User's Guide for Vertical City Weather Generator (VCWG v1.3.2)

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The Vertical City Weather Generator (VCWG) is a software that predicts the urban microclimate in relation to a nearby rural climate given the urban characteristics. VCWG predicts vertical profiles of temperature, wind speed, humidity, and turbulence kinetic energy as well as the building energy performance in an urban area. More details on the model can be found at the Atmospheric Innovations Research (AIR) laboratory website at www.aaa-scientists.com and corresponding publications [Moradi et al., 2021, Moradi, 2021, Aliabadi et al., 2021, Moradi et al., 2022].

To run the VCWG, it is required to put the weather file (*.epw) of the region of interest in the directory e.g. "Resources/epw/Basel_BUBBLE.epw". This file can be downloaded from EnergyPlus (https://energyplus.net/). The VCWG can take input parameters from the file located in the directory e.g. "resources/parameters/initialize_Basel". This file contains the required parameters of the case study including urban characteristics, vegetation parameters, view factors, and simulation parameters. The user is able to change the parameters to define and run a simulation of interest. If desired, new view factors can be obtained by running "UWG/Run_RayTracing.py" and copy and paste the results from file e.g. "UWG/ViewFactor_BASEL.txt" into the input file e.g. "resources/parameters/initialize_Basel". In the python file "VCWG/VCWGv1.3.2.py" located in the main directory, the user is required to change the name of weather file and the name of the initialization file to the ones located in the directories of "resources/epw" and "resources/parameters/", respectively. Once the user runs "VCWG/VCWGv1.3.2.py", the simulation will start. Depending

on the simulation parameters, it takes a few minutes to generate the output files located in the "Output" directory. It is recommended to discard the first 24 hours of simulation as spin-up period while considering results after this period.

"VCWGv1.3.2.py" is designed to run on Python 2.7.13. This version of Python can be downloaded from "https://www.python.org/downloads/release/python-2713/". For example for a 64-bit Windows operating system the installation file will be "python-2.7.13.amd64". The following packages and versions can be used: numpy 1.14.3, scipy 1.1.0, matplotlib 2.2.2. Note that other packages may also work.

"UWG/Run_RayTracing.py" is designed to run on Python 3.6.1. This version of Python can be downloaded from "https://www.python.org/downloads/release/python-361/". For example for a 64-bit Windows operating system the installation file will be "python-3.6.1-amd64". The following packages and versions can be used: numpy 1.19.5, scipy 1.1.0, matplotlib 3.1.1. Note that other packages may also work.

References

[Aliabadi et al., 2021] Aliabadi, A. A., Moradi, M., McLeod, R. M., Calder, D., and Dernovsek, R. (2021). How Much Building Renewable Energy Is Enough? The Vertical City Weather Generator (VCWG v1.4.4). *Atmosphere*, 12(7):882.

[Moradi, 2021] Moradi, M. (2021). *The Vertical City Weather Generator*. PhD thesis, University of Guelph, Guelph.

[Moradi et al., 2021] Moradi, M., Dyer, B., Nazem, A., Nambiar, M. K., Nahian, M. R., Bueno, B., Mackey, C., Vasanthakumar, S., Nazarian, N., Krayenhoff, E. S., Norford, L. K., and Aliabadi, A. A. (2021). The Vertical City Weather Generator (VCWG v1.3.2). *Geosci. Model Dev.*, 14(2):961–984.

[Moradi et al., 2022] Moradi, M., Krayenhoff, E. S., and Aliabadi, A. A. (2022). A comprehensive indoor–outdoor urban climate model with hydrology: The Vertical City Weather Generator (VCWG v2.0.0). *Building and Environment*, 207:108406.