Micro-meteorological Observations and Studies over the Sea

by

Tadao TAKAHASHI

Abstract

Observed data — wind speed, temperature, and vapour pressure at 5 levels above the sea surface up to the 400cm height, evaporation from the sea surface, and wind wave elements — obtained at Kagoshima Bay during 1953–1956 are given in Part I.

In Part II, it is concluded that the layer of hydrodynamically smooth flow, surmounted with the hydrodynamically rough flow of land origin, exsists always near by the sea surface, and that the thickness (h) of the lower layer of smooth flow can be expressed by a rough empirical formula of $h \fallingdotseq a\sqrt{t}$, where t is progressive time (ratio of fetch and wind speed at 400cm height) and a is a constant depending upon stability condition, i. e. $a=3.1$ (under stable condition)~20.0 (under strong instability).

The critical values of friction velocity for the first formation of wind waves and the generation of whitecaps are determined empirically as 3.7cm/sec and 17cm/sec respectively in Part III; and humidity profiles and evaporation from the sea surface are discussed in Part IV.

Contents

Introduction.

Part I. Micro-meteorological Observations at Kagoshima Bay during 1953–1956.
1. Method of observation.
2. Observed data.

Part II. Wind Profiles over the Sea not far apart from Land.
1. Historical note.
2. Wind profiles under neutral condition of stability.
3. Wind profiles under stable condition.
4. Wind profiles under unstable condition.
5. Conclusions and remarks.

Part III. Wind Profiles and Wind Waves.
1. Introduction.
2. Critical friction velocity for the first formation of wind waves.
3. Generation of whitecaps.
4. Friction velocity and wave length and height.
5. Conclusion.

Part IV. Humidity Profiles over the Sea and Evaporation from its Surface.
1. Humidity profiles over the sea.
2. Evaporation from the sea surface.
3. Conclusion.

Acknowledgement.

References.

Introduction

It is noticed recently that the lowest layer of the atmosphere next to the sea surface up to several meters, as well as next to the ground surface, is a quite special region where comparatively weak wind and less austausch prevail. Detailed studies on phenomena occurring in this layer are desired as micro-meteorological problems.

Micro-meteorological studies over the sea have such an advantage that a physical treatment is comparatively easy owing to physically simple character of sea surface. On the other hand, observed data over the sea are less numerous than over the ground, due to increased difficulties in observations. From this point of view, the author have carried out micro-meteorological observations over the sea at Kagoshima Bay and attempts to get new knowledge concerning the problems of wind profile and evaporation and so on which give rise to discussion in this branch of meteorology.

Part I Micro-meteorological Observations at Kagoshima Bay during 1953–1956.

1. Method of Observation.

Observing levels of 25, 50, 100, 200, and 400cm above the sea surface are conveniently selected for measurements of wind speed, air temperature, and vapour pressure. Surface water temperature, evaporation, wave length, wave height, and wave period are also observed.

Thermocouple anemometers (S. Kawata and others[1]), which are always free from the effect of temperature of ambient air, are used for wind speed measurements, keeping their hotwire in plumb line to prevent them from the effect of the variation of wind direction. Detailed type of them made and used by the author for the practical purpose is somewhat different from Kawata's type, but it is quite same in principle. Reading in millivoltmeter (5mV in full scale) is converted into wind speed (cm/sec) by means of calibration curves, obtained from careful experiments in our laboratory.

In actual observations over the sea, thermocouple anemometers mounted at 5 levels are connected with a switch board and a millivoltmeter. Average values for 30 seconds for each anemometer are read in turn, and these measurements are repeated 4 times successively. Mean values of these four 30 second averages for each specified level are calculated and are regarded as the wind speed at the specified levels. Since it takes 10 minutes during the observations stated above, mean wind speed during the identical 10 minutes are measured simultaneously with cup anemometers (one contact for ca 50m of air flow) at three levels mostly (100, 200, and 400cm excepting the early observations). One of cup anemometers is calibrated in the wind tunnel in Meteorological Agency of Japan and others are calibrated on the roof of Kagoshima Meteorological Observatory and our laboratry comparing with standard ones.

For temperature and vapour pressure measurements, a set of dry and wet thermopiles (12 couples of copper-constantan) is used at 25 and 50cm levels successively and Assmann's aspiration psychrometers at 50, 100, 200, and 400cm levels.

One side junction of thermopile, shaped like a comb and eqipped with a radiation shield, is mounted at a observing level; while the other side, sealed with paraffin wax into 12 small glass tubes, is floated at the sea surface, maintaining the glass tubes vertical to the surface by a float (wooden frame supporting the glass tubes) and a sinker. The temperature difference between air and water is read directly in millivoltmeter (5mV in full scale) and the reading is converted into temperature (to the order of 0.1°C) by means of calibration curves. Air temperature is obtained from this temperature difference and from the surface water temperature, simultaneously observed with a mercury thermometer graduated at every 1/10°C. Average values for 30 seconds are read twice at two levels in turn. Mean values of these two averages for each specified level are employed as temperature data at the specified levels. Assmann's psychrometers are read after 3 minute aspiration. When the two different instruments give different values for the same level of 50cm, the values obtained with thermopile are rejected.

For evaporation measurements, a pan is used. This is a cylindrical vessel (20cm in diameter and 25cm in depth) equipped with a small wooden float surrounding its body. Containing the neighbouring sea water of 13cm deep to be evaporated, it is floated on the sea surface, after the float is adjusted to keep the inside water level as nearly same as outside sea level. To protect the pan from inundation due to waves, it is moored to the inside of a floating square frame (2m in side) without floor and with sinkers, locating at a nearly central point of the frame. Six hours later, the decrease of the contained water in the pan is measured with a common rain measuring glass.

Water temperature inside of the pan agreed always with that of the outside of even the frame, but the exposure of the contained water to be evaporated is not under the natural condition owing to the edge of the pan and the frame. The disturbances of the inside water are of course much less than those of outside water.

Another cylindrical pan (20cm in diameter and 10cm in depth) containing the neighbouring sea water of 2cm deep, in the interest of comparison, is exposed on the deck of the observing boat and the decrease of the contained water for 6 hours is measured with the rain measuring glass.

To measure the wave length, waves are photographed including two scales, crossed perpendicularly to each other and suspended horizontally at a short distance above wave crests. It is obvious that the wave length (L) is given by the relation of

$$L=\frac{l}{N}\sin\left(\tan^{-1}\frac{m}{l}\right),$$

when portions of the two scales covering N waves are l cm and m cm in length respectively. When wave length exceeds about 200cm, aditional measurements are made by the well-known usual method estimating wave length on the basis of observing ship's length.

To observe wave height and period, a floating scale of well-known Froude's type is used. The heights and numbers of successive individual waves passing through the location of the scale during one minute are measured by naked eyes, and then mean height and wave period are calculated. For very short waves, average height is estimated directly, because individual wave heights cannot be observed by this primitive way.

2. Observed Data

The observing points are indicated in Fig. 1 and the observing periods are shown in the following table. All instruments are calibrated carefully in our laboratory before and after each series of observations. When the calibration curves obtained after a specified series of observations disagree with those before the observations, the specified series of observed data are all rejected. (These series are not included in the table.)

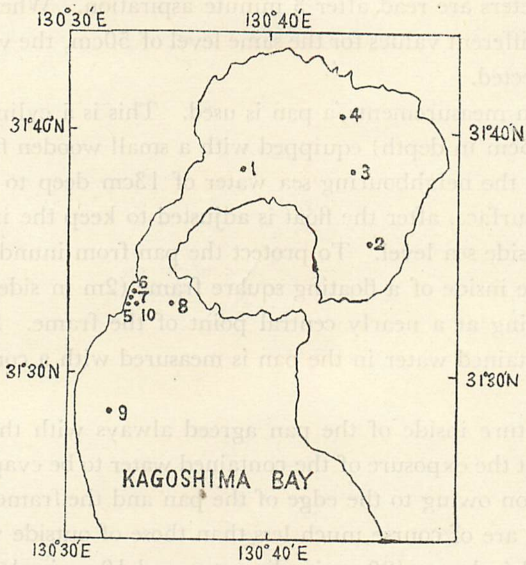


Fig. 1. Map showing observing points.

Observing periods

Series	Period	Station	No. of obs.	Method of setting
A	Sept., 1953	1, 2, 3, 4	4	Boat
B	Oct., 1953	5	2	Fixed to sea floor
C	Dec., 1953-Jan., 1954	6	31	Fixed to sea floor
D	Dec., 1954	7	148	Boat
E	April-May, 1955	8, 9, 10	69	Boat
F	Aug., 1955	10	15	Boat
G	Oct.-Nov., 1955	9, 7	83	Boat
H	Aug.-Sept., 1956	9	50	Boat
		Total	402	

For the series B and C, the instruments are mounted to movable arms stretching from a pole fixed to the sea floor and are moved up and down along the pole according to the tide to retain them, except for cup anemometers, at specified elevations.

For other series, observations are made on a small fishing boat (9m in length), which is moored to three buoys (glass ball of ca 40cm in diameter) connected respectively to dropped three anchors surrounding the boat. The instruments are mounted to arms stretching outerward from a pole set up specially for the present purpose at a corner of its stern. The stern has been kept formost to wind during observations, adjusting the lengths of rope from the boat to the buoys and also the locations on the boat connecting the ends of the ropes. It took only 1–5 minutes to complete this procedure of keeping the stern windward at a shift of wind or tidal current. Furthermore, to get more reliable data, the boat is equipped specially with a sea-anchor preventing it from undesirable tossing, though the weighty engine lying at the center on the boat floor has the similar effect. The setting of the instruments and examples of the procedure at a shift of wind or tidal current are illustrated in Fig. 2.

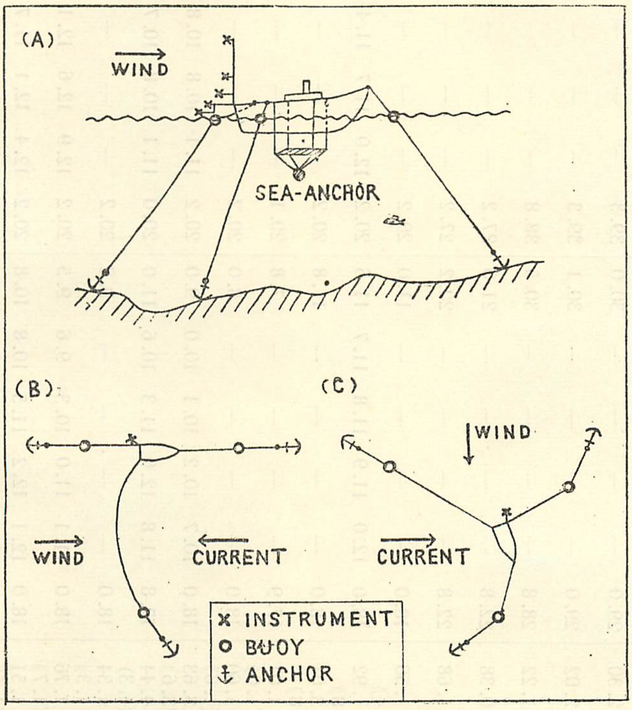


Fig. 2. (A) Arrangement of observing boat and setting of instruments.
(B), (C) Examples of situation under different directions of wind and tidal current.

The observed data are listed in the following three tables. In the table wind speed, temperature, and vapour pressure are denoted by u (in m/sec), T (in °C), and e (in mb) respectively. Subscripts indicate specified observing heights (cm) above the sea surface, T_0 is the surface water temperature, and e_0 is saturation vapour pressure at the sea surface and is obtained from the saturation value corresponding to the surface water temperature multiplied by a constant of 0.98 for its lowering due to salinity. Values in bracket in wind speed column are obtained with cup anemometers.

Observed data of wind, temperature, and vapour pressure

No.	Date	Time	St.	Wind speed (m/sec)					Temperature (°C)						Vapour pressure (mb)						Wind dir.	Fetch (m)
				u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}		
	1953	h m																				
1	Sept. 8	11.00	1	1.00	1.05	1.10	1.16	1.20	28.9	—	—	—	—	28.5	39.0	—	—	—	—	—	N N E	10,200
2	〃 〃	13.00	2	1.32	1.38	1.44	1.58	2.30	29.0	—	—	—	—	30.0	39.3	—	—	—	—	—	E S E	2,700
3	〃 〃	13.30	3	1.63	1.75	1.86	1.88	2.02	29.0	—	—	—	—	30.1	39.3	—	—	—	—	—	E S E	5,800
4	〃 〃	14.30	4	0.94	1.00	1.05	1.12	1.22	28.8	—	—	—	—	30.5	38.8	—	—	—	—	—	E S E	9,000
5	Oct. 30	16.30	5	0.21	0.23	0.26	0.30	0.38	22.8	—	—	—	—	21.0	27.2	—	—	—	—	—	calm	—
6	〃 〃	17.00	〃	1.01	1.12	1.22	1.40	1.68	22.8	—	—	—	—	20.2	27.2	—	—	—	—	—	N	180
7	Dec. 23	11.20	6	0.97	1.08 ((1.0))*	1.14	1.31 ((1.4))	1.50	18.0	—	—	—	—	11.0	20.2	—	—	—	—	—	N	200
8	〃 〃	12.10	〃	1.15	1.35 ((1.4))	1.42	1.65 ((1.8))	1.92	18.0	12.0	11.9	11.8	11.7	11.6	20.2	12.0	11.7	11.4	10.4	10.2	N	200
9	〃 〃	12.40	〃	1.64	1.97 ((2.3))	2.35	2.58 ((2.8))	3.01	18.0	—	—	—	—	11.8	20.2	—	—	—	—	—	N	200
10	〃 24	10.20	〃	0.84 ((0.8))	0.89	0.95 ((0.9))	0.96	1.07 ((1.0))	17.9	—	—	—	—	7.8	20.1	—	—	—	—	—	N	200
11	〃 〃	10.40	〃	1.22	1.30 (1.3)	1.44 ((1.4))	1.50	1.60 ((1.6))	18.0	—	—	—	—	8.0	20.2	—	—	—	—	—	N	200
12	〃 〃	11.30	〃	2.07	2.35 ((2.5))	2.70 ((3.0))	3.18	3.63 ((3.6))	18.0	10.7	10.2	10.1	10.0	9.0	20.2	11.1	10.8	10.8	10.8	10.6	N	200
13	〃 〃	12.00	〃	2.39 ((2.5))	2.95	3.40 ((3.7))	3.82	4.44 (4.3)	17.8	11.8	12.0	11.3	10.6	11.0	20.0	11.1	10.8	10.7	10.7	10.7	N	200
14	〃 25	09.00	〃	0.90 ((0.9))	0.95	0.98 ((1.0))	1.13	1.34 ((1.3))	18.0	—	—	—	—	9.2	20.2	—	—	—	—	—	NW	90
15	〃 〃	09.30	〃	1.20 ((1.2))	1.30	1.38 ((1.4))	1.55	1.76 ((1.7))	18.0	11.1	11.0	10.3	9.6	9.5	20.2	12.9	12.6	12.1	11.5	11.4	NW	90
16	〃 〃	10.30	〃	1.09 ((1.0))	1.13	1.20 ((1.2))	1.36	1.51 ((1.5))	18.0	12.1	12.2	11.5	10.8	10.8	20.2	12.4	12.1	11.7	11.0	11.0	N	200
17	〃 〃	11.30	〃	0.70	0.80	0.83	1.05	1.29	18.0	13.4	13.5	12.9	12.3	12.3	20.2	13.1	12.6	11.7	10.7	10.6	N	200
18	〃 〃	12.10	〃	0.80	0.85	0.88	1.02	1.15	18.0	13.8	13.9	13.5	13.1	12.9	20.2	13.0	12.4	11.7	11.1	11.1	N	200
19	1954 Jan. 6	08.20	〃	1.24 ((1.2))	1.33	1.42 (1.4)	1.51	1.56 ((1.5))	16.7	9.0	7.4	6.3	6.3	5.6	18.6	10.0	8.5	7.7	7.6	7.4	N N E	400

* Values in double bracket are obtained at different levels (cm), which are as follows: No. 7, 60, 270; No. 8, 80, 290; No. 9, 90, 300; No. 10, 40, 130, 380; No. 11, 140, 390; No. 12, 70, 160, 410; No. 13, 30, 150; No. 14, 40, 160, 410; No. 15, 20, 140, 390; No. 16, 20, 140, 390; No. 19, 20, 350;

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Date		Time	St.	Wind speed (m/sec)					Temperature (°C)						Vapour pressure (mb)						Wind dir.	Fetch (m)
					u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}		
	1954		h m																				
20	Jan.	6	09.10	6	0.99	1.08 (1.0)	1.11	1.29 (1.1)	1.30 (1.3)	17.0	11.7	11.5	10.7	10.1	9.8	19.0	10.7	9.1	7.9	7.8	8.0	NNE	400
21	〃	〃	10.10	〃	1.00	1.09 (1.1)	1.16	1.23 (1.2)	1.33 (1.3)	17.0	12.7	12.5	11.9	11.9	11.8	19.0	8.5	8.0	7.4	7.1	7.0	NNE	400
22	〃	〃	10.50	〃	1.40	1.48 (1.5)	1.67	1.72 (1.6)	1.87 (1.8)	17.3	12.8	12.7	12.1	12.1	11.8	19.3	8.8	8.0	7.0	7.0	7.0	NNE	400
23	〃	7	08.10	〃	2.05	2.12 (2.0)	2.30	2.59 (2.3)	2.95 (2.9)	16.8	9.4	9.2	9.1	9.1	9.0	18.7	9.4	8.9	7.9	7.9	8.3	NNE	400
24	〃	〃	09.00	〃	2.45	2.62 (2.5)	2.77	3.08 (2.9)	3.47 (3.3)	16.8	9.4	9.2	9.3	9.3	9.0	18.7	9.8	9.2	7.8	7.5	7.6	NNE	400
25	〃	〃	10.00	〃	2.20	2.34 (2.2)	2.47	2.83 (2.6)	3.20 (3.2)	17.2	11.3	11.1	11.3	11.1	10.6	19.2	9.9	8.1	7.2	6.4	6.8	NNE	400
26	〃	〃	10.40	〃	2.86	3.04 (3.1)	3.24	3.64 (3.6)	3.94 (4.0)	17.2	11.6	11.4	11.3	11.0	10.4	19.2	8.0	7.3	7.1	6.4	6.2	NNE	400
27	〃	〃	11.30	〃	2.45	2.59 (2.7)	2.83	3.23 (3.1)	3.60 (3.6)	17.2	11.8	11.5	11.2	11.1	11.0	19.2	7.2	6.6	6.1	6.0	6.0	NNE	400
28	〃	8	09.00	〃	5.50 (5.8)	5.85	6.20	6.58 (6.5)	7.35	16.3	11.1	10.7	10.9	10.9	10.8	18.2	10.3	10.2	10.0	9.9	10.0	NE	22,500
29	〃	〃	09.30	〃	4.90 (4.9)	5.15	5.44	5.72 (5.8)	6.13	16.4	11.9	11.2	11.1	11.0	11.0	18.3	11.6	11.8	9.9	9.4	9.5	NE	22,500
30	〃	〃	10.00	〃	4.31 (4.3)	4.48	4.80	5.12 (5.1)	5.36	16.4	12.6	12.2	11.3	11.4	11.3	18.3	10.7	9.9	9.8	9.6	9.3	NE	22,500
31	〃	〃	10.50	〃	4.68	5.07 (5.0)	5.29	5.70 (5.8)	6.01	16.2	12.7	12.5	12.2	11.8	11.8	18.0	10.7	9.2	9.7	9.3	9.3	NE	22,500
32	〃	〃	11.40	〃	3.83	4.07 (4.1)	4.34	4.56 (4.7)	4.85	15.9	12.9	12.8	12.7	12.6	12.6	17.7	10.6	10.2	10.0	9.9	9.9	NE	22,500
33	〃	〃	12.00	〃	2.28	2.49 (2.5)	2.59	2.76 (2.8)	2.93	16.0	—	—	—	—	12.8	17.8	—	—	—	—	—	NE	22,500
34	〃	14	13.30	〃	1.49	1.85 (2.0)	2.21	2.52 (2.4)	2.84 (2.9)	17.4	15.6	15.2	14.8	15.0	14.8	19.5	13.9	12.8	11.7	11.7	11.2	NNW	120
35	〃	〃	14.10	〃	1.77	2.01 (2.1)	2.30	2.75	3.18 (3.2)	17.4	15.0	14.8	14.7	14.6	14.6	19.5	13.3	12.5	11.9	11.6	11.5	NNW	120
36	〃	〃	15.00	〃	0.91	1.20 (1.2)	1.55	1.69 (1.7)	1.98 (1.9)	17.3	15.4	15.2	15.1	14.8	15.0	19.3	13.0	11.9	11.6	11.2	10.9	NNW	120
37	〃	〃	15.30	〃	2.23	2.74 (2.9)	3.24	4.02 (3.9)	4.67 (4.8)	17.3	—	—	—	—	14.7	19.3	—	—	—	—	—	NNW	120
38	Dec.	15	15.00	7	2.60	3.30	3.65 (3.6)	4.11 (4.1)	4.61 (4.7)	18.9	11.2	11.2	11.1	11.2	11.0	21.4	9.0	8.5	8.2	8.5	8.4	NNW	160
39	〃	〃	16.00	〃	2.51	2.70	2.84 (2.9)	3.29 (3.3)	3.62 (3.5)	18.9	9.7	9.6	9.5	9.4	9.1	21.4	8.7	8.9	8.2	6.9	5.9	N	200

No. 20, 40, 120, 370; No. 21, 140, 390; No. 22, 70, 170, 420; No. 23, 40, 140, 390; No. 24, 40, 140, 390; No. 25, 150; No. 26, 170, 420; No. 27, 70, 190, 440; No. 28, 30, 210; No. 29, 30, 210; No. 30, 30, 220; No. 31, 240; No. 32, 60, 250; No. 33, 70, 250; No. 34, 60, 160, 410; No. 35, 70, 420; No. 36, 40, 180, 430; No. 37, 190, 440;

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Data	Time	St.	Wind speed (m/sec)					Temperature (°C)						Vapoure pressure (mb)						Wind dir.	Fetch (m)
				u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}		
40	1954 Dec. 15	h m 18.00	7	1.07	1.15	1.27 (1.3)	1.35 (1.3)	1.48 (1.4)	18.8	6.1	6.1	6.2	5.7	5.9	21.3	7.1	7.0	6.4	7.2	6.3	NNW	160
41	〃 〃	19.00	〃	1.30	1.49	1.57 (1.5)	1.67 (1.7)	1.78 (1.8)	18.9	4.8	4.3	4.7	4.5	4.5	21.4	6.8	7.1	7.4	7.4	6.7	NNW	160
42	〃 〃	20.00	〃	1.39	1.41	1.56 (1.6)	1.70 (1.7)	1.76 (1.8)	18.7	—	4.2	4.1	4.0	4.1	21.1	—	7.8	7.3	7.8	6.0	NNW	160
43	〃 〃	21.00	〃	1.66	1.72	1.87 (1.8)	1.95 (1.9)	2.09 (2.0)	18.6	—	2.7	2.6	2.5	2.4	21.0	—	7.8	7.1	6.5	6.7	NNW	160
44	〃 〃	22.00	〃	2.28	2.45	2.60 (2.6)	2.77 (2.8)	3.15 (3.1)	18.6	—	2.7	2.2	1.7	2.2	21.0	—	6.7	6.7	6.7	6.9	NNW	160
45	〃 〃	23.00	〃	2.12	2.23	2.38 (2.3)	2.66 (2.6)	2.97 (2.9)	18.6	—	4.1	3.2	2.3	2.7	21.0	—	7.3	6.8	6.4	6.6	NNW	160
46	〃 16	00.00	〃	1.53	1.60	1.80 (1.7)	1.75 (1.8)	1.87 (1.8)	18.6	—	3.4	3.1	3.1	2.8	21.0	—	7.3	7.0	6.4	6.0	NNW	160
47	〃 〃	01.00	〃	1.59	1.63	1.86 (1.9)	1.96 (2.0)	2.08 (2.0)	18.5	—	4.3	4.0	4.3	3.8	20.9	—	7.2	7.0	6.8	6.6	NNW	160
48	〃 〃	02.00	〃	1.77	1.91	2.06 (2.0)	2.20 (2.2)	2.35 (2.3)	18.5	—	4.5	4.3	4.1	4.0	20.9	—	8.3	7.3	6.3	6.5	NNW	160
49	〃 〃	03.00	〃	1.20	1.45	1.49 (1.4)	1.47 (1.5)	1.64 (1.6)	18.3	—	5.5	5.0	4.5	4.7	20.6	—	8.2	7.5	6.7	6.7	N	200
50	〃 〃	04.00	〃	1.41	1.46	1.63 (1.6)	1.65 (1.6)	1.69 (1.7)	18.4	—	5.3	5.0	4.7	4.7	20.7	—	8.6	7.5	6.3	6.4	NNW	160
51	〃 〃	06.00	〃	1.37	1.42	1.50 (1.4)	1.61 (1.6)	1.67 (1.6)	18.6	—	4.4	4.3	4.2	4.2	21.0	—	8.1	7.4	6.8	6.5	NW	150
52	〃 〃	07.00	〃	1.35	1.65	1.61 (1.7)	1.93 (1.8)	1.95 (1.9)	18.7	—	3.4	3.4	3.4	3.3	21.1	—	8.4	7.4	6.5	6.4	NNW	160
53	〃 〃	08.00	〃	1.37	1.44	1.61 (1.6)	1.75 (1.7)	1.80 (1.8)	18.6	—	4.3	3.9	3.5	3.3	21.0	—	7.1	7.0	6.9	6.4	NW	150
54	〃 〃	09.00	〃	1.16	1.20	1.33 (1.3)	1.35 (1.3)	1.55 (1.6)	18.8	—	11.5	10.6	9.7	9.5	21.3	—	10.0	9.1	8.2	7.6	NW	150
55	〃 〃	10.00	〃	0.50	0.48	0.51 (0.3)	0.54 (0.5)	0.60 (0.7)	19.1	—	14.2	12.8	11.4	11.2	21.7	—	14.1	11.6	9.1	8.3	NW	150
56	〃 〃	11.00	〃	1.08	1.25	1.22 (1.2)	1.39 (1.5)	1.48 (1.5)	19.0	—	16.0	14.0	12.0	11.8	21.5	—	10.1	9.3	8.4	8.4	NW	150
57	〃 〃	12.00	〃	0.67	0.74	0.88 (0.8)	0.85 (0.8)	0.90 (0.9)	19.0	—	12.6	12.6	12.6	12.4	21.5	—	10.5	9.2	7.9	7.9	NE	22,700
58	〃 〃	13.00	〃	0.80	0.89	1.01 (1.0)	0.99 (1.0)	1.07 (1.1)	18.9	12.8	12.9	12.4	12.1	12.2	21.4	9.5	9.4	9.5	9.4	9.2	NE	22,700
59	〃 〃	14.00	〃	1.39	1.46	1.63 (1.6)	1.72 (1.7)	2.01 (2.0)	18.8	13.5	13.3	13.5	13.1	13.1	21.3	10.0	9.6	9.2	9.0	8.7	N	200
60	〃 17	09.00	〃	3.38	4.13	4.71 (4.7)	5.39 (5.5)	6.15 (6.1)	18.7	11.0	10.6	10.2	9.8	9.5	21.1	9.9	9.1	8.3	6.8	6.5	N	200

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Date	Time	St.	Wind speed (m/sec)					Temperature (°C)						Vapour pressure (mb)						Wind dir.	Fetch (m)
				u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}		
61	1954 Dec. 17	h m 10.00	7	3.29	3.87	4.32 (4.3)	5.04 (5.0)	5.53 (5.5)	18.8	13.4	12.5	11.6	10.6	11.2	21.3	11.6	9.4	7.2	6.5	7.2	N	200
62	〃 〃	11.00	〃	2.85	3.05	3.58 (3.5)	3.96 (4.0)	4.50 (4.5)	18.8	12.1	11.6	11.7	11.6	11.4	21.3	8.2	8.1	6.3	6.6	6.4	NW	150
63	〃 〃	12.00	〃	3.16	3.35	3.78 (3.7)	4.24 (4.2)	4.66 (4.7)	18.4	15.7	13.7	12.4	11.4	11.6	20.7	11.4	9.5	8.3	7.6	7.4	N	200
64	〃 〃	13.00	〃	2.71	2.88	3.06 (3.0)	3.50 (3.5)	3.92 (3.9)	18.6	12.9	12.9	12.9	11.8	12.6	21.0	7.7	7.5	7.4	7.3	7.0	NNE	450
65	〃 〃	14.00	〃	2.35	2.52	2.78 (2.7)	2.90 (2.9)	3.07 (3.0)	18.0	13.5	13.2	13.5	12.7	12.4	20.2	8.4	7.2	6.0	6.1	5.1	NE	22,700
66	〃 〃	15.00	〃	2.11	2.24	2.39 (2.4)	2.67 (2.7)	3.13 (3.1)	18.4	15.0	14.4	13.8	13.2	12.8	20.7	9.5	8.7	7.9	6.5	6.2	N	200
67	〃 〃	16.00	〃	1.42	1.59	1.65 (1.6)	1.91 (2.0)	2.16 (2.1)	17.8	13.0	12.4	12.2	12.0	11.8	20.0	7.9	7.5	7.0	6.8	6.6	NNW	160
68	〃 〃	17.00	〃	1.29	1.35	1.44 (1.4)	1.52 (1.6)	1.67 (1.6)	18.4	11.0	10.8	10.6	10.4	10.2	20.7	8.3	7.9	7.4	6.2	6.2	NW	150
69	〃 〃	18.00	〃	1.32	1.42	1.48 (1.4)	1.64 (1.6)	1.70 (1.6)	18.7	8.8	8.5	8.2	8.1	8.4	21.1	8.1	7.8	7.5	7.1	7.2	NNW	160
70	〃 〃	19.00	〃	1.45	1.43	1.61 (1.5)	1.70 (1.7)	1.79 (1.7)	18.4	7.9	7.4	6.9	6.9	6.8	20.7	8.7	8.1	7.6	7.4	7.6	NW	150
71	〃 〃	20.00	〃	1.62	1.66	1.90 (2.0)	2.09 (2.0)	2.12 (2.1)	18.4	6.1	5.6	5.1	5.1	5.4	20.7	8.9	8.1	7.3	7.1	7.3	NW	150
72	〃 〃	21.00	〃	1.66	1.86	1.98 (1.9)	1.95 (1.9)	2.14 (2.1)	18.5	5.6	5.3	5.0	4.8	4.8	20.9	8.7	7.9	7.1	7.2	7.0	WNW	150
73	〃 〃	22.00	〃	1.55	1.69	1.71 (1.8)	1.84 (1.8)	2.01 (2.0)	18.7	5.0	4.4	3.8	3.5	3.4	21.1	8.7	7.9	7.0	6.9	6.6	NNW	160
74	〃 〃	23.00	〃	1.90	1.95	2.17 (2.1)	2.17 (2.1)	2.42 (2.5)	18.7	5.0	4.6	4.2	4.5	5.0	21.1	8.2	7.7	7.3	7.0	7.2	NW	150
75	〃 18	00.00	〃	3.26	3.57	3.74 (3.8)	4.13 (4.1)	4.59 (4.5)	18.6	7.2	6.2	5.4	5.4	4.4	21.0	8.4	8.2	7.9	7.6	7.2	NW	150
76	〃 〃	01.00	〃	1.69	1.80	1.91 (1.9)	2.04 (2.0)	2.16 (2.2)	18.3	5.3	5.2	5.1	4.8	4.8	20.6	7.7	7.6	7.4	7.0	7.0	W	170
77	〃 〃	02.00	〃	2.17	2.29	2.41 (2.5)	2.76 (2.7)	3.18 (3.1)	17.9	5.4	5.2	5.2	4.8	4.6	20.1	7.6	7.3	7.1	6.8	7.0	NW	150
78	〃 〃	03.00	〃	1.97	1.90	2.11 (2.1)	2.27 (2.2)	2.45 (2.5)	17.0	3.8	3.5	3.8	3.3	3.6	19.0	7.1	7.0	6.9	6.7	6.6	NW	150
79	〃 〃	04.00	〃	2.19	2.23	2.54 (2.6)	2.64 (2.5)	2.77 (2.8)	17.1	5.5	4.9	3.6	3.0	2.7	19.1	7.7	7.3	6.8	6.4	6.3	NW	150
80	〃 〃	05.00	〃	1.59	1.56	1.77 (1.6)	2.01 (1.9)	1.99 (1.9)	17.2	4.0	3.8	3.6	3.3	3.3	19.2	8.2	7.5	6.8	6.8	6.7	NW	150
81	〃 〃	06.00	〃	2.07	2.31	2.38 (2.2)	2.38 (2.3)	2.51 (2.4)	17.7	3.3	2.8	2.3	2.0	1.8	19.8	7.6	7.1	6.6	6.4	6.1	W	170

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Date	Time	St.	Wind speed (m/sec)					Temperature (°C)						Vapour pressure (mb)						Wind dir.	Fetch (m)
				u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}		
	1954	h m																				
82	Dec. 18	07.00	7	2.45	2.50	2.71 (2.7)	2.86 (2.9)	3.07 (3.1)	18.3	3.1	3.1	2.2	1.8	1.6	20.6	7.3	7.3	6.6	6.5	6.2	W	170
83	〃 〃	08.00	〃	1.55	1.64	1.75 (1.8)	1.83 (1.9)	2.01 (2.0)	18.0	6.3	5.3	4.3	3.7	3.0	20.2	8.3	8.0	7.7	7.1	6.6	W	170
84	〃 〃	09.00	〃	3.33	3.51	3.82 (3.9)	4.35 (4.4)	4.93 (4.9)	18.4	13.8	12.6	11.4	11.3	11.2	20.7	14.6	12.8	11.0	10.5	10.4	NNW	160
85	〃 〃	10.00	〃	1.92	2.14	2.30 (2.3)	2.56 (2.6)	2.93 (2.9)	17.4	13.8	13.0	12.2	11.9	12.0	19.5	12.8	11.9	11.1	10.4	10.2	NW	150
86	〃 〃	11.00	〃	2.04	2.18	2.35 (2.3)	2.58 (2.5)	3.00 (3.0)	17.0	13.5	13.3	13.5	12.5	12.3	19.0	12.3	11.9	11.4	10.7	10.3	N	200
87	〃 〃	12.00	〃	1.86	2.03	2.18 (2.1)	2.47 (2.5)	2.78 (2.7)	17.4	12.8	12.7	12.6	11.9	11.7	19.5	12.7	12.1	11.6	11.6	10.8	NNE	450
88	〃 〃	13.00	〃	1.45	1.54	1.65 (1.6)	1.78 (1.8)	1.87 (1.8)	17.8	15.0	14.8	14.6	13.9	13.9	20.0	11.1	10.9	11.1	10.1	9.9	NE	22,700
89	〃 〃	14.00	〃	2.15	2.25	2.44 (2.3)	2.64 (2.7)	3.05 (3.0)	17.9	15.9	15.8	15.9	15.0	14.9	20.1	13.4	12.4	11.4	10.6	10.5	NNE	450
90	〃 〃	15.00	〃	1.95	2.02	2.20 (2.2)	2.35 (2.3)	2.65 (2.6)	18.1	16.2	16.0	15.8	15.7	15.6	20.3	11.8	11.5	11.8	11.4	11.3	NNE	450
91	〃 〃	16.00	〃	0.41	0.38	0.40 (0.3)	0.53 (0.5)	0.57 (0.5)	17.6	16.0	15.8	16.0	16.2	15.8	19.7	12.2	11.8	11.3	10.7	10.0	NNE	450
92	〃 〃	17.00	〃	1.45	1.60	1.61 (1.6)	1.69 (1.6)	1.84 (1.8)	18.0	13.4	13.9	13.4	13.7	13.3	20.2	12.4	12.3	12.1	11.1	10.5	WNW	150
93	〃 〃	18.00	〃	1.51	1.47	1.70 (1.7)	1.70 (1.8)	1.86 (1.8)	18.2	12.5	12.2	11.9	11.6	11.4	20.5	11.8	11.4	11.0	10.3	10.6	NW	150
94	〃 〃	19.00	〃	1.55	1.52	1.68 (1.6)	1.80 (1.9)	1.92 (1.9)	18.1	10.8	10.8	10.8	10.2	10.0	20.3	11.1	10.8	10.5	10.1	9.7	NNW	160
95	〃 〃	20.00	〃	1.58	1.77	1.85 (1.8)	1.94 (2.0)	2.08 (2.0)	18.6	9.7	9.6	9.5	8.8	8.5	21.0	10.7	10.5	10.3	9.6	9.2	W	170
96	〃 〃	21.00	〃	1.60	1.65	1.85 (1.8)	1.87 (1.9)	2.02 (1.9)	18.5	8.0	7.8	7.6	7.2	7.0	20.9	9.7	9.5	9.2	9.1	8.7	NW	150
97	〃 〃	22.00	〃	1.65	1.69	1.80 (1.8)	1.95 (1.9)	2.09 (2.0)	18.5	7.3	6.9	6.6	6.5	6.7	20.9	9.7	9.0	8.8	8.8	8.6	NW	150
98	〃 〃	23.00	〃	1.49	1.69	1.66 (1.6)	1.85 (1.8)	1.95 (2.0)	18.4	8.4	8.0	7.6	6.8	6.6	20.7	10.4	10.0	9.6	9.1	8.5	NNW	160
99	〃 19	00.00	〃	2.13	2.32	2.40 (2.4)	2.58 (2.5)	2.73 (2.7)	18.5	8.0	7.9	7.3	6.7	6.2	20.9	10.2	10.1	9.4	8.6	8.4	NW	150
100	〃 〃	01.00	〃	1.58	1.77	1.84 (1.8)	2.07 (2.0)	2.14 (2.1)	18.5	8.5	8.2	8.0	7.0	7.2	20.9	10.4	10.2	9.6	8.9	8.9	NNW	160
101	〃 〃	02.00	〃	1.53	1.60	1.62 (1.6)	1.81 (1.8)	1.95 (1.9)	17.9	8.5	8.5	8.2	7.5	7.3	20.1	9.4	9.8	9.9	9.3	9.1	NW	150
102	〃 〃	04.00	〃	1.61	1.70	1.84 (1.8)	1.97 (1.9)	2.08 (2.1)	18.4	9.4	9.2	8.8	8.2	7.9	20.7	10.8	10.8	10.2	9.8	9.1	NNW	160

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Date	Time	St.	Wind speed (m/sec)					Temperature (°C)						Vapour pressure (mb)						Wind dir.	Fetch (m)
				u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}		
	1954	h m																				
103	Dec. 19	05.00	7	1.54	1.64	1.73 (1.8)	1.87 (1.9)	1.98 (1.9)	18.6	9.2	9.2	8.9	8.2	7.9	21.0	10.8	10.6	10.0	9.8	9.1	NNW	160
104	〃 〃	06.00	〃	1.71	1.90	1.98 (2.0)	2.13 (2.1)	2.26 (2.2)	18.5	9.4	9.1	8.5	7.9	7.5	20.9	10.6	10.4	10.1	9.7	9.1	NNW	160
105	〃 〃	07.00	〃	1.59	1.67	1.80 (1.8)	1.88 (1.8)	2.07 (2.0)	18.4	9.8	8.9	8.7	7.9	7.5	20.7	10.9	10.3	10.1	9.3	9.0	WNW	150
106	〃 〃	08.00	〃	1.67	1.90	2.03 (2.0)	2.16 (2.1)	2.30 (2.3)	18.4	10.4	9.5	9.5	8.6	8.3	20.7	10.7	10.3	10.3	9.5	9.4	NNW	160
107	〃 〃	09.00	〃	0.84	0.91	0.96 (0.9)	1.02 (1.0)	1.15 (1.1)	18.6	12.9	12.6	12.8	12.8	13.3	21.0	12.8	12.5	11.8	11.3	11.1	SW	400
108	〃 〃	10.00	〃	2.41	2.60	2.75 (2.7)	2.94 (2.9)	3.12 (3.1)	18.8	15.3	15.7	14.7	15.0	14.2	21.3	14.4	13.8	13.2	13.0	12.5	NE	22,700
109	〃 〃	11.00	〃	1.07	1.12	1.15 (1.2)	1.40 (1.3)	1.48 (1.4)	18.4	16.8	16.6	16.4	15.8	15.2	20.7	13.8	13.6	13.2	13.3	11.9	NE	22,700
110	〃 〃	12.00	〃	1.90	2.15	2.47 (2.4)	2.60 (2.7)	2.96 (2.9)	18.7	17.3	17.3	17.0	16.6	16.6	21.1	10.6	9.7	9.7	9.2	8.4	WNW	150
111	〃 〃	13.00	〃	2.05	2.42	2.78 (2.7)	3.12 (3.4)	3.62 (3.6)	19.0	17.6	17.4	17.4	17.3	16.7	21.5	11.9	11.4	11.2	11.1	10.5	W	170
112	〃 〃	14.00	〃	2.98	3.33	3.64 (3.6)	3.87 (4.0)	4.26 (4.3)	18.5	17.1	16.9	17.2	16.3	16.5	20.9	12.4	11.5	10.5	10.3	10.0	WNW	150
113	〃 〃	15.00	〃	2.47	2.88	3.48 (3.5)	4.04 (4.0)	4.50 (4.5)	18.9	15.9	16.2	16.1	16.3	16.3	21.4	13.7	12.8	12.6	12.3	12.4	W	170
114	〃 〃	16.00	〃	1.68	1.77	1.90 (1.9)	2.23 (2.2)	2.50 (2.5)	18.9	16.2	16.1	16.0	16.5	16.3	21.4	14.2	13.9	12.6	11.5	10.5	W	170
115	〃 〃	17.00	〃	2.48	2.59	2.83 (2.8)	3.19 (3.2)	3.63 (3.6)	18.7	14.6	14.7	15.3	14.9	14.6	21.1	12.8	13.2	12.4	12.7	12.4	W	170
116	〃 〃	18.00	〃	1.16	1.29	1.38 (1.3)	1.47 (1.4)	1.80 (1.7)	18.5	13.9	13.6	13.4	13.6	13.2	20.9	13.2	12.5	12.0	12.0	11.8	NW	150
117	〃 〃	19.00	〃	0.77	0.83	0.82 (0.6)	0.75 (0.6)	0.93 (0.8)	18.6	12.5	12.2	12.4	12.1	11.9	21.0	13.2	12.2	12.0	11.9	11.3	NW	150
118	〃 〃	20.00	〃	0.85	0.95	0.98 (1.0)	1.07 (1.1)	1.14 (1.1)	18.6	12.1	12.0	11.7	11.6	11.4	21.0	12.2	12.0	11.4	11.5	11.6	W	170
119	〃 〃	21.00	〃	0.91	1.02	1.09 (1.0)	0.98 (1.0)	1.17 (1.1)	18.6	11.8	11.6	11.6	11.4	11.3	21.0	12.6	12.1	12.3	11.9	11.7	NW	150
120	〃 〃	22.00	〃	0.97	1.05	1.04 (1.1)	1.16 (1.1)	1.35 (1.3)	18.6	12.4	11.4	11.9	11.2	11.0	21.0	13.4	12.2	11.4	11.5	11.2	NW	150
121	〃 〃	23.00	〃	1.25	1.33	1.39 (1.4)	1.45 (1.5)	1.70 (1.7)	18.5	10.7	10.6	9.8	9.4	9.4	20.9	12.0	11.9	11.2	10.9	10.8	NW	150
122	〃 20	00.00	〃	1.48	1.62	1.70 (1.7)	1.72 (1.8)	1.75 (1.8)	18.6	9.5	9.3	9.2	9.0	8.8	21.0	10.9	11.0	10.8	10.5	10.2	NW	150
123	〃 〃	01.00	〃	1.23	1.25	1.30 (1.3)	1.49 (1.4)	1.56 (1.5)	18.4	11.1	9.8	9.6	9.2	8.8	20.7	11.2	10.8	10.6	10.2	9.9	NW	150

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Date	Time	St.	Wind speed (m/sec)					Temperature (°C)						Vapour pressure (mb)						Wind dir.	Fetch (m)
				u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}		
	1954	h m																				
124	Dec. 20	02.00	7	1.06	1.25	1.23 (1.3)	1.30 (1.3)	1.51 (1.4)	18.6	10.8	9.2	8.8	8.8	8.4	21.0	11.4	10.6	10.2	9.9	9.9	NNW	160
125	〃 〃	03.00	〃	1.09	1.08	1.08 (1.0)	1.14 (1.1)	1.29 (1.2)	18.7	10.8	9.2	8.6	8.5	8.4	21.1	11.7	10.6	10.3	9.8	9.8	NNW	160
126	〃 〃	04.00	〃	0.87	0.97	0.98 (1.0)	1.05 (1.0)	1.15 (1.1)	18.9	10.6	9.6	9.6	9.4	8.6	21.4	12.0	11.4	11.1	10.5	9.8	NNW	160
127	〃 〃	05.00	〃	0.90	1.05	1.14 (1.1)	1.21 (1.2)	1.38 (1.3)	18.8	10.9	10.8	11.0	10.1	9.8	21.3	12.9	11.7	11.5	10.7	11.1	NW	150
128	〃 〃	06.00	〃	2.22	2.32	2.55 (2.5)	2.70 (2.7)	3.03 (3.0)	18.8	12.0	11.6	11.6	11.3	11.3	21.3	11.1	10.0	9.6	10.2	9.6	NW	150
129	〃 〃	07.00	〃	1.57	1.67	1.80 (1.7)	1.92 (1.9)	2.05 (2.0)	18.6	11.6	11.1	11.4	11.0	11.0	21.0	9.6	8.4	8.7	8.4	8.1	N	200
130	〃 〃	08.00	〃	0.99	1.12	1.11 (1.2)	1.23 (1.3)	1.35 (1.3)	18.7	11.4	11.3	11.3	11.1	11.0	21.1	9.3	8.6	8.6	8.6	8.4	N	200
131	〃 〃	09.00	〃	2.39	2.53	2.74 (2.7)	2.90 (2.9)	3.25 (3.2)	18.6	12.5	12.3	12.4	12.0	11.7	21.0	9.3	9.1	8.9	8.0	7.7	NW	150
132	〃 〃	10.00	〃	2.28	2.44	2.62 (2.7)	3.06 (3.1)	3.50 (3.4)	18.8	13.5	13.4	13.5	13.0	12.9	21.3	10.2	9.4	8.6	8.5	8.1	NW	150
133	〃 〃	11.00	〃	3.12	3.26	3.53 (3.5)	3.90 (3.9)	4.44 (4.4)	18.7	13.7	13.5	13.7	12.4	13.3	21.1	11.9	10.8	9.8	9.3	8.6	NNW	160
134	〃 〃	12.00	〃	3.55	3.88	4.68 (4.8)	5.30 (5.2)	6.22 (6.2)	18.8	13.6	13.5	13.4	13.4	13.1	21.3	8.2	8.2	8.1	9.2	8.6	NW	150
135	〃 〃	13.00	〃	3.87	4.16	4.82 (4.9)	5.50 (5.6)	6.47 (6.4)	18.8	14.3	14.1	13.9	13.5	13.1	21.3	12.7	11.3	9.9	10.2	10.2	WNW	150
136	〃 〃	14.00	〃	3.07	3.30	3.62 (3.6)	4.06 (4.0)	4.50 (4.5)	18.9	13.8	13.8	13.8	13.4	13.0	21.4	9.7	9.1	8.5	10.6	10.0	NNW	160
137	〃 〃	15.00	〃	2.46	2.65	2.90 (2.9)	3.44 (3.4)	3.98 (3.9)	18.7	13.2	13.1	13.2	12.9	12.8	21.1	10.4	10.0	9.7	9.9	8.9	NW	150
138	〃 〃	16.00	〃	3.30	3.60	3.83 (3.8)	4.30 (4.3)	4.72 (4.6)	18.7	12.3	12.3	12.3	12.4	12.2	21.1	10.3	10.1	10.0	10.4	9.8	NW	150
139	〃 〃	17.00	〃	1.52	1.60	1.71 (1.7)	1.83 (1.9)	2.01 (2.0)	18.6	11.4	11.2	11.0	10.9	10.9	21.0	11.6	11.2	10.7	10.5	9.9	NW	150
140	〃 〃	18.00	〃	1.97	1.88	2.14 (2.2)	2.30 (2.3)	2.39 (2.3)	18.6	10.8	10.5	10.2	10.0	9.9	21.0	9.5	9.5	9.4	9.0	9.0	N	200
141	〃 〃	19.00	〃	1.19	1.30	1.40 (1.4)	1.46 (1.5)	1.58 (1.5)	18.4	8.7	8.4	8.1	8.2	8.2	20.7	9.6	9.3	9.1	8.7	8.4	NNW	160
142	〃 〃	20.00	〃	1.60	1.78	1.90 (1.9)	2.04 (2.0)	2.16 (2.1)	18.5	8.1	8.0	7.9	7.9	8.0	20.9	9.3	8.5	7.8	7.8	7.5	NW	150
143	〃 〃	21.00	〃	1.53	1.70	1.77 (1.7)	1.83 (1.8)	2.04 (1.9)	18.3	9.8	9.5	9.2	8.9	9.0	20.6	9.8	9.4	9.1	8.6	7.9	NW	150
144	〃 〃	22.00	〃	1.03	1.08	1.24 (1.1)	1.23 (1.2)	1.35 (1.3)	18.3	8.9	8.4	8.4	8.6	8.6	20.6	11.0	9.6	8.9	8.1	8.1	W	170

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Date	Time	St.	Wind speed (m/sec)					Temperature (°C)						Vapour pressure (mb)						Wind dir.	Fetch (m)
				u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}		
145	1954 Dec. 20	h m 23.00	7	0.89	1.13	1.10 (1.0)	1.19 (1.2)	1.32 (1.3)	18.2	8.9	8.8	8.7	8.8	8.6	20.5	8.2	8.0	7.8	7.5	7.3	NNW	160
146	〃 21	00.00	〃	2.25	2.51	2.54 (2.6)	2.70 (2.8)	2.95 (2.9)	18.5	9.4	9.0	8.6	8.4	8.4	20.9	12.1	10.1	8.0	7.2	6.4	W	170
147	〃 〃	01.00	〃	2.65	2.88	3.09 (3.0)	3.22 (3.3)	3.40 (3.3)	18.4	8.6	8.4	8.5	8.0	7.9	20.7	9.2	8.0	6.6	6.6	6.3	NW	150
148	〃 〃	02.00	〃	1.46	1.53	1.65 (1.5)	1.77 (1.8)	1.85 (1.7)	18.4	8.2	8.0	7.9	7.6	7.4	20.7	8.5	8.0	7.5	7.2	7.2	W	170
149	〃 〃	03.00	〃	1.60	1.79	1.90 (1.9)	1.95 (2.0)	2.11 (2.1)	18.5	7.2	7.1	7.2	6.8	6.8	20.9	8.4	7.8	7.2	6.7	7.0	W	170
150	〃 〃	04.00	〃	1.56	1.71	1.85 (1.8)	1.86 (1.9)	2.06 (2.0)	18.2	6.6	6.4	6.2	5.8	5.7	20.5	8.8	8.4	8.0	7.7	7.6	W	170
151	〃 〃	05.00	〃	1.76	1.83	2.07 (2.0)	2.17 (2.2)	2.33 (2.3)	18.2	6.9	6.8	6.6	6.2	6.0	20.5	9.0	8.0	7.6	7.7	7.5	W	170
152	〃 〃	06.00	〃	2.06	2.28	2.00 (2.4)	2.55 (2.5)	2.67 (2.6)	18.2	6.3	6.2	5.7	5.5	5.4	20.5	8.4	7.8	7.5	7.4	7.3	W	170
153	〃 〃	07.00	〃	1.66	1.85	1.95 (1.9)	2.01 (2.1)	2.22 (2.2)	18.3	7.3	7.0	6.7	6.5	6.2	20.6	7.6	7.4	7.2	6.9	6.5	W	170
154	〃 〃	08.00	〃	1.76	1.88	1.95 (2.0)	2.13 (2.1)	2.20 (2.2)	18.3	8.4	8.2	8.0	7.3	7.2	20.6	7.7	7.6	7.7	7.2	6.7	WNW	150
155	〃 〃	09.00	〃	3.06	3.31	3.57 (3.5)	3.72 (3.9)	4.28 (4.2)	18.3	11.3	11.5	11.3	11.2	10.7	20.6	11.5	10.4	9.9	9.6	8.9	N	200
156	〃 〃	10.00	〃	2.48	2.57	2.75 (2.7)	3.03 (3.0)	3.38 (3.3)	18.4	12.2	12.1	12.4	12.0	11.6	20.7	10.5	9.1	8.9	8.3	8.0	N	200
157	〃 〃	11.00	〃	1.85	1.96	2.05 (2.1)	2.22 (2.2)	2.37 (2.3)	18.4	12.6	12.5	12.2	12.4	12.2	20.7	9.8	9.1	8.7	7.1	7.3	NE	22,700
158	〃 〃	12.00	〃	2.72	2.90	3.14 (3.1)	3.33 (3.3)	3.54 (3.5)	17.8	14.1	14.1	14.1	13.4	13.4	20.0	10.3	9.8	9.4	7.6	6.8	NE	22,700
159	〃 〃	13.00	〃	1.65	1.71	1.90 (1.9)	2.05 (2.0)	2.08 (2.0)	17.5	15.2	15.1	15.2	14.8	14.8	19.6	10.1	9.6	9.1	8.2	7.9	E	5,200
160	〃 〃	14.00	〃	0.57	0.66	0.71 (0.6)	0.70 (0.7)	0.73 (0.7)	17.5	15.0	15.0	14.9	15.3	15.2	19.6	9.0	8.6	8.1	8.1	7.6	SE	24,000
161	〃 〃	15.00	〃	1.65	1.77	1.88 (1.8)	2.18 (2.1)	2.36 (2.3)	17.8	15.5	15.2	15.5	15.1	15.3	20.0	11.0	10.4	10.1	9.4	8.6	S	500
162	〃 〃	16.00	〃	0.70	0.79	0.74 (0.4)	0.70 (0.4)	0.78 (0.5)	17.8	16.4	15.6	15.2	15.8	15.6	20.0	10.4	10.3	10.0	9.9	9.9	S	500
163	〃 〃	17.00	〃	1.50	1.62	1.74 (1.8)	1.93 (1.9)	2.05 (2.0)	18.4	13.8	14.0	13.6	13.8	13.6	20.7	10.9	10.8	9.8	9.6	9.6	WNW	150
164	〃 〃	18.00	〃	1.29	1.40	1.50 (1.5)	1.63 (1.6)	1.69 (1.7)	18.5	10.0	10.3	9.8	9.9	10.1	20.9	10.7	10.3	9.8	9.3	9.5	N	200
165	〃 〃	19.00	〃	2.16	2.25	2.47 (2.4)	2.64 (2.6)	2.96 (2.9)	18.4	8.8	8.9	8.8	8.6	8.1	20.7	10.3	9.6	9.2	9.1	8.9	NW	150

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Date	Time	St.	Wind speed (m/sec)					Temperature (°C)						Vapour pressure (mb)						Wind dir.	Fetch (m)
				u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}		
166	1954 Dec. 21	h m 20.00	7	2.01	2.11	2.30 (2.3)	2.47 (2.5)	2.75 (2.7)	18.2	7.5	7.4	7.4	7.1	6.6	20.5	9.4	8.9	8.8	8.6	8.4	WNW	150
167	〃 〃	21.00	〃	2.18	2.41	2.56 (2.6)	2.75 (2.8)	2.86 (2.8)	18.3	6.6	6.3	6.1	6.0	5.8	20.6	8.7	8.4	8.4	8.0	7.9	N	200
168	〃 〃	22.00	〃	1.54	1.72	1.88 (1.8)	1.80 (1.9)	2.06 (2.0)	18.1	5.4	5.6	5.5	5.2	5.2	20.3	7.7	8.1	8.1	7.8	7.8	N	200
169	〃 〃	23.00	〃	3.80	3.97	4.25 (4.3)	4.63 (4.6)	5.00 (5.0)	17.8	5.5	5.4	5.2	5.4	4.9	20.0	8.4	8.2	7.6	7.6	7.3	NNW	160
170	〃 22	00.00	〃	1.93	2.20	2.34 (2.3)	2.60 (2.6)	2.95 (3.0)	17.7	4.1	4.2	4.1	3.8	3.8	19.8	7.7	7.5	7.2	6.9	6.8	NNW	160
171	〃 〃	01.00	〃	2.23	2.50	2.72 (2.8)	2.95 (2.9)	3.02 (3.0)	18.0	4.9	4.6	4.5	4.2	3.9	20.2	8.0	7.5	7.3	7.0	6.8	NNW	160
172	〃 〃	02.00	〃	2.78	3.05	3.12 (3.2)	3.25 (3.4)	3.57 (3.5)	17.8	3.9	3.6	3.2	3.3	2.9	20.0	7.2	7.1	7.2	6.9	6.6	NNW	160
173	〃 〃	03.00	〃	2.61	2.88	3.09 (3.1)	3.35 (3.4)	3.78 (3.8)	17.9	3.8	3.6	3.3	3.3	3.3	20.1	6.9	6.9	6.7	6.9	6.9	NNW	160
174	〃 〃	04.00	〃	2.06	2.26	2.37 (2.4)	2.60 (2.5)	2.62 (2.6)	18.0	4.5	3.9	3.7	3.5	3.3	20.2	7.9	7.5	7.2	7.0	6.5	NNW	160
175	〃 〃	05.00	〃	2.16	2.18	2.39 (2.3)	2.50 (2.5)	2.65 (2.7)	18.0	4.3	3.8	3.5	3.2	3.1	20.2	7.9	7.5	7.4	7.2	7.0	NW	150
176	〃 〃	06.00	〃	2.61	3.02	3.20 (3.1)	3.55 (3.7)	4.03 (4.0)	18.2	4.4	4.3	3.9	3.5	3.1	20.5	8.0	7.8	7.3	7.2	7.0	NNW	160
177	〃 〃	07.00	〃	2.20	2.33	2.47 (2.5)	2.71 (2.8)	3.25 (3.2)	17.8	10.6	9.6	8.6	8.2	8.1	20.0	11.7	11.2	10.7	10.3	10.1	WNW	150
178	〃 〃	08.00	〃	1.84	1.98	2.10 (2.1)	2.29 (2.2)	2.52 (2.5)	18.2	9.9	9.8	9.7	9.7	9.6	20.5	11.8	11.7	11.6	11.1	10.8	NW	150
179	〃 〃	09.00	〃	1.56	1.67	1.82 (1.8)	2.04 (2.1)	2.33 (2.3)	18.1	10.3	9.9	9.5	9.4	9.2	20.3	10.6	10.1	10.1	10.1	10.1	NW	150
180	〃 〃	10.00	〃	1.51	1.83	1.95 (1.9)	2.17 (2.2)	2.41 (2.4)	18.2	14.5	14.3	14.0	13.4	13.1	20.5	13.0	12.6	12.7	11.8	11.7	NNW	160
181	〃 〃	11.00	〃	1.72	1.94	1.92 (2.0)	2.14 (2.1)	2.13 (2.1)	18.7	15.2	15.0	14.5	14.7	15.0	21.1	14.3	14.0	13.0	12.8	13.8	E	5,200
182	〃 〃	12.00	〃	1.68	1.87	1.98 (1.9)	2.20 (2.1)	2.26 (2.3)	18.8	15.1	15.2	14.9	15.1	14.8	21.3	15.1	14.5	13.2	12.2	12.8	E	5,200
183	〃 〃	13.00	〃	1.16	1.35	1.67 (1.6)	1.89 (1.9)	2.13 (2.1)	19.0	18.0	17.8	18.0	17.2	17.5	21.5	12.0	11.4	10.8	9.7	9.8	NNW	160
184	〃 〃	14.00	〃	2.28	2.60	3.14 (3.2)	3.53 (3.5)	4.02 (3.9)	18.8	17.9	18.0	17.9	17.4	17.4	21.3	12.7	12.4	12.7	12.2	11.8	W	170
185	〃 〃	15.00	〃	1.88	2.16	2.58 (2.5)	2.95 (2.9)	3.37 (3.3)	18.8	16.5	16.3	16.1	15.7	15.7	21.3	13.6	13.4	13.4	13.0	11.8	WNW	150
186	1955 April26	09.00	8	2.08	2.18	2.30 (2.3)	2.58 (2.5)	2.87 (2.9)	18.1	17.3	17.2	17.0	17.1	16.5	20.3	11.9	11.8	11.6	11.2	11.8	W	3,100

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Date	Time	St.	Wind speed (m/sec)					Temperature (°C)						Vapour pressure (mb)						Wind dir.	Fetch (m)
				u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}		
	1955	h m																				
187	April 26	10.00	8	2.45	2.55	2.81 (2.9)	3.17 (3.1)	3.54 (3.5)	18.3	18.2	18.3	18.0	17.9	17.8	20.6	11.9	11.7	11.9	11.3	11.4	W	3,100
188	〃 〃	11.00	〃	3.58	3.91	4.20 (4.2)	4.74 (4.6)	5.35 (5.4)	18.2	18.2	18.5	18.2	17.7	18.2	20.5	14.7	14.5	13.8	13.1	11.6	W	3,100
189	〃 〃	12.00	〃	1.65	1.82	1.97 (2.0)	2.10 (2.0)	2.38 (2.3)	18.2	18.8	19.5	18.8	18.6	18.9	20.5	12.2	11.6	12.0	11.5	11.6	W	3,100
190	〃 〃	13.00	〃	2.40	2.55	2.72 (2.8)	3.13 (3.1)	3.42 (3.4)	18.1	19.5	19.5	19.8	19.7	19.5	20.3	13.3	12.3	12.2	10.8	11.7	W	3,100
191	〃 〃	14.00	〃	2.10	2.38	2.44 (2.4)	2.60 (2.5)	2.90 (2.9)	18.2	19.4	19.5	20.2	19.4	19.4	20.5	13.9	14.4	13.5	13.2	12.7	S W	10,500
192	〃 〃	15.00	〃	1.46	1.57	1.69 (1.6)	1.78 (1.7)	1.89 (1.9)	18.0	19.8	20.0	20.2	19.9	19.9	20.2	14.0	14.4	13.1	12.5	12.3	S W	10,500
193	〃 〃	16.00	〃	2.27	2.33	2.58 (2.5)	2.97 (2.9)	3.29 (3.2)	18.1	20.3	20.4	20.4	20.0	20.2	20.3	16.6	16.1	15.9	14.9	14.1	W	3,100
194	〃 〃	17.00	〃	2.80	2.96	3.10 (3.1)	3.38 (3.3)	3.67 (3.6)	18.1	19.0	19.0	19.0	19.6	20.0	20.3	17.4	17.3	17.4	17.6	17.3	S W	10,500
195	〃 〃	18.00	〃	2.40	2.53	2.78 (2.7)	2.97 (2.9)	3.11 (3.1)	17.7	18.0	18.2	18.0	19.3	19.3	19.8	17.6	17.2	16.6	16.7	16.3	S S W	17,000
196	〃 〃	19.00	〃	3.00	3.15	3.43 (3.3)	3.54 (3.5)	3.75 (3.8)	17.8	18.3	18.5	18.7	18.7	18.8	20.0	16.4	16.3	16.2	16.0	16.1	S S W	17,000
197	〃 〃	20.00	〃	2.78	2.89	3.04 (3.0)	3.20 (3.2)	3.40 (3.4)	17.9	—	18.1	18.1	18.1	18.1	20.1	—	17.3	16.0	14.8	14.8	N N W	5,000
198	〃 〃	21.00	〃	0.98	0.91	1.12 (1.0)	1.17 (1.1)	1.38 (1.4)	17.8	18.0	18.0	18.0	18.1	18.2	20.0	16.4	16.1	15.7	15.7	14.9	N	2,100
199	〃 〃	22.00	〃	2.96	3.15	3.39 (3.3)	3.83 (3.8)	4.24 (4.3)	17.3	—	17.2	17.4	17.4	17.4	19.3	—	18.9	18.2	17.0	14.7	E	2,700
200	〃 〃	23.00	〃	2.20	2.28	2.55 (2.5)	2.63 (2.6)	2.93 (2.9)	17.6	17.1	17.0	16.9	16.9	16.9	19.7	15.6	15.5	15.4	15.2	15.4	N E	2,000
201	〃 27	00.00	〃	2.28	2.57	2.57 (2.7)	2.75 (2.8)	3.11 (3.0)	17.2	17.0	16.9	16.9	16.8	16.8	19.2	14.7	14.7	14.7	15.1	14.6	N E	2,000
202	〃 〃	01.00	〃	1.96	2.15	2.14 (2.2)	2.37 (2.3)	2.68 (2.7)	17.9	17.2	17.2	17.0	17.0	16.7	20.1	15.9	15.9	15.3	15.0	15.2	N E	2,000
203	〃 〃	02.00	〃	3.00	3.21	3.34 (3.4)	3.78 (3.7)	4.23 (4.1)	17.8	17.0	16.8	16.6	16.6	16.7	20.0	15.7	15.5	15.3	15.3	15.0	N E	2,000
204	〃 〃	03.00	〃	2.75	2.93	3.06 (3.0)	3.36 (3.4)	3.67 (3.6)	17.9	16.9	16.8	16.7	16.7	16.6	20.1	14.2	14.1	14.2	14.5	14.4	N N E	1,700
205	〃 〃	04.00	〃	1.87	1.95	2.11 (2.1)	2.26 (2.2)	2.64 (2.5)	17.8	—	16.6	16.5	16.4	16.3	20.0	—	15.2	15.2	15.2	14.8	N E	2,000
206	〃 〃	05.00	〃	1.95	2.17	2.29 (2.2)	2.45 (2.4)	2.63 (2.5)	17.8	16.7	16.6	16.5	16.3	16.3	20.0	17.0	16.1	15.3	15.5	15.8	N	2,100
207	〃 〃	06.00	〃	2.88	3.03	3.25 (3.2)	3.40 (3.4)	3.81 (3.8)	17.9	16.8	16.7	16.6	16.5	16.3	20.1	16.5	15.9	15.3	15.2	15.3	N	2,100

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Date	Time	St.	Wind speed (m/sec)					Temperature (°C)						Vapour pressure (mb)						Wind dir.	Fetch (m)
				u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}		
	1955	h m																				
208	April 27	07.00	8	3.22	3.45	3.56 (3.6)	3.82 (3.8)	4.35 (4.2)	18.0	17.2	17.2	17.2	16.8	16.8	20.2	16.5	16.5	16.5	16.4	15.1	N	2,100
209	〃 〃	08.00	〃	3.10	3.31	3.53 (3.4)	3.92 (3.8)	4.33 (4.3)	18.1	17.9	17.8	17.9	17.5	17.4	20.3	15.8	15.7	15.8	15.3	15.1	N	2,100
210	〃 〃	09.00	〃	2.82	3.00	3.25 (3.2)	3.77 (3.7)	4.39 (4.3)	18.3	18.2	18.4	18.6	18.6	18.6	20.6	16.3	16.2	16.1	16.2	16.8	N E	2,000
211	〃 28	21.00	9	2.35	2.51	2.67 (2.7)	2.88 (2.8)	3.24 (3.2)	19.0	19.8	19.9	19.9	19.8	19.8	21.5	19.6	19.8	19.2	19.6	19.0	S	10,600
212	〃 〃	22.00	〃	1.19	1.28	1.40 (1.4)	1.49 (1.4)	1.66 (1.6)	19.2	19.6	19.6	19.6	19.5	19.5	21.8	19.0	19.0	19.2	19.4	19.0	S S W	5,300
213	〃 〃	23.00	〃	1.75	1.93	1.93 (2.0)	2.10 (2.1)	2.36 (2.4)	19.2	19.1	19.3	19.2	19.2	19.2	21.8	20.1	19.4	19.0	19.0	18.9	N N W	4,300
214	〃 29	00.00	〃	0.55	0.51	0.60 (0.4)	0.66 (0.6)	0.72 (0.6)	18.9	18.6	18.6	18.8	18.8	18.8	21.4	19.6	19.6	19.1	19.1	19.1	N W	3,000
215	〃 〃	01.00	〃	1.68	1.80	1.92 (2.0)	2.06 (2.1)	2.24 (2.2)	19.3	18.9	18.9	18.7	18.6	18.6	21.9	19.4	19.4	19.2	19.1	19.1	N W	3,000
216	〃 〃	02.00	〃	1.58	1.76	1.97 (1.9)	1.98 (1.9)	2.09 (2.1)	19.4	18.1	17.7	17.6	17.8	17.8	22.1	19.0	18.5	18.6	18.5	18.6	S W	3,500
217	〃 〃	03.00	〃	1.33	1.43	1.62 (1.5)	1.65 (1.6)	1.78 (1.9)	19.3	17.9	17.8	17.6	17.8	17.8	21.9	19.0	18.6	19.0	18.6	18.3	S W	3,500
218	〃 〃	04.00	〃	1.80	1.85	1.85 (1.9)	1.94 (1.9)	2.09 (2.1)	19.8	18.3	18.0	17.9	17.8	17.8	22.6	19.1	18.9	18.6	18.6	18.5	N N W	4,300
219	〃 〃	05.00	〃	1.18	1.31	1.34 (1.4)	1.65 (1.5)	1.64 (1.6)	19.8	18.2	18.2	18.2	18.1	18.0	22.6	19.3	18.9	18.9	18.8	18.5	W N W	2,800
220	〃 〃	06.00	〃	0.80	0.86	0.93 (0.9)	0.97 (1.0)	1.05 (1.0)	19.0	18.0	18.1	18.0	17.9	17.9	21.5	19.1	18.6	18.5	18.4	18.4	N	6,000
221	〃 〃	07.00	〃	1.16	1.28	1.33 (1.3)	1.37 (1.4)	1.50 (1.5)	19.1	18.2	18.2	18.1	18.0	18.1	21.7	19.1	18.9	19.0	18.7	18.6	N	6,000
222	〃 〃	08.00	〃	1.02	1.13	1.16 (1.2)	1.30 (1.3)	1.33 (1.3)	19.2	19.0	18.8	18.6	18.1	18.2	21.8	20.0	19.9	19.6	19.0	19.1	N W	3,000
223	〃 〃	09.00	〃	0.68	0.73	0.80 (0.7)	0.77 (0.8)	0.85 (0.8)	18.8	18.2	18.0	17.9	17.8	18.2	21.3	20.1	19.9	19.3	19.6	19.1	N	6,000
224	〃 〃	10.00	〃	1.68	1.86	1.97 (2.0)	2.06 (2.1)	2.22 (2.2)	18.9	18.5	18.5	18.3	18.1	18.1	21.4	19.9	19.7	19.3	19.4	19.6	N E	11,000
225	〃 〃	11.00	〃	0.67	0.73	0.80 (0.7)	0.76 (0.7)	0.88 (0.9)	18.9	18.6	18.6	18.8	18.4	18.3	21.4	20.0	20.0	19.7	19.2	19.3	N E	11,000
226	〃 〃	21.00	〃	1.95	2.14	2.27 (2.3)	2.36 (2.4)	2.58 (2.5)	18.9	18.5	18.6	18.3	18.3	18.2	21.4	20.7	20.4	19.8	19.5	19.5	N	6,000
227	〃 〃	22.00	〃	1.18	1.26	1.37 (1.4)	1.51 (1.5)	1.56 (1.6)	18.8	18.0	17.6	17.5	17.2	17.4	21.3	18.7	19.0	18.7	18.7	18.3	N W	3,000
228	〃 〃	23.00	〃	5.48	5.85	6.22 (6.2)	6.58 (6.5)	6.99 (6.9)	18.9	18.6	18.4	18.4	18.3	18.3	21.4	19.8	20.0	19.4	19.5	19.3	S E	33,000

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Date	Time	St.	Wind speed (m/sec)					Temperature (°C)						Vapour pressure (mb)						Wind dir.	Fetch (m)
				u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}		
	1955	h m																				
229	May 1	15.00	9	1.55	1.64	1.82 (1.8)	1.93 (1.8)	2.15 (2.1)	20.8	20.8	20.5	21.0	21.1	21.2	24.1	20.4	20.0	20.4	20.2	20.5	S W	3,500
230	〃 〃	16.00	〃	1.45	1.55	1.63 (1.6)	1.75 (1.7)	1.99 (1.9)	20.7	21.0	21.1	21.2	21.6	21.4	23.9	21.4	20.6	20.7	20.0	19.4	S W	3,500
231	〃 〃	17.00	〃	3.25	3.48	3.75 (3.7)	4.20 (4.2)	4.73 (4.6)	20.9	21.0	21.4	21.0	21.4	21.5	24.2	21.5	21.0	20.4	20.6	20.1	S W	3,500
232	〃 〃	18.00	〃	4.48	4.82	5.16 (5.1)	5.41 (5.4)	6.00 (5.9)	20.7	21.2	21.2	21.2	21.4	21.6	23.9	20.7	20.5	20.7	20.2	20.0	S	10,600
233	〃 〃	19.00	〃	3.89	4.16	4.47 (4.4)	4.75 (4.8)	5.19 (5.3)	20.6	—	20.4	20.6	20.4	20.4	23.8	—	21.4	20.3	19.2	19.8	S S W	5,300
234	〃 〃	20.00	〃	5.60	6.05	6.50 (6.4)	6.88 (6.8)	7.24 (7.3)	20.4	—	20.4	20.3	20.4	20.2	23.5	—	20.6	20.5	20.4	20.6	S S E	25,000
235	〃 〃	21.00	〃	3.55	3.84	4.07 (4.1)	4.26 (4.3)	4.67 (4.6)	19.8	—	20.3	20.3	20.3	20.4	22.6	—	19.9	19.7	19.9	19.2	S S E	25,000
236	〃 〃	22.00	〃	3.05	3.27	3.51 (3.4)	3.88 (3.9)	4.35 (4.3)	19.6	—	19.5	19.8	20.1	20.2	22.3	—	19.4	19.6	19.6	19.9	E	13,400
237	〃 〃	23.00	〃	1.63	1.80	1.90 (1.9)	2.06 (2.0)	2.17 (2.1)	19.6	—	19.9	19.9	19.9	19.9	22.3	—	18.6	18.6	18.6	18.8	S	10,600
238	〃 2	00.00	〃	3.22	3.44	3.63 (3.6)	3.87 (3.8)	4.21 (4.2)	19.6	—	19.8	19.8	19.8	19.8	22.3	—	20.0	19.6	19.2	19.4	S	10,600
239	〃 〃	01.00	〃	0.81	0.83	0.94 (0.8)	1.04 (1.0)	1.05 (1.0)	19.6	—	19.4	19.6	19.8	19.8	22.3	—	19.7	19.0	18.3	18.1	N	6,000
240	〃 〃	02.00	〃	1.45	1.57	1.68 (1.6)	1.80 (1.8)	1.97 (1.9)	19.5	—	19.6	19.9	19.6	19.4	22.2	—	17.8	17.6	17.4	18.1	N	6,000
241	〃 〃	03.00	〃	0.98	1.10	1.15 (1.1)	1.27 (1.3)	1.33 (1.3)	19.0	—	19.9	19.9	19.9	20.0	21.5	—	16.9	16.7	16.5	15.9	S E	33,000
242	〃 〃	04.00	〃	0.96	1.03	1.12 (1.0)	1.25 (1.2)	1.23 (1.2)	19.4	—	19.7	19.7	19.7	19.8	22.1	—	18.1	17.9	17.8	17.3	E	13,400
243	〃 〃	06.00	〃	2.53	2.67	2.88 (2.9)	3.06 (3.0)	3.40 (3.4)	19.3	—	20.1	20.3	20.1	20.4	21.9	—	17.6	17.5	17.5	17.5	N E	11,000
244	〃 〃	07.00	〃	2.62	2.87	3.04 (3.0)	3.22 (3.2)	3.44 (3.4)	19.4	—	20.2	20.3	20.4	20.6	22.1	—	16.7	16.6	16.7	16.6	S S E	25,000
245	〃 〃	08.00	〃	2.46	2.65	2.87 (2.8)	3.28 (3.2)	3.66 (3.6)	19.6	—	19.9	20.0	20.1	20.4	22.3	—	17.8	17.5	17.3	16.7	W	2,600
246	〃 8	15.00	10	—	—	0.22	—	0.30	19.3	—	19.8	19.9	19.8	19.9	21.9	—	22.7	22.0	21.2	21.0	calm	—
247	〃 〃	21.00	〃	—	—	1.03	—	1.21	19.1	—	18.8	19.0	19.2	19.2	21.7	—	21.5	21.4	21.2	20.8	S E	24,000
248	〃 9	03.00	〃	—	—	0.45	—	0.60	18.8	—	18.4	18.5	18.6	18.6	21.3	—	20.4	20.3	20.2	19.6	S	650
249	〃 〃	09.00	〃	—	—	2.76	—	3.12	19.2	—	19.6	20.3	19.6	19.5	21.8	—	21.2	20.9	21.2	21.4	N E	23,000

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Date	Time	St.	Wind speed (m/sec)					Temperature (°C)						Vapour pressure (mb)						Wind dir.	Fetch (m)
				u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}		
	1955	h m																				
250	May 9	15.00	10	—	—	2.98	—	3.72	21.2	—	22.8	22.9	22.8	22.9	24.7	—	24.2	23.4	22.6	22.3	E	5,200
251	〃 〃	21.00	〃	—	—	1.07	—	1.41	20.2	—	20.1	20.3	20.5	20.5	23.2	—	21.8	21.7	21.6	21.2	NW	430
252	〃 10	03.00	〃	—	—	0.35	—	0.30	18.9	—	18.4	18.3	18.4	18.4	21.4	—	19.9	19.8	19.8	19.2	calm	—
253	〃 〃	09.00	〃	—	—	1.58	—	1.80	19.7	—	21.0	21.7	21.0	20.9	22.5	—	19.8	19.6	19.8	20.1	NE	23,000
254	〃 〃	15.00	〃	—	—	0.75	—	0.90	20.2	—	22.8	22.9	22.8	22.9	23.2	—	22.2	21.4	20.7	20.4	S	650
255	Aug. 5	15.00	〃	—	—	4.33	—	5.65	29.0	—	31.0	31.1	31.0	31.1	39.3	—	31.8	31.8	30.8	31.8	N	700
256	〃 〃	18.00	〃	—	—	3.52	—	4.65	27.9	—	26.8	26.6	26.8	26.9	36.8	—	30.2	29.8	29.5	29.1	NW	430
257	〃 〃	21.00	〃	—	—	2.46	—	3.05	28.0	—	26.6	26.4	26.6	26.6	37.0	—	30.6	30.5	30.3	29.8	N	700
258	〃 6	00.00	〃	—	—	1.25	—	1.39	27.5	—	25.5	25.4	25.3	25.3	36.0	—	31.1	29.9	28.7	30.2	NE	23,000
259	〃 〃	03.00	〃	—	—	1.88	—	2.42	27.0	—	24.4	24.3	24.4	24.4	34.9	—	28.7	28.7	28.6	27.9	N	700
260	〃 〃	06.00	〃	—	—	1.63	—	2.03	27.2	—	24.3	24.1	23.9	24.0	35.4	—	27.7	27.6	27.7	27.7	NW	430
261	〃 〃	09.00	〃	—	—	1.07	—	1.23	27.6	—	28.7	29.4	28.7	28.6	36.2	—	29.3	28.0	26.7	27.0	NE	23,000
262	〃 〃	12.00	〃	—	—	0.80	—	0.91	27.2	—	29.1	29.8	29.1	28.9	35.4	—	29.5	29.0	28.4	28.6	NE	23,000
263	〃 〃	15.00	〃	—	—	4.04	—	5.05	29.7	—	31.0	31.1	31.0	31.1	40.9	—	33.4	32.4	31.3	31.0	E	5,200
264	〃 〃	18.00	〃	—	—	1.75	—	2.30	28.1	—	28.1	28.3	28.5	28.6	37.3	—	30.4	30.0	29.6	29.3	S	650
265	〃 〃	21.00	〃	—	—	3.35	—	4.35	27.2	—	25.9	25.7	25.9	25.9	35.4	—	30.6	30.4	30.3	29.8	NW	430
266	〃 7	00.00	〃	—	—	1.05	—	1.32	26.7	—	26.0	25.9	25.8	25.8	34.3	—	28.1	28.1	28.1	28.4	NW	430
267	〃 〃	09.00	〃	—	—	1.93	—	2.52	27.5	—	28.3	29.0	28.3	28.2	36.0	—	28.0	27.7	28.0	28.3	N	700
268	〃 〃	12.00	〃	—	—	2.47	—	2.78	28.5	—	29.8	30.5	29.8	29.6	38.1	—	30.3	29.8	30.3	30.4	NE	23,000
269	〃 〃	15.00	〃	—	—	2.06	—	2.32	28.4	—	31.1	31.2	31.1	31.2	37.9	—	33.1	32.0	31.0	30.7	NE	23,000
270	Oct. 26	21.00	9	1.82	1.98	2.13 (2.1)	2.16 (2.2)	2.30 (2.3)	21.9	18.9	19.0	18.8	18.6	18.7	25.7	19.6	20.6	20.3	20.0	20.2	N	6,000

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Date		Time	St.	Wind speed (m/sec)					Temperature (°C)						Vapour pressure (mb)						Wind dir.	Fetch (m)
					u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}		
	1955		h m																				
271	Oct.	26	22.00	9	2.37	2.59	2.80 (2.7)	2.93 (2.9)	3.10 (3.1)	22.1	18.5	18.8	19.2	18.3	18.5	26.1	20.5	19.9	20.0	20.0	19.9	N	6,000
272	〃	〃	23.00	〃	1.68	1.86	2.04 (2.0)	2.16 (2.1)	2.30 (2.3)	21.8	19.1	18.6	18.8	18.0	17.9	25.6	19.5	20.0	19.9	19.5	20.3	N	6,000
273	〃	27	00.00	〃	2.17	2.30	2.43 (2.4)	2.61 (2.5)	2.80 (2.7)	22.1	19.2	18.2	18.4	17.7	17.4	26.1	20.0	19.9	20.2	20.1	19.7	N N E	29,000
274	〃	〃	06.00	〃	1.82	1.89	1.96 (2.0)	2.22 (2.2)	2.28 (2.2)	22.1	19.7	20.0	19.6	19.1	18.7	26.1	20.7	20.7	—	—	—	N	6,000
275	〃	〃	07.00	〃	1.46	1.58	1.69 (1.6)	1.83 (1.8)	1.93 (1.8)	22.0	19.7	19.1	19.2	18.8	18.7	25.9	20.9	20.5	21.2	21.3	21.2	N	6,000
276	〃	〃	08.00	〃	1.72	1.82	1.92 (1.8)	2.06 (2.0)	2.18 (2.2)	21.9	19.5	19.4	18.9	19.1	18.8	25.7	20.8	21.1	20.8	20.7	20.5	N E	11,000
277	〃	〃	09.00	〃	0.47	0.49	0.50 (0.3)	0.55 (0.3)	0.52 (0.2)	21.2	20.6	21.2	20.2	20.2	20.1	24.7	23.2	22.8	22.4	22.2	22.3	W	2,600
278	〃	〃	10.00	〃	0.37	0.44	0.43 (0.3)	0.45 (0.4)	0.47 (0.4)	21.9	21.3	21.8	21.8	21.1	21.1	25.7	21.4	22.8	21.9	21.0	21.6	calm	—
279	〃	〃	11.00	〃	1.03	1.13	1.24 (1.2)	1.35 (1.3)	1.58 (1.5)	22.2	22.2	21.6	21.6	21.5	21.5	26.2	23.6	22.9	22.5	21.9	21.9	W	2,600
280	〃	〃	12.00	〃	—	—	(1.0)	(1.2)	(1.3)	23.0	23.0	21.9	21.9	21.8	21.9	27.5	23.5	22.3	22.3	21.7	21.9	W	2,600
281	〃	〃	13.00	〃	—	—	(0.4)	(0.0)	(0.4)	22.8	21.7	23.0	22.2	21.3	21.3	27.2	24.6	23.5	22.5	22.9	22.9	calm	—
282	〃	〃	14.00	〃	—	—	(0.0)	(0.0)	(0.3)	22.5	21.9	21.8	21.9	22.1	22.0	26.7	22.9	22.4	22.3	22.2	22.0	calm	—
283	〃	〃	15.00	〃	—	—	(0.0)	(0.0)	(0.2)	22.4	20.7	21.2	22.1	21.9	21.3	26.5	23.8	23.0	21.5	21.7	22.3	calm	—
284	〃	〃	16.00	〃	—	—	(0.0)	(0.0)	(0.3)	22.3	22.2	21.9	21.9	21.8	21.7	26.4	24.5	22.1	20.0	19.9	19.9	calm	—
285	〃	〃	17.00	〃	—	—	(0.3)	(0.5)	(0.5)	22.2	21.1	21.8	22.0	21.9	21.8	26.2	23.7	22.8	22.0	21.7	22.0	W S W	3,000
286	〃	〃	18.00	〃	—	—	(1.2)	(1.2)	(1.5)	21.8	21.8	21.5	21.9	21.7	21.7	25.6	23.1	22.2	21.5	20.1	20.0	W	2,600
287	〃	〃	19.00	〃	—	—	(0.0)	(0.0)	(0.0)	21.9	21.9	21.6	21.4	21.3	21.4	25.7	22.5	21.9	21.6	21.0	20.8	calm	—
288	〃	〃	20.00	〃	—	—	(0.0)	(0.0)	(0.0)	22.1	21.6	21.5	21.0	21.4	21.3	26.1	20.4	20.5	20.0	19.5	19.6	calm	—
289	〃	〃	21.00	〃	—	—	(0.0)	(0.0)	(0.3)	22.1	19.2	19.1	19.2	19.1	18.7	26.1	21.0	20.7	20.4	20.7	20.2	calm	—
290	〃	〃	22.00	〃	—	—	(1.6)	(1.6)	(1.7)	22.1	19.2	19.2	19.2	18.5	18.7	26.1	20.2	20.2	20.2	20.1	19.8	N	6,000
291	〃	〃	23.00	〃	—	—	(0.6)	(0.4)	(0.6)	22.1	18.6	18.2	18.3	18.0	17.7	26.1	20.2	19.9	19.5	19.1	18.7	N	6,000

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Date	Time	St.	Wind speed (m/sec) u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	Temperature (°C) T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	Vapour pressure (mb) e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}	Wind dir.	Fetch (m)
292	1955 Oct. 28	h m 00.00	9	—	—	(1.3)	(1.4)	(1.6)	21.9	18.7	17.8	17.7	17.4	17.1	25.7	21.0	20.2	19.7	19.5	18.9	N	6,000
293	〃 〃	01.00	〃	—	—	(1.9)	(2.0)	(2.2)	21.8	18.7	18.6	18.2	17.7	18.1	25.6	20.6	19.4	19.3	19.3	18.6	NW	3,000
294	〃 〃	02.00	〃	—	—	(2.6)	(2.8)	(3.0)	21.7	18.6	18.5	18.3	18.1	18.0	25.4	20.0	19.1	18.9	18.4	18.1	NW	3,000
295	〃 〃	03.00	〃	—	—	(1.7)	(1.9)	(2.0)	21.8	18.3	17.8	17.4	16.7	17.0	25.6	20.0	19.0	18.9	18.4	17.9	NW	3,000
296	〃 〃	04.00	〃	—	—	(2.6)	(2.8)	(3.0)	21.8	18.3	18.3	17.7	17.3	17.4	25.6	20.0	20.0	20.1	19.4	18.7	NW	3,000
297	〃 〃	05.00	〃	—	—	(1.8)	(2.0)	(2.1)	21.8	18.4	18.2	18.0	17.9	17.9	25.6	20.0	19.7	19.3	19.5	19.3	NNE	29,000
298	〃 〃	06.00	〃	—	—	(0.8)	(0.8)	(0.8)	21.9	18.5	18.3	17.9	17.8	17.7	25.7	20.1	19.8	19.5	19.2	18.9	NE	11,000
299	〃 〃	07.00	〃	—	—	(0.0)	(0.0)	(0.3)	21.8	19.2	18.9	18.9	18.6	18.6	25.6	20.8	20.2	20.0	20.2	19.6	calm	—
300	〃 〃	08.00	〃	—	—	(0.7)	(0.8)	(0.8)	21.9	21.9	21.9	21.8	21.5	21.3	25.7	24.3	23.6	23.2	23.4	22.5	SE	33,000
301	〃 〃	09.00	〃	—	—	(1.4)	(1.5)	(1.7)	22.0	22.1	22.1	22.1	22.2	22.3	25.9	23.3	23.0	23.0	22.8	22.0	SE	33,000
302	〃 29	13.00	〃	4.96	5.52	6.08 (6.0)	6.82 (7.0)	7.45 (7.4)	22.1	—	—	—	—	20.8	26.1	—	—	—	—	—	N	6,000
303	〃 〃	15.00	〃	5.60	6.20	6.80 (6.7)	7.64 (7.6)	8.33 (8.5)	22.1	21.6	21.2	21.0	21.0	20.8	26.1	23.2	21.9	21.7	21.2	19.8	N	6,000
304	〃 〃	16.00	〃	4.40	4.67	5.03 (5.0)	5.68 (5.8)	6.50 (6.4)	22.1	22.1	22.1	21.6	21.9	21.9	26.1	22.5	20.3	18.2	19.4	17.8	NNW	4,300
305	〃 〃	17.00	〃	4.62	4.83	5.25 (5.2)	5.48 (5.5)	6.00 (6.1)	22.0	20.8	20.2	20.1	20.0	20.1	25.9	21.0	18.6	18.1	18.9	18.1	N	6,000
306	〃 〃	18.00	〃	5.31	5.67	6.03 (5.9)	6.31 (6.3)	6.85 (7.1)	21.8	19.5	19.3	18.6	19.0	17.8	25.6	21.0	19.0	18.1	18.6	17.3	N	6,000
307	〃 〃	19.00	〃	5.18	5.49	5.80 (5.9)	6.13 (6.2)	6.70 (6.9)	21.9	19.2	18.6	17.8	17.7	18.2	25.7	20.4	19.0	19.2	18.9	17.4	N	6,000
308	〃 〃	20.00	〃	6.90	6.95	7.00 (6.9)	7.16 (7.3)	8.20 (8.2)	21.7	18.6	18.4	18.3	18.2	18.2	25.4	19.1	18.1	16.6	16.7	16.7	N	6,000
309	〃 〃	21.00	〃	2.09	2.30	2.48 (2.4)	2.60 (2.7)	2.81 (2.7)	21.2	18.0	17.8	17.8	17.6	17.8	24.7	17.0	16.6	16.6	16.6	16.2	N	6,000
310	〃 〃	22.00	〃	2.13	2.35	2.46 (2.5)	2.60 (2.6)	2.75 (2.7)	21.5	17.8	17.5	17.5	17.4	17.5	25.1	17.3	17.0	16.8	16.9	16.4	N	6,000
311	〃 〃	23.00	〃	2.84	3.05	3.25 (3.2)	3.49 (3.5)	3.64 (3.7)	22.1	17.8	17.2	17.1	16.9	16.8	26.1	17.3	16.3	16.0	15.9	15.5	N	6,000
312	〃 30	00.00	〃	2.15	2.28	2.57 (2.5)	2.57 (2.7)	2.83 (2.8)	21.2	17.3	16.8	16.7	16.6	16.8	24.7	16.4	15.5	14.9	15.1	14.1	N	6,000

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Date	Time	St.	Wind speed (m/sec) u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	Temperature (°C) T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	Vapour pressure (mb) e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}	Wind dir.	Fetch (m)
	1955	h m																				
313	Oct. 30	01.00	9	2.68	2.83	3.05 (3.1)	3.18 (3.2)	3.35 (3.5)	21.8	17.6	17.4	16.9	16.4	16.4	25.6	15.3	14.0	13.9	13.5	13.7	N	6,000
314	〃 〃	02.00	〃	2.75	2.94	3.05 (3.1)	3.28 (3.3)	3.50 (3.5)	21.9	17.7	17.4	17.0	17.0	16.8	25.7	16.5	16.0	14.8	14.8	14.4	N	6,000
315	〃 〃	03.00	〃	0.90	0.85	1.04 (1.0)	1.05 (0.8)	1.00 (1.1)	21.9	17.7	17.3	17.2	17.2	17.0	25.7	17.0	15.9	14.7	14.3	14.0	NW	3,000
316	〃 〃	04.00	〃	1.46	1.62	1.65 (1.7)	1.77 (1.7)	1.67 (1.8)	21.9	17.9	17.1	16.9	16.4	15.9	25.7	17.4	16.7	15.8	15.2	14.9	NW	3,000
317	〃 〃	05.00	〃	3.14	3.48	3.65 (3.6)	3.83 (3.9)	4.10 (4.1)	21.8	17.5	17.0	16.6	16.4	16.2	25.6	17.5	16.2	15.1	15.2	15.0	NE	11,000
318	〃 〃	06.00	〃	2.27	2.49	2.60 (2.7)	2.93 (2.9)	3.00 (3.1)	21.9	17.8	17.4	17.2	17.2	17.4	25.7	18.3	16.3	15.2	15.0	15.1	NE	11,000
319	〃 〃	07.00	〃	2.55	2.80	2.97 (2.9)	3.26 (3.2)	3.23 (3.3)	21.8	18.3	18.0	17.8	17.7	17.6	25.6	17.5	16.1	15.7	15.2	15.0	NE	11,000
320	〃 〃	08.00	〃	1.85	1.97	2.20 (2.1)	2.25 (2.2)	2.35 (2.4)	21.9	18.0	17.7	17.7	17.4	17.5	25.7	18.7	16.3	15.8	15.1	14.5	NNE	29,000
321	〃 〃	09.00	〃	2.27	2.50	2.48 (2.6)	3.00 (2.8)	3.45 (3.4)	22.0	18.2	18.0	18.2	18.2	18.0	25.9	17.8	16.3	15.2	14.7	14.7	NW	3,000
322	〃 〃	10.00	〃	3.30	3.50	3.62 (3.6)	3.98 (3.8)	4.71 (4.8)	21.9	19.3	19.0	18.8	18.5	17.6	25.7	20.0	16.9	16.8	17.4	16.0	NW	3,000
323	〃 〃	11.00	〃	5.24	5.55	5.86 (6.0)	6.63 (6.8)	7.50 (7.9)	21.3	19.5	18.4	18.7	18.3	18.6	24.8	18.5	17.1	17.1	17.2	16.4	NW	3,000
324	〃 〃	11.25	〃	5.07	5.30	5.53 (5.7)	5.84 (5.9)	6.85 (6.7)	21.4	—	—	—	—	18.7	25.0	—	—	—	—	—	NW	3,000
325	〃 〃	12.00	〃	5.12	5.41	5.70 (5.7)	6.15 (6.0)	6.68 (6.8)	21.7	19.6	19.1	18.5	18.4	18.9	25.4	18.6	18.1	18.0	17.5	15.5	NW	3,000
326	Nov. 1	15.00	7	1.25	1.38	1.47 (1.5)	1.72 (1.7)	1.97 (1.9)	22.5	21.4	20.7	20.4	20.0	20.1	26.7	18.0	16.7	16.5	16.4	15.6	SSW	400
327	〃 〃	16.00	〃	1.00	1.12	1.24 (1.1)	1.30 (1.3)	1.58 (1.5)	22.2	20.5	20.3	20.3	20.1	20.3	26.2	18.2	17.7	17.0	16.3	16.0	S	500
328	〃 〃	16.40	〃	1.13	1.17	1.25 (1.3)	1.33 (1.3)	1.50 (1.5)	22.0	—	—	—	—	20.0	25.9	—	—	—	—	—	S	500
329	〃 〃	17.00	〃	0.95	1.04	1.10 (1.0)	1.35 (1.4)	1.62 (1.7)	21.8	19.0	18.7	18.8	18.9	18.9	25.6	19.2	18.8	17.0	16.8	16.8	N	200
330	〃 〃	17.40	〃	0.83	0.87	0.96 (0.8)	1.20 (1.2)	1.63 (1.5)	22.0	—	—	—	—	16.8	25.9	—	—	—	—	—	N	200
331	〃 〃	18.00	〃	0.85	0.94	1.03 (1.0)	1.22 (1.1)	1.50 (1.4)	22.1	16.8	16.6	16.4	16.3	16.6	26.1	16.7	16.5	16.6	16.5	16.5	N	200
332	〃 〃	19.00	〃	0.97	1.02	1.13 (1.2)	1.39 (1.3)	1.50 (1.5)	22.0	15.9	15.2	15.2	15.1	14.9	25.9	16.3	15.7	15.5	15.8	15.4	NW	150
333	〃 〃	20.00	〃	1.08	1.20	1.25 (1.2)	1.46 (1.4)	1.78 (1.7)	21.8	14.7	14.5	14.2	14.2	14.0	25.6	15.3	15.3	14.8	14.8	14.8	NNW	160

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Date	Time	St.	Wind speed (m/sec) u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	Temperature (°C) T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	Vapour pressure (mb) e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}	Wind dir.	Fetch (m)
334	1955 Nov. 1	h m 21.00	7	1.21	1.32	1.37 (1.1)	1.56 (1.5)	1.72 (1.8)	21.6	13.9	13.4	13.0	12.9	12.6	25.3	15.2	14.5	14.2	13.9	13.8	NW	150
335	〃 〃	22.00	〃	1.36	1.45	1.58 (1.6)	1.92 (2.0)	2.33 (2.3)	21.6	13.1	12.8	12.5	12.3	12.4	25.3	14.2	14.0	13.8	13.5	13.3	NW	150
336	〃 〃	23.00	〃	0.98	1.10	1.13 (1.2)	1.50 (1.5)	1.72 (1.6)	21.5	12.5	11.9	11.6	11.4	11.4	25.1	13.8	13.5	13.2	12.7	12.7	NW	150
337	〃 2	00.00	〃	1.70	1.74	2.00 (2.0)	2.26 (2.2)	2.60 (2.4)	21.6	12.4	11.8	11.4	11.3	11.2	25.3	13.8	13.0	12.9	12.6	12.5	WNW	150
338	〃 〃	01.00	〃	1.23	1.41	1.50 (1.6)	1.85 (1.7)	2.12 (2.0)	21.6	12.6	11.8	11.0	11.1	11.3	25.3	13.8	13.2	12.7	12.6	12.5	NW	150
339	〃 〃	02.00	〃	1.47	1.60	1.60 (1.7)	2.00 (2.0)	2.39 (2.3)	21.6	12.5	11.8	11.3	10.8	10.6	25.3	14.0	13.4	12.8	12.2	11.9	NW	150
340	〃 〃	03.00	〃	1.75	1.85	1.77 (1.9)	2.03 (2.1)	2.43 (2.5)	21.4	11.8	11.2	11.0	10.6	10.3	25.0	13.5	12.8	12.4	12.2	11.9	NW	150
341	〃 〃	04.00	〃	1.76	1.90	1.97 (1.9)	2.35 (2.4)	2.60 (2.6)	21.6	13.4	12.2	11.6	11.1	10.8	25.3	15.0	13.4	12.9	12.4	12.0	WNW	150
342	〃 〃	05.00	〃	1.00	1.10	1.23 (1.3)	1.57 (1.5)	2.10 (1.9)	21.5	13.4	12.7	11.9	11.4	11.3	25.1	15.0	13.9	13.0	12.7	12.6	WNW	150
343	〃 〃	06.00	〃	1.03	1.12	1.15 (1.1)	1.42 (1.5)	1.80 (1.9)	21.4	13.8	12.1	11.6	11.2	11.3	25.0	15.1	13.5	13.0	12.7	12.6	WNW	150
344	〃 〃	07.00	〃	1.41	1.50	1.60 (1.5)	2.16 (2.0)	2.31 (2.4)	21.2	14.2	13.2	12.5	12.2	12.5	24.7	15.3	14.2	13.7	13.4	13.4	NW	150
345	〃 〃	08.00	〃	1.01	1.06	1.15 (1.2)	1.50 (1.4)	1.72 (1.6)	21.7	15.8	14.9	14.6	14.4	14.0	25.4	16.3	15.2	14.7	14.5	14.1	NW	150
346	〃 〃	09.00	〃	1.00	1.09	1.47 (1.3)	1.68 (1.6)	1.94 (1.7)	21.6	18.0	17.3	17.1	16.6	16.2	25.3	17.4	16.4	15.8	15.4	15.0	NNW	160
347	〃 〃	10.00	〃	0.80	0.93	1.20 (1.1)	1.36 (1.5)	1.98 (2.0)	21.5	18.2	17.9	17.9	17.9	17.9	25.1	17.6	16.2	15.6	15.4	14.6	NW	150
348	〃 〃	11.00	〃	0.45	0.86	1.09 (1.2)	1.90 (1.9)	1.98 (2.2)	21.6	19.8	19.5	19.3	18.9	18.4	25.3	18.6	16.7	15.4	14.8	15.3	NNW	160
349	〃 〃	12.00	〃	0.73	1.11	1.50 (1.6)	1.80 (2.0)	2.30 (2.4)	21.9	19.6	18.5	17.5	17.1	17.4	25.7	18.8	16.9	16.4	15.5	16.3	N	200
350	〃 〃	13.00	〃	2.24	2.60	3.25 (3.1)	3.55 (3.7)	4.22 (4.3)	22.1	20.6	20.1	20.2	20.5	20.5	26.1	18.7	16.7	16.8	16.1	17.6	W	170
351	〃 〃	14.00	〃	1.82	2.15	2.68 (2.6)	3.15 (3.1)	3.63 (3.5)	22.2	20.4	20.3	20.1	19.7	19.5	26.2	17.1	16.0	15.4	16.2	16.0	W	170
352	〃 〃	15.00	〃	1.63	1.96	2.33 (2.4)	2.88 (2.8)	3.45 (3.3)	22.1	21.1	20.7	20.3	19.9	19.7	26.1	18.5	18.0	16.2	15.9	17.0	W	170
353	1956 Aug. 31	15.00	9	1.64	1.73	1.85 (1.9)	1.94 (1.9)	2.06 (2.0)	29.1	30.0	30.4	30.7	30.9	30.9	39.5	31.1	30.7	30.5	30.6	30.6	SSE	25,000
354	〃 〃	16.00	〃	3.05	3.28	3.50 (3.5)	3.75 (3.7)	4.17 (4.1)	28.8	29.5	29.5	29.7	29.7	29.8	38.8	33.7	32.9	31.9	31.1	30.8	S	10,600

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Date	Time	St.	Wind speed (m/sec)					Temperature (°C)						Vapour pressure (mb)						Wind dir.	Fetch (m)
				u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}		
	1956	h m																				
355	Aug. 31	17.00	9	3.08	3.35	3.52 (3.6)	3.85 (3.8)	4.36 (4.3)	28.4	29.3	29.5	29.6	29.6	29.7	37.9	31.4	31.3	31.5	31.2	30.7	S	10,600
356	〃 〃	18.00	〃	2.65	2.81	3.06 (3.0)	3.28 (3.2)	3.66 (3.6)	28.2	28.5	28.6	28.6	28.7	28.8	37.5	33.3	32.7	32.6	31.8	31.5	S S W	5,300
357	〃 〃	19.00	〃	2.38	2.63	2.84 (2.8)	3.16 (3.0)	3.50 (3.4)	28.3	28.0	27.7	27.4	27.4	27.5	37.7	32.5	29.9	29.8	29.6	29.5	NW	3,000
358	〃 〃	20.00	〃	1.89	1.94	2.05 (2.1)	2.22 (2.3)	2.32 (2.4)	28.3	27.3	27.2	27.0	27.0	26.9	37.7	27.9	27.7	27.6	27.6	27.9	NW	3,000
359	〃 〃	21.00	〃	1.39	1.37	1.53 (1.6)	1.64 (1.6)	1.75 (1.8)	28.3	27.1	27.1	27.0	27.1	27.0	37.7	27.0	25.1	24.7	24.4	25.4	N	6,000
360	〃 〃	22.00	〃	1.16	1.24	1.25 (1.2)	1.34 (1.3)	1.46 (1.4)	28.3	27.2	26.9	26.8	26.8	26.8	37.7	28.7	28.4	28.2	27.7	27.7	N N W	4,300
361	〃 〃	23.00	〃	1.00	1.05	1.13 (1.1)	1.20 (1.2)	1.23 (1.3)	28.2	26.7	26.6	26.5	25.4	26.2	37.5	27.5	27.1	27.4	26.8	26.9	NW	3,000
362	Sept. 1	00.00	〃	0.84	0.93	1.00 (1.0)	1.09 (1.0)	1.12 (1.2)	28.3	26.9	26.5	26.3	26.2	26.1	37.7	30.4	29.4	28.5	28.4	28.2	W	2,600
363	〃 〃	01.00	〃	0.90	0.91	1.00 (0.6)	1.10 (1.0)	1.13 (1.2)	28.1	26.9	26.3	26.0	25.9	25.7	37.3	30.4	29.5	29.5	30.1	29.7	W	2,600
364	〃 〃	02.00	〃	2.98	3.15	3.46 (3.5)	3.65 (3.6)	3.90 (3.8)	27.9	25.8	25.0	24.9	24.9	24.8	36.8	30.1	29.7	29.2	29.0	28.6	N	6,000
365	〃 〃	03.00	〃	2.60	2.81	2.95 (3.0)	3.23 (3.2)	3.34 (3.4)	27.9	25.7	25.2	24.9	24.8	24.8	36.8	29.9	29.8	29.5	28.6	28.3	N	6,000
366	〃 〃	04.00	〃	1.96	2.10	2.30 (2.4)	2.38 (2.4)	2.54 (2.6)	27.7	25.2	25.0	24.9	24.8	24.7	36.4	31.0	30.2	29.7	29.5	29.6	N	6,000
367	〃 〃	05.00	〃	2.98	3.13	3.38 (3.4)	3.65 (3.6)	3.72 (3.8)	27.8	24.9	24.7	24.6	24.5	24.4	36.6	30.2	29.9	29.7	29.3	28.8	N	6,000
368	〃 〃	06.00	〃	2.56	2.67	2.95 (3.0)	3.04 (3.1)	3.20 (3.2)	27.7	25.2	25.1	25.0	24.9	24.8	36.4	31.0	30.1	29.7	29.0	28.1	NW	3,000
369	〃 〃	07.00	〃	1.98	2.08	2.15 (2.2)	2.22 (2.3)	2.27 (2.4)	27.7	26.7	26.4	26.4	26.3	26.3	36.4	30.5	29.2	28.7	28.5	28.3	N N W	4,300
370	〃 〃	08.00	〃	2.63	2.73	2.92 (3.0)	3.19 (3.1)	3.38 (3.4)	27.9	27.4	27.1	27.0	27.0	27.0	36.8	31.1	30.3	30.3	30.1	29.6	N E	11,000
371	〃 〃	09.00	〃	0.60	0.66	0.74 (0.0)	0.88 (0.0)	0.85 (0.8)	28.3	28.1	28.0	27.9	27.7	27.6	37.7	30.4	29.7	29.7	29.6	29.2	N E	11,000
372	〃 〃	10.00	〃	1.05	1.11	1.15 (1.2)	1.26 (1.2)	1.30 (1.2)	28.6	28.3	28.2	28.2	28.0	28.0	38.4	32.1	30.3	29.8	29.2	28.6	S E	33,000
373	〃 〃	11.00	〃	0.62	0.64	0.70 (0.0)	0.80 (0.0)	0.80 (0.4)	29.0	28.7	28.6	28.5	28.5	28.5	39.3	28.9	28.5	28.3	28.3	28.3	S S W	5,300
374	〃 〃	12.00	〃	0.55	0.60	0.63 (0.0)	0.72 (0.0)	0.75 (0.6)	29.3	29.5	29.5	29.6	29.6	29.7	39.9	27.6	27.4	27.3	26.8	26.8	S W	3,500
375	〃 〃	13.00	〃	0.98	1.05	1.13 (1.1)	1.17 (1.1)	1.29 (1.2)	29.8	30.6	30.8	31.0	31.3	31.6	41.1	31.1	30.4	30.0	29.3	28.6	S S W	5,300

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Date	Time	St.	Wind speed (m/sec)					Temperature (°C)						Vapour pressure (mb)						Wind dir.	Fetch (m)
				u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}		
376	1956 Sept. 1	h m 14.00	9	2.16	2.27	2.43 (2.5)	2.65 (2.6)	2.97 (2.9)	29.4	30.3	30.5	30.5	30.5	30.5	40.2	31.8	31.7	31.7	31.4	31.1	S S W	5,300
377	〃 〃	15.00	〃	2.55	2.70	2.85 (2.9)	3.24 (3.2)	3.67 (3.6)	28.8	29.4	29.6	29.5	29.7	29.7	38.8	33.2	33.1	32.9	32.8	32.8	S S W	5,300
378	〃 〃	16.00	〃	2.84	3.01	3.29 (3.3)	3.76 (3.7)	4.06 (4.1)	28.2	29.0	29.1	29.2	29.3	29.3	37.5	34.3	34.0	33.4	33.3	32.5	S W	3,500
379	〃 〃	17.00	〃	4.96	5.26	5.58 (5.5)	5.76 (5.8)	6.45 (6.4)	27.8	28.4	28.5	28.6	28.8	28.8	36.6	32.8	32.7	32.7	32.5	32.5	S S E	25,000
380	〃 〃	18.00	〃	3.71	4.03	4.24 (4.2)	4.45 (4.5)	5.06 (5.0)	27.9	28.3	28.4	28.5	28.6	28.6	36.8	32.3	32.0	31.4	31.6	31.3	S	10,600
381	〃 〃	19.00	〃	—	—	(7.5)	(8.2)	(9.1)	28.0	28.0	28.0	28.0	28.0	28.1	37.0	31.0	31.0	31.0	31.2	30.6	S	10,600
382	〃 〃	20.00	〃	—	—	(6.2)	(6.8)	(7.5)	28.3	—	27.9	27.9	27.9	27.9	37.7	—	31.4	31.3	31.0	30.8	S	10,600
383	〃 〃	21.00	〃	—	—	(5.0)	(5.2)	(5.4)	28.2	27.7	27.8	27.9	27.8	27.8	37.5	32.1	31.6	31.0	30.6	30.3	S S E	25,000
384	〃 〃	22.00	〃	—	—	(2.9)	(3.0)	(3.2)	27.9	27.8	27.8	27.8	27.8	27.7	36.8	30.8	30.8	30.8	30.6	30.4	S S E	25,000
385	〃 〃	23.00	〃	—	—	(2.6)	(2.6)	(2.8)	27.8	27.1	27.1	27.1	27.0	27.1	36.6	31.8	31.3	30.8	30.6	30.5	N	6,000
386	〃 2	00.00	〃	—	—	(1.5)	(1.5)	(1.6)	27.8	27.0	26.8	26.6	26.2	26.3	36.6	31.3	30.7	30.1	29.6	29.3	N	6,000
387	〃 〃	01.00	〃	—	—	(1.2)	(1.3)	(1.3)	27.7	26.1	26.1	26.1	26.0	25.9	36.4	32.5	31.7	30.9	31.3	30.6	WNW	2,800
388	〃 〃	02.00	〃	—	—	(1.6)	(1.7)	(1.8)	27.8	26.8	25.9	25.8	25.7	25.8	36.6	31.3	31.1	30.9	30.4	30.4	NW	3,000
389	〃 〃	03.00	〃	—	—	(3.1)	(3.3)	(3.4)	27.4	25.8	25.8	25.8	25.7	25.7	35.8	30.9	30.9	30.9	30.4	30.4	N N W	4,300
390	〃 〃	04.00	〃	—	—	(2.0)	(2.1)	(2.3)	27.5	25.8	25.7	25.6	25.5	25.4	36.0	31.4	30.9	30.5	30.3	30.1	N N W	4,300
391	〃 〃	05.00	〃	—	—	(2.2)	(2.3)	(2.4)	27.6	25.7	25.6	25.5	25.6	25.4	36.2	31.0	30.8	30.6	30.0	30.4	N	6,000
392	〃 〃	06.00	〃	—	—	(3.0)	(3.2)	(3.4)	27.6	26.0	25.7	25.4	25.4	25.2	36.2	31.2	30.7	31.2	30.4	30.0	N N W	4,300
393	〃 〃	07.00	〃	3.17	3.34	3.56 (3.6)	3.80 (3.8)	3.95 (4.0)	27.6	26.9	26.7	26.5	26.5	26.6	36.2	31.4	31.1	30.7	29.9	29.6	N N W	4,300
394	〃 〃	08.00	〃	1.36	1.50	1.55 (1.4)	1.68 (1.6)	1.92 (1.9)	27.8	27.9	27.9	27.9	27.9	27.9	36.6	30.5	30.2	30.0	30.0	29.7	NW	3,000
395	〃 〃	09.00	〃	0.83	0.88	0.98	1.08	1.11 (1.0)	28.2	28.4	28.5	28.6	28.7	28.7	37.5	30.2	29.8	30.0	29.7	28.7	N N E	29,000
396	〃 〃	10.00	〃	0.66	0.71	0.73 (0.0)	0.78 (0.6)	0.85 (1.0)	28.4	—	28.9	29.0	29.1	29.0	37.9	—	29.6	30.0	29.7	28.7	N E	11,000

Observed data of wind, temperature, and vapour pressure (Continued)

No.	Date	Time	St.	Wind speed (m/sec) u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	Temperature (°C) T_0	T_{25}	T_{50}	T_{100}	T_{200}	T_{400}	Vapour pressure (mb) e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}	Wind dir.	Fetch (m)
397	1956 Sept. 2	h m 10.45	9	0.85	0.90	0.98 (0.6)	1.10 (0.6)	1.15 (1.2)	28.3	—	—	—	—	29.3	37.7	—	—	—	—	—	NE	11,000
398	〃 〃	11.00	〃	0.53	0.60	0.59 (0.0)	0.59 (0.0)	0.65 (0.6)	28.3	29.2	29.3	29.4	29.4	29.4	37.7	30.4	30.3	30.3	30.0	29.3	NE	11,000
399	〃 〃	12.00	〃	0.55	0.62	0.65 (0.3)	0.71 (0.6)	0.93 (1.0)	28.3	29.3	29.6	29.7	30.1	30.4	37.7	28.5	27.6	26.8	27.0	26.0	W	2,600
400	〃 〃	13.00	〃	1.00	1.12	1.18 (1.2)	1.35 (1.3)	1.56 (1.5)	28.9	30.0	30.3	30.3	30.5	30.6	39.0	31.5	30.7	29.7	28.8	27.9	SW	3,500
401	〃 〃	14.00	〃	4.38	4.71	5.05 (5.1)	5.45 (5.4)	5.82 (5.7)	28.5	29.8	29.9	30.0	30.0	30.1	38.1	30.7	30.2	30.7	31.2	30.6	SE	33,000
402	〃 〃	15.00	〃	5.35	5.70	6.15 (6.2)	6.60 (6.5)	6.88 (6.8)	28.4	—	29.9	29.9	29.9	30.0	37.9	—	32.3	32.1	31.8	30.1	SE	33,000

Observed data of wave elements

No.	Length (cm)	Height (cm)	Period (sec)	Remark
1	10	2	0.33	
2	15	2	0.38	
3	15	1	0.37	
4	9.0	1	0.30	
5	0	0	0	no wave
6	8.1	1	0.29	
7	15	2	0.33	
8	18	2	0.34	
9	20	1	0.43	
10	8.2	1	0.35	
11	13	1	0.38	
12	10	1	0.32	
13	23	2	0.41	
14	6.8	0.5	0.31	
15	8.0	0.5	0.31	
16	7.5	1	0.31	
17	0	0	0	no wave
18	0	0	0	no wave
19	8.5	1	0.29	
20	7.4	0.5	0.27	
21	10	1	0.38	
22	15	1	0.35	
23	17	2	0.41	
24	24	4	0.40	
25	25	3	0.43	
26	48	3	0.54	
27	36	4	0.44	
28	230	28	1.20	whitecaps
29	210	36	1.33	whitecaps
30	195	26	1.76	whitecaps
31	350	35	2.07	whitecaps
32	300	36	1.58	whitecaps
34	10	1	0.38	
35	13	1	0.40	
36	10	1	0.34	
37	15	1	0.38	
38	38	4	0.42	
39	57	6	0.62	
54	18	2	0.39	
55	0	0	0	no wave
56	12	2	0.40	
57	0	0	0	no wave
58	6.3	0.5	0.27	

Observed data of wave elements (Continued)

No.	Length (cm)	Height (cm)	Period (sec)	Remark
59	14	2	0.39	
60	125	10	1.15	
61	105	7	0.94	
62	88	5	0.75	
63	74	6	0.61	
64	120	6	1.00	
65	61	5	0.65	
66	31	4	0.46	
67	12	3	0.38	
68	18	2	0.39	
84	155	12	1.30	
85	39	5	0.49	
86	46	6	0.58	
87	27	4	0.45	
88	22	3	0.43	
89	64	8	0.70	
90	36	4	0.61	
91	0	0	0	no wave
92	6.5	1	0.30	
108	55	6	0.61	
109	9.1	1	0.27	
110	12	1	0.32	
111	32	2	0.48	
112	57	3	0.63	
113	28	3	0.41	
114	15	1	0.41	
131	27	3	0.39	
132	33	3	0.46	
133	32	3	0.53	
134	40	4	0.55	
135	41	3	0.54	
136	30	2	0.49	
137	36	2	0.47	
138	43	3	0.62	
155	55	6	0.60	
156	43	4	0.60	
157	30	1	0.53	
158	38	4	0.43	
159	31	3	0.48	
160	0	0	0	no wave
161	18	2	0.41	
162	0	0	0	no wave
163	12	1	0.38	
179	14	1	0.39	

No.	Length (cm)	Height (cm)	Period (sec)	Remark
180	32	2	0.41	
181	25	3	0.38	
182	32	4	0.45	
183	6.5	0.5	0.26	
184	43	3	0.55	
185	49	3	0.61	
186	40	5	0.52	
187	20	4	0.40	
188	55	7	0.65	
189	33	4	0.45	
190	36	5	0.45	
191	18	2	0.39	
192	11	1	0.32	
193	24	3	0.39	
223	0	0	0	no wave
224	14	2	0.35	
225	0	0	0	no wave
228	—	—	—	whitecaps
230	30	6	0.43	
231	120	15	1.28	
232	480	55	2.14	whitecaps
277	0	0	0	no wave
278	0	0	0	no wave
279	7.6	0.5	0.26	
280	7.3	0.5	0.29	
281	0	0	0	no wave
302	—	—	—	whitecaps
303	360	30	1.82	whitecaps
304	280	25	1.67	whitecaps
305	—	—	—	whitecaps
306	—	—	—	whitecaps
321	120	17	0.94	
322	175	32	1.50	whitecaps
323	360	40	1.50	whitecaps
324	430	55	2.00	whitecaps
325	360	24	1.30	whitecaps
326	15	1	0.31	
327	13	1	0.32	
328	10	1	0.32	
330	8.0	1	0.30	
344	7.8	6	0.31	
345	4.5	0.5	0.26	
346	10	0.5	0.29	
347	7.2	0.5	0.26	

Observed data of wave elements (Continued)

No.	Length (cm)	Height (cm)	Period (sec)	Remark
348	0	0	0	no wave
349	0	0	0	no wave
350	25	4	0.39	
351	35	3	0.38	
352	38	3	0.42	
354	110	8	1.09	
355	180	9	1.40	
370	50	6	0.68	
371	0	0	0	no wave
372	9.2	1	0.27	
373	0	0	0	no wave
374	0	0	0	no wave
375	9.2	1	0.29	
376	61	6	0.83	
377	43	7	0.65	
378	38	6	0.43	
379	—	—	—	whitecaps
395	8.8	0.5	0.31	
396	0	0	0	no wave
397	8.3	1	0.32	
398	0	0	0	no wave
399	0	0	0	no wave
400	5.8	0.5	0.29	
401	400	21	1.94	whitecaps
402	530	23	2.07	whitecaps

Observed data of evaporation

Date	Time (from-to)	Evaporation from (mm/6 hours) sea surface	pan on deck
Dec. 23, 1953	09ʰ–15ʰ	1.12	1.50
〃 24, 〃	09–15	1.48	0.55
〃 25, 〃	09–15	0.67	0.47
Jan. 6, 1954	09–15	1.82	0.60
〃 7, 〃	09–15	1.35	1.10
〃 8, 〃	09–15	1.60	0.58
〃 14, 〃	09–15	0.75	0.70
Dec. 15, 〃	15–21	1.13	0.55
〃 〃, 〃	21–03	1.00	0.16
〃 16, 〃	03–09	0.75	0.10
〃 〃, 〃	09–15	0.82	0.43
〃 17, 〃	09–15	1.10	1.28
〃 〃, 〃	15–21	1.92	0.44
〃 〃, 〃	21–03	1.44	0.12
〃 18, 〃	03–09	3.05	0.23
〃 〃, 〃	09–15	1.26	1.17
〃 〃, 〃	15–21	1.71	0.20
〃 〃, 〃	21–03	1.85	0.11
〃 19, 〃	03–09	1.38	0.10
〃 〃, 〃	09–15	1.30	1.30
〃 〃, 〃	15–21	1.67	0.28
〃 〃, 〃	21–03	0.55	0.05
〃 20, 〃	03–09	1.65	0.17
〃 〃, 〃	09–15	1.51	1.13
Dec. 20, 1954	15ʰ–21ʰ	1.35	0.45
〃 〃, 〃	21–03	1.08	0.40
〃 21, 〃	03–09	1.85	0.52
〃 〃, 〃	09–15	1.70	1.83
〃 〃, 〃	15–21	1.90	0.50
〃 〃, 〃	21–03	3.80	0.10
〃 22, 〃	03–09	1.63	0.12
〃 〃, 〃	09–15	0.83	1.40
April 26, 1955	09–15	0.51	0.65
〃 〃, 〃	15–21	0.16	0.25
〃 〃, 〃	21–03	0.25	0.10
〃 27, 〃	03–09	0.27	0.48
〃 28, 〃	21–03	0.33	0.12
〃 29, 〃	03–09	0.21	0.52
〃 〃, 〃	09–15	0.40	0.84
〃 〃, 〃	21–03	0.34	0.15
May 1, 〃	15–21	0.20	0.31
〃 〃, 〃	21–03	0.18	0.10
〃 2, 〃	03–09	0.20	0.62
〃 8, 〃	15–21	0.15	0.25
〃 〃, 〃	21–03	0.31	0.10
〃 9, 〃	03–09	0.45	0.68
〃 〃, 〃	09–15	0.19	1.25
〃 〃, 〃	15–21	0.68	0.95

Observed data of evaporation (Continued)

Date	Time (from-to)	Evaporation from (mm/6 hours)	
		sea surface	pan on deck
May 9, 1955	21^{h}-03^{h}	0. 30	0. 13
〃 10, 〃	03-09	0. 22	0. 50
〃 〃, 〃	09-15	0. 30	0. 85
Aug. 5, 〃	15-21	0. 33	1. 32
〃 〃, 〃	21-03	0. 85	0. 27
〃 6, 〃	03-09	1. 06	0. 55
〃 〃, 〃	09-15	0. 77	3. 74
〃 〃, 〃	15-21	0. 30	1. 08
〃 〃, 〃	21-03	0. 45	0. 55
〃 7, 〃	09-15	0. 95	3. 86
Oct. 26, 〃	21-03	1. 25	0. 50
〃 27, 〃	03-09	1. 16	0. 68
〃 〃, 〃	09-15	0. 80	2. 03
〃 〃, 〃	15-21	1. 72	0. 35
〃 〃, 〃	21-03	1. 80	0. 53
〃 28, 〃	03-09	1. 10	0. 25
〃 29, 〃	09-15	0. 85	0. 92

Date	Time (from-to)	Evaporation from (mm/6 hours)	
		sea surface	pan on deck
Oct. 29, 1955	15^{h}-21^{h}	1. 30	0. 74
〃 〃, 〃	21-03	1. 56	0. 31
〃 30, 〃	03-09	1. 27	0. 26
〃 〃, 〃	09-15	1. 06	1. 34
Nov. 1, 〃	15-21	0. 73	0. 60
〃 〃, 〃	21-03	1. 24	0. 05
〃 2, 〃	03-09	1. 61	0. 10
〃 〃, 〃	09-15	1. 35	2. 20
Aug.31, 1956	15-21	0. 40	2. 17
〃 〃, 〃	21-03	1. 05	0. 33
Sept. 1, 〃	03-09	1. 40	0. 54
〃 〃, 〃	09-15	1. 72	3. 56
〃 〃, 〃	15-21	0. 83	2. 00
〃 〃, 〃	21-03	0. 80	0. 28
〃 2, 〃	03-09	0. 92	0. 35
〃 〃, 〃	09-15	1. 21	2. 88

Part II Wind Profiles over the Sea not far apart from Land

1. Historical Note.

Wind observations at several levels up ot a few meters over the sea were made by G. Wüst[2] for the first time. Analysing these Wüst's data, W. Shoulejkin's, and R. B. Montgomery's, C. G. Rossby[3] concluded that the wind profile for light wind over the sea obeys the well-known Karman's formula,

$$\frac{u}{u_*}=5.5+\frac{1}{k_0}\ \ln\ \frac{u_* z}{\nu}, \qquad (1)$$

of hydrodynamically smooth flow; and that for moderate or strong wind a layer obeying Karman's formula (1) exsists below a layer obeying Prandtle's formula,

$$\frac{u}{u_*}=\frac{1}{k_0}\ \ln\ \frac{z}{z_0}, \qquad (2)$$

of hydrodynamically rough flow and the boundary of these two layers is ca lm in height. In the preceeding equations, u is wind speed (cm/sec) at z cm upwards from the sea surface, u_* is friction velocity and is $\sqrt{\frac{\tau_0}{\rho}}$ (τ_0 shearing stress, ρ density of air), k_0 is Karman's constant of ca 0.4, ν kinematic molecular viscosity, and z_0 roughness parameter, which is equal to ca 0.6cm according to Rossby.

H. Bruch[4], using his own observations in the layer below 225 cm, showed that the two layers, pointed out by Rossby, exsist and the boundary between them is 64cm in height independent of wind speed. H. U. Roll[5] pointed out the effect of moving mast on Wüst's data and manifested that wind profile over the sea obeys equation (1) of hydrodynamically smooth flow, according to his own observations in the layer below 200 cm level made with instruments mounted to a pole fixed to the sea floor.

On the other hand, F. Model,[6] reanalysing Bruch's data, showed that wind profile can be considered to obey equation (2) of hydrodynamically rough flow and $z_0=0.03$–0.06cm independent of wind speed. E. L. Deacon,[7] basing on N. Johnson's data, also stated that wind profile obeys equation (2) and $z_0=0.02$–0.04cm. J. S. Hay,[8] according to his own observations, suggested that wind profile within 50–800 cm above the sea surface obeys equation (2) and z_0 increases with wind speed (0.02–0.25 cm). He added some discussions concerning effects of stability on wind profile.

2. Wind Profiles under Neutral Condition of Stability.

The discussions reviewed in the preceeding section are based on the aerodynamical analogy. Therefore, such wind profiles are picked up here that they can be considered to be almost free from any influence of stability condition. This condition of nearly neutral equilibrium of stability is defined here as the temperature difference ($T_{400}-T_0$) of $-0.5\sim+0.5$°C (inclusive of both limits).

In the present observations, made at Kagoshima Bay, air flow arriving at observing points after having passed over land area is observed. It is well-known that wind profile over land obeys equation (2) of hydrodynamically rough flow. Accordingly, when air flow with this character over land area sweeps over the sea of hydrodynamically smooth surface, it is expected that a lower layer forms into obeying equation (1) and that the thickness of this layer increases with progressive time.

To confirm these expectations, observed data must be classified into some groups according to progressive time. The author defines the progressive time (t) as the ratio of fetch (f) and wind speed at 400 cm level (u_{400}), i. e. $t(\text{sec})=\frac{f}{u_{400}}$, where fetch ($f$) is defined as windward straight distance from a observing point to the coast.

Observed data belonging to this category of neutral condition of stability are classified into three groups according to progressive time as follows:

(i) $t<600$ sec, (ii) $600\leq t<3{,}000$ sec, (iii) $3{,}000$ sec$\leq t$.

The mean values for each group will be discussed, because more reliable conclusion will be derived from mean profile than from individual ones. The mean wind profiles for each group under neutral condition of stability are as follows.

Mean wind profile under the condition of $-0.5°C\leq T_{400}-T_0\leq+0.5°C$

Range of t (sec)	Wind speed (cm/sec)					Range of u_{400} (cm/sec)	No. of obs.
	u_{25}	u_{50}	u_{100}	u_{200}	u_{400}		
$t<600$	320	346	373	426	487	439–535	2
$600\leq t<3{,}000$	251	267	285	310	345	138–650	11
$3{,}000\leq t$	138	148	160	172	181	72–724	11

These observed profiles are compared with equation (1) of hydrodynamically smooth flow, and the results are shown in the following table in the form of wind ratio. Calculated values in this table are obtained by equation (1) from the respective mean values of wind speed at $z=25$cm. Inspecting the results shown in this table, we can find following facts:

(1) For $t\geq3{,}000$ sec, wind profile obeys equation (1) up to at least the observing height of 400 cm.

(2) For $t<3{,}000$ sec, wind profile in a lower layer obeys equation (1), and the height of upper boundary of this layer increases with increasing t.

Comparison between observed and calculated wind ratio under neutral condition of stability

Range of t (sec)		Height (cm)				
		25	50	100	200	400
$t<600$	Observed	1.000	1.081	1.166	1.331	1.522
	Calculated	1.000	1.070	1.140	1.210	1.281
	Difference (%)		+1.0	+2.3	+10.0	+18.8
$600\leq t<3{,}000$	Observed	1.000	1.064	1.135	1.235	1.374
	Calculated	1.000	1.071	1.143	1.215	1.287
	Difference (%)		−0.7	−0.7	+1.6	+6.8
$3{,}000\leq t$	Observed	1.000	1.072	1.159	1.246	1.312
	Calculated	1.000	1.076	1.152	1.228	1.304
	Difference (%)		−0.4	+0.6	+1.5	+0.6

In the latter case of $t<3{,}000$ sec, supposing that the upper layer obeys equation (2) of hydrodynamically rough flow, while the lower layer obeys equation (1) of hydrodynamically smooth flow, we can find the height of the boundary (h) of these two layers. According to R. B. Montgomery,[9] if we assume that u is continuous at $z=h$ and allow that u_* is discontinuous at $z=h$, the required height (h) is obtained by the equation of

$$\ln\frac{h}{z_0}=\frac{5.5k_0+\ln\frac{u_{*1}z_0}{\nu}}{\frac{u_{*2}}{u_{*1}}-1}, \qquad (3)$$

derived from equations (1) and (2), where u_{*1} and u_{*2} are friction velocity in the lower and upper layers respectively. Numerical values of z_0 and u_{*2} are calculated by equation (2) from observed values of u_{200} and u_{400}, assuming $h<200$ cm, while u_{*1} is calculated by equation (1) from observed value of u_{25}. Thus, numerical values of h can be obtained by (3) from these values and they are 105 cm and 164 cm for $t=518$ sec (mean value of individual ones belonging to (i) $t<600$ sec) and $t=1{,}306$ sec (mean value for (ii) $600\leq t<3{,}000$ sec) respectively. From these h values, rough empirical formula of $h\doteqdot 4.6\sqrt{t}$ is obtained, assuming that h is proportional to $\sqrt{t}$.

3. Wind Profiles under Stable Condition.

The stratification will be called stable, when the temperature difference $(T_{400}-T_0)$ exceeds $+0.5$°C. No actual value of this temperature difference exceeds $+2.8$°C. Observed data belonging to this category of stable condition are classified into following three steps of progressive time;

(i) $t<3{,}000$ sec (ii) $3{,}000\leq t<8{,}000$ sec (iii) $8{,}000\text{ sec}\leq t$,

because there is no complete set of observation belonging to $t<600$ sec and are considerable number of observations of large progressive time. Mean wind profiles for each step of t are calculated and listed as follows.

Mean wind profile under the condition of $+0.5°\text{C}<T_{400}-T_0$

Range of t (sec)	Wind speed (cm/sec)					Range of u_{400} (cm/sec)	No. of obs.
	u_{25}	u_{50}	u_{100}	u_{200}	u_{400}		
$t<3{,}000$	238	255	273	299	336	93-600	19
$3{,}000\leq t<8{,}000$	283	304	325	345	374	122-688	14
$8{,}000\leq t$	93	101	106	114	121	65-206	5

These observed profiles and those of hydrodynamically smooth flow are compared in the following table in the form of wind ratio. Inspecting the table, we can see the following facts:

(1) For $t\geq 8{,}000$ sec, agreement between observed and calculated profiles is pretty good up to at least the observing height of 400 cm.

(2) For $t<8{,}000$ sec, wind profile only in the lower layer obeys equation (1), and the thickness of the layer increases with progressive time.

Comparison between observed and calculated wind ratio under stable condition

Range of t (sec)		Height (cm) 25	50	100	200	400
$t<3,000$	Observed	1.000	1.071	1.147	1.256	1.412
	Calculated	1.000	1.072	1.144	1.216	1.288
	Difference (%)		−0.1	+0.3	+3.3	+9.6
$3,000\leq t<8,000$	Observed	1.000	1.074	1.148	1.219	1.322
	Calculated	1.000	1.071	1.141	1.213	1.284
	Difference (%)		+0.3	+0.6	+0.5	+3.0
$8,000\leq t$	Observed	1.000	1.086	1.140	1.226	1.301
	Calculated	1.000	1.079	1.158	1.237	1.316
	Difference (%)		+0.6	−1.6	−0.9	−1.1

In the latter case of $t<8,000$ sec, we obtain the following results, calculating the height of the boundary (h) by the same way to the previous section:

(i) $h=147$ cm for $t=1,720$ sec, (ii) $h=186$ cm for $t=4,801$ sec.

Accordingly, a rough empirical formula of $h\doteqdot 3.1\sqrt{t}$ is obtained.

4. Wind Profiles under Unstable Condition.

The stratification will be called unstable, when the temperature difference ($T_{400}-T_0$) is lower than -0.5°C. The observed data belonging to this category of unstable condition are divided into three stages of instability,

(a) $-5.0^\circ\mathrm{C}\leq T_{400}-T_0<-0.5^\circ\mathrm{C}$ (weak instability),

(b) $-10.0^\circ\mathrm{C}\leq T_{400}-T_0<-5.0^\circ\mathrm{C}$ (moderate instability),

(c) $T_{400}-T_0<-10.0^\circ\mathrm{C}$ (strong instability),

since there are great number of observations under unstable condition.

(a) For weak instability, mean wind profiles and the comparison of these with equation (1) are shown in the following tables. In this case, there are considerable number of observations of small progressive time. Therefore, the boundaries of subdivision by t are somewhat different from the previous cases. It is seen from the table that wind profiles obey equation (1) up to the 400 cm level for $t\geq 1,500$ sec.

Mean wind profile under the condition of $-5.0^\circ\mathrm{C}\leq T_{400}-T_0<-0.5^\circ\mathrm{C}$

Range of t (sec)	Wind speed (cm/sec) u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	Range of u_{400} (cm/sec)	No. of obs.
$t<60$	209	242	284	324	372	284–467	13
$60\leq t<300$	131	148	166	191	221	162–305	15
$300\leq t<1,500$	312	331	351	380	422	57–833	30
$1,500\leq t<3,000$	173	186	199	212	223	112–390	27
$3,000\leq t$	188	202	215	230	242	52–699	25

Comparison between observed and calculated wind ratio under weak instability

Range of t (sec)		Height (cm) 25	50	100	200	400
$t<60$	Observed	1.000	1.158	1.359	1.550	1.780
	Calculated	1.000	1.073	1.146	1.219	1.292
	Difference (%)		+7.9	+18.6	+27.2	+37.8
$60\leq t<300$	Observed	1.000	1.130	1.267	1.458	1.687
	Calculated	1.000	1.076	1.153	1.229	1.306
	Difference (%)		+5.0	+9.9	+18.6	+29.2
$300\leq t<1{,}500$	Observed	1.000	1.061	1.125	1.218	1.353
	Calculated	1.000	1.070	1.140	1.211	1.281
	Difference (%)		−1.0	−1.3	+0.6	+5.6
$1{,}500\leq t<3{,}000$	Observed	1.000	1.075	1.150	1.225	1.289
	Calculated	1.000	1.074	1.148	1.223	1.297
	Difference (%)		+0.1	+0.2	+0.2	−0.6
$3{,}000\leq t$	Observed	1.000	1.074	1.144	1.223	1.287
	Calculated	1.000	1.073	1.147	1.221	1.295
	Difference (%)		+0.1	−0.3	+0.2	−0.6

(b) For moderate instability, mean wind profiles and the similar comparison as previous case are shown in the following tables. The boundaries of subdivision by t are a bit changed again, because there are few observations of large t and more observations of small t than previous case. It is seen from the table that wind profile up to the 400 cm height obeys equation (1) for $t\geq 300$ sec.

Mean wind profile under the condition of $-10.0°\text{C}\leq T_{400}-T_0<-5.0°\text{C}$

Range of t (sec)	Wind speed (cm/sec) u_{25}	u_{50}	u_{100}	u_{200}	u_{400}	Range of u_{400} (cm/sec)	No. of obs.
$t<60$	273	300	333	374	425	176–647	23
$60\leq t<100$	141	151	164	182	204	134–313	25
$100\leq t<300$	131	142	151	168	190	60–394	29
$300\leq t$	235	251	267	283	301	90–735	16

Comparison between observed and calculated wind ratio under moderate instability

Range of t (sec)		Height (cm) 25	50	100	200	400
$t<60$	Observed	1.000	1.099	1.220	1.370	1.557
	Calculated	1.000	1.071	1.142	1.213	1.285
	Difference (%)		+2.6	+6.8	+12.9	+21.2
$60\leq t<100$	Observed	1.000	1.071	1.163	1.291	1.447
	Calculated	1.000	1.075	1.151	1.227	1.303
	Difference (%)		−0.4	+1.0	+5.2	+11.1
$100\leq t<300$	Observed	1.000	1.084	1.153	1.282	1.450
	Calculated	1.000	1.076	1.153	1.229	1.305
	Difference (%)		+0.7	0.0	+4.3	+11.1
$300\leq t$	Observed	1.000	1.068	1.136	1.204	1.281
	Calculated	1.000	1.072	1.144	1.216	1.289
	Difference (%)		−0.4	−0.7	−1.0	−0.6

(c) For strong instability, no observation is taken under large t. Therefore, the observed data are subdivided into two steps of t ($t<60$ sec and $60\,\mathrm{sec}\leq t$). Mean wind profiles and the similar comparison as before are shown in the following tables.

Mean wind profile under the condition of $T_{400}-T_0<-10.0°C$

Range of t (sec)	Wind speed (cm/sec)					Range of u_{400} (cm/sec)	No. of obs.
	u_{25}	u_{50}	u_{100}	u_{200}	u_{400}		
$t<60$	236	254	271	294	324	260–500	20
$60\leq t$	151	162	172	186	200	107–286	57

Comparison between observed and calculated wind ratio under strong instability

Range of t (sec)		Height (cm)				
		25	50	100	200	400
$t<60$	Observed	1.000	1.076	1.148	1.246	1.373
	Calculated	1.000	1.072	1.144	1.216	1.289
	Difference (%)		+0.4	+0.3	+2.5	+6.5
$60\leq t$	Observed	1.000	1.073	1.139	1.232	1.325
	Calculated	1.000	1.075	1.150	1.226	1.301
	Difference (%)		−0.2	−1.0	+0.5	+1.8

The relation between the height (h) of the lower layer obeying equation (1) of hydrodynamically smooth flow and the progressive time (t) is already assumed to be a parabolic form. A verification for this assumption can be shown from the comparatively great numbers of observed data under unstable conditions. Numerical values of h, calculated by the same procedure as before in these cases, are plotted against t in Fig. 3. It is understood from Fig. 3 that the appropriateness of the assumption is pretty good and rough empirical fromulae of $h\doteqdot 7.3\sqrt{t}$, $h\doteqdot 12.7\sqrt{t}$, and $h\doteqdot 20.0\sqrt{t}$ are obtained for weak, moderate, and strong instability respectively.

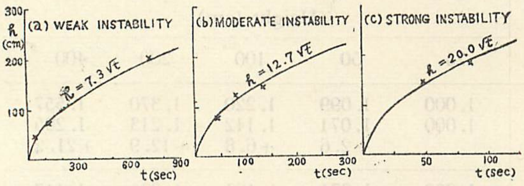


Fig. 3. Parabolic increase of the thickness (h) of the lower layer of smooth flow with increasing progressive time (t) under (a) weak, (b) moderate, and (c) strong instability. Calculated values by equation (3) indicated by crosses.

5. Conclusions and Remarks

Following conclusions are derived from the studies stated above:

(1) Wind profile over the mid-ocean far apart from land under any condition of stability can be considered to obey equation (1) of hydrodynamically smooth flow.

(2) When air flow sweeps over the sea surface after having passed over land area, a lower layer near the sea surface forms into obeying equation (1) of hydrodynami-

cally smooth flow and the thickness of the layer (h) increases with progressive time (t), while wind profile above this layer can be considered to obey equation (2) of hydrodynamically rough flow in the same manner as that over land.

(3) The relations between the height of the lower layer (h), within which wind profile obeys equation (1), and the progressive time (t) are represented by the following rough empirical formulae:

$h \doteqdot 3.1\sqrt{t}$ for stable condition,

$h \doteqdot 4.6\sqrt{t}$ for neutral condition of stabiiity,

$h \doteqdot 7.3\sqrt{t}$ for weak instability,

$h \doteqdot 12.7\sqrt{t}$ for moderate instability,

$h \doteqdot 20.0\sqrt{t}$ for strong instability.

From these relations it is clear that h increases rapidly with progressive time under unstable condition and slowly under stable condition. This influence of stability condition on wind profile is an especially notable fact which deserves dynamical explanations.

Remarks:

The exsistence of the lower layer over the sea obeying equation (1) of hydrodynamically smooth flow is a remarkable fact pointed out by Rossby. According to him, wind profile within the layer below usual anemometer heights obeys equation (1) for light wind, while only the lower part of the layer obeys equation (1) for moderate wind. However, if the fetch (f) is constant, the height of the lower layer (h) obeying equation (1) must increase for light wind, because progressive time (t) becomes obviously larger than that for moderate wind. The height (h) for light wind in his conclusion seems to exceed the observing height, though the perfect confirmation to this reasoning cannot be made owing to indistinction of full details of the data employed by him. Therefore, Rossby's results are consistent with our results.

H. Bruch's conclusion is similar to the author's, but he did not discuss how the height of the boundary of the two layers is determined. H. U. Roll's conclusion is also consistent with the author's. According to him, wind profile obeys equation (1) within whole layer up to the observing height of 200cm. His conclusion seems to be natural, because many observations were taken when it blows from the sea, though fetches are not indicated clearly.

On the other hand, the layer obeying equation (1) is disregarded by Model, Hay, and Johnson, as stated above. However, in Hay's observations, it is supposed that the height of the lower layer (h) will be about 50 cm, because progressive time come within about 100–200 sec from numerical values of the fetch of ca 1,000m and wind speed of 5–10m/sec. Moreover, wind speed at 50 cm level indicates frequently a higher value than that obtained by the best fitting of equation (2) to whole observing layer. Therefore, his observations cannot be serious objections to our conclusions. Model's study is similar to Hay's one using best fitting method. Johnson's observations can be out of discussion, because the observing levels are very high. It must be added that we can readily see from simple calculations that the incomplete sets of our observed data, rejected in the calculations of mean wind profile, also support our conclusions.

Part III Wind Profiles and Wind Waves

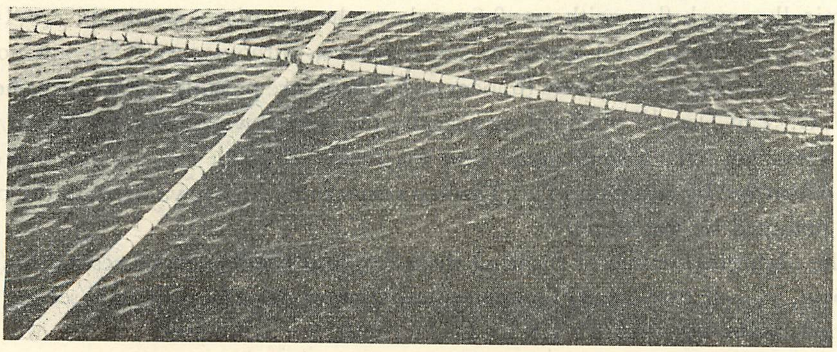
1. Introduction.

It is a well-known fact that the state of sea surface or wind waves depends upon wind speed prevailing above the surface. From this fact, Beaufort's wind force scale is derived empirically. However, a description of this relation between wind speed and wind waves is nonsence unless the anemometer height is specified, because wind speed above the sea surface varies with height.

It can be considered that the dynamically controlling force of formation of wind waves is shearing stress (τ_0), namely it depends upon friction velocity, $u_*(=\sqrt{\frac{\tau_0}{\rho}})$. From this point of view, relations between friction velocity and wind waves are examined from our observed data. Friction velocity for this purpose is calculated by equation (1) of hydrodynamically smooth flow from numerical value of observed wind speed at the lowest observing level, assuming that a layer obeying equation (1) exsists always above the sea surface at least up to the level, according to the conclusion of Part II of the present paper.

2. Critical Friction Velocity for the First Formation of Wind Waves.

There are 156 sets of simultaneous observations of wind and waves and in 21 of these sets no persistent waves are found (data table in Part I). For these 21 cases no numerical value of friction velocity exceeds 3.71cm/sec, while for all of the remainder sets it is equal to or more than 3.71cm/sec. Therefore, the numerical value of $u_{*1} \doteqdot 3.7$cm/sec can be adopted as an empirical critical value for the first formation of wind waves, according to our observations. There are three sets of $u_{*1}=3.71$cm/sec and no waves are formed for one of these three sets (No. 18), while waves are formed for the other two (No. 58, No. 347). The state of sea surface in the case of No. 58 is shown in plate.



The state of sea surface at the observation of No. 58.

Lengths of wave for these two cases at the critical friction velocity of 3.71cm/sec do not coincide with each other, i. e. they are 6.3cm and 7.2cm. Furthermore, shorter wave lengths are observed at higher friction velocity than those for the above-mentioned two cases, i. e. $L=4.5$cm for $u_{*1}=4.57$cm/sec (No. 345) and $L=5.8$cm for

$u_{*1}=4.54$cm/sec (No. 400). Therefore, it is hard to determine uniquely the critical wave length at the first formation of wind waves from just our observed data.

For the critical friction velocity of 3.7cm/sec, wind speed at several levels is calculated by equation (1) and is shown in the following table.

Wind speed calculated by (1) for $u_{*1}=3.7$cm/sec

Height (cm)	25	50	100	200	400
Wind speed (cm/sec)	80	86	93	99	105

If it is assumed that the height of the layer obeying equation (1) is 25cm and that the upper layer above 25cm obeys equation (2) of hydrodynamically rough flow with $z_0=0.6$cm, wind speed at several levels is as follows by the equations for the critical friction velocity of 3.7cm/sec.

Calculated wind speed for $u_{*1}=3.7$cm/sec, $h=25$cm, $z_0=0.6$cm

Height (cm)	25	50	100	200	400
Wind speed (cm/sec)	80	95	110	125	140

Critical wind speed for the first formation of wind waves, obtained empirically by H. Jeffreys,[10)] was 110cm/sec. A comparison of this value, obtained at uncertain height, with our result can be made from a determination of the height (z_a) where $u=110$cm/sec on the basis of the critical friction velocity of 3.7cm/sec. For hydrodynamically smooth flow, we obtain $z_a=656$cm by equation (1). However, his observations were made over a small pond, where the progressive time was expected to be small. Then, assuming hydrodynamically smooth flow below $z=25$cm and hydrodynamically rough flow with $z_0=0.6$cm above the elevation, we obtain $z_a=100$cm. Therefore, a critical wind speed, as stated before, without specifying anemometer height is nonsence, though these (656cm and 100cm) are possible anemometer heights.

W. G. Van Dorn[11)] obtained empirically the critical wind speed of 200cm/sec at 25cm elevation over a small pond near sea coast. Friction velocity for this case is $u_{*1}=8.5$cm/sec by equation (1). This is a remarkably higher value than the critical value obtained by the author.

The numerical values of shearing stress (τ_0) and coefficients of resistance (γ^2_{25} at $z=25$cm, γ^2_{400} at $z=400$cm) for the critical friction velocity of 3.7cm/sec are easily obtained, assuming $\rho \doteqdot 1.2\times 10^{-3}$, and the results are as follows:

$$\tau_0 \quad = u^2_{*1}\rho = 1.64\times 10^{-2} \text{ dyne/cm}^2$$

$$\gamma^2_{25} = \frac{u^2_{*1}}{u^2_{25}} = 2.14\times 10^{-3}$$

$$\gamma^2_{400} = \frac{u^2_{*1}}{u^2_{400}} = 1.24\times 10^{-3}.$$

3. Generation of Whitecaps.

Whitecaps appear in 19 cases among 156 observations. Numerical values of u_{*1} for these cases are higher than 17cm/sec, except for two cases (No. 32 and 322) with u_{*1} of 15.32cm/sec and 13.37cm/sec respectively. The latter, 13.37cm/sec, is the lowest value. However, no whitecaps appear in 6 cases (No. 60, 84, 134, 135, 138, and 188), even though u_{*1} exceeds 13.37cm/sec and one of them exceeds 15.32cm/sec (No. 135).

It is adequate from these facts to presume $u_{*1} \doteqdot 17$cm/sec as the empirical value of the critical friction velocity for generation of whitecaps. For this value of 17cm/sec, wind profiles are obtained as follows, by equation (1) assuming $h=400$cm, and by equations (1) and (2) assuming $h=25$cm and $z_0=0.6$cm.

Calculated wind speed for $u_{*1}=17$cm/sec

Height (cm)	25	50	100	200	400	Assumption
Wind speed (cm/sec)	431	461	490	520	549	$h=400$cm
	431	511	591	671	751	$h=25$cm, $z_0=0.6$cm

At 25cm level the critical wind speed is 431cm/sec, whereas the critical wind speed indicated by W. H. Munk[12] is 660cm/sec, where the anemometer level is not specified. Calculating the height where $u=660$cm/sec for $u_{*1}=17$cm/sec, we obtain 54.5m by equation (1) assuming h=anemometer height, and 182cm by equations (1) and (2) assuming $h=25$cm and $z_0=0.6$cm. The former is too high value for an anemometer height and the latter corresponds to a case of too short progressive time. Therefore, his result is inconsistent with the author's.

The numerical values of shearing stress and coefficients of resistance at $z=25$cm and 400cm for the critical friction velocity of 17cm/sec are as follows:

$$\tau_0 = 34.7 \times 10^{-2} \text{ dyne/cm}^2$$

$$\gamma_{25}^2 = 1.56 \times 10^{-3}$$

$$\gamma_{400}^2 = 0.96 \times 10^{-3}.$$

4. Friction Velocity and Wave Length and Height.

The dependency of wave length (L) and height (H) on friction velocity is examined from the respective mean values for each group, into which the observed data are classified according to individual values of u_{*1}(3.7–6, 6–9, 9–12, 12–17, and more than 17cm/sec).

The results are shown in the following table. It is seen that the mean values of wave length and height both increase with increasing friction velocity. However, the ranges of individual values for a specified group remarkably overlap on those of neighbouring groups.

Dependency of mean wave length and height on friction velocity

Range of u_{*1} (cm/sec)	Mean of u_{*1} (cm/sec)	Mean value		Range		No. of obs.
		Length (cm)	Height (cm)	Length (cm)	Height (cm)	
3.7–6	4.70	10.1	1.1	4.5–18	0.5–2	33
6–9	7.39	23.3	2.6	6.5–49	1–6	37
9–12	10.20	45.5	4.7	15–120	1–17	29
12–17	13.40	99.8	9.8	30–300	2–36	17
17–	19.23	348.8	33.2	195–530	21–55	12

Wave steepness (H/L) and wave age (C/u_{25}) are calculated from the mean values and the results are shown in the following table, where wave velocity (C) is calculated by the ratio of observed mean wave length and observed mean wave period, and u_{25} by equation (1) from the mean value of u_{*1}. It is seen that H/L and C/u_{25} are nearly constant with increasing friction velocity.

Wave steepness and wave age

Range of u_{*1} (cm/sec)	H/L	Mean observed wave period (sec)	C (cm/sec)	u_{25} (cm/sec)	C/u_{25}
3.7–6	0.11	0.32	32	104	0.31
6–9	0.11	0.42	55	172	0.32
9–12	0.10	0.55	83	245	0.34
12–17	0.10	0.91	110	331	0.33
17–	0.10	1.73	202	493	0.41

5. Conclusion.

From the simultaneous observations of wind profile and wave elements, the following facts are empirically derived:

(1) The critical friction velocity for the first formation of wind waves is 3.7cm/sec. No waves appear when friction velocity is less than this value.

(2) The critical friction velocity for generation of whitecaps is ca 17cm/sec. Whitecaps generate when friction velocity exceeds this value.

(3) Wave length and height increase generally with increasing friction velocity, though individual values are often far from this tendency.

(4) Wave steepness (H/L) and wave age (C/u_{25}) are nearly constant with increasing friction velocity as far as we concern.

It is noticed that the observing level of wind speed must be specified, when the critical values are given in wind speed itself instead of friction velocity. More than all, it is notable that the numerical values of the critical friction velocity stated above are inconsistent with other researchers' results. These facts deserve future dynamical illustrations.

Part IV Humidity Profiles over the Sea and Evaporation from its Surface

1. Humidity Profiles over the Sea.

Observed data of vapour pressure are classified into the same groups as wind data are classified in Part II. Mean profiles for each group are shown in the following table and Fig. 4.

Mean humidity profile under different conditions of stability

Stability condition (°C)	Range of t (sec)	Vapour pressure (mb) e_0	e_{25}	e_{50}	e_{100}	e_{200}	e_{400}	No. of obs.
$+0.5<T_{400}-T_0$	$t<3,000$	31.10	25.82	25.34	25.08	24.66	24.30	16
	$3,000\leq t<8,000$	27.23	22.01	21.93	21.50	21.38	21.01	8
	$8,000\leq t$	38.60	30.75	30.50	30.40	30.30	29.95	2
$-0.5\leq T_{400}-T_0\leq +0.5$	$t<600$	20.55	15.50	15.35	14.95	14.65	14.20	2
	$600\leq t<3,000$	25.67	21.18	20.62	20.27	20.22	19.82	9
	$3,000\leq t$	31.81	26.13	25.83	25.63	25.44	25.18	9
$-5.0\leq T_{400}-T_0<-0.5$	$t<60$	22.17	14.10	13.37	12.88	12.69	12.55	12
	$60\leq t<300$	22.21	14.51	13.70	13.04	12.44	12.19	14
	$300\leq t<1,500$	25.67	20.14	19.36	19.07	18.86	18.42	31
	$1,500\leq t<3,000$	29.15	23.62	23.18	22.87	22.59	22.49	33
	$3,000\leq t$	25.59	20.03	19.36	19.06	18.83	18.54	31
$-10.0\leq T_{400}-T_0<-5.0$	$t<60$	20.88	10.82	10.05	9.34	9.19	8.85	23
	$60\leq t<100$	21.91	12.07	11.59	11.26	10.84	10.63	22
	$100\leq t<300$	20.72	11.27	10.63	10.15	9.82	9.73	24
	$300\leq t$	21.65	12.49	11.82	11.18	10.83	10.66	15
$T_{400}-T_0<-10.0$	$t<60$	20.88	9.17	8.65	8.16	7.89	7.67	18
	$60\leq t$	21.21	9.78	9.31	8.93	8.63	8.40	46

Assuming that eddy diffusivity of vapour transport is equal to that of momentum transport, Montgomery[9] derived the following relations which represent the expected water vapour distribution above the sea surface; i.e.

$$-\frac{1}{e_0-e_b}\frac{de}{d\ln z}=\left(0.96+\ln\frac{u_{*1}b}{\kappa}\right)^{-1}, \tag{4}$$

when wind profile obeys equation (1) of hydrodynamically smooth flow; and

$$-\frac{1}{e_0-e_b}\frac{de}{d\ln z}=\left[\ln\frac{b}{h}+\frac{u_{*2}}{u_{*1}}\left(0.96+\ln\frac{u_{*1}h}{\kappa}\right)\right]^{-1}, \tag{5}$$

when wind profile above the height of h obeys equation (2) of hydrodynamically rough flow. In the preceeding equations e_b is vapour pressure (mb) at b cm upward from the sea surface, b is any standard level, and κ is kinematic coefficient of molecular diffusion of water vapour through air.

An examination of these formulae (4) and (5) is made from the present observed data. Assuming that humidity profile obeys a logarithmic law and adopting $b=400$cm,

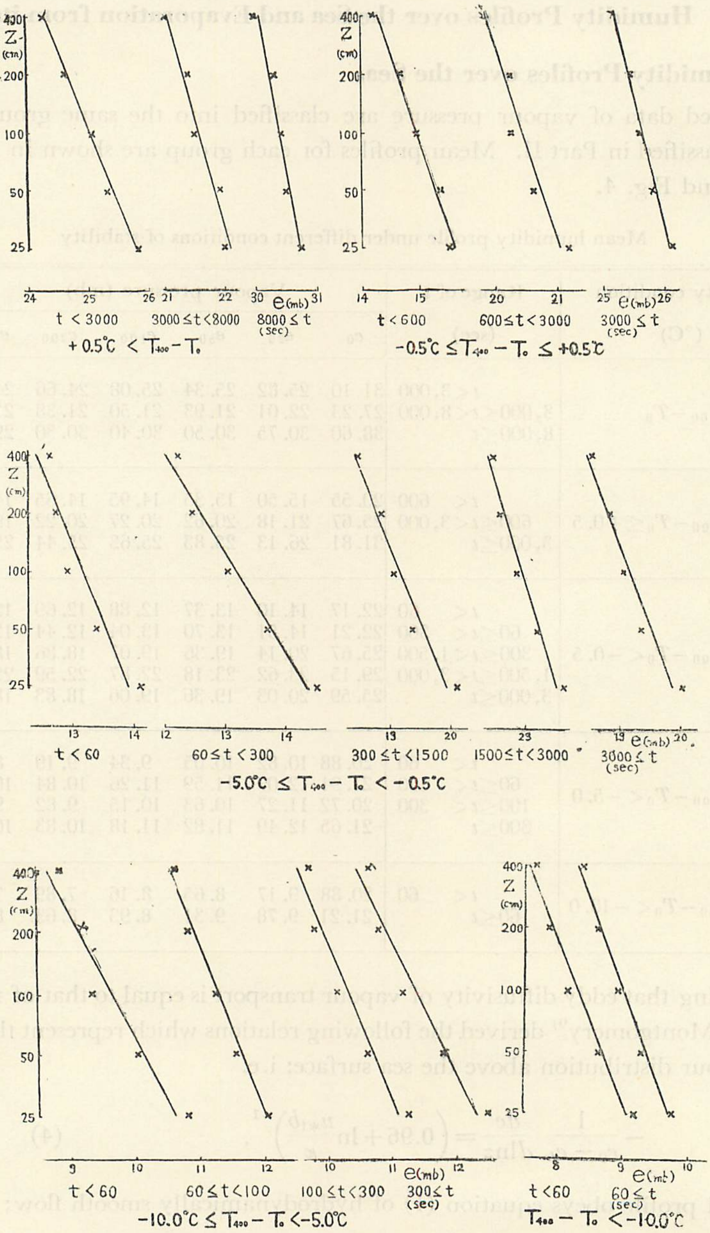


Fig. 4. Humidity profiles at different steps of progressive time under different conditions of stability. Straight lines in $\ln z$-e diagram determined by the least square method. Observed values indicated by crosses.

we can calculate the numerical values of the left hand side of the equations by the least square method from the observed vapour pressure listed in the preceeding table. Numerical values of right hand side of them can be calculated from the results obtained in Part II. These values of both sides are listed in the following table. It is seen that the agreements of one side with the other are insufficient. This fact suggests that the assumption, which the formulae (4) and (5) are based on, cannot be exempt from amendments, though the fact may be partly due to possible inaccuracy of humidity measurements.

Examination of the formulae (4) and (5)

Stability condition (°C)	Range of t (sec)	Left hand side	Right hand side	Formula
$+0.5<T_{400}-T_0$	$t<3,000$	0.078	0.046	(5)
	$3,000\leq t<8,000$	0.059	0.066	(5)
	$8,000\leq t$	0.029	0.102	(4)
$-0.5\leq T_{400}-T_0\leq+0.5$	$t<600$	0.074	0.037	(5)
	$600\leq t<3,000$	0.076	0.050	(5)
	$3,000\leq t$	0.049	0.099	(4)
$-5.0\leq T_{400}-T_0<-0.5$	$t<60$	0.056	0.035	(5)
	$60\leq t<300$	0.085	0.037	(5)
	$300\leq t<1,500$	0.078	0.049	(5)
	$1,500\leq t<3,000$	0.061	0.097	(4)
	$3,000\leq t$	0.071	0.096	(4)
$-10.0\leq T_{400}-T_0<-5.0$	$t<60$	0.057	0.039	(5)
	$60\leq t<100$	0.046	0.051	(5)
	$100\leq t<300$	0.051	0.048	(5)
	$300\leq t$	0.061	0.094	(4)
$T_{400}-T_0<-10.0$	$t<60$	0.041	0.056	(5)
	$60\leq t$	0.039	0.081	(5)

However, it is seen in Fig. 4 that humidity profile seems to obey a logarithmic law, except for the cases under unstable conditions, and that for unstable conditions it shows convex form against e-axis in $\ln z$-e diagram independent of progressive time. This fact suggests that two layers obeying different logarithmic laws of humidity profile may exsist and that the boundary between them will be higher than the observing height under an unknown condition.

2. Evaporation from the Sea Surface.

The observed data of evaporation for 6 hours, obtained by the method stated in Part I, are classified into four groups according to observing month (April and May; August and September; October and November; December and January), since the numbers of observations for each month are too low to find a character of annual variation of evaporation from the sea surface. Mean values for each group or season are calculated and the results are listed in the following table, which includes also the similar mean values of those from a pan on deck in the interest of comparison.

It can be considered that this table indicates the actual conditions of seasonal and diurnal variation of evaporation from the sea surface at Kagoshima Bay. The character of variation is quite different from the case of pan on deck, though the annual mean value does not differ so much.

Mean amount of 6 hour evaporation

Month	Time (from-to) (h)	Evaporation from sea surface (mm)	Evaporation from pan on deck (mm)	No. of obs.
April-May	03-09	0.27	0.56	5
	09-15	0.35	0.90	4
	15-21	0.30	0.44	4
	21-03	0.29	0.12	6
	Total	1.21	2.02	
Aug.-Sept.	03-09	1.13	0.48	3
	09-15	1.16	3.51	4
	15-21	0.47	1.64	4
	21-03	0.79	0.36	4
	Total	3.55	5.99	
Oct.-Nov.	03-09	1.29	0.32	4
	09-15	1.02	1.62	4
	15-21	1.25	0.56	3
	21-03	1.46	0.35	4
	Total	5.02	2.85	
Dec.-Jan.	03-09	1.72	0.21	6
	09-15	1.24	1.00	14
	15-21	1.61	0.40	6
	21-03	1.62	0.16	6
	Total	6.19	1.77	
Annual mean value of one day evaporation		3.99	3.16	

The evaporation from the sea surface is given as the product of eddy diffusivity and the vertical gradient of specific humidity. Several formulae of evaporation proposed by several researchers are all based on this point of view, since one of them was proposed by H. U. Sverdrup[13] for the first time. Montgomery[9] derived the following formulae giving evaporation (E gr/cm^{2}sec) from hydrodynamically smooth or rough sea surface, when humidity profiles are given by equations (4) and (5) respectively. He gets

$$E=\rho k_0 u_{*1}\Gamma_1(q_0-q_b) \tag{6}$$

on hydrodynamically smooth surface; and

$$E=\rho k_0 u_{*2}\Gamma_2(q_0-q_b) \tag{7}$$

on hydrodynamically rough surface, where q_0 and q_b are specific humidity at the sea surface and at b cm height respectively, and Γ_1 and Γ_2 are given by equations (4) and (5) respectively in the form of $\Gamma=-\dfrac{1}{e_0-e_b}\dfrac{de}{d\ln z}$.

It is stated in the preceeding section that the assumption, involved in the derivation of these equations, cannot be confirmed from the present observed data. If we assume these equations hold, evaporation can be determined from our observed data of wind and humidity profiles. From this point of view, evaporation for individual instances is calculated by equation (6) from observed value of u_{*1} and q_b based both on the lowest observing level, and of Γ_1 obtained by the right hand side of equation (4). To compare this with the observed 6 hour evaporation, the individual values within a specified time interval are summed up and multiplied, if necessary, by a constant to make 6 hour evaporation. Mean values of them for every two months are listed in the following table. Agreements of these results with the observed values of evaporation, shown in the preceeding table, are not sufficient. But it should be reserved to regard this assumption inadequate, because the disagreements may be partly due to possible inaccuracy of humidity measurements.

The well-known practical formula of evaporation proposed by C. W. Thornthwaite and B. Holzman[14] can be represented by the form of

$$E=\frac{\rho k_0 u_*(q_1-q_2)}{\ln\frac{z_2}{z_1}}, \tag{8}$$

where q_1 and q_2 are specific humidity at z_1 and $z_2$cm levels respectively. This equation holds when wind and humidity profiles obey logarithmic laws. The former condition is approximately satisfied by actual profiles, as shown in Part II; and the latter condition is approximately satisfied by actual profiles except for those under unstable condition, as shown in the preceeding section. Assuming $u_*=u_{*1}$, calculated by equation (1) from wind speed at the lowest observing level, and taking $z_1=25$ cm and $z_2=50$ cm and 400 cm, numerical values of expected evaporation for individual instances are calculated by equation (8). When the observed data of e_{25} is lacking, its numerical value is estimated by logarithmic extrapolation. Six hour evaporation, obtained by the same procedure as before, is shown in the following table. Agreements of calculated values for two cases with the observed values are both insufficient even though unstable cases are rejected.

Calculated values of 6 hour evaporation (mm)

Month	Time (from-to) (h)	Evaporation calculated by equation (6)	Evaporation calculated by equation (8): $z_1=25$cm, $z_2=50$cm	Evaporation calculated by equation (8): $z_1=25$cm, $z_2=400$cm
April-May	03-09	0.18	0.15	0.08
	09-15	0.18	0.26	0.20
	15-21	0.14	0.35	0.29
	21-03	0.13	0.07	0.13
Aug.-Sept.	03-09	0.38	0.37	0.26
	09-15	0.42	0.41	0.31
	15-21	0.60	0.48	0.37
	21-03	0.36	0.20	0.18
Oct.-Nov.	03-09	0.38	0.54	0.28
	09-15	0.45	1.49	0.81
	15-21	0.38	1.05	0.52
	21-03	0.50	0.35	0.21
Dec.-Jan.	03-09	0.70	0.35	0.26
	09-15	0.63	0.56	0.37
	15-21	0.63	0.22	0.22
	21-03	0.76	0.31	0.25

3. Conclusion.

Actual conditions of seasonal and diurnal variation of evaporation from the sea surface are indicated from direct observations taken at Kagoshima Bay. These results are compared with the expected values, calculated from observed wind and humidity profiles by Montgomery's formula and by Thornthwaite and Holzman's formula. Agreements between them are insufficient. Therefore, the problem of the way calculating the evaporation from the sea surface from wind and humidity profiles deserves further studies.

Acknowledgement

The author wishes to express his sincere thanks to Professor T. Namekawa, Director of Meteorological Research Institute, Kyoto University, for his encouragement and helpful advice. He is also indebted to Captain S. Ueda, Research Vessel Kagoshima-maru, Kagoshima University, and his crew; and to Captain K. Takahashi, Research Vessei Hayato-maru, Kagoshima University, and his crew; and to 21 college students, for their kind assistances in observations over the sea.

References

1. Kawata, S., Nishimura, K., and Omori, Y., 1952; Researches on thermocouple anemometer, Denki Hyoron (Electrical Review), 40, 2.
2. Wüst, G., 1920; Die Verdunstung auf dem Meere, Veröf. Inst. Meer., Univ. Berlin, N. F. A., 6.
3. Rossby, C. G., 1936; On the frictional force between air and water and on the occurrence of a laminar boundary layer next to the surface of the sea, Pap. Phys. Ocea. Met., 4, 3.
4. Bruch, H., 1940; Die Vertikale Verteilung von Windgeschwindigkeit und Temperatur in den untersten Metern über der Wasseroberfläche, Veröf. Inst. Meer., Univ. Berlin, N. F. A., 38.
5. Roll, H.U., 1948; Wassernahes Windprofil und Wellen auf dem Wattenmeer, Ann. d. Met., Hamburg, 1, 4/5, 139.
6. Model, F., 1942; Die Rauhigkeit der Meeresoberfläche, Gerl. Beitr. Geophys., 59, 102.
7. Deacon, E. L., 1953; Vertical profiles of mean wind in the surface layers of the atmosphere, Geophys. Mem., Met. Off., London, 91.
8. Hay, J. S., 1955; Some observations of air flow over the sea, Quart. J. R. Met. Soc., 81, 307.
9. Montgomery, R. B., 1940; Observations of vertical humidity distribution above the ocean surface and their relation to evaporation, Pap. Phys. Ocea. Met., 7, 4.
10. Jeffreys, H., 1925; On the formation of water waves by wind, Proc. Roy. Soc. London, A, 107, 189.
11. Van Dorn, W. G., 1953; Wind stress on an artificial pond, J. Mar. Res., 12, 3.
12. Munk, W. H., 1947; A critical wind speed for air-sea boundary processes, J. Mar. Res., 6, 3.
13. Sverdrup, H. U., 1936; Das maritime Verdunstungsproblem, Ann. d. Hydr. u. mar. Met., 64, 41.
14. Thornthwaite, C. W. and Holzman, B., 1939; The determination of evaporation from land and water surfaces, Monthly Weather Rev., 67, 4.