

AD 670018

AD



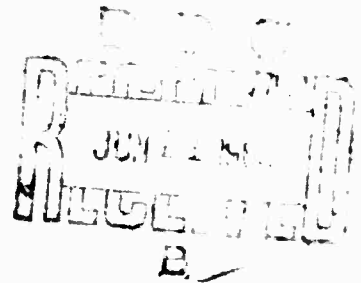
MONTHLY
MICROCLIMATIC SUMMARY

DECEMBER 1967

ENVIRONMENTAL DATA BASE
FOR REGIONAL STUDIES IN THE HUMID TROPICS

USATECOM Project No. 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

This document has been approved
for public release and sale; its
distribution is unlimited.

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

**BEST
AVAILABLE COPY**

ENVIRONMENTAL DATA BASE
FOR REGIONAL STUDIES IN THE HUMID TROPICS

MONTHLY
MICROCLIMATIC SUMMARY

DECEMBER 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.

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 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 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 (39 meters, Albrook)	16
Relative Frequencies of Wind Directions (32 meters, Albrook)	17
Relative Frequencies of Wind Directions (30 meters, Chiva Chiva).	18
Relative Frequencies of Wind Directions (4 meters, Chiva Chiva)	19
Summary of Elements with Non-Hourly Frequencies of	
Observation	20
Evaporation (Albrook)	
Precipitation (manual gauge network, Albrook)	
Evaporation (Chiva Chiva)	
Minimum Grass Temperature (Chiva Chiva)	

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

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.

The relative humidity data contained in this report required some adjustment due to the difficult problems in maintaining hair hygrometers in the humid tropics. The hygrometers show saturation at a time when the psychrometer shows a relative humidity well below 100%. For this reason the hourly measurements made by means of a hair hygrometer have been modified on the basis of simultaneous psychrometer readings of other levels. Details will be given in the fourth Semiannual Report. It can be assumed that the means of relative humidity presented in this volume are very close to the true means.

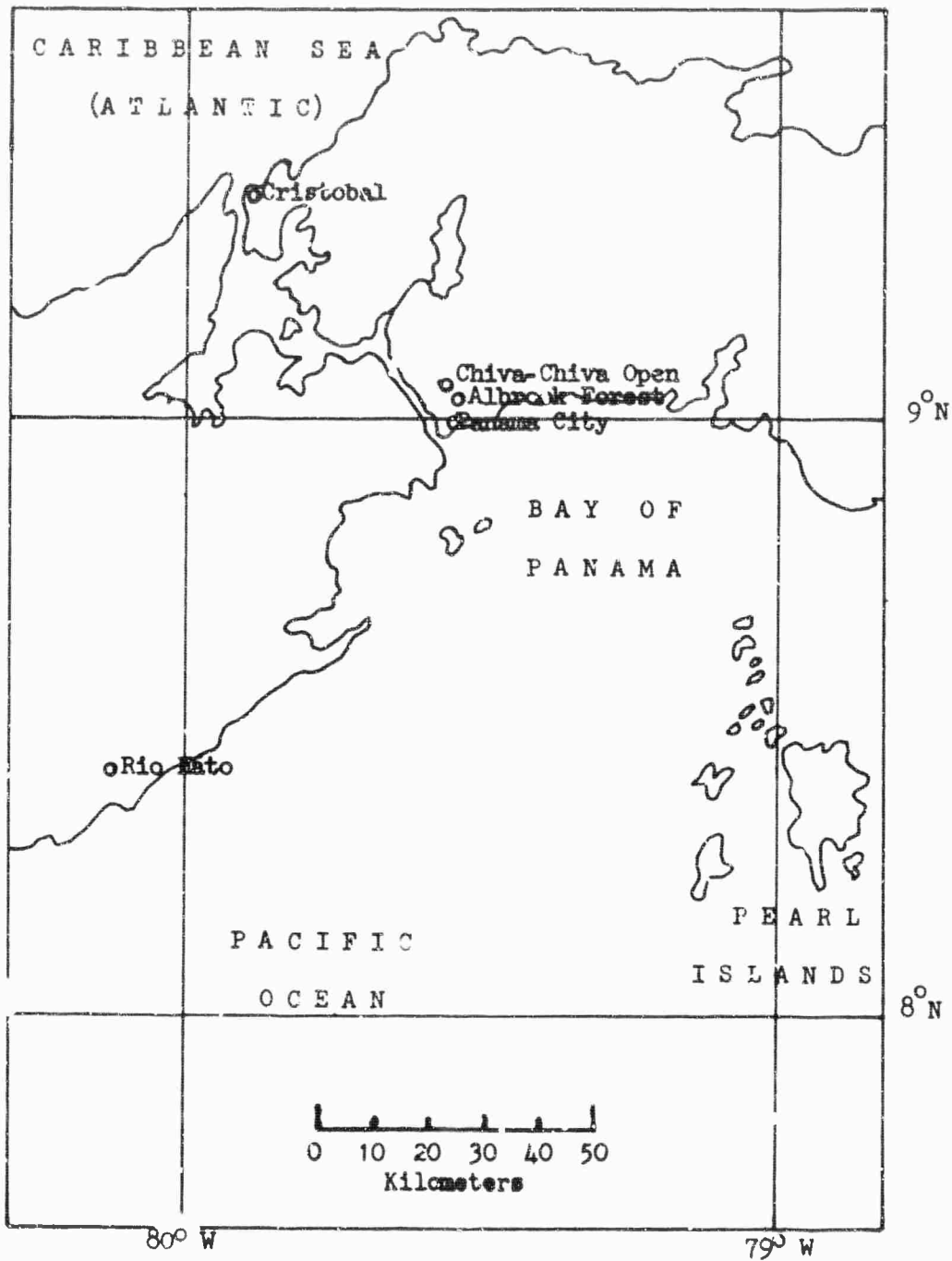


FIGURE 1. LOCATION MAP, ISTHMUS OF PANAMA

FIGURE 2. FREQUENCY OF OBSERVATIONS

# Element	<u>Height (meters)</u>										<u>Frequency</u>	
	<u>0.5</u>	<u>1.0</u>	<u>2.0</u>	<u>4.0</u>	<u>13.5</u>	<u>26.5</u>	<u>30.0</u>	<u>32.0</u>	<u>39.0</u>	<u>46.0</u>		
<u>Temperature:</u>												
Dry Bulb	-	1	2	2	2	2	-	3	-	-	1	Hourly*
Wet Bulb	-	1	-	2	2	-	-	-	-	-	-	Hourly*
Grass Minimum	3	-	-	-	-	-	-	-	-	-	-	Once Daily
<u>Relative Humidity</u>												
	-	1	2	2	2	1	2	-	3	-	1	Hourly*
<u>Barometric Pressure</u>												
	-	-	1	-	-	-	-	-	-	-	-	Continuously
<u>Evaporation</u>												
	-	1	-	-	-	-	2	-	2	-	2	Once Daily
<u>* Precipitation:</u>												
Recording Gage	-	-	1	-	-	-	-	-	-	-	2	Continuously
Manual Gage	-	-	2	-	-	-	-	-	-	-	-	4 Times Daily
<u>Wind:</u>												
Direction	-	-	-	-	-	-	3	1	-	-	-	Continuously
Speed	-	-	-	-	-	-	3	2	2	-	-	Hourly

1. Albrook and Chiya Chiya
2. Albrook only
3. Chiya Chiya only

* Observations made with sling psychrometer when recorders are inoperative.

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

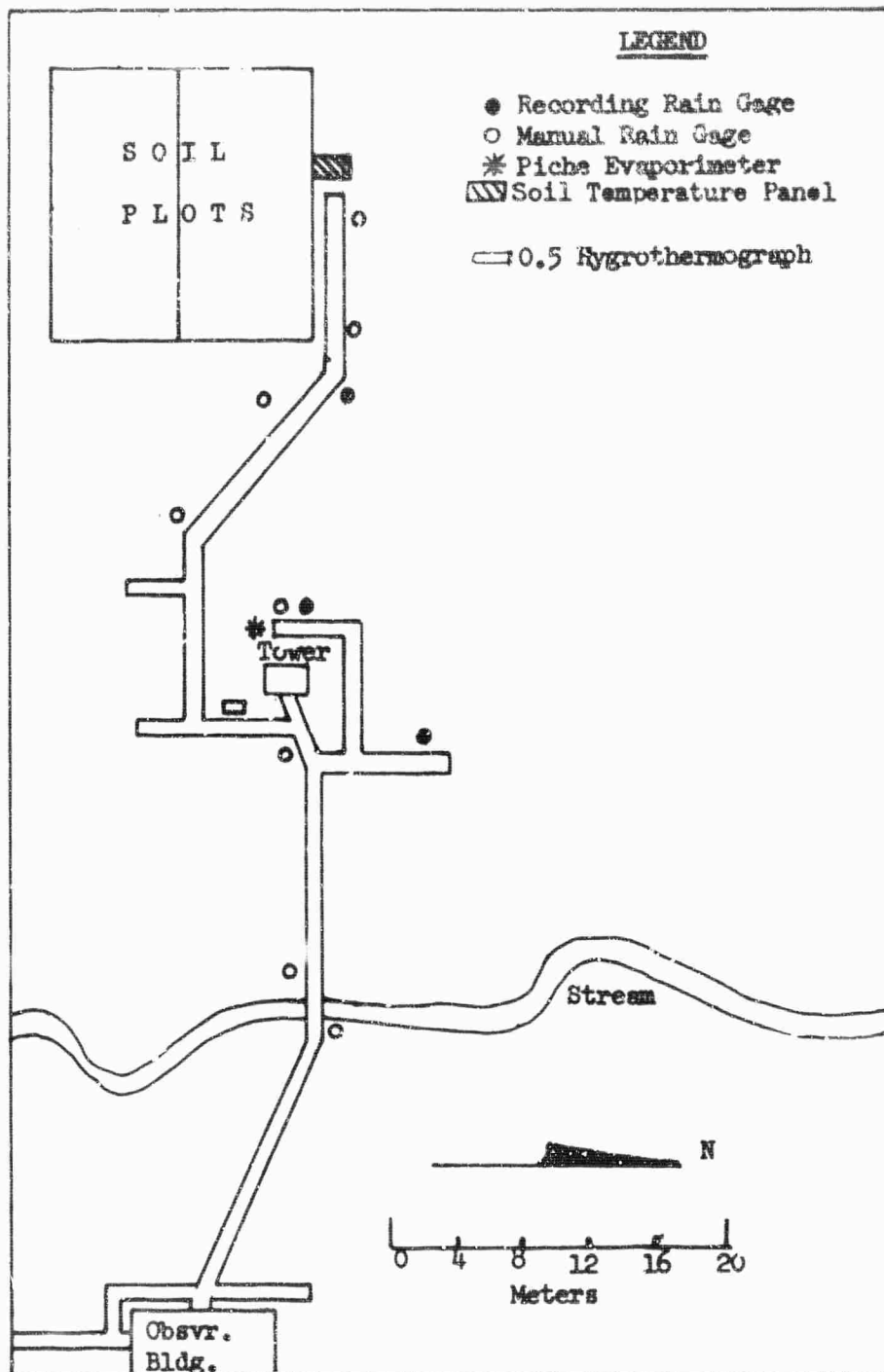


FIGURE 3. ALBROOK FOREST SITE, GENERALIZED PLOT

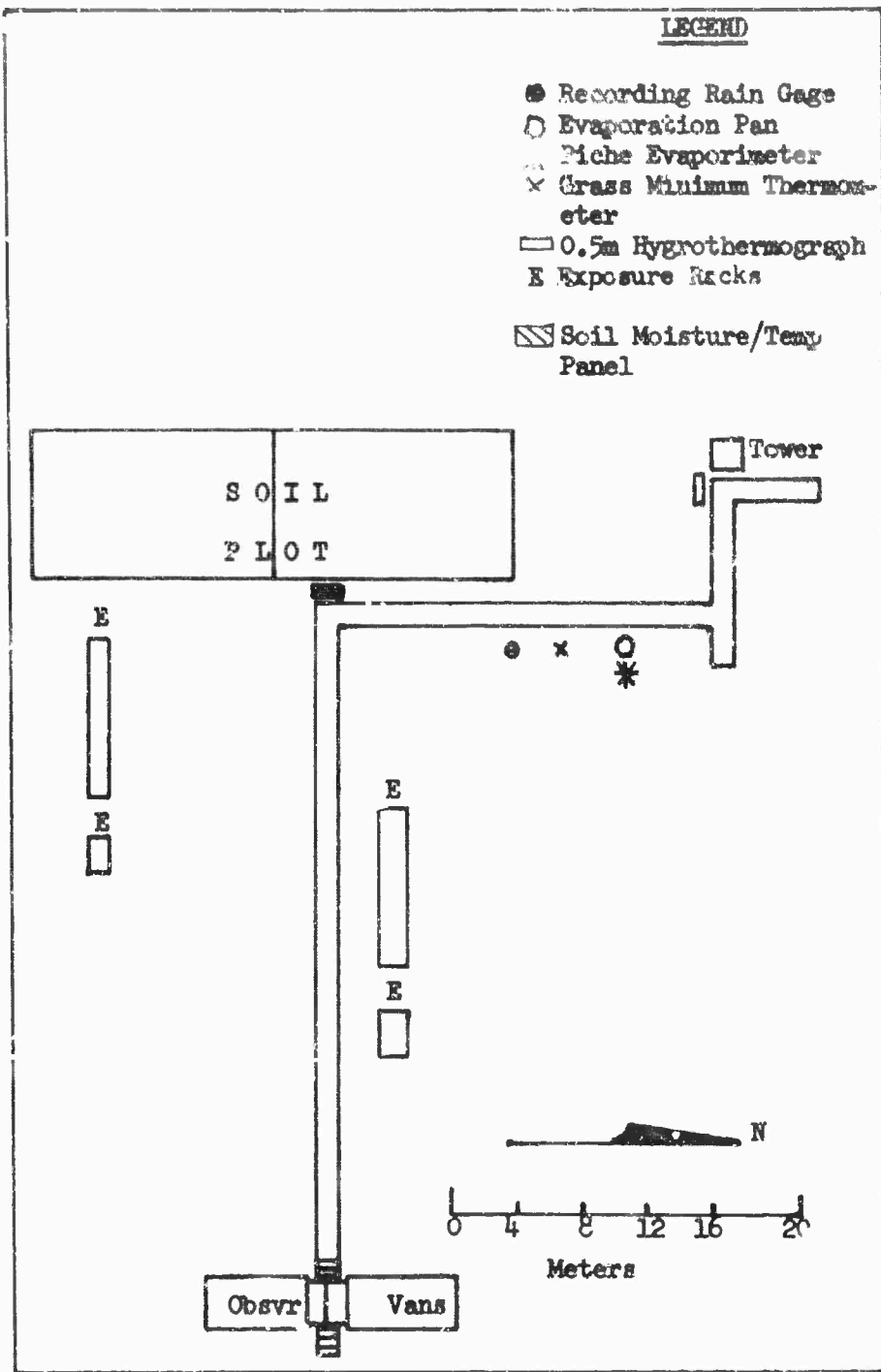


FIGURE 4. CHIVA CHIVA OPEN, GENERALIZED PLOT

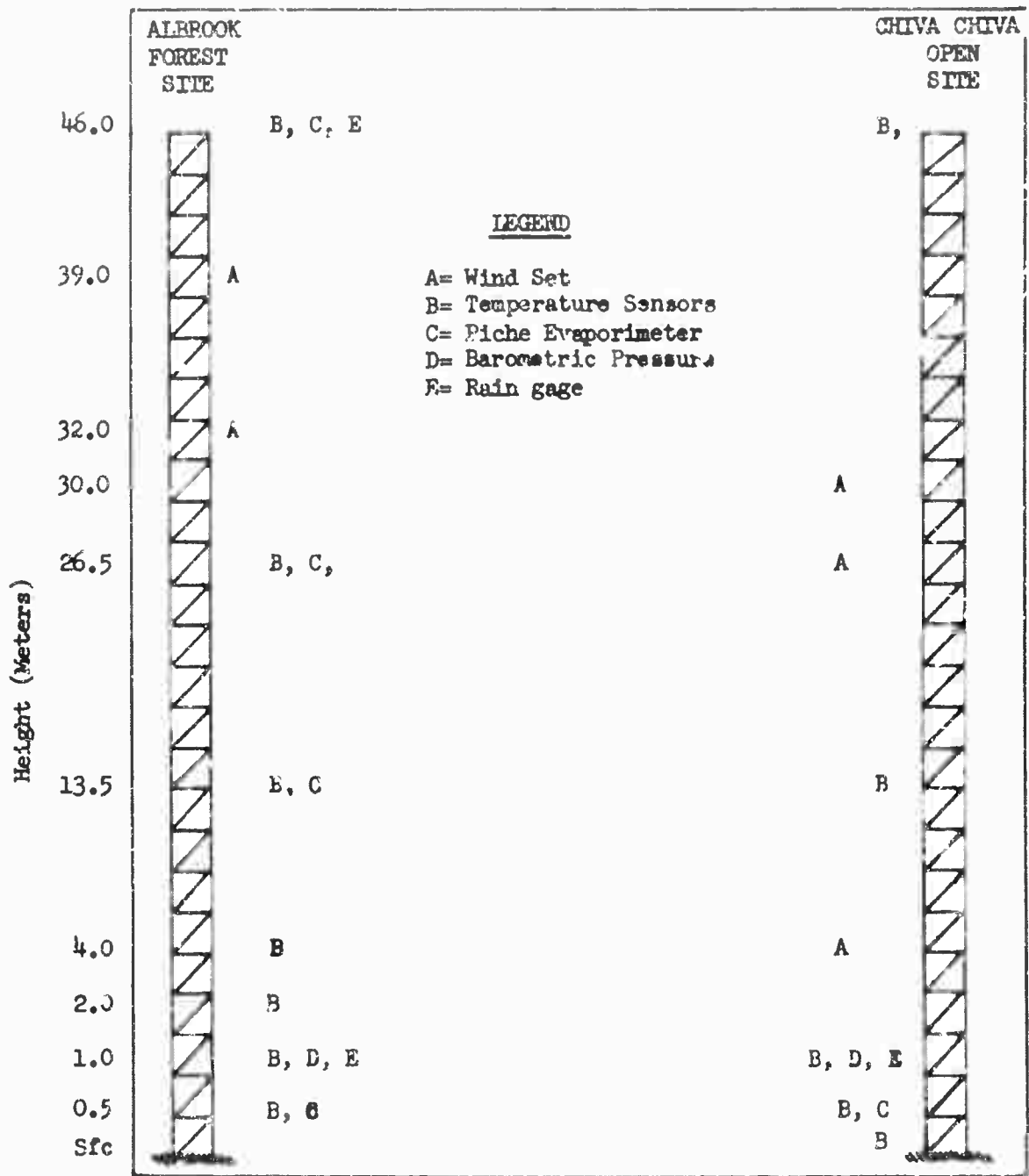


FIGURE 5. INSTRUMENT LOCATION ON TOWERS

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA
 DECEMBER 1967

Exposure	Monthly Means of Air Temperature by Hour (°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	No. of Obs.	Min.	Mean	Max.	
Albrook (Forest site)	46.0 m		74.7	74.5	74.3	74.2	74.0	74.1	74.6	76.5	79.3	81.2	82.8	83.6	83.1	82.6	81.8	80.9	79.9	78.2	77.0	76.3	75.8	75.3	75.1	74.8	743	70.7	77.7	87.2
	28.5 m		This level was not instrumented for air temperature at this time																											
	26.5 m		73.6	73.7	73.5	73.4	73.2	73.2	73.6	75.7	75.8	81.8	83.6	84.4	84.0	83.4	82.5	81.1	79.9	77.6	76.0	75.3	74.7	74.4	74.1	74.0	744	69.9	77.3	87.8
	13.5 m		73.8	73.8	73.4	73.3	73.2	73.0	73.4	75.0	77.3	79.4	81.1	81.8	81.7	81.1	80.7	80.0	79.2	77.4	76.1	75.3	74.5	74.2	74.3	74.0	721	59.3	73.6	85.0
	8.0 m		This level was not instrumented for air temperature at this time																											
	4.0 m		73.6	73.4	73.0	72.7	72.5	72.5	72.5	75.0	74.9	77.1	78.9	80.3	80.6	80.6	80.1	79.7	78.9	77.9	76.3	75.3	74.8	74.3	74.0	73.8	73.7	743	68.2	75.9
2.0 m		73.2	73.0	72.8	72.5	72.5	72.2	72.4	74.1	76.6	78.7	80.1	80.9	80.5	80.0	79.6	78.7	77.8	76.4	75.2	74.5	74.1	73.8	73.6	73.4	743	68.0	75.7	84.9	
1.0 m		73.3	73.1	72.8	72.6	72.6	72.3	72.5	74.0	76.3	78.2	79.7	80.3	80.1	79.7	79.5	78.5	77.7	76.3	75.3	74.5	74.2	73.6	73.5	743	67.5	75.6	84.7		
0.5 m		73.4	73.3	72.9	72.8	72.6	72.5	72.6	74.1	76.3	78.0	79.6	80.1	79.9	79.6	79.3	78.5	77.7	76.3	75.4	74.7	74.3	74.1	73.7	73.7	742	68.0	75.6	84.3	

Chiva Chiva (Open site)	46.0 m		74.5	74.3	74.0	73.9	73.9	73.7	74.0	76.1	78.5	80.4	82.3	83.3	83.5	82.9	82.4	80.9	80.1	78.6	77.0	76.5	75.9	75.4	75.1	74.9	744	69.2	77.6	87.0
	32.0 m		74.3	74.1	73.7	73.6	73.5	73.3	73.7	75.6	78.6	80.6	82.3	83.4	83.6	83.1	82.5	81.0	80.1	78.4	76.9	76.3	75.7	75.2	74.8	74.7	744	68.9	77.5	87.0
	13.5 m		74.1	73.9	73.6	73.5	73.3	72.8	73.3	76.1	79.2	81.3	83.2	84.5	84.4	83.8	82.8	81.4	80.4	78.4	77.0	76.1	75.6	75.1	74.7	74.5	744	67.4	77.6	89.1
	0.5 m		73.5	73.1	72.7	72.4	71.9	71.7	73.2	77.9	81.3	83.7	85.9	86.5	86.6	86.0	84.3	82.8	80.6	78.0	76.4	75.7	75.1	74.5	74.0	73.7	706	65.0	78.0	92.5

SUMMARY OF METEOROLOGICAL OBSERVATIONS

HOURLY DATA

DECEMBER 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	16	14	16	19	24	21	16	21	16	21	27	34	42	48	45	47	50	42	34	25	20	20	17	17	21					
	28.5 m							This level was not instrumented for relative humidity at this time																							
	26.5 m	7	9	9	9	13	13	10	13	10	13	22	25	33	34	33	37	35	34	33	33	25	17	11	16	8	8				
	13.5 m	9	11	9	8	11	12	10	9	13	20	34	35	40	39	40	35	32	27	21	19	11	10	9	9	9					
	0.8 m							This level was not instrumented for relative humidity at this time																							
4.0 m	9	11	11	6	12	9	6	12	15	25	25	37	42	34	37	23	21	20	14	10	10	10	9	7	10						
2.0 m	8	6	5	8	5	5	4	5	11	22	30	34	34	28	36	20	18	17	12	10	10	10	6	9	7						
1.0 m	5	5	5	9	5	5	4	7	10	19	28	34	35	25	33	23	17	16	10	9	9	9	6	8	6						
0.5 m	5	8	5	8	4	4	5	4	11	14	28	31	35	19	22	18	17	14	12	8	7	8	7	6	5						

* No monthly summary was computed for the ranges.

Chiva Chiva (Open site)	46.0 m	20	17	16	15	21	17	17	17	21	20	26	37	37	39	44	44	44	44	33	29	19	18	17	14	18
	32.0 m	18	18	18	20	20	17	17	23	21	30	37	35	40	44	42	41	35	28	28	19	15	13	16	16	16
	13.5 m	20	20	19	17	21	17	15	20	22	30	40	40	44	43	46	42	35	27	24	19	17	17	15	17	17
	0.5 m	14	8	11	16	9	13	12	20	28	27	35	39	39	41	44	43	36	24	19	14	12	14	10	10	10

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA
 DECEMBER 1967

Exposure	Site Code ^a	Monthly Means ² of other Elements by Hour																								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	No. of Obs.	Min.	Mean	Max.
		WB (4.0 m)	72.8	72.6	72.3	72.1	72.0	71.9	72.4	74.1	75.6	76.4	76.9	77.0	77.4	77.4	77.1	76.7	76.1	75.0	74.2	73.8	73.5	73.3	73.1	73.0	743	67.7	74.4
WB (2.0 m)	72.8	72.7	72.5	72.2	72.1	71.9	72.1	73.7	75.6	76.8	77.4	77.8	77.7	77.7	77.5	77.1	75.3	75.2	74.5	73.8	73.5	73.4	73.0	73.0	743	67.0	74.6	81.0	
WB (0.5 m)	73.1	72.9	72.7	72.5	72.5	72.2	72.5	73.9	75.8	76.9	77.7	78.1	78.1	78.1	78.0	77.3	76.7	75.6	74.8	74.2	74.0	73.7	73.4	73.4	743	67.3	74.9	82.0	
BP	.759	.743	.726	.724	.730	.745	.767	.783	.798	.801	.791	.768	.742	.716	.700	.696	.702	.717	.734	.754	.772	.782	.782	.777	739	.600	.750	.890	
P1	0.01	0.05	0.02	0.49	0.00	0.02	0.16	0.00	0.01	0.33	0.16	0.07	0.10	0.15	0.02	0.21	0.30	0.02	0.01	0.00	0.00	0.00	0.00	0.00	53	0.01	7.04	1.04	
P2	0.00	0.00	0.00	0.47	0.02	0.00	0.00	0.00	0.00	0.00	0.07	0.05	0.26	0.53	0.08	0.14	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23	0.01	4.59	1.25	
P4	0.00	0.00	0.00	0.70	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.16	0.46	0.09	0.13	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13	0.01	3.44	0.82	

2

WB (0.5 m)	72.8	72.5	72.2	71.8	71.4	71.1	72.4	75.4	76.7	77.8	78.7	78.4	78.8	78.8	78.0	76.9	76.0	75.0	74.3	74.0	73.7	73.3	73.1	72.8	704	64.8	74.8	83.2
BP	.859	.842	.827	.823	.827	.841	.859	.880	.897	.902	.892	.867	.838	.812	.798	.796	.802	.819	.835	.854	.872	.882	.881	.874	742	.695	.840	.995
PS	0.00	0.00	0.06	0.55	0.11	0.00	0.00	0.02	0.00	0.00	0.02	0.02	0.25	0.13	0.13	0.28	0.18	0.04	0.00	0.20	0.00	0.00	0.00	0.00	29	0.01	5.11	1.25

WB - Wet bulb temperature (°F)
 BP - Barometric pressure (in. of Hg minus 29.0)
 PS - Precipitation at 1.0 m. in open area (in.) P2 - Precipitation under full canopy (in.)
 P1 - Precipitation at 46.0 m. above canopy (in.) P4 - Precipitation under open canopy (in.)
² Monthly means of precipitation are computed for precipitation days. Precipitation totals are substituted for the mean in the monthly summary.

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA
 DECEMBER 1967

Exposure	Site Code ¹	Monthly Ranges ² of other Elements by Hour																								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)	WB (4.0 m)	7.6	7.2	7.6	8.3	8.0	8.1	6.9	5.5	4.8	5.4	4.5	6.9	6.8	8.0	8.1	7.2	6.5	6.2	4.5	5.2	6.3	5.8	7.1	6.9	
	WB (2.0 m)	7.7	7.2	8.0	9.0	7.9	8.0	7.6	5.7	5.2	5.9	4.1	5.9	6.0	9.2	9.1	8.2	7.0	5.9	5.7	5.9	6.3	6.5	6.3	7.0	
	WB (0.5 m)	7.8	7.0	7.9	8.7	7.1	7.8	7.1	6.2	4.8	5.0	4.9	4.8	6.0	9.9	9.9	8.9	6.9	5.8	6.1	5.9	6.0	6.9	6.6	7.5	
	BP	.190	.185	.175	.170	.160	.160	.170	.195	.190	.190	.190	.185	.180	.175	.165	.160	.165	.160	.185	.180	.185	.180	.175	.175	
P1	0.00	0.00	0.00	0.95	0.00	0.02	0.45	0.00	0.00	0.00	0.00	0.15	0.36	0.50	0.17	0.74	1.03	0.02	0.00	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	0.03	0.74	1.24	0.14	0.36	0.63	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	0.29	0.69	0.00	0.24	0.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

* No monthly summary was computed for the ranges.

37

Chiva Chiva (Open site)	WB (0.5 m)	8.0	8.5	10.0	10.0	10.5	11.7	9.3	8.2	9.1	8.2	7.8	7.2	7.8	9.7	10.3	8.4	6.5	6.1	6.3	7.4	7.3	8.0	7.2	7.5	
	BP	.190	.205	.205	.180	.175	.165	.200	.210	.210	.195	.180	.200	.185	.190	.180	.170	.170	.175	.195	.185	.175	.180	.175	.190	
	P5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.45	0.19	1.24	0.30	0.06	0.00	0.00	0.00	0.00	0.00	0.00	

WB - Wet bulb temperature (°F)
 BP - Barometric pressure (In. of Hg minus 29.0)

P5 - Precipitation at 1.0 m. in open area (in.)
 P1 - Precipitation at 46.0 m. above canopy (in.)

P2 - Precipitation under full canopy (in.)
 P4 - Precipitation under open canopy (in.)

² Monthly ranges of precipitation are computed for precipitation days.

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA

DECEMBER 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.	Mean	Max.
Albrook (Forest site)	39.0 m	5	5	4	4	4	4	4	5	5	5	5	5	5	6	6	6	6	6	5	5	5	5	5	5	5	606	0	5
	32.0 m	3	3	3	3	3	3	3	3	3	3	4	4	4	3	4	4	4	4	3	3	3	3	4	3	3	742	0	3

41

26.5 m	4	4	4	3	3	3	3	3	4	5	7	7	8	9	8	9	9	8	7	7	5	6	5	5	4	4	744	0	5
4.0 m	3	3	2	2	2	2	2	2	3	5	6	6	7	8	7	8	8	7	7	5	4	4	4	3	3	3	744	0	4

Chiva Chiva (Open site)

SUMMARY OF METEOROLOGICAL OBSERVATIONS
HOURLY DATA

DECEMBER 1967

Exposure	Monthly Ranges of Wind Speed by Hour (miles/hr.)																								Monthly Summary*	
	Site	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23		24
39.0 m	8	9	6	8	12	9	7	10	8	9	11	9	10	14	12	14	11	12	10	11	12	11	10	10	7	
32.0 m	6	6	6	7	8	5	6	9	6	7	8	7	7	11	8	10	9	8	8	5	7	7	6	5		
Albrook (Forest site)																										

* No monthly summary was computed for the ranges.

26.5 m	10	10	12	8	9	15	9	10	9	11	12	13	15	11	14	15	12	9	14	10	13	10	10	12	
4.0 m	7	7	7	4	5	9	7	6	9	11	10	13	14	9	12	12	13	10	11	7	10	7	9	8	
Chiva Chiva (Open site)																									

ALBROOK (Forest site) DECEMBER 1967

Relative Frequencies* of Wind Directions by Hour at 39.0 m.
(%)

Hr. 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				25.0								25.0			33.3		33.3							
NNE	25.0																	33.3	33.3					33.3
NE									25.0											33.0				
ENE					25.0																			
E																								
ESE								25.0																
SE									50.0	25.0			25.0											
SSE									25.0															
S				50.0						25.0	25.0	50.0	25.0	25.0		33.3	33.3							
SSW	50.0		25.0	25.0	25.0	25.0								25.0		33.3					33.3	33.3	33.3	33.3
SW		25.0	25.0		25.0	25.0	66.6	25.0	25.0		25.0		25.0			33.3		33.3	66.6	66.6	66.6	66.6	33.3	
WSW	25.0	50.0	25.0		25.0			25.0					25.0	25.0	33.3									33.3
W		25.0									25.0				33.3									
WNW								25.0	25.0															
NW						50.0	33.3	25.0					25.0						33.3					
NNW			25.0																					
CALM									25.0								33.3							

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

ALBROOK (Forest site) DECEMBER 1967

Relative Frequencies* of Wind Directions by Hour at 32.0 m.
(%)

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	19.4	6.4	19.4	6.4	16.1	19.4	16.7	16.1	19.4	20.1	12.9	9.7	9.7	12.9	22.6	16.1	16.1	22.6	29.0	22.6	16.1	19.4	12.9	25.8
NNE				5.2	3.2	6.4	3.3	6.4	6.4	6.5	6.4	6.4		22.6		9.7	9.7	12.9		3.2	3.2			
NE			3.2	6.4	3.2				6.4	3.3	9.7	6.4	16.1	6.4	9.7	9.7	6.4	6.4	3.2					3.2
ENE									3.2		3.2	3.2	6.4	3.2	3.2									
E	3.2			3.2				6.4	3.2		3.2	3.2	3.2	3.2	6.4	3.2	6.4	3.2						
ESE									3.2		12.9						3.2							
SE					3.2				9.7	6.6		3.2	3.2		9.7	6.4		3.2	3.2	3.2				
SSE										6.6		3.2	3.2	3.2										
S			3.2						6.4	10.1	12.9	19.4	12.9	12.9	12.9	6.4	3.2		3.2				3.2	
SSW					3.2							3.2	3.2		3.2	3.2								
SW				3.2			3.3	6.4		10.1			6.4	9.7	6.4	6.4	3.2							3.2
WSW		3.2		6.4	3.2					3.3		9.7		6.4	3.2	3.2	3.2				3.2		9.7	
W			3.2	6.4	3.2		6.6	9.7	3.2	3.3	6.4	3.2			3.2	6.4	12.9			3.2	3.2	3.2	3.2	5.4
WNW	3.2	9.7	3.2	6.4	6.4	9.7	6.6	12.9	12.9	6.6	12.9	3.2	3.2	3.2	3.2	6.4		6.4	6.4	6.4	9.7	6.4	12.9	9.7
NW	35.5	19.4	25.8	16.1	22.6	19.4	13.4	19.4	9.7	16.7	9.7	6.4	6.4	3.2	9.7	3.2	19.4	16.1	25.8	29.0	29.0	25.8	12.9	19.4
NNW	29.0	48.4	32.2	35.5	38.7	35.7	35.7	16.1	16.1	6.6	3.2	19.4	19.4	9.7	9.7	12.9	12.9	19.4	25.8	22.6	22.6	38.7	38.7	32.2
CALM	9.7	12.9	9.7	6.4	3.2	3.2	13.4	6.4			6.4		6.4	3.2	3.2	3.2	3.2	12.9	3.2	9.7	12.9	6.4	6.4	

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

CHIVA CHIVA (Open site) DECEMBER 1967

Relative Frequencies* of Wind Directions by Hour at 30.0 m.
(%)

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	3.2	3.2	6.4	6.4	3.2			6.4	3.2	3.2	9.7	9.7	12.9	9.7		3.2	3.2	3.2	6.4	3.2		3.2			
NNE		6.4	6.4	3.2	3.2	3.2												6.4							
NE	3.2							6.4	9.7			3.2	3.2	3.2	3.2			3.2		6.4					
ENE							3.2	3.2			3.2	9.7		6.4		3.2									
E										3.2			3.2												3.2
ESE								3.2									3.2	3.2							
SE	3.2				3.2				3.2				3.2		6.4	9.7									
SSE					3.2					3.2	3.2				6.4										
S				6.4	3.2		6.4		3.2	9.7	16.1	3.2	16.1	9.7	3.2	6.4	3.2		6.4						3.2
SSW	3.2		3.2		6.4	6.4		3.2				3.2		6.4						3.2	6.4				3.2
SW	3.2	3.2		3.2		6.4	6.4	3.2	3.2	6.4		3.2				6.4	3.2					3.2	6.4		
WSW	3.2		3.2	3.2	9.7			3.2	3.2			3.2									3.2	5.4	6.4	3.2	
W		3.2	3.2	9.7	6.4	9.7	9.7	12.9	6.4	6.4	3.2	3.2	3.2		6.4	3.2	12.9	6.4	9.7	9.7	6.4	9.7	3.2	22.6	
WNW	38.7	25.8	16.1	29.0	22.6	25.8	25.8	25.8	25.6	32.2	32.2	12.9	16.1	19.4	29.0	19.4	22.6	29.0	16.1	41.9	41.9	35.5	25.8	22.6	
NW	25.8	32.2	35.5	19.4	22.6	22.6	25.8	25.8	35.5	22.6	22.6	41.9	38.7	41.9	25.8	35.5	38.7	41.9	51.6	22.6	25.8	32.2	38.7	25.8	
NNW		3.2	6.4	6.4	3.2	6.4	3.2		6.4	12.9	9.7	6.4		3.2	19.4	12.9	12.9	3.2	3.2	3.2	6.4			3.2	6.4
CALM	16.1	22.6	19.4	12.9	12.9	19.4	19.4	6.4				3.2							6.4	9.7	9.7	9.7	12.9	6.4	

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

CHIVA CHIVA (Open site) DECEMBER 1967

Relative Frequencies³ of Wind Directions by Hour at 4.0 m.

(%)

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	7.7	7.7	15.4		23.1	7.7		15.7	16.7	8.3	25.0	8.3		8.3	8.3		8.3	8.3	16.7	8.3				8.3	
NNE				23.1		15.4		8.3		8.3			8.3		8.3		8.3	8.3	8.3						8.3
NE	7.7	15.4	7.7	7.7	15.4	15.4		8.3		8.3		16.7		16.7	8.3		8.3	16.7		8.3					
ENE		7.7		7.7	7.7		8.3																		16.7
E		7.7			7.7		8.3				8.3					16.7				8.3		8.3			
ESE	7.7			7.7	7.7									8.3							8.3				
SE							16.7						8.3		8.3	8.3	8.3	16.7	8.3						
SSB											8.3		8.3		8.3						8.3				
S	30.7	7.7	7.7	23.1	7.7	7.7				16.7	25.0	8.3		8.3		8.3	8.3			8.3				6.3	8.3
SSW								8.3		8.3		8.3													8.3
SW	7.7	7.7					8.3	8.3	8.3		8.3		8.3		8.3		8.3	8.3	8.3				16.7	8.3	8.3
WSW			7.7	7.7		7.7						8.3					8.3			8.3	16.7	8.3			
W	7.7	7.7	15.4	7.7		7.7	8.3	16.7	8.3	8.3	8.3	16.7	16.7				8.3	8.3		15.7	16.7	8.3			16.7
WNW				7.7	7.7	7.7	16.7	8.3	16.7				25.0	8.3	33.3	8.3	25.0		25.0	8.3	8.3	8.3	16.7	16.7	16.7
NW	15.4	23.1	15.4	7.7	15.4	23.1	8.3	25.0	41.7	25.0	8.3	33.3	16.7	25.0	25.0	33.3	16.7	16.7	16.7		25.0	33.3	25.0	16.7	16.7
NNW	7.7		15.4						8.3		8.3		8.3	8.3	8.3		8.3	16.7	8.3	25.0	16.7	8.3	8.3	8.3	0.3
CALM	7.7	15.4	15.4		7.7	7.7	25.0												8.3		8.3	8.3	8.3	16.7	

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

SUMMARY OF NON HOURLY DATA

DECEMBER 1957

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)	Evaporation ³ (in. at 4 levels)	Piche (46.0 m)	29	0.073	8.659*	0.549
		Piche (26.5 m)	31	0.024	5.521	0.348
		Piche (13.5 m)	29	0.006	1.857*	0.171
		Piche (0.5 m)	16	0.012	0.615*	0.067
	Precipitation from Raingauge Network ² (in. at 1.0 meters)	Gauge # 1	19	0.01	4.60*	1.80
		Gauge # 2	22	0.01	8.55*	2.58
		Gauge # 3	21	0.01	6.46*	1.95
		Gauge # 4	20	0.01	5.75*	2.36
		Gauge # 5	21	0.01	6.85*	2.53
		Gauge # 6	21	0.01	6.48*	2.45
		Gauge # 7	21	0.01	6.94	1.90
		Gauge # 8	19	0.01	5.15*	2.35
	Chiva Chiva (Open site)	Evaporation ³ (in. at 0.5 meters)	Piche	28	0.018	5.664*
Pan			29	0.043	4.761*	0.385
Minimum Grass temp ³ (°F at grass tips)		None	26	43.2	63.3	73.8

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 association 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, December 1967: Environmental Data Base for Regional Studies in the Humid Tropics			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Data Summary, December 1967			
5. AUTHOR(S) (First name, middle initial, last name)			
6. REPORT DATE April 1968		7a. TOTAL NO. OF PAGES 28	7b. NO. OF REFS
8a. CONTRACT OR GRANT NO.		8b. ORIGINATOR'S REPORT NUMBER(S)	
a. PROJEC. NO. 2M025001A724-01			
c. USATECOM No. 9-4-0013-01		8b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
d. Work Unit: USATTC #001			
10. DISTRIBUTION STATEMENT Distribution of this document is unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY Advanced Research Projects Agency Army Research Projects Office, OCIRD	
13. ABSTRACT This report contains detailed microclimatic data for December 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						