F9 - PREPARING SKY TEMPERATURE AND CONVECTIVE SURFACE HEAT TRANSFER COEFFICIENT DATA FROM EPW IN PHYSIBEL SOFTWARE FORMAT

1. Introduction

This document explains how to generate ready-to-use function files for sky temperature and convective heat transfer coefficient from an EPW file, compatible with VOLTRA and BISTRA. This document elaborate on the used correlations and is accompanied by an Excel spreadsheet and python script to auto-generate the input files for VOLTRA/BISTRA.

If you are working with other types of climatic data, please refer to the Physibel Knowledge Base document F3 – Preparing Climatologic Data in Physibel Software Format, which provides guidance on creating all required input files, including air temperature, sky temperature, horizontal global and diffuse solar radiation, and convective surface heat transfer coefficient.

Therefore, this document applies strictly to EPW files. For other data formats, please consult the relevant Physibel Knowledge Base documentation.

2. Calculation

Sky temperature

EPW files contain data on incoming horizontal infrared radiation. It is possible to derive the sky temperature from this value using the following equation:

$\theta_{sky} = \sqrt[4]{\frac{I_{IR}}{\sigma}} - 273.15$ with $\sigma = 5.67 \cdot 10^{-8}\ W/m^2K^4$

Convective surface heat transfer coefficient

EPW files also contain information on wind speed. The following formula, proposed by Taki and Loveday[1] for leeward building surfaces, is used to calculate convective surface heat transfer coefficient based on wind speed:

$h_c = 5.85 \cdot v^{0.52}$

Remark

Various correlations are available for calculating both sky temperature and the convective surface heat transfer coefficient. If users prefer to apply alternative correlations, they can modify the relevant sections in either the Visual Basic code within the Excel spreadsheet or the Python script.

[1] External convection coefficients for framed rectangular elements on building facades, A.H. Taki, D.L. Loveday, Energy and Buildings 24 (1996)

The correlations described above are implemented in both the Excel spreadsheet and the Python code. The following sections explain how to generate the required function files using these implemented correlations.

3. The Excel spreadsheet file

SkyTemp_and_Hcoeff_fromEPW.xlsm

The file SkyTemp_and_Hcoeff_fromEPW.xlsm is a ready-to-use conversion tool designed to read EPW files, extract the necessary data, and generate function files for Physibel software.

The Excel file consists of three sheets: Input, Data, and Results. The Input sheet contains general information extracted from the EPW file, such as location, country, latitude, longitude, and time zone. The Data sheet includes the extracted parameters required for calculating sky temperature and the convective surface heat transfer coefficient. The Results sheet presents the calculated sky temperature and convective surface heat transfer coefficient.

Figure 1 shows the Input sheet of the Excel file. To ensure the tool functions correctly, the user must first enable macros. Clicking the Read EPW File button prompts the user to choose an EPW file.

After a file is selected, the macro extracts the required data, including day information, outdoor air temperature, dew point temperature, infrared radiation, and wind speed. These extracted values are displayed in the Data sheet, while the calculated sky temperature and convective heat transfer coefficient are presented in the Results sheet.

Upon completion of these calculations, the user will see the interface shown in Figure 2. By clicking the Save Functions button, two files are automatically generated in the same directory as the EPW file: one CityName_Sky.FTE file for sky temperature and one CityName_HCoeff.FHT file for the surface heat transfer coefficient.

These files can then be imported directly into VOLTRA or BISTRA for use in the simulation model.

Remark

In the Data sheet, row 1 contains the values at 01:00 on January 1st. This is consistent with most EPW data sources. However, Physibel functions always start at 00:00. To account for this, the conversion procedure (implemented in Visual Basic) assumes that the data at 00:00 are identical to those at 01:00. As a result, the first two rows in the Results sheet are identical (Figure 3).

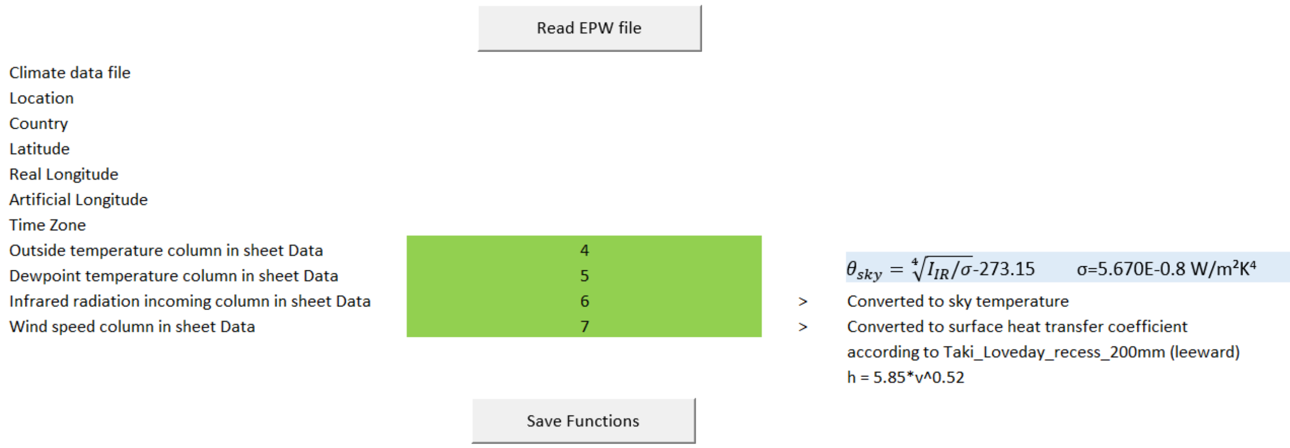


Figure 1 Input sheet of SkyTemp_and_Hcoeff_fromEPW.xlsm

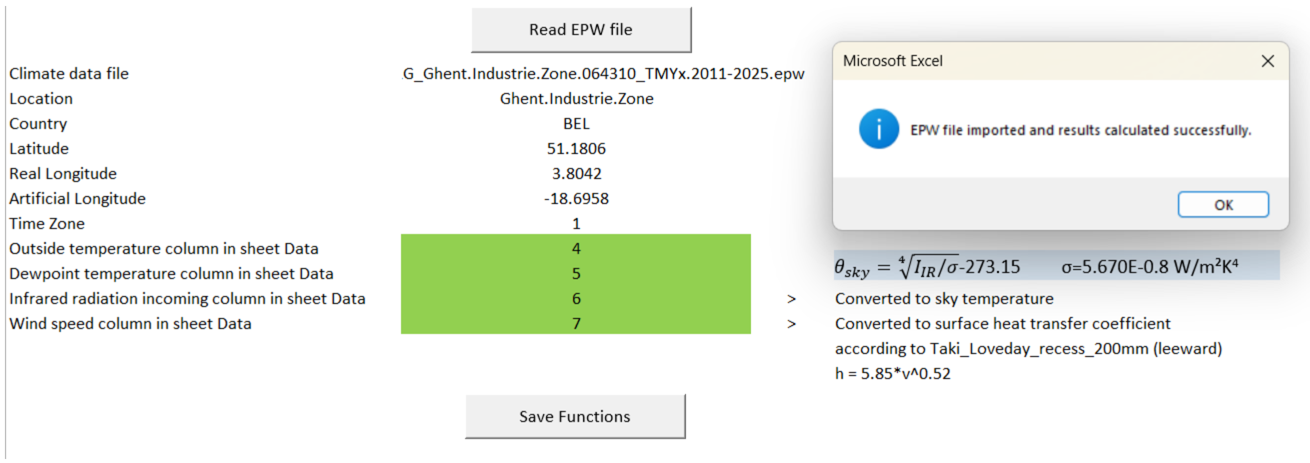
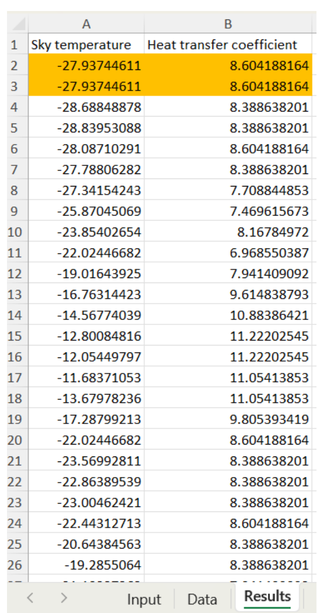


Figure 2 Pop-up message and Input sheet after uploading an EPW file



	A	B
1	Sky temperature	Heat transfer coefficient
2	-27.93744611	8.604188164
3	-27.93744611	8.604188164
4	-28.68848878	8.388638201
5	-28.83953088	8.388638201
6	-28.08710291	8.604188164
7	-27.78806282	8.388638201
8	-27.34154243	7.708844853
9	-25.87045069	7.469615673
10	-23.85402654	8.16784972
11	-22.02446682	6.968550387
12	-19.01643925	7.941409092
13	-16.76314423	9.614838793
14	-14.56774039	10.88386421
15	-12.80084816	11.22202545
16	-12.05449797	11.22202545
17	-11.68371053	11.05413853
18	-13.67978236	11.05413853
19	-17.28799213	9.805393419
20	-22.02446682	8.604188164
21	-23.56992811	8.388638201
22	-22.86389539	8.388638201
23	-23.00462421	8.388638201
24	-22.44312713	8.604188164
25	-20.64384563	8.388638201
26	-19.2855064	8.388638201

Figure 3 Sky temperature and heat transfer coefficient results

4. The Python script and application

SkyTemp_and_Hcoeff_fromEPW.exe
SkyTemp_and_Hcoeff_fromEPW.py

As an alternative to the Excel tool, a Python script or a precompiled executable application can be used to generate the required function files.

User can double-click to execute SkyTemp_and_Hcoeff_fromEPW.exe or run the Python script in an environment, then a pop-up window will appear (Figure 4, left). By clicking the button to read an EPW file, the user is prompted to select a file. After the file is selected, a second screen is displayed confirming that both function files have been successfully created (Figure 4, right). Those files are saved in the same directory as the EPW file.

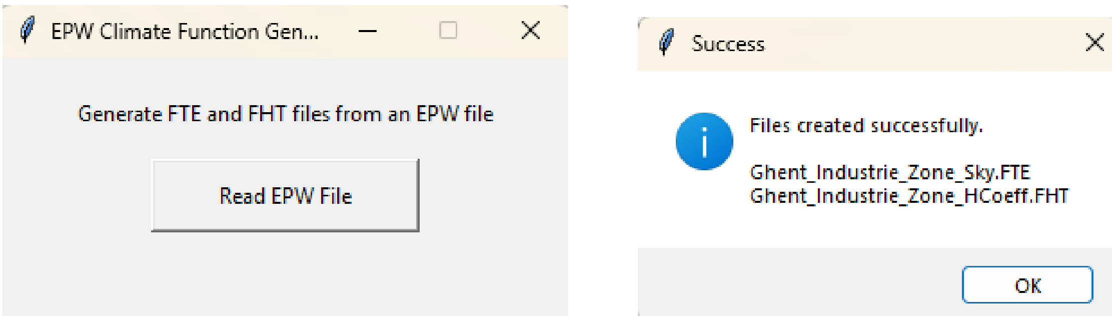


Figure 4 Pop-up window and success message