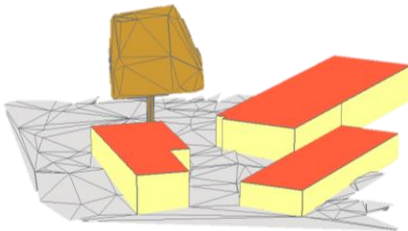


# CitySim crash course

**Camilo León-Sánchez, Denis Giannelli, Giorgio Agugiaro**



Last update: 31 August 2024



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# Overview

- CitySim in a nutshell
- Quick installation guide
- CitySim fundamentals
  - GUI & main functionalities
  - Input data requirements
    - XML-encoded CitySim file or xml-encoded CityGML file
    - Climate data (.cli)
    - Horizon data (.hor)
  - Typical operations
    - Solar analysis
  - Output data
    - CityGML 2.0 + Energy ADE
    - TSV files
- References
- Appendix

# CitySim in a nutshell

- **CitySim**

- Is a set of software tools to provide a decision support for urban energy planners and stakeholders to minimize the net use of non-renewable energy sources as well as the associated emissions of greenhouse gases ([EPFL](#))
- It is fast (compared to other dynamic simulation engines), reliable (successfully tested against energy monitoring) and needs few input data (available at early design stages) ([KAEMCO](#))
- Currently, it consists of two main modules:

- a) **CitySim (Solver)**

- Originally developed at the Solar Energy and Building Physics Laboratory of EPFL, it is a **command-line Integrated solver** for simulating the energy demand and supply of buildings for space conditioning, together with the specification of the input buildings' characteristics and the climate files

- b) **CitySim Pro**

- It is a **Graphical User Interface (GUI)** built on top of the CitySim Solver and originally developed at KAEMCO

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# CitySim in a nutshell

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- **Several applications**

- Short-wave irradiation ( $\text{Wh}/\text{m}^2$ ) at surface resolution
- Long-wave net irradiation ( $\text{Wh}/\text{m}^2$ ) at surface resolution, except for shading surfaces
- Surface temperature ( $^{\circ}\text{C}$ ) at surface resolution, except for shading surfaces
- Photovoltaic production ( $\text{Wh}$ ) at building resolution
- Solar thermal production ( $\text{Wh}$ ) at building resolution
- Sky view factor  $[0,1]$  at surface resolution
- Heating demand ( $\text{Wh}/\text{m}^3$ ) at thermal zone resolution
- Cooling demand ( $\text{Wh}/\text{m}^3$ ) at thermal zone resolution
- Indoor temperature ( $^{\circ}\text{C}$ ) at thermal zone resolution

- **Different temporal resolutions of results visualised in the GUI**

- Hourly values
- Daily values (average or summation, depending on the application)
- Monthly values (average or summation, depending on the application)
- Yearly values (average or summation, depending on the application)

**However: exported values are always at hourly resolution!**

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- **Several applications**

- Short-wave irradiation ( $\text{Wh}/\text{m}^2$ ) at surface resolution
- Long-wave net irradiation ( $\text{Wh}/\text{m}^2$ ) at surface resolution, except for shading surfaces
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- Indoor temperature ( $^{\circ}\text{C}$ ) at thermal zone resolution

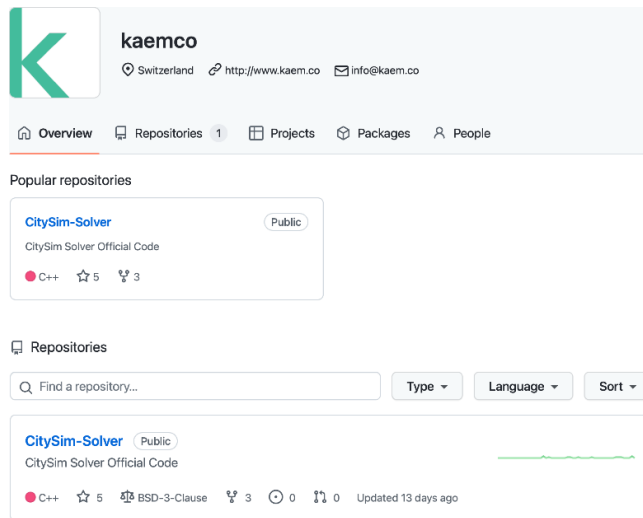
- **Different temporal resolutions of results visualised in the GUI**

- Hourly values
- Daily values (average or summation, depending on the application)
- Monthly values (average or summation, depending on the application)
- Yearly values (average or summation, depending on the application)

**However: exported values are always at hourly resolution!**

# Quick installation guide

- There are two possibilities to use CitySim:
  - CitySim Solver "only". Available in GitHub. It is the actual engine performing the simulations
    - <https://www.epfl.ch/labs/leso/transfer/software/citysim/>
    - <https://github.com/kaemco/CitySim-Solver>
  - CitySim Pro. A GUI that allows the visualisation of data and ease its use. CitySim Pro is free to use, but it requires a license that can be requested online
    - <http://www.kaemco.ch/download.php>



**kaemco**  
 Switzerland <http://www.kaem.co> [info@kaem.co](mailto:info@kaem.co)

Overview Repositories 1 Projects Packages People

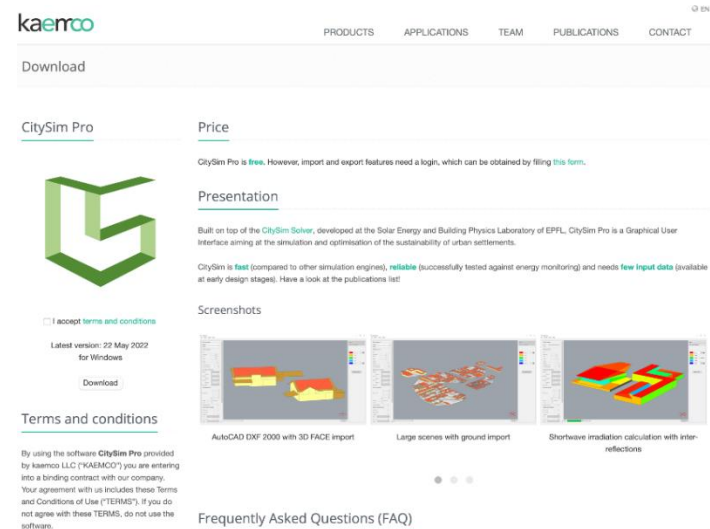
Popular repositories

**CitySim-Solver** Public  
 CitySim Solver Official Code  
 C++ 5 3

Repositories

Find a repository... Type Language Sort

**CitySim-Solver** Public  
 CitySim Solver Official Code  
 C++ 5 BSD-3-Clause 3 0 0 Updated 13 days ago



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Download

CitySim Pro

Price

CitySim Pro is **free**. However, import and export features need a login, which can be obtained by filling [this form](#).

Presentation

Built on top of the [CitySim Solver](#), developed at the Solar Energy and Building Physics Laboratory of EPFL, CitySim Pro is a Graphical User Interface aiming at the simulation and optimisation of the sustainability of urban settlements.

CitySim is **fast** (compared to other simulation engines), **reliable** (successfully tested against energy monitoring) and needs **few input data** (available at early design stages). Have a look at the publications list!

Screenshots

AutoCAD DXF 2000 with 3D FACE import Large scenes with ground import Shortwave irradiation calculation with inter-reflections

Terms and conditions

By using the software CitySim Pro provided by kaemco LLC ("KAEMCO") you are entering into a binding contract with our company. Your agreement with us includes these Terms and Conditions of Use ("TERMS"), if you do not agree with these TERMS, do not use the software.

Frequently Asked Questions (FAQ)

# CitySim Solver fundamentals

- **How to install CitySim Solver?**

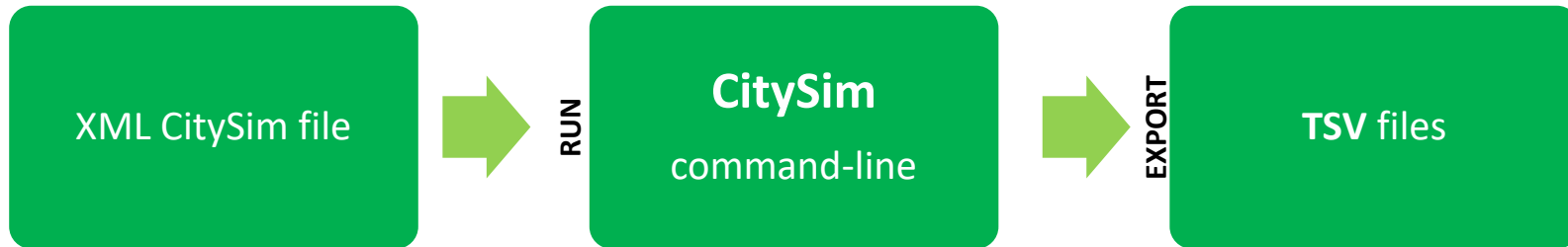
- Clone or download the Github CitySim-solver repository
- Build the binaries for the corresponding OS: Windows, macOS, Linux (Ubuntu), Docker

Name	Date Modified	Size	Kind
▼ Windows	26 July 2022 at 19:06	29,1 MB	Folder
CitySimd.exe	21 April 2022 at 17:58	23,7 MB	Windows EXE File
CitySim.exe	21 April 2022 at 17:58	5,5 MB	Windows EXE File
▼ Linux	26 July 2022 at 19:06	14,4 MB	Folder
CitySimd	15 June 2022 at 10:49	12,4 MB	Unix Executable File
CitySim	15 June 2022 at 10:48	1,9 MB	Unix Executable File
▼ Mac	26 July 2022 at 19:06	8,9 MB	Folder
CitySimd	18 March 2022 at 16:16	7,1 MB	Unix Executable File
CitySim	18 March 2022 at 16:16	1,8 MB	Unix Executable File

# CitySim Solver fundamentals

## Overview of data workflows

- CitySim runs all applications at a time
- It is wise to **first** run simulations with small datasets, and **then** with the complete dataset
- Data pipeline consists of the following steps:



`Path_to_executable_files`

`path_to_XML_file`

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```
Windows PowerShell X Windows PowerS
Day: 355      Memory usage: 488.3 Mb
Day: 356      Memory usage: 494.7 Mb
Saving results...
Day: 357      Memory usage: 115.9 Mb
Day: 358      Memory usage: 122.2 Mb
Day: 359      Memory usage: 128.6 Mb
Day: 360      Memory usage: 134.9 Mb
Day: 361      Memory usage: 141.2 Mb
Day: 362      Memory usage: 147.5 Mb
Day: 363      Memory usage: 153.8 Mb
Day: 364      Memory usage: 160.2 Mb
Day: 365      Memory usage: 166.5 Mb
Simulation ended.

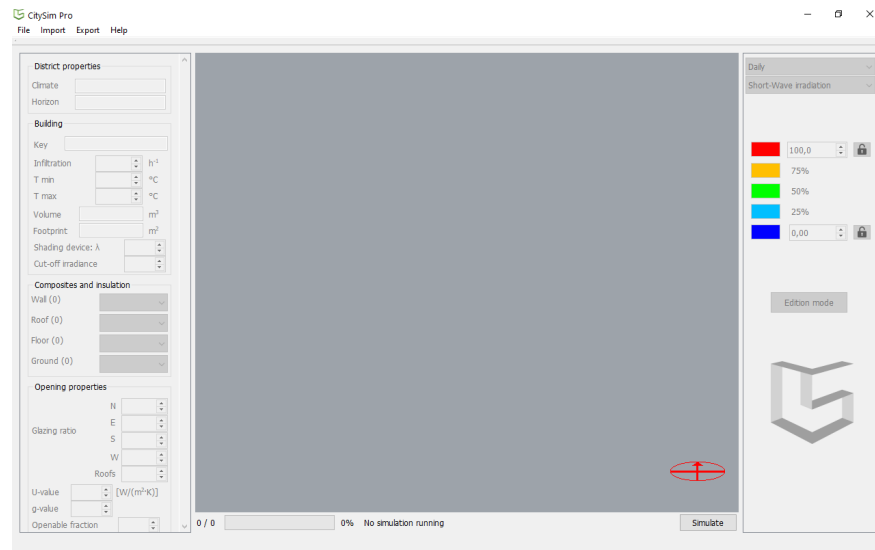
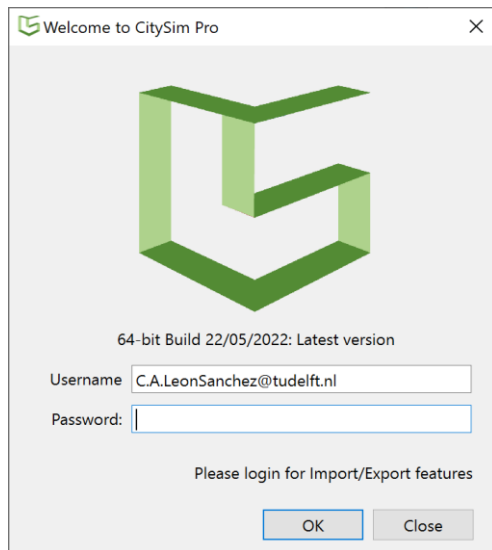
Days          : 0
Hours         : 1
Minutes       : 18
Seconds       : 2
Milliseconds  : 904
Ticks         : 46829049357
TotalDays     : 0.0542002886076389
TotalHours    : 1.300800692658333
TotalMinutes  : 78.048415595
TotalSeconds  : 4682.9049357
TotalMilliseconds : 4682904.9357
```

```
Settings x Windows PowerShell x + v
PS C:\Users\Camilo Leon\citysim> Measure-Command {.\CitySim.exe
"C:\Users\Camilo Leon\Rijssen_statusQuo_CitySim_input_NoDTM.xml"
}
```

# CitySim Pro fundamentals

- **How to install CitySim Pro?**

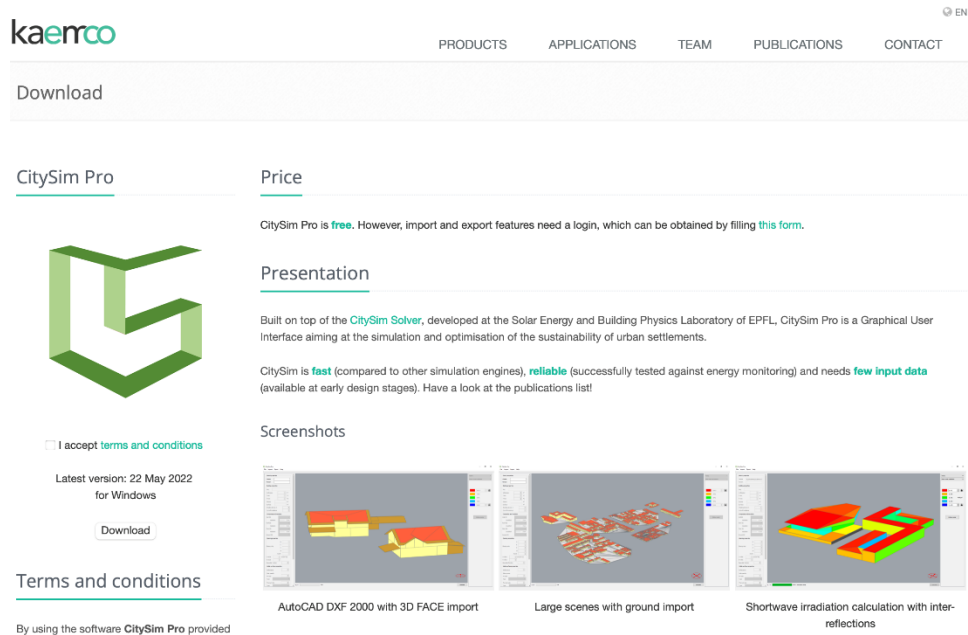
- Extract the CitySimPro.zip file and place it on a directory of your preference
  - E.g. C:\Program Files
- Double-click on CitySimPro.exe
- Upon first run, you will be asked to insert your license credentials



# Quick installation guide

- **How to install CitySim Pro?**

- Access the developer's website [here](#);
- Fill and sign [this form](#), and send it to the developer at [info@kaemco.ch](mailto:info@kaemco.ch) ;
- You will receive a login and password to activate the license
- Attention: CitySim Pro is available only for Windows 32/64bit!



The screenshot shows the 'kaemco' website with a navigation menu (PRODUCTS, APPLICATIONS, TEAM, PUBLICATIONS, CONTACT) and a 'Download' button. Below the navigation is a section for 'CitySim Pro' with a 'Price' sub-section. The 'Price' section states that CitySim Pro is free but requires a login. A 'Presentation' section describes the software as a Graphical User Interface for urban sustainability simulation. A 'Screenshots' section shows three examples: 'AutoCAD DXF 2000 with 3D FACE import', 'Large scenes with ground import', and 'Shortwave irradiation calculation with inter-reflections'. At the bottom, there is a 'Terms and conditions' section with a 'Download' button and a note about the latest version (22 May 2022 for Windows).

**kaemco** PRODUCTS APPLICATIONS TEAM PUBLICATIONS CONTACT

Download

CitySim Pro

Price

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Screenshots

AutoCAD DXF 2000 with 3D FACE import

Large scenes with ground import

Shortwave irradiation calculation with inter-reflections

I accept [terms and conditions](#)

Latest version: 22 May 2022 for Windows

Download

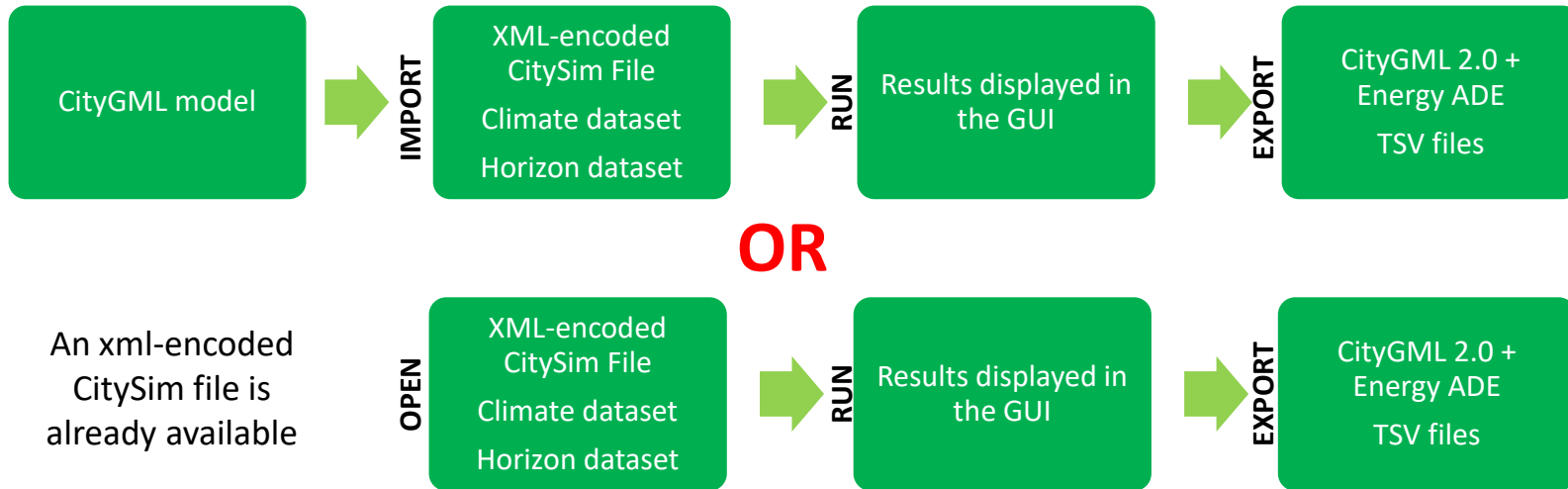
Terms and conditions

By using the software CitySim Pro provided

# CitySim Pro fundamentals

## Overview of data workflows

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# CitySim fundamentals

## Foreword

The following slides are based on a very simple CityGML model just to demonstrate the potentialities of CitySim

- This CityGML model contains objects from three modules of the CityGML schema:
  - 3 Buildings
  - 1 SolitaryVegetationObjects
  - 1 Relief
- The focus is on converting an (xml-encoded) CityGML file to a CitySim file
- For more details about the **xml encoding of CitySim files**, please refer to the examples at (...)\CitySimPro\64-bit\Resources\exampleXmlFiles

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FME Data Inspector - 2021.0

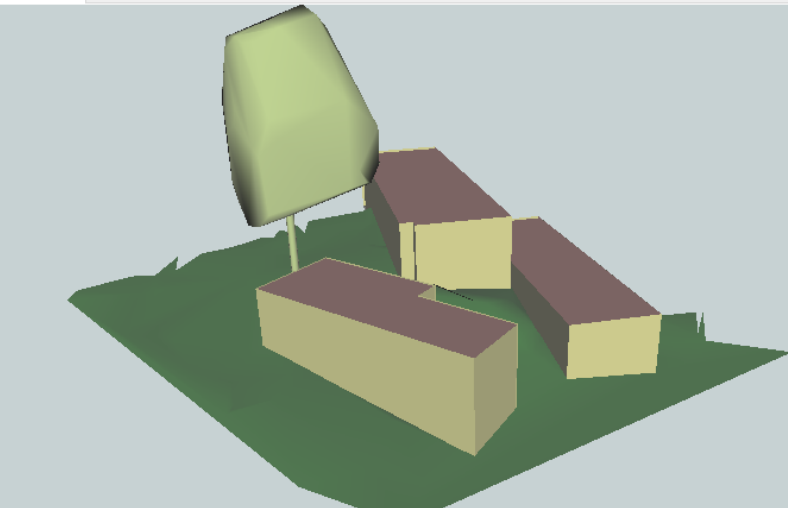
File View Camera Tools Window Help

Open Add Close Save As Save Selected Refresh Stop 2D 3D Table Slideshow Measure Orbit Select Pan Zoom In Zoom Out Zoom Selected Zoom Extents Select No Geometry Filter Mark Background

Display Control

- View 1 (31)
- GEO5014-2021\_CitySi... (31)
  - Building (3)
  - CityModel (1)
  - GroundSurface (3)
  - ReliefFeature (1)
  - RoofSurface (3)
  - SolitaryVegetat... (1)
  - TINRelief (1)
  - WallSurface (18)

3 Buildings  
1 SolitaryVegetationObject  
1 Relief Feature



Feature Information

Property	Value

Features Selected: 0

Table View

GEO5014-2021\_CitySim\_CrashCourse [CITYGML] - Building

Building x CityModel x

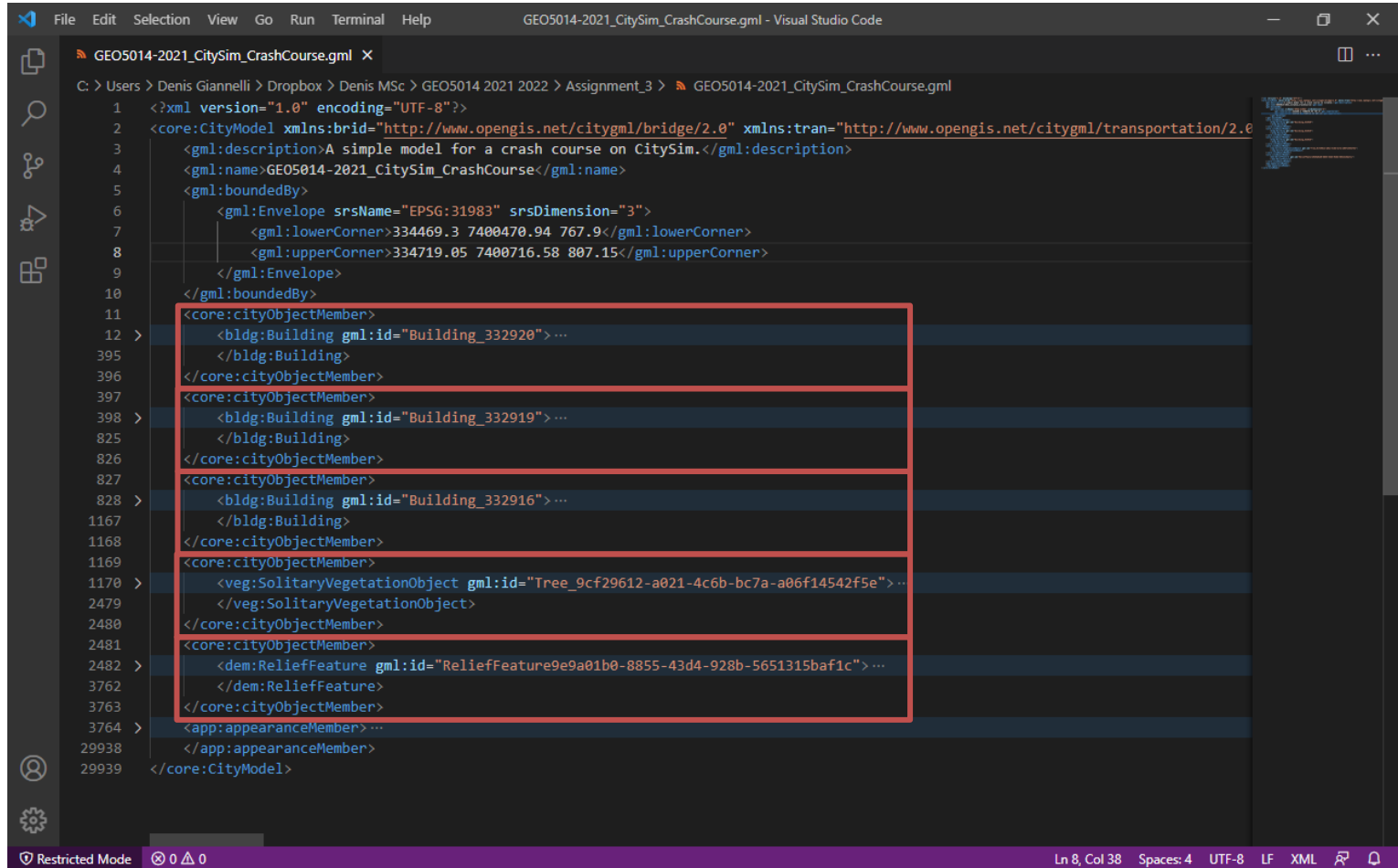
gml_id	gml_parent_id	citygml_target_uri	citygml_feature_role	citygml_feature_role_attr_name	citygml_feature_role_attr_val	gml_description	gml_name	citygml_creation
1 Building_332920	CityModel_5ac1f5...	http://www.opengis.n...	cityObjectMember	<missing>	<missing>	Designed with the L...	Building_332920	<missing>

Q in any column 3 row(s)

Log Table View

X: ----- Y: ----- SIRGAS2000.UTM-23S Meter

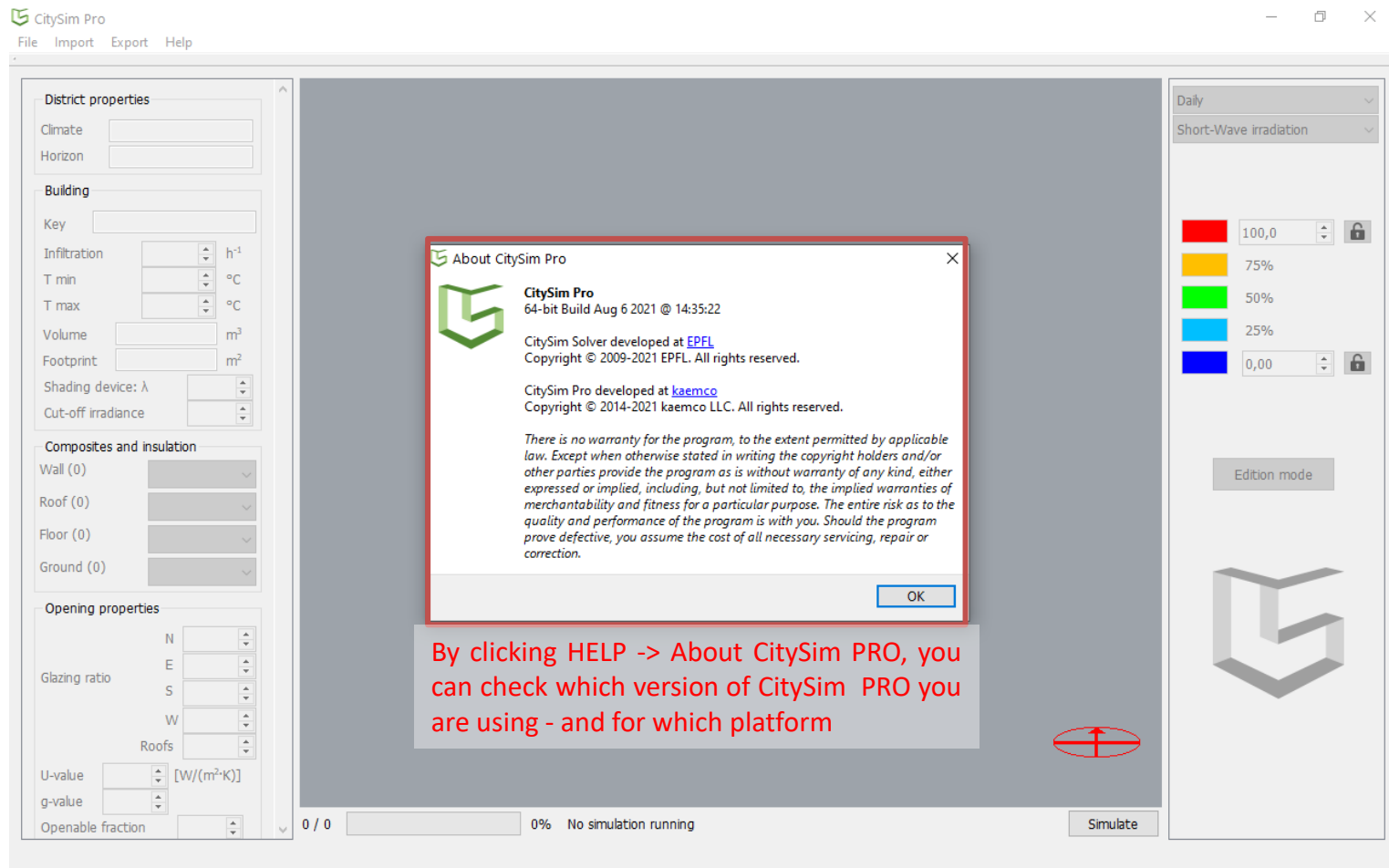
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```
1 <?xml version="1.0" encoding="UTF-8"?>
2 <core:CityModel xmlns:brid="http://www.opengis.net/citygml/bridge/2.0" xmlns:tran="http://www.opengis.net/citygml/transportation/2.0"
3   <gml:description>A simple model for a crash course on CitySim.</gml:description>
4   <gml:name>GEO5014-2021_CitySim_CrashCourse</gml:name>
5   <gml:boundedBy>
6     <gml:Envelope srsName="EPSG:31983" srsDimension="3">
7       <gml:lowerCorner>334469.3 7400470.94 767.9</gml:lowerCorner>
8       <gml:upperCorner>334719.05 7400716.58 807.15</gml:upperCorner>
9     </gml:Envelope>
10  </gml:boundedBy>
11  <core:cityObjectMember>
12    <blgd:Building gml:id="Building_332920">...
13  </blgd:Building>
14 </core:cityObjectMember>
15 <core:cityObjectMember>
16  <blgd:Building gml:id="Building_332919">...
17 </blgd:Building>
18 </core:cityObjectMember>
19 <core:cityObjectMember>
20  <blgd:Building gml:id="Building_332916">...
21 </blgd:Building>
22 </core:cityObjectMember>
23 <core:cityObjectMember>
24  <veg:SolitaryVegetationObject gml:id="Tree_9cf29612-a021-4c6b-bc7a-a06f14542f5e">...
25 </veg:SolitaryVegetationObject>
26 </core:cityObjectMember>
27 <core:cityObjectMember>
28  <dem:ReliefFeature gml:id="ReliefFeature9e9a01b0-8855-43d4-928b-5651315baf1c">...
29 </dem:ReliefFeature>
30 </core:cityObjectMember>
31 <app:appearanceMember>...
32 </app:appearanceMember>
33 </core:CityModel>
```

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The screenshot shows the CitySim Pro software interface. On the left, there are property panels for 'District properties', 'Building', 'Composites and insulation', and 'Opening properties'. The main window displays a 3D city model. On the right, there are color selection controls and a 'Simulate' button. An 'About CitySim Pro' dialog box is open in the center, providing version and copyright information.

**About CitySim Pro**

CitySim Pro  
64-bit Build Aug 6 2021 @ 14:35:22

CitySim Solver developed at [EPFL](#).  
Copyright © 2009-2021 EPFL. All rights reserved.

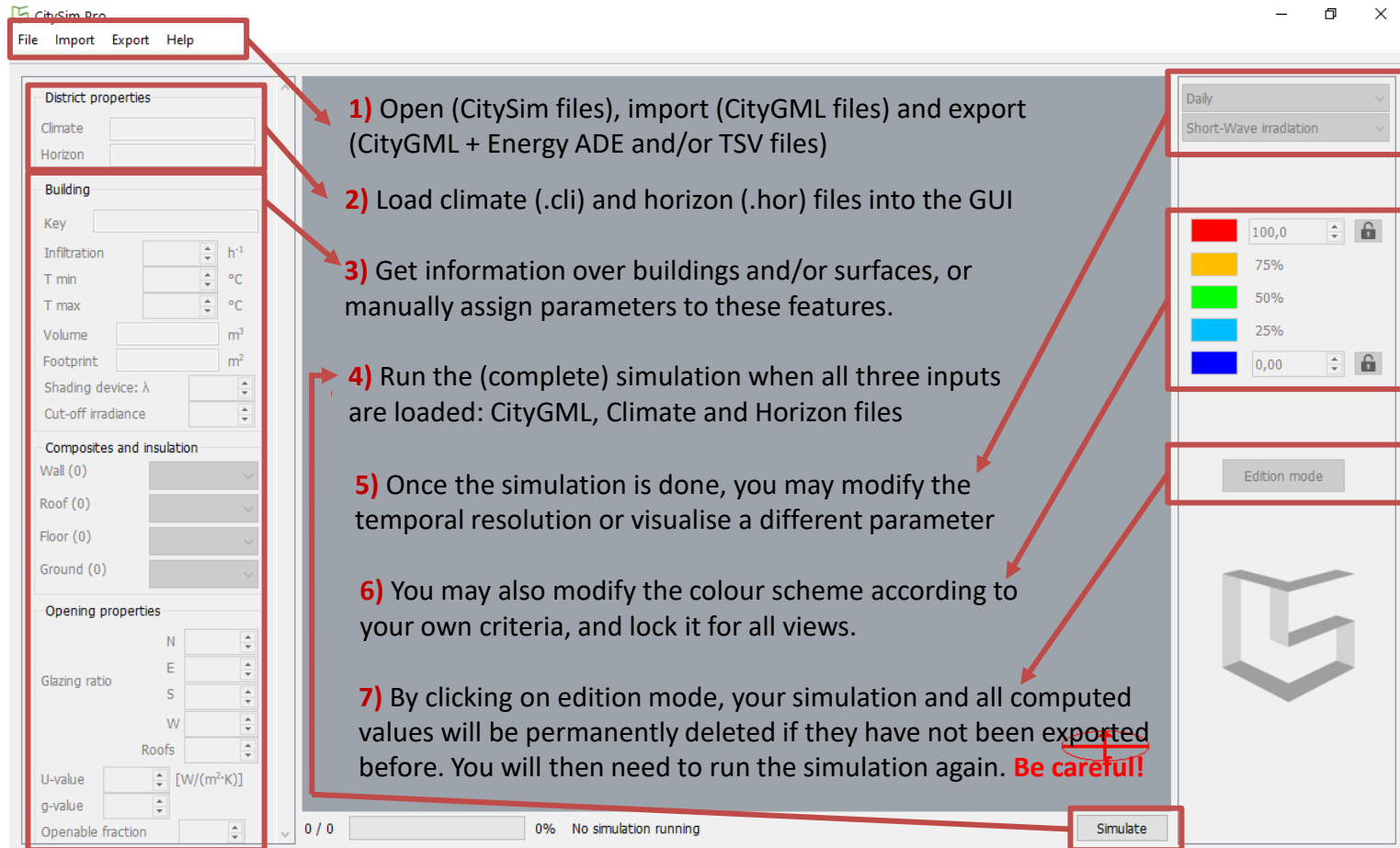
CitySim Pro developed at [kaemco](#).  
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OK

By clicking HELP -> About CitySim PRO, you can check which version of CitySim PRO you are using - and for which platform

# CitySim fundamentals



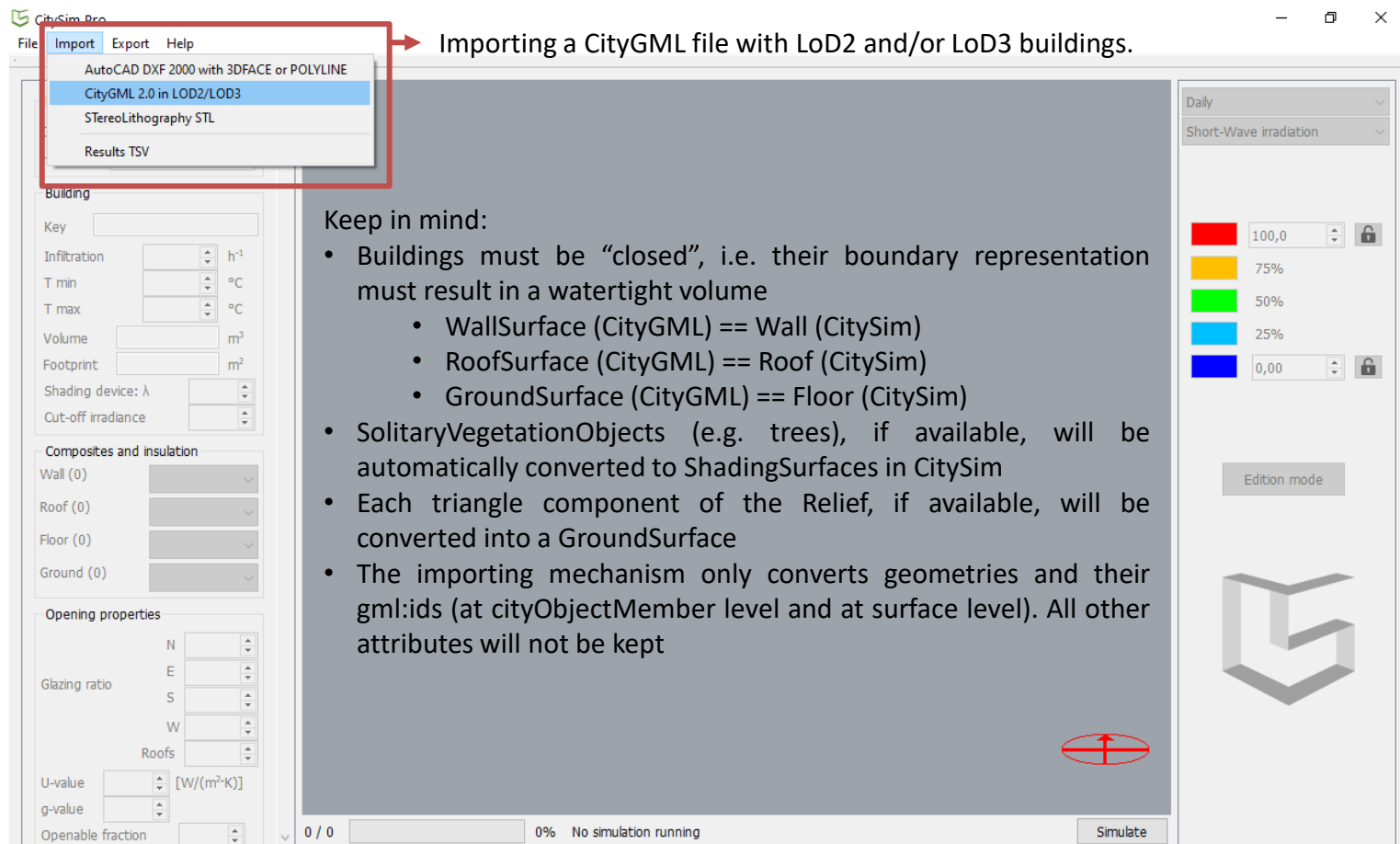
The screenshot shows the CitySim Pro interface with several key components highlighted by red boxes:

- Menu Bar:** File, Import, Export, Help
- Left Panel (District properties):** Includes sections for Climate, Building (with fields for Key, Infiltration, T min, T max, Volume, Footprint, Shading device, Cut-off irradiance), Composites and insulation (Wall, Roof, Floor, Ground), and Opening properties (Glazing ratio, Roofs, U-value, g-value, Openable fraction).
- Top Right:** A dropdown menu set to 'Daily' and another set to 'Short-Wave irradiation'.
- Middle Right:** A color scheme legend with five color swatches and their corresponding percentages: Red (100,0), Yellow (75%), Green (50%), Cyan (25%), and Blue (0,00). Lock icons are present next to the Red and Blue swatches.
- Bottom Right:** An 'Edition mode' button and a large 3D 'G' logo.
- Bottom Center:** A 'Simulate' button.
- Status Bar:** Shows '0 / 0', '0%', and 'No simulation running'.

Seven numbered instructions are overlaid on the screenshot, with red arrows pointing to the corresponding GUI elements:

- 1) Open (CitySim files), import (CityGML files) and export (CityGML + Energy ADE and/or TSV files)
- 2) Load climate (.cli) and horizon (.hor) files into the GUI
- 3) Get information over buildings and/or surfaces, or manually assign parameters to these features.
- 4) Run the (complete) simulation when all three inputs are loaded: CityGML, Climate and Horizon files
- 5) Once the simulation is done, you may modify the temporal resolution or visualise a different parameter
- 6) You may also modify the colour scheme according to your own criteria, and lock it for all views.
- 7) By clicking on edition mode, your simulation and all computed values will be permanently deleted if they have not been exported before. You will then need to run the simulation again. **Be careful!**

# CitySim fundamentals



Importing a CityGML file with LoD2 and/or LoD3 buildings.

Keep in mind:

- Buildings must be “closed”, i.e. their boundary representation must result in a watertight volume
  - WallSurface (CityGML) == Wall (CitySim)
  - RoofSurface (CityGML) == Roof (CitySim)
  - GroundSurface (CityGML) == Floor (CitySim)
- SolitaryVegetationObjects (e.g. trees), if available, will be automatically converted to ShadingSurfaces in CitySim
- Each triangle component of the Relief, if available, will be converted into a GroundSurface
- The importing mechanism only converts geometries and their gml:ids (at cityObjectMember level and at surface level). All other attributes will not be kept

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CitySim Pro
File Import Export Help
— □ ×

**District properties**

Climate

Horizon

**Building**

Key

Infiltration  h<sup>-1</sup>

T min  °C

T max  °C

Volume  m<sup>3</sup>

Footprint  m<sup>2</sup>

Shading device: λ

Cut-off irradiance

**Composites and insulation**

Wall (0)

Roof (0)

Floor (0)

Ground (0)

**Opening properties**

N

E

S

W

Roofs

U-value  [W/(m<sup>2</sup>·K)]

g-value

Openable fraction

**GUI navigation shortcuts:**

- Left click: select only one surface.
- shit + left click: select multiple surfaces.
- ctrl + left click: select a whole building.
- ctrl + shift + left click: select multiple buildings.
- scroll up and down: zoom in and zoom out
- hold scroll: pan the model.
- hold right click: rotate the model.
- Right click: remove outer lines, export save/copy image

Daily

Short-Wave irradiation

■ 100,0


■ 75%

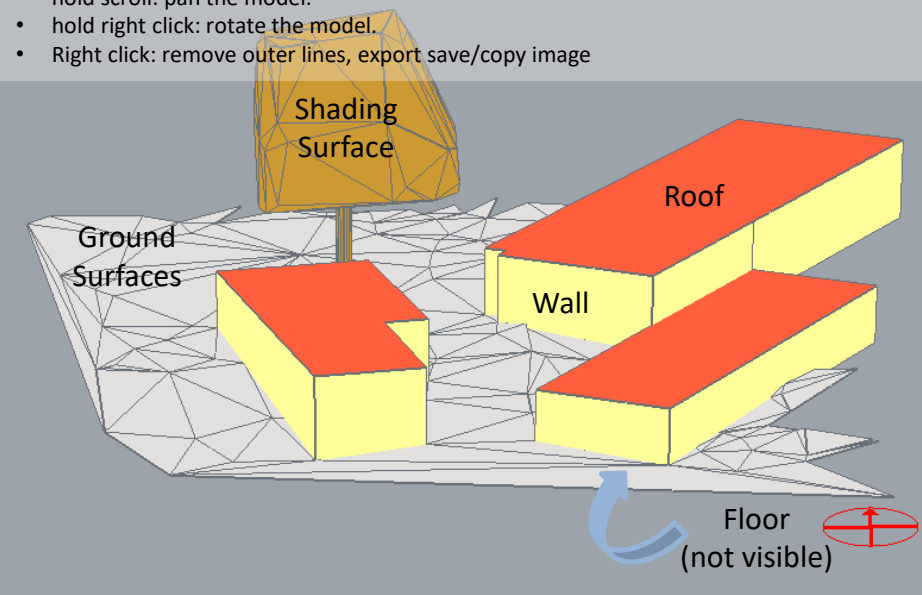
■ 50%

■ 25%

■ 0,00

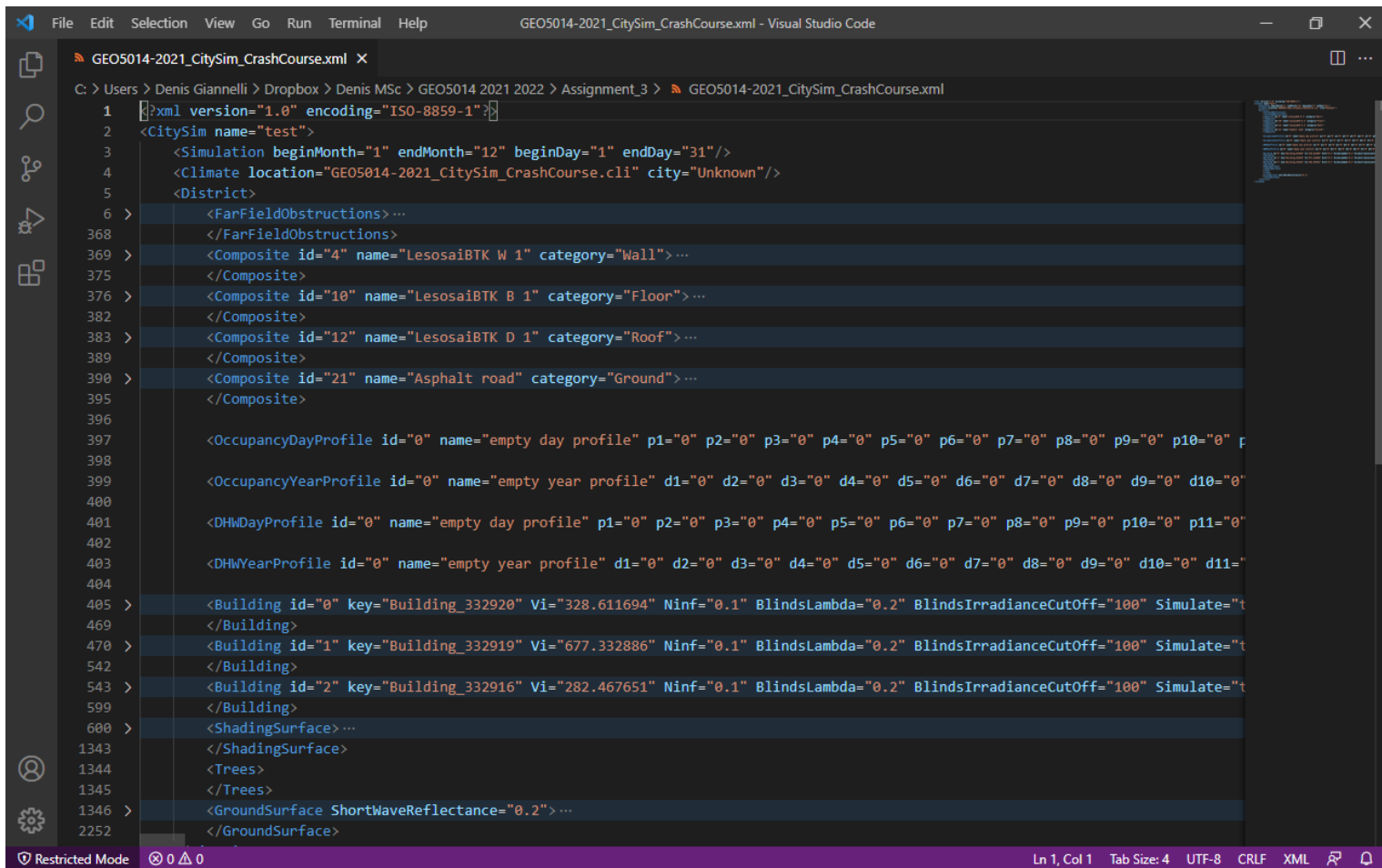
Edition mode





0 / 0  0%
Simulate

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```
1 <?xml version="1.0" encoding="ISO-8859-1"?>
2 <CitySim name="test">
3   <Simulation beginMonth="1" endMonth="12" beginDay="1" endDay="31"/>
4   <Climate location="GEO5014-2021_CitySim_CrashCourse.cli" city="Unknown"/>
5   <District>
6     <FarFieldObstructions> ...
368   </FarFieldObstructions>
369   <Composite id="4" name="LesosaiBTK W 1" category="Wall"> ...
375   </Composite>
376   <Composite id="10" name="LesosaiBTK B 1" category="Floor"> ...
382   </Composite>
383   <Composite id="12" name="LesosaiBTK D 1" category="Roof"> ...
389   </Composite>
390   <Composite id="21" name="Asphalt road" category="Ground"> ...
395   </Composite>
396
397   <OccupancyDayProfile id="0" name="empty day profile" p1="0" p2="0" p3="0" p4="0" p5="0" p6="0" p7="0" p8="0" p9="0" p10="0" p11="0" p12="0">
398
399   <OccupancyYearProfile id="0" name="empty year profile" d1="0" d2="0" d3="0" d4="0" d5="0" d6="0" d7="0" d8="0" d9="0" d10="0" d11="0" d12="0">
400
401   <DHWDayProfile id="0" name="empty day profile" p1="0" p2="0" p3="0" p4="0" p5="0" p6="0" p7="0" p8="0" p9="0" p10="0" p11="0" p12="0">
402
403   <DHWYearProfile id="0" name="empty year profile" d1="0" d2="0" d3="0" d4="0" d5="0" d6="0" d7="0" d8="0" d9="0" d10="0" d11="0" d12="0">
404
405   <Building id="0" key="Building_332920" Vi="328.611694" Ninf="0.1" BlindsLambda="0.2" BlindsIrradianceCutOff="100" Simulate="true">
469   </Building>
470   <Building id="1" key="Building_332919" Vi="677.332886" Ninf="0.1" BlindsLambda="0.2" BlindsIrradianceCutOff="100" Simulate="true">
542   </Building>
543   <Building id="2" key="Building_332916" Vi="282.467651" Ninf="0.1" BlindsLambda="0.2" BlindsIrradianceCutOff="100" Simulate="true">
599   </Building>
600   <ShadingSurface> ...
1343   </ShadingSurface>
1344   <Trees>
1345   </Trees>
1346   <GroundSurface ShortWaveReflectance="0.2"> ...
2252   </GroundSurface>
```

# CitySim fundamentals

CitySim Pro

File Import Export Help

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Building ID=1

Key:

Infiltration:  h<sup>-1</sup>

T min:  °C

T max:  °C

Volume:  m<sup>3</sup>

Footprint:  m<sup>2</sup>

Shading device: λ:

Cut-off irradiance:

Composites and insulation

Wall (7):

Roof (1):

Floor (1):

Ground (0):

Opening properties

N:

E:

S:

W:

Roofs:

U-value:  [W/(m<sup>2</sup>·K)]

g-value:

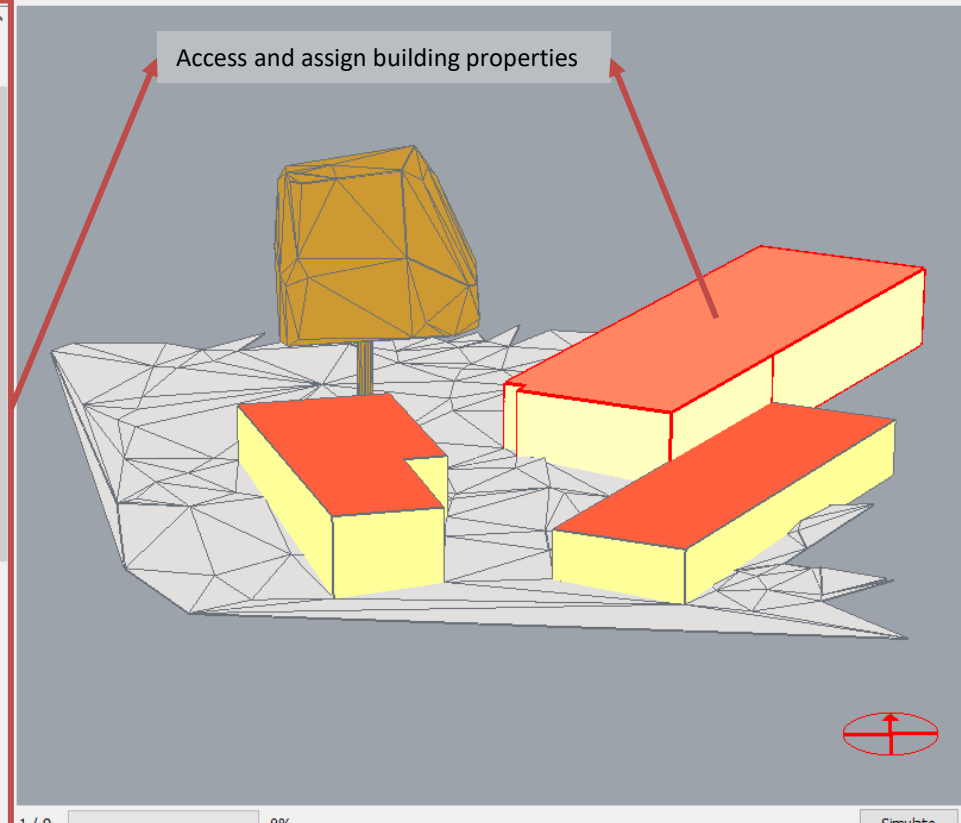
Openable fraction:

Visible surfaces

Reflectance:

Solar panels:

Access and assign building properties




Daily

Short-Wave irradiation

<div style="width: 15px; height: 15px; background-color: red; border: 1px solid gray;"></div>	1,715	<input type="text" value=""/>	<input type="checkbox"/>
<div style="width: 15px; height: 15px; background-color: orange; border: 1px solid gray;"></div>	1.342	<input type="text" value=""/>	<input type="checkbox"/>
<div style="width: 15px; height: 15px; background-color: green; border: 1px solid gray;"></div>	0.969		MWh/m <sup>2</sup>
<div style="width: 15px; height: 15px; background-color: cyan; border: 1px solid gray;"></div>	0.596	<input type="text" value=""/>	<input type="checkbox"/>
<div style="width: 15px; height: 15px; background-color: blue; border: 1px solid gray;"></div>	0,223	<input type="text" value=""/>	<input type="checkbox"/>

Edition mode



1 / 9
0%

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**Composites and insulation**

Wall (0) ▼

Roof (1) LesosaIBTK D ▼

Floor (0) ▼

Ground (0) ▼

---

**Opening properties**

N ▲ ▼

E ▲ ▼

S ▲ ▼

W ▲ ▼

Roofs 0,00 ▲ ▼

U-value 0,00 ▲ ▼ [W/(m²·K)]

g-value 0,00 ▲ ▼

Openable fraction 0,00 ▲ ▼

---

**Visible surface ID=8**

Reflectance 0,20 ▲ ▼

Solar panels:

PV ratio 0,00 ▲ ▼

Type ▼

Thermal ratio 0,00 ▲ ▼

Type ▼

---

**Grounds**

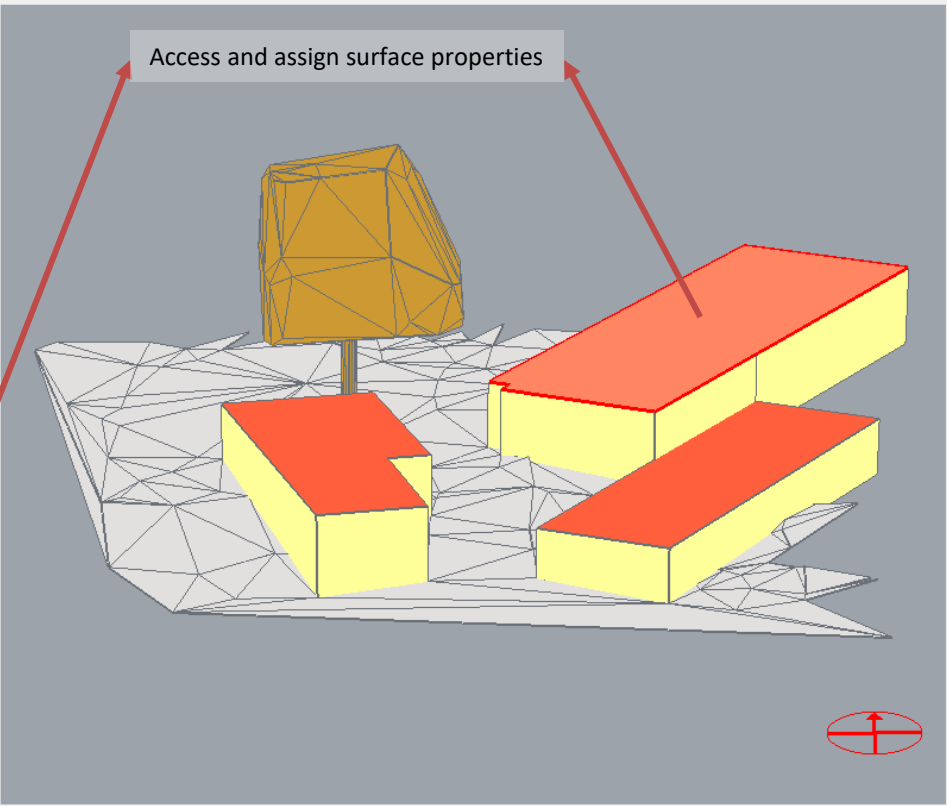
Reflectance ▲ ▼

---

**Occupants**

Number ▲ ▼ p

Density ▲ ▼ m²/p



Access and assign surface properties

Daily ▼

Short-Wave irradiation ▼

---

■ 1,715 ▲ ▼ 🔒

■ 1,342

■ 0,969 MWh/m²


■ 0,596

■ 0,223 ▲ ▼ 🔒

---

Edition mode

---



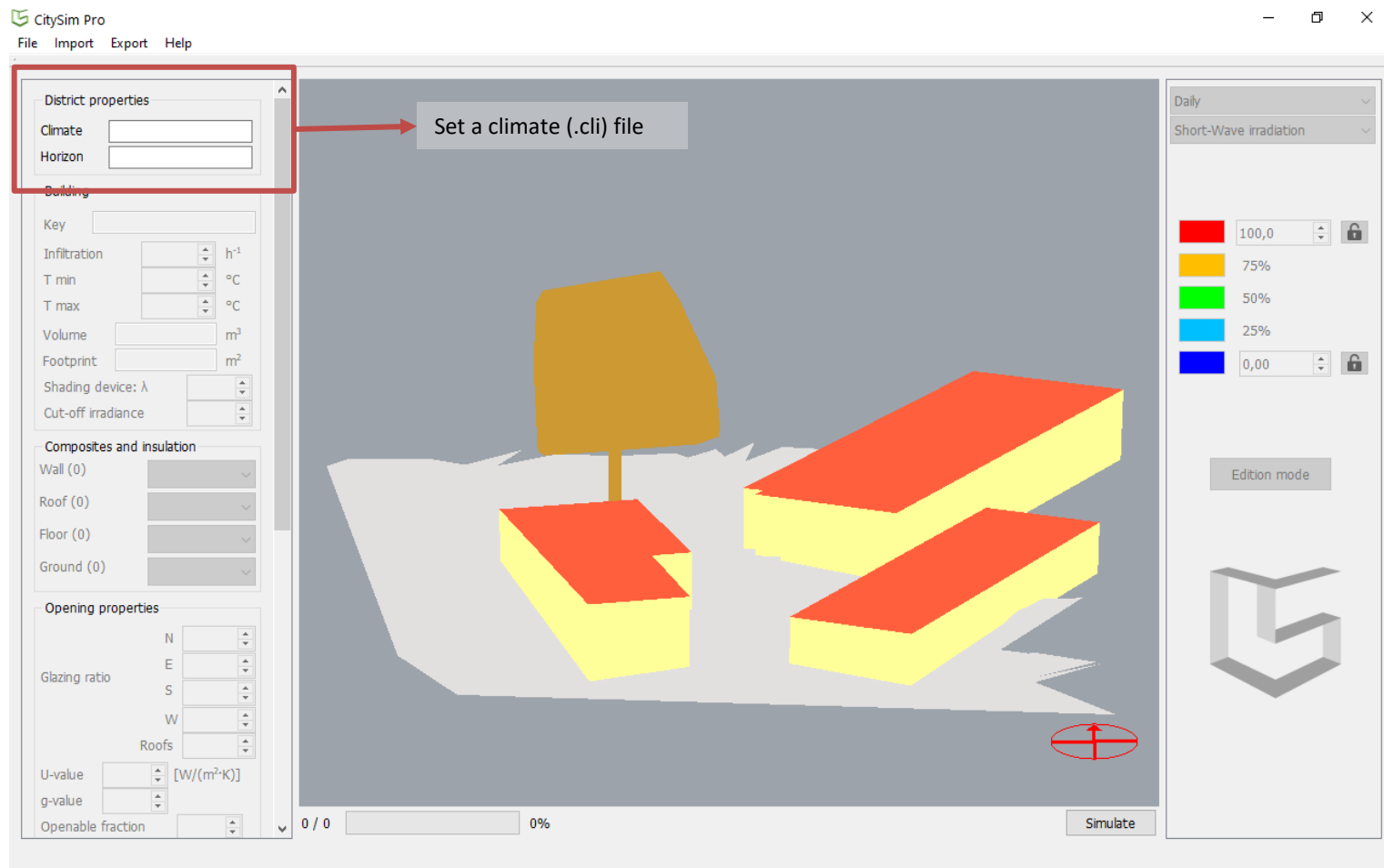

---

0 / 1 0%

Simulate

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The screenshot shows the CitySim Pro software interface. The main window displays a 3D model of a city district with several buildings. The buildings are colored in red, yellow, and blue, representing different materials or properties. A red arrow points from the 'District properties' panel to a text box that says 'Set a climate (.cli) file'. The 'District properties' panel is highlighted with a red box and contains the following fields:

- District properties
  - Climate:
  - Horizon:
- Building
  - Key:
  - Infiltration:  h<sup>-1</sup>
  - T min:  °C
  - T max:  °C
  - Volume:  m<sup>3</sup>
  - Footprint:  m<sup>2</sup>
  - Shading device: λ
  - Cut-off irradiance:
- Composites and insulation
  - Wall (0):
  - Roof (0):
  - Floor (0):
  - Ground (0):
- Opening properties
  - N:
  - E:
  - S:
  - W:
  - Roofs:
  - U-value:  [W/(m<sup>2</sup>·K)]
  - g-value:
  - Openable fraction:

On the right side of the interface, there is a 'Daily' panel with a dropdown menu for 'Short-Wave irradiation'. Below this, there are five color-coded buttons with numerical values and lock icons:

- Red: 100,0
- Yellow: 75%
- Green: 50%
- Cyan: 25%
- Blue: 0,00

Below these buttons is an 'Edition mode' button and a 3D coordinate system icon. At the bottom right, there is a 'Simulate' button. The status bar at the bottom shows '0 / 0' and '0%'.

Heino\_EPW\_citiesim.cli

Users > camiloleon > Dropbox > My Mac (Camilos-MacBook-Pro.local) > Desktop > Heino\_EPW\_citiesim.cli

```

1 Heino
2 52.4344,6.2589,3.6,+1
3
4
5 dm m h G_Dh G_Bn Ta Ts FF DD RH RR N
6 1 1 1 0 0 2.80 2.80 4.00 220 87 0.0 6
7 1 1 2 0 0 2.50 2.50 3.70 224 88 0.0 7
8 1 1 3 0 0 2.30 2.30 3.30 224 89 0.0 7
9 1 1 4 0 0 2.00 2.00 3.00 190 90 0.0 7
10 1 1 5 0 0 2.00 2.00 3.20 235 89 0.0 7
11 1 1 6 0 0 2.00 2.00 3.30 209 88 0.0 6
12 1 1 7 0 0 2.00 2.00 3.50 212 87 0.0 6
13 1 1 8 0 0 1.90 1.90 3.70 205 86 0.0 6
14 1 1 9 39 242 1.90 1.90 3.80 220 84 0.0 8
15 1 1 10 77 180 1.90 1.90 4.00 210 83 0.0 6
16 1 1 11 101 134 2.20 2.20 4.20 220 82 0.0 6
17 1 1 12 100 141 2.60 2.60 4.30 209 81 0.0 6
18 1 1 13 85 134 2.90 2.90 4.50 216 80 0.0 6
19 1 1 14 56 80 3.20 3.20 4.70 210 79 0.0 6
20 1 1 15 20 16 3.60 3.60 4.80 213 78 0.0 6
21 1 1 16 2 0 3.90 3.90 5.00 210 77 0.0 6
22 1 1 17 0 0 4.00 4.00 5.20 212 76 0.0 6
23 1 1 18 0 0 4.10 4.10 5.30 207 75 0.0 6
24 1 1 19 0 0 4.20 4.20 5.50 207 74 0.0 5
25 1 1 20 0 0 4.20 4.20 5.70 206 73 0.0 5
26 1 1 21 0 0 4.30 4.30 5.80 207 72 0.0 5
27 1 1 22 0 0 4.40 4.40 6.00 210 71 0.0 5
28 1 1 23 0 0 4.50 4.50 5.00 216 79 0.0 6
29 1 1 24 0 0 4.70 4.70 4.00 216 87 0.4 7
30 2 1 1 0 0 4.40 4.40 4.80 216 99 0.4 8
31 2 1 2 0 0 4.70 4.70 5.50 218 97 1.2 8
32 2 1 3 0 0 5.00 5.00 6.20 221 96 0.1 8
33 2 1 4 0 0 5.30 5.30 7.00 220 95 0.2 8
34 2 1 5 0 0 5.90 5.90 7.00 227 91 0.5 7
35 2 1 6 0 0 6.60 6.60 7.00 232 87 0.1 7
36 2 1 7 0 0 7.20 7.20 7.00 238 84 0.0 6
37 2 1 8 0 0 7.80 7.80 7.00 249 81 0.4 6
38 2 1 9 25 150 8.50 8.50 7.00 273 78 0.3 6
39 2 1 10 55 345 9.10 9.10 7.00 270 75 0.0 6
40 2 1 11 67 524 8.70 8.70 6.80 280 74 0.0 5
41 2 1 12 63 559 8.40 8.40 6.70 276 74 0.0 5
42 2 1 13 56 478 8.00 8.00 6.50 274 73 0.0 5
  
```

**Name of your weather station (string)**

**Latitude, Longitude, Altitude, (Geographical) time zone index**

**An empty line**

**Header (TAB-separated values)**

- dm (day of the month) – INT [1,31]
- m (month of the year) – INT [1,12]
- h (hour of the day) – INT [1,24]
- G\_h (Global horizontal irradiance W/m<sup>2</sup>) – FLOAT
- Ta (Air temperature °C) – FLOAT
- Ts (Soil temperature °C) – FLOAT
- FF (Wind Speed m/s) – FLOAT
- DD (Wind Direction ° Az North and clock-wise) – INT
- RH (Relative Humidity %) – INT
- RR (Precipitation mm) – FLOAT
- N (Nebulosity octas) – INT [0,8]

**MAKE SURE THAT THE RECORDS ARE WRITTEN CHRONOLOGICALLY, CITYSIM DOES NOT READ THE FIRST THREE COLUMNS AND ASSUMES A TIMELINE SERIES.**

**All these attributes can be retrieved from the Dutch weather datasets**

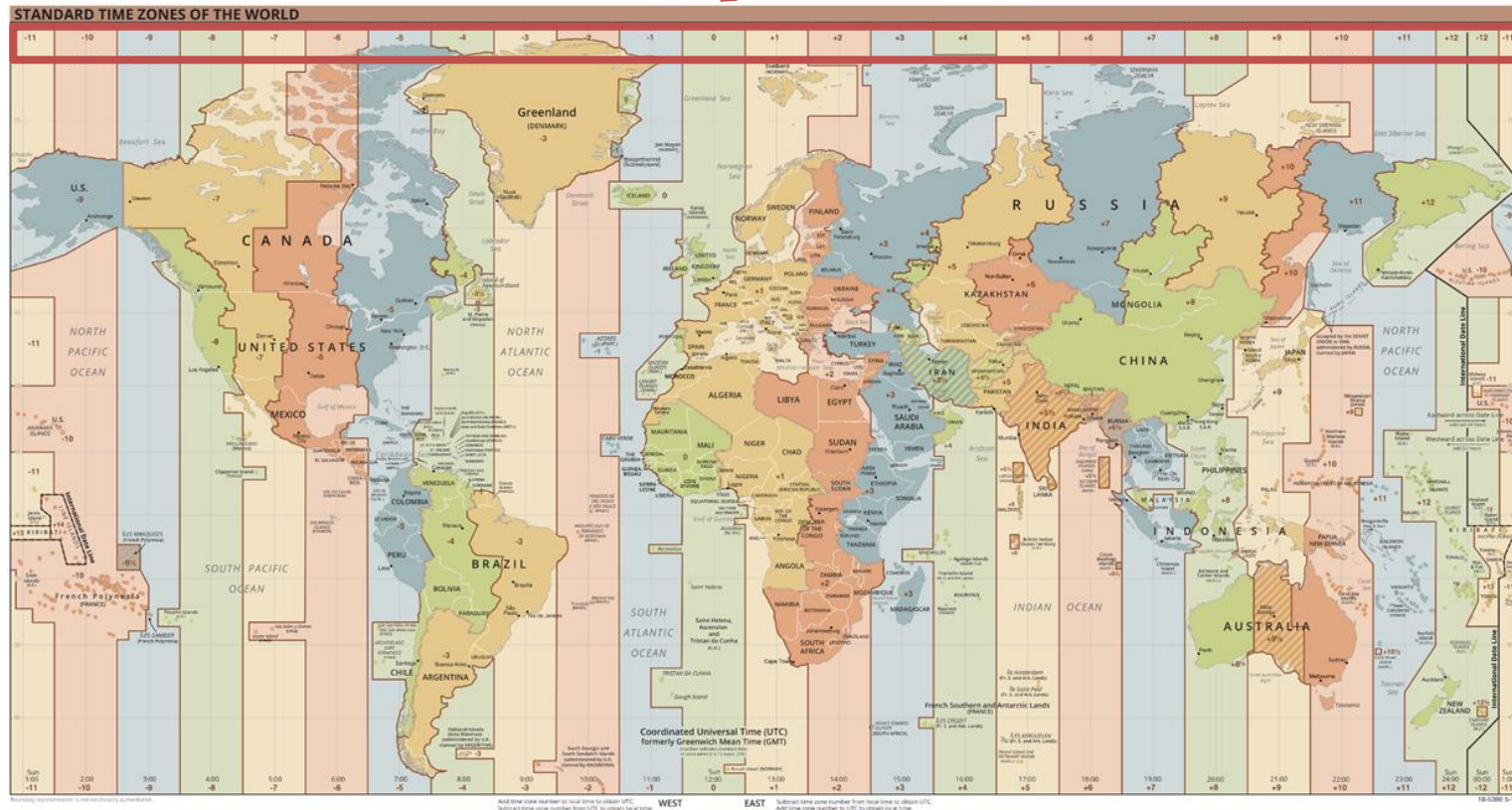
**365 x 24 = 8.760 Records**

**Do NOT insert records for the 29<sup>th</sup> of February (leap year).**

# CitySim fundamentals

Latitude, Longitude, Altitude, time zone index

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Watch out! Some countries have a time zone that does not correspond to the actual geographical time zone (e.g. Argentina, Spain, etc.)

## Weather data (according to Meteonorm)

Payerne  
 46.8116    6.9424    490    1

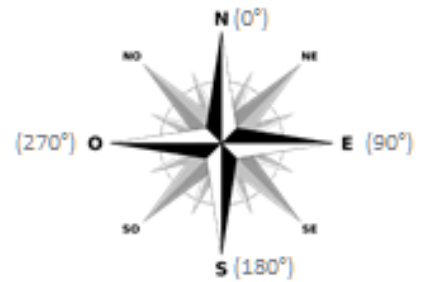
m	dm	h	ST	Az	hs
1	1	1	23.91	-177	0
1	1	2	0.91	-150.2	0
1	1	3	1.91	-125.6	0

G_Bn	G_Dh
0	0
0	0
0	0

Ta	FF	DD	RH
8.6	0.8	173	74
8.3	0.4	252	76
8	0.3	249	74

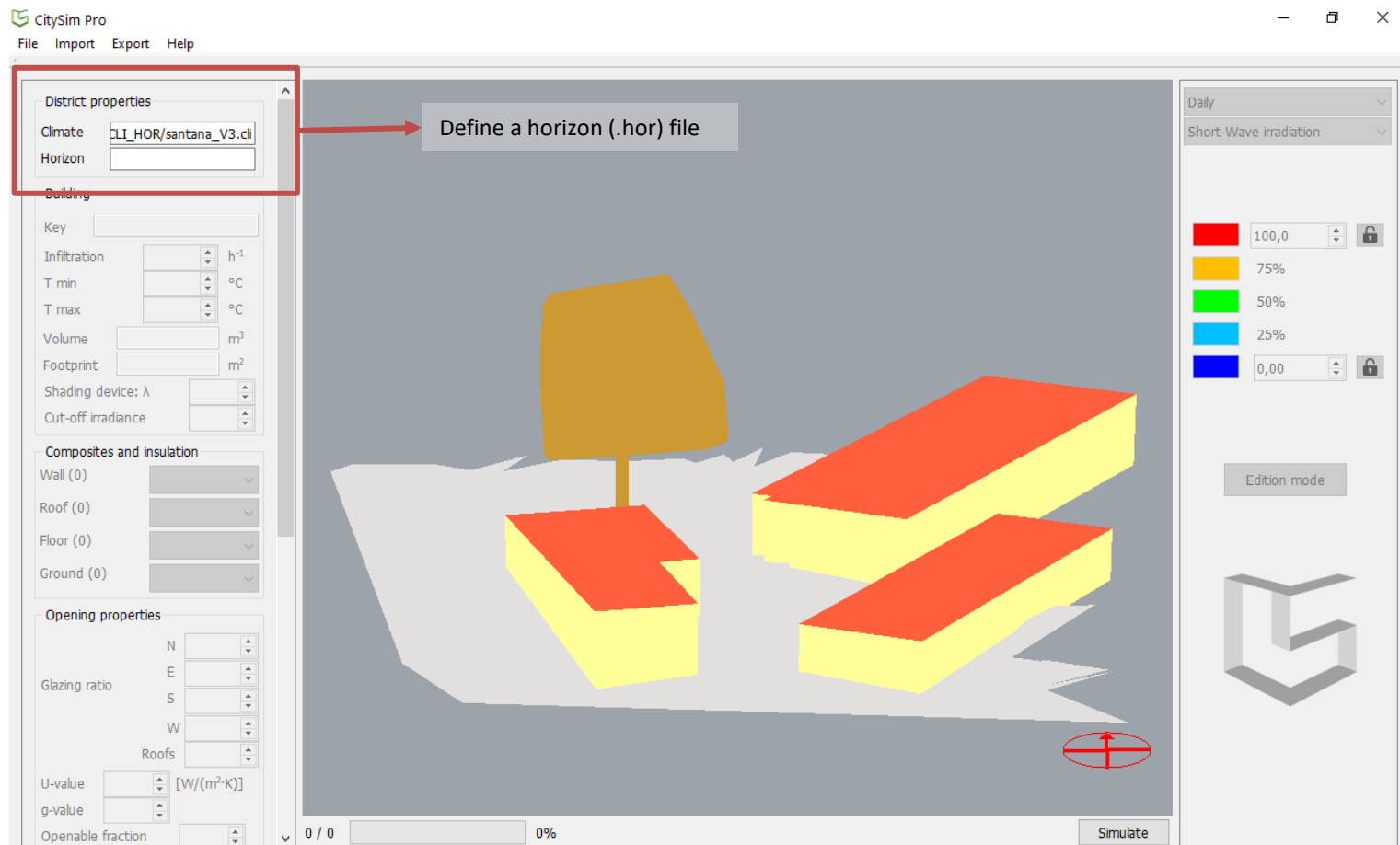
If  
 • Beam (solar) normal irradiance ( $G_{Bn}$ )  
 AND  
 • Diffuse horizontal irradiance ( $G_{Dh}$ )  
 are known, then you may substitute  
 • Global horizontal irradiance ( $G_h$ )  
 with these two for a more accurate algorithm

- m: month [1..12]
- dm: day of the month [1..31]
- h: hour [1..24]
- Ta: air temperature (°C)
- FF: wind speed (m/s)
- DD: wind direction (**azimuth from North, clockwise**)



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The screenshot shows the CitySim Pro software interface. On the left, there is a sidebar with various settings panels. The 'District properties' panel is highlighted with a red box and contains the following fields:

- Climate:  (An arrow points from this field to a text box that says 'Define a horizon (.hor) file')
- Horizon:

Below this are sections for 'Building' (with fields for Key, Infiltration, T min, T max, Volume, Footprint, Shading device, and Cut-off irradiance), 'Composites and insulation' (with dropdowns for Wall, Roof, Floor, and Ground), and 'Opening properties' (with dropdowns for N, E, S, W, and Roofs, and fields for U-value, g-value, and Openable fraction).

The central 3D view shows a simplified model of a city block with several buildings. The buildings have yellow walls and red roofs. A tree is visible in the background. A red compass rose is located in the bottom right corner of the 3D view.

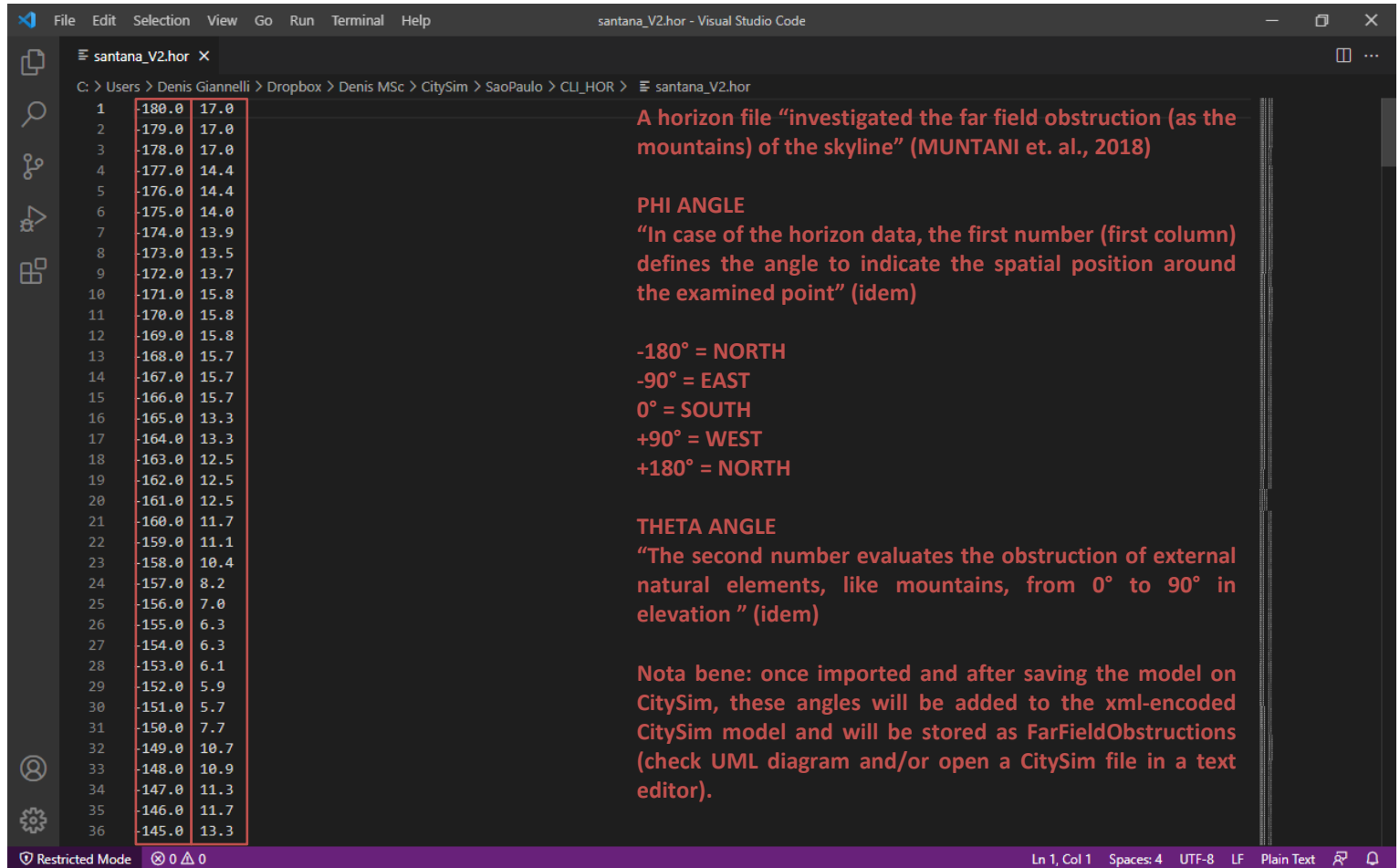
On the right side of the interface, there is a control panel with a 'Daily' dropdown menu, a 'Short-Wave irradiation' dropdown menu, and a color-coded legend with the following values:

- Red: 100,0
- Yellow: 75%
- Green: 50%
- Cyan: 25%
- Blue: 0,00

Below the legend is an 'Edition mode' button and a large 3D 'G' logo. At the bottom right, there is a 'Simulate' button. The bottom status bar shows '0 / 0' and '0%'.

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The screenshot shows a Visual Studio Code editor window titled 'santana\_V2.hor'. The left sidebar displays a file explorer with the path 'C:\Users> Denis Giannelli > Dropbox > Denis MSc > CitySim > SaoPaulo > CLI\_HOR > santana\_V2.hor'. The main editor area contains a table of horizon data and explanatory text.

1	-180.0	17.0
2	-179.0	17.0
3	-178.0	17.0
4	-177.0	14.4
5	-176.0	14.4
6	-175.0	14.0
7	-174.0	13.9
8	-173.0	13.5
9	-172.0	13.7
10	-171.0	15.8
11	-170.0	15.8
12	-169.0	15.8
13	-168.0	15.7
14	-167.0	15.7
15	-166.0	15.7
16	-165.0	13.3
17	-164.0	13.3
18	-163.0	12.5
19	-162.0	12.5
20	-161.0	12.5
21	-160.0	11.7
22	-159.0	11.1
23	-158.0	10.4
24	-157.0	8.2
25	-156.0	7.0
26	-155.0	6.3
27	-154.0	6.3
28	-153.0	6.1
29	-152.0	5.9
30	-151.0	5.7
31	-150.0	7.7
32	-149.0	10.7
33	-148.0	10.9
34	-147.0	11.3
35	-146.0	11.7
36	-145.0	13.3

**A horizon file “investigated the far field obstruction (as the mountains) of the skyline” (MUNTANI et. al., 2018)**

**PHI ANGLE**  
 “In case of the horizon data, the first number (first column) defines the angle to indicate the spatial position around the examined point” (idem)

**-180° = NORTH**  
**-90° = EAST**  
**0° = SOUTH**  
**+90° = WEST**  
**+180° = NORTH**

**THETA ANGLE**  
 “The second number evaluates the obstruction of external natural elements, like mountains, from 0° to 90° in elevation” (idem)

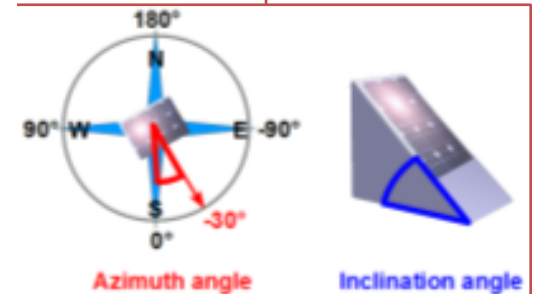
**Nota bene:** once imported and after saving the model on CitySim, these angles will be added to the xml-encoded CitySim model and will be stored as FarFieldObstructions (check UML diagram and/or open a CitySim file in a text editor).

## Solar irradiance on a surface (according to Meteonorm)

Payenne													
m	dm	h	ST	Az	hs	G_Bn	G_Dh	Ta	FF	DD	RH		
46.8116	6.9424	490	1										
1	1	1	23.91	-177	0	0	0	8.6	0.8	173	74		
1	1	2	0.91	-150.2	0	0	0	8.3	0.4	252	76		
1	1	3	1.91	-125.6	0	0	0	8	0.3	249	74		

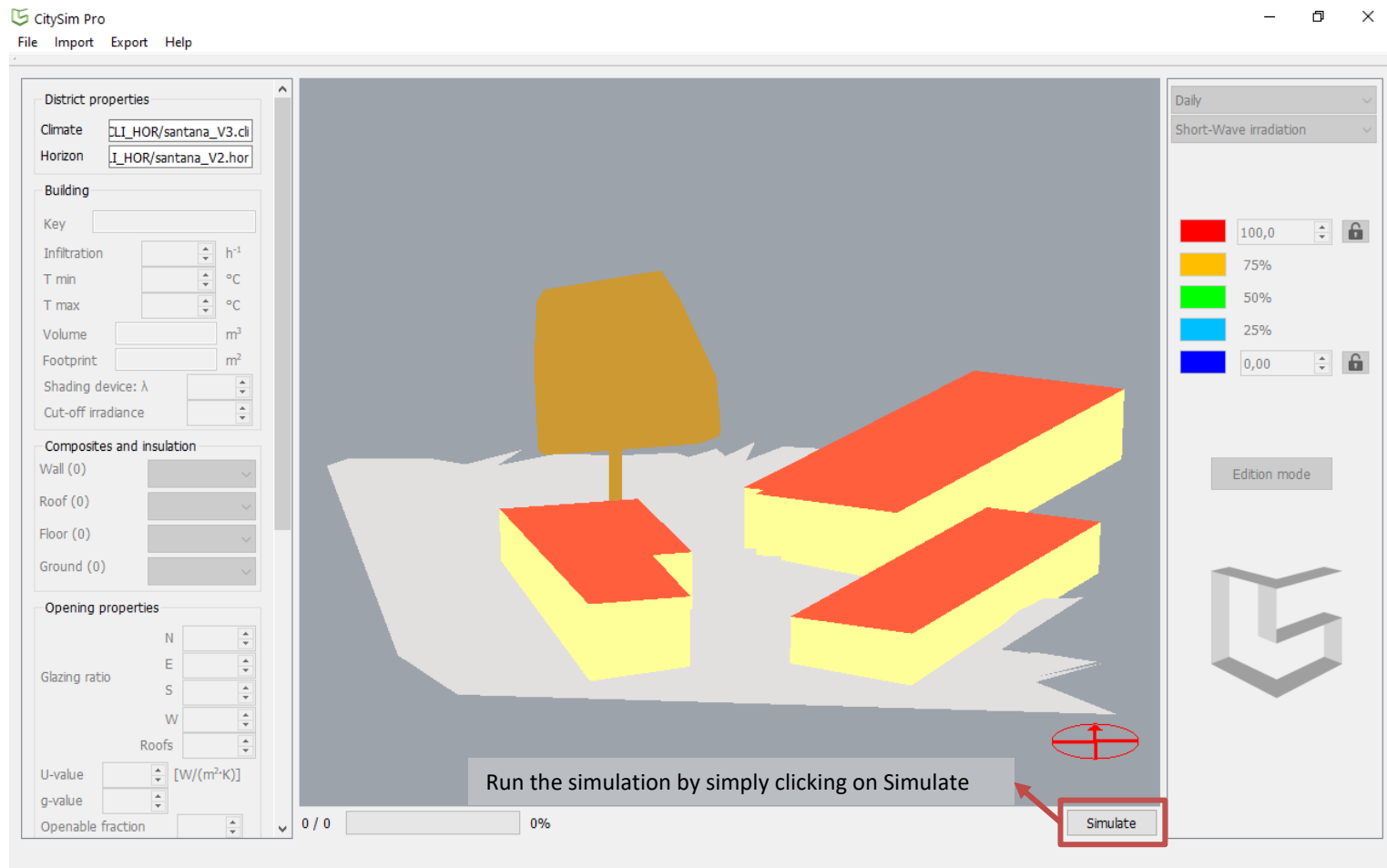
- Az: azimuth of the sun position (**from South, clockwise**)
- hs: height (vertical angle) of the sun (from the horizontal plane)
- G\_Bn: Direct (Beam) solar normal irradiance (W/m<sup>2</sup>)
- G\_Dn: Diffuse (i.e. Sky without sun) solar irradiance on the horizontal plane (W/m<sup>2</sup>)

**WATCH OUT! Look here how to encode phi and theta values in a .HOR file**



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The screenshot shows the CitySim Pro software interface. On the left, there are several panels for configuring simulation parameters:

- District properties:**
  - Climate:
  - Horizon:
- Building:**
  - Key:
  - Infiltration:  h<sup>-1</sup>
  - T min:  °C
  - T max:  °C
  - Volume:  m<sup>3</sup>
  - Footprint:  m<sup>2</sup>
  - Shading device: λ
  - Cut-off irradiance
- Composites and insulation:**
  - Wall (0)
  - Roof (0)
  - Floor (0)
  - Ground (0)
- Opening properties:**
  - Glazing ratio:
    - N:
    - E:
    - S:
    - W:
  - Roofs:
  - U-value:  [W/(m<sup>2</sup>·K)]
  - g-value:
  - Openable fraction:

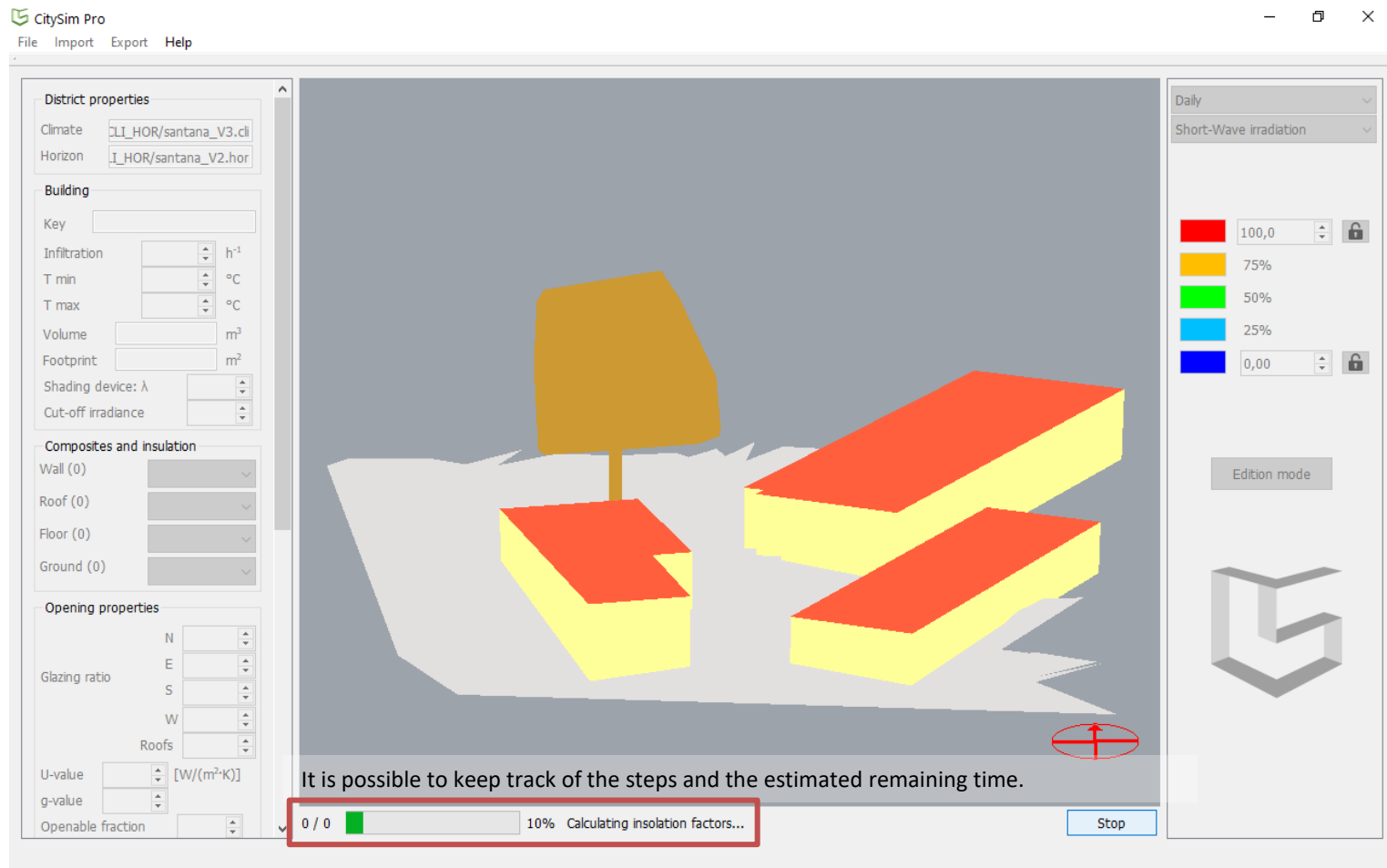
The central 3D view shows a simplified city model with a tree and several rectangular buildings. The buildings have red roofs and yellow walls. A text box at the bottom of the 3D view reads: "Run the simulation by simply clicking on Simulate". A red arrow points from this text box to a "Simulate" button located in the bottom right corner of the interface.

On the right side of the interface, there is a control panel:

- Simulation type: Daily
- Irradiation type: Short-Wave irradiation
- Color-coded simulation results:
  - Red: 100,0
  - Yellow: 75%
  - Green: 50%
  - Cyan: 25%
  - Blue: 0,00
- Buttons: "Edition mode" and a large stylized "G" logo.

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The screenshot shows the CitySim Pro software interface. On the left, there are several configuration panels:
 

- District properties:** Climate (I\_HOR/santana\_V3.cl), Horizon (I\_HOR/santana\_V2.hor).
- Building:** Key, Infiltration (h<sup>-1</sup>), T min (°C), T max (°C), Volume (m<sup>3</sup>), Footprint (m<sup>2</sup>), Shading device: λ, Cut-off irradiance.
- Composites and insulation:** Wall (0), Roof (0), Floor (0), Ground (0).
- Opening properties:** Glazing ratio (N, E, S, W), Roofs (U-value [W/(m<sup>2</sup>·K)], g-value, Openable fraction).

The central 3D view shows a building model with a red roof and yellow walls. A red crosshair is visible in the bottom right corner of the 3D view.

On the right side, there is a control panel with a dropdown menu set to "Daily" and "Short-Wave irradiation". Below this are five color-coded sliders:
 

- Red: 100,0 (locked)
- Yellow: 75%
- Green: 50%
- Cyan: 25%
- Blue: 0,00 (locked)

 An "Edition mode" button is located below the sliders. At the bottom right of the interface is a "Stop" button.

At the bottom of the interface, a progress bar shows "0 / 0" with a green indicator, "10% Calculating insulation factors...", and a "Stop" button. A red box highlights this progress bar area.

Text overlay at the bottom of the 3D view: "It is possible to keep track of the steps and the estimated remaining time."



# CitySim fundamentals

## IMPORTANT!

- 1) As soon as the simulation is successfully completed, **save immediately** the results as TSV files and – optionally – as CityGML (+ Energy ADE)
- 2) Once the results are stored, you do not need to run the simulation again to explore the results in the GUI. If CitySim crashes, you can simply re-open it and load the stored results!

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**District properties**

Climate:

Horizon:

**Building**

Key:

Infiltration:  h<sup>-1</sup>

T min:  °C

T max:  °C

Volume:  m<sup>3</sup>

Footprint:  m<sup>2</sup>

Shading device: λ

Cut-off irradiance

**Composites and insulation**

Wall (0)

Roof (0)

Floor (0)

Ground (0)

**Opening properties**

N

E

S

W

Roofs

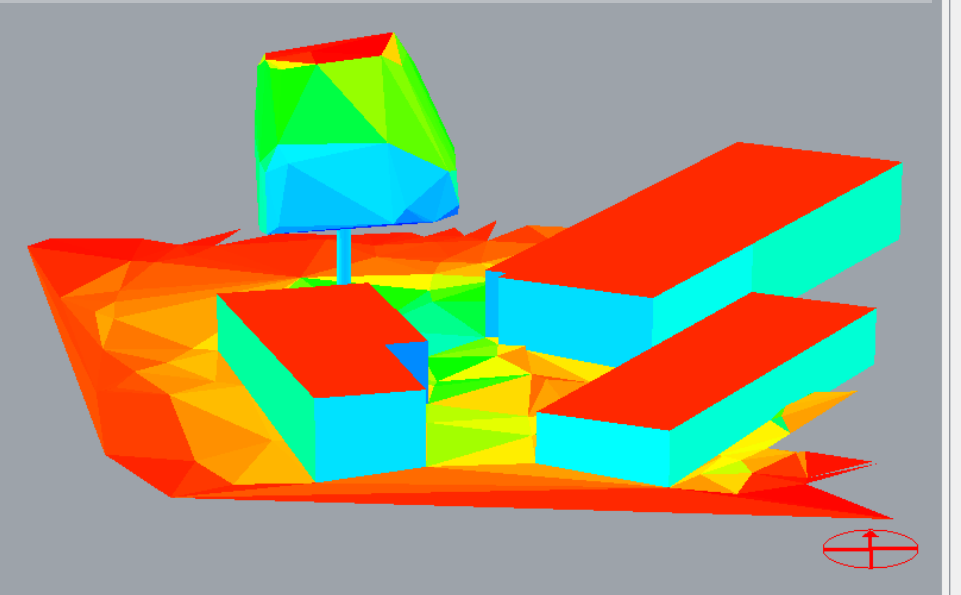
U-value:  [W/(m<sup>2</sup>·K)]

g-value:

Openable fraction:

For **visualisation** purposes: check the available time granularity!

When a coarser temporal resolution is selected, CitySim may perform an average or a summation of the values, depending on the variable that is under analysis...



Daily

Hourly


Daily

Monthly

Yearly

<span style="display: inline-block; width: 15px; height: 15px; background-color: red; border: 1px solid black;"></span>	5,548	<input type="text"/>	<input type="checkbox"/>
<span style="display: inline-block; width: 15px; height: 15px; background-color: orange; border: 1px solid black;"></span>	4.340	<input type="text"/>	<input type="checkbox"/>
<span style="display: inline-block; width: 15px; height: 15px; background-color: green; border: 1px solid black;"></span>	3.133	<input type="text" value="kWh/m²"/>	<input type="checkbox"/>
<span style="display: inline-block; width: 15px; height: 15px; background-color: cyan; border: 1px solid black;"></span>	1.925	<input type="text"/>	<input type="checkbox"/>
<span style="display: inline-block; width: 15px; height: 15px; background-color: blue; border: 1px solid black;"></span>	0,717	<input type="text"/>	<input type="checkbox"/>

Edition mode



0 / 0

100% Simulation done.
Simulate

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**District properties**

Climate:

Horizon:

**Building**

Key:

Infiltration:  h<sup>-1</sup>

T min:  °C

T max:  °C

Volume:  m<sup>3</sup>

Footprint:  m<sup>2</sup>

Shading device: λ

Cut-off irradiance

**Composites and insulation**

Wall (0)

Roof (0)

Floor (0)

Ground (0)

**Opening properties**

N

E

S

W

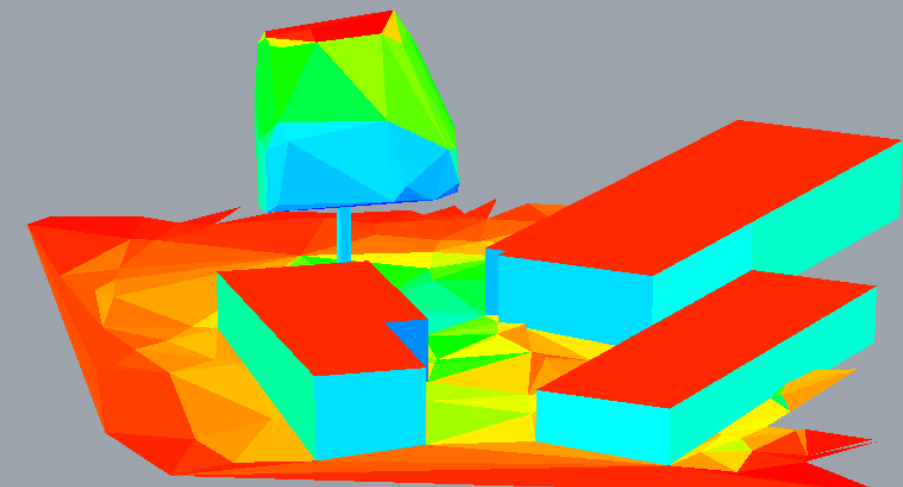
Roofs

U-value:  [W/(m<sup>2</sup>·K)]

g-value:

Openable fraction:

There are different variables available, they can be explored selecting them in this drop down menu



Daily


- Short-Wave irradiation
- Short-Wave irradiation**
- Long-Wave net irradiation
- Surface temperature
- PhotoVoltaic production
- Solar Thermal production
- Sky View Factor
- Heating demand
- Cooling demand
- Indoor temperature

3.133 kWh/m<sup>2</sup>

1.925

0,717

Edition mode



0 / 0  100% Simulation done.
Simulate

# CitySim fundamentals

CitySim Pro

File Import Export Help

**District properties**

Climate:   
 Horizon:

**Building**

Key:

Infiltration:  h<sup>-1</sup>  
 T min:  °C  
 T max:  °C  
 Volume:  m<sup>3</sup>  
 Footprint:  m<sup>2</sup>  
 Shading device: λ   
 Cut-off irradiance

**Composites and insulation**

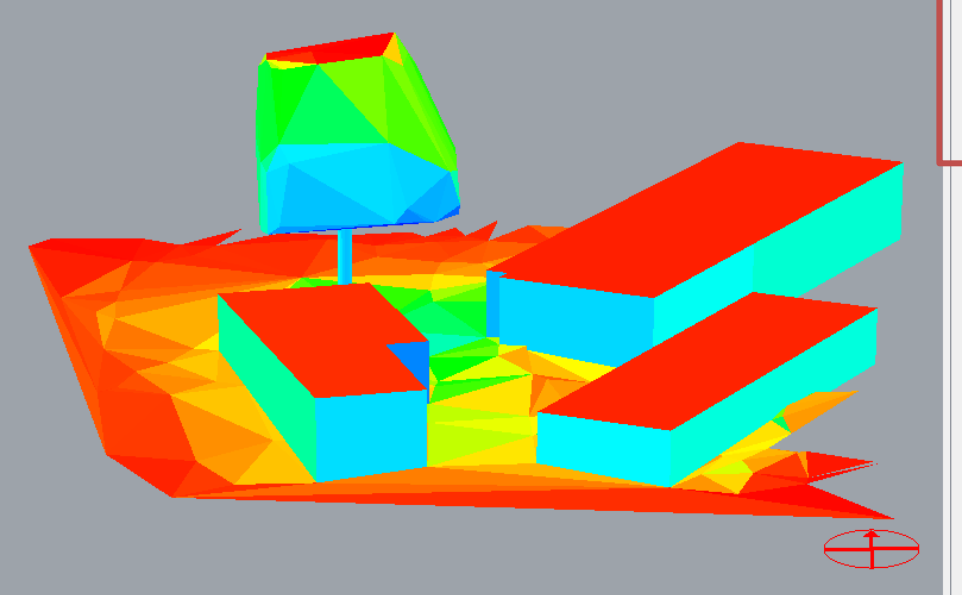
Wall (0)   
 Roof (0)   
 Floor (0)   
 Ground (0)

**Opening properties**

N   
 E   
 S   
 W   
 Roofs

U-value:  [W/(m<sup>2</sup>·K)]  
 g-value:   
 Openable fraction:

You may also use the locks to set a fixed colour ramp for all values throughout a time series and compare monthly results. Hint: check the lowest and highest values of each time series and lock these.




Monthly

Short-Wave irradiation

Month:

154,7	<input type="text"/>	<input type="checkbox"/>
121.1	<input type="text"/>	<input type="checkbox"/>
87.5	kWh/m <sup>2</sup>	<input type="checkbox"/>
53.9	<input type="text"/>	<input type="checkbox"/>
20,3	<input type="text"/>	<input type="checkbox"/>

Edition mode



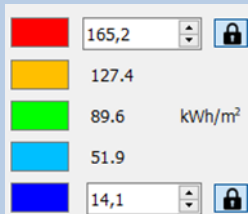
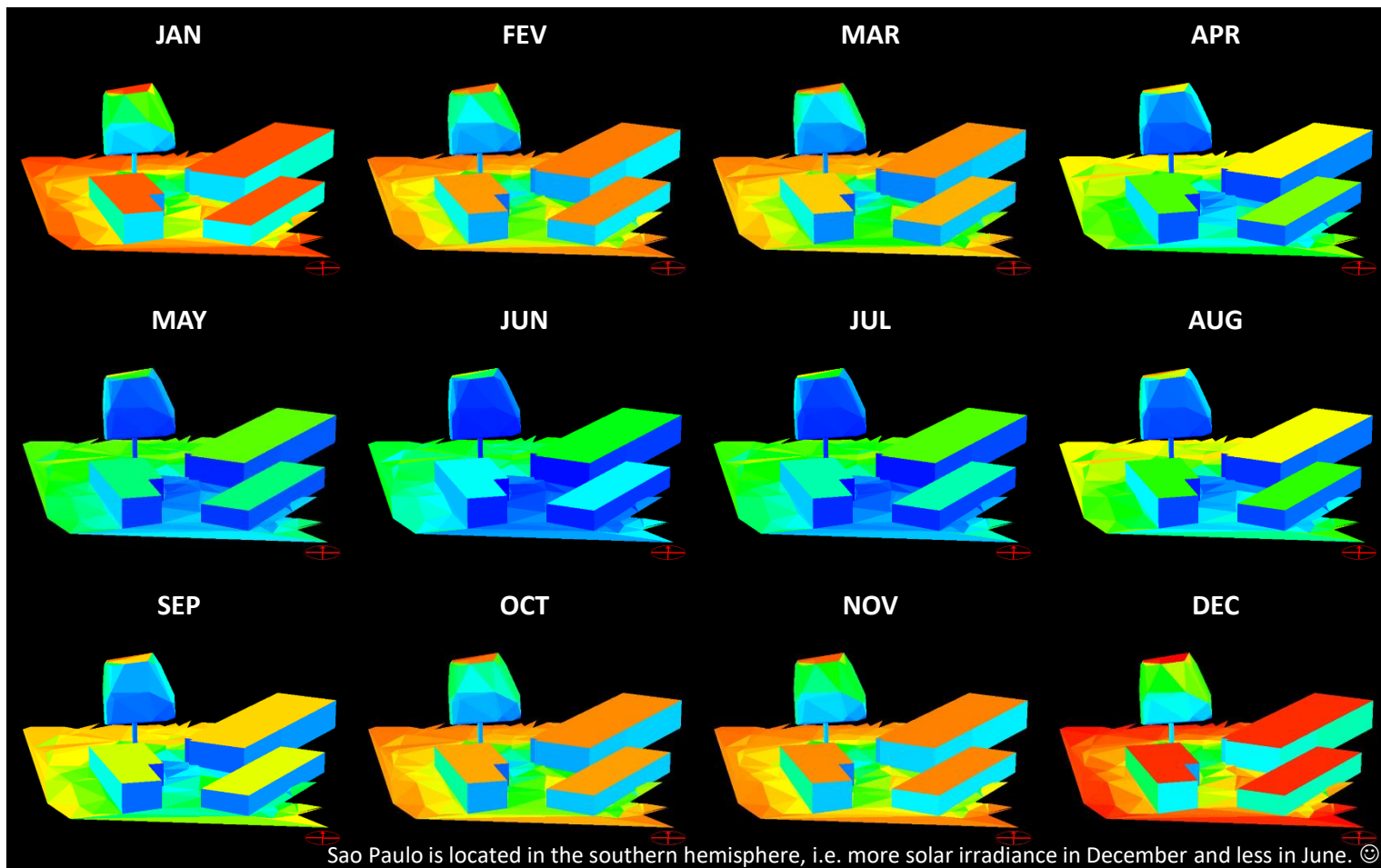
0 / 0  100% Simulation done.

Simulate

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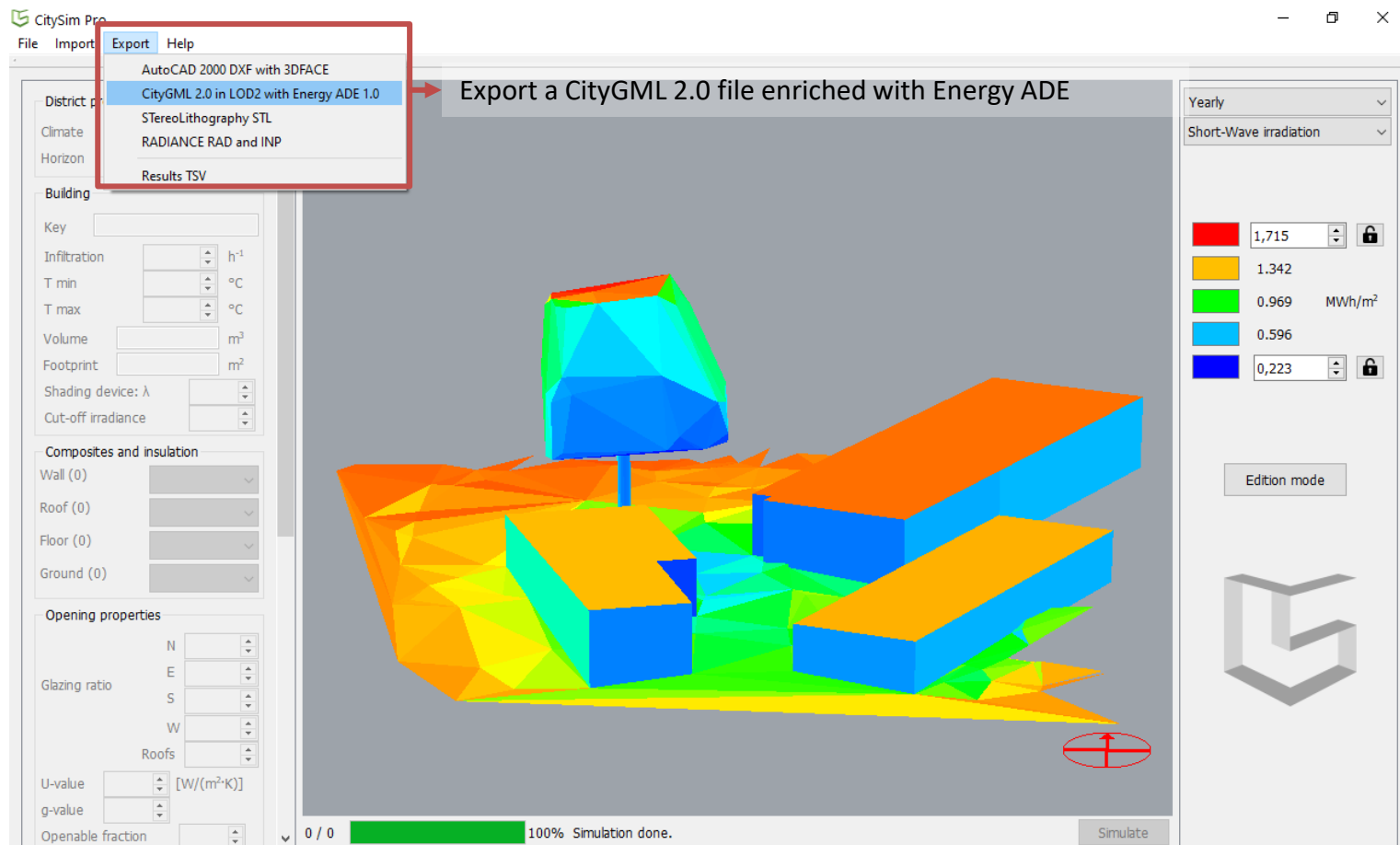
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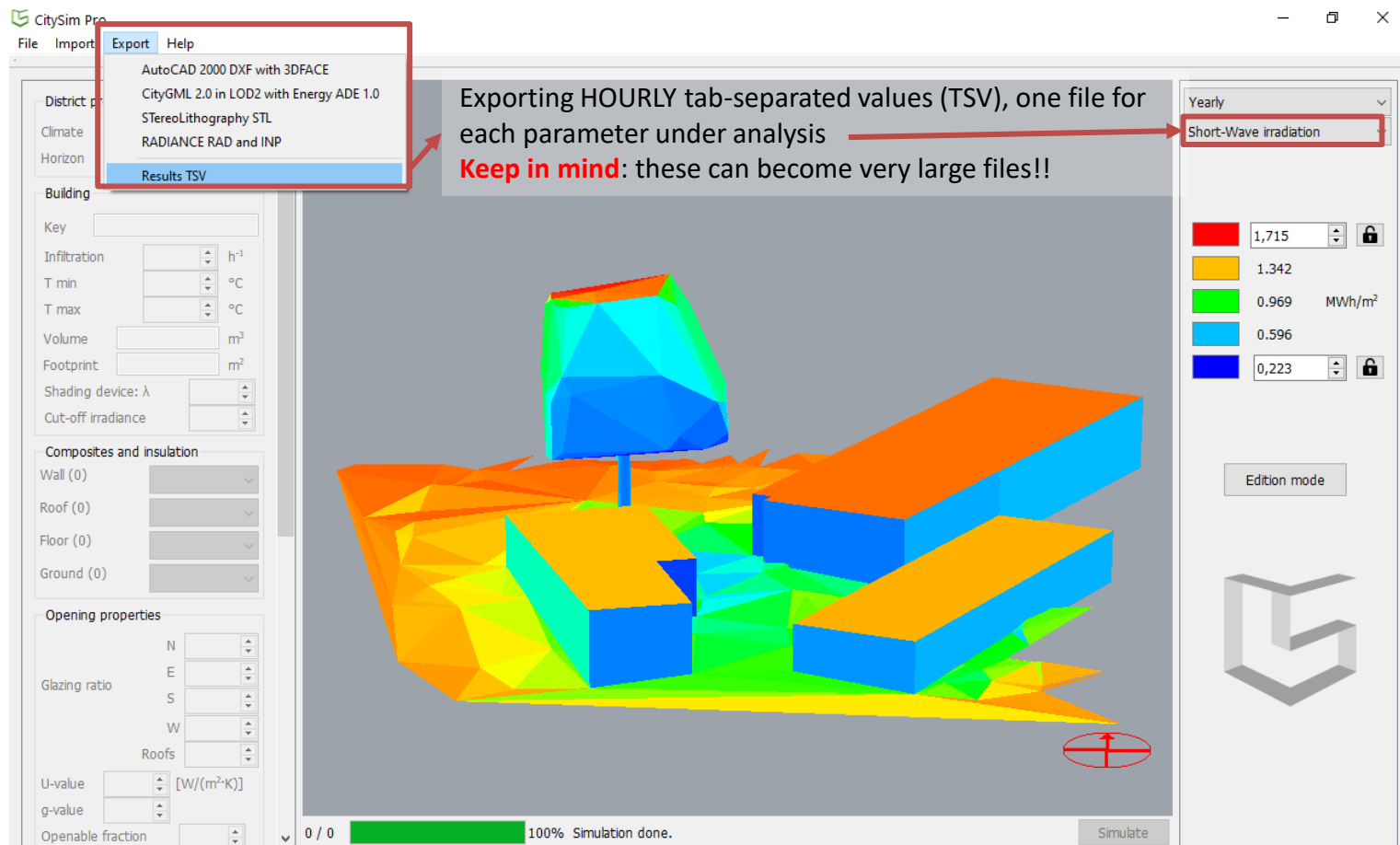


The screenshot shows the CitySim Pro software interface. The 'Export' menu is open, highlighting 'CityGML 2.0 in LOD2 with Energy ADE 1.0'. A red arrow points from this menu item to a text box that reads 'Export a CityGML 2.0 file enriched with Energy ADE'. The main window displays a 3D model of a city block with buildings colored according to energy simulation results. The color scale on the right indicates energy consumption values: red (1,715), orange (1,342), yellow (0,969 MWh/m²), green (0,596), and blue (0,223). The interface also includes various settings panels on the left and a 'Simulate' button at the bottom right.





















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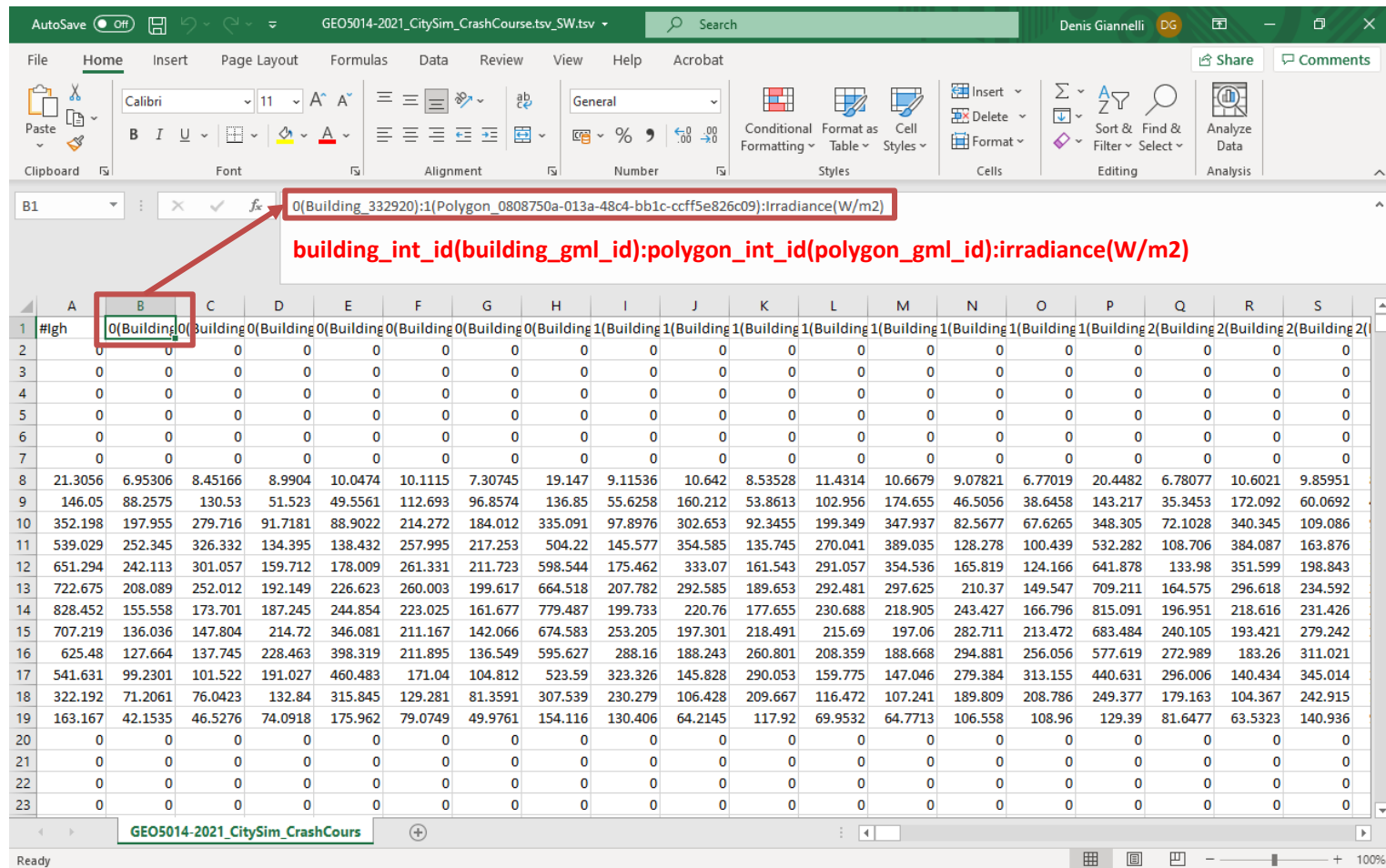
The screenshot shows the CitySim Pro software interface. The 'Export' menu is open, listing options: AutoCAD 2000 DXF with 3DFACE, CityGML 2.0 in LOD2 with Energy ADE 1.0, STereoLithography STL, RADIANCE RAD and INP, and **Results TSV** (highlighted in blue). A red box highlights the 'Export' menu and the 'Results TSV' option. A red arrow points from the 'Results TSV' option to a text box that reads: 'Exporting HOURLY tab-separated values (TSV), one file for each parameter under analysis' and 'Keep in mind: these can become very large files!!'. Another red arrow points from this text box to the 'Short-Wave irradiation' option in the 'Yearly' dropdown menu on the right. The main 3D view shows a city model with buildings colored in a gradient from blue to red, representing different irradiation levels. The right sidebar shows a legend with color-coded values: 1,715 (red), 1,342 (orange), 0,969 (green) MWh/m², 0,596 (cyan), and 0,223 (blue). A 'Simulate' button is visible at the bottom right, and a progress bar at the bottom indicates '100% Simulation done.'.

The chosen directory will contain several TSV files, one of which stores short-wave (SW) irradiation values

Name	Date Modified	Size	Kind
 Rijssen_statusQuo_CitySim_input_NoDTM.gml	2 September 2022 at 15:14	8,5 MB	GML document
 Rijssen_statusQuo_CitySim_input_NoDTM_YearlyResultsPerBuilding.out	2 September 2022 at 15:14	2 KB	Document
 Rijssen_statusQuo_CitySim_input_NoDTM_YearlyResults.out	2 September 2022 at 15:14	387 bytes	Document
 Rijssen_statusQuo_CitySim_input_NoDTM_Inertia.out	2 September 2022 at 15:14	3 KB	Document
 Rijssen_statusQuo_CitySim_input_NoDTM_Area.out	2 September 2022 at 15:14	3 KB	Document
 Rijssen_statusQuo_CitySim_input_NoDTM_ClimaticData.out	2 September 2022 at 15:14	420 KB	Document
 Rijssen_statusQuo_CitySim_input_NoDTM_CM.out	2 September 2022 at 15:14	9 KB	Document
 Rijssen_statusQuo_CitySim_input_NoDTM_ET.out	2 September 2022 at 15:14	9 KB	Document
 Rijssen_statusQuo_CitySim_input_NoDTM_HC.out	2 September 2022 at 15:14	53,9 MB	Document
 Rijssen_statusQuo_CitySim_input_NoDTM_TS.out	2 September 2022 at 15:14	58,7 MB	Document
 Rijssen_statusQuo_CitySim_input_NoDTM_TH.out	2 September 2022 at 15:13	16,7 MB	Document
 Rijssen_statusQuo_CitySim_input_NoDTM_LW.out	2 September 2022 at 15:13	69,4 MB	Document
 Rijssen_statusQuo_CitySim_input_NoDTM_DL.out	2 September 2022 at 15:13	86,9 MB	Document
 Rijssen_statusQuo_CitySim_input_NoDTM_SWv.out	2 September 2022 at 15:12	34,9 MB	Document
 Rijssen_statusQuo_CitySim_input_NoDTM_SW.out	2 September 2022 at 15:11	42,8 MB	Document
 Rijssen_statusQuo_CitySim_input_NoDTM_VF.out	2 September 2022 at 15:10	79 KB	Document
 Rijssen_statusQuo_CitySim_input_NoDTM.stl	2 September 2022 at 15:09	278 KB	Surface...esh File
 Rijssen_statusQuo_CitySim_input_NoDTM.dxf	2 September 2022 at 15:09	998 KB	AutoCA...cument

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AutoSave Off | GEO5014-2021\_CitySim\_CrashCourse.tsv\_SW.tsv | Search | Denis Giannelli DG

File Home Insert Page Layout Formulas Data Review View Help Acrobat | Share Comments

Clipboard | Font | Alignment | Number | Styles | Cells | Editing | Analysis

Formula Bar: `=0(Building_332920):1(Polygon_0808750a-013a-48c4-bb1c-ccff5e826c09):irradiance(W/m2)`

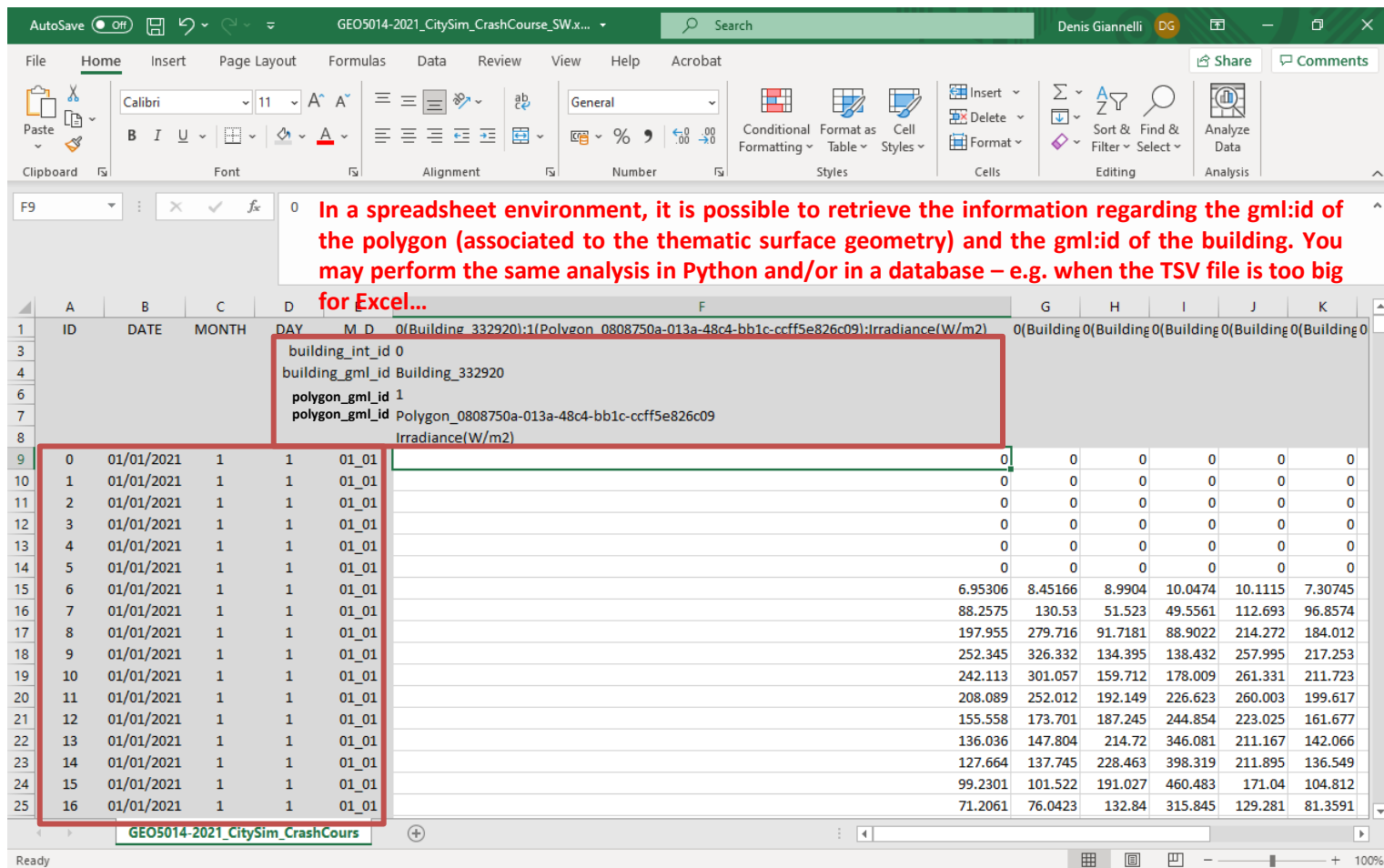
Red text below formula bar: `building_int_id(building_gml_id):polygon_int_id(polygon_gml_id):irradiance(W/m2)`

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	#high	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	21.3056	6.95306	8.45166	8.9904	10.0474	10.1115	7.30745	19.147	9.11536	10.642	8.53528	11.4314	10.6679	9.07821	6.77019	20.4482	6.78077	10.6021	9.85951
9	146.05	88.2575	130.53	51.523	49.5561	112.693	96.8574	136.85	55.6258	160.212	53.8613	102.956	174.655	46.5056	38.6458	143.217	35.3453	172.092	60.0692
10	352.198	197.955	279.716	91.7181	88.9022	214.272	184.012	335.091	97.8976	302.653	92.3455	199.349	347.937	82.5677	67.6265	348.305	72.1028	340.345	109.086
11	539.029	252.345	326.332	134.395	138.432	257.995	217.253	504.22	145.577	354.585	135.745	270.041	389.035	128.278	100.439	532.282	108.706	384.087	163.876
12	651.294	242.113	301.057	159.712	178.009	261.331	211.723	598.544	175.462	333.07	161.543	291.057	354.536	165.819	124.166	641.878	133.98	351.599	198.843
13	722.675	208.089	252.012	192.149	226.623	260.003	199.617	664.518	207.782	292.585	189.653	292.481	297.625	210.37	149.547	709.211	164.575	296.618	234.592
14	828.452	155.558	173.701	187.245	244.854	223.025	161.677	779.487	199.733	220.76	177.655	230.688	218.905	243.427	166.796	815.091	196.951	218.616	231.426
15	707.219	136.036	147.804	214.72	346.081	211.167	142.066	674.583	253.205	197.301	218.491	215.69	197.06	282.711	213.472	683.484	240.105	193.421	279.242
16	625.48	127.664	137.745	228.463	398.319	211.895	136.549	595.627	288.16	188.243	260.801	208.359	188.668	294.881	256.056	577.619	272.989	183.26	311.021
17	541.631	99.2301	101.522	191.027	460.483	171.04	104.812	523.59	323.326	145.828	290.053	159.775	147.046	279.384	313.155	440.631	296.006	140.434	345.014
18	322.192	71.2061	76.0423	132.84	315.845	129.281	81.3591	307.539	230.279	106.428	209.667	116.472	107.241	189.809	208.786	249.377	179.163	104.367	242.915
19	163.167	42.1535	46.5276	74.0918	175.962	79.0749	49.9761	154.116	130.406	64.2145	117.92	69.9532	64.7713	106.558	108.96	129.39	81.6477	63.5323	140.936
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Ready | GEO5014-2021\_CitySim\_CrashCours | 100%

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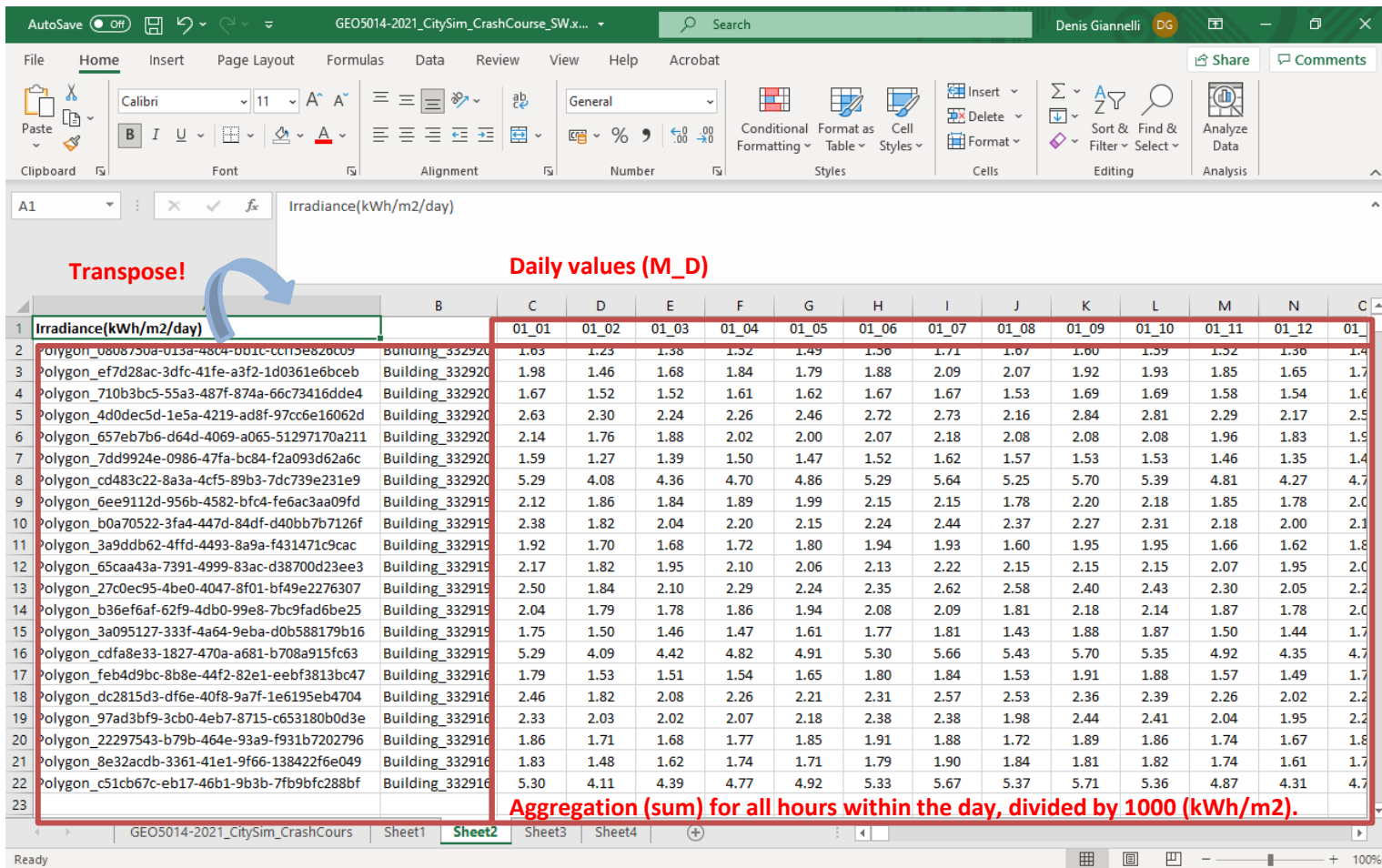


**In a spreadsheet environment, it is possible to retrieve the information regarding the gml:id of the polygon (associated to the thematic surface geometry) and the gml:id of the building. You may perform the same analysis in Python and/or in a database – e.g. when the TSV file is too big for Excel...**

ID	DATE	MONTH	DAY	M	D	Irradiance(W/m2)						
0	01/01/2021	1	1	01	01	0	0	0	0	0	0	0
1	01/01/2021	1	1	01	01	0	0	0	0	0	0	0
2	01/01/2021	1	1	01	01	0	0	0	0	0	0	0
3	01/01/2021	1	1	01	01	0	0	0	0	0	0	0
4	01/01/2021	1	1	01	01	0	0	0	0	0	0	0
5	01/01/2021	1	1	01	01	0	0	0	0	0	0	0
6	01/01/2021	1	1	01	01	6.95306	8.45166	8.9904	10.0474	10.1115	7.30745	
7	01/01/2021	1	1	01	01	88.2575	130.53	51.523	49.5561	112.693	96.8574	
8	01/01/2021	1	1	01	01	197.955	279.716	91.7181	88.9022	214.272	184.012	
9	01/01/2021	1	1	01	01	252.345	326.332	134.395	138.432	257.995	217.253	
10	01/01/2021	1	1	01	01	242.113	301.057	159.712	178.009	261.331	211.723	
11	01/01/2021	1	1	01	01	208.089	252.012	192.149	226.623	260.003	199.617	
12	01/01/2021	1	1	01	01	155.558	173.701	187.245	244.854	223.025	161.677	
13	01/01/2021	1	1	01	01	136.036	147.804	214.72	346.081	211.167	142.066	
14	01/01/2021	1	1	01	01	127.664	137.745	228.463	398.319	211.895	136.549	
15	01/01/2021	1	1	01	01	99.2301	101.522	191.027	460.483	171.04	104.812	
16	01/01/2021	1	1	01	01	71.2061	76.0423	132.84	315.845	129.281	81.3591	

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**Transpose!**

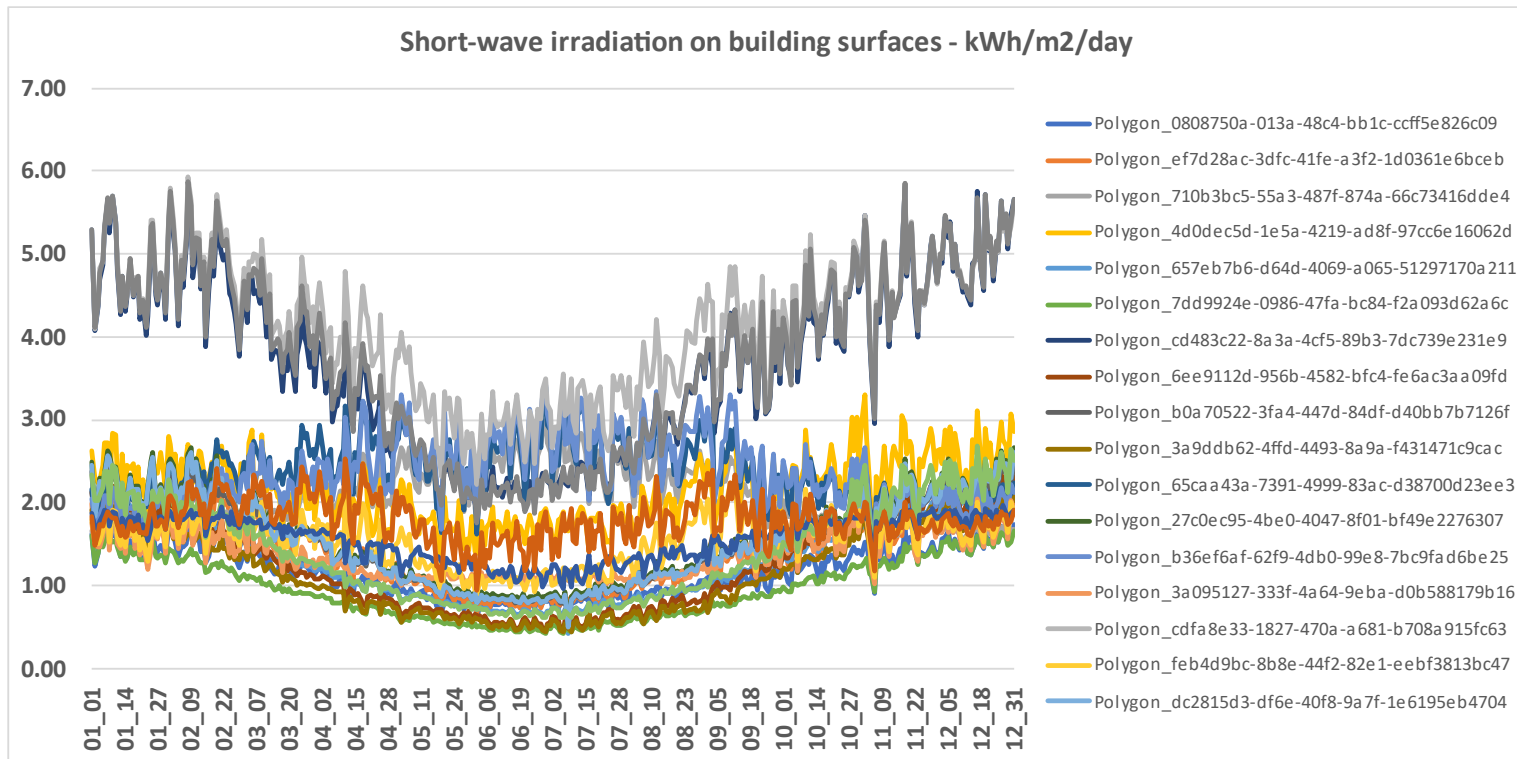
**Daily values (M\_D)**

	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1	Irradiance(kWh/m2/day)		01_01	01_02	01_03	01_04	01_05	01_06	01_07	01_08	01_09	01_10	01_11	01_12	01_13
2	Polygon_0808750a-013a-48c4-8b1c-cc95e826c09	Building_332920	1.83	1.23	1.38	1.52	1.49	1.36	1.71	1.67	1.60	1.59	1.52	1.36	1.4
3	Polygon_ef7d28ac-3ffc-41fe-a3f2-1d0361e6bceb	Building_332920	1.98	1.46	1.68	1.84	1.79	1.88	2.09	2.07	1.92	1.93	1.85	1.65	1.7
4	Polygon_710b3bc5-55a3-487f-874a-66c73416dde4	Building_332920	1.67	1.52	1.52	1.61	1.62	1.67	1.67	1.53	1.69	1.69	1.58	1.54	1.6
5	Polygon_4d0dec5d-1e5a-4219-ad8f-97cc6e16062d	Building_332920	2.63	2.30	2.24	2.26	2.46	2.72	2.73	2.16	2.84	2.81	2.29	2.17	2.5
6	Polygon_657eb7b6-d64d-4069-a065-51297170a211	Building_332920	2.14	1.76	1.88	2.02	2.00	2.07	2.18	2.08	2.08	2.08	1.96	1.83	1.9
7	Polygon_7dd9924e-0986-47fa-bc84-f2a093d62a6c	Building_332920	1.59	1.27	1.39	1.50	1.47	1.52	1.62	1.57	1.53	1.53	1.46	1.35	1.4
8	Polygon_cd483c22-8a3a-4cf5-89b3-7dc739e231e9	Building_332920	5.29	4.08	4.36	4.70	4.86	5.29	5.64	5.25	5.70	5.39	4.81	4.27	4.7
9	Polygon_6ee9112d-956b-4582-bfc4-fe6ac3aa09fd	Building_332919	2.12	1.86	1.84	1.89	1.99	2.15	2.15	1.78	2.20	2.18	1.85	1.78	2.0
10	Polygon_b0a70522-3fa4-447d-84df-d40bb7b7126f	Building_332919	2.38	1.82	2.04	2.20	2.15	2.24	2.44	2.37	2.27	2.31	2.18	2.00	2.1
11	Polygon_3a9dd662-4ffd-4493-8a9a-f431471c9cac	Building_332919	1.92	1.70	1.68	1.72	1.80	1.94	1.93	1.60	1.95	1.95	1.66	1.62	1.8
12	Polygon_65caa43a-7391-4999-83ac-d38700d23ee3	Building_332919	2.17	1.82	1.95	2.10	2.06	2.13	2.22	2.15	2.15	2.15	2.07	1.95	2.0
13	Polygon_27c0ec95-4be0-4047-8f01-bf49e2276307	Building_332919	2.50	1.84	2.10	2.29	2.24	2.35	2.62	2.58	2.40	2.43	2.30	2.05	2.2
14	Polygon_b36ef6af-62f9-4db0-99e8-7bc9fad6be25	Building_332919	2.04	1.79	1.78	1.86	1.94	2.08	2.09	1.81	2.18	2.14	1.87	1.78	2.0
15	Polygon_3a095127-333f-4a64-9eba-d0b588179b16	Building_332919	1.75	1.50	1.46	1.47	1.61	1.77	1.81	1.43	1.88	1.87	1.50	1.44	1.7
16	Polygon_cdfa8e33-1827-470a-a681-b708a915fc63	Building_332919	5.29	4.09	4.42	4.82	4.91	5.30	5.66	5.43	5.70	5.35	4.92	4.35	4.7
17	Polygon_feb4d9bc-8b8e-44f2-82e1-eebf3813bc47	Building_332916	1.79	1.53	1.51	1.54	1.65	1.80	1.84	1.53	1.91	1.88	1.57	1.49	1.7
18	Polygon_dc2815d3-df6e-40f8-9a7f-1e6195eb4704	Building_332916	2.46	1.82	2.08	2.26	2.21	2.31	2.57	2.53	2.36	2.39	2.26	2.02	2.2
19	Polygon_97ad3bf9-3cb0-4eb7-8715-c653180b0d3e	Building_332916	2.33	2.03	2.02	2.07	2.18	2.38	2.38	1.98	2.44	2.41	2.04	1.95	2.2
20	Polygon_22297543-b79b-464e-93a9-f931b7202796	Building_332916	1.86	1.71	1.68	1.77	1.85	1.91	1.88	1.72	1.89	1.86	1.74	1.67	1.8
21	Polygon_8e32acdb-3361-41e1-9f66-138422f6e049	Building_332916	1.83	1.48	1.62	1.74	1.71	1.79	1.90	1.84	1.81	1.82	1.74	1.61	1.7
22	Polygon_c51cb67c-eb17-46b1-9b3b-7fb9bfc288bf	Building_332916	5.30	4.11	4.39	4.77	4.92	5.33	5.67	5.37	5.71	5.36	4.87	4.31	4.7
23															

**Aggregation (sum) for all hours within the day, divided by 1000 (kWh/m2).**

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AutoSave  GEO5014-2021\_CitySim\_CrashCourse\_SW.x... Search Denis Giannelli DG

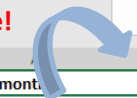
File Home Insert Page Layout Formulas Data Review View Help Acrobat

Clipboard Font Alignment Number Styles Cells Editing Analysis

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A1 Irradiance(kWh/m2/month)

**Transpose!** 

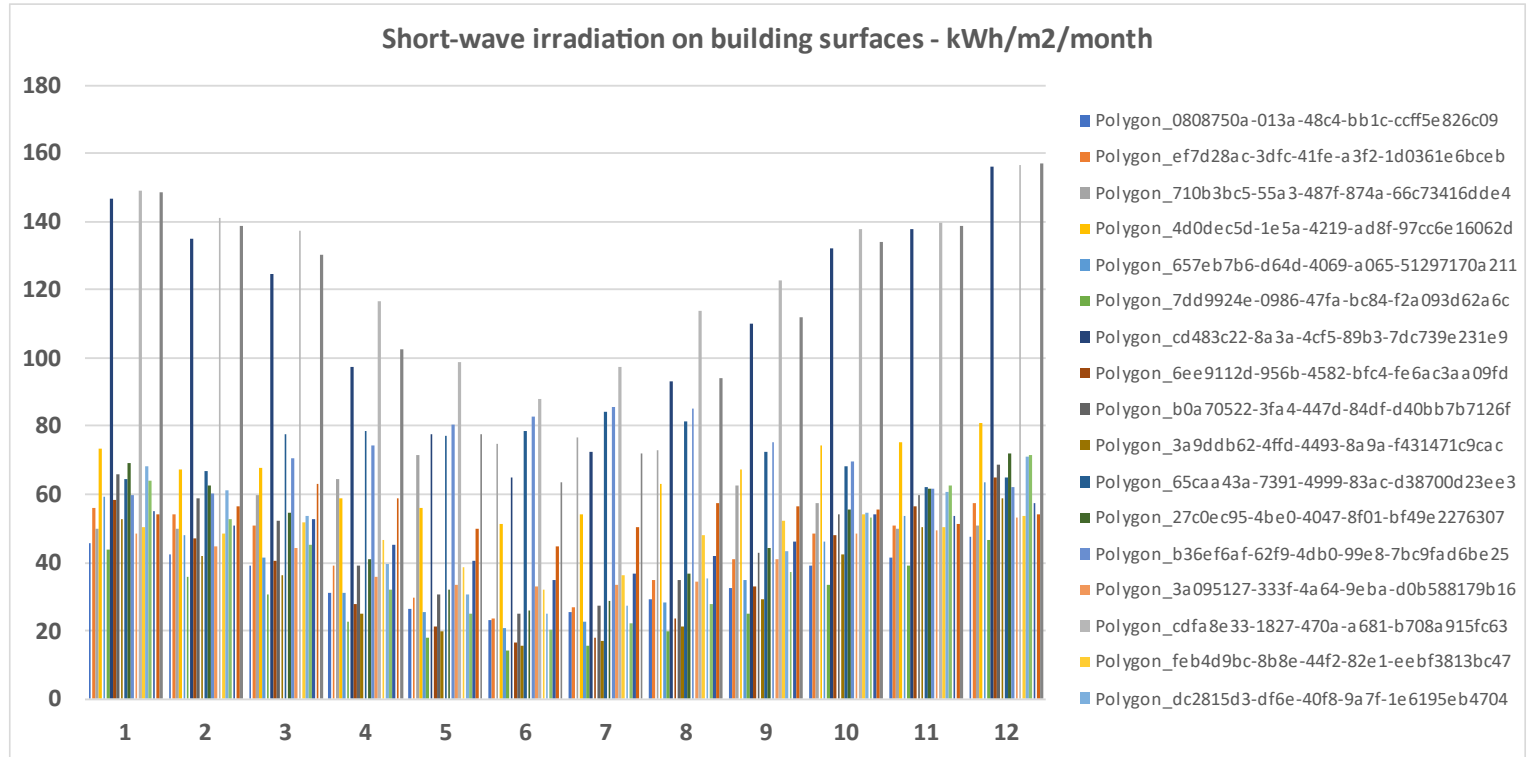
**Monthly values (M)**

	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Irradiance(kWh/m2/month)	1	2	3	4	5	6	7	8	9	10	11	12
2	Polygon_0808750a-013a-48c4-8b1c-cc85e826c09	Building_332920	46	42	39	31	26	23	29	32	39	42	48
3	Polygon_ef7d28ac-3ffc-41fe-a3f2-1d0361e6bceb	Building_332920	56	54	51	39	30	24	27	35	41	48	51
4	Polygon_710b3bc5-55a3-487f-874a-66c73416dde4	Building_332920	50	50	60	64	72	75	77	73	63	57	50
5	Polygon_4d0dec5d-1e5a-4219-ad8f-97cc6e16062d	Building_332920	73	67	68	59	56	51	54	63	67	74	75
6	Polygon_657eb7b6-d64d-4069-a065-51297170a211	Building_332920	59	48	41	31	25	21	22	28	35	46	54
7	Polygon_7dd9924e-0986-47fa-bc84-f2a093d62a6c	Building_332920	44	36	30	22	18	14	16	20	25	34	39
8	Polygon_cd483c22-8a3a-4cf5-89b3-7dc739e231e9	Building_332920	147	135	125	97	78	65	73	93	110	132	138
9	Polygon_6ee9112d-956b-4582-bfc4-fe6ac3aa09fd	Building_332919	58	47	40	28	21	17	18	23	33	48	56
10	Polygon_b0a70522-3fa4-447d-84df-d40bb7b7126f	Building_332919	66	59	52	39	31	25	27	35	43	54	60
11	Polygon_3a9ddb62-4ffd-4493-8a9a-f431471c9cac	Building_332919	53	42	36	25	20	16	17	21	29	43	50
12	Polygon_65caa43a-7391-4999-83ac-d38700d23ee3	Building_332919	65	67	77	78	77	78	84	82	72	68	62
13	Polygon_27c0ec95-4be0-4047-8f01-bf49e2276307	Building_332919	69	62	55	41	32	26	29	37	44	56	62
14	Polygon_b36ef6af-62f9-4db0-99e8-7bc9fad6be25	Building_332919	60	60	71	74	81	83	86	85	75	69	61
15	Polygon_3a095127-333f-4a64-9eba-d0b588179b16	Building_332919	49	44	44	36	34	33	33	34	41	49	49
16	Polygon_cdfa8e33-1827-470a-a681-b708a915fc63	Building_332919	149	141	137	117	99	88	97	114	123	138	140
17	Polygon_feb4d9bc-8b8e-44f2-82e1-eebf3813bc47	Building_332916	50	49	52	47	39	32	36	48	52	54	50
18	Polygon_dc2815d3-df6e-40f8-9a7f-1e6195eb4704	Building_332916	68	61	54	40	31	25	27	35	43	55	61
19	Polygon_97ad3bf9-3cb0-4eb7-8715-c653180b0d3e	Building_332916	64	53	45	32	25	20	22	28	37	53	63
20	Polygon_22297543-b79b-464e-93a9-f931b7202796	Building_332916	55	51	53	45	40	35	37	42	46	54	57
21	Polygon_8e32acdb-3361-41e1-9f66-138422f6e049	Building_332916	54	57	63	59	50	45	51	57	56	56	51
22	Polygon_c51cb76c-eb17-46b1-9b3b-7fb9bfc288bf	Building_332916	149	139	130	102	78	63	72	94	112	134	139
23													

**Aggregation (sum) of all hours within the month, divided by 1000 (kWh/m<sup>2</sup>).**

Ready GEO5014-2021\_CitySim\_CrashCourse Sheet1 Sheet2 Sheet3 Sheet4 100%

- Overview
- CitySim in a Nutshell
- Quick installation guide
- CitySim fundamentals**
- References
- Appendix



# References

- E. Walter, J.H. Kämpf, A verification of CitySim results using the BESTEST and monitored consumption values, 2nd IBPSA-Italy conference Bozen-Bolzano, 4th – 6th February 2015 [[download](#)]
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