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Procedure for Packing Weather Files for DOE-2.1e

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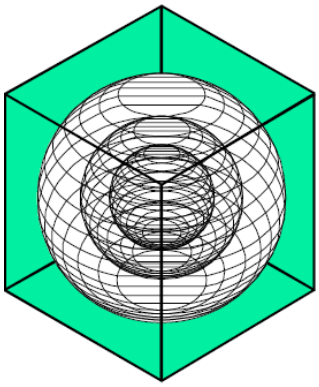

ENERGY SYSTEMS LABORATORY

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CHAPTER 1

1. OVERVIEW

Energy Systems laboratory (ESL) prepares 17 of Texas stations' weather files for DOE-2.1e simulation every year. This report describes the procedure how to get and pack the weather data for DOE-2.1e simulation. Overall procedure is shown in Table 1.

Table 1. Overall procedure for packing weather data for DOE-2.1e simulation

Procedure		Content	Methods				
1		Original files	1) Copy data from "cloud cover" tab in "main hourly data" Excel files 2) Files Names: "XXX2008"				
2		Filling-in gaps					
	2.1	Gaps & Mask	1) Calculation: Use "Gap calculation" program 2) Mask: Make from horly data 3) Files Names: GAPS_XXX_2XXX.xls & MASK_XXX_2XXX.xls				
		2.2.1	Temperature: (1) Tdb, Twb, Tdp: 1) gaps<=6: Linear interpolation 2) gaps>6: Psychrometric relationship (in case of one data missing) or Nearby weather station (2) Wind speed, wind direction, percipitation, station pressur 1) Station pressure: last value previous to the gap 2) No fill-in for wind speed, wind direction, precipitation			2.2.2	Solar radiation: (1) gaps<=6: Linear interpolation (2) 6<gaps<=48: taking the trend between the adjacent days of the gap (3) gaps>=48: Nearby station
3	3.1	Excel files with plots (hourly)	1) 9 items 1-1) 8760 data (delete Feb.29 for leap year) 1-2) Check files name (Station no.). Make notes if station no. are different with existing files 2) Check plots 2-1) No (-99) values on plots 2-2) Check that Tdb > Twb> Tdp (use "if command") 3) Files Names: HourlyTS_XXX_XXXXX_2XXX.xls		3.2	Excel files with plots (daily)	1) Convertion: Use "Par" program 2) 9 items 2-1) 365 data 2-2) Check files name (Station no.). Make notes if station no. are different with existing files 3) Check plots 3-1) No default values on plots 3-2) Check that Tdb > Twb> Tdp (use "if command") 4) Files Names: DailyTS_XXX_XXXXX_2XXX
4	4.1	CSV files (hourly)	1) XLS files convert to CSV files (for DOS)		4.2	CSV files (daily)	1) XLS files convert to CSV files (for DOS)
5	5.1	PDF files (hourly)	1) Plots files convert to PDF files (make sure the title(Name, year). View→header)		5.2	PDF files (daily)	1) Plots files convert to PDF files (make sure the title(Name, year). View→header)
6		TRY file Preparation -Excel files	1) Files Names: PrepTRY_XXX_2XXX_				
7		TRY file Preparation -Text files	1) The last column copies to Notepad 2) Save it as "TRY_XXX_2XXX_.TPE" (693 KB)				
8		INP DOE Weather files - packing	1) INP files for packing→ check manual 2) Files Names: TRY_XXX_2XXX.INP				
9		OUT DOE Weather files - packing	1) OUT files for packing 2) Files Names: TRY_XXX_2XXX.OUT				
10		DOE Weather files	1) Files Names: TRY_XXX_2XXX				

In addition, Figure 1 and Table 2 show the 17 of Texas weather stations which represent the each area of the Texas.

Table 2. List of 17 Texas weather stations and their WBAN

2008

City	Station		WBAN
Abilene	Abilene Rgnl. AP.	ABI	13962
Amarillo	Amarillo Intl. AP.	AMA	23047
Austin	Austin Bergstrom AP.	AUS	13904
Brownsville	Brownsville S. Padre Island Intl.	BRO	12919
Corpus Christi	Corpus Christi Intl. AP.	CRP	12924
Dallas Fort Worth	Dallas Fort Worth Intl. AP.	DFW	03927
El Paso	El Paso Intl. AP.	ELP	23044
Houston	Houston Intercontinental AP.	IAH	12960
Lubbock	Lubbock Intl. AP.	LBB	23042
Lufkin	Angelina County AP.	LFK	93987
Midland	Midland Itnl. AP.	MAF	23023
Port Arthur	Port Arthur/Jeffers	BPT	12917
San Angelo	San Angelo / Maths Field	SJT	23034
San Antonio	San Antonio Intl. AP.	SAT	12921
Victoria	Victoria Rgnl. AP.	VCT	12912
Waco	Waco Rgnl. AP.	ACT	13959
Wichita Falls	Wichita Falls Municipal AP.	SPS	13966

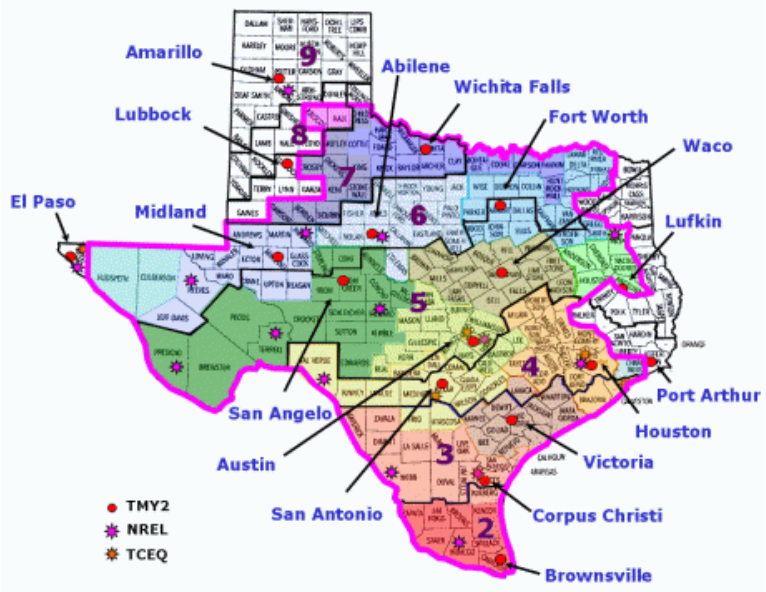


Figure 1. Location of 17 Texas weather stations

CHAPTER 2

1. OVERVIEW

Chapter 2 describes procedure of packing weather file for the 17 Texas weather stations step by step. Brief procedure is shown in Figure 2.

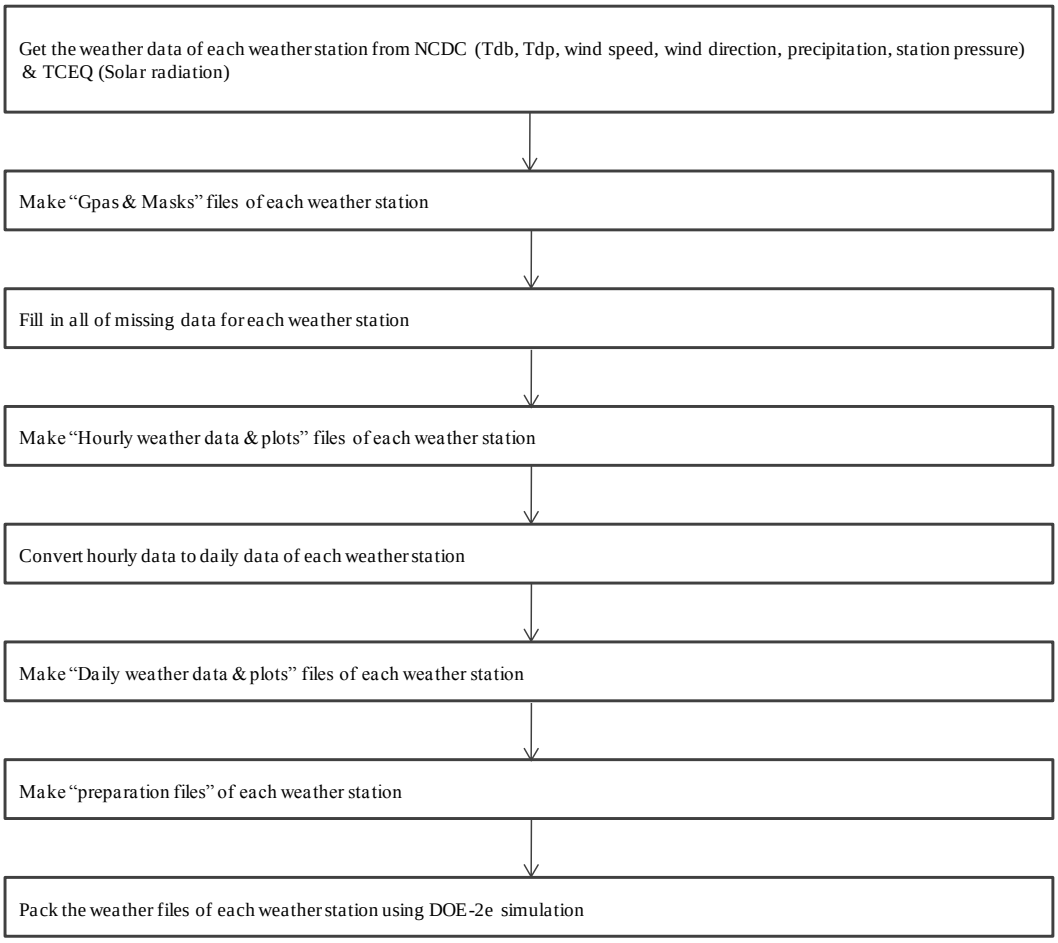


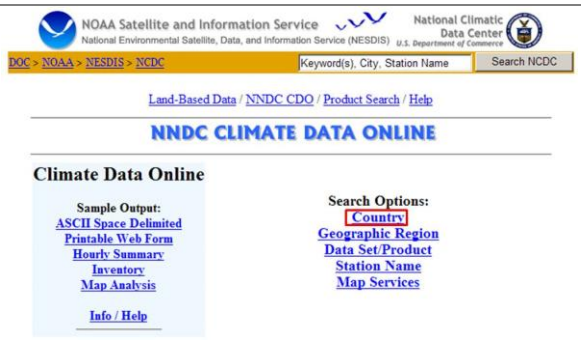
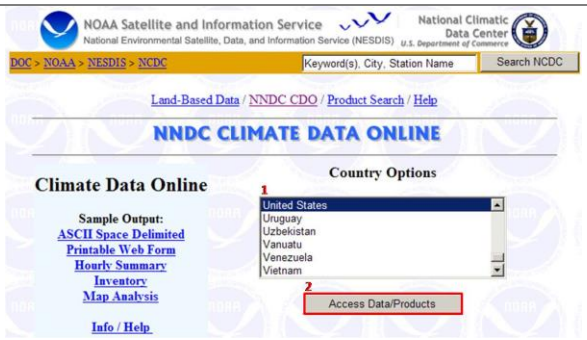
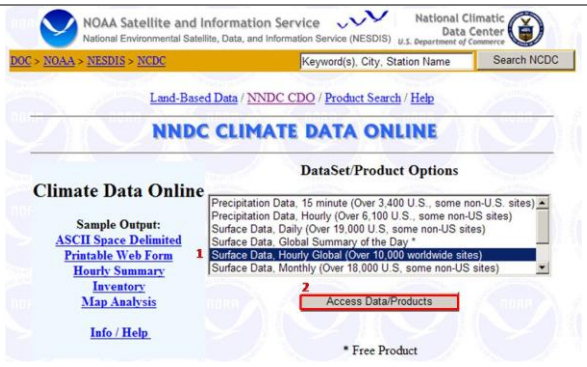
Figure 2. Brief procedure of packing weather data for DOE-2.1e simulation

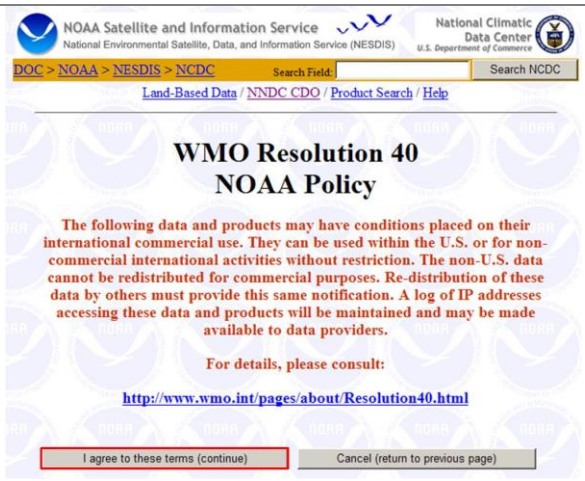
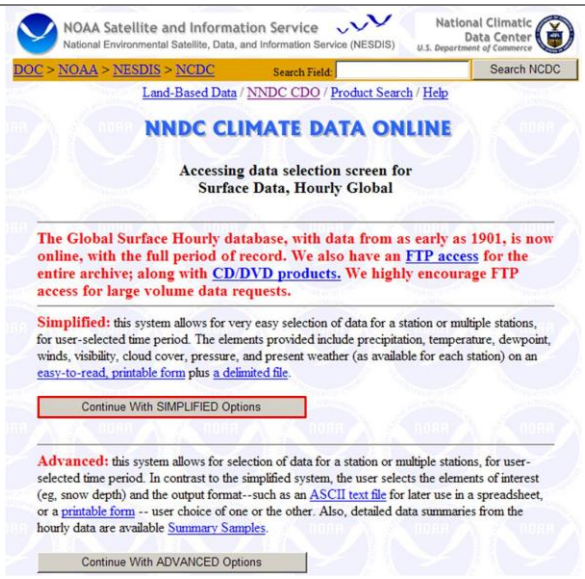
2. PROCESS OF PACKING WEATHER DATA FOR DOE-2.1e SIMULATION

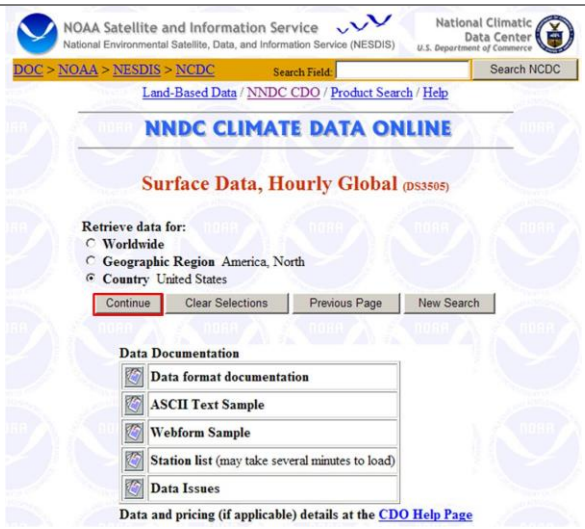
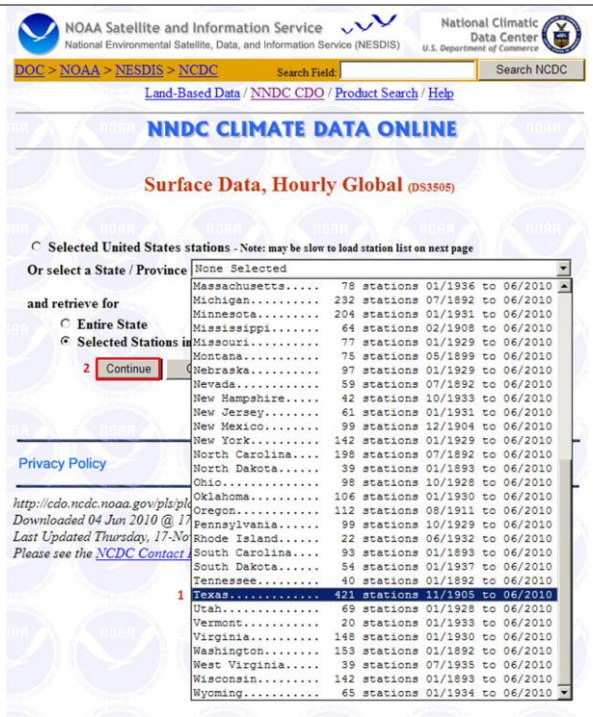
2.1. ORIGINAL DATA

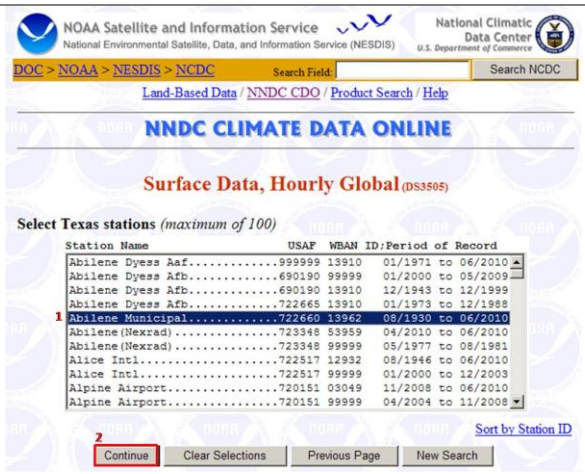
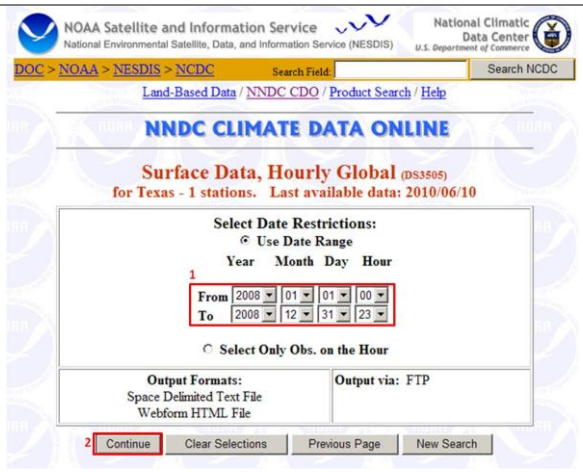
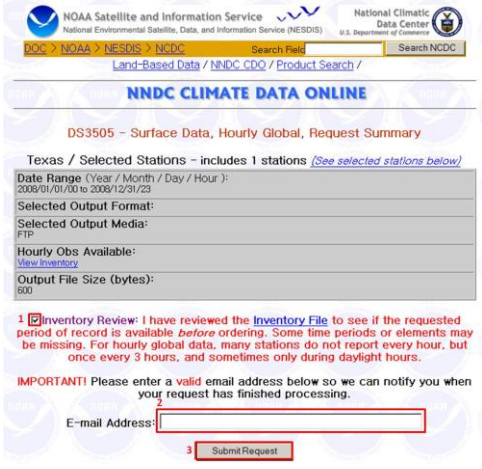
Required weather data can be downloaded from National Climatic Data Center website (NCDC), and solar radiation data (Global solar radiation) can be downloaded from Texas Commission on Environmental Quality (TCEQ).

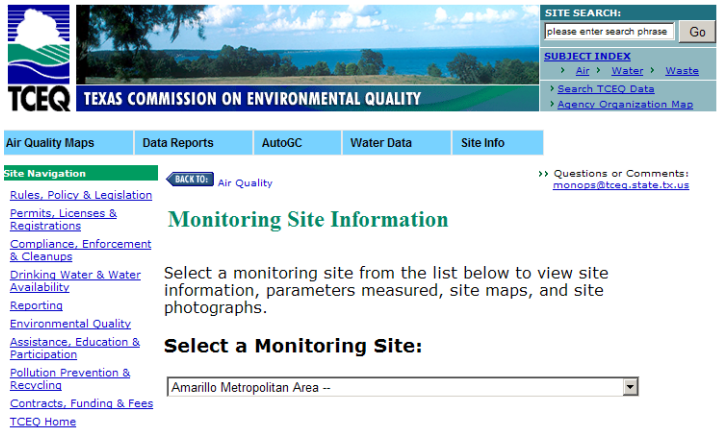
Figure 3 shows each step of procedure to get weather data from the NCDC and TECQ website.

	**NCDC:** (http://www7.ncdc.noaa.gov/CDO/cdo) Step 1. Click "Country"
	Step 2. Select country and click "Access Data Products"
	Step3. Select "Surface Data, Hourly Global (Over 10,000 worldwide sites)", and click "Access Data Products"

	Step4. Click "I agree to these terms (continue)"
	Step5. Click "Continue With SIMPLIFIED Options"

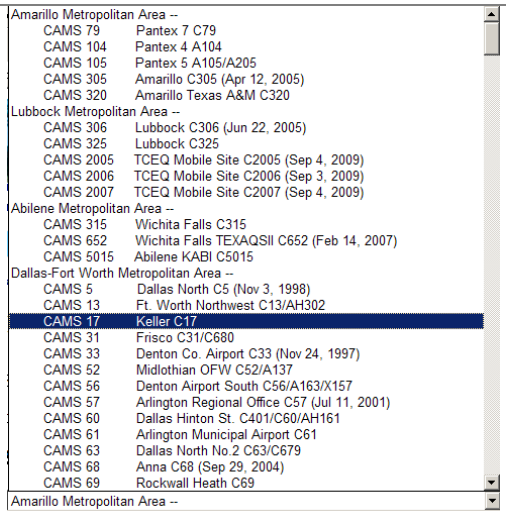
	Step6. Click “Continue”
	Step7. Select “Texas” and click “Continue”

	Step8. Select a Texas Station considering with WBAN and Period of Record you look for, and click “Continue”
	Step9. Select Date Restrictions (for a year), and click “Continue”
	Step10. Check “inventory Review”, and input e-mail address where you want to receive, and click “Submit Request” (Done)



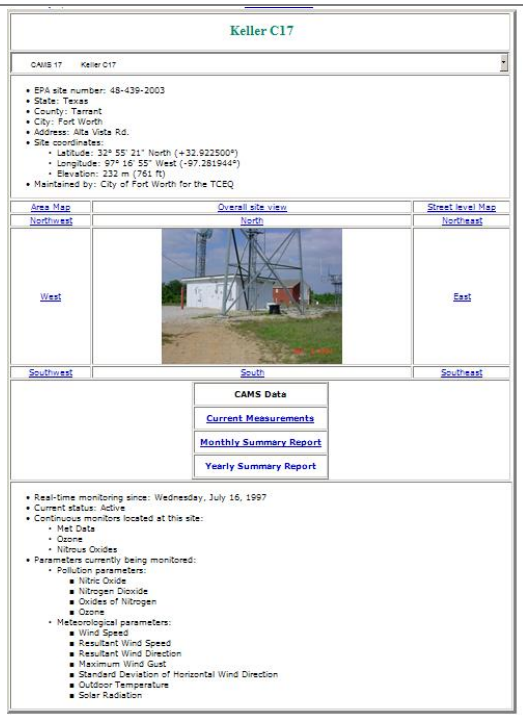
TCEQ:

(http://www.tceq.state.tx.us/cgi-bin/compliance/monops/site_photo.pl)

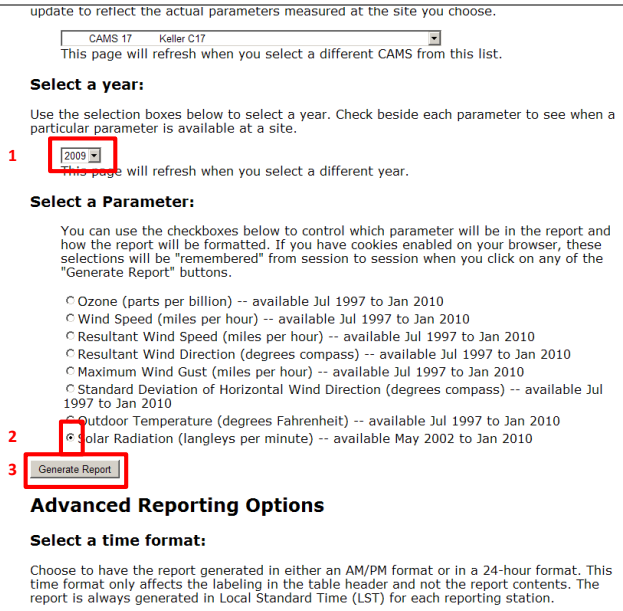


Step1. Select weather stations

See Excel file in M drive (M:\Weather files _ SB5\Weather files packing\2009\Solar Radiation\06-07-08-09 radiation gaps.xls) to figure out all weather stations for solar radiation.



Step2. Click “Yearly Summary Report”



Step3. Check year (1) you want, verify solar radiation is selected (2), and click “Generate Report”

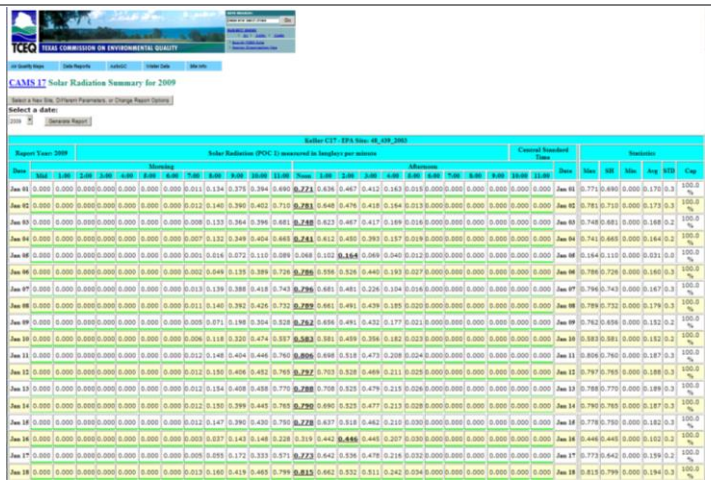
	(Done)

Figure 3. Process of downloading weather data from NCDC and TCEQ website

- NCDC website:

In order to obtain all 17 Texas stations' weather data, step1 through step10 (NCDC part) for each of Texas weather station needs to be repeated. When the weather data are arrived to the e-mail account, each of Texas station weather data (Figure 4) needs to be copied and pasted to text file (Notepad), and saved them named as "Station name Year" (e.g. Abilene 2008) in "1_Original data" folder in M drive (M:\Weather files _ SB5\Weather files packing\2008\1_Original_data).

- TCEQ website:

In order to obtain all 17 Texas station's solar radiation data, step1 through step3 (TCEQ part) for each of Texas weather station needs to be repeated. Each of solar radiation data needs to be copied and pasted to Excel file, and save them in "1_Original data" folder in M drive (M:\Weather files _ SB5\Weather files packing\2008\1_Original_data).

Figure 4 shows an example of text file which downloaded from NCDC website, and Figure 5 shows 17 original files for all of Texas stations in "1_Original data" folder in M drive.

USAF	WBAN	YR--MODAHRMN	DIR	SPD	GUS	CLG	SKC	L	M	H	VSB	WW	WW	WW	W	TEMP	DEWP	SLP	ALT	STP	MAX	MIN	PCP01	PCP06	PCP24	PCPXX	SD
722660	13962	200801010000	360	11	***	722	CLR	0	0	0	10.0	**	**	**	*	47	10	1026.1	*****	961.3	53	36	*****	*****	*****	*****	**
722660	13962	200801010052	010	10	***	722	CLR	*	*	*	10.0	**	**	**	*	43	10	1027.8	30.35	*******	***	***	*****	*****	*****	*****	**
722660	13962	200801010152	360	7	***	722	CLR	*	*	*	10.0	**	**	**	*	39	10	1029.5	30.39	*******	***	***	*****	*****	*****	*****	**
722660	13962	200801010252	010	7	***	722	CLR	*	*	*	10.0	**	**	**	*	36	9	1030.9	30.43	*******	***	***	*****	*****	*****	*****	**
722660	13962	200801010352	020	8	***	722	CLR	*	*	*	10.0	**	**	**	*	34	9	1032.2	30.47	*******	***	***	*****	*****	*****	*****	**
722660	13962	200801010452	010	6	***	722	CLR	*	*	*	10.0	**	**	**	*	32	9	1033.2	30.50	*******	***	***	*****	*****	*****	*****	**
722660	13962	200801010552	360	7	***	722	CLR	*	*	*	10.0	**	**	**	*	30	9	1034.2	30.53	*******	47	30	*****	*****	*****	*****	**
722660	13962	200801010600	360	7	***	722	CLR	0	0	0	10.0	**	**	**	*	30	8	1034.2	*****	968.6	50	30	*****	*****	*****	*****	**
722660	13962	200801010652	010	8	***	722	CLR	*	*	*	10.0	**	**	**	*	30	9	1034.5	30.54	*******	***	***	*****	*****	*****	*****	**
722660	13962	200801010752	360	5	***	722	CLR	*	*	*	10.0	**	**	**	*	28	9	1035.3	30.57	*******	***	***	*****	*****	*****	*****	**
722660	13962	200801010852	330	5	***	722	CLR	*	*	*	10.0	**	**	**	*	28	10	1036.1	30.59	*******	***	***	*****	*****	*****	*****	**
722660	13962	200801010952	***	0	***	722	CLR	*	*	*	10.0	**	**	**	*	27	10	1037.1	30.62	*******	***	***	*****	*****	*****	*****	**
722660	13962	200801011052	200	3	***	722	CLR	*	*	*	10.0	**	**	**	*	21	10	1038.2	30.64	*******	***	***	*****	*****	*****	*****	**
722660	13962	200801011152	260	6	***	722	CLR	*	*	*	10.0	**	**	**	*	21	10	1039.3	30.66	*******	31	19	*****	*****	*****	*****	**
722660	13962	200801011200	260	6	***	722	CLR	0	0	0	10.0	**	**	**	*	21	10	1039.3	*****	972.8	53	19	*****	*****	*****	*****	**
722660	13962	200801011252	270	6	***	722	CLR	*	*	*	10.0	**	**	**	*	21	10	1040.8	30.71	*******	***	***	*****	*****	*****	*****	**
722660	13962	200801011352	***	0	***	722	CLR	*	*	*	10.0	**	**	**	*	19	10	1041.9	30.73	*******	***	***	*****	*****	*****	*****	**
722660	13962	200801011452	250	3	***	722	CLR	*	*	*	10.0	**	**	**	*	27	14	1042.9	30.76	*******	***	***	*****	*****	*****	*****	**
722660	13962	200801011552	340	5	***	722	CLR	*	*	*	10.0	**	**	**	*	34	14	1043.3	30.78	*******	***	***	*****	*****	*****	*****	**
722660	13962	200801011652	340	5	***	722	CLR	*	*	*	10.0	**	**	**	*	39	14	1044.0	30.81	*******	***	***	*****	*****	*****	*****	**
722660	13962	200801011752	350	6	***	722	CLR	*	*	*	10.0	**	**	**	*	45	10	1043.4	30.79	*******	***	20	0.00T	0.00T	*****	*****	**
722660	13962	200801011800	350	6	***	722	CLR	0	0	0	10.0	**	**	**	*	44	11	1043.4	*****	977.0	44	20	*****	0.00	*****	*****	**

Figure 4. 2008 weather data for Abilene 2008 from NCDC

Name	Size	Type	Date Modified
Abilene 2008.txt	1,542 KB	Text Document	5/27/2010 3:40 PM
Amarillo 2008.txt	1,753 KB	Text Document	5/27/2010 4:07 PM
Austin 2008.txt	1,547 KB	Text Document	5/27/2010 4:06 PM
Brownsville 2008.txt	1,647 KB	Text Document	5/27/2010 4:04 PM
Corpus Christi 2008.txt	1,569 KB	Text Document	5/27/2010 4:02 PM
Dallas Fortworth 2008.txt	1,757 KB	Text Document	5/27/2010 4:01 PM
El Paso 2008.txt	1,571 KB	Text Document	5/27/2010 3:59 PM
Houston 2008.txt	1,568 KB	Text Document	5/27/2010 3:38 PM
Lubbock 2008.txt	1,507 KB	Text Document	5/27/2010 3:57 PM
Lufkin 2008.txt	1,565 KB	Text Document	5/27/2010 3:56 PM
Midland 2008.txt	1,463 KB	Text Document	5/27/2010 3:55 PM
Port Arthur 2008.txt	1,696 KB	Text Document	5/27/2010 3:53 PM
San Angelo 2008.txt	1,505 KB	Text Document	5/27/2010 3:52 PM
San Antonio 2008.txt	1,742 KB	Text Document	5/27/2010 3:50 PM
Victoria 2008.txt	1,765 KB	Text Document	5/27/2010 3:48 PM
Waco 2008.txt	1,600 KB	Text Document	5/27/2010 3:44 PM
Wichita Falls 2008.txt	1,546 KB	Text Document	5/27/2010 3:42 PM

Figure 5. 17 Texas weather stations data in "1_Original data" folder in M drive

2.2. GAPS

There are a number of missing weather data in NCDC such as 2nd and 9th rows of "column T (ALT)" in Table 3, and solar radiation data in TCEQ. The missing data for 17 Texas weather stations need to be identified in this step.

"Gaps" is file to figure out how many missing weather data exit, as well as how many gap of length exist. Table 4 shows an example of "gaps" for "Abilene 2008 weather data". The shortest gap of length in this example is "1", and the longest gap of length in this example is "10". The "gaps" file should be presented all of the existing gaps of length.

Required weather elements in this file are:

- Tdb – Dry bulb temperature
- Twb – Wet bulb temperature
- Tdp – Dew point temperature
- Wind speed
- Wind dir. – Wind direction
- GSR – Global solar radiation
- NDSR – Normal direct solar radiation
- Precipitation
- Stat. Pres. – Station pressure

In order to make "gaps" file, each of the downloaded weather text file needs to be opened with the Excel. To open the weather text file with the Excel, choose "From Other Sources" on "Data" menu in the Excel, select "XML data import", and choose the Texas station's weather text file. Then, select "Delimited" data type, and check in "Space". The Table 3 shows the example of the Excel file. The marked elements in red are the weather data which need for the packing DOE-2.1e weather simulation.

Table 3. Abilene 2008 weather data from NCDC in Excel

Day Wind Dir. Wind Speed Temperature Dew point temp. Stat. Pres. Precipitation

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1	USAF	WBAN	YR--MODAHRM	DIR	SPD	GUS	CLG	SKC	L	M	H	VSB	WW	WW	WW	W	TEMP	DEWP	SLP	ALT	STP	MAX	MIN	PCP01	PCP06	PCP24	PCPXX	SD
2	722660	13962	200801010000	360	11	***	722	CLR	0	0	0	10	**	**	**	*	47	10	1026.1	*****	961.3	53	36	*****	*****	*****	*****	**
3	722660	13962	200801010052	10	10	***	722	CLR	*	*	*	10	**	**	**	*	43	10	1027.8	30.35	******	***	***	*****	*****	*****	*****	**
4	722660	13962	200801010152	360	7	***	722	CLR	*	*	*	10	**	**	**	*	39	10	1029.5	30.39	******	***	***	*****	*****	*****	*****	**
5	722660	13962	200801010252	10	7	***	722	CLR	*	*	*	10	**	**	**	*	36	9	1030.9	30.43	******	***	***	*****	*****	*****	*****	**
6	722660	13962	200801010352	20	8	***	722	CLR	*	*	*	10	**	**	**	*	34	9	1032.2	30.47	******	***	***	*****	*****	*****	*****	**
7	722660	13962	200801010452	10	6	***	722	CLR	*	*	*	10	**	**	**	*	32	9	1033.2	30.5	******	***	***	*****	*****	*****	*****	**
8	722660	13962	200801010552	360	7	***	722	CLR	*	*	*	10	**	**	**	*	30	9	1034.2	30.53	******	47	30	*****	*****	*****	*****	**
9	722660	13962	200801010600	360	7	***	722	CLR	0	0	0	10	**	**	**	*	30	8	1034.2	*****	968.6	50	30	*****	*****	*****	*****	**
10	722660	13962	200801010652	10	8	***	722	CLR	*	*	*	10	**	**	**	*	30	9	1034.9	30.54	******	***	***	*****	*****	*****	*****	**
11	722660	13962	200801010752	360	5	***	722	CLR	*	*	*	10	**	**	**	*	28	9	1035.3	30.57	******	***	***	*****	*****	*****	*****	**
12	722660	13962	200801010852	330	5	***	722	CLR	*	*	*	10	**	**	**	*	28	10	1036.1	30.59	******	***	***	*****	*****	*****	*****	**
13	722660	13962	200801010952	***	0	***	722	CLR	*	*	*	10	**	**	**	*	27	10	1037.1	30.62	******	***	***	*****	*****	*****	*****	**
14	722660	13962	200801011052	200	3	***	722	CLR	*	*	*	10	**	**	**	*	21	10	1038.2	30.64	******	***	***	*****	*****	*****	*****	**

Then, extracting necessary data from the Excel file (i.e. Wind direction, Wind speed, Temperature, Dew point temperature, Station pressure, Precipitation) needs to be done. Template format Excel file for this step is stored in M drive (M:\Weather files _ SB5\Weather files packing\2008\Process\Weather). In this file, there are eight tabs: final, could cover, initial process, look up, default values, unit conversion, and count gaps (Figure 6). In these tabs, the extracted weather data need to be pasted in "cloud cover" tab, and majority of minutes need to be put in "look up" tab. This part will be described more detail in below. Then, necessary data process will be done by itself in this Excel file. The result is in "unit conversion" tab (Figure 8).

Figure 6. Eight tabs in template Excel file

Figure 7 shows the "cloud cover" tab after put the all extracted weather data to the template Excel file, and Figure 8 shows the result of the process, which is hourly weather data.

	A	B	C	D	E	F	G
1	YR--MODAHRMN	DIR	SPD	TEMP	DEWP	ALT	PCP01
2	200801010000	90	6	45	16	*****	*****
3	200801010052	90	7	41	18	30.24	*****
4	200801010152	100	8	37	18	30.23	*****
5							
11691	200812312343	350	16	34	28	30.36	*****
11692	200812312349	350	15	34	28	30.37	*****
11693	200812312352	330	15	34	28	30.37	*****

Figure 7. Excel file which extracted the necessary weather elements

	A	B	C	D	E	F	G	H	I	J	K
1	Labeled Time		Drg Bulb	Wet Bulb	Dew Point	Wind speed	Wind DIR	Solar (Global)	Solar (Normal Direct)	Station Pressure	STATION
2			(F)	(F)	(F)	(knots)	(Deg)	(Btu/sqft-hr)	(Btu/sqft-hr)	(inches Hg)	Number
3	1/1/2008	0:00	47.00	39.06	10.00	9.56	360.00	0.0	0.0	30.35	13962
4	1/1/2008	1:00	43.00	36.20	10.00	8.69	10.00	0.0	0.0	30.35	13962
5	1/1/2008	2:00	39.00	33.27	10.00	6.08	360.00	0.0	0.0	30.39	13962
6	1/1/2008	3:00	36.00	30.94	9.00	6.08	10.00	0.0	0.0	30.43	13962
7	1/1/2008	4:00	34.00	29.46	9.00	6.95	20.00	0.0	0.0	30.47	13962
8	1/1/2008	5:00	32.00	27.95	9.00	5.21	10.00	0.0	0.0	30.50	13962
9	1/1/2008	6:00	30.00	26.42	9.00	6.08	360.00	0.0	0.0	30.53	13962
10	1/1/2008	7:00	30.00	26.42	9.00	6.95	10.00	0.0	0.0	30.54	13962
11	1/1/2008	8:00	28.00	24.86	9.00	4.34	360.00	33.9	92.9	30.57	13962
12	1/1/2008	9:00	28.00	24.97	10.00	4.34	330.00	89.1	184.6	30.59	13962
13	1/1/2008	10:00	27.00	24.19	10.00	0.00	-99.00	132.3	208.8	30.62	13962

Figure 8. Unit conversion tab

Here is brief explanation of the process performed in this template Excel file. As shown in Figure 7, the extracted data have more than 8760 rows (in this case, 11693 rows) for each element because the weather data from NCDC were recorded by less than an hour. Therefore, finding out and extracting majority of minute (i.e. 52 minutes in this case) of the data are required to make 8760 data (hourly data) using "Look up" function in the Excel (see the "Look up" tab of the file).

Then, it is required to add "Wet-bulb temperature", "Global solar radiation", and "Direct normal solar radiation" data on the columns of "unit conversion" tab in this file.

Since there are no data for wet-bulb temperature in the NCDC website, these data need to be calculated from dry-bulb temperature, dew point temperature, and station pressure using psychrometric equations. At the same time, missing data for the wet-bulb temperature also need to be identified. To do these processes at the same time, "IF" command can be used. "=IF(C3=-99,-99,IF(J3=-99,J3,Twetbulb(J3,C3,E3)))" is an example of "IF" command I used. However, prior to use this command, "psychr2004e.xla" program need to be added to the Excel file first. The program calculates the wet-bulb temperature by psychrometric equations. This program is also in M drive (M:\Weather files _ SB5\Weather files packing\Programs). To add the program to the Excel, in case of using Excel 2007, open the "Excel Option" window first, and go to the "Add-Ins" tab then, check the "Psychr_JCB".

In addition, there are two more things to do; one is adding "Global solar radiation" data on "unit conversion" tab, and another is calculating "Normal Direct Solar Radiation (NDSR)" from the "Global solar radiation" data. In order to calculate NDSR, template Excel file in M drive is used (M:\Weather files _ SB5\Weather files packing\2008\Process\Solar Radiation\NDSR). In the template Excel file, adequate latitude and longitude of Texas station need to be put first. The information is included in files downloaded from the NCDC website. In addition, it is required to check whether year, month, and date in

the file are correct or not. After that, the "Global solar radiation" data need to be pasted in "column Q" of the file, then, NDSR data are calculated in "column AA". Figure 9 shows an example of the NDSR template file, and marked part in red (right) is the calculated NDSR data.

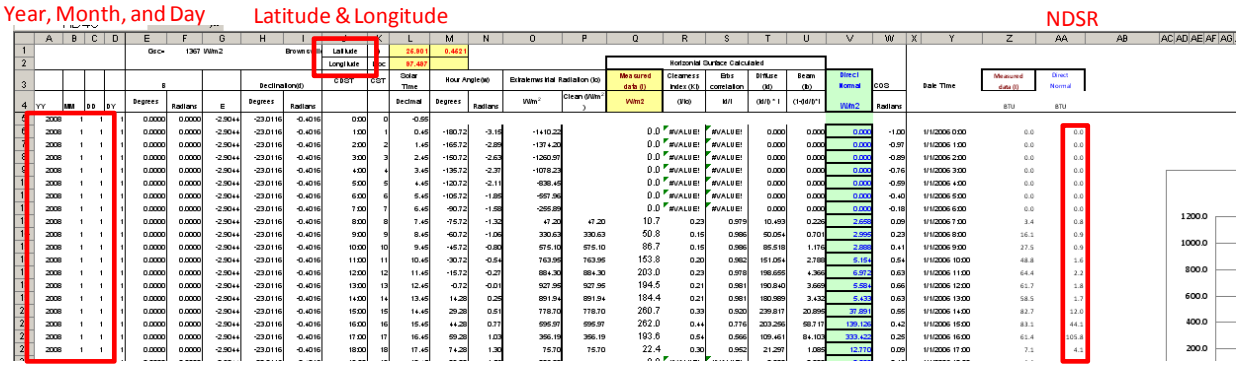


Figure 9. An example of NDSR processing file

After these processes, the "gap.xls" file in M drive (M:\Weather files _ SB5\Weather files packing\Programs) is used to calculate the "total number of cells with default values" and "gaps of length". First, copy the values of certain element, for example, dry-bulb temperature in this case, and paste them on "column C" on the program, and make it runs. Then, "total number of cells with default values" and "gaps of length" can be calculated as shown in Figure 10. It is required to repeat this process every elements (9 elements) and every 17 Texas stations.

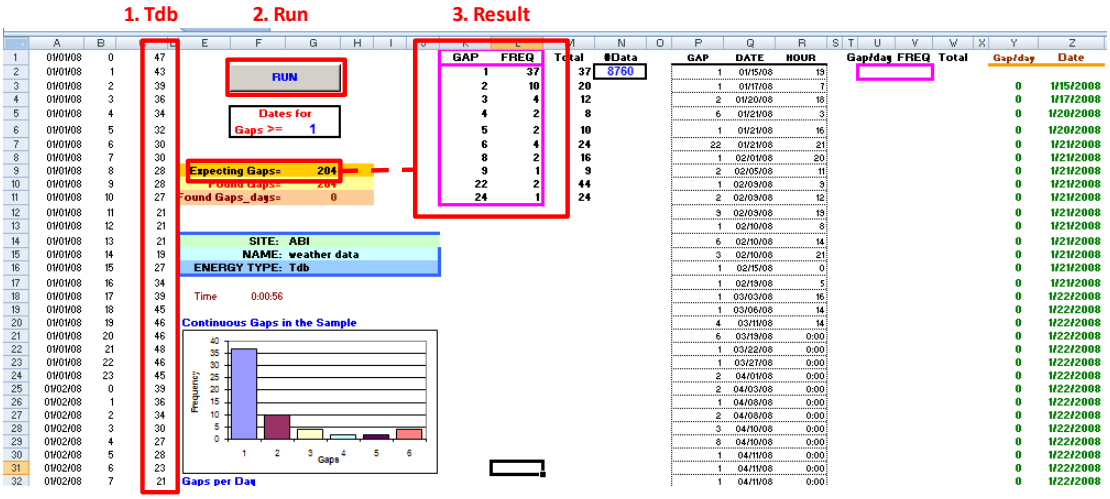


Figure 10. The result of "gap.xls" program in case of calculating gaps for Tdb

Then, the result data (i.e. "total number of cells with default values" and "gaps of length") from the program can be copied and pasted on gaps file stored in M drive (M:\Weather files _ SB5\Weather files packing\2008\2_Gaps), and named it as "GAPS_XXX_2XXX.xls" (i.e. "GAPS_ABI_2008.xls" in this case). Table 4 shows an example of the gaps file.

Table 4. An example of gaps file

	Tdb	Twb	Tdp	Wind speed	Wind dir.	GSR	NDSR	Precipitation	Stat. Pres
Total number of cells with default values	204	204	204	207	743	207	207	160	189
gaps of length 1	37	37	37	40	258	47	47	29	37
gaps of length 2	10	10	10	9	76	8	8	6	7
gaps of length 3	4	4	4	3	26	5	5	2	3
gaps of length 4	2	2	2	5	14	2	2		2
gaps of length 5	2	2	2	2	9	2	2	2	2
gaps of length 6	4	4	4	3	5	3	3	3	3
gaps of length 7				1	4				
gaps of length 8	2	2	2	1	1	2	2	1	2
gaps of length 9	1	1	1	1	1	1	1	1	1
gaps of length 10					1				

2.3. MASKS

"Masks" is file to figure out what particular time periods the missing weather data exist. Figure 11 shows an example of "Masks" file for "Abilene 2008 weather data". In this figure, number "1" indicates that there is a missing data in that time period. For example, there are missing data of wind direction at 4:00 and 8:00 on Jan. 1 2008 as shown in Figure 11.

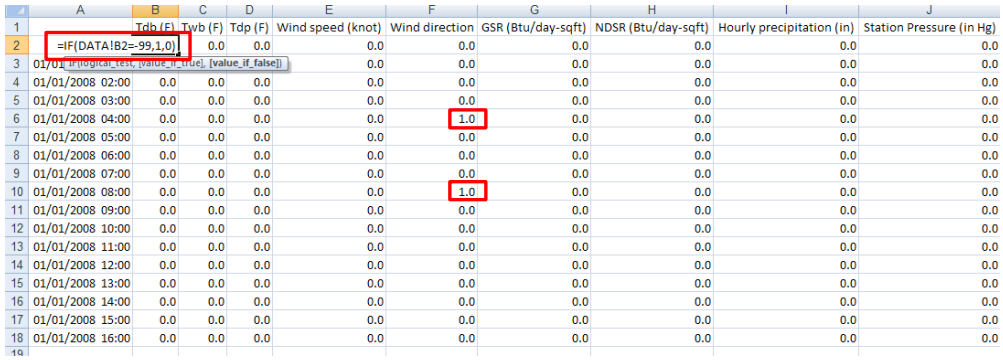
	A	B	C	D	E	F	G	H	I	J
1		Tdb	Twb	Tdp	Wind Speed	Wind Direction	GSR	NDSR	Precipitation	station pressure
2	1/1/2008 0:00	-	-	-	-	-	-	-	-	-
3	1/1/2008 1:00	-	-	-	-	-	-	-	-	-
4	1/1/2008 2:00	-	-	-	-	-	-	-	-	-
5	1/1/2008 3:00	-	-	-	-	-	-	-	-	-
6	1/1/2008 4:00	-	-	-	-	1	-	-	-	-
7	1/1/2008 5:00	-	-	-	-	-	-	-	-	-
8	1/1/2008 6:00	-	-	-	-	-	-	-	-	-
9	1/1/2008 7:00	-	-	-	-	-	-	-	-	-
10	1/1/2008 8:00	-	-	-	-	1	-	-	-	-
11	1/1/2008 9:00	-	-	-	-	-	-	-	-	-
12	1/1/2008 10:00	-	-	-	-	-	-	-	-	-

Figure 11. An example of Masks file

In order to make this file, it is needed to copy and paste the hourly weather data (Figure 8) to new Excel file, and use "IF" command such as "=IF(B1=-99,1,0)" to figure out what particular time periods have the missing data. Figure 12 shows the hourly data which copied and pasted in new Excel, and Figure 13 shows the result of "Masks" file. Then, the file needs to be saved as "MASK_XXX_2XXX.xls" (i.e. "MASK_ABI_2008.xls" in this case) in "3_Mask" folder in M drive (M:\Weather files _ SB5\Weather files packing\2008\3_Mask).

	A	B	C	D	E	F	G	H	I	J
1		Tdb (F)	Twb (F)	Tdp (F)	Wind speed (knot)	Wind direction	GSR (Btu/day-sqft)	NDSR (Btu/day-sqft)	Hourly precipitation (in)	Station Pressure (in Hg)
2	01/01/2008 00:00	30.0	26.4	9.0	6.1	360.0	0.0	0.0	0.0	30.5
3	01/01/2008 01:00	30.0	26.4	9.0	7.0	10.0	0.0	0.0	0.0	30.5
4	01/01/2008 02:00	28.0	24.9	9.0	4.3	360.0	0.0	0.0	0.0	30.6
5	01/01/2008 03:00	28.0	25.0	10.0	4.3	330.0	0.0	0.0	0.0	30.6
6	01/01/2008 04:00	27.0	24.2	10.0	0.0	-99.0	0.0	0.0	0.0	30.6
7	01/01/2008 05:00	21.0	19.3	10.0	2.6	200.0	0.0	0.0	0.0	30.6
8	01/01/2008 06:00	21.0	19.3	10.0	5.2	260.0	0.0	0.0	0.0	30.7
9	01/01/2008 07:00	21.0	19.4	10.0	5.2	270.0	0.0	0.0	0.0	30.7
10	01/01/2008 08:00	19.0	17.7	10.0	0.0	-99.0	33.9	92.9	0.0	30.7
11	01/01/2008 09:00	27.0	24.7	14.0	2.6	250.0	89.1	184.6	0.0	30.8
12	01/01/2008 10:00	34.0	30.1	14.0	4.3	340.0	132.3	208.8	0.0	30.8

Figure 12. Hourly data which copied and pasted in new Excel



	A	B	C	D	E	F	G	H	I	J
1		Tdb (F)	Twb (F)	Tdp (F)	Wind speed (knot)	Wind direction	GSR (Btu/day-sqft)	NDSR (Btu/day-sqft)	Hourly precipitation (in)	Station Pressure (in Hg)
2		=IF(DATA!B2=-99,1,0)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	01/01	IF(logical_test, [value_if_true], [value_if_false])			0.0	0.0	0.0	0.0	0.0	0.0
4	01/01/2008 02:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	01/01/2008 03:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	01/01/2008 04:00	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
7	01/01/2008 05:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	01/01/2008 06:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	01/01/2008 07:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	01/01/2008 08:00	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
11	01/01/2008 09:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	01/01/2008 10:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	01/01/2008 11:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	01/01/2008 12:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	01/01/2008 13:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	01/01/2008 14:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	01/01/2008 15:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	01/01/2008 16:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 13. An example of masks file with IF command in Excel

2.4. FILLING IN THE MISSING DATA

As described as earlier, there are many missing weather data from the NCDC and TCEQ. Prior to pack the weather data for DOE-2.1e simulation, filling in the missing data should be done.

The weather elements which need to be filled in are:

- Station pressure
- Temperature: dry-bulb temperature, wet-bulb temperature, and dew-point temperature
- Solar radiation: global solar radiation, and normal direct solar radiation

There is method to fill in the missing data of each element. For more information, there are two papers in M drive (M:\Weather files _ SB5\Weather files packing\Manual\DOE2): 1) Baltazar, J-C., Haberl, J., Culp, C., Yazdani, B., Gilman, D., Procedures For the Integration of Complete Year Texas Weather Data Files For eCalc-Emissions Reduction Calculator (Baltazar et al. 2007), and 2) Long, N., Real-Time Weather Data Access Guide (Long 2006).

Figure 14 shows general flow for filling in the missing weather data.

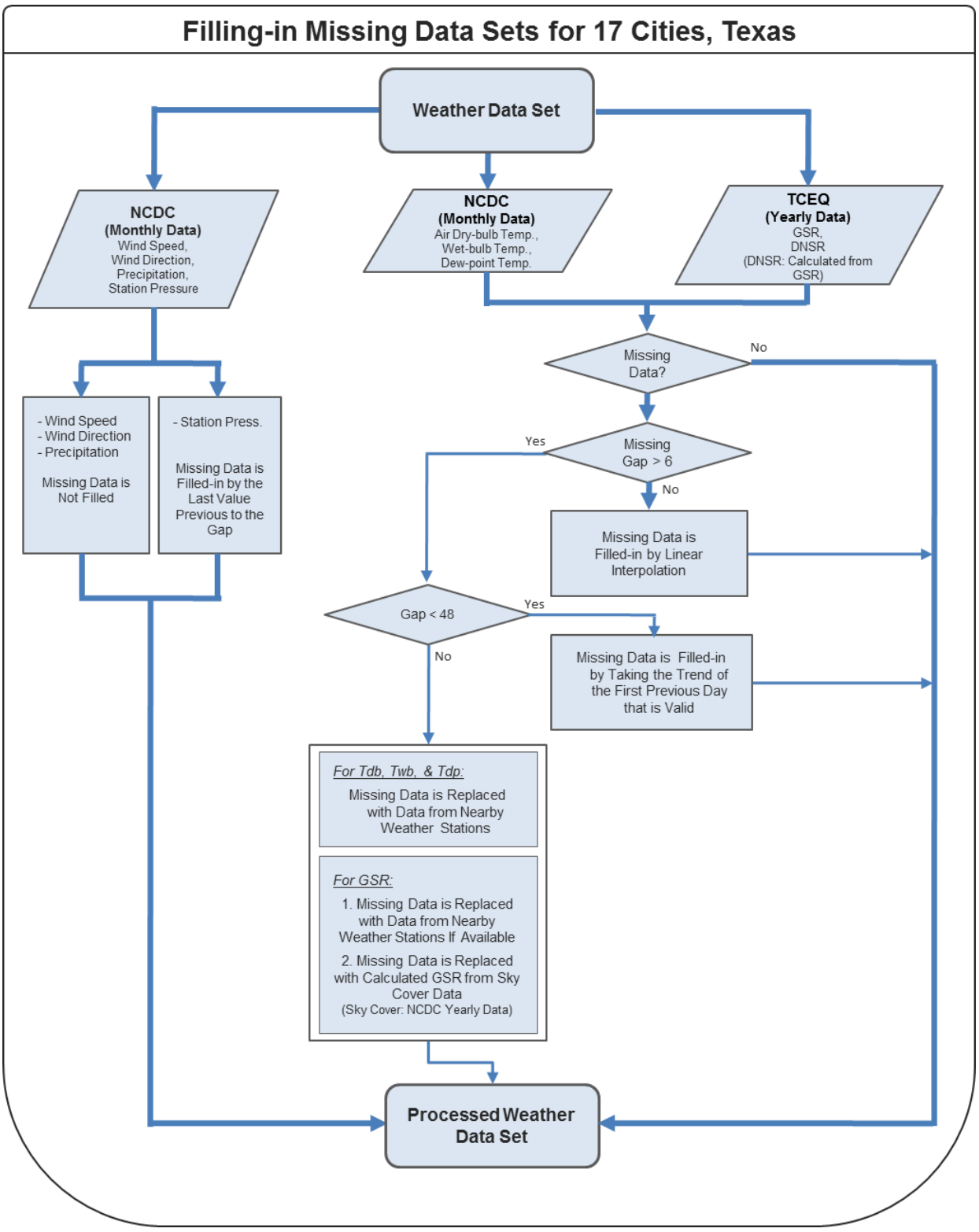

Filling-in Missing Data Sets for 17 Cities, Texas
Weather Data Set
NCDC
(Monthly Data)
Wind Speed,
Wind Direction,
Precipitation,
Station Pressure
NCDC
(Monthly Data)
Air Dry-bulb Temp.,
Wet-bulb Temp.,
Dew-point Temp.
TCEQ
(Yearly Data)
GSR,
DNSR
(DNSR: Calculated from GSR)
Missing Data?
No
Yes
Missing Gap > 6
No
- Wind Speed
- Wind Direction
- Precipitation
Missing Data is Not Filled
- Station Press.
Missing Data is Filled-in by the Last Value Previous to the Gap
Missing Data is Filled-in by Linear Interpolation
Gap < 48
Yes
No
Missing Data is Filled-in by Taking the Trend of the First Previous Day that is Valid
For Tdb, Twb, & Tdp:
Missing Data is Replaced with Data from Nearby Weather Stations
For GSR:
1. Missing Data is Replaced with Data from Nearby Weather Stations If Available
2. Missing Data is Replaced with Calculated GSR from Sky Cover Data
(Sky Cover: NCDC Yearly Data)
Processed Weather Data Set

Figure 14. General flowchart for filling in weather data

(1) Station pressure

The missing station pressures need to be filled with last value previous to the gap.

(2) Temperature: dry-bulb temperature, wet-bulb temperature, and dew-point temperature

(2-1) The length of gaps <= 6 hours: The missing data need to be filled by linear interpolation (Equation (1)).

$$f(t_n) = f(t_1) + \left(\frac{f(t_2) - f(t_1)}{t_2 - t_1}\right) \cdot n \qquad (1)$$

Where: $f(t_n)$ is the time step to fill
$f(t_1)$ and $f(t_2)$ are the values around the missing time step

(2-2) 6 hours < The length of gaps < 48 hours: The missing data need to be filled by taking the trend of the first previous day that is valid as seen in Equation (2).

$$f(t_n) = f(t_{n-d}) + (f(t_1) - f(t_{1-d}) + \left(\frac{(f(t_2) - f(t_{2-d})) - (f(t_1) - f(t_{1-d}))}{t_2 - t_1 + 1}\right) \cdot n \qquad (2)$$

Where: $f(t_n)$ is the time step to fill
$f(t_1)$ and $f(t_2)$ are the values around the missing time step
d is the offset back to the previous valid day

(2-3) The length of gaps >= 48 hours: The missing data need to be filled by data from nearby weather stations (see Figure 15 for the alternative weather stations).

(3) Solar radiation: Global solar radiation, and normal direct solar radiation

(3-1, 2) Same as "(2) temperature" method

(3-3) The length of gaps >= 48 hours: The missing data need to be filled by data from nearby solar radiation station (see Figure 16 for the alternative solar radiation stations for 2008).

(3-4) No solar radiation data: Some counties such as Abilene, Amarillo, Austin, Lubbock, Midland, and San Angelo do not have solar radiation data for 2008. In this case, "Sky cover" data is used to calculate solar radiation. The "Sky cover" data can be downloaded from the NCDC website. To calculate the solar radiation from the "Sky cover", Excel file in M drive (M:\Weather files _ SB5\Weather files packing\Programs\SR_Calculation_from_SkyCover.xlsx) is used. Latitude, longitude, year, and "Sky cover" need to be put in this file so that solar radiation can be calculated automatically by itself. Figure 17 is an example of the Excel file.

(4) Other weather data: Wind speed, wind direction, precipitation

The missing data are not be filled in, just leave the missing data as "-99".

Figure 18 and 19 show an example of Excel file in M drive (M:\Weather files _ SB5\Weather files packing\Programs\Hourly_Missing_Filled_Calc.xlsx) for calculating the missing data.

Weather Stations Names		Alternative Stations for Gap Filling (1st Option)		Alternative Stations for Gap Filling (2nd Option)	
ABI	Abilene Regional Airport	SJT	San Angelo Mathis Field		
AMA	Amarillo International Airport	LBB	Lubbock International Airport		
BRO	Brownsville S. Padre Island International	PIL	Port Isabel Cameron County Airport	HRL	Harlingen Rio Grande Valley
LBB	Lubbock International Airport		No Missing Hours of >=6		
MAF	Midland International Airport	ODO	Odessa Schlemeyer Field		
SJT	San Angelo Mathis Field	ABI	Abilene Regional Airport		
ACT	Waco Regional Airport	CLL	College Station Easterwood Airport		
SPS	Wichita Falls Municipal Airport	DTO	Denton Municipal Airport	ABI	Abilene Regional Airport
ATT	Austin Camp Mabry	AUS	Austin-Bergstrom International Airport		
BPT	Port Arthur Se Tx Rgnl Airport	GLS	Scholes International At Galveston Airport		
CRP	Corpus Christi International Airport	ALI	Alice International Airport		
DFW	Dallas - Fort Worth International Airport				
ELP	El Paso International Airport	GDP	Guadalupe Pass Auto Met Observing System		
GGG	Longview E Tx Rgnl Airport	AWOS	Nacogdoches		
IAH	Houston Bush Intercontinental				
SAT	San Antonio International Airport	TYR	Tyler Pounds Regional Airport		
VCT	Victoria Regional Airport	RKP	Aransas County Airport		

Figure 15. Alternative weather stations

City		Code	Location	Recommended County	Recommended Stations (First Option)
Abilene		ABI	Abilene Regional Airport		
Amarillo		AMA	Amarillo International Airport		
Austin		AUS	Austin Camp Mabry	Travis	
Brownsville		BRO	Brownsville S. Padre Island International	Cameron	C 80 (78 hrs gaps)
Corpus Christi		CRP	Corpus Christi International Airport	Nueces	C 4 (103 hrs gap)
Fort Worth		DFW	Dallas - Fort Worth International Airport	Denton	C 56 (101 hrs gaps)
El Paso		ELP	El Paso International Airport	El Paso	C 12 (5 hrs gap)
Houston		IAH	Houston Bush Intercontinental	Harris	C403 (522 hrs gaps)
Lubbock		LBB	Lubbock International Airport		
Lufkin		LFK	Longview E Tx Rgnl Airport	Smith	C 82 (39 hrs gaps)
Midland		MAF	Midland International Airport		
Port Arthur		BPT	Port Arthur Se Tx Rgnl Airport	Jefferson	C2 (317 hrs gaps)
San Angelo		SJT	San Angelo Mathis Field		
San Antonio		SAT	San Antonio International Airport	Bexar	C 58 (Zero gaps)
Victoria		VCT	Victoria Regional Airport	Victoria	C 87 (189 hrs gaps)
Waco		ACT	Waco Regional Airport	Johnson	C77 (1 hr gaps)
Wichita Falls		SPS	Wichita Falls Municipal Airport	Denton	C 56 (101 hrs gaps)

Second Option/s
C42 (1652 hrs gaps) & C43 (76 hrs gaps)
C44 (2 hrs gap)
C71 (ZERO gaps)
C37 (225 hrs gaps) & C41 (49 hrs gap)
C15 (86 hrs gaps), C35 (282 hrs gaps), C45 (308 hrs gaps), C53 (458 hrs gaps) , C1015 (2384 hrs gaps), C78 (110 hrs gaps)
C85 (138 hrs gaps)
C28 (250 hrs gaps), C64 (398 hrs gaps), C643 (262 hrs gaps), C9 (295 hrs gaps)
C73 (1 hr gaps)

Figure 16. Alternative solar radiation stations for 2008

						Latitude		Longituded								y =	1037.6 x	-42.41	R2 = 0.9297
						35.1		101.4											
	Yr	Month	Day	HrMn	SKY Cv	DOY	B	E	δ	std time	Solar time	Hour angle	sin α	I_{GC}	1 - 0.75(Cv/8)$^{3.4}$	I_G(W/m2)	I_G(BTU/hr-ft2)		
01/01/08 00:53	2008	1	1	53	7	1	0.0000	-2.9044	-0.4016	0	-0.81			0	0	-	0	5.60	
01/01/08 01:53	2008	1	1	153	7	1	0.0000	-2.9044	-0.4016	1	0.19	-3.22	-0.98	0	0	-	0	5.60	
01/01/08 02:53	2008	1	1	253	7	1	0.0000	-2.9044	-0.4016	2	1.19	-2.96	-0.97	0	0	-	0	5.60	
01/01/08 03:53	2008	1	1	353	8	1	0.0000	-2.9044	-0.4016	3	2.19	-2.70	-0.91	0	0	-	0	6.40	
01/01/08 04:53	2008	1	1	453	7	1	0.0000	-2.9044	-0.4016	4	3.19	-2.44	-0.80	0	0	-	0	5.60	
01/01/08 05:53	2008	1	1	553	7	1	0.0000	-2.9044	-0.4016	5	4.19	-2.18	-0.65	0	0	-	0	5.60	
01/01/08 06:53	2008	1	1	653	7	1	0.0000	-2.9044	-0.4016	6	5.19	-1.91	-0.48	0	0	-	0	5.60	
01/01/08 07:53	2008	1	1	753	8	1	0.0000	-2.9044	-0.4016	7	6.19	-1.65	-0.29	0	0	-	0	6.40	
01/01/08 08:53	2008	1	1	853	7	1	0.0000	-2.9044	-0.4016	8	7.19	-1.39	-0.09	0	0	-	0	5.60	
01/01/08 09:53	2008	1	1	953	2	1	0.0000	-2.9044	-0.4016	9	8.19	-1.13	0.10	59	0.993269346	58	18	1.60	
01/01/08 10:53	2008	1	1	1053	0	1	0.0000	-2.9044	-0.4016	10	9.19	-0.87	0.26	230	1	230	73	-	
01/01/08 11:53	2008	1	1	1153	0	1	0.0000	-2.9044	-0.4016	11	10.19	-0.60	0.39	367	1	367	116	-	
01/01/08 12:53	2008	1	1	1253	0	1	0.0000	-2.9044	-0.4016	12	11.19	-0.34	0.48	460	1	460	146	-	
01/01/08 13:53	2008	1	1	1353	2	1	0.0000	-2.9044	-0.4016	13	12.19	-0.08	0.53	503	0.993269346	499	158	1.60	
01/01/08 14:53	2008	1	1	1453	0	1	0.0000	-2.9044	-0.4016	14	13.19	0.18	0.52	493	1	493	156	-	
01/01/08 15:53	2008	1	1	1553	0	1	0.0000	-2.9044	-0.4016	15	14.19	0.44	0.46	430	1	430	136	-	
01/01/08 16:53	2008	1	1	1653	0	1	0.0000	-2.9044	-0.4016	16	15.19	0.70	0.35	319	1	319	101	-	
01/01/08 17:53	2008	1	1	1753	0	1	0.0000	-2.9044	-0.4016	17	16.19	0.97	0.20	168	1	168	53	-	
01/01/08 18:53	2008	1	1	1853	0	1	0.0000	-2.9044	-0.4016	18	17.19	1.23	0.03	0	0	-	0	-	
01/01/08 19:53	2008	1	1	1953	0	1	0.0000	-2.9044	-0.4016	19	18.19	1.49	-0.16	0	0	-	0	-	
01/01/08 20:53	2008	1	1	2053	0	1	0.0000	-2.9044	-0.4016	20	19.19	1.75	-0.36	0	0	-	0	-	
01/01/08 21:53	2008	1	1	2153	0	1	0.0000	-2.9044	-0.4016	21	20.19	2.01	-0.55	0	0	-	0	-	
01/01/08 22:53	2008	1	1	2253	0	1	0.0000	-2.9044	-0.4016	22	21.19	2.27	-0.71	0	0	-	0	-	
01/01/08 23:53	2008	1	1	2353	0	1	0.0000	-2.9044	-0.4016	23	22.19	2.54	-0.84	0	0	-	0	-	
01/02/08 00:53	2008	1	2	53	0	2	0.0172	-3.3517	-0.4002	0	-0.82	-0.34	0.48	0	0	-	0	-	
01/02/08 01:53	2008	1	2	153	0	2	0.0172	-3.3517	-0.4002	1	0.18	-3.22	-0.97	0	0	-	0	-	
01/02/08 02:53	2008	1	2	253	0	2	0.0172	-3.3517	-0.4002	2	1.18	-2.96	-0.97	0	0	-	0	-	
01/02/08 03:53	2008	1	2	353	0	2	0.0172	-3.3517	-0.4002	3	2.18	-2.70	-0.91	0	0	-	0	-	
01/02/08 04:53	2008	1	2	453	0	2	0.0172	-3.3517	-0.4002	4	3.18	-2.44	-0.80	0	0	-	0	-	
01/02/08 05:53	2008	1	2	553	0	2	0.0172	-3.3517	-0.4002	5	4.18	-2.18	-0.65	0	0	-	0	-	

Figure 17. An example of the Excel for calculating solar radiation from sky cover data

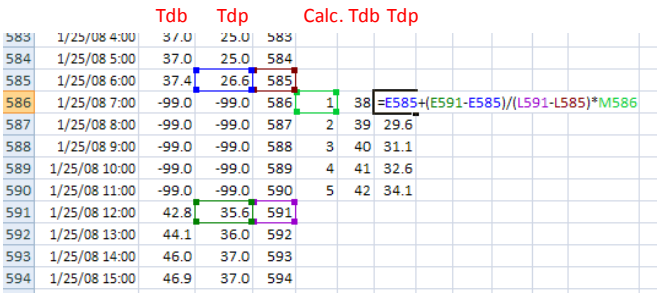


Figure 18. An example file for calculating missing data (gaps<=6 hrs, Equation (1))

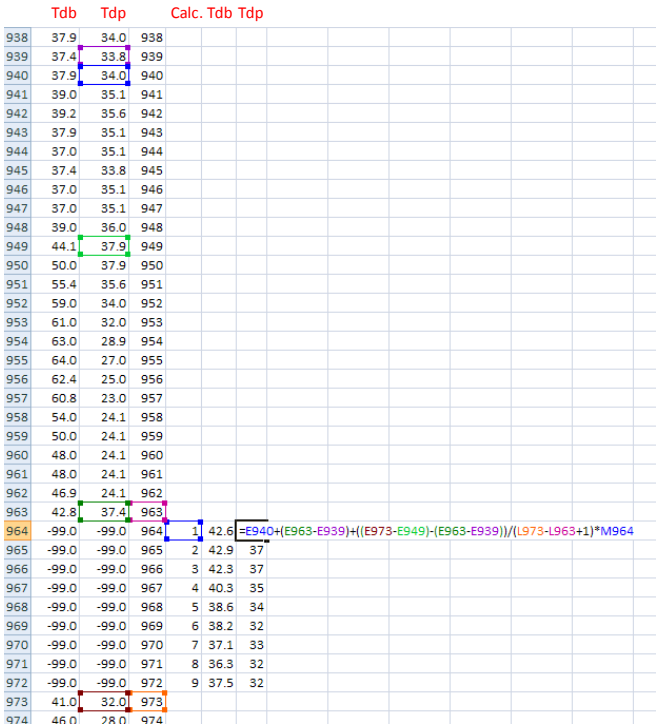


Figure 19. An example file for calculating missing data (6<gaps<48 hrs, Equation (2))

2.5. HOURLY AND DAILY DATA FILE

2.5.1. Hourly CSV file

After filling in the missing weather data for 17 Texas stations, the next step is to make hourly weather files in CSV format (Comma Separated Values). In order to do this, just copy the data from the file which

is already filled in the missing data, then, paste them to another Excel file (M:\Weather files _ SB5\Weather files packing\2008\4-1_Hourly_CSV). Figure 20 shows an example of hourly CSV file for "Abilene 2008".

In hourly CSV file, the weather data of each element should have 8760 data (24 hrs x 365 days). Note that, for leap year, the data for 29th of February need to be deleted. In addition, it is required to check whether temperature values are adequate or not, it means, dry-bulb temperature should have the biggest values, wet-bulb temperature, and dew-point temperature should follow (i.e. Tdb > Twb > Tdp).

The hourly CSV file should be named as "Hourly_XXX_XXXX_2XXX.xls" (i.e. "Hourly_ABI_1362_2008" in this case) in "4-1 Hourly CSV" folder in M drive (M:\Weather files _ SB5\Weather files packing\2008).

	A	B	C	D	E	F	G	H	I	J	K
1	Date Time	Dry-Bulb T	Wet-Bulb	Dew-Poin	Wind Spe	Wind Dire	Global Sol	Direct Nor	Precipitat	Station Pressure (in Hg)	
2	1/1/2008 0:00	30	26.4	9	6.1	360	0	0	0	30.5	
3	1/1/2008 1:00	30	26.4	9	7	10	0	0	0	30.5	
4	1/1/2008 2:00	28	24.9	9	4.3	360	0	0	0	30.6	
5	1/1/2008 3:00	28	25	10	4.3	330	0	0	0	30.6	
6	1/1/2008 4:00	27	24.2	10	0	-99	0	0	0	30.6	
7	1/1/2008 5:00	21	19.3	10	2.6	200	0	0	0	30.6	
8	1/1/2008 6:00	21	19.3	10	5.2	260	0	0	0	30.7	
9	1/1/2008 7:00	21	19.4	10	5.2	270	0	0	0	30.7	
10	1/1/2008 8:00	19	17.7	10	0	-99	33.9	92.9	0	30.7	
11	1/1/2008 9:00	27	24.7	14	2.6	250	89.1	184.6	0	30.8	
12	1/1/2008 10:00	34	30.1	14	4.3	340	132.3	208.8	0	30.8	

Figure 20. An example of hourly CSV file

2.5.2. HourlyTS Excel file

In this step, hourly time series file, including 9 weather element plots needs to be made. Using hourly data file (i.e. Hourly CSV file), copy the hourly data to "data" tab in another Excel file in M drive (M:\Weather files _ SB5\Weather files packing\2008\4-2_HourlyTS_Excel). In this file, there are two tabs: "data" tab, and "time series" tab. When you put the hourly data on "data" tab, time series plots will be generated on "time series" tab. The completed hourly time series file needs to be stored in "4-2_HourlyTS_Excel" folder in M drive (M:\Weather files _ SB5\Weather files packing\2008).

(1) "Data" tab

Figure 21 shows an example of "data" tab which copied and pasted the data from Hourly CSV file.

	A	B	C	D	E	F	G	H	I	J	K
1		Tdb (F)	Twb (F)	Tdp (F)	nd speed (kn	Vind directio	R (Btu/day-sq	R (Btu/day-sy	precipitatio	Pressure (in Hg)	
2	01/01/2008 00:00	30.0	26.4	9.0	6.1	360.0	0.0	0.0	0.0	30.5	
3	01/01/2008 01:00	30.0	26.4	9.0	7.0	10.0	0.0	0.0	0.0	30.5	
4	01/01/2008 02:00	28.0	24.9	9.0	4.3	360.0	0.0	0.0	0.0	30.6	
5	01/01/2008 03:00	28.0	25.0	10.0	4.3	330.0	0.0	0.0	0.0	30.6	
6	01/01/2008 04:00	27.0	24.2	10.0	0.0	-99.0	0.0	0.0	0.0	30.6	
7	01/01/2008 05:00	21.0	19.3	10.0	2.6	200.0	0.0	0.0	0.0	30.6	
8	01/01/2008 06:00	21.0	19.3	10.0	5.2	260.0	0.0	0.0	0.0	30.7	
9	01/01/2008 07:00	21.0	19.4	10.0	5.2	270.0	0.0	0.0	0.0	30.7	
10	01/01/2008 08:00	19.0	17.7	10.0	0.0	-99.0	33.9	92.9	0.0	30.7	
11	01/01/2008 09:00	27.0	24.7	14.0	2.6	250.0	89.1	184.6	0.0	30.8	
12	01/01/2008 10:00	34.0	30.1	14.0	4.3	340.0	132.3	208.8	0.0	30.8	

Figure 21. An example of "data" tab of hourly time series file

(2) "Time Series XXX" tab (i.e. "Time Series ABI" tab in this case)

This tab shows hourly plots of 9 weather elements, and Figure 22 shows an example of the plots.

In this step, there are two things need to be verified:

- Texas station name on tab, and
- Texas station name and year on plot:

To change the Texas station name and year on plot, go to "View" menu → "Page Layout", and change the header name as "Abilene (ABI) Abilene Regional Airport Yr: 2008" in case of this example (Figure 221).

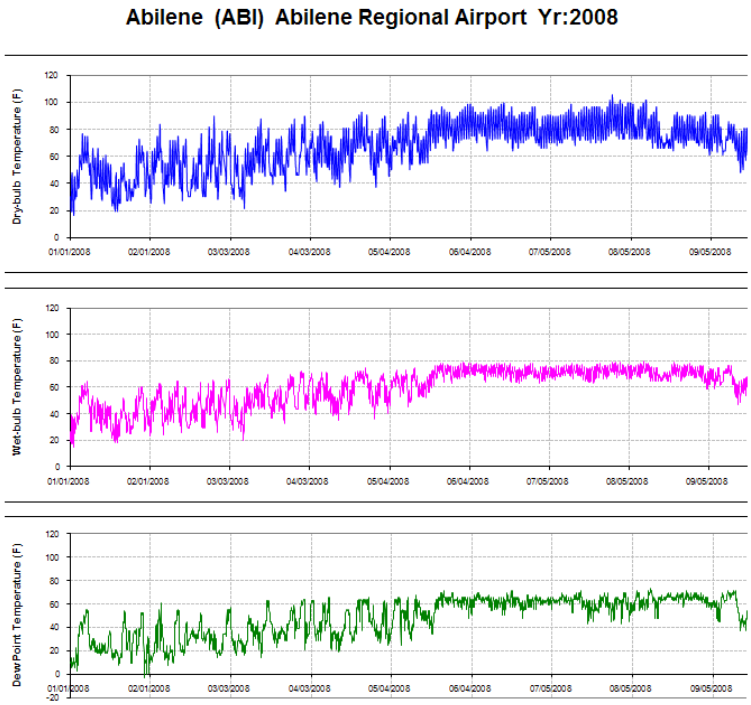


Figure 22. An example of "time series" tab

2.5.3. Daily CSV file

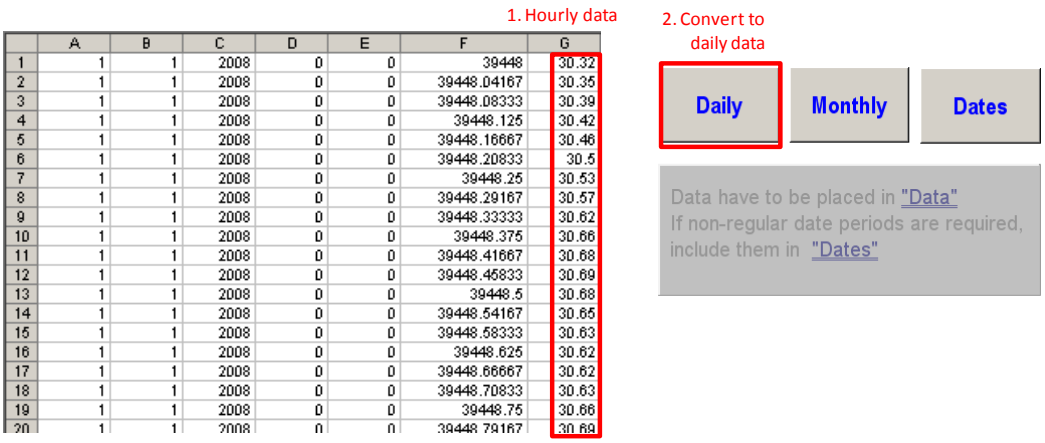
Next step is converting the hourly data to daily data using "Par" program in M drive (M:\Weather files _ SB5\Weather files packing\Programs\par.xls).

Daily CSV file should have 365 data for each Texas station weather file. Note that, for leap year, the data for 29th of February need to be deleted. In addition, it is required to check whether temperature values are adequate or not, it means, dry-bulb temperature should have the biggest values, wet-bulb temperature, and dew-point temperature should follow (i.e. Tdb > Twb > Tdp).

The daily CSV file should be named as "Daily_XXX_XXXX_2XXX.xls" (i.e. "Daily_ABI_1362_2008" in this case) in "4-3 Daily CSV" folder in M drive (M:\Weather files _ SB5\Weather files packing\2008).

In order to convert the hourly data to daily data, the program "Par" is used. First, copy the each weather element, in this case, the dry-bulb temperature, and paste them to "data" tab in "par" file as Figure 23.

After that, click the "daily" button on "main" tab of this file, then the calculation will start, and the hourly data are converted to daily data. Then, you can copy the converted daily data to another file in M drive (M:\Weather files _ SB5\Weather files packing\2008\4-3_Daily_CSV). Figure 24 shows an example of daily CSV file for Abilene 2008.



	A	B	C	D	E	F	G
1	1	1	2008	0	0	39448	30.32
2	1	1	2008	0	0	39448.04167	30.35
3	1	1	2008	0	0	39448.08333	30.39
4	1	1	2008	0	0	39448.125	30.42
5	1	1	2008	0	0	39448.16667	30.46
6	1	1	2008	0	0	39448.20833	30.5
7	1	1	2008	0	0	39448.25	30.53
8	1	1	2008	0	0	39448.29167	30.57
9	1	1	2008	0	0	39448.33333	30.62
10	1	1	2008	0	0	39448.375	30.66
11	1	1	2008	0	0	39448.41667	30.68
12	1	1	2008	0	0	39448.45833	30.69
13	1	1	2008	0	0	39448.5	30.68
14	1	1	2008	0	0	39448.54167	30.65
15	1	1	2008	0	0	39448.58333	30.63
16	1	1	2008	0	0	39448.625	30.62
17	1	1	2008	0	0	39448.66667	30.62
18	1	1	2008	0	0	39448.70833	30.63
19	1	1	2008	0	0	39448.75	30.66
20	1	1	2008	0	0	39448.79167	30.69

Figure 23. An example of "Par" program (left: "Data" tab, right: "Main" tab)

	A	B	C	D	E	F	G	H	I	J	K	L
1	Date	Average D	Average V	Average D	Average V	Average V	Total Glob	Total Norr	Total Prec	Average Station Pressure (in Hg)		
2	1/1/2008 0:00	33.1	28.7	9.3	5	217.6	1065.8	1698.6	0	30.7		
3	1/2/2008 0:00	29.9	26.2	9.3	4.6	142.9	1069.5	1705.9	0	30.8		
4	1/3/2008 0:00	39.5	33.8	10.6	14.5	162.5	685.2	871	0	30.5		
5	1/4/2008 0:00	49.3	44.8	34.3	15.5	182.5	1075.6	1705.3	0	30.2		
6	1/5/2008 0:00	61.5	53.9	40.9	14.6	204.2	1079.7	1710.7	0	30		
7	1/6/2008 0:00	62.6	56.3	46.6	12.9	182.5	1083.5	1709.9	0	29.9		
8	1/7/2008 0:00	62.9	58.8	53.5	11.1	177.5	946.6	1294	0	29.8		
9	1/8/2008 0:00	49.7	44.1	29.8	8.8	257	1094	1717.5	0	30.1		
10	1/9/2008 0:00	47.6	41.2	25.8	10.9	180.4	1099.9	1720.4	0	30		
11	1/10/2008 0:00	49	42.3	24.2	9.9	277	1105.5	1724.7	0	30		
12	1/11/2008 0:00	49.1	41.6	21.4	9.8	200	1111.4	1727.5	0	29.9		

Figure 24. An example of daily CSV file

2.5.4. DailyTS Excel file

In this step, daily time series file, including 9 weather element plots also needs to be made. Using daily data file (i.e. daily CSV file), copy the daily data to "data" tab in another Excel file in M drive (M:\Weather files _ SB5\Weather files packing\2008\4-4_DailyTS_Excel). In this file, there are also two

tabs: “data” tab, and “time series” tab. When you put the daily data on “data” tab, time series plots will be generated on “time series” tab. The completed daily time series file needs to be stored in “4-4_DailyTS_Excel” folder in M drive (M:\Weather files _ SB5\Weather files packing\2008).

(1) “Data” tab

Figure 25 shows an example of “data” tab which copied and pasted the data from daily CSV file.

	A	B	C	D	E	F	G	H	I	J
1		Tdb (F)	Twb (F)	Tdp (F)	Wind speed	Wind directi	GSR (Btu/da	NDSR (Btu/d	Daily precipitation (in)	
2	01/01/2008 00:00	33.1	28.7	9.3	5.0	217.6	1065.8	1698.6	0.0	30.7
3	01/02/2008 00:00	29.9	26.2	9.3	4.6	142.9	1069.5	1705.9	0.0	30.8
4	01/03/2008 00:00	39.5	33.8	10.6	14.5	162.5	685.2	871.0	0.0	30.5
5	01/04/2008 00:00	49.3	44.8	34.3	15.5	182.5	1075.6	1705.3	0.0	30.2
6	01/05/2008 00:00	61.5	53.9	40.9	14.6	204.2	1079.7	1710.7	0.0	30.0
7	01/06/2008 00:00	62.6	56.3	46.6	12.9	182.5	1083.5	1709.9	0.0	29.9
8	01/07/2008 00:00	62.9	58.8	53.5	11.1	177.5	946.6	1294.0	0.0	29.8
9	01/08/2008 00:00	49.7	44.1	29.8	8.8	257.0	1094.0	1717.5	0.0	30.1
10	01/09/2008 00:00	47.6	41.2	25.8	10.9	180.4	1099.9	1720.4	0.0	30.0
11	01/10/2008 00:00	49.0	42.3	24.2	9.9	277.0	1105.5	1724.7	0.0	30.0
12	01/11/2008 00:00	49.1	41.6	21.4	9.8	200.0	1111.4	1727.5	0.0	29.9

Figure 25. An example of “data” tab of daily time series file

(2) “Time Series XXX” tab (i.e. “Time Series ABI” tab in this case)

This tab shows daily plots of 9 weather elements, and Figure 26 shows an example of the plots.

In this step, there are also two things need to be verified.

- Texas station name on tab, and
- Texas station name and year on plot:

To change the Texas station name and year on plot, go to “View” menu → “Page Layout”, and change the header name as “Abilene (ABI) Abilene Regional Airport Yr: 2008” in case of this example (Figure 26).

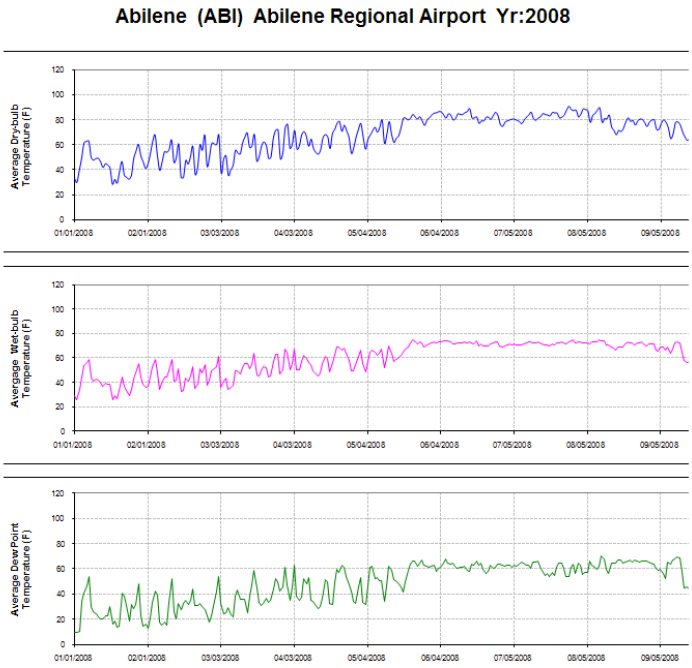


Figure 26. An example of time series tab

2.6. PDF PLOTS

2.6.1. Hourly PDF

Next step is to make PDF file for each of hourly plot which made at previous step. In this step, particular program which can produce PDF file needs to be used such as "Adobe Acrobat Professional". On the "time series" tab of "HourlyTS_Excel" file, the plots need to be converted to PDF file using the conversion program, and the generated PDF file need to be saved as "HourlyTS_XXX_XXXXX_2XXX.pdf" (i.e. "HourlyTS_ABI_13962_2008" in this case) in M drive (M:\Weather files _ SB5\Weather files packing\2008\5-1_Hourly_PDF). Figure 27 shows an example of hourly PDF file.

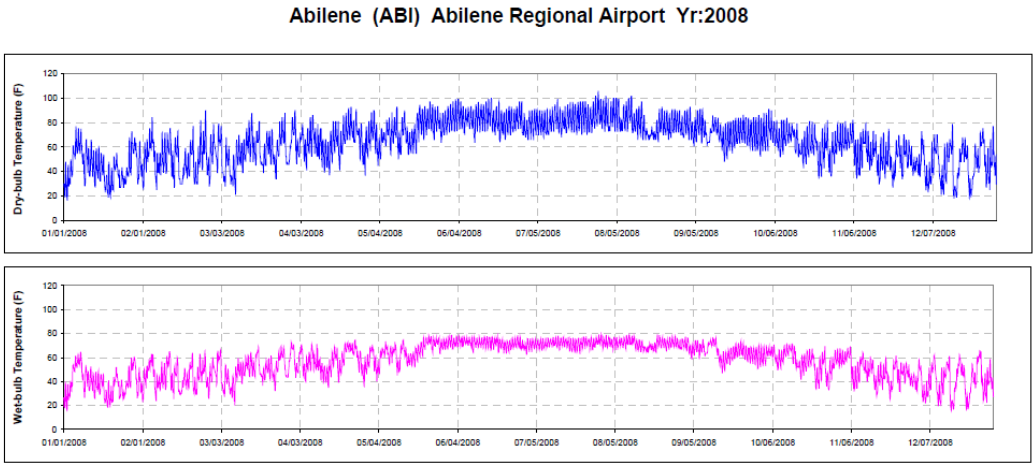


Figure 27. An example of hourly PDF file

2.6.2. Daily PDF

As hourly PDF file, the plots in "DailyTS_Excel" file need to be converted to PDF file, and the generated PDF file needs to be saved as "DailyTS_XXX_XXXXX_2XXX.pdf" (i.e. "DailyTS_ABI_13962_2008" in this case) in M drive (M:\Weather files _ SB5\Weather files packing\2008\5-2_Daily_PDF). Figure 28 shows an example of daily PDF file.

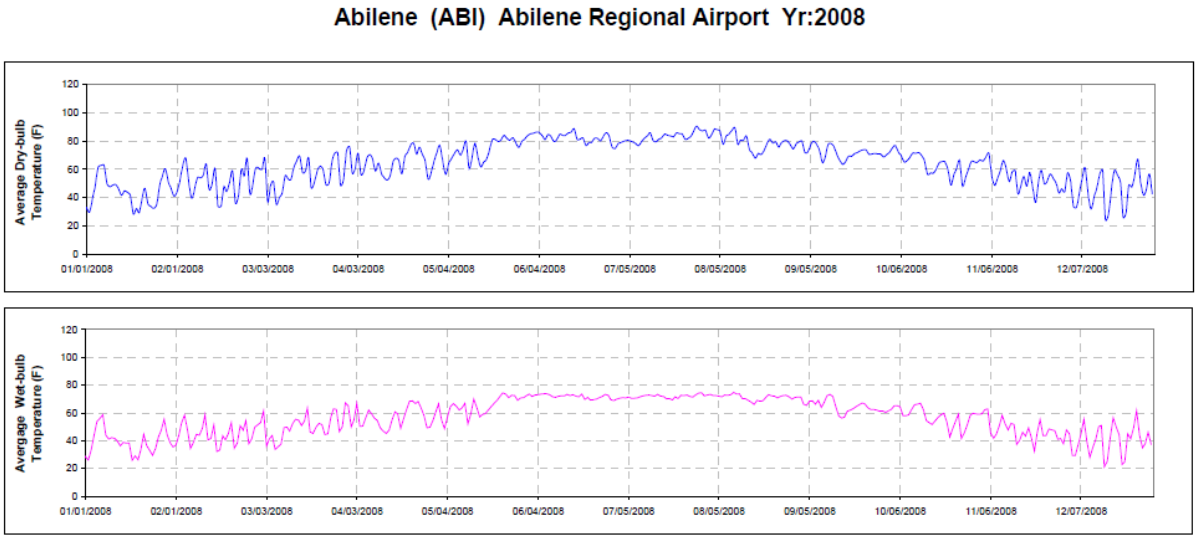


Figure 28. An example of daily PDF file

2.7. PRETRY FILE

This is the last step for preparing DOE-2.1e weather input file. The file needs to be filled with 9 elements of weather data and other information. Figure 29 shows an example of the PreTRY file for "Abilene 2008". As seen in Figure 29, when the data for "column A" through "column K" are filled, required formatted data for DOE-2.1e weather input file are generated in "column X". The data for "column A" through "column K" can be obtained from hourly data file previously made, and the template file for PreTRY is stored in M drive (M:\Weather files _ SB5\Weather files packing\2008\6_PrepTRY). The completed PreTRY file should be named as "PrepTRY_XXX_2XXX" (i.e. "PrepTRY_ABI_2008" in this case).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	Labeled Time		Dry Bulb	Wet Bulb	Dew Point	Wind speed	Wind DIR	Solar (Global)	Solar (Normal Direct)	Station Pressure	STATION	Dry Bulb	Wet Bulb	Dew Point	Wind DIR	Wind speed	Stat Pressure	Solar (Global)	Solar (Normal Direct)	Year	Mo	D y	Hr	
2			(F)	(F)	(F)	(knots)	(Deg)	(Btu/sqft-hr)	(Btu/sqft-hr)	(inches Hg)	Number	(F)	(F)	(F)	(Deg)	(knots)	(inches Hg)	(Btu/sqft-hr)	(Btu/sqft-hr)					1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890
3	1/1/08	0:00	30	26	9	6	360	0	0	30.5	13962	30	26.4	9	360	6.08	30.5	0	0	2008	1	1	0	13962030026009360063053099999999999999999999999999999000000 2008010100
4	1/1/08	1:00	30	26	9	7	10	0	0	30.5	13962	30	26.4	9	10	6.95	30.5	0	0	2008	1	1	1	13962030026009010007305409999999999999999999999999999000000 2008010101
5	1/1/08	2:00	28	25	9	4	360	0	0	30.6	13962	28	24.9	9	360	4.34	30.6	0	0	2008	1	1	2	13962028025009360043057099999999999999999999999999999000000 2008010102
6	1/1/08	3:00	28	25	10	4	330	0	0	30.6	13962	28	25	10	330	4.34	30.6	0	0	2008	1	1	3	13962028025010330004305809999999999999999999999999999000000 2008010103
7	1/1/08	4:00	27	24	10	0	-99	0	0	30.6	13962	27	24.2	10	999	0	30.6	0	0	2008	1	1	4	13962027024010999000306209999999999999999999999999999000000 2008010104
8	1/1/08	5:00	21	19	10	3	200	0	0	30.6	13962	21	19.3	10	200	2.61	30.6	0	0	2008	1	1	5	13962021019010200003306409999999999999999999999999999000000 2008010105
9	1/1/08	6:00	21	19	10	5	260	0	0	30.7	13962	21	19.3	10	260	5.21	30.7	0	0	2008	1	1	6	13962021019010260005306609999999999999999999999999999000000 2008010106
10	1/1/08	7:00	21	19	10	5	270	0	0	30.7	13962	21	19.4	10	270	5.21	30.7	0	0	2008	1	1	7	13962021019010270005307109999999999999999999999999999000000 2008010107
11	1/1/08	8:00	19	18	10	0	-99	34	93	30.7	13962	19	17.7	10	999	0	30.7	33.9	92.9	2008	1	1	8	13962019018010399000307309999999999999999999999999999000340093 2008010108
12	1/1/08	9:00	27	25	14	3	250	89	185	30.8	13962	27	24.7	14	250	2.61	30.8	89.1	184.6	2008	1	1	9	13962027025014250003307609999999999999999999999999999000890185 2008010109
13	1/1/08	10:00	34	30	14	4	340	132	209	30.8	13962	34	30.1	14	340	4.34	30.8	132.3	208.8	2008	1	1	10	13962034030014340004307809999999999999999999999999999001320209 2008010110
14	1/1/08	11:00	39	34	14	4	340	161	218	30.8	13962	39	33.8	14	340	4.34	30.8	160.8	218	2008	1	1	11	13962039034014340004308109999999999999999999999999999001610218 2008010111
15	1/1/08	12:00	45	38	10	5	350	173	221	30.8	13962	45	37.7	10	350	5.21	30.8	172.9	221.1	2008	1	1	12	13962045038010350005307909999999999999999999999999999001730221 2008010112
16	1/1/08	13:00	46	38	5	8	350	168	221	30.8	13962	46	38	5	350	7.82	30.8	167.8	220.6	2008	1	1	13	13962046038005350006307509999999999999999999999999999001680221 2008010113
17	1/1/08	14:00	46	38	7	11	10	145	213	30.7	13962	46	38.1	7	10	11.3	30.7	145.3	213.4	2008	1	1	14	13962046038007010011307309999999999999999999999999999001450213 2008010114
18	1/1/08	15:00	48	40	7	10	360	107	195	30.7	13962	48	39.6	7	360	9.56	30.7	107.2	195.3	2008	1	1	15	13962048040007360010307309999999999999999999999999999001070195 2008010115
19	1/1/08	16:00	46	38	5	10	350	57	144	30.7	13962	46	38	5	350	9.56	30.7	56.5	143.9	2008	1	1	16	13962046038005350010307309999999999999999999999999999000570144 2008010116
20	1/1/08	17:00	45	37	7	8	10	0	0	30.7	13962	45	37.4	7	10	7.82	30.7	0	0	2008	1	1	17	13962045037007010008307309999999999999999999999999999000000000 2008010117
21	1/1/08	18:00	39	33	9	7	20	0	0	30.7	13962	39	33.2	9	20	6.95	30.7	0	0	2008	1	1	18	13962039033009020007307409999999999999999999999999999000000000 2008010118
22	1/1/08	19:00	36	31	9	5	30	0	0	30.8	13962	36	31	9	30	5.21	30.8	0	0	2008	1	1	19	13962036031009030005307609999999999999999999999999999000000000 2008010119
23	1/1/08	20:00	34	29	9	4	50	0	0	30.8	13962	34	29.5	9	50	4.34	30.8	0	0	2008	1	1	20	13962034029009050004307709999999999999999999999999999000000000 2008010120
24	1/1/08	21:00	30	26	9	4	100	0	0	30.8	13962	30	26.4	9	100	4.34	30.8	0	0	2008	1	1	21	13962030026009100004307809999999999999999999999999999000000000 2008010121
25	1/1/08	22:00	27	24	9	3	220	0	0	30.8	13962	27	24.1	9	220	2.61	30.8	0	0	2008	1	1	22	13962027024009220003308009999999999999999999999999999000000000 2008010122
26	1/1/08	23:00	28	25	9	0	-99	0	0	30.8	13962	28	24.9	9	999	0	30.8	0	0	2008	1	1	23	13962028025009990003081099999999999999999999999999999000000000 2008010123
27	1/2/08	0:00	23	21	10	3	280	0	0	30.8	13962	23	21	10	280	2.61	30.8	0	0	2008	1	2	0	13962023021010280003308109999999999999999999999999999000000000 2008010200
28	1/2/08	1:00	21	19	10	4	230	0	0	30.8	13962	21	19.4	10	230	4.34	30.8	0	0	2008	1	2	1	13962021019010230004308109999999999999999999999999999000000000 2008010201

Figure 29. An example of PreTRY file

2.8. TRY_TPE FILE

"TRY_TPE" file is one of files to be used when you pack DOE-2.1e weather file by DOE-2.1e simulation.

From the PreTRY file, copy the data in "column X" and paste them to TPE format file which is stored in M drive (M:\Weather files _ SB5\Weather files packing\2008\7_TRY_TPE). The file name should be "TRY_XXX_2XXX.TPE" (i.e. "TRY_ABI_2008.TPE" in this case). Figure 30 shows an example of TRY_TPE file.

```
139620300260093600063053099999999999999999999999999999900000000      2008010100
139620300260090100073054099999999999999999999999999999900000000      2008010101
139620280250093600043057099999999999999999999999999999900000000      2008010102
139620280250103300043059099999999999999999999999999999900000000      2008010103
139620270240109990003062099999999999999999999999999999900000000      2008010104
139620210190102000033064099999999999999999999999999999900000000      2008010105
139620210190102600053066099999999999999999999999999999900000000      2008010106
139620210190102700053071099999999999999999999999999999900000000      2008010107
139620190180109990003073099999999999999999999999999999900340093      2008010108
139620270250142500033076099999999999999999999999999900890185         2008010109
139620340300143400043078099999999999999999999999999901320209         2008010110
139620390340143400043081099999999999999999999999999901610218         2008010111
139620450380103500053079099999999999999999999999999901730221         2008010112
139620460380053500083075099999999999999999999999999901680221         2008010113
139620460380070100113073099999999999999999999999999901450213         2008010114
```

Figure 30. An example of TRY_TPE file

2.9. TRY_INP FILE

"TRY_INP" file is one of files to be used along with "TRY_TPE" file when you pack DOE-2.1e weather file by DOE-2.1e simulation.

This file includes general information about weather station. Figure 31 can explain more detail about the contents of the file. This file is also stored in M drive (M:\Weather files _ SB5\Weather files packing\2008\8_TRY_INP). The file name should be "TRY_XXX_2XXX.INP" (i.e. "TRY_ABI_2008.INP" in this case). Figure 32 shows an example of TRY_INP file.

PACK

line 1: The word PACK in columns 1-4.

line 2: The station name in columns 1-20. This name will be written on the output file as identification. The entry here is for the user only and is arbitrary.

line 3: The data is entered as shown below. When the format is shown as L, it signifies that the datum must be left justified in the columns indicated. The format R signifies that the datum must be right justified in the columns indicated, and the format D means that the value should be entered with a decimal point (neither right or left justification is required). For those with FORTRAN background: L corresponds to A6, R to I6, and D to F6.1.

Example of how the data is entered (line 3)

Columns	Format	Description
1-6	L	A code-word specifying the unpacked file type. Options are TMY2, WYEC2, CD144, CD144S[a],TRY, TRYSLM[a], TD9685, and OTHER[b].
7-12	R	Weather station number. This is required.
		Note: for TMY2 files, the following inputs on line 3 may be left blank
13-18	R	The year of the weather data (e.g., 1999). This is required for CD144 and TD9685 files (which can contain several years of weather data). For other files, –999 should be input.
19-24	R	Time zone (as in the SITE-PARAMETERS command)
25-30	D	Latitude (degrees). Positive north of the equator, negative south of the equator.
31-36	D	Longitude (degrees). Positive west of Greenwich, negative east of Greenwich.
37-42	L	A code-word specifying the number of bits per word to be used in packing the output file. The options are 60-BIT or 30-BIT (for 32-bit machines)
43-48	L	A code-word specifying the type of output file. The options are NORMAL and SOLAR. NORMAL produces a DOE-2 weather file with no solar data. SOLAR produces a file containing solar information.
49-54	R	Interpolation interval. The program fills in missing data by linear interpolation between the last and the next value present, if the number of hours of missing data is less than or equal to the interpolation interval. If more hours of data are missing than the interpolation interval, it still does interpolation up to 24 hours and a warning message is issued. If more than 24 hours are missing, the previous value is used. The interpolation interval must be less than 24[c].
55-60	D	This sets the maximum dry-bulb temperature change allowed in one hour. Changes larger than this will cause a warning message to be printed.
61-66	D	Soil thermal diffusivity (ft^2/hr). Used for calculating monthly ground temperatures. A value of 0.010 can be used for dry soil, 0.025 for average soil, and 0.050 for wet soil.
67-72	D	Station altitude (feet), used in CD144 and TD9685.
73-78	R	Location needed only for CD144S and TRYSLM to choose a cloud cover model. See ILOC. Used only for CD144 and TRY formats. Select the location that best represents the data being packaged.

[a] CD144S tells the weather processor to read a file in CD144 format and add ersatz solar data using the ASHRAE clear sky model, SOLMET cloud cover regressions formula, and the Erbs-Klein-Duffie direct/diffuse model. TRYSLM does the same for data in TRY formats.

[b] If OTHER is chosen, the data should either be in the DOE-2 measured weather data format (see Processing Nonstandard Weather Data) or a special OTHER processing subroutine must be written and installed in the weather processor. To accomplish the latter, the you must have the source code and a FORTRAN compiler.

[c] The weather processor makes no evaluation of the data to see that it is internally consistent, except that during interpolation it never allows the wet-bulb temperature to exceed the dry-bulb temperature, or the dew point temperature to exceed the wet-bulb temperature.

ILOC and Station Name			
01 ALBUQUERQUE, NM	08 CHARLESTON, SC	15 GREAT FALLS, MT	21 NEW YORK, NY
02 APALACHICOLA, FL	09 COLUMBIA, MO	16LAKE CHARLES, LA	22 NORTH OMAHA, NE
03 BISMARCK, ND	10 DODGE CITY, KS	17 MADISON, WI	23 PHOENIX, AZ
04 BOSTON, MA	11 EL PASO, TX	18 MEDFORD, OR	24 SANTA MARIA, CA
05 BROWNSVILLE, TX	12 ELY, NV	19 MIAMI, FL	25 SEATTLE-TACOMA,
06 CAPE HATTERAS, NC	13 FORT WORTH, TX	20 NASHVILLE, TN	26 WASHINGTON, DC
07 CARIBOU, ME	14 FRESNO, CA		

line 4: Contains the 12 clearness numbers (one per month) in D format in column intervals 1-6, 7-12, 13-18, etc. (skip for TMY2; unused for WYEC2, so can be just 1.0). See 1993 ASHRAE Fundamentals, p. 27.12.

line 5: Contains the 12 ground temperatures (one per month in F) in D format in column intervals 1-6, 7-12, 13-18, etc. (skip for TMY2). A value of –999 will flag the program to calculate the ground temperature using the method of Kusuda and Achenbach (ASHRAE Trans. 41 (1965) p. 61).

Figure 31. Explanation of contents for INP file (Buhl, 1999)

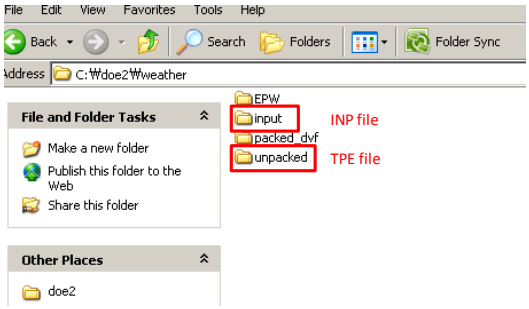
```
PACK
T_ABI 2008
TRY    13962  -999     6 32.4  99.7 30-BITSOLAR      4 20.  0.025       13
0.55  0.52  0.54  0.51  0.47  0.45  0.42  0.42  0.42  0.48  0.56  0.56
-999.
LIST
PACKED  -999  -999     1    12
END
```

Figure 32. An example of TRY_INP file (Buhl, 1999)

2.10. TRY_OUT & TRY_BIN FILE

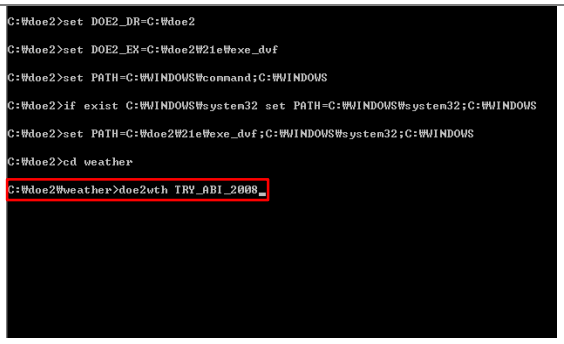
"TRY_out" files for 17 Texas stations are stored in M drive (M:\Weather files _ SB5\Weather files packing\2008\9_TRY_OUT). The file should be named as "TRY_XXX_2XXX.out" (i.e. "TRY_ABI_2008.out" in this case).

In order to obtain "TRY_out" file, DOE-2.1e simulation needs to be run. Figure 33 shows the process of packing weather file using DOE-2.1e simulation.



1. Put "TRY_INP" file in "input" folder (C:\doe2\weather), and "TRY_TPE" file in "unpacked" folder (C:\doe2\weather).

   INP, TPE files are certain Texas station file expected to be packed.



2. Open DOE-2e command window, and put command as "doe2wth TRY_XXX_2XXX", in this case, "doe2wth TRY_ABI_2008.

   Then, run the simulation.

Figure 33. Process of packing weather file using DOE-2.1e simulation

After run the simulation, “TRY_XXX_2XXX.out” file (i.e.“TRY_ABI_2008.out” in this case) and “TRY_XXX_2XXX.bin” file (i.e. “TRY_ABI_2008.bin” in this case) are generated in “input” folder and “packed_dvf” folder, respectively.

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National Climatic Data Center (U.S.). <http://www7.ncdc.noaa.gov/CDO/cdo>

Texas Commission on Environmental Quality (U.S.) <http://www.tceq.state.tx.us/cgi-bin/compliance/monops/site_photo.pl>