

1. Introduction

Typical climatologic data required by the transient Physibel programs BISTRA and VOLTRA are hourly values during 1 year of:

- air temperature
- horizontal diffuse solar radiation
- wind speed
- horizontal global solar radiation
- sky temperature

This document explains how climatic data (Meteonorm, TRY, TMY2s, measured data, standard data) can be converted into the Physibel software format using a spreadsheet file.

A procedure is given to control the solar data.

2. The spreadsheet file [climate_converter_physibel.xlsm](#)

The file [climate_converter_physibel.xlsm](#) is ready to convert automatically hourly data created in Meteonorm or from other sources into the Physibel software format.

The file contains 3 sheets: Input, Data, Database.

The source climatic data are in the sheet Data.

For each hour a row occurs. Each hourly climatic quantity for which a conversion is required shall be in a specific column. In [climate_converter_physibel.xlsm](#) the content is the following:

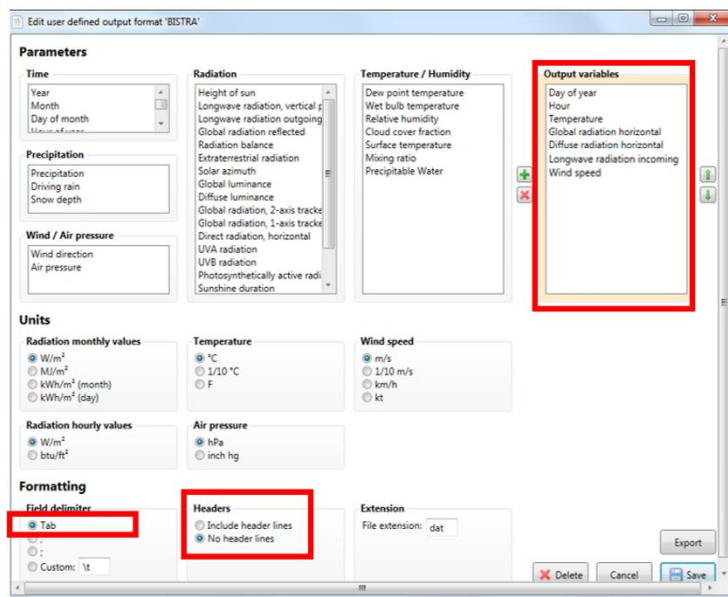
- column A day number (1-365)
- column B hour (1-24)
- column C air temperature [°C]
- column D horizontal global solar radiation [W/m²]
- column E horizontal diffuse solar radiation [W/m²]
- column F long wave radiation (incoming) [W/m²]
- column G wind speed [m/s].

	A	B	C	D	E	F	G
1	1.0	1.0	0.2	0.0	0.0	269.0	2.6
2	1.0	2.0	0.3	0.0	0.0	269.0	2.1
3	1.0	3.0	-0.1	0.0	0.0	268.0	1.9
4	1.0	4.0	-0.2	0.0	0.0	267.0	2.2
5	1.0	5.0	-0.4	0.0	0.0	267.0	2.1
6	1.0	6.0	-0.2	0.0	0.0	268.0	2.4
7	1.0	7.0	-0.5	0.0	0.0	266.0	2.0
8	1.0	8.0	-0.8	0.0	0.0	265.0	2.7
9	1.0	9.0	-0.5	0.0	0.0	267.0	2.4
10	1.0	10.0	0.3	32.0	30.0	270.0	4.1
11	1.0	11.0	0.2	100.0	72.0	270.0	3.4
12	1.0	12.0	1.4	125.0	100.0	283.0	3.2
13	1.0	13.0	2.2	236.0	113.0	252.0	3.6
14	1.0	14.0	2.6	106.0	101.0	306.0	4.1
15	1.0	15.0	3.1	78.0	78.0	308.0	3.6
16	1.0	16.0	3.6	37.0	37.0	311.0	4.8
17	1.0	17.0	3.6	2.0	2.0	311.0	3.8
18	1.0	18.0	3.3	0.0	0.0	301.0	4.1
19	1.0	19.0	2.9	0.0	0.0	299.0	3.4
20	1.0	20.0	2.8	0.0	0.0	299.0	3.4
21	1.0	21.0	2.7	0.0	0.0	290.0	3.6
22	1.0	22.0	2.3	0.0	0.0	288.0	2.7
23	1.0	23.0	1.5	0.0	0.0	285.0	2.2
24	1.0	24.0	2.1	0.0	0.0	279.0	2.0

Important conventions are:

- Row 1 contains the data at 1h00, 1st of January. This is the case for most data sources. The Physibel functions however always start at 0h00. This is considered in the conversion procedure (written in Visual Basic); the data at 0h00 are assumed identical to the data at 1h00.
- The columns contents may be different. Less data may occur.
- The time columns aren't necessary.

If a well formatted independent file with climate data is available, these data can be imported automatically in the sheet Data using the Read Climate Data button in the Input sheet.



The file UcclhourMN4.dat is an example. It was created using the program Meteororm, using the output settings listed above: no header, tab hyphenation and output variables as specified.

The sheet Database contains information about the climatic station. When creating new climate functions in Physibel software format **insert (or overwrite) a row** with the following information:

*.DAT FILE	City, Country	Latitude	real Longitude	artificial Longitude	n
BarchourMN4	Barcelona, Spain	41.53	2.25	-20.25	1
CarahourMN4	Caracas, La Carlota, Venezuela	10.50	-66.88	-14.38	-4
DeBiltMN4	De Bilt, NL	52.10	5.18	-17.32	1
LondhourMN4	London, UK	51.60	0.05	-7.45	0
TraphourMN4	Trappes, France	48.77	2.02	-20.48	1
TaihourMN4	Taipei, Taiwan	24.83	123.72	-3.78	8
UcclhourMN4	Ukkel, Belgium	50.80	4.35	-18.15	1

- column A name of the data file containing the climatic data
If the sheet Data is prepared manually a file name can be omitted.
- column B city and country; the name is used in the header of the files that will be created
- column C latitude [°]
- column D real longitude [°] (positive East of Greenwich)
The decimals used in latitude and longitude are decimals not minutes:
example .77 corresponds to 46 ' (46/60 = .77).
- column E artificial longitude [°]: explained below (controlling solar data).
- column F time zone.

The sheet Input allows reading the source data and save them as functions in Physibel software format.

- The Read Climate Data button allows reading the source data (.DAT file if available). The source data are copied into the Data sheet. **If the Data sheet is prepared manually, the button shouldn't be used.**

- Row 5, column B contains the name of the source data file.
- Rows 6 to 9, column B contain the climatic station information taken from the Database sheet.
- The user defined rows 10 to 15, column B contain for each of the climatic quantities the column number used in the Data sheet. A zero value can be used if the climatic quantity isn't available.
- The user defined row 17, column B contains the name of the functions in Physibel software data format.
- The Save Functions button allows to create 6 functions

- Name.FTE air temperature
- Name.FSG horizontal global solar radiation
- Name.FSD horizontal diffuse solar radiation
- Name_SKY.FTE sky temperature
- Name_HCoeff.FHT convective surface heat transfer coefficient

The values in the first 4 functions are just copies of the source values.

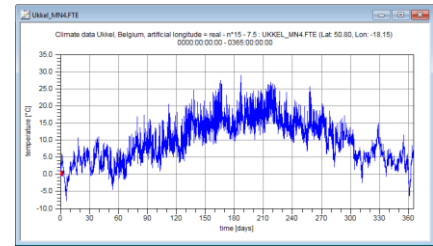
The values in the sky temperature functions are derived from the incoming long wave radiation source values using the formula $\theta_{sky} = \sqrt[4]{I_{IR}/\sigma} - 273.15$ with $\sigma = 5.670E-08$ W/m²K⁴ (Stefan-Boltzmann constant).

The values in the convective surface heat transfer coefficient functions are derived from the wind speed source values using the formula $h_c = 4 + 4 \cdot v$ stated in Annex C of EN ISO 6946(2017)¹. To apply other convection relations, the user should adapt the Visual Basic

¹ EN ISO 6946:2017 Building components and building elements – Thermal resistance and thermal transmittance – Calculation methods

code behind the spreadsheet. Examples of other convection relations are given in [CHTC_f\(wind_speed\)_Ukkel.xlsx](#).

Once the functions in Physibel format are created sheet, it is recommended to open them using the Physibel program FUNCEDIT (available in the same folder as the program BISTRA or VOLTRA). Opening the file Ukkel_MN4.FTE for example results in displaying the graph at right (if not some syntax error occurs). The program FUNCEDIT can be used to change the graph scale settings.

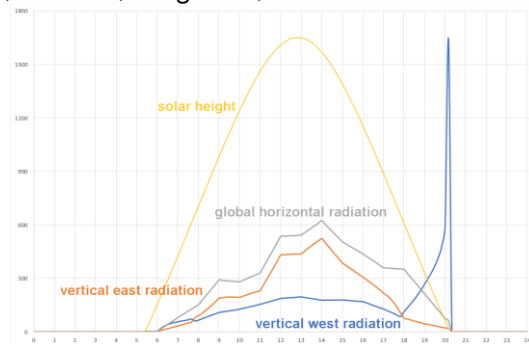
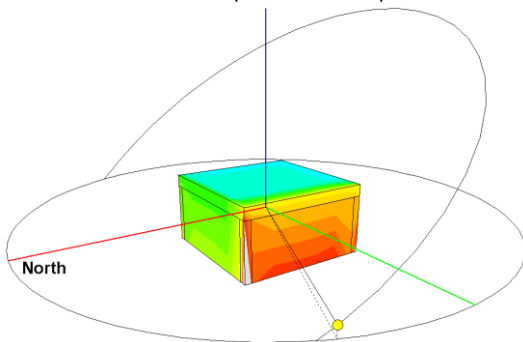


3. Controlling the solar data.

Why solar data needs to be controlled (and corrected).

The functions Ukkel_real_long.FTE, Ukkel_real_long.FSG and Ukkel_real_long.FSD were obtained from the data [UcclhourMN4.dat](#) (from Meteonorm version 4). The latitude is 50.8 °. The longitude is 4.35 °. The time zone is 1.

The solar altitude isn't available in the solar data: it is calculated for each time step by the Physibel software (BISTRA or VOLTRA). The Physibel software assumes local time, and therefore the sun position depends on time, latitude, longitude, and time zone.



A transient simulation (with VOLTRA) is done on a box on 7 August using the climate functions. The given global solar radiation and the simulated solar radiation on the roof and on the East and West walls and the simulated solar altitude are shown in the graph right above. An unrealistic solar radiation ($> 1500 \text{ W/m}^2$) is obtained for the West wall. The reason is the following: around 20h00 the solar altitude is very low (see picture left above) while the global horizontal solar radiation is still considerable; deriving the vertical West radiation from the low solar altitude and the considerable global horizontal radiation results in the unrealistic value. Clearly there is a conflict between the solar data and the solar processing in the Physibel software. The conflict is due to:

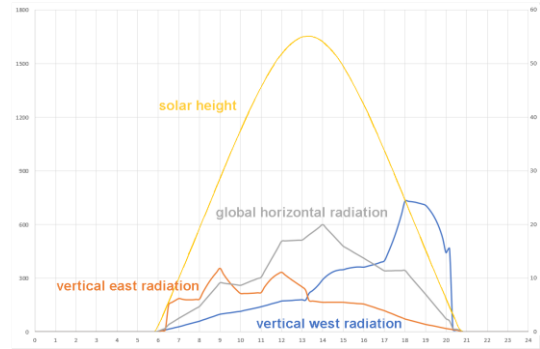
- A difference in time definition between the solar data and the Physibel software.
- The Physibel software assumes that the solar radiation at a specific hour is the value at that time, while several climate databases assume that the solar radiation at a specific hour is the average over the past hour.

How to correct solar data.

A pragmatic method is used to solve the conflict mentioned above. It has 2 elements:

- An "artificial longitude" always in combination with a time zone 0 is used: **artificial longitude = real longitude – time zone x 15 – 7.5 °**. This corresponds to a time shift of half an hour.
- In the Physibel software define a sun obstacle from **-180° to +180° and from 0° to 5° high**.

The functions Ukkel_MN4 were created using such an artificial longitude. Repeating the previous simulation using these functions results in the graph besides.



How to control solar data.

To control the data the solar radiation on an East and a West wall are compared. The East/West ratio should be about 100 %. A deviation of a few % is acceptable.

In BISTRA

- Open the data [climate_solar_control_BISTRA.bst](#).
- Edit > Functions: define the .FTE, .FSG and .FSD file to be controlled.
- Calculation.
- Close BISTRA.
- Open the file [climate_solar_control_BISTRA.txt](#) in a texteditor (as TextPad, NotePad) and copy the whole contents.
- Open the file [climate_solar_control_BISTRA.xlsx](#).
- Select cell H1 and paste the BISTRA results.
- Control the East/West ratio. If not acceptable, use another artificial longitude in [climate_converter_physibel.xlsm](#).

A	B	C	D	E	F	G	H	I	J	K	L
1	Ukkel MN4, G+D										
2	Month	South	West	North	East	East/West		BISTRA : Report Output			
3	1	26544	11851	6763	17258			BISTRA data file: climate_control_3D_BISTRA.bst			
4	2	42011	20039	11633	21348			Column 1: Time (ddd hh:mm:ss)			
5	3	58165	27811	20791	37423			Column 2: Colour 30: absorbed solar energy [W/m²]			
6	4	79025	52802	32446	54870			Column 3: Colour 31: absorbed solar energy [W/m²]			
7	5	77782	79336	47264	78802			Column 4: Colour 28: absorbed solar energy [W/m²]			
8	6	79664	73272	48925	78320			Column 5: Colour 29: absorbed solar energy [W/m²]			
9	7	75222	74875	52670	78374						
10	8	74428	69623	48925	64922						
11	9	67436	44977	25178	48742			0000:00:00	0	0	0
12	10	58211	30982	15968	33028			0000:01:00	0	0	0
13	11	32149	13728	8845	13511			0000:01:30	0	0	0
14	12	24215	8222	5075	8848			0000:02:00	0	0	0
15	13	16281	2676	1406	5075			0000:02:30	0	0	0
16	14	8346	827	271	827			0000:03:00	0	0	0
17	15	67863	34673	31364	52481	101%					

In VOLTRA

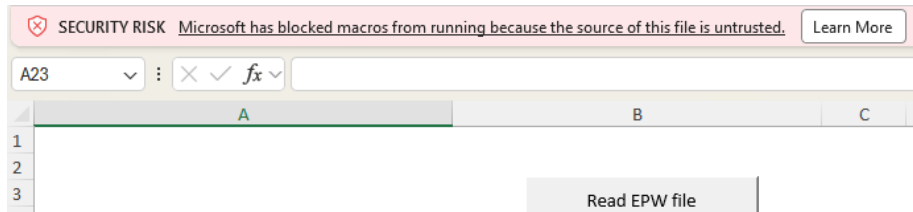
- Open the data [climate_solar_control_VOLTRA.vtr](#).
- Edit > Functions: define the .FTE, .FSG and .FSD file to be controlled.
- Calculation.
- Close VOLTRA.
- Open the file [climate_solar_control_VOLTRA.txt](#) in a texteditor (as TextPad, NotePad) and copy the whole contents.
- Open the file [climate_solar_control_VOLTRA.xlsx](#).
- Select cell H1 and paste the VOLTRA results.
- Control the East/West ratio. If not acceptable, use another artificial longitude in [climate_converter_physibel.xlsm](#).

A	B	C	D	E	F	G	H	I	J	K	L	M
1	Ukkel MN4, G+D											
2	Month	South	West	North	East	East/West		VOLTRA : Report Output				
3	1	26544	11851	6763	17258			VOLTRA data file: climate_quality_control_VOLTRA.vtr				
4	2	42011	20039	11633	21348			Column 1: Time [s]				
5	3	58165	27811	20791	37423			Column 2: Colour 30: absorbed solar flux on faces oriented to Ymax [W/m²]				
6	4	79025	52802	32446	54870			Column 3: Colour 31: absorbed solar flux on faces oriented to Ymin [W/m²]				
7	5	77782	79336	47264	78802			Column 4: Colour 28: absorbed solar flux on faces oriented to Xmax [W/m²]				
8	6	79664	73272	48925	78320			Column 5: Colour 29: absorbed solar flux on faces oriented to Xmin [W/m²]				
9	7	75222	74875	52670	78374							
10	8	74428	69623	48925	64922							
11	9	67716	44883	25122	48827			1600	0	0	0	0
12	10	58226	29996	15970	33091			2600	0	0	0	0
13	11	32052	13639	8806	13456			6400	0	0	0	0
14	12	24184	8192	5077	8915			7200	0	0	0	0
15	13	16281	2676	1406	5075			9000	0	0	0	0
16	14	8346	827	271	827			10000	0	0	0	0
17	15	67768	34485	31445	52458	101%						

Multiple climate data files in Physibel software format, tested using the procedure above, are attached to this document.

General Remark

In some cases, Excel may block macros from running, preventing the files from being created. In such situations, users may encounter an error similar to the one shown below.



To resolve this issue, right-click on the Excel file in its folder, select Properties, and check the Unblock option as shown below. After applying this change, reopen the file and enable macros.

