Good to Know

A french start-up that has developed a method for calculating UHI maps: https://elioth.com/la-maitrise-de-l-ilot-de-chaleur-urbain/

You can download the plugin developed by the start-up on Qgis, here the procedure to do so.

ICE version 1.0
HOWTO #english

https://gitlab.com/elioth/ice/ [FR]

ICE is free software; you can redistribute it and/or modify it under the terms of the GNU General Public License

STEP 0

Prepare and clean your layers, in order to have:

- One layer for the buildings,
- One for the trees,
- One for each ground typology,
- One for the project extent

STEP 1

Use **model #1** to rasterize buildings and trees.

- Option 1 : if the trees are in points file
- Option 2 : if the trees are in polygons

**Raster : Image in shades of grey based on a variable, here the height*

STEP 2

Shadow modelling hour by hour on July 21st

Use **UMEP pluggin** : UMEP → Processor → Solar radiation → Daily Shadow Pattern

Then fill in :

- Building and ground DSM with “OUTPUT” (Buildings raster)
- Vegetation Canopy with “OUTPUT_arbres” (Trees raster) (Tick “use vegetation DSM” beforehand)
- Choose July 21st, of 2021
- Time interval = 1 hour
- Daylight saving time = YES
- UTC offset = 1 if the project is in France
- Select a specific path to a folder to save the shadow files

Run the model and copy the created shadows files into Qgis.

STEP 3

Use **model #3** to associate a material ID to every ground type.

Check the database to know the correlation between the ID and the wanted material (ex : 'AS1' = Asphalt).

The model was created for 2 layers at one time, so you'll need to use the model for each ground type that you have. The first layer is always the biggest one.

- First time :
  - Layer 1 : Project extent with the main material (ex : 'AS1')
  - Layer 2 : Another layer with its ground type ID (ex : 'VG1')
- 2nd time and next :
  - Layer 1 : Last "OUT_sol_id" (created at the previous used of model #3) with '' (empty to avoid writing over previously filled material IDs)
  - Layer 2 : Another layer with its ground type ID (ex : 'VG2')

There is no need to fill in the trees here, it is only data about the ground type.

Copy the csv material database in Qgis. Then use **model #3.2** in order to join the database and the layer previously created (OUT_sol_id). Verify that the new layer is filled with all the material properties (albedo, thermal capacity, etc.).

It's possible to visualize the different ground types of the layer "OUT_sol_with_base" with colors using Properties → categorize → order

STEP 4

Use **model #4** to create the mesh.

The mesh is only on the ground so here you fill in "OUT_sol_with_base" (the previously created layer with material properties). This step also requires shadows data, in order to optimize the mesh.

- Option 1 : Fill in the hourly shadows rasters one by one by hand. Be careful to associate each file to the corresponding hour of the day.
- Option 2 : It reads the hourly shadows files. Be careful, if the file are not called "Shadow_20210721_HH00_LST" it won't work.

Density = 4 by default (1 is very dense, 6 is sparse).

Save the mesh file on your computer.

STEP 5 - WEATHER

It requires evapotranspiration potential, you need to fill in ICE_ETo.csv file with monthly ETo data that you can find on https://donneespubliques.meteofrance.fr/?fond=produit&id_produit=117&id_rubrique=39 **for France**. Then drag and drop the file to Qgis. (check ICE_ETo_howto.txt in ICE_database to understand)

Use **model #5** (python script) to solve heat equation and estimate ground mean temperature.

(Plugins → Python console → Open scripts)

Select the mesh layer and run the python script.

This step requires local weather data :

- Option 1 : Create a csv file of the 21st of July only. Drag and drop the file to Qgis and call the layer "weather"
- Option 2 : A box will ask you to fill in the path to the .epw weather file (this is a better option).

You will obtain a new layer "temperature_mean" with all the mesh points, their parameters (thermal capacity, etc), their shadows values, the temperature hour by hour and the mean temperature over the day.

STEP 6

In order to obtain a raster of the ground temperature, use TIN interpolation in the tool box.

Fill in the vector layer with "temperature_mean" and the interpolation attribute with the one you want to rasterize (for example : T_mean). Add a vector layer, select a linear interpolation method and fill in the extent with temperature_mean (use the same extent as the layer).

Then, use **model #6** in order to remove buildings from the image.

Finally, it's possible to finalize the visualization in :

Properties → colors → spectral → reverse → categorize and adapt label values for a better readability

➔ Apply

Then go to Project → New presentation

➔ Add a new map
➔ Add a legend, a title, etc.