

AD 661083

①

AD



MONTHLY
MICROCLIMATIC SUMMARY

APRIL 1967

ENVIRONMENTAL DATA BASE
FOR REGIONAL STUDIES IN THE HUMID TROPICS

USATECOM Project No. 9-4-0013-01

US ARMY
TROPIC TEST CENTER
Fort Clayton, Canal Zone

Sponsored by

Advanced Research Projects Agency, ARPA Order No. 740
Army Research Office, OCRD, Project No. 2M025001A724 01

Reproduced by the
CLEARINGHOUSE
for Federal Scientific & Technical
Information Springfield Va 22151

DDC
RECEIVED
NOV 13 1967
C

**BEST
AVAILABLE COPY**

CC 11, 107	
CYSTI	WHITE SECTION ☒
DDC	BUFF SECTION ☐
U. A. HONORED	☐
JUSTIFICATION	
.....	
BY	
DISTRIBUTION/AVAILABILITY CODES	
DIST.	AVAIL. and or SPECIAL
/	

Destroy this report when it is no longer needed. Do not return it to the originator.

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

The use of trade names in this report does not constitute an official endorsement or approval of such commercial hardware or software. This report may not be cited for purposes of advertisement.

Distribution of this document is unlimited

ENVIRONMENTAL DATA BASE
FOR REGIONAL STUDIES IN THE HUMID TROPICS

MONTHLY
MICROCLIMATIC SUMMARY

APRIL 1967

Prepared by

Michael A. Fradel, Project Officer
and
Dr. Wilfried H. Portig, Meteorologist

USATECOM Project No. 9-4-0013-01

This research was supported by the Advanced
Research Projects Agency of the Department
of Defense and by the Army Research Office,
OCRD, Department of Army

Conducted by

US Army
Tropic Test Center
Fort Clayton, Canal Zone
with contractual services provided by
Weather Engineers of Panama Corp.

Disregard all references to satellite sites.

Distribution of this document is unlimited

BLANK PAGE

TABLE OF CONTENTS

	<u>Page</u>
Introduction	1
Sites.	1
Instrumentation.	1
Data Reduction and Storage	2
 Figures	
1. Location Map, Isthmus of Panama.	3
2. Frequency of Observations.	4
3. Albrook Forest Site, Generalized Plot.	5
4. Chiva Chiva Open Site, Generalized Plot.	6
5. Instrument Location on Towers.	7
 Data Summary Sheets	
Monthly Means of Air Temperature by Hour	8
Monthly Ranges of Air Temperature by Hour.	9
Monthly Means of Relative Humidity by Hour	10
Monthly Ranges of Relative Humidity by Hour.	11
Monthly Means of Other Elements by Hour.	12
Monthly Means of Soil Surface Temperature by Hour	
Monthly Means of Wet Bulb Temperature by Hour	
Monthly Means of Barometric Pressure by Hour	
Monthly Means of Precipitation by Hour	
Monthly Totals of Precipitation	
Monthly Ranges of Other Elements by Hour.	13
Monthly Ranges of Soil Surface Temperature by Hour	
Monthly Ranges of Wet Bulb Temperature by Hour	
Monthly Ranges of Barometric Pressure by Hour	
Monthly Ranges of Precipitation by Hour	
Monthly Means of Wind Speed by Hour.	14
Monthly Ranges of Wind Speed by Hour	15
Relative Frequencies of Wind Directions (46 meters, Albrook) . .	16
Relative Frequencies of Wind Directions (26.5 meters, Albrook)..	17
Relative Frequencies of Wind Directions (4 meters, Albrook). . .	18
Relative Frequencies of Wind Directions (46 meters, Chiva Chiva).	19
Relative Frequencies of Wind Directions (26.5 meters, Chiva Chiva).	20
Relative Frequencies of Wind Directions (4 meters, Chiva Chiva).	21
Summary of Elements with Non-Hourly Frequencies of Observation.	22
WBGT (Albrook)	
Evaporation (Albrook)	
Precipitation (Manual gauge network, Albrook)	
Precipitation (Stem Flow, Albrook)	
WBGT (Chiva Chiva)	

TABLE OF CONTENTS (cont'd)

Minimum Grass Temperature (Chiva Chiva)
Maximum Temperature (Albrook satellite)
Minimum Temperature (Albrook satellite)
Maximum Relative Humidity (Albrook satellite)
Minimum Relative Humidity (Albrook satellite)
Precipitation (Albrook satellite)
Maximum Temperature (Fort Kobbe satellite)
Minimum Temperature (Fort Kobbe satellite)
Maximum Relative Humidity (Fort Kobbe satellite)
Minimum Relative Humidity (Fort Kobbe satellite)
Precipitation (Fort Kobbe satellite)
Maximum Temperature (Fort Sherman satellite)
Minimum Temperature (Fort Sherman satellite)
Maximum Relative Humidity (Fort Sherman satellite)
Precipitation (Fort Sherman satellite)

MONTHLY MICROCLIMATIC SUMMARY

Introduction

Monthly microclimatic data summarized in this series of reports were collected by the US Army Tropic Test Center and the Weather Engineers of Panama Corporation under the project, Environmental Data Base for Regional Studies in the Humid Tropics. The project is sponsored by the Advanced Research Projects Agency of the Department of Defense and by the Army Research Office, Office of the Chief of Research and Development. It is an investigation of microclimatic, air chemistry, vegetation, soils, microbiological, and macrofaunal conditions at selected sites in the principal tropical environments of the Panama Canal Zone and the Rio Hato Military Reservation. The objective of the project is to assemble quantitative environmental data for RDT&E purposes.

Sites. Data summarized in this report were collected at the Albrook Forest and Chiva Chiva sites. Figure 1 shows the site locations within the Isthmus of Panama. Geographic coordinates are shown below:

Albrook Forest	09° 01'N, 79° 33'W
Chiva Chiva	09° 01'N, 79° 35'W
Fort Kobbe (satellite)	08° 54'N, 79° 34'W
Fort Sherman (satellite)	09° 16'N, 79° 59'W
Albrook (satellite)	09 00'N, 79° 33'W

The Chiva Chiva open site and the Albrook Forest site are paired for comparative study of environmental conditions in a tropical semideciduous forest and in a large clearing. Both are located in a region where the annual precipitation is approximately 80 inches and there is a pronounced dry season. The other satellite sites were located primarily for soil studies purposes. Albrook and Fort Kobbe have climatic regimes similar to the principal sites.

The Albrook and Chiva Chiva main sites are approximately four kilometers apart. Each has a 46-meter walk-up tower and an air-conditioned building to house the recording equipment and observers. Both sites are approximately 30 meters above sea level. The top of the forest canopy at the Albrook site is about 26.5 meters above the ground.

Instrumentation. A wide range of climatic elements are measured at the Albrook and Chiva Chiva sites. Types of observations and frequencies are shown on Figure 2. The towers at the Albrook and Chiva Chiva sites are similarly oriented. Sensing equipment is mounted at several levels on the towers to provide measurements through the vertical profile. Additional instruments are emplaced in the immediate vicinity on or near the ground.

All instrument exposures are duplicated at each site. Figures 3, 4, and 5 show the instrument array at these sites.

Data Reduction and Storage. All data, as applicable, are recorded at or reduced to each full hour and transposed to punch cards. These punch cards, together with all raw data, are stored in the Tropic Test Center Technical Library Annex.

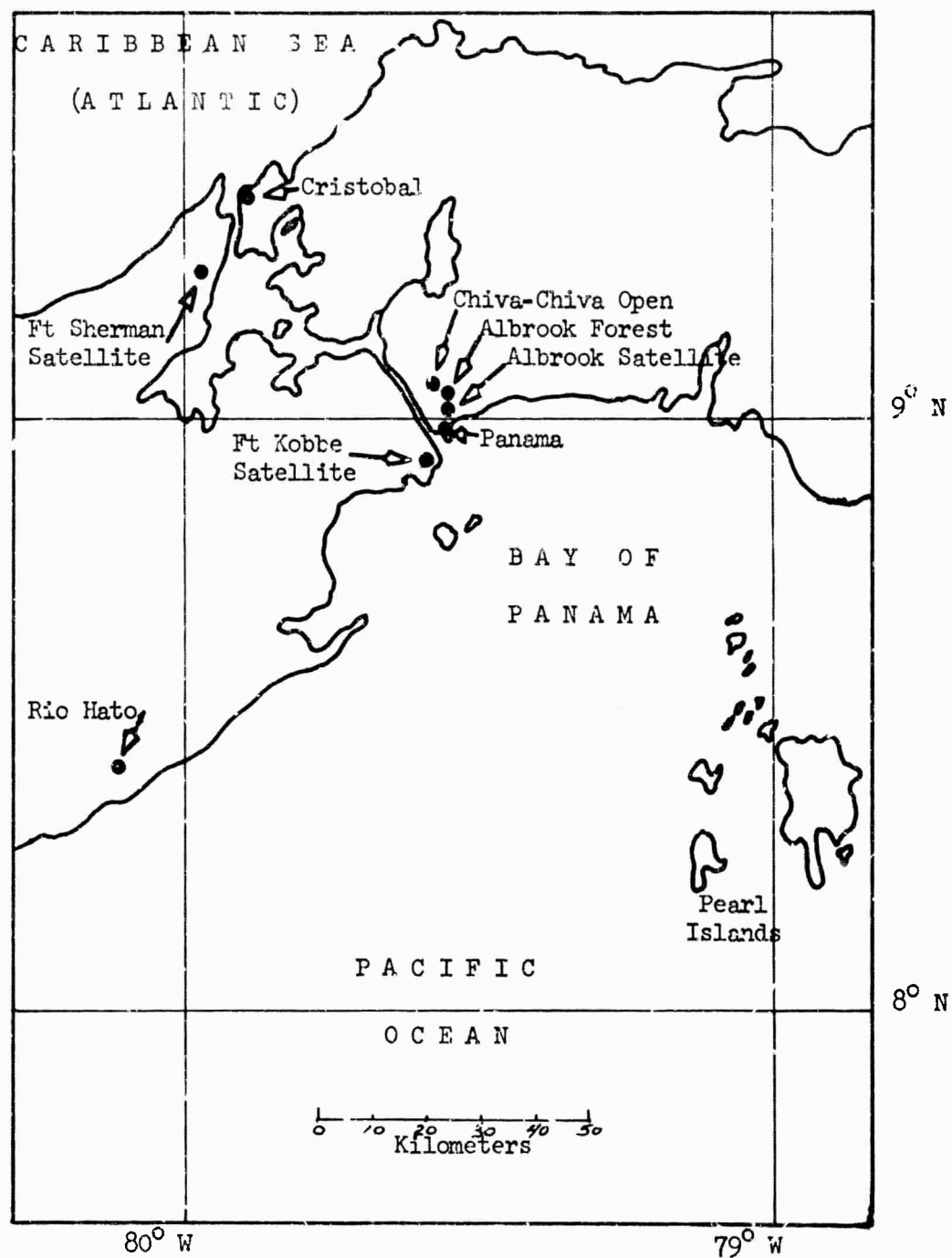


FIGURE 1.
LOCATION MAP, ISTHMUS OF PANAMA

FIGURE 2. FREQUENCY OF OBSERVATIONS

# Element	Stg	Height (meters)						Frequency	
		0.5	1.0	2.0	4.0	8.0	13.5		
Temperature:									
Dry Bulb	2	2	1	2	2	2	2	2	Hourly*/Continuously
Wet Bulb	1	2	-	2	2	-	-	-	Hourly*/Continuously
Grass Minimum	1	-	-	-	-	-	-	-	Once Daily
WBGT Index	-	-	2	-	-	-	-	-	Hourly(0600-1500 EST)
Relative Humidity	-	2	1	2	2	2	2	2	Hourly*/Continuously
Barometric Pressure	-	-	2	-	-	-	-	-	Continuously
Evaporation	2	-	-	-	-	-	-	3	Once Daily
Precipitation:									
Recording Gage	-	-	1	-	-	-	-	-	Continuously
Manual Gage	-	-	3	-	-	-	-	-	4 Times Daily
Stem Flow	-	-	3	-	-	-	-	-	4 Times Daily
Wind:									
Direction	-	-	-	-	5	-	-	-	Continuously
Speed	-	-	-	2**	5	2**	2**	2**	Hourly**/Continuously

1. All sites
 2. Albrook and Chiva Chiva
 3. Albrook only
 4. Chiva Chiva only
 5. Main sites

* Observation made with sling psychrometer when recorders are inoperative.

** Hourly.

Instrument descriptions are contained in the Environmental Data Base semiannual reports.

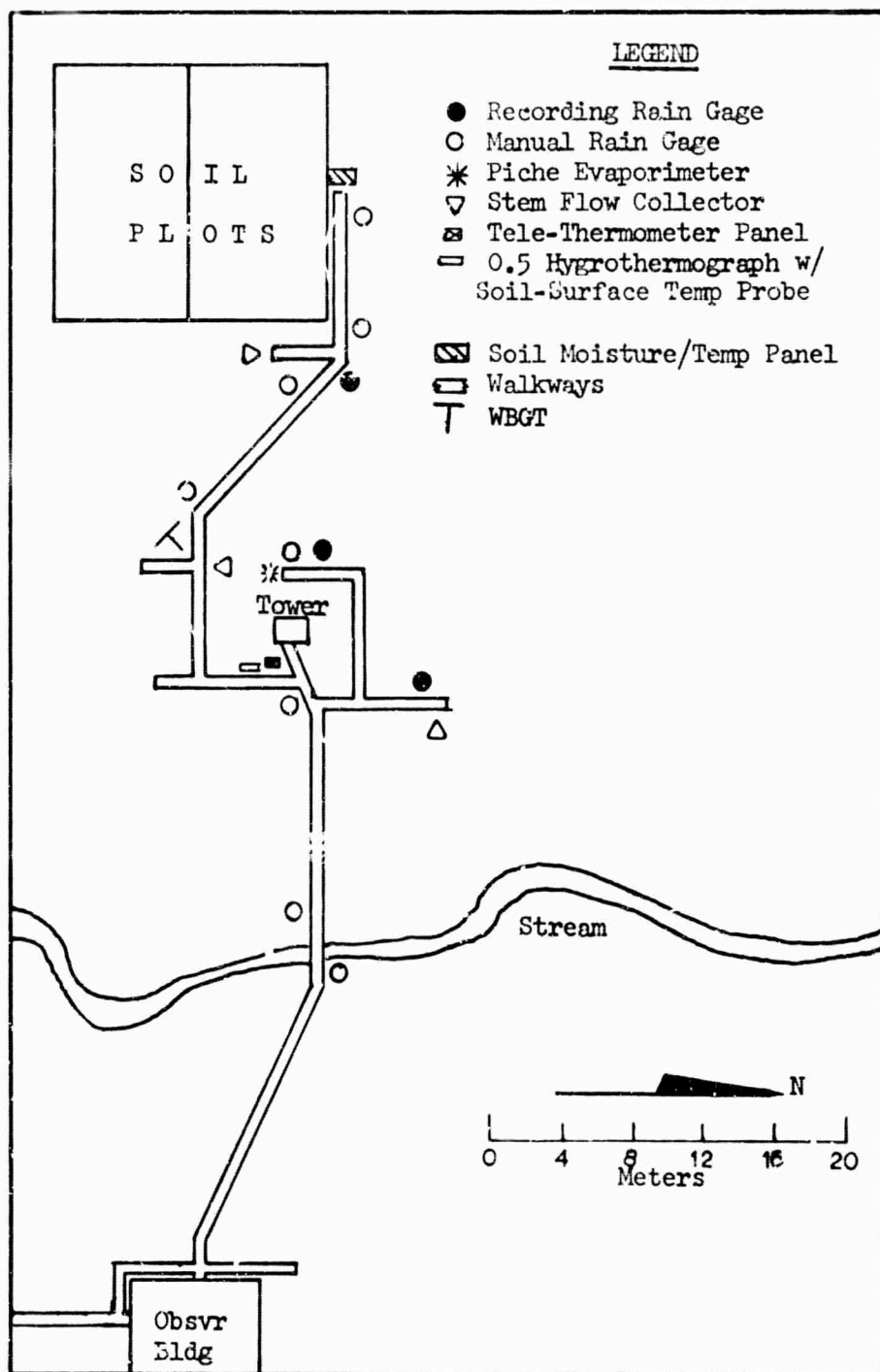


FIGURE 3.

ALBROOK FOREST SITE, GENERALIZED PLOT

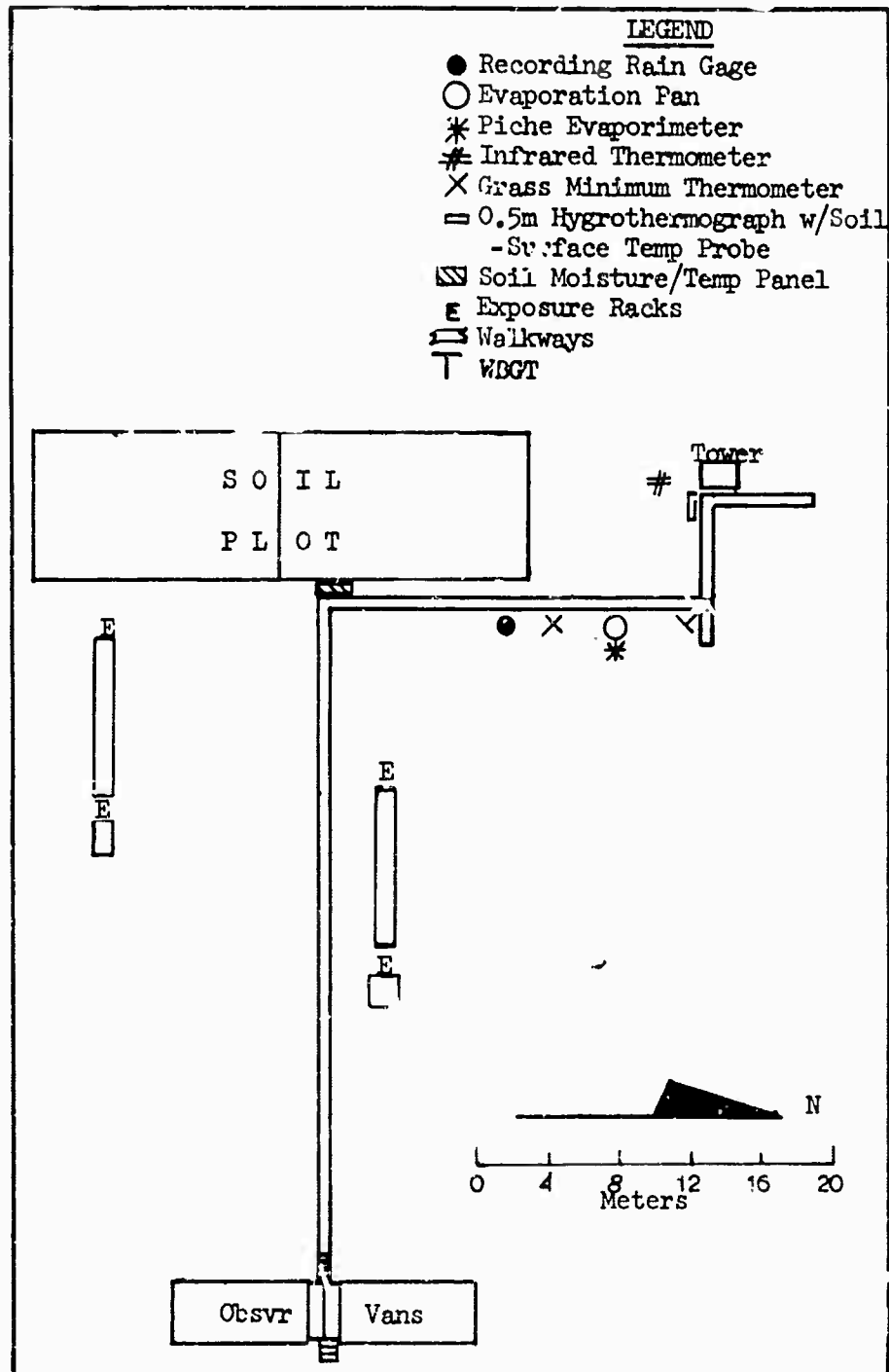


FIGURE 4.

CHIVA CHIVA OPEN, GENERALIZED PLOT

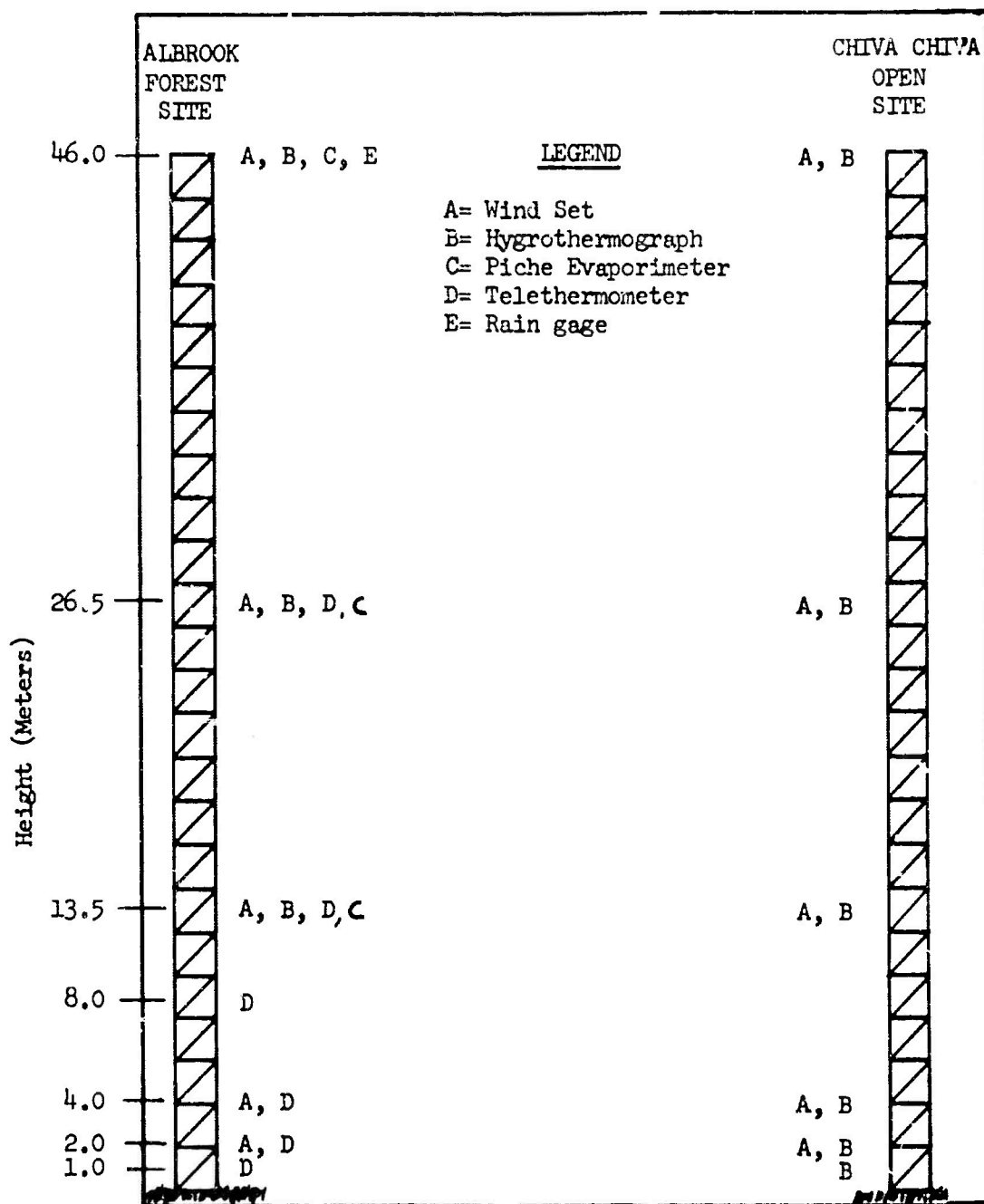


FIGURE 5.
INSTRUMENT LOCATION ON TOWERS

SUMMARY OF METEOROLOGICAL OBSERVATIONS

HOURLY DATA

APRIL 1967

Exposure		Monthly Means of Air Temperature by Hour (°C F)																								Monthly Summary													
Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	No of Obs.	Min.	Mean	Max.										
Albrook (Forest site)	46.0 m	75.6	75.3	75.1	74.7	74.6	74.5	75.8	78.6	82.4	84.7	84.8	85.3	85.9	85.1	84.0	83.3	81.6	79.6	78.1	77.5	77.0	76.6	76.3	76.0	677	70.1	79.0	91.4										
	28.5 m								This level was not instrumented for air temperature at this time																														
	26.5 m	74.9	74.7	74.3	74.1	73.8	73.8	75.6	78.7	82.9	84.9	85.2	85.8	86.3	85.8	84.4	83.5	81.9	79.7	77.5	76.9	76.3	75.9	75.5	75.2	715	69.0	79.0	92.0										
	13.5 m	74.6	74.4	74.2	73.8	73.5	73.3	74.0	76.6	79.9	82.2	83.4	84.1	84.3	84.5	83.0	82.3	81.7	79.7	78.0	77.0	76.5	75.9	75.5	75.0	719	68.2	78.2	91.9										
	8.0 m	74.4	74.3	74.0	73.6	73.3	73.1	73.9	77.0	80.0	82.5	83.6	84.0	84.5	84.0	82.7	82.3	80.9	79.1	77.7	76.7	76.1	75.6	75.1	74.7	716	68.1	78.0	92.6										
	4.0 m	74.0	73.7	73.5	73.2	72.8	72.6	73.9	77.2	80.1	82.4	83.2	84.2	84.8	84.2	82.5	82.8	80.9	79.0	77.4	76.4	75.8	75.2	74.7	74.3	704	67.2	77.8	92.4										
	2.0 m	73.9	73.6	73.5	73.1	72.9	72.6	73.8	77.0	79.7	82.2	83.2	84.4	84.8	84.3	82.5	82.5	80.9	79.0	77.3	76.4	75.7	75.2	74.6	74.2	706	67.2	77.8	92.7										
	1.0 m	74.3	74.2	73.9	73.7	73.4	72.6	73.6	77.0	79.8	82.6	83.7	84.3	85.1	84.5	82.2	82.4	81.1	79.2	77.4	76.8	76.0	75.5	75.0	74.6	697	68.2	77.9	92.5										
0.5 m	74.4	74.3	74.0	73.7	73.5	73.0	73.7	76.6	79.3	81.6	83.5	84.7	85.0	84.6	82.9	82.7	81.1	79.5	77.8	76.8	76.3	75.6	75.1	74.6	720	67.7	78.1	93.3											

8

Chiva Chiva (Open site)	46.0 m	75.8	75.7	75.3	75.2	75.0	74.8	76.3	79.3	81.9	83.4	84.3	85.2	84.7	84.5	83.7	82.9	81.3	79.9	78.6	78.0	77.3	76.9	76.6	76.1	712	70.7	79.2	89.8											
	28.5 m							This level was not instrumented for air temperature at this time																																
	26.5 m	75.8	75.6	75.2	75.0	74.6	74.6	76.0	78.9	81.7	83.3	84.3	85.3	84.9	84.8	84.2	83.4	81.6	80.4	79.0	78.3	77.6	77.1	76.7	76.3	720	70.0	79.4	90.3											
	13.5 m	75.5	75.2	75.0	74.8	74.4	74.3	75.8	78.7	81.9	83.5	84.5	85.5	85.1	85.0	84.3	83.5	81.6	80.4	78.8	78.1	77.4	77.0	76.4	76.0	720	69.1	79.3	90.2											
	8.0 m							This level was not instrumented for air temperature at this time																																
	4.0 m	75.2	74.9	74.5	74.1	73.9	73.7	76.0	80.2	83.3	85.3	86.5	87.0	86.6	86.5	86.5	85.4	82.6	80.7	79.0	78.1	77.3	76.7	76.1	75.6	716	68.1	79.8	93.9											
	2.0 m	75.0	74.7	74.3	73.9	73.7	73.5	76.0	80.4	83.4	85.5	86.6	87.2	86.6	86.7	86.6	85.6	82.6	80.6	78.7	77.9	77.1	76.4	75.8	75.4	716	67.7	79.7	93.7											
	1.0 m	74.8	74.6	74.2	74.0	73.6	73.4	76.6	81.8	84.5	87.3	88.8	88.9	88.2	88.1	87.2	86.1	83.1	80.8	78.9	77.9	76.9	76.3	75.8	75.3	712	67.5	80.2	97.0											
	0.5 m	74.9	74.8	74.4	74.1	73.7	73.6	75.4	80.1	83.3	86.3	88.0	89.1	88.0	87.6	86.9	85.5	82.8	80.5	78.4	77.5	76.7	76.1	75.6	75.2	719	68.6	77.9	97.5											

SUMMARY OF METEOROLOGICAL OBSERVATIONS

HOURLY DATA

APRIL 1967

Exposure	Site	Monthly Ranges of Air Temperature by Hour (° F)																								Monthly Summary*
		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Albrook (Forest site)	46.0 m	6.6	6.9	7.1	7.6	7.9	8.0	6.7	DTF	DTF	DTF	DTF	DTF	DTF	16.6	15.2	17.8	13.4	9.7	8.2	6.1	5.8	6.3	6.5	6.8	
	28.5 m								This level was not instrumented for air temperature at this time																	
	26.5 m	8.3	7.5	8.0	8.2	9.5	8.4	8.8	9.0	12.6	14.1	13.5	13.4	15.5	18.0	17.7	17.0	16.4	11.5	6.4	6.9	7.9	8.3	8.3	8.4	
	13.5 m	7.0	7.0	7.4	7.7	8.2	8.7	8.7	7.5	10.2	12.4	13.1	13.6	15.3	17.0	15.0	16.0	14.7	10.4	7.9	7.0	6.9	7.2	7.3	7.1	
	8.0 m	7.1	7.2	7.9	8.5	8.4	9.5	8.6	7.2	10.6	14.7	13.2	13.8	15.1	18.5	16.8	16.3	13.3	10.8	8.8	6.8	7.5	6.6	6.2	7.4	
	4.0 m	6.8	7.7	8.7	8.9	8.8	10.1	8.9	8.0	10.5	12.4	13.4	12.9	16.5	18.6	16.6	17.6	13.6	10.7	8.4	7.6	7.8	7.5	6.2	7.0	
	2.0 m	6.8	7.2	8.5	8.8	8.6	9.8	8.9	7.7	10.4	13.3	12.9	12.7	16.0	18.3	16.5	17.5	13.7	10.7	8.4	7.6	7.7	7.3	6.4	6.8	
	1.0 m	6.7	7.3	7.3	8.0	8.2	8.5	8.8	7.6	10.7	13.8	13.9	15.0	16.8	17.5	17.1	15.7	14.2	11.0	8.8	7.0	7.1	6.7	6.4	5.8	
	0.5 m	7.4	7.9	7.7	7.6	8.9	9.0	8.9	7.9	10.3	14.0	13.3	14.7	15.6	18.4	16.4	16.9	13.4	10.1	8.2	8.2	7.7	7.0	6.3	6.1	

* No monthly summary was computed for the ranges.

6

Chiva Chiva (Open site)	46.0 m	6.1	6.3	6.1	6.4	6.8	6.7	6.9	8.5	11.2	12.5	14.4	14.1	15.9	15.7	15.0	15.5	12.3	9.3	6.9	5.8	6.5	6.9	6.6	5.9	
	28.5 m								This level was not instrumented for air temperature at this time																	
	26.5 m	7.5	8.0	8.2	7.6	7.8	7.3	6.8	8.8	11.7	12.1	14.0	13.4	16.4	15.1	15.0	15.6	12.6	10.2	7.9	6.4	6.7	7.7	6.9	7.0	
	13.5 m	7.6	7.6	7.8	7.8	8.4	8.6	6.9	8.0	10.8	12.2	14.0	13.8	16.0	15.9	15.1	17.5	13.4	10.8	7.4	7.6	6.7	7.1	7.5	7.3	
	8.0 m								This level was not instrumented for air temperature at this time																	
	4.0 m	8.1	8.6	9.4	9.4	9.6	9.8	8.7	9.8	13.1	12.7	15.8	15.8	17.6	19.7	16.5	15.6	14.9	9.4	7.1	5.8	7.0	7.4	7.6	8.3	
	2.0 m	7.8	8.2	8.9	9.1	9.2	10.5	7.9	9.7	12.9	13.2	15.7	15.9	18.2	19.2	16.6	16.1	14.7	9.7	7.0	5.6	6.5	6.6	7.2	7.5	
	1.0 m	8.4	8.7	9.7	9.5	10.0	10.0	8.7	11.8	15.1	13.7	19.0	19.2	19.8	22.2	20.0	20.6	17.4	10.3	7.7	7.1	6.5	7.5	8.0	7.6	
	0.5 m	6.7	6.5	7.7	8.3	8.7	8.7	8.0	10.3	13.5	17.2	19.2	20.3	21.8	20.0	18.1	18.9	15.0	9.6	6.0	5.1	5.2	6.5	6.2	6.2	

SUMMARY OF METEOROLOGICAL OBSERVATIONS

HOURLY DATA

APRIL 1967

Exposure		Monthly Means of Relative Humidity by Hour (%)																								Monthly Summary				
Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	No of Obs.	M.in.	Mean	Max.	
Albrook (Forest site)	4	87	88	90	90	90	91	88	80	69	65	64	64	64	67	69	70	73	77	81	82	85	86	86	87	692	49	79	97	
	28.5 m	This level was not instrumented for relative humidity at this time																												
	26.5 m	90	91	91	92	92	92	89	82	72	67	65	66	65	66	70	71	74	78	83	85	87	87	88	88	717	49	80	98	
	13.5 m	91	91	92	93	93	93	93	88	79	73	71	69	68	69	73	74	75	78	82	84	87	88	89	89	719	53	83	99	
	8.0 m	This level was not instrumented for relative humidity at this time																												
	4.0 m	94	94	94	95	96	96	95	90	80	74	73	71	69	70	77	76	80	83	86	89	90	91	91	92	93	711	48	85	100
	2.0 m	94	95	95	95	96	96	96	91	82	76	74	71	70	70	78	77	80	84	87	90	90	91	91	93	94	712	44	86	100
	1.0 m	94	94	95	95	95	95	96	93	84	78	74	71	72	73	77	77	80	84	87	89	90	91	91	93	93	701	51	86	100
	0.5 m	93	94	94	94	95	95	95	92	86	81	76	72	72	72	78	78	81	84	87	89	90	91	91	93	93	719	48	86	100

10

46.0 m	87	88	88	88	89	90	90	89	87	80	74	68	65	63	64	64	66	68	72	76	80	82	84	85	86	87	720	46	78	97
28.5 m	This level was not instrumented for relative humidity at this time																													
26.5 m	88	88	89	90	90	90	90	90	87	79	72	67	63	61	64	64	65	67	72	76	79	82	83	85	86	87	720	43	78	98
13.5 m	88	89	90	91	91	91	91	91	88	79	72	66	62	61	63	63	64	66	71	76	79	82	84	85	86	87	720	41	78	99
8.0 m	This level was not instrumented for relative humidity at this time																													
4.0 m	89	90	91	92	92	92	92	92	88	78	70	65	61	61	62	62	62	64	71	75	79	82	84	86	87	88	717	44	78	100
2.0 m	90	91	92	93	93	93	93	93	89	78	70	64	62	61	62	62	62	64	72	77	81	83	85	87	88	89	716	44	79	100
1.0 m	90	91	91	92	92	92	92	92	90	80	71	64	61	60	62	62	63	66	72	78	82	85	87	89	90	90	720	43	79	99
0.5 m	90	91	91	92	92	92	92	92	91	81	72	65	61	60	63	63	65	67	73	79	83	85	87	88	89	90	719	42	80	100

SUMMARY OF METEOROLOGICAL OBSERVATIONS
 HOURLY DATA
 APRIL 1967

Exposure		Monthly Ranges of Relative Humidity by Hour (%)																								Monthly Summary*	
Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
Albrook (Forest site)	46.0 m	19	15	16	17	14	17	17	26	38	37	39	45	46	43	44	46	37	39	31	34	26	23	21	19		
	28.5 m							This level was not instrumented for relative humidity at this time																			
	26.5 m	16	16	14	15	13	17	18	26	36	37	40	46	47	44	45	49	41	36	23	22	20	19	17	16		
	13.5 m	16	16	13	12	12	13	15	20	27	35	37	42	45	44	44	46	41	37	30	29	26	24	21	20		
	8.0 m							This level was not instrumented for relative humidity at this time																			
Albrook (Forest site)	4.0 m	16	14	14	16	14	16	15	22	30	38	42	46	49	51	49	49	40	35	28	26	23	20	15	17		
	2.0 m	14	14	15	15	13	15	12	20	29	37	39	47	48	52	49	48	41	36	28	24	23	20	15	15		
	1.0 m	12	11	11	10	12	12	10	17	29	33	39	45	47	48	47	46	39	33	25	20	18	15	11	11		
	0.5 m	17	19	17	15	16	16	17	19	28	34	38	46	45	51	47	44	40	33	27	25	22	17	15	18		

* % monthly summary was computed for the ranges.

Chiva Chiva (Open site)	46.0 m	16	14	16	13	14	20	14	22	30	36	41	43	48	50	46	45	44	38	30	24	20	19	20	18		
	28.5 m							This level was not instrumented for relative humidity at this time																			
	26.5 m	16	15	16	14	16	20	15	26	31	33	37	44	48	54	48	47	49	37	30	26	21	20	22	18		
	13.5 m	16	15	18	15	17	21	15	25	32	36	39	47	52	57	51	50	50	39	31	27	22	22	23	19		
	8.0 m							This level was not instrumented for relative humidity at this time																			
Chiva Chiva (Open site)	4.0 m	17	17	19	17	20	19	20	29	39	38	42	47	53	55	52	50	43	39	32	28	22	24	27	22		
	2.0 m	16	17	18	15	19	18	18	28	36	39	43	49	52	55	50	50	44	35	27	26	21	21	22	19		
	1.0 m	13	14	14	13	14	14	14	27	34	38	44	49	52	55	50	52	47	41	31	24	21	18	10	14		
	0.5 m	14	12	16	11	19	13	17	30	34	44	53	57	57	52	49	49	42	34	28	23	21	19	20	16		

SUMMARY OF METEOROLOGICAL OBSERVATIONS HOURLY DATA

APRIL 1967

Exposure		Monthly Ranges ² of other Elements by Hour																								Monthly Summary*	
Site	Code ¹	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
Albrook (Forest site)	WB (4.0 m)	4.9	5.2	5.7	6.5	6.7	7.6	7.3	4.4	3.8	4.6	5.9	5.3	5.4	5.8	5.9	6.3	5.0	5.2	4.0	4.6	5.4	5.0	4.1	4.1		
	WB (2.0 m)	4.9	4.9	5.7	6.5	6.9	7.8	7.2	4.2	3.6	4.0	5.4	5.6	5.2	4.8	5.0	5.7	4.8	5.2	4.2	4.3	4.9	5.0	3.6	4.0		
	WB (0.5 m)	4.6	4.9	5.5	6.1	6.9	7.3	7.8	5.4	3.9	4.4	4.3	5.6	6.3	7.3	7.5	7.2	4.4	4.8	4.2	4.1	4.0	3.6	3.4	3.9		
	BP	.175	.160	.165	.160	.165	.170	.170	.180	.145	.155	.185	.180	.175	.170	.170	1.85	.180	.190	.175	.165	.175	.170	.175	.185		
	P1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.00	0.00	0.07	0.08	0.44	1.02	0.33	1.20	0.45	0.00	0.15	0.00	0.00	0.00	0.00	0.00		
	P2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.80	0.17	0.82	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	P3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.11	0.74	0.28	1.00	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	P4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.90	0.24	1.74	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

* No monthly summary was computed for the ranges.

Chiva Chiva (Open site)	WB (4.0 m)	5.0	5.1	5.0	5.9	5.7	6.8	5.2	4.6	4.1	4.1	6.0	5.7	6.6	4.6	5.7	4.9	7.0	4.7	3.8	4.2	3.9	3.3	3.7	4.0
	WB (2.0 m)	4.8	4.8	5.0	6.1	5.9	6.5	5.0	4.3	3.9	3.5	4.8	4.4	4.7	4.8	4.7	4.4	5.2	4.4	3.3	3.7	3.5	3.0	3.8	4.1
	WB (0.5 m)	5.1	5.0	5.0	6.1	6.8	7.1	6.1	4.7	3.8	4.4	4.7	4.5	4.1	4.5	4.5	5.1	4.2	4.3	4.6	3.9	3.7	3.7	3.3	4.0
	BP	.165	.165	.155	.160	.175	.175	.170	.180	.155	.160	.160	.175	.170	.160	.180	.185	.175	.168	.170	.160	.170	.165	.175	.170
	PS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.10	0.15	0.03	0.24	0.03	1.03	0.79	0.04	0.00	0.00	0.00	0.00	0.00

WB - Wet bulb temperature (°F)
BP - Barometric pressure (in. of Hg minus 29.0)
PS - Precipitation at 1.0 m. in open area (in.)
P1 - Precipitation at 46.0 m. above canopy (in.)
P2 - Precipitation under full canopy (in.)
P3 - Precipitation under drip canopy (in.)
P4 - Precipitation under open canopy (in.)

² Monthly ranges of precipitation are computed for precipitation days.

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA
APRIL 1967

Exposure	Monthly Means of Wind Speed by Hour (miles/hr.)																								Monthly Summary						
	Site	Level	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	No of Obs.	Min.	Mean	Max.	
Albrook (Forest site)	46.0 m	4	4	4	4	4	4	4	4	3	5	5	6	8	7	7	8	8	6	5	5	5	5	5	4	5	718	0	5	18	
	28.5 m									This level was not instrumented for wind speed at this time																					
	26.5 m	2	2	2	2	1	1	2	2	2	2	3	3	4	3	4	3	3	3	2	2	2	2	2	2	2	718	0	2	10	
	13.5 m									This level was not instrumented for wind speed at this time																					
	8.0 m									This level was not instrumented for wind speed at this time																					
	4.0 m	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	0	718	0	1	5	
	2.0 m										This level was not instrumented for wind speed at this time																				
1.0 m										This level was not instrumented for wind speed at this time																					
0.5 m										This level was not instrumented for wind speed at this time																					

APRIL 1967

**** No monthly summary was computed for the ranges.**

[illegible]

ALBROOK (Forest site) APRIL 1967

Relative Frequencies * of Wind Directions by Hour at 46.0 m. (%)																								
Dir.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
N	6.7			3.3			3.3		20.0	26.7	10.0	16.7	17.2	17.2	13.3	3.3	10.0		6.7		3.3	3.3	3.3	
NNE					3.3	3.3			3.3		10.0			3.4	6.7		3.3	3.3						
NE			3.3		3.3		3.3		3.3	6.7		3.3	3.4	6.9	3.3	3.3					3.3		3.3	
ENE									3.3	3.3	3.3	6.7						3.3				3.3		
E										3.3			10.3	6.9	3.3									
ESE				3.3						6.7	3.3		3.4	3.4	3.3									
SE								3.3	10.0		3.3	16.7	10.3		3.3	6.7	3.3							
SSE									6.7		13.3	6.7	10.3	6.9	6.7	3.3		3.3						
S							3.3		3.3	10.0	3.3	6.7	3.4	10.3	10.0		6.7	3.3	3.3					
SSW									3.3	3.3						3.3	3.3							
SW											3.3		3.4	3.4										
WSW	6.7	10.0	20.0	20.0	10.0	16.7	16.7	26.7	3.3	6.7	6.7	3.3	6.9	3.4	3.3	3.3		13.3	3.3	3.3	3.3	10.0	5.7	16.7
W	33.3	53.3	43.3	40.0	46.7	36.7	43.3	33.3	10.0	3.3	3.3	13.3			3.3	3.3	13.3	10.0	40.0	53.3	43.3	46.7	36.7	36.7
WNW	33.3	10.0	10.0	13.3	10.0	3.3	6.7	6.7	3.3	10.0	10.0	6.7	3.4	3.4	6.7		3.3	16.7	13.3	6.7	26.7	16.7	20.0	6.7
NW	6.7	6.7			6.7		3.3	6.7	10.0	10.0	10.0	3.3	10.3	24.0	20.0	23.3	20.0	26.7	16.7	23.3	3.3	3.3	6.7	23.3
NNW	3.3					6.7	3.3		13.3	3.3	16.7	16.7	17.2	6.9	10.0	36.7	16.7	13.3			6.7	3.3	6.7	
CALM	20.0	20.0	23.3	20.0	20.0	13.3	16.7	26.7	6.7	6.7	3.3			3.4	6.7	13.3	20.0	5.7	16.7	13.3	10.0	10.0	16.7	16.7

* Note: Due to rounding, percentages totals do not equal 100%.

ALBROOK (Forest site) APRIL 1967

Relative Frequencies * of Wind Directions by Hour at 26.5 m. (%)																								
Dir.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
N		6.7			6.7			3.3	6.7	10.0	13.3	10.0	3.4	10.3	13.3	20.0	13.3	3.3	6.7	3.3	3.3	6.7		
NNE								3.3	10.0	3.3	3.3	10.0	6.9		6.7	6.7	3.3	3.3	6.7					
NE										3.3		10.0	6.9	10.3	6.7	3.3	3.3	3.3	3.3					
ENE									3.3	13.3	3.3			6.9	6.7	3.3		3.3						
E									6.7	10.0	13.3	3.3	20.6	3.4	10.0		10.0							
ESE										3.3		3.3				3.3	3.3			3.3				
SE									3.3		3.3	10.0	6.9		3.3	3.3		3.3						
SSE											10.0	3.3	10.3	3.4	3.3	3.3								
S									10.0	10.0	3.3	10.0	10.3	17.2	13.3	10.0	13.3		3.3					
SSW									3.3	13.3	3.3	3.3					3.3							
SW			3.3					3.3	3.3			6.7	3.4					3.3		6.7				
WSW			3.3						3.3	3.3	3.3	6.7	3.4					3.3	3.3				6.7	
W	16.7	20.0	13.3	20.0	16.7	3.3	13.3	16.7		6.7	6.7	6.7	3.4	6.9		6.7	3.3	6.7	6.7	3.3	13.3	6.7	20.0	20.0
WNW	20.0	20.0	16.7	13.3	6.7	30.0	20.0	30.0	6.7	6.7	10.0	6.7	6.9			3.3	6.7	16.7	16.7	23.3	26.7	33.3	36.7	30.0
NW	40.0	26.7	23.3	23.3	26.7	6.7	23.3	10.0	30.0	3.3	10.0	3.3	10.3	20.6	13.3	10.0	16.7	30.0	30.0	26.7	33.3	20.0	16.7	26.7
NNW	3.3	3.3	3.3		3.3	3.3		3.3	3.3	3.3	10.0	6.7	6.9	10.3	6.7	13.3	10.0	10.0	6.7	10.0	6.7	10.0		
CALM	20.0	23.3	36.7	43.3	46.7	46.7	40.0	23.3	10.0	10.0	6.7		23.3	10.3	16.7	13.3	13.3	13.3	16.7	23.3	16.7	23.3	20.0	23.3

* Note: Due to rounding, percentage total, do not equal 100%.

ALBROOK (Forest site) APRIL 1967

Relative Frequencies * of Wind Directions by Hour at 4.0 m. (%)																								
Dir.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
N	6.7	3.3		3.3		10.0		3.3		3.3	3.3				3.3	6.7	13.3	6.7	3.3	3.3	3.3			6.7
NNE							3.3		3.3		3.3	6.7	6.9	10.3					3.3	3.3		3.3	6.7	
NE	3.3		3.3					3.3	3.3	3.3	3.3	6.9			6.7	3.3	3.3					3.3		
ENE									6.7	3.3	3.3		3.4						6.7					
E									6.7	16.7	3.3	10.0	10.3	6.9	3.3	10.0								
ESE											3.3	16.7	6.9		6.7		3.3							
SE								3.3		3.3	3.3	3.3	13.7	3.4					3.3					
SSE								3.3	3.3	3.3	3.3		3.4	6.9		3.3						3.3		
S								13.3	6.7	13.3	20.0	23.3	17.2	10.3	10.0	10.0	13.3	6.7			3.3			
SSW								3.3		3.3	3.3	3.3					6.7							
SW									6.7	6.7	3.3	3.3	3.4	3.4						6.7	6.7	3.3	3.3	3.3
WSW						3.3			3.3	3.3	3.3		3.4	3.4					2.3	3.3	3.3			
W	3.3				3.3				6.7				3.4		3.3	3.3	3.3	3.3	3.3		6.7	3.3	10.0	
WNW	6.7	3.3	3.3	10.0	3.3	6.7	6.7				3.3			6.9	6.7			13.3	6.7	6.7		6.7	3.3	13.3
NW	10.0	10.0	13.3	6.7	6.7		10.0	3.3	3.3	3.3	3.3	3.3		3.4	3.3	6.7			3.3		6.7	3.3	10.0	10.0
NNW		3.3	3.3			3.3			3.3					3.4	6.7		6.7							3.3
CALM	70.0	80.0	76.7	80.0	86.7	76.7	80.0	66.7	50.0	36.7	36.7	30.0	20.6	41	50.0	56.7	50.0	70.0	66.7	76.7	70.0	73.3	66.7	63.3

* Note: Due to rounding, percentage totals do not equal 100%.

CHIVA CHIVA (Open site) APRIL 1967

Relative Frequencies * of Wind Directions by Hour at 46.0 m. (%)																								
Dir.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
N	3.3	6.9		6.3	10.3	10.0	6.9	10.7	13.7	24.0	30.9	17.2	14.2	13.7	2.5	20.0	13.7	6.7	17.2	6.9	6.9	3.4	3.3	
NNE	6.7		6.7							10.3	13.7	10.3	7.2	3.4	10.7	3.3	3.4	6.7						
NE												3.4					3.4	3.3						
ENE					3.4				10.3	3.4		3.4		3.4	3.5			3.3	3.4	3.4	6.9			
E	3.3						3.4		3.4	3.4	3.4		7.2		3.5	3.3		3.3				3.4	3.3	
ESE									6.9	3.4	3.4	6.9	3.5											
SE				3.3					10.3	3.4	6.9		10.7	10.3	3.5	6.7	6.9			3.4				
SSE									3.4		6.9	7.2	6.9			3.3	3.4		3.4					
S						6.7		3.5	6.9	3.4	6.9	10.3	3.5	6.9	10.7		6.9	3.3	10.3					
SSW										6.9		3.4		3.4	3.5									
SW			3.3								3.4			3.4		3.3								6.9
WSW		6.9		6.7			3.4			6.9							3.4							
W	3.3	3.4	3.3	3.3	3.4	10.0	6.9	3.5		3.4	3.4		7.2					6.9	6.9	6.9	6.9	6.9	6.7	3.4
WNW	13.3	17.2	20.0	13.3	20.6	16.7	20.6	10.7	3.4	3.4	3.4	3.4	3.5	3.4		3.3	6.9	6.7		13.7	3.4		16.7	13.7
NW	40.0	37.8	40.0	50.0	54.9	33.3	48.1	50.0	3.7	13.7	10.3	17.2	14.2	6.9	21.4	30.0	13.7	13.3	20.6	30.9	34.3	44.6	33.3	58.4
NNW	30.0	27.5	26.7	20.0	6.9	23.3	10.3	21.4	27.5	13.7	13.7	17.2	21.4	37.8	39.3	26.7	37.8	50.0	37.8	41.2	41.2	41.2	36.7	17.2
CALM																		3.3						

* Note: Due to rounding, per centage totals do not equal 100%.

CHIVA CHIVA (Open site) APRIL 1967

		Relative Frequencies * of Wind Directions by Hour at 26.5 m. (%)																							
Dir.	Hr.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
N		13.7	24.9	6.9	13.7	10.7	21.4	7.2	22.2	28.6	29.6	28.6	21.4	25.9	35.6	22.2	24.0	21.4	34.3	42.8	35.6	28.6	17.9	34.3	14.2
NNE		3.4	3.5	6.9	3.4	7.2	7.2	3.5	3.7	7.2	11.1	21.4	10.7		10.7	11.1	13.7	14.2	6.9	3.5	7.2	3.5	3.5		
NE		3.4			3.4			3.5		3.5	3.7	7.2	10.7	14.8	7.2	3.7	3.4	7.2	3.4	3.5	3.5				
ENE										7.2				3.7		7.4			6.9					3.4	
E		3.4		3.4							7.4	3.5	3.5	7.4	3.5				3.4	3.5		7.2	3.5		
E.E										3.5		3.5	7.2			3.7	6.9				3.5				
SE				6.9	3.4		3.5			14.2	3.7	10.7		11.1	10.7		3.4								
SSE											7.4	3.5	3.5	3.7	3.5	7.4		10.7							
S		3.4	3.5							3.5		3.5	10.7	3.7	10.7	7.4	3.4		3.4	7.2					
SSW							3.5				3.7	3.5	3.5												
SW					3.4				3.7		7.4	3.5	3.5			3.7	3.4	3.5							3.5
WSW			3.5		3.4		3.5	3.5				3.5													
W					3.4		3.5	7.2	3.7		7.4			3.7		3.7		3.5		3.5		7.2	10.3	3.5	
WNW		10.3	3.5	3.4	13.7	7.2	3.5	17.9	3.7	3.5		3.5		3.7				7.2	6.9	3.5		3.5			7.2
NW		20.6	17.9	17.2	20.6	46.3	21.4	17.9	25.9	14.2				3.7	7.2	3.7	10.3	7.2	3.4		17.9	21.4	14.2	13.7	23.6
NNW		37.8	32.1	41.2	27.5	21.4	24.9	28.6	29.6	14.2	18.5	3.5	24.9	18.5	10.7	25.9	27.5	24.9	24.0	28.6	28.6	32.1	37.0	37.8	42.8
CALM		3.4	10.7	13.7	3.4	7.2	7.2	10.7	7.4								3.4		6.9	3.5	3.5	3.5	3.5		

* Note: Due to rounding, percentage totals do not equal 100%.

CHIVA CHIVA (Open site) APRIL 1967

Relative Frequencies * of Wind Directions by Hour at 4.0 m. (%)																								
Dir.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	2.	23	24
N		6.9	6.7	6.7	17.2	6.7	6.9	10.7	24.0	6.9	30.9	20.6	17.9	13.7	10.7	16.7	13.7	13.3	6.9	6.9	10.3	13.7	13.3	13.7
NNE	3.3	13.7	13.3		3.4	13.3		3.5	3.4	3.4	13.7	10.3	3.5	3.4	3.5	6.7	13.7	6.7	3.4		3.4		3.3	3.4
NE	6.7			13.3		13.3		7.2	6.9	10.3	3.4	6.9	3.5	10.3	10.7	3.3	3.4	10.0	3.4	6.9	3.4		3.3	3.4
ENE	6.7	3.4	6.7	3.3	6.9		3.4		3.4	3.4				3.4		3.3		3.3			3.4			
E		3.4		3.3		3.3	3.4		3.4		3.4		7.2					3.3	3.4					
ESE									3.4		3.4	6.9	3.5		3.5	3.3								
SE			3.3	3.3						6.9	3.4		13.7			6.7		3.3						
SSE									10.3		3.4		14.2		3.5		6.9		3.4					
S							6.9	3.5	10.3	6.9	13.7	17.2	7.2	10.3	14.2	3.3	6.9		3.4					
SSW								3.5		13.7	3.4	3.4			3.5	3.3						3.4	3.3	3.4
SW				3.3			3.4			6.9	3.4						6.9					3.4		
WSW				3.3						3.4				3.4		3.3		3.3				3.4	3.3	3.4
W	3.3	3.4				3.3	10.3	7.2	3.4		3.4		7.2						6.9	3.4			3.3	
WNW	10.0	6.9	13.3	16.7	17.2	3.3	13.7	10.7	3.4					6.9		3.3	10.3	6.7		6.9	10.3	17.2	6.7	17.2
NW	50.0	34.3	43.3	36.7	27.5	16.7	30.9	32.1	17.2	20.6	3.4	24.0	21.4	17.2	14.2	20.3	10.3	10.0	20.6	30.9	34.3	17.2	40.0	37.8
NNW	16.7	20.6	10.0	3.3	13.7	26.7	6.9	17.9	10.3	17.2	10.3	10.3	14.2	17.2	35.6	26.7	27.5	36.7	48.1	41.2	34.3	4.2	20.0	10.3
CALM	3.3	6.9	3.3	6.7	13.7	13.3	13.7	3.5										3.3		3.4			3.3	6.9

* Note: Due to rounding, percentage totals do not equal 100%.

SUMMARY OF NON HOURLY DATA

APRIL 1967

Summary of Elements with Non-hourly Frequencies of Observation

Site	Element, Units and Exposure	Description	Number of Obs.	Minimum Value	Mean or Total Value	Maximum Value
Albrook (Forest site)	WBG T Index ¹ (at 1.5 meters)	Index value	402	68.1	77.4	83.1
		Dry bulb temp.	402	68.2	80.3	92.5
		Wet bulb temp.	402	68.0	75.8	81.0
		Black bulb temp.	402	68.2	81.5	95.1
	Evaporation ³ (in. at 4 levels)	Piche (46.0 m)	29	0.024	14.660*	0.909
		Piche (26.5 m)	29	0.024	9.253*	0.586
		Piche (13.5 m)	28	0.012	4.613*	0.293
		Piche (0.5 m)	26	0.006	3.123*	0.244
	Precipitation from Raingauge Network ² (in. at 1.0 meters)	Gauge # 1	20	0.01	6.09*	2.25
		Gauge # 2	20	0.01	5.97*	1.41
		Gauge # 3	19	0.01	6.28*	1.67
		Gauge # 4	19	0.01	5.04*	1.20
		Gauge # 5	19	0.01	5.93*	1.47
		Gauge # 6	18	0.01	5.44*	1.39
		Gauge # 7	20	0.01	4.72*	0.96
		Gauge # 8	18	0.01	4.98*	1.09
	Stem Flow ² (in. at 2.0 meters)	Small tree	16	0.01	5.70*	1.37
		Medium tree	16	0.01	4.76*	1.00
		Large tree	12	0.01	46.96*	19.75
Chiva Chiva (Open site)	WBG T Index ¹ (at 1.5 meters)	Index value	412	67.0	80.1	88.5
		Dry bulb temp.	412	67.5	83.8	97.0
		Wet bulb temp.	412	67.0	76.0	80.1
		Black bulb temp.	412	66.7	92.6	120.8
	Evaporation ³ (in. at 0.5 meters)	Piche	30	0.024	12.673*	0.744
		Pan	27	0.037	5.711*	0.349
	Minimum Grass temp ³ (°F at grass tips)	None	27	65.3	70.0	73.8

- 1 - Hourly observations between 0600 and 1900 hours inclusive
2 - Six hourly observations
3 - Daily observations

*Total Values

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) US Army Tropic Test Center Fort Clayton, Canal Zone		2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	
2b. GROUP			
3. REPORT TITLE Monthly Microclimatic Summary, April 1967: Environmental Data Base for Regional Studies in the Humid Tropics			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Data Summary, April 1967			
5. AUTHOR(S) (First name, middle initial, last name)			
6. REPORT DATE September 1967		7a. TOTAL NO. OF PAGES 28	7b. NO. OF REFS
8a. CONTRACT OR GRANT NO.		8b. ORIGINATOR'S REPORT NUMBER(S)	
b. PROJECT NO. 2M025001A724-01			
c. USATECOM No. 9-4-0013-01			
d. Work Unit: USATTC #001		8b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
10. DISTRIBUTION STATEMENT Distribution of this document is unlimited			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY Advanced Research Projects Agency Army Research Projects Office, OCRD	
13. ABSTRACT This report contains detailed microclimatic data for April 1967 from specific sites in the Panama Canal Zone and vicinity. The data are presented in tabular form, summarized for hourly and/or daily observations from surface to 46-meter levels. Elements listed are: temperature, pressure, precipitation, wind speed and direction, relative humidity, and evaporation.			

DD FORM 1473

REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

UNCLASSIFIED

Security Classification

14.

KEY WORDS

LINK A

LINK B

LINK C

ROLE

WT

ROLE

WT

ROLE

WT

Climate
Microclimatology
Tropic Environment
Humid Tropics
Panama Canal Zone Microclimatology
Data Base

UNCLASSIFIED

Security Classification