MET.O.14

METEOROLOGICAL OFFICE
BOUNDARY LAYER RESEARCH BRANCH
TURBULENCE & DIFFUSION NOTE

T.D.N. No.155

A COMPARISON OF SEVERAL METHODS OF ASSESSING THE SURFACE ENERGY BALANCE OVER A GRASS SURFACE

- A preliminary report on the Cardington experiment, 1983

by

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May 1984

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A comparison of several methods of assessing the surface energy balance over a grass surface - A preliminary report on the Cardington experiment, 1983

1. Introduction

From 21 April to 18 May, 1983, an experiment was carried out at the Meteorological Research Unit, RAF, Cardington, to measure directly the components of the energy budget over a grass surface. The principal objective of the experiment was to verify the model, developed mainly from the Cardington data, 1976, for estimating the heat and momentum fluxes in the surface layer from routine meteorological data (Smith and Hunt, 1978; Wang, 1984). Further instrumentation was set up to enable independent estimates of the fluxes to be made for intercomparison. The weather during the observational period was very changeable and mostly rather wet. The daily rainfall during this period is shown in Fig. 1.

The data (hourly mean values) are presented in the Appendix; they were selected according to the following criteria:

a. No rainfall during the hour of observation;

b. No identifiable instrument malfunction.

2. Site description

The experimental area is illustrated in Fig. 2 which shows the distance and bearing of the nearest obstacles to the 16 m profile mast. It provides a good exposure to the wind from most directions. There are, however, two large hangars (approximately 50 m high) about 300 m to the north. The laboratory buildings (approximately 4 m high) 50 m to the east of the two 16 m masts may have more influence on the profile measurements. Other buildings and topographic changes normally lie 1-2 km away. The most open area lies in south-west (190°-300°).

Both the site and its immediate surroundings are grass covered. The grass height was normally about 10 cm; but late in the observational period the grass in the instrumented area grew up to 20-25 cm.

3. Measurement of the surface energy budget

The measurement of the surface energy budget was done in four ways:-

a. Direct measurement of net radiation, evaporation and soil heat flux and the use of an energy balance equation to derive the sensible heat flux;

b. Estimation of fluxes from mean wind and temperature profiles;

c. Direct measurements of sensible heat and momentum fluxes by sonic anemometer;

d. Routine meteorological observations.

These measurements are described below.

i. Net radiation

The net radiation R_n was measured by two types of net radiometer: one is a standard polythene-shielded Funk type; the other is a ventilated Kew Observatory pattern. Both were supported parallel to the surface at a height of approximately 1 m. The accuracy is between 5 and 10 percent. The readings of the two radiometers agree very well, except during precipitation when the Kew type was apparently unreliable.

ii. Evaporation

Evaporation was measured directly by a lysimeter, a square tank of surface area 2 m^2 and depth 50 cm, containing a sample of soil and a grass surface representative of the surrounding site. The tank is mounted on a balance constructed in situ around it. The change in the weight of this tank due to evaporation from the surface or rainfall upon it is monitored automatically. If Δh mm is the equivalent depth of water evaporated from the surface of the lysimeter during a period Δt seconds, the rate of evaporation E per unit area is given by

$$E = \frac{\Delta h}{\Delta t} \; kg.s^{-1}m^{-2} \qquad (1)$$

The latent heat flux

$$LE = \lambda . E \tag{2}$$

where λ is the latent heat of water vaporization.

The lysimeter cannot normally resolve variations in the evaporation rate over periods less than one hour. This is due to the difficulty of monitoring the small weight change of the huge amount of soil, and also, due to the effect of the turbulent wind field over the surface of the lysimeter. During the experiment the output of the lysimeter often appeared to have an oscillation with period approximately 3 min, which might be one of the reasonant oscillations of the mechanical system of the balance. But, nevertheless, the lysimeter has proved to be a direct and consistently reliable means of presenting an hourly mean value of LE continuously, with an accuracy of between 10 and 20 percent.

iii. Soil heat flux

Three conventional flux plates were buried at depths of 5, 10 and 15 cm under the surface to measure the heat flux at those depths. The downward soil heat flux G at the surface (Z=0) is estimated by extrapolation from the outputs of the three plates. This is because it is physically impossible to measure this quantity without disturbing the surface. Furthermore, not only does the finite size of the sensors produce an unavoidable volume - integrated measurement, but also the sensors must be buried deep enough to prevent any direct sky or solar radiation reaching them.

The diurnal variation of soil heat flux in a two-day period is shown in Fig. 3. It is very similar to Richards' result which was obtained from the 1976 experiment at Cardington (Richards, 1979). Again, Richards' extrapolation table for deriving G has proved to be adequate for processing the data from the flux plates used in this experiment.

iv. Sensible heat flux

The sensible heat flux H can be calculated from the well known surface energy balance equation

$$R_n = H + LE + G \qquad (3)$$

after we have obtained the values of R_n, G, and LE from the measurements mentioned above. This is the residual method. Other methods of obtaining H will be given later.

v. Wind and temperature profiles.

A 16 m mast was used with a wind vane at the top and 4 Porton-type anemometers mounted at 1, 3, 8.7 and 16 m to measure the wind profile. Temperature differences were measured between 0.5 m and 2 m and between 0.5 m and 8 m using three thermistors with radiation shielding and natural aspiration.

The use of profile data to evaluate fluxes and the comparison with other methods are discussed in section 4.

vi. Direct measurements of turbulent fluxes

A sonic anemometer mounted at the top of a 16 m mast was used to measure the turbulent fluxes directly. A fast temperature sensor consisting of a 0.025 mm platinum wire was attached to the sonic head, and the output processed with the sonic signals. By this means more precise measurements of mean temperature (t_p) and sesnsible heat flux (H_p) can be obtained.

The sonic anemometer worked very well through the whole observational period. Unfortunately the attached platinum wire is very fragile and broke at some time during the last 9 days.

vii. Standard meteorological observations

Observations of screen dry-and wet-bulb temperatures were made when possible, and a thermogrpah and hygrograph provided values of temperature and relative humidity during periods when no observer was present. The accuracies of the thermograph and hygrograph were poor, so observations from RAE Bedford were used as a check in the later data analysis.

A sky camera was used to take pictures of cloud cover normally once an hour. The cloud data from Bedford station were used as a check as well.

A raingauge was used to measure the amount and time period of rainfall.

4. Analysis of the data

a. Diurnal variation of the wind profile and surface energy budget.

In Fig. 4 the hourly variation of the wind profile is shown for two rather fine days with a wind direction (at 16 m) mainly SSW. It illustrates the classical departure of the vertical wind profile from the logarithmic law in diabatic conditions. When the layer is unstable, e.g. around midday, the profile is curved towards "Height" axis. However when the layer becomes rather stable the curvature reverses its sense. This behaviour is predictable from the similarity theory shown by equations (6) and (9) in the next paragraph.

Fig. 5 shows the hourly variation of the components of surface energy budget for the first four days, which are representative of the whole observational period. Of the four terms in the budget it is noted that the net radiation R_n is generally the largest, and, furthermore, is usually subject to the greatest daily changes. This is because R_n is strongly dependent on the elevation of the sun and on meteorological factors such as cloud cover (type, amount and depth), and atmosphere turbidity. We have developed a model to evaluate R_n based on these factors, which will be discussed later. The other components in the energy budget reflect the variation in Rn to a greater or lesser degree. Soil heat flux G, for instance, follows Rn closely, but with greatly reduced amplitude. Smith's formula,

$$G = \left(0{\cdot}4\frac{S}{S_m} - 0{\cdot}2\right) R_n \qquad (4)$$

(F B Smith, Private communication) is suitable for use in modelling work, where S is solar elevation (see later, equation (23)), and Sm is the midday value of S.

The latent heat flux LE plays a very important role in the surface energy budget. In this observational period, LE is the second largest term, and is a strong function of Rn. This is because there is an adequate supply of soil moisture in this period. Generally LE is a complex function of Rn, G, the drying power of the wind (i.e. wind speed and relative humidity), and the ground state, mainly the moisture content of the soil. Monteith presented a formula to estimate LE by introducing the surface resistance (Monteith, 1965), which will be discussed in the last part of this section.

b. Analysis of the profile data.

Based on the Monin-Obukhov similarity theory for the surface layer of the atmosphere boundary layer the so-called profile method was used to estimate the heat and momentum flux at the surface. According to the similarity theory, with the assumption of stationary and horizontally homogeneous conditions, vertical gradients of any conservative quantity are functions of height Z and Z/L only, where

$$L = -\frac{\bar{\theta}\, u_*^3}{g k H} \rho C_p \qquad (5)$$

is the Monin-Obukhov length; u_*, the friction velocity; $\bar{\theta}$, the mean potential temperature of the surface layer; K, the Von Karman constant; ρ, the density of air; Cp, the specific heat of air at constant pressure. For wind and temperature we have

$$u(z_2) - u(z_1) = \frac{u_*}{K} \cdot \psi_m \qquad (6)$$

$$\theta(z_2) - \theta(z_1) = -\frac{\theta_*}{K} \cdot \psi_h \qquad (7)$$

where Z_1 and Z_2 are two heights at which wind and temperature are measured, θ_* is a scaling quantity defined by

$$H = \rho C_p u_* \theta_* \qquad (8)$$

ψ_m and ψ_h are the so-called integrated universal functions (Paulsen, 1970):

Unstable case (Z/L<0)

$$\psi_m = \ln\frac{Z_2}{Z_1} + \ln\left[\frac{(X_1^2+1)(X_1+1)^2}{(X_2^2+1)(X_2+1)^2}\right] + 2\left(\tan^{-1}X_1 - \tan^{-1}X_2\right) \qquad (9)$$

$$\psi_h = \alpha\left[\ln\frac{Z_2}{Z_1} + 2\ln\left(\frac{Y_1+1}{Y_2+1}\right)\right] \qquad (10)$$

Stable case (Z/L>0)

$$\psi_m = \ln\frac{Z_2}{Z_1} + \frac{\beta}{L}(Z_2 - Z_1) \qquad (11)$$

$$\psi_h = \alpha\ln\frac{Z_2}{Z_1} + \frac{\beta}{L}(Z_2 - Z_1) \qquad (12)$$

where

$$X_1 = \left(1 - \gamma_m\frac{Z_1}{L}\right)^{1/4} \qquad (13)$$

$$X_2 = \left(1 - \gamma_m\frac{Z_2}{L}\right)^{1/4} \qquad (14)$$

$$Y_1 = \left(1 - \gamma_h\frac{Z_1}{L}\right)^{1/2} \qquad (15)$$

$$\gamma_2 = \left(1 - \gamma_h \frac{z_2}{L}\right)^{1/2} \qquad (16)$$

There are at present two widely used parameterizations

a. $\gamma_m = 15$, $\gamma_h = 9$, $\alpha = 0.74$, $\beta = 4.7$, $K=0.35$ (17)

(Businger et al, 1971)

b. $\gamma_m = \gamma_h = 16$, $\alpha = 1$, $\beta=5.0$, $K=0.40$ (18)

(Dyer and Hicks, 1970)

Equations (6) - (8) were used to calculate u_* and H from the profile data. The accuracy of the results is clearly limited by the semi-empirical description of Ψ_m and Ψ_h. For Cardington data, furthermore, it is noticed that because the profile mast is surrounded by buildings and other topographic features, the surface layer, in which the vertical variation of the fluxes is very small (e.g. less than 20%), is rather shallow. So for the comparison with other surface measurements only the lowest layer of the profile data was used in the calculation.

Fig. 6 shows a comparison of sensible heat flux calculated by the profile method and by the residual method (Eq. (3)). It is not surprising that the points are rather widely scattered due to the errors of measurements in both methods. However, the correlation between the two sets of result is very good.

The values of H and U_* from the profile method were compared with those directly measured by the sonic anemometer. These are shown in Fig. 7 and 8. The values of sensible heat flux measured by sonic anemometer are rather lower, particularly in the daytime when H is rather large. This is very likely due to the height difference - as mentioned above, the sonic anemometer was mounted at 16 m, but the data used in the profile method are from the lowest layer (0.5 - 3 m) only. It may have been better to mount the sonic anemometer at a lower height in this experiment.

The Dyer and Hicks' parameterization (18) was used in the profile method calculation mentioned above. The difference between the results obtained by use of Dyer and Hicks' scheme and Businger et al's scheme is normally less than 5%.

c. Roughness length

Roughness length Z_0 is one of the most important parameters in modelling the boundary layer. In neutral conditions it can be evaluated by use of the logarithmic law,

$$\frac{ku}{u_*} = \ln \frac{z}{z_0} \qquad (19)$$

Then

$$\ln z = \frac{k}{u_*} u + \ln z_0 \qquad (20)$$

where u is the wind speed at height z. Equation (20) can be used to determine z_0 from the wind profile measurements by linear regression of u on z, i.e. no independent evaluation of U_* and K is required. The slope of the regression line of course gives K/U_*.

In the absence of truly neutral runs, as in our case, the determination of Z_0 is not so straightforward. Here the 'profile method' outlined in last paragraph was used. For unstable conditions, from the wind profile of the integrated form (6).

$$\frac{ku}{u_*} = \ln\frac{z}{z_0} + \ln\left[\frac{(x_0^2+1)(x_0+1)^2}{(x^2+1)(x+1)^2}\right] + 2\tan^{-1}x - 2\tan^{-1}x_0$$

$$\approx \ln\frac{z}{z_0} - \ln\left[\left(\frac{x^2+1}{2}\right)\left(\frac{x+1}{2}\right)^2\right] + 2\tan^{-1}x - \frac{\pi}{2} \qquad (21)$$

where $x = (1 - 16\frac{z}{L})^{1/4}$, $x_0 = (1 - 16\frac{z_0}{L})^{1/4}$ (using Dyer and Hicks' scheme). In this experiment, normally, $|L|$ >10m. So it is adequate to assume $x_0 \approx 1$ to simplify the calculation.

z_0 was calculated for each wind profile measurement in the unstable case, by use of (21). The results are shown in Fig. 9 and 10.

Fig. 9 shows z_0 as a function of wind direction, for each half of the observation period. The mean value in the second half period is larger than that of the first half period because the grass had grown. The effect of wind direction is also seen, particularly in Fig. 10, in which estimates of z_0 have been made from the wind shear over different height intervals. The values of z_0 calculated from the wind speeds at 8.7 and 16 m are appraently greater with winds from 90°-120°, as in Fig. 9. This reflects the influence of the laboratory buildings which are only 50 m away to the east of the profile mast.

d. The relationship between net radiation and solar elevation for different cloud conditions.

The net radiation Rn plays a predominant role in the surface energy balance. Its estimation from readily available meteorological data, i.e. solar elevation and cloud cover, has been discussed by many authors (e.g. see Nielsen et al, 1981). Based on the analysis of Cardington data (1976), we have developed a model (Wang, 1984) which is efficient and convenient for practical use. According to the model, Rn can be evaluated by following equation:

$$R_n = a_0 + a_1 s + a_2 s^2 + a_3 s^3 \qquad (22)$$

where s is solar elevation (the sine of solar elevation angle), which is related to the latitude ϕ of the station, the Julian day number n and the local time t:

$$s = \sin\phi \sin A + \cos\phi \cos A \cos\frac{\pi}{12}(t-12) \qquad (23)$$

where

$$A = 23.3 \sin\left[\frac{2\pi(n-81)}{N}\right] \qquad (24)$$

N is the number of days in the year (365 or 366). The coefficients a_0-a_3 in (22) are mainly related to the cloud cover and must be determined empirically. In our model, for a short grass surface, the coefficients are shown in the following Table.

Cloud condition	a_0	a_1	a_2	a_3
I	-45.0	102.5	742.2	-172.1
II	6.2	41.6	155.9	99.6

Unit: W/m^2

The cloud cover has been very much simplified by grouping into only two classes. The "total amount" refers to medium and low cloud only, high cloud being neglected.

I. total amount ≦6 oktas,

II. Total amount ≧7 OKTAS.

Fig. 11 shows the variation of Rn in a typical partly cloudy day (condition I) in this experiment. The observed hourly mean value and the value calculated by the model are also plotted. It can be seen that even though the value of Rn fluctuated a good deal because of the very changeable cloud state, the model value is still a good representation of the hourly mean value.

Fig. 12 and 13 show the comparison between the observed value and the model value of Rn for the whole period of this experiment. Since the weather in this period was very changeable, the points are rather scattered. But the agreement is still very good.

e. Estimation of surface turbulent fluxes from routine meteorological data.

The model for this estimation has been fully discussed by Wang (1984). Briefly, this model consists of a set of empirical formulae to evaluate the parameters in the Monteith Formula (Monteith, 1965).

$$H = \frac{r_a + r_{st} - r_i}{(1+\bar{\Delta}/\gamma)r_a + r_{st}} (R_n - G) \tag{25}$$

After the estimation of H, U_* can be calculated from the similarity equations, such as (6), (9) etc., and by use of a method of interactive calculations.

In equations (25), r_a, r_{st} and r_i are the so called resistances of the surface layers. ra is mainly related to the wind speed,

$$r_a \approx 260/u_{10} \tag{26}$$

where U_{10} is the wind speed at a standard height 10 m. r_i is mainly related to the humidity of the air,

$$r_i = \frac{\rho c_p}{\gamma(R_n - G)} e_s(T)\left(1 - \frac{h}{100}\right) \tag{27}$$

where h is the relative humidity observed at screen level, $\ell_s(T)$ is the saturated water vapour pressure at the observed screen temperature T, and $\gamma \approx 0.646$ is the so called psychrometric parameter.

r_{st}, the so called stomatal resistance, was introduced by Monteith (1965) to relate the latent heat flux, i.e. the evaporation from the vegetated ground, with the micrometeorological state just within the vegetated surface. r_{st} is small when there is more water available in the ground; r_{st} is large when the ground is dry and the temperature is high. Many authors (e.g. Deheer et al, 1981) have tried to evaluate r_{st} using standard meteorological data. The new model (Wang, 1984) under consideration here is convenient in use, and is mainly based on the following considerations:

i. r_{st} during the few hours directly after rainfall is very small (0-50 sm^{-1}).

ii. After an appreciable rainfall (daily amount ≥1 mm), the value of r_{st} drops down to a minimum value at first, then it increases day by day, the rate of increase being larger when the daily mean temperature is higher. During a hot/dry spell, after 10 days, r_{st} may be as large as 1000-2000 sm^{-1}.

iii. For a more reliable estimation, the hourly variation of r_{st} during the day should be considered. In the early morning, particularly when there is a dewfall, r_{st} is normally less than

50 sm^{-1}; then, it increases with time till about 09 hours local time. From about 09 to about 17 hours, r_{st} is nearly a constant at the daily mean value as estimated by ii. In the late afternoon, for a few hours, r_{st} may reach a peak value and then decrease rapidly during the evening.

The results derived from this model (the so-called resistance method) for the period of this experiment are compared with those from the profile method in Fig. 14. Fig. 15 shows a comparison of friction velocity U_* derived from the two methods. A iterative calculation has been used in deriving U_* in the resistance method. It can be seen that the agreement between the two methods is very good.

5. Concluding remarks

From the data analysis, the following remarks can be made:

a. The experiment was generally successful. Although the weather in the observation period was rather wet and changeable, causing malfunction of some instruments at times, most of the data (over 400 hours) are still reliable. Compared with the 1976 experiment (Richards, 1979), this was a short period of observation. However since the main intention was to carry out a careful investigation of the surface energy balance, many of the measurements were specially made and every effort was made to ensure that the data were reliable.

b. Our model for estimating net radiation Rn and sensible heat flux H (and friction velocity U_*) from readily available meteorological data was based on the analysis of data from the 1976 experiment at Cardington. Some parts of the model were slightly modified to provide a better fit to the data from both experiments. It was shown in last section that the model is adequate. This gives us more confidence to use the model to treat some independent data sets. The result is satisfactory (Wang, 1984).

c. The four methods of measuring or estimating the surface fluxes, namely the residual method, the profile methods, the resistance method, and the eddy-correlation method (through turbulence measurements), are proved to be compatible in this experiment. The fluxes measured by sonic anemometer were slightly lower than the result of other methods. It is very likely because of the rather shallow surface layer at Cardington.

d. The data are worth further investigation and could be useful for other studies. For this reason the hourly mean values of the data are tabulated in the Appendix.

Acknowledgement

The author would like to express his extreme gratitude to personnel in the Boundary Layer Research Branch, particularly Dr J C King (Cardington) and Mr J Crabtree, for arranging and directing the experiment and help in preparing this paper.

References

Businger, J.A. et al, 1971, Flux-profile relationships in the atmospheric surface layer. J. Atm. Sci., 28, 181-189.

Deheer Amissals et al, 1981, Calculation of sensible and latent heat fluxes and surface resistance from profile data. Boundary-Layer Meteor., 20, 35-49.

Dyer, A.J. and B.B. Hicks, 1970, Flux-gradient relationships in the constant flux layer. Quart. J. Roy. Meteor. Soc., 96, 715-721.

Monteith, J.L., 1965, Evaporation and environment. In 'The State and Movemement of water in Living Organisms. 19th Symp. Soc. Exp. Biol., 205-235.

Nielsen, L.B. et al, 1981, Net incoming radiation estimated from hourly global radiation and/or cloud observations. J. Climatology, 1, 255-272.

Paulsen, C.A., 1970, The mathematical representation of wind and temperature profiles in the unstable atmospheric surface layer. J. Appl. Meteor., 9, 857-861.

Richards, C.J., 1979, Micrometeorological Characteristics of the 1976 hot spells. Met. Mag., 108, 11-26.

Smith, F.B. and Hunt, R.D., 1978, Estimation of sensible heat flux over grassland. TDN. No. 91.

Wang Jiemin, 1984, Estimation of fluxes from routine meteorological data. (Unpublished).

LIST OF FIGURES

Fig. 5 Diurnal variation of surface energy budget

R = net radiation, E = latent heat flux

H = sensible heat flux, G = soil heat flux

The dotted line denotes the variation of sensible heat flux measured by sonic anemometer.

Fig. 6 A comparison of H calculated by two methods

Mean: $\overline{H}_{profile} = 52\ W/m^2$, $\overline{H}_{Residual} = 80\ W/m^2$

Standard deviation: $\sigma_{H\ profile} = 76\ W/m^2$, $\sigma_{H\ Residual} = 80\ W/m^2$

Correlation: r = 0.93

Fig. 7 A comparison of sensible heat flux calculated by the profile method (H(PROF)) and measured by sonic anemometer (H(SS), H(SP)), where H(SP) is the measured sensible heat flux with temperature measured by platinum wire (denoted by +):

Mean: $\overline{H}_{(ss)} = 23\ W/m^2$, $\overline{H}_{(prof)} = 40\ W/m^2$

Standard deviation: $\sigma_{H(ss)} = 42.8\ W/m^2$, $\sigma_{H(PROF)} = 69.5\ W/m^2$

Correlation: r = 0.94

Fig. 8 A comparison of friction velocity calculated by the profile method ($U_*(PROF)$) and measured by sonic anemometer ($U_*(S)$)

Mean: $\overline{U}_{*(s)} = 0.30$ m/s, $\overline{U}_{*(PROF)} = 0.34$ ms/

Standard deviation: $\sigma_{u*(s)} = 0.12$ m/s, $\sigma_{u*(PROF)} = 0.16$ m/s

Correlation: $r = 0.81$

Fig. 9 Roughness length Z_o, as a function of wind direction, for each half of the observation period. The mean value for each period is shown in the figure.

Fig. 10 Roughness length Z_o calculated using wind measurements from different height intervals:

1: 1-3 m

2: 2-8 m

3: 3-16 m

for the data of the first half of observation period.

Fig. 11 The hourly variation of Rn on a typical partly cloudy day, 10 May 1983. The curve is based on the 10 min average of readings taken every 10 sec.

+ Hourly mean value

o Value calculated by the model

The hourly cloud reports are presented at the top of the diagram. Total amounts are shown in the circle.

Fig. 12 The scatter of Rn with respect to solar elevation s under two cloud conditions:

. Cloud condition I

+ Cloud condition II

Curve I: $R_n = 172.1s^3 + 742.2s^2 + 102.5s - 45.0$

Curve II: $R_n = 99.6s^3 + 155.9s^2 + 41.6s + 62$

Fig. 13 Comparison of observed net radiation (R_{no}) with those calculated by the model (R_{nc})

mean: R_{no} = 186 W/m^2, R_{nc} = 197 W/m^2

standard deviation: R_{RNO} = 148 W/m^2, R $_{RNC}$ = 147 W/m^2

correlation: r = 0.92

standard error: E = 60 W/m2

Fig. 14 Comparison of the values of sensible heat flux obtained by the profile method and by the resistance method.

Mean: H_p = 105 W/m^2, H_R = 92 W/m^2

Standard deviation: A_{HP} = 58 W/m^2, R_{HR} = 48 W/m^2

Correlation: r = 0.92

Standard error: E = 27 W/m2

Fig. 15 Comparison of the values of friction velocity obtained by the profile method and by the resistance method.

Mean: $U*_p$ = 0.40 m/s, $U*_R$ = 0.38 m/s

Standard deviation: R_{u*p} = 0.14 m/s, $Ru*_R$ = 0.12 m/s

Correlation: = 0.95

Standard error: E = 0.05 m/s

Appendix: Data Tabulation

The data tabulated are mainly hourly mean values which were selected from the whole data set according to the following criteria:

a. No rainfall during the hour;

b. No identifiable instrument malfunction (some data apparently wrong are printed with *****)

The first part of the data consist of:

WD	=	Wind direction (16 m), deg from true N	Porton type wind vane and anemometers
U1	=	Wind speed (1 m), ms^{-1}	
U2	=	Wind speed (3 m), ms^{-1}	
U3	=	Wind speed (8.7 m), ms^{-1}	
U4	=	Wind speed (16 m), ms^{-1}	
RNF	=	Net radiation, measured by Funk type radiometer, Wm^{-2}	
RNK	=	Net radiation, measured by Kew type radiometer, Wm^{-2}	
G5R	=	Soil heat flux at 5 cm, reference, Wm^{-2}	
G5	=	Soil heat flux at 5 cm, Wm^{-2}	
G10	=	Soil heat flux at 10 cm, Wm^{-2}	
G15	=	Soil heat flux at 15 cm, Wm^{-2}	
G	=	Surface soil heat flux, Wm^{-2}	
LE	=	Latent heat flux, Lysimeter, Wm^{-2}	
USON	=	Mean Wind speed measured by sonic anemometer at 16 m, ms^{-1}	
Tp	=	Temperature, measured by platinum wire, at 16 m, °C.	
HS	=	Sensible heat flux, measured by sonic anemometer, Wm^{-2}	

HP = Sensible heat flux, measured by platinum wire + sonic, Wm^{-2}

$$\left.\begin{array}{ll} UW = \overline{U'W'} = -U_*^2 \\ UU = \overline{U'U'} \\ VV = \overline{V'V'} \\ WW = \overline{W'W'} \end{array}\right\} \text{measured by sonic anemometer, } M^2S^{-2}$$

The second part of the data consist of:

T = temperature, screen (1.15 m) dry bulb, °C

h = relative humidity, screen (1.15 m), %

cloud, including cloud condition (I or II), total amount, main type and its amount. The cloud condition was grouped mostly according to the pictures of sky camera (Cardington); some were from Bedford data.

Time: Julian day number had been used, see table below.*

H~GMT.

*Table: The date and Julian day number

Date	Julian	Date	Julian
Apr 22	112	May 6	126
23	113	7	127
24	114	8	128
25	115	9	129
26	116	10	130
27	117	11	131
28	118	12	132
29	119	13	133
30	120	14	134
May 1	121	15	135
2	122	16	136
3	123	17	137
4	124	18	138
5	125		

APPENDIX

Day/H		T°C	h%	Cloud
112	9	10	77	II 7/1Cu5Sc7Ac
:	10	10	75	II 7/2Cu4Sc7Ac
:	11	11	75	II 7/3Cu3Sc6Ac
:	12	13	70	I 5/4Cu
:	13	12	72	II 6/6Cu
:	15	12	76	II 6/4Cb
:	16	14	67	II 6/3Cb3Sc
113	7	9	90	I 1/1Sc
:	8	11	84	I 4/4Cu
:	9	11	77	I 7/2Cu6Ci
:	10	11	71	I 7/3Cu7Ci
:	11	12	69	I 7/6Cu7Cs
:	12	13	66	I 7/4Cu7Cs
:	13	13	62	I 6/3Cu7Cs
:	14	12	58	I 6/5Cu3Ci
:	15	14	56	I 6/3Cu4Ci
:	16	14	66	II 7/3Cu7Sc
:	18	12	96	II 6/1Cb4Sc
:	19	10	96	II 7/6Cb
114	7	9	95	I 3/1Cu3Sc
:	8	10	86	I 1/1Cu
:	9	11	78	I 3/2Cu
:	10	12	66	I 5/5Cu
:	12	13	62	I 7/2Cu7Cs
:	13	13	61	II 7/2Cu4Ac
:	14	12	58	I 6/2Cu5Ci
:	15	14	58	I 7/3Cu6Cs
:	16	14	70	I 6/2Cu5Ci
:	17	13	76	I 1/1Cu
:	18	12	9C	I 3/1Cu3Ci
:	19	10	96	I 5/1Ac5Ci
115	8	8	95	II 8/8Sc
:	9	8	93	I 8/1St6Sc8Ac
:	10	10	93	I 7/1St4Cu7Ac
:	11	11	75	I 5/5Cu
:	12	13	63	I 6/6Cu
:	13	13	63	I 5/4Cu
:	14	13	61	II 6/5Cu
:	15	13	59	II 7/3Cu6Sc

Day/H		T°C	h%	Cloud
115	16	12	58	II 7/2Cu6Sc
:	17	12	62	II 7/1Cu7Sc
:	18	12	63	II 6/1Cu5Ci
:	19	11	74	II 7/1Cu4Sc5Ci
116	7	8	88	I 2/1Sc
:	8	11	85	I 3/2Sc3Ci
:	9	13	79	I 3/1Sc3Ci
:	10	14	68	I 4/1Cu4Ci
:	11	16	63	I 5/3Cu3Ci
:	17	11	90	II 7/6Cb3Ac5Ci
:	18	11	88	II 7/2Cb3Sc6Ci
:	19	10	95	II 6/1Cb5Ac
117	7	8	99	II 7/4St6Sc
:	8	8	96	II 8/8St
:	9	9	95	II 8/8St
:	10	11	87	I 7/2Cu7Cs
:	11	12	81	I 7/2Cu7Cs
:	12	13	78	II 7/1Cu7Cs
:	13	13	74	I 7/1Cu7Cs
:	14	14	70	I 7/1Cu7Cs
:	15	13	69	I 7/1Cu7Cs
:	16	13	64	I 7/1Cu7Cs
:	17	12	66	I 7/1Cu7Sc
:	18	10	85	I 7/1Cu7Cs
:	19	9	93	I 7/1Ac7Cs
118	10	12	83	II 7/3St7Sc
:	11	13	80	I 5/Cu
:	12	13	79	I 5/5Cu
:	13	14	74	I 4/4Cu
:	14	15	70	I 6/4Cu4Ci
:	15	15	56	I 4/4Cu
:	16	15	60	I 4/4Cu
:	17	14	61	I 2/2Cu
:	18	12	58	I 5/1Cb
:	19	11	71	I 6/5Cu
119	7	8	87	I 8/3Sc6Ac8Cs
:	8	10	94	I 2/1St
:	9	12	82	I 2/1Cu
:	10	14	74	I 3/3Cu

Day/H	T°C	h%	Cloud
123 9	9	82	II 7/4Cu7Sc
: 10	9	77	II 7/3Cu7Sc
: 11	10	73	II 8/3Cu8Sc
: 12	11	68	II 7/3Cu5Sc
: 13	11	67	II 8/3Cu8Sc
: 14	11	67	II 8/4Cu5Sc
: 15	12	62	II 7/3Cu7Sc
: 17	11	73	II 6/3Cu5Sc
: 19	10	86	I 4/3Cu3Sc
124 7	5	100	II FOG
: 8	6	100	II FOG
: 9	7	100	I 8/8St
: 10	9	98	I 8/7St
: 11	11	88	I 6/6St
: 12	12	87	I 5/5Cu
: 13	13	71	I 2/2Cu
: 14	14	69	II 2/2Cu
: 15	13	64	II 3/3Cu
: 16	13	70	II 6/2Cu5Sc
: 17	12	74	I 8/2Cu8Sc
: 18	11	76	8/8Sc
: 19	11	82	8/8Sc
125 7	10	95	I 8/7St6Sc
: 8	12	93	I 8/6St8Sc
: 9	14	87	I 7/3St6Cs
: 10	15	82	I 7/1St3Sc7Cs
: 11	16	78	II 7/1Cu3Ac7Cc
: 12	16	75	II 8/4Cu8Cs
: 13	17	74	II 8/4Cu4As8Cs
: 14	17	73	II 8/4Cu8As
: 15	17	72	II 8/3Sc8As
: 16	16	77	I 8/3Sc8As
: 17	16	75	I 8/1Sc3Ac8Cs
126 9	14	98	II 7/4St7Sc
: 10	11	87	II 7/2St6Cu6Sc
: 11	12	76	I 5/5Cu
: 12	12	71	I 5/5Cu
: 13	12	70	I 6/3Cu3Sc
: 14	12	68	I 6/4Cu3Sc

Day/H	T°C	h%	Cloud
126 15	12	64	I 6/5Cu
: 16	12	63	I 3/1Cu3Sc
: 17	11	66	I 2/1Cu
129 12	12	88	II 8/5St8Sc
: 13	12	79	I 8/1Cu8Sc
: 14	13	69	I 5/3Cu
: 15	13	62	I 7/5Cu
: 16	13	62	I 7/6Cu
: 17	12	57	I 6/3Ac
: 18	10	56	I 4/4Cu
: 19	8	59	4/4Cu
130 7	7	83	I 7/1Cu7Cs
: 8	9	78	I 7/1Cu6Cs
: 9	10	68	I 7/5Cb5Cs
: 10	11	63	I 6/5Cu
: 11	12	60	I 6/5Cu
: 12	12	58	I 6/5Cu
: 13	12	60	I 6/1Cb4Cn
: 14	13	61	I 5/1Cb5Cu
: 15	12	60	I 6/2Cb5Cu
: 16	12	64	I 6/1Cb4Cu
: 17	11	64	I 7/1Cb3Cu
: 18	10	66	I 7/1Cu6Ci
: 19	9	68	I 7/1Cu6Cs
131 7	7	90	I 5/2St4Cu
: 8	9	82	I 7/2St5Cu
: 9	10	72	I 7/4Cu2Sc
: 10	11	69	II 7/7Cu
: 11	11	65	II 8/4Cu3Sc
: 12	11	64	II 7/5Cu6Sc
: 13	13	57	I 6/3Cu3Sc
: 14	12	60	II 7/7Cu
: 15	12	67	I 7/7Cu
: 16	11	76	I 6/3Cu4Sc
: 17	11	76	I 5/2Cu3Sc
: 18	11	79	I 5/5Cu
: 19	9	85	I 3/3Cu
132 10	9	90	8/2St5Sc8Ns
: 11	10	82	II 7/6Cu7Sc

Day/H		T°C	h%		Cloud
132	12	12	73	I	7/3Cu6Sc
:	13	12	80	I	5/5Cu
:	14	13	70	I	4/4Cu
:	17	10	84		7/6Cb
134	7	9	92	I	7/2St7Sc
:	8	10	80	I	6/6Cu
:	9	11	76	I	6/6Cu
:	10	12	67	I	6/6Cu
:	11	14	60	I	6/6Cu
:	12	15	56	II	6/1Cb5Cu
:	13	15	57	II	7/2Cb5Cu
:	14	15	51	I	6/2Cb4Cu
:	5	15	48	I	5/1Cb4Cu
:	16	14	62	I	5/1Cb4Cu
:	17	14	63	I	4/1Cb3Cu
:	18	14	61	I	4/1Cb3Cu
:	19	12.	62	I	4/2Cu3Ci
135	13	10	90	II	7/1Cu7Ns
:	14	10	90	I	8/1St7As8Cs
:	15	12	86	I	7/3Cu6Cs
:	16	13	71	I	7/2Cu3Sc6Ci
:	17	14	61	I	4/3Cu
:	18	13	57	I	1/1Cu
:	19	12	67	I	1/1Cu
136	7	11	80	I	7/2Ac7Ci
:	10	17	70	I	7/1Cu7Ci
:	11	17	62	I	7/4Cu6Ci
:	12	17	61	I	7/3Cu6Ci
:	13	17	61	II	7/3Cu6Cs
:	17	12	96		7/1St7Sc
:	18	12	96		7/1Cu5Ac5Ci
:	19	11	96		7/1St7Ac
137	7	11	84	I	4/4Cu
:	8	12	80	I	6/6Cu
:	9	13	74	II	7/5Cu3Sc
:	10	13	70	II	71St6Cu
:	11	14	70	II	7/5Cu5Sc
:	12	15	65	I	7/1Cu6Sc
:	13	14	65	I	7/5Cu4Sc

Day/H		T°C	h%		Cloud
137	14	13	74	I	7/1cb4Cu5Sc
:	15	13	74	I	7/3Cb5Sc
:	16	13	74	I	6/1cb3Cu
:	17	12	80	I	6/2Cu3Sc
:	18	11	83	I	6/2Cb3Sc
:	19	10	86	I	6/1Cb5Cu

DATA OF EXPERIMENT OF SURFACE ENERGY BALANCE,CARDINGTON,APR–MAY,1983. HOURLY MEANS

DAY/H	WD	U1	U2	U3	U4	DT1	DT2	RNF	RNK	G5R	G5	G10	G15	G	LE	USON	TP	HS	HP	UW	UU	VV	WW
112 0	62.	1.53	2.02	2.37	2.37	-0.99	-1.50	-13.	-49.	-14.	-23.	-10.	-3.	-35.	32.	2.2	6.7	-2.	-8.	-0.001	0.081	0.058	0.016
112 9	118.	6.91	8.68	10.05	11.51	-0.03	0.03	118.	107.	9.	16.	4.	-1.	25.	76.	9.7	11.3	5.	-12.	-0.306	2.600	1.770	0.660
11210	125.	6.15	7.72	8.89	9.75	0.34	0.64	242.	246.	11.	19.	7.	2.	29.	92.	8.6	11.1	59.	47.	-0.283	2.100	1.370	0.573
11211	115.	6.82	8.42	9.58	10.67	0.96	1.56	492.	498.	21.	40.	12.	5.	63.	213.	9.1	12.1	145.	119.	-0.320	2.000	1.910	0.600
11212	112.	6.5[illegible]	8.14	9.22	9.95	0.65	1.09	333.	349.	28.	49.	21.	9.	76.	165.	8.9	12.7	85.	65.	-0.272	1.480	1.670	0.473
11213	106.	5.41	6.69	7.59	6.88	0.32	0.57	195.	207.	22.	35.	24.	14.	55.	136.	7.7	13.1	47.	33.	-0.240	1.400	1.090	0.335
11215	129.	4.89	6.10	6.99	7.93	0.02	0.14	180.	178.	20.	31.	19.	15.	48.	92.	6.7	14.1	14.	3.	-0.186	1.420	0.811	0.414
11216	111.	4.76	6.05	7.02	7.80	-0.01	0.04	106.	121.	16.	25.	20.	15.	39.	112.	6.7	14.2	2.	-2.	-0.165	1.180	1.000	0.333
11217	133.	5.49	6.88	7.86	9.19	-0.28	-0.39	9.	15.	9.	11.	17.	15.	17.	53.	7.6	13.8	-25.	-34.	-0.212	1.920	0.961	0.564
11218	129.	4.50	5.65	6.55	7.37	-0.26	-0.35	-15.	-7.	2.	0.	11.	13.	1.	40.	6.3	12.2	-21.	-26.	-0.194	1.310	0.510	0.400
11219	117.	4.80	5.99	6.91	7.92	-0.20	-0.25	-24.	-15.	-2.	-4.	7.	10.	-6.	28.	6.5	11.1	-21.	-20.	-0.179	0.936	0.633	0.335
11221	102.	3.55	4.42	5.06	4.41	-0.16	-0.20	-18.	-35.	-3.	-5.	2.	5.	-7.	8.	5.4	10.3	-18.	-14.	-0.128	0.594	0.468	0.202
11222	105.	4.15	5.26	6.03	5.55	-0.19	-0.23	-26.	-25.	-3.	-5.	1.	4.	-8.	4.	6.4	10.1	-17.	-15.	-0.117	0.591	0.423	0.213
11223	107.	3.88	4.96	5.85	6.21	-0.23	-0.32	-29.	-26.	-4.	-6.	-0.	3.	-10.	0.	5.9	10.2	-17.	-14.	-0.070	0.475	0.345	0.166
113 0	118.	3.58	4.52	5.41	6.44	-0.31	-0.46	-33.	-34.	-5.	-8.	-1.	2.	-12.	0.	5.3	10.2	-23.	-20.	-0.068	0.446	0.332	0.154
113 1	150.	3.49	4.41	5.07	5.81	-0.36	-0.52	-45.	-38.	-5.	-8.	-2.	1.	-13.	-4.	5.2	10.4	-31.	-30.	-0.134	0.804	0.333	0.236
113 2	164.	1.63	2.21	2.76	3.32	-0.77	-1.20	-55.	-53.	-7.	-10.	-3.	-0.	-16.	-8.	3.2	10.0	-20.	-19.	-0.064	0.426	0.177	0.147
113 3	143.	1.88	2.49	3.10	3.77	-0.80	-1.30	-59.	-57.	-9.	-14.	-5.	-1.	-21.	-5.	3.3	9.4	-21.	-19.	-0.045	0.253	0.114	0.107
113 4	140.	2.18	2.81	3.46	4.18	-0.64	-1.08	-52.	-49.	-10.	-14.	-7.	-3.	-22.	8.	3.7	9.3	-21.	-19.	-0.049	0.330	0.112	0.113
113 5	136.	1.20	1.63	2.28	2.88	-0.79	-1.35	-31.	-36.	-10.	-15.	-8.	-4.	-23.	-40.	2.6	8.9	-13.	-11.	-0.024	0.182	0.035	0.064
113 6	130.	2.70	3.38	3.90	4.44	-0.01	-0.03	39.	34.	-8.	-10.	-8.	-5.	-16.	-4.	3.8	9.6	-4.	-4.	-0.048	0.435	0.216	0.151
113 7	166.	3.39	4.20	4.74	5.30	0.39	0.68	156.	155.	1.	2.	-5.	-5.	3.	72.	4.7	10.7	34.	30.	-0.134	0.823	0.459	0.305
113 8	150.	3.75	4.63	5.19	5.72	0.55	1.00	262.	263.	11.	16.	1.	-2.	25.	124.	5.1	11.5	61.	56.	-0.153	0.997	0.514	0.324
113 9	160.	4.04	4.97	5.57	6.18	0.62	1.05	231.	237.	19.	28.	8.	2.	44.	116.	5.2	12.0	66.	61.	-0.167	1.050	0.699	0.356
11310	161.	4.01	4.92	5.52	6.05	0.68	1.17	307.	321.	23.	36.	15.	6.	56.	132.	5.4	12.5	64.	60.	-0.152	0.916	0.618	0.350
11311	165.	3.28	4.02	4.53	4.95	0.57	1.01	235.	253.	25.	37.	20.	11.	58.	136.	4.3	13.0	43.	41.	-0.086	0.693	0.454	0.231
11312	164.	3.12	3.85	4.25	4.62	0.55	0.92	258.	273.	22.	31.	22.	14.	49.	106.	4.0	13.6	51.	46.	-0.055	0.782	0.603	0.243
11313	160.	3.91	4.76	5.37	5.90	0.60	1.04	312.	335.	24.	37.	23.	16.	57.	177.	5.0	14.3	70.	63.	-0.153	1.020	0.892	0.310
11314	147.	4.23	5.27	5.99	6.71	0.35	0.65	242.	262.	27.	41.	26.	18.	63.	167.	5.8	14.4	52.	43.	-0.163	1.230	0.627	0.346
11315	161.	3.85	4.75	5.47	6.17	-0.04	0.00	93.	106.	17.	22.	25.	20.	34.	112.	5.4	14.1	-2.	-8.	-0.157	1.120	0.545	0.321
11316	162.	3.05	3.85	4.33	5.00	-0.12	-0.12	46.	58.	8.	10.	19.	18.	15.	52.	4.5	13.0	-1.	-4.	-0.097	0.660	0.335	0.211
11318	126.	2.02	2.49	2.99	3.57	-0.10	-0.28	-4.	0.	-1.	-2.	9.	12.	-3.	28.	3.1	10.5	-7.	-6.	-0.023	0.135	0.076	0.048
11319	147.	1.98	2.60	3.32	3.97	-0.59	-1.11	-45.	-46.	-4.	-7.	5.	9.	-11.	-8.	3.6	10.5	-19.	-18.	-0.040	0.223	0.100	0.090
11320	186.	2.59	3.46	4.34	5.16	-0.57	-1.06	-47.	-46.	-7.	-11.	1.	6.	-18.	32.	4.3	9.9	-19.	-20.	-0.055	0.443	0.212	0.120
11321	188.	1.90	2.59	3.45	4.22	-0.57	-1.02	-38.	-34.	-9.	-15.	-2.	3.	-24.	-4.	3.5	8.9	-13.	-12.	-0.025	0.190	0.104	0.062
11322	192.	2.14	2.81	3.61	4.17	-0.42	-0.72	-37.	-30.	-3.	-12.	-5.	1.	-19.	68.	3.6	8.7	-12.	-11.	-0.021	0.250	0.147	0.084
11323	204.	1.65	2.30	3.09	3.71	-0.68	-1.14	-50.	-47.	-10.	-16.	-6.	-1.	-25.	-36.	3.3	7.7	-13.	-12.	-0.027	0.256	0.147	0.071
114 0	216.	1.76	2.44	3.27	3.93	-0.92	-1.60	-65.	-67.	-12.	-20.	-8.	-2.	-31.	28.	3.7	6.9	-17.	-17.	-0.025	0.211	0.154	0.065
114 1	210.	1.33	2.01	2.80	3.31	-1.25	-2.12	-62.	-65.	-13.	-22.	-10.	-4.	-34.	0.	3.1	6.2	-8.	-7.	-0.010	0.108	0.103	0.037
114 2	198.	1.01	1.73	2.58	3.03	-1.30	-2.39	-58.	-61.	-15.	-24.	-13.	-6.	-37.	-12.	2.6	5.8	-5.	-4.	-0.005	0.083	0.055	0.023
114 3	168.	0.46	0.81	1.44	1.80	-1.26	-1.93	-43.	-59.	-15.	-25.	-14.	-8.	-39.	0.	1.6	4.8	-5.	-5.	-0.011	0.134	0.075	0.033
114 4	110.	0.84	0.9[illegible]	1.13	1.12	-1.23	-1.69	-20.	-56.	-16.	-25.	-16.	-10.	-39.	-20.	1.0	4.7	-6.	-5.	-0.014	0.155	0.162	0.040
114 5	88.	0.89	1.09	[illegible]	1.34	-0.76	-1.02	20.	-28.	-15.	-23.	-17.	-11.	-37.	-24.	1.4	4.6	-7.	-8.	-0.001	0.223	0.313	0.030
114 6	97.	2.21	2.71	[illegible]	3.08	0.15	0.43	117.	93.	-10.	-13.	-16.	-12.	-20.	3.	2.7	6.2	6.	7.	-0.044	0.348	0.284	0.133
114 7	134.	3.7[illegible]	4.63	[illegible]	5.72	0.41	0.86	189.	175.	1.	3.	-9.	-10.	5.	72.	5.0	8.3	44.	38.	-0.150	0.689	0.347	0.268
114 8	139.	[illegible]	5.38	5.99	6.31	0.57	1.16	294.	238.	8.	13.	-3.	-7.	21.	116.	5.9	10.2	72.	64.	-0.193	0.995	0.561	0.384
114 9	135.	[illegible]	5.38	6.01	6.65	0.51	1.03	294.	300.	16.	28.	5.	-2.	44.	161.	5.8	11.4	79.	68.	-0.146	0.941	0.560	0.315
11410	140.	[illegible]	5.30	5.94	6.63	0.51	1.05	312.	329.	16.	29.	12.	3.	45.	128.	5.7	12.1	64.	54.	-0.133	1.030	0.895	0.362
11412	118.	4.45	5.53	6.26	6.81	0.71	1.19	357.	374.	25.	45.	23.	12.	71.	189.	5.9	13.8	73.	64.	-0.127	1.320	1.490	0.315
11413	118.	4.06	5.00	5.58	5.99	0.43	0.73	253.	272.	22.	39.	26.	16.	61.	148.	5.3	14.3	45.	34.	-0.148	1.010	1.050	0.287
11414	117.	4.54	[illegible].61	6.39	6.92	0.42	0.73	283.	307.	20.	36.	26.	18.	57.	173.	6.1	15.1	41.	32.	-0.104	1.250	1.150	0.296
11415	108.	5.02	[illegible].25	7.22	7.50	0.30	0.56	269.	279.	20.	35.	26.	19.	55.	217.	6.9	15.5	53.	36.	-0.213	1.720	1.380	0.332
11416	96.	5.26	6.19	6.78	5.20	0.06	0.19	149.	182.	15.	26.	24.	19.	40.	155.	7.9	14.8	28.	15.	-0.257	1.580	1.220	0.363
11417	96.	4.75	5.49	6.13	4.20	-0.21	-0.27	33.	61.	7.	12.	19.	18.	18.	123.	7.4	14.2	-12.	-22.	-0.213	1.410	0.932	0.335
11418	90.	3.64	4.19	4.88	3.[illegible]0	-0.37	-0.52	-44.	-33.	-1.	-1.	13.	15.	-1.	44.	6.3	12.9	-32.	-33.	-0.157	0.896	0.486	0.240
11419	75.	3.17	3.96	4.94	5.74	-0.30	-0.33	-60.	-54.	-5.	-8.	7.	11.	-13.	24.	5.3	11.5	-26.	-23.	-0.031	0.533	0.312	0.140

DATA OF EXPERIMENT OF SURFACE ENERGY BALANCE, CARDINGTON, APR-MAY, 1983. HOURLY MEANS

DAY/H	WD	U1	U2	U3	U4	DT1	DT2	RNF	RNK	G5R	G5	G10	G15	G	LE	USON	TP.	HS	HP	UW	UU	VV	WW
11420	73.	3.21	4.03	4.86	5.90	-0.31	-0.32	-69.	-63.	-7.	-12.	2.	7.	-19.	16.	5.5	10.4	-28.	-25.	-0.097	0.585	0.312	0.168
11421	76.	4.12	5.14	6.36	7.24	-0.27	-0.29	-65.	-59.	-8.	-14.	-2.	4.	-22.	16.	6.7	10.0	-32.	-30.	-0.170	0.930	0.496	0.275
11422	75.	4.11	5.21	6.39	7.26	-0.21	-0.20	-49.	-43.	-9.	-14.	-4.	1.	-22.	20.	6.8	9.7	-28.	-27.	-0.167	0.863	0.483	0.271
11423	73.	4.15	5.24	6.50	7.63	-0.17	-0.14	-35.	-28.	-8.	-13.	-6.	-1.	-20.	12.	7.1	9.8	-27.	-27.	-0.190	1.060	0.560	0.301
115 0	89.	3.77	4.58	5.41	5.34	-0.16	-0.16	-18.	-11.	-6.	-10.	-6.	-2.	-15.	20.	6.1	10.2	-22.	-21.	-0.160	0.876	0.759	0.247
115 1	72.	3.03	3.83	4.90	5.73	-0.18	-0.20	-25.	-19.	-5.	-8.	-5.	-2.	-13.	8.	5.2	10.3	-16.	-13.	-0.071	0.419	0.273	0.125
115 2	75.	3.90	4.84	6.04	6.90	-0.20	-0.17	-32.	-25.	-5.	-8.	-5.	-3.	-12.	20.	6.4	10.6	-23.	-22.	-0.146	0.755	0.432	0.227
115 3	92.	3.96	4.96	5.90	6.45	-0.16	-0.15	-19.	-25.	-5.	-7.	-5.	-3.	-12.	-32.	6.0	10.7	-22.	-21.	-0.163	0.906	1.930	0.280
115 8	124.	1.79	2.18	2.49	2.66	-0.10	0.08	41.	-3.	-0.	1.	-2.	-2.	1.	-4.	2.2	9.0	3.	2.	-0.021	0.160	0.096	0.060
115 9	162.	1.48	1.84	2.00	2.12	0.10	0.30	97.	103.	2.	4.	-0.	-1.	7.	8.	2.2	9.9	16.	10.	-0.014	0.262	0.179	0.085
11510	187.	3.10	3.78	4.22	4.43	0.88	1.33	353.	366.	12.	23.	3.	0.	37.	128.	3.7	11.1	77.	61.	-0.058	0.456	0.365	0.171
11511	188.	3.28	4.01	4.57	4.94	0.74	1.17	330.	356.	20.	33.	13.	4.	51.	140.	4.2	12.3	61.	50.	-0.061	0.640	0.833	0.208
11512	166.	3.54	4.31	4.82	5.20	0.96	1.52	435.	481.	29.	52.	20.	9.	82.	217.	4.4	13.2	117.	104.	-0.098	1.020	0.995	0.267
11513	159.	3.58	4.38	4.92	5.46	0.62	1.05	314.	343.	31.	53.	29.	15.	83.	197.	4.6	13.7	88.	74.	-0.132	0.938	0.494	0.280
11514	152.	3.69	4.69	5.28	5.93	0.12	0.30	164.	179.	20.	31.	29.	20.	48.	116.	5.1	13.9	12.	3.	-0.107	0.967	0.594	0.254
11515	155.	3.74	4.66	5.35	5.98	0.01	0.12	134.	152.	13.	20.	24.	20.	31.	132.	5.2	14.0	16.	6.	-0.137	1.000	0.563	0.319
11516	161.	3.01	3.72	4.29	4.88	-0.12	-0.14	65.	78.	6.	9.	18.	18.	14.	52.	4.3	13.5	-8.	-14.	-0.104	0.632	0.313	0.232
11517	125.	2.89	3.61	4.27	4.91	-0.21	-0.26	42.	62.	5.	8.	13.	15.	12.	96.	4.2	13.5	-12.	-16.	-0.054	0.567	0.283	0.127
11518	109.	2.36	3.41	4.17	4.78	-0.34	-0.57	-10.	-2.	-0.	-0.	10.	12.	0.	40.	4.2	12.9	-20.	-22.	-0.043	0.281	0.241	0.100
11519	103.	1.86	2.92	3.75	4.17	-0.39	-0.73	-29.	-23.	-4.	-5.	6.	10.	-8.	28.	4.1	12.1	-15.	-15.	-0.028	0.195	0.149	0.058
11520	100.	2.36	3.21	3.90	3.53	-0.41	-0.67	-50.	-46.	-6.	-8.	2.	7.	-13.	35.	4.5	11.2	-19.	-18.	-0.058	0.559	0.304	0.101
11521	107.	1.21	1.94	2.93	3.82	-0.81	-1.55	-59.	-58.	-9.	-14.	-1.	4.	-22.	-4.	3.3	9.5	-7.	-6.	-0.007	0.125	0.132	0.021
11522	104.	1.80	2.73	3.53	4.00	-0.43	-0.74	-50.	-46.	-10.	-15.	-5.	1.	-24.	0.	3.9	9.0	-20.	-18.	-0.039	0.216	0.172	0.071
11523	123.	2.74	3.59	4.28	5.05	-0.30	-0.44	-30.	-21.	-10.	-13.	-6.	-1.	-21.	8.	4.3	9.2	-21.	-21.	-0.059	0.390	0.363	0.130
116 0	115.	2.50	3.41	4.15	5.03	-0.44	-0.71	-57.	-50.	-9.	-13.	-7.	-2.	-20.	4.	4.3	9.0	-21.	-20.	-0.053	0.231	0.246	0.111
116 1	102.	2.07	3.04	3.75	3.61	-0.23	-0.33	-25.	-19.	-10.	-13.	-8.	-3.	-21.	4.	4.2	8.7	-15.	-14.	-0.051	0.292	0.221	0.091
116 2	105.	1.72	2.60	3.23	3.70	-0.26	-0.40	-26.	-19.	-8.	-11.	-8.	-4.	-17.	16.	3.5	8.8	-12.	-11.	-0.040	0.241	0.183	0.074
116 3	108.	1.13	1.49	2.12	2.76	-0.87	-1.29	-54.	-52.	-9.	-13.	-8.	-5.	-20.	12.	2.6	8.1	-12.	-10.	-0.022	0.136	0.130	0.048
116 4	86.	1.16	1.39	1.60	1.42	-0.91	-1.25	-46.	-54.	-12.	-17.	-9.	-5.	-27.	-12.	2.0	7.0	-9.	-7.	-0.017	0.110	0.101	0.037
116 5	149.	0.83	1.03	1.38	1.59	-0.64	-0.85	0.	-17.	-12.	-17.	-11.	-6.	-26.	-29.	1.3	7.0	-5.	-3.	-0.007	0.157	0.199	0.037
116 6	125.	2.63	3.36	3.82	4.33	0.05	0.13	63.	33.	-8.	-10.	-11.	-7.	-16.	4.	3.7	8.7	-3.	-4.	-0.061	0.326	0.182	0.131
116 7	125.	3.27	4.05	4.52	5.00	0.53	0.94	210.	195.	-1.	2.	-7.	-7.	2.	48.	4.2	10.4	44.	39.	-0.075	0.434	0.345	0.179
116 8	121.	2.51	3.15	3.45	3.43	0.90	1.52	312.	311.	14.	22.	0.	-4.	35.	120.	3.2	12.2	69.	60.	-0.060	0.427	0.470	0.173
116 9	132.	3.26	4.06	4.44	4.77	0.89	1.51	377.	379.	24.	33.	11.	1.	60.	165.	4.1	13.8	103.	92.	-0.072	0.739	1.120	0.256
11610	129.	3.78	4.81	5.41	5.89	0.90	1.50	419.	425.	30.	50.	20.	8.	78.	205.	5.1	14.8	12.	69.	-0.062	0.909	0.968	0.292
11611	131.	3.89	4.80	5.41	5.94	1.03	1.70	494.	517.	34.	58.	28.	14.	91.	261.	5.0	15.6	131.	118.	-0.112	1.130	1.150	0.319
11617	165.	0.74	0.88	1.09	1.13	-0.03	0.02	32.	34.	3.	4.	7.	10.	5.	16.	1.0	12.2	-2.	-3.	-0.003	0.118	0.201	0.024
11618	83.	1.19	1.53	1.91	2.13	-0.35	-0.60	-12.	-11.	2.	2.	7.	9.	3.	36.	1.8	12.3	-5.	-5.	-0.010	0.173	0.101	0.028
11619	38.	1.73	2.21	2.85	3.20	-0.55	-1.04	-39.	-46.	-3.	-6.	5.	8.	-9.	0.	2.7	11.6	-4.	-5.	-0.003	0.161	0.032	0.027
11620	76.	1.34	1.69	2.11	2.00	-0.62	-1.03	-44.	-50.	-7.	-11.	1.	5.	-16.	-12.	2.3	10.9	-5.	-4.	-0.008	0.103	0.076	0.023
11621	55.	0.98	1.25	1.50	1.47	-0.57	-0.78	-19.	-18.	-8.	-12.	-2.	3.	-18.	4.	1.4	10.6	-3.	-2.	-0.001	0.056	0.100	0.028
11622	66.	0.72	0.93	1.05	0.86	-0.58	-0.78	-13.	-10.	-6.	-9.	-4.	1.	-14.	4.	1.0	10.6	-2.	-1.	-0.002	0.039	0.032	0.010
11623	53.	0.27	0.22	0.36	0.34	-1.09	-1.67	-12.	-7.	-6.	-8.	-4.	-0.	-12.	4.	0.4	10.6	0.	-0.	-0.001	0.017	0.018	0.003
117 0	164.	0.44	0.57	0.46	0.34	-1.21	-2.18	-17.	-16.	-6.	-9.	-4.	-1.	-13.	4.	0.5	10.1	-0.	-0.	-0.002	0.035	0.027	0.002
117 1	347.	0.93	1.19	1.29	1.32	-0.93	-1.49	-24.	-29.	-7.	-10.	-5.	-1.	-16.	-24.	1.3	10.2	-2.	-2.	-0.006	0.102	0.049	0.037
117 2	115.	1.05	1.27	1.41	1.57	-0.51	-0.90	-19.	-19.	-8.	-11.	-6.	-2.	-17.	12.	1.3	9.5	-14.	-13.	-0.030	0.321	0.180	0.114
117 3	23.	1.90	2.40	2.81	3.01	-0.16	-0.16	-13.	-15.	-7.	-10.	-6.	-3.	-15.	0.	2.4	9.0	-1.	-0.	-0.007	0.113	0.099	0.045
117 4	45.	0.62	0.80	1.07	1.25	-0.36	-0.61	-7.	-6.	-7.	-9.	-6.	-3.	-15.	0.	1.1	8.4	-6.	-5.	-0.012	0.069	0.067	0.030
117 5	37.	1.48	1.81	2.12	2.27	-0.01	0.10	5.	7.	-6.	-8.	-6.	-4.	-12.	8.	2.2	8.4	0.	0.	-0.017	0.150	0.094	0.033
117 6	100.	0.96	1.12	1.27	1.21	0.12	0.31	25.	27.	-4.	-5.	-5.	-4.	-7.	4.	1.2	8.3	3.	4.	-0.003	0.046	0.057	0.022
117 7	131.	1.35	1.61	1.73	1.62	0.25	0.50	75.	81.	-0.	1.	-4.	-3.	2.	20.	1.5	8.6	7.	8.	-0.002	0.103	0.103	0.070
117 8	26.	2.53	3.06	3.40	3.48	0.36	0.67	122.	127.	5.	8.	-0.	-2.	12.	52.	3.1	9.1	12.	11.	-0.023	0.289	0.353	0.174
117 9	29.	2.34	2.79	3.09	3.26	0.55	0.97	204.	209.	9.	14.	3.	0.	22.	39.	3.0	9.9	32.	31.	-0.034	0.230	0.423	0.122
11710	30.	2.22	2.64	2.97	[illegible]	0.84	1.39	[illegible]	337.	19.	31.	9.	3.	48.	140.	2.7	11.3	52.	59.	-0.029	0.463	0.343	0.171
11711	31.	3.76	4.55	5.03	5.57	0.96	1.57	420.	437.	27.	40.	17.	8.	63.	209.	4.7	12.2	123.	122.	-0.170	0.864	0.865	0.301
11712	32.	3.43	4.21	4.75	5.17	0.96	1.57	420.	445.	29.	42.	23.	13.	66.	181.	4.5	12.4	110.	107.	-0.120	0.704	0.844	0.287

DATA OF EXPERIMENT OF SURFACE ENERGY BALANCE, CARDINGTON, APR-MAY, 1983. HOURLY MEANS

DAY/H	WD	U1	U2	U3	U4	DT1	DT2	RNF	RNK	GSR	G5	G10	G15	G	LE	USON	TP	HS	HP	UW	UU	VV	WW
11713	35.	3.25	3.85	4.27	4.47	1.11	1.74	453.	484.	33.	49.	28.	17.	76.	215.	3.9	13.0	121.	121.	-0.054	0.690	0.926	0.263
11714	32.	3.43	4.06	4.55	4.81	0.73	1.21	340.	372.	33.	46.	32.	21.	71.	217.	4.2	13.5	68.	66.	-0.046	0.759	1.020	0.353
11715	28.	3.52	4.26	4.73	5.07	0.33	0.67	219.	244.	25.	32.	30.	23.	50.	161.	4.4	13.6	39.	36.	-0.051	0.647	1.030	0.270
11716	48.	2.84	3.43	4.06	4.57	0.11	0.30	96.	103.	15.	18.	26.	22.	28.	100.	4.0	13.7	20.	16.	-0.052	0.477	0.382	0.102
11717	51.	2.88	3.48	4.01	4.48	-0.15	-0.13	14.	17.	6.	6.	19.	20.	10.	72.	3.8	13.1	-4.	-5.	-0.020	0.306	0.159	0.047
11718	55.	3.13	3.96	4.74	5.31	-0.19	-0.25	-36.	-33.	-1.	-4.	12.	16.	-6.	36.	4.7	11.2	-6.	-7.	-0.034	0.313	0.139	0.080
11719	51.	2.52	3.03	3.65	4.27	-0.23	-0.32	-44.	-43.	-7.	-11.	6.	12.	-16.	4.	3.7	10.1	-4.	-4.	-0.007	0.101	0.061	0.022
11720	49.	1.89	2.29	2.81	3.32	-0.16	-0.18	-26.	-24.	-7.	-11.	1.	8.	-17.	16.	3.0	9.6	-4.	-3.	-0.010	0.100	0.057	0.027
11721	54.	0.98	1.30	1.72	1.94	-0.34	-0.49	-23.	-26.	-7.	-11.	-1.	5.	-17.	4.	1.8	9.1	-2.	-1.	-0.006	0.061	0.073	0.012
11722	42.	1.76	2.22	2.68	2.94	-0.24	-0.27	-36.	-32.	-8.	-13.	-3.	2.	-20.	11.	2.7	8.2	-3.	-3.	-0.016	0.128	0.100	0.035
11723	58.	0.86	1.14	1.49	1.59	-0.32	-0.47	-25.	-23.	-9.	-13.	-5.	0.	-21.	4.	1.5	7.8	-2.	-2.	-0.004	0.036	0.015	0.008
118 0	73.	0.38	0.50	0.74	0.70	-1.58	-2.08	-36.	-42.	-10.	-15.	-6.	-1.	-23.	0.	0.8	7.5	-0.	-1.	-0.001	0.018	0.035	0.002
118 1	78.	0.53	0.60	0.73	0.68	-2.73	-4.11	-18.	-35.	-12.	-20.	-8.	-3.	-31.	-12.	0.6	7.2	-1.	-1.	-0.001	0.030	0.053	0.003
118 2	95.	0.38	0.40	0.49	0.76	-0.90	-1.71	-8.	-7.	-12.	-18.	-11.	-5.	-28.	-8.	0.8	7.1	-4.	-3.	0.004	0.062	0.035	0.008
118 3	49.	0.75	0.97	1.35	1.46	-0.26	-0.50	-8.	-8.	-11.	-16.	-11.	-6.	-24.	0.	1.5	6.9	-0.	-0.	0.003	0.029	0.023	0.005
118 4	64.	0.52	0.58	0.75	0.82	-1.16	-1.52	-11.	-22.	-10.	-15.	-11.	-7.	-24.	16	0.9	6.1	0.	1.	0.002	0.035	0.074	0.003
118 5	47.	1.02	1.27	1.73	1.91	-0.17	-0.24	23.	8.	-11.	-16.	-11.	-7.	-25.	-32.	1.7	6.0	-0.	-0.	-0.002	0.066	0.027	0.007
118 6	134.	0.75	0.83	0.90	0.83	0.22	0.45	84.	80.	-6.	-7.	-10.	-8.	-10.	-20.	0.9	7.0	8.	5.	0.005	0.058	0.043	0.022
11810	240.	3.34	4.16	4.57	4.66	1.16	1.84	379.	405.	22.	30.	12.	5.	47.	140.	4.4	11.6	125.	121.	-0.052	0.445	0.732	0.228
11811	235.	3.78	4.65	5.20	5.45	1.23	2.05	423.	446.	29.	33.	19.	9.	60.	193.	5.0	12.1	160.	147.	-0.076	0.572	0.847	0.278
11812	233.	4.25	5.23	5.92	6.25	0.98	1.69	363.	393.	30.	37.	24.	14.	57.	197.	5.8	12.7	136.	126.	-0.119	0.695	0.717	0.256
11813	228.	3.89	4.88	5.55	5.88	0.96	1.65	383.	430.	26.	31.	25.	17.	49.	173.	5.6	13.4	124.	114.	-0.103	0.654	0.855	0.264
11814	234.	3.80	4.62	5.27	5.59	0.81	1.45	354.	405.	30.	33.	26.	19.	60.	201.	5.4	14.5	114.	100.	-0.112	0.878	1.090	0.240
11815	229.	3.80	4.70	5.33	5.64	0.49	0.96	251.	304.	26.	32.	27.	21.	49.	177.	5.4	14.8	67.	59.	-0.064	0.756	0.612	0.186
11816	230.	3.19	3.97	4.61	4.92	0.15	0.41	126.	177.	18.	19.	25.	21.	30.	116.	4.8	14.8	29.	23.	-0.064	0.590	0.604	0.133
11817	230.	2.67	3.47	4.29	4.90	-0.27	-0.44	20.	48.	9.	8.	20.	20.	12.	89.	4.6	14.6	-5.	-7.	-0.036	0.423	0.301	0.088
11818	226.	2.36	3.08	3.91	4.55	-0.44	-0.80	-24.	-21.	1.	-3.	13.	17.	-5.	12.	4.4	13.2	-12.	-13.	-0.027	0.299	0.239	0.079
11819	231.	1.63	2.32	3.20	3.91	-0.78	-1.51	-35.	-71.	-4.	-8.	7.	12.	-13.	12.	3.8	12.3	-10.	-9.	-0.012	0.252	0.189	0.038
11820	294.	1.12	1.48	2.02	2.43	-0.89	-1.44	-28.	-12.	-7.	-11.	2.	9.	-18.	0.	2.4	11.3	-6.	-6.	-0.004	0.299	0.174	0.050
11821	45.	1.00	1.29	1.59	1.70	-1.15	-1.59	-51.	-43.	-8.	-13.	-1.	5.	-21.	32.	1.6	10.4	-1.	-2.	-0.017	0.153	0.126	0.066
11822	206.	0.93	1.24	1.50	1.33	-2.27	-3.25	-31.	-36.	-11.	-18.	-4.	3.	-28.	-8.	1.5	9.3	-1.	-1.	-0.000	0.066	0.072	0.005
11823	216.	0.60	0.69	0.91	0.97	-2.43	-3.69	-18.	-30.	-12.	-20.	-7.	-0.	-31.	-16.	0.9	8.3	-3.	-3.	0.003	0.057	0.013	0.003
119 0	243.	0.96	1.28	1.54	1.50	-2.46	-3.68	-16.	-34.	-14.	-22.	-9.	-3.	-34.	4.	1.5	7.3	-3.	-2.	0.003	0.050	0.113	0.002
119 1	266.	0.93	1.44	1.93	2.00	-2.74	-4.24	-16.	-33.	-14.	-22.	-11.	-5.	-34.	16.	2.1	7.8	0.	0.	0.002	0.051	0.078	0.002
119 2	205.	0.60	0.88	1.66	1.98	-1.33	-3.37	-16.	-29.	-14.	-22.	-12.	-7.	-35.	0.	1.8	7.1	2.	2.	-0.001	0.031	0.058	0.006
119 3	208.	0.57	0.57	0.98	1.62	-2.71	-3.36	-15.	-31.	-15.	-23.	-14.	-8.	-36.	-8.	1.6	6.8	-1.	-1.	0.001	0.027	0.045	0.004
119 4	221.	0.99	1.32	1.81	2.40	-1.96	-2.92	-10.	-30.	-15.	-23.	-15.	-10.	-36.	-8.	2.2	6.3	2.	2.	0.001	0.028	0.044	0.004
119 5	215.	1.00	1.48	2.33	3.26	-0.98	-1.81	38.	-4.	-14.	-21.	-15.	-11.	-33.	-36.	3.1	6.5	-2.	-2.	-0.002	0.053	0.036	0.009
119 6	226.	1.41	1.75	2.02	2.11	0.23	0.40	128.	65.	-9.	-12.	-14.	-11.	-19.	-16.	2.0	7.7	5.	6.	-0.012	0.171	0.090	0.042
119 7	233.	3.23	4.05	4.61	4.94	0.59	1.02	210.	182.	-1.	-1.	-10.	-10.	-1.	92.	4.6	9.5	40.	39.	-0.103	0.489	0.260	0.140
119 8	235.	2.97	3.67	4.09	4.18	1.07	1.75	312.	313.	10.	11.	-3.	-7.	17.	116.	4.2	10.6	74.	67.	-0.053	0.371	0.346	0.154
119 9	236.	3.51	4.36	4.85	5.04	1.17	1.87	409.	425.	20.	27.	5.	-2.	43.	165.	4.6	12.4	129.	119.	-0.099	0.675	0.841	0.214
11910	231.	4.29	5.24	5.83	6.13	1.28	2.01	503.	518.	29.	41.	14.	4.	64.	257.	5.6	13.5	165.	147.	-0.115	1.040	1.100	0.326
11913	232.	3.63	4.55	5.31	5.80	0.32	0.55	206.	127.	17.	22.	16.	14.	35.	72.	5.2	14.5	110.	99.	-0.093	0.856	1.100	0.266
11915	206.	2.11	2.77	3.49	4.02	-0.23	-0.50	3.	-15.	-0.	-2.	6.	10.	-3.	-36.	5.5	13.6	16.	9.	-0.076	0.750	0.500	0.172
11916	216.	0.84	1.14	1.65	2.31	-1.27	-1.77	-34.	-31.	-7.	-12.	0.	6.	-19.	8.	3.9	13.1	3.	1.	-0.042	0.329	0.266	0.102
11917	212.	0.50	0.63	1.16	2.06	-1.24	-2.04	-22.	-24.	-10.	-17.	-5.	0.	-27.	4.	4.4	12.4	5.	-5.	-0.005	0.636	0.567	0.118
11918	223.	0.56	0.55	0.75	1.09	-1.87	-2.30	-12.	-20.	-11.	-19.	-9.	-4.	-29.	8.	3.8	12.3	-8.	-8.	-0.019	0.189	0.135	0.053
11919	216.	0.34	0.27	0.40	0.86	-2.10	-3.16	-10.	-12.	-12.	-19.	-10.	-7.	-30.	8.	3.1	11.2	-10.	-6.	-0.014	0.175	0.915	0.052
11920	201.	0.31	0.37	1.06	1.27	-1.93	-4.03	-4.	-10.	-12.	-20.	-12.	-9.	-31.	-28.	2.1	10.1	-2.	-1.	-0.000	0.053	0.031	0.007
11921	184.	0.31	0.48	0.95	1.40	-0.29	-0.83	62.	26.	-10.	-14.	-12.	-10.	-22.	-22.	2.5	9.6	2.	2.	0.002	0.061	0.051	0.004
120 7	238.	0.97	1.12	1.13	1.11	0.61	1.03	243.	264.	8.	15.	-3.	-6.	23.	112.	1.3	10.2	29.	25.	-0.015	0.034	0.131	0.067
120 8	132.	0.97	1.03	1.14	1.01	0.73	1.01	315.	344.	24.	40.	13.	5.	62.	239.	1.0	11.8	96.	62.	0.016	0.163	0.196	0.162
120 9	112.	1.97	2.43	2.69	2.55	0.75	1.12	310.	339.	26.	43.	24.	17.	76.	349.	0.7	13.1	65.	61.	0.002	0.234	0.135	0.126
12010	100.	2.42	3.10	3.46	3.24	0.65	1.04	289.	319.	24.	45.	27.	23.	71.	337.	0.9	14.1	62.	32.	0.018	0.459	0.233	0.142
12011	98.	2.89	3.75	4.29	3.99	0.17	0.35	137.	166.	14.	26.	24.	24.	40.	237.	2.0	14.4	58.	34.	0.021	0.537	0.379	0.133

DATA OF EXPERIMENT OF SURFACE ENERGY BALANCE,CARDINGTON,APR-MAY,1983. HOURLY MEANS

DAY/H	WD	U1	U2	U3	U4	DT1	DT2	RNF	RNK	G5R	G5	G10	G15	G	LE	USON	TP	HS	HP	UW	UU	VV	WW
12012	85.	2.70	3.08	3.76	3.61	-0.22	-0.27	4.	20.	2.	5.	14.	19.	7.	132.	2.8	14.9	76.	55.	-0.037	0.635	0.621	0.173
12013	63.	2.14	2.73	3.62	4.35	-0.45	-0.83	-44.	-36.	-6.	-10.	4.	11.	-15.	32.	3.6	15.0	63.	50.	-0.055	0.763	0.719	0.161
121 3	52.	2.79	3.37	3.88	4.36	0.02	0.14	20.	25.	-4.	-5.	-5.	-4.	-8.	8.	6.2	9.4	-2.	28.	-0.094	0.704	0.477	0.207
121 4	80.	2.47	2.74	3.38	3.46	0.13	0.24	68.	84.	2.	4.	-1.	-2.	7.	52.	5.2	10.0	61.	-3.	-0.096	0.546	0.357	0.191
121 9	168.	1.89	2.44	2.88	3.30	-0.08	-0.26	20.	43.	2.	3.	5.	6.	5.	144.	3.9	11.7	7.	-13.	-0.078	0.454	0.221	0.099
12119	165.	1.51	1.97	2.33	2.72	-0.16	-0.34	-10.	11.	-3.	-4.	1.	4.	-6.	64.	2.2	*****	-5.	*****	-0.024	0.192	0.070	0.058
12122	222.	5.17	6.54	7.73	8.59	-0.13	-0.17	-11.	-36.	-11.	-17.	-8.	-4.	-27.	0.	6.0	*****	9.	*****	-0.119	0.265	0.545	0.249
122 0	212.	4.46	5.75	6.72	7.38	-0.06	-0.02	22.	6.	-9.	-13.	-9.	-7.	-20.	120.	9.2	*****	6.	*****	-0.295	1.920	1.020	0.552
122 1	211.	4.62	5.87	6.99	7.62	0.11	0.30	87.	105.	-4.	-5.	-7.	-7.	-8.	165.	7.8	8.1	-8.	-20.	-0.165	1.360	0.757	0.383
123 7	254.	5.09	6.52	7.69	8.16	0.01	0.10	59.	74.	-1.	-3.	-5.	-6.	-5.	132.	7.4	9.2	12.	1.	-0.180	1.330	0.816	0.379
123 9	262.	4.53	5.78	6.83	7.37	-0.01	0.05	57.	73.	1.	-2.	-3.	-4.	-3.	48.	7.3	9.7	4.	-7.	-0.150	1.230	0.803	0.347
12310	264.	4.60	5.90	6.76	7.26	0.08	0.20	90.	111.	1.	-1.	-3.	-4.	-2.	*****	7.0	10.0	10.	-1.	-0.161	1.220	0.860	0.324
12311	273.	4.70	5.94	6.90	7.39	0.23	0.44	149.	175.	4.	3.	-2.	-3.	5.	*****	6.9	10.7	24.	14.	-0.142	1.250	0.934	0.329
12312	283.	4.43	5.70	6.55	7.00	0.07	0.16	105.	130.	6.	4.	1.	-2.	7.	*****	6.5	11.3	8.	0.	-0.110	1.140	1.010	0.391
12313	308.	3.36	4.27	4.89	5.06	-0.10	-0.11	52.	73.	5.	3.	2.	-0.	5.	80.	4.5	11.6	1.	-4.	-0.092	0.757	0.603	0.242
12314	309.	2.76	3.47	3.94	4.08	0.18	0.33	122.	147.	4.	5.	1.	0.	7.	68.	3.7	12.0	15.	15.	-0.066	0.436	0.459	0.197
12315	290.	2.77	3.53	4.01	4.17	0.14	0.26	113.	138.	8.	11.	3.	1.	17.	76.	3.8	12.6	14.	12.	-0.047	0.458	0.620	0.164
12317	319.	0.86	1.12	1.35	1.32	-0.11	-0.12	28.	48.	5.	7.	5.	3.	11.	16.	1.3	12.0	-2.	-2.	-0.013	0.146	0.177	0.058
12319	144.	0.37	0.36	0.33	0.20	-1.16	-1.77	-16.	-4.	-2.	-3.	2.	3.	-5.	24.	0.4	10.7	-0.	-1.	-0.001	0.020	0.026	0.004
12320	105.	0.60	0.75	0.81	0.78	-2.07	-3.76	-23.	-28.	-6.	-10.	-1.	2.	-16.	12.	0.8	10.1	-1.	-0.	-0.001	0.060	0.026	0.003
12321	131.	0.42	0.39	0.10	0.46	-2.19	-3.81	-9.	-8.	-10.	-15.	-5.	-1.	-24.	-4.	0.6	9.7	1.	2.	0.000	0.020	0.010	0.001
12322	185.	0.37	0.46	0.27	0.28	-0.85	-2.16	-4.	8.	-9.	-13.	-7.	-3.	-20.	-4.	0.4	9.0	0.	1.	-0.000	0.023	0.019	0.003
12323	43.	0.53	0.64	0.94	1.29	-0.70	-1.58	-6.	-1.	-7.	-11.	-7.	-4.	-16.	4.	1.2	9.0	-1.	-1.	0.000	0.066	0.023	0.005
124 0	49.	1.19	1.63	2.06	2.38	-0.78	-1.41	-11.	-37.	-8.	-12.	-7.	-5.	-19.	-12.	1.9	7.6	-2.	-2.	-0.001	0.064	0.030	0.006
124 1	52.	1.06	1.38	1.82	2.03	-0.84	-1.48	-9.	-24.	-10.	-15.	-9.	-6.	-24.	0.	1.8	6.4	-3.	-3.	-0.002	0.031	0.050	0.004
124 2	51.	0.93	1.34	1.88	2.17	-0.44	-1.00	-9.	-21.	-11.	-16.	-10.	-7.	-24.	8.	2.0	5.9	-2.	-2.	-0.000	0.034	0.036	0.006
124 3	50.	0.73	1.02	1.56	1.89	-0.85	-1.52	-11.	-25.	-11.	-17.	-11.	-8.	-26.	0.	1.8	5.2	-1.	-0.	0.001	0.030	0.026	0.004
124 4	36.	1.04	1.49	1.92	2.06	-0.63	-1.01	-3.	-12.	-12.	-18.	-12.	-9.	-28.	-32.	1.9	5.5	-1.	-1.	-0.002	0.035	0.029	0.012
124 5	46.	1.01	1.21	1.41	1.45	-0.02	0.07	35.	17.	-10.	-13.	-12.	-10.	-21.	-4.	1.5	5.4	4.	4.	-0.009	0.076	0.031	0.027
124 6	34.	1.68	2.03	2.21	2.27	0.42	0.74	74.	99.	-6.	-6.	-10.	-9.	-10.	4.	2.0	5.0	15.	14.	-0.003	0.103	0.113	0.058
124 7	41.	1.91	2.31	2.57	2.71	0.55	0.95	97.	120.	-1.	1.	-7.	-8.	2.	12.	2.5	5.9	54.	29.	-0.039	0.227	0.195	0.097
124 8	51.	1.43	1.68	1.88	1.92	0.62	1.03	135.	155.	4.	8.	-3.	-6.	12.	40.	1.6	6.6	34.	27.	-0.032	0.197	0.207	0.037
124 9	40.	2.26	2.70	3.00	3.23	0.92	1.56	233.	260.	9.	16.	2.	-3.	26.	68.	2.8	7.6	54.	47.	-0.010	0.272	0.289	0.106
12410	39.	2.81	3.35	3.73	3.99	1.43	2.46	432.	451.	19.	35.	8.	1.	55.	157.	3.4	*****	94.	*****	-0.032	0.391	0.494	0.177
12411	40.	2.95	3.55	3.97	4.27	1.19	1.95	379.	396.	27.	45.	17.	6.	70.	157.	3.6	11.0	122.	98.	-0.011	0.501	0.826	0.214
12412	43.	3.14	3.84	4.34	4.67	1.18	1.91	418.	459.	28.	45.	23.	12.	71.	161.	3.9	12.0	117.	109.	-0.026	0.501	0.802	0.206
12413	55.	2.94	3.52	3.94	4.18	1.02	1.67	330.	369.	31.	51.	28.	17.	79.	197.	3.6	13.2	103.	102.	-0.065	0.626	0.509	0.184
12414	77.	2.64	3.04	3.54	3.62	0.44	0.75	193.	221.	24.	38.	29.	21.	60.	116.	3.6	13.9	36.	31.	-0.059	0.480	0.723	0.117
12415	83.	2.55	2.83	3.36	3.50	0.00	0.08	62.	80.	15.	22.	26.	21.	35.	64.	3.9	13.9	-2.	-0.	-0.067	0.400	0.287	0.096
12416	86.	2.60	2.89	3.38	3.22	-0.07	-0.03	35.	53.	7.	11.	19.	19.	17.	56.	3.9	13.8	-6.	-8.	-0.062	0.376	0.233	0.096
12417	108.	3.10	4.33	4.96	5.02	-0.15	-0.18	1.	8.	2.	3.	14.	16.	4.	32.	5.2	12.9	-12.	-14.	-0.110	0.643	0.537	0.180
12418	108.	2.40	3.40	4.15	4.66	-0.14	-0.19	-6.	15.	-1.	-1.	9.	13.	-2.	32.	4.1	12.1	-10.	-12.	-0.072	0.473	0.264	0.117
12419	98.	2.03	2.76	3.32	2.89	-0.12	-0.13	-10.	9.	-3.	-3.	5.	9.	-5.	20.	3.6	11.5	-7.	-7.	-0.061	0.433	0.292	0.112
12420	101.	2.49	3.52	4.19	3.89	-0.09	-0.07	-14.	6.	-4.	-5.	3.	7.	-8.	20.	4.4	10.6	-9.	-9.	-0.109	0.774	0.417	0.165
12421	83.	1.64	2.04	2.42	2.23	-0.06	0.00	-9.	10.	-5.	-6.	1.	5.	-9.	7.	2.6	10.2	-5.	-4.	-0.066	0.361	0.345	0.122
12422	87.	1.88	2.31	2.66	2.53	-0.05	0.02	-7.	9.	-4.	-5.	-1.	3.	-8.	12.	2.9	10.2	-4.	-4.	-0.058	0.355	0.233	0.114
12423	92.	1.61	1.90	2.21	2.07	-0.04	0.03	-4.	13.	-4.	-5.	-1.	2.	-8.	4.	2.5	10.3	-3.	-2.	-0.059	0.235	0.232	0.088
125 0	105.	1.95	2.58	2.94	2.96	-0.07	-0.02	-4.	16.	-4.	-5.	-2.	1.	-7.	0.	2.7	10.4	-5.	-4.	-0.036	0.232	0.277	0.107
125 1	118.	2.55	3.28	3.85	4.43	-0.11	-0.11	-14.	10.	-4.	-5.	-2.	0.	-8.	12.	3.8	10.3	-6.	-5.	-0.035	0.203	0.175	0.078
125 2	109.	2.29	3.16	3.77	4.14	-0.06	-0.02	-5.	19.	-4.	-5.	-2.	-0.	-3.	16.	3.6	10.4	-5.	-4.	-0.033	0.237	0.219	0.075
125 3	101.	1.70	2.51	3.04	2.52	-0.08	-0.06	-12.	10.	-4.	-5.	-3.	-1.	-8.	8.	3.3	10.2	-5.	-4.	-0.042	0.209	0.146	0.082
125 4	105.	1.94	2.94	3.61	4.12	-0.15	-0.20	-22.	-1.	-5.	-7.	-3.	-1.	-10.	-4.	3.6	9.5	-8.	-6.	-0.030	0.173	0.130	0.079
125 5	104.	2.32	3.40	3.90	3.70	0.05	0.19	19.	40.	-4.	-5.	-4.	-2.	-3.	8.	3.3	9.4	2.	2.	-0.070	0.453	0.301	0.103
125 6	105.	2.53	3.47	3.97	3.97	0.21	0.45	64.	86.	-2.	0.	-3.	-2.	0.	18.	3.9	9.9	16.	15.	-0.039	0.433	0.419	0.141
125 7	106.	2.37	3.22	3.67	3.67	0.33	0.69	118.	139.	2.	6.	-0.	-1.	9.	39.	3.7	10.6	22.	21.	-0.053	0.325	0.341	0.123
125 8	102.	2.54	3.46	3.90	3.76	0.69	1.12	226.	243.	8.	17.	3.	1.	27.	56.	3.7	11.9	57.	53.	-0.071	0.453	0.351	0.162

DATA OF EXPERIMENT OF SURFACE ENERGY BALANCE,CARDINGTON,APR-MAY,1983. HOURLY MEANS

DAY/H	WD	U1	U2	U3	U4	DT1	DT2	RNF	RNK	G5R	G5	G10	G15	G	LE	USON	TP	HS	HP	UW	UU	VV	WW
125 9	105.	2.78	3.74	4.27	4.08	0.71	1.18	283.	304.	15.	30.	10.	4.	47.	96.	4.1	13.6	78.	71.	-0.124	0.631	0.501	0.202
12510	103.	3.57	5.03	5.61	5.03	0.63	1.06	323.	340.	19.	37.	16.	8.	57.	148.	5.4	14.8	42.	56.	-0.132	0.732	0.822	0.236
12511	110.	3.88	5.29	6.06	6.36	0.51	0.90	310.	330.	21.	41.	21.	12.	64.	175.	5.8	15.8	69.	60.	-0.149	1.030	1.330	0.293
12512	120.	3.83	4.99	5.74	6.50	0.39	0.73	267.	289.	20.	35.	24.	16.	55.	140.	5.4	16.4	48.	38.	-0.144	1.000	1.070	0.259
12513	106.	3.81	5.23	6.05	6.25	0.34	0.62	257.	278.	20.	36.	24.	18.	57.	157.	5.9	16.9	38.	30.	-0.136	0.782	0.824	0.255
12514	104.	3.64	5.17	5.92	5.80	0.16	0.31	178.	197.	16.	28.	24.	20.	44.	100.	6.0	17.0	14.	8.	-0.116	0.831	0.736	0.240
12515	106.	3.68	5.16	6.04	6.32	0.10	0.20	155.	176.	15.	26.	23.	20.	41.	120.	6.0	17.3	11.	2.	-0.106	0.784	0.773	0.226
12516	102.	3.81	5.56	6.25	5.54	0.05	0.10	126.	145.	12.	21.	21.	19.	33.	118.	6.6	16.8	7.	2.	-0.190	1.110	0.779	0.272
12517	102.	3.68	5.47	6.35	5.64	-0.12	-0.19	47.	62.	8.	14.	19.	19.	21.	18.	6.4	16.1	-11.	-14.	-0.160	1.000	0.689	0.282
126 5	83.	0.84	1.04	1.26	1.18	-0.13	-0.12	3.	12.	-2.	-2.	-1.	1.	-3.	-4.	1.4	12.6	-5.	-3.	-0.006	0.237	0.229	0.053
126 8	196.	1.34	1.67	1.87	1.81	0.37	0.72	103.	77.	3.	6.	1.	2.	10.	13.	1.7	*****	20.	*****	-0.028	0.115	0.109	0.071
126 9	190.	2.24	2.77	3.12	3.23	0.60	1.01	203.	223.	13.	21.	6.	3.	33.	92.	2.7	*****	49.	*****	-0.041	0.349	0.311	0.131
12610	193.	3.31	4.18	4.93	5.32	0.59	0.96	309.	315.	17.	26.	11.	7.	41.	165.	4.7	13.6	35.	-64.	-0.070	0.533	0.607	0.179
12611	198.	4.73	6.00	7.03	7.51	0.89	1.50	552.	551.	27.	38.	16.	10.	60.	289.	6.3	16.8	99.	76.	-0.155	1.370	1.110	0.319
12612	202.	3.70	4.70	5.48	5.92	0.49	0.85	309.	325.	29.	36.	22.	15.	56.	169.	5.2	16.7	57.	44.	-0.111	0.734	1.020	0.211
12613	193.	4.09	5.25	6.10	6.57	0.55	0.97	349.	371.	25.	34.	23.	18.	53.	233.	5.4	17.4	79.	61.	-0.112	1.140	1.530	0.313
12614	191.	4.71	5.97	7.06	7.75	0.33	0.59	283.	314.	25.	34.	24.	20.	54.	181.	6.6	17.5	43.	23.	-0.161	1.340	1.210	0.349
12615	190.	4.67	5.91	7.00	7.75	0.29	0.55	278.	309.	19.	25.	24.	21.	38.	209.	6.7	17.5	37.	21.	-0.128	1.380	1.200	0.318
12616	190.	4.27	5.48	6.57	7.25	0.05	0.11	154.	191.	14.	17.	21.	21.	26.	140.	6.2	17.3	8.	-5.	-0.126	1.110	0.769	0.242
12617	197.	3.19	4.17	5.18	5.90	-0.21	-0.42	33.	62.	7.	7.	17.	19.	10.	84.	5.1	16.7	-18.	-22.	-0.071	0.763	0.483	0.184
129 9	180.	4.66	5.97	7.05	7.91	0.13	0.30	95.	85.	2.	3.	-1.	-3.	5.	12.	6.5	*****	17.	*****	-0.193	1.500	0.605	0.397
12912	230.	3.58	4.61	5.38	5.85	0.13	0.26	137.	135.	6.	7.	4.	3.	11.	92.	5.4	*****	20.	*****	-0.101	0.690	1.150	0.224
12913	234.	4.53	5.81	6.77	7.49	0.23	0.40	226.	233.	9.	11.	4.	4.	16.	120.	7.0	*****	43.	*****	-0.195	1.460	1.000	0.375
12914	231.	5.10	6.52	7.72	8.58	0.09	0.16	185.	193.	12.	10.	6.	5.	16.	169.	8.1	*****	11.	*****	-0.143	1.920	1.170	0.411
12915	237.	5.83	7.46	8.66	9.65	0.14	0.29	217.	226.	12.	9.	6.	6.	14.	144.	9.0	*****	32.	*****	-0.234	2.010	1.240	0.519
12916	243.	5.76	7.31	8.51	9.40	0.17	0.37	182.	203.	11.	6.	6.	6.	9.	173.	8.8	*****	56.	*****	-0.103	3.570	2.480	0.544
12917	225.	6.70	8.70	10.15	11.36	-0.05	-0.03	92.	122.	4.	-3.	4.	6.	-5.	133.	10.4	*****	12.	*****	-0.294	3.070	1.840	0.697
12918	228.	6.11	7.84	9.34	10.40	-0.32	-0.50	-39.	-18.	-5.	-15.	-1.	4.	-24.	104.	10.1	*****	-14.	*****	-0.252	2.420	1.350	0.612
12919	222.	4.29	5.56	6.76	7.75	-0.49	-0.83	-77.	-64.	-10.	-21.	-5.	0.	-33.	56.	7.5	*****	-35.	*****	-0.153	1.170	0.662	0.324
12920	221.	4.16	5.49	6.64	7.71	-0.49	-0.33	-82.	-69.	-13.	-23.	-8.	-3.	-36.	36.	7.1	*****	-36.	*****	-0.109	0.776	0.534	0.278
12921	217.	2.82	3.76	4.84	5.72	-0.61	-1.15	-77.	-64.	-14.	-23.	-10.	-6.	-37.	12.	5.4	*****	-26.	*****	-0.055	0.389	0.252	0.130
12922	210.	3.49	4.61	5.77	6.68	-0.53	-0.94	-77.	-61.	-14.	-23.	-12.	-9.	-37.	24.	5.8	*****	-33.	*****	-0.030	0.544	0.371	0.185
12923	205.	4.21	5.47	6.61	7.49	-0.45	-0.73	-77.	-60.	-15.	-23.	-13.	-10.	-36.	4.	6.6	*****	-37.	*****	-0.110	0.868	0.626	0.323
130 0	205.	3.65	4.82	5.87	6.63	-0.47	-0.80	-78.	-60.	-15.	-23.	-13.	-11.	-35.	40.	6.2	*****	-37.	*****	-0.113	0.939	0.583	[illegible]
130 1	192.	2.72	3.70	4.76	5.63	-0.53	-0.97	-75.	-55.	-15.	-22.	-13.	-12.	-34.	4.	4.8	*****	-26.	*****	-0.064	0.378	0.253	0.144
130 2	184.	2.60	3.52	4.42	5.28	-0.51	-0.90	-73.	-53.	-14.	-21.	-14.	-13.	-33.	4.	4.6	*****	-30.	*****	-0.063	0.421	0.184	0.145
130 3	177.	1.93	2.70	3.43	4.16	-0.55	-0.92	-69.	-50.	-14.	-20.	-14.	-13.	-32.	0.	3.6	*****	-27.	*****	-0.071	0.428	0.172	0.146
130 4	181.	2.26	3.05	3.89	4.63	-0.47	-0.81	-60.	-44.	-14.	-20.	-13.	-14.	-32.	-16.	4.0	*****	-28.	*****	-0.065	0.486	0.170	0.155
130 5	174.	3.26	4.25	5.04	5.79	-0.03	-0.08	1.	-6.	-13.	-17.	-13.	-14.	-27.	4.	4.9	*****	-12.	*****	-0.149	0.899	0.346	0.291
130 6	184.	4.18	5.55	6.64	7.28	0.29	0.57	110.	95.	-9.	-12.	-12.	-14.	-18.	12.	6.1	*****	26.	*****	-0.177	1.120	0.375	0.290
130 7	191.	4.87	6.35	7.48	8.12	0.63	1.17	248.	237.	-3.	-2.	-9.	-12.	-4.	100.	6.8	*****	73.	*****	-0.144	0.846	0.913	0.340
130 8	198.	4.85	6.20	7.25	7.89	0.82	1.51	350.	352.	5.	7.	-5.	-9.	11.	144.	6.5	*****	97.	*****	-0.136	1.370	1.310	0.360
130 9	200.	4.84	6.17	7.22	7.98	0.59	1.08	281.	290.	10.	13.	1.	-5.	20.	161.	6.8	*****	74.	*****	-0.159	1.160	1.060	0.375
13010	198.	4.77	6.16	7.27	7.95	0.48	0.88	268.	280.	9.	11.	3.	-1.	17.	112.	6.5	*****	56.	*****	-0.152	1.320	1.430	0.375
13011	198.	5.65	7.24	8.51	9.22	0.87	1.57	513.	544.	15.	24.	5.	1.	38.	270.	7.8	*****	136.	*****	-0.188	2.020	2.220	0.524
13012	190.	5.92	7.61	8.80	9.59	0.92	1.65	462.	490.	23.	37.	13.	7.	57.	305.	8.2	*****	139.	*****	-0.163	1.530	1.810	0.506
13013	189.	6.07	7.82	9.28	10.33	0.68	1.27	395.	423.	18.	28.	14.	10.	43.	197.	8.8	*****	103.	*****	-0.203	2.040	2.020	0.522
13014	191.	6.31	8.09	9.50	10.56	0.51	0.96	337.	365.	18.	27.	15.	13.	42.	221.	8.7	*****	90.	*****	-0.213	1.230	1.550	0.535
13015	198.	6.13	7.96	9.36	10.39	0.17	0.35	163.	184.	10.	11.	13.	14.	18.	132.	8.7	*****	64.	*****	-0.224	1.830	2.150	0.556
13016	191.	6.70	8.55	10.14	11.29	0.20	0.42	183.	219.	5.	6.	9.	12.	9.	173.	9.3	*****	44.	*****	-0.234	2.670	2.330	0.597
13017	183.	5.17	6.77	8.20	9.15	-0.11	-0.16	40.	61.	0.	-1.	6.	10.	-2.	88.	7.5	*****	-4.	*****	-0.206	1.560	1.200	0.433
13018	185.	4.39	5.80	6.97	7.90	-0.28	-0.47	-18.	4.	-5.	-7.	2.	7.	-12.	52.	6.6	*****	-25.	*****	-0.113	1.100	0.594	0.334
13019	177.	3.71	4.90	5.95	6.77	-0.33	-0.57	-40.	-18.	-7.	-11.	-1.	4.	-17.	40.	5.8	*****	-29.	*****	-0.126	1.000	0.308	0.272
13020	174.	3.55	4.62	5.56	6.38	-0.33	-0.54	-46.	-24.	-9.	-13.	-3.	1.	-20.	20.	5.2	*****	-30.	*****	-0.123	1.160	0.405	0.300
13021	174.	3.23	4.30	5.21	6.07	-0.45	-0.75	-64.	-43.	-10.	-14.	-5.	-1.	-22.	15.	5.3	*****	-31.	*****	-0.116	1.120	0.376	0.275
13023	160.	3.01	3.91	4.64	5.34	-0.37	-0.52	-44.	-69.	-10.	-14.	-7.	-5.	-22.	-28.	4.8	*****	-30.	*****	-0.157	0.756	0.366	0.322

DATA OF EXPERIMENT OF SURFACE ENERGY BALANCE, CARDINGTON, APR-MAY, 1983. HOURLY MEANS

DAY/H	WD	U1	U2	U3	U4	DT1	DT2	RNF	RNK	G5R	G5	G10	G15	G	LE	USON	TP	HS	HP	UW	UU	VV	WW
131 0	151.	2.23	2.95	3.57	4.23	-0.54	-0.83	-57.	-43.	-11.	-16.	-8.	-6.	-25.	12.	3.8	*****	-27.	*****	-0.111	0.578	0.254	0.225
131 3	140.	2.11	2.77	3.26	3.68	-0.24	-0.27	-28.	-24.	-9.	-13.	-8.	-8.	-20.	24.	3.3	*****	-10.	*****	-0.072	0.327	0.123	0.130
131 4	150.	1.97	2.61	3.18	3.77	-0.46	-0.67	-43.	-41.	-11.	-16.	-9.	-8.	-24.	-24.	3.5	*****	-19.	*****	-0.072	0.381	0.163	0.145
131 5	133.	2.74	3.53	4.03	4.58	-0.07	0.04	19.	1.	-11.	-14.	-9.	-9.	-22.	0.	3.9	*****	-2.	*****	-0.095	0.414	0.167	0.174
131 6	147.	3.12	4.00	4.47	4.94	0.29	0.61	110.	83.	-8.	-10.	-9.	-9.	-16.	34.	4.5	*****	27.	*****	-0.125	0.501	0.336	0.294
131 7	164.	3.58	4.58	5.23	5.84	0.53	0.96	209.	216.	-2.	1.	-7.	-9.	1.	72.	5.1	*****	78.	*****	-0.200	1.130	0.732	0.451
131 8	164.	4.15	5.33	6.07	6.84	0.58	1.04	258.	271.	4.	8.	-2.	-6.	13.	112.	6.0	*****	62.	*****	-0.229	1.560	0.820	0.464
131 9	172.	4.07	5.22	6.09	6.90	0.50	0.88	231.	254.	8.	14.	2.	-3.	22.	128.	5.7	*****	54.	*****	-0.191	1.270	0.518	0.326
13110	161.	3.80	4.87	5.52	6.18	0.61	1.03	287.	314.	9.	17.	4.	1.	26.	136.	5.3	*****	75.	*****	-0.157	1.010	0.762	0.370
13111	174.	3.61	4.67	5.46	6.22	0.55	0.93	246.	274.	13.	22.	8.	4.	34.	144.	5.3	*****	50.	*****	-0.118	0.874	0.711	0.286
13112	183.	3.40	4.33	5.03	5.55	0.48	0.86	252.	257.	10.	13.	9.	7.	21.	88.	4.7	*****	40.	*****	-0.119	0.679	0.610	0.229
13113	166.	3.17	3.93	4.51	4.90	0.95	1.60	403.	453.	17.	31.	10.	8.	43.	241.	4.1	*****	119.	*****	-0.099	0.907	0.679	0.317
13114	193.	3.73	4.84	5.77	6.39	0.08	0.17	104.	120.	15.	20.	14.	12.	31.	96.	5.3	*****	6.	*****	-0.099	0.744	0.754	0.226
13115	215.	3.90	4.95	5.88	6.46	0.59	1.11	247.	278.	13.	15.	11.	12.	23.	177.	5.6	*****	78.	*****	-0.114	1.020	1.090	0.261
13116	214.	3.56	4.68	5.57	6.04	0.19	0.39	103.	104.	3.	4.	9.	12.	6.	53.	5.6	*****	18.	*****	-0.091	0.776	0.462	0.197
13117	203.	3.34	4.34	5.21	5.75	-0.01	0.06	40.	75.	3.	0.	6.	10.	0.	72.	5.4	*****	5.	*****	-0.086	0.720	0.495	0.193
13118	202.	1.80	2.49	3.40	4.03	-0.47	-0.94	-29.	4.	-2.	-5.	3.	7.	-7.	48.	3.6	*****	-9.	*****	-0.012	0.316	0.261	0.058
13119	177.	0.99	1.65	2.56	3.36	-1.44	-2.63	-35.	-17.	-6.	-9.	1.	5.	-14.	0.	2.8	*****	-8.	*****	-0.011	0.115	0.058	0.031
13120	179.	1.51	2.16	2.99	3.78	-0.66	-1.34	-39.	-20.	-7.	-10.	-2.	2.	-16.	0.	3.3	*****	-17.	*****	-0.014	0.292	0.173	0.030
13121	180.	2.05	2.81	3.68	4.43	-0.48	-0.92	-39.	-18.	-7.	-10.	-3.	0.	-16.	24.	3.7	*****	-19.	*****	-0.020	0.363	0.177	0.101
13122	177.	2.38	3.24	4.11	4.99	-0.47	-0.90	-58.	-37.	-8.	-12.	-4.	-1.	-19.	12.	4.2	*****	-25.	*****	-0.056	0.407	0.130	0.115
13123	178.	1.61	2.31	3.14	3.91	-0.64	-1.21	-63.	-45.	-9.	-13.	-6.	-3.	-21.	-8.	3.5	*****	-16.	*****	-0.034	0.251	0.093	0.020
132 0	169.	1.44	2.03	2.60	3.21	-0.78	-1.27	-61.	-45.	-10.	-14.	-7.	-4.	-22.	-4.	2.8	*****	-21.	*****	-0.053	0.362	0.143	0.120
13210	202.	2.84	3.63	4.16	4.45	0.55	0.97	196.	218.	8.	11.	1.	-2.	18.	83.	3.9	*****	42.	*****	-0.041	0.613	0.567	0.141
13211	219.	3.59	4.59	5.37	5.83	0.71	1.21	303.	320.	11.	14.	4.	1.	21.	120.	5.3	*****	69.	*****	-0.127	0.972	0.641	0.221
13212	217.	3.22	4.14	4.71	5.03	0.74	1.23	326.	349.	23.	28.	8.	4.	44.	209.	4.8	*****	70.	*****	-0.065	0.526	0.723	0.212
13213	204.	5.31	6.85	8.03	8.77	0.57	1.06	357.	284.	18.	18.	11.	8.	28.	64.	7.6	*****	83.	*****	-0.170	2.090	1.640	0.449
13214	213.	5.71	7.39	8.70	9.60	0.45	0.84	319.	333.	20.	22.	12.	10.	34.	169.	8.7	*****	71.	*****	-0.195	1.840	2.070	0.445
13217	203.	3.96	5.13	6.14	6.77	0.01	-0.03	78.	105.	1.	-3.	3.	8.	-4.	99.	5.8	*****	-2.	*****	-0.100	0.735	0.523	0.243
13220	183.	0.94	1.42	1.92	2.28	-0.44	-0.81	-21.	-46.	-6.	-9.	-3.	1.	-15.	-12.	1.9	*****	-3.	*****	-0.003	0.083	0.106	0.014
13221	161.	1.65	2.39	3.19	3.90	-1.03	-1.91	-49.	-47.	-8.	-12.	-4.	-1.	-19.	-24.	3.0	*****	-20.	*****	-0.023	0.333	0.130	0.052
13222	186.	3.65	4.91	6.15	7.23	-0.48	-0.90	-62.	-52.	-10.	-14.	-6.	-2.	-22.	16.	5.8	*****	-43.	*****	-0.103	0.773	0.392	0.249
13223	189.	3.37	4.51	5.64	6.52	-0.51	-0.97	-69.	-57.	-10.	-14.	-7.	-4.	-22.	12.	5.6	*****	-41.	*****	-0.088	0.592	0.333	0.208
133 0	184.	3.95	5.24	6.58	7.77	-0.48	-0.90	-71.	-55.	-11.	-14.	-7.	-5.	-22.	0.	6.4	*****	-44.	*****	-0.109	0.734	0.378	0.240
133 1	184.	3.68	4.91	6.12	7.12	-0.49	-0.90	-73.	-56.	-11.	-14.	-8.	-6.	-22.	12.	6.0	*****	-41.	*****	-0.093	0.710	0.295	0.219
133 2	190.	4.10	5.44	6.72	7.70	-0.45	-0.83	-74.	-56.	-10.	-14.	-8.	-7.	-22.	4.	6.4	*****	-42.	*****	-0.116	0.721	0.490	0.282
133 3	183.	3.28	4.31	5.38	6.19	-0.48	-0.87	-73.	-55.	-10.	-14.	-8.	-7.	-21.	10.	5.4	*****	-33.	*****	-0.092	0.700	0.362	0.221
133 4	181.	3.28	4.40	5.47	6.42	-0.41	-0.75	-58.	-41.	-10.	-13.	-8.	-8.	-21.	4.	5.4	*****	-36.	*****	-0.091	0.631	0.256	0.193
133 5	177.	3.40	4.48	5.44	6.42	-0.11	-0.22	8.	5.	-9.	-11.	-8.	-3.	-16.	-8.	5.4	*****	-23.	*****	-0.139	0.853	0.295	0.268
133 6	186.	4.25	5.59	6.66	7.49	0.15	0.23	104.	81.	-5.	-5.	-7.	-8.	-7.	48.	6.4	*****	3.	*****	-0.165	1.140	0.617	0.354
133 8	191.	5.06	6.55	7.74	8.49	0.54	0.86	300.	285.	4.	4.	-2.	-4.	6.	116.	7.1	*****	63.	*****	-0.151	1.350	1.040	0.450
133 9	197.	5.86	7.63	8.97	9.84	0.63	1.19	423.	433.	13.	17.	2.	-2.	27.	193.	8.3	*****	96.	*****	-0.215	1.910	1.910	0.514
13310	196.	6.05	7.70	9.18	10.21	0.65	1.14	409.	422.	19.	24.	7.	2.	38.	229.	8.7	*****	96.	*****	-0.219	2.190	1.920	0.560
13311	187.	5.60	7.30	8.60	9.47	0.57	1.02	355.	346.	23.	31.	11.	6.	43.	185.	7.8	*****	84.	*****	-0.172	1.650	1.460	0.503
13315	196.	5.26	6.87	8.16	8.90	0.40	0.75	297.	323.	14.	14.	14.	15.	21.	169.	7.8	*****	22.	*****	-0.124	1.800	1.230	0.445
13316	202.	4.39	5.65	6.75	7.40	0.17	0.33	144.	159.	11.	10.	12.	14.	16.	112.	6.9	*****	21.	*****	-0.097	1.620	1.760	0.377
13317	195.	3.57	4.66	5.57	6.20	-0.05	-0.03	64.	96.	6.	5.	9.	13.	8.	76.	5.1	*****	-6.	*****	-0.099	1.080	0.550	0.218
13318	193.	3.76	4.89	5.99	6.73	-0.31	-0.59	-1.	27.	1.	-1.	7.	11.	-2.	83.	5.9	*****	-17.	*****	-0.074	0.907	0.564	0.254
13319	183.	2.02	2.89	3.97	4.84	-0.71	-1.52	-62.	-41.	-4.	-9.	3.	8.	-13.	12.	4.1	*****	-21.	*****	-0.022	0.251	0.211	0.089
13320	182.	1.92	2.78	3.83	4.87	-0.72	-1.51	-63.	-44.	-7.	-12.	-0.	5.	-19.	0.	4.1	*****	-22.	*****	-0.026	0.201	0.144	0.075
13321	189.	1.83	2.66	3.83	4.77	-0.70	-1.55	-60.	-41.	-8.	-14.	-3.	2.	-21.	12.	3.9	*****	-18.	*****	-0.015	0.169	0.116	0.055
13322	195.	1.34	2.02	2.86	3.50	-0.79	-1.49	-53.	-35.	-9.	-14.	-4.	0.	-21.	0.	3.3	*****	-13.	*****	-0.025	0.185	0.122	0.053
13323	196.	0.91	1.56	2.51	3.12	-1.07	-2.03	-56.	-37.	-9.	-14.	-5.	-2.	-22.	12.	2.0	*****	-10.	*****	-0.014	0.103	0.132	0.040
134 0	213.	0.76	1.20	1.73	2.11	-1.72	-2.91	-52.	-37.	-10.	-16.	-6.	-3.	-24.	-4.	2.0	*****	-7.	*****	-0.005	0.050	0.035	0.026
134 1	204.	0.92	1.37	2.00	2.35	-0.73	-1.20	-7.	11.	-10.	-14.	-7.	-4.	-22.	-8.	2.1	*****	-5.	*****	-0.003	0.127	0.091	0.035
134 2	164.	0.73	1.14	1.50	1.77	-1.12	-1.55	-36.	-23.	-8.	-11.	-7.	-5.	-18.	16.	1.7	*****	-2.	*****	-0.003	0.066	0.069	0.020

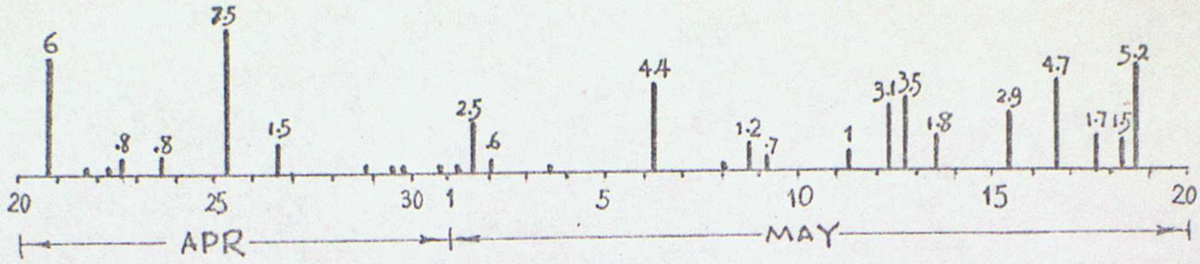
DATA OF EXPERIMENT OF SURFACE ENERGY BALANCE,CARDINGTON,APR-MAY,1983. HOURLY MEANS

DAY/H	WD	U1	U2	U3	U4	DT1	DT2	RNF	RNK	GSR	G5	G10	G15	G	LE	USON	TP	HS	HP	UW	UU	VV	WW
134 3	197.	0.80	1.17	1.54	1.88	-2.01	-2.92	-25.	-35.	-11.	-16.	-8.	-6.	-26.	-20.	1.8	*****	-5.	*****	-0.003	0.071	0.121	0.029
134 4	225.	0.86	1.28	1.74	1.97	-1.50	-2.24	-1.	-21.	-12.	-17.	-9.	-7.	-23.	-20.	2.0	*****	-6.	*****	-0.005	0.059	0.074	0.022
134 5	208.	1.35	1.84	2.38	2.68	-0.32	-0.47	64.	16.	-9.	-12.	-9.	-8.	-18.	-20.	2.2	*****	-4.	*****	-0.012	0.171	0.134	0.048
134 6	5.	2.66	3.42	4.01	4.34	0.37	0.66	153.	107.	-4.	-5.	-7.	-8.	-8.	52.	3.6	*****	14.	*****	-0.045	0.393	0.293	0.123
134 7	206.	3.54	4.53	5.36	5.88	0.72	0.57	142.	142.	1.	2.	-5.	-6.	2.	40.	5.2	*****	19.	*****	-0.034	0.719	0.571	0.199
134 8	198.	3.88	5.02	5.86	6.32	0.71	1.24	281.	288.	7.	10.	-1.	-4.	15.	148.	5.3	*****	75.	*****	-0.117	0.825	0.770	0.252
134 9	196.	3.87	5.04	5.86	6.34	0.83	1.37	355.	363.	12.	16.	3.	-1.	26.	167.	5.5	*****	69.	*****	-0.076	0.752	0.861	0.256
13410	198.	3.58	4.59	5.31	5.70	0.70	1.17	326.	332.	16.	22.	7.	3.	34.	132.	4.9	*****	58.	*****	-0.117	0.828	0.711	0.219
13411	190.	4.55	5.92	6.89	7.54	0.95	1.61	494.	513.	23.	34.	11.	7.	54.	265.	6.2	*****	105.	*****	-0.122	1.330	1.190	0.327
13412	191.	3.78	4.95	5.97	6.55	0.46	0.77	311.	339.	24.	31.	17.	12.	49.	189.	5.4	*****	51.	*****	-0.150	0.989	0.962	0.267
13413	188.	3.94	5.17	6.20	6.88	0.23	0.36	234.	266.	18.	21.	17.	15.	33.	157.	5.6	*****	16.	*****	-0.112	0.964	0.854	0.276
13414	194.	4.97	6.40	7.48	8.20	0.48	0.85	377.	414.	20.	27.	16.	15.	42.	241.	6.8	*****	67.	*****	-0.132	1.430	1.150	0.338
13415	215.	3.75	4.86	5.79	6.38	0.24	0.43	211.	243.	20.	22.	16.	16.	34.	189.	5.8	*****	24.	*****	-0.117	0.919	1.330	0.252
13416	214.	2.78	3.59	4.34	4.78	-0.03	-0.06	101.	134.	11.	10.	14.	16.	16.	88.	4.4	*****	3.	*****	-0.067	0.899	1.070	0.165
13417	196.	3.14	4.15	5.12	5.86	-0.19	-0.38	49.	89.	5.	4.	10.	14.	6.	100.	4.9	*****	-15.	*****	-0.056	0.571	0.541	0.169
13418	197.	1.94	2.74	3.82	4.64	-0.65	-1.40	-30.	1.	-1.	-3.	7.	12.	-5.	51.	4.1	*****	-18.	*****	-0.019	0.231	0.174	0.072
13419	188.	0.69	1.46	2.87	4.07	-1.49	-3.39	-57.	-38.	-5.	-9.	3.	9.	-14.	19.	3.6	*****	-5.	*****	-0.002	0.063	0.041	0.014
13420	169.	1.04	1.70	2.51	3.31	-2.08	-3.60	-52.	-37.	-8.	-12.	-0.	6.	-19.	4.	2.9	*****	-20.	*****	-0.032	0.193	0.117	0.063
13421	170.	1.14	1.76	2.56	3.30	-1.49	-2.73	-55.	-38.	-9.	-13.	-3.	3.	-20.	12.	3.0	*****	-17.	*****	-0.032	0.190	0.133	0.065
13422	189.	0.75	1.27	1.91	2.28	-2.20	-3.33	-56.	-36.	-10.	-14.	-4.	0.	-22.	0.	1.9	*****	-3.	*****	-0.003	0.072	0.070	0.029
13423	175.	0.82	1.37	2.10	2.91	-1.43	-2.55	-42.	-24.	-10.	-14.	-6.	-2.	-22.	-3.	2.5	*****	-21.	*****	-0.030	0.163	0.084	0.056
135 0	158.	0.57	0.93	1.36	1.91	-2.16	-3.36	-43.	-27.	-10.	-15.	-7.	-3.	-23.	4.	1.8	*****	-4.	*****	-0.006	0.070	0.023	0.014
135 1	125.	0.57	0.84	1.26	1.66	-1.67	-2.43	-32.	-22.	-11.	-16.	-8.	-5.	-25.	-20.	1.6	*****	-11.	*****	-0.020	0.149	0.063	0.047
135 2	81.	0.86	1.07	1.23	1.07	-1.03	-1.45	-41.	-34.	-11.	-14.	-8.	-6.	-23.	8.	1.1	*****	-5.	*****	-0.013	0.105	0.157	0.040
135 3	105.	0.68	0.98	1.35	1.55	-1.42	-2.02	-37.	-31.	-11.	-15.	-8.	-7.	-24.	8.	1.4	*****	-7.	*****	-0.012	0.083	0.100	0.036
135 4	78.	0.85	1.19	1.59	1.65	-0.79	-1.33	-10.	-9.	-11.	-14.	-9.	-8.	-23.	-15.	1.4	*****	-5.	*****	0.002	0.077	0.111	0.031
135 5	91.	1.46	1.93	2.35	2.51	0.01	0.12	30.	37.	-8.	-9.	-8.	-8.	-14.	-8.	2.3	*****	-4.	*****	-0.012	0.217	0.156	0.059
135 6	106.	1.38	1.86	2.10	2.04	0.11	0.25	48.	65.	-3.	-2.	-6.	-7.	-3.	12.	2.1	*****	-6.	*****	-0.026	0.149	0.134	0.060
135 8	96.	1.14	1.47	1.68	1.33	0.18	0.34	66.	41.	1.	4.	-2.	-4.	6.	-28.	1.7	*****	4.	*****	-0.012	0.034	0.111	0.031
13513	142.	2.35	3.01	3.44	3.63	0.50	0.94	200.	220.	4.	9.	2.	2.	14.	64.	3.2	*****	43.	*****	-0.035	0.340	0.194	0.174
13514	153.	2.67	3.44	3.93	4.29	0.58	1.01	218.	253.	12.	22.	6.	4.	34.	103.	3.6	*****	49.	*****	-0.112	0.624	0.429	0.193
13515	179.	2.85	3.71	4.35	4.80	0.47	0.74	209.	246.	13.	21.	9.	7.	32.	92.	4.1	*****	27.	*****	-0.081	0.797	0.387	0.194
13516	190.	4.35	5.65	6.75	7.63	0.10	0.12	165.	203.	11.	16.	10.	9.	24.	140.	6.4	*****	3.	*****	-0.115	1.330	0.818	0.306
13517	196.	4.04	5.32	6.40	7.13	-0.10	-0.22	78.	127.	6.	6.	8.	10.	9.	104.	6.1	*****	-17.	*****	-0.102	1.030	0.821	0.280
13518	198.	2.66	3.62	4.70	5.54	-0.46	-0.94	-19.	20.	0.	-2.	5.	9.	-3.	72.	4.8	*****	-25.	*****	-0.051	0.531	0.352	0.149
13519	178.	1.14	1.87	2.91	3.76	-1.18	-2.45	-54.	-32.	-4.	-7.	2.	7.	-10.	28.	3.2	*****	-10.	*****	-0.012	0.170	0.156	0.036
13520	166.	1.32	1.99	2.76	3.53	-1.34	-2.36	-64.	-48.	-7.	-11.	-1.	4.	-17.	-8.	3.1	*****	-26.	*****	-0.051	0.277	0.141	0.099
13521	156.	1.23	1.84	2.49	3.20	-1.22	-2.02	-57.	-43.	-8.	-13.	-3.	1.	-20.	-12.	2.8	*****	-23.	*****	-0.047	0.264	0.103	0.037
13522	139.	1.65	2.36	3.19	4.06	-0.91	-1.71	-62.	-47.	-9.	-13.	-5.	-1.	-21.	0.	3.5	*****	-22.	*****	-0.027	0.250	0.094	0.032
13523	132.	1.93	2.72	3.57	4.42	-0.69	-1.29	-64.	-47.	-10.	-14.	-6.	-3.	-21.	-4.	4.0	*****	-29.	*****	-0.036	0.290	0.091	0.092
136 0	119.	1.63	2.30	3.06	3.93	-0.69	-1.17	-62.	-48.	-10.	-13.	-6.	-4.	-21.	-4.	3.5	*****	-20.	*****	-0.034	0.205	0.101	0.076
136 1	88.	1.19	1.53	1.85	1.94	-0.99	-1.57	-48.	-43.	-10.	-14.	-7.	-5.	-22.	-4.	1.9	*****	-13.	*****	-0.017	0.155	0.303	0.057
136 2	87.	1.45	1.91	2.36	2.12	-0.49	-0.79	-38.	-46.	-11.	-15.	-8.	-6.	-23.	-8.	2.6	*****	-14.	*****	-0.010	0.178	0.204	0.062
136 3	51.	1.83	2.43	2.82	2.75	-0.53	-0.74	-34.	-48.	-11.	-14.	-8.	-7.	-23.	-12.	2.6	*****	-5.	*****	-0.002	0.133	0.165	0.054
136 4	56.	1.81	2.33	2.82	2.86	-0.35	-0.54	-13.	-32.	-10.	-14.	-8.	-8.	-22.	-24.	2.9	*****	-10.	*****	-0.011	0.257	0.304	0.104
136 5	77.	1.92	2.24	2.82	2.99	-0.06	-0.02	40.	28.	-8.	-10.	-8.	-8.	-15.	8.	3.1	*****	-9.	*****	-0.056	0.350	0.204	0.095
136 6	74.	2.77	3.13	4.04	4.41	0.25	0.41	130.	103.	-3.	-2.	-6.	-8.	-3.	0.	4.0	*****	8.	*****	-0.095	0.485	0.221	0.140
136 7	85.	2.75	3.31	3.85	3.67	0.53	0.76	223.	207.	3.	8.	-3.	-6.	12.	377.	4.2	*****	26.	*****	-0.089	0.482	0.407	0.158
13610	99.	5.55	8.13	8.80	7.23	0.57	0.90	433.	454.	19.	34.	12.	8.	53.	281.	8.9	*****	81.	*****	-0.379	2.120	1.860	0.553
13611	96.	6.04	8.38	9.04	7.18	0.58	0.94	494.	493.	21.	38.	15.	11.	60.	281.	10.2	*****	103.	*****	-0.500	2.740	2.510	0.730
13612	92.	5.98	7.89	8.97	7.67	0.37	0.62	415.	413.	21.	37.	18.	16.	58.	265.	10.0	*****	71.	*****	-0.444	2.810	2.550	0.727
13613	90.	6.10	7.73	9.05	8.34	0.09	0.16	272.	273.	16.	27.	19.	18.	43.	249.	10.0	*****	40.	*****	-0.565	3.220	1.850	0.725
13614	100.	6.16	8.26	9.33	7.59	-0.12	-0.18	124.	76.	9.	15.	16.	19.	23.	96.	10.9	*****	-5.	*****	-0.525	3.120	1.830	0.852
13617	104.	2.65	3.80	4.29	4.26	0.09	0.15	60.	74.	1.	3.	5.	10.	5.	48.	4.3	*****	2.	*****	-0.032	0.575	0.450	0.162
13618	102.	3.37	4.93	5.76	5.53	-0.13	-0.22	0.	10.	0.	1.	4.	8.	2.	32.	6.0	*****	-14.	*****	-0.147	1.050	0.626	0.247
13619	102.	2.55	3.90	4.47	4.33	-0.22	-0.36	-25.	-14.	2.	-3.	3.	7.	-4.	12.	4.7	*****	-18.	*****	-0.075	0.461	0.345	0.143

DATA OF EXPERIMENT OF SURFACE ENERGY BALANCE, CARDINGTON, APR-MAY, 1983. HOURLY MEANS

DAY/H	WD	U1	U2	U3	U4	DT1	DT2	RNF	RNK	G5R	G5	G10	G15	G	LE	USON	TP	HS	HP	UW	UU	VV	WW
13620	106.	2.06	3.11	3.94	4.79	-0.37	-0.65	-39.	-27.	-4.	-5.	1.	5.	-8.	12.	4.1	*****	-15.	*****	-0.035	0.277	0.207	0.086
13621	103.	1.60	2.42	3.26	3.78	-0.72	-1.38	-56.	-43.	-6.	-8.	-0.	4.	-13.	12.	3.7	*****	-19.	*****	-0.025	0.177	0.202	0.063
13622	117.	2.50	3.50	4.30	5.21	-0.60	-1.02	-63.	-52.	-9.	-11.	-2.	2.	-18.	8.	4.4	*****	-34.	*****	-0.063	0.394	0.236	0.145
13623	131.	2.19	2.97	3.66	4.33	-0.80	-0.99	-63.	-51.	-9.	-12.	-4.	-0.	-19.	-4.	3.8	*****	-28.	*****	-0.063	0.410	0.167	0.143
137 0	114.	1.16	1.99	2.74	3.49	-0.83	-1.63	-56.	-43.	-10.	-13.	-5.	-2.	-20.	-8.	2.9	*****	-11.	*****	-0.016	0.125	0.104	0.045
137 1	110.	1.55	2.50	3.29	4.25	-0.67	-1.21	-56.	-50.	-11.	-13.	-6.	-3.	-21.	-20.	3.4	*****	-19.	*****	-0.025	0.192	0.153	0.069
137 2	114.	0.81	1.15	1.68	2.12	-1.10	-1.60	-43.	-41.	-11.	-14.	-6.	-4.	-22.	8.	1.9	*****	-12.	*****	-0.018	0.141	0.100	0.047
137 3	139.	1.00	1.54	2.12	2.69	-0.99	-1.75	-33.	-30.	-11.	-14.	-7.	-5.	-22.	-12.	2.3	*****	-17.	*****	-0.019	0.207	0.148	0.075
137 4	111.	1.12	1.47	1.82	1.97	-0.99	-1.63	-25.	-35.	-10.	-13.	-7.	-6.	-21.	-32.	1.9	*****	-12.	*****	-0.013	0.176	0.124	0.070
137 5	159.	2.76	3.62	4.31	5.03	-0.32	-0.52	19.	4.	-9.	-10.	-7.	-6.	-16.	-4.	4.2	*****	-27.	*****	-0.119	0.736	0.327	0.230
137 6	167.	3.22	4.20	4.83	5.45	0.22	0.34	117.	83.	-5.	-5.	-6.	-6.	-8.	44.	4.7	*****	8.	*****	-0.163	1.140	0.523	0.353
137 7	174.	3.56	4.66	5.48	6.20	0.50	0.79	224.	224.	1.	3.	-4.	-5.	5.	88.	5.3	*****	34.	*****	-0.152	1.120	0.612	0.347
137 8	163.	3.29	4.22	4.82	5.38	0.63	1.02	280.	290.	8.	14.	0.	-3.	21.	148.	4.7	*****	58.	*****	-0.134	1.040	0.746	0.288
137 9	167.	2.69	3.49	3.98	4.49	0.34	0.55	172.	193.	12.	19.	5.	1.	30.	116.	3.9	*****	23.	*****	-0.035	0.867	0.370	0.237
13710	160.	3.08	4.07	4.73	5.40	0.01	0.04	129.	135.	9.	14.	7.	4.	22.	72.	4.7	*****	-1.	*****	-0.115	1.160	0.453	0.292
13711	138.	3.68	4.82	5.58	6.24	0.54	0.93	326.	337.	9.	18.	7.	6.	28.	165.	5.3	*****	59.	*****	-0.156	1.050	0.606	0.363
13712	145.	4.53	5.91	6.87	7.66	0.49	0.85	369.	392.	18.	35.	11.	8.	54.	205.	6.8	*****	82.	*****	-0.259	1.810	0.940	0.536
13713	168.	4.54	5.90	6.88	7.83	0.33	0.54	254.	276.	16.	26.	14.	12.	41.	177.	6.6	*****	44.	*****	-0.268	1.750	0.864	0.532
13714	163.	4.26	5.57	6.49	7.35	0.32	0.62	274.	233.	10.	16.	13.	14.	25.	-12.	5.9	*****	37.	*****	-0.210	2.250	1.130	0.506
13715	147.	4.52	5.90	6.91	7.79	0.45	0.83	303.	273.	14.	24.	12.	14.	38.	132.	6.7	*****	76.	*****	-0.273	2.090	0.975	0.500
13716	116.	4.09	5.46	6.42	7.19	0.34	0.64	206.	236.	10.	19.	13.	14.	29.	140.	6.1	*****	41.	*****	-0.135	1.240	0.915	0.317
13717	102.	4.26	6.03	6.80	6.02	-0.03	0.00	41.	52.	4.	9.	12.	14.	14.	83.	7.6	*****	9.	*****	-0.257	1.750	1.170	0.441
13718	100.	3.97	5.95	6.69	5.55	-0.15	-0.21	-5.	4.	-3.	-3.	8.	13.	-4.	40.	7.5	*****	-16.	*****	-0.254	1.610	0.880	0.391
13719	95.	2.94	3.90	4.16	3.02	-0.25	-0.36	-37.	-24.	-6.	-6.	4.	9.	-9.	28.	5.5	*****	-20.	*****	-0.123	0.676	0.430	0.201
13720	89.	2.89	3.57	4.22	3.88	-0.25	-0.34	-36.	-24.	-7.	-9.	1.	6.	-13.	-12.	5.1	*****	-26.	*****	-0.096	0.546	0.379	0.185
13722	105.	3.66	5.36	6.25	6.85	-0.24	-0.40	-19.	-12.	-7.	-8.	-2.	2.	-13.	24.	6.3	*****	-29.	*****	-0.130	0.856	0.559	0.276
13723	103.	3.27	5.07	5.91	5.63	-0.19	-0.29	-18.	-30.	-7.	-8.	-3.	0.	-12.	7.	6.2	*****	-21.	*****	-0.137	0.813	0.479	0.246

Fig 1



6
.8
.8
7.5
1.5
2.5
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4.4
1.2
.7
1
3.1
3.5
1.8
2.9
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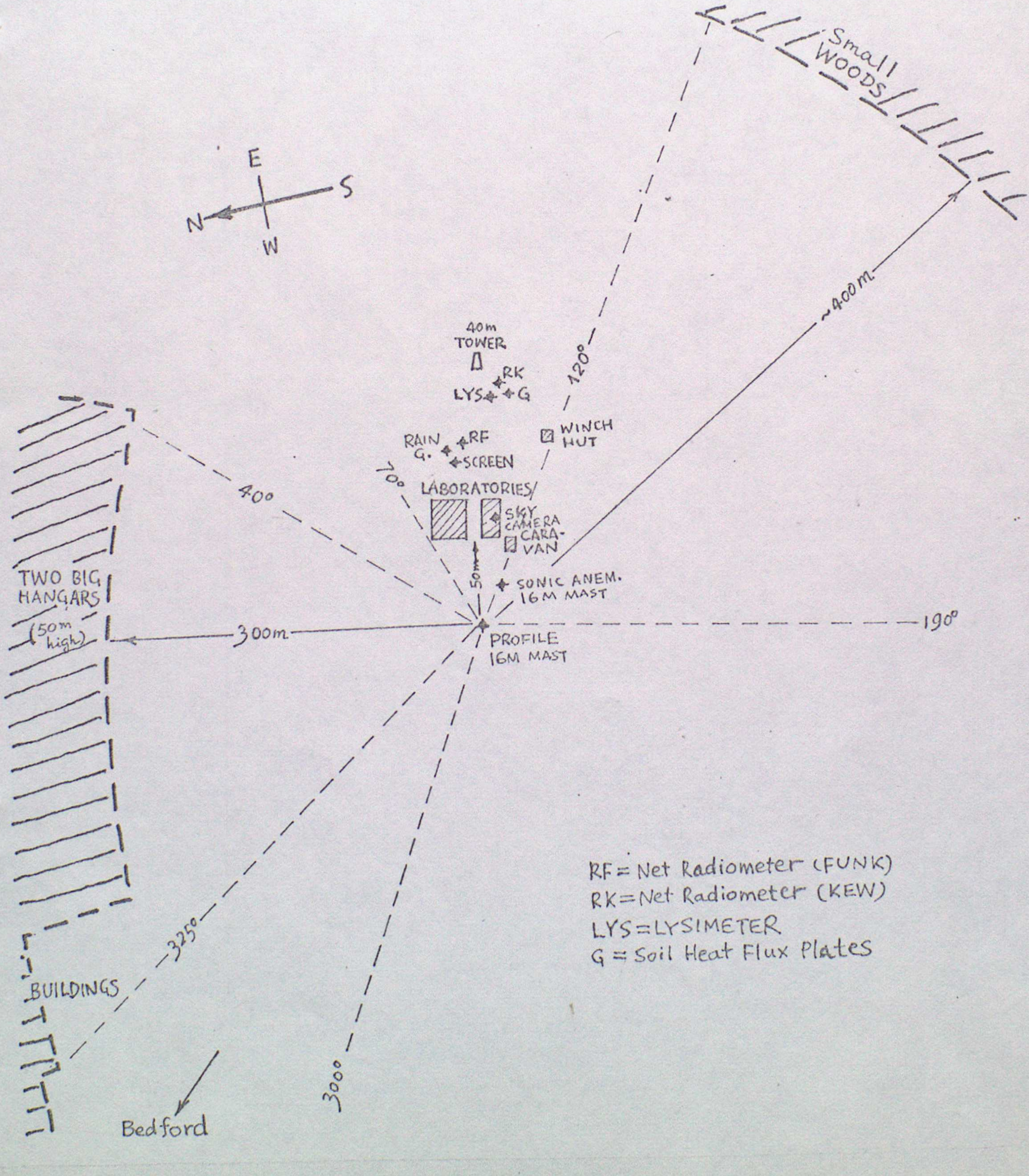
1.5
5.2
20
25
30
1
5
10
15
20
APR
MAY

Fig 2



Small WOODS
E
S
N
W
~400m
40m TOWER
RK
LYS
G
120°
RAIN G.
RF
SCREEN
WINCH HUT
70°
400
LABORATORIES/
SKY CAMERA
CARA-VAN
50m
SONIC ANEM. 16M MAST
TWO BIG HANGARS (50m high)
300m
190°
PROFILE 16M MAST
BUILDINGS
325°
3000
Bedford
RF = Net Radiometer (FUNK)
RK = Net Radiometer (KEW)
LYS = LYSIMETER
G = Soil Heat Flux Plates

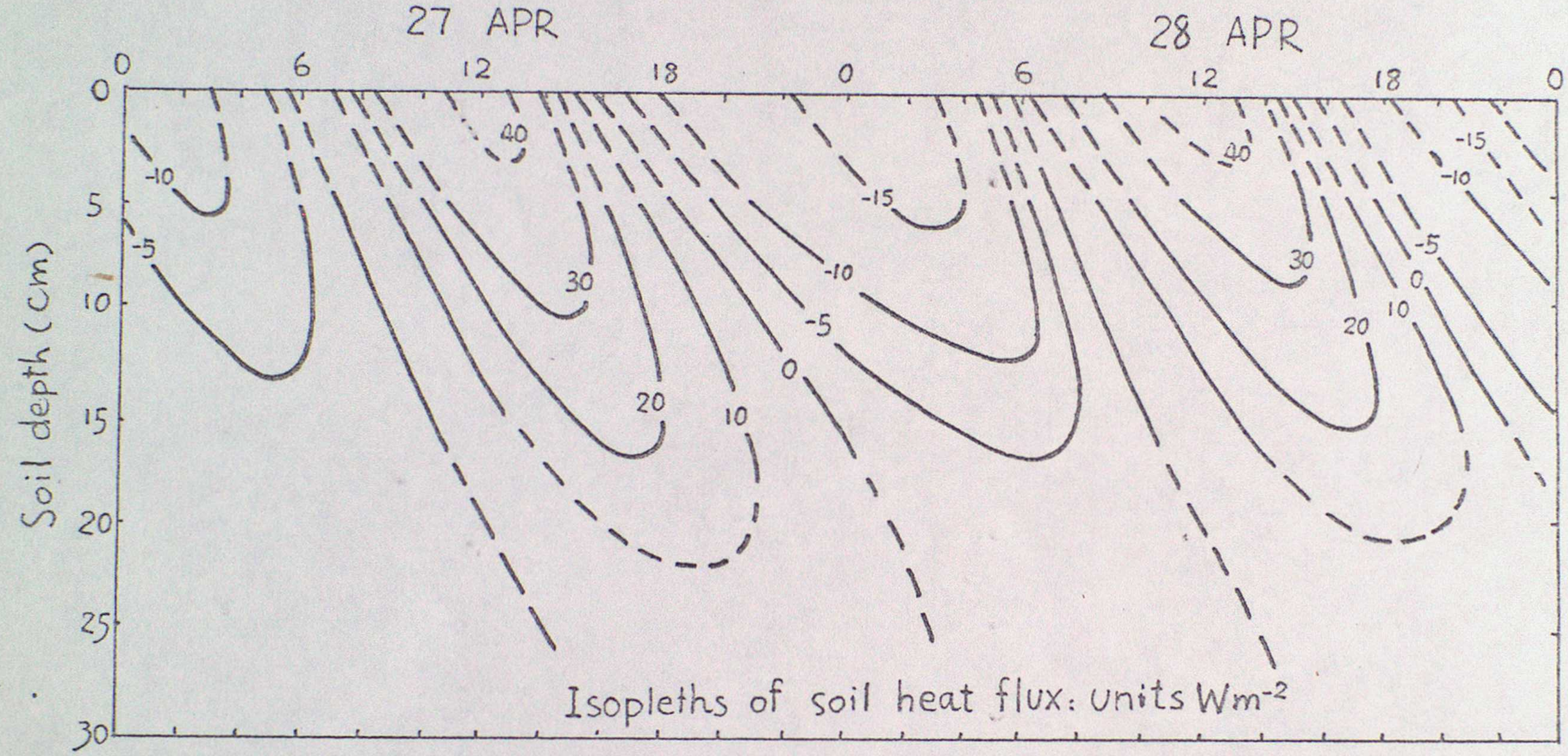


Fig 3 . The diurnal variation of Soil heat flux at Cardington: 27-28 Apr. 1983

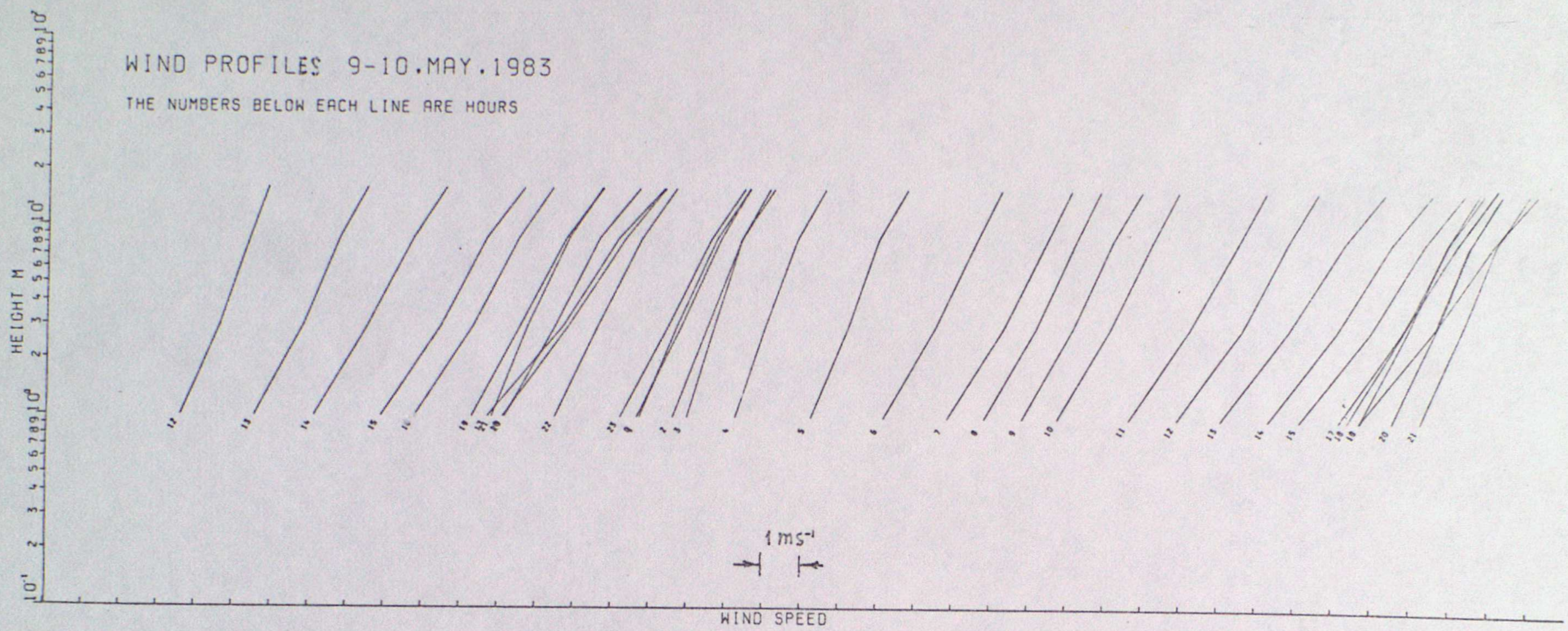


Fig 4. Wind Profiles in the surface layer on 9-10, May, 1983.

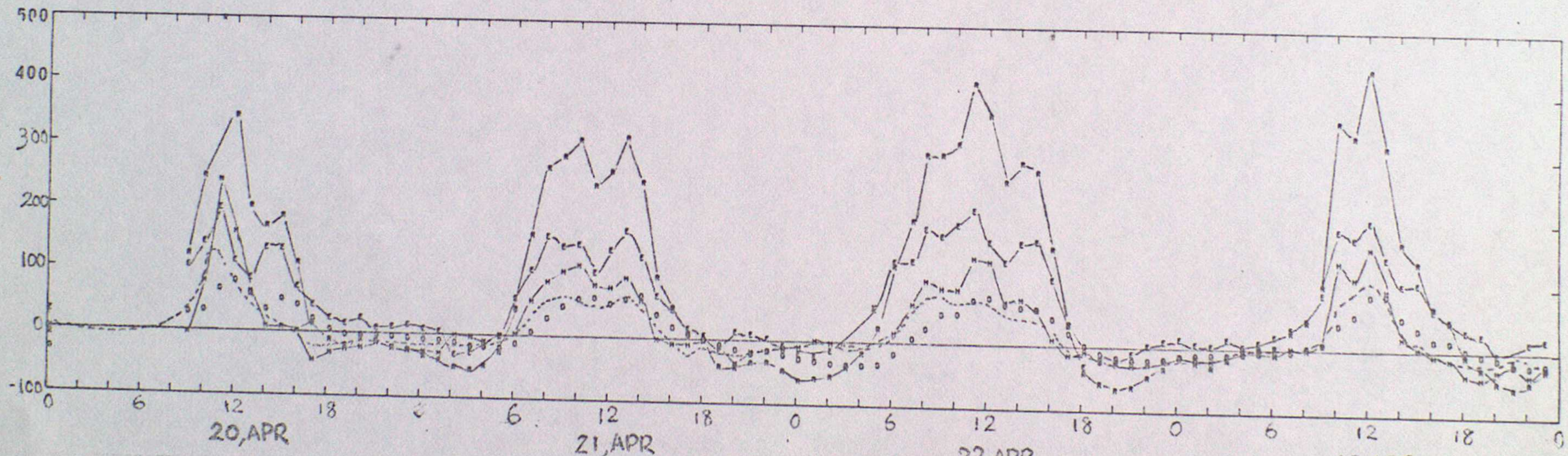


Fig 5. Diurnal variation of surface energy budget. R = net Radiation, E = Latent heat flux
H = Sensible heat flux, G = Soil heat flux

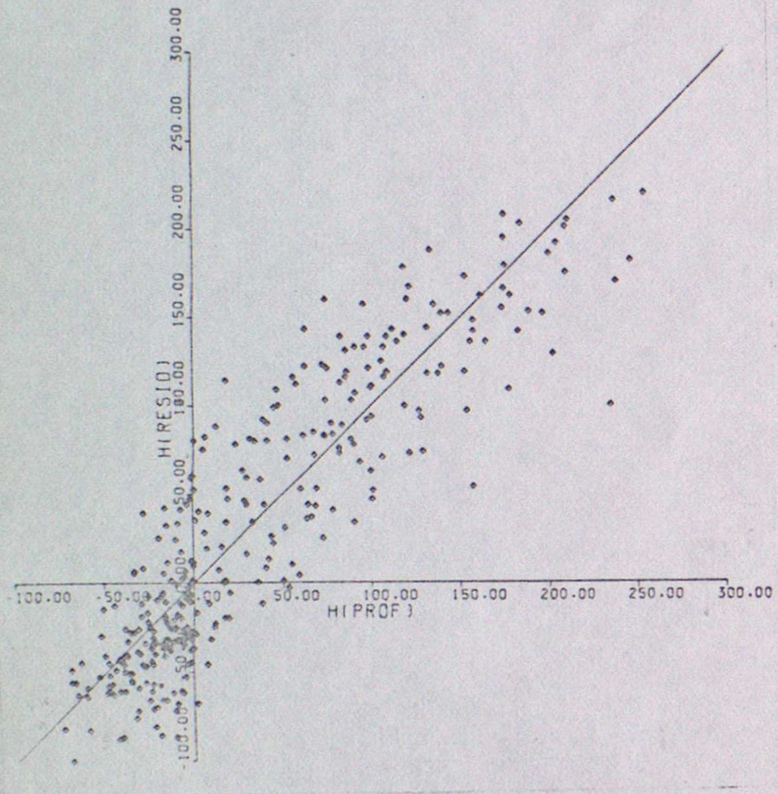


Fig 6

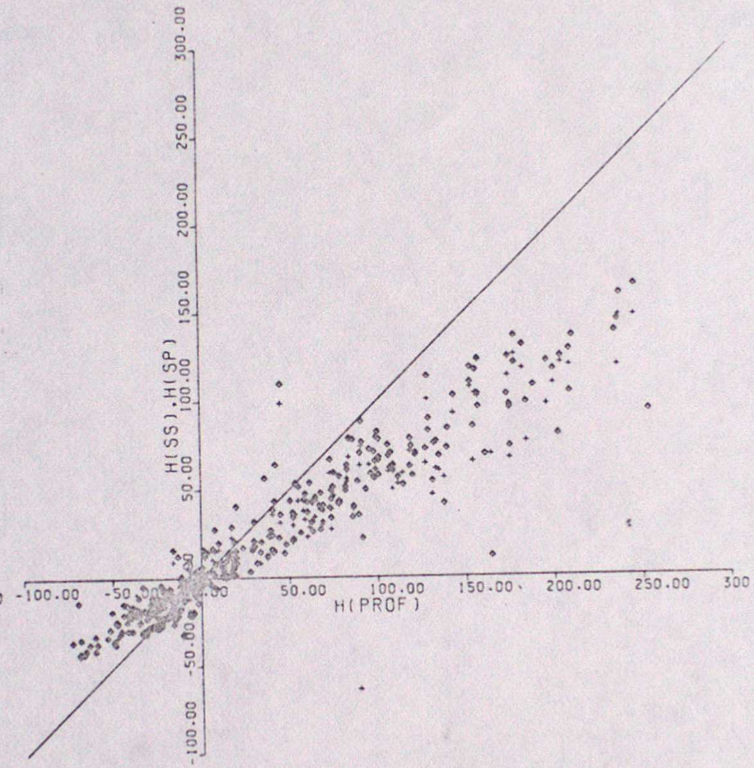


Fig 7

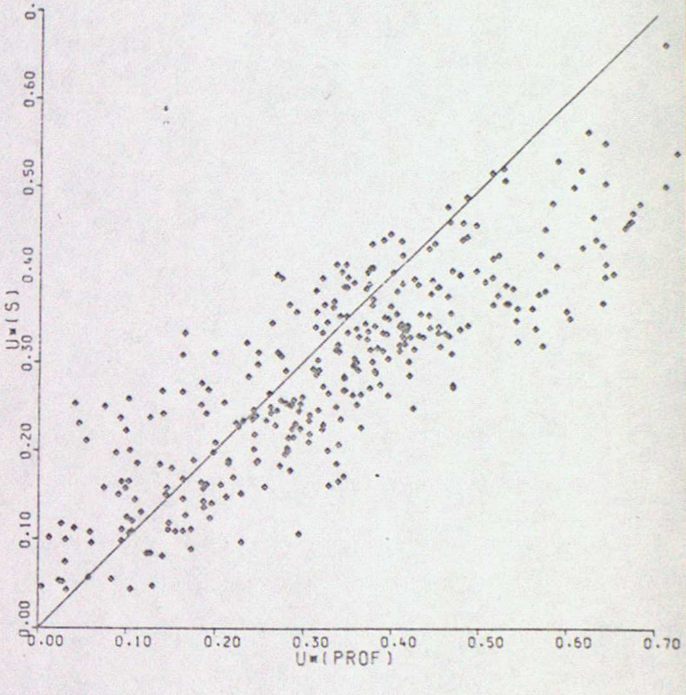
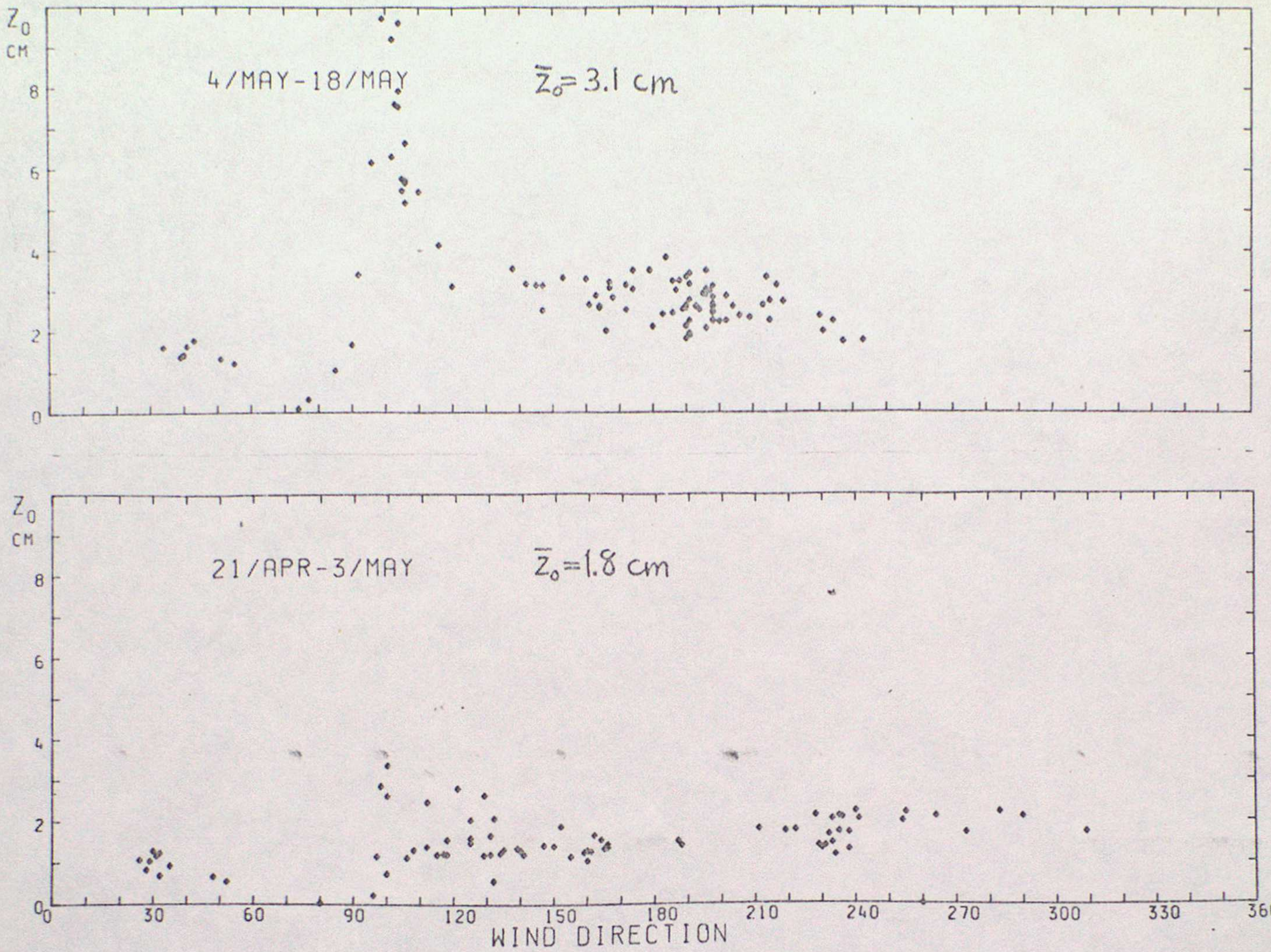
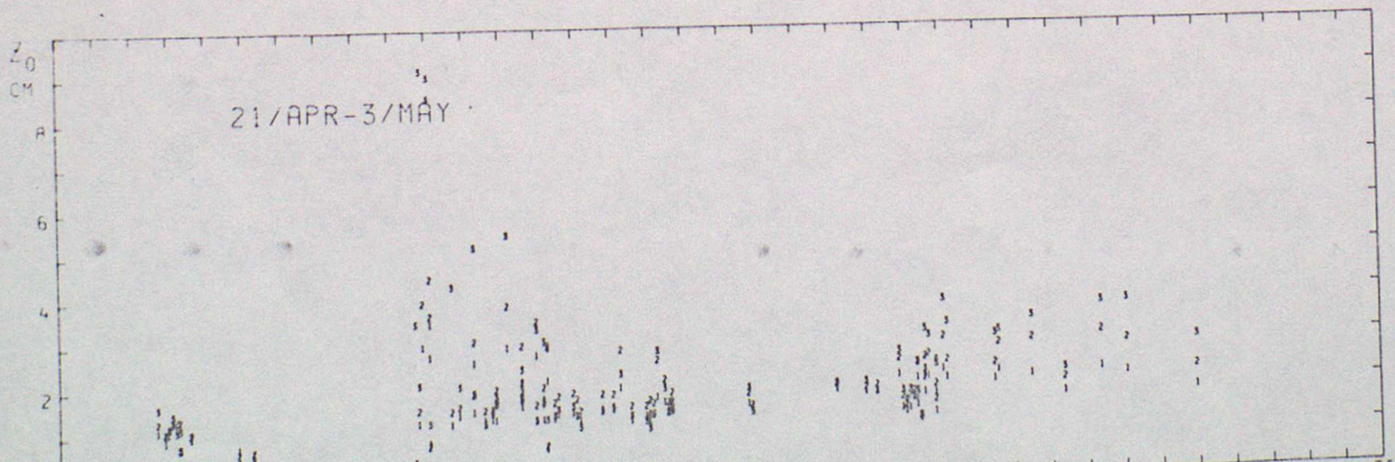


Fig 8



Z0
CM
4/MAY-18/MAY
$\bar{Z}_o$=3.1 cm
8
6
4
2
0
21/APR-3/MAY
$\bar{Z}_o$=1.8 cm
30
60
90
120
150
180
210
240
270
300
330
360
WIND DIRECTION

Fig 9



Z0
CM
21/APR-3/MAY
6
4
2
0
30
60
90
120
150
180
210
240
270
300
330
360
WIND DIRECTION

Fig 10

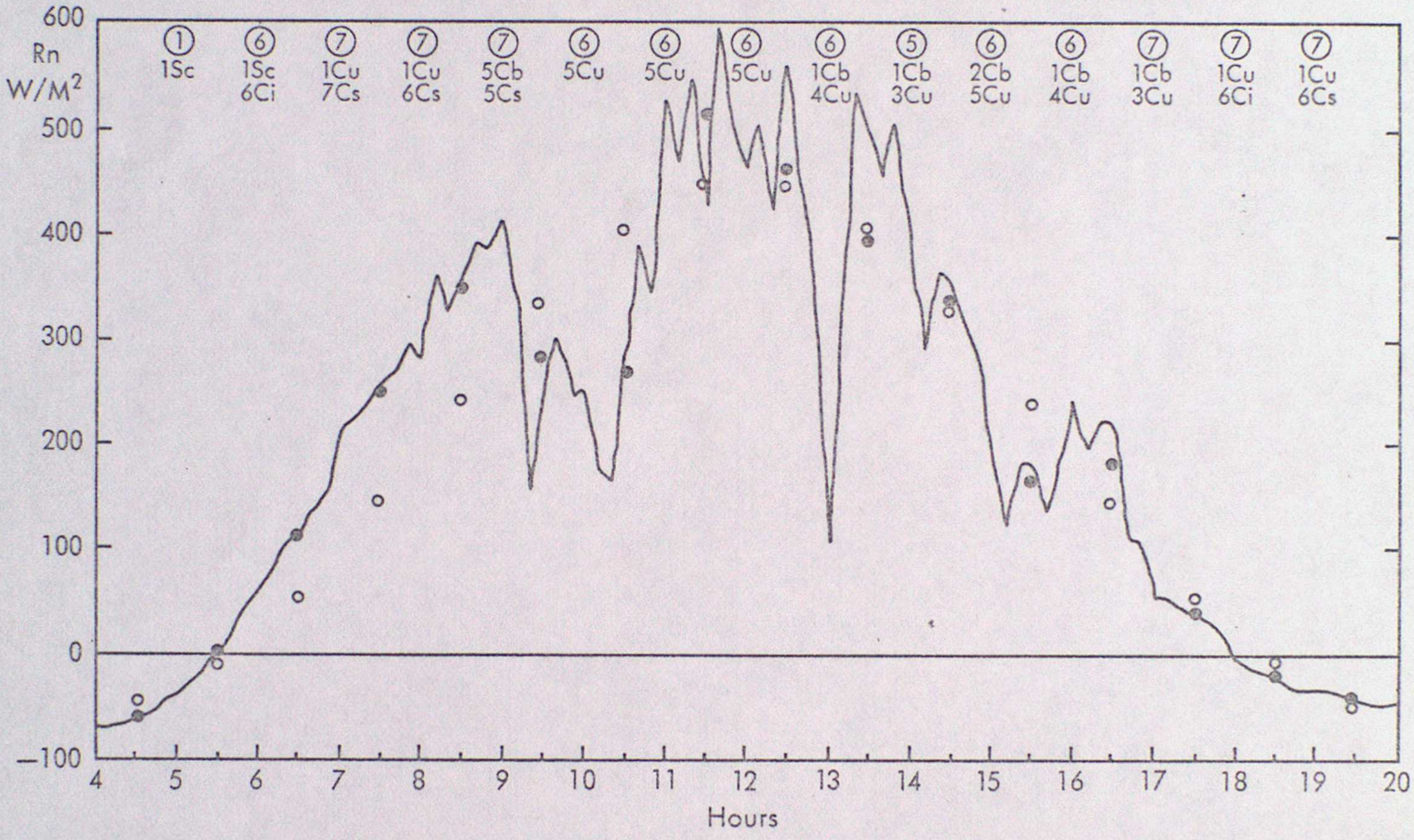

Rn
W/M²
600
500
400
300
200
100
0
−100
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Hours
① 1Sc
⑥ 1Sc 6Ci
⑦ 1Cu 7Cs
⑦ 1Cu 6Cs
⑦ 5Cb 5Cs
⑥ 5Cu
⑥ 5Cu
⑥ 5Cu
⑥ 1Cb 4Cu
⑤ 1Cb 3Cu
⑥ 2Cb 5Cu
⑥ 1Cb 4Cu
⑦ 1Cb 3Cu
⑦ 1Cu 6Ci
⑦ 1Cu 6Cs

Fig 11

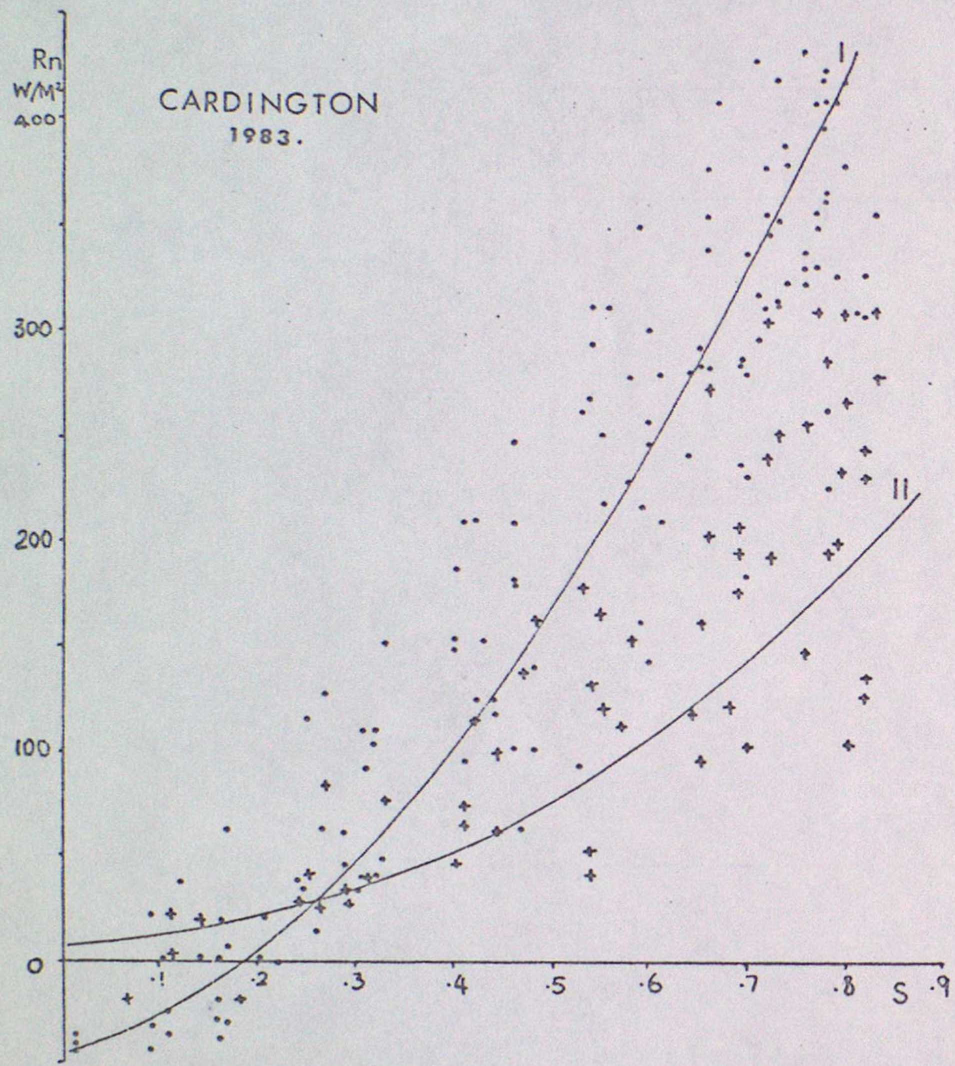

Rn W/M²
CARDINGTON
1983.
400
300
200
100
0
·1
·2
·3
·4
·5
·6
·7
·8
S
·9
I
II

Fig 12

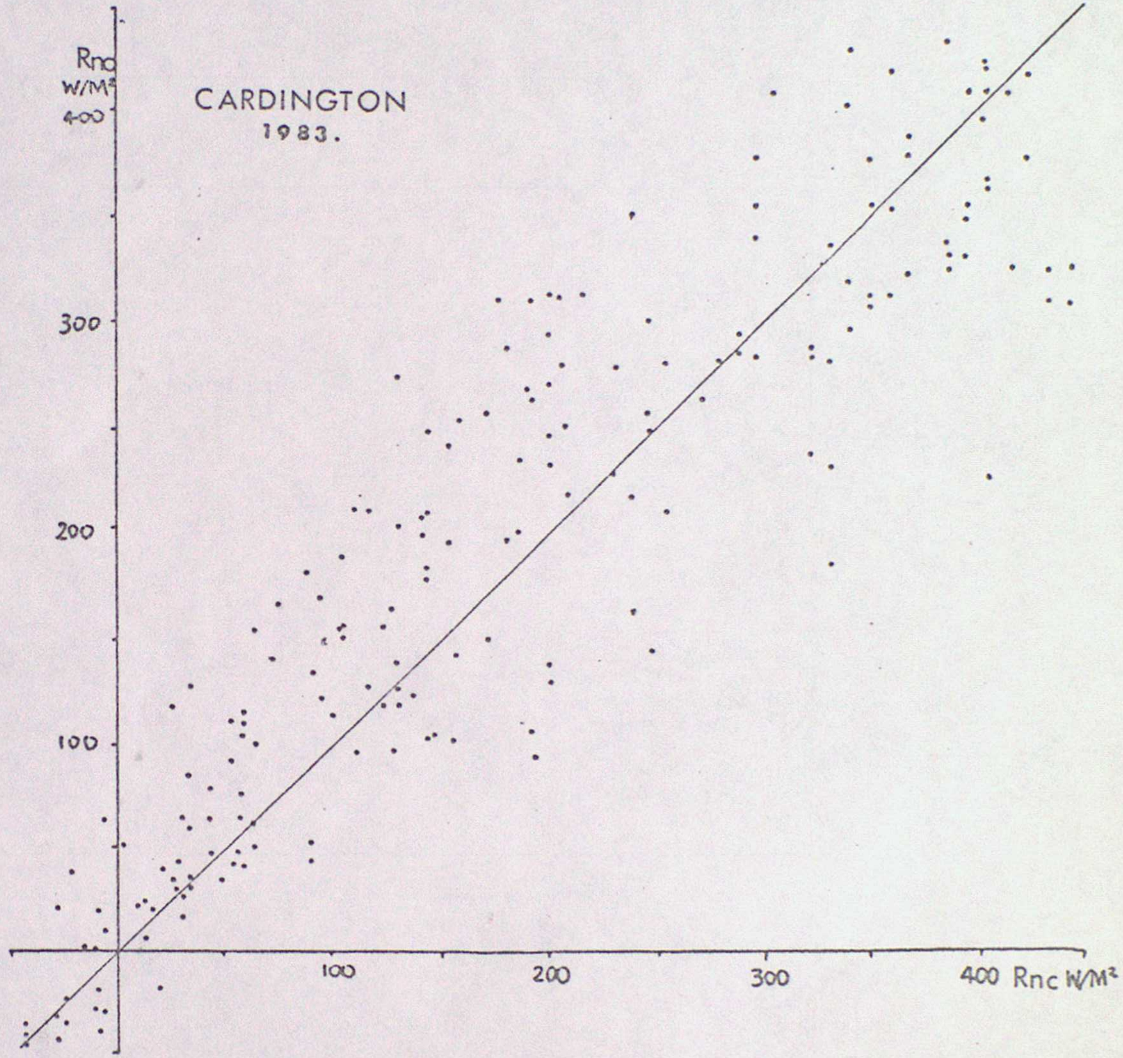
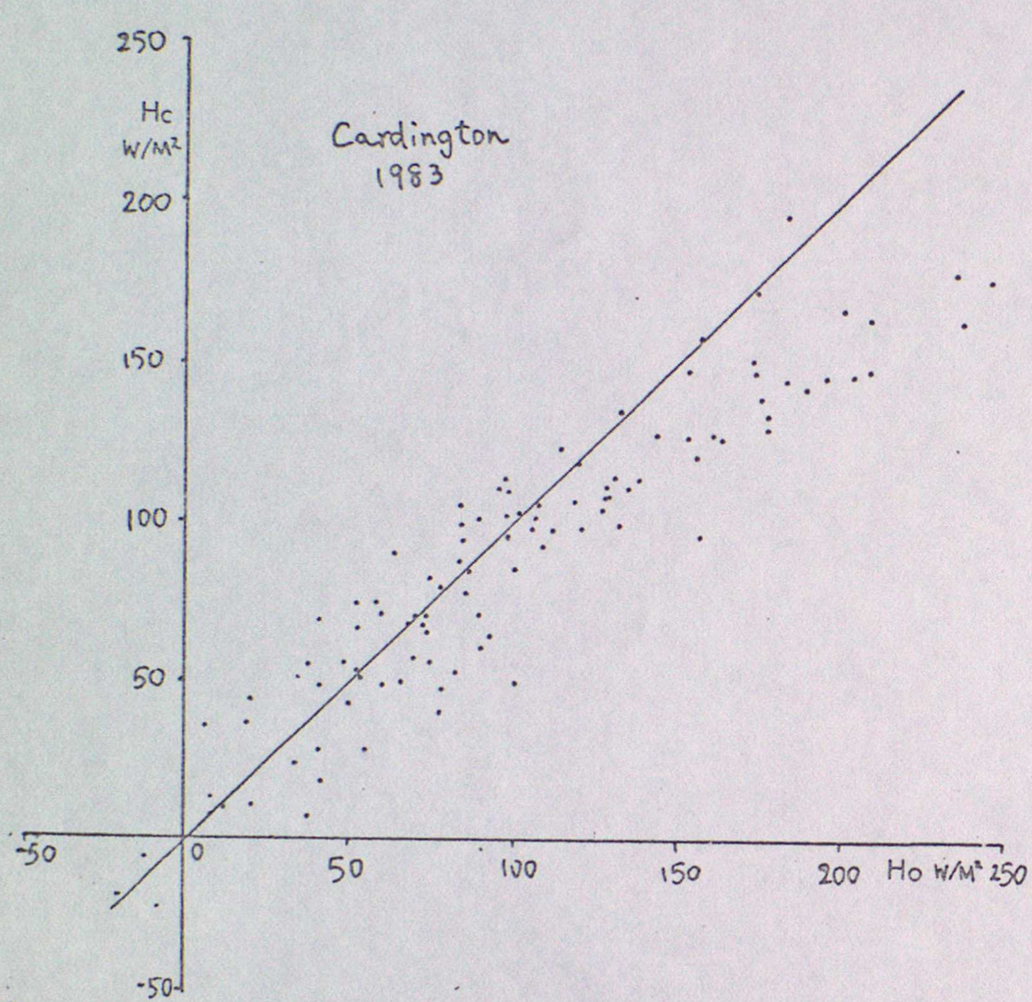
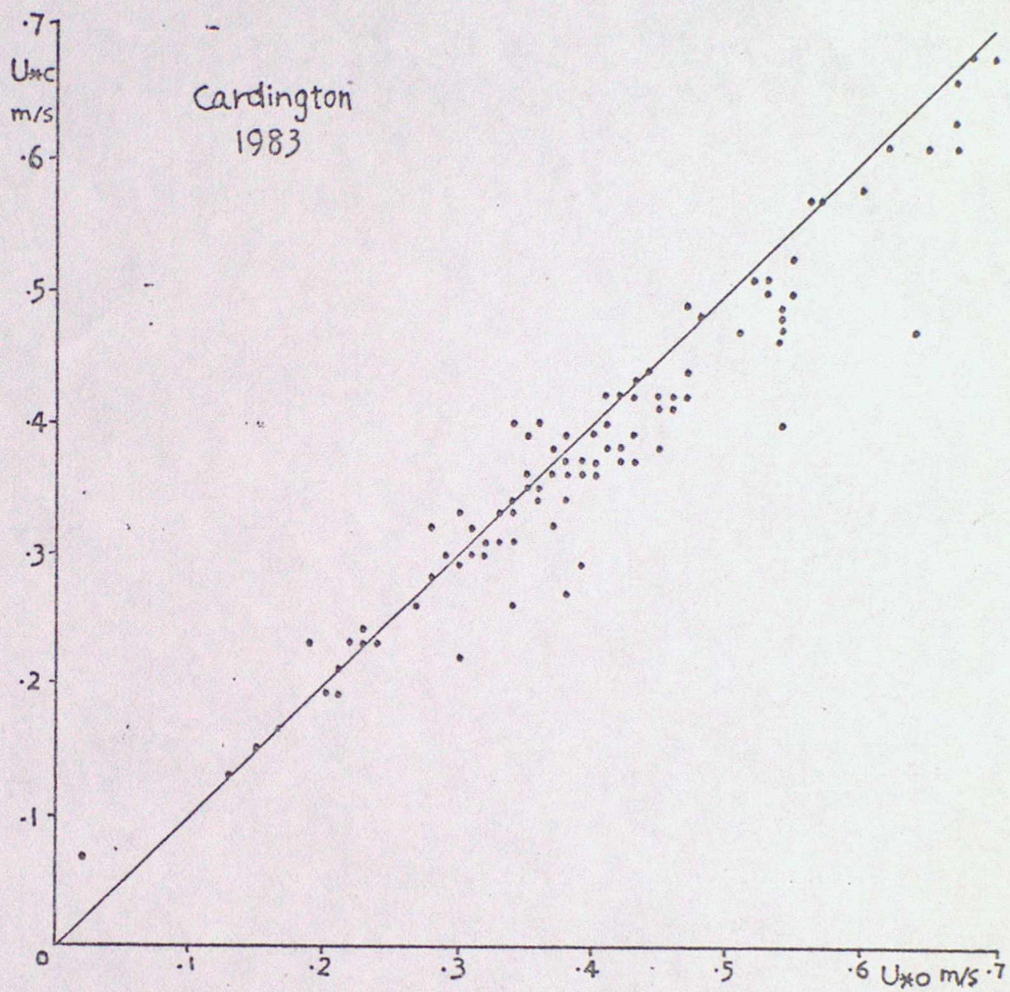

Rnc W/M²
CARDINGTON
1983.
400
300
200
100
100
200
300
400 Rnc W/M²

Fig 13



250
Hc
W/M²
200
150
100
50
-50
0
50
100
150
200
Ho W/M² 250
-50
Cardington
1983

Fig 14



·7
U*c
m/s
·6
·5
·4
·3
·2
·1
0
·1
·2
·3
·4
·5
·6 U*o m/s ·7
Cardington
1983

Fig 15