5.2 WEATHER

The quality of the erosion estimates from RWEQ is directly proportional to the quality of the input data. While all input data are important, it is extremely important that good weather data are used to estimate erosion.

5.2.1 What is a weather file?

A weather file contains parameters that describe the wind speed distributions, wind directions, air temperatures, solar radiation, snow cover and rainfall data for each month. The RWEQ program identifies time periods from the management file, then computes the wind factor, rainfall, etc. for that time interval. The wind factor is adjusted for soil wetness and snow cover to produce the weather factor.

5.2.2 Sources of weather files

The weather data for RWEQ are extracted from weather data files assembled by Skidmore and Tatarko. The basic weather file consists of an identification line and 18 lines of data. Weather files may be edited in the DOS editor. The original file for Lubbock, Texas (TX23042.DAT) with an explanation for each line is in Table 5.2.2.

5.2.2.1 **Line 1:** Includes starting mark # , a unique WBAN number associated with this WERIS (Wind Energy Resource Information System) site, the country, state, and city or name of site.

5.2.2.2 **Line 2:** Latitude, longitude, and elevation (in meters) of site or field. This line also includes beginning and ending record dates (year/mo/day) and a three-letter code. For example, ARW means 24 observations each day, rooftop anemometer location, and the Weather Service as the recording agency.

A Number of observations each day

A	24	E	4
B	19-23	F	<3
C	12-18	G	>24
D	5-11	U	Unknown

R Anemometer location

R	Rooftop	E	Estimated wind, no anemometer
G	Ground-mast	O	Other
B	Beacon- tower	U	Unknown

W Recording Agency

A	Air Force	W	Weather Service
D	USDA	F	FAA
E	Expt Station	O	Other
N	Navy	U	Unknown

5.2.2.3 **Line 3:** Weibull scale parameter, c (m/sec). Wind speeds were recorded at different heights but were adjusted to a standard height of 10 meters in the WERIS (Wind Energy Resource Information System) files. For complete instructions see Skidmore and Tatarko (1990)(APPENDIX-Q).

5.2.2.4 **Line 4:** Weibull shape parameter, k (dimensionless). For complete instructions see Skidmore and Tatarko (1990)(APPENDIX-Q).

5.2.2.5 **Line 5:** Air density (kg/m^3) (Weast, 1986).

$$\rho = 348.0 \frac{(1.013 - 0.1183\, EL + 0.0048\, EL^2)}{T} \qquad \textbf{[1]}$$

where

ρ = air density, kg/m^3
EL = site elevation, kilometers
T = absolute temperature, degrees Kelvin.

5.2.2.6 **Line 6:** Prevailing erosive wind direction (degrees). Wind direction where the parallel wind forces are maximum and perpendicular wind forces are minimum. For complete instructions see Skidmore (1965).

5.2.2.7 **Line 7:** Preponderance in the prevailing wind direction. This is a ratio of the parallel/ perpendicular wind forces. A value of 1 means no prevailing direction, a value of 4 means the wind forces parallel are four times greater than the wind forces perpendicular to this direction. For complete instructions see Skidmore (1965). For each time period wind force in 4 directions is used to compute soil erosion for each direction.

5.2.2.8 **Line 8:** Positive parallel ratio is the ratio of the magnitude of wind forces in the prevailing wind direction to the forces parallel but from the opposite direction. For complete instructions see Skidmore (1965).

5.2.2.9 **Line 9:** Percent of calm time (no wind). Whenever the wind speed at a height of 10 meters is less than 0.995 m/sec, it is assumed calm or no wind. For derivation description see Skidmore and Tatarko (1990)(APPENDIX-Q).

5.2.2.10 **Line 10:** Average maximum temperature (degrees C). The maximum daily temperatures for a month are averaged. Maximum and minimum temperatures are used to compute the potential evapotranspiration (ET_p) which is used to compute soil wetness.

5.2.2.11 **Line 11:** Average minimum temperature (degrees C). The minimum daily temperatures for a month are averaged.

5.2.2.12 **Line 12:** Dew point is the temperature at which air moisture condenses on a cool body (degrees C). Obtained from CLIGEN databases (Nicks and Lane, 1989). Dew point is not used in RWEQ97 but may be used in subsequent versions.

5.2.2.13 **Line 13:** Solar radiation (Mj/m^2) is normally measured or obtained from CLIGEN databases (Nicks and Lane, 1989). Solar radiation is used to compute ET_p to quantify the effect of soil wetness on wind erosion. Values are accumulated for each time period.

5.2.2.14 **Line 14:** Precipitation (mm) is a total for each month. The number of rain-days and average maximum and minimum temperatures are used to compute decomposition days to describe plant residue decay.

5.2.2.15 **Line 15:** *DPPT* is the average number of days during the time period having measurable precipitation. It is determined from rainfall data or computed from a program developed by Hanson, Cumming, Woolhiser, and Richardson (personal communication). *DPPT* is used in RWEQ97 to compute residue decomposition and soil wetness.

5.2.2.16 **Line 16:** The probability of snow depth more than 25.4 mm is determined from maps (Dickson and Posey, 1967). Snow cover (*SC*) = 1 - probability of snow depth>25.4 mm

5.2.2.17 **Line 17:** Rainfall erosive energy (*EI*) in (Mj-mm/ha-h) is computed from recording rain gauge data or monthly distribution computed from annual *EI* value using Brown and Foster (1987) procedures. *EI* for each time period is used to determine soil roughness decay.

5.2.2.18 **Line 18:** Data line is reserved for future use.

5.2.2.19 **Line 19:** Latitude, longitude and distance from weather station to the WERIS site. Also includes state and city, and station code (WB - weather bureau, AP - airport). This information is not used in this version of RWEQ.

Table 5.2.2. Typical weather data file with key. For index to weather files see APPENDICES D1-D5.

```
1    # 23042 USA TX LUBBOCK
2    33 39 N 101 50 W 990 19500628 19641231 ARW
3    6.26  7.15  7.62  7.52  7.28  7.01  5.88  5.14  5.57  5.77  6.15  6.32
4    2.62  2.66  2.60  2.73  2.84  3.04  2.90  3.15  2.96  2.84  2.68  2.53
5    1.14  1.13  1.11  1.09  1.07  1.05  1.05  1.05  1.07  1.09  1.12  1.14
6      23   225   292   225   202   180   180   180   202    23    23   225
7     1.3   1.3   1.1   1.5   1.4   1.8   2.2   1.7   2.5   2.0   1.5   1.4
8    0.55  0.59  0.93  0.66  0.75  0.83  0.79  0.86  0.56  0.54  0.53  0.59
9     3.3   3.3   3.3   3.3   3.3   3.3   3.3   3.3   3.3   3.3   3.3   3.3
10   11.7  14.4  18.9  23.9  27.8  32.8  33.3  32.8  28.9  23.9  17.2  12.8
11   -3.9  -1.6   1.7   7.2  12.2  17.2  18.9  18.3  14.4   8.3   1.7  -2.8
12   -3.9  -3.3  -2.8   2.8   9.4  13.9  16.1  15.6  12.8   7.2  -0.6  -4.4
13    369   436   614   715   815   858   843   760   672   520   414   354
14     13    15    22    32    70    65    54    54    62    58    15    15
15      2     3     3     3     5     5     5     6     5     3     3     2
16      0     0     0     0     0     0     0     0     0     0     0     0
17      0     0    11    11   154   253   154   154   154   154    44    11
18     .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0    .0
19    33  39   N 101  49   W    1.5  TX    LUBBOCK WB AP
```

line#	Item	Meaning			
1.	#	Starting mark			
	23042	Unique WBAN number associated with this WERIS (Wind Energy Resource Information System) site			
	USA	Country			
	TX	State			
	Lubbock	Name of the site			
2.	33 39 N	Latitude of the location (33° 39' N)			
	101 50 W	longitude of the location (101° 50' W)			
	990	Elevation (m)			
	19500628	Beginning record date (YEAR/MONTH/DAY)			
	19641231	Ending record date (YEAR/MONTH/DAY)			
	ARW	Three letter ID:			
		A -- # of observation/day			
		A	24	E	4
		B	19-23	F	<3
		C	12-18	G	>24
		D	5-11	U	unknown
		R -- Anemometer location			
		R	Roof-top	E	estimated wind, no anemometer
		G	Ground mast	O	other
		B	Beacon tower	U	unknown
		W -- Recording Agency			
		A	Air Force	W	weather service
		D	USDA	F	FAA
		E	Expt Station	O	other
		N	Navy	U	unknown
	90	Annual rainfall erosivity (EI) in English unit (hundreds of foot-tonf-inch/acre-hour). The value is from RUSLE database.			
	91	EI distribution curve number in RUSLE database.			
3.	6.26 ...	Weibull scale parameter, C (m/s)			
4.	2.62 ...	Weibull shape parameter, K			
5.	1.14 ...	Air density (kg/m^3)			
6.	23 ...	Prevailing wind erosion direction (degree)			
7.	1.3 ...	Preponderance in the prevailing wind erosion direction			
8.	.55 ...	Positive parallel ratio			
9.	3.3 ...	Percent of calm time (no wind)			
10.	11.7 ...	Average maximum temperature (°C)			
11.	3.9 ...	Average minimum temperature (°C)			
12.	-3.9 ...	Dew point			
13.	369 ...	Solar radiation (MJ/m^2)			
14.	13 ...	Precipitation (mm)			
15.	2 ...	DPPT (Avg # of days during period having measurable precipitation)			
16.	0 ...	Probability of snow depth over 25.4 (mm)			
17.	0 ...	EI value in metric unit (MJ-mm/ha-h). The monthly distribution is calculated based on the cumulative EI distribution (using EI curve number as an index) and the annual EI value.			
18.	.0...	Reserved for future use			
19.	33 39 N	Latitude of CLIGEN weather station (33° 39' N)			
	101 49 W	Longitude of CLIGEN weather station (101° 49' W)			
	1.5	Distance (km) from the WERIS site to the weather station			
	TX LUBBOCK	State and city where the weather station is located			
	WB AP	Station code name (WB-weather bureau, AP-airport)			

5.2.3 **Developing a new weather data file**

To assemble a weather file a reliable source of data is needed. This may sound redundant, but it cannot be overemphasized. In developing the wind data files for RWEQ, Dr. Skidmore and Dr. Tatarko took great pains to standardize the anemometer heights and identify the locations of the sensors. The WERIS (Wind Energy Resource Information System) data files are good sources, but the reporting periods may not represent long-term average conditions.

A new weather file can be developed from "scratch", but normally an existing weather file is edited to incorporate site specific or new data. An example of the need for editing a weather file is the use of edited weather files with validation sites management systems to estimate erosion with RWEQ.

Before erosion was computed, the weather data file closest to the validation site was modified to reflect the measured weather conditions at the site for the erosion measurement period. At the validation sites the wind speeds were recorded every minute. Air temperature, humidity, solar radiation, and rainfall were recorded every 10 minutes. Weather files were modified with monthly *c*, *k*, % calm, average maximum and minimum temperatures, solar radiation, precipitation, rain days and the storm erosivity (*EI*) for the time period that the erosion samplers were in the field. The prevailing wind direction, air density, preponderance, positive parallel ratios, snow cover, and dew point temperature in the weather data files were not changed.

The SAS System is used to summarize the weather data. For illustration purposes, wind speed data for May, 1990 from Big Spring, Texas is used to compute the Weibull wind speed coefficients. (See Table 5.2.3.1 for the May weather summary output by the SAS program.) All windspeed values (1440 X 31 = 44,640) from the 2-meter anemometer (*WS4*) are converted to 10-meter wind speeds (*WS10*) using the 1/7 power equation (Elliot, 1979.) The 10-meter wind speeds are used to compute the Weibull shape and scale factors and frequency of calm periods.

The wind speeds were ranked in ascending order (to the nearest 0.1m/sec). The data set begins with the 10-meter wind speed greater than but as close to 1 as possible. (See Table 5.2.3.2 for SAS output generated by PROC FREQ.) Wind speeds less than 1 m/s are considered calm. The cumulative percent (F_0) at this wind speed is 3.35 in Table 5.2.3.2. The percent of the total observations that occurred in each wind speed class was calculated. The cumulative frequency and cumulative percent were also calculated.

The cumulative percent for succeeding observations is $F(u)$ (Table 5.2.3.2). The last observation in the data set gives the total number of observations in the data set in the cumulative frequency column (44,640 in Table 5.2.3.2 example).

Following the instructions in "Stochastic wind simulation for erosion modeling" (Appendix Q, equations 4-7) the data set is reduced to an *x* and a *y* variable. The *a* and *b* coefficients from a linear regression are used to compute *c* and *k*.

Table 5.2.3.1

USDA-ARS, BIG SPRING, TEXAS

SUMMARY OF BIG SPRING, TEXAS DATA LOGGER
May, 1990

WEIBULL WIND COEFFICIENTS: c=6.62 k=3.05 % calm=3.35

MON	DAY	MAX TEMP C	MIN TEMP C	WIND MAX m/sec	WIND AVG m/sec	WIND FACTOR $(WS-5)^2(WS)$	SENSIT	AVG DIR deg	AVG RH %	TOTAL RAIN mm	EI *	SOLAR RAD cal/cm^2
5	.	42	6	11.2	4.5	401235	53777	169	42	7.4	3.36	18037
5	1	12	8	9.7	6.0	18979	1961	44	84	1.5	0.54	127
5	2	13	7	7.3	3.8	1707	2056	117	90	3.3	0.90	154
5	3	20	6	8.5	3.4	4294	1895	269	67	.	.	502
5	4	21	6	7.3	3.8	1389	1787	199	51	.	.	631
5	5	23	7	7.0	2.4	422	1715	79	44	.	.	615
5	6	26	7	8.4	2.0	102	1737	177	35	.	.	675
5	7	27	14	9.4	5.6	19761	1593	174	29	.	.	618
5	8	34	14	9.0	5.3	13279	1677	210	43	.	.	673
5	9	26	13	9.3	5.0	15150	1560	116	38	.	.	677
5	10	21	9	7.8	4.5	4276	1594	92	32	.	.	399
5	11	33	14	10.1	4.3	8637	1608	190	44	.	.	524
5	12	31	12	7.1	2.7	235	1677	240	35	.	.	702
5	13	36	16	9.9	4.8	21978	1699	147	21	.	.	654
5	14	38	21	10.4	5.2	28076	1799	187	38	.	.	646
5	15	37	23	11.2	6.3	37835	1735	193	44	.	.	577
5	16	33	19	9.7	4.4	16393	1733	227	31	.	.	711
5	17	27	14	9.1	5.8	13349	1462	87	48	.	.	429
5	18	31	20	10.7	6.9	71549	1562	179	51	.	.	574
5	19	36	21	9.8	5.2	22312	1707	233	35	.	.	694
5	20	34	18	10.6	5.1	33303	1774	256	11	.	.	701
5	21	30	13	8.2	3.9	5857	1633	93	36	.	.	681
5	22	32	15	6.1	3.2	71	1756	88	41	.	.	683
5	23	36	19	8.9	4.8	10002	1797	140	37	.	.	670
5	24	38	21	10.5	5.2	12202	1791	208	45	.	.	586
5	25	42	23	9.9	4.5	8138	1964	233	28	.	.	624
5	26	38	22	7.0	3.6	439	1976	262	28	.	.	644
5	27	33	17	7.9	4.1	5235	1899	148	27	.	.	693
5	28	28	18	7.8	4.8	3506	1622	76	62	.	.	589
5	29	33	20	10.5	4.7	11897	1422	153	60	2.5	1.92	304
5	30	35	13	7.4	2.9	354	1790	246	32	.	.	715
5	31	36	20	10.8	4.5	10509	1796	167	44	.	.	565

MONTHLY AVERAGES

Max. temp	Min. temp	Max. wind speed
30.3	15.2	8.9

Monthly averages are based on available data.

* The units of EI are megajoule-millimeter/hectare-hour.
. The first line in the table is a summary of the entire table.

Table 5.2.3.2

OUTPUT FROM PROC FREQUENCY for TX 05/1990

WS4	WS10	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0.9	1.1	182	0.41	1494	3.35
1.0	1.2	221	0.50	1715	3.84
1.1	1.3	278	0.62	1993	4.46
1.2	1.4	290	0.65	2283	5.11
1.3	1.6	344	0.77	2627	5.88
1.4	1.7	373	0.84	3000	6.72
1.5	1.8	411	0.92	3411	7.64
1.6	1.9	566	1.27	3977	8.91
1.7	2.1	535	1.20	4512	10.11
1.8	2.2	575	1.29	5087	11.40
1.9	2.3	563	1.26	5650	12.66
2.0	2.5	589	1.32	6239	13.98
2.1	2.6	574	1.29	6813	15.26
2.2	2.7	556	1.25	7369	16.51
2.3	2.8	519	1.16	7888	17.67
2.4	3.0	518	1.16	8406	18.83
2.5	3.1	510	1.14	8916	19.97
2.6	3.2	523	1.17	9439	21.14
2.7	3.3	580	1.30	10019	22.44
2.8	3.5	526	1.18	10545	23.62
2.9	3.6	514	1.15	11059	24.77
3.0	3.7	541	1.21	11600	25.99
3.1	3.8	572	1.28	12172	27.27
3.2	4.0	586	1.31	12758	28.58
3.3	4.1	668	1.50	13426	30.08
3.4	4.2	658	1.47	14084	31.55
3.5	4.3	647	1.45	14731	33.00
3.6	4.5	629	1.41	15360	34.41
3.7	4.6	725	1.62	16085	36.03
3.8	4.7	691	1.55	16776	37.58
3.9	4.8	697	1.56	17473	39.14
4.0	5.0	708	1.59	18181	40.73
4.1	5.1	763	1.71	18944	42.44
4.2	5.2	683	1.53	19627	43.97
4.3	5.3	808	1.81	20435	45.78
4.4	5.5	756	1.69	21191	47.47
4.5	5.6	877	1.96	22068	49.44
4.6	5.7	859	1.92	22927	51.36
4.7	5.8	805	1.80	23732	53.16
4.8	6.0	839	1.88	24571	55.04
4.9	6.1	839	1.88	25410	56.92
5.0	6.2	812	1.82	26222	58.74
5.1	6.4	885	1.98	27107	60.72
5.2	6.5	830	1.86	27937	62.58
5.3	6.6	844	1.89	28781	64.47
5.4	6.7	877	1.96	29658	66.44
5.5	6.9	842	1.89	30500	68.32
5.6	7.0	824	1.85	31324	70.17
5.7	7.1	846	1.90	32170	72.07
5.8	7.2	782	1.75	32952	73.82
5.9	7.4	797	1.79	33749	75.60
6.0	7.5	779	1.75	34528	77.35
6.1	7.6	779	1.75	35307	79.09
6.2	7.7	731	1.64	36038	80.73
6.3	7.9	728	1.63	36766	82.36
6.4	8.0	641	1.44	37407	83.80
6.5	8.1	626	1.40	38033	85.20
6.6	8.2	585	1.31	38618	86.51
6.7	8.4	563	1.26	39181	87.77
6.8	8.5	486	1.09	39667	88.86

OUTPUT FROM PROC FREQUENCY for TX 05/1990

WS4	WS10	Frequency	Percent	Cumulative Frequency	Cumulative Percent
6.9	8.6	460	1.03	40127	89.89
7.0	8.7	433	0.97	40560	90.86
7.1	8.9	393	0.88	40953	91.74
7.2	9.0	347	0.78	41300	92.52
7.3	9.1	346	0.78	41646	93.29
7.4	9.2	298	0.67	41944	93.96
7.5	9.4	304	0.68	42248	94.64
7.6	9.5	254	0.57	42502	95.21
7.7	9.6	240	0.54	42742	95.75
7.8	9.7	236	0.53	42978	96.28
7.9	9.9	203	0.45	43181	96.73
8.0	10.0	175	0.39	43356	97.12
8.1	10.1	158	0.35	43514	97.48
8.2	10.3	136	0.30	43650	97.78
8.3	10.4	132	0.30	43782	98.08
8.4	10.5	104	0.23	43886	98.31
8.5	10.6	98	0.22	43984	98.53
8.6	10.8	96	0.22	44080	98.75
8.7	10.9	84	0.19	44164	98.93
8.8	11.0	68	0.15	44232	99.09
8.9	11.1	57	0.13	44289	99.21
9.0	11.3	63	0.14	44352	99.35
9.1	11.4	44	0.10	44396	99.45
9.2	11.5	36	0.08	44432	99.53
9.3	11.6	42	0.09	44474	99.63
9.4	11.8	22	0.05	44496	99.68
9.5	11.9	30	0.07	44526	99.74
9.6	12.0	18	0.04	44544	99.78
9.7	12.2	18	0.04	44562	99.83
9.8	12.3	21	0.05	44583	99.87
9.9	12.4	12	0.03	44595	99.90
10.0	12.6	3	0.01	44598	99.91
10.1	12.6	10	0.02	44608	99.93
10.2	12.8	6	0.01	44614	99.94
10.3	13.0	3	0.01	44617	99.95
10.4	13.0	8	0.02	44625	99.97
10.5	13.2	3	0.01	44628	99.97
10.6	13.3	3	0.01	44631	99.98
10.7	13.4	1	0.00	44632	99.98
10.8	13.5	3	0.01	44635	99.99
10.9	13.7	3	0.01	44638	100.00
11.2	14.1	2	0.00	44640	100.00

$$F_1(u) = \left[\frac{F(u) - F_0}{1 - F_0} \right] = 1 - e^{-\left(\frac{u}{c}\right)^k} \qquad \textbf{[2]}$$

where

F(u)	=	cumulative distribution
$F_1(u)$	=	cumulative distribution with calm periods eliminated
F_0	=	frequency of calm periods (assumed < 1 meter/sec @ 10 meter height)
k	=	Weibull shape parameter, dimensionless
c	=	Weibull scale parameter, m/sec
u	=	wind speed at 10 meters.

Taking the logarithm twice, this equation becomes

$$ln\left[-ln\left(1 - F_1(u) \right) \right] = -k \; ln\, c \; + k \; ln\, u \qquad \textbf{[3]}$$

This equation may be expressed in linear fashion as

$$y = a + bx \qquad \textbf{[4]}$$

when

y	=	ln [- ln (1 - F_1 (*u*)]
a	=	- *k* ln*c*
b	=	*k*
x	=	ln*u*.

With this equation, the *c* and *k* coefficients can be determined using a standard least square method.

All of the changes made for May in the Big Spring, Texas weather file (Table 5.2.3.3) are bolded in Table 5.2.3.4. The same technique was used for January, February, March, and April in 1990 to complete the modified file, BSTX90.W1 (Table 5.2.3.5).

When all of the new *c*, *k*, % calm, average maximum and minimum temperatures, solar radiation, rain days and storm erosivity values were assembled, modifications to weather files were made in the DOS editor. For example, at the C:\RWEQ97> prompt, type **EDIT W\TX23005.DAT** (Big Spring, Texas WERIS file). Overwrite with updated data, but be sure to leave a space between monthly data on the same line. In the Big Spring, Texas example overwrite the May value for *c* (7.05) with the newly calculated value (6.62) (Figure 5.2.3.4).

After all changes have been made, select SAVE AS from the FILE menu. (Selecting SAVE would overwrite the original file.) Type the name of the new weather file (*e.g.* **W\BSTX90.W1**) (Figure 5.2.3.5) and press <enter>. Select EXIT from the FILE menu to exit the editor.

Table 5.2.3.3. Unmodified WERIS file for Big Spring, Texas (TX23005.DAT).

23005 USA TX BIG_SPRING
32 14 N 101 30 W 784 19590507 19701231 AGA 95 91

5.91	6.50	7.30	7.25	7.05	6.80	5.97	5.52	5.68	5.93	5.83	5.70
2.13	2.15	2.35	2.47	2.65	2.68	2.82	2.61	2.47	2.26	2.15	2.12
1.17	1.15	1.13	1.10	1.09	1.08	1.07	1.08	1.09	1.11	1.14	1.16
247	45	247	225	180	180	180	180	180	180	180	225
1.3	1.5	1.2	1.0	2.1	5.1	3.7	1.6	3.5	3.6	2.1	1.5
0.70	0.56	0.71	0.79	0.86	0.93	0.96	0.85	0.75	0.80	0.64	0.60
8.0	6.6	3.3	3.6	3.2	3.8	4.0	4.7	6.1	7.2	7.8	9.5
13.6	16.3	20.8	25.9	29.8	33.7	34.7	34.2	30.6	25.7	19.0	15.3
-1.3	1.1	4.8	10.3	15.2	19.5	21.6	20.9	17.3	11.4	4.5	0.4
-3.1	-1.3	-1.0	4.0	10.5	14.9	16.0	15.2	13.7	8.5	1.9	-1.6
378	442	612	699	810	844	845	766	668	527	411	357
17	15	17	35	76	49	47	45	67	42	16	14
3.5	3.2	2.7	3.8	6.2	4.6	4.8	5.0	5.5	4.5	2.9	2.7
0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5
0	0	16	16	226	371	226	226	226	226	64	16
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

32 13 N 101 30 W 1.9 TX BIG SPRING WB AP

Table 5.2.3.4. WERIS file for Big Spring, Texas with changes for May bolded.

23005 USA TX BIG_SPRING
32 14 N 101 30 W 784 19590507 19701231 AGA 95 91

5.91	6.50	7.30	7.25	**6.62**	6.80	5.97	5.52	5.68	5.93	5.83	5.70
2.13	2.15	2.35	2.47	**3.05**	2.68	2.82	2.61	2.47	2.26	2.15	2.12
1.17	1.15	1.13	1.10	1.09	1.08	1.07	1.08	1.09	1.11	1.14	1.16
247	45	247	225	180	180	180	180	180	180	180	225
1.3	1.5	1.2	1.0	2.1	5.1	3.7	1.6	3.5	3.6	2.1	1.5
0.70	0.56	0.71	0.79	0.86	0.93	0.96	0.85	0.75	0.80	0.64	0.60
8.0	6.6	3.3	3.6	**3.4**	3.8	4.0	4.7	6.1	7.2	7.8	9.5
13.6	16.3	20.8	25.9	**30.3**	33.7	34.7	34.2	30.6	25.7	19.0	15.3
-1.3	1.1	4.8	10.3	**15.2**	19.5	21.6	20.9	17.3	11.4	4.5	0.4
-3.1	-1.3	-1.0	4.0	10.5	14.9	16.0	15.2	13.7	8.5	1.9	-1.6
378	442	612	699	**582**	844	845	766	668	527	411	357
17	15	17	35	**7**	49	47	45	67	42	16	14
3.5	3.2	2.7	3.8	**3**	4.6	4.8	5.0	5.5	4.5	2.9	2.7
0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5
0	0	16	16	**3**	371	226	226	226	226	64	16
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

32 13 N 101 30 W 1.9 TX BIG SPRING WB AP

Table 5.2.3.5. Big Spring, Texas WERIS file modified for January to May 1990 with measured data (BSTX90.W1).

23005 USA TX BIG_SPRING modified for Big Spring, TX JAN-MAY 1990
32 14 N 101 30 W 784 19590507 19701231 AGA 95 91

5.68	6.07	6.21	5.90	6.62	6.80	5.97	5.52	5.68	5.93	5.83	5.70
2.11	2.30	2.05	2.00	3.05	2.68	2.82	2.61	2.47	2.26	2.15	2.12
1.17	1.15	1.13	1.10	1.09	1.08	1.07	1.08	1.09	1.11	1.14	1.16
247	45	247	225	180	180	180	180	180	180	180	225
1.3	1.5	1.2	1.0	2.1	5.1	3.7	1.6	3.5	3.6	2.1	1.5
0.70	0.56	0.71	0.79	0.86	0.93	0.96	0.85	0.75	0.80	0.64	0.60
5	5.2	5.6	3.4	3.4	3.8	4.0	4.7	6.1	7.2	7.8	9.5
17.1	18.9	19.6	24.8	30.3	33.7	34.7	34.2	30.6	25.7	19.0	15.3
0.5	2.6	6.8	10.8	15.2	19.5	21.6	20.9	17.3	11.4	4.5	0.4
-3.1	-1.3	-1.0	4.0	10.5	14.9	16.0	15.2	13.7	8.5	1.9	-1.6
294	349	319	474	582	844	845	766	668	527	411	357
27	44	34	65	7	49	47	45	67	42	16	14
3	7	10	7	3	4.6	4.8	5.0	5.5	4.5	2.9	2.7
0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5
72	153	86	177	3	371	226	226	226	226	64	16
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

32 13 N 101 30 W 1.9 TX BIG SPRING WB AP

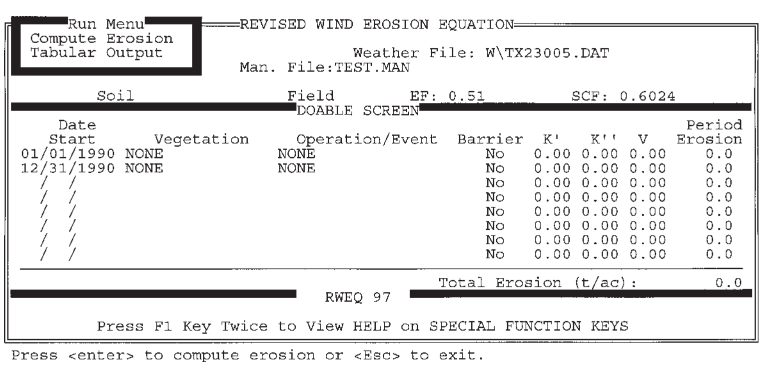
A new weather file may be added to the choice list that is accessed in the RWEQ program. At the C:\RWEQ97> prompt, type **EDIT RWEQ.CLS**. Find "*climate"in the listing. (See Section 2.2.4.) At the end of this line press <enter>. Type the name of the new weather file (*e.g.* **BSTX90.W1**). Select SAVE from the FILE menu to save the new version of RWEQ.CLS. Select EXIT from the FILE menu to exit the editor.

5.2.4 **Examples of influence of weather on erosion estimates with RWEQ**

To illustrate the influence of weather, erosion is calculated using the same management file (TEST.MAN) with 9 different weather files. This management file was created in Section 5.1. It has no crop, no tillage and no barriers; the 10 acre, circular field has a sandy loam soil.

A.	At the **`Client`** prompt	type the filename **TEST** and press <enter> to bring in the TEST.MAN file prompt and the Big Spring, Texas weather file (W\TX23005.DAT).
B.	At the **`Weather File`** prompt	press <enter> to advance.
C.	At the **`Man. File`** prompt	press <enter> to advance.
D.	In the **`Soil Properties`** window	press <enter> 7 times to accept all values in the window and advance to the **`Field Geometry`** prompt.
E.	In the **`Field Geometry`** window	press <enter> 6 times to accept all values in the window.
F.	At the **`Field`** prompt	press <enter> to advance to the **`EF`** prompt.
G.	At the **`EF`** prompt	press <enter> to accept the calculated EF and advance to the **`DOABLE SCREEN`**.
H.	In the **`DOABLE SCREEN`**	press F10 to compute erosion (Figure 5.2.4.1). Select Compute Erosion in the Run Menu window and press <enter>. When computations are complete, press Esc.

Figure 5.2.4.1



In the **DOABLE SCREEN** notice the 367.2 t/ac total erosion for the period (Figure 5.2.4.2).

Figure 5.2.4.2

```
                    REVISED WIND EROSION EQUATION
 Client: TEST                        Weather File: W\TX23005.DAT
                       Man. File:TEST.MAN

       Soil                Field        EF: 0.51          SCF: 0.6024
                             DOABLE SCREEN
    Date                                                            Period
   Start      Vegetation      Operation/Event  Barrier  K'   K''   V    Erosion
 01/01/1990 NONE             NONE                No   1.00 1.00 1.00     0.0
 12/31/1990 NONE             NONE                No   1.00 1.00 1.00   367.2
    /  /                                         No   0.00 0.00 0.00     0.0
    /  /                                         No   0.00 0.00 0.00     0.0
    /  /                                         No   0.00 0.00 0.00     0.0
    /  /                                         No   0.00 0.00 0.00     0.0
    /  /                                         No   0.00 0.00 0.00     0.0
    /  /                                         No   0.00 0.00 0.00     0.0
                                           Total Erosion (t/ac):       367.2
                                 RWEQ 97

       Press F1 Key Twice to View HELP on SPECIAL FUNCTION KEYS
Press F9 for Barrier Information window or <enter> to continue.
```

In the **DOABLE SCREEN** press F10 again. This time select *Tabular Output* in the **Run Menu** window and press <enter>.

The tabular output shows the weather factor (*WF*) for the 24 erosion periods (Figure 5.2.4.3). The weather factor includes the wind factor, air density, acceleration due to gravity, soil wetness, and snow cover.

Figure 5.2.4.3

```
    Run Menu        REVISED WIND EROSION EQUATION
                      Erosion Computation Summary
       Start              E     CSL    Qmax      S         WF       K'    K''    V     S
 Pd    Date      Days   t/ac   t/ac  lbs/ft     ft
  1 01/01/1990    15   12.89    5.4   145.2     378       35.3 1.000 1.000 1.000 1
  2 01/16/1990    15   12.89    5.4   145.2     378       35.3 1.000 1.000 1.000 1
  3 01/31/1990    15   23.72    9.8   227.0     326       62.2 1.000 1.000 1.000 1
  4 02/15/1990    15   23.72    9.8   227.0     326       62.2 1.000 1.000 1.000 1
  5 03/02/1990    15   38.23   22.1   415.4     263       96.4 1.000 1.000 1.000 1
  6 03/17/1990    15   38.23   22.1   415.4     263       96.4 1.000 1.000 1.000 1
  7 04/01/1990    15   31.21   17.3   346.0     281       79.0 1.000 1.000 1.000 1
  8 04/16/1990    15   31.21   17.3   346.0     281       79.0 1.000 1.000 1.000 1
  9 05/01/1990    15   19.65   17.2   346.4     281       53.4 1.000 1.000 1.000 1
 10 05/16/1990    15   19.65   17.2   346.4     281       53.4 1.000 1.000 1.000 1
 11 05/31/1990    15   15.54   18.4   363.8     276       42.0 1.000 1.000 1.000 1
 12 06/15/1990    15   15.54   18.4   363.8     276       42.0 1 000 1.000 1.000 1
 13 06/30/1990    15    4.63    3.5   104.7     424       13.5 1.000 1.000 1.000 1
 14 07/15/1990    15    4.63    3.5   104.7     424       13.5 1.000 1.000 1.000 1
 15 07/30/1990    15    2.58    1.0    41.2     559        9.3 1.000 1.000 1.000 1
 16 08/14/1990    15    2.58    1.0    41.2     559        9.3 1.000 1.000 1.000 1
 17 08/29/1990    15    4.47    2.5    81.4     459       14.2 1.000 1.000 1.000 1
 18 09/13/1990    15    4.47    2.5    81.4     459       14.2 1.000 1.000 1.000 1
 19 09/28/1990    15    9.78    7.6   189.0     349       27.7 1.000 1.000 1.000 1
 20 10/13/1990    15    9.78    7.6   189.0     349       27.7 1.000 1.000 1.000 1
 21 10/28/1990    15   10.62    5.2   142.7     384       30.9 1.000 1.000 1.000 1
 22 11/12/1990    15   10.62    5.2   142.7     384       30.9 1.000 1.000 1.000 1
 23 11/27/1990    15    9.45    3.2    97.4     428       27.8 1.000 1.000 1.000 1
 24 12/12/1990    15    9.45    3.2    97.4     428       27.8 1.000 1.000 1.000 1

                                          Total Erosion (t/ac):       367.2
 KEY_ESC= Exit Period Info Display
        Press F1 Key Twice to View HELP on SPECIAL FUNCTION KEYS
Use arrows, <tab>, or <enter> keys to move through screen.
```

Estimated erosion with weather files from nine different regions of the country are run using this same management file (TEST.MAN). The weather factor (*WF*) and erosion (*E*) for each erosion period for these nine sites are summarized in Tables 5.2.4.1 and 5.2.4.2.

The largest 15 day WF is not in the Great Plains, but is in Kalului, Maui. The WF at Fresno, California is very small.

For these soil, field, and management conditions the weather at Akron, Colorado produced the most erosion; in fact, there is erosion in every time period for Akron, Colorado. Surprisingly, the estimated erosion at Kahului, Maui, Hawaii was next, followed by Big Spring, TX; Goodland, Kansas; Joliet, Illinois; Spokane, Washington; Orlando, Florida; Rome, New York; and Fresno, California. These erosion estimates are based on average weather conditions. Infrequent but exceptional wind events may produce considerable erosion even at Fresno, California.

Table 5.2.4.1 Comparison of weather factors (*WF*) by erosion periods for nine different weather files.

period	start date	CA	CO	FL	HI	IL	KS	NY	TX	WA
1	01/01/1990	0.0	38.8	5.1	13.3	8.5	17.9	0.0	35.3	0.0
2	01/16/1990	0.0	38.8	5.1	13.3	8.5	17.9	0.0	35.3	0.0
3	01/31/1990	0.1	54.5	11.9	9.6	29.0	27.4	0.0	62.2	8.2
4	02/15/1990	0.1	54.5	11.9	9.6	29.0	27.4	0.0	62.2	8.2
5	03/02/1990	0.8	131.2	14.3	21.8	48.3	81.6	4.2	96.4	12.7
6	03/17/1990	0.8	131.2	14.3	21.8	48.3	81.6	4.2	96.4	12.7
7	04/01/1990	1.2	118.4	8.2	41.6	47.1	82.3	14.9	79.0	15.8
8	04/16/1990	1.2	118.4	8.2	41.6	47.1	82.3	14.9	79.0	15.8
9	05/01/1990	1.4	66.6	4.2	66.6	16.1	48.6	6.6	53.4	7.7
10	05/16/1990	1.4	66.6	4.2	66.6	16.1	48.6	6.6	53.4	7.7
11	05/31/1990	1.3	45.6	3.2	100.2	11.4	45.6	2.4	42.0	6.9
12	06/15/1990	1.3	45.6	3.2	100.2	11.4	45.6	2.4	42.0	6.9
13	06/30/1990	0.2	39.1	0.6	98.2	1.9	21.2	0.9	13.5	3.1
14	07/15/1990	0.2	39.1	0.6	98.2	1.9	21.2	0.9	13.5	3.1
15	07/30/1990	0.1	33.3	0.4	81.4	0.8	19.0	0.7	9.3	2.6
16	08/14/1990	0.1	33.3	0.4	81.4	0.8	19.0	0.7	9.3	2.6
17	08/29/1990	0.0	55.2	2.3	59.0	3.7	28.6	0.9	14.2	4.3
18	09/13/1990	0.0	55.2	2.3	59.0	3.7	28.6	0.9	14.2	4.3
19	09/28/1990	0.0	43.4	4.7	38.8	7.9	23.8	2.6	27.7	5.0
20	10/13/1990	0.0	43.4	4.7	38.8	7.9	23.8	2.6	27.7	5.0
21	10/28/1990	0.0	83.4	4.0	15.4	18.7	32.2	0.0	30.9	1.6
22	11/12/1990	0.0	83.4	4.0	15.4	18.7	32.2	0.0	30.9	1.6
23	11/27/1990	0.0	63.9	5.0	10.9	3.7	22.0	0.0	27.8	0.0
24	12/12/1990	0.0	63.9	5.0	10.9	3.7	22.0	0.0	27.8	0.0
25	12/27/1990	0.0	17.0	1.3	2.9	1.0	5.9	0.0	7.4	0.0
Total WF		10.2	1563.8	129.1	1116.5	395.2	906.3	66.4	990.8	135.8

Table 5.2.4.2 Comparison of erosion (*E*) by erosion periods for nine different weather files.

period	start date	CA	CO	FL	HI	IL	KS	NY	TX	WA
1	01/01/1990	0.00	15.39	1.00	3.85	2.38	6.58	0.00	12.89	0.00
2	01/16/1990	0.00	15.39	1.00	3.85	2.38	6.58	0.00	12.89	0.00
3	01/31/1990	0.00	21.79	3.65	3.10	11.11	10.44	0.00	23.72	2.59
4	02/15/1990	0.00	21.79	3.65	3.10	11.11	10.44	0.00	23.72	2.59
5	03/02/1990	0.00	52.85	4.56	8.36	18.96	32.52	0.88	38.23	4.59
6	03/17/1990	0.00	52.85	4.56	8.36	18.96	32.52	0.88	38.23	4.59
7	04/01/1990	0.14	47.06	1.95	16.97	18.59	32.37	5.34	31.21	5.62
8	04/16/1990	0.14	47.06	1.95	16.97	18.59	32.37	5.34	31.21	5.62
9	05/01/1990	0.19	25.69	0.80	27.29	5.48	18.44	1.83	19.65	2.28
10	05/16/1990	0.19	25.69	0.80	27.29	5.48	18.44	1.83	19.65	2.28
11	05/31/1990	0.17	17.14	0.47	41.11	3.74	16.64	0.40	15.54	1.94
12	06/15/1990	0.17	17.14	0.47	41.11	3.74	16.64	0.40	15.54	1.94
13	06/30/1990	0.00	14.66	0.00	40.17	0.29	7.43	0.00	4.63	0.61
14	07/15/1990	0.00	14.66	0.00	40.17	0.29	7.43	0.00	4.63	0.61
15	07/30/1990	0.00	11.83	0.00	33.29	0.00	6.73	0.00	2.58	0.47
16	08/14/1990	0.00	11.83	0.00	33.29	0.00	6.73	0.00	2.58	0.47
17	08/29/1990	0.00	21.35	0.17	24.11	0.77	9.90	0.00	4.47	0.98
18	09/13/1990	0.00	21.35	0.17	24.11	0.77	9.90	0.00	4.47	0.98
19	09/28/1990	0.00	16.35	0.79	15.69	2.47	8.01	0.43	9.78	1.27
20	10/13/1990	0.00	16.35	0.79	15.69	2.47	8.01	0.43	9.78	1.27
21	10/28/1990	0.00	33.64	0.69	5.60	6.61	12.27	0.00	10.62	0.24
22	11/12/1990	0.00	33.64	0.69	5.60	6.61	12.27	0.00	10.62	0.24
23	11/27/1990	0.00	25.74	0.92	3.41	0.75	8.29	0.00	9.45	0.00
24	12/12/1990	0.00	25.74	0.92	3.41	0.75	8.29	0.00	9.45	0.00
25	12/27/1990	0.00	6.23	0.00	0.52	0.00	1.56	0.00	1.61	0.00
Total Erosion		1.0	614.2	30.0	446.4	142.3	341.0	17.8	367.2	41.2

The weather file used for each of the states is given below.

CA	CA93193.DAT	CO	CO24015.DAT	FL	FL12841.DAT
HI	HI22516.DAT	IL	IL14834.DAT	KS	KS23065.DAT
NY	NY14717.DAT	TX	TX23005.DAT	WA	WA24157.DAT