



UCAM
UNIVERSIDAD
CATÓLICA DE MURCIA

User Manual of MapSWAT

A QGIS extension for preparing SWAT input maps.

Adrián López Ballesteros* (alopez6@ucam.edu)

Javier Senent Aparicio (jsenent@ucam.edu)

Patricia Jimeno Sáez (pjimeno@ucam.edu)

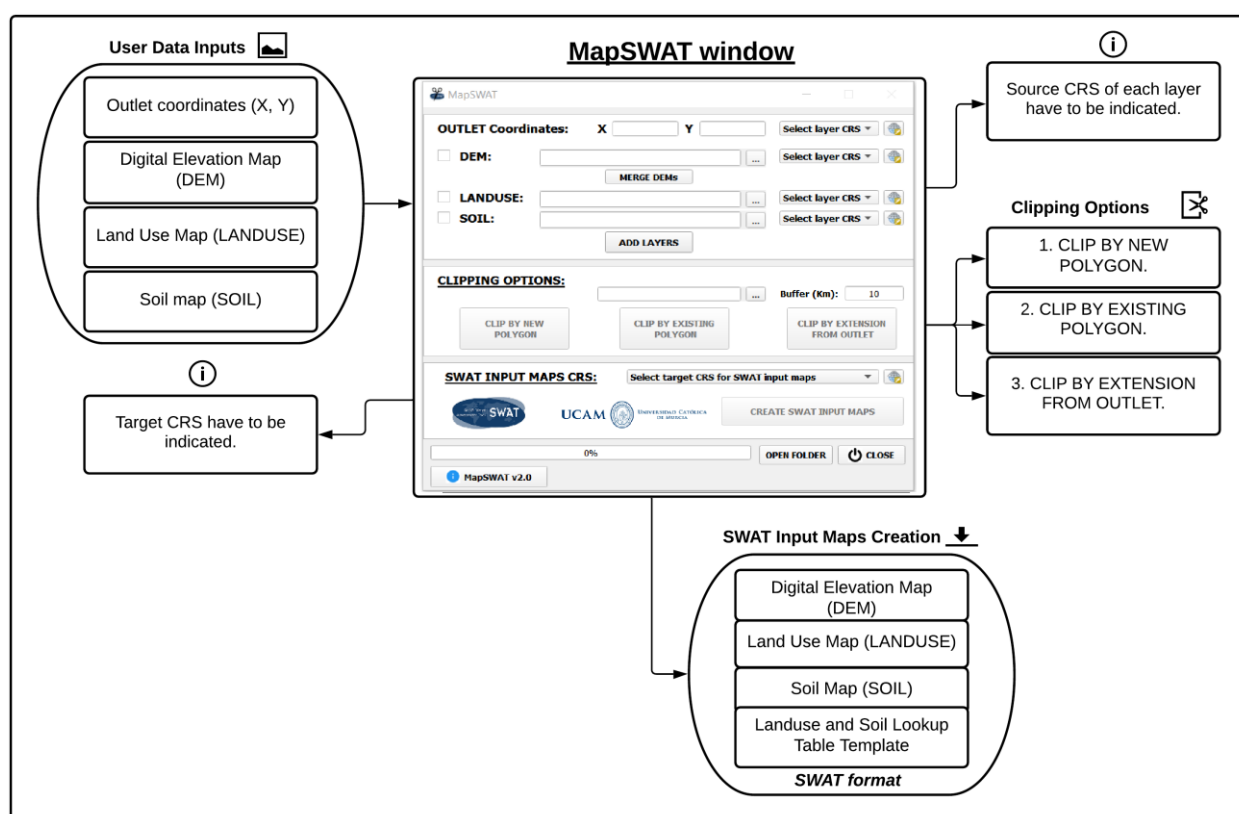
Julio Pérez Sánchez (jperez058@ucam.edu)

Department of Civil Engineering, Catholic University of San Antonio (UCAM), Murcia, Spain.

1. Introduction.	3
2. Installing MapSWAT.	4
3. Before using MapSWAT.	5
4. MapSWAT setup.	6
4.1. User Data Inputs.	7
4.2. Clipping Options.	11
4.3. SWAT Input Maps Creation.	15
4.4. Opening the MapSWAT folder.	17
4.5. Closing the MapSWAT plugin.	18
4.6. About MapSWAT.	19
5. How to use MapSWAT files in QSWAT or QSWAT+.	19

1. Introduction.

MapSWAT is a plugin for QGIS developed using Python 3 programming language. This plugin is valid for any QGIS 3 version, although we recommend using the long term release version. MapSWAT allows the preparation of input maps for both versions of SWAT (Soil and Water Assessment Tool), SWAT2012 and SWAT+. Preprocessing of SWAT input data can be a laborious task. MapSWAT was developed to optimize and reduce the time of SWAT input maps preprocessing as well as avoid possible errors due to required format by SWAT.



Input maps required by the SWAT model are: a digital elevation map (DEM), a land use map (LANDUSE) and a soil map (SOIL). The main window is divided in three parts:

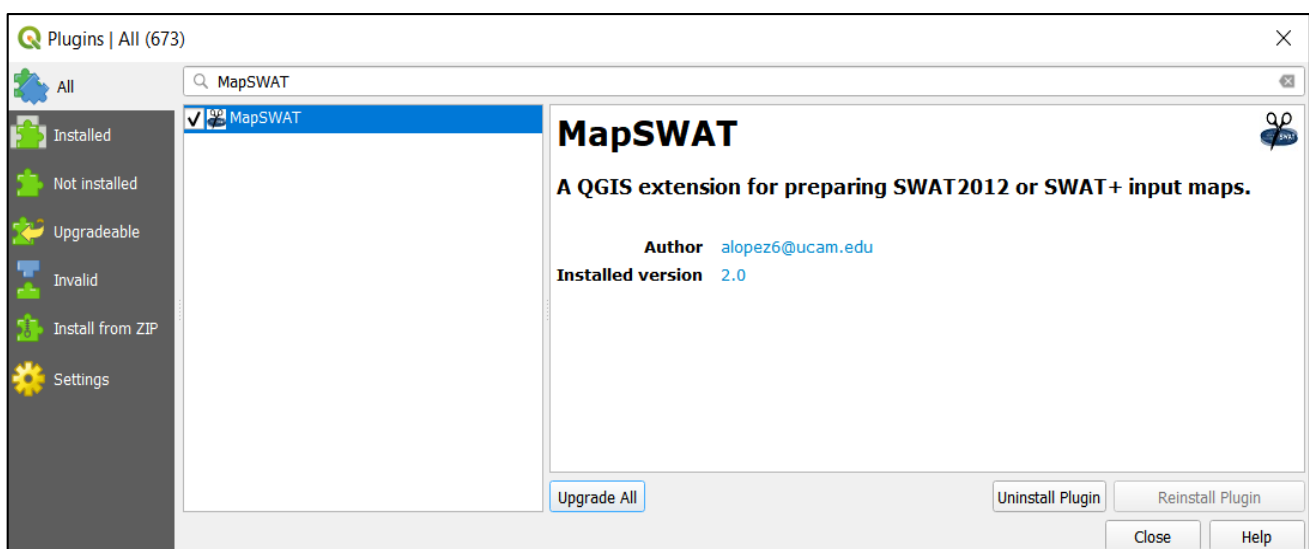
- 1) **User Data Inputs.** In this part users have to introduce their raw maps and select the source Coordinate Reference System (CRS) of each one. This part includes the option of drawing the outlet of the study area from its coordinates (X, Y) and the option of merging several DEMs.

- 2) **Clipping Options.** Three clipping options of maps are implemented in MapSWAT: (1) Clip map by new polygon; (2) Clip map by existing polygon and (3) Clip map by extension from outlet. These options produce the polygon or mask layer to clip the user maps.
- 3) **SWAT Input Maps Creation.** In this last part, the user maps are clipped from the mask layer and reprojected into the target CRS. Users have to indicate a metric CRS to be compatible with SWAT format.

In summary, MapSWAT allows the transformation of raw user maps to SWAT required-format maps.

2. Installing MapSWAT.

- Before installing the MapSWAT plugin, it is necessary to download and install QGIS 3.x (<https://www.qgis.org/en/site/index.html>), we recommend using the long term release version.
- Get the MapSWAT installer and run it with the default settings. The installer adds MapSWAT to the plugins folder of QGIS 3: `{userappdata}\QGIS\QGIS3\profiles\default\python\plugins`.
- Open a QGIS 3 project, go to **Plugins > Manage and Install Plugins ... > All** and search for MapSWAT. Check MapSWAT and close the **Plugins** window. A MapSWAT button will appear in the QGIS toolbar.

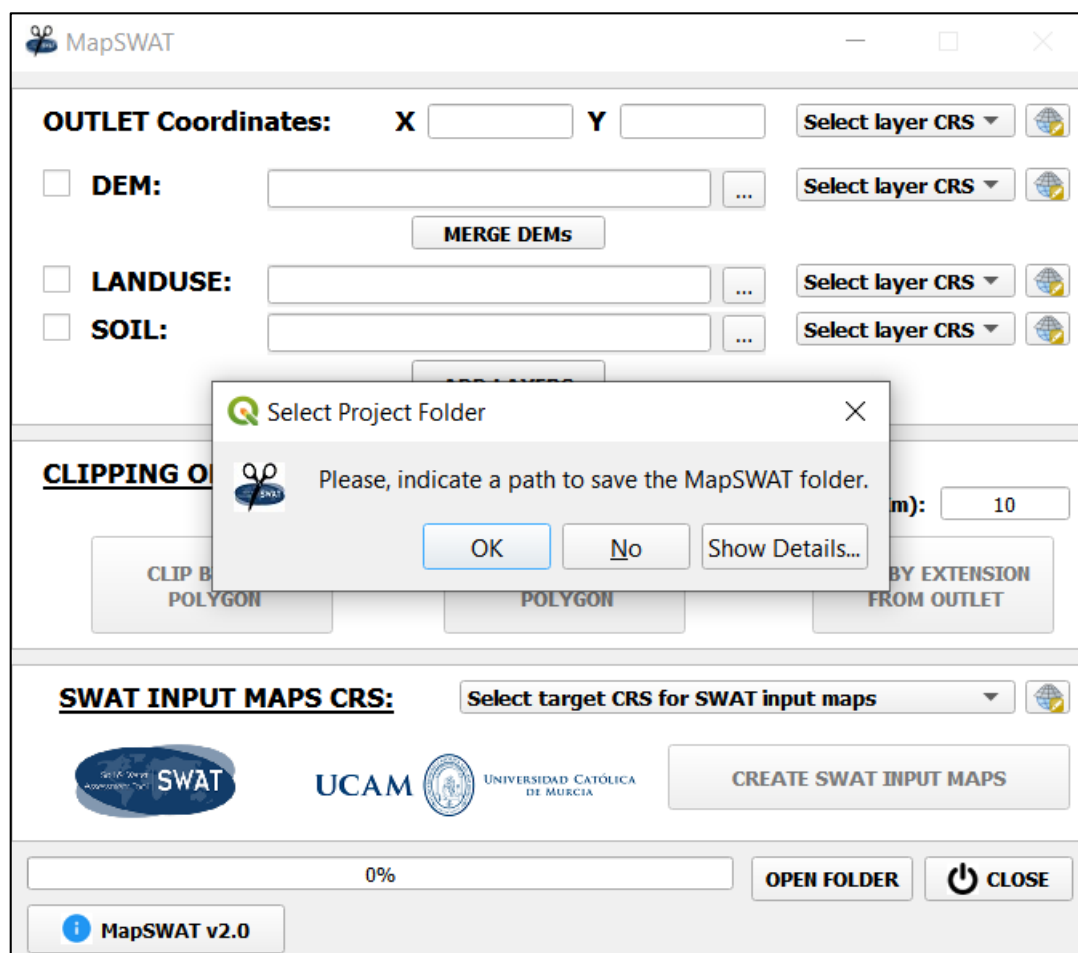


3. Before using MapSWAT.

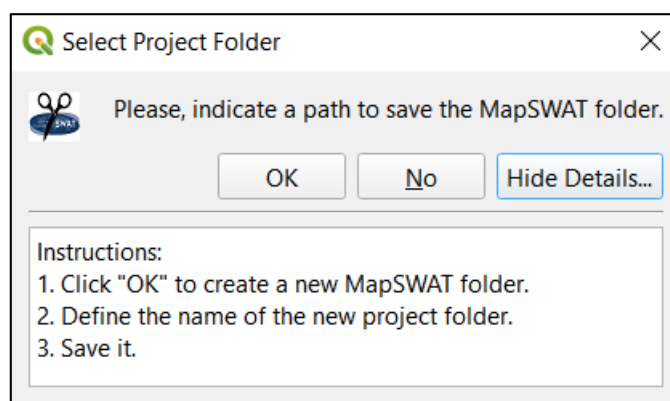
- MapSWAT is a single-use program, which means that when the program is closed all generated files will be removed from QGIS canvas. However, all files will be still available in the MapSWAT folder.
- The MapSWAT folder can be found in the new directory created by the user when the plugin is opened. A new folder is automatically generated each time that the program is used.
- MapSWAT will only create selected input maps, so remember checking the box of each input map ☒ before introducing their path.
- If any python error appears during the use of MapSWAT, we recommend rebooting QGIS program to solve it.
- Try to run MapSWAT according to the step order described in the next section.

4. MapSWAT setup.

- Click on the MapSWAT button of the QGIS toolbar  to open the MapSWAT plugin.






- Before going to the main MapSWAT window, users have to indicate a path to save the MapSWAT folder.




4.1. User Data Inputs.



- In the first part of MapSWAT, users can introduce raster layers such as, a digital elevation map (DEM), a land use map (LANDUSE) and a soil map (SOIL). To do this, users must check the box of each SWAT input map ☒ that they want to prepared and introduce the raster file path .



☒ **DEM:** C:\INPUTS_MapSWAT\DEM\srtm_35_04.tif  ...



☒ **LANDUSE:** INPUTS_MapSWAT\LANDUSE\ea_land_1.tif  ...
☒ **SOIL:** C:\INPUTS_MapSWAT\SOIL\ea_soil_1.tif  ...


- After previous step, users have to indicate the source CRS of each raster layer



☒ **DEM:** C:\INPUTS_MapSWAT\DEM\srtm_35_04.tif  ... **EPSG:4326 - WGS** 

☒ **LANDUSE:** INPUTS_MapSWAT\LANDUSE\ea_land_1.tif  ... **EPSG:4326 - WGS** 

☒ **SOIL:** C:\INPUTS_MapSWAT\SOIL\ea_soil_1.tif  ... **EPSG:4326 - WGS** 

- A Coordinate Reference System selector  has been implemented to facilitate layer CRS searching. To enable the CRS selector, users have to uncheck the **Select layer CRS** option.

Coordinate Reference System Selector

☒ Select layer CRS

Filter

Recently Used Coordinate Reference Systems


Coordinate Reference System	Authority ID
ETRS89 / UTM zone 30N	EPSG:25830
WGS 84 / UTM zone 16N	EPSG:32616
WGS 84	EPSG:4326
WGS 84 / UTM zone 21S	EPSG:32721

Predefined Coordinate Reference Systems ☐ Hide deprecated CRSs

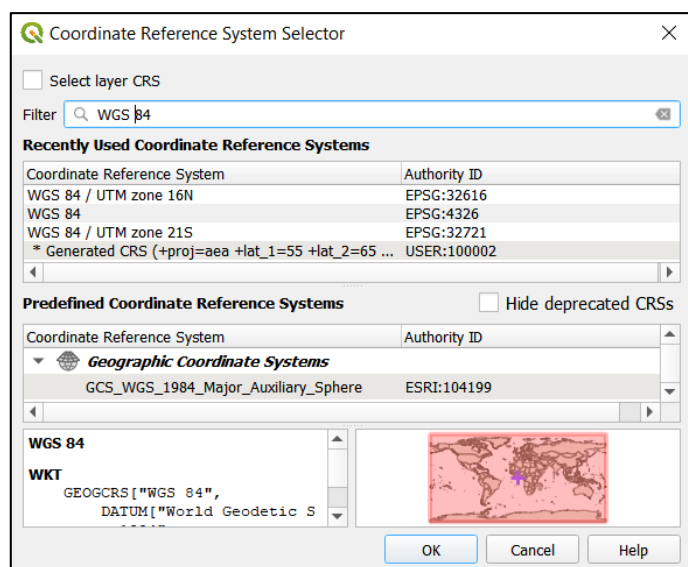
Coordinate Reference System	Authority ID
WGS 84	EPSG:4326
WGS 84	EPSG:4979

WGS 84

WKT
GEOGCRS["WGS 84",
DATUM["World Geodetic S



OK Cancel Help



- Before adding the map layers, users can introduce an outlet point coordinates to easily locate the study area in the map canvas. In the same way as in raster layers, the source reference system of the outlet coordinates has to be selected.

OUTLET Coordinates: X Y

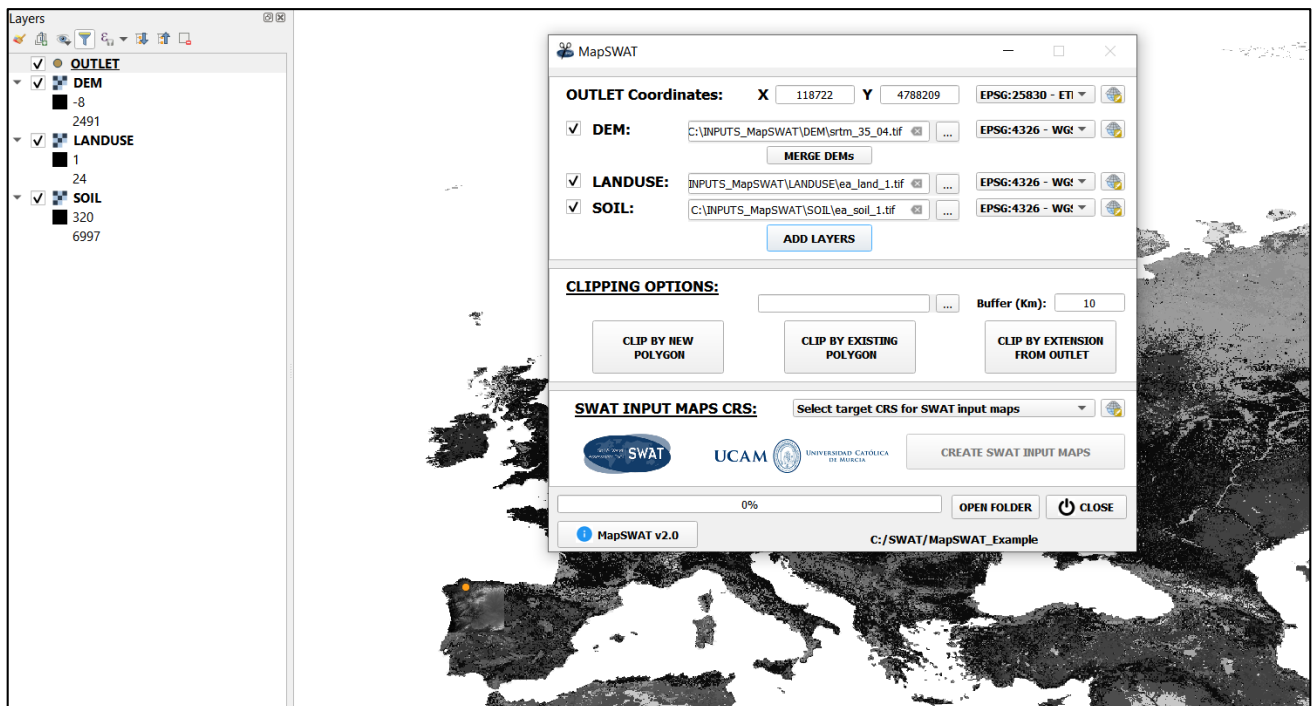
☒ **DEM:**


☒ **LANDUSE:**

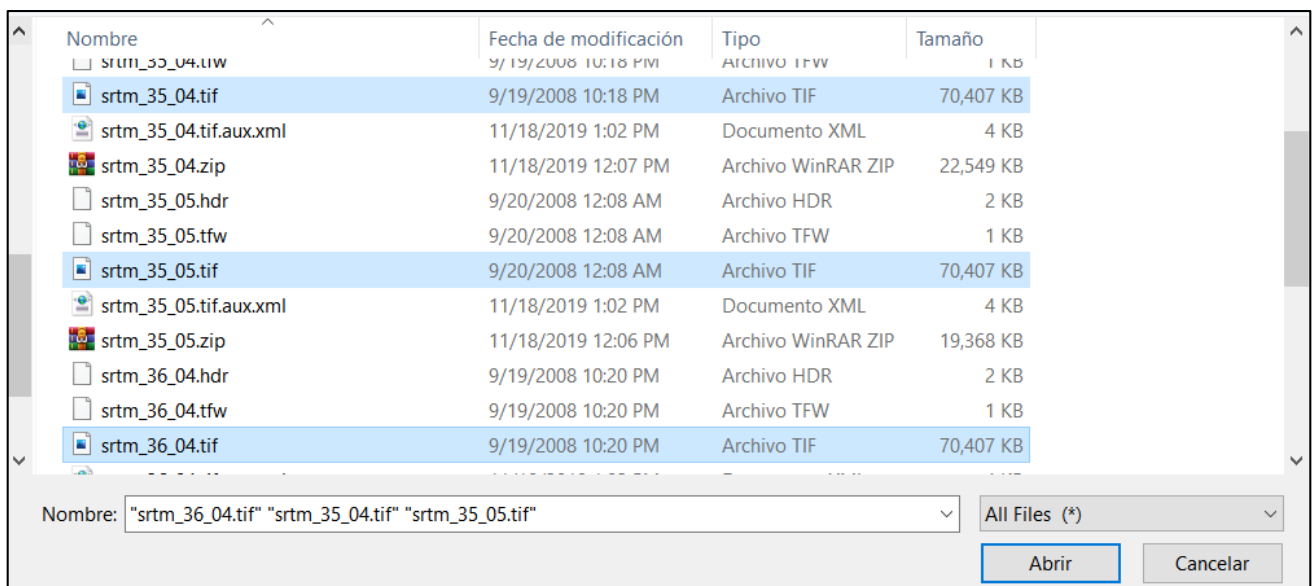
☒ **SOIL:**

- When previous steps have been done, users have to click on the **ADD LAYERS** button to add their selected maps and outlet point to QGIS map canvas.

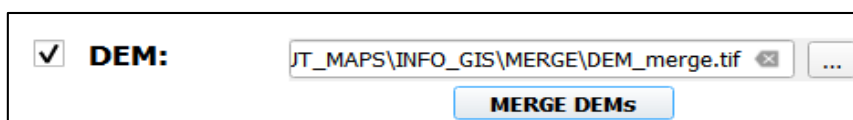
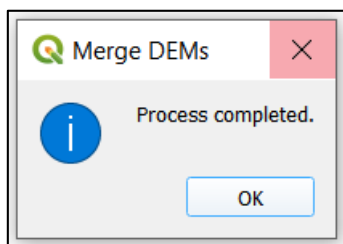
MapSWAT: A QGIS extension for preparing SWAT input maps.



- Additionally, a **MERGE DEMs** button have been included in the MapSWAT plugin. To use it, user must click on the **MERGE DEMs** button, select the merging raster layers (CTRL + ) and click on the **OPEN** button.



- An information window will appear after finishing the merger DEMs process and the path of the new merged DEM file will be added automatically.






4.2. Clipping Options.

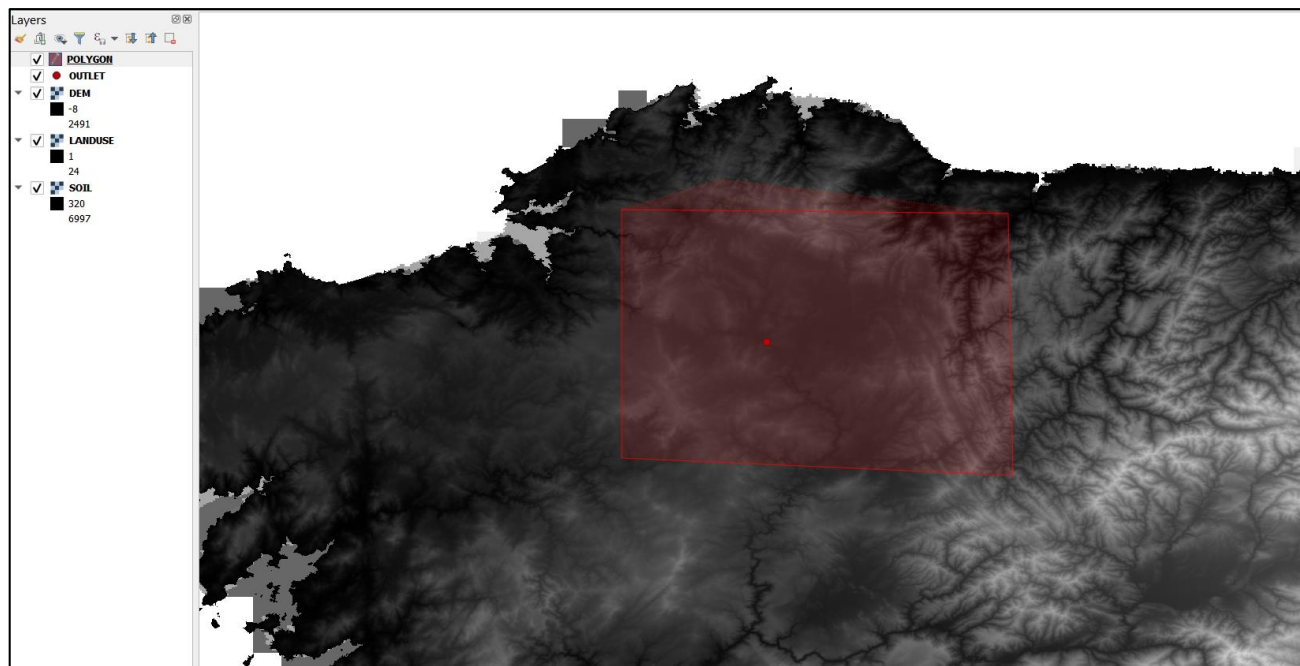
- Three maps clipping options are included in MapSWAT:




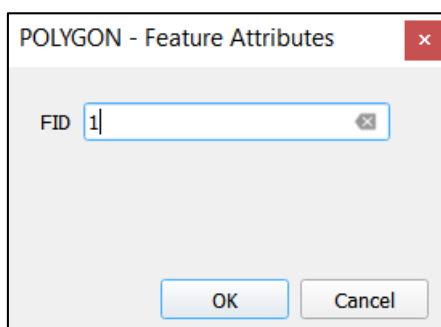
- 1) **CLIP BY NEW POLYGON:** A polygon has to be manually drawn after selecting this option.



- When clicking on the **CLIP BY NEW POLYGON** button, MapSWAT activates the **Toggle Editing**  of QGIS and automatically selects the **Add Polygon Feature**  tool. Users only have to draw a polygon about the study area using the left click  for each vertex.




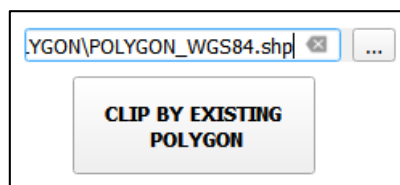
- After drawing a polygon that includes all the study area, push the right click  and a window to select a FID number will appear. Set any number, for example 1, and click on the **OK** button.



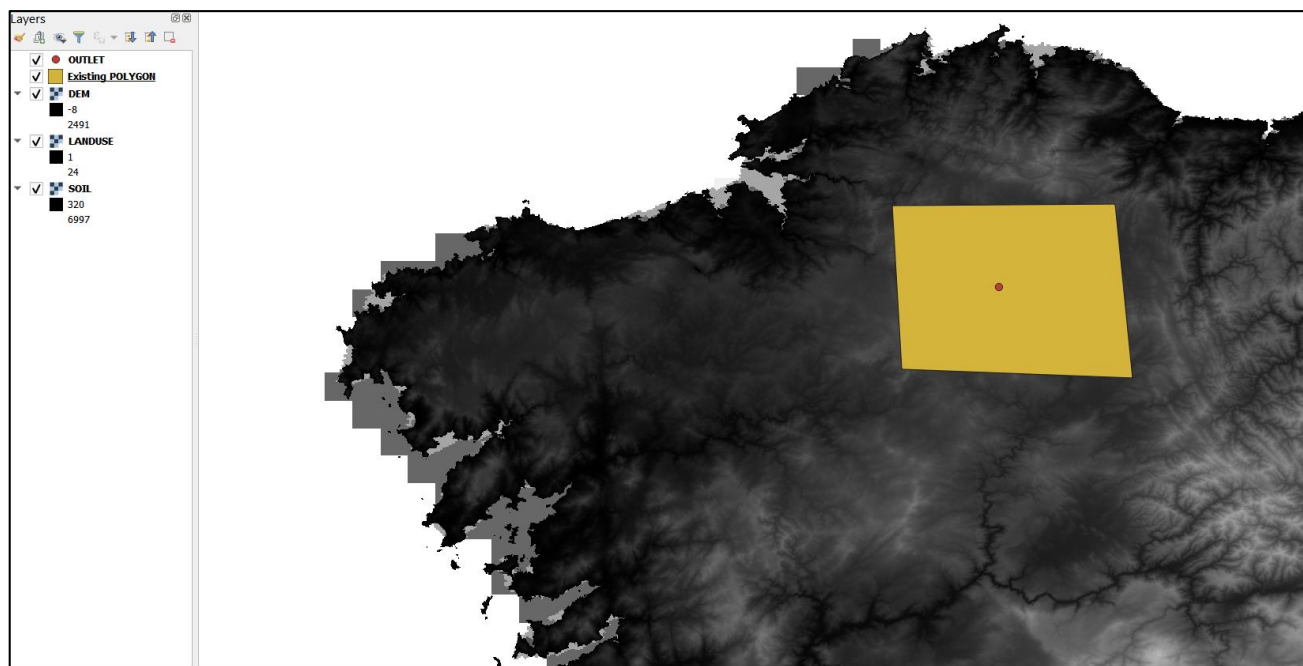
- A new layer called "**POLYGON**" will be added to QGIS map canvas.



- 2) **CLIP BY EXISTING POLYGON:** An existing polygon created in other MapSWAT project can be reused with this option. To do this, users have to introduce the polygon path  (...\\MapSWAT_ProjectName\\INFO_GIS\\POLYGON\\POLYGON_WGS84.shp) and click on the **CLIP BY EXISTING POLYGON** button.



- A new layer called “**Existing POLYGON**” will be added to QGIS map canvas.

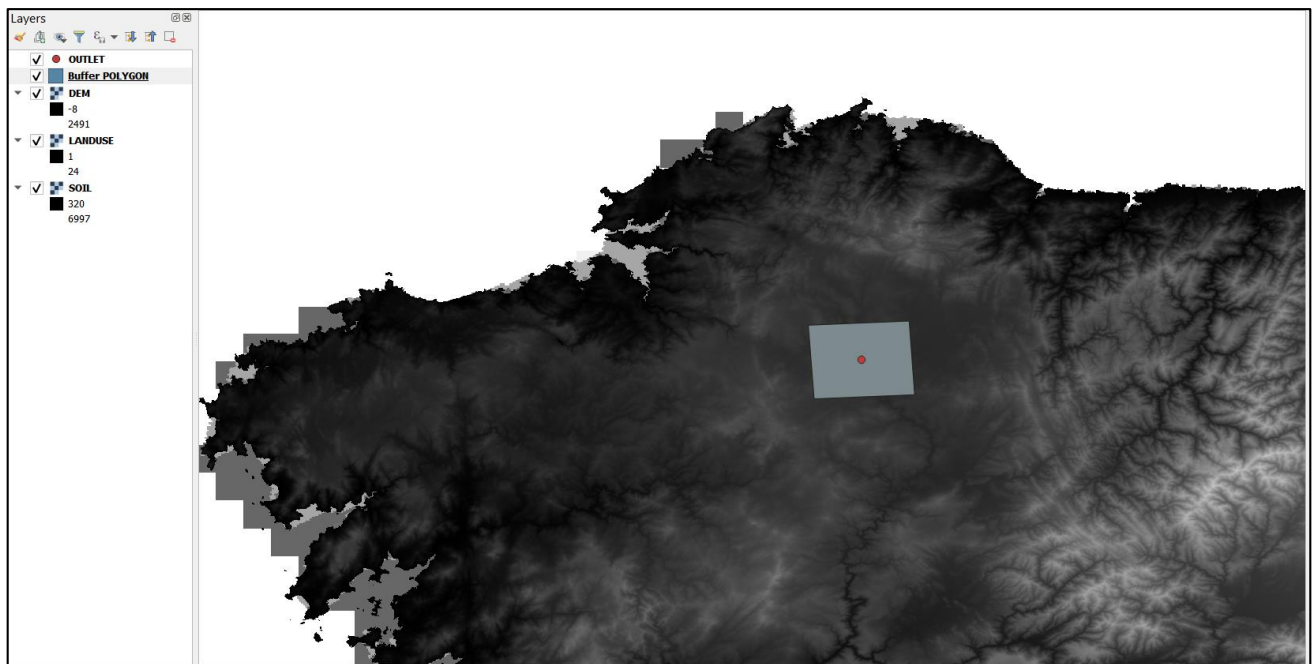


- If users want to introduce their own polygons (not obtain from MapSWAT), they can use this option but the polygon layers has to be in a WGS84 lat-long projection.
- 3) **CLIP BY EXTENSION FROM OUTLET:** With this option, a polygon is automatically created around the outlet point. To do this, users have to indicate the buffer distance in kilometers (10 Km by default) and click on the **CLIP BY EXTENSION FROM OUTLET** button.

Buffer (Km):

**CLIP BY EXTENSION
FROM OUTLET**

- A new layer called “**Buffer POLYGON**” will be added to QGIS map canvas.

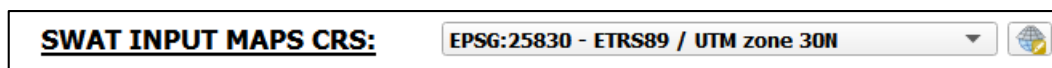


- This clipping option is only enabled if the outlet point has been introduced in the **User Data Inputs** part.

4.3. SWAT Input Maps Creation.



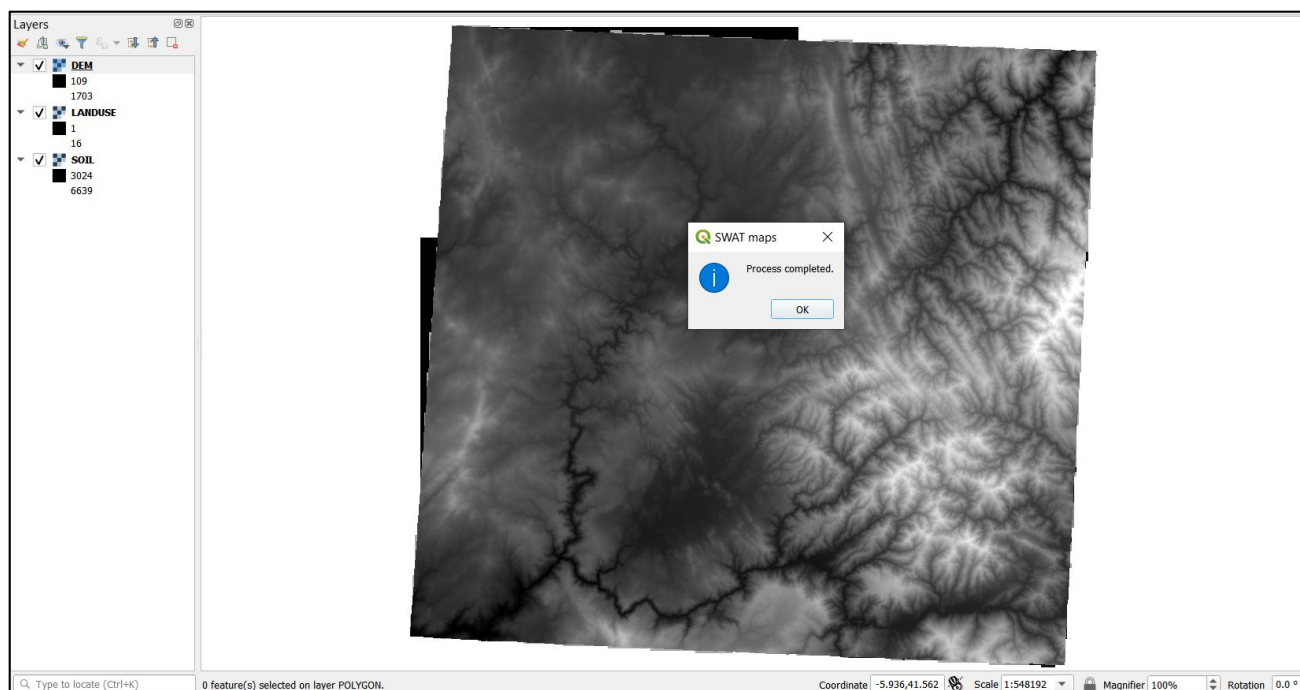
- Users have to indicate a target CRS to reproject all generated maps. The target CRS needs to be a metric CRS, for example UTM.



- Click on the **CREATE SWAT INPUTS MAPS** button to clip and reproject all selected user maps. An information window will appear when the process is completed and the MapSWAT window will be automatically minimized.

CREATE SWAT INPUT MAPS

- A set of new layers ("**DEM**", "**LANDUSE**" and "**SOIL**") will be added to QGIS map canvas.



- Additionally, for **LANDUSE** and **SOIL** input maps a template of their **LOOKUP tables** will be automatically created. These files are found in the **TABLES** directory (...\\MapSWAT_ProjectName\\TABLES) of the MapSWAT folder. Afterwards, users only need to link each raster value of the study area with its SWAT database code.

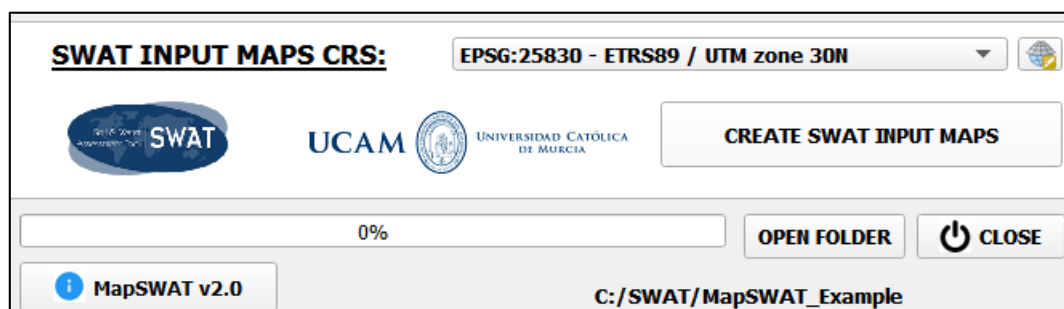
Landuse_Table-MapSWAT.csv
Soil_Table-MapSWAT.csv

	A	B
1	LANDUSE_ID	SWAT_CODE
2	1	
3	2	
4	5	
5	6	
6	7	
7	9	
8	10	
9	11	
10	13	
11	15	
12	16	
13		
14		

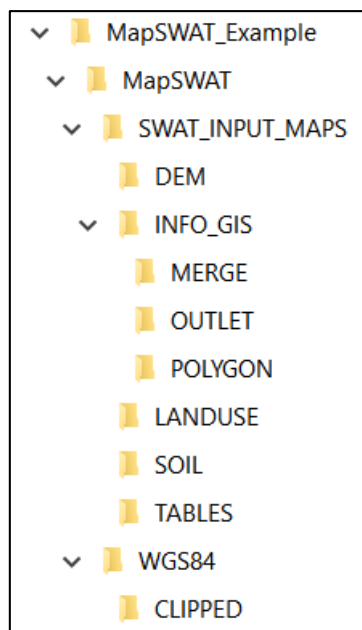
	A	B
1	SOIL_ID	SNAM
2	3024	
3	6639	
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		

4.4. Opening the MapSWAT folder.

- In MapSWAT, all generated files are automatically saved in the MapSWAT folder. To access them, users have to click on the **OPEN FOLDER** button or look for the folder path of the bottom right corner.



- Subfolders into the MapSWAT folder are classified in the following structure:

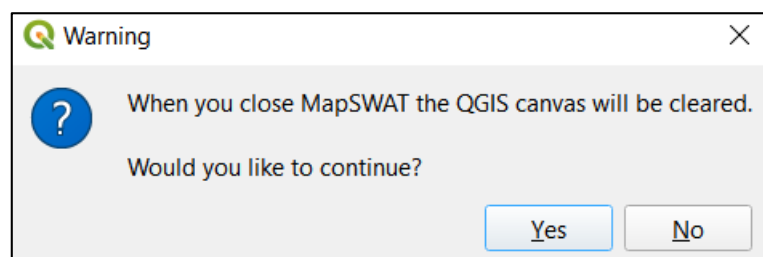


4.5. Closing the MapSWAT plugin.

- Users have to close MapSWAT by clicking on the **CLOSE** button due to Close (X) caption button is disabled in the MapSWAT plugin.



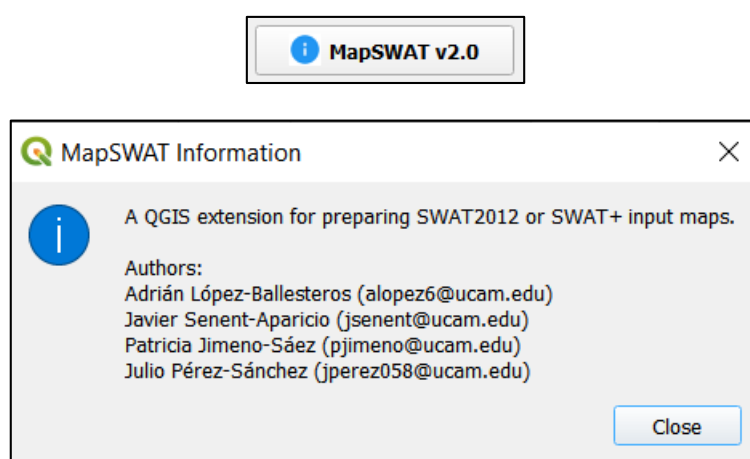
- Before closing, a warning window will be shown to remind users that the QGIS canvas will be cleared and all uploaded files will disappear.



- When click on the **Yes** button, the QGIS map canvas will be cleared and a new MapSWAT project can be run.

4.6. About MapSWAT.

- Click on the **ABOUT** button to get information about MapSWAT and email addresses of authors.



5. How to use MapSWAT files in QSWAT or QSWAT+.

- All files created by MapSWAT can be directly used as input data for QSWAT:
- For STEP 1 “**Delineate Watershed**” of SWAT, users can select the DEM (...\\MapSWAT\\SWAT_INPUT_MAPS\\DEM\\DEM.tif) generated by MapSWAT.
- If the outlet point of the watershed have been also generated with MapSWAT, users can add it to QGIS in order to define the study area outlet in the SWAT model (...\\MapSWAT\\SWAT_INPUT_MAPS\\INFO_GIS\\OUTLET\\OUTLET.shp).
- For STEP 2 “**Create HRUs**” of SWAT, users can select the landuse map (...\\MapSWAT\\SWAT_INPUT_MAPS\\LANDUSE\\LANDUSE.tif) and the soil map (...\\MapSWAT\\SWAT_INPUT_MAPS\\SOIL\\SOIL.tif) generated by MapSWAT.
- Lookup tables for landuse (...\\MapSWAT\\SWAT_INPUT_MAPS\\TABLES\\Landuse_Table-MapSWAT.csv) and soil (...\\MapSWAT\\SWAT_INPUT_MAPS\\TABLES\\Soil_Table-MapSWAT.csv) generated by MapSWAT can be used after completing them with the SWAT database codes.