User Guide for Monte Carlo Analysis

Introduction

This application use a Monte Carlo analysis to calibrate Thorton and Running (TR) Rs coefficients used in estimation of incident solar radiation using historic maximum, minimum and dew point temperature and measure solar radiation. Intent of Monte Carlo Analysis is to optimize estimation of the three coefficients (b0, b1, and b2).

This application has two modes: First, compute optimized B parameters for each station, export them to an Excel workbook, and average them. If calibrating for a basin, place these parameters into a TR equation and compare results with TR calculations that use standard parameters. This process allows for determination of optimized TR Rs coefficients that are more accurate at estimating Rs than standard coefficients for each basin.

Application can be configured two ways – one that uses program specified data heading and input units (C and MJ/m2/day) or user data headings, units[1] and other parameters from an configuration (aka initialization) "ini" file.

Setup

1. Following is an inventory of files.
    - Application Manager(s)
        - run_solar_rad_opt.py or variation suited for given application
    - Code files
        - solar_radiation_opt.py
        - solar_config.py
        - emprso_w_tr.py
    - Data Files
        - Input time series file (text or workbook; see "RecordedMetData)
        - Optional "ini" file with user specifications

2. Place code files in a common folder. Manager(s), "ini" and time series files can be located elsewhere. Code path, "ini", and/or time series files need to be specified in manager(s).

3. Edit manager code for desired setup. Which arguments that need to be modified depend on if an "ini" file is being using. If an "ini" file is being used, "file_name" specification is "ini" file; otherwise it is time-series file. If using an "ini" file, time-series file is specified in "ini" file.

[1] Default units are metric but user can specify English units. Internal and output units are always metric.

4. Set number of iterations by changing value of “mc_iterations”. Expect about 15 seconds of runtime for every 1000 iterations. Experience has shown that a more consistent optimization[2] is obtained with 20000 iteration.

Various manager setups and “ini” setups are included with application code.

Optimization

1. Ensure that comparison flag is set as:
    comparison_flag = False

2. Run manger script. An analysis plot and “…log.txt” file are generated. In addition, if save_flag is set to “True”, computed output are posted as a time series file.

3. Go into workspace and locate file with prefix same as time series file and ending with "_Processed_Optimazation_log.txt" This output some iteration output, various statistics and final Thorton and Running coefficients.

4. Run optimization for each station.

Comparisons

1. Place TR coefficients of individual stations into a workbook and compute their average. Example workbook “MultiNode_OptTRResults” is provided.

2. Open emprso_w_tr.py and set values of b0, b1, and b2 arguments to averages of basin.

3. Set “comparison_flag” to “True” in an application manager.

4. Run manager.

5. Go into workspace and locate file with prefix same as time series file and ending with "_Processed_Comparison_log.txt" This output some iteration output, various statistics and final TR coefficients.

6. Post output into averaging workbook.

7. Repeat optimizations for each station[3].

[2] Because of randomness of Monte-Carlo process, the more iterations used the more repeatable results will be.
[3] Optimization set can be done for an individual station.