THE CLIMATE OF GOBABEB

by

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(With 4 figures and 8 tables)

INTRODUCTION

The Namib Desert Research Station in South West Africa is situated at Gobabeb on the northern bank of the dry Kuiseb River some 60 miles southeast of Walvis Bay and about 35 miles from the Atlantic coast. The geographical coordinates are: Latitude 23°34′S; Longitude 15°03′E; Height above mean sea level 407 m (1335 ft.).

The instrumental equipment at the climatological station makes provision for the measurement of atmospheric pressure, surface air temperature, soil temperature, humidity of the air, wind direction and force, precipitation, evaporation from a class A evaporation pan, and sunshine duration. Except for the latter two parameters and for soil temperature, autographic instruments are also provided. Observations are made daily at three terminal hours, viz. 0800, 1400 and 2000 South African Standard Time which is 2 hours ahead of Greenwich Mean Time. At present five years' complete records are available namely from October 1962 to September 1967 and these form the basis of the tables and discussion presented in the following pages.

The aim of this paper is to present in short the main climatological features obtaining at the Research Station without, however, embarking on an analysis of all the interesting details that could be extracted from the present records. A more detailed analysis is no doubt desirable but had best be postponed until at least 10 years' continuous records are available.

Further most interesting reading on the climate, weather and other features of the Namib region may be found in works by Wellington (1), Logan (2) and in "Weather on the Coasts of Southern Africa"(3).

AIR TEMPERATURE

As measured in a Stevenson screen, the air temperature has varied from an absolute maximum of 42.3°C to an absolute minimum of 2.1°C, giving an absolute range of 40.2°C. Mean daily maxima are about 32°C in the summer months December to April and about 27°C in mid-winter. Mean daily minima vary from about 15°C in summer to 10°C in winter, whilst the average daily aperiodic range (mean max. — mean min.) remains fairly constant throughout the year and is of the order of 16 to 18.5°C. Details on mean and extreme temperatures as well as of other elements are contained in Table 1.

The frequency of days with temperatures exceeding or falling under certain threshold values is climatologically of special interest. Referring again to Table 1, we notice that, in March, hot days with a maximum temperature of at least 35°C (95°F) occur on the average ten times and that such high temperatures are less frequent in other months and, as yet, have not been measured in June or July. During the five years of records daily minima have not fallen below freezing point, but minima below 5°C have been measured mainly during the months June to September; these occur on the average on three days in July and are less frequent in the other months mentioned (see Table 1). "Tropical nights"

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(1) Wellington, J. H.: *Southern Africa: A Geographical Study,* **1**; Cambridge 1955.

(2) Logan, R. F.: The Central Namib Desert, S.W. Africa. *U.S. Nat. Acad. Sci.-Nat. Res. Coun., Publ.* **758**; Washington 1960.

(3) South Africa (Union of): South African Air Force Met. Service of the Royal Navy. *"Weather on the Coasts of Southern Africa".* **2**: 1—16, plate 1; Cape Town 1944.

with a minimum temperature exceeding 20°C are likely in all months except June, July and August and are most frequent during March, April and May when roughly three to five such nights are indicated. Cool days during which the maximum temperature does not rise above 17.5°C (63.5°F) are rather infrequent but do occasionally occur from June to September; the coldest day yet recorded (viz. in August) showed a maximum temperature of 14.5°C (58°F). In the hot season, November to March, maximum temperatures on the coolest days are not likely to fall below 22°C (72°F).

The mean diurnal variation of temperature for every month and for the year as gained from thermograph traces appears in Table 2, the last column of which shows the mean monthly temperatures from which the annual variation becomes apparent. This table shows that March is the warmest month with a mean temperature of 24.2°C and July the coldest with 17.7°C. The annual range is therefore small (6.5°C) as is the case in most coastal climates. On the other hand the diurnal wave of temperature shows a large amplitude comparable with continental conditions in middle latitudes. This

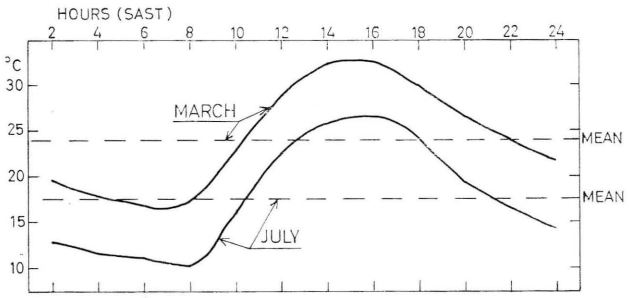

Figure 1: Mean diurnal variation of Temperature (March and July).

is illustrated in Figure 1 which shows the diurnal variation for the warmest and coldest months. Especially in winter the temperature rises extremely rapidly from 8.00 a.m. to 11.00 a.m. and is due to the intense heating of the desert in the absence of cloud during the day as well as intense terrestrial radiation at night. It will be seen that the mean diurnal range is more than twice the mean annual range.

SOIL TEMPERATURE

Average soil temperatures at various depths below the surface and at three terminal hours are contained in Table 3. From about 30 cm depth all three terminal hours show (within about 1°C) the same temperatures month for month, which indicates that the diurnal wave dies out just beyond 30 cm. The annual variation however, is still apparent at 120 cm depth, though its amplitude has decreased to 4.7°. Some idea of the daily heating of the soil is provided by observing at the three terminal hours 8 a.m., 2 p.m. and 8 p.m. It will be seen that near the surface the highest temperatures occur at 9 p.m. and one would expect the maximum soil temperature to occur normally somewhere between 2 and 8 p.m., probably between 4 and 5 p.m., and the minimum before 8 a.m. The highest soil temperature at 10 cm depth, measured on a single day, was 42.2°C in January and the lowest 10.4°C in August.

HUMIDITY OF THE AIR

On the whole the air is very dry. Mean monthly relative humidity varies from 60% in February to 36% in May as shown in the last column of Table 4. It is only in the early morning hours of the summer months that the mean humidity rises above 70 or 80%. During the afternoon in summer it drops to about 30% and in winter to about 20%. Extremely low values below 5% have been observed on individual days whilst during foggy weather 100% is reached.

The diurnal variation has a large amplitude in summer and a much smaller amplitude in winter. This is mainly due to the fact (as will be shown later) that in summer northwesterly winds transport moisture landwards at night but during the day the intense heating of the atmosphere causes the relative humidity to drop considerably; in winter on the other hand, the wind is mainly from the southeast to northeast, transporting initially dry air, so that, even at night the relative humidity barely exceeds 50%. These facts are well illustrated in Figure 2, which shows the diurnal variation for the moistest and driest months.

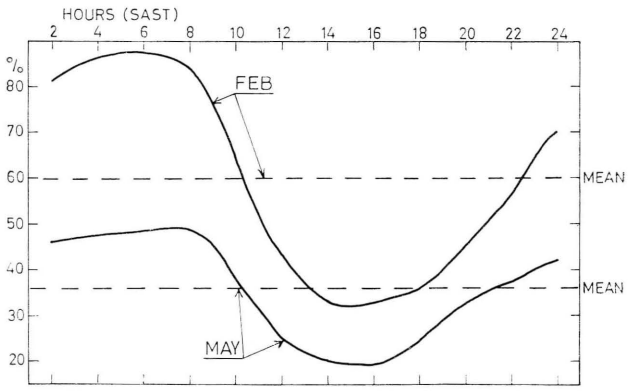

Figure 2: Mean diurnal variation of Relative Humidity (February and May).

DURATION OF SUNSHINE

A summary of the sunshine duration at Gobabeb, as gained from a Campbell-Stokes sunshine recorder, appears in Table 5. Firstly it will be seen that in

every month the average duration per day is practically 10 or 11 hours. Since days are longer in summer the percentage of the astronomically possible duration is less in summer than in winter; thus we find that, in mid-summer, the average duration is 80% of the possible, whilst in winter the percentage is well above 90%. This indicates that summer, as will be established later, is the more cloudy or foggy season and that, in winter, full sunshine is the usual condition. This is shown quite clearly in the frequency of days falling within certain categories of sunshine duration. It is noteworthy that days with no sunshine (overcast days) and days with less than 50% of the possible sunshine occur very rarely. By far the greater number of days enjoy more than 50% of the possible sunshine and in winter practically all days (more than 25 per month) receive very nearly the full quota of the possible sunshine duration.

The diurnal variation shows quite definitely that the mornings are cloudier (having less sunshine) than the afternoons as is also evident from the cloud statistics in Table 1. An examination of the hourly values (Table 5) shows that, from about 10 a.m. more than nine tenths of the possible hourly sunshine occurs in practically all months, which indicates that most fog and cloud clears at about that time.

WIND

The main characteristics of the wind regime at Gobabeb appear in Table 6. We notice the important fact that easterly to southeasterly winds are at maximum frequency in winter and have mean velocities up to 21 km per hour; on the other hand, winds from the NW sector show their highest frequency in summer but have considerably lower velocities.

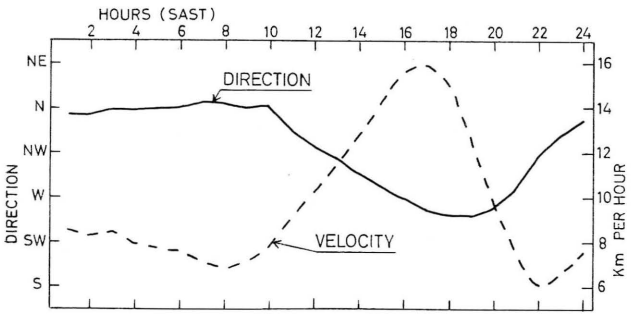

Figure 3: Mean hourly wind vectors — January.

The diurnal variation of wind speed is given in Table 7. The main features are that, in summer, the maximum speed is reached in the late afternoon at about 1800h and the minimum at about 0600h, whilst in the winter months May, June and July, the maximum is reached at or just before noon and the minimum at midnight. April seems to be the month with least wind; Table 6 also shows that April has the greatest frequency of calms.

The diurnal variation of wind direction as obtained by calculating the hourly wind vector (for January and July) shows some interesting features. Figures 3 and 4 indicate the results graphically. In January the direction shows little change throughout the day: The direction (or air displacement) is from the north up to about 1000h, then starts backing to west-south-west till 1900 (7 p.m.) and eventually veers back to north; the velocity is fairly low at night but shows a very pronounced maximum at

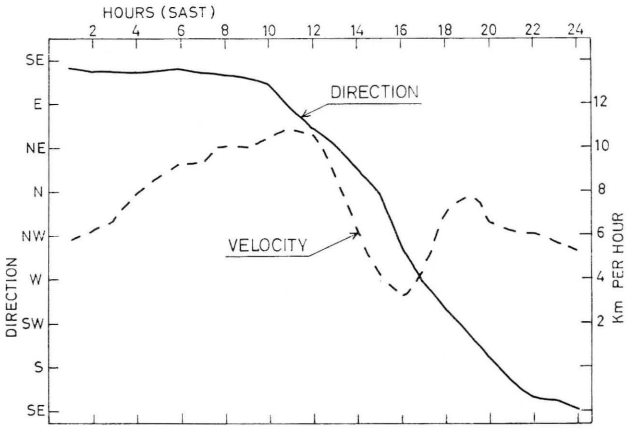

Figure 4: Mean hourly wind vectors — July.

1600 to 1700h, due to the strong southwesterly sea-breeze which penetrates inland at least as far as Gobabeb at an altitude of 400 metres; how far inland and to what altitude the sea-breeze penetrates is unfortunately not known on account of insufficient data.

In July, on the other hand, the direction is southeasterly at night up till about 1000h and then starts backing round the clock, becoming southeasterly again at midnight. In July, however, the velocity reaches a primary maximum at 1100h, then drops to almost calm and attains a secondary maximum at 1900h, the latter being again due to the sea-breeze which, however, is much less pronounced in winter. Table 7, which gives the variation of speed only, also shows most of these characteristics.

PRECIPITATION

Although five years is too short a period on which an average of precipitation can be based, especially for a desert station, the annual figure shown in Table 1, viz. 24 mm, is in reasonable agreement with those for Swakopmund and Walvis Bay. Precipitation does occur the year round, but seems to be mainly concentrated around the summer months January to March. This is in agree-

ment with the wind regime and the humidity data. The frequency of days with precipitation (Table 1) also shows that precipitation is most likely in summer, though, taking all the evidence into account, there seems to be some slight indication of a double maximum in the rainfall regime, namely in March and September.

EVAPORATION

The available records indicate that the average annual evaporation from a free water surface in a class A evaporation pan is about 138 inches (3505 mm) per year. This is about on a par with the evaporation at Windhoek. Also, the annual march of average evaporation shown in Table 8 agrees fairly well with conditions at Windhoek.

It would appear that the individual monthly amounts can vary quite considerably, due probably to the prevalence or otherwise of easterly berg winds. Thus, for instance, two different Julys showed evaporation totals of 11.1 and 7.1 inches.

FOG AND OTHER PHENOMENA

Fog, due both to advection from the cold ocean off the coast and to terrestrial radiation, occurs almost exclusively at night and clears at approximately 10 a.m. in the morning. It is mainly associated with light to moderate northerly to northwesterly winds. Table 1 shows the frequency of fog at 8 a.m.; however, it sometimes clears before 0800h and very exceptionally occurs in the afternoon or evening, so that the *number of days* with fog will be somewhat in excess of the frequency at 8 a.m. It will be seen from Table 1 that fog is mainly a summer phenomenon, having the greatest frequency in September and October, whilst May is the month with least fog.

THUNDER

It is most surprising to find a relatively high frequency of days with thunder so near to the west coast. Table 1 shows that thunder is heard on an average of 23 days per year, occurring mainly in January to March. Associated precipitation, however, is very slight and has not, as yet, exceeded 16.5 mm on a single day.

A display of lightning is quite often observed in the evenings against the great western escarpment in a northeasterly or easterly direction from Gobabeb. Cumulo-nimbus clouds apparently discharge their moisture against the escarpment but usually produce only insignificant precipitation at Gobabeb. Lightning displays have been observed from about October to May; they are most common in February and March but rarely seen in April, May or June.

HAIL

During the five years of observations, hail has occurred only once, and surprisingly enough, at 4.00 a.m. in September 1965, when hailstones of $\frac{3}{8}''$ diameter fell and the total precipitation, measured at 8 a.m., was 11.7 mm.

SNOW

During the period of observations at Gobabeb snow has not been observed, though snow is known to have fallen in that area, albeit rarely.

DUST AND SANDSTORMS

As shown in Table 1, sand or duststorms, probably the most unpleasant weather phenomena at Gobabeb, occur practically in all months of the year, but are most prevalent in winter from May to about October. They occur on an average of 15 days per year and are associated with easterly berg winds as well as with the strong southwesterly sea-breeze (see Figues 3 and 4).

CLOUDINESS

From the average monthly cloud coverage shown in Table 1, it is quite evident that there is a marked annual as well as diurnal variation in cloud amount. Summer is the main cloudy season whilst in winter skies are usually clear or only slightly cloudy.

Summer mornings are very often overcast with a layer of stratus or stratocumulus, which clears away in the course of the forenoon, leaving the afternoon and early evening only slightly cloudy, very often with remnants of altocumulus and cirrus, the latter very likely the remains of cumulo-nimbus.

TABLE 1: **Mean monthly temperatures (°C), cloud (oktas) and precipitation (mm) data.**

Month	Av. daily max. temp.	Av. daily min. temp.	$\frac{\text{max.} + \text{min.}}{2}$	Aperiodic range max. — min	True mean temp. (24 hrs.)	Abs. max.	Abs. min.	Lowest daily max.	Highest daily min.	No. of days with max. temp. ≥ 35°	≥ 30°	≤ 17.5°	≤ 10.0°	No. of days with min. temp. ≤ 0.0°	≤ 5.0°	≥ 20.0°
J	31.6	14.9	23.2	16.7	22.2	40.4	10.4	21.6	24.1	4.4	21.2	0	0	0	0	2.0
F	31.6	14.8	23.2	16.8	22.1	39.7	9.4	21.5	23.6	4.4	19.4	0	0	0	0	0.6
M	33.5	16.0	24.8	17.5	24.2	42.3	9.9	25.4	25.9	10.2	25.8	0	0	0	0	5.0
A	31.5	14.4	23.0	17.1	22.2	39.4	5.1	19.5	24.3	5.8	20.8	0	0	0	0	4.4
M	30.7	14.5	22.6	16.2	21.8	37.0	5.2	18.6	21.4	7.6	20.4	0	0	0	0	2.4
J	26.9	11.2	19.1	15.7	18.1	33.0	2.2	14.8	20.0	0	9.4	0.6	0	0	1.8	0
J	26.9	10.1	18.5	16.8	17.7	34.8	2.1	17.2	19.1	0	10.0	0.4	0	0	3.0	0
A	27.6	10.4	19.0	17.2	17.9	37.4	3.0	14.5	18.8	1.8	12.4	0.6	0	0	2.2	0
S	29.1	10.6	19.9	18.5	18.9	40.3	3.6	16.9	23.0	5.6	12.6	0.2	0	0	1.0	0.4
O	29.5	11.0	20.2	18.5	19.3	40.6	5.4	18.0	12.5	2.8	12.6	0	0	0	0	0.6
N	30.5	11.7	21.1	18.8	20.3	39.6	4.8	23.9	22.2	2.2	16.8	0	0	0	0.2	0.4
D	31.2	13.2	22.2	18.0	21.3	41.9	8.6	24.2	19.8	4.2	18.6	0	0	0	0	0
Year	30.1	12.7	21.4	17.4	20.5	42.3	2.1	14.5	25.9	49.0	200.0	1.8	0	0	8.2	15.8

Month	Average precipitation	Max. in 24 hrs.	No. of days with precipitation:— ≥ 0.1	≥ 1.0	≥ 10.0	≥ 25.0	No. of days with:— Thunder	Hail	Fog[1]	Sandstorm	Av. cloud coverage at 0800 h.	at 1400 h.	at 2000 h.
J	3.3	5.4	2.6	0.8	0.0	0	4.8	0	3.0	1.0	5.5	2.0	2.4
F	0.6	1.2	1.0	0.2	0.0	0	4.6	0	4.2	1.0	5.1	2.0	2.0
M	6.4	16.5	1.8	1.4	0.2	0	4.0	0	3.6	0.0	3.5	2.2	2.4
A	1.5	5.0	1.2	0.2	0.0	0	1.4	0	2.4	0.7	2.3	1.3	1.1
M	2.5	5.5	1.0	0.6	0.0	0	0.6	0	0.8	1.5	1.6	1.2	1.0
J	0.7	2.4	0.6	0.2	0.0	0	0.2	0	1.4	2.0	1.5	0.8	0.9
J	0.5	1.9	0.6	0.2	0.0	0	0.2	0	2.0	1.0	1.4	0.7	0.6
A	2.6	12.0	0.6	0.2	0.2	0	0.4	0	3.4	1.5	2.5	0.9	1.0
S	2.7	11.7	1.0	0.4	0.2	0	1.2	0.2	5.8	2.0	3.5	1.2	1.2
O	0.8	3.6	0.4	0.2	0.0	0	2.2	0	5.4	1.6	3.9	1.7	1.6
N	1.0	2.0	0.4	0.4	0.0	0	1.0	0	4.4	1.6	4.1	1.7	1.6
D	1.2	3.3	0.6	0.2	0.0	0	2.4	0	3.8	0.7	4.6	1.3	1.4
Year	23.8	16.5	11.8	5.0	0.6	0	23.0	0.2	40.2	14.6	3.3	1.4	1.4

[1]) Fog frequency at 0800 h. only.

TABLE 2: **Mean monthly diurnal variation of temperature (°C).**

Month	Hours, S.A. standard time												
	2	4	6	8	10	12	14	16	18	20	22	24	Mean
J	17.3	15.9	15.4	16.2	20.6	25.7	29.8	30.6	28.7	25.2	21.9	19.2	22.2
F	17.2	16.0	15.3	15.9	20.3	26.0	30.0	30.8	28.5	24.6	21.9	19.3	22.1
M	19.6	18.0	16.9	17.0	22.9	28.8	32.4	32.5	29.9	26.5	24.1	21.8	24.2
A	17.5	16.3	15.3	15.2	21.2	27.2	30.4	30.8	27.8	24.0	21.8	19.4	22.2
M	16.8	15.9	15.4	15.3	21.3	27.1	29.7	30.2	27.8	23.3	20.7	18.3	21.8
J	13.6	12.8	12.4	12.2	17.0	23.0	25.8	26.2	23.9	19.3	16.8	14.8	18.1
J	12.8	11.8	11.3	11.0	15.9	22.6	25.9	26.4	24.2	19.4	16.5	14.2	17.7
A	13.1	12.0	11.2	11.0	16.6	22.7	26.0	26.8	24.4	19.9	17.0	14.6	17.9
S	13.6	12.3	11.6	11.8	17.5	23.7	27.5	28.1	25.5	21.1	18.0	15.5	18.9
O	13.9	12.6	11.5	12.7	18.3	24.1	27.8	28.2	25.6	21.5	18.6	16.1	19.3
N	14.8	13.4	12.4	13.4	19.2	25.4	28.9	29.5	27.1	23.0	19.5	17.0	20.3
D	15.7	14.3	13.6	14.9	20.4	26.1	29.6	30.2	27.9	24.0	20.6	17.8	21.3
Year	15.5	14.3	13.5	13.9	19.3	25.2	28.3	29.2	26.8	22.7	19.8	17.3	20.5

TABLE 3: **Mean monthly soil temperatures (°C) at various depths (cm).**

Mth.	at 0800 S.A.S.T.					at 1400 S.A.S.T.					at 2000 S.A.S.T.				
	10	20	30	60	120 cm	10	20	30	60	120 cm	10	20	30	60	120 cm
J	26.4	31.3	31.3	30.8	28.7	33.1	30.7	31.2	30.8	28.7	37.9	32.9	32.4	30.7	28.7
F	26.6	31.3	31.3	31.0	29.2	32.6	30.5	31.1	31.0	29.2	37.8	32.7	32.3	30.9	29.2
M	26.7	31.0	31.2	31.0	29.4	33.1	30.5	31.1	31.1	29.4	37.0	32.8	32.3	30.9	29.4
A	23.7	28.0	28.5	29.2	29.0	29.6	27.6	28.3	29.2	29.0	33.2	29.6	29.4	29.1	28.9
M	21.3	25.1	25.7	26.8	27.8	26.2	24.9	25.7	26.9	27.8	29.4	26.5	26.6	26.8	27.7
J	18.3	21.6	22.3	24.1	26.2	21.5	21.2	22.2	24.1	26.2	25.1	22.8	22.9	24.0	26.1
J	17.7	20.9	21.4	23.0	25.0	20.8	20.4	21.5	23.1	25.1	24.7	22.0	22.1	23.0	25.1
A	18.8	21.9	22.3	23.3	24.7	22.6	21.6	22.4	23.4	24.7	26.4	23.4	23.2	23.4	24.7
S	21.2	24.6	24.9	25.1	25.1	25.8	24.2	24.8	25.1	25.1	29.9	26.3	25.8	25.1	25.2
O	21.8	26.1	26.6	26.6	25.8	29.8	26.0	26.6	26.6	25.8	32.6	28.9	28.0	26.7	25.8
N	23.8	28.1	28.7	28.3	26.9	31.9	28.0	27.8	28.4	26.9	35.5	30.6	30.1	28.3	26.9
D	25.3	30.3	30.3	29.8	27.9	32.8	29.8	30.3	29.9	27.9	37.0	32.1	31.5	29.8	27.9
Year	22.6	26.7	27.0	27.4	27.1	28.3	26.3	26.9	27.5	27.1	32.2	28.4	28.1	27.4	27.1
Range	9.0	10.4	9.9	8.0	4.7	12.3	10.3	9.7	8.0	4.7	13.2	10.9	10.3	7.9	4.7

TABLE 4: **Mean monthly diurnal variation of relative humidity (%).**

Month	Hour, S.A. standard time												
	2	4	6	8	10	13	14	16	18	20	22	24	Mean
J	78	84	86	82	63	43	33	31	35	44	57	69	59
F	81	86	87	84	64	43	33	33	35	45	57	70	60
M	67	74	77	76	56	37	28	28	31	38	47	56	51
A	60	64	67	67	53	34	25	25	30	40	46	53	47
M	46	47	48	49	38	25	20	19	24	33	37	42	36
J	52	54	54	53	43	30	22	21	26	37	43	49	40
J	52	54	54	54	43	28	21	21	27	38	45	50	41
A	57	60	62	62	49	34	26	24	29	40	49	54	45
S	66	69	71	70	53	39	27	25	30	38	52	60	50
O	73	77	78	73	52	34	26	25	29	39	52	64	52
N	75	80	82	74	53	34	26	25	28	39	55	66	53
D	79	82	84	78	58	38	30	29	32	42	57	70	57
Year	65	69	71	69	52	35	26	25	30	39	50	59	49

TABLE 5: **Average monthly sunshine duration (hours) and frequency of days falling within certain categories of duration.**

Month	Hour ending (local apparent time)														Daily average	% of possible	No. of days with:—				
	6	7	8	9	10	11	12	13	14	15	16	17	18	19			No sunshine	1—10% of possible	11—49% of possible	50—89% of possible	90—100% of possible
J	.07	.38	.59	.85	.92	.94	.97	.99	.99	.97	.95	.95	.86	.33	10.7	80	0.0	0.0	1.0	22.3	7.7
F	.06	.46	.62	.80	.91	.94	.94	.94	.97	.98	.97	.93	.90	.20	10.6	83	0.0	0.4	1.3	14.3	12.0
M	—	.58	.83	.91	.93	.95	.98	.96	.95	.93	.90	.86	.69	—	10.5	86	0.4	0.0	0.3	11.4	19.0
A	—	.38	.78	.86	.90	.95	.97	.98	.98	.96	.96	.95	.54	—	10.2	89	0.3	0.3	0.3	7.0	22.0
M	—	.24	.91	.94	.97	.98	1.00	1.00	.98	.99	.98	.94	.36	—	10.3	94	0.0	0.0	0.3	4.0	26.7
J	—	.17	.85	.88	.94	.96	.98	.99	.99	.99	.99	.97	.23	—	9.9	93	0.3	0.0	0.0	4.0	25.7
J	—	.18	.88	.93	.95	.96	.99	1.00	1.00	1.00	1.00	.99	.26	—	10.1	93	0.0	0.0	0.0	3.7	27.3
A	—	.23	.72	.82	.83	.97	1.00	1.00	1.00	1.00	.99	.96	.37	—	9.9	88	0.0	0.0	0.0	11.7	19.3
S	—	.33	.66	.76	.88	.94	.95	.97	.97	.97	.97	.93	.56	—	9.9	83	0.3	0.0	2.0	11.0	16.7
O	.04	.56	.72	.83	.90	.93	.96	.97	.95	.94	.95	.95	.84	.08	10.6	84	0.0	0.3	1.0	14.0	15.7
N	.15	.57	.73	.90	.97	.97	.95	.95	.97	.96	.95	.95	.94	.34	11.3	86	0.0	0.0	1.4	12.3	16.3
D	.15	.49	.67	.88	.96	.98	.97	.97	.98	.98	.97	.96	.95	.45	11.4	84	0.0	0.0	0.7	18.3	12.0
Year	.09	.38	.75	.86	.92	.96	.97	.98	.98	.98	.98	.95	.63	.28	10.5	87	1.3	1.0	8.3	134.0	220.4

TABLE 6: **Monthly direction frequency (%) and mean velocity (V, in km/hr) for each of eight directions.**

Mth.	N		NE		E		SE		S		SW		W		NW		Calm
	%	V	%	V	%	V	%	V	%	V	%	V	%	V	%	V	%
J	31	14	2	10	1	8	1	7	2	9	15	17	14	14	24	13	10
F	24	12	2	8	1	8	1	9	4	12	16	16	16	13	22	12	14
M	18	11	3	10	2	17	5	10	8	13	14	17	13	13	13	12	24
A	8	11	3	13	7	14	10	9	10	12	15	15	10	12	8	11	29
M	7	13	7	17	12	17	27	10	10	12	10	15	6	11	5	11	16
J	6	14	8	19	14	21	25	12	11	13	10	13	5	10	6	12	15
J	7	14	6	21	13	20	29	11	9	11	10	13	4	10	5	11	17
A	11	12	4	14	7	17	19	11	10	13	14	14	8	10	7	11	20
S	14	11	3	9	4	16	9	13	10	15	18	16	10	11	11	11	21
O	13	11	2	10	3	17	3	9	13	14	22	17	12	12	12	11	20
N	19	12	2	7	1	14	2	12	7	13	20	18	14	13	16	12	19
D	26	13	2	7	1	16	1	7	3	12	15	17	16	13	22	13	14
Year	15	12	4	12	5	15	11	10	8	12	15	16	11	12	13	12	18

TABLE 7: **Mean monthly diurnal variation of wind speed in km/hr.**

Month	Hours, S.A. standard time												
	2	4	6	8	10	12	14	16	18	20	22	24	Mean
J	10.0	9.1	8.6	8.6	9.5	12.1	15.2	19.3	18.6	14.6	11.9	10.4	12.3
F	8.5	7.1	5.9	6.4	8.2	11.3	14.5	18.0	18.1	14.6	10.5	9.3	11.0
M	6.0	5.7	4.7	6.9	6.2	11.2	12.9	17.1	18.8	14.7	9.4	6.7	10.0
A	4.3	4.4	5.0	5.1	7.2	9.0	11.7	14.4	17.4	12.7	7.5	5.1	8.6
M	6.9	9.5	10.1	11.0	13.1	13.8	12.4	12.5	13.6	10.2	7.2	6.1	10.5
J	10.0	10.5	11.6	11.9	16.6	17.0	14.2	13.3	12.7	10.5	9.4	9.0	12.2
J	8.2	9.4	11.4	12.2	13.4	16.0	14.7	12.2	13.1	10.1	8.4	6.9	11.3
A	6.7	7.5	8.1	8.1	9.9	12.6	12.2	13.5	15.1	11.7	8.5	6.0	10.0
S	6.3	6.0	6.7	7.2	8.2	10.7	13.3	17.1	17.1	12.4	9.3	7.3	10.1
O	6.7	4.7	4.4	5.3	8.8	12.2	15.0	18.8	19.3	14.0	10.5	7.9	10.6
N	6.2	5.3	4.6	6.3	9.2	12.7	16.2	19.8	20.4	15.1	10.3	7.6	11.1
D	6.3	6.9	5.9	7.5	9.2	13.5	16.1	19.0	18.5	15.1	10.9	8.8	11.6
Year	7.3	7.2	7.3	8.0	10.0	12.7	14.0	16.3	16.9	13.0	9.5	7.6	10.8

TABLE 8: **Average Evaporation in mm.**

	J	F	M	A	M	J	J	A	S	O	N	D	Year
Windhoek	353	262	249	246	229	193	206	272	333	389	358	378	3468
Gobabeb	353	300	332	277	279	229	226	239	262	307	340	363	3507