Hydrologic and Water Quality System (HAWQS)
HAWQS Project

- A national watershed and water quality assessment system
- Cooperative project of the:
  - USEPA
  - USDA-ARS Grassland Soil and Water Research Lab
  - AgriLIFE Research, Texas A&M University
- HAWQS 1.0 released September 2017, currently developing 2.0
SWAT Model

• SWAT is the core model in HAWQS
  • Soil Water Assessment Tool

• SWAT was developed by USDA-ARS
  • Result of over 45 years of USDA model development
  • Widely used around the world for water quality, water supply, and climate change modeling
  • 498 peer reviewed journal articles in 2017
  • Over 3474 peer reviewed journal articles in 25 years
  • Requires users to gather data for each project, download or create

• Also available for SWAT
  • SWAT-CUP (calibration and uncertainty tool)
  • SWAT Check
  • VizSWAT (visualization tool)
  • Open source version QSWAT
    • QGIS
SWAT Model cont.

• Physically based model
  • Requires specific information about weather, soil properties, topography, vegetation, land management
  • Physical processes associated with water movement, sediment movement, crop growth, and nutrient cycling are directly modeled.

• Mostly public domain databases, tools, and technology

• Benefits
  • Can be used for locations without monitoring data
  • SWAT is a robust watershed model that has been tested by users throughout the world.
SWAT Model cont.

- **Hydrology**
  - Canopy Storage and Infiltration
  - Evapotranspiration
  - Surface Runoff and Subsurface Flow
  - Base/Return Flow
  - Channel properties
  - Ponds and Reservoirs

- **Climate**
  - Optional Weather Generation
  - Snow and Soil Temperature

- **Crop and Land Management**
  - Land Surface biomass
  - Crop uptake of N & P
  - Potential evapotranspiration (PET)
  - Water, temperature, nitrogen and phosphorous stress

- **Land Management**
  - Land Cover (Crop Growth)
  - Soils
  - Tillage Practices
  - Harvesting & Grazing
  - Erosion
  - Fertilizer and Pesticides
  - Water Withdrawals and Irrigation
  - Urban Land
  - Atmospheric Deposition
• Current version of SWAT
  • ArcSWAT 12.10.19 (released Jan 24, 2018)
  • Extension in ESRI ArcMap
  • Requires user to process data to match project area
SWAT Model Output

• Nutrients (N & P)
• Sediments
• Streamflow
• Algae
• Carbonaceous biochemical oxygen demand (CBOD)
• Nitrate in surface runoff
• Most standard chloro-organic pesticides

• Trace metals
  • Upland
  • Streams
    • Cadmium (Cd)
    • Copper (Cu)
    • Nickel (Ni)
    • Lead (Pb)
    • Zinc (Zn)
HAWQS vs. SWAT

• Automatic data processing
• Internet based interface
• More efficient
  • Speeds up model setup
• Minimal computer requirements
• Multiple user access
HAWQS cont.

• Front-end web and desktop interfaces for users

• Middle-tier servers for handling user requests and responses

• Back-end database holds all SWAT related datasets and SWAT model
HAWQS Data

• Stream Networks (NHDPlus)
• Watershed boundaries (HUCS)
• Elevation Data
  • (30 and 90 meter DEM)
• Point Source
  • SPARROW
• Land Use (NLCD and CDL)
• Soils (STATSGO)
• Weather (NCDC, PRISM, NEXRAD)
• Aerial Deposition (NADP)
• Ag Data
  • USDA livestock, fertilizer, etc
HAWQS Scale

• National Scale Model (Continental USA)
  • HAWQS users select outlet of the watershed based on HUC (Hydrologic Unit Code)
  • Currently HAWQS projects are defined based on hydrological boundaries

• HAWQS watershed scale
  • 8 digit HUC (~700 sq miles)
  • 10 digit HUC (~227 sq miles)
  • 12 digit HUC (~40 sq miles)
HAWQS Calibration and Validation

• Tested model performance by adjusting input parameters in a way that the output from the model is very close to observed values.
• ~100 locations across country
• Flow, sediment, total N and P
• Current work is underway to calibrate HAWQS Nationally at the HUC 4 scale (40 sq miles)
Potential Applications

• Weather scenarios on water quality and quantity
• Benefits of conservation practice at national scale
• Point and nonpoint pollution control scenarios
• Management alternatives
  • CAFOs, fertilization, land use change
• Benefit assessment of water programs
• Development of regulations and policies
• Assessment of existing policies
• Further calibration and crowdsourcing of calibration and validation
Potential Applications cont.

• HAWQS is a continuous time model (long-term yield model). This model is not designed to simulate the effects of single events (i.e. flood routing from a single storm)
Demo 1

- Develop Baseline Scenario.
- Develop Scenario with change in landuse.
- Compare the flow and total nitrogen.
Land use
What is HAWQS?

HAWQS is an advanced, state-of-the-art total water quantity and quality modeling system with databases, interfaces and models that is being developed for the U.S. Environmental Protection Agency's Office of Water to evaluate the impacts of management alternatives, pollution control scenarios, and climate change scenarios on the quantity and quality of water at a national scale.

HAWQS is capable of supporting a wide variety of national- and regional-scale economic and policy analyses by simulating baseline and alternative water quality conditions with respect to the following water quality constituents:

- sediments
- pathogens
- nutrients
- biological oxygen demand
- dissolved oxygen
- pesticides

As an information management tool, HAWQS is a continental-scale system capable of handling large data files and intensive computations. It is designed as a distributed modeling system that allows multiple users at different locations to simultaneously access the system, perform simulations, and store results.

How does HAWQS work?

1. Log in or register for a new account to get started
2. Create a project
   - Choose a desired catchment resolution: HUC8, HUC10 or HUC12
   - Select your ending HUC ID from a map
   - Specify the model run duration and model run frequency
3. Make further customizations to your model
   - Set HRUs to eliminate minor land uses, soils and slopes
   - Edit general watershed inputs and databases (basin, fertilizer, urban)
   - Edit subbasin inputs (curve number, potholes, sediment routing)
   - Modify SWAT output by selecting reach, subbasin and HRU parameters
4. Generate SWAT Input files
5. Run the latest version of SWAT
6. Analyze your results
   - Run SWAT Check—a program designed to identify potential model problems
   - Generate output reach statistics
   - View output summary charts
   - Download a zip of all project files
### Projects

<table>
<thead>
<tr>
<th>Name</th>
<th>Last Modified</th>
<th>Rec.</th>
<th>Start HUC</th>
<th>End HUC</th>
<th># Subs</th>
<th>Area</th>
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<tr>
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<td>HUC 8</td>
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<td>07110009</td>
<td>07110009</td>
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<td>447,002.21 km²</td>
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<td>821</td>
<td>3,273,262.31 km²</td>
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<tr>
<td>VIE</td>
<td>6/1/2018 11:48 AM</td>
<td>HUC 8</td>
<td>08807810</td>
<td>08807810</td>
<td>821</td>
<td>3,273,262.31 km²</td>
</tr>
<tr>
<td>Rock River</td>
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<td>HUC 8</td>
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<td>1261</td>
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<td>07070005</td>
<td>5</td>
<td>30,508.21 km²</td>
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</tbody>
</table>

- Archives a project you are no longer using, but may want to come back to at a later date. More about archiving. You have 27 archived projects. Browse your archive.
- Permanently deletes project.

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This project was jointly sponsored by the U.S. EPA Office of Water, the USDA Agricultural Research Service, and Texas A&M AgriLife Research.
Click the map near the downstream point of your watershed to begin. The map will display the upstream HUCs of your watershed as well as other nearby HUCs.

Current position: 34.234, -117.033

Map options
- Data resolution:
  - HUC 8
- Enter a downstream HUC:
  - Go

Map legend:
- HUC in the watershed
- Downstream HUC
- HUCs surrounding downstream HUC, but not in the watershed
- Stream

Disclaimer:
You may find that the total area of a watershed in HUC 8 does not match the area of the watershed in HUC 10 or HUC 12 resolutions. Some of the 10 and 12-digit basins do not flow into the big subbasins because they are closed subbasins; i.e., the rivers do not flow out of the subbasin. watersheds area still look incorrect? Please submit an error report and we will look into it.
Click the map near the downstream point of your watershed to begin. The map will display the upstream HUCs of your watershed as well as other nearby HUCs.

Map options

- Data resolution
- HUC 10
- Enter a downstream HUC

Map legend

- HUC in the watershed
- Downstream HUC
- HUCs surrounding downstream HUC, but not in the watershed
- Stream

Create your project

The watershed shown above contains 1 subbasins and 57 HRUs from the head of the watershed to HUC 0713001006. View watershed routine.

Give your project a unique name

- Demo1

Receive an email notification when the project is set up? [Help me decide]

Advanced

Create project

Disclaimer

You may find that the total area of a watershed in HUC 8 does not match the area of the watershed in HUC 10 or HUC 12 resolutions. Some of the 10 and 12-digit basins do not flow into the big subbasins because they are closed subbasins, i.e., the rivers do not flow out of the subbasin. Watershed area still look incorrect? Please submit an error report and we will look into it.
Please wait while we generate watershed statistics and files for your new project.

You do not need to leave your browser open while tasks are running. If you selected to receive email notifications, we will email you after each task completes.
Set HRUs

You can set threshold levels to eliminate minor land use, soils, and slopes in each subbasin. This will reduce the number of HRUs in your project, allowing for quicker input file writing and SWAT model runs. Thresholds may only be modified before any scenarios are added to your project. After creating scenarios, you will need to create a new project or delete all scenarios if you want to reset thresholds.

Scenarios

Create a scenario for your project. A project scenario is where you go to customize SWAT input variables and run the model. You can create multiple scenarios and make side-by-side output comparisons.

Project Files

Create a zip of all your project files and download them to your computer for offline use. We recommend waiting until you are done running all scenarios for this project before creating this file. It may take several hours if you have multiple scenarios and your project area is large (>10,000 HRUs).

Note: Please be aware that not all watersheds are calibrated. To review the calibrations, go to the help menu.
Create a scenario

Scenario name
Baseline

Weather dataset
PRISM

Simulation start date (01/01/1931 or later)
01/01/1981

Simulation and data (12/31/2015 or earlier)
12/31/1990

Set up/warm-up years
2

Make sure your HRUs are set. They cannot be modified later.
### Scenario Settings

- **Scenario name**: Baseline
- **Weather dataset**: PRISM
- **Simulation start date**: 1/1/1981
- **Simulation end date**: 12/31/1990
- **Setup/around years**: 2
- **SWAT output print setting**: Daily
- **SWAT model version to run**: SWAT 2012 rev. 639
- **Last modified**: 8/10/2010 5:07 AM

### Run Scenario Tasks

- **Run SWAT input files**: Reiver
- **Run SWAT output files**: Reiver
- **Process SWAT output files**: Reiver
- **Receive email notifications when tasks complete**: Reiver

### Customize SWAT Input Data

**General watershed inputs and databases**

- Basic input data
- Fertilizer input data
- Runoff efficiency
- Urban input data
- Land use update
- Weather data
- Climate equation
- Climate sensitivity/variability analysis
- Channel constant
- Subbasin inputs
- Curve number
- Entropy variables
- Sediment
- Source method
- Point source
- SWAT output to print
- Reach, subbasin, and HRU variables to print
- hills to print
Projects ▶ Demo1

Scenarios

<table>
<thead>
<tr>
<th>Name</th>
<th>Last Modified</th>
<th>Start</th>
<th>End</th>
<th>Skip</th>
<th>Print</th>
</tr>
</thead>
</table>

Create a scenario

Project Files

Create a zip of all your project files and download them to your computer for offline use. We recommend waiting until you are done running all standards for this project before creating this file. It may take several hours if you have multiple scenarios and your project is large (>10,000 HRUs).

Create zip of project files

Receive an email when complete?

Project Documents

You don't have any documents uploaded for this project.

Upload a new document

Project Error Reports

You don't have any error reports submitted for this project.

Create a new error report

Note: Please be aware that not all watersheds are calibrated. To review the calibrations, go to the help menu.
The land use update file (lup.dat) is an optional file which allows HRU fraction updating during a simulation run. The lup.dat file is particularly useful to initialize conservation measures mid-simulation. After their initialization, the practices remain in effect for the remainder of the simulation.

The lup.dat file must contain five parameters per line: sequential number, month, day, year, and name of the file that contains the fraction update. You are restricted to 25 lines in lup.dat. Each file referenced in lup.dat must reserve the first line for comments, then for each line after contain the HRU number and updated HRU fraction value. The number of HRUs in the file must match the number of HRUs in your project or you will receive an error. In addition, the HRU fraction for each subbasin in your project must add up to one.

Download model files containing the file structure needed for your project.

Download project HRUs

Read the instructions for accommodation check or land use update.
Projects > Demo1 > Landuse > Land use update

The land use update file (lup.dat) is an optional file which allows HRU fraction updating during a simulation run. The lup.dat file is particularly useful to initialize conservation measures mid-simulation. After their initialization, the practices remain in effect for the remainder of the simulation.

The lup.dat file must contain five parameters per line: sequential number, month, day, year, and name of the file that contains the fraction update. You are restricted to 25 lines in lup.dat. Each file referenced in lup.dat must reserve the first line for comments, then for each line after contain the HRU number and updated HRU fraction value. The number of HRUs in the file must match the number of HRUs in your project or you will receive an error. In addition, the HRU fraction for each subbasin in your project must add up to one.

Download a sample zip file containing the file structure needed for your project.

Upload land use update zip file
Choose File: No file chosen
Upload file  Cancel and go back to scenario
1 1 1 1981 LupInput0.dat
LupInputO.dat file for hru fraction reset

1  0.00470
2  0.00220
3  0.00160
4  0.000320
5  0.02680
6  0.02760
7  0.00070
8  0.000180
9  0.011450
10 0.000520
11 0.000090
12 0.000320
13 0.221650
14 0.000960
15 0.000450
16 0.000550
17 0.150740
18 0.002370
19 0.000060
20 0.010770
21 0.000030
22 0.001090
23 0.000010
24 0.000390
25 0.000030
26 0.003660
27 0.123800
28 0.338550
29 0.005110
30 0.019230
31 0.022740
32 0.000050
33 0.003100
34 0.020700
35 0.06000
36 0.005050
37 0.002260
38 0.000150
39 0.000150
40 0.000250
41 0.000080
42 0.000450
43 0.002160
44 0.223650
45 0.000020
46 0.000020
47 0.000010
Each Subbasin fraction must add up to 1.0

An HRU (Hydraulic Response Unit) is a combination of a unique subbasin, landuse, slope, soil.
LupInput0.dat file for hru fraction reset

1  0.002235
2  0.00023
3  0.00016
4  0.00012
5  0.16261121
6  0.01393
7  0.010335
8  0.00818
9  0.01145
10 0.00002
11 0.00009
12 0.00032
13 0.110925
14 0.00448
15 0.00045
16 0.000275
17 0.07537
18 0.01462281
19 0.00006
20 0.005385
21 0.00003
22 0.00109
23 0.000005
24 0.00039
25 0.0001855089
26 0.00153
27 0.2238
28 0.25783982
29 0.00511
30 0.01923
31 0.02274
32 0.00005
33 0.0031
34 0.0207
35 0.006
36 0.000252
37 0.00113
38 0.00015
39 0.002282761
40 0.00025
41 0.00008
42 0.000049
43 0.000216
44 0.111823
45 0.00002
46 0.00002
47 0.00001
Projects > Demo1 > Landuse > Land use update

The land use update file (lup.dat) is an optional file which allows HRU fraction updating during a simulation run. The lup.dat file is particularly useful to initialize conservation measures mid-simulation. After their initialization, the practices remain in effect for the remainder of the simulation.

The lup.dat file must contain five parameters per line: sequential number, month, day, year, and name of the file that contains the fraction update. You are restricted to 25 lines in lup.dat. Each file referenced in lup.dat must reserve the first line for comments, then for each line after contain the HRU number and updated HRU fraction value. The number of HRUs in the file must match the number of HRUs in your project or you will receive an error. In addition, the HRU fraction for each subbasin in your project must add up to one.

Download a sample zip file containing the file structure needed for your project.
Download your project HRUs.
Read the SWAT2012 3D Documentation chapter on land use update.

✓ Your changes have been saved 8/16/2018 11:47 AM. Download your data or click here to remove all changes and not use a land use update file.

Upload land use update zip file
Choose File
Upload file
Cancel and go back to scenario
**Scenario Settings**

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<tr>
<th>Scenario name</th>
<th>Landuse</th>
<th>Last run</th>
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<tr>
<td>Weather dataset</td>
<td>PRISM</td>
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<td>Simulation start date</td>
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<td>Simulation end date</td>
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<td>Setup/warm-up years</td>
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<tr>
<td>SWAT output print scaling</td>
<td>Daily</td>
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<td>SWAT model version to run</td>
<td>SWAT 2012 rev. 659</td>
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**Run Scenario Tasks**

- Write SWAT input files
- Write SWAT output files
- Run SWAT 2012 rev. 659
- Process SWAT output files

**Customize SWAT Input Data**

- General watershed inputs and databases
- Weather data
  - Climate scenarios
  - Climate sensitivity/sensitivity analysis
- Subbasin inputs
  - Curve number
  - Pothole variables
  - Sediment delivery method
  - Point source
  - SWAT output to print
  - Reach, subzone, and HRU activation to print
  - HRUs to warn
Calculating output reach statistics is a two-step process. Processing statistics can take several minutes or hours depending on your model size and number of years simulated, so we want to give you the option of selecting several types of statistics then processing them all at once. Read more on how this page works.

1. Request reach output statistics

   Values: Load/Flow Duration Curve

   Variables:
   - Select all/inone
   - FLOW_IN
   - FLOW_OUT
   - EVAP
   - TLOSS
   - SBD_IN
   - SED_OUT
   - SEDCONC
   - LOCAL_IN

   Subbasins:
   - Select all/inone
   - 0713001053

2. Process data

   CSV of output reach data
   Download
   This file will include total N and total P concentrations if total N and total P were selected as [reach output variables] before you ran SWAT.

   Note: Please be aware that not all watersheds are calibrated. To review the calibrations, go to the help menu.
Calculating output reach statistics is a two-step process. Processing statistics can take several minutes or hours depending on your model size and number of years simulated, so we want to give you the option of selecting several types of statistics rather than processing them all at once. Read more on how this page works.

1. Request reach output statistics

   - **Variables:**
     - Average
     - TOT N

   - **Variables:**
     - BED_PST
     - BACTP_OUT
     - BACTP_POUT
     - CUETAL1
     - CUETAL2
     - CUETAL3
     - TOT_N
     - TOT_P
     - NO3INC

   - **Subbasins:**
     - Select all/none
     - 0713001103

2. Process data

   - [Download CSV of output reach data]
     - This file will include total N and total P concentrations if total N and total P were selected as reach output variables before you ran SWAT.

   Note: Please be aware that not all watersheds are calibrated. To review the calibrations, go to the help menu.
Calculating output reach statistics is a two-step process. Processing statistics can take several minutes or hours depending on your model size and number of years simulated, so we want to give you the option of selecting several types of statistics than processing them all at once. Read more on how this page works.

1. Request reach output statistics

- Your changes have been saved. Your new request is listed under 2. Process data.

<table>
<thead>
<tr>
<th>Values</th>
<th>Load/Flow Duration Curve</th>
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</thead>
<tbody>
<tr>
<td>Variables</td>
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<tr>
<td></td>
<td>CMFIA#2</td>
</tr>
<tr>
<td></td>
<td>CMFIA#3</td>
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<td>TOT_N</td>
</tr>
<tr>
<td></td>
<td>TOT_P</td>
</tr>
<tr>
<td></td>
<td>NO3CONC</td>
</tr>
</tbody>
</table>

2. Process data

- CSV of output.rch data
  - This file will include total N and total P concentrations if total N and total P were selected as reach output variables before you ran SWAT.

- Unprocessed: Average
  - Variables: FLOW_OUT, TOT_N
  - Subbasins: 0713001008
  - Submitted: 2/16/2018 11:41 AM

Click the button below to process all items marked unprocessed above.

- Receive an email notification when processing is complete?

- Process data

Note: Please be aware that not all watersheds are calibrated. To review the calibrations, go to the help menu.
Calculating output reach statistics is a two-step process. Processing statistics can take several minutes or hours depending on your model size and number of years simulated, so we want to give you the option of selecting several types of statistics then processing them all at once. Read more on how this page works.

1. Request reach output statistics

- Your changes have been saved. Your new request is listed under 2. Process data.

Values: Load/Flow Duration Curve

Variables:
- FLOW_IN
- FLOW_OUT
- EVAP
- TLOSS
- NRTN
- SED_IN
- SED_OUT
- CHL

Subbasins:
- Select all/none
- 0713001003

2. Process data

CSV of output reach data

The file will include total N and total P concentrations if total N and total P were selected at reach output setup before you ran SWAT.

Download

Note: Please be aware that not all watersheds are calibrated. To review the calibrations, go to the help menu.
Projects > Demo1 > Baseline > Output reach data > Charts

Create a chart from your output reach statistics data request. Select a subbasin and your variables to plot below. For each variable, you can choose the chart type (e.g., line, area, column, etc.) and if you want it to have its own y-axis. Download CSV of your request data.

Subbasin: 0713001083

Variables:
- FLOW_OUT
  - Add y-axis?
  - Chart type: line
- TOT_N
  - Add y-axis?
  - Chart type: line

Attempt to align y-axis?
Calculating output reach statistics is a two-step process. Processing statistics can take several minutes or hours depending on your model size and number of years simulated, so we want to give you the option of selecting several types of statistics then processing them all at once. Read more on how this page works.

1. Request reach output statistics
   - Values: Load/Flow Duration Curve
   - Variables: Select one or more variables
   - Subbasins: Select one or more subbasins

2. Process data
   - CSV of output reach data
     - Download
     - Charts

Note: Please be aware that not all watersheds are calibrated. To review the calibrations, go to the help menu.
Results – Flow
Results – Total Nitrogen
### Scenario Settings

<table>
<thead>
<tr>
<th>Scenario name</th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weather dataset</td>
<td>FRISM</td>
</tr>
<tr>
<td>Simulation start date</td>
<td>1/1/1981</td>
</tr>
<tr>
<td>Simulation end date</td>
<td>12/31/1990</td>
</tr>
<tr>
<td>Set-up/warm-up years</td>
<td>2</td>
</tr>
<tr>
<td>SWAT output print setting</td>
<td>Daily</td>
</tr>
<tr>
<td>SWAT model version to run</td>
<td>SWAT 2012 rev. 659</td>
</tr>
<tr>
<td>Last modified</td>
<td>8/10/2013 11:11 AM</td>
</tr>
</tbody>
</table>

### Run Scenario Tasks

- Rewrite SWAT input files  
  Last run: 8/10/2016 11:10 AM
- Write SWAT editor tables  
  Last run: Never
- Rerun SWAT 2012 rev. 659 (time estimate)  
  Last run: 8/10/2016 11:10 AM
- Reprocess SWAT output files  
  Last run: 8/10/2016 11:10 AM
- Receive email notifications when tasks complete? (Data we decide)  
  Last run: Never

### Scenario Output Data

- SWAT 2012 rev. 659 execution results
  - Output summary chart
  - Download input txt
  - Download output std
  - Run SWAT Check to identify potential model problems
### Scenario Settings

<table>
<thead>
<tr>
<th>Scenario name</th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weather dataset</td>
<td>PRISM</td>
</tr>
<tr>
<td>Simulation start date</td>
<td>1/1/1991</td>
</tr>
<tr>
<td>Simulation end date</td>
<td>12/31/1990</td>
</tr>
<tr>
<td>Set-up/warm-up years</td>
<td>2</td>
</tr>
<tr>
<td>SWAT output print setting</td>
<td>Daily</td>
</tr>
<tr>
<td>SWAT model version to run</td>
<td>SWAT 2012 rev. 659</td>
</tr>
<tr>
<td>Last modified</td>
<td>8/10/2018 11:11 AM</td>
</tr>
</tbody>
</table>

### Customize SWAT Input Data

- General watershed inputs and databases
  - Basin input data
  - Fertilizer input data
  - Nutrient efficiency:
  - Urban input data
  - Land use update
- Weather data
  - Climate scenarios
  - Climate sensitivity/variability analysis
  - User driven

---

### Run Scenario Tasks

- Re-run SWAT input files: 8/10/2018 11:11 AM
- Verify SWAT editor settings
- Re-process SWAT output file: 8/10/2018 11:11 AM
- Receive email notifications when tasks complete?
  - [ ] (keep me updated)

---

### 1st Scenario Output Data

- SWAT 2012 rev. 659 execution results:
  - Output reach data
  - Output summary charts
  - Download input.txt
  - Download output.txt

---

Run SWAT Check to identify potential model problems
SWAT Check extracts modal output from a SWAT project and performs many simple checks to identify potential modeling problems. The intended purpose of this program is to identify modeling problems early in the modeling process. Modelling problems often result in the need to recalibrate or redevelop a model, resulting in an unacceptably large time investment. This program is designed to compare a variety of SWAT outputs to nominal ranges based on the judgement of model developers. A warning does not necessarily indicate a problem; the purpose is to bring attention to unusual predictions. This software also provides a visual representation of various model outputs to aid in user training.

Simulation Details

Hydrology

Realistic hydrology is the foundation of any model. Pay particular attention to subwatershed operation, basin flow and surface runoff. Basin flow/streamflow ratios for the US are provided by the USGS; these data are accessible via the button below. The ranges specified here are general guidelines only, and may not apply to your simulation area.

View average monthly basin values
View US basin flow ratios

Water Balance Ranges

<table>
<thead>
<tr>
<th>Water Balance Ranges</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streamflow/Precip</td>
<td>0.321</td>
</tr>
<tr>
<td>Basinflow/Total Flo</td>
<td>0.037</td>
</tr>
<tr>
<td>Surface Runoff/Total Flow</td>
<td>0.963</td>
</tr>
<tr>
<td>Precip/Precip</td>
<td>0.007</td>
</tr>
<tr>
<td>Deep Recharge/Precip</td>
<td>0.000</td>
</tr>
<tr>
<td>ET/Precip</td>
<td>0.782</td>
</tr>
</tbody>
</table>

Messages and Warnings

- Surface runoff ratio may be high (>0.8)
- Groundwater ratio may be low
Projects > Demo1 > Metadata

This page lists your SWAT input data settings for each scenario in your project.

Watershed

<table>
<thead>
<tr>
<th>Name</th>
<th>Data Resolution</th>
<th>Starting HUC ED</th>
<th>Ending HUC ED</th>
<th>Number of Subbasins</th>
<th>Project Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demo1</td>
<td>HUC 10</td>
<td>Hood</td>
<td>07100103</td>
<td>1</td>
<td>579.04 km²</td>
</tr>
</tbody>
</table>

HRUs

<table>
<thead>
<tr>
<th>Number of HRUs</th>
<th>Land Use Threshold</th>
<th>Soil Type Threshold</th>
<th>Slope Class Threshold</th>
<th>Land Use Classes Exempted</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>

Scenarios

<table>
<thead>
<tr>
<th>Scenario Name</th>
<th>SWAT Version</th>
<th>Simulation Start Date</th>
<th>Simulation End Date</th>
<th>Set-up/Warm-up Years</th>
<th>Print Setting</th>
<th>Climate Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>SWAT 2012 Rev.6E59</td>
<td>1/1/1981</td>
<td>12/31/1990</td>
<td>2</td>
<td>Daily</td>
<td>Actual climate data</td>
</tr>
<tr>
<td>Landscape</td>
<td>SWAT 2012 Rev.6E59</td>
<td>1/1/1981</td>
<td>12/31/1990</td>
<td>2</td>
<td>Daily</td>
<td>Actual climate data</td>
</tr>
</tbody>
</table>

Basin Input Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range</th>
<th>Units</th>
<th>SWAT Default</th>
<th>Baseline</th>
<th>Landscape</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDFDOC</td>
<td>0 to 5</td>
<td>°C</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>NDFDSC</td>
<td>-5 to 5</td>
<td>°C</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>NDFDOC</td>
<td>0 to 0.5</td>
<td>°C</td>
<td>4.5</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>NDFDOC</td>
<td>0 to 0</td>
<td>°C</td>
<td>4.5</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>SWAT</td>
<td>0 to 1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>SWAT</td>
<td>0 to 1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>SWAT</td>
<td>0 to 1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>SWAT</td>
<td>0 to 1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range</th>
<th>Units</th>
<th>SWAT Default</th>
<th>Baseline</th>
<th>Landscape</th>
</tr>
</thead>
<tbody>
<tr>
<td>2NDDOC</td>
<td>0.5 to 1</td>
<td>°C</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>2NDDOC</td>
<td>0.5 to 2</td>
<td>°C</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3EROC</td>
<td>0 to 0</td>
<td>°C</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3EROC</td>
<td>0 to 24</td>
<td>°C</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Basin - Water Balance

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range</th>
<th>Units</th>
<th>SWAT Default</th>
<th>Baseline</th>
<th>Landscape</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZON</td>
<td>0</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ZEROGS</td>
<td>0.5 to 2</td>
<td>°C</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>ZEROGS</td>
<td>4</td>
<td></td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>
Projects > Demo1

Scenarios

<table>
<thead>
<tr>
<th>Name</th>
<th>Last Modified</th>
<th>Start</th>
<th>End</th>
<th>Skip</th>
<th>Print</th>
</tr>
</thead>
</table>

Create a scenario

Project Files

Create a zip of all your project files and download them to your computer for offline use. We recommend waiting until you are done running all scenarios for this project before creating this file. It may take several hours if you have multiple scenarios and your project is large (>10,000 HRUs).

Create zip of project files

Receive an email when complete?

Project Documents

You don't have any documents uploaded for this project.

Upload a new document

Project Error Reports

You don't have any error reports submitted for this project.

Create a new error report

HUC 10 Watershed - Head to 0743041002

Hover over a subbasin

Project areas: 57.84 km²

Number of subbasins: 1

Number of HRUs: 57

Review your HRUs View metadata Change project name

Note: Please be aware that not all watersheds are calibrated. To review the calibrations, go to the help menu.
Demo 2

• Develop Baseline Scenario.
• Increase and decrease precipitation by 5%.
<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set-up/warm-up years</td>
<td>2</td>
</tr>
<tr>
<td>SWAT output print setting</td>
<td>Daily</td>
</tr>
<tr>
<td>SWAT model version to run</td>
<td>SWAT 2012 rev. 659</td>
</tr>
<tr>
<td>Last modified</td>
<td>8/8/2018 1:38 PM</td>
</tr>
</tbody>
</table>

### Customize SWAT Input Data

- **General watershed inputs and databases**
  - Last modified: 8/8/2018 1:35 PM
  - Basin Input data
  - Fertilizer Input data
  - Nutrient efficiency
  - Urban Input data
  - Land Use update

- **Weather data**
  - Climate scenarios
    - Climate Sensitivity/variability analysis
      - Last modified: 8/8/2018 1:35 PM
    - Weather generator

- **Subbasin inputs**

### Scenario Output Data

- SWAT 2012 rev. 659 execution results
  - Output reach data
  - Output summary charts
  - Download input.std
  - Download output.std

- Run SWAT Check to identify potential model problems
Adjust monthly rainfall and temperature for each subbasin in your project. Read the SWAT2012 IQ documentation chapter on subbasin inputs, see page 6 for climate sensitivity variables.

You last saved changes to your climate sensitivity data 8/8/2018 1:35 PM. Click here to remove all changes and use the default climate sensitivity data.

Increase or decrease rainfall by up to 100%:

Increase or decrease temperature by up to 20°C:

Apply to all subbasins and months

Saved climate sensitivity/variability analysis modifications

NOTE: Each row below is applied in order, starting from the top. Bottom settings may overwrite rows above. Click here to remove all changes and use the default climate sensitivity data.

<table>
<thead>
<tr>
<th>RFINC %</th>
<th>TMPINC °C</th>
<th>Subbasins</th>
<th>Months</th>
<th>Added</th>
</tr>
</thead>
<tbody>
<tr>
<td>5%</td>
<td>0°C</td>
<td>All</td>
<td>All</td>
<td>8/8/2018 1:35 PM</td>
</tr>
</tbody>
</table>
Run Scenario Tasks

- Re-write SWAT input files  8/8/2018 1:36 PM
- Write SWAT editor tables  Never
- Re-run SWAT 2012 rev. 659  8/8/2018 1:36 PM
- Re-process SWAT output files  8/8/2018 1:36 PM
- Receive email notifications when tasks complete? (Help me decide)

Run selected tasks

Projects > Illinois Demo > Precipitation +5% > Output reach data

Calculating output reach statistics is a two-step process. Processing statistics can take several minutes or hours depending on your model size and number of years simulated, so we want to give you the option of selecting several types of statistics then processing them all at once. Read more on how this page works.

1. Request reach output statistics

- Values:
  - Average

- Variables:
  - Select all-none
  - FLOW_IN
  - FLOW_OUT
  - EVAP
  - TLOSS
  - SED_IN
  - SED_OUT
  - SEDCONC

2. Process data

CSV of output.rch data
- Download
- Charts

Note: Please be aware that not all watersheds are calibrated. To review the calibrations, go to the help menu.

Request statistics
Cancel and go back to scenario

Scenario Output Data

- SWAT 2012 rev. 659 execution results
  - Output reach data
  - Output summary charts
  - Download input std
  - Download output std

Run SWAT Check to identify potential model problems
HAWQS incorporates twelve CMIP5 Models. These inputs are only available at the HUC 8 and 10 resolutions. Read more about Global Circulation Model (GCM) inputs.

Select a climate model:
- GFDL-CM3

Select a time series:
- Future data (2006-2099)

Select a scenario:
- Select an option...
- RCP45
- RCP85
Questions?