Smithsonian Tropical Research Institute

2005 Meteorological and Hydrological Summary for Barro Colorado Island

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Introduction

This is the twelfth of a series of yearly reports summarising the past year's Smithsonian Tropical Research Institute's Terrestrial-Environmental Sciences Program (T-ESP) Meteorological and Hydrological Monitoring Program on BCI. This report is not meant to be exhaustive in its coverage in that it summaries only some of the most 'important' or interesting parameters available. Any comments on how future yearly summaries could be improved would be appreciated. Additional copies of this report, reports from previous years, and downloadable data from BCI and other research locations, can be obtained from: http://striweb.si.edu/esp/physical_monitoring/summary_bci.htm

Setting

The meteorology and hydrology monitoring programs on BCI are described in detail in Climate and Moisture Variability in a Tropical Forest: Long-term Records from Barro Colorado Island, Panamá. Windsor (1990). Much of the information on the next five pages has been extracted from this source.

BCI (9°10'N, 79°51'W) is a completely forested, 1567 ha island with a 53.9 km perimeter, rising 137m above Lake Gatun. The island receives an average of 2632 mm of rain per year**.** The meteorological year is divided into two parts: a pronounced dry season (approximately from mid-December to the end of April), and a wet season (May to mid-December). On average, only 293 mm of rain falls during the dry season. Relative humidity, soil moisture, air pressure, solar radiation, evapotranspiration, wind speed and direction all show marked wet/dry season differences. On the other hand, temperature varies relatively little throughout the year.

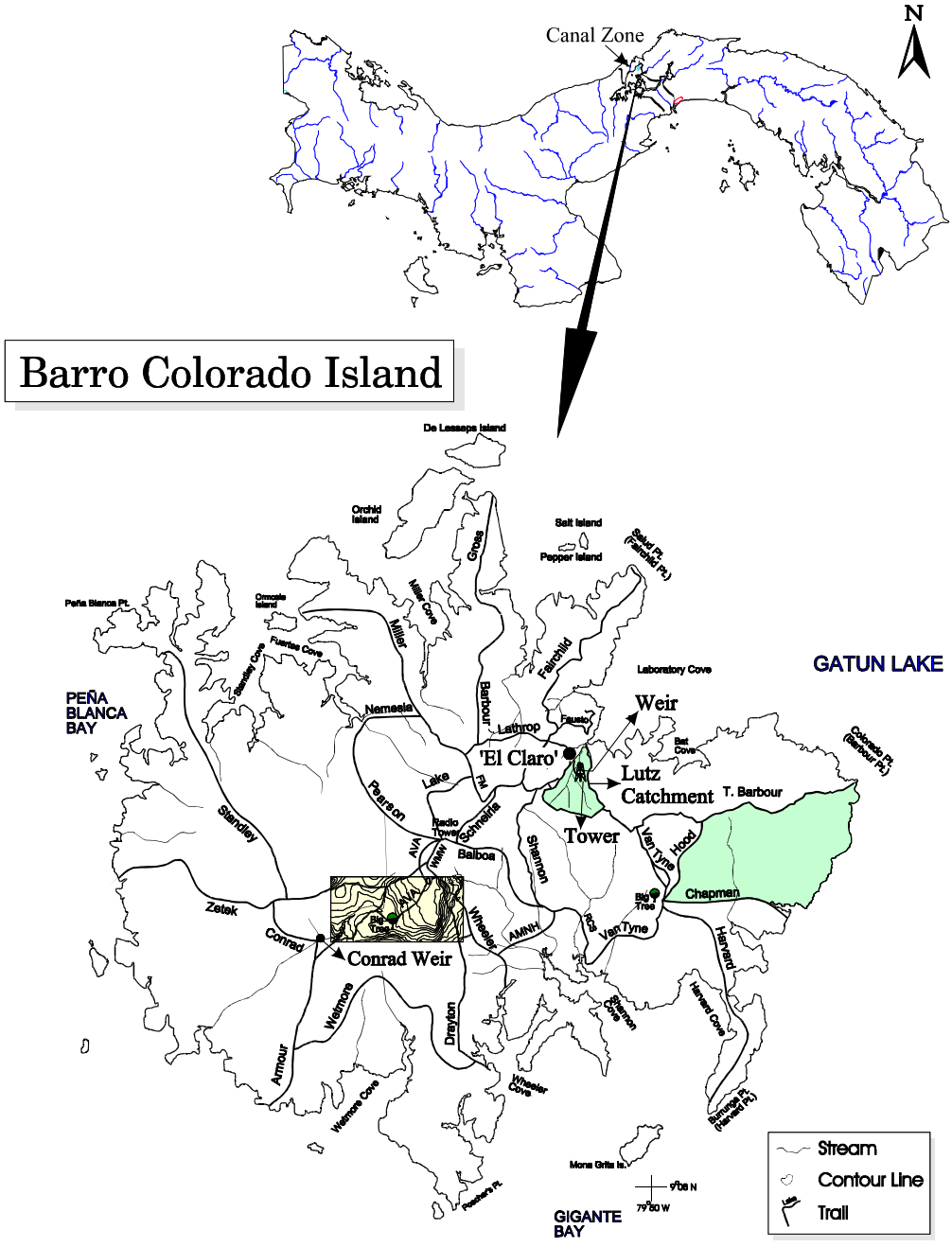
This report summarises data taken from two locations: a 48 m walk-up tower located within the Lutz catchment, and a small clearing ('El Claro') located among several laboratory buildings (see map on the following page). The tower, with sensors at 10 m intervals, provides a vertical meteorological transect through the forest canopy. The Lutz catchment, located on the Northeast slope of BCI, and is probably typical of many small catchment areas on the island. The catchment encompasses 9.73 ha. The Lutz catchment is located immediately southwest of the laboratory clearing and dormitory area. The Clearing is a grass-covered area located near several laboratory buildings.

The physical aspects of both the Clearing and the Tower have changed relatively little over time. However, cycles of vegetation removal and re-growth may have had subtle effects at both locations. The recent removal and construction of buildings near to the Clearing may also have affected the local climate. Furthermore, it is evident that the canopy surrounding the Tower has risen, perhaps by as much as 5m, since the Tower was erected – with possible measurement implications, especially at the highest levels.

In October of 2004, three new, 6-foot sections were added to the top of the tower. It was necessary to remove many banches from trees next to the tower during this operation.

The new maximum height of the tower is now approximately 48m. A parallel series of meterological measurements are now being made a both the old maximum height and the new. The exceptions to this will be: wind direction (it's now not possible to measure at the old height), and solar radiation (assumed to be unaffected by the change in height).

Data were collected using two different methods: electro-mechanically (electronic sensors, data loggers, chart recorders, etc.), and manually (rain gauges, max-min thermometers, sling psychrometers, soil samples, ETGages) by a technician - Mr. Raúl Ríos. In general, manual readings tend to provide the most accurate measurements over the long-term and, as a result, when both types of data are available, the manual readings are used in this report. Some of the disadvantages of these measurements are that they are not available for every day, and they are usually taken only once a day (once a week for soil samples).



Some summaries (temperature, relative humidity, and soil humidity) are based entirely on manual measurements. Other summaries (solar radiation, wind direction) are based entirely on electro-mechanical measurements. Finally, some summaries (rainfall and wind speed) are based on combinations of manual and electro-mechanical measurements.

The Data

This report summarises the following data:

Lutz Tower	1m	relative humidity
		temperature
	40m	evapotranspiration
		relative humidity
		temperature
		wind speed and direction
	48m	evapotranspiration
		solar radiation
		relative humidity
		temperature
		wind speed and direction
Lutz catchment		run-off
		soil moisture
'El Claro'		evapotranspiration
		rainfall
		relative humidity
		temperature

Rainfall

Rainfall was collected by rain gauges in the Clearing, and by tipping buckets in both the Clearing and near the Lutz weir. The rain gauges were read at approximately 9:00 am every day except weekends and holidays. Tipping buckets provide continuous rainfall information, but tend to underestimate total rainfall by between 2% and 12% and for that reason are not used to provide data on absolute rainfall totals. Tipping buckets generate 'events' for every 0.254 mm of rainfall recorded. The underestimation seems to be due to the instruments' inability to properly record intense periods of rainfall. In order to 'fill in' the missing rain gauge data, a computer program was written by the author that uses tipping bucket rainfall data to distribute the rain gauge data for those days when readings were not made. The program takes the total rainfall collected in the rain gauge and divides it up proportionally according to the rainfall patterns recorded by the tipping bucket. The estimated rainfall for the missing days is exactly equal to the rainfall collected by the rain gauge. The daily rainfall for the Clearing is shown on page 8.

Page 9 shows the monthly totals for this year. The graph on the same page compares this year's monthly totals with the average monthly totals (±SD) for the period 1929 to 2004.

Page 10 shows yearly rainfall totals for all year since 1925. Time series graph and frequency histograms are presented for these data.

Page 11 breaks yearly rainfall approximately into wet and dry seasons. The average beginning and end dates for the seasons as defined by the PCC (Dec. 20 and May 2) were used. The two graphs on this page are frequency histograms showing the distribution of rainfalls (1929 to 2004) for the Dry and Wet Seasons. The arrow ➡ in each graph shows the rainfall for 2005 in relation to previous years. The small crossbar —|— above each graph represents the mean (vertical bar) and the standard deviation (horizontal bar) for the period 1929 - 2004.

Page 12 shows the beginning and end dates of the Panama Canal watershed dry season as defined by the Meteorological and Hydrological Branch of the Panama Canal Authority (PCA). The PCA defines the existence of dry season by tracking 11 variables (see list below) and then making a subjective decision based on the performance of these variables, and their prior experience with weather patterns in the Panama Canal area. There are no publications justifying the use of this system and any questions should be directed to Mike Hart of the Met. & Hyd. Branch of the Panama Canal Authority (EIEH-MET@pancanal.com). The data from Page 11 are shown graphically on Page 13.

Westerly Component of 300 HPA Wind
Gatun Lake Basin evaporation > 0.13" day^{-1}
Sea temperature at Amador < 80 °F
< 5 grams of water vapor kg^{-1} below 12.0 ft
Temp-Dew point difference SFC-400 HPA., > 10°C
Howard Airforce Base wind speed SFC-4000 ft., > 15 knots
Inter-Tropical Convergence Zone > 2 deg. Lat. south of Panama
Pacific Coast sea breeze < 2 hours day^{-1}
Atlantic Coast surface wind average > 6.0 M.P.H.
Gatun Lake level (corrected for water usage) falling
Gatun Watershed daily rainfall average (of 26 stations) < .25"

Pages 14 and 15 show an analysis of rainfall 'events' (*storms*). For convenience, and again somewhat arbitrarily, I have defined a storm as any continuous period of rain separated by at least an hour from any other rainfall. Since this analysis required the timing of rainfall events, tipping bucket data were used. As a result, the absolute size of rainfall events should be considered as only an estimate since they will tend to disproportionately underestimate the size of storms - larger storms will be more underestimated than smaller ones. Keeping this in mind, the tables and graphs on this page compare the maximum storm size and the average storm size and duration per month for the period 1972 to 2004 and for the year 2005.

Run-off

Run-off at the Lutz catchment area was determined from the water level in a 120° V-notch weir. The height of the water was recorded by two separate instruments: continuously by a Stevens A-71 strip-chart, water level recorder and at five-minute intervals with an ISCO Bubble Flow Meter. Data from these devices are converted (either directly or through a digitizing process) into run-off (m^3) and then into rainfall equivalents.

Daily Lutz creek weir run-off totals are shown on page 16. These data are shown in terms of the equivalents of precipitation in mm. These values are calculated by taking the run-off and dividing by the total surface area of the catchment area (9.73 ha). In this way, the run-off can be more conveniently compared to the amount of rainfall.

Pages 17 show the total monthly run-off. The graph on the bottom of page 18 compares average monthly run-off for the period 1973 to 2004 with 2005. The graph on the top of page 18 compares monthly accumulated precipitation with 2005 and long-term monthly accumulated run-off (in rainfall equivalents).

Soil Moisture

Soil moisture was determined gravimetrically based on samples collected every two weeks. Samples are taken at two depths (0-10cm and 30-40cm) from ten sites in the Lutz catchment area. Samples of approximately 2.5 cm soil cores are made with an 'Oakfield punch'. Page 19 shows the average soil moistures (% water by wet weight of soil) per month at each sample depth. The graph on the same page compares monthly averages for the period 1986 to 2004 with those for 2005.

Relative Humidity

Relative humidity was measured using the traditional method of wet and dry-bulb psychrometry. Measurements in the Clearing, at the base, middle and top of the Lutz tower (1m, 20m and 40m, respectively) were made at approximately 12:30 p.m. using a Taylor Sling Psychrometer. Data were also collected on an hourly basis by dataloggers attached to newly installed Vaisala electronic temperature/humidity sensors. These data are not reported in this yearly summary.

The average monthly relative humidities are shown in tabular and graphical form on pages 20 and 21, respectively.

Temperature

Shaded air temperature was measured in the Clearing, at the base and the top of the Lutz tower by Taylor max-min thermometers. Measurements were made by hand at approximately 930 am. Data were also collected on an hourly basis by dataloggers attached

to Vaisala electronic temperature/humidity sensors. These data are not reported in this yearly summary. The average monthly maximum and minimum temperatures for these three locations are shown in tabular and graphical form on page 22 and 23, respectively.

Solar Radiation

Global solar radiation was measured at the top of the Lutz tower using a Li-Cor LI200SB pyrranometer attached to a datalogger. Hourly total (MJ m^{-2}), maximum and minimum (J m^{-2} s^{-1}) were recorded. A Li-Cor 190SB sensor recorded Photosynthetically Active Radiation (PAR) similarly.

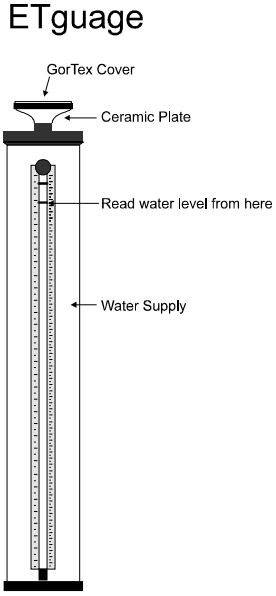
Page 24 shows the Daily Global Radiation values and Page 25 shows the Daily PAR values for 2005. Page 26 shows total monthly Global Radiation and PAR.

Wind Speed and Direction

Hourly average, maximum and minimum wind speed plus average wind direction was recorded at the top of the Lutz tower using a Model 05035 Young Anemometer connected to a data logger. Total wind passage was recorded on working days at approximately 9:30 am using an analogue totalizing anemometer. This device is believed to be more accurate than the Young Anemometer, especially during periods of low wind speeds due to totalizing anemometer's lower wind-speed threshold.

Page 27 shows the total daily wind passage from 40m and 48m. Page 28 shows average and maximum daily wind speeds from the Young Anemometer located at 48m. The page 29 shows daily average wind direction. The angles indicated in the table and graph on this page represent the direction into which the wind was predominately blowing on a given day. Page 30 shows the monthly average wind speed (based on the totalizing anemometer) from 40m and 48m, and monthly average directions (Young Anemometer) for the year.

Estimated Evapotranspiration and Water Balance



Evapotranspiration was added to the meteorological program on BCI beginning on December of 1992 and is estimated using ceramic plate atmometers known as ETgages. ETgages estimate evapotranspiration by allowing water to be drawn up through a ceramic disk and out through a GorTex cover. A recent study by Fontain and Todd (Measuring Evaporation with Ceramic Bellani Plate Atmometers, 1993, Water Resources Bulletin, Vol. 29, No. 5, p. 785-795) found that such devices perform very well compared with more traditional methods of measuring evaporation.

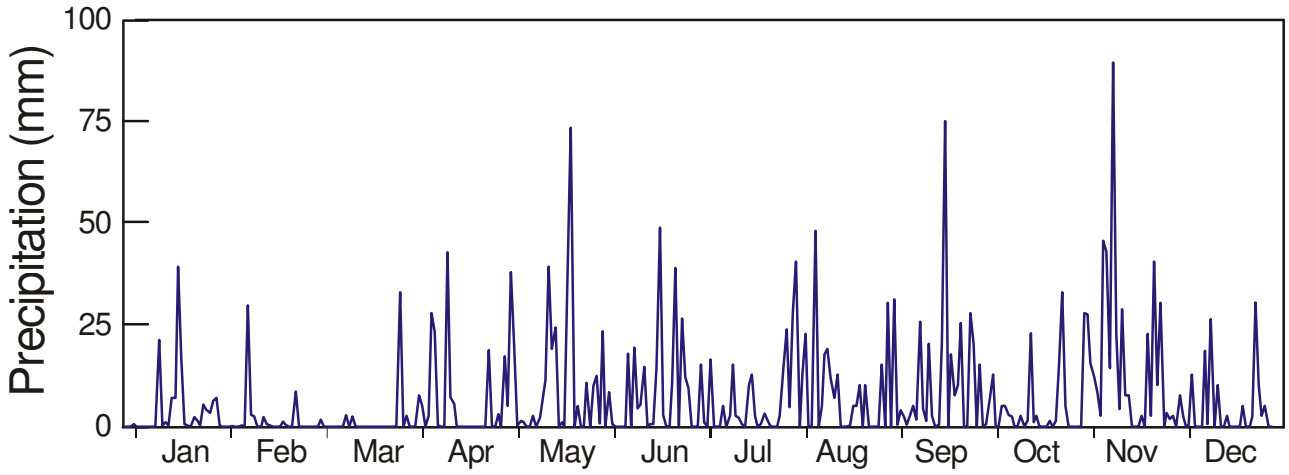
There are two ETgages currently being used on BCI: one in the Clearing located at a height of 1.5m and a second on the top of the 40m tower near the Lutz weir. ETgages are read at approximately the same time of day and with the same frequency and the rain gauges on BCI.

The data from the ETgages are used to estimate the total water balance for the Lutz catchment. Water balance is calculated as: Rainfall - Weir run-off - Evapotranspiration.

The results from the ETgages and the estimated water balance (Precipitation - (Run Off + Evapotranspiration)) for the Lutz Tower for from Nov. 1993 to the end of 2005 are given on pages 31 and 32.

Daily Rainfall (mm) on BCI recorded at ~930 hrs

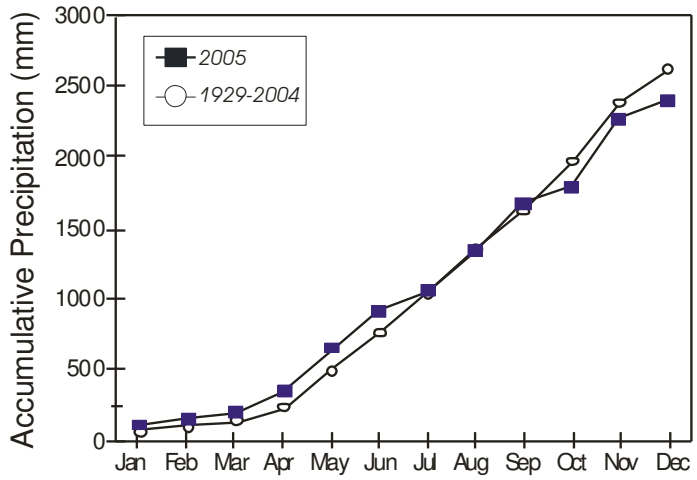
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	0.0	0.0	0.0	0.0	3.0	12.5	0.0	4.8	30.5	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.6	0.0	27.9	0.0	0.6	27.9	7.6
3	0.0	0.0	0.0	0.0	17.4	23.5	0.0	40.6	31.4	7.1	27.7	2.3
4	0.5	0.1	1.5	7.6	5.1	0.0	15.2	0.0	0.3	12.7	15.5	0.0
5	0.0	0.0	0.0	5.1	38.1	8.5	1.0	12.7	3.9	0.0	12.1	0.2
6	0.0	0.0	0.0	0.0	20.3	0.6	0.0	22.9	2.2	0.0	8.3	12.7
7	0.0	0.2	0.0	2.5	0.2	0.0	16.5	0.0	0.4	5.1	2.5	0.0
8	0.0	0.0	0.0	27.9	1.3	0.0	0.0	0.0	2.5	5.1	45.7	0.0
9	0.0	29.8	0.0	23.2	1.1	0.0	0.0	48.3	5.1	2.7	43.2	0.0
10	0.0	2.9	0.0	0.1	0.0	0.0	0.0	0.0	1.6	2.4	14.3	18.7
11	0.0	2.4	0.0	0.0	0.0	18.0	5.1	5.1	25.8	0.0	89.8	0.6
12	21.3	0.0	2.7	0.0	2.5	0.0	0.0	17.8	4.4	0.0	22.7	26.4
13	0.3	0.0	0.0	42.9	0.0	19.5	2.5	19.1	1.3	2.5	4.3	0.0
14	1.0	2.3	2.4	7.3	2.0	4.5	15.2	12.0	20.3	0.0	28.9	10.2
15	0.2	0.5	0.0	5.4	6.4	5.3	2.5	7.0	2.5	1.5	7.6	0.0
16	7.0	0.2	0.0	0.0	11.4	14.7	2.0	12.7	0.0	23.0	7.6	0.0
17	7.0	0.0	0.0	0.0	39.4	0.0	0.5	0.0	0.3	0.9	0.0	2.5
18	39.4	0.0	0.0	0.0	19.2	0.6	0.0	0.0	20.8	2.5	0.0	0.0
19	16.8	0.0	0.0	0.0	24.4	0.5	10.2	0.0	75.4	0.0	0.0	0.0
20	0.5	1.2	0.0	0.0	0.0	14.3	12.7	0.3	0.0	0.0	2.5	0.0
21	0.3	0.3	0.0	0.0	0.9	49.0	2.5	4.9	17.8	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	2.8	0.0	4.9	7.6	1.3	22.9	5.1
23	2.2	0.0	0.0	0.0	37.2	0.0	0.5	10.2	10.2	0.0	2.5	0.0
24	1.4	8.6	0.0	0.0	73.7	0.0	3.2	0.0	25.4	1.3	40.6	0.0
25	0.3	0.0	0.0	0.0	0.0	10.9	1.3	10.2	0.0	15.2	10.2	2.3
26	5.3	0.0	0.0	18.8	5.1	39.2	0.0	0.0	0.0	33.0	30.5	30.6
27	4.1	0.0	0.0	0.0	0.0	0.2	0.0	0.0	27.9	5.1	0.0	10.2
28	3.3	0.0	0.0	0.0	0.0	26.7	0.0	0.0	20.3	0.0	3.3	2.5
29	6.3		33.0		10.8	12.2	2.5	0.0	0.0	0.0	1.8	5.1
30	7.0		0.0		0.0	9.4	14.6	15.2	15.2	0.0	2.5	0.0
31	0.3		2.5		10.0		23.8	0.0		0.0		0.0
	124.2	**48.4**	**42.2**	**141.0**	**329.3**	**273.3**	**132.1**	**276.5**	**353.1**	**121.9**	**475.0**	**137.2**

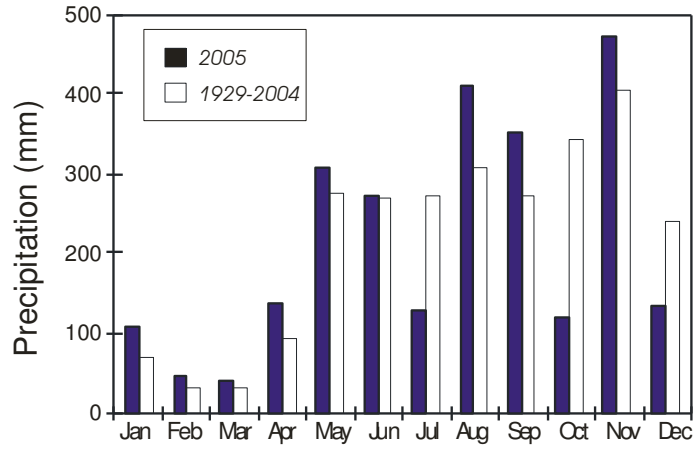


Monthly Rainfall at 'El Claro' - Rain Guage

Rainfall (mm)

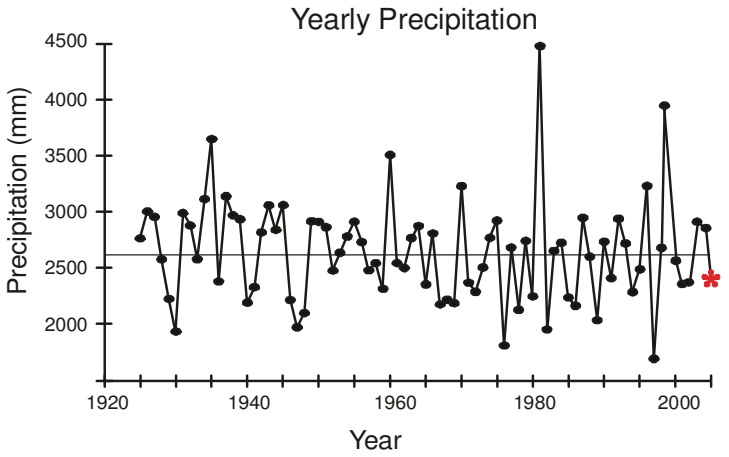
	Average	Min	Max	S.D.	2005	Rank (n=77)
January	70.1	0.0	374.0	76.1	**110.7**	**16**
February	31.3	0.5	186.4	34.1	**48.4**	**17**
March	33.5	0.0	173.7	36.2	**42.2**	**24**
April	93.9	0.0	463.8	86.4	**141.0**	**17**
May	279.3	78.5	622.0	102.3	**308.5**	**27**
June	271.8	66.8	541.0	87.4	**273.3**	**36**
July	274.7	92.0	725.9	95.9	**132.1**	**74**
August	310.9	149.6	586.0	92.0	**276.5**	**46**
September	273.2	130.8	507.0	85.5	**353.1**	**13**
October	343.8	153.9	544.0	94.6	**121.9**	**77**
November	407.9	110.0	1056.1	188.1	**475.0**	**23**
December	243.2	15.9	712.7	175.2	**137.2**	**53**
Total	**2633.6**	**1699.7**	**4465.0**	**455.6**	**2419.8**	**50**

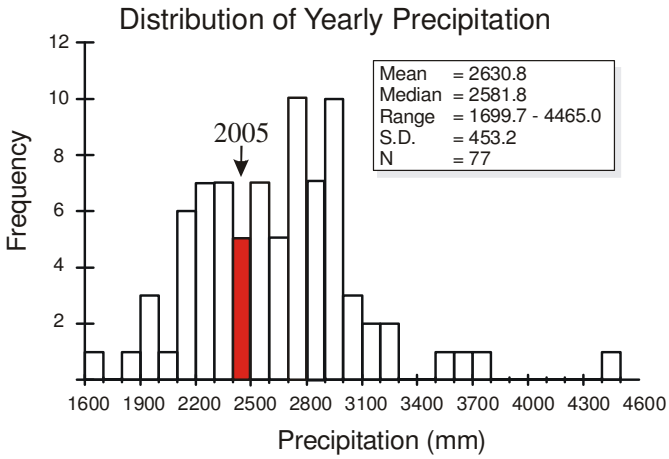




Yearly Rainfall (mm) at 'El Claro' - Rain Gauge

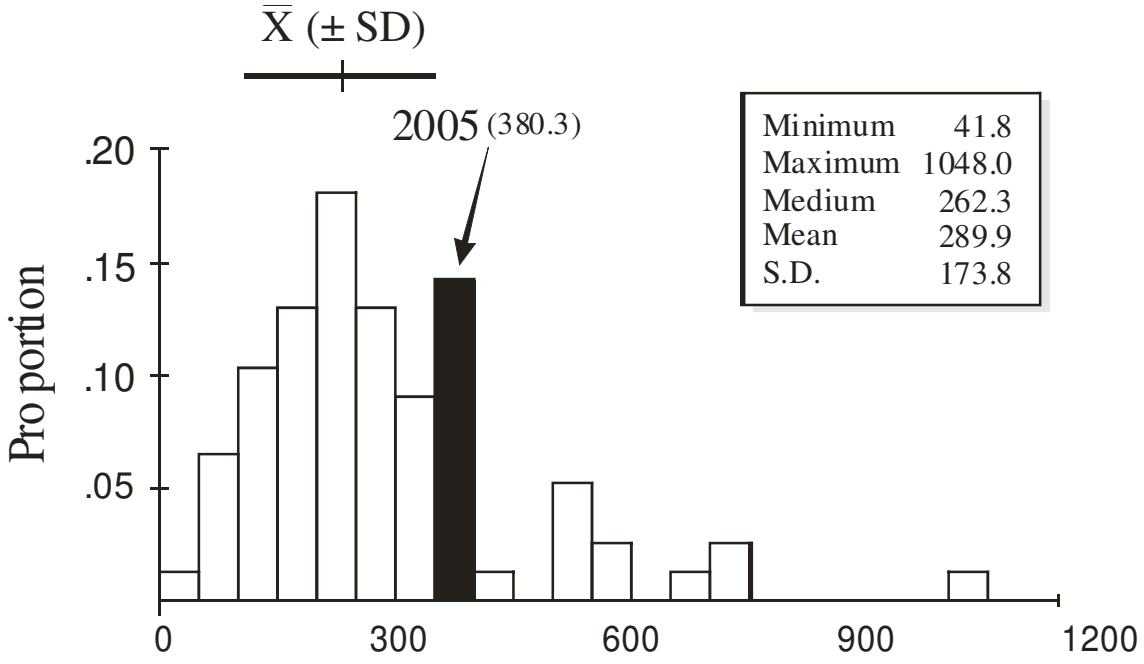
Year	Rain	Year	Rain	Year	Rain
1925	2764.0	1952	2481.6	1979	2742.0
1926	3003.0	1953	2637.5	1980	2252.0
1927	2956.1	1954	2684.3	1981	4465.0
1928	2579.1	1955	2910.3	1982	1960.0
1929	2228.3	1956	2729.7	1983	2654.0
1930	1940.6	1957	2482.1	1984	2726.0
1931	2981.5	1958	2545.1	1985	2242.0
1932	2878.6	1959	2317.0	1986	2167.6
1933	2581.9	1960	3500.4	1987	2955.2
1934	3109.5	1961	2545.6	1988	2602.9
1935	3642.6	1962	2373.4	1989	2176.2
1936	2384.3	1963	2767.1	1990	2767.5
1937	3117.6	1964	2875.3	1991	2642.4
1938	2969.0	1965	2357.1	1992	3047.5
1939	2932.9	1966	2807.7	1993	2729.2
1940	2195.8	1967	2181.4	1994	2285.2
1941	2332.2	1968	2223.5	1995	2531.1
1942	2816.9	1969	2192.5	1996	3227.8
1943	3055.4	1970	3141.2	1997	1699.7
1944	2838.7	1971	2373.6	1998	2683.8
1945	3058.9	1972	2292.0	1999	3726.1
1946	2221.0	1973	2506.0	2000	2550.2
1947	1978.2	1974	2770.0	2001	2331.2
1948	2105.7	1975	2923.0	2002	2300.6
1949	2916.2	1976	1818.0	2003	2891.8
1950	2908.3	1977	2685.0	2004	2745.5
1951	2863.8	1978	2132.0	**2005**	**2419.8**



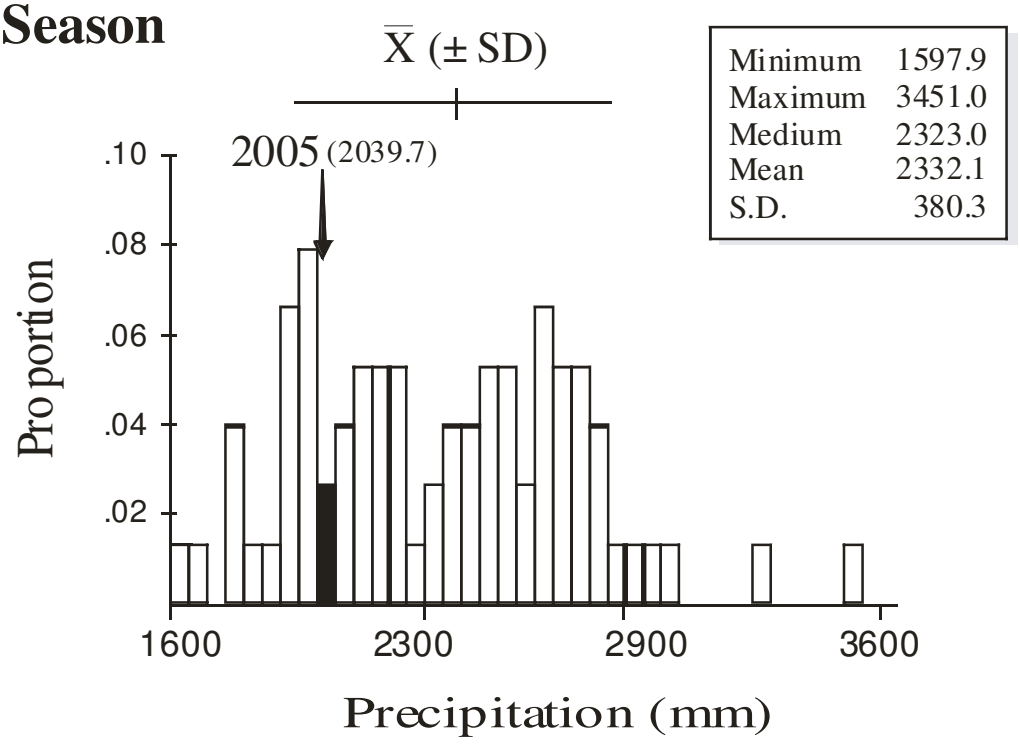


Seasonal Distribution of Precipitation

Dry Season



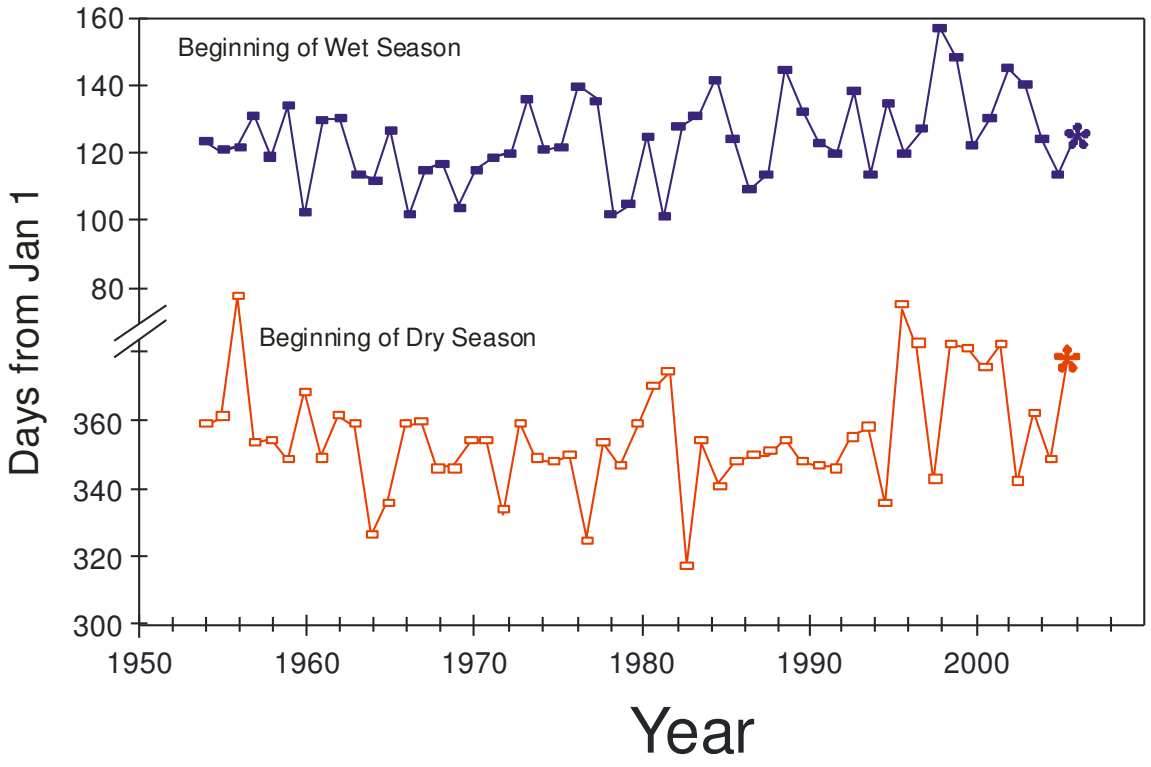
Wet Season

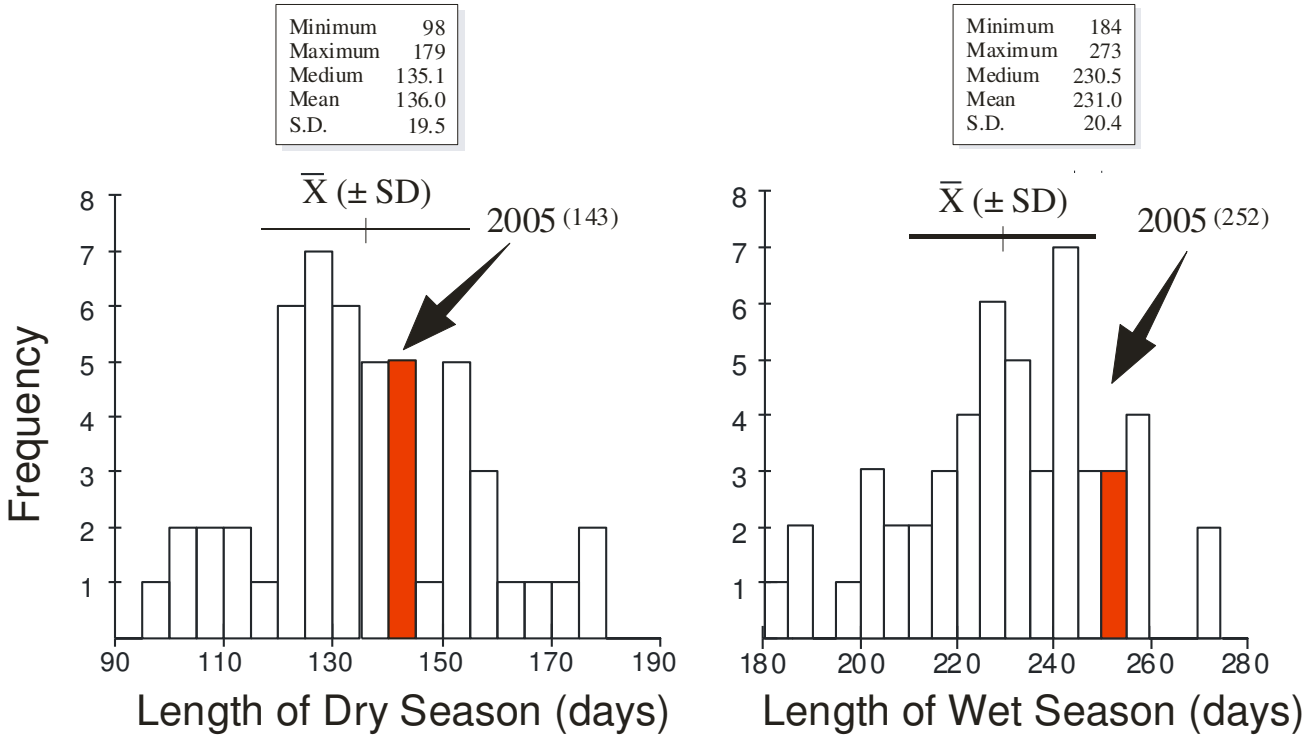


PCA Dry Season Beginning and End Dates

Year	Begin	End	Length		Year	Begin	End	Length	
			Dry Season	Wet Season				Dry Season	Wet Season
1954	25-Dec-53	05-May-54	131	236	1998	09-Dec-97	29-May-98	171	234
1955	27-Dec-54	02-May-55	126	275	1999	18-Jan-99	03-May-99	105	259
1956	01-Feb-56	02-May-56	91	231	2000	17-Jan-00	10-May-00	114	245
1957	19-Dec-56	12-May-57	144	223	2001	10-Jan-01	26-May-01	136	237
1958	21-Dec-57	30-Apr-58	130	229	2002	18-Jan-02	21-May-02	123	201
1959	15-Dec-58	15-May-59	151	234	2003	08-Dec-02	05-May-03	148	238
1960	04-Jan-60	12-Apr-60	99	247	2004	29-Dec-03	24-Apr-04	117	234
1961	15-Dec-60	11-May-61	147	231	**2005**	**14-Dec-05**	**06-May-04**	**143**	**252**
1962	28-Dec-61	11-May-62	134	228	**2006**	**13-Jan-06**			
1963	25-Dec-62	25-Apr-63	121	213					
1964	24-Nov-63	22-Apr-64	150	224					
1965	02-Dec-64	08-May-65	157	231					
1966	25-Dec-65	13-Apr-66	109	257					
1967	26-Dec-66	26-Apr-67	121	231					
1968	13-Dec-67	27-Apr-68	136	229					
1969	12-Dec-68	16-Apr-69	125	248					
1970	20-Dec-69	26-Apr-70	127	239					
1971	21-Dec-70	30-Apr-71	130	213					
1972	29-Nov-71	30-Apr-72	153	239					
1973	25-Dec-72	17-May-73	143	212					
1974	15-Dec-73	02-May-74	138	226					
1975	14-Dec-74	03-May-75	140	227					
1976	16-Dec-75	20-May-76	156	185					
1977	21-Nov-76	17-May-77	177	217					
1978	20-Dec-77	13-Apr-78	114	244					
1979	13-Dec-78	16-Apr-79	124	252					
1980	24-Dec-79	05-May-80	133	244					
1981	04-Jan-81	12-Apr-81	98	273					
1982	10-Jan-82	09-May-82	119	189					
1983	14-Nov-82	12-May-83	179	222					
1984	20-Dec-83	22-May-84	154	199					
1985	07-Dec-84	06-May-85	150	222					
1986	14-Dec-85	20-Apr-86	127	240					
1987	16-Dec-86	25-Apr-87	130	235					
1988	16-Dec-87	25-May-88	161	209					
1989	20-Dec-88	14-May-89	145	214					
1990	14-Dec-89	04-May-90	141	223					
1991	13-Dec-90	01-May-91	139	226					
1992	13-Dec-91	18-May-92	157	217					
1993	21-Dec-92	25-Apr-93	125	243					
1994	24-Dec-93	16-May-94	143	200					
1995	02-Dec-94	01-May-95	150	271					
1996	27-Jan-96	07-May-96	101	255					
1997	17-Jan-97	07-Jun-97	141	185					
					Avg	**21-Dec**	**04-May**	**135.1**	**230.5**
					SD	**±16 days**	**±13 days**	**19.5**	**20.4**

Seasonality Distribution



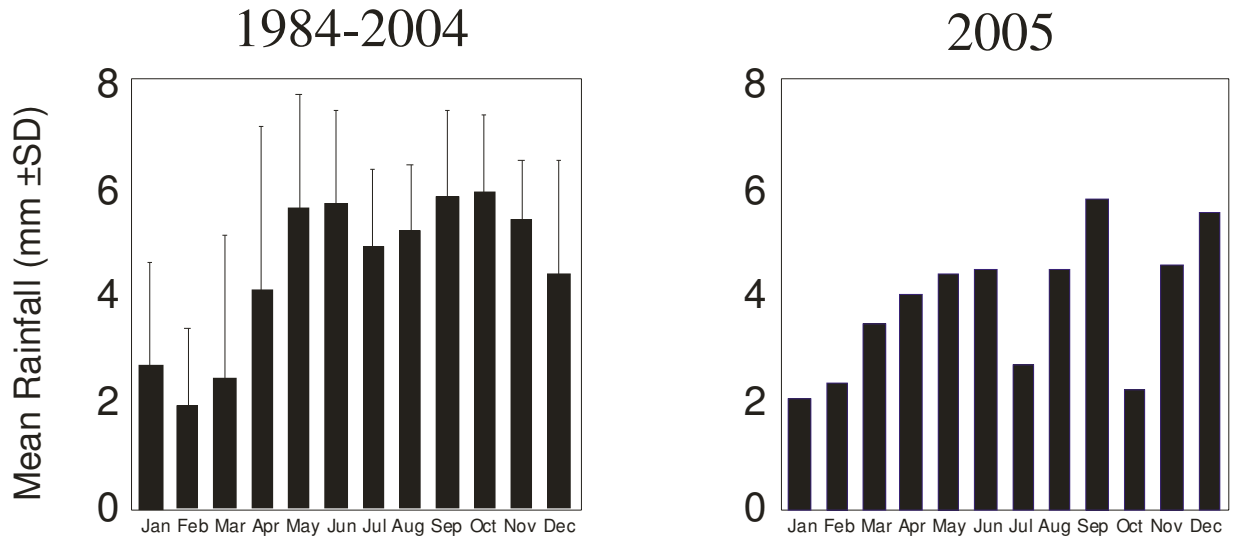


Storm Analysis

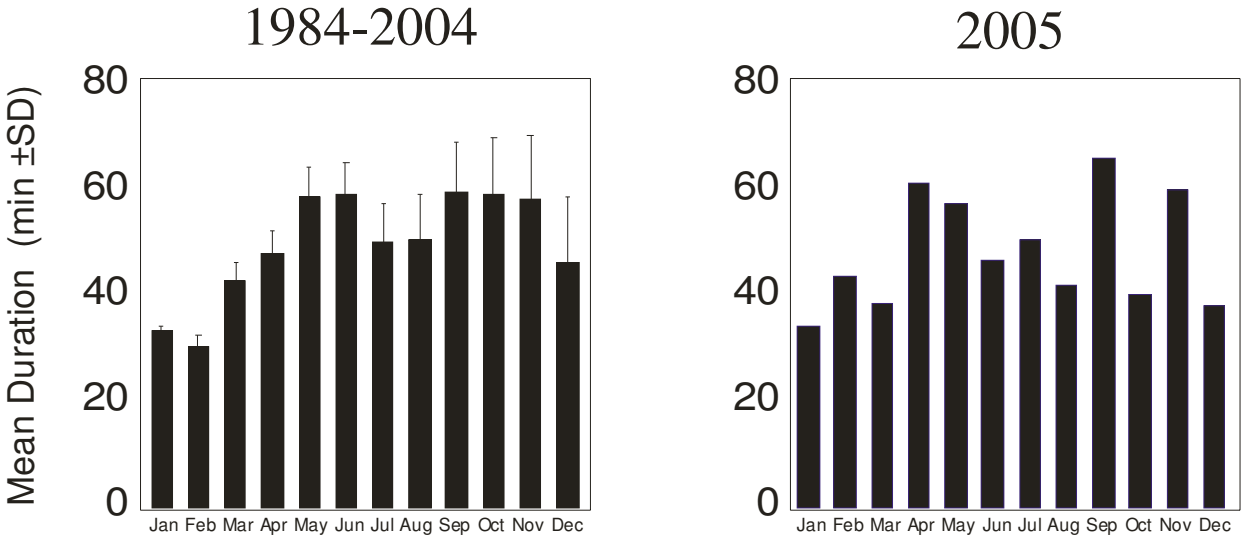
	Max. Rainfall per Storm (mm)			Storm Duration (min.)		
	1984-2004		**2005**	**1984-2004**		**2005**
	Mean	S.D.		Mean	S.D.	
January	23.0	25.7	17.8	31.4	17.2	34.8
February	11.4	11.7	23.1	28.5	23.9	44.4
March	13.9	14.6	27.2	40.4	39.7	39.5
April	32.7	31.7	23.4	45.2	35.2	62.6
May	54.4	26.7	61.0	55.4	13.8	58.6
June	53.2	22.0	33.8	55.5	9.4	47.8
July	48.3	18.3	13.5	47.2	8.9	51.5
August	49.6	17.6	40.4	47.7	9.9	42.7
September	50.2	19.7	44.4	55.9	11.1	67.3
October	49.8	20.6	16.5	55.8	12.1	40.9
November	47.0	15.4	74.4	55.0	15.0	61.0
December	42.1	23.9	83.8	43.4	18.4	38.9

	Av. Rainfall per Storm (mm)		
	1984-2004		**2005**
	Mean	S.D.	
January	2.6	1.9	2.2
February	1.9	1.4	2.5
March	2.4	2.6	3.7
April	4.0	3.0	4.3
May	5.5	2.1	4.7
June	5.6	1.7	4.8
July	4.8	1.4	2.9
August	5.1	1.2	4.8
September	5.7	1.6	6.2
October	5.8	1.4	2.4
November	5.3	1.1	4.9
December	4.3	2.1	5.9

Average Monthly Storm Size

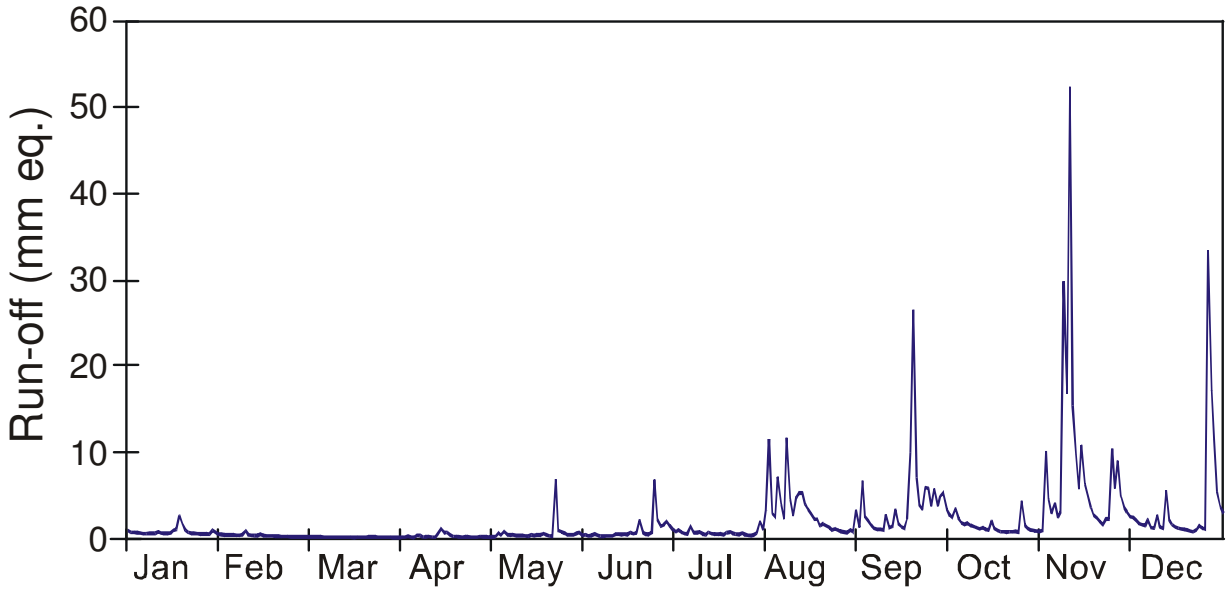


Average Monthly Storm Duration



Daily Lutz Weir Run-off (mm .eq.)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	0.8	0.4	0.1	0.0	0.1	0.3	1.0	3.2	1.2	2.6	0.8	2.3
2	0.6	0.3	0.1	0.1	0.1	0.3	0.7	11.4	6.6	2.4	10.0	2.0
3	0.6	0.3	0.1	0.1	0.1	0.2	0.9	2.8	2.4	3.4	4.5	1.7
4	0.6	0.3	0.1	0.2	0.6	0.2	0.6	2.4	2.0	2.2	2.8	1.5
5	0.6	0.3	0.1	0.1	0.3	0.5	0.5	7.1	1.5	1.7	4.0	1.4
6	0.5	0.3	0.1	0.0	0.7	0.3	0.5	3.9	1.1	1.6	2.4	2.0
7	0.5	0.3	0.1	0.3	0.3	0.2	1.3	2.1	1.0	1.7	3.0	1.2
8	0.5	0.3	0.1	0.2	0.3	0.2	0.6	11.6	1.0	1.4	29.7	1.1
9	0.5	0.8	0.1	0.1	0.4	0.2	0.6	4.5	0.9	1.3	16.7	2.6
10	0.5	0.4	0.1	0.1	0.2	0.2	0.7	2.6	2.7	1.2	52.2	1.3
11	0.7	0.3	0.1	0.1	0.2	0.2	0.4	4.7	1.2	1.1	15.3	1.1
12	0.6	0.2	0.1	0.1	0.2	0.4	0.4	5.2	1.3	1.2	9.7	5.5
13	0.5	0.3	0.1	0.1	0.2	0.4	0.6	5.2	3.3	1.0	5.7	2.0
14	0.5	0.4	0.1	0.4	0.2	0.4	0.5	3.8	1.6	0.9	10.8	1.5
15	0.6	0.3	0.1	1.1	0.3	0.4	0.4	3.3	1.3	2.0	6.2	1.3
16	0.8	0.2	0.1	0.6	0.2	0.4	0.4	2.8	1.1	1.1	4.9	1.1
17	1.0	0.2	0.0	0.6	0.3	0.6	0.5	2.2	2.2	0.8	3.5	1.1
18	2.6	0.2	0.1	0.3	0.3	0.5	0.4	2.2	9.9	0.7	2.6	0.9
19	1.6	0.2	0.1	0.1	0.5	0.6	0.6	1.4	26.4	0.7	2.3	0.9
20	0.9	0.2	0.1	0.1	0.4	2.0	0.7	1.6	7.0	0.7	1.8	0.8
21	0.7	0.2	0.1	0.1	0.2	0.6	0.5	1.4	3.9	0.7	1.6	0.7
22	0.5	0.1	0.1	0.1	0.2	0.5	0.4	1.2	3.3	0.7	2.2	0.9
23	0.5	0.1	0.1	0.1	6.8	0.4	0.4	0.9	5.8	0.8	2.2	1.4
24	0.5	0.1	0.1	0.1	0.8	0.6	0.6	1.1	5.8	0.7	10.3	1.1
25	0.5	0.1	0.1	0.1	0.7	6.7	0.4	0.8	3.7	4.3	5.7	1.0
26	0.5	0.1	0.1	0.1	0.5	2.1	0.3	0.7	5.7	1.5	8.9	33.4
27	0.5	0.1	0.1	0.1	0.3	1.3	0.3	0.7	3.7	1.1	4.8	17.1
28	0.4	0.1	0.1	0.1	0.3	1.5	0.3	0.6	4.8	0.9	3.5	11.4
29	0.9		0.1	0.1	0.3	1.9	0.6	0.9	5.2	0.8	3.0	5.4
30	0.6		0.0	0.1	0.5	1.4	1.9	0.7	3.3	0.8	2.4	3.6
31	0.4		0.0		0.6		0.9	3.2		0.7		2.8

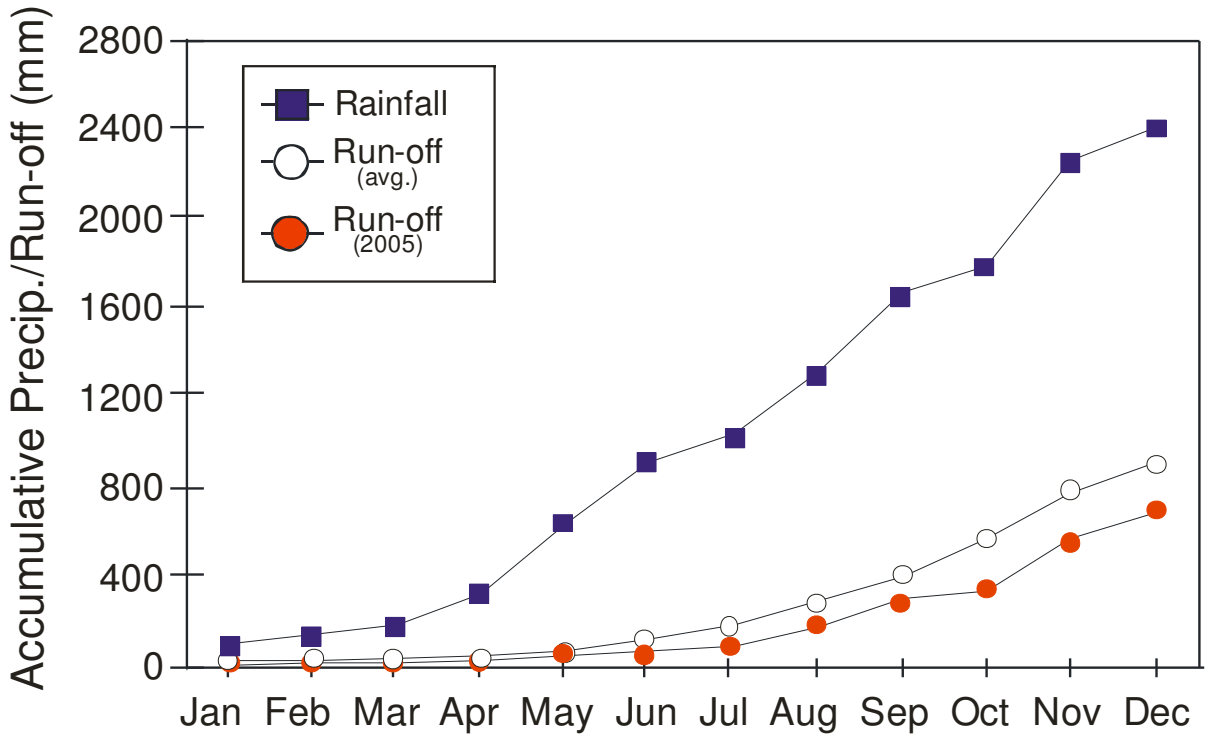


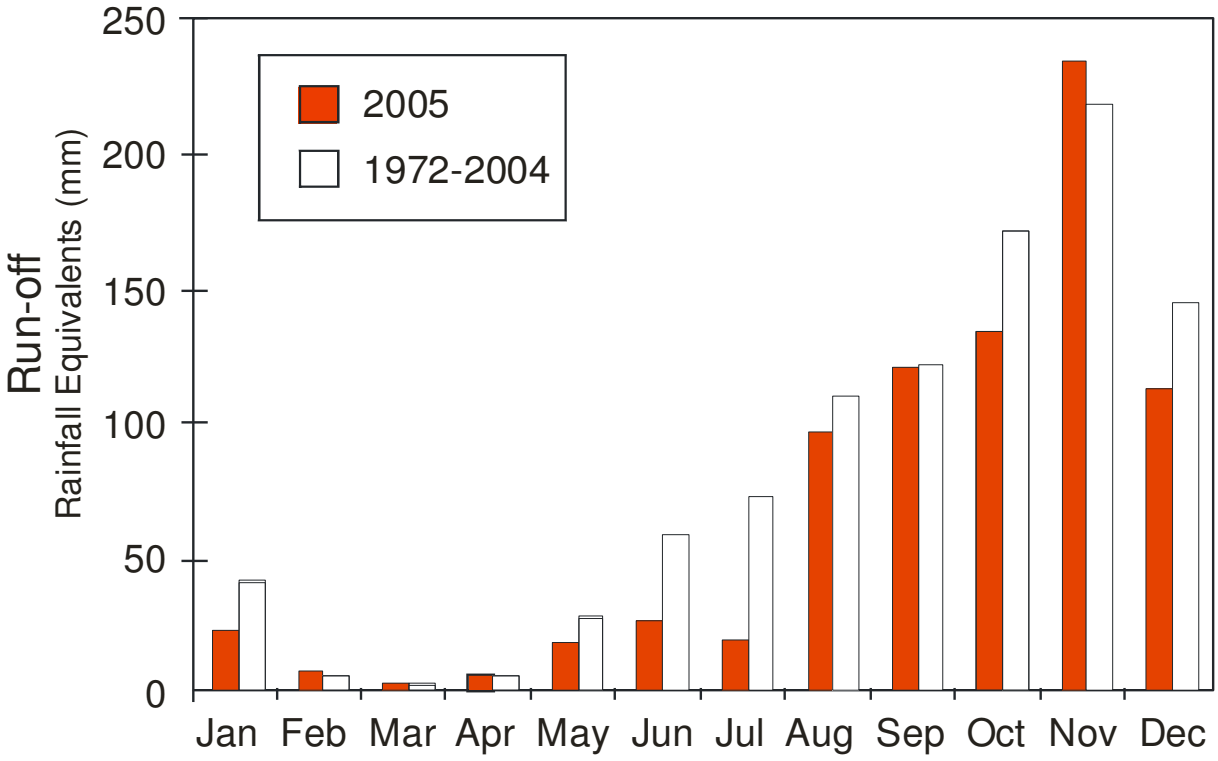
Monthly Run-off at Lutz Weir

Run-off (mm eq.)

	Long-term Averages (1972 - 2004)		2005
	Total	S.D.	Total
January	38.2	61.1	**21.5**
February	5.3	9.9	**7.0**
March	1.8	2.5	**2.2**
April	5.4	19.4	**5.6**
May	26.0	42.0	**17.4**
June	54.8	69.9	**25.6**
July	68.5	51.4	**18.7**
August	104.2	75.3	**96.0**
September	115.1	67.2	**120.6**
October	162.5	83.6	**42.6**
November	207.1	102.8	**233.6**
December	136.6	120.9	**112.1**
Total	931.0	422.7	**693.5**

Monthly run-off at Lutz Weir





Lutz Catchment Soil Moisture

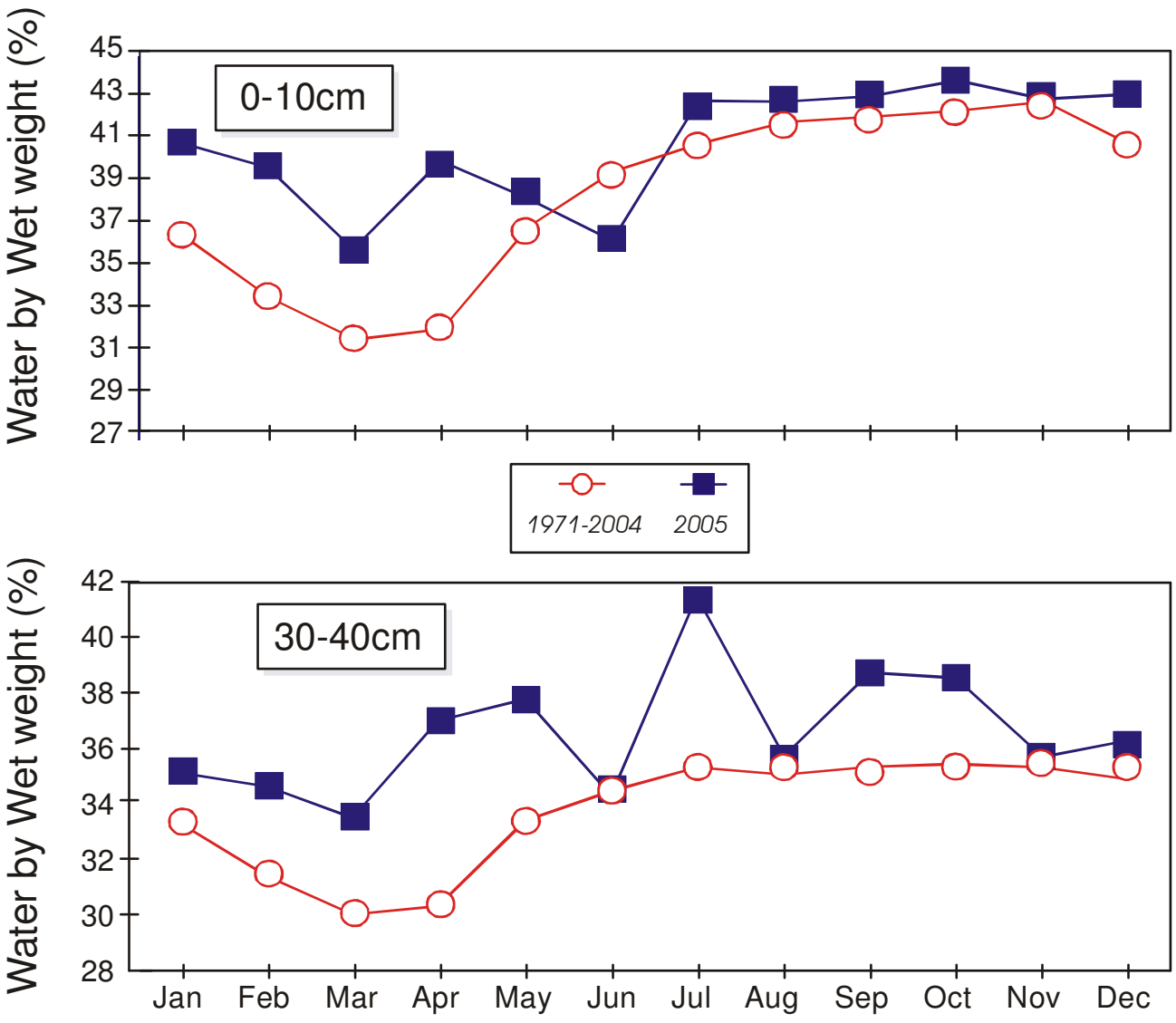
(H_2O/wet wt of soil)

	Long-term Averages (1972-2004)				2005	
	0-10 cm		30-40 cm		0-10 cm	30-40 cm
	Mean	S.D.	Mean	S.D.		
January	36.2	3.2	33.3	2.6	**40.9**	**35.1**
February	33.3	2.3	31.4	1.4	**39.8**	**34.6**
March	31.4	2.2	30.0	1.3	**35.9**	**33.5**
April	31.9	2.4	30.3	1.5	**39.0**	**36.4**
May	36.8	2.3	33.4	1.5	**38.4**	**37.0**
June	39.4	1.6	34.5	1.0	**36.4**	**34.3**
July	40.7	1.4	35.3	1.3	**42.9**	**41.5**
August	41.6	1.8	35.1	0.7	**42.9**	**35.7**
September	41.9	1.5	35.4	1.0	**43.3**	**38.8**
October	42.2	1.7	35.5	0.9	**43.9**	**38.6**
November	42.6	1.6	35.4	1.2	**42.6**	**35.8**
December	40.6	2.8	34.9	1.7	**43.2**	**36.3**

(H_2O/dry wt of soil)

	Long-term Averages (1972-2004)				2005	
	0-10 cm		30-40 cm		0-10 cm	30-40 cm
	Mean	S.D.	Mean	S.D.		
January	58.3	8.4	51.1	6.5	**70.3**	**55.2**
February	50.8	5.6	46.5	3.5	**66.7**	**54.0**
March	46.8	5.0	43.8	3.2	**56.7**	**51.2**
April	48.1	5.7	44.9	4.3	**66.8**	**58.7**
May	59.6	5.8	51.3	4.3	**63.6**	**63.2**
June	66.4	4.3	53.4	2.5	**57.6**	**53.3**
July	70.3	4.2	55.9	4.9	**75.9**	**71.7**
August	72.9	5.6	54.6	1.6	**75.9**	**56.5**
September	72.7	9.3	54.6	7.0	**77.1**	**64.6**
October	75.2	5.5	56.0	2.8	**79.8**	**64.2**
November	74.8	7.1	55.1	4.1	**74.6**	**56.5**
December	70.4	8.0	54.3	4.4	**78.2**	**58.7**

Lutz Catchment Soil Moisture



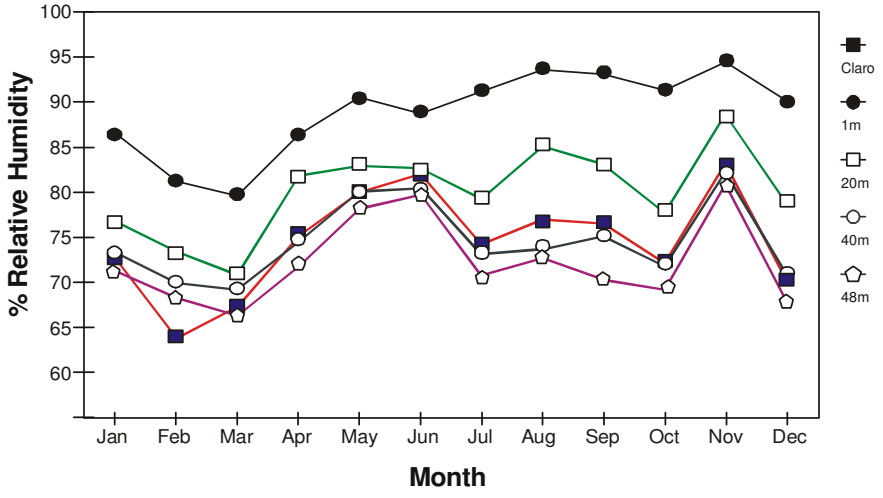
Relative Humidity (%)

Long-term Averages (1972-2004)

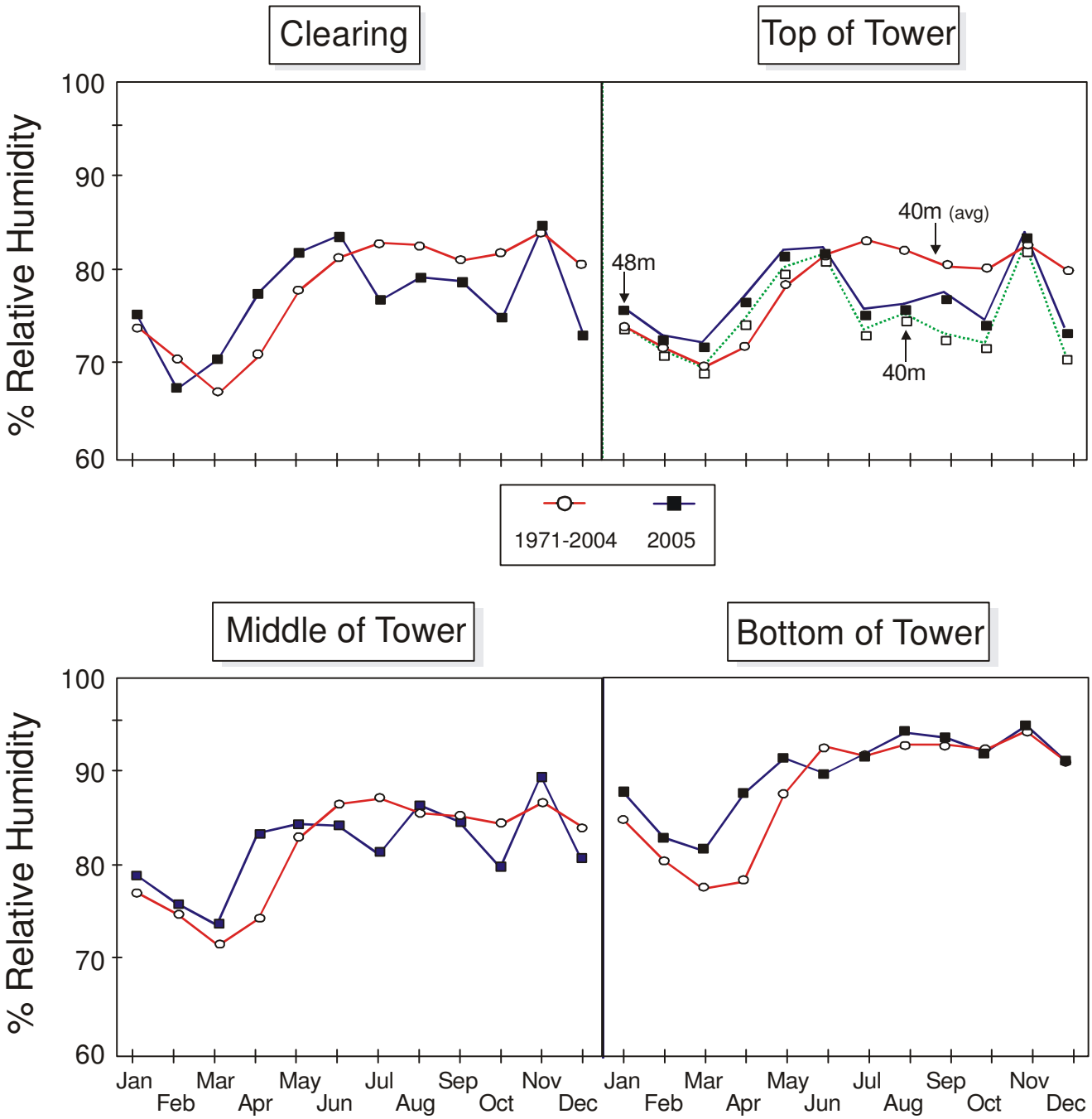
	'El Claro'		1m		20m		40m		48m	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
January	74.1	4.3	85.4	3.6	77.6	3.7	74.7	3.4	73.3	2.2
February	70.6	3.9	80.9	3.7	75.1	3.7	72.1	3.8	69.0	1.2
March	67.1	4.0	77.8	4.2	71.9	3.6	70.3	3.1	66.9	4.5
April	71.0	4.7	78.5	4.8	74.8	3.1	72.4	2.7	70.5	2.1
May	77.9	4.7	87.9	4.0	83.3	3.2	79.1	3.7	77.8	4.3
June	81.4	4.1	93.1	2.6	86.8	3.1	82.2	3.3	77.6	3.1
July	82.7	4.3	92.0	6.0	87.5	2.8	83.9	3.1	82.0	3.4
August	82.8	4.3	93.2	2.6	86.2	2.7	82.8	2.4	82.6	3.1
September	81.0	4.5	93.2	1.7	85.5	2.1	81.0	3.0	76.7	0.1
October	81.7	3.9	92.7	5.1	84.7	3.2	80.7	3.2	79.1	0.9
November	83.9	3.9	94.5	2.6	86.8	3.9	83.2	4.1	83.2	3.0
December	80.5	5.1	91.5	3.7	84.5	6.9	80.6	4.9	81.5	5.2

2005

	'El Claro'	1m	20m	40m	48m
January	**75.6**	**88.0**	**79.3**	**76.2**	**74.4**
February	**67.7**	**83.2**	**76.3**	**73.2**	**71.7**
March	**70.8**	**81.8**	**74.0**	**72.5**	**69.9**
April	**77.8**	**87.8**	**83.7**	**77.2**	**74.8**
May	**82.1**	**91.2**	**84.7**	**82.2**	**80.5**
June	**83.9**	**89.9**	**84.5**	**82.5**	**81.9**
July	**77.7**	**92.0**	**81.5**	**76.0**	**73.9**
August	**79.4**	**94.2**	**76.5**	**76.5**	**75.6**
September	**79.0**	**93.7**	**84.9**	**77.8**	**73.5**
October	**75.1**	**92.2**	**80.1**	**74.8**	**72.5**
November	**85.0**	**95.0**	**89.8**	**84.1**	**82.9**
December	**73.3**	**91.1**	**81.0**	**74.0**	**71.3**



Relative Humidity (%)

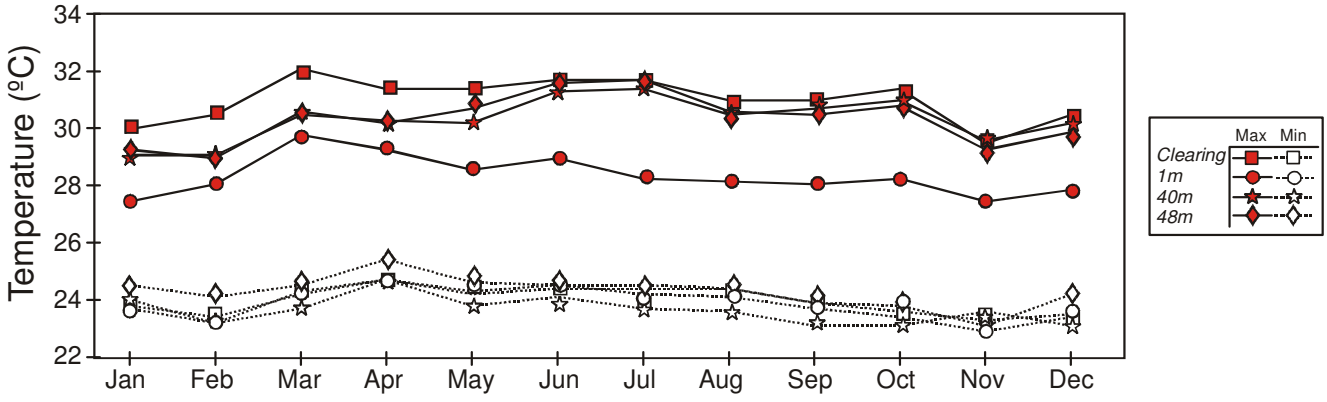


Avg. Monthly Maximum & Minimum (°C) Temperatures

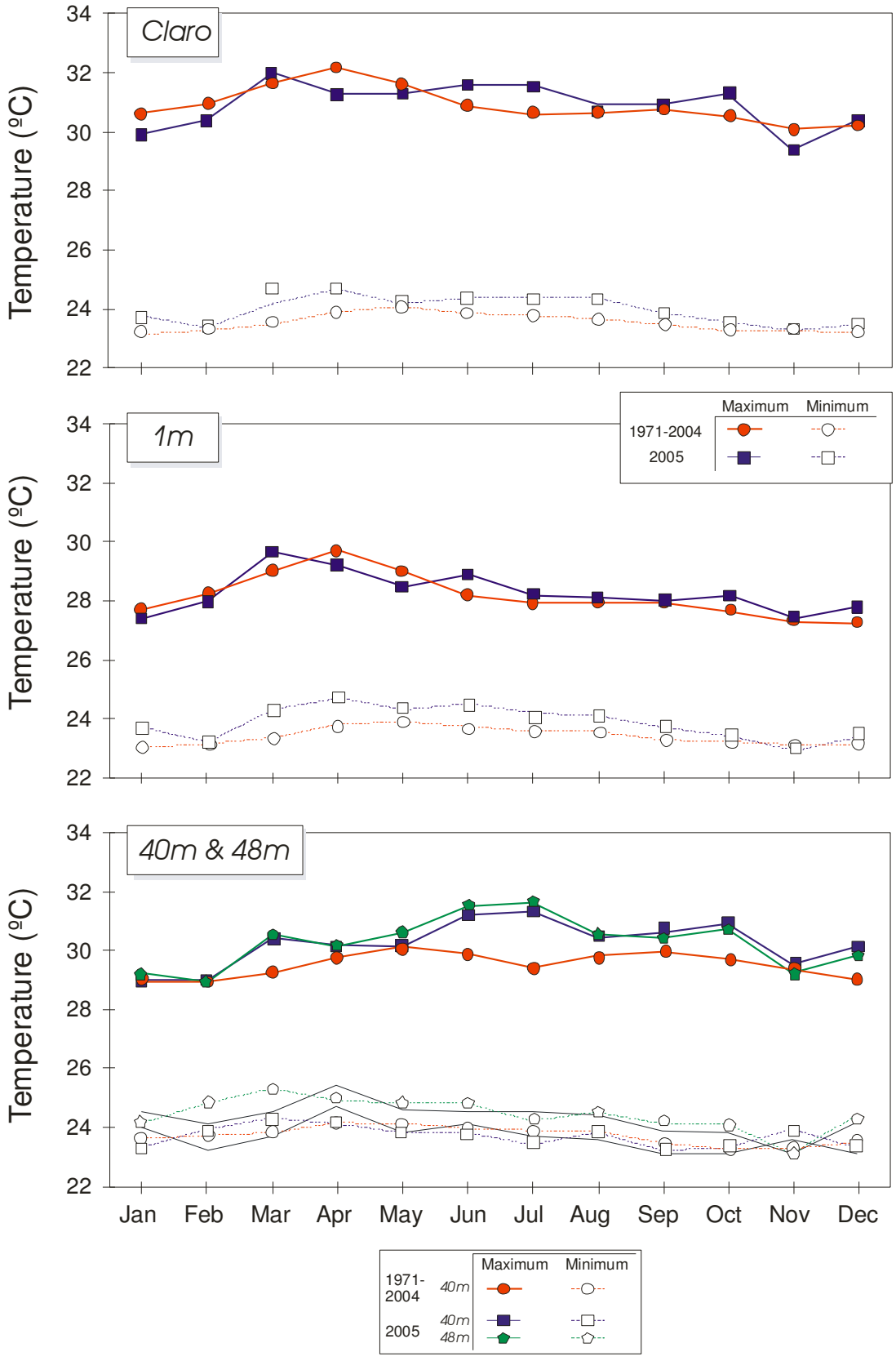
Long-term Averages (1972-2004)

	'El Claro'		1m		40m		48m	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
January	31.0	23.1	28.3	23.0	29.0	23.6	30.0	24.7
February	31.6	23.2	29.1	23.2	29.4	23.8	30.4	25.0
March	32.2	23.4	29.7	23.4	29.8	23.8	30.5	24.9
April	31.6	23.9	29.0	23.8	30.1	24.2	30.7	25.1
May	30.9	24.0	28.1	23.9	29.9	24.1	30.6	24.8
June	30.5	23.8	27.9	23.7	29.4	24.0	29.7	24.5
July	30.6	23.7	27.9	23.6	29.8	23.9	29.9	24.4
August	30.8	23.6	27.9	23.6	30.0	23.9	30.7	24.6
September	30.5	23.4	27.6	23.3	29.8	23.5	30.6	24.3
October	30.0	23.2	27.3	23.2	29.4	23.3	30.0	24.2
November	30.2	23.2	27.2	23.1	29.0	23.3	29.7	24.3
December	31.0	23.2	28.3	23.1	29.0	23.5	30.0	24.5

2005	'El Claro'		1m		40m		48m	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
January	**30.4**	**23.8**	**28.0**	**23.7**	**29.0**	**24.0**	**28.9**	**24.5**
February	**32.0**	**23.4**	**29.7**	**23.2**	**30.4**	**23.2**	**30.5**	**24.1**
March	**31.3**	**24.2**	**29.2**	**24.3**	**30.2**	**23.7**	**30.1**	**24.5**
April	**31.4**	**24.7**	**28.5**	**24.7**	**30.2**	**24.7**	**30.8**	**25.4**
May	**31.6**	**24.2**	**28.9**	**24.4**	**31.2**	**23.8**	**31.5**	**24.6**
June	**31.6**	**24.4**	**28.2**	**24.5**	**31.3**	**24.1**	**31.6**	**24.5**
July	**30.9**	**24.4**	**28.1**	**24.2**	**30.4**	**23.7**	**30.5**	**24.5**
August	**30.9**	**24.4**	**28.0**	**24.1**	**30.6**	**23.6**	**31.9**	**24.4**
September	**31.3**	**23.9**	**28.2**	**23.7**	**30.9**	**23.1**	**30.7**	**23.9**
October	**29.4**	**23.6**	**27.4**	**23.4**	**29.5**	**23.1**	**29.2**	**22.8**
November	**30.4**	**23.5**	**28.0**	**23.3**	**29.0**	**22.9**	**28.9**	**23.6**
December	**30.4**	**23.5**	**27.8**	**23.4**	**30.1**	**23.1**	**29.8**	**24.2**

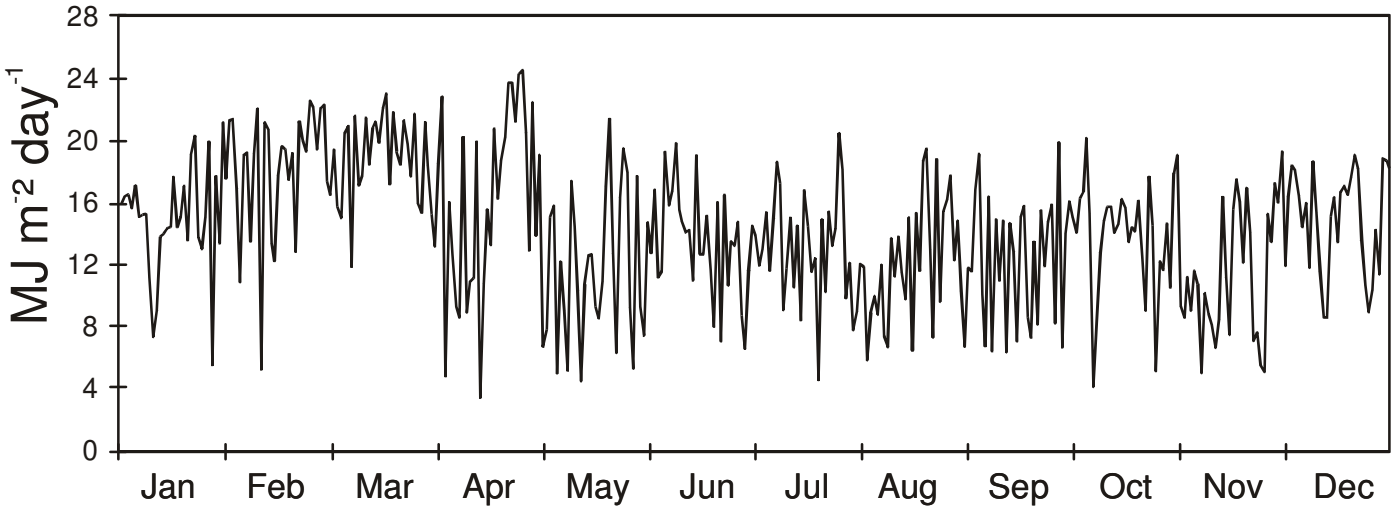


Temperature Maximum & Minimum (°C)



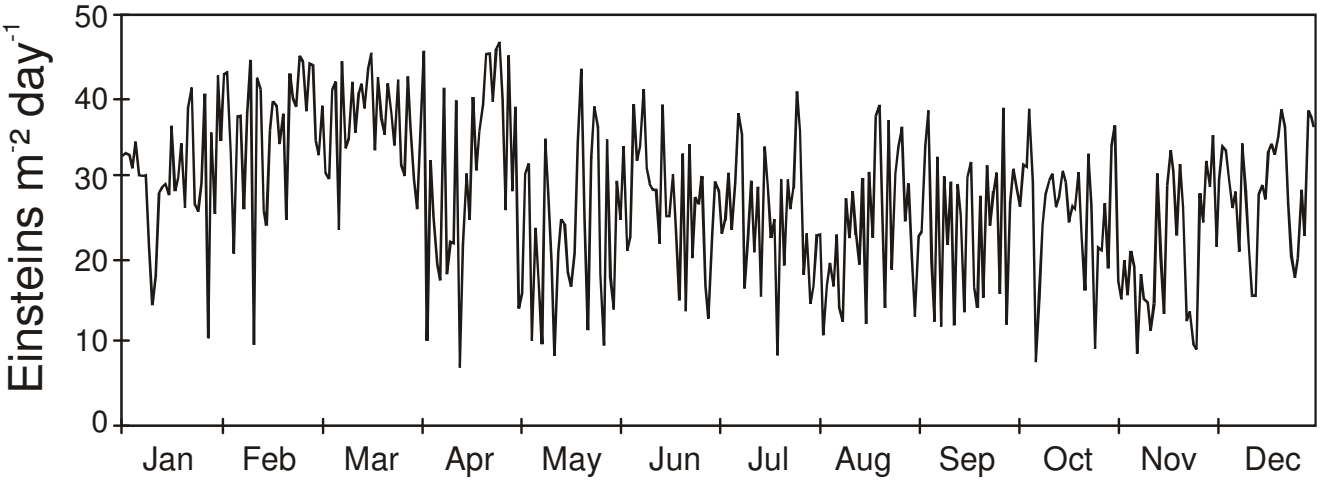
Daily Total Radiation (MJ m^{-2} day^{-1})

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	15.9	21.2	17.3	13.1	19.0	14.7	14.4	12.0	11.8	15.0	9.3	11.9
2	16.4	21.3	16.4	18.4	6.7	12.7	13.8	11.8	11.5	14.0	8.6	16.3
3	16.5	16.8	19.3	22.7	7.8	16.8	11.9	5.9	16.8	16.2	11.2	18.3
4	15.6	10.9	15.7	4.8	15.0	11.2	13.0	8.9	19.1	16.6	9.0	18.0
5	17.1	19.0	15.0	16.0	15.8	11.5	15.3	10.0	10.1	20.1	11.6	16.4
6	15.0	19.1	20.4	12.6	5.0	19.2	11.6	8.8	6.7	15.2	10.7	14.4
7	15.2	13.5	20.9	9.3	12.2	15.8	14.9	12.0	16.3	4.2	5.0	15.9
8	15.2	19.1	11.8	8.6	9.0	16.7	18.6	7.4	6.4	8.4	10.2	11.7
9	11.1	22.0	21.5	20.1	5.2	19.7	17.2	6.7	14.9	12.7	8.8	18.6
10	7.3	5.2	17.0	8.9	17.3	15.5	9.1	13.7	10.9	14.8	8.1	15.3
11	9.0	21.1	17.7	10.9	14.4	14.7	11.7	11.2	14.8	15.7	6.7	11.5
12	13.8	20.6	21.4	11.1	10.3	14.0	15.0	13.8	6.3	15.7	8.5	8.6
13	14.0	13.3	18.4	19.9	4.5	14.2	10.5	11.5	14.6	14.0	16.3	8.6
14	14.3	12.2	20.8	3.5	10.7	11.0	14.5	9.8	12.8	14.6	11.2	15.1
15	14.4	17.7	21.1	10.8	12.6	19.0	8.4	15.0	7.1	16.2	7.5	16.3
16	17.6	19.5	19.8	15.5	12.6	12.7	16.7	6.5	15.0	15.6	15.5	13.4
17	14.4	19.3	22.0	13.2	9.3	12.6	14.4	15.3	15.7	13.4	17.4	16.6
18	15.1	17.4	22.9	20.7	8.5	15.1	11.5	11.6	8.6	14.4	16.0	17.0
19	17.0	19.1	17.1	16.2	10.9	11.6	12.4	18.6	7.3	14.1	12.1	16.5
20	13.5	12.8	21.7	18.7	17.0	8.0	4.6	19.4	13.5	16.1	16.9	17.5
21	19.1	21.2	19.2	20.2	21.3	16.0	14.9	13.0	8.1	12.4	14.0	19.0
22	20.2	19.9	18.4	23.6	12.7	7.1	10.2	7.3	15.5	9.0	7.1	18.1
23	13.7	19.2	21.2	23.6	6.3	16.4	15.4	18.7	11.9	17.6	7.6	13.6
24	13.0	22.4	19.7	21.1	16.3	10.6	13.2	9.6	14.7	14.5	5.5	10.7
25	15.0	22.0	17.6	24.2	19.4	13.5	14.3	15.4	15.8	5.1	5.1	8.9
26	19.9	19.3	21.6	24.4	17.9	13.2	20.4	16.2	8.2	12.2	15.2	10.4
27	5.5	22.0	15.9	20.4	9.2	14.7	18.0	17.7	19.8	11.6	13.4	14.2
28	17.7	22.2	15.3	12.9	5.3	8.7	9.8	12.3	6.7	14.6	17.2	11.4
29	13.3		21.1	22.4	17.6	6.6	12.1	14.8	14.0	10.5	15.9	18.8
30	21.1		18.3	13.8	9.3	11.6	7.8	10.3	16.0	17.8	19.2	18.6
31	17.5		15.2		7.4		9.0	6.7		19.0		18.1



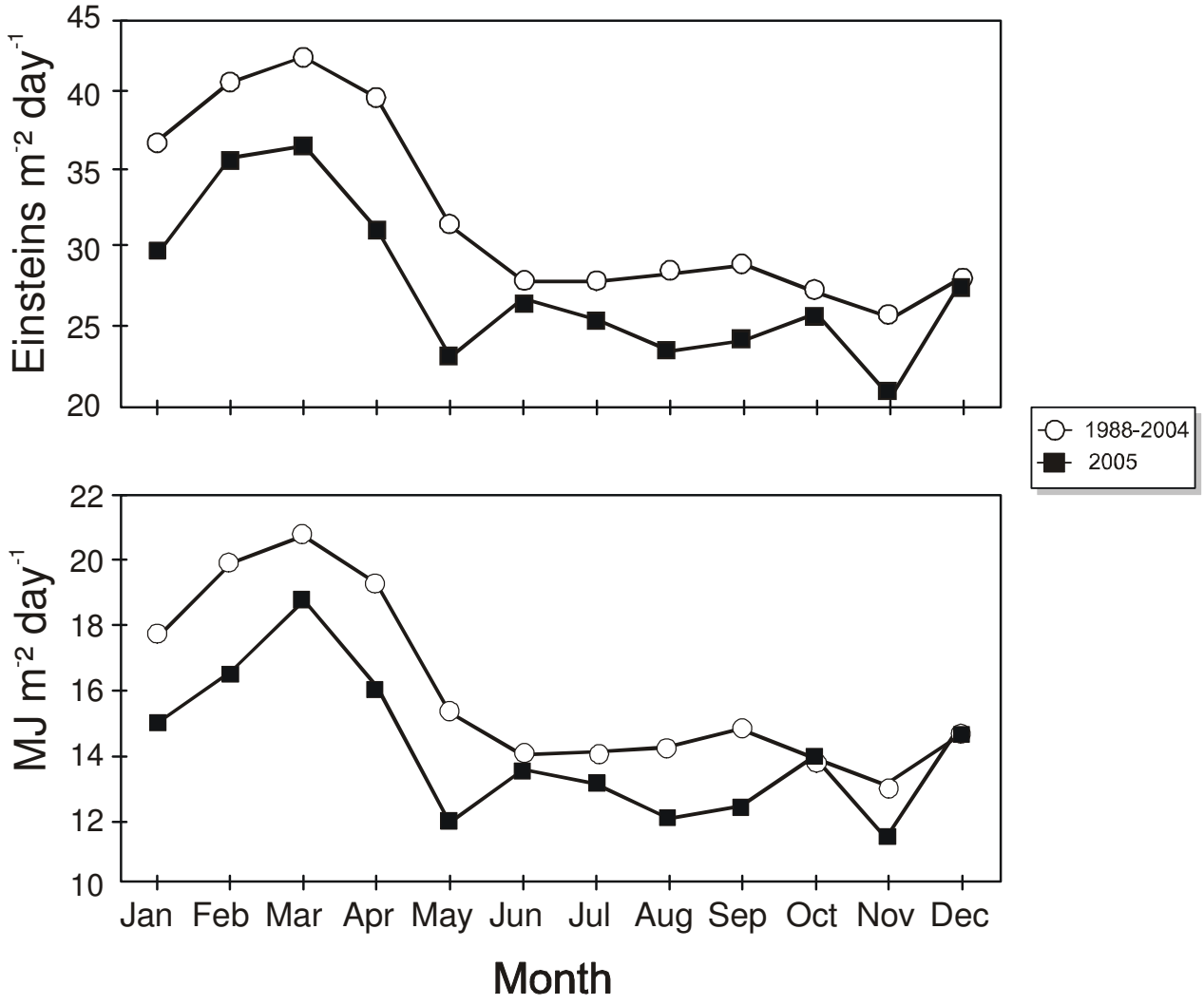
Daily Total PAR (Einsteins m^{-2} day^{-1})

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	32.6	42.6	34.5	26.2	38.6	29.6	29.6	23.0	22.8	28.6	17.4	21.6
2	33.0	42.8	32.8	36.3	14.1	24.9	28.4	23.1	23.4	26.5	15.2	29.8
3	32.8	33.0	38.8	45.5	16.0	33.9	23.2	10.8	33.9	31.6	19.9	33.8
4	31.2	20.8	30.7	10.1	30.5	21.1	24.8	16.9	38.2	31.3	15.7	33.4
5	34.4	37.5	29.9	32.2	31.7	22.8	30.6	19.6	19.9	38.4	21.1	30.0
6	30.3	37.6	40.7	25.3	10.1	39.0	23.7	16.8	12.5	29.5	19.1	26.3
7	30.2	26.2	41.7	19.5	23.9	32.1	29.4	23.1	32.6	7.5	8.6	28.3
8	30.3	37.9	23.7	17.5	17.4	33.8	37.9	14.1	11.9	15.6	18.2	21.0
9	21.6	44.4	44.2	40.9	9.7	40.8	35.3	12.5	30.1	24.2	15.2	34.2
10	14.5	9.6	33.6	18.3	34.8	31.2	16.5	27.5	21.9	28.1	14.8	28.4
11	18.0	42.2	34.7	22.2	27.9	29.3	22.5	22.7	29.5	29.7	11.4	21.3
12	28.1	40.8	41.7	22.0	19.7	28.6	29.7	28.4	12.0	30.5	14.7	15.6
13	28.9	26.0	35.5	39.4	8.3	28.5	20.9	23.0	29.2	26.4	30.5	15.6
14	29.2	24.2	40.4	6.9	20.9	22.0	28.9	19.5	25.6	27.7	20.4	28.0
15	27.9	35.8	41.5	21.8	24.9	38.9	15.5	29.9	13.6	30.8	13.4	29.1
16	36.3	39.3	38.5	30.5	24.3	25.3	33.8	12.2	30.0	29.4	29.1	27.4
17	28.4	38.8	43.4	24.9	18.5	25.3	29.1	30.7	31.9	24.6	33.4	33.2
18	30.1	34.1	45.2	39.9	16.8	30.5	22.7	22.7	16.6	26.6	30.8	34.1
19	34.2	37.8	33.4	30.9	20.8	23.4	25.0	37.5	14.1	26.2	23.0	32.8
20	26.4	24.8	42.2	35.7	34.4	15.1	8.4	38.9	27.8	30.7	31.6	35.0
21	38.5	42.7	37.4	39.0	43.3	32.9	29.8	25.2	15.4	22.8	26.4	38.3
22	41.0	39.6	35.2	45.1	25.0	13.8	19.3	14.1	31.5	16.3	12.6	36.2
23	26.8	38.7	41.5	45.2	11.4	34.1	29.8	37.0	24.2	32.9	13.7	26.8
24	25.9	44.9	37.9	39.2	32.4	20.2	26.2	18.8	28.4	26.6	9.7	20.5
25	29.4	44.2	33.9	45.7	38.7	27.6	28.7	30.6	30.6	9.2	9.1	17.8
26	40.2	38.2	42.0	46.5	36.2	26.8	40.5	33.8	15.8	21.5	28.1	20.2
27	10.4	43.9	31.6	39.5	18.1	30.2	35.7	36.2	38.5	21.2	24.6	28.5
28	35.5	43.8	30.2	26.0	9.6	16.8	18.2	24.7	12.1	26.9	32.1	22.9
29	25.6		42.3	44.9	34.7	12.8	23.2	29.3	26.9	18.9	28.9	38.2
30	42.5		36.2	28.4	17.9	23.0	14.6	20.3	31.1	34.0	35.2	37.4
31	34.5		29.9		13.9		16.8	13.1		36.4		36.2



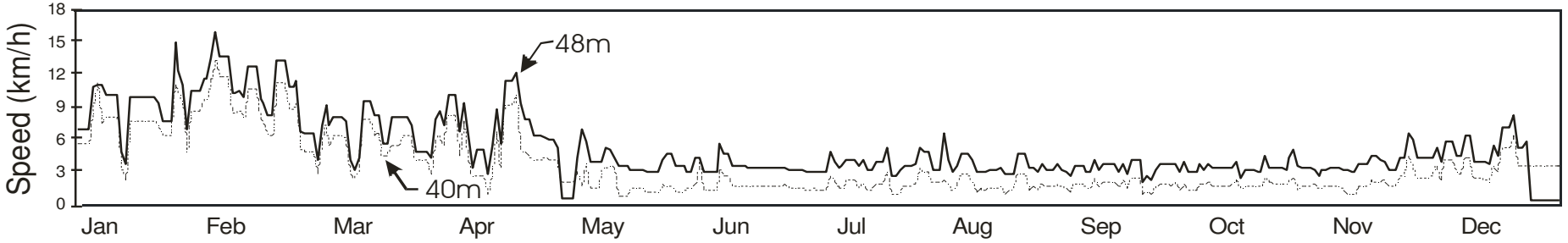
Total Monthly Solar Radiation

	Long-term Average (1988-2004)				2005	
	PAR (Einsteins m^{-2} day^{-1})		Pyranometer (MJ m^{-2} day^{-1})		PA R	Pyran.
	Mean	S.D.	Mean	S.D.		
January	37.1	4.8	17.7	1.1	**30.0**	**15.0**
February	41.0	4.6	20.0	1.1	**36.2**	**18.2**
March	42.7	3.3	20.9	1.1	**36.9**	**18.8**
April	40.1	3.2	19.4	1.1	**31.5**	**16.1**
May	31.7	3.6	15.3	1.4	**23.4**	**11.8**
June	28.1	3.4	14.0	1.1	**27.1**	**13.5**
July	28.1	3.3	14.1	1.2	**25.8**	**13.0**
August	28.6	3.6	14.2	1.7	**23.7**	**12.0**
September	29.2	3.1	14.8	1.1	**24.4**	**12.4**
October	27.3	4.5	13.9	1.5	**26.2**	**13.9**
November	25.7	4.1	13.0	1.1	**20.8**	**11.4**
December	28.5	5.8	14.6	2.4	**28.5**	**14.8**



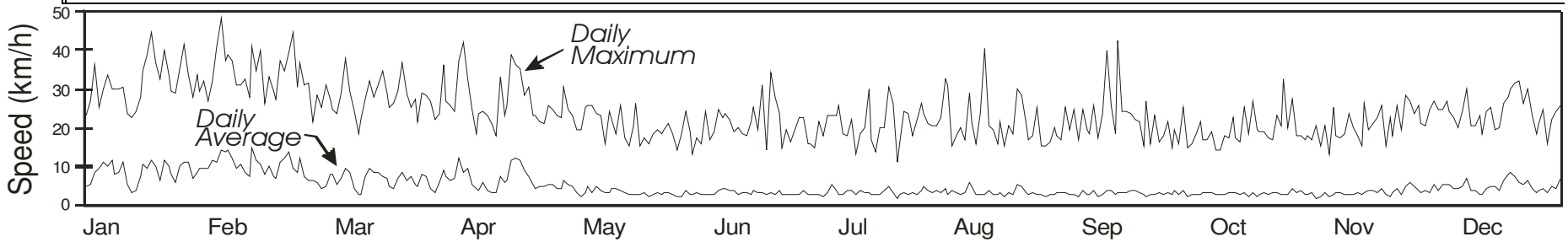
Daily Average Wind Speed – Totalizing Anemometer (km/h)

	Jan.		Feb.		Mar.		Apr.		May		June		July		Aug.		Sep.		Oct.		Nov.		Dec.	
	40m	48m	40m	48m	40m	48m	40m	48m	40m	48m	40m	48m	40m	48m	40m	48m	40m	48m	40m	48m	40m	48m	40m	48m
1	5.3	6.7	9.4	11.4	2.6	3.8	5.1	6.9	1.7	0.3	1.3	2.7	1.2	2.7	1.7	3.0	1.1	2.8	1.1	2.7	1.6	2.9	3.3	5.0
2	5.3	6.7	9.5	11.3	5.3	7.1	8.0	9.8	1.7	0.3	1.5	3.9	0.9	2.7	1.9	6.2	0.9	2.2	1.1	2.7	1.2	2.4	2.0	3.6
3	5.3	6.7	11.2	13.2	7.0	8.8	8.0	9.8	1.7	0.3	3.7	3.9	0.9	2.7	1.5	3.8	1.6	3.2	1.1	2.7	1.3	2.8	3.8	5.6
4	5.3	6.7	13.1	15.6	5.2	7.0	8.0	9.8	2.6	4.0	0.9	2.7	0.9	2.7	1.0	2.7	1.6	3.2	1.6	3.4	1.3	2.8	3.8	5.6
5	8.9	10.6	11.4	13.5	6.0	7.7	4.1	6.5	1.3	6.7	0.9	2.7	2.3	4.5	1.3	3.3	1.6	3.2	1.5	2.9	1.4	3.1	3.8	5.6
6	10.8	1.9	11.4	13.5	6.0	7.7	7.3	9.0	3.5	5.5	0.9	2.7	2.0	3.7	2.4	4.4	1.2	2.8	1.8	3.5	1.4	3.1	2.7	4.1
7	7.1	19.5	11.4	13.5	6.0	7.7	3.8	6.0	1.2	3.6	0.9	2.7	1.3	3.0	2.4	4.4	1.2	2.8	1.3	3.1	1.4	3.1	2.4	4.2
8	7.8	9.8	8.2	9.9	5.8	7.3	2.3	3.1	1.2	3.6	2.9	5.4	1.1	3.3	2.4	4.4	2.1	3.8	1.3	3.1	1.1	2.9	4.1	6.1
9	7.8	9.8	8.2	9.9	2.6	3.9	2.3	4.7	1.2	3.6	2.3	4.3	1.9	3.7	1.7	3.8	1.3	2.9	1.3	3.1	0.6	2.8	4.1	6.1
10	7.8	9.8	8.3	10.2	2.1	2.8	2.3	4.7	3.0	3.6	2.3	4.3	1.9	3.7	0.9	2.8	1.7	3.4	1.3	3.1	0.6	2.7	2.1	3.6
11	7.8	9.8	7.7	9.7	2.6	4.0	2.3	4.7	3.0	4.9	1.4	3.2	1.9	3.7	1.1	2.7	1.7	3.4	1.3	3.1	0.6	2.7	2.1	3.6
12	2.9	4.6	10.5	12.5	7.6	9.3	0.6	2.5	3.3	4.8	1.4	3.2	1.2	3.3	1.0	2.7	1.7	3.4	1.7	3.1	1.4	3.5	2.1	3.6
13	2.0	3.5	10.5	12.5	7.6	9.3	2.8	5.2	3.0	4.1	1.4	3.2	1.6	3.8	1.2	2.9	1.7	3.4	1.8	3.5	1.4	3.5	2.0	3.7
14	2.5	4.5	10.5	12.5	7.6	9.3	6.5	8.6	0.5	3.3	1.4	3.2	1.1	2.9	1.2	2.9	1.3	2.6	1.1	2.2	1.4	3.5	1.8	3.4
15	2.1	4.1	7.7	9.5	6.2	7.9	3.0	5.4	0.5	3.3	1.4	3.1	1.0	2.8	1.2	2.9	1.9	3.5	1.4	3.0	1.8	4.2	3.3	5.1
16	2.1	4.1	7.2	9.0	6.2	7.9	9.0	11.2	0.5	3.3	1.4	3.1	1.5	3.5	1.4	3.1	1.3	2.4	1.4	3.0	1.7	4.2	2.7	4.2
17	2.1	4.1	6.1	7.9	4.1	5.4	9.0	11.2	1.1	2.8	1.4	3.1	1.5	3.5	0.6	2.5	2.1	3.8	1.4	3.0	1.7	3.9	4.8	6.9
18	2.3	4.2	6.1	7.9	4.1	5.4	9.0	11.2	1.1	2.8	1.4	3.1	1.5	3.5	1.1	2.6	2.1	3.8	1.3	2.6	2.0	3.6	4.8	6.9
19	2.3	4.2	10.8	13.0	5.1	7.8	9.8	11.8	1.3	2.9	1.4	3.1	2.7	4.9	1.1	2.6	2.1	3.8	1.3	2.6	1.4	2.9	4.8	6.9
20	38.4	42.9	10.8	13.0	5.1	7.8	4.6	9.1	1.2	2.8	1.4	3.1	0.7	2.3	2.5	4.4	0.7	1.8	2.2	4.1	1.4	2.9	6.0	7.9
21	6.9	9.2	10.8	13.0	5.1	7.8	4.6	7.5	0.7	2.7	1.4	3.1	0.7	2.3	2.5	4.4	0.9	2.4	1.8	3.2	1.4	2.9	3.2	4.9
22	6.1	7.3	8.7	10.6	6.0	7.7	4.2	7.5	0.7	2.7	1.4	3.1	0.7	2.9	2.5	4.4	0.6	1.9	1.6	3.1	2.3	4.0	3.2	4.9
23	6.1	7.3	8.4	10.6	6.0	7.7	3.8	6.0	0.7	2.7	1.4	3.1	1.4	3.3	1.1	3.0	1.4	2.8	1.6	3.1	2.3	4.0	3.2	5.5
24	6.1	7.3	9.0	11.0	6.1	6.9	3.8	6.0	0.7	2.7	1.6	3.1	1.4	3.3	1.4	3.1	1.6	3.4	1.6	3.1	4.2	6.3	3.2	
25	10.7	14.7	4.7	6.5	3.8	4.6	3.8	6.0	1.5	3.9	1.2	2.9	1.4	3.3	1.1	2.6	1.6	3.4	1.5	3.0	3.5	5.6	3.2	
26	10.0	12.0	4.6	6.3	3.8	4.6	4.0	5.9	1.3	4.4	1.2	2.9	1.6	3.5	1.6	3.5	1.6	3.4	1.9	4.0	2.2	4.0	3.2	
27	9.0	10.8	4.6	6.3	3.8	4.6	3.8	5.7	1.4	4.4	1.2	2.9	3.0	5.0	1.3	2.9	1.4	3.4	2.1	4.7	2.2	4.0	3.2	
28	4.5	6.6	4.6	6.3	3.8	4.6	3.8	5.7	0.9	3.3	1.2	2.9	2.6	4.5	1.3	2.9	1.7	3.5	1.0	3.2	2.2	4.0	3.2	
29	8.2	10.2			2.4	4.1	3.8	5.0	0.9	3.3	1.0	2.7	2.6	4.5	1.3	2.9	1.0	2.7	1.5	3.0	2.2	4.0	3.2	
30	8.2	10.2			5.6	7.6	1.7	0.3	0.9	3.3	1.0	2.7	1.7	3.0	1.5	3.5	1.6	3.5	1.5	3.0	2.4	4.0	3.2	
31	8.2	10.2			6.1	8.3			1.3	2.7			1.7	3.0	1.4	2.9			1.5	3.0			3.2	



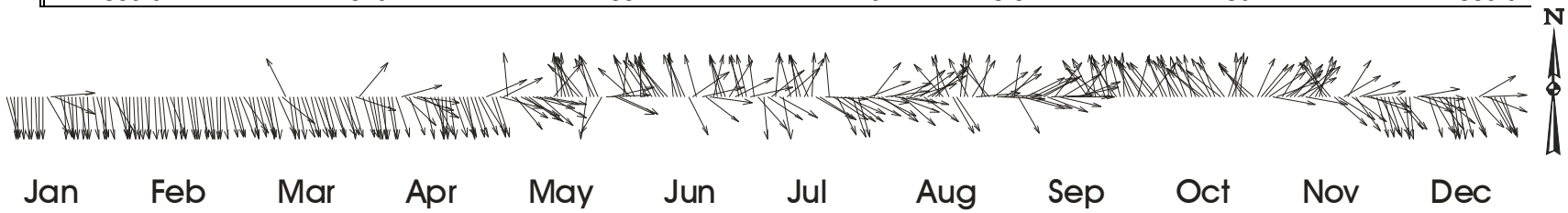
Daily Average Wind Speed (km/h)

	Jan.		Feb.		Mar.		Apr.		May		June		July		Aug.		Sep.		Oct.		Nov.		Dec.	
	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
1	5.2	23.6	11.8	32.1	5.2	31.1	6.8	26.0	5.0	23.4	3.5	17.7	2.9	21.9	4.4	33.0	2.9	19.5	2.8	16.3	1.8	20.7	4.0	24.8
2	5.7	27.1	11.7	41.5	8.3	27.5	7.2	24.6	3.8	19.7	2.9	16.2	2.4	18.3	3.2	31.2	3.2	25.1	3.3	18.8	2.5	15.4	5.5	24.9
3	9.0	36.5	14.4	48.3	8.2	25.1	12.2	37.4	2.6	19.8	3.3	24.5	3.7	23.2	4.0	15.5	2.5	17.0	3.0	21.7	3.5	20.9	5.6	27.3
4	10.0	25.6	14.1	37.7	5.9	24.1	8.7	42.2	3.7	25.4	3.2	17.1	5.9	23.5	3.6	18.1	3.9	24.9	3.5	17.3	2.5	13.8	5.6	24.7
5	11.3	30.3	14.6	39.2	7.2	29.2	10.0	32.9	5.1	26.2	3.2	19.4	4.3	23.3	3.2	20.1	3.0	19.8	3.5	17.0	3.1	25.4	4.6	22.7
6	10.3	33.9	12.6	37.4	9.7	37.9	5.7	25.0	3.8	26.0	4.3	25.2	3.1	25.9	3.5	17.3	3.0	18.8	3.7	19.0	3.8	18.3	4.8	20.3
7	11.7	30.3	9.8	31.5	8.6	29.5	4.6	18.6	5.1	24.0	4.4	23.0	3.1	18.6	5.9	29.1	3.9	26.3	2.9	14.6	3.3	17.5	5.4	24.6
8	8.1	30.2	10.8	31.1	4.8	24.3	3.9	24.1	4.3	23.5	4.5	23.7	4.2	18.3	5.3	22.1	2.8	17.5	2.8	14.7	3.0	18.5	7.4	30.2
9	9.0	30.4	9.0	32.6	3.2	18.7	6.1	24.3	3.4	16.3	4.2	22.4	4.0	22.3	3.2	16.0	3.1	23.8	3.2	18.2	3.2	23.8	4.2	21.1
10	11.2	30.5	8.0	28.2	3.0	22.3	3.9	23.5	3.7	24.5	3.9	19.4	3.3	13.6	2.8	24.1	4.0	40.1	3.5	17.8	3.3	20.4	4.2	20.7
11	5.6	24.0	15.1	41.4	7.9	27.6	3.5	21.4	4.8	22.5	3.1	20.2	4.0	18.6	3.0	40.8	4.1	26.3	3.6	22.7	3.8	18.2	3.2	23.6
12	3.8	22.9	12.1	34.9	9.7	32.3	3.8	18.2	4.5	18.9	3.4	18.8	3.8	20.5	3.9	20.7	3.0	18.8	3.7	17.9	3.1	15.7	3.0	18.8
13	4.2	24.7	11.0	40.3	9.0	28.1	7.9	33.1	4.2	26.0	3.8	18.3	3.6	30.3	3.1	19.8	3.4	42.7	2.9	16.8	3.8	26.4	4.4	24.7
14	7.8	28.2	8.4	26.7	8.7	31.2	6.0	23.6	3.4	17.9	3.0	22.0	3.3	17.4	3.2	16.3	3.6	24.4	3.4	25.6	4.3	19.7	5.3	25.7
15	10.8	34.8	10.5	33.2	8.0	35.0	6.6	26.1	3.2	15.7	4.1	25.7	3.0	14.0	3.4	21.9	3.5	24.4	2.6	18.8	4.2	21.6	4.9	19.5
16	10.0	39.3	7.9	29.8	7.3	29.3	11.9	39.1	3.1	20.9	3.8	19.9	3.1	20.3	2.4	15.5	4.0	24.0	3.5	27.1	3.6	22.9	3.9	20.1
17	12.2	44.9	7.5	27.6	5.2	25.3	12.6	36.4	2.8	26.3	3.7	31.4	4.4	20.5	3.4	21.1	4.3	22.2	2.7	19.5	4.6	25.8	6.6	26.4
18	10.3	37.2	11.4	37.3	4.6	26.3	11.9	35.6	3.3	15.7	3.1	14.8	5.1	30.7	3.0	18.8	3.5	21.9	3.2	19.3	3.1	15.4	8.0	28.1
19	6.7	32.7	12.3	34.8	7.2	29.9	9.5	28.9	3.7	17.7	3.7	34.6	3.7	26.6	5.5	30.2	3.0	15.7	3.8	19.3	2.5	22.9	8.6	30.3
20	11.8	39.9	13.9	39.5	8.6	36.9	7.8	30.9	2.7	16.0	3.3	28.3	1.9	11.3	5.1	28.9	2.5	27.1	3.2	17.5	3.8	18.1	7.9	31.7
21	10.5	34.1	10.0	44.9	6.7	29.1	5.5	23.2	3.1	18.7	4.1	24.2	3.3	16.3	3.5	21.2	2.8	16.3	3.5	17.2	4.7	25.9	6.0	32.3
22	8.3	29.5	8.8	30.9	7.6	25.3	4.7	23.3	3.5	19.9	2.9	14.9	3.7	24.3	2.9	17.0	2.8	23.4	3.5	23.3	3.1	19.8	5.5	26.7
23	6.4	29.1	12.5	37.0	5.6	27.6	5.3	21.9	2.9	18.6	3.2	19.9	3.3	24.1	3.7	18.0	3.7	16.7	3.3	20.9	5.2	28.8	6.8	30.4
24	10.2	35.5	7.9	31.1	5.1	21.9	5.1	21.5	3.4	19.8	3.1	16.9	3.5	18.2	3.2	25.7	3.1	18.1	3.3	32.6	6.1	27.0	4.7	23.4
25	11.5	41.8	6.7	32.0	8.3	29.2	5.6	25.8	3.5	21.3	2.9	19.5	3.3	22.4	3.2	15.8	3.7	21.9	3.2	20.1	5.4	24.0	3.4	18.6
26	11.6	33.7	6.9	21.7	7.5	28.7	5.7	24.9	3.1	18.6	3.1	23.1	4.3	26.4	2.7	15.5	3.1	15.0	4.7	27.6	3.9	25.9	4.1	21.6
27	7.0	28.1	6.2	28.8	4.5	27.2	4.5	23.2	2.7	14.8	3.9	23.1	5.0	24.2	3.3	16.8	3.9	20.0	3.8	18.3	3.7	21.3	4.7	25.2
28	9.0	33.9	4.4	25.6	3.6	22.2	4.5	22.7	2.7	18.7	3.0	16.2	4.2	21.2	3.0	20.1	2.8	15.9	4.3	18.1	4.2	21.0	3.5	16.2
29	9.8	29.5			6.0	23.9	6.8	30.5	4.2	24.5	3.0	16.2	3.8	21.1	3.8	18.3	3.9	25.3	2.8	17.4	3.6	24.8	5.3	22.5
30	9.9	32.2			9.1	36.6	5.5	25.0	3.2	19.4	3.0	15.1	4.1	21.0	3.4	17.1	2.4	15.2	3.1	18.0	5.9	27.0	4.4	24.5
31	10.0	27.3			7.6	27.0			2.8	13.7			3.5	23.1	3.5	25.3			3.5	17.4			7.2	25.8



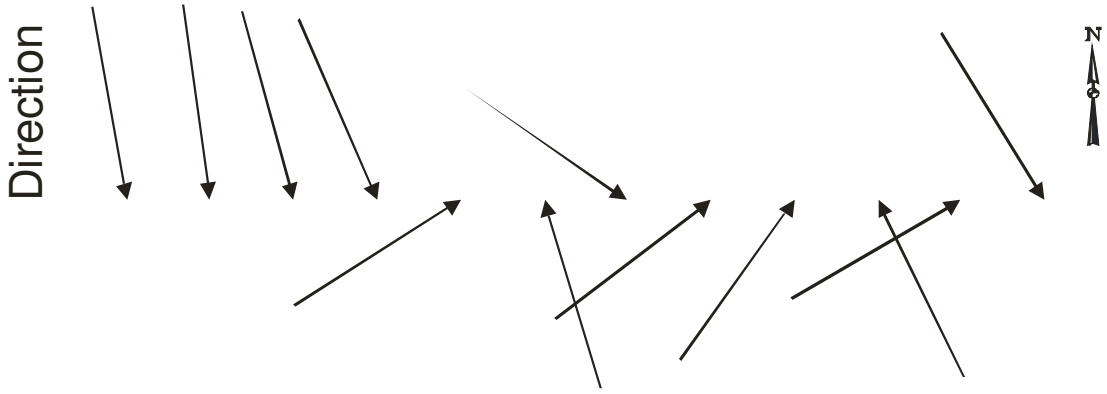
Average Daily Wind Direction

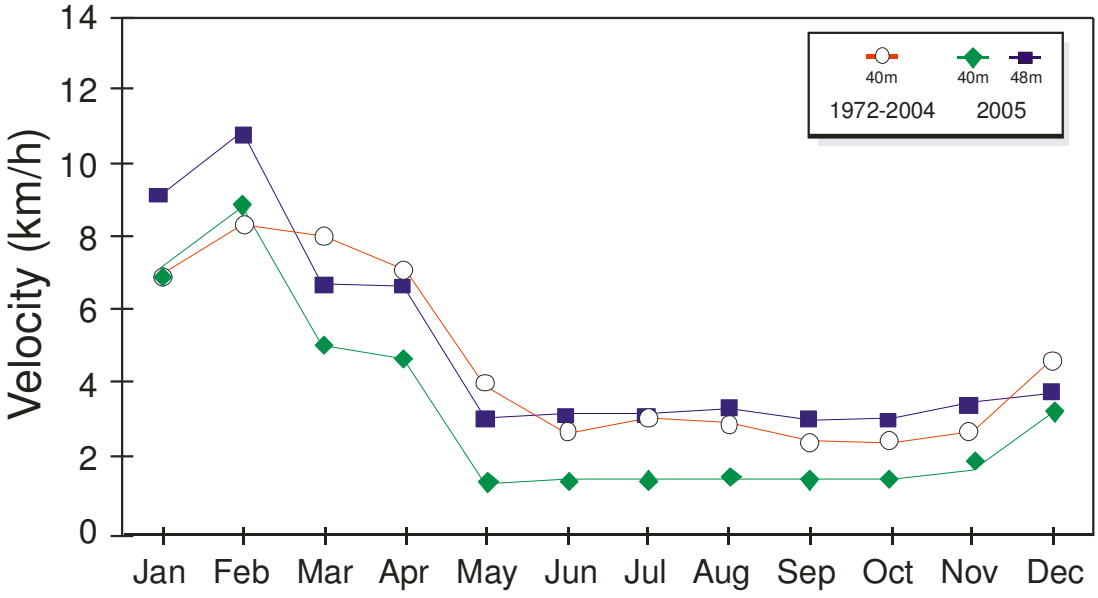
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	344.5	356.1	345.4	351.0	286.3	162.4	258.5	298.3	237.4	159.5	205.2	332.9
2	346.8	356.2	351.8	348.6	244.1	131.0	172.1	306.0	226.7	155.6	220.7	345.7
3	357.7	358.9	345.7	356.5	175.0	153.5	319.3	263.4	187.9	196.2	221.8	341.2
4	359.2	356.2	341.6	348.9	301.6	182.3	354.0	252.7	330.4	146.8	236.1	337.9
5	357.0	0.5	344.3	353.0	322.1	167.4	303.5	278.2	286.5	141.8	281.3	321.8
6	356.8	357.3	352.6	343.5	296.5	146.5	230.8	292.9	244.9	219.1	250.3	322.5
7	359.3	353.1	350.0	254.5	304.2	148.2	184.6	312.6	286.5	142.0	213.1	353.5
8	356.5	353.3	334.3	312.1	307.2	157.4	299.4	280.0	243.4	141.2	237.1	354.8
9	359.2	346.1	310.8	337.7	285.8	145.8	349.3	232.8	244.6	161.1	231.8	292.0
10	358.8	339.0	153.0	289.5	280.9	142.9	228.9	253.9	242.4	155.3	222.7	259.5
11	332.0	358.6	352.6	279.1	312.8	137.9	163.3	234.8	291.5	167.4	245.1	272.6
12	265.4	356.3	353.7	300.0	280.5	175.1	172.4	305.6	268.8	156.9	229.4	290.5
13	295.7	356.6	349.6	348.1	301.3	163.2	165.8	242.2	218.0	145.1	281.6	342.3
14	342.9	348.5	343.8	334.1	220.3	163.0	205.8	231.7	283.9	149.2	224.7	332.2
15	355.6	351.8	343.4	333.6	175.2	155.3	156.3	226.7	238.9	157.1	211.5	322.0
16	351.2	353.8	346.5	353.1	180.6	335.0	183.2	174.0	271.2	172.0	199.2	310.9
17	356.7	347.3	341.7	356.5	164.8	236.2	301.5	136.7	270.4	155.4	157.8	342.7
18	356.6	354.8	339.2	357.0	161.1	164.1	304.2	156.6	256.8	130.7	142.6	351.4
19	351.2	353.6	348.6	352.3	159.1	257.5	272.7	330.1	250.0	127.1	139.3	352.4
20	0.3	356.7	347.6	343.6	138.0	307.8	176.3	325.9	214.6	136.6	312.6	349.5
21	358.7	355.2	340.3	337.6	141.5	278.8	304.4	185.4	145.0	152.5	302.4	344.6
22	351.2	358.5	346.2	342.0	8.3	192.8	332.6	188.4	151.7	158.3	241.9	334.5
23	344.0	355.0	338.2	349.5	163.4	169.9	307.7	152.1	170.2	129.0	212.1	338.7
24	353.8	347.2	337.4	340.9	152.7	164.0	293.2	212.6	130.7	141.8	305.6	317.1
25	357.2	343.8	348.2	342.7	156.1	157.7	307.2	265.9	162.4	198.6	325.5	240.1
26	353.7	347.7	345.3	334.1	29.1	211.7	344.6	192.2	173.8	201.5	250.6	267.9
27	328.1	339.7	290.0	327.3	268.0	244.4	343.8	152.1	152.6	180.8	264.4	291.5
28	345.5	327.4	219.4	246.8	259.0	171.3	298.1	138.9	143.3	183.7	283.7	330.6
29	351.3		346.0	340.6	295.8	161.2	279.1	234.5	163.0	144.5	292.9	332.6
30	353.1		347.2	341.0	294.8	166.7	249.3	268.5	175.7	137.2	343.8	335.7
31	359.0		349.2		185.2		216.7	273.8		130.7		339.9



Average Monthly Wind Speed and Direction

	Long-term Av.			2005		
	Avg. Speed		Direction	Speed		Direction
	40m	48m		40m	48m	
January	7.1	9.5	357	**7.1**	**9.0**	**350**
February	8.4	10.1	3	**8.5**	**10.3**	**352**
March	8.2	10.8	1	**5.1**	**6.7**	**345**
April	7.1	8.5	352	**4.7**	**6.6**	**337**
May	3.9	5.1	305	**1.4**	**3.1**	**238**
June	2.7	3.5	269	**1.5**	**3.2**	**164**
July	3.1	4.0	307	**1.5**	**3.2**	**258**
August	2.9	4.0	265	**1.5**	**3.4**	**233**
September	2.5	3.2	219	**1.5**	**3.1**	**216**
October	2.4	4.3	217	**1.5**	**4.8**	**154**
November	2.7	3.8	260	**1.7**	**3.4**	**240**
December	4.8	6.1	333	**3.3**	**3.8**	**333**





Estimated Evapotranspiration and Water Balance

Average (1993-2004)	'El Claro'			'40m'			'48m'		
	Month^{-1}	Day^{-1}	S.D.	Month^{-1}	Day^{-1}	S.D.	Month^{-1}	Day^{-1}	S.D.
January	**97.5**	**3.2**	**0.8**	**146.3**	**4.7**	**0.6**	**174.3**	**5.8**	**0.3**
February	**116.9**	**4.1**	**0.8**	**155.3**	**5.5**	**0.5**	**176.6**	**6.3**	**0.4**
March	**137.6**	**4.4**	**0.7**	**175.6**	**5.8**	**0.6**	**182.1**	**6.0**	**0.3**
April	**116.3**	**3.9**	**0.5**	**153.3**	**5.2**	**0.5**	**149.0**	**5.2**	**0.5**
May	**79.2**	**2.6**	**0.8**	**102.8**	**3.4**	**0.7**	**103.8**	**3.5**	**1.0**
June	**58.1**	**1.9**	**0.5**	**79.8**	**2.7**	**0.5**	**88.1**	**2.8**	**0.3**
July	**61.4**	**2.0**	**0.3**	**81.3**	**2.6**	**0.5**	**86.5**	**2.8**	**0.4**
August	**59.7**	**2.0**	**0.2**	**84.0**	**2.7**	**0.5**	**87.1**	**2.7**	**0.1**
September	**64.4**	**2.2**	**0.4**	**85.2**	**2.9**	**0.3**	**97.6**	**3.4**	**0.1**
October	**65.2**	**2.1**	**0.3**	**87.0**	**2.8**	**0.3**	**91.8**	**2.8**	**0.2**
November	**47.3**	**1.6**	**0.4**	**71.2**	**2.4**	**0.7**	**74.8**	**2.6**	**0.4**
December	**62.8**	**2.0**	**0.8**	**98.9**	**3.2**	**1.1**	**118.1**	**3.8**	**1.2**

2005	Evapotranspiration (mm eq. day^{-1})			Net Water Balance (mm eq. day^{-1})		
	'El Claro'	40 m	48 m	'El Claro'	40 m	48 m
January	**3.0**	**4.5**	**5.1**	**-0.2**	**-3.5**	**-4.1**
February	**4.2**	**5.1**	**6.0**	**-2.7**	**-4.2**	**-5.1**
March	**4.3**	**4.6**	**5.4**	**-3.0**	**-3.5**	**-4.3**
April	**3.2**	**3.6**	**4.2**	**1.4**	**1.0**	**0.4**
May	**2.2**	**2.7**	**3.2**	**7.2**	**7.1**	**6.6**
June	**2.3**	**2.6**	**3.4**	**6.0**	**6.0**	**5.2**
July	**2.2**	**2.4**	**2.9**	**1.4**	**1.0**	**0.5**
August	**1.6**	**2.3**	**3.3**	**4.2**	**6.0**	**5.0**
September	**1.3**	**2.2**	**2.9**	**6.5**	**6.4**	**5.7**
October	**2.2**	**3.0**	**3.3**	**0.4**	**-3.0**	**-3.4**
November	**1.2**	**2.1**	**2.2**	**6.8**	**12.3**	**12.2**
December	**2.8**	**3.3**	**3.9**	**-2.1**	**-6.6**	**-7.3**

Estimated Evapotranspiration and Water Balance