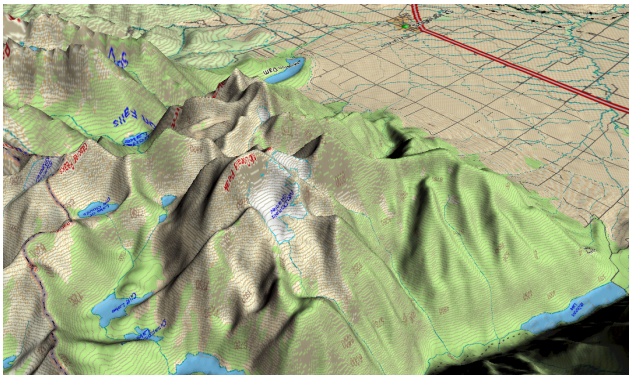
MT-CLIM for Excel



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Contents

1 INTRODUCTION

The mountain microclimate simulator (MTCLIM) extrapolates meteorological variables from a point of measurement (referred to as the "base" station) to the sudy "site" of interest, making corrections for differences in elevation, slope and aspect between the base station and the site (Hungerford et al. 1989). It uses very common measurements of daily maximum and minimum temperature and precipitation to estimate incoming solar radiation, humidity and daylength, while correcting temperature and precipitation measurements based on user defined lapse rates and differences in base and site isohyet values.

2 MTCLIM for Excel (MTCLIM-XL)

MTCLIM for Excel packages all the logic of MTCLIM into a single, user-friendly interface that runs within a Microsoft Excel spreadsheet. It was developed in Visual Basic for Applications and the code is contained as modules embedded in the workbook. The application consists of two worksheets and a set of self-contained functions.

2.1 Initialization worksheet

The first worksheet is for initialization of the MTCLIM simulation (Figure 1). This worksheet contains site physiographic information such as latitude, elevation, slope and aspect, as well as information about the base location. The format of this worksheet is almost indentical to old MTCLIM INI files with two exceptions. First, parameters are defined by keywords as opposed to being expected in some pre-specified order. Second, parameters can be entered in any order. All parameter keywords are expected to be present in the first column of the worksheet and the values corresponding to those keywords must be in the second column of the worksheet. In the MTCLIM-XL workbook, there is a worksheet named Keywords that lists each required keyword and describes them. The initialization parameters are as follows:

NOTE: Keywords are not case sensitive. I.E. INPUT_WORKSHEET, input_worksheet, and Input_Worksheet are all equivalent.

INPUT_WORKSHEET - The worksheet name that contains the met observations.

OUTPUT_WORKSHEET - The desired output worksheet name. The model extension will be added internally to this name. For example, if you input "miss84" as the output worksheet name, the final output worksheet will be miss84.mtc43. This is done for consis-

tency with previous MTCLIM versions. If this worksheet already exists, the entire worksheet will be cleared by the program and new output will be generated.

GRAPH_OUTPUT - The program now has a graphic output option. Set this option to 1 to graph all the values of solar radiation, daylength, vapor pressure (or vapor pressure deficit) and temperatures. These graphs are created as embedded graphs in the OUTPUT_WORKSHEET page.

NMETDAYS - The total number of days of meteorological observations present on INPUT_WORKSHEET.

DEWPOINT_FLAG - MTCLIM can use dewpoint observations if available for the estimation of radiation and humidity. Set this flag to 1 to use them, otherwise, the program will determine whether to use minimum temperature or an interative estimation of humidity as describe by Kimball et al. (1997).

HUMIDITY_FLAG - MTCLIM can output humidity as either vapor pressure or daytime average vapor pressure deficit.

YEAR_FLAG - If their is a year column in the input met data worksheet, set this to 1, otherwise set it to 0.

NOTE: In MTCLIM, the term BASE is used for the location where observations were collected. The term SITE is used for the location to which we are extrapolating.

BASE_ELEV - The elevation of the base station in meters.

BASE_ISOHYET - The isohyet of the base station in centimeters.

SITE_LAT - The latitude of the site in degrees.

SITE_ELEV - The elevation of the site in meters.

SITE_SLOPE - The slope of the site in degrees.

SITE_ASPECT - The aspect of the site in degrees from North.

SITE_ISOHYET - The isohyet of the site in centimeters.

SITE_EHORIZ - The east horizon of the site in degrees.

SITE_WHORIZ - The west horizon of the site in degrees.

TMAX_LR - The maximum temperature lapse rate in degrees C per kilometer.

TMIN_LR - The minimum temperature lapse rate in degrees C per kilometer.

2.2 Meteorological observations input worksheet

The second input to MTCLIM-XL is a worksheet of the meteorological observations of maximum temperature, minimum temperature and precipitation at the base location (Figure 2). MTCLIM-XL expects to find these observations in the Excel worksheet defined by the INPUT_WORKSHEET keyword. The keywords in the meteorological observations input worksheet are required to be in the first row of the worksheet. The order of the columns does not matter. There are fout required keywords and two optional keywords as follows:

Yearday (Required) - The julian date of the observation (1-366).

Tmax (Required) - Observed maximum temperature in degrees C.

Tmin (Required) - Observed minimum temperature in degrees C.

Prcp (Required) - Observed total daily precipitation in centimeters.

Tdew (Optional) - Observed dewpoint temperature total in degrees C. Only required if DEWPOINT_FLAG is set.

Year (Optional) - Year of observation. Only required is YEAR_FLAG is set in initialization worksheet.

3 Running MTCLIM-XL

Once you have created the initialization worksheet and you have imported the meteorological observations to another worksheet, you are ready to run MTCLIM-XL. First, open the MTCLIM-XL.xls file. It may ask you whether or not you would like to enable macros, if it does, click the enable macros option. The program should automatically make a button at the bottom of the Excel window called "Run MT-CLIM".

Start by creating a new initialization worksheet. There is a sample worksheet already contained within the program called "default". You can either rename this worksheet, create a copy of it or simply fill in the values. To create a copy of the worksheet, right click on the worksheet tab name at the bottom of the screen and click "Move or copy". The you can just click the "Create a copy" checkbox to make a copy. You can then rename the copy by right clicking the tab and selecting "Rename". In any case, make sure the first column contains all the keywords and the second column contains the keyword values as seen in the example.

Next, import your meteorological data into another worksheet. Remember to make sure the column headings match the required keywords. The order of the columns does not matter.

The last step is to run the MTCLIM program. There are two ways to do this. If the button "Run MT-CLIM" appeared at the bottom of the Excel program window, press it. Otherwise, from the "File" menu, choose the "Macro" submenu and the "Macros" option (Alt+F8), click "RunMTCLIM" from the list of avaialable macros then click "Run". Both methods will bring up a dialog box asking for the initialization worksheet name (Figure 3). Type the name of the initialization worksheet that you created above and click OK. If the program executed successfully, there will be a new worksheet created with your data. If the GRAPH_OUTPUT flag was set, graphs will also be created on your output worksheet.

4 References

4.1 MTCLIM Development

Thornton PE, Hasenauer H and White MA. 2000. Simultaneous estimation of daily solar radiation and humidity from observed temperature and precipitation: an application over complex terrain in Austria. Agricultural and Forest Meteorology 104, 255-271.

Thornton PE and Running SW. 1999. An improved algorithm for estimating incident daily

solar radiation from measurements of temperature, humidity, and precipitation. Agriculture and Forest Meteorology 93, 211-228.

Kimball JS, Running SW and Nemani RR. 1997. An improved method for estimating surface humidity from daily minimum temperature. Agricultural and Forest Meteorology 85, 87-98.

Glassy J and Running SW. 1994. Validating diurnal climatology logic of the MT-CLIM logic across a climatic gradient of Oregon. Ecological Applications 4, 248-257.

Hungerford RD, Running SW, Nemani RR and Coughlan JC. 1989. MTCLIM: A mountain microclimate extrapolation model. USDA Forest Service. Res. Paper INT-414 52pp.

Running SW, Nemani RR and Hungerford RD. 1987. Extrapolation of synoptic meteorological data in mountainous terrain, and its use for simulating forest evapotranspiration and photosynthesis. Canadian Journal of Forest Research 17, 472-483.

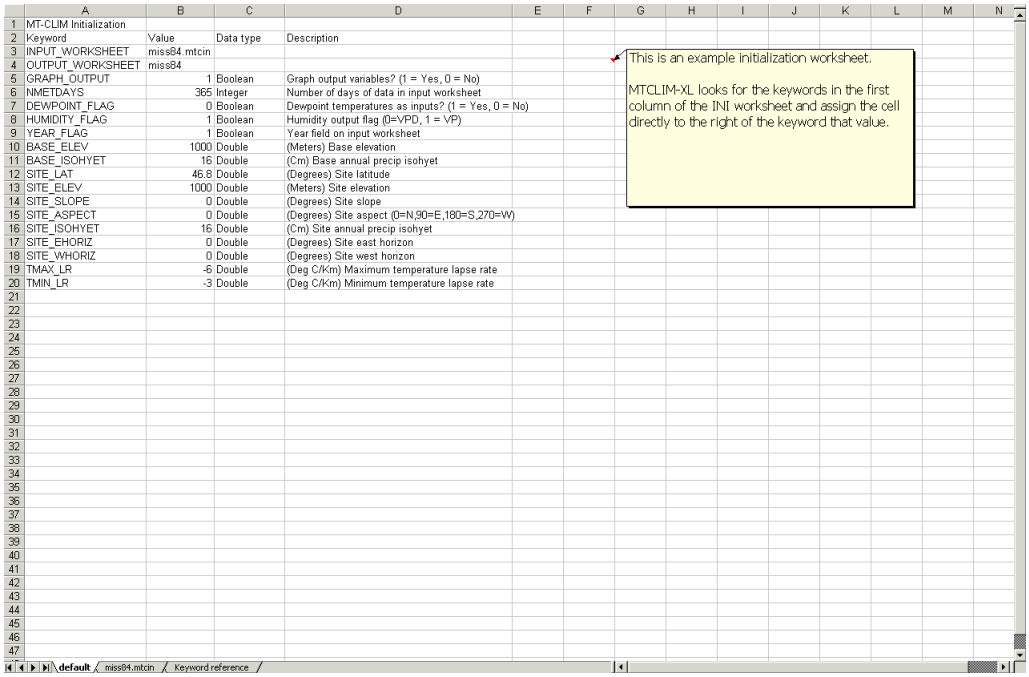
4.2 MTCLIM Applications

Chiesi M, Maselli F, Bindi M, Fibbi L, Bonora L, Raschi A, Tognetti R, Cermak J and Nadezhdina N. 2002. Calibration and application of FOREST-BGC in a Mediterranean area by the use of conventional and remote sensing data. Ecological Modelling 154(2), 251-262.

Almeida AC and Landsberg JJ. Evaluating methods of estimating global radiation and vapor pressure deficit using a dense network of automatic weather stations in coastal Brazil. Agricultural and Forest Meteorology, In Press.

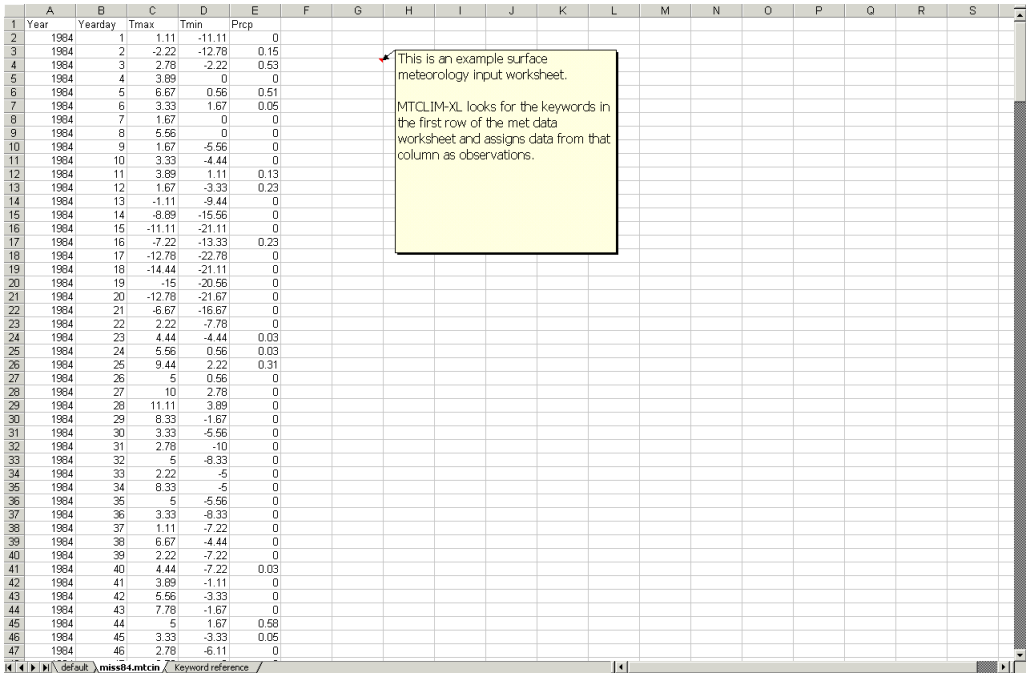
5 Code History

Original code written by R.R. Nemani
Updated 04/01/1989 by J.C. Coughlan
Updated 12/23/1989 by Joe Glassy
Updated 01/04/1993 by Raymond Hunt (version 2.1)
Updated 03/26/1997 by Peter Thornton (version 3.0)
Updated 07/28/1997 by Peter Thornton (version 3.1)
Updated 05/07/1998 by Peter Thornton (version 4.0)
Updated 08/01/1998 by Peter Thornton (version 4.1)
Updated 04/20/1999 by Peter Thornton (version 4.2)
Updated 01/20/2000 by Peter Thornton (version 4.3)
Updated 09/04/2003 by W. Matt Jolly (version 4.3XL)



	A	B	C	D
1	MT-CLIM Initialization			
2	Keyword	Value	Data type	Description
3	INPUT_WORKSHEET	miss84.mtcin		
4	OUTPUT_WORKSHEET	miss84		
5	GRAPH_OUTPUT	1	Boolean	Graph output variables? (1 = Yes, 0 = No)
6	NMETDAYS	365	Integer	Number of days of data in input worksheet
7	DEWPOINT_FLAG	0	Boolean	Dewpoint temperatures as inputs? (1 = Yes, 0 = No)
8	HUMIDITY_FLAG	1	Boolean	Humidity output flag (0=VPD, 1 = VP)
9	YEAR_FLAG	1	Boolean	Year field on input worksheet
10	BASE_ELEV	1000	Double	(Meters) Base elevation
11	BASE_ISOHYET	16	Double	(Cm) Base annual precip isohyet
12	SITE_LAT	46.8	Double	(Degrees) Site latitude
13	SITE_ELEV	1000	Double	(Meters) Site elevation
14	SITE_SLOPE	0	Double	(Degrees) Site slope
15	SITE_ASPECT	0	Double	(Degrees) Site aspect (0=N,90=E,180=S,270=W)
16	SITE_ISOHYET	16	Double	(Cm) Site annual precip isohyet
17	SITE_EHORIZ	0	Double	(Degrees) Site east horizon
18	SITE_WHORIZ	0	Double	(Degrees) Site west horizon
19	TMAX_LR	-6	Double	(Deg C/Km) Maximum temperature lapse rate
20	TMIN_LR	-3	Double	(Deg C/Km) Minimum temperature lapse rate

Figure 1: *Screen capture of an example initialization worksheet for MTCLIM-XL*



	A	B	C	D	E
1	Year	Yearday	Tmax	Tmin	Prcp
2	1984	1	1.11	-11.11	0
3	1984	2	-2.22	-12.78	0.15
4	1984	3	2.78	-2.22	0.53
5	1984	4	3.89	0	0
6	1984	5	6.67	0.56	0.51
7	1984	6	3.33	1.67	0.05
8	1984	7	1.67	0	0
9	1984	8	5.56	0	0
10	1984	9	1.67	-5.56	0
11	1984	10	3.33	-4.44	0
12	1984	11	3.89	1.11	0.13
13	1984	12	1.67	-3.33	0.23
14	1984	13	-1.11	-9.44	0
15	1984	14	-8.89	-15.56	0
16	1984	15	-11.11	-21.11	0
17	1984	16	-7.22	-13.33	0.23
18	1984	17	-12.78	-22.78	0
19	1984	18	-14.44	-21.11	0
20	1984	19	-15	-20.56	0
21	1984	20	-12.78	-21.67	0
22	1984	21	-6.67	-16.67	0
23	1984	22	2.22	-7.78	0
24	1984	23	4.44	-4.44	0.03
25	1984	24	5.56	0.56	0.03
26	1984	25	9.44	2.22	0.31
27	1984	26	5	0.56	0
28	1984	27	10	2.78	0
29	1984	28	11.11	3.89	0
30	1984	29	8.33	-1.67	0
31	1984	30	3.33	-5.56	0
32	1984	31	2.78	-10	0
33	1984	32	5	-8.33	0
34	1984	33	2.22	-5	0
35	1984	34	8.33	-5	0
36	1984	35	5	-5.56	0
37	1984	36	3.33	-8.33	0
38	1984	37	1.11	-7.22	0
39	1984	38	6.67	-4.44	0
40	1984	39	2.22	-7.22	0
41	1984	40	4.44	-7.22	0.03
42	1984	41	3.89	-1.11	0
43	1984	42	5.56	-3.33	0
44	1984	43	7.78	-1.67	0
45	1984	44	5	1.67	0.58
46	1984	45	3.33	-3.33	0.05
47	1984	46	2.78	-6.11	0

Figure 2: *Screen capture of an example met data input worksheet for MTCLIM-XL*

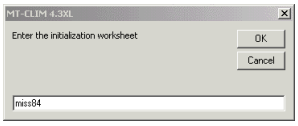


Figure 3: *Input dialog box prompting the user to enter the name of the initialization worksheet to use when running MTCLIM-XL.*

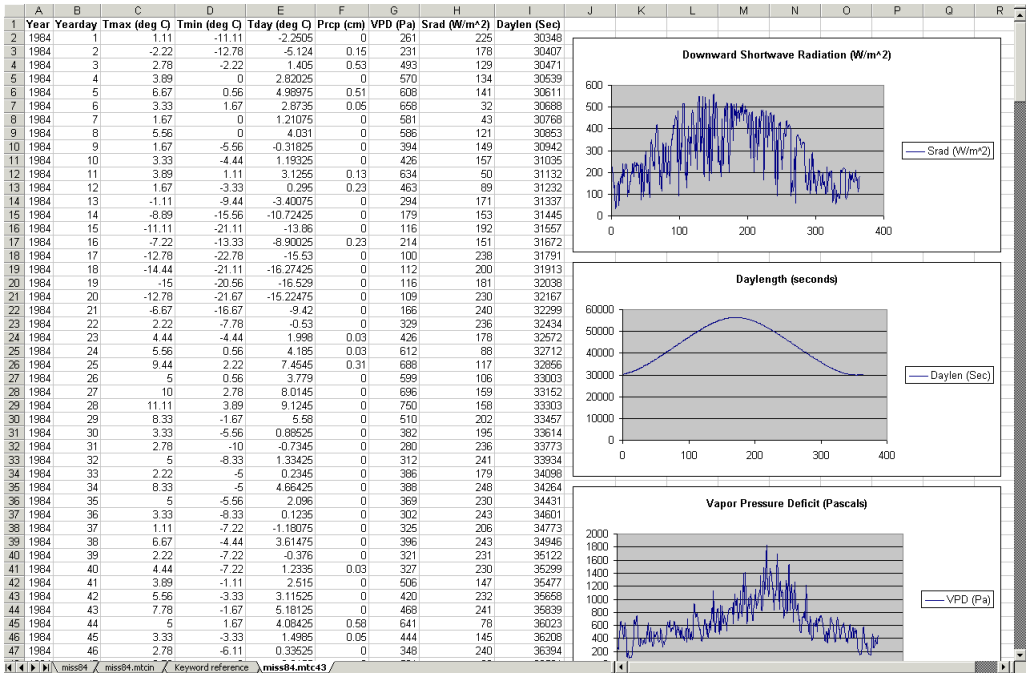


Figure 4: *Output generated by the MTCLIM-XL program (Shown with the GRAPH_OUTPUT option set)*