Wind and temperature profile characteristics in a tropical evergreen forest in Thailand

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ABSTRACT

Certain micrometeorological properties of the wind structure within a tropical forest region in Thailand are discussed. The forest canopy height is approximately 30 m. Characteristics of the wind and temperature profile within and above the forest and in a cleared area surrounded by forest are derived from data taken along two 50 m towers. Three periods of study are selected for comparison: a two-week period in January, 1970 during the cool, dry northeast monsoonal flow; a ten-day period in June, 1970 and a six-day period in September, 1970 during two phases of the warm, moist southwest monsoon. Diurnal and interseasonal variations in the general structure of the wind and temperature profiles, the stability, roughness and canopy stress are determined and discussed.

Introduction

This report relates to the micrometeorological properties of a tropical dry evergreen forest in Thailand. The data were obtained during a scientific field program called TREND (Tropical Environmental Data) under the sponsorship and management of the Earth Sciences Laboratory, U.S. Army Natick Laboratories (Dr Paul Dalrymple: Project Supervisor) and carried out by the Applied Scientific Research Corporation of Thailand in collaboration with several agencies of the Thai Government. The experiments were conducted during the years 1967–70 as an interdisciplinary study of a tropical dry evergreen forest environment and embodied surveys of micrometeorological conditions; hydrologic factors; soil, vegetation and biological surveys.

The forest area under study is the Sakaerat Forest, an area of about 80 square kilometers in Thailand situated at approximately 14°31′ N, 101°55′ E which is about 60 km south-southwest of Khorat and about 190 km northeast of Bangkok. This region is under the climatological influence of a warm and moist monsoonal flow from the southwest during the period April to September and a cool, dry monsoonal flow from the northeast during the period November to February. Thompson & Landsberg (1975) discuss the general setting of the study site and give a comprehensive summary of the climatological conditions in Sakaerat Forest for the period of the study with comparisons with other locations in Southeast Asia.

The focus of this paper is to give a preliminary analysis of the micrometeorological conditions in the forest canopy. Meteorological data were taken along two towers approximately 50 m high and 450 m apart. One tower penetrated the forest, the other was erected in a small clearing and both were based at about 535 m above sea level on terrain with a moderate slope from southwest to northeast. Fig. 1 shows the forest area which is generally two-storied with a dense and continuous crown canopy ranging from 20–35 m high and a lower level with tops ranging from 5–17 m high.

The experimental design for the micrometeorological survey called for the collection and processing of temperature, dew point temperature, wind speed and direction at numerous levels along both towers, various radiation fluxes at the tops of the towers and near the ground

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Fig. 1. The Sakaerat Forest area looking northeast from over the tower in the forest with the tower in the clearing in the center of the photograph.

in the forest, sub-surface temperature profiles near both towers as well as temperature, relative humidity, precipitation, evaporation and hours of sunshine at various ground stations in the experimental area. Fig. 2 shows a schematic representation of the tower data sensors. A general account of the instrumentation and monitoring procedures is given by ASRCT (1969). The results presented in this paper emanate from current efforts at the University of Maryland to extract useful micrometeorological information from the raw data available to us from Project TREND.

Preliminary analysis of temperature and wind profiles

Temperature and wind speed data from the two towers were subjected to preliminary analysis for three different periods of the year. Figs. 3*a*, *b*, *c* show typical temperature and wind speed profiles for each tower during day and night periods for January 1–14, 1970, during the cool, dry northeast monsoonal flow; for June 20–30, 1970 and September 6–12, 1970 during the warm, moist southwest monsoonal flow. The profiles represent averages of all available profiles during the hours shown and over the periods mentioned above.

The cleared area generally maintains higher temperature and wind speed than the forest. There is an inversion of temperature just beneath the forest canopy in January during the daytime with strong lapse above. The warmest temperature is at 30 m, generally near the canopy top. This warm layer tends to carry over into the clearing. Even though the temperature in January is lower than in June or September, this warming effect is more pronounced in January. This is because the cloud cover is less during the cool northeast monsoon than during the moist southwest monsoon and the sun shines on the forest for longer periods of the day in January than in June or September (see Thompson & Landsberg, 1975). The nocturnal profile of temperature for January also shows prominent radiational cooling at the canopy top level due, in part, to the low values of precipitable water in the air column above the forest region during the northeast monsoon (Thompson & Landsberg, 1975).

The temperature of the forest floor in all three months is considerably cooler during the day than the surface in the clearing.

During the January daytime period shown,

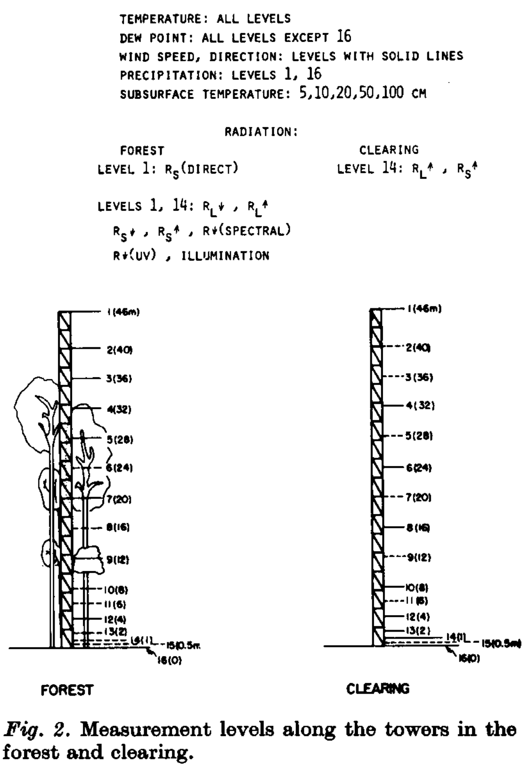

Fig. 2. Measurement levels along the towers in the forest and clearing.

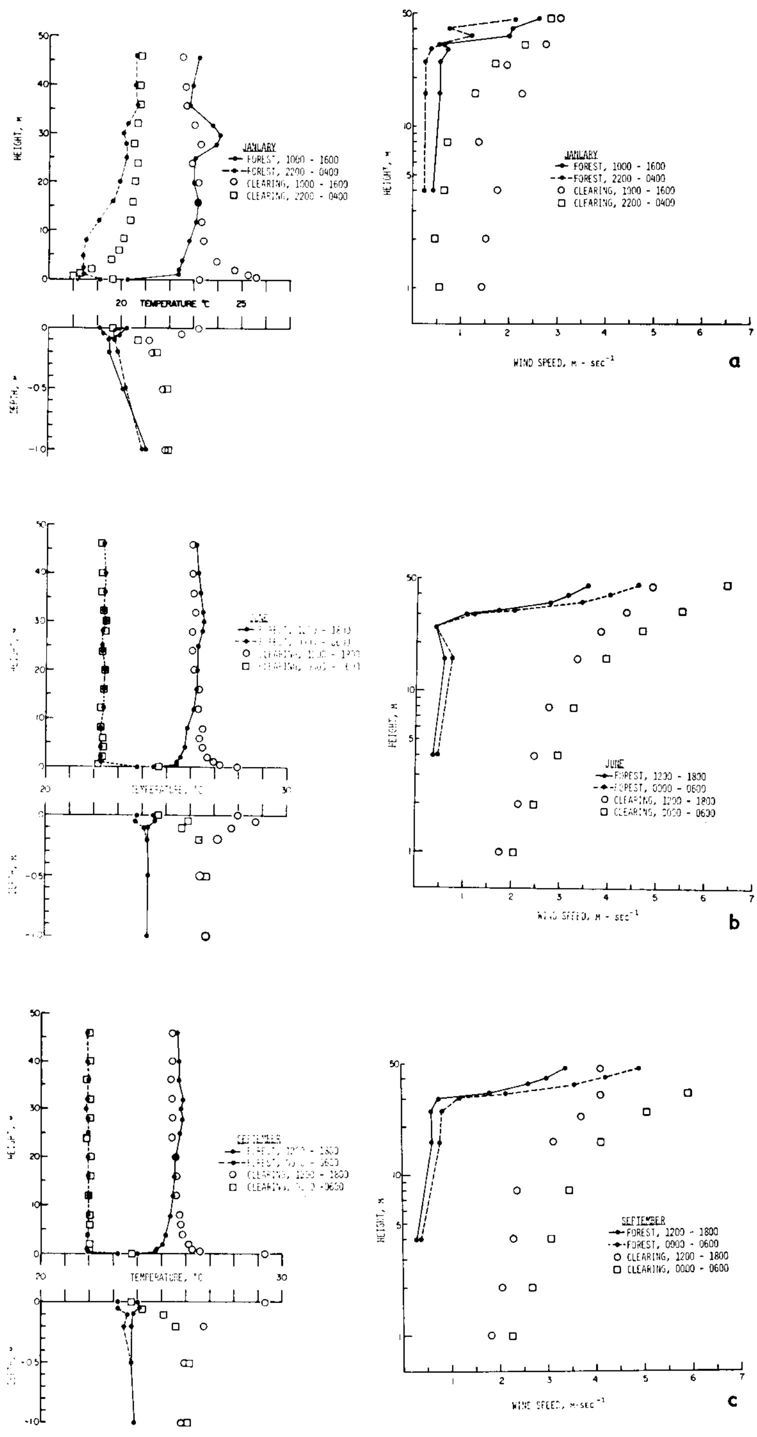

Fig. 3. Wind and temperature profiles for the forest and clearing in (*a*) January, (*b*) June, and (*c*) September.

the surface temperature in the clearing was cooler than at 1 m above the surface due to low shrub growth which was subsequently cleared —the daytime temperature profiles in the clearing for June and September show maximum temperatures at the surface. Consistent with this, the surface temperature in the clearing during the night in January remained warmer than at 1 m. This is due, in part, to the displacement of the effective level of radiational cooling to the top of the shrub growth and possibly also to a drainage cooling effect above the surface of the sloping terrain which is evident in the profiles for both the forest and the clearing. During June and September, the higher moisture content of the air tends to suppress any strong surface radiational cooling in the clearing during the nighttime hours. This leads to a diurnal change in the temperature profile which amounts to more of a shift to cooler temperatures at all levels during the night than a lapse reversal at low levels.

The nocturnal temperature profile in the clearing during the drier month of January also shows a rather strong inversion above 1 m while the strongest inversions in the forest occur above the lower and upper stories of the forest. The nocturnal profiles of temperature in the clearing during June and September do not exhibit the prominent inverted structure of January.

The day-night temperature difference at 30 m, near the top of the forest canopy, is 4°C for all three months while at the surface the difference is only about 1°C or less. In contrast to this, in the clearing the differences are generally largest at the surface. Of course, such differences between six-hour averaged temperatures under-estimates the true diurnal variations in temperature. For example, Thompson & Landsberg (1975) have established the mean diurnal variation of air temperature at Sakaerat Forest to be about 7°C in June, 8–9°C in September and 11–12°C in December.

The sub-surface temperature profiles show the clearing to remain always warmer than the forest soil even to a depth of 1 m. The surface temperature undergoes a stronger diurnal variation in the clearing as expected. The temperature differences between the floors of the forest and clearing during the daytime period are about 3°C, 3.5°C and 5.3°C in January, June and September respectively while at night the differences are only about 1°C or less for all three months. At 1 m depth, the differences in temperature between the forest and cleared area are about 1°C, 2.5°C and 2°C for January, June and September respectively with very little variation from day to night.

The wind speed profiles show the drag effect of the forest canopy in all seasons and at all times of the day. Above the forest canopy, the wind speed tends to show a logarithmic behavior while within the canopy, the wind speeds are low with rather unremarkable vertical variation. The anemometer at the 40 m level of the tower in the forest had a bearing failure during January so that the values shown for 40 m are not representative of the winds at that level.[1] This anemometer was replaced shortly after the two week period represented by the January data and does not contaminate the profiles for June or September.

The day-night differences in the wind speeds indicate a nocturnal increase of wind speed at all levels in June and September during the southwest monsoon, but a daytime maximum of winds in January during the northeast monsoon. This is the case in both the forest and clearing.

The wind speed profiles in the clearing depart considerably from a logarithmic relation indicating that the cleared area is significantly influenced by the surrounding forest. It should be noted, however, that the data appear to define two distinguishable layers with the wind speed in the first 10 or so meters behaving differently than the data above. This is particularly evident in the June and September periods. Presumably, the wind characteristics at low levels are closely influenced by roughness and stability conditions near the floor of the forest while the forest canopy influences the wind behavior at upper levels along the tower.

Stability characteristics of the forest area

For an assessment of the mean stability characteristics of the Sakaerat Forest area, values of the Richardson number were computed for several layers using wind and temperature profiles averaged for each thirty minute period of the day and further averaged over the periods in January, June and Sep-

[1] Personal communication with J. Zabransky, Field Experimenter during the TREND project.

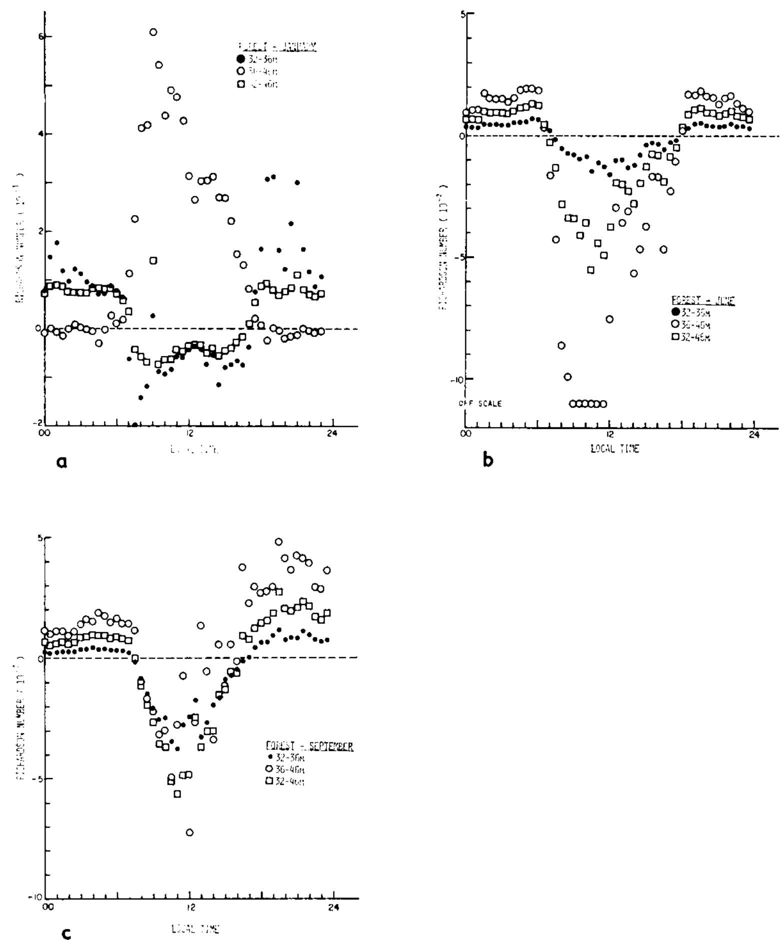

Fig. 4. Diurnal variation of Richardson number for various layers above the forest canopy during (*a*) January, (*b*) June, (*c*) September.

tember represented by Fig. 3. Fig. 4 shows the diurnal variation of the various Richardson numbers for these three months. Richardson numbers are generally positive during nighttime hours changing to negative values during the day. The transition times are about 0700 and 1700. The major exception to this cycle is during the month of January where the daytime warm layer development above the canopy mentioned previously yields unstable conditions in the layer 32–36 m, but stable daytime conditions in the layer 36–46 m. The two layers show more consistency during June and September. The reader should take care to note the different scales in Fig. 4*a* and Figs. 4*b*, *c*.

Bulk Richardson gradient numbers were computed in the manner of Lettau (1957) for several conglomerate layers in the forest and clearing. The bulk Richardson gradient number is computed from local Richardson numbers as follows:

$$(\mathrm{Ri})_L = \sum_j (\mathrm{Ri})_j / \sum_j Z_j$$

where $(\mathrm{Ri})_j$ is the local Richardson number at a given geometric mean height Z_j and the sum is over the various sub-layers comprising a thicker layer whose stability is to be characterized. Lettau presents the stability classification shown in Table 1 for layers near the surface. Fig. 5 shows values of $(\mathrm{Ri})_L$ for the layer 32–46 m above the forest canopy. The summa-

Table 1. *Stability classification of bulk Richardson gradient number (after Lettau, 1957)*

Stability class	$(Ri)_L$, $(10^{-3}/m)$	Stability class	$(Ri)_L$, $(10^{-3}/m)$
L3 = Extreme lapse	< than −15	I1 = Weak inversion	5 to 6
L2 = Moderate lapse	−15 to −10	I2 = Moderate inversion	7 to 9
L1 = Weak lapse	− 9 to −5	I3 = Strong inversion	10 to 19
N = Neutral	− 4 to 4	I4 = Extreme inversion	> 19

tion is carried out over the three geometric mean heights of 33.9, 40.7 and 38.4 m. All values shown fall within the neutral classification of convective stability according to Lettau's classification. The values for January are all positive and exhibit an irregular diurnal variation due to the more complicated thermal structure as exemplified in Figs. 3*a* and 4*a*. The values for June and September are smaller in magnitude and quite consistent with slight positive values at night and negative values during the day from about 0700 to 1600 local time.

Figs. 6*a*, *b* show bulk Richardson gradient numbers for the layer 1–16 m in the clearing. Geometric mean heights for these computations are 1.41, 2, 4 and 8 m. Note that the scale for January is two orders of magnitude larger than that for June and September corresponding to much greater extremes of stability and instability during the clear sky conditions of January. The diurnal variation during January is also much more irregular than during June or September although all three months show negative values during the day and positive values at night.

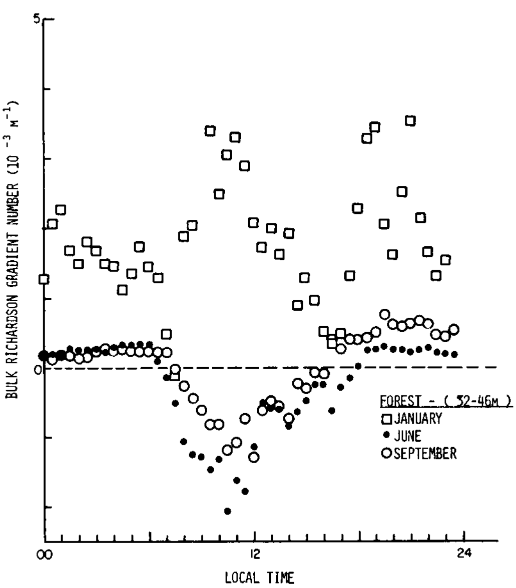

Fig. 5. Bulk Richardson gradient number for the microlayer above the forest canopy for January, June and September.

Fig. 6*c* shows bulk Richardson gradient numbers for the layer 16–46 m in the clearing (geometric mean heights for these computations are 13.9, 22.6, 33.2, 38.4 m). The scale is the same as Fig. 6*b* but, again, two orders of magnitude smaller than Fig. 6*a*. Thus, the range of stability is much greater in the lower layer than the upper layer during January but comparable during June and September. The bulk Richardson gradient numbers are in the neutral category of Lettau from midnight to about 0730 during June and September but in an inversion class during these hours in January. January and June show a shift to negative values during the day but September exhibits stable conditions during the daytime hours. All months show neutral or stable values after about 1700 local time.

Roughness characteristics of the forest area

Estimates of roughness parameter, z_0, datum displacement height, d, and friction velocity, u_*, were made for the forest canopy using a large sample of 30-minute averaged wind profiles occurring during near-neutral conditions in January, June and September. Computation of $(Ri)_L$ were first made for each individual 30-minute averaged wind and temperature profile for the periods January 8–10, 1970; June 20–26, 1970; and September 9–11, 1970 for the layer 30–46 m just above the forest canopy. The resulting values were used to screen the sample to extract only those profiles falling into the

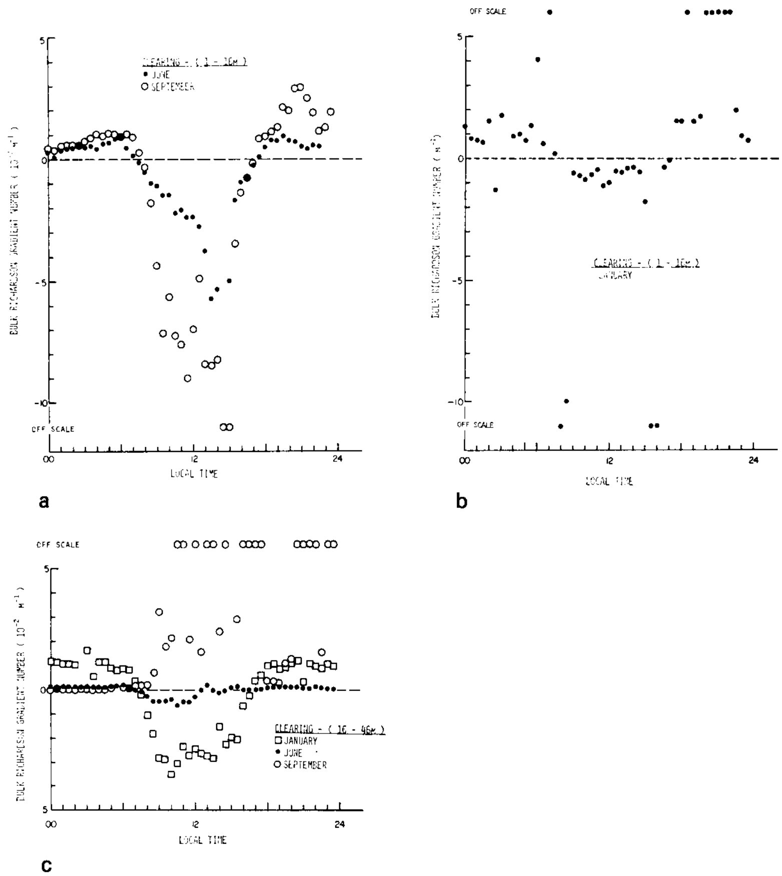

Fig. 6. Bulk Richardson gradient number for the lower and upper portions of the microlayer in the clearing for January, June and September.

"N" category of Table 1. Since there was doubt about the wind speed measurements at 40 m in January, the data at this level were excluded for this period. For comparison, computations of $(\mathrm{Ri})_L$ were also made for the layers 1–16 m and 16–46 m in the clearing for the June and September periods. A frequency distribution of the number of occurrences in each stability class is given in Table 2. Nearly all the cases sampled for the layer above the forest canopy during the moist, southwest monsoon period (i.e. those for June and September) fell into the near-neutral classification of Lettau. For the same layer in January, during the cool, dry northeast monsoon, about 41% of the cases exhibited near-neutral conditions with slightly less than 10% falling in various of the unstable categories and slightly less than half falling in various of the stable categories. For the clearing, the lower layer exhibits a wider variation of stability than does the upper layer for both June and September. Slightly less than 80% of the cases in June and about 69% of the cases in September show near-neutral conditions in the upper layer of the clearing; evidence of the modifying influence of the surrounding forest as noted earlier.

For near-neutral conditions, it is hypothesized that the wind speed variation with height above the forest canopy is represented by the logarithmic relation

$$u(z) = (u_*/k) \ln[(z - d + z_0)/z_0]$$

where $u(z)$ is the wind speed, u_* is the friction velocity appropriate to the canopy, k = Von Karman's constant, z_0 is the canopy roughness parameter and d is the datum displacement height. Of the various methods for estimating

Table 2. *Frequency distribution of convective stability classes for periods in January, June and September*

Period layer	No. of cases	Stability class L3	L2	L1	N	I1	I2	I3	I4
Jan. 8–10, 1970									
Forest-(30–46 m)	144	3	2	9	59	6	6	6	52
June 20–26, 1970									
Forest-(30–46 m)	336	0	0	0	336	0	0	0	0
June 20–22, 1970									
Clearing-(1–16 m)	138	31	8	12	71	15	0	0	1
June 20–22, 1970									
Clearing-(16–46 m)	138	1	7	16	108	3	0	3	0
Sept. 9–11, 1970									
Forest-(30–46 m)	144	0	0	1	140	3	0	0	0
Sept. 9–11, 1970									
Clearing-(1–16 m)	144	38	4	7	17	21	14	15	28
Sept. 9–11, 1970									
Clearing-(16–46 m)	144	0	0	0	99	6	8	5	26

z_0, d and u_* which appear in the literature, the method adopted in this study is that described by Stearn's (1970), although comparisons will be made with other methods. In Stearn's method, the parameters z_0, d, u_* are determined by an iterative procedure designed to minimize the mean square deviation $\Sigma_i E_i^2$ where

$$E_i = u(z_i) - (u_*/k) \ln [(z_i - d + z_0)/z_0]$$

The iteration procedure of Stearn's was applied to the ensemble of 30-minute averaged wind speed profiles in the layer 30–46 m above the forest canopy which fell in the "N" category of Table 2. The June data were further partitioned into a batch (A) of 201 cases for which the solar radiation impinging on the forest canopy was relatively steady, and a batch (B) of 72 cases during periods of comparatively rapid fluctuations of solar radiation. The iterative procedure converged for 273 of the 336 June cases but only 40 of 59 cases in January and 67 of 96 cases during September. The cases for which convergence was not obtained generally corresponded to values of $(\mathrm{Ri})_L$ which were negative and somewhat near the cut-off of the "N" classification of Table 1 suggesting that the limits of this category should be narrower than as given in Table 1. Other investigators [for example, Lenschow & Johnson (1968)] have chosen to narrow the limits of the *near-neutral category*.

The resulting estimates of the averages and standard deviations of the parameters z_0, d, u_* are presented in Table 3. The roughness parameter varied considerably over the periods examined. The mean value for the January days was only 0.83 meters with a standard deviation more than half of the mean value. The mean profiles of Fig. 3 indicate lower wind speeds during January than during June and September. For June, the mean value of forest roughness parameter is about 5.5 m with standard deviation only a third of the mean value. The values of datum displacement height show more consistency over the three periods but are larger in January than in September or June.

The friction velocity u_*, and canopy stress $\tau = \varrho u_*^2$, are smallest in January and largest during June. The relative variability of stress shown in Table 3 is large for all seasons ranging from 54 to 90%. The friction velocities for the Sakaerat Forest are comparable to those found by Stewart & Thom (1973) for the Thetford Pine Forest in Norfolk having a mean canopy height of about 16 m, and to those found by Allen (1968) within a Japanese Larch plantation of mean canopy height about 10 m. The summer and fall mean values at Sakaerat are a factor of 2–3 larger than those reported by Baumgartner (1956) in a forest of canopy height 5–7 m.

Our results using Stearn's method were

Table 3. *Average values and standard deviations of roughness parameter, datum displacement level, friction velocity and canopy stress for the Sakaerat forest*

Period ... No. of convergent cases ...	$\bar{z}_0$ (m) [σ_{z_0} (m)]	$\bar{d}$ (m) [σ_d (m)]	$\bar{u}_*$ (m s^{-1}) [σ_{u_*} (m s^{-1})]	$\bar{\tau} = \tau(\bar{u}_*)$ (dynes cm^{-2})	$\tau_- = \tau(\bar{u}_* - \sigma_{u_*})$ (dynes cm^{-2})	$\tau_+ = \tau(\bar{u}_* + \sigma_{u_*})$ (dynes cm^{-2})	$(\tau_+ - \tau_-)/2\bar{\tau}$
January 8–10, 1970	0.83	29.53	0.33	1.31	0.7	2.1	0.54
40 cases	[0.47]	[0.05]	[0.09]				
June 20–26, 1970(A)	5.48	27.18	1.42	24.2	11.5	42.0	0.63
201 cases	[1.66]	[0.69]	[0.45]				
June 20–26, 1970(B)	5.62	27.16	1.26	19.1	7.9	35.1	0.70
72 cases	[1.77]	[0.72]	[0.45]				
Sept. 9–10, 1970	3.61	28.09	1.07	13.7	4.2	28.8	0.90
67 cases	[1.10]	[0.75]	[0.48]				
Average (weighted by no. of cases)	4.69	27.58	1.21	17.6	—	—	—

compared against various empirical formulae which have appeared in the literature. Stanhill (1969) gives a relationship between d and canopy height, h, as follows:

$$\log(d) = (0.9793)\log(h) - 0.1536$$

This relationship seems to be in excellent agreement with values reported in the literature for vegetation canopies of lower height. Sceicz et al. (1969) found an empirical relationship between z_0 and h as follows:

$$\log(z_0) = \log(h) - 0.98$$

Fig. 7 shows estimates of d and z_0 using these formulae for canopy height values of 29–35 m along with our results using Stearn's method and a summary of several other studies given by Leonard & Federer (1973). The Stanhill formula yields a displacement height some 4–10 m smaller than the values estimated using Stearn's method. The Sceicz formula yields a result which is consistent with the profile estimate for September but not for January or June.

A test was made for possible correlations between z_0 and d with wind speed at the top of the tower (46 m). Rauner (1960) found that z_0 increases and d decreases with increasing wind speed while Tajchmann (1967) found that z_0 decreases and d remained constant as wind speed increased. Allen (1968) and Belt (1969) found no significant dependence on wind speed if d were allowed to be different for each computation of (z_0, d) but when a fixed value of d was used for an ensemble of profiles, z_0 was found to decrease as wind speed increased but only for a particular wind direction. In the present study, the profiles were not partitioned according to wind direction, however, d and z_0 were computed independently for each profile.

Table 4 shows the results of a simple correlation-regression analysis applied to the ensemble of 384 cases in January, June and September. It should be noted that the range of wind speeds above the forest canopy is not very large. Nonetheless, the roughness parameter is found to be an increasing function of wind speed and the datum displacement height a decreasing function of wind speed, which supports the findings of Rauner. Both parameters correlate best with the wind speed near the canopy (i.e. $u(32)$) but the correlation between d and $u(46)$ is also significant at the 5% level. The correlation between roughness and wind speed is slightly better when the logarithm of z_0 is used.

Finally, a preliminary analysis was made of a small sample of wind speed profiles in the clearing to determine to what extent these profiles can be fitted by simple algebraic relationships. Profiles of 30-minute averaged wind speeds for four days in January and two days in June were fitted, in the least squares sense,

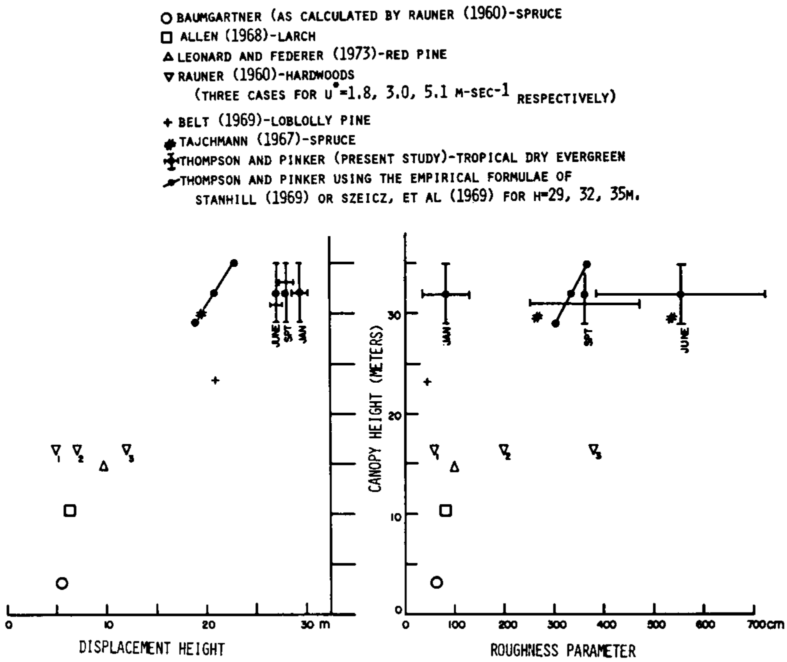

Fig. 7. Summary of various results on the relationship between datum displacement level, roughness parameter, and canopy height.

to linear and quadratic functions of height. Table 5 shows the results of these trials. The data at the top 6 or 7 levels in the clearing seem to be adequately fit by a linear relation and the winds at all levels seem to be adequately fit by a quadratic relation.

Summary

An analysis of the characteristics of wind and temperature distributions in a tropical evergreen forest in Thailand has been presented in this paper. Temperatures are generally cooler

Table 4. *Correlation and regression statistics for 384 cases of 30-minute averaged wind profiles in January, June and September above the Sakaerat Forest* ($Y = A + BX$)

Y	X	$\bar{Y}$ (Y)	σ_y (Y)	$\bar{X}$ (cm sec^{-1})	σ_x (cm sec^{-1})	A (Y)	B (Y/X)	R (correlation)	F ratio	Standard error of estimate (Y)
z_0 (cm)	u (46)	466	214	429	139	79.3	0.900	0.586	200	173.5
z_0 (cm)	u (32)	466	214	181	78	147.4	1.758	0.639	263*	164.8
d (cm)	u (46)	2 761	102	429	139	2 968	−0.483	0.659	293*	770
d (cm)	u (32)	2 761	102	181	78	2 945	−1.017	0.774	568*	649
ln [z_0 (cm)]	u (46)	5.968	0.708	429	139	4.645	0.00308	0.607	232	0.563
ln [z_0 (cm)]	u (32)	5.968	0.708	181	78	4.808	0.00641	0.704	374*	0.504
ln [d (cm)]	u (46)	7.923	0.037	429	139	7.997	−0.00017	0.656	289*	0.028
ln [d (cm)]	u (32)	7.923	0.037	181	78	7.988	0.00036	0.770	556*	0.024

* Significant at the 5 % level.

Table 5. *Preliminary results of fitting wind speed data in the cleared area to linear and quadratic profile equations for January and June*

Date	No. of tower levels used starting from the top	No. of profiles	Degree of polynomial	Explained variance (%)
June 20–21, 1970	6	96	1	98.7
June 20–21, 1970	7	96	1	98.1
June 20–21, 1970	8	96	1	96.7
June 20–21, 1970	8	96	2	98.2
Jan. 4–5, 1970	6	96	1	79.5
Jan. 4–5, 1970	7	96	1	79.8
Jan. 4–5, 1970	6	96	2	82.9
Jan. 4–5, 1970	8	96	2	83.9
Jan. 6–7, 1970	6	96	1	97.9
Jan. 6–7, 1970	7	96	1	97.5

and wind speeds lower during the northeast monsoon season as compared with the southwest monsoon period. Conditions are more variable during January since the skies are clearer, the moisture content of the atmosphere above the forest is less and the radiational budget is more dynamic. The atmosphere just above the canopy therefore exhibits a much more complex thermal character during January than June or September with a large diurnal variation of stability which is also highly dependent on the proximity to the canopy.

Conditions during the warm, moist southwest monsoon generally show a much weaker diurnal variation. Cloudiness and atmospheric moisture are greater during this season which tends to dampen the diurnal cycle in the radiation budget and, hence, the variation of stability above the canopy. There is a much higher frequency of near-neutral conditions above the canopy during this season than during the cool, dry northeast monsoon season.

For near neutral conditions in both monsoon periods, the winds in the microlayer above the forest canopy show a reasonable fit to a displaced logarithmic profile. The datum displacement height has an average value of about 27.6 m but varies over a range of about 2(1/4) m from the northeast to southwest monsoon periods. This seasonal variation is about 3 times larger than the standard deviation of the short period sample estimate during the southwest monsoon period and nearly 50 times larger than that for the northeast monsoon sample.

The roughness parameter for the canopy exhibits a strong seasonal variation with a mean value of 0.83 m for the January sample, 5.55 m for the June sample and 3.61 m for the September sample. The seasonal variation is about 2.7 times larger than the standard deviation in z_0 during the short period samples of June but about 10 times larger than that for January. The canopy stress has a mean value of 1.3 dynes cm^{-2} for January and the much larger mean values of 21.6 dynes cm^{-2} for June and 13.7 dynes cm^{-2} for September.

It is interesting to note that for the January cases for which the stability of the air above the canopy is much more variable and the wind speeds are smaller, the datum displacement height has its maximum value and greatest consistency while the roughness parameter has its lowest value and least (relative) consistency. A pooled sample of the 30-minute averaged profiles of wind speed occurring in near-neutral conditions in January, June and September (some 384 cases) reveal a significant positive correlation between roughness parameter and wind speed and a significant negative correlation between datum displacement height and wind speed.

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ХАРАКТЕРИСТИКИ ПРОФИЛЕЙ ВЕТРА И ТЕМПЕРАТУРЫ В ТРОПИЧЕСКОМ ВЕЧНОЗЕЛЕНОМ ЛЕСУ В ТАПЛАНДЕ

Обсуждаются некоторые микрометеорологические свойства структуры ветра внутри области тропического леса в Тапланде. С помощью данных, полученных на двух 50-метровых мачтах, определяются характеристики профилей ветра и температуры внутри леса и над ним и в расчищенной области, окруженной лесом. Для сравнения выбраны три периода наблюдений: двухнедельный период в январе 1970 г. во время холодного и сухого северовосточного муссонного ветра и шестидневный период в сентябре 1970 г. во время двух фаз теплого и влажного юго-западного муссона. Определяются и обсуждаются суточные и межсезонные вариации в общей структуре профилей ветра и температуры, гидростатическая устойчивость, шероховатость и напряжение трения над лесом.