTO	EQ_SLP	D50	CLAY	CARBON
hydcha01	4	6.998	0.401	0	0.307	0.050	1	0.010	0.005	17.436	0.001	12	50	0.040
hydcha02	4	6.665	0.389	0	1.945	0.050	1	0.010	0.005	17.155	0.001	12	50	0.040
hydcha03	3	5.569	0.345	0	0.484	0.050	1	0.010	0.005	16.157	0.001	12	50	0.040
hydcha04	3	5.310	0.334	0	1.648	0.050	1	0.010	0.005	15.903	0.001	12	50	0.040
hydcha05	3	5.049	0.323	0	0.632	0.050	1	0.010	0.005	15.638	0.001	12	50	0.040
hydcha06	3	4.881	0.316	0.031	0.260	0.050	1	0.010	0.005	15.463	0.001	12	50	0.040
hydcha07	3	4.042	0.278	0.017	0.355	0.050	1	0.010	0.005	14.521	0.001	12	50	0.040
hydcha08	3	3.968	0.275	0.010	0.477	0.050	1	0.010	0.005	14.432	0.001	12	50	0.040
hydcha09	3	3.746	0.265	0.021	1.009	0.050	1	0.010	0.005	14.157	0.001	12	50	0.040
hydcha10	3	3.599	0.258	0.009	0.235	0.050	1	0.010	0.005	13.970	0.001	12	50	0.040
hydcha11	3	3.423	0.249	0.031	0.392	0.050	1	0.010	0.005	13.737	0.001	12	50	0.040
hydcha12	2	2.193	0.185	0	0.072	0.050	1	0.010	0.005	11.843	0.001	12	50	0.040
hydcha13	3	3.313	0.244	0.018	0.272	0.050	1	0.010	0.005	13.589	0.001	12	50	0.040
hydcha14	3	2.708	0.213	0	0.060	0.050	1	0.010	0.005	12.705	0.001	12	50	0.040
hydcha15	3	3.229	0.240	0.009	0.115	0.050	1	0.010	0.005	13.474	0.001	12	50	0.040
hydcha16	3	3.119	0.234	0.014	0.072	0.050	1	0.010	0.005	13.319	0.001	12	50	0.040

Example table view

Sort by a column in the table by clicking on the heading name. It will toggle ascending or descending direction as indicated by the arrows next to the name.

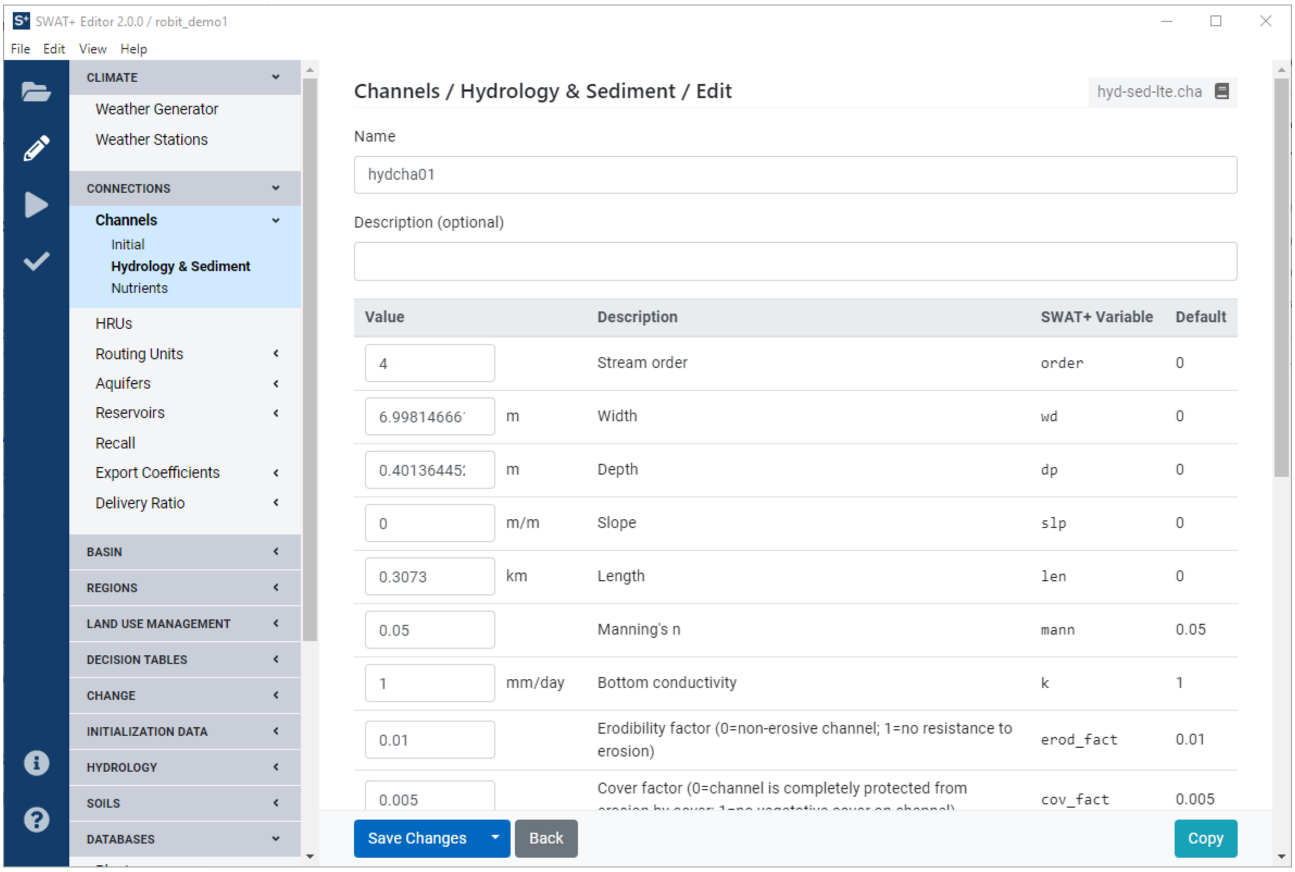
Tables with many records can be scrolled and then paged by clicking the page number or arrow links at the bottom of the table.

Each row may contain an edit/view icon on the far left to access the data in the row, and a delete icon on the far right (may need to scroll to access the far right of the table). We do not recommend deleting rows unless you are absolutely sure they are not used elsewhere in your model. Due to the relationships of data in SWAT+, deleting records could have unintended effects and break your model. Deleting cannot be undone; if in doubt, make a backup of your project SQLite database first.

In the search box up top, start typing the name of the objects you want to find. Matching options will appear in the table. Remove the text from the search box to remove the filter.

In the action bar at the bottom, click create new record to add an item to the table. The import/export data button allows you to quickly access your data in CSV (comma-separated values spreadsheet) format, in most cases. We recommend exporting your data (or empty table is okay) first to get a template with the column names. You may then modify the file and import it back into the editor.

Editing Form



Channels / Hydrology & Sediment / Edit

hyd-sed-lte.cha

Name

hydcha01

Description (optional)

Value		Description	SWAT+ Variable	Default
4		Stream order	order	0
6.99814666	m	Width	wd	0
0.40136445	m	Depth	dp	0
0	m/m	Slope	slp	0
0.3073	km	Length	len	0
0.05		Manning's n	mann	0.05
1	mm/day	Bottom conductivity	k	1
0.01		Erodibility factor (0=non-erosive channel; 1=no resistance to erosion)	erod_fact	0.01
0.005		Cover factor (0=channel is completely protected from	cov_fact	0.005

Example edit form

Most objects in SWAT+ have a name field and are identified using this name. Names should be unique and not contain spaces (spaces will be automatically converted to underscores).

Each edit form will have a save changes button at the bottom. Be sure to click this button after making any changes and before leaving the form.

Press the back button to return to the previous screen. Click copy to make a copy of the current object you are viewing. You will be asked to give the copied object a unique name. Note: the copy function is not available for all object types, including connection objects.

Look-up Fields

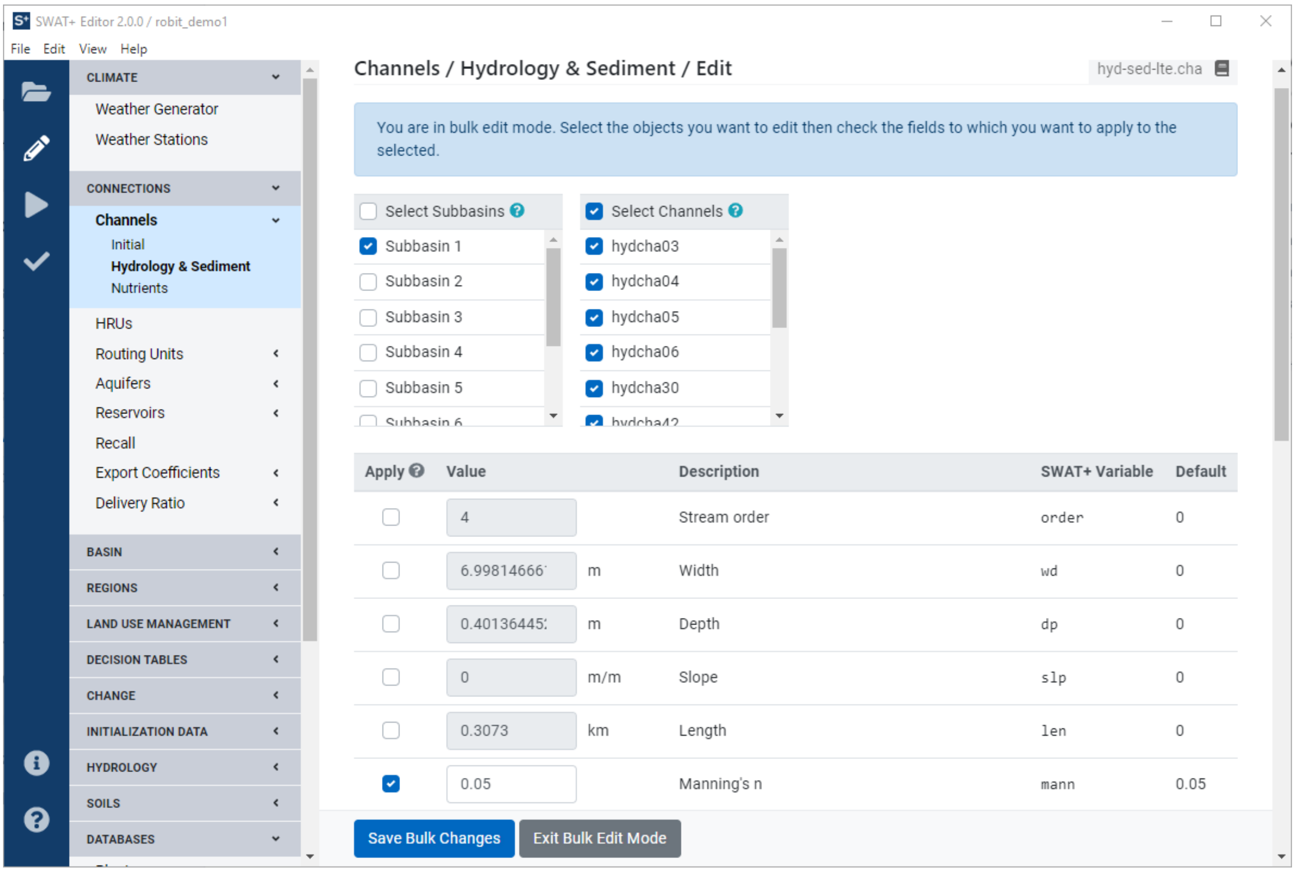
There are a lot of relationships between objects in SWAT+. For example, all fields in your channel properties table link to rows in other tables. In SWAT+ Editor forms, you can easily select these related rows by starting to type an object's name and select it as it pops up. If you accidentally enter an incorrect name, the editor will return an error stating the record does not exist in your database.

Example look-up form field

Bulk Editing

If you want to apply changes to a field for multiple objects at once, you can use bulk edit mode. Select one object from the table as your base. This can be useful if you want to use its values to apply across many other objects, but if you're using entirely new values, it does not matter which object you select.

From the object's edit form page, click the arrow on the right side of the save changes button and then click "Make changes to multiple records..." to enter bulk edit mode.



Channels / Hydrology & Sediment / Edit

You are in bulk edit mode. Select the objects you want to edit then check the fields to which you want to apply to the selected.

□ Select Subbasins	☑ Select Channels
☑ Subbasin 1	☑ hydcha03
□ Subbasin 2	☑ hydcha04
□ Subbasin 3	☑ hydcha05
□ Subbasin 4	☑ hydcha06
□ Subbasin 5	☑ hydcha30
□ Subbasin 6	☑ hydcha42

Apply	Value		Description	SWAT+ Variable	Default
□	4		Stream order	order	0
□	6.99814666	m	Width	wd	0
□	0.40136445	m	Depth	dp	0
□	0	m/m	Slope	slp	0
□	0.3073	km	Length	len	0
☑	0.05		Manning's n	mann	0.05

Example edit form in bulk editing mode

First, select the objects to which you want to make changes. Note that the object you're currently viewing is not selected by default. For most sections, you can filter your selection by subbasin first. If you're editing an HRU-level objects, you can also filter by landuse. In the above example, we checked Subbasin 1, which then populated the next list with channels that fall into Subbasin 1. All are selected by default, but you can uncheck as needed.

Next, choose which fields you want to edit by clicking the check box to the left of the field. In the above example, we checked the box for Manning's n. Enter the value you want and click Save Bulk Changes. Manning's n will be updated to your new value for each selected channel.

Getting Started with Your Data

We recommend starting in the climate section, and importing your weather generators and observed weather data. If you're coming from GIS, when you import weather generators or observed data, it will create weather stations and match them to your spatial objects automatically.

Climate

Weather Stations

Weather stations are linked from all of your connection objects (channels, HRUs, etc.) in SWAT+. If you are coming from QSWAT+, it is much better to import stations either from the weather generator section, or the observed weather file importer than it is to create them manually.

By importing through one of the methods described below, your new stations will be automatically matched your spatial connection objects.

Import Weather Generator Data

Click the import data button to import weather generator (wgn) data for your project. If you installed the SWAT+ databases, this file will be selected by default along with the CFSR world table. USA wgn data is also available from this database; type wgn_us to use this table.

You may also add your own data to this database using the wgn and corresponding wgn_mon tables.

→ How to Use SQLite /user/how-to-use-sqlite

Below the table name field is a check box asking if you are using observed weather data. By default (unchecked), when you click start import, weather stations will be created based on your wgn locations. If you are using observed weather data and prefer to have weather stations created based on this data, check this box–stations will not be created when you start import, and instead they will be created for you when you import your observed weather data files.

If you are not using observed weather data, it is important to leave the box unchecked so that weather stations are created for you.

CSV Import

If you do not want to use the SQLite database, you may import CSV files of your weather generator data. Two CSV files are required.

1. Stations CSV file:
   - Columns `id, name, lat, lon, elev, rain_yrs`
   - `id` should be uniquely numbered
2. Monthly values CSV file:
   - Columns `id, wgn_id, month, tmp_max_ave, tmp_min_ave, tmp_max_sd, tmp_min_sd, pcp_ave, pcp_sd, pcp_skew, wet_dry, wet_wet, pcp_days, pcp_hhr, slr_ave, dew_ave, wnd_ave`
   - `id` should be uniquely numbered
   - `wgn_id` corresponds to the `id` column from the stations file

Import Observed Weather Data

Import observed weather data from the top of the weather stations section. The data files may be in one of two formats: SWAT2012/Global Weather Data CFSR website format, or SWAT+.

> ⓘ After importing observed weather data, be sure to modify your simulation run time to match your weather dates.

SWAT2012/Global Weather Data CFSR Website Format

Each measurement included in your data must have the following entry file names:

Measurement	Entry File
Precipitation	pcp.txt
Temperature	tmp.txt
Solar radiation	solar.txt
Relative humidity	rh.txt
Wind speed	wind.txt

Each entry file is a comma-separated list of stations. Each station name should have a corresponding .txt file (e.g., name p326-963 should have a p326-963.txt file).

ID	Name	Latitude	Longitude	Elevation
1	p326-963	32.628	-96.250	142.0

Each station file should have the first line as the starting day as YYYYMMDD (e.g., 19790101). The following lines are the measurement for each day, one line per day. For temperature, each line will be max,min (e.g., 10.138,-2.662).

Weather data may be downloaded from the Global Weather CFSR website.

SWAT+ Format

Each measurement included in your data must have the following entry file names:

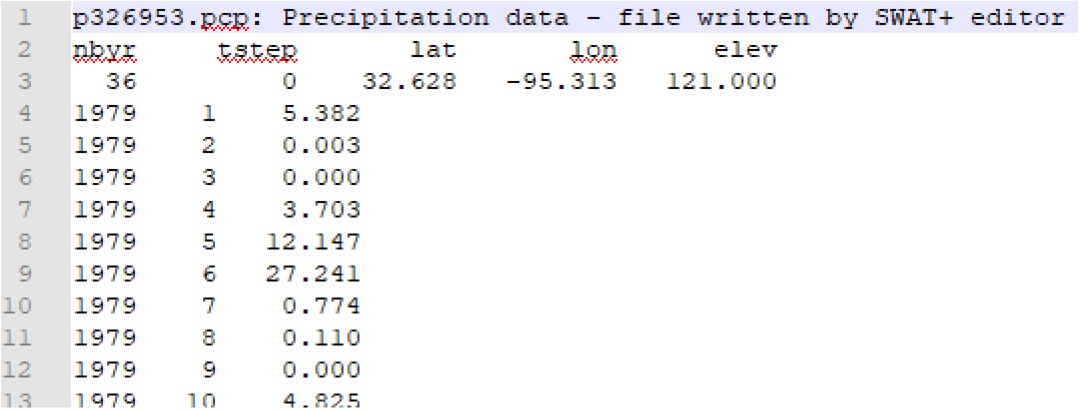
Measurement	Entry File
Precipitation	pcp.cli
Temperature	tmp.cli
Solar radiation	slr.cli
Relative humidity	hmd.cli

Wind speed	wnd.cli

Each entry file has a title line (any text allowed), followed by a heading line, followed by a list of filenames for each station. Filenames should be listed alphabetically.

pcp.cli: precipitation file names
filename
p326953.pcp
p326956.pcp

Each station file has a title line, followed by a heading line and data line for time and location. Measurements for each timestep are in the lines to follow. For temperature, the measurements will be listed as max then min.



```
p326953.pcp: Precipitation data - file written by SWAT+ editor
nbyr      tstep        lat        lon       elev
  36          0     32.628    -95.313    121.000
1979     1     5.382
1979     2     0.003
1979     3     0.000
1979     4     3.703
1979     5    12.147
1979     6    27.241
1979     7     0.774
1979     8     0.110
1979     9     0.000
1979    10     4.825
```

Weather Generator Parameters

SWAT+ Input File	Database Tables
weather-wgn.cli	weather_wgn_cli
	weather_wgn_cli_mon

weather_wgn_cli

Field	Type	Description	Units	Range
id	int	Auto-assigned identifier		
name	text	Name of weather generator		
lat	real	Latitude of weather station	deg.	+/-90
lon	real	Longitude of weather station	deg.	+/-180
elev	real	Elevation of weather station	m	0-5000
rain_yrs	int	Number of years of recorded maximum monthly 0.5h rainfall data		5-100

weather_wgn_cli_mon

Each entry in weather_wgn_cli will have 12 rows in weather_wgn_cli_mon.

Field	Type	Description	Units	Range
id	int	Auto-assigned identifier		
wgn_id	int	ID of row in weather_wgn_cli		
month	int	Month		
tmp_max_ave	real	Average or mean daily maximum air temperature for month	°C	-30-50
tmp_min_ave	real	Average or mean daily minimum air temperature for month	°C	-40-40
tmp_max_sd	real	Standard deviation for daily maximum air temperature in month	°C	0.1-100

tmp_min_sd	real	Standard deviation for daily minimum air temperature in month	°C	0.1-30
pcp_ave	real	Average or mean total monthly precipitation	mm	0-600
pcp_sd	real	Standard deviation for the average daily precipitation	mm/day	0.1-50
pcp_skew	real	Skew coefficient for the average daily precipitation	mm	-50-20
wet_dry	real	Probability of a wet day after a dry day		0-0.95
wet_wet	real	Probability of a wet day after a wet day		0-0.95
pcp_days	real	Average number of days of precipitation in a month		0-31
pcp_hhr	real	Maximum 0.5 hour rainfall in entire period of record for month	mm	0-125
slr_ave	real	Average daily solar radiation for the month	MJ/m^2/day	0-750
dew_ave	real	Average daily dew point temperature for each month	°C	-50-25
wnd_ave	real	Average wind speed for the month	m/s	0-100

Weather Stations Parameters

SWAT+ Input File	Database Tables
weather-sta.cli	weather_sta_cli
	weather_file

weather_sta_cli

When entering an observed weather file name in the station editor, you may start typing to search for existing weather files adding during the import step. If adding observed files manually, just type the name of the file (e.g., p326953.pcp), and put that file in the directory you plan to write input files (e.g., your TxtInOut). Files must be in SWAT+ format. If your weather data is in SWAT2012 format or from the Global Weather CFSR website, please use the import step to convert them to SWAT+.

Field	Type	Description
id	int	Auto-assigned identifier
name	text	Name of the weather station
wgn_id	int	ID of row in weather_wgn_cli
pcp	text	Precipitation gage filename or "sim" if simulated
tmp	text	Temperature gage filename or "sim" if simulated
slr	text	Solar radiation gage filename or "sim" if simulated
hmd	text	Relative humidity gage filename or "sim" if simulated
wnd	text	Wind speed gage filename or "sim" if simulated
wnd_dir	text	Wind direction gage filename
atmo_dep	text	Atmospheric deposition data file name
lat	real	Latitude of weather station
lon	real	Longitude of weather station

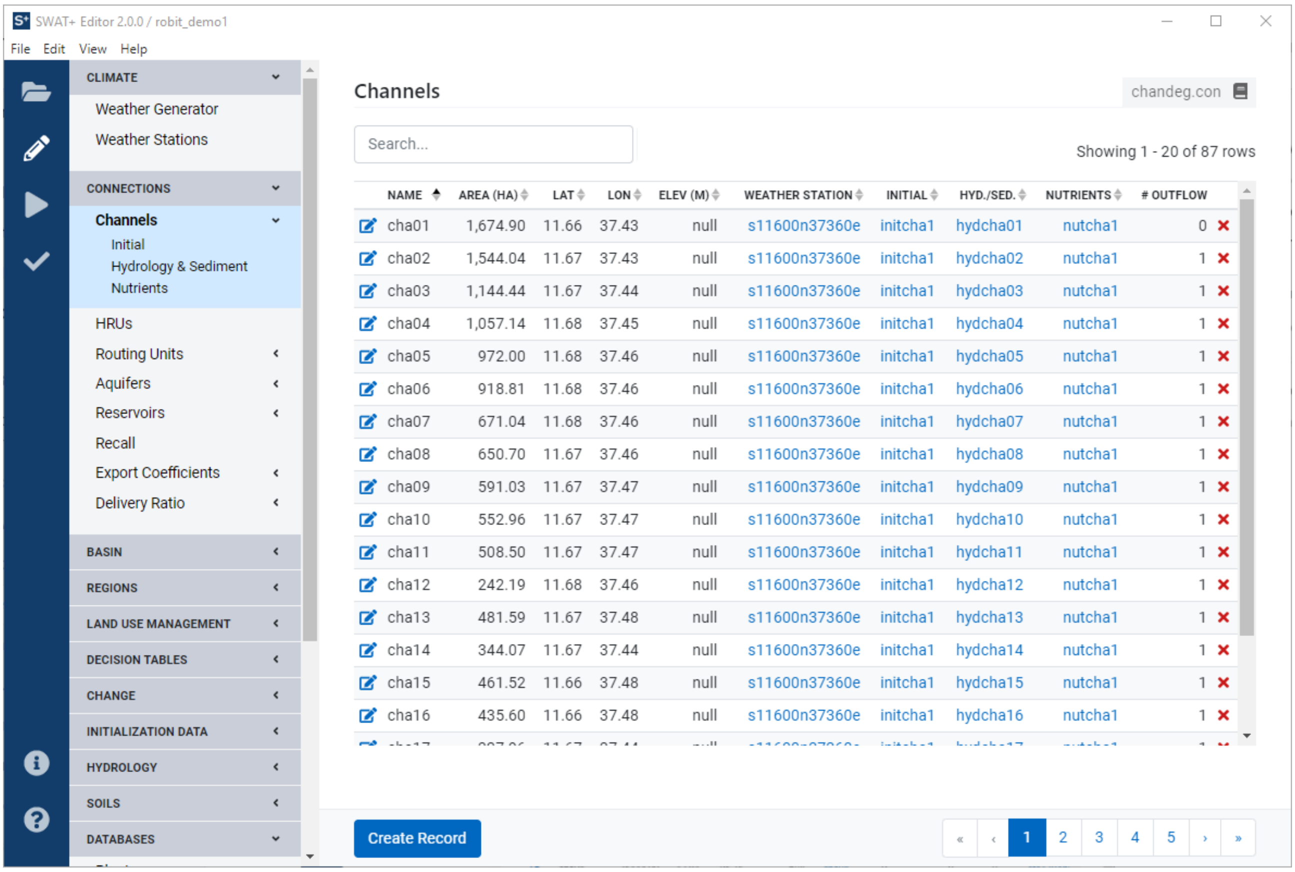
weather_file

This table is only used if you import observed weather data files. If entering stations manually, this table will not be populated.

Field	Type	Description
id	int	Auto-assigned identifier
filename	text	Name of the weather data file
type	text	Type of weather data: pcp, tmp, slr, hmd, wnd
lat	real	Latitude of weather station in file
lon	real	Longitude of weather station in file

Connections

The connections section contains all spatial object connectivity for the simulation run. In SWAT+ Editor, all connection object properties can be set through this section. For example, when you click on channels, you will see additional menu links appear for initialization, hydrology and sediment, and nutrients.



Channels

Showing 1 - 20 of 87 rows

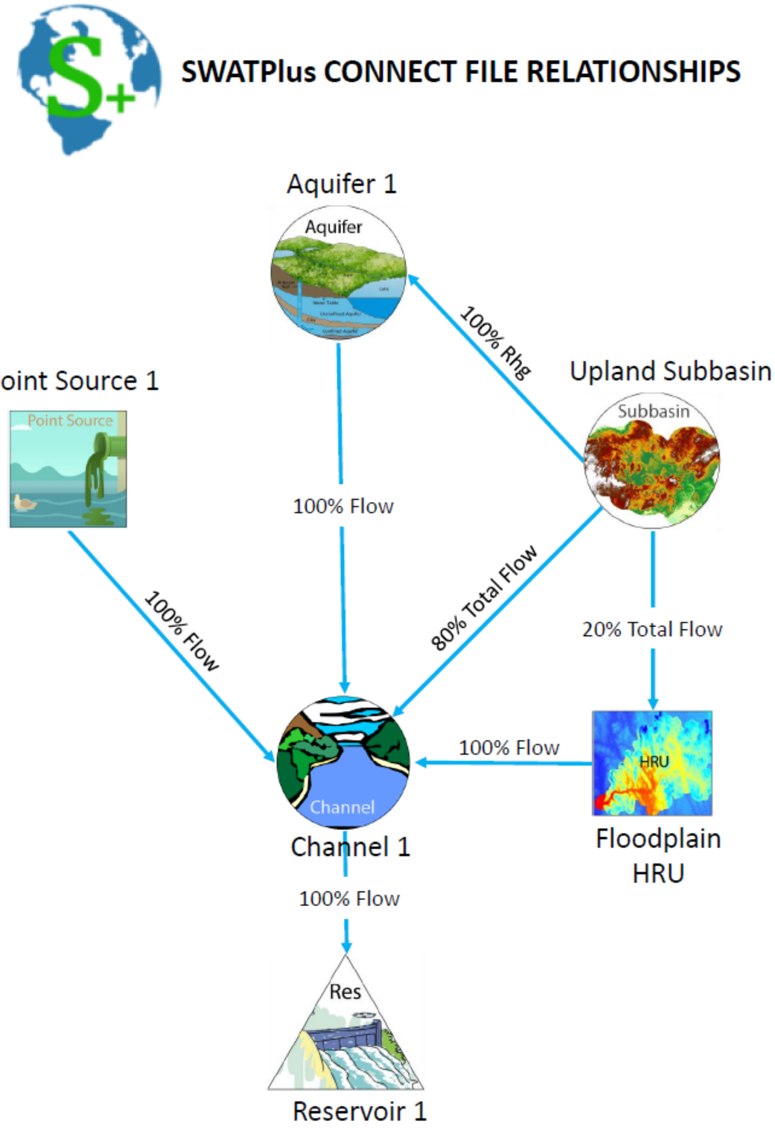
NAME	AREA (HA)	LAT	LON	ELEV (M)	WEATHER STATION	INITIAL	HYD./SED.	NUTRIENTS	# OUTFLOW
cha01	1,674.90	11.66	37.43	null	s11600n37360e	initcha1	hydcha01	nutcha1	0
cha02	1,544.04	11.67	37.43	null	s11600n37360e	initcha1	hydcha02	nutcha1	1
cha03	1,144.44	11.67	37.44	null	s11600n37360e	initcha1	hydcha03	nutcha1	1
cha04	1,057.14	11.68	37.45	null	s11600n37360e	initcha1	hydcha04	nutcha1	1
cha05	972.00	11.68	37.46	null	s11600n37360e	initcha1	hydcha05	nutcha1	1
cha06	918.81	11.68	37.46	null	s11600n37360e	initcha1	hydcha06	nutcha1	1
cha07	671.04	11.68	37.46	null	s11600n37360e	initcha1	hydcha07	nutcha1	1
cha08	650.70	11.67	37.46	null	s11600n37360e	initcha1	hydcha08	nutcha1	1
cha09	591.03	11.67	37.47	null	s11600n37360e	initcha1	hydcha09	nutcha1	1
cha10	552.96	11.67	37.47	null	s11600n37360e	initcha1	hydcha10	nutcha1	1
cha11	508.50	11.67	37.47	null	s11600n37360e	initcha1	hydcha11	nutcha1	1
cha12	242.19	11.68	37.46	null	s11600n37360e	initcha1	hydcha12	nutcha1	1
cha13	481.59	11.67	37.48	null	s11600n37360e	initcha1	hydcha13	nutcha1	1
cha14	344.07	11.67	37.44	null	s11600n37360e	initcha1	hydcha14	nutcha1	1
cha15	461.52	11.66	37.48	null	s11600n37360e	initcha1	hydcha15	nutcha1	1
cha16	435.60	11.66	37.48	null	s11600n37360e	initcha1	hydcha16	nutcha1	1

All connection objects have a similar format as seen in the above figure. Each connection object will have properties associated with it (such as initial, hydrology and sediment, and nutrients in this example) as well as a weather station. Click on these names in the table, or from the edit view page, click the button next to their names to view information about the properties object or weather station.

Each connection object may have outflow. The total number of outflow connections is shown in the right-most column of the table (note: you may need to use the horizontal scroll button at the bottom of the table if it is wide). To view the outflow objects, click the edit icon on the left of the row you want to view.

If you imported your project from GIS, your connection objects are populated automatically during project setup.

Explanation of SWAT+ Spatial Objects



Example connectivity

Subbasin

The subbasin is defined by the DEM in the GIS interface as it always has been. All flow within the subbasin drains to the subbasin outlet.

Landscape Unit

A landscape unit (LSU) is defined as a collection of HRUs and can be defined as a subbasin, or it could be a flood plain or upland unit, or it could be a grid cell with multiple HRUs. The landscape unit is not routed, it only used for output. The landscape unit output files (waterbal, nutbal, losses, and plant weather) are output for HRUs, landscape units, and for the basin. Two input files are required: 1) landscape elements and, 2) landscape define. The elements file includes HRUs and their corresponding LSU fraction and basin fractions. The define file specifies which HRUs are contained in each LSU.

Routing Unit

A routing unit is a collection of hydrographs that can be routed to any spatial object. The routing unit can be configured as a subbasin, then total flow (surface, lateral and tile flow) from the routing unit can be sent to a channel and all recharge from the routing unit sent to an aquifer. This is analogous to the current approach in SWAT. However, SWAT+ gives us much more flexibility in configuring a routing unit. For example, in CEAP, we are routing each HRU (field) through a small channel (gully or grass waterway) before it reaches the main channel. In this case, the routing unit is a collection of flow from the small channels. We also envision simulating multiple representative hillslopes to define a routing unit. Also, we are setting up scenarios that define a routing unit using tile flow from multiple fields and sending that flow to a wetland.

The routing unit is the spatial unit SWAT+ that allows us to lump outputs and route the outputs to any other spatial object. It gives us considerably more flexibility than the old subbasin lumping approach in SWAT, and will continue to be a convenient way of spatial lumping until we can simulate individual fields or cells in each basin.

Channels

> ⓘ Documentation for this section is not available yet. For now, please refer to the SWAT+ input/output documentation PDF for parameter definitions.

HRUs

> ⓘ Documentation for this section is not available yet. For now, please refer to the SWAT+ input/output documentation PDF for parameter definitions.

Routing Units

> ⓘ Documentation for this section is not available yet. For now, please refer to the SWAT+ input/output documentation PDF for parameter definitions.

Aquifers

Documentation for this section is not available yet. For now, please refer to the SWAT+ input/output documentation PDF for parameter definitions.

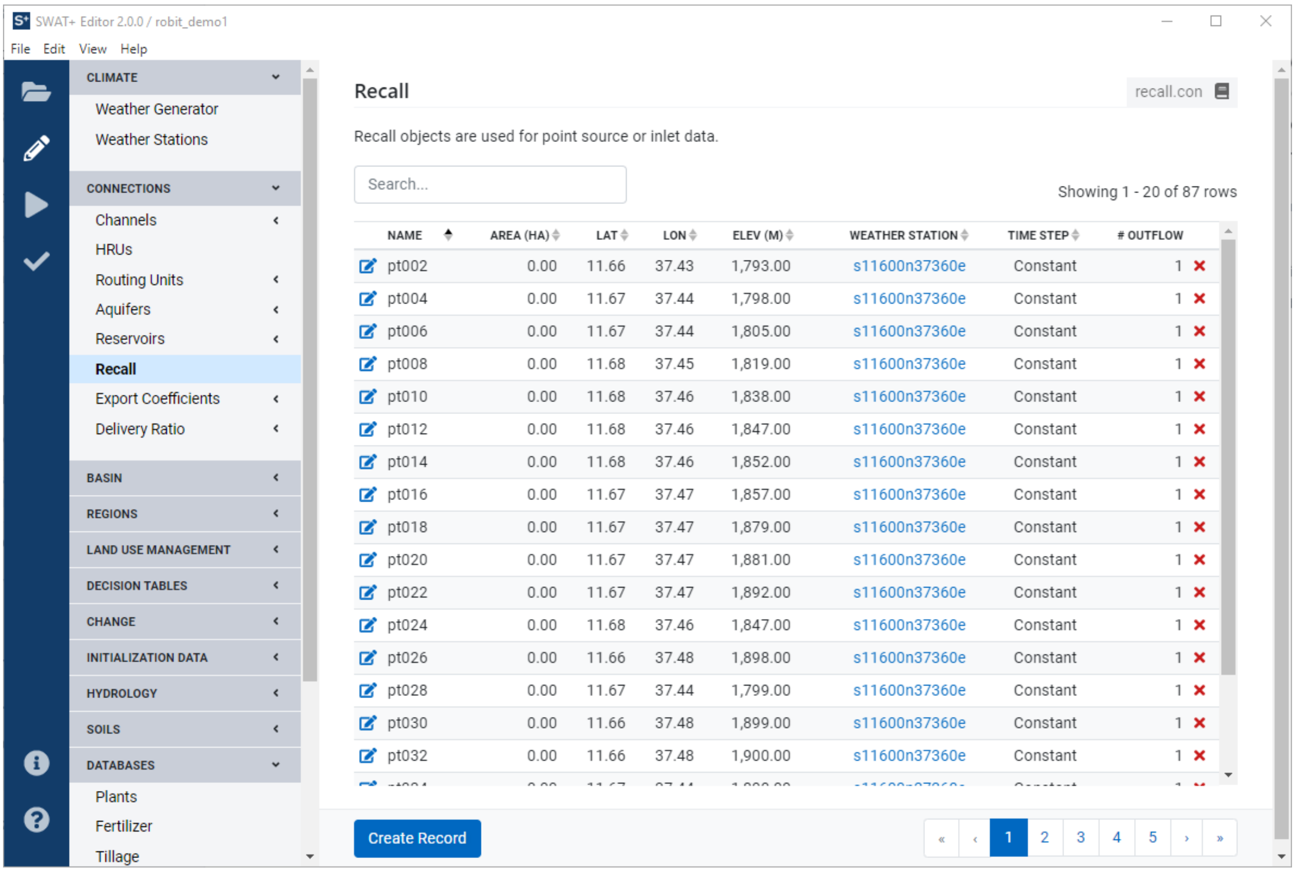
Reservoirs

> ⓘ Documentation for this section is not available yet. For now, please refer to the SWAT+ input/output documentation PDF for parameter definitions.

Recall (Point Source/Inlet)

Recall objects are used for connecting point source or inlet data to your watershed. If you added point source in QSWAT+, when you import your project into SWAT+ Editor it will be connected via the recall section.

By default, constant data with all zero values during the default simulation period is added. To add your own recall data, click the recall item in the edit menu under connections.



Recall

Recall objects are used for point source or inlet data.

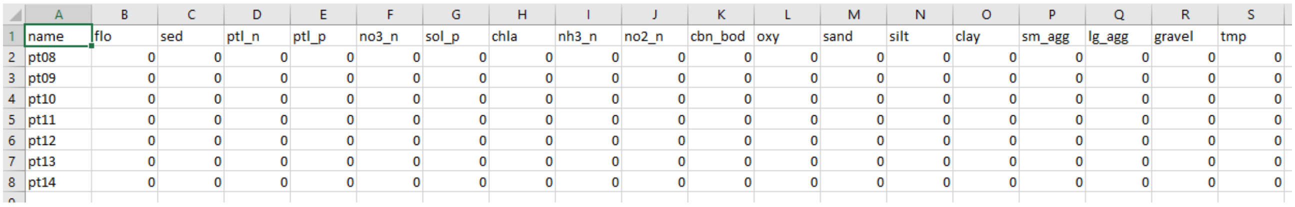
Showing 1 - 20 of 87 rows

NAME	AREA (HA)	LAT	LON	ELEV (M)	WEATHER STATION	TIME STEP	# OUTFLOW
pt002	0.00	11.66	37.43	1,793.00	s11600n37360e	Constant	1
pt004	0.00	11.67	37.44	1,798.00	s11600n37360e	Constant	1
pt006	0.00	11.67	37.44	1,805.00	s11600n37360e	Constant	1
pt008	0.00	11.68	37.45	1,819.00	s11600n37360e	Constant	1
pt010	0.00	11.68	37.46	1,838.00	s11600n37360e	Constant	1
pt012	0.00	11.68	37.46	1,847.00	s11600n37360e	Constant	1
pt014	0.00	11.68	37.46	1,852.00	s11600n37360e	Constant	1
pt016	0.00	11.67	37.47	1,857.00	s11600n37360e	Constant	1
pt018	0.00	11.67	37.47	1,879.00	s11600n37360e	Constant	1
pt020	0.00	11.67	37.47	1,881.00	s11600n37360e	Constant	1
pt022	0.00	11.67	37.47	1,892.00	s11600n37360e	Constant	1
pt024	0.00	11.68	37.46	1,847.00	s11600n37360e	Constant	1
pt026	0.00	11.66	37.48	1,898.00	s11600n37360e	Constant	1
pt028	0.00	11.67	37.44	1,799.00	s11600n37360e	Constant	1
pt030	0.00	11.66	37.48	1,899.00	s11600n37360e	Constant	1
pt032	0.00	11.66	37.48	1,900.00	s11600n37360e	Constant	1

Constant Data

By default, your recall data is imported as constant. To insert your values, you can edit each item individually by clicking the edit button and manually entering each value. Alternatively, you may upload a CSV of your data.

From the recall section, click the import/export button from the action bar at the bottom. Import is selected by default, so click the export button toggle. Choose a folder name, and click the export data button to get a template for your data.



name	flo	sed	ptl_n	ptl_p	no3_n	sol_p	chla	nh3_n	no2_n	cbn_bod	oxy	sand	silt	clay	sm_agg	lg_agg	gravel	tmp
pt08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pt09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pt10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pt11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pt12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pt13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
pt14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Example template file after exporting

Constant data will be located in the `recall.csv` file in the directory you selected. Edit the CSV as needed, save, and then go back to the editor and click the import/output button again. This time toggle the import button. Choose your directory containing your modified files and click the import CSV data button. Your updated values will appear in the table.

Time Series Data

By default recall data is imported as constant, however this can be changed by clicking the edit button next to a row in the recall data table. Select the new time step for your data: daily, monthly, or yearly. Click the save changes button. Next, press the back button to go back to the table view. Click the import/export button. Import is selected by default, so click the export button toggle. Choose a folder name, and click the export data button to get a template for your data.

Your directory may now contain two files: a recall.csv containing constant data, and another csv file named for the recall object (e.g., `pt002`) you changed to time series.

Open the time series file after it is exported to see the template for your data. Modify your data as needed matching the time step you selected previously. Be sure the years match your simulation run time. In a yearly time step, `t_step` equals 1 through number of years. For monthly data, `t_step` equals the number of the month, and for daily it is the number of the day of the year.

You change other recall objects from constant to time series, and you can mix and match all different types (constant, yearly, monthly, and daily). For any recall objects moving from constant to time series, first delete its row in `recall.csv`. Then create a new csv with the file name matching the recall object's name and insert your time series data. Similarly, if you want to move from time series back to constant, just delete the time series file and add a row back into `recall.csv` for the object.

To import your data, click the import/export data button again and this time click to toggle import. Choose your directory and click import data. Your new data will appear in the table.

Recall Table Definitions

SWAT+ Input File	Database Table
recall.rec	recall_rec

Field	Type	Description
id	int	Auto-assigned identifier
name	text	Name of recall object
rec_typ	int	Time step for recall object (1-daily, 2-monthly, 3-yearly)

Each record in recall_rec will have a data file named {name}.rec. All of this data is stored in a single recall_dat table in the database.

SWAT+ Input File	Database Table
{name}.rec	recall_dat

Field	Type	Description	Units
yr	int	Year	

t_step	int	Timestep	
flo	real	Volume of water	m^3
sed	real	Sediment	metric ton
ptl_n	real	Organic nitrogen	kg N
ptl_p	real	Organic phosphorus	kg P
no3_n	real	Nitrate	kg N
sol_p	real	Mineral (soluble P)	kg P
chla	real	Chlorophyll-a	kg
nh3_n	real	Ammonia	kg N
no2_n	real	Nitrogen dioxide	kg N
cbn_bod	real	Carbonaceous biological oxygen demand	kg
oxy	real	Dissolved oxygen	kg
sand	real	Detached sand	
silt	real	Detached silt	
clay	real	Detached clay	
sm_agg	real	Detached small ag	
lg_agg	real	Detached large ag	
gravel	real	Gravel	
tmp	real	Temperature	deg c

Export Coefficients

> ⓘ Documentation for this section is not available yet. For now, please refer to the SWAT+ input/output documentation PDF for parameter definitions.

Special note about using export coefficients with constant point source/inlet data

In SWAT+, constant values for point sources and inlets are stored in the export coefficients properties file, exco.exc, while time series data are stored entirely in the recall section.

However, in the editor, we keep both constant and time series point sources and inlets in the **recall section**. When you write input files, the editor will write to the exco.exc and exco_om.exc files appropriately.

Delivery Ratio

Documentation for this section is not available yet. For now, please refer to the SWAT+ input/output documentation PDF for parameter definitions.

Basin

General watershed attributes are defined in the basin input files: codes and parameters. These attributes control a diversity of physical processes at the watershed level. The interfaces will automatically set these parameters to the default or recommended values listed in the variable documentation. Users can use the default values or change them to better reflect what is happening in a given watershed. Variables governing bacteria or pesticide transport need to be initialized only if these processes are being modeled in the watershed. Even if nutrients are not being studied in a watershed, some attention must be paid to these variables because nutrient cycling impacts plant growth which in turn affects the hydrologic cycle.

Codes

SWAT+ Input File	Database Table
codes.bsn	codes_bsn

codes_bsn

Field	Type	Description
pet_file	text	Potential ET filename
wq_file	text	Watershed stream water quality filename
pet	int	Potential ET method code
event	int	Event code
crack	int	Crack flow code
rtu_wq	int	Subbasin water quality code
sed_det	int	Max half-hour rainfall frac calc

rte_cha	int	Water routing method
deg_cha	int	Channel degradation code
wq_cha	int	Stream water quality code
rte_pest	int	Redefined to the sequence number of pest in NPNO(:) to be routed through the watershed
cn	int	CN method flag
c_fact	int	C-factor
carbon	int	Carbon code
baseflo	int	Baseflow distribution factor during the day for subdaily runs
uhyd	int	Unit hydrograph method
sed_cha	int	Instream sediment model
tiledrain	int	Tile drainage EQ code
wtable	int	Water table depth algorithms code
soil_p	int	Soil phosphorus model
abstr_init	int	Initial abstraction on impervious cover
atmo_dep	text	Atmospheric deposition code
stor_max	int	Max depressional storage selection code
headwater	int	Headwater code

Parameters

SWAT+ Input File	Database Table

parameters.bsn	parameters_bsn

parameters_bsn

Field	Type	Description	Units	Default	Range
lai_noevap	real	Leaf area index at which no evaporation occurs from water surface		3	0-10
sw_init	real	Initial soil water storage expressed as a fraction of field capacity water content		0	0-1
surq_lag	real	Surface runoff lag coefficient		4	1-24
adj_pkrt	real	Peak rate adjustment factor for sediment routing in the subbasin (tributary channels)		1	0.5-2
adj_pkrt_sed	real	Peak rate adjustment factor for sediment routing in the main channel		1	0-2
lin_sed	real	Linear parameter for calculating the maximum amount of sediment that can be reentrained during channel sediment routing		0.0001	0.0001-0.01
exp_sed	real	Exponent parameter for calculating sediment reentrained in channel sediment routing		1	1-1.5
orgn_min	real	Rate factor for humus mineralization of active organic nutrients (N and P)		0.0003	0.001-0.003

n_uptake	real	Nitrogen uptake distribution parameter		20	0-100
p_uptake	real	Phosphorus uptake distribution parameter		20	0-100
n_perc	real	Nitrate percolation coefficient		0.2	0-1
p_perc	real	Phosphorus percolation coefficient	10 m^3/M	10	10-17.5
p_soil	real	Phosphorus soil partitioning coefficient	m^3/Mg	175	100-200
p_avail	real	Phosphorus availability index		0.4	0.01-0.7
rsd_decomp	real	Residue decomposition coefficient		0.05	0.02-0.1
pest_perc	real	Pesticide percolation coefficient		0.5	0-1
msk_co1	real	Calibration coefficient to control impact of the storage time constant for the reach at bankfull depth		0.75	0-10
msk_co2	real	Calibration coefficient used to control impact of the storage time constant for low flow (where low flow is when river is at 0.1 bankfull depth) upon the km value calculated for the reach		0.25	0-10
msk_x	real	Weighting factor control relative importance of inflow rate and outflow rate in determining storage on reach		0.2	0-0.3

trans_loss	real	Fraction of transmission losses from main channel that enter deep aquifer		0	0-1
evap_adj	real	Reach evaporation adjustment factor		0.6	0.5-1
cn_co	real	Currently not being used			
denit_exp	real	Denitrification exponential rate coefficient		1.4	0-3
denit_frac	real	Denitrification threshold water content		1.3	0-1
man_bact	real	Fraction of manure applied to land areas that has active colony forming units		0.15	0-1
adj_uhyd	real	Adjustment factor for subdaily unit hydrograph basetime		0	0-1
cn_froz	real	Parameter for frozen soil adjustment on infiltration/runoff		0.000862	0-0
dorm_hr	real	Time threshold used to define dormancy	hrs	0	0-24
s_max	real	Currently not being used			
n_fix	real	Nitrogen fixation coefficient		0.5	0-1
n_fix_max	real	Maximum daily-n fixation	kg/ha	20	1-20
rsd_decay	real	Minimum daily residue decay		0.01	0-0.05
rsd_cover	real	Residue cover factor for computing fraction of cover		0.3	0.1-0.5
vel_crit	real	Critical velocity		5	0-10

res_sed	real	Reservoir sediment settling coefficient		0.184	0.09-0.27
uhyd_alpha	real	Alpha coefficient for gamma function unit hydrograph		5	0.5-10
splash	real	Splash erosion coefficient		1	0.9-3.1
rill	real	Rill erosion coefficient		0.7	0.5-2
surq_exp	real	Exponential coefficient for overland flow		1.2	1-3
cov_mgt	real	Scaling parameter for cover and management factor for overland flow erosion		0.03	0.001-0.45
cha_d50	real	Median particle diameter of main channel	mm	50	10-100
cha_part_sd	real	Geometric standard deviation of particle size		1.57	1-5
adj_cn	real	Currently not being used			
igen	int	Random generator code 0 = use default number; 1 = generate new numbers in every simulation		0	0-1

Regions

Documentation for this section is not available yet. For now, please refer to the SWAT+ input/output documentation PDF for parameter definitions.

→ SWAT+ IO Documentation /user/io

Land Use Management

A primary goal of environmental modeling is to assess the impact of human activities on a given system. Central to this assessment is the itemization of the land and water management practices taking place within the system. This section contains input data for planting, harvest, irrigation applications, nutrient applications, pesticide applications, and tillage operations. Information regarding tile drains and urban areas is also stored in this file.

SWAT+ Input File	Database Table
landuse.lum	landuse_lum
management.sch	management_sch
	management_sch_auto
	management_sch_op
cntable.lum	cntable_lum
ovn_table.lum	ovn_table_lum
cons_practice.lum	cons_practice_lum

In addition to the above, SWAT+ Editor groups the operations databases in this section of the editor. However, within the SWAT+ master watershed file (file.cio), these are listed under the ops section.

SWAT+ Input File	Database Table
graze.ops	graze_ops
harv.ops	harv_ops
irr.ops	irr_ops
sweep.ops	sweep_ops

fire.ops	fire_ops
chem_app.ops	chem_app_ops

Land Use Management

This section is the entry point for management data in SWAT+. It comprises cross-walks to several other sections of data.

This data is accessed from the HRU properties section (hru-data.hru).

landuse_lum

Field	Type	Description	Related Table
id	int	Auto-assigned identifier	
name	text	Name of the land use properties	
cal_group	text	Calibration group	
plnt_com_id	int	Plant community	plant_ini
mgt_id	int	Management schedule	management_sch
cn2_id	int	Curve number	cntable_lum
cons_prac_id	int	Conservation practices	cons_prac_lum
urban_id	int	Urban land use	urban_urb
urb_ro	text	Urban runoff	
ov_mann_id	int	Overland flow Manning's n	ovn_table_lum
tile_id	int	Tile drain	tiledrain_str
sep_id	int	Septic tank	septic_str

vfs_id	int	Filter strip	filterstrip_str
grww_id	int	Grassed waterway	grassedww_str
bmp_id	int	Best management practices	bmpuser_str
description	text	Optional description of the row	

Management Schedules

Management schedules comprise auto-schedules (decision tables) and/or operations schedules.

When you import your project from GIS, SWAT+ assigns auto-schedules for management based on your crop land use.

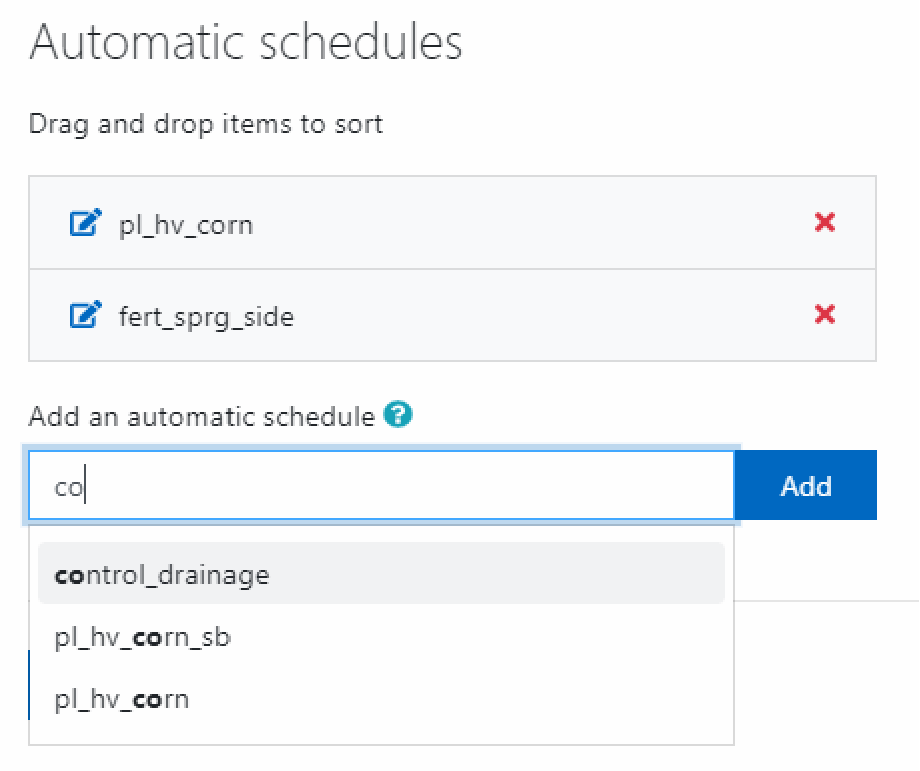
Plant Type (in plants_plt)	Decision Table Template
warm_annual	pl_hv_corn
cold_annual	pl_hv_wwht
perennial	no management schedule

For example, oats is a cold annual crop. If this crop is in your HRUs, a decision table named pl_hv_oats will be created based on the template of pl_hv_wwht when you import your data from GIS.

Adding/Editing a Schedule

From the management schedules section, click create a new record or click edit on a row in the table. Give your schedule a unique name.

To add an automatic schedule, start typing a decision table name in the box provided. Click the desired result from the list of matches that pops up, and click the add button. If you enter more than one schedule, you can drag and drop to sort.



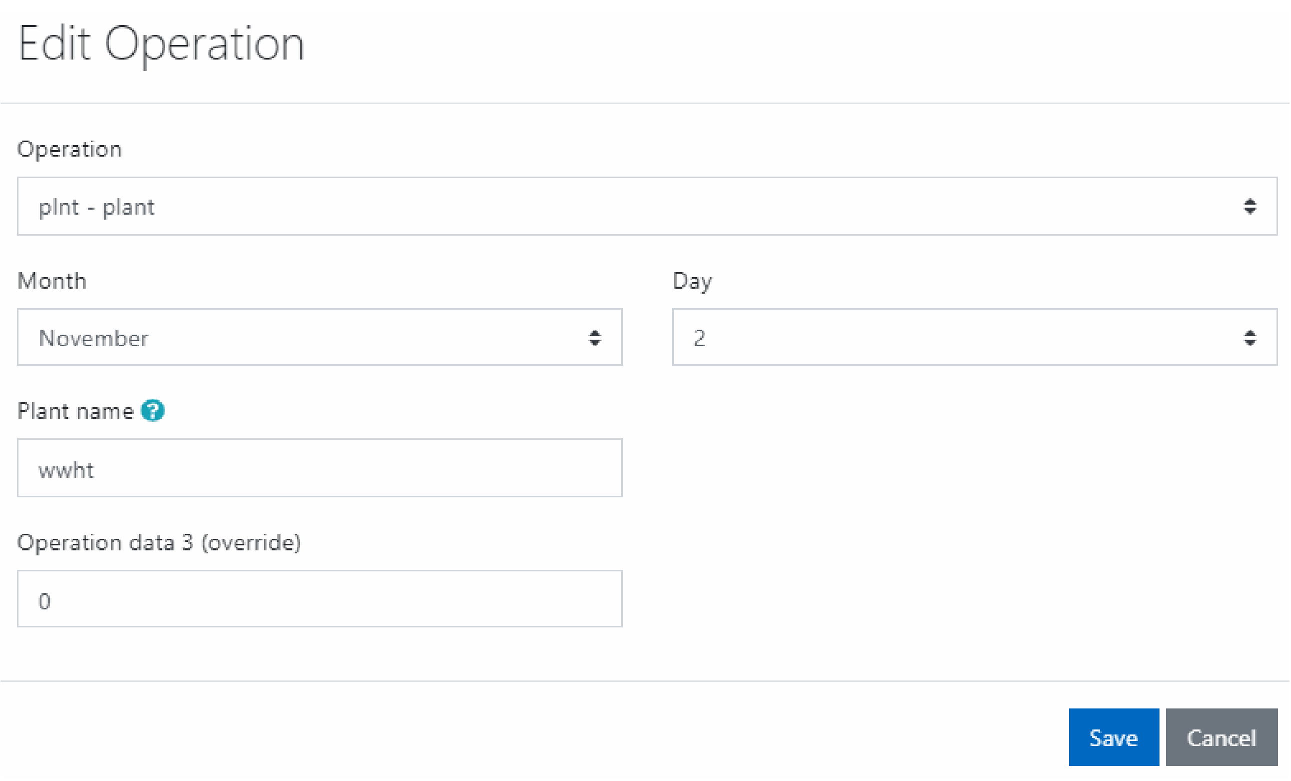
Automatic schedules

Drag and drop items to sort

Add an automatic schedule

Example of adding automatic schedules

To add an operation, click the add operation button. Select your operation type from the form that pops up and complete the remaining fields. Click save when done to add the operation to your table.



Edit Operation

Operation: plnt - plant

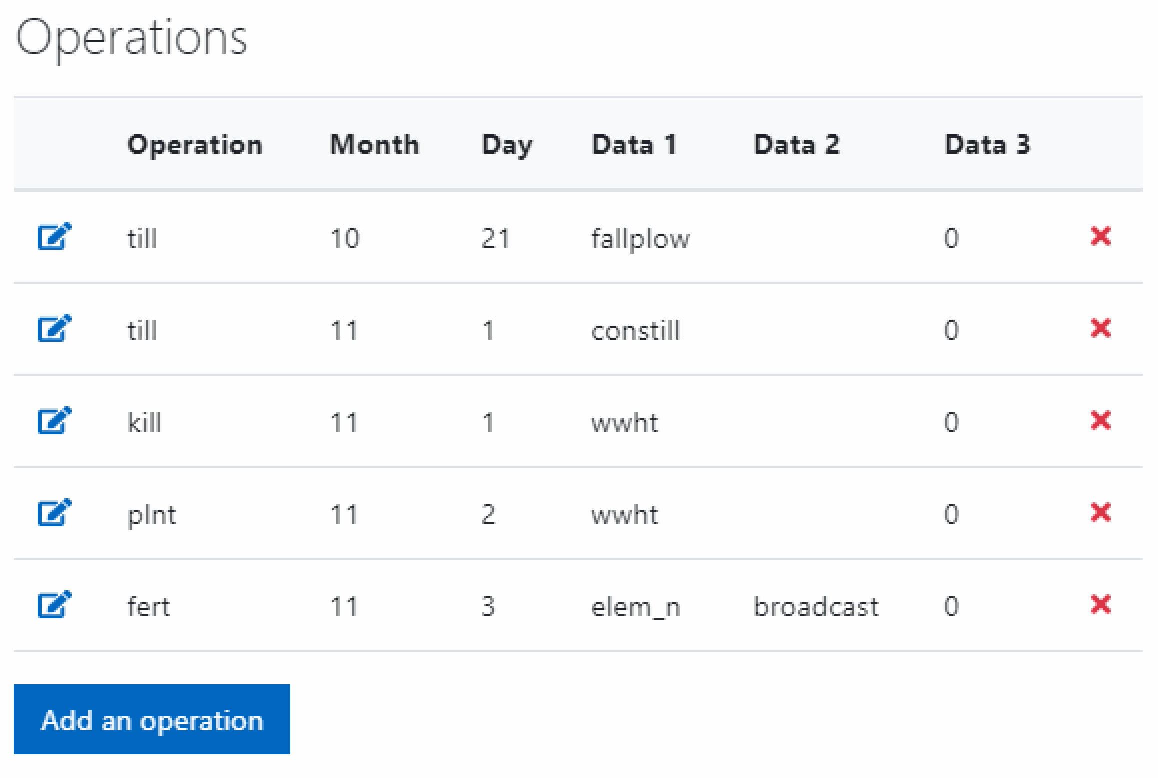
Month: November

Day: 2

Plant name: wwht

Operation data 3 (override): 0

Example of adding a plant operation



Operations

	Operation	Month	Day	Data 1	Data 2	Data 3	
✎	till	10	21	fallplow		0	✕
✎	till	11	1	constill		0	✕
✎	kill	11	1	wwht		0	✕
✎	plnt	11	2	wwht		0	✕
✎	fert	11	3	elem_n	broadcast	0	✕

Example operations table

When you're done adding automatic schedules and operations, **click the save changes button** to save your management schedule.

Table Parameters

management_sch

Field	Type	Description
id	int	Auto-assigned identifier
name	text	Name of the schedule

management_sch_auto

Field	Type	Description
id	int	Auto-assigned identifier
management_sch_id	int	ID of management schedule
d_table_id	int	ID of decision table

management_sch_op

Field	Type	Description
id	int	Auto-assigned identifier
management_sch_id	int	ID of management schedule
op_typ	text	Type of operation (see options below)
mon	int	Month operation takes place
day	int	Day operation takes place
op_data1	text	Dependent on op_typ (see options below)
op_data2	text	
op_data3	real	Override value

Operations Types

Code	Description
plnt	plant
harv	harvest only
kill	kill
hvkl	harvest and kill
till	tillage
irrm	irrigation
fert	fertilizer
pest	pesticide application
graz	grazing
burn	burn
swep	street sweep
prtp	print plant vars
skip	skip to end of the year

Operation Data 1 Values

Code	Value	Look-up Table
plnt	plant name	plants_plt
harv	plant name	plants_plt
kill	plant name	plants_plt
hvkl	plant name	plants_plt

till	tillage name	tillage_til
irrm	irrigation operation name	irr_ops
fert	fertilizer name	fertilizer_frt
pest	pesticide name	pesticide_pst
graz	graze operation name	graze_ops
burn	fire operation name	fire_ops
swep	street sweep operation name	sweep_ops
prtp	none	
skip	none	

Operation Data 2 Values

Code	Value	Look-up Table
plnt	none	
harv	harvest operation name	harv_ops
kill	none	
hvkl	harvest operation name	harv_ops
till	none	
irrm	none	
fert	chemical application operation name	chem_app_ops
pest	chemical application operation name	chem_app_ops
graz	none	
burn	none	

swep	none
prtp	none
skip	none

Operations Databases

Values in the operations tables are provided in the SWAT+ datasets database and copied to your project database during project setup. You may modify them or add new rows as needed in the editor.

Harvest

SWAT+ Input File	Database Table
harv.ops	harv_ops

Field	Type	Description	Units
id	int	Auto-assigned identifier	
name	text	Name of operation	
harv_typ	text	Harvest type: grain, biomass, residue, tree, or tuber	
harv_idx	real	Harvest index target specified at harvest	
harv_eff	real	Harvest efficiency	
harv_bm_min	real	Minimum biomass to allow harvest	kg/ha
description	text	Optional description	

Graze

SWAT+ Input File	Database Table
graze.ops	graze_ops

Field	Type	Description	Units	Range
id	int	Auto-assigned identifier		
name	text	Name of operation		
fert_id	int	ID of fertilizer from fertilizer_frt		
bm_eat	real	Dry weight of biomass removed by grazing daily	kg/ha	0-500
bm_tramp	real	Dry weight of biomass removed by trampling daily	kg/ha	0-500
man_amt	real	Dry weight of manure deposited	kg/ha	0-500
grz_bm_min	real	Minimum plant biomass for grazing to occur	kg/ha	0-5000
description	text	Optional description		

Irrigation

SWAT+ Input File	Database Table
irr.ops	irr_ops

Field	Type	Description	Units	Range
id	int	Auto-assigned identifier		
name	text	Name of operation		
irr_eff	real	Irrigation efficiency		0-1
surq_rto	real	Surface runoff ratio		0-1

irr_amt	real	Depth of application for subsurface	mm	0-100
irr_salt	real	Concentration of salt in irrigation water	mg/l	
irr_no3n	real	Concentration of nitrate in irrigation water	mg/l	
irr_po4n	real	Concentration of phosphate in irrigation water	mg/l	
description	text	Optional description		

Chemical Application

SWAT+ Input File	Database Table
chem_app.ops	chem_app_ops

Field	Type	Description	Units
id	int	Auto-assigned identifier	
name	text	Name of operation	
chem_form	text	Chemical form: liquid or solid	
app_typ	text	Application type: spread, spray, inject, direct	
app_eff	real	Application efficiency	
foliar_eff	real	Foliar efficiency	
inject_dp	real	Injection depth	mm
surf_frac	real	Surface fraction amount in upper 10mm	
drift_pot	real	Drift potential	
aerial_unif	real	Aerial uniformity	
description	text	Optional description	

Fire

SWAT+ Input File	Database Table
fire.ops	fire_ops

Field	Type	Description
id	int	Auto-assigned identifier
name	text	Name of operation
chg_cn2	real	Change in SCS curve number II value
frac_burn	real	Fraction burned
description	text	Optional description

Sweep

SWAT+ Input File	Database Table
sweep.ops	sweep_ops

Field	Type	Description
id	int	Auto-assigned identifier
name	text	Name of operation
swp_eff	real	Removal efficiency of sweeping operation
frac_curb	real	Fraction of the curb length that is sweep-able
description	text	Optional description

Curve Number Table

Values in this table are provided in the SWAT+ datasets database and copied to your project database during project setup. You may modify them or add new rows as needed in the editor.

SWAT+ Input File	Database Table
cntable.lum	cntable_lum

Field	Type	Description	Range
id	int	Auto-assigned identifier	
name	text	Name of curve number entry	
cn_a	real	Curve number for hydrologic soil group A	30-100
cn_b	real	Curve number for hydrologic soil group B	30-100
cn_c	real	Curve number for hydrologic soil group C	30-100
cn_d	real	Curve number for hydrologic soil group D	30-100
description	text	Optional description	
treat	text	Treatment/Practice	
cond_cov	text	Condition of cover	

Conservation Practices

Values in this table are provided in the SWAT+ datasets database and copied to your project database during project setup. You may modify them or add new rows as needed in the editor.

SWAT+ Input File	Database Table
cons_practice.lum	cons_practice_lum

Field	Type	Description
id	int	Auto-assigned identifier
name	text	Name of curve number entry
usle_p	real	Usle p factor
slp_len_max	real	Maximum slope length
description	text	Optional description

Overland Flow Manning's n

Values in this table are provided in the SWAT+ datasets database and copied to your project database during project setup. You may modify them or add new rows as needed in the editor.

SWAT+ Input File	Database Table
ovn_table.lum	ovn_table_lum

Field	Type	Description
id	int	Auto-assigned identifier
name	text	Name of curve number entry
ovn_mean	real	Overland flow Manning's n = mean
ovn_min	real	Overland flow Manning's n = min

ovn_max	real	Overland flow Manning's n = max
description	text	Optional description

Decision Tables

Decision tables are a precise yet compact way to model complex rule sets and their corresponding actions. Decision tables, like flowcharts and if-then-else and switch-case statements, associate conditions with actions to perform, but in many cases do so in a more elegant way (see Wikipedia article on decision tables).

Structure of decision tables:

1. Conditions
2. Condition alternatives
3. Actions
4. Action entries

Each decision corresponds to a variable, relation or predicate whose possible values are listed among the condition alternatives. Each action is a procedure or operation to perform, and the entries specify whether (or in what order) the action is to be performed for the set of condition alternatives the entry corresponds to. Many decision tables include in their condition alternatives the "don't care" symbol, a hyphen. Using "don't cares" can simplify decision tables, especially when a given condition has little influence on the actions to be performed. In some cases, entire conditions thought to be important initially are found to be irrelevant when none of the conditions influence which actions are performed.

Usage in SWAT+

There are four decision table sections in SWAT+: land use management, reservoir release, scenario land use, and flow conditions.

See the land use management documentation, under management schedules for how to choose a decision table for your HRUs.

→ Land Use Management /user/editor/inputs/land-use-management

Reservoir release decision tables are assigned from the reservoir properties section under connections in SWAT+ Editor.

Modifying Decision Tables in SWAT+ Editor

In the current version of SWAT+ editor, we do not have a GUI available for editing decision tables, however we have provided the ability to export the decision table file. You may then make changes to it in a text editor, and upload back into SWAT+ Editor.

Table Definitions

SWAT+ Input File	Database Table
lum.dtl, res_rel.dtl, scen_lu.dtl, flo_con.dtl	d_table_dtl
	d_table_dtl_cond
	d_table_dtl_cond_alt
	d_table_dtl_act
	d_table_dtl_act_out

d_table_dtl

Field	Type	Description
id	int	Auto-assigned identifier
name	text	Name of the decision table
file_name	text	File name denoting type of decision table: lum.dtl, res_rel.dtl, scen_lu.dtl, flo_con.dtl

d_table_dtl_cond

Field	Type	Description	Related Table
id	int	Auto-assigned identifier	
d_table_id	int	ID of decision table	d_table_dtl
var	text	Condition variable	
obj	text	Object variable (res, hru, etc)	
obj_num	int	Object number	
lim_var	text	Limit variable (evol, pvol, fc, etc)	
lim_op	text	Limit operator (*, +, -)	
lim_const	real	Limit constant	

d_table_dtl_cond_alt

Field	Type	Description	Related Table
id	int	Auto-assigned identifier	
cond_id	int	ID of condition	d_table_dtl_cond
alt	text	Condition alternatives (>, <, =)	

d_table_dtl_act

Field	Type	Description	Related Table
id	int	Auto-assigned identifier	
d_table_id	int	ID of decision table	d_table_dtl

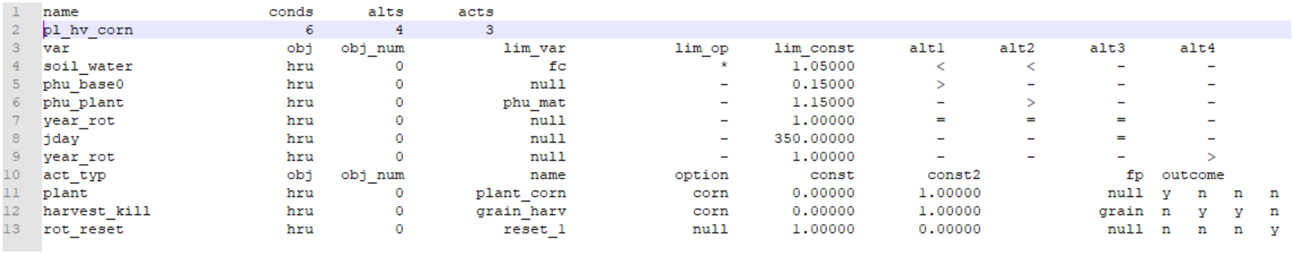
act_typ	text	Type of action (reservoir, irrigate, etc)
obj	text	Object variable (res, hru, etc)
obj_num	int	Object number
name	text	Name of action
option	text	Action option-specific to type of action (e.g., for reservoir, option to input rate, days of draw-down, weir equation pointer, etc)
const	real	Constant used for rate, days, etc
const2	real	
fp	text	Pointer for option (e.g., weir equation pointer)

d_table_dtl_act_out

Field	Type	Description	Related Table
id	int	Auto-assigned identifier	
act_id	int	ID of action	d_table_dtl_act
outcome	bool	Perform action (1 or true), or don't perform action (0 or false)	

Text File Example and Explanation

The following is an example of a decision table in the lum.dtl input file. It is a table for warm season annual crops, using continuous corn.



```
name                     conds      alts      acts
pl_hv_corn                   6         4         3
var                        obj   obj_num           lim_var            lim_op    lim_const      alt1      alt2      alt3      alt4
soil_water                 hru         0                fc                 *      1.05000         <         <         -         -
phu_base0                  hru         0              null                 -      0.15000         >         -         -         -
phu_plant                  hru         0           phu_mat                 -      1.15000         -         >         -         -
year_rot                   hru         0              null                 -      1.00000         =         =         =         -
jday                       hru         0              null                 -    350.00000         -         -         =         -
year_rot                   hru         0              null                 -      1.00000         -         -         -         >
act_typ                    obj   obj_num              name            option        const        const2                fp outcome
plant                      hru         0        plant_corn              corn      0.00000       1.00000              null  y   n   n   n
harvest_kill               hru         0        grain_harv              corn      0.00000       1.00000             grain  n   y   y   n
rot_reset                  hru         0           reset_1              null      1.00000       0.00000              null  n   n   n   y
```

In the above table, there are 6 conditions, 4 alternatives and 3 actions.

Description of the conditions

1. soil_water – if soil water is too high (> 1.50*field capacity), it will be too wet to operate machinery
2. plant_gro – ("n") Planting allowed if plant is not growing.
3. phu_base0 – (0.15) when the sum base zero heat units for the year (starting Jan 1) exceeds 0.15, indicating it's warm enough to plant
4. phu_plant – (1.15) harvest is scheduled when the sum of the heat units for the crop exceed 1.15 (if the heat units to maturity for the crop = 1500, then harvest would be scheduled at 1.15 * 1500 = 1725).
5. year_rot – needed to identify the current year of rotation. In this example, corn is grown in year 1.
6. days_plant – days since last plant (200) to ensure harvest occurs before next crop is planted.

Description of the alternatives

If all of the conditions for each alternative are met, outcomes are checked for 'y' to take action. Alternatives with dash ('-') are not checked.

1. plant corn based on heat units: if soil water < 1.50*fc and if phubase0 > 0.15*phu_mat and if year_rot = 1 then check outcomes for 'y' and if 'y', take that action (plant)
2. Harvest corn based on crop accumulated heat units: if soil_water < 1.50*fc and if phu_plant > 1.15*phu_mat and if year_rot = 1 and then check outcomes for 'y' and if 'y', take that action (plant)
3. Harvest corn based on days since planting: if year_rot = 1 and if days_plant =200 then check outcomes for 'y' and if 'y', take that action (harvest)

4. Reset rotation year: if year_rot > 1 then check outcomes for ‘y’ and if ‘y’, take that action (rot_reset)

Description of the actions

1. plant: corn – cross walked to plant name in plants.plt file
2. harvest_kill: corn – cross walked to plant name in plants.plt file grain – relates to harvest type in harv.ops file
3. rot_reset: rotation reset – for continuous corn (1 year rotation). The rotation year is reset to 1 at the end of every year.

Change/Calibration

Documentation for this section is not available yet. For now, please refer to the SWAT+ input/output documentation PDF for parameter definitions.

→ **SWAT+ IO Documentation** /user/io

Initialization Data

Documentation for this section is not available yet. For now, please refer to the SWAT+ input/output documentation PDF for parameter definitions.

→ **SWAT+ IO Documentation** /user/io

Hydrology

Documentation for this section is not available yet. For now, please refer to the SWAT+ input/output documentation PDF for parameter definitions.

→ **SWAT+ IO Documentation** /user/io

Soils

Documentation for this section is not available yet. For now, please refer to the SWAT+ input/output documentation PDF for parameter definitions.

→ SWAT+ IO Documentation /user/io

Databases

Documentation for this section is not available yet. For now, please refer to the SWAT+ input/output documentation PDF for parameter definitions.

→ **SWAT+ IO Documentation** /user/io

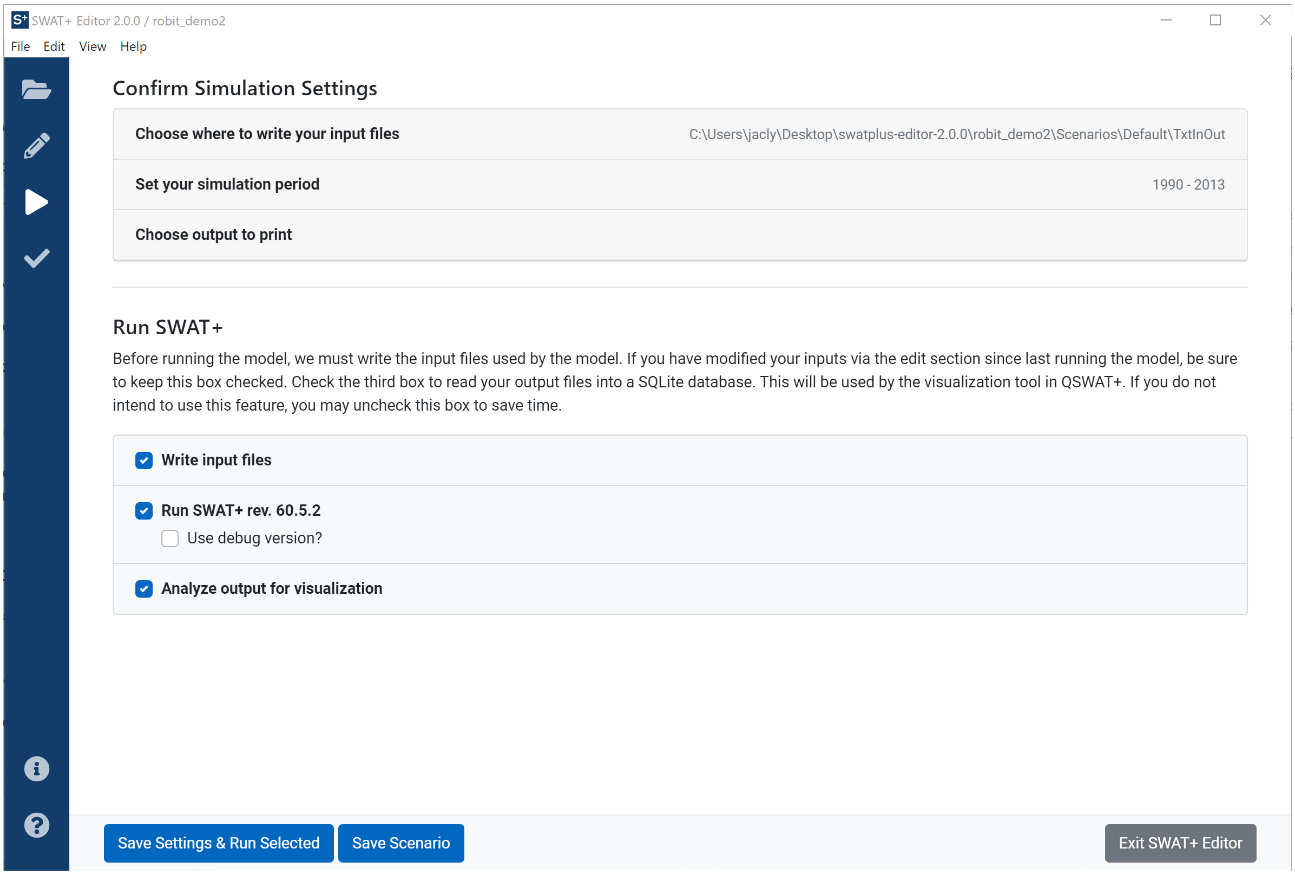
Structural

Documentation for this section is not available yet. For now, please refer to the SWAT+ input/output documentation PDF for parameter definitions.

→ **SWAT+ IO Documentation** /user/io

Run SWAT+

After writing your input files, click the play/triangle button in the leftmost blue toolbar to go to the run SWAT+ section.



Confirm Simulation Settings

Choose where to write your input files	C:\Users\jacly\Desktop\swatplus-editor-2.0.0\robit_demo2\Scenarios\Default\TxtInOut
Set your simulation period	1990 - 2013
Choose output to print	

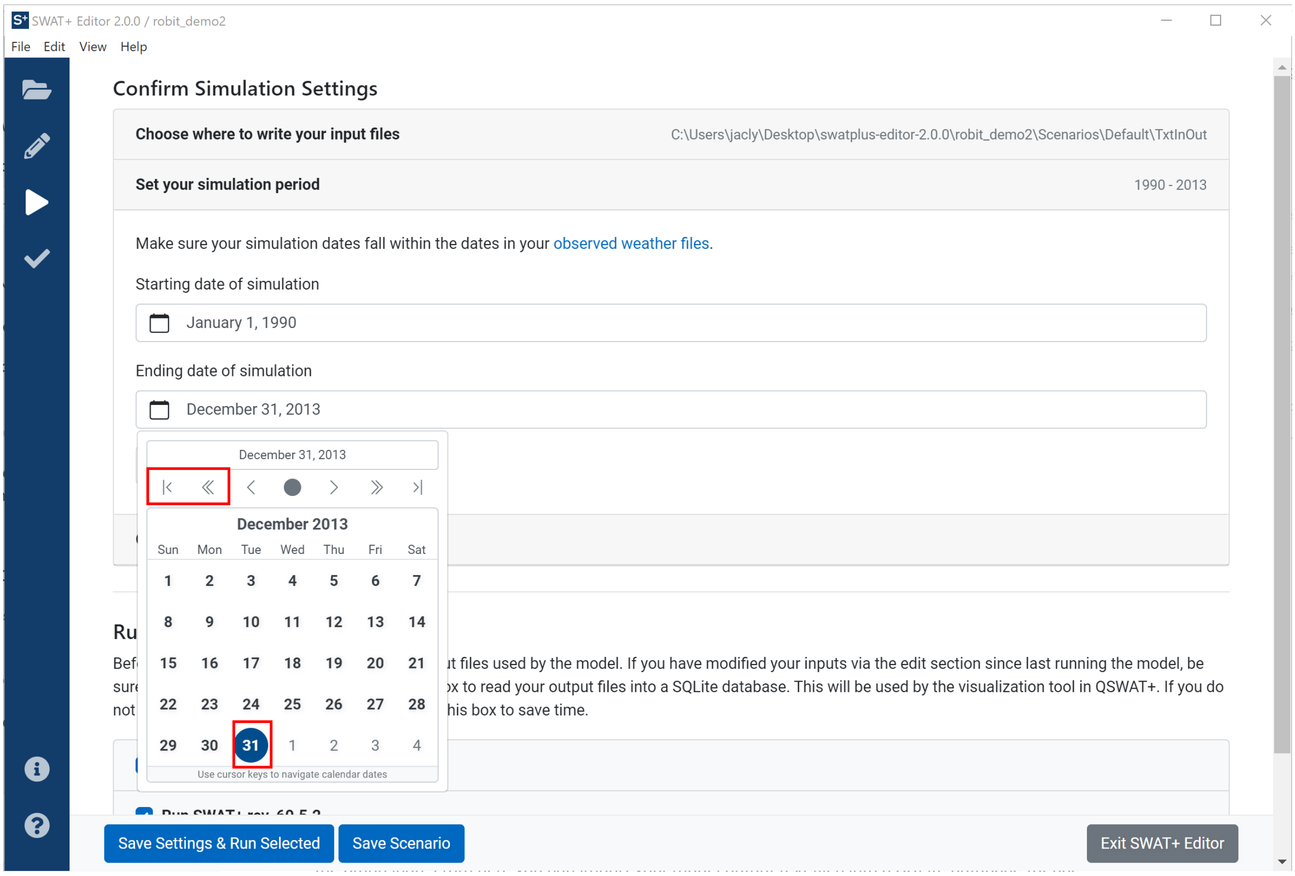
Run SWAT+

Before running the model, we must write the input files used by the model. If you have modified your inputs via the edit section since last running the model, be sure to keep this box checked. Check the third box to read your output files into a SQLite database. This will be used by the visualization tool in QSWAT+. If you do not intend to use this feature, you may uncheck this box to save time.

- ☑ **Write input files**
- ☑ **Run SWAT+ rev. 60.5.2**
  - □ Use debug version?
- ☑ **Analyze output for visualization**

You will see three sections up top to adjust your simulation settings if desired. Your input files will be saved to `[Project Directory]/Scenarios/Default/TxtInOut` by default. Click on "Set your simulation period" to adjust your starting and ending simulation dates.

When you click on a date picker, please note that you may use the arrows at the top of the date picker to move between decades and years. Then click the day on the calendar to confirm the new date.


SWAT+ Editor 2.0.0 / robit_demo2
File Edit View Help
Save Settings & Run Selected
Save Scenario
Exit SWAT+ Editor

Confirm Simulation Settings

Choose where to write your input files C:\Users\jacly\Desktop\swatplus-editor-2.0.0\robit_demo2\Scenarios\Default\TxtInOut

Set your simulation period 1990 - 2013

Make sure your simulation dates fall within the dates in your observed weather files.

Starting date of simulation

January 1, 1990

Ending date of simulation

December 31, 2013

December 31, 2013

December 2013

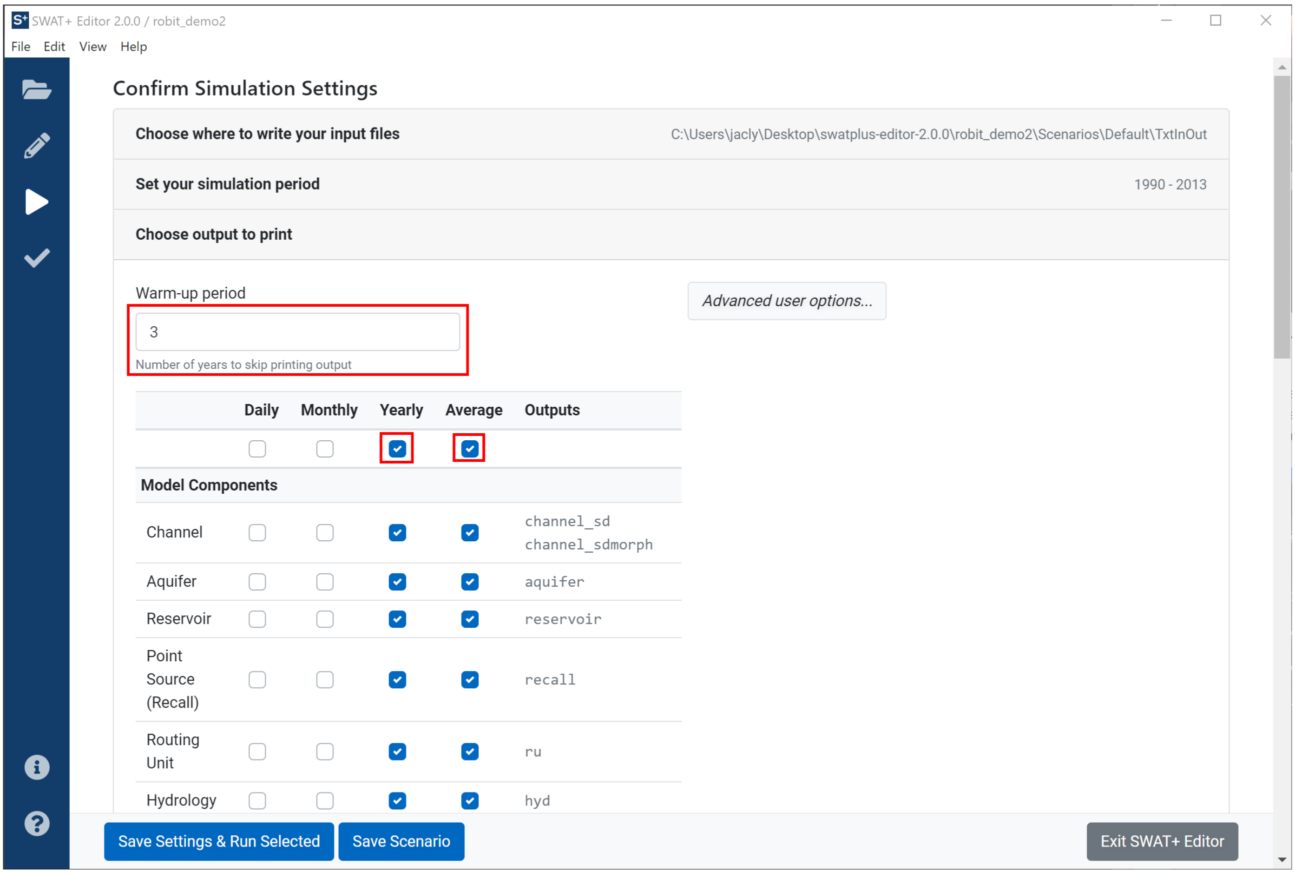
Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	1	2	3	4

Use cursor keys to navigate calendar dates

Ru

Bef ut files used by the model. If you have modified your inputs via the edit section since last running the model, be sure ox to read your output files into a SQLite database. This will be used by the visualization tool in QSWAT+. If you do not his box to save time.

Next you may choose your output to print.



Confirm Simulation Settings

Choose where to write your input files C:\Users\jacly\Desktop\swatplus-editor-2.0.0\robit_demo2\Scenarios\Default\TxtInOut

Set your simulation period 1990 - 2013

Choose output to print

Warm-up period

3

Number of years to skip printing output

	Daily	Monthly	Yearly	Average	Outputs
	□	□	☑	☑	
Model Components					
Channel	□	□	☑	☑	`channel_sd` `channel_sdmorph`
Aquifer	□	□	☑	☑	`aquifer`
Reservoir	□	□	☑	☑	`reservoir`
Point Source (Recall)	□	□	☑	☑	`recall`
Routing Unit	□	□	☑	☑	`ru`
Hydrology	□	□	☑	☑	`hyd`

Here is where you set your model warm-up period (2-5 years is recommended) and select which type of output to print. If you intend to use SWAT+ Check, be sure all yearly and annual average files are selected. Use the checkboxes in the top row of the table to select all. Click the advanced user options button on the right for more printing options, such as printing output in CSV. This will print CSV files in addition to the text files that are printed by default.

Collapse the "Choose output to print" section to see the list of run tasks.

Here is a brief description of each task:

1. **Write input files**
   Translate your data saved from the edit inputs section in your project SQLite database to text files read by SWAT+. Any time you make edits, be sure to keep this box checked to re-write your files.
2. **Run SWAT+**
   Execute a compiled version of the model.
3. **Analyze output for visualization**
   Read the output text files generated by the model into a SQLite database used for SWAT+ check and the QSWAT+ visualization tool

If you encounter an error during the model run, check the box to run the debug version (note: debug is only available on Windows) and run the model again. Copy the contents of the output error and see our SWAT+ model user group for help diagnosing the problem.

QSWAT+ Manual

QSWAT+ Manual v.2.0 QSWATPlus_Manual_v2.0.pdf - 5MB

SWAT+ IO Documentation

The SWAT+ input documentation is available as a PDF file here. However, you may also follow the SWAT+ Editor documentation through this website, as it will describe the SWAT+ input files and fields. SWAT+ output documentation is in early stages of development and may be downloaded as a PDF file below

SWAT+ Revision 60.5 Input Documentation inputs_swatplus_rev60_5.pdf - 3MB

SWAT+ Revision 60.5 Output Documentation outputs_swatplus_rev60_5.pdf - 144KB

SWAT+ Editor Documentation /user/editor

How to Use SQLite

QSWAT+ and SWAT+ Editor use a SQLite database to hold model input data to allow easy manipulation by the user. The database is structured to closely resemble the SWAT+ input text files in order to keep a clean link between the model and editor.

Opening the SQLite Database

We recommend using the SWAT+ Editor program provided to browse and edit SWAT+ input data. However, if you need to access the database, we recommend using:

- SQLite Studio

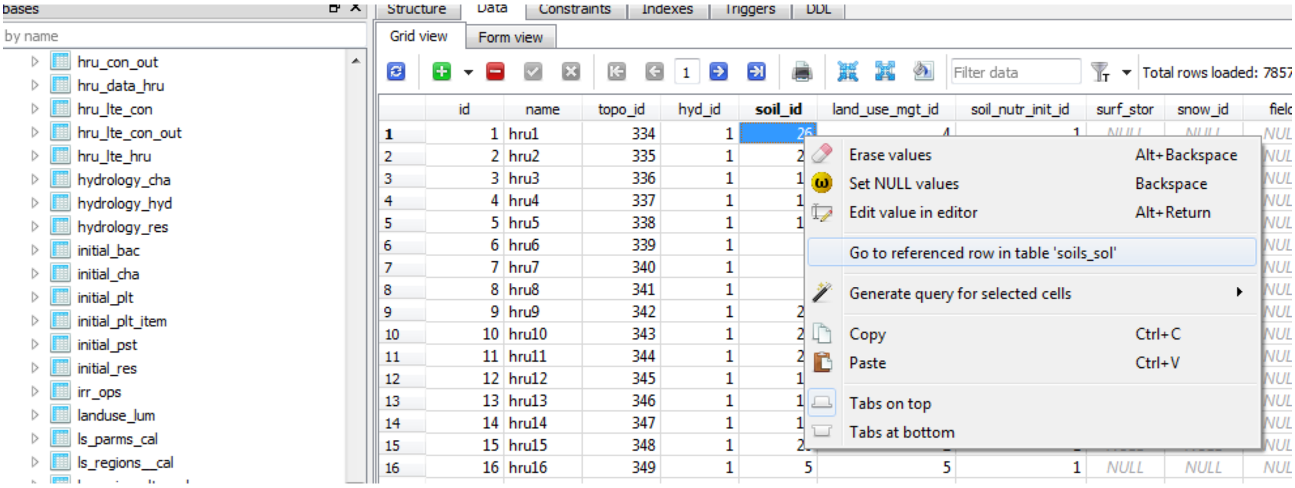
There are many other alternatives out there. A few of them are:

- DB Browser for SQLite
- SQLite Manager, Firefox Add-On

Understanding Table Relationships

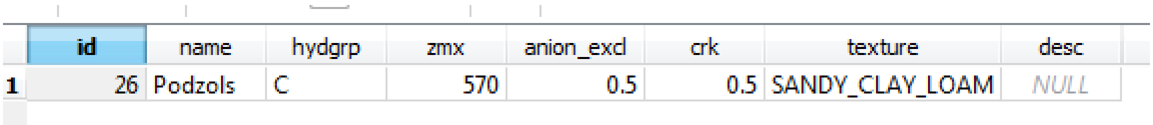
SWAT+ contains many cross-walks between files, and the database follows suit by creating foreign key relationships where applicable. In the SWAT+ text files, you will see files reference object names from another file. In the database however, these are done with an integer id. Relational databases make it easy to view the referenced row.

In SQLite Studio, right-click a foreign key id in a row of data, and select “Go to referenced row in table …” as shown in the image below. This will open the referenced row of data in a new tab.



	id	name	topo_id	hyd_id	soil_id	land_use_mgt_id	soil_nutr_init_id	surf_stor	snow_id	field
1	1	hru1	334	1	26	4	1	NULL	NULL	NUL
2	2	hru2	335	1	2					NUL
3	3	hru3	336	1	1					NUL
4	4	hru4	337	1	1					NUL
5	5	hru5	338	1	1					NUL
6	6	hru6	339	1						NUL
7	7	hru7	340	1						NUL
8	8	hru8	341	1						NUL
9	9	hru9	342	1	2					NUL
10	10	hru10	343	1	2					NUL
11	11	hru11	344	1	2					NUL
12	12	hru12	345	1	1					NUL
13	13	hru13	346	1	1					NUL
14	14	hru14	347	1	1					NUL
15	15	hru15	348	1	2					NUL
16	16	hru16	349	1	5	5	1	NULL	NULL	NUL

Results in:



	id	name	hydgrp	zmx	anion_excl	crk	texture	desc
1	26	Podzols	C	570	0.5	0.5	SANDY_CLAY_LOAM	NULL

Developer Docs

SWAT+ Editor Design

SWAT+ Editor is a program that allows users to modify SWAT+ inputs easily without having to touch the SWAT+ input text files directly. The editor will import a watershed created in QSWAT+, or allow the user to create a SWAT+ project from scratch. The user may write input files and run the SWAT+ model through the editor.

Technologies

The following software is used to create and build SWAT+ Editor:

- Node.js
- Electron
- Vue.js 2.x
- Bootstrap 4
- Python 3.x
- PyInstaller
- SQLite
- Peewee ORM

Database Design

SWAT+ Editor uses a SQLite database to hold model input data to allow easy manipulation by the user. The database is structured to closely resemble the SWAT+ ASCII text files in order to keep a clean link between the model and editor. The following conventions are used in the project database:

- The table names will match the text file names, replacing any "." or "-" with an underscore "_".
- The table column names will match the model's variable names. All names use lowercase and underscores.

- Any text file with a variable number of repetitive columns will use a related table in the database. For example, many of the connection files contain a variable number of repeated outflow connection columns (obtyp_out, obtyno_out, hytyp_out, frac_out). In the database, we represent these in a separate table, basically transposing a potentially long horizontal file to columns.
- All tables will use a numeric “id” as the primary key, and foreign key relationships will use these integer ids instead of a text name. This will allow for easier modification of these object names by the user and help keep the database size down for large projects.

A separate SQLite database containing common datasets and input metadata will be provided with SWAT+ Editor. (This is a replacement for the SWAT2012.mdb packaged with SWAT2012 versions of ArcSWAT, QSWAT, and SWATeditor.)

In addition, reformatted SSURGO and STATSGO soils databases is available for download. The structure of the soils database has been split into two tables: a soil table and soil_layer table.

Similarly, the global weather weather generator database is available for download in SQLite format. The structure of the wgn database has been split into two tables: a wgn table and wgn_monthly_value table.

Database Access in the Python API

SWAT+ Editor uses the Peewee ORM (object-relational mapping) to represent and work with the tables in Python. The use of an ORM provides a layer of abstraction and portability in hopes of streamlining future SWAT+ development projects.

Relationships are defined in a Peewee ORM python class as a `ForeignKeyField` . In the python class, the field will be named after the object it is referencing. In the database, this name will automatically be appended by the referencing table’s column name, which is usually `id` .

For example, we have two tables representing soils: soils (`soils_sol`) and layers (`soils_sol_layer`). The layer table has a foreign key to the main soils table, so we know to which soil the layer belongs. In the python class, this field is named `soil` , and in the database it is called `soil_id` .

Source Code

See the link below for information about accessing and running the source code.

→ Source Code /source-code