

ICEtool v2026.07.01

User manual #EN

<https://github.com/Art-Ev/ICEtool>

If **ICEtool** is based on a set of physical phenomena put into equations, the result remains an **estimate**. As some phenomena are simplified and others are not taken into account (for the moment), An analysis performed with ICEtool cannot replace a real model performed with specialized tools or software (e.g. *envi-met*). Finally, ICEtool is intended to be used up to neighborhood scale. It should not be used beyond that scale, for example at the city level (the influence of some physical phenomena not considered in the calculation would then become too important at this scale).

In case of difficulties, an example project gathering all the files and information necessary to carry out the different procedures and visualizations is provided. To access it, use the "Generate an example project" function in the "Help" section of ICEtool.

STEP_0:

Study location choice:

- Already identified project
- identification of a high-stakes area, for example from satellite data such as LST (Land Surface Temperature) that can be cross-referenced with data describing the affected population.

Check that the QGIS processing toolbox panel is active (CTRL-ALT-T) and that ICEtool processing procedures are available.

STEP_1: Project creation and setup

1. Generate the project folder by indicating its location, project name and CRS (created qgz file is opened automatically).
2. Fill in the various files contained in the "Step_1" folder of the project folder created:
 - a. **WeatherData** : place an **.epw file** in the **Step_1** folder (epw is a standard format describing weather data).

An epw file can be generated by a software like Meteonorm or downloaded from platforms like :

- <https://climate.onebuilding.org/default.html>
- <https://www.ladybug.tools/epwmap/>
- <https://energyplus.net/weather>

- b. Use the QGIS project file (.qgz) at the root of the project folder to complete the following layers (these are stored in the **Project_data.gpkg** file in the **Step_1** folder):
 - **Study_area** : polygon describing the **total area** of the study site
 - **Buildings** : polygons describing **buildings** in the area (if a default value can be applied, it is strongly recommended to fill in the building height field). In France, this information can for example be retrieved directly from the **cadastre** or from the **BD Topo** provided by the **IGN**. In the same way, in

case of a green roof, it's recommended to fill the information concerning the substrate thickness, and the number of plant stratas.

- **Trees** : point layer describing the location of **vegetation**, its radius, height, foliage underside & foliage transparency
- **Ground** : description of **ground materials**. Create non-overlapping polygons (e.g. by activating the non-overlapping option integrated in QGIS, tutorial [here](#)). Fill in the material code, the presence of trees in the area, and the other information if the material chosen is a plant material (fully natural area, the substrate thickness, and the number of plant strata), giving better results on CBSH. The material properties should automatically appear in the layer table (imported from the **Material_database.csv** file in the **Step_1** folder). Use one of the fixed-temperature materials to model, for example, a fountain with constantly renewed water.

***Optional:** add new materials and adjust coefficients by modifying **Material_database.csv** file in **Step_1** folder.*

- **Shading blocks (optional)** : floating blocks, used for shadow computation, described with minimum height, maximum height and transparency. Can be used to set up solar panels, building eaves, ...
- **Lights (optional)** : point layer describing the public lightning. This layer only has a visual purpose for now, it won't be used for the following steps. It is recommended to disable the other layers («Trees» and «Ground») for optimal rendering. Fill the information: the height (in meters), power (in lumens), and optionally the angle (in degrees) of the lighting, the bulb temperature (in kelvin), as well as the minimum illuminance from which the area is viewed in darkness (in lux).

STEP_2: Preparing for shadows generation

UMEP shadow generator requires in our case the use of raster files describing both the ground level and buildings heights

Create rasters procedure: procedure parameters are pre-filled (layers & default values to be used) except for the study site's area, which still needs to be filled in. It's possible to adjust these parameters manually.

BuildingTerrain_raster.tif file is automatically created in the **Step_2** folder of the project directory.

Add "BuildingTerrain_raster.tif" to your QGIS project to continue.

Advanced users: you can also generate rasters yourself, for example to include information from a digital terrain model.

STEP 3: Calculating shadows with UMEP shadow generator

To compute shadows, [UMEP](#) shadow generator has been modified and included directly into ICETool. To run it, you need to fill these parameters :

- **Building and ground DSM:** BuildingTerrain_raster.tif (Step_2 folder)
- **Trees (pre-filled) :**
 - o **Tree layer**
 - o **Foliage radius**
 - o **Treetop**
 - o **Foliage underside**
 - o **Foliage transparency**
 - o **Default foliage transparency**

- **Date** : Select the desired study date (*This choice is crucial – don't just pick a random day !*)
- **UTC offset** : ex. +1 for France
- **Daylight Saving Time**
- **Advanced settings, shading blocks (pre-filled):**
 - o **Use shading blocks**
 - o **Shading blocks layer**
 - o **Min height**
 - o **Max height**
 - o **Transparency**

Generated files describe the shadows throughout the day (hour by hour) and can be find in “Step_3” folder.

STEP_4: Calculation of temperatures throughout the day

To calculate ground temperatures throughout the day:

- **Enter the date for the desired analysis**
- **Check that the buildings and ground layers are correctly filled in**
- **Check that the path to your weather data file is correct**
- **Spatial accuracy (advanced parameter, default=1.0)** : parameter describing the spatial accuracy of the calculation, decrease to speed up the calculation, increase to increase spatial accuracy.

Other necessary files will be automatically retrieved from the various **Step** folders.

Calculation time may vary depending on your computer, using the default settings for example project should give a calculation time of less than 3min (approx. 1min22 on the computers used during development).

Result will automatically be saved in a csv file in the **Step_4** folder and loaded into QGIS with a preconfigured symbology of the maximum temperatures observed on study day.

Loaded layer contains the following fields:

- **min_DegC** : minimum temperature observed during the day (in degrees Celsius)
- **mean_DegC** : average temperature observed during the day (in degrees Celsius)
- **max_DegC** : maximum temperature observed during the day (in degrees Celsius)
- **Temp_DegC** : contains a list describing ground temperatures throughout the day for each hour

The results of a simulation should be analyzed over the course of a day, not based on a single figure!

Analysis of results :

Resulting layer allows for each configuration tested to create comparative visuals or to obtain key comparison indicators.

For example: with QGIS Group Stats tool (equivalent to Microsoft Excel pivot tables), it is possible in a few clicks to calculate for a scenario: the average, median and maximum of the warmest temperatures observed in the study area.

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2		50,54	35,3503	34,89

Once « Ground », « Trees » & « Buildings » layers are completed, several indicators are dynamically calculated (but you shouldn't limit your analysis to these):

- **CR** : « Coefficient de ruissèlement » is the Runoff Coefficient
- **CBSH** : « Coefficient de Biotope de Surface harmonisé » , based [on the work](#) of Berlin City. This indicator has been modified and is now using the definition provided by the CSTB ([description Here](#)) . Final result is between 0 and 1.
- **Artificial** : % of ground artificialization
- **Mean of daily max temps**